
Description of STM32F7 HAL and Low-layer drivers

Introduction

STMCube™ is STMicroelectronics's original initiative to ease developers' life by reducing development efforts, time and cost. STM32Cube covers the STM32 portfolio.

STM32Cube Version 1.x includes:

- The STM32CubeMX, a graphical software configuration tool that allows generating C initialization code using graphical wizards.
- A comprehensive embedded software platform, delivered per series (such as STM32CubeF7 for STM32F7 Series)
 - The STM32Cube Hardware Abstraction Layer (HAL), an STM32 abstraction layer embedded software, ensuring maximized portability across the STM32 portfolio
 - A consistent set of middleware components such as RTOS, USB, TCP/IP, Graphics
 - The Low Layer APIs (LL) offering a fast, light-weight, expert-oriented layer which is closer to the hardware than the HAL. The LL APIs are available only for a set of peripherals.
 - All embedded software utilities coming with a full set of examples.

The HAL driver layer provides a generic multi-instance simple set of APIs (application programming interfaces) to interact with the upper layer (application, libraries and stacks).

The HAL driver APIs are split into two categories: generic APIs which provide common and generic functions for all the STM32 series and extension APIs which include specific and customized functions for a given family or part number. The HAL drivers include a complete set of ready-to-use APIs which simplify the user application implementation. As an example, the communication peripherals contain APIs to initialize and configure the peripheral, to manage data transfers based on polling, to handle interrupts or DMA, and to manage communication errors.

The HAL drivers are feature-oriented instead of IP-oriented. As an example, the timer APIs are split into several categories following the functions offered by the IP: basic timer, capture, pulse width modulation (PWM), etc. The HAL driver layer implements run-time failure detection by checking the input values of all functions. Such dynamic checking contributes to enhance the firmware robustness. Run-time detection is also suitable for user application development and debugging.

The LL drivers offer hardware services based on the available features of the STM32 peripherals. These services reflect exactly the hardware capabilities and provide atomic operations that must be called following the programming model described in the product line reference manual. As a result, the LL services are not based on standalone processes and do not require any additional memory resources to save their states, counter or data pointers: all operations are performed by changing the associated peripheral registers content. Contrary to the HAL, the LL APIs are not provided for peripherals for which optimized access is not a key feature, or for those requiring heavy software configuration and/or complex upper level stack (such as FSMC, USB, SDMMC).

The HAL and LL are complementary and cover a wide range of applications requirements:

- The HAL offers high-level and feature-oriented APIs, with a high-portability level. They hide the MCU and peripheral complexity to end-user.
- The LL offers low-level APIs at registers level, with better optimization but less portability. They require deep knowledge of the MCU and peripherals specifications.

The source code of HAL and LL drivers is developed in Strict ANSI-C which makes it independent from the development tools. It is checked with CodeSonar™ static analysis tool. It is fully documented and is MISRA-C 2004 compliant.



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1 Acronyms and definitions

Table 1: Acronyms and definitions

Acronym	Definition
ADC	Analog-to-digital converter
ANSI	American National Standards Institute
API	Application Programming Interface
BSP	Board Support Package
CAN	Controller area network
CEC	Consumer electronic controller
CMSIS	Cortex Microcontroller Software Interface Standard
CPU	Central Processing Unit
CRC	CRC calculation unit
DAC	Digital to analog converter
DFSDM	Digital filter sigma delta modulators
DMA	Direct Memory Access
DSI	Display serial interface
ETH	Ethernet controller
EXTI	External interrupt/event controller
FLASH	Flash memory
FMC	Flexible memory controller
GPIO	General purpose I/Os
HAL	Hardware abstraction layer
HCD	USB Host Controller Driver
I2C	Inter-integrated circuit
I2S	Inter-integrated sound
IRDA	InfraRed Data Association
IWDG	Independent watchdog
LCD	Liquid Crystal Display Controller
LTDC	LCD TFT Display Controller
MDIOS	Management data input/output (MDIO) slave
MMC	Multi Media Card
MSP	MCU Specific Package
NAND	NAND Flash memory
NOR	Nor Flash memory
NVIC	Nested Vectored Interrupt Controller
PCD	USB Peripheral Controller Driver
PWR	Power controller

Acronym	Definition
QSPI	QUADSPI Flash memory Interface
RCC	Reset and clock controller
RTC	Real-time clock
SAI	Serial Audio Interface
SD	Secure Digital
SRAM	SRAM external memory
SMARTCARD	Smartcard IC
SPI	Serial Peripheral interface
SPDIFRX	SPDIF-RX Receiver interface
SysTick	System tick timer
TIM	Advanced-control, general-purpose or basic timer
UART	Universal asynchronous receiver/transmitter
USART	Universal synchronous receiver/transmitter
WWDG	Window watchdog
USB	Universal Serial Bus
PPP	STM32 peripheral or block

2 Overview of HAL drivers

The HAL drivers were designed to offer a rich set of APIs and to interact easily with the application upper layers.

Each driver consists of a set of functions covering the most common peripheral features. The development of each driver is driven by a common API which standardizes the driver structure, the functions and the parameter names.

The HAL drivers include a set of driver modules, each module being linked to a standalone peripheral. However, in some cases, the module is linked to a peripheral functional mode. As an example, several modules exist for the USART peripheral: UART driver module, USART driver module, SMARTCARD driver module and IRDA driver module.

The HAL main features are the following:

- Cross-family portable set of APIs covering the common peripheral features as well as extension APIs in case of specific peripheral features.
- Three API programming models: polling, interrupt and DMA.
- APIs are RTOS compliant:
 - Fully reentrant APIs
 - Systematic usage of timeouts in polling mode.
- Support of peripheral multi-instance allowing concurrent API calls for multiple instances of a given peripheral (USART1, USART2...)
- All HAL APIs implement user-callback functions mechanism:
 - Peripheral Init/DeInit HAL APIs can call user-callback functions to perform peripheral system level Initialization/De-Initialization (clock, GPIOs, interrupt, DMA)
 - Peripherals interrupt events
 - Error events.
- Object locking mechanism: safe hardware access to prevent multiple spurious accesses to shared resources.
- Timeout used for all blocking processes: the timeout can be a simple counter or a timebase.

2.1 HAL and user-application files

2.1.1 HAL driver files

A HAL drivers are composed of the following set of files:

Table 2: HAL driver files

File	Description
<i>stm32f7xx_hal_ppp.c</i>	Main peripheral/module driver file. It includes the APIs that are common to all STM32 devices. <i>Example: stm32f7xx_hal_adc.c, stm32f7xx_hal_irda.c, ...</i>
<i>stm32f7xx_hal_ppp.h</i>	Header file of the main driver C file It includes common data, handle and enumeration structures, define statements and macros, as well as the exported generic APIs. <i>Example: stm32f7xx_hal_adc.h, stm32f7xx_hal_irda.h, ...</i>

File	Description
<i>stm32f7xx_hal_ppp_ex.c</i>	Extension file of a peripheral/module driver. It includes the specific APIs for a given part number or family, as well as the newly defined APIs that overwrite the default generic APIs if the internal process is implemented in different way. <i>Example: stm32f7xx_hal_adc_ex.c, stm32f7xx_hal_dma_ex.c, ...</i>
<i>stm32f7xx_hal_ppp_ex.h</i>	Header file of the extension C file. It includes the specific data and enumeration structures, define statements and macros, as well as the exported device part number specific APIs <i>Example: stm32f7xx_hal_adc_ex.h, stm32f7xx_hal_dma_ex.h, ...</i>
<i>stm32f7xx_hal.c</i>	This file is used for HAL initialization and contains DBGMCU, Remap and Time Delay based on systick APIs.
<i>stm32f7xx_hal.h</i>	<i>stm32f7xx_hal.c</i> header file
<i>stm32f7xx_hal_msp_template.c</i>	Template file to be copied to the user application folder. It contains the MSP initialization and de-initialization (main routine and callbacks) of the peripheral used in the user application.
<i>stm32f7xx_hal_conf_template.h</i>	Template file allowing to customize the drivers for a given application.
<i>stm32f7xx_hal_def.h</i>	Common HAL resources such as common define statements, enumerations, structures and macros.

2.1.2 User-application files

The minimum files required to build an application using the HAL are listed in the table below:

Table 3: User-application files

File	Description
<i>system_stm32f7xx.c</i>	This file contains SystemInit() which is called at startup just after reset and before branching to the main program. It does not configure the system clock at startup (contrary to the standard library). This is to be done using the HAL APIs in the user files. It allows relocating the vector table in internal SRAM.
<i>startup_stm32f7xx.s</i>	Toolchain specific file that contains reset handler and exception vectors. For some toolchains, it allows adapting the stack/heap size to fit the application requirements.
<i>stm32f7xx_flash.icf (optional)</i>	Linker file for EWARM toolchain allowing mainly to adapt the stack/heap size to fit the application requirements.
<i>stm32f7xx_hal_msp.c</i>	This file contains the MSP initialization and de-initialization (main routine and callbacks) of the peripheral used in the user application.
<i>stm32f7xx_hal_conf.h</i>	This file allows the user to customize the HAL drivers for a specific application. It is not mandatory to modify this configuration. The application can use the default configuration without any modification.

File	Description
<i>stm32f7xx_it.c/.h</i>	This file contains the exceptions handler and peripherals interrupt service routine, and calls HAL_IncTick() at regular time intervals to increment a local variable (declared in <i>stm32f7xx_hal.c</i>) used as HAL timebase. By default, this function is called each 1ms in SysTick ISR. . The PPP_IRQHandler() routine must call HAL_PPP_IRQHandler() if an interrupt based process is used within the application.
<i>main.c/.h</i>	This file contains the main program routine, mainly: <ul style="list-style-type: none"> the call to HAL_Init() assert_failed() implementation system clock configuration peripheral HAL initialization and user application code.

The STM32Cube package comes with ready-to-use project templates, one for each supported board. Each project contains the files listed above and a preconfigured project for the supported toolchains.

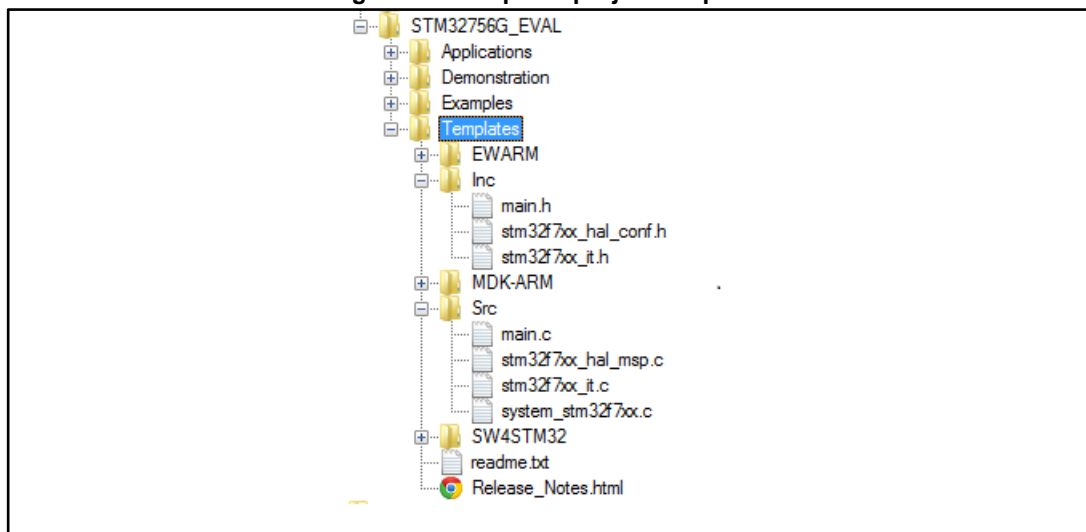
Each project template provides empty main loop function and can be used as a starting point to get familiar with project settings for STM32Cube. Its features are the following:

- It contains the sources of HAL, CMSIS and BSP drivers which are the minimal components to develop a code on a given board.
- It contains the include paths for all the firmware components.
- It defines the STM32 device supported, and allows configuring the CMSIS and HAL drivers accordingly.
- It provides ready to use user files preconfigured as defined below:
 - HAL is initialized
 - SysTick ISR implemented for HAL_Delay()
 - System clock configured with the maximum frequency of the device



If an existing project is copied to another location, then include paths must be updated.

Figure 1: Example of project template



2.2 HAL data structures

Each HAL driver can contain the following data structures:

- Peripheral handle structures
- Initialization and configuration structures
- Specific process structures.

2.2.1 Peripheral handle structures

The APIs have a modular generic multi-instance architecture that allows working with several IP instances simultaneously.

PPP_HandleTypeDef *handle is the main structure that is implemented in the HAL drivers. It handles the peripheral/module configuration and registers and embeds all the structures and variables needed to follow the peripheral device flow.

The peripheral handle is used for the following purposes:

- Multi-instance support: each peripheral/module instance has its own handle. As a result instance resources are independent.
- Peripheral process intercommunication: the handle is used to manage shared data resources between the process routines.
Example: global pointers, DMA handles, state machine.
- Storage: this handle is used also to manage global variables within a given HAL driver.

An example of peripheral structure is shown below:

```
typedef struct
{
  USART_TypeDef *Instance; /* USART registers base address */
  USART_InitTypeDef Init; /* Usart communication parameters */
  uint8_t *pTxBuffPtr; /* Pointer to Usart Tx transfer Buffer */
  uint16_t TxXferSize; /* Usart Tx Transfer size */
  __IO uint16_t TxXferCount; /* Usart Tx Transfer Counter */
  uint8_t *pRxBuffPtr; /* Pointer to Usart Rx transfer Buffer */
  uint16_t RxXferSize; /* Usart Rx Transfer size */
  __IO uint16_t RxXferCount; /* Usart Rx Transfer Counter */
  DMA_HandleTypeDef *hdmatx; /* Usart Tx DMA Handle parameters */
  DMA_HandleTypeDef *hdmarx; /* Usart Rx DMA Handle parameters */
  HAL_LockTypeDef Lock; /* Locking object */
  __IO HAL_USART_StateTypeDef State; /* Usart communication state */
  __IO HAL_USART_ErrorTypeDef ErrorCode; /* USART Error code */
}USART_HandleTypeDef;
```



1) The multi-instance feature implies that all the APIs used in the application are re-entrant and avoid using global variables because subroutines can fail to be re-entrant if they rely on a global variable to remain unchanged but that variable is modified when the subroutine is recursively invoked. For this reason, the following rules are respected:

- Re-entrant code does not hold any static (or global) non-constant data: re-entrant functions can work with global data. For example, a re-entrant interrupt service routine can grab a piece of hardware status to work with (e.g. serial port read buffer) which is not only global, but volatile. Still, typical use of static variables and global data is not advised, in the sense that only atomic read-modify-write instructions should be used in these variables. It should not be possible for an interrupt or signal to occur during the execution of such an instruction.
- Reentrant code does not modify its own code.



2) When a peripheral can manage several processes simultaneously using the DMA (full duplex case), the DMA interface handle for each process is added in the PPP_HandleTypeDef.



3) For the shared and system peripherals, no handle or instance object is used. The peripherals concerned by this exception are the following:

- GPIO
- SYSTICK
- NVIC
- PWR
- RCC
- FLASH.

2.2.2 Initialization and configuration structure

These structures are defined in the generic driver header file when it is common to all part numbers. When they can change from one part number to another, the structures are defined in the extension header file for each part number.

```
typedef struct
{
  uint32_t BaudRate; /*!< This member configures the UART communication baudrate.*/
  uint32_t WordLength; /*!< Specifies the number of data bits transmitted or received
  in a frame.*/
  uint32_t StopBits; /*!< Specifies the number of stop bits transmitted.*/
  uint32_t Parity; /*!< Specifies the parity mode. */
  uint32_t Mode; /*!< Specifies whether the Receive or Transmit mode is enabled or
  disabled.*/
  uint32_t HwFlowCtl; /*!< Specifies whether the hardware flow control mode is enabled
  or disabled.*/
  uint32_t OverSampling; /*!< Specifies whether the Over sampling 8 is enabled or
  disabled,
  to achieve higher speed (up to fPCLK/8).*/
}UART_InitTypeDef;
```



The config structure is used to initialize the sub-modules or sub-instances. See below example:

```
HAL_ADC_ConfigChannel (ADC_HandleTypeDef* hadc, ADC_ChannelConfTypeDef*
sConfig)
```

2.2.3 Specific process structures

The specific process structures are used for specific process (common APIs). They are defined in the generic driver header file.

Example:

```
HAL_PPP_Process (PPP_HandleTypeDef* hadc, PPP_ProcessConfig* sConfig)
```

2.3 API classification

The HAL APIs are classified into three categories:

- **Generic APIs:** common generic APIs applying to all STM32 devices. These APIs are consequently present in the generic HAL driver files of all STM32 microcontrollers.

```
HAL_StatusTypeDef HAL_ADC_Init(ADC_HandleTypeDef* hadc); HAL_StatusTypeDef
HAL_ADC_DeInit(ADC_HandleTypeDef *hadc); HAL_StatusTypeDef
HAL_ADC_Start(ADC_HandleTypeDef* hadc); HAL_StatusTypeDef
HAL_ADC_Stop(ADC_HandleTypeDef* hadc); HAL_StatusTypeDef
HAL_ADC_Start_IT(ADC_HandleTypeDef* hadc); HAL_StatusTypeDef
HAL_ADC_Stop_IT(ADC_HandleTypeDef* hadc); void HAL_ADC_IRQHandler(ADC_HandleTypeDef*
hadc);
```

Extension APIs:

This set of API is divided into two sub-categories :

- **Family specific APIs:** APIs applying to a given family. They are located in the extension HAL driver file (see example below related to the ADC).

```
HAL_StatusTypeDef HAL_ADCEx_Calibration_Start(ADC_HandleTypeDef* hadc, uint32_t
SingleDiff); uint32_t HAL_ADCEx_Calibration_GetValue(ADC_HandleTypeDef* hadc,
uint32_t SingleDiff);
```

- **Device part number specific APIs:**

These APIs are implemented in the extension file and delimited by specific define statements relative to a given part number.

```
#if defined(STM32F756xx)
HAL_StatusTypeDef HAL_HASHex_SHA224_Accumulate(HASH_HandleTypeDef *hhash, uint8_t
*pInBuffer, uint32_t Size);
#endif /* STM32F756xx */
```



The data structure related to the specific APIs is delimited by the device part number define statement. It is located in the corresponding extension header C file.

The following table summarizes the location of the different categories of HAL APIs in the driver files.

Table 4: APIs classification

	Generic file	Extension file
Common APIs	X	X ⁽¹⁾
Family specific APIs		X
Device specific APIs		X

Notes:

⁽¹⁾In some cases, the implementation for a specific device part number may change. In this case the generic API is declared as weak function in the extension file. The API is implemented again to overwrite the default function



Family specific APIs are only related to a given family. This means that if a specific API is implemented in another family, and the arguments of this latter family are different, additional structures and arguments might need to be added.



The IRQ handlers are used for common and family specific processes.

2.4 Devices supported by HAL drivers

Table 5: List of devices supported by HAL and LL drivers

IP/Module	STM32F722xx	STM32F723xx	STM32F732xx	STM32F733xx	STM32F745xx	STM32F746xx	STM32F756xx	STM32F765xx	STM32F767xx	STM32F768xx	STM32F769xx	STM32F777xx	STM32F778xx	STM32F779xx
stm32f7xx_hal.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_adc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
tm32f7xx_hal_adc_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_can.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_cec.c	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_cortex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_crc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_cryp.c	No	No	Yes	Yes	No	No	Yes	No	No	No	No	Yes	Yes	Yes
stm32f7xx_hal_cryp_ex.c	No	No	Yes	Yes	No	No	Yes	No	No	No	No	Yes	Yes	Yes
stm32f7xx_hal_dac.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_dac_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_dcmi.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_dcmi_ex.c	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_dfsdm.c	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_dma.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_dma_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_dma2d.c	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_dsi.c	No	No	No	No	No	No	No	No	No	Yes	Yes	No	Yes	Yes
stm32f7xx_hal_eth.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_flash.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

IP/Module	STM32F722xx	STM32F723xx	STM32F732xx	STM32F733xx	STM32F745xx	STM32F746xx	STM32F756xx	STM32F765xx	STM32F767xx	STM32F768xx	STM32F769xx	STM32F777xx	STM32F778xx	STM32F779xx
stm32f7xx_hal_flash_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_gpio.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_gpio_ex.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_hash.c	No	No	No	No	No	No	Yes	No	No	No	No	Yes	Yes	Yes
stm32f7xx_hal_hash_ex.c	No	No	No	No	No	No	Yes	No	No	No	No	Yes	Yes	Yes
stm32f7xx_hal_hcd.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_i2c.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_i2c_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_i2s.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_i2s_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_irda.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_iwdg.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_jpeg.c	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_lptim.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_ltdc.c	No	No	No	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_mdios.c	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_mmc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_nand.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_nor.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_pcd.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

IP/Module	STM32F722xx	STM32F723xx	STM32F732xx	STM32F733xx	STM32F745xx	STM32F746xx	STM32F756xx	STM32F765xx	STM32F767xx	STM32F768xx	STM32F769xx	STM32F777xx	STM32F778xx	STM32F779xx
stm32f7xx_hal_pcd_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_pwr.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_pwr_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_qspi.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_rcc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_rcc_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_rng.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_rtc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_rtc_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_sai.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_sai_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_sd.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_sdram.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_smartcard.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_smartcard_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_smbus.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_spdifrx.c	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_spi.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_sram.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_tim.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

IP/Module	STM32F722xx	STM32F723xx	STM32F732xx	STM32F733xx	STM32F745xx	STM32F746xx	STM32F756xx	STM32F765xx	STM32F767xx	STM32F768xx	STM32F769xx	STM32F777xx	STM32F778xx	STM32F779xx
stm32f7xx_hal_tim_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_uart.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_usart.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_hal_wwdg.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_fmc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_sdmmc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_usb.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_adc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_crc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_dac.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_dma.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_dma2d.c	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_exti.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_gpio.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_i2c.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_lptim.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_pwr.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_rcc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_rng.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_rtc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

IP/Module	STM32F722xx	STM32F723xx	STM32F732xx	STM32F733xx	STM32F745xx	STM32F746xx	STM32F756xx	STM32F765xx	STM32F767xx	STM32F768xx	STM32F769xx	STM32F777xx	STM32F778xx	STM32F779xx
stm32f7xx_ll_spi.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_tim.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_usart.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32f7xx_ll_utils.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

2.5 HAL driver rules

2.5.1 HAL API naming rules

The following naming rules are used in HAL drivers:

Table 6: HAL API naming rules

	Generic	Family specific	Device specific
File names	<i>stm32f7xx_hal_ppp (c/h)</i>	<i>stm32f7xx_hal_ppp_ex (c/h)</i>	<i>stm32f7xx_hal_ppp_ex (c/h)</i>
Module name	<i>HAL_PPP_MODULE</i>		
Function name	<i>HAL_PPP_Function HAL_PPP_FeatureFunction_ MODE</i>	<i>HAL_PPPEX_Function HAL_PPPEX_FeatureFunction_ MODE</i>	<i>HAL_PPPEX_Function HAL_PPPEX_FeatureFunction_ MODE</i>
Handle name	<i>PPP_HandleTypeDef</i>	NA	NA
Init structure name	<i>PPP_InitTypeDef</i>	NA	<i>PPP_InitTypeDef</i>
Enum name	<i>HAL_PPP_StructnameTypeDef</i>	NA	NA

- The **PPP** prefix refers to the peripheral functional mode and not to the peripheral itself. For example, if the USART, PPP can be USART, IRDA, UART or SMARTCARD depending on the peripheral mode.
- The constants used in one file are defined within this file. A constant used in several files is defined in a header file. All constants are written in uppercase, except for peripheral driver function parameters.
- typedef variable names should be suffixed with *_TypeDef*.
- Registers are considered as constants. In most cases, their name is in uppercase and uses the same acronyms as in the stm32f7xx reference manuals.
- Peripheral registers are declared in the *PPP_TypeDef* structure (e.g. *ADC_TypeDef*) in *stm32f7xxx.h* header file. *stm32f7xxx.h* corresponds to *stm32f722xx.h*, *stm32f723xx.h*, *stm32f732xx.h*, *stm32f733xx.h*, *stm32f745xx.h*, *stm32f746xx.h*, *stm32f756xx.h*, *stm32f765xx.h*, *stm32f767xx.h*, *stm32f768xx.h*, *stm32f769xx.h*, *stm32f777xx.h*, *stm32f778xx.h* and *stm32f779xx.h*.
- Peripheral function names are prefixed by *HAL_*, then the corresponding peripheral acronym in uppercase followed by an underscore. The first letter of each word is in uppercase (e.g. *HAL_UART_Transmit()*). Only one underscore is allowed in a function name to separate the peripheral acronym from the rest of the function name.
- The structure containing the PPP peripheral initialization parameters are named *PPP_InitTypeDef* (e.g. *ADC_InitTypeDef*).
- The structure containing the Specific configuration parameters for the PPP peripheral are named *PPP_xxxxConfTypeDef* (e.g. *ADC_ChannelConfTypeDef*).
- Peripheral handle structures are named *PPP_HandleTypeDef* (e.g. *DMA_HandleTypeDef*).
- The functions used to initialize the PPP peripheral according to parameters specified in *PPP_InitTypeDef* are named *HAL_PPP_Init* (e.g. *HAL_TIM_Init()*).
- The functions used to reset the PPP peripheral registers to their default values are named *PPP_DeInit*, e.g. *TIM_DeInit*.

- The **MODE** suffix refers to the process mode, which can be polling, interrupt or DMA. As an example, when the DMA is used in addition to the native resources, the function should be called: `HAL_PPP_Function_DMA ()`.
- The **Feature** prefix should refer to the new feature.
Example: `HAL_ADC_Start()` refers to the injection mode

2.5.2 HAL general naming rules

- For the shared and system peripherals, no handle or instance object is used. This rule applies to the following peripherals:
 - GPIO
 - SYSTICK
 - NVIC
 - RCC
 - FLASH.

Example: The `HAL_GPIO_Init()` requires only the GPIO address and its configuration parameters.

```
HAL StatusTypeDef HAL_GPIO_Init (GPIO_TypeDef* GPIOx, GPIO_InitTypeDef *Init)
{
  /*GPIO Initialization body */
}
```

- The macros that handle interrupts and specific clock configurations are defined in each peripheral/module driver. These macros are exported in the peripheral driver header files so that they can be used by the extension file. The list of these macros is defined below: This list is not exhaustive and other macros related to peripheral features can be added, so that they can be used in the user application.

Table 7: Macros handling interrupts and specific clock configurations

Macros	Description
<code>__HAL_PPP_ENABLE_IT(__HANDLE__, __INTERRUPT__)</code>	Enables a specific peripheral interrupt
<code>__HAL_PPP_DISABLE_IT(__HANDLE__, __INTERRUPT__)</code>	Disables a specific peripheral interrupt
<code>__HAL_PPP_GET_IT (__HANDLE__, __INTERRUPT __)</code>	Gets a specific peripheral interrupt status
<code>__HAL_PPP_CLEAR_IT (__HANDLE__, __INTERRUPT __)</code>	Clears a specific peripheral interrupt status
<code>__HAL_PPP_GET_FLAG (__HANDLE__, __FLAG__)</code>	Gets a specific peripheral flag status
<code>__HAL_PPP_CLEAR_FLAG (__HANDLE__, __FLAG__)</code>	Clears a specific peripheral flag status
<code>__HAL_PPP_ENABLE(__HANDLE__)</code>	Enables a peripheral
<code>__HAL_PPP_DISABLE(__HANDLE__)</code>	Disables a peripheral
<code>__HAL_PPP_XXXX (__HANDLE__, __PARAM__)</code>	Specific PPP HAL driver macro
<code>__HAL_PPP_GET_IT_SOURCE (__HANDLE__, __INTERRUPT __)</code>	Checks the source of specified interrupt

- NVIC and SYSTICK are two ARM Cortex core features. The APIs related to these features are located in the `stm32f7xx_hal_cortex.c` file.

- When a status bit or a flag is read from registers, it is composed of shifted values depending on the number of read values and of their size. In this case, the returned status width is 32 bits. Example: STATUS = XX | (YY << 16) or STATUS = XX | (YY << 8) | (YY << 16) | (YY << 24)".
- The PPP handles are valid before using the HAL_PPP_Init() API. The init function performs a check before modifying the handle fields.

```
HAL_PPP_Init(PPP_HandleTypeDef) if(hppp == NULL) { return HAL_ERROR; }
```

- The macros defined below are used:
 - Conditional macro:#define ABS(x) (((x) > 0) ? (x) : -(x))
 - Pseudo-code macro (multiple instructions macro):

```
#define HAL_LINKDMA( HANDLE , PPP_DMA_FIELD , DMA_HANDLE ) \ do{ \
( HANDLE )->PPP_DMA_FIELD = &( DMA_HANDLE ); \ ( DMA_HANDLE ).Parent = \
( HANDLE ); \ } while(0)
```

2.5.3 HAL interrupt handler and callback functions

Besides the APIs, HAL peripheral drivers include:

- HAL_PPP_IRQHandler() peripheral interrupt handler that should be called from stm32f7xx_it.c
- User callback functions.

The user callback functions are defined as empty functions with “weak” attribute. They have to be defined in the user code.

There are three types of user callbacks functions:

- Peripheral system level initialization/ de-Initialization callbacks: HAL_PPP_MspInit() and HAL_PPP_MspDeInit
- Process complete callbacks : HAL_PPP_ProcessCpltCallback
- Error callback: HAL_PPP_ErrorCallback.

Table 8: Callback functions

Callback functions	Example
HAL_PPP_MspInit() / _DeInit()	Example: HAL_USART_MspInit() Called from HAL_PPP_Init() API function to perform peripheral system level initialization (GPIOs, clock, DMA, interrupt)
HAL_PPP_ProcessCpltCallback	Example: HAL_USART_TxCpltCallback Called by peripheral or DMA interrupt handler when the process completes
HAL_PPP_ErrorCallback	Example: HAL_USART_ErrorCallback Called by peripheral or DMA interrupt handler when an error occurs

2.6 HAL generic APIs

The generic APIs provide common generic functions applying to all STM32 devices. They are composed of four APIs groups:

- **Initialization and de-initialization functions:** HAL_PPP_Init(), HAL_PPP_DeInit()
- **IO operation functions:** HAL_PPP_Read(), HAL_PPP_Write(), HAL_PPP_Transmit(), HAL_PPP_Receive()
- **Control functions:** HAL_PPP_Set (), HAL_PPP_Get ().
- **State and Errors functions:** HAL_PPP_GetState (), HAL_PPP_GetError ().



For some peripheral/module drivers, these groups are modified depending on the peripheral/module implementation.

Example: in the timer driver, the API grouping is based on timer features (PWM, OC, IC...).

The initialization and de-initialization functions allow initializing a peripheral and configuring the low-level resources, mainly clocks, GPIO, alternate functions (AF) and possibly DMA and interrupts. The *HAL_DeInit()* function restores the peripheral default state, frees the low-level resources and removes any direct dependency with the hardware.

The IO operation functions perform a row access to the peripheral payload data in write and read modes.

The control functions are used to change dynamically the peripheral configuration and set another operating mode.

The peripheral state and errors functions allow retrieving in runtime the peripheral and data flow states, and identifying the type of errors that occurred. The example below is based on the ADC peripheral. The list of generic APIs is not exhaustive. It is only given as an example.

Table 9: HAL generic APIs

Function group	Common API name	Description
Initialization group	<i>HAL_ADC_Init()</i>	This function initializes the peripheral and configures the low-level resources (clocks, GPIO, AF..)
	<i>HAL_ADC_DeInit()</i>	This function restores the peripheral default state, frees the low-level resources and removes any direct dependency with the hardware.
IO operation group	<i>HAL_ADC_Start ()</i>	This function starts ADC conversions when the polling method is used
	<i>HAL_ADC_Stop ()</i>	This function stops ADC conversions when the polling method is used
	<i>HAL_ADC_PollForConversion()</i>	This function allows waiting for the end of conversions when the polling method is used. In this case, a timeout value is specified by the user according to the application.
	<i>HAL_ADC_Start_IT()</i>	This function starts ADC conversions when the interrupt method is used
	<i>HAL_ADC_Stop_IT()</i>	This function stops ADC conversions when the interrupt method is used
	<i>HAL_ADC_IRQHandler()</i>	This function handles ADC interrupt requests
	<i>HAL_ADC_ConvCpltCallback()</i>	Callback function called in the IT subroutine to indicate the end of the current process or when a DMA transfer has completed
	<i>HAL_ADC_ErrorCallback()</i>	Callback function called in the IT subroutine if a peripheral error or a DMA transfer error occurred
Control group	<i>HAL_ADC_ConfigChannel()</i>	This function configures the selected ADC regular channel, the corresponding rank in the sequencer and the sample time
	<i>HAL_ADC_AnalogWDGConfig</i>	This function configures the analog watchdog for the selected ADC

Function group	Common API name	Description
State and Errors group	HAL_ADC_GetState()	This function allows getting in runtime the peripheral and the data flow states.
	HAL_ADC_GetError()	This function allows getting in runtime the error that occurred during IT routine

2.7 HAL extension APIs

2.7.1 HAL extension model overview

The extension APIs provide specific functions or overwrite modified APIs for a specific family (series) or specific part number within the same family.

The extension model consists of an additional file, stm32f7xx_hal_ppp_ex.c, that includes all the specific functions and define statements (stm32f7xx_hal_ppp_ex.h) for a given part number.

Below an example based on the ADC peripheral:

Table 10: HAL extension APIs

Function Group	Common API Name
HAL_ADCEx_CalibrationStart()	This function is used to start the automatic ADC calibration

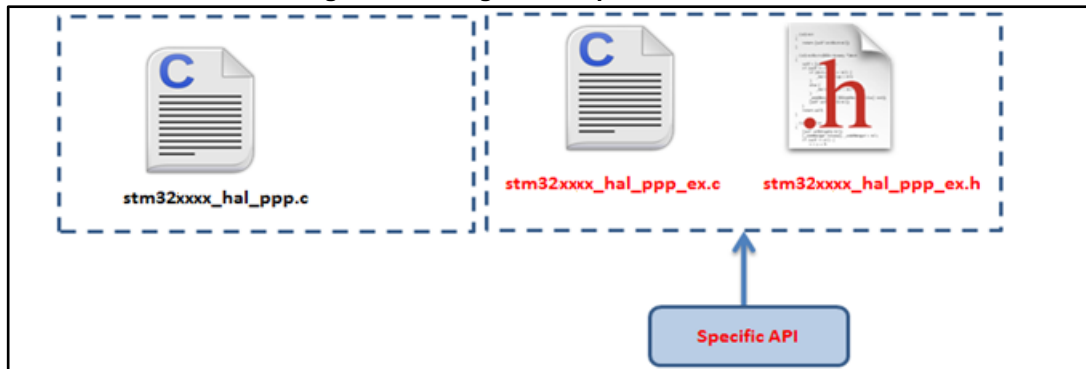
2.7.2 HAL extension model cases

The specific IP features can be handled by the HAL drivers in five different ways. They are described below.

Case 1: Adding a part number-specific function

When a new feature specific to a given device is required, the new APIs are added in the stm32f7xx_hal_ppp_ex.c extension file. They are named HAL_PPPEx_Function().

Figure 2: Adding device-specific functions



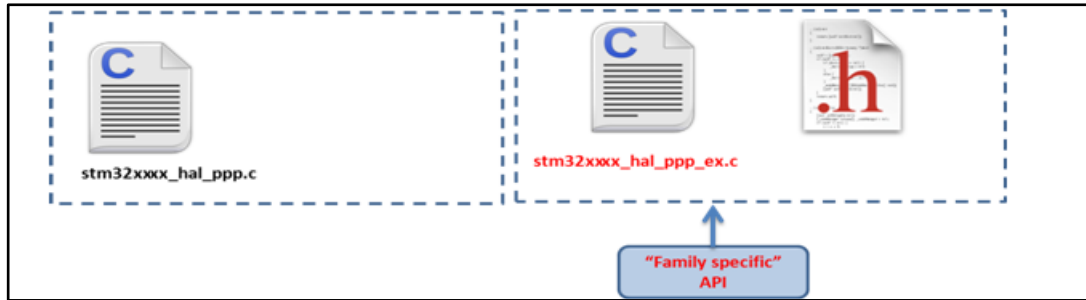
Example: stm32f7xx_hal_hash_ex.h

```
#if defined(STM32F756xx)
HAL_StatusTypeDef HAL_HASHEx_SHA224_Accumulate(HASH_HandleTypeDef *hhash, uint8_t
*pInBuffer, uint32_t Size);
HAL_StatusTypeDef HAL_HASHEx_SHA256_Accumulate(HASH_HandleTypeDef *hhash, uint8_t
*pInBuffer, uint32_t Size);
#endif /* STM32F756xx */
```

Case 2: Adding a family-specific function

In this case, the API is added in the extension driver C file and named HAL_PPPEx_Function ().

Figure 3: Adding family-specific functions

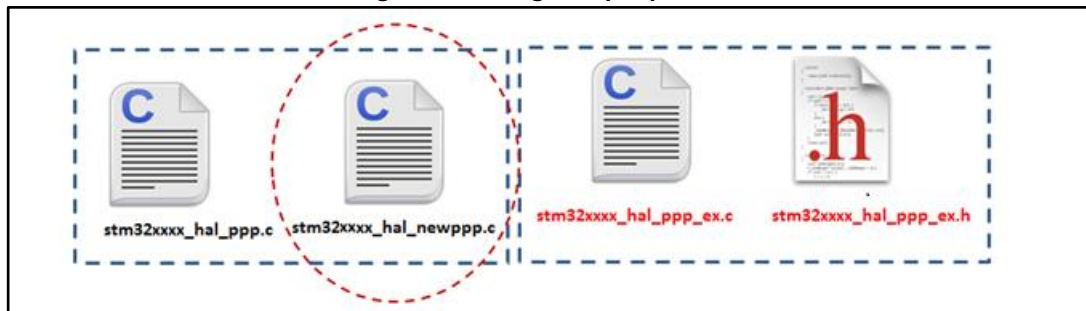


Case 3: Adding a new peripheral (specific to a device belonging to a given family)

When a peripheral which is available only in a specific device is required, the APIs corresponding to this new peripheral/module are added in stm32f7xx_hal_newppp.c. However the inclusion of this file is selected in the stm32f7_hal_conf.h using the macro:

```
#define HAL_NEWPPP_MODULE_ENABLED
```

Figure 4: Adding new peripherals

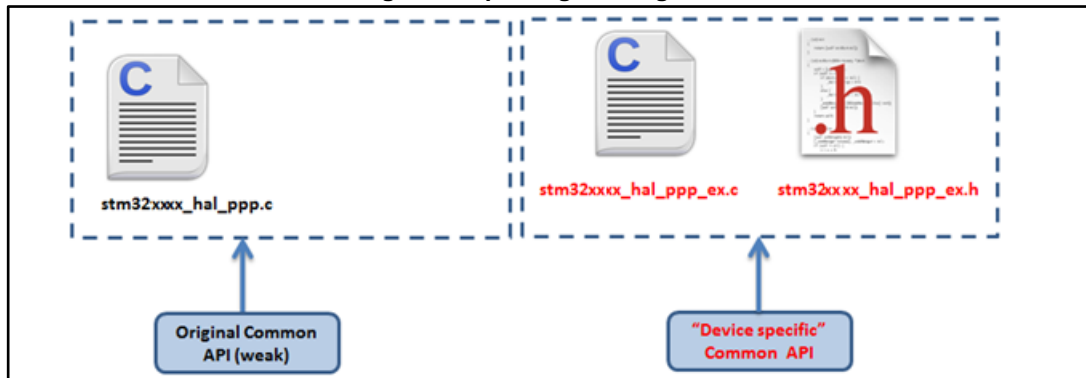


Example: xx_hal_sai.c/h

Case 4: Updating existing common APIs

In this case, the routines are defined with the same names in the xx_hal_ppp_ex.c extension file, while the generic API is defined as weak, so that the compiler will overwrite the original routine by the new defined function.

Figure 5: Updating existing APIs



Case 5: Updating existing data structures

The data structure for a specific device part number (e.g. PPP_InitTypeDef) can have different fields. In this case, the data structure is defined in the extension header file and delimited by the specific part number define statement.

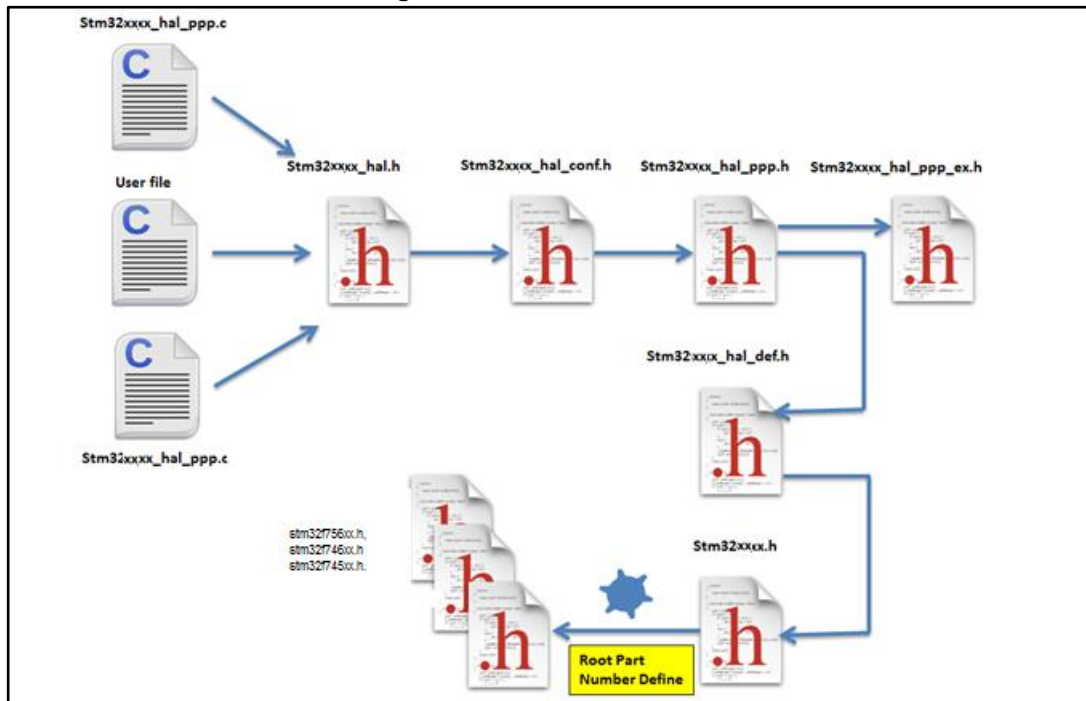
Example:

```
#if defined (STM32F756xx)
typedef struct
{
  (...)
} PPP_InitTypeDef;
#endif /* STM32F756xx */
```

2.8 File inclusion model

The header of the common HAL driver file (stm32f7xx_hal.h) includes the common configurations for the whole HAL library. It is the only header file that is included in the user sources and the HAL C sources files to be able to use the HAL resources.

Figure 6: File inclusion model



A PPP driver is a standalone module which is used in a project. The user must enable the corresponding USE_HAL_PPP_MODULE define statement in the configuration file.

```
/* *****
 * @file stm32f7xx_hal_conf.h
 * @author MCD Application Team
 * @version VX.Y.Z * @date dd-mm-yyyy
 * @brief This file contains the modules to be used
 * *****
 (...)
#define USE_HAL_USART_MODULE
#define USE_HAL_IRDA_MODULE
#define USE_HAL_DMA_MODULE
#define USE_HAL_RCC_MODULE
 (...)
*/
```

2.9 HAL common resources

The common HAL resources, such as common define enumerations, structures and macros, are defined in *stm32f7xx_hal_def.h*. The main common define enumeration is *HAL_StatusTypeDef*.

- **HAL Status**

The HAL status is used by almost all HAL APIs, except for boolean functions and IRQ handler. It returns the status of the current API operations. It has four possible values as described below:

```
typedef enum { HAL_OK = 0x00, HAL_ERROR = 0x01, HAL_BUSY = 0x02, HAL_TIMEOUT = 0x03 } HAL_StatusTypeDef;
```

- **HAL Locked**

The HAL lock is used by all HAL APIs to prevent accessing by accident shared resources.

```
typedef enum { HAL_UNLOCKED = 0x00, /*!<Resources unlocked */ HAL_LOCKED = 0x01 /*!<Resources locked */ } HAL_LockTypeDef;
```

- In addition to common resources, the *stm32f7xx_hal_def.h* file calls the *stm32f7xx.h* file in CMSIS library to get the data structures and the address mapping for all peripherals:

- Declarations of peripheral registers and bits definition.
- Macros to access peripheral registers hardware (Write register, Read register...etc.).

- **Common macros**

- Macro defining `HAL_MAX_DELAY`

```
#define HAL_MAX_DELAY 0xFFFFFFFF
```

- Macro linking a PPP peripheral to a DMA structure pointer: `__HAL_LINKDMA()`;

```
#define __HAL_LINKDMA( HANDLE, PPP_DMA_FIELD, DMA_HANDLE ) \ do{ \ ( HANDLE )-> PPP_DMA_FIELD = &( DMA_HANDLE ); \ ( DMA_HANDLE ).Parent = ( HANDLE ); \ } while(0)
```

2.10 HAL configuration

The configuration file, *stm32f7xx_hal_conf.h*, allows customizing the drivers for the user application. Modifying this configuration is not mandatory: the application can use the default configuration without any modification.

To configure these parameters, the user should enable, disable or modify some options by uncommenting, commenting or modifying the values of the related define statements as described in the table below:

Table 11: Define statements used for HAL configuration

Configuration item	Description	Default Value
HSE_VALUE	Defines the value of the external oscillator (HSE) expressed in Hz. The user must adjust this define statement when using a different crystal value.	25 000 000 Hz
HSE_STARTUP_TIMEOUT	Timeout for HSE start-up, expressed in ms	5000
HSI_VALUE	Defines the value of the internal oscillator (HSI) expressed in Hz.	16 000 000 Hz
LSE_VALUE	Defines the value of the external oscillator (HSE) expressed in Hz. The user must adjust this define statement when using a different crystal value.	32768 Hz

Configuration item	Description	Default Value
LSE_STARTUP_TIMEOUT	Timeout for LSE start-up, expressed in ms	5000
VDD_VALUE	VDD value	3300 (mV)
USE_RTOS	Enables the use of RTOS	FALSE (reserved for future use)
PREFETCH_ENABLE	Enables prefetch feature	TRUE



The `stm32f7xx_hal_conf_template.h` file is located in the HAL driver *Inc* folder. It should be copied to the user folder, renamed and modified as described above.



By default, the values defined in the `stm32f7xx_hal_conf_template.h` file are the same as the ones used for the examples and demonstrations. All HAL include files are enabled so that they can be used in the user code without modifications.

2.11 HAL system peripheral handling

This chapter gives an overview of how the system peripherals are handled by the HAL drivers. The full API list is provided within each peripheral driver description section.

2.11.1 Clock

Two main functions can be used to configure the system clock:

- `HAL_RCC_OscConfig` (`RCC_OscInitTypeDef *RCC_OscInitStruct`). This function configures/enables multiple clock sources (HSE, HSI, LSE, LSI, PLL).
- `HAL_RCC_ClockConfig` (`RCC_ClkInitTypeDef *RCC_ClkInitStruct, uint32_t FLatency`). This function
 - selects the system clock source
 - configures AHB, APB1 and APB2 clock dividers
 - configures the number of Flash memory wait states
 - updates the SysTick configuration when HCLK clock changes.

Some peripheral clocks are not derived from the system clock (RTC, USB...). In this case, the clock configuration is performed by an extended API defined in `stm32f7xx_hal_rcc_ex.c`: `HAL_RCCEx_PeriphCLKConfig(RCC_PeriphCLKInitTypeDef *PeriphClkInit)`.

Additional RCC HAL driver functions are available:

- `HAL_RCC_DeInit()` Clock de-init function that return clock configuration to reset state
- Get clock functions that allow retrieving various clock configurations (system clock, HCLK, PCLK1, PCLK2, ...)
- MCO and CSS configuration functions

A set of macros are defined in `stm32f7xx_hal_rcc.h` and `stm32f7xx_hal_rcc_ex.h`. They allow executing elementary operations on RCC block registers, such as peripherals clock gating/reset control:

- `__PPP_CLK_ENABLE/ __PPP_CLK_DISABLE` to enable/disable the peripheral clock
- `__PPP_FORCE_RESET/ __PPP_RELEASE_RESET` to force/release peripheral reset

- `__PPP_CLK_SLEEP_ENABLE/ __PPP_CLK_SLEEP_DISABLE` to enable/disable the peripheral clock during low power (Sleep) mode.

2.11.2 GPIOs

GPIO HAL APIs are the following:

- `HAL_GPIO_Init()` / `HAL_GPIO_DeInit()`
- `HAL_GPIO_ReadPin()` / `HAL_GPIO_WritePin()`
- `HAL_GPIO_TogglePin ()`.

In addition to standard GPIO modes (input, output, analog), the pin mode can be configured as EXTI with interrupt or event generation.

When selecting EXTI mode with interrupt generation, the user must call `HAL_GPIO_EXTI_IRQHandler()` from `stm32f7xx_it.c` and implement `HAL_GPIO_EXTI_Callback()`

The table below describes the `GPIO_InitTypeDef` structure field.

Table 12: Description of `GPIO_InitTypeDef` structure

Structure field	Description
Pin	Specifies the GPIO pins to be configured. Possible values: <code>GPIO_PIN_x</code> or <code>GPIO_PIN_All</code> , where <code>x[0..15]</code>
Mode	Specifies the operating mode for the selected pins: GPIO mode or EXTI mode. Possible values are: <ul style="list-style-type: none"> • <u>GPIO mode</u> <ul style="list-style-type: none"> – <code>GPIO_MODE_INPUT</code> : Input floating – <code>GPIO_MODE_OUTPUT_PP</code> : Output push-pull – <code>GPIO_MODE_OUTPUT_OD</code> : Output open drain – <code>GPIO_MODE_AF_PP</code> : Alternate function push-pull – <code>GPIO_MODE_AF_OD</code> : Alternate function open drain – <code>GPIO_MODE_ANALOG</code> : Analog mode • <u>External Interrupt mode</u> <ul style="list-style-type: none"> – <code>GPIO_MODE_IT_RISING</code> : Rising edge trigger detection – <code>GPIO_MODE_IT_FALLING</code> : Falling edge trigger detection – <code>GPIO_MODE_IT_RISING_FALLING</code> : Rising/Falling edge trigger detection • <u>External Event mode</u> <ul style="list-style-type: none"> – <code>GPIO_MODE_EVT_RISING</code> : Rising edge trigger detection – <code>GPIO_MODE_EVT_FALLING</code> : Falling edge trigger detection – <code>GPIO_MODE_EVT_RISING_FALLING</code>: Rising/Falling edge trigger detection
Pull	Specifies the Pull-up or Pull-down activation for the selected pins. Possible values are: <code>GPIO_NOPULL</code> <code>GPIO_PULLUP</code> <code>GPIO_PULLDOWN</code>

Structure field	Description
Speed	Specifies the speed for the selected pins Possible values are: GPIO_SPEED_LOW GPIO_SPEED_MEDIUM GPIO_SPEED_HIGH

Please find below typical GPIO configuration examples:

- Configuring GPIOs as output push-pull to drive external LEDs

```
GPIO_InitStruct.Pin = GPIO_PIN_12 | GPIO_PIN_13 | GPIO_PIN_14 | GPIO_PIN_15;
GPIO_InitStruct.Mode = GPIO_MODE_OUTPUT_PP;
GPIO_InitStruct.Pull = GPIO_PULLUP;
GPIO_InitStruct.Speed = GPIO_SPEED_MEDIUM;
HAL_GPIO_Init(GPIOD, &GPIO_InitStruct);
```

- Configuring PA0 as external interrupt with falling edge sensitivity:

```
GPIO_InitStructure.Mode = GPIO_MODE_IT_FALLING;
GPIO_InitStructure.Pull = GPIO_NOPULL;
GPIO_InitStructure.Pin = GPIO_PIN_0;
HAL_GPIO_Init(GPIOA, &GPIO_InitStructure);
```

2.11.3 Cortex NVIC and SysTick timer

The Cortex HAL driver, stm32f7xx_hal_cortex.c, provides APIs to handle NVIC and SysTick. The supported APIs include:

- HAL_NVIC_SetPriority()/ HAL_NVIC_SetPriorityGrouping()
- HAL_NVIC_GetPriority() / HAL_NVIC_GetPriorityGrouping()
- HAL_NVIC_EnableIRQ()/HAL_NVIC_DisableIRQ()
- HAL_NVIC_SystemReset()
- HAL_SYSTICK_IRQHandler()
- HAL_NVIC_GetPendingIRQ() / HAL_NVIC_SetPendingIRQ () / HAL_NVIC_ClearPendingIRQ()
- HAL_NVIC_GetActive(IRQn)
- HAL_SYSTICK_Config()
- HAL_SYSTICK_CLKSourceConfig()
- HAL_SYSTICK_Callback()

2.11.4 PWR

The PWR HAL driver handles power management. The features shared between all STM32 Series are listed below:

- PVD configuration, enabling/disabling and interrupt handling
 - HAL_PWR_ConfigPVD()
 - HAL_PWR_EnablePVD() / HAL_PWR_DisablePVD()
 - HAL_PWR_PVD_IRQHandler()
 - HAL_PWR_PVDcallback()
- Wakeup pin configuration
 - HAL_PWR_EnableWakeUpPin() / HAL_PWR_DisableWakeUpPin()
- Low-power mode entry
 - HAL_PWR_EnterSLEEPMode()
 - HAL_PWR_EnterSTOPMode()
 - HAL_PWR_EnterSTANDBYMode()



2.11.5 EXTI

The EXTI is not considered as a standalone peripheral but rather as a service used by other peripheral. As a result there are no EXTI APIs but each peripheral HAL driver implements the associated EXTI configuration and EXTI function are implemented as macros in its header file.

The first 16 EXTI lines connected to the GPIOs are managed within the GPIO driver. The GPIO_InitTypeDef structure allows configuring an I/O as external interrupt or external event.

The EXTI lines connected internally to the PVD, RTC, USB, and Ethernet are configured within the HAL drivers of these peripheral through the macros given in the table below. The EXTI internal connections depend on the targeted STM32 microcontroller (refer to the product datasheet for more details):

Table 13: Description of EXTI configuration macros

Macros	Description
<code>__HAL_PPP_{SUBBLOCK}_EXTI_ENABLE_IT()</code>	Enables a given EXTI line interrupt Example: <code>__HAL_PWR_PVD_EXTI_ENABLE_IT()</code>
<code>__HAL_PPP_{SUBBLOCK}_EXTI_DISABLE_IT()</code>	Disables a given EXTI line. Example: <code>__HAL_PWR_PVD_EXTI_DISABLE_IT()</code>
<code>__HAL_PPP_{SUBBLOCK}_EXTI_GET_FLAG()</code>	Gets a given EXTI line interrupt flag pending bit status. Example: <code>__HAL_PWR_PVD_EXTI_GET_FLAG()</code>
<code>__HAL_PPP_{SUBBLOCK}_EXTI_CLEAR_FLAG()</code>	Clears a given EXTI line interrupt flag pending bit. Example; <code>__HAL_PWR_PVD_EXTI_CLEAR_FLAG()</code>
<code>__HAL_PPP_{SUBBLOCK}_EXTI_GENERATE_SWIT()</code>	Generates a software interrupt for a given EXTI line. Example: <code>__HAL_PWR_PVD_EXTI_GENERATE_SWIT()</code>
<code>__HAL_PPP_SUBBLOCK_EXTI_ENABLE_EVENT()</code>	Enables a given EXTI line event Example: <code>__HAL_RTC_WAKEUP_EXTI_ENABLE_EVENT()</code>
<code>__HAL_PPP_SUBBLOCK_EXTI_DISABLE_EVENT()</code>	Disables a given EXTI line event Example: <code>__HAL_RTC_WAKEUP_EXTI_DISABLE_EVENT()</code>
<code>__HAL_PPP_SUBBLOCK_EXTI_ENABLE_RISING_EDGE()</code>	Configures an EXTI Interrupt or Event on rising edge
<code>__HAL_PPP_SUBBLOCK_EXTI_DISABLE_FALLING_EDGE()</code>	Enables an EXTI Interrupt or Event on Falling edge

Macros	Description
<code>__HAL_PPP_SUBBLOCK_EXTI_DISABLE_RISING_EDGE()</code>	Disables an EXTI Interrupt or Event on rising edge
<code>__HAL_PPP_SUBBLOCK_EXTI_DISABLE_FALLING_EDGE()</code>	Disables an EXTI Interrupt or Event on Falling edge
<code>__HAL_PPP_SUBBLOCK_EXTI_ENABLE_RISING_FALLING_EDGE()</code>	Enables an EXTI Interrupt or Event on Rising/Falling edge
<code>__HAL_PPP_SUBBLOCK_EXTI_DISABLE_RISING_FALLING_EDGE()</code>	Disables an EXTI Interrupt or Event on Rising/Falling edge

If the EXTI interrupt mode is selected, the user application must call `HAL_PPP_FUNCTION_IRQHandler()` (for example `HAL_PWR_PVD_IRQHandler()`), from `stm32f7xx_it.c` file, and implement `HAL_PPP_FUNCTIONCallback()` callback function (for example `HAL_PWR_PVDCallback()`).

2.11.6 DMA

The DMA HAL driver allows enabling and configuring the peripheral to be connected to the DMA Channels (except for internal SRAM/FLASH memory which do not require any initialization). Refer to the product reference manual for details on the DMA request corresponding to each peripheral.

For a given channel, `HAL_DMA_Init()` API allows programming the required configuration through the following parameters:

- Transfer Direction
- Source and Destination data formats
- Circular, Normal or peripheral flow control mode
- Channels Priority level
- Source and Destination Increment mode

Two operating modes are available:

- Polling mode I/O operation
 - a. Use `HAL_DMA_Start()` to start DMA transfer when the source and destination addresses and the Length of data to be transferred have been configured.
 - b. Use `HAL_DMA_PollForTransfer()` to poll for the end of current transfer. In this case a fixed timeout can be configured depending on the user application.
- Interrupt mode I/O operation
 - a. Configure the DMA interrupt priority using `HAL_NVIC_SetPriority()`
 - b. Enable the DMA IRQ handler using `HAL_NVIC_EnableIRQ()`
 - c. Use `HAL_DMA_Start_IT()` to start DMA transfer when the source and destination addresses and the length of data to be transferred have been configured. In this case the DMA interrupt is configured.
 - d. Use `HAL_DMA_IRQHandler()` called under `DMA_IRQHandler()` Interrupt subroutine
 - e. When data transfer is complete, `HAL_DMA_IRQHandler()` function is executed and a user function can be called by customizing `XferCpltCallback` and `XferErrorCallback` function pointer (i.e. a member of DMA handle structure).

Additional functions and macros are available to ensure efficient DMA management:

- Use HAL_DMA_GetState() function to return the DMA state and HAL_DMA_GetError() in case of error detection.
- Use HAL_DMA_Abort() function to abort the current transfer

The most used DMA HAL driver macros are the following:

- __HAL_DMA_ENABLE: enables the specified DMA Channels.
- __HAL_DMA_DISABLE: disables the specified DMA Channels.
- __HAL_DMA_GET_FLAG: gets the DMA Channels pending flags.
- __HAL_DMA_CLEAR_FLAG: clears the DMA Channels pending flags.
- __HAL_DMA_ENABLE_IT: enables the specified DMA Channels interrupts.
- __HAL_DMA_DISABLE_IT: disables the specified DMA Channels interrupts.
- __HAL_DMA_GET_IT_SOURCE: checks whether the specified DMA stream interrupt has occurred or not.



When a peripheral is used in DMA mode, the DMA initialization should be done in the HAL_PPP_MspInit() callback. In addition, the user application should associate the DMA handle to the PPP handle (refer to section “HAL IO operation functions”).



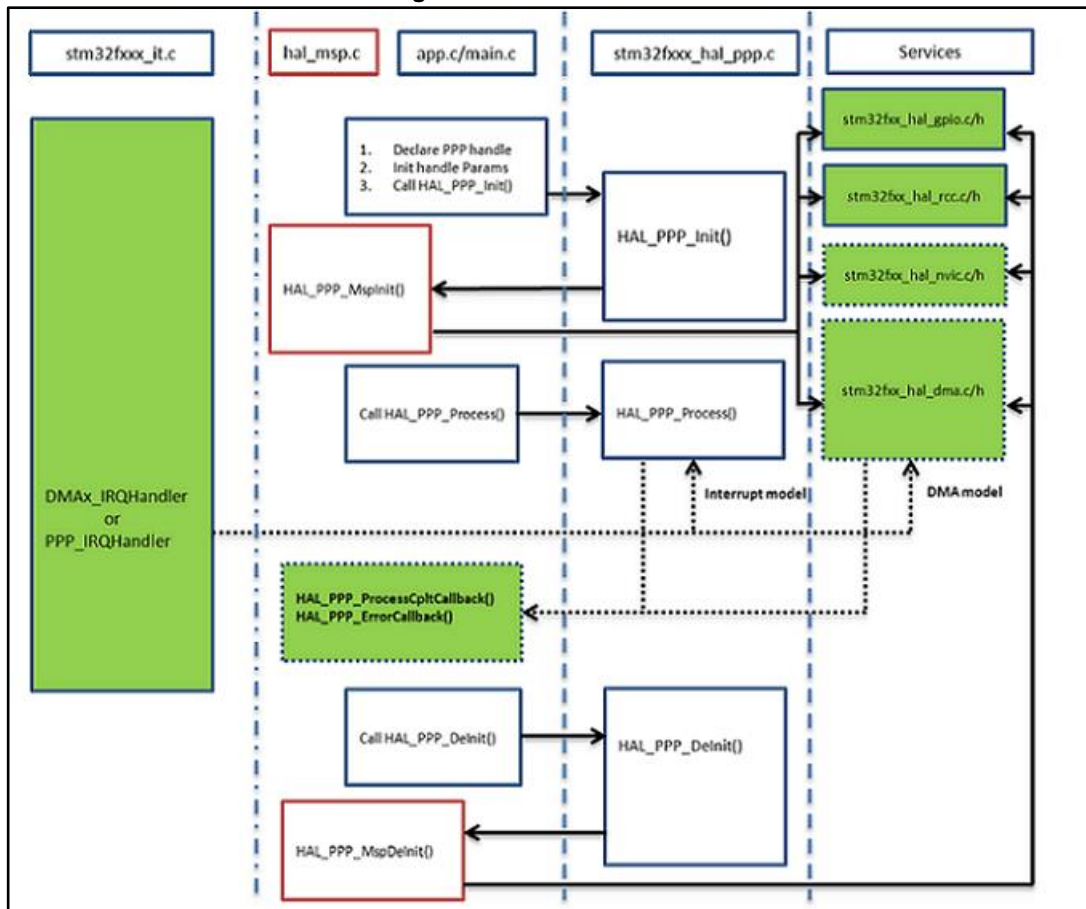
DMA channel callbacks need to be initialized by the user application only in case of memory-to-memory transfer. However when peripheral-to-memory transfers are used, these callbacks are automatically initialized by calling a process API function that uses the DMA.

2.12 How to use HAL drivers

2.12.1 HAL usage models

The following figure shows the typical use of the HAL driver and the interaction between the application user, the HAL driver and the interrupts.

Figure 7: HAL driver model



The functions implemented in the HAL driver are shown in green, the functions called from interrupt handlers in dotted lines, and the msp functions implemented in the user application in red. Non-dotted lines represent the interactions between the user application functions.

Basically, the HAL driver APIs are called from user files and optionally from interrupt handlers file when the APIs based on the DMA or the PPP peripheral dedicated interrupts are used.

When DMA or PPP peripheral interrupts are used, the PPP process complete callbacks are called to inform the user about the process completion in real-time event mode (interrupts). Note that the same process completion callbacks are used for DMA in interrupt mode.

2.12.2 HAL initialization

2.12.2.1 HAL global initialization

In addition to the peripheral initialization and de-initialization functions, a set of APIs are provided to initialize the HAL core implemented in file stm32f7xx_hal.c.

- HAL_Init(): this function must be called at application startup to
 - initialize data/instruction cache and pre-fetch queue
 - set SysTick timer to generate an interrupt each 1ms (based on HSI clock) with the lowest priority

- call HAL_MspInit() user callback function to perform system level initializations (Clock, GPIOs, DMA, interrupts). HAL_MspInit() is defined as “weak” empty function in the HAL drivers.
- HAL_DeInit()
 - resets all peripherals
 - calls function HAL_MspDeInit() which is a user callback function to do system level De-Initializations.
- HAL_GetTick(): this function gets current SysTick counter value (incremented in SysTick interrupt) used by peripherals drivers to handle timeouts.
- HAL_Delay(). this function implements a delay (expressed in milliseconds) using the SysTick timer.

Care must be taken when using HAL_Delay() since this function provides an accurate delay (expressed in milliseconds) based on a variable incremented in SysTick ISR. This means that if HAL_Delay() is called from a peripheral ISR, then the SysTick interrupt must have highest priority (numerically lower) than the peripheral interrupt, otherwise the caller ISR will be blocked.

2.12.2.2 System clock initialization

The clock configuration is done at the beginning of the user code. However the user can change the configuration of the clock in his own code. Please find below the typical Clock configuration sequence:

```
void SystemClock Config(void) {
    RCC_ClkInitTypeDef RCC_ClkInitStruct;
    RCC_OscInitTypeDef RCC_OscInitStruct;
    HAL_StatusTypeDef ret = HAL_OK; /* Enable
    HSE Oscillator and activate PLL with HSE as source */
    RCC_OscInitStruct.OscillatorType = RCC_OSCILLATORTYPE_HSE;
    RCC_OscInitStruct.HSEState = RCC_HSE_ON;
    RCC_OscInitStruct.PLL.PLLState = RCC_PLL_ON;
    RCC_OscInitStruct.PLL.PLLSource = RCC_PLLSOURCE_HSE;
    RCC_OscInitStruct.PLL.PLLM = 25;
    RCC_OscInitStruct.PLL.PLLN = 432;
    RCC_OscInitStruct.PLL.PLLP = RCC_PLLP_DIV2;
    RCC_OscInitStruct.PLL.PLLQ = 9;
    ret = HAL_RCC_OscConfig(&RCC_OscInitStruct);
    if(ret != HAL_OK)
    {
        while(1)
        { ; }
    }
    /* Activate
    the OverDrive to reach the 216 MHz Frequency */
    ret = HAL_PWREx_EnableOverDrive();
    if(ret != HAL_OK)
    {
        while(1)
        { ; }
    }
    /* Select
    PLL as system clock source and configure the HCLK, PCLK1 and PCLK2 clocks
    dividers
    */
    RCC_ClkInitStruct.ClockType = (RCC_CLOCKTYPE_SYSCLK | RCC_CLOCKTYPE_HCLK |
    RCC_CLOCKTYPE_PCLK1 | RCC_CLOCKTYPE_PCLK2);
    RCC_ClkInitStruct.SYSCLKSource = RCC_SYSCLKSOURCE_PLLCLK;
    RCC_ClkInitStruct.AHBCLKDivider = RCC_SYSCLK_DIV1;
    RCC_ClkInitStruct.APB1CLKDivider = RCC_HCLK_DIV4;
    RCC_ClkInitStruct.APB2CLKDivider = RCC_HCLK_DIV2;
    ret = HAL_RCC_ClockConfig(&RCC_ClkInitStruct, FLASH_LATENCY_7);
    if(ret != HAL_OK)
    {
        while(1)
        { ; } }
    }
}
```

2.12.2.3 HAL MSP initialization process

The peripheral initialization is done through *HAL_PPP_Init()* while the hardware resources initialization used by a peripheral (PPP) is performed during this initialization by calling MSP callback function *HAL_PPP_MspInit()*.

The *MspInit* callback performs the low level initialization related to the different additional hardware resources: RCC, GPIO, NVIC and DMA.

All the HAL drivers with handles include two MSP callbacks for initialization and de-initialization:

```

/**
 * @brief Initializes the PPP MSP.
 * @param hppp: PPP handle
 * @retval None */
void __weak HAL_PPP_MspInit(PPP_HandleTypeDef *hppp) {
/* NOTE : This function Should not be modified, when the callback is needed,
the HAL_PPP_MspInit could be implemented in the user file */
}
/**
 * @brief DeInitializes PPP MSP.
 * @param hppp: PPP handle
 * @retval None */
void __weak HAL_PPP_MspDeInit(PPP_HandleTypeDef *hppp) {
/* NOTE : This function Should not be modified, when the callback is needed,
the HAL_PPP_MspDeInit could be implemented in the user file */
}

```

The MSP callbacks are declared empty as weak functions in each peripheral driver. The user can use them to set the low level initialization code or omit them and use his own initialization routine.

The HAL MSP callback is implemented inside the *stm32f7xx_hal_msp.c* file in the user folders. An *stm32f7xx_hal_msp.c* file template is located in the HAL folder and should be copied to the user folder. It can be generated automatically by STM32CubeMX tool and further modified. Note that all the routines are declared as weak functions and could be overwritten or removed to use user low level initialization code.

stm32f7xx_hal_msp.c file contains the following functions:

Table 14: MSP functions

Routine	Description
void HAL_MspInit()	Global MSP initialization routine
void HAL_MspDeInit()	Global MSP de-initialization routine
void HAL_PPP_MspInit()	PPP MSP initialization routine
void HAL_PPP_MspDeInit()	PPP MSP de-initialization routine

By default, if no peripheral needs to be de-initialized during the program execution, the whole MSP initialization is done in *Hal_MspInit()* and MSP De-Initialization in the *Hal_MspDeInit()*. In this case the *HAL_PPP_MspInit()* and *HAL_PPP_MspDeInit()* are not implemented.

When one or more peripherals needs to be de-initialized in run time and the low level resources of a given peripheral need to be released and used by another peripheral, *HAL_PPP_MspDeInit()* and *HAL_PPP_MspInit()* are implemented for the concerned peripheral and other peripherals initialization and de-Initialization are kept in the global *HAL_MspInit()* and the *HAL_MspDeInit()*.

If there is nothing to be initialized by the global *HAL_MspInit()* and *HAL_MspDeInit()*, the two routines can simply be omitted.



2.12.3 HAL IO operation process

The HAL functions with internal data processing like Transmit, Receive, Write and Read are generally provided with three data processing modes as follows:

- Polling mode
- Interrupt mode
- DMA mode

2.12.3.1 Polling mode

In Polling mode, the HAL functions return the process status when the data processing in blocking mode is complete. The operation is considered complete when the function returns the HAL_OK status, otherwise an error status is returned. The user can get more information through the *HAL_PPP_GetState()* function. The data processing is handled internally in a loop. A timeout (expressed in ms) is used to prevent process hanging.

The example below shows the typical Polling mode processing sequence :

```
HAL StatusTypeDef HAL_PPP_Transmit ( PPP_HandleTypeDef * pHandle, uint8_t pData,
int16_t tSize, uint32_t tTimeout)
{
    if((pData == NULL) || (tSize == 0))
    {
        return HAL_ERROR;
    }
    (...) while (data processing is running)
    {
        if( timeout reached )
        {
            return HAL_TIMEOUT;
        }
    }
    (...)
    return HAL_OK; }

```

2.12.3.2 Interrupt mode

In Interrupt mode, the HAL function returns the process status after starting the data processing and enabling the appropriate interruption. The end of the operation is indicated by a callback declared as a weak function. It can be customized by the user to be informed in real-time about the process completion. The user can also get the process status through the *HAL_PPP_GetState()* function.

In Interrupt mode, four functions are declared in the driver:

- *HAL_PPP_Process_IT()*: launch the process
- *HAL_PPP_IRQHandler()*: the global PPP peripheral interruption
- *__weak HAL_PPP_ProcessCpltCallback ()*: the callback relative to the process completion.
- *__weak HAL_PPP_ProcessErrorCallback()*: the callback relative to the process Error.

To use a process in Interrupt mode, *HAL_PPP_Process_IT()* is called in the user file and *HAL_PPP_IRQHandler* in *stm32f7xx_it.c*.

The *HAL_PPP_ProcessCpltCallback()* function is declared as weak function in the driver. This means that the user can declare it again in the application. The function in the driver is not modified.

An example of use is illustrated below:

main.c file:

```

UART_HandleTypeDef UartHandle;
int main(void)
{
  /* Set User Parameters */
  UartHandle.Init.BaudRate = 9600;
  UartHandle.Init.WordLength = UART_DATABITS_8;
  UartHandle.Init.StopBits = UART_STOPBITS_1;
  UartHandle.Init.Parity = UART_PARITY_NONE;
  UartHandle.Init.HwFlowCtl = UART_HWCONTROL_NONE;
  UartHandle.Init.Mode = UART_MODE_TX_RX;
  UartHandle.Init.Instance = USART1;
  HAL_UART_Init(&UartHandle);
  HAL_UART_SendIT(&UartHandle, TxBuffer, sizeof(TxBuffer));
  while (1);
}
void HAL_UART_TxCpltCallback(UART_HandleTypeDef *huart)
{
}
void HAL_UART_ErrorCallback(UART_HandleTypeDef *huart)
{
}

```

stm32f7xx_it.c file:

```

extern UART_HandleTypeDef UartHandle;
void USART1_IRQHandler(void)
{
  HAL_UART_IRQHandler(&UartHandle);
}

```

2.12.3.3 DMA mode

In DMA mode, the HAL function returns the process status after starting the data processing through the DMA and after enabling the appropriate DMA interruption. The end of the operation is indicated by a callback declared as a weak function and can be customized by the user to be informed in real-time about the process completion. The user can also get the process status through the *HAL_PPP_GetState()* function. For the DMA mode, three functions are declared in the driver:

- *HAL_PPP_Process_DMA()*: launch the process
- *HAL_PPP_DMA_IRQHandler()*: the DMA interruption used by the PPP peripheral
- *__weak HAL_PPP_ProcessCpltCallback()*: the callback relative to the process completion.
- *__weak HAL_PPP_ErrorCpltCallback()*: the callback relative to the process Error.

To use a process in DMA mode, *HAL_PPP_Process_DMA()* is called in the user file and the *HAL_PPP_DMA_IRQHandler()* is placed in the *stm32f7xx_it.c*. When DMA mode is used, the DMA initialization is done in the *HAL_PPP_MspInit()* callback. The user should also associate the DMA handle to the PPP handle. For this purpose, the handles of all the peripheral drivers that use the DMA must be declared as follows:

```

typedef struct
{
  PPP_TypeDef *Instance; /* Register base address */
  PPP_InitTypeDef Init; /* PPP communication parameters */
  HAL_StateTypeDef State; /* PPP communication state */
  (...)
  DMA_HandleTypeDef *hdma; /* associated DMA handle */
} PPP_HandleTypeDef;

```

The initialization is done as follows (UART example):

```

int main(void)
{
  /* Set User Parameters */
  UartHandle.Init.BaudRate = 9600;

```

```

UartHandle.Init.WordLength = UART_DATABITS_8;
UartHandle.Init.StopBits = UART_STOPBITS_1;
UartHandle.Init.Parity = UART_PARITY_NONE;
UartHandle.Init.HwFlowCtl = UART_HWCONTROL_NONE;
UartHandle.Init.Mode = UART_MODE_TX_RX;
UartHandle.Init.Instance = UART1;
HAL_UART_Init(&UartHandle);
(..)
}
void HAL_USART_MspInit (UART_HandleTypeDef * huart)
{
static DMA_HandleTypeDef hdma_tx;
static DMA_HandleTypeDef hdma_rx;
(...)
__HAL_LINKDMA(UartHandle, DMA_Handle_tx, hdma_tx);
__HAL_LINKDMA(UartHandle, DMA_Handle_rx, hdma_rx);
(...)
}

```

The `HAL_PPP_ProcessCpltCallback()` function is declared as weak function in the driver that means, the user can declare it again in the application code. The function in the driver should not be modified.

An example of use is illustrated below:

main.c file:

```

UART_HandleTypeDef UartHandle;
int main(void)
{
/* Set User Parameters */
UartHandle.Init.BaudRate = 9600;
UartHandle.Init.WordLength = UART_DATABITS_8;
UartHandle.Init.StopBits = UART_STOPBITS_1;
UartHandle.Init.Parity = UART_PARITY_NONE;
UartHandle.Init.HwFlowCtl = UART_HWCONTROL_NONE;
UartHandle.Init.Mode = UART_MODE_TX_RX; UartHandle.Init.Instance = USART1;
HAL_UART_Init(&UartHandle);
HAL_UART_Send_DMA(&UartHandle, TxBuffer, sizeof(TxBuffer));
while (1);
}
void HAL_UART_TxCpltCallback(UART_HandleTypeDef *phuart)
{
}
void HAL_UART_TxErrorCallback(UART_HandleTypeDef *phuart)
{
}

```

stm32f7xx_it.c file:

```

extern UART_HandleTypeDef UartHandle;
void DMAx_IRQHandler(void)
{
HAL_DMA_IRQHandler(&UartHandle.DMA_Handle_tx);
}

```

`HAL_USART_TxCpltCallback()` and `HAL_USART_ErrorCallback()` should be linked in the `HAL_PPP_Process_DMA()` function to the DMA transfer complete callback and the DMA transfer Error callback by using the following statement:

```

HAL_PPP_Process_DMA (PPP_HandleTypeDef *hPPP, Params...)
{
(...)
hPPP->DMA_Handle->XferCpltCallback = HAL_USART_TxCpltCallback ;
hPPP->DMA_Handle->XferErrorCallback = HAL_USART_ErrorCallback ;
(...)
}

```

2.12.4 Timeout and error management

2.12.4.1 Timeout management

The timeout is often used for the APIs that operate in polling mode. It defines the delay during which a blocking process should wait till an error is returned. An example is provided below:

```
HAL_StatusTypeDef HAL_DMA_PollForTransfer(DMA_HandleTypeDef *hdma, uint32_t CompleteLevel, uint32_t Timeout)
```

The timeout possible value are the following:

Table 15: Timeout values

Timeout value	Description
0	No poll : Immediate process check and exit
1 ... (HAL_MAX_DELAY -1) ⁽¹⁾	Timeout in ms
HAL_MAX_DELAY	Infinite poll till process is successful

Notes:

⁽¹⁾HAL_MAX_DELAY is defined in the stm32f7xx_hal_def.h as 0xFFFFFFFF

However, in some cases, a fixed timeout is used for system peripherals or internal HAL driver processes. In these cases, the timeout has the same meaning and is used in the same way, except when it is defined locally in the drivers and cannot be modified or introduced as an argument in the user application.

Example of fixed timeout:

```
#define LOCAL_PROCESS_TIMEOUT 100
HAL_StatusTypeDef HAL_PPP_Process(PPP_HandleTypeDef)
{
    (...)
    timeout = HAL_GetTick() + LOCAL_PROCESS_TIMEOUT;
    (...)
    while(ProcessOngoing)
    {
        (...)
        if(HAL_GetTick() >= timeout)
        {
            /* Process unlocked */
            HAL_UNLOCK(hppp);
            hppp->State= HAL_PPP_STATE_TIMEOUT;
            return HAL_PPP_STATE_TIMEOUT;
        }
    }
    (...)
}
```

The following example shows how to use the timeout inside the polling functions:

```
HAL_PPP_StateTypeDef HAL_PPP_Poll (PPP_HandleTypeDef *hppp, uint32_t Timeout)
{
    (...)
    timeout = HAL_GetTick() + Timeout;
    (...)
    while(ProcessOngoing)
    {
        (...)
        if(Timeout != HAL_MAX_DELAY)
        {
            if(HAL_GetTick() >= timeout)
            {
                /* Process unlocked */
```



```

    HAL_UNLOCK(hppp);
    hppp->State= HAL_PPP_STATE_TIMEOUT;
    return hppp->State;
}
}
(...)
}

```

2.12.4.2 Error management

The HAL drivers implement a check on the following items:

- Valid parameters: for some process the used parameters should be valid and already defined, otherwise the system may crash or go into an undefined state. These critical parameters are checked before being used (see example below).

```

HAL_StatusTypeDef HAL_PPP_Process(PPP_HandleTypeDef* hppp, uint32_t *pdata, uint32
Size) { if ((pdata == NULL) || (Size == 0)) { return HAL_ERROR; } }

```

- Valid handle: the PPP peripheral handle is the most important argument since it keeps the PPP driver vital parameters. It is always checked in the beginning of the *HAL_PPP_Init()* function.

```

HAL_StatusTypeDef HAL_PPP_Init(PPP_HandleTypeDef* hppp) { if (hppp == NULL) //the
handle should be already allocated { return HAL_ERROR; } }

```

- Timeout error: the following statement is used when a timeout error occurs:

```

while (Process ongoing) { timeout = HAL_GetTick() + Timeout;
while (data processing is running) { if(timeout) { return HAL_TIMEOUT; } }

```

When an error occurs during a peripheral process, *HAL_PPP_Process()* returns with a *HAL_ERROR* status. The HAL PPP driver implements the *HAL_PPP_GetError()* to allow retrieving the origin of the error.

```

HAL_PPP_ErrorTypeDef HAL_PPP_GetError (PPP_HandleTypeDef *hppp);

```

In all peripheral handles, a *HAL_PPP_ErrorTypeDef* is defined and used to store the last error code.

```

typedef struct
{
    PPP_TypeDef * Instance; /* PPP registers base address */
    PPP_InitTypeDef Init; /* PPP initialization parameters */
    HAL_LockTypeDef Lock; /* PPP locking object */
    IO HAL_PPP_StateTypeDef State; /* PPP state */
    IO HAL_PPP_ErrorTypeDef ErrorCode; /* PPP Error code */
    (...)
    /* PPP specific parameters */
}
PPP_HandleTypeDef;

```

The error state and the peripheral global state are always updated before returning an error:

```

PPP->State = HAL_PPP_READY; /* Set the peripheral ready */
PPP->ErrorCode = HAL_ERRORCODE ; /* Set the error code */
HAL_UNLOCK(PPP) ; /* Unlock the PPP resources */
return HAL_ERROR; /*return with HAL error */

```

HAL_PPP_GetError() must be used in interrupt mode in the error callback:

```

void HAL_PPP_ProcessCpltCallback(PPP_HandleTypeDef *hspi)
{
    ErrorCode = HAL_PPP_GetError (hppp); /* retrieve error code */
}

```

2.12.4.3 Run-time checking

The HAL implements run-time failure detection by checking the input values of all HAL driver functions. The run-time checking is achieved by using an `assert_param` macro. This macro is used in all the HAL driver functions which have an input parameter. It allows verifying that the input value lies within the parameter allowed values.

To enable the run-time checking, use the `assert_param` macro, and leave the define `USE_FULL_ASSERT` uncommented in `stm32f7xx_hal_conf.h` file.

```
void HAL_UART_Init(UART_HandleTypeDef *huart)
{
    (..) /* Check the parameters */
    assert_param(IS_UART_INSTANCE(huart->Instance));
    assert_param(IS_UART_BAUDRATE(huart->Init.BaudRate));
    assert_param(IS_UART_WORD_LENGTH(huart->Init.WordLength));
    assert_param(IS_UART_STOPBITS(huart->Init.StopBits));
    assert_param(IS_UART_PARITY(huart->Init.Parity));
    assert_param(IS_UART_MODE(huart->Init.Mode));
    assert_param(IS_UART_HARDWARE_FLOW_CONTROL(huart->Init.HwFlowCtl));
    (..)

    /** @defgroup UART Word Length *
    @{
    */
    #define UART_WORDLENGTH_8B ((uint32_t)0x00000000)
    #define UART_WORDLENGTH_9B ((uint32_t)USART_CR1_M)
    #define IS_UART_WORD_LENGTH(LENGTH) (((LENGTH) == UART_WORDLENGTH_8B) || \
    \ ((LENGTH) == UART_WORDLENGTH_9B))
```

If the expression passed to the `assert_param` macro is false, the `assert_failed` function is called and returns the name of the source file and the source line number of the call that failed. If the expression is true, no value is returned.

The `assert_param` macro is implemented in `stm32f7xx_hal_conf.h`:

```
/* Exported macro -----*/
#ifdef USE_FULL_ASSERT
/**
 * @brief The assert_param macro is used for function's parameters check.
 * @param expr: If expr is false, it calls assert failed function
 * which reports the name of the source file and the source
 * line number of the call that failed.
 * If expr is true, it returns no value.
 * @retval None */
#define assert_param(expr) ((expr)?(void)0:assert_failed((uint8_t *) FILE ,
    LINE ))
/* Exported functions -----*/
void assert_failed(uint8_t* file, uint32_t line);
#else
#define assert_param(expr) ((void)0)
#endif /* USE_FULL_ASSERT */
```

The `assert_failed` function is implemented in the `main.c` file or in any other user C file:

```
#ifdef USE_FULL_ASSERT /**
 * @brief Reports the name of the source file and the source line number
 * where the assert_param error has occurred.
 * @param file: pointer to the source file name
 * @param line: assert_param error line source number
 * @retval None */
void assert_failed(uint8_t* file, uint32_t line)
{
    /* User can add his own implementation to report the file name and line number,
    ex: printf("Wrong parameters value: file %s on line %d\r\n", file, line) */
    /* Infinite loop */
    while (1)
    {
    }
}
```



Because of the overhead run-time checking introduces, it is recommended to use it during application code development and debugging, and to remove it from the final application to improve code size and speed.

3 Overview of Low Layer drivers

The Low Layer (LL) drivers are designed to offer a fast light-weight expert-oriented layer which is closer to the hardware than the HAL. Contrary to the HAL, LL APIs are not provided for peripherals where optimized access is not a key feature, or those requiring heavy software configuration and/or complex upper-level stack (such as FSMC, USB or SDMMC).

The LL drivers feature:

- A set of functions to initialize peripheral main features according to the parameters specified in data structures
- A set of functions used to fill initialization data structures with the reset values of each field
- Functions to perform peripheral de-initialization (peripheral registers restored to their default values)
- A set of inline functions for direct and atomic register access
- Full independence from HAL since LL drivers can be used either in standalone mode (without HAL drivers) or in mixed mode (with HAL drivers)
- Full coverage of the supported peripheral features.

The Low Layer drivers provide hardware services based on the available features of the STM32 peripherals. These services reflect exactly the hardware capabilities and provide one-shot operations that must be called following the programming model described in the microcontroller line reference manual. As a result, the LL services do not implement any processing and do not require any additional memory resources to save their states, counter or data pointers: all the operations are performed by changing the associated peripheral registers content.

3.1 Low Layer files

The Low Layer drivers are built around header/C files (one per each supported peripheral) plus five header files for some System and Cortex related features.

Table 16: LL driver files

File	Description
<i>stm32f7xx_ll_bus.h</i>	This is the h-source file for core bus control and peripheral clock activation and deactivation <i>Example: LL_AHB2_GRP1_EnableClock</i>
<i>stm32f7xx_ll_ppp.h/c</i>	stm32f7xx_ll_ppp.c provides peripheral initialization functions such as LL_PPP_Init(), LL_PPP_StructInit(), LL_PPP_DeInit(). All the other APIs are defined within stm32f7xx_ll_ppp.h file. The Low Layer PPP driver is a standalone module. To use it, the application must include it in the <i>stm32f7xx_ll_ppp.h</i> file.
<i>stm32f7xx_ll_cortex.h</i>	Cortex-M related register operation APIs including the SysTick, Low power (LL_SYSTICK_XXXXX, LL_LPM_XXXXX "Low Power Mode" ...)
<i>stm32f7xx_ll_utils.h/c</i>	This file covers the generic APIs: <ul style="list-style-type: none"> • Read of device unique ID and electronic signature • Timebase and delay management • System clock configuration.
<i>stm32f7xx_ll_system.h</i>	System related operations (LL_SYSCFG_XXX, LL_DBGMCU_XXX, LL_FLASH_XXX and LL_VREFBUF_XXX)



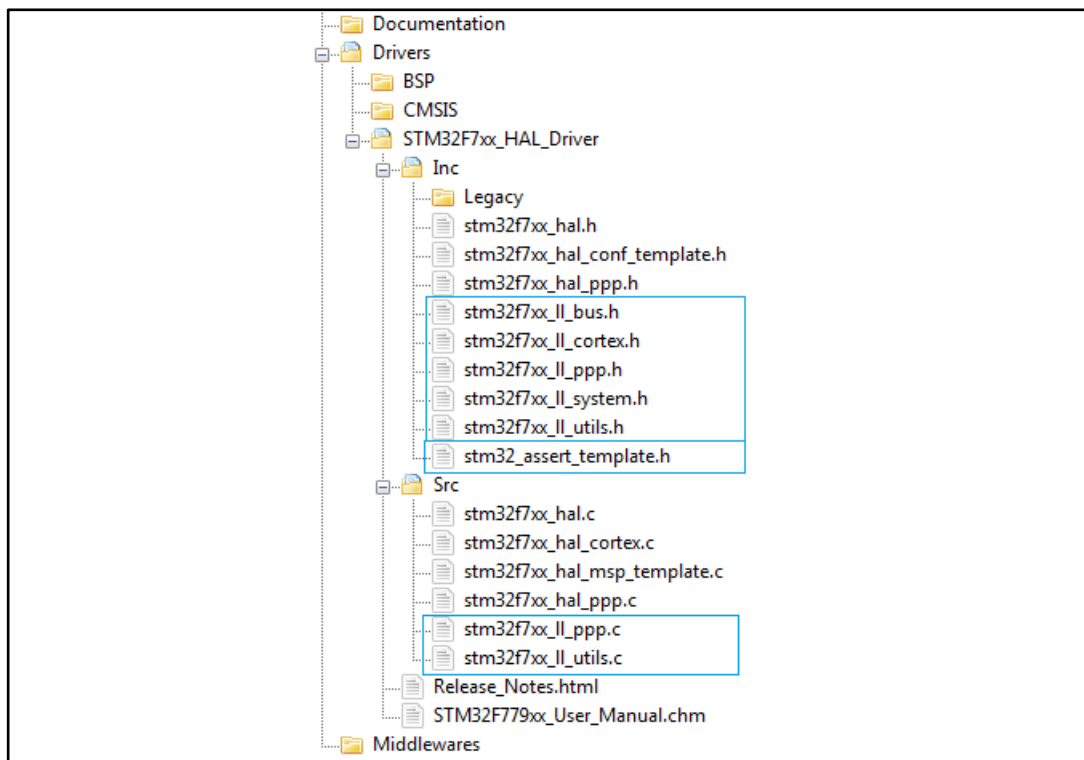
File	Description
stm32_assert_template.h	Template file allowing to define the assert_param macro, that is used when run-time checking is enabled. This file is required only when the LL drivers are used in standalone mode (without calling the HAL APIs). It should be copied to the application folder and renamed to stm32_assert.h.



There is no configuration file for the LL drivers.

The Low Layer files are located in the same HAL driver folder.

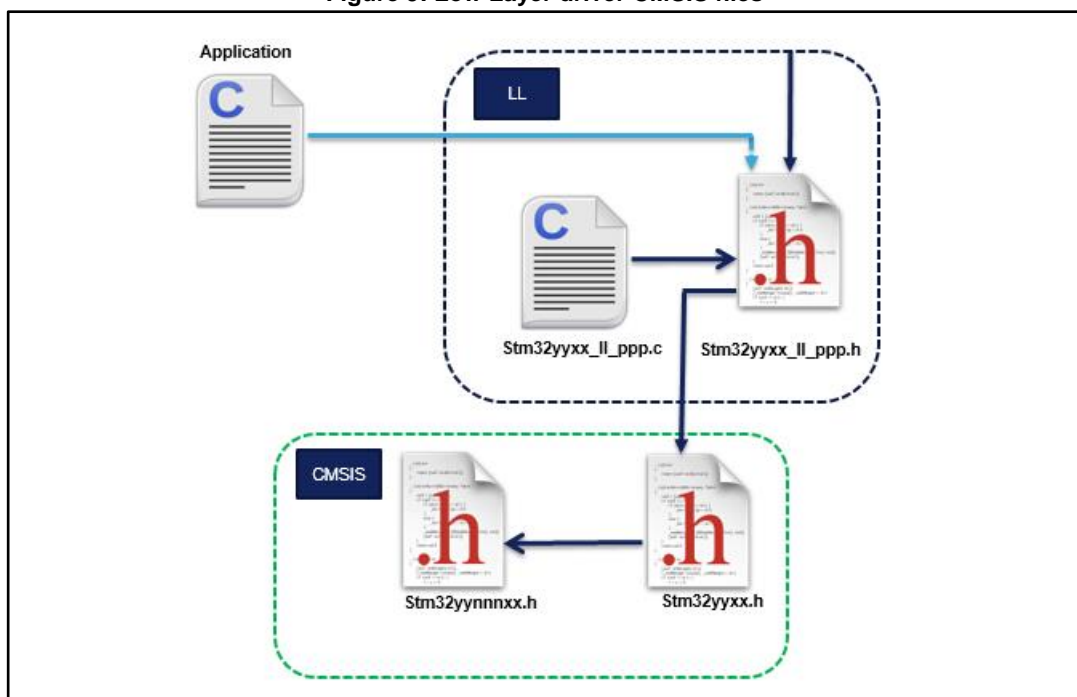
Figure 8: Low Layer driver folders



In general, Low Layer drivers include only the STM32 CMSIS device file.

```
#include "stm32yxx.h"
```

Figure 9: Low Layer driver CMSIS files



Application files have to include only the used Low Layer driver header files.

3.2 Overview of Low Layer APIs and naming rules

3.2.1 Peripheral initialization functions

The LL drivers offer three set of initialization functions. They are defined in stm32f7xx_ll_ppp.c file:

- Functions to initialize peripheral main features according to the parameters specified in data structures
- A set of functions used to fill initialization data structures with the reset values of each field
- Function for peripheral de-initialization (peripheral registers restored to their default values)

The definition of these LL initialization functions and associated resources (structure, literals and prototypes) is conditioned by a compilation switch: *USE_FULL_LL_DRIVER*. To use these functions, this switch must be added in the toolchain compiler preprocessor or to any generic header file which is processed before the LL drivers.

The below table shows the list of the common functions provided for all the supported peripherals:

Table 17: Common peripheral initialization functions

Functions	Return Type	Parameters	Description
LL_PPP_Init	<i>ErrorStatus</i>	<ul style="list-style-type: none"> • <i>PPP_TypeDef* PPPx</i> • <i>LL_PPP_InitTypeDef* PPP_InitStruct</i> 	Initializes the peripheral main features according to the parameters specified in <i>PPP_InitStruct</i> . Example: LL_USART_Init(USART_TypeDef *USARTx, LL_USART_InitTypeDef *USART_InitStruct)
LL_PPP_StructInit	<i>void</i>	<ul style="list-style-type: none"> • <i>LL_PPP_InitTypeDef* PPP_InitStruct</i> 	Fills each <i>PPP_InitStruct</i> member with its default value. Example. LL_USART_StructInit(LL_USART_InitTypeDef *USART_InitStruct)
LL_PPP_DeInit	<i>ErrorStatus</i>	<ul style="list-style-type: none"> • <i>PPP_TypeDef* PPPx</i> 	De-initializes the peripheral registers, that is restore them to their default reset values. Example. LL_USART_DeInit(USART_TypeDef *USARTx)

Additional functions are available for some peripherals (refer to [Table 18: "Optional peripheral initialization functions"](#))

Table 18: Optional peripheral initialization functions

Functions	Return Type	Parameters	Examples
LL_PPP{CATEGORY}_Init	ErrorStatus	<ul style="list-style-type: none"> • <i>PPP_TypeDef* PPPx</i> • <i>LL_PPP{CATEGORY}_InitTypeDef* PPP{CATEGORY}_InitStruct</i> 	<p>Initializes peripheral features according to the parameters specified in PPP_InitStruct.</p> <p>Example: LL_ADC_INJ_Init(ADC_TypeDef *ADCx, LL_ADC_INJ_InitTypeDef *ADC_INJ_InitStruct)</p> <p>LL_RTC_TIME_Init(RTC_TypeDef *RTCx, uint32_t RTC_Format, LL_RTC_TimeTypeDef *RTC_TimeStruct)</p> <p>LL_RTC_DATE_Init(RTC_TypeDef *RTCx, uint32_t RTC_Format, LL_RTC_DateTypeDef *RTC_DateStruct)</p> <p>LL_TIM_IC_Init(TIM_TypeDef* TIMx, uint32_t Channel, LL_TIM_IC_InitTypeDef* TIM_IC_InitStruct)</p> <p>LL_TIM_ENCODER_Init(TIM_TypeDef* TIMx, LL_TIM_ENCODER_InitTypeDef* TIM_EncoderInitStruct)</p>
LL_PPP{CATEGORY}_StructInit	void	<i>LL_PPP{CATEGORY}_InitTypeDef* PPP{CATEGORY}_InitStruct</i>	<p>Fills each <i>PPP{CATEGORY}_InitStruct</i> member with its default value.</p> <p>Example: LL_ADC_INJ_StructInit(LL_ADC_INJ_InitTypeDef *ADC_INJ_InitStruct)</p>
LL_PPP_CommonInit	ErrorStatus	<ul style="list-style-type: none"> • <i>PPP_TypeDef* PPPx</i> • <i>LL_PPP_CommonInitTypeDef* PPP_CommonInitStruct</i> 	<p>Initializes the common features shared between different instances of the same peripheral.</p> <p>Example: LL_ADC_CommonInit(ADC_Common_TypeDef *ADCxy_COMMON, LL_ADC_CommonInitTypeDef *ADC_CommonInitStruct)</p>

Functions	Return Type	Parameters	Examples
LL_PPP_CommonStructInit	void	LL_PPP_CommonInitTypeDef* PPP_CommonInitStruct	Fills each PPP_CommonInitStruct member with its default value Example: LL_ADC_CommonStructInit(LL_ADC_CommonInitTypeDef *ADC_CommonInitStruct)
LL_PPP_ClockInit	ErrorStatus	<ul style="list-style-type: none"> • PPP_TypeDef* PPPx • LL_PPP_ClockInitTypeDef* PPP_ClockInitStruct 	Initializes the peripheral clock configuration in synchronous mode. Example: LL_USART_ClockInit(USART_TypeDef *USARTx, LL_USART_ClockInitTypeDef *USART_ClockInitStruct)
LL_PPP_ClockStructInit	void	LL_PPP_ClockInitTypeDef* *PPP_ClockInitStruct	Fills each PPP_ClockInitStruct member with its default value Example: LL_USART_ClockStructInit(LL_USART_ClockInitTypeDef *USART_ClockInitStruct)

3.2.1.1 Run-time checking

Like HAL drivers, LL initialization functions implement run-time failure detection by checking the input values of all LL driver functions. For more details please refer to [Section 2.12.4.3: "Run-time checking"](#).

When using the LL drivers in standalone mode (without calling HAL functions), the following actions are required to use run-time checking:

1. Copy stm32_assert_template.h to the application folder and rename it to stm32_assert.h. This file defines the assert_param macro which is used when run-time checking is enabled.
2. Include stm32_assert.h file within the application main header file.
3. Add the USE_FULL_ASSERT compilation switch in the toolchain compiler preprocessor or in any generic header file which is processed before the stm32_assert.h driver.



Run-time checking is not available for LL inline functions.

3.2.2 Peripheral register-level configuration functions

On top of the peripheral initialization functions, the LL drivers offer a set of inline functions for direct atomic register access. Their format is as follows:

```
__STATIC_INLINE return_type LL_PPP_Function (PPP_TypeDef *PPPx, args)
```

The "Function" naming is defined depending to the action category:

- **Specific Interrupt, DMA request and status flags management:** Set/Get/Clear/Enable/Disable flags on interrupt and status registers

Table 19: Specific Interrupt, DMA request and status flags management

Name	Examples
<i>LL_PPP_{_CATEGORY}_ActionItem_BITNAME</i> <i>LL_PPP{_CATEGORY}_IsItem_BITNAME_Action</i>	<ul style="list-style-type: none"> • LL_RCC_IsActiveFlag_LSIRDY • LL_RCC_IsActiveFlag_FWRST() • LL_ADC_ClearFlag_EOC(ADC1) • LL_DMA_ClearFlag_TCx(DMA_TypeDef* DMAx)

Table 20: Available function formats

Item	Action	Format
Flag	Get	<i>LL_PPP_IsActiveFlag_BITNAME</i>
	Clear	<i>LL_PPP_ClearFlag_BITNAME</i>
Interrupts	Enable	<i>LL_PPP_EnableIT_BITNAME</i>
	Disable	<i>LL_PPP_DisableIT_BITNAME</i>
	Get	<i>LL_PPP_IsEnabledIT_BITNAME</i>
DMA	Enable	<i>LL_PPP_EnableDMAReq_BITNAME</i>
	Disable	<i>LL_PPP_DisableDMAReq_BITNAME</i>
	Get	<i>LL_PPP_IsEnabledDMAReq_BITNAME</i>



BITNAME refers to the peripheral register bit name as described in the product line reference manual.

- **Peripheral clock activation/deactivation management:** Enable/Disable/Reset a peripheral clock

Table 21: Peripheral clock activation/deactivation management

Name	Examples
<i>LL_BUS_GRPx_ActionClock{Mode}</i>	<ul style="list-style-type: none"> • <i>LL_AHB2_GRP1_EnableClock</i> (<i>LL_AHB2_GRP1_PERIPH_GPIOA LL_AHB2_GRP1_PERIPH_GPIOB</i>) • <i>by LL_APB1_GRP1_EnableClockSleep</i> (<i>LL_APB1_GRP1_PERIPH_DAC1</i>)



'x' corresponds to the group index and refers to the index of the modified register on a given bus.

- **Peripheral activation/deactivation management:** Enable/disable a peripheral or activate/deactivate specific peripheral features

Table 22: Peripheral activation/deactivation management

Name	Examples
LL_PPP{ _CATEGORY}_Action{Item} LL_PPP{ _CATEGORY}_IsItemAction	<ul style="list-style-type: none"> • LL_ADC_Enable () • LL_ADC_StartCalibration(); • LL_ADC_IsCalibrationOnGoing; • LL_RCC_HSI_Enable () • LL_RCC_HSI_IsReady()

- **Peripheral configuration management:** Set/get a peripheral configuration settings

Table 23: Peripheral configuration management

Name	Examples
LL_PPP{ _CATEGORY}_Set{ or Get}ConfigItem	LL_USART_SetBaudRate (USART2, Clock, LL_USART_BAUDRATE_9600)

- **Peripheral register management:** Write/read the content of a register/retrun DMA relative register address

Table 24: Peripheral register management

Name
LL_PPP_WriteReg(__INSTANCE__, __REG__, __VALUE__)
LL_PPP_ReadReg(__INSTANCE__, __REG__)
LL_PPP_DMA_GetRegAddr (PPP_TypeDef *PPPx,{Sub Instance if any ex: Channel} , {uint32_t Propriety})



The Propriety is a variable used to identify the DMA transfer direction or the data register type.

4 Cohabiting of HAL and LL

The Low Layer is designed to be used in standalone mode or combined with the HAL. It cannot be automatically used with the HAL for the same peripheral instance. If you use the LL APIs for a specific instance, you can still use the HAL APIs for other instances. Be careful that the Low Layer might overwrite some registers which content is mirrored in the HAL handles.

4.1 Low Layer driver used in standalone mode

The Low Layer APIs can be used without calling the HAL driver services. This is done by simply including `stm32f7xx_ll_ppp.h` in the application files. The LL APIs for a given peripheral are called by executing the same sequence as the one recommended by the programming model in the corresponding product line reference manual. In this case the HAL drivers associated to the used peripheral can be removed from the workspace. However the STM32CubeF7 framework should be used in the same way as in the HAL drivers case which means that System file, startup file and CMSIS should always be used.



When the BSP drivers are included, the used HAL drivers associated with the BSP functions drivers should be included in the workspace, even if they are not used by the application layer.

4.2 Mixed use of Low Layer APIs and HAL drivers

In this case the Low Layer APIs are used in conjunction with the HAL drivers to achieve direct and register level based operations.

Mixed use is allowed, however some consideration should be taken into account:

- It is recommended to avoid using simultaneously the HAL APIs and the combination of Low Layer APIs for a given peripheral instance. If this is the case, one or more private fields in the HAL PPP handle structure should be updated accordingly.
- For operations and processes that do not alter the handle fields including the initialization structure, the HAL driver APIs and the Low Layer services can be used together for the same peripheral instance.
- The Low Layer drivers can be used without any restriction with all the HAL drivers that are not based on handle objects (RCC, common HAL, flash and GPIO).

Several examples showing how to use HAL and LL in the same application are provided within `stm32f7` firmware package (refer to `Examples_MIX` projects).



1. When the HAL Init/DeInit APIs are not used and are replaced by the Low Layer macros, the `InitMsp()` functions are not called and the MSP initialization should be done in the user application.
2. When process APIs are not used and the corresponding function is performed through the Low Layer APIs, the callbacks are not called and post processing or error management should be done by the user application.
3. When the LL APIs is used for process operations, the IRQ handler HAL APIs cannot be called and the IRQ should be implemented by the user application. Each LL driver implements the macros needed to read and clear the associated interrupt flags.

5 HAL System Driver

5.1 HAL Firmware driver API description

5.1.1 How to use this driver

The common HAL driver contains a set of generic and common APIs that can be used by the PPP peripheral drivers and the user to start using the HAL.

The HAL contains two APIs' categories:

- Common HAL APIs
- Services HAL APIs

5.1.2 Initialization and de-initialization functions

This section provides functions allowing to:

- Initializes the Flash interface the NVIC allocation and initial clock configuration. It initializes the systick also when timeout is needed and the backup domain when enabled.
- de-Initializes common part of the HAL
- Configure The time base source to have 1ms time base with a dedicated Tick interrupt priority.
 - Systick timer is used by default as source of time base, but user can eventually implement his proper time base source (a general purpose timer for example or other time source), keeping in mind that Time base duration should be kept 1ms since PPP_TIMEOUT_VALUES are defined and handled in milliseconds basis.
 - Time base configuration function (HAL_InitTick ()) is called automatically at the beginning of the program after reset by HAL_Init() or at any time when clock is configured, by HAL_RCC_ClockConfig().
 - Source of time base is configured to generate interrupts at regular time intervals. Care must be taken if HAL_Delay() is called from a peripheral ISR process, the Tick interrupt line must have higher priority (numerically lower) than the peripheral interrupt. Otherwise the caller ISR process will be blocked.
 - functions affecting time base configurations are declared as __weak to make override possible in case of other implementations in user file.

This section contains the following APIs:

- [HAL_Init\(\)](#)
- [HAL_DeInit\(\)](#)
- [HAL_MspInit\(\)](#)
- [HAL_MspDeInit\(\)](#)
- [HAL_InitTick\(\)](#)

5.1.3 HAL Control functions

This section provides functions allowing to:

- Provide a tick value in millisecond
- Provide a blocking delay in millisecond
- Suspend the time base source interrupt
- Resume the time base source interrupt
- Get the HAL API driver version
- Get the device identifier

- Get the device revision identifier
- Enable/Disable Debug module during SLEEP mode
- Enable/Disable Debug module during STOP mode
- Enable/Disable Debug module during STANDBY mode

This section contains the following APIs:

- [HAL_IncTick\(\)](#)
- [HAL_GetTick\(\)](#)
- [HAL_Delay\(\)](#)
- [HAL_SuspendTick\(\)](#)
- [HAL_ResumeTick\(\)](#)
- [HAL_GetHalVersion\(\)](#)
- [HAL_GetREVID\(\)](#)
- [HAL_GetDEVID\(\)](#)
- [HAL_DBGMCU_EnableDBGSleepMode\(\)](#)
- [HAL_DBGMCU_DisableDBGSleepMode\(\)](#)
- [HAL_DBGMCU_EnableDBGStopMode\(\)](#)
- [HAL_DBGMCU_DisableDBGStopMode\(\)](#)
- [HAL_DBGMCU_EnableDBGStandbyMode\(\)](#)
- [HAL_DBGMCU_DisableDBGStandbyMode\(\)](#)
- [HAL_EnableCompensationCell\(\)](#)
- [HAL_DisableCompensationCell\(\)](#)
- [HAL_EnableFMCMemorySwapping\(\)](#)
- [HAL_DisableFMCMemorySwapping\(\)](#)
- [HAL_EnableMemorySwappingBank\(\)](#)
- [HAL_DisableMemorySwappingBank\(\)](#)

5.1.4 Detailed description of functions

HAL_Init

Function name	HAL_StatusTypeDef HAL_Init (void)
Function description	This function is used to initialize the HAL Library; it must be the first instruction to be executed in the main program (before to call any other HAL function), it performs the following: Configure the Flash prefetch, and instruction cache through ART accelerator.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • SysTick is used as time base for the HAL_Delay() function, the application need to ensure that the SysTick time base is always set to 1 millisecond to have correct HAL operation.

HAL_DeInit

Function name	HAL_StatusTypeDef HAL_DeInit (void)
Function description	This function de-Initializes common part of the HAL and stops the systick.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_Msplnit

Function name	void HAL_Msplnit (void)
---------------	---------------------------------

Function description Initializes the MSP.

Return values

- **None:**

HAL_MspDeInit

Function name **void HAL_MspDeInit (void)**

Function description DeInitializes the MSP.

Return values

- **None:**

HAL_InitTick

Function name **HAL_StatusTypeDef HAL_InitTick (uint32_t TickPriority)**

Function description This function configures the source of the time base.

Parameters

- **TickPriority:** Tick interrupt priority.

Return values

- **HAL:** status

Notes

- This function is called automatically at the beginning of program after reset by HAL_Init() or at any time when clock is reconfigured by HAL_RCC_ClockConfig().
- In the default implementation, SysTick timer is the source of time base. It is used to generate interrupts at regular time intervals. Care must be taken if HAL_Delay() is called from a peripheral ISR process, The the SysTick interrupt must have higher priority (numerically lower) than the peripheral interrupt. Otherwise the caller ISR process will be blocked. The function is declared as `__weak` to be overwritten in case of other implementation in user file.

HAL_IncTick

Function name **void HAL_IncTick (void)**

Function description This function is called to increment a global variable "uwTick" used as application time base.

Return values

- **None:**

Notes

- In the default implementation, this variable is incremented each 1ms in SysTick ISR.
- This function is declared as `__weak` to be overwritten in case of other implementations in user file.

HAL_Delay

Function name **void HAL_Delay (__IO uint32_t Delay)**

Function description This function provides accurate delay (in milliseconds) based on variable incremented.

Parameters

- **Delay:** specifies the delay time length, in milliseconds.

Return values

- **None:**

Notes

- In the default implementation , SysTick timer is the source of time base. It is used to generate interrupts at regular time

intervals where uwTick is incremented.

- This function is declared as `__weak` to be overwritten in case of other implementations in user file.

HAL_GetTick

Function name **uint32_t HAL_GetTick (void)**

Function description Provides a tick value in millisecond.

Return values

- **tick:** value

Notes

- This function is declared as `__weak` to be overwritten in case of other implementations in user file.

HAL_SuspendTick

Function name **void HAL_SuspendTick (void)**

Function description Suspend Tick increment.

Return values

- **None:**

Notes

- In the default implementation , SysTick timer is the source of time base. It is used to generate interrupts at regular time intervals. Once HAL_SuspendTick() is called, the SysTick interrupt will be disabled and so Tick increment is suspended.
- This function is declared as `__weak` to be overwritten in case of other implementations in user file.

HAL_ResumeTick

Function name **void HAL_ResumeTick (void)**

Function description Resume Tick increment.

Return values

- **None:**

Notes

- In the default implementation , SysTick timer is the source of time base. It is used to generate interrupts at regular time intervals. Once HAL_ResumeTick() is called, the SysTick interrupt will be enabled and so Tick increment is resumed.
- This function is declared as `__weak` to be overwritten in case of other implementations in user file.

HAL_GetHalVersion

Function name **uint32_t HAL_GetHalVersion (void)**

Function description Returns the HAL revision.

Return values

- **version:** : 0xXYZR (8bits for each decimal, R for RC)

HAL_GetREVID

Function name **uint32_t HAL_GetREVID (void)**

Function description Returns the device revision identifier.

Return values

- **Device:** revision identifier

HAL_GetDEVID

Function name **uint32_t HAL_GetDEVID (void)**

Function description Returns the device identifier.

Return values • **Device:** identifier

HAL_DBGMCU_EnableDBGSleepMode

Function name **void HAL_DBGMCU_EnableDBGSleepMode (void)**

Function description Enable the Debug Module during SLEEP mode.

Return values • **None:**

HAL_DBGMCU_DisableDBGSleepMode

Function name **void HAL_DBGMCU_DisableDBGSleepMode (void)**

Function description Disable the Debug Module during SLEEP mode.

Return values • **None:**

HAL_DBGMCU_EnableDBGStopMode

Function name **void HAL_DBGMCU_EnableDBGStopMode (void)**

Function description Enable the Debug Module during STOP mode.

Return values • **None:**

HAL_DBGMCU_DisableDBGStopMode

Function name **void HAL_DBGMCU_DisableDBGStopMode (void)**

Function description Disable the Debug Module during STOP mode.

Return values • **None:**

HAL_DBGMCU_EnableDBGStandbyMode

Function name **void HAL_DBGMCU_EnableDBGStandbyMode (void)**

Function description Enable the Debug Module during STANDBY mode.

Return values • **None:**

HAL_DBGMCU_DisableDBGStandbyMode

Function name **void HAL_DBGMCU_DisableDBGStandbyMode (void)**

Function description Disable the Debug Module during STANDBY mode.

Return values • **None:**

HAL_EnableCompensationCell

Function name **void HAL_EnableCompensationCell (void)**

Function description Enables the I/O Compensation Cell.

- Return values
- **None:**
- Notes
- The I/O compensation cell can be used only when the device supply voltage ranges from 2.4 to 3.6 V.

HAL_DisableCompensationCell

- Function name
- void HAL_DisableCompensationCell (void)**
- Function description
- Power-down the I/O Compensation Cell.
- Return values
- **None:**
- Notes
- The I/O compensation cell can be used only when the device supply voltage ranges from 2.4 to 3.6 V.

HAL_EnableFMCMemorySwapping

- Function name
- void HAL_EnableFMCMemorySwapping (void)**
- Function description
- Enables the FMC Memory Mapping Swapping.
- Return values
- **None:**
- Notes
- SDRAM is accessible at 0x60000000 and NOR/RAM is accessible at 0xC0000000

HAL_DisableFMCMemorySwapping

- Function name
- void HAL_DisableFMCMemorySwapping (void)**
- Function description
- Disables the FMC Memory Mapping Swapping.
- Return values
- **None:**
- Notes
- SDRAM is accessible at 0xC0000000 (default mapping) and NOR/RAM is accessible at 0x60000000 (default mapping)

HAL_EnableMemorySwappingBank

- Function name
- void HAL_EnableMemorySwappingBank (void)**
- Function description
- Enable the Internal FLASH Bank Swapping.
- Return values
- **None:**
- Notes
- This function can be used only for STM32F77xx/STM32F76xx devices.
 - Flash Bank2 mapped at 0x08000000 (AXI) (aliased at 0x00200000 (TCM)) and Flash Bank1 mapped at 0x08100000 (AXI) (aliased at 0x00300000 (TCM))

HAL_DisableMemorySwappingBank

- Function name
- void HAL_DisableMemorySwappingBank (void)**
- Function description
- Disable the Internal FLASH Bank Swapping.
- Return values
- **None:**
- Notes
- This function can be used only for STM32F77xx/STM32F76xx

devices.

- The default state : Flash Bank1 mapped at 0x08000000 (AXI) (aliased at 0x00200000 (TCM)) and Flash Bank2 mapped at 0x08100000 (AXI)(aliased at 0x00300000 (TCM))

5.2 HAL Firmware driver defines

5.2.1 HAL

HAL Exported Macros

__HAL_DBGMCU_FREEZE_TIM2
__HAL_DBGMCU_FREEZE_TIM3
__HAL_DBGMCU_FREEZE_TIM4
__HAL_DBGMCU_FREEZE_TIM5
__HAL_DBGMCU_FREEZE_TIM6
__HAL_DBGMCU_FREEZE_TIM7
__HAL_DBGMCU_FREEZE_TIM12
__HAL_DBGMCU_FREEZE_TIM13
__HAL_DBGMCU_FREEZE_TIM14
__HAL_DBGMCU_FREEZE_LPTIM1
__HAL_DBGMCU_FREEZE_RTC
__HAL_DBGMCU_FREEZE_WWDG
__HAL_DBGMCU_FREEZE_IWDG
__HAL_DBGMCU_FREEZE_I2C1_TIMEOUT
__HAL_DBGMCU_FREEZE_I2C2_TIMEOUT
__HAL_DBGMCU_FREEZE_I2C3_TIMEOUT
__HAL_DBGMCU_FREEZE_I2C4_TIMEOUT
__HAL_DBGMCU_FREEZE_CAN1
__HAL_DBGMCU_FREEZE_CAN2
__HAL_DBGMCU_FREEZE_TIM1
__HAL_DBGMCU_FREEZE_TIM8
__HAL_DBGMCU_FREEZE_TIM9
__HAL_DBGMCU_FREEZE_TIM10
__HAL_DBGMCU_FREEZE_TIM11
__HAL_DBGMCU_UNFREEZE_TIM2
__HAL_DBGMCU_UNFREEZE_TIM3
__HAL_DBGMCU_UNFREEZE_TIM4
__HAL_DBGMCU_UNFREEZE_TIM5
__HAL_DBGMCU_UNFREEZE_TIM6

__HAL_DBGMCU_UNFREEZE_TIM7
__HAL_DBGMCU_UNFREEZE_TIM12
__HAL_DBGMCU_UNFREEZE_TIM13
__HAL_DBGMCU_UNFREEZE_TIM14
__HAL_DBGMCU_UNFREEZE_LPTIM1
__HAL_DBGMCU_UNFREEZE_RTC
__HAL_DBGMCU_UNFREEZE_WWDG
__HAL_DBGMCU_UNFREEZE_IWDG
__HAL_DBGMCU_UNFREEZE_I2C1_TIMEO
UT
__HAL_DBGMCU_UNFREEZE_I2C2_TIMEO
UT
__HAL_DBGMCU_UNFREEZE_I2C3_TIMEO
UT
__HAL_DBGMCU_UNFREEZE_I2C4_TIMEO
UT
__HAL_DBGMCU_UNFREEZE_CAN1
__HAL_DBGMCU_UNFREEZE_CAN2
__HAL_DBGMCU_UNFREEZE_TIM1
__HAL_DBGMCU_UNFREEZE_TIM8
__HAL_DBGMCU_UNFREEZE_TIM9
__HAL_DBGMCU_UNFREEZE_TIM10
__HAL_DBGMCU_UNFREEZE_TIM11
__HAL_SYSCFG_REMAPMEMORY_FMC
__HAL_SYSCFG_REMAPMEMORY_FMC_SD
RAM
__HAL_SYSCFG_GET_BOOT_MODE

__HAL_SYSCFG_BREAK_LOCKUP_LOCK

Description:

- Return the memory boot mapping as configured by user.

Return value:

- The: boot mode as configured by user. The returned value can be one of the following values:
 - SYSCFG_MEM_BOOT_ADD0
 - SYSCFG_MEM_BOOT_ADD1

Notes:

- The selected configuration is locked and can be unlocked only by system reset.

Enable and lock the connection of Cortex-M7 LOCKUP (Hardfault) output to

__HAL_SYSCFG_BREAK_PVD_LOCK

TIM1/8 Break input.

Notes:

- The selected configuration is locked and can be unlocked only by system reset.

Enable and lock the PVD connection to Timer1/8 Break input, as well as the PVDE and PLS[2:0] in the PWR_CR1 register.

HAL state definition

HAL_SMBUS_STATE_RESET

SMBUS not yet initialized or disabled

HAL_SMBUS_STATE_READY

SMBUS initialized and ready for use

HAL_SMBUS_STATE_BUSY

SMBUS internal process is ongoing

HAL_SMBUS_STATE_MASTER_BUSY_TX

Master Data Transmission process is ongoing

HAL_SMBUS_STATE_MASTER_BUSY_RX

Master Data Reception process is ongoing

HAL_SMBUS_STATE_SLAVE_BUSY_TX

Slave Data Transmission process is ongoing

HAL_SMBUS_STATE_SLAVE_BUSY_RX

Slave Data Reception process is ongoing

HAL_SMBUS_STATE_TIMEOUT

Timeout state

HAL_SMBUS_STATE_ERROR

Reception process is ongoing

HAL_SMBUS_STATE_LISTEN

Address Listen Mode is ongoing

Boot Mode

SYSCFG_MEM_BOOT_ADD0

SYSCFG_MEM_BOOT_ADD1

6 HAL ADC Generic Driver

6.1 ADC Firmware driver registers structures

6.1.1 ADC_InitTypeDef

Data Fields

- *uint32_t* **ClockPrescaler**
- *uint32_t* **Resolution**
- *uint32_t* **DataAlign**
- *uint32_t* **ScanConvMode**
- *uint32_t* **EOCSelection**
- *uint32_t* **ContinuousConvMode**
- *uint32_t* **NbrOfConversion**
- *uint32_t* **DiscontinuousConvMode**
- *uint32_t* **NbrOfDiscConversion**
- *uint32_t* **ExternalTrigConv**
- *uint32_t* **ExternalTrigConvEdge**
- *uint32_t* **DMAContinuousRequests**

Field Documentation

- *uint32_t* **ADC_InitTypeDef::ClockPrescaler**
Select ADC clock prescaler. The clock is common for all the ADCs. This parameter can be a value of [ADC_ClockPrescaler](#)
- *uint32_t* **ADC_InitTypeDef::Resolution**
Configures the ADC resolution. This parameter can be a value of [ADC_Resolution](#)
- *uint32_t* **ADC_InitTypeDef::DataAlign**
Specifies ADC data alignment to right (MSB on register bit 11 and LSB on register bit 0) (default setting) or to left (if regular group: MSB on register bit 15 and LSB on register bit 4, if injected group (MSB kept as signed value due to potential negative value after offset application): MSB on register bit 14 and LSB on register bit 3). This parameter can be a value of [ADC_Data_Align](#)
- *uint32_t* **ADC_InitTypeDef::ScanConvMode**
Configures the sequencer of regular and injected groups. This parameter can be associated to parameter 'DiscontinuousConvMode' to have main sequence subdivided in successive parts. If disabled: Conversion is performed in single mode (one channel converted, the one defined in rank 1). Parameters 'NbrOfConversion' and 'InjectedNbrOfConversion' are discarded (equivalent to set to 1). If enabled: Conversions are performed in sequence mode (multiple ranks defined by 'NbrOfConversion'/'InjectedNbrOfConversion' and each channel rank). Scan direction is upward: from rank1 to rank 'n'. This parameter can be a value of [ADC_Scan_mode](#). This parameter can be set to ENABLE or DISABLE
- *uint32_t* **ADC_InitTypeDef::EOCSelection**
Specifies what EOC (End Of Conversion) flag is used for conversion by polling and interruption: end of conversion of each rank or complete sequence. This parameter can be a value of [ADC_EOCSelection](#). Note: For injected group, end of conversion (flag&IT) is raised only at the end of the sequence. Therefore, if end of conversion is set to end of each conversion, injected group should not be used with interruption (HAL_ADCEx_InjectedStart_IT) or polling (HAL_ADCEx_InjectedStart and HAL_ADCEx_InjectedPollForConversion). By the way, polling is still possible since driver will use an estimated timing for end of injected conversion. Note: If overrun

feature is intended to be used, use ADC in mode 'interruption' (function **HAL_ADC_Start_IT()**) with parameter EOCSelection set to end of each conversion or in mode 'transfer by DMA' (function **HAL_ADC_Start_DMA()**). If overrun feature is intended to be bypassed, use ADC in mode 'polling' or 'interruption' with parameter EOCSelection must be set to end of sequence

- ***uint32_t ADC_InitTypeDef::ContinuousConvMode***
Specifies whether the conversion is performed in single mode (one conversion) or continuous mode for regular group, after the selected trigger occurred (software start or external trigger). This parameter can be set to ENABLE or DISABLE.
- ***uint32_t ADC_InitTypeDef::NbrOfConversion***
Specifies the number of ranks that will be converted within the regular group sequencer. To use regular group sequencer and convert several ranks, parameter 'ScanConvMode' must be enabled. This parameter must be a number between Min_Data = 1 and Max_Data = 16.
- ***uint32_t ADC_InitTypeDef::DiscontinuousConvMode***
Specifies whether the conversions sequence of regular group is performed in Complete-sequence/Discontinuous-sequence (main sequence subdivided in successive parts). Discontinuous mode is used only if sequencer is enabled (parameter 'ScanConvMode'). If sequencer is disabled, this parameter is discarded. Discontinuous mode can be enabled only if continuous mode is disabled. If continuous mode is enabled, this parameter setting is discarded. This parameter can be set to ENABLE or DISABLE.
- ***uint32_t ADC_InitTypeDef::NbrOfDiscConversion***
Specifies the number of discontinuous conversions in which the main sequence of regular group (parameter NbrOfConversion) will be subdivided. If parameter 'DiscontinuousConvMode' is disabled, this parameter is discarded. This parameter must be a number between Min_Data = 1 and Max_Data = 8.
- ***uint32_t ADC_InitTypeDef::ExternalTrigConv***
Selects the external event used to trigger the conversion start of regular group. If set to ADC_SOFTWARE_START, external triggers are disabled. If set to external trigger source, triggering is on event rising edge by default. This parameter can be a value of [ADC_External_trigger_Source_Regular](#)
- ***uint32_t ADC_InitTypeDef::ExternalTrigConvEdge***
Selects the external trigger edge of regular group. If trigger is set to ADC_SOFTWARE_START, this parameter is discarded. This parameter can be a value of [ADC_External_trigger_edge_Regular](#)
- ***uint32_t ADC_InitTypeDef::DMAContinuousRequests***
Specifies whether the DMA requests are performed in one shot mode (DMA transfer stop when number of conversions is reached) or in Continuous mode (DMA transfer unlimited, whatever number of conversions). Note: In continuous mode, DMA must be configured in circular mode. Otherwise an overrun will be triggered when DMA buffer maximum pointer is reached. Note: This parameter must be modified when no conversion is on going on both regular and injected groups (ADC disabled, or ADC enabled without continuous mode or external trigger that could launch a conversion). This parameter can be set to ENABLE or DISABLE.

6.1.2 ADC_ChannelConfTypeDef

Data Fields

- ***uint32_t Channel***
- ***uint32_t Rank***
- ***uint32_t SamplingTime***
- ***uint32_t Offset***

Field Documentation

- ***uint32_t ADC_ChannelConfTypeDef::Channel***
Specifies the channel to configure into ADC regular group. This parameter can be a value of [ADC_channels](#)
- ***uint32_t ADC_ChannelConfTypeDef::Rank***
Specifies the rank in the regular group sequencer. This parameter must be a number between Min_Data = 1 and Max_Data = 16 This parameter can be a value of [ADC_regular_rank](#)
- ***uint32_t ADC_ChannelConfTypeDef::SamplingTime***
Sampling time value to be set for the selected channel. Unit: ADC clock cycles
Conversion time is the addition of sampling time and processing time (12 ADC clock cycles at ADC resolution 12 bits, 11 cycles at 10 bits, 9 cycles at 8 bits, 7 cycles at 6 bits). This parameter can be a value of [ADC_sampling_times](#) Caution: This parameter updates the parameter property of the channel, that can be used into regular and/or injected groups. If this same channel has been previously configured in the other group (regular/injected), it will be updated to last setting. Note: In case of usage of internal measurement channels (VrefInt/Vbat/TempSensor), sampling time constraints must be respected (sampling time can be adjusted in function of ADC clock frequency and sampling time setting) Refer to device datasheet for timings values, parameters TS_vrefint, TS_temp (values rough order: 4us min).
- ***uint32_t ADC_ChannelConfTypeDef::Offset***
Reserved for future use, can be set to 0

6.1.3 ADC_AnalogWDGConfTypeDef

Data Fields

- ***uint32_t WatchdogMode***
- ***uint32_t HighThreshold***
- ***uint32_t LowThreshold***
- ***uint32_t Channel***
- ***uint32_t ITMode***
- ***uint32_t WatchdogNumber***

Field Documentation

- ***uint32_t ADC_AnalogWDGConfTypeDef::WatchdogMode***
Configures the ADC analog watchdog mode. This parameter can be a value of [ADC_analog_watchdog_selection](#)
- ***uint32_t ADC_AnalogWDGConfTypeDef::HighThreshold***
Configures the ADC analog watchdog High threshold value. This parameter must be a 12-bit value.
- ***uint32_t ADC_AnalogWDGConfTypeDef::LowThreshold***
Configures the ADC analog watchdog High threshold value. This parameter must be a 12-bit value.
- ***uint32_t ADC_AnalogWDGConfTypeDef::Channel***
Configures ADC channel for the analog watchdog. This parameter has an effect only if watchdog mode is configured on single channel This parameter can be a value of [ADC_channels](#)
- ***uint32_t ADC_AnalogWDGConfTypeDef::ITMode***
Specifies whether the analog watchdog is configured in interrupt mode or in polling mode. This parameter can be set to ENABLE or DISABLE
- ***uint32_t ADC_AnalogWDGConfTypeDef::WatchdogNumber***
Reserved for future use, can be set to 0

6.1.4 ADC_HandleTypeDef

Data Fields

- ***ADC_TypeDef * Instance***
- ***ADC_InitTypeDef Init***
- ***__IO uint32_t NbrOfCurrentConversionRank***
- ***DMA_HandleTypeDef * DMA_Handle***
- ***HAL_LockTypeDef Lock***
- ***__IO uint32_t State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***ADC_TypeDef* ADC_HandleTypeDef::Instance***
Register base address
- ***ADC_InitTypeDef ADC_HandleTypeDef::Init***
ADC required parameters
- ***__IO uint32_t ADC_HandleTypeDef::NbrOfCurrentConversionRank***
ADC number of current conversion rank
- ***DMA_HandleTypeDef* ADC_HandleTypeDef::DMA_Handle***
Pointer DMA Handler
- ***HAL_LockTypeDef ADC_HandleTypeDef::Lock***
ADC locking object
- ***__IO uint32_t ADC_HandleTypeDef::State***
ADC communication state
- ***__IO uint32_t ADC_HandleTypeDef::ErrorCode***
ADC Error code

6.2 ADC Firmware driver API description

6.2.1 ADC Peripheral features

1. 12-bit, 10-bit, 8-bit or 6-bit configurable resolution.
2. Interrupt generation at the end of conversion, end of injected conversion, and in case of analog watchdog or overrun events
3. Single and continuous conversion modes.
4. Scan mode for automatic conversion of channel 0 to channel x.
5. Data alignment with in-built data coherency.
6. Channel-wise programmable sampling time.
7. External trigger option with configurable polarity for both regular and injected conversion.
8. Dual/Triple mode (on devices with 2 ADCs or more).
9. Configurable DMA data storage in Dual/Triple ADC mode.
10. Configurable delay between conversions in Dual/Triple interleaved mode.
11. ADC conversion type (refer to the datasheets).
12. ADC supply requirements: 2.4 V to 3.6 V at full speed and down to 1.8 V at slower speed.
13. ADC input range: VREF(minus) = VIN = VREF(plus).
14. DMA request generation during regular channel conversion.

6.2.2 How to use this driver

1. Initialize the ADC low level resources by implementing the HAL_ADC_MspInit():
 - a. Enable the ADC interface clock using `__HAL_RCC_ADC_CLK_ENABLE()`
 - b. ADC pins configuration
 - Enable the clock for the ADC GPIOs using the following function:
`__HAL_RCC_GPIOx_CLK_ENABLE()`
 - Configure these ADC pins in analog mode using `HAL_GPIO_Init()`
 - c. In case of using interrupts (e.g. `HAL_ADC_Start_IT()`)

- Configure the ADC interrupt priority using HAL_NVIC_SetPriority()
 - Enable the ADC IRQ handler using HAL_NVIC_EnableIRQ()
 - In ADC IRQ handler, call HAL_ADC_IRQHandler()
- d. In case of using DMA to control data transfer (e.g. HAL_ADC_Start_DMA())
- Enable the DMAx interface clock using __HAL_RCC_DMAx_CLK_ENABLE()
 - Configure and enable two DMA streams stream for managing data transfer from peripheral to memory (output stream)
 - Associate the initialized DMA handle to the CRYIP DMA handle using __HAL_LINKDMA()
 - Configure the priority and enable the NVIC for the transfer complete interrupt on the two DMA Streams. The output stream should have higher priority than the input stream.

Configuration of ADC, groups regular/injected, channels parameters

1. Configure the ADC parameters (resolution, data alignment, ...) and regular group parameters (conversion trigger, sequencer, ...) using function HAL_ADC_Init().
2. Configure the channels for regular group parameters (channel number, channel rank into sequencer, ..., into regular group) using function HAL_ADC_ConfigChannel().
3. Optionally, configure the injected group parameters (conversion trigger, sequencer, ..., of injected group) and the channels for injected group parameters (channel number, channel rank into sequencer, ..., into injected group) using function HAL_ADCEx_InjectedConfigChannel().
4. Optionally, configure the analog watchdog parameters (channels monitored, thresholds, ...) using function HAL_ADC_AnalogWDGConfig().
5. Optionally, for devices with several ADC instances: configure the multimode parameters using function HAL_ADCEx_MultiModeConfigChannel().

Execution of ADC conversions

1. ADC driver can be used among three modes: polling, interruption, transfer by DMA.

Polling mode IO operation

- Start the ADC peripheral using HAL_ADC_Start()
- Wait for end of conversion using HAL_ADC_PollForConversion(), at this stage user can specify the value of timeout according to his end application
- To read the ADC converted values, use the HAL_ADC_GetValue() function.
- Stop the ADC peripheral using HAL_ADC_Stop()

Interrupt mode IO operation

- Start the ADC peripheral using HAL_ADC_Start_IT()
- Use HAL_ADC_IRQHandler() called under ADC_IRQHandler() Interrupt subroutine
- At ADC end of conversion HAL_ADC_ConvCpltCallback() function is executed and user can add his own code by customization of function pointer HAL_ADC_ConvCpltCallback
- In case of ADC Error, HAL_ADC_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_ADC_ErrorCallback
- Stop the ADC peripheral using HAL_ADC_Stop_IT()

DMA mode IO operation

- Start the ADC peripheral using HAL_ADC_Start_DMA(), at this stage the user specify the length of data to be transferred at each end of conversion

- At The end of data transfer by HAL_ADC_ConvCpltCallback() function is executed and user can add his own code by customization of function pointer HAL_ADC_ConvCpltCallback
- In case of transfer Error, HAL_ADC_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_ADC_ErrorCallback
- Stop the ADC peripheral using HAL_ADC_Stop_DMA()

ADC HAL driver macros list

Below the list of most used macros in ADC HAL driver.

- __HAL_ADC_ENABLE : Enable the ADC peripheral
- __HAL_ADC_DISABLE : Disable the ADC peripheral
- __HAL_ADC_ENABLE_IT: Enable the ADC end of conversion interrupt
- __HAL_ADC_DISABLE_IT: Disable the ADC end of conversion interrupt
- __HAL_ADC_GET_IT_SOURCE: Check if the specified ADC interrupt source is enabled or disabled
- __HAL_ADC_CLEAR_FLAG: Clear the ADC's pending flags
- __HAL_ADC_GET_FLAG: Get the selected ADC's flag status
- ADC_GET_RESOLUTION: Return resolution bits in CR1 register



You can refer to the ADC HAL driver header file for more useful macros

Deinitialization of ADC

1. Disable the ADC interface
 - ADC clock can be hard reset and disabled at RCC top level.
 - Hard reset of ADC peripherals using macro __HAL_RCC_ADC_FORCE_RESET(), __HAL_RCC_ADC_RELEASE_RESET().
 - ADC clock disable using the equivalent macro/functions as configuration step.
 - Example: Into HAL_ADC_MspDeInit() (recommended code location) or with other device clock parameters configuration:
 - HAL_RCC_GetOscConfig(&RCC_OscInitStructure);
 - RCC_OscInitStructure.OscillatorType = RCC_OSCILLATORTYPE_HSI;
 - RCC_OscInitStructure.HSIState = RCC_HSI_OFF; (if not used for system clock)
 - HAL_RCC_OscConfig(&RCC_OscInitStructure);
2. ADC pins configuration
 - Disable the clock for the ADC GPIOs using macro __HAL_RCC_GPIOx_CLK_DISABLE()
3. Optionally, in case of usage of ADC with interruptions:
 - Disable the NVIC for ADC using function HAL_NVIC_DisableIRQ(ADCx_IRQn)
4. Optionally, in case of usage of DMA:
 - Deinitialize the DMA using function HAL_DMA_DeInit().
 - Disable the NVIC for DMA using function HAL_NVIC_DisableIRQ(DMAx_Channelx_IRQn)

6.2.3 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize and configure the ADC.
- De-initialize the ADC.

This section contains the following APIs:

- [HAL_ADC_Init\(\)](#)
- [HAL_ADC_DeInit\(\)](#)
- [HAL_ADC_MspInit\(\)](#)
- [HAL_ADC_MspDeInit\(\)](#)

6.2.4 IO operation functions

This section provides functions allowing to:

- Start conversion of regular channel.
- Stop conversion of regular channel.
- Start conversion of regular channel and enable interrupt.
- Stop conversion of regular channel and disable interrupt.
- Start conversion of regular channel and enable DMA transfer.
- Stop conversion of regular channel and disable DMA transfer.
- Handle ADC interrupt request.

This section contains the following APIs:

- [HAL_ADC_Start\(\)](#)
- [HAL_ADC_Stop\(\)](#)
- [HAL_ADC_PollForConversion\(\)](#)
- [HAL_ADC_PollForEvent\(\)](#)
- [HAL_ADC_Start_IT\(\)](#)
- [HAL_ADC_Stop_IT\(\)](#)
- [HAL_ADC_IRQHandler\(\)](#)
- [HAL_ADC_Start_DMA\(\)](#)
- [HAL_ADC_Stop_DMA\(\)](#)
- [HAL_ADC_GetValue\(\)](#)
- [HAL_ADC_ConvCpltCallback\(\)](#)
- [HAL_ADC_ConvHalfCpltCallback\(\)](#)
- [HAL_ADC_LevelOutOfWindowCallback\(\)](#)
- [HAL_ADC_ErrorCallback\(\)](#)

6.2.5 Peripheral Control functions

This section provides functions allowing to:

- Configure regular channels.
- Configure injected channels.
- Configure multimode.
- Configure the analog watch dog.

This section contains the following APIs:

- [HAL_ADC_ConfigChannel\(\)](#)
- [HAL_ADC_AnalogWDGConfig\(\)](#)

6.2.6 Peripheral State and errors functions

This subsection provides functions allowing to

- Check the ADC state
- Check the ADC Error

This section contains the following APIs:

- [HAL_ADC_GetState\(\)](#)
- [HAL_ADC_GetError\(\)](#)

6.2.7 Detailed description of functions

HAL_ADC_Init

Function name	HAL_StatusTypeDef HAL_ADC_Init (ADC_HandleTypeDef * hadc)
Function description	Initializes the ADCx peripheral according to the specified parameters in the ADC_InitStruct and initializes the ADC MSP.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function is used to configure the global features of the ADC (ClockPrescaler, Resolution, Data Alignment and number of conversion), however, the rest of the configuration parameters are specific to the regular channels group (scan mode activation, continuous mode activation, External trigger source and edge, DMA continuous request after the last transfer and End of conversion selection).

HAL_ADC_DeInit

Function name	HAL_StatusTypeDef HAL_ADC_DeInit (ADC_HandleTypeDef * hadc)
Function description	Deinitializes the ADCx peripheral registers to their default reset values.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_ADC_MspInit

Function name	void HAL_ADC_MspInit (ADC_HandleTypeDef * hadc)
Function description	Initializes the ADC MSP.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
Return values	<ul style="list-style-type: none"> • None:

HAL_ADC_MspDeInit

Function name	void HAL_ADC_MspDeInit (ADC_HandleTypeDef * hadc)
Function description	Deinitializes the ADC MSP.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
Return values	<ul style="list-style-type: none"> • None:

HAL_ADC_Start

Function name	HAL_StatusTypeDef HAL_ADC_Start (ADC_HandleTypeDef * hadc)
Function description	Enables ADC and starts conversion of the regular channels.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_ADC_Stop

Function name	HAL_StatusTypeDef HAL_ADC_Stop (ADC_HandleTypeDef * hadc)
Function description	Disables ADC and stop conversion of regular channels.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
Return values	<ul style="list-style-type: none"> • HAL: status.
Notes	<ul style="list-style-type: none"> • Caution: This function will stop also injected channels.

HAL_ADC_PollForConversion

Function name	HAL_StatusTypeDef HAL_ADC_PollForConversion (ADC_HandleTypeDef * hadc, uint32_t Timeout)
Function description	Poll for regular conversion complete.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC. • Timeout: Timeout value in millisecond.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • ADC conversion flags EOS (end of sequence) and EOC (end of conversion) are cleared by this function. • This function cannot be used in a particular setup: ADC configured in DMA mode and polling for end of each conversion (ADC init parameter "EOCSelection" set to ADC_EOC_SINGLE_CONV). In this case, DMA resets the flag EOC and polling cannot be performed on each conversion. Nevertheless, polling can still be performed on the complete sequence.

HAL_ADC_PollForEvent

Function name	HAL_StatusTypeDef HAL_ADC_PollForEvent (ADC_HandleTypeDef * hadc, uint32_t EventType, uint32_t Timeout)
Function description	Poll for conversion event.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC. • EventType: the ADC event type. This parameter can be one of the following values:

- ADC_AWD_EVENT: ADC Analog watch Dog event.
- ADC_OVR_EVENT: ADC Overrun event.
- **Timeout:** Timeout value in millisecond.

Return values

- **HAL:** status

HAL_ADC_Start_IT

Function name **HAL_StatusTypeDef HAL_ADC_Start_IT (ADC_HandleTypeDef * hadc)**

Function description Enables the interrupt and starts ADC conversion of regular channels.

Parameters

- **hadc:** pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.

Return values

- **HAL:** status.

HAL_ADC_Stop_IT

Function name **HAL_StatusTypeDef HAL_ADC_Stop_IT (ADC_HandleTypeDef * hadc)**

Function description Disables the interrupt and stop ADC conversion of regular channels.

Parameters

- **hadc:** pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.

Return values

- **HAL:** status.

Notes

- Caution: This function will stop also injected channels.

HAL_ADC_IRQHandler

Function name **void HAL_ADC_IRQHandler (ADC_HandleTypeDef * hadc)**

Function description Handles ADC interrupt request.

Parameters

- **hadc:** pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.

Return values

- **None:**

HAL_ADC_Start_DMA

Function name **HAL_StatusTypeDef HAL_ADC_Start_DMA (ADC_HandleTypeDef * hadc, uint32_t * pData, uint32_t Length)**

Function description Enables ADC DMA request after last transfer (Single-ADC mode) and enables ADC peripheral.

Parameters

- **hadc:** pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
- **pData:** The destination Buffer address.
- **Length:** The length of data to be transferred from ADC peripheral to memory.

Return values

- **HAL:** status

HAL_ADC_Stop_DMA

Function name **HAL_StatusTypeDef HAL_ADC_Stop_DMA (ADC_HandleTypeDef * hadc)**

Function description Disables ADC DMA (Single-ADC mode) and disables ADC peripheral.

Parameters

- **hadc:** pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.

Return values

- **HAL:** status

HAL_ADC_GetValue

Function name **uint32_t HAL_ADC_GetValue (ADC_HandleTypeDef * hadc)**

Function description Gets the converted value from data register of regular channel.

Parameters

- **hadc:** pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.

Return values

- **Converted:** value

HAL_ADC_ConvCpltCallback

Function name **void HAL_ADC_ConvCpltCallback (ADC_HandleTypeDef * hadc)**

Function description Regular conversion complete callback in non blocking mode.

Parameters

- **hadc:** pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.

Return values

- **None:**

HAL_ADC_ConvHalfCpltCallback

Function name **void HAL_ADC_ConvHalfCpltCallback (ADC_HandleTypeDef * hadc)**

Function description Regular conversion half DMA transfer callback in non blocking mode.

Parameters

- **hadc:** pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.

Return values

- **None:**

HAL_ADC_LevelOutOfWindowCallback

Function name **void HAL_ADC_LevelOutOfWindowCallback (ADC_HandleTypeDef * hadc)**

Function description Analog watchdog callback in non blocking mode.

Parameters

- **hadc:** pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.

Return values • **None:**

HAL_ADC_ErrorCallback

Function name **void HAL_ADC_ErrorCallback (ADC_HandleTypeDef * hadc)**

Function description Error ADC callback.

Parameters • **hadc:** pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.

Return values • **None:**

Notes • In case of error due to overrun when using ADC with DMA transfer (HAL ADC handle parameter "ErrorCode" to state "HAL_ADC_ERROR_OVR"): Reinitialize the DMA using function "HAL_ADC_Stop_DMA()". If needed, restart a new ADC conversion using function "HAL_ADC_Start_DMA()" (this function is also clearing overrun flag)

HAL_ADC_ConfigChannel

Function name **HAL_StatusTypeDef HAL_ADC_ConfigChannel (ADC_HandleTypeDef * hadc, ADC_ChannelConfTypeDef * sConfig)**

Function description Configures for the selected ADC regular channel its corresponding rank in the sequencer and its sample time.

Parameters • **hadc:** pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
• **sConfig:** ADC configuration structure.

Return values • **HAL:** status

HAL_ADC_AnalogWDGConfig

Function name **HAL_StatusTypeDef HAL_ADC_AnalogWDGConfig (ADC_HandleTypeDef * hadc, ADC_AnalogWDGConfTypeDef * AnalogWDGConfig)**

Function description Configures the analog watchdog.

Parameters • **hadc:** pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
• **AnalogWDGConfig:** : pointer to an ADC_AnalogWDGConfTypeDef structure that contains the configuration information of ADC analog watchdog.

Return values • **HAL:** status

Notes • Analog watchdog thresholds can be modified while ADC conversion is on going. In this case, some constraints must be taken into account: the programmed threshold values are effective from the next ADC EOC (end of unitary conversion). Considering that registers write delay may happen due to bus activity, this might cause an uncertainty on the effective timing of the new programmed threshold values.

HAL_ADC_GetState

Function name	uint32_t HAL_ADC_GetState (ADC_HandleTypeDef * hadc)
Function description	return the ADC state
Parameters	<ul style="list-style-type: none">• hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
Return values	<ul style="list-style-type: none">• HAL: state

HAL_ADC_GetError

Function name	uint32_t HAL_ADC_GetError (ADC_HandleTypeDef * hadc)
Function description	Return the ADC error code.
Parameters	<ul style="list-style-type: none">• hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
Return values	<ul style="list-style-type: none">• ADC: Error Code

6.3 ADC Firmware driver defines

6.3.1 ADC

ADC Analog Watchdog Selection

ADC_ANALOGWATCHDOG_SINGLE_REG
ADC_ANALOGWATCHDOG_SINGLE_INJEC
ADC_ANALOGWATCHDOG_SINGLE_REGINJEC
ADC_ANALOGWATCHDOG_ALL_REG
ADC_ANALOGWATCHDOG_ALL_INJEC
ADC_ANALOGWATCHDOG_ALL_REGINJEC
ADC_ANALOGWATCHDOG_NONE

ADC Common Channels

ADC_CHANNEL_0
ADC_CHANNEL_1
ADC_CHANNEL_2
ADC_CHANNEL_3
ADC_CHANNEL_4
ADC_CHANNEL_5
ADC_CHANNEL_6
ADC_CHANNEL_7
ADC_CHANNEL_8
ADC_CHANNEL_9
ADC_CHANNEL_10
ADC_CHANNEL_11

ADC_CHANNEL_12
ADC_CHANNEL_13
ADC_CHANNEL_14
ADC_CHANNEL_15
ADC_CHANNEL_16
ADC_CHANNEL_17
ADC_CHANNEL_18
ADC_CHANNEL_VREFINT
ADC_CHANNEL_VBAT

ADC Channels Type

ADC_ALL_CHANNELS
ADC_REGULAR_CHANNELS reserved for future use
ADC_INJECTED_CHANNELS reserved for future use

ADC Clock Prescaler

ADC_CLOCK_SYNC_PCLK_DIV2
ADC_CLOCK_SYNC_PCLK_DIV4
ADC_CLOCK_SYNC_PCLK_DIV6
ADC_CLOCK_SYNC_PCLK_DIV8

ADC Data Align

ADC_DATAALIGN_RIGHT
ADC_DATAALIGN_LEFT

ADC Delay Between 2 Sampling Phases

ADC_TWOSAMPLINGDELAY_5CYCLES
ADC_TWOSAMPLINGDELAY_6CYCLES
ADC_TWOSAMPLINGDELAY_7CYCLES
ADC_TWOSAMPLINGDELAY_8CYCLES
ADC_TWOSAMPLINGDELAY_9CYCLES
ADC_TWOSAMPLINGDELAY_10CYCLES
ADC_TWOSAMPLINGDELAY_11CYCLES
ADC_TWOSAMPLINGDELAY_12CYCLES
ADC_TWOSAMPLINGDELAY_13CYCLES
ADC_TWOSAMPLINGDELAY_14CYCLES
ADC_TWOSAMPLINGDELAY_15CYCLES
ADC_TWOSAMPLINGDELAY_16CYCLES
ADC_TWOSAMPLINGDELAY_17CYCLES
ADC_TWOSAMPLINGDELAY_18CYCLES

ADC_TWOSAMPLINGDELAY_19CYCLES

ADC_TWOSAMPLINGDELAY_20CYCLES

ADC EOC Selection

ADC_EOC_SEQ_CONV

ADC_EOC_SINGLE_CONV

ADC_EOC_SINGLE_SEQ_CONV reserved for future use

ADC Error Code

HAL_ADC_ERROR_NONE No error

HAL_ADC_ERROR_INTERNAL ADC IP internal error: if problem of clocking, enable/disable, erroneous state

HAL_ADC_ERROR_OVR Overrun error

HAL_ADC_ERROR_DMA DMA transfer error

ADC Event Type

ADC_AWD_EVENT

ADC_OVR_EVENT

ADC Exported Macros

`__HAL_ADC_RESET_HANDLE_STATE` **Description:**

- Reset ADC handle state.

Parameters:

- `__HANDLE__`: ADC handle

Return value:

- None

`__HAL_ADC_ENABLE`

Description:

- Enable the ADC peripheral.

Parameters:

- `__HANDLE__`: ADC handle

Return value:

- None

`__HAL_ADC_DISABLE`

Description:

- Disable the ADC peripheral.

Parameters:

- `__HANDLE__`: ADC handle

Return value:

- None

`__HAL_ADC_ENABLE_IT`

Description:

- Enable the ADC end of conversion interrupt.

`__HAL_ADC_DISABLE_IT`

Parameters:

- `__HANDLE__`: specifies the ADC Handle.
- `__INTERRUPT__`: ADC Interrupt.

Return value:

- None

Description:

- Disable the ADC end of conversion interrupt.

Parameters:

- `__HANDLE__`: specifies the ADC Handle.
- `__INTERRUPT__`: ADC interrupt.

Return value:

- None

Description:

- Check if the specified ADC interrupt source is enabled or disabled.

`__HAL_ADC_GET_IT_SOURCE`

Parameters:

- `__HANDLE__`: specifies the ADC Handle.
- `__INTERRUPT__`: specifies the ADC interrupt source to check.

Return value:

- The: new state of `__IT__` (TRUE or FALSE).

Description:

- Clear the ADC's pending flags.

`__HAL_ADC_CLEAR_FLAG`

Parameters:

- `__HANDLE__`: specifies the ADC Handle.
- `__FLAG__`: ADC flag.

Return value:

- None

Description:

- Get the selected ADC's flag status.

`__HAL_ADC_GET_FLAG`

Parameters:

- `__HANDLE__`: specifies the ADC Handle.
- `__FLAG__`: ADC flag.

Return value:

- None

ADC Exported Types

`HAL_ADC_STATE_RESET`

ADC not yet initialized or disabled

HAL_ADC_STATE_READY	ADC peripheral ready for use
HAL_ADC_STATE_BUSY_INTERNAL	ADC is busy to internal process (initialization, calibration)
HAL_ADC_STATE_TIMEOUT	TimeOut occurrence
HAL_ADC_STATE_ERROR_INTERNAL	Internal error occurrence
HAL_ADC_STATE_ERROR_CONFIG	Configuration error occurrence
HAL_ADC_STATE_ERROR_DMA	DMA error occurrence
HAL_ADC_STATE_REG_BUSY	A conversion on group regular is ongoing or can occur (either by continuous mode, external trigger, low power auto power-on (if feature available), multimode ADC master control (if feature available))
HAL_ADC_STATE_REG_EOC	Conversion data available on group regular
HAL_ADC_STATE_REG_OVR	Overrun occurrence
HAL_ADC_STATE_INJ_BUSY	A conversion on group injected is ongoing or can occur (either by auto-injection mode, external trigger, low power auto power-on (if feature available), multimode ADC master control (if feature available))
HAL_ADC_STATE_INJ_EOC	Conversion data available on group injected
HAL_ADC_STATE_AWD1	Out-of-window occurrence of analog watchdog 1
HAL_ADC_STATE_AWD2	Not available on STM32F7 device: Out-of-window occurrence of analog watchdog 2
HAL_ADC_STATE_AWD3	Not available on STM32F7 device: Out-of-window occurrence of analog watchdog 3
HAL_ADC_STATE_MULTIMODE_SLAVE	Not available on STM32F7 device: ADC in multimode slave state, controlled by another ADC master (

ADC External Trigger Edge Regular

ADC_EXTERNALTRIGCONVEDGE_NONE
 ADC_EXTERNALTRIGCONVEDGE_RISING
 ADC_EXTERNALTRIGCONVEDGE_FALLING
 ADC_EXTERNALTRIGCONVEDGE_RISINGFALLING

ADC External Trigger Source Regular

ADC_EXTERNALTRIGCONV_T1_CC1
 ADC_EXTERNALTRIGCONV_T1_CC2
 ADC_EXTERNALTRIGCONV_T1_CC3
 ADC_EXTERNALTRIGCONV_T2_CC2
 ADC_EXTERNALTRIGCONV_T5_TRGO
 ADC_EXTERNALTRIGCONV_T4_CC4

ADC_EXTERNALTRIGCONV_T3_CC4
ADC_EXTERNALTRIGCONV_T8_TRGO
ADC_EXTERNALTRIGCONV_T8_TRGO2
ADC_EXTERNALTRIGCONV_T1_TRGO
ADC_EXTERNALTRIGCONV_T1_TRGO2
ADC_EXTERNALTRIGCONV_T2_TRGO
ADC_EXTERNALTRIGCONV_T4_TRGO
ADC_EXTERNALTRIGCONV_T6_TRGO
ADC_EXTERNALTRIGCONV_EXT_IT11
ADC_SOFTWARE_START

ADC Flags Definition

ADC_FLAG_AWD
ADC_FLAG_EOC
ADC_FLAG_JEOC
ADC_FLAG_JSTRT
ADC_FLAG_STRT
ADC_FLAG_OVR

ADC Interrupts Definition

ADC_IT_EOC
ADC_IT_AWD
ADC_IT_JEOC
ADC_IT_OVR

ADC group regular sequencer rank

ADC_REGULAR_RANK_1	ADC regular conversion rank 1
ADC_REGULAR_RANK_2	ADC regular conversion rank 2
ADC_REGULAR_RANK_3	ADC regular conversion rank 3
ADC_REGULAR_RANK_4	ADC regular conversion rank 4
ADC_REGULAR_RANK_5	ADC regular conversion rank 5
ADC_REGULAR_RANK_6	ADC regular conversion rank 6
ADC_REGULAR_RANK_7	ADC regular conversion rank 7
ADC_REGULAR_RANK_8	ADC regular conversion rank 8
ADC_REGULAR_RANK_9	ADC regular conversion rank 9
ADC_REGULAR_RANK_10	ADC regular conversion rank 10
ADC_REGULAR_RANK_11	ADC regular conversion rank 11
ADC_REGULAR_RANK_12	ADC regular conversion rank 12
ADC_REGULAR_RANK_13	ADC regular conversion rank 13

ADC_REGULAR_RANK_14 ADC regular conversion rank 14

ADC_REGULAR_RANK_15 ADC regular conversion rank 15

ADC_REGULAR_RANK_16 ADC regular conversion rank 16

ADC Resolution

ADC_RESOLUTION_12B

ADC_RESOLUTION_10B

ADC_RESOLUTION_8B

ADC_RESOLUTION_6B

ADC Sampling Times

ADC_SAMPLETIME_3CYCLES

ADC_SAMPLETIME_15CYCLES

ADC_SAMPLETIME_28CYCLES

ADC_SAMPLETIME_56CYCLES

ADC_SAMPLETIME_84CYCLES

ADC_SAMPLETIME_112CYCLES

ADC_SAMPLETIME_144CYCLES

ADC_SAMPLETIME_480CYCLES

ADC sequencer scan mode

ADC_SCAN_DISABLE Scan mode disabled

ADC_SCAN_ENABLE Scan mode enabled

7 HAL ADC Extension Driver

7.1 ADCEX Firmware driver registers structures

7.1.1 ADC_InjectionConfTypeDef

Data Fields

- *uint32_t InjectedChannel*
- *uint32_t InjectedRank*
- *uint32_t InjectedSamplingTime*
- *uint32_t InjectedOffset*
- *uint32_t InjectedNbrOfConversion*
- *uint32_t InjectedDiscontinuousConvMode*
- *uint32_t AutoInjectedConv*
- *uint32_t ExternalTrigInjecConv*
- *uint32_t ExternalTrigInjecConvEdge*

Field Documentation

- ***uint32_t ADC_InjectionConfTypeDef::InjectedChannel***
Selection of ADC channel to configure This parameter can be a value of [ADC_channels](#) Note: Depending on devices, some channels may not be available on package pins. Refer to device datasheet for channels availability.
- ***uint32_t ADC_InjectionConfTypeDef::InjectedRank***
Rank in the injected group sequencer This parameter must be a value of [ADCEX_injected_rank](#) Note: In case of need to disable a channel or change order of conversion sequencer, rank containing a previous channel setting can be overwritten by the new channel setting (or parameter number of conversions can be adjusted)
- ***uint32_t ADC_InjectionConfTypeDef::InjectedSamplingTime***
Sampling time value to be set for the selected channel. Unit: ADC clock cycles
Conversion time is the addition of sampling time and processing time (12 ADC clock cycles at ADC resolution 12 bits, 11 cycles at 10 bits, 9 cycles at 8 bits, 7 cycles at 6 bits). This parameter can be a value of [ADC_sampling_times](#) Caution: This parameter updates the parameter property of the channel, that can be used into regular and/or injected groups. If this same channel has been previously configured in the other group (regular/injected), it will be updated to last setting. Note: In case of usage of internal measurement channels (VrefInt/Vbat/TempSensor), sampling time constraints must be respected (sampling time can be adjusted in function of ADC clock frequency and sampling time setting) Refer to device datasheet for timings values, parameters TS_vrefint, TS_temp (values rough order: 4us min).
- ***uint32_t ADC_InjectionConfTypeDef::InjectedOffset***
Defines the offset to be subtracted from the raw converted data (for channels set on injected group only). Offset value must be a positive number. Depending of ADC resolution selected (12, 10, 8 or 6 bits), this parameter must be a number between Min_Data = 0x000 and Max_Data = 0xFFF, 0x3FF, 0xFF or 0x3F respectively.
- ***uint32_t ADC_InjectionConfTypeDef::InjectedNbrOfConversion***
Specifies the number of ranks that will be converted within the injected group sequencer. To use the injected group sequencer and convert several ranks, parameter 'ScanConvMode' must be enabled. This parameter must be a number between Min_Data = 1 and Max_Data = 4. Caution: this setting impacts the entire injected group. Therefore, call of **HAL_ADCEX_InjectedConfigChannel()** to configure

- a channel on injected group can impact the configuration of other channels previously set.
- uint32_t ADC_InjectionConfTypeDef::InjectedDiscontinuousConvMode***
 Specifies whether the conversions sequence of injected group is performed in Complete-sequence/Discontinuous-sequence (main sequence subdivided in successive parts). Discontinuous mode is used only if sequencer is enabled (parameter 'ScanConvMode'). If sequencer is disabled, this parameter is discarded. Discontinuous mode can be enabled only if continuous mode is disabled. If continuous mode is enabled, this parameter setting is discarded. This parameter can be set to ENABLE or DISABLE. Note: For injected group, number of discontinuous ranks increment is fixed to one-by-one. Caution: this setting impacts the entire injected group. Therefore, call of **HAL_ADCEX_InjectedConfigChannel()** to configure a channel on injected group can impact the configuration of other channels previously set.
 - uint32_t ADC_InjectionConfTypeDef::AutoInjectedConv***
 Enables or disables the selected ADC automatic injected group conversion after regular one This parameter can be set to ENABLE or DISABLE. Note: To use Automatic injected conversion, discontinuous mode must be disabled ('DiscontinuousConvMode' and 'InjectedDiscontinuousConvMode' set to DISABLE) Note: To use Automatic injected conversion, injected group external triggers must be disabled ('ExternalTrigInjecConv' set to ADC_SOFTWARE_START) Note: In case of DMA used with regular group: if DMA configured in normal mode (single shot) JAUTO will be stopped upon DMA transfer complete. To maintain JAUTO always enabled, DMA must be configured in circular mode. Caution: this setting impacts the entire injected group. Therefore, call of **HAL_ADCEX_InjectedConfigChannel()** to configure a channel on injected group can impact the configuration of other channels previously set.
 - uint32_t ADC_InjectionConfTypeDef::ExternalTrigInjecConv***
 Selects the external event used to trigger the conversion start of injected group. If set to ADC_INJECTED_SOFTWARE_START, external triggers are disabled. If set to external trigger source, triggering is on event rising edge. This parameter can be a value of [ADCEX_External_trigger_Source_Injected](#) Note: This parameter must be modified when ADC is disabled (before ADC start conversion or after ADC stop conversion). If ADC is enabled, this parameter setting is bypassed without error reporting (as it can be the expected behaviour in case of another parameter update on the fly) Caution: this setting impacts the entire injected group. Therefore, call of **HAL_ADCEX_InjectedConfigChannel()** to configure a channel on injected group can impact the configuration of other channels previously set.
 - uint32_t ADC_InjectionConfTypeDef::ExternalTrigInjecConvEdge***
 Selects the external trigger edge of injected group. This parameter can be a value of [ADCEX_External_trigger_edge_Injected](#). If trigger is set to ADC_INJECTED_SOFTWARE_START, this parameter is discarded. Caution: this setting impacts the entire injected group. Therefore, call of **HAL_ADCEX_InjectedConfigChannel()** to configure a channel on injected group can impact the configuration of other channels previously set.

7.1.2 ADC_MultiModeTypeDef

Data Fields

- uint32_t Mode***
- uint32_t DMAAccessMode***
- uint32_t TwoSamplingDelay***

Field Documentation

- **`uint32_t ADC_MultiModeTypeDef::Mode`**
Configures the ADC to operate in independent or multi mode. This parameter can be a value of [ADCEX_Common_mode](#)
- **`uint32_t ADC_MultiModeTypeDef::DMAAccessMode`**
Configures the Direct memory access mode for multi ADC mode. This parameter can be a value of [ADCEX_Direct_memory_access_mode_for_multi_mode](#)
- **`uint32_t ADC_MultiModeTypeDef::TwoSamplingDelay`**
Configures the Delay between 2 sampling phases. This parameter can be a value of [ADC_delay_between_2_sampling_phases](#)

7.2 ADCEX Firmware driver API description

7.2.1 How to use this driver

1. Initialize the ADC low level resources by implementing the `HAL_ADC_MspInit()`:
 - a. Enable the ADC interface clock using `__HAL_RCC_ADC_CLK_ENABLE()`
 - b. ADC pins configuration
 - Enable the clock for the ADC GPIOs using the following function:
`__HAL_RCC_GPIOx_CLK_ENABLE()`
 - Configure these ADC pins in analog mode using `HAL_GPIO_Init()`
 - c. In case of using interrupts (e.g. `HAL_ADC_Start_IT()`)
 - Configure the ADC interrupt priority using `HAL_NVIC_SetPriority()`
 - Enable the ADC IRQ handler using `HAL_NVIC_EnableIRQ()`
 - In ADC IRQ handler, call `HAL_ADC_IRQHandler()`
 - d. In case of using DMA to control data transfer (e.g. `HAL_ADC_Start_DMA()`)
 - Enable the DMAx interface clock using
`__HAL_RCC_DMAx_CLK_ENABLE()`
 - Configure and enable two DMA streams stream for managing data transfer from peripheral to memory (output stream)
 - Associate the initialized DMA handle to the ADC DMA handle using
`__HAL_LINKDMA()`
 - Configure the priority and enable the NVIC for the transfer complete interrupt on the two DMA Streams. The output stream should have higher priority than the input stream.
2. Configure the ADC Prescaler, conversion resolution and data alignment using the `HAL_ADC_Init()` function.
3. Configure the ADC Injected channels group features, use `HAL_ADC_Init()` and `HAL_ADC_ConfigChannel()` functions.
4. Three operation modes are available within this driver :

Polling mode IO operation

- Start the ADC peripheral using `HAL_ADCEX_InjectedStart()`
- Wait for end of conversion using `HAL_ADC_PollForConversion()`, at this stage user can specify the value of timeout according to his end application
- To read the ADC converted values, use the `HAL_ADCEX_InjectedGetValue()` function.
- Stop the ADC peripheral using `HAL_ADCEX_InjectedStop()`

Interrupt mode IO operation

- Start the ADC peripheral using `HAL_ADCEX_InjectedStart_IT()`
- Use `HAL_ADC_IRQHandler()` called under `ADC_IRQHandler()` Interrupt subroutine
- At ADC end of conversion `HAL_ADCEX_InjectedConvCpltCallback()` function is executed and user can add his own code by customization of function pointer `HAL_ADCEX_InjectedConvCpltCallback`

- In case of ADC Error, HAL_ADCEx_InjectedErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_ADCEx_InjectedErrorCallback
- Stop the ADC peripheral using HAL_ADCEx_InjectedStop_IT()

DMA mode IO operation

- Start the ADC peripheral using HAL_ADCEx_InjectedStart_DMA(), at this stage the user specify the length of data to be transferred at each end of conversion
- At The end of data transfer ba HAL_ADCEx_InjectedConvCpltCallback() function is executed and user can add his own code by customization of function pointer HAL_ADCEx_InjectedConvCpltCallback
- In case of transfer Error, HAL_ADCEx_InjectedErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_ADCEx_InjectedErrorCallback
- Stop the ADC peripheral using HAL_ADCEx_InjectedStop_DMA()

Multi mode ADCs Regular channels configuration

- Select the Multi mode ADC regular channels features (dual or triple mode) and configure the DMA mode using HAL_ADCEx_MultiModeConfigChannel() functions.
- Start the ADC peripheral using HAL_ADCEx_MultiModeStart_DMA(), at this stage the user specify the length of data to be transferred at each end of conversion
- Read the ADCs converted values using the HAL_ADCEx_MultiModeGetValue() function.

7.2.2 Extended features functions

This section provides functions allowing to:

- Start conversion of injected channel.
- Stop conversion of injected channel.
- Start multimode and enable DMA transfer.
- Stop multimode and disable DMA transfer.
- Get result of injected channel conversion.
- Get result of multimode conversion.
- Configure injected channels.
- Configure multimode.

This section contains the following APIs:

- [*HAL_ADCEx_InjectedStart\(\)*](#)
- [*HAL_ADCEx_InjectedStart_IT\(\)*](#)
- [*HAL_ADCEx_InjectedStop\(\)*](#)
- [*HAL_ADCEx_InjectedPollForConversion\(\)*](#)
- [*HAL_ADCEx_InjectedStop_IT\(\)*](#)
- [*HAL_ADCEx_InjectedGetValue\(\)*](#)
- [*HAL_ADCEx_MultiModeStart_DMA\(\)*](#)
- [*HAL_ADCEx_MultiModeStop_DMA\(\)*](#)
- [*HAL_ADCEx_MultiModeGetValue\(\)*](#)
- [*HAL_ADCEx_InjectedConvCpltCallback\(\)*](#)
- [*HAL_ADCEx_InjectedConfigChannel\(\)*](#)
- [*HAL_ADCEx_MultiModeConfigChannel\(\)*](#)

7.2.3 Detailed description of functions

HAL_ADCEx_InjectedStart

Function name	HAL_StatusTypeDef HAL_ADCEx_InjectedStart (ADC_HandleTypeDef * hadc)
Function description	Enables the selected ADC software start conversion of the injected channels.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_ADCEx_InjectedStop

Function name	HAL_StatusTypeDef HAL_ADCEx_InjectedStop (ADC_HandleTypeDef * hadc)
Function description	Stop conversion of injected channels.
Parameters	<ul style="list-style-type: none"> • hadc: ADC handle
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • If ADC must be disabled and if conversion is on going on regular group, function HAL_ADC_Stop must be used to stop both injected and regular groups, and disable the ADC. • If injected group mode auto-injection is enabled, function HAL_ADC_Stop must be used. • In case of auto-injection mode, HAL_ADC_Stop must be used.

HAL_ADCEx_InjectedPollForConversion

Function name	HAL_StatusTypeDef HAL_ADCEx_InjectedPollForConversion (ADC_HandleTypeDef * hadc, uint32_t Timeout)
Function description	Poll for injected conversion complete.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC. • Timeout: Timeout value in millisecond.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_ADCEx_InjectedStart_IT

Function name	HAL_StatusTypeDef HAL_ADCEx_InjectedStart_IT (ADC_HandleTypeDef * hadc)
Function description	Enables the interrupt and starts ADC conversion of injected channels.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
Return values	<ul style="list-style-type: none"> • HAL: status.

HAL_ADCEx_InjectedStop_IT

Function name	HAL_StatusTypeDef HAL_ADCEx_InjectedStop_IT (ADC_HandleTypeDef * hadc)
Function description	Stop conversion of injected channels, disable interruption of end-of-conversion.
Parameters	<ul style="list-style-type: none"> • hadc: ADC handle
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • If ADC must be disabled and if conversion is on going on regular group, function HAL_ADC_Stop must be used to stop both injected and regular groups, and disable the ADC. • If injected group mode auto-injection is enabled, function HAL_ADC_Stop must be used.

HAL_ADCEx_InjectedGetValue

Function name	uint32_t HAL_ADCEx_InjectedGetValue (ADC_HandleTypeDef * hadc, uint32_t InjectedRank)
Function description	Gets the converted value from data register of injected channel.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC. • InjectedRank: the ADC injected rank. This parameter can be one of the following values: <ul style="list-style-type: none"> – ADC_INJECTED_RANK_1: Injected Channel1 selected – ADC_INJECTED_RANK_2: Injected Channel2 selected – ADC_INJECTED_RANK_3: Injected Channel3 selected – ADC_INJECTED_RANK_4: Injected Channel4 selected
Return values	<ul style="list-style-type: none"> • None:

HAL_ADCEx_MultiModeStart_DMA

Function name	HAL_StatusTypeDef HAL_ADCEx_MultiModeStart_DMA (ADC_HandleTypeDef * hadc, uint32_t * pData, uint32_t Length)
Function description	Enables ADC DMA request after last transfer (Multi-ADC mode) and enables ADC peripheral.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC. • pData: Pointer to buffer in which transferred from ADC peripheral to memory will be stored. • Length: The length of data to be transferred from ADC peripheral to memory.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • Caution: This function must be used only with the ADC master.

HAL_ADCEx_MultiModeStop_DMA

Function name	HAL_StatusTypeDef HAL_ADCEx_MultiModeStop_DMA (ADC_HandleTypeDef * hadc)
Function description	Disables ADC DMA (multi-ADC mode) and disables ADC peripheral.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_ADCEx_MultiModeGetValue

Function name	uint32_t HAL_ADCEx_MultiModeGetValue (ADC_HandleTypeDef * hadc)
Function description	Returns the last ADC1, ADC2 and ADC3 regular conversions results data in the selected multi mode.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
Return values	<ul style="list-style-type: none"> • The: converted data value.

HAL_ADCEx_InjectedConvCpltCallback

Function name	void HAL_ADCEx_InjectedConvCpltCallback (ADC_HandleTypeDef * hadc)
Function description	Injected conversion complete callback in non blocking mode.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC.
Return values	<ul style="list-style-type: none"> • None:

HAL_ADCEx_InjectedConfigChannel

Function name	HAL_StatusTypeDef HAL_ADCEx_InjectedConfigChannel (ADC_HandleTypeDef * hadc, ADC_InjectionConfTypeDef * sConfigInjected)
Function description	Configures for the selected ADC injected channel its corresponding rank in the sequencer and its sample time.
Parameters	<ul style="list-style-type: none"> • hadc: pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC. • sConfigInjected: ADC configuration structure for injected channel.
Return values	<ul style="list-style-type: none"> • None:

HAL_ADCEx_MultiModeConfigChannel

Function name	HAL_StatusTypeDef HAL_ADCEx_MultiModeConfigChannel (ADC_HandleTypeDef * hadc, ADC_MultiModeTypeDef * multimode)
---------------	--

Function description	Configures the ADC multi-mode.
Parameters	<ul style="list-style-type: none"> • hadc: : pointer to a ADC_HandleTypeDef structure that contains the configuration information for the specified ADC. • multimode: : pointer to an ADC_MultiModeTypeDef structure that contains the configuration information for multimode.
Return values	<ul style="list-style-type: none"> • HAL: status

7.3 ADCEx Firmware driver defines

7.3.1 ADCEx

ADC Specific Channels

ADC_CHANNEL_TEMPSENSOR

ADC Common Mode

ADC_MODE_INDEPENDENT

ADC_DUALMODE_REGSIMULT_INJECSIMULT

ADC_DUALMODE_REGSIMULT_ALTERTRIG

ADC_DUALMODE_INJECSIMULT

ADC_DUALMODE_REGSIMULT

ADC_DUALMODE_INTERL

ADC_DUALMODE_ALTERTRIG

ADC_TRIPLEMODE_REGSIMULT_INJECSIMULT

ADC_TRIPLEMODE_REGSIMULT_AlterTrig

ADC_TRIPLEMODE_INJECSIMULT

ADC_TRIPLEMODE_REGSIMULT

ADC_TRIPLEMODE_INTERL

ADC_TRIPLEMODE_ALTERTRIG

ADC Direct Memory Access Mode For Multi Mode

ADC_DMAACCESSMODE_DISABLED DMA mode disabled

ADC_DMAACCESSMODE_1 DMA mode 1 enabled (2 / 3 half-words one by one - 1 then 2 then 3)

ADC_DMAACCESSMODE_2 DMA mode 2 enabled (2 / 3 half-words by pairs - 2&1 then 1&3 then 3&2)

ADC_DMAACCESSMODE_3 DMA mode 3 enabled (2 / 3 bytes by pairs - 2&1 then 1&3 then 3&2)

ADC External Trigger Edge Injected

ADC_EXTERNALTRIGINJECCONVEDGE_NONE

ADC_EXTERNALTRIGINJECCONVEDGE_RISING

ADC_EXTERNALTRIGINJECCONVEDGE_FALLING

ADC_EXTERNALTRIGINJECCONVEDGE_RISINGFALLING

ADC External Trigger Source Injected

ADC_EXTERNALTRIGINJECCONV_T1_TRGO

ADC_EXTERNALTRIGINJECCONV_T1_CC4

ADC_EXTERNALTRIGINJECCONV_T2_TRGO

ADC_EXTERNALTRIGINJECCONV_T2_CC1

ADC_EXTERNALTRIGINJECCONV_T3_CC4

ADC_EXTERNALTRIGINJECCONV_T4_TRGO

ADC_EXTERNALTRIGINJECCONV_T8_CC4

ADC_EXTERNALTRIGINJECCONV_T1_TRGO2

ADC_EXTERNALTRIGINJECCONV_T8_TRGO

ADC_EXTERNALTRIGINJECCONV_T8_TRGO2

ADC_EXTERNALTRIGINJECCONV_T3_CC3

ADC_EXTERNALTRIGINJECCONV_T5_TRGO

ADC_EXTERNALTRIGINJECCONV_T3_CC1

ADC_EXTERNALTRIGINJECCONV_T6_TRGO

ADC_INJECTED_SOFTWARE_START

ADC Injected Channel Rank

ADC_INJECTED_RANK_1

ADC_INJECTED_RANK_2

ADC_INJECTED_RANK_3

ADC_INJECTED_RANK_4

8 HAL CAN Generic Driver

8.1 CAN Firmware driver registers structures

8.1.1 CAN_InitTypeDef

Data Fields

- *uint32_t Prescaler*
- *uint32_t Mode*
- *uint32_t SJW*
- *uint32_t BS1*
- *uint32_t BS2*
- *uint32_t TTCM*
- *uint32_t ABOM*
- *uint32_t AWUM*
- *uint32_t NART*
- *uint32_t RFLM*
- *uint32_t TXFP*

Field Documentation

- *uint32_t CAN_InitTypeDef::Prescaler*
Specifies the length of a time quantum. This parameter must be a number between Min_Data = 1 and Max_Data = 1024
- *uint32_t CAN_InitTypeDef::Mode*
Specifies the CAN operating mode. This parameter can be a value of [CAN_operating_mode](#)
- *uint32_t CAN_InitTypeDef::SJW*
Specifies the maximum number of time quanta the CAN hardware is allowed to lengthen or shorten a bit to perform resynchronization. This parameter can be a value of [CAN_synchronisation_jump_width](#)
- *uint32_t CAN_InitTypeDef::BS1*
Specifies the number of time quanta in Bit Segment 1. This parameter can be a value of [CAN_time_quantum_in_bit_segment_1](#)
- *uint32_t CAN_InitTypeDef::BS2*
Specifies the number of time quanta in Bit Segment 2. This parameter can be a value of [CAN_time_quantum_in_bit_segment_2](#)
- *uint32_t CAN_InitTypeDef::TTCM*
Enable or disable the time triggered communication mode. This parameter can be set to ENABLE or DISABLE.
- *uint32_t CAN_InitTypeDef::ABOM*
Enable or disable the automatic bus-off management. This parameter can be set to ENABLE or DISABLE
- *uint32_t CAN_InitTypeDef::AWUM*
Enable or disable the automatic wake-up mode. This parameter can be set to ENABLE or DISABLE
- *uint32_t CAN_InitTypeDef::NART*
Enable or disable the non-automatic retransmission mode. This parameter can be set to ENABLE or DISABLE
- *uint32_t CAN_InitTypeDef::RFLM*
Enable or disable the receive FIFO Locked mode. This parameter can be set to ENABLE or DISABLE

- ***uint32_t CAN_InitTypeDef::TXFP***
Enable or disable the transmit FIFO priority. This parameter can be set to ENABLE or DISABLE

8.1.2 CAN_FilterConfTypeDef

Data Fields

- ***uint32_t FilterIdHigh***
- ***uint32_t FilterIdLow***
- ***uint32_t FilterMaskIdHigh***
- ***uint32_t FilterMaskIdLow***
- ***uint32_t FilterFIFOAssignment***
- ***uint32_t FilterNumber***
- ***uint32_t FilterMode***
- ***uint32_t FilterScale***
- ***uint32_t FilterActivation***
- ***uint32_t BankNumber***

Field Documentation

- ***uint32_t CAN_FilterConfTypeDef::FilterIdHigh***
Specifies the filter identification number (MSBs for a 32-bit configuration, first one for a 16-bit configuration). This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF
- ***uint32_t CAN_FilterConfTypeDef::FilterIdLow***
Specifies the filter identification number (LSBs for a 32-bit configuration, second one for a 16-bit configuration). This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF
- ***uint32_t CAN_FilterConfTypeDef::FilterMaskIdHigh***
Specifies the filter mask number or identification number, according to the mode (MSBs for a 32-bit configuration, first one for a 16-bit configuration). This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF
- ***uint32_t CAN_FilterConfTypeDef::FilterMaskIdLow***
Specifies the filter mask number or identification number, according to the mode (LSBs for a 32-bit configuration, second one for a 16-bit configuration). This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF
- ***uint32_t CAN_FilterConfTypeDef::FilterFIFOAssignment***
Specifies the FIFO (0 or 1) which will be assigned to the filter. This parameter can be a value of [CAN_filter_FIFO](#)
- ***uint32_t CAN_FilterConfTypeDef::FilterNumber***
Specifies the filter which will be initialized. This parameter must be a number between Min_Data = 0 and Max_Data = 27
- ***uint32_t CAN_FilterConfTypeDef::FilterMode***
Specifies the filter mode to be initialized. This parameter can be a value of [CAN_filter_mode](#)
- ***uint32_t CAN_FilterConfTypeDef::FilterScale***
Specifies the filter scale. This parameter can be a value of [CAN_filter_scale](#)
- ***uint32_t CAN_FilterConfTypeDef::FilterActivation***
Enable or disable the filter. This parameter can be set to ENABLE or DISABLE.
- ***uint32_t CAN_FilterConfTypeDef::BankNumber***
Select the start slave bank filter. This parameter must be a number between Min_Data = 0 and Max_Data = 28

8.1.3 CanTxMsgTypeDef

Data Fields

- *uint32_t StdId*
- *uint32_t ExtId*
- *uint32_t IDE*
- *uint32_t RTR*
- *uint32_t DLC*
- *uint8_t Data*

Field Documentation

- *uint32_t CanTxMsgTypeDef::StdId*
Specifies the standard identifier. This parameter must be a number between Min_Data = 0 and Max_Data = 0x7FF
- *uint32_t CanTxMsgTypeDef::ExtId*
Specifies the extended identifier. This parameter must be a number between Min_Data = 0 and Max_Data = 0x1FFFFFFF
- *uint32_t CanTxMsgTypeDef::IDE*
Specifies the type of identifier for the message that will be transmitted. This parameter can be a value of [CAN_Identifier_Type](#)
- *uint32_t CanTxMsgTypeDef::RTR*
Specifies the type of frame for the message that will be transmitted. This parameter can be a value of [CAN_remote_transmission_request](#)
- *uint32_t CanTxMsgTypeDef::DLC*
Specifies the length of the frame that will be transmitted. This parameter must be a number between Min_Data = 0 and Max_Data = 8
- *uint8_t CanTxMsgTypeDef::Data[8]*
Contains the data to be transmitted. This parameter must be a number between Min_Data = 0 and Max_Data = 0xFF

8.1.4 CanRxMsgTypeDef

Data Fields

- *uint32_t StdId*
- *uint32_t ExtId*
- *uint32_t IDE*
- *uint32_t RTR*
- *uint32_t DLC*
- *uint8_t Data*
- *uint32_t FMI*
- *uint32_t FIFONumber*

Field Documentation

- *uint32_t CanRxMsgTypeDef::StdId*
Specifies the standard identifier. This parameter must be a number between Min_Data = 0 and Max_Data = 0x7FF
- *uint32_t CanRxMsgTypeDef::ExtId*
Specifies the extended identifier. This parameter must be a number between Min_Data = 0 and Max_Data = 0x1FFFFFFF
- *uint32_t CanRxMsgTypeDef::IDE*
Specifies the type of identifier for the message that will be received. This parameter can be a value of [CAN_Identifier_Type](#)

- ***uint32_t CanRxMsgTypeDef::RTR***
Specifies the type of frame for the received message. This parameter can be a value of [CAN_remote_transmission_request](#)
- ***uint32_t CanRxMsgTypeDef::DLC***
Specifies the length of the frame that will be received. This parameter must be a number between Min_Data = 0 and Max_Data = 8
- ***uint8_t CanRxMsgTypeDef::Data[8]***
Contains the data to be received. This parameter must be a number between Min_Data = 0 and Max_Data = 0xFF
- ***uint32_t CanRxMsgTypeDef::FMI***
Specifies the index of the filter the message stored in the mailbox passes through. This parameter must be a number between Min_Data = 0 and Max_Data = 0xFF
- ***uint32_t CanRxMsgTypeDef::FIFONumber***
Specifies the receive FIFO number. This parameter can be CAN_FIFO0 or CAN_FIFO1

8.1.5 CAN_HandleTypeDef

Data Fields

- ***CAN_TypeDef * Instance***
- ***CAN_InitTypeDef Init***
- ***CanTxMsgTypeDef * pTxMsg***
- ***CanRxMsgTypeDef * pRxMsg***
- ***__IO HAL_CAN_StateTypeDef State***
- ***HAL_LockTypeDef Lock***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***CAN_TypeDef* CAN_HandleTypeDef::Instance***
Register base address
- ***CAN_InitTypeDef CAN_HandleTypeDef::Init***
CAN required parameters
- ***CanTxMsgTypeDef* CAN_HandleTypeDef::pTxMsg***
Pointer to transmit structure
- ***CanRxMsgTypeDef* CAN_HandleTypeDef::pRxMsg***
Pointer to reception structure
- ***__IO HAL_CAN_StateTypeDef CAN_HandleTypeDef::State***
CAN communication state
- ***HAL_LockTypeDef CAN_HandleTypeDef::Lock***
CAN locking object
- ***__IO uint32_t CAN_HandleTypeDef::ErrorCode***
CAN Error code This parameter can be a value of [CAN_Error_Code](#)

8.2 CAN Firmware driver API description

8.2.1 How to use this driver

1. Enable the CAN controller interface clock using `__HAL_RCC_CAN1_CLK_ENABLE()` for CAN1, `__HAL_RCC_CAN2_CLK_ENABLE()` for CAN2 and `__HAL_RCC_CAN3_CLK_ENABLE()` for CAN3. In case you are using CAN2 only, you have to enable the CAN1 clock.
2. CAN pins configuration
 - Enable the clock for the CAN GPIOs using the following function:
`__HAL_RCC_GPIOx_CLK_ENABLE()`

- Connect and configure the involved CAN pins to AF9 using the following function HAL_GPIO_Init()
- 3. Initialize and configure the CAN using HAL_CAN_Init() function.
- 4. Transmit the desired CAN frame using HAL_CAN_Transmit() function.
- 5. Or transmit the desired CAN frame using HAL_CAN_Transmit_IT() function.
- 6. Receive a CAN frame using HAL_CAN_Receive() function.
- 7. Or receive a CAN frame using HAL_CAN_Receive_IT() function.

Polling mode IO operation

- Start the CAN peripheral transmission and wait the end of this operation using HAL_CAN_Transmit(), at this stage user can specify the value of timeout according to his end application
- Start the CAN peripheral reception and wait the end of this operation using HAL_CAN_Receive(), at this stage user can specify the value of timeout according to his end application

Interrupt mode IO operation

- Start the CAN peripheral transmission using HAL_CAN_Transmit_IT()
- Start the CAN peripheral reception using HAL_CAN_Receive_IT()
- Use HAL_CAN_IRQHandler() called under the used CAN Interrupt subroutine
- At CAN end of transmission HAL_CAN_TxCpltCallback() function is executed and user can add his own code by customization of function pointer HAL_CAN_TxCpltCallback
- In case of CAN Error, HAL_CAN_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_CAN_ErrorCallback

CAN HAL driver macros list

Below the list of most used macros in CAN HAL driver.

- __HAL_CAN_ENABLE_IT: Enable the specified CAN interrupts
- __HAL_CAN_DISABLE_IT: Disable the specified CAN interrupts
- __HAL_CAN_GET_IT_SOURCE: Check if the specified CAN interrupt source is enabled or disabled
- __HAL_CAN_CLEAR_FLAG: Clear the CAN's pending flags
- __HAL_CAN_GET_FLAG: Get the selected CAN's flag status



You can refer to the CAN HAL driver header file for more useful macros

8.2.2 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize and configure the CAN.
- De-initialize the CAN.

This section contains the following APIs:

- [**HAL_CAN_Init\(\)**](#)
- [**HAL_CAN_ConfigFilter\(\)**](#)
- [**HAL_CAN_DeInit\(\)**](#)
- [**HAL_CAN_MspInit\(\)**](#)

- [HAL_CAN_MspDeInit\(\)](#)

8.2.3 IO operation functions

This section provides functions allowing to:

- Transmit a CAN frame message.
- Receive a CAN frame message.
- Enter CAN peripheral in sleep mode.
- Wake up the CAN peripheral from sleep mode.

This section contains the following APIs:

- [HAL_CAN_Transmit\(\)](#)
- [HAL_CAN_Transmit_IT\(\)](#)
- [HAL_CAN_Receive\(\)](#)
- [HAL_CAN_Receive_IT\(\)](#)
- [HAL_CAN_Sleep\(\)](#)
- [HAL_CAN_WakeUp\(\)](#)
- [HAL_CAN_IRQHandler\(\)](#)
- [HAL_CAN_TxCpltCallback\(\)](#)
- [HAL_CAN_RxCpltCallback\(\)](#)
- [HAL_CAN_ErrorCallback\(\)](#)

8.2.4 Peripheral State and Error functions

This subsection provides functions allowing to :

- Check the CAN state.
- Check CAN Errors detected during interrupt process

This section contains the following APIs:

- [HAL_CAN_GetState\(\)](#)
- [HAL_CAN_GetError\(\)](#)

8.2.5 Detailed description of functions

HAL_CAN_Init

Function name	HAL_StatusTypeDef HAL_CAN_Init (CAN_HandleTypeDef * hcan)
Function description	Initializes the CAN peripheral according to the specified parameters in the CAN_InitStruct.
Parameters	<ul style="list-style-type: none"> • hcan: pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CAN_ConfigFilter

Function name	HAL_StatusTypeDef HAL_CAN_ConfigFilter (CAN_HandleTypeDef * hcan, CAN_FilterConfTypeDef * sFilterConfig)
Function description	Configures the CAN reception filter according to the specified parameters in the CAN_FilterInitStruct.

- Parameters
- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
 - **sFilterConfig:** pointer to a CAN_FilterConfTypeDef structure that contains the filter configuration information.

- Return values
- **None:**

HAL_CAN_DeInit

Function name **HAL_StatusTypeDef HAL_CAN_DeInit (CAN_HandleTypeDef * hcan)**

Function description Deinitializes the CANx peripheral registers to their default reset values.

- Parameters
- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

- Return values
- **HAL:** status

HAL_CAN_MspInit

Function name **void HAL_CAN_MspInit (CAN_HandleTypeDef * hcan)**

Function description Initializes the CAN MSP.

- Parameters
- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

- Return values
- **None:**

HAL_CAN_MspDeInit

Function name **void HAL_CAN_MspDeInit (CAN_HandleTypeDef * hcan)**

Function description DeInitializes the CAN MSP.

- Parameters
- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

- Return values
- **None:**

HAL_CAN_Transmit

Function name **HAL_StatusTypeDef HAL_CAN_Transmit (CAN_HandleTypeDef * hcan, uint32_t Timeout)**

Function description Initiates and transmits a CAN frame message.

- Parameters
- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
 - **Timeout:** Specify Timeout value

- Return values
- **HAL:** status

HAL_CAN_Transmit_IT

Function name **HAL_StatusTypeDef HAL_CAN_Transmit_IT (CAN_HandleTypeDef * hcan)**

Function description	Initiates and transmits a CAN frame message.
Parameters	<ul style="list-style-type: none"> • hcan: pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CAN_Receive

Function name	HAL_StatusTypeDef HAL_CAN_Receive (CAN_HandleTypeDef * hcan, uint8_t FIFONumber, uint32_t Timeout)
Function description	Receives a correct CAN frame.
Parameters	<ul style="list-style-type: none"> • hcan: pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN. • FIFONumber: FIFO Number value • Timeout: Specify Timeout value
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CAN_Receive_IT

Function name	HAL_StatusTypeDef HAL_CAN_Receive_IT (CAN_HandleTypeDef * hcan, uint8_t FIFONumber)
Function description	Receives a correct CAN frame.
Parameters	<ul style="list-style-type: none"> • hcan: Pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN. • FIFONumber: Specify the FIFO number
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CAN_Sleep

Function name	HAL_StatusTypeDef HAL_CAN_Sleep (CAN_HandleTypeDef * hcan)
Function description	Enters the Sleep (low power) mode.
Parameters	<ul style="list-style-type: none"> • hcan: pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
Return values	<ul style="list-style-type: none"> • HAL: status.

HAL_CAN_WakeUp

Function name	HAL_StatusTypeDef HAL_CAN_WakeUp (CAN_HandleTypeDef * hcan)
Function description	Wakes up the CAN peripheral from sleep mode, after that the CAN peripheral is in the normal mode.
Parameters	<ul style="list-style-type: none"> • hcan: pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
Return values	<ul style="list-style-type: none"> • HAL: status.

HAL_CAN_IRQHandler

Function name	void HAL_CAN_IRQHandler (CAN_HandleTypeDef * hcan)
Function description	Handles CAN interrupt request.
Parameters	<ul style="list-style-type: none">• hcan: pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
Return values	<ul style="list-style-type: none">• None:

HAL_CAN_TxCpltCallback

Function name	void HAL_CAN_TxCpltCallback (CAN_HandleTypeDef * hcan)
Function description	Transmission complete callback in non blocking mode.
Parameters	<ul style="list-style-type: none">• hcan: pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
Return values	<ul style="list-style-type: none">• None:

HAL_CAN_RxCpltCallback

Function name	void HAL_CAN_RxCpltCallback (CAN_HandleTypeDef * hcan)
Function description	Transmission complete callback in non blocking mode.
Parameters	<ul style="list-style-type: none">• hcan: pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
Return values	<ul style="list-style-type: none">• None:

HAL_CAN_ErrorCallback

Function name	void HAL_CAN_ErrorCallback (CAN_HandleTypeDef * hcan)
Function description	Error CAN callback.
Parameters	<ul style="list-style-type: none">• hcan: pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
Return values	<ul style="list-style-type: none">• None:

HAL_CAN_GetError

Function name	uint32_t HAL_CAN_GetError (CAN_HandleTypeDef * hcan)
Function description	Return the CAN error code.
Parameters	<ul style="list-style-type: none">• hcan: pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
Return values	<ul style="list-style-type: none">• CAN: Error Code

HAL_CAN_GetState

Function name	HAL_CAN_StateTypeDef HAL_CAN_GetState (CAN_HandleTypeDef * hcan)
Function description	return the CAN state

Parameters	<ul style="list-style-type: none"> • hcan: pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
Return values	<ul style="list-style-type: none"> • HAL: state

8.3 CAN Firmware driver defines

8.3.1 CAN

CAN Error Code

HAL_CAN_ERROR_NONE	No error
HAL_CAN_ERROR_EWG	EWG error
HAL_CAN_ERROR_EPV	EPV error
HAL_CAN_ERROR_BOF	BOF error
HAL_CAN_ERROR_STF	Stuff error
HAL_CAN_ERROR_FOR	Form error
HAL_CAN_ERROR_ACK	Acknowledgment error
HAL_CAN_ERROR_BR	Bit recessive
HAL_CAN_ERROR_BD	LEC dominant
HAL_CAN_ERROR_CRC	LEC transfer error

CAN Exported Macros

<code>__HAL_CAN_RESET_HANDLE_STATE</code>	<p>Description:</p> <ul style="list-style-type: none"> • Reset CAN handle state. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: specifies the CAN Handle. <p>Return value:</p> <ul style="list-style-type: none"> • None
<code>__HAL_CAN_ENABLE_IT</code>	<p>Description:</p> <ul style="list-style-type: none"> • Enable the specified CAN interrupts. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: CAN handle • <code>__INTERRUPT__</code>: CAN Interrupt <p>Return value:</p> <ul style="list-style-type: none"> • None
<code>__HAL_CAN_DISABLE_IT</code>	<p>Description:</p> <ul style="list-style-type: none"> • Disable the specified CAN interrupts. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: CAN handle • <code>__INTERRUPT__</code>: CAN Interrupt <p>Return value:</p>

`__HAL_CAN_MSG_PENDING`

- None

Description:

- Return the number of pending received messages.

Parameters:

- `__HANDLE__`: CAN handle
- `__FIFONUMBER__`: Receive FIFO number, `CAN_FIFO0` or `CAN_FIFO1`.

Return value:

- The: number of pending message.

`__HAL_CAN_GET_FLAG`**Description:**

- Check whether the specified CAN flag is set or not.

Parameters:

- `__HANDLE__`: CAN Handle
- `__FLAG__`: specifies the flag to check. This parameter can be one of the following values:
 - `CAN_TSR_RQCP0`: Request MailBox0 Flag
 - `CAN_TSR_RQCP1`: Request MailBox1 Flag
 - `CAN_TSR_RQCP2`: Request MailBox2 Flag
 - `CAN_FLAG_TXOK0`: Transmission OK MailBox0 Flag
 - `CAN_FLAG_TXOK1`: Transmission OK MailBox1 Flag
 - `CAN_FLAG_TXOK2`: Transmission OK MailBox2 Flag
 - `CAN_FLAG_TME0`: Transmit mailbox 0 empty Flag
 - `CAN_FLAG_TME1`: Transmit mailbox 1 empty Flag
 - `CAN_FLAG_TME2`: Transmit mailbox 2 empty Flag
 - `CAN_FLAG_FMP0`: FIFO 0 Message Pending Flag
 - `CAN_FLAG_FF0`: FIFO 0 Full Flag
 - `CAN_FLAG_FOV0`: FIFO 0 Overrun Flag
 - `CAN_FLAG_FMP1`: FIFO 1 Message Pending Flag
 - `CAN_FLAG_FF1`: FIFO 1 Full Flag
 - `CAN_FLAG_FOV1`: FIFO 1 Overrun Flag
 - `CAN_FLAG_WKU`: Wake up Flag
 - `CAN_FLAG_SLAK`: Sleep acknowledge Flag

- CAN_FLAG_SLAKI: Sleep acknowledge Flag
- CAN_FLAG_EWG: Error Warning Flag
- CAN_FLAG_EPV: Error Passive Flag
- CAN_FLAG_BOF: Bus-Off Flag

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

`__HAL_CAN_CLEAR_FLAG`**Description:**

- Clear the specified CAN pending flag.

Parameters:

- __HANDLE__: CAN Handle.
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
 - CAN_TSR_RQCP0: Request MailBox0 Flag
 - CAN_TSR_RQCP1: Request MailBox1 Flag
 - CAN_TSR_RQCP2: Request MailBox2 Flag
 - CAN_FLAG_TXOK0: Transmission OK MailBox0 Flag
 - CAN_FLAG_TXOK1: Transmission OK MailBox1 Flag
 - CAN_FLAG_TXOK2: Transmission OK MailBox2 Flag
 - CAN_FLAG_TME0: Transmit mailbox 0 empty Flag
 - CAN_FLAG_TME1: Transmit mailbox 1 empty Flag
 - CAN_FLAG_TME2: Transmit mailbox 2 empty Flag
 - CAN_FLAG_FMP0: FIFO 0 Message Pending Flag
 - CAN_FLAG_FF0: FIFO 0 Full Flag
 - CAN_FLAG_FOV0: FIFO 0 Overrun Flag
 - CAN_FLAG_FMP1: FIFO 1 Message Pending Flag
 - CAN_FLAG_FF1: FIFO 1 Full Flag
 - CAN_FLAG_FOV1: FIFO 1 Overrun Flag
 - CAN_FLAG_WKU: Wake up Flag
 - CAN_FLAG_SLAK: Sleep acknowledge Flag
 - CAN_FLAG_SLAKI: Sleep acknowledge Flag

Return value:

`__HAL_CAN_GET_IT_SOURCE`

- The: new state of `__FLAG__` (TRUE or FALSE).

Description:

- Check if the specified CAN interrupt source is enabled or disabled.

Parameters:

- `__HANDLE__`: CAN Handle
- `__INTERRUPT__`: specifies the CAN interrupt source to check. This parameter can be one of the following values:
 - `CAN_IT_TME`: Transmit mailbox empty interrupt enable
 - `CAN_IT_FMP0`: FIFO0 message pending interrupt enable
 - `CAN_IT_FMP1`: FIFO1 message pending interrupt enable

Return value:

- The: new state of `__IT__` (TRUE or FALSE).

`__HAL_CAN_TRANSMIT_STATUS`**Description:**

- Check the transmission status of a CAN Frame.

Parameters:

- `__HANDLE__`: CAN Handle
- `__TRANSMITMAILBOX__`: the number of the mailbox that is used for transmission.

Return value:

- The: new status of transmission (TRUE or FALSE).

`__HAL_CAN_FIFO_RELEASE`**Description:**

- Release the specified receive FIFO.

Parameters:

- `__HANDLE__`: CAN handle
- `__FIFONUMBER__`: Receive FIFO number, `CAN_FIFO0` or `CAN_FIFO1`.

Return value:

- None

`__HAL_CAN_CANCEL_TRANSMIT`**Description:**

- Cancel a transmit request.

Parameters:

- `__HANDLE__`: CAN Handle
- `__TRANSMITMAILBOX__`: the number of

the mailbox that is used for transmission.

Return value:

- None

Description:

- Enable or disable the DBG Freeze for CAN.

Parameters:

- `__HANDLE__`: CAN Handle
- `__NEWSTATE__`: new state of the CAN peripheral. This parameter can be: ENABLE (CAN reception/transmission is frozen during debug. Reception FIFOs can still be accessed/controlled normally) or DISABLE (CAN is working during debug).

Return value:

- None

`__HAL_CAN_DBG_FREEZE`

CAN Filter FIFO

`CAN_FILTER_FIFO0` Filter FIFO 0 assignment for filter x

`CAN_FILTER_FIFO1` Filter FIFO 1 assignment for filter x

CAN Filter Mode

`CAN_FILTERMODE_IDMASK` Identifier mask mode

`CAN_FILTERMODE_IDLIST` Identifier list mode

CAN Filter Scale

`CAN_FILTERSCALE_16BIT` Two 16-bit filters

`CAN_FILTERSCALE_32BIT` One 32-bit filter

CAN Flags

`CAN_FLAG_RQCP0` Request MailBox0 flag

`CAN_FLAG_RQCP1` Request MailBox1 flag

`CAN_FLAG_RQCP2` Request MailBox2 flag

`CAN_FLAG_TXOK0` Transmission OK MailBox0 flag

`CAN_FLAG_TXOK1` Transmission OK MailBox1 flag

`CAN_FLAG_TXOK2` Transmission OK MailBox2 flag

`CAN_FLAG_TME0` Transmit mailbox 0 empty flag

`CAN_FLAG_TME1` Transmit mailbox 0 empty flag

`CAN_FLAG_TME2` Transmit mailbox 0 empty flag

`CAN_FLAG_FF0` FIFO 0 Full flag

`CAN_FLAG_FOV0` FIFO 0 Overrun flag

`CAN_FLAG_FF1` FIFO 1 Full flag

`CAN_FLAG_FOV1` FIFO 1 Overrun flag

CAN_FLAG_INAK	Initialization acknowledge flag
CAN_FLAG_SLAKE	Sleep acknowledge flag
CAN_FLAG_ERRI	Error flag
CAN_FLAG_WKU	Wake up flag
CAN_FLAG_SLAKEI	Sleep acknowledge flag
CAN_FLAG_EWG	Error warning flag
CAN_FLAG_EPV	Error passive flag
CAN_FLAG_BOFF	Bus-Off flag

CAN Identifier Type

CAN_ID_STD	Standard Id
CAN_ID_EXT	Extended Id

CAN InitStatus

CAN_INITSTATUS_FAILED	CAN initialization failed
CAN_INITSTATUS_SUCCESS	CAN initialization OK

CAN Interrupts

CAN_IT_TME	Transmit mailbox empty interrupt
CAN_IT_FMP0	FIFO 0 message pending interrupt
CAN_IT_FF0	FIFO 0 full interrupt
CAN_IT_FOV0	FIFO 0 overrun interrupt
CAN_IT_FMP1	FIFO 1 message pending interrupt
CAN_IT_FF1	FIFO 1 full interrupt
CAN_IT_FOV1	FIFO 1 overrun interrupt
CAN_IT_WKU	Wake-up interrupt
CAN_IT_SLK	Sleep acknowledge interrupt
CAN_IT_EWG	Error warning interrupt
CAN_IT_EPV	Error passive interrupt
CAN_IT_BOFF	Bus-off interrupt
CAN_IT_LEC	Last error code interrupt
CAN_IT_ERR	Error Interrupt

CAN Mailboxes Definition

CAN_TXMAILBOX_0
CAN_TXMAILBOX_1
CAN_TXMAILBOX_2

CAN Operating Mode

CAN_MODE_NORMAL	Normal mode
CAN_MODE_LOOPBACK	Loopback mode

CAN_MODE_SILENT Silent mode
CAN_MODE_SILENT_LOOPBACK Loopback combined with silent mode

CAN Receive FIFO Number Constants

CAN_FIFO0 CAN FIFO 0 used to receive
CAN_FIFO1 CAN FIFO 1 used to receive

CAN Remote Transmission Request

CAN_RTR_DATA Data frame
CAN_RTR_REMOTE Remote frame

CAN Synchronisation Jump Width

CAN_SJW_1TQ 1 time quantum
CAN_SJW_2TQ 2 time quantum
CAN_SJW_3TQ 3 time quantum
CAN_SJW_4TQ 4 time quantum

CAN Time Quantum in bit segment 1

CAN_BS1_1TQ 1 time quantum
CAN_BS1_2TQ 2 time quantum
CAN_BS1_3TQ 3 time quantum
CAN_BS1_4TQ 4 time quantum
CAN_BS1_5TQ 5 time quantum
CAN_BS1_6TQ 6 time quantum
CAN_BS1_7TQ 7 time quantum
CAN_BS1_8TQ 8 time quantum
CAN_BS1_9TQ 9 time quantum
CAN_BS1_10TQ 10 time quantum
CAN_BS1_11TQ 11 time quantum
CAN_BS1_12TQ 12 time quantum
CAN_BS1_13TQ 13 time quantum
CAN_BS1_14TQ 14 time quantum
CAN_BS1_15TQ 15 time quantum
CAN_BS1_16TQ 16 time quantum

CAN Time Quantum in bit segment 2

CAN_BS2_1TQ 1 time quantum
CAN_BS2_2TQ 2 time quantum
CAN_BS2_3TQ 3 time quantum
CAN_BS2_4TQ 4 time quantum
CAN_BS2_5TQ 5 time quantum

CAN_BS2_6TQ	6 time quantum
CAN_BS2_7TQ	7 time quantum
CAN_BS2_8TQ	8 time quantum

9 HAL CEC Generic Driver

9.1 CEC Firmware driver registers structures

9.1.1 CEC_InitTypeDef

Data Fields

- *uint32_t* **SignalFreeTime**
- *uint32_t* **Tolerance**
- *uint32_t* **BRERxStop**
- *uint32_t* **BREErrorBitGen**
- *uint32_t* **LBPEErrorBitGen**
- *uint32_t* **BroadcastMsgNoErrorBitGen**
- *uint32_t* **SignalFreeTimeOption**
- *uint32_t* **ListenMode**
- *uint16_t* **OwnAddress**
- *uint8_t* * **RxBuffer**

Field Documentation

- *uint32_t* **CEC_InitTypeDef::SignalFreeTime**
Set SFT field, specifies the Signal Free Time. It can be one of [CEC_Signal_Free_Time](#) and belongs to the set {0,...,7} where 0x0 is the default configuration else means 0.5 + (SignalFreeTime - 1) nominal data bit periods
- *uint32_t* **CEC_InitTypeDef::Tolerance**
Set RXTOL bit, specifies the tolerance accepted on the received waveforms, it can be a value of [CEC_Tolerance](#) : it is either CEC_STANDARD_TOLERANCE or CEC_EXTENDED_TOLERANCE
- *uint32_t* **CEC_InitTypeDef::BRERxStop**
Set BRESTP bit [CEC_BRERxStop](#) : specifies whether or not a Bit Rising Error stops the reception. CEC_NO_RX_STOP_ON_BRE: reception is not stopped. CEC_RX_STOP_ON_BRE: reception is stopped.
- *uint32_t* **CEC_InitTypeDef::BREErrorBitGen**
Set BREGEN bit [CEC_BREErrorBitGen](#) : specifies whether or not an Error-Bit is generated on the CEC line upon Bit Rising Error detection. CEC_BRE_ERRORBIT_NO_GENERATION: no error-bit generation. CEC_BRE_ERRORBIT_GENERATION: error-bit generation if BRESTP is set.
- *uint32_t* **CEC_InitTypeDef::LBPEErrorBitGen**
Set LBPEGEN bit [CEC_LBPEErrorBitGen](#) : specifies whether or not an Error-Bit is generated on the CEC line upon Long Bit Period Error detection. CEC_LBPE_ERRORBIT_NO_GENERATION: no error-bit generation. CEC_LBPE_ERRORBIT_GENERATION: error-bit generation.
- *uint32_t* **CEC_InitTypeDef::BroadcastMsgNoErrorBitGen**
Set BRDNOGEN bit [CEC_BroadCastMsgErrorBitGen](#) : allows to avoid an Error-Bit generation on the CEC line upon an error detected on a broadcast message. It supersedes BREGEN and LBPEGEN bits for a broadcast message error handling. It can take two values: 1) CEC_BROADCASTERROR_ERRORBIT_GENERATION. a) BRE detection: error-bit generation on the CEC line if BRESTP=CEC_RX_STOP_ON_BRE and BREGEN=CEC_BRE_ERRORBIT_NO_GENERATION. b) LBPE detection: error-bit generation on the CEC line if LBPGEN=CEC_LBPE_ERRORBIT_NO_GENERATION. 2)

CEC_BROADCASTERROR_NO_ERRORBIT_GENERATION. no error-bit generation in case neither a) nor b) are satisfied. Additionally, there is no error-bit generation in case of Short Bit Period Error detection in a broadcast message while LSTN bit is set.

- ***uint32_t CEC_InitTypeDef::SignalFreeTimeOption***
Set SFTOP bit ***CEC_SFT_Option*** : specifies when SFT timer starts.
CEC_SFT_START_ON_TXSOM SFT: timer starts when TXSOM is set by software.
CEC_SFT_START_ON_TX_RX_END: SFT timer starts automatically at the end of message transmission/reception.
- ***uint32_t CEC_InitTypeDef::ListenMode***
Set LSTN bit ***CEC_Listening_Mode*** : specifies device listening mode. It can take two values:CEC_REDUCED_LISTENING_MODE: CEC peripheral receives only message addressed to its own address (OAR). Messages addressed to different destination are ignored. Broadcast messages are always received.CEC_FULL_LISTENING_MODE: CEC peripheral receives messages addressed to its own address (OAR) with positive acknowledge. Messages addressed to different destination are received, but without interfering with the CEC bus: no acknowledge sent.
- ***uint16_t CEC_InitTypeDef::OwnAddress***
Own addresses configuration This parameter can be a value of ***CEC_OWN_ADDRESS***
- ***uint8_t* CEC_InitTypeDef::RxBuffer***
CEC Rx buffer pointer

9.1.2 CEC_HandleTypeDef

Data Fields

- ***CEC_TypeDef * Instance***
- ***CEC_InitTypeDef Init***
- ***uint8_t * pTxBuffPtr***
- ***uint16_t TxXferCount***
- ***uint16_t RxXferSize***
- ***HAL_LockTypeDef Lock***
- ***HAL_CEC_StateTypeDef gState***
- ***HAL_CEC_StateTypeDef RxState***
- ***uint32_t ErrorCode***

Field Documentation

- ***CEC_TypeDef* CEC_HandleTypeDef::Instance***
CEC registers base address
- ***CEC_InitTypeDef CEC_HandleTypeDef::Init***
CEC communication parameters
- ***uint8_t* CEC_HandleTypeDef::pTxBuffPtr***
Pointer to CEC Tx transfer Buffer
- ***uint16_t CEC_HandleTypeDef::TxXferCount***
CEC Tx Transfer Counter
- ***uint16_t CEC_HandleTypeDef::RxXferSize***
CEC Rx Transfer size, 0: header received only
- ***HAL_LockTypeDef CEC_HandleTypeDef::Lock***
Locking object
- ***HAL_CEC_StateTypeDef CEC_HandleTypeDef::gState***
CEC state information related to global Handle management and also related to Tx operations. This parameter can be a value of ***HAL_CEC_StateTypeDef***
- ***HAL_CEC_StateTypeDef CEC_HandleTypeDef::RxState***
CEC state information related to Rx operations. This parameter can be a value of ***HAL_CEC_StateTypeDef***

- ***uint32_t CEC_HandleTypeDef::ErrorCode***
For errors handling purposes, copy of ISR register in case error is reported

9.2 CEC Firmware driver API description

9.2.1 How to use this driver

The CEC HAL driver can be used as follow:

1. Declare a CEC_HandleTypeDef handle structure.
2. Initialize the CEC low level resources by implementing the HAL_CEC_MspInit ()API:
 - a. Enable the CEC interface clock.
 - b. CEC pins configuration:
 - Enable the clock for the CEC GPIOs.
 - Configure these CEC pins as alternate function pull-up.
 - c. NVIC configuration if you need to use interrupt process (HAL_CEC_Transmit_IT() and HAL_CEC_Receive_IT() APIs):
 - Configure the CEC interrupt priority.
 - Enable the NVIC CEC IRQ handle.
 - The specific CEC interrupts (Transmission complete interrupt, RXNE interrupt and Error Interrupts) will be managed using the macros `__HAL_CEC_ENABLE_IT()` and `__HAL_CEC_DISABLE_IT()` inside the transmit and receive process.
3. Program the Signal Free Time (SFT) and SFT option, Tolerance, reception stop in case of Bit Rising Error, Error-Bit generation conditions, device logical address and Listen mode in the hcec Init structure.
4. Initialize the CEC registers by calling the HAL_CEC_Init() API.



This API (HAL_CEC_Init()) configures also the low level Hardware (GPIO, CLOCK, CORTEX...etc) by calling the customed HAL_CEC_MspInit() API.

9.2.2 Initialization and Configuration functions

This subsection provides a set of functions allowing to initialize the CEC

- The following parameters need to be configured:
 - SignalFreeTime
 - Tolerance
 - BRERxStop (RX stopped or not upon Bit Rising Error)
 - BREErrorBitGen (Error-Bit generation in case of Bit Rising Error)
 - LBPEErrorBitGen (Error-Bit generation in case of Long Bit Period Error)
 - BroadcastMsgNoErrorBitGen (Error-bit generation in case of broadcast message error)
 - SignalFreeTimeOption (SFT Timer start definition)
 - OwnAddress (CEC device address)
 - ListenMode

This section contains the following APIs:

- [*HAL_CEC_Init\(\)*](#)
- [*HAL_CEC_DeInit\(\)*](#)
- [*HAL_CEC_SetDeviceAddress\(\)*](#)
- [*HAL_CEC_MspInit\(\)*](#)
- [*HAL_CEC_MspDeInit\(\)*](#)

9.2.3 IO operation functions

This section contains the following APIs:

- [HAL_CEC_Transmit_IT\(\)](#)
- [HAL_CEC_GetLastReceivedFrameSize\(\)](#)
- [HAL_CEC_ChangeRxBuffer\(\)](#)
- [HAL_CEC_IRQHandler\(\)](#)
- [HAL_CEC_TxCpltCallback\(\)](#)
- [HAL_CEC_RxCpltCallback\(\)](#)
- [HAL_CEC_ErrorCallback\(\)](#)

9.2.4 Peripheral Control function

This subsection provides a set of functions allowing to control the CEC.

- [HAL_CEC_GetState\(\)](#) API can be helpful to check in run-time the state of the CEC peripheral.
- [HAL_CEC_GetError\(\)](#) API can be helpful to check in run-time the error of the CEC peripheral.

This section contains the following APIs:

- [HAL_CEC_GetState\(\)](#)
- [HAL_CEC_GetError\(\)](#)

9.2.5 Detailed description of functions

HAL_CEC_Init

Function name	HAL_StatusTypeDef HAL_CEC_Init (CEC_HandleTypeDef * hcec)
Function description	Initializes the CEC mode according to the specified parameters in the CEC_InitTypeDef and creates the associated handle .
Parameters	<ul style="list-style-type: none"> • hcec: CEC handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CEC_DeInit

Function name	HAL_StatusTypeDef HAL_CEC_DeInit (CEC_HandleTypeDef * hcec)
Function description	DeInitializes the CEC peripheral.
Parameters	<ul style="list-style-type: none"> • hcec: CEC handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CEC_SetDeviceAddress

Function name	HAL_StatusTypeDef HAL_CEC_SetDeviceAddress (CEC_HandleTypeDef * hcec, uint16_t CEC_OwnAddress)
Function description	Initializes the Own Address of the CEC device.
Parameters	<ul style="list-style-type: none"> • hcec: CEC handle • CEC_OwnAddress: The CEC own address.

Return values

- **HAL:** status

HAL_CEC_Msplnit

Function name **void HAL_CEC_Msplnit (CEC_HandleTypeDef * hcec)**

Function description CEC MSP Init.

Parameters

- **hcec:** CEC handle

Return values

- **None:**

HAL_CEC_MspDelnit

Function name **void HAL_CEC_MspDelnit (CEC_HandleTypeDef * hcec)**

Function description CEC MSP Delnit.

Parameters

- **hcec:** CEC handle

Return values

- **None:**

HAL_CEC_Transmit_IT

Function name **HAL_StatusTypeDef HAL_CEC_Transmit_IT (CEC_HandleTypeDef * hcec, uint8_t InitiatorAddress, uint8_t DestinationAddress, uint8_t * pData, uint32_t Size)**

Function description Send data in interrupt mode.

Parameters

- **hcec:** CEC handle
- **InitiatorAddress:** Initiator address
- **DestinationAddress:** destination logical address
- **pData:** pointer to input byte data buffer
- **Size:** amount of data to be sent in bytes (without counting the header). 0 means only the header is sent (ping operation). Maximum TX size is 15 bytes (1 opcode and up to 14 operands).

Return values

- **HAL:** status

HAL_CEC_GetLastReceivedFrameSize

Function name **uint32_t HAL_CEC_GetLastReceivedFrameSize (CEC_HandleTypeDef * hcec)**

Function description Get size of the received frame.

Parameters

- **hcec:** CEC handle

Return values

- **Frame:** size

HAL_CEC_ChangeRxBuffer

Function name **void HAL_CEC_ChangeRxBuffer (CEC_HandleTypeDef * hcec, uint8_t * Rxbuffer)**

Function description Change Rx Buffer.

Parameters

- **hcec:** CEC handle

- **Rxbuffer:** Rx Buffer
 - **Frame:** size
- Return values
- Notes
- This function can be called only inside the HAL_CEC_RxCpltCallback()

HAL_CEC_IRQHandler

- Function name **void HAL_CEC_IRQHandler (CEC_HandleTypeDef * hcec)**
- Function description This function handles CEC interrupt requests.
- Parameters
- **hcec:** CEC handle
- Return values
- **None:**

HAL_CEC_TxCpltCallback

- Function name **void HAL_CEC_TxCpltCallback (CEC_HandleTypeDef * hcec)**
- Function description Tx Transfer completed callback.
- Parameters
- **hcec:** CEC handle
- Return values
- **None:**

HAL_CEC_RxCpltCallback

- Function name **void HAL_CEC_RxCpltCallback (CEC_HandleTypeDef * hcec, uint32_t RxFrameSize)**
- Function description Rx Transfer completed callback.
- Parameters
- **hcec:** CEC handle
 - **RxFrameSize:** Size of frame
- Return values
- **None:**

HAL_CEC_ErrorCallback

- Function name **void HAL_CEC_ErrorCallback (CEC_HandleTypeDef * hcec)**
- Function description CEC error callbacks.
- Parameters
- **hcec:** CEC handle
- Return values
- **None:**

HAL_CEC_GetState

- Function name **HAL_CEC_StateTypeDef HAL_CEC_GetState (CEC_HandleTypeDef * hcec)**
- Function description return the CEC state
- Parameters
- **hcec:** pointer to a CEC_HandleTypeDef structure that contains the configuration information for the specified CEC module.
- Return values
- **HAL:** state

HAL_CEC_GetError

Function name	uint32_t HAL_CEC_GetError (CEC_HandleTypeDef * hcec)
Function description	Return the CEC error code.
Parameters	<ul style="list-style-type: none"> hcec: : pointer to a CEC_HandleTypeDef structure that contains the configuration information for the specified CEC.
Return values	<ul style="list-style-type: none"> CEC: Error Code

9.3 CEC Firmware driver defines**9.3.1 CEC*****CEC all RX or TX errors flags***

CEC_ISR_ALL_ERROR

CEC Error Bit Generation if Bit Rise Error reported

CEC_BRE_ERRORBIT_NO_GENERATION

CEC_BRE_ERRORBIT_GENERATION

CEC Reception Stop on Error

CEC_NO_RX_STOP_ON_BRE

CEC_RX_STOP_ON_BRE

CEC Error Bit Generation on Broadcast message

CEC_BROADCASTERROR_ERRORBIT_GENERATION

CEC_BROADCASTERROR_NO_ERRORBIT_GENERATION

CEC Error Code

HAL_CEC_ERROR_NONE	no error
HAL_CEC_ERROR_RXOVR	CEC Rx-Overrun
HAL_CEC_ERROR_BRE	CEC Rx Bit Rising Error
HAL_CEC_ERROR_SBPE	CEC Rx Short Bit period Error
HAL_CEC_ERROR_LBPE	CEC Rx Long Bit period Error
HAL_CEC_ERROR_RXACKE	CEC Rx Missing Acknowledge
HAL_CEC_ERROR_ARBLST	CEC Arbitration Lost
HAL_CEC_ERROR_TXUDR	CEC Tx-Buffer Underrun
HAL_CEC_ERROR_TXERR	CEC Tx-Error
HAL_CEC_ERROR_TXACKE	CEC Tx Missing Acknowledge

CEC Exported Macros`__HAL_CEC_RESET_HANDLE_STATE`**Description:**

- Reset CEC handle gstate & RxState.

Parameters:

`__HAL_CEC_GET_FLAG`

- `__HANDLE__`: CEC handle.

Return value:

- None

Description:

- Checks whether or not the specified CEC interrupt flag is set.

Parameters:

- `__HANDLE__`: specifies the CEC Handle.
- `__FLAG__`: specifies the flag to check.
 - `CEC_FLAG_TXACKE`: Tx Missing acknowledge Error
 - `CEC_FLAG_TXERR`: Tx Error.
 - `CEC_FLAG_TXUDR`: Tx-Buffer Underrun.
 - `CEC_FLAG_TXEND`: End of transmission (successful transmission of the last byte).
 - `CEC_FLAG_TXBR`: Tx-Byte Request.
 - `CEC_FLAG_ARBLST`: Arbitration Lost
 - `CEC_FLAG_RXACKE`: Rx-Missing Acknowledge
 - `CEC_FLAG_LBPE`: Rx Long period Error
 - `CEC_FLAG_SBPE`: Rx Short period Error
 - `CEC_FLAG_BRE`: Rx Bit Rising Error
 - `CEC_FLAG_RXOVR`: Rx Overrun.
 - `CEC_FLAG_RXEND`: End Of Reception.
 - `CEC_FLAG_RXBR`: Rx-Byte Received.

Return value:

- ITStatus

Description:

- Clears the interrupt or status flag when raised (write at 1)

Parameters:

- `__HANDLE__`: specifies the CEC Handle.

`__HAL_CEC_CLEAR_FLAG`

- `__FLAG__`: specifies the interrupt/status flag to clear. This parameter can be one of the following values:
 - `CEC_FLAG_TXACHE`: Tx Missing acknowledge Error
 - `CEC_FLAG_TXERR`: Tx Error.
 - `CEC_FLAG_TXUDR`: Tx-Buffer Underrun.
 - `CEC_FLAG_TXEND`: End of transmission (successful transmission of the last byte).
 - `CEC_FLAG_TXBR`: Tx-Byte Request.
 - `CEC_FLAG_ARBLST`: Arbitration Lost
 - `CEC_FLAG_RXACHE`: Rx-Missing Acknowledge
 - `CEC_FLAG_LBPE`: Rx Long period Error
 - `CEC_FLAG_SBPE`: Rx Short period Error
 - `CEC_FLAG_BRE`: Rx Bit Rising Error
 - `CEC_FLAG_RXOVR`: Rx Overrun.
 - `CEC_FLAG_RXEND`: End Of Reception.
 - `CEC_FLAG_RXBR`: Rx-Byte Received.

Return value:

- none

Description:

- Enables the specified CEC interrupt.

Parameters:

- `__HANDLE__`: specifies the CEC Handle.
- `__INTERRUPT__`: specifies the CEC interrupt to enable. This parameter can be one of the following values:
 - `CEC_IT_TXACHE`: Tx Missing acknowledge Error IT Enable
 - `CEC_IT_TXERR`: Tx Error IT Enable
 - `CEC_IT_TXUDR`: Tx-Buffer Underrun IT Enable

`__HAL_CEC_ENABLE_IT`

- CEC_IT_TXEND: End of transmission IT Enable
- CEC_IT_TXBR: Tx-Byte Request IT Enable
- CEC_IT_ARBLST: Arbitration Lost IT Enable
- CEC_IT_RXACHE: Rx-Missing Acknowledge IT Enable
- CEC_IT_LBPE: Rx Long period Error IT Enable
- CEC_IT_SBPE: Rx Short period Error IT Enable
- CEC_IT_BRE: Rx Bit Rising Error IT Enable
- CEC_IT_RXOVR: Rx Overrun IT Enable
- CEC_IT_RXEND: End Of Reception IT Enable
- CEC_IT_RXBR: Rx-Byte Received IT Enable

Return value:

- none

Description:

- Disables the specified CEC interrupt.

Parameters:

- `__HANDLE__`: specifies the CEC Handle.
- `__INTERRUPT__`: specifies the CEC interrupt to disable. This parameter can be one of the following values:
 - CEC_IT_TXACHE: Tx Missing acknowledge Error IT Enable
 - CEC_IT_TXERR: Tx Error IT Enable
 - CEC_IT_TXUDR: Tx-Buffer Underrun IT Enable
 - CEC_IT_TXEND: End of transmission IT Enable
 - CEC_IT_TXBR: Tx-Byte Request IT Enable
 - CEC_IT_ARBLST: Arbitration Lost IT Enable
 - CEC_IT_RXACHE: Rx-Missing Acknowledge IT Enable
 - CEC_IT_LBPE: Rx Long period Error IT Enable

`__HAL_CEC_DISABLE_IT`

- CEC_IT_SBPE: Rx Short period Error IT Enable
- CEC_IT_BRE: Rx Bit Rising Error IT Enable
- CEC_IT_RXOVR: Rx Overrun IT Enable
- CEC_IT_RXEND: End Of Reception IT Enable
- CEC_IT_RXBR: Rx-Byte Received IT Enable

Return value:

- none

Description:

- Checks whether or not the specified CEC interrupt is enabled.

Parameters:

- `__HANDLE__`: specifies the CEC Handle.
- `__INTERRUPT__`: specifies the CEC interrupt to check. This parameter can be one of the following values:
 - CEC_IT_TXACKE: Tx Missing acknowledge Error IT Enable
 - CEC_IT_TXERR: Tx Error IT Enable
 - CEC_IT_TXUDR: Tx-Buffer Underrun IT Enable
 - CEC_IT_TXEND: End of transmission IT Enable
 - CEC_IT_TXBR: Tx-Byte Request IT Enable
 - CEC_IT_ARBLST: Arbitration Lost IT Enable
 - CEC_IT_RXACKE: Rx-Missing Acknowledge IT Enable
 - CEC_IT_LBPE: Rx Long period Error IT Enable
 - CEC_IT_SBPE: Rx Short period Error IT Enable
 - CEC_IT_BRE: Rx Bit Rising Error IT Enable
 - CEC_IT_RXOVR: Rx Overrun IT Enable
 - CEC_IT_RXEND: End Of Reception IT Enable
 - CEC_IT_RXBR: Rx-Byte Received IT Enable

`__HAL_CEC_GET_IT_SOURCE`

`__HAL_CEC_ENABLE`

Return value:

- FlagStatus

Description:

- Enables the CEC device.

Parameters:

- `__HANDLE__`: specifies the CEC Handle.

Return value:

- none

Description:

- Disables the CEC device.

Parameters:

- `__HANDLE__`: specifies the CEC Handle.

Return value:

- none

Description:

- Set Transmission Start flag.

Parameters:

- `__HANDLE__`: specifies the CEC Handle.

Return value:

- none

Description:

- Set Transmission End flag.

Parameters:

- `__HANDLE__`: specifies the CEC Handle.

Return value:

- none: If the CEC message consists of only one byte, TXEOM must be set before of TXSOM.

Description:

- Get Transmission Start flag.

Parameters:

- `__HANDLE__`: specifies the CEC Handle.

`__HAL_CEC_DISABLE`

`__HAL_CEC_FIRST_BYTE_TX_SET`

`__HAL_CEC_LAST_BYTE_TX_SET`

`__HAL_CEC_GET_TRANSMISSION_START_FLAG`

`__HAL_CEC_GET_TRANSMISSION_END_FLAG`

Return value:

- FlagStatus

Description:

- Get Transmission End flag.

Parameters:

- `__HANDLE__`: specifies the CEC Handle.

Return value:

- FlagStatus

Description:

- Clear OAR register.

Parameters:

- `__HANDLE__`: specifies the CEC Handle.

Return value:

- none

Description:

- Set OAR register (without resetting previously set address in case of multi-address mode)
To reset OAR,

Parameters:

- `__HANDLE__`: specifies the CEC Handle.
- `__ADDRESS__`: Own Address value (CEC logical address is identified by bit position)

Return value:

- none

`__HAL_CEC_CLEAR_OAR`

`__HAL_CEC_SET_OAR`

CEC Flags definition

`CEC_FLAG_TXACKE`

`CEC_FLAG_TXERR`

`CEC_FLAG_TXUDR`

`CEC_FLAG_TXEND`

`CEC_FLAG_TXBR`

`CEC_FLAG_ARBLST`

`CEC_FLAG_RXACKE`

`CEC_FLAG_LBPE`

`CEC_FLAG_SBPE`

CEC_FLAG_BRE

CEC_FLAG_RXOVR

CEC_FLAG_RXEND

CEC_FLAG_RXBR

CEC all RX errors interrupts enabling flag

CEC_IER_RX_ALL_ERR

CEC all TX errors interrupts enabling flag

CEC_IER_TX_ALL_ERR

CEC Initiator logical address position in message header

CEC_INITIATOR_LSB_POS

CEC Interrupts definition

CEC_IT_TXACKE

CEC_IT_TXERR

CEC_IT_TXUDR

CEC_IT_TXEND

CEC_IT_TXBR

CEC_IT_ARBLST

CEC_IT_RXACKE

CEC_IT_LBPE

CEC_IT_SBPE

CEC_IT_BRE

CEC_IT_RXOVR

CEC_IT_RXEND

CEC_IT_RXBR

CEC Error Bit Generation if Long Bit Period Error reported

CEC_LBPE_ERRORBIT_NO_GENERATION

CEC_LBPE_ERRORBIT_GENERATION

CEC Listening mode option

CEC_REDUCED_LISTENING_MODE

CEC_FULL_LISTENING_MODE

CEC Device Own Address position in CEC CFGR register

CEC_CFGR_OAR_LSB_POS

CEC Own Address

CEC_OWN_ADDRESS_NONE

CEC_OWN_ADDRESS_0

CEC_OWN_ADDRESS_1

CEC_OWN_ADDRESS_2
CEC_OWN_ADDRESS_3
CEC_OWN_ADDRESS_4
CEC_OWN_ADDRESS_5
CEC_OWN_ADDRESS_6
CEC_OWN_ADDRESS_7
CEC_OWN_ADDRESS_8
CEC_OWN_ADDRESS_9
CEC_OWN_ADDRESS_10
CEC_OWN_ADDRESS_11
CEC_OWN_ADDRESS_12
CEC_OWN_ADDRESS_13
CEC_OWN_ADDRESS_14

CEC Signal Free Time start option

CEC_SFT_START_ON_TXSOM
CEC_SFT_START_ON_TX_RX_END

CEC Signal Free Time setting parameter

CEC_DEFAULT_SFT
CEC_0_5_BITPERIOD_SFT
CEC_1_5_BITPERIOD_SFT
CEC_2_5_BITPERIOD_SFT
CEC_3_5_BITPERIOD_SFT
CEC_4_5_BITPERIOD_SFT
CEC_5_5_BITPERIOD_SFT
CEC_6_5_BITPERIOD_SFT

CEC Receiver Tolerance

CEC_STANDARD_TOLERANCE
CEC_EXTENDED_TOLERANCE

10 HAL CORTEX Generic Driver

10.1 CORTEX Firmware driver registers structures

10.1.1 MPU_Region_InitTypeDef

Data Fields

- *uint8_t Enable*
- *uint8_t Number*
- *uint32_t BaseAddress*
- *uint8_t Size*
- *uint8_t SubRegionDisable*
- *uint8_t TypeExtField*
- *uint8_t AccessPermission*
- *uint8_t DisableExec*
- *uint8_t IsShareable*
- *uint8_t IsCacheable*
- *uint8_t IsBufferable*

Field Documentation

- ***uint8_t MPU_Region_InitTypeDef::Enable***
Specifies the status of the region. This parameter can be a value of [CORTEX_MPU_Region_Enable](#)
- ***uint8_t MPU_Region_InitTypeDef::Number***
Specifies the number of the region to protect. This parameter can be a value of [CORTEX_MPU_Region_Number](#)
- ***uint32_t MPU_Region_InitTypeDef::BaseAddress***
Specifies the base address of the region to protect.
- ***uint8_t MPU_Region_InitTypeDef::Size***
Specifies the size of the region to protect. This parameter can be a value of [CORTEX_MPU_Region_Size](#)
- ***uint8_t MPU_Region_InitTypeDef::SubRegionDisable***
Specifies the number of the subregion protection to disable. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF
- ***uint8_t MPU_Region_InitTypeDef::TypeExtField***
Specifies the TEX field level. This parameter can be a value of [CORTEX_MPU_TEX_Levels](#)
- ***uint8_t MPU_Region_InitTypeDef::AccessPermission***
Specifies the region access permission type. This parameter can be a value of [CORTEX_MPU_Region_Permission_Attributes](#)
- ***uint8_t MPU_Region_InitTypeDef::DisableExec***
Specifies the instruction access status. This parameter can be a value of [CORTEX_MPU_Instruction_Access](#)
- ***uint8_t MPU_Region_InitTypeDef::IsShareable***
Specifies the shareability status of the protected region. This parameter can be a value of [CORTEX_MPU_Access_Shareable](#)
- ***uint8_t MPU_Region_InitTypeDef::IsCacheable***
Specifies the cacheable status of the region protected. This parameter can be a value of [CORTEX_MPU_Access_Cacheable](#)

- ***uint8_t MPU_Region_InitTypeDef::IsBufferable***
Specifies the bufferable status of the protected region. This parameter can be a value of ***CORTEX_MPU_Access_Bufferable***

10.2 CORTEX Firmware driver API description

10.2.1 How to use this driver

How to configure Interrupts using CORTEX HAL driver

This section provides functions allowing to configure the NVIC interrupts (IRQ). The Cortex-M4 exceptions are managed by CMSIS functions.

1. Configure the NVIC Priority Grouping using `HAL_NVIC_SetPriorityGrouping()` function according to the following table.
2. Configure the priority of the selected IRQ Channels using `HAL_NVIC_SetPriority()`.
3. Enable the selected IRQ Channels using `HAL_NVIC_EnableIRQ()`.
4. please refer to programming manual for details in how to configure priority. When the `NVIC_PRIORITYGROUP_0` is selected, IRQ preemption is no more possible. The pending IRQ priority will be managed only by the sub priority. IRQ priority order (sorted by highest to lowest priority): Lowest preemption priorityLowest sub priorityLowest hardware priority (IRQ number)

How to configure SysTick using CORTEX HAL driver

Setup SysTick Timer for time base.

- The `HAL_SYSTICK_Config()` function calls the `SysTick_Config()` function which is a CMSIS function that:
 - Configures the SysTick Reload register with value passed as function parameter.
 - Configures the SysTick IRQ priority to the lowest value (0x0F).
 - Resets the SysTick Counter register.
 - Configures the SysTick Counter clock source to be Core Clock Source (HCLK).
 - Enables the SysTick Interrupt.
 - Starts the SysTick Counter.
- You can change the SysTick Clock source to be `HCLK_Div8` by calling the macro `__HAL_CORTEX_SYSTICKCLK_CONFIG(SYSTICK_CLKSOURCE_HCLK_DIV8)` just after the `HAL_SYSTICK_Config()` function call. The `__HAL_CORTEX_SYSTICKCLK_CONFIG()` macro is defined inside the `stm32f7xx_hal_cortex.h` file.
- You can change the SysTick IRQ priority by calling the `HAL_NVIC_SetPriority(SysTick_IRQn,...)` function just after the `HAL_SYSTICK_Config()` function call. The `HAL_NVIC_SetPriority()` call the `NVIC_SetPriority()` function which is a CMSIS function.
- To adjust the SysTick time base, use the following formula: Reload Value = SysTick Counter Clock (Hz) x Desired Time base (s)
 - Reload Value is the parameter to be passed for `HAL_SYSTICK_Config()` function
 - Reload Value should not exceed 0xFFFFF

10.2.2 Initialization and de-initialization functions

This section provides the CORTEX HAL driver functions allowing to configure Interrupts SysTick functionalities

This section contains the following APIs:

- [HAL_NVIC_SetPriorityGrouping\(\)](#)
- [HAL_NVIC_SetPriority\(\)](#)
- [HAL_NVIC_EnableIRQ\(\)](#)
- [HAL_NVIC_DisableIRQ\(\)](#)
- [HAL_NVIC_SystemReset\(\)](#)
- [HAL_SYSTICK_Config\(\)](#)

10.2.3 Peripheral Control functions

This subsection provides a set of functions allowing to control the CORTEX (NVIC, SYSTICK, MPU) functionalities.

This section contains the following APIs:

- [HAL_MPU_Disable\(\)](#)
- [HAL_MPU_Enable\(\)](#)
- [HAL_MPU_ConfigRegion\(\)](#)
- [HAL_NVIC_GetPriorityGrouping\(\)](#)
- [HAL_NVIC_GetPriority\(\)](#)
- [HAL_NVIC_SetPendingIRQ\(\)](#)
- [HAL_NVIC_GetPendingIRQ\(\)](#)
- [HAL_NVIC_ClearPendingIRQ\(\)](#)
- [HAL_NVIC_GetActive\(\)](#)
- [HAL_SYSTICK_CLKSourceConfig\(\)](#)
- [HAL_SYSTICK_IRQHandler\(\)](#)
- [HAL_SYSTICK_Callback\(\)](#)

10.2.4 Detailed description of functions

HAL_NVIC_SetPriorityGrouping

Function name	void HAL_NVIC_SetPriorityGrouping (uint32_t PriorityGroup)
Function description	Sets the priority grouping field (preemption priority and subpriority) using the required unlock sequence.
Parameters	<ul style="list-style-type: none"> • PriorityGroup: The priority grouping bits length. This parameter can be one of the following values: <ul style="list-style-type: none"> – NVIC_PRIORITYGROUP_0: 0 bits for preemption priority 4 bits for subpriority – NVIC_PRIORITYGROUP_1: 1 bits for preemption priority 3 bits for subpriority – NVIC_PRIORITYGROUP_2: 2 bits for preemption priority 2 bits for subpriority – NVIC_PRIORITYGROUP_3: 3 bits for preemption priority 1 bits for subpriority – NVIC_PRIORITYGROUP_4: 4 bits for preemption priority 0 bits for subpriority
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • When the NVIC_PriorityGroup_0 is selected, IRQ preemption is no more possible. The pending IRQ priority will be managed only by the subpriority.

HAL_NVIC_SetPriority

Function name	void HAL_NVIC_SetPriority (IRQn_Type IRQn, uint32_t PreemptPriority, uint32_t SubPriority)
Function description	Sets the priority of an interrupt.
Parameters	<ul style="list-style-type: none">• IRQn: External interrupt number. This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32f7xxx.h))• PreemptPriority: The preemption priority for the IRQn channel. This parameter can be a value between 0 and 15 A lower priority value indicates a higher priority• SubPriority: the subpriority level for the IRQ channel. This parameter can be a value between 0 and 15 A lower priority value indicates a higher priority.
Return values	<ul style="list-style-type: none">• None:

HAL_NVIC_EnableIRQ

Function name	void HAL_NVIC_EnableIRQ (IRQn_Type IRQn)
Function description	Enables a device specific interrupt in the NVIC interrupt controller.
Parameters	<ul style="list-style-type: none">• IRQn: External interrupt number. This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32f7xxx.h))
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• To configure interrupts priority correctly, the NVIC_PriorityGroupConfig() function should be called before.

HAL_NVIC_DisableIRQ

Function name	void HAL_NVIC_DisableIRQ (IRQn_Type IRQn)
Function description	Disables a device specific interrupt in the NVIC interrupt controller.
Parameters	<ul style="list-style-type: none">• IRQn: External interrupt number. This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32f7xxx.h))
Return values	<ul style="list-style-type: none">• None:

HAL_NVIC_SystemReset

Function name	void HAL_NVIC_SystemReset (void)
Function description	Initiates a system reset request to reset the MCU.
Return values	<ul style="list-style-type: none">• None:

HAL_SYSTICK_Config

Function name	uint32_t HAL_SYSTICK_Config (uint32_t TicksNumb)
---------------	---

Function description	Initializes the System Timer and its interrupt, and starts the System Tick Timer.
Parameters	<ul style="list-style-type: none"> • TicksNumb: Specifies the ticks Number of ticks between two interrupts.
Return values	<ul style="list-style-type: none"> • status: - 0 Function succeeded. <ul style="list-style-type: none"> – 1 Function failed.

HAL_MPU_Enable

Function name	void HAL_MPU_Enable (uint32_t MPU_Control)
Function description	Enables the MPU.
Parameters	<ul style="list-style-type: none"> • MPU_Control: Specifies the control mode of the MPU during hard fault, NMI, FAULTMASK and privileged access to the default memory This parameter can be one of the following values: <ul style="list-style-type: none"> – MPU_HFNMI_PRIVDEF_NONE – MPU_HARDFAULT_NMI – MPU_PRIVILEGED_DEFAULT – MPU_HFNMI_PRIVDEF
Return values	<ul style="list-style-type: none"> • None:

HAL_MPU_Disable

Function name	void HAL_MPU_Disable (void)
Function description	Disables the MPU.
Return values	<ul style="list-style-type: none"> • None:

HAL_MPU_ConfigRegion

Function name	void HAL_MPU_ConfigRegion (MPU_Region_InitTypeDef * MPU_Init)
Function description	Initializes and configures the Region and the memory to be protected.
Parameters	<ul style="list-style-type: none"> • MPU_Init: Pointer to a MPU_Region_InitTypeDef structure that contains the initialization and configuration information.
Return values	<ul style="list-style-type: none"> • None:

HAL_NVIC_GetPriorityGrouping

Function name	uint32_t HAL_NVIC_GetPriorityGrouping (void)
Function description	Gets the priority grouping field from the NVIC Interrupt Controller.
Return values	<ul style="list-style-type: none"> • Priority: grouping field (SCB->AIRCR [10:8] PRIGROUP field)

HAL_NVIC_GetPriority

Function name	void HAL_NVIC_GetPriority (IRQn_Type IRQn, uint32_t PriorityGroup, uint32_t * pPreemptPriority, uint32_t *
---------------	---

pSubPriority)

Function description	Gets the priority of an interrupt.
Parameters	<ul style="list-style-type: none"> • IRQn: External interrupt number. This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32f7xxx.h)) • PriorityGroup: the priority grouping bits length. This parameter can be one of the following values: <ul style="list-style-type: none"> – NVIC_PRIORITYGROUP_0: 0 bits for preemption priority 4 bits for subpriority – NVIC_PRIORITYGROUP_1: 1 bits for preemption priority 3 bits for subpriority – NVIC_PRIORITYGROUP_2: 2 bits for preemption priority 2 bits for subpriority – NVIC_PRIORITYGROUP_3: 3 bits for preemption priority 1 bits for subpriority – NVIC_PRIORITYGROUP_4: 4 bits for preemption priority 0 bits for subpriority • pPreemptPriority: Pointer on the Preemptive priority value (starting from 0). • pSubPriority: Pointer on the Subpriority value (starting from 0).
Return values	<ul style="list-style-type: none"> • None:

HAL_NVIC_GetPendingIRQ

Function name	uint32_t HAL_NVIC_GetPendingIRQ (IRQn_Type IRQn)
Function description	Gets Pending Interrupt (reads the pending register in the NVIC and returns the pending bit for the specified interrupt).
Parameters	<ul style="list-style-type: none"> • IRQn: External interrupt number. This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32f7xxx.h))
Return values	<ul style="list-style-type: none"> • status: - 0 Interrupt status is not pending. <ul style="list-style-type: none"> – 1 Interrupt status is pending.

HAL_NVIC_SetPendingIRQ

Function name	void HAL_NVIC_SetPendingIRQ (IRQn_Type IRQn)
Function description	Sets Pending bit of an external interrupt.
Parameters	<ul style="list-style-type: none"> • IRQn: External interrupt number This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32f7xxx.h))
Return values	<ul style="list-style-type: none"> • None:

HAL_NVIC_ClearPendingIRQ

Function name	void HAL_NVIC_ClearPendingIRQ (IRQn_Type IRQn)
---------------	---

Function description	Clears the pending bit of an external interrupt.
Parameters	<ul style="list-style-type: none">• IRQn: External interrupt number. This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32f7xxx.h))
Return values	<ul style="list-style-type: none">• None:

HAL_NVIC_GetActive

Function name	uint32_t HAL_NVIC_GetActive (IRQn_Type IRQn)
Function description	Gets active interrupt (reads the active register in NVIC and returns the active bit).
Parameters	<ul style="list-style-type: none">• IRQn: External interrupt number This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32f7xxx.h))
Return values	<ul style="list-style-type: none">• status: - 0 Interrupt status is not pending.<ul style="list-style-type: none">- 1 Interrupt status is pending.

HAL_SYSTICK_CLKSourceConfig

Function name	void HAL_SYSTICK_CLKSourceConfig (uint32_t CLKSource)
Function description	Configures the SysTick clock source.
Parameters	<ul style="list-style-type: none">• CLKSource: specifies the SysTick clock source. This parameter can be one of the following values:<ul style="list-style-type: none">- SYSTICK_CLKSOURCE_HCLK_DIV8: AHB clock divided by 8 selected as SysTick clock source.- SYSTICK_CLKSOURCE_HCLK: AHB clock selected as SysTick clock source.
Return values	<ul style="list-style-type: none">• None:

HAL_SYSTICK_IRQHandler

Function name	void HAL_SYSTICK_IRQHandler (void)
Function description	This function handles SYSTICK interrupt request.
Return values	<ul style="list-style-type: none">• None:

HAL_SYSTICK_Callback

Function name	void HAL_SYSTICK_Callback (void)
Function description	SYSTICK callback.
Return values	<ul style="list-style-type: none">• None:

10.3 CORTEX Firmware driver defines

10.3.1 CORTEX

CORTEX MPU Instruction Access Bufferable

MPU_ACCESS_BUFFERABLE

MPU_ACCESS_NOT_BUFFERABLE

CORTEX MPU Instruction Access Cacheable

MPU_ACCESS_CACHEABLE

MPU_ACCESS_NOT_CACHEABLE

CORTEX MPU Instruction Access Shareable

MPU_ACCESS_SHAREABLE

MPU_ACCESS_NOT_SHAREABLE

MPU HFNMI and PRIVILEGED Access control

MPU_HFNMI_PRIVDEF_NONE

MPU_HARDFAULT_NMI

MPU_PRIVILEGED_DEFAULT

MPU_HFNMI_PRIVDEF

CORTEX MPU Instruction Access

MPU_INSTRUCTION_ACCESS_ENABLE

MPU_INSTRUCTION_ACCESS_DISABLE

CORTEX MPU Region Enable

MPU_REGION_ENABLE

MPU_REGION_DISABLE

CORTEX MPU Region Number

MPU_REGION_NUMBER0

MPU_REGION_NUMBER1

MPU_REGION_NUMBER2

MPU_REGION_NUMBER3

MPU_REGION_NUMBER4

MPU_REGION_NUMBER5

MPU_REGION_NUMBER6

MPU_REGION_NUMBER7

CORTEX MPU Region Permission Attributes

MPU_REGION_NO_ACCESS

MPU_REGION_PRIV_RW

MPU_REGION_PRIV_RW_URO

MPU_REGION_FULL_ACCESS

MPU_REGION_PRIV_RO
MPU_REGION_PRIV_RO_URO

CORTEX MPU Region Size

MPU_REGION_SIZE_32B
MPU_REGION_SIZE_64B
MPU_REGION_SIZE_128B
MPU_REGION_SIZE_256B
MPU_REGION_SIZE_512B
MPU_REGION_SIZE_1KB
MPU_REGION_SIZE_2KB
MPU_REGION_SIZE_4KB
MPU_REGION_SIZE_8KB
MPU_REGION_SIZE_16KB
MPU_REGION_SIZE_32KB
MPU_REGION_SIZE_64KB
MPU_REGION_SIZE_128KB
MPU_REGION_SIZE_256KB
MPU_REGION_SIZE_512KB
MPU_REGION_SIZE_1MB
MPU_REGION_SIZE_2MB
MPU_REGION_SIZE_4MB
MPU_REGION_SIZE_8MB
MPU_REGION_SIZE_16MB
MPU_REGION_SIZE_32MB
MPU_REGION_SIZE_64MB
MPU_REGION_SIZE_128MB
MPU_REGION_SIZE_256MB
MPU_REGION_SIZE_512MB
MPU_REGION_SIZE_1GB
MPU_REGION_SIZE_2GB
MPU_REGION_SIZE_4GB

MPU TEX Levels

MPU_TEX_LEVEL0
MPU_TEX_LEVEL1
MPU_TEX_LEVEL2

CORTEX Preemption Priority Group

NVIC_PRIORITYGROUP_0 0 bits for pre-emption priority 4 bits for subpriority
NVIC_PRIORITYGROUP_1 1 bits for pre-emption priority 3 bits for subpriority
NVIC_PRIORITYGROUP_2 2 bits for pre-emption priority 2 bits for subpriority
NVIC_PRIORITYGROUP_3 3 bits for pre-emption priority 1 bits for subpriority
NVIC_PRIORITYGROUP_4 4 bits for pre-emption priority 0 bits for subpriority

CORTEX_SysTick clock source

SYSTICK_CLKSOURCE_HCLK_DIV8

SYSTICK_CLKSOURCE_HCLK

11 HAL CRC Generic Driver

11.1 CRC Firmware driver registers structures

11.1.1 CRC_InitTypeDef

Data Fields

- *uint8_t DefaultPolynomialUse*
- *uint8_t DefaultInitValueUse*
- *uint32_t GeneratingPolynomial*
- *uint32_t CRCLength*
- *uint32_t InitValue*
- *uint32_t InputDataInversionMode*
- *uint32_t OutputDataInversionMode*

Field Documentation

- ***uint8_t CRC_InitTypeDef::DefaultPolynomialUse***
This parameter is a value of [CRC_Default_Polynomial](#) and indicates if default polynomial is used. If set to DEFAULT_POLYNOMIAL_ENABLE, resort to default $X^{32} + X^{26} + X^{23} + X^{22} + X^{16} + X^{12} + X^{11} + X^{10} + X^8 + X^7 + X^5 + X^4 + X^2 + X + 1$. In that case, there is no need to set GeneratingPolynomial field. If otherwise set to DEFAULT_POLYNOMIAL_DISABLE, GeneratingPolynomial and CRCLength fields must be set
- ***uint8_t CRC_InitTypeDef::DefaultInitValueUse***
This parameter is a value of [CRC_Default_InitValue_Use](#) and indicates if default init value is used. If set to DEFAULT_INIT_VALUE_ENABLE, resort to default 0xFFFFFFFF value. In that case, there is no need to set InitValue field. If otherwise set to DEFAULT_INIT_VALUE_DISABLE, InitValue field must be set
- ***uint32_t CRC_InitTypeDef::GeneratingPolynomial***
Set CRC generating polynomial. 7, 8, 16 or 32-bit long value for a polynomial degree respectively equal to 7, 8, 16 or 32. This field is written in normal representation, e.g., for a polynomial of degree 7, $X^7 + X^6 + X^5 + X^2 + 1$ is written 0x65. No need to specify it if DefaultPolynomialUse is set to DEFAULT_POLYNOMIAL_ENABLE
- ***uint32_t CRC_InitTypeDef::CRCLength***
This parameter is a value of [CRC_Polynomial_Sizes](#) and indicates CRC length. Value can be either one of CRC_POLYLENGTH_32B (32-bit CRC) CRC_POLYLENGTH_16B (16-bit CRC) CRC_POLYLENGTH_8B (8-bit CRC) CRC_POLYLENGTH_7B (7-bit CRC)
- ***uint32_t CRC_InitTypeDef::InitValue***
Init value to initiate CRC computation. No need to specify it if DefaultInitValueUse is set to DEFAULT_INIT_VALUE_ENABLE
- ***uint32_t CRC_InitTypeDef::InputDataInversionMode***
This parameter is a value of [CRCEX_Input_Data_Inversion](#) and specifies input data inversion mode. Can be either one of the following values
CRC_INPUTDATA_INVERSION_NONE no input data inversion
CRC_INPUTDATA_INVERSION_BYTE byte-wise inversion, 0x1A2B3C4D becomes 0x58D43CB2
CRC_INPUTDATA_INVERSION_HALFWORD halfword-wise inversion, 0x1A2B3C4D becomes 0xD458B23C
CRC_INPUTDATA_INVERSION_WORD word-wise inversion, 0x1A2B3C4D becomes 0xB23CD458
- ***uint32_t CRC_InitTypeDef::OutputDataInversionMode***
This parameter is a value of [CRCEX_Output_Data_Inversion](#) and specifies output

data (i.e. CRC) inversion mode. Can be either CRC_OUTPUTDATA_INVERSION_DISABLE no CRC inversion, or CRC_OUTPUTDATA_INVERSION_ENABLE CRC 0x11223344 is converted into 0x22CC4488

11.1.2 CRC_HandleTypeDef

Data Fields

- **CRC_TypeDef * Instance**
- **CRC_InitTypeDef Init**
- **HAL_LockTypeDef Lock**
- **__IO HAL_CRC_StateTypeDef State**
- **uint32_t InputDataFormat**

Field Documentation

- **CRC_TypeDef* CRC_HandleTypeDef::Instance**
Register base address
- **CRC_InitTypeDef CRC_HandleTypeDef::Init**
CRC configuration parameters
- **HAL_LockTypeDef CRC_HandleTypeDef::Lock**
CRC Locking object
- **__IO HAL_CRC_StateTypeDef CRC_HandleTypeDef::State**
CRC communication state
- **uint32_t CRC_HandleTypeDef::InputDataFormat**
This parameter is a value of [CRC_Input_Buffer_Format](#) and specifies input data format. Can be either CRC_INPUTDATA_FORMAT_BYTES input data is a stream of bytes (8-bit data) CRC_INPUTDATA_FORMAT_HALFWORDS input data is a stream of half-words (16-bit data) CRC_INPUTDATA_FORMAT_WORDS input data is a stream of words (32-bits data) Note that constant CRC_INPUT_FORMAT_UNDEFINED is defined but an initialization error must occur if InputBufferFormat is not one of the three values listed above

11.2 CRC Firmware driver API description

11.2.1 CRC How to use this driver

1. Enable CRC AHB clock using `__HAL_RCC_CRC_CLK_ENABLE()`;
2. Initialize CRC calculator
 - specify generating polynomial (IP default or non-default one)
 - specify initialization value (IP default or non-default one)
 - specify input data format
 - specify input or output data inversion mode if any
3. Use `HAL_CRC_Accumulate()` function to compute the CRC value of the input data buffer starting with the previously computed CRC as initialization value
4. Use `HAL_CRC_Calculate()` function to compute the CRC value of the input data buffer starting with the defined initialization value (default or non-default) to initiate CRC calculation

11.2.2 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the CRC according to the specified parameters in the `CRC_InitTypeDef` and create the associated handle
- Deinitialize the CRC peripheral

- Initialize the CRC MSP
- Deinitialize CRC MSP

This section contains the following APIs:

- [HAL_CRC_Init\(\)](#)
- [HAL_CRC_DeInit\(\)](#)
- [HAL_CRC_Msplnit\(\)](#)
- [HAL_CRC_MspDeInit\(\)](#)

11.2.3 Peripheral Control functions

This section provides functions allowing to:

- Compute the 7, 8, 16 or 32-bit CRC value of an 8, 16 or 32-bit data buffer using combination of the previous CRC value and the new one. or
- Compute the 7, 8, 16 or 32-bit CRC value of an 8, 16 or 32-bit data buffer independently of the previous CRC value.

This section contains the following APIs:

- [HAL_CRC_Accumulate\(\)](#)
- [HAL_CRC_Calculate\(\)](#)

11.2.4 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- [HAL_CRC_GetState\(\)](#)

11.2.5 Detailed description of functions

HAL_CRC_Init

Function name **HAL_StatusTypeDef HAL_CRC_Init (CRC_HandleTypeDef * hcrc)**

Function description Initialize the CRC according to the specified parameters in the CRC_InitTypeDef and create the associated handle.

Parameters

- **hcrc**: CRC handle

Return values

- **HAL**: status

HAL_CRC_DeInit

Function name **HAL_StatusTypeDef HAL_CRC_DeInit (CRC_HandleTypeDef * hcrc)**

Function description Deinitialize the CRC peripheral.

Parameters

- **hcrc**: CRC handle

Return values

- **HAL**: status

HAL_CRC_Msplnit

Function name **void HAL_CRC_Msplnit (CRC_HandleTypeDef * hcrc)**

Function description	Initialize the CRC MSP.
Parameters	<ul style="list-style-type: none"> • hcrc: CRC handle
Return values	<ul style="list-style-type: none"> • None:

HAL_CRC_MspDeInit

Function name	void HAL_CRC_MspDeInit (CRC_HandleTypeDef * hcrc)
Function description	DeInitialize the CRC MSP.
Parameters	<ul style="list-style-type: none"> • hcrc: CRC handle
Return values	<ul style="list-style-type: none"> • None:

HAL_CRC_Accumulate

Function name	uint32_t HAL_CRC_Accumulate (CRC_HandleTypeDef * hcrc, uint32_t pBuffer, uint32_t BufferLength)
Function description	Compute the 7, 8, 16 or 32-bit CRC value of an 8, 16 or 32-bit data buffer starting with the previously computed CRC as initialization value.
Parameters	<ul style="list-style-type: none"> • hcrc: CRC handle • pBuffer: pointer to the input data buffer, exact input data format is provided by hcrc->InputDataFormat. • BufferLength: input data buffer length (number of bytes if pBuffer type is * uint8_t, number of half-words if pBuffer type is * uint16_t, number of words if pBuffer type is * uint32_t).
Return values	<ul style="list-style-type: none"> • uint32_t: CRC (returned value LSBs for CRC shorter than 32 bits)
Notes	<ul style="list-style-type: none"> • By default, the API expects a uint32_t pointer as input buffer parameter. Input buffer pointers with other types simply need to be cast in uint32_t and the API will internally adjust its input data processing based on the handle field hcrc->InputDataFormat.

HAL_CRC_Calculate

Function name	uint32_t HAL_CRC_Calculate (CRC_HandleTypeDef * hcrc, uint32_t pBuffer, uint32_t BufferLength)
Function description	Compute the 7, 8, 16 or 32-bit CRC value of an 8, 16 or 32-bit data buffer starting with hcrc->Instance->INIT as initialization value.
Parameters	<ul style="list-style-type: none"> • hcrc: CRC handle • pBuffer: pointer to the input data buffer, exact input data format is provided by hcrc->InputDataFormat. • BufferLength: input data buffer length (number of bytes if pBuffer type is * uint8_t, number of half-words if pBuffer type is * uint16_t, number of words if pBuffer type is * uint32_t).
Return values	<ul style="list-style-type: none"> • uint32_t: CRC (returned value LSBs for CRC shorter than 32 bits)
Notes	<ul style="list-style-type: none"> • By default, the API expects a uint32_t pointer as input buffer

parameter. Input buffer pointers with other types simply need to be cast in uint32_t and the API will internally adjust its input data processing based on the handle field hcrc->InputDataFormat.

HAL_CRC_GetState

Function name	HAL_CRC_StateTypeDef HAL_CRC_GetState (CRC_HandleTypeDef * hcrc)
Function description	Return the CRC state.
Parameters	<ul style="list-style-type: none"> • hcrc: CRC handle
Return values	<ul style="list-style-type: none"> • HAL: state

11.3 CRC Firmware driver defines

11.3.1 CRC

Default CRC computation initialization value

DEFAULT_CRC_INITVALUE

Indicates whether or not default init value is used

DEFAULT_INIT_VALUE_ENABLE

DEFAULT_INIT_VALUE_DISABLE

Indicates whether or not default polynomial is used

DEFAULT_POLYNOMIAL_ENABLE

DEFAULT_POLYNOMIAL_DISABLE

Default CRC generating polynomial

DEFAULT_CRC32_POLY

CRC Exported Functions

HAL_CRC_Input_Data_Reverse

HAL_CRC_Output_Data_Reverse

CRC exported macros

__HAL_CRC_RESET_HANDLE_STATE

Description:

- Reset CRC handle state.

Parameters:

- __HANDLE__: CRC handle.

Return value:

- None

__HAL_CRC_DR_RESET

Description:

- Reset CRC Data Register.

Parameters:



<p><code>__HAL_CRC_INITIALCRCVALUE_CONFIG</code></p>	<ul style="list-style-type: none"> • <code>__HANDLE__</code>: CRC handle <p>Return value:</p> <ul style="list-style-type: none"> • None. <p>Description:</p> <ul style="list-style-type: none"> • Set CRC INIT non-default value. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: CRC handle • <code>__INIT__</code>: 32-bit initial value <p>Return value:</p> <ul style="list-style-type: none"> • None.
<p><code>__HAL_CRC_SET_IDR</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Stores a 8-bit data in the Independent Data(ID) register. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: CRC handle • <code>__VALUE__</code>: 8-bit value to be stored in the ID register <p>Return value:</p> <ul style="list-style-type: none"> • None
<p><code>__HAL_CRC_GET_IDR</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Returns the 8-bit data stored in the Independent Data(ID) register. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: CRC handle <p>Return value:</p> <ul style="list-style-type: none"> • 8-bit: value of the ID register

CRC input buffer format

CRC_INPUTDATA_FORMAT_UNDEFINED
CRC_INPUTDATA_FORMAT_BYTES
CRC_INPUTDATA_FORMAT_HALFWORDS
CRC_INPUTDATA_FORMAT_WORDS

Polynomial sizes to configure the IP

CRC_POLYLENGTH_32B
CRC_POLYLENGTH_16B
CRC_POLYLENGTH_8B
CRC_POLYLENGTH_7B

CRC polynomial possible sizes actual definitions

HAL_CRC_LENGTH_32B

HAL_CRC_LENGTH_16B

HAL_CRC_LENGTH_8B

HAL_CRC_LENGTH_7B

12 HAL CRC Extension Driver

12.1 CRCEX Firmware driver API description

12.1.1 CRC Extended features functions

This subsection provides function allowing to:

- Set CRC polynomial if different from default one.

This section contains the following APIs:

- [HAL_CRCEX_Polynomial_Set\(\)](#)
- [HAL_CRCEX_Input_Data_Reverse\(\)](#)
- [HAL_CRCEX_Output_Data_Reverse\(\)](#)

12.1.2 Detailed description of functions

HAL_CRCEX_Polynomial_Set

Function name	HAL_StatusTypeDef HAL_CRCEX_Polynomial_Set (CRC_HandleTypeDef * hcrc, uint32_t Pol, uint32_t PolyLength)
Function description	Initializes the CRC polynomial if different from default one.
Parameters	<ul style="list-style-type: none"> • hcrc: CRC handle • Pol: CRC generating polynomial (7, 8, 16 or 32-bit long) This parameter is written in normal representation, e.g. for a polynomial of degree 7, $X^7 + X^6 + X^5 + X^2 + 1$ is written 0x65 for a polynomial of degree 16, $X^{16} + X^{12} + X^5 + 1$ is written 0x1021 • PolyLength: CRC polynomial length This parameter can be one of the following values: <ul style="list-style-type: none"> – CRC_POLYLENGTH_7B: 7-bit long CRC (generating polynomial of degree 7) – CRC_POLYLENGTH_8B: 8-bit long CRC (generating polynomial of degree 8) – CRC_POLYLENGTH_16B: 16-bit long CRC (generating polynomial of degree 16) – CRC_POLYLENGTH_32B: 32-bit long CRC (generating polynomial of degree 32)
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRCEX_Input_Data_Reverse

Function name	HAL_StatusTypeDef HAL_CRCEX_Input_Data_Reverse (CRC_HandleTypeDef * hcrc, uint32_t InputReverseMode)
Function description	Set the Reverse Input data mode.
Parameters	<ul style="list-style-type: none"> • hcrc: CRC handle • InputReverseMode: Input Data inversion mode This parameter can be one of the following values: <ul style="list-style-type: none"> – CRC_INPUTDATA_INVERSION_NONE: no change in

- bit order (default value)
- CRC_INPUTDATA_INVERSION_BYTE: Byte-wise bit reversal
- CRC_INPUTDATA_INVERSION_HALFWORD: HalfWord-wise bit reversal
- CRC_INPUTDATA_INVERSION_WORD: Word-wise bit reversal

Return values

- **HAL:** status

HAL_CRCEX_Output_Data_Reverse

Function name **HAL_StatusTypeDef HAL_CRCEX_Output_Data_Reverse (CRC_HandleTypeDef * hcrc, uint32_t OutputReverseMode)**

Function description Set the Reverse Output data mode.

Parameters

- **hcrc:** CRC handle
- **OutputReverseMode:** Output Data inversion mode This parameter can be one of the following values:
 - CRC_OUTPUTDATA_INVERSION_DISABLE: no CRC inversion (default value)
 - CRC_OUTPUTDATA_INVERSION_ENABLE: bit-level inversion (e.g for a 8-bit CRC: 0xB5 becomes 0xAD)

Return values

- **HAL:** status

12.2 CRCEX Firmware driver defines

12.2.1 CRCEX

CRC Extended exported macros

__HAL_CRC_OUTPUTREVERSAL_ENABLE **Description:**

- Set CRC output reversal.

Parameters:

- **__HANDLE__:** : CRC handle

Return value:

- None.

__HAL_CRC_OUTPUTREVERSAL_DISABLE **Description:**

- Unset CRC output reversal.

Parameters:

- **__HANDLE__:** : CRC handle

Return value:

- None.

__HAL_CRC_POLYNOMIAL_CONFIG **Description:**

- Set CRC non-default polynomial.

Parameters:

- `__HANDLE__`: : CRC handle
- `__POLYNOMIAL__`: 7, 8, 16 or 32-bit polynomial

Return value:

- None.

CRC Extended input data inversion modes`CRC_INPUTDATA_INVERSION_NONE``CRC_INPUTDATA_INVERSION_BYTE``CRC_INPUTDATA_INVERSION_HALFWORD``CRC_INPUTDATA_INVERSION_WORD``IS_CRC_INPUTDATA_INVERSION_MODE`***CRC Extended output data inversion modes***`CRC_OUTPUTDATA_INVERSION_DISABLE``CRC_OUTPUTDATA_INVERSION_ENABLE``IS_CRC_OUTPUTDATA_INVERSION_MODE`

13 HAL CRYP Generic Driver

13.1 CRYP Firmware driver registers structures

13.1.1 CRYP_InitTypeDef

Data Fields

- *uint32_t* **DataType**
- *uint32_t* **KeySize**
- *uint8_t* * **pKey**
- *uint8_t* * **pInitVect**
- *uint8_t* **IVSize**
- *uint8_t* **TagSize**
- *uint8_t* * **Header**
- *uint32_t* **HeaderSize**
- *uint8_t* * **pScratch**

Field Documentation

- *uint32_t* **CRYP_InitTypeDef::DataType**
32-bit data, 16-bit data, 8-bit data or 1-bit string. This parameter can be a value of [CRYP_Data_Type](#)
- *uint32_t* **CRYP_InitTypeDef::KeySize**
Used only in AES mode only : 128, 192 or 256 bit key length. This parameter can be a value of [CRYP_Key_Size](#)
- *uint8_t** **CRYP_InitTypeDef::pKey**
The key used for encryption/decryption
- *uint8_t** **CRYP_InitTypeDef::pInitVect**
The initialization vector used also as initialization counter in CTR mode
- *uint8_t* **CRYP_InitTypeDef::IVSize**
The size of initialization vector. This parameter (called nonce size in CCM) is used only in AES-128/192/256 encryption/decryption CCM mode
- *uint8_t* **CRYP_InitTypeDef::TagSize**
The size of returned authentication TAG. This parameter is used only in AES-128/192/256 encryption/decryption CCM mode
- *uint8_t** **CRYP_InitTypeDef::Header**
The header used in GCM and CCM modes
- *uint32_t* **CRYP_InitTypeDef::HeaderSize**
The size of header buffer in bytes
- *uint8_t** **CRYP_InitTypeDef::pScratch**
Scratch buffer used to append the header. It's size must be equal to header size + 21 bytes. This parameter is used only in AES-128/192/256 encryption/decryption CCM mode

13.1.2 CRYP_HandleTypeDef

Data Fields

- *CRYP_TypeDef* * **Instance**
- *CRYP_InitTypeDef* **Init**
- *uint8_t* * **pCrypInBuffPtr**
- *uint8_t* * **pCrypOutBuffPtr**
- **__IO uint16_t** **CrypInCount**

- **`__IO uint16_t CrypOutCount`**
- **`HAL_StatusTypeDef Status`**
- **`HAL_PhaseTypeDef Phase`**
- **`DMA_HandleTypeDef * hdmain`**
- **`DMA_HandleTypeDef * hdmaout`**
- **`HAL_LockTypeDef Lock`**
- **`__IO HAL_CRYPT_STATTypeDef State`**

Field Documentation

- **`CRYPT_TypeDef* CRYPT_HandleTypeDef::Instance`**
CRYP registers base address
- **`CRYPT_InitTypeDef CRYPT_HandleTypeDef::Init`**
CRYP required parameters
- **`uint8_t* CRYPT_HandleTypeDef::pCrypInBuffPtr`**
Pointer to CRYP processing (encryption, decryption,...) buffer
- **`uint8_t* CRYPT_HandleTypeDef::pCrypOutBuffPtr`**
Pointer to CRYP processing (encryption, decryption,...) buffer
- **`__IO uint16_t CRYPT_HandleTypeDef::CrypInCount`**
Counter of input data
- **`__IO uint16_t CRYPT_HandleTypeDef::CrypOutCount`**
Counter of output data
- **`HAL_StatusTypeDef CRYPT_HandleTypeDef::Status`**
CRYP peripheral status
- **`HAL_PhaseTypeDef CRYPT_HandleTypeDef::Phase`**
CRYP peripheral phase
- **`DMA_HandleTypeDef* CRYPT_HandleTypeDef::hdmain`**
CRYP In DMA handle parameters
- **`DMA_HandleTypeDef* CRYPT_HandleTypeDef::hdmaout`**
CRYP Out DMA handle parameters
- **`HAL_LockTypeDef CRYPT_HandleTypeDef::Lock`**
CRYP locking object
- **`__IO HAL_CRYPT_STATTypeDef CRYPT_HandleTypeDef::State`**
CRYP peripheral state

13.2 CRYP Firmware driver API description

13.2.1 How to use this driver

The CRYP HAL driver can be used as follows:

1. Initialize the CRYP low level resources by implementing the `HAL_CRYPT_MspInit()`:
 - a. Enable the CRYP interface clock using `__HAL_RCC_CRYPT_CLK_ENABLE()`
 - b. In case of using interrupts (e.g. `HAL_CRYPT_AESECB_Encrypt_IT()`)
 - Configure the CRYP interrupt priority using `HAL_NVIC_SetPriority()`
 - Enable the CRYP IRQ handler using `HAL_NVIC_EnableIRQ()`
 - In CRYP IRQ handler, call `HAL_CRYPT_IRQHandler()`
 - c. In case of using DMA to control data transfer (e.g. `HAL_CRYPT_AESECB_Encrypt_DMA()`)
 - Enable the DMAx interface clock using `__DMAx_CLK_ENABLE()`
 - Configure and enable two DMA streams one for managing data transfer from memory to peripheral (input stream) and another stream for managing data transfer from peripheral to memory (output stream)
 - Associate the initialized DMA handle to the CRYP DMA handle using `__HAL_LINKDMA()`

- Configure the priority and enable the NVIC for the transfer complete interrupt on the two DMA Streams. The output stream should have higher priority than the input stream HAL_NVIC_SetPriority() and HAL_NVIC_EnableIRQ()
- 2. Initialize the CRYPT HAL using HAL_CRYPT_Init(). This function configures mainly:
 - a. The data type: 1-bit, 8-bit, 16-bit and 32-bit
 - b. The key size: 128, 192 and 256. This parameter is relevant only for AES
 - c. The encryption/decryption key. It's size depends on the algorithm used for encryption/decryption
 - d. The initialization vector (counter). It is not used ECB mode.
- 3. Three processing (encryption/decryption) functions are available:
 - a. Polling mode: encryption and decryption APIs are blocking functions i.e. they process the data and wait till the processing is finished, e.g. HAL_CRYPT_AESCBC_Encrypt()
 - b. Interrupt mode: encryption and decryption APIs are not blocking functions i.e. they process the data under interrupt, e.g. HAL_CRYPT_AESCBC_Encrypt_IT()
 - c. DMA mode: encryption and decryption APIs are not blocking functions i.e. the data transfer is ensured by DMA, e.g. HAL_CRYPT_AESCBC_Encrypt_DMA()
- 4. When the processing function is called at first time after HAL_CRYPT_Init() the CRYPT peripheral is initialized and processes the buffer in input. At second call, the processing function performs an append of the already processed buffer. When a new data block is to be processed, call HAL_CRYPT_Init() then the processing function.
- 5. Call HAL_CRYPT_DeInit() to deinitialize the CRYPT peripheral.

13.2.2 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the CRYPT according to the specified parameters in the CRYPT_InitTypeDef and creates the associated handle
- Deinitialize the CRYPT peripheral
- Initialize the CRYPT MSP
- Deinitialize CRYPT MSP

This section contains the following APIs:

- [HAL_CRYPT_Init\(\)](#)
- [HAL_CRYPT_DeInit\(\)](#)
- [HAL_CRYPT_MspInit\(\)](#)
- [HAL_CRYPT_MspDeInit\(\)](#)

13.2.3 AES processing functions

This section provides functions allowing to:

- Encrypt plaintext using AES-128/192/256 using chaining modes
- Decrypt cyphertext using AES-128/192/256 using chaining modes

Three processing functions are available:

- Polling mode
- Interrupt mode
- DMA mode

This section contains the following APIs:

- [HAL_CRYPT_AESECB_Encrypt\(\)](#)
- [HAL_CRYPT_AESCBC_Encrypt\(\)](#)
- [HAL_CRYPT_AESCTR_Encrypt\(\)](#)
- [HAL_CRYPT_AESECB_Decrypt\(\)](#)

- [HAL_CRYP_AESCBC_Decrypt\(\)](#)
- [HAL_CRYP_AESCTR_Decrypt\(\)](#)
- [HAL_CRYP_AESECB_Encrypt_IT\(\)](#)
- [HAL_CRYP_AESCBC_Encrypt_IT\(\)](#)
- [HAL_CRYP_AESCTR_Encrypt_IT\(\)](#)
- [HAL_CRYP_AESECB_Decrypt_IT\(\)](#)
- [HAL_CRYP_AESCBC_Decrypt_IT\(\)](#)
- [HAL_CRYP_AESCTR_Decrypt_IT\(\)](#)
- [HAL_CRYP_AESECB_Encrypt_DMA\(\)](#)
- [HAL_CRYP_AESCBC_Encrypt_DMA\(\)](#)
- [HAL_CRYP_AESCTR_Encrypt_DMA\(\)](#)
- [HAL_CRYP_AESECB_Decrypt_DMA\(\)](#)
- [HAL_CRYP_AESCBC_Decrypt_DMA\(\)](#)
- [HAL_CRYP_AESCTR_Decrypt_DMA\(\)](#)

13.2.4 DES processing functions

This section provides functions allowing to:

- Encrypt plaintext using DES using ECB or CBC chaining modes
- Decrypt cyphertext using ECB or CBC chaining modes

Three processing functions are available:

- Polling mode
- Interrupt mode
- DMA mode

This section contains the following APIs:

- [HAL_CRYP_DESECB_Encrypt\(\)](#)
- [HAL_CRYP_DESECB_Decrypt\(\)](#)
- [HAL_CRYP_DESCBC_Encrypt\(\)](#)
- [HAL_CRYP_DESCBC_Decrypt\(\)](#)
- [HAL_CRYP_DESECB_Encrypt_IT\(\)](#)
- [HAL_CRYP_DESCBC_Encrypt_IT\(\)](#)
- [HAL_CRYP_DESECB_Decrypt_IT\(\)](#)
- [HAL_CRYP_DESCBC_Decrypt_IT\(\)](#)
- [HAL_CRYP_DESECB_Encrypt_DMA\(\)](#)
- [HAL_CRYP_DESCBC_Encrypt_DMA\(\)](#)
- [HAL_CRYP_DESECB_Decrypt_DMA\(\)](#)
- [HAL_CRYP_DESCBC_Decrypt_DMA\(\)](#)

13.2.5 TDES processing functions

This section provides functions allowing to:

- Encrypt plaintext using TDES based on ECB or CBC chaining modes
- Decrypt cyphertext using TDES based on ECB or CBC chaining modes

Three processing functions are available:

- Polling mode
- Interrupt mode
- DMA mode

This section contains the following APIs:

- [HAL_CRYP_TDESECB_Encrypt\(\)](#)

- [HAL_Cryp_TDESECB_Decrypt\(\)](#)
- [HAL_Cryp_TDESCBC_Encrypt\(\)](#)
- [HAL_Cryp_TDESCBC_Decrypt\(\)](#)
- [HAL_Cryp_TDESECB_Encrypt_IT\(\)](#)
- [HAL_Cryp_TDESCBC_Encrypt_IT\(\)](#)
- [HAL_Cryp_TDESECB_Decrypt_IT\(\)](#)
- [HAL_Cryp_TDESCBC_Decrypt_IT\(\)](#)
- [HAL_Cryp_TDESECB_Encrypt_DMA\(\)](#)
- [HAL_Cryp_TDESCBC_Encrypt_DMA\(\)](#)
- [HAL_Cryp_TDESECB_Decrypt_DMA\(\)](#)
- [HAL_Cryp_TDESCBC_Decrypt_DMA\(\)](#)

13.2.6 DMA callback functions

This section provides DMA callback functions:

- DMA Input data transfer complete
- DMA Output data transfer complete
- DMA error

This section contains the following APIs:

- [HAL_Cryp_InCpltCallback\(\)](#)
- [HAL_Cryp_OutCpltCallback\(\)](#)
- [HAL_Cryp_ErrorCallback\(\)](#)

13.2.7 CRYP IRQ handler management

This section provides CRYP IRQ handler function.

This section contains the following APIs:

- [HAL_Cryp_IRQHandler\(\)](#)

13.2.8 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral.

This section contains the following APIs:

- [HAL_Cryp_GetState\(\)](#)

13.2.9 Detailed description of functions

HAL_Cryp_Init

Function name	HAL_StatusTypeDef HAL_Cryp_Init (Cryp_HandleTypeDef * hcryp)
Function description	Initializes the CRYP according to the specified parameters in the Cryp_InitTypeDef and creates the associated handle.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a Cryp_HandleTypeDef structure that contains the configuration information for CRYP module
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_Cryp_DeInit

Function name	HAL_StatusTypeDef HAL_Cryp_DeInit
---------------	--

(CRYP_HandleTypeDef * hcryp)

Function description	DeInitializes the CRYP peripheral.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYP_Msplnit

Function name	void HAL_CRYP_Msplnit (CRYP_HandleTypeDef * hcryp)
Function description	Initializes the CRYP MSP.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
Return values	<ul style="list-style-type: none"> • None:

HAL_CRYP_MspDeInit

Function name	void HAL_CRYP_MspDeInit (CRYP_HandleTypeDef * hcryp)
Function description	DeInitializes CRYP MSP.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
Return values	<ul style="list-style-type: none"> • None:

HAL_CRYP_AESECB_Encrypt

Function name	HAL_StatusTypeDef HAL_CRYP_AESECB_Encrypt (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData, uint32_t Timeout)
Function description	Initializes the CRYP peripheral in AES ECB encryption mode then encrypt pPlainData.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 16. • pCypherData: Pointer to the cyphertext buffer • Timeout: Specify Timeout value
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYP_AESECB_Decrypt

Function name	HAL_StatusTypeDef HAL_CRYP_AESECB_Decrypt (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData, uint32_t Timeout)
Function description	Initializes the CRYP peripheral in AES ECB decryption mode then decrypted pCypherData.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pCypherData: Pointer to the cyphertext buffer

- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

HAL_CRYPT_AESCBC_Encrypt

Function name HAL_StatusTypeDef HAL_CRYPT_AESCBC_Encrypt (CRYPT_HandleTypeDef * hcrypt, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData, uint32_t Timeout)

Function description Initializes the CRYPT peripheral in AES CBC encryption mode then encrypt pPlainData.

Parameters

- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

HAL_CRYPT_AESCBC_Decrypt

Function name HAL_StatusTypeDef HAL_CRYPT_AESCBC_Decrypt (CRYPT_HandleTypeDef * hcrypt, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData, uint32_t Timeout)

Function description Initializes the CRYPT peripheral in AES ECB decryption mode then decrypted pCypherData.

Parameters

- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
- **pCypherData:** Pointer to the cyphertext buffer
- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

HAL_CRYPT_AESCTR_Encrypt

Function name HAL_StatusTypeDef HAL_CRYPT_AESCTR_Encrypt (CRYPT_HandleTypeDef * hcrypt, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData, uint32_t Timeout)

Function description Initializes the CRYPT peripheral in AES CTR encryption mode then encrypt pPlainData.

Parameters

- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

HAL_CRYPT_AESCTR_Decrypt

Function name **HAL_StatusTypeDef HAL_CRYPT_AESCTR_Decrypt (CRYPT_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData, uint32_t Timeout)**

Function description Initializes the CRYPT peripheral in AES CTR decryption mode then decrypted pCypherData.

Parameters

- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
- **pCypherData:** Pointer to the cyphertext buffer
- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

HAL_CRYPT_AESECB_Encrypt_IT

Function name **HAL_StatusTypeDef HAL_CRYPT_AESECB_Encrypt_IT (CRYPT_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)**

Function description Initializes the CRYPT peripheral in AES ECB encryption mode using Interrupt.

Parameters

- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer, must be a multiple of 16 bytes
- **pCypherData:** Pointer to the cyphertext buffer

Return values

- **HAL:** status

HAL_CRYPT_AESCBC_Encrypt_IT

Function name **HAL_StatusTypeDef HAL_CRYPT_AESCBC_Encrypt_IT (CRYPT_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)**

Function description Initializes the CRYPT peripheral in AES CBC encryption mode using Interrupt.

Parameters

- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer, must be a multiple of 16 bytes
- **pCypherData:** Pointer to the cyphertext buffer

Return values

- **HAL:** status

HAL_CRYPT_AESCTR_Encrypt_IT

Function name	HAL_StatusTypeDef HAL_CRYPT_AESCTR_Encrypt_IT (CRYPT_HandleTypeDef * hcrypt, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)
Function description	Initializes the CRYP peripheral in AES CTR encryption mode using Interrupt.
Parameters	<ul style="list-style-type: none">• hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYP module• pPlainData: Pointer to the plaintext buffer• Size: Length of the plaintext buffer, must be a multiple of 16 bytes• pCypherData: Pointer to the cyphertext buffer
Return values	<ul style="list-style-type: none">• HAL: status

HAL_CRYPT_AESECB_Decrypt_IT

Function name	HAL_StatusTypeDef HAL_CRYPT_AESECB_Decrypt_IT (CRYPT_HandleTypeDef * hcrypt, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)
Function description	Initializes the CRYP peripheral in AES ECB decryption mode using Interrupt.
Parameters	<ul style="list-style-type: none">• hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYP module• pCypherData: Pointer to the cyphertext buffer• Size: Length of the plaintext buffer, must be a multiple of 16.• pPlainData: Pointer to the plaintext buffer
Return values	<ul style="list-style-type: none">• HAL: status

HAL_CRYPT_AESCTR_Decrypt_IT

Function name	HAL_StatusTypeDef HAL_CRYPT_AESCTR_Decrypt_IT (CRYPT_HandleTypeDef * hcrypt, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)
Function description	Initializes the CRYP peripheral in AES CTR decryption mode using Interrupt.
Parameters	<ul style="list-style-type: none">• hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYP module• pCypherData: Pointer to the cyphertext buffer• Size: Length of the plaintext buffer, must be a multiple of 16• pPlainData: Pointer to the plaintext buffer
Return values	<ul style="list-style-type: none">• HAL: status

HAL_CRYPT_AESCBC_Decrypt_IT

Function name	HAL_StatusTypeDef HAL_CRYPT_AESCBC_Decrypt_IT (CRYPT_HandleTypeDef * hcrypt, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)
Function description	Initializes the CRYP peripheral in AES CBC decryption mode

using IT.

- | | |
|---------------|--|
| Parameters | <ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pCypherData: Pointer to the cyphertext buffer • Size: Length of the plaintext buffer, must be a multiple of 16 • pPlainData: Pointer to the plaintext buffer |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_CRYP_AESECB_Encrypt_DMA

Function name HAL_StatusTypeDef HAL_CRYP_AESECB_Encrypt_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)

Function description Initializes the CRYP peripheral in AES ECB encryption mode using DMA.

- | | |
|------------|--|
| Parameters | <ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 16 bytes • pCypherData: Pointer to the cyphertext buffer |
|------------|--|

- | | |
|---------------|--|
| Return values | <ul style="list-style-type: none"> • HAL: status |
|---------------|--|

HAL_CRYP_AESECB_Decrypt_DMA

Function name HAL_StatusTypeDef HAL_CRYP_AESECB_Decrypt_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)

Function description Initializes the CRYP peripheral in AES ECB decryption mode using DMA.

- | | |
|------------|--|
| Parameters | <ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pCypherData: Pointer to the cyphertext buffer • Size: Length of the plaintext buffer, must be a multiple of 16 bytes • pPlainData: Pointer to the plaintext buffer |
|------------|--|

- | | |
|---------------|--|
| Return values | <ul style="list-style-type: none"> • HAL: status |
|---------------|--|

HAL_CRYP_AESCBC_Encrypt_DMA

Function name HAL_StatusTypeDef HAL_CRYP_AESCBC_Encrypt_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)

Function description Initializes the CRYP peripheral in AES CBC encryption mode using DMA.

- | | |
|------------|---|
| Parameters | <ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 16. |
|------------|---|

- **pCypherData:** Pointer to the cyphertext buffer
- Return values
- **HAL:** status

HAL_CRYPT_AESCBC_Decrypt_DMA

Function name **HAL_StatusTypeDef HAL_CRYPT_AESCBC_Decrypt_DMA (CRYPT_HandleTypeDef * hcrypt, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)**

Function description Initializes the CRYPT peripheral in AES CBC encryption mode using DMA.

- Parameters
- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
 - **pCypherData:** Pointer to the cyphertext buffer
 - **Size:** Length of the plaintext buffer, must be a multiple of 16 bytes
 - **pPlainData:** Pointer to the plaintext buffer

- Return values
- **HAL:** status

HAL_CRYPT_AESCTR_Encrypt_DMA

Function name **HAL_StatusTypeDef HAL_CRYPT_AESCTR_Encrypt_DMA (CRYPT_HandleTypeDef * hcrypt, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)**

Function description Initializes the CRYPT peripheral in AES CTR encryption mode using DMA.

- Parameters
- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
 - **pPlainData:** Pointer to the plaintext buffer
 - **Size:** Length of the plaintext buffer, must be a multiple of 16.
 - **pCypherData:** Pointer to the cyphertext buffer

- Return values
- **HAL:** status

HAL_CRYPT_AESCTR_Decrypt_DMA

Function name **HAL_StatusTypeDef HAL_CRYPT_AESCTR_Decrypt_DMA (CRYPT_HandleTypeDef * hcrypt, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)**

Function description Initializes the CRYPT peripheral in AES CTR decryption mode using DMA.

- Parameters
- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
 - **pCypherData:** Pointer to the cyphertext buffer
 - **Size:** Length of the plaintext buffer, must be a multiple of 16
 - **pPlainData:** Pointer to the plaintext buffer

- Return values
- **HAL:** status

HAL_CRYPT_DESECB_Encrypt

Function name	HAL_StatusTypeDef HAL_CRYPT_DESECB_Encrypt (CRYPT_HandleTypeDef * hcrypt, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData, uint32_t Timeout)
Function description	Initializes the CRYP peripheral in DES ECB encryption mode.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYP module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 8 • pCypherData: Pointer to the cyphertext buffer • Timeout: Specify Timeout value
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPT_DESECB_Decrypt

Function name	HAL_StatusTypeDef HAL_CRYPT_DESECB_Decrypt (CRYPT_HandleTypeDef * hcrypt, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData, uint32_t Timeout)
Function description	Initializes the CRYP peripheral in DES ECB decryption mode.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYP module • pCypherData: Pointer to the cyphertext buffer • Size: Length of the plaintext buffer, must be a multiple of 8 • pPlainData: Pointer to the plaintext buffer • Timeout: Specify Timeout value
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPT_DESCBC_Encrypt

Function name	HAL_StatusTypeDef HAL_CRYPT_DESCBC_Encrypt (CRYPT_HandleTypeDef * hcrypt, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData, uint32_t Timeout)
Function description	Initializes the CRYP peripheral in DES CBC encryption mode.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYP module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 8 • pCypherData: Pointer to the cyphertext buffer • Timeout: Specify Timeout value
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPT_DESCBC_Decrypt

Function name	HAL_StatusTypeDef HAL_CRYPT_DESCBC_Decrypt (CRYPT_HandleTypeDef * hcrypt, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData, uint32_t Timeout)
Function description	Initializes the CRYP peripheral in DES ECB decryption mode.

- Parameters
- **hcryp**: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
 - **pCypherData**: Pointer to the cyphertext buffer
 - **Size**: Length of the plaintext buffer, must be a multiple of 8
 - **pPlainData**: Pointer to the plaintext buffer
 - **Timeout**: Specify Timeout value
- Return values
- **HAL**: status

HAL_CRYPT_DESECB_Encrypt_IT

- Function name **HAL_StatusTypeDef HAL_CRYPT_DESECB_Encrypt_IT (CRYPT_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)**
- Function description Initializes the CRYPT peripheral in DES ECB encryption mode using IT.
- Parameters
- **hcryp**: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
 - **pPlainData**: Pointer to the plaintext buffer
 - **Size**: Length of the plaintext buffer, must be a multiple of 8
 - **pCypherData**: Pointer to the cyphertext buffer
- Return values
- **HAL**: status

HAL_CRYPT_DESECB_Decrypt_IT

- Function name **HAL_StatusTypeDef HAL_CRYPT_DESECB_Decrypt_IT (CRYPT_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)**
- Function description Initializes the CRYPT peripheral in DES ECB decryption mode using IT.
- Parameters
- **hcryp**: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
 - **pPlainData**: Pointer to the plaintext buffer
 - **Size**: Length of the plaintext buffer, must be a multiple of 8
 - **pCypherData**: Pointer to the cyphertext buffer
- Return values
- **HAL**: status

HAL_CRYPT_DESCBC_Encrypt_IT

- Function name **HAL_StatusTypeDef HAL_CRYPT_DESCBC_Encrypt_IT (CRYPT_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)**
- Function description Initializes the CRYPT peripheral in DES CBC encryption mode using interrupt.
- Parameters
- **hcryp**: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
 - **pPlainData**: Pointer to the plaintext buffer
 - **Size**: Length of the plaintext buffer, must be a multiple of 8
 - **pCypherData**: Pointer to the cyphertext buffer

Return values

- **HAL:** status

HAL_CRYPT_DESCBC_Decrypt_IT

Function name **HAL_StatusTypeDef HAL_CRYPT_DESCBC_Decrypt_IT (CRYPT_HandleTypeDef * hcrypt, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)**

Function description Initializes the CRYPT peripheral in DES ECB decryption mode using interrupt.

Parameters

- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer, must be a multiple of 8
- **pCypherData:** Pointer to the cyphertext buffer

Return values

- **HAL:** status

HAL_CRYPT_DESECB_Encrypt_DMA

Function name **HAL_StatusTypeDef HAL_CRYPT_DESECB_Encrypt_DMA (CRYPT_HandleTypeDef * hcrypt, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)**

Function description Initializes the CRYPT peripheral in DES ECB encryption mode using DMA.

Parameters

- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer, must be a multiple of 8
- **pCypherData:** Pointer to the cyphertext buffer

Return values

- **HAL:** status

HAL_CRYPT_DESECB_Decrypt_DMA

Function name **HAL_StatusTypeDef HAL_CRYPT_DESECB_Decrypt_DMA (CRYPT_HandleTypeDef * hcrypt, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)**

Function description Initializes the CRYPT peripheral in DES ECB decryption mode using DMA.

Parameters

- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer, must be a multiple of 8
- **pCypherData:** Pointer to the cyphertext buffer

Return values

- **HAL:** status

HAL_CRYPT_DESCBC_Encrypt_DMA

Function name **HAL_StatusTypeDef HAL_CRYPT_DESCBC_Encrypt_DMA (CRYPT_HandleTypeDef * hcrypt, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)**

Function description	Initializes the CRYP peripheral in DES CBC encryption mode using DMA.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 8 • pCypherData: Pointer to the cyphertext buffer
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPT_DESCBC_Decrypt_DMA

Function name	HAL_StatusTypeDef HAL_CRYPT_DESCBC_Decrypt_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)
Function description	Initializes the CRYP peripheral in DES ECB decryption mode using DMA.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 8 • pCypherData: Pointer to the cyphertext buffer
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPT_TDESECB_Encrypt

Function name	HAL_StatusTypeDef HAL_CRYPT_TDESECB_Encrypt (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData, uint32_t Timeout)
Function description	Initializes the CRYP peripheral in TDES ECB encryption mode then encrypt pPlainData.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 8 • pCypherData: Pointer to the cyphertext buffer • Timeout: Specify Timeout value
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPT_TDESCBC_Encrypt

Function name	HAL_StatusTypeDef HAL_CRYPT_TDESCBC_Encrypt (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData, uint32_t Timeout)
Function description	Initializes the CRYP peripheral in TDES CBC encryption mode then encrypt pPlainData.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 8

- **pCypherData:** Pointer to the cyphertext buffer
 - **Timeout:** Specify Timeout value
- Return values
- **HAL:** status

HAL_CRYPT_TDESECB_Decrypt

- Function name **HAL_StatusTypeDef HAL_CRYPT_TDESECB_Decrypt (CRYPT_HandleTypeDef * hcrypt, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData, uint32_t Timeout)**
- Function description Initializes the CRYPT peripheral in TDES ECB decryption mode then decrypted pCypherData.
- Parameters
- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
 - **pPlainData:** Pointer to the plaintext buffer
 - **Size:** Length of the plaintext buffer, must be a multiple of 8
 - **pCypherData:** Pointer to the cyphertext buffer
 - **Timeout:** Specify Timeout value
- Return values
- **HAL:** status

HAL_CRYPT_TDESCBC_Decrypt

- Function name **HAL_StatusTypeDef HAL_CRYPT_TDESCBC_Decrypt (CRYPT_HandleTypeDef * hcrypt, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData, uint32_t Timeout)**
- Function description Initializes the CRYPT peripheral in TDES CBC decryption mode then decrypted pCypherData.
- Parameters
- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
 - **pCypherData:** Pointer to the cyphertext buffer
 - **Size:** Length of the plaintext buffer, must be a multiple of 8
 - **pPlainData:** Pointer to the plaintext buffer
 - **Timeout:** Specify Timeout value
- Return values
- **HAL:** status

HAL_CRYPT_TDESECB_Encrypt_IT

- Function name **HAL_StatusTypeDef HAL_CRYPT_TDESECB_Encrypt_IT (CRYPT_HandleTypeDef * hcrypt, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)**
- Function description Initializes the CRYPT peripheral in TDES ECB encryption mode using interrupt.
- Parameters
- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
 - **pPlainData:** Pointer to the plaintext buffer
 - **Size:** Length of the plaintext buffer, must be a multiple of 8
 - **pCypherData:** Pointer to the cyphertext buffer
- Return values
- **HAL:** status

HAL_CRYPT_TDESECB_Decrypt_IT

Function name	HAL_StatusTypeDef HAL_CRYPT_TDESECB_Decrypt_IT (CRYPT_HandleTypeDef * hcrypt, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)
Function description	Initializes the CRYPT peripheral in TDES ECB decryption mode.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 8 • pCypherData: Pointer to the cyphertext buffer
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPT_TDESCBC_Encrypt_IT

Function name	HAL_StatusTypeDef HAL_CRYPT_TDESCBC_Encrypt_IT (CRYPT_HandleTypeDef * hcrypt, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)
Function description	Initializes the CRYPT peripheral in TDES CBC encryption mode.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 8 • pCypherData: Pointer to the cyphertext buffer
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPT_TDESCBC_Decrypt_IT

Function name	HAL_StatusTypeDef HAL_CRYPT_TDESCBC_Decrypt_IT (CRYPT_HandleTypeDef * hcrypt, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)
Function description	Initializes the CRYPT peripheral in TDES CBC decryption mode.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module • pCypherData: Pointer to the cyphertext buffer • Size: Length of the plaintext buffer, must be a multiple of 8 • pPlainData: Pointer to the plaintext buffer
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPT_TDESECB_Encrypt_DMA

Function name	HAL_StatusTypeDef HAL_CRYPT_TDESECB_Encrypt_DMA (CRYPT_HandleTypeDef * hcrypt, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)
Function description	Initializes the CRYPT peripheral in TDES ECB encryption mode using DMA.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module • pPlainData: Pointer to the plaintext buffer

- **Size:** Length of the plaintext buffer, must be a multiple of 8
 - **pCypherData:** Pointer to the cyphertext buffer
- Return values
- **HAL:** status

HAL_CRYPT_TDESECB_Decrypt_DMA

Function name **HAL_StatusTypeDef HAL_CRYPT_TDESECB_Decrypt_DMA (CRYPT_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)**

Function description Initializes the CRYP peripheral in TDES ECB decryption mode using DMA.

- Parameters
- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYP module
 - **pPlainData:** Pointer to the plaintext buffer
 - **Size:** Length of the plaintext buffer, must be a multiple of 8
 - **pCypherData:** Pointer to the cyphertext buffer

- Return values
- **HAL:** status

HAL_CRYPT_TDESCBC_Encrypt_DMA

Function name **HAL_StatusTypeDef HAL_CRYPT_TDESCBC_Encrypt_DMA (CRYPT_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)**

Function description Initializes the CRYP peripheral in TDES CBC encryption mode using DMA.

- Parameters
- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYP module
 - **pPlainData:** Pointer to the plaintext buffer
 - **Size:** Length of the plaintext buffer, must be a multiple of 8
 - **pCypherData:** Pointer to the cyphertext buffer

- Return values
- **HAL:** status

HAL_CRYPT_TDESCBC_Decrypt_DMA

Function name **HAL_StatusTypeDef HAL_CRYPT_TDESCBC_Decrypt_DMA (CRYPT_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)**

Function description Initializes the CRYP peripheral in TDES CBC decryption mode using DMA.

- Parameters
- **hcryp:** pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYP module
 - **pCypherData:** Pointer to the cyphertext buffer
 - **Size:** Length of the plaintext buffer, must be a multiple of 8
 - **pPlainData:** Pointer to the plaintext buffer

- Return values
- **HAL:** status

HAL_CRYPT_InCpltCallback

Function name	void HAL_CRYPT_InCpltCallback (CRYPT_HandleTypeDef * hcryp)
Function description	Input FIFO transfer completed callbacks.
Parameters	<ul style="list-style-type: none">• hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
Return values	<ul style="list-style-type: none">• None:

HAL_CRYPT_OutCpltCallback

Function name	void HAL_CRYPT_OutCpltCallback (CRYPT_HandleTypeDef * hcryp)
Function description	Output FIFO transfer completed callbacks.
Parameters	<ul style="list-style-type: none">• hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
Return values	<ul style="list-style-type: none">• None:

HAL_CRYPT_ErrorCallback

Function name	void HAL_CRYPT_ErrorCallback (CRYPT_HandleTypeDef * hcryp)
Function description	CRYPT error callbacks.
Parameters	<ul style="list-style-type: none">• hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
Return values	<ul style="list-style-type: none">• None:

HAL_CRYPT_IRQHandler

Function name	void HAL_CRYPT_IRQHandler (CRYPT_HandleTypeDef * hcryp)
Function description	This function handles CRYPT interrupt request.
Parameters	<ul style="list-style-type: none">• hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
Return values	<ul style="list-style-type: none">• None:

HAL_CRYPT_GetState

Function name	HAL_CRYPT_STATETypeDef HAL_CRYPT_GetState (CRYPT_HandleTypeDef * hcryp)
Function description	Returns the CRYPT state.
Parameters	<ul style="list-style-type: none">• hcryp: pointer to a CRYPT_HandleTypeDef structure that contains the configuration information for CRYPT module
Return values	<ul style="list-style-type: none">• HAL: state

13.3 CRYP Firmware driver defines

13.3.1 CRYP

CRYP Data Type

CRYP_DATATYPE_32B

CRYP_DATATYPE_16B

CRYP_DATATYPE_8B

CRYP_DATATYPE_1B

CRYP CRYP_AlgoModeDirection

CRYP_CR_ALGOMODE_DIRECTION

CRYP_CR_ALGOMODE_TDES_ECB_ENCRYPT

CRYP_CR_ALGOMODE_TDES_ECB_DECRYPT

CRYP_CR_ALGOMODE_TDES_CBC_ENCRYPT

CRYP_CR_ALGOMODE_TDES_CBC_DECRYPT

CRYP_CR_ALGOMODE_DES_ECB_ENCRYPT

CRYP_CR_ALGOMODE_DES_ECB_DECRYPT

CRYP_CR_ALGOMODE_DES_CBC_ENCRYPT

CRYP_CR_ALGOMODE_DES_CBC_DECRYPT

CRYP_CR_ALGOMODE_AES_ECB_ENCRYPT

CRYP_CR_ALGOMODE_AES_ECB_DECRYPT

CRYP_CR_ALGOMODE_AES_CBC_ENCRYPT

CRYP_CR_ALGOMODE_AES_CBC_DECRYPT

CRYP_CR_ALGOMODE_AES_CTR_ENCRYPT

CRYP_CR_ALGOMODE_AES_CTR_DECRYPT

CRYP CRYP_Interrupt

CRYP_IT_INI Input FIFO Interrupt

CRYP_IT_OUTI Output FIFO Interrupt

CRYP CRYP_Flags

CRYP_FLAG_BUSY The CRYP core is currently processing a block of data or a key preparation (for AES decryption).

CRYP_FLAG_IFEM Input FIFO is empty

CRYP_FLAG_IFNF Input FIFO is not Full

CRYP_FLAG_OFNE Output FIFO is not empty

CRYP_FLAG_OFFU Output FIFO is Full

CRYP_FLAG_OUTRIS Output FIFO service raw interrupt status

CRYP_FLAG_INRIS Input FIFO service raw interrupt status

CRYP Exported Macros

<code>__HAL_CRYPT_RESET_HANDLE_STATE</code>	Description: <ul style="list-style-type: none">Reset CRYPT handle state. Parameters: <ul style="list-style-type: none"><code>__HANDLE__</code>: specifies the CRYPT handle. Return value: <ul style="list-style-type: none">None
<code>__HAL_CRYPT_ENABLE</code>	Description: <ul style="list-style-type: none">Enable/Disable the CRYPT peripheral. Parameters: <ul style="list-style-type: none"><code>__HANDLE__</code>: specifies the CRYPT handle. Return value: <ul style="list-style-type: none">None
<code>__HAL_CRYPT_DISABLE</code>	
<code>__HAL_CRYPT_FIFO_FLUSH</code>	Description: <ul style="list-style-type: none">Flush the data FIFO. Parameters: <ul style="list-style-type: none"><code>__HANDLE__</code>: specifies the CRYPT handle. Return value: <ul style="list-style-type: none">None
<code>__HAL_CRYPT_SET_MODE</code>	Description: <ul style="list-style-type: none">Set the algorithm mode: AES-ECB, AES-CBC, AES-CTR, DES-ECB, DES-CBC. Parameters: <ul style="list-style-type: none"><code>__HANDLE__</code>: specifies the CRYPT handle.MODE: The algorithm mode. Return value: <ul style="list-style-type: none">None
<code>__HAL_CRYPT_GET_FLAG</code>	Description: <ul style="list-style-type: none">Check whether the specified CRYPT flag is set or not. Parameters: <ul style="list-style-type: none"><code>__HANDLE__</code>: specifies the CRYPT handle.<code>__FLAG__</code>: specifies the flag to check. This parameter can be one of the following values:

- CRYP_FLAG_BUSY: The CRYP core is currently processing a block of data or a key preparation (for AES decryption).
- CRYP_FLAG_IFEM: Input FIFO is empty
- CRYP_FLAG_IFNF: Input FIFO is not full
- CRYP_FLAG_INRIS: Input FIFO service raw interrupt is pending
- CRYP_FLAG_OFNE: Output FIFO is not empty
- CRYP_FLAG_OFFU: Output FIFO is full
- CRYP_FLAG_OUTRIS: Input FIFO service raw interrupt is pending

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

`__HAL_CRYPT_GET_IT`**Description:**

- Check whether the specified CRYP interrupt is set or not.

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __INTERRUPT__: specifies the interrupt to check. This parameter can be one of the following values:
 - CRYP_IT_INRIS: Input FIFO service raw interrupt is pending
 - CRYP_IT_OUTRIS: Output FIFO service raw interrupt is pending

Return value:

- The: new state of __INTERRUPT__ (TRUE or FALSE).

`__HAL_CRYPT_ENABLE_IT`**Description:**

- Enable the CRYP interrupt.

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __INTERRUPT__: CRYP Interrupt.

Return value:

- None

`__HAL_CRYPT_DISABLE_IT`**Description:**

- Disable the CRYP interrupt.

Parameters:

- `__HANDLE__`: specifies the CRYP handle.
- `__INTERRUPT__`: CRYP interrupt.

Return value:

- None

CRYP Key Size`CRYP_KEYSIZE_128B``CRYP_KEYSIZE_192B``CRYP_KEYSIZE_256B`

14 HAL CRYP Extension Driver

14.1 CRYPEX Firmware driver API description

14.1.1 How to use this driver

The CRYP Extension HAL driver can be used as follows:

1. Initialize the CRYP low level resources by implementing the `HAL_Cryp_MspInit()`:
 - a. Enable the CRYP interface clock using `__HAL_RCC_Cryp_CLK_ENABLE()`
 - b. In case of using interrupts (e.g. `HAL_CrypEx_AesGcm_Encrypt_IT()`)
 - Configure the CRYP interrupt priority using `HAL_NVIC_SetPriority()`
 - Enable the CRYP IRQ handler using `HAL_NVIC_EnableIRQ()`
 - In CRYP IRQ handler, call `HAL_Cryp_IRQHandler()`
 - c. In case of using DMA to control data transfer (e.g. `HAL_AES_ECB_Encrypt_DMA()`)
 - Enable the DMAx interface clock using `__DMAx_CLK_ENABLE()`
 - Configure and enable two DMA streams one for managing data transfer from memory to peripheral (input stream) and another stream for managing data transfer from peripheral to memory (output stream)
 - Associate the initialized DMA handle to the CRYP DMA handle using `__HAL_LINKDMA()`
 - Configure the priority and enable the NVIC for the transfer complete interrupt on the two DMA Streams. The output stream should have higher priority than the input stream `HAL_NVIC_SetPriority()` and `HAL_NVIC_EnableIRQ()`
2. Initialize the CRYP HAL using `HAL_Cryp_Init()`. This function configures mainly:
 - a. The data type: 1-bit, 8-bit, 16-bit and 32-bit
 - b. The key size: 128, 192 and 256. This parameter is relevant only for AES
 - c. The encryption/decryption key. Its size depends on the algorithm used for encryption/decryption
 - d. The initialization vector (counter). It is not used ECB mode.
3. Three processing (encryption/decryption) functions are available:
 - a. Polling mode: encryption and decryption APIs are blocking functions i.e. they process the data and wait till the processing is finished e.g. `HAL_CrypEx_AesGcm_Encrypt()`
 - b. Interrupt mode: encryption and decryption APIs are not blocking functions i.e. they process the data under interrupt e.g. `HAL_CrypEx_AesGcm_Encrypt_IT()`
 - c. DMA mode: encryption and decryption APIs are not blocking functions i.e. the data transfer is ensured by DMA e.g. `HAL_CrypEx_AesGcm_Encrypt_DMA()`
4. When the processing function is called at first time after `HAL_Cryp_Init()` the CRYP peripheral is initialized and processes the buffer in input. At second call, the processing function performs an append of the already processed buffer. When a new data block is to be processed, call `HAL_Cryp_Init()` then the processing function.
5. In AES-GCM and AES-CCM modes are an authenticated encryption algorithms which provide authentication messages. `HAL_AES_GCM_Finish()` and `HAL_AES_CCM_Finish()` are used to provide those authentication messages. Call those functions after the processing ones (polling, interrupt or DMA). e.g. in AES-CCM mode call `HAL_CrypEx_AesCCM_Encrypt()` to encrypt the plain data then call `HAL_CrypEx_AesCCM_Finish()` to get the authentication message For CCM Encrypt/Decrypt API's, only `DataType = 8-bit` is supported by this version. The `HAL_CrypEx_AesGcm_xxxx()` implementation is limited to 32bits inputs data length (Plain/Cyphertext, Header) compared with GCM standards specifications (800-38D).
6. Call `HAL_Cryp_DeInit()` to deinitialize the CRYP peripheral.

14.1.2 Extended AES processing functions

This section provides functions allowing to:

- Encrypt plaintext using AES-128/192/256 using GCM and CCM chaining modes
- Decrypt cyphertext using AES-128/192/256 using GCM and CCM chaining modes
- Finish the processing. This function is available only for GCM and CCM

Three processing methods are available:

- Polling mode
- Interrupt mode
- DMA mode

This section contains the following APIs:

- [HAL_CRYPEX_AESCCM_Encrypt\(\)](#)
- [HAL_CRYPEX_AESGCM_Encrypt\(\)](#)
- [HAL_CRYPEX_AESGCM_Decrypt\(\)](#)
- [HAL_CRYPEX_AESGCM_Finish\(\)](#)
- [HAL_CRYPEX_AESCCM_Finish\(\)](#)
- [HAL_CRYPEX_AESCCM_Decrypt\(\)](#)
- [HAL_CRYPEX_AESGCM_Encrypt_IT\(\)](#)
- [HAL_CRYPEX_AESCCM_Encrypt_IT\(\)](#)
- [HAL_CRYPEX_AESGCM_Decrypt_IT\(\)](#)
- [HAL_CRYPEX_AESCCM_Decrypt_IT\(\)](#)
- [HAL_CRYPEX_AESGCM_Encrypt_DMA\(\)](#)
- [HAL_CRYPEX_AESCCM_Encrypt_DMA\(\)](#)
- [HAL_CRYPEX_AESGCM_Decrypt_DMA\(\)](#)
- [HAL_CRYPEX_AESCCM_Decrypt_DMA\(\)](#)

14.1.3 CRYPEX IRQ handler management

This section provides CRYPEX IRQ handler function.

This section contains the following APIs:

- [HAL_CRYPEX_GCMCCM_IRQHandler\(\)](#)

14.1.4 Detailed description of functions

HAL_CRYPEX_AESGCM_Encrypt

Function name	HAL_StatusTypeDef HAL_CRYPEX_AESGCM_Encrypt (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData, uint32_t Timeout)
Function description	Initializes the CRYP peripheral in AES GCM encryption mode then encrypt pPlainData.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 16 • pCypherData: Pointer to the cyphertext buffer • Timeout: Timeout duration
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPEX_AESGCM_Decrypt

Function name	HAL_StatusTypeDef HAL_CRYPEX_AESGCM_Decrypt (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData, uint32_t Timeout)
Function description	Initializes the CRYP peripheral in AES GCM decryption mode then decrypted pCypherData.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pCypherData: Pointer to the cyphertext buffer • Size: Length of the cyphertext buffer, must be a multiple of 16 • pPlainData: Pointer to the plaintext buffer • Timeout: Timeout duration
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPEX_AESGCM_Finish

Function name	HAL_StatusTypeDef HAL_CRYPEX_AESGCM_Finish (CRYP_HandleTypeDef * hcryp, uint32_t Size, uint8_t * AuthTag, uint32_t Timeout)
Function description	Computes the authentication TAG.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • Size: Total length of the plain/cyphertext buffer • AuthTag: Pointer to the authentication buffer • Timeout: Timeout duration
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPEX_AESCCM_Encrypt

Function name	HAL_StatusTypeDef HAL_CRYPEX_AESCCM_Encrypt (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData, uint32_t Timeout)
Function description	Initializes the CRYP peripheral in AES CCM encryption mode then encrypt pPlainData.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 16 • pCypherData: Pointer to the cyphertext buffer • Timeout: Timeout duration
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPEX_AESCCM_Decrypt

Function name	HAL_StatusTypeDef HAL_CRYPEX_AESCCM_Decrypt (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData, uint32_t Timeout)
---------------	---

Function description	Initializes the CRYP peripheral in AES CCM decryption mode then decrypted pCypherData.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 16 • pCypherData: Pointer to the cyphertext buffer • Timeout: Timeout duration
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPEX_AESCCM_Finish

Function name	HAL_StatusTypeDef HAL_CRYPEX_AESCCM_Finish (CRYP_HandleTypeDef * hcryp, uint8_t * AuthTag, uint32_t Timeout)
Function description	Computes the authentication TAG for AES CCM mode.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • AuthTag: Pointer to the authentication buffer • Timeout: Timeout duration
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This API is called after HAL_AES_CCM_Encrypt()/HAL_AES_CCM_Decrypt()

HAL_CRYPEX_AESGCM_Encrypt_IT

Function name	HAL_StatusTypeDef HAL_CRYPEX_AESGCM_Encrypt_IT (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)
Function description	Initializes the CRYP peripheral in AES GCM encryption mode using IT.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pPlainData: Pointer to the plaintext buffer • Size: Length of the plaintext buffer, must be a multiple of 16 • pCypherData: Pointer to the cyphertext buffer
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_CRYPEX_AESGCM_Decrypt_IT

Function name	HAL_StatusTypeDef HAL_CRYPEX_AESGCM_Decrypt_IT (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)
Function description	Initializes the CRYP peripheral in AES GCM decryption mode using IT.
Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module • pCypherData: Pointer to the cyphertext buffer

- **Size:** Length of the cyphertext buffer, must be a multiple of 16
 - **pPlainData:** Pointer to the plaintext buffer
- Return values
- **HAL:** status

HAL_CRYPEx_AESCCM_Encrypt_IT

Function name **HAL_StatusTypeDef HAL_CRYPEx_AESCCM_Encrypt_IT (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)**

Function description Initializes the CRYP peripheral in AES CCM encryption mode using interrupt.

- Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
 - **pPlainData:** Pointer to the plaintext buffer
 - **Size:** Length of the plaintext buffer, must be a multiple of 16
 - **pCypherData:** Pointer to the cyphertext buffer

- Return values
- **HAL:** status

HAL_CRYPEx_AESCCM_Decrypt_IT

Function name **HAL_StatusTypeDef HAL_CRYPEx_AESCCM_Decrypt_IT (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)**

Function description Initializes the CRYP peripheral in AES CCM decryption mode using interrupt then decrypted pCypherData.

- Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
 - **pCypherData:** Pointer to the cyphertext buffer
 - **Size:** Length of the plaintext buffer, must be a multiple of 16
 - **pPlainData:** Pointer to the plaintext buffer

- Return values
- **HAL:** status

HAL_CRYPEx_AESGCM_Encrypt_DMA

Function name **HAL_StatusTypeDef HAL_CRYPEx_AESGCM_Encrypt_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)**

Function description Initializes the CRYP peripheral in AES GCM encryption mode using DMA.

- Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
 - **pPlainData:** Pointer to the plaintext buffer
 - **Size:** Length of the plaintext buffer, must be a multiple of 16
 - **pCypherData:** Pointer to the cyphertext buffer

- Return values
- **HAL:** status

HAL_CRYPEX_AESGCM_Decrypt_DMA

Function name HAL_StatusTypeDef HAL_CRYPEX_AESGCM_Decrypt_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)

Function description Initializes the CRYP peripheral in AES GCM decryption mode using DMA.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer.
- **Size:** Length of the cyphertext buffer, must be a multiple of 16
- **pPlainData:** Pointer to the plaintext buffer

Return values

- **HAL:** status

HAL_CRYPEX_AESCCM_Encrypt_DMA

Function name HAL_StatusTypeDef HAL_CRYPEX_AESCCM_Encrypt_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)

Function description Initializes the CRYP peripheral in AES CCM encryption mode using interrupt.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer, must be a multiple of 16
- **pCypherData:** Pointer to the cyphertext buffer

Return values

- **HAL:** status

HAL_CRYPEX_AESCCM_Decrypt_DMA

Function name HAL_StatusTypeDef HAL_CRYPEX_AESCCM_Decrypt_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)

Function description Initializes the CRYP peripheral in AES CCM decryption mode using DMA then decrypted pCypherData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer
- **Size:** Length of the plaintext buffer, must be a multiple of 16
- **pPlainData:** Pointer to the plaintext buffer

Return values

- **HAL:** status

HAL_CRYPEX_GCMCCM_IRQHandler

Function name void HAL_CRYPEX_GCMCCM_IRQHandler (CRYP_HandleTypeDef * hcryp)

Function description This function handles CRYPEX interrupt request.

Parameters	<ul style="list-style-type: none"> • hcryp: pointer to a CRYPEx_HandleTypeDef structure that contains the configuration information for CRYP module
Return values	<ul style="list-style-type: none"> • None:

14.2 CRYPEx Firmware driver defines

14.2.1 CRYPEx

CRYP AlgoModeDirection

CRYP_CR_ALGOMODE_AES_GCM_ENCRYPT

CRYP_CR_ALGOMODE_AES_GCM_DECRYPT

CRYP_CR_ALGOMODE_AES_CCM_ENCRYPT

CRYP_CR_ALGOMODE_AES_CCM_DECRYPT

CRYP PhaseConfig

CRYP_PHASE_INIT

CRYP_PHASE_HEADER

CRYP_PHASE_PAYLOAD

CRYP_PHASE_FINAL

CRYP Exported Macros

`__HAL_CRYP_SET_PHASE` **Description:**

- Set the phase: Init, header, payload, final.

Parameters:

- `__HANDLE__`: specifies the CRYP handle.
- `__PHASE__`: The phase.

Return value:

- None

15 HAL DAC Generic Driver

15.1 DAC Firmware driver registers structures

15.1.1 DAC_HandleTypeDef

Data Fields

- *DAC_TypeDef * Instance*
- *__IO HAL_DAC_StateTypeDef State*
- *HAL_LockTypeDef Lock*
- *DMA_HandleTypeDef * DMA_Handle1*
- *DMA_HandleTypeDef * DMA_Handle2*
- *__IO uint32_t ErrorCode*

Field Documentation

- *DAC_TypeDef* DAC_HandleTypeDef::Instance*
Register base address
- *__IO HAL_DAC_StateTypeDef DAC_HandleTypeDef::State*
DAC communication state
- *HAL_LockTypeDef DAC_HandleTypeDef::Lock*
DAC locking object
- *DMA_HandleTypeDef* DAC_HandleTypeDef::DMA_Handle1*
Pointer DMA handler for channel 1
- *DMA_HandleTypeDef* DAC_HandleTypeDef::DMA_Handle2*
Pointer DMA handler for channel 2
- *__IO uint32_t DAC_HandleTypeDef::ErrorCode*
DAC Error code

15.1.2 DAC_ChannelConfTypeDef

Data Fields

- *uint32_t DAC_Trigger*
- *uint32_t DAC_OutputBuffer*

Field Documentation

- *uint32_t DAC_ChannelConfTypeDef::DAC_Trigger*
Specifies the external trigger for the selected DAC channel. This parameter can be a value of [DAC_trigger_selection](#)
- *uint32_t DAC_ChannelConfTypeDef::DAC_OutputBuffer*
Specifies whether the DAC channel output buffer is enabled or disabled. This parameter can be a value of [DAC_output_buffer](#)

15.2 DAC Firmware driver API description

15.2.1 DAC Peripheral features

DAC Channels

The device integrates two 12-bit Digital Analog Converters that can be used independently or simultaneously (dual mode):

1. DAC channel1 with DAC_OUT1 (PA4) as output
2. DAC channel2 with DAC_OUT2 (PA5) as output

DAC Triggers

Digital to Analog conversion can be non-triggered using DAC_TRIGGER_NONE and DAC_OUT1/DAC_OUT2 is available once writing to DHRx register.

Digital to Analog conversion can be triggered by:

1. External event: EXTI Line 9 (any GPIOx_Pin9) using DAC_TRIGGER_EXT_IT9. The used pin (GPIOx_Pin9) must be configured in input mode.
2. Timers TRGO: TIM2, TIM4, TIM5, TIM6, TIM7 and TIM8 (DAC_TRIGGER_T2_TRGO, DAC_TRIGGER_T4_TRGO...)
3. Software using DAC_TRIGGER_SOFTWARE

DAC Buffer mode feature

Each DAC channel integrates an output buffer that can be used to reduce the output impedance, and to drive external loads directly without having to add an external operational amplifier. To enable, the output buffer use `sConfig.DAC_OutputBuffer = DAC_OUTPUTBUFFER_ENABLE;`



Refer to the device datasheet for more details about output impedance value with and without output buffer.

DAC wave generation feature

Both DAC channels can be used to generate

1. Noise wave using `HAL_DACEx_NoiseWaveGenerate()`
2. Triangle wave using `HAL_DACEx_TriangleWaveGenerate()`

DAC data format

The DAC data format can be:

1. 8-bit right alignment using `DAC_ALIGN_8B_R`
2. 12-bit left alignment using `DAC_ALIGN_12B_L`
3. 12-bit right alignment using `DAC_ALIGN_12B_R`

DAC data value to voltage correspondence

The analog output voltage on each DAC channel pin is determined by the following equation: $DAC_OUTx = VREF+ * DOR / 4095$ with DOR is the Data Output Register VEF+ is the input voltage reference (refer to the device datasheet) e.g. To set DAC_OUT1 to 0.7V, use Assuming that $VREF+ = 3.3V$, $DAC_OUT1 = (3.3 * 868) / 4095 = 0.7V$

DMA requests

A DMA1 request can be generated when an external trigger (but not a software trigger) occurs if DMA1 requests are enabled using `HAL_DAC_Start_DMA()`

DMA1 requests are mapped as following:

1. DAC channel1 : mapped on DMA1 Stream5 channel7 which must be already configured
2. DAC channel2 : mapped on DMA1 Stream6 channel7 which must be already configured For Dual mode and specific signal (Triangle and noise) generation please refer to Extension Features Driver description

15.2.2 How to use this driver

- DAC APB clock must be enabled to get write access to DAC registers using HAL_DAC_Init()
- Configure DAC_OUTx (DAC_OUT1: PA4, DAC_OUT2: PA5) in analog mode.
- Configure the DAC channel using HAL_DAC_ConfigChannel() function.
- Enable the DAC channel using HAL_DAC_Start() or HAL_DAC_Start_DMA functions

Polling mode IO operation

- Start the DAC peripheral using HAL_DAC_Start()
- To read the DAC last data output value, use the HAL_DAC_GetValue() function.
- Stop the DAC peripheral using HAL_DAC_Stop()

DMA mode IO operation

- Start the DAC peripheral using HAL_DAC_Start_DMA(), at this stage the user specify the length of data to be transferred at each end of conversion
- At The end of data transfer HAL_DAC_ConvCpltCallbackCh1() or HAL_DAC_ConvCpltCallbackCh2() function is executed and user can add his own code by customization of function pointer HAL_DAC_ConvCpltCallbackCh1 or HAL_DAC_ConvCpltCallbackCh2
- In case of transfer Error, HAL_DAC_ErrorCallbackCh1() function is executed and user can add his own code by customization of function pointer HAL_DAC_ErrorCallbackCh1
- Stop the DAC peripheral using HAL_DAC_Stop_DMA()

DAC HAL driver macros list

Below the list of most used macros in DAC HAL driver.

- __HAL_DAC_ENABLE : Enable the DAC peripheral
- __HAL_DAC_DISABLE : Disable the DAC peripheral
- __HAL_DAC_CLEAR_FLAG: Clear the DAC's pending flags
- __HAL_DAC_GET_FLAG: Get the selected DAC's flag status



You can refer to the DAC HAL driver header file for more useful macros

15.2.3 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize and configure the DAC.
- De-initialize the DAC.

This section contains the following APIs:

- [HAL_DAC_Init\(\)](#)
- [HAL_DAC_DeInit\(\)](#)
- [HAL_DAC_MspInit\(\)](#)
- [HAL_DAC_MspDeInit\(\)](#)

15.2.4 IO operation functions

This section provides functions allowing to:

- Start conversion.
- Stop conversion.
- Start conversion and enable DMA transfer.
- Stop conversion and disable DMA transfer.
- Get result of conversion.

This section contains the following APIs:

- [HAL_DAC_Start\(\)](#)
- [HAL_DAC_Stop\(\)](#)
- [HAL_DAC_Start_DMA\(\)](#)
- [HAL_DAC_Stop_DMA\(\)](#)
- [HAL_DAC_GetValue\(\)](#)
- [HAL_DAC_IRQHandler\(\)](#)
- [HAL_DAC_ConvCpltCallbackCh1\(\)](#)
- [HAL_DAC_ConvHalfCpltCallbackCh1\(\)](#)
- [HAL_DAC_ErrorCallbackCh1\(\)](#)
- [HAL_DAC_DMAUnderrunCallbackCh1\(\)](#)

15.2.5 Peripheral Control functions

This section provides functions allowing to:

- Configure channels.
- Set the specified data holding register value for DAC channel.

This section contains the following APIs:

- [HAL_DAC_ConfigChannel\(\)](#)
- [HAL_DAC_SetValue\(\)](#)

15.2.6 Peripheral State and Errors functions

This subsection provides functions allowing to

- Check the DAC state.
- Check the DAC Errors.

This section contains the following APIs:

- [HAL_DAC_GetState\(\)](#)
- [HAL_DAC_GetError\(\)](#)
- [HAL_DAC_IRQHandler\(\)](#)
- [HAL_DAC_ConvCpltCallbackCh1\(\)](#)
- [HAL_DAC_ConvHalfCpltCallbackCh1\(\)](#)
- [HAL_DAC_ErrorCallbackCh1\(\)](#)
- [HAL_DAC_DMAUnderrunCallbackCh1\(\)](#)

15.2.7 Detailed description of functions

HAL_DAC_Init

Function name	HAL_StatusTypeDef HAL_DAC_Init (DAC_HandleTypeDef * hdac)
Function description	Initializes the DAC peripheral according to the specified parameters in the DAC_InitStruct.
Parameters	<ul style="list-style-type: none">• hdac: pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_DAC_DeInit

Function name	HAL_StatusTypeDef HAL_DAC_DeInit (DAC_HandleTypeDef * hdac)
Function description	Deinitializes the DAC peripheral registers to their default reset values.
Parameters	<ul style="list-style-type: none">• hdac: pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_DAC_MspInit

Function name	void HAL_DAC_MspInit (DAC_HandleTypeDef * hdac)
Function description	Initializes the DAC MSP.
Parameters	<ul style="list-style-type: none">• hdac: pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
Return values	<ul style="list-style-type: none">• None:

HAL_DAC_MspDeInit

Function name	void HAL_DAC_MspDeInit (DAC_HandleTypeDef * hdac)
Function description	Deinitializes the DAC MSP.
Parameters	<ul style="list-style-type: none">• hdac: pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
Return values	<ul style="list-style-type: none">• None:

HAL_DAC_Start

Function name	HAL_StatusTypeDef HAL_DAC_Start (DAC_HandleTypeDef * hdac, uint32_t Channel)
Function description	Enables DAC and starts conversion of channel.
Parameters	<ul style="list-style-type: none">• hdac: pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.• Channel: The selected DAC channel. This parameter can be one of the following values:

- DAC_CHANNEL_1: DAC Channel1 selected
- DAC_CHANNEL_2: DAC Channel2 selected

Return values

- **HAL:** status

HAL_DAC_Stop

Function name **HAL_StatusTypeDef HAL_DAC_Stop (DAC_HandleTypeDef * hdac, uint32_t Channel)**

Function description Disables DAC and stop conversion of channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
 - DAC_CHANNEL_1: DAC Channel1 selected
 - DAC_CHANNEL_2: DAC Channel2 selected

Return values

- **HAL:** status

HAL_DAC_Start_DMA

Function name **HAL_StatusTypeDef HAL_DAC_Start_DMA (DAC_HandleTypeDef * hdac, uint32_t Channel, uint32_t * pData, uint32_t Length, uint32_t Alignment)**

Function description Enables DAC and starts conversion of channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
 - DAC_CHANNEL_1: DAC Channel1 selected
 - DAC_CHANNEL_2: DAC Channel2 selected
- **pData:** The destination peripheral Buffer address.
- **Length:** The length of data to be transferred from memory to DAC peripheral
- **Alignment:** Specifies the data alignment for DAC channel. This parameter can be one of the following values:
 - DAC_ALIGN_8B_R: 8bit right data alignment selected
 - DAC_ALIGN_12B_L: 12bit left data alignment selected
 - DAC_ALIGN_12B_R: 12bit right data alignment selected

Return values

- **HAL:** status

HAL_DAC_Stop_DMA

Function name **HAL_StatusTypeDef HAL_DAC_Stop_DMA (DAC_HandleTypeDef * hdac, uint32_t Channel)**

Function description Disables DAC and stop conversion of channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
 - DAC_CHANNEL_1: DAC Channel1 selected

- DAC_CHANNEL_2: DAC Channel2 selected

Return values

- **HAL:** status

HAL_DAC_GetValue

Function name **uint32_t HAL_DAC_GetValue (DAC_HandleTypeDef * hdac, uint32_t Channel)**

Function description Returns the last data output value of the selected DAC channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
 - DAC_CHANNEL_1: DAC Channel1 selected
 - DAC_CHANNEL_2: DAC Channel2 selected

Return values

- **The:** selected DAC channel data output value.

HAL_DAC_ConfigChannel

Function name **HAL_StatusTypeDef HAL_DAC_ConfigChannel (DAC_HandleTypeDef * hdac, DAC_ChannelConfTypeDef * sConfig, uint32_t Channel)**

Function description Configures the selected DAC channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **sConfig:** DAC configuration structure.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
 - DAC_CHANNEL_1: DAC Channel1 selected
 - DAC_CHANNEL_2: DAC Channel2 selected

Return values

- **HAL:** status

HAL_DAC_SetValue

Function name **HAL_StatusTypeDef HAL_DAC_SetValue (DAC_HandleTypeDef * hdac, uint32_t Channel, uint32_t Alignment, uint32_t Data)**

Function description Set the specified data holding register value for DAC channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
 - DAC_CHANNEL_1: DAC Channel1 selected
 - DAC_CHANNEL_2: DAC Channel2 selected
- **Alignment:** Specifies the data alignment. This parameter can be one of the following values:
 - DAC_ALIGN_8B_R: 8bit right data alignment selected
 - DAC_ALIGN_12B_L: 12bit left data alignment selected
 - DAC_ALIGN_12B_R: 12bit right data alignment selected

- **Data:** Data to be loaded in the selected data holding register.
- **Return values**
- **HAL:** status

HAL_DAC_GetState

Function name **HAL_DAC_StateTypeDef HAL_DAC_GetState (DAC_HandleTypeDef * hdac)**

Function description return the DAC state

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **HAL:** state

HAL_DAC_IRQHandler

Function name **void HAL_DAC_IRQHandler (DAC_HandleTypeDef * hdac)**

Function description Handles DAC interrupt request.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **None:**

HAL_DAC_GetError

Function name **uint32_t HAL_DAC_GetError (DAC_HandleTypeDef * hdac)**

Function description Return the DAC error code.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **DAC:** Error Code

HAL_DAC_ConvCpltCallbackCh1

Function name **void HAL_DAC_ConvCpltCallbackCh1 (DAC_HandleTypeDef * hdac)**

Function description Conversion complete callback in non blocking mode for Channel1.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **None:**

HAL_DAC_ConvHalfCpltCallbackCh1

Function name **void HAL_DAC_ConvHalfCpltCallbackCh1 (DAC_HandleTypeDef * hdac)**

Function description Conversion half DMA transfer callback in non blocking mode for Channel1.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values • **None:**

HAL_DAC_ErrorCallbackCh1

Function name **void HAL_DAC_ErrorCallbackCh1 (DAC_HandleTypeDef * hdac)**

Function description Error DAC callback for Channel1.

Parameters • **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values • **None:**

HAL_DAC_DMAUnderrunCallbackCh1

Function name **void HAL_DAC_DMAUnderrunCallbackCh1 (DAC_HandleTypeDef * hdac)**

Function description DMA underrun DAC callback for channel1.

Parameters • **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values • **None:**

15.3 DAC Firmware driver defines

15.3.1 DAC

DAC Channel Selection

DAC_CHANNEL_1

DAC_CHANNEL_2

DAC Data Alignment

DAC_ALIGN_12B_R

DAC_ALIGN_12B_L

DAC_ALIGN_8B_R

DAC Error Code

HAL_DAC_ERROR_NONE No error

HAL_DAC_ERROR_DMAUNDERRUNCH1 DAC channel1 DAM underrun error

HAL_DAC_ERROR_DMAUNDERRUNCH2 DAC channel2 DAM underrun error

HAL_DAC_ERROR_DMA DMA error

DAC Exported Macros

__HAL_DAC_RESET_HANDLE_STATE **Description:**

- Reset DAC handle state.

Parameters:

- **__HANDLE__:** specifies the DAC handle.

Return value:



`__HAL_DAC_ENABLE`

- None

Description:

- Enable the DAC channel.

Parameters:

- `__HANDLE__`: specifies the DAC handle.
- `__DAC_CHANNEL__`: specifies the DAC channel

Return value:

- None

`__HAL_DAC_DISABLE`

Description:

- Disable the DAC channel.

Parameters:

- `__HANDLE__`: specifies the DAC handle
- `__DAC_CHANNEL__`: specifies the DAC channel.

Return value:

- None

`__HAL_DAC_ENABLE_IT`

Description:

- Enable the DAC interrupt.

Parameters:

- `__HANDLE__`: specifies the DAC handle
- `__INTERRUPT__`: specifies the DAC interrupt.

Return value:

- None

`__HAL_DAC_DISABLE_IT`

Description:

- Disable the DAC interrupt.

Parameters:

- `__HANDLE__`: specifies the DAC handle
- `__INTERRUPT__`: specifies the DAC interrupt.

Return value:

- None

`__HAL_DAC_GET_IT_SOURCE`

Description:

- Checks if the specified DAC interrupt source is enabled or disabled.

Parameters:

- `__HANDLE__`: DAC handle
- `__INTERRUPT__`: DAC interrupt source to check This parameter can be any

`__HAL_DAC_GET_FLAG`

`__HAL_DAC_CLEAR_FLAG`

DAC Flags Definition

`DAC_FLAG_DMAUDR1`

`DAC_FLAG_DMAUDR2`

DAC IT Definition

`DAC_IT_DMAUDR1`

`DAC_IT_DMAUDR2`

DAC Output Buffer

`DAC_OUTPUTBUFFER_ENABLE`

`DAC_OUTPUTBUFFER_DISABLE`

combination of the following values:

- `DAC_IT_DMAUDR1`: DAC channel 1 DMA underrun interrupt
- `DAC_IT_DMAUDR2`: DAC channel 2 DMA underrun interrupt

Return value:

- State: of interruption (SET or RESET)

Description:

- Get the selected DAC's flag status.

Parameters:

- `__HANDLE__`: specifies the DAC handle.
- `__FLAG__`: specifies the flag to clear. This parameter can be any combination of the following values:
 - `DAC_FLAG_DMAUDR1`: DMA underrun 1 flag
 - `DAC_FLAG_DMAUDR2`: DMA underrun 2 flag

Return value:

- None

Description:

- Clear the DAC's flag.

Parameters:

- `__HANDLE__`: specifies the DAC handle.
- `__FLAG__`: specifies the flag to clear. This parameter can be any combination of the following values:
 - `DAC_FLAG_DMAUDR1`: DMA underrun 1 flag
 - `DAC_FLAG_DMAUDR2`: DMA underrun 2 flag

Return value:

- None

DAC Trigger Selection

DAC_TRIGGER_NONE	Conversion is automatic once the DAC1_DHRxxxx register has been loaded, and not by external trigger
DAC_TRIGGER_T2_TRGO	TIM2 TRGO selected as external conversion trigger for DAC channel
DAC_TRIGGER_T4_TRGO	TIM4 TRGO selected as external conversion trigger for DAC channel
DAC_TRIGGER_T5_TRGO	TIM5 TRGO selected as external conversion trigger for DAC channel
DAC_TRIGGER_T6_TRGO	TIM6 TRGO selected as external conversion trigger for DAC channel
DAC_TRIGGER_T7_TRGO	TIM7 TRGO selected as external conversion trigger for DAC channel
DAC_TRIGGER_T8_TRGO	TIM8 TRGO selected as external conversion trigger for DAC channel
DAC_TRIGGER_EXT_IT9	EXTI Line9 event selected as external conversion trigger for DAC channel
DAC_TRIGGER_SOFTWARE	Conversion started by software trigger for DAC channel

16 HAL DAC Extension Driver

16.1 DACEx Firmware driver API description

16.1.1 How to use this driver

- When Dual mode is enabled (i.e DAC Channel1 and Channel2 are used simultaneously) : Use HAL_DACEx_DualGetValue() to get digital data to be converted and use HAL_DACEx_DualSetValue() to set digital value to converted simultaneously in Channel 1 and Channel 2.
- Use HAL_DACEx_TriangleWaveGenerate() to generate Triangle signal.
- Use HAL_DACEx_NoiseWaveGenerate() to generate Noise signal.

16.1.2 Extended features functions

This section provides functions allowing to:

- Start conversion.
- Stop conversion.
- Start conversion and enable DMA transfer.
- Stop conversion and disable DMA transfer.
- Get result of conversion.
- Get result of dual mode conversion.

This section contains the following APIs:

- [HAL_DACEx_DualGetValue\(\)](#)
- [HAL_DACEx_TriangleWaveGenerate\(\)](#)
- [HAL_DACEx_NoiseWaveGenerate\(\)](#)
- [HAL_DACEx_DualSetValue\(\)](#)
- [HAL_DACEx_ConvCpltCallbackCh2\(\)](#)
- [HAL_DACEx_ConvHalfCpltCallbackCh2\(\)](#)
- [HAL_DACEx_ErrorCallbackCh2\(\)](#)
- [HAL_DACEx_DMAUnderrunCallbackCh2\(\)](#)

16.1.3 Detailed description of functions

HAL_DACEx_DualGetValue

Function name **uint32_t HAL_DACEx_DualGetValue (DAC_HandleTypeDef * hdac)**

Function description Returns the last data output value of the selected DAC channel.

Parameters • **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values • **The:** selected DAC channel data output value.

HAL_DACEx_TriangleWaveGenerate

Function name **HAL_StatusTypeDef HAL_DACEx_TriangleWaveGenerate (DAC_HandleTypeDef * hdac, uint32_t Channel, uint32_t Amplitude)**

Function description	Enables or disables the selected DAC channel wave generation.
Parameters	<ul style="list-style-type: none"> • hdac: pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC. • Channel: The selected DAC channel. This parameter can be one of the following values: <ul style="list-style-type: none"> – DAC_CHANNEL_1: DAC Channel1 selected – DAC_CHANNEL_2: DAC Channel2 selected • Amplitude: Select max triangle amplitude. This parameter can be one of the following values: <ul style="list-style-type: none"> – DAC_TRIANGLEAMPLITUDE_1: Select max triangle amplitude of 1 – DAC_TRIANGLEAMPLITUDE_3: Select max triangle amplitude of 3 – DAC_TRIANGLEAMPLITUDE_7: Select max triangle amplitude of 7 – DAC_TRIANGLEAMPLITUDE_15: Select max triangle amplitude of 15 – DAC_TRIANGLEAMPLITUDE_31: Select max triangle amplitude of 31 – DAC_TRIANGLEAMPLITUDE_63: Select max triangle amplitude of 63 – DAC_TRIANGLEAMPLITUDE_127: Select max triangle amplitude of 127 – DAC_TRIANGLEAMPLITUDE_255: Select max triangle amplitude of 255 – DAC_TRIANGLEAMPLITUDE_511: Select max triangle amplitude of 511 – DAC_TRIANGLEAMPLITUDE_1023: Select max triangle amplitude of 1023 – DAC_TRIANGLEAMPLITUDE_2047: Select max triangle amplitude of 2047 – DAC_TRIANGLEAMPLITUDE_4095: Select max triangle amplitude of 4095
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DACEx_NoiseWaveGenerate

Function name	HAL_StatusTypeDef HAL_DACEx_NoiseWaveGenerate (DAC_HandleTypeDef * hdac, uint32_t Channel, uint32_t Amplitude)
Function description	Enables or disables the selected DAC channel wave generation.
Parameters	<ul style="list-style-type: none"> • hdac: pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC. • Channel: The selected DAC channel. This parameter can be one of the following values: <ul style="list-style-type: none"> – DAC_CHANNEL_1: DAC Channel1 selected – DAC_CHANNEL_2: DAC Channel2 selected • Amplitude: Unmask DAC channel LFSR for noise wave generation. This parameter can be one of the following values: <ul style="list-style-type: none"> – DAC_LFSRUNMASK_BIT0: Unmask DAC channel LFSR bit0 for noise wave generation

- DAC_LFSRUNMASK_BITS1_0: Unmask DAC channel LFSR bit[1:0] for noise wave generation
- DAC_LFSRUNMASK_BITS2_0: Unmask DAC channel LFSR bit[2:0] for noise wave generation
- DAC_LFSRUNMASK_BITS3_0: Unmask DAC channel LFSR bit[3:0] for noise wave generation
- DAC_LFSRUNMASK_BITS4_0: Unmask DAC channel LFSR bit[4:0] for noise wave generation
- DAC_LFSRUNMASK_BITS5_0: Unmask DAC channel LFSR bit[5:0] for noise wave generation
- DAC_LFSRUNMASK_BITS6_0: Unmask DAC channel LFSR bit[6:0] for noise wave generation
- DAC_LFSRUNMASK_BITS7_0: Unmask DAC channel LFSR bit[7:0] for noise wave generation
- DAC_LFSRUNMASK_BITS8_0: Unmask DAC channel LFSR bit[8:0] for noise wave generation
- DAC_LFSRUNMASK_BITS9_0: Unmask DAC channel LFSR bit[9:0] for noise wave generation
- DAC_LFSRUNMASK_BITS10_0: Unmask DAC channel LFSR bit[10:0] for noise wave generation
- DAC_LFSRUNMASK_BITS11_0: Unmask DAC channel LFSR bit[11:0] for noise wave generation

Return values

- **HAL:** status

HAL_DACEx_DualSetValue

Function name

HAL_StatusTypeDef HAL_DACEx_DualSetValue (DAC_HandleTypeDef * hdac, uint32_t Alignment, uint32_t Data1, uint32_t Data2)

Function description

Set the specified data holding register value for dual DAC channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Alignment:** Specifies the data alignment for dual channel DAC. This parameter can be one of the following values:
DAC_ALIGN_8B_R: 8bit right data alignment selected
DAC_ALIGN_12B_L: 12bit left data alignment selected
DAC_ALIGN_12B_R: 12bit right data alignment selected
- **Data1:** Data for DAC Channel2 to be loaded in the selected data holding register.
- **Data2:** Data for DAC Channel1 to be loaded in the selected data holding register.

Return values

- **HAL:** status

Notes

- In dual mode, a unique register access is required to write in both DAC channels at the same time.

HAL_DACEx_ConvCpltCallbackCh2

Function name

void HAL_DACEx_ConvCpltCallbackCh2 (DAC_HandleTypeDef * hdac)

Function description

Conversion complete callback in non blocking mode for Channel2.

- | | |
|---------------|--|
| Parameters | <ul style="list-style-type: none"> • hdac: pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC. |
| Return values | <ul style="list-style-type: none"> • None: |

HAL_DACEx_ConvHalfCpltCallbackCh2

- | | |
|----------------------|--|
| Function name | void HAL_DACEx_ConvHalfCpltCallbackCh2 (DAC_HandleTypeDef * hdac) |
| Function description | Conversion half DMA transfer callback in non blocking mode for Channel2. |
| Parameters | <ul style="list-style-type: none"> • hdac: pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC. |
| Return values | <ul style="list-style-type: none"> • None: |

HAL_DACEx_ErrorCallbackCh2

- | | |
|----------------------|--|
| Function name | void HAL_DACEx_ErrorCallbackCh2 (DAC_HandleTypeDef * hdac) |
| Function description | Error DAC callback for Channel2. |
| Parameters | <ul style="list-style-type: none"> • hdac: pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC. |
| Return values | <ul style="list-style-type: none"> • None: |

HAL_DACEx_DMAUnderrunCallbackCh2

- | | |
|----------------------|--|
| Function name | void HAL_DACEx_DMAUnderrunCallbackCh2 (DAC_HandleTypeDef * hdac) |
| Function description | DMA underrun DAC callback for channel2. |
| Parameters | <ul style="list-style-type: none"> • hdac: pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC. |
| Return values | <ul style="list-style-type: none"> • None: |

DAC_DMAConvCpltCh2

- | | |
|----------------------|---|
| Function name | void DAC_DMAConvCpltCh2 (DMA_HandleTypeDef * hdma) |
| Function description | DMA conversion complete callback. |
| Parameters | <ul style="list-style-type: none"> • hdma: pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module. |
| Return values | <ul style="list-style-type: none"> • None: |

DAC_DMAErrorCh2

- | | |
|----------------------|--|
| Function name | void DAC_DMAErrorCh2 (DMA_HandleTypeDef * hdma) |
| Function description | DMA error callback. |
| Parameters | <ul style="list-style-type: none"> • hdma: pointer to a DMA_HandleTypeDef structure that |

contains the configuration information for the specified DMA module.

Return values • **None:**

DAC_DMAHalfConvCpltCh2

Function name **void DAC_DMAHalfConvCpltCh2 (DMA_HandleTypeDef *hdma)**

Function description DMA half transfer complete callback.

Parameters • **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.

Return values • **None:**

16.2 DACEx Firmware driver defines

16.2.1 DACEx

DAC LFS Run Mask Triangle Amplitude

DAC_LFSRUNMASK_BIT0	Unmask DAC channel LFSR bit0 for noise wave generation
DAC_LFSRUNMASK_BITS1_0	Unmask DAC channel LFSR bit[1:0] for noise wave generation
DAC_LFSRUNMASK_BITS2_0	Unmask DAC channel LFSR bit[2:0] for noise wave generation
DAC_LFSRUNMASK_BITS3_0	Unmask DAC channel LFSR bit[3:0] for noise wave generation
DAC_LFSRUNMASK_BITS4_0	Unmask DAC channel LFSR bit[4:0] for noise wave generation
DAC_LFSRUNMASK_BITS5_0	Unmask DAC channel LFSR bit[5:0] for noise wave generation
DAC_LFSRUNMASK_BITS6_0	Unmask DAC channel LFSR bit[6:0] for noise wave generation
DAC_LFSRUNMASK_BITS7_0	Unmask DAC channel LFSR bit[7:0] for noise wave generation
DAC_LFSRUNMASK_BITS8_0	Unmask DAC channel LFSR bit[8:0] for noise wave generation
DAC_LFSRUNMASK_BITS9_0	Unmask DAC channel LFSR bit[9:0] for noise wave generation
DAC_LFSRUNMASK_BITS10_0	Unmask DAC channel LFSR bit[10:0] for noise wave generation
DAC_LFSRUNMASK_BITS11_0	Unmask DAC channel LFSR bit[11:0] for noise wave generation
DAC_TRIANGLEAMPLITUDE_1	Select max triangle amplitude of 1
DAC_TRIANGLEAMPLITUDE_3	Select max triangle amplitude of 3

DAC_TRIANGLEAMPLITUDE_7	Select max triangle amplitude of 7
DAC_TRIANGLEAMPLITUDE_15	Select max triangle amplitude of 15
DAC_TRIANGLEAMPLITUDE_31	Select max triangle amplitude of 31
DAC_TRIANGLEAMPLITUDE_63	Select max triangle amplitude of 63
DAC_TRIANGLEAMPLITUDE_127	Select max triangle amplitude of 127
DAC_TRIANGLEAMPLITUDE_255	Select max triangle amplitude of 255
DAC_TRIANGLEAMPLITUDE_511	Select max triangle amplitude of 511
DAC_TRIANGLEAMPLITUDE_1023	Select max triangle amplitude of 1023
DAC_TRIANGLEAMPLITUDE_2047	Select max triangle amplitude of 2047
DAC_TRIANGLEAMPLITUDE_4095	Select max triangle amplitude of 4095

17 HAL DCMI Generic Driver

17.1 DCMI Firmware driver registers structures

17.1.1 DCMI_CodesInitTypeDef

Data Fields

- *uint8_t FrameStartCode*
- *uint8_t LineStartCode*
- *uint8_t LineEndCode*
- *uint8_t FrameEndCode*

Field Documentation

- *uint8_t DCMI_CodesInitTypeDef::FrameStartCode*
Specifies the code of the frame start delimiter.
- *uint8_t DCMI_CodesInitTypeDef::LineStartCode*
Specifies the code of the line start delimiter.
- *uint8_t DCMI_CodesInitTypeDef::LineEndCode*
Specifies the code of the line end delimiter.
- *uint8_t DCMI_CodesInitTypeDef::FrameEndCode*
Specifies the code of the frame end delimiter.

17.1.2 DCMI_InitTypeDef

Data Fields

- *uint32_t SynchroMode*
- *uint32_t PCKPolarity*
- *uint32_t VSPolarity*
- *uint32_t HSPolarity*
- *uint32_t CaptureRate*
- *uint32_t ExtendedDataMode*
- *DCMI_CodesInitTypeDef SynchroCode*
- *uint32_t JPEGMode*
- *uint32_t ByteSelectMode*
- *uint32_t ByteSelectStart*
- *uint32_t LineSelectMode*
- *uint32_t LineSelectStart*

Field Documentation

- *uint32_t DCMI_InitTypeDef::SynchroMode*
Specifies the Synchronization Mode: Hardware or Embedded. This parameter can be a value of [DCMI_Synchronization_Mode](#)
- *uint32_t DCMI_InitTypeDef::PCKPolarity*
Specifies the Pixel clock polarity: Falling or Rising. This parameter can be a value of [DCMI_PIXCK_Polarity](#)
- *uint32_t DCMI_InitTypeDef::VSPolarity*
Specifies the Vertical synchronization polarity: High or Low. This parameter can be a value of [DCMI_VSYNC_Polarity](#)
- *uint32_t DCMI_InitTypeDef::HSPolarity*
Specifies the Horizontal synchronization polarity: High or Low. This parameter can be a value of [DCMI_HSYNC_Polarity](#)

- ***uint32_t DCMI_InitTypeDef::CaptureRate***
Specifies the frequency of frame capture: All, 1/2 or 1/4. This parameter can be a value of [DCMI_Capture_Rate](#)
- ***uint32_t DCMI_InitTypeDef::ExtendedDataMode***
Specifies the data width: 8-bit, 10-bit, 12-bit or 14-bit. This parameter can be a value of [DCMI_Extended_Data_Mode](#)
- ***DCMI_CodesInitTypeDef DCMI_InitTypeDef::SyncroCode***
Specifies the code of the line/frame start delimiter and the line/frame end delimiter
- ***uint32_t DCMI_InitTypeDef::JPEGMode***
Enable or Disable the JPEG mode. This parameter can be a value of [DCMI_MODE_JPEG](#)
- ***uint32_t DCMI_InitTypeDef::ByteSelectMode***
Specifies the data to be captured by the interface This parameter can be a value of [DCMI_Byte_Select_Mode](#)
- ***uint32_t DCMI_InitTypeDef::ByteSelectStart***
Specifies if the data to be captured by the interface is even or odd This parameter can be a value of [DCMI_Byte_Select_Start](#)
- ***uint32_t DCMI_InitTypeDef::LineSelectMode***
Specifies the line of data to be captured by the interface This parameter can be a value of [DCMI_Line_Select_Mode](#)
- ***uint32_t DCMI_InitTypeDef::LineSelectStart***
Specifies if the line of data to be captured by the interface is even or odd This parameter can be a value of [DCMI_Line_Select_Start](#)

17.1.3 DCMI_HandleTypeDef

Data Fields

- ***DCMI_TypeDef * Instance***
- ***DCMI_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_DCMI_StateTypeDef State***
- ***__IO uint32_t XferCount***
- ***__IO uint32_t XferSize***
- ***uint32_t XferTransferNumber***
- ***uint32_t pBuffPtr***
- ***DMA_HandleTypeDef * DMA_Handle***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***DCMI_TypeDef* DCMI_HandleTypeDef::Instance***
DCMI Register base address
- ***DCMI_InitTypeDef DCMI_HandleTypeDef::Init***
DCMI parameters
- ***HAL_LockTypeDef DCMI_HandleTypeDef::Lock***
DCMI locking object
- ***__IO HAL_DCMI_StateTypeDef DCMI_HandleTypeDef::State***
DCMI state
- ***__IO uint32_t DCMI_HandleTypeDef::XferCount***
DMA transfer counter
- ***__IO uint32_t DCMI_HandleTypeDef::XferSize***
DMA transfer size
- ***uint32_t DCMI_HandleTypeDef::XferTransferNumber***
DMA transfer number

- **`uint32_t DCMI_HandleTypeDef::pBuffPtr`**
Pointer to DMA output buffer
- **`DMA_HandleTypeDef* DCMI_HandleTypeDef::DMA_Handle`**
Pointer to the DMA handler
- **`__IO uint32_t DCMI_HandleTypeDef::ErrorCode`**
DCMI Error code

17.2 DCMI Firmware driver API description

17.2.1 How to use this driver

The sequence below describes how to use this driver to capture image from a camera module connected to the DCMI Interface. This sequence does not take into account the configuration of the camera module, which should be made before to configure and enable the DCMI to capture images.

1. Program the required configuration through following parameters: horizontal and vertical polarity, pixel clock polarity, Capture Rate, Synchronization Mode, code of the frame delimiter and data width using `HAL_DCMI_Init()` function.
2. Configure the `DMA2_Stream1` channel1 to transfer Data from DCMI DR register to the destination memory buffer.
3. Program the required configuration through following parameters: DCMI mode, destination memory Buffer address and the data length and enable capture using `HAL_DCMI_Start_DMA()` function.
4. Optionally, configure and Enable the CROP feature to select a rectangular window from the received image using `HAL_DCMI_ConfigCrop()` and `HAL_DCMI_EnableCROP()` functions
5. The capture can be stopped using `HAL_DCMI_Stop()` function.
6. To control DCMI state you can use the function `HAL_DCMI_GetState()`.

DCMI HAL driver macros list

Below the list of most used macros in DCMI HAL driver.

- `__HAL_DCMI_ENABLE`: Enable the DCMI peripheral.
- `__HAL_DCMI_DISABLE`: Disable the DCMI peripheral.
- `__HAL_DCMI_GET_FLAG`: Get the DCMI pending flags.
- `__HAL_DCMI_CLEAR_FLAG`: Clear the DCMI pending flags.
- `__HAL_DCMI_ENABLE_IT`: Enable the specified DCMI interrupts.
- `__HAL_DCMI_DISABLE_IT`: Disable the specified DCMI interrupts.
- `__HAL_DCMI_GET_IT_SOURCE`: Check whether the specified DCMI interrupt has occurred or not.



You can refer to the DCMI HAL driver header file for more useful macros

17.2.2 Initialization and Configuration functions

This section provides functions allowing to:

- Initialize and configure the DCMI
- De-initialize the DCMI

This section contains the following APIs:

- [HAL_DCMI_Init\(\)](#)
- [HAL_DCMI_DeInit\(\)](#)
- [HAL_DCMI_MspInit\(\)](#)
- [HAL_DCMI_MspDeInit\(\)](#)

17.2.3 IO operation functions

This section provides functions allowing to:

- Configure destination address and data length and Enables DCMI DMA request and enables DCMI capture
- Stop the DCMI capture.
- Handles DCMI interrupt request.

This section contains the following APIs:

- [HAL_DCMI_Start_DMA\(\)](#)
- [HAL_DCMI_Stop\(\)](#)
- [HAL_DCMI_Suspend\(\)](#)
- [HAL_DCMI_Resume\(\)](#)
- [HAL_DCMI_IRQHandler\(\)](#)
- [HAL_DCMI_ErrorCallback\(\)](#)
- [HAL_DCMI_LineEventCallback\(\)](#)
- [HAL_DCMI_VsyncEventCallback\(\)](#)
- [HAL_DCMI_FrameEventCallback\(\)](#)
- [HAL_DCMI_VsyncCallback\(\)](#)
- [HAL_DCMI_HsyncCallback\(\)](#)

17.2.4 Peripheral Control functions

This section provides functions allowing to:

- Configure the CROP feature.
- Enable/Disable the CROP feature.
- Set embedded synchronization delimiters unmask.

This section contains the following APIs:

- [HAL_DCMI_ConfigCrop\(\)](#)
- [HAL_DCMI_DisableCrop\(\)](#)
- [HAL_DCMI_EnableCrop\(\)](#)

17.2.5 Peripheral State and Errors functions

This subsection provides functions allowing to

- Check the DCMI state.
- Get the specific DCMI error flag.

This section contains the following APIs:

- [HAL_DCMI_GetState\(\)](#)
- [HAL_DCMI_GetError\(\)](#)

17.2.6 Detailed description of functions

HAL_DCMI_Init

Function name

HAL_StatusTypeDef HAL_DCMI_Init (DCMI_HandleTypeDef *

hdcmi)

Function description	Initializes the DCMI according to the specified parameters in the DCMI_InitTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none"> • hdcmi: pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DCMI_DeInit

Function name	HAL_StatusTypeDef HAL_DCMI_DeInit (DCMI_HandleTypeDef * hdcmi)
Function description	Deinitializes the DCMI peripheral registers to their default reset values.
Parameters	<ul style="list-style-type: none"> • hdcmi: pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DCMI_MspInit

Function name	void HAL_DCMI_MspInit (DCMI_HandleTypeDef * hdcmi)
Function description	Initializes the DCMI MSP.
Parameters	<ul style="list-style-type: none"> • hdcmi: pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.
Return values	<ul style="list-style-type: none"> • None:

HAL_DCMI_MspDeInit

Function name	void HAL_DCMI_MspDeInit (DCMI_HandleTypeDef * hdcmi)
Function description	Deinitializes the DCMI MSP.
Parameters	<ul style="list-style-type: none"> • hdcmi: pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.
Return values	<ul style="list-style-type: none"> • None:

HAL_DCMI_Start_DMA

Function name	HAL_StatusTypeDef HAL_DCMI_Start_DMA (DCMI_HandleTypeDef * hdcmi, uint32_t DCMI_Mode, uint32_t pData, uint32_t Length)
Function description	Enables DCMI DMA request and enables DCMI capture.
Parameters	<ul style="list-style-type: none"> • hdcmi: pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI. • DCMI_Mode: DCMI capture mode snapshot or continuous grab. • pData: The destination memory Buffer address (LCD Frame buffer). • Length: The length of capture to be transferred.

Return values

- **HAL:** status

HAL_DCMI_Stop

Function name **HAL_StatusTypeDef HAL_DCMI_Stop (DCMI_HandleTypeDef * hdcmi)**

Function description Disable DCMI DMA request and Disable DCMI capture.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **HAL:** status

HAL_DCMI_Suspend

Function name **HAL_StatusTypeDef HAL_DCMI_Suspend (DCMI_HandleTypeDef * hdcmi)**

Function description Suspend DCMI capture.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **HAL:** status

HAL_DCMI_Resume

Function name **HAL_StatusTypeDef HAL_DCMI_Resume (DCMI_HandleTypeDef * hdcmi)**

Function description Resume DCMI capture.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **HAL:** status

HAL_DCMI_ErrorCallback

Function name **void HAL_DCMI_ErrorCallback (DCMI_HandleTypeDef * hdcmi)**

Function description Error DCMI callback.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **None:**

HAL_DCMI_LineEventCallback

Function name **void HAL_DCMI_LineEventCallback (DCMI_HandleTypeDef * hdcmi)**

Function description Line Event callback.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **None:**

HAL_DCMI_FrameEventCallback

Function name	void HAL_DCMI_FrameEventCallback (DCMI_HandleTypeDef * hdcmi)
Function description	Frame Event callback.
Parameters	<ul style="list-style-type: none">• hdcmi: pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.
Return values	<ul style="list-style-type: none">• None:

HAL_DCMI_VsyncEventCallback

Function name	void HAL_DCMI_VsyncEventCallback (DCMI_HandleTypeDef * hdcmi)
Function description	VSYNC Event callback.
Parameters	<ul style="list-style-type: none">• hdcmi: pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.
Return values	<ul style="list-style-type: none">• None:

HAL_DCMI_VsyncCallback

Function name	void HAL_DCMI_VsyncCallback (DCMI_HandleTypeDef * hdcmi)
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Function description

HAL_DCMI_HsyncCallback

Function name	void HAL_DCMI_HsyncCallback (DCMI_HandleTypeDef * hdcmi)
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Function description

HAL_DCMI_IRQHandler

Function name	void HAL_DCMI_IRQHandler (DCMI_HandleTypeDef * hdcmi)
Function description	Handles DCMI interrupt request.
Parameters	<ul style="list-style-type: none">• hdcmi: pointer to a DCMI_HandleTypeDef structure that contains the configuration information for the DCMI.
Return values	<ul style="list-style-type: none">• None:

HAL_DCMI_ConfigCrop

Function name	HAL_StatusTypeDef HAL_DCMI_ConfigCrop (DCMI_HandleTypeDef * hdcmi, uint32_t X0, uint32_t Y0, uint32_t XSize, uint32_t YSize)
Function description	Configure the DCMI CROP coordinate.
Parameters	<ul style="list-style-type: none">• hdcmi: pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.• YSize: DCMI Line number• XSize: DCMI Pixel per line

- **X0:** DCMI window X offset
 - **Y0:** DCMI window Y offset
- Return values
- **HAL:** status

HAL_DCMI_EnableCrop

- Function name **HAL_StatusTypeDef HAL_DCMI_EnableCrop (DCMI_HandleTypeDef * hdcmi)**
- Function description Enable the Crop feature.
- Parameters
- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.
- Return values
- **HAL:** status

HAL_DCMI_DisableCrop

- Function name **HAL_StatusTypeDef HAL_DCMI_DisableCrop (DCMI_HandleTypeDef * hdcmi)**
- Function description Disable the Crop feature.
- Parameters
- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.
- Return values
- **HAL:** status

HAL_DCMI_GetState

- Function name **HAL_DCMI_StateTypeDef HAL_DCMI_GetState (DCMI_HandleTypeDef * hdcmi)**
- Function description Return the DCMI state.
- Parameters
- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.
- Return values
- **HAL:** state

HAL_DCMI_GetError

- Function name **uint32_t HAL_DCMI_GetError (DCMI_HandleTypeDef * hdcmi)**
- Function description Return the DCMI error code.
- Parameters
- **hdcmi:** : pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.
- Return values
- **DCMI:** Error Code

17.3 DCMI Firmware driver defines

17.3.1 DCMI

DCMI Byte Select Mode

DCMI_BSM_ALL Interface captures all received data

DCMI_BSM_OTHER	Interface captures every other byte from the received data
DCMI_BSM_ALTERNATE_4	Interface captures one byte out of four
DCMI_BSM_ALTERNATE_2	Interface captures two bytes out of four

DCMI Byte Select Start

DCMI_OEBS_ODD	Interface captures first data from the frame/line start, second one being dropped
DCMI_OEBS_EVEN	Interface captures second data from the frame/line start, first one being dropped

DCMI Capture Mode

DCMI_MODE_CONTINUOUS	The received data are transferred continuously into the destination memory through the DMA
DCMI_MODE_SNAPSHOT	Once activated, the interface waits for the start of frame and then transfers a single frame through the DMA

DCMI Capture Rate

DCMI_CR_ALL_FRAME	All frames are captured
DCMI_CR_ALTERNATE_2_FRAME	Every alternate frame captured
DCMI_CR_ALTERNATE_4_FRAME	One frame in 4 frames captured

DCMI Error Code

HAL_DCMI_ERROR_NONE	No error
HAL_DCMI_ERROR_OVR	Overrun error
HAL_DCMI_ERROR_SYNC	Synchronization error
HAL_DCMI_ERROR_TIMEOUT	Timeout error
HAL_DCMI_ERROR_DMA	DMA error

DCMI Exported Macros

__HAL_DCMI_RESET_HANDLE_STATE	Description: <ul style="list-style-type: none"> Reset DCMI handle state. Parameters: <ul style="list-style-type: none"> __HANDLE__: specifies the DCMI handle. Return value: <ul style="list-style-type: none"> None
__HAL_DCMI_ENABLE	Description: <ul style="list-style-type: none"> Enable the DCMI. Parameters: <ul style="list-style-type: none"> __HANDLE__: DCMI handle Return value: <ul style="list-style-type: none"> None
__HAL_DCMI_DISABLE	Description:

`__HAL_DCMI_GET_FLAG`

- Disable the DCMI.

Parameters:

- `__HANDLE__`: DCMI handle

Return value:

- None

Description:

- Get the DCMI pending flag.

Parameters:

- `__HANDLE__`: DCMI handle
- `__FLAG__`: Get the specified flag. This parameter can be one of the following values (no combination allowed)
 - `DCMI_FLAG_HSYNC`: HSYNC pin state (active line / synchronization between lines)
 - `DCMI_FLAG_VSYNC`: VSYNC pin state (active frame / synchronization between frames)
 - `DCMI_FLAG_FNE`: FIFO empty flag
 - `DCMI_FLAG_FRAMERI`: Frame capture complete flag mask
 - `DCMI_FLAG_OVRRI`: Overrun flag mask
 - `DCMI_FLAG_ERRRI`: Synchronization error flag mask
 - `DCMI_FLAG_VSYNCR`: VSYNC flag mask
 - `DCMI_FLAG_LINER`: Line flag mask
 - `DCMI_FLAG_FRAMEMI`: DCMI Capture complete masked interrupt status
 - `DCMI_FLAG_OVRMI`: DCMI Overrun masked interrupt status
 - `DCMI_FLAG_ERRMI`: DCMI Synchronization error masked interrupt status
 - `DCMI_FLAG_VSYNCMI`: DCMI VSYNC masked interrupt status
 - `DCMI_FLAG_LINEMI`: DCMI Line masked interrupt status

Return value:

- The: state of FLAG.

Description:

- Clear the DCMI pending flags.

Parameters:

- `__HANDLE__`: DCMI handle
- `__FLAG__`: specifies the flag to clear.

`__HAL_DCMI_CLEAR_FLAG`

`__HAL_DCMI_ENABLE_IT`

This parameter can be any combination of the following values:

- DCMI_FLAG_FRAMERI: Frame capture complete flag mask
- DCMI_FLAG_OVFRI: Overflow flag mask
- DCMI_FLAG_ERRRI: Synchronization error flag mask
- DCMI_FLAG_VSYNCR: VSYNC flag mask
- DCMI_FLAG_LINER: Line flag mask

Return value:

- None

Description:

- Enable the specified DCMI interrupts.

Parameters:

- `__HANDLE__`: DCMI handle
- `__INTERRUPT__`: specifies the DCMI interrupt sources to be enabled. This parameter can be any combination of the following values:
 - DCMI_IT_FRAME: Frame capture complete interrupt mask
 - DCMI_IT_OVF: Overflow interrupt mask
 - DCMI_IT_ERR: Synchronization error interrupt mask
 - DCMI_IT_VSYNC: VSYNC interrupt mask
 - DCMI_IT_LINE: Line interrupt mask

Return value:

- None

`__HAL_DCMI_DISABLE_IT`

Description:

- Disable the specified DCMI interrupts.

Parameters:

- `__HANDLE__`: DCMI handle
- `__INTERRUPT__`: specifies the DCMI interrupt sources to be enabled. This parameter can be any combination of the following values:
 - DCMI_IT_FRAME: Frame capture complete interrupt mask
 - DCMI_IT_OVF: Overflow interrupt mask
 - DCMI_IT_ERR: Synchronization error interrupt mask
 - DCMI_IT_VSYNC: VSYNC interrupt mask

- DCMI_IT_LINE: Line interrupt mask

Return value:

- None

Description:

- Check whether the specified DCMI interrupt has occurred or not.

Parameters:

- __HANDLE__: DCMI handle
- __INTERRUPT__: specifies the DCMI interrupt source to check. This parameter can be one of the following values:
 - DCMI_IT_FRAME: Frame capture complete interrupt mask
 - DCMI_IT_OVF: Overflow interrupt mask
 - DCMI_IT_ERR: Synchronization error interrupt mask
 - DCMI_IT_VSYNC: VSYNC interrupt mask
 - DCMI_IT_LINE: Line interrupt mask

Return value:

- The: state of INTERRUPT.

__HAL_DCMI_GET_IT_SOURCE

DCMI Extended Data Mode

DCMI_EXTEND_DATA_8B	Interface captures 8-bit data on every pixel clock
DCMI_EXTEND_DATA_10B	Interface captures 10-bit data on every pixel clock
DCMI_EXTEND_DATA_12B	Interface captures 12-bit data on every pixel clock
DCMI_EXTEND_DATA_14B	Interface captures 14-bit data on every pixel clock

DCMI Flags

DCMI_FLAG_HSYNC	HSYNC pin state (active line / synchronization between lines)
DCMI_FLAG_VSYNC	VSYNC pin state (active frame / synchronization between frames)
DCMI_FLAG_FNE	FIFO not empty flag
DCMI_FLAG_FRAMERI	Frame capture complete interrupt flag
DCMI_FLAG_OVRRI	Overrun interrupt flag
DCMI_FLAG_ERRRI	Synchronization error interrupt flag
DCMI_FLAG_VSYNCRI	VSYNC interrupt flag
DCMI_FLAG_LINERI	Line interrupt flag
DCMI_FLAG_FRAMEMI	DCMI Frame capture complete masked interrupt status
DCMI_FLAG_OVRMI	DCMI Overrun masked interrupt status
DCMI_FLAG_ERRMI	DCMI Synchronization error masked interrupt status
DCMI_FLAG_VSYNCMI	DCMI VSYNC masked interrupt status

DCMI_FLAG_LINEMI DCMI Line masked interrupt status

DCMI HSYNC Polarity

DCMI_HSPOLARITY_LOW Horizontal synchronization active Low

DCMI_HSPOLARITY_HIGH Horizontal synchronization active High

DCMI interrupt sources

DCMI_IT_FRAME Capture complete interrupt

DCMI_IT_OVR Overrun interrupt

DCMI_IT_ERR Synchronization error interrupt

DCMI_IT_VSYNC VSYNC interrupt

DCMI_IT_LINE Line interrupt

DCMI Line Select Mode

DCMI_LSM_ALL Interface captures all received lines

DCMI_LSM_ALTERNATE_2 Interface captures one line out of two

DCMI Line Select Start

DCMI_OELS_ODD Interface captures first line from the frame start, second one being dropped

DCMI_OELS_EVEN Interface captures second line from the frame start, first one being dropped

DCMI MODE JPEG

DCMI_JPEG_DISABLE Mode JPEG Disabled

DCMI_JPEG_ENABLE Mode JPEG Enabled

DCMI PIXCK Polarity

DCMI_PCKPOLARITY_FALLING Pixel clock active on Falling edge

DCMI_PCKPOLARITY_RISING Pixel clock active on Rising edge

DCMI Synchronization Mode

DCMI_SYNCHRO_HARDWARE Hardware synchronization data capture (frame/line start/stop) is synchronized with the HSYNC/VSYNC signals

DCMI_SYNCHRO_EMBEDDED Embedded synchronization data capture is synchronized with synchronization codes embedded in the data flow

DCMI VSYNC Polarity

DCMI_VSPOLARITY_LOW Vertical synchronization active Low

DCMI_VSPOLARITY_HIGH Vertical synchronization active High

DCMI Window Coordinate

DCMI_WINDOW_COORDINATE Window coordinate

DCMI Window Height

DCMI_WINDOW_HEIGHT Window Height

18 HAL DFSDM Generic Driver

18.1 DFSDM Firmware driver registers structures

18.1.1 DFSDM_Channel_OutputClockTypeDef

Data Fields

- *FunctionalState Activation*
- *uint32_t Selection*
- *uint32_t Divider*

Field Documentation

- *FunctionalState DFSDM_Channel_OutputClockTypeDef::Activation*
Output clock enable/disable
- *uint32_t DFSDM_Channel_OutputClockTypeDef::Selection*
Output clock is system clock or audio clock. This parameter can be a value of [DFSDM_Channel_OuputClock](#)
- *uint32_t DFSDM_Channel_OutputClockTypeDef::Divider*
Output clock divider. This parameter must be a number between Min_Data = 2 and Max_Data = 256

18.1.2 DFSDM_Channel_InputTypeDef

Data Fields

- *uint32_t Multiplexer*
- *uint32_t DataPacking*
- *uint32_t Pins*

Field Documentation

- *uint32_t DFSDM_Channel_InputTypeDef::Multiplexer*
Input is external serial inputs or internal register. This parameter can be a value of [DFSDM_Channel_InputMultiplexer](#)
- *uint32_t DFSDM_Channel_InputTypeDef::DataPacking*
Standard, interleaved or dual mode for internal register. This parameter can be a value of [DFSDM_Channel_DataPacking](#)
- *uint32_t DFSDM_Channel_InputTypeDef::Pins*
Input pins are taken from same or following channel. This parameter can be a value of [DFSDM_Channel_InputPins](#)

18.1.3 DFSDM_Channel_SerialInterfaceTypeDef

Data Fields

- *uint32_t Type*
- *uint32_t SpiClock*

Field Documentation

- *uint32_t DFSDM_Channel_SerialInterfaceTypeDef::Type*
SPI or Manchester modes. This parameter can be a value of [DFSDM_Channel_SerialInterfaceType](#)

- ***uint32_t DFSDM_Channel_SerialInterfaceTypeDef::SpiClock***
SPI clock select (external or internal with different sampling point). This parameter can be a value of [DFSDM_Channel_SpiClock](#)

18.1.4 DFSDM_Channel_AwdTypeDef

Data Fields

- ***uint32_t FilterOrder***
- ***uint32_t Oversampling***

Field Documentation

- ***uint32_t DFSDM_Channel_AwdTypeDef::FilterOrder***
Analog watchdog Sinc filter order. This parameter can be a value of [DFSDM_Channel_AwdFilterOrder](#)
- ***uint32_t DFSDM_Channel_AwdTypeDef::Oversampling***
Analog watchdog filter oversampling ratio. This parameter must be a number between Min_Data = 1 and Max_Data = 32

18.1.5 DFSDM_Channel_InitTypeDef

Data Fields

- ***DFSDM_Channel_OutputClockTypeDef OutputClock***
- ***DFSDM_Channel_InputTypeDef Input***
- ***DFSDM_Channel_SerialInterfaceTypeDef SerialInterface***
- ***DFSDM_Channel_AwdTypeDef Awd***
- ***int32_t Offset***
- ***uint32_t RightBitShift***

Field Documentation

- ***DFSDM_Channel_OutputClockTypeDef DFSDM_Channel_InitTypeDef::OutputClock***
DFSDM channel output clock parameters
- ***DFSDM_Channel_InputTypeDef DFSDM_Channel_InitTypeDef::Input***
DFSDM channel input parameters
- ***DFSDM_Channel_SerialInterfaceTypeDef DFSDM_Channel_InitTypeDef::SerialInterface***
DFSDM channel serial interface parameters
- ***DFSDM_Channel_AwdTypeDef DFSDM_Channel_InitTypeDef::Awd***
DFSDM channel analog watchdog parameters
- ***int32_t DFSDM_Channel_InitTypeDef::Offset***
DFSDM channel offset. This parameter must be a number between Min_Data = -8388608 and Max_Data = 8388607
- ***uint32_t DFSDM_Channel_InitTypeDef::RightBitShift***
DFSDM channel right bit shift. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1F

18.1.6 DFSDM_Channel_HandleTypeDef

Data Fields

- ***DFSDM_Channel_TypeDef * Instance***
- ***DFSDM_Channel_InitTypeDef Init***
- ***HAL_DFSDM_Channel_StateTypeDef State***

Field Documentation

- ***DFSDM_Channel_TypeDef* DFSDM_Channel_HandleTypeDef::Instance***
DFSDM channel instance
- ***DFSDM_Channel_InitTypeDef DFSDM_Channel_HandleTypeDef::Init***
DFSDM channel init parameters
- ***HAL_DFSDM_Channel_StateTypeDef DFSDM_Channel_HandleTypeDef::State***
DFSDM channel state

18.1.7 DFSDM_Filter_RegularParamTypeDef

Data Fields

- ***uint32_t Trigger***
- ***FunctionalState FastMode***
- ***FunctionalState DmaMode***

Field Documentation

- ***uint32_t DFSDM_Filter_RegularParamTypeDef::Trigger***
Trigger used to start regular conversion: software or synchronous. This parameter can be a value of [DFSDM_Filter_Trigger](#)
- ***FunctionalState DFSDM_Filter_RegularParamTypeDef::FastMode***
Enable/disable fast mode for regular conversion
- ***FunctionalState DFSDM_Filter_RegularParamTypeDef::DmaMode***
Enable/disable DMA for regular conversion

18.1.8 DFSDM_Filter_InjectedParamTypeDef

Data Fields

- ***uint32_t Trigger***
- ***FunctionalState ScanMode***
- ***FunctionalState DmaMode***
- ***uint32_t ExtTrigger***
- ***uint32_t ExtTriggerEdge***

Field Documentation

- ***uint32_t DFSDM_Filter_InjectedParamTypeDef::Trigger***
Trigger used to start injected conversion: software, external or synchronous. This parameter can be a value of [DFSDM_Filter_Trigger](#)
- ***FunctionalState DFSDM_Filter_InjectedParamTypeDef::ScanMode***
Enable/disable scanning mode for injected conversion
- ***FunctionalState DFSDM_Filter_InjectedParamTypeDef::DmaMode***
Enable/disable DMA for injected conversion
- ***uint32_t DFSDM_Filter_InjectedParamTypeDef::ExtTrigger***
External trigger. This parameter can be a value of [DFSDM_Filter_ExtTrigger](#)
- ***uint32_t DFSDM_Filter_InjectedParamTypeDef::ExtTriggerEdge***
External trigger edge: rising, falling or both. This parameter can be a value of [DFSDM_Filter_ExtTriggerEdge](#)

18.1.9 DFSDM_Filter_FilterParamTypeDef

Data Fields

- ***uint32_t SincOrder***
- ***uint32_t Oversampling***
- ***uint32_t IntOversampling***

Field Documentation

- ***uint32_t DFSDM_Filter_FilterParamTypeDef::SincOrder***
Sinc filter order. This parameter can be a value of [DFSDM_Filter_SincOrder](#)
- ***uint32_t DFSDM_Filter_FilterParamTypeDef::Oversampling***
Filter oversampling ratio. This parameter must be a number between Min_Data = 1 and Max_Data = 1024
- ***uint32_t DFSDM_Filter_FilterParamTypeDef::IntOversampling***
Integrator oversampling ratio. This parameter must be a number between Min_Data = 1 and Max_Data = 256

18.1.10 DFSDM_Filter_InitTypeDef

Data Fields

- ***DFSDM_Filter_RegularParamTypeDef RegularParam***
- ***DFSDM_Filter_InjectedParamTypeDef InjectedParam***
- ***DFSDM_Filter_FilterParamTypeDef FilterParam***

Field Documentation

- ***DFSDM_Filter_RegularParamTypeDef DFSDM_Filter_InitTypeDef::RegularParam***
DFSDM regular conversion parameters
- ***DFSDM_Filter_InjectedParamTypeDef DFSDM_Filter_InitTypeDef::InjectedParam***
DFSDM injected conversion parameters
- ***DFSDM_Filter_FilterParamTypeDef DFSDM_Filter_InitTypeDef::FilterParam***
DFSDM filter parameters

18.1.11 DFSDM_Filter_HandleTypeDef

Data Fields

- ***DFSDM_Filter_TypeDef * Instance***
- ***DFSDM_Filter_InitTypeDef Init***
- ***DMA_HandleTypeDef * hdmaReg***
- ***DMA_HandleTypeDef * hdmaInj***
- ***uint32_t RegularContMode***
- ***uint32_t RegularTrigger***
- ***uint32_t InjectedTrigger***
- ***uint32_t ExtTriggerEdge***
- ***FunctionalState InjectedScanMode***
- ***uint32_t InjectedChannelsNbr***
- ***uint32_t InjConvRemaining***
- ***HAL_DFSDM_Filter_StateTypeDef State***
- ***uint32_t ErrorCode***

Field Documentation

- ***DFSDM_Filter_TypeDef* DFSDM_Filter_HandleTypeDef::Instance***
DFSDM filter instance
- ***DFSDM_Filter_InitTypeDef DFSDM_Filter_HandleTypeDef::Init***
DFSDM filter init parameters
- ***DMA_HandleTypeDef* DFSDM_Filter_HandleTypeDef::hdmaReg***
Pointer on DMA handler for regular conversions
- ***DMA_HandleTypeDef* DFSDM_Filter_HandleTypeDef::hdmaInj***
Pointer on DMA handler for injected conversions
- ***uint32_t DFSDM_Filter_HandleTypeDef::RegularContMode***
Regular conversion continuous mode

- ***uint32_t DFSDM_Filter_HandleTypeDef::RegularTrigger***
Trigger used for regular conversion
- ***uint32_t DFSDM_Filter_HandleTypeDef::InjectedTrigger***
Trigger used for injected conversion
- ***uint32_t DFSDM_Filter_HandleTypeDef::ExtTriggerEdge***
Rising, falling or both edges selected
- ***FunctionalState DFSDM_Filter_HandleTypeDef::InjectedScanMode***
Injected scanning mode
- ***uint32_t DFSDM_Filter_HandleTypeDef::InjectedChannelsNbr***
Number of channels in injected sequence
- ***uint32_t DFSDM_Filter_HandleTypeDef::InjConvRemaining***
Injected conversions remaining
- ***HAL_DFSDM_Filter_StateTypeDef DFSDM_Filter_HandleTypeDef::State***
DFSDM filter state
- ***uint32_t DFSDM_Filter_HandleTypeDef::ErrorCode***
DFSDM filter error code

18.1.12 DFSDM_Filter_AwdParamTypeDef

Data Fields

- ***uint32_t DataSource***
- ***uint32_t Channel***
- ***int32_t HighThreshold***
- ***int32_t LowThreshold***
- ***uint32_t HighBreakSignal***
- ***uint32_t LowBreakSignal***

Field Documentation

- ***uint32_t DFSDM_Filter_AwdParamTypeDef::DataSource***
Values from digital filter or from channel watchdog filter. This parameter can be a value of [DFSDM_Filter_AwdDataSource](#)
- ***uint32_t DFSDM_Filter_AwdParamTypeDef::Channel***
Analog watchdog channel selection. This parameter can be a values combination of [DFSDM_Channel_Selection](#)
- ***int32_t DFSDM_Filter_AwdParamTypeDef::HighThreshold***
High threshold for the analog watchdog. This parameter must be a number between Min_Data = -8388608 and Max_Data = 8388607
- ***int32_t DFSDM_Filter_AwdParamTypeDef::LowThreshold***
Low threshold for the analog watchdog. This parameter must be a number between Min_Data = -8388608 and Max_Data = 8388607
- ***uint32_t DFSDM_Filter_AwdParamTypeDef::HighBreakSignal***
Break signal assigned to analog watchdog high threshold event. This parameter can be a values combination of [DFSDM_BreakSignals](#)
- ***uint32_t DFSDM_Filter_AwdParamTypeDef::LowBreakSignal***
Break signal assigned to analog watchdog low threshold event. This parameter can be a values combination of [DFSDM_BreakSignals](#)

18.2 DFSDM Firmware driver API description

18.2.1 How to use this driver

Channel initialization

1. User has first to initialize channels (before filters initialization).
2. As prerequisite, fill in the HAL_DFSDM_ChannelMspInit() :
 - Enable DFSDMz clock interface with __HAL_RCC_DFSDMz_CLK_ENABLE().
 - Enable the clocks for the DFSDMz GPIOs with __HAL_RCC_GPIOx_CLK_ENABLE().
 - Configure these DFSDMz pins in alternate mode using HAL_GPIO_Init().
 - If interrupt mode is used, enable and configure DFSDMz_FLT0 global interrupt with HAL_NVIC_SetPriority() and HAL_NVIC_EnableIRQ().
3. Configure the output clock, input, serial interface, analog watchdog, offset and data right bit shift parameters for this channel using the HAL_DFSDM_ChannelInit() function.

Channel clock absence detector

1. Start clock absence detector using HAL_DFSDM_ChannelCkabStart() or HAL_DFSDM_ChannelCkabStart_IT().
2. In polling mode, use HAL_DFSDM_ChannelPollForCkab() to detect the clock absence.
3. In interrupt mode, HAL_DFSDM_ChannelCkabCallback() will be called if clock absence is detected.
4. Stop clock absence detector using HAL_DFSDM_ChannelCkabStop() or HAL_DFSDM_ChannelCkabStop_IT().
5. Please note that the same mode (polling or interrupt) has to be used for all channels because the channels are sharing the same interrupt.
6. Please note also that in interrupt mode, if clock absence detector is stopped for one channel, interrupt will be disabled for all channels.

Channel short circuit detector

1. Start short circuit detector using HAL_DFSDM_ChannelScdStart() or HAL_DFSDM_ChannelScdStart_IT().
2. In polling mode, use HAL_DFSDM_ChannelPollForScd() to detect short circuit.
3. In interrupt mode, HAL_DFSDM_ChannelScdCallback() will be called if short circuit is detected.
4. Stop short circuit detector using HAL_DFSDM_ChannelScdStop() or HAL_DFSDM_ChannelScdStop_IT().
5. Please note that the same mode (polling or interrupt) has to be used for all channels because the channels are sharing the same interrupt.
6. Please note also that in interrupt mode, if short circuit detector is stopped for one channel, interrupt will be disabled for all channels.

Channel analog watchdog value

1. Get analog watchdog filter value of a channel using HAL_DFSDM_ChannelGetAwdValue().

Channel offset value

1. Modify offset value of a channel using HAL_DFSDM_ChannelModifyOffset().

Filter initialization

1. After channel initialization, user has to init filters.
2. As prerequisite, fill in the HAL_DFSDM_FilterMspInit() :

- If interrupt mode is used, enable and configure DFSDMz_FLTx global interrupt with HAL_NVIC_SetPriority() and HAL_NVIC_EnableIRQ(). Please note that DFSDMz_FLT0 global interrupt could be already enabled if interrupt is used for channel.
 - If DMA mode is used, configure DMA with HAL_DMA_Init() and link it with DFSDMz filter handle using __HAL_LINKDMA().
3. Configure the regular conversion, injected conversion and filter parameters for this filter using the HAL_DFSDM_FilterInit() function.

Filter regular channel conversion

1. Select regular channel and enable/disable continuous mode using HAL_DFSDM_FilterConfigRegChannel().
2. Start regular conversion using HAL_DFSDM_FilterRegularStart(), HAL_DFSDM_FilterRegularStart_IT(), HAL_DFSDM_FilterRegularStart_DMA() or HAL_DFSDM_FilterRegularMsbStart_DMA().
3. In polling mode, use HAL_DFSDM_FilterPollForRegConversion() to detect the end of regular conversion.
4. In interrupt mode, HAL_DFSDM_FilterRegConvCpltCallback() will be called at the end of regular conversion.
5. Get value of regular conversion and corresponding channel using HAL_DFSDM_FilterGetRegularValue().
6. In DMA mode, HAL_DFSDM_FilterRegConvHalfCpltCallback() and HAL_DFSDM_FilterRegConvCpltCallback() will be called respectively at the half transfer and at the transfer complete. Please note that HAL_DFSDM_FilterRegConvHalfCpltCallback() will be called only in DMA circular mode.
7. Stop regular conversion using HAL_DFSDM_FilterRegularStop(), HAL_DFSDM_FilterRegularStop_IT() or HAL_DFSDM_FilterRegularStop_DMA().

Filter injected channels conversion

1. Select injected channels using HAL_DFSDM_FilterConfigInjChannel().
2. Start injected conversion using HAL_DFSDM_FilterInjectedStart(), HAL_DFSDM_FilterInjectedStart_IT(), HAL_DFSDM_FilterInjectedStart_DMA() or HAL_DFSDM_FilterInjectedMsbStart_DMA().
3. In polling mode, use HAL_DFSDM_FilterPollForInjConversion() to detect the end of injected conversion.
4. In interrupt mode, HAL_DFSDM_FilterInjConvCpltCallback() will be called at the end of injected conversion.
5. Get value of injected conversion and corresponding channel using HAL_DFSDM_FilterGetInjectedValue().
6. In DMA mode, HAL_DFSDM_FilterInjConvHalfCpltCallback() and HAL_DFSDM_FilterInjConvCpltCallback() will be called respectively at the half transfer and at the transfer complete. Please note that HAL_DFSDM_FilterInjConvCpltCallback() will be called only in DMA circular mode.
7. Stop injected conversion using HAL_DFSDM_FilterInjectedStop(), HAL_DFSDM_FilterInjectedStop_IT() or HAL_DFSDM_FilterInjectedStop_DMA().

Filter analog watchdog

1. Start filter analog watchdog using HAL_DFSDM_FilterAwdStart_IT().
2. HAL_DFSDM_FilterAwdCallback() will be called if analog watchdog occurs.
3. Stop filter analog watchdog using HAL_DFSDM_FilterAwdStop_IT().

Filter extreme detector

1. Start filter extreme detector using HAL_DFSDM_FilterExdStart().
2. Get extreme detector maximum value using HAL_DFSDM_FilterGetExdMaxValue().
3. Get extreme detector minimum value using HAL_DFSDM_FilterGetExdMinValue().
4. Start filter extreme detector using HAL_DFSDM_FilterExdStop().

Filter conversion time

1. Get conversion time value using HAL_DFSDM_FilterGetConvTimeValue().

18.2.2 Channel initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the DFSDM channel.
- De-initialize the DFSDM channel.

This section contains the following APIs:

- [HAL_DFSDM_ChannelInit\(\)](#)
- [HAL_DFSDM_ChannelDeInit\(\)](#)
- [HAL_DFSDM_ChannelMspInit\(\)](#)
- [HAL_DFSDM_ChannelMspDeInit\(\)](#)

18.2.3 Channel operation functions

This section provides functions allowing to:

- Manage clock absence detector feature.
- Manage short circuit detector feature.
- Get analog watchdog value.
- Modify offset value.

This section contains the following APIs:

- [HAL_DFSDM_ChannelCkabStart\(\)](#)
- [HAL_DFSDM_ChannelPollForCkab\(\)](#)
- [HAL_DFSDM_ChannelCkabStop\(\)](#)
- [HAL_DFSDM_ChannelCkabStart_IT\(\)](#)
- [HAL_DFSDM_ChannelCkabCallback\(\)](#)
- [HAL_DFSDM_ChannelCkabStop_IT\(\)](#)
- [HAL_DFSDM_ChannelScdStart\(\)](#)
- [HAL_DFSDM_ChannelPollForScd\(\)](#)
- [HAL_DFSDM_ChannelScdStop\(\)](#)
- [HAL_DFSDM_ChannelScdStart_IT\(\)](#)
- [HAL_DFSDM_ChannelScdCallback\(\)](#)
- [HAL_DFSDM_ChannelScdStop_IT\(\)](#)
- [HAL_DFSDM_ChannelGetAwdValue\(\)](#)
- [HAL_DFSDM_ChannelModifyOffset\(\)](#)

18.2.4 Channel state function

This section provides function allowing to:

- Get channel handle state.

This section contains the following APIs:

- [HAL_DFSDM_ChannelGetState\(\)](#)

18.2.5 Filter initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the DFSDM filter.
- De-initialize the DFSDM filter.

This section contains the following APIs:

- [*HAL_DFSDM_FilterInit\(\)*](#)
- [*HAL_DFSDM_FilterDeInit\(\)*](#)
- [*HAL_DFSDM_FilterMspInit\(\)*](#)
- [*HAL_DFSDM_FilterMspDeInit\(\)*](#)

18.2.6 Filter control functions

This section provides functions allowing to:

- Select channel and enable/disable continuous mode for regular conversion.
- Select channels for injected conversion.

This section contains the following APIs:

- [*HAL_DFSDM_FilterConfigRegChannel\(\)*](#)
- [*HAL_DFSDM_FilterConfigInjChannel\(\)*](#)

18.2.7 Filter operation functions

This section provides functions allowing to:

- Start conversion of regular/injected channel.
- Poll for the end of regular/injected conversion.
- Stop conversion of regular/injected channel.
- Start conversion of regular/injected channel and enable interrupt.
- Call the callback functions at the end of regular/injected conversions.
- Stop conversion of regular/injected channel and disable interrupt.
- Start conversion of regular/injected channel and enable DMA transfer.
- Stop conversion of regular/injected channel and disable DMA transfer.
- Start analog watchdog and enable interrupt.
- Call the callback function when analog watchdog occurs.
- Stop analog watchdog and disable interrupt.
- Start extreme detector.
- Stop extreme detector.
- Get result of regular channel conversion.
- Get result of injected channel conversion.
- Get extreme detector maximum and minimum values.
- Get conversion time.
- Handle DFSDM interrupt request.

This section contains the following APIs:

- [*HAL_DFSDM_FilterRegularStart\(\)*](#)
- [*HAL_DFSDM_FilterPollForRegConversion\(\)*](#)
- [*HAL_DFSDM_FilterRegularStop\(\)*](#)
- [*HAL_DFSDM_FilterRegularStart_IT\(\)*](#)
- [*HAL_DFSDM_FilterRegularStop_IT\(\)*](#)
- [*HAL_DFSDM_FilterRegularStart_DMA\(\)*](#)
- [*HAL_DFSDM_FilterRegularMsbStart_DMA\(\)*](#)
- [*HAL_DFSDM_FilterRegularStop_DMA\(\)*](#)

- [HAL_DFSDM_FilterGetRegularValue\(\)](#)
- [HAL_DFSDM_FilterInjectedStart\(\)](#)
- [HAL_DFSDM_FilterPollForInjConversion\(\)](#)
- [HAL_DFSDM_FilterInjectedStop\(\)](#)
- [HAL_DFSDM_FilterInjectedStart_IT\(\)](#)
- [HAL_DFSDM_FilterInjectedStop_IT\(\)](#)
- [HAL_DFSDM_FilterInjectedStart_DMA\(\)](#)
- [HAL_DFSDM_FilterInjectedMsbStart_DMA\(\)](#)
- [HAL_DFSDM_FilterInjectedStop_DMA\(\)](#)
- [HAL_DFSDM_FilterGetInjectedValue\(\)](#)
- [HAL_DFSDM_FilterAwdStart_IT\(\)](#)
- [HAL_DFSDM_FilterAwdStop_IT\(\)](#)
- [HAL_DFSDM_FilterExdStart\(\)](#)
- [HAL_DFSDM_FilterExdStop\(\)](#)
- [HAL_DFSDM_FilterGetExdMaxValue\(\)](#)
- [HAL_DFSDM_FilterGetExdMinValue\(\)](#)
- [HAL_DFSDM_FilterGetConvTimeValue\(\)](#)
- [HAL_DFSDM_IRQHandler\(\)](#)
- [HAL_DFSDM_FilterRegConvCpltCallback\(\)](#)
- [HAL_DFSDM_FilterRegConvHalfCpltCallback\(\)](#)
- [HAL_DFSDM_FilterInjConvCpltCallback\(\)](#)
- [HAL_DFSDM_FilterInjConvHalfCpltCallback\(\)](#)
- [HAL_DFSDM_FilterAwdCallback\(\)](#)
- [HAL_DFSDM_FilterErrorCallback\(\)](#)

18.2.8 Filter state functions

This section provides functions allowing to:

- Get the DFSDM filter state.
- Get the DFSDM filter error.

This section contains the following APIs:

- [HAL_DFSDM_FilterGetState\(\)](#)
- [HAL_DFSDM_FilterGetError\(\)](#)

18.2.9 Detailed description of functions

HAL_DFSDM_ChannelInit

Function name	HAL_StatusTypeDef HAL_DFSDM_ChannelInit (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)
Function description	Initialize the DFSDM channel according to the specified parameters in the DFSDM_ChannelInitTypeDef structure and initialize the associated handle.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle.
Return values	<ul style="list-style-type: none"> • HAL: status.

HAL_DFSDM_ChannelDeInit

Function name	HAL_StatusTypeDef HAL_DFSDM_ChannelDeInit (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)
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Function description	De-initialize the DFSDM channel.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle.
Return values	<ul style="list-style-type: none"> • HAL: status.

HAL_DFSDM_ChannelMspInit

Function name	void HAL_DFSDM_ChannelMspInit (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)
Function description	Initialize the DFSDM channel MSP.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle.
Return values	<ul style="list-style-type: none"> • None:

HAL_DFSDM_ChannelMspDeInit

Function name	void HAL_DFSDM_ChannelMspDeInit (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)
Function description	De-initialize the DFSDM channel MSP.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle.
Return values	<ul style="list-style-type: none"> • None:

HAL_DFSDM_ChannelCkabStart

Function name	HAL_StatusTypeDef HAL_DFSDM_ChannelCkabStart (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)
Function description	This function allows to start clock absence detection in polling mode.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • Same mode has to be used for all channels. • If clock is not available on this channel during 5 seconds, clock absence detection will not be activated and function will return HAL_TIMEOUT error.

HAL_DFSDM_ChannelCkabStart_IT

Function name	HAL_StatusTypeDef HAL_DFSDM_ChannelCkabStart_IT (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)
Function description	This function allows to start clock absence detection in interrupt mode.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • Same mode has to be used for all channels. • If clock is not available on this channel during 5 seconds, clock absence detection will not be activated and function will return HAL_TIMEOUT error.

HAL_DFSDM_ChannelCkabStop

Function name	HAL_StatusTypeDef HAL_DFSDM_ChannelCkabStop (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)
Function description	This function allows to stop clock absence detection in polling mode.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DFSDM_ChannelCkabStop_IT

Function name	HAL_StatusTypeDef HAL_DFSDM_ChannelCkabStop_IT (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)
Function description	This function allows to stop clock absence detection in interrupt mode.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • Interrupt will be disabled for all channels

HAL_DFSDM_ChannelScdStart

Function name	HAL_StatusTypeDef HAL_DFSDM_ChannelScdStart (DFSDM_Channel_HandleTypeDef * hdfsdm_channel, uint32_t Threshold, uint32_t BreakSignal)
Function description	This function allows to start short circuit detection in polling mode.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle. • Threshold: : Short circuit detector threshold. This parameter must be a number between Min_Data = 0 and Max_Data = 255. • BreakSignal: : Break signals assigned to short circuit event. This parameter can be a values combination of DFSDM break signals.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • Same mode has to be used for all channels

HAL_DFSDM_ChannelScdStart_IT

Function name	HAL_StatusTypeDef HAL_DFSDM_ChannelScdStart_IT (DFSDM_Channel_HandleTypeDef * hdfsdm_channel, uint32_t Threshold, uint32_t BreakSignal)
Function description	This function allows to start short circuit detection in interrupt mode.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle. • Threshold: : Short circuit detector threshold. This parameter must be a number between Min_Data = 0 and Max_Data = 255. • BreakSignal: : Break signals assigned to short circuit event. This parameter can be a values combination of DFSDM break

signals.

- Return values
- **HAL:** status
- Notes
- Same mode has to be used for all channels

HAL_DFSDM_ChannelScdStop

- Function name **HAL_StatusTypeDef HAL_DFSDM_ChannelScdStop (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)**
- Function description This function allows to stop short circuit detection in polling mode.
- Parameters
- **hdfsdm_channel:** : DFSDM channel handle.
- Return values
- **HAL:** status

HAL_DFSDM_ChannelScdStop_IT

- Function name **HAL_StatusTypeDef HAL_DFSDM_ChannelScdStop_IT (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)**
- Function description This function allows to stop short circuit detection in interrupt mode.
- Parameters
- **hdfsdm_channel:** : DFSDM channel handle.
- Return values
- **HAL:** status
- Notes
- Interrupt will be disabled for all channels

HAL_DFSDM_ChannelGetAwdValue

- Function name **int16_t HAL_DFSDM_ChannelGetAwdValue (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)**
- Function description This function allows to get channel analog watchdog value.
- Parameters
- **hdfsdm_channel:** : DFSDM channel handle.
- Return values
- **Channel:** analog watchdog value.

HAL_DFSDM_ChannelModifyOffset

- Function name **HAL_StatusTypeDef HAL_DFSDM_ChannelModifyOffset (DFSDM_Channel_HandleTypeDef * hdfsdm_channel, int32_t Offset)**
- Function description This function allows to modify channel offset value.
- Parameters
- **hdfsdm_channel:** : DFSDM channel handle.
 - **Offset:** : DFSDM channel offset. This parameter must be a number between Min_Data = -8388608 and Max_Data = 8388607.
- Return values
- **HAL:** status.

HAL_DFSDM_ChannelPollForCkab

- Function name **HAL_StatusTypeDef HAL_DFSDM_ChannelPollForCkab (DFSDM_Channel_HandleTypeDef * hdfsdm_channel, uint32_t**

Timeout)

Function description	This function allows to poll for the clock absence detection.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle. • Timeout: : Timeout value in milliseconds.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DFSDM_ChannelPollForScd

Function name	HAL_StatusTypeDef HAL_DFSDM_ChannelPollForScd (DFSDM_Channel_HandleTypeDef * hdfsdm_channel, uint32_t Timeout)
Function description	This function allows to poll for the short circuit detection.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle. • Timeout: : Timeout value in milliseconds.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DFSDM_ChannelCkabCallback

Function name	void HAL_DFSDM_ChannelCkabCallback (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)
Function description	Clock absence detection callback.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle.
Return values	<ul style="list-style-type: none"> • None:

HAL_DFSDM_ChannelScdCallback

Function name	void HAL_DFSDM_ChannelScdCallback (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)
Function description	Short circuit detection callback.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle.
Return values	<ul style="list-style-type: none"> • None:

HAL_DFSDM_ChannelGetState

Function name	HAL_DFSDM_Channel_StateTypeDef HAL_DFSDM_ChannelGetState (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)
Function description	This function allows to get the current DFSDM channel handle state.
Parameters	<ul style="list-style-type: none"> • hdfsdm_channel: : DFSDM channel handle.
Return values	<ul style="list-style-type: none"> • DFSDM: channel state.

HAL_DFSDM_FilterInit

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterInit (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
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Function description	Initialize the DFSDM filter according to the specified parameters in the DFSDM_FilterInitTypeDef structure and initialize the associated handle.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • HAL: status.

HAL_DFSDM_FilterDeInit

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterDeInit (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	De-initializes the DFSDM filter.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • HAL: status.

HAL_DFSDM_FilterMspInit

Function name	void HAL_DFSDM_FilterMspInit (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	Initializes the DFSDM filter MSP.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • None:

HAL_DFSDM_FilterMspDeInit

Function name	void HAL_DFSDM_FilterMspDeInit (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	De-initializes the DFSDM filter MSP.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • None:

HAL_DFSDM_FilterConfigRegChannel

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterConfigRegChannel (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t Channel, uint32_t ContinuousMode)
Function description	This function allows to select channel and to enable/disable continuous mode for regular conversion.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle. • Channel: : Channel for regular conversion. This parameter can be a value of DFSDM Channel Selection. • ContinuousMode: : Enable/disable continuous mode for regular conversion. This parameter can be a value of DFSDM Continuous Mode.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DFSDM_FilterConfigInjChannel

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterConfigInjChannel (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t Channel)
Function description	This function allows to select channels for injected conversion.
Parameters	<ul style="list-style-type: none">• hdfsdm_filter: : DFSDM filter handle.• Channel: : Channels for injected conversion. This parameter can be a values combination of DFSDM Channel Selection.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_DFSDM_FilterRegularStart

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterRegularStart (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	This function allows to start regular conversion in polling mode.
Parameters	<ul style="list-style-type: none">• hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none">• HAL: status
Notes	<ul style="list-style-type: none">• This function should be called only when DFSDM filter instance is in idle state or if injected conversion is ongoing.

HAL_DFSDM_FilterRegularStart_IT

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterRegularStart_IT (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	This function allows to start regular conversion in interrupt mode.
Parameters	<ul style="list-style-type: none">• hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none">• HAL: status
Notes	<ul style="list-style-type: none">• This function should be called only when DFSDM filter instance is in idle state or if injected conversion is ongoing.

HAL_DFSDM_FilterRegularStart_DMA

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterRegularStart_DMA (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, int32_t * pData, uint32_t Length)
Function description	This function allows to start regular conversion in DMA mode.
Parameters	<ul style="list-style-type: none">• hdfsdm_filter: : DFSDM filter handle.• pData: : The destination buffer address.• Length: : The length of data to be transferred from DFSDM filter to memory.
Return values	<ul style="list-style-type: none">• HAL: status
Notes	<ul style="list-style-type: none">• This function should be called only when DFSDM filter instance is in idle state or if injected conversion is ongoing. Please note that data on buffer will contain signed regular conversion value on 24 most significant bits and

corresponding channel on 3 least significant bits.

HAL_DFSDM_FilterRegularMsbStart_DMA

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterRegularMsbStart_DMA (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, int16_t * pData, uint32_t Length)
Function description	This function allows to start regular conversion in DMA mode and to get only the 16 most significant bits of conversion.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle. • pData: : The destination buffer address. • Length: : The length of data to be transferred from DFSDM filter to memory.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function should be called only when DFSDM filter instance is in idle state or if injected conversion is ongoing. Please note that data on buffer will contain signed 16 most significant bits of regular conversion.

HAL_DFSDM_FilterRegularStop

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterRegularStop (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	This function allows to stop regular conversion in polling mode.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function should be called only if regular conversion is ongoing.

HAL_DFSDM_FilterRegularStop_IT

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterRegularStop_IT (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	This function allows to stop regular conversion in interrupt mode.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function should be called only if regular conversion is ongoing.

HAL_DFSDM_FilterRegularStop_DMA

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterRegularStop_DMA (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	This function allows to stop regular conversion in DMA mode.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.

- Return values
- **HAL:** status
- Notes
- This function should be called only if regular conversion is ongoing.

HAL_DFSDM_FilterInjectedStart

- Function name **HAL_StatusTypeDef HAL_DFSDM_FilterInjectedStart (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)**
- Function description This function allows to start injected conversion in polling mode.
- Parameters
- **hdfsdm_filter:** : DFSDM filter handle.
- Return values
- **HAL:** status
- Notes
- This function should be called only when DFSDM filter instance is in idle state or if regular conversion is ongoing.

HAL_DFSDM_FilterInjectedStart_IT

- Function name **HAL_StatusTypeDef HAL_DFSDM_FilterInjectedStart_IT (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)**
- Function description This function allows to start injected conversion in interrupt mode.
- Parameters
- **hdfsdm_filter:** : DFSDM filter handle.
- Return values
- **HAL:** status
- Notes
- This function should be called only when DFSDM filter instance is in idle state or if regular conversion is ongoing.

HAL_DFSDM_FilterInjectedStart_DMA

- Function name **HAL_StatusTypeDef HAL_DFSDM_FilterInjectedStart_DMA (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, int32_t * pData, uint32_t Length)**
- Function description This function allows to start injected conversion in DMA mode.
- Parameters
- **hdfsdm_filter:** : DFSDM filter handle.
 - **pData:** : The destination buffer address.
 - **Length:** : The length of data to be transferred from DFSDM filter to memory.
- Return values
- **HAL:** status
- Notes
- This function should be called only when DFSDM filter instance is in idle state or if regular conversion is ongoing. Please note that data on buffer will contain signed injected conversion value on 24 most significant bits and corresponding channel on 3 least significant bits.

HAL_DFSDM_FilterInjectedMsbStart_DMA

- Function name **HAL_StatusTypeDef HAL_DFSDM_FilterInjectedMsbStart_DMA (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, int16_t * pData, uint32_t Length)**

Function description	This function allows to start injected conversion in DMA mode and to get only the 16 most significant bits of conversion.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle. • pData: : The destination buffer address. • Length: : The length of data to be transferred from DFSDM filter to memory.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function should be called only when DFSDM filter instance is in idle state or if regular conversion is ongoing. Please note that data on buffer will contain signed 16 most significant bits of injected conversion.

HAL_DFSDM_FilterInjectedStop

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterInjectedStop (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	This function allows to stop injected conversion in polling mode.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function should be called only if injected conversion is ongoing.

HAL_DFSDM_FilterInjectedStop_IT

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterInjectedStop_IT (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	This function allows to stop injected conversion in interrupt mode.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function should be called only if injected conversion is ongoing.

HAL_DFSDM_FilterInjectedStop_DMA

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterInjectedStop_DMA (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	This function allows to stop injected conversion in DMA mode.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function should be called only if injected conversion is ongoing.

HAL_DFSDM_FilterAwdStart_IT

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterAwdStart_IT (DFSDM_Filter_HandleTypeDef * hdfsdm_filter,
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DFSDM_Filter_AwdParamTypeDef * awdParam)

Function description	This function allows to start filter analog watchdog in interrupt mode.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle. • awdParam: : DFSDM filter analog watchdog parameters.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DFSDM_FilterAwdStop_IT

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterAwdStop_IT (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	This function allows to stop filter analog watchdog in interrupt mode.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DFSDM_FilterExdStart

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterExdStart (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t Channel)
Function description	This function allows to start extreme detector feature.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle. • Channel: : Channels where extreme detector is enabled. This parameter can be a values combination of DFSDM Channel Selection.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DFSDM_FilterExdStop

Function name	HAL_StatusTypeDef HAL_DFSDM_FilterExdStop (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	This function allows to stop extreme detector feature.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DFSDM_FilterGetRegularValue

Function name	int32_t HAL_DFSDM_FilterGetRegularValue (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t * Channel)
Function description	This function allows to get regular conversion value.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle. • Channel: : Corresponding channel of regular conversion.
Return values	<ul style="list-style-type: none"> • Regular: conversion value

HAL_DFSDM_FilterGetInjectedValue

Function name	int32_t HAL_DFSDM_FilterGetInjectedValue (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t * Channel)
Function description	This function allows to get injected conversion value.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle. • Channel: : Corresponding channel of injected conversion.
Return values	<ul style="list-style-type: none"> • Injected: conversion value

HAL_DFSDM_FilterGetExdMaxValue

Function name	int32_t HAL_DFSDM_FilterGetExdMaxValue (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t * Channel)
Function description	This function allows to get extreme detector maximum value.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle. • Channel: : Corresponding channel.
Return values	<ul style="list-style-type: none"> • Extreme: detector maximum value This value is between Min_Data = -8388608 and Max_Data = 8388607.

HAL_DFSDM_FilterGetExdMinValue

Function name	int32_t HAL_DFSDM_FilterGetExdMinValue (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t * Channel)
Function description	This function allows to get extreme detector minimum value.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle. • Channel: : Corresponding channel.
Return values	<ul style="list-style-type: none"> • Extreme: detector minimum value This value is between Min_Data = -8388608 and Max_Data = 8388607.

HAL_DFSDM_FilterGetConvTimeValue

Function name	uint32_t HAL_DFSDM_FilterGetConvTimeValue (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	This function allows to get conversion time value.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • Conversion: time value
Notes	<ul style="list-style-type: none"> • To get time in second, this value has to be divided by DFSDM clock frequency.

HAL_DFSDM_IRQHandler

Function name	void HAL_DFSDM_IRQHandler (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	This function handles the DFSDM interrupts.

- Parameters
- **hdfsdm_filter:** : DFSDM filter handle.
- Return values
- **None:**

HAL_DFSDM_FilterPollForRegConversion

- Function name
- HAL_StatusTypeDef HAL_DFSDM_FilterPollForRegConversion (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t Timeout)**
- Function description
- This function allows to poll for the end of regular conversion.
- Parameters
- **hdfsdm_filter:** : DFSDM filter handle.
 - **Timeout:** : Timeout value in milliseconds.
- Return values
- **HAL:** status
- Notes
- This function should be called only if regular conversion is ongoing.

HAL_DFSDM_FilterPollForInjConversion

- Function name
- HAL_StatusTypeDef HAL_DFSDM_FilterPollForInjConversion (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t Timeout)**
- Function description
- This function allows to poll for the end of injected conversion.
- Parameters
- **hdfsdm_filter:** : DFSDM filter handle.
 - **Timeout:** : Timeout value in milliseconds.
- Return values
- **HAL:** status
- Notes
- This function should be called only if injected conversion is ongoing.

HAL_DFSDM_FilterRegConvCpltCallback

- Function name
- void HAL_DFSDM_FilterRegConvCpltCallback (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)**
- Function description
- Regular conversion complete callback.
- Parameters
- **hdfsdm_filter:** : DFSDM filter handle.
- Return values
- **None:**
- Notes
- In interrupt mode, user has to read conversion value in this function using HAL_DFSDM_FilterGetRegularValue.

HAL_DFSDM_FilterRegConvHalfCpltCallback

- Function name
- void HAL_DFSDM_FilterRegConvHalfCpltCallback (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)**
- Function description
- Half regular conversion complete callback.
- Parameters
- **hdfsdm_filter:** : DFSDM filter handle.
- Return values
- **None:**

HAL_DFSDM_FilterInjConvCpltCallback

Function name	void HAL_DFSDM_FilterInjConvCpltCallback (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	Injected conversion complete callback.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • In interrupt mode, user has to read conversion value in this function using HAL_DFSDM_FilterGetInjectedValue.

HAL_DFSDM_FilterInjConvHalfCpltCallback

Function name	void HAL_DFSDM_FilterInjConvHalfCpltCallback (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	Half injected conversion complete callback.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • None:

HAL_DFSDM_FilterAwdCallback

Function name	void HAL_DFSDM_FilterAwdCallback (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t Channel, uint32_t Threshold)
Function description	Filter analog watchdog callback.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle. • Channel: : Corresponding channel. • Threshold: : Low or high threshold has been reached.
Return values	<ul style="list-style-type: none"> • None:

HAL_DFSDM_FilterErrorCallback

Function name	void HAL_DFSDM_FilterErrorCallback (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	Error callback.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • None:

HAL_DFSDM_FilterGetState

Function name	HAL_DFSDM_Filter_StateTypeDef HAL_DFSDM_FilterGetState (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	This function allows to get the current DFSDM filter handle state.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • DFSDM: filter state.

HAL_DFSDM_FilterGetError

Function name	uint32_t HAL_DFSDM_FilterGetError (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)
Function description	This function allows to get the current DFSDM filter error.
Parameters	<ul style="list-style-type: none"> • hdfsdm_filter: : DFSDM filter handle.
Return values	<ul style="list-style-type: none"> • DFSDM: filter error code.

18.3 DFSDM Firmware driver defines**18.3.1 DFSDM*****DFSDM analog watchdog threshold***

DFSDM_AWD_HIGH_THRESHOLD Analog watchdog high threshold

DFSDM_AWD_LOW_THRESHOLD Analog watchdog low threshold

DFSDM break signals

DFSDM_NO_BREAK_SIGNAL No break signal

DFSDM_BREAK_SIGNAL_0 Break signal 0

DFSDM_BREAK_SIGNAL_1 Break signal 1

DFSDM_BREAK_SIGNAL_2 Break signal 2

DFSDM_BREAK_SIGNAL_3 Break signal 3

DFSDM channel analog watchdog filter order

DFSDM_CHANNEL_FASTSINC_ORDER FastSinc filter type

DFSDM_CHANNEL_SINC1_ORDER Sinc 1 filter type

DFSDM_CHANNEL_SINC2_ORDER Sinc 2 filter type

DFSDM_CHANNEL_SINC3_ORDER Sinc 3 filter type

DFSDM channel input data packing

DFSDM_CHANNEL_STANDARD_MODE Standard data packing mode

DFSDM_CHANNEL_INTERLEAVED_MODE Interleaved data packing mode

DFSDM_CHANNEL_DUAL_MODE Dual data packing mode

DFSDM channel input multiplexer

DFSDM_CHANNEL_EXTERNAL_INPUTS Data are taken from external inputs

DFSDM_CHANNEL_INTERNAL_REGISTER Data are taken from internal register

DFSDM channel input pins

DFSDM_CHANNEL_SAME_CHANNEL_PINS Input from pins on same channel

DFSDM_CHANNEL_FOLLOWING_CHANNEL_PINS Input from pins on following channel

DFSDM channel output clock selection

DFSDM_CHANNEL_OUTPUT_CLOCK_SYSTEM Source for output clock is system clock

DFSDM_CHANNEL_OUTPUT_CLOCK_AUDIO Source for output clock is audio clock

DFSDM Channel Selection

DFSDM_CHANNEL_0
 DFSDM_CHANNEL_1
 DFSDM_CHANNEL_2
 DFSDM_CHANNEL_3
 DFSDM_CHANNEL_4
 DFSDM_CHANNEL_5
 DFSDM_CHANNEL_6
 DFSDM_CHANNEL_7

DFSDM channel serial interface type

DFSDM_CHANNEL_SPI_RISING	SPI with rising edge
DFSDM_CHANNEL_SPI_FALLING	SPI with falling edge
DFSDM_CHANNEL_MANCHESTER_RISING	Manchester with rising edge
DFSDM_CHANNEL_MANCHESTER_FALLING	Manchester with falling edge

DFSDM channel SPI clock selection

DFSDM_CHANNEL_SPI_CLOCK_EXTERNAL	External SPI clock
DFSDM_CHANNEL_SPI_CLOCK_INTERNAL	Internal SPI clock
DFSDM_CHANNEL_SPI_CLOCK_INTERNAL_DIV2_FALLING	Internal SPI clock divided by 2, falling edge
DFSDM_CHANNEL_SPI_CLOCK_INTERNAL_DIV2_RISING	Internal SPI clock divided by 2, rising edge

DFSDM Continuous Mode

DFSDM_CONTINUOUS_CONV_OFF	Conversion are not continuous
DFSDM_CONTINUOUS_CONV_ON	Conversion are continuous

DFSDM Exported Macros

<code>__HAL_DFSDM_CHANNEL_RESET_HANDLE_STATE</code>	<p>Description:</p> <ul style="list-style-type: none"> Reset DFSDM channel handle state. <p>Parameters:</p> <ul style="list-style-type: none"> <code>__HANDLE__</code>: DFSDM channel handle. <p>Return value:</p> <ul style="list-style-type: none"> None
<code>__HAL_DFSDM_FILTER_RESET_HANDLE_STATE</code>	<p>Description:</p> <ul style="list-style-type: none"> Reset DFSDM filter handle state. <p>Parameters:</p> <ul style="list-style-type: none"> <code>__HANDLE__</code>: DFSDM

filter handle.

Return value:

- None

DFSDM filter analog watchdog data source

DFSDM_FILTER_AWD_FILTER_DATA From digital filter

DFSDM_FILTER_AWD_CHANNEL_DATA From analog watchdog channel

DFSDM filter error code

DFSDM_FILTER_ERROR_NONE No error

DFSDM_FILTER_ERROR_REGULAR_OVERRUN Overrun occurs during regular conversion

DFSDM_FILTER_ERROR_INJECTED_OVERRUN Overrun occurs during injected conversion

DFSDM_FILTER_ERROR_DMA DMA error occurs

DFSDM filter external trigger

DFSDM_FILTER_EXT_TRIG_TIM1_TRGO For DFSDM filter 0, 1, 2 and 3

DFSDM_FILTER_EXT_TRIG_TIM1_TRGO2 For DFSDM filter 0, 1, 2 and 3

DFSDM_FILTER_EXT_TRIG_TIM8_TRGO For DFSDM filter 0, 1, 2 and 3

DFSDM_FILTER_EXT_TRIG_TIM8_TRGO2 For DFSDM filter 0, 1, 2 and 3

DFSDM_FILTER_EXT_TRIG_TIM3_TRGO For DFSDM filter 0, 1, 2 and 3

DFSDM_FILTER_EXT_TRIG_TIM4_TRGO For DFSDM filter 0, 1, 2 and 3

DFSDM_FILTER_EXT_TRIG_TIM10_OC1 For DFSDM filter 0, 1, 2 and 3

DFSDM_FILTER_EXT_TRIG_TIM6_TRGO For DFSDM filter 0, 1, 2 and 3

DFSDM_FILTER_EXT_TRIG_TIM7_TRGO For DFSDM filter 0, 1, 2 and 3

DFSDM_FILTER_EXT_TRIG_EXTI11 For DFSDM filter 0, 1, 2 and 3

DFSDM_FILTER_EXT_TRIG_EXTI15 For DFSDM filter 0, 1, 2 and 3

DFSDM_FILTER_EXT_TRIG_LPTIM1_OUT For DFSDM filter 0, 1, 2 and 3

DFSDM filter external trigger edge

DFSDM_FILTER_EXT_TRIG_RISING_EDGE External rising edge

DFSDM_FILTER_EXT_TRIG_FALLING_EDGE External falling edge

DFSDM_FILTER_EXT_TRIG_BOTH_EDGES External rising and falling edges

DFSDM filter sinc order

DFSDM_FILTER_FASTSINC_ORDER FastSinc filter type

DFSDM_FILTER_SINC1_ORDER Sinc 1 filter type

DFSDM_FILTER_SINC2_ORDER Sinc 2 filter type

DFSDM_FILTER_SINC3_ORDER Sinc 3 filter type

DFSDM_FILTER_SINC4_ORDER Sinc 4 filter type

DFSDM_FILTER_SINC5_ORDER Sinc 5 filter type

DFSDM filter conversion trigger

DFSDM_FILTER_SW_TRIGGER	Software trigger
DFSDM_FILTER_SYNC_TRIGGER	Synchronous with DFSDM_FLT0
DFSDM_FILTER_EXT_TRIGGER	External trigger (only for injected conversion)

19 HAL DMA2D Generic Driver

19.1 DMA2D Firmware driver registers structures

19.1.1 DMA2D_ColorTypeDef

Data Fields

- *uint32_t Blue*
- *uint32_t Green*
- *uint32_t Red*

Field Documentation

- *uint32_t DMA2D_ColorTypeDef::Blue*
Configures the blue value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.
- *uint32_t DMA2D_ColorTypeDef::Green*
Configures the green value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.
- *uint32_t DMA2D_ColorTypeDef::Red*
Configures the red value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.

19.1.2 DMA2D_CLUTCfgTypeDef

Data Fields

- *uint32_t * pCLUT*
- *uint32_t CLUTColorMode*
- *uint32_t Size*

Field Documentation

- *uint32_t* DMA2D_CLUTCfgTypeDef::pCLUT*
Configures the DMA2D CLUT memory address.
- *uint32_t DMA2D_CLUTCfgTypeDef::CLUTColorMode*
Configures the DMA2D CLUT color mode. This parameter can be one value of [DMA2D_CLUT_CM](#).
- *uint32_t DMA2D_CLUTCfgTypeDef::Size*
Configures the DMA2D CLUT size. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.

19.1.3 DMA2D_InitTypeDef

Data Fields

- *uint32_t Mode*
- *uint32_t ColorMode*
- *uint32_t OutputOffset*
- *uint32_t AlphaInverted*
- *uint32_t RedBlueSwap*

Field Documentation

- ***uint32_t DMA2D_InitTypeDef::Mode***
Configures the DMA2D transfer mode. This parameter can be one value of [DMA2D_Mode](#).
- ***uint32_t DMA2D_InitTypeDef::ColorMode***
Configures the color format of the output image. This parameter can be one value of [DMA2D_Output_Color_Mode](#).
- ***uint32_t DMA2D_InitTypeDef::OutputOffset***
Specifies the Offset value. This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0x3FFF.
- ***uint32_t DMA2D_InitTypeDef::AlphaInverted***
Select regular or inverted alpha value for the output pixel format converter. This parameter can be one value of [DMA2D_Alpha_Inverted](#).
- ***uint32_t DMA2D_InitTypeDef::RedBlueSwap***
Select regular mode (RGB or ARGB) or swap mode (BGR or ABGR) for the output pixel format converter. This parameter can be one value of [DMA2D_RB_Swap](#).

19.1.4 DMA2D_LayerCfgTypeDef

Data Fields

- ***uint32_t InputOffset***
- ***uint32_t InputColorMode***
- ***uint32_t AlphaMode***
- ***uint32_t InputAlpha***
- ***uint32_t AlphaInverted***
- ***uint32_t RedBlueSwap***

Field Documentation

- ***uint32_t DMA2D_LayerCfgTypeDef::InputOffset***
Configures the DMA2D foreground or background offset. This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0x3FFF.
- ***uint32_t DMA2D_LayerCfgTypeDef::InputColorMode***
Configures the DMA2D foreground or background color mode. This parameter can be one value of [DMA2D_Input_Color_Mode](#).
- ***uint32_t DMA2D_LayerCfgTypeDef::AlphaMode***
Configures the DMA2D foreground or background alpha mode. This parameter can be one value of [DMA2D_Alpha_Mode](#).
- ***uint32_t DMA2D_LayerCfgTypeDef::InputAlpha***
Specifies the DMA2D foreground or background alpha value and color value in case of A8 or A4 color mode. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF except for the color modes detailed below.
Note:In case of A8 or A4 color mode (ARGB), this parameter must be a number between Min_Data = 0x00000000 and Max_Data = 0xFFFFFFFF where InputAlpha[24:31] is the alpha value ALPHA[0:7] InputAlpha[16:23] is the red value RED[0:7] InputAlpha[8:15] is the green value GREEN[0:7] InputAlpha[0:7] is the blue value BLUE[0:7].
- ***uint32_t DMA2D_LayerCfgTypeDef::AlphaInverted***
Select regular or inverted alpha value. This parameter can be one value of [DMA2D_Alpha_Inverted](#). This feature is only available on devices : STM32F756xx, STM32F767xx, STM32F769xx, STM32F777xx and STM32F779xx.
- ***uint32_t DMA2D_LayerCfgTypeDef::RedBlueSwap***
Select regular mode (RGB or ARGB) or swap mode (BGR or ABGR). This parameter can be one value of [DMA2D_RB_Swap](#) This feature is only available on devices : STM32F756xx, STM32F767xx, STM32F769xx, STM32F777xx and STM32F779xx.

