Models H242A and H242B Preamplifiers Operating and Service Manual

This manual applies to instruments marked
"Rev 02" on Serial Number Tag

Printed in U.S.A.

3156 02C 0581

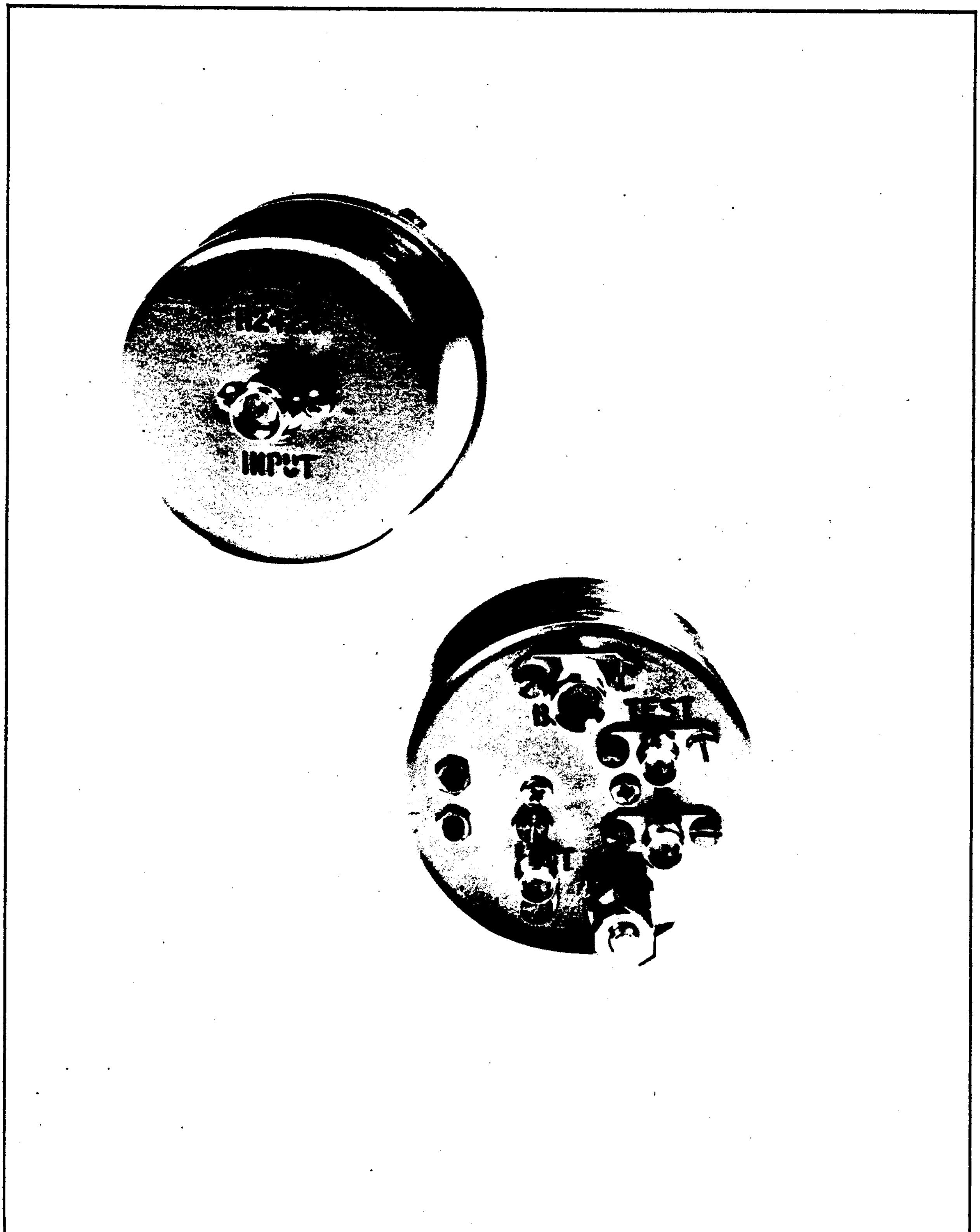
IMPORTANT

A metal mounting clamp has been supplied with your H242 preamp. This clamp should be used to mount the preamplifier to the chamber wall when used within a vacuum enclosure. The clamp will serve as a thermal path between the detector-preamplifier and the metal chamber wall, thus limiting the temperature rise of the detector and electronics. Failure to use a suitable heat sink mounting within a vacuum chamber may result in an unacceptable temperature rise for the preamp and detector. Resolution degradation may occur if the surface barrier detector temperature is allowed to increase above 21^0C.

For applications where the H242 will not be in a vacuum, and where the detector is mounted directly to the preamp (without cable between the two parts) some slight improvement in resolution might be obtained if the preamp is mounted to a metal heat sink by use of the clamp. This improvement would be caused by the reduced temperature rise of the detector.

