

- A versatile, integrated, alpha spectrometer for measuring low-activity samples that decay by alpha-particle emission
- Includes sample changer, detector, bias supply, preamplifier, amplifiers, and calibration pulser in a NIM-standard double-width module
- Accommodates horizontal samples up to 5.1 cm (2 in.) in diameter with adjustable sample-to-detector spacing
- Available with low-background ULTRA-AS™ Series detectors up to 1200 mm² in active area
- Easy access to vacuum chamber through hinged door featuring a high-reliability O-ring seal
- Removable, nickel-plated brass chamber simplifies decontamination
- Calibrated outputs and controls for selected energy ranges
- Complete, turn-key, multiple-unit alpha spectrometer systems available

The SOLOIST is an integrated spectrometer for measuring low-activity samples that decay by alpha-particle emission. It incorporates all the necessary functions within a NIM-standard double-width module. The module includes vacuum chamber, detector, bias supply for the detector, complete amplifying chain (preamplifier, amplifier, and biased amplifier), and calibration pulser.

The SOLOIST offers three flexible methods for recording the alpha emission activity. The simplest is to record the gross counting rate above the 2.5-MeV threshold using an external counter and timer. To achieve much lower detection limits, the linear amplifier output can be fed to a multichannel pulse-height analyzer (MCA) for quantitative analysis of specific isotope peaks in the 3- to 10-MeV energy spectrum. The biased amplifier output of the SOLOIST offers selection of a restricted energy range (containing only the peaks of interest) for analysis on the MCA. This feature allows a larger number of alpha spectrometers to be multiplexed into the limited memory size of a single MCA. A front-panel switch provides 6 selectable energy ranges at the biased amplifier output (3 to 8 MeV, 4 to 7 MeV, 3 to 5 MeV, 4 to 6 MeV, 5 to 7 MeV, and 6 to 8 MeV). Three front-panel adjustments permit precise calibration on any selected energy range.

The SOLOIST includes a robust, low-background, sample chamber. The chamber is cast in brass, then machined to close tolerances, before being nickel plated to ensure easy decontamination. In the event of severe contamination, the chamber may be easily isolated from vacuum, and then removed from the module. A compressed, high-performance O-ring, retained in a dove-tailed groove in the face of the chamber, provides an ultra-reliable vacuum seal for the chamber door. Nickel-plated brass sample trays slide into the chamber to provide an adjustable and precisely reproducible sample-to-detector spacing. Trays are available to handle sample sizes from 13 mm (0.5 in.) to 51 mm (2 in.), with sample-to-detector spacing selectable from 1 to 41 mm in increments of 4 mm. The front-panel PUMP/HOLD/VENT valve makes it easy to insert, count, and remove samples without disturbing the vacuum on other SOLOIST chambers attached to the same vacuum pump. A standard Swagelok® fitting on the rear panel simplifies