19.1.5 `__DMA2D_HandleTypeDef`

Data Fields

- `DMA2D_TypeDef * Instance`
- `DMA2D_InitTypeDef Init`
- `void(* XferCpltCallback`
- `void(* XferErrorCallback`
- `DMA2D_LayerCfgTypeDef LayerCfg`
- `HAL_LockTypeDef Lock`
- `__IO HAL_DMA2D_StateTypeDef State`
- `__IO uint32_t ErrorCode`

Field Documentation

- `DMA2D_TypeDef* __DMA2D_HandleTypeDef::Instance`
DMA2D register base address.
- `DMA2D_InitTypeDef __DMA2D_HandleTypeDef::Init`
DMA2D communication parameters.
- `void(* __DMA2D_HandleTypeDef::XferCpltCallback)(struct __DMA2D_HandleTypeDef *hdma2d)`
DMA2D transfer complete callback.
- `void(* __DMA2D_HandleTypeDef::XferErrorCallback)(struct __DMA2D_HandleTypeDef *hdma2d)`
DMA2D transfer error callback.
- `DMA2D_LayerCfgTypeDef __DMA2D_HandleTypeDef::LayerCfg[MAX_DMA2D_LAYER]`
DMA2D Layers parameters
- `HAL_LockTypeDef __DMA2D_HandleTypeDef::Lock`
DMA2D lock.
- `__IO HAL_DMA2D_StateTypeDef __DMA2D_HandleTypeDef::State`
DMA2D transfer state.
- `__IO uint32_t __DMA2D_HandleTypeDef::ErrorCode`
DMA2D error code.

19.2 DMA2D Firmware driver API description

19.2.1 How to use this driver

1. Program the required configuration through the following parameters: the transfer mode, the output color mode and the output offset using `HAL_DMA2D_Init()` function.
2. Program the required configuration through the following parameters: the input color mode, the input color, the input alpha value, the alpha mode, the red/blue swap mode, the inverted alpha mode and the input offset using `HAL_DMA2D_ConfigLayer()` function for foreground or/and background layer.

Polling mode IO operation

1. Configure `pdata` parameter (explained hereafter), destination and data length and enable the transfer using `HAL_DMA2D_Start()`.
2. Wait for end of transfer using `HAL_DMA2D_PollForTransfer()`, at this stage user can specify the value of timeout according to his end application.

Interrupt mode IO operation

1. Configure `pdata` parameter, destination and data length and enable the transfer using `HAL_DMA2D_Start_IT()`.

2. Use HAL_DMA2D_IRQHandler() called under DMA2D_IRQHandler() interrupt subroutine.
3. At the end of data transfer HAL_DMA2D_IRQHandler() function is executed and user can add his own function by customization of function pointer XferCpltCallback (member of DMA2D handle structure).
4. In case of error, the HAL_DMA2D_IRQHandler() function will call the callback XferErrorCallback. In Register-to-Memory transfer mode, pdata parameter is the register color, in Memory-to-memory or Memory-to-Memory with pixel format conversion pdata is the source address. Configure the foreground source address, the background source address, the destination and data length then Enable the transfer using HAL_DMA2D_BlendingStart() in polling mode and HAL_DMA2D_BlendingStart_IT() in interrupt mode. HAL_DMA2D_BlendingStart() and HAL_DMA2D_BlendingStart_IT() functions are used if the memory to memory with blending transfer mode is selected.
5. Optionally, configure and enable the CLUT using HAL_DMA2D_CLUTLoad() in polling mode or HAL_DMA2D_CLUTLoad_IT() in interrupt mode.
6. Optionally, configure the line watermark in using the API HAL_DMA2D_ProgramLineEvent()
7. Optionally, configure the dead time value in the AHB clock cycle inserted between two consecutive accesses on the AHB master port in using the API HAL_DMA2D_ConfigDeadTime() and enable/disable the functionality with the APIs HAL_DMA2D_EnableDeadTime() or HAL_DMA2D_DisableDeadTime().
8. The transfer can be suspended, resumed and aborted using the following functions: HAL_DMA2D_Suspend(), HAL_DMA2D_Resume(), HAL_DMA2D_Abort().
9. The CLUT loading can be suspended, resumed and aborted using the following functions: HAL_DMA2D_CLUTLoading_Suspend(), HAL_DMA2D_CLUTLoading_Resume(), HAL_DMA2D_CLUTLoading_Abort().
10. To control the DMA2D state, use the following function: HAL_DMA2D_GetState().
11. To read the DMA2D error code, use the following function: HAL_DMA2D_GetError().

DMA2D HAL driver macros list

Below the list of most used macros in DMA2D HAL driver :

- `__HAL_DMA2D_ENABLE`: Enable the DMA2D peripheral.
- `__HAL_DMA2D_GET_FLAG`: Get the DMA2D pending flags.
- `__HAL_DMA2D_CLEAR_FLAG`: Clear the DMA2D pending flags.
- `__HAL_DMA2D_ENABLE_IT`: Enable the specified DMA2D interrupts.
- `__HAL_DMA2D_DISABLE_IT`: Disable the specified DMA2D interrupts.
- `__HAL_DMA2D_GET_IT_SOURCE`: Check whether the specified DMA2D interrupt is enabled or not.



You can refer to the DMA2D HAL driver header file for more useful macros

19.2.2 Initialization and Configuration functions

This section provides functions allowing to:

- Initialize and configure the DMA2D
- De-initialize the DMA2D

This section contains the following APIs:

- [*HAL_DMA2D_Init\(\)*](#)

- [HAL_DMA2D_DeInit\(\)](#)
- [HAL_DMA2D_MspInit\(\)](#)
- [HAL_DMA2D_MspDeInit\(\)](#)

19.2.3 IO operation functions

This section provides functions allowing to:

- Configure the pdata, destination address and data size then start the DMA2D transfer.
- Configure the source for foreground and background, destination address and data size then start a MultiBuffer DMA2D transfer.
- Configure the pdata, destination address and data size then start the DMA2D transfer with interrupt.
- Configure the source for foreground and background, destination address and data size then start a MultiBuffer DMA2D transfer with interrupt.
- Abort DMA2D transfer.
- Suspend DMA2D transfer.
- Resume DMA2D transfer.
- Enable CLUT transfer.
- Configure CLUT loading then start transfer in polling mode.
- Configure CLUT loading then start transfer in interrupt mode.
- Abort DMA2D CLUT loading.
- Suspend DMA2D CLUT loading.
- Resume DMA2D CLUT loading.
- Poll for transfer complete.
- handle DMA2D interrupt request.
- Transfer watermark callback.
- CLUT Transfer Complete callback.

This section contains the following APIs:

- [HAL_DMA2D_Start\(\)](#)
- [HAL_DMA2D_Start_IT\(\)](#)
- [HAL_DMA2D_BlendingStart\(\)](#)
- [HAL_DMA2D_BlendingStart_IT\(\)](#)
- [HAL_DMA2D_Abort\(\)](#)
- [HAL_DMA2D_Suspend\(\)](#)
- [HAL_DMA2D_Resume\(\)](#)
- [HAL_DMA2D_EnableCLUT\(\)](#)
- [HAL_DMA2D_CLUTLoad\(\)](#)
- [HAL_DMA2D_CLUTLoad_IT\(\)](#)
- [HAL_DMA2D_CLUTLoading_Abort\(\)](#)
- [HAL_DMA2D_CLUTLoading_Suspend\(\)](#)
- [HAL_DMA2D_CLUTLoading_Resume\(\)](#)
- [HAL_DMA2D_PollForTransfer\(\)](#)
- [HAL_DMA2D_IRQHandler\(\)](#)
- [HAL_DMA2D_LineEventCallback\(\)](#)
- [HAL_DMA2D_CLUTLoadingCpltCallback\(\)](#)

19.2.4 Peripheral Control functions

This section provides functions allowing to:

- Configure the DMA2D foreground or background layer parameters.
- Configure the DMA2D CLUT transfer.
- Configure the line watermark

- Configure the dead time value.
- Enable or disable the dead time value functionality.

This section contains the following APIs:

- [HAL_DMA2D_ConfigLayer\(\)](#)
- [HAL_DMA2D_ConfigCLUT\(\)](#)
- [HAL_DMA2D_ProgramLineEvent\(\)](#)
- [HAL_DMA2D_EnableDeadTime\(\)](#)
- [HAL_DMA2D_DisableDeadTime\(\)](#)
- [HAL_DMA2D_ConfigDeadTime\(\)](#)

19.2.5 Peripheral State and Errors functions

This subsection provides functions allowing to :

- Get the DMA2D state
- Get the DMA2D error code

This section contains the following APIs:

- [HAL_DMA2D_GetState\(\)](#)
- [HAL_DMA2D_GetError\(\)](#)

19.2.6 Detailed description of functions

HAL_DMA2D_Init

Function name	HAL_StatusTypeDef HAL_DMA2D_Init (DMA2D_HandleTypeDef * hdma2d)
Function description	Initialize the DMA2D according to the specified parameters in the DMA2D_InitTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none"> • hdma2d: pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMA2D_DeInit

Function name	HAL_StatusTypeDef HAL_DMA2D_DeInit (DMA2D_HandleTypeDef * hdma2d)
Function description	Deinitializes the DMA2D peripheral registers to their default reset values.
Parameters	<ul style="list-style-type: none"> • hdma2d: pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
Return values	<ul style="list-style-type: none"> • None:

HAL_DMA2D_MspInit

Function name	void HAL_DMA2D_MspInit (DMA2D_HandleTypeDef * hdma2d)
Function description	Initializes the DMA2D MSP.
Parameters	<ul style="list-style-type: none"> • hdma2d: pointer to a DMA2D_HandleTypeDef structure that

contains the configuration information for the DMA2D.

Return values • **None:**

HAL_DMA2D_MspDeInit

Function name **void HAL_DMA2D_MspDeInit (DMA2D_HandleTypeDef * hdma2d)**

Function description DeInitializes the DMA2D MSP.

Parameters • **hdma2d:** pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.

Return values • **None:**

HAL_DMA2D_Start

Function name **HAL_StatusTypeDef HAL_DMA2D_Start (DMA2D_HandleTypeDef * hdma2d, uint32_t pdata, uint32_t DstAddress, uint32_t Width, uint32_t Height)**

Function description Start the DMA2D Transfer.

Parameters • **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
 • **pdata:** Configure the source memory Buffer address if Memory-to-Memory or Memory-to-Memory with pixel format conversion mode is selected, or configure the color value if Register-to-Memory mode is selected.
 • **DstAddress:** The destination memory Buffer address.
 • **Width:** The width of data to be transferred from source to destination (expressed in number of pixels per line).
 • **Height:** The height of data to be transferred from source to destination (expressed in number of lines).

Return values • **HAL:** status

HAL_DMA2D_BlendingStart

Function name **HAL_StatusTypeDef HAL_DMA2D_BlendingStart (DMA2D_HandleTypeDef * hdma2d, uint32_t SrcAddress1, uint32_t SrcAddress2, uint32_t DstAddress, uint32_t Width, uint32_t Height)**

Function description Start the multi-source DMA2D Transfer.

Parameters • **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
 • **SrcAddress1:** The source memory Buffer address for the foreground layer.
 • **SrcAddress2:** The source memory Buffer address for the background layer.
 • **DstAddress:** The destination memory Buffer address.
 • **Width:** The width of data to be transferred from source to destination (expressed in number of pixels per line).
 • **Height:** The height of data to be transferred from source to destination (expressed in number of lines).

Return values

- **HAL:** status

HAL_DMA2D_Start_IT

Function name **HAL_StatusTypeDef HAL_DMA2D_Start_IT (DMA2D_HandleTypeDef * hdma2d, uint32_t pdata, uint32_t DstAddress, uint32_t Width, uint32_t Height)**

Function description Start the DMA2D Transfer with interrupt enabled.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **pdata:** Configure the source memory Buffer address if the Memory-to-Memory or Memory-to-Memory with pixel format conversion mode is selected, or configure the color value if Register-to-Memory mode is selected.
- **DstAddress:** The destination memory Buffer address.
- **Width:** The width of data to be transferred from source to destination (expressed in number of pixels per line).
- **Height:** The height of data to be transferred from source to destination (expressed in number of lines).

Return values

- **HAL:** status

HAL_DMA2D_BlendingStart_IT

Function name **HAL_StatusTypeDef HAL_DMA2D_BlendingStart_IT (DMA2D_HandleTypeDef * hdma2d, uint32_t SrcAddress1, uint32_t SrcAddress2, uint32_t DstAddress, uint32_t Width, uint32_t Height)**

Function description Start the multi-source DMA2D Transfer with interrupt enabled.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **SrcAddress1:** The source memory Buffer address for the foreground layer.
- **SrcAddress2:** The source memory Buffer address for the background layer.
- **DstAddress:** The destination memory Buffer address.
- **Width:** The width of data to be transferred from source to destination (expressed in number of pixels per line).
- **Height:** The height of data to be transferred from source to destination (expressed in number of lines).

Return values

- **HAL:** status

HAL_DMA2D_Suspend

Function name **HAL_StatusTypeDef HAL_DMA2D_Suspend (DMA2D_HandleTypeDef * hdma2d)**

Function description Suspend the DMA2D Transfer.

Parameters

- **hdma2d:** pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.

Return values

- **HAL:** status

HAL_DMA2D_Resume

Function name	HAL_StatusTypeDef HAL_DMA2D_Resume (DMA2D_HandleTypeDef * hdma2d)
Function description	Resume the DMA2D Transfer.
Parameters	<ul style="list-style-type: none"> • hdma2d: pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMA2D_Abort

Function name	HAL_StatusTypeDef HAL_DMA2D_Abort (DMA2D_HandleTypeDef * hdma2d)
Function description	Abort the DMA2D Transfer.
Parameters	<ul style="list-style-type: none"> • hdma2d: : pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMA2D_EnableCLUT

Function name	HAL_StatusTypeDef HAL_DMA2D_EnableCLUT (DMA2D_HandleTypeDef * hdma2d, uint32_t LayerIdx)
Function description	Enable the DMA2D CLUT Transfer.
Parameters	<ul style="list-style-type: none"> • hdma2d: Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D. • LayerIdx: DMA2D Layer index. This parameter can be one of the following values: 0(background) / 1(foreground)
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMA2D_CLUTLoad

Function name	HAL_StatusTypeDef HAL_DMA2D_CLUTLoad (DMA2D_HandleTypeDef * hdma2d, DMA2D_CLUTCfgTypeDef CLUTCfg, uint32_t LayerIdx)
Function description	Start DMA2D CLUT Loading.
Parameters	<ul style="list-style-type: none"> • hdma2d: Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D. • CLUTCfg: Pointer to a DMA2D_CLUTCfgTypeDef structure that contains the configuration information for the color look up table. • LayerIdx: DMA2D Layer index. This parameter can be one of the following values: 0(background) / 1(foreground)
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • Invoking this API is similar to calling HAL_DMA2D_ConfigCLUT() then HAL_DMA2D_EnableCLUT().

HAL_DMA2D_CLUTLoad_IT

Function name	HAL_StatusTypeDef HAL_DMA2D_CLUTLoad_IT (DMA2D_HandleTypeDef * hdma2d, DMA2D_CLUTCfgTypeDef CLUTCfg, uint32_t LayerIdx)
Function description	Start DMA2D CLUT Loading with interrupt enabled.
Parameters	<ul style="list-style-type: none"> • hdma2d: Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D. • CLUTCfg: Pointer to a DMA2D_CLUTCfgTypeDef structure that contains the configuration information for the color look up table. • LayerIdx: DMA2D Layer index. This parameter can be one of the following values: 0(background) / 1(foreground)
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMA2D_CLUTLoading_Abort

Function name	HAL_StatusTypeDef HAL_DMA2D_CLUTLoading_Abort (DMA2D_HandleTypeDef * hdma2d, uint32_t LayerIdx)
Function description	Abort the DMA2D CLUT loading.
Parameters	<ul style="list-style-type: none"> • hdma2d: : Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D. • LayerIdx: DMA2D Layer index. This parameter can be one of the following values: 0(background) / 1(foreground)
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMA2D_CLUTLoading_Suspend

Function name	HAL_StatusTypeDef HAL_DMA2D_CLUTLoading_Suspend (DMA2D_HandleTypeDef * hdma2d, uint32_t LayerIdx)
Function description	Suspend the DMA2D CLUT loading.
Parameters	<ul style="list-style-type: none"> • hdma2d: Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D. • LayerIdx: DMA2D Layer index. This parameter can be one of the following values: 0(background) / 1(foreground)
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMA2D_CLUTLoading_Resume

Function name	HAL_StatusTypeDef HAL_DMA2D_CLUTLoading_Resume (DMA2D_HandleTypeDef * hdma2d, uint32_t LayerIdx)
Function description	Resume the DMA2D CLUT loading.
Parameters	<ul style="list-style-type: none"> • hdma2d: pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D. • LayerIdx: DMA2D Layer index. This parameter can be one of the following values: 0(background) / 1(foreground)
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMA2D_PollForTransfer

Function name	HAL_StatusTypeDef HAL_DMA2D_PollForTransfer (DMA2D_HandleTypeDef * hdma2d, uint32_t Timeout)
Function description	Polling for transfer complete or CLUT loading.
Parameters	<ul style="list-style-type: none">• hdma2d: Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.• Timeout: Timeout duration
Return values	<ul style="list-style-type: none">• HAL: status

HAL_DMA2D_IRQHandler

Function name	void HAL_DMA2D_IRQHandler (DMA2D_HandleTypeDef * hdma2d)
Function description	Handle DMA2D interrupt request.
Parameters	<ul style="list-style-type: none">• hdma2d: Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_DMA2D_LineEventCallback

Function name	void HAL_DMA2D_LineEventCallback (DMA2D_HandleTypeDef * hdma2d)
Function description	Transfer watermark callback.
Parameters	<ul style="list-style-type: none">• hdma2d: pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
Return values	<ul style="list-style-type: none">• None:

HAL_DMA2D_CLUTLoadingCpltCallback

Function name	void HAL_DMA2D_CLUTLoadingCpltCallback (DMA2D_HandleTypeDef * hdma2d)
Function description	CLUT Transfer Complete callback.
Parameters	<ul style="list-style-type: none">• hdma2d: pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
Return values	<ul style="list-style-type: none">• None:

HAL_DMA2D_ConfigLayer

Function name	HAL_StatusTypeDef HAL_DMA2D_ConfigLayer (DMA2D_HandleTypeDef * hdma2d, uint32_t LayerIdx)
Function description	Configure the DMA2D Layer according to the specified parameters in the DMA2D_InitTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none">• hdma2d: pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.• LayerIdx: DMA2D Layer index. This parameter can be one of the following values: 0(background) / 1(foreground)

Return values

- **HAL:** status

HAL_DMA2D_ConfigCLUT

Function name **HAL_StatusTypeDef HAL_DMA2D_ConfigCLUT (DMA2D_HandleTypeDef * hdma2d, DMA2D_CLUTCfgTypeDef CLUTCfg, uint32_t LayerIdx)**

Function description Configure the DMA2D CLUT Transfer.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **CLUTCfg:** Pointer to a DMA2D_CLUTCfgTypeDef structure that contains the configuration information for the color look up table.
- **LayerIdx:** DMA2D Layer index. This parameter can be one of the following values: 0(background) / 1(foreground)

Return values

- **HAL:** status

HAL_DMA2D_ProgramLineEvent

Function name **HAL_StatusTypeDef HAL_DMA2D_ProgramLineEvent (DMA2D_HandleTypeDef * hdma2d, uint32_t Line)**

Function description Configure the line watermark.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **Line:** Line Watermark configuration (maximum 16-bit long value expected).

Return values

- **HAL:** status

Notes

- HAL_DMA2D_ProgramLineEvent() API enables the transfer watermark interrupt.
- The transfer watermark interrupt is disabled once it has occurred.

HAL_DMA2D_EnableDeadTime

Function name **HAL_StatusTypeDef HAL_DMA2D_EnableDeadTime (DMA2D_HandleTypeDef * hdma2d)**

Function description Enable DMA2D dead time feature.

Parameters

- **hdma2d:** DMA2D handle.

Return values

- **HAL:** status

HAL_DMA2D_DisableDeadTime

Function name **HAL_StatusTypeDef HAL_DMA2D_DisableDeadTime (DMA2D_HandleTypeDef * hdma2d)**

Function description Disable DMA2D dead time feature.

Parameters

- **hdma2d:** DMA2D handle.

Return values

- **HAL:** status

HAL_DMA2D_ConfigDeadTime

Function name	HAL_StatusTypeDef HAL_DMA2D_ConfigDeadTime (DMA2D_HandleTypeDef * hdma2d, uint8_t DeadTime)
Function description	Configure dead time.
Parameters	<ul style="list-style-type: none"> • hdma2d: DMA2D handle. • DeadTime: dead time value.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • The dead time value represents the guaranteed minimum number of cycles between two consecutive transactions on the AHB bus.

HAL_DMA2D_GetState

Function name	HAL_DMA2D_StateTypeDef HAL_DMA2D_GetState (DMA2D_HandleTypeDef * hdma2d)
Function description	Return the DMA2D state.
Parameters	<ul style="list-style-type: none"> • hdma2d: pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
Return values	<ul style="list-style-type: none"> • HAL: state

HAL_DMA2D_GetError

Function name	uint32_t HAL_DMA2D_GetError (DMA2D_HandleTypeDef * hdma2d)
Function description	Return the DMA2D error code.
Parameters	<ul style="list-style-type: none"> • hdma2d: : pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for DMA2D.
Return values	<ul style="list-style-type: none"> • DMA2D: Error Code

19.3 DMA2D Firmware driver defines**19.3.1 DMA2D*****DMA2D API Aliases***

HAL_DMA2D_DisableCLUT Aliased to HAL_DMA2D_CLUTLoading_Abort for compatibility with legacy code

DMA2D ALPHA Inversion

DMA2D_REGULAR_ALPHA No modification of the alpha channel value

DMA2D_INVERTED_ALPHA Invert the alpha channel value

DMA2D Alpha Mode

DMA2D_NO_MODIF_ALPHA No modification of the alpha channel value

DMA2D_REPLACE_ALPHA Replace original alpha channel value by programmed alpha value

DMA2D_COMBINE_ALPHA Replace original alpha channel value by programmed

alpha value with original alpha channel value

DMA2D CLUT Color Mode

DMA2D_CCM_ARGB8888 ARGB8888 DMA2D CLUT color mode

DMA2D_CCM_RGB888 RGB888 DMA2D CLUT color mode

DMA2D CLUT Size

DMA2D_CLUT_SIZE DMA2D CLUT size

DMA2D Color Value

DMA2D_COLOR_VALUE Color value mask

DMA2D Error Code

HAL_DMA2D_ERROR_NONE No error

HAL_DMA2D_ERROR_TE Transfer error

HAL_DMA2D_ERROR_CE Configuration error

HAL_DMA2D_ERROR_CAE CLUT access error

HAL_DMA2D_ERROR_TIMEOUT Timeout error

DMA2D Exported Macros

`__HAL_DMA2D_RESET_HANDLE_STATE` **Description:**

- Reset DMA2D handle state.

Parameters:

- `__HANDLE__`: specifies the DMA2D handle.

Return value:

- None

`__HAL_DMA2D_ENABLE`

Description:

- Enable the DMA2D.

Parameters:

- `__HANDLE__`: DMA2D handle

Return value:

- None.

`__HAL_DMA2D_GET_FLAG`

Description:

- Get the DMA2D pending flags.

Parameters:

- `__HANDLE__`: DMA2D handle
- `__FLAG__`: flag to check. This parameter can be any combination of the following values:
 - DMA2D_FLAG_CE: Configuration error flag
 - DMA2D_FLAG_CTC: CLUT transfer complete flag

- DMA2D_FLAG_CAE: CLUT access error flag
- DMA2D_FLAG_TW: Transfer Watermark flag
- DMA2D_FLAG_TC: Transfer complete flag
- DMA2D_FLAG_TE: Transfer error flag

Return value:

- The: state of FLAG.

Description:

- Clear the DMA2D pending flags.

Parameters:

- __HANDLE__: DMA2D handle
- __FLAG__: specifies the flag to clear. This parameter can be any combination of the following values:
 - DMA2D_FLAG_CE: Configuration error flag
 - DMA2D_FLAG_CTC: CLUT transfer complete flag
 - DMA2D_FLAG_CAE: CLUT access error flag
 - DMA2D_FLAG_TW: Transfer Watermark flag
 - DMA2D_FLAG_TC: Transfer complete flag
 - DMA2D_FLAG_TE: Transfer error flag

Return value:

- None

Description:

- Enable the specified DMA2D interrupts.

Parameters:

- __HANDLE__: DMA2D handle
- __INTERRUPT__: specifies the DMA2D interrupt sources to be enabled. This parameter can be any combination of the following values:
 - DMA2D_IT_CE: Configuration error interrupt mask
 - DMA2D_IT_CTC: CLUT transfer complete interrupt mask
 - DMA2D_IT_CAE: CLUT access error interrupt mask
 - DMA2D_IT_TW: Transfer Watermark interrupt mask
 - DMA2D_IT_TC: Transfer complete

__HAL_DMA2D_CLEAR_FLAG

__HAL_DMA2D_ENABLE_IT

- interrupt mask
- DMA2D_IT_TE: Transfer error interrupt mask

Return value:

- None

Description:

- Disable the specified DMA2D interrupts.

Parameters:

- `__HANDLE__`: DMA2D handle
- `__INTERRUPT__`: specifies the DMA2D interrupt sources to be disabled. This parameter can be any combination of the following values:
 - DMA2D_IT_CE: Configuration error interrupt mask
 - DMA2D_IT_CTC: CLUT transfer complete interrupt mask
 - DMA2D_IT_CAE: CLUT access error interrupt mask
 - DMA2D_IT_TW: Transfer Watermark interrupt mask
 - DMA2D_IT_TC: Transfer complete interrupt mask
 - DMA2D_IT_TE: Transfer error interrupt mask

Return value:

- None

Description:

- Check whether the specified DMA2D interrupt source is enabled or not.

Parameters:

- `__HANDLE__`: DMA2D handle
- `__INTERRUPT__`: specifies the DMA2D interrupt source to check. This parameter can be one of the following values:
 - DMA2D_IT_CE: Configuration error interrupt mask
 - DMA2D_IT_CTC: CLUT transfer complete interrupt mask
 - DMA2D_IT_CAE: CLUT access error interrupt mask
 - DMA2D_IT_TW: Transfer Watermark interrupt mask
 - DMA2D_IT_TC: Transfer complete interrupt mask
 - DMA2D_IT_TE: Transfer error

`__HAL_DMA2D_DISABLE_IT`

`__HAL_DMA2D_GET_IT_SOURCE`

interrupt mask

Return value:

- The: state of INTERRUPT source.

DMA2D Exported Types

MAX_DMA2D_LAYER

DMA2D Flags

DMA2D_FLAG_CE	Configuration Error Interrupt Flag
DMA2D_FLAG_CTC	CLUT Transfer Complete Interrupt Flag
DMA2D_FLAG_CAE	CLUT Access Error Interrupt Flag
DMA2D_FLAG_TW	Transfer Watermark Interrupt Flag
DMA2D_FLAG_TC	Transfer Complete Interrupt Flag
DMA2D_FLAG_TE	Transfer Error Interrupt Flag

DMA2D Input Color Mode

DMA2D_INPUT_ARGB8888	ARGB8888 color mode
DMA2D_INPUT_RGB888	RGB888 color mode
DMA2D_INPUT_RGB565	RGB565 color mode
DMA2D_INPUT_ARGB1555	ARGB1555 color mode
DMA2D_INPUT_ARGB4444	ARGB4444 color mode
DMA2D_INPUT_L8	L8 color mode
DMA2D_INPUT_AL44	AL44 color mode
DMA2D_INPUT_AL88	AL88 color mode
DMA2D_INPUT_L4	L4 color mode
DMA2D_INPUT_A8	A8 color mode
DMA2D_INPUT_A4	A4 color mode

DMA2D Interrupts

DMA2D_IT_CE	Configuration Error Interrupt
DMA2D_IT_CTC	CLUT Transfer Complete Interrupt
DMA2D_IT_CAE	CLUT Access Error Interrupt
DMA2D_IT_TW	Transfer Watermark Interrupt
DMA2D_IT_TC	Transfer Complete Interrupt
DMA2D_IT_TE	Transfer Error Interrupt

DMA2D Maximum Line Watermark

DMA2D_LINE_WATERMARK_MAX DMA2D maximum line watermark

DMA2D Maximum Number of Layers

DMA2D_MAX_LAYER DMA2D maximum number of layers

DMA2D Mode

DMA2D_M2M	DMA2D memory to memory transfer mode
DMA2D_M2M_PFC	DMA2D memory to memory with pixel format conversion transfer mode
DMA2D_M2M_BLEND	DMA2D memory to memory with blending transfer mode
DMA2D_R2M	DMA2D register to memory transfer mode

DMA2D Offset

DMA2D_OFFSET	Line Offset
--------------	-------------

DMA2D Output Color Mode

DMA2D_OUTPUT_ARGB8888	ARGB8888 DMA2D color mode
DMA2D_OUTPUT_RGB888	RGB888 DMA2D color mode
DMA2D_OUTPUT_RGB565	RGB565 DMA2D color mode
DMA2D_OUTPUT_ARGB1555	ARGB1555 DMA2D color mode
DMA2D_OUTPUT_ARGB4444	ARGB4444 DMA2D color mode

DMA2D Red and Blue Swap

DMA2D_RB_REGULAR	Select regular mode (RGB or ARGB)
DMA2D_RB_SWAP	Select swap mode (BGR or ABGR)

DMA2D Shifts

DMA2D_POSITION_FGPFCCR_CS	Required left shift to set foreground CLUT size
DMA2D_POSITION_BGPFCCR_CS	Required left shift to set background CLUT size
DMA2D_POSITION_FGPFCCR_CCM	Required left shift to set foreground CLUT color mode
DMA2D_POSITION_BGPFCCR_CCM	Required left shift to set background CLUT color mode
DMA2D_POSITION_OPFCCR_AI	Required left shift to set output alpha inversion
DMA2D_POSITION_FGPFCCR_AI	Required left shift to set foreground alpha inversion
DMA2D_POSITION_BGPFCCR_AI	Required left shift to set background alpha inversion
DMA2D_POSITION_OPFCCR_RBS	Required left shift to set output Red/Blue swap
DMA2D_POSITION_FGPFCCR_RBS	Required left shift to set foreground Red/Blue swap
DMA2D_POSITION_BGPFCCR_RBS	Required left shift to set background Red/Blue swap
DMA2D_POSITION_AMTCR_DT	Required left shift to set deadtime value
DMA2D_POSITION_FGPFCCR_AM	Required left shift to set foreground alpha mode
DMA2D_POSITION_BGPFCCR_AM	Required left shift to set background alpha mode
DMA2D_POSITION_FGPFCCR_ALPHA	Required left shift to set foreground alpha value
DMA2D_POSITION_BGPFCCR_ALPHA	Required left shift to set background alpha

value

DMA2D_POSITION_NLR_PL Required left shift to set pixels per lines value

DMA2D Size

DMA2D_PIXEL DMA2D number of pixels per line

DMA2D_LINE DMA2D number of lines

DMA2D Time Out

DMA2D_TIMEOUT_ABORT 1s

DMA2D_TIMEOUT_SUSPEND 1s

20 HAL DMA Generic Driver

20.1 DMA Firmware driver registers structures

20.1.1 DMA_InitTypeDef

Data Fields

- *uint32_t Channel*
- *uint32_t Direction*
- *uint32_t PeriphInc*
- *uint32_t MemInc*
- *uint32_t PeriphDataAlignment*
- *uint32_t MemDataAlignment*
- *uint32_t Mode*
- *uint32_t Priority*
- *uint32_t FIFOMode*
- *uint32_t FIFOThreshold*
- *uint32_t MemBurst*
- *uint32_t PeriphBurst*

Field Documentation

- *uint32_t DMA_InitTypeDef::Channel*
Specifies the channel used for the specified stream. This parameter can be a value of [DMAEx_Channel_selection](#)
- *uint32_t DMA_InitTypeDef::Direction*
Specifies if the data will be transferred from memory to peripheral, from memory to memory or from peripheral to memory. This parameter can be a value of [DMA_Data_transfer_direction](#)
- *uint32_t DMA_InitTypeDef::PeriphInc*
Specifies whether the Peripheral address register should be incremented or not. This parameter can be a value of [DMA_Peripheral_incremented_mode](#)
- *uint32_t DMA_InitTypeDef::MemInc*
Specifies whether the memory address register should be incremented or not. This parameter can be a value of [DMA_Memory_incremented_mode](#)
- *uint32_t DMA_InitTypeDef::PeriphDataAlignment*
Specifies the Peripheral data width. This parameter can be a value of [DMA_Peripheral_data_size](#)
- *uint32_t DMA_InitTypeDef::MemDataAlignment*
Specifies the Memory data width. This parameter can be a value of [DMA_Memory_data_size](#)
- *uint32_t DMA_InitTypeDef::Mode*
Specifies the operation mode of the DMAy Streamx. This parameter can be a value of [DMA_mode](#)
Note:The circular buffer mode cannot be used if the memory-to-memory data transfer is configured on the selected Stream
- *uint32_t DMA_InitTypeDef::Priority*
Specifies the software priority for the DMAy Streamx. This parameter can be a value of [DMA_Priority_level](#)
- *uint32_t DMA_InitTypeDef::FIFOMode*
Specifies if the FIFO mode or Direct mode will be used for the specified stream. This parameter can be a value of [DMA_FIFO_direct_mode](#)

Note:The Direct mode (FIFO mode disabled) cannot be used if the memory-to-memory data transfer is configured on the selected stream

- ***uint32_t DMA_InitTypeDef::FIFOThreshold***
Specifies the FIFO threshold level. This parameter can be a value of [DMA_FIFO_threshold_level](#)
- ***uint32_t DMA_InitTypeDef::MemBurst***
Specifies the Burst transfer configuration for the memory transfers. It specifies the amount of data to be transferred in a single non interruptible transaction. This parameter can be a value of [DMA_Memory_burst](#)
Note:The burst mode is possible only if the address Increment mode is enabled.
- ***uint32_t DMA_InitTypeDef::PeriphBurst***
Specifies the Burst transfer configuration for the peripheral transfers. It specifies the amount of data to be transferred in a single non interruptible transaction. This parameter can be a value of [DMA_Peripheral_burst](#)
Note:The burst mode is possible only if the address Increment mode is enabled.

20.1.2 `__DMA_HandleTypeDef`

Data Fields

- ***DMA_Stream_TypeDef * Instance***
- ***DMA_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_DMA_StateTypeDef State***
- ***void * Parent***
- ***void(* XferCpltCallback***
- ***void(* XferHalfCpltCallback***
- ***void(* XferM1CpltCallback***
- ***void(* XferM1HalfCpltCallback***
- ***void(* XferErrorCallback***
- ***void(* XferAbortCallback***
- ***__IO uint32_t ErrorCode***
- ***uint32_t StreamBaseAddress***
- ***uint32_t StreamIndex***

Field Documentation

- ***DMA_Stream_TypeDef* __DMA_HandleTypeDef::Instance***
Register base address
- ***DMA_InitTypeDef __DMA_HandleTypeDef::Init***
DMA communication parameters
- ***HAL_LockTypeDef __DMA_HandleTypeDef::Lock***
DMA locking object
- ***__IO HAL_DMA_StateTypeDef __DMA_HandleTypeDef::State***
DMA transfer state
- ***void* __DMA_HandleTypeDef::Parent***
Parent object state
- ***void(* __DMA_HandleTypeDef::XferCpltCallback)(struct __DMA_HandleTypeDef *hdma)***
DMA transfer complete callback
- ***void(* __DMA_HandleTypeDef::XferHalfCpltCallback)(struct __DMA_HandleTypeDef *hdma)***
DMA Half transfer complete callback
- ***void(* __DMA_HandleTypeDef::XferM1CpltCallback)(struct __DMA_HandleTypeDef *hdma)***
DMA transfer complete Memory1 callback

- **`void(* __DMA_HandleTypeDef::XferM1HalfCpltCallback)(struct __DMA_HandleTypeDef *hdma)`**
DMA transfer Half complete Memory1 callback
- **`void(* __DMA_HandleTypeDef::XferErrorCallback)(struct __DMA_HandleTypeDef *hdma)`**
DMA transfer error callback
- **`void(* __DMA_HandleTypeDef::XferAbortCallback)(struct __DMA_HandleTypeDef *hdma)`**
DMA transfer Abort callback
- **`__IO uint32_t __DMA_HandleTypeDef::ErrorCode`**
DMA Error code
- **`uint32_t __DMA_HandleTypeDef::StreamBaseAddress`**
DMA Stream Base Address
- **`uint32_t __DMA_HandleTypeDef::StreamIndex`**
DMA Stream Index

20.2 DMA Firmware driver API description

20.2.1 How to use this driver

1. Enable and configure the peripheral to be connected to the DMA Stream (except for internal SRAM/FLASH memories: no initialization is necessary) please refer to Reference manual for connection between peripherals and DMA requests.
2. For a given Stream, program the required configuration through the following parameters: Transfer Direction, Source and Destination data formats, Circular, Normal or peripheral flow control mode, Stream Priority level, Source and Destination Increment mode, FIFO mode and its Threshold (if needed), Burst mode for Source and/or Destination (if needed) using HAL_DMA_Init() function. Prior to HAL_DMA_Init() the clock must be enabled for DMA through the following macros: __HAL_RCC_DMA1_CLK_ENABLE() or __HAL_RCC_DMA2_CLK_ENABLE().

Polling mode IO operation

- Use HAL_DMA_Start() to start DMA transfer after the configuration of Source address and destination address and the Length of data to be transferred.
- Use HAL_DMA_PollForTransfer() to poll for the end of current transfer, in this case a fixed Timeout can be configured by User depending from his application.
- Use HAL_DMA_Abort() function to abort the current transfer.

Interrupt mode IO operation

- Configure the DMA interrupt priority using HAL_NVIC_SetPriority()
 - Enable the DMA IRQ handler using HAL_NVIC_EnableIRQ()
 - Use HAL_DMA_Start_IT() to start DMA transfer after the configuration of Source address and destination address and the Length of data to be transferred. In this case the DMA interrupt is configured
 - Use HAL_DMA_IRQHandler() called under DMA_IRQHandler() Interrupt subroutine
 - At the end of data transfer HAL_DMA_IRQHandler() function is executed and user can add his own function by customization of function pointer XferCpltCallback and XferErrorCallback (i.e a member of DMA handle structure).
1. Use HAL_DMA_GetState() function to return the DMA state and HAL_DMA_GetError() in case of error detection.
 2. Use HAL_DMA_Abort_IT() function to abort the current transfer In Memory-to-Memory transfer mode, Circular mode is not allowed. The FIFO is used mainly to reduce bus usage and to allow data packing/unpacking: it is possible to set different

Data Sizes for the Peripheral and the Memory (ie. you can set Half-Word data size for the peripheral to access its data register and set Word data size for the Memory to gain in access time. Each two half words will be packed and written in a single access to a Word in the Memory). When FIFO is disabled, it is not allowed to configure different Data Sizes for Source and Destination. In this case the Peripheral Data Size will be applied to both Source and Destination.

DMA HAL driver macros list

Below the list of most used macros in DMA HAL driver.

- `__HAL_DMA_ENABLE`: Enable the specified DMA Stream.
- `__HAL_DMA_DISABLE`: Disable the specified DMA Stream.
- `__HAL_DMA_GET_IT_SOURCE`: Check whether the specified DMA Stream interrupt has occurred or not.



You can refer to the DMA HAL driver header file for more useful macros

20.2.2 Initialization and de-initialization functions

This section provides functions allowing to initialize the DMA Stream source and destination addresses, incrementation and data sizes, transfer direction, circular/normal mode selection, memory-to-memory mode selection and Stream priority value.

The `HAL_DMA_Init()` function follows the DMA configuration procedures as described in reference manual.

This section contains the following APIs:

- [*HAL_DMA_Init\(\)*](#)
- [*HAL_DMA_DeInit\(\)*](#)

20.2.3 IO operation functions

This section provides functions allowing to:

- Configure the source, destination address and data length and Start DMA transfer
- Configure the source, destination address and data length and Start DMA transfer with interrupt
- Abort DMA transfer
- Poll for transfer complete
- Handle DMA interrupt request

This section contains the following APIs:

- [*HAL_DMA_Start\(\)*](#)
- [*HAL_DMA_Start_IT\(\)*](#)
- [*HAL_DMA_Abort\(\)*](#)
- [*HAL_DMA_Abort_IT\(\)*](#)
- [*HAL_DMA_PollForTransfer\(\)*](#)
- [*HAL_DMA_IRQHandler\(\)*](#)
- [*HAL_DMA_RegisterCallback\(\)*](#)
- [*HAL_DMA_UnRegisterCallback\(\)*](#)
- [*HAL_DMA_CleanCallbacks\(\)*](#)

20.2.4 State and Errors functions

This subsection provides functions allowing to

- Check the DMA state
- Get error code

This section contains the following APIs:

- [HAL_DMA_GetState\(\)](#)
- [HAL_DMA_GetError\(\)](#)

20.2.5 Detailed description of functions

HAL_DMA_Init

Function name	HAL_StatusTypeDef HAL_DMA_Init (DMA_HandleTypeDef * hdma)
Function description	Initialize the DMA according to the specified parameters in the DMA_InitTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none"> • hdma: Pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Stream.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMA_DeInit

Function name	HAL_StatusTypeDef HAL_DMA_DeInit (DMA_HandleTypeDef * hdma)
Function description	DeInitializes the DMA peripheral.
Parameters	<ul style="list-style-type: none"> • hdma: pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Stream.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMA_Start

Function name	HAL_StatusTypeDef HAL_DMA_Start (DMA_HandleTypeDef * hdma, uint32_t SrcAddress, uint32_t DstAddress, uint32_t DataLength)
Function description	Starts the DMA Transfer.
Parameters	<ul style="list-style-type: none"> • hdma: : pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Stream. • SrcAddress: The source memory Buffer address • DstAddress: The destination memory Buffer address • DataLength: The length of data to be transferred from source to destination
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMA_Start_IT

Function name	HAL_StatusTypeDef HAL_DMA_Start_IT (DMA_HandleTypeDef * hdma, uint32_t SrcAddress, uint32_t DstAddress, uint32_t DataLength)
Function description	Start the DMA Transfer with interrupt enabled.
Parameters	<ul style="list-style-type: none"> • hdma: pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Stream. • SrcAddress: The source memory Buffer address • DstAddress: The destination memory Buffer address • DataLength: The length of data to be transferred from source to destination
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMA_Abort

Function name	HAL_StatusTypeDef HAL_DMA_Abort (DMA_HandleTypeDef * hdma)
Function description	Aborts the DMA Transfer.
Parameters	<ul style="list-style-type: none"> • hdma: : pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Stream.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • After disabling a DMA Stream, a check for wait until the DMA Stream is effectively disabled is added. If a Stream is disabled while a data transfer is ongoing, the current data will be transferred and the Stream will be effectively disabled only after the transfer of this single data is finished.

HAL_DMA_Abort_IT

Function name	HAL_StatusTypeDef HAL_DMA_Abort_IT (DMA_HandleTypeDef * hdma)
Function description	Aborts the DMA Transfer in Interrupt mode.
Parameters	<ul style="list-style-type: none"> • hdma: : pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Stream.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMA_PollForTransfer

Function name	HAL_StatusTypeDef HAL_DMA_PollForTransfer (DMA_HandleTypeDef * hdma, HAL_DMA_LevelCompleteTypeDef CompleteLevel, uint32_t Timeout)
Function description	Polling for transfer complete.
Parameters	<ul style="list-style-type: none"> • hdma: pointer to a DMA_HandleTypeDef structure that

	contains the configuration information for the specified DMA Stream.
	<ul style="list-style-type: none"> • CompleteLevel: Specifies the DMA level complete. • Timeout: Timeout duration.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • The polling mode is kept in this version for legacy. it is recommended to use the IT model instead. This model could be used for debug purpose. • The HAL_DMA_PollForTransfer API cannot be used in circular and double buffering mode (automatic circular mode).

HAL_DMA_IRQHandler

Function name	void HAL_DMA_IRQHandler (DMA_HandleTypeDef * hdma)
Function description	Handles DMA interrupt request.
Parameters	<ul style="list-style-type: none"> • hdma: pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Stream.
Return values	<ul style="list-style-type: none"> • None:

HAL_DMA_CleanCallbacks

Function name	HAL_StatusTypeDef HAL_DMA_CleanCallbacks (DMA_HandleTypeDef * hdma)
Function description	

HAL_DMA_RegisterCallback

Function name	HAL_StatusTypeDef HAL_DMA_RegisterCallback (DMA_HandleTypeDef * hdma, HAL_DMA_CallbackIDTypeDef CallbackID, void(*)(DMA_HandleTypeDef *_hdma) pCallback)
Function description	Register callbacks.
Parameters	<ul style="list-style-type: none"> • hdma: pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Stream. • CallbackID: User Callback identifier a DMA_HandleTypeDef structure as parameter. • pCallback: pointer to private callback function which has pointer to a DMA_HandleTypeDef structure as parameter.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMA_UnRegisterCallback

Function name	HAL_StatusTypeDef HAL_DMA_UnRegisterCallback (DMA_HandleTypeDef * hdma, HAL_DMA_CallbackIDTypeDef CallbackID)
Function description	UnRegister callbacks.
Parameters	<ul style="list-style-type: none"> • hdma: pointer to a DMA_HandleTypeDef structure that

- contains the configuration information for the specified DMA Stream.
- **CallbackID:** User Callback identifier a HAL_DMA_CallbackIDTypeDef ENUM as parameter.
- Return values
- **HAL:** status

HAL_DMA_GetState

- Function name **HAL_DMA_StateTypeDef HAL_DMA_GetState (DMA_HandleTypeDef * hdma)**
- Function description Returns the DMA state.
- Parameters
- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Stream.
- Return values
- **HAL:** state

HAL_DMA_GetError

- Function name **uint32_t HAL_DMA_GetError (DMA_HandleTypeDef * hdma)**
- Function description Return the DMA error code.
- Parameters
- **hdma:** : pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Stream.
- Return values
- **DMA:** Error Code

20.3 DMA Firmware driver defines**20.3.1 DMA*****DMA Data transfer direction***

DMA_PERIPH_TO_MEMORY	Peripheral to memory direction
DMA_MEMORY_TO_PERIPH	Memory to peripheral direction
DMA_MEMORY_TO_MEMORY	Memory to memory direction

DMA Error Code

HAL_DMA_ERROR_NONE	No error
HAL_DMA_ERROR_TE	Transfer error
HAL_DMA_ERROR_FE	FIFO error
HAL_DMA_ERROR_DME	Direct Mode error
HAL_DMA_ERROR_TIMEOUT	Timeout error
HAL_DMA_ERROR_PARAM	Parameter error
HAL_DMA_ERROR_NO_XFER	Abort requested with no Xfer ongoing
HAL_DMA_ERROR_NOT_SUPPORTED	Not supported mode

DMA FIFO direct mode

DMA_FIFOMODE_DISABLE FIFO mode disable

DMA_FIFOMODE_ENABLE FIFO mode enable

DMA FIFO threshold level

DMA_FIFO_THRESHOLD_1QUARTERFULL FIFO threshold 1 quart full configuration

DMA_FIFO_THRESHOLD_HALFFULL FIFO threshold half full configuration

DMA_FIFO_THRESHOLD_3QUARTERSFULL FIFO threshold 3 quarts full configuration

DMA_FIFO_THRESHOLD_FULL FIFO threshold full configuration

DMA flag definitions

DMA_FLAG_FEIF0_4

DMA_FLAG_DMEIF0_4

DMA_FLAG_TEIF0_4

DMA_FLAG_HTIF0_4

DMA_FLAG_TCIF0_4

DMA_FLAG_FEIF1_5

DMA_FLAG_DMEIF1_5

DMA_FLAG_TEIF1_5

DMA_FLAG_HTIF1_5

DMA_FLAG_TCIF1_5

DMA_FLAG_FEIF2_6

DMA_FLAG_DMEIF2_6

DMA_FLAG_TEIF2_6

DMA_FLAG_HTIF2_6

DMA_FLAG_TCIF2_6

DMA_FLAG_FEIF3_7

DMA_FLAG_DMEIF3_7

DMA_FLAG_TEIF3_7

DMA_FLAG_HTIF3_7

DMA_FLAG_TCIF3_7

DMA Handle index

TIM_DMA_ID_UPDATE Index of the DMA handle used for Update DMA requests

TIM_DMA_ID_CC1 Index of the DMA handle used for Capture/Compare 1 DMA requests

TIM_DMA_ID_CC2 Index of the DMA handle used for Capture/Compare 2 DMA requests

TIM_DMA_ID_CC3 Index of the DMA handle used for Capture/Compare 3 DMA requests

TIM_DMA_ID_CC4 Index of the DMA handle used for Capture/Compare 4 DMA requests

TIM_DMA_ID_COMMUTATION Index of the DMA handle used for Commutation DMA requests

TIM_DMA_ID_TRIGGER Index of the DMA handle used for Trigger DMA requests

DMA interrupt enable definitions

DMA_IT_TC

DMA_IT_HT

DMA_IT_TE

DMA_IT_DME

DMA_IT_FE

DMA Memory burst

DMA_MBURST_SINGLE

DMA_MBURST_INC4

DMA_MBURST_INC8

DMA_MBURST_INC16

DMA Memory data size

DMA_MDATAALIGN_BYTE Memory data alignment: Byte

DMA_MDATAALIGN_HALFWORD Memory data alignment: HalfWord

DMA_MDATAALIGN_WORD Memory data alignment: Word

DMA Memory incremented mode

DMA_MINC_ENABLE Memory increment mode enable

DMA_MINC_DISABLE Memory increment mode disable

DMA mode

DMA_NORMAL Normal mode

DMA_CIRCULAR Circular mode

DMA_PFCTRL Peripheral flow control mode

DMA Peripheral burst

DMA_PBURST_SINGLE

DMA_PBURST_INC4

DMA_PBURST_INC8

DMA_PBURST_INC16

DMA Peripheral data size

DMA_PDATAALIGN_BYTE Peripheral data alignment: Byte

DMA_PDATAALIGN_HALFWORD Peripheral data alignment: HalfWord

DMA_PDATAALIGN_WORD Peripheral data alignment: Word

DMA Peripheral incremented mode

DMA_PINC_ENABLE Peripheral increment mode enable

DMA_PINC_DISABLE Peripheral increment mode disable

DMA Priority level

DMA_PRIORITY_LOW	Priority level: Low
DMA_PRIORITY_MEDIUM	Priority level: Medium
DMA_PRIORITY_HIGH	Priority level: High
DMA_PRIORITY_VERY_HIGH	Priority level: Very High

21 HAL DMA Extension Driver

21.1 DMAEx Firmware driver API description

21.1.1 How to use this driver

The DMA Extension HAL driver can be used as follows:

- Start a multi buffer transfer using the HAL_DMA_MultiBufferStart() function for polling mode or HAL_DMA_MultiBufferStart_IT() for interrupt mode. In Memory-to-Memory transfer mode, Multi (Double) Buffer mode is not allowed. When Multi (Double) Buffer mode is enabled, the transfer is circular by default. In Multi (Double) buffer mode, it is possible to update the base address for the AHB memory port on the fly (DMA_SxM0AR or DMA_SxM1AR) when the stream is enabled.

21.1.2 Extended features functions

This section provides functions allowing to:

- Configure the source, destination address and data length and Start MultiBuffer DMA transfer
- Configure the source, destination address and data length and Start MultiBuffer DMA transfer with interrupt
- Change on the fly the memory0 or memory1 address.

This section contains the following APIs:

- [HAL_DMAEx_MultiBufferStart\(\)](#)
- [HAL_DMAEx_MultiBufferStart_IT\(\)](#)
- [HAL_DMAEx_ChangeMemory\(\)](#)

21.1.3 Detailed description of functions

HAL_DMAEx_MultiBufferStart

Function name HAL_StatusTypeDef HAL_DMAEx_MultiBufferStart (DMA_HandleTypeDef * hdma, uint32_t SrcAddress, uint32_t DstAddress, uint32_t SecondMemAddress, uint32_t DataLength)

Function description Starts the multi_buffer DMA Transfer.

Parameters

- **hdma:** : pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Stream.
- **SrcAddress:** The source memory Buffer address
- **DstAddress:** The destination memory Buffer address
- **SecondMemAddress:** The second memory Buffer address in case of multi buffer Transfer
- **DataLength:** The length of data to be transferred from source to destination

Return values

- **HAL:** status

HAL_DMAEx_MultiBufferStart_IT

Function name	HAL_StatusTypeDef HAL_DMAEx_MultiBufferStart_IT (DMA_HandleTypeDef * hdma, uint32_t SrcAddress, uint32_t DstAddress, uint32_t SecondMemAddress, uint32_t DataLength)
Function description	Starts the multi_buffer DMA Transfer with interrupt enabled.
Parameters	<ul style="list-style-type: none"> • hdma: pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Stream. • SrcAddress: The source memory Buffer address • DstAddress: The destination memory Buffer address • SecondMemAddress: The second memory Buffer address in case of multi buffer Transfer • DataLength: The length of data to be transferred from source to destination
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DMAEx_ChangeMemory

Function name	HAL_StatusTypeDef HAL_DMAEx_ChangeMemory (DMA_HandleTypeDef * hdma, uint32_t Address, HAL_DMA_MemoryTypeDef memory)
Function description	Change the memory0 or memory1 address on the fly.
Parameters	<ul style="list-style-type: none"> • hdma: pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Stream. • Address: The new address • memory: the memory to be changed, This parameter can be one of the following values: MEMORY0 / MEMORY1
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • The MEMORY0 address can be changed only when the current transfer use MEMORY1 and the MEMORY1 address can be changed only when the current transfer use MEMORY0.

21.2 DMAEx Firmware driver defines**21.2.1 DMAEx*****DMA Channel selection***

DMA_CHANNEL_0	DMA Channel 0
DMA_CHANNEL_1	DMA Channel 1
DMA_CHANNEL_2	DMA Channel 2
DMA_CHANNEL_3	DMA Channel 3
DMA_CHANNEL_4	DMA Channel 4
DMA_CHANNEL_5	DMA Channel 5

DMA_CHANNEL_6	DMA Channel 6
DMA_CHANNEL_7	DMA Channel 7
DMA_CHANNEL_8	DMA Channel 8
DMA_CHANNEL_9	DMA Channel 9
DMA_CHANNEL_10	DMA Channel 10
DMA_CHANNEL_11	DMA Channel 11
DMA_CHANNEL_12	DMA Channel 12
DMA_CHANNEL_13	DMA Channel 13
DMA_CHANNEL_14	DMA Channel 14
DMA_CHANNEL_15	DMA Channel 15

22 HAL DSI Generic Driver

22.1 DSI Firmware driver registers structures

22.1.1 DSI_InitTypeDef

Data Fields

- *uint32_t AutomaticClockLaneControl*
- *uint32_t TXEscapeCkdiv*
- *uint32_t NumberOfLanes*

Field Documentation

- *uint32_t DSI_InitTypeDef::AutomaticClockLaneControl*
Automatic clock lane control This parameter can be any value of [DSI_Automatic_Clk_Lane_Control](#)
- *uint32_t DSI_InitTypeDef::TXEscapeCkdiv*
TX Escape clock division The values 0 and 1 stop the TX_ESC clock generation
- *uint32_t DSI_InitTypeDef::NumberOfLanes*
Number of lanes This parameter can be any value of [DSI_Number_Of_Lanes](#)

22.1.2 DSI_PLLInitTypeDef

Data Fields

- *uint32_t PLLNDIV*
- *uint32_t PLLIDF*
- *uint32_t PLLODF*

Field Documentation

- *uint32_t DSI_PLLInitTypeDef::PLLNDIV*
PLL Loop Division Factor This parameter must be a value between 10 and 125
- *uint32_t DSI_PLLInitTypeDef::PLLIDF*
PLL Input Division Factor This parameter can be any value of [DSI_PLL_IDF](#)
- *uint32_t DSI_PLLInitTypeDef::PLLODF*
PLL Output Division Factor This parameter can be any value of [DSI_PLL_ODF](#)

22.1.3 DSI_VidCfgTypeDef

Data Fields

- *uint32_t VirtualChannelID*
- *uint32_t ColorCoding*
- *uint32_t LooselyPacked*
- *uint32_t Mode*
- *uint32_t PacketSize*
- *uint32_t NumberOfChunks*
- *uint32_t NullPacketSize*
- *uint32_t HSPolarity*
- *uint32_t VSPolarity*
- *uint32_t DEPolarity*
- *uint32_t HorizontalSyncActive*
- *uint32_t HorizontalBackPorch*

- ***uint32_t HorizontalLine***
- ***uint32_t VerticalSyncActive***
- ***uint32_t VerticalBackPorch***
- ***uint32_t VerticalFrontPorch***
- ***uint32_t VerticalActive***
- ***uint32_t LPCommandEnable***
- ***uint32_t LPLargestPacketSize***
- ***uint32_t LPVACTLargestPacketSize***
- ***uint32_t LPHorizontalFrontPorchEnable***
- ***uint32_t LPHorizontalBackPorchEnable***
- ***uint32_t LPVerticalActiveEnable***
- ***uint32_t LPVerticalFrontPorchEnable***
- ***uint32_t LPVerticalBackPorchEnable***
- ***uint32_t LPVerticalSyncActiveEnable***
- ***uint32_t FrameBTAcknowledgeEnable***

Field Documentation

- ***uint32_t DSI_VidCfgTypeDef::VirtualChannelID***
Virtual channel ID
- ***uint32_t DSI_VidCfgTypeDef::ColorCoding***
Color coding for LTDC interface This parameter can be any value of [DSI_Color_Coding](#)
- ***uint32_t DSI_VidCfgTypeDef::LooselyPacked***
Enable or disable loosely packed stream (needed only when using 18-bit configuration). This parameter can be any value of [DSI_LooselyPacked](#)
- ***uint32_t DSI_VidCfgTypeDef::Mode***
Video mode type This parameter can be any value of [DSI_Video_Mode_Type](#)
- ***uint32_t DSI_VidCfgTypeDef::PacketSize***
Video packet size
- ***uint32_t DSI_VidCfgTypeDef::NumberOfChunks***
Number of chunks
- ***uint32_t DSI_VidCfgTypeDef::NullPacketSize***
Null packet size
- ***uint32_t DSI_VidCfgTypeDef::HSPolarity***
HSYNC pin polarity This parameter can be any value of [DSI_HSYNC_Polarity](#)
- ***uint32_t DSI_VidCfgTypeDef::VSPolarity***
VSYNC pin polarity This parameter can be any value of [DSI_VSYNC_Polarity](#)
- ***uint32_t DSI_VidCfgTypeDef::DEPolarity***
Data Enable pin polarity This parameter can be any value of [DSI_DATA_ENABLE_Polarity](#)
- ***uint32_t DSI_VidCfgTypeDef::HorizontalSyncActive***
Horizontal synchronism active duration (in lane byte clock cycles)
- ***uint32_t DSI_VidCfgTypeDef::HorizontalBackPorch***
Horizontal back-porch duration (in lane byte clock cycles)
- ***uint32_t DSI_VidCfgTypeDef::HorizontalLine***
Horizontal line duration (in lane byte clock cycles)
- ***uint32_t DSI_VidCfgTypeDef::VerticalSyncActive***
Vertical synchronism active duration
- ***uint32_t DSI_VidCfgTypeDef::VerticalBackPorch***
Vertical back-porch duration
- ***uint32_t DSI_VidCfgTypeDef::VerticalFrontPorch***
Vertical front-porch duration
- ***uint32_t DSI_VidCfgTypeDef::VerticalActive***
Vertical active duration

- ***uint32_t DSI_VidCfgTypeDef::LPCommandEnable***
Low-power command enable This parameter can be any value of [DSI_LP_Command](#)
- ***uint32_t DSI_VidCfgTypeDef::LPLargestPacketSize***
The size, in bytes, of the low power largest packet that can fit in a line during VSA, VBP and VFP regions
- ***uint32_t DSI_VidCfgTypeDef::LPVACTLargestPacketSize***
The size, in bytes, of the low power largest packet that can fit in a line during VACT region
- ***uint32_t DSI_VidCfgTypeDef::LPHorizontalFrontPorchEnable***
Low-power horizontal front-porch enable This parameter can be any value of [DSI_LP_HFP](#)
- ***uint32_t DSI_VidCfgTypeDef::LPHorizontalBackPorchEnable***
Low-power horizontal back-porch enable This parameter can be any value of [DSI_LP_HBP](#)
- ***uint32_t DSI_VidCfgTypeDef::LPVerticalActiveEnable***
Low-power vertical active enable This parameter can be any value of [DSI_LP_VACT](#)
- ***uint32_t DSI_VidCfgTypeDef::LPVerticalFrontPorchEnable***
Low-power vertical front-porch enable This parameter can be any value of [DSI_LP_VFP](#)
- ***uint32_t DSI_VidCfgTypeDef::LPVerticalBackPorchEnable***
Low-power vertical back-porch enable This parameter can be any value of [DSI_LP_VBP](#)
- ***uint32_t DSI_VidCfgTypeDef::LPVerticalSyncActiveEnable***
Low-power vertical sync active enable This parameter can be any value of [DSI_LP_VSYNC](#)
- ***uint32_t DSI_VidCfgTypeDef::FrameBTAAcknowledgeEnable***
Frame bus-turn-around acknowledge enable This parameter can be any value of [DSI_FBTA_acknowledge](#)

22.1.4 DSI_CmdCfgTypeDef

Data Fields

- ***uint32_t VirtualChannelID***
- ***uint32_t ColorCoding***
- ***uint32_t CommandSize***
- ***uint32_t TearingEffectSource***
- ***uint32_t TearingEffectPolarity***
- ***uint32_t HSPolarity***
- ***uint32_t VSPolarity***
- ***uint32_t DEPolarity***
- ***uint32_t VSyncPol***
- ***uint32_t AutomaticRefresh***
- ***uint32_t TEAcknowledgeRequest***

Field Documentation

- ***uint32_t DSI_CmdCfgTypeDef::VirtualChannelID***
Virtual channel ID
- ***uint32_t DSI_CmdCfgTypeDef::ColorCoding***
Color coding for LTDC interface This parameter can be any value of [DSI_Color_Coding](#)
- ***uint32_t DSI_CmdCfgTypeDef::CommandSize***
Maximum allowed size for an LTDC write memory command, measured in pixels. This parameter can be any value between 0x00 and 0xFFFF

- ***uint32_t DSI_CmdCfgTypeDef::TearingEffectSource***
Tearing effect source This parameter can be any value of [DSI_TearingEffectSource](#)
- ***uint32_t DSI_CmdCfgTypeDef::TearingEffectPolarity***
Tearing effect pin polarity This parameter can be any value of [DSI_TearingEffectPolarity](#)
- ***uint32_t DSI_CmdCfgTypeDef::HSPolarity***
HSYNC pin polarity This parameter can be any value of [DSI_HSYNC_Polarity](#)
- ***uint32_t DSI_CmdCfgTypeDef::VSPolarity***
VSYNC pin polarity This parameter can be any value of [DSI_VSYNC_Polarity](#)
- ***uint32_t DSI_CmdCfgTypeDef::DEPolarity***
Data Enable pin polarity This parameter can be any value of [DSI_DATA_ENABLE_Polarity](#)
- ***uint32_t DSI_CmdCfgTypeDef::VSyncPol***
VSync edge on which the LTDC is halted This parameter can be any value of [DSI_VSYNC_Polarity](#)
- ***uint32_t DSI_CmdCfgTypeDef::AutomaticRefresh***
Automatic refresh mode This parameter can be any value of [DSI_AutomaticRefresh](#)
- ***uint32_t DSI_CmdCfgTypeDef::TEAcknowledgeRequest***
Tearing Effect Acknowledge Request Enable This parameter can be any value of [DSI_TE_AcknowledgeRequest](#)

22.1.5 DSI_LPCmdTypeDef

Data Fields

- ***uint32_t LPGenShortWriteNoP***
- ***uint32_t LPGenShortWriteOneP***
- ***uint32_t LPGenShortWriteTwoP***
- ***uint32_t LPGenShortReadNoP***
- ***uint32_t LPGenShortReadOneP***
- ***uint32_t LPGenShortReadTwoP***
- ***uint32_t LPGenLongWrite***
- ***uint32_t LPDcsShortWriteNoP***
- ***uint32_t LPDcsShortWriteOneP***
- ***uint32_t LPDcsShortReadNoP***
- ***uint32_t LPDcsLongWrite***
- ***uint32_t LPMaxReadPacket***
- ***uint32_t AcknowledgeRequest***

Field Documentation

- ***uint32_t DSI_LPCmdTypeDef::LPGenShortWriteNoP***
Generic Short Write Zero parameters Transmission This parameter can be any value of [DSI_LP_LPGenShortWriteNoP](#)
- ***uint32_t DSI_LPCmdTypeDef::LPGenShortWriteOneP***
Generic Short Write One parameter Transmission This parameter can be any value of [DSI_LP_LPGenShortWriteOneP](#)
- ***uint32_t DSI_LPCmdTypeDef::LPGenShortWriteTwoP***
Generic Short Write Two parameters Transmission This parameter can be any value of [DSI_LP_LPGenShortWriteTwoP](#)
- ***uint32_t DSI_LPCmdTypeDef::LPGenShortReadNoP***
Generic Short Read Zero parameters Transmission This parameter can be any value of [DSI_LP_LPGenShortReadNoP](#)
- ***uint32_t DSI_LPCmdTypeDef::LPGenShortReadOneP***
Generic Short Read One parameter Transmission This parameter can be any value of [DSI_LP_LPGenShortReadOneP](#)

- ***uint32_t DSI_LPCmdTypeDef::LPGenShortReadTwoP***
Generic Short Read Two parameters Transmission This parameter can be any value of [DSI_LP_LPGenShortReadTwoP](#)
- ***uint32_t DSI_LPCmdTypeDef::LPGenLongWrite***
Generic Long Write Transmission This parameter can be any value of [DSI_LP_LPGenLongWrite](#)
- ***uint32_t DSI_LPCmdTypeDef::LPDcsShortWriteNoP***
DCS Short Write Zero parameters Transmission This parameter can be any value of [DSI_LP_LPdcsShortWriteNoP](#)
- ***uint32_t DSI_LPCmdTypeDef::LPDcsShortWriteOneP***
DCS Short Write One parameter Transmission This parameter can be any value of [DSI_LP_LPdcsShortWriteOneP](#)
- ***uint32_t DSI_LPCmdTypeDef::LPDcsShortReadNoP***
DCS Short Read Zero parameters Transmission This parameter can be any value of [DSI_LP_LPdcsShortReadNoP](#)
- ***uint32_t DSI_LPCmdTypeDef::LPDcsLongWrite***
DCS Long Write Transmission This parameter can be any value of [DSI_LP_LPdcsLongWrite](#)
- ***uint32_t DSI_LPCmdTypeDef::LPMaxReadPacket***
Maximum Read Packet Size Transmission This parameter can be any value of [DSI_LP_LPMaxReadPacket](#)
- ***uint32_t DSI_LPCmdTypeDef::AcknowledgeRequest***
Acknowledge Request Enable This parameter can be any value of [DSI_AcknowledgeRequest](#)

22.1.6 DSI_PHY_TimerTypeDef

Data Fields

- ***uint32_t ClockLaneHS2LPTime***
- ***uint32_t ClockLaneLP2HSTime***
- ***uint32_t DataLaneHS2LPTime***
- ***uint32_t DataLaneLP2HSTime***
- ***uint32_t DataLaneMaxReadTime***
- ***uint32_t StopWaitTime***

Field Documentation

- ***uint32_t DSI_PHY_TimerTypeDef::ClockLaneHS2LPTime***
The maximum time that the D-PHY clock lane takes to go from high-speed to low-power transmission
- ***uint32_t DSI_PHY_TimerTypeDef::ClockLaneLP2HSTime***
The maximum time that the D-PHY clock lane takes to go from low-power to high-speed transmission
- ***uint32_t DSI_PHY_TimerTypeDef::DataLaneHS2LPTime***
The maximum time that the D-PHY data lanes takes to go from high-speed to low-power transmission
- ***uint32_t DSI_PHY_TimerTypeDef::DataLaneLP2HSTime***
The maximum time that the D-PHY data lanes takes to go from low-power to high-speed transmission
- ***uint32_t DSI_PHY_TimerTypeDef::DataLaneMaxReadTime***
The maximum time required to perform a read command
- ***uint32_t DSI_PHY_TimerTypeDef::StopWaitTime***
The minimum wait period to request a High-Speed transmission after the Stop state

22.1.7 DSI_HOST_TimeoutTypeDef

Data Fields

- *uint32_t TimeoutCkdiv*
- *uint32_t HighSpeedTransmissionTimeout*
- *uint32_t LowPowerReceptionTimeout*
- *uint32_t HighSpeedReadTimeout*
- *uint32_t LowPowerReadTimeout*
- *uint32_t HighSpeedWriteTimeout*
- *uint32_t HighSpeedWritePrespMode*
- *uint32_t LowPowerWriteTimeout*
- *uint32_t BTATimeout*

Field Documentation

- *uint32_t DSI_HOST_TimeoutTypeDef::TimeoutCkdiv*
Time-out clock division
- *uint32_t DSI_HOST_TimeoutTypeDef::HighSpeedTransmissionTimeout*
High-speed transmission time-out
- *uint32_t DSI_HOST_TimeoutTypeDef::LowPowerReceptionTimeout*
Low-power reception time-out
- *uint32_t DSI_HOST_TimeoutTypeDef::HighSpeedReadTimeout*
High-speed read time-out
- *uint32_t DSI_HOST_TimeoutTypeDef::LowPowerReadTimeout*
Low-power read time-out
- *uint32_t DSI_HOST_TimeoutTypeDef::HighSpeedWriteTimeout*
High-speed write time-out
- *uint32_t DSI_HOST_TimeoutTypeDef::HighSpeedWritePrespMode*
High-speed write presp mode This parameter can be any value of [DSI_HS_PrespMode](#)
- *uint32_t DSI_HOST_TimeoutTypeDef::LowPowerWriteTimeout*
Low-speed write time-out
- *uint32_t DSI_HOST_TimeoutTypeDef::BTATimeout*
BTA time-out

22.1.8 DSI_HandleTypeDef

Data Fields

- *DSI_TypeDef * Instance*
- *DSI_InitTypeDef Init*
- *HAL_LockTypeDef Lock*
- *__IO HAL_DSI_StateTypeDef State*
- *__IO uint32_t ErrorCode*
- *uint32_t ErrorMsk*

Field Documentation

- *DSI_TypeDef* DSI_HandleTypeDef::Instance*
Register base address
- *DSI_InitTypeDef DSI_HandleTypeDef::Init*
DSI required parameters
- *HAL_LockTypeDef DSI_HandleTypeDef::Lock*
DSI peripheral status
- *__IO HAL_DSI_StateTypeDef DSI_HandleTypeDef::State*
DSI communication state

- `__IO uint32_t DSI_HandleTypeDef::ErrorCode`
DSI Error code
- `uint32_t DSI_HandleTypeDef::ErrorMsk`
DSI Error monitoring mask

22.2 DSI Firmware driver API description

22.2.1 Initialization and Configuration functions

This section provides functions allowing to:

- Initialize and configure the DSI
- De-initialize the DSI

This section contains the following APIs:

- [*HAL_DSI_Init\(\)*](#)
- [*HAL_DSI_DeInit\(\)*](#)
- [*HAL_DSI_GetError\(\)*](#)
- [*HAL_DSI_ConfigErrorMonitor\(\)*](#)
- [*HAL_DSI_MspInit\(\)*](#)
- [*HAL_DSI_MspDeInit\(\)*](#)

22.2.2 IO operation functions

This section provides function allowing to:

- Handle DSI interrupt request

This section contains the following APIs:

- [*HAL_DSI_IRQHandler\(\)*](#)
- [*HAL_DSI_TearingEffectCallback\(\)*](#)
- [*HAL_DSI_EndOfRefreshCallback\(\)*](#)
- [*HAL_DSI_ErrorCallback\(\)*](#)

22.2.3 Peripheral Control functions

This section contains the following APIs:

- [*HAL_DSI_SetGenericVCID\(\)*](#)
- [*HAL_DSI_ConfigVideoMode\(\)*](#)
- [*HAL_DSI_ConfigAdaptedCommandMode\(\)*](#)
- [*HAL_DSI_ConfigCommand\(\)*](#)
- [*HAL_DSI_ConfigFlowControl\(\)*](#)
- [*HAL_DSI_ConfigPhyTimer\(\)*](#)
- [*HAL_DSI_ConfigHostTimeouts\(\)*](#)
- [*HAL_DSI_Start\(\)*](#)
- [*HAL_DSI_Stop\(\)*](#)
- [*HAL_DSI_Refresh\(\)*](#)
- [*HAL_DSI_ColorMode\(\)*](#)
- [*HAL_DSI_Shutdown\(\)*](#)
- [*HAL_DSI_ShortWrite\(\)*](#)
- [*HAL_DSI_LongWrite\(\)*](#)
- [*HAL_DSI_Read\(\)*](#)
- [*HAL_DSI_EnterULPMData\(\)*](#)
- [*HAL_DSI_ExitULPMData\(\)*](#)
- [*HAL_DSI_EnterULPM\(\)*](#)

- [HAL_DSI_ExitULPM\(\)](#)
- [HAL_DSI_PatternGeneratorStart\(\)](#)
- [HAL_DSI_PatternGeneratorStop\(\)](#)
- [HAL_DSI_SetSlewRateAndDelayTuning\(\)](#)
- [HAL_DSI_SetLowPowerRXFilter\(\)](#)
- [HAL_DSI_SetSDD\(\)](#)
- [HAL_DSI_SetLanePinsConfiguration\(\)](#)
- [HAL_DSI_SetPHYTimings\(\)](#)
- [HAL_DSI_ForceTXStopMode\(\)](#)
- [HAL_DSI_ForceRXLowPower\(\)](#)
- [HAL_DSI_ForceDataLanesInRX\(\)](#)
- [HAL_DSI_SetPullDown\(\)](#)
- [HAL_DSI_SetContentionDetectionOff\(\)](#)

22.2.4 Peripheral State and Errors functions

This subsection provides functions allowing to

- Check the DSI state.
- Get error code.

This section contains the following APIs:

- [HAL_DSI_GetState\(\)](#)

22.2.5 Detailed description of functions

HAL_DSI_Init

Function name	HAL_StatusTypeDef HAL_DSI_Init (DSI_HandleTypeDef * hdsi, DSI_PLLInitTypeDef * PLLInit)
Function description	Initializes the DSI according to the specified parameters in the DSI_InitTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI. • PLLInit: pointer to a DSI_PLLInitTypeDef structure that contains the PLL Clock structure definition for the DSI.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_DeInit

Function name	HAL_StatusTypeDef HAL_DSI_DeInit (DSI_HandleTypeDef * hdsi)
Function description	De-initializes the DSI peripheral registers to their default reset values.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_Msplnit

Function name	void HAL_DSI_Msplnit (DSI_HandleTypeDef * hdsi)
---------------	--

Function description	Initializes the DSI MSP.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
Return values	<ul style="list-style-type: none"> • None:

HAL_DSI_MspDeInit

Function name	void HAL_DSI_MspDeInit (DSI_HandleTypeDef * hdsi)
Function description	De-initializes the DSI MSP.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
Return values	<ul style="list-style-type: none"> • None:

HAL_DSI_IRQHandler

Function name	void HAL_DSI_IRQHandler (DSI_HandleTypeDef * hdsi)
Function description	Handles DSI interrupt request.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_TearingEffectCallback

Function name	void HAL_DSI_TearingEffectCallback (DSI_HandleTypeDef * hdsi)
Function description	Tearing Effect DSI callback.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
Return values	<ul style="list-style-type: none"> • None:

HAL_DSI_EndOfRefreshCallback

Function name	void HAL_DSI_EndOfRefreshCallback (DSI_HandleTypeDef * hdsi)
Function description	End of Refresh DSI callback.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
Return values	<ul style="list-style-type: none"> • None:

HAL_DSI_ErrorCallback

Function name	void HAL_DSI_ErrorCallback (DSI_HandleTypeDef * hdsi)
Function description	Operation Error DSI callback.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **None:**

HAL_DSI_SetGenericVCID

Function name **HAL_StatusTypeDef HAL_DSI_SetGenericVCID (DSI_HandleTypeDef * hdsi, uint32_t VirtualChannelID)**

Function description Configure the Generic interface read-back Virtual Channel ID.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **VirtualChannelID:** Virtual channel ID

Return values

- **HAL:** status

HAL_DSI_ConfigVideoMode

Function name **HAL_StatusTypeDef HAL_DSI_ConfigVideoMode (DSI_HandleTypeDef * hdsi, DSI_VidCfgTypeDef * VidCfg)**

Function description Select video mode and configure the corresponding parameters.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **VidCfg:** pointer to a DSI_VidCfgTypeDef structure that contains the DSI video mode configuration parameters

Return values

- **HAL:** status

HAL_DSI_ConfigAdaptedCommandMode

Function name **HAL_StatusTypeDef HAL_DSI_ConfigAdaptedCommandMode (DSI_HandleTypeDef * hdsi, DSI_CmdCfgTypeDef * CmdCfg)**

Function description Select adapted command mode and configure the corresponding parameters.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **CmdCfg:** pointer to a DSI_CmdCfgTypeDef structure that contains the DSI command mode configuration parameters

Return values

- **HAL:** status

HAL_DSI_ConfigCommand

Function name **HAL_StatusTypeDef HAL_DSI_ConfigCommand (DSI_HandleTypeDef * hdsi, DSI_LPCmdTypeDef * LPCmd)**

Function description Configure command transmission mode: High-speed or Low-power and enable/disable acknowledge request after packet transmission.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **LPCmd:** pointer to a DSI_LPCmdTypeDef structure that contains the DSI command transmission mode configuration parameters

Return values

- **HAL:** status

HAL_DSI_ConfigFlowControl

Function name **HAL_StatusTypeDef HAL_DSI_ConfigFlowControl (DSI_HandleTypeDef * hdsi, uint32_t FlowControl)**

Function description Configure the flow control parameters.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **FlowControl:** flow control feature(s) to be enabled. This parameter can be any combination of DSI Flow Control.

Return values

- **HAL:** status

HAL_DSI_ConfigPhyTimer

Function name **HAL_StatusTypeDef HAL_DSI_ConfigPhyTimer (DSI_HandleTypeDef * hdsi, DSI_PHY_TimerTypeDef * PhyTimers)**

Function description Configure the DSI PHY timer parameters.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **PhyTimers:** DSI_PHY_TimerTypeDef structure that contains the DSI PHY timing parameters

Return values

- **HAL:** status

HAL_DSI_ConfigHostTimeouts

Function name **HAL_StatusTypeDef HAL_DSI_ConfigHostTimeouts (DSI_HandleTypeDef * hdsi, DSI_HOST_TimeoutTypeDef * HostTimeouts)**

Function description Configure the DSI HOST timeout parameters.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **HostTimeouts:** DSI_HOST_TimeoutTypeDef structure that contains the DSI host timeout parameters

Return values

- **HAL:** status

HAL_DSI_Start

Function name **HAL_StatusTypeDef HAL_DSI_Start (DSI_HandleTypeDef * hdsi)**

Function description Start the DSI module.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **HAL:** status

HAL_DSI_Stop

Function name	HAL_StatusTypeDef HAL_DSI_Stop (DSI_HandleTypeDef * hdsi)
Function description	Stop the DSI module.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_Refresh

Function name	HAL_StatusTypeDef HAL_DSI_Refresh (DSI_HandleTypeDef * hdsi)
Function description	Refresh the display in command mode.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_ColorMode

Function name	HAL_StatusTypeDef HAL_DSI_ColorMode (DSI_HandleTypeDef * hdsi, uint32_t ColorMode)
Function description	Controls the display color mode in Video mode.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI. • ColorMode: Color mode (full or 8-colors). This parameter can be any value of DSI Color Mode
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_Shutdown

Function name	HAL_StatusTypeDef HAL_DSI_Shutdown (DSI_HandleTypeDef * hdsi, uint32_t Shutdown)
Function description	Control the display shutdown in Video mode.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI. • Shutdown: Shut-down (Display-ON or Display-OFF). This parameter can be any value of DSI ShutDown
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_ShortWrite

Function name	HAL_StatusTypeDef HAL_DSI_ShortWrite (DSI_HandleTypeDef * hdsi, uint32_t ChannelID, uint32_t Mode, uint32_t Param1, uint32_t Param2)
Function description	DCS or Generic short write command.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that

- contains the configuration information for the DSI.
 - **ChannelID:** Virtual channel ID.
 - **Mode:** DSI short packet data type. This parameter can be any value of DSI SHORT WRITE PKT Data Type.
 - **Param1:** DSC command or first generic parameter. This parameter can be any value of DSI DCS Command or a generic command code.
 - **Param2:** DSC parameter or second generic parameter.
- Return values
- **HAL:** status

HAL_DSI_LongWrite

- Function name **HAL_StatusTypeDef HAL_DSI_LongWrite (DSI_HandleTypeDef * hdsi, uint32_t ChannelID, uint32_t Mode, uint32_t NbParams, uint32_t Param1, uint8_t * ParametersTable)**
- Function description DCS or Generic long write command.
- Parameters
- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
 - **ChannelID:** Virtual channel ID.
 - **Mode:** DSI long packet data type. This parameter can be any value of DSI LONG WRITE PKT Data Type.
 - **NbParams:** Number of parameters.
 - **Param1:** DSC command or first generic parameter. This parameter can be any value of DSI DCS Command or a generic command code
 - **ParametersTable:** Pointer to parameter values table.
- Return values
- **HAL:** status

HAL_DSI_Read

- Function name **HAL_StatusTypeDef HAL_DSI_Read (DSI_HandleTypeDef * hdsi, uint32_t ChannelNbr, uint8_t * Array, uint32_t Size, uint32_t Mode, uint32_t DCSCmd, uint8_t * ParametersTable)**
- Function description Read command (DCS or generic)
- Parameters
- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
 - **ChannelNbr:** Virtual channel ID
 - **Array:** pointer to a buffer to store the payload of a read back operation.
 - **Size:** Data size to be read (in byte).
 - **Mode:** DSI read packet data type. This parameter can be any value of DSI SHORT READ PKT Data Type.
 - **DCSCmd:** DCS get/read command.
 - **ParametersTable:** Pointer to parameter values table.
- Return values
- **HAL:** status

HAL_DSI_EnterULPMData

- Function name **HAL_StatusTypeDef HAL_DSI_EnterULPMData**

(DSI_HandleTypeDef * hdsi)

Function description	Enter the ULPM (Ultra Low Power Mode) with the D-PHY PLL running (only data lanes are in ULPM)
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_ExitULPMData

Function name	HAL_StatusTypeDef HAL_DSI_ExitULPMData (DSI_HandleTypeDef * hdsi)
Function description	Exit the ULPM (Ultra Low Power Mode) with the D-PHY PLL running (only data lanes are in ULPM)
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_EnterULPM

Function name	HAL_StatusTypeDef HAL_DSI_EnterULPM (DSI_HandleTypeDef * hdsi)
Function description	Enter the ULPM (Ultra Low Power Mode) with the D-PHY PLL turned off (both data and clock lanes are in ULPM)
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_ExitULPM

Function name	HAL_StatusTypeDef HAL_DSI_ExitULPM (DSI_HandleTypeDef * hdsi)
Function description	Exit the ULPM (Ultra Low Power Mode) with the D-PHY PLL turned off (both data and clock lanes are in ULPM)
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_PatternGeneratorStart

Function name	HAL_StatusTypeDef HAL_DSI_PatternGeneratorStart (DSI_HandleTypeDef * hdsi, uint32_t Mode, uint32_t Orientation)
Function description	Start test pattern generation.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI. • Mode: Pattern generator mode This parameter can be one of the following values: 0 : Color bars (horizontal or vertical) 1 :

- BER pattern (vertical only)
- **Orientation:** Pattern generator orientation This parameter can be one of the following values: 0 : Vertical color bars 1 : Horizontal color bars
- Return values
- **HAL:** status

HAL_DSI_PatternGeneratorStop

- Function name **HAL_StatusTypeDef HAL_DSI_PatternGeneratorStop (DSI_HandleTypeDef * hdsi)**
- Function description Stop test pattern generation.
- Parameters
- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- Return values
- **HAL:** status

HAL_DSI_SetSlewRateAndDelayTuning

- Function name **HAL_StatusTypeDef HAL_DSI_SetSlewRateAndDelayTuning (DSI_HandleTypeDef * hdsi, uint32_t CommDelay, uint32_t Lane, uint32_t Value)**
- Function description Set Slew-Rate And Delay Tuning.
- Parameters
- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
 - **CommDelay:** Communication delay to be adjusted. This parameter can be any value of DSI Communication Delay
 - **Lane:** select between clock or data lanes. This parameter can be any value of DSI Lane Group
 - **Value:** Custom value of the slew-rate or delay
- Return values
- **HAL:** status

HAL_DSI_SetLowPowerRXFilter

- Function name **HAL_StatusTypeDef HAL_DSI_SetLowPowerRXFilter (DSI_HandleTypeDef * hdsi, uint32_t Frequency)**
- Function description Low-Power Reception Filter Tuning.
- Parameters
- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
 - **Frequency:** cutoff frequency of low-pass filter at the input of LPRX
- Return values
- **HAL:** status

HAL_DSI_SetSDD

- Function name **HAL_StatusTypeDef HAL_DSI_SetSDD (DSI_HandleTypeDef * hdsi, FunctionalState State)**
- Function description Activate an additional current path on all lanes to meet the SDDTx parameter defined in the MIPI D-PHY specification.

- | | |
|---------------|---|
| Parameters | <ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI. • State: ENABLE or DISABLE |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_DSI_SetLanePinsConfiguration

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_DSI_SetLanePinsConfiguration (DSI_HandleTypeDef * hdsi, uint32_t CustomLane, uint32_t Lane, FunctionalState State) |
| Function description | Custom lane pins configuration. |
| Parameters | <ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI. • CustomLane: Function to be applied on selected lane. This parameter can be any value of DSI CustomLane • Lane: select between clock or data lane 0 or data lane 1. This parameter can be any value of DSI Lane Select • State: ENABLE or DISABLE |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_DSI_SetPHYTimings

- | | |
|----------------------|--|
| Function name | HAL_StatusTypeDef HAL_DSI_SetPHYTimings (DSI_HandleTypeDef * hdsi, uint32_t Timing, FunctionalState State, uint32_t Value) |
| Function description | Set custom timing for the PHY. |
| Parameters | <ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI. • Timing: PHY timing to be adjusted. This parameter can be any value of DSI PHY Timing • State: ENABLE or DISABLE • Value: Custom value of the timing |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_DSI_ForceTXStopMode

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_DSI_ForceTXStopMode (DSI_HandleTypeDef * hdsi, uint32_t Lane, FunctionalState State) |
| Function description | Force the Clock/Data Lane in TX Stop Mode. |
| Parameters | <ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI. • Lane: select between clock or data lanes. This parameter can be any value of DSI Lane Group • State: ENABLE or DISABLE |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_DSI_ForceRXLowPower

Function name	HAL_StatusTypeDef HAL_DSI_ForceRXLowPower (DSI_HandleTypeDef * hdsi, FunctionalState State)
Function description	Forces LP Receiver in Low-Power Mode.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI. • State: ENABLE or DISABLE
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_ForceDataLanesInRX

Function name	HAL_StatusTypeDef HAL_DSI_ForceDataLanesInRX (DSI_HandleTypeDef * hdsi, FunctionalState State)
Function description	Force Data Lanes in RX Mode after a BTA.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI. • State: ENABLE or DISABLE
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_SetPullDown

Function name	HAL_StatusTypeDef HAL_DSI_SetPullDown (DSI_HandleTypeDef * hdsi, FunctionalState State)
Function description	Enable a pull-down on the lanes to prevent from floating states when unused.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI. • State: ENABLE or DISABLE
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_SetContentionDetectionOff

Function name	HAL_StatusTypeDef HAL_DSI_SetContentionDetectionOff (DSI_HandleTypeDef * hdsi, FunctionalState State)
Function description	Switch off the contention detection on data lanes.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI. • State: ENABLE or DISABLE
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_DSI_GetError

Function name	uint32_t HAL_DSI_GetError (DSI_HandleTypeDef * hdsi)
Function description	Return the DSI error code.
Parameters	<ul style="list-style-type: none"> • hdsi: pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **DSI:** Error Code

HAL_DSI_ConfigErrorMonitor

Function name **HAL_StatusTypeDef HAL_DSI_ConfigErrorMonitor (DSI_HandleTypeDef * hdsi, uint32_t ActiveErrors)**

Function description Enable the error monitor flags.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **ActiveErrors:** indicates which error interrupts will be enabled. This parameter can be any combination of DSI Error Data Type.

Return values

- **HAL:** status

HAL_DSI_GetState

Function name **HAL_DSI_StateTypeDef HAL_DSI_GetState (DSI_HandleTypeDef * hdsi)**

Function description Return the DSI state.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **HAL:** state

22.3 DSI Firmware driver defines

22.3.1 DSI

DSI Acknowledge Request

DSI_ACKNOWLEDGE_DISABLE

DSI_ACKNOWLEDGE_ENABLE

DSI Automatic Refresh

DSI_AR_DISABLE

DSI_AR_ENABLE

DSI Automatic Clk Lane Control

DSI_AUTO_CLK_LANE_CTRL_DISABLE

DSI_AUTO_CLK_LANE_CTRL_ENABLE

DSI Color Coding

DSI_RGB565 The values 0x00000001 and 0x00000002 can also be used for the RGB565 color mode configuration

DSI_RGB666 The value 0x00000004 can also be used for the RGB666 color mode configuration

DSI_RGB888

DSI Color Mode

DSI_COLOR_MODE_FULL

DSI_COLOR_MODE_EIGHT

DSI Communication Delay

DSI_SLEW_RATE_HSTX

DSI_SLEW_RATE_LPTX

DSI_HS_DELAY

DSI CustomLane

DSI_SWAP_LANE_PINS

DSI_INVERT_HS_SIGNAL

DSI DATA ENABLE Polarity

DSI_DATA_ENABLE_ACTIVE_HIGH

DSI_DATA_ENABLE_ACTIVE_LOW

DSI DCS Command

DSI_ENTER_IDLE_MODE

DSI_ENTER_INVERT_MODE

DSI_ENTER_NORMAL_MODE

DSI_ENTER_PARTIAL_MODE

DSI_ENTER_SLEEP_MODE

DSI_EXIT_IDLE_MODE

DSI_EXIT_INVERT_MODE

DSI_EXIT_SLEEP_MODE

DSI_GET_3D_CONTROL

DSI_GET_ADDRESS_MODE

DSI_GET_BLUE_CHANNEL

DSI_GET_DIAGNOSTIC_RESULT

DSI_GET_DISPLAY_MODE

DSI_GET_GREEN_CHANNEL

DSI_GET_PIXEL_FORMAT

DSI_GET_POWER_MODE

DSI_GET_RED_CHANNEL

DSI_GET_SCANLINE

DSI_GET_SIGNAL_MODE

DSI_NOP

DSI_READ_DDB_CONTINUE

DSI_READ_DDB_START

DSI_READ_MEMORY_CONTINUE

DSI_READ_MEMORY_START
DSI_SET_3D_CONTROL
DSI_SET_ADDRESS_MODE
DSI_SET_COLUMN_ADDRESS
DSI_SET_DISPLAY_OFF
DSI_SET_DISPLAY_ON
DSI_SET_GAMMA_CURVE
DSI_SET_PAGE_ADDRESS
DSI_SET_PARTIAL_COLUMNS
DSI_SET_PARTIAL_ROWS
DSI_SET_PIXEL_FORMAT
DSI_SET_SCROLL_AREA
DSI_SET_SCROLL_START
DSI_SET_TEAR_OFF
DSI_SET_TEAR_ON
DSI_SET_TEAR_SCANLINE
DSI_SET_VSYNC_TIMING
DSI_SOFT_RESET
DSI_WRITE_LUT
DSI_WRITE_MEMORY_CONTINUE
DSI_WRITE_MEMORY_START

DSI Error Data Type

HAL_DSI_ERROR_NONE
HAL_DSI_ERROR_ACK acknowledge errors
HAL_DSI_ERROR_PHY PHY related errors
HAL_DSI_ERROR_TX transmission error
HAL_DSI_ERROR_RX reception error
HAL_DSI_ERROR_ECC ECC errors
HAL_DSI_ERROR_CRC CRC error
HAL_DSI_ERROR_PSE Packet Size error
HAL_DSI_ERROR_EOT End Of Transmission error
HAL_DSI_ERROR_OVF FIFO overflow error
HAL_DSI_ERROR_GEN Generic FIFO related errors

DSI FBTA Acknowledge

DSI_FBTA_DISABLE
DSI_FBTA_ENABLE

DSI Flags

DSI_FLAG_TE

DSI_FLAG_ER

DSI_FLAG_BUSY

DSI_FLAG_PLLLS

DSI_FLAG_PLLL

DSI_FLAG_PLLU

DSI_FLAG_RRS

DSI_FLAG_RR

DSI Flow Control

DSI_FLOW_CONTROL_CRC_RX

DSI_FLOW_CONTROL_ECC_RX

DSI_FLOW_CONTROL_BTA

DSI_FLOW_CONTROL_EOTP_RX

DSI_FLOW_CONTROL_EOTP_TX

DSI_FLOW_CONTROL_ALL

DSI HSYNC Polarity

DSI_HSYNC_ACTIVE_HIGH

DSI_HSYNC_ACTIVE_LOW

DSI HS Presp Mode

DSI_HS_PM_DISABLE

DSI_HS_PM_ENABLE

DSI Interrupts

DSI_IT_TE

DSI_IT_ER

DSI_IT_PLLL

DSI_IT_PLLU

DSI_IT_RR

DSI Lane Group

DSI_CLOCK_LANE

DSI_CLOCK_LANE

DSI_DATA_LANES

DSI Lane Select

DSI_DATA_LANE0

DSI_DATA_LANE1

DSI LONG WRITE PKT Data Type

DSI_DCS_LONG_PKT_WRITE DCS long write

DSI_GEN_LONG_PKT_WRITE Generic long write

DSI Loosely Packed

DSI_LOOSELY_PACKED_ENABLE

DSI_LOOSELY_PACKED_DISABLE

DSI LP Command

DSI_LP_COMMAND_DISABLE

DSI_LP_COMMAND_ENABLE

DSI LP HBP

DSI_LP_HBP_DISABLE

DSI_LP_HBP_ENABLE

DSI LP HFP

DSI_LP_HFP_DISABLE

DSI_LP_HFP_ENABLE

DSI LP LPDcs Long Write

DSI_LP_DLW_DISABLE

DSI_LP_DLW_ENABLE

DSI LP LPDcs Short Read NoP

DSI_LP_DSR0P_DISABLE

DSI_LP_DSR0P_ENABLE

DSI LP LPDcs Short Write NoP

DSI_LP_DSW0P_DISABLE

DSI_LP_DSW0P_ENABLE

DSI LP LPDcs Short Write OneP

DSI_LP_DSW1P_DISABLE

DSI_LP_DSW1P_ENABLE

DSI LP LPGen LongWrite

DSI_LP_GLW_DISABLE

DSI_LP_GLW_ENABLE

DSI LP LPGen Short Read NoP

DSI_LP_GSR0P_DISABLE

DSI_LP_GSR0P_ENABLE

DSI LP LPGen Short Read OneP

DSI_LP_GSR1P_DISABLE

DSI_LP_GSR1P_ENABLE

DSI LP LPGen Short Read TwoP

DSI_LP_GSR2P_DISABLE

DSI_LP_GSR2P_ENABLE

DSI LP LPGen Short Write NoP

DSI_LP_GSW0P_DISABLE

DSI_LP_GSW0P_ENABLE

DSI LP LPGen Short Write OneP

DSI_LP_GSW1P_DISABLE

DSI_LP_GSW1P_ENABLE

DSI LP LPGen Short Write TwoP

DSI_LP_GSW2P_DISABLE

DSI_LP_GSW2P_ENABLE

DSI LP LPMax Read Packet

DSI_LP_MRDP_DISABLE

DSI_LP_MRDP_ENABLE

DSI LP VACT

DSI_LP_VACT_DISABLE

DSI_LP_VACT_ENABLE

DSI LP VBP

DSI_LP_VBP_DISABLE

DSI_LP_VBP_ENABLE

DSI LP VFP

DSI_LP_VFP_DISABLE

DSI_LP_VFP_ENABLE

DSI LP VSYNC

DSI_LP_VSYNC_DISABLE

DSI_LP_VSYNC_ENABLE

DSI Number Of Lanes

DSI_ONE_DATA_LANE

DSI_TWO_DATA_LANES

DSI PHY Timing

DSI_TCLK_POST

DSI_TLPX_CLK

DSI_THS_EXIT

DSI_TLPX_DATA

DSI_THS_ZERO

DSI_THS_TRAIL

DSI_THS_PREPARE

DSI_TCLK_ZERO

DSI_TCLK_PREPARE

DSI PLL IDF

DSI_PLL_IN_DIV1

DSI_PLL_IN_DIV2

DSI_PLL_IN_DIV3

DSI_PLL_IN_DIV4

DSI_PLL_IN_DIV5

DSI_PLL_IN_DIV6

DSI_PLL_IN_DIV7

DSI PLL ODF

DSI_PLL_OUT_DIV1

DSI_PLL_OUT_DIV2

DSI_PLL_OUT_DIV4

DSI_PLL_OUT_DIV8

DSI SHORT READ PKT Data Type

DSI_DCS_SHORT_PKT_READ DCS short read

DSI_GEN_SHORT_PKT_READ_P0 Generic short read, no parameters

DSI_GEN_SHORT_PKT_READ_P1 Generic short read, one parameter

DSI_GEN_SHORT_PKT_READ_P2 Generic short read, two parameters

DSI SHORT WRITE PKT Data Type

DSI_DCS_SHORT_PKT_WRITE_P0 DCS short write, no parameters

DSI_DCS_SHORT_PKT_WRITE_P1 DCS short write, one parameter

DSI_GEN_SHORT_PKT_WRITE_P0 Generic short write, no parameters

DSI_GEN_SHORT_PKT_WRITE_P1 Generic short write, one parameter

DSI_GEN_SHORT_PKT_WRITE_P2 Generic short write, two parameters

DSI ShutDown

DSI_DISPLAY_ON

DSI_DISPLAY_OFF

DSI Tearing Effect Polarity

DSI_TE_RISING_EDGE

DSI_TE_FALLING_EDGE

DSI Tearing Effect Source

DSI_TE_DSILINK

DSI_TE_EXTERNAL

DSI TE Acknowledge Request

DSI_TE_ACKNOWLEDGE_DISABLE

DSI_TE_ACKNOWLEDGE_ENABLE

DSI Video Mode Type

DSI_VID_MODE_NB_PULSES

DSI_VID_MODE_NB_EVENTS

DSI_VID_MODE_BURST

DSI VSYNC Polarity

DSI_VSYNC_ACTIVE_HIGH

DSI_VSYNC_ACTIVE_LOW

23 HAL ETH Generic Driver

23.1 ETH Firmware driver registers structures

23.1.1 ETH_InitTypeDef

Data Fields

- *uint32_t AutoNegotiation*
- *uint32_t Speed*
- *uint32_t DuplexMode*
- *uint16_t PhyAddress*
- *uint8_t * MACAddr*
- *uint32_t RxMode*
- *uint32_t ChecksumMode*
- *uint32_t MediaInterface*

Field Documentation

- *uint32_t ETH_InitTypeDef::AutoNegotiation*
Selects or not the AutoNegotiation mode for the external PHY The AutoNegotiation allows an automatic setting of the Speed (10/100Mbps) and the mode (half/full-duplex). This parameter can be a value of [ETH_AutoNegotiation](#)
- *uint32_t ETH_InitTypeDef::Speed*
Sets the Ethernet speed: 10/100 Mbps. This parameter can be a value of [ETH_Speed](#)
- *uint32_t ETH_InitTypeDef::DuplexMode*
Selects the MAC duplex mode: Half-Duplex or Full-Duplex mode This parameter can be a value of [ETH_Duplex_Mode](#)
- *uint16_t ETH_InitTypeDef::PhyAddress*
Ethernet PHY address. This parameter must be a number between Min_Data = 0 and Max_Data = 32
- *uint8_t* ETH_InitTypeDef::MACAddr*
MAC Address of used Hardware: must be pointer on an array of 6 bytes
- *uint32_t ETH_InitTypeDef::RxMode*
Selects the Ethernet Rx mode: Polling mode, Interrupt mode. This parameter can be a value of [ETH_Rx_Mode](#)
- *uint32_t ETH_InitTypeDef::ChecksumMode*
Selects if the checksum is check by hardware or by software. This parameter can be a value of [ETH_Checksum_Mode](#)
- *uint32_t ETH_InitTypeDef::MediaInterface*
Selects the media-independent interface or the reduced media-independent interface. This parameter can be a value of [ETH_Media_Interface](#)

23.1.2 ETH_MACInitTypeDef

Data Fields

- *uint32_t Watchdog*
- *uint32_t Jabber*
- *uint32_t InterFrameGap*
- *uint32_t CarrierSense*
- *uint32_t ReceiveOwn*
- *uint32_t LoopbackMode*
- *uint32_t ChecksumOffload*

- ***uint32_t* RetryTransmission**
- ***uint32_t* AutomaticPadCRCStrip**
- ***uint32_t* BackOffLimit**
- ***uint32_t* DeferralCheck**
- ***uint32_t* ReceiveAll**
- ***uint32_t* SourceAddrFilter**
- ***uint32_t* PassControlFrames**
- ***uint32_t* BroadcastFramesReception**
- ***uint32_t* DestinationAddrFilter**
- ***uint32_t* PromiscuousMode**
- ***uint32_t* MulticastFramesFilter**
- ***uint32_t* UnicastFramesFilter**
- ***uint32_t* HashTableHigh**
- ***uint32_t* HashTableLow**
- ***uint32_t* PauseTime**
- ***uint32_t* ZeroQuantaPause**
- ***uint32_t* PauseLowThreshold**
- ***uint32_t* UnicastPauseFrameDetect**
- ***uint32_t* ReceiveFlowControl**
- ***uint32_t* TransmitFlowControl**
- ***uint32_t* VLANTagComparison**
- ***uint32_t* VLANTagIdentifier**

Field Documentation

- ***uint32_t* ETH_MACInitTypeDef::Watchdog**
Selects or not the Watchdog timer When enabled, the MAC allows no more then 2048 bytes to be received. When disabled, the MAC can receive up to 16384 bytes. This parameter can be a value of [ETH_Watchdog](#)
- ***uint32_t* ETH_MACInitTypeDef::Jabber**
Selects or not Jabber timer When enabled, the MAC allows no more then 2048 bytes to be sent. When disabled, the MAC can send up to 16384 bytes. This parameter can be a value of [ETH_Jabber](#)
- ***uint32_t* ETH_MACInitTypeDef::InterFrameGap**
Selects the minimum IFG between frames during transmission. This parameter can be a value of [ETH_Inter_Frame_Gap](#)
- ***uint32_t* ETH_MACInitTypeDef::CarrierSense**
Selects or not the Carrier Sense. This parameter can be a value of [ETH_Carrier_Sense](#)
- ***uint32_t* ETH_MACInitTypeDef::ReceiveOwn**
Selects or not the ReceiveOwn, ReceiveOwn allows the reception of frames when the TX_EN signal is asserted in Half-Duplex mode. This parameter can be a value of [ETH_Receive_Own](#)
- ***uint32_t* ETH_MACInitTypeDef::LoopbackMode**
Selects or not the internal MAC MII Loopback mode. This parameter can be a value of [ETH_Loop_Back_Mode](#)
- ***uint32_t* ETH_MACInitTypeDef::ChecksumOffload**
Selects or not the IPv4 checksum checking for received frame payloads' TCP/UDP/ICMP headers. This parameter can be a value of [ETH_Checksum_Offload](#)
- ***uint32_t* ETH_MACInitTypeDef::RetryTransmission**
Selects or not the MAC attempt retries transmission, based on the settings of BL, when a collision occurs (Half-Duplex mode). This parameter can be a value of [ETH_Retry_Transmission](#)

- ***uint32_t ETH_MACInitTypeDef::AutomaticPadCRCStrip***
Selects or not the Automatic MAC Pad/CRC Stripping. This parameter can be a value of [ETH_Automatic_Pad_CRC_Strip](#)
- ***uint32_t ETH_MACInitTypeDef::BackOffLimit***
Selects the BackOff limit value. This parameter can be a value of [ETH_Back_Off_Limit](#)
- ***uint32_t ETH_MACInitTypeDef::DeferralCheck***
Selects or not the deferral check function (Half-Duplex mode). This parameter can be a value of [ETH_Deferral_Check](#)
- ***uint32_t ETH_MACInitTypeDef::ReceiveAll***
Selects or not all frames reception by the MAC (No filtering). This parameter can be a value of [ETH_Receive_All](#)
- ***uint32_t ETH_MACInitTypeDef::SourceAddrFilter***
Selects the Source Address Filter mode. This parameter can be a value of [ETH_Source_Addr_Filter](#)
- ***uint32_t ETH_MACInitTypeDef::PassControlFrames***
Sets the forwarding mode of the control frames (including unicast and multicast PAUSE frames) This parameter can be a value of [ETH_Pass_Control_Frames](#)
- ***uint32_t ETH_MACInitTypeDef::BroadcastFramesReception***
Selects or not the reception of Broadcast Frames. This parameter can be a value of [ETH_Broadcast_Frames_Reception](#)
- ***uint32_t ETH_MACInitTypeDef::DestinationAddrFilter***
Sets the destination filter mode for both unicast and multicast frames. This parameter can be a value of [ETH_Destination_Addr_Filter](#)
- ***uint32_t ETH_MACInitTypeDef::PromiscuousMode***
Selects or not the Promiscuous Mode This parameter can be a value of [ETH_Promiscuous_Mode](#)
- ***uint32_t ETH_MACInitTypeDef::MulticastFramesFilter***
Selects the Multicast Frames filter mode:
None/HashTableFilter/PerfectFilter/PerfectHashTableFilter. This parameter can be a value of [ETH_Multicast_Frames_Filter](#)
- ***uint32_t ETH_MACInitTypeDef::UnicastFramesFilter***
Selects the Unicast Frames filter mode:
HashTableFilter/PerfectFilter/PerfectHashTableFilter. This parameter can be a value of [ETH_Unicast_Frames_Filter](#)
- ***uint32_t ETH_MACInitTypeDef::HashTableHigh***
This field holds the higher 32 bits of Hash table. This parameter must be a number between Min_Data = 0x0 and Max_Data = 0xFFFFFFFF
- ***uint32_t ETH_MACInitTypeDef::HashTableLow***
This field holds the lower 32 bits of Hash table. This parameter must be a number between Min_Data = 0x0 and Max_Data = 0xFFFFFFFF
- ***uint32_t ETH_MACInitTypeDef::PauseTime***
This field holds the value to be used in the Pause Time field in the transmit control frame. This parameter must be a number between Min_Data = 0x0 and Max_Data = 0xFFFF
- ***uint32_t ETH_MACInitTypeDef::ZeroQuantaPause***
Selects or not the automatic generation of Zero-Quanta Pause Control frames. This parameter can be a value of [ETH_Zero_Quanta_Pause](#)
- ***uint32_t ETH_MACInitTypeDef::PauseLowThreshold***
This field configures the threshold of the PAUSE to be checked for automatic retransmission of PAUSE Frame. This parameter can be a value of [ETH_Pause_Low_Threshold](#)
- ***uint32_t ETH_MACInitTypeDef::UnicastPauseFrameDetect***
Selects or not the MAC detection of the Pause frames (with MAC Address0 unicast

address and unique multicast address). This parameter can be a value of

[ETH_Unicast_Pause_Frame_Detect](#)

- ***uint32_t ETH_MACInitTypeDef::ReceiveFlowControl***
Enables or disables the MAC to decode the received Pause frame and disable its transmitter for a specified time (Pause Time) This parameter can be a value of [ETH_Receive_Flow_Control](#)
- ***uint32_t ETH_MACInitTypeDef::TransmitFlowControl***
Enables or disables the MAC to transmit Pause frames (Full-Duplex mode) or the MAC back-pressure operation (Half-Duplex mode) This parameter can be a value of [ETH_Transmit_Flow_Control](#)
- ***uint32_t ETH_MACInitTypeDef::VLANTagComparison***
Selects the 12-bit VLAN identifier or the complete 16-bit VLAN tag for comparison and filtering. This parameter can be a value of [ETH_VLAN_Tag_Comparison](#)
- ***uint32_t ETH_MACInitTypeDef::VLANTagIdentifier***
Holds the VLAN tag identifier for receive frames

23.1.3 ETH_DMAInitTypeDef

Data Fields

- ***uint32_t DropTCPIPChecksumErrorFrame***
- ***uint32_t ReceiveStoreForward***
- ***uint32_t FlushReceivedFrame***
- ***uint32_t TransmitStoreForward***
- ***uint32_t TransmitThresholdControl***
- ***uint32_t ForwardErrorFrames***
- ***uint32_t ForwardUndersizedGoodFrames***
- ***uint32_t ReceiveThresholdControl***
- ***uint32_t SecondFrameOperate***
- ***uint32_t AddressAlignedBeats***
- ***uint32_t FixedBurst***
- ***uint32_t RxDMABurstLength***
- ***uint32_t TxDMABurstLength***
- ***uint32_t EnhancedDescriptorFormat***
- ***uint32_t DescriptorSkipLength***
- ***uint32_t DMAArbitration***

Field Documentation

- ***uint32_t ETH_DMAInitTypeDef::DropTCPIPChecksumErrorFrame***
Selects or not the Dropping of TCP/IP Checksum Error Frames. This parameter can be a value of [ETH_Drop_TCP_IP_Checksum_Error_Frame](#)
- ***uint32_t ETH_DMAInitTypeDef::ReceiveStoreForward***
Enables or disables the Receive store and forward mode. This parameter can be a value of [ETH_Receive_Store_Forward](#)
- ***uint32_t ETH_DMAInitTypeDef::FlushReceivedFrame***
Enables or disables the flushing of received frames. This parameter can be a value of [ETH_Flush_Received_Frame](#)
- ***uint32_t ETH_DMAInitTypeDef::TransmitStoreForward***
Enables or disables Transmit store and forward mode. This parameter can be a value of [ETH_Transmit_Store_Forward](#)
- ***uint32_t ETH_DMAInitTypeDef::TransmitThresholdControl***
Selects or not the Transmit Threshold Control. This parameter can be a value of [ETH_Transmit_Threshold_Control](#)

- ***uint32_t ETH_DMAInitTypeDef::ForwardErrorFrames***
Selects or not the forward to the DMA of erroneous frames. This parameter can be a value of [ETH_Forward_Error_Frames](#)
- ***uint32_t ETH_DMAInitTypeDef::ForwardUndersizedGoodFrames***
Enables or disables the Rx FIFO to forward Undersized frames (frames with no Error and length less than 64 bytes) including pad-bytes and CRC) This parameter can be a value of [ETH_Forward_Undersized_Good_Frames](#)
- ***uint32_t ETH_DMAInitTypeDef::ReceiveThresholdControl***
Selects the threshold level of the Receive FIFO. This parameter can be a value of [ETH_Receive_Threshold_Control](#)
- ***uint32_t ETH_DMAInitTypeDef::SecondFrameOperate***
Selects or not the Operate on second frame mode, which allows the DMA to process a second frame of Transmit data even before obtaining the status for the first frame. This parameter can be a value of [ETH_Second_Frame_Operate](#)
- ***uint32_t ETH_DMAInitTypeDef::AddressAlignedBeats***
Enables or disables the Address Aligned Beats. This parameter can be a value of [ETH_Address_Aligned_Beats](#)
- ***uint32_t ETH_DMAInitTypeDef::FixedBurst***
Enables or disables the AHB Master interface fixed burst transfers. This parameter can be a value of [ETH_Fixed_Burst](#)
- ***uint32_t ETH_DMAInitTypeDef::RxDMABurstLength***
Indicates the maximum number of beats to be transferred in one Rx DMA transaction. This parameter can be a value of [ETH_Rx_DMA_Burst_Length](#)
- ***uint32_t ETH_DMAInitTypeDef::TxDMABurstLength***
Indicates the maximum number of beats to be transferred in one Tx DMA transaction. This parameter can be a value of [ETH_Tx_DMA_Burst_Length](#)
- ***uint32_t ETH_DMAInitTypeDef::EnhancedDescriptorFormat***
Enables the enhanced descriptor format. This parameter can be a value of [ETH_DMA_Enhanced_descriptor_format](#)
- ***uint32_t ETH_DMAInitTypeDef::DescriptorSkipLength***
Specifies the number of word to skip between two unchained descriptors (Ring mode) This parameter must be a number between Min_Data = 0 and Max_Data = 32
- ***uint32_t ETH_DMAInitTypeDef::DMAArbitration***
Selects the DMA Tx/Rx arbitration. This parameter can be a value of [ETH_DMA_Arbitration](#)

23.1.4 ETH_DMADescTypeDef

Data Fields

- ***__IO uint32_t Status***
- ***uint32_t ControlBufferSize***
- ***uint32_t Buffer1Addr***
- ***uint32_t Buffer2NextDescAddr***
- ***uint32_t ExtendedStatus***
- ***uint32_t Reserved1***
- ***uint32_t TimeStampLow***
- ***uint32_t TimeStampHigh***

Field Documentation

- ***__IO uint32_t ETH_DMADescTypeDef::Status***
Status
- ***uint32_t ETH_DMADescTypeDef::ControlBufferSize***
Control and Buffer1, Buffer2 lengths

- ***uint32_t ETH_DMADescTypeDef::Buffer1Addr***
Buffer1 address pointer
- ***uint32_t ETH_DMADescTypeDef::Buffer2NextDescAddr***
Buffer2 or next descriptor address pointer Enhanced Ethernet DMA PTP Descriptors
- ***uint32_t ETH_DMADescTypeDef::ExtendedStatus***
Extended status for PTP receive descriptor
- ***uint32_t ETH_DMADescTypeDef::Reserved1***
Reserved
- ***uint32_t ETH_DMADescTypeDef::TimeStampLow***
Time Stamp Low value for transmit and receive
- ***uint32_t ETH_DMADescTypeDef::TimeStampHigh***
Time Stamp High value for transmit and receive

23.1.5 ETH_DMARxFramelInfos

Data Fields

- ***ETH_DMADescTypeDef * FSRxDesc***
- ***ETH_DMADescTypeDef * LSRxDesc***
- ***uint32_t SegCount***
- ***uint32_t length***
- ***uint32_t buffer***

Field Documentation

- ***ETH_DMADescTypeDef* ETH_DMARxFramelInfos::FSRxDesc***
First Segment Rx Desc
- ***ETH_DMADescTypeDef* ETH_DMARxFramelInfos::LSRxDesc***
Last Segment Rx Desc
- ***uint32_t ETH_DMARxFramelInfos::SegCount***
Segment count
- ***uint32_t ETH_DMARxFramelInfos::length***
Frame length
- ***uint32_t ETH_DMARxFramelInfos::buffer***
Frame buffer

23.1.6 ETH_HandleTypeDef

Data Fields

- ***ETH_TypeDef * Instance***
- ***ETH_InitTypeDef Init***
- ***uint32_t LinkStatus***
- ***ETH_DMADescTypeDef * RxDesc***
- ***ETH_DMADescTypeDef * TxDesc***
- ***ETH_DMARxFramelInfos RxFrameInfos***
- ***__IO HAL_ETH_StateTypeDef State***
- ***HAL_LockTypeDef Lock***

Field Documentation

- ***ETH_TypeDef* ETH_HandleTypeDef::Instance***
Register base address
- ***ETH_InitTypeDef ETH_HandleTypeDef::Init***
Ethernet Init Configuration
- ***uint32_t ETH_HandleTypeDef::LinkStatus***
Ethernet link status

- ***ETH_DMADescTypeDef* ETH_HandleTypeDef::RxDesc***
Rx descriptor to Get
- ***ETH_DMADescTypeDef* ETH_HandleTypeDef::TxDesc***
Tx descriptor to Set
- ***ETH_DMARxFramInfos ETH_HandleTypeDef::RxFramInfos***
last Rx frame infos
- ***__IO HAL_ETH_StateTypeDef ETH_HandleTypeDef::State***
ETH communication state
- ***HAL_LockTypeDef ETH_HandleTypeDef::Lock***
ETH Lock

23.2 ETH Firmware driver API description

23.2.1 How to use this driver

1. Declare a `ETH_HandleTypeDef` handle structure, for example: `ETH_HandleTypeDef heth;`
2. Fill parameters of `Init` structure in `heth` handle
3. Call `HAL_ETH_Init()` API to initialize the Ethernet peripheral (MAC, DMA, ...)
4. Initialize the ETH low level resources through the `HAL_ETH_Msplnit()` API:
 - a. Enable the Ethernet interface clock using
 - `__HAL_RCC_ETHMAC_CLK_ENABLE();`
 - `__HAL_RCC_ETHMACTX_CLK_ENABLE();`
 - `__HAL_RCC_ETHMACRX_CLK_ENABLE();`
 - b. Initialize the related GPIO clocks
 - c. Configure Ethernet pin-out
 - d. Configure Ethernet NVIC interrupt (IT mode)
5. Initialize Ethernet DMA Descriptors in chain mode and point to allocated buffers:
 - a. `HAL_ETH_DMATxDescListInit();` for Transmission process
 - b. `HAL_ETH_DMARxDescListInit();` for Reception process
6. Enable MAC and DMA transmission and reception:
 - a. `HAL_ETH_Start();`
7. Prepare ETH DMA TX Descriptors and give the hand to ETH DMA to transfer the frame to MAC TX FIFO:
 - a. `HAL_ETH_TransmitFrame();`
8. Poll for a received frame in ETH RX DMA Descriptors and get received frame parameters
 - a. `HAL_ETH_GetReceivedFrame();` (should be called into an infinite loop)
9. Get a received frame when an ETH RX interrupt occurs:
 - a. `HAL_ETH_GetReceivedFrame_IT();` (called in IT mode only)
10. Communicate with external PHY device:
 - a. Read a specific register from the PHY `HAL_ETH_ReadPHYRegister();`
 - b. Write data to a specific RHY register: `HAL_ETH_WritePHYRegister();`
11. Configure the Ethernet MAC after ETH peripheral initialization
`HAL_ETH_ConfigMAC();` all MAC parameters should be filled.
12. Configure the Ethernet DMA after ETH peripheral initialization
`HAL_ETH_ConfigDMA();` all DMA parameters should be filled.

23.2.2 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize and configure the Ethernet peripheral
- De-initialize the Ethernet peripheral

This section contains the following APIs:

- [HAL_ETH_Init\(\)](#)
- [HAL_ETH_DeInit\(\)](#)
- [HAL_ETH_DMATxDescListInit\(\)](#)
- [HAL_ETH_DMARxDescListInit\(\)](#)
- [HAL_ETH_MspInit\(\)](#)
- [HAL_ETH_MspDeInit\(\)](#)

23.2.3 IO operation functions

This section provides functions allowing to:

- Transmit a frame [HAL_ETH_TransmitFrame\(\)](#);
- Receive a frame [HAL_ETH_GetReceivedFrame\(\)](#);
[HAL_ETH_GetReceivedFrame_IT\(\)](#);
- Read from an External PHY register [HAL_ETH_ReadPHYRegister\(\)](#);
- Write to an External PHY register [HAL_ETH_WritePHYRegister\(\)](#);

This section contains the following APIs:

- [HAL_ETH_TransmitFrame\(\)](#)
- [HAL_ETH_GetReceivedFrame\(\)](#)
- [HAL_ETH_GetReceivedFrame_IT\(\)](#)
- [HAL_ETH_IRQHandler\(\)](#)
- [HAL_ETH_TxCpltCallback\(\)](#)
- [HAL_ETH_RxCpltCallback\(\)](#)
- [HAL_ETH_ErrorCallback\(\)](#)
- [HAL_ETH_ReadPHYRegister\(\)](#)
- [HAL_ETH_WritePHYRegister\(\)](#)

23.2.4 Peripheral Control functions

This section provides functions allowing to:

- Enable MAC and DMA transmission and reception. [HAL_ETH_Start\(\)](#);
- Disable MAC and DMA transmission and reception. [HAL_ETH_Stop\(\)](#);
- Set the MAC configuration in runtime mode [HAL_ETH_ConfigMAC\(\)](#);
- Set the DMA configuration in runtime mode [HAL_ETH_ConfigDMA\(\)](#);

This section contains the following APIs:

- [HAL_ETH_Start\(\)](#)
- [HAL_ETH_Stop\(\)](#)
- [HAL_ETH_ConfigMAC\(\)](#)
- [HAL_ETH_ConfigDMA\(\)](#)

23.2.5 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral and the data flow.

- Get the ETH handle state: [HAL_ETH_GetState\(\)](#);

This section contains the following APIs:

- [HAL_ETH_GetState\(\)](#)

23.2.6 Detailed description of functions

HAL_ETH_Init

Function name	HAL_StatusTypeDef HAL_ETH_Init (ETH_HandleTypeDef * heth)
Function description	Initializes the Ethernet MAC and DMA according to default parameters.
Parameters	<ul style="list-style-type: none"> • heth: pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_ETH_DeInit

Function name	HAL_StatusTypeDef HAL_ETH_DeInit (ETH_HandleTypeDef * heth)
Function description	De-Initializes the ETH peripheral.
Parameters	<ul style="list-style-type: none"> • heth: pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_ETH_MspInit

Function name	void HAL_ETH_MspInit (ETH_HandleTypeDef * heth)
Function description	Initializes the ETH MSP.
Parameters	<ul style="list-style-type: none"> • heth: pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
Return values	<ul style="list-style-type: none"> • None:

HAL_ETH_MspDeInit

Function name	void HAL_ETH_MspDeInit (ETH_HandleTypeDef * heth)
Function description	DeInitializes ETH MSP.
Parameters	<ul style="list-style-type: none"> • heth: pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
Return values	<ul style="list-style-type: none"> • None:

HAL_ETH_DMA TxDescListInit

Function name	HAL_StatusTypeDef HAL_ETH_DMA TxDescListInit (ETH_HandleTypeDef * heth, ETH_DMA DescTypeDef * DMATxDescTab, uint8_t * TxBuff, uint32_t TxBuffCount)
Function description	Initializes the DMA Tx descriptors in chain mode.
Parameters	<ul style="list-style-type: none"> • heth: pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module • DMATxDescTab: Pointer to the first Tx desc list • TxBuff: Pointer to the first TxBuffer list

- **TxBuffCount:** Number of the used Tx desc in the list
- Return values
- **HAL:** status

HAL_ETH_DMARxDescListInit

Function name **HAL_StatusTypeDef HAL_ETH_DMARxDescListInit (ETH_HandleTypeDef * heth, ETH_DMADescTypeDef * DMARxDescTab, uint8_t * RxBuff, uint32_t RxBuffCount)**

Function description Initializes the DMA Rx descriptors in chain mode.

- Parameters
- **heth:** pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
 - **DMARxDescTab:** Pointer to the first Rx desc list
 - **RxBuff:** Pointer to the first RxBuffer list
 - **RxBuffCount:** Number of the used Rx desc in the list

- Return values
- **HAL:** status

HAL_ETH_TransmitFrame

Function name **HAL_StatusTypeDef HAL_ETH_TransmitFrame (ETH_HandleTypeDef * heth, uint32_t FrameLength)**

Function description Sends an Ethernet frame.

- Parameters
- **heth:** pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
 - **FrameLength:** Amount of data to be sent

- Return values
- **HAL:** status

HAL_ETH_GetReceivedFrame

Function name **HAL_StatusTypeDef HAL_ETH_GetReceivedFrame (ETH_HandleTypeDef * heth)**

Function description Checks for received frames.

- Parameters
- **heth:** pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module

- Return values
- **HAL:** status

HAL_ETH_ReadPHYRegister

Function name **HAL_StatusTypeDef HAL_ETH_ReadPHYRegister (ETH_HandleTypeDef * heth, uint16_t PHYReg, uint32_t * RegValue)**

Function description Reads a PHY register.

- Parameters
- **heth:** pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
 - **PHYReg:** PHY register address, is the index of one of the 32 PHY register. This parameter can be one of the following values: PHY_BCR: Transceiver Basic Control Register, PHY_BSR: Transceiver Basic Status Register. More PHY register could be read depending on the used PHY

- **RegValue:** PHY register value
- Return values
 - **HAL:** status

HAL_ETH_WritePHYRegister

- Function name** HAL_StatusTypeDef HAL_ETH_WritePHYRegister (ETH_HandleTypeDef * heth, uint16_t PHYReg, uint32_t RegValue)
- Function description** Writes to a PHY register.
- Parameters**
- **heth:** pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
 - **PHYReg:** PHY register address, is the index of one of the 32 PHY register. This parameter can be one of the following values: PHY_BCR: Transceiver Control Register. More PHY register could be written depending on the used PHY
 - **RegValue:** the value to write
- Return values**
- **HAL:** status

HAL_ETH_GetReceivedFrame_IT

- Function name** HAL_StatusTypeDef HAL_ETH_GetReceivedFrame_IT (ETH_HandleTypeDef * heth)
- Function description** Gets the Received frame in interrupt mode.
- Parameters**
- **heth:** pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
- Return values**
- **HAL:** status

HAL_ETH_IRQHandler

- Function name** void HAL_ETH_IRQHandler (ETH_HandleTypeDef * heth)
- Function description** This function handles ETH interrupt request.
- Parameters**
- **heth:** pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
- Return values**
- **HAL:** status

HAL_ETH_TxCpltCallback

- Function name** void HAL_ETH_TxCpltCallback (ETH_HandleTypeDef * heth)
- Function description** Tx Transfer completed callbacks.
- Parameters**
- **heth:** pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
- Return values**
- **None:**

HAL_ETH_RxCpltCallback

- Function name** void HAL_ETH_RxCpltCallback (ETH_HandleTypeDef * heth)

Function description	Rx Transfer completed callbacks.
Parameters	<ul style="list-style-type: none"> • heth: pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
Return values	<ul style="list-style-type: none"> • None:

HAL_ETH_ErrorCallback

Function name	void HAL_ETH_ErrorCallback (ETH_HandleTypeDef * heth)
Function description	Ethernet transfer error callbacks.
Parameters	<ul style="list-style-type: none"> • heth: pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
Return values	<ul style="list-style-type: none"> • None:

HAL_ETH_Start

Function name	HAL_StatusTypeDef HAL_ETH_Start (ETH_HandleTypeDef * heth)
Function description	Enables Ethernet MAC and DMA reception/transmission.
Parameters	<ul style="list-style-type: none"> • heth: pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_ETH_Stop

Function name	HAL_StatusTypeDef HAL_ETH_Stop (ETH_HandleTypeDef * heth)
Function description	Stop Ethernet MAC and DMA reception/transmission.
Parameters	<ul style="list-style-type: none"> • heth: pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_ETH_ConfigMAC

Function name	HAL_StatusTypeDef HAL_ETH_ConfigMAC (ETH_HandleTypeDef * heth, ETH_MACInitTypeDef * macconf)
Function description	Set ETH MAC Configuration.
Parameters	<ul style="list-style-type: none"> • heth: pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module • macconf: MAC Configuration structure
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_ETH_ConfigDMA

Function name	HAL_StatusTypeDef HAL_ETH_ConfigDMA (ETH_HandleTypeDef * heth, ETH_DMAInitTypeDef * dmaconf)
Function description	Sets ETH DMA Configuration.

- | | |
|---------------|--|
| Parameters | <ul style="list-style-type: none"> • heth: pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module • dmaconf: DMA Configuration structure |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_ETH_GetState

- | | |
|----------------------|---|
| Function name | HAL_ETH_StateTypeDef HAL_ETH_GetState (ETH_HandleTypeDef * heth) |
| Function description | Return the ETH HAL state. |
| Parameters | <ul style="list-style-type: none"> • heth: pointer to a ETH_HandleTypeDef structure that contains the configuration information for ETHERNET module |
| Return values | <ul style="list-style-type: none"> • HAL: state |

23.3 ETH Firmware driver defines

23.3.1 ETH

ETH Address Aligned Beats

ETH_ADDRESSALIGNEDBEATS_ENABLE
 ETH_ADDRESSALIGNEDBEATS_DISABLE

ETH Automatic Pad CRC Strip

ETH_AUTOMATICPADCRCSTRIP_ENABLE
 ETH_AUTOMATICPADCRCSTRIP_DISABLE

ETH AutoNegotiation

ETH_AUTONEGOTIATION_ENABLE
 ETH_AUTONEGOTIATION_DISABLE

ETH Back Off Limit

ETH_BACKOFFLIMIT_10
 ETH_BACKOFFLIMIT_8
 ETH_BACKOFFLIMIT_4
 ETH_BACKOFFLIMIT_1

ETH Broadcast Frames Reception

ETH_BROADCASTFRAMESRECEPTION_ENABLE
 ETH_BROADCASTFRAMESRECEPTION_DISABLE

ETH Buffers setting

ETH_MAX_PACKET_SIZE	ETH_HEADER + ETH_EXTRA + ETH_VLAN_TAG + ETH_MAX_ETH_PAYLOAD + ETH_CRC
ETH_HEADER	6 byte Dest addr, 6 byte Src addr, 2 byte length/type
ETH_CRC	Ethernet CRC
ETH_EXTRA	Extra bytes in some cases



ETH_VLAN_TAG	optional 802.1q VLAN Tag
ETH_MIN_ETH_PAYLOAD	Minimum Ethernet payload size
ETH_MAX_ETH_PAYLOAD	Maximum Ethernet payload size
ETH_JUMBO_FRAME_PAYLOAD	Jumbo frame payload size
ETH_RX_BUF_SIZE	
ETH_RXBUFNB	
ETH_TX_BUF_SIZE	
ETH_TXBUFNB	
ETH Carrier Sense	
ETH_CARRIERSENCE_ENABLE	
ETH_CARRIERSENCE_DISABLE	
ETH Checksum Mode	
ETH_CHECKSUM_BY_HARDWARE	
ETH_CHECKSUM_BY_SOFTWARE	
ETH Checksum Offload	
ETH_CHECKSUMOFFLOAD_ENABLE	
ETH_CHECKSUMOFFLOAD_DISABLE	
ETH Deferral Check	
ETH_DEFFERRALCHECK_ENABLE	
ETH_DEFFERRALCHECK_DISABLE	
ETH Destination Addr Filter	
ETH_DESTINATIONADDRFILTER_NORMAL	
ETH_DESTINATIONADDRFILTER_INVERSE	
ETH DMA Arbitration	
ETH_DMAARBITRATION_ROUNDROBIN_RXTX_1_1	
ETH_DMAARBITRATION_ROUNDROBIN_RXTX_2_1	
ETH_DMAARBITRATION_ROUNDROBIN_RXTX_3_1	
ETH_DMAARBITRATION_ROUNDROBIN_RXTX_4_1	
ETH_DMAARBITRATION_RXPRIORTX	
ETH DMA Enhanced descriptor format	
ETH_DMAENHANCEDDESCRIPTOR_ENABLE	
ETH_DMAENHANCEDDESCRIPTOR_DISABLE	
ETH DMA Flags	
ETH_DMA_FLAG_TST	Time-stamp trigger interrupt (on DMA)
ETH_DMA_FLAG_PMT	PMT interrupt (on DMA)
ETH_DMA_FLAG_MMC	MMC interrupt (on DMA)

ETH_DMA_FLAG_DATATRANSFERERROR	Error bits 0-Rx DMA, 1-Tx DMA
ETH_DMA_FLAG_READWRITEERROR	Error bits 0-write transfer, 1-read transfer
ETH_DMA_FLAG_ACCESSERROR	Error bits 0-data buffer, 1-desc. access
ETH_DMA_FLAG_NIS	Normal interrupt summary flag
ETH_DMA_FLAG_AIS	Abnormal interrupt summary flag
ETH_DMA_FLAG_ER	Early receive flag
ETH_DMA_FLAG_FBE	Fatal bus error flag
ETH_DMA_FLAG_ET	Early transmit flag
ETH_DMA_FLAG_RWT	Receive watchdog timeout flag
ETH_DMA_FLAG_RPS	Receive process stopped flag
ETH_DMA_FLAG_RBU	Receive buffer unavailable flag
ETH_DMA_FLAG_R	Receive flag
ETH_DMA_FLAG_TU	Underflow flag
ETH_DMA_FLAG_RO	Overflow flag
ETH_DMA_FLAG_TJT	Transmit jabber timeout flag
ETH_DMA_FLAG_TBU	Transmit buffer unavailable flag
ETH_DMA_FLAG_TPS	Transmit process stopped flag
ETH_DMA_FLAG_T	Transmit flag

ETH DMA Interrupts

ETH_DMA_IT_TST	Time-stamp trigger interrupt (on DMA)
ETH_DMA_IT_PMT	PMT interrupt (on DMA)
ETH_DMA_IT_MMC	MMC interrupt (on DMA)
ETH_DMA_IT_NIS	Normal interrupt summary
ETH_DMA_IT_AIS	Abnormal interrupt summary
ETH_DMA_IT_ER	Early receive interrupt
ETH_DMA_IT_FBE	Fatal bus error interrupt
ETH_DMA_IT_ET	Early transmit interrupt
ETH_DMA_IT_RWT	Receive watchdog timeout interrupt
ETH_DMA_IT_RPS	Receive process stopped interrupt
ETH_DMA_IT_RBU	Receive buffer unavailable interrupt
ETH_DMA_IT_R	Receive interrupt
ETH_DMA_IT_TU	Underflow interrupt
ETH_DMA_IT_RO	Overflow interrupt
ETH_DMA_IT_TJT	Transmit jabber timeout interrupt
ETH_DMA_IT_TBU	Transmit buffer unavailable interrupt
ETH_DMA_IT_TPS	Transmit process stopped interrupt

ETH_DMA_IT_T	Transmit interrupt	
ETH DMA overflow		
ETH_DMA_OVERFLOW_RXFIFOCOUNTER		Overflow bit for FIFO overflow counter
ETH_DMA_OVERFLOW_MISSEDFRAMECOUNTER		Overflow bit for missed frame counter
ETH DMA receive process state		
ETH_DMA_RECEIVEPROCESS_STOPPED		Stopped - Reset or Stop Rx Command issued
ETH_DMA_RECEIVEPROCESS_FETCHING		Running - fetching the Rx descriptor
ETH_DMA_RECEIVEPROCESS_WAITING		Running - waiting for packet
ETH_DMA_RECEIVEPROCESS_SUSPENDED		Suspended - Rx Descriptor unavailable
ETH_DMA_RECEIVEPROCESS_CLOSING		Running - closing descriptor
ETH_DMA_RECEIVEPROCESS_QUEUING		Running - queuing the receive frame into host memory
ETH DMA RX Descriptor		
ETH_DMARXDESC_OWN		OWN bit: descriptor is owned by DMA engine
ETH_DMARXDESC_AFM		DA Filter Fail for the rx frame
ETH_DMARXDESC_FL		Receive descriptor frame length
ETH_DMARXDESC_ES		Error summary: OR of the following bits: DE OE IPC LC RWT RE CE
ETH_DMARXDESC_DE		Descriptor error: no more descriptors for receive frame
ETH_DMARXDESC_SAF		SA Filter Fail for the received frame
ETH_DMARXDESC_LE		Frame size not matching with length field
ETH_DMARXDESC_OE		Overflow Error: Frame was damaged due to buffer overflow

ETH_DMARXDESC_VLAN	VLAN Tag: received frame is a VLAN frame
ETH_DMARXDESC_FS	First descriptor of the frame
ETH_DMARXDESC_LS	Last descriptor of the frame
ETH_DMARXDESC_IPV4HCE	IPC Checksum Error: Rx Ipv4 header checksum error
ETH_DMARXDESC_LC	Late collision occurred during reception
ETH_DMARXDESC_FT	Frame type - Ethernet, otherwise 802.3
ETH_DMARXDESC_RWT	Receive Watchdog Timeout: watchdog timer expired during reception
ETH_DMARXDESC_RE	Receive error: error reported by MII interface
ETH_DMARXDESC_DBE	Dribble bit error: frame contains non int multiple of 8 bits
ETH_DMARXDESC_CE	CRC error
ETH_DMARXDESC_MAMPCE	Rx MAC Address/Payload Checksum Error: Rx MAC address matched/ Rx Payload Checksum Error
ETH_DMARXDESC_DIC	Disable Interrupt on Completion
ETH_DMARXDESC_RBS2	Receive Buffer2 Size
ETH_DMARXDESC_RER	Receive End of Ring
ETH_DMARXDESC_RCH	Second Address Chained

ETH_DMARXDESC_RBS1	Receive Buffer1 Size
ETH_DMARXDESC_B1AP	Buffer1 Address Pointer
ETH_DMARXDESC_B2AP	Buffer2 Address Pointer
ETH_DMAPTPRXDESC_PTPV	
ETH_DMAPTPRXDESC_PTPFT	
ETH_DMAPTPRXDESC_PTPMT	
ETH_DMAPTPRXDESC_PTPMT_SYNC	
ETH_DMAPTPRXDESC_PTPMT_FOLLOWUP	
ETH_DMAPTPRXDESC_PTPMT_DELAYREQ	
ETH_DMAPTPRXDESC_PTPMT_DELAYRESP	
ETH_DMAPTPRXDESC_PTPMT_PDELAYREQ_ANNOUNCE	
ETH_DMAPTPRXDESC_PTPMT_PDELAYRESP_MANAG	
ETH_DMAPTPRXDESC_PTPMT_PDELAYRESPFOLLOWUP_SIGNAL	
ETH_DMAPTPRXDESC_IPV6PR	
ETH_DMAPTPRXDESC_IPV4PR	
ETH_DMAPTPRXDESC_IPCB	
ETH_DMAPTPRXDESC_IPPE	
ETH_DMAPTPRXDESC_IPHE	
ETH_DMAPTPRXDESC_IPPT	
ETH_DMAPTPRXDESC_IPPT_UDP	
ETH_DMAPTPRXDESC_IPPT_TCP	
ETH_DMAPTPRXDESC_IPPT_ICMP	
ETH_DMAPTPRXDESC_RTSL	
ETH_DMAPTPRXDESC_RTSH	
ETH DMA Rx descriptor buffers	
ETH_DMARXDESC_BUFFER1	DMA Rx Desc Buffer1
ETH_DMARXDESC_BUFFER2	DMA Rx Desc Buffer2
ETH DMA transmit process state	
ETH_DMA_TRANSMITPROCESS_STOPPED	Stopped - Reset or Stop Tx Command issued
ETH_DMA_TRANSMITPROCESS_FETCHING	Running - fetching the Tx descriptor
ETH_DMA_TRANSMITPROCESS_WAITING	Running - waiting for status
ETH_DMA_TRANSMITPROCESS_READING	Running - reading the data from host memory

ETH_DMA_TRANSMITPROCESS_SUSPENDED	Suspended - Tx Descriptor unavailable
ETH_DMA_TRANSMITPROCESS_CLOSING	Running - closing Rx descriptor
ETH DMA TX Descriptor	
ETH_DMATXDESC_OWN	OWN bit: descriptor is owned by DMA engine
ETH_DMATXDESC_IC	Interrupt on Completion
ETH_DMATXDESC_LS	Last Segment
ETH_DMATXDESC_FS	First Segment
ETH_DMATXDESC_DC	Disable CRC
ETH_DMATXDESC_DP	Disable Padding
ETH_DMATXDESC_TTSE	Transmit Time Stamp Enable
ETH_DMATXDESC_CIC	Checksum Insertion Control: 4 cases
ETH_DMATXDESC_CIC_BYPASS	Do Nothing: Checksum Engine is bypassed
ETH_DMATXDESC_CIC_IPV4HEADER	IPv4 header Checksum Insertion
ETH_DMATXDESC_CIC_TCPUDPICMP_SEGMENT	TCP/UDP/ICMP Checksum Insertion calculated over segment only
ETH_DMATXDESC_CIC_TCPUDPICMP_FULL	TCP/UDP/ICMP Checksum Insertion fully calculated
ETH_DMATXDESC_TER	Transmit End of Ring
ETH_DMATXDESC_TCH	Second Address Chained
ETH_DMATXDESC_TTSS	Tx Time Stamp Status
ETH_DMATXDESC_IHE	IP Header Error
ETH_DMATXDESC_ES	Error summary: OR of the following bits: UE ED EC LCO NC LCA FF JT
ETH_DMATXDESC_JT	Jabber Timeout
ETH_DMATXDESC_FF	Frame Flushed: DMA/MTL flushed the frame due to SW flush
ETH_DMATXDESC_PCE	Payload Checksum Error
ETH_DMATXDESC_LCA	Loss of Carrier: carrier lost during transmission
ETH_DMATXDESC_NC	No Carrier: no carrier signal from the transceiver
ETH_DMATXDESC_LCO	Late Collision: transmission aborted due to collision
ETH_DMATXDESC_EC	Excessive Collision: transmission aborted after 16 collisions

ETH_DMATXDESC_VF	VLAN Frame
ETH_DMATXDESC_CC	Collision Count
ETH_DMATXDESC_ED	Excessive Deferral
ETH_DMATXDESC_UF	Underflow Error: late data arrival from the memory
ETH_DMATXDESC_DB	Deferred Bit
ETH_DMATXDESC_TBS2	Transmit Buffer2 Size
ETH_DMATXDESC_TBS1	Transmit Buffer1 Size
ETH_DMATXDESC_B1AP	Buffer1 Address Pointer
ETH_DMATXDESC_B2AP	Buffer2 Address Pointer
ETH_DMAPTPTXDESC_TTSL	
ETH_DMAPTPTXDESC_TTSH	

ETH DMA Tx descriptor Checksum Insertion Control

ETH_DMATXDESC_CHECKSUMBYPASS	Checksum engine bypass
ETH_DMATXDESC_CHECKSUMIPV4HEADER	IPv4 header checksum insertion
ETH_DMATXDESC_CHECKSUMTCPUDPICMPSEGMENT	TCP/UDP/ICMP checksum insertion. Pseudo header checksum is assumed to be present
ETH_DMATXDESC_CHECKSUMTCPUDPICMPFULL	TCP/UDP/ICMP checksum fully in hardware including pseudo header

ETH DMA Tx descriptor segment

ETH_DMATXDESC_LASTSEGMENTS	Last Segment
ETH_DMATXDESC_FIRSTSEGMENT	First Segment

ETH Drop TCP IP Checksum Error Frame

ETH_DROPTCPIPChecksumERRORFRAME_ENABLE
ETH_DROPTCPIPChecksumERRORFRAME_DISABLE

ETH Duplex Mode

ETH_MODE_FULLDUPLEX
ETH_MODE_HALFDUPLEX

ETH Exported Macros

__HAL_ETH_RESET_HANDLE_STATE

Description:

- Reset ETH handle state.

Parameters:

- __HANDLE__: specifies the ETH handle.

Return value:

__HAL_ETH_DMATXDESC_GET_FLAG	<ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Checks whether the specified Ethernet DMA Tx Desc flag is set or not. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: ETH Handle • __FLAG__: specifies the flag of TDES0 to check. <p>Return value:</p> <ul style="list-style-type: none"> • the: ETH_DMATxDescFlag (SET or RESET).
__HAL_ETH_DMARXDESC_GET_FLAG	<p>Description:</p> <ul style="list-style-type: none"> • Checks whether the specified Ethernet DMA Rx Desc flag is set or not. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: ETH Handle • __FLAG__: specifies the flag of RDES0 to check. <p>Return value:</p> <ul style="list-style-type: none"> • the: ETH_DMATxDescFlag (SET or RESET).
__HAL_ETH_DMARXDESC_ENABLE_IT	<p>Description:</p> <ul style="list-style-type: none"> • Enables the specified DMA Rx Desc receive interrupt. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: ETH Handle <p>Return value:</p> <ul style="list-style-type: none"> • None
__HAL_ETH_DMARXDESC_DISABLE_IT	<p>Description:</p> <ul style="list-style-type: none"> • Disables the specified DMA Rx Desc receive interrupt. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: ETH Handle <p>Return value:</p> <ul style="list-style-type: none"> • None
__HAL_ETH_DMARXDESC_SET_OWN_BIT	<p>Description:</p> <ul style="list-style-type: none"> • Set the specified DMA Rx Desc Own bit. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: ETH Handle

`__HAL_ETH_DMATXDESC_GET_COLLISION_COUNT`

Return value:

- None

Description:

- Returns the specified Ethernet DMA Tx Desc collision count.

Parameters:

- `__HANDLE__`: ETH Handle

Return value:

- The: Transmit descriptor collision counter value.

`__HAL_ETH_DMATXDESC_SET_OWN_BIT`

Description:

- Set the specified DMA Tx Desc Own bit.

Parameters:

- `__HANDLE__`: ETH Handle

Return value:

- None

`__HAL_ETH_DMATXDESC_ENABLE_IT`

Description:

- Enables the specified DMA Tx Desc Transmit interrupt.

Parameters:

- `__HANDLE__`: ETH Handle

Return value:

- None

`__HAL_ETH_DMATXDESC_DISABLE_IT`

Description:

- Disables the specified DMA Tx Desc Transmit interrupt.

Parameters:

- `__HANDLE__`: ETH Handle

Return value:

- None

`__HAL_ETH_DMATXDESC_CHECKSUM_INSERTION`

Description:

- Selects the specified Ethernet DMA Tx Desc Checksum Insertion.

Parameters:

- `__HANDLE__`: ETH Handle
- `__CHECKSUM__`: specifies is the DMA Tx desc checksum insertion. This parameter can be one of the following values:

- ETH_DMATXDESC_CHECKSUMBYPASS : Checksum bypass
- ETH_DMATXDESC_CHECKSUMIPV4HEADER : IPv4 header checksum
- ETH_DMATXDESC_CHECKSUMTCPUDPICMPSEGMENT : TCP/UDP/ICMP checksum. Pseudo header checksum is assumed to be present
- ETH_DMATXDESC_CHECKSUMTCPUDPICMPFULL : TCP/UDP/ICMP checksum fully in hardware including pseudo header

Return value:

- None

`__HAL_ETH_DMATXDESC_CRC_ENABLE`

Description:

- Enables the DMA Tx Desc CRC.

Parameters:

- `__HANDLE__`: ETH Handle

Return value:

- None

`__HAL_ETH_DMATXDESC_CRC_DISABLE`

Description:

- Disables the DMA Tx Desc CRC.

Parameters:

- `__HANDLE__`: ETH Handle

Return value:

- None

`__HAL_ETH_DMATXDESC_SHORT_FRAME_PADDING_ENABLE`

Description:

- Enables the DMA Tx Desc padding for frame shorter than 64 bytes.

Parameters:

- `__HANDLE__`: ETH Handle

Return value:

- None

`__HAL_ETH_DMATXDESC_SHORT_FRAME_PADDING_DISABLE`

Description:

- Disables the DMA Tx Desc padding for frame shorter than 64 bytes.

Parameters:

- `__HANDLE__`: ETH Handle

Return value:

`__HAL_ETH_MAC_ENABLE_IT`

- None

Description:

- Enables the specified Ethernet MAC interrupts.

Parameters:

- `__HANDLE__`: : ETH Handle
- `__INTERRUPT__`: specifies the Ethernet MAC interrupt sources to be enabled or disabled. This parameter can be any combination of the following values:
 - `ETH_MAC_IT_TST` : Time stamp trigger interrupt
 - `ETH_MAC_IT_PMT` : PMT interrupt

Return value:

- None

`__HAL_ETH_MAC_DISABLE_IT`

Description:

- Disables the specified Ethernet MAC interrupts.

Parameters:

- `__HANDLE__`: : ETH Handle
- `__INTERRUPT__`: specifies the Ethernet MAC interrupt sources to be enabled or disabled. This parameter can be any combination of the following values:
 - `ETH_MAC_IT_TST` : Time stamp trigger interrupt
 - `ETH_MAC_IT_PMT` : PMT interrupt

Return value:

- None

`__HAL_ETH_INITIATE_PAUSE_CONTROL_FRAME`

Description:

- Initiate a Pause Control Frame (Full-duplex only).

Parameters:

- `__HANDLE__`: ETH Handle

Return value:

- None

`__HAL_ETH_GET_FLOW_CONTROL_BUSY_STATUS`

Description:

- Checks whether the Ethernet flow control busy bit is set or not.

Parameters:

`__HAL_ETH_BACK_PRESSURE_ACTIVATION_ENABLE`

- `__HANDLE__`: ETH Handle

Return value:

- The: new state of flow control busy status bit (SET or RESET).

Description:

- Enables the MAC Back Pressure operation activation (Half-duplex only).

Parameters:

- `__HANDLE__`: ETH Handle

Return value:

- None

`__HAL_ETH_BACK_PRESSURE_ACTIVATION_DISABLE`

Description:

- Disables the MAC BackPressure operation activation (Half-duplex only).

Parameters:

- `__HANDLE__`: ETH Handle

Return value:

- None

`__HAL_ETH_MAC_GET_FLAG`

Description:

- Checks whether the specified Ethernet MAC flag is set or not.

Parameters:

- `__HANDLE__`: ETH Handle
- `__FLAG__`: specifies the flag to check. This parameter can be one of the following values:
 - `ETH_MAC_FLAG_TST` : Time stamp trigger flag
 - `ETH_MAC_FLAG_MMCT` : MMC transmit flag
 - `ETH_MAC_FLAG_MMCR` : MMC receive flag
 - `ETH_MAC_FLAG_MMC` : MMC flag
 - `ETH_MAC_FLAG_PMT` : PMT flag

Return value:

- The: state of Ethernet MAC flag.

Description:

- Enables the specified Ethernet DMA interrupts.

Parameters:

- `__HANDLE__`: : ETH Handle

`__HAL_ETH_DMA_ENABLE_IT`

<p><code>__HAL_ETH_DMA_DISABLE_IT</code></p>	<ul style="list-style-type: none"> • <code>__INTERRUPT__</code>: specifies the Ethernet DMA interrupt sources to be enabled <p>Return value:</p> <ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Disables the specified Ethernet DMA interrupts. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: : ETH Handle • <code>__INTERRUPT__</code>: specifies the Ethernet DMA interrupt sources to be disabled. <p>Return value:</p> <ul style="list-style-type: none"> • None
<p><code>__HAL_ETH_DMA_CLEAR_IT</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Clears the Ethernet DMA IT pending bit. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: : ETH Handle • <code>__INTERRUPT__</code>: specifies the interrupt pending bit to clear. <p>Return value:</p> <ul style="list-style-type: none"> • None
<p><code>__HAL_ETH_DMA_GET_FLAG</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Checks whether the specified Ethernet DMA flag is set or not. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: ETH Handle • <code>__FLAG__</code>: specifies the flag to check. <p>Return value:</p> <ul style="list-style-type: none"> • The: new state of ETH_DMA_FLAG (SET or RESET).
<p><code>__HAL_ETH_DMA_CLEAR_FLAG</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Checks whether the specified Ethernet DMA flag is set or not. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: ETH Handle • <code>__FLAG__</code>: specifies the flag to clear. <p>Return value:</p> <ul style="list-style-type: none"> • The: new state of ETH_DMA_FLAG

(SET or RESET).

`__HAL_ETH_GET_DMA_OVERFLOW_STATUS`

Description:

- Checks whether the specified Ethernet DMA overflow flag is set or not.

Parameters:

- `__HANDLE__`: ETH Handle
- `__OVERFLOW__`: specifies the DMA overflow flag to check. This parameter can be one of the following values:
 - `ETH_DMA_OVERFLOW_RXFIFO_COUNTER` : Overflow for FIFO Overflows Counter
 - `ETH_DMA_OVERFLOW_MISSED_FRAME_COUNTER` : Overflow for Buffer Unavailable Missed Frame Counter

Return value:

- The: state of Ethernet DMA overflow Flag (SET or RESET).

`__HAL_ETH_SET_RECEIVE_WATCHDOG_TIMER`

Description:

- Set the DMA Receive status watchdog timer register value.

Parameters:

- `__HANDLE__`: ETH Handle
- `__VALUE__`: DMA Receive status watchdog timer register value

Return value:

- None

`__HAL_ETH_GLOBAL_UNICAST_WAKEUP_ENABLE`

Description:

- Enables any unicast packet filtered by the MAC address recognition to be a wake-up frame.

Parameters:

- `__HANDLE__`: ETH Handle.

Return value:

- None

`__HAL_ETH_GLOBAL_UNICAST_WAKEUP_DISABLE`

Description:

- Disables any unicast packet filtered by the MAC address recognition to be a wake-up frame.

Parameters:

- `__HANDLE__`: ETH Handle.

__HAL_ETH_WAKEUP_FRAME_DETECTION_ENABLE	<p>Return value:</p> <ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Enables the MAC Wake-Up Frame Detection. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: ETH Handle.
__HAL_ETH_WAKEUP_FRAME_DETECTION_DISABLE	<p>Return value:</p> <ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Disables the MAC Wake-Up Frame Detection. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: ETH Handle.
__HAL_ETH_MAGIC_PACKET_DETECTION_ENABLE	<p>Return value:</p> <ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Enables the MAC Magic Packet Detection. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: ETH Handle.
__HAL_ETH_MAGIC_PACKET_DETECTION_DISABLE	<p>Return value:</p> <ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Disables the MAC Magic Packet Detection. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: ETH Handle.
__HAL_ETH_POWER_DOWN_ENABLE	<p>Return value:</p> <ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Enables the MAC Power Down. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: ETH Handle
__HAL_ETH_POWER_DOWN_DISABLE	<p>Return value:</p> <ul style="list-style-type: none"> • None <p>Description:</p>

- Disables the MAC Power Down.

Parameters:

- `__HANDLE__`: ETH Handle

Return value:

- None

`__HAL_ETH_GET_PMT_FLAG_STATUS`**Description:**

- Checks whether the specified Ethernet PMT flag is set or not.

Parameters:

- `__HANDLE__`: ETH Handle.
- `__FLAG__`: specifies the flag to check. This parameter can be one of the following values:
 - `ETH_PMT_FLAG_WUFFRPR`: Wake-Up Frame Filter Register Pointer Reset
 - `ETH_PMT_FLAG_WUFR`: Wake-Up Frame Received
 - `ETH_PMT_FLAG_MPR`: Magic Packet Received

Return value:

- The: new state of Ethernet PMT Flag (SET or RESET).

`__HAL_ETH_MMC_COUNTER_FULL_PR
ESET`**Description:**

- Preset and Initialize the MMC counters to almost-full value: `0xFFFF_FFF0` (full - 16)

Parameters:

- `__HANDLE__`: ETH Handle.

Return value:

- None

`__HAL_ETH_MMC_COUNTER_HALF_PR
ESET`**Description:**

- Preset and Initialize the MMC counters to almost-half value: `0x7FFF_FFF0` (half - 16)

Parameters:

- `__HANDLE__`: ETH Handle.

Return value:

- None

`__HAL_ETH_MMC_COUNTER_FREEZE_
ENABLE`**Description:**

- Enables the MMC Counter Freeze.

<p><code>__HAL_ETH_MMC_COUNTER_FREEZE_DISABLE</code></p>	<p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: ETH Handle. <p>Return value:</p> <ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Disables the MMC Counter Freeze.
<p><code>__HAL_ETH_ETH_MMC_RESET_ONREAD_ENABLE</code></p>	<p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: ETH Handle. <p>Return value:</p> <ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Enables the MMC Reset On Read.
<p><code>__HAL_ETH_ETH_MMC_RESET_ONREAD_DISABLE</code></p>	<p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: ETH Handle. <p>Return value:</p> <ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Disables the MMC Reset On Read.
<p><code>__HAL_ETH_ETH_MMC_COUNTER_ROLLOVER_ENABLE</code></p>	<p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: ETH Handle. <p>Return value:</p> <ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Enables the MMC Counter Stop Rollover.
<p><code>__HAL_ETH_ETH_MMC_COUNTER_ROLLOVER_DISABLE</code></p>	<p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: ETH Handle. <p>Return value:</p> <ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Disables the MMC Counter Stop Rollover.

`__HAL_ETH_MMC_COUNTERS_RESET`**Description:**

- Resets the MMC Counters.

Parameters:

- `__HANDLE__`: ETH Handle.

Return value:

- None

`__HAL_ETH_MMC_RX_IT_ENABLE`**Description:**

- Enables the specified Ethernet MMC Rx interrupts.

Parameters:

- `__HANDLE__`: ETH Handle.
- `__INTERRUPT__`: specifies the Ethernet MMC interrupt sources to be enabled or disabled. This parameter can be one of the following values:
 - `ETH_MMC_IT_RGUF` : When Rx good unicast frames counter reaches half the maximum value
 - `ETH_MMC_IT_RFAE` : When Rx alignment error counter reaches half the maximum value
 - `ETH_MMC_IT_RFCE` : When Rx crc error counter reaches half the maximum value

Return value:

- None

`__HAL_ETH_MMC_RX_IT_DISABLE`**Description:**

- Disables the specified Ethernet MMC Rx interrupts.

Parameters:

- `__HANDLE__`: ETH Handle.
- `__INTERRUPT__`: specifies the Ethernet MMC interrupt sources to be enabled or disabled. This parameter can be one of the following values:
 - `ETH_MMC_IT_RGUF` : When Rx good unicast frames counter reaches half the maximum value
 - `ETH_MMC_IT_RFAE` : When Rx alignment error counter reaches half the maximum value
 - `ETH_MMC_IT_RFCE` : When Rx crc error counter reaches half the maximum value

Return value:

`__HAL_ETH_MMC_TX_IT_ENABLE`

- None

Description:

- Enables the specified Ethernet MMC Tx interrupts.

Parameters:

- `__HANDLE__`: ETH Handle.
- `__INTERRUPT__`: specifies the Ethernet MMC interrupt sources to be enabled or disabled. This parameter can be one of the following values:
 - `ETH_MMC_IT_TGF` : When Tx good frame counter reaches half the maximum value
 - `ETH_MMC_IT_TGFMSC`: When Tx good multi col counter reaches half the maximum value
 - `ETH_MMC_IT_TGFSC` : When Tx good single col counter reaches half the maximum value

Return value:

- None

`__HAL_ETH_MMC_TX_IT_DISABLE`

Description:

- Disables the specified Ethernet MMC Tx interrupts.

Parameters:

- `__HANDLE__`: ETH Handle.
- `__INTERRUPT__`: specifies the Ethernet MMC interrupt sources to be enabled or disabled. This parameter can be one of the following values:
 - `ETH_MMC_IT_TGF` : When Tx good frame counter reaches half the maximum value
 - `ETH_MMC_IT_TGFMSC`: When Tx good multi col counter reaches half the maximum value
 - `ETH_MMC_IT_TGFSC` : When Tx good single col counter reaches half the maximum value

Return value:

- None

`__HAL_ETH_WAKEUP_EXTI_ENABLE_I`
`T`

Description:

- Enables the ETH External interrupt line.

Return value:

- None

<code>__HAL_ETH_WAKEUP_EXTI_DISABLE_IT</code>	Description: <ul style="list-style-type: none">Disables the ETH External interrupt line. Return value: <ul style="list-style-type: none">None
<code>__HAL_ETH_WAKEUP_EXTI_ENABLE_EVENT</code>	Description: <ul style="list-style-type: none">Enable event on ETH External event line. Return value: <ul style="list-style-type: none">None.
<code>__HAL_ETH_WAKEUP_EXTI_DISABLE_EVENT</code>	Description: <ul style="list-style-type: none">Disable event on ETH External event line. Return value: <ul style="list-style-type: none">None.
<code>__HAL_ETH_WAKEUP_EXTI_GET_FLAG</code>	Description: <ul style="list-style-type: none">Get flag of the ETH External interrupt line. Return value: <ul style="list-style-type: none">None
<code>__HAL_ETH_WAKEUP_EXTI_CLEAR_FLAG</code>	Description: <ul style="list-style-type: none">Clear flag of the ETH External interrupt line. Return value: <ul style="list-style-type: none">None
<code>__HAL_ETH_WAKEUP_EXTI_ENABLE_RISING_EDGE_TRIGGER</code>	Description: <ul style="list-style-type: none">Enables rising edge trigger to the ETH External interrupt line. Return value: <ul style="list-style-type: none">None
<code>__HAL_ETH_WAKEUP_EXTI_DISABLE_RISING_EDGE_TRIGGER</code>	Description: <ul style="list-style-type: none">Disables the rising edge trigger to the ETH External interrupt line. Return value: <ul style="list-style-type: none">None
<code>__HAL_ETH_WAKEUP_EXTI_ENABLE_FALLING_EDGE_TRIGGER</code>	Description: <ul style="list-style-type: none">Enables falling edge trigger to the ETH External interrupt line. Return value:

<p><code>__HAL_ETH_WAKEUP_EXTI_DISABLE_FALLING_EDGE_TRIGGER</code></p>	<ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Disables falling edge trigger to the ETH External interrupt line. <p>Return value:</p> <ul style="list-style-type: none"> • None
<p><code>__HAL_ETH_WAKEUP_EXTI_ENABLE_FALLINGRISING_TRIGGER</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Enables rising/falling edge trigger to the ETH External interrupt line. <p>Return value:</p> <ul style="list-style-type: none"> • None
<p><code>__HAL_ETH_WAKEUP_EXTI_DISABLE_FALLINGRISING_TRIGGER</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Disables rising/falling edge trigger to the ETH External interrupt line. <p>Return value:</p> <ul style="list-style-type: none"> • None
<p><code>__HAL_ETH_WAKEUP_EXTI_GENERATE_SWIT</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Generate a Software interrupt on selected EXTI line. <p>Return value:</p> <ul style="list-style-type: none"> • None.

ETH EXTI LINE WAKEUP

`ETH_EXTI_LINE_WAKEUP` External interrupt line 19 Connected to the ETH EXTI Line

ETH Fixed Burst

`ETH_FIXEDBURST_ENABLE`

`ETH_FIXEDBURST_DISABLE`

ETH Flush Received Frame

`ETH_FLUSHRECEIVEDFRAME_ENABLE`

`ETH_FLUSHRECEIVEDFRAME_DISABLE`

ETH Forward Error Frames

`ETH_FORWARDERRORFRAMES_ENABLE`

`ETH_FORWARDERRORFRAMES_DISABLE`

ETH Forward Undersized Good Frames

`ETH_FORWARDUNDERSIZEDGOODFRAMES_ENABLE`

`ETH_FORWARDUNDERSIZEDGOODFRAMES_DISABLE`

ETH Inter Frame Gap

`ETH_INTERFRAMEGAP_96BIT` minimum IFG between frames during transmission is 96Bit

ETH_INTERFRAMEGAP_88BIT	minimum IFG between frames during transmission is 88Bit
ETH_INTERFRAMEGAP_80BIT	minimum IFG between frames during transmission is 80Bit
ETH_INTERFRAMEGAP_72BIT	minimum IFG between frames during transmission is 72Bit
ETH_INTERFRAMEGAP_64BIT	minimum IFG between frames during transmission is 64Bit
ETH_INTERFRAMEGAP_56BIT	minimum IFG between frames during transmission is 56Bit
ETH_INTERFRAMEGAP_48BIT	minimum IFG between frames during transmission is 48Bit
ETH_INTERFRAMEGAP_40BIT	minimum IFG between frames during transmission is 40Bit

ETH Jabber

ETH_JABBER_ENABLE

ETH_JABBER_DISABLE

ETH Loop Back Mode

ETH_LOOPBACKMODE_ENABLE

ETH_LOOPBACKMODE_DISABLE

ETH MAC addresses

ETH_MAC_ADDRESS0

ETH_MAC_ADDRESS1

ETH_MAC_ADDRESS2

ETH_MAC_ADDRESS3

ETH MAC addresses filter Mask bytes

ETH_MAC_ADDRESSMASK_BYTE6 Mask MAC Address high reg bits [15:8]

ETH_MAC_ADDRESSMASK_BYTE5 Mask MAC Address high reg bits [7:0]

ETH_MAC_ADDRESSMASK_BYTE4 Mask MAC Address low reg bits [31:24]

ETH_MAC_ADDRESSMASK_BYTE3 Mask MAC Address low reg bits [23:16]

ETH_MAC_ADDRESSMASK_BYTE2 Mask MAC Address low reg bits [15:8]

ETH_MAC_ADDRESSMASK_BYTE1 Mask MAC Address low reg bits [7:0]

ETH MAC addresses filter SA DA

ETH_MAC_ADDRESSFILTER_SA

ETH_MAC_ADDRESSFILTER_DA

ETH MAC Flags

ETH_MAC_FLAG_TST Time stamp trigger flag (on MAC)

ETH_MAC_FLAG_MMCT MMC transmit flag

ETH_MAC_FLAG_MMCR MMC receive flag

ETH_MAC_FLAG_MMC MMC flag (on MAC)

ETH_MAC_FLAG_PMT PMT flag (on MAC)

ETH MAC Interrupts

ETH_MAC_IT_TST Time stamp trigger interrupt (on MAC)

ETH_MAC_IT_MMCT MMC transmit interrupt

ETH_MAC_IT_MMCR MMC receive interrupt

ETH_MAC_IT_MMC MMC interrupt (on MAC)

ETH_MAC_IT_PMT PMT interrupt (on MAC)

ETH Media Interface

ETH_MEDIA_INTERFACE_MII

ETH_MEDIA_INTERFACE_RMII

ETH MMC Rx Interrupts

ETH_MMC_IT_RGUF When Rx good unicast frames counter reaches half the maximum value

ETH_MMC_IT_RFAE When Rx alignment error counter reaches half the maximum value

ETH_MMC_IT_RFCE When Rx crc error counter reaches half the maximum value

ETH MMC Tx Interrupts

ETH_MMC_IT_TGF When Tx good frame counter reaches half the maximum value

ETH_MMC_IT_TGFMSC When Tx good multi col counter reaches half the maximum value

ETH_MMC_IT_TGFSC When Tx good single col counter reaches half the maximum value

ETH Multicast Frames Filter

ETH_MULTICASTFRAMESFILTER_PERFECTHASHTABLE

ETH_MULTICASTFRAMESFILTER_HASHTABLE

ETH_MULTICASTFRAMESFILTER_PERFECT

ETH_MULTICASTFRAMESFILTER_NONE

ETH Pass Control Frames

ETH_PASSCONTROLFRAMES_BLOCKALL

MAC filters all control frames from reaching the application

ETH_PASSCONTROLFRAMES_FORWARDALL

MAC forwards all control frames to application even if they fail the Address Filter

ETH_PASSCONTROLFRAMES_FORWARDPASSEDADDRFILTER

MAC forwards control frames that pass the Address Filter.

ETH Pause Low Threshold

ETH_PAUSELOWTHRESHOLD_MINUS4	Pause time minus 4 slot times
ETH_PAUSELOWTHRESHOLD_MINUS28	Pause time minus 28 slot times
ETH_PAUSELOWTHRESHOLD_MINUS144	Pause time minus 144 slot times
ETH_PAUSELOWTHRESHOLD_MINUS256	Pause time minus 256 slot times

ETH PMT Flags

ETH_PMT_FLAG_WUFFRPR	Wake-Up Frame Filter Register Pointer Reset
ETH_PMT_FLAG_WUFR	Wake-Up Frame Received
ETH_PMT_FLAG_MPR	Magic Packet Received

ETH Promiscuous Mode

ETH_PROMISCUOUS_MODE_ENABLE
ETH_PROMISCUOUS_MODE_DISABLE

ETH Receive All

ETH_RECEIVEALL_ENABLE
ETH_RECEIVEALL_DISABLE

ETH Receive Flow Control

ETH_RECEIVEFLOWCONTROL_ENABLE
ETH_RECEIVEFLOWCONTROL_DISABLE

ETH Receive Own

ETH_RECEIVEOWN_ENABLE
ETH_RECEIVEOWN_DISABLE

ETH Receive Store Forward

ETH_RECEIVESTOREFORWARD_ENABLE
ETH_RECEIVESTOREFORWARD_DISABLE

ETH Receive Threshold Control

ETH_RECEIVEDTHRESHOLDCONTROL_64BYTES	threshold level of the MTL Receive FIFO is 64 Bytes
ETH_RECEIVEDTHRESHOLDCONTROL_32BYTES	threshold level of the MTL Receive FIFO is 32 Bytes
ETH_RECEIVEDTHRESHOLDCONTROL_96BYTES	threshold level of the MTL Receive FIFO is 96 Bytes
ETH_RECEIVEDTHRESHOLDCONTROL_128BYTES	threshold level of the MTL Receive FIFO is 128 Bytes

ETH Retry Transmission

ETH_RETRYTRANSMISSION_ENABLE
ETH_RETRYTRANSMISSION_DISABLE

ETH Rx DMA Burst Length

ETH_RXDMABURSTLENGTH_1BEAT	maximum number of beats to be
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	transferred in one RxDMA transaction is 1
ETH_RXDMABURSTLENGTH_2BEAT	maximum number of beats to be transferred in one RxDMA transaction is 2
ETH_RXDMABURSTLENGTH_4BEAT	maximum number of beats to be transferred in one RxDMA transaction is 4
ETH_RXDMABURSTLENGTH_8BEAT	maximum number of beats to be transferred in one RxDMA transaction is 8
ETH_RXDMABURSTLENGTH_16BEAT	maximum number of beats to be transferred in one RxDMA transaction is 16
ETH_RXDMABURSTLENGTH_32BEAT	maximum number of beats to be transferred in one RxDMA transaction is 32
ETH_RXDMABURSTLENGTH_4XPBL_4BEAT	maximum number of beats to be transferred in one RxDMA transaction is 4
ETH_RXDMABURSTLENGTH_4XPBL_8BEAT	maximum number of beats to be transferred in one RxDMA transaction is 8
ETH_RXDMABURSTLENGTH_4XPBL_16BEAT	maximum number of beats to be transferred in one RxDMA transaction is 16
ETH_RXDMABURSTLENGTH_4XPBL_32BEAT	maximum number of beats to be transferred in one RxDMA transaction is 32
ETH_RXDMABURSTLENGTH_4XPBL_64BEAT	maximum number of beats to be transferred in one RxDMA transaction is 64
ETH_RXDMABURSTLENGTH_4XPBL_128BEAT	maximum number of beats to be transferred in one RxDMA transaction is 128

ETH Rx Mode

ETH_RXPOLLING_MODE

ETH_RXINTERRUPT_MODE

ETH Second Frame Operate

ETH_SECONDFRAMEOPERARTE_ENABLE

ETH_SECONDFRAMEOPERARTE_DISABLE

ETH Source Addr Filter

ETH_SOURCEADDRFILTER_NORMAL_ENABLE

ETH_SOURCEADDRFILTER_INVERSE_ENABLE

ETH_SOURCEADDRFILTER_DISABLE

ETH Speed

ETH_SPEED_10M

ETH_SPEED_100M

ETH Transmit Flow Control

ETH_TRANSMITFLOWCONTROL_ENABLE

ETH_TRANSMITFLOWCONTROL_DISABLE

ETH Transmit Store Forward

ETH_TRANSMITSTOREFORWARD_ENABLE

ETH_TRANSMITSTOREFORWARD_DISABLE

ETH Transmit Threshold Control

ETH_TRANSMITTHRESHOLDCONTROL_64BYTES	threshold level of the MTL Transmit FIFO is 64 Bytes
ETH_TRANSMITTHRESHOLDCONTROL_128BYTES	threshold level of the MTL Transmit FIFO is 128 Bytes
ETH_TRANSMITTHRESHOLDCONTROL_192BYTES	threshold level of the MTL Transmit FIFO is 192 Bytes
ETH_TRANSMITTHRESHOLDCONTROL_256BYTES	threshold level of the MTL Transmit FIFO is 256 Bytes
ETH_TRANSMITTHRESHOLDCONTROL_40BYTES	threshold level of the MTL Transmit FIFO is 40 Bytes
ETH_TRANSMITTHRESHOLDCONTROL_32BYTES	threshold level of the MTL Transmit FIFO is 32 Bytes
ETH_TRANSMITTHRESHOLDCONTROL_24BYTES	threshold level of the MTL Transmit FIFO is 24 Bytes
ETH_TRANSMITTHRESHOLDCONTROL_16BYTES	threshold level of the MTL Transmit FIFO is 16 Bytes

ETH Tx DMA Burst Length

ETH_TXDMABURSTLENGTH_1BEAT	maximum number of beats to be transferred in one TxDMA (or both) transaction is 1
ETH_TXDMABURSTLENGTH_2BEAT	maximum number of beats to be transferred in one TxDMA (or both) transaction is 2
ETH_TXDMABURSTLENGTH_4BEAT	maximum number of beats to be transferred in one TxDMA (or both) transaction is 4
ETH_TXDMABURSTLENGTH_8BEAT	maximum number of beats to be transferred in one TxDMA (or both) transaction is 8
ETH_TXDMABURSTLENGTH_16BEAT	maximum number of beats to be transferred in one TxDMA (or both) transaction is 16

ETH_TXDMABURSTLENGTH_32BEAT	maximum number of beats to be transferred in one TxDMA (or both) transaction is 32
ETH_TXDMABURSTLENGTH_4XPBL_4BEAT	maximum number of beats to be transferred in one TxDMA (or both) transaction is 4
ETH_TXDMABURSTLENGTH_4XPBL_8BEAT	maximum number of beats to be transferred in one TxDMA (or both) transaction is 8
ETH_TXDMABURSTLENGTH_4XPBL_16BEAT	maximum number of beats to be transferred in one TxDMA (or both) transaction is 16
ETH_TXDMABURSTLENGTH_4XPBL_32BEAT	maximum number of beats to be transferred in one TxDMA (or both) transaction is 32
ETH_TXDMABURSTLENGTH_4XPBL_64BEAT	maximum number of beats to be transferred in one TxDMA (or both) transaction is 64
ETH_TXDMABURSTLENGTH_4XPBL_128BEAT	maximum number of beats to be transferred in one TxDMA (or both) transaction is 128

ETH Unicast Frames Filter

ETH_UNICASTFRAMESFILTER_PERFECTHASHTABLE

ETH_UNICASTFRAMESFILTER_HASHTABLE

ETH_UNICASTFRAMESFILTER_PERFECT

ETH Unicast Pause Frame Detect

ETH_UNICASTPAUSEFRAMEDETECT_ENABLE

ETH_UNICASTPAUSEFRAMEDETECT_DISABLE

ETH VLAN Tag Comparison

ETH_VLANTAGCOMPARISON_12BIT

ETH_VLANTAGCOMPARISON_16BIT

ETH Watchdog

ETH_WATCHDOG_ENABLE

ETH_WATCHDOG_DISABLE

ETH Zero Quanta Pause

ETH_ZEROQUANTAPAUSE_ENABLE

ETH_ZEROQUANTAPAUSE_DISABLE

24 HAL FLASH Generic Driver

24.1 FLASH Firmware driver registers structures

24.1.1 FLASH_ProcessTypeDef

Data Fields

- *__IO FLASH_ProcedureTypeDef ProcedureOnGoing*
- *__IO uint32_t NbSectorsToErase*
- *__IO uint8_t VoltageForErase*
- *__IO uint32_t Sector*
- *__IO uint32_t Address*
- *HAL_LockTypeDef Lock*
- *__IO uint32_t ErrorCode*

Field Documentation

- *__IO FLASH_ProcedureTypeDef FLASH_ProcessTypeDef::ProcedureOnGoing*
- *__IO uint32_t FLASH_ProcessTypeDef::NbSectorsToErase*
- *__IO uint8_t FLASH_ProcessTypeDef::VoltageForErase*
- *__IO uint32_t FLASH_ProcessTypeDef::Sector*
- *__IO uint32_t FLASH_ProcessTypeDef::Address*
- *HAL_LockTypeDef FLASH_ProcessTypeDef::Lock*
- *__IO uint32_t FLASH_ProcessTypeDef::ErrorCode*

24.2 FLASH Firmware driver API description

24.2.1 FLASH peripheral features

The Flash memory interface manages CPU AHB I-Code and D-Code accesses to the Flash memory. It implements the erase and program Flash memory operations and the read and write protection mechanisms.

The Flash memory interface accelerates code execution with a system of instruction prefetch and cache lines.

The FLASH main features are:

- Flash memory read operations
- Flash memory program/erase operations
- Read / write protections
- Prefetch on I-Code
- 64 cache lines of 128 bits on I-Code
- 8 cache lines of 128 bits on D-Code

24.2.2 How to use this driver

This driver provides functions and macros to configure and program the FLASH memory of all STM32F7xx devices.

1. FLASH Memory IO Programming functions:
 - Lock and Unlock the FLASH interface using HAL_FLASH_Unlock() and HAL_FLASH_Lock() functions
 - Program functions: byte, half word, word and double word

- There Two modes of programming :
 - Polling mode using HAL_FLASH_Program() function
 - Interrupt mode using HAL_FLASH_Program_IT() function
- 2. Interrupts and flags management functions :
 - Handle FLASH interrupts by calling HAL_FLASH_IRQHandler()
 - Wait for last FLASH operation according to its status
 - Get error flag status by calling HAL_SetErrorCode()

In addition to these functions, this driver includes a set of macros allowing to handle the following operations:

- Set the latency
- Enable/Disable the prefetch buffer
- Enable/Disable the Instruction cache and the Data cache
- Reset the Instruction cache and the Data cache
- Enable/Disable the FLASH interrupts
- Monitor the FLASH flags status



For any Flash memory program operation (erase or program), the CPU clock frequency (HCLK) must be at least 1MHz.



The contents of the Flash memory are not guaranteed if a device reset occurs during a Flash memory operation.



Any attempt to read the Flash memory while it is being written or erased, causes the bus to stall. Read operations are processed correctly once the program operation has completed. This means that code or data fetches cannot be performed while a write/erase operation is ongoing.

24.2.3 Programming operation functions

This subsection provides a set of functions allowing to manage the FLASH program operations.

This section contains the following APIs:

- [*HAL_FLASH_Program\(\)*](#)
- [*HAL_FLASH_Program_IT\(\)*](#)
- [*HAL_FLASH_IRQHandler\(\)*](#)
- [*HAL_FLASH_EndOfOperationCallback\(\)*](#)
- [*HAL_FLASH_OperationErrorCallback\(\)*](#)

24.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the FLASH memory operations.

This section contains the following APIs:

- [*HAL_FLASH_Unlock\(\)*](#)
- [*HAL_FLASH_Lock\(\)*](#)
- [*HAL_FLASH_OB_Unlock\(\)*](#)

- [HAL_FLASH_OB_Lock\(\)](#)
- [HAL_FLASH_OB_Launch\(\)](#)

24.2.5 Peripheral Errors functions

This subsection permits to get in run-time Errors of the FLASH peripheral.

This section contains the following APIs:

- [HAL_FLASH_GetError\(\)](#)
- [FLASH_WaitForLastOperation\(\)](#)

24.2.6 Detailed description of functions

HAL_FLASH_Program

Function name	HAL_StatusTypeDef HAL_FLASH_Program (uint32_t TypeProgram, uint32_t Address, uint64_t Data)
Function description	Program byte, halfword, word or double word at a specified address.
Parameters	<ul style="list-style-type: none"> • TypeProgram: Indicate the way to program at a specified address. This parameter can be a value of FLASH Type Program • Address: specifies the address to be programmed. • Data: specifies the data to be programmed
Return values	<ul style="list-style-type: none"> • HAL_StatusTypeDef: HAL Status

HAL_FLASH_Program_IT

Function name	HAL_StatusTypeDef HAL_FLASH_Program_IT (uint32_t TypeProgram, uint32_t Address, uint64_t Data)
Function description	Program byte, halfword, word or double word at a specified address with interrupt enabled.
Parameters	<ul style="list-style-type: none"> • TypeProgram: Indicate the way to program at a specified address. This parameter can be a value of FLASH Type Program • Address: specifies the address to be programmed. • Data: specifies the data to be programmed
Return values	<ul style="list-style-type: none"> • HAL: Status

HAL_FLASH_IRQHandler

Function name	void HAL_FLASH_IRQHandler (void)
Function description	This function handles FLASH interrupt request.
Return values	<ul style="list-style-type: none"> • None:

HAL_FLASH_EndOfOperationCallback

Function name	void HAL_FLASH_EndOfOperationCallback (uint32_t ReturnValue)
Function description	FLASH end of operation interrupt callback.

- Parameters
- **ReturnValue:** The value saved in this parameter depends on the ongoing procedure
 - Sectors Erase: Sector which has been erased (if 0xFFFFFFFF, it means that all the selected sectors have been erased)
 - Program : Address which was selected for data program
 - Mass Erase : No return value expected

- Return values
- **None:**

HAL_FLASH_OperationErrorCallback

Function name **void HAL_FLASH_OperationErrorCallback (uint32_t ReturnValue)**

Function description FLASH operation error interrupt callback.

- Parameters
- **ReturnValue:** The value saved in this parameter depends on the ongoing procedure
 - Sectors Erase: Sector which has been erased (if 0xFFFFFFFF, it means that all the selected sectors have been erased)
 - Program : Address which was selected for data program
 - Mass Erase : No return value expected

- Return values
- **None:**

HAL_FLASH_Unlock

Function name **HAL_StatusTypeDef HAL_FLASH_Unlock (void)**

Function description Unlock the FLASH control register access.

- Return values
- **HAL:** Status

HAL_FLASH_Lock

Function name **HAL_StatusTypeDef HAL_FLASH_Lock (void)**

Function description Locks the FLASH control register access.

- Return values
- **HAL:** Status

HAL_FLASH_OB_Unlock

Function name **HAL_StatusTypeDef HAL_FLASH_OB_Unlock (void)**

Function description Unlock the FLASH Option Control Registers access.

- Return values
- **HAL:** Status

HAL_FLASH_OB_Lock

Function name **HAL_StatusTypeDef HAL_FLASH_OB_Lock (void)**

Function description Lock the FLASH Option Control Registers access.

- Return values
- **HAL:** Status

HAL_FLASH_OB_Launch

Function name	HAL_StatusTypeDef HAL_FLASH_OB_Launch (void)
Function description	Launch the option byte loading.
Return values	<ul style="list-style-type: none"> • HAL: Status

HAL_FLASH_GetError

Function name	uint32_t HAL_FLASH_GetError (void)
Function description	Get the specific FLASH error flag.
Return values	<ul style="list-style-type: none"> • FLASH_ErrorCode: The returned value can be: <ul style="list-style-type: none"> – FLASH_ERROR_ERS: FLASH Erasing Sequence error flag – FLASH_ERROR_PGP: FLASH Programming Parallelism error flag – FLASH_ERROR_PGA: FLASH Programming Alignment error flag – FLASH_ERROR_WRP: FLASH Write protected error flag – FLASH_ERROR_OPERATION: FLASH operation Error flag

FLASH_WaitForLastOperation

Function name	HAL_StatusTypeDef FLASH_WaitForLastOperation (uint32_t Timeout)
Function description	Wait for a FLASH operation to complete.
Parameters	<ul style="list-style-type: none"> • Timeout: maximum flash operation timeout
Return values	<ul style="list-style-type: none"> • HAL: Status

24.3 FLASH Firmware driver defines**24.3.1 FLASH*****FLASH Error Code***

HAL_FLASH_ERROR_NONE	No error
HAL_FLASH_ERROR_ERS	Programming Sequence error
HAL_FLASH_ERROR_PGP	Programming Parallelism error
HAL_FLASH_ERROR_PGA	Programming Alignment error
HAL_FLASH_ERROR_WRP	Write protection error
HAL_FLASH_ERROR_OPERATION	Operation Error
HAL_FLASH_ERROR_RD	Read Protection Error

FLASH Exported Macros

__HAL_FLASH_SET_LATENCY	Description:
	<ul style="list-style-type: none"> • Set the FLASH Latency.

__HAL_FLASH_GET_LATENCY

Parameters:

- `__LATENCY__`: FLASH Latency
The value of this parameter depend on device used within the same series

Return value:

- none

Description:

- Get the FLASH Latency.

Return value:

- FLASH: Latency The value of this parameter depend on device used within the same series

__HAL_FLASH_PREFETCH_BUFFER_ENABLE

Description:

- Enable the FLASH prefetch buffer.

Return value:

- none

__HAL_FLASH_PREFETCH_BUFFER_DISABLE

Description:

- Disable the FLASH prefetch buffer.

Return value:

- none

__HAL_FLASH_ART_ENABLE

Description:

- Enable the FLASH Adaptive Real-Time memory accelerator.

Return value:

- none

Notes:

- The ART accelerator is available only for flash access on ITCM interface.

__HAL_FLASH_ART_DISABLE

Description:

- Disable the FLASH Adaptive Real-Time memory accelerator.

Return value:

- none

__HAL_FLASH_ART_RESET

Description:

- Resets the FLASH Adaptive Real-Time memory accelerator.

Return value:

`__HAL_FLASH_ENABLE_IT`

- None

Notes:

- This function must be used only when the Adaptive Real-Time memory accelerator is disabled.

Description:

- Enable the specified FLASH interrupt.

Parameters:

- `__INTERRUPT__`: FLASH interrupt This parameter can be any combination of the following values:
 - `FLASH_IT_EOP`: End of FLASH Operation Interrupt
 - `FLASH_IT_ERR`: Error Interrupt

Return value:

- none

`__HAL_FLASH_DISABLE_IT`**Description:**

- Disable the specified FLASH interrupt.

Parameters:

- `__INTERRUPT__`: FLASH interrupt This parameter can be any combination of the following values:
 - `FLASH_IT_EOP`: End of FLASH Operation Interrupt
 - `FLASH_IT_ERR`: Error Interrupt

Return value:

- none

`__HAL_FLASH_GET_FLAG`**Description:**

- Get the specified FLASH flag status.

Parameters:

- `__FLAG__`: specifies the FLASH flag to check. This parameter can be one of the following values:
 - `FLASH_FLAG_EOP`: FLASH End of Operation flag
 - `FLASH_FLAG_OPERR`: FLASH operation Error flag
 - `FLASH_FLAG_WRPERR`:

FLASH Write protected error flag

- FLASH_FLAG_PGAERR: FLASH Programming Alignment error flag
- FLASH_FLAG_PGPERR: FLASH Programming Parallelism error flag
- FLASH_FLAG_ERSERR : FLASH Erasing Sequence error flag
- FLASH_FLAG_BSY : FLASH Busy flag

Return value:

- The: new state of __FLAG__ (SET or RESET).

Description:

- Clear the specified FLASH flag.

Parameters:

- __FLAG__: specifies the FLASH flags to clear. This parameter can be any combination of the following values:
 - FLASH_FLAG_EOP : FLASH End of Operation flag
 - FLASH_FLAG_OPERR : FLASH operation Error flag
 - FLASH_FLAG_WRPERR: FLASH Write protected error flag
 - FLASH_FLAG_PGAERR: FLASH Programming Alignment error flag
 - FLASH_FLAG_PGPERR: FLASH Programming Parallelism error flag
 - FLASH_FLAG_ERSERR : FLASH Erasing Sequence error flag

Return value:

- none

Description:

- Calculate the FLASH Boot Base Adress (BOOT_ADD0 or BOOT_ADD1)

Parameters:

- __ADDRESS__: FLASH Boot Address (in the range 0x0000

`__HAL_FLASH_CLEAR_FLAG`

`__HAL_FLASH_CALC_BOOT_BASE_ADR`

0000 to 0x2004 FFFF with a granularity of 16KB)

Return value:

- The: FLASH Boot Base Adress

Notes:

- Returned value BOOT_ADDx[15:0] corresponds to boot address [29:14].

FLASH Flag definition

FLASH_FLAG_EOP	FLASH End of Operation flag
FLASH_FLAG_OPERR	FLASH operation Error flag
FLASH_FLAG_WRPERR	FLASH Write protected error flag
FLASH_FLAG_PGAERR	FLASH Programming Alignment error flag
FLASH_FLAG_PGPERR	FLASH Programming Parallelism error flag
FLASH_FLAG_ERSERR	FLASH Erasing Sequence error flag
FLASH_FLAG_BSY	FLASH Busy flag
FLASH_FLAG_ALL_ERRORS	

FLASH Interrupt definition

FLASH_IT_EOP	End of FLASH Operation Interrupt source
FLASH_IT_ERR	Error Interrupt source

FLASH Private macros to check input parameters

IS_FLASH_TYPEPROGRAM

FLASH Keys

FLASH_KEY1
FLASH_KEY2
FLASH_OPT_KEY1
FLASH_OPT_KEY2

FLASH Latency

FLASH_LATENCY_0	FLASH Zero Latency cycle
FLASH_LATENCY_1	FLASH One Latency cycle
FLASH_LATENCY_2	FLASH Two Latency cycles
FLASH_LATENCY_3	FLASH Three Latency cycles
FLASH_LATENCY_4	FLASH Four Latency cycles
FLASH_LATENCY_5	FLASH Five Latency cycles
FLASH_LATENCY_6	FLASH Six Latency cycles
FLASH_LATENCY_7	FLASH Seven Latency cycles
FLASH_LATENCY_8	FLASH Eight Latency cycles

FLASH_LATENCY_9 FLASH Nine Latency cycles
 FLASH_LATENCY_10 FLASH Ten Latency cycles
 FLASH_LATENCY_11 FLASH Eleven Latency cycles
 FLASH_LATENCY_12 FLASH Twelve Latency cycles
 FLASH_LATENCY_13 FLASH Thirteen Latency cycles
 FLASH_LATENCY_14 FLASH Fourteen Latency cycles
 FLASH_LATENCY_15 FLASH Fifteen Latency cycles

FLASH Program Parallelism

FLASH_PSIZE_BYTE
 FLASH_PSIZE_HALF_WORD
 FLASH_PSIZE_WORD
 FLASH_PSIZE_DOUBLE_WORD
 CR_PSIZE_MASK

FLASH Sectors

FLASH_SECTOR_0 Sector Number 0
 FLASH_SECTOR_1 Sector Number 1
 FLASH_SECTOR_2 Sector Number 2
 FLASH_SECTOR_3 Sector Number 3
 FLASH_SECTOR_4 Sector Number 4
 FLASH_SECTOR_5 Sector Number 5
 FLASH_SECTOR_6 Sector Number 6
 FLASH_SECTOR_7 Sector Number 7

FLASH Type Program

FLASH_TYPEPROGRAM_BYTE Program byte (8-bit) at a specified address
 FLASH_TYPEPROGRAM_HALFWORD Program a half-word (16-bit) at a specified address
 FLASH_TYPEPROGRAM_WORD Program a word (32-bit) at a specified address
 FLASH_TYPEPROGRAM_DOUBLEWORD Program a double word (64-bit) at a specified address

25 HAL FLASH Extension Driver

25.1 FLASHEx Firmware driver registers structures

25.1.1 FLASH_EraseInitTypeDef

Data Fields

- *uint32_t TypeErase*
- *uint32_t Banks*
- *uint32_t Sector*
- *uint32_t NbSectors*
- *uint32_t VoltageRange*

Field Documentation

- *uint32_t FLASH_EraseInitTypeDef::TypeErase*
Mass erase or sector Erase. This parameter can be a value of [FLASHEx_Type_Erase](#)
- *uint32_t FLASH_EraseInitTypeDef::Banks*
Select banks to erase when Mass erase is enabled. This parameter must be a value of [FLASHEx_Banks](#)
- *uint32_t FLASH_EraseInitTypeDef::Sector*
Initial FLASH sector to erase when Mass erase is disabled This parameter must be a value of [FLASHEx_Sectors](#)
- *uint32_t FLASH_EraseInitTypeDef::NbSectors*
Number of sectors to be erased. This parameter must be a value between 1 and (max number of sectors - value of Initial sector)
- *uint32_t FLASH_EraseInitTypeDef::VoltageRange*
The device voltage range which defines the erase parallelism This parameter must be a value of [FLASHEx_Voltage_Range](#)

25.1.2 FLASH_OBProgramInitTypeDef

Data Fields

- *uint32_t OptionType*
- *uint32_t WRPState*
- *uint32_t WRPSector*
- *uint32_t RDPLLevel*
- *uint32_t BORLevel*
- *uint32_t USERConfig*
- *uint32_t BootAddr0*
- *uint32_t BootAddr1*

Field Documentation

- *uint32_t FLASH_OBProgramInitTypeDef::OptionType*
Option byte to be configured. This parameter can be a value of [FLASHEx_Option_Type](#)
- *uint32_t FLASH_OBProgramInitTypeDef::WRPState*
Write protection activation or deactivation. This parameter can be a value of [FLASHEx_WRP_State](#)

- ***uint32_t FLASH_OBProgramInitTypeDef::WRPSector***
Specifies the sector(s) to be write protected. The value of this parameter depend on device used within the same series
- ***uint32_t FLASH_OBProgramInitTypeDef::RDPLLevel***
Set the read protection level. This parameter can be a value of [FLASHEx_Option_Bytes_Read_Protection](#)
- ***uint32_t FLASH_OBProgramInitTypeDef::BORLevel***
Set the BOR Level. This parameter can be a value of [FLASHEx_BOR_Reset_Level](#)
- ***uint32_t FLASH_OBProgramInitTypeDef::USERConfig***
Program the FLASH User Option Byte: WWDG_SW / IWDG_SW / RST_STOP / RST_STDBY / IWDG_FREEZE_STOP / IWDG_FREEZE_SANDBY / nDBANK / nDBOOT. nDBANK / nDBOOT are only available for STM32F76xxx/STM32F77xxx devices
- ***uint32_t FLASH_OBProgramInitTypeDef::BootAddr0***
Boot base address when Boot pin = 0. This parameter can be a value of [FLASHEx_Boot_Address](#)
- ***uint32_t FLASH_OBProgramInitTypeDef::BootAddr1***
Boot base address when Boot pin = 1. This parameter can be a value of [FLASHEx_Boot_Address](#)

25.2 FLASHEx Firmware driver API description

25.2.1 Flash Extension features

Comparing to other previous devices, the FLASH interface for STM32F76xx/STM32F77xx devices contains the following additional features

- Capacity up to 2 Mbyte with dual bank architecture supporting read-while-write capability (RWW)
- Dual bank memory organization
- Dual boot mode

25.2.2 How to use this driver

This driver provides functions to configure and program the FLASH memory of all STM32F7xx devices. It includes

1. FLASH Memory Erase functions:
 - Lock and Unlock the FLASH interface using HAL_FLASH_Unlock() and HAL_FLASH_Lock() functions
 - Erase function: Erase sector, erase all sectors
 - There are two modes of erase :
 - Polling Mode using HAL_FLASHEx_Erase()
 - Interrupt Mode using HAL_FLASHEx_Erase_IT()
2. Option Bytes Programming functions: Use HAL_FLASHEx_OBProgram() to :
 - Set/Reset the write protection
 - Set the Read protection Level
 - Set the BOR level
 - Program the user Option Bytes

25.2.3 Extended programming operation functions

This subsection provides a set of functions allowing to manage the Extension FLASH programming operations Operations.

This section contains the following APIs:

- [HAL_FLASHEx_Erase\(\)](#)
- [HAL_FLASHEx_Erase_IT\(\)](#)
- [HAL_FLASHEx_OBProgram\(\)](#)
- [HAL_FLASHEx_OBGetConfig\(\)](#)

25.2.4 Detailed description of functions

HAL_FLASHEx_Erase

Function name	HAL_StatusTypeDef HAL_FLASHEx_Erase (FLASH_EraseInitTypeDef * pEraseInit, uint32_t * SectorError)
Function description	Perform a mass erase or erase the specified FLASH memory sectors.
Parameters	<ul style="list-style-type: none"> • pEraseInit: pointer to an FLASH_EraseInitTypeDef structure that contains the configuration information for the erasing. • SectorError: pointer to variable that contains the configuration information on faulty sector in case of error (0xFFFFFFFF means that all the sectors have been correctly erased)
Return values	<ul style="list-style-type: none"> • HAL: Status

HAL_FLASHEx_Erase_IT

Function name	HAL_StatusTypeDef HAL_FLASHEx_Erase_IT (FLASH_EraseInitTypeDef * pEraseInit)
Function description	Perform a mass erase or erase the specified FLASH memory sectors with interrupt enabled.
Parameters	<ul style="list-style-type: none"> • pEraseInit: pointer to an FLASH_EraseInitTypeDef structure that contains the configuration information for the erasing.
Return values	<ul style="list-style-type: none"> • HAL: Status

HAL_FLASHEx_OBProgram

Function name	HAL_StatusTypeDef HAL_FLASHEx_OBProgram (FLASH_OBProgramInitTypeDef * pOBInit)
Function description	Program option bytes.
Parameters	<ul style="list-style-type: none"> • pOBInit: pointer to an FLASH_OBInitStruct structure that contains the configuration information for the programming.
Return values	<ul style="list-style-type: none"> • HAL: Status

HAL_FLASHEx_OBGetConfig

Function name	void HAL_FLASHEx_OBGetConfig (FLASH_OBProgramInitTypeDef * pOBInit)
Function description	Get the Option byte configuration.
Parameters	<ul style="list-style-type: none"> • pOBInit: pointer to an FLASH_OBInitStruct structure that contains the configuration information for the programming.
Return values	<ul style="list-style-type: none"> • None:

FLASH_Erase_Sector

Function name	void FLASH_Erase_Sector (uint32_t Sector, uint8_t VoltageRange)
Function description	Erase the specified FLASH memory sector.
Parameters	<ul style="list-style-type: none"> • Sector: FLASH sector to erase The value of this parameter depend on device used within the same series • VoltageRange: The device voltage range which defines the erase parallelism. This parameter can be one of the following values: <ul style="list-style-type: none"> – FLASH_VOLTAGE_RANGE_1: when the device voltage range is 1.8V to 2.1V, the operation will be done by byte (8-bit) – FLASH_VOLTAGE_RANGE_2: when the device voltage range is 2.1V to 2.7V, the operation will be done by half word (16-bit) – FLASH_VOLTAGE_RANGE_3: when the device voltage range is 2.7V to 3.6V, the operation will be done by word (32-bit) – FLASH_VOLTAGE_RANGE_4: when the device voltage range is 2.7V to 3.6V + External Vpp, the operation will be done by double word (64-bit)
Return values	<ul style="list-style-type: none"> • None:

25.3 FLASHEx Firmware driver defines**25.3.1 FLASHEx****FLASH Banks**

FLASH_BANK_1	Bank 1
FLASH_BANK_2	Bank 2
FLASH_BANK_BOTH	Bank1 and Bank2

FLASH Boot Address

OB_BOOTADDR_ITCM_RAM	Boot from ITCM RAM (0x00000000)
OB_BOOTADDR_SYSTEM	Boot from System memory bootloader (0x00100000)
OB_BOOTADDR_ITCM_FLASH	Boot from Flash on ITCM interface (0x00200000)
OB_BOOTADDR_AXIM_FLASH	Boot from Flash on AXIM interface (0x08000000)
OB_BOOTADDR_DTCM_RAM	Boot from DTCM RAM (0x20000000)
OB_BOOTADDR_SRAM1	Boot from SRAM1 (0x20010000)
OB_BOOTADDR_SRAM2	Boot from SRAM2 (0x2004C000)

FLASH BOR Reset Level

OB_BOR_LEVEL3	Supply voltage ranges from 2.70 to 3.60 V
OB_BOR_LEVEL2	Supply voltage ranges from 2.40 to 2.70 V
OB_BOR_LEVEL1	Supply voltage ranges from 2.10 to 2.40 V
OB_BOR_OFF	Supply voltage ranges from 1.62 to 2.10 V

FLASH Private macros to check input parameters

IS_FLASH_TYPEERASE
IS_VOLTAGERANGE
IS_WRPSTATE
IS_OPTIONBYTE
IS_OB_BOOT_ADDRESS
IS_OB_RDP_LEVEL
IS_OB_WWDG_SOURCE
IS_OB_IWDG_SOURCE
IS_OB_STOP_SOURCE
IS_OB_STDBY_SOURCE
IS_OB_IWDG_STOP_FREEZE
IS_OB_IWDG_STDBY_FREEZE
IS_OB_BOR_LEVEL
IS_FLASH_LATENCY
IS_FLASH_ADDRESS
IS_FLASH_NBSECTORS
IS_FLASH_SECTOR
IS_OB_WRP_SECTOR
IS_OB_NDBANK
IS_FLASH_BANK
IS_OB_NDBOOT

FLASH Mass Erase bit

FLASH_MER_BIT 2 MER bits

FLASH Option Bytes IWatchdog

OB_IWDG_SW Software IWDG selected
OB_IWDG_HW Hardware IWDG selected

FLASH IWDG Counter Freeze in STANDBY

OB_IWDG_STDBY_FREEZE Freeze IWDG counter in STANDBY mode
OB_IWDG_STDBY_ACTIVE IWDG counter active in STANDBY mode

FLASH IWDG Counter Freeze in STOP

OB_IWDG_STOP_FREEZE Freeze IWDG counter in STOP mode
OB_IWDG_STOP_ACTIVE IWDG counter active in STOP mode

FLASH Single Bank or Dual Bank

OB_NDBANK_SINGLE_BANK NDBANK bit is set : Single Bank mode
OB_NDBANK_DUAL_BANK NDBANK bit is reset : Dual Bank mode

FLASH Option Bytes nDBOOT

OB_DUAL_BOOT_DISABLE

OB_DUAL_BOOT_ENABLE

FLASH Option Bytes nRST_STDBY

OB_STDBY_NO_RST No reset generated when entering in STANDBY

OB_STDBY_RST Reset generated when entering in STANDBY

FLASH Option Bytes nRST_STOP

OB_STOP_NO_RST No reset generated when entering in STOP

OB_STOP_RST Reset generated when entering in STOP

FLASH Option Bytes Read Protection

OB_RDP_LEVEL_0

OB_RDP_LEVEL_1

OB_RDP_LEVEL_2 Warning: When enabling read protection level 2 it s no more possible to go back to level 1 or 0

FLASH Option Bytes Write Protection

OB_WRP_SECTOR_0 Write protection of Single Bank Sector0

OB_WRP_SECTOR_1 Write protection of Single Bank Sector1

OB_WRP_SECTOR_2 Write protection of Single Bank Sector2

OB_WRP_SECTOR_3 Write protection of Single Bank Sector3

OB_WRP_SECTOR_4 Write protection of Single Bank Sector4

OB_WRP_SECTOR_5 Write protection of Single Bank Sector5

OB_WRP_SECTOR_6 Write protection of Single Bank Sector6

OB_WRP_SECTOR_7 Write protection of Single Bank Sector7

OB_WRP_SECTOR_8 Write protection of Single Bank Sector8

OB_WRP_SECTOR_9 Write protection of Single Bank Sector9

OB_WRP_SECTOR_10 Write protection of Single Bank Sector10

OB_WRP_SECTOR_11 Write protection of Single Bank Sector11

OB_WRP_SECTOR_All Write protection of all Sectors for Single Bank Flash

OB_WRP_DB_SECTOR_0 Write protection of Dual Bank Sector0

OB_WRP_DB_SECTOR_1 Write protection of Dual Bank Sector1

OB_WRP_DB_SECTOR_2 Write protection of Dual Bank Sector2

OB_WRP_DB_SECTOR_3 Write protection of Dual Bank Sector3

OB_WRP_DB_SECTOR_4 Write protection of Dual Bank Sector4

OB_WRP_DB_SECTOR_5 Write protection of Dual Bank Sector5

OB_WRP_DB_SECTOR_6 Write protection of Dual Bank Sector6

OB_WRP_DB_SECTOR_7 Write protection of Dual Bank Sector7

OB_WRP_DB_SECTOR_8 Write protection of Dual Bank Sector8

OB_WRP_DB_SECTOR_9 Write protection of Dual Bank Sector9

OB_WRP_DB_SECTOR_10	Write protection of Dual Bank Sector10
OB_WRP_DB_SECTOR_11	Write protection of Dual Bank Sector11
OB_WRP_DB_SECTOR_12	Write protection of Dual Bank Sector12
OB_WRP_DB_SECTOR_13	Write protection of Dual Bank Sector13
OB_WRP_DB_SECTOR_14	Write protection of Dual Bank Sector14
OB_WRP_DB_SECTOR_15	Write protection of Dual Bank Sector15
OB_WRP_DB_SECTOR_16	Write protection of Dual Bank Sector16
OB_WRP_DB_SECTOR_17	Write protection of Dual Bank Sector17
OB_WRP_DB_SECTOR_18	Write protection of Dual Bank Sector18
OB_WRP_DB_SECTOR_19	Write protection of Dual Bank Sector19
OB_WRP_DB_SECTOR_20	Write protection of Dual Bank Sector20
OB_WRP_DB_SECTOR_21	Write protection of Dual Bank Sector21
OB_WRP_DB_SECTOR_22	Write protection of Dual Bank Sector22
OB_WRP_DB_SECTOR_23	Write protection of Dual Bank Sector23
OB_WRP_DB_SECTOR_All	Write protection of all Sectors for Dual Bank Flash

FLASH Option Bytes WWatchdog

OB_WWDG_SW	Software WWDG selected
OB_WWDG_HW	Hardware WWDG selected

FLASH Option Type

OPTIONBYTE_WRP	WRP option byte configuration
OPTIONBYTE_RDP	RDP option byte configuration
OPTIONBYTE_USER	USER option byte configuration
OPTIONBYTE_BOR	BOR option byte configuration
OPTIONBYTE_BOOTADDR_0	Boot 0 Address configuration
OPTIONBYTE_BOOTADDR_1	Boot 1 Address configuration

FLASH Sectors

FLASH_SECTOR_8	Sector Number 8
FLASH_SECTOR_9	Sector Number 9
FLASH_SECTOR_10	Sector Number 10
FLASH_SECTOR_11	Sector Number 11
FLASH_SECTOR_12	Sector Number 12
FLASH_SECTOR_13	Sector Number 13
FLASH_SECTOR_14	Sector Number 14
FLASH_SECTOR_15	Sector Number 15
FLASH_SECTOR_16	Sector Number 16
FLASH_SECTOR_17	Sector Number 17

FLASH_SECTOR_18 Sector Number 18
FLASH_SECTOR_19 Sector Number 19
FLASH_SECTOR_20 Sector Number 20
FLASH_SECTOR_21 Sector Number 21
FLASH_SECTOR_22 Sector Number 22
FLASH_SECTOR_23 Sector Number 23

FLASH Type Erase

FLASH_TYPEERASE_SECTORS Sectors erase only
FLASH_TYPEERASE_MASSERASE Flash Mass erase activation

FLASH Voltage Range

FLASH_VOLTAGE_RANGE_1 Device operating range: 1.8V to 2.1V
FLASH_VOLTAGE_RANGE_2 Device operating range: 2.1V to 2.7V
FLASH_VOLTAGE_RANGE_3 Device operating range: 2.7V to 3.6V
FLASH_VOLTAGE_RANGE_4 Device operating range: 2.7V to 3.6V + External Vpp

FLASH WRP State

OB_WRPSTATE_DISABLE Disable the write protection of the desired bank 1 sectors
OB_WRPSTATE_ENABLE Enable the write protection of the desired bank 1 sectors

26 HAL GPIO Generic Driver

26.1 GPIO Firmware driver registers structures

26.1.1 GPIO_InitTypeDef

Data Fields

- *uint32_t Pin*
- *uint32_t Mode*
- *uint32_t Pull*
- *uint32_t Speed*
- *uint32_t Alternate*

Field Documentation

- *uint32_t GPIO_InitTypeDef::Pin*
Specifies the GPIO pins to be configured. This parameter can be any value of [GPIO_pins_define](#)
- *uint32_t GPIO_InitTypeDef::Mode*
Specifies the operating mode for the selected pins. This parameter can be a value of [GPIO_mode_define](#)
- *uint32_t GPIO_InitTypeDef::Pull*
Specifies the Pull-up or Pull-Down activation for the selected pins. This parameter can be a value of [GPIO_pull_define](#)
- *uint32_t GPIO_InitTypeDef::Speed*
Specifies the speed for the selected pins. This parameter can be a value of [GPIO_speed_define](#)
- *uint32_t GPIO_InitTypeDef::Alternate*
Peripheral to be connected to the selected pins. This parameter can be a value of [GPIO_Alternate_function_selection](#)

26.2 GPIO Firmware driver API description

26.2.1 GPIO Peripheral features

Subject to the specific hardware characteristics of each I/O port listed in the datasheet, each port bit of the General Purpose IO (GPIO) Ports, can be individually configured by software in several modes:

- Input mode
- Analog mode
- Output mode
- Alternate function mode
- External interrupt/event lines

During and just after reset, the alternate functions and external interrupt lines are not active and the I/O ports are configured in input floating mode.

All GPIO pins have weak internal pull-up and pull-down resistors, which can be activated or not.

In Output or Alternate mode, each IO can be configured on open-drain or push-pull type and the IO speed can be selected depending on the VDD value.

All ports have external interrupt/event capability. To use external interrupt lines, the port must be configured in input mode. All available GPIO pins are connected to the 16 external interrupt/event lines from EXTI0 to EXTI15.

The external interrupt/event controller consists of up to 23 edge detectors (16 lines are connected to GPIO) for generating event/interrupt requests (each input line can be independently configured to select the type (interrupt or event) and the corresponding trigger event (rising or falling or both). Each line can also be masked independently.

26.2.2 How to use this driver

1. Enable the GPIO AHB clock using the following function:
`__HAL_RCC_GPIOx_CLK_ENABLE()`.
2. Configure the GPIO pin(s) using `HAL_GPIO_Init()`.
 - Configure the IO mode using "Mode" member from `GPIO_InitTypeDef` structure
 - Activate Pull-up, Pull-down resistor using "Pull" member from `GPIO_InitTypeDef` structure.
 - In case of Output or alternate function mode selection: the speed is configured through "Speed" member from `GPIO_InitTypeDef` structure.
 - In alternate mode is selection, the alternate function connected to the IO is configured through "Alternate" member from `GPIO_InitTypeDef` structure.
 - Analog mode is required when a pin is to be used as ADC channel or DAC output.
 - In case of external interrupt/event selection the "Mode" member from `GPIO_InitTypeDef` structure select the type (interrupt or event) and the corresponding trigger event (rising or falling or both).
3. In case of external interrupt/event mode selection, configure NVIC IRQ priority mapped to the EXTI line using `HAL_NVIC_SetPriority()` and enable it using `HAL_NVIC_EnableIRQ()`.
4. To get the level of a pin configured in input mode use `HAL_GPIO_ReadPin()`.
5. To set/reset the level of a pin configured in output mode use `HAL_GPIO_WritePin()/HAL_GPIO_TogglePin()`.
6. To lock pin configuration until next reset use `HAL_GPIO_LockPin()`.
7. During and just after reset, the alternate functions are not active and the GPIO pins are configured in input floating mode (except JTAG pins).
8. The LSE oscillator pins `OSC32_IN` and `OSC32_OUT` can be used as general purpose (PC14 and PC15, respectively) when the LSE oscillator is off. The LSE has priority over the GPIO function.
9. The HSE oscillator pins `OSC_IN/OSC_OUT` can be used as general purpose PH0 and PH1, respectively, when the HSE oscillator is off. The HSE has priority over the GPIO function.

26.2.3 Initialization and de-initialization functions

This section provides functions allowing to initialize and de-initialize the GPIOs to be ready for use.

This section contains the following APIs:

- [`HAL_GPIO_Init\(\)`](#)
- [`HAL_GPIO_DeInit\(\)`](#)

26.2.4 IO operation functions

This section contains the following APIs:

- [`HAL_GPIO_ReadPin\(\)`](#)
- [`HAL_GPIO_WritePin\(\)`](#)

- [HAL_GPIO_TogglePin\(\)](#)
- [HAL_GPIO_LockPin\(\)](#)
- [HAL_GPIO_EXTI_IRQHandler\(\)](#)
- [HAL_GPIO_EXTI_Callback\(\)](#)

26.2.5 Detailed description of functions

HAL_GPIO_Init

Function name	void HAL_GPIO_Init (GPIO_TypeDef * GPIOx, GPIO_InitTypeDef * GPIO_Init)
Function description	Initializes the GPIOx peripheral according to the specified parameters in the GPIO_Init.
Parameters	<ul style="list-style-type: none"> • GPIOx: where x can be (A..K) to select the GPIO peripheral. • GPIO_Init: pointer to a GPIO_InitTypeDef structure that contains the configuration information for the specified GPIO peripheral.
Return values	<ul style="list-style-type: none"> • None:

HAL_GPIO_DeInit

Function name	void HAL_GPIO_DeInit (GPIO_TypeDef * GPIOx, uint32_t GPIO_Pin)
Function description	De-initializes the GPIOx peripheral registers to their default reset values.
Parameters	<ul style="list-style-type: none"> • GPIOx: where x can be (A..K) to select the GPIO peripheral. • GPIO_Pin: specifies the port bit to be written. This parameter can be one of GPIO_PIN_x where x can be (0..15).
Return values	<ul style="list-style-type: none"> • None:

HAL_GPIO_ReadPin

Function name	GPIO_PinState HAL_GPIO_ReadPin (GPIO_TypeDef * GPIOx, uint16_t GPIO_Pin)
Function description	Reads the specified input port pin.
Parameters	<ul style="list-style-type: none"> • GPIOx: where x can be (A..K) to select the GPIO peripheral. • GPIO_Pin: specifies the port bit to read. This parameter can be GPIO_PIN_x where x can be (0..15).
Return values	<ul style="list-style-type: none"> • The: input port pin value.

HAL_GPIO_WritePin

Function name	void HAL_GPIO_WritePin (GPIO_TypeDef * GPIOx, uint16_t GPIO_Pin, GPIO_PinState PinState)
Function description	Sets or clears the selected data port bit.
Parameters	<ul style="list-style-type: none"> • GPIOx: where x can be (A..K) to select the GPIO peripheral. • GPIO_Pin: specifies the port bit to be written. This parameter can be one of GPIO_PIN_x where x can be (0..15). • PinState: specifies the value to be written to the selected bit.

This parameter can be one of the GPIO_PinState enum values:

- GPIO_PIN_RESET: to clear the port pin
- GPIO_PIN_SET: to set the port pin

Return values

- **None:**

Notes

- This function uses GPIOx_BSRR register to allow atomic read/modify accesses. In this way, there is no risk of an IRQ occurring between the read and the modify access.

HAL_GPIO_TogglePin

Function name **void HAL_GPIO_TogglePin (GPIO_TypeDef * GPIOx, uint16_t GPIO_Pin)**

Function description Toggles the specified GPIO pins.

Parameters

- **GPIOx:** Where x can be (A..I) to select the GPIO peripheral.
- **GPIO_Pin:** Specifies the pins to be toggled.

Return values

- **None:**

HAL_GPIO_LockPin

Function name **HAL_StatusTypeDef HAL_GPIO_LockPin (GPIO_TypeDef * GPIOx, uint16_t GPIO_Pin)**

Function description Locks GPIO Pins configuration registers.

Parameters

- **GPIOx:** where x can be (A..F) to select the GPIO peripheral for STM32F7 family
- **GPIO_Pin:** specifies the port bit to be locked. This parameter can be any combination of GPIO_PIN_x where x can be (0..15).

Return values

- **None:**

Notes

- The locked registers are GPIOx_MODER, GPIOx_OTYPER, GPIOx_OSPEEDR, GPIOx_PUPDR, GPIOx_AFR1 and GPIOx_AFR2.
- The configuration of the locked GPIO pins can no longer be modified until the next reset.

HAL_GPIO_EXTI_IRQHandler

Function name **void HAL_GPIO_EXTI_IRQHandler (uint16_t GPIO_Pin)**

Function description This function handles EXTI interrupt request.

Parameters

- **GPIO_Pin:** Specifies the pins connected EXTI line

Return values

- **None:**

HAL_GPIO_EXTI_Callback

Function name **void HAL_GPIO_EXTI_Callback (uint16_t GPIO_Pin)**

Function description EXTI line detection callbacks.

Parameters	• GPIO_Pin: Specifies the pins connected EXTI line
Return values	• None:

26.3 GPIO Firmware driver defines

26.3.1 GPIO

GPIO Alternate Function Selection

GPIO_AF0_RTC_50Hz
GPIO_AF0_MCO
GPIO_AF0_SWJ
GPIO_AF0_TRACE
GPIO_AF1_TIM1
GPIO_AF1_TIM2
GPIO_AF1_UART5
GPIO_AF1_I2C4
GPIO_AF2_TIM3
GPIO_AF2_TIM4
GPIO_AF2_TIM5
GPIO_AF3_TIM8
GPIO_AF3_TIM9
GPIO_AF3_TIM10
GPIO_AF3_TIM11
GPIO_AF3_LPTIM1
GPIO_AF3_CEC
GPIO_AF3_DFSDM1
GPIO_AF4_I2C1
GPIO_AF4_I2C2
GPIO_AF4_I2C3
GPIO_AF4_I2C4
GPIO_AF4_CEC
GPIO_AF4_USART1
GPIO_AF5_SPI1
GPIO_AF5_SPI2
GPIO_AF5_SPI3
GPIO_AF5_SPI4
GPIO_AF5_SPI5
GPIO_AF5_SPI6

GPIO_AF6_SPI3
GPIO_AF6_SAI1
GPIO_AF6_UART4
GPIO_AF6_DFSDM1
GPIO_AF7_USART1
GPIO_AF7_USART2
GPIO_AF7_USART3
GPIO_AF7_UART5
GPIO_AF7_SPDIFRX
GPIO_AF7_SPI2
GPIO_AF7_SPI3
GPIO_AF7_SPI6
GPIO_AF7_DFSDM1
GPIO_AF8_UART4
GPIO_AF8_UART5
GPIO_AF8_USART6
GPIO_AF8_UART7
GPIO_AF8_UART8
GPIO_AF8_SPDIFRX
GPIO_AF8_SAI2
GPIO_AF8_SPI6
GPIO_AF9_CAN1
GPIO_AF9_CAN2
GPIO_AF9_TIM12
GPIO_AF9_TIM13
GPIO_AF9_TIM14
GPIO_AF9_QUADSPI
GPIO_AF9_LTDC
GPIO_AF9_FMC
GPIO_AF10_OTG_FS
GPIO_AF10_OTG_HS
GPIO_AF10_QUADSPI
GPIO_AF10_SAI2
GPIO_AF10_DFSDM1
GPIO_AF10_SDMMC2
GPIO_AF10_LTDC

GPIO_AF11_ETH
 GPIO_AF11_CAN3
 GPIO_AF11_SDMMC2
 GPIO_AF11_I2C4
 GPIO_AF12_FMC
 GPIO_AF12_OTG_HS_FS
 GPIO_AF12_SDMMC1
 GPIO_AF12_MDIOS
 GPIO_AF12_UART7
 GPIO_AF13_DCMI
 GPIO_AF13_DSI
 GPIO_AF13_LTDC
 GPIO_AF14_LTDC
 GPIO_AF15_EVENTOUT

GPIO Exported Macros

`__HAL_GPIO_EXTI_GET_FLAG`

Description:

- Checks whether the specified EXTI line flag is set or not.

Parameters:

- `__EXTI_LINE__`: specifies the EXTI line flag to check. This parameter can be `GPIO_PIN_x` where x can be(0..15)

Return value:

- The: new state of `__EXTI_LINE__` (SET or RESET).

`__HAL_GPIO_EXTI_CLEAR_FLAG`

Description:

- Clears the EXTI's line pending flags.

Parameters:

- `__EXTI_LINE__`: specifies the EXTI lines flags to clear. This parameter can be any combination of `GPIO_PIN_x` where x can be (0..15)

Return value:

- None

`__HAL_GPIO_EXTI_GET_IT`

Description:

- Checks whether the specified EXTI line is asserted or not.

Parameters:

- `__EXTI_LINE__`: specifies the EXTI line to

check. This parameter can be
GPIO_PIN_x where x can be(0..15)

Return value:

- The: new state of __EXTI_LINE__ (SET or RESET).

Description:

- Clears the EXTI's line pending bits.

Parameters:

- __EXTI_LINE__: specifies the EXTI lines to clear. This parameter can be any combination of GPIO_PIN_x where x can be (0..15)

Return value:

- None

__HAL_GPIO_EXTI_CLEAR_IT

__HAL_GPIO_EXTI_GENERATE_SWIT

Description:

- Generates a Software interrupt on selected EXTI line.

Parameters:

- __EXTI_LINE__: specifies the EXTI line to check. This parameter can be GPIO_PIN_x where x can be(0..15)

Return value:

- None

GPIO mode define

GPIO_MODE_INPUT

Input Floating Mode

GPIO_MODE_OUTPUT_PP

Output Push Pull Mode

GPIO_MODE_OUTPUT_OD

Output Open Drain Mode

GPIO_MODE_AF_PP

Alternate Function Push Pull Mode

GPIO_MODE_AF_OD

Alternate Function Open Drain Mode

GPIO_MODE_ANALOG

Analog Mode

GPIO_MODE_IT_RISING

External Interrupt Mode with Rising edge trigger detection

GPIO_MODE_IT_FALLING

External Interrupt Mode with Falling edge trigger detection

GPIO_MODE_IT_RISING_FALLING

External Interrupt Mode with Rising/Falling edge trigger detection

GPIO_MODE_EVT_RISING

External Event Mode with Rising edge trigger detection

GPIO_MODE_EVT_FALLING

External Event Mode with Falling edge trigger detection

GPIO_MODE_EVT_RISING_FALLING

External Event Mode with Rising/Falling edge

trigger detection

GPIO pins define

GPIO_PIN_0

GPIO_PIN_1

GPIO_PIN_2

GPIO_PIN_3

GPIO_PIN_4

GPIO_PIN_5

GPIO_PIN_6

GPIO_PIN_7

GPIO_PIN_8

GPIO_PIN_9

GPIO_PIN_10

GPIO_PIN_11

GPIO_PIN_12

GPIO_PIN_13

GPIO_PIN_14

GPIO_PIN_15

GPIO_PIN_All

GPIO_PIN_MASK

GPIO pull define

GPIO_NOPULL No Pull-up or Pull-down activation

GPIO_PULLUP Pull-up activation

GPIO_PULLDOWN Pull-down activation

GPIO speed define

GPIO_SPEED_FREQ_LOW Low speed

GPIO_SPEED_FREQ_MEDIUM Medium speed

GPIO_SPEED_FREQ_HIGH Fast speed

GPIO_SPEED_FREQ_VERY_HIGH High speed

27 HAL GPIO Extension Driver

27.1 GPIOEx Firmware driver defines

27.1.1 GPIOEx

GPIO Get Port Index

GPIO_GET_INDEX

GPIO Check Alternate Function

IS_GPIO_AF

28 HAL HASH Generic Driver

28.1 HASH Firmware driver registers structures

28.1.1 HASH_InitTypeDef

Data Fields

- *uint32_t* **DataType**
- *uint32_t* **KeySize**
- *uint8_t ** **pKey**

Field Documentation

- *uint32_t* **HASH_InitTypeDef::DataType**
32-bit data, 16-bit data, 8-bit data or 1-bit string. This parameter can be a value of [HASH_Data_Type](#)
- *uint32_t* **HASH_InitTypeDef::KeySize**
The key size is used only in HMAC operation
- *uint8_t ** **HASH_InitTypeDef::pKey**
The key is used only in HMAC operation

28.1.2 HASH_HandleTypeDef

Data Fields

- **HASH_InitTypeDef** *Init*
- *uint8_t ** **pHashInBuffPtr**
- *uint8_t ** **pHashOutBuffPtr**
- *__IO uint32_t* **HashBuffSize**
- *__IO uint32_t* **HashInCount**
- *__IO uint32_t* **HashITCounter**
- **HAL_StatusTypeDef** *Status*
- **HAL_HASH_PhaseTypeDef** *Phase*
- **DMA_HandleTypeDef *** *hdmain*
- **HAL_LockTypeDef** *Lock*
- *__IO HAL_HASH_StateTypeDef* **State**

Field Documentation

- **HASH_InitTypeDef** **HASH_HandleTypeDef::Init**
HASH required parameters
- *uint8_t ** **HASH_HandleTypeDef::pHashInBuffPtr**
Pointer to input buffer
- *uint8_t ** **HASH_HandleTypeDef::pHashOutBuffPtr**
Pointer to input buffer
- *__IO uint32_t* **HASH_HandleTypeDef::HashBuffSize**
Size of buffer to be processed
- *__IO uint32_t* **HASH_HandleTypeDef::HashInCount**
Counter of inputted data
- *__IO uint32_t* **HASH_HandleTypeDef::HashITCounter**
Counter of issued interrupts
- **HAL_StatusTypeDef** **HASH_HandleTypeDef::Status**
HASH peripheral status

- **HAL_HASH_PhaseTypeDef HASH_HandleTypeDef::Phase**
HASH peripheral phase
- **DMA_HandleTypeDef* HASH_HandleTypeDef::hdmain**
HASH In DMA handle parameters
- **HAL_LockTypeDef HASH_HandleTypeDef::Lock**
HASH locking object
- **__IO HAL_HASH_StateTypeDef HASH_HandleTypeDef::State**
HASH peripheral state

28.2 HASH Firmware driver API description

28.2.1 How to use this driver

The HASH HAL driver can be used as follows:

1. Initialize the HASH low level resources by implementing the HAL_HASH_MspInit():
 - a. Enable the HASH interface clock using `__HAL_RCC_HASH_CLK_ENABLE()`
 - b. In case of using processing APIs based on interrupts (e.g. `HAL_HMAC_SHA1_Start_IT()`)
 - Configure the HASH interrupt priority using `HAL_NVIC_SetPriority()`
 - Enable the HASH IRQ handler using `HAL_NVIC_EnableIRQ()`
 - In HASH IRQ handler, call `HAL_HASH_IRQHandler()`
 - c. In case of using DMA to control data transfer (e.g. `HAL_HMAC_SHA1_Start_DMA()`)
 - Enable the DMAx interface clock using `__DMAx_CLK_ENABLE()`
 - Configure and enable one DMA stream one for managing data transfer from memory to peripheral (input stream). Managing data transfer from peripheral to memory can be performed only using CPU
 - Associate the initialized DMA handle to the HASH DMA handle using `__HAL_LINKDMA()`
 - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Stream using `HAL_NVIC_SetPriority()` and `HAL_NVIC_EnableIRQ()`
2. Initialize the HASH HAL using `HAL_HASH_Init()`. This function configures mainly:
 - a. The data type: 1-bit, 8-bit, 16-bit and 32-bit.
 - b. For HMAC, the encryption key.
 - c. For HMAC, the key size used for encryption.
3. Three processing functions are available:
 - a. Polling mode: processing APIs are blocking functions i.e. they process the data and wait till the digest computation is finished e.g. `HAL_HASH_SHA1_Start()`
 - b. Interrupt mode: encryption and decryption APIs are not blocking functions i.e. they process the data under interrupt e.g. `HAL_HASH_SHA1_Start_IT()`
 - c. DMA mode: processing APIs are not blocking functions and the CPU is not used for data transfer i.e. the data transfer is ensured by DMA e.g. `HAL_HASH_SHA1_Start_DMA()`
4. When the processing function is called at first time after `HAL_HASH_Init()` the HASH peripheral is initialized and processes the buffer in input. After that, the digest computation is started. When processing multi-buffer use the accumulate function to write the data in the peripheral without starting the digest computation. In last buffer use the start function to input the last buffer and start the digest computation.
 - a. e.g. `HAL_HASH_SHA1_Accumulate()` : write 1st data buffer in the peripheral without starting the digest computation
 - b. write (n-1)th data buffer in the peripheral without starting the digest computation
 - c. `HAL_HASH_SHA1_Start()` : write (n)th data buffer in the peripheral and start the digest computation

5. In HMAC mode, there is no Accumulate API. Only Start API is available.
6. In case of using DMA, call the DMA start processing e.g. `HAL_HASH_SHA1_Start_DMA()`. After that, call the finish function in order to get the digest value e.g. `HAL_HASH_SHA1_Finish()`
7. Call `HAL_HASH_DeInit()` to deinitialize the HASH peripheral.

28.2.2 HASH processing using polling mode functions

This section provides functions allowing to calculate in polling mode the hash value using one of the following algorithms:

- MD5
- SHA1

This section contains the following APIs:

- [*HAL_HASH_MD5_Start\(\)*](#)
- [*HAL_HASH_MD5_Accumulate\(\)*](#)
- [*HAL_HASH_SHA1_Start\(\)*](#)
- [*HAL_HASH_SHA1_Accumulate\(\)*](#)

28.2.3 HASH processing using interrupt mode functions

This section provides functions allowing to calculate in interrupt mode the hash value using one of the following algorithms:

- MD5
- SHA1

This section contains the following APIs:

- [*HAL_HASH_MD5_Start_IT\(\)*](#)
- [*HAL_HASH_SHA1_Start_IT\(\)*](#)
- [*HAL_HASH_IRQHandler\(\)*](#)
- [*HAL_HMAC_SHA1_Start\(\)*](#)
- [*HAL_HMAC_MD5_Start\(\)*](#)

28.2.4 HASH processing using DMA mode functions

This section provides functions allowing to calculate in DMA mode the hash value using one of the following algorithms:

- MD5
- SHA1

This section contains the following APIs:

- [*HAL_HASH_MD5_Start_DMA\(\)*](#)
- [*HAL_HASH_MD5_Finish\(\)*](#)
- [*HAL_HASH_SHA1_Start_DMA\(\)*](#)
- [*HAL_HASH_SHA1_Finish\(\)*](#)
- [*HAL_HASH_SHA1_Start_IT\(\)*](#)
- [*HAL_HASH_MD5_Start_IT\(\)*](#)

28.2.5 HMAC processing using polling mode functions

This section provides functions allowing to calculate in polling mode the HMAC value using one of the following algorithms:

- MD5
- SHA1

This section contains the following APIs:

- [HAL_HMAC_MD5_Start\(\)](#)
- [HAL_HMAC_SHA1_Start\(\)](#)
- [HAL_HASH_SHA1_Start_DMA\(\)](#)
- [HAL_HASH_SHA1_Finish\(\)](#)
- [HAL_HASH_MD5_Start_DMA\(\)](#)
- [HAL_HASH_MD5_Finish\(\)](#)

28.2.6 HMAC processing using DMA mode functions

This section provides functions allowing to calculate in DMA mode the HMAC value using one of the following algorithms:

- MD5
- SHA1

This section contains the following APIs:

- [HAL_HMAC_MD5_Start_DMA\(\)](#)
- [HAL_HMAC_SHA1_Start_DMA\(\)](#)

28.2.7 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral.

This section contains the following APIs:

- [HAL_HASH_GetState\(\)](#)
- [HAL_HASH_IRQHandler\(\)](#)

28.2.8 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the HASH according to the specified parameters in the HASH_InitTypeDef and creates the associated handle.
- Deinitialize the HASH peripheral.
- Initialize the HASH MSP.
- Deinitialize HASH MSP.

This section contains the following APIs:

- [HAL_HASH_Init\(\)](#)
- [HAL_HASH_DeInit\(\)](#)
- [HAL_HASH_MspInit\(\)](#)
- [HAL_HASH_MspDeInit\(\)](#)
- [HAL_HASH_InCpltCallback\(\)](#)
- [HAL_HASH_ErrorCallback\(\)](#)
- [HAL_HASH_DgstCpltCallback\(\)](#)

28.2.9 Detailed description of functions

HAL_HASH_Init

Function name	HAL_StatusTypeDef HAL_HASH_Init (HASH_HandleTypeDef * hhash)
Function description	Initializes the HASH according to the specified parameters in the HASH_HandleTypeDef and creates the associated handle.

- | | |
|---------------|---|
| Parameters | <ul style="list-style-type: none"> • hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_HASH_DeInit

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_HASH_DeInit (HASH_HandleTypeDef * hhash) |
| Function description | Deinitializes the HASH peripheral. |
| Parameters | <ul style="list-style-type: none"> • hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module |
| Return values | <ul style="list-style-type: none"> • HAL: status |
| Notes | <ul style="list-style-type: none"> • This API must be called before starting a new processing. |

HAL_HASH_SHA1_Start

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_HASH_SHA1_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout) |
| Function description | Initializes the HASH peripheral in SHA1 mode then processes pInBuffer. |
| Parameters | <ul style="list-style-type: none"> • hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module • pInBuffer: Pointer to the input buffer (buffer to be hashed). • Size: Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware. • pOutBuffer: Pointer to the computed digest. Its size must be 20 bytes. • Timeout: Timeout value |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_HASH_MD5_Start

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_HASH_MD5_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout) |
| Function description | Initializes the HASH peripheral in MD5 mode then processes pInBuffer. |
| Parameters | <ul style="list-style-type: none"> • hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module • pInBuffer: Pointer to the input buffer (buffer to be hashed). • Size: Length of the input buffer in bytes. If the Size is multiple of 64 bytes, appending the input buffer is possible. If the Size is not multiple of 64 bytes, the padding is managed by hardware and appending the input buffer is no more possible. • pOutBuffer: Pointer to the computed digest. Its size must be 16 bytes. • Timeout: Timeout value |

Return values

- **HAL:** status

HAL_HASH_MD5_Accumulate

Function name **HAL_StatusTypeDef HAL_HASH_MD5_Accumulate (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)**

Function description Initializes the HASH peripheral in MD5 mode then writes the pInBuffer.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
- **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
- **Size:** Length of the input buffer in bytes. If the Size is multiple of 64 bytes, appending the input buffer is possible. If the Size is not multiple of 64 bytes, the padding is managed by hardware and appending the input buffer is no more possible.

Return values

- **HAL:** status

HAL_HASH_SHA1_Accumulate

Function name **HAL_StatusTypeDef HAL_HASH_SHA1_Accumulate (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)**

Function description Initializes the HASH peripheral in SHA1 mode then processes pInBuffer.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
- **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
- **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.

Return values

- **HAL:** status

Notes

- Input buffer size in bytes must be a multiple of 4 otherwise the digest computation is corrupted.

HAL_HMAC_SHA1_Start

Function name **HAL_StatusTypeDef HAL_HMAC_SHA1_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)**

Function description Initializes the HASH peripheral in HMAC SHA1 mode then processes pInBuffer.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
- **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
- **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
- **pOutBuffer:** Pointer to the computed digest. Its size must be 20 bytes.
- **Timeout:** Timeout value

Return values

- **HAL:** status

HAL_HMAC_MD5_Start

Function name **HAL_StatusTypeDef HAL_HMAC_MD5_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)**

Function description Initializes the HASH peripheral in HMAC MD5 mode then processes pInBuffer.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
- **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
- **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
- **pOutBuffer:** Pointer to the computed digest. Its size must be 20 bytes.
- **Timeout:** Timeout value

Return values

- **HAL:** status

HAL_HASH_SHA1_Start_IT

Function name **HAL_StatusTypeDef HAL_HASH_SHA1_Start_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)**

Function description Initializes the HASH peripheral in SHA1 mode then processes pInBuffer.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
- **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
- **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
- **pOutBuffer:** Pointer to the computed digest. Its size must be 20 bytes.

Return values

- **HAL:** status

HAL_HASH_MD5_Start_IT

Function name **HAL_StatusTypeDef HAL_HASH_MD5_Start_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)**

Function description Initializes the HASH peripheral in MD5 mode then processes pInBuffer.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
- **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
- **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
- **pOutBuffer:** Pointer to the computed digest. Its size must be 16 bytes.

Return values

- **HAL:** status

HAL_HASH_SHA1_Start_DMA

Function name **HAL_StatusTypeDef HAL_HASH_SHA1_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)**

Function description Initializes the HASH peripheral in SHA1 mode then enables DMA to control data transfer.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
- **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
- **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.

Return values

- **HAL:** status

HAL_HASH_SHA1_Finish

Function name **HAL_StatusTypeDef HAL_HASH_SHA1_Finish (HASH_HandleTypeDef * hhash, uint8_t * pOutBuffer, uint32_t Timeout)**

Function description Returns the computed digest in SHA1 mode.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
- **pOutBuffer:** Pointer to the computed digest. Its size must be 20 bytes.
- **Timeout:** Timeout value

Return values

- **HAL:** status

HAL_HASH_MD5_Start_DMA

Function name **HAL_StatusTypeDef HAL_HASH_MD5_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)**

Function description Initializes the HASH peripheral in MD5 mode then enables DMA to control data transfer.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
- **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
- **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.

Return values

- **HAL:** status

HAL_HASH_MD5_Finish

Function name **HAL_StatusTypeDef HAL_HASH_MD5_Finish (HASH_HandleTypeDef * hhash, uint8_t * pOutBuffer, uint32_t Timeout)**

Function description	Returns the computed digest in MD5 mode.
Parameters	<ul style="list-style-type: none">• hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module• pOutBuffer: Pointer to the computed digest. Its size must be 16 bytes.• Timeout: Timeout value
Return values	<ul style="list-style-type: none">• HAL: status

HAL_HMAC_SHA1_Start_DMA

Function name	HAL_StatusTypeDef HAL_HMAC_SHA1_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)
Function description	Initializes the HASH peripheral in HMAC SHA1 mode then enables DMA to control data transfer.
Parameters	<ul style="list-style-type: none">• hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module• pInBuffer: Pointer to the input buffer (buffer to be hashed).• Size: Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_HMAC_MD5_Start_DMA

Function name	HAL_StatusTypeDef HAL_HMAC_MD5_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)
Function description	Initializes the HASH peripheral in HMAC MD5 mode then enables DMA to control data transfer.
Parameters	<ul style="list-style-type: none">• hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module• pInBuffer: Pointer to the input buffer (buffer to be hashed).• Size: Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_HASH_IRQHandler

Function name	void HAL_HASH_IRQHandler (HASH_HandleTypeDef * hhash)
Function description	This function handles HASH interrupt request.
Parameters	<ul style="list-style-type: none">• hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
Return values	<ul style="list-style-type: none">• None:

HAL_HASH_GetState

Function name	HAL_HASH_StateTypeDef HAL_HASH_GetState (HASH_HandleTypeDef * hhash)
---------------	---

Function description	return the HASH state
Parameters	<ul style="list-style-type: none"> • hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
Return values	<ul style="list-style-type: none"> • HAL: state

HAL_HASH_MspInit

Function name	void HAL_HASH_MspInit (HASH_HandleTypeDef * hhash)
Function description	Initializes the HASH MSP.
Parameters	<ul style="list-style-type: none"> • hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
Return values	<ul style="list-style-type: none"> • None:

HAL_HASH_MspDeInit

Function name	void HAL_HASH_MspDeInit (HASH_HandleTypeDef * hhash)
Function description	DeInitializes HASH MSP.
Parameters	<ul style="list-style-type: none"> • hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
Return values	<ul style="list-style-type: none"> • None:

HAL_HASH_InCpltCallback

Function name	void HAL_HASH_InCpltCallback (HASH_HandleTypeDef * hhash)
Function description	Input data transfer complete callback.
Parameters	<ul style="list-style-type: none"> • hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
Return values	<ul style="list-style-type: none"> • None:

HAL_HASH_DgstCpltCallback

Function name	void HAL_HASH_DgstCpltCallback (HASH_HandleTypeDef * hhash)
Function description	Digest computation complete callback.
Parameters	<ul style="list-style-type: none"> • hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This callback is not relevant with DMA.

HAL_HASH_ErrorCallback

Function name	void HAL_HASH_ErrorCallback (HASH_HandleTypeDef * hhash)
Function description	Data transfer Error callback.

Parameters	<ul style="list-style-type: none"> • hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
Return values	<ul style="list-style-type: none"> • None:

28.3 HASH Firmware driver defines

28.3.1 HASH

HASH Data Type

HASH_DATATYPE_32B	32-bit data. No swapping
HASH_DATATYPE_16B	16-bit data. Each half word is swapped
HASH_DATATYPE_8B	8-bit data. All bytes are swapped
HASH_DATATYPE_1B	1-bit data. In the word all bits are swapped

HASH Algorithm Selection

HASH_ALGOSELECTION_SHA1	HASH function is SHA1
HASH_ALGOSELECTION_SHA224	HASH function is SHA224
HASH_ALGOSELECTION_SHA256	HASH function is SHA256
HASH_ALGOSELECTION_MD5	HASH function is MD5

HASH Algorithm Mode

HASH_ALGOMODE_HASH	Algorithm is HASH
HASH_ALGOMODE_HMAC	Algorithm is HMAC

HASH HMAC Long key

HASH_HMAC_KEYTYPE_SHORTKEY	HMAC Key is <= 64 bytes
HASH_HMAC_KEYTYPE_LONGKEY	HMAC Key is > 64 bytes

HASH Flags definition

HASH_FLAG_DINIS	16 locations are free in the DIN : A new block can be entered into the input buffer
HASH_FLAG_DCIS	Digest calculation complete
HASH_FLAG_DMAS	DMA interface is enabled (DMAE=1) or a transfer is ongoing
HASH_FLAG_BUSY	The hash core is Busy : processing a block of data
HASH_FLAG_DINNE	DIN not empty : The input buffer contains at least one word of data

HASH Interrupts definition

HASH_IT_DINI	A new block can be entered into the input buffer (DIN)
HASH_IT_DCI	Digest calculation complete

HASH Exported Macros

<code>__HAL_HASH_RESET_HANDLE_STATE</code>	Description: <ul style="list-style-type: none"> • Reset HASH handle state. Parameters: <ul style="list-style-type: none"> • <code>__HANDLE__</code>: specifies the HASH
--	---

<p>__HAL_HASH_GET_FLAG</p>	<p>handle.</p> <p>Return value:</p> <ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Check whether the specified HASH flag is set or not. <p>Parameters:</p> <ul style="list-style-type: none"> • __FLAG__: specifies the flag to check. This parameter can be one of the following values: <ul style="list-style-type: none"> – HASH_FLAG_DINIS: A new block can be entered into the input buffer. – HASH_FLAG_DCIS: Digest calculation complete – HASH_FLAG_DMAS: DMA interface is enabled (DMAE=1) or a transfer is ongoing – HASH_FLAG_BUSY: The hash core is Busy : processing a block of data – HASH_FLAG_DINNE: DIN not empty : The input buffer contains at least one word of data <p>Return value:</p> <ul style="list-style-type: none"> • The: new state of __FLAG__ (TRUE or FALSE).
<p>__HAL_HASH_SET_MDMAT</p>	<p>Description:</p> <ul style="list-style-type: none"> • Enable the multiple DMA mode. <p>Return value:</p> <ul style="list-style-type: none"> • None
<p>__HAL_HASH_RESET_MDMAT</p>	<p>Description:</p> <ul style="list-style-type: none"> • Disable the multiple DMA mode. <p>Return value:</p> <ul style="list-style-type: none"> • None
<p>__HAL_HASH_START_DIGEST</p>	<p>Description:</p> <ul style="list-style-type: none"> • Start the digest computation. <p>Return value:</p> <ul style="list-style-type: none"> • None
<p>__HAL_HASH_SET_NBVALIDBITS</p>	<p>Description:</p> <ul style="list-style-type: none"> • Set the number of valid bits in last word written in Data register. <p>Parameters:</p> <ul style="list-style-type: none"> • SIZE: size in byte of last data written in

Data register.

Return value:

- None

29 HAL HASH Extension Driver

29.1 HASHEx Firmware driver API description

29.1.1 How to use this driver

The HASH HAL driver can be used as follows:

1. Initialize the HASH low level resources by implementing the HAL_HASH_MspInit():
 - a. Enable the HASH interface clock using `__HAL_RCC_HASH_CLK_ENABLE()`
 - b. In case of using processing APIs based on interrupts (e.g. `HAL_HMACEx_SHA224_Start()`)
 - Configure the HASH interrupt priority using `HAL_NVIC_SetPriority()`
 - Enable the HASH IRQ handler using `HAL_NVIC_EnableIRQ()`
 - In HASH IRQ handler, call `HAL_HASH_IRQHandler()`
 - c. In case of using DMA to control data transfer (e.g. `HAL_HMACEx_SHA224_Start_DMA()`)
 - Enable the DMAx interface clock using `__DMAx_CLK_ENABLE()`
 - Configure and enable one DMA stream one for managing data transfer from memory to peripheral (input stream). Managing data transfer from peripheral to memory can be performed only using CPU
 - Associate the initialized DMA handle to the HASH DMA handle using `__HAL_LINKDMA()`
 - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Stream: `HAL_NVIC_SetPriority()` and `HAL_NVIC_EnableIRQ()`
2. Initialize the HASH HAL using `HAL_HASH_Init()`. This function configures mainly:
 - a. The data type: 1-bit, 8-bit, 16-bit and 32-bit.
 - b. For HMAC, the encryption key.
 - c. For HMAC, the key size used for encryption.
3. Three processing functions are available:
 - a. Polling mode: processing APIs are blocking functions i.e. they process the data and wait till the digest computation is finished e.g. `HAL_HASHEx_SHA224_Start()`
 - b. Interrupt mode: encryption and decryption APIs are not blocking functions i.e. they process the data under interrupt e.g. `HAL_HASHEx_SHA224_Start_IT()`
 - c. DMA mode: processing APIs are not blocking functions and the CPU is not used for data transfer i.e. the data transfer is ensured by DMA e.g. `HAL_HASHEx_SHA224_Start_DMA()`
4. When the processing function is called at first time after `HAL_HASH_Init()` the HASH peripheral is initialized and processes the buffer in input. After that, the digest computation is started. When processing multi-buffer use the accumulate function to write the data in the peripheral without starting the digest computation. In last buffer use the start function to input the last buffer and start the digest computation.
 - a. e.g. `HAL_HASHEx_SHA224_Accumulate()` : write 1st data buffer in the peripheral without starting the digest computation
 - b. write (n-1)th data buffer in the peripheral without starting the digest computation
 - c. `HAL_HASHEx_SHA224_Start()` : write (n)th data buffer in the peripheral and start the digest computation
5. In HMAC mode, there is no Accumulate API. Only Start API is available.
6. In case of using DMA, call the DMA start processing e.g. `HAL_HASHEx_SHA224_Start_DMA()`. After that, call the finish function in order to get the digest value e.g. `HAL_HASHEx_SHA224_Finish()`
7. Call `HAL_HASH_DeInit()` to deinitialize the HASH peripheral.

29.1.2 HASH processing using polling mode functions

This section provides functions allowing to calculate in polling mode the hash value using one of the following algorithms:

- SHA224
- SHA256

This section contains the following APIs:

- [*HAL_HASHEx_SHA224_Start\(\)*](#)
- [*HAL_HASHEx_SHA256_Start\(\)*](#)
- [*HAL_HASHEx_SHA224_Accumulate\(\)*](#)
- [*HAL_HASHEx_SHA256_Accumulate\(\)*](#)

29.1.3 HMAC processing using polling mode functions

This section provides functions allowing to calculate in polling mode the HMAC value using one of the following algorithms:

- SHA224
- SHA256

This section contains the following APIs:

- [*HAL_HMACEx_SHA224_Start\(\)*](#)
- [*HAL_HMACEx_SHA256_Start\(\)*](#)

29.1.4 HASH processing using interrupt functions

This section provides functions allowing to calculate in interrupt mode the hash value using one of the following algorithms:

- SHA224
- SHA256

This section contains the following APIs:

- [*HAL_HASHEx_SHA224_Start_IT\(\)*](#)
- [*HAL_HASHEx_SHA256_Start_IT\(\)*](#)
- [*HAL_HASHEx_IRQHandler\(\)*](#)

29.1.5 HASH processing using DMA functions

This section provides functions allowing to calculate in DMA mode the hash value using one of the following algorithms:

- SHA224
- SHA256

This section contains the following APIs:

- [*HAL_HASHEx_SHA224_Start_DMA\(\)*](#)
- [*HAL_HASHEx_SHA224_Finish\(\)*](#)
- [*HAL_HASHEx_SHA256_Start_DMA\(\)*](#)
- [*HAL_HASHEx_SHA256_Finish\(\)*](#)

29.1.6 HMAC processing using DMA functions

This section provides functions allowing to calculate in DMA mode the HMAC value using one of the following algorithms:

- SHA224
- SHA256

This section contains the following APIs:

- [HAL_HMACEx_SHA224_Start_DMA\(\)](#)
- [HAL_HMACEx_SHA256_Start_DMA\(\)](#)

29.1.7 Detailed description of functions

HAL_HASHEX_SHA224_Start

Function name HAL_StatusTypeDef HAL_HASHEX_SHA224_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)

Function description Initializes the HASH peripheral in SHA224 mode then processes pInBuffer.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
- **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
- **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
- **pOutBuffer:** Pointer to the computed digest. Its size must be 28 bytes.
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

HAL_HASHEX_SHA256_Start

Function name HAL_StatusTypeDef HAL_HASHEX_SHA256_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)

Function description Initializes the HASH peripheral in SHA256 mode then processes pInBuffer.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
- **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
- **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
- **pOutBuffer:** Pointer to the computed digest. Its size must be 32 bytes.
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

HAL_HASHEX_SHA224_Accumulate

Function name HAL_StatusTypeDef HAL_HASHEX_SHA224_Accumulate (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description Initializes the HASH peripheral in SHA224 mode then processes pInBuffer.

- Parameters
- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
 - **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
 - **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
- Return values
- **HAL:** status

HAL_HASHEx_SHA256_Accumulate

- Function name **HAL_StatusTypeDef HAL_HASHEx_SHA256_Accumulate (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)**
- Function description Initializes the HASH peripheral in SHA256 mode then processes pInBuffer.
- Parameters
- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
 - **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
 - **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
- Return values
- **HAL:** status

HAL_HMACEx_SHA224_Start

- Function name **HAL_StatusTypeDef HAL_HMACEx_SHA224_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)**
- Function description Initializes the HASH peripheral in HMAC SHA224 mode then processes pInBuffer.
- Parameters
- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
 - **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
 - **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
 - **pOutBuffer:** Pointer to the computed digest. Its size must be 20 bytes.
 - **Timeout:** Timeout value
- Return values
- **HAL:** status

HAL_HMACEx_SHA256_Start

- Function name **HAL_StatusTypeDef HAL_HMACEx_SHA256_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)**
- Function description Initializes the HASH peripheral in HMAC SHA256 mode then processes pInBuffer.
- Parameters
- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
 - **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
 - **Size:** Length of the input buffer in bytes. If the Size is not

- multiple of 64 bytes, the padding is managed by hardware.
 - **pOutBuffer:** Pointer to the computed digest. Its size must be 20 bytes.
 - **Timeout:** Timeout value
- Return values
- **HAL:** status

HAL_HASHEx_SHA224_Start_IT

Function name **HAL_StatusTypeDef HAL_HASHEx_SHA224_Start_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)**

Function description Initializes the HASH peripheral in SHA224 mode then processes pInBuffer.

- Parameters
- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
 - **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
 - **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
 - **pOutBuffer:** Pointer to the computed digest. Its size must be 20 bytes.

- Return values
- **HAL:** status

HAL_HASHEx_SHA256_Start_IT

Function name **HAL_StatusTypeDef HAL_HASHEx_SHA256_Start_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)**

Function description Initializes the HASH peripheral in SHA256 mode then processes pInBuffer.

- Parameters
- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
 - **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
 - **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
 - **pOutBuffer:** Pointer to the computed digest. Its size must be 20 bytes.

- Return values
- **HAL:** status

HAL_HASHEx_SHA224_Start_DMA

Function name **HAL_StatusTypeDef HAL_HASHEx_SHA224_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)**

Function description Initializes the HASH peripheral in SHA224 mode then enables DMA to control data transfer.

- Parameters
- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
 - **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
 - **Size:** Length of the input buffer in bytes. If the Size is not

multiple of 64 bytes, the padding is managed by hardware.

Return values

- **HAL:** status

HAL_HASHEx_SHA224_Finish

Function name **HAL_StatusTypeDef HAL_HASHEx_SHA224_Finish (HASH_HandleTypeDef * hhash, uint8_t * pOutBuffer, uint32_t Timeout)**

Function description Returns the computed digest in SHA224.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
- **pOutBuffer:** Pointer to the computed digest. Its size must be 28 bytes.
- **Timeout:** Timeout value

Return values

- **HAL:** status

HAL_HASHEx_SHA256_Start_DMA

Function name **HAL_StatusTypeDef HAL_HASHEx_SHA256_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)**

Function description Initializes the HASH peripheral in SHA256 mode then enables DMA to control data transfer.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
- **pInBuffer:** Pointer to the input buffer (buffer to be hashed).
- **Size:** Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.

Return values

- **HAL:** status

HAL_HASHEx_SHA256_Finish

Function name **HAL_StatusTypeDef HAL_HASHEx_SHA256_Finish (HASH_HandleTypeDef * hhash, uint8_t * pOutBuffer, uint32_t Timeout)**

Function description Returns the computed digest in SHA256.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
- **pOutBuffer:** Pointer to the computed digest. Its size must be 32 bytes.
- **Timeout:** Timeout value

Return values

- **HAL:** status

HAL_HMACEx_SHA224_Start_DMA

Function name **HAL_StatusTypeDef HAL_HMACEx_SHA224_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)**

Function description	Initializes the HASH peripheral in HMAC SHA224 mode then enables DMA to control data transfer.
Parameters	<ul style="list-style-type: none"> • hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module • pInBuffer: Pointer to the input buffer (buffer to be hashed). • Size: Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_HMACEx_SHA256_Start_DMA

Function name	HAL_StatusTypeDef HAL_HMACEx_SHA256_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)
Function description	Initializes the HASH peripheral in HMAC SHA256 mode then enables DMA to control data transfer.
Parameters	<ul style="list-style-type: none"> • hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module • pInBuffer: Pointer to the input buffer (buffer to be hashed). • Size: Length of the input buffer in bytes. If the Size is not multiple of 64 bytes, the padding is managed by hardware.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_HASHEx_IRQHandler

Function name	void HAL_HASHEx_IRQHandler (HASH_HandleTypeDef * hhash)
Function description	This function handles HASH interrupt request.
Parameters	<ul style="list-style-type: none"> • hhash: pointer to a HASH_HandleTypeDef structure that contains the configuration information for HASH module
Return values	<ul style="list-style-type: none"> • None:

30 HAL HCD Generic Driver

30.1 HCD Firmware driver registers structures

30.1.1 HCD_HandleTypeDef

Data Fields

- *HCD_TypeDef * Instance*
- *HCD_InitTypeDef Init*
- *HCD_HCTypeDef hc*
- *HAL_LockTypeDef Lock*
- *__IO HCD_StateTypeDef State*
- *void * pData*

Field Documentation

- *HCD_TypeDef* HCD_HandleTypeDef::Instance*
Register base address
- *HCD_InitTypeDef HCD_HandleTypeDef::Init*
HCD required parameters
- *HCD_HCTypeDef HCD_HandleTypeDef::hc[15]*
Host channels parameters
- *HAL_LockTypeDef HCD_HandleTypeDef::Lock*
HCD peripheral status
- *__IO HCD_StateTypeDef HCD_HandleTypeDef::State*
HCD communication state
- *void* HCD_HandleTypeDef::pData*
Pointer Stack Handler

30.2 HCD Firmware driver API description

30.2.1 How to use this driver

1. Declare a HCD_HandleTypeDef handle structure, for example: HCD_HandleTypeDef hhcd;
2. Fill parameters of Init structure in HCD handle
3. Call HAL_HCD_Init() API to initialize the HCD peripheral (Core, Host core, ...)
4. Initialize the HCD low level resources through the HAL_HCD_MspInit() API:
 - a. Enable the HCD/USB Low Level interface clock using the following macros
 - __HAL_RCC_USB_OTG_FS_CLK_ENABLE();
 - __HAL_RCC_USB_OTG_HS_CLK_ENABLE(); (For High Speed Mode)
 - __HAL_RCC_USB_OTG_HS_ULPI_CLK_ENABLE(); (For High Speed Mode)
 - b. Initialize the related GPIO clocks
 - c. Configure HCD pin-out
 - d. Configure HCD NVIC interrupt
5. Associate the Upper USB Host stack to the HAL HCD Driver:
 - a. hhcd.pData = phost;
6. Enable HCD transmission and reception:
 - a. HAL_HCD_Start();

30.2.2 Initialization and de-initialization functions

This section provides functions allowing to:

This section contains the following APIs:

- [HAL_HCD_Init\(\)](#)
- [HAL_HCD_HC_Init\(\)](#)
- [HAL_HCD_HC_Halt\(\)](#)
- [HAL_HCD_DelInit\(\)](#)
- [HAL_HCD_Msplnit\(\)](#)
- [HAL_HCD_MspDelnit\(\)](#)

30.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the USB Host Data Transfer

This section contains the following APIs:

- [HAL_HCD_HC_SubmitRequest\(\)](#)
- [HAL_HCD_IRQHandler\(\)](#)
- [HAL_HCD_SOF_Callback\(\)](#)
- [HAL_HCD_Connect_Callback\(\)](#)
- [HAL_HCD_Disconnect_Callback\(\)](#)
- [HAL_HCD_HC_NotifyURBChange_Callback\(\)](#)

30.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the HCD data transfers.

This section contains the following APIs:

- [HAL_HCD_Start\(\)](#)
- [HAL_HCD_Stop\(\)](#)
- [HAL_HCD_ResetPort\(\)](#)

30.2.5 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- [HAL_HCD_GetState\(\)](#)
- [HAL_HCD_HC_GetURBState\(\)](#)
- [HAL_HCD_HC_GetXferCount\(\)](#)
- [HAL_HCD_HC_GetState\(\)](#)
- [HAL_HCD_GetCurrentFrame\(\)](#)
- [HAL_HCD_GetCurrentSpeed\(\)](#)

30.2.6 Detailed description of functions

HAL_HCD_Init

Function name	HAL_StatusTypeDef HAL_HCD_Init (HCD_HandleTypeDef * hhcd)
Function description	Initialize the host driver.
Parameters	<ul style="list-style-type: none"> • hhcd: HCD handle

Return values

- **HAL:** status

HAL_HCD_DeInit

Function name **HAL_StatusTypeDef HAL_HCD_DeInit (HCD_HandleTypeDef * hhcd)**

Function description Deinitialize the host driver.

Parameters

- **hhcd:** HCD handle

Return values

- **HAL:** status

HAL_HCD_HC_Init

Function name **HAL_StatusTypeDef HAL_HCD_HC_Init (HCD_HandleTypeDef * hhcd, uint8_t ch_num, uint8_t epnum, uint8_t dev_address, uint8_t speed, uint8_t ep_type, uint16_t mps)**

Function description Initialize a host channel.

Parameters

- **hhcd:** HCD handle
- **ch_num:** Channel number. This parameter can be a value from 1 to 15
- **epnum:** Endpoint number. This parameter can be a value from 1 to 15
- **dev_address:** : Current device address This parameter can be a value from 0 to 255
- **speed:** Current device speed. This parameter can be one of these values: HCD_SPEED_HIGH: High speed mode, HCD_SPEED_FULL: Full speed mode, HCD_SPEED_LOW: Low speed mode
- **ep_type:** Endpoint Type. This parameter can be one of these values: EP_TYPE_CTRL: Control type, EP_TYPE_ISOC: Isochronous type, EP_TYPE_BULK: Bulk type, EP_TYPE_INTR: Interrupt type
- **mps:** Max Packet Size. This parameter can be a value from 0 to 32K

Return values

- **HAL:** status

HAL_HCD_HC_Halt

Function name **HAL_StatusTypeDef HAL_HCD_HC_Halt (HCD_HandleTypeDef * hhcd, uint8_t ch_num)**

Function description Halt a host channel.

Parameters

- **hhcd:** HCD handle
- **ch_num:** Channel number. This parameter can be a value from 1 to 15

Return values

- **HAL:** status

HAL_HCD_Msplnit

Function name **void HAL_HCD_Msplnit (HCD_HandleTypeDef * hhcd)**

Function description Initialize the HCD MSP.

Parameters

- **hhcd:** HCD handle

Return values

- **None:**

HAL_HCD_MspDeInit

Function name **void HAL_HCD_MspDeInit (HCD_HandleTypeDef * hhcd)**

Function description DeInitialize the HCD MSP.

Parameters

- **hhcd:** HCD handle

Return values

- **None:**

HAL_HCD_HC_SubmitRequest

Function name **HAL_StatusTypeDef HAL_HCD_HC_SubmitRequest (HCD_HandleTypeDef * hhcd, uint8_t ch_num, uint8_t direction, uint8_t ep_type, uint8_t token, uint8_t * pbuff, uint16_t length, uint8_t do_ping)**

Function description Submit a new URB for processing.

Parameters

- **hhcd:** HCD handle
- **ch_num:** Channel number. This parameter can be a value from 1 to 15
- **direction:** Channel number. This parameter can be one of these values: 0 : Output / 1 : Input
- **ep_type:** Endpoint Type. This parameter can be one of these values: EP_TYPE_CTRL: Control type/ EP_TYPE_ISOC: Isochronous type/ EP_TYPE_BULK: Bulk type/ EP_TYPE_INTR: Interrupt type/
- **token:** Endpoint Type. This parameter can be one of these values: 0: HC_PID_SETUP / 1: HC_PID_DATA1
- **pbuff:** pointer to URB data
- **length:** Length of URB data
- **do_ping:** activate do ping protocol (for high speed only). This parameter can be one of these values: 0 : do ping inactive / 1 : do ping active

Return values

- **HAL:** status

HAL_HCD_IRQHandler

Function name **void HAL_HCD_IRQHandler (HCD_HandleTypeDef * hhcd)**

Function description Handle HCD interrupt request.

Parameters

- **hhcd:** HCD handle

Return values

- **None:**

HAL_HCD_SOF_Callback

Function name **void HAL_HCD_SOF_Callback (HCD_HandleTypeDef * hhcd)**

Function description SOF callback.

- Parameters
- **hhcd:** HCD handle
- Return values
- **None:**

HAL_HCD_Connect_Callback

- Function name **void HAL_HCD_Connect_Callback (HCD_HandleTypeDef * hhcd)**
- Function description Connection Event callback.
- Parameters
- **hhcd:** HCD handle
- Return values
- **None:**

HAL_HCD_Disconnect_Callback

- Function name **void HAL_HCD_Disconnect_Callback (HCD_HandleTypeDef * hhcd)**
- Function description Disconnection Event callback.
- Parameters
- **hhcd:** HCD handle
- Return values
- **None:**

HAL_HCD_HC_NotifyURBChange_Callback

- Function name **void HAL_HCD_HC_NotifyURBChange_Callback (HCD_HandleTypeDef * hhcd, uint8_t chnum, HCD_URBStateTypeDef urb_state)**
- Function description Notify URB state change callback.
- Parameters
- **hhcd:** HCD handle
 - **chnum:** Channel number. This parameter can be a value from 1 to 15
 - **urb_state:** This parameter can be one of these values: URB_IDLE/ URB_DONE/ URB_NOTREADY/ URB_NYET/ URB_ERROR/ URB_STALL/
- Return values
- **None:**

HAL_HCD_ResetPort

- Function name **HAL_StatusTypeDef HAL_HCD_ResetPort (HCD_HandleTypeDef * hhcd)**
- Function description Reset the host port.
- Parameters
- **hhcd:** HCD handle
- Return values
- **HAL:** status

HAL_HCD_Start

- Function name **HAL_StatusTypeDef HAL_HCD_Start (HCD_HandleTypeDef * hhcd)**
- Function description Start the host driver.

- Parameters
- **hhcd:** HCD handle
- Return values
- **HAL:** status

HAL_HCD_Stop

- Function name **HAL_StatusTypeDef HAL_HCD_Stop (HCD_HandleTypeDef * hhcd)**
- Function description Stop the host driver.
- Parameters
- **hhcd:** HCD handle
- Return values
- **HAL:** status

HAL_HCD_GetState

- Function name **HCD_StateTypeDef HAL_HCD_GetState (HCD_HandleTypeDef * hhcd)**
- Function description Return the HCD handle state.
- Parameters
- **hhcd:** HCD handle
- Return values
- **HAL:** state

HAL_HCD_HC_GetURBState

- Function name **HCD_URBStateTypeDef HAL_HCD_HC_GetURBState (HCD_HandleTypeDef * hhcd, uint8_t chnum)**
- Function description Return URB state for a channel.
- Parameters
- **hhcd:** HCD handle
 - **chnum:** Channel number. This parameter can be a value from 1 to 15
- Return values
- **URB:** state. This parameter can be one of these values: URB_IDLE/ URB_DONE/ URB_NOTREADY/ URB_NYET/ URB_ERROR/ URB_STALL

HAL_HCD_HC_GetXferCount

- Function name **uint32_t HAL_HCD_HC_GetXferCount (HCD_HandleTypeDef * hhcd, uint8_t chnum)**
- Function description Return the last host transfer size.
- Parameters
- **hhcd:** HCD handle
 - **chnum:** Channel number. This parameter can be a value from 1 to 15
- Return values
- **last:** transfer size in byte

HAL_HCD_HC_GetState

- Function name **HCD_HCStateTypeDef HAL_HCD_HC_GetState (HCD_HandleTypeDef * hhcd, uint8_t chnum)**
- Function description Return the Host Channel state.

Parameters	<ul style="list-style-type: none"> • hhcd: HCD handle • chnum: Channel number. This parameter can be a value from 1 to 15
Return values	<ul style="list-style-type: none"> • Host: channel state This parameter can be one of these values: HC_IDLE/ HC_XFRC/ HC_HALTED/ HC_NYET/ HC_NAK/ HC_STALL/ HC_XACTERR/ HC_BBLERR/ HC_DATATGLERR

HAL_HCD_GetCurrentFrame

Function name	uint32_t HAL_HCD_GetCurrentFrame (HCD_HandleTypeDef * hhcd)
Function description	Return the current Host frame number.
Parameters	<ul style="list-style-type: none"> • hhcd: HCD handle
Return values	<ul style="list-style-type: none"> • Current: Host frame number

HAL_HCD_GetCurrentSpeed

Function name	uint32_t HAL_HCD_GetCurrentSpeed (HCD_HandleTypeDef * hhcd)
Function description	Return the Host enumeration speed.
Parameters	<ul style="list-style-type: none"> • hhcd: HCD handle
Return values	<ul style="list-style-type: none"> • Enumeration: speed

30.3 HCD Firmware driver defines

30.3.1 HCD

HCD Exported Macros

__HAL_HCD_ENABLE
 __HAL_HCD_DISABLE
 __HAL_HCD_GET_FLAG
 __HAL_HCD_CLEAR_FLAG
 __HAL_HCD_IS_INVALID_INTERRUPT
 __HAL_HCD_CLEAR_HC_INT
 __HAL_HCD_MASK_HALT_HC_INT
 __HAL_HCD_UNMASK_HALT_HC_INT
 __HAL_HCD_MASK_ACK_HC_INT
 __HAL_HCD_UNMASK_ACK_HC_INT

HCD Instance definition

IS_HCD_ALL_INSTANCE

HCD PHY Module

HCD_PHY_ULPI

HCD_PHY_EMBEDDED

HCD Speed

HCD_SPEED_HIGH

HCD_SPEED_LOW

HCD_SPEED_FULL

31 HAL I2C Generic Driver

31.1 I2C Firmware driver registers structures

31.1.1 I2C_InitTypeDef

Data Fields

- *uint32_t Timing*
- *uint32_t OwnAddress1*
- *uint32_t AddressingMode*
- *uint32_t DualAddressMode*
- *uint32_t OwnAddress2*
- *uint32_t OwnAddress2Masks*
- *uint32_t GeneralCallMode*
- *uint32_t NoStretchMode*

Field Documentation

- *uint32_t I2C_InitTypeDef::Timing*
Specifies the I2C_TIMINGR_register value. This parameter calculated by referring to I2C initialization section in Reference manual
- *uint32_t I2C_InitTypeDef::OwnAddress1*
Specifies the first device own address. This parameter can be a 7-bit or 10-bit address.
- *uint32_t I2C_InitTypeDef::AddressingMode*
Specifies if 7-bit or 10-bit addressing mode is selected. This parameter can be a value of [I2C_ADDRESSING_MODE](#)
- *uint32_t I2C_InitTypeDef::DualAddressMode*
Specifies if dual addressing mode is selected. This parameter can be a value of [I2C_DUAL_ADDRESSING_MODE](#)
- *uint32_t I2C_InitTypeDef::OwnAddress2*
Specifies the second device own address if dual addressing mode is selected This parameter can be a 7-bit address.
- *uint32_t I2C_InitTypeDef::OwnAddress2Masks*
Specifies the acknowledge mask address second device own address if dual addressing mode is selected This parameter can be a value of [I2C_OWN_ADDRESS2_MASKS](#)
- *uint32_t I2C_InitTypeDef::GeneralCallMode*
Specifies if general call mode is selected. This parameter can be a value of [I2C_GENERAL_CALL_ADDRESSING_MODE](#)
- *uint32_t I2C_InitTypeDef::NoStretchMode*
Specifies if nostretch mode is selected. This parameter can be a value of [I2C_NOSTRETCH_MODE](#)

31.1.2 __I2C_HandleTypeDef

Data Fields

- *I2C_TypeDef * Instance*
- *I2C_InitTypeDef Init*
- *uint8_t * pBuffPtr*
- *uint16_t XferSize*
- *__IO uint16_t XferCount*

- `__IO uint32_t XferOptions`
- `__IO uint32_t PreviousState`
- `HAL_StatusTypeDef(* XferISR`
- `DMA_HandleTypeDef * hdmatx`
- `DMA_HandleTypeDef * hdmarx`
- `HAL_LockTypeDef Lock`
- `__IO HAL_I2C_StateTypeDef State`
- `__IO HAL_I2C_ModeTypeDef Mode`
- `__IO uint32_t ErrorCode`
- `__IO uint32_t AddrEventCount`

Field Documentation

- `I2C_TypeDef* __I2C_HandleTypeDef::Instance`
I2C registers base address
- `I2C_InitTypeDef __I2C_HandleTypeDef::Init`
I2C communication parameters
- `uint8_t* __I2C_HandleTypeDef::pBuffPtr`
Pointer to I2C transfer buffer
- `uint16_t __I2C_HandleTypeDef::XferSize`
I2C transfer size
- `__IO uint16_t __I2C_HandleTypeDef::XferCount`
I2C transfer counter
- `__IO uint32_t __I2C_HandleTypeDef::XferOptions`
I2C sequential transfer options, this parameter can be a value of [I2C_XFEROPTIONS](#)
- `__IO uint32_t __I2C_HandleTypeDef::PreviousState`
I2C communication Previous state
- `HAL_StatusTypeDef(* __I2C_HandleTypeDef::XferISR)(struct __I2C_HandleTypeDef *hi2c, uint32_t ITFlags, uint32_t ITSources)`
I2C transfer IRQ handler function pointer
- `DMA_HandleTypeDef* __I2C_HandleTypeDef::hdmatx`
I2C Tx DMA handle parameters
- `DMA_HandleTypeDef* __I2C_HandleTypeDef::hdmarx`
I2C Rx DMA handle parameters
- `HAL_LockTypeDef __I2C_HandleTypeDef::Lock`
I2C locking object
- `__IO HAL_I2C_StateTypeDef __I2C_HandleTypeDef::State`
I2C communication state
- `__IO HAL_I2C_ModeTypeDef __I2C_HandleTypeDef::Mode`
I2C communication mode
- `__IO uint32_t __I2C_HandleTypeDef::ErrorCode`
I2C Error code
- `__IO uint32_t __I2C_HandleTypeDef::AddrEventCount`
I2C Address Event counter

31.2 I2C Firmware driver API description

31.2.1 How to use this driver

The I2C HAL driver can be used as follows:

1. Declare a `I2C_HandleTypeDef` handle structure, for example: `I2C_HandleTypeDef hi2c;`
2. Initialize the I2C low level resources by implementing the `HAL_I2C_MspInit()` API:
 - a. Enable the I2Cx interface clock

- b. I2C pins configuration
 - Enable the clock for the I2C GPIOs
 - Configure I2C pins as alternate function open-drain
- c. NVIC configuration if you need to use interrupt process
 - Configure the I2Cx interrupt priority
 - Enable the NVIC I2C IRQ Channel
- d. DMA Configuration if you need to use DMA process
 - Declare a DMA_HandleTypeDef handle structure for the transmit or receive stream
 - Enable the DMAx interface clock using
 - Configure the DMA handle parameters
 - Configure the DMA Tx or Rx stream
 - Associate the initialized DMA handle to the hi2c DMA Tx or Rx handle
 - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx or Rx stream
3. Configure the Communication Clock Timing, Own Address1, Master Addressing mode, Dual Addressing mode, Own Address2, Own Address2 Mask, General call and Nostretch mode in the hi2c Init structure.
4. Initialize the I2C registers by calling the HAL_I2C_Init(), configures also the low level Hardware (GPIO, CLOCK, NVIC...etc) by calling the customized HAL_I2C_MspInit(&hi2c) API.
5. To check if target device is ready for communication, use the function HAL_I2C_IsDeviceReady()
6. For I2C IO and IO MEM operations, three operation modes are available within this driver :

Polling mode IO operation

- Transmit in master mode an amount of data in blocking mode using HAL_I2C_Master_Transmit()
- Receive in master mode an amount of data in blocking mode using HAL_I2C_Master_Receive()
- Transmit in slave mode an amount of data in blocking mode using HAL_I2C_Slave_Transmit()
- Receive in slave mode an amount of data in blocking mode using HAL_I2C_Slave_Receive()

Polling mode IO MEM operation

- Write an amount of data in blocking mode to a specific memory address using HAL_I2C_Mem_Write()
- Read an amount of data in blocking mode from a specific memory address using HAL_I2C_Mem_Read()

Interrupt mode IO operation

- Transmit in master mode an amount of data in non-blocking mode using HAL_I2C_Master_Transmit_IT()
- At transmission end of transfer, HAL_I2C_MasterTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MasterTxCpltCallback()
- Receive in master mode an amount of data in non-blocking mode using HAL_I2C_Master_Receive_IT()

- At reception end of transfer, HAL_I2C_MasterRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MasterRxCpltCallback()
- Transmit in slave mode an amount of data in non-blocking mode using HAL_I2C_Slave_Transmit_IT()
- At transmission end of transfer, HAL_I2C_SlaveTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_SlaveTxCpltCallback()
- Receive in slave mode an amount of data in non-blocking mode using HAL_I2C_Slave_Receive_IT()
- At reception end of transfer, HAL_I2C_SlaveRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_SlaveRxCpltCallback()
- In case of transfer Error, HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_I2C_ErrorCallback()
- Abort a master I2C process communication with Interrupt using HAL_I2C_Master_Abort_IT()
- End of abort process, HAL_I2C_AbortCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_AbortCpltCallback()
- Discard a slave I2C process communication using __HAL_I2C_GENERATE_NACK() macro. This action will inform Master to generate a Stop condition to discard the communication.

Interrupt mode IO sequential operation



These interfaces allow to manage a sequential transfer with a repeated start condition when a direction change during transfer

- A specific option field manage the different steps of a sequential transfer
- Option field values are defined through @ref I2C_XFEROPTIONS and are listed below:
 - I2C_FIRST_AND_LAST_FRAME: No sequential usage, fonctionnal is same as associated interfaces in no sequential mode
 - I2C_FIRST_FRAME: Sequential usage, this option allow to manage a sequence with start condition, address and data to transfer without a final stop condition
 - I2C_FIRST_AND_NEXT_FRAME: Sequential usage (Master only), this option allow to manage a sequence with start condition, address and data to transfer without a final stop condition, an then permit a call the same master sequential interface several times (like HAL_I2C_Master_Sequential_Transmit_IT() then HAL_I2C_Master_Sequential_Transmit_IT())
 - I2C_NEXT_FRAME: Sequential usage, this option allow to manage a sequence with a restart condition, address and with new data to transfer if the direction change or manage only the new data to transfer if no direction change and without a final stop condition in both cases
 - I2C_LAST_FRAME: Sequential usage, this option allow to manage a sequence with a restart condition, address and with new data to transfer if the direction change or manage only the new data to transfer if no direction change and with a final stop condition in both cases
- Differents sequential I2C interfaces are listed below:
 - Sequential transmit in master I2C mode an amount of data in non-blocking mode using HAL_I2C_Master_Sequential_Transmit_IT()

- At transmission end of current frame transfer, HAL_I2C_MasterTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MasterTxCpltCallback()
- Sequential receive in master I2C mode an amount of data in non-blocking mode using HAL_I2C_Master_Sequential_Receive_IT()
 - At reception end of current frame transfer, HAL_I2C_MasterRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MasterRxCpltCallback()
- Abort a master I2C process communication with Interrupt using HAL_I2C_Master_Abort_IT()
 - End of abort process, HAL_I2C_AbortCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_AbortCpltCallback()
- Enable/disable the Address listen mode in slave I2C mode using HAL_I2C_EnableListen_IT() HAL_I2C_DisableListen_IT()
 - When address slave I2C match, HAL_I2C_AddrCallback() is executed and user can add his own code to check the Address Match Code and the transmission direction request by master (Write/Read).
 - At Listen mode end HAL_I2C_ListenCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_ListenCpltCallback()
- Sequential transmit in slave I2C mode an amount of data in non-blocking mode using HAL_I2C_Slave_Sequential_Transmit_IT()
 - At transmission end of current frame transfer, HAL_I2C_SlaveTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_SlaveTxCpltCallback()
- Sequential receive in slave I2C mode an amount of data in non-blocking mode using HAL_I2C_Slave_Sequential_Receive_IT()
 - At reception end of current frame transfer, HAL_I2C_SlaveRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_SlaveRxCpltCallback()
- In case of transfer Error, HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_I2C_ErrorCallback()
- Abort a master I2C process communication with Interrupt using HAL_I2C_Master_Abort_IT()
- End of abort process, HAL_I2C_AbortCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_AbortCpltCallback()
- Discard a slave I2C process communication using __HAL_I2C_GENERATE_NACK() macro. This action will inform Master to generate a Stop condition to discard the communication.

Interrupt mode IO MEM operation

- Write an amount of data in non-blocking mode with Interrupt to a specific memory address using HAL_I2C_Mem_Write_IT()
- At Memory end of write transfer, HAL_I2C_MemTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MemTxCpltCallback()
- Read an amount of data in non-blocking mode with Interrupt from a specific memory address using HAL_I2C_Mem_Read_IT()
- At Memory end of read transfer, HAL_I2C_MemRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MemRxCpltCallback()

- In case of transfer Error, HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_I2C_ErrorCallback()

DMA mode IO operation

- Transmit in master mode an amount of data in non-blocking mode (DMA) using HAL_I2C_Master_Transmit_DMA()
- At transmission end of transfer, HAL_I2C_MasterTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MasterTxCpltCallback()
- Receive in master mode an amount of data in non-blocking mode (DMA) using HAL_I2C_Master_Receive_DMA()
- At reception end of transfer, HAL_I2C_MasterRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MasterRxCpltCallback()
- Transmit in slave mode an amount of data in non-blocking mode (DMA) using HAL_I2C_Slave_Transmit_DMA()
- At transmission end of transfer, HAL_I2C_SlaveTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_SlaveTxCpltCallback()
- Receive in slave mode an amount of data in non-blocking mode (DMA) using HAL_I2C_Slave_Receive_DMA()
- At reception end of transfer, HAL_I2C_SlaveRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_SlaveRxCpltCallback()
- In case of transfer Error, HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_I2C_ErrorCallback()
- Abort a master I2C process communication with Interrupt using HAL_I2C_Master_Abort_IT()
- End of abort process, HAL_I2C_AbortCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_AbortCpltCallback()
- Discard a slave I2C process communication using __HAL_I2C_GENERATE_NACK() macro. This action will inform Master to generate a Stop condition to discard the communication.

DMA mode IO MEM operation

- Write an amount of data in non-blocking mode with DMA to a specific memory address using HAL_I2C_Mem_Write_DMA()
- At Memory end of write transfer, HAL_I2C_MemTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MemTxCpltCallback()
- Read an amount of data in non-blocking mode with DMA from a specific memory address using HAL_I2C_Mem_Read_DMA()
- At Memory end of read transfer, HAL_I2C_MemRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MemRxCpltCallback()
- In case of transfer Error, HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_I2C_ErrorCallback()

I2C HAL driver macros list

Below the list of most used macros in I2C HAL driver.

- __HAL_I2C_ENABLE: Enable the I2C peripheral
- __HAL_I2C_DISABLE: Disable the I2C peripheral

- `__HAL_I2C_GENERATE_NACK`: Generate a Non-Acknowledge I2C peripheral in Slave mode
- `__HAL_I2C_GET_FLAG`: Check whether the specified I2C flag is set or not
- `__HAL_I2C_CLEAR_FLAG`: Clear the specified I2C pending flag
- `__HAL_I2C_ENABLE_IT`: Enable the specified I2C interrupt
- `__HAL_I2C_DISABLE_IT`: Disable the specified I2C interrupt



You can refer to the I2C HAL driver header file for more useful macros

31.2.2 Initialization and de-initialization functions

This subsection provides a set of functions allowing to initialize and deinitialize the I2Cx peripheral:

- User must Implement `HAL_I2C_MspInit()` function in which he configures all related peripherals resources (CLOCK, GPIO, DMA, IT and NVIC).
- Call the function `HAL_I2C_Init()` to configure the selected device with the selected configuration:
 - Clock Timing
 - Own Address 1
 - Addressing mode (Master, Slave)
 - Dual Addressing mode
 - Own Address 2
 - Own Address 2 Mask
 - General call mode
 - Nostretch mode
- Call the function `HAL_I2C_DeInit()` to restore the default configuration of the selected I2Cx peripheral.

This section contains the following APIs:

- [*HAL_I2C_Init\(\)*](#)
- [*HAL_I2C_DeInit\(\)*](#)
- [*HAL_I2C_MspInit\(\)*](#)
- [*HAL_I2C_MspDeInit\(\)*](#)

31.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the I2C data transfers.

1. There are two modes of transfer:
 - Blocking mode : The communication is performed in the polling mode. The status of all data processing is returned by the same function after finishing transfer.
 - No-Blocking mode : The communication is performed using Interrupts or DMA. These functions return the status of the transfer startup. The end of the data processing will be indicated through the dedicated I2C IRQ when using Interrupt mode or the DMA IRQ when using DMA mode.
2. Blocking mode functions are :
 - `HAL_I2C_Master_Transmit()`
 - `HAL_I2C_Master_Receive()`
 - `HAL_I2C_Slave_Transmit()`
 - `HAL_I2C_Slave_Receive()`
 - `HAL_I2C_Mem_Write()`

- HAL_I2C_Mem_Read()
- HAL_I2C_IsDeviceReady()
- 3. No-Blocking mode functions with Interrupt are :
 - HAL_I2C_Master_Transmit_IT()
 - HAL_I2C_Master_Receive_IT()
 - HAL_I2C_Slave_Transmit_IT()
 - HAL_I2C_Slave_Receive_IT()
 - HAL_I2C_Mem_Write_IT()
 - HAL_I2C_Mem_Read_IT()
- 4. No-Blocking mode functions with DMA are :
 - HAL_I2C_Master_Transmit_DMA()
 - HAL_I2C_Master_Receive_DMA()
 - HAL_I2C_Slave_Transmit_DMA()
 - HAL_I2C_Slave_Receive_DMA()
 - HAL_I2C_Mem_Write_DMA()
 - HAL_I2C_Mem_Read_DMA()
- 5. A set of Transfer Complete Callbacks are provided in non Blocking mode:
 - HAL_I2C_MemTxCpltCallback()
 - HAL_I2C_MemRxCpltCallback()
 - HAL_I2C_MasterTxCpltCallback()
 - HAL_I2C_MasterRxCpltCallback()
 - HAL_I2C_SlaveTxCpltCallback()
 - HAL_I2C_SlaveRxCpltCallback()
 - HAL_I2C_ErrorCallback()

This section contains the following APIs:

- [*HAL_I2C_Master_Transmit\(\)*](#)
- [*HAL_I2C_Master_Receive\(\)*](#)
- [*HAL_I2C_Slave_Transmit\(\)*](#)
- [*HAL_I2C_Slave_Receive\(\)*](#)
- [*HAL_I2C_Master_Transmit_IT\(\)*](#)
- [*HAL_I2C_Master_Receive_IT\(\)*](#)
- [*HAL_I2C_Slave_Transmit_IT\(\)*](#)
- [*HAL_I2C_Slave_Receive_IT\(\)*](#)
- [*HAL_I2C_Master_Transmit_DMA\(\)*](#)
- [*HAL_I2C_Master_Receive_DMA\(\)*](#)
- [*HAL_I2C_Slave_Transmit_DMA\(\)*](#)
- [*HAL_I2C_Slave_Receive_DMA\(\)*](#)
- [*HAL_I2C_Mem_Write\(\)*](#)
- [*HAL_I2C_Mem_Read\(\)*](#)
- [*HAL_I2C_Mem_Write_IT\(\)*](#)
- [*HAL_I2C_Mem_Read_IT\(\)*](#)
- [*HAL_I2C_Mem_Write_DMA\(\)*](#)
- [*HAL_I2C_Mem_Read_DMA\(\)*](#)
- [*HAL_I2C_IsDeviceReady\(\)*](#)
- [*HAL_I2C_Master_Sequential_Transmit_IT\(\)*](#)
- [*HAL_I2C_Master_Sequential_Receive_IT\(\)*](#)
- [*HAL_I2C_Slave_Sequential_Transmit_IT\(\)*](#)
- [*HAL_I2C_Slave_Sequential_Receive_IT\(\)*](#)
- [*HAL_I2C_EnableListen_IT\(\)*](#)
- [*HAL_I2C_DisableListen_IT\(\)*](#)
- [*HAL_I2C_Master_Abort_IT\(\)*](#)

31.2.4 Peripheral State, Mode and Error functions

This subsection permit to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- [HAL_I2C_GetState\(\)](#)
- [HAL_I2C_GetMode\(\)](#)
- [HAL_I2C_GetError\(\)](#)

31.2.5 Detailed description of functions

HAL_I2C_Init

Function name	HAL_StatusTypeDef HAL_I2C_Init (I2C_HandleTypeDef * hi2c)
Function description	Initializes the I2C according to the specified parameters in the I2C_InitTypeDef and initialize the associated handle.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_DeInit

Function name	HAL_StatusTypeDef HAL_I2C_DeInit (I2C_HandleTypeDef * hi2c)
Function description	Deinitialize the I2C peripheral.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_MspInit

Function name	void HAL_I2C_MspInit (I2C_HandleTypeDef * hi2c)
Function description	Initialize the I2C MSP.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • None:

HAL_I2C_MspDeInit

Function name	void HAL_I2C_MspDeInit (I2C_HandleTypeDef * hi2c)
Function description	Deinitialize the I2C MSP.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • None:

HAL_I2C_Master_Transmit

Function name	HAL_StatusTypeDef HAL_I2C_Master_Transmit
---------------	--

(I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description	Transmits in master mode an amount of data in blocking mode.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • pData: Pointer to data buffer • Size: Amount of data to be sent • Timeout: Timeout duration
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_Master_Receive

Function name	HAL_StatusTypeDef HAL_I2C_Master_Receive (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t Timeout)
Function description	Receives in master mode an amount of data in blocking mode.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • pData: Pointer to data buffer • Size: Amount of data to be sent • Timeout: Timeout duration
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_Slave_Transmit

Function name	HAL_StatusTypeDef HAL_I2C_Slave_Transmit (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size, uint32_t Timeout)
Function description	Transmits in slave mode an amount of data in blocking mode.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • pData: Pointer to data buffer • Size: Amount of data to be sent • Timeout: Timeout duration
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_Slave_Receive

Function name	HAL_StatusTypeDef HAL_I2C_Slave_Receive (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size, uint32_t Timeout)
Function description	Receive in slave mode an amount of data in blocking mode.

- | | |
|---------------|--|
| Parameters | <ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • pData: Pointer to data buffer • Size: Amount of data to be sent • Timeout: Timeout duration |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_I2C_Mem_Write

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_I2C_Mem_Write (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint16_t MemAddress, uint16_t MemAddSize, uint8_t * pData, uint16_t Size, uint32_t Timeout) |
| Function description | Write an amount of data in blocking mode to a specific memory address. |
| Parameters | <ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • MemAddress: Internal memory address • MemAddSize: Size of internal memory address • pData: Pointer to data buffer • Size: Amount of data to be sent • Timeout: Timeout duration |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_I2C_Mem_Read

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_I2C_Mem_Read (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint16_t MemAddress, uint16_t MemAddSize, uint8_t * pData, uint16_t Size, uint32_t Timeout) |
| Function description | Read an amount of data in blocking mode from a specific memory address. |
| Parameters | <ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • MemAddress: Internal memory address • MemAddSize: Size of internal memory address • pData: Pointer to data buffer • Size: Amount of data to be sent • Timeout: Timeout duration |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_I2C_IsDeviceReady

- | | |
|---------------|--|
| Function name | HAL_StatusTypeDef HAL_I2C_IsDeviceReady |
|---------------|--|

(I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint32_t Trials, uint32_t Timeout)

Function description	Checks if target device is ready for communication.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • Trials: Number of trials • Timeout: Timeout duration
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function is used with Memory devices

HAL_I2C_Master_Transmit_IT

Function name	HAL_StatusTypeDef HAL_I2C_Master_Transmit_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size)
Function description	Transmit in master mode an amount of data in non-blocking mode with Interrupt.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • pData: Pointer to data buffer • Size: Amount of data to be sent
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_Master_Receive_IT

Function name	HAL_StatusTypeDef HAL_I2C_Master_Receive_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size)
Function description	Receive in master mode an amount of data in non-blocking mode with Interrupt.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • pData: Pointer to data buffer • Size: Amount of data to be sent
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_Slave_Transmit_IT

Function name	HAL_StatusTypeDef HAL_I2C_Slave_Transmit_IT
---------------	--

(I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size)

Function description	Transmit in slave mode an amount of data in non-blocking mode with Interrupt.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • pData: Pointer to data buffer • Size: Amount of data to be sent
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_Slave_Receive_IT

Function name	HAL_StatusTypeDef HAL_I2C_Slave_Receive_IT (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size)
Function description	Receive in slave mode an amount of data in non-blocking mode with Interrupt.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • pData: Pointer to data buffer • Size: Amount of data to be sent
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_Mem_Write_IT

Function name	HAL_StatusTypeDef HAL_I2C_Mem_Write_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint16_t MemAddress, uint16_t MemAddSize, uint8_t * pData, uint16_t Size)
Function description	Write an amount of data in non-blocking mode with Interrupt to a specific memory address.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • MemAddress: Internal memory address • MemAddSize: Size of internal memory address • pData: Pointer to data buffer • Size: Amount of data to be sent
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_Mem_Read_IT

Function name	HAL_StatusTypeDef HAL_I2C_Mem_Read_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint16_t MemAddress, uint16_t MemAddSize, uint8_t * pData, uint16_t Size)
Function description	Read an amount of data in non-blocking mode with Interrupt from a specific memory address.

Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • MemAddress: Internal memory address • MemAddSize: Size of internal memory address • pData: Pointer to data buffer • Size: Amount of data to be sent
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_Master_Sequential_Transmit_IT

Function name	HAL_StatusTypeDef HAL_I2C_Master_Sequential_Transmit_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t XferOptions)
Function description	Sequential transmit in master I2C mode an amount of data in non-blocking mode with Interrupt.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • pData: Pointer to data buffer • Size: Amount of data to be sent • XferOptions: Options of Transfer, value of I2C Sequential Transfer Options
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This interface allow to manage repeated start condition when a direction change during transfer

HAL_I2C_Master_Sequential_Receive_IT

Function name	HAL_StatusTypeDef HAL_I2C_Master_Sequential_Receive_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t XferOptions)
Function description	Sequential receive in master I2C mode an amount of data in non-blocking mode with Interrupt.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • pData: Pointer to data buffer • Size: Amount of data to be sent • XferOptions: Options of Transfer, value of I2C Sequential Transfer Options
Return values	<ul style="list-style-type: none"> • HAL: status

- Notes
- This interface allow to manage repeated start condition when a direction change during transfer

HAL_I2C_Slave_Sequential_Transmit_IT

- Function name **HAL_StatusTypeDef HAL_I2C_Slave_Sequential_Transmit_IT (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size, uint32_t XferOptions)**
- Function description Sequential transmit in slave/device I2C mode an amount of data in non-blocking mode with Interrupt.
- Parameters
- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
 - **pData:** Pointer to data buffer
 - **Size:** Amount of data to be sent
 - **XferOptions:** Options of Transfer, value of I2C Sequential Transfer Options
- Return values
- **HAL:** status
- Notes
- This interface allow to manage repeated start condition when a direction change during transfer

HAL_I2C_Slave_Sequential_Receive_IT

- Function name **HAL_StatusTypeDef HAL_I2C_Slave_Sequential_Receive_IT (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size, uint32_t XferOptions)**
- Function description Sequential receive in slave/device I2C mode an amount of data in non-blocking mode with Interrupt.
- Parameters
- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
 - **pData:** Pointer to data buffer
 - **Size:** Amount of data to be sent
 - **XferOptions:** Options of Transfer, value of I2C Sequential Transfer Options
- Return values
- **HAL:** status
- Notes
- This interface allow to manage repeated start condition when a direction change during transfer

HAL_I2C_EnableListen_IT

- Function name **HAL_StatusTypeDef HAL_I2C_EnableListen_IT (I2C_HandleTypeDef * hi2c)**
- Function description Enable the Address listen mode with Interrupt.
- Parameters
- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- Return values
- **HAL:** status

HAL_I2C_DisableListen_IT

Function name	HAL_StatusTypeDef HAL_I2C_DisableListen_IT (I2C_HandleTypeDef * hi2c)
Function description	Disable the Address listen mode with Interrupt.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_Master_Abort_IT

Function name	HAL_StatusTypeDef HAL_I2C_Master_Abort_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress)
Function description	Abort a master I2C IT or DMA process communication with Interrupt.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_Master_Transmit_DMA

Function name	HAL_StatusTypeDef HAL_I2C_Master_Transmit_DMA (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size)
Function description	Transmit in master mode an amount of data in non-blocking mode with DMA.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • pData: Pointer to data buffer • Size: Amount of data to be sent
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_Master_Receive_DMA

Function name	HAL_StatusTypeDef HAL_I2C_Master_Receive_DMA (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size)
Function description	Receive in master mode an amount of data in non-blocking mode with DMA.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call

- interface
- **pData:** Pointer to data buffer
 - **Size:** Amount of data to be sent
- Return values
- **HAL:** status

HAL_I2C_Slave_Transmit_DMA

- Function name **HAL_StatusTypeDef HAL_I2C_Slave_Transmit_DMA (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size)**
- Function description Transmit in slave mode an amount of data in non-blocking mode with DMA.
- Parameters
- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
 - **pData:** Pointer to data buffer
 - **Size:** Amount of data to be sent
- Return values
- **HAL:** status

HAL_I2C_Slave_Receive_DMA

- Function name **HAL_StatusTypeDef HAL_I2C_Slave_Receive_DMA (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size)**
- Function description Receive in slave mode an amount of data in non-blocking mode with DMA.
- Parameters
- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
 - **pData:** Pointer to data buffer
 - **Size:** Amount of data to be sent
- Return values
- **HAL:** status

HAL_I2C_Mem_Write_DMA

- Function name **HAL_StatusTypeDef HAL_I2C_Mem_Write_DMA (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint16_t MemAddress, uint16_t MemAddSize, uint8_t * pData, uint16_t Size)**
- Function description Write an amount of data in non-blocking mode with DMA to a specific memory address.
- Parameters
- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
 - **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shift at right before call interface
 - **MemAddress:** Internal memory address
 - **MemAddSize:** Size of internal memory address
 - **pData:** Pointer to data buffer
 - **Size:** Amount of data to be sent
- Return values
- **HAL:** status

HAL_I2C_Mem_Read_DMA

Function name	HAL_StatusTypeDef HAL_I2C_Mem_Read_DMA (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint16_t MemAddress, uint16_t MemAddSize, uint8_t * pData, uint16_t Size)
Function description	Reads an amount of data in non-blocking mode with DMA from a specific memory address.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • MemAddress: Internal memory address • MemAddSize: Size of internal memory address • pData: Pointer to data buffer • Size: Amount of data to be read
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2C_EV_IRQHandler

Function name	void HAL_I2C_EV_IRQHandler (I2C_HandleTypeDef * hi2c)
Function description	This function handles I2C event interrupt request.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • None:

HAL_I2C_ER_IRQHandler

Function name	void HAL_I2C_ER_IRQHandler (I2C_HandleTypeDef * hi2c)
Function description	This function handles I2C error interrupt request.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • None:

HAL_I2C_MasterTxCpltCallback

Function name	void HAL_I2C_MasterTxCpltCallback (I2C_HandleTypeDef * hi2c)
Function description	Master Tx Transfer completed callback.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • None:

HAL_I2C_MasterRxCpltCallback

Function name	void HAL_I2C_MasterRxCpltCallback (I2C_HandleTypeDef * hi2c)
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Function description	Master Rx Transfer completed callback.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • None:

HAL_I2C_SlaveTxCpltCallback

Function name	void HAL_I2C_SlaveTxCpltCallback (I2C_HandleTypeDef * hi2c)
Function description	Slave Tx Transfer completed callback.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • None:

HAL_I2C_SlaveRxCpltCallback

Function name	void HAL_I2C_SlaveRxCpltCallback (I2C_HandleTypeDef * hi2c)
Function description	Slave Rx Transfer completed callback.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • None:

HAL_I2C_AddrCallback

Function name	void HAL_I2C_AddrCallback (I2C_HandleTypeDef * hi2c, uint8_t TransferDirection, uint16_t AddrMatchCode)
Function description	Slave Address Match callback.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C. • TransferDirection: Master request Transfer Direction (Write/Read), value of I2C Transfer Direction Master Point of View • AddrMatchCode: Address Match Code
Return values	<ul style="list-style-type: none"> • None:

HAL_I2C_ListenCpltCallback

Function name	void HAL_I2C_ListenCpltCallback (I2C_HandleTypeDef * hi2c)
Function description	Listen Complete callback.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • None:

HAL_I2C_MemTxCpltCallback

Function name	void HAL_I2C_MemTxCpltCallback (I2C_HandleTypeDef * hi2c)
Function description	Memory Tx Transfer completed callback.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • None:

HAL_I2C_MemRxCpltCallback

Function name	void HAL_I2C_MemRxCpltCallback (I2C_HandleTypeDef * hi2c)
Function description	Memory Rx Transfer completed callback.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • None:

HAL_I2C_ErrorCallback

Function name	void HAL_I2C_ErrorCallback (I2C_HandleTypeDef * hi2c)
Function description	I2C error callback.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • None:

HAL_I2C_AbortCpltCallback

Function name	void HAL_I2C_AbortCpltCallback (I2C_HandleTypeDef * hi2c)
Function description	I2C abort callback.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • None:

HAL_I2C_GetState

Function name	HAL_I2C_StateTypeDef HAL_I2C_GetState (I2C_HandleTypeDef * hi2c)
Function description	Return the I2C handle state.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> • HAL: state

HAL_I2C_GetMode

Function name	HAL_I2C_ModeTypeDef HAL_I2C_GetMode
---------------	--

(I2C_HandleTypeDef * hi2c)

Function description	Returns the I2C Master, Slave, Memory or no mode.
Parameters	<ul style="list-style-type: none"> hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for I2C module
Return values	<ul style="list-style-type: none"> HAL: mode

HAL_I2C_GetError

Function name	uint32_t HAL_I2C_GetError (I2C_HandleTypeDef * hi2c)
Function description	Return the I2C error code.
Parameters	<ul style="list-style-type: none"> hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
Return values	<ul style="list-style-type: none"> I2C: Error Code

31.3 I2C Firmware driver defines**31.3.1 I2C*****I2C Addressing Mode***

I2C_ADDRESSINGMODE_7BIT

I2C_ADDRESSINGMODE_10BIT

I2C Dual Addressing Mode

I2C_DUALADDRESS_DISABLE

I2C_DUALADDRESS_ENABLE

I2C Error Code definition

HAL_I2C_ERROR_NONE	No error
HAL_I2C_ERROR_BERR	BERR error
HAL_I2C_ERROR_ARLO	ARLO error
HAL_I2C_ERROR_AF	ACKF error
HAL_I2C_ERROR_OVR	OVR error
HAL_I2C_ERROR_DMA	DMA transfer error
HAL_I2C_ERROR_TIMEOUT	Timeout error
HAL_I2C_ERROR_SIZE	Size Management error

I2C Exported Macros

__HAL_I2C_RESET_HANDLE_STATE	Description:
	<ul style="list-style-type: none"> Reset I2C handle state.
	Parameters:
	<ul style="list-style-type: none"> __HANDLE__: specifies the I2C Handle.
	Return value:
	<ul style="list-style-type: none"> None

`__HAL_I2C_ENABLE_IT`**Description:**

- Enable the specified I2C interrupt.

Parameters:

- `__HANDLE__`: specifies the I2C Handle.
- `__INTERRUPT__`: specifies the interrupt source to enable. This parameter can be one of the following values:
 - `I2C_IT_ERRI` Errors interrupt enable
 - `I2C_IT_TCI` Transfer complete interrupt enable
 - `I2C_IT_STOPI` STOP detection interrupt enable
 - `I2C_IT_NACKI` NACK received interrupt enable
 - `I2C_IT_ADDRI` Address match interrupt enable
 - `I2C_IT_RXI` RX interrupt enable
 - `I2C_IT_TXI` TX interrupt enable

Return value:

- None

`__HAL_I2C_DISABLE_IT`**Description:**

- Disable the specified I2C interrupt.

Parameters:

- `__HANDLE__`: specifies the I2C Handle.
- `__INTERRUPT__`: specifies the interrupt source to disable. This parameter can be one of the following values:
 - `I2C_IT_ERRI` Errors interrupt enable
 - `I2C_IT_TCI` Transfer complete interrupt enable
 - `I2C_IT_STOPI` STOP detection interrupt enable
 - `I2C_IT_NACKI` NACK received interrupt enable
 - `I2C_IT_ADDRI` Address match interrupt enable
 - `I2C_IT_RXI` RX interrupt enable
 - `I2C_IT_TXI` TX interrupt enable

Return value:

- None

`__HAL_I2C_GET_IT_SOURCE`**Description:**

- Check whether the specified I2C interrupt source is enabled or not.

Parameters:

- `__HANDLE__`: specifies the I2C Handle.
- `__INTERRUPT__`: specifies the I2C

interrupt source to check. This parameter can be one of the following values:

- I2C_IT_ERRI Errors interrupt enable
- I2C_IT_TCI Transfer complete interrupt enable
- I2C_IT_STOPI STOP detection interrupt enable
- I2C_IT_NACKI NACK received interrupt enable
- I2C_IT_ADDRI Address match interrupt enable
- I2C_IT_RXI RX interrupt enable
- I2C_IT_TXI TX interrupt enable

Return value:

- The: new state of `__INTERRUPT__` (SET or RESET).

`__HAL_I2C_GET_FLAG`

Description:

- Check whether the specified I2C flag is set or not.

Parameters:

- `__HANDLE__`: specifies the I2C Handle.
- `__FLAG__`: specifies the flag to check. This parameter can be one of the following values:
 - I2C_FLAG_TXE Transmit data register empty
 - I2C_FLAG_TXIS Transmit interrupt status
 - I2C_FLAG_RXNE Receive data register not empty
 - I2C_FLAG_ADDR Address matched (slave mode)
 - I2C_FLAG_AF Acknowledge failure received flag
 - I2C_FLAG_STOPF STOP detection flag
 - I2C_FLAG_TC Transfer complete (master mode)
 - I2C_FLAG_TCR Transfer complete reload
 - I2C_FLAG_BERR Bus error
 - I2C_FLAG_ARLO Arbitration lost
 - I2C_FLAG_OVR Overrun/Underrun
 - I2C_FLAG_PECERR PEC error in reception
 - I2C_FLAG_TIMEOUT Timeout or Tlow detection flag
 - I2C_FLAG_ALERT SMBus alert
 - I2C_FLAG_BUSY Bus busy
 - I2C_FLAG_DIR Transfer direction

(slave mode)

`__HAL_I2C_CLEAR_FLAG`**Return value:**

- The: new state of `__FLAG__` (SET or RESET).

Description:

- Clear the I2C pending flags which are cleared by writing 1 in a specific bit.

Parameters:

- `__HANDLE__`: specifies the I2C Handle.
- `__FLAG__`: specifies the flag to clear. This parameter can be any combination of the following values:
 - `I2C_FLAG_TXE` Transmit data register empty
 - `I2C_FLAG_ADDR` Address matched (slave mode)
 - `I2C_FLAG_AF` Acknowledge failure received flag
 - `I2C_FLAG_STOPF` STOP detection flag
 - `I2C_FLAG_BERR` Bus error
 - `I2C_FLAG_ARLO` Arbitration lost
 - `I2C_FLAG_OVR` Overrun/Underrun
 - `I2C_FLAG_PECERR` PEC error in reception
 - `I2C_FLAG_TIMEOUT` Timeout or Tlow detection flag
 - `I2C_FLAG_ALERT` SMBus alert

Return value:

- None

Description:

- Enable the specified I2C peripheral.

Parameters:

- `__HANDLE__`: specifies the I2C Handle.

Return value:

- None

`__HAL_I2C_ENABLE``__HAL_I2C_DISABLE`**Description:**

- Disable the specified I2C peripheral.

Parameters:

- `__HANDLE__`: specifies the I2C Handle.

Return value:

- None

`__HAL_I2C_GENERATE_NACK`**Description:**

- Generate a Non-Acknowledge I2C peripheral in Slave mode.

Parameters:

- `__HANDLE__`: specifies the I2C Handle.

Return value:

- None

I2C Flag definition

I2C_FLAG_TXE

I2C_FLAG_TXIS

I2C_FLAG_RXNE

I2C_FLAG_ADDR

I2C_FLAG_AF

I2C_FLAG_STOPF

I2C_FLAG_TC

I2C_FLAG_TCR

I2C_FLAG_BERR

I2C_FLAG_ARLO

I2C_FLAG_OVR

I2C_FLAG_PECERR

I2C_FLAG_TIMEOUT

I2C_FLAG_ALERT

I2C_FLAG_BUSY

I2C_FLAG_DIR

I2C General Call Addressing Mode

I2C_GENERALCALL_DISABLE

I2C_GENERALCALL_ENABLE

I2C Interrupt configuration definition

I2C_IT_ERRI

I2C_IT_TCI

I2C_IT_STOPI

I2C_IT_NACKI

I2C_IT_ADDRI

I2C_IT_RXI

I2C_IT_TXI

I2C Memory Address Size

I2C_MEMADD_SIZE_8BIT

I2C_MEMADD_SIZE_16BIT

I2C No-Stretch Mode

I2C_NOSTRETCH_DISABLE

I2C_NOSTRETCH_ENABLE

I2C Own Address2 Masks

I2C_OA2_NOMASK

I2C_OA2_MASK01

I2C_OA2_MASK02

I2C_OA2_MASK03

I2C_OA2_MASK04

I2C_OA2_MASK05

I2C_OA2_MASK06

I2C_OA2_MASK07

I2C Reload End Mode

I2C_RELOAD_MODE

I2C_AUTOEND_MODE

I2C_SOFTEND_MODE

I2C Start or Stop Mode

I2C_NO_STARTSTOP

I2C_GENERATE_STOP

I2C_GENERATE_START_READ

I2C_GENERATE_START_WRITE

I2C Transfer Direction Master Point of View

I2C_DIRECTION_TRANSMIT

I2C_DIRECTION_RECEIVE

I2C Sequential Transfer Options

I2C_FIRST_FRAME

I2C_FIRST_AND_NEXT_FRAME

I2C_NEXT_FRAME

I2C_FIRST_AND_LAST_FRAME

I2C_LAST_FRAME

32 HAL I2C Extension Driver

32.1 I2CEx Firmware driver API description

32.1.1 I2C peripheral Extended features

Comparing to other previous devices, the I2C interface for STM32F7xx devices contains the following additional features

- Possibility to disable or enable Analog Noise Filter
- Use of a configured Digital Noise Filter
- Disable or enable Fast Mode Plus

32.1.2 How to use this driver

This driver provides functions to:

1. Configure I2C Analog noise filter using the function `HAL_I2CEx_ConfigAnalogFilter()`
2. Configure I2C Digital noise filter using the function `HAL_I2CEx_ConfigDigitalFilter()`
3. Configure the enable or disable of fast mode plus driving capability using the functions
 - `HAL_I2CEx_EnableFastModePlus()`
 - `HAL_I2CEx_DisableFastModePlus()`

32.1.3 Extended features functions

This section provides functions allowing to:

- Configure Noise Filters
- Configure Fast Mode Plus

This section contains the following APIs:

- [HAL_I2CEx_ConfigAnalogFilter\(\)](#)
- [HAL_I2CEx_ConfigDigitalFilter\(\)](#)
- [HAL_I2CEx_EnableFastModePlus\(\)](#)
- [HAL_I2CEx_DisableFastModePlus\(\)](#)

32.1.4 Detailed description of functions

HAL_I2CEx_ConfigAnalogFilter

Function name `HAL_StatusTypeDef HAL_I2CEx_ConfigAnalogFilter(I2C_HandleTypeDef * hi2c, uint32_t AnalogFilter)`

Function description Configure I2C Analog noise filter.

Parameters

- **hi2c**: Pointer to a `I2C_HandleTypeDef` structure that contains the configuration information for the specified I2Cx peripheral.
- **AnalogFilter**: New state of the Analog filter.

Return values

- **HAL**: status

HAL_I2CEx_ConfigDigitalFilter

Function name `HAL_StatusTypeDef HAL_I2CEx_ConfigDigitalFilter`

(I2C_HandleTypeDef * hi2c, uint32_t DigitalFilter)

Function description	Configure I2C Digital noise filter.
Parameters	<ul style="list-style-type: none"> • hi2c: Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2Cx peripheral. • DigitalFilter: Coefficient of digital noise filter between Min_Data=0x00 and Max_Data=0x0F.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2CEx_EnableFastModePlus

Function name	void HAL_I2CEx_EnableFastModePlus (uint32_t ConfigFastModePlus)
Function description	Enable the I2C fast mode plus driving capability.
Parameters	<ul style="list-style-type: none"> • ConfigFastModePlus: Selects the pin. This parameter can be one of the I2C Extended Fast Mode Plus values
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • For I2C1, fast mode plus driving capability can be enabled on all selected I2C1 pins using I2C_FASTMODEPLUS_I2C1 parameter or independently on each one of the following pins PB6, PB7, PB8 and PB9. • For remaining I2C1 pins (PA14, PA15...) fast mode plus driving capability can be enabled only by using I2C_FASTMODEPLUS_I2C1 parameter. • For all I2C2 pins fast mode plus driving capability can be enabled only by using I2C_FASTMODEPLUS_I2C2 parameter. • For all I2C3 pins fast mode plus driving capability can be enabled only by using I2C_FASTMODEPLUS_I2C3 parameter. • For all I2C4 pins fast mode plus driving capability can be enabled only by using I2C_FASTMODEPLUS_I2C4 parameter.

HAL_I2CEx_DisableFastModePlus

Function name	void HAL_I2CEx_DisableFastModePlus (uint32_t ConfigFastModePlus)
Function description	Disable the I2C fast mode plus driving capability.
Parameters	<ul style="list-style-type: none"> • ConfigFastModePlus: Selects the pin. This parameter can be one of the I2C Extended Fast Mode Plus values
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • For I2C1, fast mode plus driving capability can be disabled on all selected I2C1 pins using I2C_FASTMODEPLUS_I2C1 parameter or independently on each one of the following pins PB6, PB7, PB8 and PB9. • For remaining I2C1 pins (PA14, PA15...) fast mode plus driving capability can be disabled only by using I2C_FASTMODEPLUS_I2C1 parameter.

- For all I2C2 pins fast mode plus driving capability can be disabled only by using I2C_FASTMODEPLUS_I2C2 parameter.
- For all I2C3 pins fast mode plus driving capability can be disabled only by using I2C_FASTMODEPLUS_I2C3 parameter.
- For all I2C4 pins fast mode plus driving capability can be disabled only by using I2C_FASTMODEPLUS_I2C4 parameter.

32.2 I2CEx Firmware driver defines

32.2.1 I2CEx

I2C Extended Analog Filter

I2C_ANALOGFILTER_ENABLE

I2C_ANALOGFILTER_DISABLE

I2C Extended Fast Mode Plus

I2C_FMP_NOT_SUPPORTED	Fast Mode Plus not supported
I2C_FASTMODEPLUS_PB6	Enable Fast Mode Plus on PB6
I2C_FASTMODEPLUS_PB7	Enable Fast Mode Plus on PB7
I2C_FASTMODEPLUS_PB8	Enable Fast Mode Plus on PB8
I2C_FASTMODEPLUS_PB9	Enable Fast Mode Plus on PB9
I2C_FASTMODEPLUS_I2C1	Enable Fast Mode Plus on I2C1 pins
I2C_FASTMODEPLUS_I2C2	Enable Fast Mode Plus on I2C2 pins
I2C_FASTMODEPLUS_I2C3	Enable Fast Mode Plus on I2C3 pins
I2C_FASTMODEPLUS_I2C4	Enable Fast Mode Plus on I2C4 pins

33 HAL I2S Generic Driver

33.1 I2S Firmware driver registers structures

33.1.1 I2S_InitTypeDef

Data Fields

- *uint32_t Mode*
- *uint32_t Standard*
- *uint32_t DataFormat*
- *uint32_t MCLKOutput*
- *uint32_t AudioFreq*
- *uint32_t CPOL*
- *uint32_t ClockSource*

Field Documentation

- *uint32_t I2S_InitTypeDef::Mode*
Specifies the I2S operating mode. This parameter can be a value of [I2S_Mode](#)
- *uint32_t I2S_InitTypeDef::Standard*
Specifies the standard used for the I2S communication. This parameter can be a value of [I2S_Standard](#)
- *uint32_t I2S_InitTypeDef::DataFormat*
Specifies the data format for the I2S communication. This parameter can be a value of [I2S_Data_Format](#)
- *uint32_t I2S_InitTypeDef::MCLKOutput*
Specifies whether the I2S MCLK output is enabled or not. This parameter can be a value of [I2S_MCLK_Output](#)
- *uint32_t I2S_InitTypeDef::AudioFreq*
Specifies the frequency selected for the I2S communication. This parameter can be a value of [I2S_Audio_Frequency](#)
- *uint32_t I2S_InitTypeDef::CPOL*
Specifies the idle state of the I2S clock. This parameter can be a value of [I2S_Clock_Polarity](#)
- *uint32_t I2S_InitTypeDef::ClockSource*
Specifies the I2S Clock Source. This parameter can be a value of [I2S_Clock_Source](#)

33.1.2 I2S_HandleTypeDef

Data Fields

- *SPI_TypeDef * Instance*
- *I2S_InitTypeDef Init*
- *uint16_t * pTxBuffPtr*
- *__IO uint16_t TxXferSize*
- *__IO uint16_t TxXferCount*
- *uint16_t * pRxBuffPtr*
- *__IO uint16_t RxXferSize*
- *__IO uint16_t RxXferCount*
- *DMA_HandleTypeDef * hdmatx*
- *DMA_HandleTypeDef * hdmarx*
- *__IO HAL_LockTypeDef Lock*
- *__IO HAL_I2S_StateTypeDef State*

- `__IO uint32_t ErrorCode`

Field Documentation

- `SPI_TypeDef* I2S_HandleTypeDef::Instance`
- `I2S_InitTypeDef I2S_HandleTypeDef::Init`
- `uint16_t* I2S_HandleTypeDef::pTxBuffPtr`
- `__IO uint16_t I2S_HandleTypeDef::TxXferSize`
- `__IO uint16_t I2S_HandleTypeDef::TxXferCount`
- `uint16_t* I2S_HandleTypeDef::pRxBuffPtr`
- `__IO uint16_t I2S_HandleTypeDef::RxXferSize`
- `__IO uint16_t I2S_HandleTypeDef::RxXferCount`
- `DMA_HandleTypeDef* I2S_HandleTypeDef::hdmatx`
- `DMA_HandleTypeDef* I2S_HandleTypeDef::hdmarx`
- `__IO HAL_LockTypeDef I2S_HandleTypeDef::Lock`
- `__IO HAL_I2S_StateTypeDef I2S_HandleTypeDef::State`
- `__IO uint32_t I2S_HandleTypeDef::ErrorCode`

33.2 I2S Firmware driver API description

33.2.1 How to use this driver

The I2S HAL driver can be used as follows:

1. Declare a `I2S_HandleTypeDef` handle structure.
2. Initialize the I2S low level resources by implement the `HAL_I2S_MspInit()` API:
 - a. Enable the SPIx interface clock.
 - b. I2S pins configuration:
 - Enable the clock for the I2S GPIOs.
 - Configure these I2S pins as alternate function pull-up.
 - c. NVIC configuration if you need to use interrupt process (`HAL_I2S_Transmit_IT()` and `HAL_I2S_Receive_IT()` APIs).
 - Configure the I2Sx interrupt priority.
 - Enable the NVIC I2S IRQ handle.
 - d. DMA Configuration if you need to use DMA process (`HAL_I2S_Transmit_DMA()` and `HAL_I2S_Receive_DMA()` APIs):
 - Declare a DMA handle structure for the Tx/Rx channel.
 - Enable the DMAx interface clock.
 - Configure the declared DMA handle structure with the required Tx/Rx parameters.
 - Configure the DMA Tx/Rx Channel.
 - Associate the initialized DMA handle to the I2S DMA Tx/Rx handle.
 - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx/Rx Channel.
3. Program the Mode, Standard, Data Format, MCLK Output, Audio frequency and Polarity using `HAL_I2S_Init()` function. The specific I2S interrupts (Transmission complete interrupt, RXNE interrupt and Error Interrupts) will be managed using the macros `__HAL_I2S_ENABLE_IT()` and `__HAL_I2S_DISABLE_IT()` inside the transmit and receive process. Make sure that either: I2S clock is configured based on `SYSCCLK` or External clock source is configured after setting correctly the define constant `EXTERNAL_CLOCK_VALUE` in the `stm32f3xx_hal_conf.h` file.
4. Three mode of operations are available within this driver :

Polling mode IO operation

- Send an amount of data in blocking mode using `HAL_I2S_Transmit()`

- Receive an amount of data in blocking mode using HAL_I2S_Receive()

Interrupt mode IO operation

- Send an amount of data in non blocking mode using HAL_I2S_Transmit_IT()
- At transmission end of half transfer HAL_I2S_TxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_TxHalfCpltCallback
- At transmission end of transfer HAL_I2S_TxCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_TxCpltCallback
- Receive an amount of data in non blocking mode using HAL_I2S_Receive_IT()
- At reception end of half transfer HAL_I2S_RxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_RxHalfCpltCallback
- At reception end of transfer HAL_I2S_RxCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_RxCpltCallback
- In case of transfer Error, HAL_I2S_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_I2S_ErrorCallback

DMA mode IO operation

- Send an amount of data in non blocking mode (DMA) using HAL_I2S_Transmit_DMA()
- At transmission end of half transfer HAL_I2S_TxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_TxHalfCpltCallback
- At transmission end of transfer HAL_I2S_TxCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_TxCpltCallback
- Receive an amount of data in non blocking mode (DMA) using HAL_I2S_Receive_DMA()
- At reception end of half transfer HAL_I2S_RxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_RxHalfCpltCallback
- At reception end of transfer HAL_I2S_RxCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_RxCpltCallback
- In case of transfer Error, HAL_I2S_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_I2S_ErrorCallback
- Pause the DMA Transfer using HAL_I2S_DMABase()
- Resume the DMA Transfer using HAL_I2S_DMAResume()
- Stop the DMA Transfer using HAL_I2S_DMAStop()

I2S HAL driver macros list

Below the list of most used macros in I2S HAL driver.

- __HAL_I2S_ENABLE: Enable the specified SPI peripheral (in I2S mode)
- __HAL_I2S_DISABLE: Disable the specified SPI peripheral (in I2S mode)
- __HAL_I2S_ENABLE_IT : Enable the specified I2S interrupts
- __HAL_I2S_DISABLE_IT : Disable the specified I2S interrupts
- __HAL_I2S_GET_FLAG: Check whether the specified I2S flag is set or not



You can refer to the I2S HAL driver header file for more useful macros

33.2.2 Initialization and de-initialization functions

This subsection provides a set of functions allowing to initialize and de-initialize the I2Sx peripheral in simplex mode:

- User must Implement HAL_I2S_MspInit() function in which he configures all related peripherals resources (CLOCK, GPIO, DMA, IT and NVIC).
- Call the function HAL_I2S_Init() to configure the selected device with the selected configuration:
 - Mode
 - Standard
 - Data Format
 - MCLK Output
 - Audio frequency
 - Polarity
 - Full duplex mode
- Call the function HAL_I2S_DeInit() to restore the default configuration of the selected I2Sx peripheral.

This section contains the following APIs:

- [HAL_I2S_Init\(\)](#)
- [HAL_I2S_DeInit\(\)](#)
- [HAL_I2S_MspInit\(\)](#)
- [HAL_I2S_MspDeInit\(\)](#)

33.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the I2S data transfers.

1. There are two modes of transfer:
 - Blocking mode : The communication is performed in the polling mode. The status of all data processing is returned by the same function after finishing transfer.
 - No-Blocking mode : The communication is performed using Interrupts or DMA. These functions return the status of the transfer startup. The end of the data processing will be indicated through the dedicated I2S IRQ when using Interrupt mode or the DMA IRQ when using DMA mode.
2. Blocking mode functions are :
 - HAL_I2S_Transmit()
 - HAL_I2S_Receive()
3. No-Blocking mode functions with Interrupt are :
 - HAL_I2S_Transmit_IT()
 - HAL_I2S_Receive_IT()
4. No-Blocking mode functions with DMA are :
 - HAL_I2S_Transmit_DMA()
 - HAL_I2S_Receive_DMA()
5. A set of Transfer Complete Callbacks are provided in non Blocking mode:
 - HAL_I2S_TxCpltCallback()
 - HAL_I2S_RxCpltCallback()
 - HAL_I2S_ErrorCallback()

This section contains the following APIs:

- [HAL_I2S_Transmit\(\)](#)
- [HAL_I2S_Receive\(\)](#)
- [HAL_I2S_Transmit_IT\(\)](#)
- [HAL_I2S_Receive_IT\(\)](#)

- [HAL_I2S_Transmit_DMA\(\)](#)
- [HAL_I2S_Receive_DMA\(\)](#)
- [HAL_I2S_DMAMPause\(\)](#)
- [HAL_I2S_DMAResume\(\)](#)
- [HAL_I2S_DMAStop\(\)](#)
- [HAL_I2S_IRQHandler\(\)](#)
- [HAL_I2S_TxHalfCpltCallback\(\)](#)
- [HAL_I2S_TxCpltCallback\(\)](#)
- [HAL_I2S_RxHalfCpltCallback\(\)](#)
- [HAL_I2S_RxCpltCallback\(\)](#)
- [HAL_I2S_ErrorCallback\(\)](#)

33.2.4 Peripheral State and Errors functions

This subsection permits to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- [HAL_I2S_GetState\(\)](#)
- [HAL_I2S_GetError\(\)](#)

33.2.5 Detailed description of functions

HAL_I2S_Init

Function name	HAL_StatusTypeDef HAL_I2S_Init (I2S_HandleTypeDef * hi2s)
Function description	Initializes the I2S according to the specified parameters in the I2S_InitTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none"> • hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2S_DeInit

Function name	HAL_StatusTypeDef HAL_I2S_DeInit (I2S_HandleTypeDef * hi2s)
Function description	DeInitializes the I2S peripheral.
Parameters	<ul style="list-style-type: none"> • hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_I2S_Msplnit

Function name	void HAL_I2S_Msplnit (I2S_HandleTypeDef * hi2s)
Function description	I2S MSP Init.
Parameters	<ul style="list-style-type: none"> • hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	<ul style="list-style-type: none"> • None:

HAL_I2S_MspDelnit

Function name **void HAL_I2S_MspDelnit (I2S_HandleTypeDef * hi2s)**

Function description I2S MSP Delnit.

Parameters

- **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module

Return values

- **None:**

HAL_I2S_Transmit

Function name **HAL_StatusTypeDef HAL_I2S_Transmit (I2S_HandleTypeDef * hi2s, uint16_t * pData, uint16_t Size, uint32_t Timeout)**

Function description Transmit an amount of data in blocking mode.

Parameters

- **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
- **pData:** a 16-bit pointer to data buffer.
- **Size:** number of data sample to be sent:
- **Timeout:** Timeout duration

Return values

- **HAL:** status

Notes

- When a 16-bit data frame or a 16-bit data frame extended is selected during the I2S configuration phase, the Size parameter means the number of 16-bit data length in the transaction and when a 24-bit data frame or a 32-bit data frame is selected the Size parameter means the number of 16-bit data length.
- The I2S is kept enabled at the end of transaction to avoid the clock de-synchronization between Master and Slave(example: audio streaming).

HAL_I2S_Receive

Function name **HAL_StatusTypeDef HAL_I2S_Receive (I2S_HandleTypeDef * hi2s, uint16_t * pData, uint16_t Size, uint32_t Timeout)**

Function description Receive an amount of data in blocking mode.

Parameters

- **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
- **pData:** a 16-bit pointer to data buffer.
- **Size:** number of data sample to be sent:
- **Timeout:** Timeout duration

Return values

- **HAL:** status

Notes

- When a 16-bit data frame or a 16-bit data frame extended is selected during the I2S configuration phase, the Size parameter means the number of 16-bit data length in the transaction and when a 24-bit data frame or a 32-bit data frame is selected the Size parameter means the number of 16-bit data length.
- The I2S is kept enabled at the end of transaction to avoid the clock de-synchronization between Master and Slave(example: audio streaming).

- In I2S Master Receiver mode, just after enabling the peripheral the clock will be generate in continuous way and as the I2S is not disabled at the end of the I2S transaction.

HAL_I2S_Transmit_IT

Function name	HAL_StatusTypeDef HAL_I2S_Transmit_IT (I2S_HandleTypeDef * hi2s, uint16_t * pData, uint16_t Size)
Function description	Transmit an amount of data in non-blocking mode with Interrupt.
Parameters	<ul style="list-style-type: none"> • hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module • pData: a 16-bit pointer to data buffer. • Size: number of data sample to be sent:
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • When a 16-bit data frame or a 16-bit data frame extended is selected during the I2S configuration phase, the Size parameter means the number of 16-bit data length in the transaction and when a 24-bit data frame or a 32-bit data frame is selected the Size parameter means the number of 16-bit data length. • The I2S is kept enabled at the end of transaction to avoid the clock de-synchronization between Master and Slave(example: audio streaming).

HAL_I2S_Receive_IT

Function name	HAL_StatusTypeDef HAL_I2S_Receive_IT (I2S_HandleTypeDef * hi2s, uint16_t * pData, uint16_t Size)
Function description	Receive an amount of data in non-blocking mode with Interrupt.
Parameters	<ul style="list-style-type: none"> • hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module • pData: a 16-bit pointer to the Receive data buffer. • Size: number of data sample to be sent:
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • When a 16-bit data frame or a 16-bit data frame extended is selected during the I2S configuration phase, the Size parameter means the number of 16-bit data length in the transaction and when a 24-bit data frame or a 32-bit data frame is selected the Size parameter means the number of 16-bit data length. • The I2S is kept enabled at the end of transaction to avoid the clock de-synchronization between Master and Slave(example: audio streaming). • It is recommended to use DMA for the I2S receiver to avoid de-synchronisation between Master and Slave otherwise the I2S interrupt should be optimized.

HAL_I2S_IRQHandler

Function name	void HAL_I2S_IRQHandler (I2S_HandleTypeDef * hi2s)
Function description	This function handles I2S interrupt request.
Parameters	<ul style="list-style-type: none">• hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	<ul style="list-style-type: none">• HAL: status

HAL_I2S_Transmit_DMA

Function name	HAL_StatusTypeDef HAL_I2S_Transmit_DMA (I2S_HandleTypeDef * hi2s, uint16_t * pData, uint16_t Size)
Function description	Transmit an amount of data in non-blocking mode with DMA.
Parameters	<ul style="list-style-type: none">• hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module• pData: a 16-bit pointer to the Transmit data buffer.• Size: number of data sample to be sent:
Return values	<ul style="list-style-type: none">• HAL: status
Notes	<ul style="list-style-type: none">• When a 16-bit data frame or a 16-bit data frame extended is selected during the I2S configuration phase, the Size parameter means the number of 16-bit data length in the transaction and when a 24-bit data frame or a 32-bit data frame is selected the Size parameter means the number of 16-bit data length.• The I2S is kept enabled at the end of transaction to avoid the clock de-synchronization between Master and Slave(example: audio streaming).

HAL_I2S_Receive_DMA

Function name	HAL_StatusTypeDef HAL_I2S_Receive_DMA (I2S_HandleTypeDef * hi2s, uint16_t * pData, uint16_t Size)
Function description	Receive an amount of data in non-blocking mode with DMA.
Parameters	<ul style="list-style-type: none">• hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module• pData: a 16-bit pointer to the Receive data buffer.• Size: number of data sample to be sent:
Return values	<ul style="list-style-type: none">• HAL: status
Notes	<ul style="list-style-type: none">• When a 16-bit data frame or a 16-bit data frame extended is selected during the I2S configuration phase, the Size parameter means the number of 16-bit data length in the transaction and when a 24-bit data frame or a 32-bit data frame is selected the Size parameter means the number of 16-bit data length.• The I2S is kept enabled at the end of transaction to avoid the clock de-synchronization between Master and Slave(example: audio streaming).

HAL_I2S_DMAPause

Function name	HAL_StatusTypeDef HAL_I2S_DMAPause (I2S_HandleTypeDef * hi2s)
Function description	Pauses the audio stream playing from the Media.
Parameters	<ul style="list-style-type: none">• hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	<ul style="list-style-type: none">• HAL: status

HAL_I2S_DMAResume

Function name	HAL_StatusTypeDef HAL_I2S_DMAResume (I2S_HandleTypeDef * hi2s)
Function description	Resumes the audio stream playing from the Media.
Parameters	<ul style="list-style-type: none">• hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	<ul style="list-style-type: none">• HAL: status

HAL_I2S_DMAStop

Function name	HAL_StatusTypeDef HAL_I2S_DMAStop (I2S_HandleTypeDef * hi2s)
Function description	Stops the audio stream playing from the Media.
Parameters	<ul style="list-style-type: none">• hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	<ul style="list-style-type: none">• HAL: status

HAL_I2S_TxHalfCpltCallback

Function name	void HAL_I2S_TxHalfCpltCallback (I2S_HandleTypeDef * hi2s)
Function description	Tx Transfer Half completed callbacks.
Parameters	<ul style="list-style-type: none">• hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	<ul style="list-style-type: none">• None:

HAL_I2S_TxCpltCallback

Function name	void HAL_I2S_TxCpltCallback (I2S_HandleTypeDef * hi2s)
Function description	Tx Transfer completed callbacks.
Parameters	<ul style="list-style-type: none">• hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	<ul style="list-style-type: none">• None:

HAL_I2S_RxHalfCpltCallback

Function name	void HAL_I2S_RxHalfCpltCallback (I2S_HandleTypeDef * hi2s)
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Function description	Rx Transfer half completed callbacks.
Parameters	<ul style="list-style-type: none"> • hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	<ul style="list-style-type: none"> • None:

HAL_I2S_RxCpltCallback

Function name	void HAL_I2S_RxCpltCallback (I2S_HandleTypeDef * hi2s)
Function description	Rx Transfer completed callbacks.
Parameters	<ul style="list-style-type: none"> • hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	<ul style="list-style-type: none"> • None:

HAL_I2S_ErrorCallback

Function name	void HAL_I2S_ErrorCallback (I2S_HandleTypeDef * hi2s)
Function description	I2S error callbacks.
Parameters	<ul style="list-style-type: none"> • hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	<ul style="list-style-type: none"> • None:

HAL_I2S_GetState

Function name	HAL_I2S_StateTypeDef HAL_I2S_GetState (I2S_HandleTypeDef * hi2s)
Function description	Return the I2S state.
Parameters	<ul style="list-style-type: none"> • hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	<ul style="list-style-type: none"> • HAL: state

HAL_I2S_GetError

Function name	uint32_t HAL_I2S_GetError (I2S_HandleTypeDef * hi2s)
Function description	Return the I2S error code.
Parameters	<ul style="list-style-type: none"> • hi2s: pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	<ul style="list-style-type: none"> • I2S: Error Code

33.3 I2S Firmware driver defines

33.3.1 I2S

I2S Audio Frequency

I2S_AUDIOFREQ_192K

I2S_AUDIOFREQ_96K

I2S_AUDIOFREQ_48K
 I2S_AUDIOFREQ_44K
 I2S_AUDIOFREQ_32K
 I2S_AUDIOFREQ_22K
 I2S_AUDIOFREQ_16K
 I2S_AUDIOFREQ_11K
 I2S_AUDIOFREQ_8K
 I2S_AUDIOFREQ_DEFAULT

I2S Clock Polarity

I2S_CPOL_LOW
 I2S_CPOL_HIGH

I2S Clock Source

I2S_CLOCK_EXTERNAL
 I2S_CLOCK_PLL

I2S Data Format

I2S_DATAFORMAT_16B
 I2S_DATAFORMAT_16B_EXTENDED
 I2S_DATAFORMAT_24B
 I2S_DATAFORMAT_32B

I2S Error Defintion

HAL_I2S_ERROR_NONE	No error
HAL_I2S_ERROR_TIMEOUT	Timeout error
HAL_I2S_ERROR_OVR	OVR error
HAL_I2S_ERROR_UDR	UDR error
HAL_I2S_ERROR_DMA	DMA transfer error
HAL_I2S_ERROR_UNKNOW	Unknow Error error

I2S Exported Macros

__HAL_I2S_RESET_HANDLE_STATE **Description:**

- Reset I2S handle state.

Parameters:

- **__HANDLE__**: specifies the I2S handle.

Return value:

- None

__HAL_I2S_ENABLE

Description:

- Enable or disable the specified SPI peripheral (in I2S mode).

Parameters:

`__HAL_I2S_DISABLE`
`__HAL_I2S_ENABLE_IT`

- `__HANDLE__`: specifies the I2S Handle.

Return value:

- None

Description:

- Enable or disable the specified I2S interrupts.

Parameters:

- `__HANDLE__`: specifies the I2S Handle.
- `__INTERRUPT__`: specifies the interrupt source to enable or disable. This parameter can be one of the following values:
 - `I2S_IT_TXE`: Tx buffer empty interrupt enable
 - `I2S_IT_RXNE`: RX buffer not empty interrupt enable
 - `I2S_IT_ERR`: Error interrupt enable

Return value:

- None

`__HAL_I2S_DISABLE_IT`
`__HAL_I2S_GET_IT_SOURCE`

Description:

- Checks if the specified I2S interrupt source is enabled or disabled.

Parameters:

- `__HANDLE__`: specifies the I2S Handle. This parameter can be I2S where x: 1, 2, or 3 to select the I2S peripheral.
- `__INTERRUPT__`: specifies the I2S interrupt source to check. This parameter can be one of the following values:
 - `I2S_IT_TXE`: Tx buffer empty interrupt enable
 - `I2S_IT_RXNE`: RX buffer not empty interrupt enable
 - `I2S_IT_ERR`: Error interrupt enable

Return value:

- The: new state of `__IT__` (TRUE or FALSE).

Description:

- Checks whether the specified I2S flag is set or not.

Parameters:

- `__HANDLE__`: specifies the I2S Handle.
- `__FLAG__`: specifies the flag to check. This parameter can be one of the following

`__HAL_I2S_GET_FLAG`

values:

- I2S_FLAG_RXNE: Receive buffer not empty flag
- I2S_FLAG_TXE: Transmit buffer empty flag
- I2S_FLAG_UDR: Underrun flag
- I2S_FLAG_OVR: Overrun flag
- I2S_FLAG_FRE: Frame error flag
- I2S_FLAG_CHSIDE: Channel Side flag
- I2S_FLAG_BSY: Busy flag

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

`__HAL_I2S_CLEAR_OVRFLAG`

Description:

- Clears the I2S OVR pending flag.

Parameters:

- `__HANDLE__`: specifies the I2S Handle.

Return value:

- None

`__HAL_I2S_CLEAR_UDRFLAG`

Description:

- Clears the I2S UDR pending flag.

Parameters:

- `__HANDLE__`: specifies the I2S Handle.

Return value:

- None

I2S Flags Definition

`I2S_FLAG_TXE`

`I2S_FLAG_RXNE`

`I2S_FLAG_UDR`

`I2S_FLAG_OVR`

`I2S_FLAG_FRE`

`I2S_FLAG_CHSIDE`

`I2S_FLAG_BSY`

I2S Interrupts Definition

`I2S_IT_TXE`

`I2S_IT_RXNE`

`I2S_IT_ERR`

I2S Mclk Output

`I2S_MCLKOUTPUT_ENABLE`

I2S_MCLKOUTPUT_DISABLE

I2S Mode

I2S_MODE_SLAVE_TX

I2S_MODE_SLAVE_RX

I2S_MODE_MASTER_TX

I2S_MODE_MASTER_RX

I2S Standard

I2S_STANDARD_PHILIPS

I2S_STANDARD_MSB

I2S_STANDARD_LSB

I2S_STANDARD_PCM_SHORT

I2S_STANDARD_PCM_LONG

34 HAL IRDA Generic Driver

34.1 IRDA Firmware driver registers structures

34.1.1 IRDA_InitTypeDef

Data Fields

- *uint32_t BaudRate*
- *uint32_t WordLength*
- *uint32_t Parity*
- *uint16_t Mode*
- *uint8_t Prescaler*
- *uint16_t PowerMode*

Field Documentation

- *uint32_t IRDA_InitTypeDef::BaudRate*
This member configures the IRDA communication baud rate. The baud rate register is computed using the following formula: Baud Rate Register = ((PCLKx) / ((hirda->Init.BaudRate)))
- *uint32_t IRDA_InitTypeDef::WordLength*
Specifies the number of data bits transmitted or received in a frame. This parameter can be a value of [IRDAEx_Word_Length](#)
- *uint32_t IRDA_InitTypeDef::Parity*
Specifies the parity mode. This parameter can be a value of [IRDA_Parity](#)
Note:When parity is enabled, the computed parity is inserted at the MSB position of the transmitted data (9th bit when the word length is set to 9 data bits; 8th bit when the word length is set to 8 data bits).
- *uint16_t IRDA_InitTypeDef::Mode*
Specifies whether the Receive or Transmit mode is enabled or disabled. This parameter can be a value of [IRDA_Transfer_Mode](#)
- *uint8_t IRDA_InitTypeDef::Prescaler*
Specifies the Prescaler value for dividing the UART/USART source clock to achieve low-power frequency.
Note:Prescaler value 0 is forbidden
- *uint16_t IRDA_InitTypeDef::PowerMode*
Specifies the IRDA power mode. This parameter can be a value of [IRDA_Low_Power](#)

34.1.2 IRDA_HandleTypeDef

Data Fields

- *USART_TypeDef * Instance*
- *IRDA_InitTypeDef Init*
- *uint8_t * pTxBuffPtr*
- *uint16_t TxXferSize*
- *__IO uint16_t TxXferCount*
- *uint8_t * pRxBuffPtr*
- *uint16_t RxXferSize*
- *__IO uint16_t RxXferCount*
- *uint16_t Mask*
- *DMA_HandleTypeDef * hdmatx*
- *DMA_HandleTypeDef * hdmarx*

- *HAL_LockTypeDef Lock*
- *__IO HAL_IRDA_StateTypeDef gState*
- *__IO HAL_IRDA_StateTypeDef RxState*
- *__IO uint32_t ErrorCode*

Field Documentation

- *USART_TypeDef* IRDA_HandleTypeDef::Instance*
- *IRDA_InitTypeDef IRDA_HandleTypeDef::Init*
- *uint8_t* IRDA_HandleTypeDef::pTxBuffPtr*
- *uint16_t IRDA_HandleTypeDef::TxXferSize*
- *__IO uint16_t IRDA_HandleTypeDef::TxXferCount*
- *uint8_t* IRDA_HandleTypeDef::pRxBuffPtr*
- *uint16_t IRDA_HandleTypeDef::RxXferSize*
- *__IO uint16_t IRDA_HandleTypeDef::RxXferCount*
- *uint16_t IRDA_HandleTypeDef::Mask*
- *DMA_HandleTypeDef* IRDA_HandleTypeDef::hdmatx*
- *DMA_HandleTypeDef* IRDA_HandleTypeDef::hdmarx*
- *HAL_LockTypeDef IRDA_HandleTypeDef::Lock*
- *__IO HAL_IRDA_StateTypeDef IRDA_HandleTypeDef::gState*
- *__IO HAL_IRDA_StateTypeDef IRDA_HandleTypeDef::RxState*
- *__IO uint32_t IRDA_HandleTypeDef::ErrorCode*

34.2 IRDA Firmware driver API description

34.2.1 How to use this driver

The IRDA HAL driver can be used as follows:

1. Declare a *IRDA_HandleTypeDef* handle structure (eg. *IRDA_HandleTypeDef hirda*).
2. Initialize the IRDA low level resources by implementing the *HAL_IRDA_MspInit()* API in setting the associated USART or UART in IRDA mode:
 - Enable the USARTx/UARTx interface clock.
 - USARTx/UARTx pins configuration:
 - Enable the clock for the USARTx/UARTx GPIOs.
 - Configure these USARTx/UARTx pins (TX as alternate function pull-up, RX as alternate function Input).
 - NVIC configuration if you need to use interrupt process (*HAL_IRDA_Transmit_IT()* and *HAL_IRDA_Receive_IT()* APIs):
 - Configure the USARTx/UARTx interrupt priority.
 - Enable the NVIC USARTx/UARTx IRQ handle.
 - The specific IRDA interrupts (Transmission complete interrupt, RXNE interrupt and Error Interrupts) will be managed using the macros *__HAL_IRDA_ENABLE_IT()* and *__HAL_IRDA_DISABLE_IT()* inside the transmit and receive process.
 - DMA Configuration if you need to use DMA process (*HAL_IRDA_Transmit_DMA()* and *HAL_IRDA_Receive_DMA()* APIs):
 - Declare a DMA handle structure for the Tx/Rx channel.
 - Enable the DMAx interface clock.
 - Configure the declared DMA handle structure with the required Tx/Rx parameters.
 - Configure the DMA Tx/Rx channel.
 - Associate the initialized DMA handle to the IRDA DMA Tx/Rx handle.
 - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx/Rx channel.

3. Program the Baud Rate, Word Length, Parity, IrDA Mode, Prescaler and Mode(Receiver/Transmitter) in the `hirda Init` structure.
4. Initialize the IRDA registers by calling the `HAL_IRDA_Init()` API:
 - This API configures also the low level Hardware GPIO, CLOCK, CORTEX...etc) by calling the customized `HAL_IRDA_MspInit()` API. The specific IRDA interrupts (Transmission complete interrupt, RXNE interrupt and Error Interrupts) will be managed using the macros `__HAL_IRDA_ENABLE_IT()` and `__HAL_IRDA_DISABLE_IT()` inside the transmit and receive process.
5. Three operation modes are available within this driver :

Polling mode IO operation

- Send an amount of data in blocking mode using `HAL_IRDA_Transmit()`
- Receive an amount of data in blocking mode using `HAL_IRDA_Receive()`

Interrupt mode IO operation

- Send an amount of data in non blocking mode using `HAL_IRDA_Transmit_IT()`
- At transmission end of transfer `HAL_IRDA_TxCpltCallback` is executed and user can add his own code by customization of function pointer `HAL_IRDA_TxCpltCallback`
- Receive an amount of data in non blocking mode using `HAL_IRDA_Receive_IT()`
- At reception end of transfer `HAL_IRDA_RxCpltCallback` is executed and user can add his own code by customization of function pointer `HAL_IRDA_RxCpltCallback`
- In case of transfer Error, `HAL_IRDA_ErrorCallback()` function is executed and user can add his own code by customization of function pointer `HAL_IRDA_ErrorCallback`

DMA mode IO operation

- Send an amount of data in non blocking mode (DMA) using `HAL_IRDA_Transmit_DMA()`
- At transmission end of transfer `HAL_IRDA_TxCpltCallback` is executed and user can add his own code by customization of function pointer `HAL_IRDA_TxCpltCallback`
- Receive an amount of data in non blocking mode (DMA) using `HAL_IRDA_Receive_DMA()`
- At reception end of transfer `HAL_IRDA_RxCpltCallback` is executed and user can add his own code by customization of function pointer `HAL_IRDA_RxCpltCallback`
- In case of transfer Error, `HAL_IRDA_ErrorCallback()` function is executed and user can add his own code by customization of function pointer `HAL_IRDA_ErrorCallback`

IRDA HAL driver macros list

Below the list of most used macros in IRDA HAL driver.

- `__HAL_IRDA_ENABLE`: Enable the IRDA peripheral
- `__HAL_IRDA_DISABLE`: Disable the IRDA peripheral
- `__HAL_IRDA_GET_FLAG` : Checks whether the specified IRDA flag is set or not
- `__HAL_IRDA_CLEAR_FLAG` : Clears the specified IRDA pending flag
- `__HAL_IRDA_ENABLE_IT`: Enables the specified IRDA interrupt
- `__HAL_IRDA_DISABLE_IT`: Disables the specified IRDA interrupt



You can refer to the IRDA HAL driver header file for more useful macros

34.2.2 Initialization and Configuration functions

This subsection provides a set of functions allowing to initialize the USARTx or the UARTy in IrDA mode.

- For the asynchronous mode only these parameters can be configured:
 - BaudRate
 - WordLength
 - Parity: If the parity is enabled, then the MSB bit of the data written in the data register is transmitted but is changed by the parity bit. Depending on the frame length defined by the M bit (8-bits or 9-bits), please refer to Reference manual for possible IRDA frame formats.
 - Prescaler: A pulse of width less than two and greater than one PSC period(s) may or may not be rejected. The receiver set up time should be managed by software. The IrDA physical layer specification specifies a minimum of 10 ms delay between transmission and reception (IrDA is a half duplex protocol).
 - Mode: Receiver/transmitter modes
 - IrDAMode: the IrDA can operate in the Normal mode or in the Low power mode.

The HAL_IRDA_Init() API follows IRDA configuration procedures (details for the procedures are available in reference manual).

This section contains the following APIs:

- [HAL_IRDA_Init\(\)](#)
- [HAL_IRDA_DeInit\(\)](#)
- [HAL_IRDA_MspInit\(\)](#)
- [HAL_IRDA_MspDeInit\(\)](#)

34.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the IRDA data transfers.

IrDA is a half duplex communication protocol. If the Transmitter is busy, any data on the IrDA receive line will be ignored by the IrDA decoder and if the Receiver is busy, data on the TX from the USART to IrDA will not be encoded by IrDA. While receiving data, transmission should be avoided as the data to be transmitted could be corrupted.

1. There are two modes of transfer:
 - Blocking mode: the communication is performed in polling mode. The HAL status of all data processing is returned by the same function after finishing transfer.
 - Non-Blocking mode: the communication is performed using Interrupts or DMA, these API's return the HAL status. The end of the data processing will be indicated through the dedicated IRDA IRQ when using Interrupt mode or the DMA IRQ when using DMA mode. The HAL_IRDA_TxCpltCallback(), HAL_IRDA_RxCpltCallback() user callbacks will be executed respectively at the end of the Transmit or Receive process. The HAL_IRDA_ErrorCallback() user callback will be executed when a communication error is detected.
2. Blocking mode APIs are :
 - HAL_IRDA_Transmit()
 - HAL_IRDA_Receive()
3. Non-Blocking mode APIs with Interrupt are :
 - HAL_IRDA_Transmit_IT()
 - HAL_IRDA_Receive_IT()
 - HAL_IRDA_IRQHandler()
 - IRDA_Transmit_IT()
 - IRDA_Receive_IT()
4. Non-Blocking mode functions with DMA are :

- HAL_IRDA_Transmit_DMA()
 - HAL_IRDA_Receive_DMA()
 - HAL_IRDA_DMAPause()
 - HAL_IRDA_DMAResume()
 - HAL_IRDA_DMAStop()
5. A set of Transfer Complete Callbacks are provided in Non-Blocking mode:
 - HAL_IRDA_TxHalfCpltCallback()
 - HAL_IRDA_TxCpltCallback()
 - HAL_IRDA_RxHalfCpltCallback()
 - HAL_IRDA_RxCpltCallback()
 - HAL_IRDA_ErrorCallback()
 6. Non-Blocking mode transfers could be aborted using Abort API's :
 - HAL_IRDA_Abort()
 - HAL_IRDA_AbortTransmit()
 - HAL_IRDA_AbortReceive()
 - HAL_IRDA_Abort_IT()
 - HAL_IRDA_AbortTransmit_IT()
 - HAL_IRDA_AbortReceive_IT()
 7. For Abort services based on interrupts (HAL_IRDA_Abortxxx_IT), a set of Abort Complete Callbacks are provided:
 - HAL_IRDA_AbortCpltCallback()
 - HAL_IRDA_AbortTransmitCpltCallback()
 - HAL_IRDA_AbortReceiveCpltCallback()
 8. In Non-Blocking mode transfers, possible errors are split into 2 categories. Errors are handled as follows :
 - Error is considered as Recoverable and non blocking : Transfer could go till end, but error severity is to be evaluated by user : this concerns Frame Error, Parity Error or Noise Error in Interrupt mode reception . Received character is then retrieved and stored in Rx buffer, Error code is set to allow user to identify error type, and HAL_IRDA_ErrorCallback() user callback is executed. Transfer is kept ongoing on IRDA side. If user wants to abort it, Abort services should be called by user.
 - Error is considered as Blocking : Transfer could not be completed properly and is aborted. This concerns Overrun Error In Interrupt mode reception and all errors in DMA mode. Error code is set to allow user to identify error type, and HAL_IRDA_ErrorCallback() user callback is executed.

This section contains the following APIs:

- [*HAL_IRDA_Transmit\(\)*](#)
- [*HAL_IRDA_Receive\(\)*](#)
- [*HAL_IRDA_Transmit_IT\(\)*](#)
- [*HAL_IRDA_Receive_IT\(\)*](#)
- [*HAL_IRDA_Transmit_DMA\(\)*](#)
- [*HAL_IRDA_Receive_DMA\(\)*](#)
- [*HAL_IRDA_DMAPause\(\)*](#)
- [*HAL_IRDA_DMAResume\(\)*](#)
- [*HAL_IRDA_DMAStop\(\)*](#)
- [*HAL_IRDA_Abort\(\)*](#)
- [*HAL_IRDA_AbortTransmit\(\)*](#)
- [*HAL_IRDA_AbortReceive\(\)*](#)
- [*HAL_IRDA_Abort_IT\(\)*](#)
- [*HAL_IRDA_AbortTransmit_IT\(\)*](#)
- [*HAL_IRDA_AbortReceive_IT\(\)*](#)

- [HAL_IRDA_IRQHandler\(\)](#)
- [HAL_IRDA_TxCpltCallback\(\)](#)
- [HAL_IRDA_TxHalfCpltCallback\(\)](#)
- [HAL_IRDA_RxCpltCallback\(\)](#)
- [HAL_IRDA_RxHalfCpltCallback\(\)](#)
- [HAL_IRDA_ErrorCallback\(\)](#)
- [HAL_IRDA_AbortCpltCallback\(\)](#)
- [HAL_IRDA_AbortTransmitCpltCallback\(\)](#)
- [HAL_IRDA_AbortReceiveCpltCallback\(\)](#)

34.2.4 Peripheral State and Error functions

This subsection provides a set of functions allowing to return the State of IrDA communication process and also return Peripheral Errors occurred during communication process

- `HAL_IRDA_GetState()` API can be helpful to check in run-time the state of the IRDA peripheral handle.
- `HAL_IRDA_GetError()` checks in run-time errors that could occur during communication.

This section contains the following APIs:

- [HAL_IRDA_GetState\(\)](#)
- [HAL_IRDA_GetError\(\)](#)

34.2.5 Detailed description of functions

HAL_IRDA_Init

Function name	HAL_StatusTypeDef HAL_IRDA_Init (IRDA_HandleTypeDef * hirda)
Function description	Initialize the IRDA mode according to the specified parameters in the <code>IRDA_InitTypeDef</code> and initialize the associated handle.
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a <code>IRDA_HandleTypeDef</code> structure that contains the configuration information for the specified IRDA module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_IRDA_DeInit

Function name	HAL_StatusTypeDef HAL_IRDA_DeInit (IRDA_HandleTypeDef * hirda)
Function description	Deinitialize the IRDA peripheral.
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a <code>IRDA_HandleTypeDef</code> structure that contains the configuration information for the specified IRDA module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_IRDA_Msplnit

Function name	void HAL_IRDA_Msplnit (IRDA_HandleTypeDef * hirda)
---------------	---

Function description	Initialize the IRDA MSP.
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.
Return values	<ul style="list-style-type: none"> • None:

HAL_IRDA_MspDeInit

Function name	void HAL_IRDA_MspDeInit (IRDA_HandleTypeDef * hirda)
Function description	DeInitialize the IRDA MSP.
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.
Return values	<ul style="list-style-type: none"> • None:

HAL_IRDA_Transmit

Function name	HAL_StatusTypeDef HAL_IRDA_Transmit (IRDA_HandleTypeDef * hirda, uint8_t * pData, uint16_t Size, uint32_t Timeout)
Function description	Send an amount of data in blocking mode.
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module. • pData: Pointer to data buffer. • Size: Amount of data to be sent. • Timeout: Specify timeout value.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_IRDA_Receive

Function name	HAL_StatusTypeDef HAL_IRDA_Receive (IRDA_HandleTypeDef * hirda, uint8_t * pData, uint16_t Size, uint32_t Timeout)
Function description	Receive an amount of data in blocking mode.
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module. • pData: Pointer to data buffer. • Size: Amount of data to be received. • Timeout: Specify timeout value.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_IRDA_Transmit_IT

Function name	HAL_StatusTypeDef HAL_IRDA_Transmit_IT (IRDA_HandleTypeDef * hirda, uint8_t * pData, uint16_t Size)
---------------	--

Function description	Send an amount of data in interrupt mode.
Parameters	<ul style="list-style-type: none">• hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.• pData: Pointer to data buffer.• Size: Amount of data to be sent.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_IRDA_Receive_IT

Function name	HAL_StatusTypeDef HAL_IRDA_Receive_IT (IRDA_HandleTypeDef * hirda, uint8_t * pData, uint16_t Size)
Function description	Receive an amount of data in interrupt mode.
Parameters	<ul style="list-style-type: none">• hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.• pData: Pointer to data buffer.• Size: Amount of data to be received.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_IRDA_Transmit_DMA

Function name	HAL_StatusTypeDef HAL_IRDA_Transmit_DMA (IRDA_HandleTypeDef * hirda, uint8_t * pData, uint16_t Size)
Function description	Send an amount of data in DMA mode.
Parameters	<ul style="list-style-type: none">• hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.• pData: pointer to data buffer.• Size: amount of data to be sent.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_IRDA_Receive_DMA

Function name	HAL_StatusTypeDef HAL_IRDA_Receive_DMA (IRDA_HandleTypeDef * hirda, uint8_t * pData, uint16_t Size)
Function description	Receive an amount of data in DMA mode.
Parameters	<ul style="list-style-type: none">• hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.• pData: Pointer to data buffer.• Size: Amount of data to be received.
Return values	<ul style="list-style-type: none">• HAL: status
Notes	<ul style="list-style-type: none">• When the IRDA parity is enabled (PCE = 1), the received data contains the parity bit (MSB position).

HAL_IRDA_DMAPause

Function name	HAL_StatusTypeDef HAL_IRDA_DMAPause (IRDA_HandleTypeDef * hirda)
Function description	Pause the DMA Transfer.
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_IRDA_DMAResume

Function name	HAL_StatusTypeDef HAL_IRDA_DMAResume (IRDA_HandleTypeDef * hirda)
Function description	Resume the DMA Transfer.
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_IRDA_DMAStop

Function name	HAL_StatusTypeDef HAL_IRDA_DMAStop (IRDA_HandleTypeDef * hirda)
Function description	Stop the DMA Transfer.
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_IRDA_Abort

Function name	HAL_StatusTypeDef HAL_IRDA_Abort (IRDA_HandleTypeDef * hirda)
Function description	Abort ongoing transfers (blocking mode).
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This procedure could be used for aborting any ongoing transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable IRDA Interrupts (Tx and Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY • This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

HAL_IRDA_AbortTransmit

Function name	HAL_StatusTypeDef HAL_IRDA_AbortTransmit (IRDA_HandleTypeDef * hirda)
Function description	Abort ongoing Transmit transfer (blocking mode).
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This procedure could be used for aborting any ongoing Tx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable IRDA Interrupts (Tx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY • This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

HAL_IRDA_AbortReceive

Function name	HAL_StatusTypeDef HAL_IRDA_AbortReceive (IRDA_HandleTypeDef * hirda)
Function description	Abort ongoing Receive transfer (blocking mode).
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This procedure could be used for aborting any ongoing Rx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable IRDA Interrupts (Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY • This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

HAL_IRDA_Abort_IT

Function name	HAL_StatusTypeDef HAL_IRDA_Abort_IT (IRDA_HandleTypeDef * hirda)
Function description	Abort ongoing transfers (Interrupt mode).
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This procedure could be used for aborting any ongoing transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable IRDA Interrupts (Tx and Rx)Disable the DMA transfer in the peripheral register (if

- enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback
- This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

HAL_IRDA_AbortTransmit_IT

Function name	HAL_StatusTypeDef HAL_IRDA_AbortTransmit_IT (IRDA_HandleTypeDef * hirda)
Function description	Abort ongoing Transmit transfer (Interrupt mode).
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This procedure could be used for aborting any ongoing Tx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable IRDA Interrupts (Tx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback • This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

HAL_IRDA_AbortReceive_IT

Function name	HAL_StatusTypeDef HAL_IRDA_AbortReceive_IT (IRDA_HandleTypeDef * hirda)
Function description	Abort ongoing Receive transfer (Interrupt mode).
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This procedure could be used for aborting any ongoing Rx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable IRDA Interrupts (Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback • This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

HAL_IRDA_IRQHandler

Function name	void HAL_IRDA_IRQHandler (IRDA_HandleTypeDef * hirda)
Function description	Handle IRDA interrupt request.
Parameters	<ul style="list-style-type: none">• hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.
Return values	<ul style="list-style-type: none">• None:

HAL_IRDA_TxCpltCallback

Function name	void HAL_IRDA_TxCpltCallback (IRDA_HandleTypeDef * hirda)
Function description	Tx Transfer completed callback.
Parameters	<ul style="list-style-type: none">• hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.
Return values	<ul style="list-style-type: none">• None:

HAL_IRDA_RxCpltCallback

Function name	void HAL_IRDA_RxCpltCallback (IRDA_HandleTypeDef * hirda)
Function description	Rx Transfer completed callback.
Parameters	<ul style="list-style-type: none">• hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.
Return values	<ul style="list-style-type: none">• None:

HAL_IRDA_TxHalfCpltCallback

Function name	void HAL_IRDA_TxHalfCpltCallback (IRDA_HandleTypeDef * hirda)
Function description	Tx Half Transfer completed callback.
Parameters	<ul style="list-style-type: none">• hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified USART module.
Return values	<ul style="list-style-type: none">• None:

HAL_IRDA_RxHalfCpltCallback

Function name	void HAL_IRDA_RxHalfCpltCallback (IRDA_HandleTypeDef * hirda)
Function description	Rx Half Transfer complete callback.
Parameters	<ul style="list-style-type: none">• hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

HAL_IRDA_ErrorCallback

Function name **void HAL_IRDA_ErrorCallback (IRDA_HandleTypeDef * hirda)**

Function description IRDA error callback.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

HAL_IRDA_AbortCpltCallback

Function name **void HAL_IRDA_AbortCpltCallback (IRDA_HandleTypeDef * hirda)**

Function description IRDA Abort Complete callback.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

HAL_IRDA_AbortTransmitCpltCallback

Function name **void HAL_IRDA_AbortTransmitCpltCallback (IRDA_HandleTypeDef * hirda)**

Function description IRDA Abort Complete callback.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

HAL_IRDA_AbortReceiveCpltCallback

Function name **void HAL_IRDA_AbortReceiveCpltCallback (IRDA_HandleTypeDef * hirda)**

Function description IRDA Abort Receive Complete callback.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

HAL_IRDA_GetState

Function name **HAL_IRDA_StateTypeDef HAL_IRDA_GetState (IRDA_HandleTypeDef * hirda)**

Function description Return the IRDA handle state.

Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.
Return values	<ul style="list-style-type: none"> • HAL: state

HAL_IRDA_GetError

Function name	uint32_t HAL_IRDA_GetError (IRDA_HandleTypeDef * hirda)
Function description	Return the IRDA handle error code.
Parameters	<ul style="list-style-type: none"> • hirda: Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.
Return values	<ul style="list-style-type: none"> • IRDA: Error Code

34.3 IRDA Firmware driver defines**34.3.1 IRDA****IRDA DMA Rx**

IRDA_DMA_RX_DISABLE

IRDA_DMA_RX_ENABLE

IRDA DMA Tx

IRDA_DMA_TX_DISABLE

IRDA_DMA_TX_ENABLE

IRDA Error Code

HAL_IRDA_ERROR_NONE	No error
HAL_IRDA_ERROR_PE	Parity error
HAL_IRDA_ERROR_NE	Noise error
HAL_IRDA_ERROR_FE	frame error
HAL_IRDA_ERROR_ORE	Overrun error
HAL_IRDA_ERROR_DMA	DMA transfer error

IRDA Exported Macros

__HAL_IRDA_RESET_HANDLE_STATE	Description: <ul style="list-style-type: none"> • Reset IRDA handle state. Parameters: <ul style="list-style-type: none"> • __HANDLE__: specifies the IRDA Handle. The Handle Instance which can be USART1 or USART2. Return value: <ul style="list-style-type: none"> • None
__HAL_IRDA_FLUSH_DRREGISTER	Description:

- Flush the IRDA DR register.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle.

Return value:

- None

Description:

- Clear the specified IRDA pending flag.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle.
- `__FLAG__`: specifies the flag to check. This parameter can be any combination of the following values:
 - `IRDA_CLEAR_PEF`
 - `IRDA_CLEAR_FEF`
 - `IRDA_CLEAR_NEF`
 - `IRDA_CLEAR_OREF`
 - `IRDA_CLEAR_TCF`

Return value:

- None

Description:

- Clear the IRDA PE pending flag.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle.

Return value:

- None

Description:

- Clear the IRDA FE pending flag.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle.

Return value:

- None

Description:

- Clear the IRDA NE pending flag.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle.

Return value:

- None

Description:

`__HAL_IRDA_CLEAR_FLAG`

`__HAL_IRDA_CLEAR_PEFLAG`

`__HAL_IRDA_CLEAR_FEFLAG`

`__HAL_IRDA_CLEAR_NEFLAG`

`__HAL_IRDA_CLEAR_OREFLAG`

- Clear the IRDA ORE pending flag.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle.

Return value:

- None

`__HAL_IRDA_CLEAR_IDLEFLAG`**Description:**

- Clear the IRDA IDLE pending flag.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle.

Return value:

- None

`__HAL_IRDA_GET_FLAG`**Description:**

- Check whether the specified IRDA flag is set or not.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle. The Handle Instance which can be USART1 or USART2. UART peripheral
- `__FLAG__`: specifies the flag to check. This parameter can be one of the following values:
 - `IRDA_FLAG_REACK`: Receive enable acknowledge flag
 - `IRDA_FLAG_TEACK`: Transmit enable acknowledge flag
 - `IRDA_FLAG_BUSY`: Busy flag
 - `IRDA_FLAG_ABRF`: Auto Baud rate detection flag
 - `IRDA_FLAG_ABRE`: Auto Baud rate detection error flag
 - `IRDA_FLAG_TXE`: Transmit data register empty flag
 - `IRDA_FLAG_TC`: Transmission Complete flag
 - `IRDA_FLAG_RXNE`: Receive data register not empty flag
 - `IRDA_FLAG_IDLE`: Idle Line detection flag
 - `IRDA_FLAG_ORE`: OverRun Error flag
 - `IRDA_FLAG_NE`: Noise Error flag
 - `IRDA_FLAG_FE`: Framing Error flag
 - `IRDA_FLAG_PE`: Parity Error flag

Return value:

- The: new state of `__FLAG__` (TRUE or FALSE).

`__HAL_IRDA_ENABLE_IT`**Description:**

- Enable the specified IRDA interrupt.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle. The Handle Instance which can be USART1 or USART2. UART peripheral
- `__INTERRUPT__`: specifies the IRDA interrupt source to enable. This parameter can be one of the following values:
 - `IRDA_IT_TXE`: Transmit Data Register empty interrupt
 - `IRDA_IT_TC`: Transmission complete interrupt
 - `IRDA_IT_RXNE`: Receive Data register not empty interrupt
 - `IRDA_IT_IDLE`: Idle line detection interrupt
 - `IRDA_IT_PE`: Parity Error interrupt
 - `IRDA_IT_ERR`: Error interrupt(Frame error, noise error, overrun error)

Return value:

- None

`__HAL_IRDA_DISABLE_IT`**Description:**

- Disable the specified IRDA interrupt.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle. The Handle Instance which can be USART1 or USART2.
- `__INTERRUPT__`: specifies the IRDA interrupt source to disable. This parameter can be one of the following values:
 - `IRDA_IT_TXE`: Transmit Data Register empty interrupt
 - `IRDA_IT_TC`: Transmission complete interrupt
 - `IRDA_IT_RXNE`: Receive Data register not empty interrupt
 - `IRDA_IT_IDLE`: Idle line detection interrupt
 - `IRDA_IT_PE`: Parity Error interrupt
 - `IRDA_IT_ERR`: Error interrupt(Frame error, noise error, overrun error)

Return value:

- None

`__HAL_IRDA_GET_IT`**Description:**

- Check whether the specified IRDA interrupt has occurred or not.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle. The Handle Instance which can be USART1 or USART2.
- `__IT__`: specifies the IRDA interrupt source to check. This parameter can be one of the following values:
 - IRDA_IT_TXE: Transmit Data Register empty interrupt
 - IRDA_IT_TC: Transmission complete interrupt
 - IRDA_IT_RXNE: Receive Data register not empty interrupt
 - IRDA_IT_IDLE: Idle line detection interrupt
 - IRDA_IT_ORE: OverRun Error interrupt
 - IRDA_IT_NE: Noise Error interrupt
 - IRDA_IT_FE: Framing Error interrupt
 - IRDA_IT_PE: Parity Error interrupt

Return value:

- The: new state of `__IT__` (TRUE or FALSE).

`__HAL_IRDA_GET_IT_SOURCE`

Description:

- Check whether the specified IRDA interrupt source is enabled.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle. The Handle Instance which can be USART1 or USART2.
- `__IT__`: specifies the IRDA interrupt source to check. This parameter can be one of the following values:
 - IRDA_IT_TXE: Transmit Data Register empty interrupt
 - IRDA_IT_TC: Transmission complete interrupt
 - IRDA_IT_RXNE: Receive Data register not empty interrupt
 - IRDA_IT_IDLE: Idle line detection interrupt
 - IRDA_IT_ORE: OverRun Error interrupt
 - IRDA_IT_NE: Noise Error interrupt
 - IRDA_IT_FE: Framing Error interrupt
 - IRDA_IT_PE: Parity Error interrupt

Return value:

- The: new state of `__IT__` (TRUE or FALSE).

`__HAL_IRDA_CLEAR_IT`

Description:

- Clear the specified IRDA ISR flag, in setting the proper ICR register flag.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle. The Handle Instance which can be USART1 or USART2.
- `__IT_CLEAR__`: specifies the interrupt clear register flag that needs to be set to clear the corresponding interrupt. This parameter can be one of the following values:
 - `IRDA_CLEAR_PEF`: Parity Error Clear Flag
 - `IRDA_CLEAR_FEF`: Framing Error Clear Flag
 - `IRDA_CLEAR_NEF`: Noise detected Clear Flag
 - `IRDA_CLEAR_OREF`: OverRun Error Clear Flag
 - `IRDA_CLEAR_TCF`: Transmission Complete Clear Flag

Return value:

- None

`__HAL_IRDA_SEND_REQ`**Description:**

- Set a specific IRDA request flag.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle. The Handle Instance which can be USART1 or USART2.
- `__REQ__`: specifies the request flag to set. This parameter can be one of the following values:
 - `IRDA_AUTOBAUD_REQUEST`: Auto-Baud Rate Request
 - `IRDA_RXDATA_FLUSH_REQUEST`: Receive Data flush Request
 - `IRDA_TXDATA_FLUSH_REQUEST`: Transmit data flush Request

Return value:

- None

`__HAL_IRDA_ENABLE`**Description:**

- Enable UART/USART associated to IRDA Handle.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle. The Handle Instance which can be USART1 or USART2.

Return value:

- None

`__HAL_IRDA_DISABLE`**Description:**

- Disable UART/USART associated to IRDA Handle.

Parameters:

- `__HANDLE__`: specifies the IRDA Handle. The Handle Instance which can be USART1 or USART2.

Return value:

- None

IRDA Flags`IRDA_FLAG_REACK``IRDA_FLAG_TEACK``IRDA_FLAG_BUSY``IRDA_FLAG_ABRF``IRDA_FLAG_ABRE``IRDA_FLAG_TXE``IRDA_FLAG_TC``IRDA_FLAG_RXNE``IRDA_FLAG_ORE``IRDA_FLAG_NE``IRDA_FLAG_FE``IRDA_FLAG_PE`***IRDA Interruption Mask***`IRDA_IT_MASK`***IRDA Interrupt definition***`IRDA_IT_PE``IRDA_IT_TXE``IRDA_IT_TC``IRDA_IT_RXNE``IRDA_IT_IDLE``IRDA_IT_ERR``IRDA_IT_ORE``IRDA_IT_NE``IRDA_IT_FE`***IRDA IT CLEAR Flags***`IRDA_CLEAR_PEF` Parity Error Clear Flag`IRDA_CLEAR_FEF` Framing Error Clear Flag

IRDA_CLEAR_NEF Noise detected Clear Flag
IRDA_CLEAR_OREF OverRun Error Clear Flag
IRDA_CLEAR_TCF Transmission Complete Clear Flag

IRDA Low Power

IRDA_POWERMODE_NORMAL
IRDA_POWERMODE_LOWPOWER

IRDA Mode

IRDA_MODE_DISABLE
IRDA_MODE_ENABLE

IRDA One Bit

IRDA_ONE_BIT_SAMPLE_DISABLE
IRDA_ONE_BIT_SAMPLE_ENABLE

IRDA Parity

IRDA_PARITY_NONE
IRDA_PARITY_EVEN
IRDA_PARITY_ODD

IRDA Request Parameters

IRDA_AUTOBAUD_REQUEST Auto-Baud Rate Request
IRDA_RXDATA_FLUSH_REQUEST Receive Data flush Request
IRDA_TXDATA_FLUSH_REQUEST Transmit data flush Request

IRDA State

IRDA_STATE_DISABLE
IRDA_STATE_ENABLE

IRDA Transfer Mode

IRDA_MODE_RX
IRDA_MODE_TX
IRDA_MODE_TX_RX

35 HAL IRDA Extension Driver

35.1 IRDAEx Firmware driver defines

35.1.1 IRDAEx

IRDAEx Word Length

IRDA_WORDLENGTH_7B

IRDA_WORDLENGTH_8B

IRDA_WORDLENGTH_9B

36 HAL IWDG Generic Driver

36.1 IWDG Firmware driver registers structures

36.1.1 IWDG_InitTypeDef

Data Fields

- *uint32_t Prescaler*
- *uint32_t Reload*
- *uint32_t Window*

Field Documentation

- *uint32_t IWDG_InitTypeDef::Prescaler*
Select the prescaler of the IWDG. This parameter can be a value of [IWDG_Prescaler](#)
- *uint32_t IWDG_InitTypeDef::Reload*
Specifies the IWDG down-counter reload value. This parameter must be a number between Min_Data = 0 and Max_Data = 0x0FFF
- *uint32_t IWDG_InitTypeDef::Window*
Specifies the window value to be compared to the down-counter. This parameter must be a number between Min_Data = 0 and Max_Data = 0x0FFF

36.1.2 IWDG_HandleTypeDef

Data Fields

- *IWDG_TypeDef * Instance*
- *IWDG_InitTypeDef Init*

Field Documentation

- *IWDG_TypeDef* IWDG_HandleTypeDef::Instance*
Register base address
- *IWDG_InitTypeDef IWDG_HandleTypeDef::Init*
IWDG required parameters

36.2 IWDG Firmware driver API description

36.2.1 IWDG Generic features

- The IWDG can be started by either software or hardware (configurable through option byte).
- The IWDG is clocked by Low-Speed clock (LSI) and thus stays active even if the main clock fails.
- Once the IWDG is started, the LSI is forced ON and both can not be disabled. The counter starts counting down from the reset value (0xFFF). When it reaches the end of count value (0x000) a reset signal is generated (IWDG reset).
- Whenever the key value 0x0000 AAAA is written in the IWDG_KR register, the IWDG_RLR value is reloaded in the counter and the watchdog reset is prevented.
- The IWDG is implemented in the VDD voltage domain that is still functional in STOP and STANDBY mode (IWDG reset can wake-up from STANDBY). IWDGRST flag in RCC_CSR register can be used to inform when an IWDG reset occurs.
- Debug mode : When the microcontroller enters debug mode (core halted), the IWDG counter either continues to work normally or stops, depending on DBG_IWDG_STOP

configuration bit in DBG module, accessible through `__HAL_DBGMCU_FREEZE_IWDG()` and `__HAL_DBGMCU_UNFREEZE_IWDG()` macros

Min-max timeout value @32KHz (LSI): ~125us / ~32.7s The IWDG timeout may vary due to LSI frequency dispersion. STM32F7xx devices provide the capability to measure the LSI frequency (LSI clock connected internally to TIM16 CH1 input capture). The measured value can be used to have an IWDG timeout with an acceptable accuracy.

36.2.2 How to use this driver

1. Use IWDG using `HAL_IWDG_Init()` function to :
 - Enable instance by writing Start keyword in `IWDG_KEY` register. LSI clock is forced ON and IWDG counter starts downcounting.
 - Enable write access to configuration register: `IWDG_PR`, `IWDG_RLR` & `IWDG_WINR`.
 - Configure the IWDG prescaler and counter reload value. This reload value will be loaded in the IWDG counter each time the watchdog is reloaded, then the IWDG will start counting down from this value.
 - wait for status flags to be reset
 - Depending on window parameter:
 - If Window Init parameter is same as Window register value, nothing more is done but reload counter value in order to exit function with exact time base.
 - Else modify Window register. This will automatically reload watchdog counter.
2. Then the application program must refresh the IWDG counter at regular intervals during normal operation to prevent an MCU reset, using `HAL_IWDG_Refresh()` function.

IWDG HAL driver macros list

Below the list of most used macros in IWDG HAL driver:

- `__HAL_IWDG_START`: Enable the IWDG peripheral
- `__HAL_IWDG_RELOAD_COUNTER`: Reloads IWDG counter with value defined in the reload register

36.2.3 Initialization and Start functions

This section provides functions allowing to:

- Initialize the IWDG according to the specified parameters in the `IWDG_InitTypeDef` of associated handle.
- Manage Window option.
- Once initialization is performed in `HAL_IWDG_Init` function, Watchdog is reloaded in order to exit function with correct time base.

This section contains the following APIs:

- [*HAL_IWDG_Init\(\)*](#)

36.2.4 IO operation functions

This section provides functions allowing to:

- Refresh the IWDG.

This section contains the following APIs:

- [*HAL_IWDG_Refresh\(\)*](#)

36.2.5 Detailed description of functions

HAL_IWDG_Init

Function name	HAL_StatusTypeDef HAL_IWDG_Init (IWDG_HandleTypeDef * hiwdg)
Function description	Initialize the IWDG according to the specified parameters in the IWDG_InitTypeDef and start watchdog.
Parameters	<ul style="list-style-type: none"> • hiwdg: pointer to a IWDG_HandleTypeDef structure that contains the configuration information for the specified IWDG module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_IWDG_Refresh

Function name	HAL_StatusTypeDef HAL_IWDG_Refresh (IWDG_HandleTypeDef * hiwdg)
Function description	Refresh the IWDG.
Parameters	<ul style="list-style-type: none"> • hiwdg: pointer to a IWDG_HandleTypeDef structure that contains the configuration information for the specified IWDG module.
Return values	<ul style="list-style-type: none"> • HAL: status

36.3 IWDG Firmware driver defines

36.3.1 IWDG

IWDG Exported Macros

`__HAL_IWDG_START`

Description:

- Enable the IWDG peripheral.

Parameters:

- `__HANDLE__`: IWDG handle

Return value:

- None

`__HAL_IWDG_RELOAD_COUNTER`

Description:

- Reload IWDG counter with value defined in the reload register (write access to IWDG_PR, IWDG_RLR & IWDG_WINR registers disabled).

Parameters:

- `__HANDLE__`: IWDG handle

Return value:

- None

IWDG Prescaler

IWDG_PRESCALER_4	IWDG prescaler set to 4
IWDG_PRESCALER_8	IWDG prescaler set to 8
IWDG_PRESCALER_16	IWDG prescaler set to 16
IWDG_PRESCALER_32	IWDG prescaler set to 32
IWDG_PRESCALER_64	IWDG prescaler set to 64
IWDG_PRESCALER_128	IWDG prescaler set to 128
IWDG_PRESCALER_256	IWDG prescaler set to 256
<i>IWDG Window option</i>	
IWDG_WINDOW_DISABLE	

37 HAL JPEG Generic Driver

37.1 JPEG Firmware driver registers structures

37.1.1 JPEG_ConfTypeDef

Data Fields

- *uint8_t* **ColorSpace**
- *uint8_t* **ChromaSubsampling**
- *uint32_t* **ImageHeight**
- *uint32_t* **ImageWidth**
- *uint8_t* **ImageQuality**

Field Documentation

- *uint8_t* **JPEG_ConfTypeDef::ColorSpace**
Image Color space : gray-scale, YCBCR, RGB or CMYK This parameter can be a value of [JPEG_ColorSpace_Type](#)
- *uint8_t* **JPEG_ConfTypeDef::ChromaSubsampling**
Chroma Subsampling in case of YCBCR or CMYK color space, 0-> 4:4:4 , 1-> 4:2:2, 2-> 4:1:1, 3 -> 4:2:0 This parameter can be a value of [JPEG_ChromaSubsampling_Type](#)
- *uint32_t* **JPEG_ConfTypeDef::ImageHeight**
Image height : number of lines
- *uint32_t* **JPEG_ConfTypeDef::ImageWidth**
Image width : number of pixels per line
- *uint8_t* **JPEG_ConfTypeDef::ImageQuality**
Quality of the JPEG encoding : from 1 to 100

37.1.2 JPEG_HandleTypeDef

Data Fields

- *JPEG_TypeDef * Instance*
- *JPEG_ConfTypeDef Conf*
- *uint8_t * pJpegInBuffPtr*
- *uint8_t * pJpegOutBuffPtr*
- *__IO uint32_t JpegInCount*
- *__IO uint32_t JpegOutCount*
- *uint32_t InDataLength*
- *uint32_t OutDataLength*
- *DMA_HandleTypeDef * hdmain*
- *DMA_HandleTypeDef * hdmaout*
- *uint8_t CustomQuanTable*
- *uint8_t * QuantTable0*
- *uint8_t * QuantTable1*
- *uint8_t * QuantTable2*
- *uint8_t * QuantTable3*
- *HAL_LockTypeDef Lock*
- *__IO HAL_JPEG_STATTypeDef State*
- *__IO uint32_t ErrorCode*
- *__IO uint32_t Context*

Field Documentation

- **JPEG_TypeDef* JPEG_HandleTypeDef::Instance**
JPEG peripheral register base address
- **JPEG_ConfTypeDef JPEG_HandleTypeDef::Conf**
Current JPEG encoding/decoding parameters
- **uint8_t* JPEG_HandleTypeDef::pJpegInBuffPtr**
Pointer to JPEG processing (encoding, decoding,...) input buffer
- **uint8_t* JPEG_HandleTypeDef::pJpegOutBuffPtr**
Pointer to JPEG processing (encoding, decoding,...) output buffer
- **__IO uint32_t JPEG_HandleTypeDef::JpegInCount**
Internal Counter of input data
- **__IO uint32_t JPEG_HandleTypeDef::JpegOutCount**
Internal Counter of output data
- **uint32_t JPEG_HandleTypeDef::InDataLength**
Input Buffer Length in Bytes
- **uint32_t JPEG_HandleTypeDef::OutDataLength**
Output Buffer Length in Bytes
- **DMA_HandleTypeDef* JPEG_HandleTypeDef::hdmain**
JPEG In DMA handle parameters
- **DMA_HandleTypeDef* JPEG_HandleTypeDef::hdmaout**
JPEG Out DMA handle parameters
- **uint8_t JPEG_HandleTypeDef::CustomQuanTable**
If set to 1 specify that user customized quantization tables are used
- **uint8_t* JPEG_HandleTypeDef::QuantTable0**
Basic Quantization Table for component 0
- **uint8_t* JPEG_HandleTypeDef::QuantTable1**
Basic Quantization Table for component 1
- **uint8_t* JPEG_HandleTypeDef::QuantTable2**
Basic Quantization Table for component 2
- **uint8_t* JPEG_HandleTypeDef::QuantTable3**
Basic Quantization Table for component 3
- **HAL_LockTypeDef JPEG_HandleTypeDef::Lock**
JPEG locking object
- **__IO HAL_JPEG_STATTypeDef JPEG_HandleTypeDef::State**
JPEG peripheral state
- **__IO uint32_t JPEG_HandleTypeDef::ErrorCode**
JPEG Error code
- **__IO uint32_t JPEG_HandleTypeDef::Context**
JPEG Internal context

37.2 JPEG Firmware driver API description

37.2.1 How to use this driver

1. Initialize the JPEG peripheral using HAL_JPEG_Init : No initialization parameters are required. Only the call to HAL_JPEG_Init is necessary to initialize the JPEG peripheral.
2. If operation is JPEG encoding use function HAL_JPEG_ConfigEncoding to set the encoding parameters (mandatory before calling the encoding function). the application can change the encoding parameter "ImageQuality" from 1 to 100 to obtain a more or less quality (visual quality vs the original row image), and inversely more or less jpg file size.
3. Note that for decoding operation the JPEG peripheral output data are organized in YCbCr blocks called MCU (Minimum Coded Unit) as defioned in the JPEG

specification ISO/IEC 10918-1 standard. It is up to the application to transform these YCbCr blocks to RGB data that can be display. Respectively, for Encoding operation the JPEG peripheral input should be organized in YCbCr MCU blocks. It is up to the application to perform the necessary RGB to YCbCr MCU blocks transformation before feeding the JPEG peripheral with data.

4. Use functions HAL_JPEG_Encode and HAL_JPEG_Decode to start respectively a JPEG encoding/decoding operation in polling method (blocking).
5. Use functions HAL_JPEG_Encode_IT and HAL_JPEG_Decode_IT to start respectively a JPEG encoding/decoding operation with Interrupt method (not blocking).
6. Use functions HAL_JPEG_Encode_DMA and HAL_JPEG_Decode_DMA to start respectively a JPEG encoding/decoding operation with DMA method (not blocking).
7. Callback HAL_JPEG_InfoReadyCallback is asserted if the current operation is a JPEG decoding to provide the application with JPEG image parameters. This callback is asserted when the JPEG peripheral successfully parse the JPEG header.
8. Callback HAL_JPEG_GetDataCallback is asserted for both encoding and decoding operations to inform the application that the input buffer has been consumed by the peripheral and to ask for a new data chunk if the operation (encoding/decoding) has not been complete yet.
 - This Callback should be implemented in the application side. It should call the function HAL_JPEG_ConfigInputBuffer if new input data are available, or call HAL_JPEG_Pause with parameter XferSelection set to JPEG_PAUSE_RESUME_INPUT to inform the JPEG HAL driver that the ongoing operation shall pause waiting for the application to provide a new input data chunk. Once the application succeed getting new data and if the input has been paused, the application can call the function HAL_JPEG_ConfigInputBuffer to set the new input buffer and size, then resume the JPEG HAL input by calling new function HAL_JPEG_Resume. If the application has ended feeding the HAL JPEG with input data (no more input data), the application Should call the function HAL_JPEG_ConfigInputBuffer (within the callback HAL_JPEG_GetDataCallback) with the parameter InDataLength set to zero.
 - The mechanism of HAL_JPEG_ConfigInputBuffer/HAL_JPEG_Pause/HAL_JPEG_Resume allows to the application to provide the input data (for encoding or decoding) by chunks. If the new input data chunk is not available (because data should be read from an input file for example) the application can pause the JPEG input (using function HAL_JPEG_Pause) Once the new input data chunk is available (read from a file for example), the application can call the function HAL_JPEG_ConfigInputBuffer to provide the HAL with the new chunk then resume the JPEG HAL input by calling function HAL_JPEG_Resume.
 - The application can call functions HAL_JPEG_ConfigInputBuffer then HAL_JPEG_Resume. any time (outside the HAL_JPEG_GetDataCallback) Once the new input chunk data available. However, to keep data coherency, the function HAL_JPEG_Pause must be imperatively called (if necessary) within the callback HAL_JPEG_GetDataCallback, i.e when the HAL JPEG has ended Transferring the previous chunk buffer to the JPEG peripheral.
9. Callback HAL_JPEG_DataReadyCallback is asserted when the HAL JPEG driver has filled the given output buffer with the given size.
 - This Callback should be implemented in the application side. It should call the function HAL_JPEG_ConfigOutputBuffer to provide the HAL JPEG driver with the new output buffer location and size to be used to store next data chunk. if the application is not ready to provide the output chunk location then it can call the function HAL_JPEG_Pause with parameter XferSelection set to "JPEG_PAUSE_RESUME_OUTPUT" to inform the JPEG HAL driver that it shall pause output data. Once the application is ready to receive the new data chunk

- (output buffer location free or available) it should call the function HAL_JPEG_ConfigOutputBuffer to provide the HAL JPEG driver with the new output chunk buffer location and size, then call "HAL_JPEG_Resume" to inform the HAL that it shall resume outputting data in the given output buffer.
- The mechanism of HAL_JPEG_ConfigOutputBuffer/HAL_JPEG_Pause/HAL_JPEG_Resume allows the application to receive data from the JPEG peripheral by chunks. when a chunk is received, the application can pause the HAL JPEG output data to be able to process these received data (YCbCr to RGB conversion in case of decoding or data storage in case of encoding).
 - The application can call functions HAL_JPEG_ConfigOutputBuffer then HAL_JPEG_Resume. any time (outside the HAL_JPEG_DataReadyCallback) Once the output data buffer is free to use. However, to keep data coherency, the function HAL_JPEG_Pause must be imperatively called (if necessary) within the callback HAL_JPEG_DataReadyCallback, i.e when the HAL JPEG has ended Transferring the previous chunk buffer from the JPEG peripheral to the application.
10. Callback HAL_JPEG_EncodeCpltCallback is asserted when the HAL JPEG driver has ended the current JPEG encoding operation, and all output data has been transmitted to the application.
 11. Callback HAL_JPEG_DecodeCpltCallback is asserted when the HAL JPEG driver has ended the current JPEG decoding operation. and all output data has been transmitted to the application.
 12. Callback HAL_JPEG_ErrorCallback is asserted when an error occurred during the current operation. the application can call the function "HAL_JPEG_GetError" to retrieve the error codes.
 13. By default the HAL JPEG driver uses the default quantization tables as provide in the JPEG specification (ISO/IEC 10918-1 standard) for encoding. User can change these default tables if necessary using the function HAL_JPEG_SetUserQuantTables Note that for decoding the quantization tables are automatically extracted from the JPEG header.
 14. To control JPEG state you can use the following function: HAL_JPEG_GetState()

JPEG HAL driver macros list

Below the list of most used macros in JPEG HAL driver.

- `__HAL_JPEG_RESET_HANDLE_STATE` : Reset JPEG handle state.
- `__HAL_JPEG_ENABLE` : Enable the JPEG peripheral.
- `__HAL_JPEG_DISABLE` : Disable the JPEG peripheral.
- `__HAL_JPEG_GET_FLAG` : Check the specified JPEG status flag.
- `__HAL_JPEG_CLEAR_FLAG` : Clear the specified JPEG status flag.
- `__HAL_JPEG_ENABLE_IT` : Enable the specified JPEG Interrupt.
- `__HAL_JPEG_DISABLE_IT` : Disable the specified JPEG Interrupt.
- `__HAL_JPEG_GET_IT_SOURCE` : returns the state of the specified JPEG Interrupt (Enabled or disabled).

37.2.2 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the JPEG peripheral and creates the associated handle
- Deinitialize the JPEG peripheral

This section contains the following APIs:

- [*HAL_JPEG_Init\(\)*](#)

- [HAL_JPEG_DeInit\(\)](#)
- [HAL_JPEG_MspsInit\(\)](#)
- [HAL_JPEG_MspDeInit\(\)](#)

37.2.3 Configuration functions

This section provides functions allowing to:

- [HAL_JPEG_ConfigEncoding\(\)](#) : JPEG encoding configuration
- [HAL_JPEG_GetInfo\(\)](#) : Extract the image configuration from the JPEG header during the decoding
- [HAL_JPEG_EnableHeaderParsing\(\)](#) : Enable JPEG Header parsing for decoding
- [HAL_JPEG_DisableHeaderParsing\(\)](#) : Disable JPEG Header parsing for decoding
- [HAL_JPEG_SetUserQuantTables](#) : Modify the default Quantization tables used for JPEG encoding.

This section contains the following APIs:

- [HAL_JPEG_ConfigEncoding\(\)](#)
- [HAL_JPEG_GetInfo\(\)](#)
- [HAL_JPEG_EnableHeaderParsing\(\)](#)
- [HAL_JPEG_DisableHeaderParsing\(\)](#)
- [HAL_JPEG_SetUserQuantTables\(\)](#)

37.2.4 JPEG processing functions

This section provides functions allowing to:

- [HAL_JPEG_Encode\(\)](#) : JPEG encoding with polling process
- [HAL_JPEG_Decode\(\)](#) : JPEG decoding with polling process
- [HAL_JPEG_Encode_IT\(\)](#) : JPEG encoding with interrupt process
- [HAL_JPEG_Decode_IT\(\)](#) : JPEG decoding with interrupt process
- [HAL_JPEG_Encode_DMA\(\)](#) : JPEG encoding with DMA process
- [HAL_JPEG_Decode_DMA\(\)](#) : JPEG decoding with DMA process
- [HAL_JPEG_Pause\(\)](#) : Pause the Input/Output processing
- [HAL_JPEG_Resume\(\)](#) : Resume the JPEG Input/Output processing
- [HAL_JPEG_ConfigInputBuffer\(\)](#) : Config Encoding/Decoding Input Buffer
- [HAL_JPEG_ConfigOutputBuffer\(\)](#) : Config Encoding/Decoding Output Buffer
- [HAL_JPEG_Abort\(\)](#) : Aborts the JPEG Encoding/Decoding

This section contains the following APIs:

- [HAL_JPEG_Encode\(\)](#)
- [HAL_JPEG_Decode\(\)](#)
- [HAL_JPEG_Encode_IT\(\)](#)
- [HAL_JPEG_Decode_IT\(\)](#)
- [HAL_JPEG_Encode_DMA\(\)](#)
- [HAL_JPEG_Decode_DMA\(\)](#)
- [HAL_JPEG_Pause\(\)](#)
- [HAL_JPEG_Resume\(\)](#)
- [HAL_JPEG_ConfigInputBuffer\(\)](#)
- [HAL_JPEG_ConfigOutputBuffer\(\)](#)
- [HAL_JPEG_Abort\(\)](#)

37.2.5 JPEG Decode and Encode callback functions

This section provides callback functions:

- HAL_JPEG_InfoReadyCallback() : Decoding JPEG Info ready callback
- HAL_JPEG_EncodeCpltCallback() : Encoding complete callback.
- HAL_JPEG_DecodeCpltCallback() : Decoding complete callback.
- HAL_JPEG_ErrorCallback() : JPEG error callback.
- HAL_JPEG_GetDataCallback() : Get New Data chunk callback.
- HAL_JPEG_DataReadyCallback() : Decoded/Encoded Data ready callback.

This section contains the following APIs:

- [HAL_JPEG_InfoReadyCallback\(\)](#)
- [HAL_JPEG_EncodeCpltCallback\(\)](#)
- [HAL_JPEG_DecodeCpltCallback\(\)](#)
- [HAL_JPEG_ErrorCallback\(\)](#)
- [HAL_JPEG_GetDataCallback\(\)](#)
- [HAL_JPEG_DataReadyCallback\(\)](#)

37.2.6 JPEG IRQ handler management

This section provides JPEG IRQ handler function.

- HAL_JPEG_IRQHandler() : handles JPEG interrupt request

This section contains the following APIs:

- [HAL_JPEG_IRQHandler\(\)](#)

37.2.7 Peripheral State and Error functions

This section provides JPEG State and Errors function.

- HAL_JPEG_GetState() : permits to get in run-time the JPEG state.
- HAL_JPEG_GetError() : Returns the JPEG error code if any.

This section contains the following APIs:

- [HAL_JPEG_GetState\(\)](#)
- [HAL_JPEG_GetError\(\)](#)

37.2.8 Detailed description of functions

HAL_JPEG_Init

Function name HAL_StatusTypeDef HAL_JPEG_Init (JPEG_HandleTypeDef * hjpeg)

Function description Initializes the JPEG according to the specified parameters in the JPEG_InitTypeDef and creates the associated handle.

Parameters

- **hjpeg**: pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module

Return values

- **HAL**: status

HAL_JPEG_DeInit

Function name HAL_StatusTypeDef HAL_JPEG_DeInit (JPEG_HandleTypeDef * hjpeg)

Function description DeInitializes the JPEG peripheral.

Parameters

- **hjpeg**: pointer to a JPEG_HandleTypeDef structure that

contains the configuration information for JPEG module

Return values

- **HAL:** status

HAL_JPEG_MspInit

Function name **void HAL_JPEG_MspInit (JPEG_HandleTypeDef * hjpeg)**

Function description Initializes the JPEG MSP.

Parameters

- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module

Return values

- **None:**

HAL_JPEG_MspDeInit

Function name **void HAL_JPEG_MspDeInit (JPEG_HandleTypeDef * hjpeg)**

Function description DeInitializes JPEG MSP.

Parameters

- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module

Return values

- **None:**

HAL_JPEG_ConfigEncoding

Function name **HAL_StatusTypeDef HAL_JPEG_ConfigEncoding (JPEG_HandleTypeDef * hjpeg, JPEG_ConfTypeDef * pConf)**

Function description Set the JPEG encoding configuration.

Parameters

- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module
- **pConf:** pointer to a JPEG_ConfTypeDef structure that contains the encoding configuration

Return values

- **HAL:** status

HAL_JPEG_GetInfo

Function name **HAL_StatusTypeDef HAL_JPEG_GetInfo (JPEG_HandleTypeDef * hjpeg, JPEG_ConfTypeDef * pInfo)**

Function description Extract the image configuration from the JPEG header during the decoding.

Parameters

- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module
- **pInfo:** pointer to a JPEG_ConfTypeDef structure that contains The JPEG decoded header informations

Return values

- **HAL:** status

HAL_JPEG_EnableHeaderParsing

Function name **HAL_StatusTypeDef HAL_JPEG_EnableHeaderParsing (JPEG_HandleTypeDef * hjpeg)**

Function description	Enable JPEG Header parsing for decoding.
Parameters	<ul style="list-style-type: none"> • hjpeg: pointer to a JPEG_HandleTypeDef structure that contains the configuration information for the JPEG.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_JPEG_DisableHeaderParsing

Function name	HAL_StatusTypeDef HAL_JPEG_DisableHeaderParsing (JPEG_HandleTypeDef * hjpeg)
Function description	Disable JPEG Header parsing for decoding.
Parameters	<ul style="list-style-type: none"> • hjpeg: pointer to a JPEG_HandleTypeDef structure that contains the configuration information for the JPEG.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_JPEG_SetUserQuantTables

Function name	HAL_StatusTypeDef HAL_JPEG_SetUserQuantTables (JPEG_HandleTypeDef * hjpeg, uint8_t * QTable0, uint8_t * QTable1, uint8_t * QTable2, uint8_t * QTable3)
Function description	Modify the default Quantization tables used for JPEG encoding.
Parameters	<ul style="list-style-type: none"> • hjpeg: pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module • QTable0: : pointer to uint8_t , define the user quantification table for color component 1. If NULL assume no need to update the table and no error return • QTable1: : pointer to uint8_t , define the user quantification table for color component 2. If NULL assume no need to update the table and no error return. • QTable2: : pointer to uint8_t , define the user quantification table for color component 3, If NULL assume no need to update the table and no error return. • QTable3: : pointer to uint8_t , define the user quantification table for color component 4. If NULL assume no need to update the table and no error return.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_JPEG_Encode

Function name	HAL_StatusTypeDef HAL_JPEG_Encode (JPEG_HandleTypeDef * hjpeg, uint8_t * pDataInMCU, uint32_t InDataLength, uint8_t * pDataOut, uint32_t OutDataLength, uint32_t Timeout)
Function description	Starts JPEG encoding with polling processing.
Parameters	<ul style="list-style-type: none"> • hjpeg: pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module • pDataInMCU: Pointer to the Input buffer • InDataLength: size in bytes Input buffer • pDataOut: Pointer to the jpeg output data buffer • OutDataLength: size in bytes of the Output buffer

- **Timeout:** Specify Timeout value
- Return values
- **HAL:** status

HAL_JPEG_Decode

Function name **HAL_StatusTypeDef HAL_JPEG_Decode (JPEG_HandleTypeDef * hjpeg, uint8_t * pDataIn, uint32_t InDataLength, uint8_t * pDataOutMCU, uint32_t OutDataLength, uint32_t Timeout)**

Function description Starts JPEG decoding with polling processing.

- Parameters
- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module
 - **pDataIn:** Pointer to the input data buffer
 - **InDataLength:** size in bytes Input buffer
 - **pDataOutMCU:** Pointer to the Output data buffer
 - **OutDataLength:** size in bytes of the Output buffer
 - **Timeout:** Specify Timeout value

- Return values
- **HAL:** status

HAL_JPEG_Encode_IT

Function name **HAL_StatusTypeDef HAL_JPEG_Encode_IT (JPEG_HandleTypeDef * hjpeg, uint8_t * pDataInMCU, uint32_t InDataLength, uint8_t * pDataOut, uint32_t OutDataLength)**

Function description Starts JPEG encoding with interrupt processing.

- Parameters
- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module
 - **pDataInMCU:** Pointer to the Input buffer
 - **InDataLength:** size in bytes Input buffer
 - **pDataOut:** Pointer to the jpeg output data buffer
 - **OutDataLength:** size in bytes of the Output buffer

- Return values
- **HAL:** status

HAL_JPEG_Decode_IT

Function name **HAL_StatusTypeDef HAL_JPEG_Decode_IT (JPEG_HandleTypeDef * hjpeg, uint8_t * pDataIn, uint32_t InDataLength, uint8_t * pDataOutMCU, uint32_t OutDataLength)**

Function description Starts JPEG decoding with interrupt processing.

- Parameters
- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module
 - **pDataIn:** Pointer to the input data buffer
 - **InDataLength:** size in bytes Input buffer
 - **pDataOutMCU:** Pointer to the Output data buffer
 - **OutDataLength:** size in bytes of the Output buffer

- Return values
- **HAL:** status

HAL_JPEG_Encode_DMA

Function name	HAL_StatusTypeDef HAL_JPEG_Encode_DMA (JPEG_HandleTypeDef * hjpeg, uint8_t * pDataInMCU, uint32_t InDataLength, uint8_t * pDataOut, uint32_t OutDataLength)
Function description	Starts JPEG encoding with DMA processing.
Parameters	<ul style="list-style-type: none">• hjpeg: pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module• pDataInMCU: Pointer to the Input buffer• InDataLength: size in bytes Input buffer• pDataOut: Pointer to the jpeg output data buffer• OutDataLength: size in bytes of the Output buffer
Return values	<ul style="list-style-type: none">• HAL: status

HAL_JPEG_Decode_DMA

Function name	HAL_StatusTypeDef HAL_JPEG_Decode_DMA (JPEG_HandleTypeDef * hjpeg, uint8_t * pDataIn, uint32_t InDataLength, uint8_t * pDataOutMCU, uint32_t OutDataLength)
Function description	Starts JPEG decoding with DMA processing.
Parameters	<ul style="list-style-type: none">• hjpeg: pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module• pDataIn: Pointer to the input data buffer• InDataLength: size in bytes Input buffer• pDataOutMCU: Pointer to the Output data buffer• OutDataLength: size in bytes of the Output buffer
Return values	<ul style="list-style-type: none">• HAL: status

HAL_JPEG_Pause

Function name	HAL_StatusTypeDef HAL_JPEG_Pause (JPEG_HandleTypeDef * hjpeg, uint32_t XferSelection)
Function description	Pause the JPEG Input/Output processing.
Parameters	<ul style="list-style-type: none">• hjpeg: pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module• XferSelection: This parameter can be one of the following values : JPEG_PAUSE_RESUME_INPUT : Pause Input processing JPEG_PAUSE_RESUME_OUTPUT: Pause Output processing JPEG_PAUSE_RESUME_INPUT_OUTPUT: Pause Input and Output processing
Return values	<ul style="list-style-type: none">• HAL: status

HAL_JPEG_Resume

Function name	HAL_StatusTypeDef HAL_JPEG_Resume (JPEG_HandleTypeDef * hjpeg, uint32_t XferSelection)
Function description	Resume the JPEG Input/Output processing.

- Parameters
- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module
 - **XferSelection:** This parameter can be one of the following values : JPEG_PAUSE_RESUME_INPUT : Resume Input processing JPEG_PAUSE_RESUME_OUTPUT: Resume Output processing JPEG_PAUSE_RESUME_INPUT_OUTPUT: Resume Input and Output processing

- Return values
- **HAL:** status

HAL_JPEG_ConfigInputBuffer

Function name **void HAL_JPEG_ConfigInputBuffer (JPEG_HandleTypeDef * hjpeg, uint8_t * pNewInputBuffer, uint32_t InDataLength)**

Function description Config Encoding/Decoding Input Buffer.

- Parameters
- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module.
 - **pNewInputBuffer:** Pointer to the new input data buffer
 - **InDataLength:** Size in bytes of the new Input data buffer

- Return values
- **HAL:** status

HAL_JPEG_ConfigOutputBuffer

Function name **void HAL_JPEG_ConfigOutputBuffer (JPEG_HandleTypeDef * hjpeg, uint8_t * pNewOutputBuffer, uint32_t OutDataLength)**

Function description Config Encoding/Decoding Output Buffer.

- Parameters
- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module.
 - **pNewOutputBuffer:** Pointer to the new output data buffer
 - **OutDataLength:** Size in bytes of the new Output data buffer

- Return values
- **HAL:** status

HAL_JPEG_Abort

Function name **HAL_StatusTypeDef HAL_JPEG_Abort (JPEG_HandleTypeDef * hjpeg)**

Function description Aborts the JPEG Encoding/Decoding.

- Parameters
- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module

- Return values
- **HAL:** status

HAL_JPEG_InfoReadyCallback

Function name **void HAL_JPEG_InfoReadyCallback (JPEG_HandleTypeDef * hjpeg, JPEG_ConfTypeDef * pInfo)**

Function description Decoding JPEG Info ready callback.

- Parameters
- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module

- **pInfo:** pointer to a JPEG_ConfTypeDef structure that contains The JPEG decoded header informations

Return values

- **None:**

HAL_JPEG_EncodeCpltCallback

Function name **void HAL_JPEG_EncodeCpltCallback (JPEG_HandleTypeDef * hjpeg)**

Function description Encoding complete callback.

Parameters

- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module

Return values

- **None:**

HAL_JPEG_DecodeCpltCallback

Function name **void HAL_JPEG_DecodeCpltCallback (JPEG_HandleTypeDef * hjpeg)**

Function description Decoding complete callback.

Parameters

- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module

Return values

- **None:**

HAL_JPEG_ErrorCallback

Function name **void HAL_JPEG_ErrorCallback (JPEG_HandleTypeDef * hjpeg)**

Function description JPEG error callback.

Parameters

- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module

Return values

- **None:**

HAL_JPEG_GetDataCallback

Function name **void HAL_JPEG_GetDataCallback (JPEG_HandleTypeDef * hjpeg, uint32_t NbDecodedData)**

Function description Get New Data chunk callback.

Parameters

- **hjpeg:** pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module
- **NbDecodedData:** Number of consumed data in the previous chunk in bytes

Return values

- **None:**

HAL_JPEG_DataReadyCallback

Function name **void HAL_JPEG_DataReadyCallback (JPEG_HandleTypeDef * hjpeg, uint8_t * pDataOut, uint32_t OutDataLength)**

Function description	Decoded/Encoded Data ready callback.
Parameters	<ul style="list-style-type: none"> • hjpeg: pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module • pDataOut: pointer to the output data buffer • OutDataLength: number in bytes of data available in the specified output buffer
Return values	<ul style="list-style-type: none"> • None:

HAL_JPEG_IRQHandler

Function name	void HAL_JPEG_IRQHandler (JPEG_HandleTypeDef * hjpeg)
Function description	This function handles JPEG interrupt request.
Parameters	<ul style="list-style-type: none"> • hjpeg: pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module
Return values	<ul style="list-style-type: none"> • None:

HAL_JPEG_GetState

Function name	HAL_JPEG_STATETTypeDef HAL_JPEG_GetState (JPEG_HandleTypeDef * hjpeg)
Function description	Returns the JPEG state.
Parameters	<ul style="list-style-type: none"> • hjpeg: pointer to a JPEG_HandleTypeDef structure that contains the configuration information for JPEG module
Return values	<ul style="list-style-type: none"> • JPEG: state

HAL_JPEG_GetError

Function name	uint32_t HAL_JPEG_GetError (JPEG_HandleTypeDef * hjpeg)
Function description	Return the JPEG error code.
Parameters	<ul style="list-style-type: none"> • hjpeg: : pointer to a JPEG_HandleTypeDef structure that contains the configuration information for the specified JPEG.
Return values	<ul style="list-style-type: none"> • JPEG: Error Code

37.3 JPEG Firmware driver defines

37.3.1 JPEG

JPEG Chrominance Sampling

JPEG_444_SUBSAMPLING Chroma Subsampling 4:4:4

JPEG_420_SUBSAMPLING Chroma Subsampling 4:2:0

JPEG_422_SUBSAMPLING Chroma Subsampling 4:2:2

JPEG ColorSpace

JPEG_GRAYSCALE_COLORSPACE

JPEG_YCBCR_COLORSPACE

JPEG_CMYK_COLORSPACE

JPEG Error Code definition

HAL_JPEG_ERROR_NONE	No error
HAL_JPEG_ERROR_HUFF_TABLE	Huffman Table programming error
HAL_JPEG_ERROR_QUANT_TABLE	Quantization Table programming error
HAL_JPEG_ERROR_DMA	DMA transfer error
HAL_JPEG_ERROR_TIMEOUT	Timeout error

JPEG Exported Macros

__HAL_JPEG_RESET_HANDLE_STATE	<p>Description:</p> <ul style="list-style-type: none"> • Reset JPEG handle state. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: specifies the JPEG handle. <p>Return value:</p> <ul style="list-style-type: none"> • None
__HAL_JPEG_ENABLE	<p>Description:</p> <ul style="list-style-type: none"> • Enable the JPEG peripheral. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: specifies the JPEG handle. <p>Return value:</p> <ul style="list-style-type: none"> • None
__HAL_JPEG_DISABLE	<p>Description:</p> <ul style="list-style-type: none"> • Disable the JPEG peripheral. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: specifies the JPEG handle. <p>Return value:</p> <ul style="list-style-type: none"> • None
__HAL_JPEG_GET_FLAG	<p>Description:</p> <ul style="list-style-type: none"> • Check the specified JPEG status flag. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: specifies the JPEG handle. • __FLAG__: : specifies the flag to check This parameter can be one of the following values: <ul style="list-style-type: none"> – JPEG_FLAG_IPTF : The input FIFO is not full and is bellow its threshold flag



- JPEG_FLAG_IFNFF : The input FIFO Not Full Flag, a data can be written
- JPEG_FLAG_OFTF : The output FIFO is not empty and has reach its threshold
- JPEG_FLAG_OFNEF : The output FIFO is not empty, a data is available
- JPEG_FLAG_EOCF : JPEG Codec core has finished the encoding or the decoding process and than last data has been sent to the output FIFO
- JPEG_FLAG_HPDI : JPEG Codec has finished the parsing of the headers and the internal registers have been updated
- JPEG_FLAG_COI : JPEG Codec operation on going flag

Return value:

- :: __HAL_JPEG_GET_FLAG : returns The new state of __FLAG__ (TRUE or FALSE)

Description:

- Clear the specified JPEG status flag.

Parameters:

- __HANDLE__: specifies the JPEG handle.
- __FLAG__: : specifies the flag to clear This parameter can be one of the following values:
 - JPEG_FLAG_EOCF : JPEG Codec core has finished the encoding or the decoding process and than last data has been sent to the output FIFO
 - JPEG_FLAG_HPDI : JPEG Codec has finished the parsing of the headers

Return value:

- :: None

Description:

- Enable Interrupt.

Parameters:

- __HANDLE__: specifies the JPEG handle.
- __INTERRUPT__: : specifies the interrupt to enable This parameter can be one of the following values:
 - JPEG_IT_IPT : Input FIFO Threshold

`__HAL_JPEG_CLEAR_FLAG`

`__HAL_JPEG_ENABLE_IT`

- Interrupt
- JPEG_IT_IFNF : Input FIFO Not Full Interrupt
- JPEG_IT_OFT : Output FIFO Threshold Interrupt
- JPEG_IT_OFNE : Output FIFO Not empty Interrupt
- JPEG_IT_EOC : End of Conversion Interrupt
- JPEG_IT_HPDP : Header Parsing Done Interrupt

Return value:

- : No retrun

Description:

- Disable Interrupt.

Parameters:

- `__HANDLE__`: specifies the JPEG handle.
- `__INTERRUPT__`: specifies the interrupt to disable This parameter can be one of the following values:
 - JPEG_IT_IPT : Input FIFO Threshold Interrupt
 - JPEG_IT_IFNF : Input FIFO Not Full Interrupt
 - JPEG_IT_OFT : Output FIFO Threshold Interrupt
 - JPEG_IT_OFNE : Output FIFO Not empty Interrupt
 - JPEG_IT_EOC : End of Conversion Interrupt
 - JPEG_IT_HPDP : Header Parsing Done Interrupt

Return value:

- : No retrun

Notes:

- : To disable an IT we must use `MODIFY_REG` macro to avoid writing "1" to the FIFO flush bits located in the same IT enable register (CR register).

Description:

- Get Interrupt state.

Parameters:

- `__HANDLE__`: specifies the JPEG handle.
- `__INTERRUPT__`: specifies the interrupt to check This parameter can be one of

`__HAL_JPEG_DISABLE_IT`

`__HAL_JPEG_GET_IT_SOURCE`

the following values:

- JPEG_IT_IFT : Input FIFO Threshold Interrupt
- JPEG_IT_IFNF : Input FIFO Not Full Interrupt
- JPEG_IT_OFT : Output FIFO Threshold Interrupt
- JPEG_IT_OFNE : Output FIFO Not empty Interrupt
- JPEG_IT_EOC : End of Conversion Interrupt
- JPEG_IT_HPDP : Header Parsing Done Interrupt

Return value:

- :: returns The new state of `__INTERRUPT__` (Enabled or disabled)

JPEG Flag definition

JPEG_FLAG_IFFT	Input FIFO is not full and is bellow its threshold flag
JPEG_FLAG_IFNFF	Input FIFO Not Full Flag, a data can be written
JPEG_FLAG_OFTF	Output FIFO is not empty and has reach its threshold
JPEG_FLAG_OFNEF	Output FIFO is not empty, a data is available
JPEG_FLAG_EOCF	JPEG Codec core has finished the encoding or the decoding process and than last data has been sent to the output FIFO
JPEG_FLAG_HPDPF	JPEG Codec has finished the parsing of the headers and the internal registers have been updated
JPEG_FLAG_COF	JPEG Codec operation on going flag
JPEG_FLAG_ALL	JPEG Codec All previous flag

JPEG Image Quality

JPEG_IMAGE_QUALITY_MIN	Minimum JPEG quality
JPEG_IMAGE_QUALITY_MAX	Maximum JPEG quality

JPEG Interrupt configuration definition

JPEG_IT_IFT	Input FIFO Threshold Interrupt
JPEG_IT_IFNF	Input FIFO Not Full Interrupt
JPEG_IT_OFT	Output FIFO Threshold Interrupt
JPEG_IT_OFNE	Output FIFO Not Empty Interrupt
JPEG_IT_EOC	End of Conversion Interrupt
JPEG_IT_HPDP	Header Parsing Done Interrupt

JPEG Private macros to check input parameters

IS_JPEG_CHROMASUBSAMPLING
IS_JPEG_IMAGE_QUALITY
IS_JPEG_COLORSPACE

IS_JPEG_PAUSE_RESUME_STATE

JPEG Process Pause Resume definition

JPEG_PAUSE_RESUME_INPUT

Pause/Resume Input FIFO Xfer

JPEG_PAUSE_RESUME_OUTPUT

Pause/Resume Output FIFO Xfer

JPEG_PAUSE_RESUME_INPUT_OUTPUT

Pause/Resume Input and Output FIFO Xfer

JPEG Quantization Table Size

JPEG_QUANT_TABLE_SIZE

38 HAL LPTIM Generic Driver

38.1 LPTIM Firmware driver registers structures

38.1.1 LPTIM_ClockConfigTypeDef

Data Fields

- *uint32_t Source*
- *uint32_t Prescaler*

Field Documentation

- *uint32_t LPTIM_ClockConfigTypeDef::Source*
Selects the clock source. This parameter can be a value of [LPTIM_Clock_Source](#)
- *uint32_t LPTIM_ClockConfigTypeDef::Prescaler*
Specifies the counter clock Prescaler. This parameter can be a value of [LPTIM_Clock_Prescaler](#)

38.1.2 LPTIM_ULPClockConfigTypeDef

Data Fields

- *uint32_t Polarity*
- *uint32_t SampleTime*

Field Documentation

- *uint32_t LPTIM_ULPClockConfigTypeDef::Polarity*
Selects the polarity of the active edge for the counter unit if the ULPTIM input is selected. Note: This parameter is used only when Ultra low power clock source is used. Note: If the polarity is configured on 'both edges', an auxiliary clock (one of the Low power oscillator) must be active. This parameter can be a value of [LPTIM_Clock_Polarity](#)
- *uint32_t LPTIM_ULPClockConfigTypeDef::SampleTime*
Selects the clock sampling time to configure the clock glitch filter. Note: This parameter is used only when Ultra low power clock source is used. This parameter can be a value of [LPTIM_Clock_Sample_Time](#)

38.1.3 LPTIM_TriggerConfigTypeDef

Data Fields

- *uint32_t Source*
- *uint32_t ActiveEdge*
- *uint32_t SampleTime*

Field Documentation

- *uint32_t LPTIM_TriggerConfigTypeDef::Source*
Selects the Trigger source. This parameter can be a value of [LPTIM_Trigger_Source](#)
- *uint32_t LPTIM_TriggerConfigTypeDef::ActiveEdge*
Selects the Trigger active edge. Note: This parameter is used only when an external trigger is used. This parameter can be a value of [LPTIM_External_Trigger_Polarity](#)
- *uint32_t LPTIM_TriggerConfigTypeDef::SampleTime*
Selects the trigger sampling time to configure the clock glitch filter. Note: This

parameter is used only when an external trigger is used. This parameter can be a value of [LPTIM_Trigger_Sample_Time](#)

38.1.4 LPTIM_InitTypeDef

Data Fields

- *LPTIM_ClockConfigTypeDef* **Clock**
- *LPTIM_ULPClockConfigTypeDef* **UltraLowPowerClock**
- *LPTIM_TriggerConfigTypeDef* **Trigger**
- *uint32_t* **OutputPolarity**
- *uint32_t* **UpdateMode**
- *uint32_t* **CounterSource**

Field Documentation

- *LPTIM_ClockConfigTypeDef* **LPTIM_InitTypeDef::Clock**
Specifies the clock parameters
- *LPTIM_ULPClockConfigTypeDef* **LPTIM_InitTypeDef::UltraLowPowerClock**
Specifies the Ultra Low Power clock parameters
- *LPTIM_TriggerConfigTypeDef* **LPTIM_InitTypeDef::Trigger**
Specifies the Trigger parameters
- *uint32_t* **LPTIM_InitTypeDef::OutputPolarity**
Specifies the Output polarity. This parameter can be a value of [LPTIM_Output_Polarity](#)
- *uint32_t* **LPTIM_InitTypeDef::UpdateMode**
Specifies whether the update of the autoreload and the compare values is done immediately or after the end of current period. This parameter can be a value of [LPTIM_Updating_Mode](#)
- *uint32_t* **LPTIM_InitTypeDef::CounterSource**
Specifies whether the counter is incremented each internal event or each external event. This parameter can be a value of [LPTIM_Counter_Source](#)

38.1.5 LPTIM_HandleTypeDef

Data Fields

- *LPTIM_TypeDef* * **Instance**
- *LPTIM_InitTypeDef* **Init**
- *HAL_StatusTypeDef* **Status**
- *HAL_LockTypeDef* **Lock**
- *__IO HAL_LPTIM_StateTypeDef* **State**

Field Documentation

- *LPTIM_TypeDef** **LPTIM_HandleTypeDef::Instance**
Register base address
- *LPTIM_InitTypeDef* **LPTIM_HandleTypeDef::Init**
LPTIM required parameters
- *HAL_StatusTypeDef* **LPTIM_HandleTypeDef::Status**
LPTIM peripheral status
- *HAL_LockTypeDef* **LPTIM_HandleTypeDef::Lock**
LPTIM locking object
- *__IO HAL_LPTIM_StateTypeDef* **LPTIM_HandleTypeDef::State**
LPTIM peripheral state

38.2 LPTIM Firmware driver API description

38.2.1 How to use this driver

The LPTIM HAL driver can be used as follows:

1. Initialize the LPTIM low level resources by implementing the HAL_LPTIM_MspInit():
 - a. Enable the LPTIM interface clock using `__LPTIMx_CLK_ENABLE()`.
 - b. In case of using interrupts (e.g. `HAL_LPTIM_PWM_Start_IT()`):
 - Configure the LPTIM interrupt priority using `HAL_NVIC_SetPriority()`.
 - Enable the LPTIM IRQ handler using `HAL_NVIC_EnableIRQ()`.
 - In LPTIM IRQ handler, call `HAL_LPTIM_IRQHandler()`.
2. Initialize the LPTIM HAL using `HAL_LPTIM_Init()`. This function configures mainly:
 - a. The instance: LPTIM1.
 - b. Clock: the counter clock.
 - Source: it can be either the ULPTIM input (IN1) or one of the internal clock; (APB, LSE, LSI or MSI).
 - Prescaler: select the clock divider.
 - c. UltraLowPowerClock : To be used only if the ULPTIM is selected as counter clock source.
 - Polarity: polarity of the active edge for the counter unit if the ULPTIM input is selected.
 - SampleTime: clock sampling time to configure the clock glitch filter.
 - d. Trigger: How the counter start.
 - Source: trigger can be software or one of the hardware triggers.
 - ActiveEdge: only for hardware trigger.
 - SampleTime: trigger sampling time to configure the trigger glitch filter.
 - e. OutputPolarity: 2 opposite polarities are possibles.
 - f. UpdateMode: specifies whether the update of the autoreload and the compare values is done immediately or after the end of current period.
3. Six modes are available:
 - a. PWM Mode: To generate a PWM signal with specified period and pulse, call `HAL_LPTIM_PWM_Start()` or `HAL_LPTIM_PWM_Start_IT()` for interruption mode.
 - b. One Pulse Mode: To generate pulse with specified width in response to a stimulus, call `HAL_LPTIM_OnePulse_Start()` or `HAL_LPTIM_OnePulse_Start_IT()` for interruption mode.
 - c. Set once Mode: In this mode, the output changes the level (from low level to high level if the output polarity is configured high, else the opposite) when a compare match occurs. To start this mode, call `HAL_LPTIM_SetOnce_Start()` or `HAL_LPTIM_SetOnce_Start_IT()` for interruption mode.
 - d. Encoder Mode: To use the encoder interface call `HAL_LPTIM_Encoder_Start()` or `HAL_LPTIM_Encoder_Start_IT()` for interruption mode.
 - e. Time out Mode: an active edge on one selected trigger input rests the counter. The first trigger event will start the timer, any successive trigger event will reset the counter and the timer will restart. To start this mode call `HAL_LPTIM_TimeOut_Start_IT()` or `HAL_LPTIM_TimeOut_Start_IT()` for interruption mode.
 - f. Counter Mode: counter can be used to count external events on the LPTIM Input1 or it can be used to count internal clock cycles. To start this mode, call `HAL_LPTIM_Counter_Start()` or `HAL_LPTIM_Counter_Start_IT()` for interruption mode.
4. User can stop any process by calling the corresponding API: `HAL_LPTIM_Xxx_Stop()` or `HAL_LPTIM_Xxx_Stop_IT()` if the process is already started in interruption mode.
5. Call `HAL_LPTIM_DeInit()` to deinitialize the LPTIM peripheral.

38.2.2 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the LPTIM according to the specified parameters in the LPTIM_InitTypeDef and creates the associated handle.
- Deinitialize the LPTIM peripheral.
- Initialize the LPTIM MSP.
- Deinitialize LPTIM MSP.

This section contains the following APIs:

- [*HAL_LPTIM_Init\(\)*](#)
- [*HAL_LPTIM_DeInit\(\)*](#)
- [*HAL_LPTIM_MspInit\(\)*](#)
- [*HAL_LPTIM_MspDeInit\(\)*](#)

38.2.3 LPTIM Start Stop operation functions

This section provides functions allowing to:

- Start the PWM mode.
- Stop the PWM mode.
- Start the One pulse mode.
- Stop the One pulse mode.
- Start the Set once mode.
- Stop the Set once mode.
- Start the Encoder mode.
- Stop the Encoder mode.
- Start the Timeout mode.
- Stop the Timeout mode.
- Start the Counter mode.
- Stop the Counter mode.

This section contains the following APIs:

- [*HAL_LPTIM_PWM_Start\(\)*](#)
- [*HAL_LPTIM_PWM_Stop\(\)*](#)
- [*HAL_LPTIM_PWM_Start_IT\(\)*](#)
- [*HAL_LPTIM_PWM_Stop_IT\(\)*](#)
- [*HAL_LPTIM_OnePulse_Start\(\)*](#)
- [*HAL_LPTIM_OnePulse_Stop\(\)*](#)
- [*HAL_LPTIM_OnePulse_Start_IT\(\)*](#)
- [*HAL_LPTIM_OnePulse_Stop_IT\(\)*](#)
- [*HAL_LPTIM_SetOnce_Start\(\)*](#)
- [*HAL_LPTIM_SetOnce_Stop\(\)*](#)
- [*HAL_LPTIM_SetOnce_Start_IT\(\)*](#)
- [*HAL_LPTIM_SetOnce_Stop_IT\(\)*](#)
- [*HAL_LPTIM_Encoder_Start\(\)*](#)
- [*HAL_LPTIM_Encoder_Stop\(\)*](#)
- [*HAL_LPTIM_Encoder_Start_IT\(\)*](#)
- [*HAL_LPTIM_Encoder_Stop_IT\(\)*](#)
- [*HAL_LPTIM_TimeOut_Start\(\)*](#)
- [*HAL_LPTIM_TimeOut_Stop\(\)*](#)
- [*HAL_LPTIM_TimeOut_Start_IT\(\)*](#)
- [*HAL_LPTIM_TimeOut_Stop_IT\(\)*](#)
- [*HAL_LPTIM_Counter_Start\(\)*](#)

- [HAL_LPTIM_Counter_Stop\(\)](#)
- [HAL_LPTIM_Counter_Start_IT\(\)](#)
- [HAL_LPTIM_Counter_Stop_IT\(\)](#)

38.2.4 LPTIM Read operation functions

This section provides LPTIM Reading functions.

- Read the counter value.
- Read the period (Auto-reload) value.
- Read the pulse (Compare)value.

This section contains the following APIs:

- [HAL_LPTIM_ReadCounter\(\)](#)
- [HAL_LPTIM_ReadAutoReload\(\)](#)
- [HAL_LPTIM_ReadCompare\(\)](#)

38.2.5 LPTIM IRQ handler

This section provides LPTIM IRQ handler function.

This section contains the following APIs:

- [HAL_LPTIM_IRQHandler\(\)](#)
- [HAL_LPTIM_CompareMatchCallback\(\)](#)
- [HAL_LPTIM_AutoReloadMatchCallback\(\)](#)
- [HAL_LPTIM_TriggerCallback\(\)](#)
- [HAL_LPTIM_CompareWriteCallback\(\)](#)
- [HAL_LPTIM_AutoReloadWriteCallback\(\)](#)
- [HAL_LPTIM_DirectionUpCallback\(\)](#)
- [HAL_LPTIM_DirectionDownCallback\(\)](#)

38.2.6 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral.