CONTENTS

ILLUSTRATIONS


INPUT
TEST

IMPORTANT NOTICE

This preamplifier has no input protection provisions. Under normal operating procedures and conditions, this will not present a problem. The following operating procedures and precautions are recommended:

1. **COMPLETELY DISCHARGE** the detector bias circuit before connecting a low impedance or a cable, capacitor, or other capacitive device to the Detector Input connector on the preamplifier.

2. Discharge the detector bias circuitry before making **ANY** connections to the Detector Input connector and before disconnecting the preamplifier from the detector.

3. To discharge the detector bias circuitry, remove any high voltage bias and wait 20 seconds, then connect a low impedance (preferably a short circuit) across the Detector Bias connector on the preamplifier for at least 20 seconds.

The input circuit will be destroyed if the Detector **INPUT** connector is shorted while the detector bias components are charged, and the quality of these capacitors is such that they will retain a charge for a long period of time. Such a short could result from connecting a detector, cable, capacitor, or other capacitive device such as a voltmeter probe. A short circuit, either short term or continuous, will cause the applied bias voltage (stored on C2) to be coupled through C2 directly to the input transistor, causing a catastrophic breakdown.

If a variable supply is used, merely turning down the voltage control to zero and leaving it for at least 20 seconds will suffice, since the bias circuitry will discharge itself through the output of the bias supply.

Sometimes, as when using batteries for bias, it is necessary to simply disconnect the bias supply. This situation leaves no discharge path, so a path must be provided by placing a short circuit or low impedance across the Detector Bias connector on the rear panel of the unit. **DO NOT SHORT** the Detector Input connector on the front panel.

EG&G ORTEC Models H242A and H242B Preamplifiers

1. DESCRIPTION

The EG&G ORTEC H242A and H242B Preamplifiers are charge-sensitive units, designed for use with silicon surface-barrier detectors. The preamplifiers can be operated in a vacuum chamber, permitting very short input cables for lowest input capacitance. The preamplifiers provide a separate, very fast, timing pickoff allowing the energy channel to be optimized for energy resolution and the timing output to be optimized for time resolution. The H242A is designed to operate over a detector capacitance range of 0 to 100 pF. The H242B is designed to operate over a detector capacitance range of 100 pF or more. The H242A can operate with capacitances larger than 100 pF; however, in such applications, the H242B will have better performance in both the energy and timing modes.

The H242A preamplifier has a low noise intercept and a moderate slope while the H242B has a moderate intercept and a low slope. The H242B is preferred for high capacitance detectors to provide the best energy resolution. The energy range expected in typical applications is from 0 to 200 MeV.

Two simultaneous outputs are provided; the output marked E is for energy measurements and the output marked T is for timing applications. Either or both outputs may be used as desired, since their circuits are independent. For best results, however, the T output should be terminated in 50Ω when not in use. The H242B timing output has additional gain with minimal rise time degradation (as compared to the H242A) to provide a larger timing signal for large capacitance detectors. The typical EG&G ORTEC modules that can use the timing signals from the H242A and H242B include the 934 and 583 discriminators, 574 timing amplifier, and the 474 timing filter amplifier.

A bias circuit is included to accept the operating voltage required by the surface-barrier detector. The bias input circuit in the preamplifier includes a 100-MΩ load resistor, and any detector leakage current will pass through this high resistance. A considerable voltage drop will be expected across this load resistor when used with a high-leakage detector and must be accounted for when biasing the detector.

The H242A and H242B preamplifiers contain no user serviceable components; however, if the case is opened, observe the following instructions:

1. Do not touch the high-value resistors, R3 and R5, with your fingers; the presence of skin oil can reduce the resistance of the component.

2. To prevent shock, observe the steps detailed in IMPORTANT NOTE at the front of this manual, to discharge the high voltage; the capacitors in this preamplifier are of very high quality and retain a charge much longer than is normally expected.

2. SPECIFICATIONS

2.1. ENERGY CHANNEL PERFORMANCE

NOISE Based on silicon equivalent of $\epsilon = 3.6$ eV at $\tau = 2\ \mu s$ (see Fig. 2.1).

H242A

Detector Capacitance (pF)	Typical Noise (keV)	Max. Noise Guaranteed (keV)
0	1.40	1.60
20	1.80	–
50	2.15	–
100	3.40	3.60

Typical intercept, 1.40 keV.
Typical slope, 20 eV/pF.

H242B

Detector Capacitance (pF)	Typical Noise (keV)	Max. Noise Guaranteed (keV)
100	3.00	4.00
200	4.70	–
500	9.40	–
1000	18.00	19.00

Typical intercept, 3.0 keV.
Typical slope, 16.7 eV/pF.