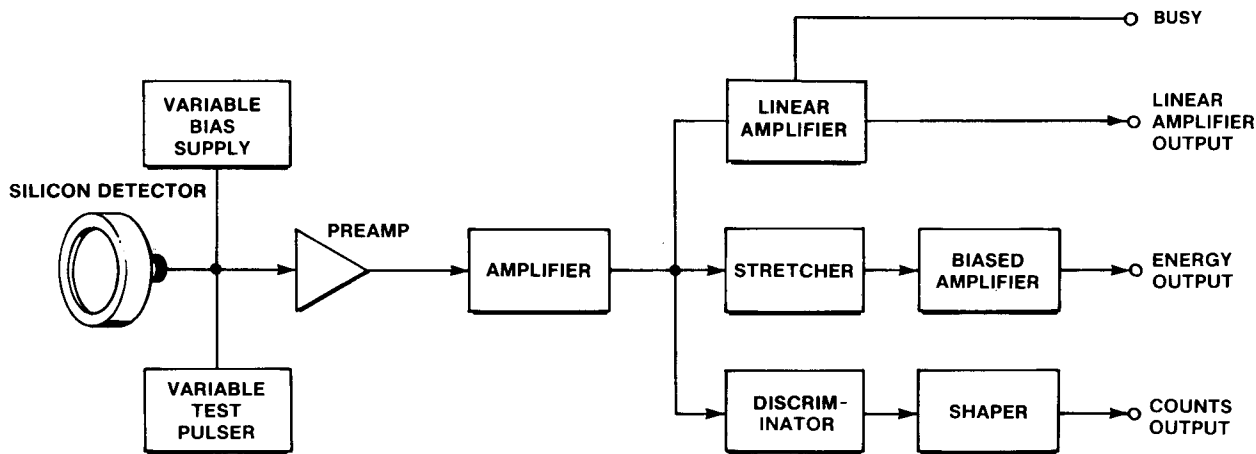


Fig. 1. A Simplified Block Diagram of the SOLOIST Electronics.

connection of the valve and chamber to an external vacuum pump. An optional pump station (Model ALPHA-PPS-115 or -230) is available for this function, and the Model 576-VM Vacuum Manifold can be added to connect up to four SOLOIST modules to the same vacuum pump.

The SOLOIST is available with an ULTRA-AS Series detector installed. These ion-implanted silicon detectors from ORTEC are specially designed and fabricated for low-background applications in alpha spectrometers. Detector sizes up to 1200 mm² in active area can be accommodated. The SOLOIST is also available without the detector to permit installation of alternative types of silicon detectors, such as ORTEC Ruggedized™ R-Series surface barrier detectors, or other ORTEC surface barrier detectors. A front-panel adjustment and internal jumpers accommodate detectors requiring positive or negative bias voltage in the range of 0 to 100 V.

A variety of single-input or multiplexed-input multichannel analyzers are available from ORTEC for use with the SOLOIST. Quantitative alpha-spectroscopy software is also offered with most of these MCAs.

Specifications

PERFORMANCE

Unless otherwise specified, the performance** is measured using a low-background 450 mm², ULTRA-AS Series detector, a good-quality ²⁴¹Am point source, and a detector-to-source spacing equal to the detector diameter.

MAXIMUM SAMPLE SIZE 51 mm (2.030 in.).

MAXIMUM SAMPLE-TO-DETECTOR SPACING 44 mm.

MAXIMUM DETECTOR SIZE 1200 mm².

ENERGY RANGES Biased amplifier (ENERGY) output: 3 to 8 MeV, 4 to 7 MeV, 3 to 5 MeV, 4 to 6 MeV, 5 to 7 MeV, and 6 to 8 MeV. Linear amplifier output (LIN AMP OUT): 3 to 10 MeV.

INTEGRAL NONLINEARITY <±0.1% of full scale in each energy range.

ENERGY RESOLUTION <20 keV.

DETECTOR EFFICIENCY >25% for a detector-to-source spacing <10 mm and a ²⁴¹Am point source.

BACKGROUND <24 counts in 24 hours above 3 MeV. Measured from the COUNTS output with no radioactive source in the chamber.

VACUUM CHAMBER

CONSTRUCTION Cast brass, with nickel plating for ease of decontamination. High-performance O-ring seal. Three-position PUMP/HOLD/VENT valve.

SAMPLE TRAYS Slide-in, nickel-plated brass sample trays are available to accommodate sample diameters from 13 mm (0.5 in.) to 51 mm (2 in.). (See Ordering Information). One sample tray (Model SOL-ST-1) is included with the SOLOIST.

SAMPLE-TO-DETECTOR DISTANCE Adjustable from nominally 1 mm to 41 mm in increments of 4 mm using slide-in

sample trays. Maximum distance from detector to bottom of chamber is approximately 44 mm.

DETECTOR SIZES The SOLOIST is available with high-performance, low-background, ULTRA-AS Series detectors. Select an active area of 300, 450, 600, 900, or 1200 mm². See Ordering Information.

