



SIGNAL PROCESSING

Model 2018EB™

Silicon Detector Preamplifier

The preamp converts the charge carriers produced in the detector by each nuclear event into a voltage pulse.



FEATURES

- Low noise design: <math><3.0\text{ keV (Si) at }0\text{ pF}</math>
- High energy rate capability: up to 2×10^6 MeV per second
- FET input, diode protected
- Small size
- Capable of operating in a vacuum chamber

DESCRIPTION

The Model 2018EB charge sensitive FET input preamp is designed for optimum performance with silicon detectors such as the Canberra™ Passivated Implanted Planar Silicon (PIPS®) detectors and legacy Silicon Surface Barrier (SSB) detectors. The preamp converts the charge carriers produced in the detector by each nuclear event into a voltage pulse. The amplitude of this voltage pulse is proportional to the collected charge according to 0.45 V per pC. This translates to a gain of 20 mV per MeV for silicon detectors operated at room temperature.

The output provides a positive polarity signal when the preamp is used with a positively biased detector. The output signal is extremely linear with energy, which makes it an ideal preamp for energy spectroscopy. The high charge rate capability of the preamp is evidenced by an energy rate capacity of 2×10^6 MeV per second when used with silicon detectors. In order to take full advantage of such high count rate capability, a main amplifier or MCA with a correspondingly high count rate ability, such as the Lynx® analyzer, should be used.

Model 2018EB | SILICON DETECTOR PREAMPLIFIER

The basic operation of the preamplifier is indicated in the functional schematic. It acts as an operational integrator which produces an output potential proportional to the accumulated charge on the feedback capacitor C_f . The integrator directly drives the energy output. To preserve pulse reliability the energy output is buffered through a series terminating resistor of 93Ω . A test input, accepting positive and negative pulses, is foreseen for calibration purposes.

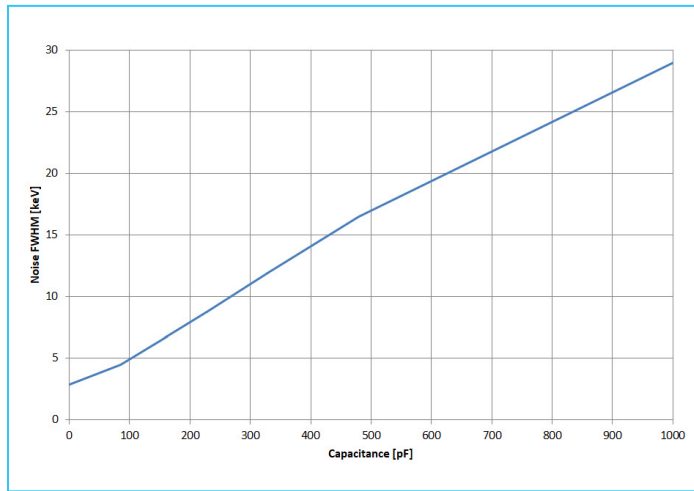


Figure 1. Typical noise performance vs. source capacitance, using the Model 2024 Spectroscopy Amplifier set at $0.5 \mu\text{s}$ unipolar near-Gaussian shaping.

The preamplifier offers a noise contribution of only 3.0 keV, FWHM, Si, with a rate of noise increase with increasing input capacitance of $\pm 27 \text{ eV per pF}$, FWHM, Si.



SPECIFICATIONS

INPUTS

- Detector input: Accepts charge pulse from semiconductor detectors including PIPS and SSB types
- HV input: Allows detector biasing up to $\pm 200 \text{ V}$ dc; detector series bias resistance is $110 \text{ M}\Omega$
- Test input: Charge coupled to preamp input at 1 pC per V ; $Z_{in} = 93 \Omega$

OUTPUTS

- Energy output: Inverted tail pulse, rise time as in Table 1 up to $\pm 10 \text{ V}$; $Z_{out} = 93 \Omega$, direct coupled

Table 1.

| C_{source} in pF | Guaranteed noise in keV FWHM, Si | Rise time in ns |
|--------------------|----------------------------------|-----------------|
| 0 | <3.0 | <32 |
| 100 | <5.7 | <43 |
| 300 | <11.0 | <50 |
| 500 | <16.3 | <58 |
| 1000 | <29.6 | <80 |

Noise performance using the Model 2024 Spectroscopy Amplifier set at $0.5 \mu\text{s}$ unipolar near-Gaussian shaping.