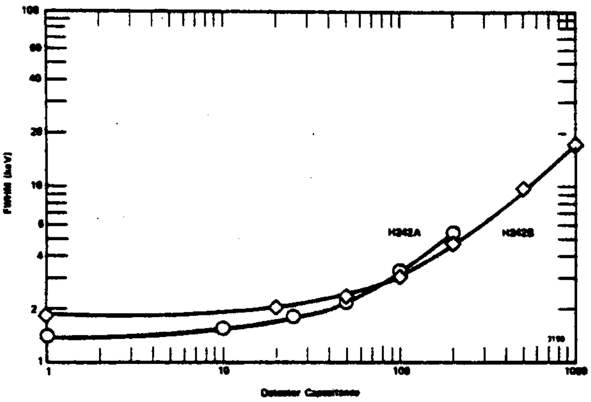


Fig. 2.1. Typical Noise Data for H242A and H242B Preamplifiers (Using EG&G ORTEC 572 Amplifier with 2.0-μs Shaping Time Constant).

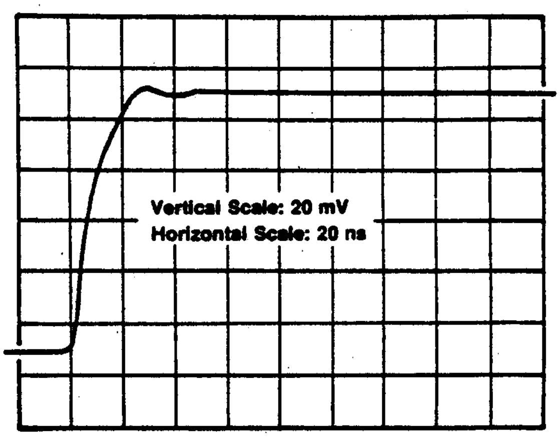


Fig. 2.2. H242A Energy Channel Output. (C_D = 0 pF.)

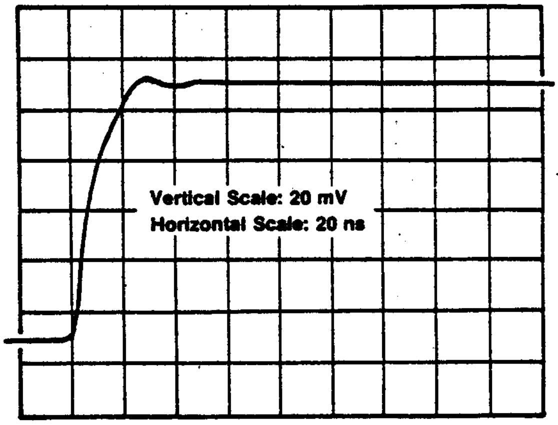


Fig. 2.3. H242B Energy Channel Output. (C_D = 100 pF.)

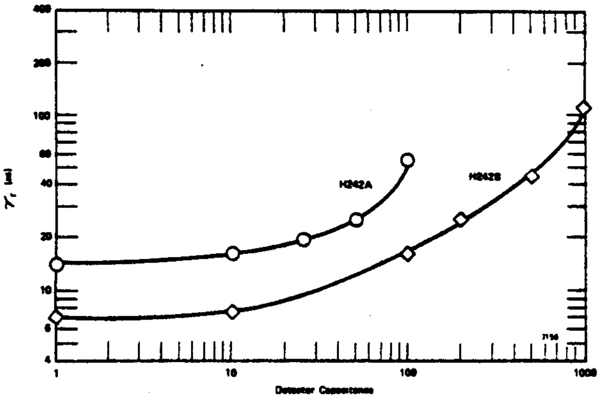


Fig. 2.4. Typical Energy Channel Rise Time Data for H242A and H242B Preamplifiers. Values for +0.5 V Signal into 93Ω.

RISE TIME Based on a 10 MeV signal into a 93Ω circuit, measured from 10% to 90% of final value (see Figs. 2.2, 2.3, and 2.4).
H242A ≤20 ns at 0 pF; ≤150 ns at 100 pF.
H242B ≤20 ns at 100 pF; ≤150 ns at 1000 pF.

CONVERSION GAIN (Charge Sensitivity)
H242A 45 mV/MeV.
H242B 20 mV/MeV.

INTEGRAL NONLINEARITY ≤0.05% guaranteed (typically ≤0.01%) for 0 to ±7 V open circuit, 0 to ±3.5 V terminated.

TEMPERATURE INSTABILITY
H242A <75 ppm/°C, 0 to 50°C.
H242B <75 ppm/°C, 0 to 50°C.

DETECTOR BIAS ISOLATION ±750 V dc.

DYNAMIC INPUT CAPACITANCE
H242A >20,000 pF at 2 μs; typically >30,000 pF.
H242B >30,000 pF at 2 μs; typically >50,000 pF.

2.2. TIMING CHANNEL PERFORMANCE

INPUT NOISE POWER SPECTRAL DENSITY
H242A Typically 0.80 nV/Hz$^{1/2}$. (15 μV rms referred to input.)
H242B Typically 0.65 nV/Hz$^{1/2}$. (10 μV rms referred to input.)

RISE TIME Measured into 50Ω, 10% to 90% final value. (See Fig. 2.5).
H242A Typically <1.0 ns for any value detector capacitance.
H242B Typically <1.5 ns for any value detector capacitance.