This section contains the following APIs:

- [HAL_LPTIM_GetState\(\)](#)

38.2.7 Detailed description of functions

HAL_LPTIM_Init

Function name **HAL_StatusTypeDef HAL_LPTIM_Init (LPTIM_HandleTypeDef * hlptim)**

Function description Initializes the LPTIM according to the specified parameters in the LPTIM_InitTypeDef and creates the associated handle.

Parameters • **hlptim:** LPTIM handle

Return values • **HAL:** status

HAL_LPTIM_DeInit

Function name **HAL_StatusTypeDef HAL_LPTIM_DeInit (LPTIM_HandleTypeDef * hlptim)**

Function description	DeInitializes the LPTIM peripheral.
Parameters	<ul style="list-style-type: none">• hlptim: LPTIM handle
Return values	<ul style="list-style-type: none">• HAL: status

HAL_LPTIM_Msplnit

Function name	void HAL_LPTIM_Msplnit (LPTIM_HandleTypeDef * hlptim)
Function description	Initializes the LPTIM MSP.
Parameters	<ul style="list-style-type: none">• hlptim: LPTIM handle
Return values	<ul style="list-style-type: none">• None:

HAL_LPTIM_MspDelnit

Function name	void HAL_LPTIM_MspDelnit (LPTIM_HandleTypeDef * hlptim)
Function description	DeInitializes LPTIM MSP.
Parameters	<ul style="list-style-type: none">• hlptim: LPTIM handle
Return values	<ul style="list-style-type: none">• None:

HAL_LPTIM_PWM_Start

Function name	HAL_StatusTypeDef HAL_LPTIM_PWM_Start (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Pulse)
Function description	Starts the LPTIM PWM generation.
Parameters	<ul style="list-style-type: none">• hlptim: : LPTIM handle• Period: : Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.• Pulse: : Specifies the compare value. This parameter must be a value between 0x0000 and 0xFFFF.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_LPTIM_PWM_Stop

Function name	HAL_StatusTypeDef HAL_LPTIM_PWM_Stop (LPTIM_HandleTypeDef * hlptim)
Function description	Stops the LPTIM PWM generation.
Parameters	<ul style="list-style-type: none">• hlptim: : LPTIM handle
Return values	<ul style="list-style-type: none">• HAL: status

HAL_LPTIM_PWM_Start_IT

Function name	HAL_StatusTypeDef HAL_LPTIM_PWM_Start_IT (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Pulse)
Function description	Starts the LPTIM PWM generation in interrupt mode.

- Parameters
- **hlptim:** : LPTIM handle
 - **Period:** : Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF
 - **Pulse:** : Specifies the compare value. This parameter must be a value between 0x0000 and 0xFFFF
- Return values
- **HAL:** status

HAL_LPTIM_PWM_Stop_IT

Function name **HAL_StatusTypeDef HAL_LPTIM_PWM_Stop_IT (LPTIM_HandleTypeDef * hlptim)**

Function description Stops the LPTIM PWM generation in interrupt mode.

Parameters

- **hlptim:** : LPTIM handle

Return values

- **HAL:** status

HAL_LPTIM_OnePulse_Start

Function name **HAL_StatusTypeDef HAL_LPTIM_OnePulse_Start (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Pulse)**

Function description Starts the LPTIM One pulse generation.

Parameters

- **hlptim:** : LPTIM handle
- **Period:** : Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.
- **Pulse:** : Specifies the compare value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

HAL_LPTIM_OnePulse_Stop

Function name **HAL_StatusTypeDef HAL_LPTIM_OnePulse_Stop (LPTIM_HandleTypeDef * hlptim)**

Function description Stops the LPTIM One pulse generation.

Parameters

- **hlptim:** : LPTIM handle

Return values

- **HAL:** status

HAL_LPTIM_OnePulse_Start_IT

Function name **HAL_StatusTypeDef HAL_LPTIM_OnePulse_Start_IT (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Pulse)**

Function description Starts the LPTIM One pulse generation in interrupt mode.

Parameters

- **hlptim:** : LPTIM handle
- **Period:** : Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.
- **Pulse:** : Specifies the compare value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

HAL_LPTIM_OnePulse_Stop_IT

Function name **HAL_StatusTypeDef HAL_LPTIM_OnePulse_Stop_IT (LPTIM_HandleTypeDef * hlptim)**

Function description Stops the LPTIM One pulse generation in interrupt mode.

Parameters

- **hlptim:** : LPTIM handle

Return values

- **HAL:** status

HAL_LPTIM_SetOnce_Start

Function name **HAL_StatusTypeDef HAL_LPTIM_SetOnce_Start (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Pulse)**

Function description Starts the LPTIM in Set once mode.

Parameters

- **hlptim:** : LPTIM handle
- **Period:** : Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.
- **Pulse:** : Specifies the compare value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

HAL_LPTIM_SetOnce_Stop

Function name **HAL_StatusTypeDef HAL_LPTIM_SetOnce_Stop (LPTIM_HandleTypeDef * hlptim)**

Function description Stops the LPTIM Set once mode.

Parameters

- **hlptim:** : LPTIM handle

Return values

- **HAL:** status

HAL_LPTIM_SetOnce_Start_IT

Function name **HAL_StatusTypeDef HAL_LPTIM_SetOnce_Start_IT (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Pulse)**

Function description Starts the LPTIM Set once mode in interrupt mode.

Parameters

- **hlptim:** : LPTIM handle
- **Period:** : Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.
- **Pulse:** : Specifies the compare value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

HAL_LPTIM_SetOnce_Stop_IT

Function name **HAL_StatusTypeDef HAL_LPTIM_SetOnce_Stop_IT**

(LPTIM_HandleTypeDef * hlptim)

Function description	Stops the LPTIM Set once mode in interrupt mode.
Parameters	<ul style="list-style-type: none"> • hlptim: : LPTIM handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LPTIM_Encoder_Start

Function name	HAL_StatusTypeDef HAL_LPTIM_Encoder_Start (LPTIM_HandleTypeDef * hlptim, uint32_t Period)
Function description	Starts the Encoder interface.
Parameters	<ul style="list-style-type: none"> • hlptim: : LPTIM handle • Period: : Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LPTIM_Encoder_Stop

Function name	HAL_StatusTypeDef HAL_LPTIM_Encoder_Stop (LPTIM_HandleTypeDef * hlptim)
Function description	Stops the Encoder interface.
Parameters	<ul style="list-style-type: none"> • hlptim: : LPTIM handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LPTIM_Encoder_Start_IT

Function name	HAL_StatusTypeDef HAL_LPTIM_Encoder_Start_IT (LPTIM_HandleTypeDef * hlptim, uint32_t Period)
Function description	Starts the Encoder interface in interrupt mode.
Parameters	<ul style="list-style-type: none"> • hlptim: : LPTIM handle • Period: : Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LPTIM_Encoder_Stop_IT

Function name	HAL_StatusTypeDef HAL_LPTIM_Encoder_Stop_IT (LPTIM_HandleTypeDef * hlptim)
Function description	Stops the Encoder interface in interrupt mode.
Parameters	<ul style="list-style-type: none"> • hlptim: : LPTIM handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LPTIM_TimeOut_Start

Function name	HAL_StatusTypeDef HAL_LPTIM_TimeOut_Start (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Timeout)
---------------	--

Function description	Starts the Timeout function.
Parameters	<ul style="list-style-type: none"> • hlptim: : LPTIM handle • Period: : Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF. • Timeout: : Specifies the TimeOut value to rest the counter. This parameter must be a value between 0x0000 and 0xFFFF.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LPTIM_TimeOut_Stop

Function name	HAL_StatusTypeDef HAL_LPTIM_TimeOut_Stop (LPTIM_HandleTypeDef * hlptim)
Function description	Stops the Timeout function.
Parameters	<ul style="list-style-type: none"> • hlptim: : LPTIM handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LPTIM_TimeOut_Start_IT

Function name	HAL_StatusTypeDef HAL_LPTIM_TimeOut_Start_IT (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Timeout)
Function description	Starts the Timeout function in interrupt mode.
Parameters	<ul style="list-style-type: none"> • hlptim: : LPTIM handle • Period: : Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF. • Timeout: : Specifies the TimeOut value to rest the counter. This parameter must be a value between 0x0000 and 0xFFFF.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LPTIM_TimeOut_Stop_IT

Function name	HAL_StatusTypeDef HAL_LPTIM_TimeOut_Stop_IT (LPTIM_HandleTypeDef * hlptim)
Function description	Stops the Timeout function in interrupt mode.
Parameters	<ul style="list-style-type: none"> • hlptim: : LPTIM handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LPTIM_Counter_Start

Function name	HAL_StatusTypeDef HAL_LPTIM_Counter_Start (LPTIM_HandleTypeDef * hlptim, uint32_t Period)
Function description	Starts the Counter mode.
Parameters	<ul style="list-style-type: none"> • hlptim: : LPTIM handle • Period: : Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

HAL_LPTIM_Counter_Stop

Function name **HAL_StatusTypeDef HAL_LPTIM_Counter_Stop (LPTIM_HandleTypeDef * hlptim)**

Function description Stops the Counter mode.

Parameters

- **hlptim:** : LPTIM handle

Return values

- **HAL:** status

HAL_LPTIM_Counter_Start_IT

Function name **HAL_StatusTypeDef HAL_LPTIM_Counter_Start_IT (LPTIM_HandleTypeDef * hlptim, uint32_t Period)**

Function description Starts the Counter mode in interrupt mode.

Parameters

- **hlptim:** : LPTIM handle
- **Period:** : Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

HAL_LPTIM_Counter_Stop_IT

Function name **HAL_StatusTypeDef HAL_LPTIM_Counter_Stop_IT (LPTIM_HandleTypeDef * hlptim)**

Function description Stops the Counter mode in interrupt mode.

Parameters

- **hlptim:** : LPTIM handle

Return values

- **HAL:** status

HAL_LPTIM_ReadCounter

Function name **uint32_t HAL_LPTIM_ReadCounter (LPTIM_HandleTypeDef * hlptim)**

Function description This function returns the current counter value.

Parameters

- **hlptim:** LPTIM handle

Return values

- **Counter:** value.

HAL_LPTIM_ReadAutoReload

Function name **uint32_t HAL_LPTIM_ReadAutoReload (LPTIM_HandleTypeDef * hlptim)**

Function description This function return the current Autoreload (Period) value.

Parameters

- **hlptim:** LPTIM handle

Return values

- **Autoreload:** value.

HAL_LPTIM_ReadCompare

Function name	uint32_t HAL_LPTIM_ReadCompare (LPTIM_HandleTypeDef * hlptim)
Function description	This function return the current Compare (Pulse) value.
Parameters	<ul style="list-style-type: none">• hlptim: LPTIM handle
Return values	<ul style="list-style-type: none">• Compare: value.

HAL_LPTIM_IRQHandler

Function name	void HAL_LPTIM_IRQHandler (LPTIM_HandleTypeDef * hlptim)
Function description	This function handles LPTIM interrupt request.
Parameters	<ul style="list-style-type: none">• hlptim: LPTIM handle
Return values	<ul style="list-style-type: none">• None:

HAL_LPTIM_CompareMatchCallback

Function name	void HAL_LPTIM_CompareMatchCallback (LPTIM_HandleTypeDef * hlptim)
Function description	Compare match callback in non blocking mode.
Parameters	<ul style="list-style-type: none">• hlptim: : LPTIM handle
Return values	<ul style="list-style-type: none">• None:

HAL_LPTIM_AutoReloadMatchCallback

Function name	void HAL_LPTIM_AutoReloadMatchCallback (LPTIM_HandleTypeDef * hlptim)
Function description	Autoreload match callback in non blocking mode.
Parameters	<ul style="list-style-type: none">• hlptim: : LPTIM handle
Return values	<ul style="list-style-type: none">• None:

HAL_LPTIM_TriggerCallback

Function name	void HAL_LPTIM_TriggerCallback (LPTIM_HandleTypeDef * hlptim)
Function description	Trigger detected callback in non blocking mode.
Parameters	<ul style="list-style-type: none">• hlptim: : LPTIM handle
Return values	<ul style="list-style-type: none">• None:

HAL_LPTIM_CompareWriteCallback

Function name	void HAL_LPTIM_CompareWriteCallback (LPTIM_HandleTypeDef * hlptim)
Function description	Compare write callback in non blocking mode.

- | | |
|---------------|---------------------------------|
| Parameters | • hlptim: : LPTIM handle |
| Return values | • None: |

HAL_LPTIM_AutoReloadWriteCallback

- | | |
|----------------------|--|
| Function name | void HAL_LPTIM_AutoReloadWriteCallback (LPTIM_HandleTypeDef * hlptim) |
| Function description | Autoreload write callback in non blocking mode. |
| Parameters | • hlptim: : LPTIM handle |
| Return values | • None: |

HAL_LPTIM_DirectionUpCallback

- | | |
|----------------------|--|
| Function name | void HAL_LPTIM_DirectionUpCallback (LPTIM_HandleTypeDef * hlptim) |
| Function description | Direction counter changed from Down to Up callback in non blocking mode. |
| Parameters | • hlptim: : LPTIM handle |
| Return values | • None: |

HAL_LPTIM_DirectionDownCallback

- | | |
|----------------------|--|
| Function name | void HAL_LPTIM_DirectionDownCallback (LPTIM_HandleTypeDef * hlptim) |
| Function description | Direction counter changed from Up to Down callback in non blocking mode. |
| Parameters | • hlptim: : LPTIM handle |
| Return values | • None: |

HAL_LPTIM_GetState

- | | |
|----------------------|---|
| Function name | HAL_LPTIM_StateTypeDef HAL_LPTIM_GetState (LPTIM_HandleTypeDef * hlptim) |
| Function description | Returns the LPTIM state. |
| Parameters | • hlptim: LPTIM handle |
| Return values | • HAL: state |

38.3 LPTIM Firmware driver defines**38.3.1 LPTIM*****LPTIM Clock Polarity***

LPTIM_CLOCKPOLARITY_RISING

LPTIM_CLOCKPOLARITY_FALLING

LPTIM_CLOCKPOLARITY_RISING_FALLING

LPTIM Clock Prescaler

LPTIM_PRESCALER_DIV1
 LPTIM_PRESCALER_DIV2
 LPTIM_PRESCALER_DIV4
 LPTIM_PRESCALER_DIV8
 LPTIM_PRESCALER_DIV16
 LPTIM_PRESCALER_DIV32
 LPTIM_PRESCALER_DIV64
 LPTIM_PRESCALER_DIV128

LPTIM Clock Sample Time

LPTIM_CLOCKSAMPLETIME_DIRECTTRANSITION
 LPTIM_CLOCKSAMPLETIME_2TRANSITIONS
 LPTIM_CLOCKSAMPLETIME_4TRANSITIONS
 LPTIM_CLOCKSAMPLETIME_8TRANSITIONS

LPTIM Clock Source

LPTIM_CLOCKSOURCE_APBCLK_LPOSC
 LPTIM_CLOCKSOURCE_ULPTIM

LPTIM Counter Source

LPTIM_COUNTERSOURCE_INTERNAL
 LPTIM_COUNTERSOURCE_EXTERNAL

LPTIM Exported Macros

__HAL_LPTIM_RESET_HANDLE_STATE

Description:

- Reset LPTIM handle state.

Parameters:

- __HANDLE__: LPTIM handle

Return value:

- None

__HAL_LPTIM_ENABLE

Description:

- Enable/Disable the LPTIM peripheral.

Parameters:

- __HANDLE__: LPTIM handle

Return value:

- None

`__HAL_LPTIM_DISABLE`

`__HAL_LPTIM_START_CONTINUOUS`

Description:

- Starts the LPTIM peripheral in Continuous or in single mode.

Parameters:

- `__HANDLE__`: DMA handle

Return value:

- None

`__HAL_LPTIM_START_SINGLE`

`__HAL_LPTIM_AUTORELOAD_SET`

Description:

- Writes the passed parameter in the Autoreload register.

Parameters:

- `__HANDLE__`: LPTIM handle
- `__VALUE__`: Autoreload value

Return value:

- None

`__HAL_LPTIM_COMPARE_SET`

Description:

- Writes the passed parameter in the Compare register.

Parameters:

- `__HANDLE__`: LPTIM handle
- `__VALUE__`: Compare value

Return value:

- None

`__HAL_LPTIM_GET_FLAG`

Description:

- Checks whether the specified LPTIM flag is set or not.

Parameters:

- `__HANDLE__`: LPTIM handle
- `__FLAG__`: LPTIM flag to check This parameter can be a value of:

- LPTIM_FLAG_DOWN : Counter direction change up Flag.
- LPTIM_FLAG_UP : Counter direction change down to up Flag.
- LPTIM_FLAG_ARR_OK : Autoreload register update OK Flag.
- LPTIM_FLAG_CMP_OK : Compare register update OK Flag.
- LPTIM_FLAG_EXT_TRIG : External trigger edge event Flag.
- LPTIM_FLAG_ARR_M : Autoreload match Flag.
- LPTIM_FLAG_CMP_M : Compare match Flag.

Return value:

- The: state of the specified flag (SET or RESET).

Description:

- Clears the specified LPTIM flag.

Parameters:

- `__HANDLE__`: LPTIM handle.
- `__FLAG__`: LPTIM flag to clear. This parameter can be a value of:
 - LPTIM_FLAG_DOWN : Counter direction change up Flag.
 - LPTIM_FLAG_UP : Counter direction change down to up Flag.
 - LPTIM_FLAG_ARR_OK : Autoreload register update OK Flag.

`__HAL_LPTIM_CLEAR_FLAG`

- LPTIM_FLAG_CMP OK : Compare register update OK Flag.
- LPTIM_FLAG_EXT TRIG : External trigger edge event Flag.
- LPTIM_FLAG_ARR M : Autoreload match Flag.
- LPTIM_FLAG_CMP M : Compare match Flag.

Return value:

- None.

Description:

- Enable the specified LPTIM interrupt.

Parameters:

- `__HANDLE__` : LPTIM handle.
- `__INTERRUPT__` : LPTIM interrupt to set. This parameter can be a value of:
 - LPTIM_IT_DOWN : Counter direction change up Interrupt.
 - LPTIM_IT_UP : Counter direction change down to up Interrupt.
 - LPTIM_IT_ARROK : Autoreload register update OK Interrupt.
 - LPTIM_IT_CMPOK : Compare register update OK Interrupt.
 - LPTIM_IT_EXTTTRI G : External trigger edge event Interrupt.
 - LPTIM_IT_ARRM : Autoreload match Interrupt.
 - LPTIM_IT_CMPM : Compare match Interrupt.

`__HAL_LPTIM_ENABLE_IT`

`__HAL_LPTIM_DISABLE_IT`**Return value:**

- None.

Description:

- Disable the specified LPTIM interrupt.

Parameters:

- `__HANDLE__`: LPTIM handle.
- `__INTERRUPT__`: LPTIM interrupt to set. This parameter can be a value of:
 - `LPTIM_IT_DOWN`: Counter direction change up Interrupt.
 - `LPTIM_IT_UP`: Counter direction change down to up Interrupt.
 - `LPTIM_IT_ARROK`: Autoreload register update OK Interrupt.
 - `LPTIM_IT_CMPOK`: Compare register update OK Interrupt.
 - `LPTIM_IT_EXTTRIG`: External trigger edge event Interrupt.
 - `LPTIM_IT_ARRM`: Autoreload match Interrupt.
 - `LPTIM_IT_CMPM`: Compare match Interrupt.

Return value:

- None.

Description:

- Checks whether the specified LPTIM interrupt is set or not.

Parameters:

- `__HANDLE__`: LPTIM handle.
- `__INTERRUPT__`: LPTIM interrupt to check. This parameter

`__HAL_LPTIM_GET_IT_SOURCE`

- can be a value of:
- LPTIM_IT_DOWN : Counter direction change up Interrupt.
 - LPTIM_IT_UP : Counter direction change down to up Interrupt.
 - LPTIM_IT_ARROK : Autoreload register update OK Interrupt.
 - LPTIM_IT_CMPOK : Compare register update OK Interrupt.
 - LPTIM_IT_EXTTRIG : External trigger edge event Interrupt.
 - LPTIM_IT_ARRM : Autoreload match Interrupt.
 - LPTIM_IT_CMPM : Compare match Interrupt.

Return value:

- Interrupt: status.

`__HAL_LPTIM_WAKEUPTIMER_EXTI_ENABLE_IT`

Description:

- Enable interrupt on the LPTIM Wake-up Timer associated Exti line.

Return value:

- None

`__HAL_LPTIM_WAKEUPTIMER_EXTI_DISABLE_IT`

Description:

- Disable interrupt on the LPTIM Wake-up Timer associated Exti line.

Return value:

- None

`__HAL_LPTIM_WAKEUPTIMER_EXTI_ENABLE_EVENT`

Description:

- Enable event on the LPTIM Wake-up Timer associated Exti line.

Return value:

- None.

<code>__HAL_LPTIM_WAKEUPTIMER_EXTI_DISABLE_EVENT</code>	Description: <ul style="list-style-type: none">• Disable event on the LPTIM Wake-up Timer associated Exti line. Return value: <ul style="list-style-type: none">• None.
<code>__HAL_LPTIM_WAKEUPTIMER_EXTI_ENABLE_FALLING_EDGE</code>	Description: <ul style="list-style-type: none">• Enable falling edge trigger on the LPTIM Wake-up Timer associated Exti line. Return value: <ul style="list-style-type: none">• None.
<code>__HAL_LPTIM_WAKEUPTIMER_EXTI_DISABLE_FALLING_EDGE</code>	Description: <ul style="list-style-type: none">• Disable falling edge trigger on the LPTIM Wake-up Timer associated Exti line. Return value: <ul style="list-style-type: none">• None.
<code>__HAL_LPTIM_WAKEUPTIMER_EXTI_ENABLE_RISING_EDGE</code>	Description: <ul style="list-style-type: none">• Enable rising edge trigger on the LPTIM Wake-up Timer associated Exti line. Return value: <ul style="list-style-type: none">• None.
<code>__HAL_LPTIM_WAKEUPTIMER_EXTI_DISABLE_RISING_EDGE</code>	Description: <ul style="list-style-type: none">• Disable rising edge trigger on the LPTIM Wake-up Timer associated Exti line. Return value: <ul style="list-style-type: none">• None.
<code>__HAL_LPTIM_WAKEUPTIMER_EXTI_ENABLE_RISING_FALLING_EDGE</code>	Description: <ul style="list-style-type: none">• Enable rising & falling edge trigger on the LPTIM Wake-up Timer associated Exti line. Return value: <ul style="list-style-type: none">• None.
<code>__HAL_LPTIM_WAKEUPTIMER_EXTI_DISABLE_RISING</code>	Description:

G_FALLING_EDGE

- Disable rising & falling edge trigger on the LPTIM Wake-up Timer associated Exti line.

Return value:

- None.

__HAL_LPTIM_WAKEUPTIMER_EXTI_GET_FLAG

Description:

- Check whether the LPTIM Wake-up Timer associated Exti line interrupt flag is set or not.

Return value:

- Line: Status.

__HAL_LPTIM_WAKEUPTIMER_EXTI_CLEAR_FLAG

Description:

- Clear the LPTIM Wake-up Timer associated Exti line flag.

Return value:

- None.

__HAL_LPTIM_WAKEUPTIMER_EXTI_GENERATE_SWIT

Description:

- Generate a Software interrupt on the LPTIM Wake-up Timer associated Exti line.

Return value:

- None.

LPTIM External Trigger Polarity

LPTIM_ACTIVEEDGE_RISING

LPTIM_ACTIVEEDGE_FALLING

LPTIM_ACTIVEEDGE_RISING_FALLING

LPTIM Flag Definition

LPTIM_FLAG_DOWN

LPTIM_FLAG_UP

LPTIM_FLAG_ARROK

LPTIM_FLAG_CMPOK

LPTIM_FLAG_EXTTTRIG

LPTIM_FLAG_ARRM

LPTIM_FLAG_CMPM

LPTIM Interrupts Definition

LPTIM_IT_DOWN

LPTIM_IT_UP

LPTIM_IT_ARROK

LPTIM_IT_CMPOK

LPTIM_IT_EXTTRIG

LPTIM_IT_ARRM

LPTIM_IT_CMPM

LPTIM Output Polarity

LPTIM_OUTPUTPOLARITY_HIGH

LPTIM_OUTPUTPOLARITY_LOW

LPTIM Trigger Sample Time

LPTIM_TRIGSAMPLETIME_DIRECTTRANSITION

LPTIM_TRIGSAMPLETIME_2TRANSITIONS

LPTIM_TRIGSAMPLETIME_4TRANSITIONS

LPTIM_TRIGSAMPLETIME_8TRANSITIONS

LPTIM Trigger Source

LPTIM_TRIGSOURCE_SOFTWARE

LPTIM_TRIGSOURCE_0

LPTIM_TRIGSOURCE_1

LPTIM_TRIGSOURCE_2

LPTIM_TRIGSOURCE_3

LPTIM_TRIGSOURCE_4

LPTIM_TRIGSOURCE_5

LPTIM Updating Mode

LPTIM_UPDATE_IMMEDIATE

LPTIM_UPDATE_ENDOFPERIOD

LPTIM WAKEUP Timer EXTI Line

LPTIM_EXTI_LINE_WAKEUPTIMER_EVENT External interrupt line 23 Connected to the LPTIM EXTI Line

39 HAL LTDC Generic Driver

39.1 LTDC Firmware driver registers structures

39.1.1 LTDC_ColorTypeDef

Data Fields

- *uint8_t Blue*
- *uint8_t Green*
- *uint8_t Red*
- *uint8_t Reserved*

Field Documentation

- *uint8_t LTDC_ColorTypeDef::Blue*
Configures the blue value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.
- *uint8_t LTDC_ColorTypeDef::Green*
Configures the green value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.
- *uint8_t LTDC_ColorTypeDef::Red*
Configures the red value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.
- *uint8_t LTDC_ColorTypeDef::Reserved*
Reserved 0xFF

39.1.2 LTDC_InitTypeDef

Data Fields

- *uint32_t HSPolarity*
- *uint32_t VSPolarity*
- *uint32_t DEPolarity*
- *uint32_t PCPolarity*
- *uint32_t HorizontalSync*
- *uint32_t VerticalSync*
- *uint32_t AccumulatedHBP*
- *uint32_t AccumulatedVBP*
- *uint32_t AccumulatedActiveW*
- *uint32_t AccumulatedActiveH*
- *uint32_t TotalWidth*
- *uint32_t TotalHeigh*
- *LTDC_ColorTypeDef Backcolor*

Field Documentation

- *uint32_t LTDC_InitTypeDef::HSPolarity*
configures the horizontal synchronization polarity. This parameter can be one value of [LTDC_HS_POLARITY](#)
- *uint32_t LTDC_InitTypeDef::VSPolarity*
configures the vertical synchronization polarity. This parameter can be one value of [LTDC_VS_POLARITY](#)

- ***uint32_t LTDC_InitTypeDef::DEPolarity***
configures the data enable polarity. This parameter can be one of value of ***LTDC_DE_POLARITY***
- ***uint32_t LTDC_InitTypeDef::PCPolarity***
configures the pixel clock polarity. This parameter can be one of value of ***LTDC_PC_POLARITY***
- ***uint32_t LTDC_InitTypeDef::HorizontalSync***
configures the number of Horizontal synchronization width. This parameter must be a number between *Min_Data* = 0x000 and *Max_Data* = 0xFFFF.
- ***uint32_t LTDC_InitTypeDef::VerticalSync***
configures the number of Vertical synchronization height. This parameter must be a number between *Min_Data* = 0x000 and *Max_Data* = 0x7FF.
- ***uint32_t LTDC_InitTypeDef::AccumulatedHBP***
configures the accumulated horizontal back porch width. This parameter must be a number between *Min_Data* = *LTDC_HorizontalSync* and *Max_Data* = 0xFFFF.
- ***uint32_t LTDC_InitTypeDef::AccumulatedVBP***
configures the accumulated vertical back porch height. This parameter must be a number between *Min_Data* = *LTDC_VerticalSync* and *Max_Data* = 0x7FF.
- ***uint32_t LTDC_InitTypeDef::AccumulatedActiveW***
configures the accumulated active width. This parameter must be a number between *Min_Data* = *LTDC_AccumulatedHBP* and *Max_Data* = 0xFFFF.
- ***uint32_t LTDC_InitTypeDef::AccumulatedActiveH***
configures the accumulated active height. This parameter must be a number between *Min_Data* = *LTDC_AccumulatedVBP* and *Max_Data* = 0x7FF.
- ***uint32_t LTDC_InitTypeDef::TotalWidth***
configures the total width. This parameter must be a number between *Min_Data* = *LTDC_AccumulatedActiveW* and *Max_Data* = 0xFFFF.
- ***uint32_t LTDC_InitTypeDef::TotalHeigh***
configures the total height. This parameter must be a number between *Min_Data* = *LTDC_AccumulatedActiveH* and *Max_Data* = 0x7FF.
- ***LTDC_ColorTypeDef LTDC_InitTypeDef::BackColor***
Configures the background color.

39.1.3 LTDC_LayerCfgTypeDef

Data Fields

- ***uint32_t WindowX0***
- ***uint32_t WindowX1***
- ***uint32_t WindowY0***
- ***uint32_t WindowY1***
- ***uint32_t PixelFormat***
- ***uint32_t Alpha***
- ***uint32_t Alpha0***
- ***uint32_t BlendingFactor1***
- ***uint32_t BlendingFactor2***
- ***uint32_t FBStartAdress***
- ***uint32_t ImageWidth***
- ***uint32_t ImageHeight***
- ***LTDC_ColorTypeDef Backcolor***

Field Documentation

- ***uint32_t LTDC_LayerCfgTypeDef::WindowX0***
Configures the Window Horizontal Start Position. This parameter must be a number between *Min_Data* = 0x000 and *Max_Data* = 0xFFFF.

- ***uint32_t LTDC_LayerCfgTypeDef::WindowX1***
Configures the Window Horizontal Stop Position. This parameter must be a number between Min_Data = 0x000 and Max_Data = 0xFFFF.
- ***uint32_t LTDC_LayerCfgTypeDef::WindowY0***
Configures the Window vertical Start Position. This parameter must be a number between Min_Data = 0x000 and Max_Data = 0x7FF.
- ***uint32_t LTDC_LayerCfgTypeDef::WindowY1***
Configures the Window vertical Stop Position. This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0x7FF.
- ***uint32_t LTDC_LayerCfgTypeDef::PixelFormat***
Specifies the pixel format. This parameter can be one of value of [LTDC_Pixelformat](#)
- ***uint32_t LTDC_LayerCfgTypeDef::Alpha***
Specifies the constant alpha used for blending. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.
- ***uint32_t LTDC_LayerCfgTypeDef::Alpha0***
Configures the default alpha value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.
- ***uint32_t LTDC_LayerCfgTypeDef::BlendingFactor1***
Select the blending factor 1. This parameter can be one of value of [LTDC_BlendingFactor1](#)
- ***uint32_t LTDC_LayerCfgTypeDef::BlendingFactor2***
Select the blending factor 2. This parameter can be one of value of [LTDC_BlendingFactor2](#)
- ***uint32_t LTDC_LayerCfgTypeDef::FBStartAddress***
Configures the color frame buffer address
- ***uint32_t LTDC_LayerCfgTypeDef::ImageWidth***
Configures the color frame buffer line length. This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0x1FFF.
- ***uint32_t LTDC_LayerCfgTypeDef::ImageHeight***
Specifies the number of line in frame buffer. This parameter must be a number between Min_Data = 0x000 and Max_Data = 0x7FF.
- ***LTDC_ColorTypeDef LTDC_LayerCfgTypeDef::Backcolor***
Configures the layer background color.

39.1.4 LTDC_HandleTypeDef

Data Fields

- ***LTDC_TypeDef * Instance***
- ***LTDC_InitTypeDef Init***
- ***LTDC_LayerCfgTypeDef LayerCfg***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_LTDC_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***LTDC_TypeDef* LTDC_HandleTypeDef::Instance***
LTDC Register base address
- ***LTDC_InitTypeDef LTDC_HandleTypeDef::Init***
LTDC parameters
- ***LTDC_LayerCfgTypeDef LTDC_HandleTypeDef::LayerCfg[MAX_LAYER]***
LTDC Layers parameters
- ***HAL_LockTypeDef LTDC_HandleTypeDef::Lock***
LTDC Lock

- `__IO HAL_LTDC_StateTypeDef LTDC_HandleTypeDef::State`
LTDC state
- `__IO uint32_t LTDC_HandleTypeDef::ErrorCode`
LTDC Error code

39.2 LTDC Firmware driver API description

39.2.1 How to use this driver

1. Program the required configuration through the following parameters: the LTDC timing, the horizontal and vertical polarity, the pixel clock polarity, Data Enable polarity and the LTDC background color value using `HAL_LTDC_Init()` function
2. Program the required configuration through the following parameters: the pixel format, the blending factors, input alpha value, the window size and the image size using `HAL_LTDC_ConfigLayer()` function for foreground or/and background layer.
3. Optionally, configure and enable the CLUT using `HAL_LTDC_ConfigCLUT()` and `HAL_LTDC_EnableCLUT` functions.
4. Optionally, enable the Dither using `HAL_LTDC_EnableDither()`.
5. Optionally, configure and enable the Color keying using `HAL_LTDC_ConfigColorKeying()` and `HAL_LTDC_EnableColorKeying` functions.
6. Optionally, configure LineInterrupt using `HAL_LTDC_ProgramLineEvent()` function
7. If needed, reconfigure and change the pixel format value, the alpha value value, the window size, the window position and the layer start address for foreground or/and background layer using respectively the following functions:
`HAL_LTDC_SetPixelFormat()`, `HAL_LTDC_SetAlpha()`,
`HAL_LTDC_SetWindowSize()`, `HAL_LTDC_SetWindowPosition()`,
`HAL_LTDC_SetAddress`.
8. Variant functions with "`_NoReload`" postfix allows to set the LTDC configuration/settings without immediate reload. This is useful in case when the program requires to modify several LTDC settings (on one or both layers) then applying(reload) these settings in one shot by calling the function "`HAL_LTDC_Reload`". After calling the "`_NoReload`" functions to set different color/format/layer settings, the program can call the function "`HAL_LTDC_Reload`". To apply(Reload) these settings. Function "`HAL_LTDC_Reload`" can be called with the parameter "`ReloadType`" set to `LTDC_RELOAD_IMMEDIATE` if an immediate reload is required. Function "`HAL_LTDC_Reload`" can be called with the parameter "`ReloadType`" set to `LTDC_RELOAD_VERTICAL_BLANKING` if the reload should be done in the next vertical blanking period, this option allows to avoid display flicker by applying the new settings during the vertical blanking period.
9. To control LTDC state you can use the following function: `HAL_LTDC_GetState()`

LTDC HAL driver macros list

Below the list of most used macros in LTDC HAL driver.

- `__HAL_LTDC_ENABLE`: Enable the LTDC.
- `__HAL_LTDC_DISABLE`: Disable the LTDC.
- `__HAL_LTDC_LAYER_ENABLE`: Enable the LTDC Layer.
- `__HAL_LTDC_LAYER_DISABLE`: Disable the LTDC Layer.
- `__HAL_LTDC_RELOAD_CONFIG`: Reload Layer Configuration.
- `__HAL_LTDC_GET_FLAG`: Get the LTDC pending flags.
- `__HAL_LTDC_CLEAR_FLAG`: Clear the LTDC pending flags.
- `__HAL_LTDC_ENABLE_IT`: Enable the specified LTDC interrupts.
- `__HAL_LTDC_DISABLE_IT`: Disable the specified LTDC interrupts.
- `__HAL_LTDC_GET_IT_SOURCE`: Check whether the specified LTDC interrupt has occurred or not.



You can refer to the LTDC HAL driver header file for more useful macros

39.2.2 Initialization and Configuration functions

This section provides functions allowing to:

- Initialize and configure the LTDC
- De-initialize the LTDC

This section contains the following APIs:

- [*HAL_LTDC_Init\(\)*](#)
- [*HAL_LTDC_DeInit\(\)*](#)
- [*HAL_LTDC_MspInit\(\)*](#)
- [*HAL_LTDC_MspDeInit\(\)*](#)
- [*HAL_LTDC_ErrorCallback\(\)*](#)
- [*HAL_LTDC_LineEvenCallback\(\)*](#)
- [*HAL_LTDC_ReloadEventCallback\(\)*](#)

39.2.3 IO operation functions

This section provides function allowing to:

- Handle LTDC interrupt request

This section contains the following APIs:

- [*HAL_LTDC_IRQHandler\(\)*](#)
- [*HAL_LTDC_ErrorCallback\(\)*](#)
- [*HAL_LTDC_LineEvenCallback\(\)*](#)
- [*HAL_LTDC_ReloadEventCallback\(\)*](#)

39.2.4 Peripheral Control functions

This section provides functions allowing to:

- Configure the LTDC foreground or/and background parameters.
- Set the active layer.
- Configure the color keying.
- Configure the C-LUT.
- Enable / Disable the color keying.
- Enable / Disable the C-LUT.
- Update the layer position.
- Update the layer size.
- Update pixel format on the fly.
- Update transparency on the fly.
- Update address on the fly.

This section contains the following APIs:

- [*HAL_LTDC_ConfigLayer\(\)*](#)
- [*HAL_LTDC_ConfigColorKeying\(\)*](#)
- [*HAL_LTDC_ConfigCLUT\(\)*](#)
- [*HAL_LTDC_EnableColorKeying\(\)*](#)
- [*HAL_LTDC_DisableColorKeying\(\)*](#)

- [HAL_LTDC_EnableCLUT\(\)](#)
- [HAL_LTDC_DisableCLUT\(\)](#)
- [HAL_LTDC_EnableDither\(\)](#)
- [HAL_LTDC_DisableDither\(\)](#)
- [HAL_LTDC_SetWindowSize\(\)](#)
- [HAL_LTDC_SetWindowPosition\(\)](#)
- [HAL_LTDC_SetPixelFormat\(\)](#)
- [HAL_LTDC_SetAlpha\(\)](#)
- [HAL_LTDC_SetAddress\(\)](#)
- [HAL_LTDC_SetPitch\(\)](#)
- [HAL_LTDC_ProgramLineEvent\(\)](#)
- [HAL_LTDC_Reload\(\)](#)
- [HAL_LTDC_ConfigLayer_NoReload\(\)](#)
- [HAL_LTDC_SetWindowSize_NoReload\(\)](#)
- [HAL_LTDC_SetWindowPosition_NoReload\(\)](#)
- [HAL_LTDC_SetPixelFormat_NoReload\(\)](#)
- [HAL_LTDC_SetAlpha_NoReload\(\)](#)
- [HAL_LTDC_SetAddress_NoReload\(\)](#)
- [HAL_LTDC_SetPitch_NoReload\(\)](#)
- [HAL_LTDC_ConfigColorKeying_NoReload\(\)](#)
- [HAL_LTDC_EnableColorKeying_NoReload\(\)](#)
- [HAL_LTDC_DisableColorKeying_NoReload\(\)](#)
- [HAL_LTDC_EnableCLUT_NoReload\(\)](#)
- [HAL_LTDC_DisableCLUT_NoReload\(\)](#)

39.2.5 Peripheral State and Errors functions

This subsection provides functions allowing to

- Check the LTDC state.
- Get error code.

This section contains the following APIs:

- [HAL_LTDC_GetState\(\)](#)
- [HAL_LTDC_GetError\(\)](#)

39.2.6 Detailed description of functions

HAL_LTDC_Init

Function name **HAL_StatusTypeDef HAL_LTDC_Init (LTDC_HandleTypeDef * hltdc)**

Function description Initializes the LTDC according to the specified parameters in the LTDC_InitTypeDef and create the associated handle.

Parameters

- **hltdc**: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

Return values

- **HAL**: status

HAL_LTDC_DeInit

Function name **HAL_StatusTypeDef HAL_LTDC_DeInit (LTDC_HandleTypeDef * hltdc)**

Function description	Deinitializes the LTDC peripheral registers to their default reset values.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
Return values	<ul style="list-style-type: none"> • None:

HAL_LTDC_MspInit

Function name	void HAL_LTDC_MspInit (LTDC_HandleTypeDef * hltdc)
Function description	Initializes the LTDC MSP.
Parameters	<ul style="list-style-type: none"> • hltdc: : pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
Return values	<ul style="list-style-type: none"> • None:

HAL_LTDC_MspDeInit

Function name	void HAL_LTDC_MspDeInit (LTDC_HandleTypeDef * hltdc)
Function description	DeInitializes the LTDC MSP.
Parameters	<ul style="list-style-type: none"> • hltdc: : pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
Return values	<ul style="list-style-type: none"> • None:

HAL_LTDC_ErrorCallback

Function name	void HAL_LTDC_ErrorCallback (LTDC_HandleTypeDef * hltdc)
Function description	Error LTDC callback.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
Return values	<ul style="list-style-type: none"> • None:

HAL_LTDC_LineEvenCallback

Function name	void HAL_LTDC_LineEvenCallback (LTDC_HandleTypeDef * hltdc)
Function description	Line Event callback.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
Return values	<ul style="list-style-type: none"> • None:

HAL_LTDC_ReloadEventCallback

Function name	void HAL_LTDC_ReloadEventCallback (LTDC_HandleTypeDef * hltdc)
Function description	Reload Event callback.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that

contains the configuration information for the LTDC.

Return values

- **None:**

HAL_LTDC_IRQHandler

Function name **void HAL_LTDC_IRQHandler (LTDC_HandleTypeDef * hltdc)**

Function description Handles LTDC interrupt request.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

Return values

- **HAL:** status

HAL_LTDC_ConfigLayer

Function name **HAL_StatusTypeDef HAL_LTDC_ConfigLayer (LTDC_HandleTypeDef * hltdc, LTDC_LayerCfgTypeDef * pLayerCfg, uint32_t LayerIdx)**

Function description Configure the LTDC Layer according to the specified parameters in the LTDC_InitTypeDef and create the associated handle.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **pLayerCfg:** pointer to a LTDC_LayerCfgTypeDef structure that contains the configuration information for the Layer.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: 0 or 1

Return values

- **HAL:** status

HAL_LTDC_SetWindowSize

Function name **HAL_StatusTypeDef HAL_LTDC_SetWindowSize (LTDC_HandleTypeDef * hltdc, uint32_t XSize, uint32_t YSize, uint32_t LayerIdx)**

Function description Set the LTDC window size.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **XSize:** LTDC Pixel per line
- **YSize:** LTDC Line number
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: 0 or 1

Return values

- **HAL:** status

HAL_LTDC_SetWindowPosition

Function name **HAL_StatusTypeDef HAL_LTDC_SetWindowPosition (LTDC_HandleTypeDef * hltdc, uint32_t X0, uint32_t Y0, uint32_t LayerIdx)**

Function description Set the LTDC window position.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

- **X0:** LTDC window X offset
- **Y0:** LTDC window Y offset
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: 0 or 1

Return values

- **HAL:** status

HAL_LTDC_SetPixelFormat

Function name **HAL_StatusTypeDef HAL_LTDC_SetPixelFormat (LTDC_HandleTypeDef * hltdc, uint32_t Pixelformat, uint32_t LayerIdx)**

Function description Reconfigure the pixel format.

- Parameters
- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
 - **Pixelformat:** new pixel format value.
 - **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: 0 or 1.

Return values

- **HAL:** status

HAL_LTDC_SetAlpha

Function name **HAL_StatusTypeDef HAL_LTDC_SetAlpha (LTDC_HandleTypeDef * hltdc, uint32_t Alpha, uint32_t LayerIdx)**

Function description Reconfigure the layer alpha value.

- Parameters
- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
 - **Alpha:** new alpha value.
 - **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: 0 or 1

Return values

- **HAL:** status

HAL_LTDC_SetAddress

Function name **HAL_StatusTypeDef HAL_LTDC_SetAddress (LTDC_HandleTypeDef * hltdc, uint32_t Address, uint32_t LayerIdx)**

Function description Reconfigure the frame buffer Address.

- Parameters
- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
 - **Address:** new address value.
 - **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: 0 or 1.

Return values

- **HAL:** status

HAL_LTDC_SetPitch

Function name **HAL_StatusTypeDef HAL_LTDC_SetPitch (LTDC_HandleTypeDef * hltdc, uint32_t LinePitchInPixels,**

uint32_t LayerIdx)

Function description	Function used to reconfigure the pitch for specific cases where the attached LayerIdx buffer have a width that is larger than the one intended to be displayed on screen.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • LinePitchInPixels: New line pitch in pixels to configure for LTDC layer 'LayerIdx'. • LayerIdx: LTDC layer index concerned by the modification of line pitch.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LTDC_ConfigColorKeying

Function name	HAL_StatusTypeDef HAL_LTDC_ConfigColorKeying (LTDC_HandleTypeDef * hltdc, uint32_t RGBValue, uint32_t LayerIdx)
Function description	Configure the color keying.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • RGBValue: the color key value • LayerIdx: LTDC Layer index. This parameter can be one of the following values: 0 or 1
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LTDC_ConfigCLUT

Function name	HAL_StatusTypeDef HAL_LTDC_ConfigCLUT (LTDC_HandleTypeDef * hltdc, uint32_t * pCLUT, uint32_t CLUTSize, uint32_t LayerIdx)
Function description	Load the color lookup table.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • pCLUT: pointer to the color lookup table address. • CLUTSize: the color lookup table size. • LayerIdx: LTDC Layer index. This parameter can be one of the following values: 0 or 1
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LTDC_EnableColorKeying

Function name	HAL_StatusTypeDef HAL_LTDC_EnableColorKeying (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)
Function description	Enable the color keying.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • LayerIdx: LTDC Layer index. This parameter can be one of the following values: 0 or 1

Return values

- **HAL:** status

HAL_LTDC_DisableColorKeying

Function name **HAL_StatusTypeDef HAL_LTDC_DisableColorKeying (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)**

Function description Disable the color keying.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: 0 or 1

Return values

- **HAL:** status

HAL_LTDC_EnableCLUT

Function name **HAL_StatusTypeDef HAL_LTDC_EnableCLUT (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)**

Function description Enable the color lookup table.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: 0 or 1

Return values

- **HAL:** status

HAL_LTDC_DisableCLUT

Function name **HAL_StatusTypeDef HAL_LTDC_DisableCLUT (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)**

Function description Disable the color lookup table.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: 0 or 1

Return values

- **HAL:** status

HAL_LTDC_ProgramLineEvent

Function name **HAL_StatusTypeDef HAL_LTDC_ProgramLineEvent (LTDC_HandleTypeDef * hltdc, uint32_t Line)**

Function description Define the position of the line interrupt.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **Line:** Line Interrupt Position.

Return values

- **HAL:** status

HAL_LTDC_EnableDither

Function name	HAL_StatusTypeDef HAL_LTDC_EnableDither (LTDC_HandleTypeDef * hltdc)
Function description	Enables Dither.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LTDC_DisableDither

Function name	HAL_StatusTypeDef HAL_LTDC_DisableDither (LTDC_HandleTypeDef * hltdc)
Function description	Disables Dither.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LTDC_Reload

Function name	HAL_StatusTypeDef HAL_LTDC_Reload (LTDC_HandleTypeDef * hltdc, uint32_t ReloadType)
Function description	LTDC configuration reload.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • ReloadType: This parameter can be one of the following values : LTDC_RELOAD_IMMEDIATE : Immediate Reload LTDC_RELOAD_VERTICAL_BLANKING : Reload in the next Vertical Blanking
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LTDC_ConfigLayer_NoReload

Function name	HAL_StatusTypeDef HAL_LTDC_ConfigLayer_NoReload (LTDC_HandleTypeDef * hltdc, LTDC_LayerCfgTypeDef * pLayerCfg, uint32_t LayerIdx)
Function description	Configure the LTDC Layer according to the specified without reloading parameters in the LTDC_InitTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • pLayerCfg: pointer to a LTDC_LayerCfgTypeDef structure that contains the configuration information for the Layer. • LayerIdx: LTDC Layer index. This parameter can be one of the following values: 0 or 1
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LTDC_SetWindowSize_NoReload

Function name	HAL_StatusTypeDef HAL_LTDC_SetWindowSize_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t XSize, uint32_t YSize, uint32_t LayerIdx)
Function description	Set the LTDC window size without reloading.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • XSize: LTDC Pixel per line • YSize: LTDC Line number • LayerIdx: LTDC Layer index. This parameter can be one of the following values: 0 or 1
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LTDC_SetWindowPosition_NoReload

Function name	HAL_StatusTypeDef HAL_LTDC_SetWindowPosition_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t X0, uint32_t Y0, uint32_t LayerIdx)
Function description	Set the LTDC window position without reloading.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • X0: LTDC window X offset • Y0: LTDC window Y offset • LayerIdx: LTDC Layer index. This parameter can be one of the following values: 0 or 1
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LTDC_SetPixelFormat_NoReload

Function name	HAL_StatusTypeDef HAL_LTDC_SetPixelFormat_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t Pixelformat, uint32_t LayerIdx)
Function description	Reconfigure the pixel format without reloading.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • Pixelformat: new pixel format value. • LayerIdx: LTDC Layer index. This parameter can be one of the following values: 0 or 1.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LTDC_SetAlpha_NoReload

Function name	HAL_StatusTypeDef HAL_LTDC_SetAlpha_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t Alpha, uint32_t LayerIdx)
Function description	Reconfigure the layer alpha value without reloading.

- | | |
|---------------|---|
| Parameters | <ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • Alpha: new alpha value. • LayerIdx: LTDC Layer index. This parameter can be one of the following values: 0 or 1 |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_LTDC_SetAddress_NoReload

- | | |
|----------------------|--|
| Function name | HAL_StatusTypeDef HAL_LTDC_SetAddress_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t Address, uint32_t LayerIdx) |
| Function description | Reconfigure the frame buffer Address without reloading. |
| Parameters | <ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • Address: new address value. • LayerIdx: LTDC Layer index. This parameter can be one of the following values: 0 or 1. |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_LTDC_SetPitch_NoReload

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_LTDC_SetPitch_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t LinePitchInPixels, uint32_t LayerIdx) |
| Function description | Function used to reconfigure the pitch for specific cases where the attached LayerIdx buffer have a width that is larger than the one intended to be displayed on screen. |
| Parameters | <ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • LinePitchInPixels: New line pitch in pixels to configure for LTDC layer 'LayerIdx'. • LayerIdx: LTDC layer index concerned by the modification of line pitch. |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_LTDC_ConfigColorKeying_NoReload

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_LTDC_ConfigColorKeying_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t RGBValue, uint32_t LayerIdx) |
| Function description | Configure the color keying without reloading. |
| Parameters | <ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • RGBValue: the color key value • LayerIdx: LTDC Layer index. This parameter can be one of the following values: 0 or 1 |

Return values

- **HAL:** status

HAL_LTDC_EnableColorKeying_NoReload

Function name **HAL_StatusTypeDef HAL_LTDC_EnableColorKeying_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)**

Function description Enable the color keying without reloading.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: 0 or 1

Return values

- **HAL:** status

HAL_LTDC_DisableColorKeying_NoReload

Function name **HAL_StatusTypeDef HAL_LTDC_DisableColorKeying_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)**

Function description Disable the color keying without reloading.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: 0 or 1

Return values

- **HAL:** status

HAL_LTDC_EnableCLUT_NoReload

Function name **HAL_StatusTypeDef HAL_LTDC_EnableCLUT_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)**

Function description Enable the color lookup table without reloading.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: 0 or 1

Return values

- **HAL:** status

HAL_LTDC_DisableCLUT_NoReload

Function name **HAL_StatusTypeDef HAL_LTDC_DisableCLUT_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)**

Function description Disable the color lookup table without reloading.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: 0 or 1

Return values

- **HAL:** status

HAL_LTDC_GetState

Function name	HAL_LTDC_StateTypeDef HAL_LTDC_GetState (LTDC_HandleTypeDef * hltdc)
Function description	Return the LTDC state.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
Return values	<ul style="list-style-type: none"> • HAL: state

HAL_LTDC_GetError

Function name	uint32_t HAL_LTDC_GetError (LTDC_HandleTypeDef * hltdc)
Function description	Return the LTDC error code.
Parameters	<ul style="list-style-type: none"> • hltdc: : pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
Return values	<ul style="list-style-type: none"> • LTDC: Error Code

39.3 LTDC Firmware driver defines**39.3.1 LTDC*****LTDC Alpha***

LTDC_ALPHA LTDC Cte Alpha mask

LTDC BACK COLOR

LTDC_COLOR Color mask

LTDC Blending Factor1

LTDC_BLENDING_FACTOR1_CA Blending factor : Cte Alpha

LTDC_BLENDING_FACTOR1_PAxCA Blending factor : Cte Alpha x Pixel Alpha

LTDC Blending Factor2

LTDC_BLENDING_FACTOR2_CA Blending factor : Cte Alpha

LTDC_BLENDING_FACTOR2_PAxCA Blending factor : Cte Alpha x Pixel Alpha

LTDC DE POLARITY

LTDC_DEPOLARITY_AL Data Enable, is active low.

LTDC_DEPOLARITY_AH Data Enable, is active high.

LTDC Error Code

HAL_LTDC_ERROR_NONE LTDC No error

HAL_LTDC_ERROR_TE LTDC Transfer error

HAL_LTDC_ERROR_FU LTDC FIFO Underrun

HAL_LTDC_ERROR_TIMEOUT LTDC Timeout error

LTDC Exported Macros

__HAL_LTDC_RESET_HANDLE_STATE **Description:**

	<ul style="list-style-type: none"> Reset LTDC handle state.
	Parameters:
	<ul style="list-style-type: none"> <code>__HANDLE__</code>: specifies the LTDC handle.
	Return value:
	<ul style="list-style-type: none"> None
	Description:
	<ul style="list-style-type: none"> Enable the LTDC.
	Parameters:
	<ul style="list-style-type: none"> <code>__HANDLE__</code>: LTDC handle
	Return value:
	<ul style="list-style-type: none"> None.
	Description:
	<ul style="list-style-type: none"> Disable the LTDC.
	Parameters:
	<ul style="list-style-type: none"> <code>__HANDLE__</code>: LTDC handle
	Return value:
	<ul style="list-style-type: none"> None.
	Description:
	<ul style="list-style-type: none"> Enable the LTDC Layer.
	Parameters:
	<ul style="list-style-type: none"> <code>__HANDLE__</code>: LTDC handle <code>__LAYER__</code>: Specify the layer to be enabled This parameter can be 0 or 1
	Return value:
	<ul style="list-style-type: none"> None.
	Description:
	<ul style="list-style-type: none"> Disable the LTDC Layer.
	Parameters:
	<ul style="list-style-type: none"> <code>__HANDLE__</code>: LTDC handle <code>__LAYER__</code>: Specify the layer to be disabled This parameter can be 0 or 1
	Return value:
	<ul style="list-style-type: none"> None.
	Description:
	<ul style="list-style-type: none"> Reload Layer Configuration.
	Parameters:

`__HAL_LTDC_ENABLE``__HAL_LTDC_DISABLE``__HAL_LTDC_LAYER_ENABLE``__HAL_LTDC_LAYER_DISABLE``__HAL_LTDC_RELOAD_CONFIG`

`__HAL_LTDC_GET_FLAG`

- `__HANDLE__`: LTDC handle

Return value:

- None.

Description:

- Get the LTDC pending flags.

Parameters:

- `__HANDLE__`: LTDC handle
- `__FLAG__`: Get the specified flag. This parameter can be any combination of the following values:
 - `LTDC_FLAG_LI`: Line Interrupt flag
 - `LTDC_FLAG_FU`: FIFO Underrun Interrupt flag
 - `LTDC_FLAG_TE`: Transfer Error interrupt flag
 - `LTDC_FLAG_RR`: Register Reload Interrupt Flag

Return value:

- The: state of FLAG (SET or RESET).

Description:

- Clears the LTDC pending flags.

Parameters:

- `__HANDLE__`: LTDC handle
- `__FLAG__`: specifies the flag to clear. This parameter can be any combination of the following values:
 - `LTDC_FLAG_LI`: Line Interrupt flag
 - `LTDC_FLAG_FU`: FIFO Underrun Interrupt flag
 - `LTDC_FLAG_TE`: Transfer Error interrupt flag
 - `LTDC_FLAG_RR`: Register Reload Interrupt Flag

Return value:

- None

Description:

- Enables the specified LTDC interrupts.

Parameters:

- `__HANDLE__`: LTDC handle
- `__INTERRUPT__`: specifies the LTDC interrupt sources to be enabled. This parameter can be any combination of the following values:
 - `LTDC_IT_LI`: Line Interrupt flag
 - `LTDC_IT_FU`: FIFO Underrun

`__HAL_LTDC_CLEAR_FLAG``__HAL_LTDC_ENABLE_IT`

<p><code>__HAL_LTDC_DISABLE_IT</code></p>	<p>Interrupt flag</p> <ul style="list-style-type: none"> – LTDC_IT_TE: Transfer Error interrupt flag – LTDC_IT_RR: Register Reload Interrupt Flag <p>Return value:</p> <ul style="list-style-type: none"> • None <p>Description:</p> <ul style="list-style-type: none"> • Disables the specified LTDC interrupts. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: LTDC handle • <code>__INTERRUPT__</code>: specifies the LTDC interrupt sources to be disabled. This parameter can be any combination of the following values: <ul style="list-style-type: none"> – LTDC_IT_LI: Line Interrupt flag – LTDC_IT_FU: FIFO Underrun Interrupt flag – LTDC_IT_TE: Transfer Error interrupt flag – LTDC_IT_RR: Register Reload Interrupt Flag <p>Return value:</p> <ul style="list-style-type: none"> • None
<p><code>__HAL_LTDC_GET_IT_SOURCE</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Checks whether the specified LTDC interrupt has occurred or not. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: LTDC handle • <code>__INTERRUPT__</code>: specifies the LTDC interrupt source to check. This parameter can be one of the following values: <ul style="list-style-type: none"> – LTDC_IT_LI: Line Interrupt flag – LTDC_IT_FU: FIFO Underrun Interrupt flag – LTDC_IT_TE: Transfer Error interrupt flag – LTDC_IT_RR: Register Reload Interrupt Flag <p>Return value:</p> <ul style="list-style-type: none"> • The: state of INTERRUPT (SET or RESET).

LTDC Exported Types

`MAX_LAYER`

LTDC Flag

LTDC_FLAG_LI

LTDC_FLAG_FU

LTDC_FLAG_TE

LTDC_FLAG_RR

LTDC HS POLARITY

LTDC_HSPOLARITY_AL Horizontal Synchronization is active low.

LTDC_HSPOLARITY_AH Horizontal Synchronization is active high.

LTDC Interrupts

LTDC_IT_LI

LTDC_IT_FU

LTDC_IT_TE

LTDC_IT_RR

LTDC LAYER Config

LTDC_STOPPOSITION LTDC Layer stop position

LTDC_STARTPOSITION LTDC Layer start position

LTDC_COLOR_FRAME_BUFFER LTDC Layer Line length

LTDC_LINE_NUMBER LTDC Layer Line number

LTDC PC POLARITY

LTDC_PCPOLARITY_IPC input pixel clock.

LTDC_PCPOLARITY_IIPC inverted input pixel clock.

LTDC Pixel format

LTDC_PIXEL_FORMAT_ARGB8888 ARGB8888 LTDC pixel format

LTDC_PIXEL_FORMAT_RGB888 RGB888 LTDC pixel format

LTDC_PIXEL_FORMAT_RGB565 RGB565 LTDC pixel format

LTDC_PIXEL_FORMAT_ARGB1555 ARGB1555 LTDC pixel format

LTDC_PIXEL_FORMAT_ARGB4444 ARGB4444 LTDC pixel format

LTDC_PIXEL_FORMAT_L8 L8 LTDC pixel format

LTDC_PIXEL_FORMAT_AL44 AL44 LTDC pixel format

LTDC_PIXEL_FORMAT_AL88 AL88 LTDC pixel format

LTDC Reload Type

LTDC_RELOAD_IMMEDIATE Immediate Reload

LTDC_RELOAD_VERTICAL_BLANKING Vertical Blanking Reload

LTDC SYNC

LTDC_HORIZONTALSYNC Horizontal synchronization width.

LTDC_VERTICALSYNC Vertical synchronization height.

LTDC VS POLARITY

LTDC_VSPOLARITY_AL Vertical Synchronization is active low.
LTDC_VSPOLARITY_AH Vertical Synchronization is active high.

40 HAL LTDC Extension Driver

40.1 LTDCEx Firmware driver API description

40.1.1 Initialization and Configuration functions

This section provides functions allowing to:

- Initialize and configure the LTDC

This section contains the following APIs:

- [HAL_LTDC_StructInitFromVideoConfig\(\)](#)
- [HAL_LTDC_StructInitFromAdaptedCommandConfig\(\)](#)

40.1.2 Detailed description of functions

HAL_LTDC_StructInitFromVideoConfig

Function name	HAL_StatusTypeDef HAL_LTDC_StructInitFromVideoConfig (LTDC_HandleTypeDef * hltdc, DSI_VidCfgTypeDef * VidCfg)
Function description	Retrieve common parameters from DSI Video mode configuration structure.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • VidCfg: pointer to a DSI_VidCfgTypeDef structure that contains the DSI video mode configuration parameters
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • The implementation of this function is taking into account the LTDC polarities inversion as described in the current LTDC specification

HAL_LTDC_StructInitFromAdaptedCommandConfig

Function name	HAL_StatusTypeDef HAL_LTDC_StructInitFromAdaptedCommandConfig (LTDC_HandleTypeDef * hltdc, DSI_CmdCfgTypeDef * CmdCfg)
Function description	Retrieve common parameters from DSI Adapted command mode configuration structure.
Parameters	<ul style="list-style-type: none"> • hltdc: pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC. • CmdCfg: pointer to a DSI_CmdCfgTypeDef structure that contains the DSI command mode configuration parameters
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • The implementation of this function is taking into account the LTDC polarities inversion as described in the current LTDC specification

41 HAL MDIOS Generic Driver

41.1 MDIOS Firmware driver registers structures

41.1.1 MDIOS_InitTypeDef

Data Fields

- *uint32_t* **PortAddress**
- *uint32_t* **PreambleCheck**

Field Documentation

- *uint32_t* **MDIOS_InitTypeDef::PortAddress**
Specifies the MDIOS port address. This parameter can be a value from 0 to 31
- *uint32_t* **MDIOS_InitTypeDef::PreambleCheck**
Specifies whether the preamble check is enabled or disabled. This parameter can be a value of [MDIOS_Preamble_Check](#)

41.1.2 MDIOS_HandleTypeDef

Data Fields

- *MDIOS_TypeDef * Instance*
- *MDIOS_InitTypeDef Init*
- *__IO HAL_MDIOS_StateTypeDef State*
- *HAL_LockTypeDef Lock*

Field Documentation

- *MDIOS_TypeDef* MDIOS_HandleTypeDef::Instance*
Register base address
- *MDIOS_InitTypeDef MDIOS_HandleTypeDef::Init*
MDIOS Init Structure
- *__IO HAL_MDIOS_StateTypeDef MDIOS_HandleTypeDef::State*
MDIOS communication state
- *HAL_LockTypeDef MDIOS_HandleTypeDef::Lock*
MDIOS Lock

41.2 MDIOS Firmware driver API description

41.2.1 How to use this driver

The MDIOS HAL driver can be used as follows:

1. Declare a MDIOS_HandleTypeDef handle structure.
2. Initialize the MDIOS low level resources by implementing the HAL_MDIOS_MspInit() API:
 - a. Enable the MDIOS interface clock.
 - b. MDIOS pins configuration:
 - Enable clocks for the MDIOS GPIOs.
 - Configure the MDIOS pins as alternate function.
 - c. NVIC configuration if you need to use interrupt process:
 - Configure the MDIOS interrupt priority.
 - Enable the NVIC MDIOS IRQ handle.
3. Program the Port Address and the Preamble Check in the Init structure.

4. Initialize the MDIOS registers by calling the HAL_MDIOS_Init() API.
5. Perform direct slave read/write operations using the following APIs:
 - a. Read the value of a DINn register: HAL_MDIOS_ReadReg()
 - b. Write a value to a DOUTn register: HAL_MDIOS_WriteReg()
6. Get the Master read/write operations flags using the following APIs:
 - a. Bit map of DOUTn registers read by Master:
HAL_MDIOS_GetReadRegAddress()
 - b. Bit map of DINn registers written by Master :
HAL_MDIOS_GetWrittenRegAddress()
7. Clear the read/write flags using the following APIs:
 - a. Clear read flags of a set of registers: HAL_MDIOS_ClearReadRegAddress()
 - b. Clear write flags of a set of registers: HAL_MDIOS_ClearWriteRegAddress()
8. Enable interrupts on events using HAL_MDIOS_EnableEvents(), when called the MDIOS will generate an interrupt in the following cases:
 - a. a DINn register written by the Master
 - b. a DOUTn register read by the Master
 - c. an error occur A callback is executed for each generated interrupt, so the driver provides the following HAL_MDIOS_WriteCpltCallback(), HAL_MDIOS_ReadCpltCallback() and HAL_MDIOS_ErrorCallback() HAL_MDIOS_IRQHandler() must be called from the MDIOS IRQ Handler, to handle the interrupt and execute the previous callbacks
9. Reset the MDIOS peripheral and all related resources by calling the HAL_MDIOS_DeInit() API.
 - a. HAL_MDIOS_MspDeInit() must be implemented to reset low level resources (GPIO, Clocks, NVIC configuration ...)

41.2.2 Initialization and Configuration functions

This subsection provides a set of functions allowing to initialize the MDIOS

- The following parameters can be configured:
 - Port Address
 - Preamble Check

This section contains the following APIs:

- [HAL_MDIOS_Init\(\)](#)
- [HAL_MDIOS_DeInit\(\)](#)
- [HAL_MDIOS_MspInit\(\)](#)
- [HAL_MDIOS_MspDeInit\(\)](#)

41.2.3 IO operation functions

This section contains the following APIs:

- [HAL_MDIOS_WriteReg\(\)](#)
- [HAL_MDIOS_ReadReg\(\)](#)
- [HAL_MDIOS_GetWrittenRegAddress\(\)](#)
- [HAL_MDIOS_GetReadRegAddress\(\)](#)
- [HAL_MDIOS_ClearWriteRegAddress\(\)](#)
- [HAL_MDIOS_ClearReadRegAddress\(\)](#)
- [HAL_MDIOS_EnableEvents\(\)](#)
- [HAL_MDIOS_IRQHandler\(\)](#)
- [HAL_MDIOS_WriteCpltCallback\(\)](#)
- [HAL_MDIOS_ReadCpltCallback\(\)](#)
- [HAL_MDIOS_ErrorCallback\(\)](#)
- [HAL_MDIOS_WakeUpCallback\(\)](#)

41.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the MDIOS.

- HAL_MDIOS_GetState() API, helpful to check in run-time the state.
- HAL_MDIOS_GetError() API, returns the errors occurred during data transfer.

This section contains the following APIs:

- [HAL_MDIOS_GetError\(\)](#)
- [HAL_MDIOS_GetState\(\)](#)

41.2.5 Detailed description of functions

HAL_MDIOS_Init

Function name HAL_StatusTypeDef HAL_MDIOS_Init (MDIOS_HandleTypeDef * hmdios)

Function description Initializes the MDIOS according to the specified parameters in the MDIOS_InitTypeDef and creates the associated handle .

Parameters

- **hmdios:** pointer to a MDIOS_HandleTypeDef structure that contains the configuration information for MDIOS module

Return values

- **HAL:** status

HAL_MDIOS_DeInit

Function name HAL_StatusTypeDef HAL_MDIOS_DeInit (MDIOS_HandleTypeDef * hmdios)

Function description DeInitializes the MDIOS peripheral.

Parameters

- **hmdios:** MDIOS handle

Return values

- **HAL:** status

HAL_MDIOS_MspInit

Function name void HAL_MDIOS_MspInit (MDIOS_HandleTypeDef * hmdios)

Function description MDIOS MSP Init.

Parameters

- **hmdios:** mdios handle

Return values

- **None:**

HAL_MDIOS_MspDeInit

Function name void HAL_MDIOS_MspDeInit (MDIOS_HandleTypeDef * hmdios)

Function description MDIOS MSP DeInit.

Parameters

- **hmdios:** mdios handle

Return values

- **None:**

HAL_MDIOS_WriteReg

Function name	HAL_StatusTypeDef HAL_MDIOS_WriteReg (MDIOS_HandleTypeDef * hmdios, uint32_t RegNum, uint16_t Data)
Function description	Writes to an MDIOS output register.
Parameters	<ul style="list-style-type: none">• hmdios: mdios handle• RegNum: MDIOS input register number• Data: Data to write
Return values	<ul style="list-style-type: none">• HAL: status

HAL_MDIOS_ReadReg

Function name	HAL_StatusTypeDef HAL_MDIOS_ReadReg (MDIOS_HandleTypeDef * hmdios, uint32_t RegNum, uint16_t * pData)
Function description	Reads an MDIOS input register.
Parameters	<ul style="list-style-type: none">• hmdios: mdios handle• RegNum: MDIOS input register number• pData: pointer to Data
Return values	<ul style="list-style-type: none">• HAL: status

HAL_MDIOS_GetWrittenRegAddress

Function name	uint32_t HAL_MDIOS_GetWrittenRegAddress (MDIOS_HandleTypeDef * hmdios)
Function description	Gets Written registers by MDIO master.
Parameters	<ul style="list-style-type: none">• hmdios: mdios handle
Return values	<ul style="list-style-type: none">• bit: map of written registers addresses

HAL_MDIOS_GetReadRegAddress

Function name	uint32_t HAL_MDIOS_GetReadRegAddress (MDIOS_HandleTypeDef * hmdios)
Function description	Gets Read registers by MDIO master.
Parameters	<ul style="list-style-type: none">• hmdios: mdios handle
Return values	<ul style="list-style-type: none">• bit: map of read registers addresses

HAL_MDIOS_ClearWriteRegAddress

Function name	HAL_StatusTypeDef HAL_MDIOS_ClearWriteRegAddress (MDIOS_HandleTypeDef * hmdios, uint32_t RegNum)
Function description	Clears Write registers flag.
Parameters	<ul style="list-style-type: none">• hmdios: mdios handle• RegNum: registers addresses to be cleared
Return values	<ul style="list-style-type: none">• HAL: status

HAL_MDIOS_ClearReadRegAddress

Function name	HAL_StatusTypeDef HAL_MDIOS_ClearReadRegAddress (MDIOS_HandleTypeDef * hmdios, uint32_t RegNum)
Function description	Clears Read register flag.
Parameters	<ul style="list-style-type: none"> • hmdios: mdios handle • RegNum: registers addresses to be cleared
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_MDIOS_EnableEvents

Function name	HAL_StatusTypeDef HAL_MDIOS_EnableEvents (MDIOS_HandleTypeDef * hmdios)
Function description	Enables Events for MDIOS peripheral.
Parameters	<ul style="list-style-type: none"> • hmdios: mdios handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_MDIOS_IRQHandler

Function name	void HAL_MDIOS_IRQHandler (MDIOS_HandleTypeDef * hmdios)
Function description	This function handles MDIOS interrupt request.
Parameters	<ul style="list-style-type: none"> • hmdios: MDIOS handle
Return values	<ul style="list-style-type: none"> • None:

HAL_MDIOS_WriteCpltCallback

Function name	void HAL_MDIOS_WriteCpltCallback (MDIOS_HandleTypeDef * hmdios)
Function description	Write Complete Callback.
Parameters	<ul style="list-style-type: none"> • hmdios: mdios handle
Return values	<ul style="list-style-type: none"> • None:

HAL_MDIOS_ReadCpltCallback

Function name	void HAL_MDIOS_ReadCpltCallback (MDIOS_HandleTypeDef * hmdios)
Function description	Read Complete Callback.
Parameters	<ul style="list-style-type: none"> • hmdios: mdios handle
Return values	<ul style="list-style-type: none"> • None:

HAL_MDIOS_ErrorCallback

Function name	void HAL_MDIOS_ErrorCallback (MDIOS_HandleTypeDef * hmdios)
---------------	--

Function description	Error Callback.
Parameters	<ul style="list-style-type: none"> • hmdios: mdios handle
Return values	<ul style="list-style-type: none"> • None:

HAL_MDIOS_WakeUpCallback

Function name	void HAL_MDIOS_WakeUpCallback (MDIOS_HandleTypeDef * hmdios)
Function description	MDIOS WAKEUP interrupt callback.
Parameters	<ul style="list-style-type: none"> • hmdios: mdios handle
Return values	<ul style="list-style-type: none"> • None:

HAL_MDIOS_GetError

Function name	uint32_t HAL_MDIOS_GetError (MDIOS_HandleTypeDef * hmdios)
Function description	Gets MDIOS error flags.
Parameters	<ul style="list-style-type: none"> • hmdios: mdios handle
Return values	<ul style="list-style-type: none"> • bit: map of occurred errors

HAL_MDIOS_GetState

Function name	HAL_MDIOS_StateTypeDef HAL_MDIOS_GetState (MDIOS_HandleTypeDef * hmdios)
Function description	Return the MDIOS HAL state.
Parameters	<ul style="list-style-type: none"> • hmdios: mdios handle
Return values	<ul style="list-style-type: none"> • MDIOS: state

41.3 MDIOS Firmware driver defines

41.3.1 MDIOS

MDIOS Exported Macros

`__HAL_MDIOS_RESET_HANDLE_STATE`

Description:

- Reset MDIOS handle state.

Parameters:

- `__HANDLE__`: MDIOS handle.

Return value:

- None

`__HAL_MDIOS_ENABLE`

Description:

- Enable/Disable the MDIOS peripheral.

Parameters:

`__HAL_MDIOS_DISABLE`
`__HAL_MDIOS_ENABLE_IT`

- `__HANDLE__`: specifies the MDIOS handle.

Return value:

- None

Description:

- Enable the MDIOS device interrupt.

Parameters:

- `__HANDLE__`: specifies the MDIOS handle.
- `__INTERRUPT__`: specifies the MDIOS interrupt sources to be enabled. This parameter can be one or a combination of the following values:
 - MDIOS_IT_WRITE: Register write interrupt
 - MDIOS_IT_READ: Register read interrupt
 - MDIOS_IT_ERROR: Error interrupt

Return value:

- None

Description:

- Disable the MDIOS device interrupt.

Parameters:

- `__HANDLE__`: specifies the MDIOS handle.
- `__INTERRUPT__`: specifies the MDIOS interrupt sources to be disabled. This parameter can be one or a combination of the following values:
 - MDIOS_IT_WRITE: Register write interrupt
 - MDIOS_IT_READ: Register read interrupt
 - MDIOS_IT_ERROR: Error interrupt

Return value:

- None

Description:

- Set MDIOS slave get write

`__HAL_MDIOS_DISABLE_IT`

`__HAL_MDIOS_GET_WRITE_FLAG`

register flag.

Parameters:

- `__HANDLE__`: specifies the MDIOS handle.
- `__FLAG__`: specifies the write register flag

Return value:

- The: state of write flag

Description:

- MDIOS slave get read register flag.

Parameters:

- `__HANDLE__`: specifies the MDIOS handle.
- `__FLAG__`: specifies the read register flag

Return value:

- The: state of read flag

Description:

- MDIOS slave get interrupt.

Parameters:

- `__HANDLE__`: specifies the MDIOS handle.
- `__FLAG__`: : specifies the Error flag. This parameter can be one or a combination of the following values:
 - MDIOS_TURNARROUND_ERROR_FLAG: Register write interrupt
 - MDIOS_START_ERROR_FLAG: Register read interrupt
 - MDIOS_PREAMBLE_ERROR_FLAG: Error interrupt

Return value:

- The: state of the error flag

Description:

- MDIOS slave clear interrupt.

Parameters:

- `__HANDLE__`: specifies the MDIOS handle.
- `__FLAG__`: : specifies the Error flag. This parameter can be one or a combination of the following

`__HAL_MDIOS_GET_READ_FLAG`

`__HAL_MDIOS_GET_ERROR_FLAG`

`__HAL_MDIOS_CLEAR_ERROR_FLAG`

	<p>values:</p> <ul style="list-style-type: none"> – MDIOS_TURNARROUND_ERROR_FLAG: Register write interrupt – MDIOS_START_ERROR_FLAG: Register read interrupt – MDIOS_PREAMBLE_ERROR_FLAG: Error interrupt <p>Return value:</p> <ul style="list-style-type: none"> • none
<p><code>__HAL_MDIOS_GET_IT_SOURCE</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Checks whether the specified MDIOS interrupt is set or not.
	<p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: specifies the MDIOS handle. • <code>__INTERRUPT__</code>: specifies the MDIOS interrupt sources This parameter can be one or a combination of the following values: <ul style="list-style-type: none"> – MDIOS_IT_WRITE: Register write interrupt – MDIOS_IT_READ: Register read interrupt – MDIOS_IT_ERROR: Error interrupt <p>Return value:</p> <ul style="list-style-type: none"> • The: state of the interrupt source
<p><code>__HAL_MDIOS_WAKEUP_EXTI_ENABLE_IT</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Enable the MDIOS WAKEUP Exti Line.
	<p>Return value:</p> <ul style="list-style-type: none"> • None.
<p><code>__HAL_MDIOS_WAKEUP_EXTI_DISABLE_IT</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Disable the MDIOS WAKEUP Exti Line.
	<p>Return value:</p> <ul style="list-style-type: none"> • None.
<p><code>__HAL_MDIOS_WAKEUP_EXTI_ENABLE_EVENT</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Enable event on MDIOS WAKEUP Exti Line. <p>Return value:</p> <ul style="list-style-type: none"> • None.

<code>__HAL_MDIOS_WAKEUP_EXTI_DISABLE_EVENT</code>	Description: <ul style="list-style-type: none">Disable event on MDIOS WAKEUP Exti Line. Return value: <ul style="list-style-type: none">None.
<code>__HAL_MDIOS_WAKEUP_EXTI_GET_FLAG</code>	Description: <ul style="list-style-type: none">checks whether the specified MDIOS WAKEUP Exti interrupt flag is set or not. Return value: <ul style="list-style-type: none">EXTI: MDIOS WAKEUP Line Status.
<code>__HAL_MDIOS_WAKEUP_EXTI_CLEAR_FLAG</code>	Description: <ul style="list-style-type: none">Clear the MDIOS WAKEUP Exti flag. Return value: <ul style="list-style-type: none">None.
<code>__HAL_MDIOS_WAKEUP_EXTI_ENABLE_RISING_EDGE_TRIGGER</code>	Description: <ul style="list-style-type: none">Enables rising edge trigger to the MDIOS External interrupt line. Return value: <ul style="list-style-type: none">None
<code>__HAL_MDIOS_WAKEUP_EXTI_DISABLE_RISING_EDGE_TRIGGER</code>	Description: <ul style="list-style-type: none">Disables the rising edge trigger to the MDIOS External interrupt line. Return value: <ul style="list-style-type: none">None
<code>__HAL_MDIOS_WAKEUP_EXTI_ENABLE_FALLING_EDGE_TRIGGER</code>	Description: <ul style="list-style-type: none">Enables falling edge trigger to the MDIOS External interrupt line. Return value: <ul style="list-style-type: none">None
<code>__HAL_MDIOS_WAKEUP_EXTI_DISABLE_FALLING_EDGE_TRIGGER</code>	Description: <ul style="list-style-type: none">Disables falling edge trigger to the MDIOS External interrupt line. Return value: <ul style="list-style-type: none">None
<code>__HAL_MDIOS_WAKEUP_EXTI_ENABLE_FALLINGRISING_TRIGGER</code>	Description: <ul style="list-style-type: none">Enables rising/falling edge trigger

to the MDIOS External interrupt line.

Return value:

- None

__HAL_MDIOS_WAKEUP_EXTI_DISABLE_FALLINGRISING_TRIGGER

Description:

- Disables rising/falling edge trigger to the MDIOS External interrupt line.

Return value:

- None

__HAL_MDIOS_WAKEUP_EXTI_GENERATE_SWIT

Description:

- Generates a Software interrupt on selected EXTI line.

Return value:

- None

MDIOS Input Output Registers Definitions

MDIOS_REG0

MDIOS_REG1

MDIOS_REG2

MDIOS_REG3

MDIOS_REG4

MDIOS_REG5

MDIOS_REG6

MDIOS_REG7

MDIOS_REG8

MDIOS_REG9

MDIOS_REG10

MDIOS_REG11

MDIOS_REG12

MDIOS_REG13

MDIOS_REG14

MDIOS_REG15

MDIOS_REG16

MDIOS_REG17

MDIOS_REG18

MDIOS_REG19

MDIOS_REG20

MDIOS_REG21

MDIOS_REG22

MDIOS_REG23

MDIOS_REG24

MDIOS_REG25

MDIOS_REG26

MDIOS_REG27

MDIOS_REG28

MDIOS_REG29

MDIOS_REG30

MDIOS_REG31

MDIOS Interrupt Flags

MDIOS_TURNAROUND_ERROR_FLAG

MDIOS_START_ERROR_FLAG

MDIOS_PREAMBLE_ERROR_FLAG

Interrupt Sources

MDIOS_IT_WRITE

MDIOS_IT_READ

MDIOS_IT_ERROR

MDIOS Preamble Check

MDIOS_PREAMBLE_CHECK_ENABLE

MDIOS_PREAMBLE_CHECK_DISABLE

MDIOS Registers Flags

MDIOS_REG0_FLAG

MDIOS_REG1_FLAG

MDIOS_REG2_FLAG

MDIOS_REG3_FLAG

MDIOS_REG4_FLAG

MDIOS_REG5_FLAG

MDIOS_REG6_FLAG

MDIOS_REG7_FLAG

MDIOS_REG8_FLAG

MDIOS_REG9_FLAG

MDIOS_REG10_FLAG

MDIOS_REG11_FLAG

MDIOS_REG12_FLAG

MDIOS_REG13_FLAG
MDIOS_REG14_FLAG
MDIOS_REG15_FLAG
MDIOS_REG16_FLAG
MDIOS_REG17_FLAG
MDIOS_REG18_FLAG
MDIOS_REG19_FLAG
MDIOS_REG20_FLAG
MDIOS_REG21_FLAG
MDIOS_REG22_FLAG
MDIOS_REG23_FLAG
MDIOS_REG24_FLAG
MDIOS_REG25_FLAG
MDIOS_REG26_FLAG
MDIOS_REG27_FLAG
MDIOS_REG28_FLAG
MDIOS_REG29_FLAG
MDIOS_REG30_FLAG
MDIOS_REG31_FLAG
MDIOS_ALLREG_FLAG
MDIOS Wakeup Line
MDIOS_WAKEUP_EXTI_LINE

42 HAL MMC Generic Driver

42.1 MMC Firmware driver registers structures

42.1.1 HAL_MMC_CardInfoTypeDef

Data Fields

- *uint32_t CardType*
- *uint32_t Class*
- *uint32_t RelCardAdd*
- *uint32_t BlockNbr*
- *uint32_t BlockSize*
- *uint32_t LogBlockNbr*
- *uint32_t LogBlockSize*

Field Documentation

- *uint32_t HAL_MMC_CardInfoTypeDef::CardType*
Specifies the card Type
- *uint32_t HAL_MMC_CardInfoTypeDef::Class*
Specifies the class of the card class
- *uint32_t HAL_MMC_CardInfoTypeDef::RelCardAdd*
Specifies the Relative Card Address
- *uint32_t HAL_MMC_CardInfoTypeDef::BlockNbr*
Specifies the Card Capacity in blocks
- *uint32_t HAL_MMC_CardInfoTypeDef::BlockSize*
Specifies one block size in bytes
- *uint32_t HAL_MMC_CardInfoTypeDef::LogBlockNbr*
Specifies the Card logical Capacity in blocks
- *uint32_t HAL_MMC_CardInfoTypeDef::LogBlockSize*
Specifies logical block size in bytes

42.1.2 MMC_HandleTypeDef

Data Fields

- *MMC_TypeDef * Instance*
- *MMC_InitTypeDef Init*
- *HAL_LockTypeDef Lock*
- *uint32_t * pTxBuffPtr*
- *uint32_t TxXferSize*
- *uint32_t * pRxBuffPtr*
- *uint32_t RxXferSize*
- *__IO uint32_t Context*
- *__IO HAL_MMC_StateTypeDef State*
- *__IO uint32_t ErrorCode*
- *DMA_HandleTypeDef * hdmarx*
- *DMA_HandleTypeDef * hdmatx*
- *HAL_MMC_CardInfoTypeDef MmcCard*
- *uint32_t CSD*
- *uint32_t CID*

Field Documentation

- ***MMC_TypeDef* MMC_HandleTypeDef::Instance***
MMC registers base address
- ***MMC_InitTypeDef MMC_HandleTypeDef::Init***
MMC required parameters
- ***HAL_LockTypeDef MMC_HandleTypeDef::Lock***
MMC locking object
- ***uint32_t* MMC_HandleTypeDef::pTxBuffPtr***
Pointer to MMC Tx transfer Buffer
- ***uint32_t MMC_HandleTypeDef::TxXferSize***
MMC Tx Transfer size
- ***uint32_t* MMC_HandleTypeDef::pRxBuffPtr***
Pointer to MMC Rx transfer Buffer
- ***uint32_t MMC_HandleTypeDef::RxXferSize***
MMC Rx Transfer size
- ***__IO uint32_t MMC_HandleTypeDef::Context***
MMC transfer context
- ***__IO HAL_MMC_StateTypeDef MMC_HandleTypeDef::State***
MMC card State
- ***__IO uint32_t MMC_HandleTypeDef::ErrorCode***
MMC Card Error codes
- ***DMA_HandleTypeDef* MMC_HandleTypeDef::hdmarx***
MMC Rx DMA handle parameters
- ***DMA_HandleTypeDef* MMC_HandleTypeDef::hdmatx***
MMC Tx DMA handle parameters
- ***HAL_MMC_CardInfoTypeDef MMC_HandleTypeDef::MmcCard***
MMC Card information
- ***uint32_t MMC_HandleTypeDef::CSD[4]***
MMC card specific data table
- ***uint32_t MMC_HandleTypeDef::CID[4]***
MMC card identification number table

42.1.3 HAL_MMC_CardCSDTypeDef

Data Fields

- ***__IO uint8_t CSDStruct***
- ***__IO uint8_t SysSpecVersion***
- ***__IO uint8_t Reserved1***
- ***__IO uint8_t TAAC***
- ***__IO uint8_t NSAC***
- ***__IO uint8_t MaxBusClkFrec***
- ***__IO uint16_t CardComdClasses***
- ***__IO uint8_t RdBlockLen***
- ***__IO uint8_t PartBlockRead***
- ***__IO uint8_t WrBlockMisalign***
- ***__IO uint8_t RdBlockMisalign***
- ***__IO uint8_t DSRImpI***
- ***__IO uint8_t Reserved2***
- ***__IO uint32_t DeviceSize***
- ***__IO uint8_t MaxRdCurrentVDDMin***
- ***__IO uint8_t MaxRdCurrentVDDMax***
- ***__IO uint8_t MaxWrCurrentVDDMin***
- ***__IO uint8_t MaxWrCurrentVDDMax***
- ***__IO uint8_t DeviceSizeMul***

- **__IO uint8_t EraseGrSize**
- **__IO uint8_t EraseGrMul**
- **__IO uint8_t WrProtectGrSize**
- **__IO uint8_t WrProtectGrEnable**
- **__IO uint8_t ManDeflECC**
- **__IO uint8_t WrSpeedFact**
- **__IO uint8_t MaxWrBlockLen**
- **__IO uint8_t WriteBlockPaPartial**
- **__IO uint8_t Reserved3**
- **__IO uint8_t ContentProtectAppli**
- **__IO uint8_t FileFormatGrouop**
- **__IO uint8_t CopyFlag**
- **__IO uint8_t PermWrProtect**
- **__IO uint8_t TempWrProtect**
- **__IO uint8_t FileFormat**
- **__IO uint8_t ECC**
- **__IO uint8_t CSD_CRC**
- **__IO uint8_t Reserved4**

Field Documentation

- **__IO uint8_t HAL_MMC_CardCSDTypeDef::CSDStruct**
CSD structure
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::SysSpecVersion**
System specification version
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::Reserved1**
Reserved
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::TAAC**
Data read access time 1
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::NSAC**
Data read access time 2 in CLK cycles
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::MaxBusClkFrec**
Max. bus clock frequency
- **__IO uint16_t HAL_MMC_CardCSDTypeDef::CardComdClasses**
Card command classes
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::RdBlockLen**
Max. read data block length
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::PartBlockRead**
Partial blocks for read allowed
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::WrBlockMisalign**
Write block misalignment
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::RdBlockMisalign**
Read block misalignment
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::DSRImpl**
DSR implemented
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::Reserved2**
Reserved
- **__IO uint32_t HAL_MMC_CardCSDTypeDef::DeviceSize**
Device Size
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::MaxRdCurrentVDDMin**
Max. read current @ VDD min
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::MaxRdCurrentVDDMax**
Max. read current @ VDD max

- **__IO uint8_t HAL_MMC_CardCSDTypeDef::MaxWrCurrentVDDMin**
Max. write current @ VDD min
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::MaxWrCurrentVDDMax**
Max. write current @ VDD max
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::DeviceSizeMul**
Device size multiplier
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::EraseGrSize**
Erase group size
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::EraseGrMul**
Erase group size multiplier
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::WrProtectGrSize**
Write protect group size
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::WrProtectGrEnable**
Write protect group enable
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::ManDefIECC**
Manufacturer default ECC
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::WrSpeedFact**
Write speed factor
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::MaxWrBlockLen**
Max. write data block length
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::WriteBlockPaPartial**
Partial blocks for write allowed
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::Reserved3**
Reserved
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::ContentProtectAppli**
Content protection application
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::FileFormatGroup**
File format group
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::CopyFlag**
Copy flag (OTP)
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::PermWrProtect**
Permanent write protection
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::TempWrProtect**
Temporary write protection
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::FileFormat**
File format
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::ECC**
ECC code
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::CSD_CRC**
CSD CRC
- **__IO uint8_t HAL_MMC_CardCSDTypeDef::Reserved4**
Always 1

42.1.4 HAL_MMC_CardCIDTypeDef

Data Fields

- **__IO uint8_t ManufacturerID**
- **__IO uint16_t OEM_AppliID**
- **__IO uint32_t ProdName1**
- **__IO uint8_t ProdName2**
- **__IO uint8_t ProdRev**
- **__IO uint32_t ProdSN**
- **__IO uint8_t Reserved1**
- **__IO uint16_t ManufactDate**

- `__IO uint8_t CID_CRC`
- `__IO uint8_t Reserved2`

Field Documentation

- `__IO uint8_t HAL_MMC_CardCIDTypeDef::ManufacturerID`
Manufacturer ID
- `__IO uint16_t HAL_MMC_CardCIDTypeDef::OEM_AppliID`
OEM/Application ID
- `__IO uint32_t HAL_MMC_CardCIDTypeDef::ProdName1`
Product Name part1
- `__IO uint8_t HAL_MMC_CardCIDTypeDef::ProdName2`
Product Name part2
- `__IO uint8_t HAL_MMC_CardCIDTypeDef::ProdRev`
Product Revision
- `__IO uint32_t HAL_MMC_CardCIDTypeDef::ProdSN`
Product Serial Number
- `__IO uint8_t HAL_MMC_CardCIDTypeDef::Reserved1`
Reserved1
- `__IO uint16_t HAL_MMC_CardCIDTypeDef::ManufactDate`
Manufacturing Date
- `__IO uint8_t HAL_MMC_CardCIDTypeDef::CID_CRC`
CID CRC
- `__IO uint8_t HAL_MMC_CardCIDTypeDef::Reserved2`
Always 1

42.2 MMC Firmware driver API description

42.2.1 How to use this driver

This driver implements a high level communication layer for read and write from/to this memory. The needed STM32 hardware resources (SDMMC and GPIO) are performed by the user in `HAL_MMC_MspInit()` function (MSP layer). Basically, the MSP layer configuration should be the same as we provide in the examples. You can easily tailor this configuration according to hardware resources.

This driver is a generic layered driver for SDMMC memories which uses the HAL SDMMC driver functions to interface with MMC and eMMC cards devices. It is used as follows:

1. Initialize the SDMMC low level resources by implement the `HAL_MMC_MspInit()` API:
 - a. Enable the SDMMC interface clock using `__HAL_RCC_SDMMC_CLK_ENABLE();`
 - b. SDMMC pins configuration for MMC card
 - Enable the clock for the SDMMC GPIOs using the functions `__HAL_RCC_GPIOx_CLK_ENABLE();`
 - Configure these SDMMC pins as alternate function pull-up using `HAL_GPIO_Init()` and according to your pin assignment;
 - c. DMA Configuration if you need to use DMA process (`HAL_MMC_ReadBlocks_DMA()` and `HAL_MMC_WriteBlocks_DMA()` APIs).
 - Enable the DMAx interface clock using `__HAL_RCC_DMAx_CLK_ENABLE();`
 - Configure the DMA using the function `HAL_DMA_Init()` with predeclared and filled.
 - d. NVIC configuration if you need to use interrupt process when using DMA transfer.
 - Configure the SDMMC and DMA interrupt priorities using functions `HAL_NVIC_SetPriority();` DMA priority is superior to SDMMC's priority

- Enable the NVIC DMA and SDMMC IRQs using function HAL_NVIC_EnableIRQ()
 - SDMMC interrupts are managed using the macros __HAL_MMC_ENABLE_IT() and __HAL_MMC_DISABLE_IT() inside the communication process.
 - SDMMC interrupts pending bits are managed using the macros __HAL_MMC_GET_IT() and __HAL_MMC_CLEAR_IT()
- e. NVIC configuration if you need to use interrupt process (HAL_MMC_ReadBlocks_IT() and HAL_MMC_WriteBlocks_IT() APIs).
- Configure the SDMMC interrupt priorities using function HAL_NVIC_SetPriority();
 - Enable the NVIC SDMMC IRQs using function HAL_NVIC_EnableIRQ()
 - SDMMC interrupts are managed using the macros __HAL_MMC_ENABLE_IT() and __HAL_MMC_DISABLE_IT() inside the communication process.
 - SDMMC interrupts pending bits are managed using the macros __HAL_MMC_GET_IT() and __HAL_MMC_CLEAR_IT()
2. At this stage, you can perform MMC read/write/erase operations after MMC card initialization

MMC Card Initialization and configuration

To initialize the MMC Card, use the HAL_MMC_Init() function. It initializes SDMMC IP (STM32 side) and the MMC Card, and put it into StandBy State (Ready for data transfer). This function provides the following operations:

1. Initialize the SDMMC peripheral interface with default configuration. The initialization process is done at 400KHz. You can change or adapt this frequency by adjusting the "ClockDiv" field. The MMC Card frequency (SDMMC_CK) is computed as follows: $SDMMC_CK = SDMMCCLK / (ClockDiv + 2)$ In initialization mode and according to the MMC Card standard, make sure that the SDMMC_CK frequency doesn't exceed 400KHz. This phase of initialization is done through SDMMC_Init() and SDMMC_PowerState_ON() SDMMC low level APIs.
2. Initialize the MMC card. The API used is HAL_MMC_InitCard(). This phase allows the card initialization and identification and check the MMC Card type (Standard Capacity or High Capacity) The initialization flow is compatible with MMC standard. This API (HAL_MMC_InitCard()) could be used also to reinitialize the card in case of plug-off plug-in.
3. Configure the MMC Card Data transfer frequency. By Default, the card transfer frequency is set to 24MHz. You can change or adapt this frequency by adjusting the "ClockDiv" field. In transfer mode and according to the MMC Card standard, make sure that the SDMMC_CK frequency doesn't exceed 25MHz and 50MHz in High-speed mode switch. To be able to use a frequency higher than 24MHz, you should use the SDMMC peripheral in bypass mode. Refer to the corresponding reference manual for more details.
4. Select the corresponding MMC Card according to the address read with the step 2.
5. Configure the MMC Card in wide bus mode: 4-bits data.

MMC Card Read operation

- You can read from MMC card in polling mode by using function HAL_MMC_ReadBlocks(). This function allows the read of 512 bytes blocks. You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_MMC_GetCardState() function for MMC card state.

- You can read from MMC card in DMA mode by using function `HAL_MMC_ReadBlocks_DMA()`. This function allows the read of 512 bytes blocks. You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through `HAL_MMC_GetCardState()` function for MMC card state. You could also check the DMA transfer process through the MMC Rx interrupt event.
- You can read from MMC card in Interrupt mode by using function `HAL_MMC_ReadBlocks_IT()`. This function allows the read of 512 bytes blocks. You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through `HAL_MMC_GetCardState()` function for MMC card state. You could also check the IT transfer process through the MMC Rx interrupt event.

MMC Card Write operation

- You can write to MMC card in polling mode by using function `HAL_MMC_WriteBlocks()`. This function allows the read of 512 bytes blocks. You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through `HAL_MMC_GetCardState()` function for MMC card state.
- You can write to MMC card in DMA mode by using function `HAL_MMC_WriteBlocks_DMA()`. This function allows the read of 512 bytes blocks. You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through `HAL_MMC_GetCardState()` function for MMC card state. You could also check the DMA transfer process through the MMC Tx interrupt event.
- You can write to MMC card in Interrupt mode by using function `HAL_MMC_WriteBlocks_IT()`. This function allows the read of 512 bytes blocks. You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through `HAL_MMC_GetCardState()` function for MMC card state. You could also check the IT transfer process through the MMC Tx interrupt event.

MMC card information

- To get MMC card information, you can use the function `HAL_MMC_GetCardInfo()`. It returns useful information about the MMC card such as block size, card type, block number ...

MMC card CSD register

- The `HAL_MMC_GetCardCSD()` API allows to get the parameters of the CSD register. Some of the CSD parameters are useful for card initialization and identification.

MMC card CID register

- The `HAL_MMC_GetCardCID()` API allows to get the parameters of the CID register. Some of the CID parameters are useful for card initialization and identification.

MMC HAL driver macros list

Below the list of most used macros in MMC HAL driver.

- `__HAL_MMC_ENABLE` : Enable the MMC device
- `__HAL_MMC_DISABLE` : Disable the MMC device
- `__HAL_MMC_DMA_ENABLE`: Enable the SDMMC DMA transfer
- `__HAL_MMC_DMA_DISABLE`: Disable the SDMMC DMA transfer
- `__HAL_MMC_ENABLE_IT`: Enable the MMC device interrupt
- `__HAL_MMC_DISABLE_IT`: Disable the MMC device interrupt
- `__HAL_MMC_GET_FLAG`: Check whether the specified MMC flag is set or not
- `__HAL_MMC_CLEAR_FLAG`: Clear the MMC's pending flags



You can refer to the MMC HAL driver header file for more useful macros

42.2.2 Initialization and de-initialization functions

This section provides functions allowing to initialize/de-initialize the MMC card device to be ready for use.

This section contains the following APIs:

- [*HAL_MMC_Init\(\)*](#)
- [*HAL_MMC_InitCard\(\)*](#)
- [*HAL_MMC_DeInit\(\)*](#)
- [*HAL_MMC_MspInit\(\)*](#)
- [*HAL_MMC_MspDeInit\(\)*](#)

42.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the data transfer from/to MMC card.

This section contains the following APIs:

- [*HAL_MMC_ReadBlocks\(\)*](#)
- [*HAL_MMC_WriteBlocks\(\)*](#)
- [*HAL_MMC_ReadBlocks_IT\(\)*](#)
- [*HAL_MMC_WriteBlocks_IT\(\)*](#)
- [*HAL_MMC_ReadBlocks_DMA\(\)*](#)
- [*HAL_MMC_WriteBlocks_DMA\(\)*](#)
- [*HAL_MMC_Erase\(\)*](#)
- [*HAL_MMC_IRQHandler\(\)*](#)
- [*HAL_MMC_GetState\(\)*](#)
- [*HAL_MMC_GetError\(\)*](#)
- [*HAL_MMC_TxCpltCallback\(\)*](#)
- [*HAL_MMC_RxCpltCallback\(\)*](#)
- [*HAL_MMC_ErrorCallback\(\)*](#)
- [*HAL_MMC_AbortCallback\(\)*](#)

42.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the MMC card operations and get the related information

This section contains the following APIs:

- [*HAL_MMC_GetCardCID\(\)*](#)

- [HAL_MMC_GetCardCSD\(\)](#)
- [HAL_MMC_GetCardInfo\(\)](#)
- [HAL_MMC_ConfigWideBusOperation\(\)](#)
- [HAL_MMC_GetCardState\(\)](#)
- [HAL_MMC_Abort\(\)](#)
- [HAL_MMC_Abort_IT\(\)](#)

42.2.5 Detailed description of functions

HAL_MMC_Init

Function name	HAL_StatusTypeDef HAL_MMC_Init (MMC_HandleTypeDef * hmmc)
Function description	Initializes the MMC according to the specified parameters in the MMC_HandleTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to the MMC handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_MMC_InitCard

Function name	HAL_StatusTypeDef HAL_MMC_InitCard (MMC_HandleTypeDef * hmmc)
Function description	Initializes the MMC Card.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function initializes the MMC card. It could be used when a card re-initialization is needed.

HAL_MMC_DeInit

Function name	HAL_StatusTypeDef HAL_MMC_DeInit (MMC_HandleTypeDef * hmmc)
Function description	De-Initializes the MMC card.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_MMC_Msplnit

Function name	void HAL_MMC_Msplnit (MMC_HandleTypeDef * hmmc)
Function description	Initializes the MMC MSP.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle
Return values	<ul style="list-style-type: none"> • None:

HAL_MMC_MspDeInit

Function name	void HAL_MMC_MspDeInit (MMC_HandleTypeDef * hmmc)
---------------	--

Function description	De-Initialize MMC MSP.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle
Return values	<ul style="list-style-type: none"> • None:

HAL_MMC_ReadBlocks

Function name	HAL_StatusTypeDef HAL_MMC_ReadBlocks (MMC_HandleTypeDef * hmmc, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks, uint32_t Timeout)
Function description	Reads block(s) from a specified address in a card.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle • pData: pointer to the buffer that will contain the received data • BlockAdd: Block Address from where data is to be read • NumberOfBlocks: Number of MMC blocks to read • Timeout: Specify timeout value
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This API should be followed by a check on the card state through HAL_MMC_GetCardState().

HAL_MMC_WriteBlocks

Function name	HAL_StatusTypeDef HAL_MMC_WriteBlocks (MMC_HandleTypeDef * hmmc, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks, uint32_t Timeout)
Function description	Allows to write block(s) to a specified address in a card.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle • pData: pointer to the buffer that will contain the data to transmit • BlockAdd: Block Address where data will be written • NumberOfBlocks: Number of MMC blocks to write • Timeout: Specify timeout value
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This API should be followed by a check on the card state through HAL_MMC_GetCardState().

HAL_MMC_Erase

Function name	HAL_StatusTypeDef HAL_MMC_Erase (MMC_HandleTypeDef * hmmc, uint32_t BlockStartAdd, uint32_t BlockEndAdd)
Function description	Erases the specified memory area of the given MMC card.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle • BlockStartAdd: Start Block address • BlockEndAdd: End Block address
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This API should be followed by a check on the card state through HAL_MMC_GetCardState().

HAL_MMC_ReadBlocks_IT

Function name	HAL_StatusTypeDef HAL_MMC_ReadBlocks_IT (MMC_HandleTypeDef * hmmc, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)
Function description	Reads block(s) from a specified address in a card.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle • pData: Pointer to the buffer that will contain the received data • BlockAdd: Block Address from where data is to be read • NumberOfBlocks: Number of blocks to read.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This API should be followed by a check on the card state through HAL_MMC_GetCardState(). • You could also check the IT transfer process through the MMC Rx interrupt event.

HAL_MMC_WriteBlocks_IT

Function name	HAL_StatusTypeDef HAL_MMC_WriteBlocks_IT (MMC_HandleTypeDef * hmmc, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)
Function description	Writes block(s) to a specified address in a card.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle • pData: Pointer to the buffer that will contain the data to transmit • BlockAdd: Block Address where data will be written • NumberOfBlocks: Number of blocks to write
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This API should be followed by a check on the card state through HAL_MMC_GetCardState(). • You could also check the IT transfer process through the MMC Tx interrupt event.

HAL_MMC_ReadBlocks_DMA

Function name	HAL_StatusTypeDef HAL_MMC_ReadBlocks_DMA (MMC_HandleTypeDef * hmmc, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)
Function description	Reads block(s) from a specified address in a card.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer MMC handle • pData: Pointer to the buffer that will contain the received data • BlockAdd: Block Address from where data is to be read • NumberOfBlocks: Number of blocks to read.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This API should be followed by a check on the card state through HAL_MMC_GetCardState().

- You could also check the DMA transfer process through the MMC Rx interrupt event.

HAL_MMC_WriteBlocks_DMA

Function name	HAL_StatusTypeDef HAL_MMC_WriteBlocks_DMA (MMC_HandleTypeDef * hmmc, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)
Function description	Writes block(s) to a specified address in a card.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle • pData: Pointer to the buffer that will contain the data to transmit • BlockAdd: Block Address where data will be written • NumberOfBlocks: Number of blocks to write
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This API should be followed by a check on the card state through HAL_MMC_GetCardState(). • You could also check the DMA transfer process through the MMC Tx interrupt event.

HAL_MMC_IRQHandler

Function name	void HAL_MMC_IRQHandler (MMC_HandleTypeDef * hmmc)
Function description	This function handles MMC card interrupt request.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle
Return values	<ul style="list-style-type: none"> • None:

HAL_MMC_TxCpltCallback

Function name	void HAL_MMC_TxCpltCallback (MMC_HandleTypeDef * hmmc)
Function description	Tx Transfer completed callbacks.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle
Return values	<ul style="list-style-type: none"> • None:

HAL_MMC_RxCpltCallback

Function name	void HAL_MMC_RxCpltCallback (MMC_HandleTypeDef * hmmc)
Function description	Rx Transfer completed callbacks.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer MMC handle
Return values	<ul style="list-style-type: none"> • None:

HAL_MMC_ErrorCallback

Function name	void HAL_MMC_ErrorCallback (MMC_HandleTypeDef * hmmc)
---------------	--

Function description	MMC error callbacks.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer MMC handle
Return values	<ul style="list-style-type: none"> • None:

HAL_MMC_AbortCallback

Function name	void HAL_MMC_AbortCallback (MMC_HandleTypeDef *hmmc)
Function description	MMC Abort callbacks.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer MMC handle
Return values	<ul style="list-style-type: none"> • None:

HAL_MMC_ConfigWideBusOperation

Function name	HAL_StatusTypeDef HAL_MMC_ConfigWideBusOperation (MMC_HandleTypeDef *hmmc, uint32_t WideMode)
Function description	Enables wide bus operation for the requested card if supported by card.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle • WideMode: Specifies the MMC card wide bus mode This parameter can be one of the following values: <ul style="list-style-type: none"> – SDMMC_BUS_WIDE_8B: 8-bit data transfer – SDMMC_BUS_WIDE_4B: 4-bit data transfer – SDMMC_BUS_WIDE_1B: 1-bit data transfer
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_MMC_GetCardState

Function name	HAL_MMC_CardStateTypeDef HAL_MMC_GetCardState (MMC_HandleTypeDef *hmmc)
Function description	Gets the current mmc card data state.
Parameters	<ul style="list-style-type: none"> • hmmc: pointer to MMC handle
Return values	<ul style="list-style-type: none"> • Card: state

HAL_MMC_GetCardCID

Function name	HAL_StatusTypeDef HAL_MMC_GetCardCID (MMC_HandleTypeDef *hmmc, HAL_MMC_CardCIDTypeDef *pCID)
Function description	Returns information the information of the card which are stored on the CID register.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle • pCID: Pointer to a HAL_MMC_CIDTypeDef structure that contains all CID register parameters
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_MMC_GetCardCSD

Function name	HAL_StatusTypeDef HAL_MMC_GetCardCSD (MMC_HandleTypeDef * hmmc, HAL_MMC_CardCSDTypeDef * pCSD)
Function description	Returns information the information of the card which are stored on the CSD register.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle • pCSD: Pointer to a HAL_MMC_CardInfoTypeDef structure that contains all CSD register parameters
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_MMC_GetCardInfo

Function name	HAL_StatusTypeDef HAL_MMC_GetCardInfo (MMC_HandleTypeDef * hmmc, HAL_MMC_CardInfoTypeDef * pCardInfo)
Function description	Gets the MMC card info.
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to MMC handle • pCardInfo: Pointer to the HAL_MMC_CardInfoTypeDef structure that will contain the MMC card status information
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_MMC_GetState

Function name	HAL_MMC_StateTypeDef HAL_MMC_GetState (MMC_HandleTypeDef * hmmc)
Function description	return the MMC state
Parameters	<ul style="list-style-type: none"> • hmmc: Pointer to mmc handle
Return values	<ul style="list-style-type: none"> • HAL: state

HAL_MMC_GetError

Function name	uint32_t HAL_MMC_GetError (MMC_HandleTypeDef * hmmc)
Function description	Return the MMC error code.
Parameters	<ul style="list-style-type: none"> • hmmc: : Pointer to a MMC_HandleTypeDef structure that contains the configuration information.
Return values	<ul style="list-style-type: none"> • MMC: Error Code

HAL_MMC_Abort

Function name	HAL_StatusTypeDef HAL_MMC_Abort (MMC_HandleTypeDef * hmmc)
Function description	Abort the current transfer and disable the MMC.
Parameters	<ul style="list-style-type: none"> • hmmc: pointer to a MMC_HandleTypeDef structure that contains the configuration information for MMC module.

Return values

- **HAL:** status

HAL_MMC_Abort_IT

Function name **HAL_StatusTypeDef HAL_MMC_Abort_IT (MMC_HandleTypeDef * hmmc)**

Function description Abort the current transfer and disable the MMC (IT mode).

Parameters

- **hmmc:** pointer to a MMC_HandleTypeDef structure that contains the configuration information for MMC module.

Return values

- **HAL:** status

42.3 MMC Firmware driver defines

42.3.1 MMC

MMC Error status enumeration Structure definition

HAL_MMC_ERROR_NONE	No error
HAL_MMC_ERROR_CMD_CRC_FAIL	Command response received (but CRC check failed)
HAL_MMC_ERROR_DATA_CRC_FAIL	Data block sent/received (CRC check failed)
HAL_MMC_ERROR_CMD_RSP_TIMEOUT	Command response timeout
HAL_MMC_ERROR_DATA_TIMEOUT	Data timeout
HAL_MMC_ERROR_TX_UNDERRUN	Transmit FIFO underrun
HAL_MMC_ERROR_RX_OVERRUN	Receive FIFO overrun
HAL_MMC_ERROR_ADDR_MISALIGNED	Misaligned address
HAL_MMC_ERROR_BLOCK_LEN_ERR	Transferred block length is not allowed for the card or the number of transferred bytes does not match the block length
HAL_MMC_ERROR_ERASE_SEQ_ERR	An error in the sequence of erase command occurs
HAL_MMC_ERROR_BAD_ERASE_PARAM	An invalid selection for erase groups
HAL_MMC_ERROR_WRITE_PROT_VIOLATION	Attempt to program a write protect block
HAL_MMC_ERROR_LOCK_UNLOCK_FAILED	Sequence or password error has been detected in unlock command or if there was an attempt to access a locked card
HAL_MMC_ERROR_COM_CRC_FAILED	CRC check of the previous command failed
HAL_MMC_ERROR_ILLEGAL_CMD	Command is not legal for the card state

HAL_MMC_ERROR_CARD_ECC_FAILED	Card internal ECC was applied but failed to correct the data
HAL_MMC_ERROR_CC_ERR	Internal card controller error
HAL_MMC_ERROR_GENERAL_UNKNOWN_ERR	General or unknown error
HAL_MMC_ERROR_STREAM_READ_UNDERRUN	The card could not sustain data reading in stream mode
HAL_MMC_ERROR_STREAM_WRITE_OVERRUN	The card could not sustain data programming in stream mode
HAL_MMC_ERROR_CID_CSD_OVERWRITE	CID/CSD overwrite error
HAL_MMC_ERROR_WP_ERASE_SKIP	Only partial address space was erased
HAL_MMC_ERROR_CARD_ECC_DISABLED	Command has been executed without using internal ECC
HAL_MMC_ERROR_ERASE_RESET	Erase sequence was cleared before executing because an out of erase sequence command was received
HAL_MMC_ERROR_AKE_SEQ_ERR	Error in sequence of authentication
HAL_MMC_ERROR_INVALID_VOLTRANGE	Error in case of invalid voltage range
HAL_MMC_ERROR_ADDR_OUT_OF_RANGE	Error when addressed block is out of range
HAL_MMC_ERROR_REQUEST_NOT_APPLICABLE	Error when command request is not applicable
HAL_MMC_ERROR_PARAM	the used parameter is not valid
HAL_MMC_ERROR_UNSUPPORTED_FEATURE	Error when feature is not insupported
HAL_MMC_ERROR_BUSY	Error when transfer process is busy
HAL_MMC_ERROR_DMA	Error while DMA transfer
HAL_MMC_ERROR_TIMEOUT	Timeout error

MMC context enumeration

MMC_CONTEXT_NONE	None
MMC_CONTEXT_READ_SINGLE_BLOCK	Read single block operation
MMC_CONTEXT_READ_MULTIPLE_BLOCK	Read multiple blocks operation
MMC_CONTEXT_WRITE_SINGLE_BLOCK	Write single block operation
MMC_CONTEXT_WRITE_MULTIPLE_BLOCK	Write multiple blocks operation
MMC_CONTEXT_IT	Process in Interrupt mode
MMC_CONTEXT_DMA	Process in DMA mode

MMC Voltage mode

MMC_HIGH_VOLTAGE_RANGE	VALUE OF ARGUMENT
------------------------	-------------------

MMC_DUAL_VOLTAGE_RANGE VALUE OF ARGUMENT
 eMMC_HIGH_VOLTAGE_RANGE for eMMC> 2Gb sector mode
 eMMC_DUAL_VOLTAGE_RANGE for eMMC> 2Gb sector mode
 MMC_INVALID_VOLTAGE_RANGE

MMC Memory Cards

MMC_HIGH_VOLTAGE_CARD
 MMC_DUAL_VOLTAGE_CARD

Exported Constants

BLOCKSIZE Block size is 512 bytes
 CAPACITY 2 G bytes constant

MMC Exported Macros

__HAL_MMC_ENABLE

Description:

- Enable the MMC device.

Return value:

- None

__HAL_MMC_DISABLE

Description:

- Disable the MMC device.

Return value:

- None

__HAL_MMC_DMA_ENABLE

Description:

- Enable the SDMMC DMA transfer.

Return value:

- None

__HAL_MMC_DMA_DISABLE

Description:

- Disable the SDMMC DMA transfer.

Return value:

- None

__HAL_MMC_ENABLE_IT

Description:

- Enable the MMC device interrupt.

Parameters:

- __HANDLE__: MMC Handle
- __INTERRUPT__: specifies the SDMMC interrupt sources to be enabled. This parameter can be one or a combination of the following values:
 - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
 - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
 - SDMMC_IT_CTIMEOUT: Command response

- timeout interrupt
- SDMMC_IT_DTIMEOUT: Data timeout interrupt
 - SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
 - SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
 - SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
 - SDMMC_IT_CMDSSENT: Command sent (no response required) interrupt
 - SDMMC_IT_DATAEND: Data end (data counter, SDIDCOUNT, is zero) interrupt
 - SDMMC_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
 - SDMMC_IT_CMDACT: Command transfer in progress interrupt
 - SDMMC_IT_TXACT: Data transmit in progress interrupt
 - SDMMC_IT_RXACT: Data receive in progress interrupt
 - SDMMC_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
 - SDMMC_IT_RXFIFOHF: Receive FIFO Half Full interrupt
 - SDMMC_IT_TXFIFO: Transmit FIFO full interrupt
 - SDMMC_IT_RXFIFO: Receive FIFO full interrupt
 - SDMMC_IT_TXFIFOE: Transmit FIFO empty interrupt
 - SDMMC_IT_RXFIFOE: Receive FIFO empty interrupt
 - SDMMC_IT_TXDAVL: Data available in transmit FIFO interrupt
 - SDMMC_IT_RXDAVL: Data available in receive FIFO interrupt
 - SDMMC_IT_SDIOIT: SD I/O interrupt received interrupt

Return value:

- None

__HAL_MMC_DISABLE_IT**Description:**

- Disable the MMC device interrupt.

Parameters:

- __HANDLE__: MMC Handle
- __INTERRUPT__: specifies the SDMMC interrupt sources to be disabled. This parameter can be one or a combination of the following values:
 - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
 - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt

- SDMMC_IT_CTIMEOUT: Command response timeout interrupt
- SDMMC_IT_DTIMEOUT: Data timeout interrupt
- SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
- SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
- SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
- SDMMC_IT_CMDSSENT: Command sent (no response required) interrupt
- SDMMC_IT_DATAEND: Data end (data counter, SDIDCOUNT, is zero) interrupt
- SDMMC_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
- SDMMC_IT_CMDACT: Command transfer in progress interrupt
- SDMMC_IT_TXACT: Data transmit in progress interrupt
- SDMMC_IT_RXACT: Data receive in progress interrupt
- SDMMC_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
- SDMMC_IT_RXFIFOHF: Receive FIFO Half Full interrupt
- SDMMC_IT_TXFIFO: Transmit FIFO full interrupt
- SDMMC_IT_RXFIFO: Receive FIFO full interrupt
- SDMMC_IT_TXFIFOE: Transmit FIFO empty interrupt
- SDMMC_IT_RXFIFOE: Receive FIFO empty interrupt
- SDMMC_IT_TXDAVL: Data available in transmit FIFO interrupt
- SDMMC_IT_RXDAVL: Data available in receive FIFO interrupt
- SDMMC_IT_SDIOIT: SD I/O interrupt received interrupt

Return value:

- None

__HAL_MMC_GET_FLAG**Description:**

- Check whether the specified MMC flag is set or not.

Parameters:

- __HANDLE__: MMC Handle
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
 - SDMMC_FLAG_CCRCFAIL: Command response received (CRC check failed)
 - SDMMC_FLAG_DCRCFAIL: Data block sent/received (CRC check failed)

- SDMMC_FLAG_CTIMEOUT: Command response timeout
- SDMMC_FLAG_DTIMEOUT: Data timeout
- SDMMC_FLAG_TXUNDERR: Transmit FIFO underrun error
- SDMMC_FLAG_RXOVERR: Received FIFO overrun error
- SDMMC_FLAG_CMDREND: Command response received (CRC check passed)
- SDMMC_FLAG_CMDSSENT: Command sent (no response required)
- SDMMC_FLAG_DATAEND: Data end (data counter, SDIDCOUNT, is zero)
- SDMMC_FLAG_DCKEND: Data block sent/received (CRC check passed)
- SDMMC_FLAG_CMDACT: Command transfer in progress
- SDMMC_FLAG_TXACT: Data transmit in progress
- SDMMC_FLAG_RXACT: Data receive in progress
- SDMMC_FLAG_TXFIFOHE: Transmit FIFO Half Empty
- SDMMC_FLAG_RXFIFOHF: Receive FIFO Half Full
- SDMMC_FLAG_TXFIFO: Transmit FIFO full
- SDMMC_FLAG_RXFIFO: Receive FIFO full
- SDMMC_FLAG_TXFIFOE: Transmit FIFO empty
- SDMMC_FLAG_RXFIFOE: Receive FIFO empty
- SDMMC_FLAG_TXDAVL: Data available in transmit FIFO
- SDMMC_FLAG_RXDAVL: Data available in receive FIFO
- SDMMC_FLAG_SDIOIT: SD I/O interrupt received

Return value:

- The: new state of MMC FLAG (SET or RESET).

__HAL_MMC_CLEAR_FLAG**Description:**

- Clear the MMC's pending flags.

Parameters:

- __HANDLE__: MMC Handle
- __FLAG__: specifies the flag to clear. This parameter can be one or a combination of the following values:
 - SDMMC_FLAG_CCRCFAIL: Command response received (CRC check failed)
 - SDMMC_FLAG_DCRCFAIL: Data block sent/received (CRC check failed)
 - SDMMC_FLAG_CTIMEOUT: Command

- response timeout
- SDMMC_FLAG_DTIMEOUT: Data timeout
- SDMMC_FLAG_TXUNDERR: Transmit FIFO underrun error
- SDMMC_FLAG_RXOVERR: Received FIFO overrun error
- SDMMC_FLAG_CMDREND: Command response received (CRC check passed)
- SDMMC_FLAG_CMDSSENT: Command sent (no response required)
- SDMMC_FLAG_DATAEND: Data end (data counter, SDIDCOUNT, is zero)
- SDMMC_FLAG_DBCKEND: Data block sent/received (CRC check passed)
- SDMMC_FLAG_SDIOIT: SD I/O interrupt received

Return value:

- None

`__HAL_MMC_GET_IT`

Description:

- Check whether the specified MMC interrupt has occurred or not.

Parameters:

- `__HANDLE__`: MMC Handle
- `__INTERRUPT__`: specifies the SDMMC interrupt source to check. This parameter can be one of the following values:
 - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
 - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
 - SDMMC_IT_CTIMEOUT: Command response timeout interrupt
 - SDMMC_IT_DTIMEOUT: Data timeout interrupt
 - SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
 - SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
 - SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
 - SDMMC_IT_CMDSSENT: Command sent (no response required) interrupt
 - SDMMC_IT_DATAEND: Data end (data counter, SDIDCOUNT, is zero) interrupt
 - SDMMC_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
 - SDMMC_IT_CMDACT: Command transfer in progress interrupt
 - SDMMC_IT_TXACT: Data transmit in progress interrupt
 - SDMMC_IT_RXACT: Data receive in progress interrupt

- SDMMC_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
- SDMMC_IT_RXFIFOHF: Receive FIFO Half Full interrupt
- SDMMC_IT_TXFIFO: Transmit FIFO full interrupt
- SDMMC_IT_RXFIFO: Receive FIFO full interrupt
- SDMMC_IT_TXFIFOE: Transmit FIFO empty interrupt
- SDMMC_IT_RXFIFOE: Receive FIFO empty interrupt
- SDMMC_IT_TXDAVL: Data available in transmit FIFO interrupt
- SDMMC_IT_RXDAVL: Data available in receive FIFO interrupt
- SDMMC_IT_SDIOIT: SD I/O interrupt received interrupt

Return value:

- The: new state of SD IT (SET or RESET).

__HAL_MMC_CLEAR_IT**Description:**

- Clear the MMC's interrupt pending bits.

Parameters:

- **__HANDLE__**: MMC Handle
- **__INTERRUPT__**: specifies the interrupt pending bit to clear. This parameter can be one or a combination of the following values:
 - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
 - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
 - SDMMC_IT_CTIMEOUT: Command response timeout interrupt
 - SDMMC_IT_DTIMEOUT: Data timeout interrupt
 - SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
 - SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
 - SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
 - SDMMC_IT_CMDSSENT: Command sent (no response required) interrupt
 - SDMMC_IT_DATAEND: Data end (data counter, SDMMC_DCOUNT, is zero) interrupt
 - SDMMC_IT_SDIOIT: SD I/O interrupt received interrupt

Return value:

- None

MMC Handle Structure definition

MMC_InitTypeDef

MMC_TypeDef

43 HAL NAND Generic Driver

43.1 NAND Firmware driver registers structures

43.1.1 NAND_IDTypeDef

Data Fields

- *uint8_t* **Maker_Id**
- *uint8_t* **Device_Id**
- *uint8_t* **Third_Id**
- *uint8_t* **Fourth_Id**

Field Documentation

- *uint8_t* **NAND_IDTypeDef::Maker_Id**
- *uint8_t* **NAND_IDTypeDef::Device_Id**
- *uint8_t* **NAND_IDTypeDef::Third_Id**
- *uint8_t* **NAND_IDTypeDef::Fourth_Id**

43.1.2 NAND_AddressTypeDef

Data Fields

- *uint16_t* **Page**
- *uint16_t* **Plane**
- *uint16_t* **Block**

Field Documentation

- *uint16_t* **NAND_AddressTypeDef::Page**
NAND memory Page address
- *uint16_t* **NAND_AddressTypeDef::Plane**
NAND memory Zone address
- *uint16_t* **NAND_AddressTypeDef::Block**
NAND memory Block address

43.1.3 NAND_DeviceConfigTypeDef

Data Fields

- *uint32_t* **PageSize**
- *uint32_t* **SpareAreaSize**
- *uint32_t* **BlockSize**
- *uint32_t* **BlockNbr**
- *uint32_t* **PlaneNbr**
- *uint32_t* **PlaneSize**
- **FunctionalState** *ExtraCommandEnable*

Field Documentation

- *uint32_t* **NAND_DeviceConfigTypeDef::PageSize**
NAND memory page (without spare area) size measured in bytes for 8 bits addressing or words for 16 bits addressing
- *uint32_t* **NAND_DeviceConfigTypeDef::SpareAreaSize**
NAND memory spare area size measured in bytes for 8 bits addressing or words for 16 bits addressing

- ***uint32_t NAND_DeviceConfigTypeDef::BlockSize***
NAND memory block size measured in number of pages
- ***uint32_t NAND_DeviceConfigTypeDef::BlockNbr***
NAND memory number of total blocks
- ***uint32_t NAND_DeviceConfigTypeDef::PlaneNbr***
NAND memory number of planes
- ***uint32_t NAND_DeviceConfigTypeDef::PlaneSize***
NAND memory zone size measured in number of blocks
- ***FunctionalState NAND_DeviceConfigTypeDef::ExtraCommandEnable***
NAND extra command needed for Page reading mode. This parameter is mandatory for some NAND parts after the read command (NAND_CMD_AREA_TRUE1) and before DATA reading sequence. Example: Toshiba THTH58BYG3S0HBAI6. This parameter could be ENABLE or DISABLE Please check the Read Mode sequence in the NAND device datasheet

43.1.4 NAND_HandleTypeDef

Data Fields

- ***FMC_NAND_TypeDef * Instance***
- ***FMC_NAND_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_NAND_StateTypeDef State***
- ***NAND_DeviceConfigTypeDef Config***

Field Documentation

- ***FMC_NAND_TypeDef* NAND_HandleTypeDef::Instance***
Register base address
- ***FMC_NAND_InitTypeDef NAND_HandleTypeDef::Init***
NAND device control configuration parameters
- ***HAL_LockTypeDef NAND_HandleTypeDef::Lock***
NAND locking object
- ***__IO HAL_NAND_StateTypeDef NAND_HandleTypeDef::State***
NAND device access state
- ***NAND_DeviceConfigTypeDef NAND_HandleTypeDef::Config***
NAND physical characteristic information structure

43.2 NAND Firmware driver API description

43.2.1 How to use this driver

This driver is a generic layered driver which contains a set of APIs used to control NAND flash memories. It uses the FMC/FSMC layer functions to interface with NAND devices. This driver is used as follows:

- NAND flash memory configuration sequence using the function HAL_NAND_Init() with control and timing parameters for both common and attribute spaces.
- Read NAND flash memory maker and device IDs using the function HAL_NAND_Read_ID(). The read information is stored in the NAND_ID_TypeDef structure declared by the function caller.
- Access NAND flash memory by read/write operations using the functions HAL_NAND_Read_Page_8b()/HAL_NAND_Read_SpareArea_8b(), HAL_NAND_Write_Page_8b()/HAL_NAND_Write_SpareArea_8b(), HAL_NAND_Read_Page_16b()/HAL_NAND_Read_SpareArea_16b(), HAL_NAND_Write_Page_16b()/HAL_NAND_Write_SpareArea_16b() to read/write page(s)/spare area(s). These functions use specific device information (Block, page

size..) predefined by the user in the NAND_DeviceConfigTypeDef structure. The read/write address information is contained by the Nand_Address_Typedef structure passed as parameter.

- Perform NAND flash Reset chip operation using the function HAL_NAND_Reset().
- Perform NAND flash erase block operation using the function HAL_NAND_Erase_Block(). The erase block address information is contained in the Nand_Address_Typedef structure passed as parameter.
- Read the NAND flash status operation using the function HAL_NAND_Read_Status().
- You can also control the NAND device by calling the control APIs HAL_NAND_ECC_Enable()/ HAL_NAND_ECC_Disable() to respectively enable/disable the ECC code correction feature or the function HAL_NAND_GetECC() to get the ECC correction code.
- You can monitor the NAND device HAL state by calling the function HAL_NAND_GetState()



This driver is a set of generic APIs which handle standard NAND flash operations. If a NAND flash device contains different operations and/or implementations, it should be implemented separately.

43.2.2 NAND Initialization and de-initialization functions

This section provides functions allowing to initialize/de-initialize the NAND memory

This section contains the following APIs:

- [HAL_NAND_Init\(\)](#)
- [HAL_NAND_DeInit\(\)](#)
- [HAL_NAND_MspInit\(\)](#)
- [HAL_NAND_MspDeInit\(\)](#)
- [HAL_NAND_IRQHandler\(\)](#)
- [HAL_NAND_ITCallback\(\)](#)
- [HAL_NAND_ConfigDevice\(\)](#)
- [HAL_NAND_Read_ID\(\)](#)

43.2.3 NAND Input and Output functions

This section provides functions allowing to use and control the NAND memory

This section contains the following APIs:

- [HAL_NAND_Read_ID\(\)](#)
- [HAL_NAND_Reset\(\)](#)
- [HAL_NAND_ConfigDevice\(\)](#)
- [HAL_NAND_Read_Page_8b\(\)](#)
- [HAL_NAND_Read_Page_16b\(\)](#)
- [HAL_NAND_Write_Page_8b\(\)](#)
- [HAL_NAND_Write_Page_16b\(\)](#)
- [HAL_NAND_Read_SpareArea_8b\(\)](#)
- [HAL_NAND_Read_SpareArea_16b\(\)](#)
- [HAL_NAND_Write_SpareArea_8b\(\)](#)
- [HAL_NAND_Write_SpareArea_16b\(\)](#)
- [HAL_NAND_Erase_Block\(\)](#)
- [HAL_NAND_Address_Inc\(\)](#)

43.2.4 NAND Control functions

This subsection provides a set of functions allowing to control dynamically the NAND interface.

This section contains the following APIs:

- [HAL_NAND_ECC_Enable\(\)](#)
- [HAL_NAND_ECC_Disable\(\)](#)
- [HAL_NAND_GetECC\(\)](#)

43.2.5 NAND State functions

This subsection permits to get in run-time the status of the NAND controller and the data flow.

This section contains the following APIs:

- [HAL_NAND_GetState\(\)](#)
- [HAL_NAND_Read_Status\(\)](#)

43.2.6 Detailed description of functions

HAL_NAND_Init

Function name	HAL_StatusTypeDef HAL_NAND_Init (NAND_HandleTypeDef * hhand, FMC_NAND_PCC_TimingTypeDef * ComSpace_Timing, FMC_NAND_PCC_TimingTypeDef * AttSpace_Timing)
Function description	Perform NAND memory Initialization sequence.
Parameters	<ul style="list-style-type: none"> • hhand: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module. • ComSpace_Timing: pointer to Common space timing structure • AttSpace_Timing: pointer to Attribute space timing structure
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_NAND_DeInit

Function name	HAL_StatusTypeDef HAL_NAND_DeInit (NAND_HandleTypeDef * hhand)
Function description	Perform NAND memory De-Initialization sequence.
Parameters	<ul style="list-style-type: none"> • hhand: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_NAND_ConfigDevice

Function name	HAL_StatusTypeDef HAL_NAND_ConfigDevice (NAND_HandleTypeDef * hhand, NAND_DeviceConfigTypeDef * pDeviceConfig)
Function description	Configure the device: Enter the physical parameters of the device.
Parameters	<ul style="list-style-type: none"> • hhand: pointer to a NAND_HandleTypeDef structure that

- contains the configuration information for NAND module.
 - **pDeviceConfig**: : pointer to NAND_DeviceConfigTypeDef structure
- Return values
- **HAL**: status

HAL_NAND_Read_ID

- Function name **HAL_StatusTypeDef HAL_NAND_Read_ID (NAND_HandleTypeDef * hhand, NAND_IDTypeDef * pNAND_ID)**
- Function description Read the NAND memory electronic signature.
- Parameters
- **hhand**: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.
 - **pNAND_ID**: NAND ID structure
- Return values
- **HAL**: status

HAL_NAND_Msplnit

- Function name **void HAL_NAND_Msplnit (NAND_HandleTypeDef * hhand)**
- Function description NAND MSP Init.
- Parameters
- **hhand**: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.
- Return values
- **None**:

HAL_NAND_MspDelnit

- Function name **void HAL_NAND_MspDelnit (NAND_HandleTypeDef * hhand)**
- Function description NAND MSP Delnit.
- Parameters
- **hhand**: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.
- Return values
- **None**:

HAL_NAND_IRQHandler

- Function name **void HAL_NAND_IRQHandler (NAND_HandleTypeDef * hhand)**
- Function description This function handles NAND device interrupt request.
- Parameters
- **hhand**: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.
- Return values
- **HAL**: status

HAL_NAND_ITCallback

- Function name **void HAL_NAND_ITCallback (NAND_HandleTypeDef * hhand)**
- Function description NAND interrupt feature callback.
- Parameters
- **hhand**: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.

Return values

- **None:**

HAL_NAND_Reset

Function name **HAL_StatusTypeDef HAL_NAND_Reset
(NAND_HandleTypeDef * h NAND)**

Function description NAND memory reset.

Parameters

- **h NAND:** pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.

Return values

- **HAL:** status

HAL_NAND_Read_Page_8b

Function name **HAL_StatusTypeDef HAL_NAND_Read_Page_8b
(NAND_HandleTypeDef * h NAND, NAND_AddressTypeDef *
pAddress, uint8_t * pBuffer, uint32_t NumPageToRead)**

Function description Read Page(s) from NAND memory block (8-bits addressing)

Parameters

- **h NAND:** pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.
- **pAddress:** : pointer to NAND address structure
- **pBuffer:** : pointer to destination read buffer
- **NumPageToRead:** : number of pages to read from block

Return values

- **HAL:** status

HAL_NAND_Write_Page_8b

Function name **HAL_StatusTypeDef HAL_NAND_Write_Page_8b
(NAND_HandleTypeDef * h NAND, NAND_AddressTypeDef *
pAddress, uint8_t * pBuffer, uint32_t NumPageToWrite)**

Function description Write Page(s) to NAND memory block (8-bits addressing)

Parameters

- **h NAND:** pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.
- **pAddress:** : pointer to NAND address structure
- **pBuffer:** : pointer to source buffer to write
- **NumPageToWrite:** : number of pages to write to block

Return values

- **HAL:** status

HAL_NAND_Read_SpareArea_8b

Function name **HAL_StatusTypeDef HAL_NAND_Read_SpareArea_8b
(NAND_HandleTypeDef * h NAND, NAND_AddressTypeDef *
pAddress, uint8_t * pBuffer, uint32_t NumSpareAreaToRead)**

Function description Read Spare area(s) from NAND memory (8-bits addressing)

Parameters

- **h NAND:** pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.
- **pAddress:** : pointer to NAND address structure
- **pBuffer:** pointer to source buffer to write

- **NumSpareAreaToRead:** Number of spare area to read
- Return values
- **HAL:** status

HAL_NAND_Write_SpareArea_8b

Function name **HAL_StatusTypeDef HAL_NAND_Write_SpareArea_8b (NAND_HandleTypeDef * h NAND, NAND_AddressTypeDef * pAddress, uint8_t * pBuffer, uint32_t NumSpareAreaToWrite)**

Function description Write Spare area(s) to NAND memory (8-bits addressing)

- Parameters
- **h NAND:** pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.
 - **pAddress:** : pointer to NAND address structure
 - **pBuffer:** : pointer to source buffer to write
 - **NumSpareAreaToWrite:** : number of spare areas to write to block

- Return values
- **HAL:** status

HAL_NAND_Read_Page_16b

Function name **HAL_StatusTypeDef HAL_NAND_Read_Page_16b (NAND_HandleTypeDef * h NAND, NAND_AddressTypeDef * pAddress, uint16_t * pBuffer, uint32_t NumPageToRead)**

Function description Read Page(s) from NAND memory block (16-bits addressing)

- Parameters
- **h NAND:** pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.
 - **pAddress:** : pointer to NAND address structure
 - **pBuffer:** : pointer to destination read buffer. pBuffer should be 16bits aligned
 - **NumPageToRead:** : number of pages to read from block

- Return values
- **HAL:** status

HAL_NAND_Write_Page_16b

Function name **HAL_StatusTypeDef HAL_NAND_Write_Page_16b (NAND_HandleTypeDef * h NAND, NAND_AddressTypeDef * pAddress, uint16_t * pBuffer, uint32_t NumPageToWrite)**

Function description Write Page(s) to NAND memory block (16-bits addressing)

- Parameters
- **h NAND:** pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.
 - **pAddress:** : pointer to NAND address structure
 - **pBuffer:** : pointer to source buffer to write. pBuffer should be 16bits aligned
 - **NumPageToWrite:** : number of pages to write to block

- Return values
- **HAL:** status

HAL_NAND_Read_SpareArea_16b

Function name **HAL_StatusTypeDef HAL_NAND_Read_SpareArea_16b (NAND_HandleTypeDef * h NAND, NAND_AddressTypeDef ***

	pAddress, uint16_t * pBuffer, uint32_t NumSpareAreaToRead)
Function description	Read Spare area(s) from NAND memory (16-bits addressing)
Parameters	<ul style="list-style-type: none"> • hnand: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module. • pAddress: : pointer to NAND address structure • pBuffer: pointer to source buffer to write. pBuffer should be 16bits aligned. • NumSpareAreaToRead: Number of spare area to read
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_NAND_Write_SpareArea_16b

Function name	HAL_StatusTypeDef HAL_NAND_Write_SpareArea_16b (NAND_HandleTypeDef * hnand, NAND_AddressTypeDef * pAddress, uint16_t * pBuffer, uint32_t NumSpareAreaTowrite)
Function description	Write Spare area(s) to NAND memory (16-bits addressing)
Parameters	<ul style="list-style-type: none"> • hnand: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module. • pAddress: : pointer to NAND address structure • pBuffer: : pointer to source buffer to write. pBuffer should be 16bits aligned. • NumSpareAreaTowrite: : number of spare areas to write to block
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_NAND_Erase_Block

Function name	HAL_StatusTypeDef HAL_NAND_Erase_Block (NAND_HandleTypeDef * hnand, NAND_AddressTypeDef * pAddress)
Function description	NAND memory Block erase.
Parameters	<ul style="list-style-type: none"> • hnand: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module. • pAddress: : pointer to NAND address structure
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_NAND_Address_Inc

Function name	uint32_t HAL_NAND_Address_Inc (NAND_HandleTypeDef * hnand, NAND_AddressTypeDef * pAddress)
Function description	Increment the NAND memory address.
Parameters	<ul style="list-style-type: none"> • hnand: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module. • pAddress: pointer to NAND address structure
Return values	<ul style="list-style-type: none"> • The: new status of the increment address operation. It can be: <ul style="list-style-type: none"> – NAND_VALID_ADDRESS: When the new address is valid address

- NAND_INVALID_ADDRESS: When the new address is invalid address

HAL_NAND_ECC_Enable

Function name	HAL_StatusTypeDef HAL_NAND_ECC_Enable (NAND_HandleTypeDef * hnd)
Function description	Enables dynamically NAND ECC feature.
Parameters	<ul style="list-style-type: none"> • hnd: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_NAND_ECC_Disable

Function name	HAL_StatusTypeDef HAL_NAND_ECC_Disable (NAND_HandleTypeDef * hnd)
Function description	Disables dynamically FMC_NAND ECC feature.
Parameters	<ul style="list-style-type: none"> • hnd: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_NAND_GetECC

Function name	HAL_StatusTypeDef HAL_NAND_GetECC (NAND_HandleTypeDef * hnd, uint32_t * ECCval, uint32_t Timeout)
Function description	Disables dynamically NAND ECC feature.
Parameters	<ul style="list-style-type: none"> • hnd: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module. • ECCval: pointer to ECC value • Timeout: maximum timeout to wait
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_NAND_GetState

Function name	HAL_NAND_StateTypeDef HAL_NAND_GetState (NAND_HandleTypeDef * hnd)
Function description	return the NAND state
Parameters	<ul style="list-style-type: none"> • hnd: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module.
Return values	<ul style="list-style-type: none"> • HAL: state

HAL_NAND_Read_Status

Function name	uint32_t HAL_NAND_Read_Status (NAND_HandleTypeDef * hnd)
Function description	NAND memory read status.

-
- | | |
|---------------|--|
| Parameters | <ul style="list-style-type: none">• hnand: pointer to a NAND_HandleTypeDef structure that contains the configuration information for NAND module. |
| Return values | <ul style="list-style-type: none">• NAND: status |

43.3 NAND Firmware driver defines

43.3.1 NAND

NAND Exported Macros

- | | |
|--|---|
| <code>__HAL_NAND_RESET_HANDLE_STATE</code> | Description: <ul style="list-style-type: none">• Reset NAND handle state. Parameters: <ul style="list-style-type: none">• <code>__HANDLE__</code>: specifies the NAND handle. Return value: <ul style="list-style-type: none">• None |
|--|---|

44 HAL NOR Generic Driver

44.1 NOR Firmware driver registers structures

44.1.1 NOR_IDTypeDef

Data Fields

- *uint16_t Manufacturer_Code*
- *uint16_t Device_Code1*
- *uint16_t Device_Code2*
- *uint16_t Device_Code3*

Field Documentation

- *uint16_t NOR_IDTypeDef::Manufacturer_Code*
Defines the device's manufacturer code used to identify the memory
- *uint16_t NOR_IDTypeDef::Device_Code1*
- *uint16_t NOR_IDTypeDef::Device_Code2*
- *uint16_t NOR_IDTypeDef::Device_Code3*
Defines the device's codes used to identify the memory. These codes can be accessed by performing read operations with specific control signals and addresses set. They can also be accessed by issuing an Auto Select command

44.1.2 NOR_CFIDef

Data Fields

- *uint16_t CFI_1*
- *uint16_t CFI_2*
- *uint16_t CFI_3*
- *uint16_t CFI_4*

Field Documentation

- *uint16_t NOR_CFIDef::CFI_1*
< Defines the information stored in the memory's Common flash interface which contains a description of various electrical and timing parameters, density information and functions supported by the memory
- *uint16_t NOR_CFIDef::CFI_2*
- *uint16_t NOR_CFIDef::CFI_3*
- *uint16_t NOR_CFIDef::CFI_4*

44.1.3 NOR_HandleTypeDef

Data Fields

- *FMC_NORSRAM_TypeDef * Instance*
- *FMC_NORSRAM_EXTENDED_TypeDef * Extended*
- *FMC_NORSRAM_InitTypeDef Init*
- *HAL_LockTypeDef Lock*
- *__IO HAL_NOR_StateTypeDef State*

Field Documentation

- *FMC_NORSRAM_TypeDef* NOR_HandleTypeDef::Instance*
Register base address

- ***FMC_NORSRAM_EXTENDED_TypeDef* NOR_HandleTypeDef::Extended***
Extended mode register base address
- ***FMC_NORSRAM_InitTypeDef NOR_HandleTypeDef::Init***
NOR device control configuration parameters
- ***HAL_LockTypeDef NOR_HandleTypeDef::Lock***
NOR locking object
- ***__IO HAL_NOR_StateTypeDef NOR_HandleTypeDef::State***
NOR device access state

44.2 NOR Firmware driver API description

44.2.1 How to use this driver

This driver is a generic layered driver which contains a set of APIs used to control NOR flash memories. It uses the FMC layer functions to interface with NOR devices. This driver is used as follows:

- NOR flash memory configuration sequence using the function HAL_NOR_Init() with control and timing parameters for both normal and extended mode.
- Read NOR flash memory manufacturer code and device IDs using the function HAL_NOR_Read_ID(). The read information is stored in the NOR_ID_TypeDef structure declared by the function caller.
- Access NOR flash memory by read/write data unit operations using the functions HAL_NOR_Read(), HAL_NOR_Program().
- Perform NOR flash erase block/chip operations using the functions HAL_NOR_Erase_Block() and HAL_NOR_Erase_Chip().
- Read the NOR flash CFI (common flash interface) IDs using the function HAL_NOR_Read_CFI(). The read information is stored in the NOR_CFI_TypeDef structure declared by the function caller.
- You can also control the NOR device by calling the control APIs HAL_NOR_WriteOperation_Enable()/ HAL_NOR_WriteOperation_Disable() to respectively enable/disable the NOR write operation
- You can monitor the NOR device HAL state by calling the function HAL_NOR_GetState()



This driver is a set of generic APIs which handle standard NOR flash operations. If a NOR flash device contains different operations and/or implementations, it should be implemented separately.

NOR HAL driver macros list

Below the list of most used macros in NOR HAL driver.

- NOR_WRITE : NOR memory write data to specified address

44.2.2 NOR Initialization and de_initialization functions

This section provides functions allowing to initialize/de-initialize the NOR memory

This section contains the following APIs:

- [***HAL_NOR_Init\(\)***](#)
- [***HAL_NOR_DeInit\(\)***](#)
- [***HAL_NOR_MspInit\(\)***](#)
- [***HAL_NOR_MspDeInit\(\)***](#)
- [***HAL_NOR_MspWait\(\)***](#)

44.2.3 NOR Input and Output functions

This section provides functions allowing to use and control the NOR memory

This section contains the following APIs:

- [HAL_NOR_Read_ID\(\)](#)
- [HAL_NOR_ReturnToReadMode\(\)](#)
- [HAL_NOR_Read\(\)](#)
- [HAL_NOR_Program\(\)](#)
- [HAL_NOR_ReadBuffer\(\)](#)
- [HAL_NOR_ProgramBuffer\(\)](#)
- [HAL_NOR_Erase_Block\(\)](#)
- [HAL_NOR_Erase_Chip\(\)](#)
- [HAL_NOR_Read_CFI\(\)](#)

44.2.4 NOR Control functions

This subsection provides a set of functions allowing to control dynamically the NOR interface.

This section contains the following APIs:

- [HAL_NOR_WriteOperation_Enable\(\)](#)
- [HAL_NOR_WriteOperation_Disable\(\)](#)

44.2.5 NOR State functions

This subsection permits to get in run-time the status of the NOR controller and the data flow.

This section contains the following APIs:

- [HAL_NOR_GetState\(\)](#)
- [HAL_NOR_GetStatus\(\)](#)

44.2.6 Detailed description of functions

HAL_NOR_Init

Function name	HAL_StatusTypeDef HAL_NOR_Init (NOR_HandleTypeDef * hnor, FMC_NORSRAM_TimingTypeDef * Timing, FMC_NORSRAM_TimingTypeDef * ExtTiming)
Function description	Perform the NOR memory Initialization sequence.
Parameters	<ul style="list-style-type: none"> • hnor: pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module. • Timing: pointer to NOR control timing structure • ExtTiming: pointer to NOR extended mode timing structure
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_NOR_DeInit

Function name	HAL_StatusTypeDef HAL_NOR_DeInit (NOR_HandleTypeDef * hnor)
Function description	Perform NOR memory De-Initialization sequence.

- | | |
|---------------|---|
| Parameters | <ul style="list-style-type: none"> • hnor: pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module. |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_NOR_Msplnit

- | | |
|----------------------|---|
| Function name | void HAL_NOR_Msplnit (NOR_HandleTypeDef * hnor) |
| Function description | NOR MSP Init. |
| Parameters | <ul style="list-style-type: none"> • hnor: pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module. |
| Return values | <ul style="list-style-type: none"> • None: |

HAL_NOR_MspDelnit

- | | |
|----------------------|---|
| Function name | void HAL_NOR_MspDelnit (NOR_HandleTypeDef * hnor) |
| Function description | NOR MSP Delnit. |
| Parameters | <ul style="list-style-type: none"> • hnor: pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module. |
| Return values | <ul style="list-style-type: none"> • None: |

HAL_NOR_MspWait

- | | |
|----------------------|--|
| Function name | void HAL_NOR_MspWait (NOR_HandleTypeDef * hnor, uint32_t Timeout) |
| Function description | NOR MSP Wait for Ready/Busy signal. |
| Parameters | <ul style="list-style-type: none"> • hnor: pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module. • Timeout: Maximum timeout value |
| Return values | <ul style="list-style-type: none"> • None: |

HAL_NOR_Read_ID

- | | |
|----------------------|--|
| Function name | HAL_StatusTypeDef HAL_NOR_Read_ID (NOR_HandleTypeDef * hnor, NOR_IDTypeDef * pNOR_ID) |
| Function description | Read NOR flash IDs. |
| Parameters | <ul style="list-style-type: none"> • hnor: pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module. • pNOR_ID: : pointer to NOR ID structure |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_NOR_ReturnToReadMode

- | | |
|----------------------|--|
| Function name | HAL_StatusTypeDef HAL_NOR_ReturnToReadMode (NOR_HandleTypeDef * hnor) |
| Function description | Returns the NOR memory to Read mode. |
| Parameters | <ul style="list-style-type: none"> • hnor: pointer to a NOR_HandleTypeDef structure that |

contains the configuration information for NOR module.

Return values

- **HAL:** status

HAL_NOR_Read

Function name **HAL_StatusTypeDef HAL_NOR_Read (NOR_HandleTypeDef * hnor, uint32_t * pAddress, uint16_t * pData)**

Function description Read data from NOR memory.

Parameters

- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
- **pAddress:** pointer to Device address
- **pData:** : pointer to read data

Return values

- **HAL:** status

HAL_NOR_Program

Function name **HAL_StatusTypeDef HAL_NOR_Program (NOR_HandleTypeDef * hnor, uint32_t * pAddress, uint16_t * pData)**

Function description Program data to NOR memory.

Parameters

- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
- **pAddress:** Device address
- **pData:** : pointer to the data to write

Return values

- **HAL:** status

HAL_NOR_ReadBuffer

Function name **HAL_StatusTypeDef HAL_NOR_ReadBuffer (NOR_HandleTypeDef * hnor, uint32_t uwAddress, uint16_t * pData, uint32_t uwBufferSize)**

Function description Reads a half-word buffer from the NOR memory.

Parameters

- **hnor:** pointer to the NOR handle
- **uwAddress:** NOR memory internal address to read from.
- **pData:** pointer to the buffer that receives the data read from the NOR memory.
- **uwBufferSize:** : number of Half word to read.

Return values

- **HAL:** status

HAL_NOR_ProgramBuffer

Function name **HAL_StatusTypeDef HAL_NOR_ProgramBuffer (NOR_HandleTypeDef * hnor, uint32_t uwAddress, uint16_t * pData, uint32_t uwBufferSize)**

Function description Writes a half-word buffer to the NOR memory.

Parameters

- **hnor:** pointer to the NOR handle
- **uwAddress:** NOR memory internal start write address

- **pData**: pointer to source data buffer.
 - **uwBufferSize**: Size of the buffer to write
- Return values
- **HAL**: status

HAL_NOR_Erase_Block

- Function name **HAL_StatusTypeDef HAL_NOR_Erase_Block (NOR_HandleTypeDef * hnor, uint32_t BlockAddress, uint32_t Address)**
- Function description Erase the specified block of the NOR memory.
- Parameters
- **hnor**: pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
 - **BlockAddress**: : Block to erase address
 - **Address**: Device address
- Return values
- **HAL**: status

HAL_NOR_Erase_Chip

- Function name **HAL_StatusTypeDef HAL_NOR_Erase_Chip (NOR_HandleTypeDef * hnor, uint32_t Address)**
- Function description Erase the entire NOR chip.
- Parameters
- **hnor**: pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
 - **Address**: : Device address
- Return values
- **HAL**: status

HAL_NOR_Read_CFI

- Function name **HAL_StatusTypeDef HAL_NOR_Read_CFI (NOR_HandleTypeDef * hnor, NOR_CFITypeDef * pNOR_CFI)**
- Function description Read NOR flash CFI IDs.
- Parameters
- **hnor**: pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
 - **pNOR_CFI**: : pointer to NOR CFI IDs structure
- Return values
- **HAL**: status

HAL_NOR_WriteOperation_Enable

- Function name **HAL_StatusTypeDef HAL_NOR_WriteOperation_Enable (NOR_HandleTypeDef * hnor)**
- Function description Enables dynamically NOR write operation.
- Parameters
- **hnor**: pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
- Return values
- **HAL**: status

HAL_NOR_WriteOperation_Disable

Function name	HAL_StatusTypeDef HAL_NOR_WriteOperation_Disable (NOR_HandleTypeDef * hnor)
Function description	Disables dynamically NOR write operation.
Parameters	<ul style="list-style-type: none"> • hnor: pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_NOR_GetState

Function name	HAL_NOR_StateTypeDef HAL_NOR_GetState (NOR_HandleTypeDef * hnor)
Function description	return the NOR controller state
Parameters	<ul style="list-style-type: none"> • hnor: pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
Return values	<ul style="list-style-type: none"> • NOR: controller state

HAL_NOR_GetStatus

Function name	HAL_NOR_StatusTypeDef HAL_NOR_GetStatus (NOR_HandleTypeDef * hnor, uint32_t Address, uint32_t Timeout)
Function description	Returns the NOR operation status.
Parameters	<ul style="list-style-type: none"> • hnor: pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module. • Address: Device address • Timeout: NOR programming Timeout
Return values	<ul style="list-style-type: none"> • NOR_Status: The returned value can be: HAL_NOR_STATUS_SUCCESS, HAL_NOR_STATUS_ERROR or HAL_NOR_STATUS_TIMEOUT

44.3 NOR Firmware driver defines**44.3.1 NOR*****NOR Exported Macros***

__HAL_NOR_RESET_HANDLE_STATE	Description:
	<ul style="list-style-type: none"> • Reset NOR handle state.
	Parameters:
	<ul style="list-style-type: none"> • __HANDLE__: specifies the NOR handle.
	Return value:
	<ul style="list-style-type: none"> • None

45 HAL PCD Generic Driver

45.1 PCD Firmware driver registers structures

45.1.1 PCD_HandleTypeDef

Data Fields

- *PCD_TypeDef * Instance*
- *PCD_InitTypeDef Init*
- *PCD_EPTypedef IN_ep*
- *PCD_EPTypedef OUT_ep*
- *HAL_LockTypeDef Lock*
- *__IO PCD_StateTypeDef State*
- *uint32_t Setup*
- *PCD_LPM_StateTypeDef LPM_State*
- *uint32_t BESL*
- *uint32_t lpm_active*
- *uint32_t battery_charging_active*
- *void * pData*

Field Documentation

- *PCD_TypeDef* PCD_HandleTypeDef::Instance*
Register base address
- *PCD_InitTypeDef PCD_HandleTypeDef::Init*
PCD required parameters
- *PCD_EPTypedef PCD_HandleTypeDef::IN_ep[16]*
IN endpoint parameters
- *PCD_EPTypedef PCD_HandleTypeDef::OUT_ep[16]*
OUT endpoint parameters
- *HAL_LockTypeDef PCD_HandleTypeDef::Lock*
PCD peripheral status
- *__IO PCD_StateTypeDef PCD_HandleTypeDef::State*
PCD communication state
- *uint32_t PCD_HandleTypeDef::Setup[12]*
Setup packet buffer
- *PCD_LPM_StateTypeDef PCD_HandleTypeDef::LPM_State*
LPM State
- *uint32_t PCD_HandleTypeDef::BESL*
- *uint32_t PCD_HandleTypeDef::lpm_active*
Enable or disable the Link Power Management . This parameter can be set to ENABLE or DISABLE
- *uint32_t PCD_HandleTypeDef::battery_charging_active*
Enable or disable Battery charging. This parameter can be set to ENABLE or DISABLE
- *void* PCD_HandleTypeDef::pData*
Pointer to upper stack Handler

45.2 PCD Firmware driver API description

45.2.1 How to use this driver

The PCD HAL driver can be used as follows:

1. Declare a PCD_HandleTypeDef handle structure, for example: PCD_HandleTypeDef hpcd;
2. Fill parameters of Init structure in HCD handle
3. Call HAL_PCD_Init() API to initialize the PCD peripheral (Core, Device core, ...)
4. Initialize the PCD low level resources through the HAL_PCD_MspInit() API:
 - a. Enable the PCD/USB Low Level interface clock using
 - __HAL_RCC_USB_OTG_FS_CLK_ENABLE();
 - __HAL_RCC_USB_OTG_HS_CLK_ENABLE(); (For High Speed Mode)
 - b. Initialize the related GPIO clocks
 - c. Configure PCD pin-out
 - d. Configure PCD NVIC interrupt
5. Associate the Upper USB device stack to the HAL PCD Driver:
 - a. hpcd.pData = pdev;
6. Enable PCD transmission and reception:
 - a. HAL_PCD_Start();

45.2.2 Initialization and de-initialization functions

This section provides functions allowing to:

This section contains the following APIs:

- [HAL_PCD_Init\(\)](#)
- [HAL_PCD_DeInit\(\)](#)
- [HAL_PCD_MspInit\(\)](#)
- [HAL_PCD_MspDeInit\(\)](#)

45.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the PCD data transfers.

This section contains the following APIs:

- [HAL_PCD_Start\(\)](#)
- [HAL_PCD_Stop\(\)](#)
- [HAL_PCD_IRQHandler\(\)](#)
- [HAL_PCD_DataOutStageCallback\(\)](#)
- [HAL_PCD_DataInStageCallback\(\)](#)
- [HAL_PCD_SetupStageCallback\(\)](#)
- [HAL_PCD_SOFCallback\(\)](#)
- [HAL_PCD_ResetCallback\(\)](#)
- [HAL_PCD_SuspendCallback\(\)](#)
- [HAL_PCD_ResumeCallback\(\)](#)
- [HAL_PCD_ISOOUTIncompleteCallback\(\)](#)
- [HAL_PCD_ISOINIncompleteCallback\(\)](#)
- [HAL_PCD_ConnectCallback\(\)](#)
- [HAL_PCD_DisconnectCallback\(\)](#)

45.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the PCD data transfers.

This section contains the following APIs:

- [HAL_PCD_DevConnect\(\)](#)
- [HAL_PCD_DevDisconnect\(\)](#)
- [HAL_PCD_SetAddress\(\)](#)
- [HAL_PCD_EP_Open\(\)](#)
- [HAL_PCD_EP_Close\(\)](#)
- [HAL_PCD_EP_Receive\(\)](#)
- [HAL_PCD_EP_GetRxCount\(\)](#)
- [HAL_PCD_EP_Transmit\(\)](#)
- [HAL_PCD_EP_SetStall\(\)](#)
- [HAL_PCD_EP_ClrStall\(\)](#)
- [HAL_PCD_EP_Flush\(\)](#)
- [HAL_PCD_ActivateRemoteWakeup\(\)](#)
- [HAL_PCD_DeActivateRemoteWakeup\(\)](#)

45.2.5 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- [HAL_PCD_GetState\(\)](#)

45.2.6 Detailed description of functions

HAL_PCD_Init

Function name	HAL_StatusTypeDef HAL_PCD_Init (PCD_HandleTypeDef * hpcd)
Function description	Initializes the PCD according to the specified parameters in the PCD_InitTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_PCD_DeInit

Function name	HAL_StatusTypeDef HAL_PCD_DeInit (PCD_HandleTypeDef * hpcd)
Function description	DeInitializes the PCD peripheral.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_PCD_Msplnit

Function name	void HAL_PCD_Msplnit (PCD_HandleTypeDef * hpcd)
Function description	Initializes the PCD MSP.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle
Return values	<ul style="list-style-type: none"> • None:

HAL_PCD_MspDeInit

Function name	void HAL_PCD_MspDeInit (PCD_HandleTypeDef * hpcd)
Function description	DeInitializes PCD MSP.
Parameters	<ul style="list-style-type: none">• hpcd: PCD handle
Return values	<ul style="list-style-type: none">• None:

HAL_PCD_Start

Function name	HAL_StatusTypeDef HAL_PCD_Start (PCD_HandleTypeDef * hpcd)
Function description	Start The USB OTG Device.
Parameters	<ul style="list-style-type: none">• hpcd: PCD handle
Return values	<ul style="list-style-type: none">• HAL: status

HAL_PCD_Stop

Function name	HAL_StatusTypeDef HAL_PCD_Stop (PCD_HandleTypeDef * hpcd)
Function description	Stop The USB OTG Device.
Parameters	<ul style="list-style-type: none">• hpcd: PCD handle
Return values	<ul style="list-style-type: none">• HAL: status

HAL_PCD_IRQHandler

Function name	void HAL_PCD_IRQHandler (PCD_HandleTypeDef * hpcd)
Function description	Handle PCD interrupt request.
Parameters	<ul style="list-style-type: none">• hpcd: PCD handle
Return values	<ul style="list-style-type: none">• HAL: status

HAL_PCD_DataOutStageCallback

Function name	void HAL_PCD_DataOutStageCallback (PCD_HandleTypeDef * hpcd, uint8_t epnum)
Function description	Data OUT stage callback.
Parameters	<ul style="list-style-type: none">• hpcd: PCD handle• epnum: endpoint number
Return values	<ul style="list-style-type: none">• None:

HAL_PCD_DataInStageCallback

Function name	void HAL_PCD_DataInStageCallback (PCD_HandleTypeDef * hpcd, uint8_t epnum)
Function description	Data IN stage callback.
Parameters	<ul style="list-style-type: none">• hpcd: PCD handle

- **epnum:** endpoint number
- Return values
- **None:**

HAL_PCD_SetupStageCallback

- Function name **void HAL_PCD_SetupStageCallback (PCD_HandleTypeDef * hpcd)**
- Function description Setup stage callback.
- Parameters • **hpcd:** PCD handle
- Return values • **None:**

HAL_PCD_SOFCallback

- Function name **void HAL_PCD_SOFCallback (PCD_HandleTypeDef * hpcd)**
- Function description USB Start Of Frame callback.
- Parameters • **hpcd:** PCD handle
- Return values • **None:**

HAL_PCD_ResetCallback

- Function name **void HAL_PCD_ResetCallback (PCD_HandleTypeDef * hpcd)**
- Function description USB Reset callback.
- Parameters • **hpcd:** PCD handle
- Return values • **None:**

HAL_PCD_SuspendCallback

- Function name **void HAL_PCD_SuspendCallback (PCD_HandleTypeDef * hpcd)**
- Function description Suspend event callback.
- Parameters • **hpcd:** PCD handle
- Return values • **None:**

HAL_PCD_ResumeCallback

- Function name **void HAL_PCD_ResumeCallback (PCD_HandleTypeDef * hpcd)**
- Function description Resume event callback.
- Parameters • **hpcd:** PCD handle
- Return values • **None:**

HAL_PCD_ISOOUTIncompleteCallback

- Function name **void HAL_PCD_ISOOUTIncompleteCallback (PCD_HandleTypeDef * hpcd, uint8_t epnum)**

Function description	Incomplete ISO OUT callback.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle • epnum: endpoint number
Return values	<ul style="list-style-type: none"> • None:

HAL_PCD_ISOINIncompleteCallback

Function name	void HAL_PCD_ISOINIncompleteCallback (PCD_HandleTypeDef * hpcd, uint8_t epnum)
Function description	Incomplete ISO IN callback.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle • epnum: endpoint number
Return values	<ul style="list-style-type: none"> • None:

HAL_PCD_ConnectCallback

Function name	void HAL_PCD_ConnectCallback (PCD_HandleTypeDef * hpcd)
Function description	Connection event callback.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle
Return values	<ul style="list-style-type: none"> • None:

HAL_PCD_DisconnectCallback

Function name	void HAL_PCD_DisconnectCallback (PCD_HandleTypeDef * hpcd)
Function description	Disconnection event callback.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle
Return values	<ul style="list-style-type: none"> • None:

HAL_PCD_DevConnect

Function name	HAL_StatusTypeDef HAL_PCD_DevConnect (PCD_HandleTypeDef * hpcd)
Function description	Connect the USB device.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_PCD_DevDisconnect

Function name	HAL_StatusTypeDef HAL_PCD_DevDisconnect (PCD_HandleTypeDef * hpcd)
Function description	Disconnect the USB device.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle

Return values

- **HAL:** status

HAL_PCD_SetAddress

Function name **HAL_StatusTypeDef HAL_PCD_SetAddress**
(PCD_HandleTypeDef * hpcd, uint8_t address)

Function description Set the USB Device address.

Parameters

- **hpcd:** PCD handle
- **address:** new device address

Return values

- **HAL:** status

HAL_PCD_EP_Open

Function name **HAL_StatusTypeDef HAL_PCD_EP_Open**
(PCD_HandleTypeDef * hpcd, uint8_t ep_addr, uint16_t ep_mps, uint8_t ep_type)

Function description Open and configure an endpoint.

Parameters

- **hpcd:** PCD handle
- **ep_addr:** endpoint address
- **ep_mps:** endpoint max packet size
- **ep_type:** endpoint type

Return values

- **HAL:** status

HAL_PCD_EP_Close

Function name **HAL_StatusTypeDef HAL_PCD_EP_Close**
(PCD_HandleTypeDef * hpcd, uint8_t ep_addr)

Function description Deactivate an endpoint.

Parameters

- **hpcd:** PCD handle
- **ep_addr:** endpoint address

Return values

- **HAL:** status

HAL_PCD_EP_Receive

Function name **HAL_StatusTypeDef HAL_PCD_EP_Receive**
(PCD_HandleTypeDef * hpcd, uint8_t ep_addr, uint8_t * pBuf, uint32_t len)

Function description Receive an amount of data.

Parameters

- **hpcd:** PCD handle
- **ep_addr:** endpoint address
- **pBuf:** pointer to the reception buffer
- **len:** amount of data to be received

Return values

- **HAL:** status

HAL_PCD_EP_Transmit

Function name **HAL_StatusTypeDef HAL_PCD_EP_Transmit**

(PCD_HandleTypeDef * hpcd, uint8_t ep_addr, uint8_t * pBuf, uint32_t len)

Function description	Send an amount of data.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle • ep_addr: endpoint address • pBuf: pointer to the transmission buffer • len: amount of data to be sent
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_PCD_EP_GetRxCount

Function name	uint16_t HAL_PCD_EP_GetRxCount (PCD_HandleTypeDef * hpcd, uint8_t ep_addr)
Function description	Get Received Data Size.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle • ep_addr: endpoint address
Return values	<ul style="list-style-type: none"> • Data: Size

HAL_PCD_EP_SetStall

Function name	HAL_StatusTypeDef HAL_PCD_EP_SetStall (PCD_HandleTypeDef * hpcd, uint8_t ep_addr)
Function description	Set a STALL condition over an endpoint.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle • ep_addr: endpoint address
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_PCD_EP_ClrStall

Function name	HAL_StatusTypeDef HAL_PCD_EP_ClrStall (PCD_HandleTypeDef * hpcd, uint8_t ep_addr)
Function description	Clear a STALL condition over in an endpoint.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle • ep_addr: endpoint address
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_PCD_EP_Flush

Function name	HAL_StatusTypeDef HAL_PCD_EP_Flush (PCD_HandleTypeDef * hpcd, uint8_t ep_addr)
Function description	Flush an endpoint.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle • ep_addr: endpoint address
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_PCD_ActivateRemoteWakeup

Function name	HAL_StatusTypeDef HAL_PCD_ActivateRemoteWakeup (PCD_HandleTypeDef * hpcd)
Function description	Activate remote wakeup signalling.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_PCD_DeActivateRemoteWakeup

Function name	HAL_StatusTypeDef HAL_PCD_DeActivateRemoteWakeup (PCD_HandleTypeDef * hpcd)
Function description	De-activate remote wakeup signalling.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_PCD_GetState

Function name	PCD_StateTypeDef HAL_PCD_GetState (PCD_HandleTypeDef * hpcd)
Function description	Return the PCD handle state.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle
Return values	<ul style="list-style-type: none"> • HAL: state

45.3 PCD Firmware driver defines**45.3.1 PCD*****PCD Exported Macros***

```

__HAL_PCD_ENABLE
__HAL_PCD_DISABLE
__HAL_PCD_GET_FLAG
__HAL_PCD_CLEAR_FLAG
__HAL_PCD_IS_INVALID_INTERRUPT
__HAL_PCD_UNGATE_PHYCLOCK
__HAL_PCD_GATE_PHYCLOCK
__HAL_PCD_IS_PHY_SUSPENDED
USB_OTG_FS_WAKEUP_EXTI_RISING_EDGE
USB_OTG_FS_WAKEUP_EXTI_FALLING_EDGE
USB_OTG_FS_WAKEUP_EXTI_RISING_FALLING_EDGE
USB_OTG_HS_WAKEUP_EXTI_RISING_EDGE
USB_OTG_HS_WAKEUP_EXTI_FALLING_EDGE

```

USB_OTG_HS_WAKEUP_EXTI_RISING_FALLING_EDGE
 USB_OTG_HS_WAKEUP_EXTI_LINE External interrupt line 20 Connected to the USB HS EXTI Line

 USB_OTG_FS_WAKEUP_EXTI_LINE External interrupt line 18 Connected to the USB FS EXTI Line

 __HAL_USB_OTG_HS_WAKEUP_EXTI_ENABLE_IT
 __HAL_USB_OTG_HS_WAKEUP_EXTI_DISABLE_IT
 __HAL_USB_OTG_HS_WAKEUP_EXTI_GET_FLAG
 __HAL_USB_OTG_HS_WAKEUP_EXTI_CLEAR_FLAG
 __HAL_USB_OTG_HS_WAKEUP_EXTI_ENABLE_RISING_EDGE
 __HAL_USB_OTG_HS_WAKEUP_EXTI_ENABLE_FALLING_EDGE
 __HAL_USB_OTG_HS_WAKEUP_EXTI_ENABLE_RISING_FALLING_EDGE
 __HAL_USB_OTG_HS_WAKEUP_EXTI_GENERATE_SWIT
 __HAL_USB_OTG_FS_WAKEUP_EXTI_ENABLE_IT
 __HAL_USB_OTG_FS_WAKEUP_EXTI_DISABLE_IT
 __HAL_USB_OTG_FS_WAKEUP_EXTI_GET_FLAG
 __HAL_USB_OTG_FS_WAKEUP_EXTI_CLEAR_FLAG
 __HAL_USB_OTG_FS_WAKEUP_EXTI_ENABLE_RISING_EDGE
 __HAL_USB_OTG_FS_WAKEUP_EXTI_ENABLE_FALLING_EDGE
 __HAL_USB_OTG_FS_WAKEUP_EXTI_ENABLE_RISING_FALLING_EDGE
 __HAL_USB_OTG_FS_WAKEUP_EXTI_GENERATE_SWIT

PCD Instance definition

IS_PCD_ALL_INSTANCE

PCD PHY Module

PCD_PHY_ULPI

PCD_PHY_EMBEDDED

PCD_PHY_UTMI

PCD Speed

PCD_SPEED_HIGH

PCD_SPEED_HIGH_IN_FULL

PCD_SPEED_FULL

Turnaround Timeout Value

USBD_HS_TRDT_VALUE

USBD_FS_TRDT_VALUE

46 HAL PCD Extension Driver

46.1 PCDEx Firmware driver API description

46.1.1 Extended features functions

This section provides functions allowing to:

- Update FIFO configuration

This section contains the following APIs:

- [HAL_PCDEx_SetTxFiFo\(\)](#)
- [HAL_PCDEx_SetRxFiFo\(\)](#)
- [HAL_PCDEx_ActivateLPM\(\)](#)
- [HAL_PCDEx_DeActivateLPM\(\)](#)
- [HAL_PCDEx_LPM_Callback\(\)](#)
- [HAL_PCDEx_ActivateBCD\(\)](#)
- [HAL_PCDEx_DeActivateBCD\(\)](#)
- [HAL_PCDEx_BCD_VBUSDetect\(\)](#)
- [HAL_PCDEx_BCD_Callback\(\)](#)

46.1.2 Detailed description of functions

HAL_PCDEx_SetTxFiFo

Function name	HAL_StatusTypeDef HAL_PCDEx_SetTxFiFo (PCD_HandleTypeDef * hpcd, uint8_t fifo, uint16_t size)
Function description	Set Tx FIFO.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle • fifo: The number of Tx fifo • size: Fifo size
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_PCDEx_SetRxFiFo

Function name	HAL_StatusTypeDef HAL_PCDEx_SetRxFiFo (PCD_HandleTypeDef * hpcd, uint16_t size)
Function description	Set Rx FIFO.
Parameters	<ul style="list-style-type: none"> • hpcd: PCD handle • size: Size of Rx fifo
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_PCDEx_ActivateLPM

Function name	HAL_StatusTypeDef HAL_PCDEx_ActivateLPM (PCD_HandleTypeDef * hpcd)
Function description	Activate LPM Feature.

- Parameters
- **hpcd**: PCD handle
- Return values
- **HAL**: status

HAL_PCDEx_DeActivateLPM

- Function name **HAL_StatusTypeDef HAL_PCDEx_DeActivateLPM (PCD_HandleTypeDef * hpcd)**
- Function description DeActivate LPM feature.
- Parameters
- **hpcd**: PCD handle
- Return values
- **HAL**: status

HAL_PCDEx_ActivateBCD

- Function name **HAL_StatusTypeDef HAL_PCDEx_ActivateBCD (PCD_HandleTypeDef * hpcd)**
- Function description

HAL_PCDEx_DeActivateBCD

- Function name **HAL_StatusTypeDef HAL_PCDEx_DeActivateBCD (PCD_HandleTypeDef * hpcd)**
- Function description

HAL_PCDEx_BCD_VBUSDetect

- Function name **void HAL_PCDEx_BCD_VBUSDetect (PCD_HandleTypeDef * hpcd)**
- Function description

HAL_PCDEx_LPM_Callback

- Function name **void HAL_PCDEx_LPM_Callback (PCD_HandleTypeDef * hpcd, PCD_LPM_MsgTypeDef msg)**
- Function description Send LPM message to user layer callback.
- Parameters
- **hpcd**: PCD handle
 - **msg**: LPM message
- Return values
- **HAL**: status

HAL_PCDEx_BCD_Callback

- Function name **void HAL_PCDEx_BCD_Callback (PCD_HandleTypeDef * hpcd, PCD_BCD_MsgTypeDef msg)**
- Function description

47 HAL PWR Generic Driver

47.1 PWR Firmware driver registers structures

47.1.1 PWR_PVDTypeDef

Data Fields

- *uint32_t PVDLevel*
- *uint32_t Mode*

Field Documentation

- *uint32_t PWR_PVDTypeDef::PVDLevel*
PVDLevel: Specifies the PVD detection level. This parameter can be a value of [PWR_PVD_detection_level](#)
- *uint32_t PWR_PVDTypeDef::Mode*
Mode: Specifies the operating mode for the selected pins. This parameter can be a value of [PWR_PVD_Mode](#)

47.2 PWR Firmware driver API description

47.2.1 Initialization and de-initialization functions

After reset, the backup domain (RTC registers, RTC backup data registers and backup SRAM) is protected against possible unwanted write accesses. To enable access to the RTC Domain and RTC registers, proceed as follows:

- Enable the Power Controller (PWR) APB1 interface clock using the `__HAL_RCC_PWR_CLK_ENABLE()` macro.
- Enable access to RTC domain using the `HAL_PWR_EnableBkUpAccess()` function.

This section contains the following APIs:

- [HAL_PWR_DeInit\(\)](#)
- [HAL_PWR_EnableBkUpAccess\(\)](#)
- [HAL_PWR_DisableBkUpAccess\(\)](#)

47.2.2 Peripheral Control functions

PVD configuration

- The PVD is used to monitor the VDD power supply by comparing it to a threshold selected by the PVD Level (PLS[2:0] bits in the PWR_CR).
- A PVDO flag is available to indicate if VDD/VDDA is higher or lower than the PVD threshold. This event is internally connected to the EXTI line16 and can generate an interrupt if enabled. This is done through `__HAL_PWR_PVD_EXTI_ENABLE_IT()` macro.
- The PVD is stopped in Standby mode.

Wake-up pin configuration

- Wake-up pin is used to wake up the system from Standby mode. This pin is forced in input pull-down configuration and is active on rising edges.
- There are up to 6 Wake-up pin in the STM32F7 devices family

Low Power modes configuration

The devices feature 3 low-power modes:

- Sleep mode: Cortex-M7 core stopped, peripherals kept running.
- Stop mode: all clocks are stopped, regulator running, regulator in low power mode
- Standby mode: 1.2V domain powered off.

Sleep mode

- Entry: The Sleep mode is entered by using the `HAL_PWR_EnterSLEEPMode(PWR_MAINREGULATOR_ON, PWR_SLEEPENTRY_WFI)` functions with
 - `PWR_SLEEPENTRY_WFI`: enter SLEEP mode with WFI instruction
 - `PWR_SLEEPENTRY_WFE`: enter SLEEP mode with WFE instruction The Regulator parameter is not used for the STM32F7 family and is kept as parameter just to maintain compatibility with the lower power families (STM32L).
- Exit: Any peripheral interrupt acknowledged by the nested vectored interrupt controller (NVIC) can wake up the device from Sleep mode.

Stop mode

In Stop mode, all clocks in the 1.2V domain are stopped, the PLL, the HSI, and the HSE RC oscillators are disabled. Internal SRAM and register contents are preserved. The voltage regulator can be configured either in normal or low-power mode. To minimize the consumption In Stop mode, FLASH can be powered off before entering the Stop mode using the `HAL_PWREx_EnableFlashPowerDown()` function. It can be switched on again by software after exiting the Stop mode using the `HAL_PWREx_DisableFlashPowerDown()` function.

- Entry: The Stop mode is entered using the `HAL_PWR_EnterSTOPMode(PWR_MAINREGULATOR_ON)` function with:
 - Main regulator ON.
 - Low Power regulator ON.
- Exit: Any EXTI Line (Internal or External) configured in Interrupt/Event mode.

Standby mode

- The Standby mode allows to achieve the lowest power consumption. It is based on the Cortex-M7 deep sleep mode, with the voltage regulator disabled. The 1.2V domain is consequently powered off. The PLL, the HSI oscillator and the HSE oscillator are also switched off. SRAM and register contents are lost except for the RTC registers, RTC backup registers, backup SRAM and Standby circuitry. The voltage regulator is OFF.
 - Entry:
 - The Standby mode is entered using the `HAL_PWR_EnterSTANDBYMode()` function.
 - Exit:
 - WKUP pin rising or falling edge, RTC alarm (Alarm A and Alarm B), RTC wakeup, tamper event, time stamp event, external reset in NRST pin, IWDG reset.

Auto-wakeup (AWU) from low-power mode

- The MCU can be woken up from low-power mode by an RTC Alarm event, an RTC Wakeup event, a tamper event or a time-stamp event, without depending on an external interrupt (Auto-wakeup mode).

- RTC auto-wakeup (AWU) from the Stop and Standby modes
 - To wake up from the Stop mode with an RTC alarm event, it is necessary to configure the RTC to generate the RTC alarm using the HAL_RTC_SetAlarm_IT() function.
 - To wake up from the Stop mode with an RTC Tamper or time stamp event, it is necessary to configure the RTC to detect the tamper or time stamp event using the HAL_RTCEx_SetTimeStamp_IT() or HAL_RTCEx_SetTamper_IT() functions.
 - To wake up from the Stop mode with an RTC WakeUp event, it is necessary to configure the RTC to generate the RTC WakeUp event using the HAL_RTCEx_SetWakeUpTimer_IT() function.

This section contains the following APIs:

- [HAL_PWR_ConfigPVD\(\)](#)
- [HAL_PWR_EnablePVD\(\)](#)
- [HAL_PWR_DisablePVD\(\)](#)
- [HAL_PWR_EnableWakeUpPin\(\)](#)
- [HAL_PWR_DisableWakeUpPin\(\)](#)
- [HAL_PWR_EnterSLEEPMode\(\)](#)
- [HAL_PWR_EnterSTOPMode\(\)](#)
- [HAL_PWR_EnterSTANDBYMode\(\)](#)
- [HAL_PWR_PVD_IRQHandler\(\)](#)
- [HAL_PWR_PVDCallback\(\)](#)
- [HAL_PWR_EnableSleepOnExit\(\)](#)
- [HAL_PWR_DisableSleepOnExit\(\)](#)
- [HAL_PWR_EnableSEVOnPend\(\)](#)
- [HAL_PWR_DisableSEVOnPend\(\)](#)

47.2.3 Detailed description of functions

HAL_PWR_DeInit

Function name	void HAL_PWR_DeInit (void)
Function description	Deinitializes the HAL PWR peripheral registers to their default reset values.
Return values	• None:

HAL_PWR_EnableBkUpAccess

Function name	void HAL_PWR_EnableBkUpAccess (void)
Function description	Enables access to the backup domain (RTC registers, RTC backup data registers and backup SRAM).
Return values	• None:
Notes	• If the HSE divided by 2, 3, ..31 is used as the RTC clock, the Backup Domain Access should be kept enabled.

HAL_PWR_DisableBkUpAccess

Function name	void HAL_PWR_DisableBkUpAccess (void)
Function description	Disables access to the backup domain (RTC registers, RTC backup data registers and backup SRAM).

- Return values
- **None:**
- Notes
- If the HSE divided by 2, 3, ..31 is used as the RTC clock, the Backup Domain Access should be kept enabled.

HAL_PWR_ConfigPVD

- Function name **void HAL_PWR_ConfigPVD (PWR_PVDTypeDef * sConfigPVD)**
- Function description Configures the voltage threshold detected by the Power Voltage Detector(PVD).
- Parameters
- **sConfigPVD:** pointer to an PWR_PVDTypeDef structure that contains the configuration information for the PVD.
- Return values
- **None:**
- Notes
- Refer to the electrical characteristics of your device datasheet for more details about the voltage threshold corresponding to each detection level.

HAL_PWR_EnablePVD

- Function name **void HAL_PWR_EnablePVD (void)**
- Function description Enables the Power Voltage Detector(PVD).
- Return values
- **None:**

HAL_PWR_DisablePVD

- Function name **void HAL_PWR_DisablePVD (void)**
- Function description Disables the Power Voltage Detector(PVD).
- Return values
- **None:**

HAL_PWR_EnableWakeUpPin

- Function name **void HAL_PWR_EnableWakeUpPin (uint32_t WakeUpPinPolarity)**
- Function description Enable the WakeUp PINx functionality.
- Parameters
- **WakeUpPinPolarity:** Specifies which Wake-Up pin to enable. This parameter can be one of the following legacy values, which sets the default polarity: detection on high level (rising edge):
 - PWR_WAKEUP_PIN1, PWR_WAKEUP_PIN2, PWR_WAKEUP_PIN3, PWR_WAKEUP_PIN4, PWR_WAKEUP_PIN5, PWR_WAKEUP_PIN6 or one of the following value where the user can explicitly states the enabled pin and the chosen polarity
 - PWR_WAKEUP_PIN1_HIGH or PWR_WAKEUP_PIN1_LOW
 - PWR_WAKEUP_PIN2_HIGH or PWR_WAKEUP_PIN2_LOW
 - PWR_WAKEUP_PIN3_HIGH or PWR_WAKEUP_PIN3_LOW

- PWR_WAKEUP_PIN4_HIGH or PWR_WAKEUP_PIN4_LOW
- PWR_WAKEUP_PIN5_HIGH or PWR_WAKEUP_PIN5_LOW
- PWR_WAKEUP_PIN6_HIGH or PWR_WAKEUP_PIN6_LOW

Return values

- **None:**

Notes

- PWR_WAKEUP_PINx and PWR_WAKEUP_PINx_HIGH are equivalent.

HAL_PWR_DisableWakeUpPin

Function name

void HAL_PWR_DisableWakeUpPin (uint32_t WakeUpPinx)

Function description

Disables the WakeUp PINx functionality.

Parameters

- **WakeUpPinx:** Specifies the Power Wake-Up pin to disable. This parameter can be one of the following values:
 - PWR_WAKEUP_PIN1
 - PWR_WAKEUP_PIN2
 - PWR_WAKEUP_PIN3
 - PWR_WAKEUP_PIN4
 - PWR_WAKEUP_PIN5
 - PWR_WAKEUP_PIN6

Return values

- **None:**

HAL_PWR_EnterSTOPMode

Function name

void HAL_PWR_EnterSTOPMode (uint32_t Regulator, uint8_t STOPEntry)

Function description

Enters Stop mode.

Parameters

- **Regulator:** Specifies the regulator state in Stop mode. This parameter can be one of the following values:
 - PWR_MAINREGULATOR_ON: Stop mode with regulator ON
 - PWR_LOWPOWERREGULATOR_ON: Stop mode with low power regulator ON
- **STOPEntry:** Specifies if Stop mode is entered with WFI or WFE instruction. This parameter can be one of the following values:
 - PWR_STOPENTRY_WFI: Enter Stop mode with WFI instruction
 - PWR_STOPENTRY_WFE: Enter Stop mode with WFE instruction

Return values

- **None:**

Notes

- In Stop mode, all I/O pins keep the same state as in Run mode.
- When exiting Stop mode by issuing an interrupt or a wakeup event, the HSI RC oscillator is selected as system clock.
- When the voltage regulator operates in low power mode, an additional startup delay is incurred when waking up from Stop

mode. By keeping the internal regulator ON during Stop mode, the consumption is higher although the startup time is reduced.

HAL_PWR_EnterSLEEPMode

Function name	void HAL_PWR_EnterSLEEPMode (uint32_t Regulator, uint8_t SLEEPEntry)
Function description	Enters Sleep mode.
Parameters	<ul style="list-style-type: none"> • Regulator: Specifies the regulator state in SLEEP mode. This parameter can be one of the following values: <ul style="list-style-type: none"> – PWR_MAINREGULATOR_ON: SLEEP mode with regulator ON – PWR_LOWPOWERREGULATOR_ON: SLEEP mode with low power regulator ON • SLEEPEntry: Specifies if SLEEP mode in entered with WFI or WFE instruction. This parameter can be one of the following values: <ul style="list-style-type: none"> – PWR_SLEEPENTRY_WFI: enter SLEEP mode with WFI instruction – PWR_SLEEPENTRY_WFE: enter SLEEP mode with WFE instruction
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • In Sleep mode, all I/O pins keep the same state as in Run mode. • In Sleep mode, the systick is stopped to avoid exit from this mode with systick interrupt when used as time base for Timeout • This parameter is not used for the STM32F7 family and is kept as parameter just to maintain compatibility with the lower power families.

HAL_PWR_EnterSTANDBYMode

Function name	void HAL_PWR_EnterSTANDBYMode (void)
Function description	Enters Standby mode.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • In Standby mode, all I/O pins are high impedance except for: Reset pad (still available)RTC_AF1 pin (PC13) if configured for tamper, time-stamp, RTC Alarm out, or RTC clock calibration out.RTC_AF2 pin (PI8) if configured for tamper or time-stamp.WKUP pins if enabled.

HAL_PWR_PVD_IRQHandler

Function name	void HAL_PWR_PVD_IRQHandler (void)
Function description	This function handles the PWR PVD interrupt request.
Return values	<ul style="list-style-type: none"> • None:



- Notes
- This API should be called under the PVD_IRQHandler().

HAL_PWR_PVDCallback

Function name **void HAL_PWR_PVDCallback (void)**

Function description PWR PVD interrupt callback.

Return values

- **None:**

HAL_PWR_EnableSleepOnExit

Function name **void HAL_PWR_EnableSleepOnExit (void)**

Function description Indicates Sleep-On-Exit when returning from Handler mode to Thread mode.

Return values

- **None:**

- Notes
- Set SLEEPONEXIT bit of SCR register. When this bit is set, the processor re-enters SLEEP mode when an interruption handling is over. Setting this bit is useful when the processor is expected to run only on interruptions handling.

HAL_PWR_DisableSleepOnExit

Function name **void HAL_PWR_DisableSleepOnExit (void)**

Function description Disables Sleep-On-Exit feature when returning from Handler mode to Thread mode.

Return values

- **None:**

- Notes
- Clears SLEEPONEXIT bit of SCR register. When this bit is set, the processor re-enters SLEEP mode when an interruption handling is over.

HAL_PWR_EnableSEVOnPend

Function name **void HAL_PWR_EnableSEVOnPend (void)**

Function description Enables CORTEX M4 SEVONPEND bit.

Return values

- **None:**

- Notes
- Sets SEVONPEND bit of SCR register. When this bit is set, this causes WFE to wake up when an interrupt moves from inactive to pended.

HAL_PWR_DisableSEVOnPend

Function name **void HAL_PWR_DisableSEVOnPend (void)**

Function description Disables CORTEX M4 SEVONPEND bit.

Return values

- **None:**

- Notes
- Clears SEVONPEND bit of SCR register. When this bit is set, this causes WFE to wake up when an interrupt moves from inactive to pended.

47.3 PWR Firmware driver defines

47.3.1 PWR

PWR Enable WUP Mask

PWR_EWUP_MASK

PWR Exported Macro

__HAL_PWR_VOLTAGESCALING_CONFIG

Description:

- macros configure the main internal regulator output voltage.

Parameters:

- __REGULATOR__: specifies the regulator output voltage to achieve a tradeoff between performance and power consumption when the device does not operate at the maximum frequency (refer to the datasheets for more details). This parameter can be one of the following values:
 - PWR_REGULATOR_VOLTAGE_SCALE1: Regulator voltage output Scale 1 mode
 - PWR_REGULATOR_VOLTAGE_SCALE2: Regulator voltage output Scale 2 mode
 - PWR_REGULATOR_VOLTAGE_SCALE3: Regulator voltage output Scale 3 mode

Return value:

- None

Description:

- Check PWR flag is set or not.

Parameters:

- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
 - PWR_FLAG_WU: Wake Up flag. This flag indicates that a wakeup event was received on the internal wakeup line in standby mode (RTC alarm (Alarm A or Alarm B), RTC Tamper event, RTC TimeStamp event or RTC Wakeup)).
 - PWR_FLAG_SB: StandBy flag. This flag indicates that the system was resumed from StandBy mode.
 - PWR_FLAG_PVDO: PVD

__HAL_PWR_GET_FLAG

Output. This flag is valid only if PVD is enabled by the HAL_PWR_EnablePVD() function. The PVD is stopped by Standby mode. For this reason, this bit is equal to 0 after Standby or reset until the PVDE bit is set.

- PWR_FLAG_BRR: Backup regulator ready flag. This bit is not reset when the device wakes up from Standby mode or by a system reset or power reset.
- PWR_FLAG_VOSRDY: This flag indicates that the Regulator voltage scaling output selection is ready.

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

Description:

- Clear the PWR's pending flags.

Parameters:

- __FLAG__: specifies the flag to clear. This parameter can be one of the following values:
 - PWR_FLAG_SB: StandBy flag

Description:

- Enable the PVD Exti Line 16.

Return value:

- None.

Description:

- Disable the PVD EXTI Line 16.

Return value:

- None.

Description:

- Enable event on PVD Exti Line 16.

Return value:

- None.

Description:

- Disable event on PVD Exti Line 16.

Return value:

__HAL_PWR_CLEAR_FLAG

__HAL_PWR_PVD_EXTI_ENABLE_IT

__HAL_PWR_PVD_EXTI_DISABLE_IT

__HAL_PWR_PVD_EXTI_ENABLE_EVENT

__HAL_PWR_PVD_EXTI_DISABLE_EVENT

<code>__HAL_PWR_PVD_EXTI_ENABLE_RISING_EDGE</code>	<ul style="list-style-type: none">• None. <p>Description:</p> <ul style="list-style-type: none">• Enable the PVD Extended Interrupt Rising Trigger. <p>Return value:</p> <ul style="list-style-type: none">• None.
<code>__HAL_PWR_PVD_EXTI_DISABLE_RISING_EDGE</code>	<p>Description:</p> <ul style="list-style-type: none">• Disable the PVD Extended Interrupt Rising Trigger. <p>Return value:</p> <ul style="list-style-type: none">• None.
<code>__HAL_PWR_PVD_EXTI_ENABLE_FALLING_EDGE</code>	<p>Description:</p> <ul style="list-style-type: none">• Enable the PVD Extended Interrupt Falling Trigger. <p>Return value:</p> <ul style="list-style-type: none">• None.
<code>__HAL_PWR_PVD_EXTI_DISABLE_FALLING_EDGE</code>	<p>Description:</p> <ul style="list-style-type: none">• Disable the PVD Extended Interrupt Falling Trigger. <p>Return value:</p> <ul style="list-style-type: none">• None.
<code>__HAL_PWR_PVD_EXTI_ENABLE_RISING_FALLING_EDGE</code>	<p>Description:</p> <ul style="list-style-type: none">• PVD EXTI line configuration: set rising & falling edge trigger. <p>Return value:</p> <ul style="list-style-type: none">• None.
<code>__HAL_PWR_PVD_EXTI_DISABLE_RISING_FALLING_EDGE</code>	<p>Description:</p> <ul style="list-style-type: none">• Disable the PVD Extended Interrupt Rising & Falling Trigger. <p>Return value:</p> <ul style="list-style-type: none">• None.
<code>__HAL_PWR_PVD_EXTI_GET_FLAG</code>	<p>Description:</p> <ul style="list-style-type: none">• checks whether the specified PVD Exti interrupt flag is set or not. <p>Return value:</p> <ul style="list-style-type: none">• EXTI: PVD Line Status.
<code>__HAL_PWR_PVD_EXTI_CLEAR_FLAG</code>	<p>Description:</p> <ul style="list-style-type: none">• Clear the PVD Exti flag.

`__HAL_PWR_PVD_EXTI_GENERATE_SWIT`

Return value:

- None.

Description:

- Generates a Software interrupt on PVD EXTI line.

Return value:

- None

PWR Flag

`PWR_FLAG_WU`

`PWR_FLAG_SB`

`PWR_FLAG_PVDO`

`PWR_FLAG_BRR`

`PWR_FLAG_VOSRDY`

PWR Private macros to check input parameters

`IS_PWR_PVD_LEVEL`

`IS_PWR_PVD_MODE`

`IS_PWR_REGULATOR`

`IS_PWR_SLEEP_ENTRY`

`IS_PWR_STOP_ENTRY`

`IS_PWR_REGULATOR_VOLTAGE`

PWR PVD detection level

`PWR_PVDLEVEL_0`

`PWR_PVDLEVEL_1`

`PWR_PVDLEVEL_2`

`PWR_PVDLEVEL_3`

`PWR_PVDLEVEL_4`

`PWR_PVDLEVEL_5`

`PWR_PVDLEVEL_6`

`PWR_PVDLEVEL_7`

PWR PVD EXTI Line

`PWR_EXTI_LINE_PVD` External interrupt line 16 Connected to the PVD EXTI Line

PWR PVD Mode

`PWR_PVD_MODE_NORMAL`

basic mode is used

`PWR_PVD_MODE_IT_RISING`

External Interrupt Mode with Rising edge trigger detection

`PWR_PVD_MODE_IT_FALLING`

External Interrupt Mode with Falling edge trigger detection

PWR_PVD_MODE_IT_RISING_FALLING	External Interrupt Mode with Rising/Falling edge trigger detection
PWR_PVD_MODE_EVENT_RISING	Event Mode with Rising edge trigger detection
PWR_PVD_MODE_EVENT_FALLING	Event Mode with Falling edge trigger detection
PWR_PVD_MODE_EVENT_RISING_FALLING	Event Mode with Rising/Falling edge trigger detection

PWR PVD Mode Mask

PVD_MODE_IT
PVD_MODE_EVT
PVD_RISING_EDGE
PVD_FALLING_EDGE

PWR Regulator state in SLEEP/STOP mode

PWR_MAINREGULATOR_ON
PWR_LOWPPOWERREGULATOR_ON

PWR Regulator Voltage Scale

PWR_REGULATOR_VOLTAGE_SCALE1
PWR_REGULATOR_VOLTAGE_SCALE2
PWR_REGULATOR_VOLTAGE_SCALE3

PWR SLEEP mode entry

PWR_SLEEPENTRY_WFI
PWR_SLEEPENTRY_WFE

PWR STOP mode entry

PWR_STOPENTRY_WFI
PWR_STOPENTRY_WFE

48 HAL PWR Extension Driver

48.1 PWREx Firmware driver API description

48.1.1 Peripheral extended features functions

Main and Backup Regulators configuration

- The backup domain includes 4 Kbytes of backup SRAM accessible only from the CPU, and address in 32-bit, 16-bit or 8-bit mode. Its content is retained even in Standby or VBAT mode when the low power backup regulator is enabled. It can be considered as an internal EEPROM when VBAT is always present. You can use the `HAL_PWREx_EnableBkUpReg()` function to enable the low power backup regulator.
- When the backup domain is supplied by VDD (analog switch connected to VDD) the backup SRAM is powered from VDD which replaces the VBAT power supply to save battery life.
- The backup SRAM is not mass erased by a tamper event. It is read protected to prevent confidential data, such as cryptographic private key, from being accessed. The backup SRAM can be erased only through the Flash interface when a protection level change from level 1 to level 0 is requested. Refer to the description of Read protection (RDP) in the Flash programming manual.
- The main internal regulator can be configured to have a tradeoff between performance and power consumption when the device does not operate at the maximum frequency. This is done through `__HAL_PWR_MAINREGULATORMODE_CONFIG()` macro which configure VOS bit in `PWR_CR` register Refer to the product datasheets for more details.

FLASH Power Down configuration

- By setting the `FPDS` bit in the `PWR_CR` register by using the `HAL_PWREx_EnableFlashPowerDown()` function, the Flash memory also enters power down mode when the device enters Stop mode. When the Flash memory is in power down mode, an additional startup delay is incurred when waking up from Stop mode.

Over-Drive and Under-Drive configuration

- In Run mode: the main regulator has 2 operating modes available:
 - Normal mode: The CPU and core logic operate at maximum frequency at a given voltage scaling (scale 1, scale 2 or scale 3)
 - Over-drive mode: This mode allows the CPU and the core logic to operate at a higher frequency than the normal mode for a given voltage scaling (scale 1, scale 2 or scale 3). This mode is enabled through `HAL_PWREx_EnableOverDrive()` function and disabled by `HAL_PWREx_DisableOverDrive()` function, to enter or exit from Over-drive mode please follow the sequence described in Reference manual.
- In Stop mode: the main regulator or low power regulator supplies a low power voltage to the 1.2V domain, thus preserving the content of registers and internal SRAM. 2 operating modes are available:
 - Normal mode: the 1.2V domain is preserved in nominal leakage mode. This mode is only available when the main regulator or the low power regulator is used in Scale 3 or low voltage mode.

- Under-drive mode: the 1.2V domain is preserved in reduced leakage mode. This mode is only available when the main regulator or the low power regulator is in low voltage mode.

This section contains the following APIs:

- [HAL_PWREx_EnableBkUpReg\(\)](#)
- [HAL_PWREx_DisableBkUpReg\(\)](#)
- [HAL_PWREx_EnableFlashPowerDown\(\)](#)
- [HAL_PWREx_DisableFlashPowerDown\(\)](#)
- [HAL_PWREx_EnableMainRegulatorLowVoltage\(\)](#)
- [HAL_PWREx_DisableMainRegulatorLowVoltage\(\)](#)
- [HAL_PWREx_EnableLowRegulatorLowVoltage\(\)](#)
- [HAL_PWREx_DisableLowRegulatorLowVoltage\(\)](#)
- [HAL_PWREx_EnableOverDrive\(\)](#)
- [HAL_PWREx_DisableOverDrive\(\)](#)
- [HAL_PWREx_EnterUnderDriveSTOPMode\(\)](#)
- [HAL_PWREx_GetVoltageRange\(\)](#)
- [HAL_PWREx_ControlVoltageScaling\(\)](#)

48.1.2 Detailed description of functions

HAL_PWREx_GetVoltageRange

Function name **uint32_t HAL_PWREx_GetVoltageRange (void)**

Function description
Returns Voltage Scaling Range.

Return values

- **VOS:** bit field (PWR_REGULATOR_VOLTAGE_SCALE1, PWR_REGULATOR_VOLTAGE_SCALE2 or PWR_REGULATOR_VOLTAGE_SCALE3)PWR_REGULATOR_VOLTAGE_SCALE1

HAL_PWREx_ControlVoltageScaling

Function name **HAL_StatusTypeDef HAL_PWREx_ControlVoltageScaling (uint32_t VoltageScaling)**

Function description Configures the main internal regulator output voltage.

Parameters

- **VoltageScaling:** specifies the regulator output voltage to achieve a tradeoff between performance and power consumption. This parameter can be one of the following values:
 - PWR_REGULATOR_VOLTAGE_SCALE1: Regulator voltage output range 1 mode, typical output voltage at 1.4 V, system frequency up to 216 MHz.
 - PWR_REGULATOR_VOLTAGE_SCALE2: Regulator voltage output range 2 mode, typical output voltage at 1.2 V, system frequency up to 180 MHz.
 - PWR_REGULATOR_VOLTAGE_SCALE3: Regulator voltage output range 2 mode, typical output voltage at 1.00 V, system frequency up to 151 MHz.

- Return values
- **HAL:** Status
- Notes
- To update the system clock frequency(SYSCLK): Set the HSI or HSE as system clock frequency using the HAL_RCC_ClockConfig(). Call the HAL_RCC_OscConfig() to configure the PLL. Call HAL_PWREx_ConfigVoltageScaling() API to adjust the voltage scale. Set the new system clock frequency using the HAL_RCC_ClockConfig().
 - The scale can be modified only when the HSI or HSE clock source is selected as system clock source, otherwise the API returns HAL_ERROR.
 - When the PLL is OFF, the voltage scale 3 is automatically selected and the VOS bits value in the PWR_CR1 register are not taken in account.
 - This API forces the PLL state ON to allow the possibility to configure the voltage scale 1 or 2.
 - The new voltage scale is active only when the PLL is ON.

HAL_PWREx_EnableFlashPowerDown

- Function name **void HAL_PWREx_EnableFlashPowerDown (void)**
- Function description Enables the Flash Power Down in Stop mode.
- Return values
- **None:**

HAL_PWREx_DisableFlashPowerDown

- Function name **void HAL_PWREx_DisableFlashPowerDown (void)**
- Function description Disables the Flash Power Down in Stop mode.
- Return values
- **None:**

HAL_PWREx_EnableBkUpReg

- Function name **HAL_StatusTypeDef HAL_PWREx_EnableBkUpReg (void)**
- Function description Enables the Backup Regulator.
- Return values
- **HAL:** status

HAL_PWREx_DisableBkUpReg

- Function name **HAL_StatusTypeDef HAL_PWREx_DisableBkUpReg (void)**
- Function description Disables the Backup Regulator.
- Return values
- **HAL:** status

HAL_PWREx_EnableMainRegulatorLowVoltage

- Function name **void HAL_PWREx_EnableMainRegulatorLowVoltage (void)**
- Function description Enables Main Regulator low voltage mode.
- Return values
- **None:**

HAL_PWREx_DisableMainRegulatorLowVoltage

Function name	void HAL_PWREx_DisableMainRegulatorLowVoltage (void)
Function description	Disables Main Regulator low voltage mode.
Return values	<ul style="list-style-type: none">• None:

HAL_PWREx_EnableLowRegulatorLowVoltage

Function name	void HAL_PWREx_EnableLowRegulatorLowVoltage (void)
Function description	Enables Low Power Regulator low voltage mode.
Return values	<ul style="list-style-type: none">• None:

HAL_PWREx_DisableLowRegulatorLowVoltage

Function name	void HAL_PWREx_DisableLowRegulatorLowVoltage (void)
Function description	Disables Low Power Regulator low voltage mode.
Return values	<ul style="list-style-type: none">• None:

HAL_PWREx_EnableOverDrive

Function name	HAL_StatusTypeDef HAL_PWREx_EnableOverDrive (void)
Function description	Activates the Over-Drive mode.
Return values	<ul style="list-style-type: none">• HAL: status
Notes	<ul style="list-style-type: none">• This mode allows the CPU and the core logic to operate at a higher frequency than the normal mode for a given voltage scaling (scale 1, scale 2 or scale 3).• It is recommended to enter or exit Over-drive mode when the application is not running critical tasks and when the system clock source is either HSI or HSE. During the Over-drive switch activation, no peripheral clocks should be enabled. The peripheral clocks must be enabled once the Over-drive mode is activated.

HAL_PWREx_DisableOverDrive

Function name	HAL_StatusTypeDef HAL_PWREx_DisableOverDrive (void)
Function description	Deactivates the Over-Drive mode.
Return values	<ul style="list-style-type: none">• HAL: status
Notes	<ul style="list-style-type: none">• This mode allows the CPU and the core logic to operate at a higher frequency than the normal mode for a given voltage scaling (scale 1, scale 2 or scale 3).• It is recommended to enter or exit Over-drive mode when the application is not running critical tasks and when the system clock source is either HSI or HSE. During the Over-drive switch activation, no peripheral clocks should be enabled. The peripheral clocks must be enabled once the Over-drive mode is activated.

HAL_PWREx_EnterUnderDriveSTOPMode

Function name	HAL_StatusTypeDef HAL_PWREx_EnterUnderDriveSTOPMode (uint32_t Regulator, uint8_t STOPEntry)
Function description	Enters in Under-Drive STOP mode.
Parameters	<ul style="list-style-type: none"> • Regulator: specifies the regulator state in STOP mode. This parameter can be one of the following values: <ul style="list-style-type: none"> – PWR_MAINREGULATOR_UNDERDRIVE_ON: Main Regulator in under-drive mode and Flash memory in power-down when the device is in Stop under-drive mode – PWR_LOWPOWERREGULATOR_UNDERDRIVE_ON: Low Power Regulator in under-drive mode and Flash memory in power-down when the device is in Stop under-drive mode • STOPEntry: specifies if STOP mode is entered with WFI or WFE instruction. This parameter can be one of the following values: <ul style="list-style-type: none"> – PWR_SLEEPENTRY_WFI: enter STOP mode with WFI instruction – PWR_SLEEPENTRY_WFE: enter STOP mode with WFE instruction
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This mode can be selected only when the Under-Drive is already active • This mode is enabled only with STOP low power mode. In this mode, the 1.2V domain is preserved in reduced leakage mode. This mode is only available when the main regulator or the low power regulator is in low voltage mode • If the Under-drive mode was enabled, it is automatically disabled after exiting Stop mode. When the voltage regulator operates in Under-drive mode, an additional startup delay is induced when waking up from Stop mode. • In Stop mode, all I/O pins keep the same state as in Run mode. • When exiting Stop mode by issuing an interrupt or a wakeup event, the HSI RC oscillator is selected as system clock. • When the voltage regulator operates in low power mode, an additional startup delay is incurred when waking up from Stop mode. By keeping the internal regulator ON during Stop mode, the consumption is higher although the startup time is reduced.

48.2 PWREx Firmware driver defines**48.2.1 PWREx***PWREx Exported Macro*

```

__HAL_PWR_OVERDRIVE_ENABLE
__HAL_PWR_OVERDRIVE_DISABLE
__HAL_PWR_OVERDRIVESWITCHING_ENABLE
__HAL_PWR_OVERDRIVESWITCHING_DISABLE

```

BLE

`__HAL_PWR_UNDERDRIVE_ENABLE`**Notes:**

- This mode is enabled only with STOP low power mode. In this mode, the 1.2V domain is preserved in reduced leakage mode. This mode is only available when the main regulator or the low power regulator is in low voltage mode. If the Under-drive mode was enabled, it is automatically disabled after exiting Stop mode. When the voltage regulator operates in Under-drive mode, an additional startup delay is induced when waking up from Stop mode.

`__HAL_PWR_UNDERDRIVE_DISABLE``__HAL_PWR_GET_ODRUDR_FLAG`**Description:**

- Check PWR flag is set or not.

Parameters:

- `__FLAG__`: specifies the flag to check. This parameter can be one of the following values:
 - `PWR_FLAG_ODRDY`: This flag indicates that the Over-drive mode is ready
 - `PWR_FLAG_ODSWRDY`: This flag indicates that the Over-drive mode switching is ready
 - `PWR_FLAG_UDRDY`: This flag indicates that the Under-drive mode is enabled in Stop mode

Return value:

- The: new state of `__FLAG__` (TRUE or FALSE).

`__HAL_PWR_CLEAR_ODRUDR_FLAG``__HAL_PWR_GET_WAKEUP_FLAG`**Description:**

- Check Wake Up flag is set or not.

Parameters:

- `__WUFLAG__`: specifies the Wake Up flag to check. This parameter can be one of the following values:
 - `PWR_WAKEUP_PIN_FLAG1`: Wakeup Pin Flag for PA0
 - `PWR_WAKEUP_PIN_FLAG2`: Wakeup Pin Flag for PA2

- PWR_WAKEUP_PIN_FLAG3: Wakeup Pin Flag for PC1
- PWR_WAKEUP_PIN_FLAG4: Wakeup Pin Flag for PC13
- PWR_WAKEUP_PIN_FLAG5: Wakeup Pin Flag for PI8
- PWR_WAKEUP_PIN_FLAG6: Wakeup Pin Flag for PI11

`__HAL_PWR_CLEAR_WAKEUP_FLAG`

Description:

- Clear the WakeUp pins flags.

Parameters:

- `__WUFLAG__`: specifies the Wake Up pin flag to clear. This parameter can be one of the following values:
 - PWR_WAKEUP_PIN_FLAG1: Wakeup Pin Flag for PA0
 - PWR_WAKEUP_PIN_FLAG2: Wakeup Pin Flag for PA2
 - PWR_WAKEUP_PIN_FLAG3: Wakeup Pin Flag for PC1
 - PWR_WAKEUP_PIN_FLAG4: Wakeup Pin Flag for PC13
 - PWR_WAKEUP_PIN_FLAG5: Wakeup Pin Flag for PI8
 - PWR_WAKEUP_PIN_FLAG6: Wakeup Pin Flag for PI11

PWREx Private macros to check input parameters

`IS_PWR_REGULATOR_UNDERDRIVE`

`IS_PWR_WAKEUP_PIN`

PWREx Over Under Drive Flag

`PWR_FLAG_ODRDY`

`PWR_FLAG_ODSWRDY`

`PWR_FLAG_UDRDY`

PWREx Regulator state in UnderDrive mode

`PWR_MAINREGULATOR_UNDERDRIVE_ON`

`PWR_LOWPOWERREGULATOR_UNDERDRIVE_ON`

PWREx Wake Up Pins

`PWR_WAKEUP_PIN1`

`PWR_WAKEUP_PIN2`

`PWR_WAKEUP_PIN3`

`PWR_WAKEUP_PIN4`

`PWR_WAKEUP_PIN5`

`PWR_WAKEUP_PIN6`

PWR_WAKEUP_PIN1_HIGH

PWR_WAKEUP_PIN2_HIGH

PWR_WAKEUP_PIN3_HIGH

PWR_WAKEUP_PIN4_HIGH

PWR_WAKEUP_PIN5_HIGH

PWR_WAKEUP_PIN6_HIGH

PWR_WAKEUP_PIN1_LOW

PWR_WAKEUP_PIN2_LOW

PWR_WAKEUP_PIN3_LOW

PWR_WAKEUP_PIN4_LOW

PWR_WAKEUP_PIN5_LOW

PWR_WAKEUP_PIN6_LOW

PWREx Wake Up Pin Flags

PWR_WAKEUP_PIN_FLAG1

PWR_WAKEUP_PIN_FLAG2

PWR_WAKEUP_PIN_FLAG3

PWR_WAKEUP_PIN_FLAG4

PWR_WAKEUP_PIN_FLAG5

PWR_WAKEUP_PIN_FLAG6

49 HAL QSPI Generic Driver

49.1 QSPI Firmware driver registers structures

49.1.1 QSPI_InitTypeDef

Data Fields

- *uint32_t* *ClockPrescaler*
- *uint32_t* *FifoThreshold*
- *uint32_t* *SampleShifting*
- *uint32_t* *FlashSize*
- *uint32_t* *ChipSelectHighTime*
- *uint32_t* *ClockMode*
- *uint32_t* *FlashID*
- *uint32_t* *DualFlash*

Field Documentation

- *uint32_t* *QSPI_InitTypeDef::ClockPrescaler*
- *uint32_t* *QSPI_InitTypeDef::FifoThreshold*
- *uint32_t* *QSPI_InitTypeDef::SampleShifting*
- *uint32_t* *QSPI_InitTypeDef::FlashSize*
- *uint32_t* *QSPI_InitTypeDef::ChipSelectHighTime*
- *uint32_t* *QSPI_InitTypeDef::ClockMode*
- *uint32_t* *QSPI_InitTypeDef::FlashID*
- *uint32_t* *QSPI_InitTypeDef::DualFlash*

49.1.2 QSPI_HandleTypeDef

Data Fields

- *QUADSPI_TypeDef * Instance*
- *QSPI_InitTypeDef Init*
- *uint8_t * pTxBuffPtr*
- *__IO uint32_t TxXferSize*
- *__IO uint32_t TxXferCount*
- *uint8_t * pRxBuffPtr*
- *__IO uint32_t RxXferSize*
- *__IO uint32_t RxXferCount*
- *DMA_HandleTypeDef * hdma*
- *__IO HAL_LockTypeDef Lock*
- *__IO HAL_QSPI_StateTypeDef State*
- *__IO uint32_t ErrorCode*
- *uint32_t Timeout*

Field Documentation

- *QUADSPI_TypeDef* QSPI_HandleTypeDef::Instance*
- *QSPI_InitTypeDef QSPI_HandleTypeDef::Init*
- *uint8_t* QSPI_HandleTypeDef::pTxBuffPtr*
- *__IO uint32_t QSPI_HandleTypeDef::TxXferSize*
- *__IO uint32_t QSPI_HandleTypeDef::TxXferCount*
- *uint8_t* QSPI_HandleTypeDef::pRxBuffPtr*

- *__IO uint32_t QSPI_HandleTypeDef::RxXferSize*
- *__IO uint32_t QSPI_HandleTypeDef::RxXferCount*
- *DMA_HandleTypeDef* QSPI_HandleTypeDef::hdma*
- *__IO HAL_LockTypeDef QSPI_HandleTypeDef::Lock*
- *__IO HAL_QSPI_StateTypeDef QSPI_HandleTypeDef::State*
- *__IO uint32_t QSPI_HandleTypeDef::ErrorCode*
- *uint32_t QSPI_HandleTypeDef::Timeout*

49.1.3 QSPI_CommandTypeDef

Data Fields

- *uint32_t Instruction*
- *uint32_t Address*
- *uint32_t AlternateBytes*
- *uint32_t AddressSize*
- *uint32_t AlternateBytesSize*
- *uint32_t DummyCycles*
- *uint32_t InstructionMode*
- *uint32_t AddressMode*
- *uint32_t AlternateByteMode*
- *uint32_t DataMode*
- *uint32_t NbData*
- *uint32_t DdrMode*
- *uint32_t DdrHoldHalfCycle*
- *uint32_t SIOOMode*

Field Documentation

- *uint32_t QSPI_CommandTypeDef::Instruction*
- *uint32_t QSPI_CommandTypeDef::Address*
- *uint32_t QSPI_CommandTypeDef::AlternateBytes*
- *uint32_t QSPI_CommandTypeDef::AddressSize*
- *uint32_t QSPI_CommandTypeDef::AlternateBytesSize*
- *uint32_t QSPI_CommandTypeDef::DummyCycles*
- *uint32_t QSPI_CommandTypeDef::InstructionMode*
- *uint32_t QSPI_CommandTypeDef::AddressMode*
- *uint32_t QSPI_CommandTypeDef::AlternateByteMode*
- *uint32_t QSPI_CommandTypeDef::DataMode*
- *uint32_t QSPI_CommandTypeDef::NbData*
- *uint32_t QSPI_CommandTypeDef::DdrMode*
- *uint32_t QSPI_CommandTypeDef::DdrHoldHalfCycle*
- *uint32_t QSPI_CommandTypeDef::SIOOMode*

49.1.4 QSPI_AutoPollingTypeDef

Data Fields

- *uint32_t Match*
- *uint32_t Mask*
- *uint32_t Interval*
- *uint32_t StatusBytesSize*
- *uint32_t MatchMode*
- *uint32_t AutomaticStop*

Field Documentation

- *uint32_t* *QSPI_AutoPollingTypeDef::Match*
- *uint32_t* *QSPI_AutoPollingTypeDef::Mask*
- *uint32_t* *QSPI_AutoPollingTypeDef::Interval*
- *uint32_t* *QSPI_AutoPollingTypeDef::StatusBytesSize*
- *uint32_t* *QSPI_AutoPollingTypeDef::MatchMode*
- *uint32_t* *QSPI_AutoPollingTypeDef::AutomaticStop*

49.1.5 QSPI_MemoryMappedTypeDef

Data Fields

- *uint32_t* *TimeOutPeriod*
- *uint32_t* *TimeOutActivation*

Field Documentation

- *uint32_t* *QSPI_MemoryMappedTypeDef::TimeOutPeriod*
- *uint32_t* *QSPI_MemoryMappedTypeDef::TimeOutActivation*

49.2 QSPI Firmware driver API description

49.2.1 How to use this driver

Initialization

1. As prerequisite, fill in the *HAL_QSPI_MspInit()* :
 - Enable QuadSPI clock interface with *__HAL_RCC_QSPI_CLK_ENABLE()*.
 - Reset QuadSPI IP with *__HAL_RCC_QSPI_FORCE_RESET()* and *__HAL_RCC_QSPI_RELEASE_RESET()*.
 - Enable the clocks for the QuadSPI GPIOs with *__HAL_RCC_GPIOx_CLK_ENABLE()*.
 - Configure these QuadSPI pins in alternate mode using *HAL_GPIO_Init()*.
 - If interrupt mode is used, enable and configure QuadSPI global interrupt with *HAL_NVIC_SetPriority()* and *HAL_NVIC_EnableIRQ()*.
 - If DMA mode is used, enable the clocks for the QuadSPI DMA channel with *__HAL_RCC_DMAx_CLK_ENABLE()*, configure DMA with *HAL_DMA_Init()*, link it with QuadSPI handle using *__HAL_LINKDMA()*, enable and configure DMA channel global interrupt with *HAL_NVIC_SetPriority()* and *HAL_NVIC_EnableIRQ()*.
2. Configure the flash size, the clock prescaler, the fifo threshold, the clock mode, the sample shifting and the CS high time using the *HAL_QSPI_Init()* function.

Indirect functional mode

1. Configure the command sequence using the *HAL_QSPI_Command()* or *HAL_QSPI_Command_IT()* functions :
 - Instruction phase : the mode used and if present the instruction opcode.
 - Address phase : the mode used and if present the size and the address value.
 - Alternate-bytes phase : the mode used and if present the size and the alternate bytes values.
 - Dummy-cycles phase : the number of dummy cycles (mode used is same as data phase).
 - Data phase : the mode used and if present the number of bytes.
 - Double Data Rate (DDR) mode : the activation (or not) of this mode and the delay if activated.

- Sending Instruction Only Once (SIOO) mode : the activation (or not) of this mode.
- 2. If no data is required for the command, it is sent directly to the memory :
 - In polling mode, the output of the function is done when the transfer is complete.
 - In interrupt mode, HAL_QSPI_CmdCpltCallback() will be called when the transfer is complete.
- 3. For the indirect write mode, use HAL_QSPI_Transmit(), HAL_QSPI_Transmit_DMA() or HAL_QSPI_Transmit_IT() after the command configuration :
 - In polling mode, the output of the function is done when the transfer is complete.
 - In interrupt mode, HAL_QSPI_FifoThresholdCallback() will be called when the fifo threshold is reached and HAL_QSPI_TxCpltCallback() will be called when the transfer is complete.
 - In DMA mode, HAL_QSPI_TxHalfCpltCallback() will be called at the half transfer and HAL_QSPI_TxCpltCallback() will be called when the transfer is complete.
- 4. For the indirect read mode, use HAL_QSPI_Receive(), HAL_QSPI_Receive_DMA() or HAL_QSPI_Receive_IT() after the command configuration :
 - In polling mode, the output of the function is done when the transfer is complete.
 - In interrupt mode, HAL_QSPI_FifoThresholdCallback() will be called when the fifo threshold is reached and HAL_QSPI_RxCpltCallback() will be called when the transfer is complete.
 - In DMA mode, HAL_QSPI_RxHalfCpltCallback() will be called at the half transfer and HAL_QSPI_RxCpltCallback() will be called when the transfer is complete.

Auto-polling functional mode

1. Configure the command sequence and the auto-polling functional mode using the HAL_QSPI_AutoPolling() or HAL_QSPI_AutoPolling_IT() functions :
 - Instruction phase : the mode used and if present the instruction opcode.
 - Address phase : the mode used and if present the size and the address value.
 - Alternate-bytes phase : the mode used and if present the size and the alternate bytes values.
 - Dummy-cycles phase : the number of dummy cycles (mode used is same as data phase).
 - Data phase : the mode used.
 - Double Data Rate (DDR) mode : the activation (or not) of this mode and the delay if activated.
 - Sending Instruction Only Once (SIOO) mode : the activation (or not) of this mode.
 - The size of the status bytes, the match value, the mask used, the match mode (OR/AND), the polling interval and the automatic stop activation.
2. After the configuration :
 - In polling mode, the output of the function is done when the status match is reached. The automatic stop is activated to avoid an infinite loop.
 - In interrupt mode, HAL_QSPI_StatusMatchCallback() will be called each time the status match is reached.

Memory-mapped functional mode

1. Configure the command sequence and the memory-mapped functional mode using the HAL_QSPI_MemoryMapped() functions :
 - Instruction phase : the mode used and if present the instruction opcode.
 - Address phase : the mode used and the size.
 - Alternate-bytes phase : the mode used and if present the size and the alternate bytes values.
 - Dummy-cycles phase : the number of dummy cycles (mode used is same as data phase).
 - Data phase : the mode used.

- Double Data Rate (DDR) mode : the activation (or not) of this mode and the delay if activated.
 - Sending Instruction Only Once (SIOO) mode : the activation (or not) of this mode.
 - The timeout activation and the timeout period.
2. After the configuration, the QuadSPI will be used as soon as an access on the AHB is done on the address range. HAL_QSPI_TimeOutCallback() will be called when the timeout expires.

Errors management and abort functionality

1. HAL_QSPI_GetError() function gives the error raised during the last operation.
2. HAL_QSPI_Abort() and HAL_QSPI_AbortIT() functions aborts any on-going operation and flushes the fifo :
 - In polling mode, the output of the function is done when the transfer complete bit is set and the busy bit cleared.
 - In interrupt mode, HAL_QSPI_AbortCpltCallback() will be called when the transfer complete bit is set.

Control functions

1. HAL_QSPI_GetState() function gives the current state of the HAL QuadSPI driver.
2. HAL_QSPI_SetTimeout() function configures the timeout value used in the driver.
3. HAL_QSPI_SetFifoThreshold() function configures the threshold on the Fifo of the QSPI IP.
4. HAL_QSPI_GetFifoThreshold() function gives the current of the Fifo's threshold

Workarounds linked to Silicon Limitation

1. Workarounds Implemented inside HAL Driver
 - Extra data written in the FIFO at the end of a read transfer

49.2.2 Initialization and Configuration functions

This subsection provides a set of functions allowing to :

- Initialize the QuadSPI.
- De-initialize the QuadSPI.

This section contains the following APIs:

- [HAL_QSPI_Init\(\)](#)
- [HAL_QSPI_DeInit\(\)](#)
- [HAL_QSPI_MspInit\(\)](#)
- [HAL_QSPI_MspDeInit\(\)](#)

49.2.3 IO operation functions

This subsection provides a set of functions allowing to :

- Handle the interrupts.
- Handle the command sequence.
- Transmit data in blocking, interrupt or DMA mode.
- Receive data in blocking, interrupt or DMA mode.
- Manage the auto-polling functional mode.
- Manage the memory-mapped functional mode.

This section contains the following APIs:

- [HAL_QSPI_IRQHandler\(\)](#)

- [HAL_QSPI_Command\(\)](#)
- [HAL_QSPI_Command_IT\(\)](#)
- [HAL_QSPI_Transmit\(\)](#)
- [HAL_QSPI_Receive\(\)](#)
- [HAL_QSPI_Transmit_IT\(\)](#)
- [HAL_QSPI_Receive_IT\(\)](#)
- [HAL_QSPI_Transmit_DMA\(\)](#)
- [HAL_QSPI_Receive_DMA\(\)](#)
- [HAL_QSPI_AutoPolling\(\)](#)
- [HAL_QSPI_AutoPolling_IT\(\)](#)
- [HAL_QSPI_MemoryMapped\(\)](#)
- [HAL_QSPI_ErrorCallback\(\)](#)
- [HAL_QSPI_AbortCpltCallback\(\)](#)
- [HAL_QSPI_CmdCpltCallback\(\)](#)
- [HAL_QSPI_RxCpltCallback\(\)](#)
- [HAL_QSPI_TxCpltCallback\(\)](#)
- [HAL_QSPI_RxHalfCpltCallback\(\)](#)
- [HAL_QSPI_TxHalfCpltCallback\(\)](#)
- [HAL_QSPI_FifoThresholdCallback\(\)](#)
- [HAL_QSPI_StatusMatchCallback\(\)](#)
- [HAL_QSPI_TimeOutCallback\(\)](#)

49.2.4 Peripheral Control and State functions

This subsection provides a set of functions allowing to :

- Check in run-time the state of the driver.
- Check the error code set during last operation.
- Abort any operation.

This section contains the following APIs:

- [HAL_QSPI_GetState\(\)](#)
- [HAL_QSPI_GetError\(\)](#)
- [HAL_QSPI_Abort\(\)](#)
- [HAL_QSPI_Abort_IT\(\)](#)
- [HAL_QSPI_SetTimeout\(\)](#)
- [HAL_QSPI_SetFifoThreshold\(\)](#)
- [HAL_QSPI_GetFifoThreshold\(\)](#)
- [HAL_QSPI_ErrorCallback\(\)](#)
- [HAL_QSPI_AbortCpltCallback\(\)](#)
- [HAL_QSPI_FifoThresholdCallback\(\)](#)
- [HAL_QSPI_CmdCpltCallback\(\)](#)
- [HAL_QSPI_RxCpltCallback\(\)](#)
- [HAL_QSPI_TxCpltCallback\(\)](#)
- [HAL_QSPI_RxHalfCpltCallback\(\)](#)
- [HAL_QSPI_TxHalfCpltCallback\(\)](#)
- [HAL_QSPI_StatusMatchCallback\(\)](#)
- [HAL_QSPI_TimeOutCallback\(\)](#)

49.2.5 Detailed description of functions

HAL_QSPI_Init

Function name HAL_StatusTypeDef HAL_QSPI_Init (QSPI_HandleTypeDef *)

hqspi)

Function description	Initializes the QSPI mode according to the specified parameters in the QSPI_InitTypeDef and creates the associated handle.
Parameters	<ul style="list-style-type: none"> • hqspi: qspi handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_QSPI_DeInit

Function name	HAL_StatusTypeDef HAL_QSPI_DeInit (QSPI_HandleTypeDef * hqspi)
Function description	DeInitializes the QSPI peripheral.
Parameters	<ul style="list-style-type: none"> • hqspi: qspi handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_QSPI_MspInit

Function name	void HAL_QSPI_MspInit (QSPI_HandleTypeDef * hqspi)
Function description	QSPI MSP Init.
Parameters	<ul style="list-style-type: none"> • hqspi: QSPI handle
Return values	<ul style="list-style-type: none"> • None:

HAL_QSPI_MspDeInit

Function name	void HAL_QSPI_MspDeInit (QSPI_HandleTypeDef * hqspi)
Function description	QSPI MSP DeInit.
Parameters	<ul style="list-style-type: none"> • hqspi: QSPI handle
Return values	<ul style="list-style-type: none"> • None:

HAL_QSPI_IRQHandler

Function name	void HAL_QSPI_IRQHandler (QSPI_HandleTypeDef * hqspi)
Function description	This function handles QSPI interrupt request.
Parameters	<ul style="list-style-type: none"> • hqspi: QSPI handle
Return values	<ul style="list-style-type: none"> • None.:

HAL_QSPI_Command

Function name	HAL_StatusTypeDef HAL_QSPI_Command (QSPI_HandleTypeDef * hqspi, QSPI_CommandTypeDef * cmd, uint32_t Timeout)
Function description	Sets the command configuration.
Parameters	<ul style="list-style-type: none"> • hqspi: QSPI handle • cmd: : structure that contains the command configuration information

- **Timeout:** : Time out duration
- Return values
- **HAL:** status
- Notes
- This function is used only in Indirect Read or Write Modes

HAL_QSPI_Transmit

- Function name **HAL_StatusTypeDef HAL_QSPI_Transmit (QSPI_HandleTypeDef * hqspi, uint8_t * pData, uint32_t Timeout)**
- Function description Transmit an amount of data in blocking mode.
- Parameters
- **hqspi:** QSPI handle
 - **pData:** pointer to data buffer
 - **Timeout:** : Time out duration
- Return values
- **HAL:** status
- Notes
- This function is used only in Indirect Write Mode

HAL_QSPI_Receive

- Function name **HAL_StatusTypeDef HAL_QSPI_Receive (QSPI_HandleTypeDef * hqspi, uint8_t * pData, uint32_t Timeout)**
- Function description Receive an amount of data in blocking mode.
- Parameters
- **hqspi:** QSPI handle
 - **pData:** pointer to data buffer
 - **Timeout:** : Time out duration
- Return values
- **HAL:** status
- Notes
- This function is used only in Indirect Read Mode

HAL_QSPI_Command_IT

- Function name **HAL_StatusTypeDef HAL_QSPI_Command_IT (QSPI_HandleTypeDef * hqspi, QSPI_CommandTypeDef * cmd)**
- Function description Sets the command configuration in interrupt mode.
- Parameters
- **hqspi:** QSPI handle
 - **cmd:** : structure that contains the command configuration information
- Return values
- **HAL:** status
- Notes
- This function is used only in Indirect Read or Write Modes

HAL_QSPI_Transmit_IT

- Function name **HAL_StatusTypeDef HAL_QSPI_Transmit_IT (QSPI_HandleTypeDef * hqspi, uint8_t * pData)**
- Function description Send an amount of data in interrupt mode.

Parameters	<ul style="list-style-type: none"> • hqspi: QSPI handle • pData: pointer to data buffer
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function is used only in Indirect Write Mode

HAL_QSPI_Receive_IT

Function name	HAL_StatusTypeDef HAL_QSPI_Receive_IT (QSPI_HandleTypeDef * hqspi, uint8_t * pData)
Function description	Receive an amount of data in no-blocking mode with Interrupt.
Parameters	<ul style="list-style-type: none"> • hqspi: QSPI handle • pData: pointer to data buffer
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function is used only in Indirect Read Mode

HAL_QSPI_Transmit_DMA

Function name	HAL_StatusTypeDef HAL_QSPI_Transmit_DMA (QSPI_HandleTypeDef * hqspi, uint8_t * pData)
Function description	Sends an amount of data in non blocking mode with DMA.
Parameters	<ul style="list-style-type: none"> • hqspi: QSPI handle • pData: pointer to data buffer
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function is used only in Indirect Write Mode • If DMA peripheral access is configured as halfword, the number of data and the fifo threshold should be aligned on halfword • If DMA peripheral access is configured as word, the number of data and the fifo threshold should be aligned on word

HAL_QSPI_Receive_DMA

Function name	HAL_StatusTypeDef HAL_QSPI_Receive_DMA (QSPI_HandleTypeDef * hqspi, uint8_t * pData)
Function description	Receives an amount of data in non blocking mode with DMA.
Parameters	<ul style="list-style-type: none"> • hqspi: QSPI handle • pData: pointer to data buffer.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function is used only in Indirect Read Mode • If DMA peripheral access is configured as halfword, the number of data and the fifo threshold should be aligned on halfword • If DMA peripheral access is configured as word, the number of data and the fifo threshold should be aligned on word

HAL_QSPI_AutoPolling

Function name	HAL_StatusTypeDef HAL_QSPI_AutoPolling (QSPI_HandleTypeDef * hqspi, QSPI_CommandTypeDef * cmd, QSPI_AutoPollingTypeDef * cfg, uint32_t Timeout)
Function description	Configure the QSPI Automatic Polling Mode in blocking mode.
Parameters	<ul style="list-style-type: none">• hqspi: QSPI handle• cmd: structure that contains the command configuration information.• cfg: structure that contains the polling configuration information.• Timeout: : Time out duration
Return values	<ul style="list-style-type: none">• HAL: status
Notes	<ul style="list-style-type: none">• This function is used only in Automatic Polling Mode

HAL_QSPI_AutoPolling_IT

Function name	HAL_StatusTypeDef HAL_QSPI_AutoPolling_IT (QSPI_HandleTypeDef * hqspi, QSPI_CommandTypeDef * cmd, QSPI_AutoPollingTypeDef * cfg)
Function description	Configure the QSPI Automatic Polling Mode in non-blocking mode.
Parameters	<ul style="list-style-type: none">• hqspi: QSPI handle• cmd: structure that contains the command configuration information.• cfg: structure that contains the polling configuration information.
Return values	<ul style="list-style-type: none">• HAL: status
Notes	<ul style="list-style-type: none">• This function is used only in Automatic Polling Mode

HAL_QSPI_MemoryMapped

Function name	HAL_StatusTypeDef HAL_QSPI_MemoryMapped (QSPI_HandleTypeDef * hqspi, QSPI_CommandTypeDef * cmd, QSPI_MemoryMappedTypeDef * cfg)
Function description	Configure the Memory Mapped mode.
Parameters	<ul style="list-style-type: none">• hqspi: QSPI handle• cmd: structure that contains the command configuration information.• cfg: structure that contains the memory mapped configuration information.
Return values	<ul style="list-style-type: none">• HAL: status
Notes	<ul style="list-style-type: none">• This function is used only in Memory mapped Mode

HAL_QSPI_ErrorCallback

Function name	void HAL_QSPI_ErrorCallback (QSPI_HandleTypeDef * hqspi)
Function description	Transfer Error callbacks.

- Parameters
- **hqspi**: QSPI handle
- Return values
- **None**:

HAL_QSPI_AbortCpltCallback

- Function name **void HAL_QSPI_AbortCpltCallback (QSPI_HandleTypeDef * hqspi)**
- Function description Abort completed callback.
- Parameters
- **hqspi**: QSPI handle
- Return values
- **None**:

HAL_QSPI_FifoThresholdCallback

- Function name **void HAL_QSPI_FifoThresholdCallback (QSPI_HandleTypeDef * hqspi)**
- Function description FIFO Threshold callbacks.
- Parameters
- **hqspi**: QSPI handle
- Return values
- **None**:

HAL_QSPI_CmdCpltCallback

- Function name **void HAL_QSPI_CmdCpltCallback (QSPI_HandleTypeDef * hqspi)**
- Function description Command completed callback.
- Parameters
- **hqspi**: QSPI handle
- Return values
- **None**:

HAL_QSPI_RxCpltCallback

- Function name **void HAL_QSPI_RxCpltCallback (QSPI_HandleTypeDef * hqspi)**
- Function description Rx Transfer completed callbacks.
- Parameters
- **hqspi**: QSPI handle
- Return values
- **None**:

HAL_QSPI_TxCpltCallback

- Function name **void HAL_QSPI_TxCpltCallback (QSPI_HandleTypeDef * hqspi)**
- Function description Tx Transfer completed callbacks.
- Parameters
- **hqspi**: QSPI handle
- Return values
- **None**:

HAL_QSPI_RxHalfCpltCallback

Function name	void HAL_QSPI_RxHalfCpltCallback (QSPI_HandleTypeDef * hqspi)
Function description	Rx Half Transfer completed callbacks.
Parameters	<ul style="list-style-type: none">• hqspi: QSPI handle
Return values	<ul style="list-style-type: none">• None:

HAL_QSPI_TxHalfCpltCallback

Function name	void HAL_QSPI_TxHalfCpltCallback (QSPI_HandleTypeDef * hqspi)
Function description	Tx Half Transfer completed callbacks.
Parameters	<ul style="list-style-type: none">• hqspi: QSPI handle
Return values	<ul style="list-style-type: none">• None:

HAL_QSPI_StatusMatchCallback

Function name	void HAL_QSPI_StatusMatchCallback (QSPI_HandleTypeDef * hqspi)
Function description	Status Match callbacks.
Parameters	<ul style="list-style-type: none">• hqspi: QSPI handle
Return values	<ul style="list-style-type: none">• None:

HAL_QSPI_TimeOutCallback

Function name	void HAL_QSPI_TimeOutCallback (QSPI_HandleTypeDef * hqspi)
Function description	Timeout callbacks.
Parameters	<ul style="list-style-type: none">• hqspi: QSPI handle
Return values	<ul style="list-style-type: none">• None:

HAL_QSPI_GetState

Function name	HAL_QSPI_StateTypeDef HAL_QSPI_GetState (QSPI_HandleTypeDef * hqspi)
Function description	Return the QSPI handle state.
Parameters	<ul style="list-style-type: none">• hqspi: QSPI handle
Return values	<ul style="list-style-type: none">• HAL: state

HAL_QSPI_GetError

Function name	uint32_t HAL_QSPI_GetError (QSPI_HandleTypeDef * hqspi)
Function description	Return the QSPI error code.
Parameters	<ul style="list-style-type: none">• hqspi: QSPI handle

Return values

- **QSPI:** Error Code

HAL_QSPI_Abort

Function name **HAL_StatusTypeDef HAL_QSPI_Abort (QSPI_HandleTypeDef * hqspi)**

Function description Abort the current transmission.

Parameters

- **hqspi:** QSPI handle

Return values

- **HAL:** status

HAL_QSPI_Abort_IT

Function name **HAL_StatusTypeDef HAL_QSPI_Abort_IT (QSPI_HandleTypeDef * hqspi)**

Function description Abort the current transmission (non-blocking function)

Parameters

- **hqspi:** QSPI handle

Return values

- **HAL:** status

HAL_QSPI_SetTimeout

Function name **void HAL_QSPI_SetTimeout (QSPI_HandleTypeDef * hqspi, uint32_t Timeout)**

Function description Set QSPI timeout.

Parameters

- **hqspi:** QSPI handle.
- **Timeout:** Timeout for the QSPI memory access.

Return values

- **None:**

HAL_QSPI_SetFifoThreshold

Function name **HAL_StatusTypeDef HAL_QSPI_SetFifoThreshold (QSPI_HandleTypeDef * hqspi, uint32_t Threshold)**

Function description Set QSPI Fifo threshold.

Parameters

- **hqspi:** QSPI handle.
- **Threshold:** Threshold of the Fifo (value between 1 and 16).

Return values

- **HAL:** status

HAL_QSPI_GetFifoThreshold

Function name **uint32_t HAL_QSPI_GetFifoThreshold (QSPI_HandleTypeDef * hqspi)**

Function description Get QSPI Fifo threshold.

Parameters

- **hqspi:** QSPI handle.

Return values

- **Fifo:** threshold (value between 1 and 16)

49.3 QSPI Firmware driver defines

49.3.1 QSPI

QSPI Address Mode

QSPI_ADDRESS_NONE	No address
QSPI_ADDRESS_1_LINE	Address on a single line
QSPI_ADDRESS_2_LINES	Address on two lines
QSPI_ADDRESS_4_LINES	Address on four lines

QSPI Address Size

QSPI_ADDRESS_8_BITS	8-bit address
QSPI_ADDRESS_16_BITS	16-bit address
QSPI_ADDRESS_24_BITS	24-bit address
QSPI_ADDRESS_32_BITS	32-bit address

QSPI Alternate Bytes Mode

QSPI_ALTERNATE_BYTES_NONE	No alternate bytes
QSPI_ALTERNATE_BYTES_1_LINE	Alternate bytes on a single line
QSPI_ALTERNATE_BYTES_2_LINES	Alternate bytes on two lines
QSPI_ALTERNATE_BYTES_4_LINES	Alternate bytes on four lines

QSPI Alternate Bytes Size

QSPI_ALTERNATE_BYTES_8_BITS	8-bit alternate bytes
QSPI_ALTERNATE_BYTES_16_BITS	16-bit alternate bytes
QSPI_ALTERNATE_BYTES_24_BITS	24-bit alternate bytes
QSPI_ALTERNATE_BYTES_32_BITS	32-bit alternate bytes

QSPI Automatic Stop

QSPI_AUTOMATIC_STOP_DISABLE	AutoPolling stops only with abort or QSPI disabling
QSPI_AUTOMATIC_STOP_ENABLE	AutoPolling stops as soon as there is a match

QSPI Chip Select High Time

QSPI_CS_HIGH_TIME_1_CYCLE	nCS stay high for at least 1 clock cycle between commands
QSPI_CS_HIGH_TIME_2_CYCLE	nCS stay high for at least 2 clock cycles between commands
QSPI_CS_HIGH_TIME_3_CYCLE	nCS stay high for at least 3 clock cycles between commands
QSPI_CS_HIGH_TIME_4_CYCLE	nCS stay high for at least 4 clock cycles between commands
QSPI_CS_HIGH_TIME_5_CYCLE	nCS stay high for at least 5 clock cycles between commands
QSPI_CS_HIGH_TIME_6_CYCLE	nCS stay high for at least 6 clock cycles between

commands

QSPI_CS_HIGH_TIME_7_CYCLE nCS stay high for at least 7 clock cycles between commands

QSPI_CS_HIGH_TIME_8_CYCLE nCS stay high for at least 8 clock cycles between commands

QSPI Clock Mode

QSPI_CLOCK_MODE_0 Clk stays low while nCS is released

QSPI_CLOCK_MODE_3 Clk goes high while nCS is released

QSPI Clock Prescaler

IS_QSPI_CLOCK_PRESCALER

QSPI Data Mode

QSPI_DATA_NONE No data

QSPI_DATA_1_LINE Data on a single line

QSPI_DATA_2_LINES Data on two lines

QSPI_DATA_4_LINES Data on four lines

QSPI Ddr HoldHalfCycle

QSPI_DDR_HHC_ANALOG_DELAY Delay the data output using analog delay in DDR mode

QSPI_DDR_HHC_HALF_CLK_DELAY Delay the data output by 1/2 clock cycle in DDR mode

QSPI Ddr Mode

QSPI_DDR_MODE_DISABLE Double data rate mode disabled

QSPI_DDR_MODE_ENABLE Double data rate mode enabled

QSPI Dual Flash Mode

QSPI_DUALFLASH_ENABLE

QSPI_DUALFLASH_DISABLE

QSPI Dummy Cycles

IS_QSPI_DUMMY_CYCLES

QSPI Error Code

HAL_QSPI_ERROR_NONE No error

HAL_QSPI_ERROR_TIMEOUT Timeout error

HAL_QSPI_ERROR_TRANSFER Transfer error

HAL_QSPI_ERROR_DMA DMA transfer error

HAL_QSPI_ERROR_INVALID_PARAM Invalid parameters error

QSPI Exported Macros

`__HAL_QSPI_RESET_HANDLE_STATE` **Description:**

- Reset QSPI handle state.

Parameters:

`__HAL_QSPI_ENABLE`

- `__HANDLE__`: QSPI handle.

Return value:

- None

Description:

- Enable QSPI.

Parameters:

- `__HANDLE__`: specifies the QSPI Handle.

Return value:

- None

Description:

- Disable QSPI.

Parameters:

- `__HANDLE__`: specifies the QSPI Handle.

Return value:

- None

Description:

- Enables the specified QSPI interrupt.

Parameters:

- `__HANDLE__`: specifies the QSPI Handle.
- `__INTERRUPT__`: specifies the QSPI interrupt source to enable. This parameter can be one of the following values:
 - `QSPI_IT_TO`: QSPI Time out interrupt
 - `QSPI_IT_SM`: QSPI Status match interrupt
 - `QSPI_IT_FT`: QSPI FIFO threshold interrupt
 - `QSPI_IT_TC`: QSPI Transfer complete interrupt
 - `QSPI_IT_TE`: QSPI Transfer error interrupt

Return value:

- None

Description:

- Disables the specified QSPI interrupt.

Parameters:

- `__HANDLE__`: specifies the QSPI Handle.
- `__INTERRUPT__`: specifies the QSPI interrupt source to disable. This parameter can be one of the following values:
 - `QSPI_IT_TO`: QSPI Timeout interrupt

`__HAL_QSPI_DISABLE`

`__HAL_QSPI_ENABLE_IT`

`__HAL_QSPI_DISABLE_IT`

- QSPI_IT_SM: QSPI Status match interrupt
- QSPI_IT_FT: QSPI FIFO threshold interrupt
- QSPI_IT_TC: QSPI Transfer complete interrupt
- QSPI_IT_TE: QSPI Transfer error interrupt

Return value:

- None

`__HAL_QSPI_GET_IT_SOURCE`**Description:**

- Checks whether the specified QSPI interrupt source is enabled.

Parameters:

- `__HANDLE__`: specifies the QSPI Handle.
- `__INTERRUPT__`: specifies the QSPI interrupt source to check. This parameter can be one of the following values:
 - QSPI_IT_TO: QSPI Time out interrupt
 - QSPI_IT_SM: QSPI Status match interrupt
 - QSPI_IT_FT: QSPI FIFO threshold interrupt
 - QSPI_IT_TC: QSPI Transfer complete interrupt
 - QSPI_IT_TE: QSPI Transfer error interrupt

Return value:

- The: new state of `__INTERRUPT__` (TRUE or FALSE).

`__HAL_QSPI_GET_FLAG`**Description:**

- Get the selected QSPI's flag status.

Parameters:

- `__HANDLE__`: specifies the QSPI Handle.
- `__FLAG__`: specifies the QSPI flag to check. This parameter can be one of the following values:
 - QSPI_FLAG_BUSY: QSPI Busy flag
 - QSPI_FLAG_TO: QSPI Time out flag
 - QSPI_FLAG_SM: QSPI Status match flag
 - QSPI_FLAG_FT: QSPI FIFO threshold flag
 - QSPI_FLAG_TC: QSPI Transfer complete flag
 - QSPI_FLAG_TE: QSPI Transfer error

flag

__HAL_QSPI_CLEAR_FLAG

Return value:

- None

Description:

- Clears the specified QSPI's flag status.

Parameters:

- __HANDLE__: specifies the QSPI Handle.
- __FLAG__: specifies the QSPI clear register flag that needs to be set This parameter can be one of the following values:
 - QSPI_FLAG_TO: QSPI Time out flag
 - QSPI_FLAG_SM: QSPI Status match flag
 - QSPI_FLAG_TC: QSPI Transfer complete flag
 - QSPI_FLAG_TE: QSPI Transfer error flag

Return value:

- None

QSPI Fifo Threshold

IS_QSPI_FIFO_THRESHOLD

QSPI Flags

- QSPI_FLAG_BUSY Busy flag: operation is ongoing
- QSPI_FLAG_TO Timeout flag: timeout occurs in memory-mapped mode
- QSPI_FLAG_SM Status match flag: received data matches in autopolling mode
- QSPI_FLAG_FT Fifo threshold flag: Fifo threshold reached or data left after read from memory is complete
- QSPI_FLAG_TC Transfer complete flag: programmed number of data have been transferred or the transfer has been aborted
- QSPI_FLAG_TE Transfer error flag: invalid address is being accessed

QSPI Flash Size

IS_QSPI_FLASH_SIZE

QSPI Flash Select

- QSPI_FLASH_ID_1
- QSPI_FLASH_ID_2

QSPI Instruction

IS_QSPI_INSTRUCTION

QSPI Instruction Mode

- QSPI_INSTRUCTION_NONE No instruction



QSPI_INSTRUCTION_1_LINE Instruction on a single line
 QSPI_INSTRUCTION_2_LINES Instruction on two lines
 QSPI_INSTRUCTION_4_LINES Instruction on four lines

QSPI Interrupts

QSPI_IT_TO Interrupt on the timeout flag
 QSPI_IT_SM Interrupt on the status match flag
 QSPI_IT_FT Interrupt on the fifo threshold flag
 QSPI_IT_TC Interrupt on the transfer complete flag
 QSPI_IT_TE Interrupt on the transfer error flag

QSPI Interval

IS_QSPI_INTERVAL

QSPI Match Mode

QSPI_MATCH_MODE_AND AND match mode between unmasked bits
 QSPI_MATCH_MODE_OR OR match mode between unmasked bits

QSPI Sample Shifting

QSPI_SAMPLE_SHIFTING_NONE No clock cycle shift to sample data
 QSPI_SAMPLE_SHIFTING_HALFCYCLE 1/2 clock cycle shift to sample data

QSPI SIOO Mode

QSPI_SIOO_INST_EVERY_CMD Send instruction on every transaction
 QSPI_SIOO_INST_ONLY_FIRST_CMD Send instruction only for the first command

QSPI Status Bytes Size

IS_QSPI_STATUS_BYTES_SIZE

QSPI TimeOut Activation

QSPI_TIMEOUT_COUNTER_DISABLE Timeout counter disabled, nCS remains active
 QSPI_TIMEOUT_COUNTER_ENABLE Timeout counter enabled, nCS released when timeout expires

QSPI TimeOut Period

IS_QSPI_TIMEOUT_PERIOD

QSPI Timeout definition

HAL_QPSI_TIMEOUT_DEFAULT_VALUE

50 HAL RCC Generic Driver

50.1 RCC Firmware driver registers structures

50.1.1 RCC_OsclnitTypeDef

Data Fields

- *uint32_t OscillatorType*
- *uint32_t HSEState*
- *uint32_t LSEState*
- *uint32_t HSIState*
- *uint32_t HSI CalibrationValue*
- *uint32_t LSISState*
- *RCC_PLLInitTypeDef PLL*

Field Documentation

- *uint32_t RCC_OsclnitTypeDef::OscillatorType*
The oscillators to be configured. This parameter can be a value of [RCC_Oscillator_Type](#)
- *uint32_t RCC_OsclnitTypeDef::HSEState*
The new state of the HSE. This parameter can be a value of [RCC_HSE_Config](#)
- *uint32_t RCC_OsclnitTypeDef::LSEState*
The new state of the LSE. This parameter can be a value of [RCC_LSE_Config](#)
- *uint32_t RCC_OsclnitTypeDef::HSIState*
The new state of the HSI. This parameter can be a value of [RCC_HSI_Config](#)
- *uint32_t RCC_OsclnitTypeDef::HSI CalibrationValue*
The HSI calibration trimming value (default is RCC_HSICALIBRATION_DEFAULT). This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1F
- *uint32_t RCC_OsclnitTypeDef::LSISState*
The new state of the LSI. This parameter can be a value of [RCC_LSI_Config](#)
- *RCC_PLLInitTypeDef RCC_OsclnitTypeDef::PLL*
PLL structure parameters

50.1.2 RCC_ClkInitTypeDef

Data Fields

- *uint32_t ClockType*
- *uint32_t SYSCLKSource*
- *uint32_t AHBCLKDivider*
- *uint32_t APB1CLKDivider*
- *uint32_t APB2CLKDivider*

Field Documentation

- *uint32_t RCC_ClkInitTypeDef::ClockType*
The clock to be configured. This parameter can be a value of [RCC_System_Clock_Type](#)
- *uint32_t RCC_ClkInitTypeDef::SYSCLKSource*
The clock source (SYSCLKS) used as system clock. This parameter can be a value of [RCC_System_Clock_Source](#)

- ***uint32_t RCC_ClkInitTypeDef::AHBCLKDivider***
The AHB clock (HCLK) divider. This clock is derived from the system clock (SYSCLK). This parameter can be a value of [RCC_AHB_Clock_Source](#)
- ***uint32_t RCC_ClkInitTypeDef::APB1CLKDivider***
The APB1 clock (PCLK1) divider. This clock is derived from the AHB clock (HCLK). This parameter can be a value of [RCC_APB1_APB2_Clock_Source](#)
- ***uint32_t RCC_ClkInitTypeDef::APB2CLKDivider***
The APB2 clock (PCLK2) divider. This clock is derived from the AHB clock (HCLK). This parameter can be a value of [RCC_APB1_APB2_Clock_Source](#)

50.2 RCC Firmware driver API description

50.2.1 RCC specific features

After reset the device is running from Internal High Speed oscillator (HSI 16MHz) with Flash 0 wait state, Flash prefetch buffer, D-Cache and I-Cache are disabled, and all peripherals are off except internal SRAM, Flash and JTAG.

- There is no prescaler on High speed (AHB) and Low speed (APB) busses; all peripherals mapped on these busses are running at HSI speed.
- The clock for all peripherals is switched off, except the SRAM and FLASH.
- All GPIOs are in input floating state, except the JTAG pins which are assigned to be used for debug purpose.

Once the device started from reset, the user application has to:

- Configure the clock source to be used to drive the System clock (if the application needs higher frequency/performance)
- Configure the System clock frequency and Flash settings
- Configure the AHB and APB busses prescalers
- Enable the clock for the peripheral(s) to be used
- Configure the clock source(s) for peripherals which clocks are not derived from the System clock (I2S, RTC, ADC, USB OTG FS/SDIO/RNG)

50.2.2 RCC Limitations

A delay between an RCC peripheral clock enable and the effective peripheral enabling should be taken into account in order to manage the peripheral read/write from/to registers.

- This delay depends on the peripheral mapping.
- If peripheral is mapped on AHB: the delay is 2 AHB clock cycle after the clock enable bit is set on the hardware register
- If peripheral is mapped on APB: the delay is 2 APB clock cycle after the clock enable bit is set on the hardware register

Implemented Workaround:

- For AHB & APB peripherals, a dummy read to the peripheral register has been inserted in each `__HAL_RCC_PPP_CLK_ENABLE()` macro.

50.2.3 Initialization and de-initialization functions

This section provides functions allowing to configure the internal/external oscillators (HSE, HSI, LSE, LSI, PLL, CSS and MCO) and the System buses clocks (SYSCLK, AHB, APB1 and APB2).

Internal/external clock and PLL configuration

1. HSI (high-speed internal), 16 MHz factory-trimmed RC used directly or through the PLL as System clock source.
2. LSI (low-speed internal), 32 KHz low consumption RC used as IWDG and/or RTC clock source.
3. HSE (high-speed external), 4 to 26 MHz crystal oscillator used directly or through the PLL as System clock source. Can be used also as RTC clock source.
4. LSE (low-speed external), 32 KHz oscillator used as RTC clock source.
5. PLL (clocked by HSI or HSE), featuring two different output clocks:
 - The first output is used to generate the high speed system clock (up to 216 MHz)
 - The second output is used to generate the clock for the USB OTG FS (48 MHz), the random analog generator (<=48 MHz) and the SDIO (<= 48 MHz).
6. CSS (Clock security system), once enable using the function `HAL_RCC_EnableCSS()` and if a HSE clock failure occurs(HSE used directly or through PLL as System clock source), the System clock is automatically switched to HSI and an interrupt is generated if enabled. The interrupt is linked to the Cortex-M7 NMI (Non-Maskable Interrupt) exception vector.
7. MCO1 (microcontroller clock output), used to output HSI, LSE, HSE or PLL clock (through a configurable prescaler) on PA8 pin.
8. MCO2 (microcontroller clock output), used to output HSE, PLL, SYSCCLK or PLLI2S clock (through a configurable prescaler) on PC9 pin.

System, AHB and APB busses clocks configuration

1. Several clock sources can be used to drive the System clock (SYSCCLK): HSI, HSE and PLL. The AHB clock (HCLK) is derived from System clock through configurable prescaler and used to clock the CPU, memory and peripherals mapped on AHB bus (DMA, GPIO...). APB1 (PCLK1) and APB2 (PCLK2) clocks are derived from AHB clock through configurable prescalers and used to clock the peripherals mapped on these busses. You can use "`HAL_RCC_GetSysClockFreq()`" function to retrieve the frequencies of these clocks. All the peripheral clocks are derived from the System clock (SYSCCLK) except: I2S: the I2S clock can be derived either from a specific PLL (PLLI2S) or from an external clock mapped on the I2S_CKIN pin. You have to use `__HAL_RCC_PLLI2S_CONFIG()` macro to configure this clock. SAI: the SAI clock can be derived either from a specific PLL (PLLI2S) or (PLLSAI) or from an external clock mapped on the I2S_CKIN pin. You have to use `__HAL_RCC_PLLI2S_CONFIG()` macro to configure this clock. RTC: the RTC clock can be derived either from the LSI, LSE or HSE clock divided by 2 to 31. You have to use `__HAL_RCC_RTC_CONFIG()` and `__HAL_RCC_RTC_ENABLE()` macros to configure this clock. USB OTG FS, SDIO and RTC: USB OTG FS require a frequency equal to 48 MHz to work correctly, while the SDIO require a frequency equal or lower than to 48. This clock is derived of the main PLL through PLLQ divider. IWDG clock which is always the LSI clock.

This section contains the following APIs:

- [*HAL_RCC_DeInit\(\)*](#)
- [*HAL_RCC_OscConfig\(\)*](#)
- [*HAL_RCC_ClockConfig\(\)*](#)

50.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the RCC Clocks frequencies.

This section contains the following APIs:

- [*HAL_RCC_MCOConfig\(\)*](#)
- [*HAL_RCC_EnableCSS\(\)*](#)
- [*HAL_RCC_DisableCSS\(\)*](#)

- [HAL_RCC_GetSysClockFreq\(\)](#)
- [HAL_RCC_GetHCLKFreq\(\)](#)
- [HAL_RCC_GetPCLK1Freq\(\)](#)
- [HAL_RCC_GetPCLK2Freq\(\)](#)
- [HAL_RCC_GetOscConfig\(\)](#)
- [HAL_RCC_GetClockConfig\(\)](#)
- [HAL_RCC_NMI_IRQHandler\(\)](#)
- [HAL_RCC_CSSCallback\(\)](#)

50.2.5 Detailed description of functions

HAL_RCC_DeInit

Function name	void HAL_RCC_DeInit (void)
Function description	Resets the RCC clock configuration to the default reset state.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The default reset state of the clock configuration is given below: HSI ON and used as system clock source HSE, PLL and PLLI2S OFF AHB, APB1 and APB2 prescaler set to 1. CSS, MCO1 and MCO2 OFF All interrupts disabled • This function doesn't modify the configuration of the Peripheral clocks LSI, LSE and RTC clocks

HAL_RCC_OscConfig

Function name	HAL_StatusTypeDef HAL_RCC_OscConfig (RCC_OscInitTypeDef * RCC_OscInitStruct)
Function description	Initializes the RCC Oscillators according to the specified parameters in the RCC_OscInitTypeDef.
Parameters	<ul style="list-style-type: none"> • RCC_OscInitStruct: pointer to an RCC_OscInitTypeDef structure that contains the configuration information for the RCC Oscillators.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • The PLL is not disabled when used as system clock. • Transitions LSE Bypass to LSE On and LSE On to LSE Bypass are not supported by this function. User should request a transition to LSE Off first and then LSE On or LSE Bypass. • Transition HSE Bypass to HSE On and HSE On to HSE Bypass are not supported by this function. User should request a transition to HSE Off first and then HSE On or HSE Bypass.

HAL_RCC_ClockConfig

Function name	HAL_StatusTypeDef HAL_RCC_ClockConfig (RCC_ClkInitTypeDef * RCC_ClkInitStruct, uint32_t FLatency)
Function description	Initializes the CPU, AHB and APB busses clocks according to the specified parameters in the RCC_ClkInitStruct.

Parameters	<ul style="list-style-type: none"> • RCC_ClkInitStruct: pointer to an RCC_OscInitTypeDef structure that contains the configuration information for the RCC peripheral. • FLatency: FLASH Latency, this parameter depend on device selected
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The SystemCoreClock CMSIS variable is used to store System Clock Frequency and updated by HAL_RCC_GetHCLKFreq() function called within this function • The HSI is used (enabled by hardware) as system clock source after startup from Reset, wake-up from STOP and STANDBY mode, or in case of failure of the HSE used directly or indirectly as system clock (if the Clock Security System CSS is enabled). • A switch from one clock source to another occurs only if the target clock source is ready (clock stable after startup delay or PLL locked). If a clock source which is not yet ready is selected, the switch will occur when the clock source will be ready. You can use HAL_RCC_GetClockConfig() function to know which clock is currently used as system clock source. • Depending on the device voltage range, the software has to set correctly HPRE[3:0] bits to ensure that HCLK not exceed the maximum allowed frequency (for more details refer to section above "Initialization/de-initialization functions")

HAL_RCC_MCOConfig

Function name	void HAL_RCC_MCOConfig (uint32_t RCC_MCOx, uint32_t RCC_MCOSource, uint32_t RCC_MCODiv)
Function description	Selects the clock source to output on MCO1 pin(PA8) or on MCO2 pin(PC9).
Parameters	<ul style="list-style-type: none"> • RCC_MCOx: specifies the output direction for the clock source. This parameter can be one of the following values: <ul style="list-style-type: none"> – RCC_MCO1: Clock source to output on MCO1 pin(PA8). – RCC_MCO2: Clock source to output on MCO2 pin(PC9). • RCC_MCOSource: specifies the clock source to output. This parameter can be one of the following values: <ul style="list-style-type: none"> – RCC_MCO1SOURCE_HSI: HSI clock selected as MCO1 source – RCC_MCO1SOURCE_LSE: LSE clock selected as MCO1 source – RCC_MCO1SOURCE_HSE: HSE clock selected as MCO1 source – RCC_MCO1SOURCE_PLLCLK: main PLL clock selected as MCO1 source – RCC_MCO2SOURCE_SYSCLK: System clock (SYSCLK) selected as MCO2 source – RCC_MCO2SOURCE_PLLI2SCLK: PLLI2S clock selected as MCO2 source – RCC_MCO2SOURCE_HSE: HSE clock selected as MCO2 source – RCC_MCO2SOURCE_PLLCLK: main PLL clock

- selected as MCO2 source
- **RCC_MCODiv:** specifies the MCOx prescaler. This parameter can be one of the following values:
 - RCC_MCODIV_1: no division applied to MCOx clock
 - RCC_MCODIV_2: division by 2 applied to MCOx clock
 - RCC_MCODIV_3: division by 3 applied to MCOx clock
 - RCC_MCODIV_4: division by 4 applied to MCOx clock
 - RCC_MCODIV_5: division by 5 applied to MCOx clock
- Return values
- **None:**
- Notes
- PA8/PC9 should be configured in alternate function mode.

HAL_RCC_EnableCSS

Function name **void HAL_RCC_EnableCSS (void)**

Function description Enables the Clock Security System.

Return values

- **None:**

Notes

- If a failure is detected on the HSE oscillator clock, this oscillator is automatically disabled and an interrupt is generated to inform the software about the failure (Clock Security System Interrupt, CSSI), allowing the MCU to perform rescue operations. The CSSI is linked to the Cortex-M7 NMI (Non-Maskable Interrupt) exception vector.

HAL_RCC_DisableCSS

Function name **void HAL_RCC_DisableCSS (void)**

Function description Disables the Clock Security System.

Return values

- **None:**

HAL_RCC_GetSysClockFreq

Function name **uint32_t HAL_RCC_GetSysClockFreq (void)**

Function description Returns the SYSCLK frequency.

Return values

- **SYSCLK:** frequency

Notes

- The system frequency computed by this function is not the real frequency in the chip. It is calculated based on the predefined constant and the selected clock source:
- If SYSCLK source is HSI, function returns values based on HSI_VALUE(*)
- If SYSCLK source is HSE, function returns values based on HSE_VALUE(**)
- If SYSCLK source is PLL, function returns values based on HSE_VALUE(**) or HSI_VALUE(*) multiplied/divided by the PLL factors.
- (*) HSI_VALUE is a constant defined in stm32f7xx_hal_conf.h file (default value 16 MHz) but the real value may vary depending on the variations in voltage and temperature.
- (**) HSE_VALUE is a constant defined in stm32f7xx_hal_conf.h file (default value 25 MHz), user has to

ensure that HSE_VALUE is same as the real frequency of the crystal used. Otherwise, this function may have wrong result.

- The result of this function could be not correct when using fractional value for HSE crystal.
- This function can be used by the user application to compute the baudrate for the communication peripherals or configure other parameters.
- Each time SYSCLK changes, this function must be called to update the right SYSCLK value. Otherwise, any configuration based on this function will be incorrect.

HAL_RCC_GetHCLKFreq

Function name **uint32_t HAL_RCC_GetHCLKFreq (void)**

Function description Returns the HCLK frequency.

Return values

- **HCLK:** frequency

Notes

- Each time HCLK changes, this function must be called to update the right HCLK value. Otherwise, any configuration based on this function will be incorrect.
- The SystemCoreClock CMSIS variable is used to store System Clock Frequency.

HAL_RCC_GetPCLK1Freq

Function name **uint32_t HAL_RCC_GetPCLK1Freq (void)**

Function description Returns the PCLK1 frequency.

Return values

- **PCLK1:** frequency

Notes

- Each time PCLK1 changes, this function must be called to update the right PCLK1 value. Otherwise, any configuration based on this function will be incorrect.

HAL_RCC_GetPCLK2Freq

Function name **uint32_t HAL_RCC_GetPCLK2Freq (void)**

Function description Returns the PCLK2 frequency.

Return values

- **PCLK2:** frequency

Notes

- Each time PCLK2 changes, this function must be called to update the right PCLK2 value. Otherwise, any configuration based on this function will be incorrect.

HAL_RCC_GetOscConfig

Function name **void HAL_RCC_GetOscConfig (RCC_OscInitTypeDef * RCC_OscInitStruct)**

Function description Configures the RCC_OscInitStruct according to the internal RCC configuration registers.

Parameters

- **RCC_OscInitStruct:** pointer to an RCC_OscInitTypeDef structure that will be configured.

Return values • **None:**

HAL_RCC_GetClockConfig

Function name **void HAL_RCC_GetClockConfig (RCC_ClkInitTypeDef * RCC_ClkInitStruct, uint32_t * pFLatency)**

Function description Configures the RCC_ClkInitStruct according to the internal RCC configuration registers.

Parameters • **RCC_ClkInitStruct:** pointer to an RCC_ClkInitTypeDef structure that will be configured.
• **pFLatency:** Pointer on the Flash Latency.

Return values • **None:**

HAL_RCC_NMI_IRQHandler

Function name **void HAL_RCC_NMI_IRQHandler (void)**

Function description This function handles the RCC CSS interrupt request.

Return values • **None:**

Notes • This API should be called under the NMI_Handler().

HAL_RCC_CSSCallback

Function name **void HAL_RCC_CSSCallback (void)**

Function description RCC Clock Security System interrupt callback.

Return values • **None:**

50.3 RCC Firmware driver defines

50.3.1 RCC

AHB1 Peripheral Clock Enable Disable

__HAL_RCC_CRC_CLK_ENABLE

__HAL_RCC_DMA1_CLK_ENABLE

__HAL_RCC_CRC_CLK_DISABLE

__HAL_RCC_DMA1_CLK_DISABLE

AHB1 Peripheral Clock Sleep Enable Disable Status

__HAL_RCC_CRC_IS_CLK_SLEEP_ENABLED

__HAL_RCC_DMA1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_CRC_IS_CLK_SLEEP_DISABLED

__HAL_RCC_DMA1_IS_CLK_SLEEP_DISABLED

AHB1 Peripheral Clock Enable Disable Status

__HAL_RCC_CRC_IS_CLK_ENABLED

__HAL_RCC_DMA1_IS_CLK_ENABLED

__HAL_RCC_CRC_IS_CLK_DISABLED
__HAL_RCC_DMA1_IS_CLK_DISABLED

RCC AHB Clock Source

RCC_SYSCLK_DIV1
RCC_SYSCLK_DIV2
RCC_SYSCLK_DIV4
RCC_SYSCLK_DIV8
RCC_SYSCLK_DIV16
RCC_SYSCLK_DIV64
RCC_SYSCLK_DIV128
RCC_SYSCLK_DIV256
RCC_SYSCLK_DIV512

RCC APB1/APB2 Clock Source

RCC_HCLK_DIV1
RCC_HCLK_DIV2
RCC_HCLK_DIV4
RCC_HCLK_DIV8
RCC_HCLK_DIV16

APB1 Peripheral Clock Enable Disable

__HAL_RCC_WWDG_CLK_ENABLE
__HAL_RCC_PWR_CLK_ENABLE
__HAL_RCC_WWDG_CLK_DISABLE
__HAL_RCC_PWR_CLK_DISABLE

APB1 Peripheral Clock Enable Disable Status

__HAL_RCC_WWDG_IS_CLK_ENABLED
__HAL_RCC_PWR_IS_CLK_ENABLED
__HAL_RCC_WWDG_IS_CLK_DISABLED
__HAL_RCC_PWR_IS_CLK_DISABLED

APB1 Peripheral Clock Sleep Enable Disable Status

__HAL_RCC_WWDG_IS_CLK_SLEEP_ENABLED
__HAL_RCC_PWR_IS_CLK_SLEEP_ENABLED
__HAL_RCC_WWDG_IS_CLK_SLEEP_DISABLED
__HAL_RCC_PWR_IS_CLK_SLEEP_DISABLED

APB1 Force Release Reset

__HAL_RCC_APB1_FORCE_RESET
__HAL_RCC_WWDG_FORCE_RESET

__HAL_RCC_PWR_FORCE_RESET

__HAL_RCC_APB1_RELEASE_RESET

__HAL_RCC_WWDG_RELEASE_RESET

__HAL_RCC_PWR_RELEASE_RESET

APB2 Peripheral Clock Enable Disable

__HAL_RCC_SYSCFG_CLK_ENABLE

__HAL_RCC_SYSCFG_CLK_DISABLE

APB2 Peripheral Clock Enable Disable Status

__HAL_RCC_SYSCFG_IS_CLK_ENABLED

__HAL_RCC_SYSCFG_IS_CLK_DISABLED

APB2 Peripheral Clock Sleep Enable Disable Status

__HAL_RCC_SYSCFG_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SYSCFG_IS_CLK_SLEEP_DISABLED

APB2 Force Release Reset

__HAL_RCC_APB2_FORCE_RESET

__HAL_RCC_SYSCFG_FORCE_RESET

__HAL_RCC_APB2_RELEASE_RESET

__HAL_RCC_SYSCFG_RELEASE_RESET

RCC BitAddress Alias

RCC_CIR_BYTE1_ADDRESS

RCC_CIR_BYTE2_ADDRESS

RCC_DBP_TIMEOUT_VALUE

RCC_LSE_TIMEOUT_VALUE

AHB/APB Peripheral Clock Sleep Enable Disable Status

__HAL_RCC_FLITF_IS_CLK_SLEEP_ENABLED

Notes:

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the peripheral clock is enabled again. By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_AXI_IS_CLK_SLEEP_ENABLED
__HAL_RCC_SRAM1_IS_CLK_SLEEP_ENABLED
__HAL_RCC_SRAM2_IS_CLK_SLEEP_ENABLED
__HAL_RCC_BKPSRAM_IS_CLK_SLEEP_ENABLED
__HAL_RCC_DTCM_IS_CLK_SLEEP_ENABLED
__HAL_RCC_DMA2_IS_CLK_SLEEP_ENABLED
__HAL_RCC_USB_OTG_HS_IS_CLK_SLEEP_ENABLED
__HAL_RCC_USB_OTG_HS_ULPI_IS_CLK_SLEEP_ENABLED
__HAL_RCC_GPIOA_IS_CLK_SLEEP_ENABLED
__HAL_RCC_GPIOB_IS_CLK_SLEEP_ENABLED
__HAL_RCC_GPIOC_IS_CLK_SLEEP_ENABLED
__HAL_RCC_GPIOD_IS_CLK_SLEEP_ENABLED
__HAL_RCC_GPIOE_IS_CLK_SLEEP_ENABLED
__HAL_RCC_GPIOF_IS_CLK_SLEEP_ENABLED
__HAL_RCC_GPIOG_IS_CLK_SLEEP_ENABLED
__HAL_RCC_GPIOH_IS_CLK_SLEEP_ENABLED
__HAL_RCC_GPIOI_IS_CLK_SLEEP_ENABLED
__HAL_RCC_FLITF_IS_CLK_SLEEP_DISABLED
__HAL_RCC_AXI_IS_CLK_SLEEP_DISABLED
__HAL_RCC_SRAM1_IS_CLK_SLEEP_DISABLED
__HAL_RCC_SRAM2_IS_CLK_SLEEP_DISABLED
__HAL_RCC_BKPSRAM_IS_CLK_SLEEP_DISABLED
__HAL_RCC_DTCM_IS_CLK_SLEEP_DISABLED
__HAL_RCC_DMA2_IS_CLK_SLEEP_DISABLED
__HAL_RCC_USB_OTG_HS_IS_CLK_SLEEP_DISABLED
__HAL_RCC_USB_OTG_HS_ULPI_IS_CLK_SLEEP_DISABLED
__HAL_RCC_GPIOA_IS_CLK_SLEEP_DISABLED
__HAL_RCC_GPIOB_IS_CLK_SLEEP_DISABLED
__HAL_RCC_GPIOC_IS_CLK_SLEEP_DISABLED
__HAL_RCC_GPIOD_IS_CLK_SLEEP_DISABLED
__HAL_RCC_GPIOE_IS_CLK_SLEEP_DISABLED
__HAL_RCC_GPIOF_IS_CLK_SLEEP_DISABLED
__HAL_RCC_GPIOG_IS_CLK_SLEEP_DISABLED
__HAL_RCC_GPIOH_IS_CLK_SLEEP_DISABLED
__HAL_RCC_GPIOI_IS_CLK_SLEEP_DISABLED

__HAL_RCC_DMA2D_IS_CLK_SLEEP_ENABLED
__HAL_RCC_ETHMAC_IS_CLK_SLEEP_ENABLED
__HAL_RCC_ETHMACTX_IS_CLK_SLEEP_ENABLED
__HAL_RCC_ETHMACRX_IS_CLK_SLEEP_ENABLED
__HAL_RCC_ETHMACPTP_IS_CLK_SLEEP_ENABLED
__HAL_RCC_GPIOJ_IS_CLK_SLEEP_ENABLED
__HAL_RCC_GPIOK_IS_CLK_SLEEP_ENABLED
__HAL_RCC_DMA2D_IS_CLK_SLEEP_DISABLED
__HAL_RCC_ETHMAC_IS_CLK_SLEEP_DISABLED
__HAL_RCC_ETHMACTX_IS_CLK_SLEEP_DISABLED
__HAL_RCC_ETHMACRX_IS_CLK_SLEEP_DISABLED
__HAL_RCC_ETHMACPTP_IS_CLK_SLEEP_DISABLED
__HAL_RCC_GPIOJ_IS_CLK_SLEEP_DISABLED
__HAL_RCC_GPIOK_IS_CLK_SLEEP_DISABLED
__HAL_RCC_DCMI_IS_CLK_SLEEP_ENABLED

Notes:

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the peripheral clock is enabled again. By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_DCMI_IS_CLK_SLEEP_DISABLED
__HAL_RCC_JPEG_IS_CLK_SLEEP_ENABLED
__HAL_RCC_JPEG_IS_CLK_SLEEP_DISABLED
__HAL_RCC_RNG_IS_CLK_SLEEP_ENABLED
__HAL_RCC_RNG_IS_CLK_SLEEP_DISABLED
__HAL_RCC_USB_OTG_FS_IS_CLK_SLEEP_ENABLED
__HAL_RCC_USB_OTG_FS_IS_CLK_SLEEP_DISABLED
__HAL_RCC_CRYP_IS_CLK_SLEEP_ENABLED
__HAL_RCC_HASH_IS_CLK_SLEEP_ENABLED

__HAL_RCC_Cryp_IS_CLK_SLEEP_Disabled
__HAL_RCC_HASH_IS_CLK_SLEEP_Disabled
__HAL_RCC_FMC_IS_CLK_SLEEP_Enabled

Notes:

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the peripheral clock is enabled again. By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_FMC_IS_CLK_SLEEP_Disabled
__HAL_RCC_QSPI_IS_CLK_SLEEP_Enabled
__HAL_RCC_QSPI_IS_CLK_SLEEP_Disabled
__HAL_RCC_TIM2_IS_CLK_SLEEP_Enabled

Notes:

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the peripheral clock is enabled again. By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_TIM3_IS_CLK_SLEEP_Enabled
__HAL_RCC_TIM4_IS_CLK_SLEEP_Enabled
__HAL_RCC_TIM5_IS_CLK_SLEEP_Enabled
__HAL_RCC_TIM6_IS_CLK_SLEEP_Enabled
__HAL_RCC_TIM7_IS_CLK_SLEEP_Enabled
__HAL_RCC_TIM12_IS_CLK_SLEEP_Enabled

__HAL_RCC_TIM13_IS_CLK_SLEEP_ENABLED
__HAL_RCC_TIM14_IS_CLK_SLEEP_ENABLED
__HAL_RCC_LPTIM1_IS_CLK_SLEEP_ENABLED
__HAL_RCC_RTC_IS_CLK_SLEEP_ENABLED
__HAL_RCC_CAN3_IS_CLK_SLEEP_ENABLED
__HAL_RCC_SPI2_IS_CLK_SLEEP_ENABLED
__HAL_RCC_SPI3_IS_CLK_SLEEP_ENABLED
__HAL_RCC_USART2_IS_CLK_SLEEP_ENABLED
__HAL_RCC_USART3_IS_CLK_SLEEP_ENABLED
__HAL_RCC_UART4_IS_CLK_SLEEP_ENABLED
__HAL_RCC_UART5_IS_CLK_SLEEP_ENABLED
__HAL_RCC_I2C1_IS_CLK_SLEEP_ENABLED
__HAL_RCC_I2C2_IS_CLK_SLEEP_ENABLED
__HAL_RCC_I2C3_IS_CLK_SLEEP_ENABLED
__HAL_RCC_CAN1_IS_CLK_SLEEP_ENABLED
__HAL_RCC_DAC_IS_CLK_SLEEP_ENABLED
__HAL_RCC_UART7_IS_CLK_SLEEP_ENABLED
__HAL_RCC_UART8_IS_CLK_SLEEP_ENABLED
__HAL_RCC_TIM2_IS_CLK_SLEEP_DISABLED
__HAL_RCC_TIM3_IS_CLK_SLEEP_DISABLED
__HAL_RCC_TIM4_IS_CLK_SLEEP_DISABLED
__HAL_RCC_TIM5_IS_CLK_SLEEP_DISABLED
__HAL_RCC_TIM6_IS_CLK_SLEEP_DISABLED
__HAL_RCC_TIM7_IS_CLK_SLEEP_DISABLED
__HAL_RCC_TIM12_IS_CLK_SLEEP_DISABLED
__HAL_RCC_TIM13_IS_CLK_SLEEP_DISABLED
__HAL_RCC_TIM14_IS_CLK_SLEEP_DISABLED
__HAL_RCC_LPTIM1_IS_CLK_SLEEP_DISABLED
__HAL_RCC_RTC_IS_CLK_SLEEP_DISABLED
__HAL_RCC_CAN3_IS_CLK_SLEEP_DISABLED
__HAL_RCC_SPI2_IS_CLK_SLEEP_DISABLED
__HAL_RCC_SPI3_IS_CLK_SLEEP_DISABLED
__HAL_RCC_USART2_IS_CLK_SLEEP_DISABLED
__HAL_RCC_USART3_IS_CLK_SLEEP_DISABLED
__HAL_RCC_UART4_IS_CLK_SLEEP_DISABLED
__HAL_RCC_UART5_IS_CLK_SLEEP_DISABLED

__HAL_RCC_I2C1_IS_CLK_SLEEP_DISABLED
__HAL_RCC_I2C2_IS_CLK_SLEEP_DISABLED
__HAL_RCC_I2C3_IS_CLK_SLEEP_DISABLED
__HAL_RCC_CAN1_IS_CLK_SLEEP_DISABLED
__HAL_RCC_DAC_IS_CLK_SLEEP_DISABLED
__HAL_RCC_UART7_IS_CLK_SLEEP_DISABLED
__HAL_RCC_UART8_IS_CLK_SLEEP_DISABLED
__HAL_RCC_SPDIFRX_IS_CLK_SLEEP_ENABLED
__HAL_RCC_I2C4_IS_CLK_SLEEP_ENABLED
__HAL_RCC_CAN2_IS_CLK_SLEEP_ENABLED
__HAL_RCC_CEC_IS_CLK_SLEEP_ENABLED
__HAL_RCC_SPDIFRX_IS_CLK_SLEEP_DISABLED
__HAL_RCC_I2C4_IS_CLK_SLEEP_DISABLED
__HAL_RCC_CAN2_IS_CLK_SLEEP_DISABLED
__HAL_RCC_CEC_IS_CLK_SLEEP_DISABLED
__HAL_RCC_TIM1_IS_CLK_SLEEP_ENABLED

Notes:

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the peripheral clock is enabled again. By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_TIM8_IS_CLK_SLEEP_ENABLED
__HAL_RCC_USART1_IS_CLK_SLEEP_ENABLED
__HAL_RCC_USART6_IS_CLK_SLEEP_ENABLED
__HAL_RCC_ADC1_IS_CLK_SLEEP_ENABLED
__HAL_RCC_ADC2_IS_CLK_SLEEP_ENABLED
__HAL_RCC_ADC3_IS_CLK_SLEEP_ENABLED
__HAL_RCC_SDMMC1_IS_CLK_SLEEP_ENABLED
__HAL_RCC_SPI1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SPI4_IS_CLK_SLEEP_ENABLED
__HAL_RCC_TIM9_IS_CLK_SLEEP_ENABLED
__HAL_RCC_TIM10_IS_CLK_SLEEP_ENABLED
__HAL_RCC_TIM11_IS_CLK_SLEEP_ENABLED
__HAL_RCC_SPI5_IS_CLK_SLEEP_ENABLED
__HAL_RCC_SAI1_IS_CLK_SLEEP_ENABLED
__HAL_RCC_SAI2_IS_CLK_SLEEP_ENABLED
__HAL_RCC_LTDC_IS_CLK_SLEEP_ENABLED
__HAL_RCC_DSI_IS_CLK_SLEEP_ENABLED
__HAL_RCC_SDMMC2_IS_CLK_SLEEP_ENABLED
__HAL_RCC_DFSDM1_IS_CLK_SLEEP_ENABLED
__HAL_RCC_MDIO_IS_CLK_SLEEP_ENABLED
__HAL_RCC_TIM1_IS_CLK_SLEEP_DISABLED
__HAL_RCC_TIM8_IS_CLK_SLEEP_DISABLED
__HAL_RCC_USART1_IS_CLK_SLEEP_DISABLED
__HAL_RCC_USART6_IS_CLK_SLEEP_DISABLED
__HAL_RCC_ADC1_IS_CLK_SLEEP_DISABLED
__HAL_RCC_ADC2_IS_CLK_SLEEP_DISABLED
__HAL_RCC_ADC3_IS_CLK_SLEEP_DISABLED
__HAL_RCC_SDMMC1_IS_CLK_SLEEP_DISABLED
__HAL_RCC_SPI1_IS_CLK_SLEEP_DISABLED
__HAL_RCC_SPI4_IS_CLK_SLEEP_DISABLED
__HAL_RCC_TIM9_IS_CLK_SLEEP_DISABLED
__HAL_RCC_TIM10_IS_CLK_SLEEP_DISABLED
__HAL_RCC_TIM11_IS_CLK_SLEEP_DISABLED
__HAL_RCC_SPI5_IS_CLK_SLEEP_DISABLED
__HAL_RCC_SAI1_IS_CLK_SLEEP_DISABLED
__HAL_RCC_SAI2_IS_CLK_SLEEP_DISABLED
__HAL_RCC_LTDC_IS_CLK_SLEEP_DISABLED
__HAL_RCC_DSI_IS_CLK_SLEEP_DISABLED
__HAL_RCC_SDMMC2_IS_CLK_SLEEP_DISABLED
__HAL_RCC_DFSDM1_IS_CLK_SLEEP_DISABLED
__HAL_RCC_MDIO_IS_CLK_SLEEP_DISABLED
__HAL_RCC_SPI6_IS_CLK_SLEEP_ENABLED
__HAL_RCC_SPI6_IS_CLK_SLEEP_DISABLED

RCC Flags

RCC_FLAG_HSIRDY
 RCC_FLAG_HSERDY
 RCC_FLAG_PLLRDY
 RCC_FLAG_PLLI2SRDY
 RCC_FLAG_PLLSAIRDY
 RCC_FLAG_LSERDY
 RCC_FLAG_LSIRDY
 RCC_FLAG_BORRST
 RCC_FLAG_PINRST
 RCC_FLAG_PORRST
 RCC_FLAG_SFTRST
 RCC_FLAG_IWDGRST
 RCC_FLAG_WWDGRST
 RCC_FLAG_LPWRRST

Flags Interrupts Management

`__HAL_RCC_ENABLE_IT`

Description:

- Enable RCC interrupt (Perform Byte access to RCC_CIR[14:8] bits to enable the selected interrupts).

Parameters:

- `__INTERRUPT__`: specifies the RCC interrupt sources to be enabled. This parameter can be any combination of the following values:
 - `RCC_IT_LSIRDY`: LSI ready interrupt.
 - `RCC_IT_LSERDY`: LSE ready interrupt.
 - `RCC_IT_HSIRDY`: HSI ready interrupt.
 - `RCC_IT_HSERDY`: HSE ready interrupt.
 - `RCC_IT_PLLRDY`: Main PLL ready interrupt.
 - `RCC_IT_PLLI2SRDY`: PLLI2S ready interrupt.

`__HAL_RCC_DISABLE_IT`

Description:

- Disable RCC interrupt (Perform Byte access to RCC_CIR[14:8] bits to disable the selected interrupts).

Parameters:

- `__INTERRUPT__`: specifies the RCC interrupt sources to be disabled. This parameter can be any combination of the following values:
 - `RCC_IT_LSIRDY`: LSI ready interrupt.

- RCC_IT_LSERDY: LSE ready interrupt.
- RCC_IT_HSIRDY: HSI ready interrupt.
- RCC_IT_HSERDY: HSE ready interrupt.
- RCC_IT_PLLRDY: Main PLL ready interrupt.
- RCC_IT_PLLI2SRDY: PLLI2S ready interrupt.

`__HAL_RCC_CLEAR_IT`**Description:**

- Clear the RCC's interrupt pending bits (Perform Byte access to RCC_CIR[23:16] bits to clear the selected interrupt pending bits.

Parameters:

- `__INTERRUPT__`: specifies the interrupt pending bit to clear. This parameter can be any combination of the following values:
 - RCC_IT_LSIRDY: LSI ready interrupt.
 - RCC_IT_LSERDY: LSE ready interrupt.
 - RCC_IT_HSIRDY: HSI ready interrupt.
 - RCC_IT_HSERDY: HSE ready interrupt.
 - RCC_IT_PLLRDY: Main PLL ready interrupt.
 - RCC_IT_PLLI2SRDY: PLLI2S ready interrupt.
 - RCC_IT_CSS: Clock Security System interrupt

`__HAL_RCC_GET_IT`**Description:**

- Check the RCC's interrupt has occurred or not.

Parameters:

- `__INTERRUPT__`: specifies the RCC interrupt source to check. This parameter can be one of the following values:
 - RCC_IT_LSIRDY: LSI ready interrupt.
 - RCC_IT_LSERDY: LSE ready interrupt.
 - RCC_IT_HSIRDY: HSI ready interrupt.
 - RCC_IT_HSERDY: HSE ready interrupt.
 - RCC_IT_PLLRDY: Main PLL ready interrupt.
 - RCC_IT_PLLI2SRDY: PLLI2S ready interrupt.
 - RCC_IT_CSS: Clock Security System interrupt

Return value:

- The: new state of `__INTERRUPT__` (TRUE

or FALSE).

`__HAL_RCC_CLEAR_RESET_FLAGS`

`RCC_FLAG_MASK`

Description:

- Check RCC flag is set or not.

Parameters:

- `__FLAG__`: specifies the flag to check. This parameter can be one of the following values:
 - `RCC_FLAG_HSIRDY`: HSI oscillator clock ready.
 - `RCC_FLAG_HSERDY`: HSE oscillator clock ready.
 - `RCC_FLAG_PLLRDY`: Main PLL clock ready.
 - `RCC_FLAG_PLLI2SRDY`: PLLI2S clock ready.
 - `RCC_FLAG_LSERDY`: LSE oscillator clock ready.
 - `RCC_FLAG_LSIRDY`: LSI oscillator clock ready.
 - `RCC_FLAG_BORRST`: POR/PDR or BOR reset.
 - `RCC_FLAG_PINRST`: Pin reset.
 - `RCC_FLAG_PORRST`: POR/PDR reset.
 - `RCC_FLAG_SFTRST`: Software reset.
 - `RCC_FLAG_IWDGRST`: Independent Watchdog reset.
 - `RCC_FLAG_WWDGRST`: Window Watchdog reset.
 - `RCC_FLAG_LPWRST`: Low Power reset.

Return value:

- The: new state of `__FLAG__` (TRUE or FALSE).

`__HAL_RCC_GET_FLAG`

Get Clock source

`__HAL_RCC_SYSCLK_CONFIG`

Description:

- Macro to configure the system clock source.

Parameters:

- `__RCC_SYSCLKSOURCE__`: specifies the system clock source. This parameter can be one of the following values:
 - `RCC_SYSCLKSOURCE_HSI`: HSI oscillator is used as system clock source.
 - `RCC_SYSCLKSOURCE_HSE`: HSE oscillator is used as system clock source.

-
- RCC_SYSCLOCKSOURCE_PLLCLK: PLL output is used as system clock source.
- `__HAL_RCC_GET_SYSCLOCKSOURCE`
RCE
- Description:**
- Macro to get the clock source used as system clock.
- Return value:**
- The: clock source used as system clock. The returned value can be one of the following:
 - RCC_SYSCLOCKSOURCE_STATUS_HSI: HSI used as system clock.
 - RCC_SYSCLOCKSOURCE_STATUS_HSE: HSE used as system clock.
 - RCC_SYSCLOCKSOURCE_STATUS_PLLCLK: PLL used as system clock.
- `__HAL_RCC_LSEDRIVE_CONFIG`
- Description:**
- Macro to configures the External Low Speed oscillator (LSE) drive capability.
- Parameters:**
- `__RCC_LSEDRIVE__`: specifies the new state of the LSE drive capability. This parameter can be one of the following values:
 - RCC_LSEDRIVE_LOW: LSE oscillator low drive capability.
 - RCC_LSEDRIVE_MEDIUMLOW: LSE oscillator medium low drive capability.
 - RCC_LSEDRIVE_MEDIUMHIGH: LSE oscillator medium high drive capability.
 - RCC_LSEDRIVE_HIGH: LSE oscillator high drive capability.
- Return value:**
- None
- Notes:**
- As the LSE is in the Backup domain and write access is denied to this domain after reset, you have to enable write access using `HAL_PWR_EnableBkUpAccess()` function before to configure the LSE (to be done once after reset).
- `__HAL_RCC_GET_PLL_OSCSOURCE`
RCE
- Description:**
- Macro to get the oscillator used as PLL clock source.
- Return value:**
- The: oscillator used as PLL clock source. The returned value can be one of the following:
 - RCC_PLLSOURCE_HSI: HSI oscillator is used as PLL clock source.

- RCC_PLLSOURCE_HSE: HSE oscillator is used as PLL clock source.

RCC HSE Config

RCC_HSE_OFF

RCC_HSE_ON

RCC_HSE_BYPASS

HSE Configuration

`__HAL_RCC_HSE_CONFIG` **Description:**

- Macro to configure the External High Speed oscillator (HSE).

Parameters:

- `__STATE__`: specifies the new state of the HSE. This parameter can be one of the following values:
 - RCC_HSE_OFF: turn OFF the HSE oscillator, HSERDY flag goes low after 6 HSE oscillator clock cycles.
 - RCC_HSE_ON: turn ON the HSE oscillator.
 - RCC_HSE_BYPASS: HSE oscillator bypassed with external clock.

Notes:

- Transitions HSE Bypass to HSE On and HSE On to HSE Bypass are not supported by this macro. User should request a transition to HSE Off first and then HSE On or HSE Bypass. After enabling the HSE (RCC_HSE_ON or RCC_HSE_Bypass), the application software should wait on HSERDY flag to be set indicating that HSE clock is stable and can be used to clock the PLL and/or system clock. HSE state can not be changed if it is used directly or through the PLL as system clock. In this case, you have to select another source of the system clock then change the HSE state (ex. disable it). The HSE is stopped by hardware when entering STOP and STANDBY modes. This function reset the CSSON bit, so if the clock security system(CSS) was previously enabled you have to enable it again after calling this function.

RCC HSI Config

RCC_HSI_OFF

RCC_HSI_ON

RCC_HSICALIBRATION_DEFAULT

HSI Configuration

`__HAL_RCC_HSI_ENABLE`

Notes:

- The HSI is stopped by hardware when entering STOP and STANDBY modes. It is used (enabled by hardware) as

system clock source after startup from Reset, wakeup from STOP and STANDBY mode, or in case of failure of the HSE used directly or indirectly as system clock (if the Clock Security System CSS is enabled). HSI can not be stopped if it is used as system clock source. In this case, you have to select another source of the system clock then stop the HSI. After enabling the HSI, the application software should wait on HSIRDY flag to be set indicating that HSI clock is stable and can be used as system clock source. When the HSI is stopped, HSIRDY flag goes low after 6 HSI oscillator clock cycles.

`__HAL_RCC_HSI_DISABLE`

`__HAL_RCC_HSI_CALIBRATIONVALUE_ADJUST`

Description:

- Macro to adjust the Internal High Speed oscillator (HSI) calibration value.

Parameters:

- `__HSICALIBRATIONVALUE__`: specifies the calibration trimming value. (default is `RCC_HSICALIBRATION_DEFAULT`).

Notes:

- The calibration is used to compensate for the variations in voltage and temperature that influence the frequency of the internal HSI RC.

RTC Clock Configuration

`__HAL_RCC_RTC_ENABLE`

Notes:

- These macros must be used only after the RTC clock source was selected.

`__HAL_RCC_RTC_DISABLE`

`__HAL_RCC_RTC_CLKPRESCALER`

Description:

- Macros to configure the RTC clock

(RTCCLK).

Parameters:

- `__RTCCLKSource__`: specifies the RTC clock source. This parameter can be one of the following values:
 - `RCC_RTCCLKSOURCE_LSE`: LSE selected as RTC clock.
 - `RCC_RTCCLKSOURCE_LSI`: LSI selected as RTC clock.
 - `RCC_RTCCLKSOURCE_HSE_DIVx`: HSE clock divided by x selected as RTC clock, where x:[2,31]

Notes:

- As the RTC clock configuration bits are in the Backup domain and write access is denied to this domain after reset, you have to enable write access using the Power Backup Access macro before to configure the RTC clock source (to be done once after reset). Once the RTC clock is configured it can't be changed unless the Backup domain is reset using `__HAL_RCC_BackupReset_RELEASE()` macro, or by a Power On Reset (POR).
- If the LSE or LSI is used as RTC clock source, the RTC continues to work in STOP and STANDBY modes, and can be used as wakeup source. However, when the HSE clock is used as RTC clock source, the RTC cannot be used in STOP and STANDBY modes. The maximum input clock frequency for RTC is 1MHz (when using HSE as RTC clock source).

`__HAL_RCC_RTC_CONFIG`

`__HAL_RCC_BACKUPRESET_FORCE`

Notes:

- This function resets the RTC peripheral (including the backup registers) and the RTC clock source selection in `RCC_CSR` register. The BKPSRAM is not affected by this reset.

`__HAL_RCC_BACKUPRESET_RELEASE`

RCC Interrupt

`RCC_IT_LSIRDY`

`RCC_IT_LSERDY`

`RCC_IT_HSIRDY`

RCC_IT_HSERDY
RCC_IT_PLLRDY
RCC_IT_PLLI2SRDY
RCC_IT_PLLSAIRDY
RCC_IT_CSS

RCC Private macros to check input parameters

IS_RCC_OSCILLATORTYPE
IS_RCC_HSE
IS_RCC_LSE
IS_RCC_HSI
IS_RCC_LSI
IS_RCC_PLL
IS_RCC_PLLSOURCE
IS_RCC_SYSCLKSOURCE
IS_RCC_PLLM_VALUE
IS_RCC_PLLN_VALUE
IS_RCC_PLLP_VALUE
IS_RCC_PLLQ_VALUE
IS_RCC_HCLK
IS_RCC_CLOCKTYPE
IS_RCC_PCLK
IS_RCC_MCO
IS_RCC_MCO1SOURCE
IS_RCC_MCO2SOURCE
IS_RCC_MCODIV
IS_RCC_CALIBRATION_VALUE
IS_RCC_RTCCLKSOURCE
IS_RCC_LSE_DRIVE

RCC LSE Drive configurations

RCC_LSEDRIVE_LOW
RCC_LSEDRIVE_MEDIUMLOW
RCC_LSEDRIVE_MEDIUMHIGH
RCC_LSEDRIVE_HIGH

RCC LSE Config

RCC_LSE_OFF
RCC_LSE_ON

RCC_LSE_BYPASS

LSE Configuration

`__HAL_RCC_LSE_CONFIG` **Description:**

- Macro to configure the External Low Speed oscillator (LSE).

Parameters:

- `__STATE__`: specifies the new state of the LSE. This parameter can be one of the following values:
 - `RCC_LSE_OFF`: turn OFF the LSE oscillator, `LSERDY` flag goes low after 6 LSE oscillator clock cycles.
 - `RCC_LSE_ON`: turn ON the LSE oscillator.
 - `RCC_LSE_BYPASS`: LSE oscillator bypassed with external clock.

Notes:

- Transitions LSE Bypass to LSE On and LSE On to LSE Bypass are not supported by this macro. User should request a transition to LSE Off first and then LSE On or LSE Bypass. As the LSE is in the Backup domain and write access is denied to this domain after reset, you have to enable write access using `HAL_PWR_EnableBkUpAccess()` function before to configure the LSE (to be done once after reset). After enabling the LSE (`RCC_LSE_ON` or `RCC_LSE_BYPASS`), the application software should wait on `LSERDY` flag to be set indicating that LSE clock is stable and can be used to clock the RTC.

RCC LSI Config

RCC_LSI_OFF

RCC_LSI_ON

LSI Configuration

`__HAL_RCC_LSI_ENABLE` **Notes:**

- After enabling the LSI, the application software should wait on `LSIRDY` flag to be set indicating that LSI clock is stable and can be used to clock the IWDG and/or the RTC. LSI can not be disabled if the IWDG is running. When the LSI is stopped, `LSIRDY` flag goes low after 6 LSI oscillator clock cycles.

`__HAL_RCC_LSI_DISABLE`

RCC MCO1 Clock Source

RCC_MCO1SOURCE_HSI

RCC_MCO1SOURCE_LSE

RCC_MCO1SOURCE_HSE

RCC_MCO1SOURCE_PLLCLK

RCC MCO2 Clock Source

RCC_MCO2SOURCE_SYSCLK

RCC_MCO2SOURCE_PLLI2SCLK

RCC_MCO2SOURCE_HSE

RCC_MCO2SOURCE_PLLCLK

RCC MCO1 Clock Prescaler

RCC_MCODIV_1

RCC_MCODIV_2

RCC_MCODIV_3

RCC_MCODIV_4

RCC_MCODIV_5

RCC MCO Index

RCC_MCO1

RCC_MCO2

Oscillator Type

RCC_OSCILLATORTYPE_NONE

RCC_OSCILLATORTYPE_HSE

RCC_OSCILLATORTYPE_HSI

RCC_OSCILLATORTYPE_LSE

RCC_OSCILLATORTYPE_LSI

RCC Peripheral Clock Force Release

__HAL_RCC_AHB1_FORCE_RESET

__HAL_RCC_CRC_FORCE_RESET

__HAL_RCC_DMA1_FORCE_RESET

__HAL_RCC_AHB1_RELEASE_RESET

__HAL_RCC_CRC_RELEASE_RESET

__HAL_RCC_DMA1_RELEASE_RESET

RCC Peripheral Clock Sleep Enable Disable

__HAL_RCC_CRC_CLK_SLEEP_ENABLE

__HAL_RCC_DMA1_CLK_SLEEP_ENABLE

__HAL_RCC_CRC_CLK_SLEEP_DISABLE

__HAL_RCC_DMA1_CLK_SLEEP_DISABLE

__HAL_RCC_WWDG_CLK_SLEEP_ENABLE

Notes:

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the

peripheral clock is enabled again.
By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_PWR_CLK_SLEEP_ENABLE
__HAL_RCC_WWDG_CLK_SLEEP_DISABLE
__HAL_RCC_PWR_CLK_SLEEP_DISABLE
__HAL_RCC_SYSCFG_CLK_SLEEP_ENABLE

Notes:

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the peripheral clock is enabled again. By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_SYSCFG_CLK_SLEEP_DISABLE

PLL Clock Divider

RCC_PLLP_DIV2
RCC_PLLP_DIV4
RCC_PLLP_DIV6
RCC_PLLP_DIV8

PLL Clock Source

RCC_PLLSOURCE_HSI
RCC_PLLSOURCE_HSE

RCC PLL Config

RCC_PLL_NONE
RCC_PLL_OFF
RCC_PLL_ON

PLL Configuration

__HAL_RCC_PLL_ENABLE

Notes:

- After enabling the main PLL, the application software should wait on PLLRDY flag to be set indicating that PLL clock is stable and can be used as system clock source. The main PLL can not be disabled if it is used as system clock source. The main PLL is disabled by hardware when entering STOP and STANDBY modes.

__HAL_RCC_PLL_DISABLE

`__HAL_RCC_PLL_PLLSOURCE_CONFIG`**Description:**

- Macro to configure the PLL clock source.

Parameters:

- `__PLLSOURCE__`: specifies the PLL entry clock source. This parameter can be one of the following values:
 - `RCC_PLLSOURCE_HSI`: HSI oscillator clock selected as PLL clock entry
 - `RCC_PLLSOURCE_HSE`: HSE oscillator clock selected as PLL clock entry

Notes:

- This function must be used only when the main PLL is disabled.

`__HAL_RCC_PLL_PLLM_CONFIG`**Description:**

- Macro to configure the PLL multiplication factor.

Parameters:

- `__PLLM__`: specifies the division factor for PLL VCO input clock. This parameter must be a number between `Min_Data = 2` and `Max_Data = 63`.

Notes:

- This function must be used only when the main PLL is disabled.
- You have to set the `PLLM` parameter correctly to ensure that the VCO input frequency ranges from 1 to 2 MHz. It is recommended to select a frequency of 2 MHz to limit PLL jitter.

PLL I2S Configuration`__HAL_RCC_I2S_CONFIG`**Description:**

- Macro to configure the I2S clock source (I2SCLK).

Parameters:

- `__SOURCE__`: specifies the I2S clock source. This parameter can be one of the following values:
 - `RCC_I2SCLKSOURCE_PLLI2S`: PLLI2S clock used as I2S clock source.
 - `RCC_I2SCLKSOURCE_EXT`: External clock mapped on the I2S_CKIN pin used as I2S clock source.

Notes:

- This function must be called before enabling the

I2S APB clock.

__HAL_RCC_PLLI2S_ENABLE **Notes:**

- The PLLI2S is disabled by hardware when entering STOP and STANDBY modes.

__HAL_RCC_PLLI2S_DISABLE

RCC RTC Clock Source

RCC_RTCCLKSOURCE_LSE

RCC_RTCCLKSOURCE_LSI

RCC_RTCCLKSOURCE_HSE_DIV2

RCC_RTCCLKSOURCE_HSE_DIV3

RCC_RTCCLKSOURCE_HSE_DIV4

RCC_RTCCLKSOURCE_HSE_DIV5

RCC_RTCCLKSOURCE_HSE_DIV6

RCC_RTCCLKSOURCE_HSE_DIV7

RCC_RTCCLKSOURCE_HSE_DIV8

RCC_RTCCLKSOURCE_HSE_DIV9

RCC_RTCCLKSOURCE_HSE_DIV10

RCC_RTCCLKSOURCE_HSE_DIV11

RCC_RTCCLKSOURCE_HSE_DIV12

RCC_RTCCLKSOURCE_HSE_DIV13

RCC_RTCCLKSOURCE_HSE_DIV14

RCC_RTCCLKSOURCE_HSE_DIV15

RCC_RTCCLKSOURCE_HSE_DIV16

RCC_RTCCLKSOURCE_HSE_DIV17

RCC_RTCCLKSOURCE_HSE_DIV18

RCC_RTCCLKSOURCE_HSE_DIV19

RCC_RTCCLKSOURCE_HSE_DIV20

RCC_RTCCLKSOURCE_HSE_DIV21

RCC_RTCCLKSOURCE_HSE_DIV22

RCC_RTCCLKSOURCE_HSE_DIV23

RCC_RTCCLKSOURCE_HSE_DIV24

RCC_RTCCLKSOURCE_HSE_DIV25

RCC_RTCCLKSOURCE_HSE_DIV26

RCC_RTCCLKSOURCE_HSE_DIV27

RCC_RTCCLKSOURCE_HSE_DIV28

RCC_RTCCLKSOURCE_HSE_DIV29

RCC_RTCCLKSOURCE_HSE_DIV30

RCC_RTCCLKSOURCE_HSE_DIV31

RCC System Clock Source

RCC_SYSCLKSOURCE_HSI

RCC_SYSCLKSOURCE_HSE

RCC_SYSCLKSOURCE_PLLCLK

System Clock Source Status

RCC_SYSCLKSOURCE_STATUS_HSI HSI used as system clock

RCC_SYSCLKSOURCE_STATUS_HSE HSE used as system clock

RCC_SYSCLKSOURCE_STATUS_PLLCLK PLL used as system clock

RCC System Clock Type

RCC_CLOCKTYPE_SYSCLK

RCC_CLOCKTYPE_HCLK

RCC_CLOCKTYPE_PCLK1

RCC_CLOCKTYPE_PCLK2

51 HAL RCC Extension Driver

51.1 RCCEX Firmware driver registers structures

51.1.1 RCC_PLLInitTypeDef

Data Fields

- *uint32_t PLLState*
- *uint32_t PLLSource*
- *uint32_t PLLM*
- *uint32_t PLLN*
- *uint32_t PLLP*
- *uint32_t PLLQ*
- *uint32_t PLLR*

Field Documentation

- *uint32_t RCC_PLLInitTypeDef::PLLState*
The new state of the PLL. This parameter can be a value of [RCC_PLL_Config](#)
- *uint32_t RCC_PLLInitTypeDef::PLLSource*
RCC_PLLSource: PLL entry clock source. This parameter must be a value of [RCC_PLL_Clock_Source](#)
- *uint32_t RCC_PLLInitTypeDef::PLLM*
PLLM: Division factor for PLL VCO input clock. This parameter must be a number between Min_Data = 2 and Max_Data = 63
- *uint32_t RCC_PLLInitTypeDef::PLLN*
PLLN: Multiplication factor for PLL VCO output clock. This parameter must be a number between Min_Data = 50 and Max_Data = 432
- *uint32_t RCC_PLLInitTypeDef::PLLP*
PLLP: Division factor for main system clock (SYSCLK). This parameter must be a value of [RCC_PLLP_Clock_Divider](#)
- *uint32_t RCC_PLLInitTypeDef::PLLQ*
PLLQ: Division factor for OTG FS, SDMMC and RNG clocks. This parameter must be a number between Min_Data = 2 and Max_Data = 15
- *uint32_t RCC_PLLInitTypeDef::PLLR*
PLLR: Division factor for DSI clock. This parameter must be a number between Min_Data = 2 and Max_Data = 7

51.1.2 RCC_PLLI2SInitTypeDef

Data Fields

- *uint32_t PLLI2SN*
- *uint32_t PLLI2SR*
- *uint32_t PLLI2SQ*
- *uint32_t PLLI2SP*

Field Documentation

- *uint32_t RCC_PLLI2SInitTypeDef::PLLI2SN*
Specifies the multiplication factor for PLLI2S VCO output clock. This parameter must be a number between Min_Data = 50 and Max_Data = 432. This parameter will be used only when PLLI2S is selected as Clock Source I2S or SAI

- ***uint32_t RCC_PLLI2SInitTypeDef::PLLI2SR***
Specifies the division factor for I2S clock. This parameter must be a number between Min_Data = 2 and Max_Data = 7. This parameter will be used only when PLLI2S is selected as Clock Source I2S or SAI
- ***uint32_t RCC_PLLI2SInitTypeDef::PLLI2SQ***
Specifies the division factor for SAI1 clock. This parameter must be a number between Min_Data = 2 and Max_Data = 15. This parameter will be used only when PLLI2S is selected as Clock Source SAI
- ***uint32_t RCC_PLLI2SInitTypeDef::PLLI2SP***
Specifies the division factor for SPDIF-RX clock. This parameter must be a value of [RCCEX_PLLI2SP_Clock_Divider](#). This parameter will be used only when PLLI2S is selected as Clock Source SPDIF-RX

51.1.3 RCC_PLLSAIInitTypeDef

Data Fields

- ***uint32_t PLLSAIN***
- ***uint32_t PLLSAIQ***
- ***uint32_t PLLSAIR***
- ***uint32_t PLLSAIP***

Field Documentation

- ***uint32_t RCC_PLLSAIInitTypeDef::PLLSAIN***
Specifies the multiplication factor for PLLI2S VCO output clock. This parameter must be a number between Min_Data = 50 and Max_Data = 432. This parameter will be used only when PLLSAI is selected as Clock Source SAI or LTDC
- ***uint32_t RCC_PLLSAIInitTypeDef::PLLSAIQ***
Specifies the division factor for SAI1 clock. This parameter must be a number between Min_Data = 2 and Max_Data = 15. This parameter will be used only when PLLSAI is selected as Clock Source SAI or LTDC
- ***uint32_t RCC_PLLSAIInitTypeDef::PLLSAIR***
specifies the division factor for LTDC clock This parameter must be a number between Min_Data = 2 and Max_Data = 7. This parameter will be used only when PLLSAI is selected as Clock Source LTDC
- ***uint32_t RCC_PLLSAIInitTypeDef::PLLSAIP***
Specifies the division factor for 48MHz clock. This parameter must be a value of [RCCEX_PLLSAIP_Clock_Divider](#) This parameter will be used only when PLLSAI is disabled

51.1.4 RCC_PeriphCLKInitTypeDef

Data Fields

- ***uint32_t PeriphClockSelection***
- ***RCC_PLLI2SInitTypeDef PLLI2S***
- ***RCC_PLLSAIInitTypeDef PLLSAI***
- ***uint32_t PLLI2SDivQ***
- ***uint32_t PLLSAIDivQ***
- ***uint32_t PLLSAIDivR***
- ***uint32_t RTCClockSelection***
- ***uint32_t I2sClockSelection***
- ***uint32_t TIMPresSelection***
- ***uint32_t Sai1ClockSelection***
- ***uint32_t Sai2ClockSelection***
- ***uint32_t Usart1ClockSelection***

- *uint32_t Usart2ClockSelection*
- *uint32_t Usart3ClockSelection*
- *uint32_t Uart4ClockSelection*
- *uint32_t Uart5ClockSelection*
- *uint32_t Usart6ClockSelection*
- *uint32_t Uart7ClockSelection*
- *uint32_t Uart8ClockSelection*
- *uint32_t I2c1ClockSelection*
- *uint32_t I2c2ClockSelection*
- *uint32_t I2c3ClockSelection*
- *uint32_t I2c4ClockSelection*
- *uint32_t Lptim1ClockSelection*
- *uint32_t CecClockSelection*
- *uint32_t Clk48ClockSelection*
- *uint32_t Sdmmc1ClockSelection*
- *uint32_t Sdmmc2ClockSelection*
- *uint32_t Dfsdm1ClockSelection*
- *uint32_t Dfsdm1AudioClockSelection*

Field Documentation

- *uint32_t RCC_PeriphCLKInitTypeDef::PeriphClockSelection*
The Extended Clock to be configured. This parameter can be a value of [RCCEX_Periph_Clock_Selection](#)
- *RCC_PLLI2SInitTypeDef RCC_PeriphCLKInitTypeDef::PLLI2S*
PLL I2S structure parameters. This parameter will be used only when PLLI2S is selected as Clock Source I2S or SAI
- *RCC_PLLSAIInitTypeDef RCC_PeriphCLKInitTypeDef::PLLSAI*
PLL SAI structure parameters. This parameter will be used only when PLLI2S is selected as Clock Source SAI or LTDC
- *uint32_t RCC_PeriphCLKInitTypeDef::PLLI2SDivQ*
Specifies the PLLI2S division factor for SAI1 clock. This parameter must be a number between Min_Data = 1 and Max_Data = 32 This parameter will be used only when PLLI2S is selected as Clock Source SAI
- *uint32_t RCC_PeriphCLKInitTypeDef::PLLSAIDivQ*
Specifies the PLLI2S division factor for SAI1 clock. This parameter must be a number between Min_Data = 1 and Max_Data = 32 This parameter will be used only when PLLSAI is selected as Clock Source SAI
- *uint32_t RCC_PeriphCLKInitTypeDef::PLLSAIDivR*
Specifies the PLLSAI division factor for LTDC clock. This parameter must be one value of [RCCEX_PLLSAI_DIVR](#)
- *uint32_t RCC_PeriphCLKInitTypeDef::RTCClockSelection*
Specifies RTC Clock source Selection. This parameter can be a value of [RCC_RTC_Clock_Source](#)
- *uint32_t RCC_PeriphCLKInitTypeDef::I2sClockSelection*
Specifies I2S Clock source Selection. This parameter can be a value of [RCCEX_I2S_Clock_Source](#)
- *uint32_t RCC_PeriphCLKInitTypeDef::TIMPresSelection*
Specifies TIM Clock Prescalers Selection. This parameter can be a value of [RCCEX_TIM_Prescaler_Selection](#)
- *uint32_t RCC_PeriphCLKInitTypeDef::Sai1ClockSelection*
Specifies SAI1 Clock Prescalers Selection This parameter can be a value of [RCCEX_SAI1_Clock_Source](#)

- ***uint32_t RCC_PeriphCLKInitTypeDef::Sai2ClockSelection***
Specifies SAI2 Clock Prescalers Selection This parameter can be a value of [RCCEx_SAI2_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::Usart1ClockSelection***
USART1 clock source This parameter can be a value of [RCCEx_USART1_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::Usart2ClockSelection***
USART2 clock source This parameter can be a value of [RCCEx_USART2_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::Usart3ClockSelection***
USART3 clock source This parameter can be a value of [RCCEx_USART3_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::Uart4ClockSelection***
UART4 clock source This parameter can be a value of [RCCEx_UART4_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::Uart5ClockSelection***
UART5 clock source This parameter can be a value of [RCCEx_UART5_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::Usart6ClockSelection***
USART6 clock source This parameter can be a value of [RCCEx_USART6_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::Uart7ClockSelection***
UART7 clock source This parameter can be a value of [RCCEx_UART7_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::Uart8ClockSelection***
UART8 clock source This parameter can be a value of [RCCEx_UART8_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::I2c1ClockSelection***
I2C1 clock source This parameter can be a value of [RCCEx_I2C1_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::I2c2ClockSelection***
I2C2 clock source This parameter can be a value of [RCCEx_I2C2_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::I2c3ClockSelection***
I2C3 clock source This parameter can be a value of [RCCEx_I2C3_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::I2c4ClockSelection***
I2C4 clock source This parameter can be a value of [RCCEx_I2C4_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::Lptim1ClockSelection***
Specifies LPTIM1 clock source This parameter can be a value of [RCCEx_LPTIM1_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::CecClockSelection***
CEC clock source This parameter can be a value of [RCCEx_CEC_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::Clk48ClockSelection***
Specifies 48Mhz clock source used by USB OTG FS, RNG and SDMMC This parameter can be a value of [RCCEx_CLK48_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::Sdmmc1ClockSelection***
SDMMC1 clock source This parameter can be a value of [RCCEx_SDMMC1_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::Sdmmc2ClockSelection***
SDMMC2 clock source This parameter can be a value of [RCCEx_SDMMC2_Clock_Source](#)
- ***uint32_t RCC_PeriphCLKInitTypeDef::Dfsdm1ClockSelection***
DFSDM1 clock source This parameter can be a value of [RCCEx_DFSDM1_Kernel_Clock_Source](#)

- ***uint32_t RCC_PeriphCLKInitTypeDef::Dfsdm1AudioClockSelection***
 DFSDM1 clock source This parameter can be a value of [RCCEx_DFSDM1_AUDIO_Clock_Source](#)

51.2 RCCEx Firmware driver API description

51.2.1 Extended Peripheral Control functions

This subsection provides a set of functions allowing to control the RCC Clocks frequencies.



Important note: Care must be taken when HAL_RCCEx_PeriphCLKConfig() is used to select the RTC clock source; in this case the Backup domain will be reset in order to modify the RTC Clock source, as consequence RTC registers (including the backup registers) and RCC_BDCR register will be set to their reset values.

This section contains the following APIs:

- [HAL_RCCEx_PeriphCLKConfig\(\)](#)
- [HAL_RCCEx_GetPeriphCLKConfig\(\)](#)
- [HAL_RCCEx_GetPeriphCLKFreq\(\)](#)

51.2.2 Detailed description of functions

HAL_RCCEx_PeriphCLKConfig

Function name	HAL_StatusTypeDef HAL_RCCEx_PeriphCLKConfig (RCC_PeriphCLKInitTypeDef * PeriphClkInit)
Function description	Initializes the RCC extended peripherals clocks according to the specified parameters in the RCC_PeriphCLKInitTypeDef.
Parameters	<ul style="list-style-type: none"> • PeriphClkInit: pointer to an RCC_PeriphCLKInitTypeDef structure that contains the configuration information for the Extended Peripherals clocks(I2S, SAI, LTDC, RTC, TIM, UARTs, USARTs, LTPIM, SDMMC...).
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • Care must be taken when HAL_RCCEx_PeriphCLKConfig() is used to select the RTC clock source; in this case the Backup domain will be reset in order to modify the RTC Clock source, as consequence RTC registers (including the backup registers) are set to their reset values.

HAL_RCCEx_GetPeriphCLKConfig

Function name	void HAL_RCCEx_GetPeriphCLKConfig (RCC_PeriphCLKInitTypeDef * PeriphClkInit)
Function description	Get the RCC_PeriphCLKInitTypeDef according to the internal RCC configuration registers.
Parameters	<ul style="list-style-type: none"> • PeriphClkInit: pointer to the configured RCC_PeriphCLKInitTypeDef structure

Return values

- **None:**

HAL_RCCEX_GetPeriphCLKFreq

Function name **uint32_t HAL_RCCEX_GetPeriphCLKFreq (uint32_t PeriphClk)**

Function description Return the peripheral clock frequency for a given peripheral(SAI..)

Parameters

- **PeriphClk:** Peripheral clock identifier This parameter can be one of the following values:
 - RCC_PERIPHCLK_SAI1: SAI1 peripheral clock
 - RCC_PERIPHCLK_SAI2: SAI2 peripheral clock

Return values

- **Frequency:** in KHz

Notes

- Return 0 if peripheral clock identifier not managed by this API

51.3 RCCEX Firmware driver defines

51.3.1 RCCEX

RCCEX CEC Clock Source

RCC_CECCLKSOURCE_LSE

RCC_CECCLKSOURCE_HSI

RCCEX CLK48 Clock Source

RCC_CLK48SOURCE_PLL

RCC_CLK48SOURCE_PLLSAIP

RCCEX DFSDM1 AUDIO Clock Source

RCC_DFSDM1AUDIOCLKSOURCE_SAI1

RCC_DFSDM1AUDIOCLKSOURCE_SAI2

RCCEX DFSDM1 Kernel Clock Source

RCC_DFSDM1CLKSOURCE_PCLK2

RCC_DFSDM1CLKSOURCE_SYSCLK

RCC DSI Clock Source

RCC_DSICLKSOURCE_DSIPHY

RCC_DSICLKSOURCE_PLLR

RCCEX Exported Macros

__HAL_RCC_PLL_CONFIG

Description:

- Macro to configure the main PLL clock source, multiplication and division factors.

Parameters:

- `__RCC_PLLSource__`: specifies the PLL entry clock source. This parameter can be one of the following values:
 - `RCC_PLLSOURCE_HSI`: HSI oscillator clock selected as PLL clock

- entry
- RCC_PLLSOURCE_HSE: HSE oscillator clock selected as PLL clock entry
- __PLLM__: specifies the division factor for PLL VCO input clock This parameter must be a number between Min_Data = 2 and Max_Data = 63.
- __PLLN__: specifies the multiplication factor for PLL VCO output clock This parameter must be a number between Min_Data = 50 and Max_Data = 432.
- __PLLQ__: specifies the division factor for main system clock (SYSCLK) This parameter must be a number in the range {2, 4, 6, or 8}.
- __PLLQ__: specifies the division factor for OTG FS, SDMMC and RNG clocks This parameter must be a number between Min_Data = 2 and Max_Data = 15.
- __PLLQ__: specifies the division factor for DSI clock This parameter must be a number between Min_Data = 2 and Max_Data = 7.

Notes:

- This function must be used only when the main PLL is disabled.
- This clock source (RCC_PLLSource) is common for the main PLL and PLLI2S.
- You have to set the PLLM parameter correctly to ensure that the VCO input frequency ranges from 1 to 2 MHz. It is recommended to select a frequency of 2 MHz to limit PLL jitter.
- You have to set the PLLN parameter correctly to ensure that the VCO output frequency is between 100 and 432 MHz.
- You have to set the PLLP parameter correctly to not exceed 216 MHz on the System clock frequency.
- If the USB OTG FS is used in your application, you have to set the PLLQ parameter correctly to have 48 MHz clock for the USB. However, the SDMMC and RNG need a frequency lower than or equal to 48 MHz to work correctly.

__HAL_RCC_TIMCLKPRESCALER**Description:**

- Macro to configure the Timers clocks prescalers.

Parameters:

- __PRESC__: : specifies the Timers clocks prescalers selection This parameter can

be one of the following values:

- **RCC_TIMPRES_DESACTIVATED:** The Timers kernels clocks prescaler is equal to HPRE if PPREx is corresponding to division by 1 or 2, else it is equal to $[(HPRE * PPREx) / 2]$ if PPREx is corresponding to division by 4 or more.
- **RCC_TIMPRES_ACTIVATED:** The Timers kernels clocks prescaler is equal to HPRE if PPREx is corresponding to division by 1, 2 or 4, else it is equal to $[(HPRE * PPREx) / 4]$ if PPREx is corresponding to division by 8 or more.

`__HAL_RCC_PLLSAI_ENABLE`

Notes:

- The PLLSAI is disabled by hardware when entering STOP and STANDBY modes.

`__HAL_RCC_PLLSAI_DISABLE`

`__HAL_RCC_PLLSAI_CONFIG`

Description:

- Macro to configure the PLLSAI clock multiplication and division factors.

Parameters:

- `__PLLSAIN__`: specifies the multiplication factor for PLLSAI VCO output clock. This parameter must be a number between `Min_Data = 50` and `Max_Data = 432`.
- `__PLLSAIP__`: specifies the division factor for USB, RNG, SDMMC clocks This parameter can be a value of
- `__PLLSAIQ__`: specifies the division factor for SAI clock This parameter must be a number between `Min_Data = 2` and `Max_Data = 15`.
- `__PLLSAIR__`: specifies the division factor for LTDC clock This parameter must be a number between `Min_Data = 2` and `Max_Data = 7`.

Notes:

- This function must be used only when the PLLSAI is disabled. PLLSAI clock source is common with the main PLL (configured in `RCC_PLLConfig` function)
- You have to set the `PLLSAIN` parameter correctly to ensure that the VCO output frequency is between `Min_Data = 100` and `Max_Data = 432` MHz.

`__HAL_RCC_PLLI2S_CONFIG`**Description:**

- Macro to configure the PLLI2S clock multiplication and division factors.

Parameters:

- `__PLLI2SN__`: specifies the multiplication factor for PLLI2S VCO output clock. This parameter must be a number between `Min_Data = 50` and `Max_Data = 432`.
- `__PLLI2SP__`: specifies the division factor for SPDDIF-RX clock. This parameter can be a value of
- `__PLLI2SQ__`: specifies the division factor for SAI clock. This parameter must be a number between `Min_Data = 2` and `Max_Data = 15`.
- `__PLLI2SR__`: specifies the division factor for I2S clock. This parameter must be a number between `Min_Data = 2` and `Max_Data = 7`.

Notes:

- This macro must be used only when the PLLI2S is disabled. PLLI2S clock source is common with the main PLL (configured in `HAL_RCC_ClockConfig()` API)
- You have to set the PLLI2SN parameter correctly to ensure that the VCO output frequency is between `Min_Data = 100` and `Max_Data = 432` MHz.
- You have to set the PLLI2SR parameter correctly to not exceed 192 MHz on the I2S clock frequency.

`__HAL_RCC_PLLI2S_PLLSAICLKDIVQ_CONFIG`**Description:**

- Macro to configure the SAI clock Divider coming from PLLI2S.

Parameters:

- `__PLLI2SDivQ__`: specifies the PLLI2S division factor for SAI1 clock. This parameter must be a number between 1 and 32. SAI1 clock frequency = $f(\text{PLLI2SQ}) / \text{__PLLI2SDivQ__}$

Notes:

- This function must be called before enabling the PLLI2S.

`__HAL_RCC_PLLSAI_PLLSAICLKDIVQ_CONFIG`**Description:**

- Macro to configure the SAI clock Divider coming from PLLSAI.

Parameters:

<p><code>__HAL_RCC_PLLSAI_PLLSAICLKDIVR_CONFIG</code></p>	<ul style="list-style-type: none"> • <code>__PLLSAIDivQ__</code>: specifies the PLLSAI division factor for SAI1 clock . This parameter must be a number between <code>Min_Data = 1</code> and <code>Max_Data = 32</code>. SAI1 clock frequency = $f(\text{PLLSAIQ}) / \text{__PLLSAIDivQ__}$ <p>Notes:</p> <ul style="list-style-type: none"> • This function must be called before enabling the PLLSAI. <p>Description:</p> <ul style="list-style-type: none"> • Macro to configure the LTDC clock Divider coming from PLLSAI. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__PLLSAIDivR__</code>: specifies the PLLSAI division factor for LTDC clock . This parameter can be a value of <p>Notes:</p> <ul style="list-style-type: none"> • This function must be called before enabling the PLLSAI.
<p><code>__HAL_RCC_SAI1_CONFIG</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Macro to configure SAI1 clock source selection. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__SOURCE__</code>: specifies the SAI1 clock source. This parameter can be one of the following values: <ul style="list-style-type: none"> – <code>RCC_SAI1CLKSOURCE_PLLI2S</code>: PLLI2S_Q clock divided by PLLI2SDIVQ used as SAI1 clock. – <code>RCC_SAI1CLKSOURCE_PLLSAI</code>: PLLISAI_Q clock divided by PLLSAIDIVQ used as SAI1 clock. – <code>RCC_SAI1CLKSOURCE_PIN</code>: External clock mapped on the I2S_CKIN pin used as SAI1 clock. – <code>RCC_SAI1CLKSOURCE_PLLSRC</code>: HSI or HSE depending from PLL Source clock used as SAI1 clock. <p>Notes:</p> <ul style="list-style-type: none"> • This function must be called before enabling PLLSAI, PLLI2S and the SAI clock. • The <code>RCC_SAI1CLKSOURCE_PLLSRC</code> value is only available with STM32F767/769/777/779xx Devices
<p><code>__HAL_RCC_GET_SAI1_SOURCE</code></p>	<p>Description:</p>

- Macro to get the SAI1 clock source.

Return value:

- The: clock source can be one of the following values:
 - RCC_SAI1CLKSOURCE_PLLI2S: PLLI2S_Q clock divided by PLLI2SDIVQ used as SAI1 clock.
 - RCC_SAI1CLKSOURCE_PLLSAI: PLLISAI_Q clock divided by PLLSAIDIVQ used as SAI1 clock.
 - RCC_SAI1CLKSOURCE_PIN: External clock mapped on the I2S_CKIN pin used as SAI1 clock.
 - RCC_SAI1CLKSOURCE_PLLSRC: HSI or HSE depending from PLL Source clock used as SAI1 clock.

Notes:

- The RCC_SAI1CLKSOURCE_PLLSRC value is only available with STM32F767/769/777/779xx Devices

Description:

- Macro to configure SAI2 clock source selection.

Parameters:

- `__SOURCE__`: specifies the SAI2 clock source. This parameter can be one of the following values:
 - RCC_SAI2CLKSOURCE_PLLI2S: PLLI2S_Q clock divided by PLLI2SDIVQ used as SAI2 clock.
 - RCC_SAI2CLKSOURCE_PLLSAI: PLLISAI_Q clock divided by PLLSAIDIVQ used as SAI2 clock.
 - RCC_SAI2CLKSOURCE_PIN: External clock mapped on the I2S_CKIN pin used as SAI2 clock.
 - RCC_SAI2CLKSOURCE_PLLSRC: HSI or HSE depending from PLL Source clock used as SAI2 clock.

Notes:

- This function must be called before enabling PLLSAI, PLLI2S and the SAI clock.
- The RCC_SAI2CLKSOURCE_PLLSRC value is only available with STM32F767/769/777/779xx Devices

Description:

- Macro to get the SAI2 clock source.

`__HAL_RCC_SAI2_CONFIG``__HAL_RCC_GET_SAI2_SOURCE`

Return value:

- The: clock source can be one of the following values:
 - RCC_SAI2CLKSOURCE_PLLI2S: PLLI2S_Q clock divided by PLLI2SDIVQ used as SAI2 clock.
 - RCC_SAI2CLKSOURCE_PLLSAI: PLLISAI_Q clock divided by PLLSAIDIVQ used as SAI2 clock.
 - RCC_SAI2CLKSOURCE_PIN: External clock mapped on the I2S_CKIN pin used as SAI2 clock.
 - RCC_SAI2CLKSOURCE_PLLSRC: HSI or HSE depending from PLL Source clock used as SAI2 clock.

Notes:

- The RCC_SAI2CLKSOURCE_PLLSRC value is only available with STM32F767/769/777/779xx Devices

__HAL_RCC_PLLSAI_ENABLE_IT
 __HAL_RCC_PLLSAI_DISABLE_IT
 __HAL_RCC_PLLSAI_CLEAR_IT
 __HAL_RCC_PLLSAI_GET_IT

Description:

- Check the PLLSAI RDY interrupt has occurred or not.

Return value:

- The: new state (TRUE or FALSE).

Description:

- Check PLLSAI RDY flag is set or not.

Return value:

- The: new state (TRUE or FALSE).

Description:

- Macro to Get I2S clock source selection.

Return value:

- The: clock source can be one of the following values:
 - RCC_I2SCLKSOURCE_PLLI2S: PLLI2S VCO output clock divided by PLLI2SR used as I2S clock.
 - RCC_I2SCLKSOURCE_EXT: External clock mapped on the I2S_CKIN pin used as I2S clock source

Description:

__HAL_RCC_PLLSAI_GET_FLAG

 __HAL_RCC_GET_I2SCLKSOURCE

 __HAL_RCC_I2C1_CONFIG

- Macro to configure the I2C1 clock (I2C1CLK).

Parameters:

- `__I2C1_CLKSOURCE__`: specifies the I2C1 clock source. This parameter can be one of the following values:
 - `RCC_I2C1CLKSOURCE_PCLK1`: PCLK1 selected as I2C1 clock
 - `RCC_I2C1CLKSOURCE_HSI`: HSI selected as I2C1 clock
 - `RCC_I2C1CLKSOURCE_SYSCLK`: System Clock selected as I2C1 clock

`__HAL_RCC_GET_I2C1_SOURCE`**Description:**

- Macro to get the I2C1 clock source.

Return value:

- The: clock source can be one of the following values:
 - `RCC_I2C1CLKSOURCE_PCLK1`: PCLK1 selected as I2C1 clock
 - `RCC_I2C1CLKSOURCE_HSI`: HSI selected as I2C1 clock
 - `RCC_I2C1CLKSOURCE_SYSCLK`: System Clock selected as I2C1 clock

`__HAL_RCC_I2C2_CONFIG`**Description:**

- Macro to configure the I2C2 clock (I2C2CLK).

Parameters:

- `__I2C2_CLKSOURCE__`: specifies the I2C2 clock source. This parameter can be one of the following values:
 - `RCC_I2C2CLKSOURCE_PCLK1`: PCLK1 selected as I2C2 clock
 - `RCC_I2C2CLKSOURCE_HSI`: HSI selected as I2C2 clock
 - `RCC_I2C2CLKSOURCE_SYSCLK`: System Clock selected as I2C2 clock

`__HAL_RCC_GET_I2C2_SOURCE`**Description:**

- Macro to get the I2C2 clock source.

Return value:

- The: clock source can be one of the following values:
 - `RCC_I2C2CLKSOURCE_PCLK1`: PCLK1 selected as I2C2 clock
 - `RCC_I2C2CLKSOURCE_HSI`: HSI selected as I2C2 clock
 - `RCC_I2C2CLKSOURCE_SYSCLK`: System Clock selected as I2C2 clock

System Clock selected as I2C2 clock

__HAL_RCC_I2C3_CONFIG

Description:

- Macro to configure the I2C3 clock (I2C3CLK).

Parameters:

- `__I2C3_CLKSOURCE__`: specifies the I2C3 clock source. This parameter can be one of the following values:
 - `RCC_I2C3CLKSOURCE_PCLK1`: PCLK1 selected as I2C3 clock
 - `RCC_I2C3CLKSOURCE_HSI`: HSI selected as I2C3 clock
 - `RCC_I2C3CLKSOURCE_SYSCLK`: System Clock selected as I2C3 clock

__HAL_RCC_GET_I2C3_SOURCE

Description:

- macro to get the I2C3 clock source.

Return value:

- The: clock source can be one of the following values:
 - `RCC_I2C3CLKSOURCE_PCLK1`: PCLK1 selected as I2C3 clock
 - `RCC_I2C3CLKSOURCE_HSI`: HSI selected as I2C3 clock
 - `RCC_I2C3CLKSOURCE_SYSCLK`: System Clock selected as I2C3 clock

__HAL_RCC_I2C4_CONFIG

Description:

- Macro to configure the I2C4 clock (I2C4CLK).

Parameters:

- `__I2C4_CLKSOURCE__`: specifies the I2C4 clock source. This parameter can be one of the following values:
 - `RCC_I2C4CLKSOURCE_PCLK1`: PCLK1 selected as I2C4 clock
 - `RCC_I2C4CLKSOURCE_HSI`: HSI selected as I2C4 clock
 - `RCC_I2C4CLKSOURCE_SYSCLK`: System Clock selected as I2C4 clock

__HAL_RCC_GET_I2C4_SOURCE

Description:

- macro to get the I2C4 clock source.

Return value:

- The: clock source can be one of the following values:
 - `RCC_I2C4CLKSOURCE_PCLK1`: PCLK1 selected as I2C4 clock
 - `RCC_I2C4CLKSOURCE_HSI`: HSI

`__HAL_RCC_USART1_CONFIG`

- selected as I2C4 clock
- `RCC_I2C4CLKSOURCE_SYSCLK`: System Clock selected as I2C4 clock

Description:

- Macro to configure the USART1 clock (USART1CLK).

Parameters:

- `__USART1_CLKSOURCE__`: specifies the USART1 clock source. This parameter can be one of the following values:
 - `RCC_USART1CLKSOURCE_PCLK2`: PCLK2 selected as USART1 clock
 - `RCC_USART1CLKSOURCE_HSI`: HSI selected as USART1 clock
 - `RCC_USART1CLKSOURCE_SYSC LK`: System Clock selected as USART1 clock
 - `RCC_USART1CLKSOURCE_LSE`: LSE selected as USART1 clock

`__HAL_RCC_GET_USART1_SOURCE`**Description:**

- macro to get the USART1 clock source.

Return value:

- The: clock source can be one of the following values:
 - `RCC_USART1CLKSOURCE_PCLK2`: PCLK2 selected as USART1 clock
 - `RCC_USART1CLKSOURCE_HSI`: HSI selected as USART1 clock
 - `RCC_USART1CLKSOURCE_SYSC LK`: System Clock selected as USART1 clock
 - `RCC_USART1CLKSOURCE_LSE`: LSE selected as USART1 clock

`__HAL_RCC_USART2_CONFIG`**Description:**

- Macro to configure the USART2 clock (USART2CLK).

Parameters:

- `__USART2_CLKSOURCE__`: specifies the USART2 clock source. This parameter can be one of the following values:
 - `RCC_USART2CLKSOURCE_PCLK1`: PCLK1 selected as USART2 clock
 - `RCC_USART2CLKSOURCE_HSI`: HSI selected as USART2 clock
 - `RCC_USART2CLKSOURCE_SYSC LK`: System Clock selected as USART2 clock
 - `RCC_USART2CLKSOURCE_LSE`:

LSE selected as USART2 clock

`__HAL_RCC_GET_USART2_SOURCE`

Description:

- macro to get the USART2 clock source.

Return value:

- The: clock source can be one of the following values:
 - `RCC_USART2CLKSOURCE_PCLK1`: PCLK1 selected as USART2 clock
 - `RCC_USART2CLKSOURCE_HSI`: HSI selected as USART2 clock
 - `RCC_USART2CLKSOURCE_SYSC LK`: System Clock selected as USART2 clock
 - `RCC_USART2CLKSOURCE_LSE`: LSE selected as USART2 clock

`__HAL_RCC_USART3_CONFIG`

Description:

- Macro to configure the USART3 clock (USART3CLK).

Parameters:

- `__USART3_CLKSOURCE__`: specifies the USART3 clock source. This parameter can be one of the following values:
 - `RCC_USART3CLKSOURCE_PCLK1`: PCLK1 selected as USART3 clock
 - `RCC_USART3CLKSOURCE_HSI`: HSI selected as USART3 clock
 - `RCC_USART3CLKSOURCE_SYSC LK`: System Clock selected as USART3 clock
 - `RCC_USART3CLKSOURCE_LSE`: LSE selected as USART3 clock

`__HAL_RCC_GET_USART3_SOURCE`

Description:

- macro to get the USART3 clock source.

Return value:

- The: clock source can be one of the following values:
 - `RCC_USART3CLKSOURCE_PCLK1`: PCLK1 selected as USART3 clock
 - `RCC_USART3CLKSOURCE_HSI`: HSI selected as USART3 clock
 - `RCC_USART3CLKSOURCE_SYSC LK`: System Clock selected as USART3 clock
 - `RCC_USART3CLKSOURCE_LSE`: LSE selected as USART3 clock

`__HAL_RCC_UART4_CONFIG`

Description:

- Macro to configure the UART4 clock

(UART4CLK).

Parameters:

- `__UART4_CLKSOURCE__`: specifies the UART4 clock source. This parameter can be one of the following values:
 - `RCC_UART4CLKSOURCE_PCLK1`: PCLK1 selected as UART4 clock
 - `RCC_UART4CLKSOURCE_HSI`: HSI selected as UART4 clock
 - `RCC_UART4CLKSOURCE_SYSCLK`: System Clock selected as UART4 clock
 - `RCC_UART4CLKSOURCE_LSE`: LSE selected as UART4 clock

`__HAL_RCC_GET_UART4_SOURCE`

Description:

- macro to get the UART4 clock source.

Return value:

- The: clock source can be one of the following values:
 - `RCC_UART4CLKSOURCE_PCLK1`: PCLK1 selected as UART4 clock
 - `RCC_UART4CLKSOURCE_HSI`: HSI selected as UART4 clock
 - `RCC_UART4CLKSOURCE_SYSCLK`: System Clock selected as UART4 clock
 - `RCC_UART4CLKSOURCE_LSE`: LSE selected as UART4 clock

`__HAL_RCC_UART5_CONFIG`

Description:

- Macro to configure the UART5 clock (UART5CLK).

Parameters:

- `__UART5_CLKSOURCE__`: specifies the UART5 clock source. This parameter can be one of the following values:
 - `RCC_UART5CLKSOURCE_PCLK1`: PCLK1 selected as UART5 clock
 - `RCC_UART5CLKSOURCE_HSI`: HSI selected as UART5 clock
 - `RCC_UART5CLKSOURCE_SYSCLK`: System Clock selected as UART5 clock
 - `RCC_UART5CLKSOURCE_LSE`: LSE selected as UART5 clock

`__HAL_RCC_GET_UART5_SOURCE`

Description:

- macro to get the UART5 clock source.

Return value:

<p><code>__HAL_RCC_USART6_CONFIG</code></p>	<ul style="list-style-type: none"> • The: clock source can be one of the following values: <ul style="list-style-type: none"> – <code>RCC_USART5CLKSOURCE_PCLK1</code>: PCLK1 selected as UART5 clock – <code>RCC_USART5CLKSOURCE_HSI</code>: HSI selected as UART5 clock – <code>RCC_USART5CLKSOURCE_SYCLK</code>: System Clock selected as UART5 clock – <code>RCC_USART5CLKSOURCE_LSE</code>: LSE selected as UART5 clock <p>Description:</p> <ul style="list-style-type: none"> • Macro to configure the USART6 clock (USART6CLK). <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__USART6_CLKSOURCE__</code>: specifies the USART6 clock source. This parameter can be one of the following values: <ul style="list-style-type: none"> – <code>RCC_USART6CLKSOURCE_PCLK1</code>: PCLK1 selected as USART6 clock – <code>RCC_USART6CLKSOURCE_HSI</code>: HSI selected as USART6 clock – <code>RCC_USART6CLKSOURCE_SYCLK</code>: System Clock selected as USART6 clock – <code>RCC_USART6CLKSOURCE_LSE</code>: LSE selected as USART6 clock
<p><code>__HAL_RCC_GET_USART6_SOURCE</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • macro to get the USART6 clock source. <p>Return value:</p> <ul style="list-style-type: none"> • The: clock source can be one of the following values: <ul style="list-style-type: none"> – <code>RCC_USART6CLKSOURCE_PCLK1</code>: PCLK1 selected as USART6 clock – <code>RCC_USART6CLKSOURCE_HSI</code>: HSI selected as USART6 clock – <code>RCC_USART6CLKSOURCE_SYCLK</code>: System Clock selected as USART6 clock – <code>RCC_USART6CLKSOURCE_LSE</code>: LSE selected as USART6 clock
<p><code>__HAL_RCC_UART7_CONFIG</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Macro to configure the UART7 clock (UART7CLK). <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__UART7_CLKSOURCE__</code>: specifies the UART7 clock source. This parameter can be one of the following values:

- RCC_UART7CLKSOURCE_PCLK1: PCLK1 selected as UART7 clock
- RCC_UART7CLKSOURCE_HSI: HSI selected as UART7 clock
- RCC_UART7CLKSOURCE_SYSCLK: System Clock selected as UART7 clock
- RCC_UART7CLKSOURCE_LSE: LSE selected as UART7 clock

__HAL_RCC_GET_UART7_SOURCE

Description:

- macro to get the UART7 clock source.

Return value:

- The: clock source can be one of the following values:
 - RCC_UART7CLKSOURCE_PCLK1: PCLK1 selected as UART7 clock
 - RCC_UART7CLKSOURCE_HSI: HSI selected as UART7 clock
 - RCC_UART7CLKSOURCE_SYSCLK: System Clock selected as UART7 clock
 - RCC_UART7CLKSOURCE_LSE: LSE selected as UART7 clock

__HAL_RCC_UART8_CONFIG

Description:

- Macro to configure the UART8 clock (UART8CLK).

Parameters:

- __UART8_CLKSOURCE__: specifies the UART8 clock source. This parameter can be one of the following values:
 - RCC_UART8CLKSOURCE_PCLK1: PCLK1 selected as UART8 clock
 - RCC_UART8CLKSOURCE_HSI: HSI selected as UART8 clock
 - RCC_UART8CLKSOURCE_SYSCLK: System Clock selected as UART8 clock
 - RCC_UART8CLKSOURCE_LSE: LSE selected as UART8 clock

__HAL_RCC_GET_UART8_SOURCE

Description:

- macro to get the UART8 clock source.

Return value:

- The: clock source can be one of the following values:
 - RCC_UART8CLKSOURCE_PCLK1: PCLK1 selected as UART8 clock
 - RCC_UART8CLKSOURCE_HSI: HSI selected as UART8 clock

- RCC_UART8CLKSOURCE_SYSCLK: System Clock selected as UART8 clock
- RCC_UART8CLKSOURCE_LSE: LSE selected as UART8 clock

`__HAL_RCC_LPTIM1_CONFIG`**Description:**

- Macro to configure the LPTIM1 clock (LPTIM1CLK).

Parameters:

- `__LPTIM1_CLKSOURCE__`: specifies the LPTIM1 clock source. This parameter can be one of the following values:
 - `RCC_LPTIM1CLKSOURCE_PCLK1`: PCLK selected as LPTIM1 clock
 - `RCC_LPTIM1CLKSOURCE_HSI`: HSI selected as LPTIM1 clock
 - `RCC_LPTIM1CLKSOURCE_LSI`: LSI selected as LPTIM1 clock
 - `RCC_LPTIM1CLKSOURCE_LSE`: LSE selected as LPTIM1 clock

`__HAL_RCC_GET_LPTIM1_SOURCE`**Description:**

- macro to get the LPTIM1 clock source.

Return value:

- The: clock source can be one of the following values:
 - `RCC_LPTIM1CLKSOURCE_PCLK1`: PCLK selected as LPTIM1 clock
 - `RCC_LPTIM1CLKSOURCE_HSI`: HSI selected as LPTIM1 clock
 - `RCC_LPTIM1CLKSOURCE_LSI`: LSI selected as LPTIM1 clock
 - `RCC_LPTIM1CLKSOURCE_LSE`: LSE selected as LPTIM1 clock

`__HAL_RCC_CEC_CONFIG`**Description:**

- Macro to configure the CEC clock (CECCLK).

Parameters:

- `__CEC_CLKSOURCE__`: specifies the CEC clock source. This parameter can be one of the following values:
 - `RCC_CECCLKSOURCE_LSE`: LSE selected as CEC clock
 - `RCC_CECCLKSOURCE_HSI`: HSI divided by 488 selected as CEC clock

`__HAL_RCC_GET_CEC_SOURCE`**Description:**

- macro to get the CEC clock source.

`__HAL_RCC_CLK48_CONFIG`**Return value:**

- The: clock source can be one of the following values:
 - `RCC_CECCLKSOURCE_LSE`: LSE selected as CEC clock
 - `RCC_CECCLKSOURCE_HSI`: HSI selected as CEC clock

Description:

- Macro to configure the CLK48 source (`CLK48CLK`).

Parameters:

- `__CLK48_SOURCE__`: specifies the CLK48 clock source. This parameter can be one of the following values:
 - `RCC_CLK48SOURCE_PLL`: PLL selected as CLK48 source
 - `RCC_CLK48SOURCE_PLLSAIP`: PLLSAIP selected as CLK48 source

`__HAL_RCC_GET_CLK48_SOURCE`**Description:**

- macro to get the CLK48 source.

Return value:

- The: clock source can be one of the following values:
 - `RCC_CLK48SOURCE_PLL`: PLL used as CLK48 source
 - `RCC_CLK48SOURCE_PLLSAIP`: PLLSAIP used as CLK48 source

`__HAL_RCC_SDMMC1_CONFIG`**Description:**

- Macro to configure the SDMMC1 clock (`SDMMC1CLK`).

Parameters:

- `__SDMMC1_CLKSOURCE__`: specifies the SDMMC1 clock source. This parameter can be one of the following values:
 - `RCC_SDMMC1CLKSOURCE_CLK48`: CLK48 selected as SDMMC clock
 - `RCC_SDMMC1CLKSOURCE_SYSCCLK`: SYSCCLK selected as SDMMC clock

`__HAL_RCC_GET_SDMMC1_SOURCE`**Description:**

- macro to get the SDMMC1 clock source.

Return value:

- The: clock source can be one of the following values:
 - `RCC_SDMMC1CLKSOURCE_CLK48`

	8: CLK48 selected as SDMMC1 clock
	– RCC_SDMMC1CLKSOURCE_SYSC LK: SYSCLK selected as SDMMC1 clock
<code>__HAL_RCC_SDMMC2_CONFIG</code>	<p>Description:</p> <ul style="list-style-type: none"> Macro to configure the SDMMC2 clock (SDMMC2CLK). <p>Parameters:</p> <ul style="list-style-type: none"> <code>__SDMMC2_CLKSOURCE__</code>: specifies the SDMMC2 clock source. This parameter can be one of the following values: <ul style="list-style-type: none"> – RCC_SDMMC2CLKSOURCE_CLK48: CLK48 selected as SDMMC2 clock – RCC_SDMMC2CLKSOURCE_SYSC LK: SYSCLK selected as SDMMC2 clock
<code>__HAL_RCC_GET_SDMMC2_SOURCE</code>	<p>Description:</p> <ul style="list-style-type: none"> macro to get the SDMMC2 clock source. <p>Return value:</p> <ul style="list-style-type: none"> The: clock source can be one of the following values: <ul style="list-style-type: none"> – RCC_SDMMC2CLKSOURCE_CLK48: CLK48 selected as SDMMC2 clock – RCC_SDMMC2CLKSOURCE_SYSC LK: SYSCLK selected as SDMMC2 clock
<code>__HAL_RCC_DFSDM1_CONFIG</code>	<p>Description:</p> <ul style="list-style-type: none"> Macro to configure the DFSDM1 clock. <p>Parameters:</p> <ul style="list-style-type: none"> <code>__DFSDM1_CLKSOURCE__</code>: specifies the DFSDM1 clock source. This parameter can be one of the following values: <ul style="list-style-type: none"> – RCC_DFSDM1CLKSOURCE_PCLK2: PCLK2 Clock selected as DFSDM clock – RCC_DFSDMCLKSOURCE_SYCLK: System Clock selected as DFSDM clock
<code>__HAL_RCC_GET_DFSDM1_SOURCE</code>	<p>Description:</p> <ul style="list-style-type: none"> Macro to get the DFSDM1 clock source. <p>Return value:</p>

	<ul style="list-style-type: none"> The: clock source can be one of the following values: <ul style="list-style-type: none"> RCC_DFSDM1CLKSOURCE_PCLK2: PCLK2 Clock selected as DFSDM1 clock RCC_DFSDM1CLKSOURCE_SYSLK: System Clock selected as DFSDM1 clock
<code>__HAL_RCC_DFSDM1AUDIO_CONFIG</code>	<p>Description:</p> <ul style="list-style-type: none"> Macro to configure the DFSDM1 Audio clock. <p>Parameters:</p> <ul style="list-style-type: none"> <code>__DFSDM1AUDIO_CLKSOURCE__</code>: specifies the DFSDM1 Audio clock source. This parameter can be one of the following values: <ul style="list-style-type: none"> RCC_DFSDM1AUDIOCLKSOURCE_SAI1: SAI1 Clock selected as DFSDM1 Audio clock RCC_DFSDM1AUDIOCLKSOURCE_SAI2: SAI2 Clock selected as DFSDM1 Audio clock
<code>__HAL_RCC_GET_DFSDM1AUDIO_SOURCE</code>	<p>Description:</p> <ul style="list-style-type: none"> Macro to get the DFSDM1 Audio clock source. <p>Return value:</p> <ul style="list-style-type: none"> The: clock source can be one of the following values: <ul style="list-style-type: none"> RCC_DFSDM1AUDIOCLKSOURCE_SAI1: SAI1 Clock selected as DFSDM1 Audio clock RCC_DFSDM1AUDIOCLKSOURCE_SAI2: SAI2 Clock selected as DFSDM1 Audio clock
<code>__HAL_RCC_DSI_CONFIG</code>	<p>Description:</p> <ul style="list-style-type: none"> Macro to configure the DSI clock. <p>Parameters:</p> <ul style="list-style-type: none"> <code>__DSI_CLKSOURCE__</code>: specifies the DSI clock source. This parameter can be one of the following values: <ul style="list-style-type: none"> RCC_DSICLKSOURCE_PLLR: PLLR output used as DSI clock. RCC_DSICLKSOURCE_DSIPHY: DSI-PHY output used as DSI clock.
<code>__HAL_RCC_GET_DSI_SOURCE</code>	<p>Description:</p> <ul style="list-style-type: none"> Macro to Get the DSI clock.

Return value:

- The: clock source can be one of the following values:
 - RCC_DSICLKSOURCE_PLLR:
PLL output used as DSI clock.
 - RCC_DSICLKSOURCE_DSIPHY:
DSI-PHY output used as DSI clock.

RCCEx Force Release Peripheral Reset

```

__HAL_RCC_DMA2_FORCE_RESET
__HAL_RCC_USB_OTG_HS_FORCE_RESET
__HAL_RCC_GPIOA_FORCE_RESET
__HAL_RCC_GPIOB_FORCE_RESET
__HAL_RCC_GPIOC_FORCE_RESET
__HAL_RCC_GPIOD_FORCE_RESET
__HAL_RCC_GPIOE_FORCE_RESET
__HAL_RCC_GPIOF_FORCE_RESET
__HAL_RCC_GPIOG_FORCE_RESET
__HAL_RCC_GPIOH_FORCE_RESET
__HAL_RCC_GPIOI_FORCE_RESET
__HAL_RCC_DMA2_RELEASE_RESET
__HAL_RCC_USB_OTG_HS_RELEASE_RESET
__HAL_RCC_GPIOA_RELEASE_RESET
__HAL_RCC_GPIOB_RELEASE_RESET
__HAL_RCC_GPIOC_RELEASE_RESET
__HAL_RCC_GPIOD_RELEASE_RESET
__HAL_RCC_GPIOE_RELEASE_RESET
__HAL_RCC_GPIOF_RELEASE_RESET
__HAL_RCC_GPIOG_RELEASE_RESET
__HAL_RCC_GPIOH_RELEASE_RESET
__HAL_RCC_GPIOI_RELEASE_RESET
__HAL_RCC_DMA2D_FORCE_RESET
__HAL_RCC_ETHMAC_FORCE_RESET
__HAL_RCC_GPIOJ_FORCE_RESET
__HAL_RCC_GPIOK_FORCE_RESET
__HAL_RCC_DMA2D_RELEASE_RESET
__HAL_RCC_ETHMAC_RELEASE_RESET
__HAL_RCC_GPIOJ_RELEASE_RESET
__HAL_RCC_GPIOK_RELEASE_RESET

```

__HAL_RCC_AHB2_FORCE_RESET
__HAL_RCC_RNG_FORCE_RESET
__HAL_RCC_USB_OTG_FS_FORCE_RESET
__HAL_RCC_AHB2_RELEASE_RESET
__HAL_RCC_RNG_RELEASE_RESET
__HAL_RCC_USB_OTG_FS_RELEASE_RESET
__HAL_RCC_JPEG_FORCE_RESET
__HAL_RCC_JPEG_RELEASE_RESET
__HAL_RCC_Cryp_FORCE_RESET
__HAL_RCC_HASH_FORCE_RESET
__HAL_RCC_Cryp_RELEASE_RESET
__HAL_RCC_HASH_RELEASE_RESET
__HAL_RCC_DcMi_FORCE_RESET
__HAL_RCC_DcMi_RELEASE_RESET
__HAL_RCC_AHB3_FORCE_RESET
__HAL_RCC_FMC_FORCE_RESET
__HAL_RCC_QSPI_FORCE_RESET
__HAL_RCC_AHB3_RELEASE_RESET
__HAL_RCC_FMC_RELEASE_RESET
__HAL_RCC_QSPI_RELEASE_RESET
__HAL_RCC_TIM2_FORCE_RESET
__HAL_RCC_TIM3_FORCE_RESET
__HAL_RCC_TIM4_FORCE_RESET
__HAL_RCC_TIM5_FORCE_RESET
__HAL_RCC_TIM6_FORCE_RESET
__HAL_RCC_TIM7_FORCE_RESET
__HAL_RCC_TIM12_FORCE_RESET
__HAL_RCC_TIM13_FORCE_RESET
__HAL_RCC_TIM14_FORCE_RESET
__HAL_RCC_LPTIM1_FORCE_RESET
__HAL_RCC_CAN3_FORCE_RESET
__HAL_RCC_SPI2_FORCE_RESET
__HAL_RCC_SPI3_FORCE_RESET
__HAL_RCC_USART2_FORCE_RESET
__HAL_RCC_USART3_FORCE_RESET
__HAL_RCC_UART4_FORCE_RESET

__HAL_RCC_UART5_FORCE_RESET
__HAL_RCC_I2C1_FORCE_RESET
__HAL_RCC_I2C2_FORCE_RESET
__HAL_RCC_I2C3_FORCE_RESET
__HAL_RCC_CAN1_FORCE_RESET
__HAL_RCC_DAC_FORCE_RESET
__HAL_RCC_UART7_FORCE_RESET
__HAL_RCC_UART8_FORCE_RESET
__HAL_RCC_TIM2_RELEASE_RESET
__HAL_RCC_TIM3_RELEASE_RESET
__HAL_RCC_TIM4_RELEASE_RESET
__HAL_RCC_TIM5_RELEASE_RESET
__HAL_RCC_TIM6_RELEASE_RESET
__HAL_RCC_TIM7_RELEASE_RESET
__HAL_RCC_TIM12_RELEASE_RESET
__HAL_RCC_TIM13_RELEASE_RESET
__HAL_RCC_TIM14_RELEASE_RESET
__HAL_RCC_LPTIM1_RELEASE_RESET
__HAL_RCC_CAN3_RELEASE_RESET
__HAL_RCC_SPI2_RELEASE_RESET
__HAL_RCC_SPI3_RELEASE_RESET
__HAL_RCC_USART2_RELEASE_RESET
__HAL_RCC_USART3_RELEASE_RESET
__HAL_RCC_UART4_RELEASE_RESET
__HAL_RCC_UART5_RELEASE_RESET
__HAL_RCC_I2C1_RELEASE_RESET
__HAL_RCC_I2C2_RELEASE_RESET
__HAL_RCC_I2C3_RELEASE_RESET
__HAL_RCC_CAN1_RELEASE_RESET
__HAL_RCC_DAC_RELEASE_RESET
__HAL_RCC_UART7_RELEASE_RESET
__HAL_RCC_UART8_RELEASE_RESET
__HAL_RCC_SPDIFRX_FORCE_RESET
__HAL_RCC_I2C4_FORCE_RESET
__HAL_RCC_CAN2_FORCE_RESET
__HAL_RCC_CEC_FORCE_RESET

__HAL_RCC_SPDIFRX_RELEASE_RESET
__HAL_RCC_I2C4_RELEASE_RESET
__HAL_RCC_CAN2_RELEASE_RESET
__HAL_RCC_CEC_RELEASE_RESET
__HAL_RCC_TIM1_FORCE_RESET
__HAL_RCC_TIM8_FORCE_RESET
__HAL_RCC_USART1_FORCE_RESET
__HAL_RCC_USART6_FORCE_RESET
__HAL_RCC_ADC_FORCE_RESET
__HAL_RCC_SDMMC1_FORCE_RESET
__HAL_RCC_SPI1_FORCE_RESET
__HAL_RCC_SPI4_FORCE_RESET
__HAL_RCC_TIM9_FORCE_RESET
__HAL_RCC_TIM10_FORCE_RESET
__HAL_RCC_TIM11_FORCE_RESET
__HAL_RCC_SPI5_FORCE_RESET
__HAL_RCC_SPI6_FORCE_RESET
__HAL_RCC_SAI1_FORCE_RESET
__HAL_RCC_SAI2_FORCE_RESET
__HAL_RCC_LTDC_FORCE_RESET
__HAL_RCC_TIM1_RELEASE_RESET
__HAL_RCC_TIM8_RELEASE_RESET
__HAL_RCC_USART1_RELEASE_RESET
__HAL_RCC_USART6_RELEASE_RESET
__HAL_RCC_ADC_RELEASE_RESET
__HAL_RCC_SDMMC1_RELEASE_RESET
__HAL_RCC_SPI1_RELEASE_RESET
__HAL_RCC_SPI4_RELEASE_RESET
__HAL_RCC_TIM9_RELEASE_RESET
__HAL_RCC_TIM10_RELEASE_RESET
__HAL_RCC_TIM11_RELEASE_RESET
__HAL_RCC_SPI5_RELEASE_RESET
__HAL_RCC_SPI6_RELEASE_RESET
__HAL_RCC_SAI1_RELEASE_RESET
__HAL_RCC_SAI2_RELEASE_RESET
__HAL_RCC_LTDC_RELEASE_RESET

__HAL_RCC_DSI_FORCE_RESET
__HAL_RCC_DSI_RELEASE_RESET
__HAL_RCC_SDMMC2_FORCE_RESET
__HAL_RCC_SDMMC2_RELEASE_RESET
__HAL_RCC_DFSDM1_FORCE_RESET
__HAL_RCC_MDIO_FORCE_RESET
__HAL_RCC_DFSDM1_RELEASE_RESET
__HAL_RCC_MDIO_RELEASE_RESET

RCCEx I2C1 Clock Source

RCC_I2C1CLKSOURCE_PCLK1
RCC_I2C1CLKSOURCE_SYSCLK
RCC_I2C1CLKSOURCE_HSI

RCCEx I2C2 Clock Source

RCC_I2C2CLKSOURCE_PCLK1
RCC_I2C2CLKSOURCE_SYSCLK
RCC_I2C2CLKSOURCE_HSI

RCCEx I2C3 Clock Source

RCC_I2C3CLKSOURCE_PCLK1
RCC_I2C3CLKSOURCE_SYSCLK
RCC_I2C3CLKSOURCE_HSI

RCCEx I2C4 Clock Source

RCC_I2C4CLKSOURCE_PCLK1
RCC_I2C4CLKSOURCE_SYSCLK
RCC_I2C4CLKSOURCE_HSI

RCCEx I2S Clock Source

RCC_I2SCLKSOURCE_PLLI2S
RCC_I2SCLKSOURCE_EXT

RCC Private macros to check input parameters

IS_RCC_PERIPHLOCK
IS_RCC_PLLI2SN_VALUE
IS_RCC_PLLI2SP_VALUE
IS_RCC_PLLI2SQ_VALUE
IS_RCC_PLLI2SR_VALUE
IS_RCC_PLLSAIN_VALUE
IS_RCC_PLLSAIP_VALUE
IS_RCC_PLLSAIQ_VALUE

IS_RCC_PLLSAIR_VALUE
IS_RCC_PLLSAI_DIVQ_VALUE
IS_RCC_PLLI2S_DIVQ_VALUE
IS_RCC_PLLSAI_DIVR_VALUE
IS_RCC_I2SCLKSOURCE
IS_RCC_SDMMC1CLKSOURCE
IS_RCC_CECCLKSOURCE
IS_RCC_USART1CLKSOURCE
IS_RCC_USART2CLKSOURCE
IS_RCC_USART3CLKSOURCE
IS_RCC_UART4CLKSOURCE
IS_RCC_UART5CLKSOURCE
IS_RCC_USART6CLKSOURCE
IS_RCC_UART7CLKSOURCE
IS_RCC_UART8CLKSOURCE
IS_RCC_I2C1CLKSOURCE
IS_RCC_I2C2CLKSOURCE
IS_RCC_I2C3CLKSOURCE
IS_RCC_I2C4CLKSOURCE
IS_RCC_LPTIM1CLK
IS_RCC_CLK48SOURCE
IS_RCC_TIMPRES
IS_RCC_PLLR_VALUE
IS_RCC_SAI1CLKSOURCE
IS_RCC_SAI2CLKSOURCE
IS_RCC_DFSDM1CLKSOURCE
IS_RCC_DFSDM1AUDIOCLKSOURCE
IS_RCC_SDMMC2CLKSOURCE
IS_RCC_DSIBYTELANECLKSOURCE

RCCEx LPTIM1 Clock Source
RCC_LPTIM1CLKSOURCE_PCLK1
RCC_LPTIM1CLKSOURCE_LSI
RCC_LPTIM1CLKSOURCE_HSI
RCC_LPTIM1CLKSOURCE_LSE

RCC Extended MCOx Clock Config
__HAL_RCC_MCO1_CONFIG **Description:**

- Macro to configure the MCO1 clock.

Parameters:

- `__MCOCLKSOURCE__`: specifies the MCO clock source. This parameter can be one of the following values:
 - `RCC_MCO1SOURCE_HSI`: HSI clock selected as MCO1 source
 - `RCC_MCO1SOURCE_LSE`: LSE clock selected as MCO1 source
 - `RCC_MCO1SOURCE_HSE`: HSE clock selected as MCO1 source
 - `RCC_MCO1SOURCE_PLLCLK`: main PLL clock selected as MCO1 source
- `__MCODIV__`: specifies the MCO clock prescaler. This parameter can be one of the following values:
 - `RCC_MCODIV_1`: no division applied to MCOx clock
 - `RCC_MCODIV_2`: division by 2 applied to MCOx clock
 - `RCC_MCODIV_3`: division by 3 applied to MCOx clock
 - `RCC_MCODIV_4`: division by 4 applied to MCOx clock
 - `RCC_MCODIV_5`: division by 5 applied to MCOx clock

`__HAL_RCC_MCO2_CONFIG`

Description:

- Macro to configure the MCO2 clock.

Parameters:

- `__MCOCLKSOURCE__`: specifies the MCO clock source. This parameter can be one of the following values:
 - `RCC_MCO2SOURCE_SYSCLK`: System clock (SYSCLK) selected as MCO2 source
 - `RCC_MCO2SOURCE_PLLI2SCLK`: PLLI2S clock selected as MCO2 source
 - `RCC_MCO2SOURCE_HSE`: HSE clock selected as MCO2 source
 - `RCC_MCO2SOURCE_PLLCLK`: main PLL clock selected as MCO2 source
- `__MCODIV__`: specifies the MCO clock prescaler. This parameter can be one of the following values:
 - `RCC_MCODIV_1`: no division applied to MCOx clock
 - `RCC_MCODIV_2`: division by 2 applied to MCOx clock
 - `RCC_MCODIV_3`: division by 3 applied to MCOx clock
 - `RCC_MCODIV_4`: division by 4 applied to MCOx clock
 - `RCC_MCODIV_5`: division by 5 applied to

MCOx clock

RCCEx_Peripheral_Clock_Enable_Disable

__HAL_RCC_BKPSRAM_CLK_ENABLE

Notes:

- After reset, the peripheral clock (used for registers read/write access) is disabled and the application software has to enable this clock before using it.

__HAL_RCC_DTCMRAMEN_CLK_ENABLE

__HAL_RCC_DMA2_CLK_ENABLE

__HAL_RCC_USB_OTG_HS_CLK_ENABLE

__HAL_RCC_USB_OTG_HS_ULPI_CLK_ENABLE

__HAL_RCC_GPIOA_CLK_ENABLE

__HAL_RCC_GPIOB_CLK_ENABLE

__HAL_RCC_GPIOC_CLK_ENABLE

__HAL_RCC_GPIOD_CLK_ENABLE

__HAL_RCC_GPIOE_CLK_ENABLE

__HAL_RCC_GPIOF_CLK_ENABLE

__HAL_RCC_GPIOG_CLK_ENABLE

__HAL_RCC_GPIOH_CLK_ENABLE

__HAL_RCC_GPIOI_CLK_ENABLE

__HAL_RCC_GPIOJ_CLK_ENABLE

__HAL_RCC_GPIOK_CLK_ENABLE

__HAL_RCC_DMA2D_CLK_ENABLE

__HAL_RCC_BKPSRAM_CLK_DISABLE

__HAL_RCC_DTCMRAMEN_CLK_DISABLE

__HAL_RCC_DMA2_CLK_DISABLE

__HAL_RCC_USB_OTG_HS_CLK_DISABLE

__HAL_RCC_USB_OTG_HS_ULPI_CLK_DISABLE

__HAL_RCC_GPIOA_CLK_DISABLE

__HAL_RCC_GPIOB_CLK_DISABLE

__HAL_RCC_GPIOC_CLK_DISABLE

__HAL_RCC_GPIOD_CLK_DISABLE

__HAL_RCC_GPIOE_CLK_DISABLE

__HAL_RCC_GPIOF_CLK_DISABLE

__HAL_RCC_GPIOG_CLK_DISABLE

__HAL_RCC_GPIOH_CLK_DISABLE
__HAL_RCC_GPIOI_CLK_DISABLE
__HAL_RCC_GPIOJ_CLK_DISABLE
__HAL_RCC_GPIOK_CLK_DISABLE
__HAL_RCC_DMA2D_CLK_DISABLE
__HAL_RCC_ETHMAC_CLK_ENABLE
__HAL_RCC_ETHMACTX_CLK_ENABLE
__HAL_RCC_ETHMACRX_CLK_ENABLE
__HAL_RCC_ETHMACPTP_CLK_ENABLE
__HAL_RCC_ETH_CLK_ENABLE
__HAL_RCC_ETHMAC_CLK_DISABLE
__HAL_RCC_ETHMACTX_CLK_DISABLE
__HAL_RCC_ETHMACRX_CLK_DISABLE
__HAL_RCC_ETHMACPTP_CLK_DISABLE
__HAL_RCC_ETH_CLK_DISABLE
__HAL_RCC_DCMI_CLK_ENABLE

Notes:

- After reset, the peripheral clock (used for registers read/write access) is disabled and the application software has to enable this clock before using it.

__HAL_RCC_DCMI_CLK_DISABLE
__HAL_RCC_JPEG_CLK_ENABLE
__HAL_RCC_JPEG_CLK_DISABLE
__HAL_RCC_RNG_CLK_ENABLE
__HAL_RCC_USB_OTG_FS_CLK_ENABLE
__HAL_RCC_RNG_CLK_DISABLE
__HAL_RCC_USB_OTG_FS_CLK_DISABLE
__HAL_RCC_Cryp_CLK_ENABLE
__HAL_RCC_HASH_CLK_ENABLE
__HAL_RCC_Cryp_CLK_DISABLE
__HAL_RCC_HASH_CLK_DISABLE
__HAL_RCC_FMC_CLK_ENABLE

Notes:

- After reset, the peripheral clock (used for registers read/write access) is disabled and the application software has to enable this clock before using

it.

__HAL_RCC_QSPI_CLK_ENABLE
__HAL_RCC_FMC_CLK_DISABLE
__HAL_RCC_QSPI_CLK_DISABLE
__HAL_RCC_TIM2_CLK_ENABLE

Notes:

- After reset, the peripheral clock (used for registers read/write access) is disabled and the application software has to enable this clock before using it.

__HAL_RCC_TIM3_CLK_ENABLE
__HAL_RCC_TIM4_CLK_ENABLE
__HAL_RCC_TIM5_CLK_ENABLE
__HAL_RCC_TIM6_CLK_ENABLE
__HAL_RCC_TIM7_CLK_ENABLE
__HAL_RCC_TIM12_CLK_ENABLE
__HAL_RCC_TIM13_CLK_ENABLE
__HAL_RCC_TIM14_CLK_ENABLE
__HAL_RCC_LPTIM1_CLK_ENABLE
__HAL_RCC_RTC_CLK_ENABLE
__HAL_RCC_CAN3_CLK_ENABLE
__HAL_RCC_SPI2_CLK_ENABLE
__HAL_RCC_SPI3_CLK_ENABLE
__HAL_RCC_USART2_CLK_ENABLE
__HAL_RCC_USART3_CLK_ENABLE
__HAL_RCC_UART4_CLK_ENABLE
__HAL_RCC_UART5_CLK_ENABLE
__HAL_RCC_I2C1_CLK_ENABLE
__HAL_RCC_I2C2_CLK_ENABLE
__HAL_RCC_I2C3_CLK_ENABLE
__HAL_RCC_CAN1_CLK_ENABLE
__HAL_RCC_DAC_CLK_ENABLE
__HAL_RCC_UART7_CLK_ENABLE
__HAL_RCC_UART8_CLK_ENABLE
__HAL_RCC_SPDIFRX_CLK_ENABLE

__HAL_RCC_I2C4_CLK_ENABLE
__HAL_RCC_CAN2_CLK_ENABLE
__HAL_RCC_CEC_CLK_ENABLE
__HAL_RCC_TIM2_CLK_DISABLE
__HAL_RCC_TIM3_CLK_DISABLE
__HAL_RCC_TIM4_CLK_DISABLE
__HAL_RCC_TIM5_CLK_DISABLE
__HAL_RCC_TIM6_CLK_DISABLE
__HAL_RCC_TIM7_CLK_DISABLE
__HAL_RCC_TIM12_CLK_DISABLE
__HAL_RCC_TIM13_CLK_DISABLE
__HAL_RCC_TIM14_CLK_DISABLE
__HAL_RCC_LPTIM1_CLK_DISABLE
__HAL_RCC_RTC_CLK_DISABLE
__HAL_RCC_CAN3_CLK_DISABLE
__HAL_RCC_SPI2_CLK_DISABLE
__HAL_RCC_SPI3_CLK_DISABLE
__HAL_RCC_USART2_CLK_DISABLE
__HAL_RCC_USART3_CLK_DISABLE
__HAL_RCC_UART4_CLK_DISABLE
__HAL_RCC_UART5_CLK_DISABLE
__HAL_RCC_I2C1_CLK_DISABLE
__HAL_RCC_I2C2_CLK_DISABLE
__HAL_RCC_I2C3_CLK_DISABLE
__HAL_RCC_CAN1_CLK_DISABLE
__HAL_RCC_DAC_CLK_DISABLE
__HAL_RCC_UART7_CLK_DISABLE
__HAL_RCC_UART8_CLK_DISABLE
__HAL_RCC_SPDIFRX_CLK_DISABLE
__HAL_RCC_I2C4_CLK_DISABLE
__HAL_RCC_CAN2_CLK_DISABLE
__HAL_RCC_CEC_CLK_DISABLE
__HAL_RCC_TIM1_CLK_ENABLE

Notes:

- After reset, the peripheral clock (used for registers read/write access) is disabled and the application software has to enable this clock before using

it.

__HAL_RCC_TIM8_CLK_ENABLE
__HAL_RCC_USART1_CLK_ENABLE
__HAL_RCC_USART6_CLK_ENABLE
__HAL_RCC_SDMMC2_CLK_ENABLE
__HAL_RCC_ADC1_CLK_ENABLE
__HAL_RCC_ADC2_CLK_ENABLE
__HAL_RCC_ADC3_CLK_ENABLE
__HAL_RCC_SDMMC1_CLK_ENABLE
__HAL_RCC_SPI1_CLK_ENABLE
__HAL_RCC_SPI4_CLK_ENABLE
__HAL_RCC_TIM9_CLK_ENABLE
__HAL_RCC_TIM10_CLK_ENABLE
__HAL_RCC_TIM11_CLK_ENABLE
__HAL_RCC_SPI5_CLK_ENABLE
__HAL_RCC_SPI6_CLK_ENABLE
__HAL_RCC_SAI1_CLK_ENABLE
__HAL_RCC_SAI2_CLK_ENABLE
__HAL_RCC_LTDC_CLK_ENABLE
__HAL_RCC_DSI_CLK_ENABLE
__HAL_RCC_DFSDM1_CLK_ENABLE
__HAL_RCC_MDIO_CLK_ENABLE
__HAL_RCC_TIM1_CLK_DISABLE
__HAL_RCC_TIM8_CLK_DISABLE
__HAL_RCC_USART1_CLK_DISABLE
__HAL_RCC_USART6_CLK_DISABLE
__HAL_RCC_SDMMC2_CLK_DISABLE
__HAL_RCC_ADC1_CLK_DISABLE
__HAL_RCC_ADC2_CLK_DISABLE
__HAL_RCC_ADC3_CLK_DISABLE
__HAL_RCC_SDMMC1_CLK_DISABLE
__HAL_RCC_SPI1_CLK_DISABLE
__HAL_RCC_SPI4_CLK_DISABLE
__HAL_RCC_TIM9_CLK_DISABLE
__HAL_RCC_TIM10_CLK_DISABLE

__HAL_RCC_TIM11_CLK_DISABLE
__HAL_RCC_SPI5_CLK_DISABLE
__HAL_RCC_SPI6_CLK_DISABLE
__HAL_RCC_SAI1_CLK_DISABLE
__HAL_RCC_SAI2_CLK_DISABLE
__HAL_RCC_LTDC_CLK_DISABLE
__HAL_RCC_DSI_CLK_DISABLE
__HAL_RCC_DFSDM1_CLK_DISABLE
__HAL_RCC_MDIO_CLK_DISABLE

Peripheral Clock Enable Disable Status

__HAL_RCC_BKPSRAM_IS_CLK_ENABLED

Notes:

- After reset, the peripheral clock (used for registers read/write access) is disabled and the application software has to enable this clock before using it.

__HAL_RCC_DTCMRAMEN_IS_CLK_ENABLED
__HAL_RCC_DMA2_IS_CLK_ENABLED
__HAL_RCC_USB_OTG_HS_IS_CLK_ENABLED
__HAL_RCC_USB_OTG_HS_ULPI_IS_CLK_ENABLED
__HAL_RCC_GPIOA_IS_CLK_ENABLED
__HAL_RCC_GPIOB_IS_CLK_ENABLED
__HAL_RCC_GPIOC_IS_CLK_ENABLED
__HAL_RCC_GPIOD_IS_CLK_ENABLED
__HAL_RCC_GPIOE_IS_CLK_ENABLED
__HAL_RCC_GPIOF_IS_CLK_ENABLED
__HAL_RCC_GPIOG_IS_CLK_ENABLED
__HAL_RCC_GPIOH_IS_CLK_ENABLED
__HAL_RCC_GPIOI_IS_CLK_ENABLED
__HAL_RCC_GPIOJ_IS_CLK_ENABLED
__HAL_RCC_GPIOK_IS_CLK_ENABLED
__HAL_RCC_DMA2D_IS_CLK_ENABLED
__HAL_RCC_BKPSRAM_IS_CLK_DISABLED
__HAL_RCC_DTCMRAMEN_IS_CLK_DISABLED
__HAL_RCC_DMA2_IS_CLK_DISABLED

__HAL_RCC_USB_OTG_HS_IS_CLK_DISABLED
__HAL_RCC_USB_OTG_HS_ULPI_IS_CLK_DISABLED
__HAL_RCC_GPIOA_IS_CLK_DISABLED
__HAL_RCC_GPIOB_IS_CLK_DISABLED
__HAL_RCC_GPIOC_IS_CLK_DISABLED
__HAL_RCC_GPIOD_IS_CLK_DISABLED
__HAL_RCC_GPIOE_IS_CLK_DISABLED
__HAL_RCC_GPIOF_IS_CLK_DISABLED
__HAL_RCC_GPIOG_IS_CLK_DISABLED
__HAL_RCC_GPIOH_IS_CLK_DISABLED
__HAL_RCC_GPIOI_IS_CLK_DISABLED
__HAL_RCC_GPIOJ_IS_CLK_DISABLED
__HAL_RCC_GPIOK_IS_CLK_DISABLED
__HAL_RCC_DMA2D_IS_CLK_DISABLED
__HAL_RCC_ETHMAC_IS_CLK_ENABLED
__HAL_RCC_ETHMACTX_IS_CLK_ENABLED
__HAL_RCC_ETHMACRX_IS_CLK_ENABLED
__HAL_RCC_ETHMACPTP_IS_CLK_ENABLED
__HAL_RCC_ETH_IS_CLK_ENABLED
__HAL_RCC_ETHMAC_IS_CLK_DISABLED
__HAL_RCC_ETHMACTX_IS_CLK_DISABLED
__HAL_RCC_ETHMACRX_IS_CLK_DISABLED
__HAL_RCC_ETHMACPTP_IS_CLK_DISABLED
__HAL_RCC_ETH_IS_CLK_DISABLED
__HAL_RCC_RNG_IS_CLK_ENABLED

__HAL_RCC_USB_OTG_FS_IS_CLK_ENABLED
__HAL_RCC_RNG_IS_CLK_DISABLED
__HAL_RCC_USB_IS_OTG_FS_CLK_DISABLED
__HAL_RCC_Cryp_IS_CLK_ENABLED
__HAL_RCC_HASH_IS_CLK_ENABLED

Notes:

- After reset, the peripheral clock (used for registers read/write access) is disabled and the application software has to enable this clock before using it.

__HAL_RCC_Cryp_IS_CLK_DISABLED
__HAL_RCC_HASH_IS_CLK_DISABLED
__HAL_RCC_DCMI_IS_CLK_ENABLED
__HAL_RCC_DCMI_IS_CLK_DISABLED
__HAL_RCC_JPEG_IS_CLK_ENABLED
__HAL_RCC_JPEG_IS_CLK_DISABLED
__HAL_RCC_FMC_IS_CLK_ENABLED

Notes:

- After reset, the peripheral clock (used for registers read/write access) is disabled and the application software has to enable this clock before using it.

__HAL_RCC_QSPI_IS_CLK_ENABLED
__HAL_RCC_FMC_IS_CLK_DISABLED
__HAL_RCC_QSPI_IS_CLK_DISABLED
__HAL_RCC_TIM2_IS_CLK_ENABLED

Notes:

- After reset, the peripheral clock (used for registers read/write access) is disabled and the application software has to enable this clock before using it.

__HAL_RCC_TIM3_IS_CLK_ENABLED
__HAL_RCC_TIM4_IS_CLK_ENABLED
__HAL_RCC_TIM5_IS_CLK_ENABLED
__HAL_RCC_TIM6_IS_CLK_ENABLED
__HAL_RCC_TIM7_IS_CLK_ENABLED
__HAL_RCC_TIM12_IS_CLK_ENABLED
__HAL_RCC_TIM13_IS_CLK_ENABLED
__HAL_RCC_TIM14_IS_CLK_ENABLED
__HAL_RCC_LPTIM1_IS_CLK_ENABLED
__HAL_RCC_CAN3_IS_CLK_ENABLED
__HAL_RCC_SPI2_IS_CLK_ENABLED
__HAL_RCC_SPI3_IS_CLK_ENABLED
__HAL_RCC_USART2_IS_CLK_ENABLED

__HAL_RCC_USART3_IS_CLK_ENABLED
__HAL_RCC_UART4_IS_CLK_ENABLED
__HAL_RCC_UART5_IS_CLK_ENABLED
__HAL_RCC_I2C1_IS_CLK_ENABLED
__HAL_RCC_I2C2_IS_CLK_ENABLED
__HAL_RCC_I2C3_IS_CLK_ENABLED
__HAL_RCC_CAN1_IS_CLK_ENABLED
__HAL_RCC_DAC_IS_CLK_ENABLED
__HAL_RCC_UART7_IS_CLK_ENABLED
__HAL_RCC_UART8_IS_CLK_ENABLED
__HAL_RCC_TIM2_IS_CLK_DISABLED
__HAL_RCC_TIM3_IS_CLK_DISABLED
__HAL_RCC_TIM4_IS_CLK_DISABLED
__HAL_RCC_TIM5_IS_CLK_DISABLED
__HAL_RCC_TIM6_IS_CLK_DISABLED
__HAL_RCC_TIM7_IS_CLK_DISABLED
__HAL_RCC_TIM12_IS_CLK_DISABLED
__HAL_RCC_TIM13_IS_CLK_DISABLED
__HAL_RCC_TIM14_IS_CLK_DISABLED
__HAL_RCC_LPTIM1_IS_CLK_DISABLED
__HAL_RCC_CAN3_IS_CLK_DISABLED
__HAL_RCC_SPI2_IS_CLK_DISABLED
__HAL_RCC_SPI3_IS_CLK_DISABLED
__HAL_RCC_USART2_IS_CLK_DISABLED
__HAL_RCC_USART3_IS_CLK_DISABLED
__HAL_RCC_UART4_IS_CLK_DISABLED
__HAL_RCC_UART5_IS_CLK_DISABLED
__HAL_RCC_I2C1_IS_CLK_DISABLED
__HAL_RCC_I2C2_IS_CLK_DISABLED
__HAL_RCC_I2C3_IS_CLK_DISABLED
__HAL_RCC_CAN1_IS_CLK_DISABLED
__HAL_RCC_DAC_IS_CLK_DISABLED
__HAL_RCC_UART7_IS_CLK_DISABLED
__HAL_RCC_UART8_IS_CLK_DISABLED
__HAL_RCC_SPDIFRX_IS_CLK_ENABLED
__HAL_RCC_CAN2_IS_CLK_ENABLED

__HAL_RCC_CEC_IS_CLK_ENABLED
__HAL_RCC_I2C4_IS_CLK_ENABLED
__HAL_RCC_SPDIFRX_IS_CLK_DISABLED
__HAL_RCC_CAN2_IS_CLK_DISABLED
__HAL_RCC_CEC_IS_CLK_DISABLED
__HAL_RCC_I2C4_IS_CLK_DISABLED
__HAL_RCC_RTC_IS_CLK_ENABLED
__HAL_RCC_RTC_IS_CLK_DISABLED
__HAL_RCC_TIM1_IS_CLK_ENABLED

Notes:

- After reset, the peripheral clock (used for registers read/write access) is disabled and the application software has to enable this clock before using it.

__HAL_RCC_TIM8_IS_CLK_ENABLED
__HAL_RCC_USART1_IS_CLK_ENABLED
__HAL_RCC_USART6_IS_CLK_ENABLED
__HAL_RCC_ADC1_IS_CLK_ENABLED
__HAL_RCC_ADC2_IS_CLK_ENABLED
__HAL_RCC_ADC3_IS_CLK_ENABLED
__HAL_RCC_SDMMC1_IS_CLK_ENABLED
__HAL_RCC_SPI1_IS_CLK_ENABLED
__HAL_RCC_SPI4_IS_CLK_ENABLED
__HAL_RCC_TIM9_IS_CLK_ENABLED
__HAL_RCC_TIM10_IS_CLK_ENABLED
__HAL_RCC_TIM11_IS_CLK_ENABLED
__HAL_RCC_SPI5_IS_CLK_ENABLED
__HAL_RCC_SPI6_IS_CLK_ENABLED
__HAL_RCC_SAI1_IS_CLK_ENABLED
__HAL_RCC_SAI2_IS_CLK_ENABLED
__HAL_RCC_LTDC_IS_CLK_ENABLED
__HAL_RCC_DSI_IS_CLK_ENABLED
__HAL_RCC_SDMMC2_IS_CLK_ENABLED
__HAL_RCC_DFSDM1_IS_CLK_ENABLED
__HAL_RCC_MDIO_IS_CLK_ENABLED

__HAL_RCC_TIM1_IS_CLK_DISABLED
__HAL_RCC_TIM8_IS_CLK_DISABLED
__HAL_RCC_USART1_IS_CLK_DISABLED
__HAL_RCC_USART6_IS_CLK_DISABLED
__HAL_RCC_ADC1_IS_CLK_DISABLED
__HAL_RCC_ADC2_IS_CLK_DISABLED
__HAL_RCC_ADC3_IS_CLK_DISABLED
__HAL_RCC_SDMMC1_IS_CLK_DISABLED
__HAL_RCC_SPI1_IS_CLK_DISABLED
__HAL_RCC_SPI4_IS_CLK_DISABLED
__HAL_RCC_TIM9_IS_CLK_DISABLED
__HAL_RCC_TIM10_IS_CLK_DISABLED
__HAL_RCC_TIM11_IS_CLK_DISABLED
__HAL_RCC_SPI5_IS_CLK_DISABLED
__HAL_RCC_SPI6_IS_CLK_DISABLED
__HAL_RCC_SAI1_IS_CLK_DISABLED
__HAL_RCC_SAI2_IS_CLK_DISABLED
__HAL_RCC_LTDC_IS_CLK_DISABLED
__HAL_RCC_DSI_IS_CLK_DISABLED
__HAL_RCC_SDMMC2_IS_CLK_DISABLED
__HAL_RCC_DFSDM1_IS_CLK_DISABLED
__HAL_RCC_MDIO_IS_CLK_DISABLED

RCCEx Peripheral Clock Sleep Enable Disable

__HAL_RCC_FLITF_CLK_SLEEP_ENABLE
__HAL_RCC_AXI_CLK_SLEEP_ENABLE
__HAL_RCC_SRAM1_CLK_SLEEP_ENABLE
__HAL_RCC_SRAM2_CLK_SLEEP_ENABLE
__HAL_RCC_BKPSRAM_CLK_SLEEP_ENABLE
__HAL_RCC_DTCM_CLK_SLEEP_ENABLE
__HAL_RCC_DMA2_CLK_SLEEP_ENABLE
__HAL_RCC_USB_OTG_HS_CLK_SLEEP_ENABLE
__HAL_RCC_USB_OTG_HS_ULPI_CLK_SLEEP_ENABLE
__HAL_RCC_GPIOA_CLK_SLEEP_ENABLE
__HAL_RCC_GPIOB_CLK_SLEEP_ENABLE
__HAL_RCC_GPIOC_CLK_SLEEP_ENABLE
__HAL_RCC_GPIOD_CLK_SLEEP_ENABLE

__HAL_RCC_GPIOE_CLK_SLEEP_ENABLE
__HAL_RCC_GPIOF_CLK_SLEEP_ENABLE
__HAL_RCC_GPIOG_CLK_SLEEP_ENABLE
__HAL_RCC_GPIOH_CLK_SLEEP_ENABLE
__HAL_RCC_GPIOI_CLK_SLEEP_ENABLE
__HAL_RCC_FLITF_CLK_SLEEP_DISABLE
__HAL_RCC_AXI_CLK_SLEEP_DISABLE
__HAL_RCC_SRAM1_CLK_SLEEP_DISABLE
__HAL_RCC_SRAM2_CLK_SLEEP_DISABLE
__HAL_RCC_BKPSRAM_CLK_SLEEP_DISABLE
__HAL_RCC_DTCM_CLK_SLEEP_DISABLE
__HAL_RCC_DMA2_CLK_SLEEP_DISABLE
__HAL_RCC_USB_OTG_HS_CLK_SLEEP_DISABLE
__HAL_RCC_USB_OTG_HS_ULPI_CLK_SLEEP_DISABLE
__HAL_RCC_GPIOA_CLK_SLEEP_DISABLE
__HAL_RCC_GPIOB_CLK_SLEEP_DISABLE
__HAL_RCC_GPIOC_CLK_SLEEP_DISABLE
__HAL_RCC_GPIOD_CLK_SLEEP_DISABLE
__HAL_RCC_GPIOE_CLK_SLEEP_DISABLE
__HAL_RCC_GPIOF_CLK_SLEEP_DISABLE
__HAL_RCC_GPIOG_CLK_SLEEP_DISABLE
__HAL_RCC_GPIOH_CLK_SLEEP_DISABLE
__HAL_RCC_GPIOI_CLK_SLEEP_DISABLE
__HAL_RCC_DMA2D_CLK_SLEEP_ENABLE
__HAL_RCC_ETHMAC_CLK_SLEEP_ENABLE
__HAL_RCC_ETHMACTX_CLK_SLEEP_ENABLE
__HAL_RCC_ETHMACRX_CLK_SLEEP_ENABLE
__HAL_RCC_ETHMACPTP_CLK_SLEEP_ENABLE
__HAL_RCC_GPIOJ_CLK_SLEEP_ENABLE
__HAL_RCC_GPIOK_CLK_SLEEP_ENABLE
__HAL_RCC_DMA2D_CLK_SLEEP_DISABLE
__HAL_RCC_ETHMAC_CLK_SLEEP_DISABLE
__HAL_RCC_ETHMACTX_CLK_SLEEP_DISABLE
__HAL_RCC_ETHMACRX_CLK_SLEEP_DISABLE
__HAL_RCC_ETHMACPTP_CLK_SLEEP_DISABLE
__HAL_RCC_GPIOJ_CLK_SLEEP_DISABLE

__HAL_RCC_GPIOK_CLK_SLEEP_DISABLE
__HAL_RCC_DCMI_CLK_SLEEP_ENABLE

Notes:

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the peripheral clock is enabled again. By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_DCMI_CLK_SLEEP_DISABLE
__HAL_RCC_JPEG_CLK_SLEEP_ENABLE
__HAL_RCC_JPEG_CLK_SLEEP_DISABLE
__HAL_RCC_RNG_CLK_SLEEP_ENABLE
__HAL_RCC_RNG_CLK_SLEEP_DISABLE
__HAL_RCC_USB_OTG_FS_CLK_SLEEP_ENABLE
__HAL_RCC_USB_OTG_FS_CLK_SLEEP_DISABLE
__HAL_RCC_Cryp_CLK_SLEEP_ENABLE
__HAL_RCC_HASH_CLK_SLEEP_ENABLE
__HAL_RCC_Cryp_CLK_SLEEP_DISABLE
__HAL_RCC_HASH_CLK_SLEEP_DISABLE
__HAL_RCC_FMC_CLK_SLEEP_ENABLE

Notes:

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the peripheral clock is enabled again. By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_FMC_CLK_SLEEP_DISABLE
__HAL_RCC_QSPI_CLK_SLEEP_ENABLE
__HAL_RCC_QSPI_CLK_SLEEP_DISABLE
__HAL_RCC_TIM2_CLK_SLEEP_ENABLE

Notes:

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the peripheral clock is enabled again. By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_TIM3_CLK_SLEEP_ENABLE
__HAL_RCC_TIM4_CLK_SLEEP_ENABLE
__HAL_RCC_TIM5_CLK_SLEEP_ENABLE
__HAL_RCC_TIM6_CLK_SLEEP_ENABLE
__HAL_RCC_TIM7_CLK_SLEEP_ENABLE
__HAL_RCC_TIM12_CLK_SLEEP_ENABLE
__HAL_RCC_TIM13_CLK_SLEEP_ENABLE
__HAL_RCC_TIM14_CLK_SLEEP_ENABLE
__HAL_RCC_LPTIM1_CLK_SLEEP_ENABLE
__HAL_RCC_CAN3_CLK_SLEEP_ENABLE
__HAL_RCC_SPI2_CLK_SLEEP_ENABLE
__HAL_RCC_SPI3_CLK_SLEEP_ENABLE
__HAL_RCC_USART2_CLK_SLEEP_ENABLE
__HAL_RCC_USART3_CLK_SLEEP_ENABLE
__HAL_RCC_UART4_CLK_SLEEP_ENABLE
__HAL_RCC_UART5_CLK_SLEEP_ENABLE
__HAL_RCC_I2C1_CLK_SLEEP_ENABLE
__HAL_RCC_I2C2_CLK_SLEEP_ENABLE
__HAL_RCC_I2C3_CLK_SLEEP_ENABLE
__HAL_RCC_CAN1_CLK_SLEEP_ENABLE
__HAL_RCC_DAC_CLK_SLEEP_ENABLE
__HAL_RCC_UART7_CLK_SLEEP_ENABLE
__HAL_RCC_UART8_CLK_SLEEP_ENABLE
__HAL_RCC_TIM2_CLK_SLEEP_DISABLE
__HAL_RCC_TIM3_CLK_SLEEP_DISABLE
__HAL_RCC_TIM4_CLK_SLEEP_DISABLE
__HAL_RCC_TIM5_CLK_SLEEP_DISABLE

__HAL_RCC_TIM6_CLK_SLEEP_DISABLE
__HAL_RCC_TIM7_CLK_SLEEP_DISABLE
__HAL_RCC_TIM12_CLK_SLEEP_DISABLE
__HAL_RCC_TIM13_CLK_SLEEP_DISABLE
__HAL_RCC_TIM14_CLK_SLEEP_DISABLE
__HAL_RCC_LPTIM1_CLK_SLEEP_DISABLE
__HAL_RCC_CAN3_CLK_SLEEP_DISABLE
__HAL_RCC_SPI2_CLK_SLEEP_DISABLE
__HAL_RCC_SPI3_CLK_SLEEP_DISABLE
__HAL_RCC_USART2_CLK_SLEEP_DISABLE
__HAL_RCC_USART3_CLK_SLEEP_DISABLE
__HAL_RCC_UART4_CLK_SLEEP_DISABLE
__HAL_RCC_UART5_CLK_SLEEP_DISABLE
__HAL_RCC_I2C1_CLK_SLEEP_DISABLE
__HAL_RCC_I2C2_CLK_SLEEP_DISABLE
__HAL_RCC_I2C3_CLK_SLEEP_DISABLE
__HAL_RCC_CAN1_CLK_SLEEP_DISABLE
__HAL_RCC_DAC_CLK_SLEEP_DISABLE
__HAL_RCC_UART7_CLK_SLEEP_DISABLE
__HAL_RCC_UART8_CLK_SLEEP_DISABLE
__HAL_RCC_RTC_CLK_SLEEP_ENABLE
__HAL_RCC_RTC_CLK_SLEEP_DISABLE
__HAL_RCC_SPDIFRX_CLK_SLEEP_ENABLE
__HAL_RCC_I2C4_CLK_SLEEP_ENABLE
__HAL_RCC_CAN2_CLK_SLEEP_ENABLE
__HAL_RCC_CEC_CLK_SLEEP_ENABLE
__HAL_RCC_SPDIFRX_CLK_SLEEP_DISABLE
__HAL_RCC_I2C4_CLK_SLEEP_DISABLE
__HAL_RCC_CAN2_CLK_SLEEP_DISABLE
__HAL_RCC_CEC_CLK_SLEEP_DISABLE
__HAL_RCC_TIM1_CLK_SLEEP_ENABLE

Notes:

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the peripheral clock is enabled again.

By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_TIM8_CLK_SLEEP_ENABLE
__HAL_RCC_USART1_CLK_SLEEP_ENABLE
__HAL_RCC_USART6_CLK_SLEEP_ENABLE
__HAL_RCC_ADC1_CLK_SLEEP_ENABLE
__HAL_RCC_ADC2_CLK_SLEEP_ENABLE
__HAL_RCC_ADC3_CLK_SLEEP_ENABLE
__HAL_RCC_SDMMC1_CLK_SLEEP_ENABLE
__HAL_RCC_SPI1_CLK_SLEEP_ENABLE
__HAL_RCC_SPI4_CLK_SLEEP_ENABLE
__HAL_RCC_TIM9_CLK_SLEEP_ENABLE
__HAL_RCC_TIM10_CLK_SLEEP_ENABLE
__HAL_RCC_TIM11_CLK_SLEEP_ENABLE
__HAL_RCC_SPI5_CLK_SLEEP_ENABLE
__HAL_RCC_SAI1_CLK_SLEEP_ENABLE
__HAL_RCC_SAI2_CLK_SLEEP_ENABLE
__HAL_RCC_LTDC_CLK_SLEEP_ENABLE
__HAL_RCC_TIM1_CLK_SLEEP_DISABLE
__HAL_RCC_TIM8_CLK_SLEEP_DISABLE
__HAL_RCC_USART1_CLK_SLEEP_DISABLE
__HAL_RCC_USART6_CLK_SLEEP_DISABLE
__HAL_RCC_ADC1_CLK_SLEEP_DISABLE
__HAL_RCC_ADC2_CLK_SLEEP_DISABLE
__HAL_RCC_ADC3_CLK_SLEEP_DISABLE
__HAL_RCC_SDMMC1_CLK_SLEEP_DISABLE
__HAL_RCC_SPI1_CLK_SLEEP_DISABLE
__HAL_RCC_SPI4_CLK_SLEEP_DISABLE
__HAL_RCC_TIM9_CLK_SLEEP_DISABLE
__HAL_RCC_TIM10_CLK_SLEEP_DISABLE
__HAL_RCC_TIM11_CLK_SLEEP_DISABLE
__HAL_RCC_SPI5_CLK_SLEEP_DISABLE
__HAL_RCC_SAI1_CLK_SLEEP_DISABLE
__HAL_RCC_SAI2_CLK_SLEEP_DISABLE

__HAL_RCC_LTDC_CLK_SLEEP_DISABLE
__HAL_RCC_DSI_CLK_SLEEP_ENABLE
__HAL_RCC_DSI_CLK_SLEEP_DISABLE
__HAL_RCC_DFSDM1_CLK_SLEEP_ENABLE
__HAL_RCC_MDIO_CLK_SLEEP_ENABLE
__HAL_RCC_DFSDM1_CLK_SLEEP_DISABLE
__HAL_RCC_MDIO_CLK_SLEEP_DISABLE
__HAL_RCC_SDMMC2_CLK_SLEEP_ENABLE
__HAL_RCC_SDMMC2_CLK_SLEEP_DISABLE
__HAL_RCC_SPI6_CLK_SLEEP_ENABLE
__HAL_RCC_SPI6_CLK_SLEEP_DISABLE

RCC Periph Clock Selection

RCC_PERIPHCLK_I2S
RCC_PERIPHCLK_LTDC
RCC_PERIPHCLK_TIM
RCC_PERIPHCLK_RTC
RCC_PERIPHCLK_USART1
RCC_PERIPHCLK_USART2
RCC_PERIPHCLK_USART3
RCC_PERIPHCLK_UART4
RCC_PERIPHCLK_UART5
RCC_PERIPHCLK_USART6
RCC_PERIPHCLK_UART7
RCC_PERIPHCLK_UART8
RCC_PERIPHCLK_I2C1
RCC_PERIPHCLK_I2C2
RCC_PERIPHCLK_I2C3
RCC_PERIPHCLK_I2C4
RCC_PERIPHCLK_LPTIM1
RCC_PERIPHCLK_SAI1
RCC_PERIPHCLK_SAI2
RCC_PERIPHCLK_CLK48
RCC_PERIPHCLK_CEC
RCC_PERIPHCLK_SDMMC1
RCC_PERIPHCLK_SPDIFRX
RCC_PERIPHCLK_PLLI2S

RCC_PERIPHCLK_SDMMC2
RCC_PERIPHCLK_DFSDM1
RCC_PERIPHCLK_DFSDM1_AUDIO
RCCEx PLLI2SP Clock Divider
RCC_PLLI2SP_DIV2
RCC_PLLI2SP_DIV4
RCC_PLLI2SP_DIV6
RCC_PLLI2SP_DIV8
RCCEx PLLSAIP Clock Divider
RCC_PLLSAIP_DIV2
RCC_PLLSAIP_DIV4
RCC_PLLSAIP_DIV6
RCC_PLLSAIP_DIV8
RCCEx PLLSAI DIVR
RCC_PLLSAIDIVR_2
RCC_PLLSAIDIVR_4
RCC_PLLSAIDIVR_8
RCC_PLLSAIDIVR_16
RCCEx SAI1 Clock Source
RCC_SAI1CLKSOURCE_PLLSAI
RCC_SAI1CLKSOURCE_PLLI2S
RCC_SAI1CLKSOURCE_PIN
RCC_SAI1CLKSOURCE_PLLSRC
RCCEx SAI2 Clock Source
RCC_SAI2CLKSOURCE_PLLSAI
RCC_SAI2CLKSOURCE_PLLI2S
RCC_SAI2CLKSOURCE_PIN
RCC_SAI2CLKSOURCE_PLLSRC
RCCEx SDMMC1 Clock Source
RCC_SDMMC1CLKSOURCE_CLK48
RCC_SDMMC1CLKSOURCE_SYSCLK
RCCEx SDMMC2 Clock Source
RCC_SDMMC2CLKSOURCE_CLK48
RCC_SDMMC2CLKSOURCE_SYSCLK
RCCEx TIM Prescaler Selection
RCC_TIMPRES_DESACTIVATED

RCC_TIMPRES_ACTIVATED

RCCEx UART4 Clock Source

RCC_UART4CLKSOURCE_PCLK1

RCC_UART4CLKSOURCE_SYSCLK

RCC_UART4CLKSOURCE_HSI

RCC_UART4CLKSOURCE_LSE

RCCEx UART5 Clock Source

RCC_UART5CLKSOURCE_PCLK1

RCC_UART5CLKSOURCE_SYSCLK

RCC_UART5CLKSOURCE_HSI

RCC_UART5CLKSOURCE_LSE

RCCEx UART7 Clock Source

RCC_UART7CLKSOURCE_PCLK1

RCC_UART7CLKSOURCE_SYSCLK

RCC_UART7CLKSOURCE_HSI

RCC_UART7CLKSOURCE_LSE

RCCEx UART8 Clock Source

RCC_UART8CLKSOURCE_PCLK1

RCC_UART8CLKSOURCE_SYSCLK

RCC_UART8CLKSOURCE_HSI

RCC_UART8CLKSOURCE_LSE

RCCEx USART1 Clock Source

RCC_USART1CLKSOURCE_PCLK2

RCC_USART1CLKSOURCE_SYSCLK

RCC_USART1CLKSOURCE_HSI

RCC_USART1CLKSOURCE_LSE

RCCEx USART2 Clock Source

RCC_USART2CLKSOURCE_PCLK1

RCC_USART2CLKSOURCE_SYSCLK

RCC_USART2CLKSOURCE_HSI

RCC_USART2CLKSOURCE_LSE

RCCEx USART3 Clock Source

RCC_USART3CLKSOURCE_PCLK1

RCC_USART3CLKSOURCE_SYSCLK

RCC_USART3CLKSOURCE_HSI

RCC_USART3CLKSOURCE_LSE

RCCEx USART6 Clock Source

RCC_USART6CLKSOURCE_PCLK2
RCC_USART6CLKSOURCE_SYSCLK
RCC_USART6CLKSOURCE_HSI
RCC_USART6CLKSOURCE_LSE

52 HAL RNG Generic Driver

52.1 RNG Firmware driver registers structures

52.1.1 RNG_HandleTypeDef

Data Fields

- *RNG_TypeDef * Instance*
- *uint32_t RandomNumber*
- *HAL_LockTypeDef Lock*
- *__IO HAL_RNG_StateTypeDef State*

Field Documentation

- *RNG_TypeDef* RNG_HandleTypeDef::Instance*
Register base address
- *uint32_t RNG_HandleTypeDef::RandomNumber*
Last Generated random number
- *HAL_LockTypeDef RNG_HandleTypeDef::Lock*
RNG locking object
- *__IO HAL_RNG_StateTypeDef RNG_HandleTypeDef::State*
RNG communication state

52.2 RNG Firmware driver API description

52.2.1 How to use this driver

The RNG HAL driver can be used as follows:

1. Enable the RNG controller clock using `__HAL_RCC_RNG_CLK_ENABLE()` macro in `HAL_RNG_MspInit()`.
2. Activate the RNG peripheral using `HAL_RNG_Init()` function.
3. Wait until the 32 bit Random Number Generator contains a valid random data using (polling/interrupt) mode.
4. Get the 32 bit random number using `HAL_RNG_GenerateRandomNumber()` function.

52.2.2 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the RNG according to the specified parameters in the `RNG_InitTypeDef` and create the associated handle
- Deinitialize the RNG peripheral
- Initialize the RNG MSP
- Deinitialize RNG MSP

This section contains the following APIs:

- [*HAL_RNG_Init\(\)*](#)
- [*HAL_RNG_DeInit\(\)*](#)
- [*HAL_RNG_MspInit\(\)*](#)
- [*HAL_RNG_MspDeInit\(\)*](#)

52.2.3 Peripheral Control functions

This section provides functions allowing to:

- Get the 32 bit Random number
- Get the 32 bit Random number with interrupt enabled
- Handle RNG interrupt request

This section contains the following APIs:

- [HAL_RNG_GenerateRandomNumber\(\)](#)
- [HAL_RNG_GenerateRandomNumber_IT\(\)](#)
- [HAL_RNG_IRQHandler\(\)](#)
- [HAL_RNG_GetRandomNumber\(\)](#)
- [HAL_RNG_GetRandomNumber_IT\(\)](#)
- [HAL_RNG_ReadLastRandomNumber\(\)](#)
- [HAL_RNG_ReadyDataCallback\(\)](#)
- [HAL_RNG_ErrorCallback\(\)](#)

52.2.4 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- [HAL_RNG_GetState\(\)](#)

52.2.5 Detailed description of functions

HAL_RNG_Init

Function name	HAL_StatusTypeDef HAL_RNG_Init (RNG_HandleTypeDef * hrng)
Function description	Initializes the RNG peripheral and creates the associated handle.
Parameters	<ul style="list-style-type: none"> • hrng: pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_RNG_DeInit

Function name	HAL_StatusTypeDef HAL_RNG_DeInit (RNG_HandleTypeDef * hrng)
Function description	Deinitializes the RNG peripheral.
Parameters	<ul style="list-style-type: none"> • hrng: pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_RNG_MspInit

Function name	void HAL_RNG_MspInit (RNG_HandleTypeDef * hrng)
Function description	Initializes the RNG MSP.
Parameters	<ul style="list-style-type: none"> • hrng: pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **None:**

HAL_RNG_MspDeInit

Function name **void HAL_RNG_MspDeInit (RNG_HandleTypeDef * hrng)**

Function description DeInitializes the RNG MSP.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **None:**

HAL_RNG_GetRandomNumber

Function name **uint32_t HAL_RNG_GetRandomNumber (RNG_HandleTypeDef * hrng)**

Function description Returns generated random number in polling mode (Obsolete)
Use HAL_RNG_GenerateRandomNumber() API instead.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **Random:** value

HAL_RNG_GetRandomNumber_IT

Function name **uint32_t HAL_RNG_GetRandomNumber_IT (RNG_HandleTypeDef * hrng)**

Function description Returns a 32-bit random number with interrupt enabled (Obsolete),
Use HAL_RNG_GenerateRandomNumber_IT() API instead.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **32-bit:** random number

HAL_RNG_GenerateRandomNumber

Function name **HAL_StatusTypeDef HAL_RNG_GenerateRandomNumber (RNG_HandleTypeDef * hrng, uint32_t * random32bit)**

Function description Generates a 32-bit random number.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.
- **random32bit:** pointer to generated random number variable if successful.

Return values

- **HAL:** status

Notes

- Each time the random number data is read the RNG_FLAG_DRDY flag is automatically cleared.

HAL_RNG_GenerateRandomNumber_IT

Function name **HAL_StatusTypeDef HAL_RNG_GenerateRandomNumber_IT (RNG_HandleTypeDef * hrng)**

Function description	Generates a 32-bit random number in interrupt mode.
Parameters	<ul style="list-style-type: none"> • hrng: pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_RNG_ReadLastRandomNumber

Function name	uint32_t HAL_RNG_ReadLastRandomNumber (RNG_HandleTypeDef * hrng)
Function description	Read latest generated random number.
Parameters	<ul style="list-style-type: none"> • hrng: pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.
Return values	<ul style="list-style-type: none"> • random: value

HAL_RNG_IRQHandler

Function name	void HAL_RNG_IRQHandler (RNG_HandleTypeDef * hrng)
Function description	Handles RNG interrupt request.
Parameters	<ul style="list-style-type: none"> • hrng: pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • In the case of a clock error, the RNG is no more able to generate random numbers because the PLL48CLK clock is not correct. User has to check that the clock controller is correctly configured to provide the RNG clock and clear the CEIS bit using <code>__HAL_RNG_CLEAR_IT()</code>. The clock error has no impact on the previously generated random numbers, and the RNG_DR register contents can be used. • In the case of a seed error, the generation of random numbers is interrupted as long as the SECS bit is '1'. If a number is available in the RNG_DR register, it must not be used because it may not have enough entropy. In this case, it is recommended to clear the SEIS bit using <code>__HAL_RNG_CLEAR_IT()</code>, then disable and enable the RNG peripheral to reinitialize and restart the RNG. • User-written <code>HAL_RNG_ErrorCallback()</code> API is called once whether SEIS or CEIS are set.

HAL_RNG_ErrorCallback

Function name	void HAL_RNG_ErrorCallback (RNG_HandleTypeDef * hrng)
Function description	RNG error callbacks.
Parameters	<ul style="list-style-type: none"> • hrng: pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.
Return values	<ul style="list-style-type: none"> • None:

HAL_RNG_ReadyDataCallback

Function name	void HAL_RNG_ReadyDataCallback (RNG_HandleTypeDef * hrng, uint32_t random32bit)
Function description	Data Ready callback in non-blocking mode.
Parameters	<ul style="list-style-type: none"> • hrng: pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG. • random32bit: generated random number.
Return values	<ul style="list-style-type: none"> • None:

HAL_RNG_GetState

Function name	HAL_RNG_StateTypeDef HAL_RNG_GetState (RNG_HandleTypeDef * hrng)
Function description	Returns the RNG state.
Parameters	<ul style="list-style-type: none"> • hrng: pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.
Return values	<ul style="list-style-type: none"> • HAL: state

52.3 RNG Firmware driver defines

52.3.1 RNG

RNG Interrupt definition

RNG_IT_DRDY	Data Ready interrupt
RNG_IT_CEI	Clock error interrupt
RNG_IT_SEI	Seed error interrupt

RNG Flag definition

RNG_FLAG_DRDY	Data ready
RNG_FLAG_CECS	Clock error current status
RNG_FLAG_SECS	Seed error current status

RNG Exported Macros

__HAL_RNG_RESET_HANDLE_STATE	<p>Description:</p> <ul style="list-style-type: none"> • Reset RNG handle state. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: RNG Handle <p>Return value:</p> <ul style="list-style-type: none"> • None
__HAL_RNG_ENABLE	<p>Description:</p> <ul style="list-style-type: none"> • Enables the RNG peripheral. <p>Parameters:</p> <ul style="list-style-type: none"> • __HANDLE__: RNG Handle



`__HAL_RNG_DISABLE`

Return value:

- None

Description:

- Disables the RNG peripheral.

Parameters:

- `__HANDLE__`: RNG Handle

Return value:

- None

`__HAL_RNG_GET_FLAG`

Description:

- Check the selected RNG flag status.

Parameters:

- `__HANDLE__`: RNG Handle
- `__FLAG__`: RNG flag This parameter can be one of the following values:
 - `RNG_FLAG_DRDY`: Data ready
 - `RNG_FLAG_CECS`: Clock error current status
 - `RNG_FLAG_SECS`: Seed error current status

Return value:

- The: new state of `__FLAG__` (SET or RESET).

Description:

- Clears the selected RNG flag status.

Parameters:

- `__HANDLE__`: RNG handle
- `__FLAG__`: RNG flag to clear

Return value:

- None

Notes:

- **WARNING:** This is a dummy macro for HAL code alignment, flags `RNG_FLAG_DRDY`, `RNG_FLAG_CECS` and `RNG_FLAG_SECS` are read-only.

`__HAL_RNG_CLEAR_FLAG`

Description:

- Enables the RNG interrupts.

Parameters:

- `__HANDLE__`: RNG Handle

Return value:

- None

`__HAL_RNG_ENABLE_IT`

`__HAL_RNG_DISABLE_IT`**Description:**

- Disables the RNG interrupts.

Parameters:

- `__HANDLE__`: RNG Handle

Return value:

- None

`__HAL_RNG_GET_IT`**Description:**

- Checks whether the specified RNG interrupt has occurred or not.

Parameters:

- `__HANDLE__`: RNG Handle
- `__INTERRUPT__`: specifies the RNG interrupt status flag to check. This parameter can be one of the following values:
 - `RNG_IT_DRDY`: Data ready interrupt
 - `RNG_IT_CEI`: Clock error interrupt
 - `RNG_IT_SEI`: Seed error interrupt

Return value:

- The: new state of `__INTERRUPT__` (SET or RESET).

`__HAL_RNG_CLEAR_IT`**Description:**

- Clear the RNG interrupt status flags.

Parameters:

- `__HANDLE__`: RNG Handle
- `__INTERRUPT__`: specifies the RNG interrupt status flag to clear. This parameter can be one of the following values:
 - `RNG_IT_CEI`: Clock error interrupt
 - `RNG_IT_SEI`: Seed error interrupt

Return value:

- None

Notes:

- `RNG_IT_DRDY` flag is read-only, reading `RNG_DR` register automatically clears `RNG_IT_DRDY`.

53 HAL RTC Generic Driver

53.1 RTC Firmware driver registers structures

53.1.1 RTC_InitTypeDef

Data Fields

- *uint32_t HourFormat*
- *uint32_t AsynchPrediv*
- *uint32_t SynchPrediv*
- *uint32_t OutPut*
- *uint32_t OutPutPolarity*
- *uint32_t OutPutType*

Field Documentation

- *uint32_t RTC_InitTypeDef::HourFormat*
Specifies the RTC Hour Format. This parameter can be a value of [RTC_Hour_Formats](#)
- *uint32_t RTC_InitTypeDef::AsynchPrediv*
Specifies the RTC Asynchronous Predivider value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x7F
- *uint32_t RTC_InitTypeDef::SynchPrediv*
Specifies the RTC Synchronous Predivider value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x7FFF
- *uint32_t RTC_InitTypeDef::OutPut*
Specifies which signal will be routed to the RTC output. This parameter can be a value of [RTCEx_Output_selection_Definitions](#)
- *uint32_t RTC_InitTypeDef::OutPutPolarity*
Specifies the polarity of the output signal. This parameter can be a value of [RTC_Output_Polarity_Definitions](#)
- *uint32_t RTC_InitTypeDef::OutPutType*
Specifies the RTC Output Pin mode. This parameter can be a value of [RTC_Output_Type_ALARM_OUT](#)

53.1.2 RTC_TimeTypeDef

Data Fields

- *uint8_t Hours*
- *uint8_t Minutes*
- *uint8_t Seconds*
- *uint32_t SubSeconds*
- *uint32_t SecondFraction*
- *uint8_t TimeFormat*
- *uint32_t DayLightSaving*
- *uint32_t StoreOperation*

Field Documentation

- *uint8_t RTC_TimeTypeDef::Hours*
Specifies the RTC Time Hour. This parameter must be a number between Min_Data = 0 and Max_Data = 12 if the RTC_HourFormat_12 is selected. This parameter must be

a number between Min_Data = 0 and Max_Data = 23 if the RTC_HourFormat_24 is selected

- ***uint8_t RTC_TimeTypeDef::Minutes***
Specifies the RTC Time Minutes. This parameter must be a number between Min_Data = 0 and Max_Data = 59
- ***uint8_t RTC_TimeTypeDef::Seconds***
Specifies the RTC Time Seconds. This parameter must be a number between Min_Data = 0 and Max_Data = 59
- ***uint32_t RTC_TimeTypeDef::SubSeconds***
Specifies the RTC_SSR RTC Sub Second register content. This parameter corresponds to a time unit range between [0-1] Second with [1 Sec / SecondFraction +1] granularity
- ***uint32_t RTC_TimeTypeDef::SecondFraction***
Specifies the range or granularity of Sub Second register content corresponding to Synchronous pre-scaler factor value (PREDIV_S) This parameter corresponds to a time unit range between [0-1] Second with [1 Sec / SecondFraction +1] granularity. This field will be used only by HAL_RTC_GetTime function
- ***uint8_t RTC_TimeTypeDef::TimeFormat***
Specifies the RTC AM/PM Time. This parameter can be a value of [RTC_AM_PM_Definitions](#)
- ***uint32_t RTC_TimeTypeDef::DayLightSaving***
Specifies RTC_DayLightSaveOperation: the value of hour adjustment. This parameter can be a value of [RTC_DayLightSaving_Definitions](#)
- ***uint32_t RTC_TimeTypeDef::StoreOperation***
Specifies RTC_StoreOperation value to be written in the BCK bit in CR register to store the operation. This parameter can be a value of [RTC_StoreOperation_Definitions](#)

53.1.3 RTC_DateTypeDef

Data Fields

- ***uint8_t WeekDay***
- ***uint8_t Month***
- ***uint8_t Date***
- ***uint8_t Year***

Field Documentation

- ***uint8_t RTC_DateTypeDef::WeekDay***
Specifies the RTC Date WeekDay. This parameter can be a value of [RTC_WeekDay_Definitions](#)
- ***uint8_t RTC_DateTypeDef::Month***
Specifies the RTC Date Month (in BCD format). This parameter can be a value of [RTC_Month_Date_Definitions](#)
- ***uint8_t RTC_DateTypeDef::Date***
Specifies the RTC Date. This parameter must be a number between Min_Data = 1 and Max_Data = 31
- ***uint8_t RTC_DateTypeDef::Year***
Specifies the RTC Date Year. This parameter must be a number between Min_Data = 0 and Max_Data = 99

53.1.4 RTC_AlarmTypeDef

Data Fields

- ***RTC_TimeTypeDef AlarmTime***

- *uint32_t AlarmMask*
- *uint32_t AlarmSubSecondMask*
- *uint32_t AlarmDateWeekDaySel*
- *uint8_t AlarmDateWeekDay*
- *uint32_t Alarm*

Field Documentation

- ***RTC_TimeTypeDef RTC_AlarmTypeDef::AlarmTime***
Specifies the RTC Alarm Time members
- ***uint32_t RTC_AlarmTypeDef::AlarmMask***
Specifies the RTC Alarm Masks. This parameter can be a value of [RTC_AlarmMask_Definitions](#)
- ***uint32_t RTC_AlarmTypeDef::AlarmSubSecondMask***
Specifies the RTC Alarm SubSeconds Masks. This parameter can be a value of [RTC_Alarm_Sub_Seconds_Masks_Definitions](#)
- ***uint32_t RTC_AlarmTypeDef::AlarmDateWeekDaySel***
Specifies the RTC Alarm is on Date or WeekDay. This parameter can be a value of [RTC_AlarmDateWeekDay_Definitions](#)
- ***uint8_t RTC_AlarmTypeDef::AlarmDateWeekDay***
Specifies the RTC Alarm Date/WeekDay. If the Alarm Date is selected, this parameter must be set to a value in the 1-31 range. If the Alarm WeekDay is selected, this parameter can be a value of [RTC_WeekDay_Definitions](#)
- ***uint32_t RTC_AlarmTypeDef::Alarm***
Specifies the alarm . This parameter can be a value of [RTC_Alarms_Definitions](#)

53.1.5 RTC_HandleTypeDef

Data Fields

- *RTC_TypeDef * Instance*
- *RTC_InitTypeDef Init*
- *HAL_LockTypeDef Lock*
- *__IO HAL_RTCStateTypeDef State*

Field Documentation

- ***RTC_TypeDef* RTC_HandleTypeDef::Instance***
Register base address
- ***RTC_InitTypeDef RTC_HandleTypeDef::Init***
RTC required parameters
- ***HAL_LockTypeDef RTC_HandleTypeDef::Lock***
RTC locking object
- ***__IO HAL_RTCStateTypeDef RTC_HandleTypeDef::State***
Time communication state

53.2 RTC Firmware driver API description

53.2.1 Backup Domain Operating Condition

The real-time clock (RTC), the RTC backup registers, and the backup SRAM (BKP SRAM) can be powered from the VBAT voltage when the main VDD supply is powered off. To retain the content of the RTC backup registers, backup SRAM, and supply the RTC when VDD is turned off, VBAT pin can be connected to an optional standby voltage supplied by a battery or by another source.

To allow the RTC operating even when the main digital supply (VDD) is turned off, the VBAT pin powers the following blocks:

1. The RTC
2. The LSE oscillator
3. The backup SRAM when the low power backup regulator is enabled
4. PC13 to PC15 I/Os, plus PI8 I/O (when available)

When the backup domain is supplied by VDD (analog switch connected to VDD), the following pins are available:

1. PC14 and PC15 can be used as either GPIO or LSE pins
2. PC13 can be used as a GPIO or as the RTC_AF1 pin
3. PI8 can be used as a GPIO or as the RTC_AF2 pin

When the backup domain is supplied by VBAT (analog switch connected to VBAT because VDD is not present), the following pins are available:

1. PC14 and PC15 can be used as LSE pins only
2. PC13 can be used as the RTC_AF1 pin
3. PI8 can be used as the RTC_AF2 pin
4. PC1 can be used as the RTC_AF3 pin

53.2.2 Backup Domain Reset

The backup domain reset sets all RTC registers and the RCC_BDCR register to their reset values. The BKPSRAM is not affected by this reset. The only way to reset the BKPSRAM is through the Flash interface by requesting a protection level change from 1 to 0.

A backup domain reset is generated when one of the following events occurs:

1. Software reset, triggered by setting the BDRST bit in the RCC Backup domain control register (RCC_BDCR).
2. VDD or VBAT power on, if both supplies have previously been powered off.

53.2.3 Backup Domain Access

After reset, the backup domain (RTC registers, RTC backup data registers and backup SRAM) is protected against possible unwanted write accesses.

To enable access to the RTC Domain and RTC registers, proceed as follows:

- Enable the Power Controller (PWR) APB1 interface clock using the `__HAL_RCC_PWR_CLK_ENABLE()` function.
- Enable access to RTC domain using the `HAL_PWR_EnableBkUpAccess()` function.
- Select the RTC clock source using the `__HAL_RCC_RTC_CONFIG()` function.
- Enable RTC Clock using the `__HAL_RCC_RTC_ENABLE()` function.

53.2.4 How to use this driver

- Enable the RTC domain access (see description in the section above).
- Configure the RTC Prescaler (Asynchronous and Synchronous) and RTC hour format using the `HAL_RTC_Init()` function.

Time and Date configuration

- To configure the RTC Calendar (Time and Date) use the `HAL_RTC_SetTime()` and `HAL_RTC_SetDate()` functions.
- To read the RTC Calendar, use the `HAL_RTC_GetTime()` and `HAL_RTC_GetDate()` functions.

Alarm configuration

- To configure the RTC Alarm use the HAL_RTC_SetAlarm() function. You can also configure the RTC Alarm with interrupt mode using the HAL_RTC_SetAlarm_IT() function.
- To read the RTC Alarm, use the HAL_RTC_GetAlarm() function.

53.2.5 RTC and low power modes

The MCU can be woken up from a low power mode by an RTC alternate function.

The RTC alternate functions are the RTC alarms (Alarm A and Alarm B), RTC wakeup, RTC tamper event detection and RTC time stamp event detection. These RTC alternate functions can wake up the system from the Stop and Standby low power modes.

The system can also wake up from low power modes without depending on an external interrupt (Auto-wakeup mode), by using the RTC alarm or the RTC wakeup events.

The RTC provides a programmable time base for waking up from the Stop or Standby mode at regular intervals. Wakeup from STOP and STANDBY modes is possible only when the RTC clock source is LSE or LSI.

53.2.6 Initialization and de-initialization functions

This section provides functions allowing to initialize and configure the RTC Prescaler (Synchronous and Asynchronous), RTC Hour format, disable RTC registers Write protection, enter and exit the RTC initialization mode, RTC registers synchronization check and reference clock detection enable.

1. The RTC Prescaler is programmed to generate the RTC 1Hz time base. It is split into 2 programmable prescalers to minimize power consumption.
 - A 7-bit asynchronous prescaler and a 13-bit synchronous prescaler.
 - When both prescalers are used, it is recommended to configure the asynchronous prescaler to a high value to minimize power consumption.
2. All RTC registers are Write protected. Writing to the RTC registers is enabled by writing a key into the Write Protection register, RTC_WPR.
3. To configure the RTC Calendar, user application should enter initialization mode. In this mode, the calendar counter is stopped and its value can be updated. When the initialization sequence is complete, the calendar restarts counting after 4 RTCCLK cycles.
4. To read the calendar through the shadow registers after Calendar initialization, calendar update or after wakeup from low power modes the software must first clear the RSF flag. The software must then wait until it is set again before reading the calendar, which means that the calendar registers have been correctly copied into the RTC_TR and RTC_DR shadow registers. The HAL_RTC_WaitForSynchro() function implements the above software sequence (RSF clear and RSF check).

