Model 113
Scintillation Preamplifier
Operating and Service Manual

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Manual Revision B

1202

Advanced Measurement Technology, Inc.

a/k/a/ ORTEC®, a subsidiary of AMETEK®, Inc.

WARRANTY

ORTEC* warrants that the items will be delivered free from defects in material or workmanship. ORTEC makes no other warranties, express or implied, and specifically NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

ORTEC's exclusive liability is limited to repairing or replacing at ORTEC's option, items found by ORTEC to be defective in workmanship or materials within one year from the date of delivery. ORTEC's liability on any claim of any kind, including negligence, loss, or damages arising out of, connected with, or from the performance or breach thereof, or from the manufacture, sale, delivery, resale, repair, or use of any item or services covered by this agreement or purchase order, shall in no case exceed the price allocable to the item or service furnished or any part thereof that gives rise to the claim. In the event ORTEC fails to manufacture or deliver items called for in this agreement or purchase order, ORTEC's exclusive liability and buyer's exclusive remedy shall be release of the buyer from the obligation to pay the purchase price. In no event shall ORTEC be liable for special or consequential damages.

Quality Control

Before being approved for shipment, each ORTEC instrument must pass a stringent set of quality control tests designed to expose any flaws in materials or workmanship. Permanent records of these tests are maintained for use in warranty repair and as a source of statistical information for design improvements.

Repair Service

If it becomes necessary to return this instrument for repair, it is essential that Customer Services be contacted in advance of its return so that a Return Authorization Number can be assigned to the unit. Also, ORTEC must be informed, either in writing, by telephone [(865) 482-4411] or by facsimile transmission [(865) 483-2133], of the nature of the fault of the instrument being returned and of the model, serial, and revision ("Rev" on rear panel) numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. The ORTEC standard procedure requires that instruments returned for repair pass the same quality control tests that are used for new-production instruments. Instruments that are returned should be packed so that they will withstand normal transit handling and must be shipped PREPAID via Air Parcel Post or United Parcel Service to the designated ORTEC repair center. The address label and the package should include the Return Authorization Number assigned. Instruments being returned that are damaged in transit due to inadequate packing will be repaired at the sender's expense, and it will be the sender's responsibility to make claim with the shipper. Instruments not in warranty should follow the same procedure and ORTEC will provide a quotation.

Damage in Transit

Shipments should be examined immediately upon receipt for evidence of external or concealed damage. The carrier making delivery should be notified immediately of any such damage, since the carrier is normally liable for damage in shipment. Packing materials, waybills, and other such documentation should be preserved in order to establish claims. After such notification to the carrier, please notify ORTEC of the circumstances so that assistance can be provided in making damage claims and in providing replacement equipment, if necessary.

CONTENTS

SAFETY INSTRUCTIONS AND SYMBOLS

This manual contains up to three levels of safety instructions that must be observed in order to avoid personal injury and/or damage to equipment or other property. These are:

DANGER Indicates a hazard that could result in death or serious bodily harm if the safety instruction is not observed.

WARNING Indicates a hazard that could result in bodily harm if the safety instruction is not observed.

CAUTION Indicates a hazard that could result in property damage if the safety instruction is not observed.

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

In addition, the following symbol may appear on the product:

ATTENTION–Refer to Manual

DANGER–High Voltage

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

SAFETY WARNINGS AND CLEANING INSTRUCTIONS

DANGER	Opening the cover of this instrument is likely to expose dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.

WARNING	Using this instrument in a manner not specified by the manufacturer may impair the protection provided by the instrument.

Cleaning Instructions

To clean the instrument exterior:

- Unplug the instrument from the ac power supply.
- Remove loose dust on the outside of the instrument with a lint-free cloth.
- Remove remaining dirt with a lint-free cloth dampened in a general-purpose detergent and water solution. Do not use abrasive cleaners.

CAUTION	To prevent moisture inside of the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.

- Allow the instrument to dry completely before reconnecting it to the power source.


ORTEC
MODEL 113
PREAMPLIFIER
INPUT
0
100
200
500
1000
INPUT CAP.
pF


POWER
OUTPUT
TEST
PULSE

ORTEC MODEL 113
SCINTILLATION PREAMPLIFIER

1. DESCRIPTION

1.1. GENERAL

The ORTEC 113 Scintillation Preamplifier is an all-transistor preamplifier designed for use with photomultiplier tubes. It is a noninverting preamplifier with no provisions for pulse shaping except the variation of fall time. The 113 is intended to operate into a shaping-type amplifier such as the ORTEC 410. A diode network prevents destruction of the input transistor if a sudden positive or negative high voltage is applied to the input.

2. SPECIFICATIONS

PERFORMANCE

RISE TIME <60 nsec.