CONVERSION GAIN
H242A $G = (440/C_{in})$mV/MeV.
Where C_{in} = Detector capacitance (pF) plus 30 pF.
H242B $G = (4400/C_{in})$mV/MeV.
Where C_{in} = Detector capacitance (pF) plus 45 pF.

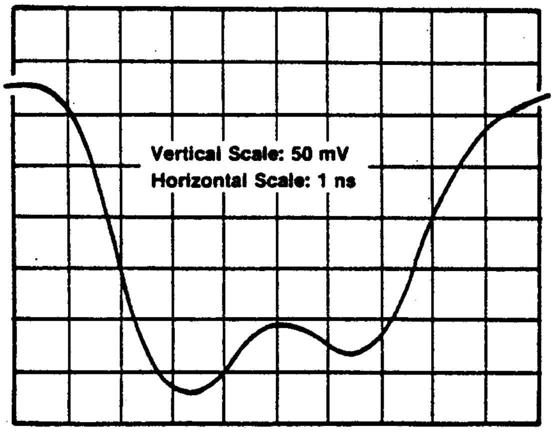


Fig. 2.5. Typical Timing Channel Output.
(H242B Shown, C_D = 0 pF, Corrected Rise Time = 0.8 ns.)

2.3. INPUTS

INPUT Accepts input signals from semiconductor charged-particle detector and provides operating bias to detector.

BIAS Accepts detector bias voltage from power supply.

TEST Accepts input voltage pulses from pulse generator for instrument and system calibration; R_{in} = 93Ω.

2.4. OUTPUTS

ENERGY CHANNEL Furnishes the output signals through R_o = 93Ω for energy measurements; polarity is opposite from input pulse polarity.

TIMING CHANNEL Furnishes a differentiated output signal compatible with typical 50Ω timing requirements; polarity is the same as the input polarity. Differentiation time constant is 50 ns.

2.5. CONNECTORS

TEST, E, AND T SMA female.

INPUT, HIGH VOLTAGE SMA male.
POWER CABLE 8-in. captive power cable, and 10-ft bias cable.

NOTE: A complete series of mating connectors and cables, including vacuum feedthroughs and connectors, is available from EG&G ORTEC.

2.6. ELECTRICAL AND MECHANICAL

POWER REQUIRED Furnished from any EG&G ORTEC main amplifier or an EG&G ORTEC 114 Power Supply through the built-in captive cable.

H242A +12 V, 15 mA; −12 V, 2 mA; +24 V, 17 mA; −24 V, 9 mA.
H242B +12 V, 23 mA; −12 V, 2 mA; +24 V, 29 mA; −24 V, 9 mA.

DIMENSIONS 1.875 in.-diameter by 1-in. high.

WEIGHT
Shipping 2 lb 6 oz. (1.08 kg).
Net 0.06 lb (0.03 kg).

3. INSTALLATION

3.1. CONNECTION TO DETECTOR

A direct connection, using 93Ω or 100Ω shielded cable, should be made between the detector and the Input connector on the preamplifier. The interconnecting cable, which acts as an impedance transformer, must be kept as short as possible in order not to degrade the wide bandwidth of the preamplifier. This will not only minimize the preamplifier noise (due to the capacitive loading of the cable) but will also maintain the stability of the preamplifier. (The complex impedance presented to the preamplifier input, due to transmission line effects acting on the detector system impedance, can disrupt the stability of the entire system.)

Due to variations in the detector system, a definite maximum cable length cannot be specified but is typically 6 inches. The length of input cable will also affect the shape of the timing output, as shown in Section 4.4, and should be kept to a minimum value.

Type RG-62/U cable is recommended for the detector-to-preamplifier connection. This is 93Ω cable with a capacitance of 13.5 pF/ft.

After the input cable has been installed, the electronic noise performance of the preamplifier can be predicted by adding the capacitance furnished by the detector to the capacitance of the cable. The cable capacitance can be calculated from its length and its rated capacitance per foot.

Figures 2.1 and 2.2 show typical performance for the H242A and H242B, based on the total input capacitance.

3.2. ENERGY OUTPUT CONNECTION TO MAIN SHAPING AMPLIFIER

The E output of the preamplifier can be used to drive a long 93Ω cable to a shaping main amplifier and is designed to be directly compatible with EG&G ORTEC main amplifiers. It can be used with any shaping main amplifier if a power supply is used to furnish preamplifier power requirements identical to those available on all EG&G ORTEC main amplifiers.

3.3. TIMING OUTPUT CONNECTION TO TIMING MODULES

The T output of the preamplifier can be used to drive a long terminated 50Ω cable to a timing module. A typical timing module is a fast discriminator or an additional amplifier, where necessary. When not being used, the T output should be terminated in 50Ω.

For a positive detector bias voltage polarity, the T output signal polarity is negative, since the timing channel is non-inverting with respect to the detector output. For EG&G ORTEC ruggedized surface-barrier detectors which require a negative detector bias polarity, the timing output will be positive. This signal can be inverted using an amplifier or an IT 100 inverting transformer.