This section contains the following APIs:

- [HAL_RTC_Init\(\)](#)
- [HAL_RTC_DeInit\(\)](#)
- [HAL_RTC_MspInit\(\)](#)
- [HAL_RTC_MspDeInit\(\)](#)

53.2.7 RTC Time and Date functions

This section provides functions allowing to configure Time and Date features

This section contains the following APIs:

- [HAL_RTC_SetTime\(\)](#)
- [HAL_RTC_GetTime\(\)](#)
- [HAL_RTC_SetDate\(\)](#)
- [HAL_RTC_GetDate\(\)](#)

53.2.8 RTC Alarm functions

This section provides functions allowing to configure Alarm feature

This section contains the following APIs:

- [HAL_RTC_SetAlarm\(\)](#)
- [HAL_RTC_SetAlarm_IT\(\)](#)
- [HAL_RTC_DeactivateAlarm\(\)](#)
- [HAL_RTC_GetAlarm\(\)](#)
- [HAL_RTC_AlarmIRQHandler\(\)](#)
- [HAL_RTC_AlarmAEventCallback\(\)](#)
- [HAL_RTC_PollForAlarmAEvent\(\)](#)

53.2.9 Peripheral Control functions

This subsection provides functions allowing to

- Wait for RTC Time and Date Synchronization

This section contains the following APIs:

- [HAL_RTC_WaitForSynchro\(\)](#)

53.2.10 Peripheral State functions

This subsection provides functions allowing to

- Get RTC state

This section contains the following APIs:

- [HAL_RTC_GetState\(\)](#)

53.2.11 Detailed description of functions

HAL_RTC_Init

Function name	HAL_StatusTypeDef HAL_RTC_Init (RTC_HandleTypeDef * hrtc)
Function description	Initializes the RTC peripheral.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_RTC_DeInit

Function name	HAL_StatusTypeDef HAL_RTC_DeInit (RTC_HandleTypeDef * hrtc)
Function description	DeInitializes the RTC peripheral.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that

contains the configuration information for RTC.

- Return values
- **HAL:** status
- Notes
- This function doesn't reset the RTC Backup Data registers.

HAL_RTC_Msplnit

Function name **void HAL_RTC_Msplnit (RTC_HandleTypeDef * hrtc)**

Function description Initializes the RTC MSP.

Parameters

- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values

- **None:**

HAL_RTC_MspDelnit

Function name **void HAL_RTC_MspDelnit (RTC_HandleTypeDef * hrtc)**

Function description Deinitializes the RTC MSP.

Parameters

- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values

- **None:**

HAL_RTC_SetTime

Function name **HAL_StatusTypeDef HAL_RTC_SetTime (RTC_HandleTypeDef * hrtc, RTC_TimeTypeDef * sTime, uint32_t Format)**

Function description Sets RTC current time.

Parameters

- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **sTime:** Pointer to Time structure
- **Format:** Specifies the format of the entered parameters. This parameter can be one of the following values:
 - **FORMAT_BIN:** Binary data format
 - **FORMAT_BCD:** BCD data format

Return values

- **HAL:** status

HAL_RTC_GetTime

Function name **HAL_StatusTypeDef HAL_RTC_GetTime (RTC_HandleTypeDef * hrtc, RTC_TimeTypeDef * sTime, uint32_t Format)**

Function description Gets RTC current time.

Parameters

- **hrtc:** RTC handle
- **sTime:** Pointer to Time structure with Hours, Minutes and Seconds fields returned with input format (BIN or BCD), also SubSeconds field returning the RTC_SSR register content and SecondFraction field the Synchronous pre-scaler factor to be used for second fraction ratio computation.
- **Format:** Specifies the format of the entered parameters. This parameter can be one of the following values:

- RTC_FORMAT_BIN: Binary data format
 - RTC_FORMAT_BCD: BCD data format
- Return values**
- **HAL:** status
- Notes**
- You can use SubSeconds and SecondFraction (sTime structure fields returned) to convert SubSeconds value in second fraction ratio with time unit following generic formula: $\text{Second fraction ratio} * \text{time_unit} = [(\text{SecondFraction} - \text{SubSeconds}) / (\text{SecondFraction} + 1)] * \text{time_unit}$ This conversion can be performed only if no shift operation is pending (ie. SHFP=0) when PREDIV_S >= SS
 - You must call HAL_RTC_GetDate() after HAL_RTC_GetTime() to unlock the values in the higher-order calendar shadow registers to ensure consistency between the time and date values. Reading RTC current time locks the values in calendar shadow registers until Current date is read to ensure consistency between the time and date values.

HAL_RTC_SetDate

- Function name** HAL_StatusTypeDef HAL_RTC_SetDate (RTC_HandleTypeDef * hrtc, RTC_DateTypeDef * sDate, uint32_t Format)
- Function description** Sets RTC current date.
- Parameters**
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
 - **sDate:** Pointer to date structure
 - **Format:** specifies the format of the entered parameters. This parameter can be one of the following values:
 - RTC_FORMAT_BIN: Binary data format
 - RTC_FORMAT_BCD: BCD data format
- Return values**
- **HAL:** status

HAL_RTC_GetDate

- Function name** HAL_StatusTypeDef HAL_RTC_GetDate (RTC_HandleTypeDef * hrtc, RTC_DateTypeDef * sDate, uint32_t Format)
- Function description** Gets RTC current date.
- Parameters**
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
 - **sDate:** Pointer to Date structure
 - **Format:** Specifies the format of the entered parameters. This parameter can be one of the following values:
 - RTC_FORMAT_BIN: Binary data format
 - RTC_FORMAT_BCD: BCD data format
- Return values**
- **HAL:** status
- Notes**
- You must call HAL_RTC_GetDate() after HAL_RTC_GetTime() to unlock the values in the higher-order calendar shadow registers to ensure consistency between the time and date values. Reading RTC current time locks the values in calendar shadow registers until Current date is read.

HAL_RTC_SetAlarm

Function name	HAL_StatusTypeDef HAL_RTC_SetAlarm (RTC_HandleTypeDef * hrtc, RTC_AlarmTypeDef * sAlarm, uint32_t Format)
Function description	Sets the specified RTC Alarm.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • sAlarm: Pointer to Alarm structure • Format: Specifies the format of the entered parameters. This parameter can be one of the following values: <ul style="list-style-type: none"> – FORMAT_BIN: Binary data format – FORMAT_BCD: BCD data format
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_RTC_SetAlarm_IT

Function name	HAL_StatusTypeDef HAL_RTC_SetAlarm_IT (RTC_HandleTypeDef * hrtc, RTC_AlarmTypeDef * sAlarm, uint32_t Format)
Function description	Sets the specified RTC Alarm with Interrupt.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • sAlarm: Pointer to Alarm structure • Format: Specifies the format of the entered parameters. This parameter can be one of the following values: <ul style="list-style-type: none"> – FORMAT_BIN: Binary data format – FORMAT_BCD: BCD data format
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • The Alarm register can only be written when the corresponding Alarm is disabled (Use the HAL_RTC_DeactivateAlarm()). • The HAL_RTC_SetTime() must be called before enabling the Alarm feature.

HAL_RTC_DeactivateAlarm

Function name	HAL_StatusTypeDef HAL_RTC_DeactivateAlarm (RTC_HandleTypeDef * hrtc, uint32_t Alarm)
Function description	Deactive the specified RTC Alarm.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • Alarm: Specifies the Alarm. This parameter can be one of the following values: <ul style="list-style-type: none"> – RTC_ALARM_A: AlarmA – RTC_ALARM_B: AlarmB
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_RTC_GetAlarm

Function name	HAL_StatusTypeDef HAL_RTC_GetAlarm (RTC_HandleTypeDef * hrtc, RTC_AlarmTypeDef * sAlarm, uint32_t Alarm, uint32_t Format)
Function description	Gets the RTC Alarm value and masks.
Parameters	<ul style="list-style-type: none">• hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.• sAlarm: Pointer to Date structure• Alarm: Specifies the Alarm. This parameter can be one of the following values:<ul style="list-style-type: none">– RTC_ALARM_A: AlarmA– RTC_ALARM_B: AlarmB• Format: Specifies the format of the entered parameters. This parameter can be one of the following values:<ul style="list-style-type: none">– RTC_FORMAT_BIN: Binary data format– RTC_FORMAT_BCD: BCD data format
Return values	<ul style="list-style-type: none">• HAL: status

HAL_RTC_AlarmIRQHandler

Function name	void HAL_RTC_AlarmIRQHandler (RTC_HandleTypeDef * hrtc)
Function description	This function handles Alarm interrupt request.
Parameters	<ul style="list-style-type: none">• hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none">• None:

HAL_RTC_PollForAlarmAEvent

Function name	HAL_StatusTypeDef HAL_RTC_PollForAlarmAEvent (RTC_HandleTypeDef * hrtc, uint32_t Timeout)
Function description	This function handles AlarmA Polling request.
Parameters	<ul style="list-style-type: none">• hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.• Timeout: Timeout duration
Return values	<ul style="list-style-type: none">• HAL: status

HAL_RTC_AlarmAEventCallback

Function name	void HAL_RTC_AlarmAEventCallback (RTC_HandleTypeDef * hrtc)
Function description	Alarm A callback.
Parameters	<ul style="list-style-type: none">• hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none">• None:

HAL_RTC_WaitForSynchro

Function name	HAL_StatusTypeDef HAL_RTC_WaitForSynchro (RTC_HandleTypeDef * hrtc)
Function description	Waits until the RTC Time and Date registers (RTC_TR and RTC_DR) are synchronized with RTC APB clock.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • The RTC Resynchronization mode is write protected, use the <code>__HAL_RTC_WRITEPROTECTION_DISABLE()</code> before calling this function. • To read the calendar through the shadow registers after Calendar initialization, calendar update or after wakeup from low power modes the software must first clear the RSF flag. The software must then wait until it is set again before reading the calendar, which means that the calendar registers have been correctly copied into the RTC_TR and RTC_DR shadow registers.

HAL_RTC_GetState

Function name	HAL_RTCStateTypeDef HAL_RTC_GetState (RTC_HandleTypeDef * hrtc)
Function description	Returns the RTC state.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none"> • HAL: state

RTC_EnterInitMode

Function name	HAL_StatusTypeDef RTC_EnterInitMode (RTC_HandleTypeDef * hrtc)
Function description	Enters the RTC Initialization mode.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • The RTC Initialization mode is write protected, use the <code>__HAL_RTC_WRITEPROTECTION_DISABLE()</code> before calling this function.

RTC_ByteToBcd2

Function name	uint8_t RTC_ByteToBcd2 (uint8_t Value)
Function description	Converts a 2 digit decimal to BCD format.
Parameters	<ul style="list-style-type: none"> • Value: Byte to be converted
Return values	<ul style="list-style-type: none"> • Converted: byte

RTC_Bcd2ToByte

Function name **uint8_t RTC_Bcd2ToByte (uint8_t Value)**

Function description Converts from 2 digit BCD to Binary.

Parameters • **Value:** BCD value to be converted

Return values • **Converted:** word

53.3 RTC Firmware driver defines**53.3.1 RTC*****RTC Alarm Date WeekDay Definitions***

RTC_ALARMDATEWEEKDAYSEL_DATE

RTC_ALARMDATEWEEKDAYSEL_WEEKDAY

RTC Alarm Mask Definitions

RTC_ALARMMASK_NONE

RTC_ALARMMASK_DATEWEEKDAY

RTC_ALARMMASK_HOURS

RTC_ALARMMASK_MINUTES

RTC_ALARMMASK_SECONDS

RTC_ALARMMASK_ALL

RTC Alarms Definitions

RTC_ALARM_A

RTC_ALARM_B

RTC Alarm Sub Seconds Masks Definitions

RTC_ALARMSUBSECONDMASK_ALL All Alarm SS fields are masked. There is no comparison on sub seconds for Alarm

RTC_ALARMSUBSECONDMASK_SS14_1 SS[14:1] are don't care in Alarm comparison. Only SS[0] is compared.

RTC_ALARMSUBSECONDMASK_SS14_2 SS[14:2] are don't care in Alarm comparison. Only SS[1:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_3 SS[14:3] are don't care in Alarm comparison. Only SS[2:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_4 SS[14:4] are don't care in Alarm comparison. Only SS[3:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_5 SS[14:5] are don't care in Alarm comparison. Only SS[4:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_6 SS[14:6] are don't care in Alarm comparison. Only SS[5:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_7 SS[14:7] are don't care in Alarm comparison. Only SS[6:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_8 SS[14:8] are don't care in Alarm

RTC_ALARMSSUBSECONDMASK_SS14_9	comparison. Only SS[7:0] are compared
RTC_ALARMSSUBSECONDMASK_SS14_10	SS[14:9] are don't care in Alarm comparison. Only SS[8:0] are compared
RTC_ALARMSSUBSECONDMASK_SS14_11	SS[14:10] are don't care in Alarm comparison. Only SS[9:0] are compared
RTC_ALARMSSUBSECONDMASK_SS14_12	SS[14:11] are don't care in Alarm comparison. Only SS[10:0] are compared
RTC_ALARMSSUBSECONDMASK_SS14_13	SS[14:12] are don't care in Alarm comparison. Only SS[11:0] are compared
RTC_ALARMSSUBSECONDMASK_SS14	SS[14:13] are don't care in Alarm comparison. Only SS[12:0] are compared
RTC_ALARMSSUBSECONDMASK_NONE	SS[14] is don't care in Alarm comparison. Only SS[13:0] are compared
	SS[14:0] are compared and must match to activate alarm.

RTC AM PM Definitions

RTC_HOURFORMAT12_AM

RTC_HOURFORMAT12_PM

RTC DayLight Saving Definitions

RTC_DAYLIGHTSAVING_SUB1H

RTC_DAYLIGHTSAVING_ADD1H

RTC_DAYLIGHTSAVING_NONE

RTC Exported Macros

__HAL_RTC_RESET_HANDLE_STATE

Description:

- Reset RTC handle state.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_WRITEPROTECTION_DISABLE

Description:

- Disable the write protection for RTC registers.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_WRITEPROTECTION_ENABLE

Description:

`__HAL_RTC_ALARM_ENABLE`

- Enable the write protection for RTC registers.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

Description:

- Enable the RTC ALARMA peripheral.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

Description:

- Disable the RTC ALARMA peripheral.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

Description:

- Enable the RTC ALARMB peripheral.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

Description:

- Disable the RTC ALARMB peripheral.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

`__HAL_RTC_ALARM_DISABLE`

`__HAL_RTC_ALARM_ENABLE`

`__HAL_RTC_ALARM_DISABLE`

`__HAL_RTC_ALARM_ENABLE_IT`**Description:**

- Enable the RTC Alarm interrupt.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__INTERRUPT__`: specifies the RTC Alarm interrupt sources to be enabled or disabled. This parameter can be any combination of the following values:
 - `RTC_IT_ALRA`: Alarm A interrupt
 - `RTC_IT_ALRB`: Alarm B interrupt

Return value:

- None

`__HAL_RTC_ALARM_DISABLE_IT`**Description:**

- Disable the RTC Alarm interrupt.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__INTERRUPT__`: specifies the RTC Alarm interrupt sources to be enabled or disabled. This parameter can be any combination of the following values:
 - `RTC_IT_ALRA`: Alarm A interrupt
 - `RTC_IT_ALRB`: Alarm B interrupt

Return value:

- None

`__HAL_RTC_ALARM_GET_IT`**Description:**

- Check whether the specified RTC Alarm interrupt has occurred or not.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__INTERRUPT__`:

specifies the RTC Alarm interrupt to check. This parameter can be:

- RTC_IT_ALRA:
Alarm A interrupt
- RTC_IT_ALRB:
Alarm B interrupt

Return value:

- None

Description:

- Get the selected RTC Alarm's flag status.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__FLAG__`: specifies the RTC Alarm Flag to check. This parameter can be:
 - RTC_FLAG_ALRAF
 - RTC_FLAG_ALRBF
 - RTC_FLAG_ALRAW
F
 - RTC_FLAG_ALRBW
F

Return value:

- None

Description:

- Clear the RTC Alarm's pending flags.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__FLAG__`: specifies the RTC Alarm Flag sources to be enabled or disabled. This parameter can be:
 - RTC_FLAG_ALRAF
 - RTC_FLAG_ALRBF

Return value:

- None

Description:

- Check whether the specified RTC Alarm interrupt has been enabled or not.

`__HAL_RTC_ALARM_GET_FLAG`

`__HAL_RTC_ALARM_CLEAR_FLAG`

`__HAL_RTC_ALARM_GET_IT_SOURCE`

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__INTERRUPT__`: specifies the RTC Alarm interrupt sources to check. This parameter can be:
 - `RTC_IT_ALRA`: Alarm A interrupt
 - `RTC_IT_ALRB`: Alarm B interrupt

Return value:

- None

Description:

- Enable interrupt on the RTC Alarm associated Exti line.

Return value:

- None

Description:

- Disable interrupt on the RTC Alarm associated Exti line.

Return value:

- None

Description:

- Enable event on the RTC Alarm associated Exti line.

Return value:

- None.

Description:

- Disable event on the RTC Alarm associated Exti line.

Return value:

- None.

Description:

- Enable falling edge trigger on the RTC Alarm associated Exti line.

Return value:

- None.

Description:

`__HAL_RTC_ALARM_EXTI_ENABLE_IT`

`__HAL_RTC_ALARM_EXTI_DISABLE_IT`

`__HAL_RTC_ALARM_EXTI_ENABLE_EVENT`

`__HAL_RTC_ALARM_EXTI_DISABLE_EVENT`

`__HAL_RTC_ALARM_EXTI_ENABLE_FALLING_EDGE`

`__HAL_RTC_ALARM_EXTI_DISABLE_FALLING_EDG`

<code>E</code>	<ul style="list-style-type: none">• Disable falling edge trigger on the RTC Alarm associated Exti line. Return value: <ul style="list-style-type: none">• None.
<code>__HAL_RTC_ALARM_EXTI_ENABLE_RISING_EDGE</code>	Description: <ul style="list-style-type: none">• Enable rising edge trigger on the RTC Alarm associated Exti line. Return value: <ul style="list-style-type: none">• None.
<code>__HAL_RTC_ALARM_EXTI_DISABLE_RISING_EDGE</code>	Description: <ul style="list-style-type: none">• Disable rising edge trigger on the RTC Alarm associated Exti line. Return value: <ul style="list-style-type: none">• None.
<code>__HAL_RTC_ALARM_EXTI_ENABLE_RISING_FALLING_EDGE</code>	Description: <ul style="list-style-type: none">• Enable rising & falling edge trigger on the RTC Alarm associated Exti line. Return value: <ul style="list-style-type: none">• None.
<code>__HAL_RTC_ALARM_EXTI_DISABLE_RISING_FALLING_EDGE</code>	Description: <ul style="list-style-type: none">• Disable rising & falling edge trigger on the RTC Alarm associated Exti line. Return value: <ul style="list-style-type: none">• None.
<code>__HAL_RTC_ALARM_EXTI_GET_FLAG</code>	Description: <ul style="list-style-type: none">• Check whether the RTC Alarm associated Exti line interrupt flag is set or not. Return value: <ul style="list-style-type: none">• Line: Status.
<code>__HAL_RTC_ALARM_EXTI_CLEAR_FLAG</code>	Description: <ul style="list-style-type: none">• Clear the RTC Alarm associated Exti line flag. Return value: <ul style="list-style-type: none">• None.

__HAL_RTC_ALARM_EXTI_GENERATE_SWIT

Description:

- Generate a Software interrupt on RTC Alarm associated Exti line.

Return value:

- None.

RTC Flags Definitions

RTC_FLAG_RECALPF

RTC_FLAG_TAMP3F

RTC_FLAG_TAMP2F

RTC_FLAG_TAMP1F

RTC_FLAG_TSOVF

RTC_FLAG_TSF

RTC_FLAG_ITSF

RTC_FLAG_WUTF

RTC_FLAG_ALRBF

RTC_FLAG_ALRAF

RTC_FLAG_INITF

RTC_FLAG_RSF

RTC_FLAG_INITS

RTC_FLAG_SHPF

RTC_FLAG_WUTWF

RTC_FLAG_ALRBWF

RTC_FLAG_ALRAWF

RTC Hour Formats

RTC_HOURFORMAT_24

RTC_HOURFORMAT_12

RTC Input Parameter Format Definitions

RTC_FORMAT_BIN

RTC_FORMAT_BCD

RTC Interrupts Definitions

RTC_IT_TS

RTC_IT_WUT

RTC_IT_ALRA

RTC_IT_ALRB

RTC_IT_TAMP

RTC_IT_TAMP1

RTC_IT_TAMP2

RTC_IT_TAMP3

RTC Private macros to check input parameters

IS_RTC_HOUR_FORMAT

IS_RTC_OUTPUT_POL

IS_RTC_OUTPUT_TYPE

IS_RTC_ASYNCH_PREDIV

IS_RTC_SYNCH_PREDIV

IS_RTC_HOUR12

IS_RTC_HOUR24

IS_RTC_MINUTES

IS_RTC_SECONDS

IS_RTC_HOURFORMAT12

IS_RTC_DAYLIGHT_SAVING

IS_RTC_STORE_OPERATION

IS_RTC_FORMAT

IS_RTC_YEAR

IS_RTC_MONTH

IS_RTC_DATE

IS_RTC_WEEKDAY

IS_RTC_ALARM_DATE_WEEKDAY_DATE

IS_RTC_ALARM_DATE_WEEKDAY_WEEKDAY

IS_RTC_ALARM_DATE_WEEKDAY_SEL

IS_RTC_ALARM_MASK

IS_RTC_ALARM

IS_RTC_ALARM_SUB_SECOND_VALUE

IS_RTC_ALARM_SUB_SECOND_MASK

RTC Month Date Definitions

RTC_MONTH_JANUARY

RTC_MONTH_FEBRUARY

RTC_MONTH_MARCH

RTC_MONTH_APRIL

RTC_MONTH_MAY

RTC_MONTH_JUNE

RTC_MONTH_JULY

RTC_MONTH_AUGUST

RTC_MONTH_SEPTMBER

RTC_MONTH_OCTOBER

RTC_MONTH_NOVEMBER

RTC_MONTH_DECEMBER

RTC Output Polarity Definitions

RTC_OUTPUT_POLARITY_HIGH

RTC_OUTPUT_POLARITY_LOW

RTC Output Type ALARM OUT

RTC_OUTPUT_TYPE_OPENDRAIN

RTC_OUTPUT_TYPE_PUSHPULL

RTC Store Operation Definitions

RTC_STOREOPERATION_RESET

RTC_STOREOPERATION_SET

RTC WeekDay Definitions

RTC_WEEKDAY_MONDAY

RTC_WEEKDAY_TUESDAY

RTC_WEEKDAY_WEDNESDAY

RTC_WEEKDAY_THURSDAY

RTC_WEEKDAY_FRIDAY

RTC_WEEKDAY_SATURDAY

RTC_WEEKDAY_SUNDAY

54 HAL RTC Extension Driver

54.1 RTCEX Firmware driver registers structures

54.1.1 RTC_TamperTypeDef

Data Fields

- *uint32_t Tamper*
- *uint32_t Interrupt*
- *uint32_t Trigger*
- *uint32_t NoErase*
- *uint32_t MaskFlag*
- *uint32_t Filter*
- *uint32_t SamplingFrequency*
- *uint32_t PrechargeDuration*
- *uint32_t TamperPullUp*
- *uint32_t TimeStampOnTamperDetection*

Field Documentation

- *uint32_t RTC_TamperTypeDef::Tamper*
Specifies the Tamper Pin. This parameter can be a value of [RTCEX_Tamper_Pins_Definitions](#)
- *uint32_t RTC_TamperTypeDef::Interrupt*
Specifies the Tamper Interrupt. This parameter can be a value of [RTCEX_Tamper_Interrupt_Definitions](#)
- *uint32_t RTC_TamperTypeDef::Trigger*
Specifies the Tamper Trigger. This parameter can be a value of [RTCEX_Tamper_Trigger_Definitions](#)
- *uint32_t RTC_TamperTypeDef::NoErase*
Specifies the Tamper no erase mode. This parameter can be a value of [RTCEX_Tamper_EraseBackUp_Definitions](#)
- *uint32_t RTC_TamperTypeDef::MaskFlag*
Specifies the Tamper Flag masking. This parameter can be a value of [RTCEX_Tamper_MaskFlag_Definitions](#)
- *uint32_t RTC_TamperTypeDef::Filter*
Specifies the RTC Filter Tamper. This parameter can be a value of [RTCEX_Tamper_Filter_Definitions](#)
- *uint32_t RTC_TamperTypeDef::SamplingFrequency*
Specifies the sampling frequency. This parameter can be a value of [RTCEX_Tamper_Sampling_Frequencies_Definitions](#)
- *uint32_t RTC_TamperTypeDef::PrechargeDuration*
Specifies the Precharge Duration . This parameter can be a value of [RTCEX_Tamper_Pin_Precharge_Duration_Definitions](#)
- *uint32_t RTC_TamperTypeDef::TamperPullUp*
Specifies the Tamper PullUp . This parameter can be a value of [RTCEX_Tamper_Pull_UP_Definitions](#)
- *uint32_t RTC_TamperTypeDef::TimeStampOnTamperDetection*
Specifies the TimeStampOnTamperDetection. This parameter can be a value of [RTCEX_Tamper_TimeStampOnTamperDetection_Definitions](#)

54.2 RTCEx Firmware driver API description

54.2.1 How to use this driver

- Enable the RTC domain access.
- Configure the RTC Prescaler (Asynchronous and Synchronous) and RTC hour format using the HAL_RTC_Init() function.

RTC Wakeup configuration

- To configure the RTC Wakeup Clock source and Counter use the HAL_RTC_SetWakeUpTimer() function. You can also configure the RTC Wakeup timer in interrupt mode using the HAL_RTC_SetWakeUpTimer_IT() function.
- To read the RTC WakeUp Counter register, use the HAL_RTC_GetWakeUpTimer() function.

TimeStamp configuration

- Enables the RTC TimeStamp using the HAL_RTC_SetTimeStamp() function. You can also configure the RTC TimeStamp with interrupt mode using the HAL_RTC_SetTimeStamp_IT() function.
- To read the RTC TimeStamp Time and Date register, use the HAL_RTC_GetTimeStamp() function.

Internal TimeStamp configuration

- Enables the RTC internal TimeStamp using the HAL_RTC_SetInternalTimeStamp() function.
- To read the RTC TimeStamp Time and Date register, use the HAL_RTC_GetTimeStamp() function.

Tamper configuration

- Enable the RTC Tamper and Configure the Tamper filter count, trigger Edge or Level according to the Tamper filter (if equal to 0 Edge else Level) value, sampling frequency, NoErase, MaskFlag, precharge or discharge and Pull-UP using the HAL_RTC_SetTamper() function. You can configure RTC Tamper with interrupt mode using HAL_RTC_SetTamper_IT() function.
- The default configuration of the Tamper erases the backup registers. To avoid erase, enable the NoErase field on the RTC_TAMPCR register.

Backup Data Registers configuration

- To write to the RTC Backup Data registers, use the HAL_RTC_BKUPWrite() function.
- To read the RTC Backup Data registers, use the HAL_RTC_BKUPRead() function.

54.2.2 RTC TimeStamp and Tamper functions

This section provides functions allowing to configure TimeStamp feature

This section contains the following APIs:

- [HAL_RTCEx_SetTimeStamp\(\)](#)
- [HAL_RTCEx_SetTimeStamp_IT\(\)](#)
- [HAL_RTCEx_DeactivateTimeStamp\(\)](#)
- [HAL_RTCEx_SetInternalTimeStamp\(\)](#)
- [HAL_RTCEx_DeactivateInternalTimeStamp\(\)](#)

- [HAL_RTCEx_GetTimeStamp\(\)](#)
- [HAL_RTCEx_SetTamper\(\)](#)
- [HAL_RTCEx_SetTamper_IT\(\)](#)
- [HAL_RTCEx_DeactivateTamper\(\)](#)
- [HAL_RTCEx_TamperTimeStampIRQHandler\(\)](#)
- [HAL_RTCEx_TimeStampEventCallback\(\)](#)
- [HAL_RTCEx_Tamper1EventCallback\(\)](#)
- [HAL_RTCEx_Tamper2EventCallback\(\)](#)
- [HAL_RTCEx_Tamper3EventCallback\(\)](#)
- [HAL_RTCEx_PollForTimeStampEvent\(\)](#)
- [HAL_RTCEx_PollForTamper1Event\(\)](#)
- [HAL_RTCEx_PollForTamper2Event\(\)](#)
- [HAL_RTCEx_PollForTamper3Event\(\)](#)

54.2.3 RTC Wake-up functions

This section provides functions allowing to configure Wake-up feature

This section contains the following APIs:

- [HAL_RTCEx_SetWakeUpTimer\(\)](#)
- [HAL_RTCEx_SetWakeUpTimer_IT\(\)](#)
- [HAL_RTCEx_DeactivateWakeUpTimer\(\)](#)
- [HAL_RTCEx_GetWakeUpTimer\(\)](#)
- [HAL_RTCEx_WakeUpTimerIRQHandler\(\)](#)
- [HAL_RTCEx_WakeUpTimerEventCallback\(\)](#)
- [HAL_RTCEx_PollForWakeUpTimerEvent\(\)](#)

54.2.4 Extension Peripheral Control functions

This subsection provides functions allowing to

- Write a data in a specified RTC Backup data register
- Read a data in a specified RTC Backup data register
- Set the Coarse calibration parameters.
- Deactivate the Coarse calibration parameters
- Set the Smooth calibration parameters.
- Configure the Synchronization Shift Control Settings.
- Configure the Calibration Pinout (RTC_CALIB) Selection (1Hz or 512Hz).
- Deactivate the Calibration Pinout (RTC_CALIB) Selection (1Hz or 512Hz).
- Enable the RTC reference clock detection.
- Disable the RTC reference clock detection.
- Enable the Bypass Shadow feature.
- Disable the Bypass Shadow feature.

This section contains the following APIs:

- [HAL_RTCEx_BKUPWrite\(\)](#)
- [HAL_RTCEx_BKUPRead\(\)](#)
- [HAL_RTCEx_SetSmoothCalib\(\)](#)
- [HAL_RTCEx_SetSynchroShift\(\)](#)
- [HAL_RTCEx_SetCalibrationOutPut\(\)](#)
- [HAL_RTCEx_DeactivateCalibrationOutPut\(\)](#)
- [HAL_RTCEx_SetRefClock\(\)](#)
- [HAL_RTCEx_DeactivateRefClock\(\)](#)
- [HAL_RTCEx_EnableBypassShadow\(\)](#)

- [HAL_RTCEx_DisableBypassShadow\(\)](#)

54.2.5 Extended features functions

This section provides functions allowing to:

- RTC Alarm B callback
- RTC Poll for Alarm B request

This section contains the following APIs:

- [HAL_RTCEx_AlarmBEventCallback\(\)](#)
- [HAL_RTCEx_PollForAlarmBEvent\(\)](#)

54.2.6 Detailed description of functions

HAL_RTCEx_SetTimeStamp

Function name	HAL_StatusTypeDef HAL_RTCEx_SetTimeStamp (RTC_HandleTypeDef * hrtc, uint32_t TimeStampEdge, uint32_t RTC_TimeStampPin)
Function description	Sets TimeStamp.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • TimeStampEdge: Specifies the pin edge on which the TimeStamp is activated. This parameter can be one of the following values: <ul style="list-style-type: none"> – RTC_TIMESTAMPEDGE_RISING: the Time stamp event occurs on the rising edge of the related pin. – RTC_TIMESTAMPEDGE_FALLING: the Time stamp event occurs on the falling edge of the related pin. • RTC_TimeStampPin: specifies the RTC TimeStamp Pin. This parameter can be one of the following values: <ul style="list-style-type: none"> – RTC_TIMESTAMPPIN_PC13: PC13 is selected as RTC TimeStamp Pin. – RTC_TIMESTAMPPIN_PI8: PI8 is selected as RTC TimeStamp Pin. – RTC_TIMESTAMPPIN_PC1: PC1 is selected as RTC TimeStamp Pin.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This API must be called before enabling the TimeStamp feature.

HAL_RTCEx_SetTimeStamp_IT

Function name	HAL_StatusTypeDef HAL_RTCEx_SetTimeStamp_IT (RTC_HandleTypeDef * hrtc, uint32_t TimeStampEdge, uint32_t RTC_TimeStampPin)
Function description	Sets TimeStamp with Interrupt.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • TimeStampEdge: Specifies the pin edge on which the TimeStamp is activated. This parameter can be one of the

following values:

- RTC_TIMESTAMPEDGE_RISING: the Time stamp event occurs on the rising edge of the related pin.
- RTC_TIMESTAMPEDGE_FALLING: the Time stamp event occurs on the falling edge of the related pin.
- **RTC_TimeStampPin:** Specifies the RTC TimeStamp Pin. This parameter can be one of the following values:
 - RTC_TIMESTAMPPIN_PC13: PC13 is selected as RTC TimeStamp Pin.
 - RTC_TIMESTAMPPIN_PI8: PI8 is selected as RTC TimeStamp Pin.
 - RTC_TIMESTAMPPIN_PC1: PC1 is selected as RTC TimeStamp Pin.

Return values

- **HAL:** status

Notes

- This API must be called before enabling the TimeStamp feature.

HAL_RTCEX_DeactivateTimeStamp

Function name

HAL_StatusTypeDef HAL_RTCEX_DeactivateTimeStamp (RTC_HandleTypeDef * hrtc)

Function description

Deactivates TimeStamp.

Parameters

- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values

- **HAL:** status

HAL_RTCEX_SetInternalTimeStamp

Function name

HAL_StatusTypeDef HAL_RTCEX_SetInternalTimeStamp (RTC_HandleTypeDef * hrtc)

Function description

Sets Internal TimeStamp.

Parameters

- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values

- **HAL:** status

Notes

- This API must be called before enabling the internal TimeStamp feature.

HAL_RTCEX_DeactivateInternalTimeStamp

Function name

HAL_StatusTypeDef HAL_RTCEX_DeactivateInternalTimeStamp (RTC_HandleTypeDef * hrtc)

Function description

Deactivates internal TimeStamp.

Parameters

- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values

- **HAL:** status

HAL_RTCEx_GetTimeStamp

Function name	HAL_StatusTypeDef HAL_RTCEx_GetTimeStamp (RTC_HandleTypeDef * hrtc, RTC_TimeTypeDef * sTimeStamp, RTC_DateTypeDef * sTimeStampDate, uint32_t Format)
Function description	Gets the RTC TimeStamp value.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • sTimeStamp: Pointer to Time structure • sTimeStampDate: Pointer to Date structure • Format: specifies the format of the entered parameters. This parameter can be one of the following values: FORMAT_BIN: Binary data format FORMAT_BCD: BCD data format
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_RTCEx_SetTamper

Function name	HAL_StatusTypeDef HAL_RTCEx_SetTamper (RTC_HandleTypeDef * hrtc, RTC_TamperTypeDef * sTamper)
Function description	Sets Tamper.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • sTamper: Pointer to Tamper Structure.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • By calling this API we disable the tamper interrupt for all tampers.

HAL_RTCEx_SetTamper_IT

Function name	HAL_StatusTypeDef HAL_RTCEx_SetTamper_IT (RTC_HandleTypeDef * hrtc, RTC_TamperTypeDef * sTamper)
Function description	Sets Tamper with interrupt.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • sTamper: Pointer to RTC Tamper.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • By calling this API we force the tamper interrupt for all tampers.

HAL_RTCEx_DeactivateTamper

Function name	HAL_StatusTypeDef HAL_RTCEx_DeactivateTamper (RTC_HandleTypeDef * hrtc, uint32_t Tamper)
Function description	Deactivates Tamper.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • Tamper: Selected tamper pin. This parameter can be

RTC_Tamper_1 and/or RTC_TAMPER_2.

Return values

- **HAL:** status

HAL_RTCEx_TamperTimeStampIRQHandler

Function name **void HAL_RTCEx_TamperTimeStampIRQHandler
(RTC_HandleTypeDef * hrtc)**

Function description This function handles TimeStamp interrupt request.

Parameters

- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values

- **None:**

HAL_RTCEx_Tamper1EventCallback

Function name **void HAL_RTCEx_Tamper1EventCallback
(RTC_HandleTypeDef * hrtc)**

Function description Tamper 1 callback.

Parameters

- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values

- **None:**

HAL_RTCEx_Tamper2EventCallback

Function name **void HAL_RTCEx_Tamper2EventCallback
(RTC_HandleTypeDef * hrtc)**

Function description Tamper 2 callback.

Parameters

- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values

- **None:**

HAL_RTCEx_Tamper3EventCallback

Function name **void HAL_RTCEx_Tamper3EventCallback
(RTC_HandleTypeDef * hrtc)**

Function description Tamper 3 callback.

Parameters

- **hrtc:** RTC handle

Return values

- **None:**

HAL_RTCEx_TimeStampEventCallback

Function name **void HAL_RTCEx_TimeStampEventCallback
(RTC_HandleTypeDef * hrtc)**

Function description TimeStamp callback.

Parameters

- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values

- **None:**

HAL_RTCEx_PollForTimeStampEvent

Function name **HAL_StatusTypeDef HAL_RTCEx_PollForTimeStampEvent (RTC_HandleTypeDef * hrtc, uint32_t Timeout)**

Function description This function handles TimeStamp polling request.

Parameters

- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_RTCEx_PollForTamper1Event

Function name **HAL_StatusTypeDef HAL_RTCEx_PollForTamper1Event (RTC_HandleTypeDef * hrtc, uint32_t Timeout)**

Function description This function handles Tamper1 Polling.

Parameters

- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_RTCEx_PollForTamper2Event

Function name **HAL_StatusTypeDef HAL_RTCEx_PollForTamper2Event (RTC_HandleTypeDef * hrtc, uint32_t Timeout)**

Function description This function handles Tamper2 Polling.

Parameters

- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_RTCEx_PollForTamper3Event

Function name **HAL_StatusTypeDef HAL_RTCEx_PollForTamper3Event (RTC_HandleTypeDef * hrtc, uint32_t Timeout)**

Function description This function handles Tamper3 Polling.

Parameters

- **hrtc:** RTC handle
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_RTCEx_SetWakeUpTimer

Function name **HAL_StatusTypeDef HAL_RTCEx_SetWakeUpTimer (RTC_HandleTypeDef * hrtc, uint32_t WakeUpCounter, uint32_t WakeUpClock)**

Function description	Sets wake up timer.
Parameters	<ul style="list-style-type: none">• hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.• WakeUpCounter: Wake up counter• WakeUpClock: Wake up clock
Return values	<ul style="list-style-type: none">• HAL: status

HAL_RTCEx_SetWakeUpTimer_IT

Function name	HAL_StatusTypeDef HAL_RTCEx_SetWakeUpTimer_IT (RTC_HandleTypeDef * hrtc, uint32_t WakeUpCounter, uint32_t WakeUpClock)
Function description	Sets wake up timer with interrupt.
Parameters	<ul style="list-style-type: none">• hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.• WakeUpCounter: Wake up counter• WakeUpClock: Wake up clock
Return values	<ul style="list-style-type: none">• HAL: status

HAL_RTCEx_DeactivateWakeUpTimer

Function name	uint32_t HAL_RTCEx_DeactivateWakeUpTimer (RTC_HandleTypeDef * hrtc)
Function description	Deactivates wake up timer counter.
Parameters	<ul style="list-style-type: none">• hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_RTCEx_GetWakeUpTimer

Function name	uint32_t HAL_RTCEx_GetWakeUpTimer (RTC_HandleTypeDef * hrtc)
Function description	Gets wake up timer counter.
Parameters	<ul style="list-style-type: none">• hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none">• Counter: value

HAL_RTCEx_WakeUpTimerIRQHandler

Function name	void HAL_RTCEx_WakeUpTimerIRQHandler (RTC_HandleTypeDef * hrtc)
Function description	This function handles Wake Up Timer interrupt request.
Parameters	<ul style="list-style-type: none">• hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none">• None:

HAL_RTCEx_WakeUpTimerEventCallback

Function name	void HAL_RTCEx_WakeUpTimerEventCallback (RTC_HandleTypeDef * hrtc)
Function description	Wake Up Timer callback.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none"> • None:

HAL_RTCEx_PollForWakeUpTimerEvent

Function name	HAL_StatusTypeDef HAL_RTCEx_PollForWakeUpTimerEvent (RTC_HandleTypeDef * hrtc, uint32_t Timeout)
Function description	This function handles Wake Up Timer Polling.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • Timeout: Timeout duration
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_RTCEx_BKUPWrite

Function name	void HAL_RTCEx_BKUPWrite (RTC_HandleTypeDef * hrtc, uint32_t BackupRegister, uint32_t Data)
Function description	Writes a data in a specified RTC Backup data register.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • BackupRegister: RTC Backup data Register number. This parameter can be: RTC_BKP_DRx where x can be from 0 to 19 to specify the register. • Data: Data to be written in the specified RTC Backup data register.
Return values	<ul style="list-style-type: none"> • None:

HAL_RTCEx_BKUPRead

Function name	uint32_t HAL_RTCEx_BKUPRead (RTC_HandleTypeDef * hrtc, uint32_t BackupRegister)
Function description	Reads data from the specified RTC Backup data Register.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • BackupRegister: RTC Backup data Register number. This parameter can be: RTC_BKP_DRx where x can be from 0 to 19 to specify the register.
Return values	<ul style="list-style-type: none"> • Read: value

HAL_RTCEx_SetSmoothCalib

Function name	HAL_StatusTypeDef HAL_RTCEx_SetSmoothCalib
---------------	---

(RTC_HandleTypeDef * hrtc, uint32_t SmoothCalibPeriod, uint32_t SmoothCalibPlusPulses, uint32_t SmoothCalibMinusPulsesValue)

Function description	Sets the Smooth calibration parameters.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • SmoothCalibPeriod: Select the Smooth Calibration Period. This parameter can be one of the following values : <ul style="list-style-type: none"> – RTC_SMOOTHCALIB_PERIOD_32SEC: The smooth calibration period is 32s. – RTC_SMOOTHCALIB_PERIOD_16SEC: The smooth calibration period is 16s. – RTC_SMOOTHCALIB_PERIOD_8SEC: The smooth calibration period is 8s. • SmoothCalibPlusPulses: Select to Set or reset the CALP bit. This parameter can be one of the following values: <ul style="list-style-type: none"> – RTC_SMOOTHCALIB_PLUSPULSES_SET: Add one RTCCLK pulses every 2*11 pulses. – RTC_SMOOTHCALIB_PLUSPULSES_RESET: No RTCCLK pulses are added. • SmoothCalibMinusPulsesValue: Select the value of CALM[8:0] bits. This parameter can be one any value from 0 to 0x000001FF.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • To deactivate the smooth calibration, the field SmoothCalibPlusPulses must be equal to SMOOTHCALIB_PLUSPULSES_RESET and the field SmoothCalibMinusPulsesValue must be equal to 0.

HAL_RTCEx_SetSynchroShift

Function name	HAL_StatusTypeDef HAL_RTCEx_SetSynchroShift (RTC_HandleTypeDef * hrtc, uint32_t ShiftAdd1S, uint32_t ShiftSubFS)
Function description	Configures the Synchronization Shift Control Settings.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • ShiftAdd1S: Select to add or not 1 second to the time calendar. This parameter can be one of the following values : <ul style="list-style-type: none"> – RTC_SHIFTADD1S_SET: Add one second to the clock calendar. – RTC_SHIFTADD1S_RESET: No effect. • ShiftSubFS: Select the number of Second Fractions to substitute. This parameter can be one any value from 0 to 0x7FFF.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • When REFCKON is set, firmware must not write to Shift control register.

HAL_RTCEx_SetCalibrationOutPut

Function name	HAL_StatusTypeDef HAL_RTCEx_SetCalibrationOutPut (RTC_HandleTypeDef * hrtc, uint32_t CalibOutput)
Function description	Configures the Calibration Pinout (RTC_CALIB) Selection (1Hz or 512Hz).
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • CalibOutput: Select the Calibration output Selection . This parameter can be one of the following values: <ul style="list-style-type: none"> – RTC_CALIBOUTPUT_512HZ: A signal has a regular waveform at 512Hz. – RTC_CALIBOUTPUT_1HZ: A signal has a regular waveform at 1Hz.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_RTCEx_DeactivateCalibrationOutPut

Function name	HAL_StatusTypeDef HAL_RTCEx_DeactivateCalibrationOutPut (RTC_HandleTypeDef * hrtc)
Function description	Deactivates the Calibration Pinout (RTC_CALIB) Selection (1Hz or 512Hz).
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_RTCEx_SetRefClock

Function name	HAL_StatusTypeDef HAL_RTCEx_SetRefClock (RTC_HandleTypeDef * hrtc)
Function description	Enables the RTC reference clock detection.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_RTCEx_DeactivateRefClock

Function name	HAL_StatusTypeDef HAL_RTCEx_DeactivateRefClock (RTC_HandleTypeDef * hrtc)
Function description	Disable the RTC reference clock detection.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_RTCEx_EnableBypassShadow

Function name	HAL_StatusTypeDef HAL_RTCEx_EnableBypassShadow
---------------	---

(RTC_HandleTypeDef * hrtc)

Function description	Enables the Bypass Shadow feature.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • When the Bypass Shadow is enabled the calendar value are taken directly from the Calendar counter.

HAL_RTCEX_DisableBypassShadow

Function name	HAL_StatusTypeDef HAL_RTCEX_DisableBypassShadow (RTC_HandleTypeDef * hrtc)
Function description	Disables the Bypass Shadow feature.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • When the Bypass Shadow is enabled the calendar value are taken directly from the Calendar counter.

HAL_RTCEX_AlarmBEventCallback

Function name	void HAL_RTCEX_AlarmBEventCallback (RTC_HandleTypeDef * hrtc)
Function description	Alarm B callback.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	<ul style="list-style-type: none"> • None:

HAL_RTCEX_PollForAlarmBEvent

Function name	HAL_StatusTypeDef HAL_RTCEX_PollForAlarmBEvent (RTC_HandleTypeDef * hrtc, uint32_t Timeout)
Function description	This function handles AlarmB Polling request.
Parameters	<ul style="list-style-type: none"> • hrtc: pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • Timeout: Timeout duration
Return values	<ul style="list-style-type: none"> • HAL: status

54.3 RTCEX Firmware driver defines**54.3.1 RTCEX*****RTCEX Add 1 Second Parameter Definitions***

RTC_SHIFTADD1S_RESET

RTC_SHIFTADD1S_SET

RTC Backup Registers Definitions

RTC_BKP_DR0

RTC_BKP_DR1

RTC_BKP_DR2

RTC_BKP_DR3

RTC_BKP_DR4

RTC_BKP_DR5

RTC_BKP_DR6

RTC_BKP_DR7

RTC_BKP_DR8

RTC_BKP_DR9

RTC_BKP_DR10

RTC_BKP_DR11

RTC_BKP_DR12

RTC_BKP_DR13

RTC_BKP_DR14

RTC_BKP_DR15

RTC_BKP_DR16

RTC_BKP_DR17

RTC_BKP_DR18

RTC_BKP_DR19

RTC_BKP_DR20

RTC_BKP_DR21

RTC_BKP_DR22

RTC_BKP_DR23

RTC_BKP_DR24

RTC_BKP_DR25

RTC_BKP_DR26

RTC_BKP_DR27

RTC_BKP_DR28

RTC_BKP_DR29

RTC_BKP_DR30

RTC_BKP_DR31

RTCEX Calib Output selection Definitions

RTC_CALIBOUTPUT_512HZ

RTC_CALIBOUTPUT_1HZ

RTCEX Exported Macros

`__HAL_RTC_WAKEOPTIMER_ENABLE`**Description:**

- Enable the RTC WakeUp Timer peripheral.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

`__HAL_RTC_WAKEOPTIMER_DISABLE`**Description:**

- Disable the RTC WakeUp Timer peripheral.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

`__HAL_RTC_WAKEOPTIMER_ENABLE_IT`**Description:**

- Enable the RTC WakeUpTimer interrupt.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__INTERRUPT__`: specifies the RTC WakeUpTimer interrupt sources to be enabled or disabled. This parameter can be:
 - `RTC_IT_WUT`: WakeUpTimer interrupt

Return value:

- None

`__HAL_RTC_WAKEOPTIMER_DISABLE_IT`**Description:**

- Disable the RTC WakeUpTimer interrupt.

`__HAL_RTC_WAKEUPTIMER_GET_IT`

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__INTERRUPT__`: specifies the RTC WakeUpTimer interrupt sources to be enabled or disabled. This parameter can be:
 - `RTC_IT_WUT`: WakeUpTimer interrupt

Return value:

- None

Description:

- Check whether the specified RTC WakeUpTimer interrupt has occurred or not.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__INTERRUPT__`: specifies the RTC WakeUpTimer interrupt sources to check. This parameter can be:
 - `RTC_IT_WUT`: WakeUpTimer interrupt

Return value:

- None

Description:

- Check whether the specified RTC Wake Up timer interrupt has been enabled or not.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__INTERRUPT__`: specifies the RTC

`__HAL_RTC_WAKEUPTIMER_GET_IT_SOURCE`

`__HAL_RTC_WAKEUPTIMER_GET_FLAG`

Wake Up timer interrupt sources to check. This parameter can be:

- `RTC_IT_WUT`: WakeUpTimer interrupt

Return value:

- None

Description:

- Get the selected RTC WakeUpTimer's flag status.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__FLAG__`: specifies the RTC WakeUpTimer Flag is pending or not. This parameter can be:
 - `RTC_FLAG_WUTF`
 - `RTC_FLAG_WUTWF`

Return value:

- None

Description:

- Clear the RTC Wake Up timer's pending flags.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__FLAG__`: specifies the RTC WakeUpTimer Flag to clear. This parameter can be:
 - `RTC_FLAG_WUTF`

Return value:

- None

Description:

`__HAL_RTC_WAKEUPTIMER_CLEAR_FLAG`

`__HAL_RTC_TAMPER1_ENABLE`

__HAL_RTC_TAMPER1_DISABLE

- Enable the RTC Tamper1 input detection.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

Description:

- Disable the RTC Tamper1 input detection.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

Description:

- Enable the RTC Tamper2 input detection.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

Description:

- Disable the RTC Tamper2 input detection.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

Description:

- Enable the RTC Tamper3 input

__HAL_RTC_TAMPER2_ENABLE

__HAL_RTC_TAMPER2_DISABLE

__HAL_RTC_TAMPER3_ENABLE

`__HAL_RTC_TAMPER3_DISABLE`

`__HAL_RTC_TAMPER_GET_IT`

detection.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

Description:

- Disable the RTC Tamper3 input detection.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

Description:

- Check whether the specified RTC Tamper interrupt has occurred or not.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__INTERRUPT__`: specifies the RTC Tamper interrupt to check. This parameter can be:
 - `RTC_IT_TAMP`: All tampers interrupts
 - `RTC_IT_TAMP1`: Tamper1 interrupt
 - `RTC_IT_TAMP2`: Tamper2 interrupt
 - `RTC_IT_TAMP3`: Tamper3 interrupt

Return value:

- None

`__HAL_RTC_TAMPER_GET_IT_SOURCE`**Description:**

- Check whether the specified RTC Tamper interrupt has been enabled or not.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__INTERRUPT__`: specifies the RTC Tamper interrupt source to check. This parameter can be:
 - `RTC_IT_TAMP`: All tampers interrupts
 - `RTC_IT_TAMP1`: Tamper1 interrupt
 - `RTC_IT_TAMP2`: Tamper2 interrupt
 - `RTC_IT_TAMP3`: Tamper3 interrupt

Return value:

- None

`__HAL_RTC_TAMPER_GET_FLAG`**Description:**

- Get the selected RTC Tamper's flag status.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__FLAG__`: specifies the RTC Tamper Flag is pending or not. This parameter can be:
 - `RTC_FLAG_TAMP1F`: Tamper1 flag
 - `RTC_FLAG_TAMP2F`: Tamper2 flag
 - `RTC_FLAG_TAMP3F`: Tamper3 flag

Return value:

`__HAL_RTC_TAMPER_CLEAR_FLAG`

- None

Description:

- Clear the RTC Tamper's pending flags.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__FLAG__`: specifies the RTC Tamper Flag sources to clear. This parameter can be:
 - `RTC_FLAG_TAMP1F`: Tamper1 flag
 - `RTC_FLAG_TAMP2F`: Tamper2 flag
 - `RTC_FLAG_TAMP3F`: Tamper3 flag

Return value:

- None

`__HAL_RTC_TIMESTAMP_ENABLE`**Description:**

- Enable the RTC TimeStamp peripheral.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

`__HAL_RTC_TIMESTAMP_DISABLE`**Description:**

- Disable the RTC TimeStamp peripheral.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

`__HAL_RTC_TIMESTAMP_ENABLE_IT`**Description:**

- Enable the RTC TimeStamp interrupt.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__INTERRUPT__`: specifies the RTC TimeStamp interrupt sources to be enabled or disabled. This parameter can be:
 - `RTC_IT_TS`: TimeStamp interrupt

Return value:

- None

`__HAL_RTC_TIMESTAMP_DISABLE_IT`**Description:**

- Disable the RTC TimeStamp interrupt.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__INTERRUPT__`: specifies the RTC TimeStamp interrupt sources to be enabled or disabled. This parameter can be:
 - `RTC_IT_TS`: TimeStamp interrupt

Return value:

- None

`__HAL_RTC_TIMESTAMP_GET_IT`**Description:**

- Check whether the specified RTC TimeStamp interrupt has occurred or not.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__INTERRUPT__`: specifies the RTC

`__HAL_RTC_TIMESTAMP_GET_IT_SOURCE`

TimeStamp interrupt sources to check. This parameter can be:

- `RTC_IT_TS`: TimeStamp interrupt

Return value:

- None

Description:

- Check whether the specified RTC Time Stamp interrupt has been enabled or not.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__INTERRUPT__`: specifies the RTC Time Stamp interrupt source to check. This parameter can be:
 - `RTC_IT_TS`: TimeStamp interrupt

Return value:

- None

Description:

- Get the selected RTC TimeStamp's flag status.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__FLAG__`: specifies the RTC TimeStamp Flag is pending or not. This parameter can be:
 - `RTC_FLAG_TSF`
 - `RTC_FLAG_TSOVF`

Return value:

- None

Description:

`__HAL_RTC_TIMESTAMP_GET_FLAG`

`__HAL_RTC_TIMESTAMP_CLEAR_FLAG`

- Clear the RTC Time Stamp's pending flags.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__FLAG__`: specifies the RTC Alarm Flag sources to clear. This parameter can be:
 - `RTC_FLAG_TSF`
 - `RTC_FLAG_TSOVF`

Return value:

- None

Description:

- Enable the RTC internal TimeStamp peripheral.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

Description:

- Disable the RTC internal TimeStamp peripheral.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

Description:

- Get the selected RTC Internal Time Stamp's flag status.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__FLAG__`: specifies

`__HAL_RTC_INTERNAL_TIMESTAMP_ENABLE`

`__HAL_RTC_INTERNAL_TIMESTAMP_DISABLE`

`__HAL_RTC_INTERNAL_TIMESTAMP_GET_FLAG`

`__HAL_RTC_INTERNAL_TIMESTAMP_CLEAR_FLAG`

the RTC Internal Time Stamp Flag is pending or not. This parameter can be:

- `RTC_FLAG_ITSF`

Return value:

- None

Description:

- Clear the RTC Internal Time Stamp's pending flags.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__FLAG__`: specifies the RTC Internal Time Stamp Flag source to clear. This parameter can be:
 - `RTC_FLAG_ITSF`

Return value:

- None

`__HAL_RTC_CALIBRATION_OUTPUT_ENABLE`

Description:

- Enable the RTC calibration output.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

`__HAL_RTC_CALIBRATION_OUTPUT_DISABLE`

Description:

- Disable the calibration output.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

`__HAL_RTC_CLOCKREF_DETECTION_ENABLE`

Description:

- Enable the clock reference detection.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

`__HAL_RTC_CLOCKREF_DETECTION_DISABLE`

Description:

- Disable the clock reference detection.

Parameters:

- `__HANDLE__`: specifies the RTC handle.

Return value:

- None

`__HAL_RTC_SHIFT_GET_FLAG`

Description:

- Get the selected RTC shift operation's flag status.

Parameters:

- `__HANDLE__`: specifies the RTC handle.
- `__FLAG__`: specifies the RTC shift operation Flag is pending or not. This parameter can be:
 - `RTC_FLAG_SHP`
 - `F`

Return value:

- None

`__HAL_RTC_WAKEUPTIMER_EXTI_ENABLE_IT`

Description:

- Enable interrupt on the RTC WakeUp Timer associated Exti line.

Return value:

- None

`__HAL_RTC_WAKEUPTIMER_EXTI_DISABLE_IT`

Description:

	<ul style="list-style-type: none">• Disable interrupt on the RTC WakeUp Timer associated Exti line.
	Return value:
	<ul style="list-style-type: none">• None
<code>__HAL_RTC_WAKEUPTIMER_EXTI_ENABLE_EVENT</code>	Description:
	<ul style="list-style-type: none">• Enable event on the RTC WakeUp Timer associated Exti line.
	Return value:
	<ul style="list-style-type: none">• None.
<code>__HAL_RTC_WAKEUPTIMER_EXTI_DISABLE_EVENT</code>	Description:
	<ul style="list-style-type: none">• Disable event on the RTC WakeUp Timer associated Exti line.
	Return value:
	<ul style="list-style-type: none">• None.
<code>__HAL_RTC_WAKEUPTIMER_EXTI_ENABLE_FALLING_EDGE</code>	Description:
	<ul style="list-style-type: none">• Enable falling edge trigger on the RTC WakeUp Timer associated Exti line.
	Return value:
	<ul style="list-style-type: none">• None.
<code>__HAL_RTC_WAKEUPTIMER_EXTI_DISABLE_FALLING_EDGE</code>	Description:
	<ul style="list-style-type: none">• Disable falling edge trigger on the RTC WakeUp Timer associated Exti line.
	Return value:
	<ul style="list-style-type: none">• None.
<code>__HAL_RTC_WAKEUPTIMER_EXTI_ENABLE_RISING_EDGE</code>	Description:
	<ul style="list-style-type: none">• Enable rising edge trigger on the RTC WakeUp Timer associated Exti line.
	Return value:
	<ul style="list-style-type: none">• None.
<code>__HAL_RTC_WAKEUPTIMER_EXTI_DISABLE_RISING_EDGE</code>	Description:
	<ul style="list-style-type: none">• Disable rising edge trigger on the RTC

__HAL_RTC_WAKEUPTIMER_EXTI_ENABLE_RISING_FALLING_EDGE

WakeUp Timer associated Exti line.

Return value:

- None.

Description:

- Enable rising & falling edge trigger on the RTC WakeUp Timer associated Exti line.

Return value:

- None.

__HAL_RTC_WAKEUPTIMER_EXTI_DISABLE_RISING_FALLING_EDGE

Description:

- Disable rising & falling edge trigger on the RTC WakeUp Timer associated Exti line.

Return value:

- None.

__HAL_RTC_WAKEUPTIMER_EXTI_GET_FLAG

Description:

- Check whether the RTC WakeUp Timer associated Exti line interrupt flag is set or not.

Return value:

- Line: Status.

__HAL_RTC_WAKEUPTIMER_EXTI_CLEAR_FLAG

Description:

- Clear the RTC WakeUp Timer associated Exti line flag.

Return value:

- None.

__HAL_RTC_WAKEUPTIMER_EXTI_GENERATE_SWIT

Description:

- Generate a Software interrupt on the RTC WakeUp Timer associated Exti line.

Return value:

- None.

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_ENABLE_IT

Description:

- Enable interrupt on

`__HAL_RTC_TAMPER_TIMESTAMP_EXTI_DISABLE_IT`

the RTC Tamper and Timestamp associated Exti line.

Return value:

- None

Description:

- Disable interrupt on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None

`__HAL_RTC_TAMPER_TIMESTAMP_EXTI_ENABLE_EVENT`

Description:

- Enable event on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None.

`__HAL_RTC_TAMPER_TIMESTAMP_EXTI_DISABLE_EVENT`

Description:

- Disable event on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None.

`__HAL_RTC_TAMPER_TIMESTAMP_EXTI_ENABLE_FALLING_EDGE`

Description:

- Enable falling edge trigger on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None.

`__HAL_RTC_TAMPER_TIMESTAMP_EXTI_DISABLE_FALLING_EDGE`

Description:

- Disable falling edge trigger on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None.

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_ENABLE_RISING_EDGE

Description:

- Enable rising edge trigger on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None.

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_DISABLE_RISING_EDGE

Description:

- Disable rising edge trigger on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None.

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_ENABLE_RISING_FALLING_EDGE

Description:

- Enable rising & falling edge trigger on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None.

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_DISABLE_RISING_FALLING_EDGE

Description:

- Disable rising & falling edge trigger on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None.

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_GET_FLAG

Description:

- Check whether the RTC Tamper and Timestamp associated Exti line interrupt flag is set or not.

Return value:

- Line: Status.

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_CLEAR_FLAG

Description:

- Clear the RTC Tamper and Timestamp associated

Exti line flag.

Return value:

- None.

`__HAL_RTC_TAMPER_TIMESTAMP_EXTI_GENERATE_S
WIT`

Description:

- Generate a Software interrupt on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None.

Private macros to check input parameters

`IS_RTC_OUTPUT`

`IS_RTC_BKP`

`IS_TIMESTAMP_EDGE`

`IS_RTC_TAMPER`

`IS_RTC_TAMPER_INTERRUPT`

`IS_RTC_TIMESTAMP_PIN`

`IS_RTC_TAMPER_TRIGGER`

`IS_RTC_TAMPER_ERASE_MODE`

`IS_RTC_TAMPER_MASKFLAG_STATE`

`IS_RTC_TAMPER_FILTER`

`IS_RTC_TAMPER_SAMPLING_FREQ`

`IS_RTC_TAMPER_PRECHARGE_DURATION`

`IS_RTC_TAMPER_TIMESTAMPONTAMPER_DETECTION`

`IS_RTC_TAMPER_PULLUP_STATE`

`IS_RTC_WAKEUP_CLOCK`

`IS_RTC_WAKEUP_COUNTER`

`IS_RTC_SMOOTH_CALIB_PERIOD`

`IS_RTC_SMOOTH_CALIB_PLUS`

`IS_RTC_SMOOTH_CALIB_MINUS`

`IS_RTC_SHIFT_ADD1S`

`IS_RTC_SHIFT_SUBFS`

`IS_RTC_CALIB_OUTPUT`

RTCEX Output selection Definitions

`RTC_OUTPUT_DISABLE`

`RTC_OUTPUT_ALARMA`

`RTC_OUTPUT_ALARMB`

RTC_OUTPUT_WAKEUP

RTCEx Smooth calib period Definitions

RTC_SMOOTHCALIB_PERIOD_32SEC If RTCCLK = 32768 Hz, Smooth calibration period is 32s, else $2^{\text{exp}20}$ RTCCLK seconds

RTC_SMOOTHCALIB_PERIOD_16SEC If RTCCLK = 32768 Hz, Smooth calibration period is 16s, else $2^{\text{exp}19}$ RTCCLK seconds

RTC_SMOOTHCALIB_PERIOD_8SEC If RTCCLK = 32768 Hz, Smooth calibration period is 8s, else $2^{\text{exp}18}$ RTCCLK seconds

RTCEx Smooth calib Plus pulses Definitions

RTC_SMOOTHCALIB_PLUSPULSES_SET The number of RTCCLK pulses added during a X -second window = Y - CALM[8:0] with Y = 512, 256, 128 when X = 32, 16, 8

RTC_SMOOTHCALIB_PLUSPULSES_RESET The number of RTCCLK pulses substituted during a 32-second window = CALM[8:0]

RTCEx Tamper EraseBackUp Definitions

RTC_TAMPER_ERASE_BACKUP_ENABLE

RTC_TAMPER_ERASE_BACKUP_DISABLE

RTCEx Tamper Filter Definitions

RTC_TAMPERFILTER_DISABLE Tamper filter is disabled

RTC_TAMPERFILTER_2SAMPLE Tamper is activated after 2 consecutive samples at the active level

RTC_TAMPERFILTER_4SAMPLE Tamper is activated after 4 consecutive samples at the active level

RTC_TAMPERFILTER_8SAMPLE Tamper is activated after 8 consecutive samples at the active level.

RTCEx Tamper Interrupt Definitions

RTC_TAMPER1_INTERRUPT

RTC_TAMPER2_INTERRUPT

RTC_TAMPER3_INTERRUPT

RTC_ALL_TAMPER_INTERRUPT

RTCEx Tamper MaskFlag Definitions

RTC_TAMPERMASK_FLAG_DISABLE

RTC_TAMPERMASK_FLAG_ENABLE

RTCEx Tamper Pins Definitions

RTC_TAMPER_1

RTC_TAMPER_2

RTC_TAMPER_3

RTCEx Tamper Pin Precharge Duration Definitions

RTC_TAMPERPRECHARGEDURATION_1RTCCLK	Tamper pins are pre-charged before sampling during 1 RTCCLK cycle
RTC_TAMPERPRECHARGEDURATION_2RTCCLK	Tamper pins are pre-charged before sampling during 2 RTCCLK cycles
RTC_TAMPERPRECHARGEDURATION_4RTCCLK	Tamper pins are pre-charged before sampling during 4 RTCCLK cycles
RTC_TAMPERPRECHARGEDURATION_8RTCCLK	Tamper pins are pre-charged before sampling during 8 RTCCLK cycles

RTCEx Tamper Pull UP Definitions

RTC_TAMPER_PULLUP_ENABLE	TimeStamp on Tamper Detection event saved
RTC_TAMPER_PULLUP_DISABLE	TimeStamp on Tamper Detection event is not saved

RTCEx Tamper Sampling Frequencies Definitions

RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV32768	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 32768$
RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV16384	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 16384$
RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV8192	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 8192$
RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV4096	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 4096$
RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV2048	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 2048$
RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV1024	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 1024$
RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV512	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 512$
RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV256	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 256$

RTCEx Tamper TimeStampOnTamperDetection Definitions

RTC_TIMESTAMPONTAMPERDETECTION_ENABLE	TimeStamp on Tamper Detection event saved
RTC_TIMESTAMPONTAMPERDETECTION_DISABLE	TimeStamp on Tamper Detection event is not saved

RTCEx Tamper Trigger Definitions

RTC_TAMPERTRIGGER_RISINGEDGE
RTC_TAMPERTRIGGER_FALLINGEDGE
RTC_TAMPERTRIGGER_LOWLEVEL
RTC_TAMPERTRIGGER_HIGHLEVEL

RTCEx TimeStamp Pin Selection

RTC_TIMESTAMPPIN_DEFAULT
RTC_TIMESTAMPPIN_POS1
RTC_TIMESTAMPPIN_POS2

RTCEx Time Stamp Edges definitions

RTC_TIMESTAMPEDGE_RISING
RTC_TIMESTAMPEDGE_FALLING

RTCEx Wakeup Timer Definitions

RTC_WAKEUPCLOCK_RTCCLK_DIV16
RTC_WAKEUPCLOCK_RTCCLK_DIV8
RTC_WAKEUPCLOCK_RTCCLK_DIV4
RTC_WAKEUPCLOCK_RTCCLK_DIV2
RTC_WAKEUPCLOCK_CK_SPRE_16BITS
RTC_WAKEUPCLOCK_CK_SPRE_17BITS

55 HAL SAI Generic Driver

55.1 SAI Firmware driver registers structures

55.1.1 SAI_InitTypeDef

Data Fields

- *uint32_t* **AudioMode**
- *uint32_t* **Synchro**
- *uint32_t* **SynchroExt**
- *uint32_t* **OutputDrive**
- *uint32_t* **NoDivider**
- *uint32_t* **FIFOThreshold**
- *uint32_t* **AudioFrequency**
- *uint32_t* **Mckdiv**
- *uint32_t* **MonoStereoMode**
- *uint32_t* **CompandingMode**
- *uint32_t* **TriState**
- *uint32_t* **Protocol**
- *uint32_t* **DataSize**
- *uint32_t* **FirstBit**
- *uint32_t* **ClockStrobing**

Field Documentation

- *uint32_t* **SAI_InitTypeDef::AudioMode**
Specifies the SAI Block audio Mode. This parameter can be a value of [SAI_Block_Mode](#)
- *uint32_t* **SAI_InitTypeDef::Synchro**
Specifies SAI Block synchronization This parameter can be a value of [SAI_Block_Synchronization](#)
- *uint32_t* **SAI_InitTypeDef::SynchroExt**
Specifies SAI external output synchronization, this setup is common for BlockA and BlockB This parameter can be a value of [SAI_Block_SyncExt](#)
Note: If both audio blocks of same SAI are used, this parameter has to be set to the same value for each audio block
- *uint32_t* **SAI_InitTypeDef::OutputDrive**
Specifies when SAI Block outputs are driven. This parameter can be a value of [SAI_Block_Output_Drive](#)
Note: this value has to be set before enabling the audio block but after the audio block configuration.
- *uint32_t* **SAI_InitTypeDef::NoDivider**
Specifies whether master clock will be divided or not. This parameter can be a value of [SAI_Block_NoDivider](#)
Note: If bit NODIV in the SAI_xCR1 register is cleared, the frame length should be aligned to a number equal to a power of 2, from 8 to 256. If bit NODIV in the SAI_xCR1 register is set, the frame length can take any of the values without constraint since the input clock of the audio block should be equal to the bit clock. There is no MCLK_x clock which can be output.
- *uint32_t* **SAI_InitTypeDef::FIFOThreshold**
Specifies SAI Block FIFO threshold. This parameter can be a value of [SAI_Block_Fifo_Threshold](#)

- ***uint32_t SAI_InitTypeDef::AudioFrequency***
Specifies the audio frequency sampling. This parameter can be a value of [SAI_Audio_Frequency](#)
- ***uint32_t SAI_InitTypeDef::Mckdiv***
Specifies the master clock divider, the parameter will be used if for AudioFrequency the user choice This parameter must be a number between Min_Data = 0 and Max_Data = 15
- ***uint32_t SAI_InitTypeDef::MonoStereoMode***
Specifies if the mono or stereo mode is selected. This parameter can be a value of [SAI_Mono_Stereo_Mode](#)
- ***uint32_t SAI_InitTypeDef::CompandingMode***
Specifies the companding mode type. This parameter can be a value of [SAI_Block_Companding_Mode](#)
- ***uint32_t SAI_InitTypeDef::TriState***
Specifies the companding mode type. This parameter can be a value of [SAI_TRISate_Management](#)
- ***uint32_t SAI_InitTypeDef::Protocol***
Specifies the SAI Block protocol. This parameter can be a value of [SAI_Block_Protocol](#)
- ***uint32_t SAI_InitTypeDef::DataSize***
Specifies the SAI Block data size. This parameter can be a value of [SAI_Block_Data_Size](#)
- ***uint32_t SAI_InitTypeDef::FirstBit***
Specifies whether data transfers start from MSB or LSB bit. This parameter can be a value of [SAI_Block_MSB_LSB_transmission](#)
- ***uint32_t SAI_InitTypeDef::ClockStrobing***
Specifies the SAI Block clock strobing edge sensitivity. This parameter can be a value of [SAI_Block_Clock_Strobing](#)

55.1.2 SAI_FramelnitTypeDef

Data Fields

- ***uint32_t FrameLength***
- ***uint32_t ActiveFrameLength***
- ***uint32_t FSDefinition***
- ***uint32_t FSPolarity***
- ***uint32_t FSOffset***

Field Documentation

- ***uint32_t SAI_FramelnitTypeDef::FrameLength***
Specifies the Frame length, the number of SCK clocks for each audio frame. This parameter must be a number between Min_Data = 8 and Max_Data = 256.
Note: If master clock MCLK_x pin is declared as an output, the frame length should be aligned to a number equal to power of 2 in order to keep in an audio frame, an integer number of MCLK pulses by bit Clock.
- ***uint32_t SAI_FramelnitTypeDef::ActiveFrameLength***
Specifies the Frame synchronization active level length. This Parameter specifies the length in number of bit clock (SCK + 1) of the active level of FS signal in audio frame. This parameter must be a number between Min_Data = 1 and Max_Data = 128
- ***uint32_t SAI_FramelnitTypeDef::FSDefinition***
Specifies the Frame synchronization definition. This parameter can be a value of [SAI_Block_FS_Definition](#)

- ***uint32_t SAI_FrameInitTypeDef::FSPolarity***
Specifies the Frame synchronization Polarity. This parameter can be a value of [SAI_Block_FS_Polarity](#)
- ***uint32_t SAI_FrameInitTypeDef::FSOffset***
Specifies the Frame synchronization Offset. This parameter can be a value of [SAI_Block_FS_Offset](#)

55.1.3 SAI_SlotInitTypeDef

Data Fields

- ***uint32_t FirstBitOffset***
- ***uint32_t SlotSize***
- ***uint32_t SlotNumber***
- ***uint32_t SlotActive***

Field Documentation

- ***uint32_t SAI_SlotInitTypeDef::FirstBitOffset***
Specifies the position of first data transfer bit in the slot. This parameter must be a number between Min_Data = 0 and Max_Data = 24
- ***uint32_t SAI_SlotInitTypeDef::SlotSize***
Specifies the Slot Size. This parameter can be a value of [SAI_Block_Slot_Size](#)
- ***uint32_t SAI_SlotInitTypeDef::SlotNumber***
Specifies the number of slot in the audio frame. This parameter must be a number between Min_Data = 1 and Max_Data = 16
- ***uint32_t SAI_SlotInitTypeDef::SlotActive***
Specifies the slots in audio frame that will be activated. This parameter can be a value of [SAI_Block_Slot_Active](#)

55.1.4 __SAI_HandleTypeDef

Data Fields

- ***SAI_Block_TypeDef * Instance***
- ***SAI_InitTypeDef Init***
- ***SAI_FrameInitTypeDef FrameInit***
- ***SAI_SlotInitTypeDef SlotInit***
- ***uint8_t * pBuffPtr***
- ***uint16_t XferSize***
- ***uint16_t XferCount***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***SAIcallback mutecallback***
- ***void(* InterruptServiceRoutine***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_SAI_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***SAI_Block_TypeDef* __SAI_HandleTypeDef::Instance***
SAI Blockx registers base address
- ***SAI_InitTypeDef __SAI_HandleTypeDef::Init***
SAI communication parameters
- ***SAI_FrameInitTypeDef __SAI_HandleTypeDef::FrameInit***
SAI Frame configuration parameters

- ***SAI_SlotInitTypeDef __SAI_HandleTypeDef::SlotInit***
SAI Slot configuration parameters
- ***uint8_t* __SAI_HandleTypeDef::pBuffPtr***
Pointer to SAI transfer Buffer
- ***uint16_t __SAI_HandleTypeDef::XferSize***
SAI transfer size
- ***uint16_t __SAI_HandleTypeDef::XferCount***
SAI transfer counter
- ***DMA_HandleTypeDef* __SAI_HandleTypeDef::hdmatx***
SAI Tx DMA handle parameters
- ***DMA_HandleTypeDef* __SAI_HandleTypeDef::hdmarx***
SAI Rx DMA handle parameters
- ***SAIcallback __SAI_HandleTypeDef::mutecallback***
SAI mute callback
- ***void(* __SAI_HandleTypeDef::InterruptServiceRoutine)(struct __SAI_HandleTypeDef *hsai)***
- ***HAL_LockTypeDef __SAI_HandleTypeDef::Lock***
SAI locking object
- ***__IO HAL_SAI_StateTypeDef __SAI_HandleTypeDef::State***
SAI communication state
- ***__IO uint32_t __SAI_HandleTypeDef::ErrorCode***
SAI Error code

55.2 SAI Firmware driver API description

55.2.1 How to use this driver

The SAI HAL driver can be used as follows:

1. Declare a `SAI_HandleTypeDef` handle structure (eg. `SAI_HandleTypeDef hsai`).
2. Initialize the SAI low level resources by implementing the `HAL_SAI_MspInit()` API:
 - a. Enable the SAI interface clock.
 - b. SAI pins configuration:
 - Enable the clock for the SAI GPIOs.
 - Configure these SAI pins as alternate function pull-up.
 - c. NVIC configuration if you need to use interrupt process (`HAL_SAI_Transmit_IT()` and `HAL_SAI_Receive_IT()` APIs):
 - Configure the SAI interrupt priority.
 - Enable the NVIC SAI IRQ handle.
 - d. DMA Configuration if you need to use DMA process (`HAL_SAI_Transmit_DMA()` and `HAL_SAI_Receive_DMA()` APIs):
 - Declare a DMA handle structure for the Tx/Rx stream.
 - Enable the DMAx interface clock.
 - Configure the declared DMA handle structure with the required Tx/Rx parameters.
 - Configure the DMA Tx/Rx Stream.
 - Associate the initialized DMA handle to the SAI DMA Tx/Rx handle.
 - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx/Rx Stream.
3. The initialization can be done by two ways
 - a. Expert mode : Initialize the structures `Init`, `FrameInit` and `SlotInit` and call `HAL_SAI_Init()`.
 - b. Simplified mode : Initialize the high part of `Init` Structure and call `HAL_SAI_InitProtocol()`.



The specific SAI interrupts (FIFO request and Overrun underrun interrupt) will be managed using the macros `__HAL_SAI_ENABLE_IT()` and `__HAL_SAI_DISABLE_IT()` inside the transmit and receive process.



Make sure that either:

- I2S PLL is configured or
- SAI PLL is configured or
- External clock source is configured after setting correctly the define constant `EXTERNAL_CLOCK_VALUE` in the `stm32f7xx_hal_conf.h` file.



In master Tx mode: enabling the audio block immediately generates the bit clock for the external slaves even if there is no data in the FIFO, However FS signal generation is conditioned by the presence of data in the FIFO.



In master Rx mode: enabling the audio block immediately generates the bit clock and FS signal for the external slaves.



It is mandatory to respect the following conditions in order to avoid bad SAI behavior:

- First bit Offset \leq (SLOT size - Data size)
- Data size \leq SLOT size
- Number of SLOT x SLOT size = Frame length
- The number of slots should be even when `SAI_FS_CHANNEL_IDENTIFICATION` is selected.

Three operation modes are available within this driver :

Polling mode IO operation

- Send an amount of data in blocking mode using `HAL_SAI_Transmit()`
- Receive an amount of data in blocking mode using `HAL_SAI_Receive()`

Interrupt mode IO operation

- Send an amount of data in non-blocking mode using `HAL_SAI_Transmit_IT()`
- At transmission end of transfer `HAL_SAI_TxCpltCallback()` is executed and user can add his own code by customization of function pointer `HAL_SAI_TxCpltCallback()`
- Receive an amount of data in non-blocking mode using `HAL_SAI_Receive_IT()`
- At reception end of transfer `HAL_SAI_RxCpltCallback()` is executed and user can add his own code by customization of function pointer `HAL_SAI_RxCpltCallback()`
- In case of flag error, `HAL_SAI_ErrorCallback()` function is executed and user can add his own code by customization of function pointer `HAL_SAI_ErrorCallback()`

DMA mode IO operation

- Send an amount of data in non-blocking mode (DMA) using `HAL_SAI_Transmit_DMA()`

- At transmission end of transfer HAL_SAI_TxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SAI_TxCpltCallback()
- Receive an amount of data in non-blocking mode (DMA) using HAL_SAI_Receive_DMA()
- At reception end of transfer HAL_SAI_RxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SAI_RxCpltCallback()
- In case of flag error, HAL_SAI_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_SAI_ErrorCallback()
- Pause the DMA Transfer using HAL_SAI_DMAMPause()
- Resume the DMA Transfer using HAL_SAI_DMAResume()
- Stop the DMA Transfer using HAL_SAI_DMAStop()

SAI HAL driver additional function list

Below the list the others API available SAI HAL driver :

- HAL_SAI_EnableTxMuteMode(): Enable the mute in tx mode
- HAL_SAI_DisableTxMuteMode(): Disable the mute in tx mode
- HAL_SAI_EnableRxMuteMode(): Enable the mute in Rx mode
- HAL_SAI_DisableRxMuteMode(): Disable the mute in Rx mode
- HAL_SAI_FlushRxFifo(): Flush the rx fifo.
- HAL_SAI_Abort(): Abort the current transfer

SAI HAL driver macros list

Below the list of most used macros in SAI HAL driver :

- __HAL_SAI_ENABLE(): Enable the SAI peripheral
- __HAL_SAI_DISABLE(): Disable the SAI peripheral
- __HAL_SAI_ENABLE_IT(): Enable the specified SAI interrupts
- __HAL_SAI_DISABLE_IT(): Disable the specified SAI interrupts
- __HAL_SAI_GET_IT_SOURCE(): Check if the specified SAI interrupt source is enabled or disabled
- __HAL_SAI_GET_FLAG(): Check whether the specified SAI flag is set or not

55.2.2 Initialization and de-initialization functions

This subsection provides a set of functions allowing to initialize and de-initialize the SAIx peripheral:

- User must implement HAL_SAI_MspInit() function in which he configures all related peripherals resources (CLOCK, GPIO, DMA, IT and NVIC).
- Call the function HAL_SAI_Init() to configure the selected device with the selected configuration:
 - Mode (Master/slave TX/RX)
 - Protocol
 - Data Size
 - MCLK Output
 - Audio frequency
 - FIFO Threshold
 - Frame Config
 - Slot Config
- Call the function HAL_SAI_DeInit() to restore the default configuration of the selected SAI peripheral.

This section contains the following APIs:

- [HAL_SAI_InitProtocol\(\)](#)
- [HAL_SAI_Init\(\)](#)
- [HAL_SAI_DeInit\(\)](#)
- [HAL_SAI_MspInit\(\)](#)
- [HAL_SAI_MspDeInit\(\)](#)

55.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the SAI data transfers.

- There are two modes of transfer:
 - Blocking mode : The communication is performed in the polling mode. The status of all data processing is returned by the same function after finishing transfer.
 - No-Blocking mode : The communication is performed using Interrupts or DMA. These functions return the status of the transfer startup. The end of the data processing will be indicated through the dedicated SAI IRQ when using Interrupt mode or the DMA IRQ when using DMA mode.
- Blocking mode functions are :
 - HAL_SAI_Transmit()
 - HAL_SAI_Receive()
 - HAL_SAI_TransmitReceive()
- Non Blocking mode functions with Interrupt are :
 - HAL_SAI_Transmit_IT()
 - HAL_SAI_Receive_IT()
 - HAL_SAI_TransmitReceive_IT()
- Non Blocking mode functions with DMA are :
 - HAL_SAI_Transmit_DMA()
 - HAL_SAI_Receive_DMA()
 - HAL_SAI_TransmitReceive_DMA()
- A set of Transfer Complete Callbacks are provided in non Blocking mode:
 - HAL_SAI_TxCpltCallback()
 - HAL_SAI_RxCpltCallback()
 - HAL_SAI_ErrorCallback()

This section contains the following APIs:

- [HAL_SAI_Transmit\(\)](#)
- [HAL_SAI_Receive\(\)](#)
- [HAL_SAI_Transmit_IT\(\)](#)
- [HAL_SAI_Receive_IT\(\)](#)
- [HAL_SAI_DMAPause\(\)](#)
- [HAL_SAI_DMAResume\(\)](#)
- [HAL_SAI_DMAStop\(\)](#)
- [HAL_SAI_Abort\(\)](#)
- [HAL_SAI_Transmit_DMA\(\)](#)
- [HAL_SAI_Receive_DMA\(\)](#)
- [HAL_SAI_EnableTxMuteMode\(\)](#)
- [HAL_SAI_DisableTxMuteMode\(\)](#)
- [HAL_SAI_EnableRxMuteMode\(\)](#)
- [HAL_SAI_DisableRxMuteMode\(\)](#)
- [HAL_SAI_IRQHandler\(\)](#)
- [HAL_SAI_TxCpltCallback\(\)](#)
- [HAL_SAI_TxHalfCpltCallback\(\)](#)
- [HAL_SAI_RxCpltCallback\(\)](#)
- [HAL_SAI_RxHalfCpltCallback\(\)](#)

- [HAL_SAI_ErrorCallback\(\)](#)

55.2.4 Peripheral State and Errors functions

This subsection permits to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- [HAL_SAI_GetState\(\)](#)
- [HAL_SAI_GetError\(\)](#)

55.2.5 Detailed description of functions

HAL_SAI_InitProtocol

Function name	HAL_StatusTypeDef HAL_SAI_InitProtocol (SAI_HandleTypeDef * hsai, uint32_t protocol, uint32_t datasize, uint32_t nbslot)
Function description	Initialize the structure FrameInit, SlotInit and the low part of Init according to the specified parameters and call the function HAL_SAI_Init to initialize the SAI block.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module. • protocol: one of the supported protocol SAI Supported protocol • datasize: one of the supported datasize SAI protocol data size the configuration information for SAI module. • nbslot: Number of slot.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SAI_Init

Function name	HAL_StatusTypeDef HAL_SAI_Init (SAI_HandleTypeDef * hsai)
Function description	Initialize the SAI according to the specified parameters.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SAI_DeInit

Function name	HAL_StatusTypeDef HAL_SAI_DeInit (SAI_HandleTypeDef * hsai)
Function description	Deinitialize the SAI peripheral.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SAI_Msplnit

Function name	void HAL_SAI_Msplnit (SAI_HandleTypeDef * hsai)
---------------	--

Function description	Initialize the SAI MSP.
Parameters	<ul style="list-style-type: none">• hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none">• None:

HAL_SAI_MspDeInit

Function name	void HAL_SAI_MspDeInit (SAI_HandleTypeDef * hsai)
Function description	Deinitialize the SAI MSP.
Parameters	<ul style="list-style-type: none">• hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none">• None:

HAL_SAI_Transmit

Function name	HAL_StatusTypeDef HAL_SAI_Transmit (SAI_HandleTypeDef * hsai, uint8_t * pData, uint16_t Size, uint32_t Timeout)
Function description	Transmit an amount of data in blocking mode.
Parameters	<ul style="list-style-type: none">• hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.• pData: Pointer to data buffer• Size: Amount of data to be sent• Timeout: Timeout duration
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SAI_Receive

Function name	HAL_StatusTypeDef HAL_SAI_Receive (SAI_HandleTypeDef * hsai, uint8_t * pData, uint16_t Size, uint32_t Timeout)
Function description	Receive an amount of data in blocking mode.
Parameters	<ul style="list-style-type: none">• hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.• pData: Pointer to data buffer• Size: Amount of data to be received• Timeout: Timeout duration
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SAI_Transmit_IT

Function name	HAL_StatusTypeDef HAL_SAI_Transmit_IT (SAI_HandleTypeDef * hsai, uint8_t * pData, uint16_t Size)
Function description	Transmit an amount of data in non-blocking mode with Interrupt.
Parameters	<ul style="list-style-type: none">• hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.• pData: Pointer to data buffer• Size: Amount of data to be sent

Return values

- **HAL:** status

HAL_SAI_Receive_IT

Function name **HAL_StatusTypeDef HAL_SAI_Receive_IT**
(SAI_HandleTypeDef * hsai, uint8_t * pData, uint16_t Size)

Function description Receive an amount of data in non-blocking mode with Interrupt.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be received

Return values

- **HAL:** status

HAL_SAI_Transmit_DMA

Function name **HAL_StatusTypeDef HAL_SAI_Transmit_DMA**
(SAI_HandleTypeDef * hsai, uint8_t * pData, uint16_t Size)

Function description Transmit an amount of data in non-blocking mode with DMA.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values

- **HAL:** status

HAL_SAI_Receive_DMA

Function name **HAL_StatusTypeDef HAL_SAI_Receive_DMA**
(SAI_HandleTypeDef * hsai, uint8_t * pData, uint16_t Size)

Function description Receive an amount of data in non-blocking mode with DMA.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be received

Return values

- **HAL:** status

HAL_SAI_DMAPause

Function name **HAL_StatusTypeDef HAL_SAI_DMAPause**
(SAI_HandleTypeDef * hsai)

Function description Pause the audio stream playing from the Media.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **HAL:** status

HAL_SAI_DMAResume

Function name **HAL_StatusTypeDef HAL_SAI_DMAResume**

(SAI_HandleTypeDef * hsai)

Function description	Resume the audio stream playing from the Media.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SAI_DMAStop

Function name	HAL_StatusTypeDef HAL_SAI_DMAStop (SAI_HandleTypeDef * hsai)
Function description	Stop the audio stream playing from the Media.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SAI_Abort

Function name	HAL_StatusTypeDef HAL_SAI_Abort (SAI_HandleTypeDef * hsai)
Function description	Abort the current transfer and disable the SAI.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SAI_EnableTxMuteMode

Function name	HAL_StatusTypeDef HAL_SAI_EnableTxMuteMode (SAI_HandleTypeDef * hsai, uint16_t val)
Function description	Enable the Tx mute mode.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module. • val: value sent during the mute SAI Block Mute Value
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SAI_DisableTxMuteMode

Function name	HAL_StatusTypeDef HAL_SAI_DisableTxMuteMode (SAI_HandleTypeDef * hsai)
Function description	Disable the Tx mute mode.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SAI_EnableRxMuteMode

Function name	HAL_StatusTypeDef HAL_SAI_EnableRxMuteMode
---------------	---

(SAI_HandleTypeDef * hsai, SAIcallback callback, uint16_t counter)

Function description	Enable the Rx mute detection.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module. • callback: function called when the mute is detected. • counter: number a data before mute detection max 63.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SAI_DisableRxMuteMode

Function name	HAL_StatusTypeDef HAL_SAI_DisableRxMuteMode (SAI_HandleTypeDef * hsai)
Function description	Disable the Rx mute detection.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SAI_IRQHandler

Function name	void HAL_SAI_IRQHandler (SAI_HandleTypeDef * hsai)
Function description	Handle SAI interrupt request.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none"> • None:

HAL_SAI_TxHalfCpltCallback

Function name	void HAL_SAI_TxHalfCpltCallback (SAI_HandleTypeDef * hsai)
Function description	Tx Transfer Half completed callback.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none"> • None:

HAL_SAI_TxCpltCallback

Function name	void HAL_SAI_TxCpltCallback (SAI_HandleTypeDef * hsai)
Function description	Tx Transfer completed callback.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none"> • None:

HAL_SAI_RxHalfCpltCallback

Function name	void HAL_SAI_RxHalfCpltCallback (SAI_HandleTypeDef * hsai)
---------------	---

hsai)

Function description	Rx Transfer half completed callback.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none"> • None:

HAL_SAI_RxCpltCallback

Function name	void HAL_SAI_RxCpltCallback (SAI_HandleTypeDef * hsai)
Function description	Rx Transfer completed callback.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none"> • None:

HAL_SAI_ErrorCallback

Function name	void HAL_SAI_ErrorCallback (SAI_HandleTypeDef * hsai)
Function description	SAI error callback.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none"> • None:

HAL_SAI_GetState

Function name	HAL_SAI_StateTypeDef HAL_SAI_GetState (SAI_HandleTypeDef * hsai)
Function description	Return the SAI handle state.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
Return values	<ul style="list-style-type: none"> • HAL: state

HAL_SAI_GetError

Function name	uint32_t HAL_SAI_GetError (SAI_HandleTypeDef * hsai)
Function description	Return the SAI error code.
Parameters	<ul style="list-style-type: none"> • hsai: pointer to a SAI_HandleTypeDef structure that contains the configuration information for the specified SAI Block.
Return values	<ul style="list-style-type: none"> • SAI: Error Code

55.3 SAI Firmware driver defines**55.3.1 SAI*****SAI Audio Frequency***

SAI_AUDIO_FREQUENCY_192K

SAI_AUDIO_FREQUENCY_96K
SAI_AUDIO_FREQUENCY_48K
SAI_AUDIO_FREQUENCY_44K
SAI_AUDIO_FREQUENCY_32K
SAI_AUDIO_FREQUENCY_22K
SAI_AUDIO_FREQUENCY_16K
SAI_AUDIO_FREQUENCY_11K
SAI_AUDIO_FREQUENCY_8K
SAI_AUDIO_FREQUENCY_MCKDIV

SAI Block Clock Strobing

SAI_CLOCKSTROBING_FALLINGEDGE
SAI_CLOCKSTROBING_RISINGEDGE

SAI Block Companding Mode

SAI_NOCOMPANDING
SAI_ULAW_1CPL_COMPANDING
SAI_ALAW_1CPL_COMPANDING
SAI_ULAW_2CPL_COMPANDING
SAI_ALAW_2CPL_COMPANDING

SAI Block Data Size

SAI_DATASIZE_8
SAI_DATASIZE_10
SAI_DATASIZE_16
SAI_DATASIZE_20
SAI_DATASIZE_24
SAI_DATASIZE_32

SAI Block Fifo Status Level

SAI_FIFOSTATUS_EMPTY
SAI_FIFOSTATUS_LESS1QUARTERFULL
SAI_FIFOSTATUS_1QUARTERFULL
SAI_FIFOSTATUS_HALFFULL
SAI_FIFOSTATUS_3QUARTERFULL
SAI_FIFOSTATUS_FULL

SAI Block Fifo Threshold

SAI_FIFOTHRESHOLD_EMPTY
SAI_FIFOTHRESHOLD_1QF
SAI_FIFOTHRESHOLD_HF

SAI_FIFOTHRESHOLD_3QF

SAI_FIFOTHRESHOLD_FULL

SAI Block Flags Definition

SAI_FLAG_OVRUDR

SAI_FLAG_MUTEDET

SAI_FLAG_WCKCFG

SAI_FLAG_FREQ

SAI_FLAG_CNRDY

SAI_FLAG_AFSDET

SAI_FLAG_LFSDET

SAI Block FS Definition

SAI_FS_STARTFRAME

SAI_FS_CHANNEL_IDENTIFICATION

SAI Block FS Offset

SAI_FS_FIRSTBIT

SAI_FS_BEFOREFIRSTBIT

SAI Block FS Polarity

SAI_FS_ACTIVE_LOW

SAI_FS_ACTIVE_HIGH

SAI Block Interrupts Definition

SAI_IT_OVRUDR

SAI_IT_MUTEDET

SAI_IT_WCKCFG

SAI_IT_FREQ

SAI_IT_CNRDY

SAI_IT_AFSDET

SAI_IT_LFSDET

SAI Block Mode

SAI_MODEMASTER_TX

SAI_MODEMASTER_RX

SAI_MODESLAVE_TX

SAI_MODESLAVE_RX

SAI Block MSB LSB transmission

SAI_FIRSTBIT_MSB

SAI_FIRSTBIT_LSB

SAI Block Mute Value

SAI_ZERO_VALUE

SAI_LAST_SENT_VALUE

SAI Block NoDivider

SAI_MASTERDIVIDER_ENABLE

SAI_MASTERDIVIDER_DISABLE

SAI Block Output Drive

SAI_OUTPUTDRIVE_DISABLE

SAI_OUTPUTDRIVE_ENABLE

SAI Block Protocol

SAI_FREE_PROTOCOL

SAI_SPDIF_PROTOCOL

SAI_AC97_PROTOCOL

SAI Block Slot Active

SAI_SLOT_NOTACTIVE

SAI_SLOTACTIVE_0

SAI_SLOTACTIVE_1

SAI_SLOTACTIVE_2

SAI_SLOTACTIVE_3

SAI_SLOTACTIVE_4

SAI_SLOTACTIVE_5

SAI_SLOTACTIVE_6

SAI_SLOTACTIVE_7

SAI_SLOTACTIVE_8

SAI_SLOTACTIVE_9

SAI_SLOTACTIVE_10

SAI_SLOTACTIVE_11

SAI_SLOTACTIVE_12

SAI_SLOTACTIVE_13

SAI_SLOTACTIVE_14

SAI_SLOTACTIVE_15

SAI_SLOTACTIVE_ALL

SAI Block Slot Size

SAI_SLOTSIZE_DATASIZE

SAI_SLOTSIZE_16B

SAI_SLOTSIZE_32B

SAI External synchronisation

SAI_SYNCEXT_DISABLE
 SAI_SYNCEXT_OUTBLOCKA_ENABLE
 SAI_SYNCEXT_OUTBLOCKB_ENABLE

SAI Block Synchronization

SAI_ASYNCHRONOUS Asynchronous
 SAI_SYNCHRONOUS Synchronous with other block of same SAI
 SAI_SYNCHRONOUS_EXT_SAI1 Synchronous with other SAI, SAI1
 SAI_SYNCHRONOUS_EXT_SAI2 Synchronous with other SAI, SAI2

SAI Error Code

HAL_SAI_ERROR_NONE No error
 HAL_SAI_ERROR_OVR Overrun Error
 HAL_SAI_ERROR_UDR Underrun error
 HAL_SAI_ERROR_AFSDET Anticipated Frame synchronisation detection
 HAL_SAI_ERROR_LFSDET Late Frame synchronisation detection
 HAL_SAI_ERROR_CNREADY codec not ready
 HAL_SAI_ERROR_WCKCFG Wrong clock configuration
 HAL_SAI_ERROR_TIMEOUT Timeout error
 HAL_SAI_ERROR_DMA DMA error

SAI Exported Macros

`__HAL_SAI_RESET_HANDLE_STATE` **Description:**

- Reset SAI handle state.

Parameters:

- `__HANDLE__`: specifies the SAI Handle.

Return value:

- None

`__HAL_SAI_ENABLE_IT`

Description:

- Enable or disable the specified SAI interrupts.

Parameters:

- `__HANDLE__`: specifies the SAI Handle.
- `__INTERRUPT__`: specifies the interrupt source to enable or disable. This parameter can be one of the following values:
 - `SAI_IT_OVRUDR`: Overrun underrun interrupt enable
 - `SAI_IT_MUTEDET`: Mute detection interrupt enable
 - `SAI_IT_WCKCFG`: Wrong Clock Configuration interrupt enable
 - `SAI_IT_FREQ`: FIFO request interrupt

- enable
- SAI_IT_CNRDY: Codec not ready interrupt enable
- SAI_IT_AFSDET: Anticipated frame synchronization detection interrupt enable
- SAI_IT_LFSDET: Late frame synchronization detection interrupt enable

Return value:

- None

`__HAL_SAI_DISABLE_IT`

`__HAL_SAI_GET_IT_SOURCE`

Description:

- Check whether the specified SAI interrupt source is enabled or not.

Parameters:

- `__HANDLE__`: specifies the SAI Handle.
- `__INTERRUPT__`: specifies the SAI interrupt source to check. This parameter can be one of the following values:
 - SAI_IT_OVRUDR: Overrun underrun interrupt enable
 - SAI_IT_MUTEDET: Mute detection interrupt enable
 - SAI_IT_WCKCFG: Wrong Clock Configuration interrupt enable
 - SAI_IT_FREQ: FIFO request interrupt enable
 - SAI_IT_CNRDY: Codec not ready interrupt enable
 - SAI_IT_AFSDET: Anticipated frame synchronization detection interrupt enable
 - SAI_IT_LFSDET: Late frame synchronization detection interrupt enable

Return value:

- The: new state of `__INTERRUPT__` (TRUE or FALSE).

`__HAL_SAI_GET_FLAG`

Description:

- Check whether the specified SAI flag is set or not.

Parameters:

- `__HANDLE__`: specifies the SAI Handle.
- `__FLAG__`: specifies the flag to check. This parameter can be one of the following values:
 - SAI_FLAG_OVRUDR: Overrun

- underrun flag.
- SAI_FLAG_MUTEDDET: Mute detection flag.
- SAI_FLAG_WCKCFG: Wrong Clock Configuration flag.
- SAI_FLAG_FREQ: FIFO request flag.
- SAI_FLAG_CNRDY: Codec not ready flag.
- SAI_FLAG_AFSDET: Anticipated frame synchronization detection flag.
- SAI_FLAG_LFSDET: Late frame synchronization detection flag.

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

`__HAL_SAI_CLEAR_FLAG`

Description:

- Clear the specified SAI pending flag.

Parameters:

- __HANDLE__: specifies the SAI Handle.
- __FLAG__: specifies the flag to check. This parameter can be any combination of the following values:
 - SAI_FLAG_OVRUDR: Clear Overrun underrun
 - SAI_FLAG_MUTEDDET: Clear Mute detection
 - SAI_FLAG_WCKCFG: Clear Wrong Clock Configuration
 - SAI_FLAG_FREQ: Clear FIFO request
 - SAI_FLAG_CNRDY: Clear Codec not ready
 - SAI_FLAG_AFSDET: Clear Anticipated frame synchronization detection
 - SAI_FLAG_LFSDET: Clear Late frame synchronization detection

Return value:

- None

`__HAL_SAI_ENABLE`

`__HAL_SAI_DISABLE`

SAI Mono Stereo Mode

`SAI_STEREO_MODE`

`SAI_MONO_MODE`

SAI Supported protocol

`SAI_I2S_STANDARD`

`SAI_I2S_MSBJUSTIFIED`

SAI_I2S_LSBJUSTIFIED

SAI_PCM_LONG

SAI_PCM_SHORT

SAI protocol data size

SAI_PROTOCOL_DATASIZE_16BIT

SAI_PROTOCOL_DATASIZE_16BITEXTENDED

SAI_PROTOCOL_DATASIZE_24BIT

SAI_PROTOCOL_DATASIZE_32BIT

SAI TRISate Management

SAI_OUTPUT_NOTRELEASED

SAI_OUTPUT_RELEASED

56 HAL SDRAM Generic Driver

56.1 SDRAM Firmware driver registers structures

56.1.1 SDRAM_HandleTypeDef

Data Fields

- *FMC_SDRAM_TypeDef * Instance*
- *FMC_SDRAM_InitTypeDef Init*
- *__IO HAL_SDRAM_StateTypeDef State*
- *HAL_LockTypeDef Lock*
- *DMA_HandleTypeDef * hdma*

Field Documentation

- *FMC_SDRAM_TypeDef* SDRAM_HandleTypeDef::Instance*
Register base address
- *FMC_SDRAM_InitTypeDef SDRAM_HandleTypeDef::Init*
SDRAM device configuration parameters
- *__IO HAL_SDRAM_StateTypeDef SDRAM_HandleTypeDef::State*
SDRAM access state
- *HAL_LockTypeDef SDRAM_HandleTypeDef::Lock*
SDRAM locking object
- *DMA_HandleTypeDef* SDRAM_HandleTypeDef::hdma*
Pointer DMA handler

56.2 SDRAM Firmware driver API description

56.2.1 How to use this driver

This driver is a generic layered driver which contains a set of APIs used to control SDRAM memories. It uses the FMC layer functions to interface with SDRAM devices. The following sequence should be followed to configure the FMC to interface with SDRAM memories:

1. Declare a SDRAM_HandleTypeDef handle structure, for example:
SDRAM_HandleTypeDef hdsram
 - Fill the SDRAM_HandleTypeDef handle "Init" field with the allowed values of the structure member.
 - Fill the SDRAM_HandleTypeDef handle "Instance" field with a predefined base register instance for NOR or SDRAM device
2. Declare a FMC_SDRAM_TimingTypeDef structure; for example:
FMC_SDRAM_TimingTypeDef Timing; and fill its fields with the allowed values of the structure member.
3. Initialize the SDRAM Controller by calling the function HAL_SDRAM_Init(). This function performs the following sequence:
 - a. MSP hardware layer configuration using the function HAL_SDRAM_MspInit()
 - b. Control register configuration using the FMC SDRAM interface function FMC_SDRAM_Init()
 - c. Timing register configuration using the FMC SDRAM interface function FMC_SDRAM_Timing_Init()
 - d. Program the SDRAM external device by applying its initialization sequence according to the device plugged in your hardware. This step is mandatory for accessing the SDRAM device.

4. At this stage you can perform read/write accesses from/to the memory connected to the SDRAM Bank. You can perform either polling or DMA transfer using the following APIs:
 - HAL_SDRAM_Read()/HAL_SDRAM_Write() for polling read/write access
 - HAL_SDRAM_Read_DMA()/HAL_SDRAM_Write_DMA() for DMA read/write transfer
5. You can also control the SDRAM device by calling the control APIs HAL_SDRAM_WriteOperation_Enable()/ HAL_SDRAM_WriteOperation_Disable() to respectively enable/disable the SDRAM write operation or the function HAL_SDRAM_SendCommand() to send a specified command to the SDRAM device. The command to be sent must be configured with the FMC_SDRAM_CommandTypeDef structure.
6. You can continuously monitor the SDRAM device HAL state by calling the function HAL_SDRAM_GetState()

56.2.2 SDRAM Initialization and de_initialization functions

This section provides functions allowing to initialize/de-initialize the SDRAM memory

This section contains the following APIs:

- [*HAL_SDRAM_Init\(\)*](#)
- [*HAL_SDRAM_DeInit\(\)*](#)
- [*HAL_SDRAM_MspInit\(\)*](#)
- [*HAL_SDRAM_MspDeInit\(\)*](#)
- [*HAL_SDRAM_IRQHandler\(\)*](#)
- [*HAL_SDRAM_RefreshErrorCallback\(\)*](#)
- [*HAL_SDRAM_DMA_XferCpltCallback\(\)*](#)
- [*HAL_SDRAM_DMA_XferErrorCallback\(\)*](#)

56.2.3 SDRAM Input and Output functions

This section provides functions allowing to use and control the SDRAM memory

This section contains the following APIs:

- [*HAL_SDRAM_Read_8b\(\)*](#)
- [*HAL_SDRAM_Write_8b\(\)*](#)
- [*HAL_SDRAM_Read_16b\(\)*](#)
- [*HAL_SDRAM_Write_16b\(\)*](#)
- [*HAL_SDRAM_Read_32b\(\)*](#)
- [*HAL_SDRAM_Write_32b\(\)*](#)
- [*HAL_SDRAM_Read_DMA\(\)*](#)
- [*HAL_SDRAM_Write_DMA\(\)*](#)

56.2.4 SDRAM Control functions

This subsection provides a set of functions allowing to control dynamically the SDRAM interface.

This section contains the following APIs:

- [*HAL_SDRAM_WriteProtection_Enable\(\)*](#)
- [*HAL_SDRAM_WriteProtection_Disable\(\)*](#)
- [*HAL_SDRAM_SendCommand\(\)*](#)
- [*HAL_SDRAM_ProgramRefreshRate\(\)*](#)
- [*HAL_SDRAM_SetAutoRefreshNumber\(\)*](#)
- [*HAL_SDRAM_GetModeStatus\(\)*](#)

56.2.5 SDRAM State functions

This subsection permits to get in run-time the status of the SDRAM controller and the data flow.

This section contains the following APIs:

- [HAL_SDRAM_GetState\(\)](#)

56.2.6 Detailed description of functions

HAL_SDRAM_Init

Function name	HAL_StatusTypeDef HAL_SDRAM_Init (SDRAM_HandleTypeDef * hsdram, FMC_SDRAM_TimingTypeDef * Timing)
Function description	Performs the SDRAM device initialization sequence.
Parameters	<ul style="list-style-type: none">• hsdram: pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.• Timing: Pointer to SDRAM control timing structure
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SDRAM_DeInit

Function name	HAL_StatusTypeDef HAL_SDRAM_DeInit (SDRAM_HandleTypeDef * hsdram)
Function description	Perform the SDRAM device initialization sequence.
Parameters	<ul style="list-style-type: none">• hsdram: pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SDRAM_MspInit

Function name	void HAL_SDRAM_MspInit (SDRAM_HandleTypeDef * hsdram)
Function description	SDRAM MSP Init.
Parameters	<ul style="list-style-type: none">• hsdram: pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
Return values	<ul style="list-style-type: none">• None:

HAL_SDRAM_MspDeInit

Function name	void HAL_SDRAM_MspDeInit (SDRAM_HandleTypeDef * hsdram)
Function description	SDRAM MSP DeInit.
Parameters	<ul style="list-style-type: none">• hsdram: pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
Return values	<ul style="list-style-type: none">• None:

HAL_SDRAM_IRQHandler

Function name	void HAL_SDRAM_IRQHandler (SDRAM_HandleTypeDef * hsdram)
Function description	This function handles SDRAM refresh error interrupt request.
Parameters	<ul style="list-style-type: none"> • hsdram: pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SDRAM_RefreshErrorCallback

Function name	void HAL_SDRAM_RefreshErrorCallback (SDRAM_HandleTypeDef * hsdram)
Function description	SDRAM Refresh error callback.
Parameters	<ul style="list-style-type: none"> • hsdram: pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
Return values	<ul style="list-style-type: none"> • None:

HAL_SDRAM_DMA_XferCpltCallback

Function name	void HAL_SDRAM_DMA_XferCpltCallback (DMA_HandleTypeDef * hdma)
Function description	DMA transfer complete callback.
Parameters	<ul style="list-style-type: none"> • hdma: pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.
Return values	<ul style="list-style-type: none"> • None:

HAL_SDRAM_DMA_XferErrorCallback

Function name	void HAL_SDRAM_DMA_XferErrorCallback (DMA_HandleTypeDef * hdma)
Function description	DMA transfer complete error callback.
Parameters	<ul style="list-style-type: none"> • hdma: DMA handle
Return values	<ul style="list-style-type: none"> • None:

HAL_SDRAM_Read_8b

Function name	HAL_StatusTypeDef HAL_SDRAM_Read_8b (SDRAM_HandleTypeDef * hsdram, uint32_t * pAddress, uint8_t * pDstBuffer, uint32_t BufferSize)
Function description	Reads 8-bit data buffer from the SDRAM memory.
Parameters	<ul style="list-style-type: none"> • hsdram: pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module. • pAddress: Pointer to read start address • pDstBuffer: Pointer to destination buffer • BufferSize: Size of the buffer to read from memory

Return values

- **HAL:** status

HAL_SDRAM_Write_8b

Function name **HAL_StatusTypeDef HAL_SDRAM_Write_8b**
(**SDRAM_HandleTypeDef * hsdram, uint32_t * pAddress,**
uint8_t * pSrcBuffer, uint32_t BufferSize)

Function description Writes 8-bit data buffer to SDRAM memory.

Parameters

- **hsdram:** pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
- **pAddress:** Pointer to write start address
- **pSrcBuffer:** Pointer to source buffer to write
- **BufferSize:** Size of the buffer to write to memory

Return values

- **HAL:** status

HAL_SDRAM_Read_16b

Function name **HAL_StatusTypeDef HAL_SDRAM_Read_16b**
(**SDRAM_HandleTypeDef * hsdram, uint32_t * pAddress,**
uint16_t * pDstBuffer, uint32_t BufferSize)

Function description Reads 16-bit data buffer from the SDRAM memory.

Parameters

- **hsdram:** pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
- **pAddress:** Pointer to read start address
- **pDstBuffer:** Pointer to destination buffer
- **BufferSize:** Size of the buffer to read from memory

Return values

- **HAL:** status

HAL_SDRAM_Write_16b

Function name **HAL_StatusTypeDef HAL_SDRAM_Write_16b**
(**SDRAM_HandleTypeDef * hsdram, uint32_t * pAddress,**
uint16_t * pSrcBuffer, uint32_t BufferSize)

Function description Writes 16-bit data buffer to SDRAM memory.

Parameters

- **hsdram:** pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
- **pAddress:** Pointer to write start address
- **pSrcBuffer:** Pointer to source buffer to write
- **BufferSize:** Size of the buffer to write to memory

Return values

- **HAL:** status

HAL_SDRAM_Read_32b

Function name **HAL_StatusTypeDef HAL_SDRAM_Read_32b**
(**SDRAM_HandleTypeDef * hsdram, uint32_t * pAddress,**
uint32_t * pDstBuffer, uint32_t BufferSize)

Function description Reads 32-bit data buffer from the SDRAM memory.

Parameters

- **hsdram:** pointer to a SDRAM_HandleTypeDef structure that

contains the configuration information for SDRAM module.

- **pAddress:** Pointer to read start address
- **pDstBuffer:** Pointer to destination buffer
- **BufferSize:** Size of the buffer to read from memory

Return values

- **HAL:** status

HAL_SDRAM_Write_32b

Function name **HAL_StatusTypeDef HAL_SDRAM_Write_32b (SDRAM_HandleTypeDef * hsdram, uint32_t * pAddress, uint32_t * pSrcBuffer, uint32_t BufferSize)**

Function description Writes 32-bit data buffer to SDRAM memory.

Parameters

- **hsdram:** pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
- **pAddress:** Pointer to write start address
- **pSrcBuffer:** Pointer to source buffer to write
- **BufferSize:** Size of the buffer to write to memory

Return values

- **HAL:** status

HAL_SDRAM_Read_DMA

Function name **HAL_StatusTypeDef HAL_SDRAM_Read_DMA (SDRAM_HandleTypeDef * hsdram, uint32_t * pAddress, uint32_t * pDstBuffer, uint32_t BufferSize)**

Function description Reads a Words data from the SDRAM memory using DMA transfer.

Parameters

- **hsdram:** pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
- **pAddress:** Pointer to read start address
- **pDstBuffer:** Pointer to destination buffer
- **BufferSize:** Size of the buffer to read from memory

Return values

- **HAL:** status

HAL_SDRAM_Write_DMA

Function name **HAL_StatusTypeDef HAL_SDRAM_Write_DMA (SDRAM_HandleTypeDef * hsdram, uint32_t * pAddress, uint32_t * pSrcBuffer, uint32_t BufferSize)**

Function description Writes a Words data buffer to SDRAM memory using DMA transfer.

Parameters

- **hsdram:** pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
- **pAddress:** Pointer to write start address
- **pSrcBuffer:** Pointer to source buffer to write
- **BufferSize:** Size of the buffer to write to memory

Return values

- **HAL:** status

HAL_SDRAM_WriteProtection_Enable

Function name	HAL_StatusTypeDef HAL_SDRAM_WriteProtection_Enable (SDRAM_HandleTypeDef * hsdram)
Function description	Enables dynamically SDRAM write protection.
Parameters	<ul style="list-style-type: none">• hsdram: pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SDRAM_WriteProtection_Disable

Function name	HAL_StatusTypeDef HAL_SDRAM_WriteProtection_Disable (SDRAM_HandleTypeDef * hsdram)
Function description	Disables dynamically SDRAM write protection.
Parameters	<ul style="list-style-type: none">• hsdram: pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SDRAM_SendCommand

Function name	HAL_StatusTypeDef HAL_SDRAM_SendCommand (SDRAM_HandleTypeDef * hsdram, FMC_SDRAM_CommandTypeDef * Command, uint32_t Timeout)
Function description	Sends Command to the SDRAM bank.
Parameters	<ul style="list-style-type: none">• hsdram: pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.• Command: SDRAM command structure• Timeout: Timeout duration
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SDRAM_ProgramRefreshRate

Function name	HAL_StatusTypeDef HAL_SDRAM_ProgramRefreshRate (SDRAM_HandleTypeDef * hsdram, uint32_t RefreshRate)
Function description	Programs the SDRAM Memory Refresh rate.
Parameters	<ul style="list-style-type: none">• hsdram: pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.• RefreshRate: The SDRAM refresh rate value
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SDRAM_SetAutoRefreshNumber

Function name	HAL_StatusTypeDef HAL_SDRAM_SetAutoRefreshNumber (SDRAM_HandleTypeDef * hsdram, uint32_t AutoRefreshNumber)
Function description	Sets the Number of consecutive SDRAM Memory auto Refresh

commands.

Parameters	<ul style="list-style-type: none"> • hsdram: pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module. • AutoRefreshNumber: The SDRAM auto Refresh number
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SDRAM_GetModeStatus

Function name	uint32_t HAL_SDRAM_GetModeStatus (SDRAM_HandleTypeDef * hsdram)
Function description	Returns the SDRAM memory current mode.
Parameters	<ul style="list-style-type: none"> • hsdram: pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
Return values	<ul style="list-style-type: none"> • The: SDRAM memory mode.

HAL_SDRAM_GetState

Function name	HAL_SDRAM_StateTypeDef HAL_SDRAM_GetState (SDRAM_HandleTypeDef * hsdram)
Function description	Returns the SDRAM state.
Parameters	<ul style="list-style-type: none"> • hsdram: pointer to a SDRAM_HandleTypeDef structure that contains the configuration information for SDRAM module.
Return values	<ul style="list-style-type: none"> • HAL: state

56.3 SDRAM Firmware driver defines

56.3.1 SDRAM

SDRAM Exported Macros

<code>__HAL_SDRAM_RESET_HANDLE_STATE</code>	Description: <ul style="list-style-type: none"> • Reset SDRAM handle state. Parameters: <ul style="list-style-type: none"> • <code>__HANDLE__</code>: specifies the SDRAM handle. Return value: <ul style="list-style-type: none"> • None
---	---

57 HAL SD Generic Driver

57.1 SD Firmware driver registers structures

57.1.1 HAL_SD_CardInfoTypeDef

Data Fields

- *uint32_t CardType*
- *uint32_t CardVersion*
- *uint32_t Class*
- *uint32_t RelCardAdd*
- *uint32_t BlockNbr*
- *uint32_t BlockSize*
- *uint32_t LogBlockNbr*
- *uint32_t LogBlockSize*

Field Documentation

- *uint32_t HAL_SD_CardInfoTypeDef::CardType*
Specifies the card Type
- *uint32_t HAL_SD_CardInfoTypeDef::CardVersion*
Specifies the card version
- *uint32_t HAL_SD_CardInfoTypeDef::Class*
Specifies the class of the card class
- *uint32_t HAL_SD_CardInfoTypeDef::RelCardAdd*
Specifies the Relative Card Address
- *uint32_t HAL_SD_CardInfoTypeDef::BlockNbr*
Specifies the Card Capacity in blocks
- *uint32_t HAL_SD_CardInfoTypeDef::BlockSize*
Specifies one block size in bytes
- *uint32_t HAL_SD_CardInfoTypeDef::LogBlockNbr*
Specifies the Card logical Capacity in blocks
- *uint32_t HAL_SD_CardInfoTypeDef::LogBlockSize*
Specifies logical block size in bytes

57.1.2 SD_HandleTypeDef

Data Fields

- *SD_TypeDef * Instance*
- *SD_InitTypeDef Init*
- *HAL_LockTypeDef Lock*
- *uint32_t * pTxBuffPtr*
- *uint32_t TxXferSize*
- *uint32_t * pRxBuffPtr*
- *uint32_t RxXferSize*
- *__IO uint32_t Context*
- *__IO HAL_SD_StateTypeDef State*
- *__IO uint32_t ErrorCode*
- *DMA_HandleTypeDef * hdmarx*
- *DMA_HandleTypeDef * hdmatx*
- *HAL_SD_CardInfoTypeDef SdCard*

- *uint32_t CSD*
- *uint32_t CID*

Field Documentation

- ***SD_TypeDef* SD_HandleTypeDef::Instance***
SD registers base address
- ***SD_InitTypeDef SD_HandleTypeDef::Init***
SD required parameters
- ***HAL_LockTypeDef SD_HandleTypeDef::Lock***
SD locking object
- ***uint32_t* SD_HandleTypeDef::pTxBuffPtr***
Pointer to SD Tx transfer Buffer
- ***uint32_t SD_HandleTypeDef::TxXferSize***
SD Tx Transfer size
- ***uint32_t* SD_HandleTypeDef::pRxBuffPtr***
Pointer to SD Rx transfer Buffer
- ***uint32_t SD_HandleTypeDef::RxXferSize***
SD Rx Transfer size
- ***__IO uint32_t SD_HandleTypeDef::Context***
SD transfer context
- ***__IO HAL_SD_StateTypeDef SD_HandleTypeDef::State***
SD card State
- ***__IO uint32_t SD_HandleTypeDef::ErrorCode***
SD Card Error codes
- ***DMA_HandleTypeDef* SD_HandleTypeDef::hdmarx***
SD Rx DMA handle parameters
- ***DMA_HandleTypeDef* SD_HandleTypeDef::hdmatx***
SD Tx DMA handle parameters
- ***HAL_SD_CardInfoTypeDef SD_HandleTypeDef::SdCard***
SD Card information
- ***uint32_t SD_HandleTypeDef::CSD[4]***
SD card specific data table
- ***uint32_t SD_HandleTypeDef::CID[4]***
SD card identification number table

57.1.3 HAL_SD_CardCSDTypedef

Data Fields

- ***__IO uint8_t CSDStruct***
- ***__IO uint8_t SysSpecVersion***
- ***__IO uint8_t Reserved1***
- ***__IO uint8_t TAAC***
- ***__IO uint8_t NSAC***
- ***__IO uint8_t MaxBusClkFrec***
- ***__IO uint16_t CardComdClasses***
- ***__IO uint8_t RdBlockLen***
- ***__IO uint8_t PartBlockRead***
- ***__IO uint8_t WrBlockMisalign***
- ***__IO uint8_t RdBlockMisalign***
- ***__IO uint8_t DSRImpl***
- ***__IO uint8_t Reserved2***
- ***__IO uint32_t DeviceSize***
- ***__IO uint8_t MaxRdCurrentVDDMin***

- **__IO uint8_t MaxRdCurrentVDDMax**
- **__IO uint8_t MaxWrCurrentVDDMin**
- **__IO uint8_t MaxWrCurrentVDDMax**
- **__IO uint8_t DeviceSizeMul**
- **__IO uint8_t EraseGrSize**
- **__IO uint8_t EraseGrMul**
- **__IO uint8_t WrProtectGrSize**
- **__IO uint8_t WrProtectGrEnable**
- **__IO uint8_t ManDefIECC**
- **__IO uint8_t WrSpeedFact**
- **__IO uint8_t MaxWrBlockLen**
- **__IO uint8_t WriteBlockPaPartial**
- **__IO uint8_t Reserved3**
- **__IO uint8_t ContentProtectAppli**
- **__IO uint8_t FileFormatGrouop**
- **__IO uint8_t CopyFlag**
- **__IO uint8_t PermWrProtect**
- **__IO uint8_t TempWrProtect**
- **__IO uint8_t FileFormat**
- **__IO uint8_t ECC**
- **__IO uint8_t CSD_CRC**
- **__IO uint8_t Reserved4**

Field Documentation

- **__IO uint8_t HAL_SD_CardCSDTypedef::CSDStruct**
CSD structure
- **__IO uint8_t HAL_SD_CardCSDTypedef::SysSpecVersion**
System specification version
- **__IO uint8_t HAL_SD_CardCSDTypedef::Reserved1**
Reserved
- **__IO uint8_t HAL_SD_CardCSDTypedef::TAAC**
Data read access time 1
- **__IO uint8_t HAL_SD_CardCSDTypedef::NSAC**
Data read access time 2 in CLK cycles
- **__IO uint8_t HAL_SD_CardCSDTypedef::MaxBusClkFrec**
Max. bus clock frequency
- **__IO uint16_t HAL_SD_CardCSDTypedef::CardComdClasses**
Card command classes
- **__IO uint8_t HAL_SD_CardCSDTypedef::RdBlockLen**
Max. read data block length
- **__IO uint8_t HAL_SD_CardCSDTypedef::PartBlockRead**
Partial blocks for read allowed
- **__IO uint8_t HAL_SD_CardCSDTypedef::WrBlockMisalign**
Write block misalignment
- **__IO uint8_t HAL_SD_CardCSDTypedef::RdBlockMisalign**
Read block misalignment
- **__IO uint8_t HAL_SD_CardCSDTypedef::DSRImpl**
DSR implemented
- **__IO uint8_t HAL_SD_CardCSDTypedef::Reserved2**
Reserved
- **__IO uint32_t HAL_SD_CardCSDTypedef::DeviceSize**
Device Size

- **__IO uint8_t HAL_SD_CardCSDTypedef::MaxRdCurrentVDDMin**
Max. read current @ VDD min
- **__IO uint8_t HAL_SD_CardCSDTypedef::MaxRdCurrentVDDMax**
Max. read current @ VDD max
- **__IO uint8_t HAL_SD_CardCSDTypedef::MaxWrCurrentVDDMin**
Max. write current @ VDD min
- **__IO uint8_t HAL_SD_CardCSDTypedef::MaxWrCurrentVDDMax**
Max. write current @ VDD max
- **__IO uint8_t HAL_SD_CardCSDTypedef::DeviceSizeMul**
Device size multiplier
- **__IO uint8_t HAL_SD_CardCSDTypedef::EraseGrSize**
Erase group size
- **__IO uint8_t HAL_SD_CardCSDTypedef::EraseGrMul**
Erase group size multiplier
- **__IO uint8_t HAL_SD_CardCSDTypedef::WrProtectGrSize**
Write protect group size
- **__IO uint8_t HAL_SD_CardCSDTypedef::WrProtectGrEnable**
Write protect group enable
- **__IO uint8_t HAL_SD_CardCSDTypedef::ManDefIECC**
Manufacturer default ECC
- **__IO uint8_t HAL_SD_CardCSDTypedef::WrSpeedFact**
Write speed factor
- **__IO uint8_t HAL_SD_CardCSDTypedef::MaxWrBlockLen**
Max. write data block length
- **__IO uint8_t HAL_SD_CardCSDTypedef::WriteBlockPaPartial**
Partial blocks for write allowed
- **__IO uint8_t HAL_SD_CardCSDTypedef::Reserved3**
Reserved
- **__IO uint8_t HAL_SD_CardCSDTypedef::ContentProtectAppli**
Content protection application
- **__IO uint8_t HAL_SD_CardCSDTypedef::FileFormatGroup**
File format group
- **__IO uint8_t HAL_SD_CardCSDTypedef::CopyFlag**
Copy flag (OTP)
- **__IO uint8_t HAL_SD_CardCSDTypedef::PermWrProtect**
Permanent write protection
- **__IO uint8_t HAL_SD_CardCSDTypedef::TempWrProtect**
Temporary write protection
- **__IO uint8_t HAL_SD_CardCSDTypedef::FileFormat**
File format
- **__IO uint8_t HAL_SD_CardCSDTypedef::ECC**
ECC code
- **__IO uint8_t HAL_SD_CardCSDTypedef::CSD_CRC**
CSD CRC
- **__IO uint8_t HAL_SD_CardCSDTypedef::Reserved4**
Always 1

57.1.4 HAL_SD_CardCIDTypedef

Data Fields

- **__IO uint8_t ManufacturerID**
- **__IO uint16_t OEM_AppliID**
- **__IO uint32_t ProdName1**
- **__IO uint8_t ProdName2**

- **__IO uint8_t ProdRev**
- **__IO uint32_t ProdSN**
- **__IO uint8_t Reserved1**
- **__IO uint16_t ManufactDate**
- **__IO uint8_t CID_CRC**
- **__IO uint8_t Reserved2**

Field Documentation

- **__IO uint8_t HAL_SD_CardCIDTypedef::ManufacturerID**
Manufacturer ID
- **__IO uint16_t HAL_SD_CardCIDTypedef::OEM_AppliID**
OEM/Application ID
- **__IO uint32_t HAL_SD_CardCIDTypedef::ProdName1**
Product Name part1
- **__IO uint8_t HAL_SD_CardCIDTypedef::ProdName2**
Product Name part2
- **__IO uint8_t HAL_SD_CardCIDTypedef::ProdRev**
Product Revision
- **__IO uint32_t HAL_SD_CardCIDTypedef::ProdSN**
Product Serial Number
- **__IO uint8_t HAL_SD_CardCIDTypedef::Reserved1**
Reserved1
- **__IO uint16_t HAL_SD_CardCIDTypedef::ManufactDate**
Manufacturing Date
- **__IO uint8_t HAL_SD_CardCIDTypedef::CID_CRC**
CID CRC
- **__IO uint8_t HAL_SD_CardCIDTypedef::Reserved2**
Always 1

57.1.5 HAL_SD_CardStatusTypedef

Data Fields

- **__IO uint8_t DataBusWidth**
- **__IO uint8_t SecuredMode**
- **__IO uint16_t CardType**
- **__IO uint32_t ProtectedAreaSize**
- **__IO uint8_t SpeedClass**
- **__IO uint8_t PerformanceMove**
- **__IO uint8_t AllocationUnitSize**
- **__IO uint16_t EraseSize**
- **__IO uint8_t EraseTimeout**
- **__IO uint8_t EraseOffset**

Field Documentation

- **__IO uint8_t HAL_SD_CardStatusTypedef::DataBusWidth**
Shows the currently defined data bus width
- **__IO uint8_t HAL_SD_CardStatusTypedef::SecuredMode**
Card is in secured mode of operation
- **__IO uint16_t HAL_SD_CardStatusTypedef::CardType**
Carries information about card type
- **__IO uint32_t HAL_SD_CardStatusTypedef::ProtectedAreaSize**
Carries information about the capacity of protected area

- **`__IO uint8_t HAL_SD_CardStatusTypeDef::SpeedClass`**
Carries information about the speed class of the card
- **`__IO uint8_t HAL_SD_CardStatusTypeDef::PerformanceMove`**
Carries information about the card's performance move
- **`__IO uint8_t HAL_SD_CardStatusTypeDef::AllocationUnitSize`**
Carries information about the card's allocation unit size
- **`__IO uint16_t HAL_SD_CardStatusTypeDef::EraseSize`**
Determines the number of AUs to be erased in one operation
- **`__IO uint8_t HAL_SD_CardStatusTypeDef::EraseTimeout`**
Determines the timeout for any number of AU erase
- **`__IO uint8_t HAL_SD_CardStatusTypeDef::EraseOffset`**
Carries information about the erase offset

57.2 SD Firmware driver API description

57.2.1 How to use this driver

This driver implements a high level communication layer for read and write from/to this memory. The needed STM32 hardware resources (SDMMC and GPIO) are performed by the user in `HAL_SD_MspInit()` function (MSP layer). Basically, the MSP layer configuration should be the same as we provide in the examples. You can easily tailor this configuration according to hardware resources.

This driver is a generic layered driver for SDMMC memories which uses the HAL SDMMC driver functions to interface with SD and uSD cards devices. It is used as follows:

1. Initialize the SDMMC low level resources by implement the `HAL_SD_MspInit()` API:
 - a. Enable the SDMMC interface clock using `__HAL_RCC_SDMMC_CLK_ENABLE();`
 - b. SDMMC pins configuration for SD card
 - Enable the clock for the SDMMC GPIOs using the functions `__HAL_RCC_GPIOx_CLK_ENABLE();`
 - Configure these SDMMC pins as alternate function pull-up using `HAL_GPIO_Init()` and according to your pin assignment;
 - c. DMA Configuration if you need to use DMA process (`HAL_SD_ReadBlocks_DMA()` and `HAL_SD_WriteBlocks_DMA()` APIs).
 - Enable the DMAx interface clock using `__HAL_RCC_DMAx_CLK_ENABLE();`
 - Configure the DMA using the function `HAL_DMA_Init()` with predeclared and filled.
 - d. NVIC configuration if you need to use interrupt process when using DMA transfer.
 - Configure the SDMMC and DMA interrupt priorities using functions `HAL_NVIC_SetPriority();` DMA priority is superior to SDMMC's priority
 - Enable the NVIC DMA and SDMMC IRQs using function `HAL_NVIC_EnableIRQ()`
 - SDMMC interrupts are managed using the macros `__HAL_SD_ENABLE_IT()` and `__HAL_SD_DISABLE_IT()` inside the communication process.
 - SDMMC interrupts pending bits are managed using the macros `__HAL_SD_GET_IT()` and `__HAL_SD_CLEAR_IT()`
 - e. NVIC configuration if you need to use interrupt process (`HAL_SD_ReadBlocks_IT()` and `HAL_SD_WriteBlocks_IT()` APIs).
 - Configure the SDMMC interrupt priorities using function `HAL_NVIC_SetPriority();`
 - Enable the NVIC SDMMC IRQs using function `HAL_NVIC_EnableIRQ()`

- SDMMC interrupts are managed using the macros `__HAL_SD_ENABLE_IT()` and `__HAL_SD_DISABLE_IT()` inside the communication process.
 - SDMMC interrupts pending bits are managed using the macros `__HAL_SD_GET_IT()` and `__HAL_SD_CLEAR_IT()`
2. At this stage, you can perform SD read/write/erase operations after SD card initialization

SD Card Initialization and configuration

To initialize the SD Card, use the `HAL_SD_Init()` function. It initializes SDMMC IP (STM32 side) and the SD Card, and put it into StandBy State (Ready for data transfer). This function provides the following operations:

1. Initialize the SDMMC peripheral interface with default configuration. The initialization process is done at 400KHz. You can change or adapt this frequency by adjusting the "ClockDiv" field. The SD Card frequency (`SDMMC_CK`) is computed as follows:
$$\text{SDMMC_CK} = \text{SDMMCCLK} / (\text{ClockDiv} + 2)$$
In initialization mode and according to the SD Card standard, make sure that the `SDMMC_CK` frequency doesn't exceed 400KHz. This phase of initialization is done through `SDMMC_Init()` and `SDMMC_PowerState_ON()` SDMMC low level APIs.
2. Initialize the SD card. The API used is `HAL_SD_InitCard()`. This phase allows the card initialization and identification and check the SD Card type (Standard Capacity or High Capacity) The initialization flow is compatible with SD standard. This API (`HAL_SD_InitCard()`) could be used also to reinitialize the card in case of plug-off plug-in.
3. Configure the SD Card Data transfer frequency. By Default, the card transfer frequency is set to 24MHz. You can change or adapt this frequency by adjusting the "ClockDiv" field. In transfer mode and according to the SD Card standard, make sure that the `SDMMC_CK` frequency doesn't exceed 25MHz and 50MHz in High-speed mode switch. To be able to use a frequency higher than 24MHz, you should use the SDMMC peripheral in bypass mode. Refer to the corresponding reference manual for more details.
4. Select the corresponding SD Card according to the address read with the step 2.
5. Configure the SD Card in wide bus mode: 4-bits data.

SD Card Read operation

- You can read from SD card in polling mode by using function `HAL_SD_ReadBlocks()`. This function allows the read of 512 bytes blocks. You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through `HAL_SD_GetCardState()` function for SD card state.
- You can read from SD card in DMA mode by using function `HAL_SD_ReadBlocks_DMA()`. This function allows the read of 512 bytes blocks. You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through `HAL_SD_GetCardState()` function for SD card state. You could also check the DMA transfer process through the SD Rx interrupt event.
- You can read from SD card in Interrupt mode by using function `HAL_SD_ReadBlocks_IT()`. This function allows the read of 512 bytes blocks. You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through `HAL_SD_GetCardState()` function for SD

card state. You could also check the IT transfer process through the SD Rx interrupt event.

SD Card Write operation

- You can write to SD card in polling mode by using function HAL_SD_WriteBlocks(). This function allows the read of 512 bytes blocks. You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_SD_GetCardState() function for SD card state.
- You can write to SD card in DMA mode by using function HAL_SD_WriteBlocks_DMA(). This function allows the read of 512 bytes blocks. You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_SD_GetCardState() function for SD card state. You could also check the DMA transfer process through the SD Tx interrupt event.
- You can write to SD card in Interrupt mode by using function HAL_SD_WriteBlocks_IT(). This function allows the read of 512 bytes blocks. You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_SD_GetCardState() function for SD card state. You could also check the IT transfer process through the SD Tx interrupt event.

SD card status

- The SD Status contains status bits that are related to the SD Memory Card proprietary features. To get SD card status use the HAL_SD_GetCardStatus().

SD card information

- To get SD card information, you can use the function HAL_SD_GetCardInfo(). It returns useful information about the SD card such as block size, card type, block number ...

SD card CSD register

- The HAL_SD_GetCardCSD() API allows to get the parameters of the CSD register. Some of the CSD parameters are useful for card initialization and identification.

SD card CID register

- The HAL_SD_GetCardCID() API allows to get the parameters of the CID register. Some of the CSD parameters are useful for card initialization and identification.

SD HAL driver macros list

Below the list of most used macros in SD HAL driver.

- __HAL_SD_ENABLE : Enable the SD device
- __HAL_SD_DISABLE : Disable the SD device
- __HAL_SD_DMA_ENABLE: Enable the SDMMC DMA transfer
- __HAL_SD_DMA_DISABLE: Disable the SDMMC DMA transfer
- __HAL_SD_ENABLE_IT: Enable the SD device interrupt
- __HAL_SD_DISABLE_IT: Disable the SD device interrupt
- __HAL_SD_GET_FLAG: Check whether the specified SD flag is set or not

- `__HAL_SD_CLEAR_FLAG`: Clear the SD's pending flags



You can refer to the SD HAL driver header file for more useful macros

57.2.2 Initialization and de-initialization functions

This section provides functions allowing to initialize/de-initialize the SD card device to be ready for use.

This section contains the following APIs:

- [*HAL_SD_Init\(\)*](#)
- [*HAL_SD_InitCard\(\)*](#)
- [*HAL_SD_DeInit\(\)*](#)
- [*HAL_SD_MspInit\(\)*](#)
- [*HAL_SD_MspDeInit\(\)*](#)

57.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the data transfer from/to SD card.

This section contains the following APIs:

- [*HAL_SD_ReadBlocks\(\)*](#)
- [*HAL_SD_WriteBlocks\(\)*](#)
- [*HAL_SD_ReadBlocks_IT\(\)*](#)
- [*HAL_SD_WriteBlocks_IT\(\)*](#)
- [*HAL_SD_ReadBlocks_DMA\(\)*](#)
- [*HAL_SD_WriteBlocks_DMA\(\)*](#)
- [*HAL_SD_Erase\(\)*](#)
- [*HAL_SD_IRQHandler\(\)*](#)
- [*HAL_SD_GetState\(\)*](#)
- [*HAL_SD_GetError\(\)*](#)
- [*HAL_SD_TxCpltCallback\(\)*](#)
- [*HAL_SD_RxCpltCallback\(\)*](#)
- [*HAL_SD_ErrorCallback\(\)*](#)
- [*HAL_SD_AbortCallback\(\)*](#)

57.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the SD card operations and get the related information

This section contains the following APIs:

- [*HAL_SD_GetCardCID\(\)*](#)
- [*HAL_SD_GetCardCSD\(\)*](#)
- [*HAL_SD_GetCardStatus\(\)*](#)
- [*HAL_SD_GetCardInfo\(\)*](#)
- [*HAL_SD_ConfigWideBusOperation\(\)*](#)
- [*HAL_SD_GetCardState\(\)*](#)
- [*HAL_SD_Abort\(\)*](#)
- [*HAL_SD_Abort_IT\(\)*](#)

57.2.5 Detailed description of functions

HAL_SD_Init

Function name	HAL_StatusTypeDef HAL_SD_Init (SD_HandleTypeDef * hsd)
Function description	Initializes the SD according to the specified parameters in the SD_HandleTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none"> • hsd: Pointer to the SD handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SD_InitCard

Function name	HAL_StatusTypeDef HAL_SD_InitCard (SD_HandleTypeDef * hsd)
Function description	Initializes the SD Card.
Parameters	<ul style="list-style-type: none"> • hsd: Pointer to SD handle
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This function initializes the SD card. It could be used when a card re-initialization is needed.

HAL_SD_DeInit

Function name	HAL_StatusTypeDef HAL_SD_DeInit (SD_HandleTypeDef * hsd)
Function description	De-Initializes the SD card.
Parameters	<ul style="list-style-type: none"> • hsd: Pointer to SD handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SD_MspInit

Function name	void HAL_SD_MspInit (SD_HandleTypeDef * hsd)
Function description	Initializes the SD MSP.
Parameters	<ul style="list-style-type: none"> • hsd: Pointer to SD handle
Return values	<ul style="list-style-type: none"> • None:

HAL_SD_MspDeInit

Function name	void HAL_SD_MspDeInit (SD_HandleTypeDef * hsd)
Function description	De-Initialize SD MSP.
Parameters	<ul style="list-style-type: none"> • hsd: Pointer to SD handle
Return values	<ul style="list-style-type: none"> • None:

HAL_SD_ReadBlocks

Function name	HAL_StatusTypeDef HAL_SD_ReadBlocks (SD_HandleTypeDef * hsd, uint8_t * pData, uint32_t BlockAdd,
---------------	---

uint32_t NumberOfBlocks, uint32_t Timeout)

Function description	Reads block(s) from a specified address in a card.
Parameters	<ul style="list-style-type: none"> • hsd: Pointer to SD handle • pData: pointer to the buffer that will contain the received data • BlockAdd: Block Address from where data is to be read • NumberOfBlocks: Number of SD blocks to read • Timeout: Specify timeout value
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This API should be followed by a check on the card state through HAL_SD_GetCardState().

HAL_SD_WriteBlocks

Function name	HAL_StatusTypeDef HAL_SD_WriteBlocks (SD_HandleTypeDef * hsd, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks, uint32_t Timeout)
Function description	Allows to write block(s) to a specified address in a card.
Parameters	<ul style="list-style-type: none"> • hsd: Pointer to SD handle • pData: pointer to the buffer that will contain the data to transmit • BlockAdd: Block Address where data will be written • NumberOfBlocks: Number of SD blocks to write • Timeout: Specify timeout value
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This API should be followed by a check on the card state through HAL_SD_GetCardState().

HAL_SD_Erase

Function name	HAL_StatusTypeDef HAL_SD_Erase (SD_HandleTypeDef * hsd, uint32_t BlockStartAdd, uint32_t BlockEndAdd)
Function description	Erases the specified memory area of the given SD card.
Parameters	<ul style="list-style-type: none"> • hsd: Pointer to SD handle • BlockStartAdd: Start Block address • BlockEndAdd: End Block address
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This API should be followed by a check on the card state through HAL_SD_GetCardState().

HAL_SD_ReadBlocks_IT

Function name	HAL_StatusTypeDef HAL_SD_ReadBlocks_IT (SD_HandleTypeDef * hsd, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)
Function description	Reads block(s) from a specified address in a card.
Parameters	<ul style="list-style-type: none"> • hsd: Pointer to SD handle

- **pData**: Pointer to the buffer that will contain the received data
 - **BlockAdd**: Block Address from where data is to be read
 - **NumberOfBlocks**: Number of blocks to read.
- Return values
- **HAL**: status
- Notes
- This API should be followed by a check on the card state through HAL_SD_GetCardState().
 - You could also check the IT transfer process through the SD Rx interrupt event.

HAL_SD_WriteBlocks_IT

- Function name **HAL_StatusTypeDef HAL_SD_WriteBlocks_IT (SD_HandleTypeDef * hsd, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)**
- Function description Writes block(s) to a specified address in a card.
- Parameters
- **hsd**: Pointer to SD handle
 - **pData**: Pointer to the buffer that will contain the data to transmit
 - **BlockAdd**: Block Address where data will be written
 - **NumberOfBlocks**: Number of blocks to write
- Return values
- **HAL**: status
- Notes
- This API should be followed by a check on the card state through HAL_SD_GetCardState().
 - You could also check the IT transfer process through the SD Tx interrupt event.

HAL_SD_ReadBlocks_DMA

- Function name **HAL_StatusTypeDef HAL_SD_ReadBlocks_DMA (SD_HandleTypeDef * hsd, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)**
- Function description Reads block(s) from a specified address in a card.
- Parameters
- **hsd**: Pointer SD handle
 - **pData**: Pointer to the buffer that will contain the received data
 - **BlockAdd**: Block Address from where data is to be read
 - **NumberOfBlocks**: Number of blocks to read.
- Return values
- **HAL**: status
- Notes
- This API should be followed by a check on the card state through HAL_SD_GetCardState().
 - You could also check the DMA transfer process through the SD Rx interrupt event.

HAL_SD_WriteBlocks_DMA

- Function name **HAL_StatusTypeDef HAL_SD_WriteBlocks_DMA (SD_HandleTypeDef * hsd, uint8_t * pData, uint32_t BlockAdd,**

uint32_t NumberOfBlocks)

Function description	Writes block(s) to a specified address in a card.
Parameters	<ul style="list-style-type: none">• hsd: Pointer to SD handle• pData: Pointer to the buffer that will contain the data to transmit• BlockAdd: Block Address where data will be written• NumberOfBlocks: Number of blocks to write
Return values	<ul style="list-style-type: none">• HAL: status
Notes	<ul style="list-style-type: none">• This API should be followed by a check on the card state through HAL_SD_GetCardState().• You could also check the DMA transfer process through the SD Tx interrupt event.

HAL_SD_IRQHandler

Function name	void HAL_SD_IRQHandler (SD_HandleTypeDef * hsd)
Function description	This function handles SD card interrupt request.
Parameters	<ul style="list-style-type: none">• hsd: Pointer to SD handle
Return values	<ul style="list-style-type: none">• None:

HAL_SD_TxCpltCallback

Function name	void HAL_SD_TxCpltCallback (SD_HandleTypeDef * hsd)
Function description	Tx Transfer completed callbacks.
Parameters	<ul style="list-style-type: none">• hsd: Pointer to SD handle
Return values	<ul style="list-style-type: none">• None:

HAL_SD_RxCpltCallback

Function name	void HAL_SD_RxCpltCallback (SD_HandleTypeDef * hsd)
Function description	Rx Transfer completed callbacks.
Parameters	<ul style="list-style-type: none">• hsd: Pointer SD handle
Return values	<ul style="list-style-type: none">• None:

HAL_SD_ErrorCallback

Function name	void HAL_SD_ErrorCallback (SD_HandleTypeDef * hsd)
Function description	SD error callbacks.
Parameters	<ul style="list-style-type: none">• hsd: Pointer SD handle
Return values	<ul style="list-style-type: none">• None:

HAL_SD_AbortCallback

Function name	void HAL_SD_AbortCallback (SD_HandleTypeDef * hsd)
---------------	---

Function description	SD Abort callbacks.
Parameters	<ul style="list-style-type: none"> • hsd: Pointer SD handle
Return values	<ul style="list-style-type: none"> • None:

HAL_SD_ConfigWideBusOperation

Function name	HAL_StatusTypeDef HAL_SD_ConfigWideBusOperation (SD_HandleTypeDef * hsd, uint32_t WideMode)
Function description	Enables wide bus operation for the requested card if supported by card.
Parameters	<ul style="list-style-type: none"> • hsd: Pointer to SD handle • WideMode: Specifies the SD card wide bus mode This parameter can be one of the following values: <ul style="list-style-type: none"> – SDMMC_BUS_WIDE_8B: 8-bit data transfer – SDMMC_BUS_WIDE_4B: 4-bit data transfer – SDMMC_BUS_WIDE_1B: 1-bit data transfer
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SD_SendSDStatus

Function name	HAL_StatusTypeDef HAL_SD_SendSDStatus (SD_HandleTypeDef * hsd, uint32_t * pSDstatus)
---------------	---

Function description

HAL_SD_GetCardState

Function name	HAL_SD_CardStateTypeDef HAL_SD_GetCardState (SD_HandleTypeDef * hsd)
Function description	Gets the current sd card data state.
Parameters	<ul style="list-style-type: none"> • hsd: pointer to SD handle
Return values	<ul style="list-style-type: none"> • Card: state

HAL_SD_GetCardCID

Function name	HAL_StatusTypeDef HAL_SD_GetCardCID (SD_HandleTypeDef * hsd, HAL_SD_CardCIDTypeDef * pCID)
Function description	Returns information the information of the card which are stored on the CID register.
Parameters	<ul style="list-style-type: none"> • hsd: Pointer to SD handle • pCID: Pointer to a HAL_SD_CIDTypeDef structure that contains all CID register parameters
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SD_GetCardCSD

Function name	HAL_StatusTypeDef HAL_SD_GetCardCSD (SD_HandleTypeDef * hsd, HAL_SD_CardCSDTypeDef * pCSD)
---------------	---

Function description	Returns information the information of the card which are stored on the CSD register.
Parameters	<ul style="list-style-type: none">• hsd: Pointer to SD handle• pCSD: Pointer to a HAL_SD_CardCSDTypeDef structure that contains all CSD register parameters
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SD_GetCardStatus

Function name	HAL_StatusTypeDef HAL_SD_GetCardStatus (SD_HandleTypeDef * hsd, HAL_SD_CardStatusTypeDef * pStatus)
Function description	Gets the SD status info.
Parameters	<ul style="list-style-type: none">• hsd: Pointer to SD handle• pStatus: Pointer to the HAL_SD_CardStatusTypeDef structure that will contain the SD card status information
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SD_GetCardInfo

Function name	HAL_StatusTypeDef HAL_SD_GetCardInfo (SD_HandleTypeDef * hsd, HAL_SD_CardInfoTypeDef * pCardInfo)
Function description	Gets the SD card info.
Parameters	<ul style="list-style-type: none">• hsd: Pointer to SD handle• pCardInfo: Pointer to the HAL_SD_CardInfoTypeDef structure that will contain the SD card status information
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SD_GetState

Function name	HAL_SD_StateTypeDef HAL_SD_GetState (SD_HandleTypeDef * hsd)
Function description	return the SD state
Parameters	<ul style="list-style-type: none">• hsd: Pointer to sd handle
Return values	<ul style="list-style-type: none">• HAL: state

HAL_SD_GetError

Function name	uint32_t HAL_SD_GetError (SD_HandleTypeDef * hsd)
Function description	Return the SD error code.
Parameters	<ul style="list-style-type: none">• hsd: : Pointer to a SD_HandleTypeDef structure that contains the configuration information.
Return values	<ul style="list-style-type: none">• SD: Error Code

HAL_SD_Abort

Function name	HAL_StatusTypeDef HAL_SD_Abort (SD_HandleTypeDef * hsd)
Function description	Abort the current transfer and disable the SD.
Parameters	<ul style="list-style-type: none"> • hsd: pointer to a SD_HandleTypeDef structure that contains the configuration information for SD module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SD_Abort_IT

Function name	HAL_StatusTypeDef HAL_SD_Abort_IT (SD_HandleTypeDef * hsd)
Function description	Abort the current transfer and disable the SD (IT mode).
Parameters	<ul style="list-style-type: none"> • hsd: pointer to a SD_HandleTypeDef structure that contains the configuration information for SD module.
Return values	<ul style="list-style-type: none"> • HAL: status

57.3 SD Firmware driver defines**57.3.1 SD*****SD Error status enumeration Structure definition***

HAL_SD_ERROR_NONE	No error
HAL_SD_ERROR_CMD_CRC_FAIL	Command response received (but CRC check failed)
HAL_SD_ERROR_DATA_CRC_FAIL	Data block sent/received (CRC check failed)
HAL_SD_ERROR_CMD_RSP_TIMEOUT	Command response timeout
HAL_SD_ERROR_DATA_TIMEOUT	Data timeout
HAL_SD_ERROR_TX_UNDERRUN	Transmit FIFO underrun
HAL_SD_ERROR_RX_OVERRUN	Receive FIFO overrun
HAL_SD_ERROR_ADDR_MISALIGNED	Misaligned address
HAL_SD_ERROR_BLOCK_LEN_ERR	Transferred block length is not allowed for the card or the number of transferred bytes does not match the block length
HAL_SD_ERROR_ERASE_SEQ_ERR	An error in the sequence of erase command occurs
HAL_SD_ERROR_BAD_ERASE_PARAM	An invalid selection for erase groups
HAL_SD_ERROR_WRITE_PROT_VIOLATION	Attempt to program a write protect block
HAL_SD_ERROR_LOCK_UNLOCK_FAILED	Sequence or password error has been detected in unlock command or if there was an attempt to access a

	locked card
HAL_SD_ERROR_COM_CRC_FAILED	CRC check of the previous command failed
HAL_SD_ERROR_ILLEGAL_CMD	Command is not legal for the card state
HAL_SD_ERROR_CARD_ECC_FAILED	Card internal ECC was applied but failed to correct the data
HAL_SD_ERROR_CC_ERR	Internal card controller error
HAL_SD_ERROR_GENERAL_UNKNOWN_ERR	General or unknown error
HAL_SD_ERROR_STREAM_READ_UNDERRUN	The card could not sustain data reading in stream mode
HAL_SD_ERROR_STREAM_WRITE_OVERRUN	The card could not sustain data programming in stream mode
HAL_SD_ERROR_CID_CSD_OVERWRITE	CID/CSD overwrite error
HAL_SD_ERROR_WP_ERASE_SKIP	Only partial address space was erased
HAL_SD_ERROR_CARD_ECC_DISABLED	Command has been executed without using internal ECC
HAL_SD_ERROR_ERASE_RESET	Erase sequence was cleared before executing because an out of erase sequence command was received
HAL_SD_ERROR_AKE_SEQ_ERR	Error in sequence of authentication
HAL_SD_ERROR_INVALID_VOLTRANGE	Error in case of invalid voltage range
HAL_SD_ERROR_ADDR_OUT_OF_RANGE	Error when addressed block is out of range
HAL_SD_ERROR_REQUEST_NOT_APPLICABLE	Error when command request is not applicable
HAL_SD_ERROR_PARAM	the used parameter is not valid
HAL_SD_ERROR_UNSUPPORTED_FEATURE	Error when feature is not insupported
HAL_SD_ERROR_BUSY	Error when transfer process is busy
HAL_SD_ERROR_DMA	Error while DMA transfer
HAL_SD_ERROR_TIMEOUT	Timeout error
SD context enumeration	
SD_CONTEXT_NONE	None
SD_CONTEXT_READ_SINGLE_BLOCK	Read single block operation
SD_CONTEXT_READ_MULTIPLE_BLOCK	Read multiple blocks operation
SD_CONTEXT_WRITE_SINGLE_BLOCK	Write single block operation
SD_CONTEXT_WRITE_MULTIPLE_BLOCK	Write multiple blocks operation
SD_CONTEXT_IT	Process in Interrupt mode
SD_CONTEXT_DMA	Process in DMA mode

SD Supported Memory Cards

CARD_SDSC

CARD_SDHC_SDXC

CARD_SECURED

SD Supported Version

CARD_V1_X

CARD_V2_X

Exported Constants

BLOCKSIZE Block size is 512 bytes

SD Exported Macros`__HAL_SD_ENABLE`**Description:**

- Enable the SD device.

Return value:

- None

`__HAL_SD_DISABLE`**Description:**

- Disable the SD device.

Return value:

- None

`__HAL_SD_DMA_ENABLE`**Description:**

- Enable the SDMMC DMA transfer.

Return value:

- None

`__HAL_SD_DMA_DISABLE`**Description:**

- Disable the SDMMC DMA transfer.

Return value:

- None

`__HAL_SD_ENABLE_IT`**Description:**

- Enable the SD device interrupt.

Parameters:

- `__HANDLE__`: SD Handle
- `__INTERRUPT__`: specifies the SDMMC interrupt sources to be enabled. This parameter can be one or a combination of the following values:
 - `SDMMC_IT_CCRCFAIL`: Command response received (CRC check failed) interrupt
 - `SDMMC_IT_DCRCFAIL`: Data block sent/received (CRC check failed) interrupt
 - `SDMMC_IT_CTIMEOUT`: Command response timeout interrupt

- SDMMC_IT_DTIMEOUT: Data timeout interrupt
- SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
- SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
- SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
- SDMMC_IT_CMDSSENT: Command sent (no response required) interrupt
- SDMMC_IT_DATAEND: Data end (data counter, SDIDCOUNT, is zero) interrupt
- SDMMC_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
- SDMMC_IT_CMDACT: Command transfer in progress interrupt
- SDMMC_IT_TXACT: Data transmit in progress interrupt
- SDMMC_IT_RXACT: Data receive in progress interrupt
- SDMMC_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
- SDMMC_IT_RXFIFOHF: Receive FIFO Half Full interrupt
- SDMMC_IT_TXFIFOE: Transmit FIFO empty interrupt
- SDMMC_IT_RXFIFOE: Receive FIFO empty interrupt
- SDMMC_IT_TXDAVL: Data available in transmit FIFO interrupt
- SDMMC_IT_RXDAVL: Data available in receive FIFO interrupt
- SDMMC_IT_SDIOIT: SD I/O interrupt received interrupt

Return value:

- None

__HAL_SD_DISABLE_IT**Description:**

- Disable the SD device interrupt.

Parameters:

- **__HANDLE__**: SD Handle
- **__INTERRUPT__**: specifies the SDMMC interrupt sources to be disabled. This parameter can be one or a combination of the following values:
 - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
 - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
 - SDMMC_IT_CTIMEOUT: Command response timeout interrupt
 - SDMMC_IT_DTIMEOUT: Data timeout interrupt

- SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
- SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
- SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
- SDMMC_IT_CMDSSENT: Command sent (no response required) interrupt
- SDMMC_IT_DATAEND: Data end (data counter, SDIDCOUNT, is zero) interrupt
- SDMMC_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
- SDMMC_IT_CMDACT: Command transfer in progress interrupt
- SDMMC_IT_TXACT: Data transmit in progress interrupt
- SDMMC_IT_RXACT: Data receive in progress interrupt
- SDMMC_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
- SDMMC_IT_RXFIFOHF: Receive FIFO Half Full interrupt
- SDMMC_IT_TXFIFOE: Transmit FIFO full interrupt
- SDMMC_IT_RXFIFOE: Receive FIFO full interrupt
- SDMMC_IT_TXFIFOE: Transmit FIFO empty interrupt
- SDMMC_IT_RXFIFOE: Receive FIFO empty interrupt
- SDMMC_IT_TXDAVL: Data available in transmit FIFO interrupt
- SDMMC_IT_RXDAVL: Data available in receive FIFO interrupt
- SDMMC_IT_SDIOIT: SD I/O interrupt received interrupt

Return value:

- None

__HAL_SD_GET_FLAG**Description:**

- Check whether the specified SD flag is set or not.

Parameters:

- __HANDLE__: SD Handle
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
 - SDMMC_FLAG_CCRCFAIL: Command response received (CRC check failed)
 - SDMMC_FLAG_DCRCFAIL: Data block sent/received (CRC check failed)
 - SDMMC_FLAG_CTIMEOUT: Command response timeout
 - SDMMC_FLAG_DTIMEOUT: Data timeout
 - SDMMC_FLAG_TXUNDERR: Transmit FIFO underrun error

- SDMMC_FLAG_RXOVERR: Received FIFO overrun error
- SDMMC_FLAG_CMDREND: Command response received (CRC check passed)
- SDMMC_FLAG_CMDSSENT: Command sent (no response required)
- SDMMC_FLAG_DATAEND: Data end (data counter, SDIDCOUNT, is zero)
- SDMMC_FLAG_DBCKEND: Data block sent/received (CRC check passed)
- SDMMC_FLAG_CMDACT: Command transfer in progress
- SDMMC_FLAG_TXACT: Data transmit in progress
- SDMMC_FLAG_RXACT: Data receive in progress
- SDMMC_FLAG_TXFIFOHE: Transmit FIFO Half Empty
- SDMMC_FLAG_RXFIFOHF: Receive FIFO Half Full
- SDMMC_FLAG_TXFIFOE: Transmit FIFO empty
- SDMMC_FLAG_RXFIFOE: Receive FIFO empty
- SDMMC_FLAG_TXDAVL: Data available in transmit FIFO
- SDMMC_FLAG_RXDAVL: Data available in receive FIFO
- SDMMC_FLAG_SDIOIT: SD I/O interrupt received

Return value:

- The: new state of SD FLAG (SET or RESET).

__HAL_SD_CLEAR_FLAG**Description:**

- Clear the SD's pending flags.

Parameters:

- **__HANDLE__**: SD Handle
- **__FLAG__**: specifies the flag to clear. This parameter can be one or a combination of the following values:
 - SDMMC_FLAG_CCRCFAIL: Command response received (CRC check failed)
 - SDMMC_FLAG_DCRCFAIL: Data block sent/received (CRC check failed)
 - SDMMC_FLAG_CTIMEOUT: Command response timeout
 - SDMMC_FLAG_DTIMEOUT: Data timeout
 - SDMMC_FLAG_TXUNDERR: Transmit FIFO underrun error
 - SDMMC_FLAG_RXOVERR: Received FIFO overrun error
 - SDMMC_FLAG_CMDREND: Command response received (CRC check passed)
 - SDMMC_FLAG_CMDSSENT: Command sent (no response required)

- SDMMC_FLAG_DATAEND: Data end (data counter, SDIDCOUNT, is zero)
- SDMMC_FLAG_DBCKEND: Data block sent/received (CRC check passed)
- SDMMC_FLAG_SDIOIT: SD I/O interrupt received

Return value:

- None

__HAL_SD_GET_IT**Description:**

- Check whether the specified SD interrupt has occurred or not.

Parameters:

- __HANDLE__: SD Handle
- __INTERRUPT__: specifies the SDMMC interrupt source to check. This parameter can be one of the following values:
 - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
 - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
 - SDMMC_IT_CTIMEOUT: Command response timeout interrupt
 - SDMMC_IT_DTIMEOUT: Data timeout interrupt
 - SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
 - SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
 - SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
 - SDMMC_IT_CMDSSENT: Command sent (no response required) interrupt
 - SDMMC_IT_DATAEND: Data end (data counter, SDIDCOUNT, is zero) interrupt
 - SDMMC_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
 - SDMMC_IT_CMDACT: Command transfer in progress interrupt
 - SDMMC_IT_TXACT: Data transmit in progress interrupt
 - SDMMC_IT_RXACT: Data receive in progress interrupt
 - SDMMC_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
 - SDMMC_IT_RXFIFOHF: Receive FIFO Half Full interrupt
 - SDMMC_IT_TXFIFO: Transmit FIFO full interrupt
 - SDMMC_IT_RXFIFO: Receive FIFO full interrupt
 - SDMMC_IT_TXFIFOE: Transmit FIFO empty interrupt
 - SDMMC_IT_RXFIFOE: Receive FIFO empty interrupt
 - SDMMC_IT_TXDAVL: Data available in transmit

- FIFO interrupt
- SDMMC_IT_RXDAVL: Data available in receive FIFO interrupt
- SDMMC_IT_SDIOIT: SD I/O interrupt received interrupt

Return value:

- The: new state of SD IT (SET or RESET).

`__HAL_SD_CLEAR_IT`**Description:**

- Clear the SD's interrupt pending bits.

Parameters:

- `__HANDLE__`: SD Handle
- `__INTERRUPT__`: specifies the interrupt pending bit to clear. This parameter can be one or a combination of the following values:
 - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
 - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
 - SDMMC_IT_CTIMEOUT: Command response timeout interrupt
 - SDMMC_IT_DTIMEOUT: Data timeout interrupt
 - SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
 - SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
 - SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
 - SDMMC_IT_CMDSSENT: Command sent (no response required) interrupt
 - SDMMC_IT_DATAEND: Data end (data counter, SDMMC_DCOUNT, is zero) interrupt
 - SDMMC_IT_SDIOIT: SD I/O interrupt received interrupt

Return value:

- None

SD Handle Structure definition

SD_InitTypeDef

SD_TypeDef

58 HAL SMARTCARD Generic Driver

58.1 SMARTCARD Firmware driver registers structures

58.1.1 SMARTCARD_InitTypeDef

Data Fields

- *uint32_t BaudRate*
- *uint32_t WordLength*
- *uint32_t StopBits*
- *uint32_t Parity*
- *uint32_t Mode*
- *uint32_t CLKPolarity*
- *uint32_t CLKPhase*
- *uint32_t CLKLastBit*
- *uint32_t OneBitSampling*
- *uint32_t Prescaler*
- *uint32_t GuardTime*
- *uint16_t NACKEnable*
- *uint32_t TimeOutEnable*
- *uint32_t TimeOutValue*
- *uint32_t BlockLength*
- *uint32_t AutoRetryCount*

Field Documentation

- *uint32_t SMARTCARD_InitTypeDef::BaudRate*
Configures the SmartCard communication baud rate. The baud rate register is computed using the following formula: Baud Rate Register = ((PCLKx) / ((hsmartcard->Init.BaudRate)))
- *uint32_t SMARTCARD_InitTypeDef::WordLength*
Specifies the number of data bits transmitted or received in a frame. This parameter [SMARTCARD_Word_Length](#) can only be set to 9 (8 data + 1 parity bits).
- *uint32_t SMARTCARD_InitTypeDef::StopBits*
Specifies the number of stop bits. This parameter can be a value of [SMARTCARD_Stop_Bits](#).
- *uint32_t SMARTCARD_InitTypeDef::Parity*
Specifies the parity mode. This parameter can be a value of [SMARTCARD_Parity](#)
Note:The parity is enabled by default (PCE is forced to 1). Since the WordLength is forced to 8 bits + parity, M is forced to 1 and the parity bit is the 9th bit.
- *uint32_t SMARTCARD_InitTypeDef::Mode*
Specifies whether the Receive or Transmit mode is enabled or disabled. This parameter can be a value of [SMARTCARD_Mode](#)
- *uint32_t SMARTCARD_InitTypeDef::CLKPolarity*
Specifies the steady state of the serial clock. This parameter can be a value of [SMARTCARD_Clock_Polarity](#)
- *uint32_t SMARTCARD_InitTypeDef::CLKPhase*
Specifies the clock transition on which the bit capture is made. This parameter can be a value of [SMARTCARD_Clock_Phase](#)
- *uint32_t SMARTCARD_InitTypeDef::CLKLastBit*
Specifies whether the clock pulse corresponding to the last transmitted data bit (MSB)

has to be output on the SCLK pin in synchronous mode. This parameter can be a value of [SMARTCARD_Last_Bit](#)

- ***uint32_t SMARTCARD_InitTypeDef::OneBitSampling***
Specifies whether a single sample or three samples' majority vote is selected. Selecting the single sample method increases the receiver tolerance to clock deviations. This parameter can be a value of [SMARTCARD_OneBit_Sampling](#)
- ***uint32_t SMARTCARD_InitTypeDef::Prescaler***
Specifies the SmartCard Prescaler
- ***uint32_t SMARTCARD_InitTypeDef::GuardTime***
Specifies the SmartCard Guard Time
- ***uint16_t SMARTCARD_InitTypeDef::NACKEnable***
Specifies whether the SmartCard NACK transmission is enabled in case of parity error. This parameter can be a value of [SMARTCARD_NACK_State](#)
- ***uint32_t SMARTCARD_InitTypeDef::TimeoutEnable***
Specifies whether the receiver timeout is enabled. This parameter can be a value of [SMARTCARD_Timeout_Enable](#)
- ***uint32_t SMARTCARD_InitTypeDef::TimeoutValue***
Specifies the receiver time out value in number of baud blocks: it is used to implement the Character Wait Time (CWT) and Block Wait Time (BWT). It is coded over 24 bits.
- ***uint32_t SMARTCARD_InitTypeDef::BlockLength***
Specifies the SmartCard Block Length in T=1 Reception mode. This parameter can be any value from 0x0 to 0xFF
- ***uint32_t SMARTCARD_InitTypeDef::AutoRetryCount***
Specifies the SmartCard auto-retry count (number of retries in receive and transmit mode). When set to 0, retransmission is disabled. Otherwise, its maximum value is 7 (before signalling an error)

58.1.2 SMARTCARD_AdvFeatureInitTypeDef

Data Fields

- ***uint32_t AdvFeatureInit***
- ***uint32_t TxPinLevelInvert***
- ***uint32_t RxPinLevelInvert***
- ***uint32_t DataInvert***
- ***uint32_t Swap***
- ***uint32_t OverrunDisable***
- ***uint32_t DMADisableonRxError***
- ***uint32_t MSBFirst***
- ***uint16_t TxCompletionIndication***

Field Documentation

- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::AdvFeatureInit***
Specifies which advanced SMARTCARD features is initialized. Several advanced features may be initialized at the same time. This parameter can be a value of [SMARTCARDEX_Advanced_Features_Initialization_Type](#)
- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::TxPinLevelInvert***
Specifies whether the TX pin active level is inverted. This parameter can be a value of [SMARTCARD_Tx_Inv](#)
- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::RxPinLevelInvert***
Specifies whether the RX pin active level is inverted. This parameter can be a value of [SMARTCARD_Rx_Inv](#)
- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::DataInvert***
Specifies whether data are inverted (positive/direct logic vs negative/inverted logic). This parameter can be a value of [SMARTCARD_Data_Inv](#)

- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::Swap***
Specifies whether TX and RX pins are swapped. This parameter can be a value of [SMARTCARD_Rx_Tx_Swap](#)
- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::OverrunDisable***
Specifies whether the reception overrun detection is disabled. This parameter can be a value of [SMARTCARD_Overrun_Disable](#)
- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::DMADisableonRxError***
Specifies whether the DMA is disabled in case of reception error. This parameter can be a value of [SMARTCARD_DMA_Disable_on_Rx_Error](#)
- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::MSBFirst***
Specifies whether MSB is sent first on UART line. This parameter can be a value of [SMARTCARD_MSB_First](#)
- ***uint16_t SMARTCARD_AdvFeatureInitTypeDef::TxCompletionIndication***
Specifies which transmission completion indication is used: before (when relevant flag is available) or once guard time period has elapsed. This parameter can be a value of [SMARTCARDEX_Transmission_Completion_Indication](#).

58.1.3 SMARTCARD_HandleTypeDef

Data Fields

- ***USART_TypeDef * Instance***
- ***SMARTCARD_InitTypeDef Init***
- ***SMARTCARD_AdvFeatureInitTypeDef AdvancedInit***
- ***uint8_t * pTxBuffPtr***
- ***uint16_t TxXferSize***
- ***__IO uint16_t TxXferCount***
- ***uint8_t * pRxBuffPtr***
- ***uint16_t RxXferSize***
- ***__IO uint16_t RxXferCount***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_SMARTCARD_StateTypeDef gState***
- ***__IO HAL_SMARTCARD_StateTypeDef RxState***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***USART_TypeDef* SMARTCARD_HandleTypeDef::Instance***
USART registers base address
- ***SMARTCARD_InitTypeDef SMARTCARD_HandleTypeDef::Init***
SmartCard communication parameters
- ***SMARTCARD_AdvFeatureInitTypeDef SMARTCARD_HandleTypeDef::AdvancedInit***
SmartCard advanced features initialization parameters
- ***uint8_t* SMARTCARD_HandleTypeDef::pTxBuffPtr***
Pointer to SmartCard Tx transfer Buffer
- ***uint16_t SMARTCARD_HandleTypeDef::TxXferSize***
SmartCard Tx Transfer size
- ***__IO uint16_t SMARTCARD_HandleTypeDef::TxXferCount***
SmartCard Tx Transfer Counter
- ***uint8_t* SMARTCARD_HandleTypeDef::pRxBuffPtr***
Pointer to SmartCard Rx transfer Buffer
- ***uint16_t SMARTCARD_HandleTypeDef::RxXferSize***
SmartCard Rx Transfer size

- **`__IO uint16_t SMARTCARD_HandleTypeDef::RxXferCount`**
SmartCard Rx Transfer Counter
- **`DMA_HandleTypeDef* SMARTCARD_HandleTypeDef::hdmatx`**
SmartCard Tx DMA Handle parameters
- **`DMA_HandleTypeDef* SMARTCARD_HandleTypeDef::hdmarx`**
SmartCard Rx DMA Handle parameters
- **`HAL_LockTypeDef SMARTCARD_HandleTypeDef::Lock`**
Locking object
- **`__IO HAL_SMARTCARD_StateTypeDef SMARTCARD_HandleTypeDef::gState`**
SmartCard state information related to global Handle management and also related to Tx operations. This parameter can be a value of **`HAL_SMARTCARD_StateTypeDef`**
- **`__IO HAL_SMARTCARD_StateTypeDef SMARTCARD_HandleTypeDef::RxState`**
SmartCard state information related to Rx operations. This parameter can be a value of **`HAL_SMARTCARD_StateTypeDef`**
- **`__IO uint32_t SMARTCARD_HandleTypeDef::ErrorCode`**

58.2 SMARTCARD Firmware driver API description

58.2.1 How to use this driver

The SMARTCARD HAL driver can be used as follows:

1. Declare a SMARTCARD_HandleTypeDef handle structure (eg. SMARTCARD_HandleTypeDef hsmartcard).
2. Associate a USART to the SMARTCARD handle hsmartcard.
3. Initialize the SMARTCARD low level resources by implementing the HAL_SMARTCARD_MspInit() API:
 - a. Enable the USARTx interface clock.
 - b. SMARTCARD pins configuration:
 - Enable the clock for the SMARTCARD GPIOs.
 - Configure these SMARTCARD pins as alternate function pull-up.
 - c. NVIC configuration if you need to use interrupt process (HAL_SMARTCARD_Transmit_IT() and HAL_SMARTCARD_Receive_IT() APIs):
 - Configure the USARTx interrupt priority.
 - Enable the NVIC USART IRQ handle.
 - The specific USART interrupts (Transmission complete interrupt, RXNE interrupt and Error Interrupts) will be managed using the macros `__HAL_SMARTCARD_ENABLE_IT()` and `__HAL_SMARTCARD_DISABLE_IT()` inside the transmit and receive process.
 - d. DMA Configuration if you need to use DMA process (HAL_SMARTCARD_Transmit_DMA() and HAL_SMARTCARD_Receive_DMA() APIs):
 - Declare a DMA handle structure for the Tx/Rx stream.
 - Enable the DMAx interface clock.
 - Configure the declared DMA handle structure with the required Tx/Rx parameters.
 - Configure the DMA Tx/Rx Stream.
 - Associate the initialized DMA handle to the SMARTCARD DMA Tx/Rx handle.
 - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx/Rx Stream.
4. Program the Baud Rate, Parity, Mode(Receiver/Transmitter), clock enabling/disabling and accordingly, the clock parameters (parity, phase, last bit), prescaler value, guard

time and NACK on transmission error enabling or disabling in the hsmartcard handle Init structure.

5. If required, program SMARTCARD advanced features (TX/RX pins swap, TimeOut, auto-retry counter,...) in the hsmartcard handle AdvancedInit structure.
6. Initialize the SMARTCARD registers by calling the HAL_SMARTCARD_Init() API:
 - This API configures also the low level Hardware GPIO, CLOCK, CORTEX...etc) by calling the customized HAL_SMARTCARD_MspInit() API.



The specific SMARTCARD interrupts (Transmission complete interrupt, RXNE interrupt and Error Interrupts) will be managed using the macros `__HAL_SMARTCARD_ENABLE_IT()` and `__HAL_SMARTCARD_DISABLE_IT()` inside the transmit and receive process.

Three operation modes are available within this driver :

Polling mode IO operation

- Send an amount of data in blocking mode using `HAL_SMARTCARD_Transmit()`
- Receive an amount of data in blocking mode using `HAL_SMARTCARD_Receive()`

Interrupt mode IO operation

- Send an amount of data in non-blocking mode using `HAL_SMARTCARD_Transmit_IT()`
- At transmission end of transfer `HAL_SMARTCARD_TxCpltCallback()` is executed and user can add his own code by customization of function pointer `HAL_SMARTCARD_TxCpltCallback()`
- Receive an amount of data in non-blocking mode using `HAL_SMARTCARD_Receive_IT()`
- At reception end of transfer `HAL_SMARTCARD_RxCpltCallback()` is executed and user can add his own code by customization of function pointer `HAL_SMARTCARD_RxCpltCallback()`
- In case of transfer Error, `HAL_SMARTCARD_ErrorCallback()` function is executed and user can add his own code by customization of function pointer `HAL_SMARTCARD_ErrorCallback()`

DMA mode IO operation

- Send an amount of data in non-blocking mode (DMA) using `HAL_SMARTCARD_Transmit_DMA()`
- At transmission end of transfer `HAL_SMARTCARD_TxCpltCallback()` is executed and user can add his own code by customization of function pointer `HAL_SMARTCARD_TxCpltCallback()`
- Receive an amount of data in non-blocking mode (DMA) using `HAL_SMARTCARD_Receive_DMA()`
- At reception end of transfer `HAL_SMARTCARD_RxCpltCallback()` is executed and user can add his own code by customization of function pointer `HAL_SMARTCARD_RxCpltCallback()`
- In case of transfer Error, `HAL_SMARTCARD_ErrorCallback()` function is executed and user can add his own code by customization of function pointer `HAL_SMARTCARD_ErrorCallback()`

SMARTCARD HAL driver macros list

Below the list of most used macros in SMARTCARD HAL driver.

- `__HAL_SMARTCARD_GET_FLAG` : Check whether or not the specified SMARTCARD flag is set
- `__HAL_SMARTCARD_CLEAR_FLAG` : Clear the specified SMARTCARD pending flag
- `__HAL_SMARTCARD_ENABLE_IT`: Enable the specified SMARTCARD interrupt
- `__HAL_SMARTCARD_DISABLE_IT`: Disable the specified SMARTCARD interrupt
- `__HAL_SMARTCARD_GET_IT_SOURCE`: Check whether or not the specified SMARTCARD interrupt is enabled



You can refer to the SMARTCARD HAL driver header file for more useful macros

58.2.2 Initialization and Configuration functions

This subsection provides a set of functions allowing to initialize the USARTx associated to the SmartCard.

- These parameters can be configured:
 - Baud Rate
 - Parity: parity should be enabled, frame Length is fixed to 8 bits plus parity
 - Receiver/transmitter modes
 - Synchronous mode (and if enabled, phase, polarity and last bit parameters)
 - Prescaler value
 - Guard bit time
 - NACK enabling or disabling on transmission error
- The following advanced features can be configured as well:
 - TX and/or RX pin level inversion
 - data logical level inversion
 - RX and TX pins swap
 - RX overrun detection disabling
 - DMA disabling on RX error
 - MSB first on communication line
 - Time out enabling (and if activated, timeout value)
 - Block length
 - Auto-retry counter

The `HAL_SMARTCARD_Init()` API follows the USART synchronous configuration procedures (details for the procedures are available in reference manual).

This section contains the following APIs:

- [*HAL_SMARTCARD_Init\(\)*](#)
- [*HAL_SMARTCARD_DeInit\(\)*](#)
- [*HAL_SMARTCARD_MspInit\(\)*](#)
- [*HAL_SMARTCARD_MspDeInit\(\)*](#)

58.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the SMARTCARD data transfers.

1. Smartcard is a single wire half duplex communication protocol. The Smartcard interface is designed to support asynchronous protocol Smartcards as defined in the ISO 7816-3 standard.
2. The USART should be configured as:
 - 8 bits plus parity: where M=1 and PCE=1 in the USART_CR1 register
 - 1.5 stop bits when transmitting and receiving: where STOP=11 in the USART_CR2 register.
3. There are two modes of transfer:
 - Blocking mode: The communication is performed in polling mode. The HAL status of all data processing is returned by the same function after finishing transfer.
 - Non-Blocking mode: The communication is performed using Interrupts or DMA, the relevant API's return the HAL status. The end of the data processing will be indicated through the dedicated SMARTCARD IRQ when using Interrupt mode or the DMA IRQ when using DMA mode.
 - The HAL_SMARTCARD_TxCpltCallback(), HAL_SMARTCARD_RxCpltCallback() user callbacks will be executed respectively at the end of the Transmit or Receive process. The HAL_SMARTCARD_ErrorCallback() user callback will be executed when a communication error is detected.
4. Blocking mode APIs are :
 - HAL_SMARTCARD_Transmit()
 - HAL_SMARTCARD_Receive()
5. Non Blocking mode APIs with Interrupt are :
 - HAL_SMARTCARD_Transmit_IT()
 - HAL_SMARTCARD_Receive_IT()
 - HAL_SMARTCARD_IRQHandler()
6. Non Blocking mode functions with DMA are :
 - HAL_SMARTCARD_Transmit_DMA()
 - HAL_SMARTCARD_Receive_DMA()
7. A set of Transfer Complete Callbacks are provided in non Blocking mode:
 - HAL_SMARTCARD_TxCpltCallback()
 - HAL_SMARTCARD_RxCpltCallback()
 - HAL_SMARTCARD_ErrorCallback()
8. Non-Blocking mode transfers could be aborted using Abort API's :
 - HAL_SMARTCARD_Abort()
 - HAL_SMARTCARD_AbortTransmit()
 - HAL_SMARTCARD_AbortReceive()
 - HAL_SMARTCARD_Abort_IT()
 - HAL_SMARTCARD_AbortTransmit_IT()
 - HAL_SMARTCARD_AbortReceive_IT()
9. For Abort services based on interrupts (HAL_SMARTCARD_Abortxxx_IT), a set of Abort Complete Callbacks are provided:
 - HAL_SMARTCARD_AbortCpltCallback()
 - HAL_SMARTCARD_AbortTransmitCpltCallback()
 - HAL_SMARTCARD_AbortReceiveCpltCallback()
10. In Non-Blocking mode transfers, possible errors are split into 2 categories. Errors are handled as follows :
 - Error is considered as Recoverable and non blocking : Transfer could go till end, but error severity is to be evaluated by user : this concerns Frame Error, Parity Error or Noise Error in Interrupt mode reception . Received character is then retrieved and stored in Rx buffer, Error code is set to allow user to identify error type, and HAL_SMARTCARD_ErrorCallback() user callback is executed.

Transfer is kept ongoing on SMARTCARD side. If user wants to abort it, Abort services should be called by user.

- Error is considered as Blocking : Transfer could not be completed properly and is aborted. This concerns Frame Error in Interrupt mode transmission, Overrun Error in Interrupt mode reception and all errors in DMA mode. Error code is set to allow user to identify error type, and HAL_SMARTCARD_ErrorCallback() user callback is executed.

This section contains the following APIs:

- [HAL_SMARTCARD_Transmit\(\)](#)
- [HAL_SMARTCARD_Receive\(\)](#)
- [HAL_SMARTCARD_Transmit_IT\(\)](#)
- [HAL_SMARTCARD_Receive_IT\(\)](#)
- [HAL_SMARTCARD_Transmit_DMA\(\)](#)
- [HAL_SMARTCARD_Receive_DMA\(\)](#)
- [HAL_SMARTCARD_Abort\(\)](#)
- [HAL_SMARTCARD_AbortTransmit\(\)](#)
- [HAL_SMARTCARD_AbortReceive\(\)](#)
- [HAL_SMARTCARD_Abort_IT\(\)](#)
- [HAL_SMARTCARD_AbortTransmit_IT\(\)](#)
- [HAL_SMARTCARD_AbortReceive_IT\(\)](#)
- [HAL_SMARTCARD_IRQHandler\(\)](#)
- [HAL_SMARTCARD_TxCpltCallback\(\)](#)
- [HAL_SMARTCARD_RxCpltCallback\(\)](#)
- [HAL_SMARTCARD_ErrorCallback\(\)](#)
- [HAL_SMARTCARD_AbortCpltCallback\(\)](#)
- [HAL_SMARTCARD_AbortTransmitCpltCallback\(\)](#)
- [HAL_SMARTCARD_AbortReceiveCpltCallback\(\)](#)

58.2.4 Peripheral State and Errors functions

This subsection provides a set of functions allowing to return the State of SmartCard handle and also return Peripheral Errors occurred during communication process

- HAL_SMARTCARD_GetState() API can be helpful to check in run-time the state of the SMARTCARD peripheral.
- HAL_SMARTCARD_GetError() checks in run-time errors that could occur during communication.

This section contains the following APIs:

- [HAL_SMARTCARD_GetState\(\)](#)
- [HAL_SMARTCARD_GetError\(\)](#)

58.2.5 Detailed description of functions

HAL_SMARTCARD_Init

Function name	HAL_StatusTypeDef HAL_SMARTCARD_Init (SMARTCARD_HandleTypeDef * hsmartcard)
Function description	Initialize the SMARTCARD mode according to the specified parameters in the SMARTCARD_HandleTypeDef and initialize the associated handle.
Parameters	<ul style="list-style-type: none"> • hsmartcard: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the

specified SMARTCARD module.

Return values

- **HAL:** status

HAL_SMARTCARD_Delnit

Function name **HAL_StatusTypeDef HAL_SMARTCARD_Delnit (SMARTCARD_HandleTypeDef * hsmartcard)**

Function description Delinitialize the SMARTCARD peripheral.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **HAL:** status

HAL_SMARTCARD_Msplnit

Function name **void HAL_SMARTCARD_Msplnit (SMARTCARD_HandleTypeDef * hsmartcard)**

Function description Initialize the SMARTCARD MSP.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **None:**

HAL_SMARTCARD_MspDelnit

Function name **void HAL_SMARTCARD_MspDelnit (SMARTCARD_HandleTypeDef * hsmartcard)**

Function description Delinitialize the SMARTCARD MSP.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **None:**

HAL_SMARTCARD_Transmit

Function name **HAL_StatusTypeDef HAL_SMARTCARD_Transmit (SMARTCARD_HandleTypeDef * hsmartcard, uint8_t * pData, uint16_t Size, uint32_t Timeout)**

Function description Send an amount of data in blocking mode.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
- **pData:** pointer to data buffer.
- **Size:** amount of data to be sent.
- **Timeout:** Timeout duration.

Return values

- **HAL:** status

HAL_SMARTCARD_Receive

Function name	HAL_StatusTypeDef HAL_SMARTCARD_Receive (SMARTCARD_HandleTypeDef * hsmartcard, uint8_t * pData, uint16_t Size, uint32_t Timeout)
Function description	Receive an amount of data in blocking mode.
Parameters	<ul style="list-style-type: none">• hsmartcard: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.• pData: pointer to data buffer.• Size: amount of data to be received.• Timeout: Timeout duration.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SMARTCARD_Transmit_IT

Function name	HAL_StatusTypeDef HAL_SMARTCARD_Transmit_IT (SMARTCARD_HandleTypeDef * hsmartcard, uint8_t * pData, uint16_t Size)
Function description	Send an amount of data in interrupt mode.
Parameters	<ul style="list-style-type: none">• hsmartcard: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.• pData: pointer to data buffer.• Size: amount of data to be sent.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SMARTCARD_Receive_IT

Function name	HAL_StatusTypeDef HAL_SMARTCARD_Receive_IT (SMARTCARD_HandleTypeDef * hsmartcard, uint8_t * pData, uint16_t Size)
Function description	Receive an amount of data in interrupt mode.
Parameters	<ul style="list-style-type: none">• hsmartcard: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.• pData: pointer to data buffer.• Size: amount of data to be received.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SMARTCARD_Transmit_DMA

Function name	HAL_StatusTypeDef HAL_SMARTCARD_Transmit_DMA (SMARTCARD_HandleTypeDef * hsmartcard, uint8_t * pData, uint16_t Size)
Function description	Send an amount of data in DMA mode.
Parameters	<ul style="list-style-type: none">• hsmartcard: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

	<ul style="list-style-type: none"> • pData: pointer to data buffer. • Size: amount of data to be sent.
Return values	<ul style="list-style-type: none"> • HAL: status
HAL_SMARTCARD_Receive_DMA	
Function name	HAL_StatusTypeDef HAL_SMARTCARD_Receive_DMA (SMARTCARD_HandleTypeDef * hsmartcard, uint8_t * pData, uint16_t Size)
Function description	Receive an amount of data in DMA mode.
Parameters	<ul style="list-style-type: none"> • hsmartcard: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module. • pData: pointer to data buffer. • Size: amount of data to be received.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • The SMARTCARD-associated USART parity is enabled (PCE = 1), the received data contain the parity bit (MSB position).

HAL_SMARTCARD_Abort

Function name	HAL_StatusTypeDef HAL_SMARTCARD_Abort (SMARTCARD_HandleTypeDef * hsmartcard)
Function description	Abort ongoing transfers (blocking mode).
Parameters	<ul style="list-style-type: none"> • hsmartcard: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This procedure could be used for aborting any ongoing transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable SMARTCARD Interrupts (Tx and Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY • This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

HAL_SMARTCARD_AbortTransmit

Function name	HAL_StatusTypeDef HAL_SMARTCARD_AbortTransmit (SMARTCARD_HandleTypeDef * hsmartcard)
Function description	Abort ongoing Transmit transfer (blocking mode).
Parameters	<ul style="list-style-type: none"> • hsmartcard: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
Return values	<ul style="list-style-type: none"> • HAL: status

- Notes
- This procedure could be used for aborting any ongoing Tx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable SMARTCARD Interrupts (Tx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY
 - This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

HAL_SMARTCARD_AbortReceive

Function name **HAL_StatusTypeDef HAL_SMARTCARD_AbortReceive (SMARTCARD_HandleTypeDef * hsmartcard)**

Function description Abort ongoing Receive transfer (blocking mode).

Parameters

- **hsmartcard**: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **HAL**: status

- Notes
- This procedure could be used for aborting any ongoing Rx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable SMARTCARD Interrupts (Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY
 - This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

HAL_SMARTCARD_Abort_IT

Function name **HAL_StatusTypeDef HAL_SMARTCARD_Abort_IT (SMARTCARD_HandleTypeDef * hsmartcard)**

Function description Abort ongoing transfers (Interrupt mode).

Parameters

- **hsmartcard**: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **HAL**: status

- Notes
- This procedure could be used for aborting any ongoing transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable SMARTCARD Interrupts (Tx and Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback
 - This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).



HAL_SMARTCARD_AbortTransmit_IT

Function name	HAL_StatusTypeDef HAL_SMARTCARD_AbortTransmit_IT (SMARTCARD_HandleTypeDef * hsmartcard)
Function description	Abort ongoing Transmit transfer (Interrupt mode).
Parameters	<ul style="list-style-type: none"> • hsmartcard: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This procedure could be used for aborting any ongoing Tx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable SMARTCARD Interrupts (Tx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback • This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

HAL_SMARTCARD_AbortReceive_IT

Function name	HAL_StatusTypeDef HAL_SMARTCARD_AbortReceive_IT (SMARTCARD_HandleTypeDef * hsmartcard)
Function description	Abort ongoing Receive transfer (Interrupt mode).
Parameters	<ul style="list-style-type: none"> • hsmartcard: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This procedure could be used for aborting any ongoing Rx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable SMARTCARD Interrupts (Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback • This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

HAL_SMARTCARD_IRQHandler

Function name	void HAL_SMARTCARD_IRQHandler (SMARTCARD_HandleTypeDef * hsmartcard)
Function description	Handle SMARTCARD interrupt requests.

- Parameters
- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
- Return values
- **None:**

HAL_SMARTCARD_TxCpltCallback

- Function name
- void HAL_SMARTCARD_TxCpltCallback (SMARTCARD_HandleTypeDef * hsmartcard)**
- Function description
- Tx Transfer completed callback.
- Parameters
- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
- Return values
- **None:**

HAL_SMARTCARD_RxCpltCallback

- Function name
- void HAL_SMARTCARD_RxCpltCallback (SMARTCARD_HandleTypeDef * hsmartcard)**
- Function description
- Rx Transfer completed callback.
- Parameters
- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
- Return values
- **None:**

HAL_SMARTCARD_ErrorCallback

- Function name
- void HAL_SMARTCARD_ErrorCallback (SMARTCARD_HandleTypeDef * hsmartcard)**
- Function description
- SMARTCARD error callback.
- Parameters
- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
- Return values
- **None:**

HAL_SMARTCARD_AbortCpltCallback

- Function name
- void HAL_SMARTCARD_AbortCpltCallback (SMARTCARD_HandleTypeDef * hsmartcard)**
- Function description
- SMARTCARD Abort Complete callback.
- Parameters
- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
- Return values
- **None:**

HAL_SMARTCARD_AbortTransmitCpltCallback

Function name	void HAL_SMARTCARD_AbortTransmitCpltCallback (SMARTCARD_HandleTypeDef * hsmartcard)
Function description	SMARTCARD Abort Complete callback.
Parameters	<ul style="list-style-type: none"> • hsmartcard: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
Return values	<ul style="list-style-type: none"> • None:

HAL_SMARTCARD_AbortReceiveCpltCallback

Function name	void HAL_SMARTCARD_AbortReceiveCpltCallback (SMARTCARD_HandleTypeDef * hsmartcard)
Function description	SMARTCARD Abort Receive Complete callback.
Parameters	<ul style="list-style-type: none"> • hsmartcard: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
Return values	<ul style="list-style-type: none"> • None:

HAL_SMARTCARD_GetState

Function name	HAL_SMARTCARD_StateTypeDef HAL_SMARTCARD_GetState (SMARTCARD_HandleTypeDef * hsmartcard)
Function description	Return the SMARTCARD handle state.
Parameters	<ul style="list-style-type: none"> • hsmartcard: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
Return values	<ul style="list-style-type: none"> • SMARTCARD: handle state

HAL_SMARTCARD_GetError

Function name	uint32_t HAL_SMARTCARD_GetError (SMARTCARD_HandleTypeDef * hsmartcard)
Function description	Return the SMARTCARD handle error code.
Parameters	<ul style="list-style-type: none"> • hsmartcard: Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
Return values	<ul style="list-style-type: none"> • SMARTCARD: handle Error Code

58.3 SMARTCARD Firmware driver defines**58.3.1 SMARTCARD*****SMARTCARD Advanced Features Initialization Type***

SMARTCARD_ADVFEATURE_NO_INIT

SMARTCARD_ADVFEATURE_TXINVERT_INIT
 SMARTCARD_ADVFEATURE_RXINVERT_INIT
 SMARTCARD_ADVFEATURE_DATAINVERT_INIT
 SMARTCARD_ADVFEATURE_SWAP_INIT
 SMARTCARD_ADVFEATURE_RXOVERRUNDISABLE_INIT
 SMARTCARD_ADVFEATURE_DMADISABLEONERROR_INIT
 SMARTCARD_ADVFEATURE_MSBFIRST_INIT

SMARTCARD Clock Phase

SMARTCARD_PHASE_1EDGE
 SMARTCARD_PHASE_2EDGE

SMARTCARD Clock Polarity

SMARTCARD_POLARITY_LOW
 SMARTCARD_POLARITY_HIGH

SMARTCARD CR3 SCAR CNT LSB POS

SMARTCARD_CR3_SCARCNT_LSB_POS

SMARTCARD Data Inv

SMARTCARD_ADVFEATURE_DATAINV_DISABLE
 SMARTCARD_ADVFEATURE_DATAINV_ENABLE

SMARTCARD DMA Disable on Rx Error

SMARTCARD_ADVFEATURE_DMA_ENABLEONRXERROR
 SMARTCARD_ADVFEATURE_DMA_DISABLEONRXERROR

SMARTCARD DMA requests

SMARTCARD_DMAREQ_TX
 SMARTCARD_DMAREQ_RX

SMARTCARD Error Code

HAL_SMARTCARD_ERROR_NONE	No error
HAL_SMARTCARD_ERROR_PE	Parity error
HAL_SMARTCARD_ERROR_NE	Noise error
HAL_SMARTCARD_ERROR_FE	frame error
HAL_SMARTCARD_ERROR_ORE	Overrun error
HAL_SMARTCARD_ERROR_DMA	DMA transfer error
HAL_SMARTCARD_ERROR_RTO	Receiver TimeOut error

SMARTCARD Exported Macros

__HAL_SMARTCARD_RESET_HANDLE_STATE

Description:

- Reset SMARTCARD handle state.

Parameters:

- __HANDLE__: specifies the SMARTCARD

Handle. The Handle Instance which can be USART1 or USART2

Return value:

- None

`__HAL_SMARTCARD_FLUSH_DRREGISTER`

Description:

- Flush the Smartcard DR register.

Parameters:

- `__HANDLE__`: specifies the SMARTCARD Handle. The Handle Instance which can be USART1 or USART2.

Return value:

- None

`__HAL_SMARTCARD_GET_FLAG`

Description:

- Checks whether the specified Smartcard flag is set or not.

Parameters:

- `__HANDLE__`: specifies the SMARTCARD Handle. The Handle Instance which can be USART1 or USART2.
- `__FLAG__`: specifies the flag to check. This parameter can be one of the following values:
 - `SMARTCARD_FLAG_REACK`: Receive enable acknowledge flag
 - `SMARTCARD_FLAG_TEACK`: Transmit enable acknowledge flag
 - `SMARTCARD_FLAG_BUSY`: Busy flag
 - `SMARTCARD_FLAG_EOBF`: End of block flag
 - `SMARTCARD_FLAG_RTOF`: Receiver timeout flag
 - `SMARTCARD_FLAG_TXE`: Transmit data register empty flag
 - `SMARTCARD_FLAG_TC`: Transmission Complete flag
 - `SMARTCARD_FLAG_RXNE`: Receive data register not empty flag
 - `SMARTCARD_FLAG_ORE`: OverRun Error flag
 - `SMARTCARD_FLAG_NE`: Noise Error flag
 - `SMARTCARD_FLAG_FE`: Framing Error flag
 - `SMARTCARD_FLAG_PE`: Parity Error flag

Return value:

`__HAL_SMARTCARD_CLEAR_FLAG`

- The: new state of `__FLAG__` (TRUE or FALSE).

Description:

- Clear the specified SMARTCARD pending flag.

Parameters:

- `__HANDLE__`: specifies the SMARTCARD Handle.
- `__FLAG__`: specifies the flag to check. This parameter can be any combination of the following values:
 - `SMARTCARD_CLEAR_PEF` Parity error clear flag
 - `SMARTCARD_CLEAR_FEF` Framing error clear flag
 - `SMARTCARD_CLEAR_NEF` Noise detected clear flag
 - `SMARTCARD_CLEAR_OREF` OverRun error clear flag
 - `SMARTCARD_CLEAR_IDLEF` Idle line detected clear flag
 - `SMARTCARD_CLEAR_TCF` Transmission complete clear flag
 - `SMARTCARD_CLEAR_RTOF` Receiver timeout clear flag
 - `SMARTCARD_CLEAR_EOBF` End of block clear flag

Return value:

- None

`__HAL_SMARTCARD_CLEAR_PEFLAG`**Description:**

- Clear the SMARTCARD PE pending flag.

Parameters:

- `__HANDLE__`: specifies the SMARTCARD Handle.

Return value:

- None

`__HAL_SMARTCARD_CLEAR_FEFLAG`**Description:**

- Clear the SMARTCARD FE pending flag.

Parameters:

- `__HANDLE__`: specifies the SMARTCARD Handle.

Return value:

- None

`__HAL_SMARTCARD_CLEAR_NEFLAG`**Description:**

G	<ul style="list-style-type: none"> • Clear the SMARTCARD NE pending flag. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: specifies the SMARTCARD Handle. <p>Return value:</p> <ul style="list-style-type: none"> • None
<code>__HAL_SMARTCARD_CLEAR_OREFLAG</code>	<p>Description:</p> <ul style="list-style-type: none"> • Clear the SMARTCARD ORE pending flag. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: specifies the SMARTCARD Handle. <p>Return value:</p> <ul style="list-style-type: none"> • None
<code>__HAL_SMARTCARD_CLEAR_IDLEFLAG</code>	<p>Description:</p> <ul style="list-style-type: none"> • Clear the SMARTCARD IDLE pending flag. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: specifies the SMARTCARD Handle. <p>Return value:</p> <ul style="list-style-type: none"> • None
<code>__HAL_SMARTCARD_ENABLE_IT</code>	<p>Description:</p> <ul style="list-style-type: none"> • Enables the specified SmartCard interrupt. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: specifies the SMARTCARD Handle. The Handle Instance which can be USART1 or USART2. • <code>__INTERRUPT__</code>: specifies the SMARTCARD interrupt to enable. This parameter can be one of the following values: <ul style="list-style-type: none"> – SMARTCARD_IT_EOBF: End Of Block interrupt – SMARTCARD_IT_RTOF: Receive TimeOut interrupt – SMARTCARD_IT_TXE: Transmit Data Register empty interrupt – SMARTCARD_IT_TC: Transmission complete interrupt – SMARTCARD_IT_RXNE: Receive Data register not empty interrupt – SMARTCARD_IT_PE: Parity Error interrupt

- SMARTCARD_IT_ERR: Error interrupt(Frame error, noise error, overrun error)

Return value:

- None

`__HAL_SMARTCARD_DISABLE_IT`**Description:**

- Disables the specified SmartCard interrupt.

Parameters:

- `__HANDLE__`: specifies the SMARTCARD Handle. The Handle Instance which can be USART1 or USART2.
- `__INTERRUPT__`: specifies the SMARTCARD interrupt to enable. This parameter can be one of the following values:
 - SMARTCARD_IT_EOBF: End Of Block interrupt
 - SMARTCARD_IT_RTOF: Receive TimeOut interrupt
 - SMARTCARD_IT_TXE: Transmit Data Register empty interrupt
 - SMARTCARD_IT_TC: Transmission complete interrupt
 - SMARTCARD_IT_RXNE: Receive Data register not empty interrupt
 - SMARTCARD_IT_PE: Parity Error interrupt
 - SMARTCARD_IT_ERR: Error interrupt(Frame error, noise error, overrun error)

Return value:

- None

`__HAL_SMARTCARD_GET_IT`**Description:**

- Checks whether the specified SmartCard interrupt has occurred or not.

Parameters:

- `__HANDLE__`: specifies the SMARTCARD Handle. The Handle Instance which can be USART1 or USART2.
- `__IT__`: specifies the SMARTCARD interrupt to check. This parameter can be one of the following values:
 - SMARTCARD_IT_EOBF: End Of Block interrupt
 - SMARTCARD_IT_RTOF: Receive TimeOut interrupt
 - SMARTCARD_IT_TXE: Transmit Data Register empty interrupt

- SMARTCARD_IT_TC: Transmission complete interrupt
- SMARTCARD_IT_RXNE: Receive Data register not empty interrupt
- SMARTCARD_IT_ORE: OverRun Error interrupt
- SMARTCARD_IT_NE: Noise Error interrupt
- SMARTCARD_IT_FE: Framing Error interrupt
- SMARTCARD_IT_PE: Parity Error interrupt

Return value:

- The: new state of __IT__ (TRUE or FALSE).

`__HAL_SMARTCARD_GET_IT_SOURCE`

Description:

- Checks whether the specified SmartCard interrupt interrupt source is enabled.

Parameters:

- `__HANDLE__`: specifies the SMARTCARD Handle. The Handle Instance which can be USART1 or USART2.
- `__IT__`: specifies the SMARTCARD interrupt source to check. This parameter can be one of the following values:
 - SMARTCARD_IT_EOBF: End Of Block interrupt
 - SMARTCARD_IT_RTOF: Receive TimeOut interrupt
 - SMARTCARD_IT_TXE: Transmit Data Register empty interrupt
 - SMARTCARD_IT_TC: Transmission complete interrupt
 - SMARTCARD_IT_RXNE: Receive Data register not empty interrupt
 - SMARTCARD_IT_ORE: OverRun Error interrupt
 - SMARTCARD_IT_NE: Noise Error interrupt
 - SMARTCARD_IT_FE: Framing Error interrupt
 - SMARTCARD_IT_PE: Parity Error interrupt

Return value:

- The: new state of __IT__ (TRUE or FALSE).

`__HAL_SMARTCARD_CLEAR_IT`

Description:

- Clears the specified SMARTCARD ISR

flag, in setting the proper ICR register flag.

Parameters:

- `__HANDLE__`: specifies the SMARTCARD Handle. The Handle Instance which can be USART1 or USART2.
- `__IT_CLEAR__`: specifies the interrupt clear register flag that needs to be set to clear the corresponding interrupt This parameter can be one of the following values:
 - `USART_CLEAR_PEF`: Parity Error Clear Flag
 - `USART_CLEAR_FEF`: Framing Error Clear Flag
 - `USART_CLEAR_NEF`: Noise detected Clear Flag
 - `USART_CLEAR_OREF`: OverRun Error Clear Flag
 - `USART_CLEAR_TCF`: Transmission Complete Clear Flag
 - `USART_CLEAR_RTOF`: Receiver Time Out Clear Flag
 - `USART_CLEAR_EOBF`: End Of Block Clear Flag

Return value:

- None

`__HAL_SMARTCARD_SEND_REQ`

Description:

- Set a specific SMARTCARD request flag.

Parameters:

- `__HANDLE__`: specifies the SMARTCARD Handle. The Handle Instance which can be USART1 or USART2.
- `__REQ__`: specifies the request flag to set This parameter can be one of the following values:
 - `SMARTCARD_RXDATA_FLUSH_REQUEST`: Receive Data flush Request
 - `SMARTCARD_TXDATA_FLUSH_REQUEST`: Transmit data flush Request

Return value:

- None

`__HAL_SMARTCARD_ENABLE`

Description:

- Enable the USART associated to the SMARTCARD Handle.

Parameters:

- `__HANDLE__`: specifies the SMARTCARD Handle. The Handle Instance which can be

__HAL_SMARTCARD_DISABLE

USART1 or USART2.

Return value:

- None

Description:

- Disable the USART associated to the SMARTCARD Handle.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle. The Handle Instance which can be USART1 or USART2.

Return value:

- None

__HAL_SMARTCARD_DMA_REQUEST_ENABLE

Description:

- Macros to enable or disable the SmartCard DMA request.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle. The Handle Instance which can be USART1 or USART2.
- __REQUEST__: specifies the SmartCard DMA request. This parameter can be one of the following values:
 - SMARTCARD_DMAREQ_TX: SmartCard DMA transmit request
 - SMARTCARD_DMAREQ_RX: SmartCard DMA receive request

__HAL_SMARTCARD_DMA_REQUEST_DISABLE

SMARTCARD GTPR GT_LSBPOS

SMARTCARD_GTPR_GT_LSB_POS

SMARTCARD Interruption Mask

SMARTCARD_IT_MASK

SMARTCARD Interrupt definition

SMARTCARD_IT_PE

SMARTCARD_IT_TXE

SMARTCARD_IT_TC

SMARTCARD_IT_RXNE

SMARTCARD_IT_IDLE

SMARTCARD_IT_ERR

SMARTCARD_IT_ORE

SMARTCARD_IT_NE

SMARTCARD_IT_FE

SMARTCARD_IT_EOB

SMARTCARD_IT_RTO

SMARTCARD IT CLEAR Flags

SMARTCARD_CLEAR_PEF Parity Error Clear Flag

SMARTCARD_CLEAR_FEF Framing Error Clear Flag

SMARTCARD_CLEAR_NEF Noise detected Clear Flag

SMARTCARD_CLEAR_OREF OverRun Error Clear Flag

SMARTCARD_CLEAR_IDLEF Idle line detected clear Flag

SMARTCARD_CLEAR_TCF Transmission Complete Clear Flag

SMARTCARD_CLEAR_RTOF Receiver Time Out Clear Flag

SMARTCARD_CLEAR_EOBF End Of Block Clear Flag

SMARTCARD Last Bit

SMARTCARD_LASTBIT_DISABLE

SMARTCARD_LASTBIT_ENABLE

SMARTCARD Mode

SMARTCARD_MODE_RX

SMARTCARD_MODE_TX

SMARTCARD_MODE_TX_RX

SMARTCARD MSB First

SMARTCARD_ADVFEATURE_MSBFIRST_DISABLE

SMARTCARD_ADVFEATURE_MSBFIRST_ENABLE

SMARTCARD NACK State

SMARTCARD_NACK_ENABLE

SMARTCARD_NACK_DISABLE

SMARTCARD OneBit Sampling

SMARTCARD_ONE_BIT_SAMPLE_DISABLE

SMARTCARD_ONE_BIT_SAMPLE_ENABLE

SMARTCARD Overrun Disable

SMARTCARD_ADVFEATURE_OVERRUN_ENABLE

SMARTCARD_ADVFEATURE_OVERRUN_DISABLE

SMARTCARD Parity

SMARTCARD_PARITY_EVEN

SMARTCARD_PARITY_ODD

SMARTCARD Request Parameters

SMARTCARD_RXDATA_FLUSH_REQUEST Receive Data flush Request

SMARTCARD_TXDATA_FLUSH_REQUEST Transmit data flush Request

SMARTCARD RTOR BLEN LSBPOS

SMARTCARD_RTOR_BLEN_LSB_POS

SMARTCARD Rx Inv

SMARTCARD_ADVFEATURE_RXINV_DISABLE

SMARTCARD_ADVFEATURE_RXINV_ENABLE

SMARTCARD Rx Tx Swap

SMARTCARD_ADVFEATURE_SWAP_DISABLE

SMARTCARD_ADVFEATURE_SWAP_ENABLE

SMARTCARD Number of Stop Bits

SMARTCARD_STOPBITS_1_5

SMARTCARD Timeout Enable

SMARTCARD_TIMEOUT_DISABLE

SMARTCARD_TIMEOUT_ENABLE

SMARTCARD Tx Inv

SMARTCARD_ADVFEATURE_TXINV_DISABLE

SMARTCARD_ADVFEATURE_TXINV_ENABLE

SMARTCARD Word Length

SMARTCARD_WORDLENGTH_9B

59 HAL SMARTCARD Extension Driver

59.1 SMARTCARDEx Firmware driver API description

59.1.1 How to use this driver

The Extended SMARTCARD HAL driver can be used as follow:

1. After having configured the SMARTCARD basic features with `HAL_SMARTCARD_Init()`, then if required, program SMARTCARD advanced features (TX/RX pins swap, TimeOut, auto-retry counter,...) in the `hsc AdvancedInit` structure.

59.1.2 Peripheral Control functions

This subsection provides a set of functions allowing to initialize the SMARTCARD.

- `HAL_SMARTCARDEx_BlockLength_Config()` API allows to configure the Block Length on the fly
- `HAL_SMARTCARDEx_TimeOut_Config()` API allows to configure the receiver timeout value on the fly
- `HAL_SMARTCARDEx_EnableReceiverTimeOut()` API enables the receiver timeout feature
- `HAL_SMARTCARDEx_DisableReceiverTimeOut()` API disables the receiver timeout feature

This section contains the following APIs:

- [*HAL_SMARTCARDEx_BlockLength_Config\(\)*](#)
- [*HAL_SMARTCARDEx_TimeOut_Config\(\)*](#)
- [*HAL_SMARTCARDEx_EnableReceiverTimeOut\(\)*](#)
- [*HAL_SMARTCARDEx_DisableReceiverTimeOut\(\)*](#)

59.1.3 Detailed description of functions

HAL_SMARTCARDEx_BlockLength_Config

Function name	void HAL_SMARTCARDEx_BlockLength_Config (SMARTCARD_HandleTypeDef * hsc, uint8_t BlockLength)
Function description	Update on the fly the SMARTCARD block length in RTOR register.
Parameters	<ul style="list-style-type: none"> • hsc: SMARTCARD handle • BlockLength: SMARTCARD block length (8-bit long at most)
Return values	<ul style="list-style-type: none"> • None:

HAL_SMARTCARDEx_TimeOut_Config

Function name	void HAL_SMARTCARDEx_TimeOut_Config (SMARTCARD_HandleTypeDef * hsc, uint32_t TimeOutValue)
Function description	Update on the fly the receiver timeout value in RTOR register.
Parameters	<ul style="list-style-type: none"> • hsc: SMARTCARD handle • TimeOutValue: receiver timeout value in number of baud blocks. The timeout value must be less or equal to

0xFFFFFFFF.

Return values

- **None:**

HAL_SMARTCARDEx_EnableReceiverTimeOut

Function name **HAL_StatusTypeDef**
HAL_SMARTCARDEx_EnableReceiverTimeOut
(SMARTCARD_HandleTypeDef * hsc)

Function description Enable the SMARTCARD receiver timeout feature.

Parameters

- **hsc:** SMARTCARD handle

Return values

- **HAL:** status

HAL_SMARTCARDEx_DisableReceiverTimeOut

Function name **HAL_StatusTypeDef**
HAL_SMARTCARDEx_DisableReceiverTimeOut
(SMARTCARD_HandleTypeDef * hsc)

Function description Disable the SMARTCARD receiver timeout feature.

Parameters

- **hsc:** SMARTCARD handle

Return values

- **HAL:** status

59.2 SMARTCARDEx Firmware driver defines

59.2.1 SMARTCARDEx

SMARTCARD advanced feature initialization type

SMARTCARD_ADVFEATURE_TXCOMPLETION TX completion indication before of after guard time

SMARTCARD Extended Exported Constants

SMARTCARD_GETCLOCKSOURCE

Description:

- Reports the SMARTCARD clock source.

Parameters:

- **__HANDLE__:** specifies the USART Handle
- **__CLOCKSOURCE__:** output variable

Return value:

- the: USART clocking source, written in **__CLOCKSOURCE__**.

SMARTCARD_TRANSMISSION_COMPLETION_SETTING

Description:

- Set the Transmission Completion flag.

SMARTCARD_TRANSMISSION_COMPLETION_FLAG

Parameters:

- `__HANDLE__`: specifies the SMARTCARD Handle.

Return value:

- None

Notes:

- If TCBGT (Transmission Complete Before Guard Time) flag is not available or if `AdvancedInit.TxCompletionIndication` is not already filled, the latter is forced to `SMARTCARD_TC` (transmission completion indication when guard time has elapsed).

Description:

- Return the transmission completion flag.

Parameters:

- `__HANDLE__`: specifies the SMARTCARD Handle.

Return value:

- Transmission: completion flag

Notes:

- Based on `AdvancedInit.TxCompletionIndication` setting, return TC or TCBGT flag. When TCBGT flag (Transmission Complete Before Guard Time) is not available, TC flag is reported.

IS_SMARTCARD_TRANSMISSION_COMPLETION

Description:

- Ensure that SMARTCARD frame transmission completion used flag is valid.

Parameters:

- `__TXCOMPLETE__`: SMARTCARD frame transmission completion used flag.

Return value:

- SET: (__TXCOMPLETE__ is valid) or RESET (__TXCOMPLETE__ is invalid)

SMARTCARD Flags

SMARTCARD_FLAG_TCBGT SMARTCARD transmission complete before guard time completion

SMARTCARD Interrupts Definition

SMARTCARD_IT_TCBGT SMARTCARD transmission complete before guard time completion interruption

SMARTCARD Interruption Clear Flags

SMARTCARD_CLEAR_PEF SMARTCARD parity error clear flag

SMARTCARD_CLEAR_FEF SMARTCARD framing error clear flag

SMARTCARD_CLEAR_NEF SMARTCARD noise detected clear flag

SMARTCARD_CLEAR_OREF SMARTCARD overrun error clear flag

SMARTCARD_CLEAR_IDLEF SMARTCARD idle line detected clear flag

SMARTCARD_CLEAR_TCF SMARTCARD transmission complete clear flag

SMARTCARD_CLEAR_TCBGTF SMARTCARD transmission complete before guard time completion clear flag

SMARTCARD_CLEAR_RTOF SMARTCARD receiver time out clear flag

SMARTCARD_CLEAR_EOBF SMARTCARD end of block clear flag

SMARTCARD Transmission Completion Indication

SMARTCARD_TCBGT SMARTCARD transmission complete before guard time

SMARTCARD_TC SMARTCARD transmission complete (flag raised when guard time has elapsed)

60 HAL SMBUS Generic Driver

60.1 SMBUS Firmware driver registers structures

60.1.1 SMBUS_InitTypeDef

Data Fields

- *uint32_t Timing*
- *uint32_t AnalogFilter*
- *uint32_t OwnAddress1*
- *uint32_t AddressingMode*
- *uint32_t DualAddressMode*
- *uint32_t OwnAddress2*
- *uint32_t OwnAddress2Masks*
- *uint32_t GeneralCallMode*
- *uint32_t NoStretchMode*
- *uint32_t PacketErrorCheckMode*
- *uint32_t PeripheralMode*
- *uint32_t SMBusTimeout*

Field Documentation

- *uint32_t SMBUS_InitTypeDef::Timing*
Specifies the SMBUS_TIMINGR_register value. This parameter calculated by referring to SMBUS initialization section in Reference manual
- *uint32_t SMBUS_InitTypeDef::AnalogFilter*
Specifies if Analog Filter is enable or not. This parameter can be a value of [SMBUS_Analog_Filter](#)
- *uint32_t SMBUS_InitTypeDef::OwnAddress1*
Specifies the first device own address. This parameter can be a 7-bit or 10-bit address.
- *uint32_t SMBUS_InitTypeDef::AddressingMode*
Specifies if 7-bit or 10-bit addressing mode for master is selected. This parameter can be a value of [SMBUS_addressing_mode](#)
- *uint32_t SMBUS_InitTypeDef::DualAddressMode*
Specifies if dual addressing mode is selected. This parameter can be a value of [SMBUS_dual_addressing_mode](#)
- *uint32_t SMBUS_InitTypeDef::OwnAddress2*
Specifies the second device own address if dual addressing mode is selected This parameter can be a 7-bit address.
- *uint32_t SMBUS_InitTypeDef::OwnAddress2Masks*
Specifies the acknowledge mask address second device own address if dual addressing mode is selected This parameter can be a value of [SMBUS_own_address2_masks](#).
- *uint32_t SMBUS_InitTypeDef::GeneralCallMode*
Specifies if general call mode is selected. This parameter can be a value of [SMBUS_general_call_addressing_mode](#).
- *uint32_t SMBUS_InitTypeDef::NoStretchMode*
Specifies if nostretch mode is selected. This parameter can be a value of [SMBUS_nostretch_mode](#)

- ***uint32_t SMBUS_InitTypeDef::PacketErrorCheckMode***
Specifies if Packet Error Check mode is selected. This parameter can be a value of [SMBUS_packet_error_check_mode](#)
- ***uint32_t SMBUS_InitTypeDef::PeripheralMode***
Specifies which mode of Peripheral is selected. This parameter can be a value of [SMBUS_peripheral_mode](#)
- ***uint32_t SMBUS_InitTypeDef::SMBusTimeout***
Specifies the content of the 32 Bits SMBUS_TIMEOUT_register value. (Enable bits and different timeout values) This parameter calculated by referring to SMBUS initialization section in Reference manual

60.1.2 SMBUS_HandleTypeDef

Data Fields

- ***I2C_TypeDef * Instance***
- ***SMBUS_InitTypeDef Init***
- ***uint8_t * pBuffPtr***
- ***uint16_t XferSize***
- ***__IO uint16_t XferCount***
- ***__IO uint32_t XferOptions***
- ***__IO uint32_t PreviousState***
- ***HAL_LockTypeDef Lock***
- ***__IO uint32_t State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***I2C_TypeDef* SMBUS_HandleTypeDef::Instance***
SMBUS registers base address
- ***SMBUS_InitTypeDef SMBUS_HandleTypeDef::Init***
SMBUS communication parameters
- ***uint8_t* SMBUS_HandleTypeDef::pBuffPtr***
Pointer to SMBUS transfer buffer
- ***uint16_t SMBUS_HandleTypeDef::XferSize***
SMBUS transfer size
- ***__IO uint16_t SMBUS_HandleTypeDef::XferCount***
SMBUS transfer counter
- ***__IO uint32_t SMBUS_HandleTypeDef::XferOptions***
SMBUS transfer options
- ***__IO uint32_t SMBUS_HandleTypeDef::PreviousState***
SMBUS communication Previous state
- ***HAL_LockTypeDef SMBUS_HandleTypeDef::Lock***
SMBUS locking object
- ***__IO uint32_t SMBUS_HandleTypeDef::State***
SMBUS communication state
- ***__IO uint32_t SMBUS_HandleTypeDef::ErrorCode***
SMBUS Error code

60.2 SMBUS Firmware driver API description

60.2.1 How to use this driver

The SMBUS HAL driver can be used as follows:

1. Declare a SMBUS_HandleTypeDef handle structure, for example:
SMBUS_HandleTypeDef hsmbus;
2. Initialize the SMBUS low level resources by implementing the HAL_SMBUS_MspInit() API:
 - a. Enable the SMBUSx interface clock
 - b. SMBUS pins configuration
 - Enable the clock for the SMBUS GPIOs
 - Configure SMBUS pins as alternate function open-drain
 - c. NVIC configuration if you need to use interrupt process
 - Configure the SMBUSx interrupt priority
 - Enable the NVIC SMBUS IRQ Channel
3. Configure the Communication Clock Timing, Bus Timeout, Own Address1, Master Addressing mode, Dual Addressing mode, Own Address2, Own Address2 Mask, General call, Nostretch mode, Peripheral mode and Packet Error Check mode in the hsmbus Init structure.
4. Initialize the SMBUS registers by calling the HAL_SMBUS_Init() API:
 - These API's configures also the low level Hardware GPIO, CLOCK, CORTEX...etc) by calling the customized HAL_SMBUS_MspInit(&hsmbus) API.
5. To check if target device is ready for communication, use the function HAL_SMBUS_IsDeviceReady()
6. For SMBUS IO operations, only one mode of operations is available within this driver

Interrupt mode IO operation

- Transmit in master/host SMBUS mode an amount of data in non-blocking mode using HAL_SMBUS_Master_Transmit_IT()
 - At transmission end of transfer HAL_SMBUS_MasterTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SMBUS_MasterTxCpltCallback()
- Receive in master/host SMBUS mode an amount of data in non-blocking mode using HAL_SMBUS_Master_Receive_IT()
 - At reception end of transfer HAL_SMBUS_MasterRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SMBUS_MasterRxCpltCallback()
- Abort a master/host SMBUS process communication with Interrupt using HAL_SMBUS_Master_Abort_IT()
 - The associated previous transfer callback is called at the end of abort process
 - mean HAL_SMBUS_MasterTxCpltCallback() in case of previous state was master transmit
 - mean HAL_SMBUS_MasterRxCpltCallback() in case of previous state was master receive
- Enable/disable the Address listen mode in slave/device or host/slave SMBUS mode using HAL_SMBUS_EnableListen_IT() HAL_SMBUS_DisableListen_IT()
 - When address slave/device SMBUS match, HAL_SMBUS_AddrCallback() is executed and user can add his own code to check the Address Match Code and the transmission direction request by master/host (Write/Read).
 - At Listen mode end HAL_SMBUS_ListenCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SMBUS_ListenCpltCallback()
- Transmit in slave/device SMBUS mode an amount of data in non-blocking mode using HAL_SMBUS_Slave_Transmit_IT()
 - At transmission end of transfer HAL_SMBUS_SlaveTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SMBUS_SlaveTxCpltCallback()

- Receive in slave/device SMBUS mode an amount of data in non-blocking mode using HAL_SMBUS_Slave_Receive_IT()
 - At reception end of transfer HAL_SMBUS_SlaveRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SMBUS_SlaveRxCpltCallback()
- Enable/Disable the SMBUS alert mode using HAL_SMBUS_EnableAlert_IT() HAL_SMBUS_DisableAlert_IT()
 - When SMBUS Alert is generated HAL_SMBUS_ErrorCallback() is executed and user can add his own code by customization of function pointer HAL_SMBUS_ErrorCallback() to check the Alert Error Code using function HAL_SMBUS_GetError()
- Get HAL state machine or error values using HAL_SMBUS_GetState() or HAL_SMBUS_GetError()
- In case of transfer Error, HAL_SMBUS_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_SMBUS_ErrorCallback() to check the Error Code using function HAL_SMBUS_GetError()

SMBUS HAL driver macros list

Below the list of most used macros in SMBUS HAL driver.

- __HAL_SMBUS_ENABLE: Enable the SMBUS peripheral
- __HAL_SMBUS_DISABLE: Disable the SMBUS peripheral
- __HAL_SMBUS_GET_FLAG: Check whether the specified SMBUS flag is set or not
- __HAL_SMBUS_CLEAR_FLAG: Clear the specified SMBUS pending flag
- __HAL_SMBUS_ENABLE_IT: Enable the specified SMBUS interrupt
- __HAL_SMBUS_DISABLE_IT: Disable the specified SMBUS interrupt



You can refer to the SMBUS HAL driver header file for more useful macros

60.2.2 Initialization and de-initialization functions

This subsection provides a set of functions allowing to initialize and deinitialize the SMBUSx peripheral:

- User must Implement HAL_SMBUS_MspInit() function in which he configures all related peripherals resources (CLOCK, GPIO, IT and NVIC).
- Call the function HAL_SMBUS_Init() to configure the selected device with the selected configuration:
 - Clock Timing
 - Bus Timeout
 - Analog Filer mode
 - Own Address 1
 - Addressing mode (Master, Slave)
 - Dual Addressing mode
 - Own Address 2
 - Own Address 2 Mask
 - General call mode
 - Nostretch mode
 - Packet Error Check mode
 - Peripheral mode

- Call the function HAL_SMBUS_DeInit() to restore the default configuration of the selected SMBUSx peripheral.

This section contains the following APIs:

- [HAL_SMBUS_Init\(\)](#)
- [HAL_SMBUS_DeInit\(\)](#)
- [HAL_SMBUS_MspInit\(\)](#)
- [HAL_SMBUS_MspDeInit\(\)](#)

60.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the SMBUS data transfers.

1. Blocking mode function to check if device is ready for usage is :
 - HAL_SMBUS_IsDeviceReady()
2. There is only one mode of transfer:
 - Non-Blocking mode : The communication is performed using Interrupts. These functions return the status of the transfer startup. The end of the data processing will be indicated through the dedicated SMBUS IRQ when using Interrupt mode.
3. Non-Blocking mode functions with Interrupt are :
 - HAL_SMBUS_Master_Transmit_IT()
 - HAL_SMBUS_Master_Receive_IT()
 - HAL_SMBUS_Slave_Transmit_IT()
 - HAL_SMBUS_Slave_Receive_IT()
 - HAL_SMBUS_EnableListen_IT()
 - HAL_SMBUS_DisableListen_IT()
 - HAL_SMBUS_EnableAlert_IT()
 - HAL_SMBUS_DisableAlert_IT()
4. A set of Transfer Complete Callbacks are provided in non-Blocking mode:
 - HAL_SMBUS_MasterTxCpltCallback()
 - HAL_SMBUS_MasterRxCpltCallback()
 - HAL_SMBUS_SlaveTxCpltCallback()
 - HAL_SMBUS_SlaveRxCpltCallback()
 - HAL_SMBUS_AddrCallback()
 - HAL_SMBUS_ListenCpltCallback()
 - HAL_SMBUS_ErrorCallback()

This section contains the following APIs:

- [HAL_SMBUS_Master_Transmit_IT\(\)](#)
- [HAL_SMBUS_Master_Receive_IT\(\)](#)
- [HAL_SMBUS_Master_Abort_IT\(\)](#)
- [HAL_SMBUS_Slave_Transmit_IT\(\)](#)
- [HAL_SMBUS_Slave_Receive_IT\(\)](#)
- [HAL_SMBUS_EnableListen_IT\(\)](#)
- [HAL_SMBUS_DisableListen_IT\(\)](#)
- [HAL_SMBUS_EnableAlert_IT\(\)](#)
- [HAL_SMBUS_DisableAlert_IT\(\)](#)
- [HAL_SMBUS_IsDeviceReady\(\)](#)

60.2.4 Peripheral State and Errors functions

This subsection permits to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- [HAL_SMBUS_GetState\(\)](#)

- [HAL_SMBUS_GetError\(\)](#)

60.2.5 Detailed description of functions

HAL_SMBUS_Init

Function name	HAL_StatusTypeDef HAL_SMBUS_Init (SMBUS_HandleTypeDef * hsmbus)
Function description	Initialize the SMBUS according to the specified parameters in the SMBUS_InitTypeDef and initialize the associated handle.
Parameters	<ul style="list-style-type: none"> • hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SMBUS_DeInit

Function name	HAL_StatusTypeDef HAL_SMBUS_DeInit (SMBUS_HandleTypeDef * hsmbus)
Function description	DeInitialize the SMBUS peripheral.
Parameters	<ul style="list-style-type: none"> • hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SMBUS_MspltInit

Function name	void HAL_SMBUS_MspltInit (SMBUS_HandleTypeDef * hsmbus)
Function description	Initialize the SMBUS MSP.
Parameters	<ul style="list-style-type: none"> • hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
Return values	<ul style="list-style-type: none"> • None:

HAL_SMBUS_MspDeInit

Function name	void HAL_SMBUS_MspDeInit (SMBUS_HandleTypeDef * hsmbus)
Function description	DeInitialize the SMBUS MSP.
Parameters	<ul style="list-style-type: none"> • hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
Return values	<ul style="list-style-type: none"> • None:

HAL_SMBUS_IsDeviceReady

Function name	HAL_StatusTypeDef HAL_SMBUS_IsDeviceReady
---------------	--

(SMBUS_HandleTypeDef * hsmbus, uint16_t DevAddress, uint32_t Trials, uint32_t Timeout)

Function description	Check if target device is ready for communication.
Parameters	<ul style="list-style-type: none"> • hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • Trials: Number of trials • Timeout: Timeout duration
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SMBUS_Master_Transmit_IT

Function name	HAL_StatusTypeDef HAL_SMBUS_Master_Transmit_IT (SMBUS_HandleTypeDef * hsmbus, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t XferOptions)
Function description	Transmit in master/host SMBUS mode an amount of data in non-blocking mode with Interrupt.
Parameters	<ul style="list-style-type: none"> • hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • pData: Pointer to data buffer • Size: Amount of data to be sent • XferOptions: Options of Transfer, value of SMBUS XferOptions definition
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SMBUS_Master_Receive_IT

Function name	HAL_StatusTypeDef HAL_SMBUS_Master_Receive_IT (SMBUS_HandleTypeDef * hsmbus, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t XferOptions)
Function description	Receive in master/host SMBUS mode an amount of data in non-blocking mode with Interrupt.
Parameters	<ul style="list-style-type: none"> • hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS. • DevAddress: Target device address: The device 7 bits address value in datasheet must be shift at right before call interface • pData: Pointer to data buffer • Size: Amount of data to be sent • XferOptions: Options of Transfer, value of SMBUS XferOptions definition

Return values

- **HAL:** status

HAL_SMBUS_Master_Abort_IT

Function name **HAL_StatusTypeDef HAL_SMBUS_Master_Abort_IT (SMBUS_HandleTypeDef * hsmbus, uint16_t DevAddress)**

Function description Abort a master/host SMBUS process communication with Interrupt.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shift at right before call interface

Return values

- **HAL:** status

Notes

- This abort can be called only if state is ready

HAL_SMBUS_Slave_Transmit_IT

Function name **HAL_StatusTypeDef HAL_SMBUS_Slave_Transmit_IT (SMBUS_HandleTypeDef * hsmbus, uint8_t * pData, uint16_t Size, uint32_t XferOptions)**

Function description Transmit in slave/device SMBUS mode an amount of data in non-blocking mode with Interrupt.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of SMBUS XferOptions definition

Return values

- **HAL:** status

HAL_SMBUS_Slave_Receive_IT

Function name **HAL_StatusTypeDef HAL_SMBUS_Slave_Receive_IT (SMBUS_HandleTypeDef * hsmbus, uint8_t * pData, uint16_t Size, uint32_t XferOptions)**

Function description Receive in slave/device SMBUS mode an amount of data in non-blocking mode with Interrupt.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of SMBUS XferOptions definition

Return values

- **HAL:** status

HAL_SMBUS_EnableAlert_IT

Function name	HAL_StatusTypeDef HAL_SMBUS_EnableAlert_IT (SMBUS_HandleTypeDef * hsmbus)
Function description	Enable the SMBUS alert mode with Interrupt.
Parameters	<ul style="list-style-type: none">• hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUSx peripheral.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SMBUS_DisableAlert_IT

Function name	HAL_StatusTypeDef HAL_SMBUS_DisableAlert_IT (SMBUS_HandleTypeDef * hsmbus)
Function description	Disable the SMBUS alert mode with Interrupt.
Parameters	<ul style="list-style-type: none">• hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUSx peripheral.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SMBUS_EnableListen_IT

Function name	HAL_StatusTypeDef HAL_SMBUS_EnableListen_IT (SMBUS_HandleTypeDef * hsmbus)
Function description	Enable the Address listen mode with Interrupt.
Parameters	<ul style="list-style-type: none">• hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SMBUS_DisableListen_IT

Function name	HAL_StatusTypeDef HAL_SMBUS_DisableListen_IT (SMBUS_HandleTypeDef * hsmbus)
Function description	Disable the Address listen mode with Interrupt.
Parameters	<ul style="list-style-type: none">• hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SMBUS_EV_IRQHandler

Function name	void HAL_SMBUS_EV_IRQHandler (SMBUS_HandleTypeDef * hsmbus)
Function description	Handle SMBUS event interrupt request.
Parameters	<ul style="list-style-type: none">• hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified

SMBUS.

Return values

- **None:**

HAL_SMBUS_ER_IRQHandler

Function name **void HAL_SMBUS_ER_IRQHandler (SMBUS_HandleTypeDef * hsmbus)**

Function description Handle SMBUS error interrupt request.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **None:**

HAL_SMBUS_MasterTxCpltCallback

Function name **void HAL_SMBUS_MasterTxCpltCallback (SMBUS_HandleTypeDef * hsmbus)**

Function description Master Tx Transfer completed callback.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **None:**

HAL_SMBUS_MasterRxCpltCallback

Function name **void HAL_SMBUS_MasterRxCpltCallback (SMBUS_HandleTypeDef * hsmbus)**

Function description Master Rx Transfer completed callback.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **None:**

HAL_SMBUS_SlaveTxCpltCallback

Function name **void HAL_SMBUS_SlaveTxCpltCallback (SMBUS_HandleTypeDef * hsmbus)**

Function description Slave Tx Transfer completed callback.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **None:**

HAL_SMBUS_SlaveRxCpltCallback

Function name **void HAL_SMBUS_SlaveRxCpltCallback (SMBUS_HandleTypeDef * hsmbus)**

Function description	Slave Rx Transfer completed callback.
Parameters	<ul style="list-style-type: none">• hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
Return values	<ul style="list-style-type: none">• None:

HAL_SMBUS_AddrCallback

Function name	void HAL_SMBUS_AddrCallback (SMBUS_HandleTypeDef * hsmbus, uint8_t TransferDirection, uint16_t AddrMatchCode)
Function description	Slave Address Match callback.
Parameters	<ul style="list-style-type: none">• hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.• TransferDirection: Master request Transfer Direction (Write/Read)• AddrMatchCode: Address Match Code
Return values	<ul style="list-style-type: none">• None:

HAL_SMBUS_ListenCpltCallback

Function name	void HAL_SMBUS_ListenCpltCallback (SMBUS_HandleTypeDef * hsmbus)
Function description	Listen Complete callback.
Parameters	<ul style="list-style-type: none">• hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
Return values	<ul style="list-style-type: none">• None:

HAL_SMBUS_ErrorCallback

Function name	void HAL_SMBUS_ErrorCallback (SMBUS_HandleTypeDef * hsmbus)
Function description	SMBUS error callback.
Parameters	<ul style="list-style-type: none">• hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
Return values	<ul style="list-style-type: none">• None:

HAL_SMBUS_GetState

Function name	uint32_t HAL_SMBUS_GetState (SMBUS_HandleTypeDef * hsmbus)
Function description	Return the SMBUS handle state.
Parameters	<ul style="list-style-type: none">• hsmbus: Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **HAL:** state

HAL_SMBUS_GetError

Function name **uint32_t HAL_SMBUS_GetError (SMBUS_HandleTypeDef * hsmbus)**

Function description Return the SMBUS error code.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **SMBUS:** Error Code

60.3 SMBUS Firmware driver defines

60.3.1 SMBUS

SMBUS addressing mode

SMBUS_ADDRESSINGMODE_7BIT

SMBUS_ADDRESSINGMODE_10BIT

SMBUS Analog Filter

SMBUS_ANALOGFILTER_ENABLE

SMBUS_ANALOGFILTER_DISABLE

SMBUS dual addressing mode

SMBUS_DUALADDRESS_DISABLE

SMBUS_DUALADDRESS_ENABLE

SMBUS Error Code definition

HAL_SMBUS_ERROR_NONE	No error
HAL_SMBUS_ERROR_BERR	BERR error
HAL_SMBUS_ERROR_ARLO	ARLO error
HAL_SMBUS_ERROR_ACKF	ACKF error
HAL_SMBUS_ERROR_OVR	OVR error
HAL_SMBUS_ERROR_HALTIMEOUT	Timeout error
HAL_SMBUS_ERROR_BUSTIMEOUT	Bus Timeout error
HAL_SMBUS_ERROR_ALERT	Alert error
HAL_SMBUS_ERROR_PECERR	PEC error

SMBUS Exported Macros

__HAL_SMBUS_RESET_HANDLE_STATE **Description:**

- Reset SMBUS handle state.

Parameters:

- **__HANDLE__:** specifies the SMBUS

`__HAL_SMBUS_ENABLE_IT`

Handle.

Return value:

- None

Description:

- Enable the specified SMBUS interrupts.

Parameters:

- `__HANDLE__`: specifies the SMBUS Handle.
- `__INTERRUPT__`: specifies the interrupt source to enable. This parameter can be one of the following values:
 - `SMBUS_IT_ERRI` Errors interrupt enable
 - `SMBUS_IT_TCI` Transfer complete interrupt enable
 - `SMBUS_IT_STOPI` STOP detection interrupt enable
 - `SMBUS_IT_NACKI` NACK received interrupt enable
 - `SMBUS_IT_ADDRI` Address match interrupt enable
 - `SMBUS_IT_RXI` RX interrupt enable
 - `SMBUS_IT_TXI` TX interrupt enable

Return value:

- None

Description:

- Disable the specified SMBUS interrupts.

Parameters:

- `__HANDLE__`: specifies the SMBUS Handle.
- `__INTERRUPT__`: specifies the interrupt source to disable. This parameter can be one of the following values:
 - `SMBUS_IT_ERRI` Errors interrupt enable
 - `SMBUS_IT_TCI` Transfer complete interrupt enable
 - `SMBUS_IT_STOPI` STOP detection interrupt enable
 - `SMBUS_IT_NACKI` NACK received interrupt enable
 - `SMBUS_IT_ADDRI` Address match interrupt enable

`__HAL_SMBUS_DISABLE_IT`

- SMBUS_IT_RXI RX interrupt enable
- SMBUS_IT_TXI TX interrupt enable

Return value:

- None

`__HAL_SMBUS_GET_IT_SOURCE`**Description:**

- Check whether the specified SMBUS interrupt source is enabled or not.

Parameters:

- `__HANDLE__`: specifies the SMBUS Handle.
- `__INTERRUPT__`: specifies the SMBUS interrupt source to check. This parameter can be one of the following values:
 - SMBUS_IT_ERRI Errors interrupt enable
 - SMBUS_IT_TCI Transfer complete interrupt enable
 - SMBUS_IT_STOPI STOP detection interrupt enable
 - SMBUS_IT_NACKI NACK received interrupt enable
 - SMBUS_IT_ADDRI Address match interrupt enable
 - SMBUS_IT_RXI RX interrupt enable
 - SMBUS_IT_TXI TX interrupt enable

Return value:

- The: new state of `__IT__` (TRUE or FALSE).

`SMBUS_FLAG_MASK`**Description:**

- Check whether the specified SMBUS flag is set or not.

Parameters:

- `__HANDLE__`: specifies the SMBUS Handle.
- `__FLAG__`: specifies the flag to check. This parameter can be one of the following values:
 - SMBUS_FLAG_TXE Transmit data register empty
 - SMBUS_FLAG_TXIS Transmit interrupt status
 - SMBUS_FLAG_RXNE Receive data register not empty

- SMBUS_FLAG_ADDR Address matched (slave mode)
- SMBUS_FLAG_AF NACK received flag
- SMBUS_FLAG_STOPF STOP detection flag
- SMBUS_FLAG_TC Transfer complete (master mode)
- SMBUS_FLAG_TCR Transfer complete reload
- SMBUS_FLAG_BERR Bus error
- SMBUS_FLAG_ARLO Arbitration lost
- SMBUS_FLAG_OVR Overrun/Underrun
- SMBUS_FLAG_PECERR PEC error in reception
- SMBUS_FLAG_TIMEOUT Timeout or Tlow detection flag
- SMBUS_FLAG_ALERT SMBus alert
- SMBUS_FLAG_BUSY Bus busy
- SMBUS_FLAG_DIR Transfer direction (slave mode)

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

__HAL_SMBUS_GET_FLAG

__HAL_SMBUS_CLEAR_FLAG

Description:

- Clear the SMBUS pending flags which are cleared by writing 1 in a specific bit.

Parameters:

- __HANDLE__: specifies the SMBUS Handle.
- __FLAG__: specifies the flag to clear. This parameter can be any combination of the following values:
 - SMBUS_FLAG_ADDR Address matched (slave mode)
 - SMBUS_FLAG_AF NACK received flag
 - SMBUS_FLAG_STOPF STOP detection flag
 - SMBUS_FLAG_BERR Bus error
 - SMBUS_FLAG_ARLO Arbitration lost
 - SMBUS_FLAG_OVR Overrun/Underrun
 - SMBUS_FLAG_PECERR PEC error in reception

- SMBUS_FLAG_TIMEOUT
Timeout or Tlow detection flag
- SMBUS_FLAG_ALERT SMBus
alert

Return value:

- None

Description:

- Enable the specified SMBUS peripheral.

Parameters:

- `__HANDLE__`: specifies the SMBUS Handle.

Return value:

- None

Description:

- Disable the specified SMBUS peripheral.

Parameters:

- `__HANDLE__`: specifies the SMBUS Handle.

Return value:

- None

Description:

- Generate a Non-Acknowledge SMBUS peripheral in Slave mode.

Parameters:

- `__HANDLE__`: specifies the SMBUS Handle.

Return value:

- None

`__HAL_SMBUS_ENABLE``__HAL_SMBUS_DISABLE``__HAL_SMBUS_GENERATE_NACK`**SMBUS Flag definition**`SMBUS_FLAG_TXE``SMBUS_FLAG_TXIS``SMBUS_FLAG_RXNE``SMBUS_FLAG_ADDR``SMBUS_FLAG_AF``SMBUS_FLAG_STOPF``SMBUS_FLAG_TC``SMBUS_FLAG_TCR`

SMBUS_FLAG_BERR
SMBUS_FLAG_ARLO
SMBUS_FLAG_OVR
SMBUS_FLAG_PECERR
SMBUS_FLAG_TIMEOUT
SMBUS_FLAG_ALERT
SMBUS_FLAG_BUSY
SMBUS_FLAG_DIR

SMBUS general call addressing mode

SMBUS_GENERALCALL_DISABLE
SMBUS_GENERALCALL_ENABLE

SMBUS Interrupt configuration definition

SMBUS_IT_ERRI
SMBUS_IT_TCI
SMBUS_IT_STOPI
SMBUS_IT_NACKI
SMBUS_IT_ADDRI
SMBUS_IT_RXI
SMBUS_IT_TXI
SMBUS_IT_TX
SMBUS_IT_RX
SMBUS_IT_ALERT
SMBUS_IT_ADDR

SMBUS nostretch mode

SMBUS_NOSTRETCH_DISABLE
SMBUS_NOSTRETCH_ENABLE

SMBUS ownaddress2 masks

SMBUS_OA2_NOMASK
SMBUS_OA2_MASK01
SMBUS_OA2_MASK02
SMBUS_OA2_MASK03
SMBUS_OA2_MASK04
SMBUS_OA2_MASK05
SMBUS_OA2_MASK06
SMBUS_OA2_MASK07

SMBUS packet error check mode

SMBUS_PEC_DISABLE

SMBUS_PEC_ENABLE

SMBUS peripheral mode

SMBUS_PERIPHERAL_MODE_SMBUS_HOST

SMBUS_PERIPHERAL_MODE_SMBUS_SLAVE

SMBUS_PERIPHERAL_MODE_SMBUS_SLAVE_ARP

SMBUS ReloadEndMode definition

SMBUS_SOFTEND_MODE

SMBUS_RELOAD_MODE

SMBUS_AUTOEND_MODE

SMBUS_SENDPEC_MODE

SMBUS StartStopMode definition

SMBUS_NO_STARTSTOP

SMBUS_GENERATE_STOP

SMBUS_GENERATE_START_READ

SMBUS_GENERATE_START_WRITE

SMBUS XferOptions definition

SMBUS_FIRST_FRAME

SMBUS_NEXT_FRAME

SMBUS_FIRST_AND_LAST_FRAME_NO_PEC

SMBUS_LAST_FRAME_NO_PEC

SMBUS_FIRST_AND_LAST_FRAME_WITH_PEC

SMBUS_LAST_FRAME_WITH_PEC

SMBUS_OTHER_FRAME_NO_PEC

SMBUS_OTHER_FRAME_WITH_PEC

SMBUS_OTHER_AND_LAST_FRAME_NO_PEC

SMBUS_OTHER_AND_LAST_FRAME_WITH_PEC

61 HAL SPDIFRX Generic Driver

61.1 SPDIFRX Firmware driver registers structures

61.1.1 SPDIFRX_InitTypeDef

Data Fields

- *uint32_t* **InputSelection**
- *uint32_t* **Retries**
- *uint32_t* **WaitForActivity**
- *uint32_t* **ChannelSelection**
- *uint32_t* **DataFormat**
- *uint32_t* **StereoMode**
- *uint32_t* **PreambleTypeMask**
- *uint32_t* **ChannelStatusMask**
- *uint32_t* **ValidityBitMask**
- *uint32_t* **ParityErrorMask**

Field Documentation

- *uint32_t* **SPDIFRX_InitTypeDef::InputSelection**
Specifies the SPDIF input selection. This parameter can be a value of [SPDIFRX_Input_Selection](#)
- *uint32_t* **SPDIFRX_InitTypeDef::Retries**
Specifies the Maximum allowed re-tries during synchronization phase. This parameter can be a value of [SPDIFRX_Max_Retries](#)
- *uint32_t* **SPDIFRX_InitTypeDef::WaitForActivity**
Specifies the wait for activity on SPDIF selected input. This parameter can be a value of [SPDIFRX_Wait_For_Activity](#).
- *uint32_t* **SPDIFRX_InitTypeDef::ChannelSelection**
Specifies whether the control flow will take the channel status from channel A or B. This parameter can be a value of [SPDIFRX_Channel_Selection](#)
- *uint32_t* **SPDIFRX_InitTypeDef::DataFormat**
Specifies the Data samples format (LSB, MSB, ...). This parameter can be a value of [SPDIFRX_Data_Format](#)
- *uint32_t* **SPDIFRX_InitTypeDef::StereoMode**
Specifies whether the peripheral is in stereo or mono mode. This parameter can be a value of [SPDIFRX_Stereo_Mode](#)
- *uint32_t* **SPDIFRX_InitTypeDef::PreambleTypeMask**
Specifies whether The preamble type bits are copied or not into the received frame. This parameter can be a value of [SPDIFRX_PT_Mask](#)
- *uint32_t* **SPDIFRX_InitTypeDef::ChannelStatusMask**
Specifies whether the channel status and user bits are copied or not into the received frame. This parameter can be a value of [SPDIFRX_ChannelStatus_Mask](#)
- *uint32_t* **SPDIFRX_InitTypeDef::ValidityBitMask**
Specifies whether the validity bit is copied or not into the received frame. This parameter can be a value of [SPDIFRX_V_Mask](#)
- *uint32_t* **SPDIFRX_InitTypeDef::ParityErrorMask**
Specifies whether the parity error bit is copied or not into the received frame. This parameter can be a value of [SPDIFRX_PE_Mask](#)

61.1.2 SPDIFRX_SetDataFormatTypeDef

Data Fields

- *uint32_t DataFormat*
- *uint32_t StereoMode*
- *uint32_t PreambleTypeMask*
- *uint32_t ChannelStatusMask*
- *uint32_t ValidityBitMask*
- *uint32_t ParityErrorMask*

Field Documentation

- *uint32_t SPDIFRX_SetDataFormatTypeDef::DataFormat*
Specifies the Data samples format (LSB, MSB, ...). This parameter can be a value of [SPDIFRX_Data_Format](#)
- *uint32_t SPDIFRX_SetDataFormatTypeDef::StereoMode*
Specifies whether the peripheral is in stereo or mono mode. This parameter can be a value of [SPDIFRX_Stereo_Mode](#)
- *uint32_t SPDIFRX_SetDataFormatTypeDef::PreambleTypeMask*
Specifies whether The preamble type bits are copied or not into the received frame. This parameter can be a value of [SPDIFRX_PT_Mask](#)
- *uint32_t SPDIFRX_SetDataFormatTypeDef::ChannelStatusMask*
Specifies whether the channel status and user bits are copied or not into the received frame. This parameter can be a value of [SPDIFRX_ChannelStatus_Mask](#)
- *uint32_t SPDIFRX_SetDataFormatTypeDef::ValidityBitMask*
Specifies whether the validity bit is copied or not into the received frame. This parameter can be a value of [SPDIFRX_V_Mask](#)
- *uint32_t SPDIFRX_SetDataFormatTypeDef::ParityErrorMask*
Specifies whether the parity error bit is copied or not into the received frame. This parameter can be a value of [SPDIFRX_PE_Mask](#)

61.1.3 SPDIFRX_HandleTypeDef

Data Fields

- *SPDIFRX_TypeDef * Instance*
- *SPDIFRX_InitTypeDef Init*
- *uint32_t * pRxBuffPtr*
- *uint32_t * pCsBuffPtr*
- *__IO uint16_t RxXferSize*
- *__IO uint16_t RxXferCount*
- *__IO uint16_t CsXferSize*
- *__IO uint16_t CsXferCount*
- *DMA_HandleTypeDef * hdmaCsRx*
- *DMA_HandleTypeDef * hdmaDrRx*
- *__IO HAL_LockTypeDef Lock*
- *__IO HAL_SPDIFRX_StateTypeDef State*
- *__IO uint32_t ErrorCode*

Field Documentation

- *SPDIFRX_TypeDef* SPDIFRX_HandleTypeDef::Instance*
- *SPDIFRX_InitTypeDef SPDIFRX_HandleTypeDef::Init*
- *uint32_t* SPDIFRX_HandleTypeDef::pRxBuffPtr*
- *uint32_t* SPDIFRX_HandleTypeDef::pCsBuffPtr*
- *__IO uint16_t SPDIFRX_HandleTypeDef::RxXferSize*

- `__IO uint16_t SPDIFRX_HandleTypeDef::RxXferCount`
- `__IO uint16_t SPDIFRX_HandleTypeDef::CsXferSize`
- `__IO uint16_t SPDIFRX_HandleTypeDef::CsXferCount`
- `DMA_HandleTypeDef* SPDIFRX_HandleTypeDef::hdmaCsRx`
- `DMA_HandleTypeDef* SPDIFRX_HandleTypeDef::hdmaDrRx`
- `__IO HAL_LockTypeDef SPDIFRX_HandleTypeDef::Lock`
- `__IO HAL_SPDIFRX_StateTypeDef SPDIFRX_HandleTypeDef::State`
- `__IO uint32_t SPDIFRX_HandleTypeDef::ErrorCode`

61.2 SPDIFRX Firmware driver API description

61.2.1 How to use this driver

The SPDIFRX HAL driver can be used as follow:

1. Declare SPDIFRX_HandleTypeDef handle structure.
2. Initialize the SPDIFRX low level resources by implement the HAL_SPDIFRX_MspInit() API:
 - a. Enable the SPDIFRX interface clock.
 - b. SPDIFRX pins configuration:
 - Enable the clock for the SPDIFRX GPIOs.
 - Configure these SPDIFRX pins as alternate function pull-up.
 - c. NVIC configuration if you need to use interrupt process (HAL_SPDIFRX_ReceiveControlFlow_IT() and HAL_SPDIFRX_ReceiveDataFlow_IT() API's).
 - Configure the SPDIFRX interrupt priority.
 - Enable the NVIC SPDIFRX IRQ handle.
 - d. DMA Configuration if you need to use DMA process (HAL_SPDIFRX_ReceiveDataFlow_DMA() and HAL_SPDIFRX_ReceiveControlFlow_DMA() API's).
 - Declare a DMA handle structure for the reception of the Data Flow channel.
 - Declare a DMA handle structure for the reception of the Control Flow channel.
 - Enable the DMAx interface clock.
 - Configure the declared DMA handle structure CtrlRx/DataRx with the required parameters.
 - Configure the DMA Channel.
 - Associate the initialized DMA handle to the SPDIFRX DMA CtrlRx/DataRx handle.
 - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA CtrlRx/DataRx channel.
3. Program the input selection, re-tries number, wait for activity, channel status selection, data format, stereo mode and masking of user bits using HAL_SPDIFRX_Init() function. The specific SPDIFRX interrupts (RXNE/CSRNE and Error Interrupts) will be managed using the macros __SPDIFRX_ENABLE_IT() and __SPDIFRX_DISABLE_IT() inside the receive process. Make sure that ck_spdif clock is configured.
4. Three operation modes are available within this driver :

Polling mode for reception operation (for debug purpose)

- Receive data flow in blocking mode using HAL_SPDIFRX_ReceiveDataFlow()
- Receive control flow of data in blocking mode using HAL_SPDIFRX_ReceiveControlFlow()

Interrupt mode for reception operation

- Receive an amount of data (Data Flow) in non blocking mode using HAL_SPDIFRX_ReceiveDataFlow_IT()
- Receive an amount of data (Control Flow) in non blocking mode using HAL_SPDIFRX_ReceiveControlFlow_IT()
- At reception end of half transfer HAL_SPDIFRX_RxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_SPDIFRX_RxHalfCpltCallback
- At reception end of transfer HAL_SPDIFRX_RxCpltCallback is executed and user can add his own code by customization of function pointer HAL_SPDIFRX_RxCpltCallback
- In case of transfer Error, HAL_SPDIFRX_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_SPDIFRX_ErrorCallback

DMA mode for reception operation

- Receive an amount of data (Data Flow) in non blocking mode (DMA) using HAL_SPDIFRX_ReceiveDataFlow_DMA()
- Receive an amount of data (Control Flow) in non blocking mode (DMA) using HAL_SPDIFRX_ReceiveControlFlow_DMA()
- At reception end of half transfer HAL_SPDIFRX_RxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_SPDIFRX_RxHalfCpltCallback
- At reception end of transfer HAL_SPDIFRX_RxCpltCallback is executed and user can add his own code by customization of function pointer HAL_SPDIFRX_RxCpltCallback
- In case of transfer Error, HAL_SPDIFRX_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_SPDIFRX_ErrorCallback
- Stop the DMA Transfer using HAL_SPDIFRX_DMAStop()

SPDIFRX HAL driver macros list

Below the list of most used macros in USART HAL driver.

- `__HAL_SPDIFRX_IDLE`: Disable the specified SPDIFRX peripheral (IDEL State)
- `__HAL_SPDIFRX_SYNC`: Enable the synchronization state of the specified SPDIFRX peripheral (SYNC State)
- `__HAL_SPDIFRX_RCV`: Enable the receive state of the specified SPDIFRX peripheral (RCV State)
- `__HAL_SPDIFRX_ENABLE_IT` : Enable the specified SPDIFRX interrupts
- `__HAL_SPDIFRX_DISABLE_IT` : Disable the specified SPDIFRX interrupts
- `__HAL_SPDIFRX_GET_FLAG`: Check whether the specified SPDIFRX flag is set or not.



You can refer to the SPDIFRX HAL driver header file for more useful macros

61.2.2 Initialization and de-initialization functions

This subsection provides a set of functions allowing to initialize and de-initialize the SPDIFRX peripheral:

- User must Implement HAL_SPDIFRX_MspInit() function in which he configures all related peripherals resources (CLOCK, GPIO, DMA, IT and NVIC).
- Call the function HAL_SPDIFRX_Init() to configure the SPDIFRX peripheral with the selected configuration:
 - Input Selection (IN0, IN1,...)
 - Maximum allowed re-tries during synchronization phase
 - Wait for activity on SPDIF selected input
 - Channel status selection (from channel A or B)
 - Data format (LSB, MSB, ...)
 - Stereo mode
 - User bits masking (PT,C,U,V,...)
- Call the function HAL_SPDIFRX_DeInit() to restore the default configuration of the selected SPDIFRXx peripheral.

This section contains the following APIs:

- [HAL_SPDIFRX_Init\(\)](#)
- [HAL_SPDIFRX_DeInit\(\)](#)
- [HAL_SPDIFRX_MspInit\(\)](#)
- [HAL_SPDIFRX_MspDeInit\(\)](#)
- [HAL_SPDIFRX_SetDataFormat\(\)](#)

61.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the SPDIFRX data transfers.

1. There is two mode of transfer:
 - Blocking mode : The communication is performed in the polling mode. The status of all data processing is returned by the same function after finishing transfer.
 - No-Blocking mode : The communication is performed using Interrupts or DMA. These functions return the status of the transfer start-up. The end of the data processing will be indicated through the dedicated SPDIFRX IRQ when using Interrupt mode or the DMA IRQ when using DMA mode.
2. Blocking mode functions are :
 - HAL_SPDIFRX_ReceiveDataFlow()
 - HAL_SPDIFRX_ReceiveControlFlow() (+@) Do not use blocking mode to receive both control and data flow at the same time.
3. No-Blocking mode functions with Interrupt are :
 - HAL_SPDIFRX_ReceiveControlFlow_IT()
 - HAL_SPDIFRX_ReceiveDataFlow_IT()
4. No-Blocking mode functions with DMA are :
 - HAL_SPDIFRX_ReceiveControlFlow_DMA()
 - HAL_SPDIFRX_ReceiveDataFlow_DMA()
5. A set of Transfer Complete Callbacks are provided in No_Blocking mode:
 - HAL_SPDIFRX_RxCpltCallback()
 - HAL_SPDIFRX_ErrorCallback()

This section contains the following APIs:

- [HAL_SPDIFRX_ReceiveDataFlow\(\)](#)
- [HAL_SPDIFRX_ReceiveControlFlow\(\)](#)
- [HAL_SPDIFRX_ReceiveDataFlow_IT\(\)](#)
- [HAL_SPDIFRX_ReceiveControlFlow_IT\(\)](#)
- [HAL_SPDIFRX_ReceiveDataFlow_DMA\(\)](#)
- [HAL_SPDIFRX_ReceiveControlFlow_DMA\(\)](#)

- [HAL_SPDIFRX_DMAStop\(\)](#)
- [HAL_SPDIFRX_IRQHandler\(\)](#)
- [HAL_SPDIFRX_RxHalfCpltCallback\(\)](#)
- [HAL_SPDIFRX_RxCpltCallback\(\)](#)
- [HAL_SPDIFRX_CxHalfCpltCallback\(\)](#)
- [HAL_SPDIFRX_CxCpltCallback\(\)](#)
- [HAL_SPDIFRX_ErrorCallback\(\)](#)

61.2.4 Peripheral State and Errors functions

This subsection permit to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- [HAL_SPDIFRX_GetState\(\)](#)
- [HAL_SPDIFRX_GetError\(\)](#)

61.2.5 Detailed description of functions

HAL_SPDIFRX_Init

Function name	HAL_StatusTypeDef HAL_SPDIFRX_Init (SPDIFRX_HandleTypeDef * hspdif)
Function description	Initializes the SPDIFRX according to the specified parameters in the SPDIFRX_InitTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none"> • hspdif: SPDIFRX handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SPDIFRX_DeInit

Function name	HAL_StatusTypeDef HAL_SPDIFRX_DeInit (SPDIFRX_HandleTypeDef * hspdif)
Function description	Deinitializes the SPDIFRX peripheral.
Parameters	<ul style="list-style-type: none"> • hspdif: SPDIFRX handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SPDIFRX_MspInit

Function name	void HAL_SPDIFRX_MspInit (SPDIFRX_HandleTypeDef * hspdif)
Function description	SPDIFRX MSP Init.
Parameters	<ul style="list-style-type: none"> • hspdif: SPDIFRX handle
Return values	<ul style="list-style-type: none"> • None:

HAL_SPDIFRX_MspDeInit

Function name	void HAL_SPDIFRX_MspDeInit (SPDIFRX_HandleTypeDef * hspdif)
Function description	SPDIFRX MSP DeInit.

- | | |
|---------------|---|
| Parameters | <ul style="list-style-type: none"> • hspdif: SPDIFRX handle |
| Return values | <ul style="list-style-type: none"> • None: |

HAL_SPDIFRX_SetDataFormat

- | | |
|----------------------|--|
| Function name | HAL_StatusTypeDef HAL_SPDIFRX_SetDataFormat (SPDIFRX_HandleTypeDef * hspdif, SPDIFRX_SetDataFormatTypeDef sDataFormat) |
| Function description | Sets the SPDIFRX dtat format according to the specified parameters in the SPDIFRX_InitTypeDef. |
| Parameters | <ul style="list-style-type: none"> • hspdif: SPDIFRX handle • sDataFormat: SPDIFRX data format |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_SPDIFRX_ReceiveDataFlow

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_SPDIFRX_ReceiveDataFlow (SPDIFRX_HandleTypeDef * hspdif, uint32_t * pData, uint16_t Size, uint32_t Timeout) |
| Function description | Receives an amount of data (Data Flow) in blocking mode. |
| Parameters | <ul style="list-style-type: none"> • hspdif: pointer to SPDIFRX_HandleTypeDef structure that contains the configuration information for SPDIFRX module. • pData: Pointer to data buffer • Size: Amount of data to be received • Timeout: Timeout duration |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_SPDIFRX_ReceiveControlFlow

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_SPDIFRX_ReceiveControlFlow (SPDIFRX_HandleTypeDef * hspdif, uint32_t * pData, uint16_t Size, uint32_t Timeout) |
| Function description | Receives an amount of data (Control Flow) in blocking mode. |
| Parameters | <ul style="list-style-type: none"> • hspdif: pointer to a SPDIFRX_HandleTypeDef structure that contains the configuration information for SPDIFRX module. • pData: Pointer to data buffer • Size: Amount of data to be received • Timeout: Timeout duration |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_SPDIFRX_ReceiveControlFlow_IT

- | | |
|----------------------|--|
| Function name | HAL_StatusTypeDef HAL_SPDIFRX_ReceiveControlFlow_IT (SPDIFRX_HandleTypeDef * hspdif, uint32_t * pData, uint16_t Size) |
| Function description | Receive an amount of data (Control Flow) with Interrupt. |
| Parameters | <ul style="list-style-type: none"> • hspdif: SPDIFRX handle |

- **pData**: a 32-bit pointer to the Receive data buffer.
 - **Size**: number of data sample (Control Flow) to be received :
- Return values
- **HAL**: status

HAL_SPDIFRX_ReceiveDataFlow_IT

- Function name **HAL_StatusTypeDef HAL_SPDIFRX_ReceiveDataFlow_IT (SPDIFRX_HandleTypeDef * hspdif, uint32_t * pData, uint16_t Size)**
- Function description Receive an amount of data (Data Flow) in non-blocking mode with Interrupt.
- Parameters
- **hspdif**: SPDIFRX handle
 - **pData**: a 32-bit pointer to the Receive data buffer.
 - **Size**: number of data sample to be received .
- Return values
- **HAL**: status

HAL_SPDIFRX_IRQHandler

- Function name **void HAL_SPDIFRX_IRQHandler (SPDIFRX_HandleTypeDef * hspdif)**
- Function description This function handles SPDIFRX interrupt request.
- Parameters
- **hspdif**: SPDIFRX handle
- Return values
- **HAL**: status

HAL_SPDIFRX_ReceiveControlFlow_DMA

- Function name **HAL_StatusTypeDef HAL_SPDIFRX_ReceiveControlFlow_DMA (SPDIFRX_HandleTypeDef * hspdif, uint32_t * pData, uint16_t Size)**
- Function description Receive an amount of data (Control Flow) with DMA.
- Parameters
- **hspdif**: SPDIFRX handle
 - **pData**: a 32-bit pointer to the Receive data buffer.
 - **Size**: number of data (Control Flow) sample to be received :
- Return values
- **HAL**: status

HAL_SPDIFRX_ReceiveDataFlow_DMA

- Function name **HAL_StatusTypeDef HAL_SPDIFRX_ReceiveDataFlow_DMA (SPDIFRX_HandleTypeDef * hspdif, uint32_t * pData, uint16_t Size)**
- Function description Receive an amount of data (Data Flow) mode with DMA.
- Parameters
- **hspdif**: SPDIFRX handle
 - **pData**: a 32-bit pointer to the Receive data buffer.
 - **Size**: number of data sample to be received :
- Return values
- **HAL**: status

HAL_SPDIFRX_DMAStop

Function name	HAL_StatusTypeDef HAL_SPDIFRX_DMAStop (SPDIFRX_HandleTypeDef * hspdif)
Function description	stop the audio stream receive from the Media.
Parameters	<ul style="list-style-type: none">• hspdif: SPDIFRX handle
Return values	<ul style="list-style-type: none">• None:

HAL_SPDIFRX_RxHalfCpltCallback

Function name	void HAL_SPDIFRX_RxHalfCpltCallback (SPDIFRX_HandleTypeDef * hspdif)
Function description	Rx Transfer (Data flow) half completed callbacks.
Parameters	<ul style="list-style-type: none">• hspdif: SPDIFRX handle
Return values	<ul style="list-style-type: none">• None:

HAL_SPDIFRX_RxCpltCallback

Function name	void HAL_SPDIFRX_RxCpltCallback (SPDIFRX_HandleTypeDef * hspdif)
Function description	Rx Transfer (Data flow) completed callbacks.
Parameters	<ul style="list-style-type: none">• hspdif: SPDIFRX handle
Return values	<ul style="list-style-type: none">• None:

HAL_SPDIFRX_ErrorCallback

Function name	void HAL_SPDIFRX_ErrorCallback (SPDIFRX_HandleTypeDef * hspdif)
Function description	SPDIFRX error callbacks.
Parameters	<ul style="list-style-type: none">• hspdif: SPDIFRX handle
Return values	<ul style="list-style-type: none">• None:

HAL_SPDIFRX_CxHalfCpltCallback

Function name	void HAL_SPDIFRX_CxHalfCpltCallback (SPDIFRX_HandleTypeDef * hspdif)
Function description	Rx (Control flow) Transfer half completed callbacks.
Parameters	<ul style="list-style-type: none">• hspdif: SPDIFRX handle
Return values	<ul style="list-style-type: none">• None:

HAL_SPDIFRX_CxCpltCallback

Function name	void HAL_SPDIFRX_CxCpltCallback (SPDIFRX_HandleTypeDef * hspdif)
Function description	Rx Transfer (Control flow) completed callbacks.

- | | |
|---------------|---|
| Parameters | <ul style="list-style-type: none"> • hspdif: SPDIFRX handle |
| Return values | <ul style="list-style-type: none"> • None: |

HAL_SPDIFRX_GetState

- | | |
|----------------------|---|
| Function name | HAL_SPDIFRX_StateTypeDef HAL_SPDIFRX_GetState (SPDIFRX_HandleTypeDef * hspdif) |
| Function description | Return the SPDIFRX state. |
| Parameters | <ul style="list-style-type: none"> • hspdif: : SPDIFRX handle |
| Return values | <ul style="list-style-type: none"> • HAL: state |

HAL_SPDIFRX_GetError

- | | |
|----------------------|---|
| Function name | uint32_t HAL_SPDIFRX_GetError (SPDIFRX_HandleTypeDef * hspdif) |
| Function description | Return the SPDIFRX error code. |
| Parameters | <ul style="list-style-type: none"> • hspdif: : SPDIFRX handle |
| Return values | <ul style="list-style-type: none"> • SPDIFRX: Error Code |

61.3 SPDIFRX Firmware driver defines**61.3.1 SPDIFRX*****SPDIFRX Channel Status Mask***

SPDIFRX_CHANNELSTATUS_OFF

SPDIFRX_CHANNELSTATUS_ON

SPDIFRX Channel Selection

SPDIFRX_CHANNEL_A

SPDIFRX_CHANNEL_B

SPDIFRX Data Format

SPDIFRX_DATAFORMAT_LSB

SPDIFRX_DATAFORMAT_MSB

SPDIFRX_DATAFORMAT_32BITS

SPDIFRX Error Code

HAL_SPDIFRX_ERROR_NONE	No error
HAL_SPDIFRX_ERROR_TIMEOUT	Timeout error
HAL_SPDIFRX_ERROR_OVR	OVR error
HAL_SPDIFRX_ERROR_PE	Parity error
HAL_SPDIFRX_ERROR_DMA	DMA transfer error
HAL_SPDIFRX_ERROR_UNKNOWN	Unknown Error error

SPDIFRX Exported Macros

<code>__HAL_SPDIFRX_RESET_HANDLE_STATE</code>	<p>Description:</p> <ul style="list-style-type: none">Reset SPDIFRX handle state. <p>Parameters:</p> <ul style="list-style-type: none"><code>__HANDLE__</code>: SPDIFRX handle. <p>Return value:</p> <ul style="list-style-type: none">None
<code>__HAL_SPDIFRX_IDLE</code>	<p>Description:</p> <ul style="list-style-type: none">Disable the specified SPDIFRX peripheral (IDLE State). <p>Parameters:</p> <ul style="list-style-type: none"><code>__HANDLE__</code>: specifies the SPDIFRX Handle. <p>Return value:</p> <ul style="list-style-type: none">None
<code>__HAL_SPDIFRX_SYNC</code>	<p>Description:</p> <ul style="list-style-type: none">Enable the specified SPDIFRX peripheral (SYNC State). <p>Parameters:</p> <ul style="list-style-type: none"><code>__HANDLE__</code>: specifies the SPDIFRX Handle. <p>Return value:</p> <ul style="list-style-type: none">None
<code>__HAL_SPDIFRX_RCV</code>	<p>Description:</p> <ul style="list-style-type: none">Enable the specified SPDIFRX peripheral (RCV State). <p>Parameters:</p> <ul style="list-style-type: none"><code>__HANDLE__</code>: specifies the SPDIFRX Handle. <p>Return value:</p> <ul style="list-style-type: none">None
<code>__HAL_SPDIFRX_ENABLE_IT</code>	<p>Description:</p> <ul style="list-style-type: none">Enable or disable the specified SPDIFRX interrupts. <p>Parameters:</p> <ul style="list-style-type: none"><code>__HANDLE__</code>: specifies the SPDIFRX Handle.<code>__INTERRUPT__</code>: specifies the interrupt source to enable or disable. This parameter can be one of the following values:

- SPDIFRX_IT_RXNE
- SPDIFRX_IT_CSRNE
- SPDIFRX_IT_PERRIE
- SPDIFRX_IT_OVRIE
- SPDIFRX_IT_SBLKIE
- SPDIFRX_IT_SYNCDIE
- SPDIFRX_IT_IFEIE

Return value:

- None

__HAL_SPDIFRX_DISABLE_IT

__HAL_SPDIFRX_GET_IT_SOURCE

Description:

- Checks if the specified SPDIFRX interrupt source is enabled or disabled.

Parameters:

- **__HANDLE__**: specifies the SPDIFRX Handle.
- **__INTERRUPT__**: specifies the SPDIFRX interrupt source to check. This parameter can be one of the following values:
 - SPDIFRX_IT_RXNE
 - SPDIFRX_IT_CSRNE
 - SPDIFRX_IT_PERRIE
 - SPDIFRX_IT_OVRIE
 - SPDIFRX_IT_SBLKIE
 - SPDIFRX_IT_SYNCDIE
 - SPDIFRX_IT_IFEIE

Return value:

- The: new state of **__IT__** (TRUE or FALSE).

__HAL_SPDIFRX_GET_FLAG

Description:

- Checks whether the specified SPDIFRX flag is set or not.

Parameters:

- **__HANDLE__**: specifies the SPDIFRX Handle.
- **__FLAG__**: specifies the flag to check. This parameter can be one of the following values:
 - SPDIFRX_FLAG_RXNE
 - SPDIFRX_FLAG_CSRNE
 - SPDIFRX_FLAG_PERR
 - SPDIFRX_FLAG_OVR
 - SPDIFRX_FLAG_SBD
 - SPDIFRX_FLAG_SYNCD
 - SPDIFRX_FLAG_FERR

- SPDIFRX_FLAG_SERR
- SPDIFRX_FLAG_TERR

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

Description:

- Clears the specified SPDIFRX SR flag, in setting the proper IFCR register bit.

Parameters:

- __HANDLE__: specifies the USART Handle.
- __IT_CLEAR__: specifies the interrupt clear register flag that needs to be set to clear the corresponding interrupt This parameter can be one of the following values:
 - SPDIFRX_FLAG_PERR
 - SPDIFRX_FLAG_OVR
 - SPDIFRX_SR_SBD
 - SPDIFRX_SR_SYNCD

Return value:

- None

__HAL_SPDIFRX_CLEAR_IT

SPDIFRX Flags Definition

SPDIFRX_FLAG_RXNE
 SPDIFRX_FLAG_CSRNE
 SPDIFRX_FLAG_PERR
 SPDIFRX_FLAG_OVR
 SPDIFRX_FLAG_SBD
 SPDIFRX_FLAG_SYNCD
 SPDIFRX_FLAG_FERR
 SPDIFRX_FLAG_SERR
 SPDIFRX_FLAG_TERR

SPDIFRX Input Selection

SPDIFRX_INPUT_IN0
 SPDIFRX_INPUT_IN1
 SPDIFRX_INPUT_IN2
 SPDIFRX_INPUT_IN3

SPDIFRX Interrupts Definition

SPDIFRX_IT_RXNE
 SPDIFRX_IT_CSRNE

SPDIFRX_IT_PERRIE

SPDIFRX_IT_OVRIE

SPDIFRX_IT_SBLKIE

SPDIFRX_IT_SYNCDIE

SPDIFRX_IT_IFEIE

SPDIFRX Maximum Retries

SPDIFRX_MAXRETRIES_NONE

SPDIFRX_MAXRETRIES_3

SPDIFRX_MAXRETRIES_15

SPDIFRX_MAXRETRIES_63

SPDIFRX Parity Error Mask

SPDIFRX_PARITYERRORMASK_OFF

SPDIFRX_PARITYERRORMASK_ON

SPDIFRX Preamble Type Mask

SPDIFRX_PREAMBLETYPEMASK_OFF

SPDIFRX_PREAMBLETYPEMASK_ON

SPDIFRX State

SPDIFRX_STATE_IDLE

SPDIFRX_STATE_SYNC

SPDIFRX_STATE_RCV

SPDIFRX Stereo Mode

SPDIFRX_STEREOMODE_DISABLE

SPDIFRX_STEREOMODE_ENABLE

SPDIFRX Validity Mask

SPDIFRX_VALIDITYMASK_OFF

SPDIFRX_VALIDITYMASK_ON

SPDIFRX Wait For Activity

SPDIFRX_WAITFORACTIVITY_OFF

SPDIFRX_WAITFORACTIVITY_ON

62 HAL SPI Generic Driver

62.1 SPI Firmware driver registers structures

62.1.1 SPI_InitTypeDef

Data Fields

- *uint32_t Mode*
- *uint32_t Direction*
- *uint32_t DataSize*
- *uint32_t CLKPolarity*
- *uint32_t CLKPhase*
- *uint32_t NSS*
- *uint32_t BaudRatePrescaler*
- *uint32_t FirstBit*
- *uint32_t TIMode*
- *uint32_t CRCCalculation*
- *uint32_t CRCPolynomial*
- *uint32_t CRCLength*
- *uint32_t NSSPMode*

Field Documentation

- *uint32_t SPI_InitTypeDef::Mode*
Specifies the SPI operating mode. This parameter can be a value of [SPI_Mode](#)
- *uint32_t SPI_InitTypeDef::Direction*
Specifies the SPI bidirectional mode state. This parameter can be a value of [SPI_Direction](#)
- *uint32_t SPI_InitTypeDef::DataSize*
Specifies the SPI data size. This parameter can be a value of [SPI_Data_Size](#)
- *uint32_t SPI_InitTypeDef::CLKPolarity*
Specifies the serial clock steady state. This parameter can be a value of [SPI_Clock_Polarity](#)
- *uint32_t SPI_InitTypeDef::CLKPhase*
Specifies the clock active edge for the bit capture. This parameter can be a value of [SPI_Clock_Phase](#)
- *uint32_t SPI_InitTypeDef::NSS*
Specifies whether the NSS signal is managed by hardware (NSS pin) or by software using the SSI bit. This parameter can be a value of [SPI_Slave_Select_management](#)
- *uint32_t SPI_InitTypeDef::BaudRatePrescaler*
Specifies the Baud Rate prescaler value which will be used to configure the transmit and receive SCK clock. This parameter can be a value of [SPI_BaudRate_Prescaler](#)
Note:The communication clock is derived from the master clock. The slave clock does not need to be set.
- *uint32_t SPI_InitTypeDef::FirstBit*
Specifies whether data transfers start from MSB or LSB bit. This parameter can be a value of [SPI_MSB_LSB_transmission](#)
- *uint32_t SPI_InitTypeDef::TIMode*
Specifies if the TI mode is enabled or not. This parameter can be a value of [SPI_TI_mode](#)

- ***uint32_t SPI_InitTypeDef::CRCCalculation***
Specifies if the CRC calculation is enabled or not. This parameter can be a value of [SPI_CRC_Calculation](#)
- ***uint32_t SPI_InitTypeDef::CRCPolynomial***
Specifies the polynomial used for the CRC calculation. This parameter must be an odd number between Min_Data = 0 and Max_Data = 65535
- ***uint32_t SPI_InitTypeDef::CRCLength***
Specifies the CRC Length used for the CRC calculation. CRC Length is only used with Data8 and Data16, not other data size This parameter can be a value of [SPI_CRC_length](#)
- ***uint32_t SPI_InitTypeDef::NSSPMode***
Specifies whether the NSSP signal is enabled or not . This parameter can be a value of [SPI_NSSP_Mode](#) This mode is activated by the NSSP bit in the SPIx_CR2 register and it takes effect only if the SPI interface is configured as Motorola SPI master (FRF=0) with capture on the first edge (SPIx_CR1 CPHA = 0, CPOL setting is ignored)..

62.1.2 `__SPI_HandleTypeDef`

Data Fields

- ***SPI_TypeDef * Instance***
- ***SPI_InitTypeDef Init***
- ***uint8_t * pTxBuffPtr***
- ***uint16_t TxXferSize***
- ***__IO uint16_t TxXferCount***
- ***uint8_t * pRxBuffPtr***
- ***uint16_t RxXferSize***
- ***__IO uint16_t RxXferCount***
- ***uint32_t CRCSize***
- ***void(* RxISR***
- ***void(* TxISR***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_SPI_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***SPI_TypeDef* __SPI_HandleTypeDef::Instance***
SPI registers base address
- ***SPI_InitTypeDef __SPI_HandleTypeDef::Init***
SPI communication parameters
- ***uint8_t* __SPI_HandleTypeDef::pTxBuffPtr***
Pointer to SPI Tx transfer Buffer
- ***uint16_t __SPI_HandleTypeDef::TxXferSize***
SPI Tx Transfer size
- ***__IO uint16_t __SPI_HandleTypeDef::TxXferCount***
SPI Tx Transfer Counter
- ***uint8_t* __SPI_HandleTypeDef::pRxBuffPtr***
Pointer to SPI Rx transfer Buffer
- ***uint16_t __SPI_HandleTypeDef::RxXferSize***
SPI Rx Transfer size
- ***__IO uint16_t __SPI_HandleTypeDef::RxXferCount***
SPI Rx Transfer Counter

- **`uint32_t __SPI_HandleTypeDef::CRCSize`**
SPI CRC size used for the transfer
- **`void(* __SPI_HandleTypeDef::RxISR)(struct __SPI_HandleTypeDef *hspi)`**
function pointer on Rx ISR
- **`void(* __SPI_HandleTypeDef::TxISR)(struct __SPI_HandleTypeDef *hspi)`**
function pointer on Tx ISR
- **`DMA_HandleTypeDef* __SPI_HandleTypeDef::hdmatx`**
SPI Tx DMA Handle parameters
- **`DMA_HandleTypeDef* __SPI_HandleTypeDef::hdmarx`**
SPI Rx DMA Handle parameters
- **`HAL_LockTypeDef __SPI_HandleTypeDef::Lock`**
Locking object
- **`__IO HAL_SPI_StateTypeDef __SPI_HandleTypeDef::State`**
SPI communication state
- **`__IO uint32_t __SPI_HandleTypeDef::ErrorCode`**
SPI Error code

62.2 SPI Firmware driver API description

62.2.1 How to use this driver

The SPI HAL driver can be used as follows:

1. Declare a SPI_HandleTypeDef handle structure, for example: SPI_HandleTypeDef hspi;
2. Initialize the SPI low level resources by implementing the HAL_SPI_MspInit() API:
 - a. Enable the SPIx interface clock
 - b. SPI pins configuration
 - Enable the clock for the SPI GPIOs
 - Configure these SPI pins as alternate function push-pull
 - c. NVIC configuration if you need to use interrupt process
 - Configure the SPIx interrupt priority
 - Enable the NVIC SPI IRQ handle
 - d. DMA Configuration if you need to use DMA process
 - Declare a DMA_HandleTypeDef handle structure for the transmit or receive Stream/Channel
 - Enable the DMAx clock
 - Configure the DMA handle parameters
 - Configure the DMA Tx or Rx Stream/Channel
 - Associate the initialized hdma_tx handle to the hspi DMA Tx or Rx handle
 - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx or Rx Stream/Channel
3. Program the Mode, BidirectionalMode , Data size, Baudrate Prescaler, NSS management, Clock polarity and phase, FirstBit and CRC configuration in the hspi Init structure.
4. Initialize the SPI registers by calling the HAL_SPI_Init() API:
 - This API configures also the low level Hardware GPIO, CLOCK, CORTEX...etc) by calling the customized HAL_SPI_MspInit() API.

Circular mode restriction:

1. The DMA circular mode cannot be used when the SPI is configured in these modes:
 - a. Master 2Lines RxOnly
 - b. Master 1Line Rx
2. The CRC feature is not managed when the DMA circular mode is enabled

- When the SPI DMA Pause/Stop features are used, we must use the following APIs the HAL_SPI_DMALPause()/ HAL_SPI_DMALStop() only under the SPI callbacks



The max SPI frequency depend on SPI data size (4bits, 5bits,..., 8bits,...15bits, 16bits), SPI mode(2 Lines fullduplex, 2 lines RxOnly, 1 line TX/RX) and Process mode (Polling, IT, DMA).



- TX/RX processes are HAL_SPI_TransmitReceive(), HAL_SPI_TransmitReceive_IT() and HAL_SPI_TransmitReceive_DMA()
- RX processes are HAL_SPI_Receive(), HAL_SPI_Receive_IT() and HAL_SPI_Receive_DMA()
- TX processes are HAL_SPI_Transmit(), HAL_SPI_Transmit_IT() and HAL_SPI_Transmit_DMA()

62.2.2 Initialization and de-initialization functions

This subsection provides a set of functions allowing to initialize and de-initialize the SPIx peripheral:

- User must implement HAL_SPI_MspInit() function in which he configures all related peripherals resources (CLOCK, GPIO, DMA, IT and NVIC).
- Call the function HAL_SPI_Init() to configure the selected device with the selected configuration:
 - Mode
 - Direction
 - Data Size
 - Clock Polarity and Phase
 - NSS Management
 - BaudRate Prescaler
 - FirstBit
 - TIMode
 - CRC Calculation
 - CRC Polynomial if CRC enabled
 - CRC Length, used only with Data8 and Data16
 - FIFO reception threshold
- Call the function HAL_SPI_DeInit() to restore the default configuration of the selected SPIx peripheral.

This section contains the following APIs:

- [*HAL_SPI_Init\(\)*](#)
- [*HAL_SPI_DeInit\(\)*](#)
- [*HAL_SPI_MspInit\(\)*](#)
- [*HAL_SPI_MspDeInit\(\)*](#)

62.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the SPI data transfers.

The SPI supports master and slave mode :

- There are two modes of transfer:

- Blocking mode: The communication is performed in polling mode. The HAL status of all data processing is returned by the same function after finishing transfer.
 - No-Blocking mode: The communication is performed using Interrupts or DMA, These APIs return the HAL status. The end of the data processing will be indicated through the dedicated SPI IRQ when using Interrupt mode or the DMA IRQ when using DMA mode. The HAL_SPI_TxCpltCallback(), HAL_SPI_RxCpltCallback() and HAL_SPI_TxRxCpltCallback() user callbacks will be executed respectively at the end of the transmit or Receive process The HAL_SPI_ErrorCallback() user callback will be executed when a communication error is detected
2. APIs provided for these 2 transfer modes (Blocking mode or Non blocking mode using either Interrupt or DMA) exist for 1Line (simplex) and 2Lines (full duplex) modes.

This section contains the following APIs:

- [*HAL_SPI_Transmit\(\)*](#)
- [*HAL_SPI_Receive\(\)*](#)
- [*HAL_SPI_TransmitReceive\(\)*](#)
- [*HAL_SPI_Transmit_IT\(\)*](#)
- [*HAL_SPI_Receive_IT\(\)*](#)
- [*HAL_SPI_TransmitReceive_IT\(\)*](#)
- [*HAL_SPI_Transmit_DMA\(\)*](#)
- [*HAL_SPI_Receive_DMA\(\)*](#)
- [*HAL_SPI_TransmitReceive_DMA\(\)*](#)
- [*HAL_SPI_Abort\(\)*](#)
- [*HAL_SPI_Abort_IT\(\)*](#)
- [*HAL_SPI_DMADefer\(\)*](#)
- [*HAL_SPI_DMAResume\(\)*](#)
- [*HAL_SPI_DMADeferStop\(\)*](#)
- [*HAL_SPI_IRQHandler\(\)*](#)
- [*HAL_SPI_TxCpltCallback\(\)*](#)
- [*HAL_SPI_RxCpltCallback\(\)*](#)
- [*HAL_SPI_TxRxCpltCallback\(\)*](#)
- [*HAL_SPI_TxHalfCpltCallback\(\)*](#)
- [*HAL_SPI_RxHalfCpltCallback\(\)*](#)
- [*HAL_SPI_TxRxHalfCpltCallback\(\)*](#)
- [*HAL_SPI_ErrorCallback\(\)*](#)
- [*HAL_SPI_AbortCpltCallback\(\)*](#)

62.2.4 Peripheral State and Errors functions

This subsection provides a set of functions allowing to control the SPI.

- HAL_SPI_GetState() API can be helpful to check in run-time the state of the SPI peripheral
- HAL_SPI_GetError() check in run-time Errors occurring during communication

This section contains the following APIs:

- [*HAL_SPI_GetState\(\)*](#)
- [*HAL_SPI_GetError\(\)*](#)

62.2.5 Detailed description of functions

HAL_SPI_Init

Function name	HAL_StatusTypeDef HAL_SPI_Init (SPI_HandleTypeDef * hspi)
Function description	Initialize the SPI according to the specified parameters in the SPI_InitTypeDef and initialize the associated handle.
Parameters	<ul style="list-style-type: none"> • hspi: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SPI_DeInit

Function name	HAL_StatusTypeDef HAL_SPI_DeInit (SPI_HandleTypeDef * hspi)
Function description	De-Initialize the SPI peripheral.
Parameters	<ul style="list-style-type: none"> • hspi: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SPI_MspInit

Function name	void HAL_SPI_MspInit (SPI_HandleTypeDef * hspi)
Function description	Initialize the SPI MSP.
Parameters	<ul style="list-style-type: none"> • hspi: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
Return values	<ul style="list-style-type: none"> • None:

HAL_SPI_MspDeInit

Function name	void HAL_SPI_MspDeInit (SPI_HandleTypeDef * hspi)
Function description	De-Initialize the SPI MSP.
Parameters	<ul style="list-style-type: none"> • hspi: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
Return values	<ul style="list-style-type: none"> • None:

HAL_SPI_Transmit

Function name	HAL_StatusTypeDef HAL_SPI_Transmit (SPI_HandleTypeDef * hspi, uint8_t * pData, uint16_t Size, uint32_t Timeout)
Function description	Transmit an amount of data in blocking mode.
Parameters	<ul style="list-style-type: none"> • hspi: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module. • pData: pointer to data buffer • Size: amount of data to be sent • Timeout: Timeout duration

Return values

- **HAL:** status

HAL_SPI_Receive

Function name **HAL_StatusTypeDef HAL_SPI_Receive (SPI_HandleTypeDef * hspi, uint8_t * pData, uint16_t Size, uint32_t Timeout)**

Function description Receive an amount of data in blocking mode.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
- **pData:** pointer to data buffer
- **Size:** amount of data to be received
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_SPI_TransmitReceive

Function name **HAL_StatusTypeDef HAL_SPI_TransmitReceive (SPI_HandleTypeDef * hspi, uint8_t * pTxData, uint8_t * pRxData, uint16_t Size, uint32_t Timeout)**

Function description Transmit and Receive an amount of data in blocking mode.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
- **pTxData:** pointer to transmission data buffer
- **pRxData:** pointer to reception data buffer
- **Size:** amount of data to be sent and received
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_SPI_Transmit_IT

Function name **HAL_StatusTypeDef HAL_SPI_Transmit_IT (SPI_HandleTypeDef * hspi, uint8_t * pData, uint16_t Size)**

Function description Transmit an amount of data in non-blocking mode with Interrupt.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
- **pData:** pointer to data buffer
- **Size:** amount of data to be sent

Return values

- **HAL:** status

HAL_SPI_Receive_IT

Function name **HAL_StatusTypeDef HAL_SPI_Receive_IT (SPI_HandleTypeDef * hspi, uint8_t * pData, uint16_t Size)**

Function description Receive an amount of data in non-blocking mode with Interrupt.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
- **pData:** pointer to data buffer

- **Size:** amount of data to be sent
- Return values
- **HAL:** status

HAL_SPI_TransmitReceive_IT

- Function name **HAL_StatusTypeDef HAL_SPI_TransmitReceive_IT (SPI_HandleTypeDef * hspi, uint8_t * pTxData, uint8_t * pRxData, uint16_t Size)**
- Function description Transmit and Receive an amount of data in non-blocking mode with Interrupt.
- Parameters
- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
 - **pTxData:** pointer to transmission data buffer
 - **pRxData:** pointer to reception data buffer
 - **Size:** amount of data to be sent and received
- Return values
- **HAL:** status

HAL_SPI_Transmit_DMA

- Function name **HAL_StatusTypeDef HAL_SPI_Transmit_DMA (SPI_HandleTypeDef * hspi, uint8_t * pData, uint16_t Size)**
- Function description Transmit an amount of data in non-blocking mode with DMA.
- Parameters
- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
 - **pData:** pointer to data buffer
 - **Size:** amount of data to be sent
- Return values
- **HAL:** status

HAL_SPI_Receive_DMA

- Function name **HAL_StatusTypeDef HAL_SPI_Receive_DMA (SPI_HandleTypeDef * hspi, uint8_t * pData, uint16_t Size)**
- Function description Receive an amount of data in non-blocking mode with DMA.
- Parameters
- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
 - **pData:** pointer to data buffer
 - **Size:** amount of data to be sent
- Return values
- **HAL:** status
- Notes
- When the CRC feature is enabled the pData Length must be Size + 1.

HAL_SPI_TransmitReceive_DMA

- Function name **HAL_StatusTypeDef HAL_SPI_TransmitReceive_DMA (SPI_HandleTypeDef * hspi, uint8_t * pTxData, uint8_t * pRxData, uint16_t Size)**
- Function description Transmit and Receive an amount of data in non-blocking mode

with DMA.

Parameters	<ul style="list-style-type: none"> • hspi: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module. • pTxData: pointer to transmission data buffer • pRxData: pointer to reception data buffer • Size: amount of data to be sent
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • When the CRC feature is enabled the pRxData Length must be Size + 1

HAL_SPI_DMAPause

Function name	HAL_StatusTypeDef HAL_SPI_DMAPause (SPI_HandleTypeDef * hspi)
Function description	Pause the DMA Transfer.
Parameters	<ul style="list-style-type: none"> • hspi: pointer to a SPI_HandleTypeDef structure that contains the configuration information for the specified SPI module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SPI_DMAResume

Function name	HAL_StatusTypeDef HAL_SPI_DMAResume (SPI_HandleTypeDef * hspi)
Function description	Resume the DMA Transfer.
Parameters	<ul style="list-style-type: none"> • hspi: pointer to a SPI_HandleTypeDef structure that contains the configuration information for the specified SPI module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SPI_DMAStop

Function name	HAL_StatusTypeDef HAL_SPI_DMAStop (SPI_HandleTypeDef * hspi)
Function description	Stop the DMA Transfer.
Parameters	<ul style="list-style-type: none"> • hspi: pointer to a SPI_HandleTypeDef structure that contains the configuration information for the specified SPI module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_SPI_Abort

Function name	HAL_StatusTypeDef HAL_SPI_Abort (SPI_HandleTypeDef * hspi)
Function description	Abort ongoing transfer (blocking mode).
Parameters	<ul style="list-style-type: none"> • hspi: SPI handle.
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • This procedure could be used for aborting any ongoing transfer (Tx and Rx), started in Interrupt or DMA mode. This

procedure performs following operations : Disable SPI Interrupts (depending of transfer direction)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY

- This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

HAL_SPI_Abort_IT

Function name **HAL_StatusTypeDef HAL_SPI_Abort_IT (SPI_HandleTypeDef * hspi)**

Function description Abort ongoing transfer (Interrupt mode).

Parameters

- **hspi**: SPI handle.

Return values

- **HAL**: status

Notes

- This procedure could be used for aborting any ongoing transfer (Tx and Rx), started in Interrupt or DMA mode. This procedure performs following operations : Disable SPI Interrupts (depending of transfer direction)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback
- This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

HAL_SPI_IRQHandler

Function name **void HAL_SPI_IRQHandler (SPI_HandleTypeDef * hspi)**

Function description Handle SPI interrupt request.

Parameters

- **hspi**: pointer to a SPI_HandleTypeDef structure that contains the configuration information for the specified SPI module.

Return values

- **None**:

HAL_SPI_TxCpltCallback

Function name **void HAL_SPI_TxCpltCallback (SPI_HandleTypeDef * hspi)**

Function description Tx Transfer completed callback.

Parameters

- **hspi**: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None**:

HAL_SPI_RxCpltCallback

Function name **void HAL_SPI_RxCpltCallback (SPI_HandleTypeDef * hspi)**

Function description Rx Transfer completed callback.

Parameters

- **hspi**: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None**:

HAL_SPI_TxRxCpltCallback

Function name **void HAL_SPI_TxRxCpltCallback (SPI_HandleTypeDef * hspi)**

Function description Tx and Rx Transfer completed callback.

Parameters

- **hspi**: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None**:

HAL_SPI_TxHalfCpltCallback

Function name **void HAL_SPI_TxHalfCpltCallback (SPI_HandleTypeDef * hspi)**

Function description Tx Half Transfer completed callback.

Parameters

- **hspi**: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None**:

HAL_SPI_RxHalfCpltCallback

Function name **void HAL_SPI_RxHalfCpltCallback (SPI_HandleTypeDef * hspi)**

Function description Rx Half Transfer completed callback.

Parameters

- **hspi**: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None**:

HAL_SPI_TxRxHalfCpltCallback

Function name **void HAL_SPI_TxRxHalfCpltCallback (SPI_HandleTypeDef * hspi)**

Function description Tx and Rx Half Transfer callback.

Parameters

- **hspi**: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None**:

HAL_SPI_ErrorCallback

Function name **void HAL_SPI_ErrorCallback (SPI_HandleTypeDef * hspi)**

Function description SPI error callback.

Parameters

- **hspi**: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None**:

HAL_SPI_AbortCpltCallback

Function name	void HAL_SPI_AbortCpltCallback (SPI_HandleTypeDef * hspi)
Function description	SPI Abort Complete callback.
Parameters	<ul style="list-style-type: none"> • hspi: SPI handle.
Return values	<ul style="list-style-type: none"> • None:

HAL_SPI_GetState

Function name	HAL_SPI_StateTypeDef HAL_SPI_GetState (SPI_HandleTypeDef * hspi)
Function description	Return the SPI handle state.
Parameters	<ul style="list-style-type: none"> • hspi: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
Return values	<ul style="list-style-type: none"> • SPI: state

HAL_SPI_GetError

Function name	uint32_t HAL_SPI_GetError (SPI_HandleTypeDef * hspi)
Function description	Return the SPI error code.
Parameters	<ul style="list-style-type: none"> • hspi: pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
Return values	<ul style="list-style-type: none"> • SPI: error code in bitmap format

62.3 SPI Firmware driver defines**62.3.1 SPI*****SPI BaudRate Prescaler***

SPI_BAUDRATEPRESCALER_2
 SPI_BAUDRATEPRESCALER_4
 SPI_BAUDRATEPRESCALER_8
 SPI_BAUDRATEPRESCALER_16
 SPI_BAUDRATEPRESCALER_32
 SPI_BAUDRATEPRESCALER_64
 SPI_BAUDRATEPRESCALER_128
 SPI_BAUDRATEPRESCALER_256

SPI Clock Phase

SPI_PHASE_1EDGE
 SPI_PHASE_2EDGE

SPI Clock Polarity

SPI_POLARITY_LOW

SPI_POLARITY_HIGH

SPI CRC Calculation

SPI_CRCCALCULATION_DISABLE

SPI_CRCCALCULATION_ENABLE

SPI CRC Length

SPI_CRC_LENGTH_DATASIZE

SPI_CRC_LENGTH_8BIT

SPI_CRC_LENGTH_16BIT

SPI Data Size

SPI_DATASIZE_4BIT

SPI_DATASIZE_5BIT

SPI_DATASIZE_6BIT

SPI_DATASIZE_7BIT

SPI_DATASIZE_8BIT

SPI_DATASIZE_9BIT

SPI_DATASIZE_10BIT

SPI_DATASIZE_11BIT

SPI_DATASIZE_12BIT

SPI_DATASIZE_13BIT

SPI_DATASIZE_14BIT

SPI_DATASIZE_15BIT

SPI_DATASIZE_16BIT

SPI Direction Mode

SPI_DIRECTION_2LINES

SPI_DIRECTION_2LINES_RXONLY

SPI_DIRECTION_1LINE

SPI Error Code

HAL_SPI_ERROR_NONE No error

HAL_SPI_ERROR_MODF MODF error

HAL_SPI_ERROR_CRC CRC error

HAL_SPI_ERROR_OVR OVR error

HAL_SPI_ERROR_FRE FRE error

HAL_SPI_ERROR_DMA DMA transfer error

HAL_SPI_ERROR_FLAG Error on RXNE/TXE/BSY/FTLVL/FRLVL Flag

HAL_SPI_ERROR_ABORT Error during SPI Abort procedure

SPI Exported Macros

__HAL_SPI_RESET_HANDLE_STATE	<p>Description:</p> <ul style="list-style-type: none"> Reset SPI handle state. <p>Parameters:</p> <ul style="list-style-type: none"> <code>__HANDLE__</code>: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral. <p>Return value:</p> <ul style="list-style-type: none"> None
__HAL_SPI_ENABLE_IT	<p>Description:</p> <ul style="list-style-type: none"> Enable or disable the specified SPI interrupts. <p>Parameters:</p> <ul style="list-style-type: none"> <code>__HANDLE__</code>: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral. <code>__INTERRUPT__</code>: specifies the interrupt source to enable or disable. This parameter can be one of the following values: <ul style="list-style-type: none"> <code>SPI_IT_TXE</code>: Tx buffer empty interrupt enable <code>SPI_IT_RXNE</code>: RX buffer not empty interrupt enable <code>SPI_IT_ERR</code>: Error interrupt enable <p>Return value:</p> <ul style="list-style-type: none"> None
__HAL_SPI_DISABLE_IT	
__HAL_SPI_GET_IT_SOURCE	<p>Description:</p> <ul style="list-style-type: none"> Check whether the specified SPI interrupt source is enabled or not. <p>Parameters:</p> <ul style="list-style-type: none"> <code>__HANDLE__</code>: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral. <code>__INTERRUPT__</code>: specifies the SPI interrupt source to check. This parameter can be one of the following values: <ul style="list-style-type: none"> <code>SPI_IT_TXE</code>: Tx buffer empty interrupt enable <code>SPI_IT_RXNE</code>: RX buffer not empty interrupt enable <code>SPI_IT_ERR</code>: Error interrupt enable <p>Return value:</p> <ul style="list-style-type: none"> The: new state of <code>__IT__</code> (TRUE or FALSE).
__HAL_SPI_GET_FLAG	<p>Description:</p>

- Check whether the specified SPI flag is set or not.

Parameters:

- `__HANDLE__`: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.
- `__FLAG__`: specifies the flag to check. This parameter can be one of the following values:
 - `SPI_FLAG_RXNE`: Receive buffer not empty flag
 - `SPI_FLAG_TXE`: Transmit buffer empty flag
 - `SPI_FLAG_CRCERR`: CRC error flag
 - `SPI_FLAG_MODF`: Mode fault flag
 - `SPI_FLAG_OVR`: Overrun flag
 - `SPI_FLAG_BSY`: Busy flag
 - `SPI_FLAG_FRE`: Frame format error flag
 - `SPI_FLAG_FTLVL`: SPI fifo transmission level
 - `SPI_FLAG_FRLVL`: SPI fifo reception level

Return value:

- The: new state of `__FLAG__` (TRUE or FALSE).

`__HAL_SPI_CLEAR_CRCERRFLAG`

Description:

- Clear the SPI CRCERR pending flag.

Parameters:

- `__HANDLE__`: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.

Return value:

- None

`__HAL_SPI_CLEAR_MODFFLAG`

Description:

- Clear the SPI MODF pending flag.

Parameters:

- `__HANDLE__`: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.

Return value:

- None

`__HAL_SPI_CLEAR_OVRFLAG`

Description:

- Clear the SPI OVR pending flag.

`__HAL_SPI_CLEAR_FREFLAG`

Parameters:

- `__HANDLE__`: specifies the SPI Handle.
This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.

Return value:

- None

Description:

- Clear the SPI FRE pending flag.

Parameters:

- `__HANDLE__`: specifies the SPI Handle.
This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.

Return value:

- None

`__HAL_SPI_ENABLE`

Description:

- Enable the SPI peripheral.

Parameters:

- `__HANDLE__`: specifies the SPI Handle.
This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.

Return value:

- None

`__HAL_SPI_DISABLE`

Description:

- Disable the SPI peripheral.

Parameters:

- `__HANDLE__`: specifies the SPI Handle.
This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.

Return value:

- None

SPI FIFO Reception Threshold

`SPI_RXFIFO_THRESHOLD`

`SPI_RXFIFO_THRESHOLD_QF`

`SPI_RXFIFO_THRESHOLD_HF`

SPI Flags Definition

`SPI_FLAG_RXNE`

`SPI_FLAG_TXE`

`SPI_FLAG_BSY`

`SPI_FLAG_CRCERR`

SPI_FLAG_MODF

SPI_FLAG_OVR

SPI_FLAG_FRE

SPI_FLAG_FTLVL

SPI_FLAG_FRLVL

SPI Interrupt Definition

SPI_IT_TXE

SPI_IT_RXNE

SPI_IT_ERR

SPI Mode

SPI_MODE_SLAVE

SPI_MODE_MASTER

SPI MSB LSB Transmission

SPI_FIRSTBIT_MSB

SPI_FIRSTBIT_LSB

SPI NSS Pulse Mode

SPI_NSS_PULSE_ENABLE

SPI_NSS_PULSE_DISABLE

SPI Reception FIFO Status Level

SPI_FRLVL_EMPTY

SPI_FRLVL_QUARTER_FULL

SPI_FRLVL_HALF_FULL

SPI_FRLVL_FULL

SPI Slave Select Management

SPI_NSS_SOFT

SPI_NSS_HARD_INPUT

SPI_NSS_HARD_OUTPUT

SPI TI Mode

SPI_TIMODE_DISABLE

SPI_TIMODE_ENABLE

SPI Transmission FIFO Status Level

SPI_FTLVL_EMPTY

SPI_FTLVL_QUARTER_FULL

SPI_FTLVL_HALF_FULL

SPI_FTLVL_FULL

63 HAL SRAM Generic Driver

63.1 SRAM Firmware driver registers structures

63.1.1 SRAM_HandleTypeDef

Data Fields

- *FMC_NORSRAM_TypeDef * Instance*
- *FMC_NORSRAM_EXTENDED_TypeDef * Extended*
- *FMC_NORSRAM_InitTypeDef Init*
- *HAL_LockTypeDef Lock*
- *__IO HAL_SRAM_StateTypeDef State*
- *DMA_HandleTypeDef * hdma*

Field Documentation

- *FMC_NORSRAM_TypeDef* SRAM_HandleTypeDef::Instance*
Register base address
- *FMC_NORSRAM_EXTENDED_TypeDef* SRAM_HandleTypeDef::Extended*
Extended mode register base address
- *FMC_NORSRAM_InitTypeDef SRAM_HandleTypeDef::Init*
SRAM device control configuration parameters
- *HAL_LockTypeDef SRAM_HandleTypeDef::Lock*
SRAM locking object
- *__IO HAL_SRAM_StateTypeDef SRAM_HandleTypeDef::State*
SRAM device access state
- *DMA_HandleTypeDef* SRAM_HandleTypeDef::hdma*
Pointer DMA handler

63.2 SRAM Firmware driver API description

63.2.1 How to use this driver

This driver is a generic layered driver which contains a set of APIs used to control SRAM memories. It uses the FMC layer functions to interface with SRAM devices. The following sequence should be followed to configure the FMC to interface with SRAM/PSRAM memories:

1. Declare a SRAM_HandleTypeDef handle structure, for example:
SRAM_HandleTypeDef hsram; and:
 - Fill the SRAM_HandleTypeDef handle "Init" field with the allowed values of the structure member.
 - Fill the SRAM_HandleTypeDef handle "Instance" field with a predefined base register instance for NOR or SRAM device
 - Fill the SRAM_HandleTypeDef handle "Extended" field with a predefined base register instance for NOR or SRAM extended mode
2. Declare two FMC_NORSRAM_TimingTypeDef structures, for both normal and extended mode timings; for example: FMC_NORSRAM_TimingTypeDef Timing and FMC_NORSRAM_TimingTypeDef ExTiming; and fill its fields with the allowed values of the structure member.
3. Initialize the SRAM Controller by calling the function HAL_SRAM_Init(). This function performs the following sequence:
 - a. MSP hardware layer configuration using the function HAL_SRAM_MspInit()

- b. Control register configuration using the FMC NORSRAM interface function `FMC_NORSRAM_Init()`
- c. Timing register configuration using the FMC NORSRAM interface function `FMC_NORSRAM_Timing_Init()`
- d. Extended mode Timing register configuration using the FMC NORSRAM interface function `FMC_NORSRAM_Extended_Timing_Init()`
- e. Enable the SRAM device using the macro `__FMC_NORSRAM_ENABLE()`
4. At this stage you can perform read/write accesses from/to the memory connected to the NOR/SRAM Bank. You can perform either polling or DMA transfer using the following APIs:
 - `HAL_SRAM_Read()/HAL_SRAM_Write()` for polling read/write access
 - `HAL_SRAM_Read_DMA()/HAL_SRAM_Write_DMA()` for DMA read/write transfer
5. You can also control the SRAM device by calling the control APIs `HAL_SRAM_WriteOperation_Enable()/ HAL_SRAM_WriteOperation_Disable()` to respectively enable/disable the SRAM write operation
6. You can continuously monitor the SRAM device HAL state by calling the function `HAL_SRAM_GetState()`

63.2.2 SRAM Initialization and de_initialization functions

This section provides functions allowing to initialize/de-initialize the SRAM memory

This section contains the following APIs:

- [*HAL_SRAM_Init\(\)*](#)
- [*HAL_SRAM_DeInit\(\)*](#)
- [*HAL_SRAM_MspInit\(\)*](#)
- [*HAL_SRAM_MspDeInit\(\)*](#)
- [*HAL_SRAM_DMA_XferCpltCallback\(\)*](#)
- [*HAL_SRAM_DMA_XferErrorCallback\(\)*](#)

63.2.3 SRAM Input and Output functions

This section provides functions allowing to use and control the SRAM memory

This section contains the following APIs:

- [*HAL_SRAM_Read_8b\(\)*](#)
- [*HAL_SRAM_Write_8b\(\)*](#)
- [*HAL_SRAM_Read_16b\(\)*](#)
- [*HAL_SRAM_Write_16b\(\)*](#)
- [*HAL_SRAM_Read_32b\(\)*](#)
- [*HAL_SRAM_Write_32b\(\)*](#)
- [*HAL_SRAM_Read_DMA\(\)*](#)
- [*HAL_SRAM_Write_DMA\(\)*](#)
- [*HAL_SRAM_DMA_XferCpltCallback\(\)*](#)
- [*HAL_SRAM_DMA_XferErrorCallback\(\)*](#)

63.2.4 SRAM Control functions

This subsection provides a set of functions allowing to control dynamically the SRAM interface.

This section contains the following APIs:

- [*HAL_SRAM_WriteOperation_Enable\(\)*](#)
- [*HAL_SRAM_WriteOperation_Disable\(\)*](#)

63.2.5 SRAM State functions

This subsection permits to get in run-time the status of the SRAM controller and the data flow.

This section contains the following APIs:

- [HAL_SRAM_GetState\(\)](#)

63.2.6 Detailed description of functions

HAL_SRAM_Init

Function name HAL_StatusTypeDef HAL_SRAM_Init (SRAM_HandleTypeDef * hsram, FMC_NORSRAM_TimingTypeDef * Timing, FMC_NORSRAM_TimingTypeDef * ExtTiming)

Function description Performs the SRAM device initialization sequence.

Parameters

- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
- **Timing:** Pointer to SRAM control timing structure
- **ExtTiming:** Pointer to SRAM extended mode timing structure

Return values

- **HAL:** status

HAL_SRAM_DeInit

Function name HAL_StatusTypeDef HAL_SRAM_DeInit (SRAM_HandleTypeDef * hsram)

Function description Performs the SRAM device De-initialization sequence.

Parameters

- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.

Return values

- **HAL:** status

HAL_SRAM_MspInit

Function name void HAL_SRAM_MspInit (SRAM_HandleTypeDef * hsram)

Function description SRAM MSP Init.

Parameters

- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.

Return values

- **None:**

HAL_SRAM_MspDeInit

Function name void HAL_SRAM_MspDeInit (SRAM_HandleTypeDef * hsram)

Function description SRAM MSP DeInit.

Parameters

- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.

Return values

- **None:**

HAL_SRAM_Read_8b

Function name **HAL_StatusTypeDef HAL_SRAM_Read_8b (SRAM_HandleTypeDef * hsram, uint32_t * pAddress, uint8_t * pDstBuffer, uint32_t BufferSize)**

Function description Reads 8-bit buffer from SRAM memory.

Parameters

- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
- **pAddress:** Pointer to read start address
- **pDstBuffer:** Pointer to destination buffer
- **BufferSize:** Size of the buffer to read from memory

Return values

- **HAL:** status

HAL_SRAM_Write_8b

Function name **HAL_StatusTypeDef HAL_SRAM_Write_8b (SRAM_HandleTypeDef * hsram, uint32_t * pAddress, uint8_t * pSrcBuffer, uint32_t BufferSize)**

Function description Writes 8-bit buffer to SRAM memory.

Parameters

- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
- **pAddress:** Pointer to write start address
- **pSrcBuffer:** Pointer to source buffer to write
- **BufferSize:** Size of the buffer to write to memory

Return values

- **HAL:** status

HAL_SRAM_Read_16b

Function name **HAL_StatusTypeDef HAL_SRAM_Read_16b (SRAM_HandleTypeDef * hsram, uint32_t * pAddress, uint16_t * pDstBuffer, uint32_t BufferSize)**

Function description Reads 16-bit buffer from SRAM memory.

Parameters

- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
- **pAddress:** Pointer to read start address
- **pDstBuffer:** Pointer to destination buffer
- **BufferSize:** Size of the buffer to read from memory

Return values

- **HAL:** status

HAL_SRAM_Write_16b

Function name **HAL_StatusTypeDef HAL_SRAM_Write_16b (SRAM_HandleTypeDef * hsram, uint32_t * pAddress, uint16_t * pSrcBuffer, uint32_t BufferSize)**

Function description Writes 16-bit buffer to SRAM memory.

Parameters

- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
- **pAddress:** Pointer to write start address
- **pSrcBuffer:** Pointer to source buffer to write



- **BufferSize:** Size of the buffer to write to memory
- Return values
- **HAL:** status

HAL_SRAM_Read_32b

Function name **HAL_StatusTypeDef HAL_SRAM_Read_32b**
(SRAM_HandleTypeDef * hsrAm, uint32_t * pAddress, uint32_t * pDstBuffer, uint32_t BufferSize)

Function description Reads 32-bit buffer from SRAM memory.

- Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
 - **pAddress:** Pointer to read start address
 - **pDstBuffer:** Pointer to destination buffer
 - **BufferSize:** Size of the buffer to read from memory

- Return values
- **HAL:** status

HAL_SRAM_Write_32b

Function name **HAL_StatusTypeDef HAL_SRAM_Write_32b**
(SRAM_HandleTypeDef * hsrAm, uint32_t * pAddress, uint32_t * pSrcBuffer, uint32_t BufferSize)

Function description Writes 32-bit buffer to SRAM memory.

- Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
 - **pAddress:** Pointer to write start address
 - **pSrcBuffer:** Pointer to source buffer to write
 - **BufferSize:** Size of the buffer to write to memory

- Return values
- **HAL:** status

HAL_SRAM_Read_DMA

Function name **HAL_StatusTypeDef HAL_SRAM_Read_DMA**
(SRAM_HandleTypeDef * hsrAm, uint32_t * pAddress, uint32_t * pDstBuffer, uint32_t BufferSize)

Function description Reads a Words data from the SRAM memory using DMA transfer.

- Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
 - **pAddress:** Pointer to read start address
 - **pDstBuffer:** Pointer to destination buffer
 - **BufferSize:** Size of the buffer to read from memory

- Return values
- **HAL:** status

HAL_SRAM_Write_DMA

Function name **HAL_StatusTypeDef HAL_SRAM_Write_DMA**
(SRAM_HandleTypeDef * hsrAm, uint32_t * pAddress, uint32_t * pSrcBuffer, uint32_t BufferSize)

Function description	Writes a Words data buffer to SRAM memory using DMA transfer.
Parameters	<ul style="list-style-type: none">• hsram: pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.• pAddress: Pointer to write start address• pSrcBuffer: Pointer to source buffer to write• BufferSize: Size of the buffer to write to memory
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SRAM_DMA_XferCpltCallback

Function name	void HAL_SRAM_DMA_XferCpltCallback (DMA_HandleTypeDef * hdma)
Function description	DMA transfer complete callback.
Parameters	<ul style="list-style-type: none">• hdma: pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
Return values	<ul style="list-style-type: none">• None:

HAL_SRAM_DMA_XferErrorCallback

Function name	void HAL_SRAM_DMA_XferErrorCallback (DMA_HandleTypeDef * hdma)
Function description	DMA transfer complete error callback.
Parameters	<ul style="list-style-type: none">• hdma: pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
Return values	<ul style="list-style-type: none">• None:

HAL_SRAM_WriteOperation_Enable

Function name	HAL_StatusTypeDef HAL_SRAM_WriteOperation_Enable (SRAM_HandleTypeDef * hsram)
Function description	Enables dynamically SRAM write operation.
Parameters	<ul style="list-style-type: none">• hsram: pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SRAM_WriteOperation_Disable

Function name	HAL_StatusTypeDef HAL_SRAM_WriteOperation_Disable (SRAM_HandleTypeDef * hsram)
Function description	Disables dynamically SRAM write operation.
Parameters	<ul style="list-style-type: none">• hsram: pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_SRAM_GetState

Function name	HAL_SRAM_StateTypeDef HAL_SRAM_GetState (SRAM_HandleTypeDef * hsram)
Function description	Returns the SRAM controller state.
Parameters	<ul style="list-style-type: none">• hsram: pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
Return values	<ul style="list-style-type: none">• HAL: state

63.3 SRAM Firmware driver defines**63.3.1 SRAM*****SRAM Exported Macros*****__HAL_SRAM_RESET_HANDLE_STATE** **Description:**

- Reset SRAM handle state.

Parameters:

- **__HANDLE__**: SRAM handle

Return value:

- None

64 HAL TIM Generic Driver

64.1 TIM Firmware driver registers structures

64.1.1 TIM_Base_InitTypeDef

Data Fields

- *uint32_t Prescaler*
- *uint32_t CounterMode*
- *uint32_t Period*
- *uint32_t ClockDivision*
- *uint32_t RepetitionCounter*
- *uint32_t AutoReloadPreload*

Field Documentation

- *uint32_t TIM_Base_InitTypeDef::Prescaler*
Specifies the prescaler value used to divide the TIM clock. This parameter can be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF
- *uint32_t TIM_Base_InitTypeDef::CounterMode*
Specifies the counter mode. This parameter can be a value of [TIM_Counter_Mode](#)
- *uint32_t TIM_Base_InitTypeDef::Period*
Specifies the period value to be loaded into the active Auto-Reload Register at the next update event. This parameter can be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF.
- *uint32_t TIM_Base_InitTypeDef::ClockDivision*
Specifies the clock division. This parameter can be a value of [TIM_ClockDivision](#)
- *uint32_t TIM_Base_InitTypeDef::RepetitionCounter*
Specifies the repetition counter value. Each time the RCR down-counter reaches zero, an update event is generated and counting restarts from the RCR value (N). This means in PWM mode that (N+1) corresponds to:the number of PWM periods in edge-aligned modethe number of half PWM period in center-aligned mode This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.
Note:This parameter is valid only for TIM1 and TIM8.
- *uint32_t TIM_Base_InitTypeDef::AutoReloadPreload*
Specifies the auto-reload preload. This parameter can be a value of [TIM_AutoReloadPreload](#)

64.1.2 TIM_OC_InitTypeDef

Data Fields

- *uint32_t OCMODE*
- *uint32_t Pulse*
- *uint32_t OCPolarity*
- *uint32_t OCNPolarity*
- *uint32_t OCFastMode*
- *uint32_t OCIdleState*
- *uint32_t OCNIdleState*

Field Documentation

- ***uint32_t TIM_OC_InitTypeDef::OCMode***
Specifies the TIM mode. This parameter can be a value of [TIMEx_Output_Compare_and_PWM_modes](#)
- ***uint32_t TIM_OC_InitTypeDef::Pulse***
Specifies the pulse value to be loaded into the Capture Compare Register. This parameter can be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF
- ***uint32_t TIM_OC_InitTypeDef::OCPolarity***
Specifies the output polarity. This parameter can be a value of [TIM_Output_Compare_Polarity](#)
- ***uint32_t TIM_OC_InitTypeDef::OCNPolarity***
Specifies the complementary output polarity. This parameter can be a value of [TIM_Output_Compare_N_Polarity](#)
Note:This parameter is valid only for TIM1 and TIM8.
- ***uint32_t TIM_OC_InitTypeDef::OCFastMode***
Specifies the Fast mode state. This parameter can be a value of [TIM_Output_Fast_State](#)
Note:This parameter is valid only in PWM1 and PWM2 mode.
- ***uint32_t TIM_OC_InitTypeDef::OCIdleState***
Specifies the TIM Output Compare pin state during Idle state. This parameter can be a value of [TIM_Output_Compare_Idle_State](#)
Note:This parameter is valid only for TIM1 and TIM8.
- ***uint32_t TIM_OC_InitTypeDef::OCNIdleState***
Specifies the TIM Output Compare pin state during Idle state. This parameter can be a value of [TIM_Output_Compare_N_Idle_State](#)
Note:This parameter is valid only for TIM1 and TIM8.

64.1.3 TIM_OnePulse_InitTypeDef

Data Fields

- ***uint32_t OCMODE***
- ***uint32_t Pulse***
- ***uint32_t OCPolarity***
- ***uint32_t OCNPolarity***
- ***uint32_t OCIdleState***
- ***uint32_t OCNIdleState***
- ***uint32_t ICPolarity***
- ***uint32_t ICSelection***
- ***uint32_t ICFILTER***

Field Documentation

- ***uint32_t TIM_OnePulse_InitTypeDef::OCMode***
Specifies the TIM mode. This parameter can be a value of [TIMEx_Output_Compare_and_PWM_modes](#)
- ***uint32_t TIM_OnePulse_InitTypeDef::Pulse***
Specifies the pulse value to be loaded into the Capture Compare Register. This parameter can be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF
- ***uint32_t TIM_OnePulse_InitTypeDef::OCPolarity***
Specifies the output polarity. This parameter can be a value of [TIM_Output_Compare_Polarity](#)
- ***uint32_t TIM_OnePulse_InitTypeDef::OCNPolarity***
Specifies the complementary output polarity. This parameter can be a value of [TIM_Output_Compare_N_Polarity](#)
Note:This parameter is valid only for TIM1 and TIM8.

- ***uint32_t TIM_OnePulse_InitTypeDef::OCIdleState***
Specifies the TIM Output Compare pin state during Idle state. This parameter can be a value of [TIM_Output_Compare_Idle_State](#)
Note:This parameter is valid only for TIM1 and TIM8.
- ***uint32_t TIM_OnePulse_InitTypeDef::OCNIdleState***
Specifies the TIM Output Compare pin state during Idle state. This parameter can be a value of [TIM_Output_Compare_N_Idle_State](#)
Note:This parameter is valid only for TIM1 and TIM8.
- ***uint32_t TIM_OnePulse_InitTypeDef::ICPolarity***
Specifies the active edge of the input signal. This parameter can be a value of [TIM_Input_Capture_Polarity](#)
- ***uint32_t TIM_OnePulse_InitTypeDef::ICSelection***
Specifies the input. This parameter can be a value of [TIM_Input_Capture_Selection](#)
- ***uint32_t TIM_OnePulse_InitTypeDef::ICFilter***
Specifies the input capture filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF

64.1.4 TIM_IC_InitTypeDef

Data Fields

- ***uint32_t ICPolarity***
- ***uint32_t ICSelection***
- ***uint32_t ICPrescaler***
- ***uint32_t ICFilter***

Field Documentation

- ***uint32_t TIM_IC_InitTypeDef::ICPolarity***
Specifies the active edge of the input signal. This parameter can be a value of [TIM_Input_Capture_Polarity](#)
- ***uint32_t TIM_IC_InitTypeDef::ICSelection***
Specifies the input. This parameter can be a value of [TIM_Input_Capture_Selection](#)
- ***uint32_t TIM_IC_InitTypeDef::ICPrescaler***
Specifies the Input Capture Prescaler. This parameter can be a value of [TIM_Input_Capture_Prescaler](#)
- ***uint32_t TIM_IC_InitTypeDef::ICFilter***
Specifies the input capture filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF

64.1.5 TIM_Encoder_InitTypeDef

Data Fields

- ***uint32_t EncoderMode***
- ***uint32_t IC1Polarity***
- ***uint32_t IC1Selection***
- ***uint32_t IC1Prescaler***
- ***uint32_t IC1Filter***
- ***uint32_t IC2Polarity***
- ***uint32_t IC2Selection***
- ***uint32_t IC2Prescaler***
- ***uint32_t IC2Filter***

Field Documentation

- ***uint32_t TIM_Encoder_InitTypeDef::EncoderMode***
Specifies the active edge of the input signal. This parameter can be a value of [TIM_Encoder_Mode](#)
- ***uint32_t TIM_Encoder_InitTypeDef::IC1Polarity***
Specifies the active edge of the input signal. This parameter can be a value of [TIM_Input_Capture_Polarity](#)
- ***uint32_t TIM_Encoder_InitTypeDef::IC1Selection***
Specifies the input. This parameter can be a value of [TIM_Input_Capture_Selection](#)
- ***uint32_t TIM_Encoder_InitTypeDef::IC1Prescaler***
Specifies the Input Capture Prescaler. This parameter can be a value of [TIM_Input_Capture_Prescaler](#)
- ***uint32_t TIM_Encoder_InitTypeDef::IC1Filter***
Specifies the input capture filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF
- ***uint32_t TIM_Encoder_InitTypeDef::IC2Polarity***
Specifies the active edge of the input signal. This parameter can be a value of [TIM_Input_Capture_Polarity](#)
- ***uint32_t TIM_Encoder_InitTypeDef::IC2Selection***
Specifies the input. This parameter can be a value of [TIM_Input_Capture_Selection](#)
- ***uint32_t TIM_Encoder_InitTypeDef::IC2Prescaler***
Specifies the Input Capture Prescaler. This parameter can be a value of [TIM_Input_Capture_Prescaler](#)
- ***uint32_t TIM_Encoder_InitTypeDef::IC2Filter***
Specifies the input capture filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF

64.1.6 TIM_ClockConfigTypeDef

Data Fields

- ***uint32_t ClockSource***
- ***uint32_t ClockPolarity***
- ***uint32_t ClockPrescaler***
- ***uint32_t ClockFilter***

Field Documentation

- ***uint32_t TIM_ClockConfigTypeDef::ClockSource***
TIM clock sources. This parameter can be a value of [TIM_Clock_Source](#)
- ***uint32_t TIM_ClockConfigTypeDef::ClockPolarity***
TIM clock polarity. This parameter can be a value of [TIM_Clock_Polarity](#)
- ***uint32_t TIM_ClockConfigTypeDef::ClockPrescaler***
TIM clock prescaler. This parameter can be a value of [TIM_Clock_Prescaler](#)
- ***uint32_t TIM_ClockConfigTypeDef::ClockFilter***
TIM clock filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF

64.1.7 TIM_ClearInputConfigTypeDef

Data Fields

- ***uint32_t ClearInputState***
- ***uint32_t ClearInputSource***
- ***uint32_t ClearInputPolarity***
- ***uint32_t ClearInputPrescaler***
- ***uint32_t ClearInputFilter***

Field Documentation

- ***uint32_t TIM_ClearInputConfigTypeDef::ClearInputState***
TIM clear Input state. This parameter can be ENABLE or DISABLE
- ***uint32_t TIM_ClearInputConfigTypeDef::ClearInputSource***
TIM clear Input sources. This parameter can be a value of [TIMEx_ClearInput_Source](#)
- ***uint32_t TIM_ClearInputConfigTypeDef::ClearInputPolarity***
TIM Clear Input polarity. This parameter can be a value of [TIM_ClearInput_Polarity](#)
- ***uint32_t TIM_ClearInputConfigTypeDef::ClearInputPrescaler***
TIM Clear Input prescaler. This parameter can be a value of [TIM_ClearInput_Prescaler](#)
- ***uint32_t TIM_ClearInputConfigTypeDef::ClearInputFilter***
TIM Clear Input filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF

64.1.8 TIM_SlaveConfigTypeDef**Data Fields**

- ***uint32_t SlaveMode***
- ***uint32_t InputTrigger***
- ***uint32_t TriggerPolarity***
- ***uint32_t TriggerPrescaler***
- ***uint32_t TriggerFilter***

Field Documentation

- ***uint32_t TIM_SlaveConfigTypeDef::SlaveMode***
Slave mode selection This parameter can be a value of [TIMEx_Slave_Mode](#)
- ***uint32_t TIM_SlaveConfigTypeDef::InputTrigger***
Input Trigger source This parameter can be a value of [TIM_Trigger_Selection](#)
- ***uint32_t TIM_SlaveConfigTypeDef::TriggerPolarity***
Input Trigger polarity This parameter can be a value of [TIM_Trigger_Polarity](#)
- ***uint32_t TIM_SlaveConfigTypeDef::TriggerPrescaler***
Input trigger prescaler This parameter can be a value of [TIM_Trigger_Prescaler](#)
- ***uint32_t TIM_SlaveConfigTypeDef::TriggerFilter***
Input trigger filter This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF

64.1.9 TIM_HandleTypeDef**Data Fields**

- ***TIM_TypeDef * Instance***
- ***TIM_Base_InitTypeDef Init***
- ***HAL_TIM_ActiveChannel Channel***
- ***DMA_HandleTypeDef * hdma***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_TIM_StateTypeDef State***

Field Documentation

- ***TIM_TypeDef* TIM_HandleTypeDef::Instance***
Register base address
- ***TIM_Base_InitTypeDef TIM_HandleTypeDef::Init***
TIM Time Base required parameters

- **HAL_TIM_ActiveChannel TIM_HandleTypeDef::Channel**
Active channel
- **DMA_HandleTypeDef* TIM_HandleTypeDef::hdma[7]**
DMA Handlers array This array is accessed by a [DMA_Handle_index](#)
- **HAL_LockTypeDef TIM_HandleTypeDef::Lock**
Locking object
- **__IO HAL_TIM_StateTypeDef TIM_HandleTypeDef::State**
TIM operation state

64.2 TIM Firmware driver API description

64.2.1 TIMER Generic features

The Timer features include:

1. 16-bit up, down, up/down auto-reload counter.
2. 16-bit programmable prescaler allowing dividing (also on the fly) the counter clock frequency either by any factor between 1 and 65536.
3. Up to 4 independent channels for:
 - Input Capture
 - Output Compare
 - PWM generation (Edge and Center-aligned Mode)
 - One-pulse mode output

64.2.2 How to use this driver

1. Initialize the TIM low level resources by implementing the following functions depending from feature used :
 - Time Base : HAL_TIM_Base_MspInit()
 - Input Capture : HAL_TIM_IC_MspInit()
 - Output Compare : HAL_TIM_OC_MspInit()
 - PWM generation : HAL_TIM_PWM_MspInit()
 - One-pulse mode output : HAL_TIM_OnePulse_MspInit()
 - Encoder mode output : HAL_TIM_Encoder_MspInit()
2. Initialize the TIM low level resources :
 - a. Enable the TIM interface clock using `__HAL_RCC_TIMx_CLK_ENABLE()`;
 - b. TIM pins configuration
 - Enable the clock for the TIM GPIOs using the following function:
`__HAL_RCC_GPIOx_CLK_ENABLE()`;
 - Configure these TIM pins in Alternate function mode using `HAL_GPIO_Init()`;
3. The external Clock can be configured, if needed (the default clock is the internal clock from the APBx), using the following function: `HAL_TIM_ConfigClockSource`, the clock configuration should be done before any start function.
4. Configure the TIM in the desired functioning mode using one of the initialization function of this driver:
 - `HAL_TIM_Base_Init`: to use the Timer to generate a simple time base
 - `HAL_TIM_OC_Init` and `HAL_TIM_OC_ConfigChannel`: to use the Timer to generate an Output Compare signal.
 - `HAL_TIM_PWM_Init` and `HAL_TIM_PWM_ConfigChannel`: to use the Timer to generate a PWM signal.
 - `HAL_TIM_IC_Init` and `HAL_TIM_IC_ConfigChannel`: to use the Timer to measure an external signal.
 - `HAL_TIM_OnePulse_Init` and `HAL_TIM_OnePulse_ConfigChannel`: to use the Timer in One Pulse Mode.
 - `HAL_TIM_Encoder_Init`: to use the Timer Encoder Interface.

5. Activate the TIM peripheral using one of the start functions depending from the feature used:
 - Time Base : HAL_TIM_Base_Start(), HAL_TIM_Base_Start_DMA(), HAL_TIM_Base_Start_IT()
 - Input Capture : HAL_TIM_IC_Start(), HAL_TIM_IC_Start_DMA(), HAL_TIM_IC_Start_IT()
 - Output Compare : HAL_TIM_OC_Start(), HAL_TIM_OC_Start_DMA(), HAL_TIM_OC_Start_IT()
 - PWM generation : HAL_TIM_PWM_Start(), HAL_TIM_PWM_Start_DMA(), HAL_TIM_PWM_Start_IT()
 - One-pulse mode output : HAL_TIM_OnePulse_Start(), HAL_TIM_OnePulse_Start_IT()
 - Encoder mode output : HAL_TIM_Encoder_Start(), HAL_TIM_Encoder_Start_DMA(), HAL_TIM_Encoder_Start_IT()
6. The DMA Burst is managed with the two following functions:
HAL_TIM_DMABurst_WriteStart() HAL_TIM_DMABurst_ReadStart()

64.2.3 Time Base functions

This section provides functions allowing to:

- Initialize and configure the TIM base.
- De-initialize the TIM base.
- Start the Time Base.
- Stop the Time Base.
- Start the Time Base and enable interrupt.
- Stop the Time Base and disable interrupt.
- Start the Time Base and enable DMA transfer.
- Stop the Time Base and disable DMA transfer.

This section contains the following APIs:

- [*HAL_TIM_Base_Init\(\)*](#)
- [*HAL_TIM_Base_DeInit\(\)*](#)
- [*HAL_TIM_Base_MspInit\(\)*](#)
- [*HAL_TIM_Base_MspDeInit\(\)*](#)
- [*HAL_TIM_Base_Start\(\)*](#)
- [*HAL_TIM_Base_Stop\(\)*](#)
- [*HAL_TIM_Base_Start_IT\(\)*](#)
- [*HAL_TIM_Base_Stop_IT\(\)*](#)
- [*HAL_TIM_Base_Start_DMA\(\)*](#)
- [*HAL_TIM_Base_Stop_DMA\(\)*](#)

64.2.4 Time Output Compare functions

This section provides functions allowing to:

- Initialize and configure the TIM Output Compare.
- De-initialize the TIM Output Compare.
- Start the Time Output Compare.
- Stop the Time Output Compare.
- Start the Time Output Compare and enable interrupt.
- Stop the Time Output Compare and disable interrupt.
- Start the Time Output Compare and enable DMA transfer.
- Stop the Time Output Compare and disable DMA transfer.

This section contains the following APIs:

- [HAL_TIM_OC_Init\(\)](#)
- [HAL_TIM_OC_DeInit\(\)](#)
- [HAL_TIM_OC_MspInit\(\)](#)
- [HAL_TIM_OC_MspDeInit\(\)](#)
- [HAL_TIM_OC_Start\(\)](#)
- [HAL_TIM_OC_Stop\(\)](#)
- [HAL_TIM_OC_Start_IT\(\)](#)
- [HAL_TIM_OC_Stop_IT\(\)](#)
- [HAL_TIM_OC_Start_DMA\(\)](#)
- [HAL_TIM_OC_Stop_DMA\(\)](#)

64.2.5 Time PWM functions

This section provides functions allowing to:

- Initialize and configure the TIM OPWM.
- De-initialize the TIM PWM.
- Start the Time PWM.
- Stop the Time PWM.
- Start the Time PWM and enable interrupt.
- Stop the Time PWM and disable interrupt.
- Start the Time PWM and enable DMA transfer.
- Stop the Time PWM and disable DMA transfer.

This section contains the following APIs:

- [HAL_TIM_PWM_Init\(\)](#)
- [HAL_TIM_PWM_DeInit\(\)](#)
- [HAL_TIM_PWM_MspInit\(\)](#)
- [HAL_TIM_PWM_MspDeInit\(\)](#)
- [HAL_TIM_PWM_Start\(\)](#)
- [HAL_TIM_PWM_Stop\(\)](#)
- [HAL_TIM_PWM_Start_IT\(\)](#)
- [HAL_TIM_PWM_Stop_IT\(\)](#)
- [HAL_TIM_PWM_Start_DMA\(\)](#)
- [HAL_TIM_PWM_Stop_DMA\(\)](#)

64.2.6 Time Input Capture functions

This section provides functions allowing to:

- Initialize and configure the TIM Input Capture.
- De-initialize the TIM Input Capture.
- Start the Time Input Capture.
- Stop the Time Input Capture.
- Start the Time Input Capture and enable interrupt.
- Stop the Time Input Capture and disable interrupt.
- Start the Time Input Capture and enable DMA transfer.
- Stop the Time Input Capture and disable DMA transfer.

This section contains the following APIs:

- [HAL_TIM_IC_Init\(\)](#)
- [HAL_TIM_IC_DeInit\(\)](#)
- [HAL_TIM_IC_MspInit\(\)](#)
- [HAL_TIM_IC_MspDeInit\(\)](#)
- [HAL_TIM_IC_Start\(\)](#)

- [HAL_TIM_IC_Stop\(\)](#)
- [HAL_TIM_IC_Start_IT\(\)](#)
- [HAL_TIM_IC_Stop_IT\(\)](#)
- [HAL_TIM_IC_Start_DMA\(\)](#)
- [HAL_TIM_IC_Stop_DMA\(\)](#)

64.2.7 Time One Pulse functions

This section provides functions allowing to:

- Initialize and configure the TIM One Pulse.
- De-initialize the TIM One Pulse.
- Start the Time One Pulse.
- Stop the Time One Pulse.
- Start the Time One Pulse and enable interrupt.
- Stop the Time One Pulse and disable interrupt.
- Start the Time One Pulse and enable DMA transfer.
- Stop the Time One Pulse and disable DMA transfer.

This section contains the following APIs:

- [HAL_TIM_OnePulse_Init\(\)](#)
- [HAL_TIM_OnePulse_DeInit\(\)](#)
- [HAL_TIM_OnePulse_MspInit\(\)](#)
- [HAL_TIM_OnePulse_MspDeInit\(\)](#)
- [HAL_TIM_OnePulse_Start\(\)](#)
- [HAL_TIM_OnePulse_Stop\(\)](#)
- [HAL_TIM_OnePulse_Start_IT\(\)](#)
- [HAL_TIM_OnePulse_Stop_IT\(\)](#)

64.2.8 Time Encoder functions

This section provides functions allowing to:

- Initialize and configure the TIM Encoder.
- De-initialize the TIM Encoder.
- Start the Time Encoder.
- Stop the Time Encoder.
- Start the Time Encoder and enable interrupt.
- Stop the Time Encoder and disable interrupt.
- Start the Time Encoder and enable DMA transfer.
- Stop the Time Encoder and disable DMA transfer.

This section contains the following APIs:

- [HAL_TIM_Encoder_Init\(\)](#)
- [HAL_TIM_Encoder_DeInit\(\)](#)
- [HAL_TIM_Encoder_MspInit\(\)](#)
- [HAL_TIM_Encoder_MspDeInit\(\)](#)
- [HAL_TIM_Encoder_Start\(\)](#)
- [HAL_TIM_Encoder_Stop\(\)](#)
- [HAL_TIM_Encoder_Start_IT\(\)](#)
- [HAL_TIM_Encoder_Stop_IT\(\)](#)
- [HAL_TIM_Encoder_Start_DMA\(\)](#)
- [HAL_TIM_Encoder_Stop_DMA\(\)](#)

64.2.9 IRQ handler management

This section provides Timer IRQ handler function.

This section contains the following APIs:

- [*HAL_TIM_IRQHandler\(\)*](#)

64.2.10 Peripheral Control functions

This section provides functions allowing to:

- Configure The Input Output channels for OC, PWM, IC or One Pulse mode.
- Configure External Clock source.
- Configure Complementary channels, break features and dead time.
- Configure Master and the Slave synchronization.
- Configure the DMA Burst Mode.

This section contains the following APIs:

- [*HAL_TIM_OC_ConfigChannel\(\)*](#)
- [*HAL_TIM_IC_ConfigChannel\(\)*](#)
- [*HAL_TIM_PWM_ConfigChannel\(\)*](#)
- [*HAL_TIM_OnePulse_ConfigChannel\(\)*](#)
- [*HAL_TIM_DMABurst_WriteStart\(\)*](#)
- [*HAL_TIM_DMABurst_WriteStop\(\)*](#)
- [*HAL_TIM_DMABurst_ReadStart\(\)*](#)
- [*HAL_TIM_DMABurst_ReadStop\(\)*](#)
- [*HAL_TIM_GenerateEvent\(\)*](#)
- [*HAL_TIM_ConfigOCrefClear\(\)*](#)
- [*HAL_TIM_ConfigClockSource\(\)*](#)
- [*HAL_TIM_ConfigTI1Input\(\)*](#)
- [*HAL_TIM_SlaveConfigSynchronization\(\)*](#)
- [*HAL_TIM_SlaveConfigSynchronization_IT\(\)*](#)
- [*HAL_TIM_ReadCapturedValue\(\)*](#)

64.2.11 TIM Callbacks functions

This section provides TIM callback functions:

- Timer Period elapsed callback
- Timer Output Compare callback
- Timer Input capture callback
- Timer Trigger callback
- Timer Error callback

This section contains the following APIs:

- [*HAL_TIM_PeriodElapsedCallback\(\)*](#)
- [*HAL_TIM_OC_DelayElapsedCallback\(\)*](#)
- [*HAL_TIM_IC_CaptureCallback\(\)*](#)
- [*HAL_TIM_PWM_PulseFinishedCallback\(\)*](#)
- [*HAL_TIM_TriggerCallback\(\)*](#)
- [*HAL_TIM_ErrorCallback\(\)*](#)

64.2.12 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- [HAL_TIM_Base_GetState\(\)](#)
- [HAL_TIM_OC_GetState\(\)](#)
- [HAL_TIM_PWM_GetState\(\)](#)
- [HAL_TIM_IC_GetState\(\)](#)
- [HAL_TIM_OnePulse_GetState\(\)](#)
- [HAL_TIM_Encoder_GetState\(\)](#)

64.2.13 Detailed description of functions

HAL_TIM_Base_Init

Function name	HAL_StatusTypeDef HAL_TIM_Base_Init (TIM_HandleTypeDef * htim)
Function description	Initializes the TIM Time base Unit according to the specified parameters in the TIM_HandleTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIM_Base_DeInit

Function name	HAL_StatusTypeDef HAL_TIM_Base_DeInit (TIM_HandleTypeDef * htim)
Function description	DeInitializes the TIM Base peripheral.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIM_Base_MspInit

Function name	void HAL_TIM_Base_MspInit (TIM_HandleTypeDef * htim)
Function description	Initializes the TIM Base MSP.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • None:

HAL_TIM_Base_MspDeInit

Function name	void HAL_TIM_Base_MspDeInit (TIM_HandleTypeDef * htim)
Function description	DeInitializes TIM Base MSP.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • None:

HAL_TIM_Base_Start

Function name	HAL_StatusTypeDef HAL_TIM_Base_Start (TIM_HandleTypeDef * htim)
Function description	Starts the TIM Base generation.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_TIM_Base_Stop

Function name	HAL_StatusTypeDef HAL_TIM_Base_Stop (TIM_HandleTypeDef * htim)
Function description	Stops the TIM Base generation.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_TIM_Base_Start_IT

Function name	HAL_StatusTypeDef HAL_TIM_Base_Start_IT (TIM_HandleTypeDef * htim)
Function description	Starts the TIM Base generation in interrupt mode.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_TIM_Base_Stop_IT

Function name	HAL_StatusTypeDef HAL_TIM_Base_Stop_IT (TIM_HandleTypeDef * htim)
Function description	Stops the TIM Base generation in interrupt mode.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_TIM_Base_Start_DMA

Function name	HAL_StatusTypeDef HAL_TIM_Base_Start_DMA (TIM_HandleTypeDef * htim, uint32_t * pData, uint16_t Length)
Function description	Starts the TIM Base generation in DMA mode.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.• pData: The source Buffer address.• Length: The length of data to be transferred from memory to peripheral.

Return values

- **HAL:** status

HAL_TIM_Base_Stop_DMA

Function name **HAL_StatusTypeDef HAL_TIM_Base_Stop_DMA (TIM_HandleTypeDef * htim)**

Function description Stops the TIM Base generation in DMA mode.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **HAL:** status

HAL_TIM_OC_Init

Function name **HAL_StatusTypeDef HAL_TIM_OC_Init (TIM_HandleTypeDef * htim)**

Function description Initializes the TIM Output Compare according to the specified parameters in the TIM_HandleTypeDef and create the associated handle.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **HAL:** status

HAL_TIM_OC_DeInit

Function name **HAL_StatusTypeDef HAL_TIM_OC_DeInit (TIM_HandleTypeDef * htim)**

Function description DeInitializes the TIM peripheral.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **HAL:** status

HAL_TIM_OC_MspInit

Function name **void HAL_TIM_OC_MspInit (TIM_HandleTypeDef * htim)**

Function description Initializes the TIM Output Compare MSP.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **None:**

HAL_TIM_OC_MspDeInit

Function name **void HAL_TIM_OC_MspDeInit (TIM_HandleTypeDef * htim)**

Function description DeInitializes TIM Output Compare MSP.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **None:**

HAL_TIM_OC_Start

Function name	HAL_StatusTypeDef HAL_TIM_OC_Start (TIM_HandleTypeDef * htim, uint32_t Channel)
Function description	Starts the TIM Output Compare signal generation.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.• Channel: TIM Channel to be enabled. This parameter can be one of the following values:<ul style="list-style-type: none">– TIM_CHANNEL_1: TIM Channel 1 selected– TIM_CHANNEL_2: TIM Channel 2 selected– TIM_CHANNEL_3: TIM Channel 3 selected– TIM_CHANNEL_4: TIM Channel 4 selected
Return values	<ul style="list-style-type: none">• HAL: status

HAL_TIM_OC_Stop

Function name	HAL_StatusTypeDef HAL_TIM_OC_Stop (TIM_HandleTypeDef * htim, uint32_t Channel)
Function description	Stops the TIM Output Compare signal generation.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.• Channel: TIM Channel to be disabled. This parameter can be one of the following values:<ul style="list-style-type: none">– TIM_CHANNEL_1: TIM Channel 1 selected– TIM_CHANNEL_2: TIM Channel 2 selected– TIM_CHANNEL_3: TIM Channel 3 selected– TIM_CHANNEL_4: TIM Channel 4 selected
Return values	<ul style="list-style-type: none">• HAL: status

HAL_TIM_OC_Start_IT

Function name	HAL_StatusTypeDef HAL_TIM_OC_Start_IT (TIM_HandleTypeDef * htim, uint32_t Channel)
Function description	Starts the TIM Output Compare signal generation in interrupt mode.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.• Channel: TIM Channel to be enabled. This parameter can be one of the following values:<ul style="list-style-type: none">– TIM_CHANNEL_1: TIM Channel 1 selected– TIM_CHANNEL_2: TIM Channel 2 selected– TIM_CHANNEL_3: TIM Channel 3 selected– TIM_CHANNEL_4: TIM Channel 4 selected
Return values	<ul style="list-style-type: none">• HAL: status

HAL_TIM_OC_Stop_IT

Function name	HAL_StatusTypeDef HAL_TIM_OC_Stop_IT
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(TIM_HandleTypeDef * htim, uint32_t Channel)

- Function description Stops the TIM Output Compare signal generation in interrupt mode.
- Parameters
 - **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **Channel:** TIM Channel to be disabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected
- Return values
 - **HAL:** status

HAL_TIM_OC_Start_DMA

- Function name **HAL_StatusTypeDef HAL_TIM_OC_Start_DMA (TIM_HandleTypeDef * htim, uint32_t Channel, uint32_t * pData, uint16_t Length)**
- Function description Starts the TIM Output Compare signal generation in DMA mode.
- Parameters
 - **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **Channel:** TIM Channel to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected
 - **pData:** The source Buffer address.
 - **Length:** The length of data to be transferred from memory to TIM peripheral
- Return values
 - **HAL:** status

HAL_TIM_OC_Stop_DMA

- Function name **HAL_StatusTypeDef HAL_TIM_OC_Stop_DMA (TIM_HandleTypeDef * htim, uint32_t Channel)**
- Function description Stops the TIM Output Compare signal generation in DMA mode.
- Parameters
 - **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **Channel:** TIM Channel to be disabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected
- Return values
 - **HAL:** status



HAL_TIM_PWM_Init

Function name	HAL_StatusTypeDef HAL_TIM_PWM_Init (TIM_HandleTypeDef * htim)
Function description	Initializes the TIM PWM Time Base according to the specified parameters in the TIM_HandleTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIM_PWM_DeInit

Function name	HAL_StatusTypeDef HAL_TIM_PWM_DeInit (TIM_HandleTypeDef * htim)
Function description	DeInitializes the TIM peripheral.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIM_PWM_MspInit

Function name	void HAL_TIM_PWM_MspInit (TIM_HandleTypeDef * htim)
Function description	Initializes the TIM PWM MSP.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • None:

HAL_TIM_PWM_MspDeInit

Function name	void HAL_TIM_PWM_MspDeInit (TIM_HandleTypeDef * htim)
Function description	DeInitializes TIM PWM MSP.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • None:

HAL_TIM_PWM_Start

Function name	HAL_StatusTypeDef HAL_TIM_PWM_Start (TIM_HandleTypeDef * htim, uint32_t Channel)
Function description	Starts the PWM signal generation.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. • Channel: TIM Channels to be enabled. This parameter can be one of the following values: <ul style="list-style-type: none"> – TIM_CHANNEL_1: TIM Channel 1 selected – TIM_CHANNEL_2: TIM Channel 2 selected

- TIM_CHANNEL_3: TIM Channel 3 selected
- TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_PWM_Stop

Function name **HAL_StatusTypeDef HAL_TIM_PWM_Stop (TIM_HandleTypeDef * htim, uint32_t Channel)**

Function description Stops the PWM signal generation.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **Channel:** TIM Channels to be disabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_PWM_Start_IT

Function name **HAL_StatusTypeDef HAL_TIM_PWM_Start_IT (TIM_HandleTypeDef * htim, uint32_t Channel)**

Function description Starts the PWM signal generation in interrupt mode.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **Channel:** TIM Channel to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_PWM_Stop_IT

Function name **HAL_StatusTypeDef HAL_TIM_PWM_Stop_IT (TIM_HandleTypeDef * htim, uint32_t Channel)**

Function description Stops the PWM signal generation in interrupt mode.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **Channel:** TIM Channels to be disabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_PWM_Start_DMA

Function name	HAL_StatusTypeDef HAL_TIM_PWM_Start_DMA (TIM_HandleTypeDef * htim, uint32_t Channel, uint32_t * pData, uint16_t Length)
Function description	Starts the TIM PWM signal generation in DMA mode.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. • Channel: TIM Channels to be enabled. This parameter can be one of the following values: <ul style="list-style-type: none"> – TIM_CHANNEL_1: TIM Channel 1 selected – TIM_CHANNEL_2: TIM Channel 2 selected – TIM_CHANNEL_3: TIM Channel 3 selected – TIM_CHANNEL_4: TIM Channel 4 selected • pData: The source Buffer address. • Length: The length of data to be transferred from memory to TIM peripheral
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIM_PWM_Stop_DMA

Function name	HAL_StatusTypeDef HAL_TIM_PWM_Stop_DMA (TIM_HandleTypeDef * htim, uint32_t Channel)
Function description	Stops the TIM PWM signal generation in DMA mode.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. • Channel: TIM Channels to be disabled. This parameter can be one of the following values: <ul style="list-style-type: none"> – TIM_CHANNEL_1: TIM Channel 1 selected – TIM_CHANNEL_2: TIM Channel 2 selected – TIM_CHANNEL_3: TIM Channel 3 selected – TIM_CHANNEL_4: TIM Channel 4 selected
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIM_IC_Init

Function name	HAL_StatusTypeDef HAL_TIM_IC_Init (TIM_HandleTypeDef * htim)
Function description	Initializes the TIM Input Capture Time base according to the specified parameters in the TIM_HandleTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIM_IC_DeInit

Function name	HAL_StatusTypeDef HAL_TIM_IC_DeInit (TIM_HandleTypeDef * htim)
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Function description	DeInitializes the TIM peripheral.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIM_IC_MspInit

Function name	void HAL_TIM_IC_MspInit (TIM_HandleTypeDef * htim)
Function description	Initializes the TIM INput Capture MSP.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • None:

HAL_TIM_IC_MspDeInit

Function name	void HAL_TIM_IC_MspDeInit (TIM_HandleTypeDef * htim)
Function description	DeInitializes TIM Input Capture MSP.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • None:

HAL_TIM_IC_Start

Function name	HAL_StatusTypeDef HAL_TIM_IC_Start (TIM_HandleTypeDef * htim, uint32_t Channel)
Function description	Starts the TIM Input Capture measurement.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. • Channel: TIM Channels to be enabled. This parameter can be one of the following values: <ul style="list-style-type: none"> – TIM_CHANNEL_1: TIM Channel 1 selected – TIM_CHANNEL_2: TIM Channel 2 selected – TIM_CHANNEL_3: TIM Channel 3 selected – TIM_CHANNEL_4: TIM Channel 4 selected
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIM_IC_Stop

Function name	HAL_StatusTypeDef HAL_TIM_IC_Stop (TIM_HandleTypeDef * htim, uint32_t Channel)
Function description	Stops the TIM Input Capture measurement.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. • Channel: TIM Channels to be disabled. This parameter can be one of the following values: <ul style="list-style-type: none"> – TIM_CHANNEL_1: TIM Channel 1 selected – TIM_CHANNEL_2: TIM Channel 2 selected

- TIM_CHANNEL_3: TIM Channel 3 selected
- TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_IC_Start_IT

Function name **HAL_StatusTypeDef HAL_TIM_IC_Start_IT (TIM_HandleTypeDef * htim, uint32_t Channel)**

Function description Starts the TIM Input Capture measurement in interrupt mode.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **Channel:** TIM Channels to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_IC_Stop_IT

Function name **HAL_StatusTypeDef HAL_TIM_IC_Stop_IT (TIM_HandleTypeDef * htim, uint32_t Channel)**

Function description Stops the TIM Input Capture measurement in interrupt mode.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **Channel:** TIM Channels to be disabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_IC_Start_DMA

Function name **HAL_StatusTypeDef HAL_TIM_IC_Start_DMA (TIM_HandleTypeDef * htim, uint32_t Channel, uint32_t * pData, uint16_t Length)**

Function description Starts the TIM Input Capture measurement on in DMA mode.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **Channel:** TIM Channels to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected
- **pData:** The destination Buffer address.

- **Length:** The length of data to be transferred from TIM peripheral to memory.
- Return values
- **HAL:** status

HAL_TIM_IC_Stop_DMA

- Function name **HAL_StatusTypeDef HAL_TIM_IC_Stop_DMA (TIM_HandleTypeDef * htim, uint32_t Channel)**
- Function description Stops the TIM Input Capture measurement on in DMA mode.
- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **Channel:** TIM Channels to be disabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected
- Return values
- **HAL:** status

HAL_TIM_OnePulse_Init

- Function name **HAL_StatusTypeDef HAL_TIM_OnePulse_Init (TIM_HandleTypeDef * htim, uint32_t OnePulseMode)**
- Function description Initializes the TIM One Pulse Time Base according to the specified parameters in the TIM_HandleTypeDef and create the associated handle.
- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **OnePulseMode:** Select the One pulse mode. This parameter can be one of the following values:
 - TIM_OP_MODE_SINGLE: Only one pulse will be generated.
 - TIM_OP_MODE_REPETITIVE: Repetitive pulses will be generated.
- Return values
- **HAL:** status

HAL_TIM_OnePulse_DeInit

- Function name **HAL_StatusTypeDef HAL_TIM_OnePulse_DeInit (TIM_HandleTypeDef * htim)**
- Function description DeInitializes the TIM One Pulse.
- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- Return values
- **HAL:** status

HAL_TIM_OnePulse_MspInit

- Function name **void HAL_TIM_OnePulse_MspInit (TIM_HandleTypeDef * htim)**

Function description	Initializes the TIM One Pulse MSP.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • None:

HAL_TIM_OnePulse_MspDeInit

Function name	void HAL_TIM_OnePulse_MspDeInit (TIM_HandleTypeDef * htim)
Function description	DeInitializes TIM One Pulse MSP.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • None:

HAL_TIM_OnePulse_Start

Function name	HAL_StatusTypeDef HAL_TIM_OnePulse_Start (TIM_HandleTypeDef * htim, uint32_t OutputChannel)
Function description	Starts the TIM One Pulse signal generation.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. • OutputChannel: : TIM Channels to be enabled. This parameter can be one of the following values: <ul style="list-style-type: none"> – TIM_CHANNEL_1: TIM Channel 1 selected – TIM_CHANNEL_2: TIM Channel 2 selected
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIM_OnePulse_Stop

Function name	HAL_StatusTypeDef HAL_TIM_OnePulse_Stop (TIM_HandleTypeDef * htim, uint32_t OutputChannel)
Function description	Stops the TIM One Pulse signal generation.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. • OutputChannel: : TIM Channels to be disable. This parameter can be one of the following values: <ul style="list-style-type: none"> – TIM_CHANNEL_1: TIM Channel 1 selected – TIM_CHANNEL_2: TIM Channel 2 selected
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIM_OnePulse_Start_IT

Function name	HAL_StatusTypeDef HAL_TIM_OnePulse_Start_IT (TIM_HandleTypeDef * htim, uint32_t OutputChannel)
Function description	Starts the TIM One Pulse signal generation in interrupt mode.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

- **OutputChannel:** : TIM Channels to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected

Return values

- **HAL:** status

HAL_TIM_OnePulse_Stop_IT

Function name **HAL_StatusTypeDef HAL_TIM_OnePulse_Stop_IT (TIM_HandleTypeDef * htim, uint32_t OutputChannel)**

Function description Stops the TIM One Pulse signal generation in interrupt mode.

- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **OutputChannel:** : TIM Channels to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected

Return values

- **HAL:** status

HAL_TIM_Encoder_Init

Function name **HAL_StatusTypeDef HAL_TIM_Encoder_Init (TIM_HandleTypeDef * htim, TIM_Encoder_InitTypeDef * sConfig)**

Function description Initializes the TIM Encoder Interface and create the associated handle.

- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **sConfig:** TIM Encoder Interface configuration structure

Return values

- **HAL:** status

HAL_TIM_Encoder_DeInit

Function name **HAL_StatusTypeDef HAL_TIM_Encoder_DeInit (TIM_HandleTypeDef * htim)**

Function description DeInitializes the TIM Encoder interface.

- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **HAL:** status

HAL_TIM_Encoder_MspInit

Function name **void HAL_TIM_Encoder_MspInit (TIM_HandleTypeDef * htim)**

Function description Initializes the TIM Encoder Interface MSP.

- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values • **None:**

HAL_TIM_Encoder_MspDeInit

Function name **void HAL_TIM_Encoder_MspDeInit (TIM_HandleTypeDef * htim)**

Function description DeInitializes TIM Encoder Interface MSP.

Parameters • **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values • **None:**

HAL_TIM_Encoder_Start

Function name **HAL_StatusTypeDef HAL_TIM_Encoder_Start (TIM_HandleTypeDef * htim, uint32_t Channel)**

Function description Starts the TIM Encoder Interface.

Parameters • **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 • **Channel:** TIM Channels to be enabled. This parameter can be one of the following values:
 – TIM_CHANNEL_1: TIM Channel 1 selected
 – TIM_CHANNEL_2: TIM Channel 2 selected
 – TIM_CHANNEL_ALL: TIM Channel 1 and TIM Channel 2 are selected

Return values • **HAL:** status

HAL_TIM_Encoder_Stop

Function name **HAL_StatusTypeDef HAL_TIM_Encoder_Stop (TIM_HandleTypeDef * htim, uint32_t Channel)**

Function description Stops the TIM Encoder Interface.

Parameters • **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 • **Channel:** TIM Channels to be disabled. This parameter can be one of the following values:
 – TIM_CHANNEL_1: TIM Channel 1 selected
 – TIM_CHANNEL_2: TIM Channel 2 selected
 – TIM_CHANNEL_ALL: TIM Channel 1 and TIM Channel 2 are selected

Return values • **HAL:** status

HAL_TIM_Encoder_Start_IT

Function name **HAL_StatusTypeDef HAL_TIM_Encoder_Start_IT (TIM_HandleTypeDef * htim, uint32_t Channel)**

Function description Starts the TIM Encoder Interface in interrupt mode.

Parameters • **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

- **Channel:** TIM Channels to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_ALL: TIM Channel 1 and TIM Channel 2 are selected
- Return values
- **HAL:** status

HAL_TIM_Encoder_Stop_IT

- Function name **HAL_StatusTypeDef HAL_TIM_Encoder_Stop_IT (TIM_HandleTypeDef * htim, uint32_t Channel)**
- Function description Stops the TIM Encoder Interface in interrupt mode.
- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **Channel:** TIM Channels to be disabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_ALL: TIM Channel 1 and TIM Channel 2 are selected
- Return values
- **HAL:** status

HAL_TIM_Encoder_Start_DMA

- Function name **HAL_StatusTypeDef HAL_TIM_Encoder_Start_DMA (TIM_HandleTypeDef * htim, uint32_t Channel, uint32_t * pData1, uint32_t * pData2, uint16_t Length)**
- Function description Starts the TIM Encoder Interface in DMA mode.
- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **Channel:** TIM Channels to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_ALL: TIM Channel 1 and TIM Channel 2 are selected
 - **pData1:** The destination Buffer address for IC1.
 - **pData2:** The destination Buffer address for IC2.
 - **Length:** The length of data to be transferred from TIM peripheral to memory.
- Return values
- **HAL:** status

HAL_TIM_Encoder_Stop_DMA

- Function name **HAL_StatusTypeDef HAL_TIM_Encoder_Stop_DMA (TIM_HandleTypeDef * htim, uint32_t Channel)**
- Function description Stops the TIM Encoder Interface in DMA mode.
- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that

contains the configuration information for TIM module.

- **Channel:** TIM Channels to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_ALL: TIM Channel 1 and TIM Channel 2 are selected

Return values

- **HAL:** status

HAL_TIM_IRQHandler

Function name **void HAL_TIM_IRQHandler (TIM_HandleTypeDef * htim)**

Function description This function handles TIM interrupts requests.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **None:**

HAL_TIM_OC_ConfigChannel

Function name **HAL_StatusTypeDef HAL_TIM_OC_ConfigChannel (TIM_HandleTypeDef * htim, TIM_OC_InitTypeDef * sConfig, uint32_t Channel)**

Function description Initializes the TIM Output Compare Channels according to the specified parameters in the TIM_OC_InitTypeDef.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **sConfig:** TIM Output Compare configuration structure
- **Channel:** TIM Channels to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_PWM_ConfigChannel

Function name **HAL_StatusTypeDef HAL_TIM_PWM_ConfigChannel (TIM_HandleTypeDef * htim, TIM_OC_InitTypeDef * sConfig, uint32_t Channel)**

Function description Initializes the TIM PWM channels according to the specified parameters in the TIM_OC_InitTypeDef.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **sConfig:** TIM PWM configuration structure
- **Channel:** TIM Channels to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected

- TIM_CHANNEL_3: TIM Channel 3 selected
- TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_IC_ConfigChannel

Function name **HAL_StatusTypeDef HAL_TIM_IC_ConfigChannel (TIM_HandleTypeDef * htim, TIM_IC_InitTypeDef * sConfig, uint32_t Channel)**

Function description Initializes the TIM Input Capture Channels according to the specified parameters in the TIM_IC_InitTypeDef.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **sConfig:** TIM Input Capture configuration structure
- **Channel:** TIM Channels to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_OnePulse_ConfigChannel

Function name **HAL_StatusTypeDef HAL_TIM_OnePulse_ConfigChannel (TIM_HandleTypeDef * htim, TIM_OnePulse_InitTypeDef * sConfig, uint32_t OutputChannel, uint32_t InputChannel)**

Function description Initializes the TIM One Pulse Channels according to the specified parameters in the TIM_OnePulse_InitTypeDef.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **sConfig:** TIM One Pulse configuration structure
- **OutputChannel:** TIM Channels to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
- **InputChannel:** TIM Channels to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected

Return values

- **HAL:** status

HAL_TIM_ConfigOCrefClear

Function name **HAL_StatusTypeDef HAL_TIM_ConfigOCrefClear (TIM_HandleTypeDef * htim, TIM_ClearInputConfigTypeDef * sClearInputConfig, uint32_t Channel)**

Function description Configures the OCRef clear feature.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that

contains the configuration information for TIM module.

- **sClearInputConfig:** pointer to a TIM_ClearInputConfigTypeDef structure that contains the OCREF clear feature and parameters for the TIM peripheral.
- **Channel:** specifies the TIM Channel. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_ConfigClockSource

Function name HAL_StatusTypeDef HAL_TIM_ConfigClockSource (TIM_HandleTypeDef * htim, TIM_ClockConfigTypeDef * sClockSourceConfig)

Function description Configures the clock source to be used.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **sClockSourceConfig:** pointer to a TIM_ClockConfigTypeDef structure that contains the clock source information for the TIM peripheral.

Return values

- **HAL:** status

HAL_TIM_ConfigTI1Input

Function name HAL_StatusTypeDef HAL_TIM_ConfigTI1Input (TIM_HandleTypeDef * htim, uint32_t TI1_Selection)

Function description Selects the signal connected to the TI1 input: direct from CH1_input or a XOR combination between CH1_input, CH2_input & CH3_input.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **TI1_Selection:** Indicate whether or not channel 1 is connected to the output of a XOR gate. This parameter can be one of the following values:
 - TIM_TI1SELECTION_CH1: The TIMx_CH1 pin is connected to TI1 input
 - TIM_TI1SELECTION_XORCOMBINATION: The TIMx_CH1, CH2 and CH3 pins are connected to the TI1 input (XOR combination)

Return values

- **HAL:** status

HAL_TIM_SlaveConfigSynchronization

Function name HAL_StatusTypeDef HAL_TIM_SlaveConfigSynchronization (TIM_HandleTypeDef * htim, TIM_SlaveConfigTypeDef * sSlaveConfig)

Function description	Configures the TIM in Slave mode.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. • sSlaveConfig: pointer to a TIM_SlaveConfigTypeDef structure that contains the selected trigger (internal trigger input, filtered timer input or external trigger input) and the) and the Slave mode (Disable, Reset, Gated, Trigger, External clock mode 1).
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIM_SlaveConfigSynchronization_IT

Function name	HAL_StatusTypeDef HAL_TIM_SlaveConfigSynchronization_IT (TIM_HandleTypeDef * htim, TIM_SlaveConfigTypeDef * sSlaveConfig)
Function description	Configures the TIM in Slave mode in interrupt mode.
Parameters	<ul style="list-style-type: none"> • htim: TIM handle. • sSlaveConfig: pointer to a TIM_SlaveConfigTypeDef structure that contains the selected trigger (internal trigger input, filtered timer input or external trigger input) and the) and the Slave mode (Disable, Reset, Gated, Trigger, External clock mode 1).
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIM_DMABurst_WriteStart

Function name	HAL_StatusTypeDef HAL_TIM_DMABurst_WriteStart (TIM_HandleTypeDef * htim, uint32_t BurstBaseAddress, uint32_t BurstRequestSrc, uint32_t * BurstBuffer, uint32_t BurstLength)
Function description	Configure the DMA Burst to transfer Data from the memory to the TIM peripheral.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. • BurstBaseAddress: TIM Base address from when the DMA will starts the Data write. This parameters can be on of the following values: <ul style="list-style-type: none"> – TIM_DMABASE_CR1 – TIM_DMABASE_CR2 – TIM_DMABASE_SMCR – TIM_DMABASE_DIER – TIM_DMABASE_SR – TIM_DMABASE_EGR – TIM_DMABASE_CCMR1 – TIM_DMABASE_CCMR2 – TIM_DMABASE_CCER – TIM_DMABASE_CNT – TIM_DMABASE_PSC – TIM_DMABASE_ARR

- TIM_DMABASE_RCR
- TIM_DMABASE_CCR1
- TIM_DMABASE_CCR2
- TIM_DMABASE_CCR3
- TIM_DMABASE_CCR4
- TIM_DMABASE_BDTR
- TIM_DMABASE_DCR
- **BurstRequestSrc:** TIM DMA Request sources. This parameters can be on of the following values:
 - TIM_DMA_UPDATE: TIM update Interrupt source
 - TIM_DMA_CC1: TIM Capture Compare 1 DMA source
 - TIM_DMA_CC2: TIM Capture Compare 2 DMA source
 - TIM_DMA_CC3: TIM Capture Compare 3 DMA source
 - TIM_DMA_CC4: TIM Capture Compare 4 DMA source
 - TIM_DMA_COM: TIM Commutation DMA source
 - TIM_DMA_TRIGGER: TIM Trigger DMA source
- **BurstBuffer:** The Buffer address.
- **BurstLength:** DMA Burst length. This parameter can be one value between TIM_DMABURSTLENGTH_1TRANSFER and TIM_DMABURSTLENGTH_18TRANSFERS.

Return values

- **HAL:** status

HAL_TIM_DMABurst_WriteStop

Function name **HAL_StatusTypeDef HAL_TIM_DMABurst_WriteStop (TIM_HandleTypeDef * htim, uint32_t BurstRequestSrc)**

Function description Stops the TIM DMA Burst mode.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **BurstRequestSrc:** TIM DMA Request sources to disable

Return values

- **HAL:** status

HAL_TIM_DMABurst_ReadStart

Function name **HAL_StatusTypeDef HAL_TIM_DMABurst_ReadStart (TIM_HandleTypeDef * htim, uint32_t BurstBaseAddress, uint32_t BurstRequestSrc, uint32_t * BurstBuffer, uint32_t BurstLength)**

Function description Configure the DMA Burst to transfer Data from the TIM peripheral to the memory.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **BurstBaseAddress:** TIM Base address from when the DMA will starts the Data read. This parameters can be on of the following values:
 - TIM_DMABASE_CR1
 - TIM_DMABASE_CR2
 - TIM_DMABASE_SMCR
 - TIM_DMABASE_DIER
 - TIM_DMABASE_SR

- TIM_DMABASE_EGR
- TIM_DMABASE_CCMR1
- TIM_DMABASE_CCMR2
- TIM_DMABASE_CCER
- TIM_DMABASE_CNT
- TIM_DMABASE_PSC
- TIM_DMABASE_ARR
- TIM_DMABASE_RCR
- TIM_DMABASE_CCR1
- TIM_DMABASE_CCR2
- TIM_DMABASE_CCR3
- TIM_DMABASE_CCR4
- TIM_DMABASE_BDTR
- TIM_DMABASE_DCR
- **BurstRequestSrc:** TIM DMA Request sources. This parameters can be on of the following values:
 - TIM_DMA_UPDATE: TIM update Interrupt source
 - TIM_DMA_CC1: TIM Capture Compare 1 DMA source
 - TIM_DMA_CC2: TIM Capture Compare 2 DMA source
 - TIM_DMA_CC3: TIM Capture Compare 3 DMA source
 - TIM_DMA_CC4: TIM Capture Compare 4 DMA source
 - TIM_DMA_COM: TIM Commutation DMA source
 - TIM_DMA_TRIGGER: TIM Trigger DMA source
- **BurstBuffer:** The Buffer address.
- **BurstLength:** DMA Burst length. This parameter can be one value between TIM_DMABURSTLENGTH_1TRANSFER and TIM_DMABURSTLENGTH_18TRANSFERS.

Return values

- **HAL:** status

HAL_TIM_DMABurst_ReadStop

Function name **HAL_StatusTypeDef HAL_TIM_DMABurst_ReadStop (TIM_HandleTypeDef * htim, uint32_t BurstRequestSrc)**

Function description Stop the DMA burst reading.

- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **BurstRequestSrc:** TIM DMA Request sources to disable.

Return values

- **HAL:** status

HAL_TIM_GenerateEvent

Function name **HAL_StatusTypeDef HAL_TIM_GenerateEvent (TIM_HandleTypeDef * htim, uint32_t EventSource)**

Function description Generate a software event.

- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **EventSource:** specifies the event source. This parameter can be one of the following values:
 - TIM_EVENTSOURCE_UPDATE: Timer update Event source



- TIM_EVENTSOURCE_CC1: Timer Capture Compare 1 Event source
- TIM_EVENTSOURCE_CC2: Timer Capture Compare 2 Event source
- TIM_EVENTSOURCE_CC3: Timer Capture Compare 3 Event source
- TIM_EVENTSOURCE_CC4: Timer Capture Compare 4 Event source
- TIM_EVENTSOURCE_COM: Timer COM event source
- TIM_EVENTSOURCE_TRIGGER: Timer Trigger Event source
- TIM_EVENTSOURCE_BREAK: Timer Break event source
- TIM_EVENTSOURCE_BREAK2: Timer Break2 event source

Return values

- **HAL:** status

Notes

- TIM6 and TIM7 can only generate an update event.
- TIM_EVENTSOURCE_COM, TIM_EVENTSOURCE_BREAK and TIM_EVENTSOURCE_BREAK2 are used only with TIM1 and TIM8.

HAL_TIM_ReadCapturedValue

Function name **uint32_t HAL_TIM_ReadCapturedValue (TIM_HandleTypeDef * htim, uint32_t Channel)**

Function description Read the captured value from Capture Compare unit.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- **Channel:** TIM Channels to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **Captured:** value

HAL_TIM_PeriodElapsedCallback

Function name **void HAL_TIM_PeriodElapsedCallback (TIM_HandleTypeDef * htim)**

Function description Period elapsed callback in non blocking mode.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **None:**

HAL_TIM_OC_DelayElapsedCallback

Function name **void HAL_TIM_OC_DelayElapsedCallback (TIM_HandleTypeDef * htim)**

Function description	Output Compare callback in non blocking mode.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none">• None:

HAL_TIM_IC_CaptureCallback

Function name	void HAL_TIM_IC_CaptureCallback (TIM_HandleTypeDef * htim)
Function description	Input Capture callback in non blocking mode.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none">• None:

HAL_TIM_PWM_PulseFinishedCallback

Function name	void HAL_TIM_PWM_PulseFinishedCallback (TIM_HandleTypeDef * htim)
Function description	PWM Pulse finished callback in non blocking mode.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none">• None:

HAL_TIM_TriggerCallback

Function name	void HAL_TIM_TriggerCallback (TIM_HandleTypeDef * htim)
Function description	Hall Trigger detection callback in non blocking mode.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none">• None:

HAL_TIM_ErrorCallback

Function name	void HAL_TIM_ErrorCallback (TIM_HandleTypeDef * htim)
Function description	Timer error callback in non blocking mode.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none">• None:

HAL_TIM_Base_GetState

Function name	HAL_TIM_StateTypeDef HAL_TIM_Base_GetState (TIM_HandleTypeDef * htim)
Function description	Return the TIM Base state.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that

contains the configuration information for TIM module.

Return values

- **HAL:** state

HAL_TIM_OC_GetState

Function name **HAL_TIM_StateTypeDef HAL_TIM_OC_GetState (TIM_HandleTypeDef * htim)**

Function description Return the TIM OC state.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **HAL:** state

HAL_TIM_PWM_GetState

Function name **HAL_TIM_StateTypeDef HAL_TIM_PWM_GetState (TIM_HandleTypeDef * htim)**

Function description Return the TIM PWM state.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **HAL:** state

HAL_TIM_IC_GetState

Function name **HAL_TIM_StateTypeDef HAL_TIM_IC_GetState (TIM_HandleTypeDef * htim)**

Function description Return the TIM Input Capture state.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **HAL:** state

HAL_TIM_OnePulse_GetState

Function name **HAL_TIM_StateTypeDef HAL_TIM_OnePulse_GetState (TIM_HandleTypeDef * htim)**

Function description Return the TIM One Pulse Mode state.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **HAL:** state

HAL_TIM_Encoder_GetState

Function name **HAL_TIM_StateTypeDef HAL_TIM_Encoder_GetState (TIM_HandleTypeDef * htim)**

Function description Return the TIM Encoder Mode state.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **HAL:** state

TIM_Base_SetConfig

Function name **void TIM_Base_SetConfig (TIM_TypeDef * TIMx, TIM_Base_InitTypeDef * Structure)**

Function description Time Base configuration.

Parameters

- **TIMx:** TIM peripheral
- **Structure:** pointer on TIM Time Base required parameters

Return values

- **None:**

TIM_TI1_SetConfig

Function name **void TIM_TI1_SetConfig (TIM_TypeDef * TIMx, uint32_t TIM_ICPolarity, uint32_t TIM_ICSelection, uint32_t TIM_ICFilter)**

Function description Configure the TI1 as Input.

Parameters

- **TIMx:** to select the TIM peripheral.
- **TIM_ICPolarity:** : The Input Polarity. This parameter can be one of the following values:
 - TIM_ICPolarity_Rising
 - TIM_ICPolarity_Falling
 - TIM_ICPolarity_BothEdge
- **TIM_ICSelection:** specifies the input to be used. This parameter can be one of the following values:
 - TIM_ICSelection_DirectTI: TIM Input 1 is selected to be connected to IC1.
 - TIM_ICSelection_IndirectTI: TIM Input 1 is selected to be connected to IC2.
 - TIM_ICSelection_TRC: TIM Input 1 is selected to be connected to TRC.
- **TIM_ICFilter:** Specifies the Input Capture Filter. This parameter must be a value between 0x00 and 0x0F.

Return values

- **None:**

Notes

- TIM_ICFilter and TIM_ICPolarity are not used in INDIRECT mode as TI2FP1 (on channel2 path) is used as the input signal. Therefore CCMR1 must be protected against uninitialized filter and polarity values.

TIM_OC1_SetConfig

Function name **void TIM_OC1_SetConfig (TIM_TypeDef * TIMx, TIM_OC_InitTypeDef * OC_Config)**

Function description Time Output Compare 1 configuration.

Parameters

- **TIMx:** to select the TIM peripheral
- **OC_Config:** The output configuration structure

Return values

- **None:**

TIM_OC2_SetConfig

Function name	void TIM_OC2_SetConfig (TIM_TypeDef * TIMx, TIM_OC_InitTypeDef * OC_Config)
Function description	Time Output Compare 2 configuration.
Parameters	<ul style="list-style-type: none"> • TIMx: to select the TIM peripheral • OC_Config: The output configuration structure
Return values	<ul style="list-style-type: none"> • None:

TIM_OC3_SetConfig

Function name	void TIM_OC3_SetConfig (TIM_TypeDef * TIMx, TIM_OC_InitTypeDef * OC_Config)
Function description	Time Output Compare 3 configuration.
Parameters	<ul style="list-style-type: none"> • TIMx: to select the TIM peripheral • OC_Config: The output configuration structure
Return values	<ul style="list-style-type: none"> • None:

TIM_OC4_SetConfig

Function name	void TIM_OC4_SetConfig (TIM_TypeDef * TIMx, TIM_OC_InitTypeDef * OC_Config)
Function description	Time Output Compare 4 configuration.
Parameters	<ul style="list-style-type: none"> • TIMx: to select the TIM peripheral • OC_Config: The output configuration structure
Return values	<ul style="list-style-type: none"> • None:

TIM_ETR_SetConfig

Function name	void TIM_ETR_SetConfig (TIM_TypeDef * TIMx, uint32_t TIM_ExtTRGPrescaler, uint32_t TIM_ExtTRGPolarity, uint32_t ExtTRGFilter)
Function description	Configures the TIMx External Trigger (ETR).
Parameters	<ul style="list-style-type: none"> • TIMx: to select the TIM peripheral • TIM_ExtTRGPrescaler: The external Trigger Prescaler. This parameter can be one of the following values: <ul style="list-style-type: none"> – TIM_ExtTRGPSC_DIV1: ETRP Prescaler OFF. – TIM_ExtTRGPSC_DIV2: ETRP frequency divided by 2. – TIM_ExtTRGPSC_DIV4: ETRP frequency divided by 4. – TIM_ExtTRGPSC_DIV8: ETRP frequency divided by 8. • TIM_ExtTRGPolarity: The external Trigger Polarity. This parameter can be one of the following values: <ul style="list-style-type: none"> – TIM_ExtTRGPolarity_Inverted: active low or falling edge active. – TIM_ExtTRGPolarity_NonInverted: active high or rising edge active. • ExtTRGFilter: External Trigger Filter. This parameter must be a value between 0x00 and 0x0F

Return values • **None:**

HAL_TIM_DMADelayPulseCplt

Function name **void HAL_TIM_DMADelayPulseCplt (DMA_HandleTypeDef * hdma)**

Function description TIM DMA Delay Pulse complete callback.

Parameters • **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.

Return values • **None:**

HAL_TIM_DMAError

Function name **void HAL_TIM_DMAError (DMA_HandleTypeDef * hdma)**

Function description TIM DMA error callback.

Parameters • **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.

Return values • **None:**

HAL_TIM_DMACaptureCplt

Function name **void HAL_TIM_DMACaptureCplt (DMA_HandleTypeDef * hdma)**

Function description TIM DMA Capture complete callback.

Parameters • **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.

Return values • **None:**

TIM_CCxChannelCmd

Function name **void TIM_CCxChannelCmd (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t ChannelState)**

Function description Enables or disables the TIM Capture Compare Channel x.

Parameters

- **TIMx:** to select the TIM peripheral
- **Channel:** specifies the TIM Channel This parameter can be one of the following values:
 - TIM_Channel_1: TIM Channel 1
 - TIM_Channel_2: TIM Channel 2
 - TIM_Channel_3: TIM Channel 3
 - TIM_Channel_4: TIM Channel 4
- **ChannelState:** specifies the TIM Channel CCxE bit new state. This parameter can be: TIM_CCx_ENABLE or TIM_CCx_Disable.

Return values • **None:**

64.3 TIM Firmware driver defines

64.3.1 TIM

TIM AOE Bit State

TIM_AUTOMATICOUTPUT_ENABLE

TIM_AUTOMATICOUTPUT_DISABLE

TIM Auto-Reload Preload

TIM_AUTORELOAD_PRELOAD_DISABLE TIMx_ARR register is not buffered

TIM_AUTORELOAD_PRELOAD_ENABLE TIMx_ARR register is buffered

TIM Break Input State

TIM_BREAK_ENABLE

TIM_BREAK_DISABLE

TIM Break Polarity

TIM_BREAKPOLARITY_LOW

TIM_BREAKPOLARITY_HIGH

TIM Clear Input Polarity

TIM_CLEARINPUTPOLARITY_INVERTED Polarity for ETRx pin

TIM_CLEARINPUTPOLARITY_NONINVERTED Polarity for ETRx pin

TIM Clear Input Prescaler

TIM_CLEARINPUTPRESCALER_DIV1 No prescaler is used

TIM_CLEARINPUTPRESCALER_DIV2 Prescaler for External ETR pin: Capture performed once every 2 events.

TIM_CLEARINPUTPRESCALER_DIV4 Prescaler for External ETR pin: Capture performed once every 4 events.

TIM_CLEARINPUTPRESCALER_DIV8 Prescaler for External ETR pin: Capture performed once every 8 events.

TIM Clock Division

TIM_CLOCKDIVISION_DIV1

TIM_CLOCKDIVISION_DIV2

TIM_CLOCKDIVISION_DIV4

TIM Clock Polarity

TIM_CLOCKPOLARITY_INVERTED Polarity for ETRx clock sources

TIM_CLOCKPOLARITY_NONINVERTED Polarity for ETRx clock sources

TIM_CLOCKPOLARITY_RISING Polarity for Tlx clock sources

TIM_CLOCKPOLARITY_FALLING Polarity for Tlx clock sources

TIM_CLOCKPOLARITY_BOTHEDGE Polarity for Tlx clock sources

TIM Clock Prescaler

TIM_CLOCKPRESCALER_DIV1 No prescaler is used

TIM_CLOCKPRESCALER_DIV2	Prescaler for External ETR Clock: Capture performed once every 2 events.
TIM_CLOCKPRESCALER_DIV4	Prescaler for External ETR Clock: Capture performed once every 4 events.
TIM_CLOCKPRESCALER_DIV8	Prescaler for External ETR Clock: Capture performed once every 8 events.

TIM Clock Source

TIM_CLOCKSOURCE_ETRMODE2
TIM_CLOCKSOURCE_INTERNAL
TIM_CLOCKSOURCE_ITR0
TIM_CLOCKSOURCE_ITR1
TIM_CLOCKSOURCE_ITR2
TIM_CLOCKSOURCE_ITR3
TIM_CLOCKSOURCE_TI1ED
TIM_CLOCKSOURCE_TI1
TIM_CLOCKSOURCE_TI2
TIM_CLOCKSOURCE_ETRMODE1

TIM Commutation Source

TIM_COMMUTATION_TRGI
TIM_COMMUTATION_SOFTWARE

TIM Counter Mode

TIM_COUNTERMODE_UP
TIM_COUNTERMODE_DOWN
TIM_COUNTERMODE_CENTERALIGNED1
TIM_COUNTERMODE_CENTERALIGNED2
TIM_COUNTERMODE_CENTERALIGNED3

TIM DMA Base address

TIM_DMABASE_CR1
TIM_DMABASE_CR2
TIM_DMABASE_SMCR
TIM_DMABASE_DIER
TIM_DMABASE_SR
TIM_DMABASE_EGR
TIM_DMABASE_CCMR1
TIM_DMABASE_CCMR2
TIM_DMABASE_CCER
TIM_DMABASE_CNT

TIM_DMABASE_PSC
TIM_DMABASE_ARR
TIM_DMABASE_RCR
TIM_DMABASE_CCR1
TIM_DMABASE_CCR2
TIM_DMABASE_CCR3
TIM_DMABASE_CCR4
TIM_DMABASE_BDTR
TIM_DMABASE_DCR
TIM_DMABASE_OR

TIM DMA Burst Length

TIM_DMABURSTLENGTH_1TRANSFER
TIM_DMABURSTLENGTH_2TRANSFERS
TIM_DMABURSTLENGTH_3TRANSFERS
TIM_DMABURSTLENGTH_4TRANSFERS
TIM_DMABURSTLENGTH_5TRANSFERS
TIM_DMABURSTLENGTH_6TRANSFERS
TIM_DMABURSTLENGTH_7TRANSFERS
TIM_DMABURSTLENGTH_8TRANSFERS
TIM_DMABURSTLENGTH_9TRANSFERS
TIM_DMABURSTLENGTH_10TRANSFERS
TIM_DMABURSTLENGTH_11TRANSFERS
TIM_DMABURSTLENGTH_12TRANSFERS
TIM_DMABURSTLENGTH_13TRANSFERS
TIM_DMABURSTLENGTH_14TRANSFERS
TIM_DMABURSTLENGTH_15TRANSFERS
TIM_DMABURSTLENGTH_16TRANSFERS
TIM_DMABURSTLENGTH_17TRANSFERS
TIM_DMABURSTLENGTH_18TRANSFERS

TIM DMA sources

TIM_DMA_UPDATE
TIM_DMA_CC1
TIM_DMA_CC2
TIM_DMA_CC3
TIM_DMA_CC4
TIM_DMA_COM

TIM_DMA_TRIGGER

TIM Encoder Mode

TIM_ENCODERMODE_TI1

TIM_ENCODERMODE_TI2

TIM_ENCODERMODE_TI12

TIM ETR Polarity

TIM_ETRPOLARITY_INVERTED Polarity for ETR source

TIM_ETRPOLARITY_NONINVERTED Polarity for ETR source

TIM ETR Prescaler

TIM_ETRPRESCALER_DIV1 No prescaler is used

TIM_ETRPRESCALER_DIV2 ETR input source is divided by 2

TIM_ETRPRESCALER_DIV4 ETR input source is divided by 4

TIM_ETRPRESCALER_DIV8 ETR input source is divided by 8

TIM Event Source

TIM_EVENTSOURCE_UPDATE

TIM_EVENTSOURCE_CC1

TIM_EVENTSOURCE_CC2

TIM_EVENTSOURCE_CC3

TIM_EVENTSOURCE_CC4

TIM_EVENTSOURCE_COM

TIM_EVENTSOURCE_TRIGGER

TIM_EVENTSOURCE_BREAK

TIM_EVENTSOURCE_BREAK2

TIM Exported Macros

__HAL_TIM_RESET_HANDLE_STATE

Description:

- Reset TIM handle state.

Parameters:

- __HANDLE__: TIM handle

Return value:

- None

__HAL_TIM_ENABLE

Description:

- Enable the TIM peripheral.

Parameters:

- __HANDLE__: TIM handle

Return value:

- None

<p><code>__HAL_TIM_URS_ENABLE</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Enable the TIM update source request. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: TIM handle <p>Return value:</p> <ul style="list-style-type: none"> • None
<p><code>__HAL_TIM_MOE_ENABLE</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Enable the TIM main Output. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: TIM handle <p>Return value:</p> <ul style="list-style-type: none"> • None
<p><code>TIM_CCER_CCxE_MASK</code> <code>TIM_CCER_CCxNE_MASK</code> <code>__HAL_TIM_DISABLE</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Disable the TIM peripheral. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: TIM handle <p>Return value:</p> <ul style="list-style-type: none"> • None
<p><code>__HAL_TIM_URS_DISABLE</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Disable the TIM update source request. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: TIM handle <p>Return value:</p> <ul style="list-style-type: none"> • None
<p><code>__HAL_TIM_MOE_DISABLE</code></p>	<p>Description:</p> <ul style="list-style-type: none"> • Disable the TIM main Output. <p>Parameters:</p> <ul style="list-style-type: none"> • <code>__HANDLE__</code>: TIM handle <p>Return value:</p> <ul style="list-style-type: none"> • None
<p><code>__HAL_TIM_ENABLE_IT</code> <code>__HAL_TIM_ENABLE_DMA</code> <code>__HAL_TIM_DISABLE_IT</code> <code>__HAL_TIM_DISABLE_DMA</code></p>	

__HAL_TIM_GET_FLAG
__HAL_TIM_CLEAR_FLAG
__HAL_TIM_GET_IT_SOURCE
__HAL_TIM_CLEAR_IT
__HAL_TIM_IS_TIM_COUNTING_
DOWN
__HAL_TIM_SET_PRESCALER
TIM_SET_ICPRESCALERVALUE
TIM_RESET_ICPRESCALERVAL
UE
TIM_SET_CAPTUREPOLARITY
TIM_RESET_CAPTUREPOLARIT
Y
__HAL_TIM_SET_COUNTER

Description:

- Sets the TIM Counter Register value on runtime.

Parameters:

- __HANDLE__: TIM handle.
- __COUNTER__: specifies the Counter register new value.

Return value:

- None

__HAL_TIM_GET_COUNTER

Description:

- Gets the TIM Counter Register value on runtime.

Parameters:

- __HANDLE__: TIM handle.

Return value:

- None

__HAL_TIM_SET_AUTORELOAD

Description:

- Sets the TIM Autoreload Register value on runtime without calling another time any Init function.

Parameters:

- __HANDLE__: TIM handle.
- __AUTORELOAD__: specifies the Counter register new value.

Return value:

- None

__HAL_TIM_GET_AUTORELOAD

Description:

`__HAL_TIM_SET_CLOCKDIVISION`
N

- Gets the TIM Autoreload Register value on runtime.

Parameters:

- `__HANDLE__`: TIM handle.

Return value:

- None

Description:

- Sets the TIM Clock Division value on runtime without calling another time any Init function.

Parameters:

- `__HANDLE__`: TIM handle.
- `__CKD__`: specifies the clock division value. This parameter can be one of the following value:
 - `TIM_CLOCKDIVISION_DIV1`
 - `TIM_CLOCKDIVISION_DIV2`
 - `TIM_CLOCKDIVISION_DIV4`

Return value:

- None

`__HAL_TIM_GET_CLOCKDIVISION`
N

Description:

- Gets the TIM Clock Division value on runtime.

Parameters:

- `__HANDLE__`: TIM handle.

Return value:

- None

`__HAL_TIM_SET_ICPRESCALER`

Description:

- Sets the TIM Input Capture prescaler on runtime without calling another time

Parameters:

- `__HANDLE__`: TIM handle.
- `__CHANNEL__`: TIM Channels to be configured. This parameter can be one of the following values:
 - `TIM_CHANNEL_1`: TIM Channel 1 selected
 - `TIM_CHANNEL_2`: TIM Channel 2 selected
 - `TIM_CHANNEL_3`: TIM Channel 3 selected
 - `TIM_CHANNEL_4`: TIM Channel 4 selected
- `__ICPSC__`: specifies the Input Capture4 prescaler new value. This parameter can be one of the following values:

- TIM_ICPSC_DIV1: no prescaler
- TIM_ICPSC_DIV2: capture is done once every 2 events
- TIM_ICPSC_DIV4: capture is done once every 4 events
- TIM_ICPSC_DIV8: capture is done once every 8 events

Return value:

- None

`__HAL_TIM_GET_ICPRESCALER`

Description:

- Gets the TIM Input Capture prescaler on runtime.

Parameters:

- `__HANDLE__`: TIM handle.
- `__CHANNEL__`: TIM Channels to be configured. This parameter can be one of the following values:
 - `TIM_CHANNEL_1`: get input capture 1 prescaler value
 - `TIM_CHANNEL_2`: get input capture 2 prescaler value
 - `TIM_CHANNEL_3`: get input capture 3 prescaler value
 - `TIM_CHANNEL_4`: get input capture 4 prescaler value

Return value:

- None

`__HAL_TIM_SET_CAPTUREPOLARITY`

Description:

- Sets the TIM Capture x input polarity on runtime.

Parameters:

- `__HANDLE__`: TIM handle.
- `__CHANNEL__`: TIM Channels to be configured. This parameter can be one of the following values:
 - `TIM_CHANNEL_1`: TIM Channel 1 selected
 - `TIM_CHANNEL_2`: TIM Channel 2 selected
 - `TIM_CHANNEL_3`: TIM Channel 3 selected
 - `TIM_CHANNEL_4`: TIM Channel 4 selected
- `__POLARITY__`: Polarity for Tlx source
 - `TIM_INPUTCHANNELPOLARITY_RISING`: Rising Edge
 - `TIM_INPUTCHANNELPOLARITY_FALLING`: Falling Edge

- TIM_INPUTCHANNELPOLARITY_BOTHEDGE: Rising and Falling Edge

Return value:

- None

Notes:

- The polarity TIM_INPUTCHANNELPOLARITY_BOTHEDGE is not authorized for TIM Channel 4.

TIM Flag definition

TIM_FLAG_UPDATE
 TIM_FLAG_CC1
 TIM_FLAG_CC2
 TIM_FLAG_CC3
 TIM_FLAG_CC4
 TIM_FLAG_COM
 TIM_FLAG_TRIGGER
 TIM_FLAG_BREAK
 TIM_FLAG_BREAK2
 TIM_FLAG_CC1OF
 TIM_FLAG_CC2OF
 TIM_FLAG_CC3OF
 TIM_FLAG_CC4OF

TIM Input Capture Polarity

TIM_ICPOLARITY_RISING
 TIM_ICPOLARITY_FALLING
 TIM_ICPOLARITY_BOTHEDGE

TIM Input Capture Prescaler

TIM_ICPSC_DIV1	Capture performed each time an edge is detected on the capture input
TIM_ICPSC_DIV2	Capture performed once every 2 events
TIM_ICPSC_DIV4	Capture performed once every 4 events
TIM_ICPSC_DIV8	Capture performed once every 8 events

TIM Input Capture Selection

TIM_ICSELECTION_DIRECTTI	TIM Input 1, 2, 3 or 4 is selected to be connected to IC1, IC2, IC3 or IC4, respectively
TIM_ICSELECTION_INDIRECTTI	TIM Input 1, 2, 3 or 4 is selected to be connected to IC2, IC1, IC4 or IC3, respectively
TIM_ICSELECTION_TRC	TIM Input 1, 2, 3 or 4 is selected to be connected to TRC

TIM Input Channel Polarity

TIM_INPUTCHANNELPOLARITY_RISING Polarity for Tlx source
TIM_INPUTCHANNELPOLARITY_FALLING Polarity for Tlx source
TIM_INPUTCHANNELPOLARITY_BOTHEEDGE Polarity for Tlx source

TIM Interrupt definition

TIM_IT_UPDATE
TIM_IT_CC1
TIM_IT_CC2
TIM_IT_CC3
TIM_IT_CC4
TIM_IT_COM
TIM_IT_TRIGGER
TIM_IT_BREAK

TIM Private macros to check input parameters

IS_TIM_COUNTER_MODE
IS_TIM_CLOCKDIVISION_DIV
IS_TIM_AUTORELOAD_PRELOAD
IS_TIM_FAST_STATE
IS_TIM_OUTPUT_STATE
IS_TIM_OUTPUTN_STATE
IS_TIM_OC_POLARITY
IS_TIM_OCN_POLARITY
IS_TIM_OCIDLE_STATE
IS_TIM_OCNIDLE_STATE
IS_TIM_IC_POLARITY
IS_TIM_IC_SELECTION
IS_TIM_IC_PRESCALER
IS_TIM_OPM_MODE
IS_TIM_ENCODER_MODE
IS_TIM_IT
IS_TIM_GET_IT
IS_TIM_DMA_SOURCE
IS_TIM_EVENT_SOURCE
IS_TIM_FLAG
IS_TIM_CLOCKSOURCE
IS_TIM_CLOCKPOLARITY

IS_TIM_CLOCKPRESCALER
IS_TIM_CLOCKFILTER
IS_TIM_CLEARINPUT_POLARITY
IS_TIM_CLEARINPUT_PRESCALER
IS_TIM_CLEARINPUT_FILTER
IS_TIM_OSSR_STATE
IS_TIM_OSSI_STATE
IS_TIM_LOCK_LEVEL
IS_TIM_BREAK_STATE
IS_TIM_BREAK_POLARITY
IS_TIM_AUTOMATIC_OUTPUT_STATE
IS_TIM_TRGO_SOURCE
IS_TIM_MSM_STATE
IS_TIM_TRIGGER_SELECTION
IS_TIM_INTERNAL_TRIGGER_SELECTION
IS_TIM_INTERNAL_TRIGGEREVENT_SELECTION
IS_TIM_TRIGGERPOLARITY
IS_TIM_TRIGGERPRESCALER
IS_TIM_TRIGGERFILTER
IS_TIM_TI1SELECTION
IS_TIM_DMA_BASE
IS_TIM_DMA_LENGTH
IS_TIM_IC_FILTER

TIM Lock level

TIM_LOCKLEVEL_OFF
TIM_LOCKLEVEL_1
TIM_LOCKLEVEL_2
TIM_LOCKLEVEL_3

TIM Master Mode Selection

TIM_TRGO_RESET
TIM_TRGO_ENABLE
TIM_TRGO_UPDATE
TIM_TRGO_OC1
TIM_TRGO_OC1REF
TIM_TRGO_OC2REF
TIM_TRGO_OC3REF

TIM_TRGO_OC4REF

TIM Master Slave Mode

TIM_MASTERSLAVEMODE_ENABLE

TIM_MASTERSLAVEMODE_DISABLE

TIM One Pulse Mode

TIM_OPMODE_SINGLE

TIM_OPMODE_REPETITIVE

TIM OSSI OffState Selection for Idle mode state

TIM_OSSI_ENABLE

TIM_OSSI_DISABLE

TIM OSSR OffState Selection for Run mode state

TIM_OSSR_ENABLE

TIM_OSSR_DISABLE

TIM Output Compare Idle State

TIM_OCIDLESTATE_SET

TIM_OCIDLESTATE_RESET

TIM Output Compare N Idle State

TIM_OCNIDLESTATE_SET

TIM_OCNIDLESTATE_RESET

TIM Complementary Output Compare Polarity

TIM_OCNPOLARITY_HIGH

TIM_OCNPOLARITY_LOW

TIM Complementary Output Compare State

TIM_OUTPUTNSTATE_DISABLE

TIM_OUTPUTNSTATE_ENABLE

TIM Output Compare Polarity

TIM_OCPOLARITY_HIGH

TIM_OCPOLARITY_LOW

TIM Output Compare State

TIM_OUTPUTSTATE_DISABLE

TIM_OUTPUTSTATE_ENABLE

TIM Output Fast State

TIM_OCFAST_DISABLE

TIM_OCFAST_ENABLE

TIM TI1 Selection

TIM_TI1SELECTION_CH1

TIM_TI1SELECTION_XORCOMBINATION

TIM Trigger Polarity

TIM_TRIGGERPOLARITY_INVERTED	Polarity for ETRx trigger sources
TIM_TRIGGERPOLARITY_NONINVERTED	Polarity for ETRx trigger sources
TIM_TRIGGERPOLARITY_RISING	Polarity for TlxFPx or TI1_ED trigger sources
TIM_TRIGGERPOLARITY_FALLING	Polarity for TlxFPx or TI1_ED trigger sources
TIM_TRIGGERPOLARITY_BOTHEDGE	Polarity for TlxFPx or TI1_ED trigger sources

TIM Trigger Prescaler

TIM_TRIGGERPRESCALER_DIV1	No prescaler is used
TIM_TRIGGERPRESCALER_DIV2	Prescaler for External ETR Trigger: Capture performed once every 2 events.
TIM_TRIGGERPRESCALER_DIV4	Prescaler for External ETR Trigger: Capture performed once every 4 events.
TIM_TRIGGERPRESCALER_DIV8	Prescaler for External ETR Trigger: Capture performed once every 8 events.

TIM Trigger Selection

TIM_TS_ITR0
TIM_TS_ITR1
TIM_TS_ITR2
TIM_TS_ITR3
TIM_TS_TI1F_ED
TIM_TS_TI1FP1
TIM_TS_TI2FP2
TIM_TS_ETRF
TIM_TS_NONE

65 HAL TIM Extension Driver

65.1 TIMEx Firmware driver registers structures

65.1.1 TIM_HallSensor_InitTypeDef

Data Fields

- *uint32_t IC1Polarity*
- *uint32_t IC1Prescaler*
- *uint32_t IC1Filter*
- *uint32_t Commutation_Delay*

Field Documentation

- *uint32_t TIM_HallSensor_InitTypeDef::IC1Polarity*
Specifies the active edge of the input signal. This parameter can be a value of [TIM_Input_Capture_Polarity](#)
- *uint32_t TIM_HallSensor_InitTypeDef::IC1Prescaler*
Specifies the Input Capture Prescaler. This parameter can be a value of [TIM_Input_Capture_Prescaler](#)
- *uint32_t TIM_HallSensor_InitTypeDef::IC1Filter*
Specifies the input capture filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF
- *uint32_t TIM_HallSensor_InitTypeDef::Commutation_Delay*
Specifies the pulse value to be loaded into the Capture Compare Register. This parameter can be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF

65.1.2 TIM_MasterConfigTypeDef

Data Fields

- *uint32_t MasterOutputTrigger*
- *uint32_t MasterOutputTrigger2*
- *uint32_t MasterSlaveMode*

Field Documentation

- *uint32_t TIM_MasterConfigTypeDef::MasterOutputTrigger*
Trigger output (TRGO) selection. This parameter can be a value of [TIM_Master_Mode_Selection](#)
- *uint32_t TIM_MasterConfigTypeDef::MasterOutputTrigger2*
Trigger output2 (TRGO2) selection This parameter can be a value of [TIMEx_Master_Mode_Selection_2](#)
- *uint32_t TIM_MasterConfigTypeDef::MasterSlaveMode*
Master/slave mode selection. This parameter can be a value of [TIM_Master_Slave_Mode](#)

65.1.3 TIM_BreakDeadTimeConfigTypeDef

Data Fields

- *uint32_t OffStateRunMode*
- *uint32_t OffStateIDLEMode*
- *uint32_t LockLevel*
- *uint32_t DeadTime*

- *uint32_t BreakState*
- *uint32_t BreakPolarity*
- *uint32_t BreakFilter*
- *uint32_t Break2State*
- *uint32_t Break2Polarity*
- *uint32_t Break2Filter*
- *uint32_t AutomaticOutput*

Field Documentation

- *uint32_t TIM_BreakDeadTimeConfigTypeDef::OffStateRunMode*
TIM off state in run mode. This parameter can be a value of [TIM_OSSR_Off_State_Selection_for_Run_mode_state](#)
- *uint32_t TIM_BreakDeadTimeConfigTypeDef::OffStateIDLEMode*
TIM off state in IDLE mode. This parameter can be a value of [TIM_OSSI_Off_State_Selection_for_Idle_mode_state](#)
- *uint32_t TIM_BreakDeadTimeConfigTypeDef::LockLevel*
TIM Lock level. This parameter can be a value of [TIM_Lock_level](#)
- *uint32_t TIM_BreakDeadTimeConfigTypeDef::DeadTime*
TIM dead Time. This parameter can be a number between Min_Data = 0x00 and Max_Data = 0xFF
- *uint32_t TIM_BreakDeadTimeConfigTypeDef::BreakState*
TIM Break State. This parameter can be a value of [TIM_Break_Input_enable_disable](#)
- *uint32_t TIM_BreakDeadTimeConfigTypeDef::BreakPolarity*
TIM Break input polarity. This parameter can be a value of [TIM_Break_Polarity](#)
- *uint32_t TIM_BreakDeadTimeConfigTypeDef::BreakFilter*
Specifies the break input filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF
- *uint32_t TIM_BreakDeadTimeConfigTypeDef::Break2State*
TIM Break2 State This parameter can be a value of [TIMEx_Break2_Input_enable_disable](#)
- *uint32_t TIM_BreakDeadTimeConfigTypeDef::Break2Polarity*
TIM Break2 input polarity This parameter can be a value of [TIMEx_Break2_Polarity](#)
- *uint32_t TIM_BreakDeadTimeConfigTypeDef::Break2Filter*
TIM break2 input filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF
- *uint32_t TIM_BreakDeadTimeConfigTypeDef::AutomaticOutput*
TIM Automatic Output Enable state This parameter can be a value of [TIM_AOE_Bit_Set_Reset](#)

65.1.4 TIMEx_BreakInputConfigTypeDef

Data Fields

- *uint32_t Source*
- *uint32_t Enable*

Field Documentation

- *uint32_t TIMEx_BreakInputConfigTypeDef::Source*
Specifies the source of the timer break input. This parameter can be a value of [TIMEx_Break_Input_Source](#)
- *uint32_t TIMEx_BreakInputConfigTypeDef::Enable*
Specifies whether or not the break input source is enabled. This parameter can be a value of [TIMEx_Break_Input_Source_Enable](#)

65.2 TIMEx Firmware driver API description

65.2.1 TIMER Extended features

The Timer Extension features include:

1. Complementary outputs with programmable dead-time for :
 - Input Capture
 - Output Compare
 - PWM generation (Edge and Center-aligned Mode)
 - One-pulse mode output
2. Synchronization circuit to control the timer with external signals and to interconnect several timers together.
3. Break input to put the timer output signals in reset state or in a known state.
4. Supports incremental (quadrature) encoder and hall-sensor circuitry for positioning purposes

65.2.2 How to use this driver

1. Initialize the TIM low level resources by implementing the following functions depending from feature used :
 - Complementary Output Compare : `HAL_TIM_OC_MspInit()`
 - Complementary PWM generation : `HAL_TIM_PWM_MspInit()`
 - Complementary One-pulse mode output : `HAL_TIM_OnePulse_MspInit()`
 - Hall Sensor output : `HAL_TIM_HallSensor_MspInit()`
2. Initialize the TIM low level resources :
 - a. Enable the TIM interface clock using `__HAL_RCC_TIMx_CLK_ENABLE()`;
 - b. TIM pins configuration
 - Enable the clock for the TIM GPIOs using the following function:
`__HAL_RCC_GPIOx_CLK_ENABLE()`;
 - Configure these TIM pins in Alternate function mode using `HAL_GPIO_Init()`;
3. The external Clock can be configured, if needed (the default clock is the internal clock from the APBx), using the following function: `HAL_TIM_ConfigClockSource`, the clock configuration should be done before any start function.
4. Configure the TIM in the desired functioning mode using one of the initialization function of this driver:
 - `HAL_TIMEx_HallSensor_Init` and `HAL_TIMEx_ConfigCommutationEvent`: to use the Timer Hall Sensor Interface and the commutation event with the corresponding Interrupt and DMA request if needed (Note that One Timer is used to interface with the Hall sensor Interface and another Timer should be used to use the commutation event).
5. Activate the TIM peripheral using one of the start functions:
 - Complementary Output Compare : `HAL_TIMEx_OCN_Start()`,
`HAL_TIMEx_OCN_Start_DMA()`, `HAL_TIMEx_OC_Start_IT()`
 - Complementary PWM generation : `HAL_TIMEx_PWMN_Start()`,
`HAL_TIMEx_PWMN_Start_DMA()`, `HAL_TIMEx_PWMN_Start_IT()`
 - Complementary One-pulse mode output : `HAL_TIMEx_OnePulseN_Start()`,
`HAL_TIMEx_OnePulseN_Start_IT()`
 - Hall Sensor output : `HAL_TIMEx_HallSensor_Start()`,
`HAL_TIMEx_HallSensor_Start_DMA()`, `HAL_TIMEx_HallSensor_Start_IT()`.

65.2.3 Timer Hall Sensor functions

This section provides functions allowing to:

- Initialize and configure TIM HAL Sensor.

- De-initialize TIM HAL Sensor.
- Start the Hall Sensor Interface.
- Stop the Hall Sensor Interface.
- Start the Hall Sensor Interface and enable interrupts.
- Stop the Hall Sensor Interface and disable interrupts.
- Start the Hall Sensor Interface and enable DMA transfers.
- Stop the Hall Sensor Interface and disable DMA transfers.

This section contains the following APIs:

- [*HAL_TIMEx_HallSensor_Init\(\)*](#)
- [*HAL_TIMEx_HallSensor_DeInit\(\)*](#)
- [*HAL_TIMEx_HallSensor_MspInit\(\)*](#)
- [*HAL_TIMEx_HallSensor_MspDeInit\(\)*](#)
- [*HAL_TIMEx_HallSensor_Start\(\)*](#)
- [*HAL_TIMEx_HallSensor_Stop\(\)*](#)
- [*HAL_TIMEx_HallSensor_Start_IT\(\)*](#)
- [*HAL_TIMEx_HallSensor_Stop_IT\(\)*](#)
- [*HAL_TIMEx_HallSensor_Start_DMA\(\)*](#)
- [*HAL_TIMEx_HallSensor_Stop_DMA\(\)*](#)

65.2.4 Timer Complementary Output Compare functions

This section provides functions allowing to:

- Start the Complementary Output Compare/PWM.
- Stop the Complementary Output Compare/PWM.
- Start the Complementary Output Compare/PWM and enable interrupts.
- Stop the Complementary Output Compare/PWM and disable interrupts.
- Start the Complementary Output Compare/PWM and enable DMA transfers.
- Stop the Complementary Output Compare/PWM and disable DMA transfers.

This section contains the following APIs:

- [*HAL_TIMEx_OC_Start\(\)*](#)
- [*HAL_TIMEx_OC_Stop\(\)*](#)
- [*HAL_TIMEx_OC_Start_IT\(\)*](#)
- [*HAL_TIMEx_OC_Stop_IT\(\)*](#)
- [*HAL_TIMEx_OC_Start_DMA\(\)*](#)
- [*HAL_TIMEx_OC_Stop_DMA\(\)*](#)

65.2.5 Timer Complementary PWM functions

This section provides functions allowing to:

- Start the Complementary PWM.
- Stop the Complementary PWM.
- Start the Complementary PWM and enable interrupts.
- Stop the Complementary PWM and disable interrupts.
- Start the Complementary PWM and enable DMA transfers.
- Stop the Complementary PWM and disable DMA transfers.
- Start the Complementary Input Capture measurement.
- Stop the Complementary Input Capture.
- Start the Complementary Input Capture and enable interrupts.
- Stop the Complementary Input Capture and disable interrupts.
- Start the Complementary Input Capture and enable DMA transfers.
- Stop the Complementary Input Capture and disable DMA transfers.

- Start the Complementary One Pulse generation.
- Stop the Complementary One Pulse.
- Start the Complementary One Pulse and enable interrupts.
- Stop the Complementary One Pulse and disable interrupts.

This section contains the following APIs:

- [HAL_TIMEx_PWMN_Start\(\)](#)
- [HAL_TIMEx_PWMN_Stop\(\)](#)
- [HAL_TIMEx_PWMN_Start_IT\(\)](#)
- [HAL_TIMEx_PWMN_Stop_IT\(\)](#)
- [HAL_TIMEx_PWMN_Start_DMA\(\)](#)
- [HAL_TIMEx_PWMN_Stop_DMA\(\)](#)

65.2.6 Timer Complementary One Pulse functions

This section provides functions allowing to:

- Start the Complementary One Pulse generation.
- Stop the Complementary One Pulse.
- Start the Complementary One Pulse and enable interrupts.
- Stop the Complementary One Pulse and disable interrupts.

This section contains the following APIs:

- [HAL_TIMEx_OnePulseN_Start\(\)](#)
- [HAL_TIMEx_OnePulseN_Stop\(\)](#)
- [HAL_TIMEx_OnePulseN_Start_IT\(\)](#)
- [HAL_TIMEx_OnePulseN_Stop_IT\(\)](#)

65.2.7 Peripheral Control functions

This section provides functions allowing to:

- Configure The Input Output channels for OC, PWM, IC or One Pulse mode.
- Configure External Clock source.
- Configure Complementary channels, break features and dead time.
- Configure Master and the Slave synchronization.
- Configure the commutation event in case of use of the Hall sensor interface.
- Configure the DMA Burst Mode.

This section contains the following APIs:

- [HAL_TIMEx_ConfigCommutationEvent\(\)](#)
- [HAL_TIMEx_ConfigCommutationEvent_IT\(\)](#)
- [HAL_TIMEx_ConfigCommutationEvent_DMA\(\)](#)
- [HAL_TIMEx_MasterConfigSynchronization\(\)](#)
- [HAL_TIMEx_ConfigBreakDeadTime\(\)](#)
- [HAL_TIMEx_ConfigBreakInput\(\)](#)
- [HAL_TIMEx_RemapConfig\(\)](#)
- [HAL_TIMEx_GroupChannel5\(\)](#)

65.2.8 Extension Callbacks functions

This section provides Extension TIM callback functions:

- Timer Commutation callback
- Timer Break callback

This section contains the following APIs:

- [HAL_TIMEx_CommutationCallback\(\)](#)
- [HAL_TIMEx_BreakCallback\(\)](#)
- [HAL_TIMEx_DMACommutationCplt\(\)](#)

65.2.9 Extension Peripheral State functions

This subsection permits to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- [HAL_TIMEx_HallSensor_GetState\(\)](#)

65.2.10 Detailed description of functions

HAL_TIMEx_HallSensor_Init

Function name	HAL_StatusTypeDef HAL_TIMEx_HallSensor_Init (TIM_HandleTypeDef * htim, TIM_HallSensor_InitTypeDef * sConfig)
Function description	Initializes the TIM Hall Sensor Interface and create the associated handle.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. • sConfig: TIM Hall Sensor configuration structure
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIMEx_HallSensor_DeInit

Function name	HAL_StatusTypeDef HAL_TIMEx_HallSensor_DeInit (TIM_HandleTypeDef * htim)
Function description	DeInitializes the TIM Hall Sensor interface.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIMEx_HallSensor_MspInit

Function name	void HAL_TIMEx_HallSensor_MspInit (TIM_HandleTypeDef * htim)
Function description	Initializes the TIM Hall Sensor MSP.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • None:

HAL_TIMEx_HallSensor_MspDeInit

Function name	void HAL_TIMEx_HallSensor_MspDeInit (TIM_HandleTypeDef * htim)
Function description	DeInitializes TIM Hall Sensor MSP.

- | | |
|---------------|---|
| Parameters | <ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. |
| Return values | <ul style="list-style-type: none"> • None: |

HAL_TIMEx_HallSensor_Start

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_TIMEx_HallSensor_Start (TIM_HandleTypeDef * htim) |
| Function description | Starts the TIM Hall Sensor Interface. |
| Parameters | <ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_TIMEx_HallSensor_Stop

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_TIMEx_HallSensor_Stop (TIM_HandleTypeDef * htim) |
| Function description | Stops the TIM Hall sensor Interface. |
| Parameters | <ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_TIMEx_HallSensor_Start_IT

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_TIMEx_HallSensor_Start_IT (TIM_HandleTypeDef * htim) |
| Function description | Starts the TIM Hall Sensor Interface in interrupt mode. |
| Parameters | <ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_TIMEx_HallSensor_Stop_IT

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_TIMEx_HallSensor_Stop_IT (TIM_HandleTypeDef * htim) |
| Function description | Stops the TIM Hall Sensor Interface in interrupt mode. |
| Parameters | <ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_TIMEx_HallSensor_Start_DMA

- | | |
|----------------------|---|
| Function name | HAL_StatusTypeDef HAL_TIMEx_HallSensor_Start_DMA (TIM_HandleTypeDef * htim, uint32_t * pData, uint16_t Length) |
| Function description | Starts the TIM Hall Sensor Interface in DMA mode. |
| Parameters | <ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that |

- contains the configuration information for TIM module.
 - **pData:** The destination Buffer address.
 - **Length:** The length of data to be transferred from TIM peripheral to memory.
- Return values
- **HAL:** status

HAL_TIMEx_HallSensor_Stop_DMA

- Function name **HAL_StatusTypeDef HAL_TIMEx_HallSensor_Stop_DMA (TIM_HandleTypeDef * htim)**
- Function description Stops the TIM Hall Sensor Interface in DMA mode.
- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
- Return values
- **HAL:** status

HAL_TIMEx_OCN_Start

- Function name **HAL_StatusTypeDef HAL_TIMEx_OCN_Start (TIM_HandleTypeDef * htim, uint32_t Channel)**
- Function description Starts the TIM Output Compare signal generation on the complementary output.
- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **Channel:** TIM Channel to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected
- Return values
- **HAL:** status

HAL_TIMEx_OCN_Stop

- Function name **HAL_StatusTypeDef HAL_TIMEx_OCN_Stop (TIM_HandleTypeDef * htim, uint32_t Channel)**
- Function description Stops the TIM Output Compare signal generation on the complementary output.
- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **Channel:** TIM Channel to be disabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected
- Return values
- **HAL:** status

HAL_TIMEx_OCN_Start_IT

Function name	HAL_StatusTypeDef HAL_TIMEx_OCN_Start_IT (TIM_HandleTypeDef * htim, uint32_t Channel)
Function description	Starts the TIM Output Compare signal generation in interrupt mode on the complementary output.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. • Channel: TIM Channel to be enabled. This parameter can be one of the following values: <ul style="list-style-type: none"> – TIM_CHANNEL_1: TIM Channel 1 selected – TIM_CHANNEL_2: TIM Channel 2 selected – TIM_CHANNEL_3: TIM Channel 3 selected – TIM_CHANNEL_4: TIM Channel 4 selected
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIMEx_OCN_Stop_IT

Function name	HAL_StatusTypeDef HAL_TIMEx_OCN_Stop_IT (TIM_HandleTypeDef * htim, uint32_t Channel)
Function description	Stops the TIM Output Compare signal generation in interrupt mode on the complementary output.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. • Channel: TIM Channel to be disabled. This parameter can be one of the following values: <ul style="list-style-type: none"> – TIM_CHANNEL_1: TIM Channel 1 selected – TIM_CHANNEL_2: TIM Channel 2 selected – TIM_CHANNEL_3: TIM Channel 3 selected – TIM_CHANNEL_4: TIM Channel 4 selected
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_TIMEx_OCN_Start_DMA

Function name	HAL_StatusTypeDef HAL_TIMEx_OCN_Start_DMA (TIM_HandleTypeDef * htim, uint32_t Channel, uint32_t * pData, uint16_t Length)
Function description	Starts the TIM Output Compare signal generation in DMA mode on the complementary output.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. • Channel: TIM Channel to be enabled. This parameter can be one of the following values: <ul style="list-style-type: none"> – TIM_CHANNEL_1: TIM Channel 1 selected – TIM_CHANNEL_2: TIM Channel 2 selected – TIM_CHANNEL_3: TIM Channel 3 selected – TIM_CHANNEL_4: TIM Channel 4 selected • pData: The source Buffer address. • Length: The length of data to be transferred from memory to

TIM peripheral

- Return values
- **HAL:** status

HAL_TIMEx_OCN_Stop_DMA

Function name **HAL_StatusTypeDef HAL_TIMEx_OCN_Stop_DMA (TIM_HandleTypeDef * htim, uint32_t Channel)**

Function description Stops the TIM Output Compare signal generation in DMA mode on the complementary output.

- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **Channel:** TIM Channel to be disabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected

- Return values
- **HAL:** status

HAL_TIMEx_PWMN_Start

Function name **HAL_StatusTypeDef HAL_TIMEx_PWMN_Start (TIM_HandleTypeDef * htim, uint32_t Channel)**

Function description Starts the PWM signal generation on the complementary output.

- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **Channel:** TIM Channel to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected

- Return values
- **HAL:** status

HAL_TIMEx_PWMN_Stop

Function name **HAL_StatusTypeDef HAL_TIMEx_PWMN_Stop (TIM_HandleTypeDef * htim, uint32_t Channel)**

Function description Stops the PWM signal generation on the complementary output.

- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **Channel:** TIM Channel to be disabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected

- Return values
- **HAL:** status

HAL_TIMEx_PWMN_Start_IT

Function name	HAL_StatusTypeDef HAL_TIMEx_PWMN_Start_IT (TIM_HandleTypeDef * htim, uint32_t Channel)
Function description	Starts the PWM signal generation in interrupt mode on the complementary output.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.• Channel: TIM Channel to be disabled. This parameter can be one of the following values:<ul style="list-style-type: none">– TIM_CHANNEL_1: TIM Channel 1 selected– TIM_CHANNEL_2: TIM Channel 2 selected– TIM_CHANNEL_3: TIM Channel 3 selected– TIM_CHANNEL_4: TIM Channel 4 selected
Return values	<ul style="list-style-type: none">• HAL: status

HAL_TIMEx_PWMN_Stop_IT

Function name	HAL_StatusTypeDef HAL_TIMEx_PWMN_Stop_IT (TIM_HandleTypeDef * htim, uint32_t Channel)
Function description	Stops the PWM signal generation in interrupt mode on the complementary output.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.• Channel: TIM Channel to be disabled. This parameter can be one of the following values:<ul style="list-style-type: none">– TIM_CHANNEL_1: TIM Channel 1 selected– TIM_CHANNEL_2: TIM Channel 2 selected– TIM_CHANNEL_3: TIM Channel 3 selected– TIM_CHANNEL_4: TIM Channel 4 selected
Return values	<ul style="list-style-type: none">• HAL: status

HAL_TIMEx_PWMN_Start_DMA

Function name	HAL_StatusTypeDef HAL_TIMEx_PWMN_Start_DMA (TIM_HandleTypeDef * htim, uint32_t Channel, uint32_t * pData, uint16_t Length)
Function description	Starts the TIM PWM signal generation in DMA mode on the complementary output.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.• Channel: TIM Channel to be enabled. This parameter can be one of the following values:<ul style="list-style-type: none">– TIM_CHANNEL_1: TIM Channel 1 selected– TIM_CHANNEL_2: TIM Channel 2 selected– TIM_CHANNEL_3: TIM Channel 3 selected– TIM_CHANNEL_4: TIM Channel 4 selected• pData: The source Buffer address.• Length: The length of data to be transferred from memory to

TIM peripheral

- Return values
- **HAL:** status

HAL_TIMEx_PWMN_Stop_DMA

Function name **HAL_StatusTypeDef HAL_TIMEx_PWMN_Stop_DMA (TIM_HandleTypeDef * htim, uint32_t Channel)**

Function description Stops the TIM PWM signal generation in DMA mode on the complementary output.

- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **Channel:** TIM Channel to be disabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected

- Return values
- **HAL:** status

HAL_TIMEx_OnePulseN_Start

Function name **HAL_StatusTypeDef HAL_TIMEx_OnePulseN_Start (TIM_HandleTypeDef * htim, uint32_t OutputChannel)**

Function description Starts the TIM One Pulse signal generation on the complementary output.

- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **OutputChannel:** TIM Channel to be enabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected

- Return values
- **HAL:** status

HAL_TIMEx_OnePulseN_Stop

Function name **HAL_StatusTypeDef HAL_TIMEx_OnePulseN_Stop (TIM_HandleTypeDef * htim, uint32_t OutputChannel)**

Function description Stops the TIM One Pulse signal generation on the complementary output.

- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **OutputChannel:** TIM Channel to be disabled. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected

- Return values
- **HAL:** status

HAL_TIMEx_OnePulseN_Start_IT

Function name	HAL_StatusTypeDef HAL_TIMEx_OnePulseN_Start_IT (TIM_HandleTypeDef * htim, uint32_t OutputChannel)
Function description	Starts the TIM One Pulse signal generation in interrupt mode on the complementary channel.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.• OutputChannel: TIM Channel to be enabled. This parameter can be one of the following values:<ul style="list-style-type: none">– TIM_CHANNEL_1: TIM Channel 1 selected– TIM_CHANNEL_2: TIM Channel 2 selected
Return values	<ul style="list-style-type: none">• HAL: status

HAL_TIMEx_OnePulseN_Stop_IT

Function name	HAL_StatusTypeDef HAL_TIMEx_OnePulseN_Stop_IT (TIM_HandleTypeDef * htim, uint32_t OutputChannel)
Function description	Stops the TIM One Pulse signal generation in interrupt mode on the complementary channel.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.• OutputChannel: TIM Channel to be disabled. This parameter can be one of the following values:<ul style="list-style-type: none">– TIM_CHANNEL_1: TIM Channel 1 selected– TIM_CHANNEL_2: TIM Channel 2 selected
Return values	<ul style="list-style-type: none">• HAL: status

HAL_TIMEx_ConfigCommutationEvent

Function name	HAL_StatusTypeDef HAL_TIMEx_ConfigCommutationEvent (TIM_HandleTypeDef * htim, uint32_t InputTrigger, uint32_t CommutationSource)
Function description	Configure the TIM commutation event sequence.
Parameters	<ul style="list-style-type: none">• htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.• InputTrigger: the Internal trigger corresponding to the Timer Interfacing with the Hall sensor. This parameter can be one of the following values:<ul style="list-style-type: none">– TIM_TS_ITR0: Internal trigger 0 selected– TIM_TS_ITR1: Internal trigger 1 selected– TIM_TS_ITR2: Internal trigger 2 selected– TIM_TS_ITR3: Internal trigger 3 selected– TIM_TS_NONE: No trigger is needed• CommutationSource: the Commutation Event source. This parameter can be one of the following values:<ul style="list-style-type: none">– TIM_COMMUTATION_TRGI: Commutation source is the TRGI of the Interface Timer– TIM_COMMUTATION_SOFTWARE: Commutation source is set by software using the COMG bit

- | | |
|---------------|--|
| Return values | <ul style="list-style-type: none"> • HAL: status |
| Notes | <ul style="list-style-type: none"> • This function is mandatory to use the commutation event in order to update the configuration at each commutation detection on the TRGI input of the Timer, the typical use of this feature is with the use of another Timer(interface Timer) configured in Hall sensor interface, this interface Timer will generate the commutation at its TRGO output (connected to Timer used in this function) each time the TI1 of the Interface Timer detect a commutation at its input TI1. |

HAL_TIMEx_ConfigCommutationEvent_IT

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|----------------------|--|
| Function name | HAL_StatusTypeDef
HAL_TIMEx_ConfigCommutationEvent_IT
(TIM_HandleTypeDef * htim, uint32_t InputTrigger, uint32_t CommutationSource) |
| Function description | Configure the TIM commutation event sequence with interrupt. |
| Parameters | <ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module. • InputTrigger: the Internal trigger corresponding to the Timer Interfacing with the Hall sensor. This parameter can be one of the following values: <ul style="list-style-type: none"> – TIM_TS_ITR0: Internal trigger 0 selected – TIM_TS_ITR1: Internal trigger 1 selected – TIM_TS_ITR2: Internal trigger 2 selected – TIM_TS_ITR3: Internal trigger 3 selected – TIM_TS_NONE: No trigger is needed • CommutationSource: the Commutation Event source. This parameter can be one of the following values: <ul style="list-style-type: none"> – TIM_COMMUTATION_TRGI: Commutation source is the TRGI of the Interface Timer – TIM_COMMUTATION_SOFTWARE: Commutation source is set by software using the COMG bit |
| Return values | <ul style="list-style-type: none"> • HAL: status |
| Notes | <ul style="list-style-type: none"> • This function is mandatory to use the commutation event in order to update the configuration at each commutation detection on the TRGI input of the Timer, the typical use of this feature is with the use of another Timer(interface Timer) configured in Hall sensor interface, this interface Timer will generate the commutation at its TRGO output (connected to Timer used in this function) each time the TI1 of the Interface Timer detect a commutation at its input TI1. |

HAL_TIMEx_ConfigCommutationEvent_DMA

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|----------------------|---|
| Function name | HAL_StatusTypeDef
HAL_TIMEx_ConfigCommutationEvent_DMA
(TIM_HandleTypeDef * htim, uint32_t InputTrigger, uint32_t CommutationSource) |
| Function description | Configure the TIM commutation event sequence with DMA. |

- Parameters**
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **InputTrigger:** the Internal trigger corresponding to the Timer Interfacing with the Hall sensor. This parameter can be one of the following values:
 - TIM_TS_ITR0: Internal trigger 0 selected
 - TIM_TS_ITR1: Internal trigger 1 selected
 - TIM_TS_ITR2: Internal trigger 2 selected
 - TIM_TS_ITR3: Internal trigger 3 selected
 - TIM_TS_NONE: No trigger is needed
 - **CommutationSource:** the Commutation Event source. This parameter can be one of the following values:
 - TIM_COMMUTATION_TRGI: Commutation source is the TRGI of the Interface Timer
 - TIM_COMMUTATION_SOFTWARE: Commutation source is set by software using the COMG bit
- Return values**
- **HAL:** status
- Notes**
- This function is mandatory to use the commutation event in order to update the configuration at each commutation detection on the TRGI input of the Timer, the typical use of this feature is with the use of another Timer(interface Timer) configured in Hall sensor interface, this interface Timer will generate the commutation at its TRGO output (connected to Timer used in this function) each time the TI1 of the Interface Timer detect a commutation at its input TI1.
 - : The user should configure the DMA in his own software, in This function only the COMDE bit is set

HAL_TIMEx_MasterConfigSynchronization

- Function name** HAL_StatusTypeDef HAL_TIMEx_MasterConfigSynchronization (TIM_HandleTypeDef * htim, TIM_MasterConfigTypeDef * sMasterConfig)
- Function description** Configures the TIM in master mode.
- Parameters**
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **sMasterConfig:** pointer to a TIM_MasterConfigTypeDef structure that contains the selected trigger output (TRGO) and the Master/Slave mode.
- Return values**
- **HAL:** status

HAL_TIMEx_ConfigBreakDeadTime

- Function name** HAL_StatusTypeDef HAL_TIMEx_ConfigBreakDeadTime (TIM_HandleTypeDef * htim, TIM_BreakDeadTimeConfigTypeDef * sBreakDeadTimeConfig)
- Function description** Configures the Break feature, dead time, Lock level, OSSR/OSSI State and the AOE(automatic output enable).
- Parameters**
- **htim:** pointer to a TIM_HandleTypeDef structure that



- contains the configuration information for TIM module.
 - **sBreakDeadTimeConfig:** pointer to a TIM_ConfigBreakDeadConfig_TypeDef structure that contains the BDTR Register configuration information for the TIM peripheral.
- Return values
- **HAL:** status

HAL_TIMEx_ConfigBreakInput

- Function name **HAL_StatusTypeDef HAL_TIMEx_ConfigBreakInput (TIM_HandleTypeDef * htim, uint32_t BreakInput, TIMEx_BreakInputConfigTypeDef * sBreakInputConfig)**
- Function description Configures the break input source.
- Parameters
- **htim:** TIM handle.
 - **BreakInput:** Break input to configure This parameter can be one of the following values:
 - TIM_BREAKINPUT_BRK: Timer break input
 - TIM_BREAKINPUT_BRK2: Timer break 2 input
 - **sBreakInputConfig:** Break input source configuration
- Return values
- **HAL:** status

HAL_TIMEx_RemapConfig

- Function name **HAL_StatusTypeDef HAL_TIMEx_RemapConfig (TIM_HandleTypeDef * htim, uint32_t Remap)**
- Function description Configures the TIM2, TIM5 and TIM11 Remapping input capabilities.
- Parameters
- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
 - **Remap:** specifies the TIM input remapping source. This parameter can be one of the following values:
 - TIM_TIM2_TIM8_TRGO: TIM2 ITR1 input is connected to TIM8 Trigger output(default)
 - TIM_TIM2_ETH_PTP: TIM2 ITR1 input is connected to ETH PTP trigger output.
 - TIM_TIM2_USBFS_SOF: TIM2 ITR1 input is connected to USB FS SOF.
 - TIM_TIM2_USBHS_SOF: TIM2 ITR1 input is connected to USB HS SOF.
 - TIM_TIM5_GPIO: TIM5 CH4 input is connected to dedicated Timer pin(default)
 - TIM_TIM5_LSI: TIM5 CH4 input is connected to LSI clock.
 - TIM_TIM5_LSE: TIM5 CH4 input is connected to LSE clock.
 - TIM_TIM5_RTC: TIM5 CH4 input is connected to RTC Output event.
 - TIM_TIM11_GPIO: TIM11 CH4 input is connected to dedicated Timer pin(default)
 - TIM_TIM11_SPDIF: SPDIF Frame synchronous
 - TIM_TIM11_HSE: TIM11 CH4 input is connected to

HSE_RTC clock (HSE divided by a programmable prescaler)

- TIM_TIM11_MCO1: TIM11 CH1 input is connected to MCO1

Return values

- **HAL:** status

HAL_TIMEx_GroupChannel5

Function name **HAL_StatusTypeDef HAL_TIMEx_GroupChannel5 (TIM_HandleTypeDef * htim, uint32_t OCRef)**

Function description Group channel 5 and channel 1, 2 or 3.

