



SIGNAL PROCESSING

2015B™

AMP/TSCA

The utility of this amplifier derives from the dual function of its pulse height analyzer circuitry.

FEATURES

- Spectroscopy grade amplifier with high count rate restoration
- Timing single channel analyzer with:
 - SCA and LLD or ULD outputs
 - LLD threshold indicator for easy set-up
 - Preamp leading edge timing
- Designed for use with proportional counters, NaI(Tl), Ge, and Si detectors



DESCRIPTION

The Mirion Model 2015B unit combines, in one single width module, a spectroscopy amplifier with gated baseline restoration and a timing single channel pulse height analyzer.

The 2015B amplifier employs a simple gated baseline restorer which, because of its symmetrical characteristic, provides high resolution for HPGe detectors at low and high counting rates.

Although it is a high performance instrument, the 2015B unit is also very versatile. It has all the characteristics necessary to make it useful with scintillation detectors, gas proportional counters, and silicon detectors. High gain, low noise, selectable time constants, and count rate optimization are several of the more important features designed into the amplifier of the 2015B unit.

The utility of the 2015B amplifier derives from the dual function of its pulse height analyzer circuitry. In the SCA mode of operation, a logic signal output is generated whenever the amplifier unipolar signal falls between the energy levels determined by the front panel controls (E and ΔE). This mode is especially useful when a wide dynamic range is required.

In the Timing (TSCA) mode the same logic signal is generated, but it is referenced in time relative to the leading edge of the preamp signal. This provides a signal that is useful in applications requiring time coincidence.

In addition to the SCA OUTPUT, the 2015B unit also provides a multifunction capability which can be programmed internally to provide a lower level (E) Discriminator Output, or an upper level DISCRIMINATOR (E + ΔE) Output or to provide an external input level for remote control of the lower level discriminator.

Precise repeatable performance is designed and built into the 2015B unit. The front panel variable controls of the Model 2015B amplifier are precision ten-turn potentiometers. The precision of the ΔE window setting can be further enhanced by use of rear panel sensitivity selector switch (ΔE Range). A front panel LED indicator is provided to assist in set up and troubleshooting. The LED is activated from the lower level discriminator and is useful for setting the discriminator just above the noise.

SPECIFICATIONS

Inputs

- Input: Accepts positive or negative linear pulses from associated preamplifier; amplitude: ± 10 V divided by the selected gain, ± 12 V maximum; rise time less than shaping time constant; decay time constant $30 \mu\text{s}$ to ∞ ; $Z_{in} \approx 1 \text{ k}\Omega$; front and rear panel BNC connectors
- Flat-topped pulses must be at least eight shaping time constants wide to produce the correct near-Gaussian output waveform

Outputs

- AMP output: Provides prompt +10 V full scale unipolar OUTPUT; active filter near-Gaussian shaping; dc restored; dc level is factory calibrated to $0 \pm 5 \text{ mV}$ dc; short circuit protected, front and rear panel BNC connectors; front panel $Z_{out} < 1 \Omega$ or $\approx 93 \Omega$, internally selectable; rear panel $Z_{out} = 93 \Omega$
- SCA output: Provides a nominally 5 V (unterminated) 500 ns positive pulse, delayed approximately 200 ns past the peak of the AMP OUTPUT signal; rise time and fall time $\leq 25 \text{ ns}$; $Z_{out} = 50 \Omega$; BNC connectors located on front and rear panels; short circuit protected

Input/Output

- DISC: Rear panel BNC connector having a multi-function capability; lower level (E) DISCRIMINATOR OUTPUT, upper level (E + ΔE) DISCRIMINATOR OUTPUT, or LLD SWEEP INPUT; one of these three modes is internally selected with jumper plugs; shipped in E position

When used as:

- Lower Level (E) DISCRIMINATOR output: Provides a positive 5 V (unterminated), 500 ns pulse; rise time and fall time $\leq 25 \text{ ns}$; $Z_{out} = 50 \Omega$; the LLD pulse is generated when the positive edge of the AMP OUT signal crosses the Lower Level (E) threshold setting
- Upper Level (E + ΔE) DISCRIMINATOR output: Same as lower level DISCRIMINATOR except the pulse appears when the AMP OUT signal crosses the threshold set by the sum of the LOWER LEVEL (E) and WINDOW (ΔE) controls
- LLD sweep input: Accepts 0 to +10 V input to externally control the SCA's lower level discriminator; $Z_{in} = 5.1 \text{ k}\Omega$; dc coupled