3.4. INPUT OPERATING POWER

Power for the H242A or H242B is supplied through the captive power cord and 9-pin Amphenol connector. This connector can be attached to the mating power connector on any EG&G ORTEC main amplifier or on an EG&G ORTEC 114 Preamplifier Power Supply. The preamplifier's power requirements must be added to the operating power requirements of the amplifier or power supply to which it is connected.

3.5. TEST PULSE

A voltage test pulse for energy calibration can be connected through the Test input connector on the H242A or H242B without the use of an external terminator. The Test input of the preamplifier has an input impedance of 93Ω and its circuitry provides charge injection to the preamplifier input. The shape of this pulse should offer a fast rise time (less than 10 ns) followed by a slow exponential decay back to the baseline (200 to 400 μs). While test pulses are being furnished to the Test input, connect either the detector (with bias applied) or its equivalent capacitance (including input cable capacitance) to the Input connector on the preamplifier.

The Test input may be used in conjunction with a pulser such as the EG&G ORTEC 419 or 448 to calibrate the preamplifier E output amplitude in terms of energy or for multichannel analyzer calibration. Note: due to stray coupling between the test circuit and other portions of the preamplifier circuitry, the transient performance of the preamplifier is best determined by connecting the actual detector signal to the Input connector.

A voltage test pulse for transient response in the preamplifiers can be applied, through a charge terminator, to the detector Input connector. If external capacitance is to be included for these tests, a BNC Tee can be inserted between the Input connector and the charge terminator, and this will then accommodate the test capacitances. Do not apply any bias during these tests.

3.6. DETECTOR BIAS INPUT

Operating bias for the detector is supplied to the Bias connector on the preamplifier and, through a filter and a large bias resistor, to the input circuitry downstream from the Input signal connector. Bias is applied to the detector via the cable connected to the Input connector.

Connect a cable from the detector bias supply (EG&G ORTEC 428 is typical) to the Bias connector on the preamplifier.

4. OPERATION

4.1. GENERAL

Figure 4.1 is a simplified block diagram of the circuitry in an EG&G ORTEC H242A or H242B Preamplifier. The energy section is a conventional charge loop with the conversion gain determined by the feedback capacitor C_f. The decay time is controlled by R_f and C_f.

The timing output is derived from the integrator error signal and the amplitude is inversely dependent upon detector capacitance as given in Section 2. The output rise time is controlled by the rise time of the FET and associated gain stages. The fall time is controlled by the rise time of the charge sensitive amplifier.

4.2. DETECTOR BIAS

The required detector bias is specified in the data furnished with the detector. Bias applied to the preamplifier through the SMA Bias connector is furnished through R2 and R3 (approximately 100 MΩ) to the Input connector. If the detector leakage current is appreciable, a large voltage drop will occur across the series load resistor in

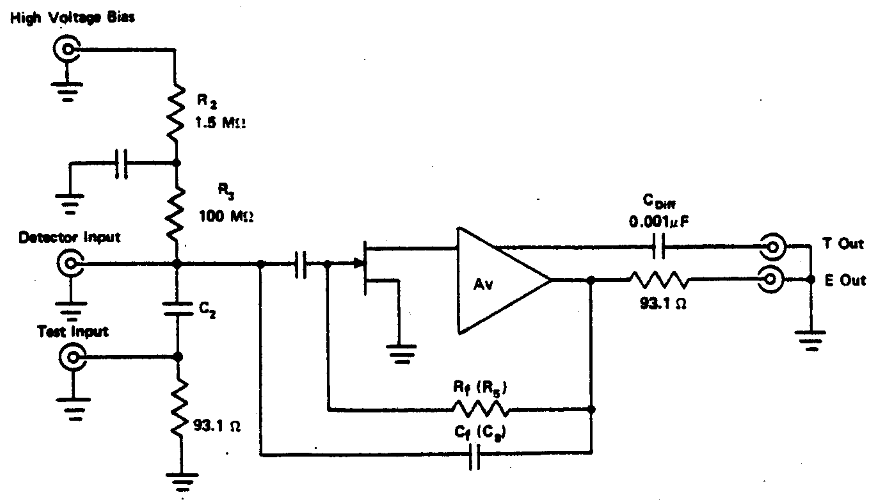


Fig. 4.1. Simplified Block Diagram of EG&G ORTEC H242A and H242B Preamplifiers.

the bias circuitry, and this must be added to the detector requirement when adjusting the bias supply.

4.3. ENERGY OUTPUT

The charge-sensitive loop is essentially an operational amplifier with capacitive feedback. The feedback capacitor in the H242A is C_f, with a value of 1 pF. The conversion gain is nominally 45 mV/MeV. The H242B feedback capacitor is 2 pF. The conversion gain is nominally 20 mV/MeV.

The energy output is a voltage step (rise time ≈ 10 ns to 150 ns, depending on detector capacitance) with an exponential return to the baseline. The decay time constant is 500 μs for the H242A and 1000 μs for the H242B. The polarity of the energy output is inverted from the polarity of the detector signal. When the (normal) positive bias polarity is used for the detector, the detector output pulses are negative and the E output of the preamplifier is positive, as shown in Figs. 2.2 and 2.3. When EG&G ORTEC ruggedized surface-barrier detectors are used with the preamplifier, negative bias is required and this results in positive detector pulses and negative E output pulses from the H242A or the H242B.