Parameters

- **htim:** TIM handle.
- **OCRef:** specifies the reference signal(s) the OC5REF is combined with. This parameter can be any combination of the following values: TIM_GROUPCH5_NONE: No effect of OC5REF on OC1REFC, OC2REFC and OC3REFC
TIM_GROUPCH5_OC1REFC: OC1REFC is the logical AND of OC1REFC and OC5REF
TIM_GROUPCH5_OC2REFC: OC2REFC is the logical AND of OC2REFC and OC5REF
TIM_GROUPCH5_OC3REFC: OC3REFC is the logical AND of OC3REFC and OC5REF

Return values

- **HAL:** status

HAL_TIMEx_CommutationCallback

Function name **void HAL_TIMEx_CommutationCallback (TIM_HandleTypeDef * htim)**

Function description Hall commutation changed callback in non blocking mode.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **None:**

HAL_TIMEx_BreakCallback

Function name **void HAL_TIMEx_BreakCallback (TIM_HandleTypeDef * htim)**

Function description Hall Break detection callback in non blocking mode.

Parameters

- **htim:** pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.

Return values

- **None:**

HAL_TIMEx_DMACommutationCplt

Function name **void HAL_TIMEx_DMACommutationCplt (DMA_HandleTypeDef * hdma)**

Function description TIM DMA Commutation callback.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA

	module.
Return values	<ul style="list-style-type: none"> • None:
HAL_TIMEx_HallSensor_GetState	
Function name	HAL_TIM_StateTypeDef HAL_TIMEx_HallSensor_GetState (TIM_HandleTypeDef * htim)
Function description	Return the TIM Hall Sensor interface state.
Parameters	<ul style="list-style-type: none"> • htim: pointer to a TIM_HandleTypeDef structure that contains the configuration information for TIM module.
Return values	<ul style="list-style-type: none"> • HAL: state

65.3 TIMEx Firmware driver defines

65.3.1 TIMEx

TIMEx Break input 2 Enable

TIM_BREAK2_DISABLE

TIM_BREAK2_ENABLE

TIMEx Break2 Polarity

TIM_BREAK2POLARITY_LOW

TIM_BREAK2POLARITY_HIGH

TIM Extended Break input

TIM_BREAKINPUT_BRK

TIM_BREAKINPUT_BRK2

TIM Extended Break input source

TIM_BREAKINPUTSOURCE_BKIN

TIM_BREAKINPUTSOURCE_DFSDM1

TIM Extended Break input source enabling

TIM_BREAKINPUTSOURCE_DISABLE

TIM_BREAKINPUTSOURCE_ENABLE

TIMEx Channel

TIM_CHANNEL_1

TIM_CHANNEL_2

TIM_CHANNEL_3

TIM_CHANNEL_4

TIM_CHANNEL_5

TIM_CHANNEL_6

TIM_CHANNEL_ALL

TIMEx Clear Input Source

TIM_CLEARINPUTSOURCE_ETR
TIM_CLEARINPUTSOURCE_NONE

TIMEx Exported Macros

__HAL_TIM_SET_COMPARE

Description:

- Sets the TIM Capture Compare Register value on runtime without calling another time ConfigChannel function.

Parameters:

- __HANDLE__: TIM handle.
- __CHANNEL__: : TIM Channels to be configured. This parameter can be one of the following values:
 - TIM_CHANNEL_1: TIM Channel 1 selected
 - TIM_CHANNEL_2: TIM Channel 2 selected
 - TIM_CHANNEL_3: TIM Channel 3 selected
 - TIM_CHANNEL_4: TIM Channel 4 selected
 - TIM_CHANNEL_5: TIM Channel 5 selected
 - TIM_CHANNEL_6: TIM Channel 6 selected
- __COMPARE__: specifies the Capture Compare register new value.

Return value:

- None

__HAL_TIM_GET_COMPARE

Description:

- Gets the TIM Capture Compare Register value on runtime.

Parameters:

- __HANDLE__: TIM handle.
- __CHANNEL__: : TIM Channel associated with the capture compare register This parameter can be one of the following values:
 - TIM_CHANNEL_1: get capture/compare 1 register value
 - TIM_CHANNEL_2: get capture/compare 2 register value
 - TIM_CHANNEL_3: get capture/compare 3 register value
 - TIM_CHANNEL_4: get capture/compare 4 register value
 - TIM_CHANNEL_5: get capture/compare 5 register value
 - TIM_CHANNEL_6: get

capture/compare 6 register value

Return value:

- None

__HAL_TIM_ENABLE_OCxPRELOAD**Description:**

- Sets the TIM Output compare preload.

Parameters:

- **__HANDLE__**: TIM handle.
- **__CHANNEL__**: TIM Channels to be configured. This parameter can be one of the following values:
 - **TIM_CHANNEL_1**: TIM Channel 1 selected
 - **TIM_CHANNEL_2**: TIM Channel 2 selected
 - **TIM_CHANNEL_3**: TIM Channel 3 selected
 - **TIM_CHANNEL_4**: TIM Channel 4 selected
 - **TIM_CHANNEL_5**: TIM Channel 5 selected
 - **TIM_CHANNEL_6**: TIM Channel 6 selected

Return value:

- None

__HAL_TIM_DISABLE_OCxPRELOAD**Description:**

- Resets the TIM Output compare preload.

Parameters:

- **__HANDLE__**: TIM handle.
- **__CHANNEL__**: TIM Channels to be configured. This parameter can be one of the following values:
 - **TIM_CHANNEL_1**: TIM Channel 1 selected
 - **TIM_CHANNEL_2**: TIM Channel 2 selected
 - **TIM_CHANNEL_3**: TIM Channel 3 selected
 - **TIM_CHANNEL_4**: TIM Channel 4 selected
 - **TIM_CHANNEL_5**: TIM Channel 5 selected
 - **TIM_CHANNEL_6**: TIM Channel 6 selected

Return value:

- None

TIMEx Group Channel 5 and Channel 1, 2 or 3

TIM_GROUPCH5_NONE

TIM_GROUPCH5_OC1REFC

TIM_GROUPCH5_OC2REFC

TIM_GROUPCH5_OC3REFC

TIMEx Master Mode Selection 2 (TRGO2)

TIM_TRGO2_RESET

TIM_TRGO2_ENABLE

TIM_TRGO2_UPDATE

TIM_TRGO2_OC1

TIM_TRGO2_OC1REF

TIM_TRGO2_OC2REF

TIM_TRGO2_OC3REF

TIM_TRGO2_OC4REF

TIM_TRGO2_OC5REF

TIM_TRGO2_OC6REF

TIM_TRGO2_OC4REF_RISINGFALLING

TIM_TRGO2_OC6REF_RISINGFALLING

TIM_TRGO2_OC4REF_RISING_OC6REF_RISING

TIM_TRGO2_OC4REF_RISING_OC6REF_FALLING

TIM_TRGO2_OC5REF_RISING_OC6REF_RISING

TIM_TRGO2_OC5REF_RISING_OC6REF_FALLING

TIMEx Output Compare and PWM Modes

TIM_OCMODE_TIMING

TIM_OCMODE_ACTIVE

TIM_OCMODE_INACTIVE

TIM_OCMODE_TOGGLE

TIM_OCMODE_PWM1

TIM_OCMODE_PWM2

TIM_OCMODE_FORCED_ACTIVE

TIM_OCMODE_FORCED_INACTIVE

TIM_OCMODE_RETRIGERRABLE_OPM1

TIM_OCMODE_RETRIGERRABLE_OPM2

TIM_OCMODE_COMBINED_PWM1

TIM_OCMODE_COMBINED_PWM2

TIM_OCMODE_ASSYMETRIC_PWM1

TIM_OCMODE_ASSYMETRIC_PWM2

TIMEx Remap

TIM_TIM2_TIM8_TRGO

TIM_TIM2_ETH_PTP

TIM_TIM2_USBFS_SOF

TIM_TIM2_USBHS_SOF

TIM_TIM5_GPIO

TIM_TIM5_LSI

TIM_TIM5_LSE

TIM_TIM5_RTC

TIM_TIM11_GPIO

TIM_TIM11_SPDIFRX

TIM_TIM11_HSE

TIM_TIM11_MCO1

TIMEx Slave mode

TIM_SLAVEMODE_DISABLE

TIM_SLAVEMODE_RESET

TIM_SLAVEMODE_GATED

TIM_SLAVEMODE_TRIGGER

TIM_SLAVEMODE_EXTERNAL1

TIM_SLAVEMODE_COMBINED_RESETTRIGGER

66 HAL UART Generic Driver

66.1 UART Firmware driver registers structures

66.1.1 UART_InitTypeDef

Data Fields

- *uint32_t BaudRate*
- *uint32_t WordLength*
- *uint32_t StopBits*
- *uint32_t Parity*
- *uint32_t Mode*
- *uint32_t HwFlowCtl*
- *uint32_t OverSampling*
- *uint32_t OneBitSampling*

Field Documentation

- ***uint32_t UART_InitTypeDef::BaudRate***
This member configures the UART communication baud rate. The baud rate register is computed using the following formula: If oversampling is 16 or in LIN mode, Baud Rate Register = ((PCLKx) / ((huart->Init.BaudRate))) If oversampling is 8, Baud Rate Register[15:4] = ((2 * PCLKx) / ((huart->Init.BaudRate)))[15:4] Baud Rate Register[3] = 0 Baud Rate Register[2:0] = (((2 * PCLKx) / ((huart->Init.BaudRate)))[3:0]) >> 1
- ***uint32_t UART_InitTypeDef::WordLength***
Specifies the number of data bits transmitted or received in a frame. This parameter can be a value of [UARTEx_Word_Length](#)
- ***uint32_t UART_InitTypeDef::StopBits***
Specifies the number of stop bits transmitted. This parameter can be a value of [UART_Stop_Bits](#)
- ***uint32_t UART_InitTypeDef::Parity***
Specifies the parity mode. This parameter can be a value of [UART_Parity](#)
Note:When parity is enabled, the computed parity is inserted at the MSB position of the transmitted data (9th bit when the word length is set to 9 data bits; 8th bit when the word length is set to 8 data bits).
- ***uint32_t UART_InitTypeDef::Mode***
Specifies whether the Receive or Transmit mode is enabled or disabled. This parameter can be a value of [UART_Mode](#)
- ***uint32_t UART_InitTypeDef::HwFlowCtl***
Specifies whether the hardware flow control mode is enabled or disabled. This parameter can be a value of [UART_Hardware_Flow_Control](#)
- ***uint32_t UART_InitTypeDef::OverSampling***
Specifies whether the Over sampling 8 is enabled or disabled, to achieve higher speed (up to fPCLK/8). This parameter can be a value of [UART_Over_Sampling](#)
- ***uint32_t UART_InitTypeDef::OneBitSampling***
Specifies whether a single sample or three samples' majority vote is selected. Selecting the single sample method increases the receiver tolerance to clock deviations. This parameter can be a value of [UART_OneBit_Sampling](#)

66.1.2 UART_AdvFeatureInitTypeDef

Data Fields

- `uint32_t AdvFeatureInit`
- `uint32_t TxPinLevelInvert`
- `uint32_t RxPinLevelInvert`
- `uint32_t DataInvert`
- `uint32_t Swap`
- `uint32_t OverrunDisable`
- `uint32_t DMADisableonRxError`
- `uint32_t AutoBaudRateEnable`
- `uint32_t AutoBaudRateMode`
- `uint32_t MSBFirst`

Field Documentation

- `uint32_t UART_AdvFeatureInitTypeDef::AdvFeatureInit`
Specifies which advanced UART features is initialized. Several Advanced Features may be initialized at the same time . This parameter can be a value of [UART_Advanced_Features_Initialization_Type](#)
- `uint32_t UART_AdvFeatureInitTypeDef::TxPinLevelInvert`
Specifies whether the TX pin active level is inverted. This parameter can be a value of [UART_Tx_Inv](#)
- `uint32_t UART_AdvFeatureInitTypeDef::RxPinLevelInvert`
Specifies whether the RX pin active level is inverted. This parameter can be a value of [UART_Rx_Inv](#)
- `uint32_t UART_AdvFeatureInitTypeDef::DataInvert`
Specifies whether data are inverted (positive/direct logic vs negative/inverted logic). This parameter can be a value of [UART_Data_Inv](#)
- `uint32_t UART_AdvFeatureInitTypeDef::Swap`
Specifies whether TX and RX pins are swapped. This parameter can be a value of [UART_Rx_Tx_Swap](#)
- `uint32_t UART_AdvFeatureInitTypeDef::OverrunDisable`
Specifies whether the reception overrun detection is disabled. This parameter can be a value of [UART_Overrun_Disable](#)
- `uint32_t UART_AdvFeatureInitTypeDef::DMADisableonRxError`
Specifies whether the DMA is disabled in case of reception error. This parameter can be a value of [UART_DMA_Disable_on_Rx_Error](#)
- `uint32_t UART_AdvFeatureInitTypeDef::AutoBaudRateEnable`
Specifies whether auto Baud rate detection is enabled. This parameter can be a value of [UART_AutoBaudRate_Enable](#)
- `uint32_t UART_AdvFeatureInitTypeDef::AutoBaudRateMode`
If auto Baud rate detection is enabled, specifies how the rate detection is carried out. This parameter can be a value of [UART_AutoBaud_Rate_Mode](#)
- `uint32_t UART_AdvFeatureInitTypeDef::MSBFirst`
Specifies whether MSB is sent first on UART line. This parameter can be a value of [UART_MSB_First](#)

66.1.3 UART_HandleTypeDef

Data Fields

- `USART_TypeDef * Instance`
- `UART_InitTypeDef Init`
- `UART_AdvFeatureInitTypeDef AdvancedInit`
- `uint8_t * pTxBuffPtr`
- `uint16_t TxXferSize`
- `__IO uint16_t TxXferCount`
- `uint8_t * pRxBuffPtr`

- ***uint16_t RxXferSize***
- ***__IO uint16_t RxXferCount***
- ***uint16_t Mask***
- ***DMA_HandleTypeDef * hdmatrix***
- ***DMA_HandleTypeDef * hdmatrix***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_UART_StateTypeDef gState***
- ***__IO HAL_UART_StateTypeDef RxState***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***USART_TypeDef* UART_HandleTypeDef::Instance***
UART registers base address
- ***UART_InitTypeDef UART_HandleTypeDef::Init***
UART communication parameters
- ***UART_AdvFeatureInitTypeDef UART_HandleTypeDef::AdvancedInit***
UART Advanced Features initialization parameters
- ***uint8_t* UART_HandleTypeDef::pTxBuffPtr***
Pointer to UART Tx transfer Buffer
- ***uint16_t UART_HandleTypeDef::TxXferSize***
UART Tx Transfer size
- ***__IO uint16_t UART_HandleTypeDef::TxXferCount***
UART Tx Transfer Counter
- ***uint8_t* UART_HandleTypeDef::pRxBuffPtr***
Pointer to UART Rx transfer Buffer
- ***uint16_t UART_HandleTypeDef::RxXferSize***
UART Rx Transfer size
- ***__IO uint16_t UART_HandleTypeDef::RxXferCount***
UART Rx Transfer Counter
- ***uint16_t UART_HandleTypeDef::Mask***
UART Rx RDR register mask
- ***DMA_HandleTypeDef* UART_HandleTypeDef::hdmatrix***
UART Tx DMA Handle parameters
- ***DMA_HandleTypeDef* UART_HandleTypeDef::hdmatrix***
UART Rx DMA Handle parameters
- ***HAL_LockTypeDef UART_HandleTypeDef::Lock***
Locking object
- ***__IO HAL_UART_StateTypeDef UART_HandleTypeDef::gState***
UART state information related to global Handle management and also related to Tx operations. This parameter can be a value of ***HAL_UART_StateTypeDef***
- ***__IO HAL_UART_StateTypeDef UART_HandleTypeDef::RxState***
UART state information related to Rx operations. This parameter can be a value of ***HAL_UART_StateTypeDef***
- ***__IO uint32_t UART_HandleTypeDef::ErrorCode***
UART Error code

66.2 UART Firmware driver API description

66.2.1 How to use this driver

The UART HAL driver can be used as follows:

1. Declare a ***UART_HandleTypeDef*** handle structure.

2. Initialize the UART low level resources by implementing the HAL_UART_MspInit() API:
 - a. Enable the USARTx interface clock.
 - b. UART pins configuration:
 - Enable the clock for the UART GPIOs.
 - Configure these UART pins as alternate function pull-up.
 - c. NVIC configuration if you need to use interrupt process (HAL_UART_Transmit_IT() and HAL_UART_Receive_IT() APIs):
 - Configure the USARTx interrupt priority.
 - Enable the NVIC USART IRQ handle.
 - d. DMA Configuration if you need to use DMA process (HAL_UART_Transmit_DMA() and HAL_UART_Receive_DMA() APIs):
 - Declare a DMA handle structure for the Tx/Rx stream.
 - Enable the DMAx interface clock.
 - Configure the declared DMA handle structure with the required Tx/Rx parameters.
 - Configure the DMA Tx/Rx Stream.
 - Associate the initialized DMA handle to the UART DMA Tx/Rx handle.
 - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx/Rx Stream.
3. Program the Baud Rate, Word Length, Stop Bit, Parity, Hardware flow control and Mode(Receiver/Transmitter) in the Init structure.
4. For the UART asynchronous mode, initialize the UART registers by calling the HAL_UART_Init() API.
5. For the UART Half duplex mode, initialize the UART registers by calling the HAL_HalfDuplex_Init() API.
6. For the LIN mode, initialize the UART registers by calling the HAL_LIN_Init() API.
7. For the Multi-Processor mode, initialize the UART registers by calling the HAL_MultiProcessor_Init() API.



The specific UART interrupts (Transmission complete interrupt, RXNE interrupt and Error Interrupts) will be managed using the macros `__HAL_UART_ENABLE_IT()` and `__HAL_UART_DISABLE_IT()` inside the transmit and receive process.



These APIs (HAL_UART_Init() and HAL_HalfDuplex_Init()) configure also the low level Hardware GPIO, CLOCK, CORTEX...etc) by calling the customized HAL_UART_MspInit() API.

Three operation modes are available within this driver :

Polling mode IO operation

- Send an amount of data in blocking mode using HAL_UART_Transmit()
- Receive an amount of data in blocking mode using HAL_UART_Receive()

Interrupt mode IO operation

- Send an amount of data in non blocking mode using HAL_UART_Transmit_IT()
- At transmission end of transfer HAL_UART_TxCpltCallback is executed and user can add his own code by customization of function pointer HAL_UART_TxCpltCallback
- Receive an amount of data in non blocking mode using HAL_UART_Receive_IT()

- At reception end of transfer HAL_UART_RxCpltCallback is executed and user can add his own code by customization of function pointer HAL_UART_RxCpltCallback
- In case of transfer Error, HAL_UART_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_UART_ErrorCallback

DMA mode IO operation

- Send an amount of data in non blocking mode (DMA) using HAL_UART_Transmit_DMA()
- At transmission end of half transfer HAL_UART_TxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_UART_TxHalfCpltCallback
- At transmission end of transfer HAL_UART_TxCpltCallback is executed and user can add his own code by customization of function pointer HAL_UART_TxCpltCallback
- Receive an amount of data in non blocking mode (DMA) using HAL_UART_Receive_DMA()
- At reception end of half transfer HAL_UART_RxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_UART_RxHalfCpltCallback
- At reception end of transfer HAL_UART_RxCpltCallback is executed and user can add his own code by customization of function pointer HAL_UART_RxCpltCallback
- In case of transfer Error, HAL_UART_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_UART_ErrorCallback
- Pause the DMA Transfer using HAL_UART_DMAPause()
- Resume the DMA Transfer using HAL_UART_DMAResume()
- Stop the DMA Transfer using HAL_UART_DMAStop()

UART HAL driver macros list

Below the list of most used macros in UART HAL driver.

- __HAL_UART_ENABLE: Enable the UART peripheral
- __HAL_UART_DISABLE: Disable the UART peripheral
- __HAL_UART_GET_FLAG : Check whether the specified UART flag is set or not
- __HAL_UART_CLEAR_IT : Clears the specified UART ISR flag
- __HAL_UART_ENABLE_IT: Enable the specified UART interrupt
- __HAL_UART_DISABLE_IT: Disable the specified UART interrupt
- __HAL_UART_GET_IT_SOURCE: Check whether the specified UART interrupt has occurred or not



You can refer to the UART HAL driver header file for more useful macros

66.2.2 Initialization and Configuration functions

This subsection provides a set of functions allowing to initialize the USARTx or the UARTy in asynchronous mode.

- For the asynchronous mode only these parameters can be configured:
 - Baud Rate
 - Word Length
 - Stop Bit
 - Parity: If the parity is enabled, then the MSB bit of the data written in the data register is transmitted but is changed by the parity bit. Depending on the frame

length defined by the M bit (8-bits or 9-bits), please refer to Reference manual for possible UART frame formats.

- Hardware flow control
- Receiver/transmitter modes
- Over Sampling Method

The HAL_UART_Init(), HAL_HalfDuplex_Init(), HAL_LIN_Init() and HAL_MultiProcessor_Init() APIs follow respectively the UART asynchronous, UART Half duplex, LIN and Multi-Processor configuration procedures (details for the procedures are available in reference manual (RM0329)).

This section contains the following APIs:

- [*HAL_UART_Init\(\)*](#)
- [*HAL_HalfDuplex_Init\(\)*](#)
- [*HAL_LIN_Init\(\)*](#)
- [*HAL_MultiProcessor_Init\(\)*](#)
- [*HAL_RS485Ex_Init\(\)*](#)
- [*HAL_UART_DeInit\(\)*](#)
- [*HAL_UART_MspInit\(\)*](#)
- [*HAL_UART_MspDeInit\(\)*](#)

66.2.3 IO operation functions

This section contains the following APIs:

- [*HAL_UART_Transmit\(\)*](#)
- [*HAL_UART_Receive\(\)*](#)
- [*HAL_UART_Transmit_IT\(\)*](#)
- [*HAL_UART_Receive_IT\(\)*](#)
- [*HAL_UART_Transmit_DMA\(\)*](#)
- [*HAL_UART_Receive_DMA\(\)*](#)
- [*HAL_UART_DMADeInit\(\)*](#)
- [*HAL_UART_DMAResume\(\)*](#)
- [*HAL_UART_DMAStop\(\)*](#)
- [*HAL_UART_IRQHandler\(\)*](#)
- [*UART_WaitOnFlagUntilTimeout\(\)*](#)
- [*HAL_UART_TxCpltCallback\(\)*](#)
- [*HAL_UART_TxHalfCpltCallback\(\)*](#)
- [*HAL_UART_RxCpltCallback\(\)*](#)
- [*HAL_UART_RxHalfCpltCallback\(\)*](#)
- [*HAL_UART_ErrorCallback\(\)*](#)

66.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the UART.

- HAL_UART_GetState() API is helpful to check in run-time the state of the UART peripheral.
- HAL_MultiProcessor_EnableMuteMode() API enables mute mode
- HAL_MultiProcessor_DisableMuteMode() API disables mute mode
- HAL_MultiProcessor_EnterMuteMode() API enters mute mode
- HAL_MultiProcessor_EnableMuteMode() API enables mute mode
- UART_SetConfig() API configures the UART peripheral
- UART_AdvFeatureConfig() API optionally configures the UART advanced features
- UART_CheckIdleState() API ensures that TEACK and/or REACK are set after initialization

- HAL_HalfDuplex_EnableTransmitter() API disables receiver and enables transmitter
- HAL_HalfDuplex_EnableReceiver() API disables transmitter and enables receiver
- HAL_LIN_SendBreak() API transmits the break characters
- HAL_MultiProcessorEx_AddressLength_Set() API optionally sets the UART node address detection length to more than 4 bits for multiprocessor address mark wake up.

This section contains the following APIs:

- [HAL_MultiProcessor_EnableMuteMode\(\)](#)
- [HAL_MultiProcessor_DisableMuteMode\(\)](#)
- [HAL_MultiProcessor_EnterMuteMode\(\)](#)
- [HAL_UART_GetState\(\)](#)
- [HAL_UART_GetError\(\)](#)
- [UART_SetConfig\(\)](#)
- [UART_AdvFeatureConfig\(\)](#)
- [UART_CheckIdleState\(\)](#)
- [HAL_HalfDuplex_EnableTransmitter\(\)](#)
- [HAL_HalfDuplex_EnableReceiver\(\)](#)
- [HAL_LIN_SendBreak\(\)](#)
- [HAL_MultiProcessorEx_AddressLength_Set\(\)](#)

66.2.5 Detailed description of functions

HAL_UART_Init

Function name	HAL_StatusTypeDef HAL_UART_Init (UART_HandleTypeDef * huart)
Function description	Initializes the UART mode according to the specified parameters in the UART_InitTypeDef and creates the associated handle .
Parameters	<ul style="list-style-type: none"> • huart: uart handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_HalfDuplex_Init

Function name	HAL_StatusTypeDef HAL_HalfDuplex_Init (UART_HandleTypeDef * huart)
Function description	Initializes the half-duplex mode according to the specified parameters in the UART_InitTypeDef and creates the associated handle .
Parameters	<ul style="list-style-type: none"> • huart: UART handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_LIN_Init

Function name	HAL_StatusTypeDef HAL_LIN_Init (UART_HandleTypeDef * huart, uint32_t BreakDetectLength)
Function description	Initialize the LIN mode according to the specified parameters in the UART_InitTypeDef and creates the associated handle .
Parameters	<ul style="list-style-type: none"> • huart: UART handle. • BreakDetectLength: specifies the LIN break detection

length. This parameter can be one of the following values:

- UART_LINBREAKDETECTLENGTH_10B 10-bit break detection
- UART_LINBREAKDETECTLENGTH_11B 11-bit break detection

Return values

- **HAL:** status

HAL_MultiProcessor_Init

Function name **HAL_StatusTypeDef HAL_MultiProcessor_Init (UART_HandleTypeDef * huart, uint8_t Address, uint32_t WakeUpMethod)**

Function description Initialize the multiprocessor mode according to the specified parameters in the UART_InitTypeDef and initialize the associated handle.

Parameters

- **huart:** UART handle.
- **Address:** UART node address (4-, 6-, 7- or 8-bit long).
- **WakeUpMethod:** specifies the UART wakeup method. This parameter can be one of the following values:
 - UART_WAKEUPMETHOD_IDLELINE WakeUp by an idle line detection
 - UART_WAKEUPMETHOD_ADDRESSMARK WakeUp by an address mark

Return values

- **HAL:** status

Notes

- If the user resorts to idle line detection wake up, the Address parameter is useless and ignored by the initialization function.
- If the user resorts to address mark wake up, the address length detection is configured by default to 4 bits only. For the UART to be able to manage 6-, 7- or 8-bit long addresses detection

HAL_RS485Ex_Init

Function name **HAL_StatusTypeDef HAL_RS485Ex_Init (UART_HandleTypeDef * huart, uint32_t Polarity, uint32_t AssertionTime, uint32_t DeassertionTime)**

Function description Initialize the RS485 Driver enable feature according to the specified parameters in the UART_InitTypeDef and creates the associated handle.

Parameters

- **huart:** UART handle.
- **Polarity:** select the driver enable polarity. This parameter can be one of the following values:
 - UART_DE_POLARITY_HIGH DE signal is active high
 - UART_DE_POLARITY_LOW DE signal is active low
- **AssertionTime:** Driver Enable assertion time: 5-bit value defining the time between the activation of the DE (Driver Enable) signal and the beginning of the start bit. It is expressed in sample time units (1/8 or 1/16 bit time, depending on the oversampling rate)
- **DeassertionTime:** Driver Enable deassertion time: 5-bit

value defining the time between the end of the last stop bit, in a transmitted message, and the de-activation of the DE (Driver Enable) signal. It is expressed in sample time units (1/8 or 1/16 bit time, depending on the oversampling rate).

Return values

- **HAL:** status

HAL_UART_DeInit

Function name **HAL_StatusTypeDef HAL_UART_DeInit (UART_HandleTypeDef * huart)**

Function description DeInitializes the UART peripheral.

Parameters

- **huart:** uart handle

Return values

- **HAL:** status

HAL_UART_MspInit

Function name **void HAL_UART_MspInit (UART_HandleTypeDef * huart)**

Function description UART MSP Init.

Parameters

- **huart:** uart handle

Return values

- **None:**

HAL_UART_MspDeInit

Function name **void HAL_UART_MspDeInit (UART_HandleTypeDef * huart)**

Function description UART MSP DeInit.

Parameters

- **huart:** uart handle

Return values

- **None:**

HAL_UART_Transmit

Function name **HAL_StatusTypeDef HAL_UART_Transmit (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size, uint32_t Timeout)**

Function description Send an amount of data in blocking mode.

Parameters

- **huart:** UART handle.
- **pData:** Pointer to data buffer.
- **Size:** Amount of data to be sent.
- **Timeout:** Timeout duration.

Return values

- **HAL:** status

HAL_UART_Receive

Function name **HAL_StatusTypeDef HAL_UART_Receive (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size, uint32_t Timeout)**

Function description Receive an amount of data in blocking mode.

- | | |
|---------------|---|
| Parameters | <ul style="list-style-type: none"> • huart: UART handle. • pData: pointer to data buffer. • Size: amount of data to be received. • Timeout: Timeout duration. |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_UART_Transmit_IT

- | | |
|----------------------|--|
| Function name | HAL_StatusTypeDef HAL_UART_Transmit_IT (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size) |
| Function description | Send an amount of data in interrupt mode. |
| Parameters | <ul style="list-style-type: none"> • huart: UART handle. • pData: pointer to data buffer. • Size: amount of data to be sent. |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_UART_Receive_IT

- | | |
|----------------------|--|
| Function name | HAL_StatusTypeDef HAL_UART_Receive_IT (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size) |
| Function description | Receive an amount of data in interrupt mode. |
| Parameters | <ul style="list-style-type: none"> • huart: UART handle. • pData: pointer to data buffer. • Size: amount of data to be received. |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_UART_Transmit_DMA

- | | |
|----------------------|--|
| Function name | HAL_StatusTypeDef HAL_UART_Transmit_DMA (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size) |
| Function description | Send an amount of data in DMA mode. |
| Parameters | <ul style="list-style-type: none"> • huart: UART handle. • pData: pointer to data buffer. • Size: amount of data to be sent. |
| Return values | <ul style="list-style-type: none"> • HAL: status |

HAL_UART_Receive_DMA

- | | |
|----------------------|--|
| Function name | HAL_StatusTypeDef HAL_UART_Receive_DMA (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size) |
| Function description | Receive an amount of data in DMA mode. |
| Parameters | <ul style="list-style-type: none"> • huart: UART handle. • pData: pointer to data buffer. • Size: amount of data to be received. |
| Return values | <ul style="list-style-type: none"> • HAL: status |
| Notes | <ul style="list-style-type: none"> • When the UART parity is enabled (PCE = 1), the received |

data contain the parity bit (MSB position).

HAL_UART_DMAPause

Function name	HAL_StatusTypeDef HAL_UART_DMAPause (UART_HandleTypeDef * huart)
Function description	Pause the DMA Transfer.
Parameters	<ul style="list-style-type: none">• huart: UART handle.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_UART_DMAResume

Function name	HAL_StatusTypeDef HAL_UART_DMAResume (UART_HandleTypeDef * huart)
Function description	Resume the DMA Transfer.
Parameters	<ul style="list-style-type: none">• huart: UART handle.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_UART_DMAStop

Function name	HAL_StatusTypeDef HAL_UART_DMAStop (UART_HandleTypeDef * huart)
Function description	Stop the DMA Transfer.
Parameters	<ul style="list-style-type: none">• huart: UART handle.
Return values	<ul style="list-style-type: none">• HAL: status

HAL_UART_IRQHandler

Function name	void HAL_UART_IRQHandler (UART_HandleTypeDef * huart)
Function description	This function handles UART interrupt request.
Parameters	<ul style="list-style-type: none">• huart: uart handle
Return values	<ul style="list-style-type: none">• None:

HAL_UART_TxHalfCpltCallback

Function name	void HAL_UART_TxHalfCpltCallback (UART_HandleTypeDef * huart)
Function description	Tx Half Transfer completed callbacks.
Parameters	<ul style="list-style-type: none">• huart: UART handle
Return values	<ul style="list-style-type: none">• None:

HAL_UART_TxCpltCallback

Function name	void HAL_UART_TxCpltCallback (UART_HandleTypeDef * huart)
---------------	--

Function description	Tx Transfer completed callbacks.
Parameters	<ul style="list-style-type: none"> • huart: uart handle
Return values	<ul style="list-style-type: none"> • None:

HAL_UART_RxHalfCpltCallback

Function name	void HAL_UART_RxHalfCpltCallback (UART_HandleTypeDef * huart)
Function description	Rx Half Transfer completed callbacks.
Parameters	<ul style="list-style-type: none"> • huart: UART handle
Return values	<ul style="list-style-type: none"> • None:

HAL_UART_RxCpltCallback

Function name	void HAL_UART_RxCpltCallback (UART_HandleTypeDef * huart)
Function description	Rx Transfer completed callbacks.
Parameters	<ul style="list-style-type: none"> • huart: uart handle
Return values	<ul style="list-style-type: none"> • None:

HAL_UART_ErrorCallback

Function name	void HAL_UART_ErrorCallback (UART_HandleTypeDef * huart)
Function description	UART error callbacks.
Parameters	<ul style="list-style-type: none"> • huart: uart handle
Return values	<ul style="list-style-type: none"> • None:

HAL_LIN_SendBreak

Function name	HAL_StatusTypeDef HAL_LIN_SendBreak (UART_HandleTypeDef * huart)
Function description	Transmits break characters.
Parameters	<ul style="list-style-type: none"> • huart: UART handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_MultiProcessorEx_AddressLength_Set

Function name	HAL_StatusTypeDef HAL_MultiProcessorEx_AddressLength_Set (UART_HandleTypeDef * huart, uint32_t AddressLength)
Function description	By default in multiprocessor mode, when the wake up method is set to address mark, the UART handles only 4-bit long addresses detection; this API allows to enable longer addresses detection (6-, 7- or 8-bit long).

Parameters	<ul style="list-style-type: none"> • huart: UART handle. • AddressLength: this parameter can be one of the following values: <ul style="list-style-type: none"> – UART_ADDRESS_DETECT_4B 4-bit long address – UART_ADDRESS_DETECT_7B 6-, 7- or 8-bit long address
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • Addresses detection lengths are: 6-bit address detection in 7-bit data mode, 7-bit address detection in 8-bit data mode, 8-bit address detection in 9-bit data mode.

HAL_MultiProcessor_EnableMuteMode

Function name	HAL_StatusTypeDef HAL_MultiProcessor_EnableMuteMode (UART_HandleTypeDef * huart)
Function description	Enable UART in mute mode (doesn't mean UART enters mute mode; to enter mute mode, HAL_MultiProcessor_EnterMuteMode() API must be called)
Parameters	<ul style="list-style-type: none"> • huart: UART handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_MultiProcessor_DisableMuteMode

Function name	HAL_StatusTypeDef HAL_MultiProcessor_DisableMuteMode (UART_HandleTypeDef * huart)
Function description	Disable UART mute mode (doesn't mean it actually wakes up the software, as it may not have been in mute mode at this very moment).
Parameters	<ul style="list-style-type: none"> • huart: uart handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_MultiProcessor_EnterMuteMode

Function name	void HAL_MultiProcessor_EnterMuteMode (UART_HandleTypeDef * huart)
Function description	Enter UART mute mode (means UART actually enters mute mode).
Parameters	<ul style="list-style-type: none"> • huart: uart handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_HalfDuplex_EnableTransmitter

Function name	HAL_StatusTypeDef HAL_HalfDuplex_EnableTransmitter (UART_HandleTypeDef * huart)
Function description	Enables the UART transmitter and disables the UART receiver.
Parameters	<ul style="list-style-type: none"> • huart: UART handle

- Return values
- **HAL:** status
 - **None:**

HAL_HalfDuplex_EnableReceiver

- Function name **HAL_StatusTypeDef HAL_HalfDuplex_EnableReceiver (UART_HandleTypeDef * huart)**
- Function description Enables the UART receiver and disables the UART transmitter.
- Parameters
- **huart:** UART handle
- Return values
- **HAL:** status

HAL_UART_GetState

- Function name **HAL_UART_StateTypeDef HAL_UART_GetState (UART_HandleTypeDef * huart)**
- Function description return the UART state
- Parameters
- **huart:** uart handle
- Return values
- **HAL:** state

HAL_UART_GetError

- Function name **uint32_t HAL_UART_GetError (UART_HandleTypeDef * huart)**
- Function description Return the UART error code.
- Parameters
- **huart:** : pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART.
- Return values
- **UART:** Error Code

UART_SetConfig

- Function name **HAL_StatusTypeDef UART_SetConfig (UART_HandleTypeDef * huart)**
- Function description Configure the UART peripheral.
- Parameters
- **huart:** uart handle
- Return values
- **None:**

UART_CheckIdleState

- Function name **HAL_StatusTypeDef UART_CheckIdleState (UART_HandleTypeDef * huart)**
- Function description Check the UART Idle State.
- Parameters
- **huart:** uart handle
- Return values
- **HAL:** status

UART_WaitOnFlagUntilTimeout

Function name **HAL_StatusTypeDef UART_WaitOnFlagUntilTimeout (UART_HandleTypeDef * huart, uint32_t Flag, FlagStatus Status, uint32_t Tickstart, uint32_t Timeout)**

Function description This function handles UART Communication Timeout.

Parameters

- **huart:** UART handle
- **Flag:** specifies the UART flag to check.
- **Status:** The new Flag status (SET or RESET).
- **Tickstart:** Tick start value
- **Timeout:** Timeout duration

Return values

- **HAL:** status

UART_AdvFeatureConfig

Function name **void UART_AdvFeatureConfig (UART_HandleTypeDef * huart)**

Function description Configure the UART peripheral advanced features.

Parameters

- **huart:** uart handle

Return values

- **None:**

66.3 UART Firmware driver defines**66.3.1 UART*****UART Advanced Feature Initialization Type***

UART_ADVFEATURE_NO_INIT

UART_ADVFEATURE_TXINVERT_INIT

UART_ADVFEATURE_RXINVERT_INIT

UART_ADVFEATURE_DATAINVERT_INIT

UART_ADVFEATURE_SWAP_INIT

UART_ADVFEATURE_RXOVERRUNDISABLE_INIT

UART_ADVFEATURE_DMADISABLEONERROR_INIT

UART_ADVFEATURE_AUTOBAUDRATE_INIT

UART_ADVFEATURE_MSBFIRST_INIT

UART Advanced Feature Auto BaudRate Enable

UART_ADVFEATURE_AUTOBAUDRATE_DISABLE

UART_ADVFEATURE_AUTOBAUDRATE_ENABLE

UART Advanced Feature AutoBaud Rate Mode

UART_ADVFEATURE_AUTOBAUDRATE_ONSTARTBIT

UART_ADVFEATURE_AUTOBAUDRATE_ONFALLINGEDGE

UART_ADVFEATURE_AUTOBAUDRATE_ON0X7FFRAME

UART_ADVFEATURE_AUTOBAUDRATE_ON0X55FRAME

UART Driver Enable Assertion Time LSB Position In CR1 Register

UART_CR1_DEAT_ADDRESS_LSB_POS

UART Driver Enable DeAssertion Time LSB Position In CR1 Register

UART_CR1_DEDT_ADDRESS_LSB_POS

UART Address-matching LSB Position In CR2 Register

UART_CR2_ADDRESS_LSB_POS

UART Advanced Feature Binary Data Inversion

UART_ADVFEATURE_DATAINV_DISABLE

UART_ADVFEATURE_DATAINV_ENABLE

UART Advanced Feature DMA Disable On Rx Error

UART_ADVFEATURE_DMA_ENABLEONRXERROR

UART_ADVFEATURE_DMA_DISABLEONRXERROR

UART DMA Rx

UART_DMA_RX_DISABLE

UART_DMA_RX_ENABLE

UART DMA Tx

UART_DMA_TX_DISABLE

UART_DMA_TX_ENABLE

UART DriverEnable Polarity

UART_DE_POLARITY_HIGH

UART_DE_POLARITY_LOW

UART Error Definition

HAL_UART_ERROR_NONE	No error
HAL_UART_ERROR_PE	Parity error
HAL_UART_ERROR_NE	Noise error
HAL_UART_ERROR_FE	frame error
HAL_UART_ERROR_ORE	Overrun error
HAL_UART_ERROR_DMA	DMA transfer error

UART Exported Macros

__HAL_UART_RESET_HANDLE_STATE

Description:

- Reset UART handle state.

Parameters:

- __HANDLE__: UART handle.

Return value:

- None

__HAL_UART_FLUSH_DRREGISTER

Description:

`__HAL_UART_CLEAR_IT`

- Flush the UART Data registers.

Parameters:

- `__HANDLE__`: specifies the UART Handle.

Description:

- Clears the specified UART ISR flag, in setting the proper ICR register flag.

Parameters:

- `__HANDLE__`: specifies the UART Handle.
- `__FLAG__`: specifies the interrupt clear register flag that needs to be set to clear the corresponding interrupt This parameter can be one of the following values:
 - `UART_CLEAR_PEF`: Parity Error Clear Flag
 - `UART_CLEAR_FEF`: Framing Error Clear Flag
 - `UART_CLEAR_NEF`: Noise detected Clear Flag
 - `UART_CLEAR_OREF`: OverRun Error Clear Flag
 - `UART_CLEAR_IDLEF`: IDLE line detected Clear Flag
 - `UART_CLEAR_TCF`: Transmission Complete Clear Flag
 - `UART_CLEAR_LBDF`: LIN Break Detection Clear Flag
 - `UART_CLEAR_CTSF`: CTS Interrupt Clear Flag
 - `UART_CLEAR_RTOF`: Receiver Time Out Clear Flag
 - `UART_CLEAR_EOBF`: End Of Block Clear Flag
 - `UART_CLEAR_CMF`: Character Match Clear Flag

Return value:

- None

`__HAL_UART_CLEAR_PEF`**Description:**

- Clear the UART PE pending flag.

Parameters:

- `__HANDLE__`: specifies the UART Handle.

Return value:

- None

`__HAL_UART_CLEAR_FEFLAG`**Description:**

- Clear the UART FE pending flag.

Parameters:

- `__HANDLE__`: specifies the UART Handle.

Return value:

- None

`__HAL_UART_CLEAR_NEFLAG`**Description:**

- Clear the UART NE pending flag.

Parameters:

- `__HANDLE__`: specifies the UART Handle.

Return value:

- None

`__HAL_UART_CLEAR_OREFLAG`**Description:**

- Clear the UART ORE pending flag.

Parameters:

- `__HANDLE__`: specifies the UART Handle.

Return value:

- None

`__HAL_UART_CLEAR_IDLEFLAG`**Description:**

- Clear the UART IDLE pending flag.

Parameters:

- `__HANDLE__`: specifies the UART Handle.

Return value:

- None

`__HAL_UART_GET_FLAG`**Description:**

- Checks whether the specified UART flag is set or not.

Parameters:

- `__HANDLE__`: specifies the UART Handle.
- `__FLAG__`: specifies the flag to check. This parameter can be one of the following values:
 - `UART_FLAG_REACK`: Receive enable acknowledge flag
 - `UART_FLAG_TEACK`: Transmit

- enable acknowledge flag
- UART_FLAG_WUF: Wake up from stop mode flag
- UART_FLAG_RWU: Receiver wake up flag (is the UART in mute mode)
- UART_FLAG_SBKF: Send Break flag
- UART_FLAG_CMF: Character match flag
- UART_FLAG_BUSY: Busy flag
- UART_FLAG_ABRF: Auto Baud rate detection flag
- UART_FLAG_ABRE: Auto Baud rate detection error flag
- UART_FLAG_EOBF: End of block flag
- UART_FLAG_RTOF: Receiver timeout flag
- UART_FLAG_CTS: CTS Change flag (not available for UART4 and UART5)
- UART_FLAG_LBD: LIN Break detection flag
- UART_FLAG_TXE: Transmit data register empty flag
- UART_FLAG_TC: Transmission Complete flag
- UART_FLAG_RXNE: Receive data register not empty flag
- UART_FLAG_IDLE: Idle Line detection flag
- UART_FLAG_ORE: OverRun Error flag
- UART_FLAG_NE: Noise Error flag
- UART_FLAG_FE: Framing Error flag
- UART_FLAG_PE: Parity Error flag

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

__HAL_UART_ENABLE_IT**Description:**

- Enables the specified UART interrupt.

Parameters:

- __HANDLE__: specifies the UART Handle.
- __INTERRUPT__: specifies the UART interrupt source to enable. This parameter can be one of the following values:
 - UART_IT_WUF: Wakeup from stop mode interrupt
 - UART_IT_CM: Character match interrupt

- UART_IT_CTS: CTS change interrupt
- UART_IT_LBD: LIN Break detection interrupt
- UART_IT_TXE: Transmit Data Register empty interrupt
- UART_IT_TC: Transmission complete interrupt
- UART_IT_RXNE: Receive Data register not empty interrupt
- UART_IT_IDLE: Idle line detection interrupt
- UART_IT_PE: Parity Error interrupt
- UART_IT_ERR: Error interrupt(Frame error, noise error, overrun error)

Return value:

- None

Description:

- Disables the specified UART interrupt.

Parameters:

- `__HANDLE__`: specifies the UART Handle.
- `__INTERRUPT__`: specifies the UART interrupt source to disable. This parameter can be one of the following values:
 - UART_IT_CM: Character match interrupt
 - UART_IT_CTS: CTS change interrupt
 - UART_IT_LBD: LIN Break detection interrupt
 - UART_IT_TXE: Transmit Data Register empty interrupt
 - UART_IT_TC: Transmission complete interrupt
 - UART_IT_RXNE: Receive Data register not empty interrupt
 - UART_IT_IDLE: Idle line detection interrupt
 - UART_IT_PE: Parity Error interrupt
 - UART_IT_ERR: Error interrupt(Frame error, noise error, overrun error)

Return value:

- None

Description:

- Checks whether the specified UART

`__HAL_UART_DISABLE_IT``__HAL_UART_GET_IT`

interrupt has occurred or not.

Parameters:

- `__HANDLE__`: specifies the UART Handle.
- `__IT__`: specifies the UART interrupt to check. This parameter can be one of the following values:
 - `UART_IT_CM`: Character match interrupt
 - `UART_IT_CTS`: CTS change interrupt (not available for UART4 and UART5)
 - `UART_IT_LBD`: LIN Break detection interrupt
 - `UART_IT_TXE`: Transmit Data Register empty interrupt
 - `UART_IT_TC`: Transmission complete interrupt
 - `UART_IT_RXNE`: Receive Data register not empty interrupt
 - `UART_IT_IDLE`: Idle line detection interrupt
 - `UART_IT_ORE`: OverRun Error interrupt
 - `UART_IT_NE`: Noise Error interrupt
 - `UART_IT_FE`: Framing Error interrupt
 - `UART_IT_PE`: Parity Error interrupt

Return value:

- The: new state of `__IT__` (TRUE or FALSE).

`__HAL_UART_GET_IT_SOURCE`**Description:**

- Checks whether the specified UART interrupt source is enabled.

Parameters:

- `__HANDLE__`: specifies the UART Handle.
- `__IT__`: specifies the UART interrupt source to check. This parameter can be one of the following values:
 - `UART_IT_CTS`: CTS change interrupt (not available for UART4 and UART5)
 - `UART_IT_LBD`: LIN Break detection interrupt
 - `UART_IT_TXE`: Transmit Data Register empty interrupt
 - `UART_IT_TC`: Transmission complete interrupt
 - `UART_IT_RXNE`: Receive Data

- register not empty interrupt
- UART_IT_IDLE: Idle line detection interrupt
- UART_IT_ORE: OverRun Error interrupt
- UART_IT_NE: Noise Error interrupt
- UART_IT_FE: Framing Error interrupt
- UART_IT_PE: Parity Error interrupt

Return value:

- The: new state of __IT__ (TRUE or FALSE).

Description:

- Set a specific UART request flag.

Parameters:

- __HANDLE__: specifies the UART Handle.
- __REQ__: specifies the request flag to set This parameter can be one of the following values:
 - UART_AUTOBAUD_REQUEST: Auto-Baud Rate Request
 - UART_SENDBREAK_REQUEST: Send Break Request
 - UART_MUTE_MODE_REQUEST: Mute Mode Request
 - UART_RXDATA_FLUSH_REQUEST: Receive Data flush Request
 - UART_TXDATA_FLUSH_REQUEST : Transmit data flush Request

Return value:

- None

Description:

- Enables the UART one bit sample method.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

Description:

- Disables the UART one bit sample method.

Parameters:

- __HANDLE__: specifies the UART

`__HAL_UART_SEND_REQ`

`__HAL_UART_ONE_BIT_SAMPLE_ENABLE`

`__HAL_UART_ONE_BIT_SAMPLE_DISABLE`

`__HAL_UART_ENABLE`

Handle.

Return value:

- None

Description:

- Enable UART.

Parameters:

- `__HANDLE__`: specifies the UART Handle.

Return value:

- None

Description:

- Disable UART.

Parameters:

- `__HANDLE__`: specifies the UART Handle.

Return value:

- None

Description:

- Enable CTS flow control This macro allows to enable CTS hardware flow control for a given UART instance, without need to call

Parameters:

- `__HANDLE__`: specifies the UART Handle. The Handle Instance can be USART1, USART2 or LPUART.

Return value:

- None

Notes:

- As macro is expected to be used for modifying CTS Hw flow control feature activation, without need for USART instance Deinit/Init, following conditions for macro call should be fulfilled : UART instance should have already been initialised (through call of `HAL_UART_Init()`) macro could only be called when corresponding UART instance is disabled (i.e `__HAL_UART_DISABLE(__HANDLE__)`) and should be followed by an Enable macro (i.e `__HAL_UART_ENABLE(__HANDLE__)`).

`__HAL_UART_DISABLE`

`__HAL_UART_HWCONTROL_CTS_ENABLE`

`__HAL_UART_HWCONTROL_CTS_DISABLE`

Description:

- Disable CTS flow control This macro allows to disable CTS hardware flow control for a given UART instance, without need to call

Parameters:

- `__HANDLE__`: specifies the UART Handle. The Handle Instance can be USART1, USART2 or LPUART.

Return value:

- None

Notes:

- As macro is expected to be used for modifying CTS Hw flow control feature activation, without need for USART instance Deinit/Init, following conditions for macro call should be fulfilled : UART instance should have already been initialised (through call of `HAL_UART_Init()`) macro could only be called when corresponding UART instance is disabled (i.e `__HAL_UART_DISABLE(__HANDLE__)`) and should be followed by an Enable macro (i.e `__HAL_UART_ENABLE(__HANDLE__)`).

`__HAL_UART_HWCONTROL_RTS_ENABLE`

Description:

- Enable RTS flow control This macro allows to enable RTS hardware flow control for a given UART instance, without need to call

Parameters:

- `__HANDLE__`: specifies the UART Handle. The Handle Instance can be USART1, USART2 or LPUART.

Return value:

- None

Notes:

- As macro is expected to be used for modifying RTS Hw flow control feature activation, without need for USART instance Deinit/Init, following conditions for macro call should be fulfilled : UART instance should have already been initialised (through call of `HAL_UART_Init()`) macro could only be called when corresponding UART

`__HAL_UART_HWCONTROL_RTS_DISABLE`

instance is disabled (i.e `__HAL_UART_DISABLE(__HANDLE__)`) and should be followed by an Enable macro (i.e `__HAL_UART_ENABLE(__HANDLE__)`).

Description:

- Disable RTS flow control This macro allows to disable RTS hardware flow control for a given UART instance, without need to call

Parameters:

- `__HANDLE__`: specifies the UART Handle. The Handle Instance can be USART1, USART2 or LPUART.

Return value:

- None

Notes:

- As macro is expected to be used for modifying RTS Hw flow control feature activation, without need for USART instance Deinit/Init, following conditions for macro call should be fulfilled : UART instance should have already been initialised (through call of `HAL_UART_Init()`)macro could only be called when corresponding UART instance is disabled (i.e `__HAL_UART_DISABLE(__HANDLE__)`) and should be followed by an Enable macro (i.e `__HAL_UART_ENABLE(__HANDLE__)`).

UART Status Flags

- UART_FLAG_TEACK
- UART_FLAG_SBKF
- UART_FLAG_CMF
- UART_FLAG_BUSY
- UART_FLAG_ABRF
- UART_FLAG_ABRE
- UART_FLAG_EOBF
- UART_FLAG_RTOF
- UART_FLAG_CTS
- UART_FLAG_CTSIF
- UART_FLAG_LBDF
- UART_FLAG_TXE



UART_FLAG_TC
UART_FLAG_RXNE
UART_FLAG_IDLE
UART_FLAG_ORE
UART_FLAG_NE
UART_FLAG_FE
UART_FLAG_PE

UART Half Duplex Selection

UART_HALF_DUPLEX_DISABLE
UART_HALF_DUPLEX_ENABLE

UART Hardware Flow Control

UART_HWCONTROL_NONE
UART_HWCONTROL_RTS
UART_HWCONTROL_CTS
UART_HWCONTROL_RTS_CTS

UART Interruptions Flag Mask

UART_IT_MASK

UART Interrupts Definition

UART_IT_PE
UART_IT_TXE
UART_IT_TC
UART_IT_RXNE
UART_IT_IDLE
UART_IT_LBD
UART_IT_CTS
UART_IT_CM
UART_IT_ERR
UART_IT_ORE
UART_IT_NE
UART_IT_FE

UART Interruption Clear Flags

UART_CLEAR_PEF	Parity Error Clear Flag
UART_CLEAR_FEF	Framing Error Clear Flag
UART_CLEAR_NEF	Noise detected Clear Flag
UART_CLEAR_OREF	OverRun Error Clear Flag
UART_CLEAR_IDLEF	IDLE line detected Clear Flag

UART_CLEAR_TCF Transmission Complete Clear Flag
UART_CLEAR_LBDF LIN Break Detection Clear Flag
UART_CLEAR_CTSF CTS Interrupt Clear Flag
UART_CLEAR_RTOF Receiver Time Out Clear Flag
UART_CLEAR_EOBF End Of Block Clear Flag
UART_CLEAR_CMF Character Match Clear Flag

UART Local Interconnection Network mode

UART_LIN_DISABLE
UART_LIN_ENABLE

UART LIN Break Detection

UART_LINBREAKDETECTLENGTH_10B
UART_LINBREAKDETECTLENGTH_11B

UART Transfer Mode

UART_MODE_RX
UART_MODE_TX
UART_MODE_TX_RX

UART Advanced Feature MSB First

UART_ADVFEATURE_MSBFIRST_DISABLE
UART_ADVFEATURE_MSBFIRST_ENABLE

UART Advanced Feature Mute Mode Enable

UART_ADVFEATURE_MUTEMODE_DISABLE
UART_ADVFEATURE_MUTEMODE_ENABLE

UART One Bit Sampling Method

UART_ONE_BIT_SAMPLE_DISABLE
UART_ONE_BIT_SAMPLE_ENABLE

UART Advanced Feature Overrun Disable

UART_ADVFEATURE_OVERRUN_ENABLE
UART_ADVFEATURE_OVERRUN_DISABLE

UART Over Sampling

UART_OVERSAMPLING_16
UART_OVERSAMPLING_8

UART Parity

UART_PARITY_NONE
UART_PARITY_EVEN
UART_PARITY_ODD

UART Receiver TimeOut

UART_RECEIVER_TIMEOUT_DISABLE

UART_RECEIVER_TIMEOUT_ENABLE

UART Request Parameters

UART_AUTOBAUD_REQUEST Auto-Baud Rate Request

UART_SENDBREAK_REQUEST Send Break Request

UART_MUTE_MODE_REQUEST Mute Mode Request

UART_RXDATA_FLUSH_REQUEST Receive Data flush Request

UART_TXDATA_FLUSH_REQUEST Transmit data flush Request

UART Advanced Feature RX Pin Active Level Inversion

UART_ADVFEATURE_RXINV_DISABLE

UART_ADVFEATURE_RXINV_ENABLE

UART Advanced Feature RX TX Pins Swap

UART_ADVFEATURE_SWAP_DISABLE

UART_ADVFEATURE_SWAP_ENABLE

UART State

UART_STATE_DISABLE

UART_STATE_ENABLE

UART Number of Stop Bits

UART_STOPBITS_1

UART_STOPBITS_2

UART polling-based communications time-out value

HAL_UART_TIMEOUT_VALUE

UART Advanced Feature TX Pin Active Level Inversion

UART_ADVFEATURE_TXINV_DISABLE

UART_ADVFEATURE_TXINV_ENABLE

UART WakeUp Methods

UART_WAKEUPMETHOD_IDLELINE

UART_WAKEUPMETHOD_ADDRESSMARK

67 HAL UART Extension Driver

67.1 UARTEEx Firmware driver API description

67.1.1 Detailed description of functions

HAL_RS485Ex_Init

Function name	HAL_StatusTypeDef HAL_RS485Ex_Init (UART_HandleTypeDef * huart, uint32_t Polarity, uint32_t AssertionTime, uint32_t DeassertionTime)
Function description	Initialize the RS485 Driver enable feature according to the specified parameters in the UART_InitTypeDef and creates the associated handle.
Parameters	<ul style="list-style-type: none"> • huart: UART handle. • Polarity: select the driver enable polarity. This parameter can be one of the following values: <ul style="list-style-type: none"> – UART_DE_POLARITY_HIGH DE signal is active high – UART_DE_POLARITY_LOW DE signal is active low • AssertionTime: Driver Enable assertion time: 5-bit value defining the time between the activation of the DE (Driver Enable) signal and the beginning of the start bit. It is expressed in sample time units (1/8 or 1/16 bit time, depending on the oversampling rate) • DeassertionTime: Driver Enable deassertion time: 5-bit value defining the time between the end of the last stop bit, in a transmitted message, and the de-activation of the DE (Driver Enable) signal. It is expressed in sample time units (1/8 or 1/16 bit time, depending on the oversampling rate).
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_MultiProcessorEx_AddressLength_Set

Function name	HAL_StatusTypeDef HAL_MultiProcessorEx_AddressLength_Set (UART_HandleTypeDef * huart, uint32_t AddressLength)
Function description	By default in multiprocessor mode, when the wake up method is set to address mark, the UART handles only 4-bit long addresses detection; this API allows to enable longer addresses detection (6-, 7- or 8-bit long).
Parameters	<ul style="list-style-type: none"> • huart: UART handle. • AddressLength: this parameter can be one of the following values: <ul style="list-style-type: none"> – UART_ADDRESS_DETECT_4B 4-bit long address – UART_ADDRESS_DETECT_7B 6-, 7- or 8-bit long address
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • Addresses detection lengths are: 6-bit address detection in 7-

bit data mode, 7-bit address detection in 8-bit data mode, 8-bit address detection in 9-bit data mode.

67.2 UARTEEx Firmware driver defines

67.2.1 UARTEEx

UARTEEx Exported Macros

UART_GETCLOCKSOURCE

Description:

- Reports the UART clock source.

Parameters:

- `__HANDLE__`: specifies the UART Handle
- `__CLOCKSOURCE__`: output variable

Return value:

- UART: clocking source, written in `__CLOCKSOURCE__`.

UART_MASK_COMPUTATION

Description:

- Reports the UART mask to apply to retrieve the received data according to the word length and to the parity bits activation.

Parameters:

- `__HANDLE__`: specifies the UART Handle

Return value:

- mask: to apply to UART RDR register value.

UARTEEx WakeUp Address Length

UART_ADDRESS_DETECT_4B

UART_ADDRESS_DETECT_7B

IS_UART_ADDRESLENGTH_DETECT

UARTEEx Word Length

UART_WORDLENGTH_7B

UART_WORDLENGTH_8B

UART_WORDLENGTH_9B

IS_UART_WORD_LENGTH

IS_LIN_WORD_LENGTH

68 HAL USART Generic Driver

68.1 USART Firmware driver registers structures

68.1.1 USART_InitTypeDef

Data Fields

- *uint32_t BaudRate*
- *uint32_t WordLength*
- *uint32_t StopBits*
- *uint32_t Parity*
- *uint32_t Mode*
- *uint32_t OverSampling*
- *uint32_t CLKPolarity*
- *uint32_t CLKPhase*
- *uint32_t CLKLastBit*

Field Documentation

- *uint32_t USART_InitTypeDef::BaudRate*
This member configures the Usart communication baud rate. The baud rate is computed using the following formula: Baud Rate Register = ((PCLKx) / ((huart->Init.BaudRate)))
- *uint32_t USART_InitTypeDef::WordLength*
Specifies the number of data bits transmitted or received in a frame. This parameter can be a value of [USARTEx_Word_Length](#)
- *uint32_t USART_InitTypeDef::StopBits*
Specifies the number of stop bits transmitted. This parameter can be a value of [USART_Stop_Bits](#)
- *uint32_t USART_InitTypeDef::Parity*
Specifies the parity mode. This parameter can be a value of [USART_Parity](#)
Note:When parity is enabled, the computed parity is inserted at the MSB position of the transmitted data (9th bit when the word length is set to 9 data bits; 8th bit when the word length is set to 8 data bits).
- *uint32_t USART_InitTypeDef::Mode*
Specifies whether the Receive or Transmit mode is enabled or disabled. This parameter can be a value of [USART_Mode](#)
- *uint32_t USART_InitTypeDef::OverSampling*
Specifies whether the Over sampling 8 is enabled or disabled, to achieve higher speed (up to fPCLK/8). This parameter can be a value of [USART_Over_Sampling](#)
- *uint32_t USART_InitTypeDef::CLKPolarity*
Specifies the steady state of the serial clock. This parameter can be a value of [USART_Clock_Polarity](#)
- *uint32_t USART_InitTypeDef::CLKPhase*
Specifies the clock transition on which the bit capture is made. This parameter can be a value of [USART_Clock_Phase](#)
- *uint32_t USART_InitTypeDef::CLKLastBit*
Specifies whether the clock pulse corresponding to the last transmitted data bit (MSB) has to be output on the SCLK pin in synchronous mode. This parameter can be a value of [USART_Last_Bit](#)

68.1.2 USART_HandleTypeDef

Data Fields

- *USART_TypeDef * Instance*
- *USART_InitTypeDef Init*
- *uint8_t * pTxBuffPtr*
- *uint16_t TxXferSize*
- *__IO uint16_t TxXferCount*
- *uint8_t * pRxBuffPtr*
- *uint16_t RxXferSize*
- *__IO uint16_t RxXferCount*
- *uint16_t Mask*
- *DMA_HandleTypeDef * hdmatx*
- *DMA_HandleTypeDef * hdmarx*
- *HAL_LockTypeDef Lock*
- *HAL_USART_StateTypeDef State*
- *__IO uint32_t ErrorCode*

Field Documentation

- *USART_TypeDef* USART_HandleTypeDef::Instance*
USART registers base address
- *USART_InitTypeDef USART_HandleTypeDef::Init*
USART communication parameters
- *uint8_t* USART_HandleTypeDef::pTxBuffPtr*
Pointer to USART Tx transfer Buffer
- *uint16_t USART_HandleTypeDef::TxXferSize*
USART Tx Transfer size
- *__IO uint16_t USART_HandleTypeDef::TxXferCount*
USART Tx Transfer Counter
- *uint8_t* USART_HandleTypeDef::pRxBuffPtr*
Pointer to USART Rx transfer Buffer
- *uint16_t USART_HandleTypeDef::RxXferSize*
USART Rx Transfer size
- *__IO uint16_t USART_HandleTypeDef::RxXferCount*
USART Rx Transfer Counter
- *uint16_t USART_HandleTypeDef::Mask*
USART Rx RDR register mask
- *DMA_HandleTypeDef* USART_HandleTypeDef::hdmatx*
USART Tx DMA Handle parameters
- *DMA_HandleTypeDef* USART_HandleTypeDef::hdmarx*
USART Rx DMA Handle parameters
- *HAL_LockTypeDef USART_HandleTypeDef::Lock*
Locking object
- *HAL_USART_StateTypeDef USART_HandleTypeDef::State*
USART communication state
- *__IO uint32_t USART_HandleTypeDef::ErrorCode*
USART Error code

68.2 USART Firmware driver API description

68.2.1 How to use this driver

The USART HAL driver can be used as follows:



1. Declare a USART_HandleTypeDef handle structure.
2. Initialize the USART low level resources by implement the HAL_USART_MspInit() API:
 - a. Enable the USARTx interface clock.
 - b. USART pins configuration:
 - Enable the clock for the USART GPIOs.
 - Configure these USART pins as alternate function pull-up.
 - c. NVIC configuration if you need to use interrupt process (HAL_USART_Transmit_IT(), HAL_USART_Receive_IT() and HAL_USART_TransmitReceive_IT() APIs):
 - Configure the USARTx interrupt priority.
 - Enable the NVIC USART IRQ handle.
 - The specific USART interrupts (Transmission complete interrupt, RXNE interrupt and Error Interrupts) will be managed using the macros __HAL_USART_ENABLE_IT() and __HAL_USART_DISABLE_IT() inside the transmit and receive process.
 - d. DMA Configuration if you need to use DMA process (HAL_USART_Transmit_DMA() HAL_USART_Receive_IT() and HAL_USART_TransmitReceive_IT() APIs):
 - Declare a DMA handle structure for the Tx/Rx stream.
 - Enable the DMAx interface clock.
 - Configure the declared DMA handle structure with the required Tx/Rx parameters.
 - Configure the DMA Tx/Rx Stream.
 - Associate the initialized DMA handle to the USART DMA Tx/Rx handle.
 - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx/Rx Stream.
3. Program the Baud Rate, Word Length, Stop Bit, Parity, Hardware flow control and Mode(Receiver/Transmitter) in the husart Init structure.
4. Initialize the USART registers by calling the HAL_USART_Init() API:
 - These API's configures also the low level Hardware (GPIO, CLOCK, CORTEX...etc) by calling the customed HAL_USART_MspInit(&husart) API.

68.2.2 Initialization and Configuration functions

This subsection provides a set of functions allowing to initialize the USART in asynchronous and in synchronous modes.

- For the asynchronous mode only these parameters can be configured:
 - Baud Rate
 - Word Length
 - Stop Bit
 - Parity: If the parity is enabled, then the MSB bit of the data written in the data register is transmitted but is changed by the parity bit.
 - USART polarity
 - USART phase
 - USART LastBit
 - Receiver/transmitter modes

The HAL_USART_Init() function follows the USART synchronous configuration procedure (details for the procedure are available in reference manual).

This section contains the following APIs:

- [HAL_USART_Init\(\)](#)
- [HAL_USART_DeInit\(\)](#)

- [HAL_USART_MspInit\(\)](#)
- [HAL_USART_MspDeInit\(\)](#)
- [HAL_USART_CheckIdleState\(\)](#)

68.2.3 IO operation functions

The USART supports master mode only: it cannot receive or send data related to an input clock (SCLK is always an output).

1. There are two mode of transfer:
 - Blocking mode: The communication is performed in polling mode. The HAL status of all data processing is returned by the same function after finishing transfer.
 - No-Blocking mode: The communication is performed using Interrupts or DMA, These API's return the HAL status. The end of the data processing will be indicated through the dedicated USART IRQ when using Interrupt mode or the DMA IRQ when using DMA mode. The HAL_USART_TxCpltCallback(), HAL_USART_RxCpltCallback() and HAL_USART_TxRxCpltCallback() user callbacks will be executed respectively at the end of the transmit or Receive process The HAL_USART_ErrorCallback()user callback will be executed when a communication error is detected
2. Blocking mode API's are :
 - HAL_USART_Transmit()in simplex mode
 - HAL_USART_Receive() in full duplex receive only
 - HAL_USART_TransmitReceive() in full duplex mode
3. Non-Blocking mode API's with Interrupt are :
 - HAL_USART_Transmit_IT()in simplex mode
 - HAL_USART_Receive_IT() in full duplex receive only
 - HAL_USART_TransmitReceive_IT()in full duplex mode
 - HAL_USART_IRQHandler()
4. No-Blocking mode functions with DMA are :
 - HAL_USART_Transmit_DMA()in simplex mode
 - HAL_USART_Receive_DMA() in full duplex receive only
 - HAL_USART_TransmitReceive_DMA() in full duplex mode
 - HAL_USART_DMAPause()
 - HAL_USART_DMAResume()
 - HAL_USART_DMAStop()
5. A set of Transfer Complete Callbacks are provided in No_Blocking mode:
 - HAL_USART_TxCpltCallback()
 - HAL_USART_RxCpltCallback()
 - HAL_USART_TxHalfCpltCallback()
 - HAL_USART_RxHalfCpltCallback()
 - HAL_USART_ErrorCallback()
 - HAL_USART_TxRxCpltCallback()

This section contains the following APIs:

- [HAL_USART_Transmit\(\)](#)
- [HAL_USART_Receive\(\)](#)
- [HAL_USART_TransmitReceive\(\)](#)
- [HAL_USART_Transmit_IT\(\)](#)
- [HAL_USART_Receive_IT\(\)](#)
- [HAL_USART_TransmitReceive_IT\(\)](#)
- [HAL_USART_Transmit_DMA\(\)](#)
- [HAL_USART_Receive_DMA\(\)](#)

- [HAL_USART_TransmitReceive_DMA\(\)](#)
- [HAL_USART_DMAPause\(\)](#)
- [HAL_USART_DMAResume\(\)](#)
- [HAL_USART_DMAStop\(\)](#)
- [HAL_USART_IRQHandler\(\)](#)
- [HAL_USART_TxCpltCallback\(\)](#)
- [HAL_USART_TxHalfCpltCallback\(\)](#)
- [HAL_USART_RxCpltCallback\(\)](#)
- [HAL_USART_RxHalfCpltCallback\(\)](#)
- [HAL_USART_TxRxCpltCallback\(\)](#)
- [HAL_USART_ErrorCallback\(\)](#)

68.2.4 Peripheral State and Errors functions

This subsection provides a set of functions allowing to return the State of USART communication process, return Peripheral Errors occurred during communication process

- HAL_USART_GetState() API can be helpful to check in run-time the state of the USART peripheral.
- HAL_USART_GetError() check in run-time errors that could be occurred during communication.

This section contains the following APIs:

- [HAL_USART_GetState\(\)](#)
- [HAL_USART_GetError\(\)](#)

68.2.5 Detailed description of functions

HAL_USART_Init

Function name	HAL_StatusTypeDef HAL_USART_Init (USART_HandleTypeDef * husart)
Function description	Initializes the USART mode according to the specified parameters in the USART_InitTypeDef and create the associated handle.
Parameters	<ul style="list-style-type: none"> • husart: USART handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_USART_DeInit

Function name	HAL_StatusTypeDef HAL_USART_DeInit (USART_HandleTypeDef * husart)
Function description	DeInitializes the USART peripheral.
Parameters	<ul style="list-style-type: none"> • husart: USART handle
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_USART_MspInit

Function name	void HAL_USART_MspInit (USART_HandleTypeDef * husart)
Function description	USART MSP Init.
Parameters	<ul style="list-style-type: none"> • husart: USART handle

Return values • **None:**

HAL_USART_MspDeInit

Function name **void HAL_USART_MspDeInit (USART_HandleTypeDef * husart)**

Function description USART MSP DeInit.

Parameters • **husart:** USART handle

Return values • **None:**

HAL_USART_CheckIdleState

Function name **HAL_StatusTypeDef HAL_USART_CheckIdleState (USART_HandleTypeDef * husart)**

Function description

HAL_USART_Transmit

Function name **HAL_StatusTypeDef HAL_USART_Transmit (USART_HandleTypeDef * husart, uint8_t * pTxData, uint16_t Size, uint32_t Timeout)**

Function description Simplex Send an amount of data in blocking mode.

Parameters • **husart:** USART handle
• **pTxData:** pointer to data buffer
• **Size:** amount of data to be sent
• **Timeout:** : Timeout duration

Return values • **HAL:** status

HAL_USART_Receive

Function name **HAL_StatusTypeDef HAL_USART_Receive (USART_HandleTypeDef * husart, uint8_t * pRxData, uint16_t Size, uint32_t Timeout)**

Function description Receive an amount of data in blocking mode.

Parameters • **husart:** USART handle
• **pRxData:** pointer to data buffer
• **Size:** amount of data to be received
• **Timeout:** : Timeout duration

Return values • **HAL:** status

Notes • To receive synchronous data, dummy data are simultaneously transmitted

HAL_USART_TransmitReceive

Function name **HAL_StatusTypeDef HAL_USART_TransmitReceive (USART_HandleTypeDef * husart, uint8_t * pTxData, uint8_t * pRxData, uint16_t Size, uint32_t Timeout)**

Function description	Full-Duplex Send and Receive an amount of data in blocking mode.
Parameters	<ul style="list-style-type: none">• husart: USART handle• pTxData: pointer to TX data buffer• pRxData: pointer to RX data buffer• Size: amount of data to be sent (same amount to be received)• Timeout: : Timeout duration
Return values	<ul style="list-style-type: none">• HAL: status

HAL_USART_Transmit_IT

Function name	HAL_StatusTypeDef HAL_USART_Transmit_IT (USART_HandleTypeDef * husart, uint8_t * pTxData, uint16_t Size)
Function description	Send an amount of data in interrupt mode.
Parameters	<ul style="list-style-type: none">• husart: USART handle• pTxData: pointer to data buffer• Size: amount of data to be sent
Return values	<ul style="list-style-type: none">• HAL: status

HAL_USART_Receive_IT

Function name	HAL_StatusTypeDef HAL_USART_Receive_IT (USART_HandleTypeDef * husart, uint8_t * pRxData, uint16_t Size)
Function description	Receive an amount of data in blocking mode To receive synchronous data, dummy data are simultaneously transmitted.
Parameters	<ul style="list-style-type: none">• husart: USART handle• pRxData: pointer to data buffer• Size: amount of data to be received
Return values	<ul style="list-style-type: none">• HAL: status

HAL_USART_TransmitReceive_IT

Function name	HAL_StatusTypeDef HAL_USART_TransmitReceive_IT (USART_HandleTypeDef * husart, uint8_t * pTxData, uint8_t * pRxData, uint16_t Size)
Function description	Full-Duplex Send and Receive an amount of data in interrupt mode.
Parameters	<ul style="list-style-type: none">• husart: USART handle• pTxData: pointer to TX data buffer• pRxData: pointer to RX data buffer• Size: amount of data to be sent (same amount to be received)
Return values	<ul style="list-style-type: none">• HAL: status

HAL_USART_Transmit_DMA

Function name	HAL_StatusTypeDef HAL_USART_Transmit_DMA (USART_HandleTypeDef * husart, uint8_t * pTxData, uint16_t Size)
Function description	Send an amount of data in DMA mode.
Parameters	<ul style="list-style-type: none"> • husart: USART handle • pTxData: pointer to data buffer • Size: amount of data to be sent
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_USART_Receive_DMA

Function name	HAL_StatusTypeDef HAL_USART_Receive_DMA (USART_HandleTypeDef * husart, uint8_t * pRxData, uint16_t Size)
Function description	Receive an amount of data in DMA mode.
Parameters	<ul style="list-style-type: none"> • husart: USART handle • pRxData: pointer to data buffer • Size: amount of data to be received
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • When the USART parity is enabled (PCE = 1), the received data contain the parity bit (MSB position) • The USART DMA transmit stream must be configured in order to generate the clock for the slave.

HAL_USART_TransmitReceive_DMA

Function name	HAL_StatusTypeDef HAL_USART_TransmitReceive_DMA (USART_HandleTypeDef * husart, uint8_t * pTxData, uint8_t * pRxData, uint16_t Size)
Function description	Full-Duplex Transmit Receive an amount of data in non blocking mode.
Parameters	<ul style="list-style-type: none"> • husart: USART handle • pTxData: pointer to TX data buffer • pRxData: pointer to RX data buffer • Size: amount of data to be received/sent
Return values	<ul style="list-style-type: none"> • HAL: status
Notes	<ul style="list-style-type: none"> • When the USART parity is enabled (PCE = 1) the data received contain the parity bit.

HAL_USART_DMAPause

Function name	HAL_StatusTypeDef HAL_USART_DMAPause (USART_HandleTypeDef * husart)
Function description	Pauses the DMA Transfer.
Parameters	<ul style="list-style-type: none"> • husart: USART handle

Return values

- **None:**

HAL_USART_DMAResume

Function name **HAL_StatusTypeDef HAL_USART_DMAResume (USART_HandleTypeDef * husart)**

Function description Resumes the DMA Transfer.

Parameters

- **husart:** USART handle

Return values

- **None:**

HAL_USART_DMAStop

Function name **HAL_StatusTypeDef HAL_USART_DMAStop (USART_HandleTypeDef * husart)**

Function description Stops the DMA Transfer.

Parameters

- **husart:** USART handle

Return values

- **None:**

HAL_USART_IRQHandler

Function name **void HAL_USART_IRQHandler (USART_HandleTypeDef * husart)**

Function description This function handles USART interrupt request.

Parameters

- **husart:** USART handle

Return values

- **None:**

HAL_USART_TxHalfCpltCallback

Function name **void HAL_USART_TxHalfCpltCallback (USART_HandleTypeDef * husart)**

Function description Tx Half Transfer completed callbacks.

Parameters

- **husart:** USART handle

Return values

- **None:**

HAL_USART_TxCpltCallback

Function name **void HAL_USART_TxCpltCallback (USART_HandleTypeDef * husart)**

Function description Tx Transfer completed callbacks.

Parameters

- **husart:** USART handle

Return values

- **None:**

HAL_USART_RxCpltCallback

Function name **void HAL_USART_RxCpltCallback (USART_HandleTypeDef * husart)**

husart)

Function description	Rx Transfer completed callbacks.
Parameters	<ul style="list-style-type: none"> • husart: USART handle
Return values	<ul style="list-style-type: none"> • None:

HAL_USART_RxHalfCpltCallback

Function name	void HAL_USART_RxHalfCpltCallback (USART_HandleTypeDef * husart)
Function description	Rx Half Transfer completed callbacks.
Parameters	<ul style="list-style-type: none"> • husart: usart handle
Return values	<ul style="list-style-type: none"> • None:

HAL_USART_TxRxCpltCallback

Function name	void HAL_USART_TxRxCpltCallback (USART_HandleTypeDef * husart)
Function description	Tx/Rx Transfers completed callback for the non-blocking process.
Parameters	<ul style="list-style-type: none"> • husart: USART handle
Return values	<ul style="list-style-type: none"> • None:

HAL_USART_ErrorCallback

Function name	void HAL_USART_ErrorCallback (USART_HandleTypeDef * husart)
Function description	USART error callbacks.
Parameters	<ul style="list-style-type: none"> • husart: USART handle
Return values	<ul style="list-style-type: none"> • None:

HAL_USART_GetState

Function name	HAL_USART_StateTypeDef HAL_USART_GetState (USART_HandleTypeDef * husart)
Function description	return the USART state
Parameters	<ul style="list-style-type: none"> • husart: USART handle
Return values	<ul style="list-style-type: none"> • HAL: state

HAL_USART_GetError

Function name	uint32_t HAL_USART_GetError (USART_HandleTypeDef * husart)
Function description	Return the USART error code.
Parameters	<ul style="list-style-type: none"> • husart: : pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART.

Return values • **USART:** Error Code

68.3 USART Firmware driver defines

68.3.1 USART

USART Clock

USART_CLOCK_DISABLE

USART_CLOCK_ENABLE

USART Clock Phase

USART_PHASE_1EDGE

USART_PHASE_2EDGE

USART Clock Polarity

USART_POLARITY_LOW

USART_POLARITY_HIGH

USART Error Code

HAL_USART_ERROR_NONE	No error
HAL_USART_ERROR_PE	Parity error
HAL_USART_ERROR_NE	Noise error
HAL_USART_ERROR_FE	Frame error
HAL_USART_ERROR_ORE	Overrun error
HAL_USART_ERROR_DMA	DMA transfer error

USART Exported Macros

`__HAL_USART_RESET_HANDLE_STATE`

Description:

- Reset USART handle state.

Parameters:

- `__HANDLE__`: USART handle.

Return value:

- None

`__HAL_USART_GET_FLAG`

Description:

- Checks whether the specified USART flag is set or not.

Parameters:

- `__HANDLE__`: specifies the USART Handle
- `__FLAG__`: specifies the flag to check. This parameter can be one of the following values:
 - USART_FLAG_REACK: Receive enable acknowledge flag
 - USART_FLAG_TEACK: Transmit enable acknowledge flag

- USART_FLAG_BUSY: Busy flag
- USART_FLAG_CTS: CTS Change flag
- USART_FLAG_TXE: Transmit data register empty flag
- USART_FLAG_TC: Transmission Complete flag
- USART_FLAG_RXNE: Receive data register not empty flag
- USART_FLAG_IDLE: Idle Line detection flag
- USART_FLAG_ORE: OverRun Error flag
- USART_FLAG_NE: Noise Error flag
- USART_FLAG_FE: Framing Error flag
- USART_FLAG_PE: Parity Error flag

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

`__HAL_USART_ENABLE_IT`**Description:**

- Enables the specified USART interrupt.

Parameters:

- __HANDLE__: specifies the USART Handle
- __INTERRUPT__: specifies the USART interrupt source to enable. This parameter can be one of the following values:
 - USART_IT_TXE: Transmit Data Register empty interrupt
 - USART_IT_TC: Transmission complete interrupt
 - USART_IT_RXNE: Receive Data register not empty interrupt
 - USART_IT_IDLE: Idle line detection interrupt
 - USART_IT_PE: Parity Error interrupt
 - USART_IT_ERR: Error interrupt(Frame error, noise error, overrun error)

Return value:

- None

`__HAL_USART_DISABLE_IT`**Description:**

- Disables the specified USART interrupt.

Parameters:

- __HANDLE__: specifies the USART Handle.
- __INTERRUPT__: specifies the USART interrupt source to disable. This parameter can be one of the following values:
 - USART_IT_TXE: Transmit Data Register empty interrupt

- USART_IT_TC: Transmission complete interrupt
- USART_IT_RXNE: Receive Data register not empty interrupt
- USART_IT_IDLE: Idle line detection interrupt
- USART_IT_PE: Parity Error interrupt
- USART_IT_ERR: Error interrupt(Frame error, noise error, overrun error)

Return value:

- None

Description:

- Checks whether the specified USART interrupt has occurred or not.

Parameters:

- __HANDLE__: specifies the USART Handle
- __IT__: specifies the USART interrupt source to check. This parameter can be one of the following values:
 - USART_IT_TXE: Transmit Data Register empty interrupt
 - USART_IT_TC: Transmission complete interrupt
 - USART_IT_RXNE: Receive Data register not empty interrupt
 - USART_IT_IDLE: Idle line detection interrupt
 - USART_IT_ORE: OverRun Error interrupt
 - USART_IT_NE: Noise Error interrupt
 - USART_IT_FE: Framing Error interrupt
 - USART_IT_PE: Parity Error interrupt

Return value:

- The: new state of __IT__ (TRUE or FALSE).

Description:

- Checks whether the specified USART interrupt source is enabled.

Parameters:

- __HANDLE__: specifies the USART Handle.
- __IT__: specifies the USART interrupt source to check. This parameter can be one of the following values:
 - USART_IT_TXE: Transmit Data Register empty interrupt
 - USART_IT_TC: Transmission complete interrupt
 - USART_IT_RXNE: Receive Data

`__HAL_USART_GET_IT`

`__HAL_USART_GET_IT_SOURCE`



- register not empty interrupt
- USART_IT_IDLE: Idle line detection interrupt
- USART_IT_ORE: OverRun Error interrupt
- USART_IT_NE: Noise Error interrupt
- USART_IT_FE: Framing Error interrupt
- USART_IT_PE: Parity Error interrupt

Return value:

- The: new state of __IT__ (TRUE or FALSE).

`__HAL_USART_CLEAR_IT`**Description:**

- Clears the specified USART ISR flag, in setting the proper ICR register flag.

Parameters:

- `__HANDLE__`: specifies the USART Handle.
- `__IT_CLEAR__`: specifies the interrupt clear register flag that needs to be set to clear the corresponding interrupt This parameter can be one of the following values:
 - `USART_CLEAR_PEF`: Parity Error Clear Flag
 - `USART_CLEAR_FEF`: Framing Error Clear Flag
 - `USART_CLEAR_NEF`: Noise detected Clear Flag
 - `USART_CLEAR_OREF`: OverRun Error Clear Flag
 - `USART_CLEAR_IDLEF`: IDLE line detected Clear Flag
 - `USART_CLEAR_TCF`: Transmission Complete Clear Flag
 - `USART_CLEAR_CTSF`: CTS Interrupt Clear Flag

Return value:

- None

`__HAL_USART_SEND_REQ`**Description:**

- Set a specific USART request flag.

Parameters:

- `__HANDLE__`: specifies the USART Handle.
- `__REQ__`: specifies the request flag to set This parameter can be one of the following values:
 - `USART_RXDATA_FLUSH_REQUEST`: Receive Data flush Request
 - `USART_TXDATA_FLUSH_REQUEST`:

Transmit data flush Request

`__HAL_USART_ENABLE`**Return value:**

- None

Description:

- Enable USART.

Parameters:

- `__HANDLE__`: specifies the USART Handle.

Return value:

- None

Description:

- Disable USART.

Parameters:

- `__HANDLE__`: specifies the USART Handle.

Return value:

- None

`__HAL_USART_DISABLE`**USART Flags**`USART_FLAG_REACK``USART_FLAG_TEACK``USART_FLAG_BUSY``USART_FLAG_CTS``USART_FLAG_CTSIF``USART_FLAG_LBDF``USART_FLAG_TXE``USART_FLAG_TC``USART_FLAG_RXNE``USART_FLAG_IDLE``USART_FLAG_ORE``USART_FLAG_NE``USART_FLAG_FE``USART_FLAG_PE`**USART Interrupts Definition**`USART_IT_PE``USART_IT_TXE``USART_IT_TC``USART_IT_RXNE`

USART_IT_IDLE

USART_IT_ERR

USART_IT_ORE

USART_IT_NE

USART_IT_FE

USART Interruption Clear Flags

USART_CLEAR_PEF Parity Error Clear Flag

USART_CLEAR_FEF Framing Error Clear Flag

USART_CLEAR_NEF Noise detected Clear Flag

USART_CLEAR_OREF OverRun Error Clear Flag

USART_CLEAR_IDLEF IDLE line detected Clear Flag

USART_CLEAR_TCF Transmission Complete Clear Flag

USART_CLEAR_CTSF CTS Interrupt Clear Flag

USART Last Bit

USART_LASTBIT_DISABLE

USART_LASTBIT_ENABLE

USART Mode

USART_MODE_RX

USART_MODE_TX

USART_MODE_TX_RX

USART Over Sampling

USART_OVERSAMPLING_16

USART_OVERSAMPLING_8

USART Parity

USART_PARITY_NONE

USART_PARITY_EVEN

USART_PARITY_ODD

USART Request Parameters

USART_RXDATA_FLUSH_REQUEST Receive Data flush Request

USART_TXDATA_FLUSH_REQUEST Transmit data flush Request

USART Number of Stop Bits

USART_STOPBITS_1

USART_STOPBITS_2

USART_STOPBITS_1_5

69 HAL USART Extension Driver

69.1 USARTE_x Firmware driver defines

69.1.1 USARTE_x

USARTE_x Word Length

USART_WORDLENGTH_7B

USART_WORDLENGTH_8B

USART_WORDLENGTH_9B

70 HAL WWDG Generic Driver

70.1 WWDG Firmware driver registers structures

70.1.1 WWDG_InitTypeDef

Data Fields

- *uint32_t Prescaler*
- *uint32_t Window*
- *uint32_t Counter*
- *uint32_t EWIMode*

Field Documentation

- *uint32_t WWDG_InitTypeDef::Prescaler*
Specifies the prescaler value of the WWDG. This parameter can be a value of [WWDG_Prescaler](#)
- *uint32_t WWDG_InitTypeDef::Window*
Specifies the WWDG window value to be compared to the downcounter. This parameter must be a number Min_Data = 0x40 and Max_Data = 0x7F
- *uint32_t WWDG_InitTypeDef::Counter*
Specifies the WWDG free-running downcounter value. This parameter must be a number between Min_Data = 0x40 and Max_Data = 0x7F
- *uint32_t WWDG_InitTypeDef::EWIMode*
Specifies if WWDG Early Wakeup Interupt is enable or not. This parameter can be a value of [WWDG_EWI_Mode](#)

70.1.2 WWDG_HandleTypeDef

Data Fields

- *WWDG_TypeDef * Instance*
- *WWDG_InitTypeDef Init*

Field Documentation

- *WWDG_TypeDef* WWDG_HandleTypeDef::Instance*
Register base address
- *WWDG_InitTypeDef WWDG_HandleTypeDef::Init*
WWDG required parameters

70.2 WWDG Firmware driver API description

70.2.1 WWDG specific features

Once enabled the WWDG generates a system reset on expiry of a programmed time period, unless the program refreshes the counter (T[6;0] downcounter) before reaching 0x3F value (i.e. a reset is generated when the counter value rolls over from 0x40 to 0x3F).

- An MCU reset is also generated if the counter value is refreshed before the counter has reached the refresh window value. This implies that the counter must be refreshed in a limited window.
- Once enabled the WWDG cannot be disabled except by a system reset.
- WWDGRST flag in RCC_CSR register informs when a WWDG reset has occurred (check available with `__HAL_RCC_GET_FLAG(RCC_FLAG_WWDGRST)`).

- The WWDG downcounter input clock is derived from the APB clock divided by a programmable prescaler.
- WWDG downcounter clock (Hz) = PCLK1 / (4096 * Prescaler)
- WWDG timeout (ms) = (1000 * (T[5;0] + 1)) / (WWDG downcounter clock) where T[5;0] are the lowest 6 bits of downcounter.
- WWDG Counter refresh is allowed between the following limits :
 - min time (ms) = (1000 * (T[5;0] - Window)) / (WWDG downcounter clock)
 - max time (ms) = (1000 * (T[5;0] - 0x40)) / (WWDG downcounter clock)
- Min-max timeout value @80 MHz(PCLK1): ~51.2 us / ~26.22 ms
- The Early Wakeup Interrupt (EWI) can be used if specific safety operations or data logging must be performed before the actual reset is generated. When the downcounter reaches the value 0x40, an EWI interrupt is generated and the corresponding interrupt service routine (ISR) can be used to trigger specific actions (such as communications or data logging), before resetting the device. In some applications, the EWI interrupt can be used to manage a software system check and/or system recovery/graceful degradation, without generating a WWDG reset. In this case, the corresponding interrupt service routine (ISR) should reload the WWDG counter to avoid the WWDG reset, then trigger the required actions. Note:When the EWI interrupt cannot be served, e.g. due to a system lock in a higher priority task, the WWDG reset will eventually be generated.
- Debug mode : When the microcontroller enters debug mode (core halted), the WWDG counter either continues to work normally or stops, depending on DBG_WWDG_STOP configuration bit in DBG module, accessible through __HAL_DBGMCU_FREEZE_WWDG() and __HAL_DBGMCU_UNFREEZE_WWDG() macros

70.2.2 How to use this driver

- Enable WWDG APB1 clock using __HAL_RCC_WWDG_CLK_ENABLE().
- Set the WWDG prescaler, refresh window, counter value and Early Wakeup Interrupt mode using HAL_WWDG_Init() function. This enables WWDG peripheral and the downcounter starts downcounting from given counter value. Init function can be called again to modify all watchdog parameters, however if EWI mode has been set once, it can't be clear until next reset.
- The application program must refresh the WWDG counter at regular intervals during normal operation to prevent an MCU reset using HAL_WWDG_Refresh() function. This operation must occur only when the counter is lower than the window value already programmed.
- if Early Wakeup Interrupt mode is enable an interrupt is generated when the counter reaches 0x40. User can add his own code in weak function HAL_WWDG_EarlyWakeupCallback().

WWDG HAL driver macros list

Below the list of most used macros in WWDG HAL driver.

- __HAL_WWDG_GET_IT_SOURCE: Check the selected WWDG's interrupt source.
- __HAL_WWDG_GET_FLAG: Get the selected WWDG's flag status.
- __HAL_WWDG_CLEAR_FLAG: Clear the WWDG's pending flags.

70.2.3 Initialization and Configuration functions

This section provides functions allowing to:

- Initialize and start the WWDG according to the specified parameters in the WWDG_InitTypeDef of associated handle.
- Initialize the WWDG MSP.

This section contains the following APIs:

- [HAL_WWDG_Init\(\)](#)
- [HAL_WWDG_Msplnit\(\)](#)

70.2.4 IO operation functions

This section provides functions allowing to:

- Refresh the WWDG.
- Handle WWDG interrupt request and associated function callback.

This section contains the following APIs:

- [HAL_WWDG_Refresh\(\)](#)
- [HAL_WWDG_IRQHandler\(\)](#)
- [HAL_WWDG_EarlyWakeupCallback\(\)](#)

70.2.5 Detailed description of functions

HAL_WWDG_Init

Function name	HAL_StatusTypeDef HAL_WWDG_Init (WWDG_HandleTypeDef * hwwdg)
Function description	Initialize the WWDG according to the specified.
Parameters	<ul style="list-style-type: none"> • hwwdg: pointer to a WWDG_HandleTypeDef structure that contains the configuration information for the specified WWDG module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_WWDG_Msplnit

Function name	void HAL_WWDG_Msplnit (WWDG_HandleTypeDef * hwwdg)
Function description	Initialize the WWDG MSP.
Parameters	<ul style="list-style-type: none"> • hwwdg: pointer to a WWDG_HandleTypeDef structure that contains the configuration information for the specified WWDG module.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • When rewriting this function in user file, mechanism may be added to avoid multiple initialize when HAL_WWDG_Init function is called again to change parameters.

HAL_WWDG_Refresh

Function name	HAL_StatusTypeDef HAL_WWDG_Refresh (WWDG_HandleTypeDef * hwwdg)
Function description	Refresh the WWDG.
Parameters	<ul style="list-style-type: none"> • hwwdg: pointer to a WWDG_HandleTypeDef structure that contains the configuration information for the specified WWDG module.
Return values	<ul style="list-style-type: none"> • HAL: status

HAL_WWDG_IRQHandler

Function name	void HAL_WWDG_IRQHandler (WWDG_HandleTypeDef * hwwdg)
Function description	Handle WWDG interrupt request.
Parameters	<ul style="list-style-type: none"> • hwwdg: pointer to a WWDG_HandleTypeDef structure that contains the configuration information for the specified WWDG module.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The Early Wakeup Interrupt (EWI) can be used if specific safety operations or data logging must be performed before the actual reset is generated. The EWI interrupt is enabled by calling HAL_WWDG_Init function with EWIMode set to WWDG_EWI_ENABLE. When the downcounter reaches the value 0x40, and EWI interrupt is generated and the corresponding Interrupt Service Routine (ISR) can be used to trigger specific actions (such as communications or data logging), before resetting the device.

HAL_WWDG_EarlyWakeupCallback

Function name	void HAL_WWDG_EarlyWakeupCallback (WWDG_HandleTypeDef * hwwdg)
Function description	WWDG Early Wakeup callback.
Parameters	<ul style="list-style-type: none"> • hwwdg: pointer to a WWDG_HandleTypeDef structure that contains the configuration information for the specified WWDG module.
Return values	<ul style="list-style-type: none"> • None:

70.3 WWDG Firmware driver defines

70.3.1 WWDG

WWDG Early Wakeup Interrupt Mode

WWDG_EWI_DISABLE EWI Disable

WWDG_EWI_ENABLE EWI Enable

WWDG Exported Macros

`__HAL_WWDG_ENABLE`

Description:

- Enable the WWDG peripheral.

Parameters:

- `__HANDLE__`: WWDG handle

Return value:

- None

`__HAL_WWDG_ENABLE_IT`

Description:

- Enable the WWDG early wakeup interrupt.

`__HAL_WWDG_GET_IT`**Parameters:**

- `__HANDLE__`: WWDG handle
- `__INTERRUPT__`: specifies the interrupt to enable. This parameter can be one of the following values:
 - `WWDG_IT_EWI`: Early wakeup interrupt

Return value:

- None

Notes:

- Once enabled this interrupt cannot be disabled except by a system reset.

Description:

- Check whether the selected WWDG interrupt has occurred or not.

Parameters:

- `__HANDLE__`: WWDG handle
- `__INTERRUPT__`: specifies the it to check. This parameter can be one of the following values:
 - `WWDG_FLAG_EWIF`: Early wakeup interrupt IT

Return value:

- The: new state of `WWDG_FLAG` (SET or RESET).

`__HAL_WWDG_CLEAR_IT`**Description:**

- Clear the WWDG interrupt pending bits.

Parameters:

- `__HANDLE__`: WWDG handle
- `__INTERRUPT__`: specifies the interrupt pending bit to clear. This parameter can be one of the following values:
 - `WWDG_FLAG_EWIF`: Early wakeup interrupt flag

Description:

- Check whether the specified WWDG flag is set or not.

Parameters:

- `__HANDLE__`: WWDG handle
- `__FLAG__`: specifies the flag to check. This parameter can be one of the following values:
 - `WWDG_FLAG_EWIF`: Early wakeup interrupt flag

Return value:

- The: new state of `WWDG_FLAG` (SET or

RESET).

`__HAL_WWDG_CLEAR_FLAG`

Description:

- Clear the WWDG's pending flags.

Parameters:

- `__HANDLE__`: WWDG handle
- `__FLAG__`: specifies the flag to clear. This parameter can be one of the following values:
 - `WWDG_FLAG_EWIF`: Early wakeup interrupt flag

Return value:

- None

`__HAL_WWDG_GET_IT_SOURCE`

Description:

- Check whether the specified WWDG interrupt source is enabled or not.

Parameters:

- `__HANDLE__`: WWDG Handle.
- `__INTERRUPT__`: specifies the WWDG interrupt source to check. This parameter can be one of the following values:
 - `WWDG_IT_EWI`: Early Wakeup Interrupt

Return value:

- state: of `__INTERRUPT__` (TRUE or FALSE).

WWDG Flag definition

`WWDG_FLAG_EWIF` Early wakeup interrupt flag

WWDG Interrupt definition

`WWDG_IT_EWI` Early wakeup interrupt

WWDG Prescaler

`WWDG_PRESCALER_1` WWDG counter clock = (PCLK1/4096)/1

`WWDG_PRESCALER_2` WWDG counter clock = (PCLK1/4096)/2

`WWDG_PRESCALER_4` WWDG counter clock = (PCLK1/4096)/4

`WWDG_PRESCALER_8` WWDG counter clock = (PCLK1/4096)/8

71 LL ADC Generic Driver

71.1 ADC Firmware driver registers structures

71.1.1 LL_ADC_CommonInitTypeDef

Data Fields

- *uint32_t CommonClock*
- *uint32_t Multimode*
- *uint32_t MultiDMATransfer*
- *uint32_t MultiTwoSamplingDelay*

Field Documentation

- *uint32_t LL_ADC_CommonInitTypeDef::CommonClock*
Set parameter common to several ADC: Clock source and prescaler. This parameter can be a value of [ADC_LL_EC_COMMON_CLOCK_SOURCE](#)This feature can be modified afterwards using unitary function [LL_ADC_SetCommonClock\(\)](#).
- *uint32_t LL_ADC_CommonInitTypeDef::Multimode*
Set ADC multimode configuration to operate in independent mode or multimode (for devices with several ADC instances). This parameter can be a value of [ADC_LL_EC_MULTI_MODE](#)This feature can be modified afterwards using unitary function [LL_ADC_SetMultimode\(\)](#).
- *uint32_t LL_ADC_CommonInitTypeDef::MultiDMATransfer*
Set ADC multimode conversion data transfer: no transfer or transfer by DMA. This parameter can be a value of [ADC_LL_EC_MULTI_DMA_TRANSFER](#)This feature can be modified afterwards using unitary function [LL_ADC_SetMultiDMATransfer\(\)](#).
- *uint32_t LL_ADC_CommonInitTypeDef::MultiTwoSamplingDelay*
Set ADC multimode delay between 2 sampling phases. This parameter can be a value of [ADC_LL_EC_MULTI_TWOSMP_DELAY](#)This feature can be modified afterwards using unitary function [LL_ADC_SetMultiTwoSamplingDelay\(\)](#).

71.1.2 LL_ADC_InitTypeDef

Data Fields

- *uint32_t Resolution*
- *uint32_t DataAlignment*
- *uint32_t SequencersScanMode*

Field Documentation

- *uint32_t LL_ADC_InitTypeDef::Resolution*
Set ADC resolution. This parameter can be a value of [ADC_LL_EC_RESOLUTION](#)This feature can be modified afterwards using unitary function [LL_ADC_SetResolution\(\)](#).
- *uint32_t LL_ADC_InitTypeDef::DataAlignment*
Set ADC conversion data alignment. This parameter can be a value of [ADC_LL_EC_DATA_ALIGN](#)This feature can be modified afterwards using unitary function [LL_ADC_SetDataAlignment\(\)](#).
- *uint32_t LL_ADC_InitTypeDef::SequencersScanMode*
Set ADC scan selection. This parameter can be a value of [ADC_LL_EC_SCAN_SELECTION](#)This feature can be modified afterwards using unitary function [LL_ADC_SetSequencersScanMode\(\)](#).

71.1.3 LL_ADC_REG_InitTypeDef

Data Fields

- *uint32_t TriggerSource*
- *uint32_t SequencerLength*
- *uint32_t SequencerDiscont*
- *uint32_t ContinuousMode*
- *uint32_t DMATransfer*

Field Documentation

- ***uint32_t LL_ADC_REG_InitTypeDef::TriggerSource***
Set ADC group regular conversion trigger source: internal (SW start) or from external IP (timer event, external interrupt line). This parameter can be a value of [ADC_LL_EC_REG_TRIGGER_SOURCE](#)
Note:On this STM32 serie, setting of external trigger edge is performed using function `LL_ADC_REG_StartConversionExtTrig()`. This feature can be modified afterwards using unitary function `LL_ADC_REG_SetTriggerSource()`.
- ***uint32_t LL_ADC_REG_InitTypeDef::SequencerLength***
Set ADC group regular sequencer length. This parameter can be a value of [ADC_LL_EC_REG_SEQ_SCAN_LENGTH](#)
Note:This parameter is discarded if scan mode is disabled (refer to parameter 'ADC_SequencersScanMode'). This feature can be modified afterwards using unitary function `LL_ADC_REG_SetSequencerLength()`.
- ***uint32_t LL_ADC_REG_InitTypeDef::SequencerDiscont***
Set ADC group regular sequencer discontinuous mode: sequence subdivided and scan conversions interrupted every selected number of ranks. This parameter can be a value of [ADC_LL_EC_REG_SEQ_DISCONT_MODE](#)
Note:This parameter has an effect only if group regular sequencer is enabled (scan length of 2 ranks or more). This feature can be modified afterwards using unitary function `LL_ADC_REG_SetSequencerDiscont()`.
- ***uint32_t LL_ADC_REG_InitTypeDef::ContinuousMode***
Set ADC continuous conversion mode on ADC group regular, whether ADC conversions are performed in single mode (one conversion per trigger) or in continuous mode (after the first trigger, following conversions launched successively automatically). This parameter can be a value of [ADC_LL_EC_REG_CONTINUOUS_MODE](#) **Note:** It is not possible to enable both ADC group regular continuous mode and discontinuous mode. This feature can be modified afterwards using unitary function `LL_ADC_REG_SetContinuousMode()`.
- ***uint32_t LL_ADC_REG_InitTypeDef::DMATransfer***
Set ADC group regular conversion data transfer: no transfer or transfer by DMA, and DMA requests mode. This parameter can be a value of [ADC_LL_EC_REG_DMA_TRANSFER](#) This feature can be modified afterwards using unitary function `LL_ADC_REG_SetDMATransfer()`.

71.1.4 LL_ADC_INJ_InitTypeDef

Data Fields

- *uint32_t TriggerSource*
- *uint32_t SequencerLength*
- *uint32_t SequencerDiscont*
- *uint32_t TrigAuto*

Field Documentation

- `uint32_t LL_ADC_INJ_InitTypeDef::TriggerSource`**
 Set ADC group injected conversion trigger source: internal (SW start) or from external IP (timer event, external interrupt line). This parameter can be a value of [ADC_LL_EC_INJ_TRIGGER_SOURCE](#)
Note: On this STM32 serie, setting of external trigger edge is performed using function `LL_ADC_INJ_StartConversionExtTrig()`. This feature can be modified afterwards using unitary function `LL_ADC_INJ_SetTriggerSource()`.
- `uint32_t LL_ADC_INJ_InitTypeDef::SequencerLength`**
 Set ADC group injected sequencer length. This parameter can be a value of [ADC_LL_EC_INJ_SEQ_SCAN_LENGTH](#)
Note: This parameter is discarded if scan mode is disabled (refer to parameter 'ADC_SequencersScanMode'). This feature can be modified afterwards using unitary function `LL_ADC_INJ_SetSequencerLength()`.
- `uint32_t LL_ADC_INJ_InitTypeDef::SequencerDiscont`**
 Set ADC group injected sequencer discontinuous mode: sequence subdivided and scan conversions interrupted every selected number of ranks. This parameter can be a value of [ADC_LL_EC_INJ_SEQ_DISCONT_MODE](#)
Note: This parameter has an effect only if group injected sequencer is enabled (scan length of 2 ranks or more). This feature can be modified afterwards using unitary function `LL_ADC_INJ_SetSequencerDiscont()`.
- `uint32_t LL_ADC_INJ_InitTypeDef::TrigAuto`**
 Set ADC group injected conversion trigger: independent or from ADC group regular. This parameter can be a value of [ADC_LL_EC_INJ_TRIG_AUTO](#) **Note:** This parameter must be set to independent trigger if injected trigger source is set to an external trigger. This feature can be modified afterwards using unitary function `LL_ADC_INJ_SetTrigAuto()`.

71.2 ADC Firmware driver API description

71.2.1 Detailed description of functions

LL_ADC_DMA_GetRegAddr

Function name `__STATIC_INLINE uint32_t LL_ADC_DMA_GetRegAddr(ADC_TypeDef * ADCx, uint32_t Register)`

Function description Function to help to configure DMA transfer from ADC: retrieve the ADC register address from ADC instance and a list of ADC registers intended to be used (most commonly) with DMA transfer.

Parameters

- ADCx:** ADC instance
- Register:** This parameter can be one of the following values:
 - (1) Available on devices with several ADC instances.
 - `LL_ADC_DMA_REG_REGULAR_DATA`
 - `LL_ADC_DMA_REG_REGULAR_DATA_MULTI (1)`

Return values

- ADC:** register address

Notes

- These ADC registers are data registers: when ADC conversion data is available in ADC data registers, ADC generates a DMA transfer request.
- This macro is intended to be used with LL DMA driver, refer to function "`LL_DMA_ConfigAddresses()`". Example:
`LL_DMA_ConfigAddresses(DMA1, LL_DMA_CHANNEL_1, LL_ADC_DMA_GetRegAddr(ADC1, LL_ADC_DMA_REG_REGULAR_DATA), (uint32_t)&< array or variable >,`

- LL_DMA_DIRECTION_PERIPH_TO_MEMORY);
 - For devices with several ADC: in multimode, some devices use a different data register outside of ADC instance scope (common data register). This macro manages this register difference, only ADC instance has to be set as parameter.
- Reference Manual to LL API cross reference:
- DR RDATA LL_ADC_DMA_GetRegAddr
 - CDR RDATA_MST LL_ADC_DMA_GetRegAddr
 - CDR RDATA_SLV LL_ADC_DMA_GetRegAddr

LL_ADC_SetCommonClock

- Function name **__STATIC_INLINE void LL_ADC_SetCommonClock (ADC_Common_TypeDef * ADCxy_COMMON, uint32_t CommonClock)**
- Function description Set parameter common to several ADC: Clock source and prescaler.
- Parameters
- **ADCxy_COMMON:** ADC common instance (can be set directly from CMSIS definition or by using helper macro `__LL_ADC_COMMON_INSTANCE()`)
 - **CommonClock:** This parameter can be one of the following values:
 - LL_ADC_CLOCK_SYNC_PCLK_DIV2
 - LL_ADC_CLOCK_SYNC_PCLK_DIV4
 - LL_ADC_CLOCK_SYNC_PCLK_DIV6
 - LL_ADC_CLOCK_SYNC_PCLK_DIV8
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CCR ADCPRE LL_ADC_SetCommonClock

LL_ADC_GetCommonClock

- Function name **__STATIC_INLINE uint32_t LL_ADC_GetCommonClock (ADC_Common_TypeDef * ADCxy_COMMON)**
- Function description Get parameter common to several ADC: Clock source and prescaler.
- Parameters
- **ADCxy_COMMON:** ADC common instance (can be set directly from CMSIS definition or by using helper macro `__LL_ADC_COMMON_INSTANCE()`)
- Return values
- **Returned:** value can be one of the following values:
 - LL_ADC_CLOCK_SYNC_PCLK_DIV2
 - LL_ADC_CLOCK_SYNC_PCLK_DIV4
 - LL_ADC_CLOCK_SYNC_PCLK_DIV6
 - LL_ADC_CLOCK_SYNC_PCLK_DIV8
- Reference Manual to LL API cross reference:
- CCR ADCPRE LL_ADC_GetCommonClock

LL_ADC_SetCommonPathInternalCh

Function name	<code>__STATIC_INLINE void LL_ADC_SetCommonPathInternalCh (ADC_Common_TypeDef * ADCxy_COMMON, uint32_t PathInternal)</code>
Function description	Set parameter common to several ADC: measurement path to internal channels (VrefInt, temperature sensor, ...).
Parameters	<ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>) • PathInternal: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – <code>LL_ADC_PATH_INTERNAL_NONE</code> – <code>LL_ADC_PATH_INTERNAL_VREFINT</code> – <code>LL_ADC_PATH_INTERNAL_TEMPSENSOR</code> – <code>LL_ADC_PATH_INTERNAL_VBAT</code>
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • One or several values can be selected. Example: (<code>LL_ADC_PATH_INTERNAL_VREFINT LL_ADC_PATH_INTERNAL_TEMPSENSOR</code>) • Stabilization time of measurement path to internal channel: After enabling internal paths, before starting ADC conversion, a delay is required for internal voltage reference and temperature sensor stabilization time. Refer to device datasheet. Refer to literal <code>LL_ADC_DELAY_VREFINT_STAB_US</code>. Refer to literal <code>LL_ADC_DELAY_TEMPSENSOR_STAB_US</code>. • ADC internal channel sampling time constraint: For ADC conversion of internal channels, a sampling time minimum value is required. Refer to device datasheet.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCR TSVREFE <code>LL_ADC_SetCommonPathInternalCh</code> • CCR VBATE <code>LL_ADC_SetCommonPathInternalCh</code>

LL_ADC_GetCommonPathInternalCh

Function name	<code>__STATIC_INLINE uint32_t LL_ADC_GetCommonPathInternalCh (ADC_Common_TypeDef * ADCxy_COMMON)</code>
Function description	Get parameter common to several ADC: measurement path to internal channels (VrefInt, temperature sensor, ...).
Parameters	<ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>)
Return values	<ul style="list-style-type: none"> • Returned: value can be a combination of the following values: <ul style="list-style-type: none"> – <code>LL_ADC_PATH_INTERNAL_NONE</code> – <code>LL_ADC_PATH_INTERNAL_VREFINT</code> – <code>LL_ADC_PATH_INTERNAL_TEMPSENSOR</code> – <code>LL_ADC_PATH_INTERNAL_VBAT</code>

- Notes
- One or several values can be selected. Example:
(LL_ADC_PATH_INTERNAL_VREFINT | LL_ADC_PATH_INTERNAL_TEMPSENSOR)
- Reference Manual to LL API cross reference:
- CCR TSVREFE LL_ADC_GetCommonPathInternalCh
 - CCR VBATE LL_ADC_GetCommonPathInternalCh

LL_ADC_SetResolution

- Function name **__STATIC_INLINE void LL_ADC_SetResolution (ADC_TypeDef * ADCx, uint32_t Resolution)**
- Function description Set ADC resolution.
- Parameters
- **ADCx:** ADC instance
 - **Resolution:** This parameter can be one of the following values:
 - LL_ADC_RESOLUTION_12B
 - LL_ADC_RESOLUTION_10B
 - LL_ADC_RESOLUTION_8B
 - LL_ADC_RESOLUTION_6B
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR1 RES LL_ADC_SetResolution

LL_ADC_GetResolution

- Function name **__STATIC_INLINE uint32_t LL_ADC_GetResolution (ADC_TypeDef * ADCx)**
- Function description Get ADC resolution.
- Parameters
- **ADCx:** ADC instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_ADC_RESOLUTION_12B
 - LL_ADC_RESOLUTION_10B
 - LL_ADC_RESOLUTION_8B
 - LL_ADC_RESOLUTION_6B
- Reference Manual to LL API cross reference:
- CR1 RES LL_ADC_GetResolution

LL_ADC_SetDataAlignment

- Function name **__STATIC_INLINE void LL_ADC_SetDataAlignment (ADC_TypeDef * ADCx, uint32_t DataAlignment)**
- Function description Set ADC conversion data alignment.
- Parameters
- **ADCx:** ADC instance
 - **DataAlignment:** This parameter can be one of the following values:
 - LL_ADC_DATA_ALIGN_RIGHT

- LL_ADC_DATA_ALIGN_LEFT
- Return values
 - **None:**
- Notes
 - Refer to reference manual for alignments formats dependencies to ADC resolutions.
- Reference Manual to LL API cross reference:
 - CR2 ALIGN LL_ADC_SetDataAlignment

LL_ADC_GetDataAlignment

- Function name **__STATIC_INLINE uint32_t LL_ADC_GetDataAlignment (ADC_TypeDef * ADCx)**
- Function description Get ADC conversion data alignment.
- Parameters
 - **ADCx:** ADC instance
- Return values
 - **Returned:** value can be one of the following values:
 - LL_ADC_DATA_ALIGN_RIGHT
 - LL_ADC_DATA_ALIGN_LEFT
- Notes
 - Refer to reference manual for alignments formats dependencies to ADC resolutions.
- Reference Manual to LL API cross reference:
 - CR2 ALIGN LL_ADC_SetDataAlignment

LL_ADC_SetSequencersScanMode

- Function name **__STATIC_INLINE void LL_ADC_SetSequencersScanMode (ADC_TypeDef * ADCx, uint32_t ScanMode)**
- Function description Set ADC sequencers scan mode, for all ADC groups (group regular, group injected).
- Parameters
 - **ADCx:** ADC instance
 - **ScanMode:** This parameter can be one of the following values:
 - LL_ADC_SEQ_SCAN_DISABLE
 - LL_ADC_SEQ_SCAN_ENABLE
- Return values
 - **None:**
- Notes
 - According to sequencers scan mode : If disabled: ADC conversion is performed in unitary conversion mode (one channel converted, that defined in rank 1). Configuration of sequencers of all ADC groups (sequencer scan length, ...) is discarded: equivalent to scan length of 1 rank. If enabled: ADC conversions are performed in sequence conversions mode, according to configuration of sequencers of each ADC group (sequencer scan length, ...). Refer to function LL_ADC_REG_SetSequencerLength() and to function LL_ADC_INJ_SetSequencerLength().
- Reference Manual to LL API cross
 - CR1 SCAN LL_ADC_SetSequencersScanMode

reference:

LL_ADC_GetSequencersScanMode

Function name	__STATIC_INLINE uint32_t LL_ADC_GetSequencersScanMode (ADC_TypeDef * ADCx)
Function description	Get ADC sequencers scan mode, for all ADC groups (group regular, group injected).
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_SEQ_SCAN_DISABLE – LL_ADC_SEQ_SCAN_ENABLE
Notes	<ul style="list-style-type: none"> • According to sequencers scan mode : If disabled: ADC conversion is performed in unitary conversion mode (one channel converted, that defined in rank 1). Configuration of sequencers of all ADC groups (sequencer scan length, ...) is discarded: equivalent to scan length of 1 rank. If enabled: ADC conversions are performed in sequence conversions mode, according to configuration of sequencers of each ADC group (sequencer scan length, ...). Refer to function LL_ADC_REG_SetSequencerLength() and to function LL_ADC_INJ_SetSequencerLength().
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 SCAN LL_ADC_GetSequencersScanMode

LL_ADC_REG_SetTriggerSource

Function name	__STATIC_INLINE void LL_ADC_REG_SetTriggerSource (ADC_TypeDef * ADCx, uint32_t TriggerSource)
Function description	Set ADC group regular conversion trigger source: internal (SW start) or from external IP (timer event, external interrupt line).
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • TriggerSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_REG_TRIG_SOFTWARE – LL_ADC_REG_TRIG_EXT_TIM1_CH1 – LL_ADC_REG_TRIG_EXT_TIM1_CH2 – LL_ADC_REG_TRIG_EXT_TIM1_CH3 – LL_ADC_REG_TRIG_EXT_TIM2_CH2 – LL_ADC_REG_TRIG_EXT_TIM5_TRGO – LL_ADC_REG_TRIG_EXT_TIM4_CH4 – LL_ADC_REG_TRIG_EXT_TIM3_CH4 – LL_ADC_REG_TRIG_EXT_TIM8_TRGO – LL_ADC_REG_TRIG_EXT_TIM8_TRGO2 – LL_ADC_REG_TRIG_EXT_TIM1_TRGO – LL_ADC_REG_TRIG_EXT_TIM1_TRGO2 – LL_ADC_REG_TRIG_EXT_TIM2_TRGO – LL_ADC_REG_TRIG_EXT_TIM4_TRGO – LL_ADC_REG_TRIG_EXT_TIM6_TRGO

	<ul style="list-style-type: none"> – LL_ADC_REG_TRIG_EXT_EXTI_LINE11
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • On this STM32 serie, setting of external trigger edge is performed using function LL_ADC_REG_StartConversionExtTrig(). • Availability of parameters of trigger sources from timer depends on timers availability on the selected device.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 EXTSEL LL_ADC_REG_SetTriggerSource • CR2 EXTEN LL_ADC_REG_SetTriggerSource

LL_ADC_REG_GetTriggerSource

Function name	__STATIC_INLINE uint32_t LL_ADC_REG_GetTriggerSource (ADC_TypeDef * ADCx)
Function description	Get ADC group regular conversion trigger source: internal (SW start) or from external IP (timer event, external interrupt line).
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_REG_TRIG_SOFTWARE – LL_ADC_REG_TRIG_EXT_TIM1_CH1 – LL_ADC_REG_TRIG_EXT_TIM1_CH2 – LL_ADC_REG_TRIG_EXT_TIM1_CH3 – LL_ADC_REG_TRIG_EXT_TIM2_CH2 – LL_ADC_REG_TRIG_EXT_TIM5_TRGO – LL_ADC_REG_TRIG_EXT_TIM4_CH4 – LL_ADC_REG_TRIG_EXT_TIM3_CH4 – LL_ADC_REG_TRIG_EXT_TIM8_TRGO – LL_ADC_REG_TRIG_EXT_TIM8_TRGO2 – LL_ADC_REG_TRIG_EXT_TIM1_TRGO – LL_ADC_REG_TRIG_EXT_TIM1_TRGO2 – LL_ADC_REG_TRIG_EXT_TIM2_TRGO – LL_ADC_REG_TRIG_EXT_TIM4_TRGO – LL_ADC_REG_TRIG_EXT_TIM6_TRGO – LL_ADC_REG_TRIG_EXT_EXTI_LINE11
Notes	<ul style="list-style-type: none"> • To determine whether group regular trigger source is internal (SW start) or external, without detail of which peripheral is selected as external trigger, (equivalent to "if(LL_ADC_REG_GetTriggerSource(ADC1) == LL_ADC_REG_TRIG_SOFTWARE)") use function LL_ADC_REG_IsTriggerSourceSWStart. • Availability of parameters of trigger sources from timer depends on timers availability on the selected device.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 EXTSEL LL_ADC_REG_GetTriggerSource • CR2 EXTEN LL_ADC_REG_GetTriggerSource

LL_ADC_REG_IsTriggerSourceSWStart

Function name	__STATIC_INLINE uint32_t LL_ADC_REG_IsTriggerSourceSWStart (ADC_TypeDef * ADCx)
Function description	Get ADC group regular conversion trigger source internal (SW start) or external.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • Value: "0" if trigger source external trigger Value "1" if trigger source SW start.
Notes	<ul style="list-style-type: none"> • In case of group regular trigger source set to external trigger, to determine which peripheral is selected as external trigger, use function LL_ADC_REG_GetTriggerSource().
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 EXTEN LL_ADC_REG_IsTriggerSourceSWStart

LL_ADC_REG_GetTriggerEdge

Function name	__STATIC_INLINE uint32_t LL_ADC_REG_GetTriggerEdge (ADC_TypeDef * ADCx)
Function description	Get ADC group regular conversion trigger polarity.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_REG_TRIG_EXT_RISING – LL_ADC_REG_TRIG_EXT_FALLING – LL_ADC_REG_TRIG_EXT_RISINGFALLING
Notes	<ul style="list-style-type: none"> • Applicable only for trigger source set to external trigger. • On this STM32 serie, setting of external trigger edge is performed using function LL_ADC_REG_StartConversionExtTrig().
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 EXTEN LL_ADC_REG_GetTriggerEdge

LL_ADC_REG_SetSequencerLength

Function name	__STATIC_INLINE void LL_ADC_REG_SetSequencerLength (ADC_TypeDef * ADCx, uint32_t SequencerNbRanks)
Function description	Set ADC group regular sequencer length and scan direction.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • SequencerNbRanks: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_REG_SEQ_SCAN_DISABLE – LL_ADC_REG_SEQ_SCAN_ENABLE_2RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_3RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_4RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_5RANKS

- LL_ADC_REG_SEQ_SCAN_ENABLE_6RANKS
- LL_ADC_REG_SEQ_SCAN_ENABLE_7RANKS
- LL_ADC_REG_SEQ_SCAN_ENABLE_8RANKS
- LL_ADC_REG_SEQ_SCAN_ENABLE_9RANKS
- LL_ADC_REG_SEQ_SCAN_ENABLE_10RANKS
- LL_ADC_REG_SEQ_SCAN_ENABLE_11RANKS
- LL_ADC_REG_SEQ_SCAN_ENABLE_12RANKS
- LL_ADC_REG_SEQ_SCAN_ENABLE_13RANKS
- LL_ADC_REG_SEQ_SCAN_ENABLE_14RANKS
- LL_ADC_REG_SEQ_SCAN_ENABLE_15RANKS
- LL_ADC_REG_SEQ_SCAN_ENABLE_16RANKS

Return values

- **None:**

Notes

- Description of ADC group regular sequencer features: For devices with sequencer fully configurable (function "LL_ADC_REG_SetSequencerRanks()" available): sequencer length and each rank affectation to a channel are configurable. This function performs configuration of: Sequence length: Number of ranks in the scan sequence. Sequence direction: Unless specified in parameters, sequencer scan direction is forward (from rank 1 to rank n). Sequencer ranks are selected using function "LL_ADC_REG_SetSequencerRanks()". For devices with sequencer not fully configurable (function "LL_ADC_REG_SetSequencerChannels()" available): sequencer length and each rank affectation to a channel are defined by channel number. This function performs configuration of: Sequence length: Number of ranks in the scan sequence is defined by number of channels set in the sequence, rank of each channel is fixed by channel HW number. (channel 0 fixed on rank 0, channel 1 fixed on rank1, ...). Sequence direction: Unless specified in parameters, sequencer scan direction is forward (from lowest channel number to highest channel number). Sequencer ranks are selected using function "LL_ADC_REG_SetSequencerChannels()".
- On this STM32 serie, group regular sequencer configuration is conditioned to ADC instance sequencer mode. If ADC instance sequencer mode is disabled, sequencers of all groups (group regular, group injected) can be configured but their execution is disabled (limited to rank 1). Refer to function LL_ADC_SetSequencersScanMode().
- Sequencer disabled is equivalent to sequencer of 1 rank: ADC conversion on only 1 channel.

Reference Manual to LL API cross reference:

- SQR1 L LL_ADC_REG_SetSequencerLength

LL_ADC_REG_GetSequencerLength

Function name

**__STATIC_INLINE uint32_t
LL_ADC_REG_GetSequencerLength (ADC_TypeDef * ADCx)**

Function description

Get ADC group regular sequencer length and scan direction.

Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_REG_SEQ_SCAN_DISABLE – LL_ADC_REG_SEQ_SCAN_ENABLE_2RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_3RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_4RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_5RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_6RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_7RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_8RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_9RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_10RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_11RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_12RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_13RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_14RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_15RANKS – LL_ADC_REG_SEQ_SCAN_ENABLE_16RANKS
Notes	<ul style="list-style-type: none"> • Description of ADC group regular sequencer features: For devices with sequencer fully configurable (function "LL_ADC_REG_SetSequencerRanks()" available): sequencer length and each rank affectation to a channel are configurable. This function retrieves: Sequence length: Number of ranks in the scan sequence. Sequence direction: Unless specified in parameters, sequencer scan direction is forward (from rank 1 to rank n). Sequencer ranks are selected using function "LL_ADC_REG_SetSequencerRanks()". For devices with sequencer not fully configurable (function "LL_ADC_REG_SetSequencerChannels()" available): sequencer length and each rank affectation to a channel are defined by channel number. This function retrieves: Sequence length: Number of ranks in the scan sequence is defined by number of channels set in the sequence, rank of each channel is fixed by channel HW number. (channel 0 fixed on rank 0, channel 1 fixed on rank1, ...). Sequence direction: Unless specified in parameters, sequencer scan direction is forward (from lowest channel number to highest channel number). Sequencer ranks are selected using function "LL_ADC_REG_SetSequencerChannels()". • On this STM32 serie, group regular sequencer configuration is conditioned to ADC instance sequencer mode. If ADC instance sequencer mode is disabled, sequencers of all groups (group regular, group injected) can be configured but their execution is disabled (limited to rank 1). Refer to function LL_ADC_SetSequencersScanMode(). • Sequencer disabled is equivalent to sequencer of 1 rank: ADC conversion on only 1 channel. • SQR1 L LL_ADC_REG_SetSequencerLength
Reference Manual to LL API cross reference:	

LL_ADC_REG_SetSequencerDiscont

Function name	__STATIC_INLINE void LL_ADC_REG_SetSequencerDiscont (ADC_TypeDef * ADCx, uint32_t SeqDiscont)
Function description	Set ADC group regular sequencer discontinuous mode: sequence subdivided and scan conversions interrupted every selected number of ranks.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • SeqDiscont: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_REG_SEQ_DISCONT_DISABLE – LL_ADC_REG_SEQ_DISCONT_1RANK – LL_ADC_REG_SEQ_DISCONT_2RANKS – LL_ADC_REG_SEQ_DISCONT_3RANKS – LL_ADC_REG_SEQ_DISCONT_4RANKS – LL_ADC_REG_SEQ_DISCONT_5RANKS – LL_ADC_REG_SEQ_DISCONT_6RANKS – LL_ADC_REG_SEQ_DISCONT_7RANKS – LL_ADC_REG_SEQ_DISCONT_8RANKS
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • It is not possible to enable both ADC group regular continuous mode and sequencer discontinuous mode. • It is not possible to enable both ADC auto-injected mode and ADC group regular sequencer discontinuous mode.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 DISCEN LL_ADC_REG_SetSequencerDiscont • CR1 DISCNUM LL_ADC_REG_SetSequencerDiscont

LL_ADC_REG_GetSequencerDiscont

Function name	__STATIC_INLINE uint32_t LL_ADC_REG_GetSequencerDiscont (ADC_TypeDef * ADCx)
Function description	Get ADC group regular sequencer discontinuous mode: sequence subdivided and scan conversions interrupted every selected number of ranks.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_REG_SEQ_DISCONT_DISABLE – LL_ADC_REG_SEQ_DISCONT_1RANK – LL_ADC_REG_SEQ_DISCONT_2RANKS – LL_ADC_REG_SEQ_DISCONT_3RANKS – LL_ADC_REG_SEQ_DISCONT_4RANKS – LL_ADC_REG_SEQ_DISCONT_5RANKS – LL_ADC_REG_SEQ_DISCONT_6RANKS – LL_ADC_REG_SEQ_DISCONT_7RANKS – LL_ADC_REG_SEQ_DISCONT_8RANKS
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 DISCEN LL_ADC_REG_GetSequencerDiscont • CR1 DISCNUM LL_ADC_REG_GetSequencerDiscont

LL_ADC_REG_SetSequencerRanks

Function name	__STATIC_INLINE void LL_ADC_REG_SetSequencerRanks (ADC_TypeDef * ADCx, uint32_t Rank, uint32_t Channel)
Function description	Set ADC group regular sequence: channel on the selected scan sequence rank.
Parameters	<ul style="list-style-type: none">• ADCx: ADC instance• Rank: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_ADC_REG_RANK_1– LL_ADC_REG_RANK_2– LL_ADC_REG_RANK_3– LL_ADC_REG_RANK_4– LL_ADC_REG_RANK_5– LL_ADC_REG_RANK_6– LL_ADC_REG_RANK_7– LL_ADC_REG_RANK_8– LL_ADC_REG_RANK_9– LL_ADC_REG_RANK_10– LL_ADC_REG_RANK_11– LL_ADC_REG_RANK_12– LL_ADC_REG_RANK_13– LL_ADC_REG_RANK_14– LL_ADC_REG_RANK_15– LL_ADC_REG_RANK_16• Channel: This parameter can be one of the following values:<ul style="list-style-type: none">(1) On STM32F7, parameter available only on ADC instance: ADC1.<ul style="list-style-type: none">– LL_ADC_CHANNEL_0– LL_ADC_CHANNEL_1– LL_ADC_CHANNEL_2– LL_ADC_CHANNEL_3– LL_ADC_CHANNEL_4– LL_ADC_CHANNEL_5– LL_ADC_CHANNEL_6– LL_ADC_CHANNEL_7– LL_ADC_CHANNEL_8– LL_ADC_CHANNEL_9– LL_ADC_CHANNEL_10– LL_ADC_CHANNEL_11– LL_ADC_CHANNEL_12– LL_ADC_CHANNEL_13– LL_ADC_CHANNEL_14– LL_ADC_CHANNEL_15– LL_ADC_CHANNEL_16– LL_ADC_CHANNEL_17– LL_ADC_CHANNEL_18– LL_ADC_CHANNEL_VREFINT (1)– LL_ADC_CHANNEL_TEMPSENSOR (1)(2)– LL_ADC_CHANNEL_VBAT (1)(2) On devices STM32F75x, STM32F74x, STM32F76x, STM32F77x, STM32F72x and STM32F73x: this internal channel is shared between temperature sensor and Vbat,

	only 1 measurement path must be enabled.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This function performs configuration of: Channels ordering into each rank of scan sequence: whatever channel can be placed into whatever rank. • On this STM32 serie, ADC group regular sequencer is fully configurable: sequencer length and each rank affectation to a channel are configurable. Refer to description of function LL_ADC_REG_SetSequencerLength(). • Depending on devices and packages, some channels may not be available. Refer to device datasheet for channels availability. • On this STM32 serie, to measure internal channels (VrefInt, TempSensor, ...), measurement paths to internal channels must be enabled separately. This can be done using function LL_ADC_SetCommonPathInternalCh().
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SQR3 SQ1 LL_ADC_REG_SetSequencerRanks • SQR3 SQ2 LL_ADC_REG_SetSequencerRanks • SQR3 SQ3 LL_ADC_REG_SetSequencerRanks • SQR3 SQ4 LL_ADC_REG_SetSequencerRanks • SQR3 SQ5 LL_ADC_REG_SetSequencerRanks • SQR3 SQ6 LL_ADC_REG_SetSequencerRanks • SQR2 SQ7 LL_ADC_REG_SetSequencerRanks • SQR2 SQ8 LL_ADC_REG_SetSequencerRanks • SQR2 SQ9 LL_ADC_REG_SetSequencerRanks • SQR2 SQ10 LL_ADC_REG_SetSequencerRanks • SQR2 SQ11 LL_ADC_REG_SetSequencerRanks • SQR2 SQ12 LL_ADC_REG_SetSequencerRanks • SQR1 SQ13 LL_ADC_REG_SetSequencerRanks • SQR1 SQ14 LL_ADC_REG_SetSequencerRanks • SQR1 SQ15 LL_ADC_REG_SetSequencerRanks • SQR1 SQ16 LL_ADC_REG_SetSequencerRanks

LL_ADC_REG_GetSequencerRanks

Function name	__STATIC_INLINE uint32_t LL_ADC_REG_GetSequencerRanks (ADC_TypeDef * ADCx, uint32_t Rank)
Function description	Get ADC group regular sequence: channel on the selected scan sequence rank.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • Rank: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_REG_RANK_1 – LL_ADC_REG_RANK_2 – LL_ADC_REG_RANK_3 – LL_ADC_REG_RANK_4 – LL_ADC_REG_RANK_5 – LL_ADC_REG_RANK_6 – LL_ADC_REG_RANK_7 – LL_ADC_REG_RANK_8 – LL_ADC_REG_RANK_9

- LL_ADC_REG_RANK_10
- LL_ADC_REG_RANK_11
- LL_ADC_REG_RANK_12
- LL_ADC_REG_RANK_13
- LL_ADC_REG_RANK_14
- LL_ADC_REG_RANK_15
- LL_ADC_REG_RANK_16

Return values

- **Returned:** value can be one of the following values: (1) On STM32F7, parameter available only on ADC instance: ADC1.
 - LL_ADC_CHANNEL_0
 - LL_ADC_CHANNEL_1
 - LL_ADC_CHANNEL_2
 - LL_ADC_CHANNEL_3
 - LL_ADC_CHANNEL_4
 - LL_ADC_CHANNEL_5
 - LL_ADC_CHANNEL_6
 - LL_ADC_CHANNEL_7
 - LL_ADC_CHANNEL_8
 - LL_ADC_CHANNEL_9
 - LL_ADC_CHANNEL_10
 - LL_ADC_CHANNEL_11
 - LL_ADC_CHANNEL_12
 - LL_ADC_CHANNEL_13
 - LL_ADC_CHANNEL_14
 - LL_ADC_CHANNEL_15
 - LL_ADC_CHANNEL_16
 - LL_ADC_CHANNEL_17
 - LL_ADC_CHANNEL_18
 - LL_ADC_CHANNEL_VREFINT (1)
 - LL_ADC_CHANNEL_TEMPSENSOR (1)(2)
 - LL_ADC_CHANNEL_VBAT (1)
- (2) On devices STM32F75x, STM32F74x, STM32F76x, STM32F77x, STM32F72x and STM32F73x limitation: this internal channel is shared between temperature sensor and Vbat, only 1 measurement path must be enabled.
- (1) For ADC channel read back from ADC register, comparison with internal channel parameter to be done using helper macro `__LL_ADC_CHANNEL_INTERNAL_TO_EXTERNAL()`.

Notes

- On this STM32 serie, ADC group regular sequencer is fully configurable: sequencer length and each rank affectation to a channel are configurable. Refer to description of function `LL_ADC_REG_SetSequencerLength()`.
- Depending on devices and packages, some channels may not be available. Refer to device datasheet for channels availability.
- Usage of the returned channel number: To reinject this channel into another function `LL_ADC_xxx`: the returned channel number is only partly formatted on definition of literals `LL_ADC_CHANNEL_x`. Therefore, it has to be compared with parts of literals `LL_ADC_CHANNEL_x` or using helper macro `__LL_ADC_CHANNEL_TO_DECIMAL_NB()`. Then the

selected literal `LL_ADC_CHANNEL_x` can be used as parameter for another function. To get the channel number in decimal format: process the returned value with the helper macro `__LL_ADC_CHANNEL_TO_DECIMAL_NB()`.

Reference Manual to LL API cross reference:

- SQR3 SQ1 `LL_ADC_REG_GetSequencerRanks`
- SQR3 SQ2 `LL_ADC_REG_GetSequencerRanks`
- SQR3 SQ3 `LL_ADC_REG_GetSequencerRanks`
- SQR3 SQ4 `LL_ADC_REG_GetSequencerRanks`
- SQR3 SQ5 `LL_ADC_REG_GetSequencerRanks`
- SQR3 SQ6 `LL_ADC_REG_GetSequencerRanks`
- SQR2 SQ7 `LL_ADC_REG_GetSequencerRanks`
- SQR2 SQ8 `LL_ADC_REG_GetSequencerRanks`
- SQR2 SQ9 `LL_ADC_REG_GetSequencerRanks`
- SQR2 SQ10 `LL_ADC_REG_GetSequencerRanks`
- SQR2 SQ11 `LL_ADC_REG_GetSequencerRanks`
- SQR2 SQ12 `LL_ADC_REG_GetSequencerRanks`
- SQR1 SQ13 `LL_ADC_REG_GetSequencerRanks`
- SQR1 SQ14 `LL_ADC_REG_GetSequencerRanks`
- SQR1 SQ15 `LL_ADC_REG_GetSequencerRanks`
- SQR1 SQ16 `LL_ADC_REG_GetSequencerRanks`

LL_ADC_REG_SetContinuousMode

Function name	<code>__STATIC_INLINE void LL_ADC_REG_SetContinuousMode(ADC_TypeDef * ADCx, uint32_t Continuous)</code>
Function description	Set ADC continuous conversion mode on ADC group regular.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • Continuous: This parameter can be one of the following values: <ul style="list-style-type: none"> – <code>LL_ADC_REG_CONV_SINGLE</code> – <code>LL_ADC_REG_CONV_CONTINUOUS</code>
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Description of ADC continuous conversion mode: single mode: one conversion per triggercontinuous mode: after the first trigger, following conversions launched successively automatically. • It is not possible to enable both ADC group regular continuous mode and sequencer discontinuous mode.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 CONT <code>LL_ADC_REG_SetContinuousMode</code>

LL_ADC_REG_GetContinuousMode

Function name	<code>__STATIC_INLINE uint32_t LL_ADC_REG_GetContinuousMode(ADC_TypeDef * ADCx)</code>
Function description	Get ADC continuous conversion mode on ADC group regular.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance

- Return values
- **Returned:** value can be one of the following values:
 - LL_ADC_REG_CONV_SINGLE
 - LL_ADC_REG_CONV_CONTINUOUS
- Notes
- Description of ADC continuous conversion mode: single mode: one conversion per triggercontinuous mode: after the first trigger, following conversions launched successively automatically.
- Reference Manual to LL API cross reference:
- CR2 CONT LL_ADC_REG_GetContinuousMode

LL_ADC_REG_SetDMATransfer

- Function name `__STATIC_INLINE void LL_ADC_REG_SetDMATransfer(ADC_TypeDef * ADCx, uint32_t DMATransfer)`
- Function description Set ADC group regular conversion data transfer: no transfer or transfer by DMA, and DMA requests mode.
- Parameters
- **ADCx:** ADC instance
 - **DMATransfer:** This parameter can be one of the following values:
 - LL_ADC_REG_DMA_TRANSFER_NONE
 - LL_ADC_REG_DMA_TRANSFER_LIMITED
 - LL_ADC_REG_DMA_TRANSFER_UNLIMITED
- Return values
- **None:**
- Notes
- If transfer by DMA selected, specifies the DMA requests mode: Limited mode (One shot mode): DMA transfer requests are stopped when number of DMA data transfers (number of ADC conversions) is reached. This ADC mode is intended to be used with DMA mode non-circular.Unlimited mode: DMA transfer requests are unlimited, whatever number of DMA data transfers (number of ADC conversions). This ADC mode is intended to be used with DMA mode circular.
 - If ADC DMA requests mode is set to unlimited and DMA is set to mode non-circular: when DMA transfers size will be reached, DMA will stop transfers of ADC conversions data ADC will raise an overrun error (overrun flag and interruption if enabled).
 - For devices with several ADC instances: ADC multimode DMA settings are available using function LL_ADC_SetMultiDMATransfer().
 - To configure DMA source address (peripheral address), use function LL_ADC_DMA_GetRegAddr().
- Reference Manual to LL API cross reference:
- CR2 DMA LL_ADC_REG_SetDMATransfer
 - CR2 DDS LL_ADC_REG_SetDMATransfer

LL_ADC_REG_GetDMATransfer

- Function name `__STATIC_INLINE uint32_t LL_ADC_REG_GetDMATransfer(ADC_TypeDef * ADCx)`

Function description	Get ADC group regular conversion data transfer: no transfer or transfer by DMA, and DMA requests mode.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_REG_DMA_TRANSFER_NONE – LL_ADC_REG_DMA_TRANSFER_LIMITED – LL_ADC_REG_DMA_TRANSFER_UNLIMITED
Notes	<ul style="list-style-type: none"> • If transfer by DMA selected, specifies the DMA requests mode: Limited mode (One shot mode): DMA transfer requests are stopped when number of DMA data transfers (number of ADC conversions) is reached. This ADC mode is intended to be used with DMA mode non-circular. Unlimited mode: DMA transfer requests are unlimited, whatever number of DMA data transfers (number of ADC conversions). This ADC mode is intended to be used with DMA mode circular. • If ADC DMA requests mode is set to unlimited and DMA is set to mode non-circular: when DMA transfers size will be reached, DMA will stop transfers of ADC conversions data ADC will raise an overrun error (overrun flag and interruption if enabled). • For devices with several ADC instances: ADC multimode DMA settings are available using function LL_ADC_GetMultiDMATransfer(). • To configure DMA source address (peripheral address), use function LL_ADC_DMA_GetRegAddr().
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 DMA LL_ADC_REG_GetDMATransfer • CR2 DDS LL_ADC_REG_GetDMATransfer

LL_ADC_REG_SetFlagEndOfConversion

Function name	__STATIC_INLINE void LL_ADC_REG_SetFlagEndOfConversion (ADC_TypeDef * ADCx, uint32_t EocSelection)
Function description	Specify which ADC flag between EOC (end of unitary conversion) or EOS (end of sequence conversions) is used to indicate the end of conversion.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • EocSelection: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_REG_FLAG_EOC_SEQUENCE_CONV – LL_ADC_REG_FLAG_EOC_UNITARY_CONV
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This feature is aimed to be set when using ADC with programming model by polling or interruption (programming model by DMA usually uses DMA interruptions to indicate end of conversion and data transfer). • For ADC group injected, end of conversion (flag&IT) is raised only at the end of the sequence.

Reference Manual to LL API cross reference:

- CR2 EOCS LL_ADC_REG_SetFlagEndOfConversion

LL_ADC_REG_GetFlagEndOfConversion

Function name `__STATIC_INLINE uint32_t LL_ADC_REG_GetFlagEndOfConversion (ADC_TypeDef * ADCx)`

Function description Get which ADC flag between EOC (end of unitary conversion) or EOS (end of sequence conversions) is used to indicate the end of conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
 - LL_ADC_REG_FLAG_EOC_SEQUENCE_CONV
 - LL_ADC_REG_FLAG_EOC_UNITARY_CONV

Reference Manual to LL API cross reference:

- CR2 EOCS LL_ADC_REG_GetFlagEndOfConversion

LL_ADC_INJ_SetTriggerSource

Function name `__STATIC_INLINE void LL_ADC_INJ_SetTriggerSource (ADC_TypeDef * ADCx, uint32_t TriggerSource)`

Function description Set ADC group injected conversion trigger source: internal (SW start) or from external IP (timer event, external interrupt line).

Parameters

- **ADCx:** ADC instance
- **TriggerSource:** This parameter can be one of the following values:
 - LL_ADC_INJ_TRIG_SOFTWARE
 - LL_ADC_INJ_TRIG_EXT_TIM1_TRGO
 - LL_ADC_INJ_TRIG_EXT_TIM1_CH4
 - LL_ADC_INJ_TRIG_EXT_TIM2_TRGO
 - LL_ADC_INJ_TRIG_EXT_TIM2_CH1
 - LL_ADC_INJ_TRIG_EXT_TIM3_CH4
 - LL_ADC_INJ_TRIG_EXT_TIM4_TRGO
 - LL_ADC_INJ_TRIG_EXT_TIM8_CH4
 - LL_ADC_INJ_TRIG_EXT_TIM1_TRGO2
 - LL_ADC_INJ_TRIG_EXT_TIM8_TRGO
 - LL_ADC_INJ_TRIG_EXT_TIM8_TRGO2
 - LL_ADC_INJ_TRIG_EXT_TIM3_CH3
 - LL_ADC_INJ_TRIG_EXT_TIM5_TRGO
 - LL_ADC_INJ_TRIG_EXT_TIM3_CH1
 - LL_ADC_INJ_TRIG_EXT_TIM6_TRGO

Return values

- **None:**

Notes

- On this STM32 serie, setting of external trigger edge is performed using function `LL_ADC_INJ_StartConversionExtTrig()`.
- Availability of parameters of trigger sources from timer

depends on timers availability on the selected device.

- Reference Manual to LL API cross reference:
- CR2 JEXTSEL LL_ADC_INJ_SetTriggerSource
 - CR2 JEXTEN LL_ADC_INJ_SetTriggerSource

LL_ADC_INJ_GetTriggerSource

Function name `__STATIC_INLINE uint32_t LL_ADC_INJ_GetTriggerSource(ADC_TypeDef * ADCx)`

Function description Get ADC group injected conversion trigger source: internal (SW start) or from external IP (timer event, external interrupt line).

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
 - LL_ADC_INJ_TRIG_SOFTWARE
 - LL_ADC_INJ_TRIG_EXT_TIM1_TRGO
 - LL_ADC_INJ_TRIG_EXT_TIM1_CH4
 - LL_ADC_INJ_TRIG_EXT_TIM2_TRGO
 - LL_ADC_INJ_TRIG_EXT_TIM2_CH1
 - LL_ADC_INJ_TRIG_EXT_TIM3_CH4
 - LL_ADC_INJ_TRIG_EXT_TIM4_TRGO
 - LL_ADC_INJ_TRIG_EXT_TIM8_CH4
 - LL_ADC_INJ_TRIG_EXT_TIM1_TRGO2
 - LL_ADC_INJ_TRIG_EXT_TIM8_TRGO
 - LL_ADC_INJ_TRIG_EXT_TIM8_TRGO2
 - LL_ADC_INJ_TRIG_EXT_TIM3_CH3
 - LL_ADC_INJ_TRIG_EXT_TIM5_TRGO
 - LL_ADC_INJ_TRIG_EXT_TIM3_CH1
 - LL_ADC_INJ_TRIG_EXT_TIM6_TRGO

Notes

- To determine whether group injected trigger source is internal (SW start) or external, without detail of which peripheral is selected as external trigger, (equivalent to "if(LL_ADC_INJ_GetTriggerSource(ADC1) == LL_ADC_INJ_TRIG_SOFTWARE)") use function LL_ADC_INJ_IsTriggerSourceSWStart.
- Availability of parameters of trigger sources from timer depends on timers availability on the selected device.

- Reference Manual to LL API cross reference:
- CR2 JEXTSEL LL_ADC_INJ_GetTriggerSource
 - CR2 JEXTEN LL_ADC_INJ_GetTriggerSource

LL_ADC_INJ_IsTriggerSourceSWStart

Function name `__STATIC_INLINE uint32_t LL_ADC_INJ_IsTriggerSourceSWStart(ADC_TypeDef * ADCx)`

Function description Get ADC group injected conversion trigger source internal (SW start) or external.

Parameters

- **ADCx:** ADC instance

Return values

- **Value:** "0" if trigger source external trigger Value "1" if trigger source SW start.

- Notes
- In case of group injected trigger source set to external trigger, to determine which peripheral is selected as external trigger, use function LL_ADC_INJ_GetTriggerSource.
- Reference Manual to LL API cross reference:
- CR2 JEXTEN LL_ADC_INJ_IsTriggerSourceSWStart

LL_ADC_INJ_GetTriggerEdge

- Function name **__STATIC_INLINE uint32_t LL_ADC_INJ_GetTriggerEdge (ADC_TypeDef * ADCx)**
- Function description Get ADC group injected conversion trigger polarity.
- Parameters
- ADCx:** ADC instance
- Return values
- Returned:** value can be one of the following values:
 - LL_ADC_INJ_TRIG_EXT_RISING
 - LL_ADC_INJ_TRIG_EXT_FALLING
 - LL_ADC_INJ_TRIG_EXT_RISINGFALLING
- Reference Manual to LL API cross reference:
- CR2 JEXTEN LL_ADC_INJ_GetTriggerEdge

LL_ADC_INJ_SetSequencerLength

- Function name **__STATIC_INLINE void LL_ADC_INJ_SetSequencerLength (ADC_TypeDef * ADCx, uint32_t SequencerNbRanks)**
- Function description Set ADC group injected sequencer length and scan direction.
- Parameters
- ADCx:** ADC instance
 - SequencerNbRanks:** This parameter can be one of the following values:
 - LL_ADC_INJ_SEQ_SCAN_DISABLE
 - LL_ADC_INJ_SEQ_SCAN_ENABLE_2RANKS
 - LL_ADC_INJ_SEQ_SCAN_ENABLE_3RANKS
 - LL_ADC_INJ_SEQ_SCAN_ENABLE_4RANKS
- Return values
- None:**
- Notes
- This function performs configuration of: Sequence length: Number of ranks in the scan sequence. Sequence direction: Unless specified in parameters, sequencer scan direction is forward (from rank 1 to rank n).
 - On this STM32 serie, group injected sequencer configuration is conditioned to ADC instance sequencer mode. If ADC instance sequencer mode is disabled, sequencers of all groups (group regular, group injected) can be configured but their execution is disabled (limited to rank 1). Refer to function LL_ADC_SetSequencersScanMode().
 - Sequencer disabled is equivalent to sequencer of 1 rank: ADC conversion on only 1 channel.
- Reference Manual to LL API cross
- JSQR JL LL_ADC_INJ_SetSequencerLength

reference:

LL_ADC_INJ_GetSequencerLength

Function name	__STATIC_INLINE uint32_t LL_ADC_INJ_GetSequencerLength (ADC_TypeDef * ADCx)
Function description	Get ADC group injected sequencer length and scan direction.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_INJ_SEQ_SCAN_DISABLE – LL_ADC_INJ_SEQ_SCAN_ENABLE_2RANKS – LL_ADC_INJ_SEQ_SCAN_ENABLE_3RANKS – LL_ADC_INJ_SEQ_SCAN_ENABLE_4RANKS
Notes	<ul style="list-style-type: none"> • This function retrieves: Sequence length: Number of ranks in the scan sequence. Sequence direction: Unless specified in parameters, sequencer scan direction is forward (from rank 1 to rank n). • On this STM32 serie, group injected sequencer configuration is conditioned to ADC instance sequencer mode. If ADC instance sequencer mode is disabled, sequencers of all groups (group regular, group injected) can be configured but their execution is disabled (limited to rank 1). Refer to function LL_ADC_SetSequencersScanMode(). • Sequencer disabled is equivalent to sequencer of 1 rank: ADC conversion on only 1 channel.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • JSQR JL LL_ADC_INJ_GetSequencerLength

LL_ADC_INJ_SetSequencerDiscont

Function name	__STATIC_INLINE void LL_ADC_INJ_SetSequencerDiscont (ADC_TypeDef * ADCx, uint32_t SeqDiscont)
Function description	Set ADC group injected sequencer discontinuous mode: sequence subdivided and scan conversions interrupted every selected number of ranks.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • SeqDiscont: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_INJ_SEQ_DISCONT_DISABLE – LL_ADC_INJ_SEQ_DISCONT_1RANK
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • It is not possible to enable both ADC group injected auto-injected mode and sequencer discontinuous mode.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 DISCEN LL_ADC_INJ_SetSequencerDiscont

LL_ADC_INJ_GetSequencerDiscont

Function name	__STATIC_INLINE uint32_t LL_ADC_INJ_GetSequencerDiscont (ADC_TypeDef * ADCx)
Function description	Get ADC group injected sequencer discontinuous mode: sequence subdivided and scan conversions interrupted every selected number of ranks.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_INJ_SEQ_DISCONT_DISABLE – LL_ADC_INJ_SEQ_DISCONT_1RANK
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 DISCEN LL_ADC_REG_GetSequencerDiscont

LL_ADC_INJ_SetSequencerRanks

Function name	__STATIC_INLINE void LL_ADC_INJ_SetSequencerRanks (ADC_TypeDef * ADCx, uint32_t Rank, uint32_t Channel)
Function description	Set ADC group injected sequence: channel on the selected sequence rank.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • Rank: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_INJ_RANK_1 – LL_ADC_INJ_RANK_2 – LL_ADC_INJ_RANK_3 – LL_ADC_INJ_RANK_4 • Channel: This parameter can be one of the following values: (1) On STM32F7, parameter available only on ADC instance: ADC1. <ul style="list-style-type: none"> – LL_ADC_CHANNEL_0 – LL_ADC_CHANNEL_1 – LL_ADC_CHANNEL_2 – LL_ADC_CHANNEL_3 – LL_ADC_CHANNEL_4 – LL_ADC_CHANNEL_5 – LL_ADC_CHANNEL_6 – LL_ADC_CHANNEL_7 – LL_ADC_CHANNEL_8 – LL_ADC_CHANNEL_9 – LL_ADC_CHANNEL_10 – LL_ADC_CHANNEL_11 – LL_ADC_CHANNEL_12 – LL_ADC_CHANNEL_13 – LL_ADC_CHANNEL_14 – LL_ADC_CHANNEL_15 – LL_ADC_CHANNEL_16 – LL_ADC_CHANNEL_17 – LL_ADC_CHANNEL_18 – LL_ADC_CHANNEL_VREFINT (1) – LL_ADC_CHANNEL_TEMPSENSOR (1)(2)

	<ul style="list-style-type: none"> – LL_ADC_CHANNEL_VBAT (1) • (2) On devices STM32F75x, STM32F74x, STM32F76x, STM32F77x, STM32F72x and STM32F73x: this internal channel is shared between temperature sensor and Vbat, only 1 measurement path must be enabled.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Depending on devices and packages, some channels may not be available. Refer to device datasheet for channels availability. • On this STM32 serie, to measure internal channels (VrefInt, TempSensor, ...), measurement paths to internal channels must be enabled separately. This can be done using function LL_ADC_SetCommonPathInternalCh().
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • JSQR JSQ1 LL_ADC_INJ_SetSequencerRanks • JSQR JSQ2 LL_ADC_INJ_SetSequencerRanks • JSQR JSQ3 LL_ADC_INJ_SetSequencerRanks • JSQR JSQ4 LL_ADC_INJ_SetSequencerRanks

LL_ADC_INJ_GetSequencerRanks

Function name	__STATIC_INLINE uint32_t LL_ADC_INJ_GetSequencerRanks (ADC_TypeDef * ADCx, uint32_t Rank)
Function description	Get ADC group injected sequence: channel on the selected sequence rank.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • Rank: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_INJ_RANK_1 – LL_ADC_INJ_RANK_2 – LL_ADC_INJ_RANK_3 – LL_ADC_INJ_RANK_4
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: (1) On STM32F7, parameter available only on ADC instance: ADC1. <ul style="list-style-type: none"> – LL_ADC_CHANNEL_0 – LL_ADC_CHANNEL_1 – LL_ADC_CHANNEL_2 – LL_ADC_CHANNEL_3 – LL_ADC_CHANNEL_4 – LL_ADC_CHANNEL_5 – LL_ADC_CHANNEL_6 – LL_ADC_CHANNEL_7 – LL_ADC_CHANNEL_8 – LL_ADC_CHANNEL_9 – LL_ADC_CHANNEL_10 – LL_ADC_CHANNEL_11 – LL_ADC_CHANNEL_12 – LL_ADC_CHANNEL_13 – LL_ADC_CHANNEL_14 – LL_ADC_CHANNEL_15 – LL_ADC_CHANNEL_16 – LL_ADC_CHANNEL_17

	<ul style="list-style-type: none"> – LL_ADC_CHANNEL_18 – LL_ADC_CHANNEL_VREFINT (1) – LL_ADC_CHANNEL_TEMPSENSOR (1)(2) – LL_ADC_CHANNEL_VBAT (1) • (2) On devices STM32F75x, STM32F74x, STM32F76x, STM32F77x, STM32F72x and STM32F73x limitation: this internal channel is shared between temperature sensor and Vbat, only 1 measurement path must be enabled. • (1) For ADC channel read back from ADC register, comparison with internal channel parameter to be done using helper macro <code>__LL_ADC_CHANNEL_INTERNAL_TO_EXTERNAL()</code>.
Notes	<ul style="list-style-type: none"> • Depending on devices and packages, some channels may not be available. Refer to device datasheet for channels availability. • Usage of the returned channel number: To reinject this channel into another function <code>LL_ADC_xxx</code>: the returned channel number is only partly formatted on definition of literals <code>LL_ADC_CHANNEL_x</code>. Therefore, it has to be compared with parts of literals <code>LL_ADC_CHANNEL_x</code> or using helper macro <code>__LL_ADC_CHANNEL_TO_DECIMAL_NB()</code>. Then the selected literal <code>LL_ADC_CHANNEL_x</code> can be used as parameter for another function. To get the channel number in decimal format: process the returned value with the helper macro <code>__LL_ADC_CHANNEL_TO_DECIMAL_NB()</code>.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • JSQR JSQ1 LL_ADC_INJ_SetSequencerRanks • JSQR JSQ2 LL_ADC_INJ_SetSequencerRanks • JSQR JSQ3 LL_ADC_INJ_SetSequencerRanks • JSQR JSQ4 LL_ADC_INJ_SetSequencerRanks

LL_ADC_INJ_SetTrigAuto

Function name	<code>__STATIC_INLINE void LL_ADC_INJ_SetTrigAuto(ADC_TypeDef * ADCx, uint32_t TrigAuto)</code>
Function description	Set ADC group injected conversion trigger: independent or from ADC group regular.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • TrigAuto: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_INJ_TRIG_INDEPENDENT – LL_ADC_INJ_TRIG_FROM_GRP_REGULAR
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This mode can be used to extend number of data registers updated after one ADC conversion trigger and with data permanently kept (not erased by successive conversions of scan of ADC sequencer ranks), up to 5 data registers: 1 data register on ADC group regular, 4 data registers on ADC group injected. • If ADC group injected trigger source is set to an external trigger, this feature must be set to independent trigger. ADC group injected automatic trigger is compliant only with group injected trigger source set to SW

start, without any further action on ADC group injected conversion start or stop: in this case, ADC group injected is controlled only from ADC group regular.

- It is not possible to enable both ADC group injected auto-injected mode and sequencer discontinuous mode.

Reference Manual to LL API cross reference:

- CR1 JAUTO LL_ADC_INJ_SetTrigAuto

LL_ADC_INJ_GetTrigAuto

Function name	__STATIC_INLINE uint32_t LL_ADC_INJ_GetTrigAuto (ADC_TypeDef * ADCx)
Function description	Get ADC group injected conversion trigger: independent or from ADC group regular.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_INJ_TRIG_INDEPENDENT – LL_ADC_INJ_TRIG_FROM_GRP_REGULAR
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 JAUTO LL_ADC_INJ_GetTrigAuto

LL_ADC_INJ_SetOffset

Function name	__STATIC_INLINE void LL_ADC_INJ_SetOffset (ADC_TypeDef * ADCx, uint32_t Rank, uint32_t OffsetLevel)
Function description	Set ADC group injected offset.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • Rank: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_INJ_RANK_1 – LL_ADC_INJ_RANK_2 – LL_ADC_INJ_RANK_3 – LL_ADC_INJ_RANK_4 • OffsetLevel: Value between Min_Data=0x000 and Max_Data=0xFFFF
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • It sets: ADC group injected rank to which the offset programmed will be appliedOffset level (offset to be subtracted from the raw converted data). Caution: Offset format is dependent to ADC resolution: offset has to be left-aligned on bit 11, the LSB (right bits) are set to 0. • Offset cannot be enabled or disabled. To emulate offset disabled, set an offset value equal to 0.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • JOFR1 JOFFSET1 LL_ADC_INJ_SetOffset • JOFR2 JOFFSET2 LL_ADC_INJ_SetOffset • JOFR3 JOFFSET3 LL_ADC_INJ_SetOffset • JOFR4 JOFFSET4 LL_ADC_INJ_SetOffset

LL_ADC_INJ_GetOffset

Function name	__STATIC_INLINE uint32_t LL_ADC_INJ_GetOffset (ADC_TypeDef * ADCx, uint32_t Rank)
Function description	Get ADC group injected offset.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • Rank: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_INJ_RANK_1 – LL_ADC_INJ_RANK_2 – LL_ADC_INJ_RANK_3 – LL_ADC_INJ_RANK_4
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x000 and Max_Data=0xFFFF
Notes	<ul style="list-style-type: none"> • It gives offset level (offset to be subtracted from the raw converted data). Caution: Offset format is dependent to ADC resolution: offset has to be left-aligned on bit 11, the LSB (right bits) are set to 0.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • JOFR1 JOFFSET1 LL_ADC_INJ_GetOffset • JOFR2 JOFFSET2 LL_ADC_INJ_GetOffset • JOFR3 JOFFSET3 LL_ADC_INJ_GetOffset • JOFR4 JOFFSET4 LL_ADC_INJ_GetOffset

LL_ADC_SetChannelSamplingTime

Function name	__STATIC_INLINE void LL_ADC_SetChannelSamplingTime (ADC_TypeDef * ADCx, uint32_t Channel, uint32_t SamplingTime)
Function description	Set sampling time of the selected ADC channel Unit: ADC clock cycles.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> (1) On STM32F7, parameter available only on ADC instance: ADC1. <ul style="list-style-type: none"> – LL_ADC_CHANNEL_0 – LL_ADC_CHANNEL_1 – LL_ADC_CHANNEL_2 – LL_ADC_CHANNEL_3 – LL_ADC_CHANNEL_4 – LL_ADC_CHANNEL_5 – LL_ADC_CHANNEL_6 – LL_ADC_CHANNEL_7 – LL_ADC_CHANNEL_8 – LL_ADC_CHANNEL_9 – LL_ADC_CHANNEL_10 – LL_ADC_CHANNEL_11 – LL_ADC_CHANNEL_12 – LL_ADC_CHANNEL_13 – LL_ADC_CHANNEL_14 – LL_ADC_CHANNEL_15 – LL_ADC_CHANNEL_16 – LL_ADC_CHANNEL_17

- LL_ADC_CHANNEL_18
- LL_ADC_CHANNEL_VREFINT (1)
- LL_ADC_CHANNEL_TEMPSENSOR (1)(2)
- LL_ADC_CHANNEL_VBAT (1)
- (2) On devices STM32F75x, STM32F74x, STM32F76x, STM32F77x, STM32F72x and STM32F73x: this internal channel is shared between temperature sensor and Vbat, only 1 measurement path must be enabled.
- **SamplingTime:** This parameter can be one of the following values:
 - LL_ADC_SAMPLINGTIME_3CYCLES
 - LL_ADC_SAMPLINGTIME_15CYCLES
 - LL_ADC_SAMPLINGTIME_28CYCLES
 - LL_ADC_SAMPLINGTIME_56CYCLES
 - LL_ADC_SAMPLINGTIME_84CYCLES
 - LL_ADC_SAMPLINGTIME_112CYCLES
 - LL_ADC_SAMPLINGTIME_144CYCLES
 - LL_ADC_SAMPLINGTIME_480CYCLES

Return values

- **None:**

Notes

- On this device, sampling time is on channel scope: independently of channel mapped on ADC group regular or injected.
- In case of internal channel (VrefInt, TempSensor, ...) to be converted: sampling time constraints must be respected (sampling time can be adjusted in function of ADC clock frequency and sampling time setting). Refer to device datasheet for timings values (parameters TS_vrefint, TS_temp, ...).
- Conversion time is the addition of sampling time and processing time. Refer to reference manual for ADC processing time of this STM32 serie.
- In case of ADC conversion of internal channel (VrefInt, temperature sensor, ...), a sampling time minimum value is required. Refer to device datasheet.

Reference Manual to LL API cross reference:

- SMPR1 SMP18 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP17 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP16 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP15 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP14 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP13 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP12 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP11 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP10 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP9 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP8 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP7 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP6 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP5 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP4 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP3 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP2 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP1 LL_ADC_SetChannelSamplingTime

- SMPR2 SMP0 LL_ADC_SetChannelSamplingTime

LL_ADC_GetChannelSamplingTime

Function name	__STATIC_INLINE uint32_t LL_ADC_GetChannelSamplingTime (ADC_TypeDef * ADCx, uint32_t Channel)
Function description	Get sampling time of the selected ADC channel Unit: ADC clock cycles.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> (1) On STM32F7, parameter available only on ADC instance: ADC1. <ul style="list-style-type: none"> – LL_ADC_CHANNEL_0 – LL_ADC_CHANNEL_1 – LL_ADC_CHANNEL_2 – LL_ADC_CHANNEL_3 – LL_ADC_CHANNEL_4 – LL_ADC_CHANNEL_5 – LL_ADC_CHANNEL_6 – LL_ADC_CHANNEL_7 – LL_ADC_CHANNEL_8 – LL_ADC_CHANNEL_9 – LL_ADC_CHANNEL_10 – LL_ADC_CHANNEL_11 – LL_ADC_CHANNEL_12 – LL_ADC_CHANNEL_13 – LL_ADC_CHANNEL_14 – LL_ADC_CHANNEL_15 – LL_ADC_CHANNEL_16 – LL_ADC_CHANNEL_17 – LL_ADC_CHANNEL_18 – LL_ADC_CHANNEL_VREFINT (1) – LL_ADC_CHANNEL_TEMPSENSOR (1)(2) – LL_ADC_CHANNEL_VBAT (1) (2) On devices STM32F75x, STM32F74x, STM32F76x, STM32F77x, STM32F72x and STM32F73x: this internal channel is shared between temperature sensor and Vbat, only 1 measurement path must be enabled.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_SAMPLINGTIME_3CYCLES – LL_ADC_SAMPLINGTIME_15CYCLES – LL_ADC_SAMPLINGTIME_28CYCLES – LL_ADC_SAMPLINGTIME_56CYCLES – LL_ADC_SAMPLINGTIME_84CYCLES – LL_ADC_SAMPLINGTIME_112CYCLES – LL_ADC_SAMPLINGTIME_144CYCLES – LL_ADC_SAMPLINGTIME_480CYCLES
Notes	<ul style="list-style-type: none"> • On this device, sampling time is on channel scope: independently of channel mapped on ADC group regular or injected.

Reference Manual to
LL API cross
reference:

- Conversion time is the addition of sampling time and processing time. Refer to reference manual for ADC processing time of this STM32 serie.
- SMPR1 SMP18 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP17 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP16 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP15 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP14 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP13 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP12 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP11 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP10 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP9 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP8 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP7 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP6 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP5 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP4 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP3 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP2 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP1 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP0 LL_ADC_GetChannelSamplingTime

LL_ADC_SetAnalogWDMonitChannels

Function name `__STATIC_INLINE void LL_ADC_SetAnalogWDMonitChannels(ADC_TypeDef * ADCx, uint32_t AWDChannelGroup)`

Function description Set ADC analog watchdog monitored channels: a single channel or all channels, on ADC groups regular and-or injected.

- Parameters
- **ADCx:** ADC instance
 - **AWDChannelGroup:** This parameter can be one of the following values: (1) On STM32F7, parameter available only on ADC instance: ADC1.
 - LL_ADC_AWD_DISABLE
 - LL_ADC_AWD_ALL_CHANNELS_REG
 - LL_ADC_AWD_ALL_CHANNELS_INJ
 - LL_ADC_AWD_ALL_CHANNELS_REG_INJ
 - LL_ADC_AWD_CHANNEL_0_REG
 - LL_ADC_AWD_CHANNEL_0_INJ
 - LL_ADC_AWD_CHANNEL_0_REG_INJ
 - LL_ADC_AWD_CHANNEL_1_REG
 - LL_ADC_AWD_CHANNEL_1_INJ
 - LL_ADC_AWD_CHANNEL_1_REG_INJ
 - LL_ADC_AWD_CHANNEL_2_REG
 - LL_ADC_AWD_CHANNEL_2_INJ
 - LL_ADC_AWD_CHANNEL_2_REG_INJ
 - LL_ADC_AWD_CHANNEL_3_REG
 - LL_ADC_AWD_CHANNEL_3_INJ
 - LL_ADC_AWD_CHANNEL_3_REG_INJ
 - LL_ADC_AWD_CHANNEL_4_REG
 - LL_ADC_AWD_CHANNEL_4_INJ

- LL_ADC_AWD_CHANNEL_4_REG_INJ
- LL_ADC_AWD_CHANNEL_5_REG
- LL_ADC_AWD_CHANNEL_5_INJ
- LL_ADC_AWD_CHANNEL_5_REG_INJ
- LL_ADC_AWD_CHANNEL_6_REG
- LL_ADC_AWD_CHANNEL_6_INJ
- LL_ADC_AWD_CHANNEL_6_REG_INJ
- LL_ADC_AWD_CHANNEL_7_REG
- LL_ADC_AWD_CHANNEL_7_INJ
- LL_ADC_AWD_CHANNEL_7_REG_INJ
- LL_ADC_AWD_CHANNEL_8_REG
- LL_ADC_AWD_CHANNEL_8_INJ
- LL_ADC_AWD_CHANNEL_8_REG_INJ
- LL_ADC_AWD_CHANNEL_9_REG
- LL_ADC_AWD_CHANNEL_9_INJ
- LL_ADC_AWD_CHANNEL_9_REG_INJ
- LL_ADC_AWD_CHANNEL_10_REG
- LL_ADC_AWD_CHANNEL_10_INJ
- LL_ADC_AWD_CHANNEL_10_REG_INJ
- LL_ADC_AWD_CHANNEL_11_REG
- LL_ADC_AWD_CHANNEL_11_INJ
- LL_ADC_AWD_CHANNEL_11_REG_INJ
- LL_ADC_AWD_CHANNEL_12_REG
- LL_ADC_AWD_CHANNEL_12_INJ
- LL_ADC_AWD_CHANNEL_12_REG_INJ
- LL_ADC_AWD_CHANNEL_13_REG
- LL_ADC_AWD_CHANNEL_13_INJ
- LL_ADC_AWD_CHANNEL_13_REG_INJ
- LL_ADC_AWD_CHANNEL_14_REG
- LL_ADC_AWD_CHANNEL_14_INJ
- LL_ADC_AWD_CHANNEL_14_REG_INJ
- LL_ADC_AWD_CHANNEL_15_REG
- LL_ADC_AWD_CHANNEL_15_INJ
- LL_ADC_AWD_CHANNEL_15_REG_INJ
- LL_ADC_AWD_CHANNEL_16_REG
- LL_ADC_AWD_CHANNEL_16_INJ
- LL_ADC_AWD_CHANNEL_16_REG_INJ
- LL_ADC_AWD_CHANNEL_17_REG
- LL_ADC_AWD_CHANNEL_17_INJ
- LL_ADC_AWD_CHANNEL_17_REG_INJ
- LL_ADC_AWD_CHANNEL_18_REG
- LL_ADC_AWD_CHANNEL_18_INJ
- LL_ADC_AWD_CHANNEL_18_REG_INJ
- LL_ADC_AWD_CH_VREFINT_REG (1)
- LL_ADC_AWD_CH_VREFINT_INJ (1)
- LL_ADC_AWD_CH_VREFINT_REG_INJ (1)
- LL_ADC_AWD_CH_TEMPSENSOR_REG (1)(2)
- LL_ADC_AWD_CH_TEMPSENSOR_INJ (1)(2)
- LL_ADC_AWD_CH_TEMPSENSOR_REG_INJ (1)(2)
- LL_ADC_AWD_CH_VBAT_REG (1)
- LL_ADC_AWD_CH_VBAT_INJ (1)
- LL_ADC_AWD_CH_VBAT_REG_INJ (1)

Return values	<ul style="list-style-type: none"> • (2) On devices STM32F7xx, a limitation: this internal channel is shared between temperature sensor and Vbat, only 1 measurement path must be enabled.
Notes	<ul style="list-style-type: none"> • None: • Once monitored channels are selected, analog watchdog is enabled. • In case of need to define a single channel to monitor with analog watchdog from sequencer channel definition, use helper macro <code>__LL_ADC_ANALOGWD_CHANNEL_GROUP()</code>. • On this STM32 serie, there is only 1 kind of analog watchdog instance: AWD standard (instance AWD1): channels monitored: can monitor 1 channel or all channels. groups monitored: ADC groups regular and-or injected. resolution: resolution is not limited (corresponds to ADC resolution configured).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 AWD1CH LL_ADC_SetAnalogWDMonitChannels • CR1 AWD1SGL LL_ADC_SetAnalogWDMonitChannels • CR1 AWD1EN LL_ADC_SetAnalogWDMonitChannels

LL_ADC_GetAnalogWDMonitChannels

Function name	<code>__STATIC_INLINE uint32_t LL_ADC_GetAnalogWDMonitChannels (ADC_TypeDef * ADCx)</code>
Function description	Get ADC analog watchdog monitored channel.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_AWD_DISABLE – LL_ADC_AWD_ALL_CHANNELS_REG – LL_ADC_AWD_ALL_CHANNELS_INJ – LL_ADC_AWD_ALL_CHANNELS_REG_INJ – LL_ADC_AWD_CHANNEL_0_REG – LL_ADC_AWD_CHANNEL_0_INJ – LL_ADC_AWD_CHANNEL_0_REG_INJ – LL_ADC_AWD_CHANNEL_1_REG – LL_ADC_AWD_CHANNEL_1_INJ – LL_ADC_AWD_CHANNEL_1_REG_INJ – LL_ADC_AWD_CHANNEL_2_REG – LL_ADC_AWD_CHANNEL_2_INJ – LL_ADC_AWD_CHANNEL_2_REG_INJ – LL_ADC_AWD_CHANNEL_3_REG – LL_ADC_AWD_CHANNEL_3_INJ – LL_ADC_AWD_CHANNEL_3_REG_INJ – LL_ADC_AWD_CHANNEL_4_REG – LL_ADC_AWD_CHANNEL_4_INJ – LL_ADC_AWD_CHANNEL_4_REG_INJ – LL_ADC_AWD_CHANNEL_5_REG – LL_ADC_AWD_CHANNEL_5_INJ – LL_ADC_AWD_CHANNEL_5_REG_INJ

- LL_ADC_AWD_CHANNEL_6_REG
- LL_ADC_AWD_CHANNEL_6_INJ
- LL_ADC_AWD_CHANNEL_6_REG_INJ
- LL_ADC_AWD_CHANNEL_7_REG
- LL_ADC_AWD_CHANNEL_7_INJ
- LL_ADC_AWD_CHANNEL_7_REG_INJ
- LL_ADC_AWD_CHANNEL_8_REG
- LL_ADC_AWD_CHANNEL_8_INJ
- LL_ADC_AWD_CHANNEL_8_REG_INJ
- LL_ADC_AWD_CHANNEL_9_REG
- LL_ADC_AWD_CHANNEL_9_INJ
- LL_ADC_AWD_CHANNEL_9_REG_INJ
- LL_ADC_AWD_CHANNEL_10_REG
- LL_ADC_AWD_CHANNEL_10_INJ
- LL_ADC_AWD_CHANNEL_10_REG_INJ
- LL_ADC_AWD_CHANNEL_11_REG
- LL_ADC_AWD_CHANNEL_11_INJ
- LL_ADC_AWD_CHANNEL_11_REG_INJ
- LL_ADC_AWD_CHANNEL_12_REG
- LL_ADC_AWD_CHANNEL_12_INJ
- LL_ADC_AWD_CHANNEL_12_REG_INJ
- LL_ADC_AWD_CHANNEL_13_REG
- LL_ADC_AWD_CHANNEL_13_INJ
- LL_ADC_AWD_CHANNEL_13_REG_INJ
- LL_ADC_AWD_CHANNEL_14_REG
- LL_ADC_AWD_CHANNEL_14_INJ
- LL_ADC_AWD_CHANNEL_14_REG_INJ
- LL_ADC_AWD_CHANNEL_15_REG
- LL_ADC_AWD_CHANNEL_15_INJ
- LL_ADC_AWD_CHANNEL_15_REG_INJ
- LL_ADC_AWD_CHANNEL_16_REG
- LL_ADC_AWD_CHANNEL_16_INJ
- LL_ADC_AWD_CHANNEL_16_REG_INJ
- LL_ADC_AWD_CHANNEL_17_REG
- LL_ADC_AWD_CHANNEL_17_INJ
- LL_ADC_AWD_CHANNEL_17_REG_INJ
- LL_ADC_AWD_CHANNEL_18_REG
- LL_ADC_AWD_CHANNEL_18_INJ
- LL_ADC_AWD_CHANNEL_18_REG_INJ

Notes

- Usage of the returned channel number: To reinject this channel into another function LL_ADC_xxx: the returned channel number is only partly formatted on definition of literals LL_ADC_CHANNEL_x. Therefore, it has to be compared with parts of literals LL_ADC_CHANNEL_x or using helper macro `__LL_ADC_CHANNEL_TO_DECIMAL_NB()`. Then the selected literal LL_ADC_CHANNEL_x can be used as parameter for another function. To get the channel number in decimal format: process the returned value with the helper macro `__LL_ADC_CHANNEL_TO_DECIMAL_NB()`. Applicable only when the analog watchdog is set to monitor one channel.
- On this STM32 serie, there is only 1 kind of analog watchdog

instance: AWD standard (instance AWD1): channels monitored: can monitor 1 channel or all channels.groups monitored: ADC groups regular and-or injected.resolution: resolution is not limited (corresponds to ADC resolution configured).

- Reference Manual to LL API cross reference:
- CR1 AWD1CH LL_ADC_GetAnalogWDMonitChannels
 - CR1 AWD1SGL LL_ADC_GetAnalogWDMonitChannels
 - CR1 AWD1EN LL_ADC_GetAnalogWDMonitChannels

LL_ADC_SetAnalogWDThresholds

Function name	__STATIC_INLINE void LL_ADC_SetAnalogWDThresholds (ADC_TypeDef * ADCx, uint32_t AWDThresholdsHighLow, uint32_t AWDThresholdValue)
Function description	Set ADC analog watchdog threshold value of threshold high or low.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • AWDThresholdsHighLow: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_AWD_THRESHOLD_HIGH – LL_ADC_AWD_THRESHOLD_LOW • AWDThresholdValue: Value between Min_Data=0x000 and Max_Data=0xFF
Return values	• None:
Notes	<ul style="list-style-type: none"> • In case of ADC resolution different of 12 bits, analog watchdog thresholds data require a specific shift. Use helper macro <code>__LL_ADC_ANALOGWD_SET_THRESHOLD_RESOLUTION()</code>. • On this STM32 serie, there is only 1 kind of analog watchdog instance: AWD standard (instance AWD1): channels monitored: can monitor 1 channel or all channels.groups monitored: ADC groups regular and-or injected.resolution: resolution is not limited (corresponds to ADC resolution configured).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • HTR HT LL_ADC_SetAnalogWDThresholds • LTR LT LL_ADC_SetAnalogWDThresholds

LL_ADC_GetAnalogWDThresholds

Function name	__STATIC_INLINE uint32_t LL_ADC_GetAnalogWDThresholds (ADC_TypeDef * ADCx, uint32_t AWDThresholdsHighLow)
Function description	Get ADC analog watchdog threshold value of threshold high or threshold low.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • AWDThresholdsHighLow: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_AWD_THRESHOLD_HIGH – LL_ADC_AWD_THRESHOLD_LOW

- | | |
|---|---|
| Return values | <ul style="list-style-type: none"> • Value: between Min_Data=0x000 and Max_Data=0xFFFF |
| Notes | <ul style="list-style-type: none"> • In case of ADC resolution different of 12 bits, analog watchdog thresholds data require a specific shift. Use helper macro <code>__LL_ADC_ANALOGWD_GET_THRESHOLD_RESOLUTION()</code>. |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • HTR HT LL_ADC_GetAnalogWDThresholds • LTR LT LL_ADC_GetAnalogWDThresholds |

LL_ADC_SetMultimode

- | | |
|---|---|
| Function name | __STATIC_INLINE void LL_ADC_SetMultimode (ADC_Common_TypeDef * ADCxy_COMMON, uint32_t Multimode) |
| Function description | Set ADC multimode configuration to operate in independent mode or multimode (for devices with several ADC instances). |
| Parameters | <ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>) • Multimode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_MULTI_INDEPENDENT – LL_ADC_MULTI_DUAL_REG_SIMULT – LL_ADC_MULTI_DUAL_REG_INTERL – LL_ADC_MULTI_DUAL_INJ_SIMULT – LL_ADC_MULTI_DUAL_INJ_ALTERN – LL_ADC_MULTI_DUAL_REG_SIM_INJ_SIM – LL_ADC_MULTI_DUAL_REG_SIM_INJ_ALT – LL_ADC_MULTI_DUAL_REG_INT_INJ_SIM – LL_ADC_MULTI_TRIPLE_REG_SIM_INJ_SIM – LL_ADC_MULTI_TRIPLE_REG_SIM_INJ_ALT – LL_ADC_MULTI_TRIPLE_INJ_SIMULT – LL_ADC_MULTI_TRIPLE_REG_SIMULT – LL_ADC_MULTI_TRIPLE_REG_INTERL – LL_ADC_MULTI_TRIPLE_INJ_ALTERN |
| Return values | <ul style="list-style-type: none"> • None: |
| Notes | <ul style="list-style-type: none"> • If multimode configuration: the selected ADC instance is either master or slave depending on hardware. Refer to reference manual. |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • CCR MULTI LL_ADC_SetMultimode |

LL_ADC_GetMultimode

- | | |
|----------------------|---|
| Function name | __STATIC_INLINE uint32_t LL_ADC_GetMultimode (ADC_Common_TypeDef * ADCxy_COMMON) |
| Function description | Get ADC multimode configuration to operate in independent mode |

or multimode (for devices with several ADC instances).

Parameters	<ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>)
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – <code>LL_ADC_MULTI_INDEPENDENT</code> – <code>LL_ADC_MULTI_DUAL_REG_SIMULT</code> – <code>LL_ADC_MULTI_DUAL_REG_INTERL</code> – <code>LL_ADC_MULTI_DUAL_INJ_SIMULT</code> – <code>LL_ADC_MULTI_DUAL_INJ_ALTERN</code> – <code>LL_ADC_MULTI_DUAL_REG_SIM_INJ_SIM</code> – <code>LL_ADC_MULTI_DUAL_REG_SIM_INJ_ALT</code> – <code>LL_ADC_MULTI_DUAL_REG_INT_INJ_SIM</code> – <code>LL_ADC_MULTI_TRIPLE_REG_SIM_INJ_SIM</code> – <code>LL_ADC_MULTI_TRIPLE_REG_SIM_INJ_ALT</code> – <code>LL_ADC_MULTI_TRIPLE_INJ_SIMULT</code> – <code>LL_ADC_MULTI_TRIPLE_REG_SIMULT</code> – <code>LL_ADC_MULTI_TRIPLE_REG_INTERL</code> – <code>LL_ADC_MULTI_TRIPLE_INJ_ALTERN</code>
Notes	<ul style="list-style-type: none"> • If multimode configuration: the selected ADC instance is either master or slave depending on hardware. Refer to reference manual.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCR MULTI <code>LL_ADC_GetMultimode</code>

LL_ADC_SetMultiDMATransfer

Function name	<code>__STATIC_INLINE void LL_ADC_SetMultiDMATransfer(ADC_Common_TypeDef * ADCxy_COMMON, uint32_t MultiDMATransfer)</code>
Function description	Set ADC multimode conversion data transfer: no transfer or transfer by DMA.
Parameters	<ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>) • MultiDMATransfer: This parameter can be one of the following values: <ul style="list-style-type: none"> – <code>LL_ADC_MULTI_REG_DMA_EACH_ADC</code> – <code>LL_ADC_MULTI_REG_DMA_LIMIT_1</code> – <code>LL_ADC_MULTI_REG_DMA_LIMIT_2</code> – <code>LL_ADC_MULTI_REG_DMA_LIMIT_3</code> – <code>LL_ADC_MULTI_REG_DMA_UNLMT_1</code> – <code>LL_ADC_MULTI_REG_DMA_UNLMT_2</code> – <code>LL_ADC_MULTI_REG_DMA_UNLMT_3</code>
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • If ADC multimode transfer by DMA is not selected: each ADC uses its own DMA channel, with its individual DMA transfer settings. If ADC multimode transfer by DMA is selected: One

DMA channel is used for both ADC (DMA of ADC master)
 Specifies the DMA requests mode: Limited mode (One shot mode): DMA transfer requests are stopped when number of DMA data transfers (number of ADC conversions) is reached. This ADC mode is intended to be used with DMA mode non-circular. Unlimited mode: DMA transfer requests are unlimited, whatever number of DMA data transfers (number of ADC conversions). This ADC mode is intended to be used with DMA mode circular.

- If ADC DMA requests mode is set to unlimited and DMA is set to mode non-circular: when DMA transfers size will be reached, DMA will stop transfers of ADC conversions data ADC will raise an overrun error (overrun flag and interruption if enabled).
- How to retrieve multimode conversion data: Whatever multimode transfer by DMA setting: using function `LL_ADC_REG_ReadMultiConversionData32()`. If ADC multimode transfer by DMA is selected: conversion data is a raw data with ADC master and slave concatenated. A macro is available to get the conversion data of ADC master or ADC slave: see helper macro `__LL_ADC_MULTI_CONV_DATA_MASTER_SLAVE()`.

Reference Manual to LL API cross reference:

- CCR MDMA `LL_ADC_SetMultiDMATransfer`
- CCR DDS `LL_ADC_SetMultiDMATransfer`

LL_ADC_GetMultiDMATransfer

Function name	<code>__STATIC_INLINE uint32_t LL_ADC_GetMultiDMATransfer(ADC_Common_TypeDef * ADCxy_COMMON)</code>
Function description	Get ADC multimode conversion data transfer: no transfer or transfer by DMA.
Parameters	<ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>)
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – <code>LL_ADC_MULTI_REG_DMA_EACH_ADC</code> – <code>LL_ADC_MULTI_REG_DMA_LIMIT_1</code> – <code>LL_ADC_MULTI_REG_DMA_LIMIT_2</code> – <code>LL_ADC_MULTI_REG_DMA_LIMIT_3</code> – <code>LL_ADC_MULTI_REG_DMA_UNLMT_1</code> – <code>LL_ADC_MULTI_REG_DMA_UNLMT_2</code> – <code>LL_ADC_MULTI_REG_DMA_UNLMT_3</code>
Notes	<ul style="list-style-type: none"> • If ADC multimode transfer by DMA is not selected: each ADC uses its own DMA channel, with its individual DMA transfer settings. If ADC multimode transfer by DMA is selected: One DMA channel is used for both ADC (DMA of ADC master) Specifies the DMA requests mode: Limited mode (One shot mode): DMA transfer requests are stopped when number of DMA data transfers (number of ADC conversions) is reached. This ADC mode is intended to be used with DMA mode non-circular. Unlimited mode: DMA transfer requests are unlimited,

whatever number of DMA data transfers (number of ADC conversions). This ADC mode is intended to be used with DMA mode circular.

- If ADC DMA requests mode is set to unlimited and DMA is set to mode non-circular: when DMA transfers size will be reached, DMA will stop transfers of ADC conversions data ADC will raise an overrun error (overrun flag and interruption if enabled).
- How to retrieve multimode conversion data: Whatever multimode transfer by DMA setting: using function `LL_ADC_REG_ReadMultiConversionData32()`. If ADC multimode transfer by DMA is selected: conversion data is a raw data with ADC master and slave concatenated. A macro is available to get the conversion data of ADC master or ADC slave: see helper macro `__LL_ADC_MULTI_CONV_DATA_MASTER_SLAVE()`.

Reference Manual to LL API cross reference:

- CCR MDMA `LL_ADC_GetMultiDMATransfer`
- CCR DDS `LL_ADC_GetMultiDMATransfer`

LL_ADC_SetMultiTwoSamplingDelay

Function name	<code>__STATIC_INLINE void LL_ADC_SetMultiTwoSamplingDelay(ADC_Common_TypeDef * ADCxy_COMMON, uint32_t MultiTwoSamplingDelay)</code>
Function description	Set ADC multimode delay between 2 sampling phases.
Parameters	<ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>) • MultiTwoSamplingDelay: This parameter can be one of the following values: <ul style="list-style-type: none"> – <code>LL_ADC_MULTI_TWOSMP_DELAY_5CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_6CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_7CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_8CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_9CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_10CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_11CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_12CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_13CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_14CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_15CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_16CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_17CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_18CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_19CYCLES</code> – <code>LL_ADC_MULTI_TWOSMP_DELAY_20CYCLES</code>
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The sampling delay range depends on ADC resolution: ADC resolution 12 bits can have maximum delay of 12 cycles. ADC resolution 10 bits can have maximum delay of 10 cycles. ADC

resolution 8 bits can have maximum delay of 8 cycles. ADC resolution 6 bits can have maximum delay of 6 cycles.

- Reference Manual to LL API cross reference:
- CCR DELAY LL_ADC_SetMultiTwoSamplingDelay

LL_ADC_GetMultiTwoSamplingDelay

- Function name `__STATIC_INLINE uint32_t LL_ADC_GetMultiTwoSamplingDelay (ADC_Common_TypeDef * ADCxy_COMMON)`
- Function description Get ADC multimode delay between 2 sampling phases.
- Parameters
- **ADCxy_COMMON:** ADC common instance (can be set directly from CMSIS definition or by using helper macro `__LL_ADC_COMMON_INSTANCE()`)
- Return values
- **Returned:** value can be one of the following values:
 - LL_ADC_MULTI_TWOSMP_DELAY_5CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_6CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_7CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_8CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_9CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_10CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_11CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_12CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_13CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_14CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_15CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_16CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_17CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_18CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_19CYCLES
 - LL_ADC_MULTI_TWOSMP_DELAY_20CYCLES

- Reference Manual to LL API cross reference:
- CCR DELAY LL_ADC_GetMultiTwoSamplingDelay

LL_ADC_Enable

- Function name `__STATIC_INLINE void LL_ADC_Enable (ADC_TypeDef * ADCx)`
- Function description Enable the selected ADC instance.
- Parameters
- **ADCx:** ADC instance
- Return values
- **None:**
- Notes
- On this STM32 serie, after ADC enable, a delay for ADC internal analog stabilization is required before performing a ADC conversion start. Refer to device datasheet, parameter tSTAB.
- Reference Manual to LL API cross
- CR2 ADON LL_ADC_Enable

reference:

LL_ADC_Disable

Function name **__STATIC_INLINE void LL_ADC_Disable (ADC_TypeDef * ADCx)**

Function description Disable the selected ADC instance.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 ADON LL_ADC_Disable

LL_ADC_IsEnabled

Function name **__STATIC_INLINE uint32_t LL_ADC_IsEnabled (ADC_TypeDef * ADCx)**

Function description Get the selected ADC instance enable state.

Parameters

- **ADCx:** ADC instance

Return values

- **0:** ADC is disabled, 1: ADC is enabled.

Reference Manual to LL API cross reference:

- CR2 ADON LL_ADC_IsEnabled

LL_ADC_REG_StartConversionSWStart

Function name **__STATIC_INLINE void LL_ADC_REG_StartConversionSWStart (ADC_TypeDef * ADCx)**

Function description Start ADC group regular conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Notes

- On this STM32 serie, this function is relevant only for internal trigger (SW start), not for external trigger: If ADC trigger has been set to software start, ADC conversion starts immediately. If ADC trigger has been set to external trigger, ADC conversion start must be performed using function LL_ADC_REG_StartConversionExtTrig(). (if external trigger edge would have been set during ADC other settings, ADC conversion would start at trigger event as soon as ADC is enabled).

Reference Manual to LL API cross reference:

- CR2 SWSTART LL_ADC_REG_StartConversionSWStart

LL_ADC_REG_StartConversionExtTrig

Function name	__STATIC_INLINE void LL_ADC_REG_StartConversionExtTrig (ADC_TypeDef * ADCx, uint32_t ExternalTriggerEdge)
Function description	Start ADC group regular conversion from external trigger.
Parameters	<ul style="list-style-type: none"> • ExternalTriggerEdge: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_REG_TRIG_EXT_RISING – LL_ADC_REG_TRIG_EXT_FALLING – LL_ADC_REG_TRIG_EXT_RISINGFALLING • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • ADC conversion will start at next trigger event (on the selected trigger edge) following the ADC start conversion command. • On this STM32 serie, this function is relevant for ADC conversion start from external trigger. If internal trigger (SW start) is needed, perform ADC conversion start using function LL_ADC_REG_StartConversionSWStart().
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 EXTEN LL_ADC_REG_StartConversionExtTrig

LL_ADC_REG_StopConversionExtTrig

Function name	__STATIC_INLINE void LL_ADC_REG_StopConversionExtTrig (ADC_TypeDef * ADCx)
Function description	Stop ADC group regular conversion from external trigger.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • No more ADC conversion will start at next trigger event following the ADC stop conversion command. If a conversion is on-going, it will be completed. • On this STM32 serie, there is no specific command to stop a conversion on-going or to stop ADC converting in continuous mode. These actions can be performed using function LL_ADC_Disable().
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 EXTEN LL_ADC_REG_StopConversionExtTrig

LL_ADC_REG_ReadConversionData32

Function name	__STATIC_INLINE uint32_t LL_ADC_REG_ReadConversionData32 (ADC_TypeDef * ADCx)
Function description	Get ADC group regular conversion data, range fit for all ADC configurations: all ADC resolutions and all oversampling increased data width (for devices with feature oversampling).

Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00000000 and Max_Data=0xFFFFFFFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DR RDATA LL_ADC_REG_ReadConversionData32

LL_ADC_REG_ReadConversionData12

Function name	__STATIC_INLINE uint16_t LL_ADC_REG_ReadConversionData12 (ADC_TypeDef * ADCx)
Function description	Get ADC group regular conversion data, range fit for ADC resolution 12 bits.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x000 and Max_Data=0xFFF
Notes	<ul style="list-style-type: none"> • For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_REG_ReadConversionData32.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DR RDATA LL_ADC_REG_ReadConversionData12

LL_ADC_REG_ReadConversionData10

Function name	__STATIC_INLINE uint16_t LL_ADC_REG_ReadConversionData10 (ADC_TypeDef * ADCx)
Function description	Get ADC group regular conversion data, range fit for ADC resolution 10 bits.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x000 and Max_Data=0x3FF
Notes	<ul style="list-style-type: none"> • For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_REG_ReadConversionData32.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DR RDATA LL_ADC_REG_ReadConversionData10

LL_ADC_REG_ReadConversionData8

Function name	__STATIC_INLINE uint8_t LL_ADC_REG_ReadConversionData8 (ADC_TypeDef * ADCx)
Function description	Get ADC group regular conversion data, range fit for ADC resolution 8 bits.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance

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| Return values | • Value: between Min_Data=0x00 and Max_Data=0xFF |
| Notes | • For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_REG_ReadConversionData32. |
| Reference Manual to LL API cross reference: | • DR RDATA LL_ADC_REG_ReadConversionData8 |

LL_ADC_REG_ReadConversionData6

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|---|--|
| Function name | __STATIC_INLINE uint8_t
LL_ADC_REG_ReadConversionData6 (ADC_TypeDef * ADCx) |
| Function description | Get ADC group regular conversion data, range fit for ADC resolution 6 bits. |
| Parameters | • ADCx: ADC instance |
| Return values | • Value: between Min_Data=0x00 and Max_Data=0x3F |
| Notes | • For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_REG_ReadConversionData32. |
| Reference Manual to LL API cross reference: | • DR RDATA LL_ADC_REG_ReadConversionData6 |

LL_ADC_REG_ReadMultiConversionData32

- | | |
|----------------------|---|
| Function name | __STATIC_INLINE uint32_t
LL_ADC_REG_ReadMultiConversionData32
(ADC_Common_TypeDef * ADCxy_COMMON, uint32_t
ConversionData) |
| Function description | Get ADC multimode conversion data of ADC master, ADC slave or raw data with ADC master and slave concatenated. |
| Parameters | <ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>) • ConversionData: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_MULTI_MASTER – LL_ADC_MULTI_SLAVE – LL_ADC_MULTI_MASTER_SLAVE |
| Return values | • Value: between Min_Data=0x00000000 and Max_Data=0xFFFFFFFF |
| Notes | • If raw data with ADC master and slave concatenated is retrieved, a macro is available to get the conversion data of ADC master or ADC slave: see helper macro <code>__LL_ADC_MULTI_CONV_DATA_MASTER_SLAVE()</code> . (however this macro is mainly intended for multimode transfer by DMA, because this function can do the same by getting multimode conversion data of ADC master or ADC slave |

separately).

- Reference Manual to LL API cross reference:
- CDR DATA1 LL_ADC_REG_ReadMultiConversionData32
 - CDR DATA2 LL_ADC_REG_ReadMultiConversionData32

LL_ADC_INJ_StartConversionSWStart

Function name `__STATIC_INLINE void LL_ADC_INJ_StartConversionSWStart(ADC_TypeDef * ADCx)`

Function description Start ADC group injected conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Notes

- On this STM32 serie, this function is relevant only for internal trigger (SW start), not for external trigger: If ADC trigger has been set to software start, ADC conversion starts immediately. If ADC trigger has been set to external trigger, ADC conversion start must be performed using function `LL_ADC_INJ_StartConversionExtTrig()`. (if external trigger edge would have been set during ADC other settings, ADC conversion would start at trigger event as soon as ADC is enabled).

- Reference Manual to LL API cross reference:
- CR2 JSWSTART LL_ADC_INJ_StartConversionSWStart

LL_ADC_INJ_StartConversionExtTrig

Function name `__STATIC_INLINE void LL_ADC_INJ_StartConversionExtTrig(ADC_TypeDef * ADCx, uint32_t ExternalTriggerEdge)`

Function description Start ADC group injected conversion from external trigger.

Parameters

- **ExternalTriggerEdge:** This parameter can be one of the following values:
 - LL_ADC_INJ_TRIG_EXT_RISING
 - LL_ADC_INJ_TRIG_EXT_FALLING
 - LL_ADC_INJ_TRIG_EXT_RISINGFALLING
- **ADCx:** ADC instance

Return values

- **None:**

Notes

- ADC conversion will start at next trigger event (on the selected trigger edge) following the ADC start conversion command.
- On this STM32 serie, this function is relevant for ADC conversion start from external trigger. If internal trigger (SW start) is needed, perform ADC conversion start using function `LL_ADC_INJ_StartConversionSWStart()`.

- Reference Manual to LL API cross reference:
- CR2 JEXTEN LL_ADC_INJ_StartConversionExtTrig

LL_ADC_INJ_StopConversionExtTrig

Function name **__STATIC_INLINE void LL_ADC_INJ_StopConversionExtTrig (ADC_TypeDef * ADCx)**

Function description Stop ADC group injected conversion from external trigger.

Parameters • **ADCx:** ADC instance

Return values • **None:**

Notes • No more ADC conversion will start at next trigger event following the ADC stop conversion command. If a conversion is on-going, it will be completed.
• On this STM32 serie, there is no specific command to stop a conversion on-going or to stop ADC converting in continuous mode. These actions can be performed using function LL_ADC_Disable().

Reference Manual to LL API cross reference: • CR2 JEXTEN LL_ADC_INJ_StopConversionExtTrig

LL_ADC_INJ_ReadConversionData32

Function name **__STATIC_INLINE uint32_t LL_ADC_INJ_ReadConversionData32 (ADC_TypeDef * ADCx, uint32_t Rank)**

Function description Get ADC group regular conversion data, range fit for all ADC configurations: all ADC resolutions and all oversampling increased data width (for devices with feature oversampling).

Parameters • **ADCx:** ADC instance
• **Rank:** This parameter can be one of the following values:
– LL_ADC_INJ_RANK_1
– LL_ADC_INJ_RANK_2
– LL_ADC_INJ_RANK_3
– LL_ADC_INJ_RANK_4

Return values • **Value:** between Min_Data=0x00000000 and Max_Data=0xFFFFFFFF

Reference Manual to LL API cross reference: • JDR1 JDATA LL_ADC_INJ_ReadConversionData32
• JDR2 JDATA LL_ADC_INJ_ReadConversionData32
• JDR3 JDATA LL_ADC_INJ_ReadConversionData32
• JDR4 JDATA LL_ADC_INJ_ReadConversionData32

LL_ADC_INJ_ReadConversionData12

Function name **__STATIC_INLINE uint16_t LL_ADC_INJ_ReadConversionData12 (ADC_TypeDef * ADCx, uint32_t Rank)**

Function description Get ADC group injected conversion data, range fit for ADC resolution 12 bits.

Parameters • **ADCx:** ADC instance
• **Rank:** This parameter can be one of the following values:
– LL_ADC_INJ_RANK_1

	<ul style="list-style-type: none"> – LL_ADC_INJ_RANK_2 – LL_ADC_INJ_RANK_3 – LL_ADC_INJ_RANK_4
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x000 and Max_Data=0xFF
Notes	<ul style="list-style-type: none"> • For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_INJ_ReadConversionData32.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • JDR1 JDATA LL_ADC_INJ_ReadConversionData12 • JDR2 JDATA LL_ADC_INJ_ReadConversionData12 • JDR3 JDATA LL_ADC_INJ_ReadConversionData12 • JDR4 JDATA LL_ADC_INJ_ReadConversionData12

LL_ADC_INJ_ReadConversionData10

Function name	__STATIC_INLINE uint16_t LL_ADC_INJ_ReadConversionData10 (ADC_TypeDef * ADCx, uint32_t Rank)
Function description	Get ADC group injected conversion data, range fit for ADC resolution 10 bits.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • Rank: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_INJ_RANK_1 – LL_ADC_INJ_RANK_2 – LL_ADC_INJ_RANK_3 – LL_ADC_INJ_RANK_4
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x000 and Max_Data=0x3FF
Notes	<ul style="list-style-type: none"> • For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_INJ_ReadConversionData32.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • JDR1 JDATA LL_ADC_INJ_ReadConversionData10 • JDR2 JDATA LL_ADC_INJ_ReadConversionData10 • JDR3 JDATA LL_ADC_INJ_ReadConversionData10 • JDR4 JDATA LL_ADC_INJ_ReadConversionData10

LL_ADC_INJ_ReadConversionData8

Function name	__STATIC_INLINE uint8_t LL_ADC_INJ_ReadConversionData8 (ADC_TypeDef * ADCx, uint32_t Rank)
Function description	Get ADC group injected conversion data, range fit for ADC resolution 8 bits.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • Rank: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_INJ_RANK_1 – LL_ADC_INJ_RANK_2 – LL_ADC_INJ_RANK_3 – LL_ADC_INJ_RANK_4

Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0xFF
Notes	<ul style="list-style-type: none"> • For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_INJ_ReadConversionData32.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • JDR1 JDATA LL_ADC_INJ_ReadConversionData8 • JDR2 JDATA LL_ADC_INJ_ReadConversionData8 • JDR3 JDATA LL_ADC_INJ_ReadConversionData8 • JDR4 JDATA LL_ADC_INJ_ReadConversionData8

LL_ADC_INJ_ReadConversionData6

Function name	__STATIC_INLINE uint8_t LL_ADC_INJ_ReadConversionData6 (ADC_TypeDef * ADCx, uint32_t Rank)
Function description	Get ADC group injected conversion data, range fit for ADC resolution 6 bits.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • Rank: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_ADC_INJ_RANK_1 – LL_ADC_INJ_RANK_2 – LL_ADC_INJ_RANK_3 – LL_ADC_INJ_RANK_4
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0x3F
Notes	<ul style="list-style-type: none"> • For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_INJ_ReadConversionData32.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • JDR1 JDATA LL_ADC_INJ_ReadConversionData6 • JDR2 JDATA LL_ADC_INJ_ReadConversionData6 • JDR3 JDATA LL_ADC_INJ_ReadConversionData6 • JDR4 JDATA LL_ADC_INJ_ReadConversionData6

LL_ADC_IsActiveFlag_EOCS

Function name	__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_EOCS (ADC_TypeDef * ADCx)
Function description	Get flag ADC group regular end of unitary conversion or end of sequence conversions, depending on ADC configuration.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • To configure flag of end of conversion, use function LL_ADC_REG_SetFlagEndOfConversion().
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR EOC LL_ADC_IsActiveFlag_EOCS

LL_ADC_IsActiveFlag_OVR

Function name	__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_OVR (ADC_TypeDef * ADCx)
Function description	Get flag ADC group regular overrun.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR OVR LL_ADC_IsActiveFlag_OVR

LL_ADC_IsActiveFlag_JEOS

Function name	__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_JEOS (ADC_TypeDef * ADCx)
Function description	Get flag ADC group injected end of sequence conversions.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR JEOC LL_ADC_IsActiveFlag_JEOS

LL_ADC_IsActiveFlag_AWD1

Function name	__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_AWD1 (ADC_TypeDef * ADCx)
Function description	Get flag ADC analog watchdog 1 flag.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR AWD LL_ADC_IsActiveFlag_AWD1

LL_ADC_ClearFlag_EOCS

Function name	__STATIC_INLINE void LL_ADC_ClearFlag_EOCS (ADC_TypeDef * ADCx)
Function description	Clear flag ADC group regular end of unitary conversion or end of sequence conversions, depending on ADC configuration.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • To configure flag of end of conversion, use function LL_ADC_REG_SetFlagEndOfConversion().
Reference Manual to LL API cross	<ul style="list-style-type: none"> • SR EOC LL_ADC_ClearFlag_EOCS

reference:

LL_ADC_ClearFlag_OVR

Function name **__STATIC_INLINE void LL_ADC_ClearFlag_OVR (ADC_TypeDef * ADCx)**

Function description Clear flag ADC group regular overrun.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross

reference:

- SR OVR LL_ADC_ClearFlag_OVR

LL_ADC_ClearFlag_JEOS

Function name **__STATIC_INLINE void LL_ADC_ClearFlag_JEOS (ADC_TypeDef * ADCx)**

Function description Clear flag ADC group injected end of sequence conversions.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross

reference:

- SR JEOS LL_ADC_ClearFlag_JEOS

LL_ADC_ClearFlag_AWD1

Function name **__STATIC_INLINE void LL_ADC_ClearFlag_AWD1 (ADC_TypeDef * ADCx)**

Function description Clear flag ADC analog watchdog 1.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross

reference:

- SR AWD LL_ADC_ClearFlag_AWD1

LL_ADC_IsActiveFlag_MST_EOCS

Function name **__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_MST_EOCS (ADC_Common_TypeDef * ADCxy_COMMON)**

Function description Get flag multimode ADC group regular end of unitary conversion or end of sequence conversions, depending on ADC configuration, of the ADC master.

Parameters

- **ADCxy_COMMON:** ADC common instance (can be set directly from CMSIS definition or by using helper macro `__LL_ADC_COMMON_INSTANCE()`)

Return values

- **State:** of bit (1 or 0).

- Notes
- To configure flag of end of conversion, use function `LL_ADC_REG_SetFlagEndOfConversion()`.
- Reference Manual to LL API cross reference:
- CSR EOC1 `LL_ADC_IsActiveFlag_MST_EOCS`

LL_ADC_IsActiveFlag_SLV1_EOCS

- Function name `__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_SLV1_EOCS (ADC_Common_TypeDef * ADCxy_COMMON)`
- Function description Get flag multimode ADC group regular end of unitary conversion or end of sequence conversions, depending on ADC configuration, of the ADC slave 1.
- Parameters
- ADCxy_COMMON:** ADC common instance (can be set directly from CMSIS definition or by using helper macro `__LL_ADC_COMMON_INSTANCE()`)
- Return values
- State:** of bit (1 or 0).
- Notes
- To configure flag of end of conversion, use function `LL_ADC_REG_SetFlagEndOfConversion()`.
- Reference Manual to LL API cross reference:
- CSR EOC2 `LL_ADC_IsActiveFlag_SLV1_EOCS`

LL_ADC_IsActiveFlag_SLV2_EOCS

- Function name `__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_SLV2_EOCS (ADC_Common_TypeDef * ADCxy_COMMON)`
- Function description Get flag multimode ADC group regular end of unitary conversion or end of sequence conversions, depending on ADC configuration, of the ADC slave 2.
- Parameters
- ADCxy_COMMON:** ADC common instance (can be set directly from CMSIS definition or by using helper macro `__LL_ADC_COMMON_INSTANCE()`)
- Return values
- State:** of bit (1 or 0).
- Notes
- To configure flag of end of conversion, use function `LL_ADC_REG_SetFlagEndOfConversion()`.
- Reference Manual to LL API cross reference:
- CSR EOC3 `LL_ADC_IsActiveFlag_SLV2_EOCS`

LL_ADC_IsActiveFlag_MST_OVR

- Function name `__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_MST_OVR (ADC_Common_TypeDef * ADCxy_COMMON)`
- Function description Get flag multimode ADC group regular overrun of the ADC master.

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| Parameters | <ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>) |
| Return values | <ul style="list-style-type: none"> • State: of bit (1 or 0). |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • CSR OVR1 LL_ADC_IsActiveFlag_MST_OVR |

LL_ADC_IsActiveFlag_SLV1_OVR

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| Function name | __STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_SLV1_OVR (ADC_Common_TypeDef * ADCxy_COMMON) |
| Function description | Get flag multimode ADC group regular overrun of the ADC slave 1. |
| Parameters | <ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>) |
| Return values | <ul style="list-style-type: none"> • State: of bit (1 or 0). |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • CSR OVR2 LL_ADC_IsActiveFlag_SLV1_OVR |

LL_ADC_IsActiveFlag_SLV2_OVR

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| Function name | __STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_SLV2_OVR (ADC_Common_TypeDef * ADCxy_COMMON) |
| Function description | Get flag multimode ADC group regular overrun of the ADC slave 2. |
| Parameters | <ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>) |
| Return values | <ul style="list-style-type: none"> • State: of bit (1 or 0). |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • CSR OVR3 LL_ADC_IsActiveFlag_SLV2_OVR |

LL_ADC_IsActiveFlag_MST_JEOS

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| Function name | __STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_MST_JEOS (ADC_Common_TypeDef * ADCxy_COMMON) |
| Function description | Get flag multimode ADC group injected end of sequence conversions of the ADC master. |
| Parameters | <ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>) |
| Return values | <ul style="list-style-type: none"> • State: of bit (1 or 0). |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • CSR JEOC LL_ADC_IsActiveFlag_MST_EOCS |

LL_ADC_IsActiveFlag_SLV1_JEOS

Function name	__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_SLV1_JEOS (ADC_Common_TypeDef * ADCxy_COMMON)
Function description	Get flag multimode ADC group injected end of sequence conversions of the ADC slave 1.
Parameters	<ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>)
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CSR JEOC2 LL_ADC_IsActiveFlag_SLV1_JEOS

LL_ADC_IsActiveFlag_SLV2_JEOS

Function name	__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_SLV2_JEOS (ADC_Common_TypeDef * ADCxy_COMMON)
Function description	Get flag multimode ADC group injected end of sequence conversions of the ADC slave 2.
Parameters	<ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>)
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CSR JEOC3 LL_ADC_IsActiveFlag_SLV2_JEOS

LL_ADC_IsActiveFlag_MST_AWD1

Function name	__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_MST_AWD1 (ADC_Common_TypeDef * ADCxy_COMMON)
Function description	Get flag multimode ADC analog watchdog 1 of the ADC master.
Parameters	<ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>)
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CSR AWD1 LL_ADC_IsActiveFlag_MST_AWD1

LL_ADC_IsActiveFlag_SLV1_AWD1

Function name	__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_SLV1_AWD1 (ADC_Common_TypeDef * ADCxy_COMMON)
Function description	Get flag multimode analog watchdog 1 of the ADC slave 1.

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| Parameters | <ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>) |
| Return values | <ul style="list-style-type: none"> • State: of bit (1 or 0). |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • CSR AWD2 LL_ADC_IsActiveFlag_SLV1_AWD1 |

LL_ADC_IsActiveFlag_SLV2_AWD1

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| Function name | <code>__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_SLV2_AWD1 (ADC_Common_TypeDef * ADCxy_COMMON)</code> |
| Function description | Get flag multimode analog watchdog 1 of the ADC slave 2. |
| Parameters | <ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>) |
| Return values | <ul style="list-style-type: none"> • State: of bit (1 or 0). |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • CSR AWD3 LL_ADC_IsActiveFlag_SLV2_AWD1 |

LL_ADC_EnableIT_EOCS

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| Function name | <code>__STATIC_INLINE void LL_ADC_EnableIT_EOCS (ADC_TypeDef * ADCx)</code> |
| Function description | Enable interruption ADC group regular end of unitary conversion or end of sequence conversions, depending on ADC configuration. |
| Parameters | <ul style="list-style-type: none"> • ADCx: ADC instance |
| Return values | <ul style="list-style-type: none"> • None: |
| Notes | <ul style="list-style-type: none"> • To configure flag of end of conversion, use function <code>LL_ADC_REG_SetFlagEndOfConversion()</code>. |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • CR1 EOCIE LL_ADC_EnableIT_EOCS |

LL_ADC_EnableIT_OVR

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| Function name | <code>__STATIC_INLINE void LL_ADC_EnableIT_OVR (ADC_TypeDef * ADCx)</code> |
| Function description | Enable ADC group regular interruption overrun. |
| Parameters | <ul style="list-style-type: none"> • ADCx: ADC instance |
| Return values | <ul style="list-style-type: none"> • None: |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • CR1 OVRIE LL_ADC_EnableIT_OVR |

LL_ADC_EnableIT_JEOS

Function name	__STATIC_INLINE void LL_ADC_EnableIT_JEOS (ADC_TypeDef * ADCx)
Function description	Enable interruption ADC group injected end of sequence conversions.
Parameters	<ul style="list-style-type: none">• ADCx: ADC instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 JEOCIE LL_ADC_EnableIT_JEOS

LL_ADC_EnableIT_AWD1

Function name	__STATIC_INLINE void LL_ADC_EnableIT_AWD1 (ADC_TypeDef * ADCx)
Function description	Enable interruption ADC analog watchdog 1.
Parameters	<ul style="list-style-type: none">• ADCx: ADC instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 AWDIE LL_ADC_EnableIT_AWD1

LL_ADC_DisableIT_EOCS

Function name	__STATIC_INLINE void LL_ADC_DisableIT_EOCS (ADC_TypeDef * ADCx)
Function description	Disable interruption ADC group regular end of unitary conversion or end of sequence conversions, depending on ADC configuration.
Parameters	<ul style="list-style-type: none">• ADCx: ADC instance
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• To configure flag of end of conversion, use function LL_ADC_REG_SetFlagEndOfConversion().
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 EOCIE LL_ADC_DisableIT_EOCS

LL_ADC_DisableIT_OVR

Function name	__STATIC_INLINE void LL_ADC_DisableIT_OVR (ADC_TypeDef * ADCx)
Function description	Disable interruption ADC group regular overrun.
Parameters	<ul style="list-style-type: none">• ADCx: ADC instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross	<ul style="list-style-type: none">• CR1 OVRIE LL_ADC_DisableIT_OVR

reference:

LL_ADC_DisableIT_JEOS

Function name	__STATIC_INLINE void LL_ADC_DisableIT_JEOS (ADC_TypeDef * ADCx)
Function description	Disable interruption ADC group injected end of sequence conversions.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 JEOCIE LL_ADC_EnableIT_JEOS

LL_ADC_DisableIT_AWD1

Function name	__STATIC_INLINE void LL_ADC_DisableIT_AWD1 (ADC_TypeDef * ADCx)
Function description	Disable interruption ADC analog watchdog 1.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 AWDIE LL_ADC_EnableIT_AWD1

LL_ADC_IsEnabledIT_EOCS

Function name	__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_EOCS (ADC_TypeDef * ADCx)
Function description	Get state of interruption ADC group regular end of unitary conversion or end of sequence conversions, depending on ADC configuration.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • To configure flag of end of conversion, use function LL_ADC_REG_SetFlagEndOfConversion(). (0: interrupt disabled, 1: interrupt enabled)
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 EOCIE LL_ADC_IsEnabledIT_EOCS

LL_ADC_IsEnabledIT_OVR

Function name	__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_OVR (ADC_TypeDef * ADCx)
Function description	Get state of interruption ADC group regular overrun (0: interrupt disabled, 1: interrupt enabled).

Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 OVRIE LL_ADC_IsEnabledIT_OVR

LL_ADC_IsEnabledIT_JEOS

Function name	__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_JEOS (ADC_TypeDef * ADCx)
Function description	Get state of interruption ADC group injected end of sequence conversions (0: interrupt disabled, 1: interrupt enabled).
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 JEOCIE LL_ADC_EnableIT_JEOS

LL_ADC_IsEnabledIT_AWD1

Function name	__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_AWD1 (ADC_TypeDef * ADCx)
Function description	Get state of interruption ADC analog watchdog 1 (0: interrupt disabled, 1: interrupt enabled).
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 AWDIE LL_ADC_EnableIT_AWD1

LL_ADC_CommonDeInit

Function name	ErrorStatus LL_ADC_CommonDeInit (ADC_Common_TypeDef * ADCxy_COMMON)
Function description	De-initialize registers of all ADC instances belonging to the same ADC common instance to their default reset values.
Parameters	<ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>)
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: ADC common registers are de-initialized – ERROR: not applicable

LL_ADC_CommonInit

Function name	ErrorStatus LL_ADC_CommonInit (ADC_Common_TypeDef * ADCxy_COMMON, LL_ADC_CommonInitTypeDef *)
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ADC_CommonInitStruct)

Function description	Initialize some features of ADC common parameters (all ADC instances belonging to the same ADC common instance) and multimode (for devices with several ADC instances available).
Parameters	<ul style="list-style-type: none"> • ADCxy_COMMON: ADC common instance (can be set directly from CMSIS definition or by using helper macro <code>__LL_ADC_COMMON_INSTANCE()</code>) • ADC_CommonInitStruct: Pointer to a <code>LL_ADC_CommonInitTypeDef</code> structure
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: ADC common registers are initialized – ERROR: ADC common registers are not initialized
Notes	<ul style="list-style-type: none"> • The setting of ADC common parameters is conditioned to ADC instances state: All ADC instances belonging to the same ADC common instance must be disabled.

LL_ADC_CommonStructInit

Function name	void LL_ADC_CommonStructInit (LL_ADC_CommonInitTypeDef * ADC_CommonInitStruct)
Function description	Set each <code>LL_ADC_CommonInitTypeDef</code> field to default value.
Parameters	<ul style="list-style-type: none"> • ADC_CommonInitStruct: Pointer to a <code>LL_ADC_CommonInitTypeDef</code> structure whose fields will be set to default values.
Return values	<ul style="list-style-type: none"> • None:

LL_ADC_DeInit

Function name	ErrorStatus LL_ADC_DeInit (ADC_TypeDef * ADCx)
Function description	De-initialize registers of the selected ADC instance to their default reset values.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: ADC registers are de-initialized – ERROR: ADC registers are not de-initialized
Notes	<ul style="list-style-type: none"> • To reset all ADC instances quickly (perform a hard reset), use function <code>LL_ADC_CommonDeInit()</code>.

LL_ADC_Init

Function name	ErrorStatus LL_ADC_Init (ADC_TypeDef * ADCx, LL_ADC_InitTypeDef * ADC_InitStruct)
Function description	Initialize some features of ADC instance.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • ADC_InitStruct: Pointer to a <code>LL_ADC_REG_InitTypeDef</code> structure

Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: ADC registers are initialized – ERROR: ADC registers are not initialized
Notes	<ul style="list-style-type: none"> • These parameters have an impact on ADC scope: ADC instance. Affects both group regular and group injected (availability of ADC group injected depends on STM32 families). Refer to corresponding unitary functions into Configuration of ADC hierarchical scope: ADC instance . • The setting of these parameters by function LL_ADC_Init() is conditioned to ADC state: ADC instance must be disabled. This condition is applied to all ADC features, for efficiency and compatibility over all STM32 families. However, the different features can be set under different ADC state conditions (setting possible with ADC enabled without conversion on going, ADC enabled with conversion on going, ...) Each feature can be updated afterwards with a unitary function and potentially with ADC in a different state than disabled, refer to description of each function for setting conditioned to ADC state. • After using this function, some other features must be configured using LL unitary functions. The minimum configuration remaining to be done is: Set ADC group regular or group injected sequencer: map channel on the selected sequencer rank. Refer to function LL_ADC_REG_SetSequencerRanks().Set ADC channel sampling time Refer to function LL_ADC_SetChannelSamplingTime();

LL_ADC_StructInit

Function name	void LL_ADC_StructInit (LL_ADC_InitTypeDef * ADC_InitStruct)
Function description	Set each LL_ADC_InitTypeDef field to default value.
Parameters	<ul style="list-style-type: none"> • ADC_InitStruct: Pointer to a LL_ADC_InitTypeDef structure whose fields will be set to default values.
Return values	<ul style="list-style-type: none"> • None:

LL_ADC_REG_Init

Function name	ErrorStatus LL_ADC_REG_Init (ADC_TypeDef * ADCx, LL_ADC_REG_InitTypeDef * ADC_REG_InitStruct)
Function description	Initialize some features of ADC group regular.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • ADC_REG_InitStruct: Pointer to a LL_ADC_REG_InitTypeDef structure
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: ADC registers are initialized – ERROR: ADC registers are not initialized
Notes	<ul style="list-style-type: none"> • These parameters have an impact on ADC scope: ADC group regular. Refer to corresponding unitary functions into

Configuration of ADC hierarchical scope: group regular (functions with prefix "REG").

- The setting of these parameters by function LL_ADC_Init() is conditioned to ADC state: ADC instance must be disabled. This condition is applied to all ADC features, for efficiency and compatibility over all STM32 families. However, the different features can be set under different ADC state conditions (setting possible with ADC enabled without conversion on going, ADC enabled with conversion on going, ...) Each feature can be updated afterwards with a unitary function and potentially with ADC in a different state than disabled, refer to description of each function for setting conditioned to ADC state.
- After using this function, other features must be configured using LL unitary functions. The minimum configuration remaining to be done is: Set ADC group regular or group injected sequencer: map channel on the selected sequencer rank. Refer to function LL_ADC_REG_SetSequencerRanks().Set ADC channel sampling time Refer to function LL_ADC_SetChannelSamplingTime();

LL_ADC_REG_StructInit

Function name	void LL_ADC_REG_StructInit (LL_ADC_REG_InitTypeDef * ADC_REG_InitStruct)
Function description	Set each LL_ADC_REG_InitTypeDef field to default value.
Parameters	<ul style="list-style-type: none"> • ADC_REG_InitStruct: Pointer to a LL_ADC_REG_InitTypeDef structure whose fields will be set to default values.
Return values	<ul style="list-style-type: none"> • None:

LL_ADC_INJ_Init

Function name	ErrorStatus LL_ADC_INJ_Init (ADC_TypeDef * ADCx, LL_ADC_INJ_InitTypeDef * ADC_INJ_InitStruct)
Function description	Initialize some features of ADC group injected.
Parameters	<ul style="list-style-type: none"> • ADCx: ADC instance • ADC_INJ_InitStruct: Pointer to a LL_ADC_INJ_InitTypeDef structure
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: ADC registers are initialized – ERROR: ADC registers are not initialized
Notes	<ul style="list-style-type: none"> • These parameters have an impact on ADC scope: ADC group injected. Refer to corresponding unitary functions into Configuration of ADC hierarchical scope: group regular (functions with prefix "INJ"). • The setting of these parameters by function LL_ADC_Init() is conditioned to ADC state: ADC instance must be disabled. This condition is applied to all ADC features, for efficiency and compatibility over all STM32 families. However, the different

features can be set under different ADC state conditions (setting possible with ADC enabled without conversion on going, ADC enabled with conversion on going, ...) Each feature can be updated afterwards with a unitary function and potentially with ADC in a different state than disabled, refer to description of each function for setting conditioned to ADC state.

- After using this function, other features must be configured using LL unitary functions. The minimum configuration remaining to be done is: Set ADC group injected sequencer: map channel on the selected sequencer rank. Refer to function LL_ADC_INJ_SetSequencerRanks(). Set ADC channel sampling time Refer to function LL_ADC_SetChannelSamplingTime();

LL_ADC_INJ_StructInit

Function name	void LL_ADC_INJ_StructInit (LL_ADC_INJ_InitTypeDef * ADC_INJ_InitStruct)
Function description	Set each LL_ADC_INJ_InitTypeDef field to default value.
Parameters	<ul style="list-style-type: none"> • ADC_INJ_InitStruct: Pointer to a LL_ADC_INJ_InitTypeDef structure whose fields will be set to default values.
Return values	<ul style="list-style-type: none"> • None:

71.3 ADC Firmware driver defines

71.3.1 ADC

Analog watchdog - Monitored channels

LL_ADC_AWD_DISABLE	ADC analog watchdog monitoring disabled
LL_ADC_AWD_ALL_CHANNELS_REG	ADC analog watchdog monitoring of all channels, converted by group regular only
LL_ADC_AWD_ALL_CHANNELS_INJ	ADC analog watchdog monitoring of all channels, converted by group injected only
LL_ADC_AWD_ALL_CHANNELS_REG_INJ	ADC analog watchdog monitoring of all channels, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_0_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN0, converted by group regular only
LL_ADC_AWD_CHANNEL_0_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN0, converted by group injected only
LL_ADC_AWD_CHANNEL_0_REG_INJ	ADC analog watchdog monitoring of

	ADC external channel (channel connected to GPIO pin) ADCx_IN0, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_1_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN1, converted by group regular only
LL_ADC_AWD_CHANNEL_1_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN1, converted by group injected only
LL_ADC_AWD_CHANNEL_1_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN1, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_2_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN2, converted by group regular only
LL_ADC_AWD_CHANNEL_2_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN2, converted by group injected only
LL_ADC_AWD_CHANNEL_2_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN2, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_3_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN3, converted by group regular only
LL_ADC_AWD_CHANNEL_3_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN3, converted by group injected only
LL_ADC_AWD_CHANNEL_3_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN3, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_4_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN4, converted by group regular only
LL_ADC_AWD_CHANNEL_4_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN4,

	converted by group injected only
LL_ADC_AWD_CHANNEL_4_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN4, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_5_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN5, converted by group regular only
LL_ADC_AWD_CHANNEL_5_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN5, converted by group injected only
LL_ADC_AWD_CHANNEL_5_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN5, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_6_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN6, converted by group regular only
LL_ADC_AWD_CHANNEL_6_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN6, converted by group injected only
LL_ADC_AWD_CHANNEL_6_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN6, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_7_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN7, converted by group regular only
LL_ADC_AWD_CHANNEL_7_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN7, converted by group injected only
LL_ADC_AWD_CHANNEL_7_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN7, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_8_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN8, converted by group regular only

LL_ADC_AWD_CHANNEL_8_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN8, converted by group injected only
LL_ADC_AWD_CHANNEL_8_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN8, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_9_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN9, converted by group regular only
LL_ADC_AWD_CHANNEL_9_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN9, converted by group injected only
LL_ADC_AWD_CHANNEL_9_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN9, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_10_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN10, converted by group regular only
LL_ADC_AWD_CHANNEL_10_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN10, converted by group injected only
LL_ADC_AWD_CHANNEL_10_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN10, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_11_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN11, converted by group regular only
LL_ADC_AWD_CHANNEL_11_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN11, converted by group injected only
LL_ADC_AWD_CHANNEL_11_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN11, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_12_REG	ADC analog watchdog monitoring of ADC external channel (channel

	connected to GPIO pin) ADCx_IN12, converted by group regular only
LL_ADC_AWD_CHANNEL_12_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN12, converted by group injected only
LL_ADC_AWD_CHANNEL_12_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN12, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_13_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN13, converted by group regular only
LL_ADC_AWD_CHANNEL_13_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN13, converted by group injected only
LL_ADC_AWD_CHANNEL_13_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN13, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_14_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN14, converted by group regular only
LL_ADC_AWD_CHANNEL_14_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN14, converted by group injected only
LL_ADC_AWD_CHANNEL_14_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN14, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_15_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN15, converted by group regular only
LL_ADC_AWD_CHANNEL_15_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN15, converted by group injected only
LL_ADC_AWD_CHANNEL_15_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN15, converted by either group regular or

	injected
LL_ADC_AWD_CHANNEL_16_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN16, converted by group regular only
LL_ADC_AWD_CHANNEL_16_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN16, converted by group injected only
LL_ADC_AWD_CHANNEL_16_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN16, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_17_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN17, converted by group regular only
LL_ADC_AWD_CHANNEL_17_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN17, converted by group injected only
LL_ADC_AWD_CHANNEL_17_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN17, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_18_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN18, converted by group regular only
LL_ADC_AWD_CHANNEL_18_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN18, converted by group injected only
LL_ADC_AWD_CHANNEL_18_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN18, converted by either group regular or injected
LL_ADC_AWD_CH_VREFINT_REG	ADC analog watchdog monitoring of ADC internal channel connected to VrefInt: Internal voltage reference, converted by group regular only
LL_ADC_AWD_CH_VREFINT_INJ	ADC analog watchdog monitoring of ADC internal channel connected to VrefInt: Internal voltage reference, converted by group injected only
LL_ADC_AWD_CH_VREFINT_REG_INJ	ADC analog watchdog monitoring of

	ADC internal channel connected to VrefInt: Internal voltage reference, converted by either group regular or injected
LL_ADC_AWD_CH_VBAT_REG	ADC analog watchdog monitoring of ADC internal channel connected to Vbat/3: Vbat voltage through a divider ladder of factor 1/3 to have Vbat always below Vdda, converted by group regular only
LL_ADC_AWD_CH_VBAT_INJ	ADC analog watchdog monitoring of ADC internal channel connected to Vbat/3: Vbat voltage through a divider ladder of factor 1/3 to have Vbat always below Vdda, converted by group injected only
LL_ADC_AWD_CH_VBAT_REG_INJ	ADC analog watchdog monitoring of ADC internal channel connected to Vbat/3: Vbat voltage through a divider ladder of factor 1/3 to have Vbat always below Vdda
LL_ADC_AWD_CH_TEMPSENSOR_REG	ADC analog watchdog monitoring of ADC internal channel connected to Temperature sensor, converted by group regular only. This internal channel is shared between temperature sensor and Vbat, only 1 measurement path must be enabled.
LL_ADC_AWD_CH_TEMPSENSOR_INJ	ADC analog watchdog monitoring of ADC internal channel connected to Temperature sensor, converted by group injected only. This internal channel is shared between temperature sensor and Vbat, only 1 measurement path must be enabled.
LL_ADC_AWD_CH_TEMPSENSOR_REG_INJ	ADC analog watchdog monitoring of ADC internal channel connected to Temperature sensor, converted by either group regular or injected. This internal channel is shared between temperature sensor and Vbat, only 1 measurement path must be enabled.

Analog watchdog - Analog watchdog number

LL_ADC_AWD1 ADC analog watchdog number 1

Analog watchdog - Thresholds

LL_ADC_AWD_THRESHOLD_HIGH ADC analog watchdog threshold high

LL_ADC_AWD_THRESHOLD_LOW ADC analog watchdog threshold low

ADC instance - Channel number

LL_ADC_CHANNEL_0	ADC external channel (channel connected to GPIO pin) ADCx_IN0
LL_ADC_CHANNEL_1	ADC external channel (channel connected to GPIO pin) ADCx_IN1
LL_ADC_CHANNEL_2	ADC external channel (channel connected to GPIO pin) ADCx_IN2
LL_ADC_CHANNEL_3	ADC external channel (channel connected to GPIO pin) ADCx_IN3
LL_ADC_CHANNEL_4	ADC external channel (channel connected to GPIO pin) ADCx_IN4
LL_ADC_CHANNEL_5	ADC external channel (channel connected to GPIO pin) ADCx_IN5
LL_ADC_CHANNEL_6	ADC external channel (channel connected to GPIO pin) ADCx_IN6
LL_ADC_CHANNEL_7	ADC external channel (channel connected to GPIO pin) ADCx_IN7
LL_ADC_CHANNEL_8	ADC external channel (channel connected to GPIO pin) ADCx_IN8
LL_ADC_CHANNEL_9	ADC external channel (channel connected to GPIO pin) ADCx_IN9
LL_ADC_CHANNEL_10	ADC external channel (channel connected to GPIO pin) ADCx_IN10
LL_ADC_CHANNEL_11	ADC external channel (channel connected to GPIO pin) ADCx_IN11
LL_ADC_CHANNEL_12	ADC external channel (channel connected to GPIO pin) ADCx_IN12
LL_ADC_CHANNEL_13	ADC external channel (channel connected to GPIO pin) ADCx_IN13
LL_ADC_CHANNEL_14	ADC external channel (channel connected to GPIO pin) ADCx_IN14
LL_ADC_CHANNEL_15	ADC external channel (channel connected to GPIO pin) ADCx_IN15
LL_ADC_CHANNEL_16	ADC external channel (channel connected to GPIO pin) ADCx_IN16
LL_ADC_CHANNEL_17	ADC external channel (channel connected to GPIO pin) ADCx_IN17
LL_ADC_CHANNEL_18	ADC external channel (channel connected to GPIO pin) ADCx_IN18
LL_ADC_CHANNEL_VREFINT	ADC internal channel connected to VrefInt: Internal voltage reference. On STM32F7, ADC channel available only on ADC instance: ADC1.
LL_ADC_CHANNEL_VBAT	ADC internal channel connected to Vbat/3: Vbat voltage through a divider ladder of factor 1/3 to have Vbat always below Vdda. On STM32F7, ADC channel available only on ADC instance: ADC1.

LL_ADC_CHANNEL_TEMPSENSOR ADC internal channel connected to Temperature sensor. On STM32F7, ADC channel available only on ADC instance: ADC1.

Channel - Sampling time

LL_ADC_SAMPLINGTIME_3CYCLES Sampling time 3 ADC clock cycles
 LL_ADC_SAMPLINGTIME_15CYCLES Sampling time 15 ADC clock cycles
 LL_ADC_SAMPLINGTIME_28CYCLES Sampling time 28 ADC clock cycles
 LL_ADC_SAMPLINGTIME_56CYCLES Sampling time 56 ADC clock cycles
 LL_ADC_SAMPLINGTIME_84CYCLES Sampling time 84 ADC clock cycles
 LL_ADC_SAMPLINGTIME_112CYCLES Sampling time 112 ADC clock cycles
 LL_ADC_SAMPLINGTIME_144CYCLES Sampling time 144 ADC clock cycles
 LL_ADC_SAMPLINGTIME_480CYCLES Sampling time 480 ADC clock cycles

ADC common - Clock source

LL_ADC_CLOCK_SYNC_PCLK_DIV2 ADC synchronous clock derived from AHB clock with prescaler division by 2
 LL_ADC_CLOCK_SYNC_PCLK_DIV4 ADC synchronous clock derived from AHB clock with prescaler division by 4
 LL_ADC_CLOCK_SYNC_PCLK_DIV6 ADC synchronous clock derived from AHB clock with prescaler division by 6
 LL_ADC_CLOCK_SYNC_PCLK_DIV8 ADC synchronous clock derived from AHB clock with prescaler division by 8

ADC common - Measurement path to internal channels

LL_ADC_PATH_INTERNAL_NONE ADC measurement pathes all disabled
 LL_ADC_PATH_INTERNAL_VREFINT ADC measurement path to internal channel VrefInt
 LL_ADC_PATH_INTERNAL_TEMPSENSOR ADC measurement path to internal channel temperature sensor
 LL_ADC_PATH_INTERNAL_VBAT ADC measurement path to internal channel Vbat

ADC instance - Data alignment

LL_ADC_DATA_ALIGN_RIGHT ADC conversion data alignment: right aligned (alignment on data register LSB bit 0)
 LL_ADC_DATA_ALIGN_LEFT ADC conversion data alignment: left aligned (alignment on data register MSB bit 15)

ADC flags

LL_ADC_FLAG_STRT ADC flag ADC group regular conversion start
 LL_ADC_FLAG_EOCS ADC flag ADC group regular end of unitary conversion or sequence conversions (to configure flag of end of conversion, use function
 LL_ADC_FLAG_OVR ADC flag ADC group regular overrun
 LL_ADC_FLAG_JSTRT ADC flag ADC group injected conversion start

LL_ADC_FLAG_JEOS	ADC flag ADC group injected end of sequence conversions (Note: on this STM32 serie, there is no flag ADC group injected end of unitary conversion. Flag noted as "JEOC" is corresponding to flag "JEOS" in other STM32 families)
LL_ADC_FLAG_AWD1	ADC flag ADC analog watchdog 1
LL_ADC_FLAG_EOCS_MST	ADC flag ADC multimode master group regular end of unitary conversion or sequence conversions (to configure flag of end of conversion, use function
LL_ADC_FLAG_EOCS_SLV1	ADC flag ADC multimode slave 1 group regular end of unitary conversion or sequence conversions (to configure flag of end of conversion, use function
LL_ADC_FLAG_EOCS_SLV2	ADC flag ADC multimode slave 2 group regular end of unitary conversion or sequence conversions (to configure flag of end of conversion, use function
LL_ADC_FLAG_OVR_MST	ADC flag ADC multimode master group regular overrun
LL_ADC_FLAG_OVR_SLV1	ADC flag ADC multimode slave 1 group regular overrun
LL_ADC_FLAG_OVR_SLV2	ADC flag ADC multimode slave 2 group regular overrun
LL_ADC_FLAG_JEOS_MST	ADC flag ADC multimode master group injected end of sequence conversions (Note: on this STM32 serie, there is no flag ADC group injected end of unitary conversion. Flag noted as "JEOC" is corresponding to flag "JEOS" in other STM32 families)
LL_ADC_FLAG_JEOS_SLV1	ADC flag ADC multimode slave 1 group injected end of sequence conversions (Note: on this STM32 serie, there is no flag ADC group injected end of unitary conversion. Flag noted as "JEOC" is corresponding to flag "JEOS" in other STM32 families)
LL_ADC_FLAG_JEOS_SLV2	ADC flag ADC multimode slave 2 group injected end of sequence conversions (Note: on this STM32 serie, there is no flag ADC group injected end of unitary conversion. Flag noted as "JEOC" is corresponding to flag "JEOS" in other STM32 families)
LL_ADC_FLAG_AWD1_MST	ADC flag ADC multimode master analog watchdog 1 of the ADC master
LL_ADC_FLAG_AWD1_SLV1	ADC flag ADC multimode slave 1 analog watchdog 1
LL_ADC_FLAG_AWD1_SLV2	ADC flag ADC multimode slave 2 analog watchdog 1

ADC instance - Groups

LL_ADC_GROUP_REGULAR	ADC group regular (available on all STM32 devices)
LL_ADC_GROUP_INJECTED	ADC group injected (not available on all STM32 devices)
LL_ADC_GROUP_REGULAR_INJECTED	ADC both groups regular and injected

Definitions of ADC hardware constraints delays

LL_ADC_DELAY_VREFINT_STAB_US	Delay for internal voltage reference
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stabilization time

LL_ADC_DELAY_TEMPSENSOR_STAB_US Delay for internal voltage reference stabilization time

ADC group injected - Sequencer discontinuous mode

LL_ADC_INJ_SEQ_DISCONT_DISABLE ADC group injected sequencer discontinuous mode disable

LL_ADC_INJ_SEQ_DISCONT_1RANK ADC group injected sequencer discontinuous mode enable with sequence interruption every rank

ADC group injected - Sequencer ranks

LL_ADC_INJ_RANK_1 ADC group injected sequencer rank 1

LL_ADC_INJ_RANK_2 ADC group injected sequencer rank 2

LL_ADC_INJ_RANK_3 ADC group injected sequencer rank 3

LL_ADC_INJ_RANK_4 ADC group injected sequencer rank 4

ADC group injected - Sequencer scan length

LL_ADC_INJ_SEQ_SCAN_DISABLE ADC group injected sequencer disable (equivalent to sequencer of 1 rank: ADC conversion on only 1 channel)

LL_ADC_INJ_SEQ_SCAN_ENABLE_2RANKS ADC group injected sequencer enable with 2 ranks in the sequence

LL_ADC_INJ_SEQ_SCAN_ENABLE_3RANKS ADC group injected sequencer enable with 3 ranks in the sequence

LL_ADC_INJ_SEQ_SCAN_ENABLE_4RANKS ADC group injected sequencer enable with 4 ranks in the sequence

ADC group injected - Trigger edge

LL_ADC_INJ_TRIG_EXT_RISING ADC group injected conversion trigger polarity set to rising edge

LL_ADC_INJ_TRIG_EXT_FALLING ADC group injected conversion trigger polarity set to falling edge

LL_ADC_INJ_TRIG_EXT_RISINGFALLING ADC group injected conversion trigger polarity set to both rising and falling edges

ADC group injected - Trigger source

LL_ADC_INJ_TRIG_SOFTWARE ADC group injected conversion trigger internal: SW start.

LL_ADC_INJ_TRIG_EXT_TIM1_TRGO ADC group injected conversion trigger from external IP: TIM1 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM1_CH4 ADC group injected conversion trigger from external IP: TIM1 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM2_TRGO ADC group injected conversion trigger from external IP: TIM2 TRGO. Trigger edge set to

	rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM2_CH1	ADC group injected conversion trigger from external IP: TIM2 channel 1 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM3_CH4	ADC group injected conversion trigger from external IP: TIM3 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM4_TRGO	ADC group injected conversion trigger from external IP: TIM4 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM8_CH4	ADC group injected conversion trigger from external IP: TIM8 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM1_TRGO2	ADC group injected conversion trigger from external IP: TIM1 TRGO2. Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM8_TRGO	ADC group injected conversion trigger from external IP: TIM8 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM8_TRGO2	ADC group injected conversion trigger from external IP: TIM8 TRGO2. Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM3_CH3	ADC group injected conversion trigger from external IP: TIM3 channel 3 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM5_TRGO	ADC group injected conversion trigger from external IP: TIM5 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM3_CH1	ADC group injected conversion trigger from external IP: TIM3 channel 1 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM6_TRGO	ADC group injected conversion trigger from external IP: TIM6 TRGO. Trigger edge set to rising edge (default setting).

ADC group injected - Automatic trigger mode

LL_ADC_INJ_TRIG_INDEPENDENT	ADC group injected conversion trigger independent. Setting mandatory if ADC group injected injected trigger source is set to an external trigger.
LL_ADC_INJ_TRIG_FROM_GRP_REGULAR	ADC group injected conversion trigger from ADC group regular. Setting compliant only with group injected trigger source set to SW start, without any further action on

ADC group injected conversion start or stop: in this case, ADC group injected is controlled only from ADC group regular.

ADC interruptions for configuration (interruption enable or disable)

LL_ADC_IT_EOCS	ADC interruption ADC group regular end of unitary conversion or sequence conversions (to configure flag of end of conversion, use function)
LL_ADC_IT_OVR	ADC interruption ADC group regular overrun
LL_ADC_IT_JEOS	ADC interruption ADC group injected end of sequence conversions (Note: on this STM32 serie, there is no flag ADC group injected end of unitary conversion. Flag noted as "JEOC" is corresponding to flag "JEOS" in other STM32 families)
LL_ADC_IT_AWD1	ADC interruption ADC analog watchdog 1

Multimode - DMA transfer

LL_ADC_MULTI_REG_DMA_EACH_ADC	ADC multimode group regular conversions are transferred by DMA: each ADC uses its own DMA channel, with its individual DMA transfer settings
LL_ADC_MULTI_REG_DMA_LIMIT_1	ADC multimode group regular conversions are transferred by DMA, one DMA channel for all ADC instances (DMA of ADC master), in limited mode (one shot mode): DMA transfer requests are stopped when number of DMA data transfers (number of ADC conversions) is reached. This ADC mode is intended to be used with DMA mode non-circular. Setting of DMA mode 1: 2 or 3 (dual or triple mode) half-words one by one, ADC1 then ADC2 then ADC3.
LL_ADC_MULTI_REG_DMA_LIMIT_2	ADC multimode group regular conversions are transferred by DMA, one DMA channel for all ADC instances (DMA of ADC master), in limited mode (one shot mode): DMA transfer requests are stopped when number of DMA data transfers (number of ADC conversions) is reached. This ADC mode is intended to be used with DMA mode non-circular. Setting of DMA mode 2: 2 or 3 (dual or triple mode) half-words one by one, ADC2&1 then ADC1&3 then ADC3&2.
LL_ADC_MULTI_REG_DMA_LIMIT_3	ADC multimode group regular conversions are transferred by DMA, one DMA channel for all ADC instances (DMA of ADC master), in limited mode (one shot mode): DMA transfer requests are stopped when number of DMA data transfers (number of ADC conversions) is reached. This ADC mode is intended to be used with DMA mode non-circular. Setting of DMA mode 3: 2 or 3 (dual or triple mode) bytes one by one, ADC2&1 then ADC1&3

	then ADC3&2.
LL_ADC_MULTI_REG_DMA_UNLMT_1	ADC multimode group regular conversions are transferred by DMA, one DMA channel for all ADC instances (DMA of ADC master), in unlimited mode: DMA transfer requests are unlimited, whatever number of DMA data transferred (number of ADC conversions) is reached. This ADC mode is intended to be used with DMA mode non-circular. Setting of DMA mode 1: 2 or 3 (dual or triple mode) half-words one by one, ADC1 then ADC2 then ADC3.
LL_ADC_MULTI_REG_DMA_UNLMT_2	ADC multimode group regular conversions are transferred by DMA, one DMA channel for all ADC instances (DMA of ADC master), in unlimited mode: DMA transfer requests are unlimited, whatever number of DMA data transferred (number of ADC conversions) is reached. This ADC mode is intended to be used with DMA mode non-circular. Setting of DMA mode 2: 2 or 3 (dual or triple mode) half-words by pairs, ADC2&1 then ADC1&3 then ADC3&2.
LL_ADC_MULTI_REG_DMA_UNLMT_3	ADC multimode group regular conversions are transferred by DMA, one DMA channel for all ADC instances (DMA of ADC master), in unlimited mode: DMA transfer requests are unlimited, whatever number of DMA data transferred (number of ADC conversions) is reached. This ADC mode is intended to be used with DMA mode non-circular. Setting of DMA mode 3: 2 or 3 (dual or triple mode) bytes one by one, ADC2&1 then ADC1&3 then ADC3&2.

Multimode - ADC master or slave

LL_ADC_MULTI_MASTER	In multimode, selection among several ADC instances: ADC master
LL_ADC_MULTI_SLAVE	In multimode, selection among several ADC instances: ADC slave
LL_ADC_MULTI_MASTER_SLAVE	In multimode, selection among several ADC instances: both ADC master and ADC slave

Multimode - Mode

LL_ADC_MULTI_INDEPENDENT	ADC dual mode disabled (ADC independent mode)
LL_ADC_MULTI_DUAL_REG_SIMULT	ADC dual mode enabled: group regular simultaneous
LL_ADC_MULTI_DUAL_REG_INTERL	ADC dual mode enabled: Combined group regular interleaved
LL_ADC_MULTI_DUAL_INJ_SIMULT	ADC dual mode enabled: group injected

	simultaneous
LL_ADC_MULTI_DUAL_INJ_ALTERN	ADC dual mode enabled: group injected alternate trigger. Works only with external triggers (not internal SW start)
LL_ADC_MULTI_DUAL_REG_SIM_INJ_SIM	ADC dual mode enabled: Combined group regular simultaneous + group injected simultaneous
LL_ADC_MULTI_DUAL_REG_SIM_INJ_ALT	ADC dual mode enabled: Combined group regular simultaneous + group injected alternate trigger
LL_ADC_MULTI_DUAL_REG_INT_INJ_SIM	ADC dual mode enabled: Combined group regular interleaved + group injected simultaneous
LL_ADC_MULTI_TRIPLE_REG_SIM_INJ_SIM	ADC triple mode enabled: Combined group regular simultaneous + group injected simultaneous
LL_ADC_MULTI_TRIPLE_REG_SIM_INJ_ALT	ADC triple mode enabled: Combined group regular simultaneous + group injected alternate trigger
LL_ADC_MULTI_TRIPLE_INJ_SIMULT	ADC triple mode enabled: group injected simultaneous
LL_ADC_MULTI_TRIPLE_REG_SIMULT	ADC triple mode enabled: group regular simultaneous
LL_ADC_MULTI_TRIPLE_REG_INTERL	ADC triple mode enabled: Combined group regular interleaved
LL_ADC_MULTI_TRIPLE_INJ_ALTERN	ADC triple mode enabled: group injected alternate trigger. Works only with external triggers (not internal SW start)

Multimode - Delay between two sampling phases

LL_ADC_MULTI_TWOSMP_DELAY_5CYCLES	ADC multimode delay between two sampling phases: 5 ADC clock cycles
LL_ADC_MULTI_TWOSMP_DELAY_6CYCLES	ADC multimode delay between two sampling phases: 6 ADC clock cycles
LL_ADC_MULTI_TWOSMP_DELAY_7CYCLES	ADC multimode delay between two sampling phases: 7 ADC clock cycles
LL_ADC_MULTI_TWOSMP_DELAY_8CYCLES	ADC multimode delay between two sampling phases: 8 ADC clock cycles
LL_ADC_MULTI_TWOSMP_DELAY_9CYCLES	ADC multimode delay between two sampling phases: 9 ADC clock cycles
LL_ADC_MULTI_TWOSMP_DELAY_10CYCLES	ADC multimode delay between two sampling phases: 10 ADC clock cycles
LL_ADC_MULTI_TWOSMP_DELAY_11CYCLES	ADC multimode delay between two sampling phases: 11 ADC clock cycles
LL_ADC_MULTI_TWOSMP_DELAY_12CYCLES	ADC multimode delay between two sampling phases: 12 ADC clock cycles

LL_ADC_MULTI_TWOSMP_DELAY_13CYCLES	ADC multimode delay between two sampling phases: 13 ADC clock cycles
LL_ADC_MULTI_TWOSMP_DELAY_14CYCLES	ADC multimode delay between two sampling phases: 14 ADC clock cycles
LL_ADC_MULTI_TWOSMP_DELAY_15CYCLES	ADC multimode delay between two sampling phases: 15 ADC clock cycles
LL_ADC_MULTI_TWOSMP_DELAY_16CYCLES	ADC multimode delay between two sampling phases: 16 ADC clock cycles
LL_ADC_MULTI_TWOSMP_DELAY_17CYCLES	ADC multimode delay between two sampling phases: 17 ADC clock cycles
LL_ADC_MULTI_TWOSMP_DELAY_18CYCLES	ADC multimode delay between two sampling phases: 18 ADC clock cycles
LL_ADC_MULTI_TWOSMP_DELAY_19CYCLES	ADC multimode delay between two sampling phases: 19 ADC clock cycles
LL_ADC_MULTI_TWOSMP_DELAY_20CYCLES	ADC multimode delay between two sampling phases: 20 ADC clock cycles

ADC registers compliant with specific purpose

LL_ADC_DMA_REG_REGULAR_DATA
 LL_ADC_DMA_REG_REGULAR_DATA_MULTI

ADC group regular - Continuous mode

LL_ADC_REG_CONV_SINGLE	ADC conversions are performed in single mode: one conversion per trigger
LL_ADC_REG_CONV_CONTINUOUS	ADC conversions are performed in continuous mode: after the first trigger, following conversions launched successively automatically

ADC group regular - DMA transfer of ADC conversion data

LL_ADC_REG_DMA_TRANSFER_NONE	ADC conversions are not transferred by DMA
LL_ADC_REG_DMA_TRANSFER_LIMITED	ADC conversion data are transferred by DMA, in limited mode (one shot mode): DMA transfer requests are stopped when number of DMA data transfers (number of ADC conversions) is reached. This ADC mode is intended to be used with DMA mode non-circular.
LL_ADC_REG_DMA_TRANSFER_UNLIMITED	ADC conversion data are transferred by DMA, in unlimited mode: DMA transfer requests are unlimited, whatever number of DMA data transferred (number of ADC conversions). This ADC mode is intended to be used with DMA mode circular.

ADC group regular - Flag EOC selection (unitary or sequence conversions)

LL_ADC_REG_FLAG_EOC_SEQUENCE_CONV	ADC flag EOC (end of unitary conversion) selected
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LL_ADC_REG_FLAG_EOC_UNITARY_CONV	ADC flag EOS (end of sequence conversions) selected
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ADC group regular - Sequencer discontinuous mode

LL_ADC_REG_SEQ_DISCONT_DISABLE	ADC group regular sequencer discontinuous mode disable
LL_ADC_REG_SEQ_DISCONT_1RANK	ADC group regular sequencer discontinuous mode enable with sequence interruption every rank
LL_ADC_REG_SEQ_DISCONT_2RANKS	ADC group regular sequencer discontinuous mode enabled with sequence interruption every 2 ranks
LL_ADC_REG_SEQ_DISCONT_3RANKS	ADC group regular sequencer discontinuous mode enable with sequence interruption every 3 ranks
LL_ADC_REG_SEQ_DISCONT_4RANKS	ADC group regular sequencer discontinuous mode enable with sequence interruption every 4 ranks
LL_ADC_REG_SEQ_DISCONT_5RANKS	ADC group regular sequencer discontinuous mode enable with sequence interruption every 5 ranks
LL_ADC_REG_SEQ_DISCONT_6RANKS	ADC group regular sequencer discontinuous mode enable with sequence interruption every 6 ranks
LL_ADC_REG_SEQ_DISCONT_7RANKS	ADC group regular sequencer discontinuous mode enable with sequence interruption every 7 ranks
LL_ADC_REG_SEQ_DISCONT_8RANKS	ADC group regular sequencer discontinuous mode enable with sequence interruption every 8 ranks

ADC group regular - Sequencer ranks

LL_ADC_REG_RANK_1	ADC group regular sequencer rank 1
LL_ADC_REG_RANK_2	ADC group regular sequencer rank 2
LL_ADC_REG_RANK_3	ADC group regular sequencer rank 3
LL_ADC_REG_RANK_4	ADC group regular sequencer rank 4
LL_ADC_REG_RANK_5	ADC group regular sequencer rank 5
LL_ADC_REG_RANK_6	ADC group regular sequencer rank 6
LL_ADC_REG_RANK_7	ADC group regular sequencer rank 7
LL_ADC_REG_RANK_8	ADC group regular sequencer rank 8
LL_ADC_REG_RANK_9	ADC group regular sequencer rank 9
LL_ADC_REG_RANK_10	ADC group regular sequencer rank 10
LL_ADC_REG_RANK_11	ADC group regular sequencer rank 11
LL_ADC_REG_RANK_12	ADC group regular sequencer rank 12
LL_ADC_REG_RANK_13	ADC group regular sequencer rank 13

LL_ADC_REG_RANK_14	ADC group regular sequencer rank 14
LL_ADC_REG_RANK_15	ADC group regular sequencer rank 15
LL_ADC_REG_RANK_16	ADC group regular sequencer rank 16

ADC group regular - Sequencer scan length

LL_ADC_REG_SEQ_SCAN_DISABLE	ADC group regular sequencer disable (equivalent to sequencer of 1 rank: ADC conversion on only 1 channel)
LL_ADC_REG_SEQ_SCAN_ENABLE_2RANKS	ADC group regular sequencer enable with 2 ranks in the sequence
LL_ADC_REG_SEQ_SCAN_ENABLE_3RANKS	ADC group regular sequencer enable with 3 ranks in the sequence
LL_ADC_REG_SEQ_SCAN_ENABLE_4RANKS	ADC group regular sequencer enable with 4 ranks in the sequence
LL_ADC_REG_SEQ_SCAN_ENABLE_5RANKS	ADC group regular sequencer enable with 5 ranks in the sequence
LL_ADC_REG_SEQ_SCAN_ENABLE_6RANKS	ADC group regular sequencer enable with 6 ranks in the sequence
LL_ADC_REG_SEQ_SCAN_ENABLE_7RANKS	ADC group regular sequencer enable with 7 ranks in the sequence
LL_ADC_REG_SEQ_SCAN_ENABLE_8RANKS	ADC group regular sequencer enable with 8 ranks in the sequence
LL_ADC_REG_SEQ_SCAN_ENABLE_9RANKS	ADC group regular sequencer enable with 9 ranks in the sequence
LL_ADC_REG_SEQ_SCAN_ENABLE_10RANKS	ADC group regular sequencer enable with 10 ranks in the sequence
LL_ADC_REG_SEQ_SCAN_ENABLE_11RANKS	ADC group regular sequencer enable with 11 ranks in the sequence
LL_ADC_REG_SEQ_SCAN_ENABLE_12RANKS	ADC group regular sequencer enable with 12 ranks in the sequence
LL_ADC_REG_SEQ_SCAN_ENABLE_13RANKS	ADC group regular sequencer enable with 13 ranks in the sequence
LL_ADC_REG_SEQ_SCAN_ENABLE_14RANKS	ADC group regular sequencer enable with 14 ranks in the sequence
LL_ADC_REG_SEQ_SCAN_ENABLE_15RANKS	ADC group regular sequencer enable with 15 ranks in the sequence
LL_ADC_REG_SEQ_SCAN_ENABLE_16RANKS	ADC group regular sequencer enable with 16 ranks in the sequence

ADC group regular - Trigger edge

LL_ADC_REG_TRIG_EXT_RISING	ADC group regular conversion trigger polarity set to rising edge
LL_ADC_REG_TRIG_EXT_FALLING	ADC group regular conversion trigger polarity set to falling edge
LL_ADC_REG_TRIG_EXT_RISINGFALLING	ADC group regular conversion trigger

polarity set to both rising and falling edges

ADC group regular - Trigger source

LL_ADC_REG_TRIG_SOFTWARE	ADC group regular conversion trigger internal: SW start.
LL_ADC_REG_TRIG_EXT_TIM1_CH1	ADC group regular conversion trigger from external IP: TIM1 channel 1 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM1_CH2	ADC group regular conversion trigger from external IP: TIM1 channel 2 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM1_CH3	ADC group regular conversion trigger from external IP: TIM1 channel 3 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM2_CH2	ADC group regular conversion trigger from external IP: TIM2 channel 2 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM5_TRGO	ADC group regular conversion trigger from external IP: TIM5 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM4_CH4	ADC group regular conversion trigger from external IP: TIM4 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM3_CH4	ADC group regular conversion trigger from external IP: TIM3 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM8_TRGO	ADC group regular conversion trigger from external IP: TIM8 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM8_TRGO2	ADC group regular conversion trigger from external IP: TIM8 TRGO2. Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM1_TRGO	ADC group regular conversion trigger from external IP: TIM1 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM1_TRGO2	ADC group regular conversion trigger from external IP: TIM1 TRGO2. Trigger edge set to

	rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM2_TRGO	ADC group regular conversion trigger from external IP: TIM2 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM4_TRGO	ADC group regular conversion trigger from external IP: TIM4 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM6_TRGO	ADC group regular conversion trigger from external IP: TIM6 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_EXTI_LINE11	ADC group regular conversion trigger from external IP: external interrupt line 11. Trigger edge set to rising edge (default setting).

ADC instance - Resolution

LL_ADC_RESOLUTION_12B	ADC resolution 12 bits
LL_ADC_RESOLUTION_10B	ADC resolution 10 bits
LL_ADC_RESOLUTION_8B	ADC resolution 8 bits
LL_ADC_RESOLUTION_6B	ADC resolution 6 bits

ADC instance - Scan selection

LL_ADC_SEQ_SCAN_DISABLE	ADC conversion is performed in unitary conversion mode (one channel converted, that defined in rank 1). Configuration of both groups regular and injected sequencers (sequence length, ...) is discarded: equivalent to length of 1 rank.
LL_ADC_SEQ_SCAN_ENABLE	ADC conversions are performed in sequence conversions mode, according to configuration of both groups regular and injected sequencers (sequence length, ...).

ADC helper macro

`__LL_ADC_CHANNEL_TO_DECIMAL_NB`

Description:

- Helper macro to get ADC channel number in decimal format from literals `LL_ADC_CHANNEL_x`.

Parameters:

- `__CHANNEL__`: This parameter can be one of the following values:
 - `LL_ADC_CHANNEL_0`
 - `LL_ADC_CHANNEL_1`
 - `LL_ADC_CHANNEL_2`
 - `LL_ADC_CHANNEL_3`
 - `LL_ADC_CHANNEL_4`
 - `LL_ADC_CHANNEL_5`
 - `LL_ADC_CHANNEL_6`
 - `LL_ADC_CHANNEL_7`
 - `LL_ADC_CHANNEL_8`
 - `LL_ADC_CHANNEL_9`

- LL_ADC_CHANNEL_10
- LL_ADC_CHANNEL_11
- LL_ADC_CHANNEL_12
- LL_ADC_CHANNEL_13
- LL_ADC_CHANNEL_14
- LL_ADC_CHANNEL_15
- LL_ADC_CHANNEL_16
- LL_ADC_CHANNEL_17
- LL_ADC_CHANNEL_18
- LL_ADC_CHANNEL_VREFINT (1)
- LL_ADC_CHANNEL_TEMPSENSOR (1)(2)
- LL_ADC_CHANNEL_VBAT (1)

Return value:

- Value: between Min_Data=0 and Max_Data=18

Notes:

- Example:
 __LL_ADC_CHANNEL_TO_DECIMAL_NB(LL_ADC_CHANNEL_4) will return decimal number "4". The input can be a value from functions where a channel number is returned, either defined with number or with bitfield (only one bit must be set).

[__LL_ADC_DECIMAL_NB_TO_CHANNEL](#)

Description:

- Helper macro to get ADC channel in literal format LL_ADC_CHANNEL_x from number in decimal format.

Parameters:

- __DECIMAL_NB__: Value between Min_Data=0 and Max_Data=18

Return value:

- Returned: value can be one of the following values:
 - LL_ADC_CHANNEL_0
 - LL_ADC_CHANNEL_1
 - LL_ADC_CHANNEL_2
 - LL_ADC_CHANNEL_3
 - LL_ADC_CHANNEL_4
 - LL_ADC_CHANNEL_5
 - LL_ADC_CHANNEL_6
 - LL_ADC_CHANNEL_7
 - LL_ADC_CHANNEL_8
 - LL_ADC_CHANNEL_9
 - LL_ADC_CHANNEL_10
 - LL_ADC_CHANNEL_11
 - LL_ADC_CHANNEL_12
 - LL_ADC_CHANNEL_13
 - LL_ADC_CHANNEL_14

- LL_ADC_CHANNEL_15
- LL_ADC_CHANNEL_16
- LL_ADC_CHANNEL_17
- LL_ADC_CHANNEL_18
- LL_ADC_CHANNEL_VREFINT (1)
- LL_ADC_CHANNEL_TEMPSENSOR (1)(2)
- LL_ADC_CHANNEL_VBAT (1)

Notes:

- Example:
__LL_ADC_DECIMAL_NB_TO_CHANNEL(4)
will return a data equivalent to
"LL_ADC_CHANNEL_4".

__LL_ADC_IS_CHANNEL_INTERNAL

Description:

- Helper macro to determine whether the selected channel corresponds to literal definitions of driver.

Parameters:

- __CHANNEL__: This parameter can be one of the following values:
 - LL_ADC_CHANNEL_0
 - LL_ADC_CHANNEL_1
 - LL_ADC_CHANNEL_2
 - LL_ADC_CHANNEL_3
 - LL_ADC_CHANNEL_4
 - LL_ADC_CHANNEL_5
 - LL_ADC_CHANNEL_6
 - LL_ADC_CHANNEL_7
 - LL_ADC_CHANNEL_8
 - LL_ADC_CHANNEL_9
 - LL_ADC_CHANNEL_10
 - LL_ADC_CHANNEL_11
 - LL_ADC_CHANNEL_12
 - LL_ADC_CHANNEL_13
 - LL_ADC_CHANNEL_14
 - LL_ADC_CHANNEL_15
 - LL_ADC_CHANNEL_16
 - LL_ADC_CHANNEL_17
 - LL_ADC_CHANNEL_18
 - LL_ADC_CHANNEL_VREFINT (1)
 - LL_ADC_CHANNEL_TEMPSENSOR (1)(2)
 - LL_ADC_CHANNEL_VBAT (1)

Return value:

- Value: "0" if the channel corresponds to a parameter definition of a ADC external channel (channel connected to a GPIO pin). Value "1" if the channel corresponds to a parameter definition of a ADC internal channel.

Notes:

- The different literal definitions of ADC channels are: ADC internal channel: LL_ADC_CHANNEL_VREFINT, LL_ADC_CHANNEL_TEMPSENSOR, ...ADC external channel (channel connected to a GPIO pin): LL_ADC_CHANNEL_1, LL_ADC_CHANNEL_2, ... The channel parameter must be a value defined from literal definition of a ADC internal channel (LL_ADC_CHANNEL_VREFINT, LL_ADC_CHANNEL_TEMPSENSOR, ...), ADC external channel (LL_ADC_CHANNEL_1, LL_ADC_CHANNEL_2, ...), must not be a value from functions where a channel number is returned from ADC registers, because internal and external channels share the same channel number in ADC registers. The differentiation is made only with parameters definitions of driver.

LL_ADC_CHANNEL_INTERNAL_TO_EXTERNAL

Description:

- Helper macro to convert a channel defined from parameter definition of a ADC internal channel (LL_ADC_CHANNEL_VREFINT, LL_ADC_CHANNEL_TEMPSENSOR, ...), to its equivalent parameter definition of a ADC external channel (LL_ADC_CHANNEL_1, LL_ADC_CHANNEL_2, ...).

Parameters:

- CHANNEL: This parameter can be one of the following values:
 - LL_ADC_CHANNEL_0
 - LL_ADC_CHANNEL_1
 - LL_ADC_CHANNEL_2
 - LL_ADC_CHANNEL_3
 - LL_ADC_CHANNEL_4
 - LL_ADC_CHANNEL_5
 - LL_ADC_CHANNEL_6
 - LL_ADC_CHANNEL_7
 - LL_ADC_CHANNEL_8
 - LL_ADC_CHANNEL_9
 - LL_ADC_CHANNEL_10
 - LL_ADC_CHANNEL_11
 - LL_ADC_CHANNEL_12
 - LL_ADC_CHANNEL_13
 - LL_ADC_CHANNEL_14
 - LL_ADC_CHANNEL_15
 - LL_ADC_CHANNEL_16
 - LL_ADC_CHANNEL_17
 - LL_ADC_CHANNEL_18
 - LL_ADC_CHANNEL_VREFINT (1)
 - LL_ADC_CHANNEL_TEMPSENSOR

(1)(2)

- LL_ADC_CHANNEL_VBAT (1)

Return value:

- Returned: value can be one of the following values:
 - LL_ADC_CHANNEL_0
 - LL_ADC_CHANNEL_1
 - LL_ADC_CHANNEL_2
 - LL_ADC_CHANNEL_3
 - LL_ADC_CHANNEL_4
 - LL_ADC_CHANNEL_5
 - LL_ADC_CHANNEL_6
 - LL_ADC_CHANNEL_7
 - LL_ADC_CHANNEL_8
 - LL_ADC_CHANNEL_9
 - LL_ADC_CHANNEL_10
 - LL_ADC_CHANNEL_11
 - LL_ADC_CHANNEL_12
 - LL_ADC_CHANNEL_13
 - LL_ADC_CHANNEL_14
 - LL_ADC_CHANNEL_15
 - LL_ADC_CHANNEL_16
 - LL_ADC_CHANNEL_17
 - LL_ADC_CHANNEL_18

Notes:

- The channel parameter can be, additionally to a value defined from parameter definition of a ADC internal channel (LL_ADC_CHANNEL_VREFINT, LL_ADC_CHANNEL_TEMPSENSOR, ...), a value defined from parameter definition of ADC external channel (LL_ADC_CHANNEL_1, LL_ADC_CHANNEL_2, ...) or a value from functions where a channel number is returned from ADC registers.

[__LL_ADC_IS_CHANNEL_INTERNAL_AVAILABLE](#)

Description:

- Helper macro to determine whether the internal channel selected is available on the ADC instance selected.

Parameters:

- `__ADC_INSTANCE__`: ADC instance
- `__CHANNEL__`: This parameter can be one of the following values:
 - LL_ADC_CHANNEL_VREFINT (1)
 - LL_ADC_CHANNEL_TEMPSENSOR (1)(2)
 - LL_ADC_CHANNEL_VBAT (1)

Return value:

- Value: "0" if the internal channel selected is not

available on the ADC instance selected. Value "1" if the internal channel selected is available on the ADC instance selected.

Notes:

- The channel parameter must be a value defined from parameter definition of a ADC internal channel (LL_ADC_CHANNEL_VREFINT, LL_ADC_CHANNEL_TEMPSENSOR, ...), must not be a value defined from parameter definition of ADC external channel (LL_ADC_CHANNEL_1, LL_ADC_CHANNEL_2, ...) or a value from functions where a channel number is returned from ADC registers, because internal and external channels share the same channel number in ADC registers. The differentiation is made only with parameters definitions of driver.

`__LL_ADC_ANALOGWD_CHANNEL_GROUP`

Description:

- Helper macro to define ADC analog watchdog parameter: define a single channel to monitor with analog watchdog from sequencer channel and groups definition.

Parameters:

- `__CHANNEL__`: This parameter can be one of the following values:
 - LL_ADC_CHANNEL_0
 - LL_ADC_CHANNEL_1
 - LL_ADC_CHANNEL_2
 - LL_ADC_CHANNEL_3
 - LL_ADC_CHANNEL_4
 - LL_ADC_CHANNEL_5
 - LL_ADC_CHANNEL_6
 - LL_ADC_CHANNEL_7
 - LL_ADC_CHANNEL_8
 - LL_ADC_CHANNEL_9
 - LL_ADC_CHANNEL_10
 - LL_ADC_CHANNEL_11
 - LL_ADC_CHANNEL_12
 - LL_ADC_CHANNEL_13
 - LL_ADC_CHANNEL_14
 - LL_ADC_CHANNEL_15
 - LL_ADC_CHANNEL_16
 - LL_ADC_CHANNEL_17
 - LL_ADC_CHANNEL_18
 - LL_ADC_CHANNEL_VREFINT (1)
 - LL_ADC_CHANNEL_TEMPSENSOR (1)(2)
 - LL_ADC_CHANNEL_VBAT (1)
- `__GROUP__`: This parameter can be one of the following values:
 - LL_ADC_GROUP_REGULAR

- LL_ADC_GROUP_INJECTED
- LL_ADC_GROUP_REGULAR_INJECTED

Return value:

- Returned: value can be one of the following values:
 - LL_ADC_AWD_DISABLE
 - LL_ADC_AWD_ALL_CHANNELS_REG
 - LL_ADC_AWD_ALL_CHANNELS_INJ
 - LL_ADC_AWD_ALL_CHANNELS_REG_I
NJ
 - LL_ADC_AWD_CHANNEL_0_REG
 - LL_ADC_AWD_CHANNEL_0_INJ
 - LL_ADC_AWD_CHANNEL_0_REG_INJ
 - LL_ADC_AWD_CHANNEL_1_REG
 - LL_ADC_AWD_CHANNEL_1_INJ
 - LL_ADC_AWD_CHANNEL_1_REG_INJ
 - LL_ADC_AWD_CHANNEL_2_REG
 - LL_ADC_AWD_CHANNEL_2_INJ
 - LL_ADC_AWD_CHANNEL_2_REG_INJ
 - LL_ADC_AWD_CHANNEL_3_REG
 - LL_ADC_AWD_CHANNEL_3_INJ
 - LL_ADC_AWD_CHANNEL_3_REG_INJ
 - LL_ADC_AWD_CHANNEL_4_REG
 - LL_ADC_AWD_CHANNEL_4_INJ
 - LL_ADC_AWD_CHANNEL_4_REG_INJ
 - LL_ADC_AWD_CHANNEL_5_REG
 - LL_ADC_AWD_CHANNEL_5_INJ
 - LL_ADC_AWD_CHANNEL_5_REG_INJ
 - LL_ADC_AWD_CHANNEL_6_REG
 - LL_ADC_AWD_CHANNEL_6_INJ
 - LL_ADC_AWD_CHANNEL_6_REG_INJ
 - LL_ADC_AWD_CHANNEL_7_REG
 - LL_ADC_AWD_CHANNEL_7_INJ
 - LL_ADC_AWD_CHANNEL_7_REG_INJ
 - LL_ADC_AWD_CHANNEL_8_REG
 - LL_ADC_AWD_CHANNEL_8_INJ
 - LL_ADC_AWD_CHANNEL_8_REG_INJ
 - LL_ADC_AWD_CHANNEL_9_REG
 - LL_ADC_AWD_CHANNEL_9_INJ
 - LL_ADC_AWD_CHANNEL_9_REG_INJ
 - LL_ADC_AWD_CHANNEL_10_REG
 - LL_ADC_AWD_CHANNEL_10_INJ
 - LL_ADC_AWD_CHANNEL_10_REG_INJ
 - LL_ADC_AWD_CHANNEL_11_REG
 - LL_ADC_AWD_CHANNEL_11_INJ
 - LL_ADC_AWD_CHANNEL_11_REG_INJ
 - LL_ADC_AWD_CHANNEL_12_REG
 - LL_ADC_AWD_CHANNEL_12_INJ
 - LL_ADC_AWD_CHANNEL_12_REG_INJ
 - LL_ADC_AWD_CHANNEL_13_REG
 - LL_ADC_AWD_CHANNEL_13_INJ

- LL_ADC_AWD_CHANNEL_13_REG_INJ
- LL_ADC_AWD_CHANNEL_14_REG
- LL_ADC_AWD_CHANNEL_14_INJ
- LL_ADC_AWD_CHANNEL_14_REG_INJ
- LL_ADC_AWD_CHANNEL_15_REG
- LL_ADC_AWD_CHANNEL_15_INJ
- LL_ADC_AWD_CHANNEL_15_REG_INJ
- LL_ADC_AWD_CHANNEL_16_REG
- LL_ADC_AWD_CHANNEL_16_INJ
- LL_ADC_AWD_CHANNEL_16_REG_INJ
- LL_ADC_AWD_CHANNEL_17_REG
- LL_ADC_AWD_CHANNEL_17_INJ
- LL_ADC_AWD_CHANNEL_17_REG_INJ
- LL_ADC_AWD_CHANNEL_18_REG
- LL_ADC_AWD_CHANNEL_18_INJ
- LL_ADC_AWD_CHANNEL_18_REG_INJ
- LL_ADC_AWD_CH_VREFINT_REG (1)
- LL_ADC_AWD_CH_VREFINT_INJ (1)
- LL_ADC_AWD_CH_VREFINT_REG_INJ (1)
- LL_ADC_AWD_CH_TEMPSENSOR_REG (1)(2)
- LL_ADC_AWD_CH_TEMPSENSOR_INJ (1)(2)
- LL_ADC_AWD_CH_TEMPSENSOR_REG_INJ (1)(2)
- LL_ADC_AWD_CH_VBAT_REG (1)
- LL_ADC_AWD_CH_VBAT_INJ (1)
- LL_ADC_AWD_CH_VBAT_REG_INJ (1)

Notes:

- To be used with function `LL_ADC_SetAnalogWDMonitChannels()`.
Example:
`LL_ADC_SetAnalogWDMonitChannels(ADC1, LL_ADC_AWD1, __LL_ADC_ANALOGWD_CHANNEL_GROUP(LL_ADC_CHANNEL4, LL_ADC_GROUP_REGULAR))`

`__LL_ADC_ANALOGWD_SET_THRESHOLD_RESOLUTION`

Description:

- Helper macro to set the value of ADC analog watchdog threshold high or low in function of ADC resolution, when ADC resolution is different of 12 bits.

Parameters:

- `__ADC_RESOLUTION__`: This parameter can be one of the following values:
 - `LL_ADC_RESOLUTION_12B`
 - `LL_ADC_RESOLUTION_10B`
 - `LL_ADC_RESOLUTION_8B`
 - `LL_ADC_RESOLUTION_6B`

- `__AWD_THRESHOLD__`: Value between `Min_Data=0x000` and `Max_Data=0xFFF`

Return value:

- Value: between `Min_Data=0x000` and `Max_Data=0xFFF`

Notes:

- To be used with function `LL_ADC_SetAnalogWDThresholds()`. Example, with a ADC resolution of 8 bits, to set the value of analog watchdog threshold high (on 8 bits): `LL_ADC_SetAnalogWDThresholds (< ADCx param>, __LL_ADC_ANALOGWD_SET_THRESHOLD_RESOLUTION(LL_ADC_RESOLUTION_8B, <threshold_value_8_bits>)`);

`__LL_ADC_ANALOGWD_GET_THRESHOLD_RESOLUTION`

Description:

- Helper macro to get the value of ADC analog watchdog threshold high or low in function of ADC resolution, when ADC resolution is different of 12 bits.

Parameters:

- `__ADC_RESOLUTION__`: This parameter can be one of the following values:
 - `LL_ADC_RESOLUTION_12B`
 - `LL_ADC_RESOLUTION_10B`
 - `LL_ADC_RESOLUTION_8B`
 - `LL_ADC_RESOLUTION_6B`
- `__AWD_THRESHOLD_12_BITS__`: Value between `Min_Data=0x000` and `Max_Data=0xFFF`

Return value:

- Value: between `Min_Data=0x000` and `Max_Data=0xFFF`

Notes:

- To be used with function `LL_ADC_GetAnalogWDThresholds()`. Example, with a ADC resolution of 8 bits, to get the value of analog watchdog threshold high (on 8 bits): `< threshold_value_6_bits> = __LL_ADC_ANALOGWD_GET_THRESHOLD_RESOLUTION (LL_ADC_RESOLUTION_8B, LL_ADC_GetAnalogWDThresholds(<ADCx param>, LL_ADC_AWD_THRESHOLD_HIGH))`;

`__LL_ADC_MULTI_CONV_DATA_MASTER_SLAVE`

Description:

- Helper macro to get the ADC multimode conversion data of ADC master or ADC slave

from raw value with both ADC conversion data concatenated.

Parameters:

- `__ADC_MULTI_MASTER_SLAVE__`: This parameter can be one of the following values:
 - `LL_ADC_MULTI_MASTER`
 - `LL_ADC_MULTI_SLAVE`
- `__ADC_MULTI_CONV_DATA__`: Value between `Min_Data=0x000` and `Max_Data=0xFFF`

Return value:

- Value: between `Min_Data=0x000` and `Max_Data=0xFFF`

Notes:

- This macro is intended to be used when multimode transfer by DMA is enabled: refer to function `LL_ADC_SetMultiDMATransfer()`. In this case the transferred data need to be processed with this macro to separate the conversion data of ADC master and ADC slave.

`__LL_ADC_COMMON_INSTANCE`

Description:

- Helper macro to select the ADC common instance to which is belonging the selected ADC instance.

Parameters:

- `__ADCx__`: ADC instance

Return value:

- ADC: common register instance

Notes:

- ADC common register instance can be used for: Set parameters common to several ADC instancesMultimode (for devices with several ADC instances) Refer to functions having argument "ADCxy_COMMON" as parameter.

`__LL_ADC_IS_ENABLED_ALL_COMMON_INSTANCE`

Description:

- Helper macro to check if all ADC instances sharing the same ADC common instance are disabled.

Parameters:

- `__ADCXY_COMMON__`: ADC common instance (can be set directly from CMSIS definition or by using helper macro)

Return value:

- Value: "0" if all ADC instances sharing the same

ADC common instance are disabled. Value "1" if at least one ADC instance sharing the same ADC common instance is enabled.

Notes:

- This check is required by functions with setting conditioned to ADC state: All ADC instances of the ADC common group must be disabled. Refer to functions having argument "ADCxy_COMMON" as parameter. On devices with only 1 ADC common instance, parameter of this macro is useless and can be ignored (parameter kept for compatibility with devices featuring several ADC common instances).

__LL_ADC_DIGITAL_SCALE**Description:**

- Helper macro to define the ADC conversion data full-scale digital value corresponding to the selected ADC resolution.

Parameters:

- **__ADC_RESOLUTION__**: This parameter can be one of the following values:
 - LL_ADC_RESOLUTION_12B
 - LL_ADC_RESOLUTION_10B
 - LL_ADC_RESOLUTION_8B
 - LL_ADC_RESOLUTION_6B

Return value:

- ADC: conversion data equivalent voltage value (unit: mV)

Notes:

- ADC conversion data full-scale corresponds to voltage range determined by analog voltage references Vref+ and Vref- (refer to reference manual).

__LL_ADC_CONVERT_DATA_RESOLUTION**Description:**

- Helper macro to convert the ADC conversion data from a resolution to another resolution.

Parameters:

- **__DATA__**: ADC conversion data to be converted
- **__ADC_RESOLUTION_CURRENT__**: Resolution of the data to be converted This parameter can be one of the following values:
 - LL_ADC_RESOLUTION_12B
 - LL_ADC_RESOLUTION_10B
 - LL_ADC_RESOLUTION_8B
 - LL_ADC_RESOLUTION_6B
- **__ADC_RESOLUTION_TARGET__**: Resolution of the data after conversion This

parameter can be one of the following values:

- LL_ADC_RESOLUTION_12B
- LL_ADC_RESOLUTION_10B
- LL_ADC_RESOLUTION_8B
- LL_ADC_RESOLUTION_6B

Return value:

- ADC: conversion data to the requested resolution

`__LL_ADC_CALC_DATA_TO_VOLTAGE`

Description:

- Helper macro to calculate the voltage (unit: mVolt) corresponding to a ADC conversion data (unit: digital value).

Parameters:

- `__VREFANALOG_VOLTAGE__`: Analog reference voltage (unit: mV)
- `__ADC_DATA__`: ADC conversion data (resolution 12 bits) (unit: digital value).
- `__ADC_RESOLUTION__`: This parameter can be one of the following values:
 - LL_ADC_RESOLUTION_12B
 - LL_ADC_RESOLUTION_10B
 - LL_ADC_RESOLUTION_8B
 - LL_ADC_RESOLUTION_6B

Return value:

- ADC: conversion data equivalent voltage value (unit: mVolt)

Notes:

- Analog reference voltage (Vref+) must be either known from user board environment or can be calculated using ADC measurement and ADC helper macro `__LL_ADC_CALC_VREFANALOG_VOLTAGE()`.

`__LL_ADC_CALC_VREFANALOG_VOLTAGE`

Description:

- Helper macro to calculate analog reference voltage (Vref+) (unit: mVolt) from ADC conversion data of internal voltage reference VrefInt.

Parameters:

- `__VREFINT_ADC_DATA__`: ADC conversion data (resolution 12 bits) of internal voltage reference VrefInt (unit: digital value).
- `__ADC_RESOLUTION__`: This parameter can be one of the following values:
 - LL_ADC_RESOLUTION_12B
 - LL_ADC_RESOLUTION_10B
 - LL_ADC_RESOLUTION_8B

– LL_ADC_RESOLUTION_6B

Return value:

- Analog: reference voltage (unit: mV)

Notes:

- Computation is using VrefInt calibration value stored in system memory for each device during production. This voltage depends on user board environment: voltage level connected to pin Vref+. On devices with small package, the pin Vref+ is not present and internally bonded to pin Vdda. On this STM32 serie, calibration data of internal voltage reference VrefInt corresponds to a resolution of 12 bits, this is the recommended ADC resolution to convert voltage of internal voltage reference VrefInt. Otherwise, this macro performs the processing to scale ADC conversion data to 12 bits.

`__LL_ADC_CALC_TEMPERATURE`

Description:

- Helper macro to calculate the temperature (unit: degree Celsius) from ADC conversion data of internal temperature sensor.

Parameters:

- `__VREFANALOG_VOLTAGE__`: Analog reference voltage (unit: mV)
- `__TEMPSENSOR_ADC_DATA__`: ADC conversion data of internal temperature sensor (unit: digital value).
- `__ADC_RESOLUTION__`: ADC resolution at which internal temperature sensor voltage has been measured. This parameter can be one of the following values:
 - LL_ADC_RESOLUTION_12B
 - LL_ADC_RESOLUTION_10B
 - LL_ADC_RESOLUTION_8B
 - LL_ADC_RESOLUTION_6B

Return value:

- Temperature: (unit: degree Celsius)

Notes:

- Computation is using temperature sensor calibration values stored in system memory for each device during production. Calculation formula: $Temperature = ((TS_ADC_DATA - TS_CAL1) * (TS_CAL2_TEMP - TS_CAL1_TEMP)) / (TS_CAL2 - TS_CAL1) + TS_CAL1_TEMP$ with $TS_ADC_DATA =$ temperature sensor raw data measured by ADC
 $Avg_Slope = (TS_CAL2 - TS_CAL1) /$

(TS_CAL2_TEMP - TS_CAL1_TEMP)
 TS_CAL1 = equivalent TS_ADC_DATA at temperature TEMP_DEGC_CAL1 (calibrated in factory)
 TS_CAL2 = equivalent TS_ADC_DATA at temperature TEMP_DEGC_CAL2 (calibrated in factory)
 Caution: Calculation relevancy under reserve that calibration parameters are correct (address and data). To calculate temperature using temperature sensor datasheet typical values (generic values less, therefore less accurate than calibrated values), use helper macro
 __LL_ADC_CALC_TEMPERATURE_TYP_PARAMS(). As calculation input, the analog reference voltage (Vref+) must be defined as it impacts the ADC LSB equivalent voltage. Analog reference voltage (Vref+) must be either known from user board environment or can be calculated using ADC measurement and ADC helper macro
 __LL_ADC_CALC_VREFANALOG_VOLTAGE(). On this STM32 serie, calibration data of temperature sensor corresponds to a resolution of 12 bits, this is the recommended ADC resolution to convert voltage of temperature sensor. Otherwise, this macro performs the processing to scale ADC conversion data to 12 bits.

`__LL_ADC_CALC_TEMPERATURE_TYP_PARAMS`

Description:

- Helper macro to calculate the temperature (unit: degree Celsius) from ADC conversion data of internal temperature sensor.

Parameters:

- `__TEMPSENSOR_TYP_AVGSLOPE__`: Device datasheet data: Temperature sensor slope typical value (unit: uV/DegCelsius). On STM32F7, refer to device datasheet parameter "Avg_Slope".
- `__TEMPSENSOR_TYP_CALX_V__`: Device datasheet data: Temperature sensor voltage typical value (at temperature and Vref+ defined in parameters below) (unit: mV). On STM32F4, refer to device datasheet parameter "V25".
- `__TEMPSENSOR_CALX_TEMP__`: Device datasheet data: Temperature at which temperature sensor voltage (see parameter above) is corresponding (unit: mV)
- `__VREFANALOG_VOLTAGE__`: Analog voltage reference (Vref+) voltage (unit: mV)
- `__TEMPSENSOR_ADC_DATA__`: ADC conversion data of internal temperature sensor (unit: digital value).
- `__ADC_RESOLUTION__`: ADC resolution at

which internal temperature sensor voltage has been measured. This parameter can be one of the following values:

- LL_ADC_RESOLUTION_12B
- LL_ADC_RESOLUTION_10B
- LL_ADC_RESOLUTION_8B
- LL_ADC_RESOLUTION_6B

Return value:

- Temperature: (unit: degree Celsius)

Notes:

- Computation is using temperature sensor typical values (refer to device datasheet).
Calculation formula: $Temperature = (TS_TYP_CALx_VOLT(uV) - TS_ADC_DATA * Conversion_uV) / Avg_Slope + CALx_TEMP$
with TS_ADC_DATA = temperature sensor raw data measured by ADC (unit: digital value)
 Avg_Slope = temperature sensor slope (unit: $\mu V/Degree\ Celsius$)
 $TS_TYP_CALx_VOLT$ = temperature sensor digital value at temperature $CALx_TEMP$ (unit: mV) Caution: Calculation relevancy under reserve the temperature sensor of the current device has characteristics in line with datasheet typical values. If temperature sensor calibration values are available on on this device (presence of macro `__LL_ADC_CALC_TEMPERATURE()`), temperature calculation will be more accurate using helper macro `__LL_ADC_CALC_TEMPERATURE()`. As calculation input, the analog reference voltage (V_{ref+}) must be defined as it impacts the ADC LSB equivalent voltage. Analog reference voltage (V_{ref+}) must be either known from user board environment or can be calculated using ADC measurement and ADC helper macro `__LL_ADC_CALC_VREFANALOG_VOLTAGE()`. ADC measurement data must correspond to a resolution of 12bits (full scale digital value 4095). If not the case, the data must be preliminarily rescaled to an equivalent resolution of 12 bits.

Common write and read registers Macros

`LL_ADC_WriteReg`

Description:

- Write a value in ADC register.

Parameters:

- `__INSTANCE__`: ADC Instance
- `__REG__`: Register to be written
- `__VALUE__`: Value to be written in the register

LL_ADC_ReadReg

Return value:

- None

Description:

- Read a value in ADC register.

Parameters:

- `__INSTANCE__`: ADC Instance
- `__REG__`: Register to be read

Return value:

- Register: value

72 LL BUS Generic Driver

72.1 BUS Firmware driver API description

72.1.1 Detailed description of functions

LL_AHB1_GRP1_EnableClock

Function name `__STATIC_INLINE void LL_AHB1_GRP1_EnableClock (uint32_t Periphs)`

Function description Enable AHB1 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_AHB1_GRP1_PERIPH_GPIOA
 - LL_AHB1_GRP1_PERIPH_GPIOB
 - LL_AHB1_GRP1_PERIPH_GPIOC
 - LL_AHB1_GRP1_PERIPH_GPIOD
 - LL_AHB1_GRP1_PERIPH_GPIOE
 - LL_AHB1_GRP1_PERIPH_GPIOF
 - LL_AHB1_GRP1_PERIPH_GPIOG
 - LL_AHB1_GRP1_PERIPH_GPIOH
 - LL_AHB1_GRP1_PERIPH_GPIOI
 - LL_AHB1_GRP1_PERIPH_GPIOJ (*)
 - LL_AHB1_GRP1_PERIPH_GPIOK (*)
 - LL_AHB1_GRP1_PERIPH_CRC
 - LL_AHB1_GRP1_PERIPH_BKPSRAM
 - LL_AHB1_GRP1_PERIPH_DTCMRAM
 - LL_AHB1_GRP1_PERIPH_DMA1
 - LL_AHB1_GRP1_PERIPH_DMA2
 - LL_AHB1_GRP1_PERIPH_DMA2D (*)
 - LL_AHB1_GRP1_PERIPH_ETHMAC (*)
 - LL_AHB1_GRP1_PERIPH_ETHMACTX (*)
 - LL_AHB1_GRP1_PERIPH_ETHMACRX (*)
 - LL_AHB1_GRP1_PERIPH_ETHMACPTP (*)
 - LL_AHB1_GRP1_PERIPH_OTGHS
 - LL_AHB1_GRP1_PERIPH_OTGHSULPI

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB1ENR GPIOAEN LL_AHB1_GRP1_EnableClock
- AHB1ENR GPIOBEN LL_AHB1_GRP1_EnableClock
- AHB1ENR GPIOCEN LL_AHB1_GRP1_EnableClock
- AHB1ENR GPIODEN LL_AHB1_GRP1_EnableClock
- AHB1ENR GPIOEEN LL_AHB1_GRP1_EnableClock
- AHB1ENR GPIOFEN LL_AHB1_GRP1_EnableClock
- AHB1ENR GPIOGEN LL_AHB1_GRP1_EnableClock
- AHB1ENR GPIOHEN LL_AHB1_GRP1_EnableClock
- AHB1ENR GPIOIEN LL_AHB1_GRP1_EnableClock
- AHB1ENR GPIOJEN LL_AHB1_GRP1_EnableClock
- AHB1ENR GPIOKEN LL_AHB1_GRP1_EnableClock

- AHB1ENR CRCEN LL_AHB1_GRP1_EnableClock
- AHB1ENR BKPSRAMEN LL_AHB1_GRP1_EnableClock
- AHB1ENR DTCMRAMEN LL_AHB1_GRP1_EnableClock
- AHB1ENR DMA1EN LL_AHB1_GRP1_EnableClock
- AHB1ENR DMA2EN LL_AHB1_GRP1_EnableClock
- AHB1ENR DMA2DEN LL_AHB1_GRP1_EnableClock
- AHB1ENR ETHMACEN LL_AHB1_GRP1_EnableClock
- AHB1ENR ETHMACTXEN LL_AHB1_GRP1_EnableClock
- AHB1ENR ETHMACRXEN LL_AHB1_GRP1_EnableClock
- AHB1ENR ETHMACPTPEN LL_AHB1_GRP1_EnableClock
- AHB1ENR OTGHSEN LL_AHB1_GRP1_EnableClock
- AHB1ENR OTGHSULPIEN LL_AHB1_GRP1_EnableClock

LL_AHB1_GRP1_IsEnabledClock

Function name `__STATIC_INLINE uint32_t LL_AHB1_GRP1_IsEnabledClock (uint32_t Periphs)`

Function description Check if AHB1 peripheral clock is enabled or not.

Parameters

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_AHB1_GRP1_PERIPH_GPIOA
 - LL_AHB1_GRP1_PERIPH_GPIOB
 - LL_AHB1_GRP1_PERIPH_GPIOC
 - LL_AHB1_GRP1_PERIPH_GPIOD
 - LL_AHB1_GRP1_PERIPH_GPIOE
 - LL_AHB1_GRP1_PERIPH_GPIOF
 - LL_AHB1_GRP1_PERIPH_GPIOG
 - LL_AHB1_GRP1_PERIPH_GPIOH
 - LL_AHB1_GRP1_PERIPH_GPIOI
 - LL_AHB1_GRP1_PERIPH_GPIOJ (*)
 - LL_AHB1_GRP1_PERIPH_GPIOK (*)
 - LL_AHB1_GRP1_PERIPH_CRC
 - LL_AHB1_GRP1_PERIPH_BKPSRAM
 - LL_AHB1_GRP1_PERIPH_DTCMRAM
 - LL_AHB1_GRP1_PERIPH_DMA1
 - LL_AHB1_GRP1_PERIPH_DMA2
 - LL_AHB1_GRP1_PERIPH_DMA2D (*)
 - LL_AHB1_GRP1_PERIPH_ETHMAC (*)
 - LL_AHB1_GRP1_PERIPH_ETHMACTX (*)
 - LL_AHB1_GRP1_PERIPH_ETHMACRX (*)
 - LL_AHB1_GRP1_PERIPH_ETHMACPTP (*)
 - LL_AHB1_GRP1_PERIPH_OTGHS
 - LL_AHB1_GRP1_PERIPH_OTGHSULPI

Return values

- **State:** of Periphs (1 or 0).

Reference Manual to LL API cross reference:

- AHB1ENR GPIOAEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR GPIOBEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR GPIOCEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR GPIODEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR GPIOEEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR GPIOFEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR GPIOGEN LL_AHB1_GRP1_IsEnabledClock

- AHB1ENR GPIOHEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR GPIOIEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR GPIOJEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR GPIOKEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR CRCEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR BKPSRAMEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR DTCMRAMEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR DMA1EN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR DMA2EN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR DMA2DEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR ETHMACEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR ETHMACTXEN
LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR ETHMACRXEN
LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR ETHMACPTPEN
LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR OTGHSEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR OTGHSULPIENDEN
LL_AHB1_GRP1_IsEnabledClock

LL_AHB1_GRP1_DisableClock

Function name `__STATIC_INLINE void LL_AHB1_GRP1_DisableClock (uint32_t Periphs)`

Function description Disable AHB1 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_AHB1_GRP1_PERIPH_GPIOA
 - LL_AHB1_GRP1_PERIPH_GPIOB
 - LL_AHB1_GRP1_PERIPH_GPIOC
 - LL_AHB1_GRP1_PERIPH_GPIOD
 - LL_AHB1_GRP1_PERIPH_GPIOE
 - LL_AHB1_GRP1_PERIPH_GPIOF
 - LL_AHB1_GRP1_PERIPH_GPIOG
 - LL_AHB1_GRP1_PERIPH_GPIOH
 - LL_AHB1_GRP1_PERIPH_GPIOI
 - LL_AHB1_GRP1_PERIPH_GPIOJ (*)
 - LL_AHB1_GRP1_PERIPH_GPIOK (*)
 - LL_AHB1_GRP1_PERIPH_CRC
 - LL_AHB1_GRP1_PERIPH_BKPSRAM
 - LL_AHB1_GRP1_PERIPH_DTCMRAM
 - LL_AHB1_GRP1_PERIPH_DMA1
 - LL_AHB1_GRP1_PERIPH_DMA2
 - LL_AHB1_GRP1_PERIPH_DMA2D (*)
 - LL_AHB1_GRP1_PERIPH_ETHMAC (*)
 - LL_AHB1_GRP1_PERIPH_ETHMACTX (*)
 - LL_AHB1_GRP1_PERIPH_ETHMACRX (*)
 - LL_AHB1_GRP1_PERIPH_ETHMACPTP (*)
 - LL_AHB1_GRP1_PERIPH_OTGHS
 - LL_AHB1_GRP1_PERIPH_OTGHSULPI

Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AHB1ENR GPIOAEN LL_AHB1_GRP1_DisableClock • AHB1ENR GPIOBEN LL_AHB1_GRP1_DisableClock • AHB1ENR GPIOCEN LL_AHB1_GRP1_DisableClock • AHB1ENR GPIODEN LL_AHB1_GRP1_DisableClock • AHB1ENR GPIOEEN LL_AHB1_GRP1_DisableClock • AHB1ENR GPIOFEN LL_AHB1_GRP1_DisableClock • AHB1ENR GPIOGEN LL_AHB1_GRP1_DisableClock • AHB1ENR GPIOHEN LL_AHB1_GRP1_DisableClock • AHB1ENR GPIOIEN LL_AHB1_GRP1_DisableClock • AHB1ENR GPIOJEN LL_AHB1_GRP1_DisableClock • AHB1ENR GPIOKEN LL_AHB1_GRP1_DisableClock • AHB1ENR CRCEN LL_AHB1_GRP1_DisableClock • AHB1ENR BKPSRAMEN LL_AHB1_GRP1_DisableClock • AHB1ENR DTCMRAMEN LL_AHB1_GRP1_DisableClock • AHB1ENR DMA1EN LL_AHB1_GRP1_DisableClock • AHB1ENR DMA2EN LL_AHB1_GRP1_DisableClock • AHB1ENR DMA2DEN LL_AHB1_GRP1_DisableClock • AHB1ENR ETHMACEN LL_AHB1_GRP1_DisableClock • AHB1ENR ETHMACTXEN LL_AHB1_GRP1_DisableClock • AHB1ENR ETHMACRXEN LL_AHB1_GRP1_DisableClock • AHB1ENR ETHMACPTPEN LL_AHB1_GRP1_DisableClock • AHB1ENR OTGHSSEN LL_AHB1_GRP1_DisableClock • AHB1ENR OTGHSULPIENDEN LL_AHB1_GRP1_DisableClock

LL_AHB1_GRP1_ForceReset

Function name	__STATIC_INLINE void LL_AHB1_GRP1_ForceReset (uint32_t Periphs)
Function description	Force AHB1 peripherals reset.
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_AHB1_GRP1_PERIPH_ALL – LL_AHB1_GRP1_PERIPH_GPIOA – LL_AHB1_GRP1_PERIPH_GPIOB – LL_AHB1_GRP1_PERIPH_GPIOC – LL_AHB1_GRP1_PERIPH_GPIOD – LL_AHB1_GRP1_PERIPH_GPIOE – LL_AHB1_GRP1_PERIPH_GPIOF – LL_AHB1_GRP1_PERIPH_GPIOG – LL_AHB1_GRP1_PERIPH_GPIOH – LL_AHB1_GRP1_PERIPH_GPIOI – LL_AHB1_GRP1_PERIPH_GPIOJ (*) – LL_AHB1_GRP1_PERIPH_GPIOK (*) – LL_AHB1_GRP1_PERIPH_CRC – LL_AHB1_GRP1_PERIPH_DMA1 – LL_AHB1_GRP1_PERIPH_DMA2 – LL_AHB1_GRP1_PERIPH_DMA2D (*) – LL_AHB1_GRP1_PERIPH_ETHMAC (*) – LL_AHB1_GRP1_PERIPH_OTGHS

Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AHB1RSTR GPIOARST LL_AHB1_GRP1_ForceReset • AHB1RSTR GPIOBRST LL_AHB1_GRP1_ForceReset • AHB1RSTR GPIOCRST LL_AHB1_GRP1_ForceReset • AHB1RSTR GPIODRST LL_AHB1_GRP1_ForceReset • AHB1RSTR GPIOERST LL_AHB1_GRP1_ForceReset • AHB1RSTR GPIOFRST LL_AHB1_GRP1_ForceReset • AHB1RSTR GPIOGRST LL_AHB1_GRP1_ForceReset • AHB1RSTR GPIOHRST LL_AHB1_GRP1_ForceReset • AHB1RSTR GPIOIRST LL_AHB1_GRP1_ForceReset • AHB1RSTR GPIOJRST LL_AHB1_GRP1_ForceReset • AHB1RSTR GPIOKRST LL_AHB1_GRP1_ForceReset • AHB1RSTR CRCSRST LL_AHB1_GRP1_ForceReset • AHB1RSTR DMA1RST LL_AHB1_GRP1_ForceReset • AHB1RSTR DMA2RST LL_AHB1_GRP1_ForceReset • AHB1RSTR DMA2DRST LL_AHB1_GRP1_ForceReset • AHB1RSTR ETHMACRST LL_AHB1_GRP1_ForceReset • AHB1RSTR OTGHSRST LL_AHB1_GRP1_ForceReset

LL_AHB1_GRP1_ReleaseReset

Function name	__STATIC_INLINE void LL_AHB1_GRP1_ReleaseReset (uint32_t Periphs)
Function description	Release AHB1 peripherals reset.
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_AHB1_GRP1_PERIPH_ALL – LL_AHB1_GRP1_PERIPH_GPIOA – LL_AHB1_GRP1_PERIPH_GPIOB – LL_AHB1_GRP1_PERIPH_GPIOC – LL_AHB1_GRP1_PERIPH_GPIOD – LL_AHB1_GRP1_PERIPH_GPIOE – LL_AHB1_GRP1_PERIPH_GPIOF – LL_AHB1_GRP1_PERIPH_GPIOG – LL_AHB1_GRP1_PERIPH_GPIOH – LL_AHB1_GRP1_PERIPH_GPIOI – LL_AHB1_GRP1_PERIPH_GPIOJ (*) – LL_AHB1_GRP1_PERIPH_GPIOK (*) – LL_AHB1_GRP1_PERIPH_CRC – LL_AHB1_GRP1_PERIPH_DMA1 – LL_AHB1_GRP1_PERIPH_DMA2 – LL_AHB1_GRP1_PERIPH_DMA2D (*) – LL_AHB1_GRP1_PERIPH_ETHMAC (*) – LL_AHB1_GRP1_PERIPH_OTGHS
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AHB1RSTR GPIOARST LL_AHB1_GRP1_ReleaseReset • AHB1RSTR GPIOBRST LL_AHB1_GRP1_ReleaseReset • AHB1RSTR GPIOCRST LL_AHB1_GRP1_ReleaseReset • AHB1RSTR GPIODRST LL_AHB1_GRP1_ReleaseReset • AHB1RSTR GPIOERST LL_AHB1_GRP1_ReleaseReset

- AHB1RSTR GPIOFRST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR GPIOGRST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR GPIOHRST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR GPIOIRST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR GPIOJRST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR GPIOKRST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR CRCRST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR DMA1RST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR DMA2RST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR DMA2DRST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR ETHMACRST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR OTGHSRST LL_AHB1_GRP1_ReleaseReset

LL_AHB1_GRP1_EnableClockLowPower

Function name	__STATIC_INLINE void LL_AHB1_GRP1_EnableClockLowPower (uint32_t Periphs)
Function description	Enable AHB1 peripheral clocks in low-power mode.
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_AHB1_GRP1_PERIPH_GPIOA – LL_AHB1_GRP1_PERIPH_GPIOB – LL_AHB1_GRP1_PERIPH_GPIOC – LL_AHB1_GRP1_PERIPH_GPIOD – LL_AHB1_GRP1_PERIPH_GPIOE – LL_AHB1_GRP1_PERIPH_GPIOF – LL_AHB1_GRP1_PERIPH_GPIOG – LL_AHB1_GRP1_PERIPH_GPIOH – LL_AHB1_GRP1_PERIPH_GPIOI – LL_AHB1_GRP1_PERIPH_GPIOJ (*) – LL_AHB1_GRP1_PERIPH_GPIOK (*) – LL_AHB1_GRP1_PERIPH_CRC – LL_AHB1_GRP1_PERIPH_AXI – LL_AHB1_GRP1_PERIPH_FLITF – LL_AHB1_GRP1_PERIPH_SRAM1 – LL_AHB1_GRP1_PERIPH_SRAM2 – LL_AHB1_GRP1_PERIPH_BKPSRAM – LL_AHB1_GRP1_PERIPH_DTCMRAM – LL_AHB1_GRP1_PERIPH_DMA1 – LL_AHB1_GRP1_PERIPH_DMA2 – LL_AHB1_GRP1_PERIPH_DMA2D (*) – LL_AHB1_GRP1_PERIPH_ETHMAC (*) – LL_AHB1_GRP1_PERIPH_ETHMACTX (*) – LL_AHB1_GRP1_PERIPH_ETHMACRX (*) – LL_AHB1_GRP1_PERIPH_ETHMACPTP (*) – LL_AHB1_GRP1_PERIPH_OTGHS – LL_AHB1_GRP1_PERIPH_OTGHSULPI
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross	<ul style="list-style-type: none"> • AHB1LPENR GPIOALPEN • LL_AHB1_GRP1_EnableClockLowPower • AHB1LPENR GPIOBLPEN

reference:

- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR GPIOCLPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR GPIODLPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR GPIOELPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR GPIOFLPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR GPIOGLPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR GPIOHLPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR GPIOILPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR GPIOJLPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR GPIOKLPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR CRCLPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR AXILPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR FLITFLPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR SRAM1LPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR SRAM2LPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR BKPSRAMLPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR DTCMRAMPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR DMA1LPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR DMA2LPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR DMA2DLPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR ETHMACLPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR ETHMACTXLLEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR ETHMACRXLLEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR ETHMACPTLPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR OTGHSLPEN
- LL_AHB1_GRP1_EnableClockLowPower
AHB1LPENR OTGHSULPILPEN



LL_AHB1_GRP1_DisableClockLowPower

Function name	__STATIC_INLINE void LL_AHB1_GRP1_DisableClockLowPower (uint32_t Periphs)
Function description	Disable AHB1 peripheral clocks in low-power mode.
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_AHB1_GRP1_PERIPH_GPIOA – LL_AHB1_GRP1_PERIPH_GPIOB – LL_AHB1_GRP1_PERIPH_GPIOC – LL_AHB1_GRP1_PERIPH_GPIOD – LL_AHB1_GRP1_PERIPH_GPIOE – LL_AHB1_GRP1_PERIPH_GPIOF – LL_AHB1_GRP1_PERIPH_GPIOG – LL_AHB1_GRP1_PERIPH_GPIOH – LL_AHB1_GRP1_PERIPH_GPIOI – LL_AHB1_GRP1_PERIPH_GPIOJ (*) – LL_AHB1_GRP1_PERIPH_GPIOK (*) – LL_AHB1_GRP1_PERIPH_CRC – LL_AHB1_GRP1_PERIPH_AXI – LL_AHB1_GRP1_PERIPH_FLITF – LL_AHB1_GRP1_PERIPH_SRAM1 – LL_AHB1_GRP1_PERIPH_SRAM2 – LL_AHB1_GRP1_PERIPH_BKPSRAM – LL_AHB1_GRP1_PERIPH_DTCMRAM – LL_AHB1_GRP1_PERIPH_DMA1 – LL_AHB1_GRP1_PERIPH_DMA2 – LL_AHB1_GRP1_PERIPH_DMA2D (*) – LL_AHB1_GRP1_PERIPH_ETHMAC (*) – LL_AHB1_GRP1_PERIPH_ETHMACTX (*) – LL_AHB1_GRP1_PERIPH_ETHMACRX (*) – LL_AHB1_GRP1_PERIPH_ETHMACPTP (*) – LL_AHB1_GRP1_PERIPH_OTGHS – LL_AHB1_GRP1_PERIPH_OTGHSULPI
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AHB1LPENR GPIOALPEN LL_AHB1_GRP1_DisableClockLowPower • AHB1LPENR GPIOBLPEN LL_AHB1_GRP1_DisableClockLowPower • AHB1LPENR GPIOCLPEN LL_AHB1_GRP1_DisableClockLowPower • AHB1LPENR GPIODLPEN LL_AHB1_GRP1_DisableClockLowPower • AHB1LPENR GPIOELPEN LL_AHB1_GRP1_DisableClockLowPower • AHB1LPENR GPIOFLPEN LL_AHB1_GRP1_DisableClockLowPower • AHB1LPENR GPIOGLPEN LL_AHB1_GRP1_DisableClockLowPower • AHB1LPENR GPIOHLPEN LL_AHB1_GRP1_DisableClockLowPower

- AHB1LPENR GPIOILPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR GPIOJLPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR GPIOKLPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR CRCLPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR AXILPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR FLITFLPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR SRAM1LPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR SRAM2LPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR BKPSRAMLPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR DTCMRAMPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR DMA1LPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR DMA2LPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR DMA2DLPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR ETHMACLPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR ETHMACTXLPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR ETHMACRXLPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR ETHMACPTLPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR OTGHSLPEN
LL_AHB1_GRP1_DisableClockLowPower
- AHB1LPENR OTGHSULPILPEN
LL_AHB1_GRP1_DisableClockLowPower

LL_AHB2_GRP1_EnableClock

Function name `__STATIC_INLINE void LL_AHB2_GRP1_EnableClock (uint32_t Periphs)`

Function description Enable AHB2 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_AHB2_GRP1_PERIPH_DCMI (*)
 - LL_AHB2_GRP1_PERIPH_JPEG (*)
 - LL_AHB2_GRP1_PERIPH_Cryp (*)
 - LL_AHB2_GRP1_PERIPH_AES (*)
 - LL_AHB2_GRP1_PERIPH_HASH (*)
 - LL_AHB2_GRP1_PERIPH_RNG

– LL_AHB2_GRP1_PERIPH_OTGFS

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB2ENR DCMIEN LL_AHB2_GRP1_EnableClock
- AHB2ENR JPEGEN LL_AHB2_GRP1_EnableClock
- AHB2ENR CRYPEN LL_AHB2_GRP1_EnableClock
- AHB2ENR AESEN LL_AHB2_GRP1_EnableClock
- AHB2ENR HASHEN LL_AHB2_GRP1_EnableClock
- AHB2ENR RNGEN LL_AHB2_GRP1_EnableClock
- AHB2ENR OTGFSEN LL_AHB2_GRP1_EnableClock

LL_AHB2_GRP1_IsEnabledClock

Function name

__STATIC_INLINE uint32_t LL_AHB2_GRP1_IsEnabledClock (uint32_t Periphs)

Function description

Check if AHB2 peripheral clock is enabled or not.

Parameters

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_AHB2_GRP1_PERIPH_DCMI (*)
 - LL_AHB2_GRP1_PERIPH_JPEG (*)
 - LL_AHB2_GRP1_PERIPH_CRYP (*)
 - LL_AHB2_GRP1_PERIPH_AES (*)
 - LL_AHB2_GRP1_PERIPH_HASH (*)
 - LL_AHB2_GRP1_PERIPH_RNG
 - LL_AHB2_GRP1_PERIPH_OTGFS

Return values

- **State:** of Periphs (1 or 0).

Reference Manual to LL API cross reference:

- AHB2ENR DCMIEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR JPEGEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR CRYPEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR AESEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR HASHEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR RNGEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR OTGFSEN LL_AHB2_GRP1_IsEnabledClock

LL_AHB2_GRP1_DisableClock

Function name

__STATIC_INLINE void LL_AHB2_GRP1_DisableClock (uint32_t Periphs)

Function description

Disable AHB2 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_AHB2_GRP1_PERIPH_DCMI (*)
 - LL_AHB2_GRP1_PERIPH_JPEG (*)
 - LL_AHB2_GRP1_PERIPH_CRYP (*)
 - LL_AHB2_GRP1_PERIPH_AES (*)
 - LL_AHB2_GRP1_PERIPH_HASH (*)
 - LL_AHB2_GRP1_PERIPH_RNG
 - LL_AHB2_GRP1_PERIPH_OTGFS

Return values

- **None:**

- Reference Manual to LL API cross reference:
- AHB2ENR DCMIEN LL_AHB2_GRP1_DisableClock
 - AHB2ENR JPEGEN LL_AHB2_GRP1_DisableClock
 - AHB2ENR CRYPEN LL_AHB2_GRP1_DisableClock
 - AHB2ENR AESEN LL_AHB2_GRP1_DisableClock
 - AHB2ENR HASHEN LL_AHB2_GRP1_DisableClock
 - AHB2ENR RNGEN LL_AHB2_GRP1_DisableClock
 - AHB2ENR OTGFSEN LL_AHB2_GRP1_DisableClock

LL_AHB2_GRP1_ForceReset

Function name `__STATIC_INLINE void LL_AHB2_GRP1_ForceReset (uint32_t Periphs)`

Function description Force AHB2 peripherals reset.

- Parameters
- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_AHB2_GRP1_PERIPH_ALL
 - LL_AHB2_GRP1_PERIPH_DCMI (*)
 - LL_AHB2_GRP1_PERIPH_JPEG (*)
 - LL_AHB2_GRP1_PERIPH_CRYP (*)
 - LL_AHB2_GRP1_PERIPH_AES (*)
 - LL_AHB2_GRP1_PERIPH_HASH (*)
 - LL_AHB2_GRP1_PERIPH_RNG
 - LL_AHB2_GRP1_PERIPH_OTGFS

Return values

- **None:**

- Reference Manual to LL API cross reference:
- AHB2RSTR DCMIRST LL_AHB2_GRP1_ForceReset
 - AHB2RSTR JPEGRST LL_AHB2_GRP1_ForceReset
 - AHB2RSTR CRYP RST LL_AHB2_GRP1_ForceReset
 - AHB2RSTR AESRST LL_AHB2_GRP1_ForceReset
 - AHB2RSTR HASHRST LL_AHB2_GRP1_ForceReset
 - AHB2RSTR RNGRST LL_AHB2_GRP1_ForceReset
 - AHB2RSTR OTGFSRST LL_AHB2_GRP1_ForceReset

LL_AHB2_GRP1_ReleaseReset

Function name `__STATIC_INLINE void LL_AHB2_GRP1_ReleaseReset (uint32_t Periphs)`

Function description Release AHB2 peripherals reset.

- Parameters
- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_AHB2_GRP1_PERIPH_ALL
 - LL_AHB2_GRP1_PERIPH_DCMI (*)
 - LL_AHB2_GRP1_PERIPH_JPEG (*)
 - LL_AHB2_GRP1_PERIPH_CRYP (*)
 - LL_AHB2_GRP1_PERIPH_AES (*)
 - LL_AHB2_GRP1_PERIPH_HASH (*)
 - LL_AHB2_GRP1_PERIPH_RNG
 - LL_AHB2_GRP1_PERIPH_OTGFS

Return values

- **None:**

- Reference Manual to
- AHB2RSTR DCMIRST LL_AHB2_GRP1_ReleaseReset

- LL API cross reference:
- AHB2RSTR JPEGRST LL_AHB2_GRP1_ReleaseReset
 - AHB2RSTR CRYPRST LL_AHB2_GRP1_ReleaseReset
 - AHB2RSTR AESRST LL_AHB2_GRP1_ReleaseReset
 - AHB2RSTR HASHRST LL_AHB2_GRP1_ReleaseReset
 - AHB2RSTR RNGRST LL_AHB2_GRP1_ReleaseReset
 - AHB2RSTR OTGFSRST LL_AHB2_GRP1_ReleaseReset

LL_AHB2_GRP1_EnableClockLowPower

- Function name **__STATIC_INLINE void**
LL_AHB2_GRP1_EnableClockLowPower (uint32_t Periphs)
- Function description Enable AHB2 peripheral clocks in low-power mode.
- Parameters
- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_AHB2_GRP1_PERIPH_DCMI (*)
 - LL_AHB2_GRP1_PERIPH_JPEG (*)
 - LL_AHB2_GRP1_PERIPH_Cryp (*)
 - LL_AHB2_GRP1_PERIPH_AES (*)
 - LL_AHB2_GRP1_PERIPH_HASH (*)
 - LL_AHB2_GRP1_PERIPH_RNG
 - LL_AHB2_GRP1_PERIPH_OTGFS
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- AHB2LPENR DCMILPEN
LL_AHB2_GRP1_EnableClockLowPower
 - AHB2LPENR JPEGLPEN
LL_AHB2_GRP1_EnableClockLowPower
 - AHB2LPENR CRYPLPEN
LL_AHB2_GRP1_EnableClockLowPower
 - AHB2LPENR AESLPEN
LL_AHB2_GRP1_EnableClockLowPower
 - AHB2LPENR HASHLPEN
LL_AHB2_GRP1_EnableClockLowPower
 - AHB2LPENR RNGLPEN
LL_AHB2_GRP1_EnableClockLowPower
 - AHB2LPENR OTGFSLPEN
LL_AHB2_GRP1_EnableClockLowPower

LL_AHB2_GRP1_DisableClockLowPower

- Function name **__STATIC_INLINE void**
LL_AHB2_GRP1_DisableClockLowPower (uint32_t Periphs)
- Function description Disable AHB2 peripheral clocks in low-power mode.
- Parameters
- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_AHB2_GRP1_PERIPH_DCMI (*)
 - LL_AHB2_GRP1_PERIPH_JPEG (*)
 - LL_AHB2_GRP1_PERIPH_Cryp (*)
 - LL_AHB2_GRP1_PERIPH_AES (*)
 - LL_AHB2_GRP1_PERIPH_HASH (*)
 - LL_AHB2_GRP1_PERIPH_RNG

	– LL_AHB2_GRP1_PERIPH_OTGFS
Return values	• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AHB2LPENR DCMILPEN • LL_AHB2_GRP1_DisableClockLowPower • AHB2LPENR JPEGLPEN • LL_AHB2_GRP1_DisableClockLowPower • AHB2LPENR CRYLPEN • LL_AHB2_GRP1_DisableClockLowPower • AHB2LPENR AESLPEN • LL_AHB2_GRP1_DisableClockLowPower • AHB2LPENR HASHLPEN • LL_AHB2_GRP1_DisableClockLowPower • AHB2LPENR RNGLPEN • LL_AHB2_GRP1_DisableClockLowPower • AHB2LPENR OTGFSLPEN • LL_AHB2_GRP1_DisableClockLowPower

LL_AHB3_GRP1_EnableClock

Function name	__STATIC_INLINE void LL_AHB3_GRP1_EnableClock (uint32_t Periphs)
Function description	Enable AHB3 peripherals clock.
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_AHB3_GRP1_PERIPH_FMC (*) – LL_AHB3_GRP1_PERIPH_QSPI
Return values	• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AHB3ENR FMCEN LL_AHB3_GRP1_EnableClock • AHB3ENR QSPIEN LL_AHB3_GRP1_EnableClock

LL_AHB3_GRP1_IsEnabledClock

Function name	__STATIC_INLINE uint32_t LL_AHB3_GRP1_IsEnabledClock (uint32_t Periphs)
Function description	Check if AHB3 peripheral clock is enabled or not.
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_AHB3_GRP1_PERIPH_FMC (*) – LL_AHB3_GRP1_PERIPH_QSPI
Return values	• State: of Periphs (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AHB3ENR FMCEN LL_AHB3_GRP1_IsEnabledClock • AHB3ENR QSPIEN LL_AHB3_GRP1_IsEnabledClock

LL_AHB3_GRP1_DisableClock

Function name	__STATIC_INLINE void LL_AHB3_GRP1_DisableClock
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(uint32_t Periphs)

Function description	Disable AHB3 peripherals clock.
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_AHB3_GRP1_PERIPH_FMC (*) – LL_AHB3_GRP1_PERIPH_QSPI
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AHB3ENR FMCEN LL_AHB3_GRP1_DisableClock • AHB3ENR QSPIEN LL_AHB3_GRP1_DisableClock

LL_AHB3_GRP1_ForceReset

Function name	__STATIC_INLINE void LL_AHB3_GRP1_ForceReset (uint32_t Periphs)
Function description	Force AHB3 peripherals reset.
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_AHB3_GRP1_PERIPH_ALL – LL_AHB3_GRP1_PERIPH_FMC (*) – LL_AHB3_GRP1_PERIPH_QSPI
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AHB3RSTR FMCRST LL_AHB3_GRP1_ForceReset • AHB3RSTR QSPIRST LL_AHB3_GRP1_ForceReset

LL_AHB3_GRP1_ReleaseReset

Function name	__STATIC_INLINE void LL_AHB3_GRP1_ReleaseReset (uint32_t Periphs)
Function description	Release AHB3 peripherals reset.
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_AHB2_GRP1_PERIPH_ALL – LL_AHB3_GRP1_PERIPH_FMC (*) – LL_AHB3_GRP1_PERIPH_QSPI
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AHB3RSTR FMCRST LL_AHB3_GRP1_ReleaseReset • AHB3RSTR QSPIRST LL_AHB3_GRP1_ReleaseReset

LL_AHB3_GRP1_EnableClockLowPower

Function name	__STATIC_INLINE void LL_AHB3_GRP1_EnableClockLowPower (uint32_t Periphs)
Function description	Enable AHB3 peripheral clocks in low-power mode.

Parameters	<ul style="list-style-type: none"> • Peripherals: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_AHB3_GRP1_PERIPH_FMC (*) – LL_AHB3_GRP1_PERIPH_QSPI
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AHB3LPENR FMCLPEN LL_AHB3_GRP1_EnableClockLowPower • AHB3LPENR QSPILPEN LL_AHB3_GRP1_EnableClockLowPower

LL_AHB3_GRP1_DisableClockLowPower

Function name	__STATIC_INLINE void LL_AHB3_GRP1_DisableClockLowPower (uint32_t Peripherals)
Function description	Disable AHB3 peripheral clocks in low-power mode.
Parameters	<ul style="list-style-type: none"> • Peripherals: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_AHB3_GRP1_PERIPH_FMC (*) – LL_AHB3_GRP1_PERIPH_QSPI
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AHB3LPENR FMCLPEN LL_AHB3_GRP1_DisableClockLowPower • AHB3LPENR QSPILPEN LL_AHB3_GRP1_DisableClockLowPower

LL_APB1_GRP1_EnableClock

Function name	__STATIC_INLINE void LL_APB1_GRP1_EnableClock (uint32_t Peripherals)
Function description	Enable APB1 peripherals clock.
Parameters	<ul style="list-style-type: none"> • Peripherals: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_APB1_GRP1_PERIPH_TIM2 – LL_APB1_GRP1_PERIPH_TIM3 – LL_APB1_GRP1_PERIPH_TIM4 – LL_APB1_GRP1_PERIPH_TIM5 – LL_APB1_GRP1_PERIPH_TIM6 – LL_APB1_GRP1_PERIPH_TIM7 – LL_APB1_GRP1_PERIPH_TIM12 – LL_APB1_GRP1_PERIPH_TIM13 – LL_APB1_GRP1_PERIPH_TIM14 – LL_APB1_GRP1_PERIPH_LPTIM1 – LL_APB1_GRP1_PERIPH_WWDG – LL_APB1_GRP1_PERIPH_SPI2 – LL_APB1_GRP1_PERIPH_SPI3 – LL_APB1_GRP1_PERIPH_SPDIFRX (*) – LL_APB1_GRP1_PERIPH_USART2 – LL_APB1_GRP1_PERIPH_USART3 – LL_APB1_GRP1_PERIPH_UART4

- LL_APB1_GRP1_PERIPH_UART5
- LL_APB1_GRP1_PERIPH_I2C1
- LL_APB1_GRP1_PERIPH_I2C2
- LL_APB1_GRP1_PERIPH_I2C3
- LL_APB1_GRP1_PERIPH_I2C4 (*)
- LL_APB1_GRP1_PERIPH_CAN1
- LL_APB1_GRP1_PERIPH_CAN2 (*)
- LL_APB1_GRP1_PERIPH_CAN3 (*)
- LL_APB1_GRP1_PERIPH_CEC (*)
- LL_APB1_GRP1_PERIPH_PWR
- LL_APB1_GRP1_PERIPH_DAC1
- LL_APB1_GRP1_PERIPH_UART7
- LL_APB1_GRP1_PERIPH_UART8
- LL_APB1_GRP1_PERIPH_RTCAPB (*)

Return values

Reference Manual to
LL API cross
reference:

- **None:**
- APB1ENR TIM2EN LL_APB1_GRP1_EnableClock
- APB1ENR TIM3EN LL_APB1_GRP1_EnableClock
- APB1ENR TIM4EN LL_APB1_GRP1_EnableClock
- APB1ENR TIM5EN LL_APB1_GRP1_EnableClock
- APB1ENR TIM6EN LL_APB1_GRP1_EnableClock
- APB1ENR TIM7EN LL_APB1_GRP1_EnableClock
- APB1ENR TIM12EN LL_APB1_GRP1_EnableClock
- APB1ENR TIM13EN LL_APB1_GRP1_EnableClock
- APB1ENR TIM14EN LL_APB1_GRP1_EnableClock
- APB1ENR LPTIM1EN LL_APB1_GRP1_EnableClock
- APB1ENR WWDGEN LL_APB1_GRP1_EnableClock
- APB1ENR SPI2EN LL_APB1_GRP1_EnableClock
- APB1ENR SPI3EN LL_APB1_GRP1_EnableClock
- APB1ENR SPDIFRXEN LL_APB1_GRP1_EnableClock
- APB1ENR USART2EN LL_APB1_GRP1_EnableClock
- APB1ENR USART3EN LL_APB1_GRP1_EnableClock
- APB1ENR UART4EN LL_APB1_GRP1_EnableClock
- APB1ENR UART5EN LL_APB1_GRP1_EnableClock
- APB1ENR I2C1EN LL_APB1_GRP1_EnableClock
- APB1ENR I2C2EN LL_APB1_GRP1_EnableClock
- APB1ENR I2C3EN LL_APB1_GRP1_EnableClock
- APB1ENR I2C4EN LL_APB1_GRP1_EnableClock
- APB1ENR CAN1EN LL_APB1_GRP1_EnableClock
- APB1ENR CAN2EN LL_APB1_GRP1_EnableClock
- APB1ENR CAN3EN LL_APB1_GRP1_EnableClock
- APB1ENR CECEN LL_APB1_GRP1_EnableClock
- APB1ENR PWREN LL_APB1_GRP1_EnableClock
- APB1ENR DACEN LL_APB1_GRP1_EnableClock
- APB1ENR UART7EN LL_APB1_GRP1_EnableClock
- APB1ENR UART8EN LL_APB1_GRP1_EnableClock
- APB1ENR RTCEN LL_APB1_GRP1_EnableClock

LL_APB1_GRP1_IsEnabledClock

Function name `__STATIC_INLINE uint32_t LL_APB1_GRP1_IsEnabledClock
(uint32_t Periphs)`

Function description	Check if APB1 peripheral clock is enabled or not.
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_APB1_GRP1_PERIPH_TIM2 – LL_APB1_GRP1_PERIPH_TIM3 – LL_APB1_GRP1_PERIPH_TIM4 – LL_APB1_GRP1_PERIPH_TIM5 – LL_APB1_GRP1_PERIPH_TIM6 – LL_APB1_GRP1_PERIPH_TIM7 – LL_APB1_GRP1_PERIPH_TIM12 – LL_APB1_GRP1_PERIPH_TIM13 – LL_APB1_GRP1_PERIPH_TIM14 – LL_APB1_GRP1_PERIPH_LPTIM1 – LL_APB1_GRP1_PERIPH_WWDG – LL_APB1_GRP1_PERIPH_SPI2 – LL_APB1_GRP1_PERIPH_SPI3 – LL_APB1_GRP1_PERIPH_SPDIFRX (*) – LL_APB1_GRP1_PERIPH_USART2 – LL_APB1_GRP1_PERIPH_USART3 – LL_APB1_GRP1_PERIPH_UART4 – LL_APB1_GRP1_PERIPH_UART5 – LL_APB1_GRP1_PERIPH_I2C1 – LL_APB1_GRP1_PERIPH_I2C2 – LL_APB1_GRP1_PERIPH_I2C3 – LL_APB1_GRP1_PERIPH_I2C4 (*) – LL_APB1_GRP1_PERIPH_CAN1 – LL_APB1_GRP1_PERIPH_CAN2 (*) – LL_APB1_GRP1_PERIPH_CAN3 (*) – LL_APB1_GRP1_PERIPH_CEC (*) – LL_APB1_GRP1_PERIPH_PWR – LL_APB1_GRP1_PERIPH_DAC1 – LL_APB1_GRP1_PERIPH_UART7 – LL_APB1_GRP1_PERIPH_UART8 – LL_APB1_GRP1_PERIPH_RTCAPB (*)
Return values	<ul style="list-style-type: none"> • State: of Periphs (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • APB1ENR TIM2EN LL_APB1_GRP1_IsEnabledClock • APB1ENR TIM3EN LL_APB1_GRP1_IsEnabledClock • APB1ENR TIM4EN LL_APB1_GRP1_IsEnabledClock • APB1ENR TIM5EN LL_APB1_GRP1_IsEnabledClock • APB1ENR TIM6EN LL_APB1_GRP1_IsEnabledClock • APB1ENR TIM7EN LL_APB1_GRP1_IsEnabledClock • APB1ENR TIM12EN LL_APB1_GRP1_IsEnabledClock • APB1ENR TIM13EN LL_APB1_GRP1_IsEnabledClock • APB1ENR TIM14EN LL_APB1_GRP1_IsEnabledClock • APB1ENR LPTIM1EN LL_APB1_GRP1_IsEnabledClock • APB1ENR WWDGEN LL_APB1_GRP1_IsEnabledClock • APB1ENR SPI2EN LL_APB1_GRP1_IsEnabledClock • APB1ENR SPI3EN LL_APB1_GRP1_IsEnabledClock • APB1ENR SPDIFRXEN LL_APB1_GRP1_IsEnabledClock • APB1ENR USART2EN LL_APB1_GRP1_IsEnabledClock • APB1ENR USART3EN LL_APB1_GRP1_IsEnabledClock

- APB1ENR UART4EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR UART5EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR I2C1EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR I2C2EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR I2C3EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR I2C4EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR CAN1EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR CAN2EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR CAN3EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR CECEN LL_APB1_GRP1_IsEnabledClock
- APB1ENR PWREN LL_APB1_GRP1_IsEnabledClock
- APB1ENR DACEN LL_APB1_GRP1_IsEnabledClock
- APB1ENR UART7EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR UART8EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR RTCEN LL_APB1_GRP1_IsEnabledClock

LL_APB1_GRP1_DisableClock

Function name `__STATIC_INLINE void LL_APB1_GRP1_DisableClock (uint32_t Periphs)`

Function description Disable APB1 peripherals clock.

- Parameters
- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_APB1_GRP1_PERIPH_TIM2
 - LL_APB1_GRP1_PERIPH_TIM3
 - LL_APB1_GRP1_PERIPH_TIM4
 - LL_APB1_GRP1_PERIPH_TIM5
 - LL_APB1_GRP1_PERIPH_TIM6
 - LL_APB1_GRP1_PERIPH_TIM7
 - LL_APB1_GRP1_PERIPH_TIM12
 - LL_APB1_GRP1_PERIPH_TIM13
 - LL_APB1_GRP1_PERIPH_TIM14
 - LL_APB1_GRP1_PERIPH_LPTIM1
 - LL_APB1_GRP1_PERIPH_WWDG
 - LL_APB1_GRP1_PERIPH_SPI2
 - LL_APB1_GRP1_PERIPH_SPI3
 - LL_APB1_GRP1_PERIPH_SPDIFRX (*)
 - LL_APB1_GRP1_PERIPH_USART2
 - LL_APB1_GRP1_PERIPH_USART3
 - LL_APB1_GRP1_PERIPH_UART4
 - LL_APB1_GRP1_PERIPH_UART5
 - LL_APB1_GRP1_PERIPH_I2C1
 - LL_APB1_GRP1_PERIPH_I2C2
 - LL_APB1_GRP1_PERIPH_I2C3
 - LL_APB1_GRP1_PERIPH_I2C4 (*)
 - LL_APB1_GRP1_PERIPH_CAN1
 - LL_APB1_GRP1_PERIPH_CAN2 (*)
 - LL_APB1_GRP1_PERIPH_CAN3 (*)
 - LL_APB1_GRP1_PERIPH_CEC (*)
 - LL_APB1_GRP1_PERIPH_PWR
 - LL_APB1_GRP1_PERIPH_DAC1
 - LL_APB1_GRP1_PERIPH_UART7

- LL_APB1_GRP1_PERIPH_UART8
- LL_APB1_GRP1_PERIPH_RTCAPB (*)

Return values

Reference Manual to
LL API cross
reference:

- **None:**
- APB1ENR TIM2EN LL_APB1_GRP1_DisableClock
- APB1ENR TIM3EN LL_APB1_GRP1_DisableClock
- APB1ENR TIM4EN LL_APB1_GRP1_DisableClock
- APB1ENR TIM5EN LL_APB1_GRP1_DisableClock
- APB1ENR TIM6EN LL_APB1_GRP1_DisableClock
- APB1ENR TIM7EN LL_APB1_GRP1_DisableClock
- APB1ENR TIM12EN LL_APB1_GRP1_DisableClock
- APB1ENR TIM13EN LL_APB1_GRP1_DisableClock
- APB1ENR TIM14EN LL_APB1_GRP1_DisableClock
- APB1ENR LPTIM1EN LL_APB1_GRP1_DisableClock
- APB1ENR WWDGEN LL_APB1_GRP1_DisableClock
- APB1ENR SPI2EN LL_APB1_GRP1_DisableClock
- APB1ENR SPI3EN LL_APB1_GRP1_DisableClock
- APB1ENR SPDIFRXEN LL_APB1_GRP1_DisableClock
- APB1ENR USART2EN LL_APB1_GRP1_DisableClock
- APB1ENR USART3EN LL_APB1_GRP1_DisableClock
- APB1ENR UART4EN LL_APB1_GRP1_DisableClock
- APB1ENR UART5EN LL_APB1_GRP1_DisableClock
- APB1ENR I2C1EN LL_APB1_GRP1_DisableClock
- APB1ENR I2C2EN LL_APB1_GRP1_DisableClock
- APB1ENR I2C3EN LL_APB1_GRP1_DisableClock
- APB1ENR I2C4EN LL_APB1_GRP1_DisableClock
- APB1ENR CAN1EN LL_APB1_GRP1_DisableClock
- APB1ENR CAN2EN LL_APB1_GRP1_DisableClock
- APB1ENR CAN3EN LL_APB1_GRP1_DisableClock
- APB1ENR CECEN LL_APB1_GRP1_DisableClock
- APB1ENR PWREN LL_APB1_GRP1_DisableClock
- APB1ENR DACEN LL_APB1_GRP1_DisableClock
- APB1ENR UART7EN LL_APB1_GRP1_DisableClock
- APB1ENR UART8EN LL_APB1_GRP1_DisableClock
- APB1ENR RTCEN LL_APB1_GRP1_DisableClock

LL_APB1_GRP1_ForceReset

Function name `__STATIC_INLINE void LL_APB1_GRP1_ForceReset (uint32_t Periphs)`

Function description Force APB1 peripherals reset.

- Parameters
- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_APB1_GRP1_PERIPH_TIM2
 - LL_APB1_GRP1_PERIPH_TIM3
 - LL_APB1_GRP1_PERIPH_TIM4
 - LL_APB1_GRP1_PERIPH_TIM5
 - LL_APB1_GRP1_PERIPH_TIM6
 - LL_APB1_GRP1_PERIPH_TIM7
 - LL_APB1_GRP1_PERIPH_TIM12
 - LL_APB1_GRP1_PERIPH_TIM13
 - LL_APB1_GRP1_PERIPH_TIM14

- LL_APB1_GRP1_PERIPH_LPTIM1
- LL_APB1_GRP1_PERIPH_WWDG
- LL_APB1_GRP1_PERIPH_SPI2
- LL_APB1_GRP1_PERIPH_SPI3
- LL_APB1_GRP1_PERIPH_SPDIFRX (*)
- LL_APB1_GRP1_PERIPH_USART2
- LL_APB1_GRP1_PERIPH_USART3
- LL_APB1_GRP1_PERIPH_UART4
- LL_APB1_GRP1_PERIPH_UART5
- LL_APB1_GRP1_PERIPH_I2C1
- LL_APB1_GRP1_PERIPH_I2C2
- LL_APB1_GRP1_PERIPH_I2C3
- LL_APB1_GRP1_PERIPH_I2C4 (*)
- LL_APB1_GRP1_PERIPH_CAN1
- LL_APB1_GRP1_PERIPH_CAN2 (*)
- LL_APB1_GRP1_PERIPH_CAN3 (*)
- LL_APB1_GRP1_PERIPH_CEC (*)
- LL_APB1_GRP1_PERIPH_PWR
- LL_APB1_GRP1_PERIPH_DAC1
- LL_APB1_GRP1_PERIPH_UART7
- LL_APB1_GRP1_PERIPH_UART8

Return values

Reference Manual to
LL API cross
reference:

- **None:**
- APB1RSTR TIM2RST LL_APB1_GRP1_ForceReset
- APB1RSTR TIM3RST LL_APB1_GRP1_ForceReset
- APB1RSTR TIM4RST LL_APB1_GRP1_ForceReset
- APB1RSTR TIM5RST LL_APB1_GRP1_ForceReset
- APB1RSTR TIM6RST LL_APB1_GRP1_ForceReset
- APB1RSTR TIM7RST LL_APB1_GRP1_ForceReset
- APB1RSTR TIM12RST LL_APB1_GRP1_ForceReset
- APB1RSTR TIM13RST LL_APB1_GRP1_ForceReset
- APB1RSTR TIM14RST LL_APB1_GRP1_ForceReset
- APB1RSTR LPTIM1RST LL_APB1_GRP1_ForceReset
- APB1RSTR WWDGRST LL_APB1_GRP1_ForceReset
- APB1RSTR SPI2RST LL_APB1_GRP1_ForceReset
- APB1RSTR SPI3RST LL_APB1_GRP1_ForceReset
- APB1RSTR SPDIFRXRST LL_APB1_GRP1_ForceReset
- APB1RSTR USART2RST LL_APB1_GRP1_ForceReset
- APB1RSTR USART3RST LL_APB1_GRP1_ForceReset
- APB1RSTR UART4RST LL_APB1_GRP1_ForceReset
- APB1RSTR UART5RST LL_APB1_GRP1_ForceReset
- APB1RSTR I2C1RST LL_APB1_GRP1_ForceReset
- APB1RSTR I2C2RST LL_APB1_GRP1_ForceReset
- APB1RSTR I2C3RST LL_APB1_GRP1_ForceReset
- APB1RSTR I2C4RST LL_APB1_GRP1_ForceReset
- APB1RSTR CAN1RST LL_APB1_GRP1_ForceReset
- APB1RSTR CAN2RST LL_APB1_GRP1_ForceReset
- APB1RSTR CAN3RST LL_APB1_GRP1_ForceReset
- APB1RSTR CECRST LL_APB1_GRP1_ForceReset
- APB1RSTR PWRRST LL_APB1_GRP1_ForceReset
- APB1RSTR DACRST LL_APB1_GRP1_ForceReset
- APB1RSTR UART7RST LL_APB1_GRP1_ForceReset

- APB1RSTR UART8RST LL_APB1_GRP1_ForceReset

LL_APB1_GRP1_ReleaseReset

Function name `__STATIC_INLINE void LL_APB1_GRP1_ReleaseReset (uint32_t Periphs)`

Function description Release APB1 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_APB1_GRP1_PERIPH_TIM2
 - LL_APB1_GRP1_PERIPH_TIM3
 - LL_APB1_GRP1_PERIPH_TIM4
 - LL_APB1_GRP1_PERIPH_TIM5
 - LL_APB1_GRP1_PERIPH_TIM6
 - LL_APB1_GRP1_PERIPH_TIM7
 - LL_APB1_GRP1_PERIPH_TIM12
 - LL_APB1_GRP1_PERIPH_TIM13
 - LL_APB1_GRP1_PERIPH_TIM14
 - LL_APB1_GRP1_PERIPH_LPTIM1
 - LL_APB1_GRP1_PERIPH_WWDG
 - LL_APB1_GRP1_PERIPH_SPI2
 - LL_APB1_GRP1_PERIPH_SPI3
 - LL_APB1_GRP1_PERIPH_SPDIFRX (*)
 - LL_APB1_GRP1_PERIPH_USART2
 - LL_APB1_GRP1_PERIPH_USART3
 - LL_APB1_GRP1_PERIPH_UART4
 - LL_APB1_GRP1_PERIPH_UART5
 - LL_APB1_GRP1_PERIPH_I2C1
 - LL_APB1_GRP1_PERIPH_I2C2
 - LL_APB1_GRP1_PERIPH_I2C3
 - LL_APB1_GRP1_PERIPH_I2C4 (*)
 - LL_APB1_GRP1_PERIPH_CAN1
 - LL_APB1_GRP1_PERIPH_CAN2 (*)
 - LL_APB1_GRP1_PERIPH_CAN3 (*)
 - LL_APB1_GRP1_PERIPH_CEC (*)
 - LL_APB1_GRP1_PERIPH_PWR
 - LL_APB1_GRP1_PERIPH_DAC1
 - LL_APB1_GRP1_PERIPH_UART7
 - LL_APB1_GRP1_PERIPH_UART8

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1RSTR TIM2RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR TIM3RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR TIM4RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR TIM5RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR TIM6RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR TIM7RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR TIM12RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR TIM13RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR TIM14RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR LPTIM1RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR WWDGRST LL_APB1_GRP1_ReleaseReset

- APB1RSTR SPI2RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR SPI3RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR SPDIFRXRST LL_APB1_GRP1_ReleaseReset
- APB1RSTR USART2RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR USART3RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR UART4RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR UART5RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR I2C1RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR I2C2RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR I2C3RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR I2C4RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR CAN1RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR CAN2RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR CAN3RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR CECRST LL_APB1_GRP1_ReleaseReset
- APB1RSTR PWRRST LL_APB1_GRP1_ReleaseReset
- APB1RSTR DACRST LL_APB1_GRP1_ReleaseReset
- APB1RSTR UART7RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR UART8RST LL_APB1_GRP1_ReleaseReset

LL_APB1_GRP1_EnableClockLowPower

Function name `__STATIC_INLINE void LL_APB1_GRP1_EnableClockLowPower (uint32_t Periphs)`

Function description Enable APB1 peripheral clocks in low-power mode.

- Parameters
- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_APB1_GRP1_PERIPH_TIM2
 - LL_APB1_GRP1_PERIPH_TIM3
 - LL_APB1_GRP1_PERIPH_TIM4
 - LL_APB1_GRP1_PERIPH_TIM5
 - LL_APB1_GRP1_PERIPH_TIM6
 - LL_APB1_GRP1_PERIPH_TIM7
 - LL_APB1_GRP1_PERIPH_TIM12
 - LL_APB1_GRP1_PERIPH_TIM13
 - LL_APB1_GRP1_PERIPH_TIM14
 - LL_APB1_GRP1_PERIPH_LPTIM1
 - LL_APB1_GRP1_PERIPH_WWDG
 - LL_APB1_GRP1_PERIPH_SPI2
 - LL_APB1_GRP1_PERIPH_SPI3
 - LL_APB1_GRP1_PERIPH_SPDIFRX (*)
 - LL_APB1_GRP1_PERIPH_USART2
 - LL_APB1_GRP1_PERIPH_USART3
 - LL_APB1_GRP1_PERIPH_UART4
 - LL_APB1_GRP1_PERIPH_UART5
 - LL_APB1_GRP1_PERIPH_I2C1
 - LL_APB1_GRP1_PERIPH_I2C2
 - LL_APB1_GRP1_PERIPH_I2C3
 - LL_APB1_GRP1_PERIPH_I2C4 (*)
 - LL_APB1_GRP1_PERIPH_CAN1
 - LL_APB1_GRP1_PERIPH_CAN2 (*)
 - LL_APB1_GRP1_PERIPH_CAN3 (*)

- LL_APB1_GRP1_PERIPH_CEC (*)
- LL_APB1_GRP1_PERIPH_PWR
- LL_APB1_GRP1_PERIPH_DAC1
- LL_APB1_GRP1_PERIPH_UART7
- LL_APB1_GRP1_PERIPH_UART8
- LL_APB1_GRP1_PERIPH_RTCAPB (*)

Return values

Reference Manual to
LL API cross
reference:

- **None:**
- APB1LPENR TIM2LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR TIM3LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR TIM4LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR TIM5LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR TIM6LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR TIM7LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR TIM12LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR TIM13LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR TIM14LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR LPTIM1LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR WWDGLPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR SPI2LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR SPI3LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR SPDIFRXLLEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR USART2LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR USART3LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR UART4LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR UART5LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR I2C1LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR I2C2LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR I2C3LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR I2C4LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR CAN1LPEN
LL_APB1_GRP1_EnableClockLowPower

- APB1LPENR CAN2LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR CAN3LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR CECLPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR PWRLPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR DACLPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR UART7LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR UART8LPEN
LL_APB1_GRP1_EnableClockLowPower
- APB1LPENR RTCLPEN
LL_APB1_GRP1_EnableClockLowPower

LL_APB1_GRP1_DisableClockLowPower

Function name	__STATIC_INLINE void LL_APB1_GRP1_DisableClockLowPower (uint32_t Periphs)
Function description	Disable APB1 peripheral clocks in low-power mode.
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_APB1_GRP1_PERIPH_TIM2 – LL_APB1_GRP1_PERIPH_TIM3 – LL_APB1_GRP1_PERIPH_TIM4 – LL_APB1_GRP1_PERIPH_TIM5 – LL_APB1_GRP1_PERIPH_TIM6 – LL_APB1_GRP1_PERIPH_TIM7 – LL_APB1_GRP1_PERIPH_TIM12 – LL_APB1_GRP1_PERIPH_TIM13 – LL_APB1_GRP1_PERIPH_TIM14 – LL_APB1_GRP1_PERIPH_LPTIM1 – LL_APB1_GRP1_PERIPH_WWDG – LL_APB1_GRP1_PERIPH_SPI2 – LL_APB1_GRP1_PERIPH_SPI3 – LL_APB1_GRP1_PERIPH_SPDIFRX (*) – LL_APB1_GRP1_PERIPH_USART2 – LL_APB1_GRP1_PERIPH_USART3 – LL_APB1_GRP1_PERIPH_UART4 – LL_APB1_GRP1_PERIPH_UART5 – LL_APB1_GRP1_PERIPH_I2C1 – LL_APB1_GRP1_PERIPH_I2C2 – LL_APB1_GRP1_PERIPH_I2C3 – LL_APB1_GRP1_PERIPH_I2C4 (*) – LL_APB1_GRP1_PERIPH_CAN1 – LL_APB1_GRP1_PERIPH_CAN2 (*) – LL_APB1_GRP1_PERIPH_CAN3 (*) – LL_APB1_GRP1_PERIPH_CEC (*) – LL_APB1_GRP1_PERIPH_PWR – LL_APB1_GRP1_PERIPH_DAC1

- LL_APB1_GRP1_PERIPH_UART7
- LL_APB1_GRP1_PERIPH_UART8
- LL_APB1_GRP1_PERIPH_RTCAPB (*)

Return values

Reference Manual to
LL API cross
reference:

- **None:**
- APB1LPENR TIM2LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR TIM3LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR TIM4LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR TIM5LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR TIM6LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR TIM7LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR TIM12LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR TIM13LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR TIM14LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR LPTIM1LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR WWDGLPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR SPI2LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR SPI3LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR SPDIFRXPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR USART2LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR USART3LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR UART4LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR UART5LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR I2C1LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR I2C2LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR I2C3LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR I2C4LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR CAN1LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR CAN2LPEN
LL_APB1_GRP1_DisableClockLowPower
- APB1LPENR CAN3LPEN

- LL_APB1_GRP1_DisableClockLowPower
APB1LPENR CECLPEN
- LL_APB1_GRP1_DisableClockLowPower
APB1LPENR PWRLPEN
- LL_APB1_GRP1_DisableClockLowPower
APB1LPENR DACLPEN
- LL_APB1_GRP1_DisableClockLowPower
APB1LPENR UART7LPEN
- LL_APB1_GRP1_DisableClockLowPower
APB1LPENR UART8LPEN
- LL_APB1_GRP1_DisableClockLowPower
APB1LPENR RTCLPEN

LL_APB2_GRP1_EnableClock

Function name `__STATIC_INLINE void LL_APB2_GRP1_EnableClock (uint32_t Periphs)`

Function description Enable APB2 peripherals clock.

- Parameters
- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_APB2_GRP1_PERIPH_TIM1
 - LL_APB2_GRP1_PERIPH_TIM8
 - LL_APB2_GRP1_PERIPH_USART1
 - LL_APB2_GRP1_PERIPH_USART6
 - LL_APB2_GRP1_PERIPH_ADC1
 - LL_APB2_GRP1_PERIPH_ADC2
 - LL_APB2_GRP1_PERIPH_ADC3
 - LL_APB2_GRP1_PERIPH_SDMMC1
 - LL_APB2_GRP1_PERIPH_SDMMC2 (*)
 - LL_APB2_GRP1_PERIPH_SPI1
 - LL_APB2_GRP1_PERIPH_SPI4
 - LL_APB2_GRP1_PERIPH_SYSCFG
 - LL_APB2_GRP1_PERIPH_TIM9
 - LL_APB2_GRP1_PERIPH_TIM10
 - LL_APB2_GRP1_PERIPH_TIM11
 - LL_APB2_GRP1_PERIPH_SPI5
 - LL_APB2_GRP1_PERIPH_SPI6 (*)
 - LL_APB2_GRP1_PERIPH_SAI1
 - LL_APB2_GRP1_PERIPH_SAI2
 - LL_APB2_GRP1_PERIPH_LTDC (*)
 - LL_APB2_GRP1_PERIPH_DSI (*)
 - LL_APB2_GRP1_PERIPH_DFSDM1 (*)
 - LL_APB2_GRP1_PERIPH_MDIO (*)
 - LL_APB2_GRP1_PERIPH_OTGPHYC (*)

Return values

- **None:**

- Reference Manual to LL API cross reference:
- APB2ENR TIM1EN LL_APB2_GRP1_EnableClock
 - APB2ENR TIM8EN LL_APB2_GRP1_EnableClock
 - APB2ENR USART1EN LL_APB2_GRP1_EnableClock
 - APB2ENR USART6EN LL_APB2_GRP1_EnableClock
 - APB2ENR ADC1EN LL_APB2_GRP1_EnableClock

- APB2ENR ADC2EN LL_APB2_GRP1_EnableClock
- APB2ENR ADC3EN LL_APB2_GRP1_EnableClock
- APB2ENR SDMMC1EN LL_APB2_GRP1_EnableClock
- APB2ENR SDMMC2EN LL_APB2_GRP1_EnableClock
- APB2ENR SPI1EN LL_APB2_GRP1_EnableClock
- APB2ENR SPI4EN LL_APB2_GRP1_EnableClock
- APB2ENR SYSCFGEN LL_APB2_GRP1_EnableClock
- APB2ENR TIM9EN LL_APB2_GRP1_EnableClock
- APB2ENR TIM10EN LL_APB2_GRP1_EnableClock
- APB2ENR TIM11EN LL_APB2_GRP1_EnableClock
- APB2ENR SPI5EN LL_APB2_GRP1_EnableClock
- APB2ENR SPI6EN LL_APB2_GRP1_EnableClock
- APB2ENR SAI1EN LL_APB2_GRP1_EnableClock
- APB2ENR SAI2EN LL_APB2_GRP1_EnableClock
- APB2ENR LTDCEN LL_APB2_GRP1_EnableClock
- APB2ENR DSIEN LL_APB2_GRP1_EnableClock
- APB2ENR DFSDM1EN LL_APB2_GRP1_EnableClock
- APB2ENR MDIOEN LL_APB2_GRP1_EnableClock
- APB2ENR OTGPHYCEN LL_APB2_GRP1_EnableClock

LL_APB2_GRP1_IsEnabledClock

Function name `__STATIC_INLINE uint32_t LL_APB2_GRP1_IsEnabledClock (uint32_t Periphs)`

Function description Check if APB2 peripheral clock is enabled or not.

Parameters

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_APB2_GRP1_PERIPH_TIM1
 - LL_APB2_GRP1_PERIPH_TIM8
 - LL_APB2_GRP1_PERIPH_USART1
 - LL_APB2_GRP1_PERIPH_USART6
 - LL_APB2_GRP1_PERIPH_ADC1
 - LL_APB2_GRP1_PERIPH_ADC2
 - LL_APB2_GRP1_PERIPH_ADC3
 - LL_APB2_GRP1_PERIPH_SDMMC1
 - LL_APB2_GRP1_PERIPH_SDMMC2 (*)
 - LL_APB2_GRP1_PERIPH_SPI1
 - LL_APB2_GRP1_PERIPH_SPI4
 - LL_APB2_GRP1_PERIPH_SYSCFG
 - LL_APB2_GRP1_PERIPH_TIM9
 - LL_APB2_GRP1_PERIPH_TIM10
 - LL_APB2_GRP1_PERIPH_TIM11
 - LL_APB2_GRP1_PERIPH_SPI5
 - LL_APB2_GRP1_PERIPH_SPI6 (*)
 - LL_APB2_GRP1_PERIPH_SAI1
 - LL_APB2_GRP1_PERIPH_SAI2
 - LL_APB2_GRP1_PERIPH_LTDC (*)
 - LL_APB2_GRP1_PERIPH_DSI (*)
 - LL_APB2_GRP1_PERIPH_DFSDM1 (*)
 - LL_APB2_GRP1_PERIPH_MDIO (*)
 - LL_APB2_GRP1_PERIPH_OTGPHYC (*)

Return values	<ul style="list-style-type: none"> • State: of Periphs (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • APB2ENR TIM1EN LL_APB2_GRP1_IsEnabledClock • APB2ENR TIM8EN LL_APB2_GRP1_IsEnabledClock • APB2ENR USART1EN LL_APB2_GRP1_IsEnabledClock • APB2ENR USART6EN LL_APB2_GRP1_IsEnabledClock • APB2ENR ADC1EN LL_APB2_GRP1_IsEnabledClock • APB2ENR ADC2EN LL_APB2_GRP1_IsEnabledClock • APB2ENR ADC3EN LL_APB2_GRP1_IsEnabledClock • APB2ENR SDMMC1EN LL_APB2_GRP1_IsEnabledClock • APB2ENR SDMMC2EN LL_APB2_GRP1_IsEnabledClock • APB2ENR SPI1EN LL_APB2_GRP1_IsEnabledClock • APB2ENR SPI4EN LL_APB2_GRP1_IsEnabledClock • APB2ENR SYSCFGEN LL_APB2_GRP1_IsEnabledClock • APB2ENR TIM9EN LL_APB2_GRP1_IsEnabledClock • APB2ENR TIM10EN LL_APB2_GRP1_IsEnabledClock • APB2ENR TIM11EN LL_APB2_GRP1_IsEnabledClock • APB2ENR SPI5EN LL_APB2_GRP1_IsEnabledClock • APB2ENR SPI6EN LL_APB2_GRP1_IsEnabledClock • APB2ENR SAI1EN LL_APB2_GRP1_IsEnabledClock • APB2ENR SAI2EN LL_APB2_GRP1_IsEnabledClock • APB2ENR LTDCEN LL_APB2_GRP1_IsEnabledClock • APB2ENR DSIEN LL_APB2_GRP1_IsEnabledClock • APB2ENR DFSDM1EN LL_APB2_GRP1_IsEnabledClock • APB2ENR MDIOEN LL_APB2_GRP1_IsEnabledClock • APB2ENR OTGPHYCEN LL_APB2_GRP1_IsEnabledClock

LL_APB2_GRP1_DisableClock

Function name `__STATIC_INLINE void LL_APB2_GRP1_DisableClock (uint32_t Periphs)`

Function description Disable APB2 peripherals clock.

Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_APB2_GRP1_PERIPH_TIM1 – LL_APB2_GRP1_PERIPH_TIM8 – LL_APB2_GRP1_PERIPH_USART1 – LL_APB2_GRP1_PERIPH_USART6 – LL_APB2_GRP1_PERIPH_ADC1 – LL_APB2_GRP1_PERIPH_ADC2 – LL_APB2_GRP1_PERIPH_ADC3 – LL_APB2_GRP1_PERIPH_SDMMC1 – LL_APB2_GRP1_PERIPH_SDMMC2 (*) – LL_APB2_GRP1_PERIPH_SPI1 – LL_APB2_GRP1_PERIPH_SPI4 – LL_APB2_GRP1_PERIPH_SYSCFG – LL_APB2_GRP1_PERIPH_TIM9 – LL_APB2_GRP1_PERIPH_TIM10 – LL_APB2_GRP1_PERIPH_TIM11 – LL_APB2_GRP1_PERIPH_SPI5 – LL_APB2_GRP1_PERIPH_SPI6 (*) – LL_APB2_GRP1_PERIPH_SAI1
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- LL_APB2_GRP1_PERIPH_SAI2
- LL_APB2_GRP1_PERIPH_LTDC (*)
- LL_APB2_GRP1_PERIPH_DSI (*)
- LL_APB2_GRP1_PERIPH_DFSDM1 (*)
- LL_APB2_GRP1_PERIPH_MDIO (*)
- LL_APB2_GRP1_PERIPH_OTGPHYC (*)

Return values

Reference Manual to
LL API cross
reference:

- **None:**
- APB2ENR TIM1EN LL_APB2_GRP1_DisableClock
- APB2ENR TIM8EN LL_APB2_GRP1_DisableClock
- APB2ENR USART1EN LL_APB2_GRP1_DisableClock
- APB2ENR USART6EN LL_APB2_GRP1_DisableClock
- APB2ENR ADC1EN LL_APB2_GRP1_DisableClock
- APB2ENR ADC2EN LL_APB2_GRP1_DisableClock
- APB2ENR ADC3EN LL_APB2_GRP1_DisableClock
- APB2ENR SDMMC1EN LL_APB2_GRP1_DisableClock
- APB2ENR SDMMC2EN LL_APB2_GRP1_DisableClock
- APB2ENR SPI1EN LL_APB2_GRP1_DisableClock
- APB2ENR SPI4EN LL_APB2_GRP1_DisableClock
- APB2ENR SYSCFGEN LL_APB2_GRP1_DisableClock
- APB2ENR TIM9EN LL_APB2_GRP1_DisableClock
- APB2ENR TIM10EN LL_APB2_GRP1_DisableClock
- APB2ENR TIM11EN LL_APB2_GRP1_DisableClock
- APB2ENR SPI5EN LL_APB2_GRP1_DisableClock
- APB2ENR SPI6EN LL_APB2_GRP1_DisableClock
- APB2ENR SAI1EN LL_APB2_GRP1_DisableClock
- APB2ENR SAI2EN LL_APB2_GRP1_DisableClock
- APB2ENR LTDCEN LL_APB2_GRP1_DisableClock
- APB2ENR DSIEN LL_APB2_GRP1_DisableClock
- APB2ENR DFSDM1EN LL_APB2_GRP1_DisableClock
- APB2ENR MDIOEN LL_APB2_GRP1_DisableClock
- APB2ENR OTGPHYCEN LL_APB2_GRP1_DisableClock

LL_APB2_GRP1_ForceReset

Function name **__STATIC_INLINE void LL_APB2_GRP1_ForceReset (uint32_t Periphs)**

Function description Force APB2 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_APB2_GRP1_PERIPH_ALL
 - LL_APB2_GRP1_PERIPH_TIM1
 - LL_APB2_GRP1_PERIPH_TIM8
 - LL_APB2_GRP1_PERIPH_USART1
 - LL_APB2_GRP1_PERIPH_USART6
 - LL_APB2_GRP1_PERIPH_ADC
 - LL_APB2_GRP1_PERIPH_SDMMC1
 - LL_APB2_GRP1_PERIPH_SDMMC2 (*)
 - LL_APB2_GRP1_PERIPH_SPI1
 - LL_APB2_GRP1_PERIPH_SPI4
 - LL_APB2_GRP1_PERIPH_SYSCFG
 - LL_APB2_GRP1_PERIPH_TIM9

- LL_APB2_GRP1_PERIPH_TIM10
- LL_APB2_GRP1_PERIPH_TIM11
- LL_APB2_GRP1_PERIPH_SPI5
- LL_APB2_GRP1_PERIPH_SPI6 (*)
- LL_APB2_GRP1_PERIPH_SAI1
- LL_APB2_GRP1_PERIPH_SAI2
- LL_APB2_GRP1_PERIPH_LTDC (*)
- LL_APB2_GRP1_PERIPH_DSI (*)
- LL_APB2_GRP1_PERIPH_DFSDM1 (*)
- LL_APB2_GRP1_PERIPH_MDIO (*)
- LL_APB2_GRP1_PERIPH_OTGPHYC (*)

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- APB2RSTR TIM1RST LL_APB2_GRP1_ForceReset
- APB2RSTR TIM8RST LL_APB2_GRP1_ForceReset
- APB2RSTR USART1RST LL_APB2_GRP1_ForceReset
- APB2RSTR USART6RST LL_APB2_GRP1_ForceReset
- APB2RSTR ADCRST LL_APB2_GRP1_ForceReset
- APB2RSTR SDMMC1RST LL_APB2_GRP1_ForceReset
- APB2RSTR SDMMC2RST LL_APB2_GRP1_ForceReset
- APB2RSTR SPI1RST LL_APB2_GRP1_ForceReset
- APB2RSTR SPI4RST LL_APB2_GRP1_ForceReset
- APB2RSTR SYSCFGRST LL_APB2_GRP1_ForceReset
- APB2RSTR TIM9RST LL_APB2_GRP1_ForceReset
- APB2RSTR TIM10RST LL_APB2_GRP1_ForceReset
- APB2RSTR TIM11RST LL_APB2_GRP1_ForceReset
- APB2RSTR SPI5RST LL_APB2_GRP1_ForceReset
- APB2RSTR SPI6RST LL_APB2_GRP1_ForceReset
- APB2RSTR SAI1RST LL_APB2_GRP1_ForceReset
- APB2RSTR SAI2RST LL_APB2_GRP1_ForceReset
- APB2RSTR LTDCRST LL_APB2_GRP1_ForceReset
- APB2RSTR DSIRST LL_APB2_GRP1_ForceReset
- APB2RSTR DFSDM1RST LL_APB2_GRP1_ForceReset
- APB2RSTR MDIORST LL_APB2_GRP1_ForceReset
- APB2RSTR OTGPHYCRST LL_APB2_GRP1_ForceReset

LL_APB2_GRP1_ReleaseReset

Function name **__STATIC_INLINE void LL_APB2_GRP1_ReleaseReset
(uint32_t Periphs)**

Function description Release APB2 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_APB2_GRP1_PERIPH_ALL
 - LL_APB2_GRP1_PERIPH_TIM1
 - LL_APB2_GRP1_PERIPH_TIM8
 - LL_APB2_GRP1_PERIPH_USART1
 - LL_APB2_GRP1_PERIPH_USART6
 - LL_APB2_GRP1_PERIPH_ADC
 - LL_APB2_GRP1_PERIPH_SDMMC1
 - LL_APB2_GRP1_PERIPH_SDMMC2 (*)
 - LL_APB2_GRP1_PERIPH_SPI1

- LL_APB2_GRP1_PERIPH_SPI4
- LL_APB2_GRP1_PERIPH_SYSCFG
- LL_APB2_GRP1_PERIPH_TIM9
- LL_APB2_GRP1_PERIPH_TIM10
- LL_APB2_GRP1_PERIPH_TIM11
- LL_APB2_GRP1_PERIPH_SPI5
- LL_APB2_GRP1_PERIPH_SPI6 (*)
- LL_APB2_GRP1_PERIPH_SAI1
- LL_APB2_GRP1_PERIPH_SAI2
- LL_APB2_GRP1_PERIPH_LTDC (*)
- LL_APB2_GRP1_PERIPH_DSI (*)
- LL_APB2_GRP1_PERIPH_DFSDM1 (*)
- LL_APB2_GRP1_PERIPH_MDIO (*)
- LL_APB2_GRP1_PERIPH_OTGPHYC (*)

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- APB2RSTR TIM1RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR TIM8RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR USART1RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR USART6RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR ADCRST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SDMMC1RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SDMMC2RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SPI1RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SPI4RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SYSCFGRST LL_APB2_GRP1_ReleaseReset
- APB2RSTR TIM9RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR TIM10RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR TIM11RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SPI5RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SPI6RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SAI1RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SAI2RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR LTDCRST LL_APB2_GRP1_ReleaseReset
- APB2RSTR DSIRST LL_APB2_GRP1_ReleaseReset
- APB2RSTR DFSDM1RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR MDIORST LL_APB2_GRP1_ReleaseReset
- APB2RSTR OTGPHYCRST LL_APB2_GRP1_ReleaseReset

LL_APB2_GRP1_EnableClockLowPower

Function name

__STATIC_INLINE void
LL_APB2_GRP1_EnableClockLowPower (uint32_t Periphs)

Function description

Enable APB2 peripheral clocks in low-power mode.

Parameters

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
 - LL_APB2_GRP1_PERIPH_TIM1
 - LL_APB2_GRP1_PERIPH_TIM8
 - LL_APB2_GRP1_PERIPH_USART1
 - LL_APB2_GRP1_PERIPH_USART6
 - LL_APB2_GRP1_PERIPH_ADC1
 - LL_APB2_GRP1_PERIPH_ADC2

- LL_APB2_GRP1_PERIPH_ADC3
- LL_APB2_GRP1_PERIPH_SDMMC1
- LL_APB2_GRP1_PERIPH_SDMMC2 (*)
- LL_APB2_GRP1_PERIPH_SPI1
- LL_APB2_GRP1_PERIPH_SPI4
- LL_APB2_GRP1_PERIPH_SYSCFG
- LL_APB2_GRP1_PERIPH_TIM9
- LL_APB2_GRP1_PERIPH_TIM10
- LL_APB2_GRP1_PERIPH_TIM11
- LL_APB2_GRP1_PERIPH_SPI5
- LL_APB2_GRP1_PERIPH_SPI6 (*)
- LL_APB2_GRP1_PERIPH_SAI1
- LL_APB2_GRP1_PERIPH_SAI2
- LL_APB2_GRP1_PERIPH_LTDC (*)
- LL_APB2_GRP1_PERIPH_DSI (*)
- LL_APB2_GRP1_PERIPH_DFSDM1 (*)
- LL_APB2_GRP1_PERIPH_MDIO (*)

Return values

Reference Manual to
LL API cross
reference:

- **None:**
- APB2LPENR TIM1LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR TIM8LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR USART1LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR USART6LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR ADC1LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR ADC2LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR ADC3LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR SDMMC1LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR SDMMC2LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR SPI1LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR SPI4LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR SYSCFGLPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR TIM9LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR TIM10LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR TIM11LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR SPI5LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR SPI6LPEN
LL_APB2_GRP1_EnableClockLowPower

- APB2LPENR SAI1LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR SAI2LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR LTDCLPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR DSILPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR DFSDM1LPEN
LL_APB2_GRP1_EnableClockLowPower
- APB2LPENR MDIOLPEN
LL_APB2_GRP1_EnableClockLowPower

LL_APB2_GRP1_DisableClockLowPower

Function name	__STATIC_INLINE void LL_APB2_GRP1_DisableClockLowPower (uint32_t Periphs)
Function description	Disable APB2 peripheral clocks in low-power mode.
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_APB2_GRP1_PERIPH_TIM1 – LL_APB2_GRP1_PERIPH_TIM8 – LL_APB2_GRP1_PERIPH_USART1 – LL_APB2_GRP1_PERIPH_USART6 – LL_APB2_GRP1_PERIPH_ADC1 – LL_APB2_GRP1_PERIPH_ADC2 – LL_APB2_GRP1_PERIPH_ADC3 – LL_APB2_GRP1_PERIPH_SDMMC1 – LL_APB2_GRP1_PERIPH_SDMMC1 (*) – LL_APB2_GRP1_PERIPH_SPI1 – LL_APB2_GRP1_PERIPH_SPI4 – LL_APB2_GRP1_PERIPH_SYSCFG – LL_APB2_GRP1_PERIPH_TIM9 – LL_APB2_GRP1_PERIPH_TIM10 – LL_APB2_GRP1_PERIPH_TIM11 – LL_APB2_GRP1_PERIPH_SPI5 – LL_APB2_GRP1_PERIPH_SPI6 (*) – LL_APB2_GRP1_PERIPH_SAI1 – LL_APB2_GRP1_PERIPH_SAI2 – LL_APB2_GRP1_PERIPH_LTDC (*) – LL_APB2_GRP1_PERIPH_DSI (*) – LL_APB2_GRP1_PERIPH_DFSDM1 (*) – LL_APB2_GRP1_PERIPH_MDIO (*)
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • APB2LPENR TIM1LPEN LL_APB2_GRP1_DisableClockLowPower • APB2LPENR TIM8LPEN LL_APB2_GRP1_DisableClockLowPower • APB2LPENR USART1LPEN LL_APB2_GRP1_DisableClockLowPower • APB2LPENR USART6LPEN

- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR ADC1LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR ADC2LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR ADC3LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR SDMMC1LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR SDMMC2LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR SPI1LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR SPI4LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR SYSCFGLPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR TIM9LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR TIM10LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR TIM11LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR SPI5LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR SPI6LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR SAI1LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR SAI2LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR LTDCLPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR DSILPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR DFSDM1LPEN
- LL_APB2_GRP1_DisableClockLowPower
APB2LPENR MDIOLPEN
- LL_APB2_GRP1_DisableClockLowPower

72.2 BUS Firmware driver defines

72.2.1 BUS

AHB1 GRP1 PERIPH

LL_AHB1_GRP1_PERIPH_ALL

LL_AHB1_GRP1_PERIPH_GPIOA

LL_AHB1_GRP1_PERIPH_GPIOB

LL_AHB1_GRP1_PERIPH_GPIOC

LL_AHB1_GRP1_PERIPH_GPIOD

LL_AHB1_GRP1_PERIPH_GPIOE
LL_AHB1_GRP1_PERIPH_GPIOF
LL_AHB1_GRP1_PERIPH_GPIOG
LL_AHB1_GRP1_PERIPH_GPIOH
LL_AHB1_GRP1_PERIPH_GPIOI
LL_AHB1_GRP1_PERIPH_GPIOJ
LL_AHB1_GRP1_PERIPH_GPIOK
LL_AHB1_GRP1_PERIPH_CRC
LL_AHB1_GRP1_PERIPH_BKPSRAM
LL_AHB1_GRP1_PERIPH_DTCMRAM
LL_AHB1_GRP1_PERIPH_DMA1
LL_AHB1_GRP1_PERIPH_DMA2
LL_AHB1_GRP1_PERIPH_DMA2D
LL_AHB1_GRP1_PERIPH_ETHMAC
LL_AHB1_GRP1_PERIPH_ETHMACTX
LL_AHB1_GRP1_PERIPH_ETHMACRX
LL_AHB1_GRP1_PERIPH_ETHMACPTP
LL_AHB1_GRP1_PERIPH_OTGHS
LL_AHB1_GRP1_PERIPH_OTGHSULPI
LL_AHB1_GRP1_PERIPH_AXI
LL_AHB1_GRP1_PERIPH_FLITF
LL_AHB1_GRP1_PERIPH_SRAM1
LL_AHB1_GRP1_PERIPH_SRAM2

AHB2 GRP1 PERIPH

LL_AHB2_GRP1_PERIPH_ALL
LL_AHB2_GRP1_PERIPH_DCMI
LL_AHB2_GRP1_PERIPH_JPEG
LL_AHB2_GRP1_PERIPH_CRYP
LL_AHB2_GRP1_PERIPH_HASH
LL_AHB2_GRP1_PERIPH_RNG
LL_AHB2_GRP1_PERIPH_OTGFS

AHB3 GRP1 PERIPH

LL_AHB3_GRP1_PERIPH_ALL
LL_AHB3_GRP1_PERIPH_FMC
LL_AHB3_GRP1_PERIPH_QSPI

APB1 GRP1 PERIPH

LL_APB1_GRP1_PERIPH_ALL
LL_APB1_GRP1_PERIPH_TIM2
LL_APB1_GRP1_PERIPH_TIM3
LL_APB1_GRP1_PERIPH_TIM4
LL_APB1_GRP1_PERIPH_TIM5
LL_APB1_GRP1_PERIPH_TIM6
LL_APB1_GRP1_PERIPH_TIM7
LL_APB1_GRP1_PERIPH_TIM12
LL_APB1_GRP1_PERIPH_TIM13
LL_APB1_GRP1_PERIPH_TIM14
LL_APB1_GRP1_PERIPH_LPTIM1
LL_APB1_GRP1_PERIPH_WWDG
LL_APB1_GRP1_PERIPH_SPI2
LL_APB1_GRP1_PERIPH_SPI3
LL_APB1_GRP1_PERIPH_SPDIFRX
LL_APB1_GRP1_PERIPH_USART2
LL_APB1_GRP1_PERIPH_USART3
LL_APB1_GRP1_PERIPH_UART4
LL_APB1_GRP1_PERIPH_UART5
LL_APB1_GRP1_PERIPH_I2C1
LL_APB1_GRP1_PERIPH_I2C2
LL_APB1_GRP1_PERIPH_I2C3
LL_APB1_GRP1_PERIPH_I2C4
LL_APB1_GRP1_PERIPH_CAN1
LL_APB1_GRP1_PERIPH_CAN2
LL_APB1_GRP1_PERIPH_CAN3
LL_APB1_GRP1_PERIPH_CEC
LL_APB1_GRP1_PERIPH_PWR
LL_APB1_GRP1_PERIPH_DAC1
LL_APB1_GRP1_PERIPH_UART7
LL_APB1_GRP1_PERIPH_UART8
LL_APB1_GRP1_PERIPH_RTCAPB

APB2 GRP1 PERIPH

LL_APB2_GRP1_PERIPH_ALL
LL_APB2_GRP1_PERIPH_TIM1
LL_APB2_GRP1_PERIPH_TIM8

LL_APB2_GRP1_PERIPH_USART1
LL_APB2_GRP1_PERIPH_USART6
LL_APB2_GRP1_PERIPH_ADC1
LL_APB2_GRP1_PERIPH_ADC2
LL_APB2_GRP1_PERIPH_ADC3
LL_APB2_GRP1_PERIPH_SDMMC1
LL_APB2_GRP1_PERIPH_SDMMC2
LL_APB2_GRP1_PERIPH_SPI1
LL_APB2_GRP1_PERIPH_SPI4
LL_APB2_GRP1_PERIPH_SYSCFG
LL_APB2_GRP1_PERIPH_TIM9
LL_APB2_GRP1_PERIPH_TIM10
LL_APB2_GRP1_PERIPH_TIM11
LL_APB2_GRP1_PERIPH_SPI5
LL_APB2_GRP1_PERIPH_SPI6
LL_APB2_GRP1_PERIPH_SAI1
LL_APB2_GRP1_PERIPH_SAI2
LL_APB2_GRP1_PERIPH_LTDC
LL_APB2_GRP1_PERIPH_DSI
LL_APB2_GRP1_PERIPH_DFSDM1
LL_APB2_GRP1_PERIPH_MDIO
LL_APB2_GRP1_PERIPH_ADC

73 LL CORTEX Generic Driver

73.1 CORTEX Firmware driver API description

73.1.1 Detailed description of functions

LL_SYSTICK_IsActiveCounterFlag

Function name `__STATIC_INLINE uint32_t LL_SYSTICK_IsActiveCounterFlag (void)`

Function description This function checks if the SysTick counter flag is active or not.

Return values

- **State:** of bit (1 or 0).

Notes

- It can be used in timeout function on application side.

Reference Manual to LL API cross reference:

- STK_CTRL COUNTFLAG LL_SYSTICK_IsActiveCounterFlag

LL_SYSTICK_SetClkSource

Function name `__STATIC_INLINE void LL_SYSTICK_SetClkSource (uint32_t Source)`

Function description Configures the SysTick clock source.

Parameters

- **Source:** This parameter can be one of the following values:
 - LL_SYSTICK_CLKSOURCE_HCLK_DIV8
 - LL_SYSTICK_CLKSOURCE_HCLK

Return values

- **None:**

Reference Manual to LL API cross reference:

- STK_CTRL CLKSOURCE LL_SYSTICK_SetClkSource

LL_SYSTICK_GetClkSource

Function name `__STATIC_INLINE uint32_t LL_SYSTICK_GetClkSource (void)`

Function description Get the SysTick clock source.

Return values

- **Returned:** value can be one of the following values:
 - LL_SYSTICK_CLKSOURCE_HCLK_DIV8
 - LL_SYSTICK_CLKSOURCE_HCLK

Reference Manual to LL API cross reference:

- STK_CTRL CLKSOURCE LL_SYSTICK_GetClkSource

LL_SYSTICK_EnableIT

Function name `__STATIC_INLINE void LL_SYSTICK_EnableIT (void)`

Function description Enable SysTick exception request.

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- STK_CTRL TICKINT LL_SYSTICK_EnableIT

LL_SYSTICK_DisableIT

- Function name `__STATIC_INLINE void LL_SYSTICK_DisableIT (void)`
- Function description Disable SysTick exception request.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- STK_CTRL TICKINT LL_SYSTICK_DisableIT

LL_SYSTICK_IsEnabledIT

- Function name `__STATIC_INLINE uint32_t LL_SYSTICK_IsEnabledIT (void)`
- Function description Checks if the SYSTICK interrupt is enabled or disabled.
- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- STK_CTRL TICKINT LL_SYSTICK_IsEnabledIT

LL_LPM_EnableSleep

- Function name `__STATIC_INLINE void LL_LPM_EnableSleep (void)`
- Function description Processor uses sleep as its low power mode.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- SCB_SCR SLEEPDEEP LL_LPM_EnableSleep

LL_LPM_EnableDeepSleep

- Function name `__STATIC_INLINE void LL_LPM_EnableDeepSleep (void)`
- Function description Processor uses deep sleep as its low power mode.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- SCB_SCR SLEEPDEEP LL_LPM_EnableDeepSleep

LL_LPM_EnableSleepOnExit

- Function name `__STATIC_INLINE void LL_LPM_EnableSleepOnExit (void)`
- Function description Configures sleep-on-exit when returning from Handler mode to Thread mode.

Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Setting this bit to 1 enables an interrupt-driven application to avoid returning to an empty main application.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SCB_SCR SLEEPONEXIT LL_LPM_EnableSleepOnExit

LL_LPM_DisableSleepOnExit

Function name	__STATIC_INLINE void LL_LPM_DisableSleepOnExit (void)
Function description	Do not sleep when returning to Thread mode.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SCB_SCR SLEEPONEXIT LL_LPM_DisableSleepOnExit

LL_LPM_EnableEventOnPend

Function name	__STATIC_INLINE void LL_LPM_EnableEventOnPend (void)
Function description	Enabled events and all interrupts, including disabled interrupts, can wakeup the processor.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SCB_SCR SEVEONPEND LL_LPM_EnableEventOnPend

LL_LPM_DisableEventOnPend

Function name	__STATIC_INLINE void LL_LPM_DisableEventOnPend (void)
Function description	Only enabled interrupts or events can wakeup the processor, disabled interrupts are excluded.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SCB_SCR SEVEONPEND LL_LPM_DisableEventOnPend

LL_HANDLER_EnableFault

Function name	__STATIC_INLINE void LL_HANDLER_EnableFault (uint32_t Fault)
Function description	Enable a fault in System handler control register (SHCSR)
Parameters	<ul style="list-style-type: none"> • Fault: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_HANDLER_FAULT_USG – LL_HANDLER_FAULT_BUS – LL_HANDLER_FAULT_MEM

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- SCB_SHCSR MEMFAULTENA LL_HANDLER_EnableFault

LL_HANDLER_DisableFault

- Function name **__STATIC_INLINE void LL_HANDLER_DisableFault (uint32_t Fault)**
- Function description Disable a fault in System handler control register (SHCSR)
- Parameters
- **Fault:** This parameter can be a combination of the following values:
 - LL_HANDLER_FAULT_USG
 - LL_HANDLER_FAULT_BUS
 - LL_HANDLER_FAULT_MEM
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- SCB_SHCSR MEMFAULTENA LL_HANDLER_DisableFault

LL_CPUID_GetImplementer

- Function name **__STATIC_INLINE uint32_t LL_CPUID_GetImplementer (void)**
- Function description Get Implementer code.
- Return values
- **Value:** should be equal to 0x41 for ARM
- Reference Manual to LL API cross reference:
- SCB_CPUID IMPLEMENTER LL_CPUID_GetImplementer

LL_CPUID_GetVariant

- Function name **__STATIC_INLINE uint32_t LL_CPUID_GetVariant (void)**
- Function description Get Variant number (The r value in the rnpn product revision identifier)
- Return values
- **Value:** between 0 and 255 (0x0: revision 0)
- Reference Manual to LL API cross reference:
- SCB_CPUID VARIANT LL_CPUID_GetVariant

LL_CPUID_GetConstant

- Function name **__STATIC_INLINE uint32_t LL_CPUID_GetConstant (void)**
- Function description Get Constant number.
- Return values
- **Value:** should be equal to 0xF for Cortex-M7 devices
- Reference Manual to LL API cross reference:
- SCB_CPUID ARCHITECTURE LL_CPUID_GetConstant

reference:

LL_CPUID_GetParNo

Function name `__STATIC_INLINE uint32_t LL_CPUID_GetParNo (void)`

Function description Get Part number.

Return values

- **Value:** should be equal to 0xC27 for Cortex-M7

Reference Manual to LL API cross reference:

- SCB_CPUID PARTNO LL_CPUID_GetParNo

LL_CPUID_GetRevision

Function name `__STATIC_INLINE uint32_t LL_CPUID_GetRevision (void)`

Function description Get Revision number (The p value in the rmpn product revision identifier, indicates patch release)

Return values

- **Value:** between 0 and 255 (0x1: patch 1)

Reference Manual to LL API cross reference:

- SCB_CPUID REVISION LL_CPUID_GetRevision

LL_MPU_Enable

Function name `__STATIC_INLINE void LL_MPU_Enable (uint32_t Options)`

Function description Enable MPU with input options.

Parameters

- **Options:** This parameter can be one of the following values:
 - LL_MPU_CTRL_HFNMI_PRIVDEF_NONE
 - LL_MPU_CTRL_HARDFAULT_NMI
 - LL_MPU_CTRL_PRIVILEGED_DEFAULT
 - LL_MPU_CTRL_HFNMI_PRIVDEF

Return values

- **None:**

Reference Manual to LL API cross reference:

- MPU_CTRL ENABLE LL_MPU_Enable

LL_MPU_Disable

Function name `__STATIC_INLINE void LL_MPU_Disable (void)`

Function description Disable MPU.

Return values

- **None:**

Reference Manual to LL API cross reference:

- MPU_CTRL ENABLE LL_MPU_Disable

LL_MPU_IsEnabled

Function name `__STATIC_INLINE uint32_t LL_MPU_IsEnabled (void)`

Function description	Check if MPU is enabled or not.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • MPU_CTRL ENABLE LL_MPU_IsEnabled

LL_MPU_EnableRegion

Function name	__STATIC_INLINE void LL_MPU_EnableRegion (uint32_t Region)
Function description	Enable a MPU region.
Parameters	<ul style="list-style-type: none"> • Region: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_MPU_REGION_NUMBER0 – LL_MPU_REGION_NUMBER1 – LL_MPU_REGION_NUMBER2 – LL_MPU_REGION_NUMBER3 – LL_MPU_REGION_NUMBER4 – LL_MPU_REGION_NUMBER5 – LL_MPU_REGION_NUMBER6 – LL_MPU_REGION_NUMBER7
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • MPU_RASR ENABLE LL_MPU_EnableRegion

LL_MPU_ConfigRegion

Function name	__STATIC_INLINE void LL_MPU_ConfigRegion (uint32_t Region, uint32_t SubRegionDisable, uint32_t Address, uint32_t Attributes)
Function description	Configure and enable a region.
Parameters	<ul style="list-style-type: none"> • Region: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_MPU_REGION_NUMBER0 – LL_MPU_REGION_NUMBER1 – LL_MPU_REGION_NUMBER2 – LL_MPU_REGION_NUMBER3 – LL_MPU_REGION_NUMBER4 – LL_MPU_REGION_NUMBER5 – LL_MPU_REGION_NUMBER6 – LL_MPU_REGION_NUMBER7 • Address: Value of region base address • SubRegionDisable: Sub-region disable value between Min_Data = 0x00 and Max_Data = 0xFF • Attributes: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_MPU_REGION_SIZE_32B or LL_MPU_REGION_SIZE_64B or LL_MPU_REGION_SIZE_128B or LL_MPU_REGION_SIZE_256B or LL_MPU_REGION_SIZE_512B or

LL_MPU_REGION_SIZE_1KB or
 LL_MPU_REGION_SIZE_2KB or
 LL_MPU_REGION_SIZE_4KB or
 LL_MPU_REGION_SIZE_8KB or
 LL_MPU_REGION_SIZE_16KB or
 LL_MPU_REGION_SIZE_32KB or
 LL_MPU_REGION_SIZE_64KB or
 LL_MPU_REGION_SIZE_128KB or
 LL_MPU_REGION_SIZE_256KB or
 LL_MPU_REGION_SIZE_512KB or
 LL_MPU_REGION_SIZE_1MB or
 LL_MPU_REGION_SIZE_2MB or
 LL_MPU_REGION_SIZE_4MB or
 LL_MPU_REGION_SIZE_8MB or
 LL_MPU_REGION_SIZE_16MB or
 LL_MPU_REGION_SIZE_32MB or
 LL_MPU_REGION_SIZE_64MB or
 LL_MPU_REGION_SIZE_128MB or
 LL_MPU_REGION_SIZE_256MB or
 LL_MPU_REGION_SIZE_512MB or
 LL_MPU_REGION_SIZE_1GB or
 LL_MPU_REGION_SIZE_2GB or
 LL_MPU_REGION_SIZE_4GB
 - LL_MPU_REGION_NO_ACCESS or
 LL_MPU_REGION_PRIV_RW or
 LL_MPU_REGION_PRIV_RW_URO or
 LL_MPU_REGION_FULL_ACCESS or
 LL_MPU_REGION_PRIV_RO or
 LL_MPU_REGION_PRIV_RO_URO
 - LL_MPU_TEX_LEVEL0 or LL_MPU_TEX_LEVEL1 or
 LL_MPU_TEX_LEVEL2 or LL_MPU_TEX_LEVEL4
 - LL_MPU_INSTRUCTION_ACCESS_ENABLE or
 LL_MPU_INSTRUCTION_ACCESS_DISABLE
 - LL_MPU_ACCESS_SHAREABLE or
 LL_MPU_ACCESS_NOT_SHAREABLE
 - LL_MPU_ACCESS_CACHEABLE or
 LL_MPU_ACCESS_NOT_CACHEABLE
 - LL_MPU_ACCESS_BUFFERABLE or
 LL_MPU_ACCESS_NOT_BUFFERABLE

Return values

• **None:**

Reference Manual to
LL API cross
reference:

- MPU_RNR REGION LL_MPU_ConfigRegion
- MPU_RBAR REGION LL_MPU_ConfigRegion
- MPU_RBAR ADDR LL_MPU_ConfigRegion
- MPU_RASR XN LL_MPU_ConfigRegion
- MPU_RASR AP LL_MPU_ConfigRegion
- MPU_RASR S LL_MPU_ConfigRegion
- MPU_RASR C LL_MPU_ConfigRegion
- MPU_RASR B LL_MPU_ConfigRegion
- MPU_RASR SIZE LL_MPU_ConfigRegion

LL_MPU_DisableRegion

Function name `__STATIC_INLINE void LL_MPU_DisableRegion (uint32_t`

	Region)
Function description	Disable a region.
Parameters	<ul style="list-style-type: none"> • Region: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_MPU_REGION_NUMBER0 – LL_MPU_REGION_NUMBER1 – LL_MPU_REGION_NUMBER2 – LL_MPU_REGION_NUMBER3 – LL_MPU_REGION_NUMBER4 – LL_MPU_REGION_NUMBER5 – LL_MPU_REGION_NUMBER6 – LL_MPU_REGION_NUMBER7
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • MPU_RNR REGION LL_MPU_DisableRegion • MPU_RASR ENABLE LL_MPU_DisableRegion

73.2 CORTEX Firmware driver defines

73.2.1 CORTEX

MPU Bufferable Access

LL_MPU_ACCESS_BUFFERABLE	Bufferable memory attribute
LL_MPU_ACCESS_NOT_BUFFERABLE	Not Bufferable memory attribute

MPU Cacheable Access

LL_MPU_ACCESS_CACHEABLE	Cacheable memory attribute
LL_MPU_ACCESS_NOT_CACHEABLE	Not Cacheable memory attribute

SYSTICK Clock Source

LL_SYSTICK_CLKSOURCE_HCLK_DIV8	AHB clock divided by 8 selected as SysTick clock source.
LL_SYSTICK_CLKSOURCE_HCLK	AHB clock selected as SysTick clock source.

MPU Control

LL_MPU_CTRL_HFNMI_PRIVDEF_NONE	Disable NMI and privileged SW access
LL_MPU_CTRL_HARDFAULT_NMI	Enables the operation of MPU during hard fault, NMI, and FAULTMASK handlers
LL_MPU_CTRL_PRIVILEGED_DEFAULT	Enable privileged software access to default memory map
LL_MPU_CTRL_HFNMI_PRIVDEF	Enable NMI and privileged SW access

Handler Fault type

LL_HANDLER_FAULT_USG	Usage fault
LL_HANDLER_FAULT_BUS	Bus fault
LL_HANDLER_FAULT_MEM	Memory management fault

MPU Instruction Access

LL_MPU_INSTRUCTION_ACCESS_ENABLE	Instruction fetches enabled
LL_MPU_INSTRUCTION_ACCESS_DISABLE	Instruction fetches disabled

MPU Region Number

LL_MPU_REGION_NUMBER0	REGION Number 0
LL_MPU_REGION_NUMBER1	REGION Number 1
LL_MPU_REGION_NUMBER2	REGION Number 2
LL_MPU_REGION_NUMBER3	REGION Number 3
LL_MPU_REGION_NUMBER4	REGION Number 4
LL_MPU_REGION_NUMBER5	REGION Number 5
LL_MPU_REGION_NUMBER6	REGION Number 6
LL_MPU_REGION_NUMBER7	REGION Number 7

MPU Region Privileges

LL_MPU_REGION_NO_ACCESS	No access
LL_MPU_REGION_PRIV_RW	RW privileged (privileged access only)
LL_MPU_REGION_PRIV_RW_URO	RW privileged - RO user (Write in a user program generates a fault)
LL_MPU_REGION_FULL_ACCESS	RW privileged & user (Full access)
LL_MPU_REGION_PRIV_RO	RO privileged (privileged read only)
LL_MPU_REGION_PRIV_RO_URO	RO privileged & user (read only)

MPU Region Size

LL_MPU_REGION_SIZE_32B	32B Size of the MPU protection region
LL_MPU_REGION_SIZE_64B	64B Size of the MPU protection region
LL_MPU_REGION_SIZE_128B	128B Size of the MPU protection region
LL_MPU_REGION_SIZE_256B	256B Size of the MPU protection region
LL_MPU_REGION_SIZE_512B	512B Size of the MPU protection region
LL_MPU_REGION_SIZE_1KB	1KB Size of the MPU protection region
LL_MPU_REGION_SIZE_2KB	2KB Size of the MPU protection region
LL_MPU_REGION_SIZE_4KB	4KB Size of the MPU protection region
LL_MPU_REGION_SIZE_8KB	8KB Size of the MPU protection region
LL_MPU_REGION_SIZE_16KB	16KB Size of the MPU protection region
LL_MPU_REGION_SIZE_32KB	32KB Size of the MPU protection region
LL_MPU_REGION_SIZE_64KB	64KB Size of the MPU protection region
LL_MPU_REGION_SIZE_128KB	128KB Size of the MPU protection region
LL_MPU_REGION_SIZE_256KB	256KB Size of the MPU protection region
LL_MPU_REGION_SIZE_512KB	512KB Size of the MPU protection region
LL_MPU_REGION_SIZE_1MB	1MB Size of the MPU protection region
LL_MPU_REGION_SIZE_2MB	2MB Size of the MPU protection region

LL_MPU_REGION_SIZE_4MB	4MB Size of the MPU protection region
LL_MPU_REGION_SIZE_8MB	8MB Size of the MPU protection region
LL_MPU_REGION_SIZE_16MB	16MB Size of the MPU protection region
LL_MPU_REGION_SIZE_32MB	32MB Size of the MPU protection region
LL_MPU_REGION_SIZE_64MB	64MB Size of the MPU protection region
LL_MPU_REGION_SIZE_128MB	128MB Size of the MPU protection region
LL_MPU_REGION_SIZE_256MB	256MB Size of the MPU protection region
LL_MPU_REGION_SIZE_512MB	512MB Size of the MPU protection region
LL_MPU_REGION_SIZE_1GB	1GB Size of the MPU protection region
LL_MPU_REGION_SIZE_2GB	2GB Size of the MPU protection region
LL_MPU_REGION_SIZE_4GB	4GB Size of the MPU protection region

MPU Shareable Access

LL_MPU_ACCESS_SHAREABLE	Shareable memory attribute
LL_MPU_ACCESS_NOT_SHAREABLE	Not Shareable memory attribute

MPU TEX Level

LL_MPU_TEX_LEVEL0	b000 for TEX bits
LL_MPU_TEX_LEVEL1	b001 for TEX bits
LL_MPU_TEX_LEVEL2	b010 for TEX bits
LL_MPU_TEX_LEVEL4	b100 for TEX bits

74 LL CRC Generic Driver

74.1 CRC Firmware driver API description

74.1.1 Detailed description of functions

LL_CRC_ResetCRCCalculationUnit

Function name `__STATIC_INLINE void LL_CRC_ResetCRCCalculationUnit (CRC_TypeDef * CRCx)`

Function description Reset the CRC calculation unit.

Parameters

- **CRCx:** CRC Instance

Return values

- **None:**

Notes

- If Programmable Initial CRC value feature is available, also set the Data Register to the value stored in the CRC_INIT register, otherwise, reset Data Register to its default value.

Reference Manual to LL API cross reference:

- CR RESET LL_CRC_ResetCRCCalculationUnit

LL_CRC_SetPolynomialSize

Function name `__STATIC_INLINE void LL_CRC_SetPolynomialSize (CRC_TypeDef * CRCx, uint32_t PolySize)`

Function description Configure size of the polynomial.

Parameters

- **CRCx:** CRC Instance
- **PolySize:** This parameter can be one of the following values:
 - LL_CRC_POLYLENGTH_32B
 - LL_CRC_POLYLENGTH_16B
 - LL_CRC_POLYLENGTH_8B
 - LL_CRC_POLYLENGTH_7B

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR POLYSIZE LL_CRC_SetPolynomialSize

LL_CRC_GetPolynomialSize

Function name `__STATIC_INLINE uint32_t LL_CRC_GetPolynomialSize (CRC_TypeDef * CRCx)`

Function description Return size of the polynomial.

Parameters

- **CRCx:** CRC Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_CRC_POLYLENGTH_32B
 - LL_CRC_POLYLENGTH_16B

- LL_CRC_POLYLENGTH_8B
 - LL_CRC_POLYLENGTH_7B
- Reference Manual to LL API cross reference:
- CR POLYSIZE LL_CRC_GetPolynomialSize

LL_CRC_SetInputDataReverseMode

Function name **__STATIC_INLINE void LL_CRC_SetInputDataReverseMode (CRC_TypeDef * CRCx, uint32_t ReverseMode)**

Function description Configure the reversal of the bit order of the input data.

- Parameters
- **CRCx:** CRC Instance
 - **ReverseMode:** This parameter can be one of the following values:
 - LL_CRC_INDATA_REVERSE_NONE
 - LL_CRC_INDATA_REVERSE_BYTE
 - LL_CRC_INDATA_REVERSE_HALFWORD
 - LL_CRC_INDATA_REVERSE_WORD

Return values

- **None:**

- Reference Manual to LL API cross reference:
- CR REV_IN LL_CRC_SetInputDataReverseMode

LL_CRC_GetInputDataReverseMode

Function name **__STATIC_INLINE uint32_t LL_CRC_GetInputDataReverseMode (CRC_TypeDef * CRCx)**

Function description Return type of reversal for input data bit order.

- Parameters
- **CRCx:** CRC Instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_CRC_INDATA_REVERSE_NONE
 - LL_CRC_INDATA_REVERSE_BYTE
 - LL_CRC_INDATA_REVERSE_HALFWORD
 - LL_CRC_INDATA_REVERSE_WORD

- Reference Manual to LL API cross reference:
- CR REV_IN LL_CRC_GetInputDataReverseMode

LL_CRC_SetOutputDataReverseMode

Function name **__STATIC_INLINE void LL_CRC_SetOutputDataReverseMode (CRC_TypeDef * CRCx, uint32_t ReverseMode)**

Function description Configure the reversal of the bit order of the Output data.

- Parameters
- **CRCx:** CRC Instance
 - **ReverseMode:** This parameter can be one of the following values:
 - LL_CRC_OUTDATA_REVERSE_NONE
 - LL_CRC_OUTDATA_REVERSE_BIT

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR REV_OUT LL_CRC_SetOutputDataReverseMode

LL_CRC_GetOutputDataReverseMode

- Function name **__STATIC_INLINE uint32_t LL_CRC_GetOutputDataReverseMode (CRC_TypeDef * CRCx)**
- Function description Configure the reversal of the bit order of the Output data.
- Parameters
- **CRCx:** CRC Instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_CRC_OUTDATA_REVERSE_NONE
 - LL_CRC_OUTDATA_REVERSE_BIT
- Reference Manual to LL API cross reference:
- CR REV_OUT LL_CRC_GetOutputDataReverseMode

LL_CRC_SetInitialData

- Function name **__STATIC_INLINE void LL_CRC_SetInitialData (CRC_TypeDef * CRCx, uint32_t InitCrc)**
- Function description Initialize the Programmable initial CRC value.
- Parameters
- **CRCx:** CRC Instance
 - **InitCrc:** Value to be programmed in Programmable initial CRC value register
- Return values
- **None:**
- Notes
- If the CRC size is less than 32 bits, the least significant bits are used to write the correct value
 - LL_CRC_DEFAULT_CRC_INITVALUE could be used as value for InitCrc parameter.
- Reference Manual to LL API cross reference:
- INIT INIT LL_CRC_SetInitialData

LL_CRC_GetInitialData

- Function name **__STATIC_INLINE uint32_t LL_CRC_GetInitialData (CRC_TypeDef * CRCx)**
- Function description Return current Initial CRC value.
- Parameters
- **CRCx:** CRC Instance
- Return values
- **Value:** programmed in Programmable initial CRC value register
- Notes
- If the CRC size is less than 32 bits, the least significant bits are used to read the correct value
- Reference Manual to
- INIT INIT LL_CRC_GetInitialData

LL API cross
reference:

LL_CRC_SetPolynomialCoef

Function name	__STATIC_INLINE void LL_CRC_SetPolynomialCoef (CRC_TypeDef * CRCx, uint32_t PolynomCoef)
Function description	Initialize the Programmable polynomial value (coefficients of the polynomial to be used for CRC calculation).
Parameters	<ul style="list-style-type: none"> • CRCx: CRC Instance • PolynomCoef: Value to be programmed in Programmable Polynomial value register
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • LL_CRC_DEFAULT_CRC32_POLY could be used as value for PolynomCoef parameter. • Please check Reference Manual and existing Errata Sheets, regarding possible limitations for Polynomial values usage. For example, for a polynomial of degree 7, $X^7 + X^6 + X^5 + X^2 + 1$ is written 0x65
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • POL POL LL_CRC_SetPolynomialCoef

LL_CRC_GetPolynomialCoef

Function name	__STATIC_INLINE uint32_t LL_CRC_GetPolynomialCoef (CRC_TypeDef * CRCx)
Function description	Return current Programmable polynomial value.
Parameters	<ul style="list-style-type: none"> • CRCx: CRC Instance
Return values	<ul style="list-style-type: none"> • Value: programmed in Programmable Polynomial value register
Notes	<ul style="list-style-type: none"> • Please check Reference Manual and existing Errata Sheets, regarding possible limitations for Polynomial values usage. For example, for a polynomial of degree 7, $X^7 + X^6 + X^5 + X^2 + 1$ is written 0x65
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • POL POL LL_CRC_GetPolynomialCoef

LL_CRC_FeedData32

Function name	__STATIC_INLINE void LL_CRC_FeedData32 (CRC_TypeDef * CRCx, uint32_t InData)
Function description	Write given 32-bit data to the CRC calculator.
Parameters	<ul style="list-style-type: none"> • CRCx: CRC Instance • InData: value to be provided to CRC calculator between between Min_Data=0 and Max_Data=0xFFFFFFFF

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- DR DR LL_CRC_FeedData32

LL_CRC_FeedData16

- Function name **__STATIC_INLINE void LL_CRC_FeedData16 (CRC_TypeDef * CRCx, uint16_t InData)**
- Function description Write given 16-bit data to the CRC calculator.
- Parameters
- **CRCx:** CRC Instance
 - **InData:** 16 bit value to be provided to CRC calculator between between Min_Data=0 and Max_Data=0xFFFF
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- DR DR LL_CRC_FeedData16

LL_CRC_FeedData8

- Function name **__STATIC_INLINE void LL_CRC_FeedData8 (CRC_TypeDef * CRCx, uint8_t InData)**
- Function description Write given 8-bit data to the CRC calculator.
- Parameters
- **CRCx:** CRC Instance
 - **InData:** 8 bit value to be provided to CRC calculator between between Min_Data=0 and Max_Data=0xFF
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- DR DR LL_CRC_FeedData8

LL_CRC_ReadData32

- Function name **__STATIC_INLINE uint32_t LL_CRC_ReadData32 (CRC_TypeDef * CRCx)**
- Function description Return current CRC calculation result.
- Parameters
- **CRCx:** CRC Instance
- Return values
- **Current:** CRC calculation result as stored in CRC_DR register (32 bits).
- Reference Manual to LL API cross reference:
- DR DR LL_CRC_ReadData32

LL_CRC_ReadData16

- Function name **__STATIC_INLINE uint16_t LL_CRC_ReadData16 (CRC_TypeDef * CRCx)**

Function description	Return current CRC calculation result.
Parameters	<ul style="list-style-type: none"> • CRCx: CRC Instance
Return values	<ul style="list-style-type: none"> • Current: CRC calculation result as stored in CRC_DR register (16 bits).
Notes	<ul style="list-style-type: none"> • This function is expected to be used in a 16 bits CRC polynomial size context.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DR DR LL_CRC_ReadData16

LL_CRC_ReadData8

Function name	__STATIC_INLINE uint8_t LL_CRC_ReadData8 (CRC_TypeDef * CRCx)
Function description	Return current CRC calculation result.
Parameters	<ul style="list-style-type: none"> • CRCx: CRC Instance
Return values	<ul style="list-style-type: none"> • Current: CRC calculation result as stored in CRC_DR register (8 bits).
Notes	<ul style="list-style-type: none"> • This function is expected to be used in a 8 bits CRC polynomial size context.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DR DR LL_CRC_ReadData8

LL_CRC_ReadData7

Function name	__STATIC_INLINE uint8_t LL_CRC_ReadData7 (CRC_TypeDef * CRCx)
Function description	Return current CRC calculation result.
Parameters	<ul style="list-style-type: none"> • CRCx: CRC Instance
Return values	<ul style="list-style-type: none"> • Current: CRC calculation result as stored in CRC_DR register (7 bits).
Notes	<ul style="list-style-type: none"> • This function is expected to be used in a 7 bits CRC polynomial size context.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DR DR LL_CRC_ReadData7

LL_CRC_Read_IDR

Function name	__STATIC_INLINE uint32_t LL_CRC_Read_IDR (CRC_TypeDef * CRCx)
Function description	Return data stored in the Independent Data(IDR) register.
Parameters	<ul style="list-style-type: none"> • CRCx: CRC Instance
Return values	<ul style="list-style-type: none"> • Value: stored in CRC_IDR register (General-purpose 8-bit

data register).

Notes

- This register can be used as a temporary storage location for one byte.

Reference Manual to LL API cross reference:

- IDR IDR LL_CRC_Read_IDR

LL_CRC_Write_IDR

Function name **__STATIC_INLINE void LL_CRC_Write_IDR (CRC_TypeDef * CRCx, uint32_t InData)**

Function description Store data in the Independent Data(IDR) register.

Parameters

- CRCx:** CRC Instance
- InData:** value to be stored in CRC_IDR register (8-bit) between between Min_Data=0 and Max_Data=0xFF

Return values

- None:**

Notes

- This register can be used as a temporary storage location for one byte.

Reference Manual to LL API cross reference:

- IDR IDR LL_CRC_Write_IDR

LL_CRC_DeInit

Function name **ErrorStatus LL_CRC_DeInit (CRC_TypeDef * CRCx)**

Function description De-initialize CRC registers (Registers restored to their default values).

Parameters

- CRCx:** CRC Instance

Return values

- An:** ErrorStatus enumeration value:
 - SUCCESS: CRC registers are de-initialized
 - ERROR: CRC registers are not de-initialized

74.2 CRC Firmware driver defines

74.2.1 CRC

Default CRC computation initialization value

LL_CRC_DEFAULT_CRC_INITVALUE Default CRC computation initialization value

Default CRC generating polynomial value

LL_CRC_DEFAULT_CRC32_POLY Default CRC generating polynomial value

Input Data Reverse

LL_CRC_INDATA_REVERSE_NONE Input Data bit order not affected

LL_CRC_INDATA_REVERSE_BYTE Input Data bit reversal done by byte

LL_CRC_INDATA_REVERSE_HALFWORD Input Data bit reversal done by half-word

LL_CRC_INDATA_REVERSE_WORD Input Data bit reversal done by word

Output Data Reverse

LL_CRC_OUTDATA_REVERSE_NONE Output Data bit order not affected

LL_CRC_OUTDATA_REVERSE_BIT Output Data bit reversal done by bit

Polynomial length

LL_CRC_POLYLENGTH_32B 32 bits Polynomial size

LL_CRC_POLYLENGTH_16B 16 bits Polynomial size

LL_CRC_POLYLENGTH_8B 8 bits Polynomial size

LL_CRC_POLYLENGTH_7B 7 bits Polynomial size

Common Write and read registers Macros

LL_CRC_WriteReg

Description:

- Write a value in CRC register.

Parameters:

- `__INSTANCE__`: CRC Instance
- `__REG__`: Register to be written
- `__VALUE__`: Value to be written in the register

Return value:

- None

LL_CRC_ReadReg

Description:

- Read a value in CRC register.

Parameters:

- `__INSTANCE__`: CRC Instance
- `__REG__`: Register to be read

Return value:

- Register: value

75 LL DAC Generic Driver

75.1 DAC Firmware driver registers structures

75.1.1 LL_DAC_InitTypeDef

Data Fields

- *uint32_t TriggerSource*
- *uint32_t WaveAutoGeneration*
- *uint32_t WaveAutoGenerationConfig*
- *uint32_t OutputBuffer*

Field Documentation

- *uint32_t LL_DAC_InitTypeDef::TriggerSource*
Set the conversion trigger source for the selected DAC channel: internal (SW start) or from external IP (timer event, external interrupt line). This parameter can be a value of [DAC_LL_EC_TRIGGER_SOURCE](#). This feature can be modified afterwards using unitary function `LL_DAC_SetTriggerSource()`.
- *uint32_t LL_DAC_InitTypeDef::WaveAutoGeneration*
Set the waveform automatic generation mode for the selected DAC channel. This parameter can be a value of [DAC_LL_EC_WAVE_AUTO_GENERATION_MODE](#). This feature can be modified afterwards using unitary function `LL_DAC_SetWaveAutoGeneration()`.
- *uint32_t LL_DAC_InitTypeDef::WaveAutoGenerationConfig*
Set the waveform automatic generation mode for the selected DAC channel. If waveform automatic generation mode is set to noise, this parameter can be a value of [DAC_LL_EC_WAVE_NOISE_LFSR_UNMASK_BITS](#). If waveform automatic generation mode is set to triangle, this parameter can be a value of [DAC_LL_EC_WAVE_TRIANGLE_AMPLITUDE](#).
Note: If waveform automatic generation mode is disabled, this parameter is discarded. This feature can be modified afterwards using unitary function `LL_DAC_SetWaveNoiseLFSR()` or `LL_DAC_SetWaveTriangleAmplitude()`, depending on the wave automatic generation selected.
- *uint32_t LL_DAC_InitTypeDef::OutputBuffer*
Set the output buffer for the selected DAC channel. This parameter can be a value of [DAC_LL_EC_OUTPUT_BUFFER](#). This feature can be modified afterwards using unitary function `LL_DAC_SetOutputBuffer()`.

75.2 DAC Firmware driver API description

75.2.1 Detailed description of functions

LL_DAC_SetTriggerSource

Function name	<code>__STATIC_INLINE void LL_DAC_SetTriggerSource (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t TriggerSource)</code>
Function description	Set the conversion trigger source for the selected DAC channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following

	<ul style="list-style-type: none"> values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2 • TriggerSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_TRIG_SOFTWARE – LL_DAC_TRIG_EXT_TIM8_TRGO – LL_DAC_TRIG_EXT_TIM7_TRGO – LL_DAC_TRIG_EXT_TIM6_TRGO – LL_DAC_TRIG_EXT_TIM5_TRGO – LL_DAC_TRIG_EXT_TIM4_TRGO – LL_DAC_TRIG_EXT_TIM2_TRGO – LL_DAC_TRIG_EXT_EXTI_LINE9
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • For conversion trigger source to be effective, DAC trigger must be enabled using function LL_DAC_EnableTrigger(). • To set conversion trigger source, DAC channel must be disabled. Otherwise, the setting is discarded. • Availability of parameters of trigger sources from timer depends on timers availability on the selected device.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR TSEL1 LL_DAC_SetTriggerSource • CR TSEL2 LL_DAC_SetTriggerSource

LL_DAC_GetTriggerSource

Function name	__STATIC_INLINE uint32_t LL_DAC_GetTriggerSource (DAC_TypeDef * DACx, uint32_t DAC_Channel)
Function description	Get the conversion trigger source for the selected DAC channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_TRIG_SOFTWARE – LL_DAC_TRIG_EXT_TIM8_TRGO – LL_DAC_TRIG_EXT_TIM7_TRGO – LL_DAC_TRIG_EXT_TIM6_TRGO – LL_DAC_TRIG_EXT_TIM5_TRGO – LL_DAC_TRIG_EXT_TIM4_TRGO – LL_DAC_TRIG_EXT_TIM2_TRGO – LL_DAC_TRIG_EXT_EXTI_LINE9
Notes	<ul style="list-style-type: none"> • For conversion trigger source to be effective, DAC trigger must be enabled using function LL_DAC_EnableTrigger(). • Availability of parameters of trigger sources from timer depends on timers availability on the selected device.
Reference Manual to LL API cross	<ul style="list-style-type: none"> • CR TSEL1 LL_DAC_GetTriggerSource • CR TSEL2 LL_DAC_GetTriggerSource

reference:

LL_DAC_SetWaveAutoGeneration

Function name	__STATIC_INLINE void LL_DAC_SetWaveAutoGeneration (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t WaveAutoGeneration)
Function description	Set the waveform automatic generation mode for the selected DAC channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2 • WaveAutoGeneration: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_WAVE_AUTO_GENERATION_NONE – LL_DAC_WAVE_AUTO_GENERATION_NOISE – LL_DAC_WAVE_AUTO_GENERATION_TRIANGLE
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR WAVE1 LL_DAC_SetWaveAutoGeneration • CR WAVE2 LL_DAC_SetWaveAutoGeneration

LL_DAC_GetWaveAutoGeneration

Function name	__STATIC_INLINE uint32_t LL_DAC_GetWaveAutoGeneration (DAC_TypeDef * DACx, uint32_t DAC_Channel)
Function description	Get the waveform automatic generation mode for the selected DAC channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_WAVE_AUTO_GENERATION_NONE – LL_DAC_WAVE_AUTO_GENERATION_NOISE – LL_DAC_WAVE_AUTO_GENERATION_TRIANGLE
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR WAVE1 LL_DAC_GetWaveAutoGeneration • CR WAVE2 LL_DAC_GetWaveAutoGeneration

LL_DAC_SetWaveNoiseLFSR

Function name	__STATIC_INLINE void LL_DAC_SetWaveNoiseLFSR (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t NoiseLFSRMask)
Function description	Set the noise waveform generation for the selected DAC channel:

	Noise mode and parameters LFSR (linear feedback shift register).
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2 • NoiseLFSRMask: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_NOISE_LFSR_UNMASK_BIT0 – LL_DAC_NOISE_LFSR_UNMASK_BITS1_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS2_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS3_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS4_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS5_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS6_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS7_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS8_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS9_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS10_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS11_0
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • For wave generation to be effective, DAC channel wave generation mode must be enabled using function LL_DAC_SetWaveAutoGeneration(). • This setting can be set when the selected DAC channel is disabled (otherwise, the setting operation is ignored).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR MAMP1 LL_DAC_SetWaveNoiseLFSR • CR MAMP2 LL_DAC_SetWaveNoiseLFSR

LL_DAC_GetWaveNoiseLFSR

Function name	__STATIC_INLINE uint32_t LL_DAC_GetWaveNoiseLFSR (DAC_TypeDef * DACx, uint32_t DAC_Channel)
Function description	Set the noise waveform generation for the selected DAC channel: Noise mode and parameters LFSR (linear feedback shift register).
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_NOISE_LFSR_UNMASK_BIT0 – LL_DAC_NOISE_LFSR_UNMASK_BITS1_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS2_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS3_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS4_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS5_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS6_0 – LL_DAC_NOISE_LFSR_UNMASK_BITS7_0

- LL_DAC_NOISE_LFSR_UNMASK_BITS8_0
- LL_DAC_NOISE_LFSR_UNMASK_BITS9_0
- LL_DAC_NOISE_LFSR_UNMASK_BITS10_0
- LL_DAC_NOISE_LFSR_UNMASK_BITS11_0

Reference Manual to
LL API cross
reference:

- CR MAMP1 LL_DAC_GetWaveNoiseLFSR
- CR MAMP2 LL_DAC_GetWaveNoiseLFSR

LL_DAC_SetWaveTriangleAmplitude

Function name **__STATIC_INLINE void LL_DAC_SetWaveTriangleAmplitude (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t TriangleAmplitude)**

Function description Set the triangle waveform generation for the selected DAC channel: triangle mode and amplitude.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
 - LL_DAC_CHANNEL_1
 - LL_DAC_CHANNEL_2
- **TriangleAmplitude:** This parameter can be one of the following values:
 - LL_DAC_TRIANGLE_AMPLITUDE_1
 - LL_DAC_TRIANGLE_AMPLITUDE_3
 - LL_DAC_TRIANGLE_AMPLITUDE_7
 - LL_DAC_TRIANGLE_AMPLITUDE_15
 - LL_DAC_TRIANGLE_AMPLITUDE_31
 - LL_DAC_TRIANGLE_AMPLITUDE_63
 - LL_DAC_TRIANGLE_AMPLITUDE_127
 - LL_DAC_TRIANGLE_AMPLITUDE_255
 - LL_DAC_TRIANGLE_AMPLITUDE_511
 - LL_DAC_TRIANGLE_AMPLITUDE_1023
 - LL_DAC_TRIANGLE_AMPLITUDE_2047
 - LL_DAC_TRIANGLE_AMPLITUDE_4095

Return values

- **None:**

Notes

- For wave generation to be effective, DAC channel wave generation mode must be enabled using function LL_DAC_SetWaveAutoGeneration().
- This setting can be set when the selected DAC channel is disabled (otherwise, the setting operation is ignored).

Reference Manual to
LL API cross
reference:

- CR MAMP1 LL_DAC_SetWaveTriangleAmplitude
- CR MAMP2 LL_DAC_SetWaveTriangleAmplitude

LL_DAC_GetWaveTriangleAmplitude

Function name **__STATIC_INLINE uint32_t LL_DAC_GetWaveTriangleAmplitude (DAC_TypeDef * DACx, uint32_t DAC_Channel)**

Function description Set the triangle waveform generation for the selected DAC

channel: triangle mode and amplitude.

Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_TRIANGLE_AMPLITUDE_1 – LL_DAC_TRIANGLE_AMPLITUDE_3 – LL_DAC_TRIANGLE_AMPLITUDE_7 – LL_DAC_TRIANGLE_AMPLITUDE_15 – LL_DAC_TRIANGLE_AMPLITUDE_31 – LL_DAC_TRIANGLE_AMPLITUDE_63 – LL_DAC_TRIANGLE_AMPLITUDE_127 – LL_DAC_TRIANGLE_AMPLITUDE_255 – LL_DAC_TRIANGLE_AMPLITUDE_511 – LL_DAC_TRIANGLE_AMPLITUDE_1023 – LL_DAC_TRIANGLE_AMPLITUDE_2047 – LL_DAC_TRIANGLE_AMPLITUDE_4095
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR MAMP1 LL_DAC_GetWaveTriangleAmplitude • CR MAMP2 LL_DAC_GetWaveTriangleAmplitude

LL_DAC_SetOutputBuffer

Function name	__STATIC_INLINE void LL_DAC_SetOutputBuffer (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t OutputBuffer)
Function description	Set the output buffer for the selected DAC channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2 • OutputBuffer: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_OUTPUT_BUFFER_ENABLE – LL_DAC_OUTPUT_BUFFER_DISABLE
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR BOFF1 LL_DAC_SetOutputBuffer • CR BOFF2 LL_DAC_SetOutputBuffer

LL_DAC_GetOutputBuffer

Function name	__STATIC_INLINE uint32_t LL_DAC_GetOutputBuffer (DAC_TypeDef * DACx, uint32_t DAC_Channel)
Function description	Get the output buffer state for the selected DAC channel.

Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_OUTPUT_BUFFER_ENABLE – LL_DAC_OUTPUT_BUFFER_DISABLE
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR BOFF1 LL_DAC_GetOutputBuffer • CR BOFF2 LL_DAC_GetOutputBuffer

LL_DAC_EnableDMAReq

Function name	__STATIC_INLINE void LL_DAC_EnableDMAReq (DAC_TypeDef * DACx, uint32_t DAC_Channel)
Function description	Enable DAC DMA transfer request of the selected channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • To configure DMA source address (peripheral address), use function LL_DAC_DMA_GetRegAddr().
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR DMAEN1 LL_DAC_EnableDMAReq • CR DMAEN2 LL_DAC_EnableDMAReq

LL_DAC_DisableDMAReq

Function name	__STATIC_INLINE void LL_DAC_DisableDMAReq (DAC_TypeDef * DACx, uint32_t DAC_Channel)
Function description	Disable DAC DMA transfer request of the selected channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • To configure DMA source address (peripheral address), use function LL_DAC_DMA_GetRegAddr().
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR DMAEN1 LL_DAC_DisableDMAReq • CR DMAEN2 LL_DAC_DisableDMAReq

LL_DAC_IsDMAReqEnabled

Function name	__STATIC_INLINE uint32_t LL_DAC_IsDMAReqEnabled (DAC_TypeDef * DACx, uint32_t DAC_Channel)
Function description	Get DAC DMA transfer request state of the selected channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR DMAEN1 LL_DAC_IsDMAReqEnabled • CR DMAEN2 LL_DAC_IsDMAReqEnabled

LL_DAC_DMA_GetRegAddr

Function name	__STATIC_INLINE uint32_t LL_DAC_DMA_GetRegAddr (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t Register)
Function description	Function to help to configure DMA transfer to DAC: retrieve the DAC register address from DAC instance and a list of DAC registers intended to be used (most commonly) with DMA transfer.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2 • Register: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_DMA_REG_DATA_12BITS_RIGHT_ALIGNED – LL_DAC_DMA_REG_DATA_12BITS_LEFT_ALIGNED – LL_DAC_DMA_REG_DATA_8BITS_RIGHT_ALIGNED
Return values	<ul style="list-style-type: none"> • DAC: register address
Notes	<ul style="list-style-type: none"> • These DAC registers are data holding registers: when DAC conversion is requested, DAC generates a DMA transfer request to have data available in DAC data holding registers. • This macro is intended to be used with LL DMA driver, refer to function "LL_DMA_ConfigAddresses()". Example: LL_DMA_ConfigAddresses(DMA1, LL_DMA_CHANNEL_1, (uint32_t)< array or variable >, LL_DAC_DMA_GetRegAddr(DAC1, LL_DAC_CHANNEL_1, LL_DAC_DMA_REG_DATA_12BITS_RIGHT_ALIGNED), LL_DMA_DIRECTION_MEMORY_TO_PERIPH);
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DHR12R1 DACC1DHR LL_DAC_DMA_GetRegAddr • DHR12L1 DACC1DHR LL_DAC_DMA_GetRegAddr • DHR8R1 DACC1DHR LL_DAC_DMA_GetRegAddr • DHR12R2 DACC2DHR LL_DAC_DMA_GetRegAddr • DHR12L2 DACC2DHR LL_DAC_DMA_GetRegAddr • DHR8R2 DACC2DHR LL_DAC_DMA_GetRegAddr

LL_DAC_Enable

Function name	__STATIC_INLINE void LL_DAC_Enable (DAC_TypeDef * DACx, uint32_t DAC_Channel)
Function description	Enable DAC selected channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • After enable from off state, DAC channel requires a delay for output voltage to reach accuracy +/- 1 LSB. Refer to device datasheet, parameter "tWAKEUP".
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR EN1 LL_DAC_Enable • CR EN2 LL_DAC_Enable

LL_DAC_Disable

Function name	__STATIC_INLINE void LL_DAC_Disable (DAC_TypeDef * DACx, uint32_t DAC_Channel)
Function description	Disable DAC selected channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR EN1 LL_DAC_Disable • CR EN2 LL_DAC_Disable

LL_DAC_IsEnabled

Function name	__STATIC_INLINE uint32_t LL_DAC_IsEnabled (DAC_TypeDef * DACx, uint32_t DAC_Channel)
Function description	Get DAC enable state of the selected channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR EN1 LL_DAC_IsEnabled • CR EN2 LL_DAC_IsEnabled

LL_DAC_EnableTrigger

Function name	__STATIC_INLINE void LL_DAC_EnableTrigger (DAC_TypeDef * DACx, uint32_t DAC_Channel)
Function description	Enable DAC trigger of the selected channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • - If DAC trigger is disabled, DAC conversion is performed automatically once the data holding register is updated, using functions "LL_DAC_ConvertData{8; 12}{Right; Left} Aligned()": LL_DAC_ConvertData12RightAligned(), ... If DAC trigger is enabled, DAC conversion is performed only when a hardware or software trigger event is occurring. Select trigger source using function LL_DAC_SetTriggerSource().
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR TEN1 LL_DAC_EnableTrigger • CR TEN2 LL_DAC_EnableTrigger

LL_DAC_DisableTrigger

Function name	__STATIC_INLINE void LL_DAC_DisableTrigger (DAC_TypeDef * DACx, uint32_t DAC_Channel)
Function description	Disable DAC trigger of the selected channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR TEN1 LL_DAC_DisableTrigger • CR TEN2 LL_DAC_DisableTrigger

LL_DAC_IsTriggerEnabled

Function name	__STATIC_INLINE uint32_t LL_DAC_IsTriggerEnabled (DAC_TypeDef * DACx, uint32_t DAC_Channel)
Function description	Get DAC trigger state of the selected channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).