CONTROLS

ENERGY RANGE Front-panel, six-position switch selects the energy range at the biased amplifier output. Selectable ranges for zero to full-scale amplitude at the ENERGY output are 3 to 8 MeV, 4 to 7 MeV, 3 to 5 MeV, 4 to 6 MeV, 5 to 7 MeV, and 6 to 8 MeV.

OFF/BIAS/PULSER Front-panel, three-position toggle switch controls the on/off conditions of the detector bias and the pulser.

SOLOIST™

Alpha Spectrometer

Switch Position	OFF	BIAS	PULSER
Detector Bias	off	on	on
Pulser	off	off	on

The associated red LED turns on when the bias voltage is on.

PULSER Front-panel 10-turn locking dial controls the pulser amplitude for energy calibration. Range: 0 to 10 MeV.

VACUUM PUMP/HOLD/VENT Front-panel, three-position valve controls the pumping or venting of the vacuum chamber. The HOLD position can be used to isolate the chamber from the vacuum pump when evacuating other chambers.

E BIAS Front-panel, 20-turn screwdriver control provides a $\pm 10\%$ adjustment of the biased amplifier threshold, to calibrate the lower limit of the energy range at the ENERGY output.

ΔE Front-panel, 20-turn screwdriver control adjusts the biased amplifier gain, to calibrate the upper limit of the energy range at the ENERGY output. The amplitude for the upper energy limit can be adjusted from 7.75 V to 10.25 V to match the input range of the ADC being used.

AMP GAIN Front-panel, 20-turn screwdriver control adjusts the full-scale calibration of the linear amplifier output (LIN AMP OUT) from 5 MeV to 10 MeV for a 10-V output pulse amplitude. Factory set for 10 MeV at 10 V.

DETECTOR POLARITY JUMPERS (+/-) Five printed circuit board jumpers select the polarity of the amplifier gain and the detector bias voltage to match the polarity of voltage required by the detector. Normally shipped in the "+" position for ULTRA-AS Series detectors.

DET BIAS ADJ Rear-panel, one-turn screwdriver control permits adjustment of the detector bias to the value specified for the installed detector. Variable from 0 to 100 V. Bias polarity is set to match the detector via the Detector Polarity Jumpers.

INPUTS

VACUUM Rear-panel vacuum connector (Swagelok connector for 0.25-in. O.D. tubing) for connecting the vacuum chamber in the module to a vacuum pump.

EXTERNAL PULSER Rear-panel BNC connector accepts external pulser signals. Input impedance is 100 Ω , dc-coupled. Input pulse polarity must be opposite that of the detector bias polarity.

OUTPUTS

COUNTS Rear-panel BNC connector provides a NIM-standard positive logic pulse for any detected particle having an energy greater than 2.5 MeV. Used for gross alpha counting, or routing in a multichannel analyzer. Pulse width is 3.5 μs . Output impedance is 50 Ω , dc-coupled.

ENERGY Rear-panel BNC connector provides the linear output signal from the biased amplifier for connection to an ADC or multichannel analyzer. Output amplitude range is factory set for 0 to +10 V which corresponds to the energy ranges selected by the front-panel ENERGY RANGE switch. See E BIAS and ΔE controls for output range adjustment and calibration. Output impedance is 100 Ω , dc-coupled.

LIN AMP OUT Rear-panel BNC connector delivers the linear amplifier output signal for connection to an ADC or multichannel analyzer. Factory adjusted for 3 to 10 MeV, corresponding to a 0- to +10-V output pulse amplitude. See AMP GAIN control for calibration adjustment. Output pulse has a unipolar, semi-Gaussian pulse shape with a 1- μs shaping time constant. Output impedance is 100 Ω , dc-coupled.

BUSY Rear-panel BNC connector produces a NIM-standard positive logic pulse whenever the module is busy processing a pulse. Can be supplied to an ADC or multichannel analyzer to assist in dead-time corrections when dead-time losses are significant. Output impedance is 10 Ω , dc-coupled.