4.4. TIMING OUTPUT

As indicated in Fig. 4.1, the timing output is derived from the integrator error signal. The conversion gain is determined by gm A_i R, where gm is the FET transconductance. A_i is an integral current gain, and R is an internal load resistor. The H242A has a voltage gain of 10 and the H242B has a voltage gain of 100. This can be converted to a conversion gain of T_o = (440 mV/E)/C_{in} for the H242A where E is the energy in MeV and C_{in} is the detector plus input capacitance in pF. Similarly the conversion gain for the H242B is T_o = (4400 mV/E)/C_{in}.

Figure 4.2 shows, for the H242A, the timing output voltage versus energy input for detector capacitances up to 100 pF. Figure 4.3 shows, for the H242B, the timing output voltage versus energy input for detector capacitances up to 1000 pF.

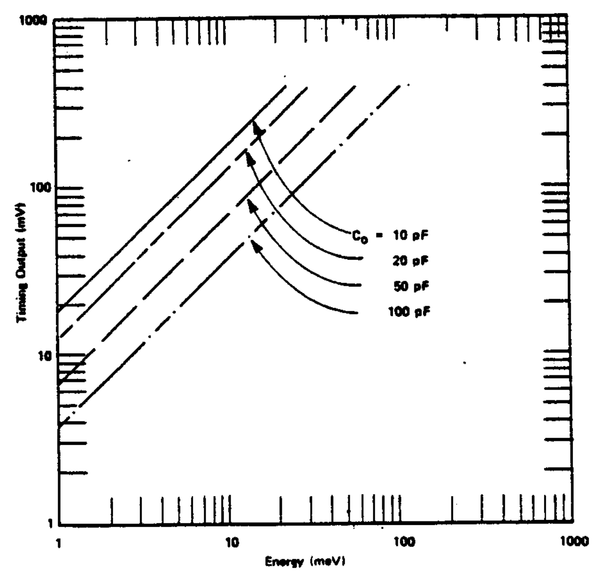


Fig. 4.2. H242A Timing Output Voltage vs Energy Input for Detector Capacitances up to 100 pF.

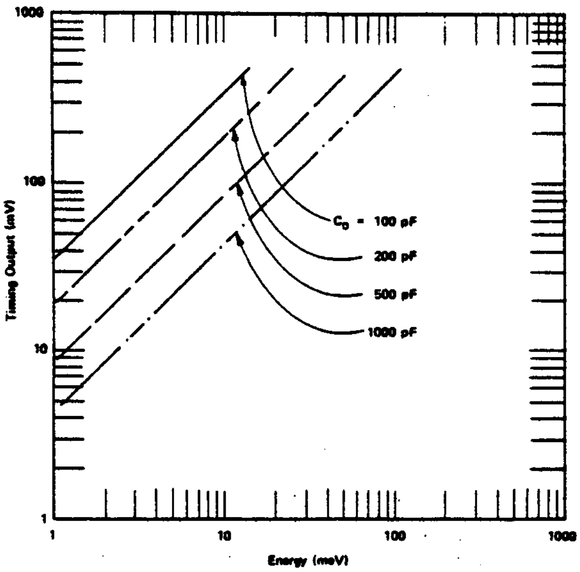


Fig. 4.3. H242B Timing Output Voltage vs Energy Input for Detector Capacitances up to 1000 pF.

The timing output is differentiated by C_{Diff} and the terminating resistor (50Ω) for a time constant of 50 ns. This differentiation will remove low-frequency noise for better timing results.

The timing output is shown in Fig. 2.5 for a pulser input with no detector connected. The rise time is measured from 10% to 90% of final value, not the peak value. If a test input is used to check the timing output rise time, it is best done by applying the input through a charge terminator directly to the input of the preamplifier. During this test, no capacitance should be connected to the input as the results will be strongly controlled by the high frequency characteristics of the capacitor and not the preamplifier. The effect of the capacitor is dependent upon type of capacitor, size, physical construction, and mounting.

The Test Input may be used to aid in setting up experiments and verifying system operation. However, the timing output shape will depend upon the delay due to cable length between preamplifier and detector and size of detector. The delay will introduce distortion as shown in Fig. 4.4 for a cable separation of 5 in. using a 100 pF detector.

The timing section is optimized for minimum cable length between detector and preamplifier. However, cable lengths of up to 6 in. give good results. The cable length does not affect the shape of the energy output.

4.5. INPUT PROTECTION IMPORTANT NOTE

The H242A and H242B preamplifiers have no provision for input protection and it is highly recommended that the operating procedures outlined at the front of the manual be followed.