- Reference Manual to LL API cross reference:
- CR TEN1 LL_DAC_IsTriggerEnabled
 - CR TEN2 LL_DAC_IsTriggerEnabled

LL_DAC_TrigSWConversion

- Function name **__STATIC_INLINE void LL_DAC_TrigSWConversion (DAC_TypeDef * DACx, uint32_t DAC_Channel)**
- Function description Trig DAC conversion by software for the selected DAC channel.
- Parameters
- **DACx:** DAC instance
 - **DAC_Channel:** This parameter can a combination of the following values:
 - LL_DAC_CHANNEL_1
 - LL_DAC_CHANNEL_2
- Return values
- **None:**
- Notes
- Preliminarily, DAC trigger must be set to software trigger using function LL_DAC_SetTriggerSource() with parameter "LL_DAC_TRIGGER_SOFTWARE". and DAC trigger must be enabled using function LL_DAC_EnableTrigger().
 - For devices featuring DAC with 2 channels: this function can perform a SW start of both DAC channels simultaneously. Two channels can be selected as parameter. Example: (LL_DAC_CHANNEL_1 | LL_DAC_CHANNEL_2)
- Reference Manual to LL API cross reference:
- SWTRIGR SWTRIG1 LL_DAC_TrigSWConversion
 - SWTRIGR SWTRIG2 LL_DAC_TrigSWConversion

LL_DAC_ConvertData12RightAligned

- Function name **__STATIC_INLINE void LL_DAC_ConvertData12RightAligned (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t Data)**
- Function description Set the data to be loaded in the data holding register in format 12 bits left alignment (LSB aligned on bit 0), for the selected DAC channel.
- Parameters
- **DACx:** DAC instance
 - **DAC_Channel:** This parameter can be one of the following values:
 - LL_DAC_CHANNEL_1
 - LL_DAC_CHANNEL_2
 - **Data:** Value between Min_Data=0x000 and Max_Data=0xFFFF
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- DHR12R1 DACC1DHR LL_DAC_ConvertData12RightAligned
 - DHR12R2 DACC2DHR LL_DAC_ConvertData12RightAligned

LL_DAC_ConvertData12LeftAligned

- Function name **__STATIC_INLINE void LL_DAC_ConvertData12LeftAligned**

(DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t Data)

Function description	Set the data to be loaded in the data holding register in format 12 bits left alignment (MSB aligned on bit 15), for the selected DAC channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2 • Data: Value between Min_Data=0x000 and Max_Data=0xFFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DHR12L1 DACC1DHR LL_DAC_ConvertData12LeftAligned • DHR12L2 DACC2DHR LL_DAC_ConvertData12LeftAligned

LL_DAC_ConvertData8RightAligned

Function name	__STATIC_INLINE void LL_DAC_ConvertData8RightAligned (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t Data)
Function description	Set the data to be loaded in the data holding register in format 8 bits left alignment (LSB aligned on bit 0), for the selected DAC channel.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2 • Data: Value between Min_Data=0x00 and Max_Data=0xFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DHR8R1 DACC1DHR LL_DAC_ConvertData8RightAligned • DHR8R2 DACC2DHR LL_DAC_ConvertData8RightAligned

LL_DAC_ConvertDualData12RightAligned

Function name	__STATIC_INLINE void LL_DAC_ConvertDualData12RightAligned (DAC_TypeDef * DACx, uint32_t DataChannel1, uint32_t DataChannel2)
Function description	Set the data to be loaded in the data holding register in format 12 bits left alignment (LSB aligned on bit 0), for both DAC channels.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DataChannel1: Value between Min_Data=0x000 and Max_Data=0xFFF • DataChannel2: Value between Min_Data=0x000 and Max_Data=0xFFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to	<ul style="list-style-type: none"> • DHR12RD DACC1DHR

- LL API cross reference:
- LL_DAC_ConvertDualData12RightAligned
 - DHR12RD DACC2DHR
 - LL_DAC_ConvertDualData12RightAligned

LL_DAC_ConvertDualData12LeftAligned

- Function name **__STATIC_INLINE void LL_DAC_ConvertDualData12LeftAligned (DAC_TypeDef * DACx, uint32_t DataChannel1, uint32_t DataChannel2)**
- Function description Set the data to be loaded in the data holding register in format 12 bits left alignment (MSB aligned on bit 15), for both DAC channels.
- Parameters
- DACx:** DAC instance
 - DataChannel1:** Value between Min_Data=0x000 and Max_Data=0xFFF
 - DataChannel2:** Value between Min_Data=0x000 and Max_Data=0xFFF
- Return values
- None:**
- Reference Manual to LL API cross reference:
- DHR12LD DACC1DHR
 - LL_DAC_ConvertDualData12LeftAligned
 - DHR12LD DACC2DHR
 - LL_DAC_ConvertDualData12LeftAligned

LL_DAC_ConvertDualData8RightAligned

- Function name **__STATIC_INLINE void LL_DAC_ConvertDualData8RightAligned (DAC_TypeDef * DACx, uint32_t DataChannel1, uint32_t DataChannel2)**
- Function description Set the data to be loaded in the data holding register in format 8 bits left alignment (LSB aligned on bit 0), for both DAC channels.
- Parameters
- DACx:** DAC instance
 - DataChannel1:** Value between Min_Data=0x00 and Max_Data=0xFF
 - DataChannel2:** Value between Min_Data=0x00 and Max_Data=0xFF
- Return values
- None:**
- Reference Manual to LL API cross reference:
- DHR8RD DACC1DHR
 - LL_DAC_ConvertDualData8RightAligned
 - DHR8RD DACC2DHR
 - LL_DAC_ConvertDualData8RightAligned

LL_DAC_RetrieveOutputData

- Function name **__STATIC_INLINE uint32_t LL_DAC_RetrieveOutputData (DAC_TypeDef * DACx, uint32_t DAC_Channel)**
- Function description Retrieve output data currently generated for the selected DAC channel.
- Parameters
- DACx:** DAC instance
 - DAC_Channel:** This parameter can be one of the following values:

	<ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x000 and Max_Data=0xFF
Notes	<ul style="list-style-type: none"> • Whatever alignment and resolution settings (using functions "LL_DAC_ConvertData{8; 12}{Right; Left} Aligned()": LL_DAC_ConvertData12RightAligned(), ...), output data format is 12 bits right aligned (LSB aligned on bit 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DOR1 DACC1DOR LL_DAC_RetrieveOutputData • DOR2 DACC2DOR LL_DAC_RetrieveOutputData

LL_DAC_IsActiveFlag_DMAUDR1

Function name	__STATIC_INLINE uint32_t LL_DAC_IsActiveFlag_DMAUDR1 (DAC_TypeDef * DACx)
Function description	Get DAC underrun flag for DAC channel 1.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR DMAUDR1 LL_DAC_IsActiveFlag_DMAUDR1

LL_DAC_IsActiveFlag_DMAUDR2

Function name	__STATIC_INLINE uint32_t LL_DAC_IsActiveFlag_DMAUDR2 (DAC_TypeDef * DACx)
Function description	Get DAC underrun flag for DAC channel 2.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR DMAUDR2 LL_DAC_IsActiveFlag_DMAUDR2

LL_DAC_ClearFlag_DMAUDR1

Function name	__STATIC_INLINE void LL_DAC_ClearFlag_DMAUDR1 (DAC_TypeDef * DACx)
Function description	Clear DAC underrun flag for DAC channel 1.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR DMAUDR1 LL_DAC_ClearFlag_DMAUDR1

LL_DAC_ClearFlag_DMAUDR2

Function name	__STATIC_INLINE void LL_DAC_ClearFlag_DMAUDR2 (DAC_TypeDef * DACx)
Function description	Clear DAC underrun flag for DAC channel 2.
Parameters	<ul style="list-style-type: none">• DACx: DAC instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• SR DMAUDR2 LL_DAC_ClearFlag_DMAUDR2

LL_DAC_EnableIT_DMAUDR1

Function name	__STATIC_INLINE void LL_DAC_EnableIT_DMAUDR1 (DAC_TypeDef * DACx)
Function description	Enable DMA underrun interrupt for DAC channel 1.
Parameters	<ul style="list-style-type: none">• DACx: DAC instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR DMAUDRIE1 LL_DAC_EnableIT_DMAUDR1

LL_DAC_EnableIT_DMAUDR2

Function name	__STATIC_INLINE void LL_DAC_EnableIT_DMAUDR2 (DAC_TypeDef * DACx)
Function description	Enable DMA underrun interrupt for DAC channel 2.
Parameters	<ul style="list-style-type: none">• DACx: DAC instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR DMAUDRIE2 LL_DAC_EnableIT_DMAUDR2

LL_DAC_DisableIT_DMAUDR1

Function name	__STATIC_INLINE void LL_DAC_DisableIT_DMAUDR1 (DAC_TypeDef * DACx)
Function description	Disable DMA underrun interrupt for DAC channel 1.
Parameters	<ul style="list-style-type: none">• DACx: DAC instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR DMAUDRIE1 LL_DAC_DisableIT_DMAUDR1

LL_DAC_DisableIT_DMAUDR2

Function name	__STATIC_INLINE void LL_DAC_DisableIT_DMAUDR2 (DAC_TypeDef * DACx)
Function description	Disable DMA underrun interrupt for DAC channel 2.
Parameters	<ul style="list-style-type: none">• DACx: DAC instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR DMAUDRIE2 LL_DAC_DisableIT_DMAUDR2

LL_DAC_IsEnabledIT_DMAUDR1

Function name	__STATIC_INLINE uint32_t LL_DAC_IsEnabledIT_DMAUDR1 (DAC_TypeDef * DACx)
Function description	Get DMA underrun interrupt for DAC channel 1.
Parameters	<ul style="list-style-type: none">• DACx: DAC instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR DMAUDRIE1 LL_DAC_IsEnabledIT_DMAUDR1

LL_DAC_IsEnabledIT_DMAUDR2

Function name	__STATIC_INLINE uint32_t LL_DAC_IsEnabledIT_DMAUDR2 (DAC_TypeDef * DACx)
Function description	Get DMA underrun interrupt for DAC channel 2.
Parameters	<ul style="list-style-type: none">• DACx: DAC instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR DMAUDRIE2 LL_DAC_IsEnabledIT_DMAUDR2

LL_DAC_DeInit

Function name	ErrorStatus LL_DAC_DeInit (DAC_TypeDef * DACx)
Function description	De-initialize registers of the selected DAC instance to their default reset values.
Parameters	<ul style="list-style-type: none">• DACx: DAC instance
Return values	<ul style="list-style-type: none">• An: ErrorStatus enumeration value:<ul style="list-style-type: none">– SUCCESS: DAC registers are de-initialized– ERROR: not applicable

LL_DAC_Init

Function name	ErrorStatus LL_DAC_Init (DAC_TypeDef * DACx, uint32_t
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DAC_Channel, LL_DAC_InitTypeDef * DAC_InitStruct)

Function description	Initialize some features of DAC instance.
Parameters	<ul style="list-style-type: none"> • DACx: DAC instance • DAC_Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DAC_CHANNEL_1 – LL_DAC_CHANNEL_2 • DAC_InitStruct: Pointer to a LL_DAC_InitTypeDef structure
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: DAC registers are initialized – ERROR: DAC registers are not initialized
Notes	<ul style="list-style-type: none"> • The setting of these parameters by function LL_DAC_Init() is conditioned to DAC state: DAC instance must be disabled.

LL_DAC_StructInit

Function name	void LL_DAC_StructInit (LL_DAC_InitTypeDef * DAC_InitStruct)
Function description	Set each LL_DAC_InitTypeDef field to default value.
Parameters	<ul style="list-style-type: none"> • DAC_InitStruct: pointer to a LL_DAC_InitTypeDef structure whose fields will be set to default values.
Return values	<ul style="list-style-type: none"> • None:

75.3 DAC Firmware driver defines**75.3.1 DAC****DAC channels**

LL_DAC_CHANNEL_1 DAC channel 1

LL_DAC_CHANNEL_2 DAC channel 2

DAC flags

LL_DAC_FLAG_DMAUDR1 DAC channel 1 flag DMA underrun

LL_DAC_FLAG_DMAUDR2 DAC channel 2 flag DMA underrun

Definitions of DAC hardware constraints delays

LL_DAC_DELAY_STARTUP_VOLTAGE_SETTLING_US Delay for DAC channel voltage settling time from DAC channel startup (transition from disable to enable)

LL_DAC_DELAY_VOLTAGE_SETTLING_US Delay for DAC channel voltage settling time

DAC interruptions

LL_DAC_IT_DMAUDRIE1 DAC channel 1 interruption DMA underrun

LL_DAC_IT_DMAUDRIE2 DAC channel 2 interruption DMA underrun

DAC channel output buffer

LL_DAC_OUTPUT_BUFFER_ENABLE	The selected DAC channel output is buffered: higher drive current capability, but also higher current consumption
LL_DAC_OUTPUT_BUFFER_DISABLE	The selected DAC channel output is not buffered: lower drive current capability, but also lower current consumption

DAC registers compliant with specific purpose

LL_DAC_DMA_REG_DATA_12BITS_RIGHT_ALIGNED	DAC channel data holding register 12 bits right aligned
LL_DAC_DMA_REG_DATA_12BITS_LEFT_ALIGNED	DAC channel data holding register 12 bits left aligned
LL_DAC_DMA_REG_DATA_8BITS_RIGHT_ALIGNED	DAC channel data holding register 8 bits right aligned

DAC channel output resolution

LL_DAC_RESOLUTION_12B	DAC channel resolution 12 bits
LL_DAC_RESOLUTION_8B	DAC channel resolution 8 bits

DAC trigger source

LL_DAC_TRIG_SOFTWARE	DAC channel conversion trigger internal (SW start)
LL_DAC_TRIG_EXT_TIM2_TRGO	DAC channel conversion trigger from external IP: TIM2 TRGO.
LL_DAC_TRIG_EXT_TIM8_TRGO	DAC channel conversion trigger from external IP: TIM8 TRGO.
LL_DAC_TRIG_EXT_TIM4_TRGO	DAC channel conversion trigger from external IP: TIM4 TRGO.
LL_DAC_TRIG_EXT_TIM6_TRGO	DAC channel conversion trigger from external IP: TIM6 TRGO.
LL_DAC_TRIG_EXT_TIM7_TRGO	DAC channel conversion trigger from external IP: TIM7 TRGO.
LL_DAC_TRIG_EXT_TIM5_TRGO	DAC channel conversion trigger from external IP: TIM5 TRGO.
LL_DAC_TRIG_EXT_EXTI_LINE9	DAC channel conversion trigger from external IP: external interrupt line 9.

DAC waveform automatic generation mode

LL_DAC_WAVE_AUTO_GENERATION_NONE	DAC channel wave auto generation mode disabled.
LL_DAC_WAVE_AUTO_GENERATION_NOISE	DAC channel wave auto generation mode enabled, set generated noise waveform.
LL_DAC_WAVE_AUTO_GENERATION_TRIANGLE	DAC channel wave auto generation mode enabled, set generated triangle waveform.

DAC wave generation - Noise LFSR unmask bits

LL_DAC_NOISE_LFSR_UNMASK_BIT0	Noise wave generation, unmask LFSR
-------------------------------	------------------------------------

	bit0, for the selected DAC channel
LL_DAC_NOISE_LFSR_UNMASK_BITS1_0	Noise wave generation, unmask LFSR bits[1:0], for the selected DAC channel
LL_DAC_NOISE_LFSR_UNMASK_BITS2_0	Noise wave generation, unmask LFSR bits[2:0], for the selected DAC channel
LL_DAC_NOISE_LFSR_UNMASK_BITS3_0	Noise wave generation, unmask LFSR bits[3:0], for the selected DAC channel
LL_DAC_NOISE_LFSR_UNMASK_BITS4_0	Noise wave generation, unmask LFSR bits[4:0], for the selected DAC channel
LL_DAC_NOISE_LFSR_UNMASK_BITS5_0	Noise wave generation, unmask LFSR bits[5:0], for the selected DAC channel
LL_DAC_NOISE_LFSR_UNMASK_BITS6_0	Noise wave generation, unmask LFSR bits[6:0], for the selected DAC channel
LL_DAC_NOISE_LFSR_UNMASK_BITS7_0	Noise wave generation, unmask LFSR bits[7:0], for the selected DAC channel
LL_DAC_NOISE_LFSR_UNMASK_BITS8_0	Noise wave generation, unmask LFSR bits[8:0], for the selected DAC channel
LL_DAC_NOISE_LFSR_UNMASK_BITS9_0	Noise wave generation, unmask LFSR bits[9:0], for the selected DAC channel
LL_DAC_NOISE_LFSR_UNMASK_BITS10_0	Noise wave generation, unmask LFSR bits[10:0], for the selected DAC channel
LL_DAC_NOISE_LFSR_UNMASK_BITS11_0	Noise wave generation, unmask LFSR bits[11:0], for the selected DAC channel

DAC wave generation - Triangle amplitude

LL_DAC_TRIANGLE_AMPLITUDE_1	Triangle wave generation, amplitude of 1 LSB of DAC output range, for the selected DAC channel
LL_DAC_TRIANGLE_AMPLITUDE_3	Triangle wave generation, amplitude of 3 LSB of DAC output range, for the selected DAC channel
LL_DAC_TRIANGLE_AMPLITUDE_7	Triangle wave generation, amplitude of 7 LSB of DAC output range, for the selected DAC channel
LL_DAC_TRIANGLE_AMPLITUDE_15	Triangle wave generation, amplitude of 15 LSB of DAC output range, for the selected DAC channel
LL_DAC_TRIANGLE_AMPLITUDE_31	Triangle wave generation, amplitude of 31 LSB of DAC output range, for the selected DAC channel
LL_DAC_TRIANGLE_AMPLITUDE_63	Triangle wave generation, amplitude of 63 LSB of DAC output range, for the selected DAC channel
LL_DAC_TRIANGLE_AMPLITUDE_127	Triangle wave generation, amplitude of 127 LSB of DAC output range, for the selected DAC channel

<code>LL_DAC_TRIANGLE_AMPLITUDE_255</code>	Triangle wave generation, amplitude of 255 LSB of DAC output range, for the selected DAC channel
<code>LL_DAC_TRIANGLE_AMPLITUDE_511</code>	Triangle wave generation, amplitude of 512 LSB of DAC output range, for the selected DAC channel
<code>LL_DAC_TRIANGLE_AMPLITUDE_1023</code>	Triangle wave generation, amplitude of 1023 LSB of DAC output range, for the selected DAC channel
<code>LL_DAC_TRIANGLE_AMPLITUDE_2047</code>	Triangle wave generation, amplitude of 2047 LSB of DAC output range, for the selected DAC channel
<code>LL_DAC_TRIANGLE_AMPLITUDE_4095</code>	Triangle wave generation, amplitude of 4095 LSB of DAC output range, for the selected DAC channel

DAC helper macro

`__LL_DAC_CHANNEL_TO_DECIMAL_NB`

Description:

- Helper macro to get DAC channel number in decimal format from literals `LL_DAC_CHANNEL_x`.

Parameters:

- `__CHANNEL__`: This parameter can be one of the following values:
 - `LL_DAC_CHANNEL_1`
 - `LL_DAC_CHANNEL_2`

Return value:

- 1...2

Notes:

- The input can be a value from functions where a channel number is returned.

`__LL_DAC_DECIMAL_NB_TO_CHANNEL`

Description:

- Helper macro to get DAC channel in literal format `LL_DAC_CHANNEL_x` from number in decimal format.

Parameters:

- `__DECIMAL_NB__`: 1...2

Return value:

- Returned: value can be one of the following values:
 - `LL_DAC_CHANNEL_1`
 - `LL_DAC_CHANNEL_2`

Notes:

- If the input parameter does not correspond to a DAC channel, this macro

`__LL_DAC_DIGITAL_SCALE`

returns value '0'.

Description:

- Helper macro to define the DAC conversion data full-scale digital value corresponding to the selected DAC resolution.

Parameters:

- `__DAC_RESOLUTION__`: This parameter can be one of the following values:
 - `LL_DAC_RESOLUTION_12B`
 - `LL_DAC_RESOLUTION_8B`

Return value:

- ADC: conversion data equivalent voltage value (unit: mVolt)

Notes:

- DAC conversion data full-scale corresponds to voltage range determined by analog voltage references V_{ref+} and V_{ref-} (refer to reference manual).

`__LL_DAC_CALC_VOLTAGE_TO_DATA`**Description:**

- Helper macro to calculate the DAC conversion data (unit: digital value) corresponding to a voltage (unit: mVolt).

Parameters:

- `__VREFANALOG_VOLTAGE__`: Analog reference voltage (unit: mV)
- `__DAC_VOLTAGE__`: Voltage to be generated by DAC channel (unit: mVolt).
- `__DAC_RESOLUTION__`: This parameter can be one of the following values:
 - `LL_DAC_RESOLUTION_12B`
 - `LL_DAC_RESOLUTION_8B`

Return value:

- DAC: conversion data (unit: digital value)

Notes:

- This helper macro is intended to provide input data in voltage rather than digital value, to be used with LL DAC functions such as `LL_DAC_ConvertData12RightAligned()`. Analog reference voltage (V_{ref+}) must be either known from user board environment or can be calculated using ADC measurement and ADC helper macro `__LL_ADC_CALC_VREFANALOG_VOLTAGE`

AGE()).

Common write and read registers macros

LL_DAC_WriteReg

Description:

- Write a value in DAC register.

Parameters:

- `__INSTANCE__`: DAC Instance
- `__REG__`: Register to be written
- `__VALUE__`: Value to be written in the register

Return value:

- None

LL_DAC_ReadReg

Description:

- Read a value in DAC register.

Parameters:

- `__INSTANCE__`: DAC Instance
- `__REG__`: Register to be read

Return value:

- Register: value

76 LL DMA2D Generic Driver

76.1 DMA2D Firmware driver registers structures

76.1.1 LL_DMA2D_InitTypeDef

Data Fields

- *uint32_t Mode*
- *uint32_t ColorMode*
- *uint32_t OutputBlue*
- *uint32_t OutputGreen*
- *uint32_t OutputRed*
- *uint32_t OutputAlpha*
- *uint32_t OutputMemoryAddress*
- *uint32_t LineOffset*
- *uint32_t NbrOfLines*
- *uint32_t NbrOfPixelsPerLines*
- *uint32_t AlphaInversionMode*
- *uint32_t RBSwapMode*

Field Documentation

- ***uint32_t LL_DMA2D_InitTypeDef::Mode***
Specifies the DMA2D transfer mode. This parameter can be one value of [DMA2D_LL_EC_MODE](#). This parameter can be modified afterwards using unitary function [LL_DMA2D_SetMode\(\)](#).
- ***uint32_t LL_DMA2D_InitTypeDef::ColorMode***
Specifies the color format of the output image. This parameter can be one value of [DMA2D_LL_EC_OUTPUT_COLOR_MODE](#). This parameter can be modified afterwards using unitary function [LL_DMA2D_SetOutputColorMode\(\)](#).
- ***uint32_t LL_DMA2D_InitTypeDef::OutputBlue***
Specifies the Blue value of the output image. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF` if `ARGB8888` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF` if `RGB888` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x1F` if `RGB565` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x1F` if `ARGB1555` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x0F` if `ARGB4444` color mode is selected. This parameter can be modified afterwards using unitary function [LL_DMA2D_SetOutputColor\(\)](#) or configuration function [LL_DMA2D_ConfigOutputColor\(\)](#).
- ***uint32_t LL_DMA2D_InitTypeDef::OutputGreen***
Specifies the Green value of the output image. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF` if `ARGB8888` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF` if `RGB888` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x3F` if `RGB565` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x1F` if `ARGB1555` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x0F` if `ARGB4444` color mode is selected. This parameter can be modified afterwards using unitary function

LL_DMA2D_SetOutputColor() or configuration function
LL_DMA2D_ConfigOutputColor().

- **uint32_t LL_DMA2D_InitTypeDef::OutputRed**
 Specifies the Red value of the output image. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF` if `ARGB8888` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF` if `RGB888` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x1F` if `RGB565` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x1F` if `ARGB1555` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x0F` if `ARGB4444` color mode is selected. This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputColor()** or configuration function **LL_DMA2D_ConfigOutputColor()**.
- **uint32_t LL_DMA2D_InitTypeDef::OutputAlpha**
 Specifies the Alpha channel of the output image. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF` if `ARGB8888` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x01` if `ARGB1555` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x0F` if `ARGB4444` color mode is selected. This parameter is not considered if `RGB888` or `RGB565` color mode is selected. This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputColor()** or configuration function **LL_DMA2D_ConfigOutputColor()**.
- **uint32_t LL_DMA2D_InitTypeDef::OutputMemoryAddress**
 Specifies the memory address. This parameter must be a number between `Min_Data = 0x0000` and `Max_Data = 0xFFFFFFFF`. This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputMemAddr()**.
- **uint32_t LL_DMA2D_InitTypeDef::LineOffset**
 Specifies the output line offset value. This parameter must be a number between `Min_Data = 0x0000` and `Max_Data = 0x3FFF`. This parameter can be modified afterwards using unitary function **LL_DMA2D_SetLineOffset()**.
- **uint32_t LL_DMA2D_InitTypeDef::NbrOfLines**
 Specifies the number of lines of the area to be transferred. This parameter must be a number between `Min_Data = 0x0000` and `Max_Data = 0xFFFF`. This parameter can be modified afterwards using unitary function **LL_DMA2D_SetNbrOfLines()**.
- **uint32_t LL_DMA2D_InitTypeDef::NbrOfPixelsPerLines**
 Specifies the number of pixels per lines of the area to be transferred. This parameter must be a number between `Min_Data = 0x0000` and `Max_Data = 0x3FFF`. This parameter can be modified afterwards using unitary function **LL_DMA2D_SetNbrOfPixelsPerLines()**.
- **uint32_t LL_DMA2D_InitTypeDef::AlphaInversionMode**
 Specifies the output alpha inversion mode. This parameter can be one value of [DMA2D_LL_EC_ALPHA_INVERSION](#). This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputAlphaInvMode()**.
- **uint32_t LL_DMA2D_InitTypeDef::RBSwapMode**
 Specifies the output Red Blue swap mode. This parameter can be one value of [DMA2D_LL_EC_RED_BLUE_SWAP](#). This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputRBSwapMode()**.

76.1.2 LL_DMA2D_LayerCfgTypeDef

Data Fields

- **uint32_t MemoryAddress**
- **uint32_t LineOffset**

- *uint32_t ColorMode*
- *uint32_t CLUTColorMode*
- *uint32_t CLUTSize*
- *uint32_t AlphaMode*
- *uint32_t Alpha*
- *uint32_t Blue*
- *uint32_t Green*
- *uint32_t Red*
- *uint32_t CLUTMemoryAddress*
- *uint32_t AlphaInversionMode*
- *uint32_t RBSwapMode*

Field Documentation

- ***uint32_t LL_DMA2D_LayerCfgTypeDef::MemoryAddress***
Specifies the foreground or background memory address. This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0xFFFFFFFF. This parameter can be modified afterwards using unitary functions **LL_DMA2D_FGND_SetMemAddr()** for foreground layer, **LL_DMA2D_BGND_SetMemAddr()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::LineOffset***
Specifies the foreground or background line offset value. This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0x3FFF. This parameter can be modified afterwards using unitary functions **LL_DMA2D_FGND_SetLineOffset()** for foreground layer, **LL_DMA2D_BGND_SetLineOffset()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::ColorMode***
Specifies the foreground or background color mode. This parameter can be one value of [DMA2D_LL_EC_INPUT_COLOR_MODE](#). This parameter can be modified afterwards using unitary functions **LL_DMA2D_FGND_SetColorMode()** for foreground layer, **LL_DMA2D_BGND_SetColorMode()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::CLUTColorMode***
Specifies the foreground or background CLUT color mode. This parameter can be one value of [DMA2D_LL_EC_CLUT_COLOR_MODE](#). This parameter can be modified afterwards using unitary functions **LL_DMA2D_FGND_SetCLUTColorMode()** for foreground layer, **LL_DMA2D_BGND_SetCLUTColorMode()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::CLUTSize***
Specifies the foreground or background CLUT size. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF. This parameter can be modified afterwards using unitary functions **LL_DMA2D_FGND_SetCLUTSize()** for foreground layer, **LL_DMA2D_BGND_SetCLUTSize()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::AlphaMode***
Specifies the foreground or background alpha mode. This parameter can be one value of [DMA2D_LL_EC_ALPHA_MODE](#). This parameter can be modified afterwards using unitary functions **LL_DMA2D_FGND_SetAlphaMode()** for foreground layer, **LL_DMA2D_BGND_SetAlphaMode()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::Alpha***
Specifies the foreground or background Alpha value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF. This parameter can be modified afterwards using unitary functions **LL_DMA2D_FGND_SetAlpha()** for foreground layer, **LL_DMA2D_BGND_SetAlpha()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::Blue***
Specifies the foreground or background Blue color value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF. This parameter can be modified afterwards using unitary functions **LL_DMA2D_FGND_SetBlueColor()** for foreground layer, **LL_DMA2D_BGND_SetBlueColor()** for background layer.

- ***uint32_t LL_DMA2D_LayerCfgTypeDef::Green***
Specifies the foreground or background Green color value. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF`. This parameter can be modified afterwards using unitary functions `LL_DMA2D_FGND_SetGreenColor()` for foreground layer, `LL_DMA2D_BGND_SetGreenColor()` for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::Red***
Specifies the foreground or background Red color value. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF`. This parameter can be modified afterwards using unitary functions `LL_DMA2D_FGND_SetRedColor()` for foreground layer, `LL_DMA2D_BGND_SetRedColor()` for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::CLUTMemoryAddress***
Specifies the foreground or background CLUT memory address. This parameter must be a number between `Min_Data = 0x0000` and `Max_Data = 0xFFFFFFFF`. This parameter can be modified afterwards using unitary functions `LL_DMA2D_FGND_SetCLUTMemAddr()` for foreground layer, `LL_DMA2D_BGND_SetCLUTMemAddr()` for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::AlphaInversionMode***
Specifies the foreground or background alpha inversion mode. This parameter can be one value of `DMA2D_LL_EC_ALPHA_INVERSION`. This parameter can be modified afterwards using unitary functions `LL_DMA2D_FGND_SetAlphaInvMode()` for foreground layer, `LL_DMA2D_BGND_SetAlphaInvMode()` for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::RBSwapMode***
Specifies the foreground or background Red Blue swap mode. This parameter can be one value of `DMA2D_LL_EC_RED_BLUE_SWAP`. This parameter can be modified afterwards using unitary functions `LL_DMA2D_FGND_SetRBSwapMode()` for foreground layer, `LL_DMA2D_BGND_SetRBSwapMode()` for background layer.

76.1.3 LL_DMA2D_ColorTypeDef

Data Fields

- ***uint32_t ColorMode***
- ***uint32_t OutputBlue***
- ***uint32_t OutputGreen***
- ***uint32_t OutputRed***
- ***uint32_t OutputAlpha***

Field Documentation

- ***uint32_t LL_DMA2D_ColorTypeDef::ColorMode***
Specifies the color format of the output image. This parameter can be one value of `DMA2D_LL_EC_OUTPUT_COLOR_MODE`. This parameter can be modified afterwards using unitary function `LL_DMA2D_SetOutputColorMode()`.
- ***uint32_t LL_DMA2D_ColorTypeDef::OutputBlue***
Specifies the Blue value of the output image. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF` if `ARGB8888` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF` if `RGB888` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x1F` if `RGB565` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x1F` if `ARGB1555` color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x0F` if `ARGB4444` color mode is selected. This parameter can be modified afterwards using unitary function `LL_DMA2D_SetOutputColor()` or configuration function `LL_DMA2D_ConfigOutputColor()`.
- ***uint32_t LL_DMA2D_ColorTypeDef::OutputGreen***
Specifies the Green value of the output image. This parameter must be a number

between `Min_Data = 0x00` and `Max_Data = 0xFF` if ARGB8888 color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF` if RGB888 color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x3F` if RGB565 color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x1F` if ARGB1555 color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x0F` if ARGB4444 color mode is selected. This parameter can be modified afterwards using unitary function `LL_DMA2D_SetOutputColor()` or configuration function `LL_DMA2D_ConfigOutputColor()`.

- **`uint32_t LL_DMA2D_ColorTypeDef::OutputRed`**
Specifies the Red value of the output image. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF` if ARGB8888 color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF` if RGB888 color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x1F` if RGB565 color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x1F` if ARGB1555 color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x0F` if ARGB4444 color mode is selected. This parameter can be modified afterwards using unitary function `LL_DMA2D_SetOutputColor()` or configuration function `LL_DMA2D_ConfigOutputColor()`.
- **`uint32_t LL_DMA2D_ColorTypeDef::OutputAlpha`**
Specifies the Alpha channel of the output image. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFF` if ARGB8888 color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x01` if ARGB1555 color mode is selected. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x0F` if ARGB4444 color mode is selected. This parameter is not considered if RGB888 or RGB565 color mode is selected. This parameter can be modified afterwards using unitary function `LL_DMA2D_SetOutputColor()` or configuration function `LL_DMA2D_ConfigOutputColor()`.

76.2 DMA2D Firmware driver API description

76.2.1 Detailed description of functions

LL_DMA2D_Start

Function name `__STATIC_INLINE void LL_DMA2D_Start (DMA2D_TypeDef * DMA2Dx)`

Function description Start a DMA2D transfer.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR START LL_DMA2D_Start

LL_DMA2D_IsTransferOngoing

Function name `__STATIC_INLINE uint32_t LL_DMA2D_IsTransferOngoing (DMA2D_TypeDef * DMA2Dx)`

Function description	Indicate if a DMA2D transfer is ongoing.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR START LL_DMA2D_IsTransferOngoing

LL_DMA2D_Suspend

Function name	__STATIC_INLINE void LL_DMA2D_Suspend (DMA2D_TypeDef * DMA2Dx)
Function description	Suspend DMA2D transfer.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• This API can be used to suspend automatic foreground or background CLUT loading.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR SUSP LL_DMA2D_Suspend

LL_DMA2D_Resume

Function name	__STATIC_INLINE void LL_DMA2D_Resume (DMA2D_TypeDef * DMA2Dx)
Function description	Resume DMA2D transfer.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• This API can be used to resume automatic foreground or background CLUT loading.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR SUSP LL_DMA2D_Resume

LL_DMA2D_IsSuspended

Function name	__STATIC_INLINE uint32_t LL_DMA2D_IsSuspended (DMA2D_TypeDef * DMA2Dx)
Function description	Indicate if DMA2D transfer is suspended.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Notes	<ul style="list-style-type: none">• This API can be used to indicate whether or not automatic foreground or background CLUT loading is suspended.
Reference Manual to LL API cross	<ul style="list-style-type: none">• CR SUSP LL_DMA2D_IsSuspended

reference:

LL_DMA2D_Abort

Function name	__STATIC_INLINE void LL_DMA2D_Abort (DMA2D_TypeDef * DMA2Dx)
Function description	Abort DMA2D transfer.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This API can be used to abort automatic foreground or background CLUT loading.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR ABORT LL_DMA2D_Abort

LL_DMA2D_IsAborted

Function name	__STATIC_INLINE uint32_t LL_DMA2D_IsAborted (DMA2D_TypeDef * DMA2Dx)
Function description	Indicate if DMA2D transfer is aborted.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • This API can be used to indicate whether or not automatic foreground or background CLUT loading is aborted.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR ABORT LL_DMA2D_IsAborted

LL_DMA2D_SetMode

Function name	__STATIC_INLINE void LL_DMA2D_SetMode (DMA2D_TypeDef * DMA2Dx, uint32_t Mode)
Function description	Set DMA2D mode.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • Mode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA2D_MODE_M2M – LL_DMA2D_MODE_M2M_PFC – LL_DMA2D_MODE_M2M_BLEND – LL_DMA2D_MODE_R2M
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR MODE LL_DMA2D_SetMode

LL_DMA2D_GetMode

Function name	__STATIC_INLINE uint32_t LL_DMA2D_GetMode (DMA2D_TypeDef * DMA2Dx)
Function description	Return DMA2D mode.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• Returned: value can be one of the following values:<ul style="list-style-type: none">– LL_DMA2D_MODE_M2M– LL_DMA2D_MODE_M2M_PFC– LL_DMA2D_MODE_M2M_BLEND– LL_DMA2D_MODE_R2M
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR MODE LL_DMA2D_GetMode

LL_DMA2D_SetOutputColorMode

Function name	__STATIC_INLINE void LL_DMA2D_SetOutputColorMode (DMA2D_TypeDef * DMA2Dx, uint32_t ColorMode)
Function description	Set DMA2D output color mode.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance• ColorMode: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_DMA2D_OUTPUT_MODE_ARGB8888– LL_DMA2D_OUTPUT_MODE_RGB888– LL_DMA2D_OUTPUT_MODE_RGB565– LL_DMA2D_OUTPUT_MODE_ARGB1555– LL_DMA2D_OUTPUT_MODE_ARGB4444
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• OPFCCR CM LL_DMA2D_SetOutputColorMode

LL_DMA2D_GetOutputColorMode

Function name	__STATIC_INLINE uint32_t LL_DMA2D_GetOutputColorMode (DMA2D_TypeDef * DMA2Dx)
Function description	Return DMA2D output color mode.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• Returned: value can be one of the following values:<ul style="list-style-type: none">– LL_DMA2D_OUTPUT_MODE_ARGB8888– LL_DMA2D_OUTPUT_MODE_RGB888– LL_DMA2D_OUTPUT_MODE_RGB565– LL_DMA2D_OUTPUT_MODE_ARGB1555– LL_DMA2D_OUTPUT_MODE_ARGB4444
Reference Manual to LL API cross	<ul style="list-style-type: none">• OPFCCR CM LL_DMA2D_GetOutputColorMode

reference:

LL_DMA2D_SetOutputRBSwapMode

Function name **__STATIC_INLINE void LL_DMA2D_SetOutputRBSwapMode (DMA2D_TypeDef * DMA2Dx, uint32_t RBSwapMode)**

Function description Set DMA2D output Red Blue swap mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **RBSwapMode:** This parameter can be one of the following values:
 - LL_DMA2D_RB_MODE_REGULAR
 - LL_DMA2D_RB_MODE_SWAP

Return values

- **None:**

Reference Manual to LL API cross reference:

- OPFCCR RBS LL_DMA2D_SetOutputRBSwapMode

LL_DMA2D_GetOutputRBSwapMode

Function name **__STATIC_INLINE uint32_t LL_DMA2D_GetOutputRBSwapMode (DMA2D_TypeDef * DMA2Dx)**

Function description Return DMA2D output Red Blue swap mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_DMA2D_RB_MODE_REGULAR
 - LL_DMA2D_RB_MODE_SWAP

Reference Manual to LL API cross reference:

- OPFCCR RBS LL_DMA2D_GetOutputRBSwapMode

LL_DMA2D_SetOutputAlphaInvMode

Function name **__STATIC_INLINE void LL_DMA2D_SetOutputAlphaInvMode (DMA2D_TypeDef * DMA2Dx, uint32_t AlphaInversionMode)**

Function description Set DMA2D output alpha inversion mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **AlphaInversionMode:** This parameter can be one of the following values:
 - LL_DMA2D_ALPHA_REGULAR
 - LL_DMA2D_ALPHA_INVERTED

Return values

- **None:**

Reference Manual to LL API cross reference:

- OPFCCR AI LL_DMA2D_SetOutputAlphaInvMode

LL_DMA2D_GetOutputAlphaInvMode

Function name	<code>__STATIC_INLINE uint32_t LL_DMA2D_GetOutputAlphaInvMode (DMA2D_TypeDef * DMA2Dx)</code>
Function description	Return DMA2D output alpha inversion mode.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DMA2D_ALPHA_REGULAR – LL_DMA2D_ALPHA_INVERTED
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OPFCCR AI LL_DMA2D_GetOutputAlphaInvMode

LL_DMA2D_SetLineOffset

Function name	<code>__STATIC_INLINE void LL_DMA2D_SetLineOffset (DMA2D_TypeDef * DMA2Dx, uint32_t LineOffset)</code>
Function description	Set DMA2D line offset, expressed on 14 bits ([13:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • LineOffset: Value between Min_Data=0 and Max_Data=0x3FFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OOR LO LL_DMA2D_SetLineOffset

LL_DMA2D_GetLineOffset

Function name	<code>__STATIC_INLINE uint32_t LL_DMA2D_GetLineOffset (DMA2D_TypeDef * DMA2Dx)</code>
Function description	Return DMA2D line offset, expressed on 14 bits ([13:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Line: offset value between Min_Data=0 and Max_Data=0x3FFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OOR LO LL_DMA2D_GetLineOffset

LL_DMA2D_SetNbrOfPixelsPerLines

Function name	<code>__STATIC_INLINE void LL_DMA2D_SetNbrOfPixelsPerLines (DMA2D_TypeDef * DMA2Dx, uint32_t NbrOfPixelsPerLines)</code>
Function description	Set DMA2D number of pixels per lines, expressed on 14 bits ([13:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • NbrOfPixelsPerLines: Value between Min_Data=0 and

Max_Data=0x3FFF

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- NLR PL LL_DMA2D_SetNbrOfPixelsPerLines

LL_DMA2D_GetNbrOfPixelsPerLines

- Function name
- __STATIC_INLINE uint32_t LL_DMA2D_GetNbrOfPixelsPerLines (DMA2D_TypeDef * DMA2Dx)**
- Function description
- Return DMA2D number of pixels per lines, expressed on 14 bits ([13:0] bits)
- Parameters
- **DMA2Dx:** DMA2D Instance
- Return values
- **Number:** of pixels per lines value between Min_Data=0 and Max_Data=0x3FFF
- Reference Manual to LL API cross reference:
- NLR PL LL_DMA2D_GetNbrOfPixelsPerLines

LL_DMA2D_SetNbrOfLines

- Function name
- __STATIC_INLINE void LL_DMA2D_SetNbrOfLines (DMA2D_TypeDef * DMA2Dx, uint32_t NbrOfLines)**
- Function description
- Set DMA2D number of lines, expressed on 16 bits ([15:0] bits).
- Parameters
- **DMA2Dx:** DMA2D Instance
 - **NbrOfLines:** Value between Min_Data=0 and Max_Data=0xFFFF
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- NLR NL LL_DMA2D_SetNbrOfLines

LL_DMA2D_GetNbrOfLines

- Function name
- __STATIC_INLINE uint32_t LL_DMA2D_GetNbrOfLines (DMA2D_TypeDef * DMA2Dx)**
- Function description
- Return DMA2D number of lines, expressed on 16 bits ([15:0] bits).
- Parameters
- **DMA2Dx:** DMA2D Instance
- Return values
- **Number:** of lines value between Min_Data=0 and Max_Data=0xFFFF
- Reference Manual to LL API cross reference:
- NLR NL LL_DMA2D_GetNbrOfLines

LL_DMA2D_SetOutputMemAddr

Function name	__STATIC_INLINE void LL_DMA2D_SetOutputMemAddr (DMA2D_TypeDef * DMA2Dx, uint32_t OutputMemoryAddress)
Function description	Set DMA2D output memory address, expressed on 32 bits ([31:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • OutputMemoryAddress: Value between Min_Data=0 and Max_Data=0xFFFFFFFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OMAR MA LL_DMA2D_SetOutputMemAddr

LL_DMA2D_GetOutputMemAddr

Function name	__STATIC_INLINE uint32_t LL_DMA2D_GetOutputMemAddr (DMA2D_TypeDef * DMA2Dx)
Function description	Get DMA2D output memory address, expressed on 32 bits ([31:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Output: memory address value between Min_Data=0 and Max_Data=0xFFFFFFFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OMAR MA LL_DMA2D_GetOutputMemAddr

LL_DMA2D_SetOutputColor

Function name	__STATIC_INLINE void LL_DMA2D_SetOutputColor (DMA2D_TypeDef * DMA2Dx, uint32_t OutputColor)
Function description	Set DMA2D output color, expressed on 32 bits ([31:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • OutputColor: Value between Min_Data=0 and Max_Data=0xFFFFFFFF
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Output color format depends on output color mode, ARGB8888, RGB888, RGB565, ARGB1555 or ARGB4444. • LL_DMA2D_ConfigOutputColor() API may be used instead if colors values formatting with respect to color mode is not done by the user code.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OCOLR BLUE LL_DMA2D_SetOutputColor • OCOLR GREEN LL_DMA2D_SetOutputColor • OCOLR RED LL_DMA2D_SetOutputColor • OCOLR ALPHA LL_DMA2D_SetOutputColor

LL_DMA2D_GetOutputColor

Function name	__STATIC_INLINE uint32_t LL_DMA2D_GetOutputColor (DMA2D_TypeDef * DMA2Dx)
Function description	Get DMA2D output color, expressed on 32 bits ([31:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Output: color value between Min_Data=0 and Max_Data=0xFFFFFFFF
Notes	<ul style="list-style-type: none"> • Alpha channel and red, green, blue color values must be retrieved from the returned value based on the output color mode (ARGB8888, RGB888, RGB565, ARGB1555 or ARGB4444) as set by LL_DMA2D_SetOutputColorMode.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OCOLR BLUE LL_DMA2D_GetOutputColor • OCOLR GREEN LL_DMA2D_GetOutputColor • OCOLR RED LL_DMA2D_GetOutputColor • OCOLR ALPHA LL_DMA2D_GetOutputColor

LL_DMA2D_SetLineWatermark

Function name	__STATIC_INLINE void LL_DMA2D_SetLineWatermark (DMA2D_TypeDef * DMA2Dx, uint32_t LineWatermark)
Function description	Set DMA2D line watermark, expressed on 16 bits ([15:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • LineWatermark: Value between Min_Data=0 and Max_Data=0xFFFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • LWR LW LL_DMA2D_SetLineWatermark

LL_DMA2D_GetLineWatermark

Function name	__STATIC_INLINE uint32_t LL_DMA2D_GetLineWatermark (DMA2D_TypeDef * DMA2Dx)
Function description	Return DMA2D line watermark, expressed on 16 bits ([15:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Line: watermark value between Min_Data=0 and Max_Data=0xFFFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • LWR LW LL_DMA2D_GetLineWatermark

LL_DMA2D_SetDeadTime

Function name	__STATIC_INLINE void LL_DMA2D_SetDeadTime (DMA2D_TypeDef * DMA2Dx, uint32_t DeadTime)
Function description	Set DMA2D dead time, expressed on 8 bits ([7:0] bits).

Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • DeadTime: Value between Min_Data=0 and Max_Data=0xFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AMTCR DT LL_DMA2D_SetDeadTime

LL_DMA2D_GetDeadTime

Function name	__STATIC_INLINE uint32_t LL_DMA2D_GetDeadTime (DMA2D_TypeDef * DMA2Dx)
Function description	Return DMA2D dead time, expressed on 8 bits ([7:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Dead: time value between Min_Data=0 and Max_Data=0xFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AMTCR DT LL_DMA2D_GetDeadTime

LL_DMA2D_EnableDeadTime

Function name	__STATIC_INLINE void LL_DMA2D_EnableDeadTime (DMA2D_TypeDef * DMA2Dx)
Function description	Enable DMA2D dead time functionality.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AMTCR EN LL_DMA2D_EnableDeadTime

LL_DMA2D_DisableDeadTime

Function name	__STATIC_INLINE void LL_DMA2D_DisableDeadTime (DMA2D_TypeDef * DMA2Dx)
Function description	Disable DMA2D dead time functionality.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AMTCR EN LL_DMA2D_DisableDeadTime

LL_DMA2D_IsEnabledDeadTime

Function name	__STATIC_INLINE uint32_t LL_DMA2D_IsEnabledDeadTime (DMA2D_TypeDef * DMA2Dx)
Function description	Indicate if DMA2D dead time functionality is enabled.

Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AMTCR EN LL_DMA2D_IsEnabledDeadTime

LL_DMA2D_FGND_SetMemAddr

Function name	__STATIC_INLINE void LL_DMA2D_FGND_SetMemAddr (DMA2D_TypeDef * DMA2Dx, uint32_t MemoryAddress)
Function description	Set DMA2D foreground memory address, expressed on 32 bits ([31:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • MemoryAddress: Value between Min_Data=0 and Max_Data=0xFFFFFFFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FGMAR MA LL_DMA2D_FGND_SetMemAddr

LL_DMA2D_FGND_GetMemAddr

Function name	__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetMemAddr (DMA2D_TypeDef * DMA2Dx)
Function description	Get DMA2D foreground memory address, expressed on 32 bits ([31:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Foreground: memory address value between Min_Data=0 and Max_Data=0xFFFFFFFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FGMAR MA LL_DMA2D_FGND_GetMemAddr

LL_DMA2D_FGND_EnableCLUTLoad

Function name	__STATIC_INLINE void LL_DMA2D_FGND_EnableCLUTLoad (DMA2D_TypeDef * DMA2Dx)
Function description	Enable DMA2D foreground CLUT loading.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FGPFCCR START LL_DMA2D_FGND_EnableCLUTLoad

LL_DMA2D_FGND_IsEnabledCLUTLoad

Function name	__STATIC_INLINE uint32_t LL_DMA2D_FGND_IsEnabledCLUTLoad (DMA2D_TypeDef * DMA2Dx)
Function description	Indicate if DMA2D foreground CLUT loading is enabled.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FGPFCCR START LL_DMA2D_FGND_IsEnabledCLUTLoad

LL_DMA2D_FGND_SetColorMode

Function name	__STATIC_INLINE void LL_DMA2D_FGND_SetColorMode (DMA2D_TypeDef * DMA2Dx, uint32_t ColorMode)
Function description	Set DMA2D foreground color mode.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • ColorMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA2D_INPUT_MODE_ARGB8888 – LL_DMA2D_INPUT_MODE_RGB888 – LL_DMA2D_INPUT_MODE_RGB565 – LL_DMA2D_INPUT_MODE_ARGB1555 – LL_DMA2D_INPUT_MODE_ARGB4444 – LL_DMA2D_INPUT_MODE_L8 – LL_DMA2D_INPUT_MODE_AL44 – LL_DMA2D_INPUT_MODE_AL88 – LL_DMA2D_INPUT_MODE_L4 – LL_DMA2D_INPUT_MODE_A8 – LL_DMA2D_INPUT_MODE_A4
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FGPFCCR CM LL_DMA2D_FGND_SetColorMode

LL_DMA2D_FGND_GetColorMode

Function name	__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetColorMode (DMA2D_TypeDef * DMA2Dx)
Function description	Return DMA2D foreground color mode.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DMA2D_INPUT_MODE_ARGB8888 – LL_DMA2D_INPUT_MODE_RGB888 – LL_DMA2D_INPUT_MODE_RGB565 – LL_DMA2D_INPUT_MODE_ARGB1555 – LL_DMA2D_INPUT_MODE_ARGB4444

- LL_DMA2D_INPUT_MODE_L8
- LL_DMA2D_INPUT_MODE_AL44
- LL_DMA2D_INPUT_MODE_AL88
- LL_DMA2D_INPUT_MODE_L4
- LL_DMA2D_INPUT_MODE_A8
- LL_DMA2D_INPUT_MODE_A4

Reference Manual to LL API cross reference:

- FGPFCCR CM LL_DMA2D_FGND_GetColorMode

LL_DMA2D_FGND_SetAlphaMode

Function name **__STATIC_INLINE void LL_DMA2D_FGND_SetAlphaMode (DMA2D_TypeDef * DMA2Dx, uint32_t AphaMode)**

Function description Set DMA2D foreground alpha mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **AphaMode:** This parameter can be one of the following values:
 - LL_DMA2D_ALPHA_MODE_NO_MODIF
 - LL_DMA2D_ALPHA_MODE_REPLACE
 - LL_DMA2D_ALPHA_MODE_COMBINE

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGPFCCR AM LL_DMA2D_FGND_SetAlphaMode

LL_DMA2D_FGND_GetAlphaMode

Function name **__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetAlphaMode (DMA2D_TypeDef * DMA2Dx)**

Function description Return DMA2D foreground alpha mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_DMA2D_ALPHA_MODE_NO_MODIF
 - LL_DMA2D_ALPHA_MODE_REPLACE
 - LL_DMA2D_ALPHA_MODE_COMBINE

Reference Manual to LL API cross reference:

- FGPFCCR AM LL_DMA2D_FGND_GetAlphaMode

LL_DMA2D_FGND_SetAlpha

Function name **__STATIC_INLINE void LL_DMA2D_FGND_SetAlpha (DMA2D_TypeDef * DMA2Dx, uint32_t Alpha)**

Function description Set DMA2D foreground alpha value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **Alpha:** Value between Min_Data=0 and Max_Data=0xFF

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- FGPFCCR ALPHA LL_DMA2D_FGND_SetAlpha

LL_DMA2D_FGND_GetAlpha

- Function name `__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetAlpha(DMA2D_TypeDef * DMA2Dx)`
- Function description Return DMA2D foreground alpha value, expressed on 8 bits ([7:0] bits).
- Parameters
- **DMA2Dx:** DMA2D Instance
- Return values
- **Alpha:** value between Min_Data=0 and Max_Data=0xFF
- Reference Manual to LL API cross reference:
- FGPFCCR ALPHA LL_DMA2D_FGND_GetAlpha

LL_DMA2D_FGND_SetRBSwapMode

- Function name `__STATIC_INLINE void LL_DMA2D_FGND_SetRBSwapMode(DMA2D_TypeDef * DMA2Dx, uint32_t RBSwapMode)`
- Function description Set DMA2D foreground Red Blue swap mode.
- Parameters
- **DMA2Dx:** DMA2D Instance
 - **RBSwapMode:** This parameter can be one of the following values:
 - LL_DMA2D_RB_MODE_REGULAR
 - LL_DMA2D_RB_MODE_SWAP
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- FGPFCCR RBS LL_DMA2D_FGND_SetRBSwapMode

LL_DMA2D_FGND_GetRBSwapMode

- Function name `__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetRBSwapMode(DMA2D_TypeDef * DMA2Dx)`
- Function description Return DMA2D foreground Red Blue swap mode.
- Parameters
- **DMA2Dx:** DMA2D Instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_DMA2D_RB_MODE_REGULAR
 - LL_DMA2D_RB_MODE_SWAP
- Reference Manual to LL API cross reference:
- FGPFCCR RBS LL_DMA2D_FGND_GetRBSwapMode

LL_DMA2D_FGND_SetAlphaInvMode

Function name	__STATIC_INLINE void LL_DMA2D_FGND_SetAlphaInvMode (DMA2D_TypeDef * DMA2Dx, uint32_t AlphaInversionMode)
Function description	Set DMA2D foreground alpha inversion mode.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • AlphaInversionMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA2D_ALPHA_REGULAR – LL_DMA2D_ALPHA_INVERTED
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FGPFCCR AI LL_DMA2D_FGND_SetAlphaInvMode

LL_DMA2D_FGND_GetAlphaInvMode

Function name	__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetAlphaInvMode (DMA2D_TypeDef * DMA2Dx)
Function description	Return DMA2D foreground alpha inversion mode.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DMA2D_ALPHA_REGULAR – LL_DMA2D_ALPHA_INVERTED
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FGPFCCR AI LL_DMA2D_FGND_GetAlphaInvMode

LL_DMA2D_FGND_SetLineOffset

Function name	__STATIC_INLINE void LL_DMA2D_FGND_SetLineOffset (DMA2D_TypeDef * DMA2Dx, uint32_t LineOffset)
Function description	Set DMA2D foreground line offset, expressed on 14 bits ([13:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • LineOffset: Value between Min_Data=0 and Max_Data=0x3FF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FGOR LO LL_DMA2D_FGND_SetLineOffset

LL_DMA2D_FGND_GetLineOffset

Function name	__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetLineOffset (DMA2D_TypeDef * DMA2Dx)
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Function description	Return DMA2D foreground line offset, expressed on 14 bits ([13:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Foreground: line offset value between Min_Data=0 and Max_Data=0x3FF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FGOR LO LL_DMA2D_FGND_GetLineOffset

LL_DMA2D_FGND_SetColor

Function name	__STATIC_INLINE void LL_DMA2D_FGND_SetColor (DMA2D_TypeDef * DMA2Dx, uint32_t Red, uint32_t Green, uint32_t Blue)
Function description	Set DMA2D foreground color values, expressed on 24 bits ([23:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • Red: Value between Min_Data=0 and Max_Data=0xFF • Green: Value between Min_Data=0 and Max_Data=0xFF • Blue: Value between Min_Data=0 and Max_Data=0xFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FGCOLR RED LL_DMA2D_FGND_SetColor • FGCOLR GREEN LL_DMA2D_FGND_SetColor • FGCOLR BLUE LL_DMA2D_FGND_SetColor

LL_DMA2D_FGND_SetRedColor

Function name	__STATIC_INLINE void LL_DMA2D_FGND_SetRedColor (DMA2D_TypeDef * DMA2Dx, uint32_t Red)
Function description	Set DMA2D foreground red color value, expressed on 8 bits ([7:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • Red: Value between Min_Data=0 and Max_Data=0xFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FGCOLR RED LL_DMA2D_FGND_SetRedColor

LL_DMA2D_FGND_GetRedColor

Function name	__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetRedColor (DMA2D_TypeDef * DMA2Dx)
Function description	Return DMA2D foreground red color value, expressed on 8 bits ([7:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Red: color value between Min_Data=0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- FGCOLR RED LL_DMA2D_FGND_GetRedColor

LL_DMA2D_FGND_SetGreenColor

Function name `__STATIC_INLINE void LL_DMA2D_FGND_SetGreenColor(DMA2D_TypeDef * DMA2Dx, uint32_t Green)`

Function description Set DMA2D foreground green color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **Green:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGCOLR GREEN LL_DMA2D_FGND_SetGreenColor

LL_DMA2D_FGND_GetGreenColor

Function name `__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetGreenColor(DMA2D_TypeDef * DMA2Dx)`

Function description Return DMA2D foreground green color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Green:** color value between Min_Data=0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- FGCOLR GREEN LL_DMA2D_FGND_GetGreenColor

LL_DMA2D_FGND_SetBlueColor

Function name `__STATIC_INLINE void LL_DMA2D_FGND_SetBlueColor(DMA2D_TypeDef * DMA2Dx, uint32_t Blue)`

Function description Set DMA2D foreground blue color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **Blue:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGCOLR BLUE LL_DMA2D_FGND_SetBlueColor

LL_DMA2D_FGND_GetBlueColor

Function name `__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetBlueColor(DMA2D_TypeDef * DMA2Dx)`

Function description	Return DMA2D foreground blue color value, expressed on 8 bits ([7:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Blue: color value between Min_Data=0 and Max_Data=0xFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FGCOLR BLUE LL_DMA2D_FGND_GetBlueColor

LL_DMA2D_FGND_SetCLUTMemAddr

Function name	__STATIC_INLINE void LL_DMA2D_FGND_SetCLUTMemAddr (DMA2D_TypeDef * DMA2Dx, uint32_t CLUTMemoryAddress)
Function description	Set DMA2D foreground CLUT memory address, expressed on 32 bits ([31:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • CLUTMemoryAddress: Value between Min_Data=0 and Max_Data=0xFFFFFFFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FGCMAR MA LL_DMA2D_FGND_SetCLUTMemAddr

LL_DMA2D_FGND_GetCLUTMemAddr

Function name	__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetCLUTMemAddr (DMA2D_TypeDef * DMA2Dx)
Function description	Get DMA2D foreground CLUT memory address, expressed on 32 bits ([31:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Foreground: CLUT memory address value between Min_Data=0 and Max_Data=0xFFFFFFFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FGCMAR MA LL_DMA2D_FGND_GetCLUTMemAddr

LL_DMA2D_FGND_SetCLUTSize

Function name	__STATIC_INLINE void LL_DMA2D_FGND_SetCLUTSize (DMA2D_TypeDef * DMA2Dx, uint32_t CLUTSize)
Function description	Set DMA2D foreground CLUT size, expressed on 8 bits ([7:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • CLUTSize: Value between Min_Data=0 and Max_Data=0xFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross	<ul style="list-style-type: none"> • FGPFCCR CS LL_DMA2D_FGND_SetCLUTSize

reference:

LL_DMA2D_FGND_GetCLUTSize

Function name `__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetCLUTSize (DMA2D_TypeDef * DMA2Dx)`

Function description Get DMA2D foreground CLUT size, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Foreground:** CLUT size value between Min_Data=0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- FGPFCCR CS LL_DMA2D_FGND_GetCLUTSize

LL_DMA2D_FGND_SetCLUTColorMode

Function name `__STATIC_INLINE void LL_DMA2D_FGND_SetCLUTColorMode (DMA2D_TypeDef * DMA2Dx, uint32_t CLUTColorMode)`

Function description Set DMA2D foreground CLUT color mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **CLUTColorMode:** This parameter can be one of the following values:
 - LL_DMA2D_CLUT_COLOR_MODE_ARGB8888
 - LL_DMA2D_CLUT_COLOR_MODE_RGB888

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGPFCCR CCM LL_DMA2D_FGND_SetCLUTColorMode

LL_DMA2D_FGND_GetCLUTColorMode

Function name `__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetCLUTColorMode (DMA2D_TypeDef * DMA2Dx)`

Function description Return DMA2D foreground CLUT color mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_DMA2D_CLUT_COLOR_MODE_ARGB8888
 - LL_DMA2D_CLUT_COLOR_MODE_RGB888

Reference Manual to LL API cross reference:

- FGPFCCR CCM LL_DMA2D_FGND_GetCLUTColorMode

LL_DMA2D_BGND_SetMemAddr

Function name	__STATIC_INLINE void LL_DMA2D_BGND_SetMemAddr (DMA2D_TypeDef * DMA2Dx, uint32_t MemoryAddress)
Function description	Set DMA2D background memory address, expressed on 32 bits ([31:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • MemoryAddress: Value between Min_Data=0 and Max_Data=0xFFFFFFFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGMAR MA LL_DMA2D_BGND_SetMemAddr

LL_DMA2D_BGND_GetMemAddr

Function name	__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetMemAddr (DMA2D_TypeDef * DMA2Dx)
Function description	Get DMA2D background memory address, expressed on 32 bits ([31:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Background: memory address value between Min_Data=0 and Max_Data=0xFFFFFFFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGMAR MA LL_DMA2D_BGND_GetMemAddr

LL_DMA2D_BGND_EnableCLUTLoad

Function name	__STATIC_INLINE void LL_DMA2D_BGND_EnableCLUTLoad (DMA2D_TypeDef * DMA2Dx)
Function description	Enable DMA2D background CLUT loading.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGPFCR START LL_DMA2D_BGND_EnableCLUTLoad

LL_DMA2D_BGND_IsEnabledCLUTLoad

Function name	__STATIC_INLINE uint32_t LL_DMA2D_BGND_IsEnabledCLUTLoad (DMA2D_TypeDef * DMA2Dx)
Function description	Indicate if DMA2D background CLUT loading is enabled.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).

Reference Manual to LL API cross reference:

- BGPFCR START LL_DMA2D_BGND_IsEnabledCLUTLoad

LL_DMA2D_BGND_SetColorMode

Function name `__STATIC_INLINE void LL_DMA2D_BGND_SetColorMode (DMA2D_TypeDef * DMA2Dx, uint32_t ColorMode)`

Function description Set DMA2D background color mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **ColorMode:** This parameter can be one of the following values:
 - LL_DMA2D_INPUT_MODE_ARGB8888
 - LL_DMA2D_INPUT_MODE_RGB888
 - LL_DMA2D_INPUT_MODE_RGB565
 - LL_DMA2D_INPUT_MODE_ARGB1555
 - LL_DMA2D_INPUT_MODE_ARGB4444
 - LL_DMA2D_INPUT_MODE_L8
 - LL_DMA2D_INPUT_MODE_AL44
 - LL_DMA2D_INPUT_MODE_AL88
 - LL_DMA2D_INPUT_MODE_L4
 - LL_DMA2D_INPUT_MODE_A8
 - LL_DMA2D_INPUT_MODE_A4

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGPFCR CM LL_DMA2D_BGND_SetColorMode

LL_DMA2D_BGND_GetColorMode

Function name `__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetColorMode (DMA2D_TypeDef * DMA2Dx)`

Function description Return DMA2D background color mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_DMA2D_INPUT_MODE_ARGB8888
 - LL_DMA2D_INPUT_MODE_RGB888
 - LL_DMA2D_INPUT_MODE_RGB565
 - LL_DMA2D_INPUT_MODE_ARGB1555
 - LL_DMA2D_INPUT_MODE_ARGB4444
 - LL_DMA2D_INPUT_MODE_L8
 - LL_DMA2D_INPUT_MODE_AL44
 - LL_DMA2D_INPUT_MODE_AL88
 - LL_DMA2D_INPUT_MODE_L4
 - LL_DMA2D_INPUT_MODE_A8
 - LL_DMA2D_INPUT_MODE_A4

Reference Manual to LL API cross reference:

- BGPFCR CM LL_DMA2D_BGND_GetColorMode

LL_DMA2D_BGND_SetAlphaMode

Function name `__STATIC_INLINE void LL_DMA2D_BGND_SetAlphaMode (DMA2D_TypeDef * DMA2Dx, uint32_t AphaMode)`

Function description Set DMA2D background alpha mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **AphaMode:** This parameter can be one of the following values:
 - LL_DMA2D_ALPHA_MODE_NO_MODIF
 - LL_DMA2D_ALPHA_MODE_REPLACE
 - LL_DMA2D_ALPHA_MODE_COMBINE

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGPFFCCR AM LL_DMA2D_BGND_SetAlphaMode

LL_DMA2D_BGND_GetAlphaMode

Function name `__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetAlphaMode (DMA2D_TypeDef * DMA2Dx)`

Function description Return DMA2D background alpha mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_DMA2D_ALPHA_MODE_NO_MODIF
 - LL_DMA2D_ALPHA_MODE_REPLACE
 - LL_DMA2D_ALPHA_MODE_COMBINE

Reference Manual to LL API cross reference:

- BGPFFCCR AM LL_DMA2D_BGND_GetAlphaMode

LL_DMA2D_BGND_SetAlpha

Function name `__STATIC_INLINE void LL_DMA2D_BGND_SetAlpha (DMA2D_TypeDef * DMA2Dx, uint32_t Alpha)`

Function description Set DMA2D background alpha value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **Alpha:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGPFFCCR ALPHA LL_DMA2D_BGND_SetAlpha

LL_DMA2D_BGND_GetAlpha

Function name `__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetAlpha (DMA2D_TypeDef * DMA2Dx)`

Function description	Return DMA2D background alpha value, expressed on 8 bits ([7:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Alpha: value between Min_Data=0 and Max_Data=0xFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGPFCR ALPHA LL_DMA2D_BGND_GetAlpha

LL_DMA2D_BGND_SetRBSwapMode

Function name	__STATIC_INLINE void LL_DMA2D_BGND_SetRBSwapMode (DMA2D_TypeDef * DMA2Dx, uint32_t RBSwapMode)
Function description	Set DMA2D background Red Blue swap mode.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • RBSwapMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA2D_RB_MODE_REGULAR – LL_DMA2D_RB_MODE_SWAP
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGPFCR RBS LL_DMA2D_BGND_SetRBSwapMode

LL_DMA2D_BGND_GetRBSwapMode

Function name	__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetRBSwapMode (DMA2D_TypeDef * DMA2Dx)
Function description	Return DMA2D background Red Blue swap mode.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DMA2D_RB_MODE_REGULAR – LL_DMA2D_RB_MODE_SWAP
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGPFCR RBS LL_DMA2D_BGND_GetRBSwapMode

LL_DMA2D_BGND_SetAlphaInvMode

Function name	__STATIC_INLINE void LL_DMA2D_BGND_SetAlphaInvMode (DMA2D_TypeDef * DMA2Dx, uint32_t AlphaInversionMode)
Function description	Set DMA2D background alpha inversion mode.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • AlphaInversionMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA2D_ALPHA_REGULAR – LL_DMA2D_ALPHA_INVERTED

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- BGPFCR AI LL_DMA2D_BGND_SetAlphaInvMode

LL_DMA2D_BGND_GetAlphaInvMode

- Function name `__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetAlphaInvMode (DMA2D_TypeDef * DMA2Dx)`
- Function description Return DMA2D background alpha inversion mode.
- Parameters
- **DMA2Dx:** DMA2D Instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_DMA2D_ALPHA_REGULAR
 - LL_DMA2D_ALPHA_INVERTED
- Reference Manual to LL API cross reference:
- BGPFCR AI LL_DMA2D_BGND_GetAlphaInvMode

LL_DMA2D_BGND_SetLineOffset

- Function name `__STATIC_INLINE void LL_DMA2D_BGND_SetLineOffset (DMA2D_TypeDef * DMA2Dx, uint32_t LineOffset)`
- Function description Set DMA2D background line offset, expressed on 14 bits ([13:0] bits).
- Parameters
- **DMA2Dx:** DMA2D Instance
 - **LineOffset:** Value between Min_Data=0 and Max_Data=0x3FF
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- BGOR LO LL_DMA2D_BGND_SetLineOffset

LL_DMA2D_BGND_GetLineOffset

- Function name `__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetLineOffset (DMA2D_TypeDef * DMA2Dx)`
- Function description Return DMA2D background line offset, expressed on 14 bits ([13:0] bits).
- Parameters
- **DMA2Dx:** DMA2D Instance
- Return values
- **Background:** line offset value between Min_Data=0 and Max_Data=0x3FF
- Reference Manual to LL API cross reference:
- BGOR LO LL_DMA2D_BGND_GetLineOffset

LL_DMA2D_BGND_SetColor

Function name	__STATIC_INLINE void LL_DMA2D_BGND_SetColor (DMA2D_TypeDef * DMA2Dx, uint32_t Red, uint32_t Green, uint32_t Blue)
Function description	Set DMA2D background color values, expressed on 24 bits ([23:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • Red: Value between Min_Data=0 and Max_Data=0xFF • Green: Value between Min_Data=0 and Max_Data=0xFF • Blue: Value between Min_Data=0 and Max_Data=0xFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGCOLR RED LL_DMA2D_BGND_SetColor • BGCOLR GREEN LL_DMA2D_BGND_SetColor • BGCOLR BLUE LL_DMA2D_BGND_SetColor

LL_DMA2D_BGND_SetRedColor

Function name	__STATIC_INLINE void LL_DMA2D_BGND_SetRedColor (DMA2D_TypeDef * DMA2Dx, uint32_t Red)
Function description	Set DMA2D background red color value, expressed on 8 bits ([7:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • Red: Value between Min_Data=0 and Max_Data=0xFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGCOLR RED LL_DMA2D_BGND_SetRedColor

LL_DMA2D_BGND_GetRedColor

Function name	__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetRedColor (DMA2D_TypeDef * DMA2Dx)
Function description	Return DMA2D background red color value, expressed on 8 bits ([7:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Red: color value between Min_Data=0 and Max_Data=0xFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGCOLR RED LL_DMA2D_BGND_GetRedColor

LL_DMA2D_BGND_SetGreenColor

Function name	__STATIC_INLINE void LL_DMA2D_BGND_SetGreenColor (DMA2D_TypeDef * DMA2Dx, uint32_t Green)
Function description	Set DMA2D background green color value, expressed on 8 bits ([7:0] bits).

Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • Green: Value between Min_Data=0 and Max_Data=0xFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGCOLR GREEN LL_DMA2D_BGND_SetGreenColor

LL_DMA2D_BGND_GetGreenColor

Function name	__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetGreenColor (DMA2D_TypeDef * DMA2Dx)
Function description	Return DMA2D background green color value, expressed on 8 bits ([7:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Green: color value between Min_Data=0 and Max_Data=0xFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGCOLR GREEN LL_DMA2D_BGND_GetGreenColor

LL_DMA2D_BGND_SetBlueColor

Function name	__STATIC_INLINE void LL_DMA2D_BGND_SetBlueColor (DMA2D_TypeDef * DMA2Dx, uint32_t Blue)
Function description	Set DMA2D background blue color value, expressed on 8 bits ([7:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • Blue: Value between Min_Data=0 and Max_Data=0xFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGCOLR BLUE LL_DMA2D_BGND_SetBlueColor

LL_DMA2D_BGND_GetBlueColor

Function name	__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetBlueColor (DMA2D_TypeDef * DMA2Dx)
Function description	Return DMA2D background blue color value, expressed on 8 bits ([7:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Blue: color value between Min_Data=0 and Max_Data=0xFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGCOLR BLUE LL_DMA2D_BGND_GetBlueColor

LL_DMA2D_BGND_SetCLUTMemAddr

Function name	__STATIC_INLINE void LL_DMA2D_BGND_SetCLUTMemAddr (DMA2D_TypeDef * DMA2Dx, uint32_t CLUTMemoryAddress)
Function description	Set DMA2D background CLUT memory address, expressed on 32 bits ([31:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • CLUTMemoryAddress: Value between Min_Data=0 and Max_Data=0xFFFFFFFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGCMAR MA LL_DMA2D_BGND_SetCLUTMemAddr

LL_DMA2D_BGND_GetCLUTMemAddr

Function name	__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetCLUTMemAddr (DMA2D_TypeDef * DMA2Dx)
Function description	Get DMA2D background CLUT memory address, expressed on 32 bits ([31:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Background: CLUT memory address value between Min_Data=0 and Max_Data=0xFFFFFFFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGCMAR MA LL_DMA2D_BGND_GetCLUTMemAddr

LL_DMA2D_BGND_SetCLUTSize

Function name	__STATIC_INLINE void LL_DMA2D_BGND_SetCLUTSize (DMA2D_TypeDef * DMA2Dx, uint32_t CLUTSize)
Function description	Set DMA2D background CLUT size, expressed on 8 bits ([7:0] bits).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • CLUTSize: Value between Min_Data=0 and Max_Data=0xFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGPFCR CS LL_DMA2D_BGND_SetCLUTSize

LL_DMA2D_BGND_GetCLUTSize

Function name	__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetCLUTSize (DMA2D_TypeDef * DMA2Dx)
Function description	Get DMA2D background CLUT size, expressed on 8 bits ([7:0] bits).

Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Background: CLUT size value between Min_Data=0 and Max_Data=0xFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGPFCR CS LL_DMA2D_BGND_GetCLUTSize

LL_DMA2D_BGND_SetCLUTColorMode

Function name	__STATIC_INLINE void LL_DMA2D_BGND_SetCLUTColorMode (DMA2D_TypeDef * DMA2Dx, uint32_t CLUTColorMode)
Function description	Set DMA2D background CLUT color mode.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • CLUTColorMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA2D_CLUT_COLOR_MODE_ARGB8888 – LL_DMA2D_CLUT_COLOR_MODE_RGB888
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGPFCR CCM LL_DMA2D_BGND_SetCLUTColorMode

LL_DMA2D_BGND_GetCLUTColorMode

Function name	__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetCLUTColorMode (DMA2D_TypeDef * DMA2Dx)
Function description	Return DMA2D background CLUT color mode.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DMA2D_CLUT_COLOR_MODE_ARGB8888 – LL_DMA2D_CLUT_COLOR_MODE_RGB888
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BGPFCR CCM LL_DMA2D_BGND_GetCLUTColorMode

LL_DMA2D_IsActiveFlag_CE

Function name	__STATIC_INLINE uint32_t LL_DMA2D_IsActiveFlag_CE (DMA2D_TypeDef * DMA2Dx)
Function description	Check if the DMA2D Configuration Error Interrupt Flag is set or not.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross	<ul style="list-style-type: none"> • ISR CEIF LL_DMA2D_IsActiveFlag_CE

reference:

LL_DMA2D_IsActiveFlag_CTC

Function name `__STATIC_INLINE uint32_t LL_DMA2D_IsActiveFlag_CTC (DMA2D_TypeDef * DMA2Dx)`

Function description Check if the DMA2D CLUT Transfer Complete Interrupt Flag is set or not.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR CTCIF LL_DMA2D_IsActiveFlag_CTC

LL_DMA2D_IsActiveFlag_CAE

Function name `__STATIC_INLINE uint32_t LL_DMA2D_IsActiveFlag_CAE (DMA2D_TypeDef * DMA2Dx)`

Function description Check if the DMA2D CLUT Access Error Interrupt Flag is set or not.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR CAEIF LL_DMA2D_IsActiveFlag_CAE

LL_DMA2D_IsActiveFlag_TW

Function name `__STATIC_INLINE uint32_t LL_DMA2D_IsActiveFlag_TW (DMA2D_TypeDef * DMA2Dx)`

Function description Check if the DMA2D Transfer Watermark Interrupt Flag is set or not.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TWIF LL_DMA2D_IsActiveFlag_TW

LL_DMA2D_IsActiveFlag_TC

Function name `__STATIC_INLINE uint32_t LL_DMA2D_IsActiveFlag_TC (DMA2D_TypeDef * DMA2Dx)`

Function description Check if the DMA2D Transfer Complete Interrupt Flag is set or not.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TCIF LL_DMA2D_IsActiveFlag_TC

LL_DMA2D_IsActiveFlag_TE

Function name **__STATIC_INLINE uint32_t LL_DMA2D_IsActiveFlag_TE (DMA2D_TypeDef * DMA2Dx)**

Function description Check if the DMA2D Transfer Error Interrupt Flag is set or not.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TEIF LL_DMA2D_IsActiveFlag_TE

LL_DMA2D_ClearFlag_CE

Function name **__STATIC_INLINE void LL_DMA2D_ClearFlag_CE (DMA2D_TypeDef * DMA2Dx)**

Function description Clear DMA2D Configuration Error Interrupt Flag.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CCEIF LL_DMA2D_ClearFlag_CE

LL_DMA2D_ClearFlag_CTC

Function name **__STATIC_INLINE void LL_DMA2D_ClearFlag_CTC (DMA2D_TypeDef * DMA2Dx)**

Function description Clear DMA2D CLUT Transfer Complete Interrupt Flag.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CCTCIF LL_DMA2D_ClearFlag_CTC

LL_DMA2D_ClearFlag_CAE

Function name **__STATIC_INLINE void LL_DMA2D_ClearFlag_CAE (DMA2D_TypeDef * DMA2Dx)**

Function description Clear DMA2D CLUT Access Error Interrupt Flag.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross

- IFCR CAECIF LL_DMA2D_ClearFlag_CAE

reference:

LL_DMA2D_ClearFlag_TW

Function name	__STATIC_INLINE void LL_DMA2D_ClearFlag_TW (DMA2D_TypeDef * DMA2Dx)
Function description	Clear DMA2D Transfer Watermark Interrupt Flag.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • IFCR CTWIF LL_DMA2D_ClearFlag_TW

LL_DMA2D_ClearFlag_TC

Function name	__STATIC_INLINE void LL_DMA2D_ClearFlag_TC (DMA2D_TypeDef * DMA2Dx)
Function description	Clear DMA2D Transfer Complete Interrupt Flag.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • IFCR CTCIF LL_DMA2D_ClearFlag_TC

LL_DMA2D_ClearFlag_TE

Function name	__STATIC_INLINE void LL_DMA2D_ClearFlag_TE (DMA2D_TypeDef * DMA2Dx)
Function description	Clear DMA2D Transfer Error Interrupt Flag.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • IFCR CTEIF LL_DMA2D_ClearFlag_TE

LL_DMA2D_EnableIT_CE

Function name	__STATIC_INLINE void LL_DMA2D_EnableIT_CE (DMA2D_TypeDef * DMA2Dx)
Function description	Enable Configuration Error Interrupt.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR CEIE LL_DMA2D_EnableIT_CE

LL_DMA2D_EnableIT_CTC

Function name	__STATIC_INLINE void LL_DMA2D_EnableIT_CTC (DMA2D_TypeDef * DMA2Dx)
Function description	Enable CLUT Transfer Complete Interrupt.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR CTCIE LL_DMA2D_EnableIT_CTC

LL_DMA2D_EnableIT_CAE

Function name	__STATIC_INLINE void LL_DMA2D_EnableIT_CAE (DMA2D_TypeDef * DMA2Dx)
Function description	Enable CLUT Access Error Interrupt.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR CAEIE LL_DMA2D_EnableIT_CAE

LL_DMA2D_EnableIT_TW

Function name	__STATIC_INLINE void LL_DMA2D_EnableIT_TW (DMA2D_TypeDef * DMA2Dx)
Function description	Enable Transfer Watermark Interrupt.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR TWIE LL_DMA2D_EnableIT_TW

LL_DMA2D_EnableIT_TC

Function name	__STATIC_INLINE void LL_DMA2D_EnableIT_TC (DMA2D_TypeDef * DMA2Dx)
Function description	Enable Transfer Complete Interrupt.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR TCIE LL_DMA2D_EnableIT_TC

LL_DMA2D_EnableIT_TE

Function name	__STATIC_INLINE void LL_DMA2D_EnableIT_TE (DMA2D_TypeDef * DMA2Dx)
Function description	Enable Transfer Error Interrupt.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR TEIE LL_DMA2D_EnableIT_TE

LL_DMA2D_DisableIT_CE

Function name	__STATIC_INLINE void LL_DMA2D_DisableIT_CE (DMA2D_TypeDef * DMA2Dx)
Function description	Disable Configuration Error Interrupt.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR CEIE LL_DMA2D_DisableIT_CE

LL_DMA2D_DisableIT_CTC

Function name	__STATIC_INLINE void LL_DMA2D_DisableIT_CTC (DMA2D_TypeDef * DMA2Dx)
Function description	Disable CLUT Transfer Complete Interrupt.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR CTCIE LL_DMA2D_DisableIT_CTC

LL_DMA2D_DisableIT_CAE

Function name	__STATIC_INLINE void LL_DMA2D_DisableIT_CAE (DMA2D_TypeDef * DMA2Dx)
Function description	Disable CLUT Access Error Interrupt.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR CAEIE LL_DMA2D_DisableIT_CAE

LL_DMA2D_DisableIT_TW

Function name	__STATIC_INLINE void LL_DMA2D_DisableIT_TW (DMA2D_TypeDef * DMA2Dx)
Function description	Disable Transfer Watermark Interrupt.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR TWIE LL_DMA2D_DisableIT_TW

LL_DMA2D_DisableIT_TC

Function name	__STATIC_INLINE void LL_DMA2D_DisableIT_TC (DMA2D_TypeDef * DMA2Dx)
Function description	Disable Transfer Complete Interrupt.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR TCIE LL_DMA2D_DisableIT_TC

LL_DMA2D_DisableIT_TE

Function name	__STATIC_INLINE void LL_DMA2D_DisableIT_TE (DMA2D_TypeDef * DMA2Dx)
Function description	Disable Transfer Error Interrupt.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR TEIE LL_DMA2D_DisableIT_TE

LL_DMA2D_IsEnabledIT_CE

Function name	__STATIC_INLINE uint32_t LL_DMA2D_IsEnabledIT_CE (DMA2D_TypeDef * DMA2Dx)
Function description	Check if the DMA2D Configuration Error interrupt source is enabled or disabled.
Parameters	<ul style="list-style-type: none">• DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR CEIE LL_DMA2D_IsEnabledIT_CE

LL_DMA2D_IsEnabledIT_CTC

Function name	__STATIC_INLINE uint32_t LL_DMA2D_IsEnabledIT_CTC (DMA2D_TypeDef * DMA2Dx)
Function description	Check if the DMA2D CLUT Transfer Complete interrupt source is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR CTCIE LL_DMA2D_IsEnabledIT_CTC

LL_DMA2D_IsEnabledIT_CAE

Function name	__STATIC_INLINE uint32_t LL_DMA2D_IsEnabledIT_CAE (DMA2D_TypeDef * DMA2Dx)
Function description	Check if the DMA2D CLUT Access Error interrupt source is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR CAEIE LL_DMA2D_IsEnabledIT_CAE

LL_DMA2D_IsEnabledIT_TW

Function name	__STATIC_INLINE uint32_t LL_DMA2D_IsEnabledIT_TW (DMA2D_TypeDef * DMA2Dx)
Function description	Check if the DMA2D Transfer Watermark interrupt source is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR TWIE LL_DMA2D_IsEnabledIT_TW

LL_DMA2D_IsEnabledIT_TC

Function name	__STATIC_INLINE uint32_t LL_DMA2D_IsEnabledIT_TC (DMA2D_TypeDef * DMA2Dx)
Function description	Check if the DMA2D Transfer Complete interrupt source is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross	<ul style="list-style-type: none"> • CR TCIE LL_DMA2D_IsEnabledIT_TC

reference:

LL_DMA2D_IsEnabledIT_TE

Function name	__STATIC_INLINE uint32_t LL_DMA2D_IsEnabledIT_TE (DMA2D_TypeDef * DMA2Dx)
Function description	Check if the DMA2D Transfer Error interrupt source is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR TEIE LL_DMA2D_IsEnabledIT_TE

LL_DMA2D_DelInit

Function name	ErrorStatus LL_DMA2D_DelInit (DMA2D_TypeDef * DMA2Dx)
Function description	De-initialize DMA2D registers (registers restored to their default values).
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: DMA2D registers are de-initialized – ERROR: DMA2D registers are not de-initialized

LL_DMA2D_Init

Function name	ErrorStatus LL_DMA2D_Init (DMA2D_TypeDef * DMA2Dx, LL_DMA2D_InitTypeDef * DMA2D_InitStruct)
Function description	Initialize DMA2D registers according to the specified parameters in DMA2D_InitStruct.
Parameters	<ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • DMA2D_InitStruct: pointer to a LL_DMA2D_InitTypeDef structure that contains the configuration information for the specified DMA2D peripheral.
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: DMA2D registers are initialized according to DMA2D_InitStruct content – ERROR: Issue occurred during DMA2D registers initialization
Notes	<ul style="list-style-type: none"> • DMA2D transfers must be disabled to set initialization bits in configuration registers, otherwise ERROR result is returned.

LL_DMA2D_StructInit

Function name	void LL_DMA2D_StructInit (LL_DMA2D_InitTypeDef * DMA2D_InitStruct)
Function description	Set each LL_DMA2D_InitTypeDef field to default value.

- | | |
|---------------|--|
| Parameters | <ul style="list-style-type: none"> • DMA2D_InitStruct: pointer to a LL_DMA2D_InitTypeDef structure whose fields will be set to default values. |
| Return values | <ul style="list-style-type: none"> • None: |

LL_DMA2D_ConfigLayer

- | | |
|----------------------|--|
| Function name | void LL_DMA2D_ConfigLayer (DMA2D_TypeDef * DMA2Dx, LL_DMA2D_LayerCfgTypeDef * DMA2D_LayerCfg, uint32_t LayerIdx) |
| Function description | Configure the foreground or background according to the specified parameters in the LL_DMA2D_LayerCfgTypeDef structure. |
| Parameters | <ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • DMA2D_LayerCfg: pointer to a LL_DMA2D_LayerCfgTypeDef structure that contains the configuration information for the specified layer. • LayerIdx: DMA2D Layer index. This parameter can be one of the following values: 0(background) / 1(foreground) |
| Return values | <ul style="list-style-type: none"> • None: |

LL_DMA2D_LayerCfgStructInit

- | | |
|----------------------|--|
| Function name | void LL_DMA2D_LayerCfgStructInit (LL_DMA2D_LayerCfgTypeDef * DMA2D_LayerCfg) |
| Function description | Set each LL_DMA2D_LayerCfgTypeDef field to default value. |
| Parameters | <ul style="list-style-type: none"> • DMA2D_LayerCfg: pointer to a LL_DMA2D_LayerCfgTypeDef structure whose fields will be set to default values. |
| Return values | <ul style="list-style-type: none"> • None: |

LL_DMA2D_ConfigOutputColor

- | | |
|----------------------|---|
| Function name | void LL_DMA2D_ConfigOutputColor (DMA2D_TypeDef * DMA2Dx, LL_DMA2D_ColorTypeDef * DMA2D_ColorStruct) |
| Function description | Initialize DMA2D output color register according to the specified parameters in DMA2D_ColorStruct. |
| Parameters | <ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance • DMA2D_ColorStruct: pointer to a LL_DMA2D_ColorTypeDef structure that contains the color configuration information for the specified DMA2D peripheral. |
| Return values | <ul style="list-style-type: none"> • None: |

LL_DMA2D_GetOutputBlueColor

- | | |
|----------------------|--|
| Function name | uint32_t LL_DMA2D_GetOutputBlueColor (DMA2D_TypeDef * DMA2Dx, uint32_t ColorMode) |
| Function description | Return DMA2D output Blue color. |
| Parameters | <ul style="list-style-type: none"> • DMA2Dx: DMA2D Instance. • ColorMode: This parameter can be one of the following |

values:

- LL_DMA2D_OUTPUT_MODE_ARGB8888
- LL_DMA2D_OUTPUT_MODE_RGB888
- LL_DMA2D_OUTPUT_MODE_RGB565
- LL_DMA2D_OUTPUT_MODE_ARGB1555
- LL_DMA2D_OUTPUT_MODE_ARGB4444

Return values

- **Output:** Blue color value between Min_Data=0 and Max_Data=0xFF

LL_DMA2D_GetOutputGreenColor

Function name **uint32_t LL_DMA2D_GetOutputGreenColor (DMA2D_TypeDef * DMA2Dx, uint32_t ColorMode)**

Function description Return DMA2D output Green color.

Parameters

- **DMA2Dx:** DMA2D Instance.
- **ColorMode:** This parameter can be one of the following values:
 - LL_DMA2D_OUTPUT_MODE_ARGB8888
 - LL_DMA2D_OUTPUT_MODE_RGB888
 - LL_DMA2D_OUTPUT_MODE_RGB565
 - LL_DMA2D_OUTPUT_MODE_ARGB1555
 - LL_DMA2D_OUTPUT_MODE_ARGB4444

Return values

- **Output:** Green color value between Min_Data=0 and Max_Data=0xFF

LL_DMA2D_GetOutputRedColor

Function name **uint32_t LL_DMA2D_GetOutputRedColor (DMA2D_TypeDef * DMA2Dx, uint32_t ColorMode)**

Function description Return DMA2D output Red color.

Parameters

- **DMA2Dx:** DMA2D Instance.
- **ColorMode:** This parameter can be one of the following values:
 - LL_DMA2D_OUTPUT_MODE_ARGB8888
 - LL_DMA2D_OUTPUT_MODE_RGB888
 - LL_DMA2D_OUTPUT_MODE_RGB565
 - LL_DMA2D_OUTPUT_MODE_ARGB1555
 - LL_DMA2D_OUTPUT_MODE_ARGB4444

Return values

- **Output:** Red color value between Min_Data=0 and Max_Data=0xFF

LL_DMA2D_GetOutputAlphaColor

Function name **uint32_t LL_DMA2D_GetOutputAlphaColor (DMA2D_TypeDef * DMA2Dx, uint32_t ColorMode)**

Function description Return DMA2D output Alpha color.

Parameters

- **DMA2Dx:** DMA2D Instance.
- **ColorMode:** This parameter can be one of the following values:

- LL_DMA2D_OUTPUT_MODE_ARGB8888
- LL_DMA2D_OUTPUT_MODE_RGB888
- LL_DMA2D_OUTPUT_MODE_RGB565
- LL_DMA2D_OUTPUT_MODE_ARGB1555
- LL_DMA2D_OUTPUT_MODE_ARGB4444

Return values

- **Output:** Alpha color value between Min_Data=0 and Max_Data=0xFF

LL_DMA2D_ConfigSize

Function name **void LL_DMA2D_ConfigSize (DMA2D_TypeDef * DMA2Dx, uint32_t NbrOfLines, uint32_t NbrOfPixelsPerLines)**

Function description Configure DMA2D transfer size.

Parameters

- **DMA2Dx:** DMA2D Instance
- **NbrOfLines:** Value between Min_Data=0 and Max_Data=0xFFFF
- **NbrOfPixelsPerLines:** Value between Min_Data=0 and Max_Data=0x3FFF

Return values

- **None:**

76.3 DMA2D Firmware driver defines

76.3.1 DMA2D

Alpha Inversion

LL_DMA2D_ALPHA_REGULAR Regular alpha

LL_DMA2D_ALPHA_INVERTED Inverted alpha

Alpha Mode

LL_DMA2D_ALPHA_MODE_NO_MODIF No modification of the alpha channel value

LL_DMA2D_ALPHA_MODE_REPLACE Replace original alpha channel value by programmed alpha value

LL_DMA2D_ALPHA_MODE_COMBINE Replace original alpha channel value by programmed alpha value with original alpha channel value

CLUT Color Mode

LL_DMA2D_CLUT_COLOR_MODE_ARGB8888 ARGB8888

LL_DMA2D_CLUT_COLOR_MODE_RGB888 RGB888

Get Flags Defines

LL_DMA2D_FLAG_CEIF Configuration Error Interrupt Flag

LL_DMA2D_FLAG CTCIF CLUT Transfer Complete Interrupt Flag

LL_DMA2D_FLAG CAEIF CLUT Access Error Interrupt Flag

LL_DMA2D_FLAG TWIF Transfer Watermark Interrupt Flag

LL_DMA2D_FLAG TCIF Transfer Complete Interrupt Flag

LL_DMA2D_FLAG_TEIF Transfer Error Interrupt Flag

Input Color Mode

LL_DMA2D_INPUT_MODE_ARGB8888 ARGB8888

LL_DMA2D_INPUT_MODE_RGB888 RGB888

LL_DMA2D_INPUT_MODE_RGB565 RGB565

LL_DMA2D_INPUT_MODE_ARGB1555 ARGB1555

LL_DMA2D_INPUT_MODE_ARGB4444 ARGB4444

LL_DMA2D_INPUT_MODE_L8 L8

LL_DMA2D_INPUT_MODE_AL44 AL44

LL_DMA2D_INPUT_MODE_AL88 AL88

LL_DMA2D_INPUT_MODE_L4 L4

LL_DMA2D_INPUT_MODE_A8 A8

LL_DMA2D_INPUT_MODE_A4 A4

IT Defines

LL_DMA2D_IT_CEIE Configuration Error Interrupt

LL_DMA2D_IT_CTCIE CLUT Transfer Complete Interrupt

LL_DMA2D_IT_CAEIE CLUT Access Error Interrupt

LL_DMA2D_IT_TWIE Transfer Watermark Interrupt

LL_DMA2D_IT_TCIE Transfer Complete Interrupt

LL_DMA2D_IT_TEIE Transfer Error Interrupt

Mode

LL_DMA2D_MODE_M2M DMA2D memory to memory transfer mode

LL_DMA2D_MODE_M2M_PFC DMA2D memory to memory with pixel format conversion transfer mode

LL_DMA2D_MODE_M2M_BLEND DMA2D memory to memory with blending transfer mode

LL_DMA2D_MODE_R2M DMA2D register to memory transfer mode

Output Color Mode

LL_DMA2D_OUTPUT_MODE_ARGB8888 ARGB8888

LL_DMA2D_OUTPUT_MODE_RGB888 RGB888

LL_DMA2D_OUTPUT_MODE_RGB565 RGB565

LL_DMA2D_OUTPUT_MODE_ARGB1555 ARGB1555

LL_DMA2D_OUTPUT_MODE_ARGB4444 ARGB4444

Red Blue Swap

LL_DMA2D_RB_MODE_REGULAR RGB or ARGB

LL_DMA2D_RB_MODE_SWAP BGR or ABGR

Common Write and read registers Macros

LL_DMA2D_WriteReg

Description:

- Write a value in DMA2D register.

Parameters:

- `__INSTANCE__`: DMA2D Instance
- `__REG__`: Register to be written
- `__VALUE__`: Value to be written in the register

Return value:

- None

LL_DMA2D_ReadReg

Description:

- Read a value in DMA2D register.

Parameters:

- `__INSTANCE__`: DMA2D Instance
- `__REG__`: Register to be read

Return value:

- Register: value

77 LL DMA Generic Driver

77.1 DMA Firmware driver registers structures

77.1.1 LL_DMA_InitTypeDef

Data Fields

- *uint32_t* **PeriphOrM2MSrcAddress**
- *uint32_t* **MemoryOrM2MDstAddress**
- *uint32_t* **Direction**
- *uint32_t* **Mode**
- *uint32_t* **PeriphOrM2MSrcIncMode**
- *uint32_t* **MemoryOrM2MDstIncMode**
- *uint32_t* **PeriphOrM2MSrcDataSize**
- *uint32_t* **MemoryOrM2MDstDataSize**
- *uint32_t* **NbData**
- *uint32_t* **Channel**
- *uint32_t* **Priority**
- *uint32_t* **FIFOMode**
- *uint32_t* **FIFOThreshold**
- *uint32_t* **MemBurst**
- *uint32_t* **PeriphBurst**

Field Documentation

- *uint32_t* **LL_DMA_InitTypeDef::PeriphOrM2MSrcAddress**
Specifies the peripheral base address for DMA transfer or as Source base address in case of memory to memory transfer direction. This parameter must be a value between `Min_Data = 0` and `Max_Data = 0xFFFFFFFF`.
- *uint32_t* **LL_DMA_InitTypeDef::MemoryOrM2MDstAddress**
Specifies the memory base address for DMA transfer or as Destination base address in case of memory to memory transfer direction. This parameter must be a value between `Min_Data = 0` and `Max_Data = 0xFFFFFFFF`.
- *uint32_t* **LL_DMA_InitTypeDef::Direction**
Specifies if the data will be transferred from memory to peripheral, from memory to memory or from peripheral to memory. This parameter can be a value of [DMA_LL_EC_DIRECTION](#). This feature can be modified afterwards using unitary function `LL_DMA_SetDataTransferDirection()`.
- *uint32_t* **LL_DMA_InitTypeDef::Mode**
Specifies the normal or circular operation mode. This parameter can be a value of [DMA_LL_EC_MODE](#)
Note: The circular buffer mode cannot be used if the memory to memory data transfer direction is configured on the selected Stream. This feature can be modified afterwards using unitary function `LL_DMA_SetMode()`.
- *uint32_t* **LL_DMA_InitTypeDef::PeriphOrM2MSrcIncMode**
Specifies whether the Peripheral address or Source address in case of memory to memory transfer direction is incremented or not. This parameter can be a value of [DMA_LL_EC_PERIPH](#). This feature can be modified afterwards using unitary function `LL_DMA_SetPeriphIncMode()`.
- *uint32_t* **LL_DMA_InitTypeDef::MemoryOrM2MDstIncMode**
Specifies whether the Memory address or Destination address in case of memory to memory transfer direction is incremented or not. This parameter can be a value of

- DMA_LL_EC_MEMORY** This feature can be modified afterwards using unitary function `LL_DMA_SetMemoryIncMode()`.
- **`uint32_t LL_DMA_InitTypeDef::PeriphOrM2MSrcDataSize`**
Specifies the Peripheral data size alignment or Source data size alignment (byte, half word, word) in case of memory to memory transfer direction. This parameter can be a value of **DMA_LL_EC_PDATALIGN** This feature can be modified afterwards using unitary function `LL_DMA_SetPeriphSize()`.
 - **`uint32_t LL_DMA_InitTypeDef::MemoryOrM2MDstDataSize`**
Specifies the Memory data size alignment or Destination data size alignment (byte, half word, word) in case of memory to memory transfer direction. This parameter can be a value of **DMA_LL_EC_MDATAALIGN** This feature can be modified afterwards using unitary function `LL_DMA_SetMemorySize()`.
 - **`uint32_t LL_DMA_InitTypeDef::NbData`**
Specifies the number of data to transfer, in data unit. The data unit is equal to the source buffer configuration set in `PeriphSize` or `MemorySize` parameters depending in the transfer direction. This parameter must be a value between `Min_Data = 0` and `Max_Data = 0x0000FFFF` This feature can be modified afterwards using unitary function `LL_DMA_SetDataLength()`.
 - **`uint32_t LL_DMA_InitTypeDef::Channel`**
Specifies the peripheral channel. This parameter can be a value of **DMA_LL_EC_CHANNEL** This feature can be modified afterwards using unitary function `LL_DMA_SetChannelSelection()`.
 - **`uint32_t LL_DMA_InitTypeDef::Priority`**
Specifies the channel priority level. This parameter can be a value of **DMA_LL_EC_PRIORITY** This feature can be modified afterwards using unitary function `LL_DMA_SetStreamPriorityLevel()`.
 - **`uint32_t LL_DMA_InitTypeDef::FIFOMode`**
Specifies if the FIFO mode or Direct mode will be used for the specified stream. This parameter can be a value of **DMA_LL_FIFOMODE**
Note: The Direct mode (FIFO mode disabled) cannot be used if the memory-to-memory data transfer is configured on the selected stream This feature can be modified afterwards using unitary functions `LL_DMA_EnableFifoMode()` or `LL_DMA_EnableFifoMode()`.
 - **`uint32_t LL_DMA_InitTypeDef::FIFOThreshold`**
Specifies the FIFO threshold level. This parameter can be a value of **DMA_LL_EC_FIFOTHRESHOLD** This feature can be modified afterwards using unitary function `LL_DMA_SetFIFOThreshold()`.
 - **`uint32_t LL_DMA_InitTypeDef::MemBurst`**
Specifies the Burst transfer configuration for the memory transfers. It specifies the amount of data to be transferred in a single non interruptible transaction. This parameter can be a value of **DMA_LL_EC_MBURST**
Note: The burst mode is possible only if the address Increment mode is enabled. This feature can be modified afterwards using unitary function `LL_DMA_SetMemoryBurstxfer()`.
 - **`uint32_t LL_DMA_InitTypeDef::PeriphBurst`**
Specifies the Burst transfer configuration for the peripheral transfers. It specifies the amount of data to be transferred in a single non interruptible transaction. This parameter can be a value of **DMA_LL_EC_PBURST**
Note: The burst mode is possible only if the address Increment mode is enabled. This feature can be modified afterwards using unitary function `LL_DMA_SetPeriphBurstxfer()`.

77.2 DMA Firmware driver API description

77.2.1 Detailed description of functions

LL_DMA_EnableStream

Function name	__STATIC_INLINE void LL_DMA_EnableStream (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Enable DMA stream.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance• Stream: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_DMA_STREAM_0– LL_DMA_STREAM_1– LL_DMA_STREAM_2– LL_DMA_STREAM_3– LL_DMA_STREAM_4– LL_DMA_STREAM_5– LL_DMA_STREAM_6– LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR EN LL_DMA_EnableStream

LL_DMA_DisableStream

Function name	__STATIC_INLINE void LL_DMA_DisableStream (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Disable DMA stream.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance• Stream: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_DMA_STREAM_0– LL_DMA_STREAM_1– LL_DMA_STREAM_2– LL_DMA_STREAM_3– LL_DMA_STREAM_4– LL_DMA_STREAM_5– LL_DMA_STREAM_6– LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR EN LL_DMA_DisableStream

LL_DMA_IsEnabledStream

Function name	__STATIC_INLINE uint32_t LL_DMA_IsEnabledStream (DMA_TypeDef * DMAx, uint32_t Stream)
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Function description	Check if DMA stream is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR EN LL_DMA_IsEnabledStream

LL_DMA_ConfigTransfer

Function name	__STATIC_INLINE void LL_DMA_ConfigTransfer (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t Configuration)
Function description	Configure all parameters linked to DMA transfer.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7 • Configuration: This parameter must be a combination of all the following values: <ul style="list-style-type: none"> – LL_DMA_DIRECTION_PERIPH_TO_MEMORY or LL_DMA_DIRECTION_MEMORY_TO_PERIPH or LL_DMA_DIRECTION_MEMORY_TO_MEMORY – LL_DMA_MODE_NORMAL or LL_DMA_MODE_CIRCULAR or LL_DMA_MODE_PFCTRL – LL_DMA_PERIPH_INCREMENT or LL_DMA_PERIPH_NOINCREMENT – LL_DMA_MEMORY_INCREMENT or LL_DMA_MEMORY_NOINCREMENT – LL_DMA_PDATAALIGN_BYTE or LL_DMA_PDATAALIGN_HALFWORD or LL_DMA_PDATAALIGN_WORD – LL_DMA_MDATAALIGN_BYTE or LL_DMA_MDATAALIGN_HALFWORD or LL_DMA_MDATAALIGN_WORD – LL_DMA_PRIORITY_LOW or

LL_DMA_PRIORITY_MEDIUM or
LL_DMA_PRIORITY_HIGH or
LL_DMA_PRIORITY_VERYHIGH

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR DIR LL_DMA_ConfigTransfer
 - CR CIRC LL_DMA_ConfigTransfer
 - CR PINC LL_DMA_ConfigTransfer
 - CR MINC LL_DMA_ConfigTransfer
 - CR PSIZE LL_DMA_ConfigTransfer
 - CR MSIZE LL_DMA_ConfigTransfer
 - CR PL LL_DMA_ConfigTransfer
 - CR PFCTRL LL_DMA_ConfigTransfer

LL_DMA_SetDataTransferDirection

- Function name **__STATIC_INLINE void LL_DMA_SetDataTransferDirection (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t Direction)**
- Function description Set Data transfer direction (read from peripheral or from memory).
- Parameters
- **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7
 - **Direction:** This parameter can be one of the following values:
 - LL_DMA_DIRECTION_PERIPH_TO_MEMORY
 - LL_DMA_DIRECTION_MEMORY_TO_PERIPH
 - LL_DMA_DIRECTION_MEMORY_TO_MEMORY
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR DIR LL_DMA_SetDataTransferDirection

LL_DMA_GetDataTransferDirection

- Function name **__STATIC_INLINE uint32_t LL_DMA_GetDataTransferDirection (DMA_TypeDef * DMAx, uint32_t Stream)**
- Function description Get Data transfer direction (read from peripheral or from memory).
- Parameters
- **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2

	<ul style="list-style-type: none"> – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_DIRECTION_PERIPH_TO_MEMORY – LL_DMA_DIRECTION_MEMORY_TO_PERIPH – LL_DMA_DIRECTION_MEMORY_TO_MEMORY
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR DIR LL_DMA_GetDataTransferDirection

LL_DMA_SetMode

Function name	__STATIC_INLINE void LL_DMA_SetMode (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t Mode)
Function description	Set DMA mode normal, circular or peripheral flow control.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7 • Mode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_MODE_NORMAL – LL_DMA_MODE_CIRCULAR – LL_DMA_MODE_PFCTRL
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR CIRC LL_DMA_SetMode • CR PFCTRL LL_DMA_SetMode

LL_DMA_GetMode

Function name	__STATIC_INLINE uint32_t LL_DMA_GetMode (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Get DMA mode normal, circular or peripheral flow control.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4

	<ul style="list-style-type: none"> – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_MODE_NORMAL – LL_DMA_MODE_CIRCULAR – LL_DMA_MODE_PFCTRL
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR CIRC LL_DMA_GetMode • CR PFCTRL LL_DMA_GetMode

LL_DMA_SetPeriphIncMode

Function name	__STATIC_INLINE void LL_DMA_SetPeriphIncMode (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t IncrementMode)
Function description	Set Peripheral increment mode.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7 • IncrementMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_PERIPH_NOINCREMENT – LL_DMA_PERIPH_INCREMENT
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR PINC LL_DMA_SetPeriphIncMode

LL_DMA_GetPeriphIncMode

Function name	__STATIC_INLINE uint32_t LL_DMA_GetPeriphIncMode (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Get Peripheral increment mode.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5

- LL_DMA_STREAM_6
 - LL_DMA_STREAM_7
- Return values
- **Returned:** value can be one of the following values:
 - LL_DMA_PERIPH_NOINCREMENT
 - LL_DMA_PERIPH_INCREMENT
- Reference Manual to LL API cross reference:
- CR PINC LL_DMA_GetPeriphIncMode

LL_DMA_SetMemoryIncMode

- Function name **__STATIC_INLINE void LL_DMA_SetMemoryIncMode (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t IncrementMode)**
- Function description Set Memory increment mode.
- Parameters
- **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7
 - **IncrementMode:** This parameter can be one of the following values:
 - LL_DMA_MEMORY_NOINCREMENT
 - LL_DMA_MEMORY_INCREMENT
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR MINC LL_DMA_SetMemoryIncMode

LL_DMA_GetMemoryIncMode

- Function name **__STATIC_INLINE uint32_t LL_DMA_GetMemoryIncMode (DMA_TypeDef * DMAx, uint32_t Stream)**
- Function description Get Memory increment mode.
- Parameters
- **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7

- Return values
- **Returned:** value can be one of the following values:
 - LL_DMA_MEMORY_NOINCREMENT
 - LL_DMA_MEMORY_INCREMENT
- Reference Manual to LL API cross reference:
- CR MINC LL_DMA_GetMemoryIncMode

LL_DMA_SetPeriphSize

- Function name `__STATIC_INLINE void LL_DMA_SetPeriphSize (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t Size)`
- Function description Set Peripheral size.
- Parameters
- **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7
 - **Size:** This parameter can be one of the following values:
 - LL_DMA_PDATAALIGN_BYTE
 - LL_DMA_PDATAALIGN_HALFWORD
 - LL_DMA_PDATAALIGN_WORD
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR PSIZE LL_DMA_SetPeriphSize

LL_DMA_GetPeriphSize

- Function name `__STATIC_INLINE uint32_t LL_DMA_GetPeriphSize (DMA_TypeDef * DMAx, uint32_t Stream)`
- Function description Get Peripheral size.
- Parameters
- **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7
- Return values
- **Returned:** value can be one of the following values:
 - LL_DMA_PDATAALIGN_BYTE
 - LL_DMA_PDATAALIGN_HALFWORD

- LL_DMA_PDATAALIGN_WORD
 - CR PSIZE LL_DMA_GetPeriphSize
- Reference Manual to LL API cross reference:

LL_DMA_SetMemorySize

- Function name **__STATIC_INLINE void LL_DMA_SetMemorySize (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t Size)**
- Function description Set Memory size.
- Parameters
- **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7
 - **Size:** This parameter can be one of the following values:
 - LL_DMA_MDATAALIGN_BYTE
 - LL_DMA_MDATAALIGN_HALFWORD
 - LL_DMA_MDATAALIGN_WORD
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR MSIZE LL_DMA_SetMemorySize

LL_DMA_GetMemorySize

- Function name **__STATIC_INLINE uint32_t LL_DMA_GetMemorySize (DMA_TypeDef * DMAx, uint32_t Stream)**
- Function description Get Memory size.
- Parameters
- **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7
- Return values
- **Returned:** value can be one of the following values:
 - LL_DMA_MDATAALIGN_BYTE
 - LL_DMA_MDATAALIGN_HALFWORD
 - LL_DMA_MDATAALIGN_WORD

Reference Manual to LL API cross reference:

- CR MSIZE LL_DMA_GetMemorySize

LL_DMA_SetIncOffsetSize

Function name

__STATIC_INLINE void LL_DMA_SetIncOffsetSize (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t OffsetSize)

Function description

Set Peripheral increment offset size.

Parameters

- **DMAx:** DMAx Instance
- **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7
- **OffsetSize:** This parameter can be one of the following values:
 - LL_DMA_OFFSETSIZE_PSIZE
 - LL_DMA_OFFSETSIZE_FIXEDTO4

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR PINCOS LL_DMA_SetIncOffsetSize

LL_DMA_GetIncOffsetSize

Function name

__STATIC_INLINE uint32_t LL_DMA_GetIncOffsetSize (DMA_TypeDef * DMAx, uint32_t Stream)

Function description

Get Peripheral increment offset size.

Parameters

- **DMAx:** DMAx Instance
- **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7

Return values

- **Returned:** value can be one of the following values:
 - LL_DMA_OFFSETSIZE_PSIZE
 - LL_DMA_OFFSETSIZE_FIXEDTO4

Reference Manual to LL API cross reference:

- CR PINCOS LL_DMA_GetIncOffsetSize

LL_DMA_SetStreamPriorityLevel

Function name **__STATIC_INLINE void LL_DMA_SetStreamPriorityLevel (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t Priority)**

Function description Set Stream priority level.

Parameters

- **DMAx:** DMAx Instance
- **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7
- **Priority:** This parameter can be one of the following values:
 - LL_DMA_PRIORITY_LOW
 - LL_DMA_PRIORITY_MEDIUM
 - LL_DMA_PRIORITY_HIGH
 - LL_DMA_PRIORITY_VERYHIGH

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR PL LL_DMA_SetStreamPriorityLevel

LL_DMA_GetStreamPriorityLevel

Function name **__STATIC_INLINE uint32_t LL_DMA_GetStreamPriorityLevel (DMA_TypeDef * DMAx, uint32_t Stream)**

Function description Get Stream priority level.

Parameters

- **DMAx:** DMAx Instance
- **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7

Return values

- **Returned:** value can be one of the following values:
 - LL_DMA_PRIORITY_LOW
 - LL_DMA_PRIORITY_MEDIUM
 - LL_DMA_PRIORITY_HIGH
 - LL_DMA_PRIORITY_VERYHIGH

Reference Manual to LL API cross reference:

- CR PL LL_DMA_GetStreamPriorityLevel

LL_DMA_SetDataLength

Function name	__STATIC_INLINE void LL_DMA_SetDataLength (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t NbData)
Function description	Set Number of data to transfer.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7 • NbData: Between 0 to 0xFFFFFFFF
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This action has no effect if stream is enabled.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • NDTR NDT LL_DMA_SetDataLength

LL_DMA_GetDataLength

Function name	__STATIC_INLINE uint32_t LL_DMA_GetDataLength (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Get Number of data to transfer.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • Between: 0 to 0xFFFFFFFF
Notes	<ul style="list-style-type: none"> • Once the stream is enabled, the return value indicate the remaining bytes to be transmitted.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • NDTR NDT LL_DMA_GetDataLength

LL_DMA_SetChannelSelection

Function name	__STATIC_INLINE void LL_DMA_SetChannelSelection (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t Channel)
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Function description	Select Channel number associated to the Stream.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7 • Channel: This parameter can be one of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_DMA_CHANNEL_0 – LL_DMA_CHANNEL_1 – LL_DMA_CHANNEL_2 – LL_DMA_CHANNEL_3 – LL_DMA_CHANNEL_4 – LL_DMA_CHANNEL_5 – LL_DMA_CHANNEL_6 – LL_DMA_CHANNEL_7 – LL_DMA_CHANNEL_8 (*) – LL_DMA_CHANNEL_9 (*) – LL_DMA_CHANNEL_10 (*) – LL_DMA_CHANNEL_11 (*) – LL_DMA_CHANNEL_12 (*) – LL_DMA_CHANNEL_13 (*) – LL_DMA_CHANNEL_14 (*) – LL_DMA_CHANNEL_15 (*)
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR CHSEL LL_DMA_SetChannelSelection

LL_DMA_GetChannelSelection

Function name	__STATIC_INLINE uint32_t LL_DMA_GetChannelSelection (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Get the Channel number associated to the Stream.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7

Return values

- **Returned:** value can be one of the following values: (*)
value not defined in all devices.
 - LL_DMA_CHANNEL_0
 - LL_DMA_CHANNEL_1
 - LL_DMA_CHANNEL_2
 - LL_DMA_CHANNEL_3
 - LL_DMA_CHANNEL_4
 - LL_DMA_CHANNEL_5
 - LL_DMA_CHANNEL_6
 - LL_DMA_CHANNEL_7
 - LL_DMA_CHANNEL_8 (*)
 - LL_DMA_CHANNEL_9 (*)
 - LL_DMA_CHANNEL_10 (*)
 - LL_DMA_CHANNEL_11 (*)
 - LL_DMA_CHANNEL_12 (*)
 - LL_DMA_CHANNEL_13 (*)
 - LL_DMA_CHANNEL_14 (*)
 - LL_DMA_CHANNEL_15 (*)

Reference Manual to
LL API cross
reference:

- CR CHSEL LL_DMA_GetChannelSelection

LL_DMA_SetMemoryBurstxfer

Function name

**__STATIC_INLINE void LL_DMA_SetMemoryBurstxfer
(DMA_TypeDef * DMAx, uint32_t Stream, uint32_t Mburst)**

Function description

Set Memory burst transfer configuration.

Parameters

- **DMAx:** DMAx Instance
- **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7
- **Mburst:** This parameter can be one of the following values:
 - LL_DMA_MBURST_SINGLE
 - LL_DMA_MBURST_INC4
 - LL_DMA_MBURST_INC8
 - LL_DMA_MBURST_INC16

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- CR MBURST LL_DMA_SetMemoryBurstxfer

LL_DMA_GetMemoryBurstxfer

Function name

__STATIC_INLINE uint32_t LL_DMA_GetMemoryBurstxfer

(DMA_TypeDef * DMAx, uint32_t Stream)

Function description	Get Memory burst transfer configuration.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_MBURST_SINGLE – LL_DMA_MBURST_INC4 – LL_DMA_MBURST_INC8 – LL_DMA_MBURST_INC16
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR MBURST LL_DMA_GetMemoryBurstxfer

LL_DMA_SetPeriphBurstxfer

Function name	__STATIC_INLINE void LL_DMA_SetPeriphBurstxfer (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t Pburst)
Function description	Set Peripheral burst transfer configuration.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7 • Pburst: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_PBURST_SINGLE – LL_DMA_PBURST_INC4 – LL_DMA_PBURST_INC8 – LL_DMA_PBURST_INC16
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR PBURST LL_DMA_SetPeriphBurstxfer

LL_DMA_GetPeriphBurstxfer

Function name	__STATIC_INLINE uint32_t LL_DMA_GetPeriphBurstxfer
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(DMA_TypeDef * DMAx, uint32_t Stream)

Function description	Get Peripheral burst transfer configuration.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_PBURST_SINGLE – LL_DMA_PBURST_INC4 – LL_DMA_PBURST_INC8 – LL_DMA_PBURST_INC16
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR PBURST LL_DMA_GetPeriphBurstxfer

LL_DMA_SetCurrentTargetMem

Function name	__STATIC_INLINE void LL_DMA_SetCurrentTargetMem (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t CurrentMemory)
Function description	Set Current target (only in double buffer mode) to Memory 1 or Memory 0.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7 • CurrentMemory: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_CURRENTTARGETMEM0 – LL_DMA_CURRENTTARGETMEM1
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR CT LL_DMA_SetCurrentTargetMem

LL_DMA_GetCurrentTargetMem

Function name	__STATIC_INLINE uint32_t LL_DMA_GetCurrentTargetMem (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Set Current target (only in double buffer mode) to Memory 1 or Memory 0.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_CURRENTTARGETMEM0 – LL_DMA_CURRENTTARGETMEM1
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR CT LL_DMA_GetCurrentTargetMem

LL_DMA_EnableDoubleBufferMode

Function name	__STATIC_INLINE void LL_DMA_EnableDoubleBufferMode (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Enable the double buffer mode.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR DBM LL_DMA_EnableDoubleBufferMode

LL_DMA_DisableDoubleBufferMode

Function name	__STATIC_INLINE void LL_DMA_DisableDoubleBufferMode (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Disable the double buffer mode.

Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR DBM LL_DMA_DisableDoubleBufferMode

LL_DMA_GetFIFOStatus

Function name	__STATIC_INLINE uint32_t LL_DMA_GetFIFOStatus (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Get FIFO status.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_FIFOSTATUS_0_25 – LL_DMA_FIFOSTATUS_25_50 – LL_DMA_FIFOSTATUS_50_75 – LL_DMA_FIFOSTATUS_75_100 – LL_DMA_FIFOSTATUS_EMPTY – LL_DMA_FIFOSTATUS_FULL
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FCR FS LL_DMA_GetFIFOStatus

LL_DMA_DisableFifoMode

Function name	__STATIC_INLINE void LL_DMA_DisableFifoMode (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Disable Fifo mode.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0

- LL_DMA_STREAM_1
- LL_DMA_STREAM_2
- LL_DMA_STREAM_3
- LL_DMA_STREAM_4
- LL_DMA_STREAM_5
- LL_DMA_STREAM_6
- LL_DMA_STREAM_7

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- FCR DMDIS LL_DMA_DisableFifoMode

LL_DMA_EnableFifoMode

Function name

**__STATIC_INLINE void LL_DMA_EnableFifoMode
(DMA_TypeDef * DMAx, uint32_t Stream)**

Function description

Enable Fifo mode.

Parameters

- **DMAx:** DMAx Instance
- **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- FCR DMDIS LL_DMA_EnableFifoMode

LL_DMA_SetFIFOThreshold

Function name

**__STATIC_INLINE void LL_DMA_SetFIFOThreshold
(DMA_TypeDef * DMAx, uint32_t Stream, uint32_t Threshold)**

Function description

Select FIFO threshold.

Parameters

- **DMAx:** DMAx Instance
- **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7
- **Threshold:** This parameter can be one of the following values:

- LL_DMA_FIFOTHRESHOLD_1_4
- LL_DMA_FIFOTHRESHOLD_1_2
- LL_DMA_FIFOTHRESHOLD_3_4
- LL_DMA_FIFOTHRESHOLD_FULL

Return values

- **None:**

Reference Manual to LL API cross reference:

- FCR FTH LL_DMA_SetFIFOThreshold

LL_DMA_GetFIFOThreshold

Function name **__STATIC_INLINE uint32_t LL_DMA_GetFIFOThreshold (DMA_TypeDef * DMAx, uint32_t Stream)**

Function description Get FIFO threshold.

Parameters

- **DMAx:** DMAx Instance
- **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7

Return values

- **Returned:** value can be one of the following values:
 - LL_DMA_FIFOTHRESHOLD_1_4
 - LL_DMA_FIFOTHRESHOLD_1_2
 - LL_DMA_FIFOTHRESHOLD_3_4
 - LL_DMA_FIFOTHRESHOLD_FULL

Reference Manual to LL API cross reference:

- FCR FTH LL_DMA_GetFIFOThreshold

LL_DMA_ConfigFifo

Function name **__STATIC_INLINE void LL_DMA_ConfigFifo (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t FifoMode, uint32_t FifoThreshold)**

Function description Configure the FIFO .

Parameters

- **DMAx:** DMAx Instance
- **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7

- **FifoMode:** This parameter can be one of the following values:
 - LL_DMA_FIFOMODE_ENABLE
 - LL_DMA_FIFOMODE_DISABLE
 - **FifoThreshold:** This parameter can be one of the following values:
 - LL_DMA_FIFOTHRESHOLD_1_4
 - LL_DMA_FIFOTHRESHOLD_1_2
 - LL_DMA_FIFOTHRESHOLD_3_4
 - LL_DMA_FIFOTHRESHOLD_FULL
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- FCR FTH LL_DMA_ConfigFifo
 - FCR DMDIS LL_DMA_ConfigFifo

LL_DMA_ConfigAddresses

- Function name **__STATIC_INLINE void LL_DMA_ConfigAddresses (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t SrcAddress, uint32_t DstAddress, uint32_t Direction)**
- Function description Configure the Source and Destination addresses.
- Parameters
- **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7
 - **SrcAddress:** Between 0 to 0xFFFFFFFF
 - **DstAddress:** Between 0 to 0xFFFFFFFF
 - **Direction:** This parameter can be one of the following values:
 - LL_DMA_DIRECTION_PERIPH_TO_MEMORY
 - LL_DMA_DIRECTION_MEMORY_TO_PERIPH
 - LL_DMA_DIRECTION_MEMORY_TO_MEMORY
- Return values
- **None:**
- Notes
- This API must not be called when the DMA stream is enabled.
- Reference Manual to LL API cross reference:
- M0AR M0A LL_DMA_ConfigAddresses
 - PAR PA LL_DMA_ConfigAddresses

LL_DMA_SetMemoryAddress

- Function name **__STATIC_INLINE void LL_DMA_SetMemoryAddress (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t MemoryAddress)**

Function description	Set the Memory address.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7 • MemoryAddress: Between 0 to 0xFFFFFFFF
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Interface used for direction LL_DMA_DIRECTION_PERIPH_TO_MEMORY or LL_DMA_DIRECTION_MEMORY_TO_PERIPH only. • This API must not be called when the DMA channel is enabled.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • M0AR M0A LL_DMA_SetMemoryAddress

LL_DMA_SetPeriphAddress

Function name	__STATIC_INLINE void LL_DMA_SetPeriphAddress (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t PeriphAddress)
Function description	Set the Peripheral address.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7 • PeriphAddress: Between 0 to 0xFFFFFFFF
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Interface used for direction LL_DMA_DIRECTION_PERIPH_TO_MEMORY or LL_DMA_DIRECTION_MEMORY_TO_PERIPH only. • This API must not be called when the DMA channel is enabled.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PAR PA LL_DMA_SetPeriphAddress

LL_DMA_GetMemoryAddress

Function name	__STATIC_INLINE uint32_t LL_DMA_GetMemoryAddress (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Get the Memory address.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • Between: 0 to 0xFFFFFFFF
Notes	<ul style="list-style-type: none"> • Interface used for direction LL_DMA_DIRECTION_PERIPH_TO_MEMORY or LL_DMA_DIRECTION_MEMORY_TO_PERIPH only.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • M0AR M0A LL_DMA_GetMemoryAddress

LL_DMA_GetPeriphAddress

Function name	__STATIC_INLINE uint32_t LL_DMA_GetPeriphAddress (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Get the Peripheral address.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • Between: 0 to 0xFFFFFFFF
Notes	<ul style="list-style-type: none"> • Interface used for direction LL_DMA_DIRECTION_PERIPH_TO_MEMORY or LL_DMA_DIRECTION_MEMORY_TO_PERIPH only.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PAR PA LL_DMA_GetPeriphAddress

LL_DMA_SetM2MSrcAddress

Function name	__STATIC_INLINE void LL_DMA_SetM2MSrcAddress (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t MemoryAddress)
Function description	Set the Memory to Memory Source address.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7 • MemoryAddress: Between 0 to 0xFFFFFFFF
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Interface used for direction LL_DMA_DIRECTION_MEMORY_TO_MEMORY only. • This API must not be called when the DMA channel is enabled.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PAR PA LL_DMA_SetM2MSrcAddress

LL_DMA_SetM2MDstAddress

Function name	__STATIC_INLINE void LL_DMA_SetM2MDstAddress (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t MemoryAddress)
Function description	Set the Memory to Memory Destination address.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7 • MemoryAddress: Between 0 to 0xFFFFFFFF
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Interface used for direction LL_DMA_DIRECTION_MEMORY_TO_MEMORY only. • This API must not be called when the DMA channel is enabled.

Reference Manual to LL API cross reference:

- M0AR M0A LL_DMA_SetM2MDstAddress

LL_DMA_GetM2MSrcAddress

Function name `__STATIC_INLINE uint32_t LL_DMA_GetM2MSrcAddress (DMA_TypeDef * DMAx, uint32_t Stream)`

Function description Get the Memory to Memory Source address.

Parameters

- **DMAx:** DMAx Instance
- **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7

Return values

- **Between:** 0 to 0xFFFFFFFF

Notes

- Interface used for direction LL_DMA_DIRECTION_MEMORY_TO_MEMORY only.

Reference Manual to LL API cross reference:

- PAR PA LL_DMA_GetM2MSrcAddress

LL_DMA_GetM2MDstAddress

Function name `__STATIC_INLINE uint32_t LL_DMA_GetM2MDstAddress (DMA_TypeDef * DMAx, uint32_t Stream)`

Function description Get the Memory to Memory Destination address.

Parameters

- **DMAx:** DMAx Instance
- **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7

Return values

- **Between:** 0 to 0xFFFFFFFF

Notes

- Interface used for direction LL_DMA_DIRECTION_MEMORY_TO_MEMORY only.

Reference Manual to LL API cross reference:

- M0AR M0A LL_DMA_GetM2MDstAddress

LL_DMA_SetMemory1Address

Function name	__STATIC_INLINE void LL_DMA_SetMemory1Address (DMA_TypeDef * DMAx, uint32_t Stream, uint32_t Address)
Function description	Set Memory 1 address (used in case of Double buffer mode).
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance• Stream: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_DMA_STREAM_0– LL_DMA_STREAM_1– LL_DMA_STREAM_2– LL_DMA_STREAM_3– LL_DMA_STREAM_4– LL_DMA_STREAM_5– LL_DMA_STREAM_6– LL_DMA_STREAM_7• Address: Between 0 to 0xFFFFFFFF
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• M1AR M1A LL_DMA_SetMemory1Address

LL_DMA_GetMemory1Address

Function name	__STATIC_INLINE uint32_t LL_DMA_GetMemory1Address (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Get Memory 1 address (used in case of Double buffer mode).
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance• Stream: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_DMA_STREAM_0– LL_DMA_STREAM_1– LL_DMA_STREAM_2– LL_DMA_STREAM_3– LL_DMA_STREAM_4– LL_DMA_STREAM_5– LL_DMA_STREAM_6– LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none">• Between: 0 to 0xFFFFFFFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• M1AR M1A LL_DMA_GetMemory1Address

LL_DMA_IsActiveFlag_HT0

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT0 (DMA_TypeDef * DMAx)
Function description	Get Stream 0 half transfer flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).

Reference Manual to LL API cross reference:

- LISR HTIF0 LL_DMA_IsActiveFlag_HT0

LL_DMA_IsActiveFlag_HT1

Function name **__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT1 (DMA_TypeDef * DMAx)**

Function description Get Stream 1 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- LISR HTIF1 LL_DMA_IsActiveFlag_HT1

LL_DMA_IsActiveFlag_HT2

Function name **__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT2 (DMA_TypeDef * DMAx)**

Function description Get Stream 2 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- LISR HTIF2 LL_DMA_IsActiveFlag_HT2

LL_DMA_IsActiveFlag_HT3

Function name **__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT3 (DMA_TypeDef * DMAx)**

Function description Get Stream 3 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- LISR HTIF3 LL_DMA_IsActiveFlag_HT3

LL_DMA_IsActiveFlag_HT4

Function name **__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT4 (DMA_TypeDef * DMAx)**

Function description Get Stream 4 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross

- HISR HTIF4 LL_DMA_IsActiveFlag_HT4

reference:

LL_DMA_IsActiveFlag_HT5

Function name `__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT5 (DMA_TypeDef * DMAx)`

Function description Get Stream 5 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- HISR HTIF0 LL_DMA_IsActiveFlag_HT5

LL_DMA_IsActiveFlag_HT6

Function name `__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT6 (DMA_TypeDef * DMAx)`

Function description Get Stream 6 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- HISR HTIF6 LL_DMA_IsActiveFlag_HT6

LL_DMA_IsActiveFlag_HT7

Function name `__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT7 (DMA_TypeDef * DMAx)`

Function description Get Stream 7 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- HISR HTIF7 LL_DMA_IsActiveFlag_HT7

LL_DMA_IsActiveFlag_TC0

Function name `__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC0 (DMA_TypeDef * DMAx)`

Function description Get Stream 0 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- LISR TCIF0 LL_DMA_IsActiveFlag_TC0

LL_DMA_IsActiveFlag_TC1

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC1 (DMA_TypeDef * DMAx)
Function description	Get Stream 1 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR TCIF1 LL_DMA_IsActiveFlag_TC1

LL_DMA_IsActiveFlag_TC2

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC2 (DMA_TypeDef * DMAx)
Function description	Get Stream 2 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR TCIF2 LL_DMA_IsActiveFlag_TC2

LL_DMA_IsActiveFlag_TC3

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC3 (DMA_TypeDef * DMAx)
Function description	Get Stream 3 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR TCIF3 LL_DMA_IsActiveFlag_TC3

LL_DMA_IsActiveFlag_TC4

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC4 (DMA_TypeDef * DMAx)
Function description	Get Stream 4 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR TCIF4 LL_DMA_IsActiveFlag_TC4

LL_DMA_IsActiveFlag_TC5

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC5 (DMA_TypeDef * DMAx)
Function description	Get Stream 5 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR TCIF0 LL_DMA_IsActiveFlag_TC5

LL_DMA_IsActiveFlag_TC6

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC6 (DMA_TypeDef * DMAx)
Function description	Get Stream 6 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR TCIF6 LL_DMA_IsActiveFlag_TC6

LL_DMA_IsActiveFlag_TC7

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC7 (DMA_TypeDef * DMAx)
Function description	Get Stream 7 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR TCIF7 LL_DMA_IsActiveFlag_TC7

LL_DMA_IsActiveFlag_TE0

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE0 (DMA_TypeDef * DMAx)
Function description	Get Stream 0 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR TEIF0 LL_DMA_IsActiveFlag_TE0

LL_DMA_IsActiveFlag_TE1

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE1 (DMA_TypeDef * DMAx)
Function description	Get Stream 1 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR TEIF1 LL_DMA_IsActiveFlag_TE1

LL_DMA_IsActiveFlag_TE2

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE2 (DMA_TypeDef * DMAx)
Function description	Get Stream 2 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR TEIF2 LL_DMA_IsActiveFlag_TE2

LL_DMA_IsActiveFlag_TE3

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE3 (DMA_TypeDef * DMAx)
Function description	Get Stream 3 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR TEIF3 LL_DMA_IsActiveFlag_TE3

LL_DMA_IsActiveFlag_TE4

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE4 (DMA_TypeDef * DMAx)
Function description	Get Stream 4 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR TEIF4 LL_DMA_IsActiveFlag_TE4

LL_DMA_IsActiveFlag_TE5

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE5 (DMA_TypeDef * DMAx)
Function description	Get Stream 5 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR TEIF0 LL_DMA_IsActiveFlag_TE5

LL_DMA_IsActiveFlag_TE6

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE6 (DMA_TypeDef * DMAx)
Function description	Get Stream 6 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR TEIF6 LL_DMA_IsActiveFlag_TE6

LL_DMA_IsActiveFlag_TE7

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE7 (DMA_TypeDef * DMAx)
Function description	Get Stream 7 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR TEIF7 LL_DMA_IsActiveFlag_TE7

LL_DMA_IsActiveFlag_DME0

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_DME0 (DMA_TypeDef * DMAx)
Function description	Get Stream 0 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR DMEIF0 LL_DMA_IsActiveFlag_DME0

LL_DMA_IsActiveFlag_DME1

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_DME1 (DMA_TypeDef * DMAx)
Function description	Get Stream 1 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR DMEIF1 LL_DMA_IsActiveFlag_DME1

LL_DMA_IsActiveFlag_DME2

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_DME2 (DMA_TypeDef * DMAx)
Function description	Get Stream 2 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR DMEIF2 LL_DMA_IsActiveFlag_DME2

LL_DMA_IsActiveFlag_DME3

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_DME3 (DMA_TypeDef * DMAx)
Function description	Get Stream 3 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR DMEIF3 LL_DMA_IsActiveFlag_DME3

LL_DMA_IsActiveFlag_DME4

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_DME4 (DMA_TypeDef * DMAx)
Function description	Get Stream 4 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR DMEIF4 LL_DMA_IsActiveFlag_DME4

LL_DMA_IsActiveFlag_DME5

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_DME5 (DMA_TypeDef * DMAx)
Function description	Get Stream 5 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR DMEIF0 LL_DMA_IsActiveFlag_DME5

LL_DMA_IsActiveFlag_DME6

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_DME6 (DMA_TypeDef * DMAx)
Function description	Get Stream 6 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR DMEIF6 LL_DMA_IsActiveFlag_DME6

LL_DMA_IsActiveFlag_DME7

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_DME7 (DMA_TypeDef * DMAx)
Function description	Get Stream 7 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR DMEIF7 LL_DMA_IsActiveFlag_DME7

LL_DMA_IsActiveFlag_FE0

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_FE0 (DMA_TypeDef * DMAx)
Function description	Get Stream 0 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR FEIF0 LL_DMA_IsActiveFlag_FE0

LL_DMA_IsActiveFlag_FE1

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_FE1 (DMA_TypeDef * DMAx)
Function description	Get Stream 1 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR FEIF1 LL_DMA_IsActiveFlag_FE1

LL_DMA_IsActiveFlag_FE2

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_FE2 (DMA_TypeDef * DMAx)
Function description	Get Stream 2 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR FEIF2 LL_DMA_IsActiveFlag_FE2

LL_DMA_IsActiveFlag_FE3

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_FE3 (DMA_TypeDef * DMAx)
Function description	Get Stream 3 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LISR FEIF3 LL_DMA_IsActiveFlag_FE3

LL_DMA_IsActiveFlag_FE4

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_FE4 (DMA_TypeDef * DMAx)
Function description	Get Stream 4 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR FEIF4 LL_DMA_IsActiveFlag_FE4

LL_DMA_IsActiveFlag_FE5

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_FE5 (DMA_TypeDef * DMAx)
Function description	Get Stream 5 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR FEIF0 LL_DMA_IsActiveFlag_FE5

LL_DMA_IsActiveFlag_FE6

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_FE6 (DMA_TypeDef * DMAx)
Function description	Get Stream 6 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR FEIF6 LL_DMA_IsActiveFlag_FE6

LL_DMA_IsActiveFlag_FE7

Function name	__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_FE7 (DMA_TypeDef * DMAx)
Function description	Get Stream 7 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HISR FEIF7 LL_DMA_IsActiveFlag_FE7

LL_DMA_ClearFlag_HT0

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_HT0 (DMA_TypeDef * DMAx)
Function description	Clear Stream 0 half transfer flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CHTIF0 LL_DMA_ClearFlag_HT0

LL_DMA_ClearFlag_HT1

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_HT1 (DMA_TypeDef * DMAx)
Function description	Clear Stream 1 half transfer flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CHTIF1 LL_DMA_ClearFlag_HT1

LL_DMA_ClearFlag_HT2

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_HT2 (DMA_TypeDef * DMAx)
Function description	Clear Stream 2 half transfer flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CHTIF2 LL_DMA_ClearFlag_HT2

LL_DMA_ClearFlag_HT3

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_HT3 (DMA_TypeDef * DMAx)
Function description	Clear Stream 3 half transfer flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CHTIF3 LL_DMA_ClearFlag_HT3

LL_DMA_ClearFlag_HT4

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_HT4 (DMA_TypeDef * DMAx)
Function description	Clear Stream 4 half transfer flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CHTIF4 LL_DMA_ClearFlag_HT4

LL_DMA_ClearFlag_HT5

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_HT5 (DMA_TypeDef * DMAx)
Function description	Clear Stream 5 half transfer flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CHTIF5 LL_DMA_ClearFlag_HT5

LL_DMA_ClearFlag_HT6

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_HT6 (DMA_TypeDef * DMAx)
Function description	Clear Stream 6 half transfer flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CHTIF6 LL_DMA_ClearFlag_HT6

LL_DMA_ClearFlag_HT7

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_HT7 (DMA_TypeDef * DMAx)
Function description	Clear Stream 7 half transfer flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CHTIF7 LL_DMA_ClearFlag_HT7

LL_DMA_ClearFlag_TC0

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TC0 (DMA_TypeDef * DMAx)
Function description	Clear Stream 0 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CTCIF0 LL_DMA_ClearFlag_TC0

LL_DMA_ClearFlag_TC1

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TC1 (DMA_TypeDef * DMAx)
Function description	Clear Stream 1 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CTCIF1 LL_DMA_ClearFlag_TC1

LL_DMA_ClearFlag_TC2

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TC2 (DMA_TypeDef * DMAx)
Function description	Clear Stream 2 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CTCIF2 LL_DMA_ClearFlag_TC2

LL_DMA_ClearFlag_TC3

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TC3 (DMA_TypeDef * DMAx)
Function description	Clear Stream 3 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CTCIF3 LL_DMA_ClearFlag_TC3

LL_DMA_ClearFlag_TC4

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TC4 (DMA_TypeDef * DMAx)
Function description	Clear Stream 4 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CTCIF4 LL_DMA_ClearFlag_TC4

LL_DMA_ClearFlag_TC5

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TC5 (DMA_TypeDef * DMAx)
Function description	Clear Stream 5 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CTCIF5 LL_DMA_ClearFlag_TC5

LL_DMA_ClearFlag_TC6

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TC6 (DMA_TypeDef * DMAx)
Function description	Clear Stream 6 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CTCIF6 LL_DMA_ClearFlag_TC6

LL_DMA_ClearFlag_TC7

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TC7 (DMA_TypeDef * DMAx)
Function description	Clear Stream 7 transfer complete flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CTCIF7 LL_DMA_ClearFlag_TC7

LL_DMA_ClearFlag_TE0

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TE0 (DMA_TypeDef * DMAx)
Function description	Clear Stream 0 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CTEIF0 LL_DMA_ClearFlag_TE0

LL_DMA_ClearFlag_TE1

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TE1 (DMA_TypeDef * DMAx)
Function description	Clear Stream 1 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CTEIF1 LL_DMA_ClearFlag_TE1

LL_DMA_ClearFlag_TE2

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TE2 (DMA_TypeDef * DMAx)
Function description	Clear Stream 2 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CTEIF2 LL_DMA_ClearFlag_TE2

LL_DMA_ClearFlag_TE3

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TE3 (DMA_TypeDef * DMAx)
Function description	Clear Stream 3 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CTEIF3 LL_DMA_ClearFlag_TE3

LL_DMA_ClearFlag_TE4

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TE4 (DMA_TypeDef * DMAx)
Function description	Clear Stream 4 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CTEIF4 LL_DMA_ClearFlag_TE4

LL_DMA_ClearFlag_TE5

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TE5 (DMA_TypeDef * DMAx)
Function description	Clear Stream 5 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CTEIF5 LL_DMA_ClearFlag_TE5

LL_DMA_ClearFlag_TE6

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TE6 (DMA_TypeDef * DMAx)
Function description	Clear Stream 6 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CTEIF6 LL_DMA_ClearFlag_TE6

LL_DMA_ClearFlag_TE7

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_TE7 (DMA_TypeDef * DMAx)
Function description	Clear Stream 7 transfer error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CTEIF7 LL_DMA_ClearFlag_TE7

LL_DMA_ClearFlag_DME0

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_DME0 (DMA_TypeDef * DMAx)
Function description	Clear Stream 0 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CDMEIF0 LL_DMA_ClearFlag_DME0

LL_DMA_ClearFlag_DME1

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_DME1 (DMA_TypeDef * DMAx)
Function description	Clear Stream 1 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CDMEIF1 LL_DMA_ClearFlag_DME1

LL_DMA_ClearFlag_DME2

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_DME2 (DMA_TypeDef * DMAx)
Function description	Clear Stream 2 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CDMEIF2 LL_DMA_ClearFlag_DME2

LL_DMA_ClearFlag_DME3

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_DME3 (DMA_TypeDef * DMAx)
Function description	Clear Stream 3 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CDMEIF3 LL_DMA_ClearFlag_DME3

LL_DMA_ClearFlag_DME4

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_DME4 (DMA_TypeDef * DMAx)
Function description	Clear Stream 4 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CDMEIF4 LL_DMA_ClearFlag_DME4

LL_DMA_ClearFlag_DME5

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_DME5 (DMA_TypeDef * DMAx)
Function description	Clear Stream 5 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CDMEIF5 LL_DMA_ClearFlag_DME5

LL_DMA_ClearFlag_DME6

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_DME6 (DMA_TypeDef * DMAx)
Function description	Clear Stream 6 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CDMEIF6 LL_DMA_ClearFlag_DME6

LL_DMA_ClearFlag_DME7

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_DME7 (DMA_TypeDef * DMAx)
Function description	Clear Stream 7 direct mode error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CDMEIF7 LL_DMA_ClearFlag_DME7

LL_DMA_ClearFlag_FE0

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_FE0 (DMA_TypeDef * DMAx)
Function description	Clear Stream 0 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CFEIF0 LL_DMA_ClearFlag_FE0

LL_DMA_ClearFlag_FE1

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_FE1 (DMA_TypeDef * DMAx)
Function description	Clear Stream 1 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CFEIF1 LL_DMA_ClearFlag_FE1

LL_DMA_ClearFlag_FE2

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_FE2 (DMA_TypeDef * DMAx)
Function description	Clear Stream 2 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CFEIF2 LL_DMA_ClearFlag_FE2

LL_DMA_ClearFlag_FE3

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_FE3 (DMA_TypeDef * DMAx)
Function description	Clear Stream 3 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• LIFCR CFEIF3 LL_DMA_ClearFlag_FE3

LL_DMA_ClearFlag_FE4

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_FE4 (DMA_TypeDef * DMAx)
Function description	Clear Stream 4 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CFEIF4 LL_DMA_ClearFlag_FE4

LL_DMA_ClearFlag_FE5

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_FE5 (DMA_TypeDef * DMAx)
Function description	Clear Stream 5 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CFEIF5 LL_DMA_ClearFlag_FE5

LL_DMA_ClearFlag_FE6

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_FE6 (DMA_TypeDef * DMAx)
Function description	Clear Stream 6 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CFEIF6 LL_DMA_ClearFlag_FE6

LL_DMA_ClearFlag_FE7

Function name	__STATIC_INLINE void LL_DMA_ClearFlag_FE7 (DMA_TypeDef * DMAx)
Function description	Clear Stream 7 FIFO error flag.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• HIFCR CFEIF7 LL_DMA_ClearFlag_FE7

LL_DMA_EnableIT_HT

Function name	__STATIC_INLINE void LL_DMA_EnableIT_HT (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Enable Half transfer interrupt.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance• Stream: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_DMA_STREAM_0– LL_DMA_STREAM_1– LL_DMA_STREAM_2– LL_DMA_STREAM_3– LL_DMA_STREAM_4– LL_DMA_STREAM_5– LL_DMA_STREAM_6

- LL_DMA_STREAM_7
- Return values
 - **None:**
- Reference Manual to LL API cross reference:
 - CR HTIE LL_DMA_EnableIT_HT

LL_DMA_EnableIT_TE

- Function name **__STATIC_INLINE void LL_DMA_EnableIT_TE (DMA_TypeDef *DMAx, uint32_t Stream)**
- Function description Enable Transfer error interrupt.
- Parameters
 - **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7
- Return values
 - **None:**
- Reference Manual to LL API cross reference:
 - CR TEIE LL_DMA_EnableIT_TE

LL_DMA_EnableIT_TC

- Function name **__STATIC_INLINE void LL_DMA_EnableIT_TC (DMA_TypeDef *DMAx, uint32_t Stream)**
- Function description Enable Transfer complete interrupt.
- Parameters
 - **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7
- Return values
 - **None:**
- Reference Manual to LL API cross reference:
 - CR TCIE LL_DMA_EnableIT_TC

LL_DMA_EnableIT_DME

Function name	__STATIC_INLINE void LL_DMA_EnableIT_DME (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Enable Direct mode error interrupt.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance• Stream: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_DMA_STREAM_0– LL_DMA_STREAM_1– LL_DMA_STREAM_2– LL_DMA_STREAM_3– LL_DMA_STREAM_4– LL_DMA_STREAM_5– LL_DMA_STREAM_6– LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR DMEIE LL_DMA_EnableIT_DME

LL_DMA_EnableIT_FE

Function name	__STATIC_INLINE void LL_DMA_EnableIT_FE (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Enable FIFO error interrupt.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance• Stream: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_DMA_STREAM_0– LL_DMA_STREAM_1– LL_DMA_STREAM_2– LL_DMA_STREAM_3– LL_DMA_STREAM_4– LL_DMA_STREAM_5– LL_DMA_STREAM_6– LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• FCR FEIE LL_DMA_EnableIT_FE

LL_DMA_DisableIT_HT

Function name	__STATIC_INLINE void LL_DMA_DisableIT_HT (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Disable Half transfer interrupt.
Parameters	<ul style="list-style-type: none">• DMAx: DMAx Instance• Stream: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_DMA_STREAM_0– LL_DMA_STREAM_1

- LL_DMA_STREAM_2
- LL_DMA_STREAM_3
- LL_DMA_STREAM_4
- LL_DMA_STREAM_5
- LL_DMA_STREAM_6
- LL_DMA_STREAM_7

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR HTIE LL_DMA_DisableIT_HT

LL_DMA_DisableIT_TE

Function name **__STATIC_INLINE void LL_DMA_DisableIT_TE (DMA_TypeDef *DMAx, uint32_t Stream)**

Function description Disable Transfer error interrupt.

- Parameters
- **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR TEIE LL_DMA_DisableIT_TE

LL_DMA_DisableIT_TC

Function name **__STATIC_INLINE void LL_DMA_DisableIT_TC (DMA_TypeDef *DMAx, uint32_t Stream)**

Function description Disable Transfer complete interrupt.

- Parameters
- **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7

- Return values
- **None:**
- Reference Manual to
- CR TCIE LL_DMA_DisableIT_TC

LL API cross
reference:

LL_DMA_DisableIT_DME

Function name	__STATIC_INLINE void LL_DMA_DisableIT_DME (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Disable Direct mode error interrupt.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR DMEIE LL_DMA_DisableIT_DME

LL_DMA_DisableIT_FE

Function name	__STATIC_INLINE void LL_DMA_DisableIT_FE (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Disable FIFO error interrupt.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FCR FEIE LL_DMA_DisableIT_FE

LL_DMA_IsEnabledIT_HT

Function name	__STATIC_INLINE uint32_t LL_DMA_IsEnabledIT_HT (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Check if Half transfer interrupt is enabled.

Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR HTIE LL_DMA_IsEnabledIT_HT

LL_DMA_IsEnabledIT_TE

Function name	__STATIC_INLINE uint32_t LL_DMA_IsEnabledIT_TE (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Check if Transfer error interrupt is enabled.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR TEIE LL_DMA_IsEnabledIT_TE

LL_DMA_IsEnabledIT_TC

Function name	__STATIC_INLINE uint32_t LL_DMA_IsEnabledIT_TC (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	Check if Transfer complete interrupt is enabled.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6

- LL_DMA_STREAM_7

- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- CR TCIE LL_DMA_IsEnabledIT_TC

LL_DMA_IsEnabledIT_DME

Function name **__STATIC_INLINE uint32_t LL_DMA_IsEnabledIT_DME (DMA_TypeDef * DMAx, uint32_t Stream)**

Function description Check if Direct mode error interrupt is enabled.

- Parameters
- **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7

- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- CR DMEIE LL_DMA_IsEnabledIT_DME

LL_DMA_IsEnabledIT_FE

Function name **__STATIC_INLINE uint32_t LL_DMA_IsEnabledIT_FE (DMA_TypeDef * DMAx, uint32_t Stream)**

Function description Check if FIFO error interrupt is enabled.

- Parameters
- **DMAx:** DMAx Instance
 - **Stream:** This parameter can be one of the following values:
 - LL_DMA_STREAM_0
 - LL_DMA_STREAM_1
 - LL_DMA_STREAM_2
 - LL_DMA_STREAM_3
 - LL_DMA_STREAM_4
 - LL_DMA_STREAM_5
 - LL_DMA_STREAM_6
 - LL_DMA_STREAM_7

- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- FCR FEIE LL_DMA_IsEnabledIT_FE

LL_DMA_Init

Function name	uint32_t LL_DMA_Init (DMA_TypeDef * DMAx, uint32_t Stream, LL_DMA_InitTypeDef * DMA_InitStruct)
Function description	Initialize the DMA registers according to the specified parameters in DMA_InitStruct.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7 • DMA_InitStruct: pointer to a LL_DMA_InitTypeDef structure.
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: DMA registers are initialized – ERROR: Not applicable
Notes	<ul style="list-style-type: none"> • To convert DMAx_Streamy Instance to DMAx Instance and Streamy, use helper macros : <code>__LL_DMA_GET_INSTANCE</code> <code>__LL_DMA_GET_STREAM</code>

LL_DMA_DeInit

Function name	uint32_t LL_DMA_DeInit (DMA_TypeDef * DMAx, uint32_t Stream)
Function description	De-initialize the DMA registers to their default reset values.
Parameters	<ul style="list-style-type: none"> • DMAx: DMAx Instance • Stream: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_DMA_STREAM_0 – LL_DMA_STREAM_1 – LL_DMA_STREAM_2 – LL_DMA_STREAM_3 – LL_DMA_STREAM_4 – LL_DMA_STREAM_5 – LL_DMA_STREAM_6 – LL_DMA_STREAM_7 – LL_DMA_STREAM_ALL
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: DMA registers are de-initialized – ERROR: DMA registers are not de-initialized

LL_DMA_StructInit

Function name	void LL_DMA_StructInit (LL_DMA_InitTypeDef * DMA_InitStruct)
Function description	Set each LL_DMA_InitTypeDef field to default value.

Parameters	<ul style="list-style-type: none"> • DMA_InitStruct: Pointer to a LL_DMA_InitTypeDef structure.
Return values	<ul style="list-style-type: none"> • None:

77.3 DMA Firmware driver defines

77.3.1 DMA

CHANNEL

LL_DMA_CHANNEL_0

LL_DMA_CHANNEL_1

LL_DMA_CHANNEL_2

LL_DMA_CHANNEL_3

LL_DMA_CHANNEL_4

LL_DMA_CHANNEL_5

LL_DMA_CHANNEL_6

LL_DMA_CHANNEL_7

LL_DMA_CHANNEL_8

LL_DMA_CHANNEL_9

LL_DMA_CHANNEL_10

LL_DMA_CHANNEL_11

LL_DMA_CHANNEL_12

LL_DMA_CHANNEL_13

LL_DMA_CHANNEL_14

LL_DMA_CHANNEL_15

CURRENTTARGETMEM

LL_DMA_CURRENTTARGETMEM0 Set CurrentTarget Memory to Memory 0

LL_DMA_CURRENTTARGETMEM1 Set CurrentTarget Memory to Memory 1

DIRECTION

LL_DMA_DIRECTION_PERIPH_TO_MEMORY Peripheral to memory direction

LL_DMA_DIRECTION_MEMORY_TO_PERIPH Memory to peripheral direction

LL_DMA_DIRECTION_MEMORY_TO_MEMORY Memory to memory direction

MODE

LL_DMA_DOUBLEBUFFER_MODE_DISABLE Disable double buffering mode

LL_DMA_DOUBLEBUFFER_MODE_ENABLE Enable double buffering mode

FIFOSTATUS 0

LL_DMA_FIFOSTATUS_0_25 0 < fifo_level < 1/4

LL_DMA_FIFOSTATUS_25_50 1/4 < fifo_level < 1/2

LL_DMA_FIFOSTATUS_50_75 1/2 < fifo_level < 3/4

LL_DMA_FIFOSTATUS_75_100 3/4 < fifo_level < full

LL_DMA_FIFOSTATUS_EMPTY FIFO is empty

LL_DMA_FIFOSTATUS_FULL FIFO is full

FIFOTHRESHOLD

LL_DMA_FIFOTHRESHOLD_1_4 FIFO threshold 1 quart full configuration

LL_DMA_FIFOTHRESHOLD_1_2 FIFO threshold half full configuration

LL_DMA_FIFOTHRESHOLD_3_4 FIFO threshold 3 quarts full configuration

LL_DMA_FIFOTHRESHOLD_FULL FIFO threshold full configuration

MBURST

LL_DMA_MBURST_SINGLE Memory burst single transfer configuration

LL_DMA_MBURST_INC4 Memory burst of 4 beats transfer configuration

LL_DMA_MBURST_INC8 Memory burst of 8 beats transfer configuration

LL_DMA_MBURST_INC16 Memory burst of 16 beats transfer configuration

MDATAALIGN

LL_DMA_MDATAALIGN_BYTE Memory data alignment : Byte

LL_DMA_MDATAALIGN_HALFWORD Memory data alignment : HalfWord

LL_DMA_MDATAALIGN_WORD Memory data alignment : Word

MEMORY

LL_DMA_MEMORY_NOINCREMENT Memory increment mode Disable

LL_DMA_MEMORY_INCREMENT Memory increment mode Enable

MODE

LL_DMA_MODE_NORMAL Normal Mode

LL_DMA_MODE_CIRCULAR Circular Mode

LL_DMA_MODE_PFCTRL Peripheral flow control mode

OFFSETSIZE

LL_DMA_OFFSETSIZE_PSIZE Peripheral increment offset size is linked to the PSIZE

LL_DMA_OFFSETSIZE_FIXEDTO4 Peripheral increment offset size is fixed to 4 (32-bit alignment)

PBURST

LL_DMA_PBURST_SINGLE Peripheral burst single transfer configuration

LL_DMA_PBURST_INC4 Peripheral burst of 4 beats transfer configuration

LL_DMA_PBURST_INC8 Peripheral burst of 8 beats transfer configuration

LL_DMA_PBURST_INC16 Peripheral burst of 16 beats transfer configuration

PDATAALIGN

LL_DMA_PDATAALIGN_BYTE Peripheral data alignment : Byte

LL_DMA_PDATAALIGN_HALFWORD Peripheral data alignment : HalfWord

LL_DMA_PDATAALIGN_WORD Peripheral data alignment : Word

PERIPH

LL_DMA_PERIPH_NOINCREMENT Peripheral increment mode Disable

LL_DMA_PERIPH_INCREMENT Peripheral increment mode Enable

PRIORITY

LL_DMA_PRIORITY_LOW Priority level : Low

LL_DMA_PRIORITY_MEDIUM Priority level : Medium

LL_DMA_PRIORITY_HIGH Priority level : High

LL_DMA_PRIORITY_VERYHIGH Priority level : Very_High

STREAM

LL_DMA_STREAM_0

LL_DMA_STREAM_1

LL_DMA_STREAM_2

LL_DMA_STREAM_3

LL_DMA_STREAM_4

LL_DMA_STREAM_5

LL_DMA_STREAM_6

LL_DMA_STREAM_7

LL_DMA_STREAM_ALL

Convert DMAxStreamy

__LL_DMA_GET_INSTANCE

Description:

- Convert DMAx_Streamy into DMAx.

Parameters:

- __STREAM_INSTANCE__:
DMAx_Streamy

Return value:

- DMAx

__LL_DMA_GET_STREAM

Description:

- Convert DMAx_Streamy into
LL_DMA_STREAM_y.

Parameters:

- __STREAM_INSTANCE__:
DMAx_Streamy

Return value:

- LL_DMA_CHANNEL_y

__LL_DMA_GET_STREAM_INSTANCE

Description:

- Convert DMA Instance DMAx and LL_DMA_STREAM_y into DMAx_Streamy.

Parameters:

- __DMA_INSTANCE__: DMAx
- __STREAM__: LL_DMA_STREAM_y

Return value:

- DMAx_Streamy

Common Write and read registers macros

LL_DMA_WriteReg

Description:

- Write a value in DMA register.

Parameters:

- __INSTANCE__: DMA Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_DMA_ReadReg

Description:

- Read a value in DMA register.

Parameters:

- __INSTANCE__: DMA Instance
- __REG__: Register to be read

Return value:

- Register: value

DMA_LL_FIFOMODE

LL_DMA_FIFOMODE_DISABLE FIFO mode disable (direct mode is enabled)

LL_DMA_FIFOMODE_ENABLE FIFO mode enable

78 LL EXTI Generic Driver

78.1 EXTI Firmware driver registers structures

78.1.1 LL_EXTI_InitTypeDef

Data Fields

- *uint32_t* **Line_0_31**
- *FunctionalState* **LineCommand**
- *uint8_t* **Mode**
- *uint8_t* **Trigger**

Field Documentation

- *uint32_t* **LL_EXTI_InitTypeDef::Line_0_31**
Specifies the EXTI lines to be enabled or disabled for Lines in range 0 to 31 This parameter can be any combination of [EXTI_LL_EC_LINE](#)
- *FunctionalState* **LL_EXTI_InitTypeDef::LineCommand**
Specifies the new state of the selected EXTI lines. This parameter can be set either to ENABLE or DISABLE
- *uint8_t* **LL_EXTI_InitTypeDef::Mode**
Specifies the mode for the EXTI lines. This parameter can be a value of [EXTI_LL_EC_MODE](#).
- *uint8_t* **LL_EXTI_InitTypeDef::Trigger**
Specifies the trigger signal active edge for the EXTI lines. This parameter can be a value of [EXTI_LL_EC_TRIGGER](#).

78.2 EXTI Firmware driver API description

78.2.1 Detailed description of functions

LL_EXTI_EnableIT_0_31

Function name `__STATIC_INLINE void LL_EXTI_EnableIT_0_31 (uint32_t ExtiLine)`

Function description Enable ExtiLine Interrupt request for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be one of the following values:
 - LL_EXTI_LINE_0
 - LL_EXTI_LINE_1
 - LL_EXTI_LINE_2
 - LL_EXTI_LINE_3
 - LL_EXTI_LINE_4
 - LL_EXTI_LINE_5
 - LL_EXTI_LINE_6
 - LL_EXTI_LINE_7
 - LL_EXTI_LINE_8
 - LL_EXTI_LINE_9
 - LL_EXTI_LINE_10
 - LL_EXTI_LINE_11
 - LL_EXTI_LINE_12
 - LL_EXTI_LINE_13

- LL_EXTI_LINE_14
- LL_EXTI_LINE_15
- LL_EXTI_LINE_16
- LL_EXTI_LINE_17
- LL_EXTI_LINE_18
- LL_EXTI_LINE_19
- LL_EXTI_LINE_20
- LL_EXTI_LINE_21
- LL_EXTI_LINE_22
- LL_EXTI_LINE_23
- LL_EXTI_LINE_24(*)
- LL_EXTI_LINE_ALL_0_31

Return values

- **None:**

Notes

- The reset value for the direct or internal lines (see RM) is set to 1 in order to enable the interrupt by default. Bits are set automatically at Power on.
- (*): Available in some devices
- Please check each device line mapping for EXTI Line availability

Reference Manual to
LL API cross
reference:

- IMR IMx LL_EXTI_EnableIT_0_31

LL_EXTI_DisableIT_0_31**Function name**

**__STATIC_INLINE void LL_EXTI_DisableIT_0_31 (uint32_t
ExtiLine)**

Function description

Disable ExtiLine Interrupt request for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be one of the following values:
 - LL_EXTI_LINE_0
 - LL_EXTI_LINE_1
 - LL_EXTI_LINE_2
 - LL_EXTI_LINE_3
 - LL_EXTI_LINE_4
 - LL_EXTI_LINE_5
 - LL_EXTI_LINE_6
 - LL_EXTI_LINE_7
 - LL_EXTI_LINE_8
 - LL_EXTI_LINE_9
 - LL_EXTI_LINE_10
 - LL_EXTI_LINE_11
 - LL_EXTI_LINE_12
 - LL_EXTI_LINE_13
 - LL_EXTI_LINE_14
 - LL_EXTI_LINE_15
 - LL_EXTI_LINE_16
 - LL_EXTI_LINE_17
 - LL_EXTI_LINE_18
 - LL_EXTI_LINE_19
 - LL_EXTI_LINE_20

	<ul style="list-style-type: none"> - LL_EXTI_LINE_21 - LL_EXTI_LINE_22 - LL_EXTI_LINE_23 - LL_EXTI_LINE_24(*) - LL_EXTI_LINE_ALL_0_31
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The reset value for the direct or internal lines (see RM) is set to 1 in order to enable the interrupt by default. Bits are set automatically at Power on. • (*): Available in some devices • Please check each device line mapping for EXTI Line availability
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • IMR IMx LL_EXTI_DisableIT_0_31

LL_EXTI_IsEnabledIT_0_31

Function name	__STATIC_INLINE uint32_t LL_EXTI_IsEnabledIT_0_31 (uint32_t ExtiLine)
Function description	Indicate if ExtiLine Interrupt request is enabled for Lines in range 0 to 31.
Parameters	<ul style="list-style-type: none"> • ExtiLine: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_EXTI_LINE_0 - LL_EXTI_LINE_1 - LL_EXTI_LINE_2 - LL_EXTI_LINE_3 - LL_EXTI_LINE_4 - LL_EXTI_LINE_5 - LL_EXTI_LINE_6 - LL_EXTI_LINE_7 - LL_EXTI_LINE_8 - LL_EXTI_LINE_9 - LL_EXTI_LINE_10 - LL_EXTI_LINE_11 - LL_EXTI_LINE_12 - LL_EXTI_LINE_13 - LL_EXTI_LINE_14 - LL_EXTI_LINE_15 - LL_EXTI_LINE_16 - LL_EXTI_LINE_17 - LL_EXTI_LINE_18 - LL_EXTI_LINE_19 - LL_EXTI_LINE_20 - LL_EXTI_LINE_21 - LL_EXTI_LINE_22 - LL_EXTI_LINE_23 - LL_EXTI_LINE_24(*) - LL_EXTI_LINE_ALL_0_31

Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • The reset value for the direct or internal lines (see RM) is set to 1 in order to enable the interrupt by default. Bits are set automatically at Power on. • (*): Available in some devices • Please check each device line mapping for EXTI Line availability
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • IMR IMx LL_EXTI_IsEnabledIT_0_31

LL_EXTI_EnableEvent_0_31

Function name	__STATIC_INLINE void LL_EXTI_EnableEvent_0_31 (uint32_t ExtiLine)
Function description	Enable ExtiLine Event request for Lines in range 0 to 31.
Parameters	<ul style="list-style-type: none"> • ExtiLine: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_EXTI_LINE_0 – LL_EXTI_LINE_1 – LL_EXTI_LINE_2 – LL_EXTI_LINE_3 – LL_EXTI_LINE_4 – LL_EXTI_LINE_5 – LL_EXTI_LINE_6 – LL_EXTI_LINE_7 – LL_EXTI_LINE_8 – LL_EXTI_LINE_9 – LL_EXTI_LINE_10 – LL_EXTI_LINE_11 – LL_EXTI_LINE_12 – LL_EXTI_LINE_13 – LL_EXTI_LINE_14 – LL_EXTI_LINE_15 – LL_EXTI_LINE_16 – LL_EXTI_LINE_17 – LL_EXTI_LINE_18 – LL_EXTI_LINE_19 – LL_EXTI_LINE_20 – LL_EXTI_LINE_21 – LL_EXTI_LINE_22 – LL_EXTI_LINE_23 – LL_EXTI_LINE_24(*) – LL_EXTI_LINE_ALL_0_31
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • (*): Available in some devices • Please check each device line mapping for EXTI Line availability
Reference Manual to LL API cross	<ul style="list-style-type: none"> • EMR EMx LL_EXTI_EnableEvent_0_31

reference:

LL_EXTI_DisableEvent_0_31

Function name `__STATIC_INLINE void LL_EXTI_DisableEvent_0_31 (uint32_t ExtiLine)`

Function description Disable ExtiLine Event request for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be one of the following values:
 - LL_EXTI_LINE_0
 - LL_EXTI_LINE_1
 - LL_EXTI_LINE_2
 - LL_EXTI_LINE_3
 - LL_EXTI_LINE_4
 - LL_EXTI_LINE_5
 - LL_EXTI_LINE_6
 - LL_EXTI_LINE_7
 - LL_EXTI_LINE_8
 - LL_EXTI_LINE_9
 - LL_EXTI_LINE_10
 - LL_EXTI_LINE_11
 - LL_EXTI_LINE_12
 - LL_EXTI_LINE_13
 - LL_EXTI_LINE_14
 - LL_EXTI_LINE_15
 - LL_EXTI_LINE_16
 - LL_EXTI_LINE_17
 - LL_EXTI_LINE_18
 - LL_EXTI_LINE_19
 - LL_EXTI_LINE_20
 - LL_EXTI_LINE_21
 - LL_EXTI_LINE_22
 - LL_EXTI_LINE_23
 - LL_EXTI_LINE_24(*)
 - LL_EXTI_LINE_ALL_0_31

Return values • **None:**

Notes

- (*): Available in some devices
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- EMR EMx LL_EXTI_DisableEvent_0_31

LL_EXTI_IsEnabledEvent_0_31

Function name `__STATIC_INLINE uint32_t LL_EXTI_IsEnabledEvent_0_31 (uint32_t ExtiLine)`

Function description Indicate if ExtiLine Event request is enabled for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be one of the following values:
 - LL_EXTI_LINE_0

- LL_EXTI_LINE_1
- LL_EXTI_LINE_2
- LL_EXTI_LINE_3
- LL_EXTI_LINE_4
- LL_EXTI_LINE_5
- LL_EXTI_LINE_6
- LL_EXTI_LINE_7
- LL_EXTI_LINE_8
- LL_EXTI_LINE_9
- LL_EXTI_LINE_10
- LL_EXTI_LINE_11
- LL_EXTI_LINE_12
- LL_EXTI_LINE_13
- LL_EXTI_LINE_14
- LL_EXTI_LINE_15
- LL_EXTI_LINE_16
- LL_EXTI_LINE_17
- LL_EXTI_LINE_18
- LL_EXTI_LINE_19
- LL_EXTI_LINE_20
- LL_EXTI_LINE_21
- LL_EXTI_LINE_22
- LL_EXTI_LINE_23
- LL_EXTI_LINE_24(*)
- LL_EXTI_LINE_ALL_0_31

Return values

- **State:** of bit (1 or 0).

Notes

- (*): Available in some devices
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- EMR EMx LL_EXTI_IsEnabledEvent_0_31

LL_EXTI_EnableRisingTrig_0_31**Function name**

__STATIC_INLINE void LL_EXTI_EnableRisingTrig_0_31 (uint32_t ExtiLine)

Function description

Enable ExtiLine Rising Edge Trigger for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
 - LL_EXTI_LINE_0
 - LL_EXTI_LINE_1
 - LL_EXTI_LINE_2
 - LL_EXTI_LINE_3
 - LL_EXTI_LINE_4
 - LL_EXTI_LINE_5
 - LL_EXTI_LINE_6
 - LL_EXTI_LINE_7
 - LL_EXTI_LINE_8
 - LL_EXTI_LINE_9

- LL_EXTI_LINE_10
- LL_EXTI_LINE_11
- LL_EXTI_LINE_12
- LL_EXTI_LINE_13
- LL_EXTI_LINE_14
- LL_EXTI_LINE_15
- LL_EXTI_LINE_16
- LL_EXTI_LINE_18
- LL_EXTI_LINE_19
- LL_EXTI_LINE_20
- LL_EXTI_LINE_21
- LL_EXTI_LINE_22

Return values

- **None:**

Notes

- The configurable wakeup lines are edge-triggered. No glitch must be generated on these lines. If a rising edge on a configurable interrupt line occurs during a write operation in the EXTI_RTISR register, the pending bit is not set. Rising and falling edge triggers can be set for the same interrupt line. In this case, both generate a trigger condition.
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- RTSR RTx LL_EXTI_EnableRisingTrig_0_31

LL_EXTI_DisableRisingTrig_0_31

Function name

__STATIC_INLINE void LL_EXTI_DisableRisingTrig_0_31 (uint32_t ExtiLine)

Function description

Disable ExtiLine Rising Edge Trigger for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
 - LL_EXTI_LINE_0
 - LL_EXTI_LINE_1
 - LL_EXTI_LINE_2
 - LL_EXTI_LINE_3
 - LL_EXTI_LINE_4
 - LL_EXTI_LINE_5
 - LL_EXTI_LINE_6
 - LL_EXTI_LINE_7
 - LL_EXTI_LINE_8
 - LL_EXTI_LINE_9
 - LL_EXTI_LINE_10
 - LL_EXTI_LINE_11
 - LL_EXTI_LINE_12
 - LL_EXTI_LINE_13
 - LL_EXTI_LINE_14
 - LL_EXTI_LINE_15
 - LL_EXTI_LINE_16
 - LL_EXTI_LINE_18
 - LL_EXTI_LINE_19

	<ul style="list-style-type: none"> – LL_EXTI_LINE_20 – LL_EXTI_LINE_21 – LL_EXTI_LINE_22
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The configurable wakeup lines are edge-triggered. No glitch must be generated on these lines. If a rising edge on a configurable interrupt line occurs during a write operation in the EXTI_RTISR register, the pending bit is not set. Rising and falling edge triggers can be set for the same interrupt line. In this case, both generate a trigger condition. • Please check each device line mapping for EXTI Line availability
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • RTSR RTx LL_EXTI_DisableRisingTrig_0_31

LL_EXTI_IsEnabledRisingTrig_0_31

Function name	__STATIC_INLINE uint32_t LL_EXTI_IsEnabledRisingTrig_0_31 (uint32_t ExtiLine)
Function description	Check if rising edge trigger is enabled for Lines in range 0 to 31.
Parameters	<ul style="list-style-type: none"> • ExtiLine: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_EXTI_LINE_0 – LL_EXTI_LINE_1 – LL_EXTI_LINE_2 – LL_EXTI_LINE_3 – LL_EXTI_LINE_4 – LL_EXTI_LINE_5 – LL_EXTI_LINE_6 – LL_EXTI_LINE_7 – LL_EXTI_LINE_8 – LL_EXTI_LINE_9 – LL_EXTI_LINE_10 – LL_EXTI_LINE_11 – LL_EXTI_LINE_12 – LL_EXTI_LINE_13 – LL_EXTI_LINE_14 – LL_EXTI_LINE_15 – LL_EXTI_LINE_16 – LL_EXTI_LINE_18 – LL_EXTI_LINE_19 – LL_EXTI_LINE_20 – LL_EXTI_LINE_21 – LL_EXTI_LINE_22
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Please check each device line mapping for EXTI Line availability
Reference Manual to	<ul style="list-style-type: none"> • RTSR RTx LL_EXTI_IsEnabledRisingTrig_0_31

LL API cross
reference:

LL_EXTI_EnableFallingTrig_0_31

Function name `__STATIC_INLINE void LL_EXTI_EnableFallingTrig_0_31
(uint32_t ExtiLine)`

Function description Enable ExtiLine Falling Edge Trigger for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
 - LL_EXTI_LINE_0
 - LL_EXTI_LINE_1
 - LL_EXTI_LINE_2
 - LL_EXTI_LINE_3
 - LL_EXTI_LINE_4
 - LL_EXTI_LINE_5
 - LL_EXTI_LINE_6
 - LL_EXTI_LINE_7
 - LL_EXTI_LINE_8
 - LL_EXTI_LINE_9
 - LL_EXTI_LINE_10
 - LL_EXTI_LINE_11
 - LL_EXTI_LINE_12
 - LL_EXTI_LINE_13
 - LL_EXTI_LINE_14
 - LL_EXTI_LINE_15
 - LL_EXTI_LINE_16
 - LL_EXTI_LINE_18
 - LL_EXTI_LINE_19
 - LL_EXTI_LINE_20
 - LL_EXTI_LINE_21
 - LL_EXTI_LINE_22

Return values

- **None:**

Notes

- The configurable wakeup lines are edge-triggered. No glitch must be generated on these lines. If a falling edge on a configurable interrupt line occurs during a write operation in the EXTI_FTSR register, the pending bit is not set. Rising and falling edge triggers can be set for the same interrupt line. In this case, both generate a trigger condition.
- Please check each device line mapping for EXTI Line availability

Reference Manual to
LL API cross
reference:

- FTSR FTx LL_EXTI_EnableFallingTrig_0_31

LL_EXTI_DisableFallingTrig_0_31

Function name `__STATIC_INLINE void LL_EXTI_DisableFallingTrig_0_31
(uint32_t ExtiLine)`

Function description Disable ExtiLine Falling Edge Trigger for Lines in range 0 to 31.

Parameters	<ul style="list-style-type: none"> • ExtiLine: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_EXTI_LINE_0 – LL_EXTI_LINE_1 – LL_EXTI_LINE_2 – LL_EXTI_LINE_3 – LL_EXTI_LINE_4 – LL_EXTI_LINE_5 – LL_EXTI_LINE_6 – LL_EXTI_LINE_7 – LL_EXTI_LINE_8 – LL_EXTI_LINE_9 – LL_EXTI_LINE_10 – LL_EXTI_LINE_11 – LL_EXTI_LINE_12 – LL_EXTI_LINE_13 – LL_EXTI_LINE_14 – LL_EXTI_LINE_15 – LL_EXTI_LINE_16 – LL_EXTI_LINE_18 – LL_EXTI_LINE_19 – LL_EXTI_LINE_20 – LL_EXTI_LINE_21 – LL_EXTI_LINE_22
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The configurable wakeup lines are edge-triggered. No glitch must be generated on these lines. If a Falling edge on a configurable interrupt line occurs during a write operation in the EXTI_FTSR register, the pending bit is not set. Rising and falling edge triggers can be set for the same interrupt line. In this case, both generate a trigger condition. • Please check each device line mapping for EXTI Line availability
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FTSR FTx LL_EXTI_DisableFallingTrig_0_31

LL_EXTI_IsEnabledFallingTrig_0_31

Function name	__STATIC_INLINE uint32_t LL_EXTI_IsEnabledFallingTrig_0_31 (uint32_t ExtiLine)
Function description	Check if falling edge trigger is enabled for Lines in range 0 to 31.
Parameters	<ul style="list-style-type: none"> • ExtiLine: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_EXTI_LINE_0 – LL_EXTI_LINE_1 – LL_EXTI_LINE_2 – LL_EXTI_LINE_3 – LL_EXTI_LINE_4 – LL_EXTI_LINE_5 – LL_EXTI_LINE_6

- LL_EXTI_LINE_7
- LL_EXTI_LINE_8
- LL_EXTI_LINE_9
- LL_EXTI_LINE_10
- LL_EXTI_LINE_11
- LL_EXTI_LINE_12
- LL_EXTI_LINE_13
- LL_EXTI_LINE_14
- LL_EXTI_LINE_15
- LL_EXTI_LINE_16
- LL_EXTI_LINE_18
- LL_EXTI_LINE_19
- LL_EXTI_LINE_20
- LL_EXTI_LINE_21
- LL_EXTI_LINE_22

Return values

- **State:** of bit (1 or 0).

Notes

- Please check each device line mapping for EXTI Line availability

Reference Manual to
LL API cross
reference:

- FTSR FTx LL_EXTI_IsEnabledFallingTrig_0_31

LL_EXTI_GenerateSWI_0_31

Function name

__STATIC_INLINE void LL_EXTI_GenerateSWI_0_31 (uint32_t ExtiLine)

Function description

Generate a software Interrupt Event for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
 - LL_EXTI_LINE_0
 - LL_EXTI_LINE_1
 - LL_EXTI_LINE_2
 - LL_EXTI_LINE_3
 - LL_EXTI_LINE_4
 - LL_EXTI_LINE_5
 - LL_EXTI_LINE_6
 - LL_EXTI_LINE_7
 - LL_EXTI_LINE_8
 - LL_EXTI_LINE_9
 - LL_EXTI_LINE_10
 - LL_EXTI_LINE_11
 - LL_EXTI_LINE_12
 - LL_EXTI_LINE_13
 - LL_EXTI_LINE_14
 - LL_EXTI_LINE_15
 - LL_EXTI_LINE_16
 - LL_EXTI_LINE_18
 - LL_EXTI_LINE_19
 - LL_EXTI_LINE_20
 - LL_EXTI_LINE_21

	– LL_EXTI_LINE_22
Return values	• None:
Notes	<ul style="list-style-type: none"> • If the interrupt is enabled on this line in the EXTI_IMR, writing a 1 to this bit when it is at '0' sets the corresponding pending bit in EXTI_PR resulting in an interrupt request generation. This bit is cleared by clearing the corresponding bit in the EXTI_PR register (by writing a 1 into the bit) • Please check each device line mapping for EXTI Line availability
Reference Manual to LL API cross reference:	• SWIER SWIx LL_EXTI_GenerateSWI_0_31

LL_EXTI_IsActiveFlag_0_31

Function name	__STATIC_INLINE uint32_t LL_EXTI_IsActiveFlag_0_31 (uint32_t ExtiLine)
Function description	Check if the ExtLine Flag is set or not for Lines in range 0 to 31.
Parameters	<ul style="list-style-type: none"> • ExtiLine: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_EXTI_LINE_0 – LL_EXTI_LINE_1 – LL_EXTI_LINE_2 – LL_EXTI_LINE_3 – LL_EXTI_LINE_4 – LL_EXTI_LINE_5 – LL_EXTI_LINE_6 – LL_EXTI_LINE_7 – LL_EXTI_LINE_8 – LL_EXTI_LINE_9 – LL_EXTI_LINE_10 – LL_EXTI_LINE_11 – LL_EXTI_LINE_12 – LL_EXTI_LINE_13 – LL_EXTI_LINE_14 – LL_EXTI_LINE_15 – LL_EXTI_LINE_16 – LL_EXTI_LINE_18 – LL_EXTI_LINE_19 – LL_EXTI_LINE_20 – LL_EXTI_LINE_21 – LL_EXTI_LINE_22
Return values	• State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • This bit is set when the selected edge event arrives on the interrupt line. This bit is cleared by writing a 1 to the bit. • Please check each device line mapping for EXTI Line availability
Reference Manual to LL API cross	• PR PIFx LL_EXTI_IsActiveFlag_0_31

reference:

LL_EXTI_ReadFlag_0_31

Function name **__STATIC_INLINE uint32_t LL_EXTI_ReadFlag_0_31 (uint32_t ExtiLine)**

Function description Read ExtLine Combination Flag for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
 - LL_EXTI_LINE_0
 - LL_EXTI_LINE_1
 - LL_EXTI_LINE_2
 - LL_EXTI_LINE_3
 - LL_EXTI_LINE_4
 - LL_EXTI_LINE_5
 - LL_EXTI_LINE_6
 - LL_EXTI_LINE_7
 - LL_EXTI_LINE_8
 - LL_EXTI_LINE_9
 - LL_EXTI_LINE_10
 - LL_EXTI_LINE_11
 - LL_EXTI_LINE_12
 - LL_EXTI_LINE_13
 - LL_EXTI_LINE_14
 - LL_EXTI_LINE_15
 - LL_EXTI_LINE_16
 - LL_EXTI_LINE_18
 - LL_EXTI_LINE_19
 - LL_EXTI_LINE_20
 - LL_EXTI_LINE_21
 - LL_EXTI_LINE_22

Return values

- **@note:** This bit is set when the selected edge event arrives on the interrupt

Notes

- This bit is set when the selected edge event arrives on the interrupt line. This bit is cleared by writing a 1 to the bit.
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- PR PIFx LL_EXTI_ReadFlag_0_31

LL_EXTI_ClearFlag_0_31

Function name **__STATIC_INLINE void LL_EXTI_ClearFlag_0_31 (uint32_t ExtiLine)**

Function description Clear ExtLine Flags for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
 - LL_EXTI_LINE_0
 - LL_EXTI_LINE_1

- LL_EXTI_LINE_2
- LL_EXTI_LINE_3
- LL_EXTI_LINE_4
- LL_EXTI_LINE_5
- LL_EXTI_LINE_6
- LL_EXTI_LINE_7
- LL_EXTI_LINE_8
- LL_EXTI_LINE_9
- LL_EXTI_LINE_10
- LL_EXTI_LINE_11
- LL_EXTI_LINE_12
- LL_EXTI_LINE_13
- LL_EXTI_LINE_14
- LL_EXTI_LINE_15
- LL_EXTI_LINE_16
- LL_EXTI_LINE_18
- LL_EXTI_LINE_19
- LL_EXTI_LINE_20
- LL_EXTI_LINE_21
- LL_EXTI_LINE_22

Return values

- **None:**

Notes

- This bit is set when the selected edge event arrives on the interrupt line. This bit is cleared by writing a 1 to the bit.
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- PR PIFx LL_EXTI_ClearFlag_0_31

LL_EXTI_Init

Function name

uint32_t LL_EXTI_Init (LL_EXTI_InitTypeDef * EXTI_InitStruct)

Function description

Initialize the EXTI registers according to the specified parameters in EXTI_InitStruct.

Parameters

- **EXTI_InitStruct:** pointer to a LL_EXTI_InitTypeDef structure.

Return values

- **An:** ErrorStatus enumeration value:
 - SUCCESS: EXTI registers are initialized
 - ERROR: not applicable

LL_EXTI_DeInit

Function name

uint32_t LL_EXTI_DeInit (void)

Function description

De-initialize the EXTI registers to their default reset values.

Return values

- **An:** ErrorStatus enumeration value:
 - SUCCESS: EXTI registers are de-initialized
 - ERROR: not applicable

LL_EXTI_StructInit

Function name	void LL_EXTI_StructInit (LL_EXTI_InitTypeDef * EXTI_InitStruct)
Function description	Set each LL_EXTI_InitTypeDef field to default value.
Parameters	<ul style="list-style-type: none"> • EXTI_InitStruct: Pointer to a LL_EXTI_InitTypeDef structure.
Return values	<ul style="list-style-type: none"> • None:

78.3 EXTI Firmware driver defines**78.3.1 EXTI****LINE**

LL_EXTI_LINE_0	Extended line 0
LL_EXTI_LINE_1	Extended line 1
LL_EXTI_LINE_2	Extended line 2
LL_EXTI_LINE_3	Extended line 3
LL_EXTI_LINE_4	Extended line 4
LL_EXTI_LINE_5	Extended line 5
LL_EXTI_LINE_6	Extended line 6
LL_EXTI_LINE_7	Extended line 7
LL_EXTI_LINE_8	Extended line 8
LL_EXTI_LINE_9	Extended line 9
LL_EXTI_LINE_10	Extended line 10
LL_EXTI_LINE_11	Extended line 11
LL_EXTI_LINE_12	Extended line 12
LL_EXTI_LINE_13	Extended line 13
LL_EXTI_LINE_14	Extended line 14
LL_EXTI_LINE_15	Extended line 15
LL_EXTI_LINE_16	Extended line 16
LL_EXTI_LINE_17	Extended line 17
LL_EXTI_LINE_18	Extended line 18
LL_EXTI_LINE_19	Extended line 19
LL_EXTI_LINE_20	Extended line 20
LL_EXTI_LINE_21	Extended line 21
LL_EXTI_LINE_22	Extended line 22
LL_EXTI_LINE_23	Extended line 23
LL_EXTI_LINE_24	Extended line 24
LL_EXTI_LINE_ALL_0_31	All Extended line not reserved

LL_EXTI_LINE_ALL All Extended line
 LL_EXTI_LINE_NONE None Extended line

Mode

LL_EXTI_MODE_IT Interrupt Mode
 LL_EXTI_MODE_EVENT Event Mode
 LL_EXTI_MODE_IT_EVENT Interrupt & Event Mode

Edge Trigger

LL_EXTI_TRIGGER_NONE No Trigger Mode
 LL_EXTI_TRIGGER_RISING Trigger Rising Mode
 LL_EXTI_TRIGGER_FALLING Trigger Falling Mode
 LL_EXTI_TRIGGER_RISING_FALLING Trigger Rising & Falling Mode

Common Write and read registers Macros

LL_EXTI_WriteReg **Description:**

- Write a value in EXTI register.

Parameters:

- `__REG__`: Register to be written
- `__VALUE__`: Value to be written in the register

Return value:

- None

LL_EXTI_ReadReg **Description:**

- Read a value in EXTI register.

Parameters:

- `__REG__`: Register to be read

Return value:

- Register: value

79 LL GPIO Generic Driver

79.1 GPIO Firmware driver registers structures

79.1.1 LL_GPIO_InitTypeDef

Data Fields

- *uint32_t Pin*
- *uint32_t Mode*
- *uint32_t Speed*
- *uint32_t OutputType*
- *uint32_t Pull*
- *uint32_t Alternate*

Field Documentation

- *uint32_t LL_GPIO_InitTypeDef::Pin*
Specifies the GPIO pins to be configured. This parameter can be any value of [GPIO_LL_EC_PIN](#)
- *uint32_t LL_GPIO_InitTypeDef::Mode*
Specifies the operating mode for the selected pins. This parameter can be a value of [GPIO_LL_EC_MODE](#).GPIO HW configuration can be modified afterwards using unitary function `LL_GPIO_SetPinMode()`.
- *uint32_t LL_GPIO_InitTypeDef::Speed*
Specifies the speed for the selected pins. This parameter can be a value of [GPIO_LL_EC_SPEED](#).GPIO HW configuration can be modified afterwards using unitary function `LL_GPIO_SetPinSpeed()`.
- *uint32_t LL_GPIO_InitTypeDef::OutputType*
Specifies the operating output type for the selected pins. This parameter can be a value of [GPIO_LL_EC_OUTPUT](#).GPIO HW configuration can be modified afterwards using unitary function `LL_GPIO_SetPinOutputType()`.
- *uint32_t LL_GPIO_InitTypeDef::Pull*
Specifies the operating Pull-up/Pull down for the selected pins. This parameter can be a value of [GPIO_LL_EC_PULL](#).GPIO HW configuration can be modified afterwards using unitary function `LL_GPIO_SetPinPull()`.
- *uint32_t LL_GPIO_InitTypeDef::Alternate*
Specifies the Peripheral to be connected to the selected pins. This parameter can be a value of [GPIO_LL_EC_AF](#).GPIO HW configuration can be modified afterwards using unitary function `LL_GPIO_SetAFPin_0_7()` and `LL_GPIO_SetAFPin_8_15()`.

79.2 GPIO Firmware driver API description

79.2.1 Detailed description of functions

LL_GPIO_SetPinMode

Function name `__STATIC_INLINE void LL_GPIO_SetPinMode (GPIO_TypeDef * GPIOx, uint32_t Pin, uint32_t Mode)`

Function description Configure gpio mode for a dedicated pin on dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **Pin:** This parameter can be one of the following values:

- LL_GPIO_PIN_0
- LL_GPIO_PIN_1
- LL_GPIO_PIN_2
- LL_GPIO_PIN_3
- LL_GPIO_PIN_4
- LL_GPIO_PIN_5
- LL_GPIO_PIN_6
- LL_GPIO_PIN_7
- LL_GPIO_PIN_8
- LL_GPIO_PIN_9
- LL_GPIO_PIN_10
- LL_GPIO_PIN_11
- LL_GPIO_PIN_12
- LL_GPIO_PIN_13
- LL_GPIO_PIN_14
- LL_GPIO_PIN_15
- **Mode:** This parameter can be one of the following values:
 - LL_GPIO_MODE_INPUT
 - LL_GPIO_MODE_OUTPUT
 - LL_GPIO_MODE_ALTERNATE
 - LL_GPIO_MODE_ANALOG

Return values

- **None:**

Notes

- I/O mode can be Input mode, General purpose output, Alternate function mode or Analog.
- Warning: only one pin can be passed as parameter.

Reference Manual to LL API cross reference:

- MODER MODEy LL_GPIO_SetPinMode

LL_GPIO_GetPinMode

Function name

__STATIC_INLINE uint32_t LL_GPIO_GetPinMode (GPIO_TypeDef * GPIOx, uint32_t Pin)

Function description

Return gpio mode for a dedicated pin on dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **Pin:** This parameter can be one of the following values:
 - LL_GPIO_PIN_0
 - LL_GPIO_PIN_1
 - LL_GPIO_PIN_2
 - LL_GPIO_PIN_3
 - LL_GPIO_PIN_4
 - LL_GPIO_PIN_5
 - LL_GPIO_PIN_6
 - LL_GPIO_PIN_7
 - LL_GPIO_PIN_8
 - LL_GPIO_PIN_9
 - LL_GPIO_PIN_10
 - LL_GPIO_PIN_11
 - LL_GPIO_PIN_12
 - LL_GPIO_PIN_13

	<ul style="list-style-type: none"> – LL_GPIO_PIN_14 – LL_GPIO_PIN_15
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_MODE_INPUT – LL_GPIO_MODE_OUTPUT – LL_GPIO_MODE_ALTERNATE – LL_GPIO_MODE_ANALOG
Notes	<ul style="list-style-type: none"> • I/O mode can be Input mode, General purpose output, Alternate function mode or Analog. • Warning: only one pin can be passed as parameter.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • MODER MODEy LL_GPIO_GetPinMode

LL_GPIO_SetPinOutputType

Function name	__STATIC_INLINE void LL_GPIO_SetPinOutputType (GPIO_TypeDef * GPIOx, uint32_t PinMask, uint32_t OutputType)
Function description	Configure gpio output type for several pins on dedicated port.
Parameters	<ul style="list-style-type: none"> • GPIOx: GPIO Port • PinMask: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_GPIO_PIN_0 – LL_GPIO_PIN_1 – LL_GPIO_PIN_2 – LL_GPIO_PIN_3 – LL_GPIO_PIN_4 – LL_GPIO_PIN_5 – LL_GPIO_PIN_6 – LL_GPIO_PIN_7 – LL_GPIO_PIN_8 – LL_GPIO_PIN_9 – LL_GPIO_PIN_10 – LL_GPIO_PIN_11 – LL_GPIO_PIN_12 – LL_GPIO_PIN_13 – LL_GPIO_PIN_14 – LL_GPIO_PIN_15 – LL_GPIO_PIN_ALL • OutputType: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_OUTPUT_PUSHPULL – LL_GPIO_OUTPUT_OPENDRAIN
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Output type as to be set when gpio pin is in output or alternate modes. Possible type are Push-pull or Open-drain.
Reference Manual to LL API cross	<ul style="list-style-type: none"> • OTyPER OTy LL_GPIO_SetPinOutputType

reference:

LL_GPIO_GetPinOutputType

Function name	__STATIC_INLINE uint32_t LL_GPIO_GetPinOutputType (GPIO_TypeDef * GPIOx, uint32_t Pin)
Function description	Return gpio output type for several pins on dedicated port.
Parameters	<ul style="list-style-type: none"> • GPIOx: GPIO Port • Pin: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_PIN_0 – LL_GPIO_PIN_1 – LL_GPIO_PIN_2 – LL_GPIO_PIN_3 – LL_GPIO_PIN_4 – LL_GPIO_PIN_5 – LL_GPIO_PIN_6 – LL_GPIO_PIN_7 – LL_GPIO_PIN_8 – LL_GPIO_PIN_9 – LL_GPIO_PIN_10 – LL_GPIO_PIN_11 – LL_GPIO_PIN_12 – LL_GPIO_PIN_13 – LL_GPIO_PIN_14 – LL_GPIO_PIN_15 – LL_GPIO_PIN_ALL
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_OUTPUT_PUSH_PULL – LL_GPIO_OUTPUT_OPENDRAIN
Notes	<ul style="list-style-type: none"> • Output type as to be set when gpio pin is in output or alternate modes. Possible type are Push-pull or Open-drain. • Warning: only one pin can be passed as parameter.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OTyPER OTy LL_GPIO_GetPinOutputType

LL_GPIO_SetPinSpeed

Function name	__STATIC_INLINE void LL_GPIO_SetPinSpeed (GPIO_TypeDef * GPIOx, uint32_t Pin, uint32_t Speed)
Function description	Configure gpio speed for a dedicated pin on dedicated port.
Parameters	<ul style="list-style-type: none"> • GPIOx: GPIO Port • Pin: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_PIN_0 – LL_GPIO_PIN_1 – LL_GPIO_PIN_2 – LL_GPIO_PIN_3 – LL_GPIO_PIN_4 – LL_GPIO_PIN_5

	<ul style="list-style-type: none"> – LL_GPIO_PIN_6 – LL_GPIO_PIN_7 – LL_GPIO_PIN_8 – LL_GPIO_PIN_9 – LL_GPIO_PIN_10 – LL_GPIO_PIN_11 – LL_GPIO_PIN_12 – LL_GPIO_PIN_13 – LL_GPIO_PIN_14 – LL_GPIO_PIN_15
Return values	<ul style="list-style-type: none"> • Speed: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_SPEED_FREQ_LOW – LL_GPIO_SPEED_FREQ_MEDIUM – LL_GPIO_SPEED_FREQ_HIGH – LL_GPIO_SPEED_FREQ_VERY_HIGH
Notes	<ul style="list-style-type: none"> • None: • I/O speed can be Low, Medium, Fast or High speed. • Warning: only one pin can be passed as parameter. • Refer to datasheet for frequency specifications and the power supply and load conditions for each speed.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OSPEEDR OSPEEDy LL_GPIO_SetPinSpeed

LL_GPIO_GetPinSpeed

Function name	__STATIC_INLINE uint32_t LL_GPIO_GetPinSpeed (GPIO_TypeDef * GPIOx, uint32_t Pin)
Function description	Return gpio speed for a dedicated pin on dedicated port.
Parameters	<ul style="list-style-type: none"> • GPIOx: GPIO Port • Pin: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_PIN_0 – LL_GPIO_PIN_1 – LL_GPIO_PIN_2 – LL_GPIO_PIN_3 – LL_GPIO_PIN_4 – LL_GPIO_PIN_5 – LL_GPIO_PIN_6 – LL_GPIO_PIN_7 – LL_GPIO_PIN_8 – LL_GPIO_PIN_9 – LL_GPIO_PIN_10 – LL_GPIO_PIN_11 – LL_GPIO_PIN_12 – LL_GPIO_PIN_13 – LL_GPIO_PIN_14 – LL_GPIO_PIN_15
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_SPEED_FREQ_LOW – LL_GPIO_SPEED_FREQ_MEDIUM

	<ul style="list-style-type: none"> – LL_GPIO_SPEED_FREQ_HIGH – LL_GPIO_SPEED_FREQ_VERY_HIGH
Notes	<ul style="list-style-type: none"> • I/O speed can be Low, Medium, Fast or High speed. • Warning: only one pin can be passed as parameter. • Refer to datasheet for frequency specifications and the power supply and load conditions for each speed.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OSPEEDR OSPEEDy LL_GPIO_GetPinSpeed

LL_GPIO_SetPinPull

Function name	__STATIC_INLINE void LL_GPIO_SetPinPull (GPIO_TypeDef * GPIOx, uint32_t Pin, uint32_t Pull)
Function description	Configure gpio pull-up or pull-down for a dedicated pin on a dedicated port.
Parameters	<ul style="list-style-type: none"> • GPIOx: GPIO Port • Pin: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_PIN_0 – LL_GPIO_PIN_1 – LL_GPIO_PIN_2 – LL_GPIO_PIN_3 – LL_GPIO_PIN_4 – LL_GPIO_PIN_5 – LL_GPIO_PIN_6 – LL_GPIO_PIN_7 – LL_GPIO_PIN_8 – LL_GPIO_PIN_9 – LL_GPIO_PIN_10 – LL_GPIO_PIN_11 – LL_GPIO_PIN_12 – LL_GPIO_PIN_13 – LL_GPIO_PIN_14 – LL_GPIO_PIN_15 • Pull: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_PULL_NO – LL_GPIO_PULL_UP – LL_GPIO_PULL_DOWN
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Warning: only one pin can be passed as parameter.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PUPDR PUPDy LL_GPIO_SetPinPull

LL_GPIO_GetPinPull

Function name	__STATIC_INLINE uint32_t LL_GPIO_GetPinPull (GPIO_TypeDef * GPIOx, uint32_t Pin)
Function description	Return gpio pull-up or pull-down for a dedicated pin on a dedicated

	port.
Parameters	<ul style="list-style-type: none"> • GPIOx: GPIO Port • Pin: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_PIN_0 – LL_GPIO_PIN_1 – LL_GPIO_PIN_2 – LL_GPIO_PIN_3 – LL_GPIO_PIN_4 – LL_GPIO_PIN_5 – LL_GPIO_PIN_6 – LL_GPIO_PIN_7 – LL_GPIO_PIN_8 – LL_GPIO_PIN_9 – LL_GPIO_PIN_10 – LL_GPIO_PIN_11 – LL_GPIO_PIN_12 – LL_GPIO_PIN_13 – LL_GPIO_PIN_14 – LL_GPIO_PIN_15
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_PULL_NO – LL_GPIO_PULL_UP – LL_GPIO_PULL_DOWN
Notes	<ul style="list-style-type: none"> • Warning: only one pin can be passed as parameter.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PUPDR PUPDy LL_GPIO_GetPinPull

LL_GPIO_SetAFPin_0_7

Function name	__STATIC_INLINE void LL_GPIO_SetAFPin_0_7 (GPIO_TypeDef * GPIOx, uint32_t Pin, uint32_t Alternate)
Function description	Configure gpio alternate function of a dedicated pin from 0 to 7 for a dedicated port.
Parameters	<ul style="list-style-type: none"> • GPIOx: GPIO Port • Pin: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_PIN_0 – LL_GPIO_PIN_1 – LL_GPIO_PIN_2 – LL_GPIO_PIN_3 – LL_GPIO_PIN_4 – LL_GPIO_PIN_5 – LL_GPIO_PIN_6 – LL_GPIO_PIN_7 • Alternate: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_AF_0 – LL_GPIO_AF_1 – LL_GPIO_AF_2 – LL_GPIO_AF_3

- LL_GPIO_AF_4
- LL_GPIO_AF_5
- LL_GPIO_AF_6
- LL_GPIO_AF_7
- LL_GPIO_AF_8
- LL_GPIO_AF_9
- LL_GPIO_AF_10
- LL_GPIO_AF_11
- LL_GPIO_AF_12
- LL_GPIO_AF_13
- LL_GPIO_AF_14
- LL_GPIO_AF_15

Return values

- **None:**

Notes

- Possible values are from AF0 to AF15 depending on target.
- Warning: only one pin can be passed as parameter.

Reference Manual to
LL API cross
reference:

- AFRL AFSELy LL_GPIO_SetAFPin_0_7

LL_GPIO_GetAFPin_0_7

Function name

**__STATIC_INLINE uint32_t LL_GPIO_GetAFPin_0_7
(GPIO_TypeDef * GPIOx, uint32_t Pin)**

Function description

Return gpio alternate function of a dedicated pin from 0 to 7 for a dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **Pin:** This parameter can be one of the following values:
 - LL_GPIO_PIN_0
 - LL_GPIO_PIN_1
 - LL_GPIO_PIN_2
 - LL_GPIO_PIN_3
 - LL_GPIO_PIN_4
 - LL_GPIO_PIN_5
 - LL_GPIO_PIN_6
 - LL_GPIO_PIN_7

Return values

- **Returned:** value can be one of the following values:
 - LL_GPIO_AF_0
 - LL_GPIO_AF_1
 - LL_GPIO_AF_2
 - LL_GPIO_AF_3
 - LL_GPIO_AF_4
 - LL_GPIO_AF_5
 - LL_GPIO_AF_6
 - LL_GPIO_AF_7
 - LL_GPIO_AF_8
 - LL_GPIO_AF_9
 - LL_GPIO_AF_10
 - LL_GPIO_AF_11
 - LL_GPIO_AF_12
 - LL_GPIO_AF_13

- LL_GPIO_AF_14
- LL_GPIO_AF_15

Reference Manual to LL API cross reference:

- AFRL AFSELY LL_GPIO_GetAFPin_0_7

LL_GPIO_SetAFPin_8_15

Function name	<code>__STATIC_INLINE void LL_GPIO_SetAFPin_8_15 (GPIO_TypeDef * GPIOx, uint32_t Pin, uint32_t Alternate)</code>
Function description	Configure gpio alternate function of a dedicated pin from 8 to 15 for a dedicated port.
Parameters	<ul style="list-style-type: none"> • GPIOx: GPIO Port • Pin: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_GPIO_PIN_8 - LL_GPIO_PIN_9 - LL_GPIO_PIN_10 - LL_GPIO_PIN_11 - LL_GPIO_PIN_12 - LL_GPIO_PIN_13 - LL_GPIO_PIN_14 - LL_GPIO_PIN_15 • Alternate: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_GPIO_AF_0 - LL_GPIO_AF_1 - LL_GPIO_AF_2 - LL_GPIO_AF_3 - LL_GPIO_AF_4 - LL_GPIO_AF_5 - LL_GPIO_AF_6 - LL_GPIO_AF_7 - LL_GPIO_AF_8 - LL_GPIO_AF_9 - LL_GPIO_AF_10 - LL_GPIO_AF_11 - LL_GPIO_AF_12 - LL_GPIO_AF_13 - LL_GPIO_AF_14 - LL_GPIO_AF_15
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Possible values are from AF0 to AF15 depending on target. • Warning: only one pin can be passed as parameter.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AFRH AFSELY LL_GPIO_SetAFPin_8_15

LL_GPIO_GetAFPin_8_15

Function name `__STATIC_INLINE uint32_t LL_GPIO_GetAFPin_8_15`

(GPIO_TypeDef * GPIOx, uint32_t Pin)

Function description	Return gpio alternate function of a dedicated pin from 8 to 15 for a dedicated port.
Parameters	<ul style="list-style-type: none"> • GPIOx: GPIO Port • Pin: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_PIN_8 – LL_GPIO_PIN_9 – LL_GPIO_PIN_10 – LL_GPIO_PIN_11 – LL_GPIO_PIN_12 – LL_GPIO_PIN_13 – LL_GPIO_PIN_14 – LL_GPIO_PIN_15
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_GPIO_AF_0 – LL_GPIO_AF_1 – LL_GPIO_AF_2 – LL_GPIO_AF_3 – LL_GPIO_AF_4 – LL_GPIO_AF_5 – LL_GPIO_AF_6 – LL_GPIO_AF_7 – LL_GPIO_AF_8 – LL_GPIO_AF_9 – LL_GPIO_AF_10 – LL_GPIO_AF_11 – LL_GPIO_AF_12 – LL_GPIO_AF_13 – LL_GPIO_AF_14 – LL_GPIO_AF_15
Notes	<ul style="list-style-type: none"> • Possible values are from AF0 to AF15 depending on target.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AFRH AFSELY LL_GPIO_GetAFPin_8_15

LL_GPIO_LockPin

Function name	__STATIC_INLINE void LL_GPIO_LockPin (GPIO_TypeDef * GPIOx, uint32_t PinMask)
Function description	Lock configuration of several pins for a dedicated port.
Parameters	<ul style="list-style-type: none"> • GPIOx: GPIO Port • PinMask: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_GPIO_PIN_0 – LL_GPIO_PIN_1 – LL_GPIO_PIN_2 – LL_GPIO_PIN_3 – LL_GPIO_PIN_4 – LL_GPIO_PIN_5

- LL_GPIO_PIN_6
- LL_GPIO_PIN_7
- LL_GPIO_PIN_8
- LL_GPIO_PIN_9
- LL_GPIO_PIN_10
- LL_GPIO_PIN_11
- LL_GPIO_PIN_12
- LL_GPIO_PIN_13
- LL_GPIO_PIN_14
- LL_GPIO_PIN_15
- LL_GPIO_PIN_ALL

Return values

- **None:**

Notes

- When the lock sequence has been applied on a port bit, the value of this port bit can no longer be modified until the next reset.
- Each lock bit freezes a specific configuration register (control and alternate function registers).

Reference Manual to LL API cross reference:

- LCKR LCKK LL_GPIO_LockPin

LL_GPIO_IsPinLocked

Function name

__STATIC_INLINE uint32_t LL_GPIO_IsPinLocked (GPIO_TypeDef * GPIOx, uint32_t PinMask)

Function description

Return 1 if all pins passed as parameter, of a dedicated port, are locked.

Parameters

- **GPIOx:** GPIO Port
- **PinMask:** This parameter can be a combination of the following values:
 - LL_GPIO_PIN_0
 - LL_GPIO_PIN_1
 - LL_GPIO_PIN_2
 - LL_GPIO_PIN_3
 - LL_GPIO_PIN_4
 - LL_GPIO_PIN_5
 - LL_GPIO_PIN_6
 - LL_GPIO_PIN_7
 - LL_GPIO_PIN_8
 - LL_GPIO_PIN_9
 - LL_GPIO_PIN_10
 - LL_GPIO_PIN_11
 - LL_GPIO_PIN_12
 - LL_GPIO_PIN_13
 - LL_GPIO_PIN_14
 - LL_GPIO_PIN_15
 - LL_GPIO_PIN_ALL

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross

- LCKR LCKy LL_GPIO_IsPinLocked

reference:

LL_GPIO_IsAnyPinLocked

Function name `__STATIC_INLINE uint32_t LL_GPIO_IsAnyPinLocked (GPIO_TypeDef * GPIOx)`

Function description Return 1 if one of the pin of a dedicated port is locked.

Parameters

- **GPIOx:** GPIO Port

Return values

- **State:** of bit (1 or 0).

Reference Manual to

- LCKR LCKK LL_GPIO_IsAnyPinLocked

LL API cross

reference:

LL_GPIO_ReadInputPort

Function name `__STATIC_INLINE uint32_t LL_GPIO_ReadInputPort (GPIO_TypeDef * GPIOx)`

Function description Return full input data register value for a dedicated port.

Parameters

- **GPIOx:** GPIO Port

Return values

- **Input:** data register value of port

Reference Manual to

- IDR IDy LL_GPIO_ReadInputPort

LL API cross

reference:

LL_GPIO_IsInputPinSet

Function name `__STATIC_INLINE uint32_t LL_GPIO_IsInputPinSet (GPIO_TypeDef * GPIOx, uint32_t PinMask)`

Function description Return if input data level for several pins of dedicated port is high or low.

Parameters

- **GPIOx:** GPIO Port
- **PinMask:** This parameter can be a combination of the following values:
 - LL_GPIO_PIN_0
 - LL_GPIO_PIN_1
 - LL_GPIO_PIN_2
 - LL_GPIO_PIN_3
 - LL_GPIO_PIN_4
 - LL_GPIO_PIN_5
 - LL_GPIO_PIN_6
 - LL_GPIO_PIN_7
 - LL_GPIO_PIN_8
 - LL_GPIO_PIN_9
 - LL_GPIO_PIN_10
 - LL_GPIO_PIN_11
 - LL_GPIO_PIN_12
 - LL_GPIO_PIN_13
 - LL_GPIO_PIN_14

- LL_GPIO_PIN_15
 - LL_GPIO_PIN_ALL
- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- IDR IDy LL_GPIO_IsInputPinSet

LL_GPIO_WriteOutputPort

Function name **__STATIC_INLINE void LL_GPIO_WriteOutputPort (GPIO_TypeDef * GPIOx, uint32_t PortValue)**

Function description Write output data register for the port.

- Parameters
- **GPIOx:** GPIO Port
 - **PortValue:** Level value for each pin of the port

Return values

- **None:**

Reference Manual to LL API cross reference:

- ODR ODy LL_GPIO_WriteOutputPort

LL_GPIO_ReadOutputPort

Function name **__STATIC_INLINE uint32_t LL_GPIO_ReadOutputPort (GPIO_TypeDef * GPIOx)**

Function description Return full output data register value for a dedicated port.

- Parameters
- **GPIOx:** GPIO Port

Return values

- **Output:** data register value of port

Reference Manual to LL API cross reference:

- ODR ODy LL_GPIO_ReadOutputPort

LL_GPIO_IsOutputPinSet

Function name **__STATIC_INLINE uint32_t LL_GPIO_IsOutputPinSet (GPIO_TypeDef * GPIOx, uint32_t PinMask)**

Function description Return if input data level for several pins of dedicated port is high or low.

- Parameters
- **GPIOx:** GPIO Port
 - **PinMask:** This parameter can be a combination of the following values:
 - LL_GPIO_PIN_0
 - LL_GPIO_PIN_1
 - LL_GPIO_PIN_2
 - LL_GPIO_PIN_3
 - LL_GPIO_PIN_4
 - LL_GPIO_PIN_5
 - LL_GPIO_PIN_6
 - LL_GPIO_PIN_7
 - LL_GPIO_PIN_8

- LL_GPIO_PIN_9
- LL_GPIO_PIN_10
- LL_GPIO_PIN_11
- LL_GPIO_PIN_12
- LL_GPIO_PIN_13
- LL_GPIO_PIN_14
- LL_GPIO_PIN_15
- LL_GPIO_PIN_ALL

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ODR ODy LL_GPIO_IsOutputPinSet

LL_GPIO_SetOutputPin

Function name

__STATIC_INLINE void LL_GPIO_SetOutputPin (GPIO_TypeDef * GPIOx, uint32_t PinMask)

Function description

Set several pins to high level on dedicated gpio port.

Parameters

- **GPIOx:** GPIO Port
- **PinMask:** This parameter can be a combination of the following values:
 - LL_GPIO_PIN_0
 - LL_GPIO_PIN_1
 - LL_GPIO_PIN_2
 - LL_GPIO_PIN_3
 - LL_GPIO_PIN_4
 - LL_GPIO_PIN_5
 - LL_GPIO_PIN_6
 - LL_GPIO_PIN_7
 - LL_GPIO_PIN_8
 - LL_GPIO_PIN_9
 - LL_GPIO_PIN_10
 - LL_GPIO_PIN_11
 - LL_GPIO_PIN_12
 - LL_GPIO_PIN_13
 - LL_GPIO_PIN_14
 - LL_GPIO_PIN_15
 - LL_GPIO_PIN_ALL

Return values

- **None:**

Reference Manual to LL API cross reference:

- BSRR BSy LL_GPIO_SetOutputPin

LL_GPIO_ResetOutputPin

Function name

__STATIC_INLINE void LL_GPIO_ResetOutputPin (GPIO_TypeDef * GPIOx, uint32_t PinMask)

Function description

Set several pins to low level on dedicated gpio port.

Parameters

- **GPIOx:** GPIO Port

- **PinMask:** This parameter can be a combination of the following values:
 - LL_GPIO_PIN_0
 - LL_GPIO_PIN_1
 - LL_GPIO_PIN_2
 - LL_GPIO_PIN_3
 - LL_GPIO_PIN_4
 - LL_GPIO_PIN_5
 - LL_GPIO_PIN_6
 - LL_GPIO_PIN_7
 - LL_GPIO_PIN_8
 - LL_GPIO_PIN_9
 - LL_GPIO_PIN_10
 - LL_GPIO_PIN_11
 - LL_GPIO_PIN_12
 - LL_GPIO_PIN_13
 - LL_GPIO_PIN_14
 - LL_GPIO_PIN_15
 - LL_GPIO_PIN_ALL

Return values

- **None:**

Reference Manual to LL API cross reference:

- BSRR BRy LL_GPIO_ResetOutputPin

LL_GPIO_TogglePin

Function name

__STATIC_INLINE void LL_GPIO_TogglePin (GPIO_TypeDef * GPIOx, uint32_t PinMask)

Function description

Toggle data value for several pin of dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **PinMask:** This parameter can be a combination of the following values:
 - LL_GPIO_PIN_0
 - LL_GPIO_PIN_1
 - LL_GPIO_PIN_2
 - LL_GPIO_PIN_3
 - LL_GPIO_PIN_4
 - LL_GPIO_PIN_5
 - LL_GPIO_PIN_6
 - LL_GPIO_PIN_7
 - LL_GPIO_PIN_8
 - LL_GPIO_PIN_9
 - LL_GPIO_PIN_10
 - LL_GPIO_PIN_11
 - LL_GPIO_PIN_12
 - LL_GPIO_PIN_13
 - LL_GPIO_PIN_14
 - LL_GPIO_PIN_15
 - LL_GPIO_PIN_ALL

Return values

- **None:**

Reference Manual to LL API cross reference:

- ODR ODy LL_GPIO_TogglePin

LL_GPIO_DeInit

Function name	ErrorStatus LL_GPIO_DeInit (GPIO_TypeDef * GPIOx)
Function description	De-initialize GPIO registers (Registers restored to their default values).
Parameters	<ul style="list-style-type: none"> • GPIOx: GPIO Port
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: GPIO registers are de-initialized – ERROR: Wrong GPIO Port

LL_GPIO_Init

Function name	ErrorStatus LL_GPIO_Init (GPIO_TypeDef * GPIOx, LL_GPIO_InitTypeDef * GPIO_InitStruct)
Function description	Initialize GPIO registers according to the specified parameters in GPIO_InitStruct.
Parameters	<ul style="list-style-type: none"> • GPIOx: GPIO Port • GPIO_InitStruct: pointer to a LL_GPIO_InitTypeDef structure that contains the configuration information for the specified GPIO peripheral.
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: GPIO registers are initialized according to GPIO_InitStruct content – ERROR: Not applicable

LL_GPIO_StructInit

Function name	void LL_GPIO_StructInit (LL_GPIO_InitTypeDef * GPIO_InitStruct)
Function description	Set each LL_GPIO_InitTypeDef field to default value.
Parameters	<ul style="list-style-type: none"> • GPIO_InitStruct: pointer to a LL_GPIO_InitTypeDef structure whose fields will be set to default values.
Return values	<ul style="list-style-type: none"> • None:

79.3 GPIO Firmware driver defines

79.3.1 GPIO

Alternate Function

LL_GPIO_AF_0	Select alternate function 0
LL_GPIO_AF_1	Select alternate function 1
LL_GPIO_AF_2	Select alternate function 2

LL_GPIO_AF_3	Select alternate function 3
LL_GPIO_AF_4	Select alternate function 4
LL_GPIO_AF_5	Select alternate function 5
LL_GPIO_AF_6	Select alternate function 6
LL_GPIO_AF_7	Select alternate function 7
LL_GPIO_AF_8	Select alternate function 8
LL_GPIO_AF_9	Select alternate function 9
LL_GPIO_AF_10	Select alternate function 10
LL_GPIO_AF_11	Select alternate function 11
LL_GPIO_AF_12	Select alternate function 12
LL_GPIO_AF_13	Select alternate function 13
LL_GPIO_AF_14	Select alternate function 14
LL_GPIO_AF_15	Select alternate function 15

Mode

LL_GPIO_MODE_INPUT	Select input mode
LL_GPIO_MODE_OUTPUT	Select output mode
LL_GPIO_MODE_ALTERNATE	Select alternate function mode
LL_GPIO_MODE_ANALOG	Select analog mode

Output Type

LL_GPIO_OUTPUT_PUSHPULL	Select push-pull as output type
LL_GPIO_OUTPUT_OPENDRAIN	Select open-drain as output type

PIN

LL_GPIO_PIN_0	Select pin 0
LL_GPIO_PIN_1	Select pin 1
LL_GPIO_PIN_2	Select pin 2
LL_GPIO_PIN_3	Select pin 3
LL_GPIO_PIN_4	Select pin 4
LL_GPIO_PIN_5	Select pin 5
LL_GPIO_PIN_6	Select pin 6
LL_GPIO_PIN_7	Select pin 7
LL_GPIO_PIN_8	Select pin 8
LL_GPIO_PIN_9	Select pin 9
LL_GPIO_PIN_10	Select pin 10
LL_GPIO_PIN_11	Select pin 11
LL_GPIO_PIN_12	Select pin 12
LL_GPIO_PIN_13	Select pin 13

LL_GPIO_PIN_14	Select pin 14
LL_GPIO_PIN_15	Select pin 15
LL_GPIO_PIN_ALL	Select all pins

Pull Up Pull Down

LL_GPIO_PULL_NO	Select I/O no pull
LL_GPIO_PULL_UP	Select I/O pull up
LL_GPIO_PULL_DOWN	Select I/O pull down

Output Speed

LL_GPIO_SPEED_FREQ_LOW	Select I/O low output speed
LL_GPIO_SPEED_FREQ_MEDIUM	Select I/O medium output speed
LL_GPIO_SPEED_FREQ_HIGH	Select I/O fast output speed
LL_GPIO_SPEED_FREQ_VERY_HIGH	Select I/O high output speed

Common Write and read registers Macros

LL_GPIO_WriteReg	Description: <ul style="list-style-type: none">Write a value in GPIO register. Parameters: <ul style="list-style-type: none"><code>__INSTANCE__</code>: GPIO Instance<code>__REG__</code>: Register to be written<code>__VALUE__</code>: Value to be written in the register Return value: <ul style="list-style-type: none">None
LL_GPIO_ReadReg	Description: <ul style="list-style-type: none">Read a value in GPIO register. Parameters: <ul style="list-style-type: none"><code>__INSTANCE__</code>: GPIO Instance<code>__REG__</code>: Register to be read Return value: <ul style="list-style-type: none">Register: value

80 LL I2C Generic Driver

80.1 I2C Firmware driver registers structures

80.1.1 LL_I2C_InitTypeDef

Data Fields

- *uint32_t PeripheralMode*
- *uint32_t Timing*
- *uint32_t AnalogFilter*
- *uint32_t DigitalFilter*
- *uint32_t OwnAddress1*
- *uint32_t TypeAcknowledge*
- *uint32_t OwnAddrSize*

Field Documentation

- *uint32_t LL_I2C_InitTypeDef::PeripheralMode*
Specifies the peripheral mode. This parameter can be a value of [I2C_LL_EC_PERIPHERAL_MODE](#). This feature can be modified afterwards using unitary function `LL_I2C_SetMode()`.
- *uint32_t LL_I2C_InitTypeDef::Timing*
Specifies the SDA setup, hold time and the SCL high, low period values. This parameter must be set by referring to the STM32CubeMX Tool and the helper macro `__LL_I2C_CONVERT_TIMINGS()`. This feature can be modified afterwards using unitary function `LL_I2C_SetTiming()`.
- *uint32_t LL_I2C_InitTypeDef::AnalogFilter*
Enables or disables analog noise filter. This parameter can be a value of [I2C_LL_EC_ANALOGFILTER_SELECTION](#). This feature can be modified afterwards using unitary functions `LL_I2C_EnableAnalogFilter()` or `LL_I2C_DisableAnalogFilter()`.
- *uint32_t LL_I2C_InitTypeDef::DigitalFilter*
Configures the digital noise filter. This parameter can be a number between `Min_Data = 0x00` and `Max_Data = 0x0F`. This feature can be modified afterwards using unitary function `LL_I2C_SetDigitalFilter()`.
- *uint32_t LL_I2C_InitTypeDef::OwnAddress1*
Specifies the device own address 1. This parameter must be a value between `Min_Data = 0x00` and `Max_Data = 0x3FFF`. This feature can be modified afterwards using unitary function `LL_I2C_SetOwnAddress1()`.
- *uint32_t LL_I2C_InitTypeDef::TypeAcknowledge*
Specifies the ACKnowledge or Non ACKnowledge condition after the address receive match code or next received byte. This parameter can be a value of [I2C_LL_EC_I2C_ACKNOWLEDGE](#). This feature can be modified afterwards using unitary function `LL_I2C_AcknowledgeNextData()`.
- *uint32_t LL_I2C_InitTypeDef::OwnAddrSize*
Specifies the device own address 1 size (7-bit or 10-bit). This parameter can be a value of [I2C_LL_EC_OWNADDRESS1](#). This feature can be modified afterwards using unitary function `LL_I2C_SetOwnAddress1()`.

80.2 I2C Firmware driver API description

80.2.1 Detailed description of functions

LL_I2C_Enable

Function name `__STATIC_INLINE void LL_I2C_Enable (I2C_TypeDef * I2Cx)`

Function description Enable I2C peripheral (PE = 1).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 PE LL_I2C_Enable

LL_I2C_Disable

Function name `__STATIC_INLINE void LL_I2C_Disable (I2C_TypeDef * I2Cx)`

Function description Disable I2C peripheral (PE = 0).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- When PE = 0, the I2C SCL and SDA lines are released. Internal state machines and status bits are put back to their reset value. When cleared, PE must be kept low for at least 3 APB clock cycles.

Reference Manual to LL API cross reference:

- CR1 PE LL_I2C_Disable

LL_I2C_IsEnabled

Function name `__STATIC_INLINE uint32_t LL_I2C_IsEnabled (I2C_TypeDef * I2Cx)`

Function description Check if the I2C peripheral is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 PE LL_I2C_IsEnabled

LL_I2C_ConfigFilters

Function name `__STATIC_INLINE void LL_I2C_ConfigFilters (I2C_TypeDef * I2Cx, uint32_t AnalogFilter, uint32_t DigitalFilter)`

Function description Configure Noise Filters (Analog and Digital).

Parameters

- **I2Cx:** I2C Instance.
- **AnalogFilter:** This parameter can be one of the following

	<ul style="list-style-type: none"> values: – LL_I2C_ANALOGFILTER_ENABLE – LL_I2C_ANALOGFILTER_DISABLE • DigitalFilter: This parameter must be a value between Min_Data=0x00 (Digital filter disabled) and Max_Data=0x0F (Digital filter enabled and filtering capability up to 15*ti2cclk). This parameter is used to configure the digital noise filter on SDA and SCL input. The digital filter will filter spikes with a length of up to DNF[3:0]*ti2cclk.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • If the analog filter is also enabled, the digital filter is added to analog filter. The filters can only be programmed when the I2C is disabled (PE = 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 ANFOFF LL_I2C_ConfigFilters • CR1 DNF LL_I2C_ConfigFilters

LL_I2C_SetDigitalFilter

Function name	__STATIC_INLINE void LL_I2C_SetDigitalFilter (I2C_TypeDef * I2Cx, uint32_t DigitalFilter)
Function description	Configure Digital Noise Filter.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • DigitalFilter: This parameter must be a value between Min_Data=0x00 (Digital filter disabled) and Max_Data=0x0F (Digital filter enabled and filtering capability up to 15*ti2cclk). This parameter is used to configure the digital noise filter on SDA and SCL input. The digital filter will filter spikes with a length of up to DNF[3:0]*ti2cclk.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • If the analog filter is also enabled, the digital filter is added to analog filter. This filter can only be programmed when the I2C is disabled (PE = 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 DNF LL_I2C_SetDigitalFilter

LL_I2C_GetDigitalFilter

Function name	__STATIC_INLINE uint32_t LL_I2C_GetDigitalFilter (I2C_TypeDef * I2Cx)
Function description	Get the current Digital Noise Filter configuration.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x0 and Max_Data=0xF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 DNF LL_I2C_GetDigitalFilter

LL_I2C_EnableAnalogFilter

Function name	__STATIC_INLINE void LL_I2C_EnableAnalogFilter (I2C_TypeDef * I2Cx)
Function description	Enable Analog Noise Filter.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This filter can only be programmed when the I2C is disabled (PE = 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 ANFOFF LL_I2C_EnableAnalogFilter

LL_I2C_DisableAnalogFilter

Function name	__STATIC_INLINE void LL_I2C_DisableAnalogFilter (I2C_TypeDef * I2Cx)
Function description	Disable Analog Noise Filter.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This filter can only be programmed when the I2C is disabled (PE = 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 ANFOFF LL_I2C_DisableAnalogFilter

LL_I2C_IsEnabledAnalogFilter

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledAnalogFilter (I2C_TypeDef * I2Cx)
Function description	Check if Analog Noise Filter is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 ANFOFF LL_I2C_IsEnabledAnalogFilter

LL_I2C_EnableDMAReq_TX

Function name	__STATIC_INLINE void LL_I2C_EnableDMAReq_TX (I2C_TypeDef * I2Cx)
Function description	Enable DMA transmission requests.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to	<ul style="list-style-type: none"> • CR1 TXDMAEN LL_I2C_EnableDMAReq_TX

LL API cross
reference:

LL_I2C_DisableDMAReq_TX

Function name	__STATIC_INLINE void LL_I2C_DisableDMAReq_TX (I2C_TypeDef * I2Cx)
Function description	Disable DMA transmission requests.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 TXDMAEN LL_I2C_DisableDMAReq_TX

LL_I2C_IsEnabledDMAReq_TX

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledDMAReq_TX (I2C_TypeDef * I2Cx)
Function description	Check if DMA transmission requests are enabled or disabled.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 TXDMAEN LL_I2C_IsEnabledDMAReq_TX

LL_I2C_EnableDMAReq_RX

Function name	__STATIC_INLINE void LL_I2C_EnableDMAReq_RX (I2C_TypeDef * I2Cx)
Function description	Enable DMA reception requests.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 RXDMAEN LL_I2C_EnableDMAReq_RX

LL_I2C_DisableDMAReq_RX

Function name	__STATIC_INLINE void LL_I2C_DisableDMAReq_RX (I2C_TypeDef * I2Cx)
Function description	Disable DMA reception requests.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross	<ul style="list-style-type: none">• CR1 RXDMAEN LL_I2C_DisableDMAReq_RX

reference:

LL_I2C_IsEnabledDMAReq_RX

Function name `__STATIC_INLINE uint32_t LL_I2C_IsEnabledDMAReq_RX (I2C_TypeDef * I2Cx)`

Function description Check if DMA reception requests are enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 RXDMAEN LL_I2C_IsEnabledDMAReq_RX

LL_I2C_DMA_GetRegAddr

Function name `__STATIC_INLINE uint32_t LL_I2C_DMA_GetRegAddr (I2C_TypeDef * I2Cx, uint32_t Direction)`

Function description Get the data register address used for DMA transfer.

Parameters

- **I2Cx:** I2C Instance
- **Direction:** This parameter can be one of the following values:
 - LL_I2C_DMA_REG_DATA_TRANSMIT
 - LL_I2C_DMA_REG_DATA_RECEIVE

Return values

- **Address:** of data register

Reference Manual to LL API cross reference:

- TXDR TXDATA LL_I2C_DMA_GetRegAddr
- RXDR RXDATA LL_I2C_DMA_GetRegAddr

LL_I2C_EnableClockStretching

Function name `__STATIC_INLINE void LL_I2C_EnableClockStretching (I2C_TypeDef * I2Cx)`

Function description Enable Clock stretching.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- This bit can only be programmed when the I2C is disabled (PE = 0).

Reference Manual to LL API cross reference:

- CR1 NOSTRETCH LL_I2C_EnableClockStretching

LL_I2C_DisableClockStretching

Function name `__STATIC_INLINE void LL_I2C_DisableClockStretching (I2C_TypeDef * I2Cx)`

Function description Disable Clock stretching.

Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This bit can only be programmed when the I2C is disabled (PE = 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 NOSTRETCH LL_I2C_DisableClockStretching

LL_I2C_IsEnabledClockStretching

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledClockStretching (I2C_TypeDef * I2Cx)
Function description	Check if Clock stretching is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 NOSTRETCH LL_I2C_IsEnabledClockStretching

LL_I2C_EnableSlaveByteControl

Function name	__STATIC_INLINE void LL_I2C_EnableSlaveByteControl (I2C_TypeDef * I2Cx)
Function description	Enable hardware byte control in slave mode.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 SBC LL_I2C_EnableSlaveByteControl

LL_I2C_DisableSlaveByteControl

Function name	__STATIC_INLINE void LL_I2C_DisableSlaveByteControl (I2C_TypeDef * I2Cx)
Function description	Disable hardware byte control in slave mode.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 SBC LL_I2C_DisableSlaveByteControl

LL_I2C_IsEnabledSlaveByteControl

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledSlaveByteControl (I2C_TypeDef * I2Cx)
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Function description	Check if hardware byte control in slave mode is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 SBC LL_I2C_IsEnabledSlaveByteControl

LL_I2C_EnableGeneralCall

Function name	__STATIC_INLINE void LL_I2C_EnableGeneralCall (I2C_TypeDef * I2Cx)
Function description	Enable General Call.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • When enabled the Address 0x00 is ACKed.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 GCEN LL_I2C_EnableGeneralCall

LL_I2C_DisableGeneralCall

Function name	__STATIC_INLINE void LL_I2C_DisableGeneralCall (I2C_TypeDef * I2Cx)
Function description	Disable General Call.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • When disabled the Address 0x00 is NACKed.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 GCEN LL_I2C_DisableGeneralCall

LL_I2C_IsEnabledGeneralCall

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledGeneralCall (I2C_TypeDef * I2Cx)
Function description	Check if General Call is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 GCEN LL_I2C_IsEnabledGeneralCall

LL_I2C_SetMasterAddressingMode

Function name	__STATIC_INLINE void LL_I2C_SetMasterAddressingMode (I2C_TypeDef * I2Cx, uint32_t AddressingMode)
Function description	Configure the Master to operate in 7-bit or 10-bit addressing mode.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • AddressingMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_I2C_ADDRESSING_MODE_7BIT – LL_I2C_ADDRESSING_MODE_10BIT
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Changing this bit is not allowed, when the START bit is set.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 ADD10 LL_I2C_SetMasterAddressingMode

LL_I2C_GetMasterAddressingMode

Function name	__STATIC_INLINE uint32_t LL_I2C_GetMasterAddressingMode (I2C_TypeDef * I2Cx)
Function description	Get the Master addressing mode.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_I2C_ADDRESSING_MODE_7BIT – LL_I2C_ADDRESSING_MODE_10BIT
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 ADD10 LL_I2C_GetMasterAddressingMode

LL_I2C_SetOwnAddress1

Function name	__STATIC_INLINE void LL_I2C_SetOwnAddress1 (I2C_TypeDef * I2Cx, uint32_t OwnAddress1, uint32_t OwnAddrSize)
Function description	Set the Own Address1.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • OwnAddress1: This parameter must be a value between Min_Data=0 and Max_Data=0x3FF. • OwnAddrSize: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_I2C_OWNADDRESS1_7BIT – LL_I2C_OWNADDRESS1_10BIT
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OAR1 OA1 LL_I2C_SetOwnAddress1 • OAR1 OA1MODE LL_I2C_SetOwnAddress1

LL_I2C_EnableOwnAddress1

Function name	__STATIC_INLINE void LL_I2C_EnableOwnAddress1 (I2C_TypeDef * I2Cx)
Function description	Enable acknowledge on Own Address1 match address.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OAR1 OA1EN LL_I2C_EnableOwnAddress1

LL_I2C_DisableOwnAddress1

Function name	__STATIC_INLINE void LL_I2C_DisableOwnAddress1 (I2C_TypeDef * I2Cx)
Function description	Disable acknowledge on Own Address1 match address.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OAR1 OA1EN LL_I2C_DisableOwnAddress1

LL_I2C_IsEnabledOwnAddress1

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledOwnAddress1 (I2C_TypeDef * I2Cx)
Function description	Check if Own Address1 acknowledge is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OAR1 OA1EN LL_I2C_IsEnabledOwnAddress1

LL_I2C_SetOwnAddress2

Function name	__STATIC_INLINE void LL_I2C_SetOwnAddress2 (I2C_TypeDef * I2Cx, uint32_t OwnAddress2, uint32_t OwnAddrMask)
Function description	Set the 7bits Own Address2.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • OwnAddress2: Value between Min_Data=0 and Max_Data=0x7F. • OwnAddrMask: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_I2C_OWNADDRESS2_NOMASK – LL_I2C_OWNADDRESS2_MASK01 – LL_I2C_OWNADDRESS2_MASK02

- LL_I2C_OWNADDRESS2_MASK03
- LL_I2C_OWNADDRESS2_MASK04
- LL_I2C_OWNADDRESS2_MASK05
- LL_I2C_OWNADDRESS2_MASK06
- LL_I2C_OWNADDRESS2_MASK07

- Return values
- **None:**
- Notes
- This action has no effect if own address2 is enabled.
- Reference Manual to LL API cross reference:
- OAR2 OA2 LL_I2C_SetOwnAddress2
 - OAR2 OA2MSK LL_I2C_SetOwnAddress2

LL_I2C_EnableOwnAddress2

- Function name **__STATIC_INLINE void LL_I2C_EnableOwnAddress2 (I2C_TypeDef * I2Cx)**
- Function description Enable acknowledge on Own Address2 match address.
- Parameters
- **I2Cx:** I2C Instance.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- OAR2 OA2EN LL_I2C_EnableOwnAddress2

LL_I2C_DisableOwnAddress2

- Function name **__STATIC_INLINE void LL_I2C_DisableOwnAddress2 (I2C_TypeDef * I2Cx)**
- Function description Disable acknowledge on Own Address2 match address.
- Parameters
- **I2Cx:** I2C Instance.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- OAR2 OA2EN LL_I2C_DisableOwnAddress2

LL_I2C_IsEnabledOwnAddress2

- Function name **__STATIC_INLINE uint32_t LL_I2C_IsEnabledOwnAddress2 (I2C_TypeDef * I2Cx)**
- Function description Check if Own Address1 acknowledge is enabled or disabled.
- Parameters
- **I2Cx:** I2C Instance.
- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- OAR2 OA2EN LL_I2C_IsEnabledOwnAddress2

LL_I2C_SetTiming

Function name	__STATIC_INLINE void LL_I2C_SetTiming (I2C_TypeDef * I2Cx, uint32_t Timing)
Function description	Configure the SDA setup, hold time and the SCL high, low period.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • Timing: This parameter must be a value between Min_Data=0 and Max_Data=0xFFFFFFFF.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This bit can only be programmed when the I2C is disabled (PE = 0). • This parameter is computed with the STM32CubeMX Tool.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TIMINGR TIMINGR LL_I2C_SetTiming

LL_I2C_GetTimingPrescaler

Function name	__STATIC_INLINE uint32_t LL_I2C_GetTimingPrescaler (I2C_TypeDef * I2Cx)
Function description	Get the Timing Prescaler setting.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x0 and Max_Data=0xF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TIMINGR PRESC LL_I2C_GetTimingPrescaler

LL_I2C_GetClockLowPeriod

Function name	__STATIC_INLINE uint32_t LL_I2C_GetClockLowPeriod (I2C_TypeDef * I2Cx)
Function description	Get the SCL low period setting.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0xFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TIMINGR SCLL LL_I2C_GetClockLowPeriod

LL_I2C_GetClockHighPeriod

Function name	__STATIC_INLINE uint32_t LL_I2C_GetClockHighPeriod (I2C_TypeDef * I2Cx)
Function description	Get the SCL high period setting.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0xFF

- Reference Manual to LL API cross reference:
- TIMINGR SCLH LL_I2C_GetClockHighPeriod

LL_I2C_GetDataHoldTime

Function name **__STATIC_INLINE uint32_t LL_I2C_GetDataHoldTime (I2C_TypeDef * I2Cx)**

Function description Get the SDA hold time.

Parameters

- **I2Cx**: I2C Instance.

Return values

- **Value**: between Min_Data=0x0 and Max_Data=0xF

- Reference Manual to LL API cross reference:
- TIMINGR SDADEL LL_I2C_GetDataHoldTime

LL_I2C_GetDataSetupTime

Function name **__STATIC_INLINE uint32_t LL_I2C_GetDataSetupTime (I2C_TypeDef * I2Cx)**

Function description Get the SDA setup time.

Parameters

- **I2Cx**: I2C Instance.

Return values

- **Value**: between Min_Data=0x0 and Max_Data=0xF

- Reference Manual to LL API cross reference:
- TIMINGR SCLDEL LL_I2C_GetDataSetupTime

LL_I2C_SetMode

Function name **__STATIC_INLINE void LL_I2C_SetMode (I2C_TypeDef * I2Cx, uint32_t PeripheralMode)**

Function description Configure peripheral mode.

Parameters

- **I2Cx**: I2C Instance.
- **PeripheralMode**: This parameter can be one of the following values:
 - LL_I2C_MODE_I2C
 - LL_I2C_MODE_SMBUS_HOST
 - LL_I2C_MODE_SMBUS_DEVICE
 - LL_I2C_MODE_SMBUS_DEVICE_ARP

Return values

- **None**:

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

- Reference Manual to LL API cross reference:
- CR1 SMBHEN LL_I2C_SetMode
 - CR1 SMBDEN LL_I2C_SetMode

LL_I2C_GetMode

Function name	__STATIC_INLINE uint32_t LL_I2C_GetMode (I2C_TypeDef * I2Cx)
Function description	Get peripheral mode.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_I2C_MODE_I2C – LL_I2C_MODE_SMBUS_HOST – LL_I2C_MODE_SMBUS_DEVICE – LL_I2C_MODE_SMBUS_DEVICE_ARP
Notes	<ul style="list-style-type: none"> • Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 SMBHEN LL_I2C_GetMode • CR1 SMBDEN LL_I2C_GetMode

LL_I2C_EnableSMBusAlert

Function name	__STATIC_INLINE void LL_I2C_EnableSMBusAlert (I2C_TypeDef * I2Cx)
Function description	Enable SMBus alert (Host or Device mode)
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance. • SMBus Device mode: SMBus Alert pin is driven low and Alert Response Address Header acknowledge is enabled. SMBus Host mode: SMBus Alert pin management is supported.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 ALERTEN LL_I2C_EnableSMBusAlert

LL_I2C_DisableSMBusAlert

Function name	__STATIC_INLINE void LL_I2C_DisableSMBusAlert (I2C_TypeDef * I2Cx)
Function description	Disable SMBus alert (Host or Device mode)
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance. • SMBus Device mode: SMBus Alert pin is not driven (can be used as a standard GPIO) and Alert Response Address

Header acknowledge is disabled. SMBus Host mode:SMBus Alert pin management is not supported.

- Reference Manual to LL API cross reference:
- CR1 ALERTEN LL_I2C_DisableSMBusAlert

LL_I2C_IsEnabledSMBusAlert

Function name `__STATIC_INLINE uint32_t LL_I2C_IsEnabledSMBusAlert(I2C_TypeDef * I2Cx)`

Function description Check if SMBus alert (Host or Device mode) is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- Macro `IS_SMBUS_ALL_INSTANCE(I2Cx)` can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

- Reference Manual to LL API cross reference:
- CR1 ALERTEN LL_I2C_IsEnabledSMBusAlert

LL_I2C_EnableSMBusPEC

Function name `__STATIC_INLINE void LL_I2C_EnableSMBusPEC(I2C_TypeDef * I2Cx)`

Function description Enable SMBus Packet Error Calculation (PEC).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro `IS_SMBUS_ALL_INSTANCE(I2Cx)` can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

- Reference Manual to LL API cross reference:
- CR1 PECEN LL_I2C_EnableSMBusPEC

LL_I2C_DisableSMBusPEC

Function name `__STATIC_INLINE void LL_I2C_DisableSMBusPEC(I2C_TypeDef * I2Cx)`

Function description Disable SMBus Packet Error Calculation (PEC).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro `IS_SMBUS_ALL_INSTANCE(I2Cx)` can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- CR1 PECEN LL_I2C_DisableSMBusPEC

LL_I2C_IsEnabledSMBusPEC

Function name `__STATIC_INLINE uint32_t LL_I2C_IsEnabledSMBusPEC(I2C_TypeDef * I2Cx)`

Function description Check if SMBus Packet Error Calculation (PEC) is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- Macro `IS_SMBUS_ALL_INSTANCE(I2Cx)` can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- CR1 PECEN LL_I2C_IsEnabledSMBusPEC

LL_I2C_ConfigSMBusTimeout

Function name `__STATIC_INLINE void LL_I2C_ConfigSMBusTimeout(I2C_TypeDef * I2Cx, uint32_t TimeoutA, uint32_t TimeoutAMode, uint32_t TimeoutB)`

Function description Configure the SMBus Clock Timeout.

Parameters

- **I2Cx:** I2C Instance.
- **TimeoutA:** This parameter must be a value between `Min_Data=0` and `Max_Data=0xFFFF`.
- **TimeoutAMode:** This parameter can be one of the following values:
 - `LL_I2C_SMBUS_TIMEOUTA_MODE_SCL_LOW`
 - `LL_I2C_SMBUS_TIMEOUTA_MODE_SDA_SCL_HIGH`
- **TimeoutB:**

Return values

- **None:**

Notes

- Macro `IS_SMBUS_ALL_INSTANCE(I2Cx)` can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- This configuration can only be programmed when associated Timeout is disabled (TimeoutA and/orTimeoutB).

Reference Manual to LL API cross reference:

- `TIMEOUTR TIMEOUTA LL_I2C_ConfigSMBusTimeout`
- `TIMEOUTR TIDLE LL_I2C_ConfigSMBusTimeout`
- `TIMEOUTR TIMEOUTB LL_I2C_ConfigSMBusTimeout`

LL_I2C_SetSMBusTimeoutA

Function name `__STATIC_INLINE void LL_I2C_SetSMBusTimeoutA(I2C_TypeDef * I2Cx, uint32_t TimeoutA)`

Function description Configure the SMBus Clock TimeoutA (SCL low timeout or SCL

and SDA high timeout depends on TimeoutA mode).

Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • TimeoutA: This parameter must be a value between Min_Data=0 and Max_Data=0xFFFF.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance. • These bits can only be programmed when TimeoutA is disabled.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TIMEOUTR TIMEOUTA LL_I2C_SetSMBusTimeoutA

LL_I2C_GetSMBusTimeoutA

Function name	__STATIC_INLINE uint32_t LL_I2C_GetSMBusTimeoutA (I2C_TypeDef * I2Cx)
Function description	Get the SMBus Clock TimeoutA setting.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0 and Max_Data=0xFFFF
Notes	<ul style="list-style-type: none"> • Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TIMEOUTR TIMEOUTA LL_I2C_GetSMBusTimeoutA

LL_I2C_SetSMBusTimeoutAMode

Function name	__STATIC_INLINE void LL_I2C_SetSMBusTimeoutAMode (I2C_TypeDef * I2Cx, uint32_t TimeoutAMode)
Function description	Set the SMBus Clock TimeoutA mode.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • TimeoutAMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_I2C_SMBUS_TIMEOUTA_MODE_SCL_LOW – LL_I2C_SMBUS_TIMEOUTA_MODE_SDA_SCL_HIGH
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance. • This bit can only be programmed when TimeoutA is disabled.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TIMEOUTR TIDLE LL_I2C_SetSMBusTimeoutAMode

LL_I2C_GetSMBusTimeoutAMode

Function name	__STATIC_INLINE uint32_t LL_I2C_GetSMBusTimeoutAMode (I2C_TypeDef * I2Cx)
Function description	Get the SMBus Clock TimeoutA mode.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_I2C_SMBUS_TIMEOUTA_MODE_SCL_LOW – LL_I2C_SMBUS_TIMEOUTA_MODE_SDA_SCL_HIGH
Notes	<ul style="list-style-type: none"> • Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TIMEOUTR TIDLE LL_I2C_GetSMBusTimeoutAMode

LL_I2C_SetSMBusTimeoutB

Function name	__STATIC_INLINE void LL_I2C_SetSMBusTimeoutB (I2C_TypeDef * I2Cx, uint32_t TimeoutB)
Function description	Configure the SMBus Extended Cumulative Clock TimeoutB (Master or Slave mode).
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • TimeoutB: This parameter must be a value between Min_Data=0 and Max_Data=0xFFFF.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance. • These bits can only be programmed when TimeoutB is disabled.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TIMEOUTR TIMEOUTB LL_I2C_SetSMBusTimeoutB

LL_I2C_GetSMBusTimeoutB

Function name	__STATIC_INLINE uint32_t LL_I2C_GetSMBusTimeoutB (I2C_TypeDef * I2Cx)
Function description	Get the SMBus Extended Cumulative Clock TimeoutB setting.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0 and Max_Data=0xFFFF
Notes	<ul style="list-style-type: none"> • Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
Reference Manual to LL API cross	<ul style="list-style-type: none"> • TIMEOUTR TIMEOUTB LL_I2C_GetSMBusTimeoutB

reference:

LL_I2C_EnableSMBusTimeout

Function name	__STATIC_INLINE void LL_I2C_EnableSMBusTimeout (I2C_TypeDef * I2Cx, uint32_t ClockTimeout)
Function description	Enable the SMBus Clock Timeout.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • ClockTimeout: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_I2C_SMBUS_TIMEOUTA – LL_I2C_SMBUS_TIMEOUTB – LL_I2C_SMBUS_ALL_TIMEOUT
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TIMEOUTR TIMOUTEN LL_I2C_EnableSMBusTimeout • TIMEOUTR TEXTEN LL_I2C_EnableSMBusTimeout

LL_I2C_DisableSMBusTimeout

Function name	__STATIC_INLINE void LL_I2C_DisableSMBusTimeout (I2C_TypeDef * I2Cx, uint32_t ClockTimeout)
Function description	Disable the SMBus Clock Timeout.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • ClockTimeout: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_I2C_SMBUS_TIMEOUTA – LL_I2C_SMBUS_TIMEOUTB – LL_I2C_SMBUS_ALL_TIMEOUT
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TIMEOUTR TIMOUTEN LL_I2C_DisableSMBusTimeout • TIMEOUTR TEXTEN LL_I2C_DisableSMBusTimeout

LL_I2C_IsEnabledSMBusTimeout

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledSMBusTimeout (I2C_TypeDef * I2Cx, uint32_t ClockTimeout)
Function description	Check if the SMBus Clock Timeout is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • ClockTimeout: This parameter can be one of the following values:

	<ul style="list-style-type: none"> - LL_I2C_SMBUS_TIMEOUTA - LL_I2C_SMBUS_TIMEOUTB - LL_I2C_SMBUS_ALL_TIMEOUT
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TIMEOUTR TIMOUTEN LL_I2C_IsEnabledSMBusTimeout • TIMEOUTR TEXTEN LL_I2C_IsEnabledSMBusTimeout

LL_I2C_EnableIT_TX

Function name	__STATIC_INLINE void LL_I2C_EnableIT_TX (I2C_TypeDef * I2Cx)
Function description	Enable TXIS interrupt.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 TXIE LL_I2C_EnableIT_TX

LL_I2C_DisableIT_TX

Function name	__STATIC_INLINE void LL_I2C_DisableIT_TX (I2C_TypeDef * I2Cx)
Function description	Disable TXIS interrupt.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 TXIE LL_I2C_DisableIT_TX

LL_I2C_IsEnabledIT_TX

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_TX (I2C_TypeDef * I2Cx)
Function description	Check if the TXIS Interrupt is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 TXIE LL_I2C_IsEnabledIT_TX

LL_I2C_EnableIT_RX

Function name	__STATIC_INLINE void LL_I2C_EnableIT_RX (I2C_TypeDef * I2Cx)
Function description	Enable RXNE interrupt.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 RXIE LL_I2C_EnableIT_RX

LL_I2C_DisableIT_RX

Function name	__STATIC_INLINE void LL_I2C_DisableIT_RX (I2C_TypeDef * I2Cx)
Function description	Disable RXNE interrupt.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 RXIE LL_I2C_DisableIT_RX

LL_I2C_IsEnabledIT_RX

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_RX (I2C_TypeDef * I2Cx)
Function description	Check if the RXNE Interrupt is enabled or disabled.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 RXIE LL_I2C_IsEnabledIT_RX

LL_I2C_EnableIT_ADDR

Function name	__STATIC_INLINE void LL_I2C_EnableIT_ADDR (I2C_TypeDef * I2Cx)
Function description	Enable Address match interrupt (slave mode only).
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 ADDRIE LL_I2C_EnableIT_ADDR

LL_I2C_DisableIT_ADDR

Function name	__STATIC_INLINE void LL_I2C_DisableIT_ADDR (I2C_TypeDef * I2Cx)
Function description	Disable Address match interrupt (slave mode only).
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 ADDRIE LL_I2C_DisableIT_ADDR

LL_I2C_IsEnabledIT_ADDR

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_ADDR (I2C_TypeDef * I2Cx)
Function description	Check if Address match interrupt is enabled or disabled.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 ADDRIE LL_I2C_IsEnabledIT_ADDR

LL_I2C_EnableIT_NACK

Function name	__STATIC_INLINE void LL_I2C_EnableIT_NACK (I2C_TypeDef * I2Cx)
Function description	Enable Not acknowledge received interrupt.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 NACKIE LL_I2C_EnableIT_NACK

LL_I2C_DisableIT_NACK

Function name	__STATIC_INLINE void LL_I2C_DisableIT_NACK (I2C_TypeDef * I2Cx)
Function description	Disable Not acknowledge received interrupt.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 NACKIE LL_I2C_DisableIT_NACK

LL_I2C_IsEnabledIT_NACK

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_NACK (I2C_TypeDef * I2Cx)
Function description	Check if Not acknowledge received interrupt is enabled or disabled.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 NACKIE LL_I2C_IsEnabledIT_NACK

LL_I2C_EnableIT_STOP

Function name	__STATIC_INLINE void LL_I2C_EnableIT_STOP (I2C_TypeDef * I2Cx)
Function description	Enable STOP detection interrupt.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 STOPIE LL_I2C_EnableIT_STOP

LL_I2C_DisableIT_STOP

Function name	__STATIC_INLINE void LL_I2C_DisableIT_STOP (I2C_TypeDef * I2Cx)
Function description	Disable STOP detection interrupt.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 STOPIE LL_I2C_DisableIT_STOP

LL_I2C_IsEnabledIT_STOP

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_STOP (I2C_TypeDef * I2Cx)
Function description	Check if STOP detection interrupt is enabled or disabled.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 STOPIE LL_I2C_IsEnabledIT_STOP

LL_I2C_EnableIT_TC

Function name	__STATIC_INLINE void LL_I2C_EnableIT_TC (I2C_TypeDef * I2Cx)
Function description	Enable Transfer Complete interrupt.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Any of these events will generate interrupt : Transfer Complete (TC) Transfer Complete Reload (TCR)
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 TCIE LL_I2C_EnableIT_TC

LL_I2C_DisableIT_TC

Function name	__STATIC_INLINE void LL_I2C_DisableIT_TC (I2C_TypeDef * I2Cx)
Function description	Disable Transfer Complete interrupt.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Any of these events will generate interrupt : Transfer Complete (TC) Transfer Complete Reload (TCR)
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 TCIE LL_I2C_DisableIT_TC

LL_I2C_IsEnabledIT_TC

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_TC (I2C_TypeDef * I2Cx)
Function description	Check if Transfer Complete interrupt is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 TCIE LL_I2C_IsEnabledIT_TC

LL_I2C_EnableIT_ERR

Function name	__STATIC_INLINE void LL_I2C_EnableIT_ERR (I2C_TypeDef * I2Cx)
Function description	Enable Error interrupts.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to

check whether or not SMBus feature is supported by the I2Cx Instance.

- Any of these errors will generate interrupt : Arbitration Loss (ARLO) Bus Error detection (BERR) Overrun/Underrun (OVR) SMBus Timeout detection (TIMEOUT) SMBus PEC error detection (PECERR) SMBus Alert pin event detection (ALERT)

Reference Manual to LL API cross reference:

- CR1 ERRIE LL_I2C_EnableIT_ERR

LL_I2C_DisableIT_ERR

Function name **__STATIC_INLINE void LL_I2C_DisableIT_ERR (I2C_TypeDef * I2Cx)**

Function description Disable Error interrupts.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- Any of these errors will generate interrupt : Arbitration Loss (ARLO) Bus Error detection (BERR) Overrun/Underrun (OVR) SMBus Timeout detection (TIMEOUT) SMBus PEC error detection (PECERR) SMBus Alert pin event detection (ALERT)

Reference Manual to LL API cross reference:

- CR1 ERRIE LL_I2C_DisableIT_ERR

LL_I2C_IsEnabledIT_ERR

Function name **__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_ERR (I2C_TypeDef * I2Cx)**

Function description Check if Error interrupts are enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 ERRIE LL_I2C_IsEnabledIT_ERR

LL_I2C_IsActiveFlag_TXE

Function name **__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_TXE (I2C_TypeDef * I2Cx)**

Function description Indicate the status of Transmit data register empty flag.

Parameters

- **I2Cx:** I2C Instance.

Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • RESET: When next data is written in Transmit data register. • SET: When Transmit data register is empty.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR TXE LL_I2C_IsActiveFlag_TXE

LL_I2C_IsActiveFlag_TXIS

Function name	__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_TXIS (I2C_TypeDef * I2Cx)
Function description	Indicate the status of Transmit interrupt flag.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • RESET: When next data is written in Transmit data register. • SET: When Transmit data register is empty.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR TXIS LL_I2C_IsActiveFlag_TXIS

LL_I2C_IsActiveFlag_RXNE

Function name	__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_RXNE (I2C_TypeDef * I2Cx)
Function description	Indicate the status of Receive data register not empty flag.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • RESET: When Receive data register is read. SET: When the received data is copied in Receive data register.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR RXNE LL_I2C_IsActiveFlag_RXNE

LL_I2C_IsActiveFlag_ADDR

Function name	__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_ADDR (I2C_TypeDef * I2Cx)
Function description	Indicate the status of Address matched flag (slave mode).
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • RESET: Clear default value. SET: When the received slave address matched with one of the enabled slave address.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR ADDR LL_I2C_IsActiveFlag_ADDR

LL_I2C_IsActiveFlag_NACK

Function name	__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_NACK (I2C_TypeDef * I2Cx)
Function description	Indicate the status of Not Acknowledge received flag.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • RESET: Clear default value. SET: When a NACK is received after a byte transmission.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR NACKF LL_I2C_IsActiveFlag_NACK

LL_I2C_IsActiveFlag_STOP

Function name	__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_STOP (I2C_TypeDef * I2Cx)
Function description	Indicate the status of Stop detection flag.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • RESET: Clear default value. SET: When a Stop condition is detected.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR STOPF LL_I2C_IsActiveFlag_STOP

LL_I2C_IsActiveFlag_TC

Function name	__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_TC (I2C_TypeDef * I2Cx)
Function description	Indicate the status of Transfer complete flag (master mode).
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • RESET: Clear default value. SET: When RELOAD=0, AUTOEND=0 and NBYTES date have been transferred.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR TC LL_I2C_IsActiveFlag_TC

LL_I2C_IsActiveFlag_TCR

Function name	__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_TCR (I2C_TypeDef * I2Cx)
Function description	Indicate the status of Transfer complete flag (master mode).
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.

Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • RESET: Clear default value. SET: When RELOAD=1 and NBYTES date have been transferred.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR TCR LL_I2C_IsActiveFlag_TCR

LL_I2C_IsActiveFlag_BERR

Function name	__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_BERR (I2C_TypeDef * I2Cx)
Function description	Indicate the status of Bus error flag.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • RESET: Clear default value. SET: When a misplaced Start or Stop condition is detected.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR BERR LL_I2C_IsActiveFlag_BERR

LL_I2C_IsActiveFlag_ARLO

Function name	__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_ARLO (I2C_TypeDef * I2Cx)
Function description	Indicate the status of Arbitration lost flag.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • RESET: Clear default value. SET: When arbitration lost.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR ARLO LL_I2C_IsActiveFlag_ARLO

LL_I2C_IsActiveFlag_OVR

Function name	__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_OVR (I2C_TypeDef * I2Cx)
Function description	Indicate the status of Overrun/Underrun flag (slave mode).
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • RESET: Clear default value. SET: When an overrun/underrun error occurs (Clock Stretching Disabled).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR OVR LL_I2C_IsActiveFlag_OVR

LL_I2C_IsActiveSMBusFlag_PECERR

Function name	__STATIC_INLINE uint32_t LL_I2C_IsActiveSMBusFlag_PECERR (I2C_TypeDef * I2Cx)
Function description	Indicate the status of SMBus PEC error flag in reception.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro <code>IS_SMBUS_ALL_INSTANCE(I2Cx)</code> can be used to check whether or not SMBus feature is supported by the I2Cx Instance. • RESET: Clear default value. SET: When the received PEC does not match with the PEC register content.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR PECERR LL_I2C_IsActiveSMBusFlag_PECERR

LL_I2C_IsActiveSMBusFlag_TIMEOUT

Function name	__STATIC_INLINE uint32_t LL_I2C_IsActiveSMBusFlag_TIMEOUT (I2C_TypeDef * I2Cx)
Function description	Indicate the status of SMBus Timeout detection flag.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro <code>IS_SMBUS_ALL_INSTANCE(I2Cx)</code> can be used to check whether or not SMBus feature is supported by the I2Cx Instance. • RESET: Clear default value. SET: When a timeout or extended clock timeout occurs.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR TIMEOUT LL_I2C_IsActiveSMBusFlag_TIMEOUT

LL_I2C_IsActiveSMBusFlag_ALERT

Function name	__STATIC_INLINE uint32_t LL_I2C_IsActiveSMBusFlag_ALERT (I2C_TypeDef * I2Cx)
Function description	Indicate the status of SMBus alert flag.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro <code>IS_SMBUS_ALL_INSTANCE(I2Cx)</code> can be used to check whether or not SMBus feature is supported by the I2Cx Instance. • RESET: Clear default value. SET: When SMBus host configuration, SMBus alert enabled and a falling edge event occurs on SMBA pin.
Reference Manual to LL API cross	<ul style="list-style-type: none"> • ISR ALERT LL_I2C_IsActiveSMBusFlag_ALERT

reference:

LL_I2C_IsActiveFlag_BUSY

Function name	__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_BUSY (I2C_TypeDef * I2Cx)
Function description	Indicate the status of Bus Busy flag.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • RESET: Clear default value. SET: When a Start condition is detected.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR BUSY LL_I2C_IsActiveFlag_BUSY

LL_I2C_ClearFlag_ADDR

Function name	__STATIC_INLINE void LL_I2C_ClearFlag_ADDR (I2C_TypeDef * I2Cx)
Function description	Clear Address Matched flag.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ICR ADDR CF LL_I2C_ClearFlag_ADDR

LL_I2C_ClearFlag_NACK

Function name	__STATIC_INLINE void LL_I2C_ClearFlag_NACK (I2C_TypeDef * I2Cx)
Function description	Clear Not Acknowledge flag.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ICR NACK CF LL_I2C_ClearFlag_NACK

LL_I2C_ClearFlag_STOP

Function name	__STATIC_INLINE void LL_I2C_ClearFlag_STOP (I2C_TypeDef * I2Cx)
Function description	Clear Stop detection flag.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to	<ul style="list-style-type: none"> • ICR STOP CF LL_I2C_ClearFlag_STOP

LL API cross
reference:

LL_I2C_ClearFlag_TXE

Function name	__STATIC_INLINE void LL_I2C_ClearFlag_TXE (I2C_TypeDef * I2Cx)
Function description	Clear Transmit data register empty flag (TXE).
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• This bit can be clear by software in order to flush the transmit data register (TXDR).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR TXE LL_I2C_ClearFlag_TXE

LL_I2C_ClearFlag_BERR

Function name	__STATIC_INLINE void LL_I2C_ClearFlag_BERR (I2C_TypeDef * I2Cx)
Function description	Clear Bus error flag.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ICR BERRCF LL_I2C_ClearFlag_BERR

LL_I2C_ClearFlag_ARLO

Function name	__STATIC_INLINE void LL_I2C_ClearFlag_ARLO (I2C_TypeDef * I2Cx)
Function description	Clear Arbitration lost flag.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ICR ARLOCF LL_I2C_ClearFlag_ARLO

LL_I2C_ClearFlag_OVR

Function name	__STATIC_INLINE void LL_I2C_ClearFlag_OVR (I2C_TypeDef * I2Cx)
Function description	Clear Overrun/Underrun flag.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:

Reference Manual to LL API cross reference:

- ICR OVRDCF LL_I2C_ClearFlag_OVR

LL_I2C_ClearSMBusFlag_PECERR

Function name `__STATIC_INLINE void LL_I2C_ClearSMBusFlag_PECERR (I2C_TypeDef * I2Cx)`

Function description Clear SMBus PEC error flag.

Parameters

- **I2Cx**: I2C Instance.

Return values

- **None**:

Notes

- Macro `IS_SMBUS_ALL_INSTANCE(I2Cx)` can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- ICR PECCF LL_I2C_ClearSMBusFlag_PECERR

LL_I2C_ClearSMBusFlag_TIMEOUT

Function name `__STATIC_INLINE void LL_I2C_ClearSMBusFlag_TIMEOUT (I2C_TypeDef * I2Cx)`

Function description Clear SMBus Timeout detection flag.

Parameters

- **I2Cx**: I2C Instance.

Return values

- **None**:

Notes

- Macro `IS_SMBUS_ALL_INSTANCE(I2Cx)` can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- ICR TIMOUTCF LL_I2C_ClearSMBusFlag_TIMEOUT

LL_I2C_ClearSMBusFlag_ALERT

Function name `__STATIC_INLINE void LL_I2C_ClearSMBusFlag_ALERT (I2C_TypeDef * I2Cx)`

Function description Clear SMBus Alert flag.

Parameters

- **I2Cx**: I2C Instance.

Return values

- **None**:

Notes

- Macro `IS_SMBUS_ALL_INSTANCE(I2Cx)` can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- ICR ALERTCF LL_I2C_ClearSMBusFlag_ALERT

LL_I2C_EnableAutoEndMode

Function name	__STATIC_INLINE void LL_I2C_EnableAutoEndMode (I2C_TypeDef * I2Cx)
Function description	Enable automatic STOP condition generation (master mode).
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• Automatic end mode : a STOP condition is automatically sent when NBYTES data are transferred. This bit has no effect in slave mode or when RELOAD bit is set.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR2 AUTOEND LL_I2C_EnableAutoEndMode

LL_I2C_DisableAutoEndMode

Function name	__STATIC_INLINE void LL_I2C_DisableAutoEndMode (I2C_TypeDef * I2Cx)
Function description	Disable automatic STOP condition generation (master mode).
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• Software end mode : TC flag is set when NBYTES data are transferre, stretching SCL low.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR2 AUTOEND LL_I2C_DisableAutoEndMode

LL_I2C_IsEnabledAutoEndMode

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledAutoEndMode (I2C_TypeDef * I2Cx)
Function description	Check if automatic STOP condition is enabled or disabled.
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR2 AUTOEND LL_I2C_IsEnabledAutoEndMode

LL_I2C_EnableReloadMode

Function name	__STATIC_INLINE void LL_I2C_EnableReloadMode (I2C_TypeDef * I2Cx)
Function description	Enable reload mode (master mode).
Parameters	<ul style="list-style-type: none">• I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none">• None:

- | | |
|---|---|
| Notes | <ul style="list-style-type: none"> The transfer is not completed after the NBYTES data transfer, NBYTES will be reloaded when TCR flag is set. |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> CR2 RELOAD LL_I2C_EnableReloadMode |

LL_I2C_DisableReloadMode

- | | |
|---|--|
| Function name | __STATIC_INLINE void LL_I2C_DisableReloadMode (I2C_TypeDef * I2Cx) |
| Function description | Disable reload mode (master mode). |
| Parameters | <ul style="list-style-type: none"> I2Cx: I2C Instance. |
| Return values | <ul style="list-style-type: none"> None: |
| Notes | <ul style="list-style-type: none"> The transfer is completed after the NBYTES data transfer(STOP or RESTART will follow). |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> CR2 RELOAD LL_I2C_DisableReloadMode |

LL_I2C_IsEnabledReloadMode

- | | |
|---|---|
| Function name | __STATIC_INLINE uint32_t LL_I2C_IsEnabledReloadMode (I2C_TypeDef * I2Cx) |
| Function description | Check if reload mode is enabled or disabled. |
| Parameters | <ul style="list-style-type: none"> I2Cx: I2C Instance. |
| Return values | <ul style="list-style-type: none"> State: of bit (1 or 0). |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> CR2 RELOAD LL_I2C_IsEnabledReloadMode |

LL_I2C_SetTransferSize

- | | |
|---|--|
| Function name | __STATIC_INLINE void LL_I2C_SetTransferSize (I2C_TypeDef * I2Cx, uint32_t TransferSize) |
| Function description | Configure the number of bytes for transfer. |
| Parameters | <ul style="list-style-type: none"> I2Cx: I2C Instance. TransferSize: This parameter must be a value between Min_Data=0x00 and Max_Data=0xFF. |
| Return values | <ul style="list-style-type: none"> None: |
| Notes | <ul style="list-style-type: none"> Changing these bits when START bit is set is not allowed. |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> CR2 NBYTES LL_I2C_SetTransferSize |

LL_I2C_GetTransferSize

Function name	__STATIC_INLINE uint32_t LL_I2C_GetTransferSize (I2C_TypeDef * I2Cx)
Function description	Get the number of bytes configured for transfer.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x0 and Max_Data=0xFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 NBYTES LL_I2C_GetTransferSize

LL_I2C_AcknowledgeNextData

Function name	__STATIC_INLINE void LL_I2C_AcknowledgeNextData (I2C_TypeDef * I2Cx, uint32_t TypeAcknowledge)
Function description	Prepare the generation of a ACKnowledge or Non ACKnowledge condition after the address receive match code or next received byte.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • TypeAcknowledge: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_I2C_ACK – LL_I2C_NACK
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Usage in Slave mode only.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 NACK LL_I2C_AcknowledgeNextData

LL_I2C_GenerateStartCondition

Function name	__STATIC_INLINE void LL_I2C_GenerateStartCondition (I2C_TypeDef * I2Cx)
Function description	Generate a START or RESTART condition.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The START bit can be set even if bus is BUSY or I2C is in slave mode. This action has no effect when RELOAD is set.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 START LL_I2C_GenerateStartCondition

LL_I2C_GenerateStopCondition

Function name	__STATIC_INLINE void LL_I2C_GenerateStopCondition (I2C_TypeDef * I2Cx)
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Function description	Generate a STOP condition after the current byte transfer (master mode).
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 STOP LL_I2C_GenerateStopCondition

LL_I2C_EnableAuto10BitRead

Function name	__STATIC_INLINE void LL_I2C_EnableAuto10BitRead (I2C_TypeDef * I2Cx)
Function description	Enable automatic RESTART Read request condition for 10bit address header (master mode).
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The master sends the complete 10bit slave address read sequence : Start + 2 bytes 10bit address in Write direction + Restart + first 7 bits of 10bit address in Read direction.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 HEAD10R LL_I2C_EnableAuto10BitRead

LL_I2C_DisableAuto10BitRead

Function name	__STATIC_INLINE void LL_I2C_DisableAuto10BitRead (I2C_TypeDef * I2Cx)
Function description	Disable automatic RESTART Read request condition for 10bit address header (master mode).
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The master only sends the first 7 bits of 10bit address in Read direction.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 HEAD10R LL_I2C_DisableAuto10BitRead

LL_I2C_IsEnabledAuto10BitRead

Function name	__STATIC_INLINE uint32_t LL_I2C_IsEnabledAuto10BitRead (I2C_TypeDef * I2Cx)
Function description	Check if automatic RESTART Read request condition for 10bit address header is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).

- Reference Manual to LL API cross reference:
- CR2 HEAD10R LL_I2C_IsEnabledAuto10BitRead

LL_I2C_SetTransferRequest

- Function name **__STATIC_INLINE void LL_I2C_SetTransferRequest (I2C_TypeDef * I2Cx, uint32_t TransferRequest)**
- Function description Configure the transfer direction (master mode).
- Parameters
- **I2Cx:** I2C Instance.
 - **TransferRequest:** This parameter can be one of the following values:
 - LL_I2C_REQUEST_WRITE
 - LL_I2C_REQUEST_READ
- Return values
- **None:**
- Notes
- Changing these bits when START bit is set is not allowed.
- Reference Manual to LL API cross reference:
- CR2 RD_WRN LL_I2C_SetTransferRequest

LL_I2C_GetTransferRequest

- Function name **__STATIC_INLINE uint32_t LL_I2C_GetTransferRequest (I2C_TypeDef * I2Cx)**
- Function description Get the transfer direction requested (master mode).
- Parameters
- **I2Cx:** I2C Instance.
- Return values
- **Returned:** value can be one of the following values:
 - LL_I2C_REQUEST_WRITE
 - LL_I2C_REQUEST_READ
- Reference Manual to LL API cross reference:
- CR2 RD_WRN LL_I2C_GetTransferRequest

LL_I2C_SetSlaveAddr

- Function name **__STATIC_INLINE void LL_I2C_SetSlaveAddr (I2C_TypeDef * I2Cx, uint32_t SlaveAddr)**
- Function description Configure the slave address for transfer (master mode).
- Parameters
- **I2Cx:** I2C Instance.
 - **SlaveAddr:** This parameter must be a value between Min_Data=0x00 and Max_Data=0x3F.
- Return values
- **None:**
- Notes
- Changing these bits when START bit is set is not allowed.
- Reference Manual to LL API cross reference:
- CR2 SADD LL_I2C_SetSlaveAddr

LL_I2C_GetSlaveAddr

Function name	__STATIC_INLINE uint32_t LL_I2C_GetSlaveAddr (I2C_TypeDef * I2Cx)
Function description	Get the slave address programmed for transfer.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x0 and Max_Data=0x3F
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 SADD LL_I2C_GetSlaveAddr

LL_I2C_HandleTransfer

Function name	__STATIC_INLINE void LL_I2C_HandleTransfer (I2C_TypeDef * I2Cx, uint32_t SlaveAddr, uint32_t SlaveAddrSize, uint32_t TransferSize, uint32_t EndMode, uint32_t Request)
Function description	Handles I2Cx communication when starting transfer or during transfer (TC or TCR flag are set).
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • SlaveAddr: Specifies the slave address to be programmed. • SlaveAddrSize: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_I2C_ADDRSLAVE_7BIT – LL_I2C_ADDRSLAVE_10BIT • TransferSize: Specifies the number of bytes to be programmed. This parameter must be a value between Min_Data=0 and Max_Data=255. • EndMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_I2C_MODE_RELOAD – LL_I2C_MODE_AUTOEND – LL_I2C_MODE_SOFTEND – LL_I2C_MODE_SMBUS_RELOAD – LL_I2C_MODE_SMBUS_AUTOEND_NO_PEC – LL_I2C_MODE_SMBUS_SOFTEND_NO_PEC – LL_I2C_MODE_SMBUS_AUTOEND_WITH_PEC – LL_I2C_MODE_SMBUS_SOFTEND_WITH_PEC • Request: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_I2C_GENERATE_NOSTARTSTOP – LL_I2C_GENERATE_STOP – LL_I2C_GENERATE_START_READ – LL_I2C_GENERATE_START_WRITE – LL_I2C_GENERATE_RESTART_7BIT_READ – LL_I2C_GENERATE_RESTART_7BIT_WRITE – LL_I2C_GENERATE_RESTART_10BIT_READ – LL_I2C_GENERATE_RESTART_10BIT_WRITE
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross	<ul style="list-style-type: none"> • CR2 SADD LL_I2C_HandleTransfer • CR2 ADD10 LL_I2C_HandleTransfer • CR2 RD_WRN LL_I2C_HandleTransfer

- reference:
- CR2 START LL_I2C_HandleTransfer
 - CR2 STOP LL_I2C_HandleTransfer
 - CR2 RELOAD LL_I2C_HandleTransfer
 - CR2 NBYTES LL_I2C_HandleTransfer
 - CR2 AUTOEND LL_I2C_HandleTransfer
 - CR2 HEAD10R LL_I2C_HandleTransfer

LL_I2C_GetTransferDirection

- Function name **__STATIC_INLINE uint32_t LL_I2C_GetTransferDirection (I2C_TypeDef * I2Cx)**
- Function description Indicate the value of transfer direction (slave mode).
- Parameters
- **I2Cx:** I2C Instance.
- Return values
- **Returned:** value can be one of the following values:
 - LL_I2C_DIRECTION_WRITE
 - LL_I2C_DIRECTION_READ
- Notes
- RESET: Write transfer, Slave enters in receiver mode. SET: Read transfer, Slave enters in transmitter mode.
- Reference Manual to LL API cross reference:
- ISR DIR LL_I2C_GetTransferDirection

LL_I2C_GetAddressMatchCode

- Function name **__STATIC_INLINE uint32_t LL_I2C_GetAddressMatchCode (I2C_TypeDef * I2Cx)**
- Function description Return the slave matched address.
- Parameters
- **I2Cx:** I2C Instance.
- Return values
- **Value:** between Min_Data=0x00 and Max_Data=0x3F
- Reference Manual to LL API cross reference:
- ISR ADDCODE LL_I2C_GetAddressMatchCode

LL_I2C_EnableSMBusPECCCompare

- Function name **__STATIC_INLINE void LL_I2C_EnableSMBusPECCCompare (I2C_TypeDef * I2Cx)**
- Function description Enable internal comparison of the SMBus Packet Error byte (transmission or reception mode).
- Parameters
- **I2Cx:** I2C Instance.
- Return values
- **None:**
- Notes
- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
 - This feature is cleared by hardware when the PEC byte is transferred, or when a STOP condition or an Address Matched is received. This bit has no effect when RELOAD bit

is set. This bit has no effect in device mode when SBC bit is not set.

- Reference Manual to LL API cross reference:
- CR2 PECBYTE LL_I2C_EnableSMBusPECCompare

LL_I2C_IsEnabledSMBusPECCompare

- Function name **__STATIC_INLINE uint32_t LL_I2C_IsEnabledSMBusPECCompare (I2C_TypeDef * I2Cx)**
- Function description Check if the SMBus Packet Error byte internal comparison is requested or not.
- Parameters
- **I2Cx:** I2C Instance.
- Return values
- **State:** of bit (1 or 0).
- Notes
- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- Reference Manual to LL API cross reference:
- CR2 PECBYTE LL_I2C_IsEnabledSMBusPECCompare

LL_I2C_GetSMBusPEC

- Function name **__STATIC_INLINE uint32_t LL_I2C_GetSMBusPEC (I2C_TypeDef * I2Cx)**
- Function description Get the SMBus Packet Error byte calculated.
- Parameters
- **I2Cx:** I2C Instance.
- Return values
- **Value:** between Min_Data=0x00 and Max_Data=0xFF
- Notes
- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- Reference Manual to LL API cross reference:
- PECCR PEC LL_I2C_GetSMBusPEC

LL_I2C_ReceiveData8

- Function name **__STATIC_INLINE uint8_t LL_I2C_ReceiveData8 (I2C_TypeDef * I2Cx)**
- Function description Read Receive Data register.
- Parameters
- **I2Cx:** I2C Instance.
- Return values
- **Value:** between Min_Data=0x00 and Max_Data=0xFF
- Reference Manual to LL API cross reference:
- RXDR RXDATA LL_I2C_ReceiveData8

LL_I2C_TransmitData8

Function name	__STATIC_INLINE void LL_I2C_TransmitData8 (I2C_TypeDef * I2Cx, uint8_t Data)
Function description	Write in Transmit Data Register .
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • Data: Value between Min_Data=0x00 and Max_Data=0xFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TXDR TXDATA LL_I2C_TransmitData8

LL_I2C_Init

Function name	uint32_t LL_I2C_Init (I2C_TypeDef * I2Cx, LL_I2C_InitTypeDef * I2C_InitStruct)
Function description	Initialize the I2C registers according to the specified parameters in I2C_InitStruct.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance. • I2C_InitStruct: pointer to a LL_I2C_InitTypeDef structure.
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: I2C registers are initialized – ERROR: Not applicable

LL_I2C_DeInit

Function name	uint32_t LL_I2C_DeInit (I2C_TypeDef * I2Cx)
Function description	De-initialize the I2C registers to their default reset values.
Parameters	<ul style="list-style-type: none"> • I2Cx: I2C Instance.
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: I2C registers are de-initialized – ERROR: I2C registers are not de-initialized

LL_I2C_StructInit

Function name	void LL_I2C_StructInit (LL_I2C_InitTypeDef * I2C_InitStruct)
Function description	Set each LL_I2C_InitTypeDef field to default value.
Parameters	<ul style="list-style-type: none"> • I2C_InitStruct: Pointer to a LL_I2C_InitTypeDef structure.
Return values	<ul style="list-style-type: none"> • None:

80.3 I2C Firmware driver defines**80.3.1 I2C*****Master Addressing Mode***

LL_I2C_ADDRESSING_MODE_7BIT Master operates in 7-bit addressing mode.

LL_I2C_ADDRESSING_MODE_10BIT Master operates in 10-bit addressing mode.

Slave Address Length

LL_I2C_ADDRSLAVE_7BIT Slave Address in 7-bit.

LL_I2C_ADDRSLAVE_10BIT Slave Address in 10-bit.

Analog Filter Selection

LL_I2C_ANALOGFILTER_ENABLE Analog filter is enabled.

LL_I2C_ANALOGFILTER_DISABLE Analog filter is disabled.

Clear Flags Defines

LL_I2C_ICR_ADDRCF Address Matched flag

LL_I2C_ICR_NACKCF Not Acknowledge flag

LL_I2C_ICR_STOPCF Stop detection flag

LL_I2C_ICR_BERRCF Bus error flag

LL_I2C_ICR_ARLOCF Arbitration Lost flag

LL_I2C_ICR_OVRCF Overrun/Underrun flag

LL_I2C_ICR_PECCF PEC error flag

LL_I2C_ICR_TIMEOUTCF Timeout detection flag

LL_I2C_ICR_ALERTCF Alert flag

Read Write Direction

LL_I2C_DIRECTION_WRITE Write transfer request by master, slave enters receiver mode.

LL_I2C_DIRECTION_READ Read transfer request by master, slave enters transmitter mode.

DMA Register Data

LL_I2C_DMA_REG_DATA_TRANSMIT Get address of data register used for transmission

LL_I2C_DMA_REG_DATA_RECEIVE Get address of data register used for reception

Start And Stop Generation

LL_I2C_GENERATE_NOSTARTSTOP Don't Generate Stop and Start condition.

LL_I2C_GENERATE_STOP Generate Stop condition (Size should be set to 0).

LL_I2C_GENERATE_START_READ Generate Start for read request.

LL_I2C_GENERATE_START_WRITE Generate Start for write request.

LL_I2C_GENERATE_RESTART_7BIT_READ Generate Restart for read request, slave 7Bit address.

LL_I2C_GENERATE_RESTART_7BIT_WRITE Generate Restart for write request, slave 7Bit address.

LL_I2C_GENERATE_RESTART_10BIT_READ Generate Restart for read request, slave 10Bit address.

LL_I2C_GENERATE_RESTART_10BIT_WRITE Generate Restart for write request, slave 10Bit address.

Get Flags Defines

LL_I2C_ISR_TXE Transmit data register empty
 LL_I2C_ISR_TXIS Transmit interrupt status
 LL_I2C_ISR_RXNE Receive data register not empty
 LL_I2C_ISR_ADDR Address matched (slave mode)
 LL_I2C_ISR_NACKF Not Acknowledge received flag
 LL_I2C_ISR_STOPF Stop detection flag
 LL_I2C_ISR_TC Transfer Complete (master mode)
 LL_I2C_ISR_TCR Transfer Complete Reload
 LL_I2C_ISR_BERR Bus error
 LL_I2C_ISR_ARLO Arbitration lost
 LL_I2C_ISR_OVR Overrun/Underrun (slave mode)
 LL_I2C_ISR_PECERR PEC Error in reception (SMBus mode)
 LL_I2C_ISR_TIMEOUT Timeout detection flag (SMBus mode)
 LL_I2C_ISR_ALERT SMBus alert (SMBus mode)
 LL_I2C_ISR_BUSY Bus busy

Acknowledge Generation

LL_I2C_ACK ACK is sent after current received byte.
 LL_I2C_NACK NACK is sent after current received byte.

IT Defines

LL_I2C_CR1_TXIE TX Interrupt enable
 LL_I2C_CR1_RXIE RX Interrupt enable
 LL_I2C_CR1_ADDRIE Address match Interrupt enable (slave only)
 LL_I2C_CR1_NACKIE Not acknowledge received Interrupt enable
 LL_I2C_CR1_STOPIE STOP detection Interrupt enable
 LL_I2C_CR1_TCIE Transfer Complete interrupt enable
 LL_I2C_CR1_ERRIE Error interrupts enable

Transfer End Mode

LL_I2C_MODE_RELOAD Enable I2C Reload mode.
 LL_I2C_MODE_AUTOEND Enable I2C Automatic end mode with no HW PEC comparison.
 LL_I2C_MODE_SOFTEND Enable I2C Software end mode with no HW PEC comparison.
 LL_I2C_MODE_SMBUS_RELOAD Enable SMBUS Automatic end mode with HW PEC comparison.
 LL_I2C_MODE_SMBUS_AUTOEND_NO_PEC Enable SMBUS Automatic end mode

	with HW PEC comparison.
LL_I2C_MODE_SMBUS_SOFTEND_NO_PEC	Enable SMBUS Software end mode with HW PEC comparison.
LL_I2C_MODE_SMBUS_AUTOEND_WITH_PEC	Enable SMBUS Automatic end mode with HW PEC comparison.
LL_I2C_MODE_SMBUS_SOFTEND_WITH_PEC	Enable SMBUS Software end mode with HW PEC comparison.

Own Address 1 Length

LL_I2C_OWNADDRESS1_7BIT	Own address 1 is a 7-bit address.
LL_I2C_OWNADDRESS1_10BIT	Own address 1 is a 10-bit address.

Own Address 2 Masks

LL_I2C_OWNADDRESS2_NOMASK	Own Address2 No mask.
LL_I2C_OWNADDRESS2_MASK01	Only Address2 bits[7:2] are compared.
LL_I2C_OWNADDRESS2_MASK02	Only Address2 bits[7:3] are compared.
LL_I2C_OWNADDRESS2_MASK03	Only Address2 bits[7:4] are compared.
LL_I2C_OWNADDRESS2_MASK04	Only Address2 bits[7:5] are compared.
LL_I2C_OWNADDRESS2_MASK05	Only Address2 bits[7:6] are compared.
LL_I2C_OWNADDRESS2_MASK06	Only Address2 bits[7] are compared.
LL_I2C_OWNADDRESS2_MASK07	No comparison is done. All Address2 are acknowledged.

Peripheral Mode

LL_I2C_MODE_I2C	I2C Master or Slave mode
LL_I2C_MODE_SMBUS_HOST	SMBus Host address acknowledge
LL_I2C_MODE_SMBUS_DEVICE	SMBus Device default mode (Default address not acknowledge)
LL_I2C_MODE_SMBUS_DEVICE_ARP	SMBus Device Default address acknowledge

Transfer Request Direction

LL_I2C_REQUEST_WRITE	Master request a write transfer.
LL_I2C_REQUEST_READ	Master request a read transfer.

SMBus TimeoutA Mode SCL SDA Timeout

LL_I2C_SMBUS_TIMEOUTA_MODE_SCL_LOW	TimeoutA is used to detect SCL low level timeout.
LL_I2C_SMBUS_TIMEOUTA_MODE_SDA_SCL_HIGH	TimeoutA is used to detect both SCL and SDA high level timeout.

SMBus Timeout Selection

LL_I2C_SMBUS_TIMEOUTA	TimeoutA enable bit
LL_I2C_SMBUS_TIMEOUTB	TimeoutB (extended clock) enable bit
LL_I2C_SMBUS_ALL_TIMEOUT	TimeoutA and TimeoutB (extended clock) enable bits

Convert SDA SCL timings**__LL_I2C_CONVERT_TIMINGS** Description:

- Configure the SDA setup, hold time and the SCL high, low period.

Parameters:

- **__PRESCALER__**: This parameter must be a value between Min_Data=0 and Max_Data=0xF.
- **__DATA_SETUP_TIME__**: This parameter must be a value between Min_Data=0 and Max_Data=0xF. (tscldel = (SCLDEL+1)xtpresc)
- **__DATA_HOLD_TIME__**: This parameter must be a value between Min_Data=0 and Max_Data=0xF. (tsdadel = SDADELxtpresc)
- **__CLOCK_HIGH_PERIOD__**: This parameter must be a value between Min_Data=0 and Max_Data=0xFF. (tsclh = (SCLH+1)xtpresc)
- **__CLOCK_LOW_PERIOD__**: This parameter must be a value between Min_Data=0 and Max_Data=0xFF. (tscll = (SCLL+1)xtpresc)

Return value:

- Value: between Min_Data=0 and Max_Data=0xFFFFFFFF

Common Write and read registers Macros**LL_I2C_WriteReg** Description:

- Write a value in I2C register.

Parameters:

- **__INSTANCE__**: I2C Instance
- **__REG__**: Register to be written
- **__VALUE__**: Value to be written in the register

Return value:

- None

LL_I2C_ReadReg Description:

- Read a value in I2C register.

Parameters:

- **__INSTANCE__**: I2C Instance
- **__REG__**: Register to be read

Return value:

- Register: value

81 LL I2S Generic Driver

81.1 I2S Firmware driver registers structures

81.1.1 LL_I2S_InitTypeDef

Data Fields

- *uint32_t Mode*
- *uint32_t Standard*
- *uint32_t DataFormat*
- *uint32_t MCLKOutput*
- *uint32_t AudioFreq*
- *uint32_t ClockPolarity*

Field Documentation

- *uint32_t LL_I2S_InitTypeDef::Mode*
Specifies the I2S operating mode. This parameter can be a value of [I2S_LL_EC_MODE](#). This feature can be modified afterwards using unitary function `LL_I2S_SetTransferMode()`.
- *uint32_t LL_I2S_InitTypeDef::Standard*
Specifies the standard used for the I2S communication. This parameter can be a value of [I2S_LL_EC_STANDARD](#). This feature can be modified afterwards using unitary function `LL_I2S_SetStandard()`.
- *uint32_t LL_I2S_InitTypeDef::DataFormat*
Specifies the data format for the I2S communication. This parameter can be a value of [I2S_LL_EC_DATA_FORMAT](#). This feature can be modified afterwards using unitary function `LL_I2S_SetDataFormat()`.
- *uint32_t LL_I2S_InitTypeDef::MCLKOutput*
Specifies whether the I2S MCLK output is enabled or not. This parameter can be a value of [I2S_LL_EC_MCLK_OUTPUT](#). This feature can be modified afterwards using unitary functions `LL_I2S_EnableMasterClock()` or `LL_I2S_DisableMasterClock()`.
- *uint32_t LL_I2S_InitTypeDef::AudioFreq*
Specifies the frequency selected for the I2S communication. This parameter can be a value of [I2S_LL_EC_AUDIO_FREQ](#). Audio Frequency can be modified afterwards using Reference manual formulas to calculate Prescaler Linear, Parity and unitary functions `LL_I2S_SetPrescalerLinear()` and `LL_I2S_SetPrescalerParity()` to set it.
- *uint32_t LL_I2S_InitTypeDef::ClockPolarity*
Specifies the idle state of the I2S clock. This parameter can be a value of [I2S_LL_EC_POLARITY](#). This feature can be modified afterwards using unitary function `LL_I2S_SetClockPolarity()`.

81.2 I2S Firmware driver API description

81.2.1 Detailed description of functions

LL_I2S_Enable

Function name `__STATIC_INLINE void LL_I2S_Enable (SPI_TypeDef * SPIx)`

Function description Select I2S mode and Enable I2S peripheral.

Parameters

- **SPIx**: SPI Instance

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- I2SCFGR I2SMOD LL_I2S_Enable
 - I2SCFGR I2SE LL_I2S_Enable

LL_I2S_Disable

- Function name **__STATIC_INLINE void LL_I2S_Disable (SPI_TypeDef * SPIx)**
- Function description Disable I2S peripheral.
- Parameters
- **SPIx:** SPI Instance
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- I2SCFGR I2SE LL_I2S_Disable

LL_I2S_IsEnabled

- Function name **__STATIC_INLINE uint32_t LL_I2S_IsEnabled (SPI_TypeDef * SPIx)**
- Function description Check if I2S peripheral is enabled.
- Parameters
- **SPIx:** SPI Instance
- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- I2SCFGR I2SE LL_I2S_IsEnabled

LL_I2S_SetDataFormat

- Function name **__STATIC_INLINE void LL_I2S_SetDataFormat (SPI_TypeDef * SPIx, uint32_t DataFormat)**
- Function description Set I2S data frame length.
- Parameters
- **SPIx:** SPI Instance
 - **DataFormat:** This parameter can be one of the following values:
 - LL_I2S_DATAFORMAT_16B
 - LL_I2S_DATAFORMAT_16B_EXTENDED
 - LL_I2S_DATAFORMAT_24B
 - LL_I2S_DATAFORMAT_32B
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- I2SCFGR DATLEN LL_I2S_SetDataFormat
 - I2SCFGR CHLEN LL_I2S_SetDataFormat

LL_I2S_GetDataFormat

- Function name **__STATIC_INLINE uint32_t LL_I2S_GetDataFormat (SPI_TypeDef * SPIx)**

Function description	Get I2S data frame length.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_I2S_DATAFORMAT_16B – LL_I2S_DATAFORMAT_16B_EXTENDED – LL_I2S_DATAFORMAT_24B – LL_I2S_DATAFORMAT_32B
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • I2SCFGR DATLEN LL_I2S_GetDataFormat • I2SCFGR CHLEN LL_I2S_GetDataFormat

LL_I2S_SetClockPolarity

Function name	__STATIC_INLINE void LL_I2S_SetClockPolarity (SPI_TypeDef * SPIx, uint32_t ClockPolarity)
Function description	Set I2S clock polarity.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance • ClockPolarity: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_I2S_POLARITY_LOW – LL_I2S_POLARITY_HIGH
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • I2SCFGR CKPOL LL_I2S_SetClockPolarity

LL_I2S_GetClockPolarity

Function name	__STATIC_INLINE uint32_t LL_I2S_GetClockPolarity (SPI_TypeDef * SPIx)
Function description	Get I2S clock polarity.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_I2S_POLARITY_LOW – LL_I2S_POLARITY_HIGH
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • I2SCFGR CKPOL LL_I2S_GetClockPolarity

LL_I2S_SetStandard

Function name	__STATIC_INLINE void LL_I2S_SetStandard (SPI_TypeDef * SPIx, uint32_t Standard)
Function description	Set I2S standard protocol.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance • Standard: This parameter can be one of the following values:

- LL_I2S_STANDARD_PHILIPS
- LL_I2S_STANDARD_MSB
- LL_I2S_STANDARD_LSB
- LL_I2S_STANDARD_PCM_SHORT
- LL_I2S_STANDARD_PCM_LONG

Return values

- **None:**

Reference Manual to LL API cross reference:

- I2SCFGR I2SSTD LL_I2S_SetStandard
- I2SCFGR PCMSYNC LL_I2S_SetStandard

LL_I2S_GetStandard

Function name `__STATIC_INLINE uint32_t LL_I2S_GetStandard (SPI_TypeDef * SPIx)`

Function description Get I2S standard protocol.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_I2S_STANDARD_PHILIPS
 - LL_I2S_STANDARD_MSB
 - LL_I2S_STANDARD_LSB
 - LL_I2S_STANDARD_PCM_SHORT
 - LL_I2S_STANDARD_PCM_LONG

Reference Manual to LL API cross reference:

- I2SCFGR I2SSTD LL_I2S_GetStandard
- I2SCFGR PCMSYNC LL_I2S_GetStandard

LL_I2S_SetTransferMode

Function name `__STATIC_INLINE void LL_I2S_SetTransferMode (SPI_TypeDef * SPIx, uint32_t Mode)`

Function description Set I2S transfer mode.

Parameters

- **SPIx:** SPI Instance
- **Mode:** This parameter can be one of the following values:
 - LL_I2S_MODE_SLAVE_TX
 - LL_I2S_MODE_SLAVE_RX
 - LL_I2S_MODE_MASTER_TX
 - LL_I2S_MODE_MASTER_RX

Return values

- **None:**

Reference Manual to LL API cross reference:

- I2SCFGR I2SCFG LL_I2S_SetTransferMode

LL_I2S_GetTransferMode

Function name `__STATIC_INLINE uint32_t LL_I2S_GetTransferMode (SPI_TypeDef * SPIx)`

Function description Get I2S transfer mode.

- | | |
|---|--|
| Parameters | <ul style="list-style-type: none"> • SPIx: SPI Instance |
| Return values | <ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_I2S_MODE_SLAVE_TX – LL_I2S_MODE_SLAVE_RX – LL_I2S_MODE_MASTER_TX – LL_I2S_MODE_MASTER_RX |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • I2SCFGR I2SCFG LL_I2S_GetTransferMode |

LL_I2S_SetPrescalerLinear

- | | |
|---|--|
| Function name | __STATIC_INLINE void LL_I2S_SetPrescalerLinear (SPI_TypeDef * SPIx, uint8_t PrescalerLinear) |
| Function description | Set I2S linear prescaler. |
| Parameters | <ul style="list-style-type: none"> • SPIx: SPI Instance • PrescalerLinear: Value between Min_Data=0x02 and Max_Data=0xFF |
| Return values | <ul style="list-style-type: none"> • None: |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • I2SPR I2SDIV LL_I2S_SetPrescalerLinear |

LL_I2S_GetPrescalerLinear

- | | |
|---|---|
| Function name | __STATIC_INLINE uint32_t LL_I2S_GetPrescalerLinear (SPI_TypeDef * SPIx) |
| Function description | Get I2S linear prescaler. |
| Parameters | <ul style="list-style-type: none"> • SPIx: SPI Instance |
| Return values | <ul style="list-style-type: none"> • PrescalerLinear: Value between Min_Data=0x02 and Max_Data=0xFF |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • I2SPR I2SDIV LL_I2S_GetPrescalerLinear |

LL_I2S_SetPrescalerParity

- | | |
|----------------------|--|
| Function name | __STATIC_INLINE void LL_I2S_SetPrescalerParity (SPI_TypeDef * SPIx, uint32_t PrescalerParity) |
| Function description | Set I2S parity prescaler. |
| Parameters | <ul style="list-style-type: none"> • SPIx: SPI Instance • PrescalerParity: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_I2S_PRESCALER_PARITY_EVEN – LL_I2S_PRESCALER_PARITY_ODD |
| Return values | <ul style="list-style-type: none"> • None: |

Reference Manual to LL API cross reference:

- I2SPR ODD LL_I2S_SetPrescalerParity

LL_I2S_GetPrescalerParity

Function name `__STATIC_INLINE uint32_t LL_I2S_GetPrescalerParity (SPI_TypeDef * SPIx)`

Function description Get I2S parity prescaler.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_I2S_PRESCALER_PARITY_EVEN
 - LL_I2S_PRESCALER_PARITY_ODD

Reference Manual to LL API cross reference:

- I2SPR ODD LL_I2S_GetPrescalerParity

LL_I2S_EnableMasterClock

Function name `__STATIC_INLINE void LL_I2S_EnableMasterClock (SPI_TypeDef * SPIx)`

Function description Enable the master clock output (Pin MCK)

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- I2SPR MCKOE LL_I2S_EnableMasterClock

LL_I2S_DisableMasterClock

Function name `__STATIC_INLINE void LL_I2S_DisableMasterClock (SPI_TypeDef * SPIx)`

Function description Disable the master clock output (Pin MCK)

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- I2SPR MCKOE LL_I2S_DisableMasterClock

LL_I2S_IsEnabledMasterClock

Function name `__STATIC_INLINE uint32_t LL_I2S_IsEnabledMasterClock (SPI_TypeDef * SPIx)`

Function description Check if the master clock output (Pin MCK) is enabled.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference: [I2SPR MCKOE LL_I2S_IsEnabledMasterClock](#)

LL_I2S_EnableAsyncStart

Function name **__STATIC_INLINE void LL_I2S_EnableAsyncStart (SPI_TypeDef * SPIx)**

Function description Enable asynchronous start.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference: [I2SCFGR ASTRTEN LL_I2S_EnableAsyncStart](#)

LL_I2S_DisableAsyncStart

Function name **__STATIC_INLINE void LL_I2S_DisableAsyncStart (SPI_TypeDef * SPIx)**

Function description Disable asynchronous start.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference: [I2SCFGR ASTRTEN LL_I2S_DisableAsyncStart](#)

LL_I2S_IsEnabledAsyncStart

Function name **__STATIC_INLINE uint32_t LL_I2S_IsEnabledAsyncStart (SPI_TypeDef * SPIx)**

Function description Check if asynchronous start is enabled.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference: [I2SCFGR ASTRTEN LL_I2S_IsEnabledAsyncStart](#)

LL_I2S_IsActiveFlag_RXNE

Function name **__STATIC_INLINE uint32_t LL_I2S_IsActiveFlag_RXNE (SPI_TypeDef * SPIx)**

Function description Check if Rx buffer is not empty.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference: [SR_RXNE LL_I2S_IsActiveFlag_RXNE](#)

reference:

LL_I2S_IsActiveFlag_TXE

Function name `__STATIC_INLINE uint32_t LL_I2S_IsActiveFlag_TXE (SPI_TypeDef * SPIx)`

Function description Check if Tx buffer is empty.

Parameters

- **SPIx**: SPI Instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR TXE LL_I2S_IsActiveFlag_TXE

LL_I2S_IsActiveFlag_BSY

Function name `__STATIC_INLINE uint32_t LL_I2S_IsActiveFlag_BSY (SPI_TypeDef * SPIx)`

Function description Get busy flag.

Parameters

- **SPIx**: SPI Instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR BSY LL_I2S_IsActiveFlag_BSY

LL_I2S_IsActiveFlag_OVR

Function name `__STATIC_INLINE uint32_t LL_I2S_IsActiveFlag_OVR (SPI_TypeDef * SPIx)`

Function description Get overrun error flag.

Parameters

- **SPIx**: SPI Instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR OVR LL_I2S_IsActiveFlag_OVR

LL_I2S_IsActiveFlag_UDR

Function name `__STATIC_INLINE uint32_t LL_I2S_IsActiveFlag_UDR (SPI_TypeDef * SPIx)`

Function description Get underrun error flag.

Parameters

- **SPIx**: SPI Instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR UDR LL_I2S_IsActiveFlag_UDR

LL_I2S_IsActiveFlag_FRE

Function name	__STATIC_INLINE uint32_t LL_I2S_IsActiveFlag_FRE (SPI_TypeDef * SPIx)
Function description	Get frame format error flag.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR FRE LL_I2S_IsActiveFlag_FRE

LL_I2S_IsActiveFlag_CHSIDE

Function name	__STATIC_INLINE uint32_t LL_I2S_IsActiveFlag_CHSIDE (SPI_TypeDef * SPIx)
Function description	Get channel side flag.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • 0: Channel Left has to be transmitted or has been received 1: Channel Right has to be transmitted or has been received It has no significance in PCM mode.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR CHSIDE LL_I2S_IsActiveFlag_CHSIDE

LL_I2S_ClearFlag_OVR

Function name	__STATIC_INLINE void LL_I2S_ClearFlag_OVR (SPI_TypeDef * SPIx)
Function description	Clear overrun error flag.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR OVR LL_I2S_ClearFlag_OVR

LL_I2S_ClearFlag_UDR

Function name	__STATIC_INLINE void LL_I2S_ClearFlag_UDR (SPI_TypeDef * SPIx)
Function description	Clear underrun error flag.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross	<ul style="list-style-type: none"> • SR UDR LL_I2S_ClearFlag_UDR

reference:

LL_I2S_ClearFlag_FRE

Function name **__STATIC_INLINE void LL_I2S_ClearFlag_FRE (SPI_TypeDef * SPIx)**

Function description Clear frame format error flag.

Parameters

- **SPIx**: SPI Instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- SR FRE LL_I2S_ClearFlag_FRE

LL_I2S_EnableIT_ERR

Function name **__STATIC_INLINE void LL_I2S_EnableIT_ERR (SPI_TypeDef * SPIx)**

Function description Enable error IT.

Parameters

- **SPIx**: SPI Instance

Return values

- **None**:

Notes

- This bit controls the generation of an interrupt when an error condition occurs (OVR, UDR and FRE in I2S mode).

Reference Manual to LL API cross reference:

- CR2 ERRIE LL_I2S_EnableIT_ERR

LL_I2S_EnableIT_RXNE

Function name **__STATIC_INLINE void LL_I2S_EnableIT_RXNE (SPI_TypeDef * SPIx)**

Function description Enable Rx buffer not empty IT.

Parameters

- **SPIx**: SPI Instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- CR2 RXNEIE LL_I2S_EnableIT_RXNE

LL_I2S_EnableIT_TXE

Function name **__STATIC_INLINE void LL_I2S_EnableIT_TXE (SPI_TypeDef * SPIx)**

Function description Enable Tx buffer empty IT.

Parameters

- **SPIx**: SPI Instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- CR2 TXEIE LL_I2S_EnableIT_TXE

LL API cross
reference:

LL_I2S_DisableIT_ERR

Function name	__STATIC_INLINE void LL_I2S_DisableIT_ERR (SPI_TypeDef * SPIx)
Function description	Disable error IT.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This bit controls the generation of an interrupt when an error condition occurs (OVR, UDR and FRE in I2S mode).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2_ERRIE LL_I2S_DisableIT_ERR

LL_I2S_DisableIT_RXNE

Function name	__STATIC_INLINE void LL_I2S_DisableIT_RXNE (SPI_TypeDef * SPIx)
Function description	Disable Rx buffer not empty IT.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2_RXNEIE LL_I2S_DisableIT_RXNE

LL_I2S_DisableIT_TXE

Function name	__STATIC_INLINE void LL_I2S_DisableIT_TXE (SPI_TypeDef * SPIx)
Function description	Disable Tx buffer empty IT.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2_TXEIE LL_I2S_DisableIT_TXE

LL_I2S_IsEnabledIT_ERR

Function name	__STATIC_INLINE uint32_t LL_I2S_IsEnabledIT_ERR (SPI_TypeDef * SPIx)
Function description	Check if ERR IT is enabled.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 ERRIE LL_I2S_IsEnabledIT_ERR

LL_I2S_IsEnabledIT_RXNE

Function name **__STATIC_INLINE uint32_t LL_I2S_IsEnabledIT_RXNE (SPI_TypeDef * SPIx)**

Function description Check if RXNE IT is enabled.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 RXNEIE LL_I2S_IsEnabledIT_RXNE

LL_I2S_IsEnabledIT_TXE

Function name **__STATIC_INLINE uint32_t LL_I2S_IsEnabledIT_TXE (SPI_TypeDef * SPIx)**

Function description Check if TXE IT is enabled.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 TXEIE LL_I2S_IsEnabledIT_TXE

LL_I2S_EnableDMAReq_RX

Function name **__STATIC_INLINE void LL_I2S_EnableDMAReq_RX (SPI_TypeDef * SPIx)**

Function description Enable DMA Rx.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 RXDMAEN LL_I2S_EnableDMAReq_RX

LL_I2S_DisableDMAReq_RX

Function name **__STATIC_INLINE void LL_I2S_DisableDMAReq_RX (SPI_TypeDef * SPIx)**

Function description Disable DMA Rx.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross

- CR2 RXDMAEN LL_I2S_DisableDMAReq_RX

reference:

LL_I2S_IsEnabledDMAReq_RX

Function name `__STATIC_INLINE uint32_t LL_I2S_IsEnabledDMAReq_RX (SPI_TypeDef * SPIx)`

Function description Check if DMA Rx is enabled.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 RXDMAEN LL_I2S_IsEnabledDMAReq_RX

LL_I2S_EnableDMAReq_TX

Function name `__STATIC_INLINE void LL_I2S_EnableDMAReq_TX (SPI_TypeDef * SPIx)`

Function description Enable DMA Tx.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 TXDMAEN LL_I2S_EnableDMAReq_TX

LL_I2S_DisableDMAReq_TX

Function name `__STATIC_INLINE void LL_I2S_DisableDMAReq_TX (SPI_TypeDef * SPIx)`

Function description Disable DMA Tx.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 TXDMAEN LL_I2S_DisableDMAReq_TX

LL_I2S_IsEnabledDMAReq_TX

Function name `__STATIC_INLINE uint32_t LL_I2S_IsEnabledDMAReq_TX (SPI_TypeDef * SPIx)`

Function description Check if DMA Tx is enabled.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 TXDMAEN LL_I2S_IsEnabledDMAReq_TX

LL_I2S_ReceiveData16

Function name	__STATIC_INLINE uint16_t LL_I2S_ReceiveData16 (SPI_TypeDef * SPIx)
Function description	Read 16-Bits in data register.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • RxData: Value between Min_Data=0x0000 and Max_Data=0xFFFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DR DR LL_I2S_ReceiveData16

LL_I2S_TransmitData16

Function name	__STATIC_INLINE void LL_I2S_TransmitData16 (SPI_TypeDef * SPIx, uint16_t TxData)
Function description	Write 16-Bits in data register.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance • TxData: Value between Min_Data=0x0000 and Max_Data=0xFFFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DR DR LL_I2S_TransmitData16

LL_I2S_DeInit

Function name	ErrorStatus LL_I2S_DeInit (SPI_TypeDef * SPIx)
Function description	De-initialize the SPI/I2S registers to their default reset values.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: SPI registers are de-initialized – ERROR: SPI registers are not de-initialized

LL_I2S_Init

Function name	ErrorStatus LL_I2S_Init (SPI_TypeDef * SPIx, LL_I2S_InitTypeDef * I2S_InitStruct)
Function description	Initializes the SPI/I2S registers according to the specified parameters in I2S_InitStruct.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance • I2S_InitStruct: pointer to a LL_I2S_InitTypeDef structure
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: SPI registers are Initialized – ERROR: SPI registers are not Initialized
Notes	<ul style="list-style-type: none"> • As some bits in SPI configuration registers can only be written when the SPI is disabled (SPI_CR1_SPE bit =0), SPI IP

should be in disabled state prior calling this function. Otherwise, ERROR result will be returned.

LL_I2S_StructInit

Function name	void LL_I2S_StructInit (LL_I2S_InitTypeDef * I2S_InitStruct)
Function description	Set each LL_I2S_InitTypeDef field to default value.
Parameters	<ul style="list-style-type: none"> • I2S_InitStruct: pointer to a LL_I2S_InitTypeDef structure whose fields will be set to default values.
Return values	<ul style="list-style-type: none"> • None:

LL_I2S_ConfigPrescaler

Function name	void LL_I2S_ConfigPrescaler (SPI_TypeDef * SPIx, uint32_t PrescalerLinear, uint32_t PrescalerParity)
Function description	Set linear and parity prescaler.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance • PrescalerLinear: value: Min_Data=0x02 and Max_Data=0xFF. • PrescalerParity: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_I2S_PRESCALER_PARITY_EVEN – LL_I2S_PRESCALER_PARITY_ODD
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • To calculate value of PrescalerLinear(I2SDIV[7:0] bits) and PrescalerParity(ODD bit) Check Audio frequency table and formulas inside Reference Manual (SPI/I2S).

81.3 I2S Firmware driver defines

81.3.1 I2S

Audio Frequency

LL_I2S_AUDIOFREQ_192K	Audio Frequency configuration 192000 Hz
LL_I2S_AUDIOFREQ_96K	Audio Frequency configuration 96000 Hz
LL_I2S_AUDIOFREQ_48K	Audio Frequency configuration 48000 Hz
LL_I2S_AUDIOFREQ_44K	Audio Frequency configuration 44100 Hz
LL_I2S_AUDIOFREQ_32K	Audio Frequency configuration 32000 Hz
LL_I2S_AUDIOFREQ_22K	Audio Frequency configuration 22050 Hz
LL_I2S_AUDIOFREQ_16K	Audio Frequency configuration 16000 Hz
LL_I2S_AUDIOFREQ_11K	Audio Frequency configuration 11025 Hz
LL_I2S_AUDIOFREQ_8K	Audio Frequency configuration 8000 Hz
LL_I2S_AUDIOFREQ_DEFAULT	Audio Freq not specified. Register I2SDIV = 2

Data format

LL_I2S_DATAFORMAT_16B	Data length 16 bits, Channel length 16bit
LL_I2S_DATAFORMAT_16B_EXTENDED	Data length 16 bits, Channel length 32bit
LL_I2S_DATAFORMAT_24B	Data length 24 bits, Channel length 32bit
LL_I2S_DATAFORMAT_32B	Data length 16 bits, Channel length 32bit

Get Flags Defines

LL_I2S_SR_RXNE	Rx buffer not empty flag
LL_I2S_SR_TXE	Tx buffer empty flag
LL_I2S_SR_BSY	Busy flag
LL_I2S_SR_UDR	Underrun flag
LL_I2S_SR_OVR	Overrun flag
LL_I2S_SR_FRE	TI mode frame format error flag

MCLK Output

LL_I2S_MCLK_OUTPUT_DISABLE	Master clock output is disabled
LL_I2S_MCLK_OUTPUT_ENABLE	Master clock output is enabled

Operation Mode

LL_I2S_MODE_SLAVE_TX	Slave Tx configuration
LL_I2S_MODE_SLAVE_RX	Slave Rx configuration
LL_I2S_MODE_MASTER_TX	Master Tx configuration
LL_I2S_MODE_MASTER_RX	Master Rx configuration

Clock Polarity

LL_I2S_POLARITY_LOW	Clock steady state is low level
LL_I2S_POLARITY_HIGH	Clock steady state is high level

Prescaler Factor

LL_I2S_PRESCALER_PARITY_EVEN	Odd factor: Real divider value is = I2SDIV * 2
LL_I2S_PRESCALER_PARITY_ODD	Odd factor: Real divider value is = (I2SDIV * 2)+1

I2s Standard

LL_I2S_STANDARD_PHILIPS	I2S standard philips
LL_I2S_STANDARD_MSB	MSB justified standard (left justified)
LL_I2S_STANDARD_LSB	LSB justified standard (right justified)
LL_I2S_STANDARD_PCM_SHORT	PCM standard, short frame synchronization
LL_I2S_STANDARD_PCM_LONG	PCM standard, long frame synchronization

Common Write and read registers Macros

LL_I2S_WriteReg	Description: <ul style="list-style-type: none"> Write a value in I2S register. Parameters: <ul style="list-style-type: none"> __INSTANCE__: I2S Instance __REG__: Register to be written
-----------------	---

LL_I2S_ReadReg

- `__VALUE__`: Value to be written in the register

Return value:

- None

Description:

- Read a value in I2S register.

Parameters:

- `__INSTANCE__`: I2S Instance
- `__REG__`: Register to be read

Return value:

- Register: value

82 LL IWDG Generic Driver

82.1 IWDG Firmware driver API description

82.1.1 Detailed description of functions

LL_IWDG_Enable

Function name `__STATIC_INLINE void LL_IWDG_Enable (IWDG_TypeDef * IWDGx)`

Function description Start the Independent Watchdog.

Parameters

- **IWDGx**: IWDG Instance

Return values

- **None**:

Notes

- Except if the hardware watchdog option is selected

Reference Manual to LL API cross reference:

- KR KEY LL_IWDG_Enable

LL_IWDG_ReloadCounter

Function name `__STATIC_INLINE void LL_IWDG_ReloadCounter (IWDG_TypeDef * IWDGx)`

Function description Reloads IWDG counter with value defined in the reload register.

Parameters

- **IWDGx**: IWDG Instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- KR KEY LL_IWDG_ReloadCounter

LL_IWDG_EnableWriteAccess

Function name `__STATIC_INLINE void LL_IWDG_EnableWriteAccess (IWDG_TypeDef * IWDGx)`

Function description Enable write access to IWDG_PR, IWDG_RLR and IWDG_WINR registers.

Parameters

- **IWDGx**: IWDG Instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- KR KEY LL_IWDG_EnableWriteAccess

LL_IWDG_DisableWriteAccess

Function name `__STATIC_INLINE void LL_IWDG_DisableWriteAccess`

(IWDG_TypeDef * IWDGx)

Function description	Disable write access to IWDG_PR, IWDG_RLR and IWDG_WINR registers.
Parameters	<ul style="list-style-type: none"> • IWDGx: IWDG Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • KR KEY LL_IWDG_DisableWriteAccess

LL_IWDG_SetPrescaler

Function name	__STATIC_INLINE void LL_IWDG_SetPrescaler (IWDG_TypeDef * IWDGx, uint32_t Prescaler)
Function description	Select the prescaler of the IWDG.
Parameters	<ul style="list-style-type: none"> • IWDGx: IWDG Instance • Prescaler: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_IWDG_PRESCALER_4 – LL_IWDG_PRESCALER_8 – LL_IWDG_PRESCALER_16 – LL_IWDG_PRESCALER_32 – LL_IWDG_PRESCALER_64 – LL_IWDG_PRESCALER_128 – LL_IWDG_PRESCALER_256
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PR PR LL_IWDG_SetPrescaler

LL_IWDG_GetPrescaler

Function name	__STATIC_INLINE uint32_t LL_IWDG_GetPrescaler (IWDG_TypeDef * IWDGx)
Function description	Get the selected prescaler of the IWDG.
Parameters	<ul style="list-style-type: none"> • IWDGx: IWDG Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_IWDG_PRESCALER_4 – LL_IWDG_PRESCALER_8 – LL_IWDG_PRESCALER_16 – LL_IWDG_PRESCALER_32 – LL_IWDG_PRESCALER_64 – LL_IWDG_PRESCALER_128 – LL_IWDG_PRESCALER_256
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PR PR LL_IWDG_GetPrescaler

LL_IWDG_SetReloadCounter

Function name	__STATIC_INLINE void LL_IWDG_SetReloadCounter (IWDG_TypeDef * IWDGx, uint32_t Counter)
Function description	Specify the IWDG down-counter reload value.
Parameters	<ul style="list-style-type: none">• IWDGx: IWDG Instance• Counter: Value between Min_Data=0 and Max_Data=0x0FFF
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• RLR RL LL_IWDG_SetReloadCounter

LL_IWDG_GetReloadCounter

Function name	__STATIC_INLINE uint32_t LL_IWDG_GetReloadCounter (IWDG_TypeDef * IWDGx)
Function description	Get the specified IWDG down-counter reload value.
Parameters	<ul style="list-style-type: none">• IWDGx: IWDG Instance
Return values	<ul style="list-style-type: none">• Value: between Min_Data=0 and Max_Data=0x0FFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• RLR RL LL_IWDG_GetReloadCounter

LL_IWDG_SetWindow

Function name	__STATIC_INLINE void LL_IWDG_SetWindow (IWDG_TypeDef * IWDGx, uint32_t Window)
Function description	Specify high limit of the window value to be compared to the down-counter.
Parameters	<ul style="list-style-type: none">• IWDGx: IWDG Instance• Window: Value between Min_Data=0 and Max_Data=0x0FFF
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• WINR WIN LL_IWDG_SetWindow

LL_IWDG_GetWindow

Function name	__STATIC_INLINE uint32_t LL_IWDG_GetWindow (IWDG_TypeDef * IWDGx)
Function description	Get the high limit of the window value specified.
Parameters	<ul style="list-style-type: none">• IWDGx: IWDG Instance
Return values	<ul style="list-style-type: none">• Value: between Min_Data=0 and Max_Data=0x0FFF
Reference Manual to	<ul style="list-style-type: none">• WINR WIN LL_IWDG_GetWindow

LL API cross
reference:

LL_IWDG_IsActiveFlag_PVU

Function name	__STATIC_INLINE uint32_t LL_IWDG_IsActiveFlag_PVU (IWDG_TypeDef * IWDGx)
Function description	Check if flag Prescaler Value Update is set or not.
Parameters	<ul style="list-style-type: none"> • IWDGx: IWDG Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR PVU LL_IWDG_IsActiveFlag_PVU

LL_IWDG_IsActiveFlag_RVU

Function name	__STATIC_INLINE uint32_t LL_IWDG_IsActiveFlag_RVU (IWDG_TypeDef * IWDGx)
Function description	Check if flag Reload Value Update is set or not.
Parameters	<ul style="list-style-type: none"> • IWDGx: IWDG Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR RVU LL_IWDG_IsActiveFlag_RVU

LL_IWDG_IsActiveFlag_WVU

Function name	__STATIC_INLINE uint32_t LL_IWDG_IsActiveFlag_WVU (IWDG_TypeDef * IWDGx)
Function description	Check if flag Window Value Update is set or not.
Parameters	<ul style="list-style-type: none"> • IWDGx: IWDG Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR WVU LL_IWDG_IsActiveFlag_WVU

LL_IWDG_IsReady

Function name	__STATIC_INLINE uint32_t LL_IWDG_IsReady (IWDG_TypeDef * IWDGx)
Function description	Check if all flags Prescaler, Reload & Window Value Update are reset or not.
Parameters	<ul style="list-style-type: none"> • IWDGx: IWDG Instance
Return values	<ul style="list-style-type: none"> • State: of bits (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR PVU LL_IWDG_IsReady • SR WVU LL_IWDG_IsReady

reference:

- SR RVU LL_IWDG_IsReady

82.2 IWDG Firmware driver defines

82.2.1 IWDG

Get Flags Defines

LL_IWDG_SR_PVU	Watchdog prescaler value update
LL_IWDG_SR_RVU	Watchdog counter reload value update
LL_IWDG_SR_WVU	Watchdog counter window value update

Prescaler Divider

LL_IWDG_PRESCALER_4	Divider by 4
LL_IWDG_PRESCALER_8	Divider by 8
LL_IWDG_PRESCALER_16	Divider by 16
LL_IWDG_PRESCALER_32	Divider by 32
LL_IWDG_PRESCALER_64	Divider by 64
LL_IWDG_PRESCALER_128	Divider by 128
LL_IWDG_PRESCALER_256	Divider by 256

Common Write and read registers Macros

LL_IWDG_WriteReg

Description:

- Write a value in IWDG register.

Parameters:

- `__INSTANCE__`: IWDG Instance
- `__REG__`: Register to be written
- `__VALUE__`: Value to be written in the register

Return value:

- None

LL_IWDG_ReadReg

Description:

- Read a value in IWDG register.

Parameters:

- `__INSTANCE__`: IWDG Instance
- `__REG__`: Register to be read

Return value:

- Register: value

83 LL LPTIM Generic Driver

83.1 LPTIM Firmware driver registers structures

83.1.1 LL_LPTIM_InitTypeDef

Data Fields

- *uint32_t* **ClockSource**
- *uint32_t* **Prescaler**
- *uint32_t* **Waveform**
- *uint32_t* **Polarity**

Field Documentation

- *uint32_t* **LL_LPTIM_InitTypeDef::ClockSource**
Specifies the source of the clock used by the LPTIM instance. This parameter can be a value of [LPTIM_LL_EC_CLK_SOURCE](#). This feature can be modified afterwards using unitary function [LL_LPTIM_SetClockSource\(\)](#).
- *uint32_t* **LL_LPTIM_InitTypeDef::Prescaler**
Specifies the prescaler division ratio. This parameter can be a value of [LPTIM_LL_EC_PRESCALER](#). This feature can be modified afterwards using using unitary function [LL_LPTIM_SetPrescaler\(\)](#).
- *uint32_t* **LL_LPTIM_InitTypeDef::Waveform**
Specifies the waveform shape. This parameter can be a value of [LPTIM_LL_EC_OUTPUT_WAVEFORM](#). This feature can be modified afterwards using unitary function [LL_LPTIM_ConfigOutput\(\)](#).
- *uint32_t* **LL_LPTIM_InitTypeDef::Polarity**
Specifies waveform polarity. This parameter can be a value of [LPTIM_LL_EC_OUTPUT_POLARITY](#). This feature can be modified afterwards using unitary function [LL_LPTIM_ConfigOutput\(\)](#).

83.2 LPTIM Firmware driver API description

83.2.1 Detailed description of functions

LL_LPTIM_Enable

Function name	<code>__STATIC_INLINE void LL_LPTIM_Enable (LPTIM_TypeDef * LPTIMx)</code>
Function description	Enable the LPTIM instance.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • After setting the ENABLE bit, a delay of two counter clock is needed before the LPTIM instance is actually enabled.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR ENABLE LL_LPTIM_Enable

LL_LPTIM_Disable

Function name	__STATIC_INLINE void LL_LPTIM_Disable (LPTIM_TypeDef * LPTIMx)
Function description	Disable the LPTIM instance.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR ENABLE LL_LPTIM_Disable

LL_LPTIM_IsEnabled

Function name	__STATIC_INLINE uint32_t LL_LPTIM_IsEnabled (LPTIM_TypeDef * LPTIMx)
Function description	Indicates whether the LPTIM instance is enabled.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR ENABLE LL_LPTIM_IsEnabled

LL_LPTIM_StartCounter

Function name	__STATIC_INLINE void LL_LPTIM_StartCounter (LPTIM_TypeDef * LPTIMx, uint32_t OperatingMode)
Function description	Starts the LPTIM counter in the desired mode.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance • OperatingMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_OPERATING_MODE_CONTINUOUS – LL_LPTIM_OPERATING_MODE_ONESHOT
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • LPTIM instance must be enabled before starting the counter. • It is possible to change on the fly from One Shot mode to Continuous mode.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR CNTSTRT LL_LPTIM_StartCounter • CR SNGSTRT LL_LPTIM_StartCounter

LL_LPTIM_SetUpdateMode

Function name	__STATIC_INLINE void LL_LPTIM_SetUpdateMode (LPTIM_TypeDef * LPTIMx, uint32_t UpdateMode)
Function description	Set the LPTIM registers update mode (enable/disable register preload)

Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance • UpdateMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_UPDATE_MODE_IMMEDIATE – LL_LPTIM_UPDATE_MODE_ENDOFPERIOD
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This function must be called when the LPTIM instance is disabled.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR PRELOAD LL_LPTIM_SetUpdateMode

LL_LPTIM_GetUpdateMode

Function name	__STATIC_INLINE uint32_t LL_LPTIM_GetUpdateMode (LPTIM_TypeDef * LPTIMx)
Function description	Get the LPTIM registers update mode.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_UPDATE_MODE_IMMEDIATE – LL_LPTIM_UPDATE_MODE_ENDOFPERIOD
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR PRELOAD LL_LPTIM_GetUpdateMode

LL_LPTIM_SetAutoReload

Function name	__STATIC_INLINE void LL_LPTIM_SetAutoReload (LPTIM_TypeDef * LPTIMx, uint32_t AutoReload)
Function description	Set the auto reload value.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance • AutoReload: Value between Min_Data=0x00 and Max_Data=0xFFFF
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The LPTIMx_ARR register content must only be modified when the LPTIM is enabled • After a write to the LPTIMx_ARR register a new write operation to the same register can only be performed when the previous write operation is completed. Any successive write before the ARROK flag be set, will lead to unpredictable results. • autoreload value be strictly greater than the compare value.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ARR ARR LL_LPTIM_SetAutoReload

LL_LPTIM_GetAutoReload

Function name	__STATIC_INLINE uint32_t LL_LPTIM_GetAutoReload (LPTIM_TypeDef * LPTIMx)
Function description	Get actual auto reload value.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • AutoReload: Value between Min_Data=0x00 and Max_Data=0xFFFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ARR ARR LL_LPTIM_GetAutoReload

LL_LPTIM_SetCompare

Function name	__STATIC_INLINE void LL_LPTIM_SetCompare (LPTIM_TypeDef * LPTIMx, uint32_t CompareValue)
Function description	Set the compare value.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance • CompareValue: Value between Min_Data=0x00 and Max_Data=0xFFFF
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • After a write to the LPTIMx_CMP register a new write operation to the same register can only be performed when the previous write operation is completed. Any successive write before the CMPOK flag be set, will lead to unpredictable results.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CMP CMP LL_LPTIM_SetCompare

LL_LPTIM_GetCompare

Function name	__STATIC_INLINE uint32_t LL_LPTIM_GetCompare (LPTIM_TypeDef * LPTIMx)
Function description	Get actual compare value.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • CompareValue: Value between Min_Data=0x00 and Max_Data=0xFFFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CMP CMP LL_LPTIM_GetCompare

LL_LPTIM_GetCounter

Function name	__STATIC_INLINE uint32_t LL_LPTIM_GetCounter (LPTIM_TypeDef * LPTIMx)
Function description	Get actual counter value.

Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • Counter: value
Notes	<ul style="list-style-type: none"> • When the LPTIM instance is running with an asynchronous clock, reading the LPTIMx_CNT register may return unreliable values. So in this case it is necessary to perform two consecutive read accesses and verify that the two returned values are identical.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CNT CNT LL_LPTIM_GetCounter

LL_LPTIM_SetCounterMode

Function name	__STATIC_INLINE void LL_LPTIM_SetCounterMode (LPTIM_TypeDef * LPTIMx, uint32_t CounterMode)
Function description	Set the counter mode (selection of the LPTIM counter clock source).
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance • CounterMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_COUNTER_MODE_INTERNAL – LL_LPTIM_COUNTER_MODE_EXTERNAL
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The counter mode can be set only when the LPTIM instance is disabled.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR COUNTMODE LL_LPTIM_SetCounterMode

LL_LPTIM_GetCounterMode

Function name	__STATIC_INLINE uint32_t LL_LPTIM_GetCounterMode (LPTIM_TypeDef * LPTIMx)
Function description	Get the counter mode.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_COUNTER_MODE_INTERNAL – LL_LPTIM_COUNTER_MODE_EXTERNAL
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR COUNTMODE LL_LPTIM_GetCounterMode

LL_LPTIM_ConfigOutput

Function name	__STATIC_INLINE void LL_LPTIM_ConfigOutput (LPTIM_TypeDef * LPTIMx, uint32_t Waveform, uint32_t Polarity)
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Function description	Configure the LPTIM instance output (LPTIMx_OUT)
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance • Waveform: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_OUTPUT_WAVEFORM_PWM – LL_LPTIM_OUTPUT_WAVEFORM_SETONCE • Polarity: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_OUTPUT_POLARITY_REGULAR – LL_LPTIM_OUTPUT_POLARITY_INVERSE
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This function must be called when the LPTIM instance is disabled. • Regarding the LPTIM output polarity the change takes effect immediately, so the output default value will change immediately after the polarity is re-configured, even before the timer is enabled.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR WAVE LL_LPTIM_ConfigOutput • CFGR WAVPOL LL_LPTIM_ConfigOutput

LL_LPTIM_SetWaveform

Function name	__STATIC_INLINE void LL_LPTIM_SetWaveform (LPTIM_TypeDef * LPTIMx, uint32_t Waveform)
Function description	Set waveform shape.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance • Waveform: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_OUTPUT_WAVEFORM_PWM – LL_LPTIM_OUTPUT_WAVEFORM_SETONCE
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR WAVE LL_LPTIM_SetWaveform

LL_LPTIM_GetWaveform

Function name	__STATIC_INLINE uint32_t LL_LPTIM_GetWaveform (LPTIM_TypeDef * LPTIMx)
Function description	Get actual waveform shape.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_OUTPUT_WAVEFORM_PWM – LL_LPTIM_OUTPUT_WAVEFORM_SETONCE
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR WAVE LL_LPTIM_GetWaveform

LL_LPTIM_SetPolarity

Function name	__STATIC_INLINE void LL_LPTIM_SetPolarity (LPTIM_TypeDef * LPTIMx, uint32_t Polarity)
Function description	Set output polarity.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance • Polarity: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_OUTPUT_POLARITY_REGULAR – LL_LPTIM_OUTPUT_POLARITY_INVERSE
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR WAVPOL LL_LPTIM_SetPolarity

LL_LPTIM_GetPolarity

Function name	__STATIC_INLINE uint32_t LL_LPTIM_GetPolarity (LPTIM_TypeDef * LPTIMx)
Function description	Get actual output polarity.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_OUTPUT_POLARITY_REGULAR – LL_LPTIM_OUTPUT_POLARITY_INVERSE
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR WAVPOL LL_LPTIM_GetPolarity

LL_LPTIM_SetPrescaler

Function name	__STATIC_INLINE void LL_LPTIM_SetPrescaler (LPTIM_TypeDef * LPTIMx, uint32_t Prescaler)
Function description	Set actual prescaler division ratio.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance • Prescaler: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_PRESCALER_DIV1 – LL_LPTIM_PRESCALER_DIV2 – LL_LPTIM_PRESCALER_DIV4 – LL_LPTIM_PRESCALER_DIV8 – LL_LPTIM_PRESCALER_DIV16 – LL_LPTIM_PRESCALER_DIV32 – LL_LPTIM_PRESCALER_DIV64 – LL_LPTIM_PRESCALER_DIV128
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This function must be called when the LPTIM instance is disabled. • When the LPTIM is configured to be clocked by an internal clock source and the LPTIM counter is configured to be

updated by active edges detected on the LPTIM external Input1, the internal clock provided to the LPTIM must be not be prescaled.

- Reference Manual to LL API cross reference:
- CFGR PRESC LL_LPTIM_SetPrescaler

LL_LPTIM_GetPrescaler

- Function name `__STATIC_INLINE uint32_t LL_LPTIM_GetPrescaler (LPTIM_TypeDef * LPTIMx)`
- Function description Get actual prescaler division ratio.
- Parameters
- **LPTIMx:** Low-Power Timer instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_LPTIM_PRESCALER_DIV1
 - LL_LPTIM_PRESCALER_DIV2
 - LL_LPTIM_PRESCALER_DIV4
 - LL_LPTIM_PRESCALER_DIV8
 - LL_LPTIM_PRESCALER_DIV16
 - LL_LPTIM_PRESCALER_DIV32
 - LL_LPTIM_PRESCALER_DIV64
 - LL_LPTIM_PRESCALER_DIV128
- Reference Manual to LL API cross reference:
- CFGR PRESC LL_LPTIM_GetPrescaler

LL_LPTIM_EnableTimeout

- Function name `__STATIC_INLINE void LL_LPTIM_EnableTimeout (LPTIM_TypeDef * LPTIMx)`
- Function description Enable the timeout function.
- Parameters
- **LPTIMx:** Low-Power Timer instance
- Return values
- **None:**
- Notes
- This function must be called when the LPTIM instance is disabled.
 - The first trigger event will start the timer, any successive trigger event will reset the counter and the timer will restart.
 - The timeout value corresponds to the compare value; if no trigger occurs within the expected time frame, the MCU is waked-up by the compare match event.
- Reference Manual to LL API cross reference:
- CFGR TIMOUT LL_LPTIM_EnableTimeout

LL_LPTIM_DisableTimeout

- Function name `__STATIC_INLINE void LL_LPTIM_DisableTimeout (LPTIM_TypeDef * LPTIMx)`

Function description	Disable the timeout function.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This function must be called when the LPTIM instance is disabled. • A trigger event arriving when the timer is already started will be ignored.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR TIMOUT LL_LPTIM_DisableTimeout

LL_LPTIM_IsEnabledTimeout

Function name	__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledTimeout (LPTIM_TypeDef * LPTIMx)
Function description	Indicate whether the timeout function is enabled.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR TIMOUT LL_LPTIM_IsEnabledTimeout

LL_LPTIM_TrigSw

Function name	__STATIC_INLINE void LL_LPTIM_TrigSw (LPTIM_TypeDef * LPTIMx)
Function description	Start the LPTIM counter.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This function must be called when the LPTIM instance is disabled.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR TRIGEN LL_LPTIM_TrigSw

LL_LPTIM_ConfigTrigger

Function name	__STATIC_INLINE void LL_LPTIM_ConfigTrigger (LPTIM_TypeDef * LPTIMx, uint32_t Source, uint32_t Filter, uint32_t Polarity)
Function description	Configure the external trigger used as a trigger event for the LPTIM.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_TRIG_SOURCE_GPIO – LL_LPTIM_TRIG_SOURCE_RTCALARMA

	<ul style="list-style-type: none"> - LL_LPTIM_TRIG_SOURCE_RTCALARMB - LL_LPTIM_TRIG_SOURCE_RTCTAMP1 - LL_LPTIM_TRIG_SOURCE_RTCTAMP2 - LL_LPTIM_TRIG_SOURCE_RTCTAMP3 - LL_LPTIM_TRIG_SOURCE_COMP1 - LL_LPTIM_TRIG_SOURCE_COMP2 • Filter: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_LPTIM_TRIG_FILTER_NONE - LL_LPTIM_TRIG_FILTER_2 - LL_LPTIM_TRIG_FILTER_4 - LL_LPTIM_TRIG_FILTER_8 • Polarity: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_LPTIM_TRIG_POLARITY_RISING - LL_LPTIM_TRIG_POLARITY_FALLING - LL_LPTIM_TRIG_POLARITY_RISING_FALLING
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This function must be called when the LPTIM instance is disabled. • An internal clock source must be present when a digital filter is required for the trigger.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR TRIGSEL LL_LPTIM_ConfigTrigger • CFGR TRGFLT LL_LPTIM_ConfigTrigger • CFGR TRIGEN LL_LPTIM_ConfigTrigger

LL_LPTIM_GetTriggerSource

Function name	__STATIC_INLINE uint32_t LL_LPTIM_GetTriggerSource (LPTIM_TypeDef * LPTIMx)
Function description	Get actual external trigger source.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> - LL_LPTIM_TRIG_SOURCE_GPIO - LL_LPTIM_TRIG_SOURCE_RTCALARMA - LL_LPTIM_TRIG_SOURCE_RTCALARMB - LL_LPTIM_TRIG_SOURCE_RTCTAMP1 - LL_LPTIM_TRIG_SOURCE_RTCTAMP2 - LL_LPTIM_TRIG_SOURCE_RTCTAMP3 - LL_LPTIM_TRIG_SOURCE_COMP1 - LL_LPTIM_TRIG_SOURCE_COMP2 • CFGR TRIGSEL LL_LPTIM_GetTriggerSource
Reference Manual to LL API cross reference:	

LL_LPTIM_GetTriggerFilter

Function name	__STATIC_INLINE uint32_t LL_LPTIM_GetTriggerFilter (LPTIM_TypeDef * LPTIMx)
Function description	Get actual external trigger filter.

- | | |
|---|---|
| Parameters | <ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance |
| Return values | <ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_TRIG_FILTER_NONE – LL_LPTIM_TRIG_FILTER_2 – LL_LPTIM_TRIG_FILTER_4 – LL_LPTIM_TRIG_FILTER_8 |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • CFGR TRGFLT LL_LPTIM_GetTriggerFilter |

LL_LPTIM_GetTriggerPolarity

- | | |
|---|--|
| Function name | __STATIC_INLINE uint32_t LL_LPTIM_GetTriggerPolarity (LPTIM_TypeDef * LPTIMx) |
| Function description | Get actual external trigger polarity. |
| Parameters | <ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance |
| Return values | <ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_TRIG_POLARITY_RISING – LL_LPTIM_TRIG_POLARITY_FALLING – LL_LPTIM_TRIG_POLARITY_RISING_FALLING |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • CFGR TRIGEN LL_LPTIM_GetTriggerPolarity |

LL_LPTIM_SetClockSource

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|---|---|
| Function name | __STATIC_INLINE void LL_LPTIM_SetClockSource (LPTIM_TypeDef * LPTIMx, uint32_t ClockSource) |
| Function description | Set the source of the clock used by the LPTIM instance. |
| Parameters | <ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance • ClockSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_LPTIM_CLK_SOURCE_INTERNAL – LL_LPTIM_CLK_SOURCE_EXTERNAL |
| Return values | <ul style="list-style-type: none"> • None: |
| Notes | <ul style="list-style-type: none"> • This function must be called when the LPTIM instance is disabled. |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • CFGR CKSEL LL_LPTIM_SetClockSource |

LL_LPTIM_GetClockSource

- | | |
|----------------------|---|
| Function name | __STATIC_INLINE uint32_t LL_LPTIM_GetClockSource (LPTIM_TypeDef * LPTIMx) |
| Function description | Get actual LPTIM instance clock source. |
| Parameters | <ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance |

- Return values
- **Returned:** value can be one of the following values:
 - LL_LPTIM_CLK_SOURCE_INTERNAL
 - LL_LPTIM_CLK_SOURCE_EXTERNAL
- Reference Manual to LL API cross reference:
- CFGR CKSEL LL_LPTIM_GetClockSource

LL_LPTIM_ConfigClock

- Function name **__STATIC_INLINE void LL_LPTIM_ConfigClock (LPTIM_TypeDef * LPTIMx, uint32_t ClockFilter, uint32_t ClockPolarity)**
- Function description Configure the active edge or edges used by the counter when the LPTIM is clocked by an external clock source.
- Parameters
- **LPTIMx:** Low-Power Timer instance
 - **ClockFilter:** This parameter can be one of the following values:
 - LL_LPTIM_CLK_FILTER_NONE
 - LL_LPTIM_CLK_FILTER_2
 - LL_LPTIM_CLK_FILTER_4
 - LL_LPTIM_CLK_FILTER_8
 - **ClockPolarity:** This parameter can be one of the following values:
 - LL_LPTIM_CLK_POLARITY_RISING
 - LL_LPTIM_CLK_POLARITY_FALLING
 - LL_LPTIM_CLK_POLARITY_RISING_FALLING
- Return values
- **None:**
- Notes
- This function must be called when the LPTIM instance is disabled.
 - When both external clock signal edges are considered active ones, the LPTIM must also be clocked by an internal clock source with a frequency equal to at least four times the external clock frequency.
 - An internal clock source must be present when a digital filter is required for external clock.
- Reference Manual to LL API cross reference:
- CFGR CKFLT LL_LPTIM_ConfigClock
 - CFGR CKPOL LL_LPTIM_ConfigClock

LL_LPTIM_GetClockPolarity

- Function name **__STATIC_INLINE uint32_t LL_LPTIM_GetClockPolarity (LPTIM_TypeDef * LPTIMx)**
- Function description Get actual clock polarity.
- Parameters
- **LPTIMx:** Low-Power Timer instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_LPTIM_CLK_POLARITY_RISING
 - LL_LPTIM_CLK_POLARITY_FALLING
 - LL_LPTIM_CLK_POLARITY_RISING_FALLING

Reference Manual to LL API cross reference:

- CFGR CKPOL LL_LPTIM_GetClockPolarity

LL_LPTIM_GetClockFilter

Function name `__STATIC_INLINE uint32_t LL_LPTIM_GetClockFilter (LPTIM_TypeDef * LPTIMx)`

Function description Get actual clock digital filter.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Returned:** value can be one of the following values:
 - LL_LPTIM_CLK_FILTER_NONE
 - LL_LPTIM_CLK_FILTER_2
 - LL_LPTIM_CLK_FILTER_4
 - LL_LPTIM_CLK_FILTER_8

Reference Manual to LL API cross reference:

- CFGR CKFLT LL_LPTIM_GetClockFilter

LL_LPTIM_SetEncoderMode

Function name `__STATIC_INLINE void LL_LPTIM_SetEncoderMode (LPTIM_TypeDef * LPTIMx, uint32_t EncoderMode)`

Function description Configure the encoder mode.

Parameters

- **LPTIMx:** Low-Power Timer instance
- **EncoderMode:** This parameter can be one of the following values:
 - LL_LPTIM_ENCODER_MODE_RISING
 - LL_LPTIM_ENCODER_MODE_FALLING
 - LL_LPTIM_ENCODER_MODE_RISING_FALLING

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.

Reference Manual to LL API cross reference:

- CFGR CKPOL LL_LPTIM_SetEncoderMode

LL_LPTIM_GetEncoderMode

Function name `__STATIC_INLINE uint32_t LL_LPTIM_GetEncoderMode (LPTIM_TypeDef * LPTIMx)`

Function description Get actual encoder mode.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Returned:** value can be one of the following values:
 - LL_LPTIM_ENCODER_MODE_RISING
 - LL_LPTIM_ENCODER_MODE_FALLING
 - LL_LPTIM_ENCODER_MODE_RISING_FALLING

Reference Manual to LL API cross reference:

- CFGR CKPOL LL_LPTIM_GetEncoderMode

LL_LPTIM_EnableEncoderMode

Function name **__STATIC_INLINE void LL_LPTIM_EnableEncoderMode (LPTIM_TypeDef * LPTIMx)**

Function description Enable the encoder mode.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.
- In this mode the LPTIM instance must be clocked by an internal clock source. Also, the prescaler division ratio must be equal to 1.
- LPTIM instance must be configured in continuous mode prior enabling the encoder mode.

Reference Manual to LL API cross reference:

- CFGR ENC LL_LPTIM_EnableEncoderMode

LL_LPTIM_DisableEncoderMode

Function name **__STATIC_INLINE void LL_LPTIM_DisableEncoderMode (LPTIM_TypeDef * LPTIMx)**

Function description Disable the encoder mode.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.

Reference Manual to LL API cross reference:

- CFGR ENC LL_LPTIM_DisableEncoderMode

LL_LPTIM_IsEnabledEncoderMode

Function name **__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledEncoderMode (LPTIM_TypeDef * LPTIMx)**

Function description Indicates whether the LPTIM operates in encoder mode.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CFGR ENC LL_LPTIM_IsEnabledEncoderMode

LL_LPTIM_ClearFLAG_CMPM

Function name	__STATIC_INLINE void LL_LPTIM_ClearFLAG_CMPM (LPTIM_TypeDef * LPTIMx)
Function description	Clear the compare match flag (CMPMCF)
Parameters	<ul style="list-style-type: none">• LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ICR CMPMCF LL_LPTIM_ClearFLAG_CMPM

LL_LPTIM_IsActiveFlag_CMPM

Function name	__STATIC_INLINE uint32_t LL_LPTIM_IsActiveFlag_CMPM (LPTIM_TypeDef * LPTIMx)
Function description	Inform application whether a compare match interrupt has occurred.
Parameters	<ul style="list-style-type: none">• LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR CMPM LL_LPTIM_IsActiveFlag_CMPM

LL_LPTIM_ClearFLAG_ARRM

Function name	__STATIC_INLINE void LL_LPTIM_ClearFLAG_ARRM (LPTIM_TypeDef * LPTIMx)
Function description	Clear the autoreload match flag (ARRMCF)
Parameters	<ul style="list-style-type: none">• LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ICR ARRMCF LL_LPTIM_ClearFLAG_ARRM

LL_LPTIM_IsActiveFlag_ARRM

Function name	__STATIC_INLINE uint32_t LL_LPTIM_IsActiveFlag_ARRM (LPTIM_TypeDef * LPTIMx)
Function description	Inform application whether a autoreload match interrupt has occurred.
Parameters	<ul style="list-style-type: none">• LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR ARRM LL_LPTIM_IsActiveFlag_ARRM

LL_LPTIM_ClearFlag_EXTTRIG

Function name	__STATIC_INLINE void LL_LPTIM_ClearFlag_EXTTRIG (LPTIM_TypeDef * LPTIMx)
Function description	Clear the external trigger valid edge flag(EXTTRIGCF).
Parameters	<ul style="list-style-type: none">• LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ICR EXTTRIGCF LL_LPTIM_ClearFlag_EXTTRIG

LL_LPTIM_IsActiveFlag_EXTTRIG

Function name	__STATIC_INLINE uint32_t LL_LPTIM_IsActiveFlag_EXTTRIG (LPTIM_TypeDef * LPTIMx)
Function description	Inform application whether a valid edge on the selected external trigger input has occurred.
Parameters	<ul style="list-style-type: none">• LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR EXTTRIG LL_LPTIM_IsActiveFlag_EXTTRIG

LL_LPTIM_ClearFlag_CMPOK

Function name	__STATIC_INLINE void LL_LPTIM_ClearFlag_CMPOK (LPTIM_TypeDef * LPTIMx)
Function description	Clear the compare register update interrupt flag (CMPOKCF).
Parameters	<ul style="list-style-type: none">• LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ICR CMPOKCF LL_LPTIM_ClearFlag_CMPOK

LL_LPTIM_IsActiveFlag_CMPOK

Function name	__STATIC_INLINE uint32_t LL_LPTIM_IsActiveFlag_CMPOK (LPTIM_TypeDef * LPTIMx)
Function description	Informs application whether the APB bus write operation to the LPTIMx_CMP register has been successfully completed; If so, a new one can be initiated.
Parameters	<ul style="list-style-type: none">• LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR CMPOK LL_LPTIM_IsActiveFlag_CMPOK

LL_LPTIM_ClearFlag_ARROK

Function name	__STATIC_INLINE void LL_LPTIM_ClearFlag_ARROK (LPTIM_TypeDef * LPTIMx)
Function description	Clear the autoreload register update interrupt flag (ARROKCF).
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ICR ARROKCF LL_LPTIM_ClearFlag_ARROK

LL_LPTIM_IsActiveFlag_ARROK

Function name	__STATIC_INLINE uint32_t LL_LPTIM_IsActiveFlag_ARROK (LPTIM_TypeDef * LPTIMx)
Function description	Informs application whether the APB bus write operation to the LPTIMx_ARR register has been successfully completed; If so, a new one can be initiated.
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR ARROK LL_LPTIM_IsActiveFlag_ARROK

LL_LPTIM_ClearFlag_UP

Function name	__STATIC_INLINE void LL_LPTIM_ClearFlag_UP (LPTIM_TypeDef * LPTIMx)
Function description	Clear the counter direction change to up interrupt flag (UPCF).
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ICR UPCF LL_LPTIM_ClearFlag_UP

LL_LPTIM_IsActiveFlag_UP

Function name	__STATIC_INLINE uint32_t LL_LPTIM_IsActiveFlag_UP (LPTIM_TypeDef * LPTIMx)
Function description	Informs the application whether the counter direction has changed from down to up (when the LPTIM instance operates in encoder mode).
Parameters	<ul style="list-style-type: none"> • LPTIMx: Low-Power Timer instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross	<ul style="list-style-type: none"> • ISR UP LL_LPTIM_IsActiveFlag_UP

reference:

LL_LPTIM_ClearFlag_DOWN

Function name **__STATIC_INLINE void LL_LPTIM_ClearFlag_DOWN (LPTIM_TypeDef * LPTIMx)**

Function description Clear the counter direction change to down interrupt flag (DOWNCF).

Parameters

- **LPTIMx**: Low-Power Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- ICR DOWNCF LL_LPTIM_ClearFlag_DOWN

LL_LPTIM_IsActiveFlag_DOWN

Function name **__STATIC_INLINE uint32_t LL_LPTIM_IsActiveFlag_DOWN (LPTIM_TypeDef * LPTIMx)**

Function description Informs the application whether the counter direction has changed from up to down (when the LPTIM instance operates in encoder mode).

Parameters

- **LPTIMx**: Low-Power Timer instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR DOWN LL_LPTIM_IsActiveFlag_DOWN

LL_LPTIM_EnableIT_CMPM

Function name **__STATIC_INLINE void LL_LPTIM_EnableIT_CMPM (LPTIM_TypeDef * LPTIMx)**

Function description Enable compare match interrupt (CMPMIE).

Parameters

- **LPTIMx**: Low-Power Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- IER CMPMIE LL_LPTIM_EnableIT_CMPM

LL_LPTIM_DisableIT_CMPM

Function name **__STATIC_INLINE void LL_LPTIM_DisableIT_CMPM (LPTIM_TypeDef * LPTIMx)**

Function description Disable compare match interrupt (CMPMIE).

Parameters

- **LPTIMx**: Low-Power Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- IER CMPMIE LL_LPTIM_DisableIT_CMPM

LL_LPTIM_IsEnabledIT_CMPM

Function name **__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledIT_CMPM (LPTIM_TypeDef * LPTIMx)**

Function description Indicates whether the compare match interrupt (CMPMIE) is enabled.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER CMPMIE LL_LPTIM_IsEnabledIT_CMPM

LL_LPTIM_EnableIT_ARRM

Function name **__STATIC_INLINE void LL_LPTIM_EnableIT_ARRM (LPTIM_TypeDef * LPTIMx)**

Function description Enable autoreload match interrupt (ARRMIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER ARRMIE LL_LPTIM_EnableIT_ARRM

LL_LPTIM_DisableIT_ARRM

Function name **__STATIC_INLINE void LL_LPTIM_DisableIT_ARRM (LPTIM_TypeDef * LPTIMx)**

Function description Disable autoreload match interrupt (ARRMIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER ARRMIE LL_LPTIM_DisableIT_ARRM

LL_LPTIM_IsEnabledIT_ARRM

Function name **__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledIT_ARRM (LPTIM_TypeDef * LPTIMx)**

Function description Indicates whether the autoreload match interrupt (ARRMIE) is enabled.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference: • IER ARRMIIE LL_LPTIM_IsEnabledIT_ARRM

LL_LPTIM_EnableIT_EXTTRIG

Function name **__STATIC_INLINE void LL_LPTIM_EnableIT_EXTTRIG (LPTIM_TypeDef * LPTIMx)**

Function description Enable external trigger valid edge interrupt (EXTTRIGIE).

Parameters • **LPTIMx**: Low-Power Timer instance

Return values • **None**:

Reference Manual to LL API cross reference: • IER EXTTRIGIE LL_LPTIM_EnableIT_EXTTRIG

LL_LPTIM_DisableIT_EXTTRIG

Function name **__STATIC_INLINE void LL_LPTIM_DisableIT_EXTTRIG (LPTIM_TypeDef * LPTIMx)**

Function description Disable external trigger valid edge interrupt (EXTTRIGIE).

Parameters • **LPTIMx**: Low-Power Timer instance

Return values • **None**:

Reference Manual to LL API cross reference: • IER EXTTRIGIE LL_LPTIM_DisableIT_EXTTRIG

LL_LPTIM_IsEnabledIT_EXTTRIG

Function name **__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledIT_EXTTRIG (LPTIM_TypeDef * LPTIMx)**

Function description Indicates external trigger valid edge interrupt (EXTTRIGIE) is enabled.

Parameters • **LPTIMx**: Low-Power Timer instance

Return values • **State**: of bit (1 or 0).

Reference Manual to LL API cross reference: • IER EXTTRIGIE LL_LPTIM_IsEnabledIT_EXTTRIG

LL_LPTIM_EnableIT_CMPOK

Function name **__STATIC_INLINE void LL_LPTIM_EnableIT_CMPOK (LPTIM_TypeDef * LPTIMx)**

Function description Enable compare register write completed interrupt (CMPOKIE).

Parameters • **LPTIMx**: Low-Power Timer instance

Return values • **None**:

Reference Manual to LL API cross reference:

- IER CMPOKIE LL_LPTIM_EnableIT_CMPOK

LL_LPTIM_DisableIT_CMPOK

Function name **__STATIC_INLINE void LL_LPTIM_DisableIT_CMPOK (LPTIM_TypeDef * LPTIMx)**

Function description Disable compare register write completed interrupt (CMPOKIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER CMPOKIE LL_LPTIM_DisableIT_CMPOK

LL_LPTIM_IsEnabledIT_CMPOK

Function name **__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledIT_CMPOK (LPTIM_TypeDef * LPTIMx)**

Function description Indicates whether the compare register write completed interrupt (CMPOKIE) is enabled.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER CMPOKIE LL_LPTIM_IsEnabledIT_CMPOK

LL_LPTIM_EnableIT_ARROK

Function name **__STATIC_INLINE void LL_LPTIM_EnableIT_ARROK (LPTIM_TypeDef * LPTIMx)**

Function description Enable autoreload register write completed interrupt (ARROKIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER ARROKIE LL_LPTIM_EnableIT_ARROK

LL_LPTIM_DisableIT_ARROK

Function name **__STATIC_INLINE void LL_LPTIM_DisableIT_ARROK (LPTIM_TypeDef * LPTIMx)**

Function description Disable autoreload register write completed interrupt (ARROKIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER ARROKIE LL_LPTIM_DisableIT_ARROK

LL_LPTIM_IsEnabledIT_ARROK

Function name `__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledIT_ARROK (LPTIM_TypeDef * LPTIMx)`

Function description Indicates whether the autoreload register write completed interrupt (ARROKIE) is enabled.

Parameters

- **LPTIMx**: Low-Power Timer instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER ARROKIE LL_LPTIM_IsEnabledIT_ARROK

LL_LPTIM_EnableIT_UP

Function name `__STATIC_INLINE void LL_LPTIM_EnableIT_UP (LPTIM_TypeDef * LPTIMx)`

Function description Enable direction change to up interrupt (UPIE).

Parameters

- **LPTIMx**: Low-Power Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- IER UPIE LL_LPTIM_EnableIT_UP

LL_LPTIM_DisableIT_UP

Function name `__STATIC_INLINE void LL_LPTIM_DisableIT_UP (LPTIM_TypeDef * LPTIMx)`

Function description Disable direction change to up interrupt (UPIE).

Parameters

- **LPTIMx**: Low-Power Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- IER UPIE LL_LPTIM_DisableIT_UP

LL_LPTIM_IsEnabledIT_UP

Function name `__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledIT_UP (LPTIM_TypeDef * LPTIMx)`

Function description Indicates whether the direction change to up interrupt (UPIE) is enabled.

Parameters

- **LPTIMx**: Low-Power Timer instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER UPIE LL_LPTIM_IsEnabledIT_UP

LL_LPTIM_EnableIT_DOWN

Function name **__STATIC_INLINE void LL_LPTIM_EnableIT_DOWN (LPTIM_TypeDef * LPTIMx)**

Function description Enable direction change to down interrupt (DOWNIE).

Parameters

- **LPTIMx**: Low-Power Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- IER DOWNIE LL_LPTIM_EnableIT_DOWN

LL_LPTIM_DisableIT_DOWN

Function name **__STATIC_INLINE void LL_LPTIM_DisableIT_DOWN (LPTIM_TypeDef * LPTIMx)**

Function description Disable direction change to down interrupt (DOWNIE).

Parameters

- **LPTIMx**: Low-Power Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- IER DOWNIE LL_LPTIM_DisableIT_DOWN

LL_LPTIM_IsEnabledIT_DOWN

Function name **__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledIT_DOWN (LPTIM_TypeDef * LPTIMx)**

Function description Indicates whether the direction change to down interrupt (DOWNIE) is enabled.

Parameters

- **LPTIMx**: Low-Power Timer instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER DOWNIE LL_LPTIM_IsEnabledIT_DOWN

LL_LPTIM_DeInit

Function name **ErrorStatus LL_LPTIM_DeInit (LPTIM_TypeDef * LPTIMx)**

Function description Set LPTIMx registers to their reset values.

Parameters

- **LPTIMx**: LP Timer instance

Return values

- **An**: ErrorStatus enumeration value:
 - SUCCESS: LPTIMx registers are de-initialized
 - ERROR: invalid LPTIMx instance

LL_LPTIM_StructInit

Function name	void LL_LPTIM_StructInit (LL_LPTIM_InitTypeDef * LPTIM_InitStruct)
Function description	Set each fields of the LPTIM_InitStruct structure to its default value.
Parameters	<ul style="list-style-type: none"> • LPTIM_InitStruct: pointer to a LL_LPTIM_InitTypeDef structure
Return values	<ul style="list-style-type: none"> • None:

LL_LPTIM_Init

Function name	ErrorStatus LL_LPTIM_Init (LPTIM_TypeDef * LPTIMx, LL_LPTIM_InitTypeDef * LPTIM_InitStruct)
Function description	Configure the LPTIMx peripheral according to the specified parameters.
Parameters	<ul style="list-style-type: none"> • LPTIMx: LP Timer Instance • LPTIM_InitStruct: pointer to a LL_LPTIM_InitTypeDef structure
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: LPTIMx instance has been initialized – ERROR: LPTIMx instance hasn't been initialized
Notes	<ul style="list-style-type: none"> • LL_LPTIM_Init can only be called when the LPTIM instance is disabled. • LPTIMx can be disabled using unitary function LL_LPTIM_Disable().

83.3 LPTIM Firmware driver defines**83.3.1 LPTIM*****Clock Filter***

LL_LPTIM_CLK_FILTER_NONE	Any external clock signal level change is considered as a valid transition
LL_LPTIM_CLK_FILTER_2	External clock signal level change must be stable for at least 2 clock periods before it is considered as valid transition
LL_LPTIM_CLK_FILTER_4	External clock signal level change must be stable for at least 4 clock periods before it is considered as valid transition
LL_LPTIM_CLK_FILTER_8	External clock signal level change must be stable for at least 8 clock periods before it is considered as valid transition

Clock Polarity

LL_LPTIM_CLK_POLARITY_RISING	The rising edge is the active edge used for counting
LL_LPTIM_CLK_POLARITY_FALLING	The falling edge is the active edge used

for counting

LL_LPTIM_CLK_POLARITY_RISING_FALLING Both edges are active edges

Clock Source

LL_LPTIM_CLK_SOURCE_INTERNAL LPTIM is clocked by internal clock source (APB clock or any of the embedded oscillators)

LL_LPTIM_CLK_SOURCE_EXTERNAL LPTIM is clocked by an external clock source through the LPTIM external Input1

Counter Mode

LL_LPTIM_COUNTER_MODE_INTERNAL The counter is incremented following each internal clock pulse

LL_LPTIM_COUNTER_MODE_EXTERNAL The counter is incremented following each valid clock pulse on the LPTIM external Input1

Encoder Mode

LL_LPTIM_ENCODER_MODE_RISING The rising edge is the active edge used for counting

LL_LPTIM_ENCODER_MODE_FALLING The falling edge is the active edge used for counting

LL_LPTIM_ENCODER_MODE_RISING_FALLING Both edges are active edges

Get Flags Defines

LL_LPTIM_ISR_CMPM Compare match

LL_LPTIM_ISR_ARRM Autoreload match

LL_LPTIM_ISR_EXTTRIG External trigger edge event

LL_LPTIM_ISR_CMPOK Compare register update OK

LL_LPTIM_ISR_ARROK Autoreload register update OK

LL_LPTIM_ISR_UP Counter direction change down to up

LL_LPTIM_ISR_DOWN Counter direction change up to down

IT Defines

LL_LPTIM_IER_CMPMIE Compare match Interrupt Enable

LL_LPTIM_IER_ARRMIE Autoreload match Interrupt Enable

LL_LPTIM_IER_EXTTRIGIE External trigger valid edge Interrupt Enable

LL_LPTIM_IER_CMPOKIE Compare register update OK Interrupt Enable

LL_LPTIM_IER_ARROKIE Autoreload register update OK Interrupt Enable

LL_LPTIM_IER_UPIE Direction change to UP Interrupt Enable

LL_LPTIM_IER_DOWNIE Direction change to down Interrupt Enable

Operating Mode

LL_LPTIM_OPERATING_MODE_CONTINUOUS LP Timer starts in continuous mode

LL_LPTIM_OPERATING_MODE_ONESHOT LP Tilmer starts in single mode

Output Polarity

LL_LPTIM_OUTPUT_POLARITY_REGULAR	The LPTIM output reflects the compare results between LPTIMx_ARR and LPTIMx_CMP registers
LL_LPTIM_OUTPUT_POLARITY_INVERSE	The LPTIM output reflects the inverse of the compare results between LPTIMx_ARR and LPTIMx_CMP registers

Output Waveform Type

LL_LPTIM_OUTPUT_WAVEFORM_PWM	LPTIM generates either a PWM waveform or a One pulse waveform depending on chosen operating mode CONTINUOUS or SINGLE
LL_LPTIM_OUTPUT_WAVEFORM_SETONCE	LPTIM generates a Set Once waveform

Prescaler Value

LL_LPTIM_PRESCALER_DIV1	Prescaler division factor is set to 1
LL_LPTIM_PRESCALER_DIV2	Prescaler division factor is set to 2
LL_LPTIM_PRESCALER_DIV4	Prescaler division factor is set to 4
LL_LPTIM_PRESCALER_DIV8	Prescaler division factor is set to 8
LL_LPTIM_PRESCALER_DIV16	Prescaler division factor is set to 16
LL_LPTIM_PRESCALER_DIV32	Prescaler division factor is set to 32
LL_LPTIM_PRESCALER_DIV64	Prescaler division factor is set to 64
LL_LPTIM_PRESCALER_DIV128	Prescaler division factor is set to 128

Trigger Filter

LL_LPTIM_TRIG_FILTER_NONE	Any trigger active level change is considered as a valid trigger
LL_LPTIM_TRIG_FILTER_2	Trigger active level change must be stable for at least 2 clock periods before it is considered as valid trigger
LL_LPTIM_TRIG_FILTER_4	Trigger active level change must be stable for at least 4 clock periods before it is considered as valid trigger
LL_LPTIM_TRIG_FILTER_8	Trigger active level change must be stable for at least 8 clock periods before it is considered as valid trigger

Trigger Polarity

LL_LPTIM_TRIG_POLARITY_RISING	LPTIM counter starts when a rising edge is detected
LL_LPTIM_TRIG_POLARITY_FALLING	LPTIM counter starts when a falling edge is detected
LL_LPTIM_TRIG_POLARITY_RISING_FALLING	LPTIM counter starts when a rising or a falling edge is detected

Trigger Source

LL_LPTIM_TRIG_SOURCE_GPIO	External input trigger is connected to TIMx_ETR input
LL_LPTIM_TRIG_SOURCE_RTCALARMA	External input trigger is connected to RTC Alarm A

LL_LPTIM_TRIG_SOURCE_RTCALARMB	External input trigger is connected to RTC Alarm B
LL_LPTIM_TRIG_SOURCE_RTCTAMP1	External input trigger is connected to RTC Tamper 1
LL_LPTIM_TRIG_SOURCE_RTCTAMP2	External input trigger is connected to RTC Tamper 2
LL_LPTIM_TRIG_SOURCE_RTCTAMP3	External input trigger is connected to RTC Tamper 3
LL_LPTIM_TRIG_SOURCE_COMP1	External input trigger is connected to COMP1 output
LL_LPTIM_TRIG_SOURCE_COMP2	External input trigger is connected to COMP2 output

Update Mode

LL_LPTIM_UPDATE_MODE_IMMEDIATE	Preload is disabled: registers are updated after each APB bus write access
LL_LPTIM_UPDATE_MODE_ENDOFPERIOD	preload is enabled: registers are updated at the end of the current LPTIM period

Common Write and read registers Macros

LL_LPTIM_WriteReg	<p>Description:</p> <ul style="list-style-type: none"> Write a value in LPTIM register. <p>Parameters:</p> <ul style="list-style-type: none"> <code>__INSTANCE__</code>: LPTIM Instance <code>__REG__</code>: Register to be written <code>__VALUE__</code>: Value to be written in the register <p>Return value:</p> <ul style="list-style-type: none"> None
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LL_LPTIM_ReadReg	<p>Description:</p> <ul style="list-style-type: none"> Read a value in LPTIM register. <p>Parameters:</p> <ul style="list-style-type: none"> <code>__INSTANCE__</code>: LPTIM Instance <code>__REG__</code>: Register to be read <p>Return value:</p> <ul style="list-style-type: none"> Register: value
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84 LL PWR Generic Driver

84.1 PWR Firmware driver API description

84.1.1 Detailed description of functions

LL_PWR_EnableUnderDriveMode

Function name `__STATIC_INLINE void LL_PWR_EnableUnderDriveMode (void)`

Function description Enable Under Drive Mode.

Return values

- **None:**

Notes

- This mode is enabled only with STOP low power mode. In this mode, the 1.2V domain is preserved in reduced leakage mode. This mode is only available when the main Regulator or the low power Regulator is in low voltage mode.
- If the Under-drive mode was enabled, it is automatically disabled after exiting Stop mode. When the voltage Regulator operates in Under-drive mode, an additional startup delay is induced when waking up from Stop mode.

Reference Manual to LL API cross reference:

- CR1 UDEN LL_PWR_EnableUnderDriveMode

LL_PWR_DisableUnderDriveMode

Function name `__STATIC_INLINE void LL_PWR_DisableUnderDriveMode (void)`

Function description Disable Under Drive Mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 UDEN LL_PWR_DisableUnderDriveMode

LL_PWR_IsEnabledUnderDriveMode

Function name `__STATIC_INLINE uint32_t LL_PWR_IsEnabledUnderDriveMode (void)`

Function description Check if Under Drive Mode is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 UDEN LL_PWR_IsEnabledUnderDriveMode

LL_PWR_EnableOverDriveSwitching

Function name	__STATIC_INLINE void LL_PWR_EnableOverDriveSwitching (void)
Function description	Enable Over drive switching.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 ODSWEN LL_PWR_EnableOverDriveSwitching

LL_PWR_DisableOverDriveSwitching

Function name	__STATIC_INLINE void LL_PWR_DisableOverDriveSwitching (void)
Function description	Disable Over drive switching.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 ODSWEN LL_PWR_DisableOverDriveSwitching

LL_PWR_IsEnabledOverDriveSwitching

Function name	__STATIC_INLINE uint32_t LL_PWR_IsEnabledOverDriveSwitching (void)
Function description	Check if Over drive switching is enabled.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 ODSWEN LL_PWR_IsEnabledOverDriveSwitching

LL_PWR_EnableOverDriveMode

Function name	__STATIC_INLINE void LL_PWR_EnableOverDriveMode (void)
Function description	Enable Over drive Mode.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 ODEN LL_PWR_EnableOverDriveMode

LL_PWR_DisableOverDriveMode

Function name	__STATIC_INLINE void LL_PWR_DisableOverDriveMode (void)
Function description	Disable Over drive Mode.
Return values	<ul style="list-style-type: none"> • None:

Reference Manual to LL API cross reference:

- CR1 ODEN LL_PWR_DisableOverDriveMode

LL_PWR_IsEnabledOverDriveMode

Function name `__STATIC_INLINE uint32_t LL_PWR_IsEnabledOverDriveMode (void)`

Function description Check if Over drive switching is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 ODEN LL_PWR_IsEnabledOverDriveMode

LL_PWR_SetRegulVoltageScaling

Function name `__STATIC_INLINE void LL_PWR_SetRegulVoltageScaling (uint32_t VoltageScaling)`

Function description Set the main internal Regulator output voltage.

Parameters

- **VoltageScaling:** This parameter can be one of the following values:
 - LL_PWR_REGU_VOLTAGE_SCALE1
 - LL_PWR_REGU_VOLTAGE_SCALE2
 - LL_PWR_REGU_VOLTAGE_SCALE3

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 VOS LL_PWR_SetRegulVoltageScaling

LL_PWR_GetRegulVoltageScaling

Function name `__STATIC_INLINE uint32_t LL_PWR_GetRegulVoltageScaling (void)`

Function description Get the main internal Regulator output voltage.

Return values

- **Returned:** value can be one of the following values:
 - LL_PWR_REGU_VOLTAGE_SCALE1
 - LL_PWR_REGU_VOLTAGE_SCALE2
 - LL_PWR_REGU_VOLTAGE_SCALE3

Reference Manual to LL API cross reference:

- CR1 VOS LL_PWR_GetRegulVoltageScaling

LL_PWR_EnableMainRegulatorDeepSleepUDMode

Function name `__STATIC_INLINE void LL_PWR_EnableMainRegulatorDeepSleepUDMode (void)`

Function description Enable Main Regulator in deepsleep under-drive Mode.

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR1 MRUDS
LL_PWR_EnableMainRegulatorDeepSleepUDMode

LL_PWR_DisableMainRegulatorDeepSleepUDMode

- Function name
- __STATIC_INLINE void
LL_PWR_DisableMainRegulatorDeepSleepUDMode (void)**
- Function description
- Disable Main Regulator in deepsleep under-drive Mode.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR1 MRUDS
LL_PWR_DisableMainRegulatorDeepSleepUDMode

LL_PWR_IsEnabledMainRegulatorDeepSleepUDMode

- Function name
- __STATIC_INLINE uint32_t
LL_PWR_IsEnabledMainRegulatorDeepSleepUDMode (void)**
- Function description
- Check if Main Regulator in deepsleep under-drive Mode is enabled.
- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- CR1 MRUDS
LL_PWR_IsEnabledMainRegulatorDeepSleepUDMode

LL_PWR_EnableLowPowerRegulatorDeepSleepUDMode

- Function name
- __STATIC_INLINE void
LL_PWR_EnableLowPowerRegulatorDeepSleepUDMode (void)**
- Function description
- Enable Low Power Regulator in deepsleep under-drive Mode.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR1 LPUDES
LL_PWR_EnableLowPowerRegulatorDeepSleepUDMode

LL_PWR_DisableLowPowerRegulatorDeepSleepUDMode

- Function name
- __STATIC_INLINE void
LL_PWR_DisableLowPowerRegulatorDeepSleepUDMode (void)**
- Function description
- Disable Low Power Regulator in deepsleep under-drive Mode.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR1 LPUDES
LL_PWR_DisableLowPowerRegulatorDeepSleepUDMode

LL_PWR_IsEnabledLowPowerRegulatorDeepSleepUDMode

Function name	__STATIC_INLINE uint32_t LL_PWR_IsEnabledLowPowerRegulatorDeepSleepUDMode (void)
Function description	Check if Low Power Regulator in deepsleep under-drive Mode is enabled.
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 LPUDS LL_PWR_IsEnabledLowPowerRegulatorDeepSleepUDMode

LL_PWR_EnableFlashPowerDown

Function name	__STATIC_INLINE void LL_PWR_EnableFlashPowerDown (void)
Function description	Enable the Flash Power Down in Stop Mode.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 FPDS LL_PWR_EnableFlashPowerDown

LL_PWR_DisableFlashPowerDown

Function name	__STATIC_INLINE void LL_PWR_DisableFlashPowerDown (void)
Function description	Disable the Flash Power Down in Stop Mode.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 FPDS LL_PWR_DisableFlashPowerDown

LL_PWR_IsEnabledFlashPowerDown

Function name	__STATIC_INLINE uint32_t LL_PWR_IsEnabledFlashPowerDown (void)
Function description	Check if the Flash Power Down in Stop Mode is enabled.
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 FPDS LL_PWR_IsEnabledFlashPowerDown

LL_PWR_EnableBkUpAccess

Function name	__STATIC_INLINE void LL_PWR_EnableBkUpAccess (void)
Function description	Enable access to the backup domain.
Return values	<ul style="list-style-type: none">• None:

Reference Manual to LL API cross reference:

- CR1 DBP LL_PWR_EnableBkUpAccess

LL_PWR_DisableBkUpAccess

Function name `__STATIC_INLINE void LL_PWR_DisableBkUpAccess (void)`

Function description Disable access to the backup domain.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 DBP LL_PWR_DisableBkUpAccess

LL_PWR_IsEnabledBkUpAccess

Function name `__STATIC_INLINE uint32_t LL_PWR_IsEnabledBkUpAccess (void)`

Function description Check if the backup domain is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 DBP LL_PWR_IsEnabledBkUpAccess

LL_PWR_EnableBkUpRegulator

Function name `__STATIC_INLINE void LL_PWR_EnableBkUpRegulator (void)`

Function description Enable Backup Regulator.

Return values

- **None:**

Notes

- When set, the Backup Regulator (used to maintain backup SRAM content in Standby and VBAT modes) is enabled. If BRE is reset, the backup Regulator is switched off. The backup SRAM can still be used but its content will be lost in the Standby and VBAT modes. Once set, the application must wait that the Backup Regulator Ready flag (BRR) is set to indicate that the data written into the RAM will be maintained in the Standby and VBAT modes.

Reference Manual to LL API cross reference:

- CSR1 BRE LL_PWR_EnableBkUpRegulator

LL_PWR_DisableBkUpRegulator

Function name `__STATIC_INLINE void LL_PWR_DisableBkUpRegulator (void)`

Function description Disable Backup Regulator.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CSR1 BRE LL_PWR_DisableBkUpRegulator

LL_PWR_IsEnabledBkUpRegulator

Function name `__STATIC_INLINE uint32_t LL_PWR_IsEnabledBkUpRegulator (void)`

Function description Check if the backup Regulator is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR1 BRE LL_PWR_IsEnabledBkUpRegulator

LL_PWR_SetRegulModeDS

Function name `__STATIC_INLINE void LL_PWR_SetRegulModeDS (uint32_t RegulMode)`

Function description Set voltage Regulator mode during deep sleep mode.

Parameters

- **RegulMode:** This parameter can be one of the following values:
 - LL_PWR_REGU_DSMODE_MAIN
 - LL_PWR_REGU_DSMODE_LOW_POWER

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 LPDS LL_PWR_SetRegulModeDS

LL_PWR_GetRegulModeDS

Function name `__STATIC_INLINE uint32_t LL_PWR_GetRegulModeDS (void)`

Function description Get voltage Regulator mode during deep sleep mode.

Return values

- **Returned:** value can be one of the following values:
 - LL_PWR_REGU_DSMODE_MAIN
 - LL_PWR_REGU_DSMODE_LOW_POWER

Reference Manual to LL API cross reference:

- CR1 LPDS LL_PWR_GetRegulModeDS

LL_PWR_SetPowerMode

Function name `__STATIC_INLINE void LL_PWR_SetPowerMode (uint32_t PMode)`

Function description Set Power Down mode when CPU enters deepsleep.

Parameters

- **PMode:** This parameter can be one of the following values:
 - LL_PWR_MODE_STOP_MAINREGU
 - LL_PWR_MODE_STOP_MAINREGU_UNDERDRIVE

- LL_PWR_MODE_STOP_LPREGU
- LL_PWR_MODE_STOP_LPREGU_UNDERDRIVE
- LL_PWR_MODE_STANDBY

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 PDDS LL_PWR_SetPowerMode
- CR1 LPDS LL_PWR_SetPowerMode
- CR1 FPDS LL_PWR_SetPowerMode
- CR1 LPU DS LL_PWR_SetPowerMode
- CR1 MRUDS LL_PWR_SetPowerMode

LL_PWR_GetPowerMode

Function name

__STATIC_INLINE uint32_t LL_PWR_GetPowerMode (void)

Function description

Get Power Down mode when CPU enters deepsleep.

Return values

- **Returned:** value can be one of the following values:
 - LL_PWR_MODE_STOP_MAINREGU
 - LL_PWR_MODE_STOP_MAINREGU_UNDERDRIVE
 - LL_PWR_MODE_STOP_LPREGU
 - LL_PWR_MODE_STOP_LPREGU_UNDERDRIVE
 - LL_PWR_MODE_STANDBY

Reference Manual to LL API cross reference:

- CR1 PDDS LL_PWR_GetPowerMode
- CR1 LPDS LL_PWR_GetPowerMode
- CR1 FPDS LL_PWR_GetPowerMode
- CR1 LPU DS LL_PWR_GetPowerMode
- CR1 MRUDS LL_PWR_GetPowerMode

LL_PWR_SetPVDLevel

Function name

__STATIC_INLINE void LL_PWR_SetPVDLevel (uint32_t PVDLevel)

Function description

Configure the voltage threshold detected by the Power Voltage Detector.

Parameters

- **PVDLevel:** This parameter can be one of the following values:
 - LL_PWR_PVDLEVEL_0
 - LL_PWR_PVDLEVEL_1
 - LL_PWR_PVDLEVEL_2
 - LL_PWR_PVDLEVEL_3
 - LL_PWR_PVDLEVEL_4
 - LL_PWR_PVDLEVEL_5
 - LL_PWR_PVDLEVEL_6
 - LL_PWR_PVDLEVEL_7

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 PLS LL_PWR_SetPVDLevel

LL_PWR_GetPVDLevel

Function name `__STATIC_INLINE uint32_t LL_PWR_GetPVDLevel (void)`

Function description Get the voltage threshold detection.

Return values

- **Returned:** value can be one of the following values:
 - LL_PWR_PVDLEVEL_0
 - LL_PWR_PVDLEVEL_1
 - LL_PWR_PVDLEVEL_2
 - LL_PWR_PVDLEVEL_3
 - LL_PWR_PVDLEVEL_4
 - LL_PWR_PVDLEVEL_5
 - LL_PWR_PVDLEVEL_6
 - LL_PWR_PVDLEVEL_7

Reference Manual to LL API cross reference:

- CR1 PLS LL_PWR_GetPVDLevel

LL_PWR_EnablePVD

Function name `__STATIC_INLINE void LL_PWR_EnablePVD (void)`

Function description Enable Power Voltage Detector.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 PVDE LL_PWR_EnablePVD

LL_PWR_DisablePVD

Function name `__STATIC_INLINE void LL_PWR_DisablePVD (void)`

Function description Disable Power Voltage Detector.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 PVDE LL_PWR_DisablePVD

LL_PWR_IsEnabledPVD

Function name `__STATIC_INLINE uint32_t LL_PWR_IsEnabledPVD (void)`

Function description Check if Power Voltage Detector is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 PVDE LL_PWR_IsEnabledPVD

LL_PWR_EnableWakeUpPin

Function name `__STATIC_INLINE void LL_PWR_EnableWakeUpPin (uint32_t WakeUpPin)`

Function description	Enable the WakeUp PINx functionality.
Parameters	<ul style="list-style-type: none"> • WakeUpPin: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_PWR_WAKEUP_PIN1 – LL_PWR_WAKEUP_PIN2 – LL_PWR_WAKEUP_PIN3 – LL_PWR_WAKEUP_PIN4 – LL_PWR_WAKEUP_PIN5 – LL_PWR_WAKEUP_PIN6
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CSR2 EWUP1 LL_PWR_EnableWakeUpPin • CSR2 EWUP2 LL_PWR_EnableWakeUpPin • CSR2 EWUP3 LL_PWR_EnableWakeUpPin • CSR2 EWUP4 LL_PWR_EnableWakeUpPin • CSR2 EWUP5 LL_PWR_EnableWakeUpPin • CSR2 EWUP6 LL_PWR_EnableWakeUpPin

LL_PWR_DisableWakeUpPin

Function name	__STATIC_INLINE void LL_PWR_DisableWakeUpPin (uint32_t WakeUpPin)
Function description	Disable the WakeUp PINx functionality.
Parameters	<ul style="list-style-type: none"> • WakeUpPin: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_PWR_WAKEUP_PIN1 – LL_PWR_WAKEUP_PIN2 – LL_PWR_WAKEUP_PIN3 – LL_PWR_WAKEUP_PIN4 – LL_PWR_WAKEUP_PIN5 – LL_PWR_WAKEUP_PIN6
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CSR2 EWUP1 LL_PWR_DisableWakeUpPin • CSR2 EWUP2 LL_PWR_DisableWakeUpPin • CSR2 EWUP3 LL_PWR_DisableWakeUpPin • CSR2 EWUP4 LL_PWR_DisableWakeUpPin • CSR2 EWUP5 LL_PWR_DisableWakeUpPin • CSR2 EWUP6 LL_PWR_DisableWakeUpPin

LL_PWR_IsEnabledWakeUpPin

Function name	__STATIC_INLINE uint32_t LL_PWR_IsEnabledWakeUpPin (uint32_t WakeUpPin)
Function description	Check if the WakeUp PINx functionality is enabled.
Parameters	<ul style="list-style-type: none"> • WakeUpPin: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_PWR_WAKEUP_PIN1 – LL_PWR_WAKEUP_PIN2 – LL_PWR_WAKEUP_PIN3

	<ul style="list-style-type: none"> – LL_PWR_WAKEUP_PIN4 – LL_PWR_WAKEUP_PIN5 – LL_PWR_WAKEUP_PIN6
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CSR2 EWUP1 LL_PWR_IsEnabledWakeUpPin • CSR2 EWUP2 LL_PWR_IsEnabledWakeUpPin • CSR2 EWUP3 LL_PWR_IsEnabledWakeUpPin • CSR2 EWUP4 LL_PWR_IsEnabledWakeUpPin • CSR2 EWUP5 LL_PWR_IsEnabledWakeUpPin • CSR2 EWUP6 LL_PWR_IsEnabledWakeUpPin

LL_PWR_SetWakeUpPinPolarityLow

Function name	__STATIC_INLINE void LL_PWR_SetWakeUpPinPolarityLow (uint32_t WakeUpPin)
Function description	Set the Wake-Up pin polarity low for the event detection.
Parameters	<ul style="list-style-type: none"> • WakeUpPin: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_PWR_WAKEUP_PIN1 – LL_PWR_WAKEUP_PIN2 – LL_PWR_WAKEUP_PIN3 – LL_PWR_WAKEUP_PIN4 – LL_PWR_WAKEUP_PIN5 – LL_PWR_WAKEUP_PIN6
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 WUPP1 LL_PWR_SetWakeUpPinPolarityLow • CR2 WUPP2 LL_PWR_SetWakeUpPinPolarityLow • CR2 WUPP3 LL_PWR_SetWakeUpPinPolarityLow • CR2 WUPP4 LL_PWR_SetWakeUpPinPolarityLow • CR2 WUPP5 LL_PWR_SetWakeUpPinPolarityLow • CR2 WUPP6 LL_PWR_SetWakeUpPinPolarityLow

LL_PWR_SetWakeUpPinPolarityHigh

Function name	__STATIC_INLINE void LL_PWR_SetWakeUpPinPolarityHigh (uint32_t WakeUpPin)
Function description	Set the Wake-Up pin polarity high for the event detection.
Parameters	<ul style="list-style-type: none"> • WakeUpPin: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_PWR_WAKEUP_PIN1 – LL_PWR_WAKEUP_PIN2 – LL_PWR_WAKEUP_PIN3 – LL_PWR_WAKEUP_PIN4 – LL_PWR_WAKEUP_PIN5 – LL_PWR_WAKEUP_PIN6
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross	<ul style="list-style-type: none"> • CR2 WUPP1 LL_PWR_SetWakeUpPinPolarityHigh • CR2 WUPP2 LL_PWR_SetWakeUpPinPolarityHigh

- reference:
- CR2 WUPP3 LL_PWR_SetWakeUpPinPolarityHigh
 - CR2 WUPP4 LL_PWR_SetWakeUpPinPolarityHigh
 - CR2 WUPP5 LL_PWR_SetWakeUpPinPolarityHigh
 - CR2 WUPP6 LL_PWR_SetWakeUpPinPolarityHigh

LL_PWR_IsWakeUpPinPolarityLow

Function name `__STATIC_INLINE uint32_t LL_PWR_IsWakeUpPinPolarityLow (uint32_t WakeUpPin)`

Function description Get the Wake-Up pin polarity for the event detection.

- Parameters
- **WakeUpPin:** This parameter can be one of the following values:
 - LL_PWR_WAKEUP_PIN1
 - LL_PWR_WAKEUP_PIN2
 - LL_PWR_WAKEUP_PIN3
 - LL_PWR_WAKEUP_PIN4
 - LL_PWR_WAKEUP_PIN5
 - LL_PWR_WAKEUP_PIN6

Return values

- **State:** of bit (1 or 0).

- Reference Manual to LL API cross reference:
- CR2 WUPP1 LL_PWR_IsWakeUpPinPolarityLow
 - CR2 WUPP2 LL_PWR_IsWakeUpPinPolarityLow
 - CR2 WUPP3 LL_PWR_IsWakeUpPinPolarityLow
 - CR2 WUPP4 LL_PWR_IsWakeUpPinPolarityLow
 - CR2 WUPP5 LL_PWR_IsWakeUpPinPolarityLow
 - CR2 WUPP6 LL_PWR_IsWakeUpPinPolarityLow

LL_PWR_EnableInternalWakeUp

Function name `__STATIC_INLINE void LL_PWR_EnableInternalWakeUp (void)`

Function description Enable Internal WakeUp.

Return values

- **None:**

- Notes
- This API must be used when RTC events (Alarm A or Alarm B, RTC Tamper, RTC TimeStamp or RTC Wakeup time) are used to wake up the system from Standby mode.

- Reference Manual to LL API cross reference:
- CSR1 EIWUP LL_PWR_EnableInternalWakeUp

LL_PWR_DisableInternalWakeUp

Function name `__STATIC_INLINE void LL_PWR_DisableInternalWakeUp (void)`

Function description Disable Internal WakeUp.

Return values

- **None:**

- Reference Manual to LL API cross
- CSR1 EIWUP LL_PWR_DisableInternalWakeUp

reference:

LL_PWR_IsEnabledInternalWakeUp

Function name `__STATIC_INLINE uint32_t LL_PWR_IsEnabledInternalWakeUp (void)`

Function description Check if the Internal WakeUp functionality is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR1 EIWUP LL_PWR_IsEnabledInternalWakeUp

LL_PWR_IsActiveFlag_WU6

Function name `__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_WU6 (void)`

Function description Get Wake-up Flag 6.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR2 WUPF6 LL_PWR_IsActiveFlag_WU6

LL_PWR_IsActiveFlag_WU5

Function name `__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_WU5 (void)`

Function description Get Wake-up Flag 5.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR2 WUPF5 LL_PWR_IsActiveFlag_WU5

LL_PWR_IsActiveFlag_WU4

Function name `__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_WU4 (void)`

Function description Get Wake-up Flag 4.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR2 WUPF4 LL_PWR_IsActiveFlag_WU4

LL_PWR_IsActiveFlag_WU3

Function name `__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_WU3 (void)`

Function description Get Wake-up Flag 3.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross

- CSR2 WUPF3 LL_PWR_IsActiveFlag_WU3

reference:

LL_PWR_IsActiveFlag_WU2

Function name `__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_WU2 (void)`

Function description Get Wake-up Flag 2.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR2 WUPF2 LL_PWR_IsActiveFlag_WU2

LL_PWR_IsActiveFlag_WU1

Function name `__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_WU1 (void)`

Function description Get Wake-up Flag 1.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR2 WUPF1 LL_PWR_IsActiveFlag_WU1

LL_PWR_IsActiveFlag_SB

Function name `__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_SB (void)`

Function description Get Standby Flag.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR1 SBF LL_PWR_IsActiveFlag_SB

LL_PWR_IsActiveFlag_PVDO

Function name `__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_PVDO (void)`

Function description Indicate whether VDD voltage is below the selected PVD threshold.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR1 PVDO LL_PWR_IsActiveFlag_PVDO

LL_PWR_IsActiveFlag_BRR

Function name `__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_BRR (void)`

Function description Get Backup Regulator ready Flag.

Return values

- **State:** of bit (1 or 0).

Reference Manual to

- CSR1 BRR LL_PWR_IsActiveFlag_BRR

LL API cross
reference:

LL_PWR_IsActiveFlag_VOS

Function name `__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_VOS (void)`

Function description Indicate whether the Regulator is ready in the selected voltage range or if its output voltage is still changing to the required voltage level.

Return values

- **State:** of bit (1 or 0).

Reference Manual to
LL API cross
reference:

- CSR1 VOSRDY LL_PWR_IsActiveFlag_VOS

LL_PWR_IsActiveFlag_OD

Function name `__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_OD (void)`

Function description Indicate whether the Over-Drive mode is ready or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to
LL API cross
reference:

- CSR1 ODRDY LL_PWR_IsActiveFlag_OD

LL_PWR_IsActiveFlag_ODSW

Function name `__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_ODSW (void)`

Function description Indicate whether the Over-Drive mode switching is ready or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to
LL API cross
reference:

- CSR1 ODSWRDY LL_PWR_IsActiveFlag_ODSW

LL_PWR_IsActiveFlag_UD

Function name `__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_UD (void)`

Function description Indicate whether the Under-Drive mode is ready or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to
LL API cross
reference:

- CSR1 UDRDY LL_PWR_IsActiveFlag_UD

LL_PWR_ClearFlag_SB

Function name `__STATIC_INLINE void LL_PWR_ClearFlag_SB (void)`

Function description Clear Standby Flag.

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR1 CSBF LL_PWR_ClearFlag_SB

LL_PWR_ClearFlag_WU6

- Function name `__STATIC_INLINE void LL_PWR_ClearFlag_WU6 (void)`
- Function description Clear Wake-up Flag 6.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR2 CWUF6 LL_PWR_ClearFlag_WU6

LL_PWR_ClearFlag_WU5

- Function name `__STATIC_INLINE void LL_PWR_ClearFlag_WU5 (void)`
- Function description Clear Wake-up Flag 5.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR2 CWUF5 LL_PWR_ClearFlag_WU5

LL_PWR_ClearFlag_WU4

- Function name `__STATIC_INLINE void LL_PWR_ClearFlag_WU4 (void)`
- Function description Clear Wake-up Flag 4.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR2 CWUF4 LL_PWR_ClearFlag_WU4

LL_PWR_ClearFlag_WU3

- Function name `__STATIC_INLINE void LL_PWR_ClearFlag_WU3 (void)`
- Function description Clear Wake-up Flag 3.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR2 CWUF3 LL_PWR_ClearFlag_WU3

LL_PWR_ClearFlag_WU2

- Function name `__STATIC_INLINE void LL_PWR_ClearFlag_WU2 (void)`
- Function description Clear Wake-up Flag 2.
- Return values
- **None:**

Reference Manual to LL API cross reference:

- CR2 CWUF2 LL_PWR_ClearFlag_WU2

LL_PWR_ClearFlag_WU1

Function name **__STATIC_INLINE void LL_PWR_ClearFlag_WU1 (void)**

Function description Clear Wake-up Flag 1.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 CWUF1 LL_PWR_ClearFlag_WU1

LL_PWR_ClearFlag_UD

Function name **__STATIC_INLINE void LL_PWR_ClearFlag_UD (void)**

Function description Clear Under-Drive ready Flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CSR1 UDRDY LL_PWR_ClearFlag_UD

LL_PWR_DeInit

Function name **ErrorStatus LL_PWR_DeInit (void)**

Function description De-initialize the PWR registers to their default reset values.

Return values

- **An:** ErrorStatus enumeration value:
 - SUCCESS: PWR registers are de-initialized
 - ERROR: not applicable

84.2 PWR Firmware driver defines

84.2.1 PWR

Clear Flags Defines

LL_PWR_CR1_CSBF Clear standby flag

LL_PWR_CR2_CWUF6 Clear WKUP pin 6

LL_PWR_CR2_CWUF5 Clear WKUP pin 5

LL_PWR_CR2_CWUF4 Clear WKUP pin 4

LL_PWR_CR2_CWUF3 Clear WKUP pin 3

LL_PWR_CR2_CWUF2 Clear WKUP pin 2

LL_PWR_CR2_CWUF1 Clear WKUP pin 1

Get Flags Defines

LL_PWR_CSR1_WUIF Wakeup flag

LL_PWR_CSR1_SBF	Standby flag
LL_PWR_CSR1_PVDO	Power voltage detector output flag
LL_PWR_CSR1_BRR	Backup Regulator ready flag
LL_PWR_CSR1_VOUSDY	Voltage scaling select flag
LL_PWR_CSR1_ODRDY	Over-drive mode ready
LL_PWR_CSR1_ODSWRDY	Over-drive mode switching ready
LL_PWR_CSR1_UDRDY	Under-drive ready flag
LL_PWR_CSR2_EWUP1	Enable WKUP pin 1
LL_PWR_CSR2_EWUP2	Enable WKUP pin 2
LL_PWR_CSR2_EWUP3	Enable WKUP pin 3
LL_PWR_CSR2_EWUP4	Enable WKUP pin 4
LL_PWR_CSR2_EWUP5	Enable WKUP pin 5
LL_PWR_CSR2_EWUP6	Enable WKUP pin 6

Mode Power

LL_PWR_MODE_STOP_MAINREGU	Enter Stop mode (with main Regulator ON) when the CPU enters deepsleep
LL_PWR_MODE_STOP_MAINREGU_UNDERDRIVE	Enter Stop mode (with main Regulator in under-drive mode) when the CPU enters deepsleep
LL_PWR_MODE_STOP_LPREGU	Enter Stop mode (with low power Regulator ON) when the CPU enters deepsleep
LL_PWR_MODE_STOP_LPREGU_UNDERDRIVE	Enter Stop mode (with low power Regulator in under-drive mode) when the CPU enters deepsleep
LL_PWR_MODE_STANDBY	Enter Standby mode when the CPU enters deepsleep

Power Voltage Detector Level

LL_PWR_PVDLEVEL_0	Voltage threshold detected by PVD 2.0 V
LL_PWR_PVDLEVEL_1	Voltage threshold detected by PVD 2.1 V
LL_PWR_PVDLEVEL_2	Voltage threshold detected by PVD 2.3 V
LL_PWR_PVDLEVEL_3	Voltage threshold detected by PVD 2.5 V
LL_PWR_PVDLEVEL_4	Voltage threshold detected by PVD 2.6 V
LL_PWR_PVDLEVEL_5	Voltage threshold detected by PVD 2.7 V
LL_PWR_PVDLEVEL_6	Voltage threshold detected by PVD 2.8 V
LL_PWR_PVDLEVEL_7	Voltage threshold detected by PVD 2.9 V

Regulator Mode In Deep Sleep Mode

LL_PWR_REGU_DSMODE_MAIN	Voltage Regulator in main mode during deepsleep mode
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LL_PWR_REGU_DSMODE_LOW_POWER Voltage Regulator in low-power mode during deepsleep mode

Regulator Voltage

LL_PWR_REGU_VOLTAGE_SCALE3

LL_PWR_REGU_VOLTAGE_SCALE2

LL_PWR_REGU_VOLTAGE_SCALE1

Wakeup Pins

LL_PWR_WAKEUP_PIN1 WKUP pin 1 : PA0

LL_PWR_WAKEUP_PIN2 WKUP pin 2 : PA2

LL_PWR_WAKEUP_PIN3 WKUP pin 3 : PC1

LL_PWR_WAKEUP_PIN4 WKUP pin 4 : PC13

LL_PWR_WAKEUP_PIN5 WKUP pin 5 : PI8

LL_PWR_WAKEUP_PIN6 WKUP pin 6 : PI11

Common write and read registers Macros

LL_PWR_WriteReg

Description:

- Write a value in PWR register.

Parameters:

- `__REG__`: Register to be written
- `__VALUE__`: Value to be written in the register

Return value:

- None

LL_PWR_ReadReg

Description:

- Read a value in PWR register.

Parameters:

- `__REG__`: Register to be read

Return value:

- Register: value

85 LL RCC Generic Driver

85.1 RCC Firmware driver registers structures

85.1.1 LL_RCC_ClocksTypeDef

Data Fields

- *uint32_t* **SYSCLK_Frequency**
- *uint32_t* **HCLK_Frequency**
- *uint32_t* **PCLK1_Frequency**
- *uint32_t* **PCLK2_Frequency**

Field Documentation

- *uint32_t* **LL_RCC_ClocksTypeDef::SYSCLK_Frequency**
SYSCLK clock frequency
- *uint32_t* **LL_RCC_ClocksTypeDef::HCLK_Frequency**
HCLK clock frequency
- *uint32_t* **LL_RCC_ClocksTypeDef::PCLK1_Frequency**
PCLK1 clock frequency
- *uint32_t* **LL_RCC_ClocksTypeDef::PCLK2_Frequency**
PCLK2 clock frequency

85.2 RCC Firmware driver API description

85.2.1 Detailed description of functions

LL_RCC_HSE_EnableCSS

Function name **__STATIC_INLINE void LL_RCC_HSE_EnableCSS (void)**

Function description Enable the Clock Security System.

Return values • **None:**

Reference Manual to LL API cross reference: • CR CSSON LL_RCC_HSE_EnableCSS

LL_RCC_HSE_EnableBypass

Function name **__STATIC_INLINE void LL_RCC_HSE_EnableBypass (void)**

Function description Enable HSE external oscillator (HSE Bypass)

Return values • **None:**

Reference Manual to LL API cross reference: • CR HSEBYP LL_RCC_HSE_EnableBypass

LL_RCC_HSE_DisableBypass

Function name **__STATIC_INLINE void LL_RCC_HSE_DisableBypass (void)**

Function description	Disable HSE external oscillator (HSE Bypass)
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR HSEBYP LL_RCC_HSE_DisableBypass

LL_RCC_HSE_Enable

Function name	<code>__STATIC_INLINE void LL_RCC_HSE_Enable (void)</code>
Function description	Enable HSE crystal oscillator (HSE ON)
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR HSEON LL_RCC_HSE_Enable

LL_RCC_HSE_Disable

Function name	<code>__STATIC_INLINE void LL_RCC_HSE_Disable (void)</code>
Function description	Disable HSE crystal oscillator (HSE ON)
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR HSEON LL_RCC_HSE_Disable

LL_RCC_HSE_IsReady

Function name	<code>__STATIC_INLINE uint32_t LL_RCC_HSE_IsReady (void)</code>
Function description	Check if HSE oscillator Ready.
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR HSERDY LL_RCC_HSE_IsReady

LL_RCC_HSI_Enable

Function name	<code>__STATIC_INLINE void LL_RCC_HSI_Enable (void)</code>
Function description	Enable HSI oscillator.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR HSION LL_RCC_HSI_Enable

LL_RCC_HSI_Disable

Function name	<code>__STATIC_INLINE void LL_RCC_HSI_Disable (void)</code>
Function description	Disable HSI oscillator.

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR HSION LL_RCC_HSI_Disable

LL_RCC_HSI_IsReady

- Function name `__STATIC_INLINE uint32_t LL_RCC_HSI_IsReady (void)`
- Function description Check if HSI clock is ready.
- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- CR HSIRDY LL_RCC_HSI_IsReady

LL_RCC_HSI_GetCalibration

- Function name `__STATIC_INLINE uint32_t LL_RCC_HSI_GetCalibration (void)`
- Function description Get HSI Calibration value.
- Return values
- **Between:** Min_Data = 0x00 and Max_Data = 0xFF
- Notes
- When HSITRIM is written, HSICAL is updated with the sum of HSITRIM and the factory trim value
- Reference Manual to LL API cross reference:
- CR HSICAL LL_RCC_HSI_GetCalibration

LL_RCC_HSI_SetCalibTrimming

- Function name `__STATIC_INLINE void LL_RCC_HSI_SetCalibTrimming (uint32_t Value)`
- Function description Set HSI Calibration trimming.
- Parameters
- **Value:** Between Min_Data = 0 and Max_Data = 31
- Return values
- **None:**
- Notes
- user-programmable trimming value that is added to the HSICAL
 - Default value is 16, which, when added to the HSICAL value, should trim the HSI to 16 MHz +/- 1 %
- Reference Manual to LL API cross reference:
- CR HSITRIM LL_RCC_HSI_SetCalibTrimming

LL_RCC_HSI_GetCalibTrimming

- Function name `__STATIC_INLINE uint32_t LL_RCC_HSI_GetCalibTrimming (void)`
- Function description Get HSI Calibration trimming.

- Return values
- **Between:** Min_Data = 0 and Max_Data = 31
- Reference Manual to LL API cross reference:
- CR HSITRIM LL_RCC_HSI_GetCalibTrimming

LL_RCC_LSE_Enable

- Function name `__STATIC_INLINE void LL_RCC_LSE_Enable (void)`
- Function description Enable Low Speed External (LSE) crystal.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- BDCR LSEON LL_RCC_LSE_Enable

LL_RCC_LSE_Disable

- Function name `__STATIC_INLINE void LL_RCC_LSE_Disable (void)`
- Function description Disable Low Speed External (LSE) crystal.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- BDCR LSEON LL_RCC_LSE_Disable

LL_RCC_LSE_EnableBypass

- Function name `__STATIC_INLINE void LL_RCC_LSE_EnableBypass (void)`
- Function description Enable external clock source (LSE bypass).
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- BDCR LSEBYP LL_RCC_LSE_EnableBypass

LL_RCC_LSE_DisableBypass

- Function name `__STATIC_INLINE void LL_RCC_LSE_DisableBypass (void)`
- Function description Disable external clock source (LSE bypass).
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- BDCR LSEBYP LL_RCC_LSE_DisableBypass

LL_RCC_LSE_SetDriveCapability

- Function name `__STATIC_INLINE void LL_RCC_LSE_SetDriveCapability (uint32_t LSEDrive)`
- Function description Set LSE oscillator drive capability.

Parameters	<ul style="list-style-type: none"> • LSEDrive: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_LSEDRIVE_LOW – LL_RCC_LSEDRIVE_MEDIUMHIGH – LL_RCC_LSEDRIVE_MEDIUMLOW – LL_RCC_LSEDRIVE_HIGH
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The oscillator is in Xtal mode when it is not in bypass mode.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BDCR LSEDRV LL_RCC_LSE_SetDriveCapability

LL_RCC_LSE_GetDriveCapability

Function name	__STATIC_INLINE uint32_t LL_RCC_LSE_GetDriveCapability (void)
Function description	Get LSE oscillator drive capability.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_LSEDRIVE_LOW – LL_RCC_LSEDRIVE_MEDIUMHIGH – LL_RCC_LSEDRIVE_MEDIUMLOW – LL_RCC_LSEDRIVE_HIGH
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BDCR LSEDRV LL_RCC_LSE_GetDriveCapability

LL_RCC_LSE_IsReady

Function name	__STATIC_INLINE uint32_t LL_RCC_LSE_IsReady (void)
Function description	Check if LSE oscillator Ready.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BDCR LSERDY LL_RCC_LSE_IsReady

LL_RCC_LSI_Enable

Function name	__STATIC_INLINE void LL_RCC_LSI_Enable (void)
Function description	Enable LSI Oscillator.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CSR LSION LL_RCC_LSI_Enable

LL_RCC_LSI_Disable

Function name	__STATIC_INLINE void LL_RCC_LSI_Disable (void)
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Function description	Disable LSI Oscillator.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CSR LSION LL_RCC_LSI_Disable

LL_RCC_LSI_IsReady

Function name	<code>__STATIC_INLINE uint32_t LL_RCC_LSI_IsReady (void)</code>
Function description	Check if LSI is Ready.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CSR LSIRDY LL_RCC_LSI_IsReady

LL_RCC_SetSysClkSource

Function name	<code>__STATIC_INLINE void LL_RCC_SetSysClkSource (uint32_t Source)</code>
Function description	Configure the system clock source.
Parameters	<ul style="list-style-type: none"> • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_SYS_CLKSOURCE_HSI – LL_RCC_SYS_CLKSOURCE_HSE – LL_RCC_SYS_CLKSOURCE_PLL
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR SW LL_RCC_SetSysClkSource

LL_RCC_GetSysClkSource

Function name	<code>__STATIC_INLINE uint32_t LL_RCC_GetSysClkSource (void)</code>
Function description	Get the system clock source.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_SYS_CLKSOURCE_STATUS_HSI – LL_RCC_SYS_CLKSOURCE_STATUS_HSE – LL_RCC_SYS_CLKSOURCE_STATUS_PLL
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR SWS LL_RCC_GetSysClkSource

LL_RCC_SetAHBPrescaler

Function name	<code>__STATIC_INLINE void LL_RCC_SetAHBPrescaler (uint32_t Prescaler)</code>
Function description	Set AHB prescaler.

Parameters	<ul style="list-style-type: none"> • Prescaler: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_SYSCLK_DIV_1 – LL_RCC_SYSCLK_DIV_2 – LL_RCC_SYSCLK_DIV_4 – LL_RCC_SYSCLK_DIV_8 – LL_RCC_SYSCLK_DIV_16 – LL_RCC_SYSCLK_DIV_64 – LL_RCC_SYSCLK_DIV_128 – LL_RCC_SYSCLK_DIV_256 – LL_RCC_SYSCLK_DIV_512
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR HPRE LL_RCC_SetAHBPrescaler

LL_RCC_SetAPB1Prescaler

Function name	__STATIC_INLINE void LL_RCC_SetAPB1Prescaler (uint32_t Prescaler)
Function description	Set APB1 prescaler.
Parameters	<ul style="list-style-type: none"> • Prescaler: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_APB1_DIV_1 – LL_RCC_APB1_DIV_2 – LL_RCC_APB1_DIV_4 – LL_RCC_APB1_DIV_8 – LL_RCC_APB1_DIV_16
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR PPRE1 LL_RCC_SetAPB1Prescaler

LL_RCC_SetAPB2Prescaler

Function name	__STATIC_INLINE void LL_RCC_SetAPB2Prescaler (uint32_t Prescaler)
Function description	Set APB2 prescaler.
Parameters	<ul style="list-style-type: none"> • Prescaler: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_APB2_DIV_1 – LL_RCC_APB2_DIV_2 – LL_RCC_APB2_DIV_4 – LL_RCC_APB2_DIV_8 – LL_RCC_APB2_DIV_16
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross	<ul style="list-style-type: none"> • CFGR PPRE2 LL_RCC_SetAPB2Prescaler

reference:

LL_RCC_GetAHBPrescaler

Function name `__STATIC_INLINE uint32_t LL_RCC_GetAHBPrescaler (void)`

Function description Get AHB prescaler.

Return values

- **Returned:** value can be one of the following values:
 - LL_RCC_SYSCLK_DIV_1
 - LL_RCC_SYSCLK_DIV_2
 - LL_RCC_SYSCLK_DIV_4
 - LL_RCC_SYSCLK_DIV_8
 - LL_RCC_SYSCLK_DIV_16
 - LL_RCC_SYSCLK_DIV_64
 - LL_RCC_SYSCLK_DIV_128
 - LL_RCC_SYSCLK_DIV_256
 - LL_RCC_SYSCLK_DIV_512

Reference Manual to LL API cross reference:

- CFGR HPRE LL_RCC_GetAHBPrescaler

LL_RCC_GetAPB1Prescaler

Function name `__STATIC_INLINE uint32_t LL_RCC_GetAPB1Prescaler (void)`

Function description Get APB1 prescaler.

Return values

- **Returned:** value can be one of the following values:
 - LL_RCC_APB1_DIV_1
 - LL_RCC_APB1_DIV_2
 - LL_RCC_APB1_DIV_4
 - LL_RCC_APB1_DIV_8
 - LL_RCC_APB1_DIV_16

Reference Manual to LL API cross reference:

- CFGR PPRE1 LL_RCC_GetAPB1Prescaler

LL_RCC_GetAPB2Prescaler

Function name `__STATIC_INLINE uint32_t LL_RCC_GetAPB2Prescaler (void)`

Function description Get APB2 prescaler.

Return values

- **Returned:** value can be one of the following values:
 - LL_RCC_APB2_DIV_1
 - LL_RCC_APB2_DIV_2
 - LL_RCC_APB2_DIV_4
 - LL_RCC_APB2_DIV_8
 - LL_RCC_APB2_DIV_16

Reference Manual to LL API cross reference:

- CFGR PPRE2 LL_RCC_GetAPB2Prescaler

LL_RCC_ConfigMCO

Function name	__STATIC_INLINE void LL_RCC_ConfigMCO (uint32_t MCOxSource, uint32_t MCOxPrescaler)
Function description	Configure MCOx.
Parameters	<ul style="list-style-type: none"> • MCOxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_MCO1SOURCE_HSI – LL_RCC_MCO1SOURCE_LSE – LL_RCC_MCO1SOURCE_HSE – LL_RCC_MCO1SOURCE_PLLCLK – LL_RCC_MCO2SOURCE_SYSCLK – LL_RCC_MCO2SOURCE_PLLI2S – LL_RCC_MCO2SOURCE_HSE – LL_RCC_MCO2SOURCE_PLLCLK • MCOxPrescaler: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_MCO1_DIV_1 – LL_RCC_MCO1_DIV_2 – LL_RCC_MCO1_DIV_3 – LL_RCC_MCO1_DIV_4 – LL_RCC_MCO1_DIV_5 – LL_RCC_MCO2_DIV_1 – LL_RCC_MCO2_DIV_2 – LL_RCC_MCO2_DIV_3 – LL_RCC_MCO2_DIV_4 – LL_RCC_MCO2_DIV_5
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR MCO1 LL_RCC_ConfigMCO • CFGR MCO1PRE LL_RCC_ConfigMCO • CFGR MCO2 LL_RCC_ConfigMCO • CFGR MCO2PRE LL_RCC_ConfigMCO

LL_RCC_SetUSARTClockSource

Function name	__STATIC_INLINE void LL_RCC_SetUSARTClockSource (uint32_t USARTxSource)
Function description	Configure USARTx clock source.
Parameters	<ul style="list-style-type: none"> • USARTxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_USART1_CLKSOURCE_PCLK2 – LL_RCC_USART1_CLKSOURCE_SYSCLK – LL_RCC_USART1_CLKSOURCE_HSI – LL_RCC_USART1_CLKSOURCE_LSE – LL_RCC_USART2_CLKSOURCE_PCLK1 – LL_RCC_USART2_CLKSOURCE_SYSCLK – LL_RCC_USART2_CLKSOURCE_HSI – LL_RCC_USART2_CLKSOURCE_LSE – LL_RCC_USART3_CLKSOURCE_PCLK1 – LL_RCC_USART3_CLKSOURCE_SYSCLK

- LL_RCC_USART3_CLKSOURCE_HSI
- LL_RCC_USART3_CLKSOURCE_LSE
- LL_RCC_USART6_CLKSOURCE_PCLK2
- LL_RCC_USART6_CLKSOURCE_SYSCCLK
- LL_RCC_USART6_CLKSOURCE_HSI
- LL_RCC_USART6_CLKSOURCE_LSE

Return values

- **None:**

Reference Manual to LL API cross reference:

- DCKCFGR2 USART1SEL LL_RCC_SetUSARTClockSource
- DCKCFGR2 USART2SEL LL_RCC_SetUSARTClockSource
- DCKCFGR2 USART3SEL LL_RCC_SetUSARTClockSource
- DCKCFGR2 USART6SEL LL_RCC_SetUSARTClockSource

LL_RCC_SetUARTClockSource

Function name

__STATIC_INLINE void LL_RCC_SetUARTClockSource (uint32_t UARTxSource)

Function description

Configure UARTx clock source.

Parameters

- **UARTxSource:** This parameter can be one of the following values:
 - LL_RCC_UART4_CLKSOURCE_PCLK1
 - LL_RCC_UART4_CLKSOURCE_SYSCCLK
 - LL_RCC_UART4_CLKSOURCE_HSI
 - LL_RCC_UART4_CLKSOURCE_LSE
 - LL_RCC_UART5_CLKSOURCE_PCLK1
 - LL_RCC_UART5_CLKSOURCE_SYSCCLK
 - LL_RCC_UART5_CLKSOURCE_HSI
 - LL_RCC_UART5_CLKSOURCE_LSE
 - LL_RCC_UART7_CLKSOURCE_PCLK1
 - LL_RCC_UART7_CLKSOURCE_SYSCCLK
 - LL_RCC_UART7_CLKSOURCE_HSI
 - LL_RCC_UART7_CLKSOURCE_LSE
 - LL_RCC_UART8_CLKSOURCE_PCLK1
 - LL_RCC_UART8_CLKSOURCE_SYSCCLK
 - LL_RCC_UART8_CLKSOURCE_HSI
 - LL_RCC_UART8_CLKSOURCE_LSE

Return values

- **None:**

Reference Manual to LL API cross reference:

- DCKCFGR2 UART4SEL LL_RCC_SetUARTClockSource
- DCKCFGR2 UART5SEL LL_RCC_SetUARTClockSource
- DCKCFGR2 UART7SEL LL_RCC_SetUARTClockSource
- DCKCFGR2 UART8SEL LL_RCC_SetUARTClockSource

LL_RCC_SetI2CClockSource

Function name

__STATIC_INLINE void LL_RCC_SetI2CClockSource (uint32_t I2CxSource)

Function description

Configure I2Cx clock source.

Parameters

- **I2CxSource:** This parameter can be one of the following values: (*) value not defined in all devices.
 - LL_RCC_I2C1_CLKSOURCE_PCLK1

- LL_RCC_I2C1_CLKSOURCE_SYSCLK
- LL_RCC_I2C1_CLKSOURCE_HSI
- LL_RCC_I2C2_CLKSOURCE_PCLK1
- LL_RCC_I2C2_CLKSOURCE_SYSCLK
- LL_RCC_I2C2_CLKSOURCE_HSI
- LL_RCC_I2C3_CLKSOURCE_PCLK1
- LL_RCC_I2C3_CLKSOURCE_SYSCLK
- LL_RCC_I2C3_CLKSOURCE_HSI
- LL_RCC_I2C4_CLKSOURCE_PCLK1 (*)
- LL_RCC_I2C4_CLKSOURCE_SYSCLK (*)
- LL_RCC_I2C4_CLKSOURCE_HSI (*)

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- DCKCFGR2 I2C1SEL LL_RCC_SetI2CClockSource
- DCKCFGR2 I2C2SEL LL_RCC_SetI2CClockSource
- DCKCFGR2 I2C3SEL LL_RCC_SetI2CClockSource
- DCKCFGR2 I2C4SEL LL_RCC_SetI2CClockSource

LL_RCC_SetLPTIMClockSource

Function name

**__STATIC_INLINE void LL_RCC_SetLPTIMClockSource
(uint32_t LPTIMxSource)**

Function description

Configure LPTIMx clock source.

Parameters

- **LPTIMxSource:** This parameter can be one of the following values:
 - LL_RCC_LPTIM1_CLKSOURCE_PCLK1
 - LL_RCC_LPTIM1_CLKSOURCE_LSI
 - LL_RCC_LPTIM1_CLKSOURCE_HSI
 - LL_RCC_LPTIM1_CLKSOURCE_LSE

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- DCKCFGR2 LPTIM1SEL LL_RCC_SetLPTIMClockSource

LL_RCC_SetSAIClockSource

Function name

**__STATIC_INLINE void LL_RCC_SetSAIClockSource (uint32_t
SAIxSource)**

Function description

Configure SAIx clock source.

Parameters

- **SAIxSource:** This parameter can be one of the following values: (*) value not defined in all devices.
 - LL_RCC_SAI1_CLKSOURCE_PLLSAI
 - LL_RCC_SAI1_CLKSOURCE_PLLI2S
 - LL_RCC_SAI1_CLKSOURCE_PIN
 - LL_RCC_SAI1_CLKSOURCE_PLLSRC (*)
 - LL_RCC_SAI2_CLKSOURCE_PLLSAI
 - LL_RCC_SAI2_CLKSOURCE_PLLI2S
 - LL_RCC_SAI2_CLKSOURCE_PIN
 - LL_RCC_SAI2_CLKSOURCE_PLLSRC (*)

- | | |
|---|--|
| Return values | <ul style="list-style-type: none"> • None: |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • DCKCFGR1 SAI1SEL LL_RCC_SetSAIClockSource • DCKCFGR1 SAI2SEL LL_RCC_SetSAIClockSource |

LL_RCC_SetSDMMCClockSource

- | | |
|---|---|
| Function name | __STATIC_INLINE void LL_RCC_SetSDMMCClockSource (uint32_t SDMMCxSource) |
| Function description | Configure SDMMC clock source. |
| Parameters | <ul style="list-style-type: none"> • SDMMCxSource: This parameter can be one of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_RCC_SDMMC1_CLKSOURCE_PLL48CLK – LL_RCC_SDMMC1_CLKSOURCE_SYSCLK – LL_RCC_SDMMC2_CLKSOURCE_PLL48CLK (*) – LL_RCC_SDMMC2_CLKSOURCE_SYSCLK (*) |
| Return values | <ul style="list-style-type: none"> • None: |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • DCKCFGR2 SDMMC1SEL LL_RCC_SetSDMMCClockSource • DCKCFGR2 SDMMC2SEL LL_RCC_SetSDMMCClockSource |

LL_RCC_SetCK48MClockSource

- | | |
|---|--|
| Function name | __STATIC_INLINE void LL_RCC_SetCK48MClockSource (uint32_t CK48MxSource) |
| Function description | Configure 48Mhz domain clock source. |
| Parameters | <ul style="list-style-type: none"> • CK48MxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_CK48M_CLKSOURCE_PLL – LL_RCC_CK48M_CLKSOURCE_PLLSAI |
| Return values | <ul style="list-style-type: none"> • None: |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • DCKCFGR2 CK48MSEL LL_RCC_SetCK48MClockSource |

LL_RCC_SetRNGClockSource

- | | |
|----------------------|--|
| Function name | __STATIC_INLINE void LL_RCC_SetRNGClockSource (uint32_t RNGxSource) |
| Function description | Configure RNG clock source. |
| Parameters | <ul style="list-style-type: none"> • RNGxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_RNG_CLKSOURCE_PLL – LL_RCC_RNG_CLKSOURCE_PLLSAI |
| Return values | <ul style="list-style-type: none"> • None: |
| Reference Manual to | <ul style="list-style-type: none"> • DCKCFGR2 CK48MSEL LL_RCC_SetRNGClockSource |

LL API cross
reference:

LL_RCC_SetUSBClockSource

Function name	__STATIC_INLINE void LL_RCC_SetUSBClockSource (uint32_t USBxSource)
Function description	Configure USB clock source.
Parameters	<ul style="list-style-type: none"> • USBxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_USB_CLKSOURCE_PLL – LL_RCC_USB_CLKSOURCE_PLLSAI
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DCKCFGR2 CK48MSEL LL_RCC_SetUSBClockSource

LL_RCC_SetCECClockSource

Function name	__STATIC_INLINE void LL_RCC_SetCECClockSource (uint32_t Source)
Function description	Configure CEC clock source.
Parameters	<ul style="list-style-type: none"> • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_CEC_CLKSOURCE_LSE – LL_RCC_CEC_CLKSOURCE_HSI_DIV488
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DCKCFGR2 CECSEL LL_RCC_SetCECClockSource

LL_RCC_SetI2SClockSource

Function name	__STATIC_INLINE void LL_RCC_SetI2SClockSource (uint32_t Source)
Function description	Configure I2S clock source.
Parameters	<ul style="list-style-type: none"> • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_I2S1_CLKSOURCE_PLLI2S – LL_RCC_I2S1_CLKSOURCE_PIN
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CFGR I2SSRC LL_RCC_SetI2SClockSource

LL_RCC_SetDSIClockSource

Function name	__STATIC_INLINE void LL_RCC_SetDSIClockSource (uint32_t Source)
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Function description	Configure DSI clock source.
Parameters	<ul style="list-style-type: none"> • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_DSI_CLKSOURCE_PHY – LL_RCC_DSI_CLKSOURCE_PLL
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DCKCFGR2 DSISEL LL_RCC_SetDSIClockSource

LL_RCC_SetDFSDMAudioClockSource

Function name	__STATIC_INLINE void LL_RCC_SetDFSDMAudioClockSource (uint32_t Source)
Function description	Configure DFSDM Audio clock source.
Parameters	<ul style="list-style-type: none"> • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_DFSDM1_AUDIO_CLKSOURCE_SAI1 – LL_RCC_DFSDM1_AUDIO_CLKSOURCE_SAI2
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DCKCFGR1 ADFSDM1SEL LL_RCC_SetDFSDMAudioClockSource

LL_RCC_SetDFSDMCKlockSource

Function name	__STATIC_INLINE void LL_RCC_SetDFSDMCKlockSource (uint32_t Source)
Function description	Configure DFSDM Kernel clock source.
Parameters	<ul style="list-style-type: none"> • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_DFSDM1_CLKSOURCE_PCLK2 – LL_RCC_DFSDM1_CLKSOURCE_SYSCLK
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DCKCFGR1 DFSDM1SEL LL_RCC_SetDFSDMCKlockSource

LL_RCC_GetUSARTClockSource

Function name	__STATIC_INLINE uint32_t LL_RCC_GetUSARTClockSource (uint32_t USARTx)
Function description	Get USARTx clock source.
Parameters	<ul style="list-style-type: none"> • USARTx: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_USART1_CLKSOURCE – LL_RCC_USART2_CLKSOURCE – LL_RCC_USART3_CLKSOURCE – LL_RCC_USART6_CLKSOURCE
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values:

- LL_RCC_USART1_CLKSOURCE_PCLK2
- LL_RCC_USART1_CLKSOURCE_SYSCLK
- LL_RCC_USART1_CLKSOURCE_HSI
- LL_RCC_USART1_CLKSOURCE_LSE
- LL_RCC_USART2_CLKSOURCE_PCLK1
- LL_RCC_USART2_CLKSOURCE_SYSCLK
- LL_RCC_USART2_CLKSOURCE_HSI
- LL_RCC_USART2_CLKSOURCE_LSE
- LL_RCC_USART3_CLKSOURCE_PCLK1
- LL_RCC_USART3_CLKSOURCE_SYSCLK
- LL_RCC_USART3_CLKSOURCE_HSI
- LL_RCC_USART3_CLKSOURCE_LSE
- LL_RCC_USART6_CLKSOURCE_PCLK2
- LL_RCC_USART6_CLKSOURCE_SYSCLK
- LL_RCC_USART6_CLKSOURCE_HSI
- LL_RCC_USART6_CLKSOURCE_LSE

Reference Manual to
LL API cross
reference:

- DCKCFGR2 USART1SEL LL_RCC_GetUSARTClockSource
- DCKCFGR2 USART2SEL LL_RCC_GetUSARTClockSource
- DCKCFGR2 USART3SEL LL_RCC_GetUSARTClockSource
- DCKCFGR2 USART6SEL LL_RCC_GetUSARTClockSource

LL_RCC_GetUARTClockSource

Function name `__STATIC_INLINE uint32_t LL_RCC_GetUARTClockSource
(uint32_t UARTx)`

Function description Get UARTx clock source.

Parameters

- **UARTx:** This parameter can be one of the following values:
 - LL_RCC_UART4_CLKSOURCE
 - LL_RCC_UART5_CLKSOURCE
 - LL_RCC_UART7_CLKSOURCE
 - LL_RCC_UART8_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
 - LL_RCC_UART4_CLKSOURCE_PCLK1
 - LL_RCC_UART4_CLKSOURCE_SYSCLK
 - LL_RCC_UART4_CLKSOURCE_HSI
 - LL_RCC_UART4_CLKSOURCE_LSE
 - LL_RCC_UART5_CLKSOURCE_PCLK1
 - LL_RCC_UART5_CLKSOURCE_SYSCLK
 - LL_RCC_UART5_CLKSOURCE_HSI
 - LL_RCC_UART5_CLKSOURCE_LSE
 - LL_RCC_UART7_CLKSOURCE_PCLK1
 - LL_RCC_UART7_CLKSOURCE_SYSCLK
 - LL_RCC_UART7_CLKSOURCE_HSI
 - LL_RCC_UART7_CLKSOURCE_LSE
 - LL_RCC_UART8_CLKSOURCE_PCLK1
 - LL_RCC_UART8_CLKSOURCE_SYSCLK
 - LL_RCC_UART8_CLKSOURCE_HSI
 - LL_RCC_UART8_CLKSOURCE_LSE

Reference Manual to
LL API cross

- DCKCFGR2 UART4SEL LL_RCC_GetUARTClockSource
- DCKCFGR2 UART5SEL LL_RCC_GetUARTClockSource

- reference:
- DCKCFGR2 UART7SEL LL_RCC_GetUARTClockSource
 - DCKCFGR2 UART8SEL LL_RCC_GetUARTClockSource

LL_RCC_GetI2CClockSource

Function name **__STATIC_INLINE uint32_t LL_RCC_GetI2CClockSource (uint32_t I2Cx)**

Function description Get I2Cx clock source.

- Parameters
- **I2Cx:** This parameter can be one of the following values:
 - LL_RCC_I2C1_CLKSOURCE
 - LL_RCC_I2C2_CLKSOURCE
 - LL_RCC_I2C3_CLKSOURCE
 - LL_RCC_I2C4_CLKSOURCE (*)

- Return values
- **Returned:** value can be one of the following values: (*) value not defined in all devices.
 - LL_RCC_I2C1_CLKSOURCE_PCLK1
 - LL_RCC_I2C1_CLKSOURCE_SYSCLK
 - LL_RCC_I2C1_CLKSOURCE_HSI
 - LL_RCC_I2C2_CLKSOURCE_PCLK1
 - LL_RCC_I2C2_CLKSOURCE_SYSCLK
 - LL_RCC_I2C2_CLKSOURCE_HSI
 - LL_RCC_I2C3_CLKSOURCE_PCLK1
 - LL_RCC_I2C3_CLKSOURCE_SYSCLK
 - LL_RCC_I2C3_CLKSOURCE_HSI
 - LL_RCC_I2C4_CLKSOURCE_PCLK1 (*)
 - LL_RCC_I2C4_CLKSOURCE_SYSCLK (*)
 - LL_RCC_I2C4_CLKSOURCE_HSI (*)

- Reference Manual to LL API cross reference:
- DCKCFGR2 I2C1SEL LL_RCC_GetI2CClockSource
 - DCKCFGR2 I2C2SEL LL_RCC_GetI2CClockSource
 - DCKCFGR2 I2C3SEL LL_RCC_GetI2CClockSource
 - DCKCFGR2 I2C4SEL LL_RCC_GetI2CClockSource

LL_RCC_GetLPTIMClockSource

Function name **__STATIC_INLINE uint32_t LL_RCC_GetLPTIMClockSource (uint32_t LPTIMx)**

Function description Get LPTIMx clock source.