Controls

- Coarse gain: Rotary switch selects gain factors of X4, X8, X16, X32, X64, X128
- Fine gain: Ten-turn precision locking dial potentiometer selects variable gain factor of X3 to X10
- P/Z: Front panel multi-turn screwdriver pole/zero adjustment optimizes the amplifier baseline recovery and overload performance for the preamplifier fall time constant and the main amplifier pulse shaping chosen; $30 \mu\text{s}$ to ∞ preamp fall time constant range
- Input: Toggle switch sets the Model 2015B unit for the polarity of the incoming preamplifier signal
- Time constants: Internal pushbutton switch selects SHAPING TIME constant of $0.5 \mu\text{s}$ or $2.0 \mu\text{s}$; factory set to $2.0 \mu\text{s}$
- Lower Level (E): Ten-turn locking dial precision potentiometer selects a baseline from 0.1 V to 10 V for the timing SCA mode, and $0 \pm 15 \text{ mV}$ to 10 V for the normal SCA mode
- Window (ΔE): Ten-turn locking dial precision potentiometer selects window width from 0 to 10 V or 0 to 1 V depending on the position of the rear panel ΔE RANGE switch
- ΔE Range: Rear panel toggle switch selects the front panel WINDOW (ΔE) range as 0 to 10 V or 0 to 1 V, full scale
- LED Indicator: Aids in setting the LLD just above the system noise

Internal Controls

- Z_{out} : Jumper plug selects AMP OUTPUT impedance of $\leq 1 \Omega$ or $\approx 93 \Omega$; factory set to $\leq 1 \Omega$
- DISC B: Jumper plug sets the rear panel DISC BNC connector as an output or input; factory set to OUT
- DISC A: Jumper plug sets the rear panel DISC BNC connector to output the Lower Level (E) Discriminator or the Upper Level (E + ΔE) discriminator when DISC B is in the OUT position; factory set to ULD
- LLD: Jumper plug sets the LOWER LEVEL discriminator threshold for Internal or EXternal; if EXternal with DISC B set to IN, the rear panel DISC BNC connector can be used as the LLD SWEEP input; factory set to IN
- SCA MODE: Jumper plug which allows the SCA to operate in the TSCA or SCA mode; factory set to TSCA



PERFORMANCE

Amplifier

- Gain: Continuously variable from X12 to X1280; product of COARSE and FINE GAIN controls
- Gain drift: $< \pm 0.0075\%/^{\circ}\text{C}$
- DC level drift: $< \pm 50 \mu\text{V}/^{\circ}\text{C}$
- Integral nonlinearity: $\leq \pm 0.05\%$ of full scale
- Overload recovery: Recovers to $\pm 2\%$ of full scale output in two pulse widths for a X1000 overload with pole/zero cancellation properly set
- Noise contribution: $< 7 \mu\text{V}$ referred to the INPUT for gains $\geq 100\text{X}$ and $2 \mu\text{s}$ SHAPING
- Pulse shaping: Near-Gaussian shape; one differentiator, two active integrators and only one secondary time constant; time to peak $\approx 1.75 \text{ X}$ shaping time constant
- Restorer: Active, gated
- Spectrum broadening: FWHM of a ^{60}Co 1.33 MeV gamma peak for an incoming count rate of 2 kcps to 50 kcps and a 9 V pulse height will change less than 16%. These results may not be reproducible if associated detector exhibits an inordinate amount of long rise time signals
- Peak stability: The peak position of a ^{60}Co 1.33 MeV gamma peak for an incoming count rate of 2 kcps to 50 kcps and a 9 V pulse height will shift less than 0.025%

SCA

- By resetting an internal jumper, the SCA OUTPUT can be used as an SCA referenced to the AMP OUTPUT crossing the LOWER LEVEL (E) discriminator or as a Timing SCA referenced to the leading edge of the amplified preamp signal; shipped in the Timing SCA mode
- TSCA output timing: ≈ 200 ns from the peak of the AMP OUT signal
- TSCA output walk: $\leq \pm 50$ ns for a 50:1 change in the AMP OUTPUT signal amplitude
- Integral nonlinearity: $\leq \pm 0.25\%$ of full scale range for LOWER LEVEL (E) and WINDOW (ΔE)
- Pulse pair resolution: With the SCA driven from a rectangular shaped pulser for LOWER LEVEL (E) thresholds ≥ 100 mV, the pulse pair resolution is ≤ 500 ns over the full linear range for the DISC (LLD) output
- Temperature drift (E and ΔE): $\leq \pm 0.005\%$ of full scale/ $^{\circ}\text{C}$ (50 ppm)
- Power supply sensitivity: Unmeasurable

Connectors

- Signal connectors: BNC type
- Preamp power: Rear panel, Amphenol 17-10090

Power Requirements

- +24 V dc – 70 mA +12 V dc – 120 mA
- –24 V dc – 25 mA –12 V dc – 120 mA

Physical

- Size: Standard single-width NIM module 3.43 x 22.12 cm (1.35 x 8.71 in.) per DOE/ER-0457T
- Net weight: 1.1 kg (2.5 lb)
- Shipping weight: 2.3 kg (5.0 lb)

Environmental

- Operating temperature: 0 to 50 $^{\circ}\text{C}$
- Operating humidity: 0-80% relative, non-condensing
- Meets the environmental conditions specified by EN 61010, Installation Category I, Pollution Degree 2