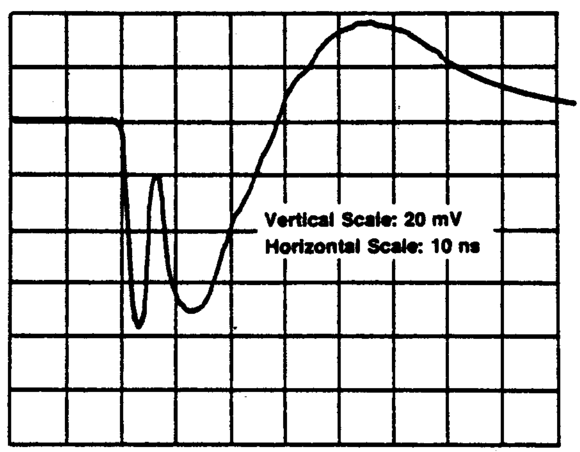


Fig. 4.4. Timing Output Signal Showing Effects of 5-in. Detector Cable When Using Test Input.

5. MAINTENANCE INSTRUCTIONS

5.1. TESTING PERFORMANCE

As ordinarily used in a counting or spectroscopy system, the preamplifier is one part of a series system involving the source of particles to be analyzed, the detector, the preamplifier, the main amplifier, and the pulse height analyzer. When proper results are not being obtained and tests are indicated to check for proper performance of the preamplifier and the other components, it is important to realize that rapid and logical testing is possible only when the individual components are separated from the system. In proving the performance of the preamplifier, it should be removed from the system and be dealt with alone, by providing a known electrical input signal and testing for the proper output signals with an oscilloscope as specified below.

1. Furnish a voltage pulse to the Test connector, as outlined in Section 3.5. The polarity of the test pulse signal should agree with the expected signal input polarity from a detector.

2. Using a calibrated pulser, the H242A E output should be inverted from the input polarity and should have a nominal scale factor of 45 mV output per 1 MeV equivalent energy (Si). The H242B E output should be inverted from the input polarity and have approximately 20 mV per 1 MeV input equivalent energy.

The timing output should have the same polarity as the input signal and, for the H242A, an amplitude given by $V_{0T} = (440/C_{in})$mV/MeV, where E is the energy in MeV and C_{in} is the total input capacitance in pF. C_{in} will depend upon the various connectors used and may be as high as 30 pF. The output for the H242B will be given by $V_{0T} = (4400/C_{in})$mV/MeV, where C_{in} is in pF. C_{in} will depend upon the various connectors used and may be as high as 45 pF for the H242B.

3. The noise contribution of the energy channel may be verified by two basic methods. In either case, the normal capacitance of the detector and associated cables should be replaced by a capacitor of equal value connected across the input connector. This is essential because the noise contribution of the preamplifier is dependent upon input capacitance, as can be seen from the noise specifications given in Section 2. The only meaningful statement of the noise level of the preamplifier is one that relates to the spread, caused by that noise, in actual spectra. This can be measured and expressed in terms of the full width at half maximum (FWHM) of a monoenergetic signal after passing through the preamplifier and main amplifier system. The noise performance referenced in Section 2 is stated in these terms, and verification methods will be described. If desired, the preamplifier can be tested with no external capacitance on the input connector, in which case the noise width should be approximately that shown for zero external capacitance. In any case, the input connector, and capacitors when used, should be completely shielded electrically. A wrapping of aluminum foil around the Input connector or a shielding cap attached to the connector will suffice for testing at zero capacitance.

4. The preamplifier must be tested in conjunction with an associated main amplifier which provides the required pulse shaping. The typical noise performance given in Section 2 is obtained using an EG&G ORTEC 572 Spectroscopy Amplifier on which the time constants have been set as specified. For comparison with these tabulated values, it is preferable to test the preamplifier under identical pulse-shaping conditions. It is also important to ensure that the noise level of the input stage of the associated main amplifier does not contribute materially to the total noise. This is usually not a problem, provided that input attenuators, if any, on the main amplifier are set for minimum attenuation.

5. If a multichannel analyzer is used following the main amplifier, testing of the noise performance can be accomplished by merely using a calibrated test pulse generator with charge terminator. With only the charge terminator connected to the Input of the preamplifier, the spread of the pulser peak thus analyzed will be due only to the noise contribution of the main preamplifier and main amplifier. The analyzer can be calibrated in terms of keV per channel by observing two different pulser peaks of known energy, and the FWHM of a peak can be computed directly from the analyzer readout.

6. It is also possible to determine the noise performance of the preamplifier by the use of a wide-bandwidth, rms, ac voltmeter such as the Hewlett-Packard 3400A, reading the main amplifier output noise level and correlating with the expected pulse amplitudes per keV of input signal under the same conditions. Again, a calibrated test pulse generator is required for an accurate measurement. In this method the preamplifier and main amplifier are set up as they would be used normally, but with a dummy capacitor (or no capacitance) on the Input connector of the preamplifier, and with the ac voltmeter connected to the main amplifier output. The noise voltage indicated on the meter, designated E_{rms}, is read and noted. Then a test pulse of known energy, E_{in} (in keV), is applied to the Input and the amplitude of the resulting output pulse, E_{out}, is measured, in volts, with an oscilloscope. The spread due to noise can then be calculated from the formula

$$\text{FWHM (keV, Si det)} = 2.35\,(E_{rms})\,(E_{in})/E_{out}$$

where E_{rms} is output noise in volts on the 3400A meter, E_{in} is input signal in keV particle energy, and E_{out} is output signal in volts corresponding to the above input. If the gain of the shaping amplifier is adjusted so that the output pulse height is 2.35 V for an input of 1 MeV equivalent charge, then the rms meter will be calibrated directly in energy (1 mV = 1 keV).