- Parameters
- **LPTIMx:** This parameter can be one of the following values:
 - LL_RCC_LPTIM1_CLKSOURCE

- Return values
- **Returned:** value can be one of the following values:
 - LL_RCC_LPTIM1_CLKSOURCE_PCLK1
 - LL_RCC_LPTIM1_CLKSOURCE_LSI
 - LL_RCC_LPTIM1_CLKSOURCE_HSI
 - LL_RCC_LPTIM1_CLKSOURCE_LSE

- Reference Manual to LL API cross reference:
- DCKCFGR2 LPTIM1SEL LL_RCC_GetLPTIMClockSource

LL_RCC_GetSAIClockSource

Function name	__STATIC_INLINE uint32_t LL_RCC_GetSAIClockSource (uint32_t SAIx)
Function description	Get SAIx clock source.
Parameters	<ul style="list-style-type: none"> • SAIx: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_SAI1_CLKSOURCE – LL_RCC_SAI2_CLKSOURCE
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_RCC_SAI1_CLKSOURCE_PLLSAI – LL_RCC_SAI1_CLKSOURCE_PLLI2S – LL_RCC_SAI1_CLKSOURCE_PIN – LL_RCC_SAI1_CLKSOURCE_PLLSRC (*) – LL_RCC_SAI2_CLKSOURCE_PLLSAI – LL_RCC_SAI2_CLKSOURCE_PLLI2S – LL_RCC_SAI2_CLKSOURCE_PIN – LL_RCC_SAI2_CLKSOURCE_PLLSRC (*)
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DCKCFGR1 SAI1SEL LL_RCC_GetSAIClockSource • DCKCFGR1 SAI2SEL LL_RCC_GetSAIClockSource

LL_RCC_GetSDMMCClockSource

Function name	__STATIC_INLINE uint32_t LL_RCC_GetSDMMCClockSource (uint32_t SDMMCx)
Function description	Get SDMMCx clock source.
Parameters	<ul style="list-style-type: none"> • SDMMCx: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_SDMMC1_CLKSOURCE – LL_RCC_SDMMC1_CLKSOURCE (*)
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_RCC_SDMMC1_CLKSOURCE_PLL48CLK – LL_RCC_SDMMC1_CLKSOURCE_SYSCLK – LL_RCC_SDMMC2_CLKSOURCE_PLL48CLK (*) – LL_RCC_SDMMC2_CLKSOURCE_SYSCLK (*)
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DCKCFGR2 SDMMC1SEL LL_RCC_GetSDMMCClockSource • DCKCFGR2 SDMMC2SEL LL_RCC_GetSDMMCClockSource

LL_RCC_GetCK48MCKlockSource

Function name	__STATIC_INLINE uint32_t LL_RCC_GetCK48MCKlockSource (uint32_t CK48Mx)
Function description	Get 48Mhz domain clock source.
Parameters	<ul style="list-style-type: none"> • CK48Mx: This parameter can be one of the following values:

- LL_RCC_CK48M_CLKSOURCE
- Return values
 - **Returned:** value can be one of the following values:
 - LL_RCC_CK48M_CLKSOURCE_PLL
 - LL_RCC_CK48M_CLKSOURCE_PLLSAI
- Reference Manual to LL API cross reference:
 - DCKCFGR2 CK48MSEL LL_RCC_GetCK48MClockSource

LL_RCC_GetRNGClockSource

- Function name **__STATIC_INLINE uint32_t LL_RCC_GetRNGClockSource (uint32_t RNGx)**
- Function description Get RNGx clock source.
- Parameters
 - **RNGx:** This parameter can be one of the following values:
 - LL_RCC_RNG_CLKSOURCE
- Return values
 - **Returned:** value can be one of the following values:
 - LL_RCC_RNG_CLKSOURCE_PLL
 - LL_RCC_RNG_CLKSOURCE_PLLSAI
- Reference Manual to LL API cross reference:
 - DCKCFGR2 CK48MSEL LL_RCC_GetRNGClockSource

LL_RCC_GetUSBClockSource

- Function name **__STATIC_INLINE uint32_t LL_RCC_GetUSBClockSource (uint32_t USBx)**
- Function description Get USBx clock source.
- Parameters
 - **USBx:** This parameter can be one of the following values:
 - LL_RCC_USB_CLKSOURCE
- Return values
 - **Returned:** value can be one of the following values:
 - LL_RCC_USB_CLKSOURCE_PLL
 - LL_RCC_USB_CLKSOURCE_PLLSAI
- Reference Manual to LL API cross reference:
 - DCKCFGR2 CK48MSEL LL_RCC_GetUSBClockSource

LL_RCC_GetCECClockSource

- Function name **__STATIC_INLINE uint32_t LL_RCC_GetCECClockSource (uint32_t CECx)**
- Function description Get CEC Clock Source.
- Parameters
 - **CECx:** This parameter can be one of the following values:
 - LL_RCC_CEC_CLKSOURCE
- Return values
 - **Returned:** value can be one of the following values:
 - LL_RCC_CEC_CLKSOURCE_LSE
 - LL_RCC_CEC_CLKSOURCE_HSI_DIV488

Reference Manual to LL API cross reference:

- DCKCFGR2 CECSEL LL_RCC_GetCECClockSource

LL_RCC_GetI2SClockSource

Function name **__STATIC_INLINE uint32_t LL_RCC_GetI2SClockSource (uint32_t I2Sx)**

Function description Get I2S Clock Source.

Parameters

- **I2Sx:** This parameter can be one of the following values:
 - LL_RCC_I2S1_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
 - LL_RCC_I2S1_CLKSOURCE_PLLI2S
 - LL_RCC_I2S1_CLKSOURCE_PIN

Reference Manual to LL API cross reference:

- CFGR I2SSRC LL_RCC_GetI2SClockSource

LL_RCC_GetDFSDMAudioClockSource

Function name **__STATIC_INLINE uint32_t LL_RCC_GetDFSDMAudioClockSource (uint32_t DFSDMx)**

Function description Get DFSDM Audio Clock Source.

Parameters

- **DFSDMx:** This parameter can be one of the following values:
 - LL_RCC_DFSDM1_AUDIO_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
 - LL_RCC_DFSDM1_AUDIO_CLKSOURCE_SAI1
 - LL_RCC_DFSDM1_AUDIO_CLKSOURCE_SAI2

Reference Manual to LL API cross reference:

- DCKCFGR1 ADFSDM1SEL LL_RCC_GetDFSDMAudioClockSource

LL_RCC_GetDFSDMClockSource

Function name **__STATIC_INLINE uint32_t LL_RCC_GetDFSDMClockSource (uint32_t DFSDMx)**

Function description Get DFSDM Audio Clock Source.

Parameters

- **DFSDMx:** This parameter can be one of the following values:
 - LL_RCC_DFSDM1_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
 - LL_RCC_DFSDM1_CLKSOURCE_PCLK2
 - LL_RCC_DFSDM1_CLKSOURCE_SYSCLK

Reference Manual to LL API cross reference:

- DCKCFGR1 DFSDM1SEL LL_RCC_GetDFSDMClockSource

LL_RCC_GetDSIClockSource

Function name	__STATIC_INLINE uint32_t LL_RCC_GetDSIClockSource (uint32_t DSIx)
Function description	Get DSI Clock Source.
Parameters	<ul style="list-style-type: none"> • DSIx: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_DSI_CLKSOURCE
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_DSI_CLKSOURCE_PHY – LL_RCC_DSI_CLKSOURCE_PLL
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DCKCFGR2 DSISEL LL_RCC_GetDSIClockSource

LL_RCC_SetRTCClockSource

Function name	__STATIC_INLINE void LL_RCC_SetRTCClockSource (uint32_t Source)
Function description	Set RTC Clock Source.
Parameters	<ul style="list-style-type: none"> • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_RTC_CLKSOURCE_NONE – LL_RCC_RTC_CLKSOURCE_LSE – LL_RCC_RTC_CLKSOURCE_LSI – LL_RCC_RTC_CLKSOURCE_HSE
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Once the RTC clock source has been selected, it cannot be changed anymore unless the Backup domain is reset, or unless a failure is detected on LSE (LSECSSD is set). The BDRST bit can be used to reset them.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BDCR RTCSEL LL_RCC_SetRTCClockSource

LL_RCC_GetRTCClockSource

Function name	__STATIC_INLINE uint32_t LL_RCC_GetRTCClockSource (void)
Function description	Get RTC Clock Source.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_RTC_CLKSOURCE_NONE – LL_RCC_RTC_CLKSOURCE_LSE – LL_RCC_RTC_CLKSOURCE_LSI – LL_RCC_RTC_CLKSOURCE_HSE
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BDCR RTCSEL LL_RCC_GetRTCClockSource

LL_RCC_EnableRTC

Function name	<code>__STATIC_INLINE void LL_RCC_EnableRTC (void)</code>
Function description	Enable RTC.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• BDCR RTCEN LL_RCC_EnableRTC

LL_RCC_DisableRTC

Function name	<code>__STATIC_INLINE void LL_RCC_DisableRTC (void)</code>
Function description	Disable RTC.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• BDCR RTCEN LL_RCC_DisableRTC

LL_RCC_IsEnabledRTC

Function name	<code>__STATIC_INLINE uint32_t LL_RCC_IsEnabledRTC (void)</code>
Function description	Check if RTC has been enabled or not.
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• BDCR RTCEN LL_RCC_IsEnabledRTC

LL_RCC_ForceBackupDomainReset

Function name	<code>__STATIC_INLINE void LL_RCC_ForceBackupDomainReset (void)</code>
Function description	Force the Backup domain reset.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• BDCR BDRST LL_RCC_ForceBackupDomainReset

LL_RCC_ReleaseBackupDomainReset

Function name	<code>__STATIC_INLINE void LL_RCC_ReleaseBackupDomainReset (void)</code>
Function description	Release the Backup domain reset.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• BDCR BDRST LL_RCC_ReleaseBackupDomainReset

LL_RCC_SetRTC_HSEPrescaler

Function name **__STATIC_INLINE void LL_RCC_SetRTC_HSEPrescaler (uint32_t Prescaler)**

Function description Set HSE Prescalers for RTC Clock.

Parameters

- **Prescaler:** This parameter can be one of the following values:
 - LL_RCC_RTC_NOCLOCK
 - LL_RCC_RTC_HSE_DIV_2
 - LL_RCC_RTC_HSE_DIV_3
 - LL_RCC_RTC_HSE_DIV_4
 - LL_RCC_RTC_HSE_DIV_5
 - LL_RCC_RTC_HSE_DIV_6
 - LL_RCC_RTC_HSE_DIV_7
 - LL_RCC_RTC_HSE_DIV_8
 - LL_RCC_RTC_HSE_DIV_9
 - LL_RCC_RTC_HSE_DIV_10
 - LL_RCC_RTC_HSE_DIV_11
 - LL_RCC_RTC_HSE_DIV_12
 - LL_RCC_RTC_HSE_DIV_13
 - LL_RCC_RTC_HSE_DIV_14
 - LL_RCC_RTC_HSE_DIV_15
 - LL_RCC_RTC_HSE_DIV_16
 - LL_RCC_RTC_HSE_DIV_17
 - LL_RCC_RTC_HSE_DIV_18
 - LL_RCC_RTC_HSE_DIV_19
 - LL_RCC_RTC_HSE_DIV_20
 - LL_RCC_RTC_HSE_DIV_21
 - LL_RCC_RTC_HSE_DIV_22
 - LL_RCC_RTC_HSE_DIV_23
 - LL_RCC_RTC_HSE_DIV_24
 - LL_RCC_RTC_HSE_DIV_25
 - LL_RCC_RTC_HSE_DIV_26
 - LL_RCC_RTC_HSE_DIV_27
 - LL_RCC_RTC_HSE_DIV_28
 - LL_RCC_RTC_HSE_DIV_29
 - LL_RCC_RTC_HSE_DIV_30
 - LL_RCC_RTC_HSE_DIV_31

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFGR RTCPRE LL_RCC_SetRTC_HSEPrescaler

LL_RCC_GetRTC_HSEPrescaler

Function name **__STATIC_INLINE uint32_t LL_RCC_GetRTC_HSEPrescaler (void)**

Function description Get HSE Prescalers for RTC Clock.

Return values

- **Returned:** value can be one of the following values:
 - LL_RCC_RTC_NOCLOCK

- LL_RCC_RTC_HSE_DIV_2
- LL_RCC_RTC_HSE_DIV_3
- LL_RCC_RTC_HSE_DIV_4
- LL_RCC_RTC_HSE_DIV_5
- LL_RCC_RTC_HSE_DIV_6
- LL_RCC_RTC_HSE_DIV_7
- LL_RCC_RTC_HSE_DIV_8
- LL_RCC_RTC_HSE_DIV_9
- LL_RCC_RTC_HSE_DIV_10
- LL_RCC_RTC_HSE_DIV_11
- LL_RCC_RTC_HSE_DIV_12
- LL_RCC_RTC_HSE_DIV_13
- LL_RCC_RTC_HSE_DIV_14
- LL_RCC_RTC_HSE_DIV_15
- LL_RCC_RTC_HSE_DIV_16
- LL_RCC_RTC_HSE_DIV_17
- LL_RCC_RTC_HSE_DIV_18
- LL_RCC_RTC_HSE_DIV_19
- LL_RCC_RTC_HSE_DIV_20
- LL_RCC_RTC_HSE_DIV_21
- LL_RCC_RTC_HSE_DIV_22
- LL_RCC_RTC_HSE_DIV_23
- LL_RCC_RTC_HSE_DIV_24
- LL_RCC_RTC_HSE_DIV_25
- LL_RCC_RTC_HSE_DIV_26
- LL_RCC_RTC_HSE_DIV_27
- LL_RCC_RTC_HSE_DIV_28
- LL_RCC_RTC_HSE_DIV_29
- LL_RCC_RTC_HSE_DIV_30
- LL_RCC_RTC_HSE_DIV_31

Reference Manual to
LL API cross
reference:

- CFGR RTCPRE LL_RCC_GetRTC_HSEPrescaler

LL_RCC_SetTIMPrescaler

Function name **__STATIC_INLINE void LL_RCC_SetTIMPrescaler (uint32_t Prescaler)**

Function description Set Timers Clock Prescalers.

Parameters

- **Prescaler:** This parameter can be one of the following values:
 - LL_RCC_TIM_PRESCALER_TWICE
 - LL_RCC_TIM_PRESCALER_FOUR_TIMES

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- DCKCFGR1 TIMPRE LL_RCC_SetTIMPrescaler

LL_RCC_GetTIMPrescaler

Function name `__STATIC_INLINE uint32_t LL_RCC_GetTIMPrescaler (void)`

Function description Get Timers Clock Prescalers.

Return values

- **Returned:** value can be one of the following values:
 - LL_RCC_TIM_PRESCALER_TWICE
 - LL_RCC_TIM_PRESCALER_FOUR_TIMES

Reference Manual to LL API cross reference:

- DCKCFGR1 TIMPRE LL_RCC_GetTIMPrescaler

LL_RCC_PLL_Enable

Function name `__STATIC_INLINE void LL_RCC_PLL_Enable (void)`

Function description Enable PLL.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR PLLON LL_RCC_PLL_Enable

LL_RCC_PLL_Disable

Function name `__STATIC_INLINE void LL_RCC_PLL_Disable (void)`

Function description Disable PLL.

Return values

- **None:**

Notes

- Cannot be disabled if the PLL clock is used as the system clock

Reference Manual to LL API cross reference:

- CR PLLON LL_RCC_PLL_Disable

LL_RCC_PLL_IsReady

Function name `__STATIC_INLINE uint32_t LL_RCC_PLL_IsReady (void)`

Function description Check if PLL Ready.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR PLLRDY LL_RCC_PLL_IsReady

LL_RCC_PLL_ConfigDomain_SYS

Function name `__STATIC_INLINE void LL_RCC_PLL_ConfigDomain_SYS (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLP)`

Function description Configure PLL used for SYSCLK Domain.

Parameters

- **Source:** This parameter can be one of the following values:
 - LL_RCC_PLLSOURCE_HSI
 - LL_RCC_PLLSOURCE_HSE
- **PLLM:** This parameter can be one of the following values:
 - LL_RCC_PLLM_DIV_2
 - LL_RCC_PLLM_DIV_3
 - LL_RCC_PLLM_DIV_4
 - LL_RCC_PLLM_DIV_5
 - LL_RCC_PLLM_DIV_6
 - LL_RCC_PLLM_DIV_7
 - LL_RCC_PLLM_DIV_8
 - LL_RCC_PLLM_DIV_9
 - LL_RCC_PLLM_DIV_10
 - LL_RCC_PLLM_DIV_11
 - LL_RCC_PLLM_DIV_12
 - LL_RCC_PLLM_DIV_13
 - LL_RCC_PLLM_DIV_14
 - LL_RCC_PLLM_DIV_15
 - LL_RCC_PLLM_DIV_16
 - LL_RCC_PLLM_DIV_17
 - LL_RCC_PLLM_DIV_18
 - LL_RCC_PLLM_DIV_19
 - LL_RCC_PLLM_DIV_20
 - LL_RCC_PLLM_DIV_21
 - LL_RCC_PLLM_DIV_22
 - LL_RCC_PLLM_DIV_23
 - LL_RCC_PLLM_DIV_24
 - LL_RCC_PLLM_DIV_25
 - LL_RCC_PLLM_DIV_26
 - LL_RCC_PLLM_DIV_27
 - LL_RCC_PLLM_DIV_28
 - LL_RCC_PLLM_DIV_29
 - LL_RCC_PLLM_DIV_30
 - LL_RCC_PLLM_DIV_31
 - LL_RCC_PLLM_DIV_32
 - LL_RCC_PLLM_DIV_33
 - LL_RCC_PLLM_DIV_34
 - LL_RCC_PLLM_DIV_35
 - LL_RCC_PLLM_DIV_36
 - LL_RCC_PLLM_DIV_37
 - LL_RCC_PLLM_DIV_38
 - LL_RCC_PLLM_DIV_39
 - LL_RCC_PLLM_DIV_40
 - LL_RCC_PLLM_DIV_41
 - LL_RCC_PLLM_DIV_42
 - LL_RCC_PLLM_DIV_43
 - LL_RCC_PLLM_DIV_44
 - LL_RCC_PLLM_DIV_45
 - LL_RCC_PLLM_DIV_46
 - LL_RCC_PLLM_DIV_47
 - LL_RCC_PLLM_DIV_48
 - LL_RCC_PLLM_DIV_49

	<ul style="list-style-type: none"> - LL_RCC_PLLM_DIV_50 - LL_RCC_PLLM_DIV_51 - LL_RCC_PLLM_DIV_52 - LL_RCC_PLLM_DIV_53 - LL_RCC_PLLM_DIV_54 - LL_RCC_PLLM_DIV_55 - LL_RCC_PLLM_DIV_56 - LL_RCC_PLLM_DIV_57 - LL_RCC_PLLM_DIV_58 - LL_RCC_PLLM_DIV_59 - LL_RCC_PLLM_DIV_60 - LL_RCC_PLLM_DIV_61 - LL_RCC_PLLM_DIV_62 - LL_RCC_PLLM_DIV_63 • PLLN: Between 50 and 432 • PLLQ: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_RCC_PLLQ_DIV_2 - LL_RCC_PLLQ_DIV_4 - LL_RCC_PLLQ_DIV_6 - LL_RCC_PLLQ_DIV_8
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • PLL Source and PLLM Divider can be written only when PLL, PLLI2S and PLLSAI are disabled • PLLN/PLLQ can be written only when PLL is disabled
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PLLCFGR PLLSRC LL_RCC_PLL_ConfigDomain_SYS • PLLCFGR PLLM LL_RCC_PLL_ConfigDomain_SYS • PLLCFGR PLLN LL_RCC_PLL_ConfigDomain_SYS • PLLCFGR PLLQ LL_RCC_PLL_ConfigDomain_SYS

LL_RCC_PLL_ConfigDomain_48M

Function name	__STATIC_INLINE void LL_RCC_PLL_ConfigDomain_48M (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLQ)
Function description	Configure PLL used for 48Mhz domain clock.
Parameters	<ul style="list-style-type: none"> • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_RCC_PLLSOURCE_HSI - LL_RCC_PLLSOURCE_HSE • PLLM: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_RCC_PLLM_DIV_2 - LL_RCC_PLLM_DIV_3 - LL_RCC_PLLM_DIV_4 - LL_RCC_PLLM_DIV_5 - LL_RCC_PLLM_DIV_6 - LL_RCC_PLLM_DIV_7 - LL_RCC_PLLM_DIV_8 - LL_RCC_PLLM_DIV_9 - LL_RCC_PLLM_DIV_10 - LL_RCC_PLLM_DIV_11 - LL_RCC_PLLM_DIV_12

- LL_RCC_PLLM_DIV_13
 - LL_RCC_PLLM_DIV_14
 - LL_RCC_PLLM_DIV_15
 - LL_RCC_PLLM_DIV_16
 - LL_RCC_PLLM_DIV_17
 - LL_RCC_PLLM_DIV_18
 - LL_RCC_PLLM_DIV_19
 - LL_RCC_PLLM_DIV_20
 - LL_RCC_PLLM_DIV_21
 - LL_RCC_PLLM_DIV_22
 - LL_RCC_PLLM_DIV_23
 - LL_RCC_PLLM_DIV_24
 - LL_RCC_PLLM_DIV_25
 - LL_RCC_PLLM_DIV_26
 - LL_RCC_PLLM_DIV_27
 - LL_RCC_PLLM_DIV_28
 - LL_RCC_PLLM_DIV_29
 - LL_RCC_PLLM_DIV_30
 - LL_RCC_PLLM_DIV_31
 - LL_RCC_PLLM_DIV_32
 - LL_RCC_PLLM_DIV_33
 - LL_RCC_PLLM_DIV_34
 - LL_RCC_PLLM_DIV_35
 - LL_RCC_PLLM_DIV_36
 - LL_RCC_PLLM_DIV_37
 - LL_RCC_PLLM_DIV_38
 - LL_RCC_PLLM_DIV_39
 - LL_RCC_PLLM_DIV_40
 - LL_RCC_PLLM_DIV_41
 - LL_RCC_PLLM_DIV_42
 - LL_RCC_PLLM_DIV_43
 - LL_RCC_PLLM_DIV_44
 - LL_RCC_PLLM_DIV_45
 - LL_RCC_PLLM_DIV_46
 - LL_RCC_PLLM_DIV_47
 - LL_RCC_PLLM_DIV_48
 - LL_RCC_PLLM_DIV_49
 - LL_RCC_PLLM_DIV_50
 - LL_RCC_PLLM_DIV_51
 - LL_RCC_PLLM_DIV_52
 - LL_RCC_PLLM_DIV_53
 - LL_RCC_PLLM_DIV_54
 - LL_RCC_PLLM_DIV_55
 - LL_RCC_PLLM_DIV_56
 - LL_RCC_PLLM_DIV_57
 - LL_RCC_PLLM_DIV_58
 - LL_RCC_PLLM_DIV_59
 - LL_RCC_PLLM_DIV_60
 - LL_RCC_PLLM_DIV_61
 - LL_RCC_PLLM_DIV_62
 - LL_RCC_PLLM_DIV_63
- **PLLN:** Between 50 and 432

	<ul style="list-style-type: none"> • PLLQ: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_PLLQ_DIV_2 – LL_RCC_PLLQ_DIV_3 – LL_RCC_PLLQ_DIV_4 – LL_RCC_PLLQ_DIV_5 – LL_RCC_PLLQ_DIV_6 – LL_RCC_PLLQ_DIV_7 – LL_RCC_PLLQ_DIV_8 – LL_RCC_PLLQ_DIV_9 – LL_RCC_PLLQ_DIV_10 – LL_RCC_PLLQ_DIV_11 – LL_RCC_PLLQ_DIV_12 – LL_RCC_PLLQ_DIV_13 – LL_RCC_PLLQ_DIV_14 – LL_RCC_PLLQ_DIV_15
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • PLL Source and PLLM Divider can be written only when PLL, PLLI2S and PLLSAI are disabled • PLLN/PLLQ can be written only when PLL is disabled • This can be selected for USB, RNG, SDMMC1
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PLLCFGR PLLSRC LL_RCC_PLL_ConfigDomain_48M • PLLCFGR PLLM LL_RCC_PLL_ConfigDomain_48M • PLLCFGR PLLN LL_RCC_PLL_ConfigDomain_48M • PLLCFGR PLLQ LL_RCC_PLL_ConfigDomain_48M

LL_RCC_PLL_ConfigDomain_DSI

Function name	__STATIC_INLINE void LL_RCC_PLL_ConfigDomain_DSI (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLR)
Function description	Configure PLL used for DSI clock.
Parameters	<ul style="list-style-type: none"> • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_PLLSOURCE_HSI – LL_RCC_PLLSOURCE_HSE • PLLM: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_PLLM_DIV_2 – LL_RCC_PLLM_DIV_3 – LL_RCC_PLLM_DIV_4 – LL_RCC_PLLM_DIV_5 – LL_RCC_PLLM_DIV_6 – LL_RCC_PLLM_DIV_7 – LL_RCC_PLLM_DIV_8 – LL_RCC_PLLM_DIV_9 – LL_RCC_PLLM_DIV_10 – LL_RCC_PLLM_DIV_11 – LL_RCC_PLLM_DIV_12 – LL_RCC_PLLM_DIV_13 – LL_RCC_PLLM_DIV_14 – LL_RCC_PLLM_DIV_15 – LL_RCC_PLLM_DIV_16

- LL_RCC_PLLM_DIV_17
- LL_RCC_PLLM_DIV_18
- LL_RCC_PLLM_DIV_19
- LL_RCC_PLLM_DIV_20
- LL_RCC_PLLM_DIV_21
- LL_RCC_PLLM_DIV_22
- LL_RCC_PLLM_DIV_23
- LL_RCC_PLLM_DIV_24
- LL_RCC_PLLM_DIV_25
- LL_RCC_PLLM_DIV_26
- LL_RCC_PLLM_DIV_27
- LL_RCC_PLLM_DIV_28
- LL_RCC_PLLM_DIV_29
- LL_RCC_PLLM_DIV_30
- LL_RCC_PLLM_DIV_31
- LL_RCC_PLLM_DIV_32
- LL_RCC_PLLM_DIV_33
- LL_RCC_PLLM_DIV_34
- LL_RCC_PLLM_DIV_35
- LL_RCC_PLLM_DIV_36
- LL_RCC_PLLM_DIV_37
- LL_RCC_PLLM_DIV_38
- LL_RCC_PLLM_DIV_39
- LL_RCC_PLLM_DIV_40
- LL_RCC_PLLM_DIV_41
- LL_RCC_PLLM_DIV_42
- LL_RCC_PLLM_DIV_43
- LL_RCC_PLLM_DIV_44
- LL_RCC_PLLM_DIV_45
- LL_RCC_PLLM_DIV_46
- LL_RCC_PLLM_DIV_47
- LL_RCC_PLLM_DIV_48
- LL_RCC_PLLM_DIV_49
- LL_RCC_PLLM_DIV_50
- LL_RCC_PLLM_DIV_51
- LL_RCC_PLLM_DIV_52
- LL_RCC_PLLM_DIV_53
- LL_RCC_PLLM_DIV_54
- LL_RCC_PLLM_DIV_55
- LL_RCC_PLLM_DIV_56
- LL_RCC_PLLM_DIV_57
- LL_RCC_PLLM_DIV_58
- LL_RCC_PLLM_DIV_59
- LL_RCC_PLLM_DIV_60
- LL_RCC_PLLM_DIV_61
- LL_RCC_PLLM_DIV_62
- LL_RCC_PLLM_DIV_63
- **PLLN:** Between 50 and 432
- **PLLRR:** This parameter can be one of the following values:
 - LL_RCC_PLLR_DIV_2
 - LL_RCC_PLLR_DIV_3
 - LL_RCC_PLLR_DIV_4

	<ul style="list-style-type: none"> – LL_RCC_PLLR_DIV_5 – LL_RCC_PLLR_DIV_6 – LL_RCC_PLLR_DIV_7
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • PLL Source and PLLM Divider can be written only when PLL, PLLI2S and PLLSAI are disabled • PLLN/PLL R can be written only when PLL is disabled • This can be selected for DSI
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PLLCFGR PLLSRC LL_RCC_PLL_ConfigDomain_DSI • PLLCFGR PLLM LL_RCC_PLL_ConfigDomain_DSI • PLLCFGR PLLN LL_RCC_PLL_ConfigDomain_DSI • PLLCFGR PLLR LL_RCC_PLL_ConfigDomain_DSI

LL_RCC_PLL_GetN

Function name	__STATIC_INLINE uint32_t LL_RCC_PLL_GetN (void)
Function description	Get Main PLL multiplication factor for VCO.
Return values	<ul style="list-style-type: none"> • Between: 50 and 432
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PLLCFGR PLLN LL_RCC_PLL_GetN

LL_RCC_PLL_GetP

Function name	__STATIC_INLINE uint32_t LL_RCC_PLL_GetP (void)
Function description	Get Main PLL division factor for PLLP.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_PLLP_DIV_2 – LL_RCC_PLLP_DIV_4 – LL_RCC_PLLP_DIV_6 – LL_RCC_PLLP_DIV_8
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PLLCFGR PLLP LL_RCC_PLL_GetP

LL_RCC_PLL_GetQ

Function name	__STATIC_INLINE uint32_t LL_RCC_PLL_GetQ (void)
Function description	Get Main PLL division factor for PLLQ.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_PLLQ_DIV_2 – LL_RCC_PLLQ_DIV_3 – LL_RCC_PLLQ_DIV_4 – LL_RCC_PLLQ_DIV_5 – LL_RCC_PLLQ_DIV_6 – LL_RCC_PLLQ_DIV_7 – LL_RCC_PLLQ_DIV_8 – LL_RCC_PLLQ_DIV_9

- LL_RCC_PLLQ_DIV_10
- LL_RCC_PLLQ_DIV_11
- LL_RCC_PLLQ_DIV_12
- LL_RCC_PLLQ_DIV_13
- LL_RCC_PLLQ_DIV_14
- LL_RCC_PLLQ_DIV_15

- Notes
- used for PLL48MCLK selected for USB, RNG, SDMMC (48 MHz clock)
- Reference Manual to LL API cross reference:
- PLLCFGR PLLQ LL_RCC_PLL_GetQ

LL_RCC_PLL_GetR

Function name `__STATIC_INLINE uint32_t LL_RCC_PLL_GetR (void)`

Function description Get Main PLL division factor for PLLR.

- Return values
- **Returned:** value can be one of the following values:
 - LL_RCC_PLLR_DIV_2
 - LL_RCC_PLLR_DIV_3
 - LL_RCC_PLLR_DIV_4
 - LL_RCC_PLLR_DIV_5
 - LL_RCC_PLLR_DIV_6
 - LL_RCC_PLLR_DIV_7

- Notes
- used for PLLCLK (system clock)
- Reference Manual to LL API cross reference:
- PLLCFGR PLLR LL_RCC_PLL_GetR

LL_RCC_PLL_GetMainSource

Function name `__STATIC_INLINE uint32_t LL_RCC_PLL_GetMainSource (void)`

Function description Get the oscillator used as PLL clock source.

- Return values
- **Returned:** value can be one of the following values:
 - LL_RCC_PLLSOURCE_HSI
 - LL_RCC_PLLSOURCE_HSE

- Reference Manual to LL API cross reference:
- PLLCFGR PLLSRC LL_RCC_PLL_GetMainSource

LL_RCC_PLL_GetDivider

Function name `__STATIC_INLINE uint32_t LL_RCC_PLL_GetDivider (void)`

Function description Get Division factor for the main PLL and other PLL.

- Return values
- **Returned:** value can be one of the following values:
 - LL_RCC_PLLM_DIV_2
 - LL_RCC_PLLM_DIV_3
 - LL_RCC_PLLM_DIV_4

- LL_RCC_PLLM_DIV_5
- LL_RCC_PLLM_DIV_6
- LL_RCC_PLLM_DIV_7
- LL_RCC_PLLM_DIV_8
- LL_RCC_PLLM_DIV_9
- LL_RCC_PLLM_DIV_10
- LL_RCC_PLLM_DIV_11
- LL_RCC_PLLM_DIV_12
- LL_RCC_PLLM_DIV_13
- LL_RCC_PLLM_DIV_14
- LL_RCC_PLLM_DIV_15
- LL_RCC_PLLM_DIV_16
- LL_RCC_PLLM_DIV_17
- LL_RCC_PLLM_DIV_18
- LL_RCC_PLLM_DIV_19
- LL_RCC_PLLM_DIV_20
- LL_RCC_PLLM_DIV_21
- LL_RCC_PLLM_DIV_22
- LL_RCC_PLLM_DIV_23
- LL_RCC_PLLM_DIV_24
- LL_RCC_PLLM_DIV_25
- LL_RCC_PLLM_DIV_26
- LL_RCC_PLLM_DIV_27
- LL_RCC_PLLM_DIV_28
- LL_RCC_PLLM_DIV_29
- LL_RCC_PLLM_DIV_30
- LL_RCC_PLLM_DIV_31
- LL_RCC_PLLM_DIV_32
- LL_RCC_PLLM_DIV_33
- LL_RCC_PLLM_DIV_34
- LL_RCC_PLLM_DIV_35
- LL_RCC_PLLM_DIV_36
- LL_RCC_PLLM_DIV_37
- LL_RCC_PLLM_DIV_38
- LL_RCC_PLLM_DIV_39
- LL_RCC_PLLM_DIV_40
- LL_RCC_PLLM_DIV_41
- LL_RCC_PLLM_DIV_42
- LL_RCC_PLLM_DIV_43
- LL_RCC_PLLM_DIV_44
- LL_RCC_PLLM_DIV_45
- LL_RCC_PLLM_DIV_46
- LL_RCC_PLLM_DIV_47
- LL_RCC_PLLM_DIV_48
- LL_RCC_PLLM_DIV_49
- LL_RCC_PLLM_DIV_50
- LL_RCC_PLLM_DIV_51
- LL_RCC_PLLM_DIV_52
- LL_RCC_PLLM_DIV_53
- LL_RCC_PLLM_DIV_54
- LL_RCC_PLLM_DIV_55
- LL_RCC_PLLM_DIV_56

- LL_RCC_PLLM_DIV_57
- LL_RCC_PLLM_DIV_58
- LL_RCC_PLLM_DIV_59
- LL_RCC_PLLM_DIV_60
- LL_RCC_PLLM_DIV_61
- LL_RCC_PLLM_DIV_62
- LL_RCC_PLLM_DIV_63

Reference Manual to LL API cross reference:

- PLLCFGR PLLM LL_RCC_PLL_GetDivider

LL_RCC_PLL_ConfigSpreadSpectrum

Function name **__STATIC_INLINE void LL_RCC_PLL_ConfigSpreadSpectrum (uint32_t Mod, uint32_t Inc, uint32_t Sel)**

Function description Configure Spread Spectrum used for PLL.

- Parameters
- **Mod:** Between Min_Data=0 and Max_Data=8191
 - **Inc:** Between Min_Data=0 and Max_Data=32767
 - **Sel:** This parameter can be one of the following values:
 - LL_RCC_SPREAD_SELECT_CENTER
 - LL_RCC_SPREAD_SELECT_DOWN

Return values

- **None:**

Notes

- These bits must be written before enabling PLL

Reference Manual to LL API cross reference:

- SSCGR MODPER LL_RCC_PLL_ConfigSpreadSpectrum
- SSCGR INCSTEP LL_RCC_PLL_ConfigSpreadSpectrum
- SSCGR SPREADSEL LL_RCC_PLL_ConfigSpreadSpectrum

LL_RCC_PLL_GetPeriodModulation

Function name **__STATIC_INLINE uint32_t LL_RCC_PLL_GetPeriodModulation (void)**

Function description Get Spread Spectrum Modulation Period for PLL.

Return values

- **Between:** Min_Data=0 and Max_Data=8191

Reference Manual to LL API cross reference:

- SSCGR MODPER LL_RCC_PLL_GetPeriodModulation

LL_RCC_PLL_GetStepIncrementation

Function name **__STATIC_INLINE uint32_t LL_RCC_PLL_GetStepIncrementation (void)**

Function description Get Spread Spectrum Incrementation Step for PLL.

Return values

- **Between:** Min_Data=0 and Max_Data=32767

Notes

- Must be written before enabling PLL

Reference Manual to LL API cross

- SSCGR INCSTEP LL_RCC_PLL_GetStepIncrementation

reference:

LL_RCC_PLL_GetSpreadSelection

Function name `__STATIC_INLINE uint32_t LL_RCC_PLL_GetSpreadSelection (void)`

Function description Get Spread Spectrum Selection for PLL.

Return values

- **Returned:** value can be one of the following values:
 - LL_RCC_SPREAD_SELECT_CENTER
 - LL_RCC_SPREAD_SELECT_DOWN

Notes

- Must be written before enabling PLL

Reference Manual to LL API cross reference:

- SSCGR SPREADSEL LL_RCC_PLL_GetSpreadSelection

LL_RCC_PLL_SpreadSpectrum_Enable

Function name `__STATIC_INLINE void LL_RCC_PLL_SpreadSpectrum_Enable (void)`

Function description Enable Spread Spectrum for PLL.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SSCGR SSCGEN LL_RCC_PLL_SpreadSpectrum_Enable

LL_RCC_PLL_SpreadSpectrum_Disable

Function name `__STATIC_INLINE void LL_RCC_PLL_SpreadSpectrum_Disable (void)`

Function description Disable Spread Spectrum for PLL.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SSCGR SSCGEN LL_RCC_PLL_SpreadSpectrum_Disable

LL_RCC_PLLI2S_Enable

Function name `__STATIC_INLINE void LL_RCC_PLLI2S_Enable (void)`

Function description Enable PLLI2S.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR PLLI2SON LL_RCC_PLLI2S_Enable

LL_RCC_PLLI2S_Disable

Function name `__STATIC_INLINE void LL_RCC_PLLI2S_Disable (void)`

Function description	Disable PLLI2S.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR PLLI2SON LL_RCC_PLLI2S_Disable

LL_RCC_PLLI2S_IsReady

Function name	<code>__STATIC_INLINE uint32_t LL_RCC_PLLI2S_IsReady (void)</code>
Function description	Check if PLLI2S Ready.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR PLLI2SRDY LL_RCC_PLLI2S_IsReady

LL_RCC_PLLI2S_ConfigDomain_SAI

Function name	<code>__STATIC_INLINE void LL_RCC_PLLI2S_ConfigDomain_SAI (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLQ, uint32_t PLLDIVQ)</code>
Function description	Configure PLLI2S used for SAI1 and SAI2 domain clock.
Parameters	<ul style="list-style-type: none"> • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_PLLSOURCE_HSI – LL_RCC_PLLSOURCE_HSE • PLLM: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_PLLM_DIV_2 – LL_RCC_PLLM_DIV_3 – LL_RCC_PLLM_DIV_4 – LL_RCC_PLLM_DIV_5 – LL_RCC_PLLM_DIV_6 – LL_RCC_PLLM_DIV_7 – LL_RCC_PLLM_DIV_8 – LL_RCC_PLLM_DIV_9 – LL_RCC_PLLM_DIV_10 – LL_RCC_PLLM_DIV_11 – LL_RCC_PLLM_DIV_12 – LL_RCC_PLLM_DIV_13 – LL_RCC_PLLM_DIV_14 – LL_RCC_PLLM_DIV_15 – LL_RCC_PLLM_DIV_16 – LL_RCC_PLLM_DIV_17 – LL_RCC_PLLM_DIV_18 – LL_RCC_PLLM_DIV_19 – LL_RCC_PLLM_DIV_20 – LL_RCC_PLLM_DIV_21 – LL_RCC_PLLM_DIV_22 – LL_RCC_PLLM_DIV_23 – LL_RCC_PLLM_DIV_24 – LL_RCC_PLLM_DIV_25 – LL_RCC_PLLM_DIV_26

- LL_RCC_PLLM_DIV_27
- LL_RCC_PLLM_DIV_28
- LL_RCC_PLLM_DIV_29
- LL_RCC_PLLM_DIV_30
- LL_RCC_PLLM_DIV_31
- LL_RCC_PLLM_DIV_32
- LL_RCC_PLLM_DIV_33
- LL_RCC_PLLM_DIV_34
- LL_RCC_PLLM_DIV_35
- LL_RCC_PLLM_DIV_36
- LL_RCC_PLLM_DIV_37
- LL_RCC_PLLM_DIV_38
- LL_RCC_PLLM_DIV_39
- LL_RCC_PLLM_DIV_40
- LL_RCC_PLLM_DIV_41
- LL_RCC_PLLM_DIV_42
- LL_RCC_PLLM_DIV_43
- LL_RCC_PLLM_DIV_44
- LL_RCC_PLLM_DIV_45
- LL_RCC_PLLM_DIV_46
- LL_RCC_PLLM_DIV_47
- LL_RCC_PLLM_DIV_48
- LL_RCC_PLLM_DIV_49
- LL_RCC_PLLM_DIV_50
- LL_RCC_PLLM_DIV_51
- LL_RCC_PLLM_DIV_52
- LL_RCC_PLLM_DIV_53
- LL_RCC_PLLM_DIV_54
- LL_RCC_PLLM_DIV_55
- LL_RCC_PLLM_DIV_56
- LL_RCC_PLLM_DIV_57
- LL_RCC_PLLM_DIV_58
- LL_RCC_PLLM_DIV_59
- LL_RCC_PLLM_DIV_60
- LL_RCC_PLLM_DIV_61
- LL_RCC_PLLM_DIV_62
- LL_RCC_PLLM_DIV_63
- **PLLN:** Between 50 and 432
- **PLLQ:** This parameter can be one of the following values:
 - LL_RCC_PLLI2SQ_DIV_2
 - LL_RCC_PLLI2SQ_DIV_3
 - LL_RCC_PLLI2SQ_DIV_4
 - LL_RCC_PLLI2SQ_DIV_5
 - LL_RCC_PLLI2SQ_DIV_6
 - LL_RCC_PLLI2SQ_DIV_7
 - LL_RCC_PLLI2SQ_DIV_8
 - LL_RCC_PLLI2SQ_DIV_9
 - LL_RCC_PLLI2SQ_DIV_10
 - LL_RCC_PLLI2SQ_DIV_11
 - LL_RCC_PLLI2SQ_DIV_12
 - LL_RCC_PLLI2SQ_DIV_13
 - LL_RCC_PLLI2SQ_DIV_14

- LL_RCC_PLLI2SQ_DIV_15
- **PLLDIVQ:** This parameter can be one of the following values:
 - LL_RCC_PLLI2SDIVQ_DIV_1
 - LL_RCC_PLLI2SDIVQ_DIV_2
 - LL_RCC_PLLI2SDIVQ_DIV_3
 - LL_RCC_PLLI2SDIVQ_DIV_4
 - LL_RCC_PLLI2SDIVQ_DIV_5
 - LL_RCC_PLLI2SDIVQ_DIV_6
 - LL_RCC_PLLI2SDIVQ_DIV_7
 - LL_RCC_PLLI2SDIVQ_DIV_8
 - LL_RCC_PLLI2SDIVQ_DIV_9
 - LL_RCC_PLLI2SDIVQ_DIV_10
 - LL_RCC_PLLI2SDIVQ_DIV_11
 - LL_RCC_PLLI2SDIVQ_DIV_12
 - LL_RCC_PLLI2SDIVQ_DIV_13
 - LL_RCC_PLLI2SDIVQ_DIV_14
 - LL_RCC_PLLI2SDIVQ_DIV_15
 - LL_RCC_PLLI2SDIVQ_DIV_16
 - LL_RCC_PLLI2SDIVQ_DIV_17
 - LL_RCC_PLLI2SDIVQ_DIV_18
 - LL_RCC_PLLI2SDIVQ_DIV_19
 - LL_RCC_PLLI2SDIVQ_DIV_20
 - LL_RCC_PLLI2SDIVQ_DIV_21
 - LL_RCC_PLLI2SDIVQ_DIV_22
 - LL_RCC_PLLI2SDIVQ_DIV_23
 - LL_RCC_PLLI2SDIVQ_DIV_24
 - LL_RCC_PLLI2SDIVQ_DIV_25
 - LL_RCC_PLLI2SDIVQ_DIV_26
 - LL_RCC_PLLI2SDIVQ_DIV_27
 - LL_RCC_PLLI2SDIVQ_DIV_28
 - LL_RCC_PLLI2SDIVQ_DIV_29
 - LL_RCC_PLLI2SDIVQ_DIV_30
 - LL_RCC_PLLI2SDIVQ_DIV_31
 - LL_RCC_PLLI2SDIVQ_DIV_32

Return values

- **None:**

Notes

- PLL Source and PLLM Divider can be written only when PLL, PLLI2S and PLLSAI are disabled
- PLLN/PLLQ can be written only when PLLI2S is disabled
- This can be selected for SAI1 and SAI2

Reference Manual to LL API cross reference:

- PLLCFGR PLLSRC LL_RCC_PLLI2S_ConfigDomain_SAI
- PLLCFGR PLLM LL_RCC_PLLI2S_ConfigDomain_SAI
- PLLI2SCFGR PLLI2SN
LL_RCC_PLLI2S_ConfigDomain_SAI
- PLLI2SCFGR PLLI2SQ
LL_RCC_PLLI2S_ConfigDomain_SAI
- DCKCFGR1 PLLI2SDIVQ
LL_RCC_PLLI2S_ConfigDomain_SAI

LL_RCC_PLLI2S_ConfigDomain_SPDIFRX

Function name	__STATIC_INLINE void LL_RCC_PLLI2S_ConfigDomain_SPDIFRX (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLP)
Function description	Configure PLLI2S used for SPDIFRX domain clock.
Parameters	<ul style="list-style-type: none">• Source: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_RCC_PLLSOURCE_HSI– LL_RCC_PLLSOURCE_HSE• PLLM: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_RCC_PLLM_DIV_2– LL_RCC_PLLM_DIV_3– LL_RCC_PLLM_DIV_4– LL_RCC_PLLM_DIV_5– LL_RCC_PLLM_DIV_6– LL_RCC_PLLM_DIV_7– LL_RCC_PLLM_DIV_8– LL_RCC_PLLM_DIV_9– LL_RCC_PLLM_DIV_10– LL_RCC_PLLM_DIV_11– LL_RCC_PLLM_DIV_12– LL_RCC_PLLM_DIV_13– LL_RCC_PLLM_DIV_14– LL_RCC_PLLM_DIV_15– LL_RCC_PLLM_DIV_16– LL_RCC_PLLM_DIV_17– LL_RCC_PLLM_DIV_18– LL_RCC_PLLM_DIV_19– LL_RCC_PLLM_DIV_20– LL_RCC_PLLM_DIV_21– LL_RCC_PLLM_DIV_22– LL_RCC_PLLM_DIV_23– LL_RCC_PLLM_DIV_24– LL_RCC_PLLM_DIV_25– LL_RCC_PLLM_DIV_26– LL_RCC_PLLM_DIV_27– LL_RCC_PLLM_DIV_28– LL_RCC_PLLM_DIV_29– LL_RCC_PLLM_DIV_30– LL_RCC_PLLM_DIV_31– LL_RCC_PLLM_DIV_32– LL_RCC_PLLM_DIV_33– LL_RCC_PLLM_DIV_34– LL_RCC_PLLM_DIV_35– LL_RCC_PLLM_DIV_36– LL_RCC_PLLM_DIV_37– LL_RCC_PLLM_DIV_38– LL_RCC_PLLM_DIV_39– LL_RCC_PLLM_DIV_40– LL_RCC_PLLM_DIV_41– LL_RCC_PLLM_DIV_42– LL_RCC_PLLM_DIV_43

	<ul style="list-style-type: none"> - LL_RCC_PLLM_DIV_44 - LL_RCC_PLLM_DIV_45 - LL_RCC_PLLM_DIV_46 - LL_RCC_PLLM_DIV_47 - LL_RCC_PLLM_DIV_48 - LL_RCC_PLLM_DIV_49 - LL_RCC_PLLM_DIV_50 - LL_RCC_PLLM_DIV_51 - LL_RCC_PLLM_DIV_52 - LL_RCC_PLLM_DIV_53 - LL_RCC_PLLM_DIV_54 - LL_RCC_PLLM_DIV_55 - LL_RCC_PLLM_DIV_56 - LL_RCC_PLLM_DIV_57 - LL_RCC_PLLM_DIV_58 - LL_RCC_PLLM_DIV_59 - LL_RCC_PLLM_DIV_60 - LL_RCC_PLLM_DIV_61 - LL_RCC_PLLM_DIV_62 - LL_RCC_PLLM_DIV_63 • PLLN: Between 50 and 432 • PLLp: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_RCC_PLLI2SP_DIV_2 - LL_RCC_PLLI2SP_DIV_4 - LL_RCC_PLLI2SP_DIV_6 - LL_RCC_PLLI2SP_DIV_8
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • PLL Source and PLLM Divider can be written only when PLL, PLLI2S and PLLSAI are disabled • PLLN/PLLp can be written only when PLLI2S is disabled • This can be selected for SPDIFRX
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PLLCFGR PLLSRC LL_RCC_PLLI2S_ConfigDomain_SPDIFRX • PLLCFGR PLLM LL_RCC_PLLI2S_ConfigDomain_SPDIFRX • PLLI2SCFGR PLLI2SN LL_RCC_PLLI2S_ConfigDomain_SPDIFRX • PLLI2SCFGR PLLI2SP LL_RCC_PLLI2S_ConfigDomain_SPDIFRX

LL_RCC_PLLI2S_ConfigDomain_I2S

Function name	__STATIC_INLINE void LL_RCC_PLLI2S_ConfigDomain_I2S (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLR)
Function description	Configure PLLI2S used for I2S1 domain clock.
Parameters	<ul style="list-style-type: none"> • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_RCC_PLLSOURCE_HSI - LL_RCC_PLLSOURCE_HSE • PLLM: This parameter can be one of the following values:

- LL_RCC_PLLM_DIV_2
- LL_RCC_PLLM_DIV_3
- LL_RCC_PLLM_DIV_4
- LL_RCC_PLLM_DIV_5
- LL_RCC_PLLM_DIV_6
- LL_RCC_PLLM_DIV_7
- LL_RCC_PLLM_DIV_8
- LL_RCC_PLLM_DIV_9
- LL_RCC_PLLM_DIV_10
- LL_RCC_PLLM_DIV_11
- LL_RCC_PLLM_DIV_12
- LL_RCC_PLLM_DIV_13
- LL_RCC_PLLM_DIV_14
- LL_RCC_PLLM_DIV_15
- LL_RCC_PLLM_DIV_16
- LL_RCC_PLLM_DIV_17
- LL_RCC_PLLM_DIV_18
- LL_RCC_PLLM_DIV_19
- LL_RCC_PLLM_DIV_20
- LL_RCC_PLLM_DIV_21
- LL_RCC_PLLM_DIV_22
- LL_RCC_PLLM_DIV_23
- LL_RCC_PLLM_DIV_24
- LL_RCC_PLLM_DIV_25
- LL_RCC_PLLM_DIV_26
- LL_RCC_PLLM_DIV_27
- LL_RCC_PLLM_DIV_28
- LL_RCC_PLLM_DIV_29
- LL_RCC_PLLM_DIV_30
- LL_RCC_PLLM_DIV_31
- LL_RCC_PLLM_DIV_32
- LL_RCC_PLLM_DIV_33
- LL_RCC_PLLM_DIV_34
- LL_RCC_PLLM_DIV_35
- LL_RCC_PLLM_DIV_36
- LL_RCC_PLLM_DIV_37
- LL_RCC_PLLM_DIV_38
- LL_RCC_PLLM_DIV_39
- LL_RCC_PLLM_DIV_40
- LL_RCC_PLLM_DIV_41
- LL_RCC_PLLM_DIV_42
- LL_RCC_PLLM_DIV_43
- LL_RCC_PLLM_DIV_44
- LL_RCC_PLLM_DIV_45
- LL_RCC_PLLM_DIV_46
- LL_RCC_PLLM_DIV_47
- LL_RCC_PLLM_DIV_48
- LL_RCC_PLLM_DIV_49
- LL_RCC_PLLM_DIV_50
- LL_RCC_PLLM_DIV_51
- LL_RCC_PLLM_DIV_52
- LL_RCC_PLLM_DIV_53

	<ul style="list-style-type: none"> - LL_RCC_PLLM_DIV_54 - LL_RCC_PLLM_DIV_55 - LL_RCC_PLLM_DIV_56 - LL_RCC_PLLM_DIV_57 - LL_RCC_PLLM_DIV_58 - LL_RCC_PLLM_DIV_59 - LL_RCC_PLLM_DIV_60 - LL_RCC_PLLM_DIV_61 - LL_RCC_PLLM_DIV_62 - LL_RCC_PLLM_DIV_63 • PLLN: Between 50 and 432 • PLLr: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_RCC_PLLI2SR_DIV_2 - LL_RCC_PLLI2SR_DIV_3 - LL_RCC_PLLI2SR_DIV_4 - LL_RCC_PLLI2SR_DIV_5 - LL_RCC_PLLI2SR_DIV_6 - LL_RCC_PLLI2SR_DIV_7
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • PLL Source and PLLM Divider can be written only when PLL, PLLI2S and PLLSAI are disabled • PLLN/PLLr can be written only when PLLI2S is disabled • This can be selected for I2S
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PLLCFGR PLLSRC LL_RCC_PLLI2S_ConfigDomain_I2S • PLLCFGR PLLM LL_RCC_PLLI2S_ConfigDomain_I2S • PLLI2SCFGR PLLI2SN LL_RCC_PLLI2S_ConfigDomain_I2S • PLLI2SCFGR PLLI2SR LL_RCC_PLLI2S_ConfigDomain_I2S

LL_RCC_PLLI2S_GetN

Function name	__STATIC_INLINE uint32_t LL_RCC_PLLI2S_GetN (void)
Function description	Get I2SPLL multiplication factor for VCO.
Return values	<ul style="list-style-type: none"> • Between: 50 and 432
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PLLI2SCFGR PLLI2SN LL_RCC_PLLI2S_GetN

LL_RCC_PLLI2S_GetQ

Function name	__STATIC_INLINE uint32_t LL_RCC_PLLI2S_GetQ (void)
Function description	Get I2SPLL division factor for PLLI2SQ.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> - LL_RCC_PLLI2SQ_DIV_2 - LL_RCC_PLLI2SQ_DIV_3 - LL_RCC_PLLI2SQ_DIV_4 - LL_RCC_PLLI2SQ_DIV_5 - LL_RCC_PLLI2SQ_DIV_6

- LL_RCC_PLLI2SQ_DIV_7
- LL_RCC_PLLI2SQ_DIV_8
- LL_RCC_PLLI2SQ_DIV_9
- LL_RCC_PLLI2SQ_DIV_10
- LL_RCC_PLLI2SQ_DIV_11
- LL_RCC_PLLI2SQ_DIV_12
- LL_RCC_PLLI2SQ_DIV_13
- LL_RCC_PLLI2SQ_DIV_14
- LL_RCC_PLLI2SQ_DIV_15

Reference Manual to LL API cross reference:

- PLLI2SCFGR PLLI2SQ LL_RCC_PLLI2S_GetQ

LL_RCC_PLLI2S_GetR

Function name `__STATIC_INLINE uint32_t LL_RCC_PLLI2S_GetR (void)`

Function description Get I2SPLL division factor for PLLI2SR.

Return values

- **Returned:** value can be one of the following values:
 - LL_RCC_PLLI2SR_DIV_2
 - LL_RCC_PLLI2SR_DIV_3
 - LL_RCC_PLLI2SR_DIV_4
 - LL_RCC_PLLI2SR_DIV_5
 - LL_RCC_PLLI2SR_DIV_6
 - LL_RCC_PLLI2SR_DIV_7

Notes

- used for PLLI2SCLK (I2S clock)

Reference Manual to LL API cross reference:

- PLLI2SCFGR PLLI2SR LL_RCC_PLLI2S_GetR

LL_RCC_PLLI2S_GetP

Function name `__STATIC_INLINE uint32_t LL_RCC_PLLI2S_GetP (void)`

Function description Get I2SPLL division factor for PLLI2SP.

Return values

- **Returned:** value can be one of the following values:
 - LL_RCC_PLLI2SP_DIV_2
 - LL_RCC_PLLI2SP_DIV_4
 - LL_RCC_PLLI2SP_DIV_6
 - LL_RCC_PLLI2SP_DIV_8

Notes

- used for PLLSPDIFRXCLK (SPDIFRX clock)

Reference Manual to LL API cross reference:

- PLLI2SCFGR PLLI2SP LL_RCC_PLLI2S_GetP

LL_RCC_PLLI2S_GetDIVQ

Function name `__STATIC_INLINE uint32_t LL_RCC_PLLI2S_GetDIVQ (void)`

Function description Get I2SPLL division factor for PLLI2SDIVQ.

Return values

- **Returned:** value can be one of the following values:
 - LL_RCC_PLLI2SDIVQ_DIV_1
 - LL_RCC_PLLI2SDIVQ_DIV_2
 - LL_RCC_PLLI2SDIVQ_DIV_3
 - LL_RCC_PLLI2SDIVQ_DIV_4
 - LL_RCC_PLLI2SDIVQ_DIV_5
 - LL_RCC_PLLI2SDIVQ_DIV_6
 - LL_RCC_PLLI2SDIVQ_DIV_7
 - LL_RCC_PLLI2SDIVQ_DIV_8
 - LL_RCC_PLLI2SDIVQ_DIV_9
 - LL_RCC_PLLI2SDIVQ_DIV_10
 - LL_RCC_PLLI2SDIVQ_DIV_11
 - LL_RCC_PLLI2SDIVQ_DIV_12
 - LL_RCC_PLLI2SDIVQ_DIV_13
 - LL_RCC_PLLI2SDIVQ_DIV_14
 - LL_RCC_PLLI2SDIVQ_DIV_15
 - LL_RCC_PLLI2SDIVQ_DIV_16
 - LL_RCC_PLLI2SDIVQ_DIV_17
 - LL_RCC_PLLI2SDIVQ_DIV_18
 - LL_RCC_PLLI2SDIVQ_DIV_19
 - LL_RCC_PLLI2SDIVQ_DIV_20
 - LL_RCC_PLLI2SDIVQ_DIV_21
 - LL_RCC_PLLI2SDIVQ_DIV_22
 - LL_RCC_PLLI2SDIVQ_DIV_23
 - LL_RCC_PLLI2SDIVQ_DIV_24
 - LL_RCC_PLLI2SDIVQ_DIV_25
 - LL_RCC_PLLI2SDIVQ_DIV_26
 - LL_RCC_PLLI2SDIVQ_DIV_27
 - LL_RCC_PLLI2SDIVQ_DIV_28
 - LL_RCC_PLLI2SDIVQ_DIV_29
 - LL_RCC_PLLI2SDIVQ_DIV_30
 - LL_RCC_PLLI2SDIVQ_DIV_31
 - LL_RCC_PLLI2SDIVQ_DIV_32

Notes

- used PLLSAI1CLK, PLLSAI2CLK selected (SAI1 and SAI2 clock)

Reference Manual to LL API cross reference:

- DCKCFGR1 PLLI2SDIVQ LL_RCC_PLLI2S_GetDIVQ

LL_RCC_PLLSAI_Enable

Function name

__STATIC_INLINE void LL_RCC_PLLSAI_Enable (void)

Function description

Enable PLLSAI.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR PLLSAION LL_RCC_PLLSAI_Enable

LL_RCC_PLLSAI_Disable

Function name	__STATIC_INLINE void LL_RCC_PLLSAI_Disable (void)
Function description	Disable PLLSAI.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR PLLSAION LL_RCC_PLLSAI_Disable

LL_RCC_PLLSAI_IsReady

Function name	__STATIC_INLINE uint32_t LL_RCC_PLLSAI_IsReady (void)
Function description	Check if PLLSAI Ready.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR PLLSAIRDY LL_RCC_PLLSAI_IsReady

LL_RCC_PLLSAI_ConfigDomain_SAI

Function name	__STATIC_INLINE void LL_RCC_PLLSAI_ConfigDomain_SAI (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLQ, uint32_t PLLDIVQ)
Function description	Configure PLLSAI used for SAI1 and SAI2 domain clock.
Parameters	<ul style="list-style-type: none"> • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_PLLSOURCE_HSI – LL_RCC_PLLSOURCE_HSE • PLLM: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_PLLM_DIV_2 – LL_RCC_PLLM_DIV_3 – LL_RCC_PLLM_DIV_4 – LL_RCC_PLLM_DIV_5 – LL_RCC_PLLM_DIV_6 – LL_RCC_PLLM_DIV_7 – LL_RCC_PLLM_DIV_8 – LL_RCC_PLLM_DIV_9 – LL_RCC_PLLM_DIV_10 – LL_RCC_PLLM_DIV_11 – LL_RCC_PLLM_DIV_12 – LL_RCC_PLLM_DIV_13 – LL_RCC_PLLM_DIV_14 – LL_RCC_PLLM_DIV_15 – LL_RCC_PLLM_DIV_16 – LL_RCC_PLLM_DIV_17 – LL_RCC_PLLM_DIV_18 – LL_RCC_PLLM_DIV_19 – LL_RCC_PLLM_DIV_20 – LL_RCC_PLLM_DIV_21 – LL_RCC_PLLM_DIV_22 – LL_RCC_PLLM_DIV_23

- LL_RCC_PLLM_DIV_24
- LL_RCC_PLLM_DIV_25
- LL_RCC_PLLM_DIV_26
- LL_RCC_PLLM_DIV_27
- LL_RCC_PLLM_DIV_28
- LL_RCC_PLLM_DIV_29
- LL_RCC_PLLM_DIV_30
- LL_RCC_PLLM_DIV_31
- LL_RCC_PLLM_DIV_32
- LL_RCC_PLLM_DIV_33
- LL_RCC_PLLM_DIV_34
- LL_RCC_PLLM_DIV_35
- LL_RCC_PLLM_DIV_36
- LL_RCC_PLLM_DIV_37
- LL_RCC_PLLM_DIV_38
- LL_RCC_PLLM_DIV_39
- LL_RCC_PLLM_DIV_40
- LL_RCC_PLLM_DIV_41
- LL_RCC_PLLM_DIV_42
- LL_RCC_PLLM_DIV_43
- LL_RCC_PLLM_DIV_44
- LL_RCC_PLLM_DIV_45
- LL_RCC_PLLM_DIV_46
- LL_RCC_PLLM_DIV_47
- LL_RCC_PLLM_DIV_48
- LL_RCC_PLLM_DIV_49
- LL_RCC_PLLM_DIV_50
- LL_RCC_PLLM_DIV_51
- LL_RCC_PLLM_DIV_52
- LL_RCC_PLLM_DIV_53
- LL_RCC_PLLM_DIV_54
- LL_RCC_PLLM_DIV_55
- LL_RCC_PLLM_DIV_56
- LL_RCC_PLLM_DIV_57
- LL_RCC_PLLM_DIV_58
- LL_RCC_PLLM_DIV_59
- LL_RCC_PLLM_DIV_60
- LL_RCC_PLLM_DIV_61
- LL_RCC_PLLM_DIV_62
- LL_RCC_PLLM_DIV_63
- **PLLN:** Between 50 and 432
- **PLLQ:** This parameter can be one of the following values:
 - LL_RCC_PLLSAIQ_DIV_2
 - LL_RCC_PLLSAIQ_DIV_3
 - LL_RCC_PLLSAIQ_DIV_4
 - LL_RCC_PLLSAIQ_DIV_5
 - LL_RCC_PLLSAIQ_DIV_6
 - LL_RCC_PLLSAIQ_DIV_7
 - LL_RCC_PLLSAIQ_DIV_8
 - LL_RCC_PLLSAIQ_DIV_9
 - LL_RCC_PLLSAIQ_DIV_10
 - LL_RCC_PLLSAIQ_DIV_11

- LL_RCC_PLLSAIQ_DIV_12
- LL_RCC_PLLSAIQ_DIV_13
- LL_RCC_PLLSAIQ_DIV_14
- LL_RCC_PLLSAIQ_DIV_15
- **PLLDIVQ:** This parameter can be one of the following values:
 - LL_RCC_PLLSAIDIVQ_DIV_1
 - LL_RCC_PLLSAIDIVQ_DIV_2
 - LL_RCC_PLLSAIDIVQ_DIV_3
 - LL_RCC_PLLSAIDIVQ_DIV_4
 - LL_RCC_PLLSAIDIVQ_DIV_5
 - LL_RCC_PLLSAIDIVQ_DIV_6
 - LL_RCC_PLLSAIDIVQ_DIV_7
 - LL_RCC_PLLSAIDIVQ_DIV_8
 - LL_RCC_PLLSAIDIVQ_DIV_9
 - LL_RCC_PLLSAIDIVQ_DIV_10
 - LL_RCC_PLLSAIDIVQ_DIV_11
 - LL_RCC_PLLSAIDIVQ_DIV_12
 - LL_RCC_PLLSAIDIVQ_DIV_13
 - LL_RCC_PLLSAIDIVQ_DIV_14
 - LL_RCC_PLLSAIDIVQ_DIV_15
 - LL_RCC_PLLSAIDIVQ_DIV_16
 - LL_RCC_PLLSAIDIVQ_DIV_17
 - LL_RCC_PLLSAIDIVQ_DIV_18
 - LL_RCC_PLLSAIDIVQ_DIV_19
 - LL_RCC_PLLSAIDIVQ_DIV_20
 - LL_RCC_PLLSAIDIVQ_DIV_21
 - LL_RCC_PLLSAIDIVQ_DIV_22
 - LL_RCC_PLLSAIDIVQ_DIV_23
 - LL_RCC_PLLSAIDIVQ_DIV_24
 - LL_RCC_PLLSAIDIVQ_DIV_25
 - LL_RCC_PLLSAIDIVQ_DIV_26
 - LL_RCC_PLLSAIDIVQ_DIV_27
 - LL_RCC_PLLSAIDIVQ_DIV_28
 - LL_RCC_PLLSAIDIVQ_DIV_29
 - LL_RCC_PLLSAIDIVQ_DIV_30
 - LL_RCC_PLLSAIDIVQ_DIV_31
 - LL_RCC_PLLSAIDIVQ_DIV_32

Return values

- **None:**

Notes

- PLL Source and PLLM Divider can be written only when PLL, PLLI2S and PLLSAI are disabled
- PLLN/PLLQ can be written only when PLLSAI is disabled
- This can be selected for SAI1 and SAI2

Reference Manual to
LL API cross
reference:

- PLLCFGR PLLSRC LL_RCC_PLLSAI_ConfigDomain_SAI
- PLLCFGR PLLM LL_RCC_PLLSAI_ConfigDomain_SAI
- PLLSAICFGR PLLSAIN
LL_RCC_PLLSAI_ConfigDomain_SAI
- PLLSAICFGR PLLSAIQ
LL_RCC_PLLSAI_ConfigDomain_SAI
- DCKCFGR1 PLLSAIDIVQ
LL_RCC_PLLSAI_ConfigDomain_SAI

LL_RCC_PLLSAI_ConfigDomain_48M

Function name `__STATIC_INLINE void LL_RCC_PLLSAI_ConfigDomain_48M (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLP)`

Function description Configure PLLSAI used for 48Mhz domain clock.

- Parameters**
- **Source:** This parameter can be one of the following values:
 - LL_RCC_PLLSOURCE_HSI
 - LL_RCC_PLLSOURCE_HSE
 - **PLLM:** This parameter can be one of the following values:
 - LL_RCC_PLLM_DIV_2
 - LL_RCC_PLLM_DIV_3
 - LL_RCC_PLLM_DIV_4
 - LL_RCC_PLLM_DIV_5
 - LL_RCC_PLLM_DIV_6
 - LL_RCC_PLLM_DIV_7
 - LL_RCC_PLLM_DIV_8
 - LL_RCC_PLLM_DIV_9
 - LL_RCC_PLLM_DIV_10
 - LL_RCC_PLLM_DIV_11
 - LL_RCC_PLLM_DIV_12
 - LL_RCC_PLLM_DIV_13
 - LL_RCC_PLLM_DIV_14
 - LL_RCC_PLLM_DIV_15
 - LL_RCC_PLLM_DIV_16
 - LL_RCC_PLLM_DIV_17
 - LL_RCC_PLLM_DIV_18
 - LL_RCC_PLLM_DIV_19
 - LL_RCC_PLLM_DIV_20
 - LL_RCC_PLLM_DIV_21
 - LL_RCC_PLLM_DIV_22
 - LL_RCC_PLLM_DIV_23
 - LL_RCC_PLLM_DIV_24
 - LL_RCC_PLLM_DIV_25
 - LL_RCC_PLLM_DIV_26
 - LL_RCC_PLLM_DIV_27
 - LL_RCC_PLLM_DIV_28
 - LL_RCC_PLLM_DIV_29
 - LL_RCC_PLLM_DIV_30
 - LL_RCC_PLLM_DIV_31
 - LL_RCC_PLLM_DIV_32
 - LL_RCC_PLLM_DIV_33
 - LL_RCC_PLLM_DIV_34
 - LL_RCC_PLLM_DIV_35
 - LL_RCC_PLLM_DIV_36
 - LL_RCC_PLLM_DIV_37
 - LL_RCC_PLLM_DIV_38
 - LL_RCC_PLLM_DIV_39
 - LL_RCC_PLLM_DIV_40
 - LL_RCC_PLLM_DIV_41
 - LL_RCC_PLLM_DIV_42
 - LL_RCC_PLLM_DIV_43

	<ul style="list-style-type: none"> - LL_RCC_PLLM_DIV_44 - LL_RCC_PLLM_DIV_45 - LL_RCC_PLLM_DIV_46 - LL_RCC_PLLM_DIV_47 - LL_RCC_PLLM_DIV_48 - LL_RCC_PLLM_DIV_49 - LL_RCC_PLLM_DIV_50 - LL_RCC_PLLM_DIV_51 - LL_RCC_PLLM_DIV_52 - LL_RCC_PLLM_DIV_53 - LL_RCC_PLLM_DIV_54 - LL_RCC_PLLM_DIV_55 - LL_RCC_PLLM_DIV_56 - LL_RCC_PLLM_DIV_57 - LL_RCC_PLLM_DIV_58 - LL_RCC_PLLM_DIV_59 - LL_RCC_PLLM_DIV_60 - LL_RCC_PLLM_DIV_61 - LL_RCC_PLLM_DIV_62 - LL_RCC_PLLM_DIV_63 • PLLN: Between 50 and 432 • PLL P: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_RCC_PLLSAIP_DIV_2 - LL_RCC_PLLSAIP_DIV_4 - LL_RCC_PLLSAIP_DIV_6 - LL_RCC_PLLSAIP_DIV_8
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • PLL Source and PLLM Divider can be written only when PLL, PLLI2S and PLLSAI are disabled • PLLN/PLL P can be written only when PLLSAI is disabled • This can be selected for USB, RNG, SDMMC1
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PLLCFGR PLLSRC LL_RCC_PLLSAI_ConfigDomain_48M • PLLCFGR PLLM LL_RCC_PLLSAI_ConfigDomain_48M • PLLSAICFGR PLLSAIN LL_RCC_PLLSAI_ConfigDomain_48M • PLLSAICFGR PLLSAIP LL_RCC_PLLSAI_ConfigDomain_48M

LL_RCC_PLLSAI_ConfigDomain_LTDC

Function name	__STATIC_INLINE void LL_RCC_PLLSAI_ConfigDomain_LTDC (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLR, uint32_t PLLDIVR)
Function description	Configure PLLSAI used for LTDC domain clock.
Parameters	<ul style="list-style-type: none"> • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_RCC_PLLSOURCE_HSI - LL_RCC_PLLSOURCE_HSE • PLLM: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_RCC_PLLM_DIV_2

- LL_RCC_PLLM_DIV_3
- LL_RCC_PLLM_DIV_4
- LL_RCC_PLLM_DIV_5
- LL_RCC_PLLM_DIV_6
- LL_RCC_PLLM_DIV_7
- LL_RCC_PLLM_DIV_8
- LL_RCC_PLLM_DIV_9
- LL_RCC_PLLM_DIV_10
- LL_RCC_PLLM_DIV_11
- LL_RCC_PLLM_DIV_12
- LL_RCC_PLLM_DIV_13
- LL_RCC_PLLM_DIV_14
- LL_RCC_PLLM_DIV_15
- LL_RCC_PLLM_DIV_16
- LL_RCC_PLLM_DIV_17
- LL_RCC_PLLM_DIV_18
- LL_RCC_PLLM_DIV_19
- LL_RCC_PLLM_DIV_20
- LL_RCC_PLLM_DIV_21
- LL_RCC_PLLM_DIV_22
- LL_RCC_PLLM_DIV_23
- LL_RCC_PLLM_DIV_24
- LL_RCC_PLLM_DIV_25
- LL_RCC_PLLM_DIV_26
- LL_RCC_PLLM_DIV_27
- LL_RCC_PLLM_DIV_28
- LL_RCC_PLLM_DIV_29
- LL_RCC_PLLM_DIV_30
- LL_RCC_PLLM_DIV_31
- LL_RCC_PLLM_DIV_32
- LL_RCC_PLLM_DIV_33
- LL_RCC_PLLM_DIV_34
- LL_RCC_PLLM_DIV_35
- LL_RCC_PLLM_DIV_36
- LL_RCC_PLLM_DIV_37
- LL_RCC_PLLM_DIV_38
- LL_RCC_PLLM_DIV_39
- LL_RCC_PLLM_DIV_40
- LL_RCC_PLLM_DIV_41
- LL_RCC_PLLM_DIV_42
- LL_RCC_PLLM_DIV_43
- LL_RCC_PLLM_DIV_44
- LL_RCC_PLLM_DIV_45
- LL_RCC_PLLM_DIV_46
- LL_RCC_PLLM_DIV_47
- LL_RCC_PLLM_DIV_48
- LL_RCC_PLLM_DIV_49
- LL_RCC_PLLM_DIV_50
- LL_RCC_PLLM_DIV_51
- LL_RCC_PLLM_DIV_52
- LL_RCC_PLLM_DIV_53
- LL_RCC_PLLM_DIV_54

- LL_RCC_PLLM_DIV_55
- LL_RCC_PLLM_DIV_56
- LL_RCC_PLLM_DIV_57
- LL_RCC_PLLM_DIV_58
- LL_RCC_PLLM_DIV_59
- LL_RCC_PLLM_DIV_60
- LL_RCC_PLLM_DIV_61
- LL_RCC_PLLM_DIV_62
- LL_RCC_PLLM_DIV_63
- **PLLN:** Between 50 and 432
- **PLLRR:** This parameter can be one of the following values:
 - LL_RCC_PLLSAIR_DIV_2
 - LL_RCC_PLLSAIR_DIV_3
 - LL_RCC_PLLSAIR_DIV_4
 - LL_RCC_PLLSAIR_DIV_5
 - LL_RCC_PLLSAIR_DIV_6
 - LL_RCC_PLLSAIR_DIV_7
- **PLLDIVR:** This parameter can be one of the following values:
 - LL_RCC_PLLSAIDIVR_DIV_2
 - LL_RCC_PLLSAIDIVR_DIV_4
 - LL_RCC_PLLSAIDIVR_DIV_8
 - LL_RCC_PLLSAIDIVR_DIV_16

Return values

- **None:**

Notes

- PLL Source and PLLM Divider can be written only when PLL, PLLI2S and PLLSAI are disabled
- PLLN/PLLRR can be written only when PLLSAI is disabled
- This can be selected for LTDC

Reference Manual to LL API cross reference:

- PLLCFGR PLLSRC LL_RCC_PLLSAI_ConfigDomain_LTDC
- PLLCFGR PLLM LL_RCC_PLLSAI_ConfigDomain_LTDC
- PLLSAICFGR PLLSAIN LL_RCC_PLLSAI_ConfigDomain_LTDC
- PLLSAICFGR PLLSAIR LL_RCC_PLLSAI_ConfigDomain_LTDC
- DCKCFGR1 PLLSAIDIVR LL_RCC_PLLSAI_ConfigDomain_LTDC

LL_RCC_PLLSAI_GetN

Function name `__STATIC_INLINE uint32_t LL_RCC_PLLSAI_GetN (void)`

Function description Get SAIPLL multiplication factor for VCO.

Return values

- **Between:** 50 and 432

Reference Manual to LL API cross reference:

- PLLSAICFGR PLLSAIN LL_RCC_PLLSAI_GetN

LL_RCC_PLLSAI_GetQ

Function name `__STATIC_INLINE uint32_t LL_RCC_PLLSAI_GetQ (void)`

Function description	Get SAIPLL division factor for PLLSAIQ.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_PLLSAIQ_DIV_2 – LL_RCC_PLLSAIQ_DIV_3 – LL_RCC_PLLSAIQ_DIV_4 – LL_RCC_PLLSAIQ_DIV_5 – LL_RCC_PLLSAIQ_DIV_6 – LL_RCC_PLLSAIQ_DIV_7 – LL_RCC_PLLSAIQ_DIV_8 – LL_RCC_PLLSAIQ_DIV_9 – LL_RCC_PLLSAIQ_DIV_10 – LL_RCC_PLLSAIQ_DIV_11 – LL_RCC_PLLSAIQ_DIV_12 – LL_RCC_PLLSAIQ_DIV_13 – LL_RCC_PLLSAIQ_DIV_14 – LL_RCC_PLLSAIQ_DIV_15
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PLLSAICFGR PLLSAIQ LL_RCC_PLLSAI_GetQ

LL_RCC_PLLSAI_GetR

Function name	__STATIC_INLINE uint32_t LL_RCC_PLLSAI_GetR (void)
Function description	Get SAIPLL division factor for PLLSAIR.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_PLLSAIR_DIV_2 – LL_RCC_PLLSAIR_DIV_3 – LL_RCC_PLLSAIR_DIV_4 – LL_RCC_PLLSAIR_DIV_5 – LL_RCC_PLLSAIR_DIV_6 – LL_RCC_PLLSAIR_DIV_7
Notes	<ul style="list-style-type: none"> • used for PLLSAICLK (SAI clock)
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PLLSAICFGR PLLSAIR LL_RCC_PLLSAI_GetR

LL_RCC_PLLSAI_GetP

Function name	__STATIC_INLINE uint32_t LL_RCC_PLLSAI_GetP (void)
Function description	Get SAIPLL division factor for PLLSAIP.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_PLLSAIP_DIV_2 – LL_RCC_PLLSAIP_DIV_4 – LL_RCC_PLLSAIP_DIV_6 – LL_RCC_PLLSAIP_DIV_8
Notes	<ul style="list-style-type: none"> • used for PLL48MCLK (48M domain clock)
Reference Manual to LL API cross	<ul style="list-style-type: none"> • PLLSAICFGR PLLSAIP LL_RCC_PLLSAI_GetP

reference:

LL_RCC_PLLSAI_GetDIVQ

Function name `__STATIC_INLINE uint32_t LL_RCC_PLLSAI_GetDIVQ (void)`

Function description Get SAIPLL division factor for PLLSAIDIVQ.

Return values

- **Returned:** value can be one of the following values:

- LL_RCC_PLLSAIDIVQ_DIV_1
- LL_RCC_PLLSAIDIVQ_DIV_2
- LL_RCC_PLLSAIDIVQ_DIV_3
- LL_RCC_PLLSAIDIVQ_DIV_4
- LL_RCC_PLLSAIDIVQ_DIV_5
- LL_RCC_PLLSAIDIVQ_DIV_6
- LL_RCC_PLLSAIDIVQ_DIV_7
- LL_RCC_PLLSAIDIVQ_DIV_8
- LL_RCC_PLLSAIDIVQ_DIV_9
- LL_RCC_PLLSAIDIVQ_DIV_10
- LL_RCC_PLLSAIDIVQ_DIV_11
- LL_RCC_PLLSAIDIVQ_DIV_12
- LL_RCC_PLLSAIDIVQ_DIV_13
- LL_RCC_PLLSAIDIVQ_DIV_14
- LL_RCC_PLLSAIDIVQ_DIV_15
- LL_RCC_PLLSAIDIVQ_DIV_16
- LL_RCC_PLLSAIDIVQ_DIV_17
- LL_RCC_PLLSAIDIVQ_DIV_18
- LL_RCC_PLLSAIDIVQ_DIV_19
- LL_RCC_PLLSAIDIVQ_DIV_20
- LL_RCC_PLLSAIDIVQ_DIV_21
- LL_RCC_PLLSAIDIVQ_DIV_22
- LL_RCC_PLLSAIDIVQ_DIV_23
- LL_RCC_PLLSAIDIVQ_DIV_24
- LL_RCC_PLLSAIDIVQ_DIV_25
- LL_RCC_PLLSAIDIVQ_DIV_26
- LL_RCC_PLLSAIDIVQ_DIV_27
- LL_RCC_PLLSAIDIVQ_DIV_28
- LL_RCC_PLLSAIDIVQ_DIV_29
- LL_RCC_PLLSAIDIVQ_DIV_30
- LL_RCC_PLLSAIDIVQ_DIV_31
- LL_RCC_PLLSAIDIVQ_DIV_32

Notes

- used PLLSAI1CLK, PLLSAI2CLK selected (SAI1 and SAI2 clock)

Reference Manual to LL API cross reference:

- DCKCFGR1 PLLSAIDIVQ LL_RCC_PLLSAI_GetDIVQ

LL_RCC_PLLSAI_GetDIVR

Function name `__STATIC_INLINE uint32_t LL_RCC_PLLSAI_GetDIVR (void)`

Function description Get SAIPLL division factor for PLLSAIDIVR.

- Return values
- **Returned:** value can be one of the following values:
 - LL_RCC_PLLSAIDIVR_DIV_2
 - LL_RCC_PLLSAIDIVR_DIV_4
 - LL_RCC_PLLSAIDIVR_DIV_8
 - LL_RCC_PLLSAIDIVR_DIV_16
- Notes
- used for LTDC domain clock
- Reference Manual to LL API cross reference:
- DCKCFGR1 PLLSAIDIVR LL_RCC_PLLSAI_GetDIVR

LL_RCC_ClearFlag_LSIRDY

- Function name **__STATIC_INLINE void LL_RCC_ClearFlag_LSIRDY (void)**
- Function description Clear LSI ready interrupt flag.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CIR LSIRDYC LL_RCC_ClearFlag_LSIRDY

LL_RCC_ClearFlag_LSERDY

- Function name **__STATIC_INLINE void LL_RCC_ClearFlag_LSERDY (void)**
- Function description Clear LSE ready interrupt flag.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CIR LSERDYC LL_RCC_ClearFlag_LSERDY

LL_RCC_ClearFlag_HSIRDY

- Function name **__STATIC_INLINE void LL_RCC_ClearFlag_HSIRDY (void)**
- Function description Clear HSI ready interrupt flag.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CIR HSIRDYC LL_RCC_ClearFlag_HSIRDY

LL_RCC_ClearFlag_HSERDY

- Function name **__STATIC_INLINE void LL_RCC_ClearFlag_HSERDY (void)**
- Function description Clear HSE ready interrupt flag.
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CIR HSERDYC LL_RCC_ClearFlag_HSERDY

LL_RCC_ClearFlag_PLLRDY

Function name	__STATIC_INLINE void LL_RCC_ClearFlag_PLLRDY (void)
Function description	Clear PLL ready interrupt flag.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CIR PLLRDYC LL_RCC_ClearFlag_PLLRDY

LL_RCC_ClearFlag_PLLI2SRDY

Function name	__STATIC_INLINE void LL_RCC_ClearFlag_PLLI2SRDY (void)
Function description	Clear PLLI2S ready interrupt flag.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CIR PLLI2SRDYC LL_RCC_ClearFlag_PLLI2SRDY

LL_RCC_ClearFlag_PLLSAIRDY

Function name	__STATIC_INLINE void LL_RCC_ClearFlag_PLLSAIRDY (void)
Function description	Clear PLLSAI ready interrupt flag.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CIR PLLSAIRDYC LL_RCC_ClearFlag_PLLSAIRDY

LL_RCC_ClearFlag_HSECSS

Function name	__STATIC_INLINE void LL_RCC_ClearFlag_HSECSS (void)
Function description	Clear Clock security system interrupt flag.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CIR CSSC LL_RCC_ClearFlag_HSECSS

LL_RCC_IsActiveFlag_LSIRDY

Function name	__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_LSIRDY (void)
Function description	Check if LSI ready interrupt occurred or not.
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CIR LSIRDYF LL_RCC_IsActiveFlag_LSIRDY

LL_RCC_IsActiveFlag_LSERDY

Function name **__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_LSERDY (void)**

Function description Check if LSE ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR LSERDYF LL_RCC_IsActiveFlag_LSERDY

LL_RCC_IsActiveFlag_HSIRDY

Function name **__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_HSIRDY (void)**

Function description Check if HSI ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR HSIRDYF LL_RCC_IsActiveFlag_HSIRDY

LL_RCC_IsActiveFlag_HSERDY

Function name **__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_HSERDY (void)**

Function description Check if HSE ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR HSERDYF LL_RCC_IsActiveFlag_HSERDY

LL_RCC_IsActiveFlag_PLLRDY

Function name **__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_PLLRDY (void)**

Function description Check if PLL ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR PLLRDYF LL_RCC_IsActiveFlag_PLLRDY

LL_RCC_IsActiveFlag_PLLI2SRDY

Function name **__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_PLLI2SRDY (void)**

Function description Check if PLLI2S ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR PLLI2SRDYF LL_RCC_IsActiveFlag_PLLI2SRDY

LL_RCC_IsActiveFlag_PLLSAIRDY

Function name `__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_PLLSAIRDY (void)`

Function description Check if PLLSAI ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR PLLSAIRDYF LL_RCC_IsActiveFlag_PLLSAIRDY

LL_RCC_IsActiveFlag_HSECSS

Function name `__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_HSECSS (void)`

Function description Check if Clock security system interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR CSSF LL_RCC_IsActiveFlag_HSECSS

LL_RCC_IsActiveFlag_IWDGRST

Function name `__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_IWDGRST (void)`

Function description Check if RCC flag Independent Watchdog reset is set or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR IWDGRSTF LL_RCC_IsActiveFlag_IWDGRST

LL_RCC_IsActiveFlag_LPWRST

Function name `__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_LPWRST (void)`

Function description Check if RCC flag Low Power reset is set or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR LPWRRSTF LL_RCC_IsActiveFlag_LPWRST

LL_RCC_IsActiveFlag_PINRST

Function name `__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_PINRST (void)`

Function description	Check if RCC flag Pin reset is set or not.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CSR PINRSTF LL_RCC_IsActiveFlag_PINRST

LL_RCC_IsActiveFlag_PORRST

Function name	__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_PORRST (void)
Function description	Check if RCC flag POR/PDR reset is set or not.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CSR PORRSTF LL_RCC_IsActiveFlag_PORRST

LL_RCC_IsActiveFlag_SFTRST

Function name	__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_SFTRST (void)
Function description	Check if RCC flag Software reset is set or not.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CSR SFTRSTF LL_RCC_IsActiveFlag_SFTRST

LL_RCC_IsActiveFlag_WWDGRST

Function name	__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_WWDGRST (void)
Function description	Check if RCC flag Window Watchdog reset is set or not.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CSR WWDGRSTF LL_RCC_IsActiveFlag_WWDGRST

LL_RCC_IsActiveFlag_BORRST

Function name	__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_BORRST (void)
Function description	Check if RCC flag BOR reset is set or not.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CSR BORRSTF LL_RCC_IsActiveFlag_BORRST

LL_RCC_ClearResetFlags

Function name	__STATIC_INLINE void LL_RCC_ClearResetFlags (void)
Function description	Set RMVF bit to clear the reset flags.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CSR RMVF LL_RCC_ClearResetFlags

LL_RCC_EnableIT_LSIRDY

Function name	__STATIC_INLINE void LL_RCC_EnableIT_LSIRDY (void)
Function description	Enable LSI ready interrupt.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CIR LSIRDYIE LL_RCC_EnableIT_LSIRDY

LL_RCC_EnableIT_LSERDY

Function name	__STATIC_INLINE void LL_RCC_EnableIT_LSERDY (void)
Function description	Enable LSE ready interrupt.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CIR LSERDYIE LL_RCC_EnableIT_LSERDY

LL_RCC_EnableIT_HSIRDY

Function name	__STATIC_INLINE void LL_RCC_EnableIT_HSIRDY (void)
Function description	Enable HSI ready interrupt.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CIR HSIRDYIE LL_RCC_EnableIT_HSIRDY

LL_RCC_EnableIT_HSERDY

Function name	__STATIC_INLINE void LL_RCC_EnableIT_HSERDY (void)
Function description	Enable HSE ready interrupt.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CIR HSERDYIE LL_RCC_EnableIT_HSERDY

LL_RCC_EnableIT_PLLRDY

Function name	__STATIC_INLINE void LL_RCC_EnableIT_PLLRDY (void)
Function description	Enable PLL ready interrupt.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CIR PLLRDYIE LL_RCC_EnableIT_PLLRDY

LL_RCC_EnableIT_PLLI2SRDY

Function name	__STATIC_INLINE void LL_RCC_EnableIT_PLLI2SRDY (void)
Function description	Enable PLLI2S ready interrupt.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CIR PLLI2SRDYIE LL_RCC_EnableIT_PLLI2SRDY

LL_RCC_EnableIT_PLLSAIRDY

Function name	__STATIC_INLINE void LL_RCC_EnableIT_PLLSAIRDY (void)
Function description	Enable PLLSAI ready interrupt.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CIR PLLSAIRDYIE LL_RCC_EnableIT_PLLSAIRDY

LL_RCC_DisableIT_LSIRDY

Function name	__STATIC_INLINE void LL_RCC_DisableIT_LSIRDY (void)
Function description	Disable LSI ready interrupt.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CIR LSIRDYIE LL_RCC_DisableIT_LSIRDY

LL_RCC_DisableIT_LSERDY

Function name	__STATIC_INLINE void LL_RCC_DisableIT_LSERDY (void)
Function description	Disable LSE ready interrupt.
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CIR LSERDYIE LL_RCC_DisableIT_LSERDY

LL_RCC_DisableIT_HSIRDY

Function name `__STATIC_INLINE void LL_RCC_DisableIT_HSIRDY (void)`
Function description Disable HSI ready interrupt.
Return values

- **None:**

Reference Manual to LL API cross reference:

- CIR HSIRDYIE LL_RCC_DisableIT_HSIRDY

LL_RCC_DisableIT_HSERDY

Function name `__STATIC_INLINE void LL_RCC_DisableIT_HSERDY (void)`
Function description Disable HSE ready interrupt.
Return values

- **None:**

Reference Manual to LL API cross reference:

- CIR HSERDYIE LL_RCC_DisableIT_HSERDY

LL_RCC_DisableIT_PLLRDY

Function name `__STATIC_INLINE void LL_RCC_DisableIT_PLLRDY (void)`
Function description Disable PLL ready interrupt.
Return values

- **None:**

Reference Manual to LL API cross reference:

- CIR PLLRDYIE LL_RCC_DisableIT_PLLRDY

LL_RCC_DisableIT_PLLI2SRDY

Function name `__STATIC_INLINE void LL_RCC_DisableIT_PLLI2SRDY (void)`
Function description Disable PLLI2S ready interrupt.
Return values

- **None:**

Reference Manual to LL API cross reference:

- CIR PLLI2SRDYIE LL_RCC_DisableIT_PLLI2SRDY

LL_RCC_DisableIT_PLLSAIRDY

Function name `__STATIC_INLINE void LL_RCC_DisableIT_PLLSAIRDY (void)`
Function description Disable PLLSAI ready interrupt.
Return values

- **None:**

Reference Manual to LL API cross reference:

- CIR PLLSAIRDYIE LL_RCC_DisableIT_PLLSAIRDY

LL_RCC_IsEnabledIT_LSIRDY

Function name **__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_LSIRDY (void)**

Function description Checks if LSI ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR LSIRDYIE LL_RCC_IsEnabledIT_LSIRDY

LL_RCC_IsEnabledIT_LSERDY

Function name **__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_LSERDY (void)**

Function description Checks if LSE ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR LSERDYIE LL_RCC_IsEnabledIT_LSERDY

LL_RCC_IsEnabledIT_HSIRDY

Function name **__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_HSIRDY (void)**

Function description Checks if HSI ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR HSIRDYIE LL_RCC_IsEnabledIT_HSIRDY

LL_RCC_IsEnabledIT_HSERDY

Function name **__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_HSERDY (void)**

Function description Checks if HSE ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR HSERDYIE LL_RCC_IsEnabledIT_HSERDY

LL_RCC_IsEnabledIT_PLLRDY

Function name **__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_PLLRDY (void)**

Function description Checks if PLL ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR PLLRDYIE LL_RCC_IsEnabledIT_PLLRDY

LL_RCC_IsEnabledIT_PLLI2SRDY

Function name **__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_PLLI2SRDY (void)**

Function description Checks if PLLI2S ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR PLLI2SRDYIE LL_RCC_IsEnabledIT_PLLI2SRDY

LL_RCC_IsEnabledIT_PLLSAIRDY

Function name **__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_PLLSAIRDY (void)**

Function description Checks if PLLSAI ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR PLLSAIRDYIE LL_RCC_IsEnabledIT_PLLSAIRDY

LL_RCC_DeInit

Function name **ErrorStatus LL_RCC_DeInit (void)**

Function description Reset the RCC clock configuration to the default reset state.

Return values

- **An:** ErrorStatus enumeration value:
 - SUCCESS: RCC registers are de-initialized
 - ERROR: not applicable

Notes

- The default reset state of the clock configuration is given below: HSI ON and used as system clock source HSE and PLL OFF AHB, APB1 and APB2 prescaler set to 1. CSS, MCO OFF All interrupts disabled
- This function doesn't modify the configuration of the Peripheral clocks LSI, LSE and RTC clocks

LL_RCC_GetSystemClocksFreq

Function name **void LL_RCC_GetSystemClocksFreq (LL_RCC_ClocksTypeDef * RCC_Clocks)**

Function description Return the frequencies of different on chip clocks; System, AHB, APB1 and APB2 buses clocks.

Parameters

- **RCC_Clocks:** pointer to a LL_RCC_ClocksTypeDef structure which will hold the clocks frequencies

Return values

- **None:**

- Notes
- Each time SYSCLK, HCLK, PCLK1 and/or PCLK2 clock changes, this function must be called to update structure fields. Otherwise, any configuration based on this function will be incorrect.

LL_RCC_GetUSARTClockFreq

- Function name **uint32_t LL_RCC_GetUSARTClockFreq (uint32_t USARTxSource)**
- Function description Return USARTx clock frequency.
- Parameters
- **USARTxSource:** This parameter can be one of the following values:
 - LL_RCC_USART1_CLKSOURCE
 - LL_RCC_USART2_CLKSOURCE
 - LL_RCC_USART3_CLKSOURCE
 - LL_RCC_USART6_CLKSOURCE
- Return values
- **USART:** clock frequency (in Hz)
 - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator (HSI or LSE) is not ready

LL_RCC_GetUARTClockFreq

- Function name **uint32_t LL_RCC_GetUARTClockFreq (uint32_t UARTxSource)**
- Function description Return UARTx clock frequency.
- Parameters
- **UARTxSource:** This parameter can be one of the following values:
 - LL_RCC_UART4_CLKSOURCE
 - LL_RCC_UART5_CLKSOURCE
 - LL_RCC_UART7_CLKSOURCE
 - LL_RCC_UART8_CLKSOURCE
- Return values
- **UART:** clock frequency (in Hz)
 - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator (HSI or LSE) is not ready

LL_RCC_GetI2CClockFreq

- Function name **uint32_t LL_RCC_GetI2CClockFreq (uint32_t I2CxSource)**
- Function description Return I2Cx clock frequency.
- Parameters
- **I2CxSource:** This parameter can be one of the following values: (*) value not defined in all devices.
 - LL_RCC_I2C1_CLKSOURCE
 - LL_RCC_I2C2_CLKSOURCE
 - LL_RCC_I2C3_CLKSOURCE
 - LL_RCC_I2C4_CLKSOURCE (*)
- Return values
- **I2C:** clock frequency (in Hz)
 - LL_RCC_PERIPH_FREQUENCY_NO indicates that HSI oscillator is not ready

LL_RCC_GetLPTIMClockFreq

Function name	uint32_t LL_RCC_GetLPTIMClockFreq (uint32_t LPTIMxSource)
Function description	Return LPTIMx clock frequency.
Parameters	<ul style="list-style-type: none"> • LPTIMxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_LPTIM1_CLKSOURCE
Return values	<ul style="list-style-type: none"> • LPTIM: clock frequency (in Hz) <ul style="list-style-type: none"> – LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator (HSI, LSI or LSE) is not ready

LL_RCC_GetSAIClockFreq

Function name	uint32_t LL_RCC_GetSAIClockFreq (uint32_t SAIxSource)
Function description	Return SAIx clock frequency.
Parameters	<ul style="list-style-type: none"> • SAIxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_SAI1_CLKSOURCE – LL_RCC_SAI2_CLKSOURCE
Return values	<ul style="list-style-type: none"> • SAI: clock frequency (in Hz) <ul style="list-style-type: none"> – LL_RCC_PERIPH_FREQUENCY_NO indicates that PLL is not ready – LL_RCC_PERIPH_FREQUENCY_NA indicates that external clock is used

LL_RCC_GetSDMMCclockFreq

Function name	uint32_t LL_RCC_GetSDMMCclockFreq (uint32_t SDMMCxSource)
Function description	Return SDMMCx clock frequency.
Parameters	<ul style="list-style-type: none"> • SDMMCxSource: This parameter can be one of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_RCC_SDMMC1_CLKSOURCE – LL_RCC_SDMMC2_CLKSOURCE (*)
Return values	<ul style="list-style-type: none"> • SDMMC: clock frequency (in Hz) <ul style="list-style-type: none"> – LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator PLL is not ready

LL_RCC_GetRNGClockFreq

Function name	uint32_t LL_RCC_GetRNGClockFreq (uint32_t RNGxSource)
Function description	Return RNGx clock frequency.
Parameters	<ul style="list-style-type: none"> • RNGxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_RNG_CLKSOURCE
Return values	<ul style="list-style-type: none"> • RNG: clock frequency (in Hz) <ul style="list-style-type: none"> – LL_RCC_PERIPH_FREQUENCY_NO indicates that

oscillator is not ready

LL_RCC_GetUSBClockFreq

Function name	uint32_t LL_RCC_GetUSBClockFreq (uint32_t USBxSource)
Function description	Return USBx clock frequency.
Parameters	<ul style="list-style-type: none"> • USBxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_USB_CLKSOURCE
Return values	<ul style="list-style-type: none"> • USB: clock frequency (in Hz)

LL_RCC_GetDFSDMClockFreq

Function name	uint32_t LL_RCC_GetDFSDMClockFreq (uint32_t DFSDMxSource)
Function description	Return DFSDMx clock frequency.
Parameters	<ul style="list-style-type: none"> • DFSDMxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_DFSDM1_CLKSOURCE
Return values	<ul style="list-style-type: none"> • DFSDM: clock frequency (in Hz)

LL_RCC_GetDFSDMAudioClockFreq

Function name	uint32_t LL_RCC_GetDFSDMAudioClockFreq (uint32_t DFSDMxSource)
Function description	Return DFSDMx Audio clock frequency.
Parameters	<ul style="list-style-type: none"> • DFSDMxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_DFSDM1_AUDIO_CLKSOURCE
Return values	<ul style="list-style-type: none"> • DFSDM: clock frequency (in Hz) <ul style="list-style-type: none"> – LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator is not ready

LL_RCC_GetI2SClockFreq

Function name	uint32_t LL_RCC_GetI2SClockFreq (uint32_t I2SxSource)
Function description	Return I2Sx clock frequency.
Parameters	<ul style="list-style-type: none"> • I2SxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_I2S1_CLKSOURCE
Return values	<ul style="list-style-type: none"> • I2S: clock frequency (in Hz) <ul style="list-style-type: none"> – LL_RCC_PERIPH_FREQUENCY_NO indicates that PLLI2S oscillator is not ready

LL_RCC_GetCECClockFreq

Function name	uint32_t LL_RCC_GetCECClockFreq (uint32_t CECxSource)
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Function description	Return CEC clock frequency.
Parameters	<ul style="list-style-type: none"> • CECxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_CEC_CLKSOURCE
Return values	<ul style="list-style-type: none"> • CEC: clock frequency (in Hz) <ul style="list-style-type: none"> – LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator (HSI or LSE) is not ready

LL_RCC_GetLTDCClockFreq

Function name	uint32_t LL_RCC_GetLTDCClockFreq (uint32_t LTDCxSource)
Function description	Return LTDC clock frequency.
Parameters	<ul style="list-style-type: none"> • LTDCxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_LTDC_CLKSOURCE
Return values	<ul style="list-style-type: none"> • LTDC: clock frequency (in Hz) <ul style="list-style-type: none"> – LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator PLLSAI is not ready

LL_RCC_GetSPDIFRXClockFreq

Function name	uint32_t LL_RCC_GetSPDIFRXClockFreq (uint32_t SPDIFRXxSource)
Function description	Return SPDIFRX clock frequency.
Parameters	<ul style="list-style-type: none"> • SPDIFRXxSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_SPDIFRX1_CLKSOURCE
Return values	<ul style="list-style-type: none"> • SPDIFRX: clock frequency (in Hz) <ul style="list-style-type: none"> – LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator is not ready

LL_RCC_GetDSIClockFreq

Function name	uint32_t LL_RCC_GetDSIClockFreq (uint32_t DSIXSource)
Function description	Return DSI clock frequency.
Parameters	<ul style="list-style-type: none"> • DSIXSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RCC_DSI_CLKSOURCE
Return values	<ul style="list-style-type: none"> • DSI: clock frequency (in Hz) <ul style="list-style-type: none"> – LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator is not ready – LL_RCC_PERIPH_FREQUENCY_NA indicates that external clock is used

85.3 RCC Firmware driver defines

85.3.1 RCC

APB low-speed prescaler (APB1)

LL_RCC_APB1_DIV_1	HCLK not divided
LL_RCC_APB1_DIV_2	HCLK divided by 2
LL_RCC_APB1_DIV_4	HCLK divided by 4
LL_RCC_APB1_DIV_8	HCLK divided by 8
LL_RCC_APB1_DIV_16	HCLK divided by 16

APB high-speed prescaler (APB2)

LL_RCC_APB2_DIV_1	HCLK not divided
LL_RCC_APB2_DIV_2	HCLK divided by 2
LL_RCC_APB2_DIV_4	HCLK divided by 4
LL_RCC_APB2_DIV_8	HCLK divided by 8
LL_RCC_APB2_DIV_16	HCLK divided by 16

Peripheral CEC get clock source

LL_RCC_CEC_CLKSOURCE CEC Clock source selection

Peripheral CEC clock source selection

LL_RCC_CEC_CLKSOURCE_LSE	LSE oscillator clock used as CEC clock
LL_RCC_CEC_CLKSOURCE_HSI_DIV488	HSI oscillator clock divided by 488 used as CEC clock

Peripheral CK48M get clock source

LL_RCC_CK48M_CLKSOURCE CK48M Domain clock source selection

Peripheral 48Mhz domain clock source selection

LL_RCC_CK48M_CLKSOURCE_PLL	PLL oscillator clock used as 48Mhz domain clock
LL_RCC_CK48M_CLKSOURCE_PLLSAI	PLLSAI oscillator clock used as 48Mhz domain clock

Clear Flags Defines

LL_RCC_CIR_LSIRDYC	LSI Ready Interrupt Clear
LL_RCC_CIR_LSERDYC	LSE Ready Interrupt Clear
LL_RCC_CIR_HSIRDYC	HSI Ready Interrupt Clear
LL_RCC_CIR_HSERDYC	HSE Ready Interrupt Clear
LL_RCC_CIR_PLLRDYC	PLL Ready Interrupt Clear
LL_RCC_CIR_PLLI2SRDYC	PLLI2S Ready Interrupt Clear
LL_RCC_CIR_PLLSAIRDYC	PLLSAI Ready Interrupt Clear
LL_RCC_CIR_CSSC	Clock Security System Interrupt Clear

Peripheral DFSDM get clock source

LL_RCC_DFSDM1_CLKSOURCE DFSDM Clock source selection

Peripheral DFSDM Audio clock source selection

LL_RCC_DFSDM1_AUDIO_CLKSOURCE_SAI1 SAI1 clock used as DFSDM1 Audio clock

LL_RCC_DFSDM1_AUDIO_CLKSOURCE_SAI2 SAI2 clock used as DFSDM1 Audio clock

Peripheral DFSDM clock source selection

LL_RCC_DFSDM1_CLKSOURCE_PCLK2 PCLK2 clock used as DFSDM1 clock

LL_RCC_DFSDM1_CLKSOURCE_SYSCLK System clock used as DFSDM1 clock

Peripheral DFSDM Audio get clock source

LL_RCC_DFSDM1_AUDIO_CLKSOURCE DFSDM Audio Clock source selection

Peripheral DSI get clock source

LL_RCC_DSI_CLKSOURCE DSI Clock source selection

Peripheral DSI clock source selection

LL_RCC_DSI_CLKSOURCE_PHY DSI-PHY clock used as DSI byte lane clock source

LL_RCC_DSI_CLKSOURCE_PLL PLL clock used as DSI byte lane clock source

Get Flags Defines

LL_RCC_CIR_LSIRDYF LSI Ready Interrupt flag

LL_RCC_CIR_LSERDYF LSE Ready Interrupt flag

LL_RCC_CIR_HSIRDYF HSI Ready Interrupt flag

LL_RCC_CIR_HSERDYF HSE Ready Interrupt flag

LL_RCC_CIR_PLLRDYF PLL Ready Interrupt flag

LL_RCC_CIR_PLLI2SRDYF PLLI2S Ready Interrupt flag

LL_RCC_CIR_PLLSAIRDYF PLLSAI Ready Interrupt flag

LL_RCC_CIR_CSSF Clock Security System Interrupt flag

LL_RCC_CSR_LPWRSTF Low-Power reset flag

LL_RCC_CSR_PINRSTF PIN reset flag

LL_RCC_CSR_PORRSTF POR/PDR reset flag

LL_RCC_CSR_SFTRSTF Software Reset flag

LL_RCC_CSR_IWDGRSTF Independent Watchdog reset flag

LL_RCC_CSR_WWDGRSTF Window watchdog reset flag

LL_RCC_CSR_BORRSTF BOR reset flag

Peripheral I2C get clock source

LL_RCC_I2C1_CLKSOURCE I2C1 Clock source selection

LL_RCC_I2C2_CLKSOURCE I2C2 Clock source selection

LL_RCC_I2C3_CLKSOURCE I2C3 Clock source selection

LL_RCC_I2C4_CLKSOURCE I2C4 Clock source selection

Peripheral I2C clock source selection

LL_RCC_I2C1_CLKSOURCE_PCLK1	PCLK1 clock used as I2C1 clock source
LL_RCC_I2C1_CLKSOURCE_SYSCCLK	SYSCCLK clock used as I2C1 clock source
LL_RCC_I2C1_CLKSOURCE_HSI	HSI clock used as I2C1 clock source
LL_RCC_I2C2_CLKSOURCE_PCLK1	PCLK1 clock used as I2C2 clock source
LL_RCC_I2C2_CLKSOURCE_SYSCCLK	SYSCCLK clock used as I2C2 clock source
LL_RCC_I2C2_CLKSOURCE_HSI	HSI clock used as I2C2 clock source
LL_RCC_I2C3_CLKSOURCE_PCLK1	PCLK1 clock used as I2C3 clock source
LL_RCC_I2C3_CLKSOURCE_SYSCCLK	SYSCCLK clock used as I2C3 clock source
LL_RCC_I2C3_CLKSOURCE_HSI	HSI clock used as I2C3 clock source
LL_RCC_I2C4_CLKSOURCE_PCLK1	PCLK1 clock used as I2C4 clock source
LL_RCC_I2C4_CLKSOURCE_SYSCCLK	SYSCCLK clock used as I2C4 clock source
LL_RCC_I2C4_CLKSOURCE_HSI	HSI clock used as I2C4 clock source

Peripheral I2S get clock source

LL_RCC_I2S1_CLKSOURCE I2S Clock source selection

Peripheral I2S clock source selection

LL_RCC_I2S1_CLKSOURCE_PLLI2S	I2S oscillator clock used as I2S1 clock
LL_RCC_I2S1_CLKSOURCE_PIN	External pin clock used as I2S1 clock

IT Defines

LL_RCC_CIR_LSIRDYIE	LSI Ready Interrupt Enable
LL_RCC_CIR_LSERDYIE	LSE Ready Interrupt Enable
LL_RCC_CIR_HSIRDYIE	HSI Ready Interrupt Enable
LL_RCC_CIR_HSERDYIE	HSE Ready Interrupt Enable
LL_RCC_CIR_PLLRDYIE	PLL Ready Interrupt Enable
LL_RCC_CIR_PLLI2SRDYIE	PLLI2S Ready Interrupt Enable
LL_RCC_CIR_PLLSAIRDYIE	PLLSAI Ready Interrupt Enable

Peripheral LPTIM get clock source

LL_RCC_LPTIM1_CLKSOURCE LPTIM1 Clock source selection

Peripheral LPTIM clock source selection

LL_RCC_LPTIM1_CLKSOURCE_PCLK1	PCLK1 clock used as LPTIM1 clock
LL_RCC_LPTIM1_CLKSOURCE_LSI	LSI oscillator clock used as LPTIM1 clock
LL_RCC_LPTIM1_CLKSOURCE_HSI	HSI oscillator clock used as LPTIM1 clock
LL_RCC_LPTIM1_CLKSOURCE_LSE	LSE oscillator clock used as LPTIM1 clock

LSE oscillator drive capability

LL_RCC_LSEDRIVE_LOW	Xtal mode lower driving capability
LL_RCC_LSEDRIVE_MEDIUMHIGH	Xtal mode medium high driving capability

LL_RCC_LSEDRIVE_MEDIUMLOW Xtal mode medium low driving capability
 LL_RCC_LSEDRIVE_HIGH Xtal mode higher driving capability

Peripheral LTDC get clock source

LL_RCC_LTDC_CLKSOURCE LTDC Clock source selection

MCO source selection

LL_RCC_MCO1SOURCE_HSI HSI selection as MCO1 source
 LL_RCC_MCO1SOURCE_LSE LSE selection as MCO1 source
 LL_RCC_MCO1SOURCE_HSE HSE selection as MCO1 source
 LL_RCC_MCO1SOURCE_PLLCLK PLLCLK selection as MCO1 source
 LL_RCC_MCO2SOURCE_SYSCLK SYSCLK selection as MCO2 source
 LL_RCC_MCO2SOURCE_PLLI2S PLLI2S selection as MCO2 source
 LL_RCC_MCO2SOURCE_HSE HSE selection as MCO2 source
 LL_RCC_MCO2SOURCE_PLLCLK PLLCLK selection as MCO2 source

MCO prescaler

LL_RCC_MCO1_DIV_1 MCO1 not divided
 LL_RCC_MCO1_DIV_2 MCO1 divided by 2
 LL_RCC_MCO1_DIV_3 MCO1 divided by 3
 LL_RCC_MCO1_DIV_4 MCO1 divided by 4
 LL_RCC_MCO1_DIV_5 MCO1 divided by 5
 LL_RCC_MCO2_DIV_1 MCO2 not divided
 LL_RCC_MCO2_DIV_2 MCO2 divided by 2
 LL_RCC_MCO2_DIV_3 MCO2 divided by 3
 LL_RCC_MCO2_DIV_4 MCO2 divided by 4
 LL_RCC_MCO2_DIV_5 MCO2 divided by 5

Oscillator Values adaptation

HSE_VALUE Value of the HSE oscillator in Hz
 HSI_VALUE Value of the HSI oscillator in Hz
 LSE_VALUE Value of the LSE oscillator in Hz
 LSI_VALUE Value of the LSI oscillator in Hz
 EXTERNAL_CLOCK_VALUE Value of the I2S_CKIN external oscillator in Hz

Peripheral clock frequency

LL_RCC_PERIPH_FREQUENCY_NO No clock enabled for the peripheral
 LL_RCC_PERIPH_FREQUENCY_NA Frequency cannot be provided as external clock

PLLI2SDIVQ division factor (PLLI2SDIVQ)

LL_RCC_PLLI2SDIVQ_DIV_1 PLLI2S division factor for PLLI2SDIVQ output by 1
 LL_RCC_PLLI2SDIVQ_DIV_2 PLLI2S division factor for PLLI2SDIVQ output by 2

LL_RCC_PLLI2SDIVQ_DIV_3	PLLI2S division factor for PLLI2SDIVQ output by 3
LL_RCC_PLLI2SDIVQ_DIV_4	PLLI2S division factor for PLLI2SDIVQ output by 4
LL_RCC_PLLI2SDIVQ_DIV_5	PLLI2S division factor for PLLI2SDIVQ output by 5
LL_RCC_PLLI2SDIVQ_DIV_6	PLLI2S division factor for PLLI2SDIVQ output by 6
LL_RCC_PLLI2SDIVQ_DIV_7	PLLI2S division factor for PLLI2SDIVQ output by 7
LL_RCC_PLLI2SDIVQ_DIV_8	PLLI2S division factor for PLLI2SDIVQ output by 8
LL_RCC_PLLI2SDIVQ_DIV_9	PLLI2S division factor for PLLI2SDIVQ output by 9
LL_RCC_PLLI2SDIVQ_DIV_10	PLLI2S division factor for PLLI2SDIVQ output by 10
LL_RCC_PLLI2SDIVQ_DIV_11	PLLI2S division factor for PLLI2SDIVQ output by 11
LL_RCC_PLLI2SDIVQ_DIV_12	PLLI2S division factor for PLLI2SDIVQ output by 12
LL_RCC_PLLI2SDIVQ_DIV_13	PLLI2S division factor for PLLI2SDIVQ output by 13
LL_RCC_PLLI2SDIVQ_DIV_14	PLLI2S division factor for PLLI2SDIVQ output by 14
LL_RCC_PLLI2SDIVQ_DIV_15	PLLI2S division factor for PLLI2SDIVQ output by 15
LL_RCC_PLLI2SDIVQ_DIV_16	PLLI2S division factor for PLLI2SDIVQ output by 16
LL_RCC_PLLI2SDIVQ_DIV_17	PLLI2S division factor for PLLI2SDIVQ output by 17
LL_RCC_PLLI2SDIVQ_DIV_18	PLLI2S division factor for PLLI2SDIVQ output by 18
LL_RCC_PLLI2SDIVQ_DIV_19	PLLI2S division factor for PLLI2SDIVQ output by 19
LL_RCC_PLLI2SDIVQ_DIV_20	PLLI2S division factor for PLLI2SDIVQ output by 20
LL_RCC_PLLI2SDIVQ_DIV_21	PLLI2S division factor for PLLI2SDIVQ output by 21
LL_RCC_PLLI2SDIVQ_DIV_22	PLLI2S division factor for PLLI2SDIVQ output by 22
LL_RCC_PLLI2SDIVQ_DIV_23	PLLI2S division factor for PLLI2SDIVQ output by 23
LL_RCC_PLLI2SDIVQ_DIV_24	PLLI2S division factor for PLLI2SDIVQ output by 24
LL_RCC_PLLI2SDIVQ_DIV_25	PLLI2S division factor for PLLI2SDIVQ output by 25
LL_RCC_PLLI2SDIVQ_DIV_26	PLLI2S division factor for PLLI2SDIVQ output by 26
LL_RCC_PLLI2SDIVQ_DIV_27	PLLI2S division factor for PLLI2SDIVQ output by 27
LL_RCC_PLLI2SDIVQ_DIV_28	PLLI2S division factor for PLLI2SDIVQ output by 28
LL_RCC_PLLI2SDIVQ_DIV_29	PLLI2S division factor for PLLI2SDIVQ output by 29
LL_RCC_PLLI2SDIVQ_DIV_30	PLLI2S division factor for PLLI2SDIVQ output by 30
LL_RCC_PLLI2SDIVQ_DIV_31	PLLI2S division factor for PLLI2SDIVQ output by 31
LL_RCC_PLLI2SDIVQ_DIV_32	PLLI2S division factor for PLLI2SDIVQ output by 32

PLLI2SP division factor (PLLI2SP)

LL_RCC_PLLI2SP_DIV_2	PLLI2S division factor for PLLI2SP output by 2
LL_RCC_PLLI2SP_DIV_4	PLLI2S division factor for PLLI2SP output by 4
LL_RCC_PLLI2SP_DIV_6	PLLI2S division factor for PLLI2SP output by 6
LL_RCC_PLLI2SP_DIV_8	PLLI2S division factor for PLLI2SP output by 8

PLLI2SQ division factor (PLLI2SQ)

LL_RCC_PLLI2SQ_DIV_2	PLLI2S division factor for PLLI2SQ output by 2
LL_RCC_PLLI2SQ_DIV_3	PLLI2S division factor for PLLI2SQ output by 3
LL_RCC_PLLI2SQ_DIV_4	PLLI2S division factor for PLLI2SQ output by 4
LL_RCC_PLLI2SQ_DIV_5	PLLI2S division factor for PLLI2SQ output by 5
LL_RCC_PLLI2SQ_DIV_6	PLLI2S division factor for PLLI2SQ output by 6
LL_RCC_PLLI2SQ_DIV_7	PLLI2S division factor for PLLI2SQ output by 7
LL_RCC_PLLI2SQ_DIV_8	PLLI2S division factor for PLLI2SQ output by 8
LL_RCC_PLLI2SQ_DIV_9	PLLI2S division factor for PLLI2SQ output by 9
LL_RCC_PLLI2SQ_DIV_10	PLLI2S division factor for PLLI2SQ output by 10
LL_RCC_PLLI2SQ_DIV_11	PLLI2S division factor for PLLI2SQ output by 11
LL_RCC_PLLI2SQ_DIV_12	PLLI2S division factor for PLLI2SQ output by 12
LL_RCC_PLLI2SQ_DIV_13	PLLI2S division factor for PLLI2SQ output by 13
LL_RCC_PLLI2SQ_DIV_14	PLLI2S division factor for PLLI2SQ output by 14
LL_RCC_PLLI2SQ_DIV_15	PLLI2S division factor for PLLI2SQ output by 15

PLLI2SR division factor (PLLI2SR)

LL_RCC_PLLI2SR_DIV_2	PLLI2S division factor for PLLI2SR output by 2
LL_RCC_PLLI2SR_DIV_3	PLLI2S division factor for PLLI2SR output by 3
LL_RCC_PLLI2SR_DIV_4	PLLI2S division factor for PLLI2SR output by 4
LL_RCC_PLLI2SR_DIV_5	PLLI2S division factor for PLLI2SR output by 5
LL_RCC_PLLI2SR_DIV_6	PLLI2S division factor for PLLI2SR output by 6
LL_RCC_PLLI2SR_DIV_7	PLLI2S division factor for PLLI2SR output by 7

PLL, PLLI2S and PLLSAI division factor

LL_RCC_PLLM_DIV_2	PLL, PLLI2S and PLLSAI division factor by 2
LL_RCC_PLLM_DIV_3	PLL, PLLI2S and PLLSAI division factor by 3
LL_RCC_PLLM_DIV_4	PLL, PLLI2S and PLLSAI division factor by 4
LL_RCC_PLLM_DIV_5	PLL, PLLI2S and PLLSAI division factor by 5
LL_RCC_PLLM_DIV_6	PLL, PLLI2S and PLLSAI division factor by 6
LL_RCC_PLLM_DIV_7	PLL, PLLI2S and PLLSAI division factor by 7
LL_RCC_PLLM_DIV_8	PLL, PLLI2S and PLLSAI division factor by 8
LL_RCC_PLLM_DIV_9	PLL, PLLI2S and PLLSAI division factor by 9
LL_RCC_PLLM_DIV_10	PLL, PLLI2S and PLLSAI division factor by 10
LL_RCC_PLLM_DIV_11	PLL, PLLI2S and PLLSAI division factor by 11
LL_RCC_PLLM_DIV_12	PLL, PLLI2S and PLLSAI division factor by 12
LL_RCC_PLLM_DIV_13	PLL, PLLI2S and PLLSAI division factor by 13
LL_RCC_PLLM_DIV_14	PLL, PLLI2S and PLLSAI division factor by 14
LL_RCC_PLLM_DIV_15	PLL, PLLI2S and PLLSAI division factor by 15

LL_RCC_PLLM_DIV_16	PLL, PLLI2S and PLLSAI division factor by 16
LL_RCC_PLLM_DIV_17	PLL, PLLI2S and PLLSAI division factor by 17
LL_RCC_PLLM_DIV_18	PLL, PLLI2S and PLLSAI division factor by 18
LL_RCC_PLLM_DIV_19	PLL, PLLI2S and PLLSAI division factor by 19
LL_RCC_PLLM_DIV_20	PLL, PLLI2S and PLLSAI division factor by 20
LL_RCC_PLLM_DIV_21	PLL, PLLI2S and PLLSAI division factor by 21
LL_RCC_PLLM_DIV_22	PLL, PLLI2S and PLLSAI division factor by 22
LL_RCC_PLLM_DIV_23	PLL, PLLI2S and PLLSAI division factor by 23
LL_RCC_PLLM_DIV_24	PLL, PLLI2S and PLLSAI division factor by 24
LL_RCC_PLLM_DIV_25	PLL, PLLI2S and PLLSAI division factor by 25
LL_RCC_PLLM_DIV_26	PLL, PLLI2S and PLLSAI division factor by 26
LL_RCC_PLLM_DIV_27	PLL, PLLI2S and PLLSAI division factor by 27
LL_RCC_PLLM_DIV_28	PLL, PLLI2S and PLLSAI division factor by 28
LL_RCC_PLLM_DIV_29	PLL, PLLI2S and PLLSAI division factor by 29
LL_RCC_PLLM_DIV_30	PLL, PLLI2S and PLLSAI division factor by 30
LL_RCC_PLLM_DIV_31	PLL, PLLI2S and PLLSAI division factor by 31
LL_RCC_PLLM_DIV_32	PLL, PLLI2S and PLLSAI division factor by 32
LL_RCC_PLLM_DIV_33	PLL, PLLI2S and PLLSAI division factor by 33
LL_RCC_PLLM_DIV_34	PLL, PLLI2S and PLLSAI division factor by 34
LL_RCC_PLLM_DIV_35	PLL, PLLI2S and PLLSAI division factor by 35
LL_RCC_PLLM_DIV_36	PLL, PLLI2S and PLLSAI division factor by 36
LL_RCC_PLLM_DIV_37	PLL, PLLI2S and PLLSAI division factor by 37
LL_RCC_PLLM_DIV_38	PLL, PLLI2S and PLLSAI division factor by 38
LL_RCC_PLLM_DIV_39	PLL, PLLI2S and PLLSAI division factor by 39
LL_RCC_PLLM_DIV_40	PLL, PLLI2S and PLLSAI division factor by 40
LL_RCC_PLLM_DIV_41	PLL, PLLI2S and PLLSAI division factor by 41
LL_RCC_PLLM_DIV_42	PLL, PLLI2S and PLLSAI division factor by 42
LL_RCC_PLLM_DIV_43	PLL, PLLI2S and PLLSAI division factor by 43
LL_RCC_PLLM_DIV_44	PLL, PLLI2S and PLLSAI division factor by 44
LL_RCC_PLLM_DIV_45	PLL, PLLI2S and PLLSAI division factor by 45
LL_RCC_PLLM_DIV_46	PLL, PLLI2S and PLLSAI division factor by 46
LL_RCC_PLLM_DIV_47	PLL, PLLI2S and PLLSAI division factor by 47
LL_RCC_PLLM_DIV_48	PLL, PLLI2S and PLLSAI division factor by 48
LL_RCC_PLLM_DIV_49	PLL, PLLI2S and PLLSAI division factor by 49
LL_RCC_PLLM_DIV_50	PLL, PLLI2S and PLLSAI division factor by 50
LL_RCC_PLLM_DIV_51	PLL, PLLI2S and PLLSAI division factor by 51

LL_RCC_PLLM_DIV_52	PLL, PLLI2S and PLLSAI division factor by 52
LL_RCC_PLLM_DIV_53	PLL, PLLI2S and PLLSAI division factor by 53
LL_RCC_PLLM_DIV_54	PLL, PLLI2S and PLLSAI division factor by 54
LL_RCC_PLLM_DIV_55	PLL, PLLI2S and PLLSAI division factor by 55
LL_RCC_PLLM_DIV_56	PLL, PLLI2S and PLLSAI division factor by 56
LL_RCC_PLLM_DIV_57	PLL, PLLI2S and PLLSAI division factor by 57
LL_RCC_PLLM_DIV_58	PLL, PLLI2S and PLLSAI division factor by 58
LL_RCC_PLLM_DIV_59	PLL, PLLI2S and PLLSAI division factor by 59
LL_RCC_PLLM_DIV_60	PLL, PLLI2S and PLLSAI division factor by 60
LL_RCC_PLLM_DIV_61	PLL, PLLI2S and PLLSAI division factor by 61
LL_RCC_PLLM_DIV_62	PLL, PLLI2S and PLLSAI division factor by 62
LL_RCC_PLLM_DIV_63	PLL, PLLI2S and PLLSAI division factor by 63

PLL division factor (PLL_P)

LL_RCC_PLLP_DIV_2	Main PLL division factor for PLL _P output by 2
LL_RCC_PLLP_DIV_4	Main PLL division factor for PLL _P output by 4
LL_RCC_PLLP_DIV_6	Main PLL division factor for PLL _P output by 6
LL_RCC_PLLP_DIV_8	Main PLL division factor for PLL _P output by 8

PLL division factor (PLL_Q)

LL_RCC_PLLQ_DIV_2	Main PLL division factor for PLL _Q output by 2
LL_RCC_PLLQ_DIV_3	Main PLL division factor for PLL _Q output by 3
LL_RCC_PLLQ_DIV_4	Main PLL division factor for PLL _Q output by 4
LL_RCC_PLLQ_DIV_5	Main PLL division factor for PLL _Q output by 5
LL_RCC_PLLQ_DIV_6	Main PLL division factor for PLL _Q output by 6
LL_RCC_PLLQ_DIV_7	Main PLL division factor for PLL _Q output by 7
LL_RCC_PLLQ_DIV_8	Main PLL division factor for PLL _Q output by 8
LL_RCC_PLLQ_DIV_9	Main PLL division factor for PLL _Q output by 9
LL_RCC_PLLQ_DIV_10	Main PLL division factor for PLL _Q output by 10
LL_RCC_PLLQ_DIV_11	Main PLL division factor for PLL _Q output by 11
LL_RCC_PLLQ_DIV_12	Main PLL division factor for PLL _Q output by 12
LL_RCC_PLLQ_DIV_13	Main PLL division factor for PLL _Q output by 13
LL_RCC_PLLQ_DIV_14	Main PLL division factor for PLL _Q output by 14
LL_RCC_PLLQ_DIV_15	Main PLL division factor for PLL _Q output by 15

PLL division factor (PLL_R)

LL_RCC_PLLR_DIV_2	Main PLL division factor for PLL _R CLK (system clock) by 2
LL_RCC_PLLR_DIV_3	Main PLL division factor for PLL _R CLK (system clock) by 3
LL_RCC_PLLR_DIV_4	Main PLL division factor for PLL _R CLK (system clock) by 4

LL_RCC_PLLR_DIV_5 Main PLL division factor for PLLCLK (system clock) by 5
LL_RCC_PLLR_DIV_6 Main PLL division factor for PLLCLK (system clock) by 6
LL_RCC_PLLR_DIV_7 Main PLL division factor for PLLCLK (system clock) by 7

PLLSAIDIVQ division factor (PLLSAIDIVQ)

LL_RCC_PLLSAIDIVQ_DIV_1 PLLSAI division factor for PLLSAIDIVQ output by 1
LL_RCC_PLLSAIDIVQ_DIV_2 PLLSAI division factor for PLLSAIDIVQ output by 2
LL_RCC_PLLSAIDIVQ_DIV_3 PLLSAI division factor for PLLSAIDIVQ output by 3
LL_RCC_PLLSAIDIVQ_DIV_4 PLLSAI division factor for PLLSAIDIVQ output by 4
LL_RCC_PLLSAIDIVQ_DIV_5 PLLSAI division factor for PLLSAIDIVQ output by 5
LL_RCC_PLLSAIDIVQ_DIV_6 PLLSAI division factor for PLLSAIDIVQ output by 6
LL_RCC_PLLSAIDIVQ_DIV_7 PLLSAI division factor for PLLSAIDIVQ output by 7
LL_RCC_PLLSAIDIVQ_DIV_8 PLLSAI division factor for PLLSAIDIVQ output by 8
LL_RCC_PLLSAIDIVQ_DIV_9 PLLSAI division factor for PLLSAIDIVQ output by 9
LL_RCC_PLLSAIDIVQ_DIV_10 PLLSAI division factor for PLLSAIDIVQ output by 10
LL_RCC_PLLSAIDIVQ_DIV_11 PLLSAI division factor for PLLSAIDIVQ output by 11
LL_RCC_PLLSAIDIVQ_DIV_12 PLLSAI division factor for PLLSAIDIVQ output by 12
LL_RCC_PLLSAIDIVQ_DIV_13 PLLSAI division factor for PLLSAIDIVQ output by 13
LL_RCC_PLLSAIDIVQ_DIV_14 PLLSAI division factor for PLLSAIDIVQ output by 14
LL_RCC_PLLSAIDIVQ_DIV_15 PLLSAI division factor for PLLSAIDIVQ output by 15
LL_RCC_PLLSAIDIVQ_DIV_16 PLLSAI division factor for PLLSAIDIVQ output by 16
LL_RCC_PLLSAIDIVQ_DIV_17 PLLSAI division factor for PLLSAIDIVQ output by 17
LL_RCC_PLLSAIDIVQ_DIV_18 PLLSAI division factor for PLLSAIDIVQ output by 18
LL_RCC_PLLSAIDIVQ_DIV_19 PLLSAI division factor for PLLSAIDIVQ output by 19
LL_RCC_PLLSAIDIVQ_DIV_20 PLLSAI division factor for PLLSAIDIVQ output by 20
LL_RCC_PLLSAIDIVQ_DIV_21 PLLSAI division factor for PLLSAIDIVQ output by 21
LL_RCC_PLLSAIDIVQ_DIV_22 PLLSAI division factor for PLLSAIDIVQ output by 22
LL_RCC_PLLSAIDIVQ_DIV_23 PLLSAI division factor for PLLSAIDIVQ output by 23
LL_RCC_PLLSAIDIVQ_DIV_24 PLLSAI division factor for PLLSAIDIVQ output by 24
LL_RCC_PLLSAIDIVQ_DIV_25 PLLSAI division factor for PLLSAIDIVQ output by 25
LL_RCC_PLLSAIDIVQ_DIV_26 PLLSAI division factor for PLLSAIDIVQ output by 26
LL_RCC_PLLSAIDIVQ_DIV_27 PLLSAI division factor for PLLSAIDIVQ output by 27
LL_RCC_PLLSAIDIVQ_DIV_28 PLLSAI division factor for PLLSAIDIVQ output by 28
LL_RCC_PLLSAIDIVQ_DIV_29 PLLSAI division factor for PLLSAIDIVQ output by 29
LL_RCC_PLLSAIDIVQ_DIV_30 PLLSAI division factor for PLLSAIDIVQ output by 30
LL_RCC_PLLSAIDIVQ_DIV_31 PLLSAI division factor for PLLSAIDIVQ output by 31
LL_RCC_PLLSAIDIVQ_DIV_32 PLLSAI division factor for PLLSAIDIVQ output by 32

PLLSAIDIVR division factor (PLLSAIDIVR)

LL_RCC_PLLSAIDIVR_DIV_2 PLLSAI division factor for PLLSAIDIVR output by 2
LL_RCC_PLLSAIDIVR_DIV_4 PLLSAI division factor for PLLSAIDIVR output by 4
LL_RCC_PLLSAIDIVR_DIV_8 PLLSAI division factor for PLLSAIDIVR output by 8
LL_RCC_PLLSAIDIVR_DIV_16 PLLSAI division factor for PLLSAIDIVR output by 16

PLLSAIP division factor (PLLSAIP)

LL_RCC_PLLSAIP_DIV_2 PLLSAI division factor for PLLSAIP output by 2
LL_RCC_PLLSAIP_DIV_4 PLLSAI division factor for PLLSAIP output by 4
LL_RCC_PLLSAIP_DIV_6 PLLSAI division factor for PLLSAIP output by 6
LL_RCC_PLLSAIP_DIV_8 PLLSAI division factor for PLLSAIP output by 8

PLLSAIQ division factor (PLLSAIQ)

LL_RCC_PLLSAIQ_DIV_2 PLLSAI division factor for PLLSAIQ output by 2
LL_RCC_PLLSAIQ_DIV_3 PLLSAI division factor for PLLSAIQ output by 3
LL_RCC_PLLSAIQ_DIV_4 PLLSAI division factor for PLLSAIQ output by 4
LL_RCC_PLLSAIQ_DIV_5 PLLSAI division factor for PLLSAIQ output by 5
LL_RCC_PLLSAIQ_DIV_6 PLLSAI division factor for PLLSAIQ output by 6
LL_RCC_PLLSAIQ_DIV_7 PLLSAI division factor for PLLSAIQ output by 7
LL_RCC_PLLSAIQ_DIV_8 PLLSAI division factor for PLLSAIQ output by 8
LL_RCC_PLLSAIQ_DIV_9 PLLSAI division factor for PLLSAIQ output by 9
LL_RCC_PLLSAIQ_DIV_10 PLLSAI division factor for PLLSAIQ output by 10
LL_RCC_PLLSAIQ_DIV_11 PLLSAI division factor for PLLSAIQ output by 11
LL_RCC_PLLSAIQ_DIV_12 PLLSAI division factor for PLLSAIQ output by 12
LL_RCC_PLLSAIQ_DIV_13 PLLSAI division factor for PLLSAIQ output by 13
LL_RCC_PLLSAIQ_DIV_14 PLLSAI division factor for PLLSAIQ output by 14
LL_RCC_PLLSAIQ_DIV_15 PLLSAI division factor for PLLSAIQ output by 15

PLLSAIR division factor (PLLSAIR)

LL_RCC_PLLSAIR_DIV_2 PLLSAI division factor for PLLSAIR output by 2
LL_RCC_PLLSAIR_DIV_3 PLLSAI division factor for PLLSAIR output by 3
LL_RCC_PLLSAIR_DIV_4 PLLSAI division factor for PLLSAIR output by 4
LL_RCC_PLLSAIR_DIV_5 PLLSAI division factor for PLLSAIR output by 5
LL_RCC_PLLSAIR_DIV_6 PLLSAI division factor for PLLSAIR output by 6
LL_RCC_PLLSAIR_DIV_7 PLLSAI division factor for PLLSAIR output by 7

PLL, PLLI2S and PLLSAI entry clock source

LL_RCC_PLLSOURCE_HSI HSI16 clock selected as PLL entry clock source
LL_RCC_PLLSOURCE_HSE HSE clock selected as PLL entry clock source

PLL Spread Spectrum Selection

LL_RCC_SPREAD_SELECT_CENTER PLL center spread spectrum selection

LL_RCC_SPREAD_SELECT_DOWN PLL down spread spectrum selection

Peripheral RNG get clock source

LL_RCC_RNG_CLKSOURCE RNG Clock source selection

Peripheral RNG clock source selection

LL_RCC_RNG_CLKSOURCE_PLL PLL clock used as RNG clock source

LL_RCC_RNG_CLKSOURCE_PLLSAI PLLSAI clock used as RNG clock source

RTC clock source selection

LL_RCC_RTC_CLKSOURCE_NONE No clock used as RTC clock

LL_RCC_RTC_CLKSOURCE_LSE LSE oscillator clock used as RTC clock

LL_RCC_RTC_CLKSOURCE_LSI LSI oscillator clock used as RTC clock

LL_RCC_RTC_CLKSOURCE_HSE HSE oscillator clock divided by HSE prescaler used as RTC clock

HSE prescaler for RTC clock

LL_RCC_RTC_NOCLOCK HSE not divided

LL_RCC_RTC_HSE_DIV_2 HSE clock divided by 2

LL_RCC_RTC_HSE_DIV_3 HSE clock divided by 3

LL_RCC_RTC_HSE_DIV_4 HSE clock divided by 4

LL_RCC_RTC_HSE_DIV_5 HSE clock divided by 5

LL_RCC_RTC_HSE_DIV_6 HSE clock divided by 6

LL_RCC_RTC_HSE_DIV_7 HSE clock divided by 7

LL_RCC_RTC_HSE_DIV_8 HSE clock divided by 8

LL_RCC_RTC_HSE_DIV_9 HSE clock divided by 9

LL_RCC_RTC_HSE_DIV_10 HSE clock divided by 10

LL_RCC_RTC_HSE_DIV_11 HSE clock divided by 11

LL_RCC_RTC_HSE_DIV_12 HSE clock divided by 12

LL_RCC_RTC_HSE_DIV_13 HSE clock divided by 13

LL_RCC_RTC_HSE_DIV_14 HSE clock divided by 14

LL_RCC_RTC_HSE_DIV_15 HSE clock divided by 15

LL_RCC_RTC_HSE_DIV_16 HSE clock divided by 16

LL_RCC_RTC_HSE_DIV_17 HSE clock divided by 17

LL_RCC_RTC_HSE_DIV_18 HSE clock divided by 18

LL_RCC_RTC_HSE_DIV_19 HSE clock divided by 19

LL_RCC_RTC_HSE_DIV_20 HSE clock divided by 20

LL_RCC_RTC_HSE_DIV_21 HSE clock divided by 21

LL_RCC_RTC_HSE_DIV_22 HSE clock divided by 22

LL_RCC_RTC_HSE_DIV_23 HSE clock divided by 23

LL_RCC_RTC_HSE_DIV_24 HSE clock divided by 24

LL_RCC_RTC_HSE_DIV_25	HSE clock divided by 25
LL_RCC_RTC_HSE_DIV_26	HSE clock divided by 26
LL_RCC_RTC_HSE_DIV_27	HSE clock divided by 27
LL_RCC_RTC_HSE_DIV_28	HSE clock divided by 28
LL_RCC_RTC_HSE_DIV_29	HSE clock divided by 29
LL_RCC_RTC_HSE_DIV_30	HSE clock divided by 30
LL_RCC_RTC_HSE_DIV_31	HSE clock divided by 31

Peripheral SAI get clock source

LL_RCC_SAI1_CLKSOURCE	SAI1 Clock source selection
LL_RCC_SAI2_CLKSOURCE	SAI2 Clock source selection

Peripheral SAI clock source selection

LL_RCC_SAI1_CLKSOURCE_PLLSAI	PLLSAI clock used as SAI1 clock source
LL_RCC_SAI1_CLKSOURCE_PLLI2S	PLLI2S clock used as SAI1 clock source
LL_RCC_SAI1_CLKSOURCE_PIN	External pin clock used as SAI1 clock source
LL_RCC_SAI1_CLKSOURCE_PLLSRC	Main source clock used as SAI1 clock source
LL_RCC_SAI2_CLKSOURCE_PLLSAI	PLLSAI clock used as SAI2 clock source
LL_RCC_SAI2_CLKSOURCE_PLLI2S	PLLI2S clock used as SAI2 clock source
LL_RCC_SAI2_CLKSOURCE_PIN	External pin clock used as SAI2 clock source
LL_RCC_SAI2_CLKSOURCE_PLLSRC	Main source clock used as SAI2 clock source

Peripheral SDMMC get clock source

LL_RCC_SDMMC1_CLKSOURCE	SDMMC1 Clock source selection
LL_RCC_SDMMC2_CLKSOURCE	SDMMC2 Clock source selection

Peripheral SDMMC clock source selection

LL_RCC_SDMMC1_CLKSOURCE_PLL48CLK	PLL 48M domain clock used as SDMMC1 clock
LL_RCC_SDMMC1_CLKSOURCE_SYSCCLK	System clock clock used as SDMMC1 clock
LL_RCC_SDMMC2_CLKSOURCE_PLL48CLK	PLL 48M domain clock used as SDMMC2 clock
LL_RCC_SDMMC2_CLKSOURCE_SYSCCLK	System clock clock used as SDMMC2 clock

Peripheral SPDIFRX get clock source

LL_RCC_SPDIFRX1_CLKSOURCE	SPDIFRX Clock source selection
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AHB prescaler

LL_RCC_SYSCCLK_DIV_1	SYSCCLK not divided
LL_RCC_SYSCCLK_DIV_2	SYSCCLK divided by 2
LL_RCC_SYSCCLK_DIV_4	SYSCCLK divided by 4
LL_RCC_SYSCCLK_DIV_8	SYSCCLK divided by 8

LL_RCC_SYSCLK_DIV_16	SYSCLK divided by 16
LL_RCC_SYSCLK_DIV_64	SYSCLK divided by 64
LL_RCC_SYSCLK_DIV_128	SYSCLK divided by 128
LL_RCC_SYSCLK_DIV_256	SYSCLK divided by 256
LL_RCC_SYSCLK_DIV_512	SYSCLK divided by 512

System clock switch

LL_RCC_SYS_CLKSOURCE_HSI	HSI selection as system clock
LL_RCC_SYS_CLKSOURCE_HSE	HSE selection as system clock
LL_RCC_SYS_CLKSOURCE_PLL	PLL selection as system clock

System clock switch status

LL_RCC_SYS_CLKSOURCE_STATUS_HSI	HSI used as system clock
LL_RCC_SYS_CLKSOURCE_STATUS_HSE	HSE used as system clock
LL_RCC_SYS_CLKSOURCE_STATUS_PLL	PLL used as system clock

Timers clocks prescalers selection

LL_RCC_TIM_PRESCALER_TWICE	Timers clock to twice PCLK
LL_RCC_TIM_PRESCALER_FOUR_TIMES	Timers clock to four time PCLK

Peripheral UART get clock source

LL_RCC_UART4_CLKSOURCE	UART4 Clock source selection
LL_RCC_UART5_CLKSOURCE	UART5 Clock source selection
LL_RCC_UART7_CLKSOURCE	UART7 Clock source selection
LL_RCC_UART8_CLKSOURCE	UART8 Clock source selection

Peripheral UART clock source selection

LL_RCC_UART4_CLKSOURCE_PCLK1	PCLK1 clock used as UART4 clock source
LL_RCC_UART4_CLKSOURCE_SYSCLK	SYSCLK clock used as UART4 clock source
LL_RCC_UART4_CLKSOURCE_HSI	HSI clock used as UART4 clock source
LL_RCC_UART4_CLKSOURCE_LSE	LSE clock used as UART4 clock source
LL_RCC_UART5_CLKSOURCE_PCLK1	PCLK1 clock used as UART5 clock source
LL_RCC_UART5_CLKSOURCE_SYSCLK	SYSCLK clock used as UART5 clock source
LL_RCC_UART5_CLKSOURCE_HSI	HSI clock used as UART5 clock source
LL_RCC_UART5_CLKSOURCE_LSE	LSE clock used as UART5 clock source
LL_RCC_UART7_CLKSOURCE_PCLK1	PCLK1 clock used as UART7 clock source
LL_RCC_UART7_CLKSOURCE_SYSCLK	SYSCLK clock used as UART7 clock source
LL_RCC_UART7_CLKSOURCE_HSI	HSI clock used as UART7 clock source
LL_RCC_UART7_CLKSOURCE_LSE	LSE clock used as UART7 clock source
LL_RCC_UART8_CLKSOURCE_PCLK1	PCLK1 clock used as UART8 clock source
LL_RCC_UART8_CLKSOURCE_SYSCLK	SYSCLK clock used as UART8 clock source

LL_RCC_UART8_CLKSOURCE_HSI HSI clock used as UART8 clock source
 LL_RCC_UART8_CLKSOURCE_LSE LSE clock used as UART8 clock source

Peripheral USART get clock source

LL_RCC_USART1_CLKSOURCE USART1 Clock source selection
 LL_RCC_USART2_CLKSOURCE USART2 Clock source selection
 LL_RCC_USART3_CLKSOURCE USART3 Clock source selection
 LL_RCC_USART6_CLKSOURCE USART6 Clock source selection

Peripheral USART clock source selection

LL_RCC_USART1_CLKSOURCE_PCLK2 PCLK2 clock used as USART1 clock source
 LL_RCC_USART1_CLKSOURCE_SYSCLK SYSCLK clock used as USART1 clock source
 LL_RCC_USART1_CLKSOURCE_HSI HSI clock used as USART1 clock source
 LL_RCC_USART1_CLKSOURCE_LSE LSE clock used as USART1 clock source
 LL_RCC_USART2_CLKSOURCE_PCLK1 PCLK1 clock used as USART2 clock source
 LL_RCC_USART2_CLKSOURCE_SYSCLK SYSCLK clock used as USART2 clock source
 LL_RCC_USART2_CLKSOURCE_HSI HSI clock used as USART2 clock source
 LL_RCC_USART2_CLKSOURCE_LSE LSE clock used as USART2 clock source
 LL_RCC_USART3_CLKSOURCE_PCLK1 PCLK1 clock used as USART3 clock source
 LL_RCC_USART3_CLKSOURCE_SYSCLK SYSCLK clock used as USART3 clock source
 LL_RCC_USART3_CLKSOURCE_HSI HSI clock used as USART3 clock source
 LL_RCC_USART3_CLKSOURCE_LSE LSE clock used as USART3 clock source
 LL_RCC_USART6_CLKSOURCE_PCLK2 PCLK2 clock used as USART6 clock source
 LL_RCC_USART6_CLKSOURCE_SYSCLK SYSCLK clock used as USART6 clock source
 LL_RCC_USART6_CLKSOURCE_HSI HSI clock used as USART6 clock source
 LL_RCC_USART6_CLKSOURCE_LSE LSE clock used as USART6 clock source

Peripheral USB get clock source

LL_RCC_USB_CLKSOURCE USB Clock source selection

Peripheral USB clock source selection

LL_RCC_USB_CLKSOURCE_PLL PLL clock used as USB clock source
 LL_RCC_USB_CLKSOURCE_PLLSAI PLLSAI1 clock used as USB clock source

Calculate frequencies

__LL_RCC_CALC_PLLCLK_FREQ

Description:

- Helper macro to calculate the PLLCLK frequency on system domain.

Parameters:

- `__INPUTFREQ__`: PLL Input frequency (based on HSE/HSI)
- `__PLLM__`: This parameter can be one of the following values:
 - `LL_RCC_PLLM_DIV_2`
 - `LL_RCC_PLLM_DIV_3`
 - `LL_RCC_PLLM_DIV_4`
 - `LL_RCC_PLLM_DIV_5`
 - `LL_RCC_PLLM_DIV_6`
 - `LL_RCC_PLLM_DIV_7`
 - `LL_RCC_PLLM_DIV_8`
 - `LL_RCC_PLLM_DIV_9`
 - `LL_RCC_PLLM_DIV_10`
 - `LL_RCC_PLLM_DIV_11`
 - `LL_RCC_PLLM_DIV_12`
 - `LL_RCC_PLLM_DIV_13`
 - `LL_RCC_PLLM_DIV_14`
 - `LL_RCC_PLLM_DIV_15`
 - `LL_RCC_PLLM_DIV_16`
 - `LL_RCC_PLLM_DIV_17`
 - `LL_RCC_PLLM_DIV_18`
 - `LL_RCC_PLLM_DIV_19`
 - `LL_RCC_PLLM_DIV_20`
 - `LL_RCC_PLLM_DIV_21`
 - `LL_RCC_PLLM_DIV_22`
 - `LL_RCC_PLLM_DIV_23`
 - `LL_RCC_PLLM_DIV_24`
 - `LL_RCC_PLLM_DIV_25`
 - `LL_RCC_PLLM_DIV_26`
 - `LL_RCC_PLLM_DIV_27`
 - `LL_RCC_PLLM_DIV_28`
 - `LL_RCC_PLLM_DIV_29`
 - `LL_RCC_PLLM_DIV_30`
 - `LL_RCC_PLLM_DIV_31`
 - `LL_RCC_PLLM_DIV_32`
 - `LL_RCC_PLLM_DIV_33`
 - `LL_RCC_PLLM_DIV_34`
 - `LL_RCC_PLLM_DIV_35`
 - `LL_RCC_PLLM_DIV_36`
 - `LL_RCC_PLLM_DIV_37`
 - `LL_RCC_PLLM_DIV_38`
 - `LL_RCC_PLLM_DIV_39`
 - `LL_RCC_PLLM_DIV_40`
 - `LL_RCC_PLLM_DIV_41`
 - `LL_RCC_PLLM_DIV_42`
 - `LL_RCC_PLLM_DIV_43`
 - `LL_RCC_PLLM_DIV_44`
 - `LL_RCC_PLLM_DIV_45`
 - `LL_RCC_PLLM_DIV_46`
 - `LL_RCC_PLLM_DIV_47`
 - `LL_RCC_PLLM_DIV_48`
 - `LL_RCC_PLLM_DIV_49`

- LL_RCC_PLLM_DIV_50
- LL_RCC_PLLM_DIV_51
- LL_RCC_PLLM_DIV_52
- LL_RCC_PLLM_DIV_53
- LL_RCC_PLLM_DIV_54
- LL_RCC_PLLM_DIV_55
- LL_RCC_PLLM_DIV_56
- LL_RCC_PLLM_DIV_57
- LL_RCC_PLLM_DIV_58
- LL_RCC_PLLM_DIV_59
- LL_RCC_PLLM_DIV_60
- LL_RCC_PLLM_DIV_61
- LL_RCC_PLLM_DIV_62
- LL_RCC_PLLM_DIV_63
- `__PLLN__`: Between 50 and 432
- `__PLL_P__`: This parameter can be one of the following values:
 - LL_RCC_PLLP_DIV_2
 - LL_RCC_PLLP_DIV_4
 - LL_RCC_PLLP_DIV_6
 - LL_RCC_PLLP_DIV_8

Return value:

- PLL: clock frequency (in Hz)

Notes:

- ex: `__LL_RCC_CALC_PLLCLK_FREQ(HSE_VALUE, LL_RCC_PLL_GetDivider(), LL_RCC_PLL_GetN(), LL_RCC_PLL_GetP());`

`__LL_RCC_CALC_PLLCLK_48M_FREQ`**Description:**

- Helper macro to calculate the PLLCLK frequency used on 48M domain.

Parameters:

- `__INPUTFREQ__`: PLL Input frequency (based on HSE/HSI)
- `__PLL_M__`: This parameter can be one of the following values:
 - LL_RCC_PLLM_DIV_2
 - LL_RCC_PLLM_DIV_3
 - LL_RCC_PLLM_DIV_4
 - LL_RCC_PLLM_DIV_5
 - LL_RCC_PLLM_DIV_6
 - LL_RCC_PLLM_DIV_7
 - LL_RCC_PLLM_DIV_8
 - LL_RCC_PLLM_DIV_9
 - LL_RCC_PLLM_DIV_10
 - LL_RCC_PLLM_DIV_11
 - LL_RCC_PLLM_DIV_12
 - LL_RCC_PLLM_DIV_13
 - LL_RCC_PLLM_DIV_14

- LL_RCC_PLLM_DIV_15
 - LL_RCC_PLLM_DIV_16
 - LL_RCC_PLLM_DIV_17
 - LL_RCC_PLLM_DIV_18
 - LL_RCC_PLLM_DIV_19
 - LL_RCC_PLLM_DIV_20
 - LL_RCC_PLLM_DIV_21
 - LL_RCC_PLLM_DIV_22
 - LL_RCC_PLLM_DIV_23
 - LL_RCC_PLLM_DIV_24
 - LL_RCC_PLLM_DIV_25
 - LL_RCC_PLLM_DIV_26
 - LL_RCC_PLLM_DIV_27
 - LL_RCC_PLLM_DIV_28
 - LL_RCC_PLLM_DIV_29
 - LL_RCC_PLLM_DIV_30
 - LL_RCC_PLLM_DIV_31
 - LL_RCC_PLLM_DIV_32
 - LL_RCC_PLLM_DIV_33
 - LL_RCC_PLLM_DIV_34
 - LL_RCC_PLLM_DIV_35
 - LL_RCC_PLLM_DIV_36
 - LL_RCC_PLLM_DIV_37
 - LL_RCC_PLLM_DIV_38
 - LL_RCC_PLLM_DIV_39
 - LL_RCC_PLLM_DIV_40
 - LL_RCC_PLLM_DIV_41
 - LL_RCC_PLLM_DIV_42
 - LL_RCC_PLLM_DIV_43
 - LL_RCC_PLLM_DIV_44
 - LL_RCC_PLLM_DIV_45
 - LL_RCC_PLLM_DIV_46
 - LL_RCC_PLLM_DIV_47
 - LL_RCC_PLLM_DIV_48
 - LL_RCC_PLLM_DIV_49
 - LL_RCC_PLLM_DIV_50
 - LL_RCC_PLLM_DIV_51
 - LL_RCC_PLLM_DIV_52
 - LL_RCC_PLLM_DIV_53
 - LL_RCC_PLLM_DIV_54
 - LL_RCC_PLLM_DIV_55
 - LL_RCC_PLLM_DIV_56
 - LL_RCC_PLLM_DIV_57
 - LL_RCC_PLLM_DIV_58
 - LL_RCC_PLLM_DIV_59
 - LL_RCC_PLLM_DIV_60
 - LL_RCC_PLLM_DIV_61
 - LL_RCC_PLLM_DIV_62
 - LL_RCC_PLLM_DIV_63
- `__PLLN__`: Between 50 and 432
 - `__PLLQ__`: This parameter can be one of the following values:

- LL_RCC_PLLQ_DIV_2
- LL_RCC_PLLQ_DIV_3
- LL_RCC_PLLQ_DIV_4
- LL_RCC_PLLQ_DIV_5
- LL_RCC_PLLQ_DIV_6
- LL_RCC_PLLQ_DIV_7
- LL_RCC_PLLQ_DIV_8
- LL_RCC_PLLQ_DIV_9
- LL_RCC_PLLQ_DIV_10
- LL_RCC_PLLQ_DIV_11
- LL_RCC_PLLQ_DIV_12
- LL_RCC_PLLQ_DIV_13
- LL_RCC_PLLQ_DIV_14
- LL_RCC_PLLQ_DIV_15

Return value:

- PLL: clock frequency (in Hz)

Notes:

- ex:
`__LL_RCC_CALC_PLLCLK_48M_FREQ`
`(HSE_VALUE, LL_RCC_PLL_GetDivider(), LL_RCC_PLL_GetN(), LL_RCC_PLL_GetQ());`

`__LL_RCC_CALC_PLLCLK_DSI_FREQ`**Description:**

- Helper macro to calculate the PLLCLK frequency used on DSI.

Parameters:

- `__INPUTFREQ__`: PLL Input frequency (based on HSE/HSI)
- `__PLLM__`: This parameter can be one of the following values:
 - LL_RCC_PLLM_DIV_2
 - LL_RCC_PLLM_DIV_3
 - LL_RCC_PLLM_DIV_4
 - LL_RCC_PLLM_DIV_5
 - LL_RCC_PLLM_DIV_6
 - LL_RCC_PLLM_DIV_7
 - LL_RCC_PLLM_DIV_8
 - LL_RCC_PLLM_DIV_9
 - LL_RCC_PLLM_DIV_10
 - LL_RCC_PLLM_DIV_11
 - LL_RCC_PLLM_DIV_12
 - LL_RCC_PLLM_DIV_13
 - LL_RCC_PLLM_DIV_14
 - LL_RCC_PLLM_DIV_15
 - LL_RCC_PLLM_DIV_16
 - LL_RCC_PLLM_DIV_17
 - LL_RCC_PLLM_DIV_18
 - LL_RCC_PLLM_DIV_19

- LL_RCC_PLLM_DIV_20
- LL_RCC_PLLM_DIV_21
- LL_RCC_PLLM_DIV_22
- LL_RCC_PLLM_DIV_23
- LL_RCC_PLLM_DIV_24
- LL_RCC_PLLM_DIV_25
- LL_RCC_PLLM_DIV_26
- LL_RCC_PLLM_DIV_27
- LL_RCC_PLLM_DIV_28
- LL_RCC_PLLM_DIV_29
- LL_RCC_PLLM_DIV_30
- LL_RCC_PLLM_DIV_31
- LL_RCC_PLLM_DIV_32
- LL_RCC_PLLM_DIV_33
- LL_RCC_PLLM_DIV_34
- LL_RCC_PLLM_DIV_35
- LL_RCC_PLLM_DIV_36
- LL_RCC_PLLM_DIV_37
- LL_RCC_PLLM_DIV_38
- LL_RCC_PLLM_DIV_39
- LL_RCC_PLLM_DIV_40
- LL_RCC_PLLM_DIV_41
- LL_RCC_PLLM_DIV_42
- LL_RCC_PLLM_DIV_43
- LL_RCC_PLLM_DIV_44
- LL_RCC_PLLM_DIV_45
- LL_RCC_PLLM_DIV_46
- LL_RCC_PLLM_DIV_47
- LL_RCC_PLLM_DIV_48
- LL_RCC_PLLM_DIV_49
- LL_RCC_PLLM_DIV_50
- LL_RCC_PLLM_DIV_51
- LL_RCC_PLLM_DIV_52
- LL_RCC_PLLM_DIV_53
- LL_RCC_PLLM_DIV_54
- LL_RCC_PLLM_DIV_55
- LL_RCC_PLLM_DIV_56
- LL_RCC_PLLM_DIV_57
- LL_RCC_PLLM_DIV_58
- LL_RCC_PLLM_DIV_59
- LL_RCC_PLLM_DIV_60
- LL_RCC_PLLM_DIV_61
- LL_RCC_PLLM_DIV_62
- LL_RCC_PLLM_DIV_63
- __PLLN__: Between 50 and 432
- __PLLR__: This parameter can be one of the following values:
 - LL_RCC_PLLR_DIV_2
 - LL_RCC_PLLR_DIV_3
 - LL_RCC_PLLR_DIV_4
 - LL_RCC_PLLR_DIV_5
 - LL_RCC_PLLR_DIV_6

- LL_RCC_PLLR_DIV_7

Return value:

- PLL: clock frequency (in Hz)

Notes:

- ex:
 __LL_RCC_CALC_PLLCLK_DSI_FREQ (HSE_VALUE,
 LL_RCC_PLL_GetDivider (),
 LL_RCC_PLL_GetN (),
 LL_RCC_PLL_GetR ());

`__LL_RCC_CALC_PLLSAI_SAI_FREQ`

Description:

- Helper macro to calculate the PLLSAI frequency used for SAI1 and SAI2 domains.

Parameters:

- `__INPUTFREQ__`: PLL Input frequency (based on HSE/HSI)
- `__PLLM__`: This parameter can be one of the following values:
 - LL_RCC_PLLM_DIV_2
 - LL_RCC_PLLM_DIV_3
 - LL_RCC_PLLM_DIV_4
 - LL_RCC_PLLM_DIV_5
 - LL_RCC_PLLM_DIV_6
 - LL_RCC_PLLM_DIV_7
 - LL_RCC_PLLM_DIV_8
 - LL_RCC_PLLM_DIV_9
 - LL_RCC_PLLM_DIV_10
 - LL_RCC_PLLM_DIV_11
 - LL_RCC_PLLM_DIV_12
 - LL_RCC_PLLM_DIV_13
 - LL_RCC_PLLM_DIV_14
 - LL_RCC_PLLM_DIV_15
 - LL_RCC_PLLM_DIV_16
 - LL_RCC_PLLM_DIV_17
 - LL_RCC_PLLM_DIV_18
 - LL_RCC_PLLM_DIV_19
 - LL_RCC_PLLM_DIV_20
 - LL_RCC_PLLM_DIV_21
 - LL_RCC_PLLM_DIV_22
 - LL_RCC_PLLM_DIV_23
 - LL_RCC_PLLM_DIV_24
 - LL_RCC_PLLM_DIV_25
 - LL_RCC_PLLM_DIV_26
 - LL_RCC_PLLM_DIV_27
 - LL_RCC_PLLM_DIV_28
 - LL_RCC_PLLM_DIV_29
 - LL_RCC_PLLM_DIV_30
 - LL_RCC_PLLM_DIV_31

- LL_RCC_PLLM_DIV_32
- LL_RCC_PLLM_DIV_33
- LL_RCC_PLLM_DIV_34
- LL_RCC_PLLM_DIV_35
- LL_RCC_PLLM_DIV_36
- LL_RCC_PLLM_DIV_37
- LL_RCC_PLLM_DIV_38
- LL_RCC_PLLM_DIV_39
- LL_RCC_PLLM_DIV_40
- LL_RCC_PLLM_DIV_41
- LL_RCC_PLLM_DIV_42
- LL_RCC_PLLM_DIV_43
- LL_RCC_PLLM_DIV_44
- LL_RCC_PLLM_DIV_45
- LL_RCC_PLLM_DIV_46
- LL_RCC_PLLM_DIV_47
- LL_RCC_PLLM_DIV_48
- LL_RCC_PLLM_DIV_49
- LL_RCC_PLLM_DIV_50
- LL_RCC_PLLM_DIV_51
- LL_RCC_PLLM_DIV_52
- LL_RCC_PLLM_DIV_53
- LL_RCC_PLLM_DIV_54
- LL_RCC_PLLM_DIV_55
- LL_RCC_PLLM_DIV_56
- LL_RCC_PLLM_DIV_57
- LL_RCC_PLLM_DIV_58
- LL_RCC_PLLM_DIV_59
- LL_RCC_PLLM_DIV_60
- LL_RCC_PLLM_DIV_61
- LL_RCC_PLLM_DIV_62
- LL_RCC_PLLM_DIV_63
- __PLLSAIN__: Between 50 and 432
- __PLLSAIQ__: This parameter can be one of the following values:
 - LL_RCC_PLLSAIQ_DIV_2
 - LL_RCC_PLLSAIQ_DIV_3
 - LL_RCC_PLLSAIQ_DIV_4
 - LL_RCC_PLLSAIQ_DIV_5
 - LL_RCC_PLLSAIQ_DIV_6
 - LL_RCC_PLLSAIQ_DIV_7
 - LL_RCC_PLLSAIQ_DIV_8
 - LL_RCC_PLLSAIQ_DIV_9
 - LL_RCC_PLLSAIQ_DIV_10
 - LL_RCC_PLLSAIQ_DIV_11
 - LL_RCC_PLLSAIQ_DIV_12
 - LL_RCC_PLLSAIQ_DIV_13
 - LL_RCC_PLLSAIQ_DIV_14
 - LL_RCC_PLLSAIQ_DIV_15
- __PLLSAIDIVQ__: This parameter can be one of the following values:
 - LL_RCC_PLLSAIDIVQ_DIV_1

- LL_RCC_PLLSAIDIVQ_DIV_2
- LL_RCC_PLLSAIDIVQ_DIV_3
- LL_RCC_PLLSAIDIVQ_DIV_4
- LL_RCC_PLLSAIDIVQ_DIV_5
- LL_RCC_PLLSAIDIVQ_DIV_6
- LL_RCC_PLLSAIDIVQ_DIV_7
- LL_RCC_PLLSAIDIVQ_DIV_8
- LL_RCC_PLLSAIDIVQ_DIV_9
- LL_RCC_PLLSAIDIVQ_DIV_10
- LL_RCC_PLLSAIDIVQ_DIV_11
- LL_RCC_PLLSAIDIVQ_DIV_12
- LL_RCC_PLLSAIDIVQ_DIV_13
- LL_RCC_PLLSAIDIVQ_DIV_14
- LL_RCC_PLLSAIDIVQ_DIV_15
- LL_RCC_PLLSAIDIVQ_DIV_16
- LL_RCC_PLLSAIDIVQ_DIV_17
- LL_RCC_PLLSAIDIVQ_DIV_18
- LL_RCC_PLLSAIDIVQ_DIV_19
- LL_RCC_PLLSAIDIVQ_DIV_20
- LL_RCC_PLLSAIDIVQ_DIV_21
- LL_RCC_PLLSAIDIVQ_DIV_22
- LL_RCC_PLLSAIDIVQ_DIV_23
- LL_RCC_PLLSAIDIVQ_DIV_24
- LL_RCC_PLLSAIDIVQ_DIV_25
- LL_RCC_PLLSAIDIVQ_DIV_26
- LL_RCC_PLLSAIDIVQ_DIV_27
- LL_RCC_PLLSAIDIVQ_DIV_28
- LL_RCC_PLLSAIDIVQ_DIV_29
- LL_RCC_PLLSAIDIVQ_DIV_30
- LL_RCC_PLLSAIDIVQ_DIV_31
- LL_RCC_PLLSAIDIVQ_DIV_32

Return value:

- PLLSAI: clock frequency (in Hz)

Notes:

- ex:


```
__LL_RCC_CALC_PLLSAI_SAI_FREQ
(HSE_VALUE,LL_RCC_PLL_GetDivide
r (), LL_RCC_PLLSAI_GetN (),
LL_RCC_PLLSAI_GetQ (),
LL_RCC_PLLSAI_GetDIVQ ());
```

`__LL_RCC_CALC_PLLSAI_48M_FREQ`

Description:

- Helper macro to calculate the PLLSAI frequency used on 48Mhz domain.

Parameters:

- `__INPUTFREQ__`: PLL Input frequency (based on HSE/HSI)
- `__PLLM__`: This parameter can be one of the following values:
 - LL_RCC_PLLM_DIV_2

- LL_RCC_PLLM_DIV_3
- LL_RCC_PLLM_DIV_4
- LL_RCC_PLLM_DIV_5
- LL_RCC_PLLM_DIV_6
- LL_RCC_PLLM_DIV_7
- LL_RCC_PLLM_DIV_8
- LL_RCC_PLLM_DIV_9
- LL_RCC_PLLM_DIV_10
- LL_RCC_PLLM_DIV_11
- LL_RCC_PLLM_DIV_12
- LL_RCC_PLLM_DIV_13
- LL_RCC_PLLM_DIV_14
- LL_RCC_PLLM_DIV_15
- LL_RCC_PLLM_DIV_16
- LL_RCC_PLLM_DIV_17
- LL_RCC_PLLM_DIV_18
- LL_RCC_PLLM_DIV_19
- LL_RCC_PLLM_DIV_20
- LL_RCC_PLLM_DIV_21
- LL_RCC_PLLM_DIV_22
- LL_RCC_PLLM_DIV_23
- LL_RCC_PLLM_DIV_24
- LL_RCC_PLLM_DIV_25
- LL_RCC_PLLM_DIV_26
- LL_RCC_PLLM_DIV_27
- LL_RCC_PLLM_DIV_28
- LL_RCC_PLLM_DIV_29
- LL_RCC_PLLM_DIV_30
- LL_RCC_PLLM_DIV_31
- LL_RCC_PLLM_DIV_32
- LL_RCC_PLLM_DIV_33
- LL_RCC_PLLM_DIV_34
- LL_RCC_PLLM_DIV_35
- LL_RCC_PLLM_DIV_36
- LL_RCC_PLLM_DIV_37
- LL_RCC_PLLM_DIV_38
- LL_RCC_PLLM_DIV_39
- LL_RCC_PLLM_DIV_40
- LL_RCC_PLLM_DIV_41
- LL_RCC_PLLM_DIV_42
- LL_RCC_PLLM_DIV_43
- LL_RCC_PLLM_DIV_44
- LL_RCC_PLLM_DIV_45
- LL_RCC_PLLM_DIV_46
- LL_RCC_PLLM_DIV_47
- LL_RCC_PLLM_DIV_48
- LL_RCC_PLLM_DIV_49
- LL_RCC_PLLM_DIV_50
- LL_RCC_PLLM_DIV_51
- LL_RCC_PLLM_DIV_52
- LL_RCC_PLLM_DIV_53
- LL_RCC_PLLM_DIV_54

- LL_RCC_PLLM_DIV_55
- LL_RCC_PLLM_DIV_56
- LL_RCC_PLLM_DIV_57
- LL_RCC_PLLM_DIV_58
- LL_RCC_PLLM_DIV_59
- LL_RCC_PLLM_DIV_60
- LL_RCC_PLLM_DIV_61
- LL_RCC_PLLM_DIV_62
- LL_RCC_PLLM_DIV_63
- __PLLSAIN__: Between 50 and 432
- __PLLSAIP__: This parameter can be one of the following values:
 - LL_RCC_PLLSAIP_DIV_2
 - LL_RCC_PLLSAIP_DIV_4
 - LL_RCC_PLLSAIP_DIV_6
 - LL_RCC_PLLSAIP_DIV_8

Return value:

- PLLSAI: clock frequency (in Hz)

Notes:

- ex:
 __LL_RCC_CALC_PLLSAI_48M_FREQ
 (HSE_VALUE, LL_RCC_PLL_GetDivider(), LL_RCC_PLLSAI_GetN(), LL_RCC_PLLSAI_GetP());

__LL_RCC_CALC_PLLSAI_LTDC_FREQ**Description:**

- Helper macro to calculate the PLLSAI frequency used for LTDC domain.

Parameters:

- __INPUTFREQ__: PLL Input frequency (based on HSE/HSI)
- __PLLM__: This parameter can be one of the following values:
 - LL_RCC_PLLM_DIV_2
 - LL_RCC_PLLM_DIV_3
 - LL_RCC_PLLM_DIV_4
 - LL_RCC_PLLM_DIV_5
 - LL_RCC_PLLM_DIV_6
 - LL_RCC_PLLM_DIV_7
 - LL_RCC_PLLM_DIV_8
 - LL_RCC_PLLM_DIV_9
 - LL_RCC_PLLM_DIV_10
 - LL_RCC_PLLM_DIV_11
 - LL_RCC_PLLM_DIV_12
 - LL_RCC_PLLM_DIV_13
 - LL_RCC_PLLM_DIV_14
 - LL_RCC_PLLM_DIV_15
 - LL_RCC_PLLM_DIV_16
 - LL_RCC_PLLM_DIV_17

- LL_RCC_PLLM_DIV_18
- LL_RCC_PLLM_DIV_19
- LL_RCC_PLLM_DIV_20
- LL_RCC_PLLM_DIV_21
- LL_RCC_PLLM_DIV_22
- LL_RCC_PLLM_DIV_23
- LL_RCC_PLLM_DIV_24
- LL_RCC_PLLM_DIV_25
- LL_RCC_PLLM_DIV_26
- LL_RCC_PLLM_DIV_27
- LL_RCC_PLLM_DIV_28
- LL_RCC_PLLM_DIV_29
- LL_RCC_PLLM_DIV_30
- LL_RCC_PLLM_DIV_31
- LL_RCC_PLLM_DIV_32
- LL_RCC_PLLM_DIV_33
- LL_RCC_PLLM_DIV_34
- LL_RCC_PLLM_DIV_35
- LL_RCC_PLLM_DIV_36
- LL_RCC_PLLM_DIV_37
- LL_RCC_PLLM_DIV_38
- LL_RCC_PLLM_DIV_39
- LL_RCC_PLLM_DIV_40
- LL_RCC_PLLM_DIV_41
- LL_RCC_PLLM_DIV_42
- LL_RCC_PLLM_DIV_43
- LL_RCC_PLLM_DIV_44
- LL_RCC_PLLM_DIV_45
- LL_RCC_PLLM_DIV_46
- LL_RCC_PLLM_DIV_47
- LL_RCC_PLLM_DIV_48
- LL_RCC_PLLM_DIV_49
- LL_RCC_PLLM_DIV_50
- LL_RCC_PLLM_DIV_51
- LL_RCC_PLLM_DIV_52
- LL_RCC_PLLM_DIV_53
- LL_RCC_PLLM_DIV_54
- LL_RCC_PLLM_DIV_55
- LL_RCC_PLLM_DIV_56
- LL_RCC_PLLM_DIV_57
- LL_RCC_PLLM_DIV_58
- LL_RCC_PLLM_DIV_59
- LL_RCC_PLLM_DIV_60
- LL_RCC_PLLM_DIV_61
- LL_RCC_PLLM_DIV_62
- LL_RCC_PLLM_DIV_63
- __PLLSAIN__: Between 50 and 432
- __PLLSAIR__: This parameter can be one of the following values:
 - LL_RCC_PLLSAIR_DIV_2
 - LL_RCC_PLLSAIR_DIV_3
 - LL_RCC_PLLSAIR_DIV_4

- LL_RCC_PLLSAIR_DIV_5
- LL_RCC_PLLSAIR_DIV_6
- LL_RCC_PLLSAIR_DIV_7
- `__PLLSAIDIVR__`: This parameter can be one of the following values:
 - LL_RCC_PLLSAIDIVR_DIV_2
 - LL_RCC_PLLSAIDIVR_DIV_4
 - LL_RCC_PLLSAIDIVR_DIV_8
 - LL_RCC_PLLSAIDIVR_DIV_16

Return value:

- PLLSAI: clock frequency (in Hz)

Notes:

- ex:
`__LL_RCC_CALC_PLLSAI_LTDC_FREQ`
`(HSE_VALUE, LL_RCC_PLL_GetDivider(), LL_RCC_PLLSAI_GetN(), LL_RCC_PLLSAI_GetR(), LL_RCC_PLLSAI_GetDIVR());`

`__LL_RCC_CALC_PLLI2S_SAI_FREQ`

Description:

- Helper macro to calculate the PLLI2S frequency used for SAI1 and SAI2 domains.

Parameters:

- `__INPUTFREQ__`: PLL Input frequency (based on HSE/HSI)
- `__PLLM__`: This parameter can be one of the following values:
 - LL_RCC_PLLM_DIV_2
 - LL_RCC_PLLM_DIV_3
 - LL_RCC_PLLM_DIV_4
 - LL_RCC_PLLM_DIV_5
 - LL_RCC_PLLM_DIV_6
 - LL_RCC_PLLM_DIV_7
 - LL_RCC_PLLM_DIV_8
 - LL_RCC_PLLM_DIV_9
 - LL_RCC_PLLM_DIV_10
 - LL_RCC_PLLM_DIV_11
 - LL_RCC_PLLM_DIV_12
 - LL_RCC_PLLM_DIV_13
 - LL_RCC_PLLM_DIV_14
 - LL_RCC_PLLM_DIV_15
 - LL_RCC_PLLM_DIV_16
 - LL_RCC_PLLM_DIV_17
 - LL_RCC_PLLM_DIV_18
 - LL_RCC_PLLM_DIV_19
 - LL_RCC_PLLM_DIV_20
 - LL_RCC_PLLM_DIV_21
 - LL_RCC_PLLM_DIV_22

- LL_RCC_PLLM_DIV_23
- LL_RCC_PLLM_DIV_24
- LL_RCC_PLLM_DIV_25
- LL_RCC_PLLM_DIV_26
- LL_RCC_PLLM_DIV_27
- LL_RCC_PLLM_DIV_28
- LL_RCC_PLLM_DIV_29
- LL_RCC_PLLM_DIV_30
- LL_RCC_PLLM_DIV_31
- LL_RCC_PLLM_DIV_32
- LL_RCC_PLLM_DIV_33
- LL_RCC_PLLM_DIV_34
- LL_RCC_PLLM_DIV_35
- LL_RCC_PLLM_DIV_36
- LL_RCC_PLLM_DIV_37
- LL_RCC_PLLM_DIV_38
- LL_RCC_PLLM_DIV_39
- LL_RCC_PLLM_DIV_40
- LL_RCC_PLLM_DIV_41
- LL_RCC_PLLM_DIV_42
- LL_RCC_PLLM_DIV_43
- LL_RCC_PLLM_DIV_44
- LL_RCC_PLLM_DIV_45
- LL_RCC_PLLM_DIV_46
- LL_RCC_PLLM_DIV_47
- LL_RCC_PLLM_DIV_48
- LL_RCC_PLLM_DIV_49
- LL_RCC_PLLM_DIV_50
- LL_RCC_PLLM_DIV_51
- LL_RCC_PLLM_DIV_52
- LL_RCC_PLLM_DIV_53
- LL_RCC_PLLM_DIV_54
- LL_RCC_PLLM_DIV_55
- LL_RCC_PLLM_DIV_56
- LL_RCC_PLLM_DIV_57
- LL_RCC_PLLM_DIV_58
- LL_RCC_PLLM_DIV_59
- LL_RCC_PLLM_DIV_60
- LL_RCC_PLLM_DIV_61
- LL_RCC_PLLM_DIV_62
- LL_RCC_PLLM_DIV_63
- __PLLI2SN__: Between 50 and 432
- __PLLI2SQ__: This parameter can be one of the following values:
 - LL_RCC_PLI2SQ_DIV_2
 - LL_RCC_PLI2SQ_DIV_3
 - LL_RCC_PLI2SQ_DIV_4
 - LL_RCC_PLI2SQ_DIV_5
 - LL_RCC_PLI2SQ_DIV_6
 - LL_RCC_PLI2SQ_DIV_7
 - LL_RCC_PLI2SQ_DIV_8
 - LL_RCC_PLI2SQ_DIV_9

- LL_RCC_PLLI2SQ_DIV_10
- LL_RCC_PLLI2SQ_DIV_11
- LL_RCC_PLLI2SQ_DIV_12
- LL_RCC_PLLI2SQ_DIV_13
- LL_RCC_PLLI2SQ_DIV_14
- LL_RCC_PLLI2SQ_DIV_15
- **__PLLI2SDIVQ__**: This parameter can be one of the following values:
 - LL_RCC_PLLI2SDIVQ_DIV_1
 - LL_RCC_PLLI2SDIVQ_DIV_2
 - LL_RCC_PLLI2SDIVQ_DIV_3
 - LL_RCC_PLLI2SDIVQ_DIV_4
 - LL_RCC_PLLI2SDIVQ_DIV_5
 - LL_RCC_PLLI2SDIVQ_DIV_6
 - LL_RCC_PLLI2SDIVQ_DIV_7
 - LL_RCC_PLLI2SDIVQ_DIV_8
 - LL_RCC_PLLI2SDIVQ_DIV_9
 - LL_RCC_PLLI2SDIVQ_DIV_10
 - LL_RCC_PLLI2SDIVQ_DIV_11
 - LL_RCC_PLLI2SDIVQ_DIV_12
 - LL_RCC_PLLI2SDIVQ_DIV_13
 - LL_RCC_PLLI2SDIVQ_DIV_14
 - LL_RCC_PLLI2SDIVQ_DIV_15
 - LL_RCC_PLLI2SDIVQ_DIV_16
 - LL_RCC_PLLI2SDIVQ_DIV_17
 - LL_RCC_PLLI2SDIVQ_DIV_18
 - LL_RCC_PLLI2SDIVQ_DIV_19
 - LL_RCC_PLLI2SDIVQ_DIV_20
 - LL_RCC_PLLI2SDIVQ_DIV_21
 - LL_RCC_PLLI2SDIVQ_DIV_22
 - LL_RCC_PLLI2SDIVQ_DIV_23
 - LL_RCC_PLLI2SDIVQ_DIV_24
 - LL_RCC_PLLI2SDIVQ_DIV_25
 - LL_RCC_PLLI2SDIVQ_DIV_26
 - LL_RCC_PLLI2SDIVQ_DIV_27
 - LL_RCC_PLLI2SDIVQ_DIV_28
 - LL_RCC_PLLI2SDIVQ_DIV_29
 - LL_RCC_PLLI2SDIVQ_DIV_30
 - LL_RCC_PLLI2SDIVQ_DIV_31
 - LL_RCC_PLLI2SDIVQ_DIV_32

Return value:

- PLLI2S: clock frequency (in Hz)

Notes:

- ex:


```
__LL_RCC_CALC_PLLI2S_SAI_FREQ
(HSE_VALUE,LL_RCC_PLL_GetDivide
r (), LL_RCC_PLLI2S_GetN (),
LL_RCC_PLLI2S_GetQ (),
LL_RCC_PLLI2S_GetDIVQ ());
```

__LL_RCC_CALC_PLLI2S_SPDIFRX_FRE **Description:**

Q

- Helper macro to calculate the PLLI2S frequency used on SPDIFRX domain.

Parameters:

- `__INPUTFREQ__`: PLL Input frequency (based on HSE/HSI)
- `__PLLM__`: This parameter can be one of the following values:
 - `LL_RCC_PLLM_DIV_2`
 - `LL_RCC_PLLM_DIV_3`
 - `LL_RCC_PLLM_DIV_4`
 - `LL_RCC_PLLM_DIV_5`
 - `LL_RCC_PLLM_DIV_6`
 - `LL_RCC_PLLM_DIV_7`
 - `LL_RCC_PLLM_DIV_8`
 - `LL_RCC_PLLM_DIV_9`
 - `LL_RCC_PLLM_DIV_10`
 - `LL_RCC_PLLM_DIV_11`
 - `LL_RCC_PLLM_DIV_12`
 - `LL_RCC_PLLM_DIV_13`
 - `LL_RCC_PLLM_DIV_14`
 - `LL_RCC_PLLM_DIV_15`
 - `LL_RCC_PLLM_DIV_16`
 - `LL_RCC_PLLM_DIV_17`
 - `LL_RCC_PLLM_DIV_18`
 - `LL_RCC_PLLM_DIV_19`
 - `LL_RCC_PLLM_DIV_20`
 - `LL_RCC_PLLM_DIV_21`
 - `LL_RCC_PLLM_DIV_22`
 - `LL_RCC_PLLM_DIV_23`
 - `LL_RCC_PLLM_DIV_24`
 - `LL_RCC_PLLM_DIV_25`
 - `LL_RCC_PLLM_DIV_26`
 - `LL_RCC_PLLM_DIV_27`
 - `LL_RCC_PLLM_DIV_28`
 - `LL_RCC_PLLM_DIV_29`
 - `LL_RCC_PLLM_DIV_30`
 - `LL_RCC_PLLM_DIV_31`
 - `LL_RCC_PLLM_DIV_32`
 - `LL_RCC_PLLM_DIV_33`
 - `LL_RCC_PLLM_DIV_34`
 - `LL_RCC_PLLM_DIV_35`
 - `LL_RCC_PLLM_DIV_36`
 - `LL_RCC_PLLM_DIV_37`
 - `LL_RCC_PLLM_DIV_38`
 - `LL_RCC_PLLM_DIV_39`
 - `LL_RCC_PLLM_DIV_40`
 - `LL_RCC_PLLM_DIV_41`
 - `LL_RCC_PLLM_DIV_42`
 - `LL_RCC_PLLM_DIV_43`
 - `LL_RCC_PLLM_DIV_44`
 - `LL_RCC_PLLM_DIV_45`
 - `LL_RCC_PLLM_DIV_46`

- LL_RCC_PLLM_DIV_47
- LL_RCC_PLLM_DIV_48
- LL_RCC_PLLM_DIV_49
- LL_RCC_PLLM_DIV_50
- LL_RCC_PLLM_DIV_51
- LL_RCC_PLLM_DIV_52
- LL_RCC_PLLM_DIV_53
- LL_RCC_PLLM_DIV_54
- LL_RCC_PLLM_DIV_55
- LL_RCC_PLLM_DIV_56
- LL_RCC_PLLM_DIV_57
- LL_RCC_PLLM_DIV_58
- LL_RCC_PLLM_DIV_59
- LL_RCC_PLLM_DIV_60
- LL_RCC_PLLM_DIV_61
- LL_RCC_PLLM_DIV_62
- LL_RCC_PLLM_DIV_63
- __PLLI2SN__: Between 50 and 432
- __PLLI2SP__: This parameter can be one of the following values:
 - LL_RCC_PLI2SP_DIV_2
 - LL_RCC_PLI2SP_DIV_4
 - LL_RCC_PLI2SP_DIV_6
 - LL_RCC_PLI2SP_DIV_8

Return value:

- PLLI2S: clock frequency (in Hz)

Notes:

- ex:
 __LL_RCC_CALC_PLI2S_SPDIFRX_FREQ
 (HSE_VALUE, LL_RCC_PLL_GetDivide
 r (), LL_RCC_PLI2S_GetN (),
 LL_RCC_PLI2S_GetP ());

[__LL_RCC_CALC_PLI2S_I2S_FREQ](#)

Description:

- Helper macro to calculate the PLLI2S frequency used for I2S domain.

Parameters:

- __INPUTFREQ__: PLL Input frequency (based on HSE/HSI)
- __PLLM__: This parameter can be one of the following values:
 - LL_RCC_PLLM_DIV_2
 - LL_RCC_PLLM_DIV_3
 - LL_RCC_PLLM_DIV_4
 - LL_RCC_PLLM_DIV_5
 - LL_RCC_PLLM_DIV_6
 - LL_RCC_PLLM_DIV_7
 - LL_RCC_PLLM_DIV_8
 - LL_RCC_PLLM_DIV_9

- LL_RCC_PLLM_DIV_10
- LL_RCC_PLLM_DIV_11
- LL_RCC_PLLM_DIV_12
- LL_RCC_PLLM_DIV_13
- LL_RCC_PLLM_DIV_14
- LL_RCC_PLLM_DIV_15
- LL_RCC_PLLM_DIV_16
- LL_RCC_PLLM_DIV_17
- LL_RCC_PLLM_DIV_18
- LL_RCC_PLLM_DIV_19
- LL_RCC_PLLM_DIV_20
- LL_RCC_PLLM_DIV_21
- LL_RCC_PLLM_DIV_22
- LL_RCC_PLLM_DIV_23
- LL_RCC_PLLM_DIV_24
- LL_RCC_PLLM_DIV_25
- LL_RCC_PLLM_DIV_26
- LL_RCC_PLLM_DIV_27
- LL_RCC_PLLM_DIV_28
- LL_RCC_PLLM_DIV_29
- LL_RCC_PLLM_DIV_30
- LL_RCC_PLLM_DIV_31
- LL_RCC_PLLM_DIV_32
- LL_RCC_PLLM_DIV_33
- LL_RCC_PLLM_DIV_34
- LL_RCC_PLLM_DIV_35
- LL_RCC_PLLM_DIV_36
- LL_RCC_PLLM_DIV_37
- LL_RCC_PLLM_DIV_38
- LL_RCC_PLLM_DIV_39
- LL_RCC_PLLM_DIV_40
- LL_RCC_PLLM_DIV_41
- LL_RCC_PLLM_DIV_42
- LL_RCC_PLLM_DIV_43
- LL_RCC_PLLM_DIV_44
- LL_RCC_PLLM_DIV_45
- LL_RCC_PLLM_DIV_46
- LL_RCC_PLLM_DIV_47
- LL_RCC_PLLM_DIV_48
- LL_RCC_PLLM_DIV_49
- LL_RCC_PLLM_DIV_50
- LL_RCC_PLLM_DIV_51
- LL_RCC_PLLM_DIV_52
- LL_RCC_PLLM_DIV_53
- LL_RCC_PLLM_DIV_54
- LL_RCC_PLLM_DIV_55
- LL_RCC_PLLM_DIV_56
- LL_RCC_PLLM_DIV_57
- LL_RCC_PLLM_DIV_58
- LL_RCC_PLLM_DIV_59
- LL_RCC_PLLM_DIV_60
- LL_RCC_PLLM_DIV_61

- LL_RCC_PLLM_DIV_62
- LL_RCC_PLLM_DIV_63
- __PLLI2SN__: Between 50 and 432
- __PLLI2SR__: This parameter can be one of the following values:
 - LL_RCC_PLLI2SR_DIV_2
 - LL_RCC_PLLI2SR_DIV_3
 - LL_RCC_PLLI2SR_DIV_4
 - LL_RCC_PLLI2SR_DIV_5
 - LL_RCC_PLLI2SR_DIV_6
 - LL_RCC_PLLI2SR_DIV_7

Return value:

- PLLI2S: clock frequency (in Hz)

Notes:

- ex:
 __LL_RCC_CALC_PLLI2S_I2S_FREQ (HSE_VALUE, LL_RCC_PLL_GetDivide
 r (), LL_RCC_PLLI2S_GetN (),
 LL_RCC_PLLI2S_GetR ());

[__LL_RCC_CALC_HCLK_FREQ](#)

Description:

- Helper macro to calculate the HCLK frequency.

Parameters:

- __SYSCLKFREQ__: SYSCLK frequency (based on HSE/HSI/PLLCLK)
- __AHBPRESCALER__: This parameter can be one of the following values:
 - LL_RCC_SYSCLK_DIV_1
 - LL_RCC_SYSCLK_DIV_2
 - LL_RCC_SYSCLK_DIV_4
 - LL_RCC_SYSCLK_DIV_8
 - LL_RCC_SYSCLK_DIV_16
 - LL_RCC_SYSCLK_DIV_64
 - LL_RCC_SYSCLK_DIV_128
 - LL_RCC_SYSCLK_DIV_256
 - LL_RCC_SYSCLK_DIV_512

Return value:

- HCLK: clock frequency (in Hz)

[__LL_RCC_CALC_PCLK1_FREQ](#)

Description:

- Helper macro to calculate the PCLK1 frequency (ABP1)

Parameters:

- __HCLKFREQ__: HCLK frequency
- __APB1PRESCALER__: This parameter can be one of the following

values:

- LL_RCC_APB1_DIV_1
- LL_RCC_APB1_DIV_2
- LL_RCC_APB1_DIV_4
- LL_RCC_APB1_DIV_8
- LL_RCC_APB1_DIV_16

Return value:

- PCLK1: clock frequency (in Hz)

Description:

- Helper macro to calculate the PCLK2 frequency (ABP2)

Parameters:

- `__HCLKFREQ__`: HCLK frequency
- `__APB2PRESCALER__`: This parameter can be one of the following values:
 - LL_RCC_APB2_DIV_1
 - LL_RCC_APB2_DIV_2
 - LL_RCC_APB2_DIV_4
 - LL_RCC_APB2_DIV_8
 - LL_RCC_APB2_DIV_16

Return value:

- PCLK2: clock frequency (in Hz)

`__LL_RCC_CALC_PCLK2_FREQ`

Common Write and read registers Macros

`LL_RCC_WriteReg`

Description:

- Write a value in RCC register.

Parameters:

- `__REG__`: Register to be written
- `__VALUE__`: Value to be written in the register

Return value:

- None

`LL_RCC_ReadReg`

Description:

- Read a value in RCC register.

Parameters:

- `__REG__`: Register to be read

Return value:

- Register: value

86 LL RNG Generic Driver

86.1 RNG Firmware driver API description

86.1.1 Detailed description of functions

LL_RNG_Enable

Function name `__STATIC_INLINE void LL_RNG_Enable (RNG_TypeDef * RNGx)`

Function description Enable Random Number Generation.

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR RNGEN LL_RNG_Enable

LL_RNG_Disable

Function name `__STATIC_INLINE void LL_RNG_Disable (RNG_TypeDef * RNGx)`

Function description Disable Random Number Generation.

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR RNGEN LL_RNG_Disable

LL_RNG_IsEnabled

Function name `__STATIC_INLINE uint32_t LL_RNG_IsEnabled (RNG_TypeDef * RNGx)`

Function description Check if Random Number Generator is enabled.

Parameters

- **RNGx:** RNG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR RNGEN LL_RNG_IsEnabled

LL_RNG_IsActiveFlag_DRDY

Function name `__STATIC_INLINE uint32_t LL_RNG_IsActiveFlag_DRDY (RNG_TypeDef * RNGx)`

Function description Indicate if the RNG Data ready Flag is set or not.

Parameters	<ul style="list-style-type: none"> • RNGx: RNG Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR DRDY LL_RNG_IsActiveFlag_DRDY

LL_RNG_IsActiveFlag_CECS

Function name	__STATIC_INLINE uint32_t LL_RNG_IsActiveFlag_CECS (RNG_TypeDef * RNGx)
Function description	Indicate if the Clock Error Current Status Flag is set or not.
Parameters	<ul style="list-style-type: none"> • RNGx: RNG Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR CECS LL_RNG_IsActiveFlag_CECS

LL_RNG_IsActiveFlag_SECS

Function name	__STATIC_INLINE uint32_t LL_RNG_IsActiveFlag_SECS (RNG_TypeDef * RNGx)
Function description	Indicate if the Seed Error Current Status Flag is set or not.
Parameters	<ul style="list-style-type: none"> • RNGx: RNG Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR SECS LL_RNG_IsActiveFlag_SECS

LL_RNG_IsActiveFlag_CEIS

Function name	__STATIC_INLINE uint32_t LL_RNG_IsActiveFlag_CEIS (RNG_TypeDef * RNGx)
Function description	Indicate if the Clock Error Interrupt Status Flag is set or not.
Parameters	<ul style="list-style-type: none"> • RNGx: RNG Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR CEIS LL_RNG_IsActiveFlag_CEIS

LL_RNG_IsActiveFlag_SEIS

Function name	__STATIC_INLINE uint32_t LL_RNG_IsActiveFlag_SEIS (RNG_TypeDef * RNGx)
Function description	Indicate if the Seed Error Interrupt Status Flag is set or not.
Parameters	<ul style="list-style-type: none"> • RNGx: RNG Instance

- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- SR SEIS LL_RNG_IsActiveFlag_SEIS

LL_RNG_ClearFlag_CEIS

- Function name **__STATIC_INLINE void LL_RNG_ClearFlag_CEIS (RNG_TypeDef * RNGx)**
- Function description Clear Clock Error interrupt Status (CEIS) Flag.
- Parameters
- **RNGx:** RNG Instance
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- SR CEIS LL_RNG_ClearFlag_CEIS

LL_RNG_ClearFlag_SEIS

- Function name **__STATIC_INLINE void LL_RNG_ClearFlag_SEIS (RNG_TypeDef * RNGx)**
- Function description Clear Seed Error interrupt Status (SEIS) Flag.
- Parameters
- **RNGx:** RNG Instance
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- SR SEIS LL_RNG_ClearFlag_SEIS

LL_RNG_EnableIT

- Function name **__STATIC_INLINE void LL_RNG_EnableIT (RNG_TypeDef * RNGx)**
- Function description Enable Random Number Generator Interrupt (applies for either Seed error, Clock Error or Data ready interrupts)
- Parameters
- **RNGx:** RNG Instance
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR IE LL_RNG_EnableIT

LL_RNG_DisableIT

- Function name **__STATIC_INLINE void LL_RNG_DisableIT (RNG_TypeDef * RNGx)**
- Function description Disable Random Number Generator Interrupt (applies for either Seed error, Clock Error or Data ready interrupts)
- Parameters
- **RNGx:** RNG Instance

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR IE LL_RNG_DisableIT

LL_RNG_IsEnabledIT

- Function name **__STATIC_INLINE uint32_t LL_RNG_IsEnabledIT (RNG_TypeDef * RNGx)**
- Function description Check if Random Number Generator Interrupt is enabled (applies for either Seed error, Clock Error or Data ready interrupts)
- Parameters
- **RNGx:** RNG Instance
- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- CR IE LL_RNG_IsEnabledIT

LL_RNG_ReadRandData32

- Function name **__STATIC_INLINE uint32_t LL_RNG_ReadRandData32 (RNG_TypeDef * RNGx)**
- Function description Return 32-bit Random Number value.
- Parameters
- **RNGx:** RNG Instance
- Return values
- **Generated:** 32-bit random value
- Reference Manual to LL API cross reference:
- DR RNDATA LL_RNG_ReadRandData32

LL_RNG_DeInit

- Function name **ErrorStatus LL_RNG_DeInit (RNG_TypeDef * RNGx)**
- Function description De-initialize RNG registers (Registers restored to their default values).
- Parameters
- **RNGx:** RNG Instance
- Return values
- **An:** ErrorStatus enumeration value:
 - SUCCESS: RNG registers are de-initialized
 - ERROR: not applicable

86.2 RNG Firmware driver defines

86.2.1 RNG

Get Flags Defines

- LL_RNG_SR_DRDY Register contains valid random data
- LL_RNG_SR_CECS Clock error current status
- LL_RNG_SR_SECS Seed error current status

LL_RNG_SR_CEIS Clock error interrupt status

LL_RNG_SR_SEIS Seed error interrupt status

IT Defines

LL_RNG_CR_IE RNG Interrupt enable

Common Write and read registers Macros

LL_RNG_WriteReg

Description:

- Write a value in RNG register.

Parameters:

- `__INSTANCE__`: RNG Instance
- `__REG__`: Register to be written
- `__VALUE__`: Value to be written in the register

Return value:

- None

LL_RNG_ReadReg

Description:

- Read a value in RNG register.

Parameters:

- `__INSTANCE__`: RNG Instance
- `__REG__`: Register to be read

Return value:

- Register: value

87 LL RTC Generic Driver

87.1 RTC Firmware driver registers structures

87.1.1 LL_RTC_InitTypeDef

Data Fields

- *uint32_t HourFormat*
- *uint32_t AsynchPrescaler*
- *uint32_t SynchPrescaler*

Field Documentation

- *uint32_t LL_RTC_InitTypeDef::HourFormat*
Specifies the RTC Hours Format. This parameter can be a value of [RTC_LL_EC_HOURFORMAT](#). This feature can be modified afterwards using unitary function `LL_RTC_SetHourFormat()`.
- *uint32_t LL_RTC_InitTypeDef::AsynchPrescaler*
Specifies the RTC Asynchronous Predivider value. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x7F`. This feature can be modified afterwards using unitary function `LL_RTC_SetAsynchPrescaler()`.
- *uint32_t LL_RTC_InitTypeDef::SynchPrescaler*
Specifies the RTC Synchronous Predivider value. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0x7FFF`. This feature can be modified afterwards using unitary function `LL_RTC_SetSynchPrescaler()`.

87.1.2 LL_RTC_TimeTypeDef

Data Fields

- *uint32_t TimeFormat*
- *uint8_t Hours*
- *uint8_t Minutes*
- *uint8_t Seconds*

Field Documentation

- *uint32_t LL_RTC_TimeTypeDef::TimeFormat*
Specifies the RTC AM/PM Time. This parameter can be a value of [RTC_LL_EC_TIME_FORMAT](#). This feature can be modified afterwards using unitary function `LL_RTC_TIME_SetFormat()`.
- *uint8_t LL_RTC_TimeTypeDef::Hours*
Specifies the RTC Time Hours. This parameter must be a number between `Min_Data = 0` and `Max_Data = 12` if the `LL_RTC_TIME_FORMAT_PM` is selected. This parameter must be a number between `Min_Data = 0` and `Max_Data = 23` if the `LL_RTC_TIME_FORMAT_AM_OR_24` is selected. This feature can be modified afterwards using unitary function `LL_RTC_TIME_SetHour()`.
- *uint8_t LL_RTC_TimeTypeDef::Minutes*
Specifies the RTC Time Minutes. This parameter must be a number between `Min_Data = 0` and `Max_Data = 59`. This feature can be modified afterwards using unitary function `LL_RTC_TIME_SetMinute()`.
- *uint8_t LL_RTC_TimeTypeDef::Seconds*
Specifies the RTC Time Seconds. This parameter must be a number between

Min_Data = 0 and Max_Data = 59 This feature can be modified afterwards using unitary function `LL_RTC_TIME_SetSecond()`.

87.1.3 LL_RTC_DateTypeDef

Data Fields

- *uint8_t* `WeekDay`
- *uint8_t* `Month`
- *uint8_t* `Day`
- *uint8_t* `Year`

Field Documentation

- *uint8_t* `LL_RTC_DateTypeDef::WeekDay`
Specifies the RTC Date WeekDay. This parameter can be a value of [RTC_LL_EC_WEEKDAY](#) This feature can be modified afterwards using unitary function `LL_RTC_DATE_SetWeekDay()`.
- *uint8_t* `LL_RTC_DateTypeDef::Month`
Specifies the RTC Date Month. This parameter can be a value of [RTC_LL_EC_MONTH](#) This feature can be modified afterwards using unitary function `LL_RTC_DATE_SetMonth()`.
- *uint8_t* `LL_RTC_DateTypeDef::Day`
Specifies the RTC Date Day. This parameter must be a number between Min_Data = 1 and Max_Data = 31 This feature can be modified afterwards using unitary function `LL_RTC_DATE_SetDay()`.
- *uint8_t* `LL_RTC_DateTypeDef::Year`
Specifies the RTC Date Year. This parameter must be a number between Min_Data = 0 and Max_Data = 99 This feature can be modified afterwards using unitary function `LL_RTC_DATE_SetYear()`.

87.1.4 LL_RTC_AlarmTypeDef

Data Fields

- *LL_RTC_TimeTypeDef* `AlarmTime`
- *uint32_t* `AlarmMask`
- *uint32_t* `AlarmDateWeekDaySel`
- *uint8_t* `AlarmDateWeekDay`

Field Documentation

- *LL_RTC_TimeTypeDef* `LL_RTC_AlarmTypeDef::AlarmTime`
Specifies the RTC Alarm Time members.
- *uint32_t* `LL_RTC_AlarmTypeDef::AlarmMask`
Specifies the RTC Alarm Masks. This parameter can be a value of [RTC_LL_EC_ALMA_MASK](#) for ALARM A or [RTC_LL_EC_ALMB_MASK](#) for ALARM B. This feature can be modified afterwards using unitary function `LL_RTC_ALMA_SetMask()` for ALARM A or `LL_RTC_ALMB_SetMask()` for ALARM B
- *uint32_t* `LL_RTC_AlarmTypeDef::AlarmDateWeekDaySel`
Specifies the RTC Alarm is on day or WeekDay. This parameter can be a value of [RTC_LL_EC_ALMA_WEEKDAY_SELECTION](#) for ALARM A or [RTC_LL_EC_ALMB_WEEKDAY_SELECTION](#) for ALARM B This feature can be modified afterwards using unitary function `LL_RTC_ALMA_EnableWeekday()` or `LL_RTC_ALMA_DisableWeekday()` for ALARM A or `LL_RTC_ALMB_EnableWeekday()` or `LL_RTC_ALMB_DisableWeekday()` for ALARM B

- **uint8_t LL_RTC_AlarmTypeDef::AlarmDateWeekDay**
Specifies the RTC Alarm Day/WeekDay. If AlarmDateWeekDaySel set to day, this parameter must be a number between Min_Data = 1 and Max_Data = 31. This feature can be modified afterwards using unitary function **LL_RTC_ALMA_SetDay()** for ALARM A or **LL_RTC_ALMB_SetDay()** for ALARM B. If AlarmDateWeekDaySel set to Weekday, this parameter can be a value of **RTC_LL_EC_WEEKDAY**. This feature can be modified afterwards using unitary function **LL_RTC_ALMA_SetWeekDay()** for ALARM A or **LL_RTC_ALMB_SetWeekDay()** for ALARM B.

87.2 RTC Firmware driver API description

87.2.1 Detailed description of functions

LL_RTC_SetHourFormat

Function name	__STATIC_INLINE void LL_RTC_SetHourFormat (RTC_TypeDef * RTCx, uint32_t HourFormat)
Function description	Set Hours format (24 hour/day or AM/PM hour format)
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • HourFormat: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_HOURFORMAT_24HOUR – LL_RTC_HOURFORMAT_AMPM
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before. • It can be written in initialization mode only (LL_RTC_EnableInitMode function)
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR FMT LL_RTC_SetHourFormat

LL_RTC_GetHourFormat

Function name	__STATIC_INLINE uint32_t LL_RTC_GetHourFormat (RTC_TypeDef * RTCx)
Function description	Get Hours format (24 hour/day or AM/PM hour format)
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_HOURFORMAT_24HOUR – LL_RTC_HOURFORMAT_AMPM
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR FMT LL_RTC_GetHourFormat

LL_RTC_SetAlarmOutEvent

Function name	__STATIC_INLINE void LL_RTC_SetAlarmOutEvent (RTC_TypeDef * RTCx, uint32_t AlarmOutput)
---------------	--

Function description	Select the flag to be routed to RTC_ALARM output.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • AlarmOutput: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_ALARMOUT_DISABLE – LL_RTC_ALARMOUT_ALMA – LL_RTC_ALARMOUT_ALMB – LL_RTC_ALARMOUT_WAKEUP
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR OSEL LL_RTC_SetAlarmOutEvent

LL_RTC_GetAlarmOutEvent

Function name	__STATIC_INLINE uint32_t LL_RTC_GetAlarmOutEvent (RTC_TypeDef * RTCx)
Function description	Get the flag to be routed to RTC_ALARM output.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_ALARMOUT_DISABLE – LL_RTC_ALARMOUT_ALMA – LL_RTC_ALARMOUT_ALMB – LL_RTC_ALARMOUT_WAKEUP
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR OSEL LL_RTC_GetAlarmOutEvent

LL_RTC_SetAlarmOutputType

Function name	__STATIC_INLINE void LL_RTC_SetAlarmOutputType (RTC_TypeDef * RTCx, uint32_t Output)
Function description	Set RTC_ALARM output type (ALARM in push-pull or open-drain output)
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Output: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_ALARM_OUTPUTTYPE_OPENDRAIN – LL_RTC_ALARM_OUTPUTTYPE_PUSHPULL
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Used only when RTC_ALARM is mapped on PC13
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OR ALARMOUTTYPE LL_RTC_SetAlarmOutputType

LL_RTC_GetAlarmOutputType

Function name	__STATIC_INLINE uint32_t LL_RTC_GetAlarmOutputType (RTC_TypeDef * RTCx)
Function description	Get RTC_ALARM output type (ALARM in push-pull or open-drain output)
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_ALARM_OUTPUTTYPE_OPENDRAIN – LL_RTC_ALARM_OUTPUTTYPE_PUSHPULL
Notes	<ul style="list-style-type: none"> • used only when RTC_ALARM is mapped on PC13
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • OR ALARMOUTTYPE LL_RTC_GetAlarmOutputType

LL_RTC_EnableInitMode

Function name	__STATIC_INLINE void LL_RTC_EnableInitMode (RTC_TypeDef * RTCx)
Function description	Enable initialization mode.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Initialization mode is used to program time and date register (RTC_TR and RTC_DR) and prescaler register (RTC_PRER). Counters are stopped and start counting from the new value when INIT is reset.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR INIT LL_RTC_EnableInitMode

LL_RTC_DisableInitMode

Function name	__STATIC_INLINE void LL_RTC_DisableInitMode (RTC_TypeDef * RTCx)
Function description	Disable initialization mode (Free running mode)
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR INIT LL_RTC_DisableInitMode

LL_RTC_SetOutputPolarity

Function name	__STATIC_INLINE void LL_RTC_SetOutputPolarity (RTC_TypeDef * RTCx, uint32_t Polarity)
Function description	Set Output polarity (pin is low when ALRAF/ALRBF/WUTF is

asserted)

Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Polarity: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_OUTPUTPOLARITY_PIN_HIGH – LL_RTC_OUTPUTPOLARITY_PIN_LOW
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR POL LL_RTC_SetOutputPolarity

LL_RTC_GetOutputPolarity

Function name	__STATIC_INLINE uint32_t LL_RTC_GetOutputPolarity (RTC_TypeDef * RTCx)
Function description	Get Output polarity.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_OUTPUTPOLARITY_PIN_HIGH – LL_RTC_OUTPUTPOLARITY_PIN_LOW
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR POL LL_RTC_GetOutputPolarity

LL_RTC_EnableShadowRegBypass

Function name	__STATIC_INLINE void LL_RTC_EnableShadowRegBypass (RTC_TypeDef * RTCx)
Function description	Enable Bypass the shadow registers.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR BYPSHAD LL_RTC_EnableShadowRegBypass

LL_RTC_DisableShadowRegBypass

Function name	__STATIC_INLINE void LL_RTC_DisableShadowRegBypass (RTC_TypeDef * RTCx)
Function description	Disable Bypass the shadow registers.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:

Reference Manual to LL API cross reference:

- CR BYPSHAD LL_RTC_DisableShadowRegBypass

LL_RTC_IsShadowRegBypassEnabled

Function name **__STATIC_INLINE uint32_t LL_RTC_IsShadowRegBypassEnabled (RTC_TypeDef * RTCx)**

Function description Check if Shadow registers bypass is enabled or not.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR BYPSHAD LL_RTC_IsShadowRegBypassEnabled

LL_RTC_EnableRefClock

Function name **__STATIC_INLINE void LL_RTC_EnableRefClock (RTC_TypeDef * RTCx)**

Function description Enable RTC_REFIN reference clock detection (50 or 60 Hz)

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- It can be written in initialization mode only (LL_RTC_EnableInitMode function)

Reference Manual to LL API cross reference:

- CR REFCKON LL_RTC_EnableRefClock

LL_RTC_DisableRefClock

Function name **__STATIC_INLINE void LL_RTC_DisableRefClock (RTC_TypeDef * RTCx)**

Function description Disable RTC_REFIN reference clock detection (50 or 60 Hz)

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- It can be written in initialization mode only (LL_RTC_EnableInitMode function)

Reference Manual to LL API cross reference:

- CR REFCKON LL_RTC_DisableRefClock

LL_RTC_SetAsynchPrescaler

Function name	__STATIC_INLINE void LL_RTC_SetAsynchPrescaler (RTC_TypeDef * RTCx, uint32_t AsynchPrescaler)
Function description	Set Asynchronous prescaler factor.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance• AsynchPrescaler: Value between Min_Data = 0 and Max_Data = 0x7F
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• PRER PREDIV_A LL_RTC_SetAsynchPrescaler

LL_RTC_SetSynchPrescaler

Function name	__STATIC_INLINE void LL_RTC_SetSynchPrescaler (RTC_TypeDef * RTCx, uint32_t SynchPrescaler)
Function description	Set Synchronous prescaler factor.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance• SynchPrescaler: Value between Min_Data = 0 and Max_Data = 0x7FFF
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• PRER PREDIV_S LL_RTC_SetSynchPrescaler

LL_RTC_GetAsynchPrescaler

Function name	__STATIC_INLINE uint32_t LL_RTC_GetAsynchPrescaler (RTC_TypeDef * RTCx)
Function description	Get Asynchronous prescaler factor.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• Value: between Min_Data = 0 and Max_Data = 0x7F
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• PRER PREDIV_A LL_RTC_GetAsynchPrescaler

LL_RTC_GetSynchPrescaler

Function name	__STATIC_INLINE uint32_t LL_RTC_GetSynchPrescaler (RTC_TypeDef * RTCx)
Function description	Get Synchronous prescaler factor.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• Value: between Min_Data = 0 and Max_Data = 0x7FFF
Reference Manual to LL API cross	<ul style="list-style-type: none">• PRER PREDIV_S LL_RTC_GetSynchPrescaler

reference:

LL_RTC_EnableWriteProtection

Function name **__STATIC_INLINE void LL_RTC_EnableWriteProtection (RTC_TypeDef * RTCx)**

Function description Enable the write protection for RTC registers.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- WPR KEY LL_RTC_EnableWriteProtection

LL_RTC_DisableWriteProtection

Function name **__STATIC_INLINE void LL_RTC_DisableWriteProtection (RTC_TypeDef * RTCx)**

Function description Disable the write protection for RTC registers.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- WPR KEY LL_RTC_DisableWriteProtection

LL_RTC_TIME_SetFormat

Function name **__STATIC_INLINE void LL_RTC_TIME_SetFormat (RTC_TypeDef * RTCx, uint32_t TimeFormat)**

Function description Set time format (AM/24-hour or PM notation)

Parameters

- **RTCx:** RTC Instance
- **TimeFormat:** This parameter can be one of the following values:
 - LL_RTC_TIME_FORMAT_AM_OR_24
 - LL_RTC_TIME_FORMAT_PM

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- It can be written in initialization mode only (LL_RTC_EnableInitMode function)

Reference Manual to LL API cross reference:

- TR PM LL_RTC_TIME_SetFormat

LL_RTC_TIME_GetFormat

Function name **__STATIC_INLINE uint32_t LL_RTC_TIME_GetFormat (RTC_TypeDef * RTCx)**

Function description	Get time format (AM or PM notation)
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_TIME_FORMAT_AM_OR_24 – LL_RTC_TIME_FORMAT_PM
Notes	<ul style="list-style-type: none"> • if shadow mode is disabled (BYPHAD=0), need to check if RSF flag is set before reading this bit • Read either RTC_SSR or RTC_TR locks the values in the higher-order calendar shadow registers until RTC_DR is read (LL_RTC_ReadReg(RTC, DR)).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TR PM LL_RTC_TIME_GetFormat

LL_RTC_TIME_SetHour

Function name	__STATIC_INLINE void LL_RTC_TIME_SetHour (RTC_TypeDef * RTCx, uint32_t Hours)
Function description	Set Hours in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Hours: Value between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before. • It can be written in initialization mode only (LL_RTC_EnableInitMode function) • helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert hour from binary to BCD format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TR HT LL_RTC_TIME_SetHour • TR HU LL_RTC_TIME_SetHour

LL_RTC_TIME_GetHour

Function name	__STATIC_INLINE uint32_t LL_RTC_TIME_GetHour (RTC_TypeDef * RTCx)
Function description	Get Hours in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23
Notes	<ul style="list-style-type: none"> • if shadow mode is disabled (BYPHAD=0), need to check if RSF flag is set before reading this bit • Read either RTC_SSR or RTC_TR locks the values in the higher-order calendar shadow registers until RTC_DR is read (LL_RTC_ReadReg(RTC, DR)). • helper macro __LL_RTC_CONVERT_BCD2BIN is available

to convert hour from BCD to Binary format

- Reference Manual to LL API cross reference:
- TR HT LL_RTC_TIME_GetHour
 - TR HU LL_RTC_TIME_GetHour

LL_RTC_TIME_SetMinute

- Function name **__STATIC_INLINE void LL_RTC_TIME_SetMinute (RTC_TypeDef * RTCx, uint32_t Minutes)**
- Function description Set Minutes in BCD format.
- Parameters
- **RTCx:** RTC Instance
 - **Minutes:** Value between Min_Data=0x00 and Max_Data=0x59
- Return values
- **None:**
- Notes
- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
 - It can be written in initialization mode only (LL_RTC_EnableInitMode function)
 - helper macro **__LL_RTC_CONVERT_BIN2BCD** is available to convert Minutes from binary to BCD format
- Reference Manual to LL API cross reference:
- TR MNT LL_RTC_TIME_SetMinute
 - TR MNU LL_RTC_TIME_SetMinute

LL_RTC_TIME_GetMinute

- Function name **__STATIC_INLINE uint32_t LL_RTC_TIME_GetMinute (RTC_TypeDef * RTCx)**
- Function description Get Minutes in BCD format.
- Parameters
- **RTCx:** RTC Instance
- Return values
- **Value:** between Min_Data=0x00 and Max_Data=0x59
- Notes
- if shadow mode is disabled (BYPHAD=0), need to check if RSF flag is set before reading this bit
 - Read either RTC_SSR or RTC_TR locks the values in the higher-order calendar shadow registers until RTC_DR is read (LL_RTC_ReadReg(RTC, DR)).
 - helper macro **__LL_RTC_CONVERT_BCD2BIN** is available to convert minute from BCD to Binary format
- Reference Manual to LL API cross reference:
- TR MNT LL_RTC_TIME_GetMinute
 - TR MNU LL_RTC_TIME_GetMinute

LL_RTC_TIME_SetSecond

- Function name **__STATIC_INLINE void LL_RTC_TIME_SetSecond (RTC_TypeDef * RTCx, uint32_t Seconds)**
- Function description Set Seconds in BCD format.

Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Seconds: Value between Min_Data=0x00 and Max_Data=0x59
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before. • It can be written in initialization mode only (LL_RTC_EnableInitMode function) • helper macro <code>__LL_RTC_CONVERT_BIN2BCD</code> is available to convert Seconds from binary to BCD format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TR ST LL_RTC_TIME_SetSecond • TR SU LL_RTC_TIME_SetSecond

LL_RTC_TIME_GetSecond

Function name	<code>__STATIC_INLINE uint32_t LL_RTC_TIME_GetSecond (RTC_TypeDef * RTCx)</code>
Function description	Get Seconds in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0x59
Notes	<ul style="list-style-type: none"> • if shadow mode is disabled (BYPHAD=0), need to check if RSF flag is set before reading this bit • Read either RTC_SSR or RTC_TR locks the values in the higher-order calendar shadow registers until RTC_DR is read (LL_RTC_ReadReg(RTC, DR)). • helper macro <code>__LL_RTC_CONVERT_BCD2BIN</code> is available to convert Seconds from BCD to Binary format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TR ST LL_RTC_TIME_GetSecond • TR SU LL_RTC_TIME_GetSecond

LL_RTC_TIME_Config

Function name	<code>__STATIC_INLINE void LL_RTC_TIME_Config (RTC_TypeDef * RTCx, uint32_t Format12_24, uint32_t Hours, uint32_t Minutes, uint32_t Seconds)</code>
Function description	Set time (hour, minute and second) in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Format12_24: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_TIME_FORMAT_AM_OR_24 – LL_RTC_TIME_FORMAT_PM • Hours: Value between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23 • Minutes: Value between Min_Data=0x00 and Max_Data=0x59 • Seconds: Value between Min_Data=0x00 and

Max_Data=0x59

Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before. • It can be written in initialization mode only (LL_RTC_EnableInitMode function) • TimeFormat and Hours should follow the same format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TR PM LL_RTC_TIME_Config • TR HT LL_RTC_TIME_Config • TR HU LL_RTC_TIME_Config • TR MNT LL_RTC_TIME_Config • TR MNU LL_RTC_TIME_Config • TR ST LL_RTC_TIME_Config • TR SU LL_RTC_TIME_Config

LL_RTC_TIME_Get

Function name	__STATIC_INLINE uint32_t LL_RTC_TIME_Get (RTC_TypeDef * RTCx)
Function description	Get time (hour, minute and second) in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Combination: of hours, minutes and seconds (Format: 0x00HHMMSS).
Notes	<ul style="list-style-type: none"> • if shadow mode is disabled (BYPHAD=0), need to check if RSF flag is set before reading this bit • Read either RTC_SSR or RTC_TR locks the values in the higher-order calendar shadow registers until RTC_DR is read (LL_RTC_ReadReg(RTC, DR)). • helper macros __LL_RTC_GET_HOUR, __LL_RTC_GET_MINUTE and __LL_RTC_GET_SECOND are available to get independently each parameter.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TR HT LL_RTC_TIME_Get • TR HU LL_RTC_TIME_Get • TR MNT LL_RTC_TIME_Get • TR MNU LL_RTC_TIME_Get • TR ST LL_RTC_TIME_Get • TR SU LL_RTC_TIME_Get

LL_RTC_TIME_EnableDayLightStore

Function name	__STATIC_INLINE void LL_RTC_TIME_EnableDayLightStore (RTC_TypeDef * RTCx)
Function description	Memorize whether the daylight saving time change has been performed.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection

function should be called before.

- Reference Manual to LL API cross reference:
- CR BKP LL_RTC_TIME_EnableDayLightStore

LL_RTC_TIME_DisableDayLightStore

Function name `__STATIC_INLINE void LL_RTC_TIME_DisableDayLightStore (RTC_TypeDef * RTCx)`

Function description Disable memorization whether the daylight saving time change has been performed.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

- Reference Manual to LL API cross reference:
- CR BKP LL_RTC_TIME_DisableDayLightStore

LL_RTC_TIME_IsDayLightStoreEnabled

Function name `__STATIC_INLINE uint32_t LL_RTC_TIME_IsDayLightStoreEnabled (RTC_TypeDef * RTCx)`

Function description Check if RTC Day Light Saving stored operation has been enabled or not.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

- Reference Manual to LL API cross reference:
- CR BKP LL_RTC_TIME_IsDayLightStoreEnabled

LL_RTC_TIME_DecHour

Function name `__STATIC_INLINE void LL_RTC_TIME_DecHour (RTC_TypeDef * RTCx)`

Function description Subtract 1 hour (winter time change)

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

- Reference Manual to LL API cross reference:
- CR SUB1H LL_RTC_TIME_DecHour

LL_RTC_TIME_IncHour

Function name	__STATIC_INLINE void LL_RTC_TIME_IncHour (RTC_TypeDef * RTCx)
Function description	Add 1 hour (summer time change)
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR ADD1H LL_RTC_TIME_IncHour

LL_RTC_TIME_GetSubSecond

Function name	__STATIC_INLINE uint32_t LL_RTC_TIME_GetSubSecond (RTC_TypeDef * RTCx)
Function description	Get Sub second value in the synchronous prescaler counter.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Sub: second value (number between 0 and 65535)
Notes	<ul style="list-style-type: none"> • You can use both SubSeconds value and SecondFraction (PREDIV_S through LL_RTC_GetSynchPrescaler function) terms returned to convert Calendar SubSeconds value in second fraction ratio with time unit following generic formula: $==> \text{Seconds fraction ratio} * \text{time_unit} = [(\text{SecondFraction} - \text{SubSeconds}) / (\text{SecondFraction} + 1)] * \text{time_unit}$ This conversion can be performed only if no shift operation is pending (ie. SHFP=0) when PREDIV_S >= SS.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SSR SS LL_RTC_TIME_GetSubSecond

LL_RTC_TIME_Synchronize

Function name	__STATIC_INLINE void LL_RTC_TIME_Synchronize (RTC_TypeDef * RTCx, uint32_t ShiftSecond, uint32_t Fraction)
Function description	Synchronize to a remote clock with a high degree of precision.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • ShiftSecond: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_SHIFT_SECOND_DELAY – LL_RTC_SHIFT_SECOND_ADVANCE • Fraction: Number of Seconds Fractions (any value from 0 to 0x7FFF)
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This operation effectively subtracts from (delays) or advance

- the clock of a fraction of a second.
 - Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
 - When REFCKON is set, firmware must not write to Shift control register.
- Reference Manual to LL API cross reference:
- SHIFTR ADD1S LL_RTC_TIME_Synchronize
 - SHIFTR SUBFS LL_RTC_TIME_Synchronize

LL_RTC_DATE_SetYear

- Function name **__STATIC_INLINE void LL_RTC_DATE_SetYear (RTC_TypeDef * RTCx, uint32_t Year)**
- Function description Set Year in BCD format.
- Parameters
- **RTCx:** RTC Instance
 - **Year:** Value between Min_Data=0x00 and Max_Data=0x99
- Return values
- **None:**
- Notes
- helper macro `__LL_RTC_CONVERT_BIN2BCD` is available to convert Year from binary to BCD format
- Reference Manual to LL API cross reference:
- DR YT LL_RTC_DATE_SetYear
 - DR YU LL_RTC_DATE_SetYear

LL_RTC_DATE_GetYear

- Function name **__STATIC_INLINE uint32_t LL_RTC_DATE_GetYear (RTC_TypeDef * RTCx)**
- Function description Get Year in BCD format.
- Parameters
- **RTCx:** RTC Instance
- Return values
- **Value:** between Min_Data=0x00 and Max_Data=0x99
- Notes
- if shadow mode is disabled (BYPHAD=0), need to check if RSF flag is set before reading this bit
 - helper macro `__LL_RTC_CONVERT_BCD2BIN` is available to convert Year from BCD to Binary format
- Reference Manual to LL API cross reference:
- DR YT LL_RTC_DATE_GetYear
 - DR YU LL_RTC_DATE_GetYear

LL_RTC_DATE_SetWeekDay

- Function name **__STATIC_INLINE void LL_RTC_DATE_SetWeekDay (RTC_TypeDef * RTCx, uint32_t WeekDay)**
- Function description Set Week day.
- Parameters
- **RTCx:** RTC Instance
 - **WeekDay:** This parameter can be one of the following values:
 - LL_RTC_WEEKDAY_MONDAY

- LL_RTC_WEEKDAY_TUESDAY
- LL_RTC_WEEKDAY_WEDNESDAY
- LL_RTC_WEEKDAY_THURSDAY
- LL_RTC_WEEKDAY_FRIDAY
- LL_RTC_WEEKDAY_SATURDAY
- LL_RTC_WEEKDAY_SUNDAY

Return values

- **None:**

Reference Manual to LL API cross reference:

- DR WDU LL_RTC_DATE_SetWeekDay

LL_RTC_DATE_GetWeekDay

Function name `__STATIC_INLINE uint32_t LL_RTC_DATE_GetWeekDay (RTC_TypeDef * RTCx)`

Function description Get Week day.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_RTC_WEEKDAY_MONDAY
 - LL_RTC_WEEKDAY_TUESDAY
 - LL_RTC_WEEKDAY_WEDNESDAY
 - LL_RTC_WEEKDAY_THURSDAY
 - LL_RTC_WEEKDAY_FRIDAY
 - LL_RTC_WEEKDAY_SATURDAY
 - LL_RTC_WEEKDAY_SUNDAY

Notes

- if shadow mode is disabled (BYP SHAD=0), need to check if RSF flag is set before reading this bit

Reference Manual to LL API cross reference:

- DR WDU LL_RTC_DATE_GetWeekDay

LL_RTC_DATE_SetMonth

Function name `__STATIC_INLINE void LL_RTC_DATE_SetMonth (RTC_TypeDef * RTCx, uint32_t Month)`

Function description Set Month in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Month:** This parameter can be one of the following values:
 - LL_RTC_MONTH_JANUARY
 - LL_RTC_MONTH_FEBRUARY
 - LL_RTC_MONTH_MARCH
 - LL_RTC_MONTH_APRIL
 - LL_RTC_MONTH_MAY
 - LL_RTC_MONTH_JUNE
 - LL_RTC_MONTH_JULY
 - LL_RTC_MONTH_AUGUST
 - LL_RTC_MONTH_SEPTEMBER
 - LL_RTC_MONTH_OCTOBER
 - LL_RTC_MONTH_NOVEMBER

	– LL_RTC_MONTH_DECEMBER
Return values	• None:
Notes	• helper macro <code>__LL_RTC_CONVERT_BIN2BCD</code> is available to convert Month from binary to BCD format
Reference Manual to LL API cross reference:	• DR MT LL_RTC_DATE_SetMonth • DR MU LL_RTC_DATE_SetMonth

LL_RTC_DATE_GetMonth

Function name	<code>__STATIC_INLINE uint32_t LL_RTC_DATE_GetMonth (RTC_TypeDef * RTCx)</code>
Function description	Get Month in BCD format.
Parameters	• RTCx: RTC Instance
Return values	• Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_MONTH_JANUARY – LL_RTC_MONTH_FEBRUARY – LL_RTC_MONTH_MARCH – LL_RTC_MONTH_APRIL – LL_RTC_MONTH_MAY – LL_RTC_MONTH_JUNE – LL_RTC_MONTH_JULY – LL_RTC_MONTH_AUGUST – LL_RTC_MONTH_SEPTEMBER – LL_RTC_MONTH_OCTOBER – LL_RTC_MONTH_NOVEMBER – LL_RTC_MONTH_DECEMBER
Notes	• if shadow mode is disabled (BYP SHAD=0), need to check if RSF flag is set before reading this bit • helper macro <code>__LL_RTC_CONVERT_BCD2BIN</code> is available to convert Month from BCD to Binary format
Reference Manual to LL API cross reference:	• DR MT LL_RTC_DATE_GetMonth • DR MU LL_RTC_DATE_GetMonth

LL_RTC_DATE_SetDay

Function name	<code>__STATIC_INLINE void LL_RTC_DATE_SetDay (RTC_TypeDef * RTCx, uint32_t Day)</code>
Function description	Set Day in BCD format.
Parameters	• RTCx: RTC Instance • Day: Value between Min_Data=0x01 and Max_Data=0x31
Return values	• None:
Notes	• helper macro <code>__LL_RTC_CONVERT_BIN2BCD</code> is available to convert Day from binary to BCD format
Reference Manual to LL API cross	• DR DT LL_RTC_DATE_SetDay

reference:

- DR DU LL_RTC_DATE_SetDay

LL_RTC_DATE_GetDay

Function name `__STATIC_INLINE uint32_t LL_RTC_DATE_GetDay (RTC_TypeDef * RTCx)`

Function description Get Day in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x01 and Max_Data=0x31

Notes

- if shadow mode is disabled (BYPHAD=0), need to check if RSF flag is set before reading this bit
- helper macro `__LL_RTC_CONVERT_BCD2BIN` is available to convert Day from BCD to Binary format

Reference Manual to LL API cross reference:

- DR DT LL_RTC_DATE_GetDay
- DR DU LL_RTC_DATE_GetDay

LL_RTC_DATE_Config

Function name `__STATIC_INLINE void LL_RTC_DATE_Config (RTC_TypeDef * RTCx, uint32_t WeekDay, uint32_t Day, uint32_t Month, uint32_t Year)`

Function description Set date (WeekDay, Day, Month and Year) in BCD format.

Parameters

- **RTCx:** RTC Instance
- **WeekDay:** This parameter can be one of the following values:
 - LL_RTC_WEEKDAY_MONDAY
 - LL_RTC_WEEKDAY_TUESDAY
 - LL_RTC_WEEKDAY_WEDNESDAY
 - LL_RTC_WEEKDAY_THURSDAY
 - LL_RTC_WEEKDAY_FRIDAY
 - LL_RTC_WEEKDAY_SATURDAY
 - LL_RTC_WEEKDAY_SUNDAY
- **Day:** Value between Min_Data=0x01 and Max_Data=0x31
- **Month:** This parameter can be one of the following values:
 - LL_RTC_MONTH_JANUARY
 - LL_RTC_MONTH_FEBRUARY
 - LL_RTC_MONTH_MARCH
 - LL_RTC_MONTH_APRIL
 - LL_RTC_MONTH_MAY
 - LL_RTC_MONTH_JUNE
 - LL_RTC_MONTH_JULY
 - LL_RTC_MONTH_AUGUST
 - LL_RTC_MONTH_SEPTEMBER
 - LL_RTC_MONTH_OCTOBER
 - LL_RTC_MONTH_NOVEMBER
 - LL_RTC_MONTH_DECEMBER
- **Year:** Value between Min_Data=0x00 and Max_Data=0x99

Return values

- **None:**

- Reference Manual to LL API cross reference:
- DR WDU LL_RTC_DATE_Config
 - DR MT LL_RTC_DATE_Config
 - DR MU LL_RTC_DATE_Config
 - DR DT LL_RTC_DATE_Config
 - DR DU LL_RTC_DATE_Config
 - DR YT LL_RTC_DATE_Config
 - DR YU LL_RTC_DATE_Config

LL_RTC_DATE_Get

- Function name `__STATIC_INLINE uint32_t LL_RTC_DATE_Get (RTC_TypeDef * RTCx)`
- Function description Get date (WeekDay, Day, Month and Year) in BCD format.
- Parameters
- **RTCx:** RTC Instance
- Return values
- **Combination:** of WeekDay, Day, Month and Year (Format: 0xWWDDMMYY).
- Notes
- if shadow mode is disabled (BYP SHAD=0), need to check if RSF flag is set before reading this bit
 - helper macros `__LL_RTC_GET_WEEKDAY`, `__LL_RTC_GET_YEAR`, `__LL_RTC_GET_MONTH`, and `__LL_RTC_GET_DAY` are available to get independently each parameter.
- Reference Manual to LL API cross reference:
- DR WDU LL_RTC_DATE_Get
 - DR MT LL_RTC_DATE_Get
 - DR MU LL_RTC_DATE_Get
 - DR DT LL_RTC_DATE_Get
 - DR DU LL_RTC_DATE_Get
 - DR YT LL_RTC_DATE_Get
 - DR YU LL_RTC_DATE_Get

LL_RTC_ALMA_Enable

- Function name `__STATIC_INLINE void LL_RTC_ALMA_Enable (RTC_TypeDef * RTCx)`
- Function description Enable Alarm A.
- Parameters
- **RTCx:** RTC Instance
- Return values
- **None:**
- Notes
- Bit is write-protected. `LL_RTC_DisableWriteProtection` function should be called before.
- Reference Manual to LL API cross reference:
- CR ALRAE LL_RTC_ALMA_Enable

LL_RTC_ALMA_Disable

- Function name `__STATIC_INLINE void LL_RTC_ALMA_Disable (RTC_TypeDef * RTCx)`

Function description	Disable Alarm A.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR ALRAE LL_RTC_ALMA_Disable

LL_RTC_ALMA_SetMask

Function name	__STATIC_INLINE void LL_RTC_ALMA_SetMask (RTC_TypeDef * RTCx, uint32_t Mask)
Function description	Specify the Alarm A masks.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Mask: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_RTC_ALMA_MASK_NONE – LL_RTC_ALMA_MASK_DATEWEEKDAY – LL_RTC_ALMA_MASK_HOURS – LL_RTC_ALMA_MASK_MINUTES – LL_RTC_ALMA_MASK_SECONDS – LL_RTC_ALMA_MASK_ALL
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMAR MSK4 LL_RTC_ALMA_SetMask • ALRMAR MSK3 LL_RTC_ALMA_SetMask • ALRMAR MSK2 LL_RTC_ALMA_SetMask • ALRMAR MSK1 LL_RTC_ALMA_SetMask

LL_RTC_ALMA_GetMask

Function name	__STATIC_INLINE uint32_t LL_RTC_ALMA_GetMask (RTC_TypeDef * RTCx)
Function description	Get the Alarm A masks.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be can be a combination of the following values: <ul style="list-style-type: none"> – LL_RTC_ALMA_MASK_NONE – LL_RTC_ALMA_MASK_DATEWEEKDAY – LL_RTC_ALMA_MASK_HOURS – LL_RTC_ALMA_MASK_MINUTES – LL_RTC_ALMA_MASK_SECONDS – LL_RTC_ALMA_MASK_ALL
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMAR MSK4 LL_RTC_ALMA_GetMask • ALRMAR MSK3 LL_RTC_ALMA_GetMask • ALRMAR MSK2 LL_RTC_ALMA_GetMask • ALRMAR MSK1 LL_RTC_ALMA_GetMask

LL_RTC_ALMA_EnableWeekday

Function name	__STATIC_INLINE void LL_RTC_ALMA_EnableWeekday (RTC_TypeDef * RTCx)
Function description	Enable AlarmA Week day selection (DU[3:0] represents the week day).
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMAR WDSSEL LL_RTC_ALMA_EnableWeekday

LL_RTC_ALMA_DisableWeekday

Function name	__STATIC_INLINE void LL_RTC_ALMA_DisableWeekday (RTC_TypeDef * RTCx)
Function description	Disable AlarmA Week day selection (DU[3:0] represents the date)
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMAR WDSSEL LL_RTC_ALMA_DisableWeekday

LL_RTC_ALMA_SetDay

Function name	__STATIC_INLINE void LL_RTC_ALMA_SetDay (RTC_TypeDef * RTCx, uint32_t Day)
Function description	Set ALARM A Day in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Day: Value between Min_Data=0x01 and Max_Data=0x31
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BIN2BCD</code> is available to convert Day from binary to BCD format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMAR DT LL_RTC_ALMA_SetDay • ALRMAR DU LL_RTC_ALMA_SetDay

LL_RTC_ALMA_GetDay

Function name	__STATIC_INLINE uint32_t LL_RTC_ALMA_GetDay (RTC_TypeDef * RTCx)
Function description	Get ALARM A Day in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x01 and Max_Data=0x31
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BCD2BIN</code> is available

to convert Day from BCD to Binary format

- Reference Manual to LL API cross reference:
- ALRMAR DT LL_RTC_ALMA_GetDay
 - ALRMAR DU LL_RTC_ALMA_GetDay

LL_RTC_ALMA_SetWeekDay

Function name **__STATIC_INLINE void LL_RTC_ALMA_SetWeekDay (RTC_TypeDef * RTCx, uint32_t WeekDay)**

Function description Set ALARM A Weekday.

- Parameters
- **RTCx:** RTC Instance
 - **WeekDay:** This parameter can be one of the following values:
 - LL_RTC_WEEKDAY_MONDAY
 - LL_RTC_WEEKDAY_TUESDAY
 - LL_RTC_WEEKDAY_WEDNESDAY
 - LL_RTC_WEEKDAY_THURSDAY
 - LL_RTC_WEEKDAY_FRIDAY
 - LL_RTC_WEEKDAY_SATURDAY
 - LL_RTC_WEEKDAY_SUNDAY

Return values • **None:**

- Reference Manual to LL API cross reference:
- ALRMAR DU LL_RTC_ALMA_SetWeekDay

LL_RTC_ALMA_GetWeekDay

Function name **__STATIC_INLINE uint32_t LL_RTC_ALMA_GetWeekDay (RTC_TypeDef * RTCx)**

Function description Get ALARM A Weekday.

- Parameters
- **RTCx:** RTC Instance

- Return values
- **Returned:** value can be one of the following values:
 - LL_RTC_WEEKDAY_MONDAY
 - LL_RTC_WEEKDAY_TUESDAY
 - LL_RTC_WEEKDAY_WEDNESDAY
 - LL_RTC_WEEKDAY_THURSDAY
 - LL_RTC_WEEKDAY_FRIDAY
 - LL_RTC_WEEKDAY_SATURDAY
 - LL_RTC_WEEKDAY_SUNDAY

- Reference Manual to LL API cross reference:
- ALRMAR DU LL_RTC_ALMA_GetWeekDay

LL_RTC_ALMA_SetTimeFormat

Function name **__STATIC_INLINE void LL_RTC_ALMA_SetTimeFormat (RTC_TypeDef * RTCx, uint32_t TimeFormat)**

Function description Set Alarm A time format (AM/24-hour or PM notation)

Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • TimeFormat: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_ALMA_TIME_FORMAT_AM – LL_RTC_ALMA_TIME_FORMAT_PM
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMAR PM LL_RTC_ALMA_SetTimeFormat

LL_RTC_ALMA_GetTimeFormat

Function name	__STATIC_INLINE uint32_t LL_RTC_ALMA_GetTimeFormat (RTC_TypeDef * RTCx)
Function description	Get Alarm A time format (AM or PM notation)
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_ALMA_TIME_FORMAT_AM – LL_RTC_ALMA_TIME_FORMAT_PM
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMAR PM LL_RTC_ALMA_GetTimeFormat

LL_RTC_ALMA_SetHour

Function name	__STATIC_INLINE void LL_RTC_ALMA_SetHour (RTC_TypeDef * RTCx, uint32_t Hours)
Function description	Set ALARM A Hours in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Hours: Value between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BIN2BCD</code> is available to convert Hours from binary to BCD format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMAR HT LL_RTC_ALMA_SetHour • ALRMAR HU LL_RTC_ALMA_SetHour

LL_RTC_ALMA_GetHour

Function name	__STATIC_INLINE uint32_t LL_RTC_ALMA_GetHour (RTC_TypeDef * RTCx)
Function description	Get ALARM A Hours in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23

- Notes
- helper macro `__LL_RTC_CONVERT_BCD2BIN` is available to convert Hours from BCD to Binary format
- Reference Manual to LL API cross reference:
- ALRMAR HT `LL_RTC_ALMA_GetHour`
 - ALRMAR HU `LL_RTC_ALMA_GetHour`

LL_RTC_ALMA_SetMinute

- Function name `__STATIC_INLINE void LL_RTC_ALMA_SetMinute(RTC_TypeDef * RTCx, uint32_t Minutes)`
- Function description Set ALARM A Minutes in BCD format.
- Parameters
- **RTCx:** RTC Instance
 - **Minutes:** Value between `Min_Data=0x00` and `Max_Data=0x59`
- Return values
- **None:**
- Notes
- helper macro `__LL_RTC_CONVERT_BIN2BCD` is available to convert Minutes from binary to BCD format
- Reference Manual to LL API cross reference:
- ALRMAR MNT `LL_RTC_ALMA_SetMinute`
 - ALRMAR MNU `LL_RTC_ALMA_SetMinute`

LL_RTC_ALMA_GetMinute

- Function name `__STATIC_INLINE uint32_t LL_RTC_ALMA_GetMinute(RTC_TypeDef * RTCx)`
- Function description Get ALARM A Minutes in BCD format.
- Parameters
- **RTCx:** RTC Instance
- Return values
- **Value:** between `Min_Data=0x00` and `Max_Data=0x59`
- Notes
- helper macro `__LL_RTC_CONVERT_BCD2BIN` is available to convert Minutes from BCD to Binary format
- Reference Manual to LL API cross reference:
- ALRMAR MNT `LL_RTC_ALMA_GetMinute`
 - ALRMAR MNU `LL_RTC_ALMA_GetMinute`

LL_RTC_ALMA_SetSecond

- Function name `__STATIC_INLINE void LL_RTC_ALMA_SetSecond(RTC_TypeDef * RTCx, uint32_t Seconds)`
- Function description Set ALARM A Seconds in BCD format.
- Parameters
- **RTCx:** RTC Instance
 - **Seconds:** Value between `Min_Data=0x00` and `Max_Data=0x59`
- Return values
- **None:**
- Notes
- helper macro `__LL_RTC_CONVERT_BIN2BCD` is available to convert Seconds from binary to BCD format
- Reference Manual to
- ALRMAR ST `LL_RTC_ALMA_SetSecond`

- LL API cross reference:
- ALRMAR SU LL_RTC_ALMA_SetSecond

LL_RTC_ALMA_GetSecond

- Function name **__STATIC_INLINE uint32_t LL_RTC_ALMA_GetSecond (RTC_TypeDef * RTCx)**
- Function description Get ALARM A Seconds in BCD format.
- Parameters
- **RTCx:** RTC Instance
- Return values
- **Value:** between Min_Data=0x00 and Max_Data=0x59
- Notes
- helper macro `__LL_RTC_CONVERT_BCD2BIN` is available to convert Seconds from BCD to Binary format
- Reference Manual to LL API cross reference:
- ALRMAR ST LL_RTC_ALMA_GetSecond
 - ALRMAR SU LL_RTC_ALMA_GetSecond

LL_RTC_ALMA_ConfigTime

- Function name **__STATIC_INLINE void LL_RTC_ALMA_ConfigTime (RTC_TypeDef * RTCx, uint32_t Format12_24, uint32_t Hours, uint32_t Minutes, uint32_t Seconds)**
- Function description Set Alarm A Time (hour, minute and second) in BCD format.
- Parameters
- **RTCx:** RTC Instance
 - **Format12_24:** This parameter can be one of the following values:
 - LL_RTC_ALMA_TIME_FORMAT_AM
 - LL_RTC_ALMA_TIME_FORMAT_PM
 - **Hours:** Value between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23
 - **Minutes:** Value between Min_Data=0x00 and Max_Data=0x59
 - **Seconds:** Value between Min_Data=0x00 and Max_Data=0x59
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- ALRMAR PM LL_RTC_ALMA_ConfigTime
 - ALRMAR HT LL_RTC_ALMA_ConfigTime
 - ALRMAR HU LL_RTC_ALMA_ConfigTime
 - ALRMAR MNT LL_RTC_ALMA_ConfigTime
 - ALRMAR MNU LL_RTC_ALMA_ConfigTime
 - ALRMAR ST LL_RTC_ALMA_ConfigTime
 - ALRMAR SU LL_RTC_ALMA_ConfigTime

LL_RTC_ALMA_GetTime

- Function name **__STATIC_INLINE uint32_t LL_RTC_ALMA_GetTime (RTC_TypeDef * RTCx)**
- Function description Get Alarm B Time (hour, minute and second) in BCD format.
- Parameters
- **RTCx:** RTC Instance

- | | |
|---|--|
| Return values | <ul style="list-style-type: none"> • Combination: of hours, minutes and seconds. |
| Notes | <ul style="list-style-type: none"> • helper macros <code>__LL_RTC_GET_HOUR</code>, <code>__LL_RTC_GET_MINUTE</code> and <code>__LL_RTC_GET_SECOND</code> are available to get independently each parameter. |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • ALRMAR HT <code>LL_RTC_ALMA_GetTime</code> • ALRMAR HU <code>LL_RTC_ALMA_GetTime</code> • ALRMAR MNT <code>LL_RTC_ALMA_GetTime</code> • ALRMAR MNU <code>LL_RTC_ALMA_GetTime</code> • ALRMAR ST <code>LL_RTC_ALMA_GetTime</code> • ALRMAR SU <code>LL_RTC_ALMA_GetTime</code> |

LL_RTC_ALMA_SetSubSecondMask

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|---|--|
| Function name | <code>__STATIC_INLINE void LL_RTC_ALMA_SetSubSecondMask (RTC_TypeDef * RTCx, uint32_t Mask)</code> |
| Function description | Set Alarm A Mask the most-significant bits starting at this bit. |
| Parameters | <ul style="list-style-type: none"> • RTCx: RTC Instance • Mask: Value between <code>Min_Data=0x00</code> and <code>Max_Data=0xF</code> |
| Return values | <ul style="list-style-type: none"> • None: |
| Notes | <ul style="list-style-type: none"> • This register can be written only when <code>ALRAE</code> is reset in <code>RTC_CR</code> register, or in initialization mode. |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • ALRMASR MASKSS <code>LL_RTC_ALMA_SetSubSecondMask</code> |

LL_RTC_ALMA_GetSubSecondMask

- | | |
|---|--|
| Function name | <code>__STATIC_INLINE uint32_t LL_RTC_ALMA_GetSubSecondMask (RTC_TypeDef * RTCx)</code> |
| Function description | Get Alarm A Mask the most-significant bits starting at this bit. |
| Parameters | <ul style="list-style-type: none"> • RTCx: RTC Instance |
| Return values | <ul style="list-style-type: none"> • Value: between <code>Min_Data=0x00</code> and <code>Max_Data=0xF</code> |
| Reference Manual to LL API cross reference: | <ul style="list-style-type: none"> • ALRMASR MASKSS <code>LL_RTC_ALMA_GetSubSecondMask</code> |

LL_RTC_ALMA_SetSubSecond

- | | |
|----------------------|--|
| Function name | <code>__STATIC_INLINE void LL_RTC_ALMA_SetSubSecond (RTC_TypeDef * RTCx, uint32_t Subsecond)</code> |
| Function description | Set Alarm A Sub seconds value. |
| Parameters | <ul style="list-style-type: none"> • RTCx: RTC Instance • Subsecond: Value between <code>Min_Data=0x00</code> and <code>Max_Data=0x7FFF</code> |
| Return values | <ul style="list-style-type: none"> • None: |
| Reference Manual to | <ul style="list-style-type: none"> • ALRMASR SS <code>LL_RTC_ALMA_SetSubSecond</code> |

LL API cross
reference:

LL_RTC_ALMA_GetSubSecond

Function name `__STATIC_INLINE uint32_t LL_RTC_ALMA_GetSubSecond (RTC_TypeDef * RTCx)`

Function description Get Alarm A Sub seconds value.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x7FFF

Reference Manual to

- ALRMSSR SS LL_RTC_ALMA_GetSubSecond

LL API cross
reference:

LL_RTC_ALMB_Enable

Function name `__STATIC_INLINE void LL_RTC_ALMB_Enable (RTC_TypeDef * RTCx)`

Function description Enable Alarm B.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to

- CR ALRBE LL_RTC_ALMB_Enable

LL API cross
reference:

LL_RTC_ALMB_Disable

Function name `__STATIC_INLINE void LL_RTC_ALMB_Disable (RTC_TypeDef * RTCx)`

Function description Disable Alarm B.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to

- CR ALRBE LL_RTC_ALMB_Disable

LL API cross
reference:

LL_RTC_ALMB_SetMask

Function name `__STATIC_INLINE void LL_RTC_ALMB_SetMask (RTC_TypeDef * RTCx, uint32_t Mask)`

Function description Specify the Alarm B masks.

Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Mask: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_RTC_ALMB_MASK_NONE – LL_RTC_ALMB_MASK_DATEWEEKDAY – LL_RTC_ALMB_MASK_HOURS – LL_RTC_ALMB_MASK_MINUTES – LL_RTC_ALMB_MASK_SECONDS – LL_RTC_ALMB_MASK_ALL
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBR MSK4 LL_RTC_ALMB_SetMask • ALRMBR MSK3 LL_RTC_ALMB_SetMask • ALRMBR MSK2 LL_RTC_ALMB_SetMask • ALRMBR MSK1 LL_RTC_ALMB_SetMask

LL_RTC_ALMB_GetMask

Function name	__STATIC_INLINE uint32_t LL_RTC_ALMB_GetMask (RTC_TypeDef * RTCx)
Function description	Get the Alarm B masks.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be can be a combination of the following values: <ul style="list-style-type: none"> – LL_RTC_ALMB_MASK_NONE – LL_RTC_ALMB_MASK_DATEWEEKDAY – LL_RTC_ALMB_MASK_HOURS – LL_RTC_ALMB_MASK_MINUTES – LL_RTC_ALMB_MASK_SECONDS – LL_RTC_ALMB_MASK_ALL
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBR MSK4 LL_RTC_ALMB_GetMask • ALRMBR MSK3 LL_RTC_ALMB_GetMask • ALRMBR MSK2 LL_RTC_ALMB_GetMask • ALRMBR MSK1 LL_RTC_ALMB_GetMask

LL_RTC_ALMB_EnableWeekday

Function name	__STATIC_INLINE void LL_RTC_ALMB_EnableWeekday (RTC_TypeDef * RTCx)
Function description	Enable AlarmB Week day selection (DU[3:0] represents the week day).
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBR WDSEL LL_RTC_ALMB_EnableWeekday

LL_RTC_ALMB_DisableWeekday

Function name	__STATIC_INLINE void LL_RTC_ALMB_DisableWeekday (RTC_TypeDef * RTCx)
Function description	Disable AlarmB Week day selection (DU[3:0] represents the date)
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBR WDSSEL LL_RTC_ALMB_DisableWeekday

LL_RTC_ALMB_SetDay

Function name	__STATIC_INLINE void LL_RTC_ALMB_SetDay (RTC_TypeDef * RTCx, uint32_t Day)
Function description	Set ALARM B Day in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Day: Value between Min_Data=0x01 and Max_Data=0x31
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BIN2BCD</code> is available to convert Day from binary to BCD format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBR DT LL_RTC_ALMB_SetDay • ALRMBR DU LL_RTC_ALMB_SetDay

LL_RTC_ALMB_GetDay

Function name	__STATIC_INLINE uint32_t LL_RTC_ALMB_GetDay (RTC_TypeDef * RTCx)
Function description	Get ALARM B Day in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x01 and Max_Data=0x31
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BCD2BIN</code> is available to convert Day from BCD to Binary format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBR DT LL_RTC_ALMB_GetDay • ALRMBR DU LL_RTC_ALMB_GetDay

LL_RTC_ALMB_SetWeekDay

Function name	__STATIC_INLINE void LL_RTC_ALMB_SetWeekDay (RTC_TypeDef * RTCx, uint32_t WeekDay)
Function description	Set ALARM B Weekday.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • WeekDay: This parameter can be one of the following values:

- LL_RTC_WEEKDAY_MONDAY
- LL_RTC_WEEKDAY_TUESDAY
- LL_RTC_WEEKDAY_WEDNESDAY
- LL_RTC_WEEKDAY_THURSDAY
- LL_RTC_WEEKDAY_FRIDAY
- LL_RTC_WEEKDAY_SATURDAY
- LL_RTC_WEEKDAY_SUNDAY

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- ALRMBR DU LL_RTC_ALMB_SetWeekDay

LL_RTC_ALMB_GetWeekDay

Function name **__STATIC_INLINE uint32_t LL_RTC_ALMB_GetWeekDay
(RTC_TypeDef * RTCx)**

Function description Get ALARM B Weekday.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_RTC_WEEKDAY_MONDAY
 - LL_RTC_WEEKDAY_TUESDAY
 - LL_RTC_WEEKDAY_WEDNESDAY
 - LL_RTC_WEEKDAY_THURSDAY
 - LL_RTC_WEEKDAY_FRIDAY
 - LL_RTC_WEEKDAY_SATURDAY
 - LL_RTC_WEEKDAY_SUNDAY

Reference Manual to
LL API cross
reference:

- ALRMBR DU LL_RTC_ALMB_GetWeekDay

LL_RTC_ALMB_SetTimeFormat

Function name **__STATIC_INLINE void LL_RTC_ALMB_SetTimeFormat
(RTC_TypeDef * RTCx, uint32_t TimeFormat)**

Function description Set ALARM B time format (AM/24-hour or PM notation)

Parameters

- **RTCx:** RTC Instance
- **TimeFormat:** This parameter can be one of the following values:
 - LL_RTC_ALMB_TIME_FORMAT_AM
 - LL_RTC_ALMB_TIME_FORMAT_PM

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- ALRMBR PM LL_RTC_ALMB_SetTimeFormat

LL_RTC_ALMB_GetTimeFormat

Function name **__STATIC_INLINE uint32_t LL_RTC_ALMB_GetTimeFormat**

(RTC_TypeDef * RTCx)

Function description	Get ALARM B time format (AM or PM notation)
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_ALMB_TIME_FORMAT_AM – LL_RTC_ALMB_TIME_FORMAT_PM
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBR PM LL_RTC_ALMB_GetTimeFormat

LL_RTC_ALMB_SetHour

Function name	__STATIC_INLINE void LL_RTC_ALMB_SetHour (RTC_TypeDef * RTCx, uint32_t Hours)
Function description	Set ALARM B Hours in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Hours: Value between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BIN2BCD</code> is available to convert Hours from binary to BCD format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBR HT LL_RTC_ALMB_SetHour • ALRMBR HU LL_RTC_ALMB_SetHour

LL_RTC_ALMB_GetHour

Function name	__STATIC_INLINE uint32_t LL_RTC_ALMB_GetHour (RTC_TypeDef * RTCx)
Function description	Get ALARM B Hours in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BCD2BIN</code> is available to convert Hours from BCD to Binary format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBR HT LL_RTC_ALMB_GetHour • ALRMBR HU LL_RTC_ALMB_GetHour

LL_RTC_ALMB_SetMinute

Function name	__STATIC_INLINE void LL_RTC_ALMB_SetMinute (RTC_TypeDef * RTCx, uint32_t Minutes)
Function description	Set ALARM B Minutes in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance

Return values	<ul style="list-style-type: none"> • Minutes: between Min_Data=0x00 and Max_Data=0x59 • None:
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BIN2BCD</code> is available to convert Minutes from binary to BCD format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBR MNT LL_RTC_ALMB_SetMinute • ALRMBR MNU LL_RTC_ALMB_SetMinute

LL_RTC_ALMB_GetMinute

Function name	<code>__STATIC_INLINE uint32_t LL_RTC_ALMB_GetMinute (RTC_TypeDef * RTCx)</code>
Function description	Get ALARM B Minutes in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0x59
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BCD2BIN</code> is available to convert Minutes from BCD to Binary format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBR MNT LL_RTC_ALMB_GetMinute • ALRMBR MNU LL_RTC_ALMB_GetMinute

LL_RTC_ALMB_SetSecond

Function name	<code>__STATIC_INLINE void LL_RTC_ALMB_SetSecond (RTC_TypeDef * RTCx, uint32_t Seconds)</code>
Function description	Set ALARM B Seconds in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Seconds: Value between Min_Data=0x00 and Max_Data=0x59
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BIN2BCD</code> is available to convert Seconds from binary to BCD format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBR ST LL_RTC_ALMB_SetSecond • ALRMBR SU LL_RTC_ALMB_SetSecond

LL_RTC_ALMB_GetSecond

Function name	<code>__STATIC_INLINE uint32_t LL_RTC_ALMB_GetSecond (RTC_TypeDef * RTCx)</code>
Function description	Get ALARM B Seconds in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0x59
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BCD2BIN</code> is available to convert Seconds from BCD to Binary format

- Reference Manual to LL API cross reference:
- ALRMBR ST LL_RTC_ALMB_GetSecond
 - ALRMBR SU LL_RTC_ALMB_GetSecond

LL_RTC_ALMB_ConfigTime

- Function name **__STATIC_INLINE void LL_RTC_ALMB_ConfigTime (RTC_TypeDef * RTCx, uint32_t Format12_24, uint32_t Hours, uint32_t Minutes, uint32_t Seconds)**
- Function description Set Alarm B Time (hour, minute and second) in BCD format.
- Parameters
- **RTCx:** RTC Instance
 - **Format12_24:** This parameter can be one of the following values:
 - LL_RTC_ALMB_TIME_FORMAT_AM
 - LL_RTC_ALMB_TIME_FORMAT_PM
 - **Hours:** Value between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23
 - **Minutes:** Value between Min_Data=0x00 and Max_Data=0x59
 - **Seconds:** Value between Min_Data=0x00 and Max_Data=0x59
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- ALRMBR PM LL_RTC_ALMB_ConfigTime
 - ALRMBR HT LL_RTC_ALMB_ConfigTime
 - ALRMBR HU LL_RTC_ALMB_ConfigTime
 - ALRMBR MNT LL_RTC_ALMB_ConfigTime
 - ALRMBR MNU LL_RTC_ALMB_ConfigTime
 - ALRMBR ST LL_RTC_ALMB_ConfigTime
 - ALRMBR SU LL_RTC_ALMB_ConfigTime

LL_RTC_ALMB_GetTime

- Function name **__STATIC_INLINE uint32_t LL_RTC_ALMB_GetTime (RTC_TypeDef * RTCx)**
- Function description Get Alarm B Time (hour, minute and second) in BCD format.
- Parameters
- **RTCx:** RTC Instance
- Return values
- **Combination:** of hours, minutes and seconds.
- Notes
- helper macros **__LL_RTC_GET_HOUR**, **__LL_RTC_GET_MINUTE** and **__LL_RTC_GET_SECOND** are available to get independently each parameter.
- Reference Manual to LL API cross reference:
- ALRMBR HT LL_RTC_ALMB_GetTime
 - ALRMBR HU LL_RTC_ALMB_GetTime
 - ALRMBR MNT LL_RTC_ALMB_GetTime
 - ALRMBR MNU LL_RTC_ALMB_GetTime
 - ALRMBR ST LL_RTC_ALMB_GetTime
 - ALRMBR SU LL_RTC_ALMB_GetTime

LL_RTC_ALMB_SetSubSecondMask

Function name	__STATIC_INLINE void LL_RTC_ALMB_SetSubSecondMask (RTC_TypeDef * RTCx, uint32_t Mask)
Function description	Set Alarm B Mask the most-significant bits starting at this bit.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Mask: Value between Min_Data=0x00 and Max_Data=0xF
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This register can be written only when ALRBE is reset in RTC_CR register, or in initialization mode.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBSSR MASKSS LL_RTC_ALMB_SetSubSecondMask

LL_RTC_ALMB_GetSubSecondMask

Function name	__STATIC_INLINE uint32_t LL_RTC_ALMB_GetSubSecondMask (RTC_TypeDef * RTCx)
Function description	Get Alarm B Mask the most-significant bits starting at this bit.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0xF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBSSR MASKSS LL_RTC_ALMB_GetSubSecondMask

LL_RTC_ALMB_SetSubSecond

Function name	__STATIC_INLINE void LL_RTC_ALMB_SetSubSecond (RTC_TypeDef * RTCx, uint32_t Subsecond)
Function description	Set Alarm B Sub seconds value.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Subsecond: Value between Min_Data=0x00 and Max_Data=0x7FFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ALRMBSSR SS LL_RTC_ALMB_SetSubSecond

LL_RTC_ALMB_GetSubSecond

Function name	__STATIC_INLINE uint32_t LL_RTC_ALMB_GetSubSecond (RTC_TypeDef * RTCx)
Function description	Get Alarm B Sub seconds value.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0x7FFF

- Reference Manual to LL API cross reference:
- ALRMBSSR SS LL_RTC_ALMB_GetSubSecond

LL_RTC_TS_EnableInternalEvent

Function name `__STATIC_INLINE void LL_RTC_TS_EnableInternalEvent (RTC_TypeDef * RTCx)`

Function description Enable internal event timestamp.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

- Reference Manual to LL API cross reference:
- CR ITSE LL_RTC_TS_EnableInternalEvent

LL_RTC_TS_DisableInternalEvent

Function name `__STATIC_INLINE void LL_RTC_TS_DisableInternalEvent (RTC_TypeDef * RTCx)`

Function description Disable internal event timestamp.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

- Reference Manual to LL API cross reference:
- CR ITSE LL_RTC_TS_DisableInternalEvent

LL_RTC_TS_Enable

Function name `__STATIC_INLINE void LL_RTC_TS_Enable (RTC_TypeDef * RTCx)`

Function description Enable Timestamp.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

- Reference Manual to LL API cross reference:
- CR TSE LL_RTC_TS_Enable

LL_RTC_TS_Disable

Function name `__STATIC_INLINE void LL_RTC_TS_Disable (RTC_TypeDef * RTCx)`

RTCx)

Function description	Disable Timestamp.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR TSE LL_RTC_TS_Disable

LL_RTC_TS_SetActiveEdge

Function name	__STATIC_INLINE void LL_RTC_TS_SetActiveEdge (RTC_TypeDef * RTCx, uint32_t Edge)
Function description	Set Time-stamp event active edge.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Edge: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_TIMESTAMP_EDGE_RISING – LL_RTC_TIMESTAMP_EDGE_FALLING
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before. • TSE must be reset when TSEEDGE is changed to avoid unwanted TSF setting
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR TSEEDGE LL_RTC_TS_SetActiveEdge

LL_RTC_TS_GetActiveEdge

Function name	__STATIC_INLINE uint32_t LL_RTC_TS_GetActiveEdge (RTC_TypeDef * RTCx)
Function description	Get Time-stamp event active edge.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_TIMESTAMP_EDGE_RISING – LL_RTC_TIMESTAMP_EDGE_FALLING
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR TSEEDGE LL_RTC_TS_GetActiveEdge

LL_RTC_TS_GetTimeFormat

Function name	__STATIC_INLINE uint32_t LL_RTC_TS_GetTimeFormat
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(RTC_TypeDef * RTCx)

Function description	Get Timestamp AM/PM notation (AM or 24-hour format)
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_TS_TIME_FORMAT_AM – LL_RTC_TS_TIME_FORMAT_PM
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TSTR PM LL_RTC_TS_GetTimeFormat

LL_RTC_TS_GetHour

Function name	__STATIC_INLINE uint32_t LL_RTC_TS_GetHour (RTC_TypeDef * RTCx)
Function description	Get Timestamp Hours in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BCD2BIN</code> is available to convert Hours from BCD to Binary format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TSTR HT LL_RTC_TS_GetHour • TSTR HU LL_RTC_TS_GetHour

LL_RTC_TS_GetMinute

Function name	__STATIC_INLINE uint32_t LL_RTC_TS_GetMinute (RTC_TypeDef * RTCx)
Function description	Get Timestamp Minutes in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0x59
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BCD2BIN</code> is available to convert Minutes from BCD to Binary format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TSTR MNT LL_RTC_TS_GetMinute • TSTR MNU LL_RTC_TS_GetMinute

LL_RTC_TS_GetSecond

Function name	__STATIC_INLINE uint32_t LL_RTC_TS_GetSecond (RTC_TypeDef * RTCx)
Function description	Get Timestamp Seconds in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0x59

- Notes
- helper macro `__LL_RTC_CONVERT_BCD2BIN` is available to convert Seconds from BCD to Binary format
- Reference Manual to LL API cross reference:
- TSTR ST LL_RTC_TS_GetSecond
 - TSTR SU LL_RTC_TS_GetSecond

LL_RTC_TS_GetTime

- Function name `__STATIC_INLINE uint32_t LL_RTC_TS_GetTime (RTC_TypeDef * RTCx)`
- Function description Get Timestamp time (hour, minute and second) in BCD format.
- Parameters
- **RTCx:** RTC Instance
- Return values
- **Combination:** of hours, minutes and seconds.
- Notes
- helper macros `__LL_RTC_GET_HOUR`, `__LL_RTC_GET_MINUTE` and `__LL_RTC_GET_SECOND` are available to get independently each parameter.
- Reference Manual to LL API cross reference:
- TSTR HT LL_RTC_TS_GetTime
 - TSTR HU LL_RTC_TS_GetTime
 - TSTR MNT LL_RTC_TS_GetTime
 - TSTR MNU LL_RTC_TS_GetTime
 - TSTR ST LL_RTC_TS_GetTime
 - TSTR SU LL_RTC_TS_GetTime

LL_RTC_TS_GetWeekDay

- Function name `__STATIC_INLINE uint32_t LL_RTC_TS_GetWeekDay (RTC_TypeDef * RTCx)`
- Function description Get Timestamp Week day.
- Parameters
- **RTCx:** RTC Instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_RTC_WEEKDAY_MONDAY
 - LL_RTC_WEEKDAY_TUESDAY
 - LL_RTC_WEEKDAY_WEDNESDAY
 - LL_RTC_WEEKDAY_THURSDAY
 - LL_RTC_WEEKDAY_FRIDAY
 - LL_RTC_WEEKDAY_SATURDAY
 - LL_RTC_WEEKDAY_SUNDAY
- Reference Manual to LL API cross reference:
- TSDR WDU LL_RTC_TS_GetWeekDay

LL_RTC_TS_GetMonth

- Function name `__STATIC_INLINE uint32_t LL_RTC_TS_GetMonth (RTC_TypeDef * RTCx)`
- Function description Get Timestamp Month in BCD format.
- Parameters
- **RTCx:** RTC Instance

Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_MONTH_JANUARY – LL_RTC_MONTH_FEBRUARY – LL_RTC_MONTH_MARCH – LL_RTC_MONTH_APRIL – LL_RTC_MONTH_MAY – LL_RTC_MONTH_JUNE – LL_RTC_MONTH_JULY – LL_RTC_MONTH_AUGUST – LL_RTC_MONTH_SEPTEMBER – LL_RTC_MONTH_OCTOBER – LL_RTC_MONTH_NOVEMBER – LL_RTC_MONTH_DECEMBER
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BCD2BIN</code> is available to convert Month from BCD to Binary format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TSDR MT LL_RTC_TS_GetMonth • TSDR MU LL_RTC_TS_GetMonth

LL_RTC_TS_GetDay

Function name	<code>__STATIC_INLINE uint32_t LL_RTC_TS_GetDay (RTC_TypeDef * RTCx)</code>
Function description	Get Timestamp Day in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x01 and Max_Data=0x31
Notes	<ul style="list-style-type: none"> • helper macro <code>__LL_RTC_CONVERT_BCD2BIN</code> is available to convert Day from BCD to Binary format
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TSDR DT LL_RTC_TS_GetDay • TSDR DU LL_RTC_TS_GetDay

LL_RTC_TS_GetDate

Function name	<code>__STATIC_INLINE uint32_t LL_RTC_TS_GetDate (RTC_TypeDef * RTCx)</code>
Function description	Get Timestamp date (WeekDay, Day and Month) in BCD format.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Combination: of Weekday, Day and Month
Notes	<ul style="list-style-type: none"> • helper macros <code>__LL_RTC_GET_WEEKDAY</code>, <code>__LL_RTC_GET_MONTH</code>, and <code>__LL_RTC_GET_DAY</code> are available to get independently each parameter.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TSDR WDU LL_RTC_TS_GetDate • TSDR MT LL_RTC_TS_GetDate • TSDR MU LL_RTC_TS_GetDate • TSDR DT LL_RTC_TS_GetDate • TSDR DU LL_RTC_TS_GetDate

LL_RTC_TS_GetSubSecond

Function name	__STATIC_INLINE uint32_t LL_RTC_TS_GetSubSecond (RTC_TypeDef * RTCx)
Function description	Get time-stamp sub second value.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0xFFFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TSSSR SS LL_RTC_TS_GetSubSecond

LL_RTC_TS_EnableOnTamper

Function name	__STATIC_INLINE void LL_RTC_TS_EnableOnTamper (RTC_TypeDef * RTCx)
Function description	Activate timestamp on tamper detection event.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TAMPCR TAMPTS LL_RTC_TS_EnableOnTamper

LL_RTC_TS_DisableOnTamper

Function name	__STATIC_INLINE void LL_RTC_TS_DisableOnTamper (RTC_TypeDef * RTCx)
Function description	Disable timestamp on tamper detection event.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TAMPCR TAMPTS LL_RTC_TS_DisableOnTamper

LL_RTC_TAMPER_Enable

Function name	__STATIC_INLINE void LL_RTC_TAMPER_Enable (RTC_TypeDef * RTCx, uint32_t Tamper)
Function description	Enable RTC_TAMPx input detection.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Tamper: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_RTC_TAMPER_1 – LL_RTC_TAMPER_2 – LL_RTC_TAMPER_3
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to	<ul style="list-style-type: none"> • TAMPCR TAMP1E LL_RTC_TAMPER_Enable

- LL API cross reference:
- TAMPCR TAMP2E LL_RTC_TAMPER_Enable
 - TAMPCR TAMP3E LL_RTC_TAMPER_Enable

LL_RTC_TAMPER_Disable

- Function name **__STATIC_INLINE void LL_RTC_TAMPER_Disable (RTC_TypeDef * RTCx, uint32_t Tamper)**
- Function description Clear RTC_TAMPx input detection.
- Parameters
- **RTCx:** RTC Instance
 - **Tamper:** This parameter can be a combination of the following values:
 - LL_RTC_TAMPER_1
 - LL_RTC_TAMPER_2
 - LL_RTC_TAMPER_3
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- TAMPCR TAMP1E LL_RTC_TAMPER_Disable
 - TAMPCR TAMP2E LL_RTC_TAMPER_Disable
 - TAMPCR TAMP3E LL_RTC_TAMPER_Disable

LL_RTC_TAMPER_EnableMask

- Function name **__STATIC_INLINE void LL_RTC_TAMPER_EnableMask (RTC_TypeDef * RTCx, uint32_t Mask)**
- Function description Enable Tamper mask flag.
- Parameters
- **RTCx:** RTC Instance
 - **Mask:** This parameter can be a combination of the following values:
 - LL_RTC_TAMPER_MASK_TAMPER1
 - LL_RTC_TAMPER_MASK_TAMPER2
 - LL_RTC_TAMPER_MASK_TAMPER3
- Return values
- **None:**
- Notes
- Associated Tamper IT must not enabled when tamper mask is set.
- Reference Manual to LL API cross reference:
- TAMPCR TAMP1MF LL_RTC_TAMPER_EnableMask
 - TAMPCR TAMP2MF LL_RTC_TAMPER_EnableMask
 - TAMPCR TAMP3MF LL_RTC_TAMPER_EnableMask

LL_RTC_TAMPER_DisableMask

- Function name **__STATIC_INLINE void LL_RTC_TAMPER_DisableMask (RTC_TypeDef * RTCx, uint32_t Mask)**
- Function description Disable Tamper mask flag.
- Parameters
- **RTCx:** RTC Instance
 - **Mask:** This parameter can be a combination of the following values:
 - LL_RTC_TAMPER_MASK_TAMPER1
 - LL_RTC_TAMPER_MASK_TAMPER2

– LL_RTC_TAMPER_MASK_TAMPER3

Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TAMPCR TAMP1MF LL_RTC_TAMPER_DisableMask • TAMPCR TAMP2MF LL_RTC_TAMPER_DisableMask • TAMPCR TAMP3MF LL_RTC_TAMPER_DisableMask

LL_RTC_TAMPER_EnableEraseBKP

Function name **__STATIC_INLINE void LL_RTC_TAMPER_EnableEraseBKP (RTC_TypeDef * RTCx, uint32_t Tamper)**

Function description Enable backup register erase after Tamper event detection.

Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Tamper: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_RTC_TAMPER_NOERASE_TAMPER1 – LL_RTC_TAMPER_NOERASE_TAMPER2 – LL_RTC_TAMPER_NOERASE_TAMPER3
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Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TAMPCR TAMP1NOERASE LL_RTC_TAMPER_EnableEraseBKP • TAMPCR TAMP2NOERASE LL_RTC_TAMPER_EnableEraseBKP • TAMPCR TAMP3NOERASE LL_RTC_TAMPER_EnableEraseBKP

LL_RTC_TAMPER_DisableEraseBKP

Function name **__STATIC_INLINE void LL_RTC_TAMPER_DisableEraseBKP (RTC_TypeDef * RTCx, uint32_t Tamper)**

Function description Disable backup register erase after Tamper event detection.

Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Tamper: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_RTC_TAMPER_NOERASE_TAMPER1 – LL_RTC_TAMPER_NOERASE_TAMPER2 – LL_RTC_TAMPER_NOERASE_TAMPER3
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Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TAMPCR TAMP1NOERASE LL_RTC_TAMPER_DisableEraseBKP • TAMPCR TAMP2NOERASE LL_RTC_TAMPER_DisableEraseBKP • TAMPCR TAMP3NOERASE LL_RTC_TAMPER_DisableEraseBKP

LL_RTC_TAMPER_DisablePullUp

Function name **__STATIC_INLINE void LL_RTC_TAMPER_DisablePullUp (RTC_TypeDef * RTCx)**

Function description	Disable RTC_TAMPx pull-up disable (Disable precharge of RTC_TAMPx pins)
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TAMPCR TAMPPUDIS LL_RTC_TAMPER_DisablePullUp

LL_RTC_TAMPER_EnablePullUp

Function name	__STATIC_INLINE void LL_RTC_TAMPER_EnablePullUp (RTC_TypeDef * RTCx)
Function description	Enable RTC_TAMPx pull-up disable (Precharge RTC_TAMPx pins before sampling)
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TAMPCR TAMPPUDIS LL_RTC_TAMPER_EnablePullUp

LL_RTC_TAMPER_SetPrecharge

Function name	__STATIC_INLINE void LL_RTC_TAMPER_SetPrecharge (RTC_TypeDef * RTCx, uint32_t Duration)
Function description	Set RTC_TAMPx precharge duration.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Duration: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_TAMPER_DURATION_1RTCCLK – LL_RTC_TAMPER_DURATION_2RTCCLK – LL_RTC_TAMPER_DURATION_4RTCCLK – LL_RTC_TAMPER_DURATION_8RTCCLK
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TAMPCR TAMPPRCH LL_RTC_TAMPER_SetPrecharge

LL_RTC_TAMPER_GetPrecharge

Function name	__STATIC_INLINE uint32_t LL_RTC_TAMPER_GetPrecharge (RTC_TypeDef * RTCx)
Function description	Get RTC_TAMPx precharge duration.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_TAMPER_DURATION_1RTCCLK – LL_RTC_TAMPER_DURATION_2RTCCLK – LL_RTC_TAMPER_DURATION_4RTCCLK

– LL_RTC_TAMPER_DURATION_8RTCCLK

Reference Manual to
LL API cross
reference:

- TAMPCR TAMPPRCH LL_RTC_TAMPER_GetPrecharge

LL_RTC_TAMPER_SetFilterCount

Function name **__STATIC_INLINE void LL_RTC_TAMPER_SetFilterCount (RTC_TypeDef * RTCx, uint32_t FilterCount)**

Function description Set RTC_TAMPx filter count.

Parameters

- **RTCx:** RTC Instance
- **FilterCount:** This parameter can be one of the following values:
 - LL_RTC_TAMPER_FILTER_DISABLE
 - LL_RTC_TAMPER_FILTER_2SAMPLE
 - LL_RTC_TAMPER_FILTER_4SAMPLE
 - LL_RTC_TAMPER_FILTER_8SAMPLE

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- TAMPCR TAMPFLT LL_RTC_TAMPER_SetFilterCount

LL_RTC_TAMPER_GetFilterCount

Function name **__STATIC_INLINE uint32_t LL_RTC_TAMPER_GetFilterCount (RTC_TypeDef * RTCx)**

Function description Get RTC_TAMPx filter count.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_RTC_TAMPER_FILTER_DISABLE
 - LL_RTC_TAMPER_FILTER_2SAMPLE
 - LL_RTC_TAMPER_FILTER_4SAMPLE
 - LL_RTC_TAMPER_FILTER_8SAMPLE

Reference Manual to
LL API cross
reference:

- TAMPCR TAMPFLT LL_RTC_TAMPER_GetFilterCount

LL_RTC_TAMPER_SetSamplingFreq

Function name **__STATIC_INLINE void LL_RTC_TAMPER_SetSamplingFreq (RTC_TypeDef * RTCx, uint32_t SamplingFreq)**

Function description Set Tamper sampling frequency.

Parameters

- **RTCx:** RTC Instance
- **SamplingFreq:** This parameter can be one of the following values:
 - LL_RTC_TAMPER_SAMPLFREQDIV_32768
 - LL_RTC_TAMPER_SAMPLFREQDIV_16384
 - LL_RTC_TAMPER_SAMPLFREQDIV_8192

- LL_RTC_TAMPER_SAMPLFREQDIV_4096
- LL_RTC_TAMPER_SAMPLFREQDIV_2048
- LL_RTC_TAMPER_SAMPLFREQDIV_1024
- LL_RTC_TAMPER_SAMPLFREQDIV_512
- LL_RTC_TAMPER_SAMPLFREQDIV_256

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMPFREQ LL_RTC_TAMPER_SetSamplingFreq

LL_RTC_TAMPER_GetSamplingFreq

Function name

**__STATIC_INLINE uint32_t
LL_RTC_TAMPER_GetSamplingFreq (RTC_TypeDef * RTCx)**

Function description

Get Tamper sampling frequency.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_RTC_TAMPER_SAMPLFREQDIV_32768
 - LL_RTC_TAMPER_SAMPLFREQDIV_16384
 - LL_RTC_TAMPER_SAMPLFREQDIV_8192
 - LL_RTC_TAMPER_SAMPLFREQDIV_4096
 - LL_RTC_TAMPER_SAMPLFREQDIV_2048
 - LL_RTC_TAMPER_SAMPLFREQDIV_1024
 - LL_RTC_TAMPER_SAMPLFREQDIV_512
 - LL_RTC_TAMPER_SAMPLFREQDIV_256

Reference Manual to LL API cross reference:

- TAMPCR TAMPFREQ LL_RTC_TAMPER_GetSamplingFreq

LL_RTC_TAMPER_EnableActiveLevel

Function name

**__STATIC_INLINE void LL_RTC_TAMPER_EnableActiveLevel
(RTC_TypeDef * RTCx, uint32_t Tamper)**

Function description

Enable Active level for Tamper input.

Parameters

- **RTCx:** RTC Instance
- **Tamper:** This parameter can be a combination of the following values:
 - LL_RTC_TAMPER_ACTIVELEVEL_TAMP1
 - LL_RTC_TAMPER_ACTIVELEVEL_TAMP2
 - LL_RTC_TAMPER_ACTIVELEVEL_TAMP3

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMP1TRG LL_RTC_TAMPER_EnableActiveLevel
- TAMPCR TAMP2TRG LL_RTC_TAMPER_EnableActiveLevel
- TAMPCR TAMP3TRG LL_RTC_TAMPER_EnableActiveLevel

LL_RTC_TAMPER_DisableActiveLevel

Function name	__STATIC_INLINE void LL_RTC_TAMPER_DisableActiveLevel (RTC_TypeDef * RTCx, uint32_t Tamper)
Function description	Disable Active level for Tamper input.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • Tamper: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_RTC_TAMPER_ACTIVELEVEL_TAMP1 – LL_RTC_TAMPER_ACTIVELEVEL_TAMP2 – LL_RTC_TAMPER_ACTIVELEVEL_TAMP3
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TAMPCR TAMP1TRG LL_RTC_TAMPER_DisableActiveLevel • TAMPCR TAMP2TRG LL_RTC_TAMPER_DisableActiveLevel • TAMPCR TAMP3TRG LL_RTC_TAMPER_DisableActiveLevel

LL_RTC_WAKEUP_Enable

Function name	__STATIC_INLINE void LL_RTC_WAKEUP_Enable (RTC_TypeDef * RTCx)
Function description	Enable Wakeup timer.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR WUTE LL_RTC_WAKEUP_Enable

LL_RTC_WAKEUP_Disable

Function name	__STATIC_INLINE void LL_RTC_WAKEUP_Disable (RTC_TypeDef * RTCx)
Function description	Disable Wakeup timer.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR WUTE LL_RTC_WAKEUP_Disable

LL_RTC_WAKEUP_IsEnabled

Function name	__STATIC_INLINE uint32_t LL_RTC_WAKEUP_IsEnabled (RTC_TypeDef * RTCx)
Function description	Check if Wakeup timer is enabled or not.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR WUTE LL_RTC_WAKEUP_IsEnabled

LL_RTC_WAKEUP_SetClock

Function name	__STATIC_INLINE void LL_RTC_WAKEUP_SetClock (RTC_TypeDef * RTCx, uint32_t WakeupClock)
Function description	Select Wakeup clock.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • WakeupClock: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_WAKEUPCLOCK_DIV_16 – LL_RTC_WAKEUPCLOCK_DIV_8 – LL_RTC_WAKEUPCLOCK_DIV_4 – LL_RTC_WAKEUPCLOCK_DIV_2 – LL_RTC_WAKEUPCLOCK_CKSPRE – LL_RTC_WAKEUPCLOCK_CKSPRE_WUT
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before. • Bit can be written only when RTC_CR WUTE bit = 0 and RTC_ISR WUTWF bit = 1
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR WUCKSEL LL_RTC_WAKEUP_SetClock

LL_RTC_WAKEUP_GetClock

Function name	__STATIC_INLINE uint32_t LL_RTC_WAKEUP_GetClock (RTC_TypeDef * RTCx)
Function description	Get Wakeup clock.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_WAKEUPCLOCK_DIV_16 – LL_RTC_WAKEUPCLOCK_DIV_8 – LL_RTC_WAKEUPCLOCK_DIV_4 – LL_RTC_WAKEUPCLOCK_DIV_2 – LL_RTC_WAKEUPCLOCK_CKSPRE – LL_RTC_WAKEUPCLOCK_CKSPRE_WUT

Reference Manual to LL API cross reference:

- CR WUCKSEL LL_RTC_WAKEUP_GetClock

LL_RTC_WAKEUP_SetAutoReload

Function name **__STATIC_INLINE void LL_RTC_WAKEUP_SetAutoReload (RTC_TypeDef * RTCx, uint32_t Value)**

Function description Set Wakeup auto-reload value.

Parameters

- **RTCx:** RTC Instance
- **Value:** Value between Min_Data=0x00 and Max_Data=0xFFFF

Return values

- **None:**

Notes

- Bit can be written only when WUTWF is set to 1 in RTC_ISR

Reference Manual to LL API cross reference:

- WUTR WUT LL_RTC_WAKEUP_SetAutoReload

LL_RTC_WAKEUP_GetAutoReload

Function name **__STATIC_INLINE uint32_t LL_RTC_WAKEUP_GetAutoReload (RTC_TypeDef * RTCx)**

Function description Get Wakeup auto-reload value.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0xFFFF

Reference Manual to LL API cross reference:

- WUTR WUT LL_RTC_WAKEUP_GetAutoReload

LL_RTC_BAK_SetRegister

Function name **__STATIC_INLINE void LL_RTC_BAK_SetRegister (RTC_TypeDef * RTCx, uint32_t BackupRegister, uint32_t Data)**

Function description Writes a data in a specified RTC Backup data register.

Parameters

- **RTCx:** RTC Instance
- **BackupRegister:** This parameter can be one of the following values:
 - LL_RTC_BKP_DR0
 - LL_RTC_BKP_DR1
 - LL_RTC_BKP_DR2
 - LL_RTC_BKP_DR3
 - LL_RTC_BKP_DR4
 - LL_RTC_BKP_DR5
 - LL_RTC_BKP_DR6
 - LL_RTC_BKP_DR7
 - LL_RTC_BKP_DR8
 - LL_RTC_BKP_DR9

- LL_RTC_BKP_DR10
- LL_RTC_BKP_DR11
- LL_RTC_BKP_DR12
- LL_RTC_BKP_DR13
- LL_RTC_BKP_DR14
- LL_RTC_BKP_DR15
- LL_RTC_BKP_DR16
- LL_RTC_BKP_DR17
- LL_RTC_BKP_DR18
- LL_RTC_BKP_DR19
- LL_RTC_BKP_DR20
- LL_RTC_BKP_DR21
- LL_RTC_BKP_DR22
- LL_RTC_BKP_DR23
- LL_RTC_BKP_DR24
- LL_RTC_BKP_DR25
- LL_RTC_BKP_DR26
- LL_RTC_BKP_DR27
- LL_RTC_BKP_DR28
- LL_RTC_BKP_DR29
- LL_RTC_BKP_DR30
- LL_RTC_BKP_DR31
- **Data:** Value between Min_Data=0x00 and Max_Data=0xFFFFFFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- BKPxR BKP LL_RTC_BAK_SetRegister

LL_RTC_BAK_GetRegister

Function name `__STATIC_INLINE uint32_t LL_RTC_BAK_GetRegister (RTC_TypeDef * RTCx, uint32_t BackupRegister)`

Function description Reads data from the specified RTC Backup data Register.

Parameters

- **RTCx:** RTC Instance
- **BackupRegister:** This parameter can be one of the following values:
 - LL_RTC_BKP_DR0
 - LL_RTC_BKP_DR1
 - LL_RTC_BKP_DR2
 - LL_RTC_BKP_DR3
 - LL_RTC_BKP_DR4
 - LL_RTC_BKP_DR5
 - LL_RTC_BKP_DR6
 - LL_RTC_BKP_DR7
 - LL_RTC_BKP_DR8
 - LL_RTC_BKP_DR9
 - LL_RTC_BKP_DR10
 - LL_RTC_BKP_DR11
 - LL_RTC_BKP_DR12
 - LL_RTC_BKP_DR13

- LL_RTC_BKP_DR14
- LL_RTC_BKP_DR15
- LL_RTC_BKP_DR16
- LL_RTC_BKP_DR17
- LL_RTC_BKP_DR18
- LL_RTC_BKP_DR19
- LL_RTC_BKP_DR20
- LL_RTC_BKP_DR21
- LL_RTC_BKP_DR22
- LL_RTC_BKP_DR23
- LL_RTC_BKP_DR24
- LL_RTC_BKP_DR25
- LL_RTC_BKP_DR26
- LL_RTC_BKP_DR27
- LL_RTC_BKP_DR28
- LL_RTC_BKP_DR29
- LL_RTC_BKP_DR30
- LL_RTC_BKP_DR31

- Return values
- **Value:** between Min_Data=0x00 and Max_Data=0xFFFFFFFF
- Reference Manual to LL API cross reference:
- BKPxR BKP LL_RTC_BAK_GetRegister

LL_RTC_CAL_SetOutputFreq

- Function name **__STATIC_INLINE void LL_RTC_CAL_SetOutputFreq (RTC_TypeDef * RTCx, uint32_t Frequency)**
- Function description Set Calibration output frequency (1 Hz or 512 Hz)
- Parameters
- **RTCx:** RTC Instance
 - **Frequency:** This parameter can be one of the following values:
 - LL_RTC_CALIB_OUTPUT_NONE
 - LL_RTC_CALIB_OUTPUT_1HZ
 - LL_RTC_CALIB_OUTPUT_512HZ
- Return values
- **None:**
- Notes
- Bits are write-protected. LL_RTC_DisableWriteProtection function should be called before.
- Reference Manual to LL API cross reference:
- CR COE LL_RTC_CAL_SetOutputFreq
 - CR COSEL LL_RTC_CAL_SetOutputFreq

LL_RTC_CAL_GetOutputFreq

- Function name **__STATIC_INLINE uint32_t LL_RTC_CAL_GetOutputFreq (RTC_TypeDef * RTCx)**
- Function description Get Calibration output frequency (1 Hz or 512 Hz)
- Parameters
- **RTCx:** RTC Instance

- Return values
- **Returned:** value can be one of the following values:
 - LL_RTC_CALIB_OUTPUT_NONE
 - LL_RTC_CALIB_OUTPUT_1HZ
 - LL_RTC_CALIB_OUTPUT_512HZ
- Reference Manual to LL API cross reference:
- CR COE LL_RTC_CAL_GetOutputFreq
 - CR COSEL LL_RTC_CAL_GetOutputFreq

LL_RTC_CAL_SetPulse

- Function name **__STATIC_INLINE void LL_RTC_CAL_SetPulse (RTC_TypeDef * RTCx, uint32_t Pulse)**
- Function description Insert or not One RTCCLK pulse every 2exp11 pulses (frequency increased by 488.5 ppm)
- Parameters
- **RTCx:** RTC Instance
 - **Pulse:** This parameter can be one of the following values:
 - LL_RTC_CALIB_INSERTPULSE_NONE
 - LL_RTC_CALIB_INSERTPULSE_SET
- Return values
- **None:**
- Notes
- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
 - Bit can be written only when RECALPF is set to 0 in RTC_ISR
- Reference Manual to LL API cross reference:
- CALR CALP LL_RTC_CAL_SetPulse

LL_RTC_CAL_IsPulseInserted

- Function name **__STATIC_INLINE uint32_t LL_RTC_CAL_IsPulseInserted (RTC_TypeDef * RTCx)**
- Function description Check if one RTCCLK has been inserted or not every 2exp11 pulses (frequency increased by 488.5 ppm)
- Parameters
- **RTCx:** RTC Instance
- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- CALR CALP LL_RTC_CAL_IsPulseInserted

LL_RTC_CAL_SetPeriod

- Function name **__STATIC_INLINE void LL_RTC_CAL_SetPeriod (RTC_TypeDef * RTCx, uint32_t Period)**
- Function description Set the calibration cycle period.
- Parameters
- **RTCx:** RTC Instance
 - **Period:** This parameter can be one of the following values:
 - LL_RTC_CALIB_PERIOD_32SEC
 - LL_RTC_CALIB_PERIOD_16SEC

	– LL_RTC_CALIB_PERIOD_8SEC
Return values	• None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before. • Bit can be written only when RECALPF is set to 0 in RTC_ISR
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CALR CALW8 LL_RTC_CAL_SetPeriod • CALR CALW16 LL_RTC_CAL_SetPeriod

LL_RTC_CAL_GetPeriod

Function name	__STATIC_INLINE uint32_t LL_RTC_CAL_GetPeriod (RTC_TypeDef * RTCx)
Function description	Get the calibration cycle period.
Parameters	• RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_CALIB_PERIOD_32SEC – LL_RTC_CALIB_PERIOD_16SEC – LL_RTC_CALIB_PERIOD_8SEC
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CALR CALW8 LL_RTC_CAL_GetPeriod • CALR CALW16 LL_RTC_CAL_GetPeriod

LL_RTC_CAL_SetMinus

Function name	__STATIC_INLINE void LL_RTC_CAL_SetMinus (RTC_TypeDef * RTCx, uint32_t CalibMinus)
Function description	Set Calibration minus.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • CalibMinus: Value between Min_Data=0x00 and Max_Data=0x1FF
Return values	• None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before. • Bit can be written only when RECALPF is set to 0 in RTC_ISR
Reference Manual to LL API cross reference:	• CALR CALM LL_RTC_CAL_SetMinus

LL_RTC_CAL_GetMinus

Function name	__STATIC_INLINE uint32_t LL_RTC_CAL_GetMinus (RTC_TypeDef * RTCx)
Function description	Get Calibration minus.

Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data= 0x1FF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CALR CALM LL_RTC_CAL_GetMinus

LL_RTC_IsActiveFlag_ITS

Function name	__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_ITS (RTC_TypeDef * RTCx)
Function description	Get Internal Time-stamp flag.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR ITSF LL_RTC_IsActiveFlag_ITS

LL_RTC_IsActiveFlag_RECALP

Function name	__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_RECALP (RTC_TypeDef * RTCx)
Function description	Get Recalibration pending Flag.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR RECALPF LL_RTC_IsActiveFlag_RECALP

LL_RTC_IsActiveFlag_TAMP3

Function name	__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_TAMP3 (RTC_TypeDef * RTCx)
Function description	Get RTC_TAMP3 detection flag.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR TAMP3F LL_RTC_IsActiveFlag_TAMP3

LL_RTC_IsActiveFlag_TAMP2

Function name	__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_TAMP2 (RTC_TypeDef * RTCx)
Function description	Get RTC_TAMP2 detection flag.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance

- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- ISR TAMP2F LL_RTC_IsActiveFlag_TAMP2

LL_RTC_IsActiveFlag_TAMP1

- Function name **__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_TAMP1 (RTC_TypeDef * RTCx)**
- Function description Get RTC_TAMP1 detection flag.
- Parameters
- **RTCx:** RTC Instance
- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- ISR TAMP1F LL_RTC_IsActiveFlag_TAMP1

LL_RTC_IsActiveFlag_TSOV

- Function name **__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_TSOV (RTC_TypeDef * RTCx)**
- Function description Get Time-stamp overflow flag.
- Parameters
- **RTCx:** RTC Instance
- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- ISR TSOVF LL_RTC_IsActiveFlag_TSOV

LL_RTC_IsActiveFlag_TS

- Function name **__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_TS (RTC_TypeDef * RTCx)**
- Function description Get Time-stamp flag.
- Parameters
- **RTCx:** RTC Instance
- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- ISR TSF LL_RTC_IsActiveFlag_TS

LL_RTC_IsActiveFlag_WUT

- Function name **__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_WUT (RTC_TypeDef * RTCx)**
- Function description Get Wakeup timer flag.
- Parameters
- **RTCx:** RTC Instance
- Return values
- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR WUTF LL_RTC_IsActiveFlag_WUT

LL_RTC_IsActiveFlag_ALRB

Function name **__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_ALRB (RTC_TypeDef * RTCx)**

Function description Get Alarm B flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR ALRBF LL_RTC_IsActiveFlag_ALRB

LL_RTC_IsActiveFlag_ALRA

Function name **__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_ALRA (RTC_TypeDef * RTCx)**

Function description Get Alarm A flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR ALRAF LL_RTC_IsActiveFlag_ALRA

LL_RTC_ClearFlag_ITS

Function name **__STATIC_INLINE void LL_RTC_ClearFlag_ITS (RTC_TypeDef * RTCx)**

Function description Clear Internal Time-stamp flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR ITSF LL_RTC_ClearFlag_ITS

LL_RTC_ClearFlag_TAMP3

Function name **__STATIC_INLINE void LL_RTC_ClearFlag_TAMP3 (RTC_TypeDef * RTCx)**

Function description Clear RTC_TAMP3 detection flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross

- ISR TAMP3F LL_RTC_ClearFlag_TAMP3

reference:

LL_RTC_ClearFlag_TAMP2

Function name **__STATIC_INLINE void LL_RTC_ClearFlag_TAMP2 (RTC_TypeDef * RTCx)**

Function description Clear RTC_TAMP2 detection flag.

Parameters

- **RTCx**: RTC Instance

Return values

- **None**:

Reference Manual to LL API cross

- ISR TAMP2F LL_RTC_ClearFlag_TAMP2

reference:

LL_RTC_ClearFlag_TAMP1

Function name **__STATIC_INLINE void LL_RTC_ClearFlag_TAMP1 (RTC_TypeDef * RTCx)**

Function description Clear RTC_TAMP1 detection flag.

Parameters

- **RTCx**: RTC Instance

Return values

- **None**:

Reference Manual to LL API cross

- ISR TAMP1F LL_RTC_ClearFlag_TAMP1

reference:

LL_RTC_ClearFlag_TSOV

Function name **__STATIC_INLINE void LL_RTC_ClearFlag_TSOV (RTC_TypeDef * RTCx)**

Function description Clear Time-stamp overflow flag.

Parameters

- **RTCx**: RTC Instance

Return values

- **None**:

Reference Manual to LL API cross

- ISR TSOVF LL_RTC_ClearFlag_TSOV

reference:

LL_RTC_ClearFlag_TS

Function name **__STATIC_INLINE void LL_RTC_ClearFlag_TS (RTC_TypeDef * RTCx)**

Function description Clear Time-stamp flag.

Parameters

- **RTCx**: RTC Instance

Return values

- **None**:

Reference Manual to LL API cross

- ISR TSF LL_RTC_ClearFlag_TS

reference:

LL_RTC_ClearFlag_WUT

Function name	__STATIC_INLINE void LL_RTC_ClearFlag_WUT (RTC_TypeDef * RTCx)
Function description	Clear Wakeup timer flag.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR WUTF LL_RTC_ClearFlag_WUT

LL_RTC_ClearFlag_ALRB

Function name	__STATIC_INLINE void LL_RTC_ClearFlag_ALRB (RTC_TypeDef * RTCx)
Function description	Clear Alarm B flag.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR ALRBF LL_RTC_ClearFlag_ALRB

LL_RTC_ClearFlag_ALRA

Function name	__STATIC_INLINE void LL_RTC_ClearFlag_ALRA (RTC_TypeDef * RTCx)
Function description	Clear Alarm A flag.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR ALRAF LL_RTC_ClearFlag_ALRA

LL_RTC_IsActiveFlag_INIT

Function name	__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_INIT (RTC_TypeDef * RTCx)
Function description	Get Initialization flag.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR INITF LL_RTC_IsActiveFlag_INIT

LL_RTC_IsActiveFlag_RS

Function name	__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_RS (RTC_TypeDef * RTCx)
Function description	Get Registers synchronization flag.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR RSF LL_RTC_IsActiveFlag_RS

LL_RTC_ClearFlag_RS

Function name	__STATIC_INLINE void LL_RTC_ClearFlag_RS (RTC_TypeDef * RTCx)
Function description	Clear Registers synchronization flag.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR RSF LL_RTC_ClearFlag_RS

LL_RTC_IsActiveFlag_INITS

Function name	__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_INITS (RTC_TypeDef * RTCx)
Function description	Get Initialization status flag.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR INITS LL_RTC_IsActiveFlag_INITS

LL_RTC_IsActiveFlag_SHP

Function name	__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_SHP (RTC_TypeDef * RTCx)
Function description	Get Shift operation pending flag.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR SHPF LL_RTC_IsActiveFlag_SHP

LL_RTC_IsActiveFlag_WUTW

Function name	__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_WUTW (RTC_TypeDef * RTCx)
Function description	Get Wakeup timer write flag.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR WUTWF LL_RTC_IsActiveFlag_WUTW

LL_RTC_IsActiveFlag_ALRBW

Function name	__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_ALRBW (RTC_TypeDef * RTCx)
Function description	Get Alarm B write flag.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR ALRBWF LL_RTC_IsActiveFlag_ALRBW

LL_RTC_IsActiveFlag_ALRAW

Function name	__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_ALRAW (RTC_TypeDef * RTCx)
Function description	Get Alarm A write flag.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR ALRAWF LL_RTC_IsActiveFlag_ALRAW

LL_RTC_EnableIT_TS

Function name	__STATIC_INLINE void LL_RTC_EnableIT_TS (RTC_TypeDef * RTCx)
Function description	Enable Time-stamp interrupt.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR TSIE LL_RTC_EnableIT_TS

LL_RTC_DisableIT_TS

Function name	__STATIC_INLINE void LL_RTC_DisableIT_TS (RTC_TypeDef * RTCx)
Function description	Disable Time-stamp interrupt.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR TSIE LL_RTC_DisableIT_TS

LL_RTC_EnableIT_WUT

Function name	__STATIC_INLINE void LL_RTC_EnableIT_WUT (RTC_TypeDef * RTCx)
Function description	Enable Wakeup timer interrupt.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR WUTIE LL_RTC_EnableIT_WUT

LL_RTC_DisableIT_WUT

Function name	__STATIC_INLINE void LL_RTC_DisableIT_WUT (RTC_TypeDef * RTCx)
Function description	Disable Wakeup timer interrupt.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR WUTIE LL_RTC_DisableIT_WUT

LL_RTC_EnableIT_ALRB

Function name	__STATIC_INLINE void LL_RTC_EnableIT_ALRB (RTC_TypeDef * RTCx)
Function description	Enable Alarm B interrupt.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance

Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR ALRBIE LL_RTC_EnableIT_ALRB

LL_RTC_DisableIT_ALRB

Function name	__STATIC_INLINE void LL_RTC_DisableIT_ALRB (RTC_TypeDef * RTCx)
Function description	Disable Alarm B interrupt.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR ALRBIE LL_RTC_DisableIT_ALRB

LL_RTC_EnableIT_ALRA

Function name	__STATIC_INLINE void LL_RTC_EnableIT_ALRA (RTC_TypeDef * RTCx)
Function description	Enable Alarm A interrupt.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR ALRAIE LL_RTC_EnableIT_ALRA

LL_RTC_DisableIT_ALRA

Function name	__STATIC_INLINE void LL_RTC_DisableIT_ALRA (RTC_TypeDef * RTCx)
Function description	Disable Alarm A interrupt.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR ALRAIE LL_RTC_DisableIT_ALRA

LL_RTC_EnableIT_TAMP3

Function name	__STATIC_INLINE void LL_RTC_EnableIT_TAMP3 (RTC_TypeDef * RTCx)
Function description	Enable Tamper 3 interrupt.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• TAMPCR TAMP3IE LL_RTC_EnableIT_TAMP3

LL_RTC_DisableIT_TAMP3

Function name	__STATIC_INLINE void LL_RTC_DisableIT_TAMP3 (RTC_TypeDef * RTCx)
Function description	Disable Tamper 3 interrupt.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• TAMPCR TAMP3IE LL_RTC_DisableIT_TAMP3

LL_RTC_EnableIT_TAMP2

Function name	__STATIC_INLINE void LL_RTC_EnableIT_TAMP2 (RTC_TypeDef * RTCx)
Function description	Enable Tamper 2 interrupt.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• TAMPCR TAMP2IE LL_RTC_EnableIT_TAMP2

LL_RTC_DisableIT_TAMP2

Function name	__STATIC_INLINE void LL_RTC_DisableIT_TAMP2 (RTC_TypeDef * RTCx)
Function description	Disable Tamper 2 interrupt.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• TAMPCR TAMP2IE LL_RTC_DisableIT_TAMP2

LL_RTC_EnableIT_TAMP1

Function name	__STATIC_INLINE void LL_RTC_EnableIT_TAMP1 (RTC_TypeDef * RTCx)
Function description	Enable Tamper 1 interrupt.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• TAMPCR TAMP1IE LL_RTC_EnableIT_TAMP1

LL_RTC_DisableIT_TAMP1

Function name	__STATIC_INLINE void LL_RTC_DisableIT_TAMP1 (RTC_TypeDef * RTCx)
Function description	Disable Tamper 1 interrupt.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• TAMPCR TAMP1IE LL_RTC_DisableIT_TAMP1

LL_RTC_EnableIT_TAMP

Function name	__STATIC_INLINE void LL_RTC_EnableIT_TAMP (RTC_TypeDef * RTCx)
Function description	Enable all Tamper Interrupt.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• TAMPCR TAMPIE LL_RTC_EnableIT_TAMP

LL_RTC_DisableIT_TAMP

Function name	__STATIC_INLINE void LL_RTC_DisableIT_TAMP (RTC_TypeDef * RTCx)
Function description	Disable all Tamper Interrupt.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• TAMPCR TAMPIE LL_RTC_DisableIT_TAMP

LL_RTC_IsEnabledIT_TS

Function name	__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_TS (RTC_TypeDef * RTCx)
Function description	Check if Time-stamp interrupt is enabled or not.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR TSIE LL_RTC_IsEnabledIT_TS

LL_RTC_IsEnabledIT_WUT

Function name	__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_WUT (RTC_TypeDef * RTCx)
Function description	Check if Wakeup timer interrupt is enabled or not.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR WUTIE LL_RTC_IsEnabledIT_WUT

LL_RTC_IsEnabledIT_ALRB

Function name	__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_ALRB (RTC_TypeDef * RTCx)
Function description	Check if Alarm B interrupt is enabled or not.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR ALRBIE LL_RTC_IsEnabledIT_ALRB

LL_RTC_IsEnabledIT_ALRA

Function name	__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_ALRA (RTC_TypeDef * RTCx)
Function description	Check if Alarm A interrupt is enabled or not.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR ALRAIE LL_RTC_IsEnabledIT_ALRA

LL_RTC_IsEnabledIT_TAMP3

Function name	__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_TAMP3 (RTC_TypeDef * RTCx)
Function description	Check if Tamper 3 interrupt is enabled or not.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• TAMPCR TAMP3IE LL_RTC_IsEnabledIT_TAMP3

LL_RTC_IsEnabledIT_TAMP2

Function name	__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_TAMP2 (RTC_TypeDef * RTCx)
Function description	Check if Tamper 2 interrupt is enabled or not.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• TAMPCR TAMP2IE LL_RTC_IsEnabledIT_TAMP2

LL_RTC_IsEnabledIT_TAMP1

Function name	__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_TAMP1 (RTC_TypeDef * RTCx)
Function description	Check if Tamper 1 interrupt is enabled or not.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• TAMPCR TAMP1IE LL_RTC_IsEnabledIT_TAMP1

LL_RTC_IsEnabledIT_TAMP

Function name	__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_TAMP (RTC_TypeDef * RTCx)
Function description	Check if all the TAMPER interrupts are enabled or not.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• TAMPCR TAMPIE LL_RTC_IsEnabledIT_TAMP

LL_RTC_DeInit

Function name	ErrorStatus LL_RTC_DeInit (RTC_TypeDef * RTCx)
Function description	De-Initializes the RTC registers to their default reset values.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: RTC registers are de-initialized – ERROR: RTC registers are not de-initialized
Notes	<ul style="list-style-type: none"> • This function doesn't reset the RTC Clock source and RTC Backup Data registers.

LL_RTC_Init

Function name	ErrorStatus LL_RTC_Init (RTC_TypeDef * RTCx, LL_RTC_InitTypeDef * RTC_InitStruct)
Function description	Initializes the RTC registers according to the specified parameters in RTC_InitStruct.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • RTC_InitStruct: pointer to a LL_RTC_InitTypeDef structure that contains the configuration information for the RTC peripheral.
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: RTC registers are initialized – ERROR: RTC registers are not initialized
Notes	<ul style="list-style-type: none"> • The RTC Prescaler register is write protected and can be written in initialization mode only.

LL_RTC_StructInit

Function name	void LL_RTC_StructInit (LL_RTC_InitTypeDef * RTC_InitStruct)
Function description	Set each LL_RTC_InitTypeDef field to default value.
Parameters	<ul style="list-style-type: none"> • RTC_InitStruct: pointer to a LL_RTC_InitTypeDef structure which will be initialized.
Return values	<ul style="list-style-type: none"> • None:

LL_RTC_TIME_Init

Function name	ErrorStatus LL_RTC_TIME_Init (RTC_TypeDef * RTCx, uint32_t RTC_Format, LL_RTC_TimeTypeDef * RTC_TimeStruct)
Function description	Set the RTC current time.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • RTC_Format: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_FORMAT_BIN – LL_RTC_FORMAT_BCD

- **RTC_TimeStruct:** pointer to a RTC_TimeTypeDef structure that contains the time configuration information for the RTC.
- Return values
- **An:** ErrorStatus enumeration value:
 - SUCCESS: RTC Time register is configured
 - ERROR: RTC Time register is not configured

LL_RTC_TIME_StructInit

- Function name **void LL_RTC_TIME_StructInit (LL_RTC_TimeTypeDef * RTC_TimeStruct)**
- Function description Set each LL_RTC_TimeTypeDef field to default value (Time = 00h:00min:00sec).
- Parameters
- **RTC_TimeStruct:** pointer to a LL_RTC_TimeTypeDef structure which will be initialized.
- Return values
- **None:**

LL_RTC_DATE_Init

- Function name **ErrorStatus LL_RTC_DATE_Init (RTC_TypeDef * RTCx, uint32_t RTC_Format, LL_RTC_DateTypeDef * RTC_DateStruct)**
- Function description Set the RTC current date.
- Parameters
- **RTCx:** RTC Instance
 - **RTC_Format:** This parameter can be one of the following values:
 - LL_RTC_FORMAT_BIN
 - LL_RTC_FORMAT_BCD
 - **RTC_DateStruct:** pointer to a RTC_DateTypeDef structure that contains the date configuration information for the RTC.
- Return values
- **An:** ErrorStatus enumeration value:
 - SUCCESS: RTC Day register is configured
 - ERROR: RTC Day register is not configured

LL_RTC_DATE_StructInit

- Function name **void LL_RTC_DATE_StructInit (LL_RTC_DateTypeDef * RTC_DateStruct)**
- Function description Set each LL_RTC_DateTypeDef field to default value (date = Monday, January 01 xx00)
- Parameters
- **RTC_DateStruct:** pointer to a LL_RTC_DateTypeDef structure which will be initialized.
- Return values
- **None:**

LL_RTC_ALMA_Init

- Function name **ErrorStatus LL_RTC_ALMA_Init (RTC_TypeDef * RTCx, uint32_t RTC_Format, LL_RTC_AlarmTypeDef * RTC_AlarmStruct)**

Function description	Set the RTC Alarm A.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • RTC_Format: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_FORMAT_BIN – LL_RTC_FORMAT_BCD • RTC_AlarmStruct: pointer to a LL_RTC_AlarmTypeDef structure that contains the alarm configuration parameters.
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: ALARMA registers are configured – ERROR: ALARMA registers are not configured
Notes	<ul style="list-style-type: none"> • The Alarm register can only be written when the corresponding Alarm is disabled (Use LL_RTC_ALMA_Disable function).

LL_RTC_ALMB_Init

Function name	ErrorStatus LL_RTC_ALMB_Init (RTC_TypeDef * RTCx, uint32_t RTC_Format, LL_RTC_AlarmTypeDef * RTC_AlarmStruct)
Function description	Set the RTC Alarm B.
Parameters	<ul style="list-style-type: none"> • RTCx: RTC Instance • RTC_Format: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_RTC_FORMAT_BIN – LL_RTC_FORMAT_BCD • RTC_AlarmStruct: pointer to a LL_RTC_AlarmTypeDef structure that contains the alarm configuration parameters.
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: ALARMB registers are configured – ERROR: ALARMB registers are not configured
Notes	<ul style="list-style-type: none"> • The Alarm register can only be written when the corresponding Alarm is disabled (LL_RTC_ALMB_Disable function).

LL_RTC_ALMA_StructInit

Function name	void LL_RTC_ALMA_StructInit (LL_RTC_AlarmTypeDef * RTC_AlarmStruct)
Function description	Set each LL_RTC_AlarmTypeDef of ALARMA field to default value (Time = 00h:00mn:00sec / Day = 1st day of the month/Mask = all fields are masked).
Parameters	<ul style="list-style-type: none"> • RTC_AlarmStruct: pointer to a LL_RTC_AlarmTypeDef structure which will be initialized.
Return values	<ul style="list-style-type: none"> • None:

LL_RTC_ALMB_StructInit

Function name	void LL_RTC_ALMB_StructInit (LL_RTC_AlarmTypeDef * RTC_AlarmStruct)
Function description	Set each LL_RTC_AlarmTypeDef of ALARMA field to default value (Time = 00h:00mn:00sec / Day = 1st day of the month/Mask = all fields are masked).
Parameters	<ul style="list-style-type: none">• RTC_AlarmStruct: pointer to a LL_RTC_AlarmTypeDef structure which will be initialized.
Return values	<ul style="list-style-type: none">• None:

LL_RTC_EnterInitMode

Function name	ErrorStatus LL_RTC_EnterInitMode (RTC_TypeDef * RTCx)
Function description	Enters the RTC Initialization mode.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• An: ErrorStatus enumeration value:<ul style="list-style-type: none">– SUCCESS: RTC is in Init mode– ERROR: RTC is not in Init mode
Notes	<ul style="list-style-type: none">• The RTC Initialization mode is write protected, use the LL_RTC_DisableWriteProtection before calling this function.

LL_RTC_ExitInitMode

Function name	ErrorStatus LL_RTC_ExitInitMode (RTC_TypeDef * RTCx)
Function description	Exit the RTC Initialization mode.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• An: ErrorStatus enumeration value:<ul style="list-style-type: none">– SUCCESS: RTC exited from in Init mode– ERROR: Not applicable
Notes	<ul style="list-style-type: none">• When the initialization sequence is complete, the calendar restarts counting after 4 RTCCLK cycles.• The RTC Initialization mode is write protected, use the LL_RTC_DisableWriteProtection before calling this function.

LL_RTC_WaitForSynchro

Function name	ErrorStatus LL_RTC_WaitForSynchro (RTC_TypeDef * RTCx)
Function description	Waits until the RTC Time and Day registers (RTC_TR and RTC_DR) are synchronized with RTC APB clock.
Parameters	<ul style="list-style-type: none">• RTCx: RTC Instance
Return values	<ul style="list-style-type: none">• An: ErrorStatus enumeration value:<ul style="list-style-type: none">– SUCCESS: RTC registers are synchronised– ERROR: RTC registers are not synchronised
Notes	<ul style="list-style-type: none">• The RTC Resynchronization mode is write protected, use the LL_RTC_DisableWriteProtection before calling this function.

- To read the calendar through the shadow registers after Calendar initialization, calendar update or after wakeup from low power modes the software must first clear the RSF flag. The software must then wait until it is set again before reading the calendar, which means that the calendar registers have been correctly copied into the RTC_TR and RTC_DR shadow registers.

87.3 RTC Firmware driver defines

87.3.1 RTC

ALARM OUTPUT

LL_RTC_ALARMOUT_DISABLE	Output disabled
LL_RTC_ALARMOUT_ALMA	Alarm A output enabled
LL_RTC_ALARMOUT_ALMB	Alarm B output enabled
LL_RTC_ALARMOUT_WAKEUP	Wakeup output enabled

ALARM OUTPUT TYPE

LL_RTC_ALARM_OUTPUTTYPE_OPENDRAIN	RTC_ALARM, when mapped on PC13, is open-drain output
LL_RTC_ALARM_OUTPUTTYPE_PUSH_PULL	RTC_ALARM, when mapped on PC13, is push-pull output

ALARMA MASK

LL_RTC_ALMA_MASK_NONE	No masks applied on Alarm A
LL_RTC_ALMA_MASK_DATEWEEKDAY	Date/day do not care in Alarm A comparison
LL_RTC_ALMA_MASK_HOURS	Hours do not care in Alarm A comparison
LL_RTC_ALMA_MASK_MINUTES	Minutes do not care in Alarm A comparison
LL_RTC_ALMA_MASK_SECONDS	Seconds do not care in Alarm A comparison
LL_RTC_ALMA_MASK_ALL	Masks all

ALARMA TIME FORMAT

LL_RTC_ALMA_TIME_FORMAT_AM	AM or 24-hour format
LL_RTC_ALMA_TIME_FORMAT_PM	PM

RTC Alarm A Date WeekDay

LL_RTC_ALMA_DATEWEEKDAYSEL_DATE	Alarm A Date is selected
LL_RTC_ALMA_DATEWEEKDAYSEL_WEEKDAY	Alarm A WeekDay is selected

ALARMB MASK

LL_RTC_ALMB_MASK_NONE	No masks applied on Alarm B
LL_RTC_ALMB_MASK_DATEWEEKDAY	Date/day do not care in Alarm B comparison
LL_RTC_ALMB_MASK_HOURS	Hours do not care in Alarm B comparison
LL_RTC_ALMB_MASK_MINUTES	Minutes do not care in Alarm B comparison
LL_RTC_ALMB_MASK_SECONDS	Seconds do not care in Alarm B comparison

LL_RTC_ALMB_MASK_ALL Masks all

ALARMB TIME FORMAT

LL_RTC_ALMB_TIME_FORMAT_AM AM or 24-hour format

LL_RTC_ALMB_TIME_FORMAT_PM PM

RTC Alarm B Date WeekDay

LL_RTC_ALMB_DATEWEEKDAYSEL_DATE Alarm B Date is selected

LL_RTC_ALMB_DATEWEEKDAYSEL_WEEKDAY Alarm B WeekDay is selected

BACKUP

LL_RTC_BKP_DR0

LL_RTC_BKP_DR1

LL_RTC_BKP_DR2

LL_RTC_BKP_DR3

LL_RTC_BKP_DR4

LL_RTC_BKP_DR5

LL_RTC_BKP_DR6

LL_RTC_BKP_DR7

LL_RTC_BKP_DR8

LL_RTC_BKP_DR9

LL_RTC_BKP_DR10

LL_RTC_BKP_DR11

LL_RTC_BKP_DR12

LL_RTC_BKP_DR13

LL_RTC_BKP_DR14

LL_RTC_BKP_DR15

LL_RTC_BKP_DR16

LL_RTC_BKP_DR17

LL_RTC_BKP_DR18

LL_RTC_BKP_DR19

LL_RTC_BKP_DR20

LL_RTC_BKP_DR21

LL_RTC_BKP_DR22

LL_RTC_BKP_DR23

LL_RTC_BKP_DR24

LL_RTC_BKP_DR25

LL_RTC_BKP_DR26

LL_RTC_BKP_DR27

LL_RTC_BKP_DR28

LL_RTC_BKP_DR29

LL_RTC_BKP_DR30

LL_RTC_BKP_DR31

Calibration pulse insertion

LL_RTC_CALIB_INSERTPULSE_NONE No RTCCLK pulses are added

LL_RTC_CALIB_INSERTPULSE_SET One RTCCLK pulse is effectively inserted every $2^{\text{exp}11}$ pulses (frequency increased by 488.5 ppm)

Calibration output

LL_RTC_CALIB_OUTPUT_NONE Calibration output disabled

LL_RTC_CALIB_OUTPUT_1HZ Calibration output is 512 Hz

LL_RTC_CALIB_OUTPUT_512HZ Calibration output is 1 Hz

Calibration period

LL_RTC_CALIB_PERIOD_32SEC Use a 32-second calibration cycle period

LL_RTC_CALIB_PERIOD_16SEC Use a 16-second calibration cycle period

LL_RTC_CALIB_PERIOD_8SEC Use a 8-second calibration cycle period

FORMAT

LL_RTC_FORMAT_BIN Binary data format

LL_RTC_FORMAT_BCD BCD data format

Get Flags Defines

LL_RTC_ISR_ITSF

LL_RTC_ISR_RECALPF

LL_RTC_ISR_TAMP3F

LL_RTC_ISR_TAMP2F

LL_RTC_ISR_TAMP1F

LL_RTC_ISR_TSOVF

LL_RTC_ISR_TSF

LL_RTC_ISR_WUTF

LL_RTC_ISR_ALRBF

LL_RTC_ISR_ALRAF

LL_RTC_ISR_INITF

LL_RTC_ISR_RSF

LL_RTC_ISR_INITS

LL_RTC_ISR_SHPF

LL_RTC_ISR_WUTWF

LL_RTC_ISR_ALRBWF

LL_RTC_ISR_ALRAWF

HOURLY FORMAT

LL_RTC_HOURFORMAT_24HOUR 24 hour/day format

LL_RTC_HOURFORMAT_AMPM AM/PM hour format

IT Defines

LL_RTC_CR_TSIE

LL_RTC_CR_WUTIE

LL_RTC_CR_ALRBIE

LL_RTC_CR_ALRAIE

LL_RTC_TAMPCR_TAMP3IE

LL_RTC_TAMPCR_TAMP2IE

LL_RTC_TAMPCR_TAMP1IE

LL_RTC_TAMPCR_TAMPIE

MONTH

LL_RTC_MONTH_JANUARY January

LL_RTC_MONTH_FEBRUARY February

LL_RTC_MONTH_MARCH March

LL_RTC_MONTH_APRIL April

LL_RTC_MONTH_MAY May

LL_RTC_MONTH_JUNE June

LL_RTC_MONTH_JULY July

LL_RTC_MONTH_AUGUST August

LL_RTC_MONTH_SEPTEMBER September

LL_RTC_MONTH_OCTOBER October

LL_RTC_MONTH_NOVEMBER November

LL_RTC_MONTH_DECEMBER December

OUTPUT POLARITY PIN

LL_RTC_OUTPUTPOLARITY_PIN_HIGH Pin is high when ALRAF/ALRBF/WUTF is asserted (depending on OSEL)

LL_RTC_OUTPUTPOLARITY_PIN_LOW Pin is low when ALRAF/ALRBF/WUTF is asserted (depending on OSEL)

SHIFT SECOND

LL_RTC_SHIFT_SECOND_DELAY

LL_RTC_SHIFT_SECOND_ADVANCE

TAMPER

LL_RTC_TAMPER_1 RTC_TAMP1 input detection

LL_RTC_TAMPER_2 RTC_TAMP2 input detection

LL_RTC_TAMPER_3 RTC_TAMP3 input detection

TAMPER ACTIVE LEVEL

LL_RTC_TAMPER_ACTIVELEVEL_TAMP1 RTC_TAMP1 input falling edge (if TAMPFLT = 00) or staying high (if TAMPFLT != 00) triggers a tamper detection event

LL_RTC_TAMPER_ACTIVELEVEL_TAMP2 RTC_TAMP2 input falling edge (if TAMPFLT = 00) or staying high (if TAMPFLT != 00) triggers a tamper detection event

LL_RTC_TAMPER_ACTIVELEVEL_TAMP3 RTC_TAMP3 input falling edge (if TAMPFLT = 00) or staying high (if TAMPFLT != 00) triggers a tamper detection event

TAMPER DURATION

LL_RTC_TAMPER_DURATION_1RTCCLK Tamper pins are pre-charged before sampling during 1 RTCCLK cycle

LL_RTC_TAMPER_DURATION_2RTCCLK Tamper pins are pre-charged before sampling during 2 RTCCLK cycles

LL_RTC_TAMPER_DURATION_4RTCCLK Tamper pins are pre-charged before sampling during 4 RTCCLK cycles

LL_RTC_TAMPER_DURATION_8RTCCLK Tamper pins are pre-charged before sampling during 8 RTCCLK cycles

TAMPER FILTER

LL_RTC_TAMPER_FILTER_DISABLE Tamper filter is disabled

LL_RTC_TAMPER_FILTER_2SAMPLE Tamper is activated after 2 consecutive samples at the active level

LL_RTC_TAMPER_FILTER_4SAMPLE Tamper is activated after 4 consecutive samples at the active level

LL_RTC_TAMPER_FILTER_8SAMPLE Tamper is activated after 8 consecutive samples at the active level.

TAMPER MASK

LL_RTC_TAMPER_MASK_TAMPER1 Tamper 1 event generates a trigger event. TAMP1F is masked and internally cleared by hardware. The backup registers are not erased

LL_RTC_TAMPER_MASK_TAMPER2 Tamper 2 event generates a trigger event. TAMP2F is masked and internally cleared by hardware. The backup registers are not erased.

LL_RTC_TAMPER_MASK_TAMPER3 Tamper 3 event generates a trigger event. TAMP3F is masked and internally cleared by hardware. The backup registers are not erased

TAMPER NO ERASE

LL_RTC_TAMPER_NOERASE_TAMPER1 Tamper 1 event does not erase the backup registers.

LL_RTC_TAMPER_NOERASE_TAMPER2	Tamper 2 event does not erase the backup registers.
LL_RTC_TAMPER_NOERASE_TAMPER3	Tamper 3 event does not erase the backup registers.

TAMPER SAMPLING FREQUENCY DIVIDER

LL_RTC_TAMPER_SAMPLFREQDIV_32768	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 32768$
LL_RTC_TAMPER_SAMPLFREQDIV_16384	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 16384$
LL_RTC_TAMPER_SAMPLFREQDIV_8192	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 8192$
LL_RTC_TAMPER_SAMPLFREQDIV_4096	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 4096$
LL_RTC_TAMPER_SAMPLFREQDIV_2048	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 2048$
LL_RTC_TAMPER_SAMPLFREQDIV_1024	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 1024$
LL_RTC_TAMPER_SAMPLFREQDIV_512	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 512$
LL_RTC_TAMPER_SAMPLFREQDIV_256	Each of the tamper inputs are sampled with a frequency = $RTCCLK / 256$

TIMESTAMP EDGE

LL_RTC_TIMESTAMP_EDGE_RISING	RTC_TS input rising edge generates a time-stamp event
LL_RTC_TIMESTAMP_EDGE_FALLING	RTC_TS input falling edge generates a time-stamp even

TIME FORMAT

LL_RTC_TIME_FORMAT_AM_OR_24	AM or 24-hour format
LL_RTC_TIME_FORMAT_PM	PM

TIMESTAMP TIME FORMAT

LL_RTC_TS_TIME_FORMAT_AM	AM or 24-hour format
LL_RTC_TS_TIME_FORMAT_PM	PM

WAKEUP CLOCK DIV

LL_RTC_WAKEUPCLOCK_DIV_16	RTC/16 clock is selected
LL_RTC_WAKEUPCLOCK_DIV_8	RTC/8 clock is selected
LL_RTC_WAKEUPCLOCK_DIV_4	RTC/4 clock is selected
LL_RTC_WAKEUPCLOCK_DIV_2	RTC/2 clock is selected
LL_RTC_WAKEUPCLOCK_CKSPRE	ck_spre (usually 1 Hz) clock is selected
LL_RTC_WAKEUPCLOCK_CKSPRE_WUT	ck_spre (usually 1 Hz) clock is selected and 2exp16 is added to the WUT counter value

WEEK DAY

LL_RTC_WEEKDAY_MONDAY	Monday
LL_RTC_WEEKDAY_TUESDAY	Tuesday
LL_RTC_WEEKDAY_WEDNESDAY	Wednesday
LL_RTC_WEEKDAY_THURSDAY	Thursday
LL_RTC_WEEKDAY_FRIDAY	Friday
LL_RTC_WEEKDAY_SATURDAY	Saturday
LL_RTC_WEEKDAY_SUNDAY	Sunday

Convert helper Macros

<code>__LL_RTC_CONVERT_BIN2BCD</code>	<p>Description:</p> <ul style="list-style-type: none"> Helper macro to convert a value from 2 digit decimal format to BCD format. <p>Parameters:</p> <ul style="list-style-type: none"> <code>__VALUE__</code>: Byte to be converted <p>Return value:</p> <ul style="list-style-type: none"> Converted: byte
---------------------------------------	--

<code>__LL_RTC_CONVERT_BCD2BIN</code>	<p>Description:</p> <ul style="list-style-type: none"> Helper macro to convert a value from BCD format to 2 digit decimal format. <p>Parameters:</p> <ul style="list-style-type: none"> <code>__VALUE__</code>: BCD value to be converted <p>Return value:</p> <ul style="list-style-type: none"> Converted: byte
---------------------------------------	---

Date helper Macros

<code>__LL_RTC_GET_WEEKDAY</code>	<p>Description:</p> <ul style="list-style-type: none"> Helper macro to retrieve weekday. <p>Parameters:</p> <ul style="list-style-type: none"> <code>__RTC_DATE__</code>: Date returned by <p>Return value:</p> <ul style="list-style-type: none"> Returned: value can be one of the following values: <ul style="list-style-type: none"> LL_RTC_WEEKDAY_MONDAY LL_RTC_WEEKDAY_TUESDAY LL_RTC_WEEKDAY_WEDNESDAY LL_RTC_WEEKDAY_THURSDAY LL_RTC_WEEKDAY_FRIDAY LL_RTC_WEEKDAY_SATURDAY LL_RTC_WEEKDAY_SUNDAY
-----------------------------------	---

<code>__LL_RTC_GET_YEAR</code>	<p>Description:</p> <ul style="list-style-type: none"> Helper macro to retrieve Year in BCD format. <p>Parameters:</p>
--------------------------------	---

- `__RTC_DATE__`: Value returned by

Return value:

- Year: in BCD format (0x00 . . . 0x99)

`__LL_RTC_GET_MONTH`**Description:**

- Helper macro to retrieve Month in BCD format.

Parameters:

- `__RTC_DATE__`: Value returned by

Return value:

- Returned: value can be one of the following values:
 - `LL_RTC_MONTH_JANUARY`
 - `LL_RTC_MONTH_FEBRUARY`
 - `LL_RTC_MONTH_MARCH`
 - `LL_RTC_MONTH_APRIL`
 - `LL_RTC_MONTH_MAY`
 - `LL_RTC_MONTH_JUNE`
 - `LL_RTC_MONTH_JULY`
 - `LL_RTC_MONTH_AUGUST`
 - `LL_RTC_MONTH_SEPTEMBER`
 - `LL_RTC_MONTH_OCTOBER`
 - `LL_RTC_MONTH_NOVEMBER`
 - `LL_RTC_MONTH_DECEMBER`

`__LL_RTC_GET_DAY`**Description:**

- Helper macro to retrieve Day in BCD format.

Parameters:

- `__RTC_DATE__`: Value returned by

Return value:

- Day: in BCD format (0x01 . . . 0x31)

Time helper Macros`__LL_RTC_GET_HOUR`**Description:**

- Helper macro to retrieve hour in BCD format.

Parameters:

- `__RTC_TIME__`: RTC time returned by

Return value:

- Hours: in BCD format (0x01 . . . 0x12 or between `Min_Data=0x00` and `Max_Data=0x23`)

`__LL_RTC_GET_MINUTE`**Description:**

- Helper macro to retrieve minute in BCD format.

Parameters:

- `__RTC_TIME__`: RTC time returned by

Return value:

- Minutes: in BCD format (0x00. . .0x59)

`__LL_RTC_GET_SECOND` **Description:**

- Helper macro to retrieve second in BCD format.

Parameters:

- `__RTC_TIME__`: RTC time returned by

Return value:

- Seconds: in format (0x00. . .0x59)

Common Write and read registers Macros

`LL_RTC_WriteReg` **Description:**

- Write a value in RTC register.

Parameters:

- `__INSTANCE__`: RTC Instance
- `__REG__`: Register to be written
- `__VALUE__`: Value to be written in the register

Return value:

- None

`LL_RTC_ReadReg` **Description:**

- Read a value in RTC register.

Parameters:

- `__INSTANCE__`: RTC Instance
- `__REG__`: Register to be read

Return value:

- Register: value

88 LL SPI Generic Driver

88.1 SPI Firmware driver registers structures

88.1.1 LL_SPI_InitTypeDef

Data Fields

- *uint32_t TransferDirection*
- *uint32_t Mode*
- *uint32_t DataWidth*
- *uint32_t ClockPolarity*
- *uint32_t ClockPhase*
- *uint32_t NSS*
- *uint32_t BaudRate*
- *uint32_t BitOrder*
- *uint32_t CRCCalculation*
- *uint32_t CRCPoly*

Field Documentation

- ***uint32_t LL_SPI_InitTypeDef::TransferDirection***
Specifies the SPI unidirectional or bidirectional data mode. This parameter can be a value of [SPI_LL_EC_TRANSFER_MODE](#). This feature can be modified afterwards using unitary function [LL_SPI_SetTransferDirection\(\)](#).
- ***uint32_t LL_SPI_InitTypeDef::Mode***
Specifies the SPI mode (Master/Slave). This parameter can be a value of [SPI_LL_EC_MODE](#). This feature can be modified afterwards using unitary function [LL_SPI_SetMode\(\)](#).
- ***uint32_t LL_SPI_InitTypeDef::DataWidth***
Specifies the SPI data width. This parameter can be a value of [SPI_LL_EC_DATAWIDTH](#). This feature can be modified afterwards using unitary function [LL_SPI_SetDataWidth\(\)](#).
- ***uint32_t LL_SPI_InitTypeDef::ClockPolarity***
Specifies the serial clock steady state. This parameter can be a value of [SPI_LL_EC_POLARITY](#). This feature can be modified afterwards using unitary function [LL_SPI_SetClockPolarity\(\)](#).
- ***uint32_t LL_SPI_InitTypeDef::ClockPhase***
Specifies the clock active edge for the bit capture. This parameter can be a value of [SPI_LL_EC_PHASE](#). This feature can be modified afterwards using unitary function [LL_SPI_SetClockPhase\(\)](#).
- ***uint32_t LL_SPI_InitTypeDef::NSS***
Specifies whether the NSS signal is managed by hardware (NSS pin) or by software using the SSI bit. This parameter can be a value of [SPI_LL_EC_NSS_MODE](#). This feature can be modified afterwards using unitary function [LL_SPI_SetNSSMode\(\)](#).
- ***uint32_t LL_SPI_InitTypeDef::BaudRate***
Specifies the BaudRate prescaler value which will be used to configure the transmit and receive SCK clock. This parameter can be a value of [SPI_LL_EC_BAUDRATEPRESCALER](#).
Note: The communication clock is derived from the master clock. The slave clock does not need to be set. This feature can be modified afterwards using unitary function [LL_SPI_SetBaudRatePrescaler\(\)](#).

- ***uint32_t LL_SPI_InitTypeDef::BitOrder***
Specifies whether data transfers start from MSB or LSB bit. This parameter can be a value of ***SPI_LL_EC_BIT_ORDER***. This feature can be modified afterwards using unitary function ***LL_SPI_SetTransferBitOrder()***.
- ***uint32_t LL_SPI_InitTypeDef::CRCCalculation***
Specifies if the CRC calculation is enabled or not. This parameter can be a value of ***SPI_LL_EC_CRC_CALCULATION***. This feature can be modified afterwards using unitary functions ***LL_SPI_EnableCRC()*** and ***LL_SPI_DisableCRC()***.
- ***uint32_t LL_SPI_InitTypeDef::CRCPoly***
Specifies the polynomial used for the CRC calculation. This parameter must be a number between `Min_Data = 0x00` and `Max_Data = 0xFFFF`. This feature can be modified afterwards using unitary function ***LL_SPI_SetCRCPolynomial()***.

88.2 SPI Firmware driver API description

88.2.1 Detailed description of functions

LL_SPI_Enable

Function name	<code>__STATIC_INLINE void LL_SPI_Enable (SPI_TypeDef * SPIx)</code>
Function description	Enable SPI peripheral.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 SPE LL_SPI_Enable

LL_SPI_Disable

Function name	<code>__STATIC_INLINE void LL_SPI_Disable (SPI_TypeDef * SPIx)</code>
Function description	Disable SPI peripheral.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • When disabling the SPI, follow the procedure described in the Reference Manual.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 SPE LL_SPI_Disable

LL_SPI_IsEnabled

Function name	<code>__STATIC_INLINE uint32_t LL_SPI_IsEnabled (SPI_TypeDef * SPIx)</code>
Function description	Check if SPI peripheral is enabled.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross	<ul style="list-style-type: none"> • CR1 SPE LL_SPI_IsEnabled

reference:

LL_SPI_SetMode

Function name	__STATIC_INLINE void LL_SPI_SetMode (SPI_TypeDef * SPIx, uint32_t Mode)
Function description	Set SPI operation mode to Master or Slave.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance • Mode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_SPI_MODE_MASTER – LL_SPI_MODE_SLAVE
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This bit should not be changed when communication is ongoing.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 MSTR LL_SPI_SetMode • CR1 SSI LL_SPI_SetMode

LL_SPI_GetMode

Function name	__STATIC_INLINE uint32_t LL_SPI_GetMode (SPI_TypeDef * SPIx)
Function description	Get SPI operation mode (Master or Slave)
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_SPI_MODE_MASTER – LL_SPI_MODE_SLAVE
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 MSTR LL_SPI_GetMode • CR1 SSI LL_SPI_GetMode

LL_SPI_SetStandard

Function name	__STATIC_INLINE void LL_SPI_SetStandard (SPI_TypeDef * SPIx, uint32_t Standard)
Function description	Set serial protocol used.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance • Standard: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_SPI_PROTOCOL_MOTOROLA – LL_SPI_PROTOCOL_TI
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This bit should be written only when SPI is disabled (SPE = 0) for correct operation.
Reference Manual to LL API cross	<ul style="list-style-type: none"> • CR2 FRF LL_SPI_SetStandard

reference:

LL_SPI_GetStandard

Function name `__STATIC_INLINE uint32_t LL_SPI_GetStandard (SPI_TypeDef * SPIx)`

Function description Get serial protocol used.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_SPI_PROTOCOL_MOTOROLA
 - LL_SPI_PROTOCOL_TI

Reference Manual to LL API cross reference:

- CR2 FRF LL_SPI_GetStandard

LL_SPI_SetClockPhase

Function name `__STATIC_INLINE void LL_SPI_SetClockPhase (SPI_TypeDef * SPIx, uint32_t ClockPhase)`

Function description Set clock phase.

Parameters

- **SPIx:** SPI Instance
- **ClockPhase:** This parameter can be one of the following values:
 - LL_SPI_PHASE_1EDGE
 - LL_SPI_PHASE_2EDGE

Return values

- **None:**

Notes

- This bit should not be changed when communication is ongoing. This bit is not used in SPI TI mode.

Reference Manual to LL API cross reference:

- CR1 CPHA LL_SPI_SetClockPhase

LL_SPI_GetClockPhase

Function name `__STATIC_INLINE uint32_t LL_SPI_GetClockPhase (SPI_TypeDef * SPIx)`

Function description Get clock phase.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_SPI_PHASE_1EDGE
 - LL_SPI_PHASE_2EDGE

Reference Manual to LL API cross reference:

- CR1 CPHA LL_SPI_GetClockPhase

LL_SPI_SetClockPolarity

Function name	__STATIC_INLINE void LL_SPI_SetClockPolarity (SPI_TypeDef * SPIx, uint32_t ClockPolarity)
Function description	Set clock polarity.
Parameters	<ul style="list-style-type: none">• SPIx: SPI Instance• ClockPolarity: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_SPI_POLARITY_LOW– LL_SPI_POLARITY_HIGH
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• This bit should not be changed when communication is ongoing. This bit is not used in SPI TI mode.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 CPOL LL_SPI_SetClockPolarity

LL_SPI_GetClockPolarity

Function name	__STATIC_INLINE uint32_t LL_SPI_GetClockPolarity (SPI_TypeDef * SPIx)
Function description	Get clock polarity.
Parameters	<ul style="list-style-type: none">• SPIx: SPI Instance
Return values	<ul style="list-style-type: none">• Returned: value can be one of the following values:<ul style="list-style-type: none">– LL_SPI_POLARITY_LOW– LL_SPI_POLARITY_HIGH
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 CPOL LL_SPI_GetClockPolarity

LL_SPI_SetBaudRatePrescaler

Function name	__STATIC_INLINE void LL_SPI_SetBaudRatePrescaler (SPI_TypeDef * SPIx, uint32_t BaudRate)
Function description	Set baud rate prescaler.
Parameters	<ul style="list-style-type: none">• SPIx: SPI Instance• BaudRate: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_SPI_BAUDRATEPRESCALER_DIV2– LL_SPI_BAUDRATEPRESCALER_DIV4– LL_SPI_BAUDRATEPRESCALER_DIV8– LL_SPI_BAUDRATEPRESCALER_DIV16– LL_SPI_BAUDRATEPRESCALER_DIV32– LL_SPI_BAUDRATEPRESCALER_DIV64– LL_SPI_BAUDRATEPRESCALER_DIV128– LL_SPI_BAUDRATEPRESCALER_DIV256
Return values	<ul style="list-style-type: none">• None:

- Notes
- These bits should not be changed when communication is ongoing. SPI BaudRate = fPCLK/Prescaler.
- Reference Manual to LL API cross reference:
- CR1 BR LL_SPI_SetBaudRatePrescaler

LL_SPI_GetBaudRatePrescaler

Function name `__STATIC_INLINE uint32_t LL_SPI_GetBaudRatePrescaler (SPI_TypeDef * SPIx)`

Function description Get baud rate prescaler.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_SPI_BAUDRATEPRESCALER_DIV2
 - LL_SPI_BAUDRATEPRESCALER_DIV4
 - LL_SPI_BAUDRATEPRESCALER_DIV8
 - LL_SPI_BAUDRATEPRESCALER_DIV16
 - LL_SPI_BAUDRATEPRESCALER_DIV32
 - LL_SPI_BAUDRATEPRESCALER_DIV64
 - LL_SPI_BAUDRATEPRESCALER_DIV128
 - LL_SPI_BAUDRATEPRESCALER_DIV256

Reference Manual to LL API cross reference:

- CR1 BR LL_SPI_GetBaudRatePrescaler

LL_SPI_SetTransferBitOrder

Function name `__STATIC_INLINE void LL_SPI_SetTransferBitOrder (SPI_TypeDef * SPIx, uint32_t BitOrder)`

Function description Set transfer bit order.

Parameters

- **SPIx:** SPI Instance
- **BitOrder:** This parameter can be one of the following values:
 - LL_SPI_LSB_FIRST
 - LL_SPI_MSB_FIRST

Return values

- **None:**

Notes

- This bit should not be changed when communication is ongoing. This bit is not used in SPI TI mode.

Reference Manual to LL API cross reference:

- CR1 LSBFIRST LL_SPI_SetTransferBitOrder

LL_SPI_GetTransferBitOrder

Function name `__STATIC_INLINE uint32_t LL_SPI_GetTransferBitOrder (SPI_TypeDef * SPIx)`

Function description Get transfer bit order.

Parameters

- **SPIx:** SPI Instance

- Return values
- **Returned:** value can be one of the following values:
 - LL_SPI_LSB_FIRST
 - LL_SPI_MSB_FIRST
- Reference Manual to LL API cross reference:
- CR1 LSBFIRST LL_SPI_GetTransferBitOrder

LL_SPI_SetTransferDirection

Function name **__STATIC_INLINE void LL_SPI_SetTransferDirection (SPI_TypeDef * SPIx, uint32_t TransferDirection)**

Function description Set transfer direction mode.

- Parameters
- **SPIx:** SPI Instance
 - **TransferDirection:** This parameter can be one of the following values:
 - LL_SPI_FULL_DUPLEX
 - LL_SPI_SIMPLEX_RX
 - LL_SPI_HALF_DUPLEX_RX
 - LL_SPI_HALF_DUPLEX_TX

Return values

- **None:**

Notes

- For Half-Duplex mode, Rx Direction is set by default. In master mode, the MOSI pin is used and in slave mode, the MISO pin is used for Half-Duplex.

- Reference Manual to LL API cross reference:
- CR1 RXONLY LL_SPI_SetTransferDirection
 - CR1 BIDIMODE LL_SPI_SetTransferDirection
 - CR1 BIDIOE LL_SPI_SetTransferDirection

LL_SPI_GetTransferDirection

Function name **__STATIC_INLINE uint32_t LL_SPI_GetTransferDirection (SPI_TypeDef * SPIx)**

Function description Get transfer direction mode.

- Parameters
- **SPIx:** SPI Instance

- Return values
- **Returned:** value can be one of the following values:
 - LL_SPI_FULL_DUPLEX
 - LL_SPI_SIMPLEX_RX
 - LL_SPI_HALF_DUPLEX_RX
 - LL_SPI_HALF_DUPLEX_TX

- Reference Manual to LL API cross reference:
- CR1 RXONLY LL_SPI_GetTransferDirection
 - CR1 BIDIMODE LL_SPI_GetTransferDirection
 - CR1 BIDIOE LL_SPI_GetTransferDirection

LL_SPI_SetDataWidth

Function name **__STATIC_INLINE void LL_SPI_SetDataWidth (SPI_TypeDef * SPIx, uint32_t DataWidth)**

Function description Set frame data width.

Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance • DataWidth: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_SPI_DATAWIDTH_4BIT – LL_SPI_DATAWIDTH_5BIT – LL_SPI_DATAWIDTH_6BIT – LL_SPI_DATAWIDTH_7BIT – LL_SPI_DATAWIDTH_8BIT – LL_SPI_DATAWIDTH_9BIT – LL_SPI_DATAWIDTH_10BIT – LL_SPI_DATAWIDTH_11BIT – LL_SPI_DATAWIDTH_12BIT – LL_SPI_DATAWIDTH_13BIT – LL_SPI_DATAWIDTH_14BIT – LL_SPI_DATAWIDTH_15BIT – LL_SPI_DATAWIDTH_16BIT
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 DS LL_SPI_SetDataWidth

LL_SPI_GetDataWidth

Function name	__STATIC_INLINE uint32_t LL_SPI_GetDataWidth (SPI_TypeDef * SPIx)
Function description	Get frame data width.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_SPI_DATAWIDTH_4BIT – LL_SPI_DATAWIDTH_5BIT – LL_SPI_DATAWIDTH_6BIT – LL_SPI_DATAWIDTH_7BIT – LL_SPI_DATAWIDTH_8BIT – LL_SPI_DATAWIDTH_9BIT – LL_SPI_DATAWIDTH_10BIT – LL_SPI_DATAWIDTH_11BIT – LL_SPI_DATAWIDTH_12BIT – LL_SPI_DATAWIDTH_13BIT – LL_SPI_DATAWIDTH_14BIT – LL_SPI_DATAWIDTH_15BIT – LL_SPI_DATAWIDTH_16BIT
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 DS LL_SPI_GetDataWidth

LL_SPI_SetRxFIFOThreshold

Function name	__STATIC_INLINE void LL_SPI_SetRxFIFOThreshold (SPI_TypeDef * SPIx, uint32_t Threshold)
---------------	--

Function description	Set threshold of RXFIFO that triggers an RXNE event.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance • Threshold: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_SPI_RX_FIFO_TH_HALF – LL_SPI_RX_FIFO_TH_QUARTER
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 FRXTH LL_SPI_SetRxFIFOThreshold

LL_SPI_GetRxFIFOThreshold

Function name	__STATIC_INLINE uint32_t LL_SPI_GetRxFIFOThreshold (SPI_TypeDef * SPIx)
Function description	Get threshold of RXFIFO that triggers an RXNE event.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_SPI_RX_FIFO_TH_HALF – LL_SPI_RX_FIFO_TH_QUARTER
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 FRXTH LL_SPI_GetRxFIFOThreshold

LL_SPI_EnableCRC

Function name	__STATIC_INLINE void LL_SPI_EnableCRC (SPI_TypeDef * SPIx)
Function description	Enable CRC.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This bit should be written only when SPI is disabled (SPE = 0) for correct operation.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 CRCEN LL_SPI_EnableCRC

LL_SPI_DisableCRC

Function name	__STATIC_INLINE void LL_SPI_DisableCRC (SPI_TypeDef * SPIx)
Function description	Disable CRC.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This bit should be written only when SPI is disabled (SPE = 0)

for correct operation.

- Reference Manual to LL API cross reference:
- CR1 CRCEN LL_SPI_DisableCRC

LL_SPI_IsEnabledCRC

- Function name **__STATIC_INLINE uint32_t LL_SPI_IsEnabledCRC (SPI_TypeDef * SPIx)**
- Function description Check if CRC is enabled.
- Parameters
- **SPIx:** SPI Instance
- Return values
- **State:** of bit (1 or 0).
- Notes
- This bit should be written only when SPI is disabled (SPE = 0) for correct operation.
- Reference Manual to LL API cross reference:
- CR1 CRCEN LL_SPI_IsEnabledCRC

LL_SPI_SetCRCWidth

- Function name **__STATIC_INLINE void LL_SPI_SetCRCWidth (SPI_TypeDef * SPIx, uint32_t CRCLength)**
- Function description Set CRC Length.
- Parameters
- **SPIx:** SPI Instance
 - **CRCLength:** This parameter can be one of the following values:
 - LL_SPI_CRC_8BIT
 - LL_SPI_CRC_16BIT
- Return values
- **None:**
- Notes
- This bit should be written only when SPI is disabled (SPE = 0) for correct operation.
- Reference Manual to LL API cross reference:
- CR1 CRCL LL_SPI_SetCRCWidth

LL_SPI_GetCRCWidth

- Function name **__STATIC_INLINE uint32_t LL_SPI_GetCRCWidth (SPI_TypeDef * SPIx)**
- Function description Get CRC Length.
- Parameters
- **SPIx:** SPI Instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_SPI_CRC_8BIT
 - LL_SPI_CRC_16BIT
- Reference Manual to LL API cross
- CR1 CRCL LL_SPI_GetCRCWidth

reference:

LL_SPI_SetCRCNext

Function name	__STATIC_INLINE void LL_SPI_SetCRCNext (SPI_TypeDef * SPIx)
Function description	Set CRCNext to transfer CRC on the line.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This bit has to be written as soon as the last data is written in the SPIx_DR register.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 CRCNEXT LL_SPI_SetCRCNext

LL_SPI_SetCRCPolynomial

Function name	__STATIC_INLINE void LL_SPI_SetCRCPolynomial (SPI_TypeDef * SPIx, uint32_t CRCPoly)
Function description	Set polynomial for CRC calculation.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance • CRCPoly: This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFFFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CRCPR CRCPOLY LL_SPI_SetCRCPolynomial

LL_SPI_GetCRCPolynomial

Function name	__STATIC_INLINE uint32_t LL_SPI_GetCRCPolynomial (SPI_TypeDef * SPIx)
Function description	Get polynomial for CRC calculation.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • Returned: value is a number between Min_Data = 0x00 and Max_Data = 0xFFFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CRCPR CRCPOLY LL_SPI_GetCRCPolynomial

LL_SPI_GetRxCRC

Function name	__STATIC_INLINE uint32_t LL_SPI_GetRxCRC (SPI_TypeDef * SPIx)
Function description	Get Rx CRC.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance

- Return values
- **Returned:** value is a number between Min_Data = 0x00 and Max_Data = 0xFFFF
- Reference Manual to LL API cross reference:
- RXCR CR RXCRC LL_SPI_GetRxCRC

LL_SPI_GetTxCRC

- Function name **__STATIC_INLINE uint32_t LL_SPI_GetTxCRC (SPI_TypeDef * SPIx)**
- Function description Get Tx CRC.
- Parameters
- **SPIx:** SPI Instance
- Return values
- **Returned:** value is a number between Min_Data = 0x00 and Max_Data = 0xFFFF
- Reference Manual to LL API cross reference:
- TXCR CR TXCRC LL_SPI_GetTxCRC

LL_SPI_SetNSSMode

- Function name **__STATIC_INLINE void LL_SPI_SetNSSMode (SPI_TypeDef * SPIx, uint32_t NSS)**
- Function description Set NSS mode.
- Parameters
- **SPIx:** SPI Instance
 - **NSS:** This parameter can be one of the following values:
 - LL_SPI_NSS_SOFT
 - LL_SPI_NSS_HARD_INPUT
 - LL_SPI_NSS_HARD_OUTPUT
- Return values
- **None:**
- Notes
- LL_SPI_NSS_SOFT Mode is not used in SPI TI mode.
- Reference Manual to LL API cross reference:
- CR1 SSM LL_SPI_SetNSSMode
 -
 - CR2 SSOE LL_SPI_SetNSSMode

LL_SPI_GetNSSMode

- Function name **__STATIC_INLINE uint32_t LL_SPI_GetNSSMode (SPI_TypeDef * SPIx)**
- Function description Get NSS mode.
- Parameters
- **SPIx:** SPI Instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_SPI_NSS_SOFT
 - LL_SPI_NSS_HARD_INPUT
 - LL_SPI_NSS_HARD_OUTPUT
- Reference Manual to LL API cross reference:
- CR1 SSM LL_SPI_GetNSSMode
 -

reference:

- CR2 SSOE LL_SPI_GetNSSMode

LL_SPI_EnableNSSPulseMgt

Function name `__STATIC_INLINE void LL_SPI_EnableNSSPulseMgt (SPI_TypeDef * SPIx)`

Function description Enable NSS pulse management.

Parameters

- **SPIx**: SPI Instance

Return values

- **None**:

Notes

- This bit should not be changed when communication is ongoing. This bit is not used in SPI TI mode.

Reference Manual to LL API cross reference:

- CR2 NSSP LL_SPI_EnableNSSPulseMgt

LL_SPI_DisableNSSPulseMgt

Function name `__STATIC_INLINE void LL_SPI_DisableNSSPulseMgt (SPI_TypeDef * SPIx)`

Function description Disable NSS pulse management.

Parameters

- **SPIx**: SPI Instance

Return values

- **None**:

Notes

- This bit should not be changed when communication is ongoing. This bit is not used in SPI TI mode.

Reference Manual to LL API cross reference:

- CR2 NSSP LL_SPI_DisableNSSPulseMgt

LL_SPI_IsEnabledNSSPulse

Function name `__STATIC_INLINE uint32_t LL_SPI_IsEnabledNSSPulse (SPI_TypeDef * SPIx)`

Function description Check if NSS pulse is enabled.

Parameters

- **SPIx**: SPI Instance

Return values

- **State**: of bit (1 or 0).

Notes

- This bit should not be changed when communication is ongoing. This bit is not used in SPI TI mode.

Reference Manual to LL API cross reference:

- CR2 NSSP LL_SPI_IsEnabledNSSPulse

LL_SPI_IsActiveFlag_RXNE

Function name `__STATIC_INLINE uint32_t LL_SPI_IsActiveFlag_RXNE (SPI_TypeDef * SPIx)`

Function description	Check if Rx buffer is not empty.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR RXNE LL_SPI_IsActiveFlag_RXNE

LL_SPI_IsActiveFlag_TXE

Function name	__STATIC_INLINE uint32_t LL_SPI_IsActiveFlag_TXE (SPI_TypeDef * SPIx)
Function description	Check if Tx buffer is empty.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR TXE LL_SPI_IsActiveFlag_TXE

LL_SPI_IsActiveFlag_CRCERR

Function name	__STATIC_INLINE uint32_t LL_SPI_IsActiveFlag_CRCERR (SPI_TypeDef * SPIx)
Function description	Get CRC error flag.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR CRCERR LL_SPI_IsActiveFlag_CRCERR

LL_SPI_IsActiveFlag_MODF

Function name	__STATIC_INLINE uint32_t LL_SPI_IsActiveFlag_MODF (SPI_TypeDef * SPIx)
Function description	Get mode fault error flag.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR MODF LL_SPI_IsActiveFlag_MODF

LL_SPI_IsActiveFlag_OVR

Function name	__STATIC_INLINE uint32_t LL_SPI_IsActiveFlag_OVR (SPI_TypeDef * SPIx)
Function description	Get overrun error flag.

Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR OVR LL_SPI_IsActiveFlag_OVR

LL_SPI_IsActiveFlag_BSY

Function name	__STATIC_INLINE uint32_t LL_SPI_IsActiveFlag_BSY (SPI_TypeDef * SPIx)
Function description	Get busy flag.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • The BSY flag is cleared under any one of the following conditions: -When the SPI is correctly disabled -When a fault is detected in Master mode (MODF bit set to 1) -In Master mode, when it finishes a data transmission and no new data is ready to be sent -In Slave mode, when the BSY flag is set to '0' for at least one SPI clock cycle between each data transfer.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR BSY LL_SPI_IsActiveFlag_BSY

LL_SPI_IsActiveFlag_FRE

Function name	__STATIC_INLINE uint32_t LL_SPI_IsActiveFlag_FRE (SPI_TypeDef * SPIx)
Function description	Get frame format error flag.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR FRE LL_SPI_IsActiveFlag_FRE

LL_SPI_GetRxFIFOLevel

Function name	__STATIC_INLINE uint32_t LL_SPI_GetRxFIFOLevel (SPI_TypeDef * SPIx)
Function description	Get FIFO reception Level.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> - LL_SPI_RX_FIFO_EMPTY - LL_SPI_RX_FIFO_QUARTER_FULL - LL_SPI_RX_FIFO_HALF_FULL - LL_SPI_RX_FIFO_FULL

Reference Manual to LL API cross reference: [SR FRLVL LL_SPI_GetRxFIFOLevel](#)

LL_SPI_GetTxFIFOLevel

Function name **__STATIC_INLINE uint32_t LL_SPI_GetTxFIFOLevel (SPI_TypeDef * SPIx)**

Function description Get FIFO Transmission Level.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_SPI_TX_FIFO_EMPTY
 - LL_SPI_TX_FIFO_QUARTER_FULL
 - LL_SPI_TX_FIFO_HALF_FULL
 - LL_SPI_TX_FIFO_FULL

Reference Manual to LL API cross reference: [SR FTLVL LL_SPI_GetTxFIFOLevel](#)

LL_SPI_ClearFlag_CRCERR

Function name **__STATIC_INLINE void LL_SPI_ClearFlag_CRCERR (SPI_TypeDef * SPIx)**

Function description Clear CRC error flag.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference: [SR CRCERR LL_SPI_ClearFlag_CRCERR](#)

LL_SPI_ClearFlag_MODF

Function name **__STATIC_INLINE void LL_SPI_ClearFlag_MODF (SPI_TypeDef * SPIx)**

Function description Clear mode fault error flag.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Notes

- Clearing this flag is done by a read access to the SPIx_SR register followed by a write access to the SPIx_CR1 register

Reference Manual to LL API cross reference: [SR MODF LL_SPI_ClearFlag_MODF](#)

LL_SPI_ClearFlag_OVR

Function name **__STATIC_INLINE void LL_SPI_ClearFlag_OVR (SPI_TypeDef * SPIx)**

Function description	Clear overrun error flag.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Clearing this flag is done by a read access to the SPIx_DR register followed by a read access to the SPIx_SR register
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR OVR LL_SPI_ClearFlag_OVR

LL_SPI_ClearFlag_FRE

Function name	__STATIC_INLINE void LL_SPI_ClearFlag_FRE (SPI_TypeDef * SPIx)
Function description	Clear frame format error flag.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Clearing this flag is done by reading SPIx_SR register
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SR FRE LL_SPI_ClearFlag_FRE

LL_SPI_EnableIT_ERR

Function name	__STATIC_INLINE void LL_SPI_EnableIT_ERR (SPI_TypeDef * SPIx)
Function description	Enable error interrupt.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This bit controls the generation of an interrupt when an error condition occurs (CRCERR, OVR, MODF in SPI mode, FRE at TI mode).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 ERRIE LL_SPI_EnableIT_ERR

LL_SPI_EnableIT_RXNE

Function name	__STATIC_INLINE void LL_SPI_EnableIT_RXNE (SPI_TypeDef * SPIx)
Function description	Enable Rx buffer not empty interrupt.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross	<ul style="list-style-type: none"> • CR2 RXNEIE LL_SPI_EnableIT_RXNE

reference:

LL_SPI_EnableIT_TXE

Function name	__STATIC_INLINE void LL_SPI_EnableIT_TXE (SPI_TypeDef * SPIx)
Function description	Enable Tx buffer empty interrupt.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 TXEIE LL_SPI_EnableIT_TXE

LL_SPI_DisableIT_ERR

Function name	__STATIC_INLINE void LL_SPI_DisableIT_ERR (SPI_TypeDef * SPIx)
Function description	Disable error interrupt.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This bit controls the generation of an interrupt when an error condition occurs (CRCERR, OVR, MODF in SPI mode, FRE at TI mode).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 ERRIE LL_SPI_DisableIT_ERR

LL_SPI_DisableIT_RXNE

Function name	__STATIC_INLINE void LL_SPI_DisableIT_RXNE (SPI_TypeDef * SPIx)
Function description	Disable Rx buffer not empty interrupt.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 RXNEIE LL_SPI_DisableIT_RXNE

LL_SPI_DisableIT_TXE

Function name	__STATIC_INLINE void LL_SPI_DisableIT_TXE (SPI_TypeDef * SPIx)
Function description	Disable Tx buffer empty interrupt.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • None:

Reference Manual to LL API cross reference:

- CR2 TXEIE LL_SPI_DisableIT_TXE

LL_SPI_IsEnabledIT_ERR

Function name `__STATIC_INLINE uint32_t LL_SPI_IsEnabledIT_ERR (SPI_TypeDef * SPIx)`

Function description Check if error interrupt is enabled.

Parameters

- **SPIx**: SPI Instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 ERRIE LL_SPI_IsEnabledIT_ERR

LL_SPI_IsEnabledIT_RXNE

Function name `__STATIC_INLINE uint32_t LL_SPI_IsEnabledIT_RXNE (SPI_TypeDef * SPIx)`

Function description Check if Rx buffer not empty interrupt is enabled.

Parameters

- **SPIx**: SPI Instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 RXNEIE LL_SPI_IsEnabledIT_RXNE

LL_SPI_IsEnabledIT_TXE

Function name `__STATIC_INLINE uint32_t LL_SPI_IsEnabledIT_TXE (SPI_TypeDef * SPIx)`

Function description Check if Tx buffer empty interrupt.

Parameters

- **SPIx**: SPI Instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 TXEIE LL_SPI_IsEnabledIT_TXE

LL_SPI_EnableDMAReq_RX

Function name `__STATIC_INLINE void LL_SPI_EnableDMAReq_RX (SPI_TypeDef * SPIx)`

Function description Enable DMA Rx.

Parameters

- **SPIx**: SPI Instance

Return values

- **None**:

Reference Manual to LL API cross

- CR2 RXDMAEN LL_SPI_EnableDMAReq_RX

reference:

LL_SPI_DisableDMAReq_RX

Function name `__STATIC_INLINE void LL_SPI_DisableDMAReq_RX (SPI_TypeDef * SPIx)`

Function description Disable DMA Rx.

Parameters

- **SPIx**: SPI Instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- CR2 RXDMAEN LL_SPI_DisableDMAReq_RX

LL_SPI_IsEnabledDMAReq_RX

Function name `__STATIC_INLINE uint32_t LL_SPI_IsEnabledDMAReq_RX (SPI_TypeDef * SPIx)`

Function description Check if DMA Rx is enabled.

Parameters

- **SPIx**: SPI Instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 RXDMAEN LL_SPI_IsEnabledDMAReq_RX

LL_SPI_EnableDMAReq_TX

Function name `__STATIC_INLINE void LL_SPI_EnableDMAReq_TX (SPI_TypeDef * SPIx)`

Function description Enable DMA Tx.

Parameters

- **SPIx**: SPI Instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- CR2 TXDMAEN LL_SPI_EnableDMAReq_TX

LL_SPI_DisableDMAReq_TX

Function name `__STATIC_INLINE void LL_SPI_DisableDMAReq_TX (SPI_TypeDef * SPIx)`

Function description Disable DMA Tx.

Parameters

- **SPIx**: SPI Instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- CR2 TXDMAEN LL_SPI_DisableDMAReq_TX

LL_SPI_IsEnabledDMAReq_TX

Function name	__STATIC_INLINE uint32_t LL_SPI_IsEnabledDMAReq_TX (SPI_TypeDef * SPIx)
Function description	Check if DMA Tx is enabled.
Parameters	<ul style="list-style-type: none">• SPIx: SPI Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR2 TXDMAEN LL_SPI_IsEnabledDMAReq_TX

LL_SPI_SetDMAParity_RX

Function name	__STATIC_INLINE void LL_SPI_SetDMAParity_RX (SPI_TypeDef * SPIx, uint32_t Parity)
Function description	Set parity of Last DMA reception.
Parameters	<ul style="list-style-type: none">• SPIx: SPI Instance• Parity: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_SPI_DMA_PARITY_ODD– LL_SPI_DMA_PARITY_EVEN
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR2 LDMARX LL_SPI_SetDMAParity_RX

LL_SPI_GetDMAParity_RX

Function name	__STATIC_INLINE uint32_t LL_SPI_GetDMAParity_RX (SPI_TypeDef * SPIx)
Function description	Get parity configuration for Last DMA reception.
Parameters	<ul style="list-style-type: none">• SPIx: SPI Instance
Return values	<ul style="list-style-type: none">• Returned: value can be one of the following values:<ul style="list-style-type: none">– LL_SPI_DMA_PARITY_ODD– LL_SPI_DMA_PARITY_EVEN
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR2 LDMARX LL_SPI_GetDMAParity_RX

LL_SPI_SetDMAParity_TX

Function name	__STATIC_INLINE void LL_SPI_SetDMAParity_TX (SPI_TypeDef * SPIx, uint32_t Parity)
Function description	Set parity of Last DMA transmission.
Parameters	<ul style="list-style-type: none">• SPIx: SPI Instance• Parity: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_SPI_DMA_PARITY_ODD– LL_SPI_DMA_PARITY_EVEN

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR2 LDMATX LL_SPI_SetDMAParity_TX

LL_SPI_GetDMAParity_TX

- Function name **__STATIC_INLINE uint32_t LL_SPI_GetDMAParity_TX (SPI_TypeDef * SPIx)**
- Function description Get parity configuration for Last DMA transmission.
- Parameters
- **SPIx:** SPI Instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_SPI_DMA_PARITY_ODD
 - LL_SPI_DMA_PARITY_EVEN
- Reference Manual to LL API cross reference:
- CR2 LDMATX LL_SPI_GetDMAParity_TX

LL_SPI_DMA_GetRegAddr

- Function name **__STATIC_INLINE uint32_t LL_SPI_DMA_GetRegAddr (SPI_TypeDef * SPIx)**
- Function description Get the data register address used for DMA transfer.
- Parameters
- **SPIx:** SPI Instance
- Return values
- **Address:** of data register
- Reference Manual to LL API cross reference:
- DR DR LL_SPI_DMA_GetRegAddr

LL_SPI_ReceiveData8

- Function name **__STATIC_INLINE uint8_t LL_SPI_ReceiveData8 (SPI_TypeDef * SPIx)**
- Function description Read 8-Bits in the data register.
- Parameters
- **SPIx:** SPI Instance
- Return values
- **RxDData:** Value between Min_Data=0x00 and Max_Data=0xFF
- Reference Manual to LL API cross reference:
- DR DR LL_SPI_ReceiveData8

LL_SPI_ReceiveData16

- Function name **__STATIC_INLINE uint16_t LL_SPI_ReceiveData16 (SPI_TypeDef * SPIx)**
- Function description Read 16-Bits in the data register.

Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • RxDData: Value between Min_Data=0x00 and Max_Data=0xFFFF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DR DR LL_SPI_ReceiveData16

LL_SPI_TransmitData8

Function name	__STATIC_INLINE void LL_SPI_TransmitData8 (SPI_TypeDef * SPIx, uint8_t TxData)
Function description	Write 8-Bits in the data register.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance • TxDData: Value between Min_Data=0x00 and Max_Data=0xFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DR DR LL_SPI_TransmitData8

LL_SPI_TransmitData16

Function name	__STATIC_INLINE void LL_SPI_TransmitData16 (SPI_TypeDef * SPIx, uint16_t TxData)
Function description	Write 16-Bits in the data register.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance • TxDData: Value between Min_Data=0x00 and Max_Data=0xFFFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DR DR LL_SPI_TransmitData16

LL_SPI_DeInit

Function name	ErrorStatus LL_SPI_DeInit (SPI_TypeDef * SPIx)
Function description	De-initialize the SPI registers to their default reset values.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: SPI registers are de-initialized – ERROR: SPI registers are not de-initialized

LL_SPI_Init

Function name	ErrorStatus LL_SPI_Init (SPI_TypeDef * SPIx, LL_SPI_InitTypeDef * SPI_InitStruct)
---------------	--

Function description	Initialize the SPI registers according to the specified parameters in SPI_InitStruct.
Parameters	<ul style="list-style-type: none"> • SPIx: SPI Instance • SPI_InitStruct: pointer to a LL_SPI_InitTypeDef structure
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value. (Return always SUCCESS)
Notes	<ul style="list-style-type: none"> • As some bits in SPI configuration registers can only be written when the SPI is disabled (SPI_CR1_SPE bit =0), SPI IP should be in disabled state prior calling this function. Otherwise, ERROR result will be returned.

LL_SPI_StructInit

Function name	void LL_SPI_StructInit (LL_SPI_InitTypeDef * SPI_InitStruct)
Function description	Set each LL_SPI_InitTypeDef field to default value.
Parameters	<ul style="list-style-type: none"> • SPI_InitStruct: pointer to a LL_SPI_InitTypeDef structure whose fields will be set to default values.
Return values	<ul style="list-style-type: none"> • None:

88.3 SPI Firmware driver defines

88.3.1 SPI

Baud Rate Prescaler

LL_SPI_BAUDRATEPRESCALER_DIV2	BaudRate control equal to fPCLK/2
LL_SPI_BAUDRATEPRESCALER_DIV4	BaudRate control equal to fPCLK/4
LL_SPI_BAUDRATEPRESCALER_DIV8	BaudRate control equal to fPCLK/8
LL_SPI_BAUDRATEPRESCALER_DIV16	BaudRate control equal to fPCLK/16
LL_SPI_BAUDRATEPRESCALER_DIV32	BaudRate control equal to fPCLK/32
LL_SPI_BAUDRATEPRESCALER_DIV64	BaudRate control equal to fPCLK/64
LL_SPI_BAUDRATEPRESCALER_DIV128	BaudRate control equal to fPCLK/128
LL_SPI_BAUDRATEPRESCALER_DIV256	BaudRate control equal to fPCLK/256

Transmission Bit Order

LL_SPI_LSB_FIRST	Data is transmitted/received with the LSB first
LL_SPI_MSB_FIRST	Data is transmitted/received with the MSB first

CRC Calculation

LL_SPI_CRCCALCULATION_DISABLE	CRC calculation disabled
LL_SPI_CRCCALCULATION_ENABLE	CRC calculation enabled

CRC Length

LL_SPI_CRC_8BIT	8-bit CRC length
LL_SPI_CRC_16BIT	16-bit CRC length

Datawidth

LL_SPI_DATAWIDTH_4BIT	Data length for SPI transfer: 4 bits
LL_SPI_DATAWIDTH_5BIT	Data length for SPI transfer: 5 bits
LL_SPI_DATAWIDTH_6BIT	Data length for SPI transfer: 6 bits
LL_SPI_DATAWIDTH_7BIT	Data length for SPI transfer: 7 bits
LL_SPI_DATAWIDTH_8BIT	Data length for SPI transfer: 8 bits
LL_SPI_DATAWIDTH_9BIT	Data length for SPI transfer: 9 bits
LL_SPI_DATAWIDTH_10BIT	Data length for SPI transfer: 10 bits
LL_SPI_DATAWIDTH_11BIT	Data length for SPI transfer: 11 bits
LL_SPI_DATAWIDTH_12BIT	Data length for SPI transfer: 12 bits
LL_SPI_DATAWIDTH_13BIT	Data length for SPI transfer: 13 bits
LL_SPI_DATAWIDTH_14BIT	Data length for SPI transfer: 14 bits
LL_SPI_DATAWIDTH_15BIT	Data length for SPI transfer: 15 bits
LL_SPI_DATAWIDTH_16BIT	Data length for SPI transfer: 16 bits

DMA Parity

LL_SPI_DMA_PARITY_EVEN	Select DMA parity Even
LL_SPI_DMA_PARITY_ODD	Select DMA parity Odd

Get Flags Defines

LL_SPI_SR_RXNE	Rx buffer not empty flag
LL_SPI_SR_TXE	Tx buffer empty flag
LL_SPI_SR_BSY	Busy flag
LL_SPI_SR_CRCERR	CRC error flag
LL_SPI_SR_MODF	Mode fault flag
LL_SPI_SR_OVR	Overrun flag
LL_SPI_SR_FRE	TI mode frame format error flag

IT Defines

LL_SPI_CR2_RXNEIE	Rx buffer not empty interrupt enable
LL_SPI_CR2_TXEIE	Tx buffer empty interrupt enable
LL_SPI_CR2_ERRIE	Error interrupt enable

Operation Mode

LL_SPI_MODE_MASTER	Master configuration
LL_SPI_MODE_SLAVE	Slave configuration

Slave Select Pin Mode

LL_SPI_NSS_SOFT	NSS managed internally. NSS pin not used and free
LL_SPI_NSS_HARD_INPUT	NSS pin used in Input. Only used in Master mode
LL_SPI_NSS_HARD_OUTPUT	NSS pin used in Output. Only used in Slave mode as chip select

Clock Phase

LL_SPI_PHASE_1EDGE First clock transition is the first data capture edge
 LL_SPI_PHASE_2EDGE Second clock transition is the first data capture edge

Clock Polarity

LL_SPI_POLARITY_LOW Clock to 0 when idle
 LL_SPI_POLARITY_HIGH Clock to 1 when idle

Serial Protocol

LL_SPI_PROTOCOL_MOTOROLA Motorola mode. Used as default value
 LL_SPI_PROTOCOL_TI TI mode

RX FIFO Level

LL_SPI_RX_FIFO_EMPTY FIFO reception empty
 LL_SPI_RX_FIFO_QUARTER_FULL FIFO reception 1/4
 LL_SPI_RX_FIFO_HALF_FULL FIFO reception 1/2
 LL_SPI_RX_FIFO_FULL FIFO reception full

RX FIFO Threshold

LL_SPI_RX_FIFO_TH_HALF RXNE event is generated if FIFO level is greater than or equal to 1/2 (16-bit)
 LL_SPI_RX_FIFO_TH_QUARTER RXNE event is generated if FIFO level is greater than or equal to 1/4 (8-bit)

Transfer Mode

LL_SPI_FULL_DUPLEX Full-Duplex mode. Rx and Tx transfer on 2 lines
 LL_SPI_SIMPLEX_RX Simplex Rx mode. Rx transfer only on 1 line
 LL_SPI_HALF_DUPLEX_RX Half-Duplex Rx mode. Rx transfer on 1 line
 LL_SPI_HALF_DUPLEX_TX Half-Duplex Tx mode. Tx transfer on 1 line

TX FIFO Level

LL_SPI_TX_FIFO_EMPTY FIFO transmission empty
 LL_SPI_TX_FIFO_QUARTER_FULL FIFO transmission 1/4
 LL_SPI_TX_FIFO_HALF_FULL FIFO transmission 1/2
 LL_SPI_TX_FIFO_FULL FIFO transmission full

Common Write and read registers Macros

LL_SPI_WriteReg

Description:

- Write a value in SPI register.

Parameters:

- `__INSTANCE__`: SPI Instance
- `__REG__`: Register to be written
- `__VALUE__`: Value to be written in the register

Return value:

- None

`LL_SPI_ReadReg`**Description:**

- Read a value in SPI register.

Parameters:

- `__INSTANCE__`: SPI Instance
- `__REG__`: Register to be read

Return value:

- Register: value

89 LL SYSTEM Generic Driver

89.1 SYSTEM Firmware driver API description

89.1.1 Detailed description of functions

LL_SYSCFG_EnableFMCMemorySwapping

Function name	__STATIC_INLINE void LL_SYSCFG_EnableFMCMemorySwapping (void)
Function description	Enables the FMC Memory Mapping Swapping.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • SDRAM is accessible at 0x60000000 and NOR/RAM is accessible at 0xC0000000
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SYSCFG_MEMRMP SWP_FMC LL_SYSCFG_EnableFMCMemorySwapping

LL_SYSCFG_DisableFMCMemorySwapping

Function name	__STATIC_INLINE void LL_SYSCFG_DisableFMCMemorySwapping (void)
Function description	Disables the FMC Memory Mapping Swapping.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • SDRAM is accessible at 0xC0000000 (default mapping) and NOR/RAM is accessible at 0x60000000 (default mapping)
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SYSCFG_MEMRMP SWP_FMC LL_SYSCFG_DisableFMCMemorySwapping

LL_SYSCFG_EnableCompensationCell

Function name	__STATIC_INLINE void LL_SYSCFG_EnableCompensationCell (void)
Function description	Enables the Compensation Cell.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The I/O compensation cell can be used only when the device supply voltage ranges from 2.4 to 3.6 V
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SYSCFG_CMPCR CMP_PD LL_SYSCFG_EnableCompensationCell

LL_SYSCFG_DisableCompensationCell

Function name	__STATIC_INLINE void
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LL_SYSCFG_DisableCompensationCell (void)

Function description	Disables the Compensation Cell.
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The I/O compensation cell can be used only when the device supply voltage ranges from 2.4 to 3.6 V
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SYSCFG_CMPCR CMP_PD LL_SYSCFG_DisableCompensationCell

LL_SYSCFG_IsActiveFlag_CMPCR

Function name	__STATIC_INLINE uint32_t LL_SYSCFG_IsActiveFlag_CMPCR (void)
Function description	Get Compensation Cell ready Flag.
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SYSCFG_CMPCR READY LL_SYSCFG_IsActiveFlag_CMPCR

LL_SYSCFG_GetRemapMemoryBoot

Function name	__STATIC_INLINE uint32_t LL_SYSCFG_GetRemapMemoryBoot (void)
Function description	Get the memory boot mapping as configured by user.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: (*) value not defined in all devices <ul style="list-style-type: none"> – LL_SYSCFG_REMAP_BOOT0 – LL_SYSCFG_REMAP_BOOT1
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SYSCFG_MEMRMP MEM_BOOT LL_SYSCFG_GetRemapMemoryBoot

LL_SYSCFG_SetPHYInterface

Function name	__STATIC_INLINE void LL_SYSCFG_SetPHYInterface (uint32_t Interface)
Function description	Select Ethernet PHY interface.
Parameters	<ul style="list-style-type: none"> • Interface: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_SYSCFG_PMC_ETHMII – LL_SYSCFG_PMC_ETHRMII
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SYSCFG_PMC MII_RMII_SEL LL_SYSCFG_SetPHYInterface

LL_SYSCFG_GetPHYInterface

Function name	__STATIC_INLINE uint32_t LL_SYSCFG_GetPHYInterface (void)
Function description	Get Ethernet PHY interface.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_SYSCFG_PMC_ETHMII – LL_SYSCFG_PMC_ETHRMII • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SYSCFG_PMC MII_RMII_SEL • LL_SYSCFG_GetPHYInterface

LL_SYSCFG_SetFlashBankMode

Function name	__STATIC_INLINE void LL_SYSCFG_SetFlashBankMode (uint32_t Bank)
Function description	Select Flash bank mode (Bank flashed at 0x08000000)
Parameters	<ul style="list-style-type: none"> • Bank: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_SYSCFG_BANKMODE_BANK1 – LL_SYSCFG_BANKMODE_BANK2
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SYSCFG_MEMRMP_FB_MODE • LL_SYSCFG_SetFlashBankMode

LL_SYSCFG_GetFlashBankMode

Function name	__STATIC_INLINE uint32_t LL_SYSCFG_GetFlashBankMode (void)
Function description	Get Flash bank mode (Bank flashed at 0x08000000)
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_SYSCFG_BANKMODE_BANK1 – LL_SYSCFG_BANKMODE_BANK2 • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SYSCFG_MEMRMP_FB_MODE • LL_SYSCFG_GetFlashBankMode

LL_SYSCFG_EnableFastModePlus

Function name	__STATIC_INLINE void LL_SYSCFG_EnableFastModePlus (uint32_t ConfigFastModePlus)
Function description	Enable the I2C fast mode plus driving capability.
Parameters	<ul style="list-style-type: none"> • ConfigFastModePlus: This parameter can be a combination of the following values: (*) value not defined in all devices <ul style="list-style-type: none"> – LL_SYSCFG_I2C_FASTMODEPLUS_PB6 – LL_SYSCFG_I2C_FASTMODEPLUS_PB7 – LL_SYSCFG_I2C_FASTMODEPLUS_PB8 (*)

- LL_SYSCFG_I2C_FASTMODEPLUS_PB9 (*)
- LL_SYSCFG_I2C_FASTMODEPLUS_I2C1
- LL_SYSCFG_I2C_FASTMODEPLUS_I2C2 (*)
- LL_SYSCFG_I2C_FASTMODEPLUS_I2C3
- LL_SYSCFG_I2C_FASTMODEPLUS_I2C4(*)

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_PMC I2C_PBx_FMP
LL_SYSCFG_EnableFastModePlus
- SYSCFG_PMC I2Cx_FMP
LL_SYSCFG_EnableFastModePlus

LL_SYSCFG_DisableFastModePlus

Function name **__STATIC_INLINE void LL_SYSCFG_DisableFastModePlus (uint32_t ConfigFastModePlus)**

Function description Disable the I2C fast mode plus driving capability.

Parameters

- **ConfigFastModePlus:** This parameter can be a combination of the following values:
 - LL_SYSCFG_I2C_FASTMODEPLUS_PB6
 - LL_SYSCFG_I2C_FASTMODEPLUS_PB7
 - LL_SYSCFG_I2C_FASTMODEPLUS_PB8 (*)
 - LL_SYSCFG_I2C_FASTMODEPLUS_PB9 (*)
 - LL_SYSCFG_I2C_FASTMODEPLUS_I2C1
 - LL_SYSCFG_I2C_FASTMODEPLUS_I2C2 (*)
 - LL_SYSCFG_I2C_FASTMODEPLUS_I2C3
 - LL_SYSCFG_I2C_FASTMODEPLUS_I2C4 (*) value not defined in all devices

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_PMC I2C_PBx_FMP
LL_SYSCFG_DisableFastModePlus
- SYSCFG_PMC I2Cx_FMP
LL_SYSCFG_DisableFastModePlus

LL_SYSCFG_SetEXTISource

Function name **__STATIC_INLINE void LL_SYSCFG_SetEXTISource (uint32_t Port, uint32_t Line)**

Function description Configure source input for the EXTI external interrupt.

Parameters

- **Port:** This parameter can be one of the following values: (*) value not defined in all devices
 - LL_SYSCFG_EXTI_PORTA
 - LL_SYSCFG_EXTI_PORTB
 - LL_SYSCFG_EXTI_PORTC
 - LL_SYSCFG_EXTI_PORTD
 - LL_SYSCFG_EXTI_PORTE
 - LL_SYSCFG_EXTI_PORTF
 - LL_SYSCFG_EXTI_PORTG
 - LL_SYSCFG_EXTI_PORTH
 - LL_SYSCFG_EXTI_PORTI

- LL_SYSCFG_EXTI_PORTJ
- LL_SYSCFG_EXTI_PORTK
- **Line:** This parameter can be one of the following values:
 - LL_SYSCFG_EXTI_LINE0
 - LL_SYSCFG_EXTI_LINE1
 - LL_SYSCFG_EXTI_LINE2
 - LL_SYSCFG_EXTI_LINE3
 - LL_SYSCFG_EXTI_LINE4
 - LL_SYSCFG_EXTI_LINE5
 - LL_SYSCFG_EXTI_LINE6
 - LL_SYSCFG_EXTI_LINE7
 - LL_SYSCFG_EXTI_LINE8
 - LL_SYSCFG_EXTI_LINE9
 - LL_SYSCFG_EXTI_LINE10
 - LL_SYSCFG_EXTI_LINE11
 - LL_SYSCFG_EXTI_LINE12
 - LL_SYSCFG_EXTI_LINE13
 - LL_SYSCFG_EXTI_LINE14
 - LL_SYSCFG_EXTI_LINE15

Return values

- **None:**
- SYSCFG_EXTICR1 EXTIx LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTIx LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTIx LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTIx LL_SYSCFG_SetEXTISource

Reference Manual to
LL API cross
reference:

LL_SYSCFG_GetEXTISource

Function name `__STATIC_INLINE uint32_t LL_SYSCFG_GetEXTISource
(uint32_t Line)`

Function description Get the configured defined for specific EXTI Line.

Parameters

- **Line:** This parameter can be one of the following values:
 - LL_SYSCFG_EXTI_LINE0
 - LL_SYSCFG_EXTI_LINE1
 - LL_SYSCFG_EXTI_LINE2
 - LL_SYSCFG_EXTI_LINE3
 - LL_SYSCFG_EXTI_LINE4
 - LL_SYSCFG_EXTI_LINE5
 - LL_SYSCFG_EXTI_LINE6
 - LL_SYSCFG_EXTI_LINE7
 - LL_SYSCFG_EXTI_LINE8
 - LL_SYSCFG_EXTI_LINE9
 - LL_SYSCFG_EXTI_LINE10
 - LL_SYSCFG_EXTI_LINE11
 - LL_SYSCFG_EXTI_LINE12
 - LL_SYSCFG_EXTI_LINE13
 - LL_SYSCFG_EXTI_LINE14
 - LL_SYSCFG_EXTI_LINE15

Return values

- **Returned:** value can be one of the following values:
 - LL_SYSCFG_EXTI_PORTA
 - LL_SYSCFG_EXTI_PORTB

- LL_SYSCFG_EXTI_PORTC
- LL_SYSCFG_EXTI_PORTD
- LL_SYSCFG_EXTI_PORTE
- LL_SYSCFG_EXTI_PORTF
- LL_SYSCFG_EXTI_PORTG
- LL_SYSCFG_EXTI_PORTH
- LL_SYSCFG_EXTI_PORTI
- LL_SYSCFG_EXTI_PORTJ
- LL_SYSCFG_EXTI_PORTK (*) value not defined in all devices

Reference Manual to LL API cross reference:

- SYSCFG_EXTICR1 EXTIX LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTIX LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTIX LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTIX LL_SYSCFG_GetEXTISource

LL_SYSCFG_SetTIMBreakInputs

Function name	__STATIC_INLINE void LL_SYSCFG_SetTIMBreakInputs (uint32_t Break)
Function description	Set connections to TIM1/8/15/16/17 Break inputs SYSCFG_CBR CLL LL_SYSCFG_SetTIMBreakInputs SYSCFG_CBR PVDL LL_SYSCFG_SetTIMBreakInputs.
Parameters	<ul style="list-style-type: none"> • Break: This parameter can be a combination of the following values: <ul style="list-style-type: none"> - LL_SYSCFG_TIMBREAK_LOCKUP - LL_SYSCFG_TIMBREAK_PVD
Return values	<ul style="list-style-type: none"> • None:

LL_SYSCFG_GetTIMBreakInputs

Function name	__STATIC_INLINE uint32_t LL_SYSCFG_GetTIMBreakInputs (void)
Function description	Get connections to TIM1/8/15/16/17 Break inputs SYSCFG_CBR CLL LL_SYSCFG_GetTIMBreakInputs SYSCFG_CBR PVDL LL_SYSCFG_GetTIMBreakInputs.
Return values	<ul style="list-style-type: none"> • Returned: value can be can be a combination of the following values: <ul style="list-style-type: none"> - LL_SYSCFG_TIMBREAK_LOCKUP - LL_SYSCFG_TIMBREAK_PVD

LL_DBGMCU_GetDeviceID

Function name	__STATIC_INLINE uint32_t LL_DBGMCU_GetDeviceID (void)
Function description	Return the device identifier.
Return values	<ul style="list-style-type: none"> • Values: between Min_Data=0x00 and Max_Data=0xFFFF
Notes	<ul style="list-style-type: none"> • For STM32F75xxx and STM32F74xxx devices, the device ID is 0x449 • For STM32F77xxx and STM32F76xxx devices, the device ID is 0x451

- For STM32F72xxx and STM32F73xxx devices, the device ID is 0x452
- Reference Manual to LL API cross reference:
- DBGMCU_IDCODE DEV_ID LL_DBGMCU_GetDeviceID

LL_DBGMCU_GetRevisionID

Function name `__STATIC_INLINE uint32_t LL_DBGMCU_GetRevisionID (void)`

Function description Return the device revision identifier.

Return values

- **Values:** between Min_Data=0x00 and Max_Data=0xFFFF

Notes

- This field indicates the revision of the device. For example, it is read as RevA -> 0x1000, Cat 2 revZ -> 0x1001

- Reference Manual to LL API cross reference:
- DBGMCU_IDCODE REV_ID LL_DBGMCU_GetRevisionID

LL_DBGMCU_EnableDBGSleepMode

Function name `__STATIC_INLINE void LL_DBGMCU_EnableDBGSleepMode (void)`

Function description Enable the Debug Module during SLEEP mode.

Return values

- **None:**

- Reference Manual to LL API cross reference:
- DBGMCU_CR DBG_SLEEP
LL_DBGMCU_EnableDBGSleepMode

LL_DBGMCU_DisableDBGSleepMode

Function name `__STATIC_INLINE void LL_DBGMCU_DisableDBGSleepMode (void)`

Function description Disable the Debug Module during SLEEP mode.

Return values

- **None:**

- Reference Manual to LL API cross reference:
- DBGMCU_CR DBG_SLEEP
LL_DBGMCU_DisableDBGSleepMode

LL_DBGMCU_EnableDBGStopMode

Function name `__STATIC_INLINE void LL_DBGMCU_EnableDBGStopMode (void)`

Function description Enable the Debug Module during STOP mode.

Return values

- **None:**

- Reference Manual to LL API cross reference:
- DBGMCU_CR DBG_STOP
LL_DBGMCU_EnableDBGStopMode

LL_DBGMCU_DisableDBGStopMode

Function name	__STATIC_INLINE void LL_DBGMCU_DisableDBGStopMode (void)
Function description	Disable the Debug Module during STOP mode.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DBGMCU_CR DBG_STOP• LL_DBGMCU_DisableDBGStopMode

LL_DBGMCU_EnableDBGStandbyMode

Function name	__STATIC_INLINE void LL_DBGMCU_EnableDBGStandbyMode (void)
Function description	Enable the Debug Module during STANDBY mode.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DBGMCU_CR DBG_STANDBY• LL_DBGMCU_EnableDBGStandbyMode

LL_DBGMCU_DisableDBGStandbyMode

Function name	__STATIC_INLINE void LL_DBGMCU_DisableDBGStandbyMode (void)
Function description	Disable the Debug Module during STANDBY mode.
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DBGMCU_CR DBG_STANDBY• LL_DBGMCU_DisableDBGStandbyMode

LL_DBGMCU_SetTracePinAssignment

Function name	__STATIC_INLINE void LL_DBGMCU_SetTracePinAssignment (uint32_t PinAssignment)
Function description	Set Trace pin assignment control.
Parameters	<ul style="list-style-type: none">• PinAssignment: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_DBGMCU_TRACE_NONE– LL_DBGMCU_TRACE_ASYNC– LL_DBGMCU_TRACE_SYNC_SIZE1– LL_DBGMCU_TRACE_SYNC_SIZE2– LL_DBGMCU_TRACE_SYNC_SIZE4
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DBGMCU_CR TRACE_IOEN• LL_DBGMCU_SetTracePinAssignment• DBGMCU_CR TRACE_MODE• LL_DBGMCU_SetTracePinAssignment

LL_DBGMCU_GetTracePinAssignment

Function name	__STATIC_INLINE uint32_t LL_DBGMCU_GetTracePinAssignment (void)
Function description	Get Trace pin assignment control.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_DBGMCU_TRACE_NONE – LL_DBGMCU_TRACE_ASYNCH – LL_DBGMCU_TRACE_SYNCH_SIZE1 – LL_DBGMCU_TRACE_SYNCH_SIZE2 – LL_DBGMCU_TRACE_SYNCH_SIZE4
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DBGMCU_CR TRACE_IOEN LL_DBGMCU_GetTracePinAssignment • DBGMCU_CR TRACE_MODE LL_DBGMCU_GetTracePinAssignment

LL_DBGMCU_APB1_GRP1_FreezePeriph

Function name	__STATIC_INLINE void LL_DBGMCU_APB1_GRP1_FreezePeriph (uint32_t Periphs)
Function description	Freeze APB1 peripherals (group1 peripherals)
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_DBGMCU_APB1_GRP1_TIM2_STOP – LL_DBGMCU_APB1_GRP1_TIM3_STOP – LL_DBGMCU_APB1_GRP1_TIM4_STOP – LL_DBGMCU_APB1_GRP1_TIM5_STOP – LL_DBGMCU_APB1_GRP1_TIM6_STOP – LL_DBGMCU_APB1_GRP1_TIM7_STOP – LL_DBGMCU_APB1_GRP1_TIM12_STOP – LL_DBGMCU_APB1_GRP1_TIM13_STOP – LL_DBGMCU_APB1_GRP1_TIM14_STOP – LL_DBGMCU_APB1_GRP1_LPTIM1_STOP – LL_DBGMCU_APB1_GRP1_RTC_STOP – LL_DBGMCU_APB1_GRP1_WWDG_STOP – LL_DBGMCU_APB1_GRP1_IWDG_STOP – LL_DBGMCU_APB1_GRP1_I2C1_STOP – LL_DBGMCU_APB1_GRP1_I2C2_STOP – LL_DBGMCU_APB1_GRP1_I2C3_STOP – LL_DBGMCU_APB1_GRP1_I2C4_STOP (*) – LL_DBGMCU_APB1_GRP1_CAN1_STOP – LL_DBGMCU_APB1_GRP1_CAN2_STOP (*) – LL_DBGMCU_APB1_GRP1_CAN3_STOP (*)
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DBGMCU_APB1_FZ_DBG_TIM2_STOP LL_DBGMCU_APB1_GRP1_FreezePeriph • DBGMCU_APB1_FZ_DBG_TIM3_STOP LL_DBGMCU_APB1_GRP1_FreezePeriph • DBGMCU_APB1_FZ_DBG_TIM4_STOP LL_DBGMCU_APB1_GRP1_FreezePeriph

- DBGMCU_APB1_FZ_DBG_TIM5_STOP
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_TIM6_STOP
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_TIM7_STOP
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_TIM12_STOP
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_TIM13_STOP
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_TIM14_STOP
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_LPTIM1_STOP
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_RTC_STOP
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_WWDG_STOP
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_IWDG_STOP
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_I2C1_SMBUS_TIMEOUT
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_I2C2_SMBUS_TIMEOUT
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_I2C3_SMBUS_TIMEOUT
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_I2C4_SMBUS_TIMEOUT
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_CAN1_STOP
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_CAN2_STOP
LL_DBGMCU_APB1_GRP1_FreezePeriph
- DBGMCU_APB1_FZ_DBG_CAN3_STOP
LL_DBGMCU_APB1_GRP1_FreezePeriph

LL_DBGMCU_APB1_GRP1_UnFreezePeriph

Function name	__STATIC_INLINE void LL_DBGMCU_APB1_GRP1_UnFreezePeriph (uint32_t Periph)
Function description	Unfreeze APB1 peripherals (group1 peripherals)
Parameters	<ul style="list-style-type: none"> • Periph: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_DBGMCU_APB1_GRP1_TIM2_STOP – LL_DBGMCU_APB1_GRP1_TIM3_STOP – LL_DBGMCU_APB1_GRP1_TIM4_STOP – LL_DBGMCU_APB1_GRP1_TIM5_STOP – LL_DBGMCU_APB1_GRP1_TIM6_STOP – LL_DBGMCU_APB1_GRP1_TIM7_STOP – LL_DBGMCU_APB1_GRP1_TIM12_STOP – LL_DBGMCU_APB1_GRP1_TIM13_STOP – LL_DBGMCU_APB1_GRP1_TIM14_STOP – LL_DBGMCU_APB1_GRP1_LPTIM1_STOP

- LL_DBGMCU_APB1_GRP1_RTC_STOP
- LL_DBGMCU_APB1_GRP1_WWDG_STOP
- LL_DBGMCU_APB1_GRP1_IWDG_STOP
- LL_DBGMCU_APB1_GRP1_I2C1_STOP
- LL_DBGMCU_APB1_GRP1_I2C2_STOP
- LL_DBGMCU_APB1_GRP1_I2C3_STOP
- LL_DBGMCU_APB1_GRP1_I2C4_STOP (*)
- LL_DBGMCU_APB1_GRP1_CAN1_STOP
- LL_DBGMCU_APB1_GRP1_CAN2_STOP (*)
- LL_DBGMCU_APB1_GRP1_CAN3_STOP (*) (*) value not defined in all devices.

Return values

Reference Manual to
LL API cross
reference:

- **None:**
- DBGMCU_APB1_FZ_DBG_TIM2_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_TIM3_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_TIM4_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_TIM5_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_TIM6_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_TIM7_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_TIM12_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_TIM13_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_TIM14_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_LPTIM1_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_RTC_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_WWDG_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_IWDG_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_I2C1_SMBUS_TIMEOUT
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_I2C2_SMBUS_TIMEOUT
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_I2C3_SMBUS_TIMEOUT
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_I2C4_SMBUS_TIMEOUT
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_CAN1_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_CAN2_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- DBGMCU_APB1_FZ_DBG_CAN3_STOP
LL_DBGMCU_APB1_GRP1_UnFreezePeriph

LL_DBGMCU_APB2_GRP1_FreezePeriph

Function name	__STATIC_INLINE void LL_DBGMCU_APB2_GRP1_FreezePeriph (uint32_t Periphs)
Function description	Freeze APB2 peripherals.
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_DBGMCU_APB2_GRP1_TIM1_STOP – LL_DBGMCU_APB2_GRP1_TIM8_STOP – LL_DBGMCU_APB2_GRP1_TIM9_STOP – LL_DBGMCU_APB2_GRP1_TIM10_STOP – LL_DBGMCU_APB2_GRP1_TIM11_STOP
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DBGMCU_APB2_FZ_DBG_TIM1_STOP LL_DBGMCU_APB2_GRP1_FreezePeriph • DBGMCU_APB2_FZ_DBG_TIM8_STOP LL_DBGMCU_APB2_GRP1_FreezePeriph • DBGMCU_APB2_FZ_DBG_TIM9_STOP LL_DBGMCU_APB2_GRP1_FreezePeriph • DBGMCU_APB2_FZ_DBG_TIM10_STOP LL_DBGMCU_APB2_GRP1_FreezePeriph • DBGMCU_APB2_FZ_DBG_TIM11_STOP LL_DBGMCU_APB2_GRP1_FreezePeriph

LL_DBGMCU_APB2_GRP1_UnFreezePeriph

Function name	__STATIC_INLINE void LL_DBGMCU_APB2_GRP1_UnFreezePeriph (uint32_t Periphs)
Function description	Unfreeze APB2 peripherals.
Parameters	<ul style="list-style-type: none"> • Periphs: This parameter can be a combination of the following values: (*) value not defined in all devices. <ul style="list-style-type: none"> – LL_DBGMCU_APB2_GRP1_TIM1_STOP – LL_DBGMCU_APB2_GRP1_TIM8_STOP – LL_DBGMCU_APB2_GRP1_TIM9_STOP – LL_DBGMCU_APB2_GRP1_TIM10_STOP – LL_DBGMCU_APB2_GRP1_TIM11_STOP
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DBGMCU_APB2_FZ_DBG_TIM1_STOP LL_DBGMCU_APB2_GRP1_UnFreezePeriph • DBGMCU_APB2_FZ_DBG_TIM8_STOP LL_DBGMCU_APB2_GRP1_UnFreezePeriph • DBGMCU_APB2_FZ_DBG_TIM9_STOP LL_DBGMCU_APB2_GRP1_UnFreezePeriph • DBGMCU_APB2_FZ_DBG_TIM10_STOP LL_DBGMCU_APB2_GRP1_UnFreezePeriph • DBGMCU_APB2_FZ_DBG_TIM11_STOP LL_DBGMCU_APB2_GRP1_UnFreezePeriph

LL_FLASH_SetLatency

Function name	__STATIC_INLINE void LL_FLASH_SetLatency (uint32_t Latency)
Function description	Set FLASH Latency.
Parameters	<ul style="list-style-type: none"> • Latency: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_FLASH_LATENCY_0 – LL_FLASH_LATENCY_1 – LL_FLASH_LATENCY_2 – LL_FLASH_LATENCY_3 – LL_FLASH_LATENCY_4 – LL_FLASH_LATENCY_5 – LL_FLASH_LATENCY_6 – LL_FLASH_LATENCY_7 – LL_FLASH_LATENCY_8 – LL_FLASH_LATENCY_9 – LL_FLASH_LATENCY_10 – LL_FLASH_LATENCY_11 – LL_FLASH_LATENCY_12 – LL_FLASH_LATENCY_13 – LL_FLASH_LATENCY_14 – LL_FLASH_LATENCY_15
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • FLASH_ACR LATENCY LL_FLASH_SetLatency

LL_FLASH_GetLatency

Function name	__STATIC_INLINE uint32_t LL_FLASH_GetLatency (void)
Function description	Get FLASH Latency.
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_FLASH_LATENCY_0 – LL_FLASH_LATENCY_1 – LL_FLASH_LATENCY_2 – LL_FLASH_LATENCY_3 – LL_FLASH_LATENCY_4 – LL_FLASH_LATENCY_5 – LL_FLASH_LATENCY_6 – LL_FLASH_LATENCY_7 – LL_FLASH_LATENCY_8 – LL_FLASH_LATENCY_9 – LL_FLASH_LATENCY_10 – LL_FLASH_LATENCY_11 – LL_FLASH_LATENCY_12 – LL_FLASH_LATENCY_13 – LL_FLASH_LATENCY_14 – LL_FLASH_LATENCY_15
Reference Manual to LL API cross	<ul style="list-style-type: none"> • FLASH_ACR LATENCY LL_FLASH_GetLatency

reference:

LL_FLASH_EnablePrefetch

Function name `__STATIC_INLINE void LL_FLASH_EnablePrefetch (void)`

Function description Enable Prefetch.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR PRFTEN LL_FLASH_EnablePrefetch

LL_FLASH_DisablePrefetch

Function name `__STATIC_INLINE void LL_FLASH_DisablePrefetch (void)`

Function description Disable Prefetch.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR PRFTEN LL_FLASH_DisablePrefetch

LL_FLASH_IsPrefetchEnabled

Function name `__STATIC_INLINE uint32_t LL_FLASH_IsPrefetchEnabled (void)`

Function description Check if Prefetch buffer is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- FLASH_ACR PRFTEN LL_FLASH_IsPrefetchEnabled

LL_FLASH_EnableART

Function name `__STATIC_INLINE void LL_FLASH_EnableART (void)`

Function description Enable ART Accelerator.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR ARTEN LL_FLASH_EnableART

LL_FLASH_DisableART

Function name `__STATIC_INLINE void LL_FLASH_DisableART (void)`

Function description Disable ART Accelerator.

Return values

- **None:**

Reference Manual to LL API cross

- FLASH_ACR ARTEN LL_FLASH_DisableART

reference:

LL_FLASH_EnableARTReset

Function name `__STATIC_INLINE void LL_FLASH_EnableARTReset (void)`

Function description Enable ART Reset.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR ARTRST LL_FLASH_EnableARTReset

LL_FLASH_DisableARTReset

Function name `__STATIC_INLINE void LL_FLASH_DisableARTReset (void)`

Function description Disable ART Reset.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR ARTRST LL_FLASH_DisableARTReset

89.2 SYSTEM Firmware driver defines

89.2.1 SYSTEM

DBGMCU APB1 GRP1 STOP IP

<code>LL_DBGMCU_APB1_GRP1_TIM2_STOP</code>	TIM2 counter stopped when core is halted
<code>LL_DBGMCU_APB1_GRP1_TIM3_STOP</code>	TIM3 counter stopped when core is halted
<code>LL_DBGMCU_APB1_GRP1_TIM4_STOP</code>	TIM4 counter stopped when core is halted
<code>LL_DBGMCU_APB1_GRP1_TIM5_STOP</code>	TIM5 counter stopped when core is halted
<code>LL_DBGMCU_APB1_GRP1_TIM6_STOP</code>	TIM6 counter stopped when core is halted
<code>LL_DBGMCU_APB1_GRP1_TIM7_STOP</code>	TIM7 counter stopped when core is halted
<code>LL_DBGMCU_APB1_GRP1_TIM12_STOP</code>	TIM12 counter stopped when core is halted
<code>LL_DBGMCU_APB1_GRP1_TIM13_STOP</code>	TIM13 counter stopped when core is halted
<code>LL_DBGMCU_APB1_GRP1_TIM14_STOP</code>	TIM14 counter stopped when core is halted
<code>LL_DBGMCU_APB1_GRP1_LPTIM1_STOP</code>	LPTIIM1 counter stopped when core is halted
<code>LL_DBGMCU_APB1_GRP1_RTC_STOP</code>	RTC counter stopped when core is halted
<code>LL_DBGMCU_APB1_GRP1_WWDG_STOP</code>	Debug Window Watchdog stopped when Core is halted
<code>LL_DBGMCU_APB1_GRP1_IWDG_STOP</code>	Debug Independent Watchdog stopped when Core is halted
<code>LL_DBGMCU_APB1_GRP1_I2C1_STOP</code>	I2C1 SMBUS timeout mode stopped when Core is halted

LL_DBGMCU_APB1_GRP1_I2C2_STOP	I2C2 SMBUS timeout mode stopped when Core is halted
LL_DBGMCU_APB1_GRP1_I2C3_STOP	I2C3 SMBUS timeout mode stopped when Core is halted
LL_DBGMCU_APB1_GRP1_I2C4_STOP	I2C4 SMBUS timeout mode stopped when core is halted
LL_DBGMCU_APB1_GRP1_CAN1_STOP	CAN1 debug stopped when Core is halted
LL_DBGMCU_APB1_GRP1_CAN2_STOP	CAN2 debug stopped when Core is halted
LL_DBGMCU_APB1_GRP1_CAN3_STOP	CAN3 debug stopped when Core is halted

DBGMCU APB2 GRP1 STOP IP

LL_DBGMCU_APB2_GRP1_TIM1_STOP	TIM1 counter stopped when core is halted
LL_DBGMCU_APB2_GRP1_TIM8_STOP	TIM8 counter stopped when core is halted
LL_DBGMCU_APB2_GRP1_TIM9_STOP	TIM9 counter stopped when core is halted
LL_DBGMCU_APB2_GRP1_TIM10_STOP	TIM10 counter stopped when core is halted
LL_DBGMCU_APB2_GRP1_TIM11_STOP	TIM11 counter stopped when core is halted

SYSCFG BANK MODE

LL_SYSCFG_BANKMODE_BANK1	Flash Bank 1 base address mapped at 0x0800 0000 (AXI) and 0x0020 0000 (TCM) and Flash Bank 2 base address mapped at 0x0810 0000 (AXI) and 0x0030 0000 (TCM)
LL_SYSCFG_BANKMODE_BANK2	Flash Bank 2 base address mapped at 0x0800 0000 (AXI) and 0x0020 0000(TCM) and Flash Bank 1 base address mapped at 0x0810 0000 (AXI) and 0x0030 0000(TCM)

SYSCFG CMP PD

LL_SYSCFG_DISABLE_CMP_PD	I/O compensation cell power-down mode
LL_SYSCFG_ENABLE_CMP_PD	I/O compensation cell enabled

SYSCFG EXTI LINE

LL_SYSCFG_EXTI_LINE0	EXTI_POSITION_0 EXTICR[0]
LL_SYSCFG_EXTI_LINE1	EXTI_POSITION_4 EXTICR[0]
LL_SYSCFG_EXTI_LINE2	EXTI_POSITION_8 EXTICR[0]
LL_SYSCFG_EXTI_LINE3	EXTI_POSITION_12 EXTICR[0]
LL_SYSCFG_EXTI_LINE4	EXTI_POSITION_0 EXTICR[1]
LL_SYSCFG_EXTI_LINE5	EXTI_POSITION_4 EXTICR[1]
LL_SYSCFG_EXTI_LINE6	EXTI_POSITION_8 EXTICR[1]
LL_SYSCFG_EXTI_LINE7	EXTI_POSITION_12 EXTICR[1]
LL_SYSCFG_EXTI_LINE8	EXTI_POSITION_0 EXTICR[2]
LL_SYSCFG_EXTI_LINE9	EXTI_POSITION_4 EXTICR[2]
LL_SYSCFG_EXTI_LINE10	EXTI_POSITION_8 EXTICR[2]

LL_SYSCFG_EXTI_LINE11	EXTI_POSITION_12 EXTICR[2]
LL_SYSCFG_EXTI_LINE12	EXTI_POSITION_0 EXTICR[3]
LL_SYSCFG_EXTI_LINE13	EXTI_POSITION_4 EXTICR[3]
LL_SYSCFG_EXTI_LINE14	EXTI_POSITION_8 EXTICR[3]
LL_SYSCFG_EXTI_LINE15	EXTI_POSITION_12 EXTICR[3]

SYSCFG EXTI PORT

LL_SYSCFG_EXTI_PORTA	EXTI PORT A
LL_SYSCFG_EXTI_PORTB	EXTI PORT B
LL_SYSCFG_EXTI_PORTC	EXTI PORT C
LL_SYSCFG_EXTI_PORTD	EXTI PORT D
LL_SYSCFG_EXTI_PORTE	EXTI PORT E
LL_SYSCFG_EXTI_PORTF	EXTI PORT F
LL_SYSCFG_EXTI_PORTG	EXTI PORT G
LL_SYSCFG_EXTI_PORTH	EXTI PORT H
LL_SYSCFG_EXTI_PORTI	EXTI PORT I
LL_SYSCFG_EXTI_PORTJ	EXTI PORT J
LL_SYSCFG_EXTI_PORTK	EXTI PORT k

SYSCFG I2C FASTMODEPLUS

LL_SYSCFG_I2C_FASTMODEPLUS_I2C1	Enable Fast Mode Plus for I2C1
LL_SYSCFG_I2C_FASTMODEPLUS_I2C2	Enable Fast Mode Plus for I2C2
LL_SYSCFG_I2C_FASTMODEPLUS_I2C3	Enable Fast Mode Plus for I2C3
LL_SYSCFG_I2C_FASTMODEPLUS_I2C4	Enable Fast Mode Plus for I2C4
LL_SYSCFG_I2C_FASTMODEPLUS_PB6	Enable Fast Mode Plus on PB6
LL_SYSCFG_I2C_FASTMODEPLUS_PB7	Enable Fast Mode Plus on PB7
LL_SYSCFG_I2C_FASTMODEPLUS_PB8	Enable Fast Mode Plus on PB8
LL_SYSCFG_I2C_FASTMODEPLUS_PB9	Enable Fast Mode Plus on PB9

FLASH LATENCY

LL_FLASH_LATENCY_0	FLASH Zero wait state
LL_FLASH_LATENCY_1	FLASH One wait state
LL_FLASH_LATENCY_2	FLASH Two wait states
LL_FLASH_LATENCY_3	FLASH Three wait states
LL_FLASH_LATENCY_4	FLASH Four wait states
LL_FLASH_LATENCY_5	FLASH five wait state
LL_FLASH_LATENCY_6	FLASH six wait state
LL_FLASH_LATENCY_7	FLASH seven wait states
LL_FLASH_LATENCY_8	FLASH eight wait states

LL_FLASH_LATENCY_9	FLASH nine wait states
LL_FLASH_LATENCY_10	FLASH ten wait states
LL_FLASH_LATENCY_11	FLASH eleven wait states
LL_FLASH_LATENCY_12	FLASH twelve wait states
LL_FLASH_LATENCY_13	FLASH thirteen wait states
LL_FLASH_LATENCY_14	FLASH fourteen wait states
LL_FLASH_LATENCY_15	FLASH fifteen wait states

SYSCFG PMC

LL_SYSCFG_PMC_ETHMII	ETH Media MII interface
LL_SYSCFG_PMC_ETHRMII	ETH Media RMII interface

SYSCFG REMAP

LL_SYSCFG_REMAP_BOOT0	Boot information after Reset
LL_SYSCFG_REMAP_BOOT1	Boot information after Reset

SYSCFG TIMER BREAK

LL_SYSCFG_TIMBREAK_LOCKUP	Enables and locks the Lockup output (raised during core lockup state) of Cortex-M7 with Break Input of TIMER1, TIMER8
LL_SYSCFG_TIMBREAK_PVD	Enables and locks the PVD connection with TIMER1, TIMER8 Break input. It also locks (write protect) the PVD_EN and PVDSEL[2:0] bits of the power controller

DBGMCU TRACE Pin Assignment

LL_DBGMCU_TRACE_NONE	TRACE pins not assigned (default state)
LL_DBGMCU_TRACE_ASYNCH	TRACE pin assignment for Asynchronous Mode
LL_DBGMCU_TRACE_SYNCH_SIZE1	TRACE pin assignment for Synchronous Mode with a TRACEDATA size of 1
LL_DBGMCU_TRACE_SYNCH_SIZE2	TRACE pin assignment for Synchronous Mode with a TRACEDATA size of 2
LL_DBGMCU_TRACE_SYNCH_SIZE4	TRACE pin assignment for Synchronous Mode with a TRACEDATA size of 4

90 LL TIM Generic Driver

90.1 TIM Firmware driver registers structures

90.1.1 LL_TIM_InitTypeDef

Data Fields

- *uint16_t Prescaler*
- *uint32_t CounterMode*
- *uint32_t Autoreload*
- *uint32_t ClockDivision*
- *uint8_t RepetitionCounter*

Field Documentation

- *uint16_t LL_TIM_InitTypeDef::Prescaler*
Specifies the prescaler value used to divide the TIM clock. This parameter can be a number between Min_Data=0x0000 and Max_Data=0xFFFF. This feature can be modified afterwards using unitary function **LL_TIM_SetPrescaler()**.
- *uint32_t LL_TIM_InitTypeDef::CounterMode*
Specifies the counter mode. This parameter can be a value of **TIM_LL_EC_COUNTERMODE**. This feature can be modified afterwards using unitary function **LL_TIM_SetCounterMode()**.
- *uint32_t LL_TIM_InitTypeDef::Autoreload*
Specifies the auto reload value to be loaded into the active Auto-Reload Register at the next update event. This parameter must be a number between Min_Data=0x0000 and Max_Data=0xFFFF. Some timer instances may support 32 bits counters. In that case this parameter must be a number between 0x0000 and 0xFFFFFFFF. This feature can be modified afterwards using unitary function **LL_TIM_SetAutoReload()**.
- *uint32_t LL_TIM_InitTypeDef::ClockDivision*
Specifies the clock division. This parameter can be a value of **TIM_LL_EC_CLOCKDIVISION**. This feature can be modified afterwards using unitary function **LL_TIM_SetClockDivision()**.
- *uint8_t LL_TIM_InitTypeDef::RepetitionCounter*
Specifies the repetition counter value. Each time the RCR downcounter reaches zero, an update event is generated and counting restarts from the RCR value (N). This means in PWM mode that (N+1) corresponds to: the number of PWM periods in edge-aligned mode the number of half PWM period in center-aligned mode This parameter must be a number between 0x00 and 0xFF. This feature can be modified afterwards using unitary function **LL_TIM_SetRepetitionCounter()**.

90.1.2 LL_TIM_OC_InitTypeDef

Data Fields

- *uint32_t OCMODE*
- *uint32_t OCState*
- *uint32_t OCNState*
- *uint32_t CompareValue*
- *uint32_t OCPolarity*
- *uint32_t OCNPolarity*
- *uint32_t OCIdleState*
- *uint32_t OCNIdleState*

Field Documentation

- ***uint32_t LL_TIM_OC_InitTypeDef::OCMode***
Specifies the output mode. This parameter can be a value of [TIM_LL_EC_OCMode](#). This feature can be modified afterwards using unitary function `LL_TIM_OC_SetMode()`.
- ***uint32_t LL_TIM_OC_InitTypeDef::OCState***
Specifies the TIM Output Compare state. This parameter can be a value of [TIM_LL_EC_OCSTATE](#). This feature can be modified afterwards using unitary functions `LL_TIM_CC_EnableChannel()` or `LL_TIM_CC_DisableChannel()`.
- ***uint32_t LL_TIM_OC_InitTypeDef::OCNState***
Specifies the TIM complementary Output Compare state. This parameter can be a value of [TIM_LL_EC_OCSTATE](#). This feature can be modified afterwards using unitary functions `LL_TIM_CC_EnableChannel()` or `LL_TIM_CC_DisableChannel()`.
- ***uint32_t LL_TIM_OC_InitTypeDef::CompareValue***
Specifies the Compare value to be loaded into the Capture Compare Register. This parameter can be a number between `Min_Data=0x0000` and `Max_Data=0xFFFF`. This feature can be modified afterwards using unitary function `LL_TIM_OC_SetCompareCHx (x=1..6)`.
- ***uint32_t LL_TIM_OC_InitTypeDef::OCPolarity***
Specifies the output polarity. This parameter can be a value of [TIM_LL_EC_OCPOLARITY](#). This feature can be modified afterwards using unitary function `LL_TIM_OC_SetPolarity()`.
- ***uint32_t LL_TIM_OC_InitTypeDef::OCNPolarity***
Specifies the complementary output polarity. This parameter can be a value of [TIM_LL_EC_OCPOLARITY](#). This feature can be modified afterwards using unitary function `LL_TIM_OC_SetPolarity()`.
- ***uint32_t LL_TIM_OC_InitTypeDef::OCIdleState***
Specifies the TIM Output Compare pin state during Idle state. This parameter can be a value of [TIM_LL_EC_OCIDLESTATE](#). This feature can be modified afterwards using unitary function `LL_TIM_OC_SetIdleState()`.
- ***uint32_t LL_TIM_OC_InitTypeDef::OCNIdleState***
Specifies the TIM Output Compare pin state during Idle state. This parameter can be a value of [TIM_LL_EC_OCIDLESTATE](#). This feature can be modified afterwards using unitary function `LL_TIM_OC_SetIdleState()`.

90.1.3 LL_TIM_IC_InitTypeDef**Data Fields**

- ***uint32_t ICPolarity***
- ***uint32_t ICActiveInput***
- ***uint32_t ICPrescaler***
- ***uint32_t ICFilter***

Field Documentation

- ***uint32_t LL_TIM_IC_InitTypeDef::ICPolarity***
Specifies the active edge of the input signal. This parameter can be a value of [TIM_LL_EC_IC_POLARITY](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetPolarity()`.
- ***uint32_t LL_TIM_IC_InitTypeDef::ICActiveInput***
Specifies the input. This parameter can be a value of [TIM_LL_EC_ACTIVEINPUT](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetActiveInput()`.
- ***uint32_t LL_TIM_IC_InitTypeDef::ICPrescaler***
Specifies the Input Capture Prescaler. This parameter can be a value of

[TIM_LL_EC_ICPSC](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetPrescaler()`.

- **`uint32_t LL_TIM_IC_InitTypeDef::ICFilter`**
Specifies the input capture filter. This parameter can be a value of [TIM_LL_EC_IC_FILTER](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetFilter()`.

90.1.4 LL_TIM_ENCODER_InitTypeDef

Data Fields

- **`uint32_t EncoderMode`**
- **`uint32_t IC1Polarity`**
- **`uint32_t IC1ActiveInput`**
- **`uint32_t IC1Prescaler`**
- **`uint32_t IC1Filter`**
- **`uint32_t IC2Polarity`**
- **`uint32_t IC2ActiveInput`**
- **`uint32_t IC2Prescaler`**
- **`uint32_t IC2Filter`**

Field Documentation

- **`uint32_t LL_TIM_ENCODER_InitTypeDef::EncoderMode`**
Specifies the encoder resolution (x2 or x4). This parameter can be a value of [TIM_LL_EC_ENCODERMODE](#). This feature can be modified afterwards using unitary function `LL_TIM_SetEncoderMode()`.
- **`uint32_t LL_TIM_ENCODER_InitTypeDef::IC1Polarity`**
Specifies the active edge of TI1 input. This parameter can be a value of [TIM_LL_EC_IC_POLARITY](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetPolarity()`.
- **`uint32_t LL_TIM_ENCODER_InitTypeDef::IC1ActiveInput`**
Specifies the TI1 input source. This parameter can be a value of [TIM_LL_EC_ACTIVEINPUT](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetActiveInput()`.
- **`uint32_t LL_TIM_ENCODER_InitTypeDef::IC1Prescaler`**
Specifies the TI1 input prescaler value. This parameter can be a value of [TIM_LL_EC_ICPSC](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetPrescaler()`.
- **`uint32_t LL_TIM_ENCODER_InitTypeDef::IC1Filter`**
Specifies the TI1 input filter. This parameter can be a value of [TIM_LL_EC_IC_FILTER](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetFilter()`.
- **`uint32_t LL_TIM_ENCODER_InitTypeDef::IC2Polarity`**
Specifies the active edge of TI2 input. This parameter can be a value of [TIM_LL_EC_IC_POLARITY](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetPolarity()`.
- **`uint32_t LL_TIM_ENCODER_InitTypeDef::IC2ActiveInput`**
Specifies the TI2 input source. This parameter can be a value of [TIM_LL_EC_ACTIVEINPUT](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetActiveInput()`.
- **`uint32_t LL_TIM_ENCODER_InitTypeDef::IC2Prescaler`**
Specifies the TI2 input prescaler value. This parameter can be a value of [TIM_LL_EC_ICPSC](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetPrescaler()`.

- ***uint32_t LL_TIM_ENCODER_InitTypeDef::IC2Filter***
Specifies the TI2 input filter. This parameter can be a value of [TIM_LL_EC_IC_FILTER](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetFilter()`.

90.1.5 LL_TIM_HALLSENSOR_InitTypeDef

Data Fields

- ***uint32_t IC1Polarity***
- ***uint32_t IC1Prescaler***
- ***uint32_t IC1Filter***
- ***uint32_t CommutationDelay***

Field Documentation

- ***uint32_t LL_TIM_HALLSENSOR_InitTypeDef::IC1Polarity***
Specifies the active edge of TI1 input. This parameter can be a value of [TIM_LL_EC_IC_POLARITY](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetPolarity()`.
- ***uint32_t LL_TIM_HALLSENSOR_InitTypeDef::IC1Prescaler***
Specifies the TI1 input prescaler value. Prescaler must be set to get a maximum counter period longer than the time interval between 2 consecutive changes on the Hall inputs. This parameter can be a value of [TIM_LL_EC_ICPSC](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetPrescaler()`.
- ***uint32_t LL_TIM_HALLSENSOR_InitTypeDef::IC1Filter***
Specifies the TI1 input filter. This parameter can be a value of [TIM_LL_EC_IC_FILTER](#). This feature can be modified afterwards using unitary function `LL_TIM_IC_SetFilter()`.
- ***uint32_t LL_TIM_HALLSENSOR_InitTypeDef::CommutationDelay***
Specifies the compare value to be loaded into the Capture Compare Register. A positive pulse (TRGO event) is generated with a programmable delay every time a change occurs on the Hall inputs. This parameter can be a number between `Min_Data = 0x0000` and `Max_Data = 0xFFFF`. This feature can be modified afterwards using unitary function `LL_TIM_OC_SetCompareCH2()`.

90.1.6 LL_TIM_BDTR_InitTypeDef

Data Fields

- ***uint32_t OSSRState***
- ***uint32_t OSSISate***
- ***uint32_t LockLevel***
- ***uint8_t DeadTime***
- ***uint16_t BreakState***
- ***uint32_t BreakPolarity***
- ***uint32_t BreakFilter***
- ***uint32_t Break2State***
- ***uint32_t Break2Polarity***
- ***uint32_t Break2Filter***
- ***uint32_t AutomaticOutput***

Field Documentation

- ***uint32_t LL_TIM_BDTR_InitTypeDef::OSSRState***
Specifies the Off-State selection used in Run mode. This parameter can be a value of [TIM_LL_EC_OSSR](#). This feature can be modified afterwards using unitary function `LL_TIM_SetOffStates()`

- Note:**This bit-field cannot be modified as long as LOCK level 2 has been programmed.
- ***uint32_t LL_TIM_BDTR_InitTypeDef::OSSISate***
Specifies the Off-State used in Idle state. This parameter can be a value of [TIM_LL_EC_OSSI](#)This feature can be modified afterwards using unitary function **LL_TIM_SetOffStates()**
Note:This bit-field cannot be modified as long as LOCK level 2 has been programmed.
 - ***uint32_t LL_TIM_BDTR_InitTypeDef::LockLevel***
Specifies the LOCK level parameters. This parameter can be a value of [TIM_LL_EC_LOCKLEVEL](#)
Note:The LOCK bits can be written only once after the reset. Once the TIMx_BDTR register has been written, their content is frozen until the next reset.
 - ***uint8_t LL_TIM_BDTR_InitTypeDef::DeadTime***
Specifies the delay time between the switching-off and the switching-on of the outputs. This parameter can be a number between Min_Data = 0x00 and Max_Data = 0xFF.This feature can be modified afterwards using unitary function **LL_TIM_OC_SetDeadTime()**
Note:This bit-field can not be modified as long as LOCK level 1, 2 or 3 has been programmed.
 - ***uint16_t LL_TIM_BDTR_InitTypeDef::BreakState***
Specifies whether the TIM Break input is enabled or not. This parameter can be a value of [TIM_LL_EC_BREAK_ENABLE](#)This feature can be modified afterwards using unitary functions **LL_TIM_EnableBRK()** or **LL_TIM_DisableBRK()**
Note:This bit-field can not be modified as long as LOCK level 1 has been programmed.
 - ***uint32_t LL_TIM_BDTR_InitTypeDef::BreakPolarity***
Specifies the TIM Break Input pin polarity. This parameter can be a value of [TIM_LL_EC_BREAK_POLARITY](#)This feature can be modified afterwards using unitary function **LL_TIM_ConfigBRK()**
Note:This bit-field can not be modified as long as LOCK level 1 has been programmed.
 - ***uint32_t LL_TIM_BDTR_InitTypeDef::BreakFilter***
Specifies the TIM Break Filter. This parameter can be a value of [TIM_LL_EC_BREAK_FILTER](#)This feature can be modified afterwards using unitary function **LL_TIM_ConfigBRK()**
Note:This bit-field can not be modified as long as LOCK level 1 has been programmed.
 - ***uint32_t LL_TIM_BDTR_InitTypeDef::Break2State***
Specifies whether the TIM Break2 input is enabled or not. This parameter can be a value of [TIM_LL_EC_BREAK2_ENABLE](#)This feature can be modified afterwards using unitary functions **LL_TIM_EnableBRK2()** or **LL_TIM_DisableBRK2()**
Note:This bit-field can not be modified as long as LOCK level 1 has been programmed.
 - ***uint32_t LL_TIM_BDTR_InitTypeDef::Break2Polarity***
Specifies the TIM Break2 Input pin polarity. This parameter can be a value of [TIM_LL_EC_BREAK2_POLARITY](#)This feature can be modified afterwards using unitary function **LL_TIM_ConfigBRK2()**
Note:This bit-field can not be modified as long as LOCK level 1 has been programmed.
 - ***uint32_t LL_TIM_BDTR_InitTypeDef::Break2Filter***
Specifies the TIM Break2 Filter. This parameter can be a value of [TIM_LL_EC_BREAK2_FILTER](#)This feature can be modified afterwards using unitary function **LL_TIM_ConfigBRK2()**

Note: This bit-field can not be modified as long as LOCK level 1 has been programmed.

- **`uint32_t LL_TIM_BDTR_InitTypeDef::AutomaticOutput`**
Specifies whether the TIM Automatic Output feature is enabled or not. This parameter can be a value of **`TIM_LL_EC_AUTOMATICOUTPUT_ENABLE`**. This feature can be modified afterwards using unitary functions **`LL_TIM_EnableAutomaticOutput()`** or **`LL_TIM_DisableAutomaticOutput()`**

Note: This bit-field can not be modified as long as LOCK level 1 has been programmed.

90.2 TIM Firmware driver API description

90.2.1 Detailed description of functions

LL_TIM_EnableCounter

Function name **`__STATIC_INLINE void LL_TIM_EnableCounter (TIM_TypeDef * TIMx)`**

Function description Enable timer counter.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 CEN LL_TIM_EnableCounter

LL_TIM_DisableCounter

Function name **`__STATIC_INLINE void LL_TIM_DisableCounter (TIM_TypeDef * TIMx)`**

Function description Disable timer counter.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 CEN LL_TIM_DisableCounter

LL_TIM_IsEnabledCounter

Function name **`__STATIC_INLINE uint32_t LL_TIM_IsEnabledCounter (TIM_TypeDef * TIMx)`**

Function description Indicates whether the timer counter is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 CEN LL_TIM_IsEnabledCounter

LL_TIM_EnableUpdateEvent

Function name	__STATIC_INLINE void LL_TIM_EnableUpdateEvent (TIM_TypeDef * TIMx)
Function description	Enable update event generation.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 UDIS LL_TIM_EnableUpdateEvent

LL_TIM_DisableUpdateEvent

Function name	__STATIC_INLINE void LL_TIM_DisableUpdateEvent (TIM_TypeDef * TIMx)
Function description	Disable update event generation.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 UDIS LL_TIM_DisableUpdateEvent

LL_TIM_IsEnabledUpdateEvent

Function name	__STATIC_INLINE uint32_t LL_TIM_IsEnabledUpdateEvent (TIM_TypeDef * TIMx)
Function description	Indicates whether update event generation is enabled.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 UDIS LL_TIM_IsEnabledUpdateEvent

LL_TIM_SetUpdateSource

Function name	__STATIC_INLINE void LL_TIM_SetUpdateSource (TIM_TypeDef * TIMx, uint32_t UpdateSource)
Function description	Set update event source.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • UpdateSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_UPDATESOURCE_REGULAR – LL_TIM_UPDATESOURCE_COUNTER
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Update event source set to LL_TIM_UPDATESOURCE_REGULAR: any of the following

events generate an update interrupt or DMA request if enabled: Counter overflow/underflowSetting the UG bitUpdate generation through the slave mode controller

- Update event source set to LL_TIM_UPDATESOURCE_COUNTER: only counter overflow/underflow generates an update interrupt or DMA request if enabled.
- CR1 URS LL_TIM_SetUpdateSource

Reference Manual to LL API cross reference:

LL_TIM_GetUpdateSource

Function name `__STATIC_INLINE uint32_t LL_TIM_GetUpdateSource(TIM_TypeDef * TIMx)`

Function description Get actual event update source.

Parameters

- **TIMx:** Timer instance

Return values

- **Returned:** value can be one of the following values:
 - LL_TIM_UPDATESOURCE_REGULAR
 - LL_TIM_UPDATESOURCE_COUNTER

Reference Manual to LL API cross reference:

- CR1 URS LL_TIM_GetUpdateSource

LL_TIM_SetOnePulseMode

Function name `__STATIC_INLINE void LL_TIM_SetOnePulseMode(TIM_TypeDef * TIMx, uint32_t OnePulseMode)`

Function description Set one pulse mode (one shot v.s.

Parameters

- **TIMx:** Timer instance
- **OnePulseMode:** This parameter can be one of the following values:
 - LL_TIM_ONEPULSEMODE_SINGLE
 - LL_TIM_ONEPULSEMODE_REPETITIVE

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 OPM LL_TIM_SetOnePulseMode

LL_TIM_GetOnePulseMode

Function name `__STATIC_INLINE uint32_t LL_TIM_GetOnePulseMode(TIM_TypeDef * TIMx)`

Function description Get actual one pulse mode.