DET/1.1 MEG OHM/HV Rear-panel test jacks permit monitoring the voltage of the detector bias supply, and the detector load current. The bias supply voltage is read at the HV test jack. The voltage measured between the two test jacks permits calculation of the detector load current flowing through the 1.1-M Ω resistor.

ELECTRICAL AND MECHANICAL

POWER REQUIRED The SOLOIST derives its power from a NIM-standard bin/power supply, such as the ORTEC

Model 4001A/4002A, or 4001A/4002D. The power required is +24 V at 120 mA, +12 V at 90 mA, -12 V at 45 mA, and -24 V at 75 mA.

WEIGHT

Net 2.4 kg (5.2 lb).

Shipping 2.3 kg (7.3 lb).

DIMENSIONS NIM-standard, double-width module 6.90 x 22.13 cm (2.70 x 8.714 in.) front panel per DOE/ER-0457T.

ACCESSORIES

SPARE CHAMBER GASKETS Replacement O-rings for the vacuum chamber door are available in quantities of 10 in a package. See Ordering Information.

SAMPLE TRAYS A variety of slide-in sample trays are available to hold different sample sizes. See Ordering Information.

VACUUM MANIFOLD The ORTEC Model 576-VM Vacuum Manifold and Control is recommended for connecting a common vacuum source to four SOLOIST modules.

PORTABLE PUMP STATION The ORTEC Model ALPHA-PPS-115 or -230 Portable Pump Station is recommended for evacuating the sample chamber in the SOLOIST. The pump station is available in both 115-V and 230-V ac version, and can be combined with the Model 575-VM Vacuum Manifold to serve multiple SOLOIST modules. The standard pump station is supplied with 1 m (40 in.) of 1-in. I.D. vacuum hose for connection to the 576-VM, and 0.9 m (36 in.) of 1/4-in. O.D. vacuum hose for coupling the larger hose to the SOLOIST. If different lengths are required, contact the factory for a special order.

MULTICHANNEL ANALYZERS WITH SOFTWARE The ENERGY output of the SOLOIST is intended for use with a multichannel pulse-height analyzer.

REPLACEMENT DETECTORS Detectors that have been severely contaminated or otherwise damaged beyond use can be replaced by ordering a new detector of the same size from the ULTRA-AS Series of detectors. Be sure to specify the ULTRA-AS detector with a B Mount.

SOLOIST™

Alpha Spectrometer

Ordering Information

To order, specify the following model numbers and descriptions:

Model Number	Description
SOLOIST	Alpha Spectrometer without detector
SOLOIST-U0300	Alpha Spectrometer with 300-mm ² ULTRA-AS detector
SOLOIST-U0450	Alpha Spectrometer with 450-mm ² ULTRA-AS detector
SOLOIST-U0600	Alpha Spectrometer with 600-mm ² ULTRA-AS detector
SOLOIST-U0900	Alpha Spectrometer with 900-mm ² ULTRA-AS detector
SOLOIST-U1200	Alpha Spectrometer with 1200-mm ² ULTRA-AS detector
Accessories	
ALPHA-PPS-115	115-V Portable Pump Station
ALPHA-PPS-230	230-V Portable Pump Station
SOL-CG	Spare O-rings for vacuum chamber door (pkg. of 10)
SOL-ST-KK	Set of Sample Trays: One each of all four sizes (.5 in. through 2 in.)
SOL-ST-1	Sample Tray for 3/4 in. (19 mm) and 1 in. (25 mm) diameter samples
SOL-ST-2	Sample Tray for 1/2 in. (13 mm) and 7/8 in. (22 mm) diameter samples
SOL-ST-3	Sample Tray for 1.25 in. (32 mm) and 1.5 in. (38 mm) diameter samples
SOL-ST-4	Sample Tray for 1.75 in. (44 mm) and 2 in. (51 mm) diameter samples
576-VM	Vacuum Manifold and Control for 115 V
576-VM-230	Vacuum Manifold and Control for 230 V

Specifications subject to change
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