7. The noise performance of the preamplifier, as measured by these methods, should not differ significantly from that given in the specifications in Section 2.

8. If, during testing of the preamplifier and detector, the noise performance of the preamplifier has been verified as outlined in the preceding section or is otherwise not suspected, a detector may be tested to some extent by duplicating the noise performance tests with the detector connected in place and with normal operating bias applied. The resulting combined noise measurement, made either with an analyzer or by the voltmeter method, indicates the sum, in quadrature, of the separate noise sources of the amplifier and the detector. The total noise is given by $(N_{tot})^2 = (N_{det})^2 + (N_{amp})^2$. Each quantity is expressed in keV FWHM.

9. The quantity N_{det} is known as the "noise width" of the detector, and is included as one of the specified parameters of each EG&G ORTEC semiconductor detector. By use of the above equation and with a knowledge of the noise of the preamplifier, the noise width of the detector can be determined. The significance of this noise width in evaluating the detector is subject to interpretation, but generally the actual resolution of the detector for protons or electrons will be approximately equal to the noise width; the resolution of the detector for alpha particles will be somewhat less than the noise width. The most useful application of determining the noise width of a detector is in the occasional monitoring of this property to verify that the detector characteristics have not undergone any significant change during use.

10. The noise of the timing output can be measured most easily by looking at the peak-to-peak noise signal on an oscilloscope with a bandwidth of at least 500 MHz.

11. The rise time of the energy channel can be measured using an EG&G ORTEC 419 Precision Pulse Generator with a matched charge terminator. Connect the 419 output through the charge terminator to the H242A or H242B input and apply a 10 MeV signal. Terminate the Energy output into a 93Ω load and use a fast oscilloscope. The rise time of the energy output, τ_{rE}, is given by

$$\tau_{rE} = \sqrt{\tau_{rsys}^2 - \tau_{rps}^2}$$

where τ_{rsys} is the rise time observed on the oscilloscope and τ_{rps} is the rise time of the pulser and oscilloscope combination. The rise times of the H242A and H242B are given in Section 2 for various values of detector capacitance.

12. To measure the rise time of the timing output requires the use of a fast pulser with a rise time of less than 1 ns and a wide band oscilloscope or sampling oscilloscope. The input should be applied as detailed in Section 4.4. The timing output rise time, τ_{rT}, is given by

$$\tau_{rT} = \sqrt{\tau_{rsys}^2 - \tau_{rps}^2}$$

where τ_{rsys} is the rise time observed on the oscilloscope and τ_{rps} is the observed rise time of the oscilloscope and pulser combination. When measuring this quantity, great care should be exercised to insure that all readings are taken on the same time scale and same general position on the oscilloscope CRT. Significant errors are possible due to error in determining the 10% to 90% of final value points and should be taken into consideration when measuring the rise time.

5.2. CLEANING

If it is necessary to clean the components and/or the printed circuit in the preamplifiers at any time, use only methanol as a cleaning solvent. Do not use compressed air or other source of pressurized gas unless it is known to be clean, and free of compressor oil. Do not use any cleaning agent other than methanol.

5.3. FACTORY REPAIR SERVICE

This instrument can be returned to EG&G ORTEC for service and repair at a nominal cost. Our standard procedure for repair ensures the same quality control and checkout as for a new instrument. Always contact the Customer Service Department at EG&G ORTEC, (615) 482-4411, before sending in an instrument for repair to obtain shipping instructions. A Return Authorization Number is required, and will be assigned to the unit. Write this number on the address label and on the package to ensure prompt attention when it reaches the factory.

AVAILABLE ACCESSORIES

The H242A and the H242B preamplifiers are supplied with the following items:

1 ea.	Clamp, for mounting in vacuum chamber.
1 ea.	Cable, preamp power extension, length 10 ft.

Available as options at additional cost are:

C-56	Adaptor, SMA male to BNC female.
C-57	Adaptor, SMA male to BNC female.
C-58	Adaptor, SMA female to BNC female.
C-59	Adaptor, SMA female to BNC male.
C-60-4	Cable Assembly, RG174/U 50Ω cable, length 4 ft., w/one SMA male and one BNC male connector.
C-60-8	Cable Assembly, same except length 8 ft.
C-60-12	Cable Assembly, same except length 12 ft.
C-61-12	Cable Assembly, High Voltage Bias, length 12 ft, RG174/U 50Ω cable w/one SMA female and one SHV male connector.