MODEL 109 PREAMPLIFIER

FEBRUARY 1966

Features

- Field-effect transistor input stage
- Suitable for semiconductor and gas ionization counters
- All silicon transistors
- Output compatible with all shaping type main amplifiers
- Nonmicrophonic
- Charge-sensitive input circuit
- 10:1 gain change, switch selectable
- May be powered from ORTEC transistor main amplifiers or remote supplies

Description

The ORTEC Model 109 Preamplifier is an all silicon transistor instrument which has been designed for semiconductor and gas ionization detectors. The unit is compatible with ORTEC transistor main amplifiers or other main amplifiers which provide signal pulse shaping. The printed circuit assembly is housed in an anodized extruded aluminum case.

Specifications

Noise level, relative amplitude, and output pulse rise time are functions of the input capacitance due to the detector, cables, and connectors. Typical performance is tabulated below.

TYPICAL PERFORMANCE

Input cap. (pF)	*Noise, with 1 μsec RC Main Amp*			*Preamp output pulse*	
	keV (fwhm,Si)	*keV (fwhm,Ge)*	*rms electrons*	*Relative amplitude*	*Rise time (nsec) 10-90%*
0	2.6	2.0	307	1.000	39
20	4.4	3.4	520	1.000	68
50	7.5	5.8	885	1.000	125
100	13.3	10.4	1570	.990	230
200	22.2	17.3	2620	.960	395

Warranty basis: ≤2.9 keV Si at 0 pF external capacitance

Output pulse shape: Rise time as in table above; exponential fall with 50μsec time constant

Integral nonlinearity: ≤0.1% for 0-1.5V output span

Temperature coefficient: ±0.01% per °C

Detector bias isolation: 1000V dc

Input open loop gain: >5000

Power required: +24 dc at 15 mA, −24V dc at 15 mA; supplied from ORTEC main amplifier or remote supply

Cable required: 10-foot compatible cable supplied with preamplifier

Power connector: Amphenol 17-20090

Saturated output amplitude: 7V at end of several hundred feet of unterminated 93-ohm cable

Output source impedance: Adjustable from 50 to 150 ohms

Charge sensitivity: 150 mV/MeV in ×10 gain position
15 mV/MeV in ×1 gain position

Detector, output, and test pulse connectors: BNC

Detector bias connector: MHV

Size: 1.75 × 4 × 6 inches (4.45 × 10.2 × 15.3 cm)

Weight: Net, 1.5 pounds (0.68 kg); gross, 2.3 pounds (1.05 kg)

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MODEL 109PC PREAMPLIFIER MODIFIED FOR PROPORTIONAL COUNTERS

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Specifications

The ORTEC Model 109PC Preamplifier is a special version of the standard Model 109, containing circuit revisions that make it suitable for use with proportional counters used in low energy x-ray or gamma-ray spectrometry. The modifications consist of changes in the input circuit connector and capacitors so as to accommodate up to 3000 volts bias on the counter, a longer clipping time, and a reduction in the value of the detector load resistor so as to minimize counter voltage variations with signal current. These modifications result in poorer noise performance of the preamplifier compared to the standard version; however, the resultant performance with the proportional counter is superior (~355 rms electrons at 0 pF; slope, 9.4 electrons per pF).

This modified preamplifier is intended for application with proportional counters such as the Reuter-Stokes RSG-30A for such purposes as low energy x-ray or gamma-ray spectrometry or counting where the theoretical limit of energy resolution is desired. It has been found in some proportional counter tubes that at high gas amplification factors there may be a significant shift in peak position with simultaneous peak broadening due to space charge effects. For example,* with the Reuter-Stokes RSG-30A proportional counter tube with 90% xenon, 10% methane gas operating at applied voltage of 2400 volts and a source of Ag$K\alpha$ (22.16 keV) x-rays, as the count rate is changed from a few counts per second to about 5000 counts per second, the peak position shifts approximately the full width at half maximum (fwhm) of the peak. A satisfactory method for reducing this effect to within acceptable limits is to reduce the gas amplification factor considerably. This, in turn, reduces the output signal from the proportional counter tube so drastically that a low noise preamplifier such as the Model 109PC is necessary to amplify the signal. Gratifying improvement is achieved over cathode followers or white follower circuits which are usually quite noisy when compared with a low noise preamp such as the Model 109PC.

Note that the Model 109PC provides pulse shaping consisting only of a 200-microsecond time constant single clip, for pileup prevention in the preamplifier. It must be followed by a suitable shaping type main amplifier such as the ORTEC Model 410.

Charge gain of the 109PC is 3.36×10^{12} volts/coulomb (0.540×10^{-6} volts/electron or 150 mV/MeV with silicon solid state detectors), reducible one-tenth by the gain switch. The detector load resistor is 22 megohms.

*Reference: R. W. Hendricks, to be published.