PERFORMANCE

- Gain drift: $< 50 \text{ ppm per } ^\circ\text{C}$, $0\text{-}50 \text{ }^\circ\text{C}$
- Detector bias isolation: $\pm 200 \text{ V}$ dc maximum
- Noise: See Table 1
- Charge sensitivity: 0.45 V/pC
- Energy sensitivity: 20 mV/MeV (Si)
- Rise time: See Table 1

CONNECTORS

- Power: Amphenol 17-20090
- Detector input and energy output: BNC
- HV input: SHV
- Test input: SMA
- 300 cm (10 ft) preamp power cable is supplied with the preamplifier

POWER REQUIREMENTS

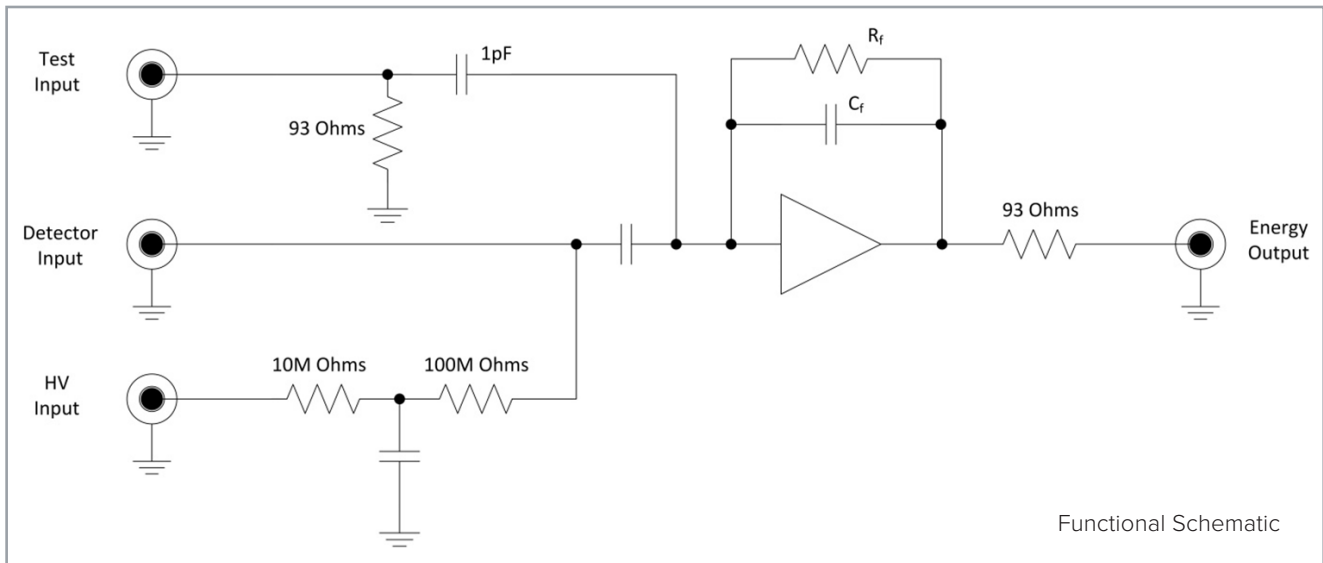
- $+ 12 \text{ V dc} - 50 \text{ mA}$
- $- 12 \text{ V dc} - 10 \text{ mA}$

PHYSICAL

- Size: $3.5 \times 2.0 \times 1.6 \text{ in.}$ ($90 \times 50 \times 40 \text{ mm}$)
- Net weight: 0.6 lb (0.25 kg)
- Shipping weight: 2.2 lb (1 kg)

ENVIRONMENTAL

- Operating temperature: $0 \text{ to } 50 \text{ }^\circ\text{C}$
- Operating humidity: $0 \text{ to } 80\%$ relative, non-condensing



SAFETY WARNINGS and OPERATION REQUIREMENTS

- The instrument should only be operated in the manner specified by Mirion Technologies.
- ⚠️ ⚠️ WARNING – During normal operation, a potentially hazardous high voltage bias is supplied to the detector via the preamplifier.
 - Only qualified personnel should carry out the installation, operation and maintenance of this preamplifier.
 - The preamplifier bias circuit can remain at high voltage for a long time. The user should exercise caution to prevent personal injury due to an electrical shock.
 - Switch off the bias supply to completely discharge the detector before connecting a cable to the detector input connector.
 - Bring the high voltage value to zero and wait for at least 30-60 seconds.
- ⚠️ ⚠️ WARNING – Do not open the preamplifier cover, opening the cover can expose you to high voltages.
- CLEANING – Disconnect all power supplies before cleaning. Do not allow water to enter the unit. Cleaning can be performed with isopropanol or deionized water on only the external surfaces.