Parameters

- **TIMx:** Timer instance

Return values

- **Returned:** value can be one of the following values:
 - LL_TIM_ONEPULSEMODE_SINGLE

- LL_TIM_ONEPULSEMODE_REPETITIVE
 - CR1 OPM LL_TIM_GetOnePulseMode
- Reference Manual to LL API cross reference:

LL_TIM_SetCounterMode

- Function name **__STATIC_INLINE void LL_TIM_SetCounterMode (TIM_TypeDef * TIMx, uint32_t CounterMode)**
- Function description Set the timer counter counting mode.
- Parameters
- **TIMx:** Timer instance
 - **CounterMode:** This parameter can be one of the following values:
 - LL_TIM_COUNTERMODE_UP
 - LL_TIM_COUNTERMODE_DOWN
 - LL_TIM_COUNTERMODE_CENTER_UP
 - LL_TIM_COUNTERMODE_CENTER_DOWN
 - LL_TIM_COUNTERMODE_CENTER_UP_DOWN
- Return values
- **None:**
- Notes
- Macro IS_TIM_COUNTER_MODE_SELECT_INSTANCE(TIMx) can be used to check whether or not the counter mode selection feature is supported by a timer instance.
- Reference Manual to LL API cross reference:
- CR1 DIR LL_TIM_SetCounterMode
 - CR1 CMS LL_TIM_SetCounterMode

LL_TIM_GetCounterMode

- Function name **__STATIC_INLINE uint32_t LL_TIM_GetCounterMode (TIM_TypeDef * TIMx)**
- Function description Get actual counter mode.
- Parameters
- **TIMx:** Timer instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_TIM_COUNTERMODE_UP
 - LL_TIM_COUNTERMODE_DOWN
 - LL_TIM_COUNTERMODE_CENTER_UP
 - LL_TIM_COUNTERMODE_CENTER_DOWN
 - LL_TIM_COUNTERMODE_CENTER_UP_DOWN
- Notes
- Macro IS_TIM_COUNTER_MODE_SELECT_INSTANCE(TIMx) can be used to check whether or not the counter mode selection feature is supported by a timer instance.
- Reference Manual to LL API cross reference:
- CR1 DIR LL_TIM_GetCounterMode
 - CR1 CMS LL_TIM_GetCounterMode

LL_TIM_EnableARRPreload

Function name	__STATIC_INLINE void LL_TIM_EnableARRPreload (TIM_TypeDef * TIMx)
Function description	Enable auto-reload (ARR) preload.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 ARPE LL_TIM_EnableARRPreload

LL_TIM_DisableARRPreload

Function name	__STATIC_INLINE void LL_TIM_DisableARRPreload (TIM_TypeDef * TIMx)
Function description	Disable auto-reload (ARR) preload.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 ARPE LL_TIM_DisableARRPreload

LL_TIM_IsEnabledARRPreload

Function name	__STATIC_INLINE uint32_t LL_TIM_IsEnabledARRPreload (TIM_TypeDef * TIMx)
Function description	Indicates whether auto-reload (ARR) preload is enabled.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 ARPE LL_TIM_IsEnabledARRPreload

LL_TIM_SetClockDivision

Function name	__STATIC_INLINE void LL_TIM_SetClockDivision (TIM_TypeDef * TIMx, uint32_t ClockDivision)
Function description	Set the division ratio between the timer clock and the sampling clock used by the dead-time generators (when supported) and the digital filters.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance• ClockDivision: This parameter can be one of the following values:<ul style="list-style-type: none">– LL_TIM_CLOCKDIVISION_DIV1– LL_TIM_CLOCKDIVISION_DIV2– LL_TIM_CLOCKDIVISION_DIV4

Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_CLOCK_DIVISION_INSTANCE(TIMx) can be used to check whether or not the clock division feature is supported by the timer instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 CKD LL_TIM_SetClockDivision

LL_TIM_GetClockDivision

Function name	__STATIC_INLINE uint32_t LL_TIM_GetClockDivision (TIM_TypeDef * TIMx)
Function description	Get the actual division ratio between the timer clock and the sampling clock used by the dead-time generators (when supported) and the digital filters.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CLOCKDIVISION_DIV1 – LL_TIM_CLOCKDIVISION_DIV2 – LL_TIM_CLOCKDIVISION_DIV4
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_CLOCK_DIVISION_INSTANCE(TIMx) can be used to check whether or not the clock division feature is supported by the timer instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 CKD LL_TIM_GetClockDivision

LL_TIM_SetCounter

Function name	__STATIC_INLINE void LL_TIM_SetCounter (TIM_TypeDef * TIMx, uint32_t Counter)
Function description	Set the counter value.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Counter: Counter value (between Min_Data=0 and Max_Data=0xFFFF or 0xFFFFFFFF)
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CNT CNT LL_TIM_SetCounter

LL_TIM_GetCounter

Function name	__STATIC_INLINE uint32_t LL_TIM_GetCounter (TIM_TypeDef * TIMx)
---------------	--

Function description	Get the counter value.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • Counter: value (between Min_Data=0 and Max_Data=0xFFFF or 0xFFFFFFFF)
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CNT CNT LL_TIM_GetCounter

LL_TIM_GetDirection

Function name	__STATIC_INLINE uint32_t LL_TIM_GetDirection (TIM_TypeDef * TIMx)
Function description	Get the current direction of the counter.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_COUNTERDIRECTION_UP – LL_TIM_COUNTERDIRECTION_DOWN
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 DIR LL_TIM_GetDirection

LL_TIM_SetPrescaler

Function name	__STATIC_INLINE void LL_TIM_SetPrescaler (TIM_TypeDef * TIMx, uint32_t Prescaler)
Function description	Set the prescaler value.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Prescaler: between Min_Data=0 and Max_Data=65535
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The counter clock frequency CK_CNT is equal to fCK_PSC / (PSC[15:0] + 1). • The prescaler can be changed on the fly as this control register is buffered. The new prescaler ratio is taken into account at the next update event. • Helper macro __LL_TIM_CALC_PSC can be used to calculate the Prescaler parameter
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PSC PSC LL_TIM_SetPrescaler

LL_TIM_GetPrescaler

Function name	__STATIC_INLINE uint32_t LL_TIM_GetPrescaler (TIM_TypeDef * TIMx)
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Function description	Get the prescaler value.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • Prescaler: value between Min_Data=0 and Max_Data=65535
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • PSC PSC LL_TIM_GetPrescaler

LL_TIM_SetAutoReload

Function name	__STATIC_INLINE void LL_TIM_SetAutoReload (TIM_TypeDef * TIMx, uint32_t AutoReload)
Function description	Set the auto-reload value.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • AutoReload: between Min_Data=0 and Max_Data=65535
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The counter is blocked while the auto-reload value is null. • Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter. • Helper macro __LL_TIM_CALC_ARR can be used to calculate the AutoReload parameter
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ARR ARR LL_TIM_SetAutoReload

LL_TIM_GetAutoReload

Function name	__STATIC_INLINE uint32_t LL_TIM_GetAutoReload (TIM_TypeDef * TIMx)
Function description	Get the auto-reload value.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • Auto-reload: value
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ARR ARR LL_TIM_GetAutoReload

LL_TIM_SetRepetitionCounter

Function name	__STATIC_INLINE void LL_TIM_SetRepetitionCounter (TIM_TypeDef * TIMx, uint32_t RepetitionCounter)
Function description	Set the repetition counter value.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance

	<ul style="list-style-type: none"> • RepetitionCounter: between Min_Data=0 and Max_Data=255
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • For advanced timer instances RepetitionCounter can be up to 65535. • Macro IS_TIM_REPETITION_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a repetition counter.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • RCR REP LL_TIM_SetRepetitionCounter

LL_TIM_GetRepetitionCounter

Function name	__STATIC_INLINE uint32_t LL_TIM_GetRepetitionCounter (TIM_TypeDef * TIMx)
Function description	Get the repetition counter value.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • Repetition: counter value
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_REPETITION_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a repetition counter.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • RCR REP LL_TIM_GetRepetitionCounter

LL_TIM_EnableUIFRemap

Function name	__STATIC_INLINE void LL_TIM_EnableUIFRemap (TIM_TypeDef * TIMx)
Function description	Force a continuous copy of the update interrupt flag (UIF) into the timer counter register (bit 31).
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This allows both the counter value and a potential roll-over condition signalled by the UIFCPY flag to be read in an atomic way.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 UIFREMAP LL_TIM_EnableUIFRemap

LL_TIM_DisableUIFRemap

Function name	__STATIC_INLINE void LL_TIM_DisableUIFRemap (TIM_TypeDef * TIMx)
Function description	Disable update interrupt flag (UIF) remapping.

Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 UIFREMAP LL_TIM_DisableUIFRemap

LL_TIM_CC_EnablePreload

Function name	__STATIC_INLINE void LL_TIM_CC_EnablePreload (TIM_TypeDef * TIMx)
Function description	Enable the capture/compare control bits (CCxE, CCxNE and OCxM) preload.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • CCxE, CCxNE and OCxM bits are preloaded, after having been written, they are updated only when a commutation event (COM) occurs. • Only on channels that have a complementary output. • Macro IS_TIM_COMMUTATION_EVENT_INSTANCE(TIMx) can be used to check whether or not a timer instance is able to generate a commutation event.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 CCPC LL_TIM_CC_EnablePreload

LL_TIM_CC_DisablePreload

Function name	__STATIC_INLINE void LL_TIM_CC_DisablePreload (TIM_TypeDef * TIMx)
Function description	Disable the capture/compare control bits (CCxE, CCxNE and OCxM) preload.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_COMMUTATION_EVENT_INSTANCE(TIMx) can be used to check whether or not a timer instance is able to generate a commutation event.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 CCPC LL_TIM_CC_DisablePreload

LL_TIM_CC_SetUpdate

Function name	__STATIC_INLINE void LL_TIM_CC_SetUpdate (TIM_TypeDef * TIMx, uint32_t CCUpdateSource)
Function description	Set the updated source of the capture/compare control bits (CCxE, CCxNE and OCxM).
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance

	<ul style="list-style-type: none"> • CCUpdateSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CCUPDATESOURCE_COMG_ONLY – LL_TIM_CCUPDATESOURCE_COMG_AND_TRGI
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_COMMUTATION_EVENT_INSTANCE(TIMx) can be used to check whether or not a timer instance is able to generate a commutation event.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 CCUS LL_TIM_CC_SetUpdate

LL_TIM_CC_SetDMAReqTrigger

Function name	__STATIC_INLINE void LL_TIM_CC_SetDMAReqTrigger (TIM_TypeDef * TIMx, uint32_t DMAReqTrigger)
Function description	Set the trigger of the capture/compare DMA request.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • DMAReqTrigger: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CCDMAREQUEST_CC – LL_TIM_CCDMAREQUEST_UPDATE
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 CCDS LL_TIM_CC_SetDMAReqTrigger

LL_TIM_CC_GetDMAReqTrigger

Function name	__STATIC_INLINE uint32_t LL_TIM_CC_GetDMAReqTrigger (TIM_TypeDef * TIMx)
Function description	Get actual trigger of the capture/compare DMA request.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CCDMAREQUEST_CC – LL_TIM_CCDMAREQUEST_UPDATE
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 CCDS LL_TIM_CC_GetDMAReqTrigger

LL_TIM_CC_SetLockLevel

Function name	__STATIC_INLINE void LL_TIM_CC_SetLockLevel (TIM_TypeDef * TIMx, uint32_t LockLevel)
Function description	Set the lock level to freeze the configuration of several capture/compare parameters.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance

	<ul style="list-style-type: none"> • LockLevel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_LOCKLEVEL_OFF – LL_TIM_LOCKLEVEL_1 – LL_TIM_LOCKLEVEL_2 – LL_TIM_LOCKLEVEL_3
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not the lock mechanism is supported by a timer instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BDTR LOCK LL_TIM_CC_SetLockLevel

LL_TIM_CC_EnableChannel

Function name	__STATIC_INLINE void LL_TIM_CC_EnableChannel (TIM_TypeDef * TIMx, uint32_t Channels)
Function description	Enable capture/compare channels.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channels: This parameter can be a combination of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH1N – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH2N – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH3N – LL_TIM_CHANNEL_CH4 – LL_TIM_CHANNEL_CH5 – LL_TIM_CHANNEL_CH6
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCER CC1E LL_TIM_CC_EnableChannel • CCER CC1NE LL_TIM_CC_EnableChannel • CCER CC2E LL_TIM_CC_EnableChannel • CCER CC2NE LL_TIM_CC_EnableChannel • CCER CC3E LL_TIM_CC_EnableChannel • CCER CC3NE LL_TIM_CC_EnableChannel • CCER CC4E LL_TIM_CC_EnableChannel • CCER CC5E LL_TIM_CC_EnableChannel • CCER CC6E LL_TIM_CC_EnableChannel

LL_TIM_CC_DisableChannel

Function name	__STATIC_INLINE void LL_TIM_CC_DisableChannel (TIM_TypeDef * TIMx, uint32_t Channels)
Function description	Disable capture/compare channels.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channels: This parameter can be a combination of the

following values:

- LL_TIM_CHANNEL_CH1
- LL_TIM_CHANNEL_CH1N
- LL_TIM_CHANNEL_CH2
- LL_TIM_CHANNEL_CH2N
- LL_TIM_CHANNEL_CH3
- LL_TIM_CHANNEL_CH3N
- LL_TIM_CHANNEL_CH4
- LL_TIM_CHANNEL_CH5
- LL_TIM_CHANNEL_CH6

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- CCER CC1E LL_TIM_CC_DisableChannel
- CCER CC1NE LL_TIM_CC_DisableChannel
- CCER CC2E LL_TIM_CC_DisableChannel
- CCER CC2NE LL_TIM_CC_DisableChannel
- CCER CC3E LL_TIM_CC_DisableChannel
- CCER CC3NE LL_TIM_CC_DisableChannel
- CCER CC4E LL_TIM_CC_DisableChannel
- CCER CC5E LL_TIM_CC_DisableChannel
- CCER CC6E LL_TIM_CC_DisableChannel

LL_TIM_CC_IsEnabledChannel

Function name

**__STATIC_INLINE uint32_t LL_TIM_CC_IsEnabledChannel
(TIM_TypeDef *TIMx, uint32_t Channels)**

Function description

Indicate whether channel(s) is(are) enabled.

Parameters

- **TIMx:** Timer instance
- **Channels:** This parameter can be a combination of the following values:
 - LL_TIM_CHANNEL_CH1
 - LL_TIM_CHANNEL_CH1N
 - LL_TIM_CHANNEL_CH2
 - LL_TIM_CHANNEL_CH2N
 - LL_TIM_CHANNEL_CH3
 - LL_TIM_CHANNEL_CH3N
 - LL_TIM_CHANNEL_CH4
 - LL_TIM_CHANNEL_CH5
 - LL_TIM_CHANNEL_CH6

Return values

- **State:** of bit (1 or 0).

Reference Manual to
LL API cross
reference:

- CCER CC1E LL_TIM_CC_IsEnabledChannel
- CCER CC1NE LL_TIM_CC_IsEnabledChannel
- CCER CC2E LL_TIM_CC_IsEnabledChannel
- CCER CC2NE LL_TIM_CC_IsEnabledChannel
- CCER CC3E LL_TIM_CC_IsEnabledChannel
- CCER CC3NE LL_TIM_CC_IsEnabledChannel
- CCER CC4E LL_TIM_CC_IsEnabledChannel
- CCER CC5E LL_TIM_CC_IsEnabledChannel
- CCER CC6E LL_TIM_CC_IsEnabledChannel

LL_TIM_OC_ConfigOutput

Function name	__STATIC_INLINE void LL_TIM_OC_ConfigOutput (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t Configuration)
Function description	Configure an output channel.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4 – LL_TIM_CHANNEL_CH5 – LL_TIM_CHANNEL_CH6 • Configuration: This parameter must be a combination of all the following values: <ul style="list-style-type: none"> – LL_TIM_OC_POLARITY_HIGH or LL_TIM_OC_POLARITY_LOW – LL_TIM_OC_IDLESTATE_LOW or LL_TIM_OC_IDLESTATE_HIGH
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCMR1 CC1S LL_TIM_OC_ConfigOutput • CCMR1 CC2S LL_TIM_OC_ConfigOutput • CCMR2 CC3S LL_TIM_OC_ConfigOutput • CCMR2 CC4S LL_TIM_OC_ConfigOutput • CCMR3 CC5S LL_TIM_OC_ConfigOutput • CCMR3 CC6S LL_TIM_OC_ConfigOutput • CCER CC1P LL_TIM_OC_ConfigOutput • CCER CC2P LL_TIM_OC_ConfigOutput • CCER CC3P LL_TIM_OC_ConfigOutput • CCER CC4P LL_TIM_OC_ConfigOutput • CCER CC5P LL_TIM_OC_ConfigOutput • CCER CC6P LL_TIM_OC_ConfigOutput • CR2 OIS1 LL_TIM_OC_ConfigOutput • CR2 OIS2 LL_TIM_OC_ConfigOutput • CR2 OIS3 LL_TIM_OC_ConfigOutput • CR2 OIS4 LL_TIM_OC_ConfigOutput • CR2 OIS5 LL_TIM_OC_ConfigOutput • CR2 OIS6 LL_TIM_OC_ConfigOutput

LL_TIM_OC_SetMode

Function name	__STATIC_INLINE void LL_TIM_OC_SetMode (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t Mode)
Function description	Define the behavior of the output reference signal OCxREF from which OCx and OCxN (when relevant) are derived.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2

- LL_TIM_CHANNEL_CH3
- LL_TIM_CHANNEL_CH4
- LL_TIM_CHANNEL_CH5
- LL_TIM_CHANNEL_CH6
- **Mode:** This parameter can be one of the following values:
 - LL_TIM_OC_MODE_FROZEN
 - LL_TIM_OC_MODE_ACTIVE
 - LL_TIM_OC_MODE_INACTIVE
 - LL_TIM_OC_MODE_TOGGLE
 - LL_TIM_OC_MODE_FORCED_INACTIVE
 - LL_TIM_OC_MODE_FORCED_ACTIVE
 - LL_TIM_OC_MODE_PWM1
 - LL_TIM_OC_MODE_PWM2
 - LL_TIM_OC_MODE_RETRIG_OPM1
 - LL_TIM_OC_MODE_RETRIG_OPM2
 - LL_TIM_OC_MODE_COMBINED_PWM1
 - LL_TIM_OC_MODE_COMBINED_PWM2
 - LL_TIM_OC_MODE_ASSYMETRIC_PWM1
 - LL_TIM_OC_MODE_ASSYMETRIC_PWM2

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- CCMR1 OC1M LL_TIM_OC_SetMode
- CCMR1 OC2M LL_TIM_OC_SetMode
- CCMR2 OC3M LL_TIM_OC_SetMode
- CCMR2 OC4M LL_TIM_OC_SetMode
- CCMR3 OC5M LL_TIM_OC_SetMode
- CCMR3 OC6M LL_TIM_OC_SetMode

LL_TIM_OC_GetMode

Function name `__STATIC_INLINE uint32_t LL_TIM_OC_GetMode
(TIM_TypeDef *TIMx, uint32_t Channel)`

Function description Get the output compare mode of an output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
 - LL_TIM_CHANNEL_CH1
 - LL_TIM_CHANNEL_CH2
 - LL_TIM_CHANNEL_CH3
 - LL_TIM_CHANNEL_CH4
 - LL_TIM_CHANNEL_CH5
 - LL_TIM_CHANNEL_CH6

Return values

- **Returned:** value can be one of the following values:
 - LL_TIM_OC_MODE_FROZEN
 - LL_TIM_OC_MODE_ACTIVE
 - LL_TIM_OC_MODE_INACTIVE
 - LL_TIM_OC_MODE_TOGGLE
 - LL_TIM_OC_MODE_FORCED_INACTIVE
 - LL_TIM_OC_MODE_FORCED_ACTIVE
 - LL_TIM_OC_MODE_PWM1
 - LL_TIM_OC_MODE_PWM2
 - LL_TIM_OC_MODE_RETRIG_OPM1

- LL_TIM_OC_MODE_RETRIG_OPM2
 - LL_TIM_OC_MODE_COMBINED_PWM1
 - LL_TIM_OC_MODE_COMBINED_PWM2
 - LL_TIM_OC_MODE_ASSYMETRIC_PWM1
 - LL_TIM_OC_MODE_ASSYMETRIC_PWM2
- Reference Manual to LL API cross reference:
- CCMR1_OC1M_LL_TIM_OC_GetMode
 - CCMR1_OC2M_LL_TIM_OC_GetMode
 - CCMR2_OC3M_LL_TIM_OC_GetMode
 - CCMR2_OC4M_LL_TIM_OC_GetMode
 - CCMR3_OC5M_LL_TIM_OC_GetMode
 - CCMR3_OC6M_LL_TIM_OC_GetMode

LL_TIM_OC_SetPolarity

- Function name **__STATIC_INLINE void LL_TIM_OC_SetPolarity (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t Polarity)**
- Function description Set the polarity of an output channel.
- Parameters
- **TIMx:** Timer instance
 - **Channel:** This parameter can be one of the following values:
 - LL_TIM_CHANNEL_CH1
 - LL_TIM_CHANNEL_CH1N
 - LL_TIM_CHANNEL_CH2
 - LL_TIM_CHANNEL_CH2N
 - LL_TIM_CHANNEL_CH3
 - LL_TIM_CHANNEL_CH3N
 - LL_TIM_CHANNEL_CH4
 - LL_TIM_CHANNEL_CH5
 - LL_TIM_CHANNEL_CH6
 - **Polarity:** This parameter can be one of the following values:
 - LL_TIM_OCPOLARITY_HIGH
 - LL_TIM_OCPOLARITY_LOW
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CCER_CC1P_LL_TIM_OC_SetPolarity
 - CCER_CC1NP_LL_TIM_OC_SetPolarity
 - CCER_CC2P_LL_TIM_OC_SetPolarity
 - CCER_CC2NP_LL_TIM_OC_SetPolarity
 - CCER_CC3P_LL_TIM_OC_SetPolarity
 - CCER_CC3NP_LL_TIM_OC_SetPolarity
 - CCER_CC4P_LL_TIM_OC_SetPolarity
 - CCER_CC5P_LL_TIM_OC_SetPolarity
 - CCER_CC6P_LL_TIM_OC_SetPolarity

LL_TIM_OC_GetPolarity

- Function name **__STATIC_INLINE uint32_t LL_TIM_OC_GetPolarity (TIM_TypeDef * TIMx, uint32_t Channel)**
- Function description Get the polarity of an output channel.
- Parameters
- **TIMx:** Timer instance
 - **Channel:** This parameter can be one of the following values:

	<ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH1N – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH2N – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH3N – LL_TIM_CHANNEL_CH4 – LL_TIM_CHANNEL_CH5 – LL_TIM_CHANNEL_CH6
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_OCPOLARITY_HIGH – LL_TIM_OCPOLARITY_LOW
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCER CC1P LL_TIM_OC_GetPolarity • CCER CC1NP LL_TIM_OC_GetPolarity • CCER CC2P LL_TIM_OC_GetPolarity • CCER CC2NP LL_TIM_OC_GetPolarity • CCER CC3P LL_TIM_OC_GetPolarity • CCER CC3NP LL_TIM_OC_GetPolarity • CCER CC4P LL_TIM_OC_GetPolarity • CCER CC5P LL_TIM_OC_GetPolarity • CCER CC6P LL_TIM_OC_GetPolarity

LL_TIM_OC_SetIdleState

Function name	__STATIC_INLINE void LL_TIM_OC_SetIdleState (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t IdleState)
Function description	Set the IDLE state of an output channel.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH1N – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH2N – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH3N – LL_TIM_CHANNEL_CH4 – LL_TIM_CHANNEL_CH5 – LL_TIM_CHANNEL_CH6 • IdleState: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_OCIDLESTATE_LOW – LL_TIM_OCIDLESTATE_HIGH
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This function is significant only for the timer instances supporting the break feature. Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 OIS1 LL_TIM_OC_SetIdleState • CR2 OIS2N LL_TIM_OC_SetIdleState • CR2 OIS2 LL_TIM_OC_SetIdleState

- CR2 OIS2N LL_TIM_OC_SetIdleState
- CR2 OIS3 LL_TIM_OC_SetIdleState
- CR2 OIS3N LL_TIM_OC_SetIdleState
- CR2 OIS4 LL_TIM_OC_SetIdleState
- CR2 OIS5 LL_TIM_OC_SetIdleState
- CR2 OIS6 LL_TIM_OC_SetIdleState

LL_TIM_OC_GetIdleState

Function name `__STATIC_INLINE uint32_t LL_TIM_OC_GetIdleState (TIM_TypeDef * TIMx, uint32_t Channel)`

Function description Get the IDLE state of an output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
 - LL_TIM_CHANNEL_CH1
 - LL_TIM_CHANNEL_CH1N
 - LL_TIM_CHANNEL_CH2
 - LL_TIM_CHANNEL_CH2N
 - LL_TIM_CHANNEL_CH3
 - LL_TIM_CHANNEL_CH3N
 - LL_TIM_CHANNEL_CH4
 - LL_TIM_CHANNEL_CH5
 - LL_TIM_CHANNEL_CH6

Return values

- **Returned:** value can be one of the following values:
 - LL_TIM_OCIDLESTATE_LOW
 - LL_TIM_OCIDLESTATE_HIGH

Reference Manual to LL API cross reference:

- CR2 OIS1 LL_TIM_OC_GetIdleState
- CR2 OIS2N LL_TIM_OC_GetIdleState
- CR2 OIS2 LL_TIM_OC_GetIdleState
- CR2 OIS2N LL_TIM_OC_GetIdleState
- CR2 OIS3 LL_TIM_OC_GetIdleState
- CR2 OIS3N LL_TIM_OC_GetIdleState
- CR2 OIS4 LL_TIM_OC_GetIdleState
- CR2 OIS5 LL_TIM_OC_GetIdleState
- CR2 OIS6 LL_TIM_OC_GetIdleState

LL_TIM_OC_EnableFast

Function name `__STATIC_INLINE void LL_TIM_OC_EnableFast (TIM_TypeDef * TIMx, uint32_t Channel)`

Function description Enable fast mode for the output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
 - LL_TIM_CHANNEL_CH1
 - LL_TIM_CHANNEL_CH2
 - LL_TIM_CHANNEL_CH3
 - LL_TIM_CHANNEL_CH4
 - LL_TIM_CHANNEL_CH5
 - LL_TIM_CHANNEL_CH6

Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Acts only if the channel is configured in PWM1 or PWM2 mode.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCMR1 OC1FE LL_TIM_OC_EnableFast • CCMR1 OC2FE LL_TIM_OC_EnableFast • CCMR2 OC3FE LL_TIM_OC_EnableFast • CCMR2 OC4FE LL_TIM_OC_EnableFast • CCMR3 OC5FE LL_TIM_OC_EnableFast • CCMR3 OC6FE LL_TIM_OC_EnableFast

LL_TIM_OC_DisableFast

Function name	__STATIC_INLINE void LL_TIM_OC_DisableFast (TIM_TypeDef * TIMx, uint32_t Channel)
Function description	Disable fast mode for the output channel.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4 – LL_TIM_CHANNEL_CH5 – LL_TIM_CHANNEL_CH6
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCMR1 OC1FE LL_TIM_OC_DisableFast • CCMR1 OC2FE LL_TIM_OC_DisableFast • CCMR2 OC3FE LL_TIM_OC_DisableFast • CCMR2 OC4FE LL_TIM_OC_DisableFast • CCMR3 OC5FE LL_TIM_OC_DisableFast • CCMR3 OC6FE LL_TIM_OC_DisableFast

LL_TIM_OC_IsEnabledFast

Function name	__STATIC_INLINE uint32_t LL_TIM_OC_IsEnabledFast (TIM_TypeDef * TIMx, uint32_t Channel)
Function description	Indicates whether fast mode is enabled for the output channel.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4 – LL_TIM_CHANNEL_CH5 – LL_TIM_CHANNEL_CH6
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross	<ul style="list-style-type: none"> • CCMR1 OC1FE LL_TIM_OC_IsEnabledFast • CCMR1 OC2FE LL_TIM_OC_IsEnabledFast • CCMR2 OC3FE LL_TIM_OC_IsEnabledFast

- reference:
- CCMR2 OC4FE LL_TIM_OC_IsEnabledFast
 - CCMR3 OC5FE LL_TIM_OC_IsEnabledFast
 - CCMR3 OC6FE LL_TIM_OC_IsEnabledFast

LL_TIM_OC_EnablePreload

- Function name **__STATIC_INLINE void LL_TIM_OC_EnablePreload (TIM_TypeDef * TIMx, uint32_t Channel)**
- Function description Enable compare register (TIMx_CCRx) preload for the output channel.
- Parameters
- **TIMx:** Timer instance
 - **Channel:** This parameter can be one of the following values:
 - LL_TIM_CHANNEL_CH1
 - LL_TIM_CHANNEL_CH2
 - LL_TIM_CHANNEL_CH3
 - LL_TIM_CHANNEL_CH4
 - LL_TIM_CHANNEL_CH5
 - LL_TIM_CHANNEL_CH6
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CCMR1 OC1PE LL_TIM_OC_EnablePreload
 - CCMR1 OC2PE LL_TIM_OC_EnablePreload
 - CCMR2 OC3PE LL_TIM_OC_EnablePreload
 - CCMR2 OC4PE LL_TIM_OC_EnablePreload
 - CCMR3 OC5PE LL_TIM_OC_EnablePreload
 - CCMR3 OC6PE LL_TIM_OC_EnablePreload

LL_TIM_OC_DisablePreload

- Function name **__STATIC_INLINE void LL_TIM_OC_DisablePreload (TIM_TypeDef * TIMx, uint32_t Channel)**
- Function description Disable compare register (TIMx_CCRx) preload for the output channel.
- Parameters
- **TIMx:** Timer instance
 - **Channel:** This parameter can be one of the following values:
 - LL_TIM_CHANNEL_CH1
 - LL_TIM_CHANNEL_CH2
 - LL_TIM_CHANNEL_CH3
 - LL_TIM_CHANNEL_CH4
 - LL_TIM_CHANNEL_CH5
 - LL_TIM_CHANNEL_CH6
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CCMR1 OC1PE LL_TIM_OC_DisablePreload
 - CCMR1 OC2PE LL_TIM_OC_DisablePreload
 - CCMR2 OC3PE LL_TIM_OC_DisablePreload
 - CCMR2 OC4PE LL_TIM_OC_DisablePreload
 - CCMR3 OC5PE LL_TIM_OC_DisablePreload
 - CCMR3 OC6PE LL_TIM_OC_DisablePreload

LL_TIM_OC_IsEnabledPreload

Function name	__STATIC_INLINE uint32_t LL_TIM_OC_IsEnabledPreload (TIM_TypeDef * TIMx, uint32_t Channel)
Function description	Indicates whether compare register (TIMx_CCRx) preload is enabled for the output channel.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4 – LL_TIM_CHANNEL_CH5 – LL_TIM_CHANNEL_CH6
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCMR1 OC1PE LL_TIM_OC_IsEnabledPreload • CCMR1 OC2PE LL_TIM_OC_IsEnabledPreload • CCMR2 OC3PE LL_TIM_OC_IsEnabledPreload • CCMR2 OC4PE LL_TIM_OC_IsEnabledPreload • CCMR3 OC5PE LL_TIM_OC_IsEnabledPreload • CCMR3 OC6PE LL_TIM_OC_IsEnabledPreload

LL_TIM_OC_EnableClear

Function name	__STATIC_INLINE void LL_TIM_OC_EnableClear (TIM_TypeDef * TIMx, uint32_t Channel)
Function description	Enable clearing the output channel on an external event.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4 – LL_TIM_CHANNEL_CH5 – LL_TIM_CHANNEL_CH6
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This function can only be used in Output compare and PWM modes. It does not work in Forced mode. • Macro IS_TIM_OCXREF_CLEAR_INSTANCE(TIMx) can be used to check whether or not a timer instance can clear the OCxREF signal on an external event.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCMR1 OC1CE LL_TIM_OC_EnableClear • CCMR1 OC2CE LL_TIM_OC_EnableClear • CCMR2 OC3CE LL_TIM_OC_EnableClear • CCMR2 OC4CE LL_TIM_OC_EnableClear • CCMR3 OC5CE LL_TIM_OC_EnableClear • CCMR3 OC6CE LL_TIM_OC_EnableClear

LL_TIM_OC_DisableClear

Function name	__STATIC_INLINE void LL_TIM_OC_DisableClear (TIM_TypeDef * TIMx, uint32_t Channel)
Function description	Disable clearing the output channel on an external event.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4 – LL_TIM_CHANNEL_CH5 – LL_TIM_CHANNEL_CH6
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_OCXREF_CLEAR_INSTANCE(TIMx) can be used to check whether or not a timer instance can clear the OCxREF signal on an external event.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCMR1 OC1CE LL_TIM_OC_DisableClear • CCMR1 OC2CE LL_TIM_OC_DisableClear • CCMR2 OC3CE LL_TIM_OC_DisableClear • CCMR2 OC4CE LL_TIM_OC_DisableClear • CCMR3 OC5CE LL_TIM_OC_DisableClear • CCMR3 OC6CE LL_TIM_OC_DisableClear

LL_TIM_OC_IsEnabledClear

Function name	__STATIC_INLINE uint32_t LL_TIM_OC_IsEnabledClear (TIM_TypeDef * TIMx, uint32_t Channel)
Function description	Indicates clearing the output channel on an external event is enabled for the output channel.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4 – LL_TIM_CHANNEL_CH5 – LL_TIM_CHANNEL_CH6
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • This function enables clearing the output channel on an external event. • This function can only be used in Output compare and PWM modes. It does not work in Forced mode. • Macro IS_TIM_OCXREF_CLEAR_INSTANCE(TIMx) can be used to check whether or not a timer instance can clear the OCxREF signal on an external event.
Reference Manual to LL API cross	<ul style="list-style-type: none"> • CCMR1 OC1CE LL_TIM_OC_IsEnabledClear • CCMR1 OC2CE LL_TIM_OC_IsEnabledClear • CCMR2 OC3CE LL_TIM_OC_IsEnabledClear

- reference:
- CCMR2 OC4CE LL_TIM_OC_IsEnabledClear
 - CCMR3 OC5CE LL_TIM_OC_IsEnabledClear
 - CCMR3 OC6CE LL_TIM_OC_IsEnabledClear

LL_TIM_OC_SetDeadTime

- Function name** `__STATIC_INLINE void LL_TIM_OC_SetDeadTime (TIM_TypeDef * TIMx, uint32_t DeadTime)`
- Function description** Set the dead-time delay (delay inserted between the rising edge of the OCxREF signal and the rising edge if the Ocx and OCxN signals).
- Parameters**
- **TIMx:** Timer instance
 - **DeadTime:** between Min_Data=0 and Max_Data=255
- Return values**
- **None:**
- Notes**
- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not dead-time insertion feature is supported by a timer instance.
 - Helper macro __LL_TIM_CALC_DEADTIME can be used to calculate the DeadTime parameter
- Reference Manual to LL API cross reference:**
- BDTR DTG LL_TIM_OC_SetDeadTime

LL_TIM_OC_SetCompareCH1

- Function name** `__STATIC_INLINE void LL_TIM_OC_SetCompareCH1 (TIM_TypeDef * TIMx, uint32_t CompareValue)`
- Function description** Set compare value for output channel 1 (TIMx_CCR1).
- Parameters**
- **TIMx:** Timer instance
 - **CompareValue:** between Min_Data=0 and Max_Data=65535
- Return values**
- **None:**
- Notes**
- In 32-bit timer implementations compare value can be between 0x00000000 and 0xFFFFFFFF.
 - Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
 - Macro IS_TIM_CC1_INSTANCE(TIMx) can be used to check whether or not output channel 1 is supported by a timer instance.
- Reference Manual to LL API cross reference:**
- CCR1 CCR1 LL_TIM_OC_SetCompareCH1

LL_TIM_OC_SetCompareCH2

- Function name** `__STATIC_INLINE void LL_TIM_OC_SetCompareCH2 (TIM_TypeDef * TIMx, uint32_t CompareValue)`

Function description	Set compare value for output channel 2 (TIMx_CCR2).
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • CompareValue: between Min_Data=0 and Max_Data=65535
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • In 32-bit timer implementations compare value can be between 0x00000000 and 0xFFFFFFFF. • Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter. • Macro IS_TIM_CC2_INSTANCE(TIMx) can be used to check whether or not output channel 2 is supported by a timer instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCR2 CCR2 LL_TIM_OC_SetCompareCH2

LL_TIM_OC_SetCompareCH3

Function name	__STATIC_INLINE void LL_TIM_OC_SetCompareCH3 (TIM_TypeDef * TIMx, uint32_t CompareValue)
Function description	Set compare value for output channel 3 (TIMx_CCR3).
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • CompareValue: between Min_Data=0 and Max_Data=65535
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • In 32-bit timer implementations compare value can be between 0x00000000 and 0xFFFFFFFF. • Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter. • Macro IS_TIM_CC3_INSTANCE(TIMx) can be used to check whether or not output channel is supported by a timer instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCR3 CCR3 LL_TIM_OC_SetCompareCH3

LL_TIM_OC_SetCompareCH4

Function name	__STATIC_INLINE void LL_TIM_OC_SetCompareCH4 (TIM_TypeDef * TIMx, uint32_t CompareValue)
Function description	Set compare value for output channel 4 (TIMx_CCR4).
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • CompareValue: between Min_Data=0 and Max_Data=65535
Return values	<ul style="list-style-type: none"> • None:

- Notes
- In 32-bit timer implementations compare value can be between 0x00000000 and 0xFFFFFFFF.
 - Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
 - Macro IS_TIM_CC4_INSTANCE(TIMx) can be used to check whether or not output channel 4 is supported by a timer instance.
- Reference Manual to LL API cross reference:
- CCR4 CCR4 LL_TIM_OC_SetCompareCH4

LL_TIM_OC_SetCompareCH5

- Function name **__STATIC_INLINE void LL_TIM_OC_SetCompareCH5 (TIM_TypeDef * TIMx, uint32_t CompareValue)**
- Function description Set compare value for output channel 5 (TIMx_CCR5).
- Parameters
- **TIMx:** Timer instance
 - **CompareValue:** between Min_Data=0 and Max_Data=65535
- Return values
- **None:**
- Notes
- Macro IS_TIM_CC5_INSTANCE(TIMx) can be used to check whether or not output channel 5 is supported by a timer instance.
- Reference Manual to LL API cross reference:
- CCR5 CCR5 LL_TIM_OC_SetCompareCH5

LL_TIM_OC_SetCompareCH6

- Function name **__STATIC_INLINE void LL_TIM_OC_SetCompareCH6 (TIM_TypeDef * TIMx, uint32_t CompareValue)**
- Function description Set compare value for output channel 6 (TIMx_CCR6).
- Parameters
- **TIMx:** Timer instance
 - **CompareValue:** between Min_Data=0 and Max_Data=65535
- Return values
- **None:**
- Notes
- Macro IS_TIM_CC6_INSTANCE(TIMx) can be used to check whether or not output channel 6 is supported by a timer instance.
- Reference Manual to LL API cross reference:
- CCR6 CCR6 LL_TIM_OC_SetCompareCH6

LL_TIM_OC_GetCompareCH1

- Function name **__STATIC_INLINE uint32_t LL_TIM_OC_GetCompareCH1 (TIM_TypeDef * TIMx)**

Function description	Get compare value (TIMx_CCR1) set for output channel 1.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • CompareValue: (between Min_Data=0 and Max_Data=65535)
Notes	<ul style="list-style-type: none"> • In 32-bit timer implementations returned compare value can be between 0x00000000 and 0xFFFFFFFF. • Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter. • Macro IS_TIM_CC1_INSTANCE(TIMx) can be used to check whether or not output channel 1 is supported by a timer instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCR1 CCR1 LL_TIM_OC_GetCompareCH1

LL_TIM_OC_GetCompareCH2

Function name	__STATIC_INLINE uint32_t LL_TIM_OC_GetCompareCH2 (TIM_TypeDef * TIMx)
Function description	Get compare value (TIMx_CCR2) set for output channel 2.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • CompareValue: (between Min_Data=0 and Max_Data=65535)
Notes	<ul style="list-style-type: none"> • In 32-bit timer implementations returned compare value can be between 0x00000000 and 0xFFFFFFFF. • Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter. • Macro IS_TIM_CC2_INSTANCE(TIMx) can be used to check whether or not output channel 2 is supported by a timer instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCR2 CCR2 LL_TIM_OC_GetCompareCH2

LL_TIM_OC_GetCompareCH3

Function name	__STATIC_INLINE uint32_t LL_TIM_OC_GetCompareCH3 (TIM_TypeDef * TIMx)
Function description	Get compare value (TIMx_CCR3) set for output channel 3.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • CompareValue: (between Min_Data=0 and Max_Data=65535)
Notes	<ul style="list-style-type: none"> • In 32-bit timer implementations returned compare value can be between 0x00000000 and 0xFFFFFFFF. • Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32

- bits counter.
 - Macro `IS_TIM_CC3_INSTANCE(TIMx)` can be used to check whether or not output channel 3 is supported by a timer instance.
- Reference Manual to LL API cross reference:
- CCR3 CCR3 LL_TIM_OC_GetCompareCH3

LL_TIM_OC_GetCompareCH4

- Function name `__STATIC_INLINE uint32_t LL_TIM_OC_GetCompareCH4(TIM_TypeDef * TIMx)`
- Function description Get compare value (TIMx_CCR4) set for output channel 4.
- Parameters
- TIMx:** Timer instance
- Return values
- CompareValue:** (between Min_Data=0 and Max_Data=65535)
- Notes
- In 32-bit timer implementations returned compare value can be between 0x00000000 and 0xFFFFFFFF.
 - Macro `IS_TIM_32B_COUNTER_INSTANCE(TIMx)` can be used to check whether or not a timer instance supports a 32 bits counter.
 - Macro `IS_TIM_CC4_INSTANCE(TIMx)` can be used to check whether or not output channel 4 is supported by a timer instance.
- Reference Manual to LL API cross reference:
- CCR4 CCR4 LL_TIM_OC_GetCompareCH4

LL_TIM_OC_GetCompareCH5

- Function name `__STATIC_INLINE uint32_t LL_TIM_OC_GetCompareCH5(TIM_TypeDef * TIMx)`
- Function description Get compare value (TIMx_CCR5) set for output channel 5.
- Parameters
- TIMx:** Timer instance
- Return values
- CompareValue:** (between Min_Data=0 and Max_Data=65535)
- Notes
- Macro `IS_TIM_CC5_INSTANCE(TIMx)` can be used to check whether or not output channel 5 is supported by a timer instance.
- Reference Manual to LL API cross reference:
- CCR5 CCR5 LL_TIM_OC_GetCompareCH5

LL_TIM_OC_GetCompareCH6

- Function name `__STATIC_INLINE uint32_t LL_TIM_OC_GetCompareCH6(TIM_TypeDef * TIMx)`
- Function description Get compare value (TIMx_CCR6) set for output channel 6.

Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • CompareValue: (between Min_Data=0 and Max_Data=65535)
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_CC6_INSTANCE(TIMx) can be used to check whether or not output channel 6 is supported by a timer instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCR6 CCR6 LL_TIM_OC_GetCompareCH6

LL_TIM_SetCH5CombinedChannels

Function name	__STATIC_INLINE void LL_TIM_SetCH5CombinedChannels (TIM_TypeDef * TIMx, uint32_t GroupCH5)
Function description	Select on which reference signal the OC5REF is combined to.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • GroupCH5: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_GROUPCH5_NONE – LL_TIM_GROUPCH5_OC1REFC – LL_TIM_GROUPCH5_OC2REFC – LL_TIM_GROUPCH5_OC3REFC
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_COMBINED3PHASEPWM_INSTANCE(TIMx) can be used to check whether or not a timer instance supports the combined 3-phase PWM mode.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCR5 GC5C3 LL_TIM_SetCH5CombinedChannels • CCR5 GC5C2 LL_TIM_SetCH5CombinedChannels • CCR5 GC5C1 LL_TIM_SetCH5CombinedChannels

LL_TIM_IC_Config

Function name	__STATIC_INLINE void LL_TIM_IC_Config (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t Configuration)
Function description	Configure input channel.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4 • Configuration: This parameter must be a combination of all the following values: <ul style="list-style-type: none"> – LL_TIM_ACTIVEINPUT_DIRECTTI or LL_TIM_ACTIVEINPUT_INDIRECTTI or LL_TIM_ACTIVEINPUT_TRC – LL_TIM_ICPSC_DIV1 or ... or LL_TIM_ICPSC_DIV8 – LL_TIM_IC_FILTER_FDIV1 or ... or

- LL_TIM_IC_FILTER_FDIV32_N8
- LL_TIM_IC_POLARITY_RISING or
LL_TIM_IC_POLARITY_FALLING or
LL_TIM_IC_POLARITY_BOTHEDGE

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- CCMR1 CC1S LL_TIM_IC_Config
- CCMR1 IC1PSC LL_TIM_IC_Config
- CCMR1 IC1F LL_TIM_IC_Config
- CCMR1 CC2S LL_TIM_IC_Config
- CCMR1 IC2PSC LL_TIM_IC_Config
- CCMR1 IC2F LL_TIM_IC_Config
- CCMR2 CC3S LL_TIM_IC_Config
- CCMR2 IC3PSC LL_TIM_IC_Config
- CCMR2 IC3F LL_TIM_IC_Config
- CCMR2 CC4S LL_TIM_IC_Config
- CCMR2 IC4PSC LL_TIM_IC_Config
- CCMR2 IC4F LL_TIM_IC_Config
- CCER CC1P LL_TIM_IC_Config
- CCER CC1NP LL_TIM_IC_Config
- CCER CC2P LL_TIM_IC_Config
- CCER CC2NP LL_TIM_IC_Config
- CCER CC3P LL_TIM_IC_Config
- CCER CC3NP LL_TIM_IC_Config
- CCER CC4P LL_TIM_IC_Config
- CCER CC4NP LL_TIM_IC_Config

LL_TIM_IC_SetActiveInput

Function name

**__STATIC_INLINE void LL_TIM_IC_SetActiveInput
(TIM_TypeDef * TIMx, uint32_t Channel, uint32_t
ICActiveInput)**

Function description

Set the active input.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
 - LL_TIM_CHANNEL_CH1
 - LL_TIM_CHANNEL_CH2
 - LL_TIM_CHANNEL_CH3
 - LL_TIM_CHANNEL_CH4
- **ICActiveInput:** This parameter can be one of the following values:
 - LL_TIM_ACTIVEINPUT_DIRECTTI
 - LL_TIM_ACTIVEINPUT_INDIRECTTI
 - LL_TIM_ACTIVEINPUT_TRC

Return values

- **None:**

Reference Manual to
LL API cross
reference:

- CCMR1 CC1S LL_TIM_IC_SetActiveInput
- CCMR1 CC2S LL_TIM_IC_SetActiveInput
- CCMR2 CC3S LL_TIM_IC_SetActiveInput
- CCMR2 CC4S LL_TIM_IC_SetActiveInput

LL_TIM_IC_GetActiveInput

Function name **__STATIC_INLINE uint32_t LL_TIM_IC_GetActiveInput (TIM_TypeDef * TIMx, uint32_t Channel)**

Function description Get the current active input.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
 - LL_TIM_CHANNEL_CH1
 - LL_TIM_CHANNEL_CH2
 - LL_TIM_CHANNEL_CH3
 - LL_TIM_CHANNEL_CH4

Return values

- **Returned:** value can be one of the following values:
 - LL_TIM_ACTIVEINPUT_DIRECTTI
 - LL_TIM_ACTIVEINPUT_INDIRECTTI
 - LL_TIM_ACTIVEINPUT_TRC

Reference Manual to LL API cross reference:

- CCMR1 CC1S LL_TIM_IC_GetActiveInput
- CCMR1 CC2S LL_TIM_IC_GetActiveInput
- CCMR2 CC3S LL_TIM_IC_GetActiveInput
- CCMR2 CC4S LL_TIM_IC_GetActiveInput

LL_TIM_IC_SetPrescaler

Function name **__STATIC_INLINE void LL_TIM_IC_SetPrescaler (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t ICPrescaler)**

Function description Set the prescaler of input channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
 - LL_TIM_CHANNEL_CH1
 - LL_TIM_CHANNEL_CH2
 - LL_TIM_CHANNEL_CH3
 - LL_TIM_CHANNEL_CH4
- **ICPrescaler:** This parameter can be one of the following values:
 - LL_TIM_ICPSC_DIV1
 - LL_TIM_ICPSC_DIV2
 - LL_TIM_ICPSC_DIV4
 - LL_TIM_ICPSC_DIV8

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCMR1 IC1PSC LL_TIM_IC_SetPrescaler
- CCMR1 IC2PSC LL_TIM_IC_SetPrescaler
- CCMR2 IC3PSC LL_TIM_IC_SetPrescaler
- CCMR2 IC4PSC LL_TIM_IC_SetPrescaler

LL_TIM_IC_GetPrescaler

Function name **__STATIC_INLINE uint32_t LL_TIM_IC_GetPrescaler (TIM_TypeDef * TIMx, uint32_t Channel)**

Function description Get the current prescaler value acting on an input channel.

Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_ICPSC_DIV1 – LL_TIM_ICPSC_DIV2 – LL_TIM_ICPSC_DIV4 – LL_TIM_ICPSC_DIV8
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCMR1 IC1PSC LL_TIM_IC_GetPrescaler • CCMR1 IC2PSC LL_TIM_IC_GetPrescaler • CCMR2 IC3PSC LL_TIM_IC_GetPrescaler • CCMR2 IC4PSC LL_TIM_IC_GetPrescaler

LL_TIM_IC_SetFilter

Function name	__STATIC_INLINE void LL_TIM_IC_SetFilter (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t ICFilter)
Function description	Set the input filter duration.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4 • ICFilter: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_IC_FILTER_FDIV1 – LL_TIM_IC_FILTER_FDIV1_N2 – LL_TIM_IC_FILTER_FDIV1_N4 – LL_TIM_IC_FILTER_FDIV1_N8 – LL_TIM_IC_FILTER_FDIV2_N6 – LL_TIM_IC_FILTER_FDIV2_N8 – LL_TIM_IC_FILTER_FDIV4_N6 – LL_TIM_IC_FILTER_FDIV4_N8 – LL_TIM_IC_FILTER_FDIV8_N6 – LL_TIM_IC_FILTER_FDIV8_N8 – LL_TIM_IC_FILTER_FDIV16_N5 – LL_TIM_IC_FILTER_FDIV16_N6 – LL_TIM_IC_FILTER_FDIV16_N8 – LL_TIM_IC_FILTER_FDIV32_N5 – LL_TIM_IC_FILTER_FDIV32_N6 – LL_TIM_IC_FILTER_FDIV32_N8
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCMR1 IC1F LL_TIM_IC_SetFilter • CCMR1 IC2F LL_TIM_IC_SetFilter • CCMR2 IC3F LL_TIM_IC_SetFilter • CCMR2 IC4F LL_TIM_IC_SetFilter

LL_TIM_IC_GetFilter

Function name	__STATIC_INLINE uint32_t LL_TIM_IC_GetFilter (TIM_TypeDef * TIMx, uint32_t Channel)
Function description	Get the input filter duration.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_IC_FILTER_FDIV1 – LL_TIM_IC_FILTER_FDIV1_N2 – LL_TIM_IC_FILTER_FDIV1_N4 – LL_TIM_IC_FILTER_FDIV1_N8 – LL_TIM_IC_FILTER_FDIV2_N6 – LL_TIM_IC_FILTER_FDIV2_N8 – LL_TIM_IC_FILTER_FDIV4_N6 – LL_TIM_IC_FILTER_FDIV4_N8 – LL_TIM_IC_FILTER_FDIV8_N6 – LL_TIM_IC_FILTER_FDIV8_N8 – LL_TIM_IC_FILTER_FDIV16_N5 – LL_TIM_IC_FILTER_FDIV16_N6 – LL_TIM_IC_FILTER_FDIV16_N8 – LL_TIM_IC_FILTER_FDIV32_N5 – LL_TIM_IC_FILTER_FDIV32_N6 – LL_TIM_IC_FILTER_FDIV32_N8
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCMR1 IC1F LL_TIM_IC_GetFilter • CCMR1 IC2F LL_TIM_IC_GetFilter • CCMR2 IC3F LL_TIM_IC_GetFilter • CCMR2 IC4F LL_TIM_IC_GetFilter

LL_TIM_IC_SetPolarity

Function name	__STATIC_INLINE void LL_TIM_IC_SetPolarity (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t ICPolarity)
Function description	Set the input channel polarity.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4 • ICPolarity: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_IC_POLARITY_RISING – LL_TIM_IC_POLARITY_FALLING – LL_TIM_IC_POLARITY_BOTHEDGE

Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCER CC1P LL_TIM_IC_SetPolarity • CCER CC1NP LL_TIM_IC_SetPolarity • CCER CC2P LL_TIM_IC_SetPolarity • CCER CC2NP LL_TIM_IC_SetPolarity • CCER CC3P LL_TIM_IC_SetPolarity • CCER CC3NP LL_TIM_IC_SetPolarity • CCER CC4P LL_TIM_IC_SetPolarity • CCER CC4NP LL_TIM_IC_SetPolarity

LL_TIM_IC_GetPolarity

Function name	__STATIC_INLINE uint32_t LL_TIM_IC_GetPolarity (TIM_TypeDef * TIMx, uint32_t Channel)
Function description	Get the current input channel polarity.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_IC_POLARITY_RISING – LL_TIM_IC_POLARITY_FALLING – LL_TIM_IC_POLARITY_BOTHEDGE
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCER CC1P LL_TIM_IC_GetPolarity • CCER CC1NP LL_TIM_IC_GetPolarity • CCER CC2P LL_TIM_IC_GetPolarity • CCER CC2NP LL_TIM_IC_GetPolarity • CCER CC3P LL_TIM_IC_GetPolarity • CCER CC3NP LL_TIM_IC_GetPolarity • CCER CC4P LL_TIM_IC_GetPolarity • CCER CC4NP LL_TIM_IC_GetPolarity

LL_TIM_IC_EnableXORCombination

Function name	__STATIC_INLINE void LL_TIM_IC_EnableXORCombination (TIM_TypeDef * TIMx)
Function description	Connect the TIMx_CH1, CH2 and CH3 pins to the TI1 input (XOR combination).
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_XOR_INSTANCE(TIMx) can be used to check whether or not a timer instance provides an XOR input.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 TI1S LL_TIM_IC_EnableXORCombination

LL_TIM_IC_DisableXORCombination

Function name	__STATIC_INLINE void LL_TIM_IC_DisableXORCombination (TIM_TypeDef * TIMx)
Function description	Disconnect the TIMx_CH1, CH2 and CH3 pins from the TI1 input.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_XOR_INSTANCE(TIMx) can be used to check whether or not a timer instance provides an XOR input.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 TI1S LL_TIM_IC_DisableXORCombination

LL_TIM_IC_IsEnabledXORCombination

Function name	__STATIC_INLINE uint32_t LL_TIM_IC_IsEnabledXORCombination (TIM_TypeDef * TIMx)
Function description	Indicates whether the TIMx_CH1, CH2 and CH3 pins are connected to the TI1 input.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_XOR_INSTANCE(TIMx) can be used to check whether or not a timer instance provides an XOR input.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 TI1S LL_TIM_IC_IsEnabledXORCombination

LL_TIM_IC_GetCaptureCH1

Function name	__STATIC_INLINE uint32_t LL_TIM_IC_GetCaptureCH1 (TIM_TypeDef * TIMx)
Function description	Get captured value for input channel 1.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • CapturedValue: (between Min_Data=0 and Max_Data=65535)
Notes	<ul style="list-style-type: none"> • In 32-bit timer implementations returned captured value can be between 0x00000000 and 0xFFFFFFFF. • Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter. • Macro IS_TIM_CC1_INSTANCE(TIMx) can be used to check whether or not input channel 1 is supported by a timer instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCR1 CCR1 LL_TIM_IC_GetCaptureCH1

LL_TIM_IC_GetCaptureCH2

Function name	__STATIC_INLINE uint32_t LL_TIM_IC_GetCaptureCH2 (TIM_TypeDef * TIMx)
Function description	Get captured value for input channel 2.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • CapturedValue: (between Min_Data=0 and Max_Data=65535)
Notes	<ul style="list-style-type: none"> • In 32-bit timer implementations returned captured value can be between 0x00000000 and 0xFFFFFFFF. • Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter. • Macro IS_TIM_CC2_INSTANCE(TIMx) can be used to check whether or not input channel 2 is supported by a timer instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCR2 CCR2 LL_TIM_IC_GetCaptureCH2

LL_TIM_IC_GetCaptureCH3

Function name	__STATIC_INLINE uint32_t LL_TIM_IC_GetCaptureCH3 (TIM_TypeDef * TIMx)
Function description	Get captured value for input channel 3.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • CapturedValue: (between Min_Data=0 and Max_Data=65535)
Notes	<ul style="list-style-type: none"> • In 32-bit timer implementations returned captured value can be between 0x00000000 and 0xFFFFFFFF. • Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter. • Macro IS_TIM_CC3_INSTANCE(TIMx) can be used to check whether or not input channel 3 is supported by a timer instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CCR3 CCR3 LL_TIM_IC_GetCaptureCH3

LL_TIM_IC_GetCaptureCH4

Function name	__STATIC_INLINE uint32_t LL_TIM_IC_GetCaptureCH4 (TIM_TypeDef * TIMx)
Function description	Get captured value for input channel 4.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • CapturedValue: (between Min_Data=0 and Max_Data=65535)

- Notes
- In 32-bit timer implementations returned captured value can be between 0x00000000 and 0xFFFFFFFF.
 - Macro `IS_TIM_32B_COUNTER_INSTANCE(TIMx)` can be used to check whether or not a timer instance supports a 32 bits counter.
 - Macro `IS_TIM_CC4_INSTANCE(TIMx)` can be used to check whether or not input channel 4 is supported by a timer instance.
- Reference Manual to LL API cross reference:
- CCR4 CCR4 LL_TIM_IC_GetCaptureCH4

LL_TIM_EnableExternalClock

- Function name `__STATIC_INLINE void LL_TIM_EnableExternalClock(TIM_TypeDef * TIMx)`
- Function description Enable external clock mode 2.
- Parameters
- **TIMx:** Timer instance
- Return values
- **None:**
- Notes
- When external clock mode 2 is enabled the counter is clocked by any active edge on the ETRF signal.
 - Macro `IS_TIM_CLOCKSOURCE_ETRMODE2_INSTANCE(TIMx)` can be used to check whether or not a timer instance supports external clock mode2.
- Reference Manual to LL API cross reference:
- SMCR ECE LL_TIM_EnableExternalClock

LL_TIM_DisableExternalClock

- Function name `__STATIC_INLINE void LL_TIM_DisableExternalClock(TIM_TypeDef * TIMx)`
- Function description Disable external clock mode 2.
- Parameters
- **TIMx:** Timer instance
- Return values
- **None:**
- Notes
- Macro `IS_TIM_CLOCKSOURCE_ETRMODE2_INSTANCE(TIMx)` can be used to check whether or not a timer instance supports external clock mode2.
- Reference Manual to LL API cross reference:
- SMCR ECE LL_TIM_DisableExternalClock

LL_TIM_IsEnabledExternalClock

- Function name `__STATIC_INLINE uint32_t LL_TIM_IsEnabledExternalClock(TIM_TypeDef * TIMx)`

Function description	Indicate whether external clock mode 2 is enabled.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_CLOCKSOURCE_ETRMODE2_INSTANCE(TIMx) can be used to check whether or not a timer instance supports external clock mode2.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SMCR ECE LL_TIM_IsEnabledExternalClock

LL_TIM_SetClockSource

Function name	__STATIC_INLINE void LL_TIM_SetClockSource (TIM_TypeDef * TIMx, uint32_t ClockSource)
Function description	Set the clock source of the counter clock.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • ClockSource: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CLOCKSOURCE_INTERNAL – LL_TIM_CLOCKSOURCE_EXT_MODE1 – LL_TIM_CLOCKSOURCE_EXT_MODE2
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • when selected clock source is external clock mode 1, the timer input the external clock is applied is selected by calling the LL_TIM_SetTriggerInput() function. This timer input must be configured by calling the LL_TIM_IC_Config() function. • Macro IS_TIM_CLOCKSOURCE_ETRMODE1_INSTANCE(TIMx) can be used to check whether or not a timer instance supports external clock mode1. • Macro IS_TIM_CLOCKSOURCE_ETRMODE2_INSTANCE(TIMx) can be used to check whether or not a timer instance supports external clock mode2.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SMCR SMS LL_TIM_SetClockSource • SMCR ECE LL_TIM_SetClockSource

LL_TIM_SetEncoderMode

Function name	__STATIC_INLINE void LL_TIM_SetEncoderMode (TIM_TypeDef * TIMx, uint32_t EncoderMode)
Function description	Set the encoder interface mode.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • EncoderMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_ENCODERMODE_X2_TI1

	<ul style="list-style-type: none"> - LL_TIM_ENCODERMODE_X2_TI2 - LL_TIM_ENCODERMODE_X4_TI12
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_ENCODER_INTERFACE_INSTANCE(TIMx) can be used to check whether or not a timer instance supports the encoder mode.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SMCR SMS LL_TIM_SetEncoderMode

LL_TIM_SetTriggerOutput

Function name	__STATIC_INLINE void LL_TIM_SetTriggerOutput (TIM_TypeDef * TIMx, uint32_t TimerSynchronization)
Function description	Set the trigger output (TRGO) used for timer synchronization .
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • TimerSynchronization: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_TIM_TRGO_RESET - LL_TIM_TRGO_ENABLE - LL_TIM_TRGO_UPDATE - LL_TIM_TRGO_CC1IF - LL_TIM_TRGO_OC1REF - LL_TIM_TRGO_OC2REF - LL_TIM_TRGO_OC3REF - LL_TIM_TRGO_OC4REF
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_MASTER_INSTANCE(TIMx) can be used to check whether or not a timer instance can operate as a master timer.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 MMS LL_TIM_SetTriggerOutput

LL_TIM_SetTriggerOutput2

Function name	__STATIC_INLINE void LL_TIM_SetTriggerOutput2 (TIM_TypeDef * TIMx, uint32_t ADCSynchronization)
Function description	Set the trigger output 2 (TRGO2) used for ADC synchronization .
Parameters	<ul style="list-style-type: none"> • TIMx: Timer Instance • ADCSynchronization: This parameter can be one of the following values: <ul style="list-style-type: none"> - LL_TIM_TRGO2_RESET - LL_TIM_TRGO2_ENABLE - LL_TIM_TRGO2_UPDATE - LL_TIM_TRGO2_CC1F - LL_TIM_TRGO2_OC1 - LL_TIM_TRGO2_OC2

- LL_TIM_TRGO2_OC3
- LL_TIM_TRGO2_OC4
- LL_TIM_TRGO2_OC5
- LL_TIM_TRGO2_OC6
- LL_TIM_TRGO2_OC4_RISINGFALLING
- LL_TIM_TRGO2_OC6_RISINGFALLING
- LL_TIM_TRGO2_OC4_RISING_OC6_RISING
- LL_TIM_TRGO2_OC4_RISING_OC6_FALLING
- LL_TIM_TRGO2_OC5_RISING_OC6_RISING
- LL_TIM_TRGO2_OC5_RISING_OC6_FALLING

Return values

- **None:**

Notes

- Macro IS_TIM_TRGO2_INSTANCE(TIMx) can be used to check whether or not a timer instance can be used for ADC synchronization.

Reference Manual to LL API cross reference:

- CR2 MMS2 LL_TIM_SetTriggerOutput2

LL_TIM_SetSlaveMode

Function name **__STATIC_INLINE void LL_TIM_SetSlaveMode (TIM_TypeDef * TIMx, uint32_t SlaveMode)**

Function description

Set the synchronization mode of a slave timer.

Parameters

- **TIMx:** Timer instance
- **SlaveMode:** This parameter can be one of the following values:
 - LL_TIM_SLAVEMODE_DISABLED
 - LL_TIM_SLAVEMODE_RESET
 - LL_TIM_SLAVEMODE_GATED
 - LL_TIM_SLAVEMODE_TRIGGER
 - LL_TIM_SLAVEMODE_COMBINED_RESETTRIGGER

Return values

- **None:**

Notes

- Macro IS_TIM_SLAVE_INSTANCE(TIMx) can be used to check whether or not a timer instance can operate as a slave timer.

Reference Manual to LL API cross reference:

- SMCR SMS LL_TIM_SetSlaveMode

LL_TIM_SetTriggerInput

Function name **__STATIC_INLINE void LL_TIM_SetTriggerInput (TIM_TypeDef * TIMx, uint32_t TriggerInput)**

Function description

Set the selects the trigger input to be used to synchronize the counter.

Parameters

- **TIMx:** Timer instance
- **TriggerInput:** This parameter can be one of the following values:
 - LL_TIM_TS_ITR0

- LL_TIM_TS_ITR1
- LL_TIM_TS_ITR2
- LL_TIM_TS_ITR3
- LL_TIM_TS_TI1F_ED
- LL_TIM_TS_TI1FP1
- LL_TIM_TS_TI2FP2
- LL_TIM_TS_ETRF

- Return values
- **None:**
- Notes
- Macro IS_TIM_SLAVE_INSTANCE(TIMx) can be used to check whether or not a timer instance can operate as a slave timer.
- Reference Manual to LL API cross reference:
- SMCR TS LL_TIM_SetTriggerInput

LL_TIM_EnableMasterSlaveMode

- Function name
- __STATIC_INLINE void LL_TIM_EnableMasterSlaveMode (TIM_TypeDef * TIMx)**
- Function description
- Enable the Master/Slave mode.
- Parameters
- **TIMx:** Timer instance
- Return values
- **None:**
- Notes
- Macro IS_TIM_SLAVE_INSTANCE(TIMx) can be used to check whether or not a timer instance can operate as a slave timer.
- Reference Manual to LL API cross reference:
- SMCR MSM LL_TIM_EnableMasterSlaveMode

LL_TIM_DisableMasterSlaveMode

- Function name
- __STATIC_INLINE void LL_TIM_DisableMasterSlaveMode (TIM_TypeDef * TIMx)**
- Function description
- Disable the Master/Slave mode.
- Parameters
- **TIMx:** Timer instance
- Return values
- **None:**
- Notes
- Macro IS_TIM_SLAVE_INSTANCE(TIMx) can be used to check whether or not a timer instance can operate as a slave timer.
- Reference Manual to LL API cross reference:
- SMCR MSM LL_TIM_DisableMasterSlaveMode

LL_TIM_IsEnabledMasterSlaveMode

- Function name
- __STATIC_INLINE uint32_t LL_TIM_IsEnabledMasterSlaveMode (TIM_TypeDef * TIMx)**

Function description	Indicates whether the Master/Slave mode is enabled.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro <code>IS_TIM_SLAVE_INSTANCE(TIMx)</code> can be used to check whether or not a timer instance can operate as a slave timer.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • SMCR MSM <code>LL_TIM_IsEnabledMasterSlaveMode</code>

LL_TIM_ConfigETR

Function name	<code>__STATIC_INLINE void LL_TIM_ConfigETR (TIM_TypeDef *TIMx, uint32_t ETRPolarity, uint32_t ETRPrescaler, uint32_t ETRFilter)</code>
Function description	Configure the external trigger (ETR) input.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • ETRPolarity: This parameter can be one of the following values: <ul style="list-style-type: none"> – <code>LL_TIM_ETR_POLARITY_NONINVERTED</code> – <code>LL_TIM_ETR_POLARITY_INVERTED</code> • ETRPrescaler: This parameter can be one of the following values: <ul style="list-style-type: none"> – <code>LL_TIM_ETR_PRESCALER_DIV1</code> – <code>LL_TIM_ETR_PRESCALER_DIV2</code> – <code>LL_TIM_ETR_PRESCALER_DIV4</code> – <code>LL_TIM_ETR_PRESCALER_DIV8</code> • ETRFilter: This parameter can be one of the following values: <ul style="list-style-type: none"> – <code>LL_TIM_ETR_FILTER_FDIV1</code> – <code>LL_TIM_ETR_FILTER_FDIV1_N2</code> – <code>LL_TIM_ETR_FILTER_FDIV1_N4</code> – <code>LL_TIM_ETR_FILTER_FDIV1_N8</code> – <code>LL_TIM_ETR_FILTER_FDIV2_N6</code> – <code>LL_TIM_ETR_FILTER_FDIV2_N8</code> – <code>LL_TIM_ETR_FILTER_FDIV4_N6</code> – <code>LL_TIM_ETR_FILTER_FDIV4_N8</code> – <code>LL_TIM_ETR_FILTER_FDIV8_N6</code> – <code>LL_TIM_ETR_FILTER_FDIV8_N8</code> – <code>LL_TIM_ETR_FILTER_FDIV16_N5</code> – <code>LL_TIM_ETR_FILTER_FDIV16_N6</code> – <code>LL_TIM_ETR_FILTER_FDIV16_N8</code> – <code>LL_TIM_ETR_FILTER_FDIV32_N5</code> – <code>LL_TIM_ETR_FILTER_FDIV32_N6</code> – <code>LL_TIM_ETR_FILTER_FDIV32_N8</code>
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro <code>IS_TIM_ETR_INSTANCE(TIMx)</code> can be used to check whether or not a timer instance provides an external trigger input.

- Reference Manual to LL API cross reference:
- SMCR ETP LL_TIM_ConfigETR
 - SMCR ETPS LL_TIM_ConfigETR
 - SMCR ETF LL_TIM_ConfigETR

LL_TIM_EnableBRK

- Function name **__STATIC_INLINE void LL_TIM_EnableBRK (TIM_TypeDef * TIMx)**
- Function description Enable the break function.
- Parameters
- **TIMx:** Timer instance
- Return values
- **None:**
- Notes
- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.
- Reference Manual to LL API cross reference:
- BDTR BKE LL_TIM_EnableBRK

LL_TIM_DisableBRK

- Function name **__STATIC_INLINE void LL_TIM_DisableBRK (TIM_TypeDef * TIMx)**
- Function description Disable the break function.
- Parameters
- **TIMx:** Timer instance
- Return values
- **None:**
- Notes
- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.
- Reference Manual to LL API cross reference:
- BDTR BKE LL_TIM_DisableBRK

LL_TIM_ConfigBRK

- Function name **__STATIC_INLINE void LL_TIM_ConfigBRK (TIM_TypeDef * TIMx, uint32_t BreakPolarity, uint32_t BreakFilter)**
- Function description Configure the break input.
- Parameters
- **TIMx:** Timer instance
 - **BreakPolarity:** This parameter can be one of the following values:
 - LL_TIM_BREAK_POLARITY_LOW
 - LL_TIM_BREAK_POLARITY_HIGH
 - **BreakFilter:** This parameter can be one of the following values:
 - LL_TIM_BREAK_FILTER_FDIV1
 - LL_TIM_BREAK_FILTER_FDIV1_N2
 - LL_TIM_BREAK_FILTER_FDIV1_N4
 - LL_TIM_BREAK_FILTER_FDIV1_N8
 - LL_TIM_BREAK_FILTER_FDIV2_N6

- LL_TIM_BREAK_FILTER_FDIV2_N8
- LL_TIM_BREAK_FILTER_FDIV4_N6
- LL_TIM_BREAK_FILTER_FDIV4_N8
- LL_TIM_BREAK_FILTER_FDIV8_N6
- LL_TIM_BREAK_FILTER_FDIV8_N8
- LL_TIM_BREAK_FILTER_FDIV16_N5
- LL_TIM_BREAK_FILTER_FDIV16_N6
- LL_TIM_BREAK_FILTER_FDIV16_N8
- LL_TIM_BREAK_FILTER_FDIV32_N5
- LL_TIM_BREAK_FILTER_FDIV32_N6
- LL_TIM_BREAK_FILTER_FDIV32_N8

- Return values
- **None:**
- Notes
- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.
- Reference Manual to LL API cross reference:
- BDTR BKP LL_TIM_ConfigBRK
 - BDTR BKF LL_TIM_ConfigBRK

LL_TIM_EnableBRK2

- Function name
- __STATIC_INLINE void LL_TIM_EnableBRK2 (TIM_TypeDef * TIMx)**
- Function description
- Enable the break 2 function.
- Parameters
- **TIMx:** Timer instance
- Return values
- **None:**
- Notes
- Macro IS_TIM_BKIN2_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a second break input.
- Reference Manual to LL API cross reference:
- BDTR BK2E LL_TIM_EnableBRK2

LL_TIM_DisableBRK2

- Function name
- __STATIC_INLINE void LL_TIM_DisableBRK2 (TIM_TypeDef * TIMx)**
- Function description
- Disable the break 2 function.
- Parameters
- **TIMx:** Timer instance
- Return values
- **None:**
- Notes
- Macro IS_TIM_BKIN2_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a second break input.
- Reference Manual to LL API cross reference:
- BDTR BK2E LL_TIM_DisableBRK2

LL_TIM_ConfigBRK2

Function name	__STATIC_INLINE void LL_TIM_ConfigBRK2 (TIM_TypeDef * TIMx, uint32_t Break2Polarity, uint32_t Break2Filter)
Function description	Configure the break 2 input.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • Break2Polarity: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_BREAK2_POLARITY_LOW – LL_TIM_BREAK2_POLARITY_HIGH • Break2Filter: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_BREAK2_FILTER_FDIV1 – LL_TIM_BREAK2_FILTER_FDIV1_N2 – LL_TIM_BREAK2_FILTER_FDIV1_N4 – LL_TIM_BREAK2_FILTER_FDIV1_N8 – LL_TIM_BREAK2_FILTER_FDIV2_N6 – LL_TIM_BREAK2_FILTER_FDIV2_N8 – LL_TIM_BREAK2_FILTER_FDIV4_N6 – LL_TIM_BREAK2_FILTER_FDIV4_N8 – LL_TIM_BREAK2_FILTER_FDIV8_N6 – LL_TIM_BREAK2_FILTER_FDIV8_N8 – LL_TIM_BREAK2_FILTER_FDIV16_N5 – LL_TIM_BREAK2_FILTER_FDIV16_N6 – LL_TIM_BREAK2_FILTER_FDIV16_N8 – LL_TIM_BREAK2_FILTER_FDIV32_N5 – LL_TIM_BREAK2_FILTER_FDIV32_N6 – LL_TIM_BREAK2_FILTER_FDIV32_N8
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_BKIN2_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a second break input.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BDTR BK2P LL_TIM_ConfigBRK2 • BDTR BK2F LL_TIM_ConfigBRK2

LL_TIM_SetOffStates

Function name	__STATIC_INLINE void LL_TIM_SetOffStates (TIM_TypeDef * TIMx, uint32_t OffStateIdle, uint32_t OffStateRun)
Function description	Select the outputs off state (enabled v.s.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • OffStateIdle: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_OSSI_DISABLE – LL_TIM_OSSI_ENABLE • OffStateRun: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_OSSR_DISABLE – LL_TIM_OSSR_ENABLE

Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BDTR OSSI LL_TIM_SetOffStates • BDTR OSSR LL_TIM_SetOffStates

LL_TIM_EnableAutomaticOutput

Function name	__STATIC_INLINE void LL_TIM_EnableAutomaticOutput (TIM_TypeDef * TIMx)
Function description	Enable automatic output (MOE can be set by software or automatically when a break input is active).
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BDTR AOE LL_TIM_EnableAutomaticOutput

LL_TIM_DisableAutomaticOutput

Function name	__STATIC_INLINE void LL_TIM_DisableAutomaticOutput (TIM_TypeDef * TIMx)
Function description	Disable automatic output (MOE can be set only by software).
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BDTR AOE LL_TIM_DisableAutomaticOutput

LL_TIM_IsEnabledAutomaticOutput

Function name	__STATIC_INLINE uint32_t LL_TIM_IsEnabledAutomaticOutput (TIM_TypeDef * TIMx)
Function description	Indicate whether automatic output is enabled.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.
Reference Manual to LL API cross	<ul style="list-style-type: none"> • BDTR AOE LL_TIM_IsEnabledAutomaticOutput

reference:

LL_TIM_EnableAllOutputs

Function name	__STATIC_INLINE void LL_TIM_EnableAllOutputs (TIM_TypeDef * TIMx)
Function description	Enable the outputs (set the MOE bit in TIMx_BDTR register).
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The MOE bit in TIMx_BDTR register allows to enable /disable the outputs by software and is reset in case of break or break2 event • Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BDTR MOE LL_TIM_EnableAllOutputs

LL_TIM_DisableAllOutputs

Function name	__STATIC_INLINE void LL_TIM_DisableAllOutputs (TIM_TypeDef * TIMx)
Function description	Disable the outputs (reset the MOE bit in TIMx_BDTR register).
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • The MOE bit in TIMx_BDTR register allows to enable /disable the outputs by software and is reset in case of break or break2 event. • Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BDTR MOE LL_TIM_DisableAllOutputs

LL_TIM_IsEnabledAllOutputs

Function name	__STATIC_INLINE uint32_t LL_TIM_IsEnabledAllOutputs (TIM_TypeDef * TIMx)
Function description	Indicates whether outputs are enabled.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BDTR MOE LL_TIM_IsEnabledAllOutputs

LL_TIM_EnableBreakInputSource

Function name	__STATIC_INLINE void LL_TIM_EnableBreakInputSource (TIM_TypeDef * TIMx, uint32_t BreakInput, uint32_t Source)
Function description	Enable the signals connected to the designated timer break input.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • BreakInput: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_BREAK_INPUT_BKIN – LL_TIM_BREAK_INPUT_BKIN2 • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_BKIN_SOURCE_BKIN – LL_TIM_BKIN_SOURCE_DF1BK
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_BREAKSOURCE_INSTANCE(TIMx) can be used to check whether or not a timer instance allows for break input selection.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AF1 BKINE LL_TIM_EnableBreakInputSource • AF1 BKDFBKE LL_TIM_EnableBreakInputSource • AF2 BK2INE LL_TIM_EnableBreakInputSource • AF2 BK2DFBKE LL_TIM_EnableBreakInputSource

LL_TIM_DisableBreakInputSource

Function name	__STATIC_INLINE void LL_TIM_DisableBreakInputSource (TIM_TypeDef * TIMx, uint32_t BreakInput, uint32_t Source)
Function description	Disable the signals connected to the designated timer break input.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • BreakInput: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_BREAK_INPUT_BKIN – LL_TIM_BREAK_INPUT_BKIN2 • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_BKIN_SOURCE_BKIN – LL_TIM_BKIN_SOURCE_DF1BK
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_BREAKSOURCE_INSTANCE(TIMx) can be used to check whether or not a timer instance allows for break input selection.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AF1 BKINE LL_TIM_DisableBreakInputSource • AF1 BKDFBKE LL_TIM_DisableBreakInputSource • AF2 BK2INE LL_TIM_DisableBreakInputSource • AF2 BK2DFBKE LL_TIM_DisableBreakInputSource

LL_TIM_SetBreakInputSourcePolarity

Function name	__STATIC_INLINE void LL_TIM_SetBreakInputSourcePolarity (TIM_TypeDef * TIMx, uint32_t BreakInput, uint32_t Source,
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uint32_t Polarity)

Function description	Set the polarity of the break signal for the timer break input.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • BreakInput: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_BREAK_INPUT_BKIN – LL_TIM_BREAK_INPUT_BKIN2 • Source: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_BKIN_SOURCE_BKIN – LL_TIM_BKIN_SOURCE_DF1BK • Polarity: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_BKIN_POLARITY_LOW – LL_TIM_BKIN_POLARITY_HIGH
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_TIM_BREAKSOURCE_INSTANCE(TIMx) can be used to check whether or not a timer instance allows for break input selection.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • AF1 BKINE LL_TIM_SetBreakInputSourcePolarity • AF1 BKDFBKE LL_TIM_SetBreakInputSourcePolarity • AF2 BK2INE LL_TIM_SetBreakInputSourcePolarity • AF2 BK2DFBKE LL_TIM_SetBreakInputSourcePolarity

LL_TIM_ConfigDMABurst

Function name	__STATIC_INLINE void LL_TIM_ConfigDMABurst (TIM_TypeDef * TIMx, uint32_t DMABurstBaseAddress, uint32_t DMABurstLength)
Function description	Configures the timer DMA burst feature.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance • DMABurstBaseAddress: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_DMABURST_BASEADDR_CR1 – LL_TIM_DMABURST_BASEADDR_CR2 – LL_TIM_DMABURST_BASEADDR_SMCR – LL_TIM_DMABURST_BASEADDR_DIER – LL_TIM_DMABURST_BASEADDR_SR – LL_TIM_DMABURST_BASEADDR_EGR – LL_TIM_DMABURST_BASEADDR_CCMR1 – LL_TIM_DMABURST_BASEADDR_CCMR2 – LL_TIM_DMABURST_BASEADDR_CCER – LL_TIM_DMABURST_BASEADDR_CNT – LL_TIM_DMABURST_BASEADDR_PSC – LL_TIM_DMABURST_BASEADDR_ARR – LL_TIM_DMABURST_BASEADDR_RCR – LL_TIM_DMABURST_BASEADDR_CCR1 – LL_TIM_DMABURST_BASEADDR_CCR2 – LL_TIM_DMABURST_BASEADDR_CCR3 – LL_TIM_DMABURST_BASEADDR_CCR4 – LL_TIM_DMABURST_BASEADDR_BDTR

- LL_TIM_DMABURST_BASEADDR_CCMR3
- LL_TIM_DMABURST_BASEADDR_CCR5
- LL_TIM_DMABURST_BASEADDR_CCR6
- LL_TIM_DMABURST_BASEADDR_OR
- LL_TIM_DMABURST_BASEADDR_AF1
- LL_TIM_DMABURST_BASEADDR_AF2
- **DMABurstLength:** This parameter can be one of the following values:
 - LL_TIM_DMABURST_LENGTH_1TRANSFER
 - LL_TIM_DMABURST_LENGTH_2TRANSFERS
 - LL_TIM_DMABURST_LENGTH_3TRANSFERS
 - LL_TIM_DMABURST_LENGTH_4TRANSFERS
 - LL_TIM_DMABURST_LENGTH_5TRANSFERS
 - LL_TIM_DMABURST_LENGTH_6TRANSFERS
 - LL_TIM_DMABURST_LENGTH_7TRANSFERS
 - LL_TIM_DMABURST_LENGTH_8TRANSFERS
 - LL_TIM_DMABURST_LENGTH_9TRANSFERS
 - LL_TIM_DMABURST_LENGTH_10TRANSFERS
 - LL_TIM_DMABURST_LENGTH_11TRANSFERS
 - LL_TIM_DMABURST_LENGTH_12TRANSFERS
 - LL_TIM_DMABURST_LENGTH_13TRANSFERS
 - LL_TIM_DMABURST_LENGTH_14TRANSFERS
 - LL_TIM_DMABURST_LENGTH_15TRANSFERS
 - LL_TIM_DMABURST_LENGTH_16TRANSFERS
 - LL_TIM_DMABURST_LENGTH_17TRANSFERS
 - LL_TIM_DMABURST_LENGTH_18TRANSFERS

Return values

- **None:**

Notes

- Macro IS_TIM_DMABURST_INSTANCE(TIMx) can be used to check whether or not a timer instance supports the DMA burst mode.

Reference Manual to LL API cross reference:

- DCR DBL LL_TIM_ConfigDMABurst
- DCR DBA LL_TIM_ConfigDMABurst

LL_TIM_SetRemap

Function name

__STATIC_INLINE void LL_TIM_SetRemap (TIM_TypeDef * TIMx, uint32_t Remap)

Function description

Remap TIM inputs (input channel, internal/external triggers).

Parameters

- **TIMx:** Timer instance
- **Remap:** Remap param depends on the TIMx. Description available only in CHM version of the User Manual (not in .pdf). Otherwise see Reference Manual description of OR registers.

Return values

- **None:**

Notes

- Macro IS_TIM_REMAP_INSTANCE(TIMx) can be used to check whether or not a some timer inputs can be remapped.

Reference Manual to LL API cross

- TIM2_OR ITR1_RMP LL_TIM_SetRemap
- TIM5_OR TI4_RMP LL_TIM_SetRemap

reference:

- TIM11_OR T11_RMP LL_TIM_SetRemap

LL_TIM_ClearFlag_UPDATE

Function name **__STATIC_INLINE void LL_TIM_ClearFlag_UPDATE (TIM_TypeDef * TIMx)**

Function description Clear the update interrupt flag (UIF).

Parameters

- **TIMx**: Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- SR UIF LL_TIM_ClearFlag_UPDATE

LL_TIM_IsActiveFlag_UPDATE

Function name **__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_UPDATE (TIM_TypeDef * TIMx)**

Function description Indicate whether update interrupt flag (UIF) is set (update interrupt is pending).

Parameters

- **TIMx**: Timer instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR UIF LL_TIM_IsActiveFlag_UPDATE

LL_TIM_ClearFlag_CC1

Function name **__STATIC_INLINE void LL_TIM_ClearFlag_CC1 (TIM_TypeDef * TIMx)**

Function description Clear the Capture/Compare 1 interrupt flag (CC1F).

Parameters

- **TIMx**: Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- SR CC1IF LL_TIM_ClearFlag_CC1

LL_TIM_IsActiveFlag_CC1

Function name **__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC1 (TIM_TypeDef * TIMx)**

Function description Indicate whether Capture/Compare 1 interrupt flag (CC1F) is set (Capture/Compare 1 interrupt is pending).

Parameters

- **TIMx**: Timer instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC1IF LL_TIM_IsActiveFlag_CC1

reference:

LL_TIM_ClearFlag_CC2

Function name `__STATIC_INLINE void LL_TIM_ClearFlag_CC2 (TIM_TypeDef * TIMx)`

Function description Clear the Capture/Compare 2 interrupt flag (CC2F).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross

- SR CC2IF LL_TIM_ClearFlag_CC2

reference:

LL_TIM_IsActiveFlag_CC2

Function name `__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC2 (TIM_TypeDef * TIMx)`

Function description Indicate whether Capture/Compare 2 interrupt flag (CC2F) is set (Capture/Compare 2 interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross

- SR CC2IF LL_TIM_IsActiveFlag_CC2

reference:

LL_TIM_ClearFlag_CC3

Function name `__STATIC_INLINE void LL_TIM_ClearFlag_CC3 (TIM_TypeDef * TIMx)`

Function description Clear the Capture/Compare 3 interrupt flag (CC3F).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross

- SR CC3IF LL_TIM_ClearFlag_CC3

reference:

LL_TIM_IsActiveFlag_CC3

Function name `__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC3 (TIM_TypeDef * TIMx)`

Function description Indicate whether Capture/Compare 3 interrupt flag (CC3F) is set (Capture/Compare 3 interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross

- SR CC3IF LL_TIM_IsActiveFlag_CC3

reference:

reference:

LL_TIM_ClearFlag_CC4

Function name `__STATIC_INLINE void LL_TIM_ClearFlag_CC4 (TIM_TypeDef * TIMx)`

Function description Clear the Capture/Compare 4 interrupt flag (CC4F).

Parameters

- **TIMx**: Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- SR CC4IF LL_TIM_ClearFlag_CC4

LL_TIM_IsActiveFlag_CC4

Function name `__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC4 (TIM_TypeDef * TIMx)`

Function description Indicate whether Capture/Compare 4 interrupt flag (CC4F) is set (Capture/Compare 4 interrupt is pending).

Parameters

- **TIMx**: Timer instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC4IF LL_TIM_IsActiveFlag_CC4

LL_TIM_ClearFlag_CC5

Function name `__STATIC_INLINE void LL_TIM_ClearFlag_CC5 (TIM_TypeDef * TIMx)`

Function description Clear the Capture/Compare 5 interrupt flag (CC5F).

Parameters

- **TIMx**: Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- SR CC5IF LL_TIM_ClearFlag_CC5

LL_TIM_IsActiveFlag_CC5

Function name `__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC5 (TIM_TypeDef * TIMx)`

Function description Indicate whether Capture/Compare 5 interrupt flag (CC5F) is set (Capture/Compare 5 interrupt is pending).

Parameters

- **TIMx**: Timer instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC5IF LL_TIM_IsActiveFlag_CC5

reference:

LL_TIM_ClearFlag_CC6

Function name `__STATIC_INLINE void LL_TIM_ClearFlag_CC6 (TIM_TypeDef * TIMx)`

Function description Clear the Capture/Compare 6 interrupt flag (CC6F).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CC6IF LL_TIM_ClearFlag_CC6

LL_TIM_IsActiveFlag_CC6

Function name `__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC6 (TIM_TypeDef * TIMx)`

Function description Indicate whether Capture/Compare 6 interrupt flag (CC6F) is set (Capture/Compare 6 interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC6IF LL_TIM_IsActiveFlag_CC6

LL_TIM_ClearFlag_COM

Function name `__STATIC_INLINE void LL_TIM_ClearFlag_COM (TIM_TypeDef * TIMx)`

Function description Clear the commutation interrupt flag (COMIF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR COMIF LL_TIM_ClearFlag_COM

LL_TIM_IsActiveFlag_COM

Function name `__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_COM (TIM_TypeDef * TIMx)`

Function description Indicate whether commutation interrupt flag (COMIF) is set (commutation interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross

- SR COMIF LL_TIM_IsActiveFlag_COM

reference:

LL_TIM_ClearFlag_TRIG

Function name `__STATIC_INLINE void LL_TIM_ClearFlag_TRIG (TIM_TypeDef * TIMx)`

Function description Clear the trigger interrupt flag (TIF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross

- SR TIF LL_TIM_ClearFlag_TRIG

reference:

LL_TIM_IsActiveFlag_TRIG

Function name `__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_TRIG (TIM_TypeDef * TIMx)`

Function description Indicate whether trigger interrupt flag (TIF) is set (trigger interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross

- SR TIF LL_TIM_IsActiveFlag_TRIG

reference:

LL_TIM_ClearFlag_BRK

Function name `__STATIC_INLINE void LL_TIM_ClearFlag_BRK (TIM_TypeDef * TIMx)`

Function description Clear the break interrupt flag (BIF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross

- SR BIF LL_TIM_ClearFlag_BRK

reference:

LL_TIM_IsActiveFlag_BRK

Function name `__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_BRK (TIM_TypeDef * TIMx)`

Function description Indicate whether break interrupt flag (BIF) is set (break interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross

- SR BIF LL_TIM_IsActiveFlag_BRK

reference:

reference:

LL_TIM_ClearFlag_BRK2

Function name **__STATIC_INLINE void LL_TIM_ClearFlag_BRK2 (TIM_TypeDef * TIMx)**

Function description Clear the break 2 interrupt flag (B2IF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR B2IF LL_TIM_ClearFlag_BRK2

LL_TIM_IsActiveFlag_BRK2

Function name **__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_BRK2 (TIM_TypeDef * TIMx)**

Function description Indicate whether break 2 interrupt flag (B2IF) is set (break 2 interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR B2IF LL_TIM_IsActiveFlag_BRK2

LL_TIM_ClearFlag_CC1OVR

Function name **__STATIC_INLINE void LL_TIM_ClearFlag_CC1OVR (TIM_TypeDef * TIMx)**

Function description Clear the Capture/Compare 1 over-capture interrupt flag (CC1OF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CC1OF LL_TIM_ClearFlag_CC1OVR

LL_TIM_IsActiveFlag_CC1OVR

Function name **__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC1OVR (TIM_TypeDef * TIMx)**

Function description Indicate whether Capture/Compare 1 over-capture interrupt flag (CC1OF) is set (Capture/Compare 1 interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC1OF LL_TIM_IsActiveFlag_CC1OVR

reference:

LL_TIM_ClearFlag_CC2OVR

Function name `__STATIC_INLINE void LL_TIM_ClearFlag_CC2OVR (TIM_TypeDef * TIMx)`

Function description Clear the Capture/Compare 2 over-capture interrupt flag (CC2OF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CC2OF LL_TIM_ClearFlag_CC2OVR

LL_TIM_IsActiveFlag_CC2OVR

Function name `__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC2OVR (TIM_TypeDef * TIMx)`

Function description Indicate whether Capture/Compare 2 over-capture interrupt flag (CC2OF) is set (Capture/Compare 2 over-capture interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC2OF LL_TIM_IsActiveFlag_CC2OVR

LL_TIM_ClearFlag_CC3OVR

Function name `__STATIC_INLINE void LL_TIM_ClearFlag_CC3OVR (TIM_TypeDef * TIMx)`

Function description Clear the Capture/Compare 3 over-capture interrupt flag (CC3OF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CC3OF LL_TIM_ClearFlag_CC3OVR

LL_TIM_IsActiveFlag_CC3OVR

Function name `__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC3OVR (TIM_TypeDef * TIMx)`

Function description Indicate whether Capture/Compare 3 over-capture interrupt flag (CC3OF) is set (Capture/Compare 3 over-capture interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC3OF LL_TIM_IsActiveFlag_CC3OVR

LL_TIM_ClearFlag_CC4OVR

Function name **__STATIC_INLINE void LL_TIM_ClearFlag_CC4OVR (TIM_TypeDef * TIMx)**

Function description Clear the Capture/Compare 4 over-capture interrupt flag (CC4OF).

Parameters

- **TIMx**: Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- SR CC4OF LL_TIM_ClearFlag_CC4OVR

LL_TIM_IsActiveFlag_CC4OVR

Function name **__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC4OVR (TIM_TypeDef * TIMx)**

Function description Indicate whether Capture/Compare 4 over-capture interrupt flag (CC4OF) is set (Capture/Compare 4 over-capture interrupt is pending).

Parameters

- **TIMx**: Timer instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC4OF LL_TIM_IsActiveFlag_CC4OVR

LL_TIM_ClearFlag_SYSBRK

Function name **__STATIC_INLINE void LL_TIM_ClearFlag_SYSBRK (TIM_TypeDef * TIMx)**

Function description Clear the system break interrupt flag (SBIF).

Parameters

- **TIMx**: Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- SR SBIF LL_TIM_ClearFlag_SYSBRK

LL_TIM_IsActiveFlag_SYSBRK

Function name **__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_SYSBRK (TIM_TypeDef * TIMx)**

Function description Indicate whether system break interrupt flag (SBIF) is set (system break interrupt is pending).

Parameters

- **TIMx**: Timer instance

- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- SR SBIF LL_TIM_IsActiveFlag_SYSBRK

LL_TIM_EnableIT_UPDATE

- Function name **__STATIC_INLINE void LL_TIM_EnableIT_UPDATE (TIM_TypeDef * TIMx)**
- Function description Enable update interrupt (UIE).
- Parameters
- **TIMx:** Timer instance
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- DIER UIE LL_TIM_EnableIT_UPDATE

LL_TIM_DisableIT_UPDATE

- Function name **__STATIC_INLINE void LL_TIM_DisableIT_UPDATE (TIM_TypeDef * TIMx)**
- Function description Disable update interrupt (UIE).
- Parameters
- **TIMx:** Timer instance
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- DIER UIE LL_TIM_DisableIT_UPDATE

LL_TIM_IsEnabledIT_UPDATE

- Function name **__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_UPDATE (TIM_TypeDef * TIMx)**
- Function description Indicates whether the update interrupt (UIE) is enabled.
- Parameters
- **TIMx:** Timer instance
- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- DIER UIE LL_TIM_IsEnabledIT_UPDATE

LL_TIM_EnableIT_CC1

- Function name **__STATIC_INLINE void LL_TIM_EnableIT_CC1 (TIM_TypeDef * TIMx)**
- Function description Enable capture/compare 1 interrupt (CC1IE).
- Parameters
- **TIMx:** Timer instance
- Return values
- **None:**

Reference Manual to LL API cross reference:

- DIER CC1IE LL_TIM_EnableIT_CC1

LL_TIM_DisableIT_CC1

Function name `__STATIC_INLINE void LL_TIM_DisableIT_CC1 (TIM_TypeDef * TIMx)`

Function description Disable capture/compare 1 interrupt (CC1IE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC1IE LL_TIM_DisableIT_CC1

LL_TIM_IsEnabledIT_CC1

Function name `__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_CC1 (TIM_TypeDef * TIMx)`

Function description Indicates whether the capture/compare 1 interrupt (CC1IE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER CC1IE LL_TIM_IsEnabledIT_CC1

LL_TIM_EnableIT_CC2

Function name `__STATIC_INLINE void LL_TIM_EnableIT_CC2 (TIM_TypeDef * TIMx)`

Function description Enable capture/compare 2 interrupt (CC2IE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC2IE LL_TIM_EnableIT_CC2

LL_TIM_DisableIT_CC2

Function name `__STATIC_INLINE void LL_TIM_DisableIT_CC2 (TIM_TypeDef * TIMx)`

Function description Disable capture/compare 2 interrupt (CC2IE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC2IE LL_TIM_DisableIT_CC2

LL_TIM_IsEnabledIT_CC2

Function name **__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_CC2 (TIM_TypeDef * TIMx)**

Function description Indicates whether the capture/compare 2 interrupt (CC2IE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER CC2IE LL_TIM_IsEnabledIT_CC2

LL_TIM_EnableIT_CC3

Function name **__STATIC_INLINE void LL_TIM_EnableIT_CC3 (TIM_TypeDef * TIMx)**

Function description Enable capture/compare 3 interrupt (CC3IE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC3IE LL_TIM_EnableIT_CC3

LL_TIM_DisableIT_CC3

Function name **__STATIC_INLINE void LL_TIM_DisableIT_CC3 (TIM_TypeDef * TIMx)**

Function description Disable capture/compare 3 interrupt (CC3IE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC3IE LL_TIM_DisableIT_CC3

LL_TIM_IsEnabledIT_CC3

Function name **__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_CC3 (TIM_TypeDef * TIMx)**

Function description Indicates whether the capture/compare 3 interrupt (CC3IE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference: • DIER CC3IE LL_TIM_IsEnabledIT_CC3

LL_TIM_EnableIT_CC4

Function name `__STATIC_INLINE void LL_TIM_EnableIT_CC4 (TIM_TypeDef * TIMx)`

Function description Enable capture/compare 4 interrupt (CC4IE).

Parameters • **TIMx**: Timer instance

Return values • **None**:

Reference Manual to LL API cross reference: • DIER CC4IE LL_TIM_EnableIT_CC4

LL_TIM_DisableIT_CC4

Function name `__STATIC_INLINE void LL_TIM_DisableIT_CC4 (TIM_TypeDef * TIMx)`

Function description Disable capture/compare 4 interrupt (CC4IE).

Parameters • **TIMx**: Timer instance

Return values • **None**:

Reference Manual to LL API cross reference: • DIER CC4IE LL_TIM_DisableIT_CC4

LL_TIM_IsEnabledIT_CC4

Function name `__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_CC4 (TIM_TypeDef * TIMx)`

Function description Indicates whether the capture/compare 4 interrupt (CC4IE) is enabled.

Parameters • **TIMx**: Timer instance

Return values • **State**: of bit (1 or 0).

Reference Manual to LL API cross reference: • DIER CC4IE LL_TIM_IsEnabledIT_CC4

LL_TIM_EnableIT_COM

Function name `__STATIC_INLINE void LL_TIM_EnableIT_COM (TIM_TypeDef * TIMx)`

Function description Enable commutation interrupt (COMIE).

Parameters • **TIMx**: Timer instance

Return values • **None**:

Reference Manual to LL API cross reference:

- DIER COMIE LL_TIM_EnableIT_COM

LL_TIM_DisableIT_COM

Function name `__STATIC_INLINE void LL_TIM_DisableIT_COM (TIM_TypeDef * TIMx)`

Function description Disable commutation interrupt (COMIE).

Parameters

- **TIMx**: Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- DIER COMIE LL_TIM_DisableIT_COM

LL_TIM_IsEnabledIT_COM

Function name `__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_COM (TIM_TypeDef * TIMx)`

Function description Indicates whether the commutation interrupt (COMIE) is enabled.

Parameters

- **TIMx**: Timer instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER COMIE LL_TIM_IsEnabledIT_COM

LL_TIM_EnableIT_TRIG

Function name `__STATIC_INLINE void LL_TIM_EnableIT_TRIG (TIM_TypeDef * TIMx)`

Function description Enable trigger interrupt (TIE).

Parameters

- **TIMx**: Timer instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- DIER TIE LL_TIM_EnableIT_TRIG

LL_TIM_DisableIT_TRIG

Function name `__STATIC_INLINE void LL_TIM_DisableIT_TRIG (TIM_TypeDef * TIMx)`

Function description Disable trigger interrupt (TIE).

Parameters

- **TIMx**: Timer instance

Return values

- **None**:

Reference Manual to LL API cross

- DIER TIE LL_TIM_DisableIT_TRIG

reference:

LL_TIM_IsEnabledIT_TRIG

Function name `__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_TRIG (TIM_TypeDef * TIMx)`

Function description Indicates whether the trigger interrupt (TIE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER TIE LL_TIM_IsEnabledIT_TRIG

LL_TIM_EnableIT_BRK

Function name `__STATIC_INLINE void LL_TIM_EnableIT_BRK (TIM_TypeDef * TIMx)`

Function description Enable break interrupt (BIE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER BIE LL_TIM_EnableIT_BRK

LL_TIM_DisableIT_BRK

Function name `__STATIC_INLINE void LL_TIM_DisableIT_BRK (TIM_TypeDef * TIMx)`

Function description Disable break interrupt (BIE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER BIE LL_TIM_DisableIT_BRK

LL_TIM_IsEnabledIT_BRK

Function name `__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_BRK (TIM_TypeDef * TIMx)`

Function description Indicates whether the break interrupt (BIE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER BIE LL_TIM_IsEnabledIT_BRK

LL_TIM_EnableDMAReq_UPDATE

Function name	__STATIC_INLINE void LL_TIM_EnableDMAReq_UPDATE (TIM_TypeDef * TIMx)
Function description	Enable update DMA request (UDE).
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DIER UDE LL_TIM_EnableDMAReq_UPDATE

LL_TIM_DisableDMAReq_UPDATE

Function name	__STATIC_INLINE void LL_TIM_DisableDMAReq_UPDATE (TIM_TypeDef * TIMx)
Function description	Disable update DMA request (UDE).
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DIER UDE LL_TIM_DisableDMAReq_UPDATE

LL_TIM_IsEnabledDMAReq_UPDATE

Function name	__STATIC_INLINE uint32_t LL_TIM_IsEnabledDMAReq_UPDATE (TIM_TypeDef * TIMx)
Function description	Indicates whether the update DMA request (UDE) is enabled.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DIER UDE LL_TIM_IsEnabledDMAReq_UPDATE

LL_TIM_EnableDMAReq_CC1

Function name	__STATIC_INLINE void LL_TIM_EnableDMAReq_CC1 (TIM_TypeDef * TIMx)
Function description	Enable capture/compare 1 DMA request (CC1DE).
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • DIER CC1DE LL_TIM_EnableDMAReq_CC1

LL_TIM_DisableDMAReq_CC1

Function name	__STATIC_INLINE void LL_TIM_DisableDMAReq_CC1 (TIM_TypeDef * TIMx)
Function description	Disable capture/compare 1 DMA request (CC1DE).
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DIER CC1DE LL_TIM_DisableDMAReq_CC1

LL_TIM_IsEnabledDMAReq_CC1

Function name	__STATIC_INLINE uint32_t LL_TIM_IsEnabledDMAReq_CC1 (TIM_TypeDef * TIMx)
Function description	Indicates whether the capture/compare 1 DMA request (CC1DE) is enabled.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DIER CC1DE LL_TIM_IsEnabledDMAReq_CC1

LL_TIM_EnableDMAReq_CC2

Function name	__STATIC_INLINE void LL_TIM_EnableDMAReq_CC2 (TIM_TypeDef * TIMx)
Function description	Enable capture/compare 2 DMA request (CC2DE).
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DIER CC2DE LL_TIM_EnableDMAReq_CC2

LL_TIM_DisableDMAReq_CC2

Function name	__STATIC_INLINE void LL_TIM_DisableDMAReq_CC2 (TIM_TypeDef * TIMx)
Function description	Disable capture/compare 2 DMA request (CC2DE).
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DIER CC2DE LL_TIM_DisableDMAReq_CC2

LL_TIM_IsEnabledDMAReq_CC2

Function name `__STATIC_INLINE uint32_t LL_TIM_IsEnabledDMAReq_CC2 (TIM_TypeDef * TIMx)`

Function description Indicates whether the capture/compare 2 DMA request (CC2DE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER CC2DE LL_TIM_IsEnabledDMAReq_CC2

LL_TIM_EnableDMAReq_CC3

Function name `__STATIC_INLINE void LL_TIM_EnableDMAReq_CC3 (TIM_TypeDef * TIMx)`

Function description Enable capture/compare 3 DMA request (CC3DE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC3DE LL_TIM_EnableDMAReq_CC3

LL_TIM_DisableDMAReq_CC3

Function name `__STATIC_INLINE void LL_TIM_DisableDMAReq_CC3 (TIM_TypeDef * TIMx)`

Function description Disable capture/compare 3 DMA request (CC3DE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC3DE LL_TIM_DisableDMAReq_CC3

LL_TIM_IsEnabledDMAReq_CC3

Function name `__STATIC_INLINE uint32_t LL_TIM_IsEnabledDMAReq_CC3 (TIM_TypeDef * TIMx)`

Function description Indicates whether the capture/compare 3 DMA request (CC3DE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER CC3DE LL_TIM_IsEnabledDMAReq_CC3

LL_TIM_EnableDMARReq_CC4

Function name	__STATIC_INLINE void LL_TIM_EnableDMARReq_CC4 (TIM_TypeDef * TIMx)
Function description	Enable capture/compare 4 DMA request (CC4DE).
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DIER CC4DE LL_TIM_EnableDMARReq_CC4

LL_TIM_DisableDMARReq_CC4

Function name	__STATIC_INLINE void LL_TIM_DisableDMARReq_CC4 (TIM_TypeDef * TIMx)
Function description	Disable capture/compare 4 DMA request (CC4DE).
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DIER CC4DE LL_TIM_DisableDMARReq_CC4

LL_TIM_IsEnabledDMARReq_CC4

Function name	__STATIC_INLINE uint32_t LL_TIM_IsEnabledDMARReq_CC4 (TIM_TypeDef * TIMx)
Function description	Indicates whether the capture/compare 4 DMA request (CC4DE) is enabled.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DIER CC4DE LL_TIM_IsEnabledDMARReq_CC4

LL_TIM_EnableDMARReq_COM

Function name	__STATIC_INLINE void LL_TIM_EnableDMARReq_COM (TIM_TypeDef * TIMx)
Function description	Enable commutation DMA request (COMDE).
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DIER COMDE LL_TIM_EnableDMARReq_COM

LL_TIM_DisableDMAReq_COM

Function name	__STATIC_INLINE void LL_TIM_DisableDMAReq_COM (TIM_TypeDef * TIMx)
Function description	Disable commutation DMA request (COMDE).
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DIER COMDE LL_TIM_DisableDMAReq_COM

LL_TIM_IsEnabledDMAReq_COM

Function name	__STATIC_INLINE uint32_t LL_TIM_IsEnabledDMAReq_COM (TIM_TypeDef * TIMx)
Function description	Indicates whether the commutation DMA request (COMDE) is enabled.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DIER COMDE LL_TIM_IsEnabledDMAReq_COM

LL_TIM_EnableDMAReq_TRIG

Function name	__STATIC_INLINE void LL_TIM_EnableDMAReq_TRIG (TIM_TypeDef * TIMx)
Function description	Enable trigger interrupt (TDE).
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DIER TDE LL_TIM_EnableDMAReq_TRIG

LL_TIM_DisableDMAReq_TRIG

Function name	__STATIC_INLINE void LL_TIM_DisableDMAReq_TRIG (TIM_TypeDef * TIMx)
Function description	Disable trigger interrupt (TDE).
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DIER TDE LL_TIM_DisableDMAReq_TRIG

LL_TIM_IsEnabledDMAReq_TRIG

Function name	__STATIC_INLINE uint32_t LL_TIM_IsEnabledDMAReq_TRIG (TIM_TypeDef * TIMx)
Function description	Indicates whether the trigger interrupt (TDE) is enabled.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• DIER TDE LL_TIM_IsEnabledDMAReq_TRIG

LL_TIM_GenerateEvent_UPDATE

Function name	__STATIC_INLINE void LL_TIM_GenerateEvent_UPDATE (TIM_TypeDef * TIMx)
Function description	Generate an update event.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• EGR UG LL_TIM_GenerateEvent_UPDATE

LL_TIM_GenerateEvent_CC1

Function name	__STATIC_INLINE void LL_TIM_GenerateEvent_CC1 (TIM_TypeDef * TIMx)
Function description	Generate Capture/Compare 1 event.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• EGR CC1G LL_TIM_GenerateEvent_CC1

LL_TIM_GenerateEvent_CC2

Function name	__STATIC_INLINE void LL_TIM_GenerateEvent_CC2 (TIM_TypeDef * TIMx)
Function description	Generate Capture/Compare 2 event.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• EGR CC2G LL_TIM_GenerateEvent_CC2

LL_TIM_GenerateEvent_CC3

Function name	__STATIC_INLINE void LL_TIM_GenerateEvent_CC3 (TIM_TypeDef * TIMx)
Function description	Generate Capture/Compare 3 event.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• EGR CC3G LL_TIM_GenerateEvent_CC3

LL_TIM_GenerateEvent_CC4

Function name	__STATIC_INLINE void LL_TIM_GenerateEvent_CC4 (TIM_TypeDef * TIMx)
Function description	Generate Capture/Compare 4 event.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• EGR CC4G LL_TIM_GenerateEvent_CC4

LL_TIM_GenerateEvent_COM

Function name	__STATIC_INLINE void LL_TIM_GenerateEvent_COM (TIM_TypeDef * TIMx)
Function description	Generate commutation event.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• EGR COMG LL_TIM_GenerateEvent_COM

LL_TIM_GenerateEvent_TRIG

Function name	__STATIC_INLINE void LL_TIM_GenerateEvent_TRIG (TIM_TypeDef * TIMx)
Function description	Generate trigger event.
Parameters	<ul style="list-style-type: none">• TIMx: Timer instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• EGR TG LL_TIM_GenerateEvent_TRIG

LL_TIM_GenerateEvent_BRK

Function name	__STATIC_INLINE void LL_TIM_GenerateEvent_BRK (TIM_TypeDef * TIMx)
Function description	Generate break event.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • EGR BG LL_TIM_GenerateEvent_BRK

LL_TIM_GenerateEvent_BRK2

Function name	__STATIC_INLINE void LL_TIM_GenerateEvent_BRK2 (TIM_TypeDef * TIMx)
Function description	Generate break 2 event.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • EGR B2G LL_TIM_GenerateEvent_BRK2

LL_TIM_DeInit

Function name	ErrorStatus LL_TIM_DeInit (TIM_TypeDef * TIMx)
Function description	Set TIMx registers to their reset values.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer instance
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: TIMx registers are de-initialized – ERROR: invalid TIMx instance

LL_TIM_StructInit

Function name	void LL_TIM_StructInit (LL_TIM_InitTypeDef * TIM_InitStruct)
Function description	Set the fields of the time base unit configuration data structure to their default values.
Parameters	<ul style="list-style-type: none"> • TIM_InitStruct: pointer to a LL_TIM_InitTypeDef structure (time base unit configuration data structure)
Return values	<ul style="list-style-type: none"> • None:

LL_TIM_Init

Function name	ErrorStatus LL_TIM_Init (TIM_TypeDef * TIMx, LL_TIM_InitTypeDef * TIM_InitStruct)
Function description	Configure the TIMx time base unit.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer Instance

- **TIM_InitStruct:** pointer to a LL_TIM_InitTypeDef structure (TIMx time base unit configuration data structure)
- Return values
- **An:** ErrorStatus enumeration value:
 - SUCCESS: TIMx registers are de-initialized
 - ERROR: not applicable

LL_TIM_OC_StructInit

Function name **void LL_TIM_OC_StructInit (LL_TIM_OC_InitTypeDef * TIM_OC_InitStruct)**

Function description Set the fields of the TIMx output channel configuration data structure to their default values.

Parameters

- **TIM_OC_InitStruct:** pointer to a LL_TIM_OC_InitTypeDef structure (the output channel configuration data structure)

Return values

- **None:**

LL_TIM_OC_Init

Function name **ErrorStatus LL_TIM_OC_Init (TIM_TypeDef * TIMx, uint32_t Channel, LL_TIM_OC_InitTypeDef * TIM_OC_InitStruct)**

Function description Configure the TIMx output channel.

Parameters

- **TIMx:** Timer Instance
- **Channel:** This parameter can be one of the following values:
 - LL_TIM_CHANNEL_CH1
 - LL_TIM_CHANNEL_CH2
 - LL_TIM_CHANNEL_CH3
 - LL_TIM_CHANNEL_CH4
 - LL_TIM_CHANNEL_CH5
 - LL_TIM_CHANNEL_CH6
- **TIM_OC_InitStruct:** pointer to a LL_TIM_OC_InitTypeDef structure (TIMx output channel configuration data structure)

Return values

- **An:** ErrorStatus enumeration value:
 - SUCCESS: TIMx output channel is initialized
 - ERROR: TIMx output channel is not initialized

LL_TIM_IC_StructInit

Function name **void LL_TIM_IC_StructInit (LL_TIM_IC_InitTypeDef * TIM_ICInitStruct)**

Function description Set the fields of the TIMx input channel configuration data structure to their default values.

Parameters

- **TIM_ICInitStruct:** pointer to a LL_TIM_IC_InitTypeDef structure (the input channel configuration data structure)

Return values

- **None:**

LL_TIM_IC_Init

Function name **ErrorStatus LL_TIM_IC_Init (TIM_TypeDef * TIMx, uint32_t**

Channel, LL_TIM_IC_InitTypeDef * TIM_IC_InitStruct)

Function description	Configure the TIMx input channel.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer Instance • Channel: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_TIM_CHANNEL_CH1 – LL_TIM_CHANNEL_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4 • TIM_IC_InitStruct: pointer to a LL_TIM_IC_InitTypeDef structure (TIMx input channel configuration data structure)
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: TIMx output channel is initialized – ERROR: TIMx output channel is not initialized

LL_TIM_ENCODER_StructInit

Function name	void LL_TIM_ENCODER_StructInit (LL_TIM_ENCODER_InitTypeDef * TIM_EncoderInitStruct)
Function description	Fills each TIM_EncoderInitStruct field with its default value.
Parameters	<ul style="list-style-type: none"> • TIM_EncoderInitStruct: pointer to a LL_TIM_ENCODER_InitTypeDef structure (encoder interface configuration data structure)
Return values	<ul style="list-style-type: none"> • None:

LL_TIM_ENCODER_Init

Function name	ErrorStatus LL_TIM_ENCODER_Init (TIM_TypeDef * TIMx, LL_TIM_ENCODER_InitTypeDef * TIM_EncoderInitStruct)
Function description	Configure the encoder interface of the timer instance.
Parameters	<ul style="list-style-type: none"> • TIMx: Timer Instance • TIM_EncoderInitStruct: pointer to a LL_TIM_ENCODER_InitTypeDef structure (TIMx encoder interface configuration data structure)
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: TIMx registers are de-initialized – ERROR: not applicable

LL_TIM_HALLSENSOR_StructInit

Function name	void LL_TIM_HALLSENSOR_StructInit (LL_TIM_HALLSENSOR_InitTypeDef * TIM_HallSensorInitStruct)
Function description	Set the fields of the TIMx Hall sensor interface configuration data structure to their default values.
Parameters	<ul style="list-style-type: none"> • TIM_HallSensorInitStruct: pointer to a LL_TIM_HALLSENSOR_InitTypeDef structure (HALL sensor interface configuration data structure)

Return values • **None:**

LL_TIM_HALLSENSOR_Init

Function name **ErrorStatus LL_TIM_HALLSENSOR_Init (TIM_TypeDef * TIMx, LL_TIM_HALLSENSOR_InitTypeDef * TIM_HallSensorInitStruct)**

Function description Configure the Hall sensor interface of the timer instance.

Parameters

- **TIMx:** Timer Instance
- **TIM_HallSensorInitStruct:** pointer to a LL_TIM_HALLSENSOR_InitTypeDef structure (TIMx HALL sensor interface configuration data structure)

Return values

- **An:** ErrorStatus enumeration value:
 - SUCCESS: TIMx registers are de-initialized
 - ERROR: not applicable

Notes

- TIMx CH1, CH2 and CH3 inputs connected through a XOR to the TI1 input channel
- TIMx slave mode controller is configured in reset mode. Selected internal trigger is TI1F_ED.
- Channel 1 is configured as input, IC1 is mapped on TRC.
- Captured value stored in TIMx_CCR1 correspond to the time elapsed between 2 changes on the inputs. It gives information about motor speed.
- Channel 2 is configured in output PWM 2 mode.
- Compare value stored in TIMx_CCR2 corresponds to the commutation delay.
- OC2REF is selected as trigger output on TRGO.
- LL_TIM_IC_POLARITY_BOTHEDGE must not be used for TI1 when it is used when TIMx operates in Hall sensor interface mode.

LL_TIM_BDTR_StructInit

Function name **void LL_TIM_BDTR_StructInit (LL_TIM_BDTR_InitTypeDef * TIM_BDTRInitStruct)**

Function description Set the fields of the Break and Dead Time configuration data structure to their default values.

Parameters

- **TIM_BDTRInitStruct:** pointer to a LL_TIM_BDTR_InitTypeDef structure (Break and Dead Time configuration data structure)

Return values • **None:**

LL_TIM_BDTR_Init

Function name **ErrorStatus LL_TIM_BDTR_Init (TIM_TypeDef * TIMx, LL_TIM_BDTR_InitTypeDef * TIM_BDTRInitStruct)**

Function description Configure the Break and Dead Time feature of the timer instance.

Parameters

- **TIMx:** Timer Instance
- **TIM_BDTRInitStruct:** pointer to a

	LL_TIM_BDTR_InitTypeDef structure (Break and Dead Time configuration data structure)
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: Break and Dead Time is initialized – ERROR: not applicable
Notes	<ul style="list-style-type: none"> • As the bits BK2P, BK2E, BK2F[3:0], BKF[3:0], AOE, BKP, BKE, OSSI, OSSR and DTG[7:0] can be write-locked depending on the LOCK configuration, it can be necessary to configure all of them during the first write access to the TIMx_BDTR register. • Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input. • Macro IS_TIM_BKIN2_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a second break input.

90.3 TIM Firmware driver defines

90.3.1 TIM

Active Input Selection

LL_TIM_ACTIVEINPUT_DIRECTTI	ICx is mapped on TIx
LL_TIM_ACTIVEINPUT_INDIRECTTI	ICx is mapped on TIy
LL_TIM_ACTIVEINPUT_TRC	ICx is mapped on TRC

Automatic output enable

LL_TIM_AUTOMATICOUTPUT_DISABLE	MOE can be set only by software
LL_TIM_AUTOMATICOUTPUT_ENABLE	MOE can be set by software or automatically at the next update event

BKIN POLARITY

LL_TIM_BKIN_POLARITY_LOW	BRK BKIN input is active low
LL_TIM_BKIN_POLARITY_HIGH	BRK BKIN input is active high

BKIN SOURCE

LL_TIM_BKIN_SOURCE_BKIN	BKIN input from AF controller
LL_TIM_BKIN_SOURCE_DF1BK	internal signal: DFSDM1 break output

Break2 Enable

LL_TIM_BREAK2_DISABLE	Break2 function disabled
LL_TIM_BREAK2_ENABLE	Break2 function enabled

BREAK2 FILTER

LL_TIM_BREAK2_FILTER_FDIV1	No filter, BRK acts asynchronously
LL_TIM_BREAK2_FILTER_FDIV1_N2	fSAMPLING=fCK_INT, N=2
LL_TIM_BREAK2_FILTER_FDIV1_N4	fSAMPLING=fCK_INT, N=4
LL_TIM_BREAK2_FILTER_FDIV1_N8	fSAMPLING=fCK_INT, N=8

LL_TIM_BREAK2_FILTER_FDIV2_N6	fSAMPLING=fDTS/2, N=6
LL_TIM_BREAK2_FILTER_FDIV2_N8	fSAMPLING=fDTS/2, N=8
LL_TIM_BREAK2_FILTER_FDIV4_N6	fSAMPLING=fDTS/4, N=6
LL_TIM_BREAK2_FILTER_FDIV4_N8	fSAMPLING=fDTS/4, N=8
LL_TIM_BREAK2_FILTER_FDIV8_N6	fSAMPLING=fDTS/8, N=6
LL_TIM_BREAK2_FILTER_FDIV8_N8	fSAMPLING=fDTS/8, N=8
LL_TIM_BREAK2_FILTER_FDIV16_N5	fSAMPLING=fDTS/16, N=5
LL_TIM_BREAK2_FILTER_FDIV16_N6	fSAMPLING=fDTS/16, N=6
LL_TIM_BREAK2_FILTER_FDIV16_N8	fSAMPLING=fDTS/16, N=8
LL_TIM_BREAK2_FILTER_FDIV32_N5	fSAMPLING=fDTS/32, N=5
LL_TIM_BREAK2_FILTER_FDIV32_N6	fSAMPLING=fDTS/32, N=6
LL_TIM_BREAK2_FILTER_FDIV32_N8	fSAMPLING=fDTS/32, N=8

BREAK2 POLARITY

LL_TIM_BREAK2_POLARITY_LOW	Break input BRK2 is active low
LL_TIM_BREAK2_POLARITY_HIGH	Break input BRK2 is active high

Break Enable

LL_TIM_BREAK_DISABLE	Break function disabled
LL_TIM_BREAK_ENABLE	Break function enabled

break filter

LL_TIM_BREAK_FILTER_FDIV1	No filter, BRK acts asynchronously
LL_TIM_BREAK_FILTER_FDIV1_N2	fSAMPLING=fCK_INT, N=2
LL_TIM_BREAK_FILTER_FDIV1_N4	fSAMPLING=fCK_INT, N=4
LL_TIM_BREAK_FILTER_FDIV1_N8	fSAMPLING=fCK_INT, N=8
LL_TIM_BREAK_FILTER_FDIV2_N6	fSAMPLING=fDTS/2, N=6
LL_TIM_BREAK_FILTER_FDIV2_N8	fSAMPLING=fDTS/2, N=8
LL_TIM_BREAK_FILTER_FDIV4_N6	fSAMPLING=fDTS/4, N=6
LL_TIM_BREAK_FILTER_FDIV4_N8	fSAMPLING=fDTS/4, N=8
LL_TIM_BREAK_FILTER_FDIV8_N6	fSAMPLING=fDTS/8, N=6
LL_TIM_BREAK_FILTER_FDIV8_N8	fSAMPLING=fDTS/8, N=8
LL_TIM_BREAK_FILTER_FDIV16_N5	fSAMPLING=fDTS/16, N=5
LL_TIM_BREAK_FILTER_FDIV16_N6	fSAMPLING=fDTS/16, N=6
LL_TIM_BREAK_FILTER_FDIV16_N8	fSAMPLING=fDTS/16, N=8
LL_TIM_BREAK_FILTER_FDIV32_N5	fSAMPLING=fDTS/32, N=5
LL_TIM_BREAK_FILTER_FDIV32_N6	fSAMPLING=fDTS/32, N=6
LL_TIM_BREAK_FILTER_FDIV32_N8	fSAMPLING=fDTS/32, N=8

BREAK INPUT

LL_TIM_BREAK_INPUT_BKIN TIMx_BKIN input
 LL_TIM_BREAK_INPUT_BKIN2 TIMx_BKIN2 input

break polarity

LL_TIM_BREAK_POLARITY_LOW Break input BRK is active low
 LL_TIM_BREAK_POLARITY_HIGH Break input BRK is active high

Capture Compare DMA Request

LL_TIM_CCDMAREQUEST_CC CCx DMA request sent when CCx event occurs
 LL_TIM_CCDMAREQUEST_UPDATE CCx DMA requests sent when update event occurs

Capture Compare Update Source

LL_TIM_CCUPDATESOURCE_COMG_ONLY Capture/compare control bits are updated by setting the COMG bit only
 LL_TIM_CCUPDATESOURCE_COMG_AND_TRGI Capture/compare control bits are updated by setting the COMG bit or when a rising edge occurs on trigger input (TRGI)

Channel

LL_TIM_CHANNEL_CH1 Timer input/output channel 1
 LL_TIM_CHANNEL_CH1N Timer complementary output channel 1
 LL_TIM_CHANNEL_CH2 Timer input/output channel 2
 LL_TIM_CHANNEL_CH2N Timer complementary output channel 2
 LL_TIM_CHANNEL_CH3 Timer input/output channel 3
 LL_TIM_CHANNEL_CH3N Timer complementary output channel 3
 LL_TIM_CHANNEL_CH4 Timer input/output channel 4
 LL_TIM_CHANNEL_CH5 Timer output channel 5
 LL_TIM_CHANNEL_CH6 Timer output channel 6

Clock Division

LL_TIM_CLOCKDIVISION_DIV1 $tDTS=tCK_INT$
 LL_TIM_CLOCKDIVISION_DIV2 $tDTS=2*tCK_INT$
 LL_TIM_CLOCKDIVISION_DIV4 $tDTS=4*tCK_INT$

Clock Source

LL_TIM_CLOCKSOURCE_INTERNAL The timer is clocked by the internal clock provided from the RCC
 LL_TIM_CLOCKSOURCE_EXT_MODE1 Counter counts at each rising or falling edge on a selected input
 LL_TIM_CLOCKSOURCE_EXT_MODE2 Counter counts at each rising or falling edge on the external trigger input ETR

Counter Direction

LL_TIM_COUNTERDIRECTION_UP	Timer counter counts up
LL_TIM_COUNTERDIRECTION_DOWN	Timer counter counts down
Counter Mode	
LL_TIM_COUNTERMODE_UP	Counter used as upcounter
LL_TIM_COUNTERMODE_DOWN	Counter used as downcounter
LL_TIM_COUNTERMODE_CENTER_UP	The counter counts up and down alternatively. Output compare interrupt flags of output channels are set only when the counter is counting down.
LL_TIM_COUNTERMODE_CENTER_DOWN	The counter counts up and down alternatively. Output compare interrupt flags of output channels are set only when the counter is counting up
LL_TIM_COUNTERMODE_CENTER_UP_DOWN	The counter counts up and down alternatively. Output compare interrupt flags of output channels are set only when the counter is counting up or down.
DMA Burst Base Address	
LL_TIM_DMABURST_BASEADDR_CR1	TIMx_CR1 register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_CR2	TIMx_CR2 register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_SMCR	TIMx_SMCR register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_DIER	TIMx_DIER register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_SR	TIMx_SR register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_EGR	TIMx_EGR register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_CCMR1	TIMx_CCMR1 register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_CCMR2	TIMx_CCMR2 register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_CCER	TIMx_CCER register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_CNT	TIMx_CNT register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_PSC	TIMx_PSC register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_ARR	TIMx_ARR register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_RCR	TIMx_RCR register is the DMA base

	address for DMA burst
LL_TIM_DMABURST_BASEADDR_CCR1	TIMx_CCR1 register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_CCR2	TIMx_CCR2 register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_CCR3	TIMx_CCR3 register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_CCR4	TIMx_CCR4 register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_BDTR	TIMx_BDTR register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_CCMR3	TIMx_CCMR3 register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_CCR5	TIMx_CCR5 register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_CCR6	TIMx_CCR6 register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_OR	TIMx_OR register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_AF1	TIMx_AF1 register is the DMA base address for DMA burst
LL_TIM_DMABURST_BASEADDR_AF2	TIMx_AF2 register is the DMA base address for DMA burst

DMA Burst Length

LL_TIM_DMABURST_LENGTH_1TRANSFER	Transfer is done to 1 register starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_2TRANSFERS	Transfer is done to 2 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_3TRANSFERS	Transfer is done to 3 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_4TRANSFERS	Transfer is done to 4 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_5TRANSFERS	Transfer is done to 5 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_6TRANSFERS	Transfer is done to 6 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_7TRANSFERS	Transfer is done to 7 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_8TRANSFERS	Transfer is done to 1 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_9TRANSFERS	Transfer is done to 9 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_10TRANSFERS	Transfer is done to 10 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_11TRANSFERS	Transfer is done to 11 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_12TRANSFERS	Transfer is done to 12 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_13TRANSFERS	Transfer is done to 13 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_14TRANSFERS	Transfer is done to 14 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_15TRANSFERS	Transfer is done to 15 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_16TRANSFERS	Transfer is done to 16 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_17TRANSFERS	Transfer is done to 17 registers starting from the DMA burst base address
LL_TIM_DMABURST_LENGTH_18TRANSFERS	Transfer is done to 18 registers starting from the DMA burst base address

Encoder Mode

LL_TIM_ENCODERMODE_X2_TI1	Encoder mode 1 - Counter counts up/down on TI2FP2 edge depending on TI1FP1 level
LL_TIM_ENCODERMODE_X2_TI2	Encoder mode 2 - Counter counts up/down on TI1FP1 edge depending on TI2FP2 level
LL_TIM_ENCODERMODE_X4_TI12	Encoder mode 3 - Counter counts up/down on both TI1FP1 and TI2FP2 edges depending on the level of the other input I

External Trigger Filter

LL_TIM_ETR_FILTER_FDIV1	No filter, sampling is done at fDTS
LL_TIM_ETR_FILTER_FDIV1_N2	fSAMPLING=fCK_INT, N=2
LL_TIM_ETR_FILTER_FDIV1_N4	fSAMPLING=fCK_INT, N=4
LL_TIM_ETR_FILTER_FDIV1_N8	fSAMPLING=fCK_INT, N=8
LL_TIM_ETR_FILTER_FDIV2_N6	fSAMPLING=fDTS/2, N=6
LL_TIM_ETR_FILTER_FDIV2_N8	fSAMPLING=fDTS/2, N=8
LL_TIM_ETR_FILTER_FDIV4_N6	fSAMPLING=fDTS/4, N=6
LL_TIM_ETR_FILTER_FDIV4_N8	fSAMPLING=fDTS/4, N=8
LL_TIM_ETR_FILTER_FDIV8_N6	fSAMPLING=fDTS/8, N=8
LL_TIM_ETR_FILTER_FDIV8_N8	fSAMPLING=fDTS/16, N=8
LL_TIM_ETR_FILTER_FDIV16_N5	fSAMPLING=fDTS/16, N=6
LL_TIM_ETR_FILTER_FDIV16_N6	fSAMPLING=fDTS/16, N=8
LL_TIM_ETR_FILTER_FDIV16_N8	fSAMPLING=fDTS/16, N=5
LL_TIM_ETR_FILTER_FDIV32_N5	fSAMPLING=fDTS/32, N=5
LL_TIM_ETR_FILTER_FDIV32_N6	fSAMPLING=fDTS/32, N=6

LL_TIM_ETR_FILTER_FDIV32_N8 fSAMPLING=fDTS/32, N=8

External Trigger Polarity

LL_TIM_ETR_POLARITY_NONINVERTED ETR is non-inverted, active at high level or rising edge

LL_TIM_ETR_POLARITY_INVERTED ETR is inverted, active at low level or falling edge

External Trigger Prescaler

LL_TIM_ETR_PRESCALER_DIV1 ETR prescaler OFF

LL_TIM_ETR_PRESCALER_DIV2 ETR frequency is divided by 2

LL_TIM_ETR_PRESCALER_DIV4 ETR frequency is divided by 4

LL_TIM_ETR_PRESCALER_DIV8 ETR frequency is divided by 8

Get Flags Defines

LL_TIM_SR_UIF Update interrupt flag

LL_TIM_SR_CC1IF Capture/compare 1 interrupt flag

LL_TIM_SR_CC2IF Capture/compare 2 interrupt flag

LL_TIM_SR_CC3IF Capture/compare 3 interrupt flag

LL_TIM_SR_CC4IF Capture/compare 4 interrupt flag

LL_TIM_SR_CC5IF Capture/compare 5 interrupt flag

LL_TIM_SR_CC6IF Capture/compare 6 interrupt flag

LL_TIM_SR_COMIF COM interrupt flag

LL_TIM_SR_TIF Trigger interrupt flag

LL_TIM_SR_BIF Break interrupt flag

LL_TIM_SR_B2IF Second break interrupt flag

LL_TIM_SR_CC1OF Capture/Compare 1 overcapture flag

LL_TIM_SR_CC2OF Capture/Compare 2 overcapture flag

LL_TIM_SR_CC3OF Capture/Compare 3 overcapture flag

LL_TIM_SR_CC4OF Capture/Compare 4 overcapture flag

LL_TIM_SR_SBIF System Break interrupt flag

GROUPCH5

LL_TIM_GROUPCH5_NONE No effect of OC5REF on OC1REFC, OC2REFC and OC3REFC

LL_TIM_GROUPCH5_OC1REFC OC1REFC is the logical AND of OC1REFC and OC5REF

LL_TIM_GROUPCH5_OC2REFC OC2REFC is the logical AND of OC2REFC and OC5REF

LL_TIM_GROUPCH5_OC3REFC OC3REFC is the logical AND of OC3REFC and OC5REF

Input Configuration Prescaler

LL_TIM_ICPSC_DIV1	No prescaler, capture is done each time an edge is detected on the capture input
LL_TIM_ICPSC_DIV2	Capture is done once every 2 events
LL_TIM_ICPSC_DIV4	Capture is done once every 4 events
LL_TIM_ICPSC_DIV8	Capture is done once every 8 events

Input Configuration Filter

LL_TIM_IC_FILTER_FDIV1	No filter, sampling is done at fDTS
LL_TIM_IC_FILTER_FDIV1_N2	fSAMPLING=fCK_INT, N=2
LL_TIM_IC_FILTER_FDIV1_N4	fSAMPLING=fCK_INT, N=4
LL_TIM_IC_FILTER_FDIV1_N8	fSAMPLING=fCK_INT, N=8
LL_TIM_IC_FILTER_FDIV2_N6	fSAMPLING=fDTS/2, N=6
LL_TIM_IC_FILTER_FDIV2_N8	fSAMPLING=fDTS/2, N=8
LL_TIM_IC_FILTER_FDIV4_N6	fSAMPLING=fDTS/4, N=6
LL_TIM_IC_FILTER_FDIV4_N8	fSAMPLING=fDTS/4, N=8
LL_TIM_IC_FILTER_FDIV8_N6	fSAMPLING=fDTS/8, N=6
LL_TIM_IC_FILTER_FDIV8_N8	fSAMPLING=fDTS/8, N=8
LL_TIM_IC_FILTER_FDIV16_N5	fSAMPLING=fDTS/16, N=5
LL_TIM_IC_FILTER_FDIV16_N6	fSAMPLING=fDTS/16, N=6
LL_TIM_IC_FILTER_FDIV16_N8	fSAMPLING=fDTS/16, N=8
LL_TIM_IC_FILTER_FDIV32_N5	fSAMPLING=fDTS/32, N=5
LL_TIM_IC_FILTER_FDIV32_N6	fSAMPLING=fDTS/32, N=6
LL_TIM_IC_FILTER_FDIV32_N8	fSAMPLING=fDTS/32, N=8

Input Configuration Polarity

LL_TIM_IC_POLARITY_RISING	The circuit is sensitive to TlxFP1 rising edge, TlxFP1 is not inverted
LL_TIM_IC_POLARITY_FALLING	The circuit is sensitive to TlxFP1 falling edge, TlxFP1 is inverted
LL_TIM_IC_POLARITY_BOTHEDGE	The circuit is sensitive to both TlxFP1 rising and falling edges, TlxFP1 is not inverted

IT Defines

LL_TIM_DIER_UIE	Update interrupt enable
LL_TIM_DIER_CC1IE	Capture/compare 1 interrupt enable
LL_TIM_DIER_CC2IE	Capture/compare 2 interrupt enable
LL_TIM_DIER_CC3IE	Capture/compare 3 interrupt enable
LL_TIM_DIER_CC4IE	Capture/compare 4 interrupt enable
LL_TIM_DIER_COMIE	COM interrupt enable
LL_TIM_DIER_TIE	Trigger interrupt enable
LL_TIM_DIER_BIE	Break interrupt enable

Lock Level

LL_TIM_LOCKLEVEL_OFF	LOCK OFF - No bit is write protected
LL_TIM_LOCKLEVEL_1	LOCK Level 1
LL_TIM_LOCKLEVEL_2	LOCK Level 2
LL_TIM_LOCKLEVEL_3	LOCK Level 3

Output Configuration Idle State

LL_TIM_OCIDLESTATE_LOW	OCx=0 (after a dead-time if OC is implemented) when MOE=0
LL_TIM_OCIDLESTATE_HIGH	OCx=1 (after a dead-time if OC is implemented) when MOE=0

Output Configuration Mode

LL_TIM_OCMODE_FROZEN	The comparison between the output compare register TIMx_CCRy and the counter TIMx_CNT has no effect on the output channel level
LL_TIM_OCMODE_ACTIVE	OCyREF is forced high on compare match
LL_TIM_OCMODE_INACTIVE	OCyREF is forced low on compare match
LL_TIM_OCMODE_TOGGLE	OCyREF toggles on compare match
LL_TIM_OCMODE_FORCED_INACTIVE	OCyREF is forced low
LL_TIM_OCMODE_FORCED_ACTIVE	OCyREF is forced high
LL_TIM_OCMODE_PWM1	In upcounting, channel y is active as long as TIMx_CNT < TIMx_CCRy else inactive. In downcounting, channel y is inactive as long as TIMx_CNT > TIMx_CCRy else active.
LL_TIM_OCMODE_PWM2	In upcounting, channel y is inactive as long as TIMx_CNT < TIMx_CCRy else active. In downcounting, channel y is active as long as TIMx_CNT > TIMx_CCRy else inactive
LL_TIM_OCMODE_RETRIG_OPM1	Retrigerrable OPM mode 1
LL_TIM_OCMODE_RETRIG_OPM2	Retrigerrable OPM mode 2
LL_TIM_OCMODE_COMBINED_PWM1	Combined PWM mode 1
LL_TIM_OCMODE_COMBINED_PWM2	Combined PWM mode 2
LL_TIM_OCMODE_ASSYMETRIC_PWM1	Asymmetric PWM mode 1
LL_TIM_OCMODE_ASSYMETRIC_PWM2	Asymmetric PWM mode 2

Output Configuration Polarity

LL_TIM_OCPOLARITY_HIGH	OCxactive high
LL_TIM_OCPOLARITY_LOW	OCxactive low

Output Configuration State

LL_TIM_OCSTATE_DISABLE	OCx is not active
LL_TIM_OCSTATE_ENABLE	OCx signal is output on the corresponding output pin

One Pulse Mode

LL_TIM_ONEPULSEMODE_SINGLE	Counter is not stopped at update event
LL_TIM_ONEPULSEMODE_REPETITIVE	Counter stops counting at the next update event

OSSI

LL_TIM_OSSI_DISABLE	When inactive, OCx/OCxN outputs are disabled
LL_TIM_OSSI_ENABLE	When inactive, OCx/OCxN outputs are first forced with their inactive level then forced to their idle level after the deadline

OSSR

LL_TIM_OSSR_DISABLE	When inactive, OCx/OCxN outputs are disabled
LL_TIM_OSSR_ENABLE	When inactive, OC/OCN outputs are enabled with their inactive level as soon as CCxE=1 or CCxNE=1

Slave Mode

LL_TIM_SLAVEMODE_DISABLED	Slave mode disabled
LL_TIM_SLAVEMODE_RESET	Reset Mode - Rising edge of the selected trigger input (TRGI) reinitializes the counter
LL_TIM_SLAVEMODE_GATED	Gated Mode - The counter clock is enabled when the trigger input (TRGI) is high
LL_TIM_SLAVEMODE_TRIGGER	Trigger Mode - The counter starts at a rising edge of the trigger TRGI
LL_TIM_SLAVEMODE_COMBINED_RESETTRIGGER	Combined reset + trigger mode - Rising edge of the selected trigger input (TRGI) reinitializes the counter, generates an update of the registers and starts the counter

TIM11 External Input Capture 1 Remap

LL_TIM_TIM11_TI1_RMP_GPIO	TIM11 channel 1 is connected to GPIO
LL_TIM_TIM11_TI1_RMP_SPDIFRX	TIM11 channel 1 is connected to SPDIFRX
LL_TIM_TIM11_TI1_RMP_HSE	TIM11 channel 1 is connected to HSE
LL_TIM_TIM11_TI1_RMP_MCO1	TIM11 channel 1 is connected to MCO1

TIM2 Internal Trigger1 Remap TIM8

LL_TIM_TIM2_ITR1_RMP_TIM8_TRGO	TIM2_ITR1 is connected to TIM8_TRGO
LL_TIM_TIM2_ITR1_RMP_ETH_PTP	TIM2_ITR1 is connected to ETH_PTP
LL_TIM_TIM2_ITR1_RMP_OTG_FS_SOF	TIM2_ITR1 is connected to OTG_FS SOF
LL_TIM_TIM2_ITR1_RMP_OTG_HS_SOF	TIM2_ITR1 is connected to OTG_HS SOF

TIM5 External Input Ch4 Remap

LL_TIM_TIM5_TI4_RMP_GPIO	TIM5 channel 4 is connected to GPIO
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LL_TIM_TIM5_TI4_RMP_LSI	TIM5 channel 4 is connected to LSI internal clock
LL_TIM_TIM5_TI4_RMP_LSE	TIM5 channel 4 is connected to LSE
LL_TIM_TIM5_TI4_RMP_RTC	TIM5 channel 4 is connected to RTC wakeup interrupt

Trigger Output

LL_TIM_TRGO_RESET	UG bit from the TIMx_EGR register is used as trigger output
LL_TIM_TRGO_ENABLE	Counter Enable signal (CNT_EN) is used as trigger output
LL_TIM_TRGO_UPDATE	Update event is used as trigger output
LL_TIM_TRGO_CC1IF	CC1 capture or a compare match is used as trigger output
LL_TIM_TRGO_OC1REF	OC1REF signal is used as trigger output
LL_TIM_TRGO_OC2REF	OC2REF signal is used as trigger output
LL_TIM_TRGO_OC3REF	OC3REF signal is used as trigger output
LL_TIM_TRGO_OC4REF	OC4REF signal is used as trigger output

Trigger Output 2

LL_TIM_TRGO2_RESET	UG bit from the TIMx_EGR register is used as trigger output 2
LL_TIM_TRGO2_ENABLE	Counter Enable signal (CNT_EN) is used as trigger output 2
LL_TIM_TRGO2_UPDATE	Update event is used as trigger output 2
LL_TIM_TRGO2_CC1F	CC1 capture or a compare match is used as trigger output 2
LL_TIM_TRGO2_OC1	OC1REF signal is used as trigger output 2
LL_TIM_TRGO2_OC2	OC2REF signal is used as trigger output 2
LL_TIM_TRGO2_OC3	OC3REF signal is used as trigger output 2
LL_TIM_TRGO2_OC4	OC4REF signal is used as trigger output 2
LL_TIM_TRGO2_OC5	OC5REF signal is used as trigger output 2
LL_TIM_TRGO2_OC6	OC6REF signal is used as trigger output 2
LL_TIM_TRGO2_OC4_RISINGFALLING	OC4REF rising or falling edges are used as trigger output 2
LL_TIM_TRGO2_OC6_RISINGFALLING	OC6REF rising or falling edges are used as trigger output 2
LL_TIM_TRGO2_OC4_RISING_OC6_RISING	OC4REF or OC6REF rising edges are used as trigger output 2
LL_TIM_TRGO2_OC4_RISING_OC6_FALLING	OC4REF rising or OC6REF falling edges are used as trigger output 2
LL_TIM_TRGO2_OC5_RISING_OC6_RISING	OC5REF or OC6REF rising edges are

used as trigger output 2

LL_TIM_TRGO2_OC5_RISING_OC6_FALLING OC5REF rising or OC6REF falling edges are used as trigger output 2

Trigger Selection

LL_TIM_TS_ITR0 Internal Trigger 0 (ITR0) is used as trigger input
 LL_TIM_TS_ITR1 Internal Trigger 1 (ITR1) is used as trigger input
 LL_TIM_TS_ITR2 Internal Trigger 2 (ITR2) is used as trigger input
 LL_TIM_TS_ITR3 Internal Trigger 3 (ITR3) is used as trigger input
 LL_TIM_TS_TI1F_ED TI1 Edge Detector (TI1F_ED) is used as trigger input
 LL_TIM_TS_TI1FP1 Filtered Timer Input 1 (TI1FP1) is used as trigger input
 LL_TIM_TS_TI2FP2 Filtered Timer Input 2 (TI2FP2) is used as trigger input
 LL_TIM_TS_ETRF Filtered external Trigger (ETRF) is used as trigger input

Update Source

LL_TIM_UPDATESOURCE_REGULAR Counter overflow/underflow, Setting the UG bit or Update generation through the slave mode controller generates an update request
 LL_TIM_UPDATESOURCE_COUNTER Only counter overflow/underflow generates an update request

Exported Macros

__LL_TIM_GETFLAG_UIFCPY **Description:**

- HELPER macro retrieving the UIFCPY flag from the counter value.

Parameters:

- __CNT__: Counter value

Return value:

- UIF: status bit

Notes:

- ex: __LL_TIM_GETFLAG_UIFCPY (LL_TIM_GetCounter ()); Relevant only if UIF flag remapping has been enabled (UIF status bit is copied to TIMx_CNT register bit 31)

__LL_TIM_CALC_DEADTIME **Description:**

- HELPER macro calculating DTG[0:7] in the TIMx_BDTR register to achieve the requested dead time duration.

Parameters:

- __TIMCLK__: timer input clock frequency (in Hz)
- __CKD__: This parameter can be one of the following values:
 - LL_TIM_CLOCKDIVISION_DIV1
 - LL_TIM_CLOCKDIVISION_DIV2

- LL_TIM_CLOCKDIVISION_DIV4
- __DT__: deadtime duration (in ns)

Return value:

- DTG[0:7]

Notes:

- ex: __LL_TIM_CALC_DEADTIME (80000000, LL_TIM_GetClockDivision (), 120);

__LL_TIM_CALC_PSC**Description:**

- HELPER macro calculating the prescaler value to achieve the required counter clock frequency.

Parameters:

- __TIMCLK__: timer input clock frequency (in Hz)
- __CNTCLK__: counter clock frequency (in Hz)

Return value:

- Prescaler: value (between Min_Data=0 and Max_Data=65535)

Notes:

- ex: __LL_TIM_CALC_PSC (80000000, 1000000);

__LL_TIM_CALC_ARR**Description:**

- HELPER macro calculating the auto-reload value to achieve the required output signal frequency.

Parameters:

- __TIMCLK__: timer input clock frequency (in Hz)
- __PSC__: prescaler
- __FREQ__: output signal frequency (in Hz)

Return value:

- Auto-reload: value (between Min_Data=0 and Max_Data=65535)

Notes:

- ex: __LL_TIM_CALC_ARR (1000000, LL_TIM_GetPrescaler (), 10000);

__LL_TIM_CALC_DELAY**Description:**

- HELPER macro calculating the compare value required to achieve the required timer output compare active/inactive delay.

Parameters:

- __TIMCLK__: timer input clock frequency (in Hz)
- __PSC__: prescaler
- __DELAY__: timer output compare active/inactive delay (in us)

Return value:

- Compare: value (between Min_Data=0 and Max_Data=65535)

Notes:

- ex: `__LL_TIM_CALC_DELAY (1000000, LL_TIM_GetPrescaler (), 10);`

`__LL_TIM_CALC_PULSE`**Description:**

- HELPER macro calculating the auto-reload value to achieve the required pulse duration (when the timer operates in one pulse mode).

Parameters:

- `__TIMCLK__`: timer input clock frequency (in Hz)
- `__PSC__`: prescaler
- `__DELAY__`: timer output compare active/inactive delay (in us)
- `__PULSE__`: pulse duration (in us)

Return value:

- Auto-reload: value (between Min_Data=0 and Max_Data=65535)

Notes:

- ex: `__LL_TIM_CALC_PULSE (1000000, LL_TIM_GetPrescaler (), 10, 20);`

`__LL_TIM_GET_ICPSC_RATIO`**Description:**

- HELPER macro retrieving the ratio of the input capture prescaler.

Parameters:

- `__ICPSC__`: This parameter can be one of the following values:
 - `LL_TIM_ICPSC_DIV1`
 - `LL_TIM_ICPSC_DIV2`
 - `LL_TIM_ICPSC_DIV4`
 - `LL_TIM_ICPSC_DIV8`

Return value:

- Input: capture prescaler ratio (1, 2, 4 or 8)

Notes:

- ex: `__LL_TIM_GET_ICPSC_RATIO (LL_TIM_IC_GetPrescaler ());`

Common Write and read registers Macros`LL_TIM_WriteReg`**Description:**

- Write a value in TIM register.

Parameters:

- `__INSTANCE__`: TIM Instance
- `__REG__`: Register to be written

LL_TIM_ReadReg

- `__VALUE__`: Value to be written in the register

Return value:

- None

Description:

- Read a value in TIM register.

Parameters:

- `__INSTANCE__`: TIM Instance
- `__REG__`: Register to be read

Return value:

- Register: value

91 LL USART Generic Driver

91.1 USART Firmware driver registers structures

91.1.1 LL_USART_InitTypeDef

Data Fields

- *uint32_t BaudRate*
- *uint32_t DataWidth*
- *uint32_t StopBits*
- *uint32_t Parity*
- *uint32_t TransferDirection*
- *uint32_t HardwareFlowControl*
- *uint32_t OverSampling*

Field Documentation

- *uint32_t LL_USART_InitTypeDef::BaudRate*
This field defines expected Usart communication baud rate. This feature can be modified afterwards using unitary function `LL_USART_SetBaudRate()`.
- *uint32_t LL_USART_InitTypeDef::DataWidth*
Specifies the number of data bits transmitted or received in a frame. This parameter can be a value of [USART_LL_EC_DATAWIDTH](#). This feature can be modified afterwards using unitary function `LL_USART_SetDataWidth()`.
- *uint32_t LL_USART_InitTypeDef::StopBits*
Specifies the number of stop bits transmitted. This parameter can be a value of [USART_LL_EC_STOPBITS](#). This feature can be modified afterwards using unitary function `LL_USART_SetStopBitsLength()`.
- *uint32_t LL_USART_InitTypeDef::Parity*
Specifies the parity mode. This parameter can be a value of [USART_LL_EC_PARITY](#). This feature can be modified afterwards using unitary function `LL_USART_SetParity()`.
- *uint32_t LL_USART_InitTypeDef::TransferDirection*
Specifies whether the Receive and/or Transmit mode is enabled or disabled. This parameter can be a value of [USART_LL_EC_DIRECTION](#). This feature can be modified afterwards using unitary function `LL_USART_SetTransferDirection()`.
- *uint32_t LL_USART_InitTypeDef::HardwareFlowControl*
Specifies whether the hardware flow control mode is enabled or disabled. This parameter can be a value of [USART_LL_EC_HWCONTROL](#). This feature can be modified afterwards using unitary function `LL_USART_SetHWFlowCtrl()`.
- *uint32_t LL_USART_InitTypeDef::OverSampling*
Specifies whether USART oversampling mode is 16 or 8. This parameter can be a value of [USART_LL_EC_OVERSAMPLING](#). This feature can be modified afterwards using unitary function `LL_USART_SetOverSampling()`.

91.1.2 LL_USART_ClockInitTypeDef

Data Fields

- *uint32_t ClockOutput*
- *uint32_t ClockPolarity*
- *uint32_t ClockPhase*
- *uint32_t LastBitClockPulse*

Field Documentation

- ***uint32_t LL_USART_ClockInitTypeDef::ClockOutput***
Specifies whether the USART clock is enabled or disabled. This parameter can be a value of ***USART_LL_EC_CLOCK***. USART HW configuration can be modified afterwards using unitary functions ***LL_USART_EnableSCLKOutput()*** or ***LL_USART_DisableSCLKOutput()***. For more details, refer to description of this function.
- ***uint32_t LL_USART_ClockInitTypeDef::ClockPolarity***
Specifies the steady state of the serial clock. This parameter can be a value of ***USART_LL_EC_POLARITY***. USART HW configuration can be modified afterwards using unitary functions ***LL_USART_SetClockPolarity()***. For more details, refer to description of this function.
- ***uint32_t LL_USART_ClockInitTypeDef::ClockPhase***
Specifies the clock transition on which the bit capture is made. This parameter can be a value of ***USART_LL_EC_PHASE***. USART HW configuration can be modified afterwards using unitary functions ***LL_USART_SetClockPhase()***. For more details, refer to description of this function.
- ***uint32_t LL_USART_ClockInitTypeDef::LastBitClockPulse***
Specifies whether the clock pulse corresponding to the last transmitted data bit (MSB) has to be output on the SCLK pin in synchronous mode. This parameter can be a value of ***USART_LL_EC_LASTCLKPULSE***. USART HW configuration can be modified afterwards using unitary functions ***LL_USART_SetLastClkPulseOutput()***. For more details, refer to description of this function.

91.2 USART Firmware driver API description**91.2.1 Detailed description of functions****LL_USART_Enable**

Function name	<code>__STATIC_INLINE void LL_USART_Enable (USART_TypeDef * USARTx)</code>
Function description	USART Enable.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 UE LL_USART_Enable

LL_USART_Disable

Function name	<code>__STATIC_INLINE void LL_USART_Disable (USART_TypeDef * USARTx)</code>
Function description	USART Disable (all USART prescalers and outputs are disabled)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • When USART is disabled, USART prescalers and outputs are stopped immediately, and current operations are discarded. The configuration of the USART is kept, but all the status

flags, in the USARTx_ISR are set to their default values.

- Reference Manual to LL API cross reference:
- CR1 UE LL_USART_Disable

LL_USART_IsEnabled

Function name **__STATIC_INLINE uint32_t LL_USART_IsEnabled (USART_TypeDef * USARTx)**

Function description Indicate if USART is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

- Reference Manual to LL API cross reference:
- CR1 UE LL_USART_IsEnabled

LL_USART_EnableDirectionRx

Function name **__STATIC_INLINE void LL_USART_EnableDirectionRx (USART_TypeDef * USARTx)**

Function description Receiver Enable (Receiver is enabled and begins searching for a start bit)

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

- Reference Manual to LL API cross reference:
- CR1 RE LL_USART_EnableDirectionRx

LL_USART_DisableDirectionRx

Function name **__STATIC_INLINE void LL_USART_DisableDirectionRx (USART_TypeDef * USARTx)**

Function description Receiver Disable.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

- Reference Manual to LL API cross reference:
- CR1 RE LL_USART_DisableDirectionRx

LL_USART_EnableDirectionTx

Function name **__STATIC_INLINE void LL_USART_EnableDirectionTx (USART_TypeDef * USARTx)**

Function description Transmitter Enable.

Parameters

- **USARTx:** USART Instance

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR1 TE LL_USART_EnableDirectionTx

LL_USART_DisableDirectionTx

- Function name **__STATIC_INLINE void LL_USART_DisableDirectionTx (USART_TypeDef * USARTx)**
- Function description Transmitter Disable.
- Parameters
- **USARTx:** USART Instance
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR1 TE LL_USART_DisableDirectionTx

LL_USART_SetTransferDirection

- Function name **__STATIC_INLINE void LL_USART_SetTransferDirection (USART_TypeDef * USARTx, uint32_t TransferDirection)**
- Function description Configure simultaneously enabled/disabled states of Transmitter and Receiver.
- Parameters
- **USARTx:** USART Instance
 - **TransferDirection:** This parameter can be one of the following values:
 - LL_USART_DIRECTION_NONE
 - LL_USART_DIRECTION_RX
 - LL_USART_DIRECTION_TX
 - LL_USART_DIRECTION_TX_RX
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR1 RE LL_USART_SetTransferDirection
 - CR1 TE LL_USART_SetTransferDirection

LL_USART_GetTransferDirection

- Function name **__STATIC_INLINE uint32_t LL_USART_GetTransferDirection (USART_TypeDef * USARTx)**
- Function description Return enabled/disabled states of Transmitter and Receiver.
- Parameters
- **USARTx:** USART Instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_USART_DIRECTION_NONE
 - LL_USART_DIRECTION_RX
 - LL_USART_DIRECTION_TX
 - LL_USART_DIRECTION_TX_RX
- Reference Manual to LL API cross reference:
- CR1 RE LL_USART_GetTransferDirection
 - CR1 TE LL_USART_GetTransferDirection

reference:

LL_USART_SetParity

Function name	__STATIC_INLINE void LL_USART_SetParity (USART_TypeDef * USARTx, uint32_t Parity)
Function description	Configure Parity (enabled/disabled and parity mode if enabled).
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • Parity: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_PARITY_NONE – LL_USART_PARITY_EVEN – LL_USART_PARITY_ODD
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • This function selects if hardware parity control (generation and detection) is enabled or disabled. When the parity control is enabled (Odd or Even), computed parity bit is inserted at the MSB position (9th or 8th bit depending on data width) and parity is checked on the received data.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 PS LL_USART_SetParity • CR1 PCE LL_USART_SetParity

LL_USART_GetParity

Function name	__STATIC_INLINE uint32_t LL_USART_GetParity (USART_TypeDef * USARTx)
Function description	Return Parity configuration (enabled/disabled and parity mode if enabled)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_USART_PARITY_NONE – LL_USART_PARITY_EVEN – LL_USART_PARITY_ODD
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 PS LL_USART_GetParity • CR1 PCE LL_USART_GetParity

LL_USART_SetWakeUpMethod

Function name	__STATIC_INLINE void LL_USART_SetWakeUpMethod (USART_TypeDef * USARTx, uint32_t Method)
Function description	Set Receiver Wake Up method from Mute mode.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • Method: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_WAKEUP_IDLELINE – LL_USART_WAKEUP_ADDRESSMARK
Return values	<ul style="list-style-type: none"> • None:

Reference Manual to LL API cross reference:

- CR1 WAKE LL_USART_SetWakeUpMethod

LL_USART_GetWakeUpMethod

Function name **__STATIC_INLINE uint32_t LL_USART_GetWakeUpMethod (USART_TypeDef * USARTx)**

Function description Return Receiver Wake Up method from Mute mode.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_USART_WAKEUP_IDLELINE
 - LL_USART_WAKEUP_ADDRESSMARK

Reference Manual to LL API cross reference:

- CR1 WAKE LL_USART_GetWakeUpMethod

LL_USART_SetDataWidth

Function name **__STATIC_INLINE void LL_USART_SetDataWidth (USART_TypeDef * USARTx, uint32_t DataWidth)**

Function description Set Word length (i.e.

Parameters

- **USARTx:** USART Instance
- **DataWidth:** This parameter can be one of the following values:
 - LL_USART_DATAWIDTH_7B
 - LL_USART_DATAWIDTH_8B
 - LL_USART_DATAWIDTH_9B

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 M0 LL_USART_SetDataWidth
- CR1 M1 LL_USART_SetDataWidth

LL_USART_GetDataWidth

Function name **__STATIC_INLINE uint32_t LL_USART_GetDataWidth (USART_TypeDef * USARTx)**

Function description Return Word length (i.e.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
 - LL_USART_DATAWIDTH_7B
 - LL_USART_DATAWIDTH_8B
 - LL_USART_DATAWIDTH_9B

Reference Manual to LL API cross reference:

- CR1 M0 LL_USART_GetDataWidth
- CR1 M1 LL_USART_GetDataWidth

LL_USART_EnableMuteMode

Function name	__STATIC_INLINE void LL_USART_EnableMuteMode (USART_TypeDef * USARTx)
Function description	Allow switch between Mute Mode and Active mode.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 MME LL_USART_EnableMuteMode

LL_USART_DisableMuteMode

Function name	__STATIC_INLINE void LL_USART_DisableMuteMode (USART_TypeDef * USARTx)
Function description	Prevent Mute Mode use.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 MME LL_USART_DisableMuteMode

LL_USART_IsEnabledMuteMode

Function name	__STATIC_INLINE uint32_t LL_USART_IsEnabledMuteMode (USART_TypeDef * USARTx)
Function description	Indicate if switch between Mute Mode and Active mode is allowed.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 MME LL_USART_IsEnabledMuteMode

LL_USART_SetOverSampling

Function name	__STATIC_INLINE void LL_USART_SetOverSampling (USART_TypeDef * USARTx, uint32_t OverSampling)
Function description	Set Oversampling to 8-bit or 16-bit mode.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • OverSampling: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_OVERSAMPLING_16 – LL_USART_OVERSAMPLING_8
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross	<ul style="list-style-type: none"> • CR1 OVER8 LL_USART_SetOverSampling

reference:

LL_USART_GetOverSampling

Function name	__STATIC_INLINE uint32_t LL_USART_GetOverSampling (USART_TypeDef * USARTx)
Function description	Return Oversampling mode.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_USART_OVERSAMPLING_16 – LL_USART_OVERSAMPLING_8
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 OVER8 LL_USART_GetOverSampling

LL_USART_SetLastClkPulseOutput

Function name	__STATIC_INLINE void LL_USART_SetLastClkPulseOutput (USART_TypeDef * USARTx, uint32_t LastBitClockPulse)
Function description	Configure if Clock pulse of the last data bit is output to the SCLK pin or not.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • LastBitClockPulse: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_LASTCLKPULSE_NO_OUTPUT – LL_USART_LASTCLKPULSE_OUTPUT
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 LBCL LL_USART_SetLastClkPulseOutput

LL_USART_GetLastClkPulseOutput

Function name	__STATIC_INLINE uint32_t LL_USART_GetLastClkPulseOutput (USART_TypeDef * USARTx)
Function description	Retrieve Clock pulse of the last data bit output configuration (Last bit Clock pulse output to the SCLK pin or not)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_USART_LASTCLKPULSE_NO_OUTPUT – LL_USART_LASTCLKPULSE_OUTPUT
Notes	<ul style="list-style-type: none"> • Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the

USARTx instance.

- Reference Manual to LL API cross reference:
- CR2 LBCL LL_USART_GetLastClkPulseOutput

LL_USART_SetClockPhase

- Function name **__STATIC_INLINE void LL_USART_SetClockPhase (USART_TypeDef * USARTx, uint32_t ClockPhase)**
- Function description Select the phase of the clock output on the SCLK pin in synchronous mode.
- Parameters
- **USARTx:** USART Instance
 - **ClockPhase:** This parameter can be one of the following values:
 - LL_USART_PHASE_1EDGE
 - LL_USART_PHASE_2EDGE
- Return values
- **None:**
- Notes
- Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- CR2 CPHA LL_USART_SetClockPhase

LL_USART_GetClockPhase

- Function name **__STATIC_INLINE uint32_t LL_USART_GetClockPhase (USART_TypeDef * USARTx)**
- Function description Return phase of the clock output on the SCLK pin in synchronous mode.
- Parameters
- **USARTx:** USART Instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_USART_PHASE_1EDGE
 - LL_USART_PHASE_2EDGE
- Notes
- Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- CR2 CPHA LL_USART_GetClockPhase

LL_USART_SetClockPolarity

- Function name **__STATIC_INLINE void LL_USART_SetClockPolarity (USART_TypeDef * USARTx, uint32_t ClockPolarity)**
- Function description Select the polarity of the clock output on the SCLK pin in synchronous mode.

Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • ClockPolarity: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_POLARITY_LOW – LL_USART_POLARITY_HIGH
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 CPOL LL_USART_SetClockPolarity

LL_USART_GetClockPolarity

Function name	__STATIC_INLINE uint32_t LL_USART_GetClockPolarity (USART_TypeDef * USARTx)
Function description	Return polarity of the clock output on the SCLK pin in synchronous mode.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_USART_POLARITY_LOW – LL_USART_POLARITY_HIGH
Notes	<ul style="list-style-type: none"> • Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 CPOL LL_USART_GetClockPolarity

LL_USART_ConfigClock

Function name	__STATIC_INLINE void LL_USART_ConfigClock (USART_TypeDef * USARTx, uint32_t Phase, uint32_t Polarity, uint32_t LBCPOutput)
Function description	Configure Clock signal format (Phase Polarity and choice about output of last bit clock pulse)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • Phase: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_PHASE_1EDGE – LL_USART_PHASE_2EDGE • Polarity: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_POLARITY_LOW – LL_USART_POLARITY_HIGH • LBCPOutput: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_LASTCLKPULSE_NO_OUTPUT – LL_USART_LASTCLKPULSE_OUTPUT

Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance. • Call of this function is equivalent to following function call sequence : Clock Phase configuration using LL_USART_SetClockPhase() functionClock Polarity configuration using LL_USART_SetClockPolarity() functionOutput of Last bit Clock pulse configuration using LL_USART_SetLastClkPulseOutput() function
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 CPHA LL_USART_ConfigClock • CR2 CPOL LL_USART_ConfigClock • CR2 LBCL LL_USART_ConfigClock

LL_USART_EnableSCLKOutput

Function name	__STATIC_INLINE void LL_USART_EnableSCLKOutput(USART_TypeDef * USARTx)
Function description	Enable Clock output on SCLK pin.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 CLKEN LL_USART_EnableSCLKOutput

LL_USART_DisableSCLKOutput

Function name	__STATIC_INLINE void LL_USART_DisableSCLKOutput(USART_TypeDef * USARTx)
Function description	Disable Clock output on SCLK pin.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 CLKEN LL_USART_DisableSCLKOutput

LL_USART_IsEnabledSCLKOutput

Function name	__STATIC_INLINE uint32_t LL_USART_IsEnabledSCLKOutput(USART_TypeDef * USARTx)
Function description	Indicate if Clock output on SCLK pin is enabled.

Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 CLKEN LL_USART_IsEnabledSCLKOutput

LL_USART_SetStopBitsLength

Function name	__STATIC_INLINE void LL_USART_SetStopBitsLength (USART_TypeDef * USARTx, uint32_t StopBits)
Function description	Set the length of the stop bits.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • StopBits: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_STOPBITS_0_5 – LL_USART_STOPBITS_1 – LL_USART_STOPBITS_1_5 – LL_USART_STOPBITS_2
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 STOP LL_USART_SetStopBitsLength

LL_USART_GetStopBitsLength

Function name	__STATIC_INLINE uint32_t LL_USART_GetStopBitsLength (USART_TypeDef * USARTx)
Function description	Retrieve the length of the stop bits.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_USART_STOPBITS_0_5 – LL_USART_STOPBITS_1 – LL_USART_STOPBITS_1_5 – LL_USART_STOPBITS_2
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 STOP LL_USART_GetStopBitsLength

LL_USART_ConfigCharacter

Function name	__STATIC_INLINE void LL_USART_ConfigCharacter (USART_TypeDef * USARTx, uint32_t DataWidth, uint32_t Parity, uint32_t StopBits)
Function description	Configure Character frame format (Datawidth, Parity control, Stop Bits)

Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • DataWidth: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_DATAWIDTH_7B – LL_USART_DATAWIDTH_8B – LL_USART_DATAWIDTH_9B • Parity: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_PARITY_NONE – LL_USART_PARITY_EVEN – LL_USART_PARITY_ODD • StopBits: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_STOPBITS_0_5 – LL_USART_STOPBITS_1 – LL_USART_STOPBITS_1_5 – LL_USART_STOPBITS_2
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Call of this function is equivalent to following function call sequence : Data Width configuration using LL_USART_SetDataWidth() functionParity Control and mode configuration using LL_USART_SetParity() functionStop bits configuration using LL_USART_SetStopBitsLength() function
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 PS LL_USART_ConfigCharacter • CR1 PCE LL_USART_ConfigCharacter • CR1 M0 LL_USART_ConfigCharacter • CR1 M1 LL_USART_ConfigCharacter • CR2 STOP LL_USART_ConfigCharacter

LL_USART_SetTXRXSwap

Function name	__STATIC_INLINE void LL_USART_SetTXRXSwap (USART_TypeDef * USARTx, uint32_t SwapConfig)
Function description	Configure TX/RX pins swapping setting.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • SwapConfig: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_TXRX_STANDARD – LL_USART_TXRX_SWAPPED
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 SWAP LL_USART_SetTXRXSwap

LL_USART_GetTXRXSwap

Function name	__STATIC_INLINE uint32_t LL_USART_GetTXRXSwap (USART_TypeDef * USARTx)
Function description	Retrieve TX/RX pins swapping configuration.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance

- Return values
- **Returned:** value can be one of the following values:
 - LL_USART_TXRX_STANDARD
 - LL_USART_TXRX_SWAPPED
- Reference Manual to LL API cross reference:
- CR2 SWAP LL_USART_GetTXRXSwap

LL_USART_SetRXPinLevel

- Function name **__STATIC_INLINE void LL_USART_SetRXPinLevel (USART_TypeDef * USARTx, uint32_t PinInvMethod)**
- Function description Configure RX pin active level logic.
- Parameters
- **USARTx:** USART Instance
 - **PinInvMethod:** This parameter can be one of the following values:
 - LL_USART_RXPIN_LEVEL_STANDARD
 - LL_USART_RXPIN_LEVEL_INVERTED
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR2 RXINV LL_USART_SetRXPinLevel

LL_USART_GetRXPinLevel

- Function name **__STATIC_INLINE uint32_t LL_USART_GetRXPinLevel (USART_TypeDef * USARTx)**
- Function description Retrieve RX pin active level logic configuration.
- Parameters
- **USARTx:** USART Instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_USART_RXPIN_LEVEL_STANDARD
 - LL_USART_RXPIN_LEVEL_INVERTED
- Reference Manual to LL API cross reference:
- CR2 RXINV LL_USART_GetRXPinLevel

LL_USART_SetTXPinLevel

- Function name **__STATIC_INLINE void LL_USART_SetTXPinLevel (USART_TypeDef * USARTx, uint32_t PinInvMethod)**
- Function description Configure TX pin active level logic.
- Parameters
- **USARTx:** USART Instance
 - **PinInvMethod:** This parameter can be one of the following values:
 - LL_USART_TXPIN_LEVEL_STANDARD
 - LL_USART_TXPIN_LEVEL_INVERTED
- Return values
- **None:**
- Reference Manual to
- CR2 TXINV LL_USART_SetTXPinLevel

LL API cross
reference:

LL_USART_GetTXPinLevel

Function name	__STATIC_INLINE uint32_t LL_USART_GetTXPinLevel (USART_TypeDef * USARTx)
Function description	Retrieve TX pin active level logic configuration.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_USART_TXPIN_LEVEL_STANDARD – LL_USART_TXPIN_LEVEL_INVERTED
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 TXINV LL_USART_GetTXPinLevel

LL_USART_SetBinaryDataLogic

Function name	__STATIC_INLINE void LL_USART_SetBinaryDataLogic (USART_TypeDef * USARTx, uint32_t DataLogic)
Function description	Configure Binary data logic.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • DataLogic: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_BINARY_LOGIC_POSITIVE – LL_USART_BINARY_LOGIC_NEGATIVE
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Allow to define how Logical data from the data register are send/received : either in positive/direct logic (1=H, 0=L) or in negative/inverse logic (1=L, 0=H)
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 DATAINV LL_USART_SetBinaryDataLogic

LL_USART_GetBinaryDataLogic

Function name	__STATIC_INLINE uint32_t LL_USART_GetBinaryDataLogic (USART_TypeDef * USARTx)
Function description	Retrieve Binary data configuration.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_USART_BINARY_LOGIC_POSITIVE – LL_USART_BINARY_LOGIC_NEGATIVE
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 DATAINV LL_USART_GetBinaryDataLogic

LL_USART_SetTransferBitOrder

Function name	__STATIC_INLINE void LL_USART_SetTransferBitOrder (USART_TypeDef * USARTx, uint32_t BitOrder)
Function description	Configure transfer bit order (either Less or Most Significant Bit First)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • BitOrder: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_BITORDER_LSBFIRST – LL_USART_BITORDER_MSBFIRST
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • MSB First means data is transmitted/received with the MSB first, following the start bit. LSB First means data is transmitted/received with data bit 0 first, following the start bit.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 MSBFIRST LL_USART_SetTransferBitOrder

LL_USART_GetTransferBitOrder

Function name	__STATIC_INLINE uint32_t LL_USART_GetTransferBitOrder (USART_TypeDef * USARTx)
Function description	Return transfer bit order (either Less or Most Significant Bit First)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_USART_BITORDER_LSBFIRST – LL_USART_BITORDER_MSBFIRST
Notes	<ul style="list-style-type: none"> • MSB First means data is transmitted/received with the MSB first, following the start bit. LSB First means data is transmitted/received with data bit 0 first, following the start bit.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 MSBFIRST LL_USART_GetTransferBitOrder

LL_USART_EnableAutoBaudRate

Function name	__STATIC_INLINE void LL_USART_EnableAutoBaudRate (USART_TypeDef * USARTx)
Function description	Enable Auto Baud-Rate Detection.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USARTx) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.
Reference Manual to LL API cross	<ul style="list-style-type: none"> • CR2 ABREN LL_USART_EnableAutoBaudRate

reference:

LL_USART_DisableAutoBaudRate

Function name	__STATIC_INLINE void LL_USART_DisableAutoBaudRate (USART_TypeDef * USARTx)
Function description	Disable Auto Baud-Rate Detection.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USARTx) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 ABREN LL_USART_DisableAutoBaudRate

LL_USART_IsEnabledAutoBaud

Function name	__STATIC_INLINE uint32_t LL_USART_IsEnabledAutoBaud (USART_TypeDef * USARTx)
Function description	Indicate if Auto Baud-Rate Detection mechanism is enabled.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USARTx) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 ABREN LL_USART_IsEnabledAutoBaud

LL_USART_SetAutoBaudRateMode

Function name	__STATIC_INLINE void LL_USART_SetAutoBaudRateMode (USART_TypeDef * USARTx, uint32_t AutoBaudRateMode)
Function description	Set Auto Baud-Rate mode bits.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • AutoBaudRateMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_AUTOBAUD_DETECT_ON_STARTBIT – LL_USART_AUTOBAUD_DETECT_ON_FALLINGEDGE – LL_USART_AUTOBAUD_DETECT_ON_7F_FRAME – LL_USART_AUTOBAUD_DETECT_ON_55_FRAME
Return values	<ul style="list-style-type: none"> • None:

- Notes
- Macro
IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USART x) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- CR2 ABRMODE LL_USART_SetAutoBaudRateMode

LL_USART_GetAutoBaudRateMode

- Function name **__STATIC_INLINE uint32_t LL_USART_GetAutoBaudRateMode (USART_TypeDef * USARTx)**
- Function description Return Auto Baud-Rate mode.
- Parameters
- USARTx:** USART Instance
- Return values
- Returned:** value can be one of the following values:
 - LL_USART_AUTOBAUD_DETECT_ON_STARTBIT
 - LL_USART_AUTOBAUD_DETECT_ON_FALLINGEDGE
 - LL_USART_AUTOBAUD_DETECT_ON_7F_FRAME
 - LL_USART_AUTOBAUD_DETECT_ON_55_FRAME
- Notes
- Macro
IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USART x) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- CR2 ABRMODE LL_USART_GetAutoBaudRateMode

LL_USART_EnableRxTimeout

- Function name **__STATIC_INLINE void LL_USART_EnableRxTimeout (USART_TypeDef * USARTx)**
- Function description Enable Receiver Timeout.
- Parameters
- USARTx:** USART Instance
- Return values
- None:**
- Reference Manual to LL API cross reference:
- CR2 RTOEN LL_USART_EnableRxTimeout

LL_USART_DisableRxTimeout

- Function name **__STATIC_INLINE void LL_USART_DisableRxTimeout (USART_TypeDef * USARTx)**
- Function description Disable Receiver Timeout.
- Parameters
- USARTx:** USART Instance

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- CR2 RTOEN LL_USART_DisableRxTimeout

LL_USART_IsEnabledRxTimeout

- Function name **__STATIC_INLINE uint32_t LL_USART_IsEnabledRxTimeout (USART_TypeDef * USARTx)**
- Function description Indicate if Receiver Timeout feature is enabled.
- Parameters
- **USARTx:** USART Instance
- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- CR2 RTOEN LL_USART_IsEnabledRxTimeout

LL_USART_ConfigNodeAddress

- Function name **__STATIC_INLINE void LL_USART_ConfigNodeAddress (USART_TypeDef * USARTx, uint32_t AddressLen, uint32_t NodeAddress)**
- Function description Set Address of the USART node.
- Parameters
- **USARTx:** USART Instance
 - **AddressLen:** This parameter can be one of the following values:
 - LL_USART_ADDRESS_DETECT_4B
 - LL_USART_ADDRESS_DETECT_7B
 - **NodeAddress:** 4 or 7 bit Address of the USART node.
- Return values
- **None:**
- Notes
- This is used in multiprocessor communication during Mute mode or Stop mode, for wake up with address mark detection.
 - 4bits address node is used when 4-bit Address Detection is selected in ADDM7. (b7-b4 should be set to 0) 8bits address node is used when 7-bit Address Detection is selected in ADDM7. (This is used in multiprocessor communication during Mute mode or Stop mode, for wake up with 7-bit address mark detection. The MSB of the character sent by the transmitter should be equal to 1. It may also be used for character detection during normal reception, Mute mode inactive (for example, end of block detection in ModBus protocol). In this case, the whole received character (8-bit) is compared to the ADD[7:0] value and CMF flag is set on match)
- Reference Manual to LL API cross reference:
- CR2 ADD LL_USART_ConfigNodeAddress
 - CR2 ADDM7 LL_USART_ConfigNodeAddress

LL_USART_GetNodeAddress

Function name	__STATIC_INLINE uint32_t LL_USART_GetNodeAddress (USART_TypeDef * USARTx)
Function description	Return 8 bit Address of the USART node as set in ADD field of CR2.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Address: of the USART node (Value between Min_Data=0 and Max_Data=255)
Notes	<ul style="list-style-type: none"> • If 4-bit Address Detection is selected in ADDM7, only 4bits (b3-b0) of returned value are relevant (b31-b4 are not relevant) If 7-bit Address Detection is selected in ADDM7, only 8bits (b7-b0) of returned value are relevant (b31-b8 are not relevant)
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 ADD LL_USART_GetNodeAddress

LL_USART_GetNodeAddressLen

Function name	__STATIC_INLINE uint32_t LL_USART_GetNodeAddressLen (USART_TypeDef * USARTx)
Function description	Return Length of Node Address used in Address Detection mode (7-bit or 4-bit)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_USART_ADDRESS_DETECT_4B – LL_USART_ADDRESS_DETECT_7B
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 ADDM7 LL_USART_GetNodeAddressLen

LL_USART_EnableRTSHWFlowCtrl

Function name	__STATIC_INLINE void LL_USART_EnableRTSHWFlowCtrl (USART_TypeDef * USARTx)
Function description	Enable RTS HW Flow Control.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 RTSE LL_USART_EnableRTSHWFlowCtrl

LL_USART_DisableRTSHWFlowCtrl

Function name	__STATIC_INLINE void LL_USART_DisableRTSHWFlowCtrl (USART_TypeDef * USARTx)
Function description	Disable RTS HW Flow Control.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 RTSE LL_USART_DisableRTSHWFlowCtrl

LL_USART_EnableCTSHWFlowCtrl

Function name	__STATIC_INLINE void LL_USART_EnableCTSHWFlowCtrl (USART_TypeDef * USARTx)
Function description	Enable CTS HW Flow Control.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 CTSE LL_USART_EnableCTSHWFlowCtrl

LL_USART_DisableCTSHWFlowCtrl

Function name	__STATIC_INLINE void LL_USART_DisableCTSHWFlowCtrl (USART_TypeDef * USARTx)
Function description	Disable CTS HW Flow Control.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 CTSE LL_USART_DisableCTSHWFlowCtrl

LL_USART_SetHWFlowCtrl

Function name	__STATIC_INLINE void LL_USART_SetHWFlowCtrl (USART_TypeDef * USARTx, uint32_t HardwareFlowControl)
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Function description	Configure HW Flow Control mode (both CTS and RTS)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • HardwareFlowControl: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_HWCONTROL_NONE – LL_USART_HWCONTROL_RTS – LL_USART_HWCONTROL_CTS – LL_USART_HWCONTROL_RTS_CTS
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 RTSE LL_USART_SetHWFlowCtrl • CR3 CTSE LL_USART_SetHWFlowCtrl

LL_USART_GetHWFlowCtrl

Function name	__STATIC_INLINE uint32_t LL_USART_GetHWFlowCtrl (USART_TypeDef * USARTx)
Function description	Return HW Flow Control configuration (both CTS and RTS)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_USART_HWCONTROL_NONE – LL_USART_HWCONTROL_RTS – LL_USART_HWCONTROL_CTS – LL_USART_HWCONTROL_RTS_CTS
Notes	<ul style="list-style-type: none"> • Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 RTSE LL_USART_GetHWFlowCtrl • CR3 CTSE LL_USART_GetHWFlowCtrl

LL_USART_EnableOneBitSamp

Function name	__STATIC_INLINE void LL_USART_EnableOneBitSamp (USART_TypeDef * USARTx)
Function description	Enable One bit sampling method.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 ONEBIT LL_USART_EnableOneBitSamp

LL_USART_DisableOneBitSamp

Function name	__STATIC_INLINE void LL_USART_DisableOneBitSamp (USART_TypeDef * USARTx)
Function description	Disable One bit sampling method.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 ONEBIT LL_USART_DisableOneBitSamp

LL_USART_IsEnabledOneBitSamp

Function name	__STATIC_INLINE uint32_t LL_USART_IsEnabledOneBitSamp (USART_TypeDef * USARTx)
Function description	Indicate if One bit sampling method is enabled.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 ONEBIT LL_USART_IsEnabledOneBitSamp

LL_USART_EnableOverrunDetect

Function name	__STATIC_INLINE void LL_USART_EnableOverrunDetect (USART_TypeDef * USARTx)
Function description	Enable Overrun detection.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 OVRDIS LL_USART_EnableOverrunDetect

LL_USART_DisableOverrunDetect

Function name	__STATIC_INLINE void LL_USART_DisableOverrunDetect (USART_TypeDef * USARTx)
Function description	Disable Overrun detection.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 OVRDIS LL_USART_DisableOverrunDetect

LL_USART_IsEnabledOverrunDetect

Function name	__STATIC_INLINE uint32_t LL_USART_IsEnabledOverrunDetect (USART_TypeDef * USARTx)
Function description	Indicate if Overrun detection is enabled.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 OVRDIS LL_USART_IsEnabledOverrunDetect

LL_USART_SetBaudRate

Function name	__STATIC_INLINE void LL_USART_SetBaudRate (USART_TypeDef * USARTx, uint32_t PeriphClk, uint32_t OverSampling, uint32_t BaudRate)
Function description	Configure USART BRR register for achieving expected Baud Rate value.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • PeriphClk: Peripheral Clock • OverSampling: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_OVERSAMPLING_16 – LL_USART_OVERSAMPLING_8 • BaudRate: Baud Rate
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Compute and set USARTDIV value in BRR Register (full BRR content) according to used Peripheral Clock, Oversampling mode, and expected Baud Rate values • Peripheral clock and Baud rate values provided as function parameters should be valid (Baud rate value != 0) • In case of oversampling by 16 and 8, BRR content must be greater than or equal to 16d.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • BRR BRR LL_USART_SetBaudRate

LL_USART_GetBaudRate

Function name	__STATIC_INLINE uint32_t LL_USART_GetBaudRate (USART_TypeDef * USARTx, uint32_t PeriphClk, uint32_t OverSampling)
Function description	Return current Baud Rate value, according to USARTDIV present in BRR register (full BRR content), and to used Peripheral Clock and Oversampling mode values.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • PeriphClk: Peripheral Clock • OverSampling: This parameter can be one of the following

	values:
	– LL_USART_OVERSAMPLING_16
	– LL_USART_OVERSAMPLING_8
Return values	• Baud: Rate
Notes	<ul style="list-style-type: none"> • In case of non-initialized or invalid value stored in BRR register, value 0 will be returned. • In case of oversampling by 16 and 8, BRR content must be greater than or equal to 16d.
Reference Manual to LL API cross reference:	• BRR BRR LL_USART_GetBaudRate

LL_USART_SetRxTimeout

Function name	__STATIC_INLINE void LL_USART_SetRxTimeout (USART_TypeDef * USARTx, uint32_t Timeout)
Function description	Set Receiver Time Out Value (expressed in nb of bits duration)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • Timeout: Value between Min_Data=0x00 and Max_Data=0x00FFFFFF
Return values	• None:
Reference Manual to LL API cross reference:	• RTOR RTO LL_USART_SetRxTimeout

LL_USART_GetRxTimeout

Function name	__STATIC_INLINE uint32_t LL_USART_GetRxTimeout (USART_TypeDef * USARTx)
Function description	Get Receiver Time Out Value (expressed in nb of bits duration)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0x00FFFFFF
Reference Manual to LL API cross reference:	• RTOR RTO LL_USART_GetRxTimeout

LL_USART_SetBlockLength

Function name	__STATIC_INLINE void LL_USART_SetBlockLength (USART_TypeDef * USARTx, uint32_t BlockLength)
Function description	Set Block Length value in reception.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • BlockLength: Value between Min_Data=0x00 and Max_Data=0xFF
Return values	• None:

Reference Manual to LL API cross reference:

- RTOR BLEN LL_USART_SetBlockLength

LL_USART_GetBlockLength

Function name **__STATIC_INLINE uint32_t LL_USART_GetBlockLength (USART_TypeDef * USARTx)**

Function description Get Block Length value in reception.

Parameters

- **USARTx:** USART Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- RTOR BLEN LL_USART_GetBlockLength

LL_USART_EnableIrda

Function name **__STATIC_INLINE void LL_USART_EnableIrda (USART_TypeDef * USARTx)**

Function description Enable IrDA mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 IREN LL_USART_EnableIrda

LL_USART_DisableIrda

Function name **__STATIC_INLINE void LL_USART_DisableIrda (USART_TypeDef * USARTx)**

Function description Disable IrDA mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 IREN LL_USART_DisableIrda

LL_USART_IsEnabledIrda

Function name **__STATIC_INLINE uint32_t LL_USART_IsEnabledIrda**

(USART_TypeDef * USARTx)

Function description	Indicate if IrDA mode is enabled.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 IREN LL_USART_IsEnabledIrda

LL_USART_SetIrdaPowerMode

Function name	__STATIC_INLINE void LL_USART_SetIrdaPowerMode (USART_TypeDef * USARTx, uint32_t PowerMode)
Function description	Configure IrDA Power Mode (Normal or Low Power)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • PowerMode: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_IRDA_POWER_NORMAL – LL_USART_IRDA_POWER_LOW
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 IRLP LL_USART_SetIrdaPowerMode

LL_USART_GetIrdaPowerMode

Function name	__STATIC_INLINE uint32_t LL_USART_GetIrdaPowerMode (USART_TypeDef * USARTx)
Function description	Retrieve IrDA Power Mode configuration (Normal or Low Power)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_USART_IRDA_POWER_NORMAL – LL_USART_PHASE_2EDGE
Notes	<ul style="list-style-type: none"> • Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 IRLP LL_USART_GetIrdaPowerMode

LL_USART_SetIrdaPrescaler

Function name	__STATIC_INLINE void LL_USART_SetIrdaPrescaler (USART_TypeDef * USARTx, uint32_t PrescalerValue)
Function description	Set Irda prescaler value, used for dividing the USART clock source to achieve the Irda Low Power frequency (8 bits value)
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance• PrescalerValue: Value between Min_Data=0x00 and Max_Data=0xFF
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• GTPR PSC LL_USART_SetIrdaPrescaler

LL_USART_GetIrdaPrescaler

Function name	__STATIC_INLINE uint32_t LL_USART_GetIrdaPrescaler (USART_TypeDef * USARTx)
Function description	Return Irda prescaler value, used for dividing the USART clock source to achieve the Irda Low Power frequency (8 bits value)
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• Irda: prescaler value (Value between Min_Data=0x00 and Max_Data=0xFF)
Notes	<ul style="list-style-type: none">• Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• GTPR PSC LL_USART_GetIrdaPrescaler

LL_USART_EnableSmartcardNACK

Function name	__STATIC_INLINE void LL_USART_EnableSmartcardNACK (USART_TypeDef * USARTx)
Function description	Enable Smartcard NACK transmission.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR3 NACK LL_USART_EnableSmartcardNACK

LL_USART_DisableSmartcardNACK

Function name	__STATIC_INLINE void LL_USART_DisableSmartcardNACK (USART_TypeDef * USARTx)
Function description	Disable Smartcard NACK transmission.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 NACK LL_USART_DisableSmartcardNACK

LL_USART_IsEnabledSmartcardNACK

Function name	__STATIC_INLINE uint32_t LL_USART_IsEnabledSmartcardNACK (USART_TypeDef * USARTx)
Function description	Indicate if Smartcard NACK transmission is enabled.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 NACK LL_USART_IsEnabledSmartcardNACK

LL_USART_EnableSmartcard

Function name	__STATIC_INLINE void LL_USART_EnableSmartcard (USART_TypeDef * USARTx)
Function description	Enable Smartcard mode.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 SCEN LL_USART_EnableSmartcard

LL_USART_DisableSmartcard

Function name	__STATIC_INLINE void LL_USART_DisableSmartcard
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(USART_TypeDef * USARTx)

Function description	Disable Smartcard mode.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 SCEN LL_USART_DisableSmartcard

LL_USART_IsEnabledSmartcard

Function name	__STATIC_INLINE uint32_t LL_USART_IsEnabledSmartcard (USART_TypeDef * USARTx)
Function description	Indicate if Smartcard mode is enabled.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 SCEN LL_USART_IsEnabledSmartcard

LL_USART_SetSmartcardAutoRetryCount

Function name	__STATIC_INLINE void LL_USART_SetSmartcardAutoRetryCount (USART_TypeDef * USARTx, uint32_t AutoRetryCount)
Function description	Set Smartcard Auto-Retry Count value (SCARCNT[2:0] bits)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • AutoRetryCount: Value between Min_Data=0 and Max_Data=7
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance. • This bit-field specifies the number of retries in transmit and receive, in Smartcard mode. In transmission mode, it specifies the number of automatic retransmission retries, before generating a transmission error (FE bit set). In reception mode, it specifies the number or erroneous reception trials, before generating a reception error (RXNE and PE bits set)
Reference Manual to LL API cross	<ul style="list-style-type: none"> • CR3 SCARCNT LL_USART_SetSmartcardAutoRetryCount

reference:

LL_USART_GetSmartcardAutoRetryCount

Function name	__STATIC_INLINE uint32_t LL_USART_GetSmartcardAutoRetryCount (USART_TypeDef * USARTx)
Function description	Return Smartcard Auto-Retry Count value (SCARCNT[2:0] bits)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Smartcard: Auto-Retry Count value (Value between Min_Data=0 and Max_Data=7)
Notes	<ul style="list-style-type: none"> • Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 SCARCNT LL_USART_GetSmartcardAutoRetryCount

LL_USART_SetSmartcardPrescaler

Function name	__STATIC_INLINE void LL_USART_SetSmartcardPrescaler (USART_TypeDef * USARTx, uint32_t PrescalerValue)
Function description	Set Smartcard prescaler value, used for dividing the USART clock source to provide the SMARTCARD Clock (5 bits value)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • PrescalerValue: Value between Min_Data=0 and Max_Data=31
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • GTPR_PSC LL_USART_SetSmartcardPrescaler

LL_USART_GetSmartcardPrescaler

Function name	__STATIC_INLINE uint32_t LL_USART_GetSmartcardPrescaler (USART_TypeDef * USARTx)
Function description	Return Smartcard prescaler value, used for dividing the USART clock source to provide the SMARTCARD Clock (5 bits value)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Smartcard: prescaler value (Value between Min_Data=0 and Max_Data=31)
Notes	<ul style="list-style-type: none"> • Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the

USARTx instance.

- Reference Manual to LL API cross reference:
- GTPR PSC LL_USART_GetSmartcardPrescaler

LL_USART_SetSmartcardGuardTime

Function name `__STATIC_INLINE void LL_USART_SetSmartcardGuardTime (USART_TypeDef * USARTx, uint32_t GuardTime)`

Function description Set Smartcard Guard time value, expressed in nb of baud clocks periods (GT[7:0] bits : Guard time value)

Parameters

- **USARTx:** USART Instance
- **GuardTime:** Value between Min_Data=0x00 and Max_Data=0xFF

Return values

- **None:**

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

- Reference Manual to LL API cross reference:
- GTPR GT LL_USART_SetSmartcardGuardTime

LL_USART_GetSmartcardGuardTime

Function name `__STATIC_INLINE uint32_t LL_USART_GetSmartcardGuardTime (USART_TypeDef * USARTx)`

Function description Return Smartcard Guard time value, expressed in nb of baud clocks periods (GT[7:0] bits : Guard time value)

Parameters

- **USARTx:** USART Instance

Return values

- **Smartcard:** Guard time value (Value between Min_Data=0x00 and Max_Data=0xFF)

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

- Reference Manual to LL API cross reference:
- GTPR GT LL_USART_GetSmartcardGuardTime

LL_USART_EnableHalfDuplex

Function name `__STATIC_INLINE void LL_USART_EnableHalfDuplex (USART_TypeDef * USARTx)`

Function description Enable Single Wire Half-Duplex mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

- Notes
- Macro `IS_UART_HALFDUPLEX_INSTANCE(USARTx)` can be used to check whether or not Half-Duplex mode is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- CR3 HDSEL `LL_USART_EnableHalfDuplex`

LL_USART_DisableHalfDuplex

- Function name `__STATIC_INLINE void LL_USART_DisableHalfDuplex(USART_TypeDef * USARTx)`
- Function description Disable Single Wire Half-Duplex mode.
- Parameters
- USARTx:** USART Instance
- Return values
- None:**
- Notes
- Macro `IS_UART_HALFDUPLEX_INSTANCE(USARTx)` can be used to check whether or not Half-Duplex mode is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- CR3 HDSEL `LL_USART_DisableHalfDuplex`

LL_USART_IsEnabledHalfDuplex

- Function name `__STATIC_INLINE uint32_t LL_USART_IsEnabledHalfDuplex(USART_TypeDef * USARTx)`
- Function description Indicate if Single Wire Half-Duplex mode is enabled.
- Parameters
- USARTx:** USART Instance
- Return values
- State:** of bit (1 or 0).
- Notes
- Macro `IS_UART_HALFDUPLEX_INSTANCE(USARTx)` can be used to check whether or not Half-Duplex mode is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- CR3 HDSEL `LL_USART_IsEnabledHalfDuplex`

LL_USART_SetLINBrkDetectionLen

- Function name `__STATIC_INLINE void LL_USART_SetLINBrkDetectionLen(USART_TypeDef * USARTx, uint32_t LINBDLength)`
- Function description Set LIN Break Detection Length.
- Parameters
- USARTx:** USART Instance
 - LINBDLength:** This parameter can be one of the following values:
 - `LL_USART_LINBREAK_DETECT_10B`
 - `LL_USART_LINBREAK_DETECT_11B`
- Return values
- None:**

- Notes
- Macro `IS_UART_LIN_INSTANCE(USARTx)` can be used to check whether or not LIN feature is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- CR2 LBDL `LL_USART_SetLINBrkDetectionLen`

LL_USART_GetLINBrkDetectionLen

- Function name `__STATIC_INLINE uint32_t LL_USART_GetLINBrkDetectionLen (USART_TypeDef * USARTx)`
- Function description Return LIN Break Detection Length.
- Parameters
- **USARTx:** USART Instance
- Return values
- **Returned:** value can be one of the following values:
 - `LL_USART_LINBREAK_DETECT_10B`
 - `LL_USART_LINBREAK_DETECT_11B`
- Notes
- Macro `IS_UART_LIN_INSTANCE(USARTx)` can be used to check whether or not LIN feature is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- CR2 LBDL `LL_USART_GetLINBrkDetectionLen`

LL_USART_EnableLIN

- Function name `__STATIC_INLINE void LL_USART_EnableLIN (USART_TypeDef * USARTx)`
- Function description Enable LIN mode.
- Parameters
- **USARTx:** USART Instance
- Return values
- **None:**
- Notes
- Macro `IS_UART_LIN_INSTANCE(USARTx)` can be used to check whether or not LIN feature is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- CR2 LINEN `LL_USART_EnableLIN`

LL_USART_DisableLIN

- Function name `__STATIC_INLINE void LL_USART_DisableLIN (USART_TypeDef * USARTx)`
- Function description Disable LIN mode.
- Parameters
- **USARTx:** USART Instance
- Return values
- **None:**
- Notes
- Macro `IS_UART_LIN_INSTANCE(USARTx)` can be used to

check whether or not LIN feature is supported by the USARTx instance.

- Reference Manual to LL API cross reference:
- CR2 LINEN LL_USART_DisableLIN

LL_USART_IsEnabledLIN

- Function name **__STATIC_INLINE uint32_t LL_USART_IsEnabledLIN (USART_TypeDef * USARTx)**
- Function description Indicate if LIN mode is enabled.
- Parameters
- **USARTx:** USART Instance
- Return values
- **State:** of bit (1 or 0).
- Notes
- Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- CR2 LINEN LL_USART_IsEnabledLIN

LL_USART_SetDEDeassertionTime

- Function name **__STATIC_INLINE void LL_USART_SetDEDeassertionTime (USART_TypeDef * USARTx, uint32_t Time)**
- Function description Set DEDT (Driver Enable De-Assertion Time), Time value expressed on 5 bits ([4:0] bits).
- Parameters
- **USARTx:** USART Instance
 - **Time:** Value between Min_Data=0 and Max_Data=31
- Return values
- **None:**
- Notes
- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- CR1 DEDT LL_USART_SetDEDeassertionTime

LL_USART_GetDEDeassertionTime

- Function name **__STATIC_INLINE uint32_t LL_USART_GetDEDeassertionTime (USART_TypeDef * USARTx)**
- Function description Return DEDT (Driver Enable De-Assertion Time)
- Parameters
- **USARTx:** USART Instance
- Return values
- **Time:** value expressed on 5 bits ([4:0] bits) : Value between Min_Data=0 and Max_Data=31
- Notes
- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is

supported by the USARTx instance.

- Reference Manual to LL API cross reference:
- CR1 DEDT LL_USART_GetDEDeassertionTime

LL_USART_SetDEAssertionTime

- Function name **__STATIC_INLINE void LL_USART_SetDEAssertionTime (USART_TypeDef * USARTx, uint32_t Time)**
- Function description Set DEAT (Driver Enable Assertion Time), Time value expressed on 5 bits ([4:0] bits).
- Parameters
- **USARTx:** USART Instance
 - **Time:** Value between Min_Data=0 and Max_Data=31
- Return values
- **None:**
- Notes
- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- CR1 DEAT LL_USART_SetDEAssertionTime

LL_USART_GetDEAssertionTime

- Function name **__STATIC_INLINE uint32_t LL_USART_GetDEAssertionTime (USART_TypeDef * USARTx)**
- Function description Return DEAT (Driver Enable Assertion Time)
- Parameters
- **USARTx:** USART Instance
- Return values
- **Time:** value expressed on 5 bits ([4:0] bits) : Value between Min_Data=0 and Max_Data=31
- Notes
- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- CR1 DEAT LL_USART_GetDEAssertionTime

LL_USART_EnableDEMode

- Function name **__STATIC_INLINE void LL_USART_EnableDEMode (USART_TypeDef * USARTx)**
- Function description Enable Driver Enable (DE) Mode.
- Parameters
- **USARTx:** USART Instance
- Return values
- **None:**
- Notes
- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 DEM LL_USART_EnableDEMode

LL_USART_DisableDEMode

Function name **__STATIC_INLINE void LL_USART_DisableDEMode (USART_TypeDef * USARTx)**

Function description Disable Driver Enable (DE) Mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 DEM LL_USART_DisableDEMode

LL_USART_IsEnabledDEMode

Function name **__STATIC_INLINE uint32_t LL_USART_IsEnabledDEMode (USART_TypeDef * USARTx)**

Function description Indicate if Driver Enable (DE) Mode is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 DEM LL_USART_IsEnabledDEMode

LL_USART_SetDESignalPolarity

Function name **__STATIC_INLINE void LL_USART_SetDESignalPolarity (USART_TypeDef * USARTx, uint32_t Polarity)**

Function description Select Driver Enable Polarity.

Parameters

- **USARTx:** USART Instance
- **Polarity:** This parameter can be one of the following values:
 - LL_USART_DE_POLARITY_HIGH
 - LL_USART_DE_POLARITY_LOW

Return values

- **None:**

Notes

- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.

Reference Manual to

- CR3 DEP LL_USART_SetDESignalPolarity

LL API cross
reference:

LL_USART_GetDESignalPolarity

Function name	__STATIC_INLINE uint32_t LL_USART_GetDESignalPolarity (USART_TypeDef * USARTx)
Function description	Return Driver Enable Polarity.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Returned: value can be one of the following values: <ul style="list-style-type: none"> – LL_USART_DE_POLARITY_HIGH – LL_USART_DE_POLARITY_LOW
Notes	<ul style="list-style-type: none"> • Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 DEP LL_USART_GetDESignalPolarity

LL_USART_ConfigAsyncMode

Function name	__STATIC_INLINE void LL_USART_ConfigAsyncMode (USART_TypeDef * USARTx)
Function description	Perform basic configuration of USART for enabling use in Asynchronous Mode (UART)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • In UART mode, the following bits must be kept cleared: LINEN bit in the USART_CR2 register,CLKEN bit in the USART_CR2 register,SCEN bit in the USART_CR3 register,IREN bit in the USART_CR3 register,HDSEL bit in the USART_CR3 register. • Call of this function is equivalent to following function call sequence : Clear LINEN in CR2 using LL_USART_DisableLIN() functionClear CLKEN in CR2 using LL_USART_DisableSCLKOutput() functionClear SCEN in CR3 using LL_USART_DisableSmartcard() functionClear IREN in CR3 using LL_USART_DisableIrda() functionClear HDSEL in CR3 using LL_USART_DisableHalfDuplex() function • Other remaining configurations items related to Asynchronous Mode (as Baud Rate, Word length, Parity, ...) should be set using dedicated functions
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 LINEN LL_USART_ConfigAsyncMode • CR2 CLKEN LL_USART_ConfigAsyncMode • CR3 SCEN LL_USART_ConfigAsyncMode • CR3 IREN LL_USART_ConfigAsyncMode • CR3 HDSEL LL_USART_ConfigAsyncMode

LL_USART_ConfigSyncMode

Function name	__STATIC_INLINE void LL_USART_ConfigSyncMode (USART_TypeDef * USARTx)
Function description	Perform basic configuration of USART for enabling use in Synchronous Mode.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • In Synchronous mode, the following bits must be kept cleared: LINEN bit in the USART_CR2 register, SCEN bit in the USART_CR3 register, IREN bit in the USART_CR3 register, HDSEL bit in the USART_CR3 register. This function also sets the USART in Synchronous mode. • Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance. • Call of this function is equivalent to following function call sequence : Clear LINEN in CR2 using LL_USART_DisableLIN() function Clear IREN in CR3 using LL_USART_DisableIrda() function Clear SCEN in CR3 using LL_USART_DisableSmartcard() function Clear HDSEL in CR3 using LL_USART_DisableHalfDuplex() function Set CLKEN in CR2 using LL_USART_EnableSCLKOutput() function • Other remaining configurations items related to Synchronous Mode (as Baud Rate, Word length, Parity, Clock Polarity, ...) should be set using dedicated functions
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 LINEN LL_USART_ConfigSyncMode • CR2 CLKEN LL_USART_ConfigSyncMode • CR3 SCEN LL_USART_ConfigSyncMode • CR3 IREN LL_USART_ConfigSyncMode • CR3 HDSEL LL_USART_ConfigSyncMode

LL_USART_ConfigLINMode

Function name	__STATIC_INLINE void LL_USART_ConfigLINMode (USART_TypeDef * USARTx)
Function description	Perform basic configuration of USART for enabling use in LIN Mode.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • In LIN mode, the following bits must be kept cleared: STOP and CLKEN bits in the USART_CR2 register, SCEN bit in the USART_CR3 register, IREN bit in the USART_CR3 register, HDSEL bit in the USART_CR3 register. This function also set the UART/USART in LIN mode. • Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance. • Call of this function is equivalent to following function call sequence : Clear CLKEN in CR2 using

- LL_USART_DisableSCLKOutput() functionClear STOP in CR2 using LL_USART_SetStopBitsLength() functionClear SCEN in CR3 using LL_USART_DisableSmartcard() functionClear IREN in CR3 using LL_USART_DisableIrda() functionClear HDSEL in CR3 using LL_USART_DisableHalfDuplex() functionSet LINEN in CR2 using LL_USART_EnableLIN() function
- Other remaining configurations items related to LIN Mode (as Baud Rate, Word length, LIN Break Detection Length, ...) should be set using dedicated functions
- Reference Manual to LL API cross reference:
- CR2 CLKEN LL_USART_ConfigLINMode
 - CR2 STOP LL_USART_ConfigLINMode
 - CR2 LINEN LL_USART_ConfigLINMode
 - CR3 IREN LL_USART_ConfigLINMode
 - CR3 SCEN LL_USART_ConfigLINMode
 - CR3 HDSEL LL_USART_ConfigLINMode

LL_USART_ConfigHalfDuplexMode

- Function name **__STATIC_INLINE void LL_USART_ConfigHalfDuplexMode (USART_TypeDef * USARTx)**
- Function description Perform basic configuration of USART for enabling use in Half Duplex Mode.
- Parameters
- **USARTx:** USART Instance
- Return values
- **None:**
- Notes
- In Half Duplex mode, the following bits must be kept cleared: LINEN bit in the USART_CR2 register,CLKEN bit in the USART_CR2 register,SCEN bit in the USART_CR3 register,IREN bit in the USART_CR3 register, This function also sets the UART/USART in Half Duplex mode.
 - Macro IS_UART_HALFDUPLEX_INSTANCE(USARTx) can be used to check whether or not Half-Duplex mode is supported by the USARTx instance.
 - Call of this function is equivalent to following function call sequence : Clear LINEN in CR2 using LL_USART_DisableLIN() functionClear CLKEN in CR2 using LL_USART_DisableSCLKOutput() functionClear SCEN in CR3 using LL_USART_DisableSmartcard() functionClear IREN in CR3 using LL_USART_DisableIrda() functionSet HDSEL in CR3 using LL_USART_EnableHalfDuplex() function
 - Other remaining configurations items related to Half Duplex Mode (as Baud Rate, Word length, Parity, ...) should be set using dedicated functions
- Reference Manual to LL API cross reference:
- CR2 LINEN LL_USART_ConfigHalfDuplexMode
 - CR2 CLKEN LL_USART_ConfigHalfDuplexMode
 - CR3 HDSEL LL_USART_ConfigHalfDuplexMode
 - CR3 SCEN LL_USART_ConfigHalfDuplexMode
 - CR3 IREN LL_USART_ConfigHalfDuplexMode

LL_USART_ConfigSmartcardMode

Function name	__STATIC_INLINE void LL_USART_ConfigSmartcardMode (USART_TypeDef * USARTx)
Function description	Perform basic configuration of USART for enabling use in Smartcard Mode.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • In Smartcard mode, the following bits must be kept cleared: LINEN bit in the USART_CR2 register, IREN bit in the USART_CR3 register, HDSEL bit in the USART_CR3 register. This function also configures Stop bits to 1.5 bits and sets the USART in Smartcard mode (SCEN bit). Clock Output is also enabled (CLKEN). • Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance. • Call of this function is equivalent to following function call sequence : Clear LINEN in CR2 using LL_USART_DisableLIN() function Clear IREN in CR3 using LL_USART_DisableIrda() function Clear HDSEL in CR3 using LL_USART_DisableHalfDuplex() function Configure STOP in CR2 using LL_USART_SetStopBitsLength() function Set CLKEN in CR2 using LL_USART_EnableSCLKOutput() function Set SCEN in CR3 using LL_USART_EnableSmartcard() function • Other remaining configurations items related to Smartcard Mode (as Baud Rate, Word length, Parity, ...) should be set using dedicated functions
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 LINEN LL_USART_ConfigSmartcardMode • CR2 STOP LL_USART_ConfigSmartcardMode • CR2 CLKEN LL_USART_ConfigSmartcardMode • CR3 HDSEL LL_USART_ConfigSmartcardMode • CR3 SCEN LL_USART_ConfigSmartcardMode

LL_USART_ConfigIrdaMode

Function name	__STATIC_INLINE void LL_USART_ConfigIrdaMode (USART_TypeDef * USARTx)
Function description	Perform basic configuration of USART for enabling use in Irda Mode.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • In IRDA mode, the following bits must be kept cleared: LINEN bit in the USART_CR2 register, STOP and CLKEN bits in the USART_CR2 register, SCEN bit in the USART_CR3 register, HDSEL bit in the USART_CR3 register. This function also sets the UART/USART in IRDA mode (IREN bit). • Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx

	instance.
	<ul style="list-style-type: none"> • Call of this function is equivalent to following function call sequence : Clear LINEN in CR2 using LL_USART_DisableLIN() functionClear CLKEN in CR2 using LL_USART_DisableSCLKOutput() functionClear SCEN in CR3 using LL_USART_DisableSmartcard() functionClear HDSEL in CR3 using LL_USART_DisableHalfDuplex() functionConfigure STOP in CR2 using LL_USART_SetStopBitsLength() functionSet IREN in CR3 using LL_USART_EnableIrda() function • Other remaining configurations items related to Irda Mode (as Baud Rate, Word length, Power mode, ...) should be set using dedicated functions
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 LINEN LL_USART_ConfigIrdaMode • CR2 CLKEN LL_USART_ConfigIrdaMode • CR2 STOP LL_USART_ConfigIrdaMode • CR3 SCEN LL_USART_ConfigIrdaMode • CR3 HDSEL LL_USART_ConfigIrdaMode • CR3 IREN LL_USART_ConfigIrdaMode

LL_USART_ConfigMultiProcessMode

Function name	__STATIC_INLINE void LL_USART_ConfigMultiProcessMode (USART_TypeDef * USARTx)
Function description	Perform basic configuration of USART for enabling use in Multi processor Mode (several USARTs connected in a network, one of the USARTs can be the master, its TX output connected to the RX inputs of the other slaves USARTs).
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • In MultiProcessor mode, the following bits must be kept cleared: LINEN bit in the USART_CR2 register,CLKEN bit in the USART_CR2 register,SCEN bit in the USART_CR3 register,IREN bit in the USART_CR3 register,HDSEL bit in the USART_CR3 register. • Call of this function is equivalent to following function call sequence : Clear LINEN in CR2 using LL_USART_DisableLIN() functionClear CLKEN in CR2 using LL_USART_DisableSCLKOutput() functionClear SCEN in CR3 using LL_USART_DisableSmartcard() functionClear IREN in CR3 using LL_USART_DisableIrda() functionClear HDSEL in CR3 using LL_USART_DisableHalfDuplex() function • Other remaining configurations items related to Multi processor Mode (as Baud Rate, Wake Up Method, Node address, ...) should be set using dedicated functions
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR2 LINEN LL_USART_ConfigMultiProcessMode • CR2 CLKEN LL_USART_ConfigMultiProcessMode • CR3 SCEN LL_USART_ConfigMultiProcessMode • CR3 HDSEL LL_USART_ConfigMultiProcessMode • CR3 IREN LL_USART_ConfigMultiProcessMode

LL_USART_IsActiveFlag_PE

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_PE (USART_TypeDef * USARTx)
Function description	Check if the USART Parity Error Flag is set or not.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR PE LL_USART_IsActiveFlag_PE

LL_USART_IsActiveFlag_FE

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_FE (USART_TypeDef * USARTx)
Function description	Check if the USART Framing Error Flag is set or not.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR FE LL_USART_IsActiveFlag_FE

LL_USART_IsActiveFlag_NE

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_NE (USART_TypeDef * USARTx)
Function description	Check if the USART Noise error detected Flag is set or not.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR NF LL_USART_IsActiveFlag_NE

LL_USART_IsActiveFlag_ORE

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_ORE (USART_TypeDef * USARTx)
Function description	Check if the USART OverRun Error Flag is set or not.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR ORE LL_USART_IsActiveFlag_ORE

LL_USART_IsActiveFlag_IDLE

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_IDLE (USART_TypeDef * USARTx)
Function description	Check if the USART IDLE line detected Flag is set or not.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR IDLE LL_USART_IsActiveFlag_IDLE

LL_USART_IsActiveFlag_RXNE

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_RXNE (USART_TypeDef * USARTx)
Function description	Check if the USART Read Data Register Not Empty Flag is set or not.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR RXNE LL_USART_IsActiveFlag_RXNE

LL_USART_IsActiveFlag_TC

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_TC (USART_TypeDef * USARTx)
Function description	Check if the USART Transmission Complete Flag is set or not.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR TC LL_USART_IsActiveFlag_TC

LL_USART_IsActiveFlag_TXE

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_TXE (USART_TypeDef * USARTx)
Function description	Check if the USART Transmit Data Register Empty Flag is set or not.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• ISR TXE LL_USART_IsActiveFlag_TXE

LL_USART_IsActiveFlag_LBD

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_LBD (USART_TypeDef * USARTx)
Function description	Check if the USART LIN Break Detection Flag is set or not.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR LBDF LL_USART_IsActiveFlag_LBD

LL_USART_IsActiveFlag_nCTS

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_nCTS (USART_TypeDef * USARTx)
Function description	Check if the USART CTS interrupt Flag is set or not.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR CTSIF LL_USART_IsActiveFlag_nCTS

LL_USART_IsActiveFlag_CTS

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_CTS (USART_TypeDef * USARTx)
Function description	Check if the USART CTS Flag is set or not.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR CTS LL_USART_IsActiveFlag_CTS

LL_USART_IsActiveFlag_RTO

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_RTO (USART_TypeDef * USARTx)
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Function description	Check if the USART Receiver Time Out Flag is set or not.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR RTOF LL_USART_IsActiveFlag_RTO

LL_USART_IsActiveFlag_EOB

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_EOB (USART_TypeDef * USARTx)
Function description	Check if the USART End Of Block Flag is set or not.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR EOBF LL_USART_IsActiveFlag_EOB

LL_USART_IsActiveFlag_ABRE

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_ABRE (USART_TypeDef * USARTx)
Function description	Check if the USART Auto-Baud Rate Error Flag is set or not.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USARTx) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ISR ABRE LL_USART_IsActiveFlag_ABRE

LL_USART_IsActiveFlag_ABR

Function name	__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_ABR (USART_TypeDef * USARTx)
Function description	Check if the USART Auto-Baud Rate Flag is set or not.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Notes	<ul style="list-style-type: none"> • Macro IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USARTx) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.

RTx) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.

- Reference Manual to LL API cross reference:
- ISR ABRF LL_USART_IsActiveFlag_ABR

LL_USART_IsActiveFlag_BUSY

Function name **__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_BUSY (USART_TypeDef * USARTx)**

Function description Check if the USART Busy Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

- Reference Manual to LL API cross reference:
- ISR BUSY LL_USART_IsActiveFlag_BUSY

LL_USART_IsActiveFlag_CM

Function name **__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_CM (USART_TypeDef * USARTx)**

Function description Check if the USART Character Match Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

- Reference Manual to LL API cross reference:
- ISR CMF LL_USART_IsActiveFlag_CM

LL_USART_IsActiveFlag_SBK

Function name **__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_SBK (USART_TypeDef * USARTx)**

Function description Check if the USART Send Break Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

- Reference Manual to LL API cross reference:
- ISR SBKF LL_USART_IsActiveFlag_SBK

LL_USART_IsActiveFlag_RWU

Function name **__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_RWU (USART_TypeDef * USARTx)**

Function description Check if the USART Receive Wake Up from mute mode Flag is set or not.

Parameters

- **USARTx:** USART Instance

- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- ISR RWU LL_USART_IsActiveFlag_RWU

LL_USART_IsActiveFlag_TEACK

- Function name **__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_TEACK (USART_TypeDef * USARTx)**
- Function description Check if the USART Transmit Enable Acknowledge Flag is set or not.
- Parameters
- **USARTx:** USART Instance
- Return values
- **State:** of bit (1 or 0).
- Reference Manual to LL API cross reference:
- ISR TEACK LL_USART_IsActiveFlag_TEACK

LL_USART_ClearFlag_PE

- Function name **__STATIC_INLINE void LL_USART_ClearFlag_PE (USART_TypeDef * USARTx)**
- Function description Clear Parity Error Flag.
- Parameters
- **USARTx:** USART Instance
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- ICR PECF LL_USART_ClearFlag_PE

LL_USART_ClearFlag_FE

- Function name **__STATIC_INLINE void LL_USART_ClearFlag_FE (USART_TypeDef * USARTx)**
- Function description Clear Framing Error Flag.
- Parameters
- **USARTx:** USART Instance
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- ICR FECF LL_USART_ClearFlag_FE

LL_USART_ClearFlag_NE

- Function name **__STATIC_INLINE void LL_USART_ClearFlag_NE (USART_TypeDef * USARTx)**
- Function description Clear Noise detected Flag.
- Parameters
- **USARTx:** USART Instance

- Return values
- **None:**
- Reference Manual to LL API cross reference:
- ICR NCF LL_USART_ClearFlag_NE

LL_USART_ClearFlag_ORE

- Function name **__STATIC_INLINE void LL_USART_ClearFlag_ORE (USART_TypeDef * USARTx)**
- Function description Clear OverRun Error Flag.
- Parameters
- **USARTx:** USART Instance
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- ICR ORECF LL_USART_ClearFlag_ORE

LL_USART_ClearFlag_IDLE

- Function name **__STATIC_INLINE void LL_USART_ClearFlag_IDLE (USART_TypeDef * USARTx)**
- Function description Clear IDLE line detected Flag.
- Parameters
- **USARTx:** USART Instance
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- ICR IDLECF LL_USART_ClearFlag_IDLE

LL_USART_ClearFlag_TC

- Function name **__STATIC_INLINE void LL_USART_ClearFlag_TC (USART_TypeDef * USARTx)**
- Function description Clear Transmission Complete Flag.
- Parameters
- **USARTx:** USART Instance
- Return values
- **None:**
- Reference Manual to LL API cross reference:
- ICR TCCF LL_USART_ClearFlag_TC

LL_USART_ClearFlag_LBD

- Function name **__STATIC_INLINE void LL_USART_ClearFlag_LBD (USART_TypeDef * USARTx)**
- Function description Clear LIN Break Detection Flag.
- Parameters
- **USARTx:** USART Instance
- Return values
- **None:**

- Notes
- Macro `IS_UART_LIN_INSTANCE(USARTx)` can be used to check whether or not LIN feature is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- ICR LBD CF LL_USART_ClearFlag_LBD

LL_USART_ClearFlag_nCTS

- Function name `__STATIC_INLINE void LL_USART_ClearFlag_nCTS(USART_TypeDef * USARTx)`
- Function description Clear CTS Interrupt Flag.
- Parameters
- USARTx:** USART Instance
- Return values
- None:**
- Notes
- Macro `IS_UART_HWFLOW_INSTANCE(USARTx)` can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- ICR CTSCF LL_USART_ClearFlag_nCTS

LL_USART_ClearFlag_RTO

- Function name `__STATIC_INLINE void LL_USART_ClearFlag_RTO(USART_TypeDef * USARTx)`
- Function description Clear Receiver Time Out Flag.
- Parameters
- USARTx:** USART Instance
- Return values
- None:**
- Reference Manual to LL API cross reference:
- ICR RTOCF LL_USART_ClearFlag_RTO

LL_USART_ClearFlag_EOB

- Function name `__STATIC_INLINE void LL_USART_ClearFlag_EOB(USART_TypeDef * USARTx)`
- Function description Clear End Of Block Flag.
- Parameters
- USARTx:** USART Instance
- Return values
- None:**
- Notes
- Macro `IS_SMARTCARD_INSTANCE(USARTx)` can be used to check whether or not Smartcard feature is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- ICR EOBCF LL_USART_ClearFlag_EOB

LL_USART_ClearFlag_CM

Function name	__STATIC_INLINE void LL_USART_ClearFlag_CM (USART_TypeDef * USARTx)
Function description	Clear Character Match Flag.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • ICR CMCF LL_USART_ClearFlag_CM

LL_USART_EnableIT_IDLE

Function name	__STATIC_INLINE void LL_USART_EnableIT_IDLE (USART_TypeDef * USARTx)
Function description	Enable IDLE Interrupt.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 IDLEIE LL_USART_EnableIT_IDLE

LL_USART_EnableIT_RXNE

Function name	__STATIC_INLINE void LL_USART_EnableIT_RXNE (USART_TypeDef * USARTx)
Function description	Enable RX Not Empty Interrupt.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 RXNEIE LL_USART_EnableIT_RXNE

LL_USART_EnableIT_TC

Function name	__STATIC_INLINE void LL_USART_EnableIT_TC (USART_TypeDef * USARTx)
Function description	Enable Transmission Complete Interrupt.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 TCIE LL_USART_EnableIT_TC

LL_USART_EnableIT_TXE

Function name	__STATIC_INLINE void LL_USART_EnableIT_TXE (USART_TypeDef * USARTx)
Function description	Enable TX Empty Interrupt.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 TXEIE LL_USART_EnableIT_TXE

LL_USART_EnableIT_PE

Function name	__STATIC_INLINE void LL_USART_EnableIT_PE (USART_TypeDef * USARTx)
Function description	Enable Parity Error Interrupt.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 PEIE LL_USART_EnableIT_PE

LL_USART_EnableIT_CM

Function name	__STATIC_INLINE void LL_USART_EnableIT_CM (USART_TypeDef * USARTx)
Function description	Enable Character Match Interrupt.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 CMIE LL_USART_EnableIT_CM

LL_USART_EnableIT_RTO

Function name	__STATIC_INLINE void LL_USART_EnableIT_RTO (USART_TypeDef * USARTx)
Function description	Enable Receiver Timeout Interrupt.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 RTOIE LL_USART_EnableIT_RTO

LL_USART_EnableIT_EOB

Function name	__STATIC_INLINE void LL_USART_EnableIT_EOB (USART_TypeDef * USARTx)
Function description	Enable End Of Block Interrupt.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 EOBIE LL_USART_EnableIT_EOB

LL_USART_EnableIT_LBD

Function name	__STATIC_INLINE void LL_USART_EnableIT_LBD (USART_TypeDef * USARTx)
Function description	Enable LIN Break Detection Interrupt.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR2 LBDIE LL_USART_EnableIT_LBD

LL_USART_EnableIT_ERROR

Function name	__STATIC_INLINE void LL_USART_EnableIT_ERROR (USART_TypeDef * USARTx)
Function description	Enable Error Interrupt.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• When set, Error Interrupt Enable Bit is enabling interrupt generation in case of a framing error, overrun error or noise flag (FE=1 or ORE=1 or NF=1 in the USARTx_ISR register). 0: Interrupt is inhibited 1: An interrupt is generated when FE=1 or ORE=1 or NF=1 in the USARTx_ISR register.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR3 EIE LL_USART_EnableIT_ERROR

LL_USART_EnableIT_CTS

Function name	__STATIC_INLINE void LL_USART_EnableIT_CTS (USART_TypeDef * USARTx)
Function description	Enable CTS Interrupt.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR3 CTSIE LL_USART_EnableIT_CTS

LL_USART_DisableIT_IDLE

Function name	__STATIC_INLINE void LL_USART_DisableIT_IDLE (USART_TypeDef * USARTx)
Function description	Disable IDLE Interrupt.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 IDLEIE LL_USART_DisableIT_IDLE

LL_USART_DisableIT_RXNE

Function name	__STATIC_INLINE void LL_USART_DisableIT_RXNE (USART_TypeDef * USARTx)
Function description	Disable RX Not Empty Interrupt.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 RXNEIE LL_USART_DisableIT_RXNE

LL_USART_DisableIT_TC

Function name	__STATIC_INLINE void LL_USART_DisableIT_TC (USART_TypeDef * USARTx)
Function description	Disable Transmission Complete Interrupt.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross	<ul style="list-style-type: none">• CR1 TCIE LL_USART_DisableIT_TC

reference:

LL_USART_DisableIT_TXE

Function name **__STATIC_INLINE void LL_USART_DisableIT_TXE (USART_TypeDef * USARTx)**

Function description Disable TX Empty Interrupt.

Parameters

- **USARTx**: USART Instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- CR1 TXEIE LL_USART_DisableIT_TXE

LL_USART_DisableIT_PE

Function name **__STATIC_INLINE void LL_USART_DisableIT_PE (USART_TypeDef * USARTx)**

Function description Disable Parity Error Interrupt.

Parameters

- **USARTx**: USART Instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- CR1 PEIE LL_USART_DisableIT_PE

LL_USART_DisableIT_CM

Function name **__STATIC_INLINE void LL_USART_DisableIT_CM (USART_TypeDef * USARTx)**

Function description Disable Character Match Interrupt.

Parameters

- **USARTx**: USART Instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- CR1 CMIE LL_USART_DisableIT_CM

LL_USART_DisableIT_RTO

Function name **__STATIC_INLINE void LL_USART_DisableIT_RTO (USART_TypeDef * USARTx)**

Function description Disable Receiver Timeout Interrupt.

Parameters

- **USARTx**: USART Instance

Return values

- **None**:

Reference Manual to LL API cross reference:

- CR1 RTOIE LL_USART_DisableIT_RTO

LL_USART_DisableIT_EOB

Function name	__STATIC_INLINE void LL_USART_DisableIT_EOB (USART_TypeDef * USARTx)
Function description	Disable End Of Block Interrupt.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR1 EOBIE LL_USART_DisableIT_EOB

LL_USART_DisableIT_LBD

Function name	__STATIC_INLINE void LL_USART_DisableIT_LBD (USART_TypeDef * USARTx)
Function description	Disable LIN Break Detection Interrupt.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR2 LBDIE LL_USART_DisableIT_LBD

LL_USART_DisableIT_ERROR

Function name	__STATIC_INLINE void LL_USART_DisableIT_ERROR (USART_TypeDef * USARTx)
Function description	Disable Error Interrupt.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• When set, Error Interrupt Enable Bit is enabling interrupt generation in case of a framing error, overrun error or noise flag (FE=1 or ORE=1 or NF=1 in the USARTx_ISR register). 0: Interrupt is inhibited 1: An interrupt is generated when FE=1 or ORE=1 or NF=1 in the USARTx_ISR register.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR3 EIE LL_USART_DisableIT_ERROR

LL_USART_DisableIT_CTS

Function name	__STATIC_INLINE void LL_USART_DisableIT_CTS (USART_TypeDef * USARTx)
Function description	Disable CTS Interrupt.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 CTSIE LL_USART_DisableIT_CTS

LL_USART_IsEnabledIT_IDLE

Function name	__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_IDLE (USART_TypeDef * USARTx)
Function description	Check if the USART IDLE Interrupt source is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 IDLEIE LL_USART_IsEnabledIT_IDLE

LL_USART_IsEnabledIT_RXNE

Function name	__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_RXNE (USART_TypeDef * USARTx)
Function description	Check if the USART RX Not Empty Interrupt is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR1 RXNEIE LL_USART_IsEnabledIT_RXNE

LL_USART_IsEnabledIT_TC

Function name	__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_TC (USART_TypeDef * USARTx)
Function description	Check if the USART Transmission Complete Interrupt is enabled or disabled.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 TCIE LL_USART_IsEnabledIT_TC

LL_USART_IsEnabledIT_TXE

Function name **__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_TXE (USART_TypeDef * USARTx)**

Function description Check if the USART TX Empty Interrupt is enabled or disabled.

Parameters

- **USARTx**: USART Instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 TXEIE LL_USART_IsEnabledIT_TXE

LL_USART_IsEnabledIT_PE

Function name **__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_PE (USART_TypeDef * USARTx)**

Function description Check if the USART Parity Error Interrupt is enabled or disabled.

Parameters

- **USARTx**: USART Instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 PEIE LL_USART_IsEnabledIT_PE

LL_USART_IsEnabledIT_CM

Function name **__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_CM (USART_TypeDef * USARTx)**

Function description Check if the USART Character Match Interrupt is enabled or disabled.

Parameters

- **USARTx**: USART Instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 CMIE LL_USART_IsEnabledIT_CM

LL_USART_IsEnabledIT_RTO

Function name **__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_RTO (USART_TypeDef * USARTx)**

Function description Check if the USART Receiver Timeout Interrupt is enabled or disabled.

Parameters

- **USARTx**: USART Instance

Return values

- **State**: of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 RTOIE LL_USART_IsEnabledIT_RTO

LL_USART_IsEnabledIT_EOB

Function name **__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_EOB (USART_TypeDef * USARTx)**

Function description Check if the USART End Of Block Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 EOBIE LL_USART_IsEnabledIT_EOB

LL_USART_IsEnabledIT_LBD

Function name **__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_LBD (USART_TypeDef * USARTx)**

Function description Check if the USART LIN Break Detection Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 LBDIE LL_USART_IsEnabledIT_LBD

LL_USART_IsEnabledIT_ERROR

Function name **__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_ERROR (USART_TypeDef * USARTx)**

Function description Check if the USART Error Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 EIE LL_USART_IsEnabledIT_ERROR

LL_USART_IsEnabledIT_CTS

Function name	__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_CTS (USART_TypeDef * USARTx)
Function description	Check if the USART CTS Interrupt is enabled or disabled.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Notes	<ul style="list-style-type: none">• Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR3 CTSIE LL_USART_IsEnabledIT_CTS

LL_USART_EnableDMAReq_RX

Function name	__STATIC_INLINE void LL_USART_EnableDMAReq_RX (USART_TypeDef * USARTx)
Function description	Enable DMA Mode for reception.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR3 DMAR LL_USART_EnableDMAReq_RX

LL_USART_DisableDMAReq_RX

Function name	__STATIC_INLINE void LL_USART_DisableDMAReq_RX (USART_TypeDef * USARTx)
Function description	Disable DMA Mode for reception.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none">• CR3 DMAR LL_USART_DisableDMAReq_RX

LL_USART_IsEnabledDMAReq_RX

Function name	__STATIC_INLINE uint32_t LL_USART_IsEnabledDMAReq_RX (USART_TypeDef * USARTx)
Function description	Check if DMA Mode is enabled for reception.
Parameters	<ul style="list-style-type: none">• USARTx: USART Instance
Return values	<ul style="list-style-type: none">• State: of bit (1 or 0).
Reference Manual to LL API cross	<ul style="list-style-type: none">• CR3 DMAR LL_USART_IsEnabledDMAReq_RX

reference:

LL_USART_EnableDMAReq_TX

Function name **__STATIC_INLINE void LL_USART_EnableDMAReq_TX (USART_TypeDef * USARTx)**

Function description Enable DMA Mode for transmission.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DMAT LL_USART_EnableDMAReq_TX

LL_USART_DisableDMAReq_TX

Function name **__STATIC_INLINE void LL_USART_DisableDMAReq_TX (USART_TypeDef * USARTx)**

Function description Disable DMA Mode for transmission.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DMAT LL_USART_DisableDMAReq_TX

LL_USART_IsEnabledDMAReq_TX

Function name **__STATIC_INLINE uint32_t LL_USART_IsEnabledDMAReq_TX (USART_TypeDef * USARTx)**

Function description Check if DMA Mode is enabled for transmission.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 DMAT LL_USART_IsEnabledDMAReq_TX

LL_USART_EnableDMADeactOnRxErr

Function name **__STATIC_INLINE void LL_USART_EnableDMADeactOnRxErr (USART_TypeDef * USARTx)**

Function description Enable DMA Disabling on Reception Error.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DDRE LL_USART_EnableDMADeactOnRxErr

LL_USART_DisableDMADeactOnRxErr

Function name	__STATIC_INLINE void LL_USART_DisableDMADeactOnRxErr (USART_TypeDef * USARTx)
Function description	Disable DMA Disabling on Reception Error.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 DDRE LL_USART_DisableDMADeactOnRxErr

LL_USART_IsEnabledDMADeactOnRxErr

Function name	__STATIC_INLINE uint32_t LL_USART_IsEnabledDMADeactOnRxErr (USART_TypeDef * USARTx)
Function description	Indicate if DMA Disabling on Reception Error is disabled.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR3 DDRE LL_USART_IsEnabledDMADeactOnRxErr

LL_USART_DMA_GetRegAddr

Function name	__STATIC_INLINE uint32_t LL_USART_DMA_GetRegAddr (USART_TypeDef * USARTx, uint32_t Direction)
Function description	Get the data register address used for DMA transfer.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • Direction: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_USART_DMA_REG_DATA_TRANSMIT – LL_USART_DMA_REG_DATA_RECEIVE
Return values	<ul style="list-style-type: none"> • Address: of data register
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • RDR RDR LL_USART_DMA_GetRegAddr • TDR TDR LL_USART_DMA_GetRegAddr

LL_USART_ReceiveData8

Function name	__STATIC_INLINE uint8_t LL_USART_ReceiveData8 (USART_TypeDef * USARTx)
Function description	Read Receiver Data register (Receive Data value, 8 bits)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0xFF
Reference Manual to	<ul style="list-style-type: none"> • RDR RDR LL_USART_ReceiveData8

LL API cross
reference:

LL_USART_ReceiveData9

Function name	__STATIC_INLINE uint16_t LL_USART_ReceiveData9 (USART_TypeDef * USARTx)
Function description	Read Receiver Data register (Receive Data value, 9 bits)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • Value: between Min_Data=0x00 and Max_Data=0x1FF
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • RDR RDR LL_USART_ReceiveData9

LL_USART_TransmitData8

Function name	__STATIC_INLINE void LL_USART_TransmitData8 (USART_TypeDef * USARTx, uint8_t Value)
Function description	Write in Transmitter Data Register (Transmit Data value, 8 bits)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • Value: between Min_Data=0x00 and Max_Data=0xFF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TDR TDR LL_USART_TransmitData8

LL_USART_TransmitData9

Function name	__STATIC_INLINE void LL_USART_TransmitData9 (USART_TypeDef * USARTx, uint16_t Value)
Function description	Write in Transmitter Data Register (Transmit Data value, 9 bits)
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • Value: between Min_Data=0x00 and Max_Data=0x1FF
Return values	<ul style="list-style-type: none"> • None:
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • TDR TDR LL_USART_TransmitData9

LL_USART_RequestAutoBaudRate

Function name	__STATIC_INLINE void LL_USART_RequestAutoBaudRate (USART_TypeDef * USARTx)
Function description	Request an Automatic Baud Rate measurement on next received data frame.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:

- Notes
- Macro `IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USARTx)` can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.
- Reference Manual to LL API cross reference:
- RQR ABRRQ LL_USART_RequestAutoBaudRate

LL_USART_RequestBreakSending

- Function name `__STATIC_INLINE void LL_USART_RequestBreakSending(USART_TypeDef * USARTx)`
- Function description Request Break sending.
- Parameters
- **USARTx**: USART Instance
- Return values
- **None**:
- Reference Manual to LL API cross reference:
- RQR SBKRQ LL_USART_RequestBreakSending

LL_USART_RequestEnterMuteMode

- Function name `__STATIC_INLINE void LL_USART_RequestEnterMuteMode(USART_TypeDef * USARTx)`
- Function description Put USART in mute mode and set the RWU flag.
- Parameters
- **USARTx**: USART Instance
- Return values
- **None**:
- Reference Manual to LL API cross reference:
- RQR MMRQ LL_USART_RequestEnterMuteMode

LL_USART_RequestRxDataFlush

- Function name `__STATIC_INLINE void LL_USART_RequestRxDataFlush(USART_TypeDef * USARTx)`
- Function description Request a Receive Data flush.
- Parameters
- **USARTx**: USART Instance
- Return values
- **None**:
- Reference Manual to LL API cross reference:
- RQR RXFRQ LL_USART_RequestRxDataFlush

LL_USART_RequestTxDataFlush

- Function name `__STATIC_INLINE void LL_USART_RequestTxDataFlush(USART_TypeDef * USARTx)`
- Function description Request a Transmit data flush.

Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • RQR TXFRQ LL_USART_RequestTxDataFlush

LL_USART_DeInit

Function name	ErrorStatus LL_USART_DeInit (USART_TypeDef * USARTx)
Function description	De-initialize USART registers (Registers restored to their default values).
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: USART registers are de-initialized – ERROR: USART registers are not de-initialized

LL_USART_Init

Function name	ErrorStatus LL_USART_Init (USART_TypeDef * USARTx, LL_USART_InitTypeDef * USART_InitStruct)
Function description	Initialize USART registers according to the specified parameters in USART_InitStruct.
Parameters	<ul style="list-style-type: none"> • USARTx: USART Instance • USART_InitStruct: pointer to a LL_USART_InitTypeDef structure that contains the configuration information for the specified USART peripheral.
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: USART registers are initialized according to USART_InitStruct content – ERROR: Problem occurred during USART Registers initialization
Notes	<ul style="list-style-type: none"> • As some bits in USART configuration registers can only be written when the USART is disabled (USART_CR1_UE bit =0), USART IP should be in disabled state prior calling this function. Otherwise, ERROR result will be returned. • Baud rate value stored in USART_InitStruct BaudRate field, should be valid (different from 0).

LL_USART_StructInit

Function name	void LL_USART_StructInit (LL_USART_InitTypeDef * USART_InitStruct)
Function description	Set each LL_USART_InitTypeDef field to default value.
Parameters	<ul style="list-style-type: none"> • USART_InitStruct: pointer to a LL_USART_InitTypeDef

structure whose fields will be set to default values.

Return values • **None:**

LL_USART_ClockInit

Function name **ErrorStatus LL_USART_ClockInit (USART_TypeDef * USARTx, LL_USART_ClockInitTypeDef * USART_ClockInitStruct)**

Function description Initialize USART Clock related settings according to the specified parameters in the USART_ClockInitStruct.

Parameters • **USARTx:** USART Instance
• **USART_ClockInitStruct:** pointer to a LL_USART_ClockInitTypeDef structure that contains the Clock configuration information for the specified USART peripheral.

Return values • **An:** ErrorStatus enumeration value:
– SUCCESS: USART registers related to Clock settings are initialized according to USART_ClockInitStruct content
– ERROR: Problem occurred during USART Registers initialization

Notes • As some bits in USART configuration registers can only be written when the USART is disabled (USART_CR1_UE bit =0), USART IP should be in disabled state prior calling this function. Otherwise, ERROR result will be returned.

LL_USART_ClockStructInit

Function name **void LL_USART_ClockStructInit (LL_USART_ClockInitTypeDef * USART_ClockInitStruct)**

Function description Set each field of a LL_USART_ClockInitTypeDef type structure to default value.

Parameters • **USART_ClockInitStruct:** pointer to a LL_USART_ClockInitTypeDef structure whose fields will be set to default values.

Return values • **None:**

91.3 USART Firmware driver defines

91.3.1 USART

Address Length Detection

LL_USART_ADDRESS_DETECT_4B 4-bit address detection method selected

LL_USART_ADDRESS_DETECT_7B 7-bit address detection (in 8-bit data mode) method selected

Autobaud Detection

LL_USART_AUTOBAUD_DETECT_ON_STARTBIT Measurement of the start bit is used to detect the baud rate

LL_USART_AUTOBAUD_DETECT_ON_FALLINGEDGE	Falling edge to falling edge measurement. Received frame must start with a single bit = 1 -> Frame = Start10xxxxxx
LL_USART_AUTOBAUD_DETECT_ON_7F_FRAME	0x7F frame detection
LL_USART_AUTOBAUD_DETECT_ON_55_FRAME	0x55 frame detection

Binary Data Inversion

LL_USART_BINARY_LOGIC_POSITIVE	Logical data from the data register are send/received in positive/direct logic. (1=H, 0=L)
LL_USART_BINARY_LOGIC_NEGATIVE	Logical data from the data register are send/received in negative/inverse logic. (1=L, 0=H). The parity bit is also inverted.

Bit Order

LL_USART_BITORDER_LSBFIRST	data is transmitted/received with data bit 0 first, following the start bit
LL_USART_BITORDER_MSBFIRST	data is transmitted/received with the MSB first, following the start bit

Clear Flags Defines

LL_USART_ICR_PECF	Parity error flag
LL_USART_ICR_FECF	Framing error flag
LL_USART_ICR_NCF	Noise detected flag
LL_USART_ICR_ORECF	Overrun error flag
LL_USART_ICR_IDLECF	Idle line detected flag
LL_USART_ICR_TCCF	Transmission complete flag
LL_USART_ICR_LBDCF	LIN break detection flag
LL_USART_ICR_CTSCF	CTS flag
LL_USART_ICR_RTOCF	Receiver timeout flag
LL_USART_ICR_EOBCF	End of block flag
LL_USART_ICR_CMCF	Character match flag

Clock Signal

LL_USART_CLOCK_DISABLE	Clock signal not provided
LL_USART_CLOCK_ENABLE	Clock signal provided

Datawidth

LL_USART_DATAWIDTH_7B	7 bits word length : Start bit, 7 data bits, n stop bits
LL_USART_DATAWIDTH_8B	8 bits word length : Start bit, 8 data bits, n stop bits
LL_USART_DATAWIDTH_9B	9 bits word length : Start bit, 9 data bits, n stop bits

Driver Enable Polarity

LL_USART_DE_POLARITY_HIGH	DE signal is active high
---------------------------	--------------------------

LL_USART_DE_POLARITY_LOW DE signal is active low

Communication Direction

LL_USART_DIRECTION_NONE Transmitter and Receiver are disabled

LL_USART_DIRECTION_RX Transmitter is disabled and Receiver is enabled

LL_USART_DIRECTION_TX Transmitter is enabled and Receiver is disabled

LL_USART_DIRECTION_TX_RX Transmitter and Receiver are enabled

DMA Register Data

LL_USART_DMA_REG_DATA_TRANSMIT Get address of data register used for transmission

LL_USART_DMA_REG_DATA_RECEIVE Get address of data register used for reception

Get Flags Defines

LL_USART_ISR_PE Parity error flag

LL_USART_ISR_FE Framing error flag

LL_USART_ISR_NE Noise detected flag

LL_USART_ISR_ORE Overrun error flag

LL_USART_ISR_IDLE Idle line detected flag

LL_USART_ISR_RXNE Read data register not empty flag

LL_USART_ISR_TC Transmission complete flag

LL_USART_ISR_TXE Transmit data register empty flag

LL_USART_ISR_LBDF LIN break detection flag

LL_USART_ISR_CTSIF CTS interrupt flag

LL_USART_ISR_CTS CTS flag

LL_USART_ISR_RTOF Receiver timeout flag

LL_USART_ISR_EOBF End of block flag

LL_USART_ISR_ABRE Auto baud rate error flag

LL_USART_ISR_ABRF Auto baud rate flag

LL_USART_ISR_BUSY Busy flag

LL_USART_ISR_CMF Character match flag

LL_USART_ISR_SBKF Send break flag

LL_USART_ISR_RWU Receiver wakeup from Mute mode flag

LL_USART_ISR_TEACK Transmit enable acknowledge flag

Hardware Control

LL_USART_HWCONTROL_NONE CTS and RTS hardware flow control disabled

LL_USART_HWCONTROL_RTS RTS output enabled, data is only requested when there is space in the receive buffer

LL_USART_HWCONTROL_CTS CTS mode enabled, data is only transmitted when the nCTS input is asserted (tied to 0)

LL_USART_HWCONTROL_RTS_CTS CTS and RTS hardware flow control enabled

IrDA Power

LL_USART_IRDA_POWER_NORMAL IrDA normal power mode

LL_USART_IRDA_POWER_LOW IrDA low power mode

IT Defines

LL_USART_CR1_IDLEIE IDLE interrupt enable

LL_USART_CR1_RXNEIE Read data register not empty interrupt enable

LL_USART_CR1_TCIE Transmission complete interrupt enable

LL_USART_CR1_TXEIE Transmit data register empty interrupt enable

LL_USART_CR1_PEIE Parity error

LL_USART_CR1_CMIE Character match interrupt enable

LL_USART_CR1_RTOIE Receiver timeout interrupt enable

LL_USART_CR1_EOBIE End of Block interrupt enable

LL_USART_CR2_LBDIE LIN break detection interrupt enable

LL_USART_CR3_EIE Error interrupt enable

LL_USART_CR3_CTSIE CTS interrupt enable

Last Clock Pulse

LL_USART_LASTCLKPULSE_NO_OUTPUT The clock pulse of the last data bit is not output to the SCLK pin

LL_USART_LASTCLKPULSE_OUTPUT The clock pulse of the last data bit is output to the SCLK pin

LIN Break Detection Length

LL_USART_LINBREAK_DETECT_10B 10-bit break detection method selected

LL_USART_LINBREAK_DETECT_11B 11-bit break detection method selected

Oversampling

LL_USART_OVERSAMPLING_16 Oversampling by 16

LL_USART_OVERSAMPLING_8 Oversampling by 8

Parity Control

LL_USART_PARITY_NONE Parity control disabled

LL_USART_PARITY_EVEN Parity control enabled and Even Parity is selected

LL_USART_PARITY_ODD Parity control enabled and Odd Parity is selected

Clock Phase

LL_USART_PHASE_1EDGE The first clock transition is the first data capture edge

LL_USART_PHASE_2EDGE The second clock transition is the first data capture edge

Clock Polarity

LL_USART_POLARITY_LOW Steady low value on SCLK pin outside transmission window

`LL_USART_POLARITY_HIGH` Steady high value on SCLK pin outside transmission window

RX Pin Active Level Inversion

`LL_USART_RXPIN_LEVEL_STANDARD` RX pin signal works using the standard logic levels

`LL_USART_RXPIN_LEVEL_INVERTED` RX pin signal values are inverted.

Stop Bits

`LL_USART_STOPBITS_0_5` 0.5 stop bit

`LL_USART_STOPBITS_1` 1 stop bit

`LL_USART_STOPBITS_1_5` 1.5 stop bits

`LL_USART_STOPBITS_2` 2 stop bits

TX Pin Active Level Inversion

`LL_USART_TXPIN_LEVEL_STANDARD` TX pin signal works using the standard logic levels

`LL_USART_TXPIN_LEVEL_INVERTED` TX pin signal values are inverted.

TX RX Pins Swap

`LL_USART_TXRX_STANDARD` TX/RX pins are used as defined in standard pinout

`LL_USART_TXRX_SWAPPED` TX and RX pins functions are swapped.

Wakeup

`LL_USART_WAKEUP_IDLELINE` USART wake up from Mute mode on Idle Line

`LL_USART_WAKEUP_ADDRESSMARK` USART wake up from Mute mode on Address Mark

Exported Macros Helper

`__LL_USART_DIV_SAMPLING8` **Description:**

- Compute USARTDIV value according to Peripheral Clock and expected Baud Rate in 8 bits sampling mode (32 bits value of USARTDIV is returned)

Parameters:

- `__PERIPHCLK__`: Peripheral Clock frequency used for USART instance
- `__BAUDRATE__`: Baud rate value to achieve

Return value:

- USARTDIV: value to be used for BRR register filling in OverSampling_8 case

`__LL_USART_DIV_SAMPLING16` **Description:**

- Compute USARTDIV value according to Peripheral Clock and expected Baud Rate in 16 bits sampling mode (32 bits value of USARTDIV is returned)

Parameters:

- `__PERIPHCLK__`: Peripheral Clock frequency used for USART instance
- `__BAUDRATE__`: Baud rate value to achieve

Return value:

- USARTDIV: value to be used for BRR register filling in OverSampling_16 case

Common Write and read registers Macros**LL_USART_WriteReg** **Description:**

- Write a value in USART register.

Parameters:

- `__INSTANCE__`: USART Instance
- `__REG__`: Register to be written
- `__VALUE__`: Value to be written in the register

Return value:

- None

LL_USART_ReadReg **Description:**

- Read a value in USART register.

Parameters:

- `__INSTANCE__`: USART Instance
- `__REG__`: Register to be read

Return value:

- Register: value

92 LL UTILS Generic Driver

92.1 UTILS Firmware driver registers structures

92.1.1 LL_UTILS_PLLInitTypeDef

Data Fields

- *uint32_t PLLM*
- *uint32_t PLLN*
- *uint32_t PLLP*

Field Documentation

- *uint32_t LL_UTILS_PLLInitTypeDef::PLLM*
Division factor for PLL VCO input clock. This parameter can be a value of [RCC_LL_EC_PLLM_DIV](#)This feature can be modified afterwards using unitary function [LL_RCC_PLL_ConfigDomain_SYS\(\)](#).
- *uint32_t LL_UTILS_PLLInitTypeDef::PLLN*
Multiplication factor for PLL VCO output clock. This parameter must be a number between `Min_Data = 50` and `Max_Data = 432`This feature can be modified afterwards using unitary function [LL_RCC_PLL_ConfigDomain_SYS\(\)](#).
- *uint32_t LL_UTILS_PLLInitTypeDef::PLLP*
Division for the main system clock. This parameter can be a value of [RCC_LL_EC_PLLP_DIV](#)This feature can be modified afterwards using unitary function [LL_RCC_PLL_ConfigDomain_SYS\(\)](#).

92.1.2 LL_UTILS_ClkInitTypeDef

Data Fields

- *uint32_t AHBCLKDivider*
- *uint32_t APB1CLKDivider*
- *uint32_t APB2CLKDivider*

Field Documentation

- *uint32_t LL_UTILS_ClkInitTypeDef::AHBCLKDivider*
The AHB clock (HCLK) divider. This clock is derived from the system clock (SYSCLK). This parameter can be a value of [RCC_LL_EC_SYSCLK_DIV](#)This feature can be modified afterwards using unitary function [LL_RCC_SetAHBPrescaler\(\)](#).
- *uint32_t LL_UTILS_ClkInitTypeDef::APB1CLKDivider*
The APB1 clock (PCLK1) divider. This clock is derived from the AHB clock (HCLK). This parameter can be a value of [RCC_LL_EC_APB1_DIV](#)This feature can be modified afterwards using unitary function [LL_RCC_SetAPB1Prescaler\(\)](#).
- *uint32_t LL_UTILS_ClkInitTypeDef::APB2CLKDivider*
The APB2 clock (PCLK2) divider. This clock is derived from the AHB clock (HCLK). This parameter can be a value of [RCC_LL_EC_APB2_DIV](#)This feature can be modified afterwards using unitary function [LL_RCC_SetAPB2Prescaler\(\)](#).

92.2 UTILS Firmware driver API description

92.2.1 System Configuration functions

System, AHB and APB buses clocks configuration

- The maximum frequency of the SYSCLK, HCLK, PCLK1 and PCLK2 is 216000000 Hz.

This section contains the following APIs:

- [LL_SetSystemCoreClock\(\)](#)
- [LL_PLL_ConfigSystemClock_HSI\(\)](#)
- [LL_PLL_ConfigSystemClock_HSE\(\)](#)

92.2.2 Detailed description of functions

LL_GetUID_Word0

Function name `__STATIC_INLINE uint32_t LL_GetUID_Word0 (void)`

Function description Get Word0 of the unique device identifier (UID based on 96 bits)

Return values

- **UID[31:0]:**

LL_GetUID_Word1

Function name `__STATIC_INLINE uint32_t LL_GetUID_Word1 (void)`

Function description Get Word1 of the unique device identifier (UID based on 96 bits)

Return values

- **UID[63:32]:**

LL_GetUID_Word2

Function name `__STATIC_INLINE uint32_t LL_GetUID_Word2 (void)`

Function description Get Word2 of the unique device identifier (UID based on 96 bits)

Return values

- **UID[95:64]:**

LL_GetFlashSize

Function name `__STATIC_INLINE uint32_t LL_GetFlashSize (void)`

Function description Get Flash memory size.

Return values

- **FLASH_SIZE[15:0]:** Flash memory size

Notes

- This bitfield indicates the size of the device Flash memory expressed in Kbytes. As an example, 0x040 corresponds to 64 Kbytes.

LL_GetPackageType

Function name `__STATIC_INLINE uint32_t LL_GetPackageType (void)`

Function description Get Package type.

Return values

- **Returned:** value can be one of the following values: (*) value not defined in all devices.
 - LL_UTILS_PACKAGETYPE_LQFP100
 - LL_UTILS_PACKAGETYPE_LQFP144_WLCSP143 (*)

- LL_UTILS_PACKAGETYPE_WLCSP180_LQFP176_UFBGA176 (*)
- LL_UTILS_PACKAGETYPE_LQFP176_LQFP208_TFBGA216 (*)

LL_InitTick

Function name	__STATIC_INLINE void LL_InitTick (uint32_t HCLKFrequency, uint32_t Ticks)
Function description	This function configures the Cortex-M SysTick source of the time base.
Parameters	<ul style="list-style-type: none">• HCLKFrequency: HCLK frequency in Hz (can be calculated thanks to RCC helper macro)• Ticks: Number of ticks
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• When a RTOS is used, it is recommended to avoid changing the SysTick configuration by calling this function, for a delay use rather osDelay RTOS service.

LL_Init1msTick

Function name	void LL_Init1msTick (uint32_t HCLKFrequency)
Function description	This function configures the Cortex-M SysTick source to have 1ms time base.
Parameters	<ul style="list-style-type: none">• HCLKFrequency: HCLK frequency in Hz
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• When a RTOS is used, it is recommended to avoid changing the Systick configuration by calling this function, for a delay use rather osDelay RTOS service.• HCLK frequency can be calculated thanks to RCC helper macro or function LL_RCC_GetSystemClocksFreq

LL_mDelay

Function name	void LL_mDelay (uint32_t Delay)
Function description	This function provides accurate delay (in milliseconds) based on SysTick counter flag.
Parameters	<ul style="list-style-type: none">• Delay: specifies the delay time length, in milliseconds.
Return values	<ul style="list-style-type: none">• None:
Notes	<ul style="list-style-type: none">• When a RTOS is used, it is recommended to avoid using blocking delay and use rather osDelay service.• To respect 1ms timebase, user should call LL_Init1msTick function which will configure Systick to 1ms

LL_SetSystemCoreClock

Function name	void LL_SetSystemCoreClock (uint32_t HCLKFrequency)
Function description	This function sets directly SystemCoreClock CMSIS variable.

Parameters	<ul style="list-style-type: none"> • HCLKFrequency: HCLK frequency in Hz (can be calculated thanks to RCC helper macro)
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • Variable can be calculated also through SystemCoreClockUpdate function.

LL_PLL_ConfigSystemClock_HSI

Function name	ErrorStatus LL_PLL_ConfigSystemClock_HSI (LL_UTILS_PLLInitTypeDef * UTILS_PLLInitStruct, LL_UTILS_ClkInitTypeDef * UTILS_ClkInitStruct)
Function description	This function configures system clock at maximum frequency with HSI as clock source of the PLL.
Parameters	<ul style="list-style-type: none"> • UTILS_PLLInitStruct: pointer to a LL_UTILS_PLLInitTypeDef structure that contains the configuration information for the PLL. • UTILS_ClkInitStruct: pointer to a LL_UTILS_ClkInitTypeDef structure that contains the configuration information for the BUS prescalers.
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: Max frequency configuration done – ERROR: Max frequency configuration not done
Notes	<ul style="list-style-type: none"> • The application need to ensure that PLL is disabled. • Function is based on the following formula: PLL output frequency = (((HSI frequency / PLLM) * PLLN) / PLLP)PLLN: ensure that the VCO input frequency ranges from 0.95 to 2.1 MHz (PLLVCO_input = HSI frequency / PLLM)PLLN: ensure that the VCO output frequency is between 100 and 432 MHz (PLLVCO_output = PLLVCO_input * PLLN)PLLP: ensure that max frequency at 216000000 Hz is reach (PLLVCO_output / PLLP)

LL_PLL_ConfigSystemClock_HSE

Function name	ErrorStatus LL_PLL_ConfigSystemClock_HSE (uint32_t HSEFrequency, uint32_t HSEBypass, LL_UTILS_PLLInitTypeDef * UTILS_PLLInitStruct, LL_UTILS_ClkInitTypeDef * UTILS_ClkInitStruct)
Function description	This function configures system clock with HSE as clock source of the PLL.
Parameters	<ul style="list-style-type: none"> • HSEFrequency: Value between Min_Data = 4000000 and Max_Data = 26000000 • HSEBypass: This parameter can be one of the following values: <ul style="list-style-type: none"> – LL_UTILS_HSEBYPASS_ON – LL_UTILS_HSEBYPASS_OFF • UTILS_PLLInitStruct: pointer to a LL_UTILS_PLLInitTypeDef structure that contains the configuration information for the PLL. • UTILS_ClkInitStruct: pointer to a LL_UTILS_ClkInitTypeDef

	structure that contains the configuration information for the BUS prescalers.
Return values	<ul style="list-style-type: none"> • An: ErrorStatus enumeration value: <ul style="list-style-type: none"> – SUCCESS: Max frequency configuration done – ERROR: Max frequency configuration not done
Notes	<ul style="list-style-type: none"> • The application need to ensure that PLL is disabled. • Function is based on the following formula: PLL output frequency = $((\text{HSE frequency} / \text{PLLM}) * \text{PLLN}) / \text{PLL P}$ PLLM: ensure that the VCO input frequency ranges from 0.95 to 2.10 MHz (PLLVCO_input = HSE frequency / PLLM) PLLN: ensure that the VCO output frequency is between 100 and 432 MHz (PLLVCO_output = PLLVCO_input * PLLN) PLLP: ensure that max frequency at 216000000 Hz is reached (PLLVCO_output / PLLP)

92.3 UTILS Firmware driver defines

92.3.1 UTILS

HSE Bypass activation

LL_UTILS_HSEBYPASS_OFF HSE Bypass is not enabled

LL_UTILS_HSEBYPASS_ON HSE Bypass is enabled

PACKAGE TYPE

LL_UTILS_PACKAGETYPE_LQFP100	LQFP100 package type
LL_UTILS_PACKAGETYPE_LQFP144_WLCSP143	LQFP144 or WLCSP143 package type
LL_UTILS_PACKAGETYPE_WLCSP180_LQFP176_UFBGA176	WLCSP180, LQFP176 or UFBGA176 package type
LL_UTILS_PACKAGETYPE_LQFP176_LQFP208_TFBGA216	LQFP176, LQFP208 or TFBGA216 package type
LL_UTILS_PACKAGETYPE_TFBGA216_LQFP176_LQFP208	LQFP176, LQFP208 or TFBGA216 package type
LL_UTILS_PACKAGETYPE_LQFP176_TFBGA216_LQFP208	LQFP176, LQFP208 or TFBGA216 package type
LL_UTILS_PACKAGETYPE_LQFP208_LQFP176_TFBGA216	LQFP176, LQFP208 or TFBGA216 package type

93 LL WWDG Generic Driver

93.1 WWDG Firmware driver API description

93.1.1 Detailed description of functions

LL_WWDG_Enable

Function name	<code>__STATIC_INLINE void LL_WWDG_Enable (WWDG_TypeDef * WWDGx)</code>
Function description	Enable Window Watchdog.
Parameters	<ul style="list-style-type: none"> • WWDGx: WWDG Instance
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • It is enabled by setting the WDGA bit in the WWDG_CR register, then it cannot be disabled again except by a reset. This bit is set by software and only cleared by hardware after a reset. When WDGA = 1, the watchdog can generate a reset.
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR WDGA LL_WWDG_Enable

LL_WWDG_IsEnabled

Function name	<code>__STATIC_INLINE uint32_t LL_WWDG_IsEnabled (WWDG_TypeDef * WWDGx)</code>
Function description	Checks if Window Watchdog is enabled.
Parameters	<ul style="list-style-type: none"> • WWDGx: WWDG Instance
Return values	<ul style="list-style-type: none"> • State: of bit (1 or 0).
Reference Manual to LL API cross reference:	<ul style="list-style-type: none"> • CR WDGA LL_WWDG_IsEnabled

LL_WWDG_SetCounter

Function name	<code>__STATIC_INLINE void LL_WWDG_SetCounter (WWDG_TypeDef * WWDGx, uint32_t Counter)</code>
Function description	Set the Watchdog counter value to provided value (7-bits T[6:0])
Parameters	<ul style="list-style-type: none"> • WWDGx: WWDG Instance • Counter: 0..0x7F (7 bit counter value)
Return values	<ul style="list-style-type: none"> • None:
Notes	<ul style="list-style-type: none"> • When writing to the WWDG_CR register, always write 1 in the MSB b6 to avoid generating an immediate reset This counter is decremented every (4096 x 2expWDGTB) PCLK cycles A reset is produced when it rolls over from 0x40 to 0x3F (bit T6

becomes cleared) Setting the counter lower than 0x40 causes an immediate reset (if WWDG enabled)

- Reference Manual to LL API cross reference:
- CR T LL_WWDG_SetCounter

LL_WWDG_GetCounter

- Function name **__STATIC_INLINE uint32_t LL_WWDG_GetCounter (WWDG_TypeDef * WWDGx)**
- Function description Return current Watchdog Counter Value (7 bits counter value)
- Parameters
- **WWDGx:** WWDG Instance
- Return values
- **7:** bit Watchdog Counter value
- Reference Manual to LL API cross reference:
- CR T LL_WWDG_GetCounter

LL_WWDG_SetPrescaler

- Function name **__STATIC_INLINE void LL_WWDG_SetPrescaler (WWDG_TypeDef * WWDGx, uint32_t Prescaler)**
- Function description Set the time base of the prescaler (WDGTB).
- Parameters
- **WWDGx:** WWDG Instance
 - **Prescaler:** This parameter can be one of the following values:
 - LL_WWDG_PRESCALER_1
 - LL_WWDG_PRESCALER_2
 - LL_WWDG_PRESCALER_4
 - LL_WWDG_PRESCALER_8
- Return values
- **None:**
- Notes
- Prescaler is used to apply ratio on PCLK clock, so that Watchdog counter is decremented every (4096 x 2^{expWDGTB}) PCLK cycles
- Reference Manual to LL API cross reference:
- CFR WDG TB LL_WWDG_SetPrescaler

LL_WWDG_GetPrescaler

- Function name **__STATIC_INLINE uint32_t LL_WWDG_GetPrescaler (WWDG_TypeDef * WWDGx)**
- Function description Return current Watchdog Prescaler Value.
- Parameters
- **WWDGx:** WWDG Instance
- Return values
- **Returned:** value can be one of the following values:
 - LL_WWDG_PRESCALER_1
 - LL_WWDG_PRESCALER_2
 - LL_WWDG_PRESCALER_4

– LL_WWDG_PRESCALER_8

- Reference Manual to LL API cross reference:
- CFR WDGTB LL_WWDG_GetPrescaler

LL_WWDG_SetWindow

- Function name **__STATIC_INLINE void LL_WWDG_SetWindow (WWDG_TypeDef * WWDGx, uint32_t Window)**
- Function description Set the Watchdog Window value to be compared to the downcounter (7-bits W[6:0]).
- Parameters
- **WWDGx:** WWDG Instance
 - **Window:** 0x00..0x7F (7 bit Window value)
- Return values
- **None:**
- Notes
- This window value defines when write in the WWDG_CR register to program Watchdog counter is allowed. Watchdog counter value update must occur only when the counter value is lower than the Watchdog window register value. Otherwise, a MCU reset is generated if the 7-bit Watchdog counter value (in the control register) is refreshed before the downcounter has reached the watchdog window register value. Physically is possible to set the Window lower then 0x40 but it is not recommended. To generate an immediate reset, it is possible to set the Counter lower than 0x40.
- Reference Manual to LL API cross reference:
- CFR W LL_WWDG_SetWindow

LL_WWDG_GetWindow

- Function name **__STATIC_INLINE uint32_t LL_WWDG_GetWindow (WWDG_TypeDef * WWDGx)**
- Function description Return current Watchdog Window Value (7 bits value)
- Parameters
- **WWDGx:** WWDG Instance
- Return values
- **7:** bit Watchdog Window value
- Reference Manual to LL API cross reference:
- CFR W LL_WWDG_GetWindow

LL_WWDG_IsActiveFlag_EWKUP

- Function name **__STATIC_INLINE uint32_t LL_WWDG_IsActiveFlag_EWKUP (WWDG_TypeDef * WWDGx)**
- Function description Indicates if the WWDG Early Wakeup Interrupt Flag is set or not.
- Parameters
- **WWDGx:** WWDG Instance
- Return values
- **State:** of bit (1 or 0).
- Notes
- This bit is set by hardware when the counter has reached the

value 0x40. It must be cleared by software by writing 0. A write of 1 has no effect. This bit is also set if the interrupt is not enabled.

- Reference Manual to LL API cross reference:
- SR EWIF LL_WWDG_IsActiveFlag_EWKUP

LL_WWDG_ClearFlag_EWKUP

Function name `__STATIC_INLINE void LL_WWDG_ClearFlag_EWKUP(WWDG_TypeDef * WWDGx)`

Function description Clear WWDG Early Wakeup Interrupt Flag (EWIF)

Parameters

- **WWDGx**: WWDG Instance

Return values

- **None**:

- Reference Manual to LL API cross reference:
- SR EWIF LL_WWDG_ClearFlag_EWKUP

LL_WWDG_EnableIT_EWKUP

Function name `__STATIC_INLINE void LL_WWDG_EnableIT_EWKUP(WWDG_TypeDef * WWDGx)`

Function description Enable the Early Wakeup Interrupt.

Parameters

- **WWDGx**: WWDG Instance

Return values

- **None**:

Notes

- When set, an interrupt occurs whenever the counter reaches value 0x40. This interrupt is only cleared by hardware after a reset

- Reference Manual to LL API cross reference:
- CFR EWI LL_WWDG_EnableIT_EWKUP

LL_WWDG_IsEnabledIT_EWKUP

Function name `__STATIC_INLINE uint32_t LL_WWDG_IsEnabledIT_EWKUP(WWDG_TypeDef * WWDGx)`

Function description Check if Early Wakeup Interrupt is enabled.

Parameters

- **WWDGx**: WWDG Instance

Return values

- **State**: of bit (1 or 0).

- Reference Manual to LL API cross reference:
- CFR EWI LL_WWDG_IsEnabledIT_EWKUP

93.2 WWDG Firmware driver defines

93.2.1 WWDG

IT Defines

LL_WWDG_CFR_EWI

PRESCALER

LL_WWDG_PRESCALER_1 WWDG counter clock = (PCLK1/4096)/1

LL_WWDG_PRESCALER_2 WWDG counter clock = (PCLK1/4096)/2

LL_WWDG_PRESCALER_4 WWDG counter clock = (PCLK1/4096)/4

LL_WWDG_PRESCALER_8 WWDG counter clock = (PCLK1/4096)/8

Common Write and read registers macros

LL_WWDG_WriteReg **Description:**

- Write a value in WWDG register.

Parameters:

- `__INSTANCE__`: WWDG Instance
- `__REG__`: Register to be written
- `__VALUE__`: Value to be written in the register

Return value:

- None

LL_WWDG_ReadReg **Description:**

- Read a value in WWDG register.

Parameters:

- `__INSTANCE__`: WWDG Instance
- `__REG__`: Register to be read

Return value:

- Register: value

94 Correspondence between API registers and API low-layer driver functions

94.1 ADC

Table 25: Correspondence between ADC registers and ADC low-layer driver functions

Register	Field	Function
CCR	ADCPRE	LL_ADC_GetCommonClock
		LL_ADC_SetCommonClock
	DDS	LL_ADC_GetMultiDMATransfer
		LL_ADC_SetMultiDMATransfer
	DELAY	LL_ADC_GetMultiTwoSamplingDelay
		LL_ADC_SetMultiTwoSamplingDelay
	MDMA	LL_ADC_GetMultiDMATransfer
		LL_ADC_SetMultiDMATransfer
	MULTI	LL_ADC_GetMultimode
		LL_ADC_SetMultimode
	TSVREFE	LL_ADC_GetCommonPathInternalCh
		LL_ADC_SetCommonPathInternalCh
	VBATE	LL_ADC_GetCommonPathInternalCh
		LL_ADC_SetCommonPathInternalCh
CDR	DATA1	LL_ADC_REG_ReadMultiConversionData32
	DATA2	LL_ADC_REG_ReadMultiConversionData32
	RDATA_MST	LL_ADC_DMA_GetRegAddr
	RDATA_SLV	LL_ADC_DMA_GetRegAddr
CR1	AWD1CH	LL_ADC_GetAnalogWDMonitChannels
		LL_ADC_SetAnalogWDMonitChannels
	AWD1EN	LL_ADC_GetAnalogWDMonitChannels
		LL_ADC_SetAnalogWDMonitChannels
	AWD1SGL	LL_ADC_GetAnalogWDMonitChannels
		LL_ADC_SetAnalogWDMonitChannels
	AWDIE	LL_ADC_EnableIT_AWD1
	DISCEN	LL_ADC_INJ_SetSequencerDiscont
		LL_ADC_REG_GetSequencerDiscont
		LL_ADC_REG_SetSequencerDiscont
	DISCNUM	LL_ADC_REG_GetSequencerDiscont
		LL_ADC_REG_SetSequencerDiscont

Register	Field	Function
	EOCIE	LL_ADC_DisableIT_EOCS
		LL_ADC_EnableIT_EOCS
		LL_ADC_IsEnabledIT_EOCS
	JAUTO	LL_ADC_INJ_GetTrigAuto
		LL_ADC_INJ_SetTrigAuto
	JEOCIE	LL_ADC_EnableIT_JEOS
	OVRIE	LL_ADC_DisableIT_OVR
		LL_ADC_EnableIT_OVR
		LL_ADC_IsEnabledIT_OVR
	RES	LL_ADC_GetResolution
		LL_ADC_SetResolution
	SCAN	LL_ADC_GetSequencersScanMode
		LL_ADC_SetSequencersScanMode
	CR2	ADON
LL_ADC_Enable		
LL_ADC_IsEnabled		
ALIGN		LL_ADC_SetDataAlignment
CONT		LL_ADC_REG_GetContinuousMode
		LL_ADC_REG_SetContinuousMode
DDS		LL_ADC_REG_GetDMATransfer
		LL_ADC_REG_SetDMATransfer
DMA		LL_ADC_REG_GetDMATransfer
		LL_ADC_REG_SetDMATransfer
EOCS		LL_ADC_REG_GetFlagEndOfConversion
		LL_ADC_REG_SetFlagEndOfConversion
EXTEN		LL_ADC_REG_GetTriggerEdge
		LL_ADC_REG_GetTriggerSource
		LL_ADC_REG_IsTriggerSourceSWStart
		LL_ADC_REG_SetTriggerSource
		LL_ADC_REG_StartConversionExtTrig
		LL_ADC_REG_StopConversionExtTrig
EXTSEL		LL_ADC_REG_GetTriggerSource
		LL_ADC_REG_SetTriggerSource
JEXTEN		LL_ADC_INJ_GetTriggerEdge
	LL_ADC_INJ_GetTriggerSource	
	LL_ADC_INJ_IsTriggerSourceSWStart	

Register	Field	Function
		LL_ADC_INJ_SetTriggerSource
		LL_ADC_INJ_StartConversionExtTrig
		LL_ADC_INJ_StopConversionExtTrig
	JEXTSEL	LL_ADC_INJ_GetTriggerSource
		LL_ADC_INJ_SetTriggerSource
	JSWSTART	LL_ADC_INJ_StartConversionSWStart
SWSTART	LL_ADC_REG_StartConversionSWStart	
CSR	AWD1	LL_ADC_IsActiveFlag_MST_AWD1
	AWD2	LL_ADC_IsActiveFlag_SLV1_AWD1
	AWD3	LL_ADC_IsActiveFlag_SLV2_AWD1
	EOC1	LL_ADC_IsActiveFlag_MST_EOCS
	EOC2	LL_ADC_IsActiveFlag_SLV1_EOCS
	EOC3	LL_ADC_IsActiveFlag_SLV2_EOCS
	JEOC	LL_ADC_IsActiveFlag_MST_EOCS
	JEOC2	LL_ADC_IsActiveFlag_SLV1_JEOS
	JEOC3	LL_ADC_IsActiveFlag_SLV2_JEOS
	OVR1	LL_ADC_IsActiveFlag_MST_OVR
	OVR2	LL_ADC_IsActiveFlag_SLV1_OVR
	OVR3	LL_ADC_IsActiveFlag_SLV2_OVR
DR	RDATA	LL_ADC_DMA_GetRegAddr
		LL_ADC_REG_ReadConversionData10
		LL_ADC_REG_ReadConversionData12
		LL_ADC_REG_ReadConversionData32
		LL_ADC_REG_ReadConversionData6
		LL_ADC_REG_ReadConversionData8
HTR	HT	LL_ADC_GetAnalogWDThresholds
		LL_ADC_SetAnalogWDThresholds
JDR1	JDATA	LL_ADC_INJ_ReadConversionData10
		LL_ADC_INJ_ReadConversionData12
		LL_ADC_INJ_ReadConversionData32
		LL_ADC_INJ_ReadConversionData6
		LL_ADC_INJ_ReadConversionData8
JDR2	JDATA	LL_ADC_INJ_ReadConversionData10
		LL_ADC_INJ_ReadConversionData12
		LL_ADC_INJ_ReadConversionData32
		LL_ADC_INJ_ReadConversionData6

Register	Field	Function
		LL_ADC_INJ_ReadConversionData8
JDR3	JDATA	LL_ADC_INJ_ReadConversionData10
		LL_ADC_INJ_ReadConversionData12
		LL_ADC_INJ_ReadConversionData32
		LL_ADC_INJ_ReadConversionData6
		LL_ADC_INJ_ReadConversionData8
JDR4	JDATA	LL_ADC_INJ_ReadConversionData10
		LL_ADC_INJ_ReadConversionData12
		LL_ADC_INJ_ReadConversionData32
		LL_ADC_INJ_ReadConversionData6
		LL_ADC_INJ_ReadConversionData8
JOFR1	JOFFSET1	LL_ADC_INJ_GetOffset
		LL_ADC_INJ_SetOffset
JOFR2	JOFFSET2	LL_ADC_INJ_GetOffset
		LL_ADC_INJ_SetOffset
JOFR3	JOFFSET3	LL_ADC_INJ_GetOffset
		LL_ADC_INJ_SetOffset
JOFR4	JOFFSET4	LL_ADC_INJ_GetOffset
		LL_ADC_INJ_SetOffset
JSQR	JL	LL_ADC_INJ_GetSequencerLength
		LL_ADC_INJ_SetSequencerLength
	JSQ1	LL_ADC_INJ_SetSequencerRanks
	JSQ2	LL_ADC_INJ_SetSequencerRanks
	JSQ3	LL_ADC_INJ_SetSequencerRanks
JSQ4	LL_ADC_INJ_SetSequencerRanks	
LTR	LT	LL_ADC_GetAnalogWDThresholds
		LL_ADC_SetAnalogWDThresholds
SMPR1	SMP10	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP11	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP12	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP13	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP14	LL_ADC_GetChannelSamplingTime

Register	Field	Function	
	SMP15	LL_ADC_SetChannelSamplingTime	
		LL_ADC_GetChannelSamplingTime	
	SMP16	LL_ADC_SetChannelSamplingTime	
		LL_ADC_GetChannelSamplingTime	
	SMP17	LL_ADC_SetChannelSamplingTime	
		LL_ADC_GetChannelSamplingTime	
	SMP18	LL_ADC_SetChannelSamplingTime	
		LL_ADC_GetChannelSamplingTime	
	SMR2	SMP0	LL_ADC_SetChannelSamplingTime
			LL_ADC_GetChannelSamplingTime
SMP1		LL_ADC_SetChannelSamplingTime	
		LL_ADC_GetChannelSamplingTime	
SMP2		LL_ADC_SetChannelSamplingTime	
		LL_ADC_GetChannelSamplingTime	
SMP3		LL_ADC_SetChannelSamplingTime	
		LL_ADC_GetChannelSamplingTime	
SMP4		LL_ADC_SetChannelSamplingTime	
		LL_ADC_GetChannelSamplingTime	
SMP5		LL_ADC_SetChannelSamplingTime	
		LL_ADC_GetChannelSamplingTime	
SMP6	LL_ADC_SetChannelSamplingTime		
	LL_ADC_GetChannelSamplingTime		
SMP7	LL_ADC_SetChannelSamplingTime		
	LL_ADC_GetChannelSamplingTime		
SMP8	LL_ADC_SetChannelSamplingTime		
	LL_ADC_GetChannelSamplingTime		
SMP9	LL_ADC_SetChannelSamplingTime		
	LL_ADC_GetChannelSamplingTime		
SQR1	L	LL_ADC_REG_SetSequencerLength	
	SQ13	LL_ADC_REG_GetSequencerRanks	
		LL_ADC_REG_SetSequencerRanks	
	SQ14	LL_ADC_REG_GetSequencerRanks	
		LL_ADC_REG_SetSequencerRanks	
	SQ15	LL_ADC_REG_GetSequencerRanks	
LL_ADC_REG_SetSequencerRanks			

Register	Field	Function	
	SQ16	LL_ADC_REG_GetSequencerRanks	
		LL_ADC_REG_SetSequencerRanks	
SQR2	SQ10	LL_ADC_REG_GetSequencerRanks	
		LL_ADC_REG_SetSequencerRanks	
	SQ11	LL_ADC_REG_GetSequencerRanks	
		LL_ADC_REG_SetSequencerRanks	
	SQ12	LL_ADC_REG_GetSequencerRanks	
		LL_ADC_REG_SetSequencerRanks	
	SQ7	LL_ADC_REG_GetSequencerRanks	
		LL_ADC_REG_SetSequencerRanks	
	SQ8	LL_ADC_REG_GetSequencerRanks	
		LL_ADC_REG_SetSequencerRanks	
	SQ9	LL_ADC_REG_GetSequencerRanks	
		LL_ADC_REG_SetSequencerRanks	
	SQR3	SQ1	LL_ADC_REG_GetSequencerRanks
			LL_ADC_REG_SetSequencerRanks
SQ2		LL_ADC_REG_GetSequencerRanks	
		LL_ADC_REG_SetSequencerRanks	
SQ3		LL_ADC_REG_GetSequencerRanks	
		LL_ADC_REG_SetSequencerRanks	
SQ4		LL_ADC_REG_GetSequencerRanks	
		LL_ADC_REG_SetSequencerRanks	
SQ5		LL_ADC_REG_GetSequencerRanks	
		LL_ADC_REG_SetSequencerRanks	
SQ6		LL_ADC_REG_GetSequencerRanks	
		LL_ADC_REG_SetSequencerRanks	
SR		AWD	LL_ADC_ClearFlag_AWD1
			LL_ADC_IsActiveFlag_AWD1
	EOC	LL_ADC_ClearFlag_EOCS	
		LL_ADC_IsActiveFlag_EOCS	
	JEOC	LL_ADC_ClearFlag_JEOS	
		LL_ADC_IsActiveFlag_JEOS	
	OVR	LL_ADC_ClearFlag_OVR	
		LL_ADC_IsActiveFlag_OVR	

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Table 26: Correspondence between BUS registers and BUS low-layer driver functions

Register	Field	Function
AHB1ENR	BKPSRAMEN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	CRCEN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	DMA1EN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	DMA2DEN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	DMA2EN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	DTCMRAMEN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	ETHMACEN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	ETHMACPTPEN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	ETHMACRXEN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	ETHMACTXEN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
GPIOAEN	LL_AHB1_GRP1_DisableClock	
	LL_AHB1_GRP1_EnableClock	
	LL_AHB1_GRP1_IsEnabledClock	
GPIOBEN	LL_AHB1_GRP1_DisableClock	



Register	Field	Function	
		LL_AHB1_GRP1_EnableClock	
		LL_AHB1_GRP1_IsEnabledClock	
	GPIOCEN		LL_AHB1_GRP1_DisableClock
			LL_AHB1_GRP1_EnableClock
			LL_AHB1_GRP1_IsEnabledClock
	GPIODEN		LL_AHB1_GRP1_DisableClock
			LL_AHB1_GRP1_EnableClock
			LL_AHB1_GRP1_IsEnabledClock
	GPIOEEN		LL_AHB1_GRP1_DisableClock
			LL_AHB1_GRP1_EnableClock
			LL_AHB1_GRP1_IsEnabledClock
	GPIOFEN		LL_AHB1_GRP1_DisableClock
			LL_AHB1_GRP1_EnableClock
			LL_AHB1_GRP1_IsEnabledClock
	GPIOGEN		LL_AHB1_GRP1_DisableClock
			LL_AHB1_GRP1_EnableClock
			LL_AHB1_GRP1_IsEnabledClock
	GPIOHEN		LL_AHB1_GRP1_DisableClock
			LL_AHB1_GRP1_EnableClock
			LL_AHB1_GRP1_IsEnabledClock
	GPIOIEN		LL_AHB1_GRP1_DisableClock
			LL_AHB1_GRP1_EnableClock
			LL_AHB1_GRP1_IsEnabledClock
	GPIOJEN		LL_AHB1_GRP1_DisableClock
			LL_AHB1_GRP1_EnableClock
			LL_AHB1_GRP1_IsEnabledClock
GPIOKEN		LL_AHB1_GRP1_DisableClock	
		LL_AHB1_GRP1_EnableClock	
		LL_AHB1_GRP1_IsEnabledClock	
OTGHSEN		LL_AHB1_GRP1_DisableClock	
		LL_AHB1_GRP1_EnableClock	
		LL_AHB1_GRP1_IsEnabledClock	
OTGHSULPIEN		LL_AHB1_GRP1_EnableClock	
OTGHSULPIENDEN		LL_AHB1_GRP1_DisableClock	
		LL_AHB1_GRP1_IsEnabledClock	
AHB1LPENR	AXILPEN	LL_AHB1_GRP1_DisableClockLowPower	

Register	Field	Function
		LL_AHB1_GRP1_EnableClockLowPower
BKPSRAMLPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
CRCLPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
DMA1LPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
DMA2DLPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
DMA2LPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
DTCMRAML PEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
ETHMACLPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
ETHMACPTLPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
ETHMACRXLPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
ETHMACTXLPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
FLITFLPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
GPIOALPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
GPIOBLPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
GPIOCLPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
GPIODLPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
GPIOELPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
GPIOFLPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower
GPIOGLPEN		LL_AHB1_GRP1_DisableClockLowPower
		LL_AHB1_GRP1_EnableClockLowPower

Register	Field	Function	
	GPIOHLPEN	LL_AHB1_GRP1_EnableClockLowPower	
		LL_AHB1_GRP1_DisableClockLowPower	
	GPIOILPEN	LL_AHB1_GRP1_EnableClockLowPower	
		LL_AHB1_GRP1_DisableClockLowPower	
	GPIOJLPEN	LL_AHB1_GRP1_EnableClockLowPower	
		LL_AHB1_GRP1_DisableClockLowPower	
	GPIOKLPEN	LL_AHB1_GRP1_EnableClockLowPower	
		LL_AHB1_GRP1_DisableClockLowPower	
	OTGHSLPEN	LL_AHB1_GRP1_EnableClockLowPower	
		LL_AHB1_GRP1_DisableClockLowPower	
	OTGHSULPILPEN	LL_AHB1_GRP1_EnableClockLowPower	
		LL_AHB1_GRP1_DisableClockLowPower	
	SRAM1LPEN	LL_AHB1_GRP1_EnableClockLowPower	
		LL_AHB1_GRP1_DisableClockLowPower	
	SRAM2LPEN	LL_AHB1_GRP1_EnableClockLowPower	
		LL_AHB1_GRP1_DisableClockLowPower	
	AHB1RSTR	CRCRST	LL_AHB1_GRP1_ForceReset
			LL_AHB1_GRP1_ReleaseReset
DMA1RST		LL_AHB1_GRP1_ForceReset	
		LL_AHB1_GRP1_ReleaseReset	
DMA2DRST		LL_AHB1_GRP1_ForceReset	
		LL_AHB1_GRP1_ReleaseReset	
DMA2RST		LL_AHB1_GRP1_ForceReset	
		LL_AHB1_GRP1_ReleaseReset	
ETHMACRST		LL_AHB1_GRP1_ForceReset	
		LL_AHB1_GRP1_ReleaseReset	
GPIOARST		LL_AHB1_GRP1_ForceReset	
		LL_AHB1_GRP1_ReleaseReset	
GPIOBRST		LL_AHB1_GRP1_ForceReset	
		LL_AHB1_GRP1_ReleaseReset	
GPIOCRST		LL_AHB1_GRP1_ForceReset	
		LL_AHB1_GRP1_ReleaseReset	
GPIODRST		LL_AHB1_GRP1_ForceReset	
		LL_AHB1_GRP1_ReleaseReset	
GPIOERST	LL_AHB1_GRP1_ForceReset		
	LL_AHB1_GRP1_ReleaseReset		

Register	Field	Function
	GPIOFRST	LL_AHB1_GRP1_ReleaseReset
		LL_AHB1_GRP1_ForceReset
	GPIOGRST	LL_AHB1_GRP1_ReleaseReset
		LL_AHB1_GRP1_ForceReset
	GPIOHRST	LL_AHB1_GRP1_ReleaseReset
		LL_AHB1_GRP1_ForceReset
	GPIOIRST	LL_AHB1_GRP1_ReleaseReset
		LL_AHB1_GRP1_ForceReset
	GPIOJRST	LL_AHB1_GRP1_ReleaseReset
		LL_AHB1_GRP1_ForceReset
	GPIOKRST	LL_AHB1_GRP1_ReleaseReset
		LL_AHB1_GRP1_ForceReset
	OTGHSRST	LL_AHB1_GRP1_ReleaseReset
		LL_AHB1_GRP1_ForceReset
AHB2ENR	AESEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	CRYPEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	DCMIEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	HASHEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	JPEGEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	OTGFSEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	RNGEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock

Register	Field	Function
AHB2LPENR	AESLPEN	LL_AHB2_GRP1_DisableClockLowPower
		LL_AHB2_GRP1_EnableClockLowPower
	CRYPLPEN	LL_AHB2_GRP1_DisableClockLowPower
		LL_AHB2_GRP1_EnableClockLowPower
	DCMILPEN	LL_AHB2_GRP1_DisableClockLowPower
		LL_AHB2_GRP1_EnableClockLowPower
	HASHLPEN	LL_AHB2_GRP1_DisableClockLowPower
		LL_AHB2_GRP1_EnableClockLowPower
	JPEGLPEN	LL_AHB2_GRP1_DisableClockLowPower
		LL_AHB2_GRP1_EnableClockLowPower
	OTGFSLPEN	LL_AHB2_GRP1_DisableClockLowPower
		LL_AHB2_GRP1_EnableClockLowPower
	RNGLPEN	LL_AHB2_GRP1_DisableClockLowPower
		LL_AHB2_GRP1_EnableClockLowPower
AHB2RSTR	AESRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	CRYPRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	DCMIRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	HASHRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	JPEGIRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	OTGFIRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	RNGIRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
AHB3ENR	FMCEN	LL_AHB3_GRP1_DisableClock
		LL_AHB3_GRP1_EnableClock
		LL_AHB3_GRP1_IsEnabledClock
	QSPIEN	LL_AHB3_GRP1_DisableClock
		LL_AHB3_GRP1_EnableClock
		LL_AHB3_GRP1_IsEnabledClock
AHB3LPENR	FMCLPEN	LL_AHB3_GRP1_DisableClockLowPower
		LL_AHB3_GRP1_EnableClockLowPower

Register	Field	Function
	QSPILPEN	LL_AHB3_GRP1_DisableClockLowPower
		LL_AHB3_GRP1_EnableClockLowPower
AHB3RSTR	FMCRST	LL_AHB3_GRP1_ForceReset
		LL_AHB3_GRP1_ReleaseReset
	QSPIRST	LL_AHB3_GRP1_ForceReset
		LL_AHB3_GRP1_ReleaseReset
APB1ENR	CAN1EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	CAN2EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	CAN3EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	CECEN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	DACEN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	I2C1EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	I2C2EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	I2C3EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	I2C4EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	LPTIM1EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock

Register	Field	Function
PWREN		LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
RTCEN		LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
SPDIFRXEN		LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
SPI2EN		LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
SPI3EN		LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
TIM12EN		LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
TIM13EN		LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
TIM14EN		LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
TIM2EN		LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
TIM3EN		LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
TIM4EN		LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
TIM5EN		LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock

Register	Field	Function
	TIM6EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	TIM7EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	UART4EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	UART5EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	UART7EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	UART8EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	USART2EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
USART3EN	LL_APB1_GRP1_DisableClock	
	LL_APB1_GRP1_EnableClock	
	LL_APB1_GRP1_IsEnabledClock	
WWDGEN	LL_APB1_GRP1_DisableClock	
	LL_APB1_GRP1_EnableClock	
	LL_APB1_GRP1_IsEnabledClock	
APB1LPENR	CAN1LPEN	LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
	CAN2LPEN	LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
	CAN3LPEN	LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
	CECLPEN	LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
	DACLPEN	LL_APB1_GRP1_DisableClockLowPower

Register	Field	Function
		LL_APB1_GRP1_EnableClockLowPower
I2C1LPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
I2C2LPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
I2C3LPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
I2C4LPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
LPTIM1LPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
PWRLPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
RTCLPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
SPDIFRXLPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
SPI2LPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
SPI3LPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
TIM12LPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
TIM13LPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
TIM14LPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
TIM2LPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
TIM3LPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
TIM4LPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
TIM5LPEN		LL_APB1_GRP1_DisableClockLowPower
		LL_APB1_GRP1_EnableClockLowPower
TIM6LPEN		LL_APB1_GRP1_DisableClockLowPower

Register	Field	Function	
	TIM7LPEN	<i>LL_APB1_GRP1_EnableClockLowPower</i>	
		<i>LL_APB1_GRP1_DisableClockLowPower</i>	
	UART4LPEN	<i>LL_APB1_GRP1_EnableClockLowPower</i>	
		<i>LL_APB1_GRP1_DisableClockLowPower</i>	
	UART5LPEN	<i>LL_APB1_GRP1_EnableClockLowPower</i>	
		<i>LL_APB1_GRP1_DisableClockLowPower</i>	
	UART7LPEN	<i>LL_APB1_GRP1_EnableClockLowPower</i>	
		<i>LL_APB1_GRP1_DisableClockLowPower</i>	
	UART8LPEN	<i>LL_APB1_GRP1_EnableClockLowPower</i>	
		<i>LL_APB1_GRP1_DisableClockLowPower</i>	
	USART2LPEN	<i>LL_APB1_GRP1_EnableClockLowPower</i>	
		<i>LL_APB1_GRP1_DisableClockLowPower</i>	
	USART3LPEN	<i>LL_APB1_GRP1_EnableClockLowPower</i>	
		<i>LL_APB1_GRP1_DisableClockLowPower</i>	
	WWDGLPEN	<i>LL_APB1_GRP1_EnableClockLowPower</i>	
		<i>LL_APB1_GRP1_DisableClockLowPower</i>	
	APB1RSTR	CAN1RST	<i>LL_APB1_GRP1_ForceReset</i>
			<i>LL_APB1_GRP1_ReleaseReset</i>
CAN2RST		<i>LL_APB1_GRP1_ForceReset</i>	
		<i>LL_APB1_GRP1_ReleaseReset</i>	
CAN3RST		<i>LL_APB1_GRP1_ForceReset</i>	
		<i>LL_APB1_GRP1_ReleaseReset</i>	
CECRST		<i>LL_APB1_GRP1_ForceReset</i>	
		<i>LL_APB1_GRP1_ReleaseReset</i>	
DACRST		<i>LL_APB1_GRP1_ForceReset</i>	
		<i>LL_APB1_GRP1_ReleaseReset</i>	
I2C1RST		<i>LL_APB1_GRP1_ForceReset</i>	
		<i>LL_APB1_GRP1_ReleaseReset</i>	
I2C2RST		<i>LL_APB1_GRP1_ForceReset</i>	
		<i>LL_APB1_GRP1_ReleaseReset</i>	
I2C3RST		<i>LL_APB1_GRP1_ForceReset</i>	
		<i>LL_APB1_GRP1_ReleaseReset</i>	
I2C4RST		<i>LL_APB1_GRP1_ForceReset</i>	
		<i>LL_APB1_GRP1_ReleaseReset</i>	
LPTIM1RST	<i>LL_APB1_GRP1_ForceReset</i>		

Register	Field	Function
		LL_APB1_GRP1_ReleaseReset
PWRRST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
SPDIFRXRST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
SPI2RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
SPI3RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
TIM12RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
TIM13RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
TIM14RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
TIM2RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
TIM3RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
TIM4RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
TIM5RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
TIM6RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
TIM7RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
UART4RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
UART5RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
UART7RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
UART8RST		LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
USART2RST		LL_APB1_GRP1_ForceReset

Register	Field	Function
		LL_APB1_GRP1_ReleaseReset
		LL_APB1_GRP1_ForceReset
	USART3RST	LL_APB1_GRP1_ReleaseReset
	WWDGRST	LL_APB1_GRP1_ForceReset LL_APB1_GRP1_ReleaseReset
APB2ENR	ADC1EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	ADC2EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	ADC3EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	DFSDM1EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	DSIEN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	LTDCCEN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	MDIOEN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	OTGPHYCEN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	SAI1EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	SAI2EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	SDMMC1EN	LL_APB2_GRP1_DisableClock

Register	Field	Function
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
SDMMC2EN		LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
SPI1EN		LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
SPI4EN		LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
SPI5EN		LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
SPI6EN		LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
SYSCFGEN		LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
TIM10EN		LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
TIM11EN		LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
TIM1EN		LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
TIM8EN		LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
TIM9EN		LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
USART1EN		LL_APB2_GRP1_DisableClock

Register	Field	Function
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	USART6EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
APB2LPENR	ADC1LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	ADC2LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	ADC3LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	DFSDM1LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	DSILPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	LTDCLPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	MDIOLPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	SAI1LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	SAI2LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	SDMMC1LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	SDMMC2LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	SPI1LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	SPI4LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	SPI5LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	SPI6LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	SYSCFGLPEN	LL_APB2_GRP1_DisableClockLowPower

Register	Field	Function
		LL_APB2_GRP1_EnableClockLowPower
	TIM10LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	TIM11LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	TIM1LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	TIM8LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	TIM9LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	USART1LPEN	LL_APB2_GRP1_DisableClockLowPower
		LL_APB2_GRP1_EnableClockLowPower
	USART6LPEN	LL_APB2_GRP1_DisableClockLowPower
LL_APB2_GRP1_EnableClockLowPower		
APB2RSTR	ADCRST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	DFSDM1RST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	DSIRST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	LTDCRST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	MDIORST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	OTGPHYCRST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	SAI1RST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
SAI2RST	LL_APB2_GRP1_ForceReset	
	LL_APB2_GRP1_ReleaseReset	
SDMMC1RST	LL_APB2_GRP1_ForceReset	
	LL_APB2_GRP1_ReleaseReset	
SDMMC2RST	LL_APB2_GRP1_ForceReset	
	LL_APB2_GRP1_ReleaseReset	
SPI1RST	LL_APB2_GRP1_ForceReset	

Register	Field	Function
	SPI4RST	LL_APB2_GRP1_ReleaseReset
		LL_APB2_GRP1_ForceReset
	SPI5RST	LL_APB2_GRP1_ReleaseReset
		LL_APB2_GRP1_ForceReset
	SPI6RST	LL_APB2_GRP1_ReleaseReset
		LL_APB2_GRP1_ForceReset
	SYSCFGRST	LL_APB2_GRP1_ReleaseReset
		LL_APB2_GRP1_ForceReset
	TIM10RST	LL_APB2_GRP1_ReleaseReset
		LL_APB2_GRP1_ForceReset
	TIM11RST	LL_APB2_GRP1_ReleaseReset
		LL_APB2_GRP1_ForceReset
	TIM1RST	LL_APB2_GRP1_ReleaseReset
		LL_APB2_GRP1_ForceReset
	TIM8RST	LL_APB2_GRP1_ReleaseReset
		LL_APB2_GRP1_ForceReset
	TIM9RST	LL_APB2_GRP1_ReleaseReset
		LL_APB2_GRP1_ForceReset
	USART1RST	LL_APB2_GRP1_ReleaseReset
		LL_APB2_GRP1_ForceReset
	USART6RST	LL_APB2_GRP1_ReleaseReset
		LL_APB2_GRP1_ForceReset

94.3 CORTEX

Table 27: Correspondence between CORTEX registers and CORTEX low-layer driver functions

Register	Field	Function
MPU_CTRL	ENABLE	LL_MPU_Disable
		LL_MPU_Enable
		LL_MPU_IsEnabled
MPU_RASR	AP	LL_MPU_ConfigRegion
	B	LL_MPU_ConfigRegion
	C	LL_MPU_ConfigRegion
	ENABLE	LL_MPU_DisableRegion
		LL_MPU_EnableRegion
S	LL_MPU_ConfigRegion	

Register	Field	Function
	SIZE	LL_MPU_ConfigRegion
	XN	LL_MPU_ConfigRegion
MPU_RBAR	ADDR	LL_MPU_ConfigRegion
	REGION	LL_MPU_ConfigRegion
MPU_RNR	REGION	LL_MPU_ConfigRegion
		LL_MPU_DisableRegion
SCB_CPUID	ARCHITECTURE	LL_CPUID_GetConstant
	IMPLEMENTER	LL_CPUID_GetImplementer
	PARTNO	LL_CPUID_GetParNo
	REVISION	LL_CPUID_GetRevision
	VARIANT	LL_CPUID_GetVariant
SCB_SCR	SEVEONPEND	LL_LPM_DisableEventOnPend
		LL_LPM_EnableEventOnPend
	SLEEPDEEP	LL_LPM_EnableDeepSleep
		LL_LPM_EnableSleep
	SLEEPONEXIT	LL_LPM_DisableSleepOnExit
		LL_LPM_EnableSleepOnExit
SCB_SHCSR	MEMFAULTENA	LL_HANDLER_DisableFault
		LL_HANDLER_EnableFault
STK_CTRL	CLKSOURCE	LL_SYSTICK_GetClkSource
		LL_SYSTICK_SetClkSource
	COUNTFLAG	LL_SYSTICK_IsActiveCounterFlag
	TICKINT	LL_SYSTICK_DisableIT
		LL_SYSTICK_EnableIT
		LL_SYSTICK_IsEnabledIT

94.4 CRC

Table 28: Correspondence between CRC registers and CRC low-layer driver functions

Register	Field	Function
CR	POLYSIZE	LL_CRC_GetPolynomialSize
		LL_CRC_SetPolynomialSize
	RESET	LL_CRC_ResetCRCCalculationUnit
	REV_IN	LL_CRC_GetInputDataReverseMode
		LL_CRC_SetInputDataReverseMode
	REV_OUT	LL_CRC_GetOutputDataReverseMode
LL_CRC_SetOutputDataReverseMode		

Register	Field	Function
DR	DR	LL_CRC_FeedData16
		LL_CRC_FeedData32
		LL_CRC_FeedData8
		LL_CRC_ReadData16
		LL_CRC_ReadData32
		LL_CRC_ReadData7
		LL_CRC_ReadData8
IDR	IDR	LL_CRC_Read_IDR
		LL_CRC_Write_IDR
INIT	INIT	LL_CRC_GetInitialData
		LL_CRC_SetInitialData
POL	POL	LL_CRC_GetPolynomialCoef
		LL_CRC_SetPolynomialCoef

94.5 DAC

Table 29: Correspondence between DAC registers and DAC low-layer driver functions

Register	Field	Function
CR	BOFF1	LL_DAC_GetOutputBuffer
		LL_DAC_SetOutputBuffer
	BOFF2	LL_DAC_GetOutputBuffer
		LL_DAC_SetOutputBuffer
	DMAEN1	LL_DAC_DisableDMAReq
		LL_DAC_EnableDMAReq
		LL_DAC_IsDMAReqEnabled
	DMAEN2	LL_DAC_DisableDMAReq
		LL_DAC_EnableDMAReq
		LL_DAC_IsDMAReqEnabled
	DMAUDRIE1	LL_DAC_DisableIT_DMAUDR1
		LL_DAC_EnableIT_DMAUDR1
		LL_DAC_IsEnabledIT_DMAUDR1
	DMAUDRIE2	LL_DAC_DisableIT_DMAUDR2
		LL_DAC_EnableIT_DMAUDR2
		LL_DAC_IsEnabledIT_DMAUDR2
	EN1	LL_DAC_Disable
		LL_DAC_Enable
		LL_DAC_IsEnabled

Register	Field	Function
	EN2	LL_DAC_Disable
		LL_DAC_Enable
		LL_DAC_IsEnabled
	MAMP1	LL_DAC_GetWaveNoiseLFSR
		LL_DAC_GetWaveTriangleAmplitude
		LL_DAC_SetWaveNoiseLFSR
		LL_DAC_SetWaveTriangleAmplitude
	MAMP2	LL_DAC_GetWaveNoiseLFSR
		LL_DAC_GetWaveTriangleAmplitude
		LL_DAC_SetWaveNoiseLFSR
		LL_DAC_SetWaveTriangleAmplitude
	TEN1	LL_DAC_DisableTrigger
		LL_DAC_EnableTrigger
		LL_DAC_IsTriggerEnabled
	TEN2	LL_DAC_DisableTrigger
		LL_DAC_EnableTrigger
		LL_DAC_IsTriggerEnabled
	TSEL1	LL_DAC_GetTriggerSource
		LL_DAC_SetTriggerSource
	TSEL2	LL_DAC_GetTriggerSource
LL_DAC_SetTriggerSource		
WAVE1	LL_DAC_GetWaveAutoGeneration	
	LL_DAC_SetWaveAutoGeneration	
WAVE2	LL_DAC_GetWaveAutoGeneration	
	LL_DAC_SetWaveAutoGeneration	
DHR12L1	DACC1DHR	LL_DAC_ConvertData12LeftAligned
		LL_DAC_DMA_GetRegAddr
DHR12L2	DACC2DHR	LL_DAC_ConvertData12LeftAligned
		LL_DAC_DMA_GetRegAddr
DHR12LD	DACC1DHR	LL_DAC_ConvertDualData12LeftAligned
	DACC2DHR	LL_DAC_ConvertDualData12LeftAligned
DHR12R1	DACC1DHR	LL_DAC_ConvertData12RightAligned
		LL_DAC_DMA_GetRegAddr
DHR12R2	DACC2DHR	LL_DAC_ConvertData12RightAligned
		LL_DAC_DMA_GetRegAddr
DHR12RD	DACC1DHR	LL_DAC_ConvertDualData12RightAligned

Register	Field	Function
	DACC2DHR	LL_DAC_ConvertDualData12RightAligned
DHR8R1	DACC1DHR	LL_DAC_ConvertData8RightAligned
		LL_DAC_DMA_GetRegAddr
DHR8R2	DACC2DHR	LL_DAC_ConvertData8RightAligned
		LL_DAC_DMA_GetRegAddr
DHR8RD	DACC1DHR	LL_DAC_ConvertDualData8RightAligned
	DACC2DHR	LL_DAC_ConvertDualData8RightAligned
DOR1	DACC1DOR	LL_DAC_RetrieveOutputData
DOR2	DACC2DOR	LL_DAC_RetrieveOutputData
SR	DMAUDR1	LL_DAC_ClearFlag_DMAUDR1
		LL_DAC_IsActiveFlag_DMAUDR1
	DMAUDR2	LL_DAC_ClearFlag_DMAUDR2
		LL_DAC_IsActiveFlag_DMAUDR2
SWTRIGR	SWTRIG1	LL_DAC_TrigSWConversion
	SWTRIG2	LL_DAC_TrigSWConversion

94.6 DMA

Table 30: Correspondence between DMA registers and DMA low-layer driver functions

Register	Field	Function
CR	CHSEL	LL_DMA_GetChannelSelection
		LL_DMA_SetChannelSelection
	CIRC	LL_DMA_ConfigTransfer
		LL_DMA_GetMode
		LL_DMA_SetMode
	CT	LL_DMA_GetCurrentTargetMem
		LL_DMA_SetCurrentTargetMem
	DBM	LL_DMA_DisableDoubleBufferMode
		LL_DMA_EnableDoubleBufferMode
	DIR	LL_DMA_ConfigTransfer
		LL_DMA_GetDataTransferDirection
		LL_DMA_SetDataTransferDirection
	DMEIE	LL_DMA_DisableIT_DME
		LL_DMA_EnableIT_DME
		LL_DMA_IsEnabledIT_DME
	EN	LL_DMA_DisableStream
		LL_DMA_EnableStream

Register	Field	Function
		LL_DMA_IsEnabledStream
	HTIE	LL_DMA_DisableIT_HT
		LL_DMA_EnableIT_HT
		LL_DMA_IsEnabledIT_HT
	MBURST	LL_DMA_GetMemoryBurstxfer
		LL_DMA_SetMemoryBurstxfer
	MINC	LL_DMA_ConfigTransfer
		LL_DMA_GetMemoryIncMode
		LL_DMA_SetMemoryIncMode
	MSIZE	LL_DMA_ConfigTransfer
		LL_DMA_GetMemorySize
		LL_DMA_SetMemorySize
	PBURST	LL_DMA_GetPeriphBurstxfer
		LL_DMA_SetPeriphBurstxfer
	PFCTRL	LL_DMA_ConfigTransfer
		LL_DMA_GetMode
		LL_DMA_SetMode
	PINC	LL_DMA_ConfigTransfer
		LL_DMA_GetPeriphIncMode
		LL_DMA_SetPeriphIncMode
	PINCOS	LL_DMA_GetIncOffsetSize
		LL_DMA_SetIncOffsetSize
	PL	LL_DMA_ConfigTransfer
		LL_DMA_GetStreamPriorityLevel
		LL_DMA_SetStreamPriorityLevel
	PSIZE	LL_DMA_ConfigTransfer
		LL_DMA_GetPeriphSize
		LL_DMA_SetPeriphSize
	TCIE	LL_DMA_DisableIT_TC
		LL_DMA_EnableIT_TC
		LL_DMA_IsEnabledIT_TC
	TEIE	LL_DMA_DisableIT_TE
		LL_DMA_EnableIT_TE
		LL_DMA_IsEnabledIT_TE
FCR	DMDIS	LL_DMA_ConfigFifo
		LL_DMA_DisableFifoMode

Register	Field	Function
		LL_DMA_EnableFifoMode
	FEIE	LL_DMA_DisableIT_FE
		LL_DMA_EnableIT_FE
		LL_DMA_IsEnabledIT_FE
	FS	LL_DMA_GetFIFOStatus
	FTH	LL_DMA_ConfigFifo
		LL_DMA_GetFIFOThreshold
LL_DMA_SetFIFOThreshold		
HIFCR	CDMEIF4	LL_DMA_ClearFlag_DME4
	CDMEIF5	LL_DMA_ClearFlag_DME5
	CDMEIF6	LL_DMA_ClearFlag_DME6
	CDMEIF7	LL_DMA_ClearFlag_DME7
	CFEIF4	LL_DMA_ClearFlag_FE4
	CFEIF5	LL_DMA_ClearFlag_FE5
	CFEIF6	LL_DMA_ClearFlag_FE6
	CFEIF7	LL_DMA_ClearFlag_FE7
	CHTIF4	LL_DMA_ClearFlag_HT4
	CHTIF5	LL_DMA_ClearFlag_HT5
	CHTIF6	LL_DMA_ClearFlag_HT6
	CHTIF7	LL_DMA_ClearFlag_HT7
	CTCIF4	LL_DMA_ClearFlag_TC4
	CTCIF5	LL_DMA_ClearFlag_TC5
	CTCIF6	LL_DMA_ClearFlag_TC6
	CTCIF7	LL_DMA_ClearFlag_TC7
	CTEIF4	LL_DMA_ClearFlag_TE4
	CTEIF5	LL_DMA_ClearFlag_TE5
	CTEIF6	LL_DMA_ClearFlag_TE6
	CTEIF7	LL_DMA_ClearFlag_TE7
HISR	DMEIF0	LL_DMA_IsActiveFlag_DME5
	DMEIF4	LL_DMA_IsActiveFlag_DME4
	DMEIF6	LL_DMA_IsActiveFlag_DME6
	DMEIF7	LL_DMA_IsActiveFlag_DME7
	FEIF0	LL_DMA_IsActiveFlag_FE5
	FEIF4	LL_DMA_IsActiveFlag_FE4
	FEIF6	LL_DMA_IsActiveFlag_FE6
	FEIF7	LL_DMA_IsActiveFlag_FE7

Register	Field	Function
	HTIF0	LL_DMA_IsActiveFlag_HT5
	HTIF4	LL_DMA_IsActiveFlag_HT4
	HTIF6	LL_DMA_IsActiveFlag_HT6
	HTIF7	LL_DMA_IsActiveFlag_HT7
	TCIF0	LL_DMA_IsActiveFlag_TC5
	TCIF4	LL_DMA_IsActiveFlag_TC4
	TCIF6	LL_DMA_IsActiveFlag_TC6
	TCIF7	LL_DMA_IsActiveFlag_TC7
	TEIF0	LL_DMA_IsActiveFlag_TE5
	TEIF4	LL_DMA_IsActiveFlag_TE4
	TEIF6	LL_DMA_IsActiveFlag_TE6
	TEIF7	LL_DMA_IsActiveFlag_TE7
LIFCR	CDMEIF0	LL_DMA_ClearFlag_DME0
	CDMEIF1	LL_DMA_ClearFlag_DME1
	CDMEIF2	LL_DMA_ClearFlag_DME2
	CDMEIF3	LL_DMA_ClearFlag_DME3
	CFEIF0	LL_DMA_ClearFlag_FE0
	CFEIF1	LL_DMA_ClearFlag_FE1
	CFEIF2	LL_DMA_ClearFlag_FE2
	CFEIF3	LL_DMA_ClearFlag_FE3
	CHTIF0	LL_DMA_ClearFlag_HT0
	CHTIF1	LL_DMA_ClearFlag_HT1
	CHTIF2	LL_DMA_ClearFlag_HT2
	CHTIF3	LL_DMA_ClearFlag_HT3
	CTCIF0	LL_DMA_ClearFlag_TC0
	CTCIF1	LL_DMA_ClearFlag_TC1
	CTCIF2	LL_DMA_ClearFlag_TC2
	CTCIF3	LL_DMA_ClearFlag_TC3
	CTEIF0	LL_DMA_ClearFlag_TE0
	CTEIF1	LL_DMA_ClearFlag_TE1
	CTEIF2	LL_DMA_ClearFlag_TE2
	CTEIF3	LL_DMA_ClearFlag_TE3
LISR	DMEIF0	LL_DMA_IsActiveFlag_DME0
	DMEIF1	LL_DMA_IsActiveFlag_DME1
	DMEIF2	LL_DMA_IsActiveFlag_DME2
	DMEIF3	LL_DMA_IsActiveFlag_DME3

Register	Field	Function
	FEIF0	LL_DMA_IsActiveFlag_FE0
	FEIF1	LL_DMA_IsActiveFlag_FE1
	FEIF2	LL_DMA_IsActiveFlag_FE2
	FEIF3	LL_DMA_IsActiveFlag_FE3
	HTIF0	LL_DMA_IsActiveFlag_HT0
	HTIF1	LL_DMA_IsActiveFlag_HT1
	HTIF2	LL_DMA_IsActiveFlag_HT2
	HTIF3	LL_DMA_IsActiveFlag_HT3
	TCIF0	LL_DMA_IsActiveFlag_TC0
	TCIF1	LL_DMA_IsActiveFlag_TC1
	TCIF2	LL_DMA_IsActiveFlag_TC2
	TCIF3	LL_DMA_IsActiveFlag_TC3
	TEIF0	LL_DMA_IsActiveFlag_TE0
	TEIF1	LL_DMA_IsActiveFlag_TE1
	TEIF2	LL_DMA_IsActiveFlag_TE2
	TEIF3	LL_DMA_IsActiveFlag_TE3
M0AR	M0A	LL_DMA_ConfigAddresses
		LL_DMA_GetM2MDstAddress
		LL_DMA_GetMemoryAddress
		LL_DMA_SetM2MDstAddress
		LL_DMA_SetMemoryAddress
M1AR	M1A	LL_DMA_GetMemory1Address
		LL_DMA_SetMemory1Address
NDTR	NDT	LL_DMA_GetDataLength
		LL_DMA_SetDataLength
PAR	PA	LL_DMA_ConfigAddresses
		LL_DMA_GetM2MSrcAddress
		LL_DMA_GetPeriphAddress
		LL_DMA_SetM2MSrcAddress
		LL_DMA_SetPeriphAddress

94.7 DMA2D

Table 31: Correspondence between DMA2D registers and DMA2D low-layer driver functions

Register	Field	Function
AMTCR	DT	LL_DMA2D_GetDeadTime
		LL_DMA2D_SetDeadTime

Register	Field	Function
	EN	LL_DMA2D_DisableDeadTime
		LL_DMA2D_EnableDeadTime
		LL_DMA2D_IsEnabledDeadTime
BGCMAR	MA	LL_DMA2D_BGND_GetCLUTMemAddr
		LL_DMA2D_BGND_SetCLUTMemAddr
BGCOLR	BLUE	LL_DMA2D_BGND_GetBlueColor
		LL_DMA2D_BGND_SetBlueColor
		LL_DMA2D_BGND_SetColor
	GREEN	LL_DMA2D_BGND_GetGreenColor
		LL_DMA2D_BGND_SetColor
		LL_DMA2D_BGND_SetGreenColor
	RED	LL_DMA2D_BGND_GetRedColor
		LL_DMA2D_BGND_SetColor
		LL_DMA2D_BGND_SetRedColor
BGMAR	MA	LL_DMA2D_BGND_GetMemAddr
		LL_DMA2D_BGND_SetMemAddr
BGOR	LO	LL_DMA2D_BGND_GetLineOffset
		LL_DMA2D_BGND_SetLineOffset
BGPFCR	AI	LL_DMA2D_BGND_GetAlphaInvMode
		LL_DMA2D_BGND_SetAlphaInvMode
	ALPHA	LL_DMA2D_BGND_GetAlpha
		LL_DMA2D_BGND_SetAlpha
	AM	LL_DMA2D_BGND_GetAlphaMode
		LL_DMA2D_BGND_SetAlphaMode
	CCM	LL_DMA2D_BGND_GetCLUTColorMode
		LL_DMA2D_BGND_SetCLUTColorMode
	CM	LL_DMA2D_BGND_GetColorMode
		LL_DMA2D_BGND_SetColorMode
	CS	LL_DMA2D_BGND_GetCLUTSize
		LL_DMA2D_BGND_SetCLUTSize
	RBS	LL_DMA2D_BGND_GetRBSwapMode
		LL_DMA2D_BGND_SetRBSwapMode
	START	LL_DMA2D_BGND_EnableCLUTLoad
LL_DMA2D_BGND_IsEnabledCLUTLoad		
CR	ABORT	LL_DMA2D_Abort
		LL_DMA2D_IsAborted

Register	Field	Function	
	CAEIE	LL_DMA2D_DisableIT_CAE	
		LL_DMA2D_EnableIT_CAE	
		LL_DMA2D_IsEnabledIT_CAE	
	CEIE	LL_DMA2D_DisableIT_CE	
		LL_DMA2D_EnableIT_CE	
		LL_DMA2D_IsEnabledIT_CE	
	CTCIE	LL_DMA2D_DisableIT_CTC	
		LL_DMA2D_EnableIT_CTC	
		LL_DMA2D_IsEnabledIT_CTC	
	MODE	LL_DMA2D_GetMode	
		LL_DMA2D_SetMode	
	START	LL_DMA2D_IsTransferOngoing	
		LL_DMA2D_Start	
	SUSP	LL_DMA2D_IsSuspended	
		LL_DMA2D_Resume	
		LL_DMA2D_Suspend	
	TCIE	LL_DMA2D_DisableIT_TC	
		LL_DMA2D_EnableIT_TC	
		LL_DMA2D_IsEnabledIT_TC	
	TEIE	LL_DMA2D_DisableIT_TE	
		LL_DMA2D_EnableIT_TE	
		LL_DMA2D_IsEnabledIT_TE	
	TWIE	LL_DMA2D_DisableIT_TW	
		LL_DMA2D_EnableIT_TW	
		LL_DMA2D_IsEnabledIT_TW	
	FGCMAR	MA	LL_DMA2D_FGND_GetCLUTMemAddr
			LL_DMA2D_FGND_SetCLUTMemAddr
FGCOLR	BLUE	LL_DMA2D_FGND_GetBlueColor	
		LL_DMA2D_FGND_SetBlueColor	
		LL_DMA2D_FGND_SetColor	
	GREEN	LL_DMA2D_FGND_GetGreenColor	
		LL_DMA2D_FGND_SetColor	
		LL_DMA2D_FGND_SetGreenColor	
	RED	LL_DMA2D_FGND_GetRedColor	
		LL_DMA2D_FGND_SetColor	
		LL_DMA2D_FGND_SetRedColor	

Register	Field	Function
FGMAR	MA	LL_DMA2D_FGND_GetMemAddr
		LL_DMA2D_FGND_SetMemAddr
FGOR	LO	LL_DMA2D_FGND_GetLineOffset
		LL_DMA2D_FGND_SetLineOffset
FGPFCCR	AI	LL_DMA2D_FGND_GetAlphaInvMode
		LL_DMA2D_FGND_SetAlphaInvMode
	ALPHA	LL_DMA2D_FGND_GetAlpha
		LL_DMA2D_FGND_SetAlpha
	AM	LL_DMA2D_FGND_GetAlphaMode
		LL_DMA2D_FGND_SetAlphaMode
	CCM	LL_DMA2D_FGND_GetCLUTColorMode
		LL_DMA2D_FGND_SetCLUTColorMode
	CM	LL_DMA2D_FGND_GetColorMode
		LL_DMA2D_FGND_SetColorMode
	CS	LL_DMA2D_FGND_GetCLUTSize
		LL_DMA2D_FGND_SetCLUTSize
	RBS	LL_DMA2D_FGND_GetRBSwapMode
		LL_DMA2D_FGND_SetRBSwapMode
	START	LL_DMA2D_FGND_EnableCLUTLoad
		LL_DMA2D_FGND_IsEnabledCLUTLoad
IFCR	CAECIF	LL_DMA2D_ClearFlag_CAE
	CCEIF	LL_DMA2D_ClearFlag_CE
	CCTCIF	LL_DMA2D_ClearFlag_CTC
	CTCIF	LL_DMA2D_ClearFlag_TC
	CTEIF	LL_DMA2D_ClearFlag_TE
	CTWIF	LL_DMA2D_ClearFlag_TW
ISR	CAEIF	LL_DMA2D_IsActiveFlag_CAE
	CEIF	LL_DMA2D_IsActiveFlag_CE
	CTCIF	LL_DMA2D_IsActiveFlag_CTC
	TCIF	LL_DMA2D_IsActiveFlag_TC
	TEIF	LL_DMA2D_IsActiveFlag_TE
	TWIF	LL_DMA2D_IsActiveFlag_TW
LWR	LW	LL_DMA2D_GetLineWatermark
		LL_DMA2D_SetLineWatermark
NLR	NL	LL_DMA2D_GetNbrOfLines
		LL_DMA2D_SetNbrOfLines

Register	Field	Function
	PL	LL_DMA2D_GetNbrOfPixelsPerLines
		LL_DMA2D_SetNbrOfPixelsPerLines
OCOLR	ALPHA	LL_DMA2D_GetOutputColor
		LL_DMA2D_SetOutputColor
	BLUE	LL_DMA2D_GetOutputColor
		LL_DMA2D_SetOutputColor
	GREEN	LL_DMA2D_GetOutputColor
		LL_DMA2D_SetOutputColor
	RED	LL_DMA2D_GetOutputColor
		LL_DMA2D_SetOutputColor
OMAR	MA	LL_DMA2D_GetOutputMemAddr
		LL_DMA2D_SetOutputMemAddr
OOR	LO	LL_DMA2D_GetLineOffset
		LL_DMA2D_SetLineOffset
OPFCCR	AI	LL_DMA2D_GetOutputAlphaInvMode
		LL_DMA2D_SetOutputAlphaInvMode
	CM	LL_DMA2D_GetOutputColorMode
		LL_DMA2D_SetOutputColorMode
	RBS	LL_DMA2D_GetOutputRBSwapMode
		LL_DMA2D_SetOutputRBSwapMode

94.8 EXTI

Table 32: Correspondence between EXTI registers and EXTI low-layer driver functions

Register	Field	Function
EMR	EMx	LL_EXTI_DisableEvent_0_31
		LL_EXTI_EnableEvent_0_31
		LL_EXTI_IsEnabledEvent_0_31
FTSR	FTx	LL_EXTI_DisableFallingTrig_0_31
		LL_EXTI_EnableFallingTrig_0_31
		LL_EXTI_IsEnabledFallingTrig_0_31
IMR	IMx	LL_EXTI_DisableIT_0_31
		LL_EXTI_EnableIT_0_31
		LL_EXTI_IsEnabledIT_0_31
PR	PIFx	LL_EXTI_ClearFlag_0_31
		LL_EXTI_IsActiveFlag_0_31
		LL_EXTI_ReadFlag_0_31

Register	Field	Function
RTSR	RTx	LL_EXTI_DisableRisingTrig_0_31
		LL_EXTI_EnableRisingTrig_0_31
		LL_EXTI_IsEnabledRisingTrig_0_31
SWIER	SWIx	LL_EXTI_GenerateSWI_0_31

94.9 GPIO

Table 33: Correspondence between GPIO registers and GPIO low-layer driver functions

Register	Field	Function
AFRH	AFSELY	LL_GPIO_GetAFPin_8_15
		LL_GPIO_SetAFPin_8_15
AFRL	AFSELY	LL_GPIO_GetAFPin_0_7
		LL_GPIO_SetAFPin_0_7
BSRR	BRy	LL_GPIO_ResetOutputPin
	BSy	LL_GPIO_SetOutputPin
IDR	IDy	LL_GPIO_IsInputPinSet
		LL_GPIO_ReadInputPort
LCKR	LCKK	LL_GPIO_IsAnyPinLocked
		LL_GPIO_LockPin
	LCKy	LL_GPIO_IsPinLocked
MODER	MODEy	LL_GPIO_GetPinMode
		LL_GPIO_SetPinMode
ODR	ODy	LL_GPIO_IsOutputPinSet
		LL_GPIO_ReadOutputPort
		LL_GPIO_TogglePin
		LL_GPIO_WriteOutputPort
OSPEEDR	OSPEEDy	LL_GPIO_GetPinSpeed
		LL_GPIO_SetPinSpeed
OTYPER	OTy	LL_GPIO_GetPinOutputType
		LL_GPIO_SetPinOutputType
PUPDR	PUPDy	LL_GPIO_GetPinPull
		LL_GPIO_SetPinPull

94.10 I2C

Table 34: Correspondence between I2C registers and I2C low-layer driver functions

Register	Field	Function
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Register	Field	Function
CR1	ADDRIE	LL_I2C_DisableIT_ADDR
		LL_I2C_EnableIT_ADDR
		LL_I2C_IsEnabledIT_ADDR
	ALERTEN	LL_I2C_DisableSMBusAlert
		LL_I2C_EnableSMBusAlert
		LL_I2C_IsEnabledSMBusAlert
	ANFOFF	LL_I2C_ConfigFilters
		LL_I2C_DisableAnalogFilter
		LL_I2C_EnableAnalogFilter
	DNF	LL_I2C_IsEnabledAnalogFilter
		LL_I2C_ConfigFilters
		LL_I2C_GetDigitalFilter
	ERRIE	LL_I2C_SetDigitalFilter
		LL_I2C_DisableIT_ERR
		LL_I2C_EnableIT_ERR
	GCEN	LL_I2C_IsEnabledIT_ERR
		LL_I2C_DisableGeneralCall
		LL_I2C_EnableGeneralCall
	NACKIE	LL_I2C_IsEnabledGeneralCall
		LL_I2C_DisableIT_NACK
		LL_I2C_EnableIT_NACK
	NOSTRETCH	LL_I2C_IsEnabledIT_NACK
		LL_I2C_DisableClockStretching
		LL_I2C_EnableClockStretching
	PE	LL_I2C_IsEnabledClockStretching
		LL_I2C_Disable
		LL_I2C_Enable
	PECEN	LL_I2C_IsEnabled
		LL_I2C_DisableSMBusPEC
		LL_I2C_EnableSMBusPEC
	RXDMAEN	LL_I2C_IsEnabledSMBusPEC
		LL_I2C_DisableDMAReq_RX
		LL_I2C_EnableDMAReq_RX
RXIE	LL_I2C_IsEnabledDMAReq_RX	
	LL_I2C_DisableIT_RX	
		LL_I2C_EnableIT_RX

Register	Field	Function	
CR2	SBC	LL_I2C_IsEnabledIT_RX	
		LL_I2C_DisableSlaveByteControl	
		LL_I2C_EnableSlaveByteControl	
	SMBDEN	LL_I2C_IsEnabledSlaveByteControl	
		LL_I2C_GetMode	
	SMBHEN	LL_I2C_SetMode	
		LL_I2C_GetMode	
	STOPIE	LL_I2C_SetMode	
		LL_I2C_DisableIT_STOP	
		LL_I2C_EnableIT_STOP	
	TCIE	LL_I2C_IsEnabledIT_STOP	
		LL_I2C_DisableIT_TC	
		LL_I2C_EnableIT_TC	
	TXDMAEN	LL_I2C_IsEnabledIT_TC	
		LL_I2C_DisableDMAReq_TX	
		LL_I2C_EnableDMAReq_TX	
	TXIE	LL_I2C_IsEnabledDMAReq_TX	
		LL_I2C_DisableIT_TX	
		LL_I2C_EnableIT_TX	
	CR2	ADD10	LL_I2C_IsEnabledIT_TX
			LL_I2C_GetMasterAddressingMode
LL_I2C_HandleTransfer			
AUTOEND		LL_I2C_SetMasterAddressingMode	
		LL_I2C_DisableAutoEndMode	
		LL_I2C_EnableAutoEndMode	
		LL_I2C_HandleTransfer	
HEAD10R		LL_I2C_IsEnabledAutoEndMode	
		LL_I2C_DisableAuto10BitRead	
		LL_I2C_EnableAuto10BitRead	
		LL_I2C_HandleTransfer	
NACK		LL_I2C_IsEnabledAuto10BitRead	
		LL_I2C_AcknowledgeNextData	
NBYTES		LL_I2C_GetTransferSize	
		LL_I2C_HandleTransfer	
		LL_I2C_SetTransferSize	
PECBYTE		LL_I2C_EnableSMBusPECCCompare	

Register	Field	Function	
		LL_I2C_IsEnabledSMBusPECCompare	
	RD_WRN		LL_I2C_GetTransferRequest
			LL_I2C_HandleTransfer
			LL_I2C_SetTransferRequest
	RELOAD		LL_I2C_DisableReloadMode
			LL_I2C_EnableReloadMode
			LL_I2C_HandleTransfer
			LL_I2C_IsEnabledReloadMode
	SADD		LL_I2C_GetSlaveAddr
			LL_I2C_HandleTransfer
			LL_I2C_SetSlaveAddr
	START		LL_I2C_GenerateStartCondition
			LL_I2C_HandleTransfer
	STOP		LL_I2C_GenerateStopCondition
		LL_I2C_HandleTransfer	
ICR	ADDRCF	LL_I2C_ClearFlag_ADDR	
	ALERTCF	LL_I2C_ClearSMBusFlag_ALERT	
	ARLOCF	LL_I2C_ClearFlag_ARLO	
	BERRCF	LL_I2C_ClearFlag_BERR	
	NACKCF	LL_I2C_ClearFlag_NACK	
	OVR	LL_I2C_ClearFlag_OVR	
	PEC	LL_I2C_ClearSMBusFlag_PECERR	
	STOPCF	LL_I2C_ClearFlag_STOP	
	TIMOUTCF	LL_I2C_ClearSMBusFlag_TIMEOUT	
ISR	ADDCODE	LL_I2C_GetAddressMatchCode	
	ADDR	LL_I2C_IsActiveFlag_ADDR	
	ALERT	LL_I2C_IsActiveSMBusFlag_ALERT	
	ARLO	LL_I2C_IsActiveFlag_ARLO	
	BERR	LL_I2C_IsActiveFlag_BERR	
	BUSY	LL_I2C_IsActiveFlag_BUSY	
	DIR	LL_I2C_GetTransferDirection	
	NACKF	LL_I2C_IsActiveFlag_NACK	
	OVR	LL_I2C_IsActiveFlag_OVR	
	PECERR	LL_I2C_IsActiveSMBusFlag_PECERR	
	RXNE	LL_I2C_IsActiveFlag_RXNE	
	STOPF	LL_I2C_IsActiveFlag_STOP	

Register	Field	Function
	TC	LL_I2C_IsActiveFlag_TC
	TCR	LL_I2C_IsActiveFlag_TCR
	TIMEOUT	LL_I2C_IsActiveSMBusFlag_TIMEOUT
	TXE	LL_I2C_ClearFlag_TXE
		LL_I2C_IsActiveFlag_TXE
	TXIS	LL_I2C_IsActiveFlag_TXIS
OAR1	OA1	LL_I2C_SetOwnAddress1
	OA1EN	LL_I2C_DisableOwnAddress1
		LL_I2C_EnableOwnAddress1
		LL_I2C_IsEnabledOwnAddress1
OA1MODE	LL_I2C_SetOwnAddress1	
OAR2	OA2	LL_I2C_SetOwnAddress2
	OA2EN	LL_I2C_DisableOwnAddress2
		LL_I2C_EnableOwnAddress2
		LL_I2C_IsEnabledOwnAddress2
OA2MSK	LL_I2C_SetOwnAddress2	
PECR	PEC	LL_I2C_GetSMBusPEC
RXDR	RXDATA	LL_I2C_DMA_GetRegAddr
		LL_I2C_ReceiveData8
TIMEOUTR	TEXTEN	LL_I2C_DisableSMBusTimeout
		LL_I2C_EnableSMBusTimeout
		LL_I2C_IsEnabledSMBusTimeout
	TIDLE	LL_I2C_ConfigSMBusTimeout
		LL_I2C_GetSMBusTimeoutAMode
		LL_I2C_SetSMBusTimeoutAMode
	TIMEOUTA	LL_I2C_ConfigSMBusTimeout
		LL_I2C_GetSMBusTimeoutA
		LL_I2C_SetSMBusTimeoutA
	TIMEOUTB	LL_I2C_ConfigSMBusTimeout
		LL_I2C_GetSMBusTimeoutB
		LL_I2C_SetSMBusTimeoutB
TIMOUTEN	LL_I2C_DisableSMBusTimeout	
	LL_I2C_EnableSMBusTimeout	
	LL_I2C_IsEnabledSMBusTimeout	
TIMINGR	PRESC	LL_I2C_GetTimingPrescaler
	SCLDEL	LL_I2C_GetDataSetupTime

Register	Field	Function
	SCLH	LL_I2C_GetClockHighPeriod
	SCLL	LL_I2C_GetClockLowPeriod
	SDADEL	LL_I2C_GetDataHoldTime
	TIMINGR	LL_I2C_SetTiming
TXDR	TXDATA	LL_I2C_DMA_GetRegAddr
		LL_I2C_TransmitData8

94.11 I2S

Table 35: Correspondence between I2S registers and I2S low-layer driver functions

Register	Field	Function
CR2	ERRIE	LL_I2S_DisableIT_ERR
		LL_I2S_EnableIT_ERR
		LL_I2S_IsEnabledIT_ERR
	RXDMAEN	LL_I2S_DisableDMAReq_RX
		LL_I2S_EnableDMAReq_RX
		LL_I2S_IsEnabledDMAReq_RX
	RXNEIE	LL_I2S_DisableIT_RXNE
		LL_I2S_EnableIT_RXNE
		LL_I2S_IsEnabledIT_RXNE
	TXDMAEN	LL_I2S_DisableDMAReq_TX
		LL_I2S_EnableDMAReq_TX
		LL_I2S_IsEnabledDMAReq_TX
TXEIE	LL_I2S_DisableIT_TXE	
	LL_I2S_EnableIT_TXE	
	LL_I2S_IsEnabledIT_TXE	
DR	DR	LL_I2S_ReceiveData16
		LL_I2S_TransmitData16
I2SCFGR	ASTRTEN	LL_I2S_DisableAsyncStart
		LL_I2S_EnableAsyncStart
		LL_I2S_IsEnabledAsyncStart
	CHLEN	LL_I2S_GetDataFormat
		LL_I2S_SetDataFormat
	CKPOL	LL_I2S_GetClockPolarity
		LL_I2S_SetClockPolarity
	DATLEN	LL_I2S_GetDataFormat
LL_I2S_SetDataFormat		

Register	Field	Function
	I2SCFG	LL_I2S_GetTransferMode
		LL_I2S_SetTransferMode
	I2SE	LL_I2S_Disable
		LL_I2S_Enable
		LL_I2S_IsEnabled
	I2SMOD	LL_I2S_Enable
	I2SSTD	LL_I2S_GetStandard
		LL_I2S_SetStandard
	PCMSYNC	LL_I2S_GetStandard
		LL_I2S_SetStandard
I2SPR	I2SDIV	LL_I2S_GetPrescalerLinear
		LL_I2S_SetPrescalerLinear
	MCKOE	LL_I2S_DisableMasterClock
		LL_I2S_EnableMasterClock
		LL_I2S_IsEnabledMasterClock
	ODD	LL_I2S_GetPrescalerParity
LL_I2S_SetPrescalerParity		
SR	BSY	LL_I2S_IsActiveFlag_BSY
	CHSIDE	LL_I2S_IsActiveFlag_CHSIDE
	FRE	LL_I2S_ClearFlag_FRE
		LL_I2S_IsActiveFlag_FRE
	OVR	LL_I2S_ClearFlag_OVR
		LL_I2S_IsActiveFlag_OVR
	RXNE	LL_I2S_IsActiveFlag_RXNE
	TXE	LL_I2S_IsActiveFlag_TXE
UDR	LL_I2S_ClearFlag_UDR	
	LL_I2S_IsActiveFlag_UDR	

94.12 IWDG

Table 36: Correspondence between IWDG registers and IWDG low-layer driver functions

Register	Field	Function
KR	KEY	LL_IWDG_DisableWriteAccess
		LL_IWDG_Enable
		LL_IWDG_EnableWriteAccess
		LL_IWDG_ReloadCounter
PR	PR	LL_IWDG_GetPrescaler

Register	Field	Function
		LL_IWDG_SetPrescaler
RLR	RL	LL_IWDG_GetReloadCounter
		LL_IWDG_SetReloadCounter
SR	PVU	LL_IWDG_IsActiveFlag_PVU
		LL_IWDG_IsReady
	RVU	LL_IWDG_IsActiveFlag_RVU
		LL_IWDG_IsReady
	WVU	LL_IWDG_IsActiveFlag_WVU
		LL_IWDG_IsReady
WINR	WIN	LL_IWDG_GetWindow
		LL_IWDG_SetWindow

94.13 LPTIM

Table 37: Correspondence between LPTIM registers and LPTIM low-layer driver functions

Register	Field	Function
ARR	ARR	LL_LPTIM_GetAutoReload
		LL_LPTIM_SetAutoReload
CFGR	CKFLT	LL_LPTIM_ConfigClock
		LL_LPTIM_GetClockFilter
	CKPOL	LL_LPTIM_ConfigClock
		LL_LPTIM_GetClockPolarity
		LL_LPTIM_GetEncoderMode
		LL_LPTIM_SetEncoderMode
		LL_LPTIM_SetEncoderMode
	CKSEL	LL_LPTIM_GetClockSource
		LL_LPTIM_SetClockSource
	COUNTMODE	LL_LPTIM_GetCounterMode
		LL_LPTIM_SetCounterMode
	ENC	LL_LPTIM_DisableEncoderMode
		LL_LPTIM_EnableEncoderMode
		LL_LPTIM_IsEnabledEncoderMode
	PRELOAD	LL_LPTIM_GetUpdateMode
		LL_LPTIM_SetUpdateMode
	PRESC	LL_LPTIM_GetPrescaler
		LL_LPTIM_SetPrescaler
	TIMOUT	LL_LPTIM_DisableTimeout
		LL_LPTIM_EnableTimeout

Register	Field	Function	
	TRGFLT	LL_LPTIM_IsEnabledTimeout	
		LL_LPTIM_ConfigTrigger LL_LPTIM_GetTriggerFilter	
	TRIGEN	LL_LPTIM_ConfigTrigger LL_LPTIM_GetTriggerPolarity LL_LPTIM_TrigSw	
		LL_LPTIM_ConfigTrigger LL_LPTIM_GetTriggerSource	
		LL_LPTIM_ConfigOutput LL_LPTIM_GetWaveform LL_LPTIM_SetWaveform	
	WAVE	LL_LPTIM_ConfigOutput LL_LPTIM_GetPolarity LL_LPTIM_SetPolarity	
		LL_LPTIM_ConfigOutput LL_LPTIM_GetPolarity LL_LPTIM_SetPolarity	
		LL_LPTIM_GetCompare LL_LPTIM_SetCompare	
	CMP	CMP	LL_LPTIM_GetCompare LL_LPTIM_SetCompare
	CNT	CNT	LL_LPTIM_GetCounter
	CR	CNTSTRT	LL_LPTIM_StartCounter
		ENABLE	LL_LPTIM_Disable LL_LPTIM_Enable LL_LPTIM_IsEnabled
SNGSTRT			LL_LPTIM_StartCounter
ICR			ARRMCF
	ARROKCF	LL_LPTIM_ClearFlag_ARROK	
	CMPMCF	LL_LPTIM_ClearFLAG_CMPM	
	CMPOKCF	LL_LPTIM_ClearFlag_CMPOK	
	DOWNCF	LL_LPTIM_ClearFlag_DOWN	
	EXTTRIGCF	LL_LPTIM_ClearFlag_EXTTRIG	
	UPCF	LL_LPTIM_ClearFlag_UP	
IER	ARRMIE	LL_LPTIM_DisableIT_ARRM LL_LPTIM_EnableIT_ARRM LL_LPTIM_IsEnabledIT_ARRM	
		ARROKIE	LL_LPTIM_DisableIT_ARROK LL_LPTIM_EnableIT_ARROK LL_LPTIM_IsEnabledIT_ARROK
			CMPMIE

Register	Field	Function
		LL_LPTIM_EnableIT_CMPM
		LL_LPTIM_IsEnabledIT_CMPM
	CMPOKIE	LL_LPTIM_DisableIT_CMPOK
		LL_LPTIM_EnableIT_CMPOK
		LL_LPTIM_IsEnabledIT_CMPOK
	DOWNIE	LL_LPTIM_DisableIT_DOWN
		LL_LPTIM_EnableIT_DOWN
		LL_LPTIM_IsEnabledIT_DOWN
	EXTTRIGIE	LL_LPTIM_DisableIT_EXTTRIG
		LL_LPTIM_EnableIT_EXTTRIG
		LL_LPTIM_IsEnabledIT_EXTTRIG
	UPIE	LL_LPTIM_DisableIT_UP
		LL_LPTIM_EnableIT_UP
		LL_LPTIM_IsEnabledIT_UP
	ISR	ARRM
ARROK		LL_LPTIM_IsActiveFlag_ARROK
CMPM		LL_LPTIM_IsActiveFlag_CMPM
CMPOK		LL_LPTIM_IsActiveFlag_CMPOK
DOWN		LL_LPTIM_IsActiveFlag_DOWN
EXTTRIG		LL_LPTIM_IsActiveFlag_EXTTRIG
UP		LL_LPTIM_IsActiveFlag_UP

94.14 PWR

Table 38: Correspondence between PWR registers and PWR low-layer driver functions

Register	Field	Function
CR1	CSBF	LL_PWR_ClearFlag_SB
	DBP	LL_PWR_DisableBkUpAccess
		LL_PWR_EnableBkUpAccess
		LL_PWR_IsEnabledBkUpAccess
	FPDS	LL_PWR_DisableFlashPowerDown
		LL_PWR_EnableFlashPowerDown
		LL_PWR_GetPowerMode
		LL_PWR_IsEnabledFlashPowerDown
		LL_PWR_SetPowerMode
	LPDS	LL_PWR_GetPowerMode
		LL_PWR_GetRegulModeDS

Register	Field	Function
		LL_PWR_SetPowerMode
		LL_PWR_SetRegulModeDS
	LPUDS	LL_PWR_DisableLowPowerRegulatorDeepSleepUDMode
		LL_PWR_EnableLowPowerRegulatorDeepSleepUDMode
		LL_PWR_GetPowerMode
		LL_PWR_IsEnabledLowPowerRegulatorDeepSleepUDMode
		LL_PWR_SetPowerMode
	MRUDS	LL_PWR_DisableMainRegulatorDeepSleepUDMode
		LL_PWR_EnableMainRegulatorDeepSleepUDMode
		LL_PWR_GetPowerMode
		LL_PWR_IsEnabledMainRegulatorDeepSleepUDMode
		LL_PWR_SetPowerMode
	ODEN	LL_PWR_DisableOverDriveMode
		LL_PWR_EnableOverDriveMode
		LL_PWR_IsEnabledOverDriveMode
	ODSWEN	LL_PWR_DisableOverDriveSwitching
		LL_PWR_EnableOverDriveSwitching
		LL_PWR_IsEnabledOverDriveSwitching
	PDDS	LL_PWR_GetPowerMode
		LL_PWR_SetPowerMode
	PLS	LL_PWR_GetPVDLevel
		LL_PWR_SetPVDLevel
	PVDE	LL_PWR_DisablePVD
		LL_PWR_EnablePVD
		LL_PWR_IsEnabledPVD
	UDEN	LL_PWR_DisableUnderDriveMode
		LL_PWR_EnableUnderDriveMode
		LL_PWR_IsEnabledUnderDriveMode
	VOS	LL_PWR_GetRegulVoltageScaling
		LL_PWR_SetRegulVoltageScaling
CR2	CWUF1	LL_PWR_ClearFlag_WU1
	CWUF2	LL_PWR_ClearFlag_WU2
	CWUF3	LL_PWR_ClearFlag_WU3
	CWUF4	LL_PWR_ClearFlag_WU4
	CWUF5	LL_PWR_ClearFlag_WU5
	CWUF6	LL_PWR_ClearFlag_WU6

Register	Field	Function
	WUPP1	<i>LL_PWR_IsWakeUpPinPolarityLow</i>
		<i>LL_PWR_SetWakeUpPinPolarityHigh</i>
		<i>LL_PWR_SetWakeUpPinPolarityLow</i>
	WUPP2	<i>LL_PWR_IsWakeUpPinPolarityLow</i>
		<i>LL_PWR_SetWakeUpPinPolarityHigh</i>
		<i>LL_PWR_SetWakeUpPinPolarityLow</i>
	WUPP3	<i>LL_PWR_IsWakeUpPinPolarityLow</i>
		<i>LL_PWR_SetWakeUpPinPolarityHigh</i>
		<i>LL_PWR_SetWakeUpPinPolarityLow</i>
	WUPP4	<i>LL_PWR_IsWakeUpPinPolarityLow</i>
		<i>LL_PWR_SetWakeUpPinPolarityHigh</i>
		<i>LL_PWR_SetWakeUpPinPolarityLow</i>
	WUPP5	<i>LL_PWR_IsWakeUpPinPolarityLow</i>
		<i>LL_PWR_SetWakeUpPinPolarityHigh</i>
		<i>LL_PWR_SetWakeUpPinPolarityLow</i>
	WUPP6	<i>LL_PWR_IsWakeUpPinPolarityLow</i>
		<i>LL_PWR_SetWakeUpPinPolarityHigh</i>
		<i>LL_PWR_SetWakeUpPinPolarityLow</i>
CSR1	BRE	<i>LL_PWR_DisableBkUpRegulator</i>
		<i>LL_PWR_EnableBkUpRegulator</i>
		<i>LL_PWR_IsEnabledBkUpRegulator</i>
	BRR	<i>LL_PWR_IsActiveFlag_BRR</i>
	EIWUP	<i>LL_PWR_DisableInternalWakeUp</i>
		<i>LL_PWR_EnableInternalWakeUp</i>
		<i>LL_PWR_IsEnabledInternalWakeUp</i>
	ODRDY	<i>LL_PWR_IsActiveFlag_OD</i>
	ODSWRDY	<i>LL_PWR_IsActiveFlag_ODSW</i>
	PVDO	<i>LL_PWR_IsActiveFlag_PVDO</i>
	SBF	<i>LL_PWR_IsActiveFlag_SB</i>
UDRDY	<i>LL_PWR_ClearFlag_UD</i>	
	<i>LL_PWR_IsActiveFlag_UD</i>	
VOSRDY	<i>LL_PWR_IsActiveFlag_VOS</i>	
CSR2	EWUP1	<i>LL_PWR_DisableWakeUpPin</i>
		<i>LL_PWR_EnableWakeUpPin</i>
		<i>LL_PWR_IsEnabledWakeUpPin</i>
	EWUP2	<i>LL_PWR_DisableWakeUpPin</i>

Register	Field	Function	
		LL_PWR_EnableWakeUpPin	
		LL_PWR_IsEnabledWakeUpPin	
	EWUP3		LL_PWR_DisableWakeUpPin
			LL_PWR_EnableWakeUpPin
			LL_PWR_IsEnabledWakeUpPin
	EWUP4		LL_PWR_DisableWakeUpPin
			LL_PWR_EnableWakeUpPin
			LL_PWR_IsEnabledWakeUpPin
	EWUP5		LL_PWR_DisableWakeUpPin
			LL_PWR_EnableWakeUpPin
			LL_PWR_IsEnabledWakeUpPin
	EWUP6		LL_PWR_DisableWakeUpPin
			LL_PWR_EnableWakeUpPin
			LL_PWR_IsEnabledWakeUpPin
	WUPF1		LL_PWR_IsActiveFlag_WU1
	WUPF2		LL_PWR_IsActiveFlag_WU2
	WUPF3		LL_PWR_IsActiveFlag_WU3
	WUPF4		LL_PWR_IsActiveFlag_WU4
WUPF5		LL_PWR_IsActiveFlag_WU5	
WUPF6		LL_PWR_IsActiveFlag_WU6	

94.15 RCC

Table 39: Correspondence between RCC registers and RCC low-layer driver functions

Register	Field	Function	
BDCR	BDRST	LL_RCC_ForceBackupDomainReset	
		LL_RCC_ReleaseBackupDomainReset	
	LSEBYP		LL_RCC_LSE_DisableBypass
			LL_RCC_LSE_EnableBypass
	LSEDRV		LL_RCC_LSE_GetDriveCapability
			LL_RCC_LSE_SetDriveCapability
	LSEON		LL_RCC_LSE_Disable
			LL_RCC_LSE_Enable
	LSERDY		LL_RCC_LSE_IsReady
	RTCEN		LL_RCC_DisableRTC
			LL_RCC_EnableRTC
			LL_RCC_IsEnabledRTC

Register	Field	Function
	RTCSEL	LL_RCC_GetRTCClockSource
		LL_RCC_SetRTCClockSource
CFGR	HPRE	LL_RCC_GetAHBPrescaler
		LL_RCC_SetAHBPrescaler
	I2SSRC	LL_RCC_GetI2SClockSource
		LL_RCC_SetI2SClockSource
	MCO1	LL_RCC_ConfigMCO
	MCO1PRE	LL_RCC_ConfigMCO
	MCO2	LL_RCC_ConfigMCO
	MCO2PRE	LL_RCC_ConfigMCO
	PPRE1	LL_RCC_GetAPB1Prescaler
		LL_RCC_SetAPB1Prescaler
	PPRE2	LL_RCC_GetAPB2Prescaler
		LL_RCC_SetAPB2Prescaler
	RTCPRE	LL_RCC_GetRTC_HSEPrescaler
		LL_RCC_SetRTC_HSEPrescaler
SW	LL_RCC_SetSysClkSource	
SWS	LL_RCC_GetSysClkSource	
CIR	CSSC	LL_RCC_ClearFlag_HSECSS
	CSSF	LL_RCC_IsActiveFlag_HSECSS
	HSERDYC	LL_RCC_ClearFlag_HSERDY
	HSERDYF	LL_RCC_IsActiveFlag_HSERDY
	HSERDYIE	LL_RCC_DisableIT_HSERDY
		LL_RCC_EnableIT_HSERDY
		LL_RCC_IsEnabledIT_HSERDY
	HSIRDYC	LL_RCC_ClearFlag_HSIRDY
	HSIRDYF	LL_RCC_IsActiveFlag_HSIRDY
	HSIRDYIE	LL_RCC_DisableIT_HSIRDY
		LL_RCC_EnableIT_HSIRDY
		LL_RCC_IsEnabledIT_HSIRDY
	LSEYDYC	LL_RCC_ClearFlag_LSERDY
	LSEYDYF	LL_RCC_IsActiveFlag_LSERDY
	LSEYDYIE	LL_RCC_DisableIT_LSERDY
		LL_RCC_EnableIT_LSERDY
LL_RCC_IsEnabledIT_LSERDY		
LSIRDYC	LL_RCC_ClearFlag_LSIRDY	

Register	Field	Function
	LSIRDYF	LL_RCC_IsActiveFlag_LSIRDY
	LSIRDYIE	LL_RCC_DisableIT_LSIRDY
		LL_RCC_EnableIT_LSIRDY
		LL_RCC_IsEnabledIT_LSIRDY
	PLLI2SRDYC	LL_RCC_ClearFlag_PLLI2SRDY
	PLLI2SRDYF	LL_RCC_IsActiveFlag_PLLI2SRDY
	PLLI2SRDYIE	LL_RCC_DisableIT_PLLI2SRDY
		LL_RCC_EnableIT_PLLI2SRDY
		LL_RCC_IsEnabledIT_PLLI2SRDY
	PLLRDYC	LL_RCC_ClearFlag_PLLRDY
	PLLRDYF	LL_RCC_IsActiveFlag_PLLRDY
	PLLRDYIE	LL_RCC_DisableIT_PLLRDY
		LL_RCC_EnableIT_PLLRDY
		LL_RCC_IsEnabledIT_PLLRDY
	PLLSAIRDYC	LL_RCC_ClearFlag_PLLSAIRDY
PLLSAIRDYF	LL_RCC_IsActiveFlag_PLLSAIRDY	
PLLSAIRDYIE	LL_RCC_DisableIT_PLLSAIRDY	
	LL_RCC_EnableIT_PLLSAIRDY	
	LL_RCC_IsEnabledIT_PLLSAIRDY	
CR	CSSON	LL_RCC_HSE_EnableCSS
	HSEBYP	LL_RCC_HSE_DisableBypass
		LL_RCC_HSE_EnableBypass
	HSEON	LL_RCC_HSE_Disable
		LL_RCC_HSE_Enable
	HSERDY	LL_RCC_HSE_IsReady
	HSICAL	LL_RCC_HSI_GetCalibration
	HSION	LL_RCC_HSI_Disable
		LL_RCC_HSI_Enable
	HSIRDY	LL_RCC_HSI_IsReady
	HSITRIM	LL_RCC_HSI_GetCalibTrimming
		LL_RCC_HSI_SetCalibTrimming
PLLI2SON	LL_RCC_PLLI2S_Disable	
	LL_RCC_PLLI2S_Enable	
PLLI2SRDY	LL_RCC_PLLI2S_IsReady	
PLLON	LL_RCC_PLL_Disable	
	LL_RCC_PLL_Enable	

Register	Field	Function
	PLLRDY	LL_RCC_PLL_IsReady
	PLLSAION	LL_RCC_PLLSAI_Disable
		LL_RCC_PLLSAI_Enable
	PLLSAIRDY	LL_RCC_PLLSAI_IsReady
CSR	BORRSTF	LL_RCC_IsActiveFlag_BORRST
	IWDGRSTF	LL_RCC_IsActiveFlag_IWDGRST
	LPWRRSTF	LL_RCC_IsActiveFlag_LPWRRST
	LSION	LL_RCC_LSI_Disable
		LL_RCC_LSI_Enable
	LSIRDY	LL_RCC_LSI_IsReady
	PINRSTF	LL_RCC_IsActiveFlag_PINRST
	PORRSTF	LL_RCC_IsActiveFlag_PORRST
	RMVF	LL_RCC_ClearResetFlags
	SFTRSTF	LL_RCC_IsActiveFlag_SFTRST
WWDGRSTF	LL_RCC_IsActiveFlag_WWDGRST	
DCKCFGR1	ADFSDM1SEL	LL_RCC_GetDFSDMAudioClockSource
		LL_RCC_SetDFSDMAudioClockSource
	DFSDM1SEL	LL_RCC_GetDFSDMClockSource
		LL_RCC_SetDFSDMClockSource
	PLLI2SDIVQ	LL_RCC_PLLI2S_ConfigDomain_SAI
		LL_RCC_PLLI2S_GetDIVQ
	PLLSAIDIVQ	LL_RCC_PLLSAI_ConfigDomain_SAI
		LL_RCC_PLLSAI_GetDIVQ
	PLLSAIDIVR	LL_RCC_PLLSAI_ConfigDomain_LTDC
		LL_RCC_PLLSAI_GetDIVR
	SAI1SEL	LL_RCC_GetSAIClockSource
		LL_RCC_SetSAIClockSource
SAI2SEL	LL_RCC_GetSAIClockSource	
	LL_RCC_SetSAIClockSource	
TIMPRE	LL_RCC_GetTIMPrescaler	
	LL_RCC_SetTIMPrescaler	
DCKCFGR2	CECSEL	LL_RCC_GetCECClockSource
		LL_RCC_SetCECClockSource
	CK48MSEL	LL_RCC_GetCK48MClockSource
		LL_RCC_GetRNGClockSource
		LL_RCC_GetUSBClockSource

Register	Field	Function
		LL_RCC_SetCK48MClockSource
		LL_RCC_SetRNGClockSource
		LL_RCC_SetUSBClockSource
	DSISEL	LL_RCC_GetDSIClockSource
		LL_RCC_SetDSIClockSource
	I2C1SEL	LL_RCC_GetI2CClockSource
		LL_RCC_SetI2CClockSource
	I2C2SEL	LL_RCC_GetI2CClockSource
		LL_RCC_SetI2CClockSource
	I2C3SEL	LL_RCC_GetI2CClockSource
		LL_RCC_SetI2CClockSource
	I2C4SEL	LL_RCC_GetI2CClockSource
		LL_RCC_SetI2CClockSource
	LPTIM1SEL	LL_RCC_GetLPTIMClockSource
		LL_RCC_SetLPTIMClockSource
	SDMMC1SEL	LL_RCC_GetSDMMCClockSource
		LL_RCC_SetSDMMCClockSource
	SDMMC2SEL	LL_RCC_GetSDMMCClockSource
		LL_RCC_SetSDMMCClockSource
	UART4SEL	LL_RCC_GetUARTClockSource
		LL_RCC_SetUARTClockSource
	UART5SEL	LL_RCC_GetUARTClockSource
		LL_RCC_SetUARTClockSource
	UART7SEL	LL_RCC_GetUARTClockSource
		LL_RCC_SetUARTClockSource
	UART8SEL	LL_RCC_GetUARTClockSource
		LL_RCC_SetUARTClockSource
	USART1SEL	LL_RCC_GetUSARTClockSource
		LL_RCC_SetUSARTClockSource
	USART2SEL	LL_RCC_GetUSARTClockSource
LL_RCC_SetUSARTClockSource		
USART3SEL	LL_RCC_GetUSARTClockSource	
	LL_RCC_SetUSARTClockSource	
USART6SEL	LL_RCC_GetUSARTClockSource	
	LL_RCC_SetUSARTClockSource	
PLLCFGR	PLLM	LL_RCC_PLLI2S_ConfigDomain_I2S

Register	Field	Function
		LL_RCC_PLLI2S_ConfigDomain_SAI
		LL_RCC_PLLI2S_ConfigDomain_SPDIFRX
		LL_RCC_PLLSAI_ConfigDomain_48M
		LL_RCC_PLLSAI_ConfigDomain_LTDC
		LL_RCC_PLLSAI_ConfigDomain_SAI
		LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_ConfigDomain_DSI
		LL_RCC_PLL_ConfigDomain_SYS
		LL_RCC_PLL_GetDivider
	PLLN	LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_ConfigDomain_DSI
		LL_RCC_PLL_ConfigDomain_SYS
		LL_RCC_PLL_GetN
	PLLQ	LL_RCC_PLL_ConfigDomain_SYS
		LL_RCC_PLL_GetP
	PLLQ	LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_GetQ
	PLLQ	LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_GetQ
	PLLQ	LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_GetQ
	PLLQ	LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_GetQ
	PLLQ	LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_GetQ
	PLLQ	LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_GetQ
	PLLQ	LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_GetQ
	PLLQ	LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_GetQ
PLLQ	LL_RCC_PLL_ConfigDomain_48M	
	LL_RCC_PLL_GetQ	
PLLQ	PLLQ	LL_RCC_PLL_ConfigDomain_DSI
		LL_RCC_PLL_GetR
		LL_RCC_PLLI2S_ConfigDomain_I2S
		LL_RCC_PLLI2S_ConfigDomain_SAI
		LL_RCC_PLLI2S_ConfigDomain_SPDIFRX
		LL_RCC_PLLSAI_ConfigDomain_48M
		LL_RCC_PLLSAI_ConfigDomain_LTDC
		LL_RCC_PLLSAI_ConfigDomain_SAI
		LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_ConfigDomain_DSI
LL_RCC_PLL_ConfigDomain_SYS		
LL_RCC_PLL_GetMainSource		
PLLQ	PLLQ	LL_RCC_PLLI2S_ConfigDomain_I2S
		LL_RCC_PLLI2S_ConfigDomain_SAI
		LL_RCC_PLLI2S_ConfigDomain_SPDIFRX
		LL_RCC_PLLI2S_GetN
	PLLQ	LL_RCC_PLLI2S_ConfigDomain_SPDIFRX
		LL_RCC_PLLI2S_GetP
		LL_RCC_PLLI2S_ConfigDomain_SAI
	PLLQ	LL_RCC_PLLI2S_ConfigDomain_I2S
		LL_RCC_PLLI2S_ConfigDomain_SAI
		LL_RCC_PLLI2S_ConfigDomain_SPDIFRX
		LL_RCC_PLLI2S_GetN
PLLQ	LL_RCC_PLLI2S_ConfigDomain_SPDIFRX	
	LL_RCC_PLLI2S_GetP	
	LL_RCC_PLLI2S_ConfigDomain_SAI	
PLLQ	LL_RCC_PLLI2S_ConfigDomain_I2S	
	LL_RCC_PLLI2S_ConfigDomain_SAI	
	LL_RCC_PLLI2S_ConfigDomain_SPDIFRX	



Register	Field	Function
	PLLI2SR	LL_RCC_PLLI2S_GetQ
		LL_RCC_PLLI2S_ConfigDomain_I2S
		LL_RCC_PLLI2S_GetR
PLLSAICFGR	PLLSAIN	LL_RCC_PLLSAI_ConfigDomain_48M
		LL_RCC_PLLSAI_ConfigDomain_LTDC
		LL_RCC_PLLSAI_ConfigDomain_SAI
		LL_RCC_PLLSAI_GetN
	PLLSAIP	LL_RCC_PLLSAI_ConfigDomain_48M
		LL_RCC_PLLSAI_GetP
	PLLSAIQ	LL_RCC_PLLSAI_ConfigDomain_SAI
		LL_RCC_PLLSAI_GetQ
	PLLSAIR	LL_RCC_PLLSAI_ConfigDomain_LTDC
		LL_RCC_PLLSAI_GetR
SSCGR	INCSTEP	LL_RCC_PLL_ConfigSpreadSpectrum
		LL_RCC_PLL_GetStepIncrementation
	MODPER	LL_RCC_PLL_ConfigSpreadSpectrum
		LL_RCC_PLL_GetPeriodModulation
	SPREADSEL	LL_RCC_PLL_ConfigSpreadSpectrum
		LL_RCC_PLL_GetSpreadSelection
	SSCGEN	LL_RCC_PLL_SpreadSpectrum_Disable
		LL_RCC_PLL_SpreadSpectrum_Enable

94.16 RNG

Table 40: Correspondence between RNG registers and RNG low-layer driver functions

Register	Field	Function
CR	IE	LL_RNG_DisableIT
		LL_RNG_EnableIT
		LL_RNG_IsEnabledIT
	RNGEN	LL_RNG_Disable
		LL_RNG_Enable
		LL_RNG_IsEnabled
DR	RNDATA	LL_RNG_ReadRandData32
SR	CECS	LL_RNG_IsActiveFlag_CECS
	CEIS	LL_RNG_ClearFlag_CEIS
		LL_RNG_IsActiveFlag_CEIS
	DRDY	LL_RNG_IsActiveFlag_DRDY

Register	Field	Function
	SECS	LL_RNG_IsActiveFlag_SECS
	SEIS	LL_RNG_ClearFlag_SEIS
		LL_RNG_IsActiveFlag_SEIS

94.17 RTC

Table 41: Correspondence between RTC registers and RTC low-layer driver functions

Register	Field	Function
ALRMAR	DT	LL_RTC_ALMA_GetDay
		LL_RTC_ALMA_SetDay
	DU	LL_RTC_ALMA_GetDay
		LL_RTC_ALMA_GetWeekDay
		LL_RTC_ALMA_SetWeekDay
	HT	LL_RTC_ALMA_SetDay
		LL_RTC_ALMA_ConfigTime
		LL_RTC_ALMA_GetHour
	HU	LL_RTC_ALMA_GetTime
		LL_RTC_ALMA_SetHour
		LL_RTC_ALMA_ConfigTime
		LL_RTC_ALMA_GetHour
	MNT	LL_RTC_ALMA_GetTime
		LL_RTC_ALMA_SetHour
		LL_RTC_ALMA_ConfigTime
		LL_RTC_ALMA_GetMinute
	MNU	LL_RTC_ALMA_GetTime
		LL_RTC_ALMA_SetMinute
		LL_RTC_ALMA_ConfigTime
		LL_RTC_ALMA_GetMinute
	MSK1	LL_RTC_ALMA_GetTime
		LL_RTC_ALMA_SetMinute
	MSK2	LL_RTC_ALMA_GetMask
		LL_RTC_ALMA_SetMask
	MSK3	LL_RTC_ALMA_GetMask
		LL_RTC_ALMA_SetMask
	MSK4	LL_RTC_ALMA_GetMask

Register	Field	Function
	PM	LL_RTC_ALMA_SetMask
		LL_RTC_ALMA_ConfigTime
		LL_RTC_ALMA_GetTimeFormat
		LL_RTC_ALMA_SetTimeFormat
	ST	LL_RTC_ALMA_ConfigTime
		LL_RTC_ALMA_GetSecond
		LL_RTC_ALMA_GetTime
		LL_RTC_ALMA_SetSecond
	SU	LL_RTC_ALMA_ConfigTime
		LL_RTC_ALMA_GetSecond
		LL_RTC_ALMA_GetTime
		LL_RTC_ALMA_SetSecond
	WDSEL	LL_RTC_ALMA_DisableWeekday
		LL_RTC_ALMA_EnableWeekday
	ALRMASRR	MASKSS
LL_RTC_ALMA_SetSubSecondMask		
SS		LL_RTC_ALMA_GetSubSecond
		LL_RTC_ALMA_SetSubSecond
ALRMBR	DT	LL_RTC_ALMB_GetDay
		LL_RTC_ALMB_SetDay
	DU	LL_RTC_ALMB_GetDay
		LL_RTC_ALMB_GetWeekDay
		LL_RTC_ALMB_SetDay
		LL_RTC_ALMB_SetWeekDay
	HT	LL_RTC_ALMB_ConfigTime
		LL_RTC_ALMB_GetHour
		LL_RTC_ALMB_GetTime
	HU	LL_RTC_ALMB_SetHour
		LL_RTC_ALMB_ConfigTime
		LL_RTC_ALMB_GetHour
		LL_RTC_ALMB_GetTime
	MNT	LL_RTC_ALMB_SetHour
		LL_RTC_ALMB_ConfigTime
		LL_RTC_ALMB_GetMinute
LL_RTC_ALMB_GetTime		
		LL_RTC_ALMB_SetMinute

Register	Field	Function
	MNU	LL_RTC_ALMB_ConfigTime
		LL_RTC_ALMB_GetMinute
		LL_RTC_ALMB_GetTime
		LL_RTC_ALMB_SetMinute
	MSK1	LL_RTC_ALMB_GetMask
		LL_RTC_ALMB_SetMask
	MSK2	LL_RTC_ALMB_GetMask
		LL_RTC_ALMB_SetMask
	MSK3	LL_RTC_ALMB_GetMask
		LL_RTC_ALMB_SetMask
	MSK4	LL_RTC_ALMB_GetMask
		LL_RTC_ALMB_SetMask
	PM	LL_RTC_ALMB_ConfigTime
		LL_RTC_ALMB_GetTimeFormat
		LL_RTC_ALMB_SetTimeFormat
	ST	LL_RTC_ALMB_ConfigTime
		LL_RTC_ALMB_GetSecond
		LL_RTC_ALMB_GetTime
		LL_RTC_ALMB_SetSecond
	SU	LL_RTC_ALMB_ConfigTime
LL_RTC_ALMB_GetSecond		
LL_RTC_ALMB_GetTime		
LL_RTC_ALMB_SetSecond		
WDSEL	LL_RTC_ALMB_DisableWeekday	
	LL_RTC_ALMB_EnableWeekday	
ALRMBSSR	MASKSS	LL_RTC_ALMB_GetSubSecondMask
		LL_RTC_ALMB_SetSubSecondMask
	SS	LL_RTC_ALMB_GetSubSecond
		LL_RTC_ALMB_SetSubSecond
BKPxR	BKP	LL_RTC_BAK_GetRegister
		LL_RTC_BAK_SetRegister
CALR	CALM	LL_RTC_CAL_GetMinus
		LL_RTC_CAL_SetMinus
	CALP	LL_RTC_CAL_IsPulseInserted
		LL_RTC_CAL_SetPulse
	CALW16	LL_RTC_CAL_GetPeriod

Register	Field	Function
		LL_RTC_CAL_SetPeriod
	CALW8	LL_RTC_CAL_GetPeriod
		LL_RTC_CAL_SetPeriod
CR	ADD1H	LL_RTC_TIME_IncHour
	ALRAE	LL_RTC_ALMA_Disable
		LL_RTC_ALMA_Enable
	ALRAIE	LL_RTC_DisableIT_ALRA
		LL_RTC_EnableIT_ALRA
		LL_RTC_IsEnabledIT_ALRA
	ALRBE	LL_RTC_ALMB_Disable
		LL_RTC_ALMB_Enable
	ALRBIE	LL_RTC_DisableIT_ALRB
		LL_RTC_EnableIT_ALRB
		LL_RTC_IsEnabledIT_ALRB
	BKP	LL_RTC_TIME_DisableDayLightStore
		LL_RTC_TIME_EnableDayLightStore
		LL_RTC_TIME_IsDayLightStoreEnabled
	BYPHAD	LL_RTC_DisableShadowRegBypass
		LL_RTC_EnableShadowRegBypass
		LL_RTC_IsShadowRegBypassEnabled
	COE	LL_RTC_CAL_GetOutputFreq
		LL_RTC_CAL_SetOutputFreq
	COSEL	LL_RTC_CAL_GetOutputFreq
		LL_RTC_CAL_SetOutputFreq
	FMT	LL_RTC_GetHourFormat
		LL_RTC_SetHourFormat
	ITSE	LL_RTC_TS_DisableInternalEvent
		LL_RTC_TS_EnableInternalEvent
	OSEL	LL_RTC_GetAlarmOutEvent
		LL_RTC_SetAlarmOutEvent
	POL	LL_RTC_GetOutputPolarity
		LL_RTC_SetOutputPolarity
	REFCKON	LL_RTC_DisableRefClock
LL_RTC_EnableRefClock		
SUB1H	LL_RTC_TIME_DecHour	
TSE	LL_RTC_TS_Disable	

Register	Field	Function	
	TSEDGE	LL_RTC_TS_Enable	
		LL_RTC_TS_GetActiveEdge	
	TSIE	LL_RTC_TS_SetActiveEdge	
		LL_RTC_DisableIT_TS	
		LL_RTC_EnableIT_TS	
	WUCKSEL	LL_RTC_IsEnabledIT_TS	
		LL_RTC_WAKEUP_GetClock	
	WUTE	LL_RTC_WAKEUP_SetClock	
		LL_RTC_WAKEUP_Disable	
		LL_RTC_WAKEUP_Enable	
	WUTIE	LL_RTC_WAKEUP_IsEnabled	
		LL_RTC_DisableIT_WUT	
		LL_RTC_EnableIT_WUT	
	DR	DT	LL_RTC_IsEnabledIT_WUT
			LL_RTC_DATE_Config
			LL_RTC_DATE_Get
			LL_RTC_DATE_GetDay
		DU	LL_RTC_DATE_SetDay
LL_RTC_DATE_Config			
LL_RTC_DATE_Get			
LL_RTC_DATE_GetDay			
MT		LL_RTC_DATE_SetDay	
		LL_RTC_DATE_Config	
		LL_RTC_DATE_Get	
		LL_RTC_DATE_GetMonth	
MU		LL_RTC_DATE_SetMonth	
		LL_RTC_DATE_Config	
		LL_RTC_DATE_Get	
		LL_RTC_DATE_GetMonth	
WDU		LL_RTC_DATE_SetMonth	
		LL_RTC_DATE_Config	
		LL_RTC_DATE_Get	
		LL_RTC_DATE_GetWeekDay	
YT		LL_RTC_DATE_SetWeekDay	
		LL_RTC_DATE_Config	
			LL_RTC_DATE_Get

Register	Field	Function
	YU	LL_RTC_DATE_GetYear
		LL_RTC_DATE_SetYear
		LL_RTC_DATE_Config
		LL_RTC_DATE_Get
		LL_RTC_DATE_GetYear
		LL_RTC_DATE_SetYear
ISR	ALRAF	LL_RTC_ClearFlag_ALRA
		LL_RTC_IsActiveFlag_ALRA
	ALRAWF	LL_RTC_IsActiveFlag_ALRAW
	ALRBF	LL_RTC_ClearFlag_ALRB
		LL_RTC_IsActiveFlag_ALRB
	ALRBWF	LL_RTC_IsActiveFlag_ALRBW
	INIT	LL_RTC_DisableInitMode
		LL_RTC_EnableInitMode
	INITF	LL_RTC_IsActiveFlag_INIT
	INITS	LL_RTC_IsActiveFlag_INITS
	ITSF	LL_RTC_ClearFlag_ITS
		LL_RTC_IsActiveFlag_ITS
	RECALPF	LL_RTC_IsActiveFlag_RECALP
	RSF	LL_RTC_ClearFlag_RS
		LL_RTC_IsActiveFlag_RS
	SHPF	LL_RTC_IsActiveFlag_SHP
	TAMP1F	LL_RTC_ClearFlag_TAMP1
		LL_RTC_IsActiveFlag_TAMP1
	TAMP2F	LL_RTC_ClearFlag_TAMP2
		LL_RTC_IsActiveFlag_TAMP2
	TAMP3F	LL_RTC_ClearFlag_TAMP3
		LL_RTC_IsActiveFlag_TAMP3
	TSF	LL_RTC_ClearFlag_TS
		LL_RTC_IsActiveFlag_TS
	TSOVF	LL_RTC_ClearFlag_TSOV
		LL_RTC_IsActiveFlag_TSOV
	WUTF	LL_RTC_ClearFlag_WUT
		LL_RTC_IsActiveFlag_WUT
WUTWF	LL_RTC_IsActiveFlag_WUTW	
OR	ALARMOUTTYPE	LL_RTC_GetAlarmOutputType

Register	Field	Function
		LL_RTC_SetAlarmOutputType
PRER	PREDIV_A	LL_RTC_GetAsynchPrescaler
		LL_RTC_SetAsynchPrescaler
	PREDIV_S	LL_RTC_GetSynchPrescaler
		LL_RTC_SetSynchPrescaler
SHIFTR	ADD1S	LL_RTC_TIME_Synchronize
	SUBFS	LL_RTC_TIME_Synchronize
SSR	SS	LL_RTC_TIME_GetSubSecond
TAMPCR	TAMP1E	LL_RTC_TAMPER_Disable
		LL_RTC_TAMPER_Enable
	TAMP1IE	LL_RTC_DisableIT_TAMP1
		LL_RTC_EnableIT_TAMP1
		LL_RTC_IsEnabledIT_TAMP1
	TAMP1MF	LL_RTC_TAMPER_DisableMask
		LL_RTC_TAMPER_EnableMask
	TAMP1NOERASE	LL_RTC_TAMPER_DisableEraseBKP
		LL_RTC_TAMPER_EnableEraseBKP
	TAMP1TRG	LL_RTC_TAMPER_DisableActiveLevel
		LL_RTC_TAMPER_EnableActiveLevel
	TAMP2E	LL_RTC_TAMPER_Disable
		LL_RTC_TAMPER_Enable
	TAMP2IE	LL_RTC_DisableIT_TAMP2
		LL_RTC_EnableIT_TAMP2
		LL_RTC_IsEnabledIT_TAMP2
	TAMP2MF	LL_RTC_TAMPER_DisableMask
		LL_RTC_TAMPER_EnableMask
	TAMP2NOERASE	LL_RTC_TAMPER_DisableEraseBKP
		LL_RTC_TAMPER_EnableEraseBKP
	TAMP2TRG	LL_RTC_TAMPER_DisableActiveLevel
		LL_RTC_TAMPER_EnableActiveLevel
	TAMP3E	LL_RTC_TAMPER_Disable
		LL_RTC_TAMPER_Enable
TAMP3IE	LL_RTC_DisableIT_TAMP3	
	LL_RTC_EnableIT_TAMP3	
	LL_RTC_IsEnabledIT_TAMP3	
TAMP3MF	LL_RTC_TAMPER_DisableMask	

Register	Field	Function	
	TAMP3NOERASE	LL_RTC_TAMPER_EnableMask	
		LL_RTC_TAMPER_DisableEraseBKP	
	TAMP3TRG	LL_RTC_TAMPER_EnableEraseBKP	
		LL_RTC_TAMPER_DisableActiveLevel	
	TAMPFLT	LL_RTC_TAMPER_EnableActiveLevel	
		LL_RTC_TAMPER_GetFilterCount	
	TAMPFREQ	LL_RTC_TAMPER_SetFilterCount	
		LL_RTC_TAMPER_GetSamplingFreq	
	TAMPIE	LL_RTC_TAMPER_SetSamplingFreq	
		LL_RTC_DisableIT_TAMP	
		LL_RTC_EnableIT_TAMP	
	TAMPPRCH	LL_RTC_IsEnabledIT_TAMP	
		LL_RTC_TAMPER_GetPrecharge	
	TAMPPUDIS	LL_RTC_TAMPER_SetPrecharge	
		LL_RTC_TAMPER_DisablePullUp	
	TAMPTS	LL_RTC_TAMPER_EnablePullUp	
LL_RTC_TS_DisableOnTamper			
TR	HT	LL_RTC_TS_EnableOnTamper	
		LL_RTC_TIME_Config	
		LL_RTC_TIME_Get	
		LL_RTC_TIME_GetHour	
	HU	LL_RTC_TIME_SetHour	
		LL_RTC_TIME_Config	
		LL_RTC_TIME_Get	
		LL_RTC_TIME_GetHour	
	MNT	LL_RTC_TIME_SetHour	
		LL_RTC_TIME_Config	
		LL_RTC_TIME_Get	
		LL_RTC_TIME_GetMinute	
	MNU	LL_RTC_TIME_SetMinute	
		LL_RTC_TIME_Config	
		LL_RTC_TIME_Get	
		LL_RTC_TIME_GetMinute	
	PM	LL_RTC_TIME_SetMinute	
		LL_RTC_TIME_Config	
			LL_RTC_TIME_GetFormat

Register	Field	Function
	ST	LL_RTC_TIME_SetFormat
		LL_RTC_TIME_Config
		LL_RTC_TIME_Get
		LL_RTC_TIME_GetSecond
		LL_RTC_TIME_SetSecond
	SU	LL_RTC_TIME_Config
		LL_RTC_TIME_Get
		LL_RTC_TIME_SetSecond
TSDR	DT	LL_RTC_TS_GetDate
		LL_RTC_TS_GetDay
	DU	LL_RTC_TS_GetDate
		LL_RTC_TS_GetDay
	MT	LL_RTC_TS_GetDate
		LL_RTC_TS_GetMonth
	MU	LL_RTC_TS_GetDate
		LL_RTC_TS_GetMonth
WDU	LL_RTC_TS_GetDate	
	LL_RTC_TS_GetWeekDay	
TSSSR	SS	LL_RTC_TS_GetSubSecond
TSTR	HT	LL_RTC_TS_GetHour
		LL_RTC_TS_GetTime
	HU	LL_RTC_TS_GetHour
		LL_RTC_TS_GetTime
	MNT	LL_RTC_TS_GetMinute
		LL_RTC_TS_GetTime
	MNU	LL_RTC_TS_GetMinute
		LL_RTC_TS_GetTime
	PM	LL_RTC_TS_GetTimeFormat
	ST	LL_RTC_TS_GetSecond
LL_RTC_TS_GetTime		
SU	LL_RTC_TS_GetSecond	
	LL_RTC_TS_GetTime	
WPR	KEY	LL_RTC_DisableWriteProtection
		LL_RTC_EnableWriteProtection
WUTR	WUT	LL_RTC_WAKEUP_GetAutoReload

Register	Field	Function
		LL_RTC_WAKEUP_SetAutoReload

94.18 SPI

Table 42: Correspondence between SPI registers and SPI low-layer driver functions

Register	Field	Function
CR1	BIDIMODE	LL_SPI_GetTransferDirection
		LL_SPI_SetTransferDirection
	BIDIOE	LL_SPI_GetTransferDirection
		LL_SPI_SetTransferDirection
	BR	LL_SPI_GetBaudRatePrescaler
		LL_SPI_SetBaudRatePrescaler
	CPHA	LL_SPI_GetClockPhase
		LL_SPI_SetClockPhase
	CPOL	LL_SPI_GetClockPolarity
		LL_SPI_SetClockPolarity
	CRCEN	LL_SPI_DisableCRC
		LL_SPI_EnableCRC
		LL_SPI_IsEnabledCRC
	CRCL	LL_SPI_GetCRCWidth
		LL_SPI_SetCRCWidth
	CRCNEXT	LL_SPI_SetCRCNext
	LSBFIRST	LL_SPI_GetTransferBitOrder
		LL_SPI_SetTransferBitOrder
	MSTR	LL_SPI_GetMode
		LL_SPI_SetMode
	RXONLY	LL_SPI_GetTransferDirection
		LL_SPI_SetTransferDirection
	SPE	LL_SPI_Disable
		LL_SPI_Enable
LL_SPI_IsEnabled		
SSI	LL_SPI_GetMode	
	LL_SPI_SetMode	
SSM	LL_SPI_GetNSSMode	
	LL_SPI_SetNSSMode	
CR2	DS	LL_SPI_GetDataWidth
		LL_SPI_SetDataWidth

Register	Field	Function
	ERRIE	<i>LL_SPI_DisableIT_ERR</i>
		<i>LL_SPI_EnableIT_ERR</i>
		<i>LL_SPI_IsEnabledIT_ERR</i>
	FRF	<i>LL_SPI_GetStandard</i>
		<i>LL_SPI_SetStandard</i>
	FRXTH	<i>LL_SPI_GetRxFIFOThreshold</i>
		<i>LL_SPI_SetRxFIFOThreshold</i>
	LDMARX	<i>LL_SPI_GetDMAParity_RX</i>
		<i>LL_SPI_SetDMAParity_RX</i>
	LDMATX	<i>LL_SPI_GetDMAParity_TX</i>
		<i>LL_SPI_SetDMAParity_TX</i>
	NSSP	<i>LL_SPI_DisableNSSPulseMgt</i>
		<i>LL_SPI_EnableNSSPulseMgt</i>
		<i>LL_SPI_IsEnabledNSSPulse</i>
	RXDMAEN	<i>LL_SPI_DisableDMAReq_RX</i>
		<i>LL_SPI_EnableDMAReq_RX</i>
		<i>LL_SPI_IsEnabledDMAReq_RX</i>
	RXNEIE	<i>LL_SPI_DisableIT_RXNE</i>
		<i>LL_SPI_EnableIT_RXNE</i>
		<i>LL_SPI_IsEnabledIT_RXNE</i>
	SSOE	<i>LL_SPI_GetNSSMode</i>
		<i>LL_SPI_SetNSSMode</i>
	TXDMAEN	<i>LL_SPI_DisableDMAReq_TX</i>
		<i>LL_SPI_EnableDMAReq_TX</i>
<i>LL_SPI_IsEnabledDMAReq_TX</i>		
TXEIE	<i>LL_SPI_DisableIT_TXE</i>	
	<i>LL_SPI_EnableIT_TXE</i>	
	<i>LL_SPI_IsEnabledIT_TXE</i>	
CRCPR	CRCPOLY	<i>LL_SPI_GetCRCPolynomial</i>
		<i>LL_SPI_SetCRCPolynomial</i>
DR	DR	<i>LL_SPI_DMA_GetRegAddr</i>
		<i>LL_SPI_ReceiveData16</i>
		<i>LL_SPI_ReceiveData8</i>
		<i>LL_SPI_TransmitData16</i>
		<i>LL_SPI_TransmitData8</i>
RXCRCR	RXCRC	<i>LL_SPI_GetRxCRC</i>

Register	Field	Function
SR	BSY	LL_SPI_IsActiveFlag_BSY
	CRCERR	LL_SPI_ClearFlag_CRCERR
		LL_SPI_IsActiveFlag_CRCERR
	FRE	LL_SPI_ClearFlag_FRE
		LL_SPI_IsActiveFlag_FRE
	FRLVL	LL_SPI_GetRxFIFOLevel
	FTLVL	LL_SPI_GetTxFIFOLevel
	MODF	LL_SPI_ClearFlag_MODF
		LL_SPI_IsActiveFlag_MODF
	OVR	LL_SPI_ClearFlag_OVR
LL_SPI_IsActiveFlag_OVR		
RXNE	LL_SPI_IsActiveFlag_RXNE	
TXE	LL_SPI_IsActiveFlag_TXE	
TXCRCR	TXCRC	LL_SPI_GetTxCRC

94.19 SYSTEM

Table 43: Correspondence between SYSTEM registers and SYSTEM low-layer driver functions

Register	Field	Function
DBGMCU_APB1_FZ	DBG_CAN1_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_CAN2_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_CAN3_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_I2C1_SMBUS_TIMEOUT	LL_DBGMCU_APB1_GRP1_FreezePeriph
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_I2C2_SMBUS_TIMEOUT	LL_DBGMCU_APB1_GRP1_FreezePeriph
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_I2C3_SMBUS_TIMEOUT	LL_DBGMCU_APB1_GRP1_FreezePeriph
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_I2C4_SMBUS_TIMEOUT	LL_DBGMCU_APB1_GRP1_FreezePeriph

Register	Field	Function
	T	LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_IWDG_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_LPTIM1_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_RTC_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM12_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM13_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM14_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM2_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM3_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM4_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM5_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM6_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM7_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_WWDG_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph LL_DBGMCU_APB1_GRP1_UnFreezePeriph

Register	Field	Function	
DBGMCU_APB2_FZ	DBG_TIM10_STOP	LL_DBGMCU_APB2_GRP1_FreezePeriph	
		LL_DBGMCU_APB2_GRP1_UnFreezePeriph	
	DBG_TIM11_STOP	LL_DBGMCU_APB2_GRP1_FreezePeriph	
		LL_DBGMCU_APB2_GRP1_UnFreezePeriph	
	DBG_TIM1_STOP	LL_DBGMCU_APB2_GRP1_FreezePeriph	
		LL_DBGMCU_APB2_GRP1_UnFreezePeriph	
	DBG_TIM8_STOP	LL_DBGMCU_APB2_GRP1_FreezePeriph	
		LL_DBGMCU_APB2_GRP1_UnFreezePeriph	
	DBG_TIM9_STOP	LL_DBGMCU_APB2_GRP1_FreezePeriph	
		LL_DBGMCU_APB2_GRP1_UnFreezePeriph	
	DBGMCU_CR	DBG_SLEEP	LL_DBGMCU_DisableDBGSleepMode
			LL_DBGMCU_EnableDBGSleepMode
DBG_STANDBY		LL_DBGMCU_DisableDBGStandbyMode	
		LL_DBGMCU_EnableDBGStandbyMode	
DBG_STOP		LL_DBGMCU_DisableDBGStopMode	
		LL_DBGMCU_EnableDBGStopMode	
TRACE_IOEN		LL_DBGMCU_GetTracePinAssignment	
		LL_DBGMCU_SetTracePinAssignment	
TRACE_MODE		LL_DBGMCU_GetTracePinAssignment	
		LL_DBGMCU_SetTracePinAssignment	
DBGMCU_IDCODE	DEV_ID	LL_DBGMCU_GetDeviceID	
	REV_ID	LL_DBGMCU_GetRevisionID	
FLASH_ACR	ARTEN	LL_FLASH_DisableART	
		LL_FLASH_EnableART	
	ARTRST	LL_FLASH_DisableARTReset	
		LL_FLASH_EnableARTReset	
	LATENCY	LL_FLASH_GetLatency	
		LL_FLASH_SetLatency	
	PRFTEN	LL_FLASH_DisablePrefetch	
		LL_FLASH_EnablePrefetch	
LL_FLASH_IsPrefetchEnabled			
SYSCFG_CMPCR	CMP_PD	LL_SYSCFG_DisableCompensationCell	
		LL_SYSCFG_EnableCompensationCell	

Register	Field	Function
	READY	LL_SYSCFG_IsActiveFlag_CMPCR
SYSCFG_EXTICR1	EXTIx	LL_SYSCFG_GetEXTISource
		LL_SYSCFG_SetEXTISource
SYSCFG_EXTICR2	EXTIx	LL_SYSCFG_GetEXTISource
		LL_SYSCFG_SetEXTISource
SYSCFG_EXTICR3	EXTIx	LL_SYSCFG_GetEXTISource
		LL_SYSCFG_SetEXTISource
SYSCFG_EXTICR4	EXTIx	LL_SYSCFG_GetEXTISource
		LL_SYSCFG_SetEXTISource
SYSCFG_MEMRMP	FB_MODE	LL_SYSCFG_GetFlashBankMode
		LL_SYSCFG_SetFlashBankMode
	MEM_BOOT	LL_SYSCFG_GetRemapMemoryBoot
	SWP_FMC	LL_SYSCFG_DisableFMCMemorySwapping
LL_SYSCFG_EnableFMCMemorySwapping		
SYSCFG_PMC	I2C_PbX_FMP	LL_SYSCFG_DisableFastModePlus
		LL_SYSCFG_EnableFastModePlus
	I2Cx_FMP	LL_SYSCFG_DisableFastModePlus
		LL_SYSCFG_EnableFastModePlus
	MII_RMII_SEL	LL_SYSCFG_GetPHYInterface
		LL_SYSCFG_SetPHYInterface

94.20 TIM

Table 44: Correspondence between TIM registers and TIM low-layer driver functions

Register	Field	Function
AF1	BKDFBKE	LL_TIM_DisableBreakInputSource
		LL_TIM_EnableBreakInputSource
		LL_TIM_SetBreakInputSourcePolarity
	BKINE	LL_TIM_DisableBreakInputSource
		LL_TIM_EnableBreakInputSource
		LL_TIM_SetBreakInputSourcePolarity
AF2	BK2DFBKE	LL_TIM_DisableBreakInputSource
		LL_TIM_EnableBreakInputSource
		LL_TIM_SetBreakInputSourcePolarity
	BK2INE	LL_TIM_DisableBreakInputSource
		LL_TIM_EnableBreakInputSource

Register	Field	Function
		LL_TIM_SetBreakInputSourcePolarity
ARR	ARR	LL_TIM_GetAutoReload
		LL_TIM_SetAutoReload
BDTR	AOE	LL_TIM_DisableAutomaticOutput
		LL_TIM_EnableAutomaticOutput
		LL_TIM_IsEnabledAutomaticOutput
	BK2E	LL_TIM_DisableBRK2
		LL_TIM_EnableBRK2
	BK2F	LL_TIM_ConfigBRK2
	BK2P	LL_TIM_ConfigBRK2
	BKE	LL_TIM_DisableBRK
		LL_TIM_EnableBRK
	BKF	LL_TIM_ConfigBRK
	BKP	LL_TIM_ConfigBRK
	DTG	LL_TIM_OC_SetDeadTime
	LOCK	LL_TIM_CC_SetLockLevel
	MOE	LL_TIM_DisableAllOutputs
		LL_TIM_EnableAllOutputs
LL_TIM_IsEnabledAllOutputs		
OSSI	LL_TIM_SetOffStates	
OSSR	LL_TIM_SetOffStates	
CCER	CC1E	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC1NE	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC1NP	LL_TIM_IC_Config
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
	CC1P	LL_TIM_IC_Config
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity
		LL_TIM_OC_ConfigOutput

Register	Field	Function
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
	CC2E	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC2NE	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC2NP	LL_TIM_IC_Config
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
	CC2P	LL_TIM_IC_Config
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity
		LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
	CC3E	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC3NE	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
LL_TIM_CC_IsEnabledChannel		
CC3NP	LL_TIM_IC_Config	
	LL_TIM_IC_GetPolarity	
	LL_TIM_IC_SetPolarity	
	LL_TIM_OC_GetPolarity	
	LL_TIM_OC_SetPolarity	
CC3P	LL_TIM_IC_Config	
	LL_TIM_IC_GetPolarity	
	LL_TIM_IC_SetPolarity	
	LL_TIM_OC_ConfigOutput	
	LL_TIM_OC_GetPolarity	
	LL_TIM_OC_SetPolarity	

Register	Field	Function
	CC4E	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC4NP	LL_TIM_IC_Config
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity
	CC4P	LL_TIM_IC_Config
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity
		LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
	CC5E	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC5P	LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
	CC6E	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC6P	LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
CCMR1	CC1S	LL_TIM_IC_Config
		LL_TIM_IC_GetActiveInput
		LL_TIM_IC_SetActiveInput
		LL_TIM_OC_ConfigOutput
	CC2S	LL_TIM_IC_Config
		LL_TIM_IC_GetActiveInput
		LL_TIM_IC_SetActiveInput
		LL_TIM_OC_ConfigOutput
	IC1F	LL_TIM_IC_Config
		LL_TIM_IC_GetFilter
		LL_TIM_IC_SetFilter
	IC1PSC	LL_TIM_IC_Config

Register	Field	Function
		LL_TIM_IC_GetPrescaler
		LL_TIM_IC_SetPrescaler
	IC2F	LL_TIM_IC_Config
		LL_TIM_IC_GetFilter
		LL_TIM_IC_SetFilter
	IC2PSC	LL_TIM_IC_Config
		LL_TIM_IC_GetPrescaler
		LL_TIM_IC_SetPrescaler
	OC1CE	LL_TIM_OC_DisableClear
		LL_TIM_OC_EnableClear
		LL_TIM_OC_IsEnabledClear
	OC1FE	LL_TIM_OC_DisableFast
		LL_TIM_OC_EnableFast
		LL_TIM_OC_IsEnabledFast
	OC1M	LL_TIM_OC_GetMode
		LL_TIM_OC_SetMode
	OC1PE	LL_TIM_OC_DisablePreload
		LL_TIM_OC_EnablePreload
		LL_TIM_OC_IsEnabledPreload
	OC2CE	LL_TIM_OC_DisableClear
		LL_TIM_OC_EnableClear
		LL_TIM_OC_IsEnabledClear
	OC2FE	LL_TIM_OC_DisableFast
		LL_TIM_OC_EnableFast
		LL_TIM_OC_IsEnabledFast
	OC2M	LL_TIM_OC_GetMode
		LL_TIM_OC_SetMode
OC2PE	LL_TIM_OC_DisablePreload	
	LL_TIM_OC_EnablePreload	
	LL_TIM_OC_IsEnabledPreload	
CCMR2	CC3S	LL_TIM_IC_Config
		LL_TIM_IC_GetActiveInput
		LL_TIM_IC_SetActiveInput
		LL_TIM_OC_ConfigOutput
	CC4S	LL_TIM_IC_Config
		LL_TIM_IC_GetActiveInput

Register	Field	Function
		LL_TIM_IC_SetActiveInput
		LL_TIM_OC_ConfigOutput
	IC3F	LL_TIM_IC_Config
		LL_TIM_IC_GetFilter
		LL_TIM_IC_SetFilter
	IC3PSC	LL_TIM_IC_Config
		LL_TIM_IC_GetPrescaler
		LL_TIM_IC_SetPrescaler
	IC4F	LL_TIM_IC_Config
		LL_TIM_IC_GetFilter
		LL_TIM_IC_SetFilter
	IC4PSC	LL_TIM_IC_Config
		LL_TIM_IC_GetPrescaler
		LL_TIM_IC_SetPrescaler
	OC3CE	LL_TIM_OC_DisableClear
		LL_TIM_OC_EnableClear
		LL_TIM_OC_IsEnabledClear
	OC3FE	LL_TIM_OC_DisableFast
		LL_TIM_OC_EnableFast
		LL_TIM_OC_IsEnabledFast
	OC3M	LL_TIM_OC_GetMode
		LL_TIM_OC_SetMode
	OC3PE	LL_TIM_OC_DisablePreload
		LL_TIM_OC_EnablePreload
		LL_TIM_OC_IsEnabledPreload
	OC4CE	LL_TIM_OC_DisableClear
		LL_TIM_OC_EnableClear
		LL_TIM_OC_IsEnabledClear
OC4FE	LL_TIM_OC_DisableFast	
	LL_TIM_OC_EnableFast	
	LL_TIM_OC_IsEnabledFast	
OC4M	LL_TIM_OC_GetMode	
	LL_TIM_OC_SetMode	
OC4PE	LL_TIM_OC_DisablePreload	
	LL_TIM_OC_EnablePreload	
	LL_TIM_OC_IsEnabledPreload	

Register	Field	Function	
CCMR3	CC5S	LL_TIM_OC_ConfigOutput	
	CC6S	LL_TIM_OC_ConfigOutput	
	OC5CE		LL_TIM_OC_DisableClear
			LL_TIM_OC_EnableClear
			LL_TIM_OC_IsEnabledClear
	OC5FE		LL_TIM_OC_DisableFast
			LL_TIM_OC_EnableFast
			LL_TIM_OC_IsEnabledFast
	OC5M		LL_TIM_OC_GetMode
			LL_TIM_OC_SetMode
	OC5PE		LL_TIM_OC_DisablePreload
			LL_TIM_OC_EnablePreload
			LL_TIM_OC_IsEnabledPreload
	OC6CE		LL_TIM_OC_DisableClear
			LL_TIM_OC_EnableClear
			LL_TIM_OC_IsEnabledClear
	OC6FE		LL_TIM_OC_DisableFast
			LL_TIM_OC_EnableFast
			LL_TIM_OC_IsEnabledFast
	OC6M		LL_TIM_OC_GetMode
			LL_TIM_OC_SetMode
	OC6PE		LL_TIM_OC_DisablePreload
			LL_TIM_OC_EnablePreload
			LL_TIM_OC_IsEnabledPreload
CCR1	CCR1	LL_TIM_IC_GetCaptureCH1	
		LL_TIM_OC_GetCompareCH1	
		LL_TIM_OC_SetCompareCH1	
CCR2	CCR2	LL_TIM_IC_GetCaptureCH2	
		LL_TIM_OC_GetCompareCH2	
		LL_TIM_OC_SetCompareCH2	
CCR3	CCR3	LL_TIM_IC_GetCaptureCH3	
		LL_TIM_OC_GetCompareCH3	
		LL_TIM_OC_SetCompareCH3	
CCR4	CCR4	LL_TIM_IC_GetCaptureCH4	
		LL_TIM_OC_GetCompareCH4	
		LL_TIM_OC_SetCompareCH4	

Register	Field	Function
CCR5	CCR5	LL_TIM_OC_GetCompareCH5
		LL_TIM_OC_SetCompareCH5
	GC5C1	LL_TIM_SetCH5CombinedChannels
	GC5C2	LL_TIM_SetCH5CombinedChannels
CCR6	CCR6	LL_TIM_OC_GetCompareCH6
		LL_TIM_OC_SetCompareCH6
CNT	CNT	LL_TIM_GetCounter
		LL_TIM_SetCounter
CR1	ARPE	LL_TIM_DisableARRPreload
		LL_TIM_EnableARRPreload
		LL_TIM_IsEnabledARRPreload
	CEN	LL_TIM_DisableCounter
		LL_TIM_EnableCounter
		LL_TIM_IsEnabledCounter
	CKD	LL_TIM_GetClockDivision
		LL_TIM_SetClockDivision
	CMS	LL_TIM_GetCounterMode
		LL_TIM_SetCounterMode
	DIR	LL_TIM_GetCounterMode
		LL_TIM_GetDirection
		LL_TIM_SetCounterMode
	OPM	LL_TIM_GetOnePulseMode
		LL_TIM_SetOnePulseMode
	UDIS	LL_TIM_DisableUpdateEvent
		LL_TIM_EnableUpdateEvent
		LL_TIM_IsEnabledUpdateEvent
	UIFREMAP	LL_TIM_DisableUIFRemap
		LL_TIM_EnableUIFRemap
URS	LL_TIM_GetUpdateSource	
	LL_TIM_SetUpdateSource	
CR2	CCDS	LL_TIM_CC_GetDMAReqTrigger
		LL_TIM_CC_SetDMAReqTrigger
	CCPC	LL_TIM_CC_DisablePreload
		LL_TIM_CC_EnablePreload
	CCUS	LL_TIM_CC_SetUpdate

Register	Field	Function	
	MMS	LL_TIM_SetTriggerOutput	
	MMS2	LL_TIM_SetTriggerOutput2	
	OIS1		LL_TIM_OC_ConfigOutput
			LL_TIM_OC_GetIdleState
			LL_TIM_OC_SetIdleState
	OIS2		LL_TIM_OC_ConfigOutput
			LL_TIM_OC_GetIdleState
			LL_TIM_OC_SetIdleState
	OIS2N		LL_TIM_OC_GetIdleState
			LL_TIM_OC_SetIdleState
	OIS3		LL_TIM_OC_ConfigOutput
			LL_TIM_OC_GetIdleState
			LL_TIM_OC_SetIdleState
	OIS3N		LL_TIM_OC_GetIdleState
			LL_TIM_OC_SetIdleState
	OIS4		LL_TIM_OC_ConfigOutput
			LL_TIM_OC_GetIdleState
			LL_TIM_OC_SetIdleState
	OIS5		LL_TIM_OC_ConfigOutput
			LL_TIM_OC_GetIdleState
			LL_TIM_OC_SetIdleState
	OIS6		LL_TIM_OC_ConfigOutput
			LL_TIM_OC_GetIdleState
			LL_TIM_OC_SetIdleState
TI1S		LL_TIM_IC_DisableXORCombination	
		LL_TIM_IC_EnableXORCombination	
		LL_TIM_IC_IsEnabledXORCombination	
DCR	DBA	LL_TIM_ConfigDMABurst	
	DBL	LL_TIM_ConfigDMABurst	
DIER	BIE	LL_TIM_DisableIT_BRK	
		LL_TIM_EnableIT_BRK	
		LL_TIM_IsEnabledIT_BRK	
	CC1DE	LL_TIM_DisableDMAReq_CC1	
		LL_TIM_EnableDMAReq_CC1	
		LL_TIM_IsEnabledDMAReq_CC1	
	CC1IE	LL_TIM_DisableIT_CC1	

Register	Field	Function
		LL_TIM_EnableIT_CC1
		LL_TIM_IsEnabledIT_CC1
CC2DE		LL_TIM_DisableDMARReq_CC2
		LL_TIM_EnableDMARReq_CC2
		LL_TIM_IsEnabledDMARReq_CC2
CC2IE		LL_TIM_DisableIT_CC2
		LL_TIM_EnableIT_CC2
		LL_TIM_IsEnabledIT_CC2
CC3DE		LL_TIM_DisableDMARReq_CC3
		LL_TIM_EnableDMARReq_CC3
		LL_TIM_IsEnabledDMARReq_CC3
CC3IE		LL_TIM_DisableIT_CC3
		LL_TIM_EnableIT_CC3
		LL_TIM_IsEnabledIT_CC3
CC4DE		LL_TIM_DisableDMARReq_CC4
		LL_TIM_EnableDMARReq_CC4
		LL_TIM_IsEnabledDMARReq_CC4
CC4IE		LL_TIM_DisableIT_CC4
		LL_TIM_EnableIT_CC4
		LL_TIM_IsEnabledIT_CC4
COMDE		LL_TIM_DisableDMARReq_COM
		LL_TIM_EnableDMARReq_COM
		LL_TIM_IsEnabledDMARReq_COM
COMIE		LL_TIM_DisableIT_COM
		LL_TIM_EnableIT_COM
		LL_TIM_IsEnabledIT_COM
TDE		LL_TIM_DisableDMARReq_TRIG
		LL_TIM_EnableDMARReq_TRIG
		LL_TIM_IsEnabledDMARReq_TRIG
TIE		LL_TIM_DisableIT_TRIG
		LL_TIM_EnableIT_TRIG
		LL_TIM_IsEnabledIT_TRIG
UDE		LL_TIM_DisableDMARReq_UPDATE
		LL_TIM_EnableDMARReq_UPDATE
		LL_TIM_IsEnabledDMARReq_UPDATE
UIE		LL_TIM_DisableIT_UPDATE

Register	Field	Function
		LL_TIM_EnableIT_UPDATE
		LL_TIM_IsEnabledIT_UPDATE
EGR	B2G	LL_TIM_GenerateEvent_BRK2
	BG	LL_TIM_GenerateEvent_BRK
	CC1G	LL_TIM_GenerateEvent_CC1
	CC2G	LL_TIM_GenerateEvent_CC2
	CC3G	LL_TIM_GenerateEvent_CC3
	CC4G	LL_TIM_GenerateEvent_CC4
	COMG	LL_TIM_GenerateEvent_COM
	TG	LL_TIM_GenerateEvent_TRIG
	UG	LL_TIM_GenerateEvent_UPDATE
PSC	PSC	LL_TIM_GetPrescaler
		LL_TIM_SetPrescaler
RCR	REP	LL_TIM_GetRepetitionCounter
		LL_TIM_SetRepetitionCounter
SMCR	ECE	LL_TIM_DisableExternalClock
		LL_TIM_EnableExternalClock
		LL_TIM_IsEnabledExternalClock
		LL_TIM_SetClockSource
	ETF	LL_TIM_ConfigETR
	ETP	LL_TIM_ConfigETR
	ETPS	LL_TIM_ConfigETR
	MSM	LL_TIM_DisableMasterSlaveMode
		LL_TIM_EnableMasterSlaveMode
		LL_TIM_IsEnabledMasterSlaveMode
	SMS	LL_TIM_SetClockSource
LL_TIM_SetEncoderMode		
LL_TIM_SetSlaveMode		
TS	LL_TIM_SetTriggerInput	
SR	B2IF	LL_TIM_ClearFlag_BRK2
		LL_TIM_IsActiveFlag_BRK2
	BIF	LL_TIM_ClearFlag_BRK
		LL_TIM_IsActiveFlag_BRK
	CC1IF	LL_TIM_ClearFlag_CC1
		LL_TIM_IsActiveFlag_CC1
	CC1OF	LL_TIM_ClearFlag_CC1OVR

Register	Field	Function
		LL_TIM_IsActiveFlag_CC1OVR
	CC2IF	LL_TIM_ClearFlag_CC2 LL_TIM_IsActiveFlag_CC2
	CC2OF	LL_TIM_ClearFlag_CC2OVR LL_TIM_IsActiveFlag_CC2OVR
	CC3IF	LL_TIM_ClearFlag_CC3 LL_TIM_IsActiveFlag_CC3
	CC3OF	LL_TIM_ClearFlag_CC3OVR LL_TIM_IsActiveFlag_CC3OVR
	CC4IF	LL_TIM_ClearFlag_CC4 LL_TIM_IsActiveFlag_CC4
	CC4OF	LL_TIM_ClearFlag_CC4OVR LL_TIM_IsActiveFlag_CC4OVR
	CC5IF	LL_TIM_ClearFlag_CC5 LL_TIM_IsActiveFlag_CC5
	CC6IF	LL_TIM_ClearFlag_CC6 LL_TIM_IsActiveFlag_CC6
	COMIF	LL_TIM_ClearFlag_COM LL_TIM_IsActiveFlag_COM
	SBIF	LL_TIM_ClearFlag_SYSBRK LL_TIM_IsActiveFlag_SYSBRK
	TIF	LL_TIM_ClearFlag_TRIG LL_TIM_IsActiveFlag_TRIG
	UIF	LL_TIM_ClearFlag_UPDATE LL_TIM_IsActiveFlag_UPDATE
TIM11_OR	TI1_RMP	LL_TIM_SetRemap
TIM2_OR	ITR1_RMP	LL_TIM_SetRemap
TIM5_OR	TI4_RMP	LL_TIM_SetRemap

94.21 USART

Table 45: Correspondence between USART registers and USART low-layer driver functions

Register	Field	Function
BRR	BRR	LL_USART_GetBaudRate LL_USART_SetBaudRate
CR1	CMIE	LL_USART_DisableIT_CM LL_USART_EnableIT_CM

Register	Field	Function
		LL_USART_IsEnabledIT_CM
DEAT		LL_USART_GetDEAssertionTime
		LL_USART_SetDEAssertionTime
DEDT		LL_USART_GetDEDeassertionTime
		LL_USART_SetDEDeassertionTime
EOBIE		LL_USART_DisableIT_EOB
		LL_USART_EnableIT_EOB
		LL_USART_IsEnabledIT_EOB
IDLEIE		LL_USART_DisableIT_IDLE
		LL_USART_EnableIT_IDLE
		LL_USART_IsEnabledIT_IDLE
M0		LL_USART_ConfigCharacter
		LL_USART_GetDataWidth
		LL_USART_SetDataWidth
M1		LL_USART_ConfigCharacter
		LL_USART_GetDataWidth
		LL_USART_SetDataWidth
MME		LL_USART_DisableMuteMode
		LL_USART_EnableMuteMode
		LL_USART_IsEnabledMuteMode
OVER8		LL_USART_GetOverSampling
		LL_USART_SetOverSampling
PCE		LL_USART_ConfigCharacter
		LL_USART_GetParity
		LL_USART_SetParity
PEIE		LL_USART_DisableIT_PE
		LL_USART_EnableIT_PE
		LL_USART_IsEnabledIT_PE
PS		LL_USART_ConfigCharacter
		LL_USART_GetParity
		LL_USART_SetParity
RE		LL_USART_DisableDirectionRx
		LL_USART_EnableDirectionRx
		LL_USART_GetTransferDirection
		LL_USART_SetTransferDirection
RTOIE		LL_USART_DisableIT_RTO

Register	Field	Function
		LL_USART_EnableIT_RTO
		LL_USART_IsEnabledIT_RTO
	RXNEIE	LL_USART_DisableIT_RXNE
		LL_USART_EnableIT_RXNE
		LL_USART_IsEnabledIT_RXNE
	TCIE	LL_USART_DisableIT_TC
		LL_USART_EnableIT_TC
		LL_USART_IsEnabledIT_TC
	TE	LL_USART_DisableDirectionTx
		LL_USART_EnableDirectionTx
		LL_USART_GetTransferDirection
		LL_USART_SetTransferDirection
	TXEIE	LL_USART_DisableIT_TXE
		LL_USART_EnableIT_TXE
		LL_USART_IsEnabledIT_TXE
	UE	LL_USART_Disable
		LL_USART_Enable
		LL_USART_IsEnabled
	WAKE	LL_USART_GetWakeUpMethod
		LL_USART_SetWakeUpMethod
CR2	ABREN	LL_USART_DisableAutoBaudRate
		LL_USART_EnableAutoBaudRate
		LL_USART_IsEnabledAutoBaud
	ABRMODE	LL_USART_GetAutoBaudRateMode
		LL_USART_SetAutoBaudRateMode
	ADD	LL_USART_ConfigNodeAddress
		LL_USART_GetNodeAddress
	ADDM7	LL_USART_ConfigNodeAddress
		LL_USART_GetNodeAddressLen
	CLKEN	LL_USART_ConfigAsyncMode
		LL_USART_ConfigHalfDuplexMode
		LL_USART_ConfigIrdaMode
		LL_USART_ConfigLINMode
LL_USART_ConfigMultiProcessMode		
LL_USART_ConfigSmartcardMode		
LL_USART_ConfigSyncMode		

Register	Field	Function
		LL_USART_DisableSCLKOutput
		LL_USART_EnableSCLKOutput
		LL_USART_IsEnabledSCLKOutput
	CPHA	LL_USART_ConfigClock
		LL_USART_GetClockPhase
		LL_USART_SetClockPhase
	CPOL	LL_USART_ConfigClock
		LL_USART_GetClockPolarity
		LL_USART_SetClockPolarity
	DATAINV	LL_USART_GetBinaryDataLogic
		LL_USART_SetBinaryDataLogic
	LBCL	LL_USART_ConfigClock
		LL_USART_GetLastClkPulseOutput
		LL_USART_SetLastClkPulseOutput
	LBDIE	LL_USART_DisableIT_LBD
		LL_USART_EnableIT_LBD
		LL_USART_IsEnabledIT_LBD
	LBDL	LL_USART_GetLINBrkDetectionLen
		LL_USART_SetLINBrkDetectionLen
	LINEN	LL_USART_ConfigAsyncMode
		LL_USART_ConfigHalfDuplexMode
		LL_USART_ConfigIrdaMode
		LL_USART_ConfigLINMode
		LL_USART_ConfigMultiProcessMode
		LL_USART_ConfigSmartcardMode
		LL_USART_ConfigSyncMode
		LL_USART_DisableLIN
LL_USART_EnableLIN		
LL_USART_IsEnabledLIN		
MSBFIRST	LL_USART_GetTransferBitOrder	
	LL_USART_SetTransferBitOrder	
RTOEN	LL_USART_DisableRxTimeout	
	LL_USART_EnableRxTimeout	
	LL_USART_IsEnabledRxTimeout	
RXINV	LL_USART_GetRXPinLevel	
	LL_USART_SetRXPinLevel	

Register	Field	Function
	STOP	LL_USART_ConfigCharacter
		LL_USART_ConfigIrdaMode
		LL_USART_ConfigLINMode
		LL_USART_ConfigSmartcardMode
		LL_USART_GetStopBitsLength
		LL_USART_SetStopBitsLength
	SWAP	LL_USART_GetTXRXSwap
		LL_USART_SetTXRXSwap
	TXINV	LL_USART_GetTXPinLevel
LL_USART_SetTXPinLevel		
CR3	CTSE	LL_USART_DisableCTSHWFlowCtrl
		LL_USART_EnableCTSHWFlowCtrl
		LL_USART_GetHWFlowCtrl
		LL_USART_SetHWFlowCtrl
	CTSIE	LL_USART_DisableIT_CTS
		LL_USART_EnableIT_CTS
		LL_USART_IsEnabledIT_CTS
	DDRE	LL_USART_DisableDMADeactOnRxErr
		LL_USART_EnableDMADeactOnRxErr
		LL_USART_IsEnabledDMADeactOnRxErr
	DEM	LL_USART_DisableDEMode
		LL_USART_EnableDEMode
		LL_USART_IsEnabledDEMode
	DEP	LL_USART_GetDESignalPolarity
		LL_USART_SetDESignalPolarity
	DMAR	LL_USART_DisableDMAReq_RX
		LL_USART_EnableDMAReq_RX
		LL_USART_IsEnabledDMAReq_RX
	DMAT	LL_USART_DisableDMAReq_TX
		LL_USART_EnableDMAReq_TX
		LL_USART_IsEnabledDMAReq_TX
	EIE	LL_USART_DisableIT_ERROR
		LL_USART_EnableIT_ERROR
		LL_USART_IsEnabledIT_ERROR
HDSEL	LL_USART_ConfigAsyncMode	
	LL_USART_ConfigHalfDuplexMode	

Register	Field	Function
		LL_USART_ConfigIrdaMode
		LL_USART_ConfigLINMode
		LL_USART_ConfigMultiProcessMode
		LL_USART_ConfigSmartcardMode
		LL_USART_ConfigSyncMode
		LL_USART_DisableHalfDuplex
		LL_USART_EnableHalfDuplex
		LL_USART_IsEnabledHalfDuplex
	IREN	LL_USART_ConfigAsyncMode
		LL_USART_ConfigHalfDuplexMode
		LL_USART_ConfigIrdaMode
		LL_USART_ConfigLINMode
		LL_USART_ConfigMultiProcessMode
		LL_USART_ConfigSyncMode
		LL_USART_DisableIrda
		LL_USART_EnableIrda
	IRLP	LL_USART_GetIrdaPowerMode
		LL_USART_SetIrdaPowerMode
	NACK	LL_USART_DisableSmartcardNACK
		LL_USART_EnableSmartcardNACK
		LL_USART_IsEnabledSmartcardNACK
	ONEBIT	LL_USART_DisableOneBitSamp
		LL_USART_EnableOneBitSamp
		LL_USART_IsEnabledOneBitSamp
	OVRDIS	LL_USART_DisableOverrunDetect
		LL_USART_EnableOverrunDetect
		LL_USART_IsEnabledOverrunDetect
	RTSE	LL_USART_DisableRTSHWFlowCtrl
		LL_USART_EnableRTSHWFlowCtrl
		LL_USART_GetHWFlowCtrl
		LL_USART_SetHWFlowCtrl
	SCARCNT	LL_USART_GetSmartcardAutoRetryCount
		LL_USART_SetSmartcardAutoRetryCount
SCEN	LL_USART_ConfigAsyncMode	
	LL_USART_ConfigHalfDuplexMode	

Register	Field	Function
		LL_USART_ConfigIrdaMode
		LL_USART_ConfigLINMode
		LL_USART_ConfigMultiProcessMode
		LL_USART_ConfigSmartcardMode
		LL_USART_ConfigSyncMode
		LL_USART_DisableSmartcard
		LL_USART_EnableSmartcard
		LL_USART_IsEnabledSmartcard
GTPR	GT	LL_USART_GetSmartcardGuardTime
		LL_USART_SetSmartcardGuardTime
	PSC	LL_USART_GetIrdaPrescaler
		LL_USART_GetSmartcardPrescaler
		LL_USART_SetIrdaPrescaler
		LL_USART_SetSmartcardPrescaler
ICR	CMCF	LL_USART_ClearFlag_CM
	CTSCF	LL_USART_ClearFlag_nCTS
	EOBCF	LL_USART_ClearFlag_EOB
	FECF	LL_USART_ClearFlag_FE
	IDLECF	LL_USART_ClearFlag_IDLE
	LBDCF	LL_USART_ClearFlag_LBD
	NCF	LL_USART_ClearFlag_NE
	ORECF	LL_USART_ClearFlag_ORE
	PECF	LL_USART_ClearFlag_PE
	RTOCF	LL_USART_ClearFlag_RTO
	TCCF	LL_USART_ClearFlag_TC
ISR	ABRE	LL_USART_IsActiveFlag_ABRE
	ABRF	LL_USART_IsActiveFlag_ABR
	BUSY	LL_USART_IsActiveFlag_BUSY
	CMF	LL_USART_IsActiveFlag_CM
	CTS	LL_USART_IsActiveFlag_CTS
	CTSIF	LL_USART_IsActiveFlag_nCTS
	EOBF	LL_USART_IsActiveFlag_EOB
	FE	LL_USART_IsActiveFlag_FE
	IDLE	LL_USART_IsActiveFlag_IDLE
	LBDF	LL_USART_IsActiveFlag_LBD
	NF	LL_USART_IsActiveFlag_NE

Register	Field	Function
	ORE	LL_USART_IsActiveFlag_ORE
	PE	LL_USART_IsActiveFlag_PE
	RTOF	LL_USART_IsActiveFlag_RTO
	RWU	LL_USART_IsActiveFlag_RWU
	RXNE	LL_USART_IsActiveFlag_RXNE
	SBKF	LL_USART_IsActiveFlag_SBK
	TC	LL_USART_IsActiveFlag_TC
	TEACK	LL_USART_IsActiveFlag_TEACK
	TXE	LL_USART_IsActiveFlag_TXE
RDR	RDR	LL_USART_DMA_GetRegAddr
		LL_USART_ReceiveData8
		LL_USART_ReceiveData9
RQR	ABRRQ	LL_USART_RequestAutoBaudRate
	MMRQ	LL_USART_RequestEnterMuteMode
	RXFRQ	LL_USART_RequestRxDataFlush
	SBKRQ	LL_USART_RequestBreakSending
	TXFRQ	LL_USART_RequestTxDataFlush
RTOR	BLEN	LL_USART_GetBlockLength
		LL_USART_SetBlockLength
	RTO	LL_USART_GetRxTimeout
		LL_USART_SetRxTimeout
TDR	TDR	LL_USART_DMA_GetRegAddr
		LL_USART_TransmitData8
		LL_USART_TransmitData9

94.22 WWDG

Table 46: Correspondence between WWDG registers and WWDG low-layer driver functions

Register	Field	Function
CFR	EWI	LL_WWDG_EnableIT_EWKUP
		LL_WWDG_IsEnabledIT_EWKUP
	W	LL_WWDG_GetWindow
		LL_WWDG_SetWindow
	WDGTB	LL_WWDG_GetPrescaler
		LL_WWDG_SetPrescaler
CR	T	LL_WWDG_GetCounter
		LL_WWDG_SetCounter

Register	Field	Function
	WDGA	LL_WWDG_Enable
		LL_WWDG_IsEnabled
SR	EWIF	LL_WWDG_ClearFlag_EWKUP
		LL_WWDG_IsActiveFlag_EWKUP

95 FAQs

General subjects

Why should I use the HAL drivers?

There are many advantages in using the HAL drivers:

- Ease of use: you can use the HAL drivers to configure and control any peripheral embedded within your STM32 MCU without prior in-depth knowledge of the product.
- HAL drivers provide intuitive and ready-to-use APIs to configure the peripherals and support polling, interrupt and DMA programming model to accommodate all application requirements, thus allowing the end-user to build a complete application by calling a few APIs.
- Higher level of abstraction than a standard peripheral library allowing to transparently manage:
 - Data transfers and processing using blocking mode (polling) or non-blocking mode (interrupt or DMA)
 - Error management through peripheral error detection and timeout mechanism.
- Generic architecture speeding up initialization and porting, thus allowing customers to focus on innovation.
- Generic set of APIs with full compatibility across the STM32 series/lines, to ease the porting task between STM32 MCUs.
- The APIs provided within the HAL drivers are feature-oriented and do not required in-depth knowledge of peripheral operation.
- The APIs provided are modular. They include initialization, IO operation and control functions. The end-user has to call init function, then start the process by calling one IO operation functions (write, read, transmit, receive, ...). Most of the peripherals have the same architecture.
- The number of functions required to build a complete and useful application is very reduced. As an example, to build a UART communication process, the user only has to call HAL_UART_Init() then HAL_UART_Transmit() or HAL_UART_Receive().

Which STM32F7 devices are supported by the HAL drivers?

The HAL drivers are developed to support all STM32F7 devices. To ensure compatibility between all devices and portability with others series and lines, the API is split into the generic and the extension APIs . For more details, please refer to [Section 2.4: "Devices supported by HAL drivers"](#).

What is the cost of using HAL drivers in term of code size and performance?

Like generic architecture drivers, the HAL drivers may induce firmware overhead.

This is due to the high abstraction level and ready-to-use APIs which allow data transfers, errors management and offloads the user application from implementation details.

Architecture

How many files should I modify to configure the HAL drivers?

Only one file needs to be modified: stm32f7xx_hal_conf.h. You can modify this file by disabling unused modules, or adjusting some parameters (i.e. HSE value, System configuration...)

A template is provided in the HAL driver folders (stm32f7xx_hal_conf_template.c).

Which header files should I include in my application to use the HAL drivers?

Only stm32f7xx_hal.h file has to be included.

What is the difference between stm32f7xx_hal_ppp.c/h and stm32f7xx_hal_ppp_ex.c/h?

The HAL driver architecture supports common features across STM32 series/lines. To support specific features, the drivers are split into two groups.

- The generic APIs (xx_hal_ppp.c): It includes the common set of APIs across all the STM32 product lines
- The extension APIs (xx_hal_ppp_ex.c): It includes the specific APIs for specific device part number or family.

Initialization and I/O operation functions

How do I configure the system clock?

Unlike the standard library, the system clock configuration is not performed in CMSIS drivers file (system_xx.c) but in the main user application by calling the two main functions, HAL_RCC_OscConfig() and HAL_RCC_ClockConfig(). It can be modified in any user application section.

What is the purpose of the *PPP_HandleTypeDef *pHandle* structure located in each driver in addition to the Initialization structure

*PPP_HandleTypeDef *pHandle* is the main structure implemented in the HAL drivers. It handles the peripheral configuration and registers, and embeds all the structures and variables required to follow the peripheral device flow (pointer to buffer, Error code, State,...)

However, this structure is not required to service peripherals such as GPIO, SYSTICK, PWR, and RCC.

What is the purpose of HAL_PPP_MspInit() and HAL_PPP_MspDeInit() functions?

These functions are called within HAL_PPP_Init() and HAL_PPP_DeInit(), respectively. They are used to perform the low level Initialization/de-initialization related to the additional hardware resources (RCC, GPIO, NVIC and DMA).

These functions are declared in xx_hal_msp.c. A template is provided in the HAL driver folders (xx_hal_msp_template.c).

When and how should I use callbacks functions (functions declared with the attribute *__weak*)?

Use callback functions for the I/O operations used in DMA or interrupt mode. The PPP process complete callbacks are called to inform the user about process completion in real-time event mode (interrupts).

The Errors callbacks are called when a processing error occurs in DMA or interrupt mode. These callbacks are customized by the user to add user proprietary code. They can be declared in the application. Note that the same process completion callbacks are used for DMA and interrupt mode.

Is it mandatory to use HAL_Init() function at the beginning of the user application?

It is mandatory to use HAL_Init() function to enable the system configuration (Prefetch, Data instruction cache,...), configure the SysTick and the NVIC priority grouping and the hardware low level initialization.

The SysTick configuration shall be adjusted by calling **HAL_RCC_ClockConfig()** function, to obtain 1 ms whatever the system clock.

Why do I need to configure the SysTick timer to use the HAL drivers?

The SysTick timer is configured to be used to generate variable increments by calling **HAL_IncTick()** function in SysTick ISR and retrieve the value of this variable by calling **HAL_GetTick()** function.

The call HAL_GetTick() function is mandatory when using HAL drivers with Polling Process or when using HAL_Delay().

Why is the SysTick timer configured to have 1 ms?

This is mandatory to ensure correct IO operation in particular for polling mode operation where the 1 ms is required as timebase.

Could HAL_Delay() function block my application under certain conditions?

Care must be taken when using HAL_Delay() since this function provides accurate delay based on a variable incremented in SysTick ISR. This implies that if HAL_Delay() is called from a peripheral ISR process, then the SysTick interrupt must have higher priority (numerically lower) than the peripheral interrupt, otherwise the caller ISR process will be blocked. Use HAL_NVIC_SetPriority() function to change the SysTick interrupt priority.

What programming model sequence should I follow to use HAL drivers ?

Follow the sequence below to use the APIs provided in the HAL drivers:

1. Call HAL_Init() function to initialize the system (data cache, NVIC priority,...).
2. Initialize the system clock by calling HAL_RCC_OscConfig() followed by HAL_RCC_ClockConfig().
3. Add HAL_IncTick() function under SysTick_Handler() ISR function to enable polling process when using HAL_Delay() function
4. Start initializing your peripheral by calling HAL_PPP_Init().
5. Implement the hardware low level initialization (Peripheral clock, GPIO, DMA,..) by calling HAL_PPP_MspInit() inxx_hal_msp.c
6. Start your process operation by calling IO operation functions.

What is the purpose of HAL_PPP_IRQHandler() function and when should I use it?

HAL_PPP_IRQHandler() is used to handle interrupt process. It is called under PPP_IRQHandler() function in xx_it.c. In this case, the end-user has to implement only the callbacks functions (prefixed by __weak) to perform the appropriate action when an interrupt is detected. Advanced users can implement their own code in PPP_IRQHandler() without calling HAL_PPP_IRQHandler().

Can I use directly the macros defined in xx_hal_ppp.h ?

Yes, you can: a set of macros is provided with the APIs. They allow accessing directly some specific features using peripheral flags.

Where must PPP_HandleTypeDef structure peripheral handler be declared?

PPP_HandleTypeDef structure peripheral handler must be declared as a global variable, so that all the structure fields are set to 0 by default. In this way, the peripheral handler default state are set to HAL_PPP_STATE_RESET, which is the default state for each peripheral after a system reset.

When should I use HAL versus LL drivers?

HAL drivers offer high-level and function-oriented APIs, with a high level of portability. Product/IPs complexity is hidden for end users. The LL drivers offer low-level APIs at registers level, with a better optimization but less portability. They require a deep knowledge of product/IPs specifications.

How can I include LL drivers in my environment? Is there any LL configuration file as for HAL?

There is no configuration file. Source code shall directly include the necessary stm32f7xx_ll_ppp.h file(s).

Can I use HAL and LL drivers together? If yes, what are the constraints?

It is possible to use both HAL and LL drivers. One can handle the IP initialization phase with HAL and then manage the I/O operations with LL drivers. The major difference between HAL and LL is that HAL drivers require to create and use handles for operation management, while LL drivers operate directly on peripheral registers. Mixing HAL and LL is illustrated in Examples_MIX example.

Are there any LL APIs which are not available with HAL?

Yes, there are. A few Cortex® APIs have been added in stm32f7xx_ll_cortex.h e.g. for accessing SCB or SysTick registers.

Why are SysTick interrupts not enabled on LL drivers?

Because when using LL drivers in standalone mode, you do not need to enable SysTick interrupts because they are not used in LL APIs, while HAL functions require SysTick interrupts to manage timeouts.

96 Revision history

Table 47: Document revision history

Date	Revision	Changes
08-Jun-2015	1	Initial release.
27-Jul-2016	2	Updated Section 1: "Acronyms and definitions" to add DFSDM / DSI / MDIOS acronyms. Updated Table 5: "List of devices supported by HAL drivers" to add new supported part numbers. Updated header files list in Section 2.5.1: "HAL API naming rules" . Added description of DFSDM, DSI, JPEG and MDIOS HAL generic drivers.
15-Feb-2017	3	Updated: Table 5: "List of devices supported by HAL and LL drivers" to add new supported part numbers and LL drivers. Updated headers file list in Section 2.5.1: "HAL API naming rules" . Added description of MMC and SMBUS HAL generic drivers. Added description of LL generic drivers.

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