PREAMPLIFIER FALL TIME Fall time constant is designed for 50 μsec, assuming a signal source impedance of 1 MΩ.

INTEGRAL NONLINEARITY ≤0.02%.

TEMPERATURE COEFFICIENT ±0.01%/°C, 10 to 50°C.

COUNTING RATE The gain shift of a 250-mV reference pulse is <0.25% with the application of an additional count rate of 65,000 counts/sec of 200-mV random pulses.

CONTROL

INPUT CAP pF Switch selects desired input capacity: 0, 100, 200, 500, 1000 pF.

INPUT

BNC connector; isolated for 1000 V; positive or negative polarity, 1 MΩ impedance shunted by 45 pF plus the capacity selected by switch S1 (0, 100, 200, 500, or 1000 pF).

OUTPUT

BNC connector; output impedance adjustable from 40 to 140Ω. Output saturation level ±10 V into open circuit; ±5.1 V into 100Ω load. Linear output ±7 V into open circuit; ±3.5 V into 100Ω load.

TEST PULSE

BNC connector; accepts a pulse generator output with fast rise and slow decay to check operation of the electronics; input impedance 100Ω.

ELECTRICAL AND MECHANICAL

POWER REQUIRED +24 V dc, 17 mA; −24 V dc, 17 mA; supplied from any ORTEC transistor main amplifier or an ORTEC Preamplifier Power Supply through 10-ft captive cable.

WEIGHT (Shipping) 2.3 lb (1.05 kg).

WEIGHT (Net) 1.5 lb (0.68 kg).

DIMENSIONS 1.75 x 4 x 6 in. (4.5 x 10.2 x 15.3 cm).

RELATED EQUIPMENT

The 113 can be operated with any ORTEC Shaping Main Amplifier. Test input pulses can be furnished from any ORTEC Pulse Generator.

3. INSTALLATION INSTRUCTIONS

3.1. CONNECTION TO PHOTOMULTIPLIER TUBE

Connect the output of the photomultiplier to the input of the 113 with a coaxial cable. This cable should be kept as short as practicable. The photomultiplier output can be taken from the anode, cathode, or any dynode and will generally be ac-coupled. The input connector of the 113 is isolated for 1000 V dc; however, it can be modified for 3000-V dc isolation by being replaced with a type SHV connector.

3.2. CONNECTION TO A SHAPING MAIN AMPLIFIER

The 113 can be used to drive long lengths of 93Ω cable to a shaping amplifier and is designed to be directly compatible with ORTEC transistor main amplifiers. The output impedance of the 113 is 93Ω; therefore if the 93Ω cable is used, it is not necessary to terminate it at the receiving end. If unterminated cable is used on the output, with impedance other than 93Ω, resistor R24 should be adjusted for an output impedance equal to the value of the cable impedance to prevent pulse reflections.

3.3. INPUT POWER

Power for the 113 is supplied through an Amphenol connector (17-20090) on the rear of the chassis. Power may be supplied by a single 45-V battery with a tap at 22.5 V (use the tap as ground, providing +22.5 V and −22.5 V; current drain is 17 mA) or by any well-filtered ±24-V power supply such as the ORTEC 114 Preamplifier Power Supply.

If the 113 is used with ORTEC transistor main amplifiers, power for the preamplifier can be supplied from the main amplifier through the interconnecting cable supplied with the 113.

3.4. TEST PULSE

A voltage pulse can be inserted at the Test Pulse connector on the rear of the 113. The 113 has a built-in charge terminator that converts the input voltage to an input charge to simulate a charge pulse from the photomultiplier tube. The shape of the voltage test pulse should have a fast rise time (less than 10^{-8} sec) followed by a slow expoential decay back to the baseline (2 to 4 X 10^{-4} sec). A 1-V input signal at the Test Pulse connector produces a pulse of approximately 135 mV when an input capacity of 100 pF is selected by S1.

4. OPERATING INSTRUCTIONS

The shape of the output pulse from the photomultiplier tube is dependent on the form of the light pulse, the transit-time spread in the photomultiplier, and the anode resistance and capacitance. Since the form of the light pulse and the transit time of the tube cannot be altered, our concern is with the anode and associated circuitry. The signal at the anode appears as a current pulse or a quantity of charge, and the voltage produced by this quantity of charge is given by

$$V = \frac{Q}{C},$$

where $C = C_s + C_{in}$ (see Fig. 4.1). (C_1 and C_2 are coupling capacitors that are large in value compared to C, and therefore accumulate a negligible amount of voltage from the charge transferred.) The voltage developed across $C_s + C_{in}$ will decay with a time constant of $\tau_f = R_\tau C$, where and R_s = high-voltage supply output resistance.

$$R_\tau = \frac{R_{in}(R_\angle + R_s)}{R_{in} + R_\angle + R_s},$$

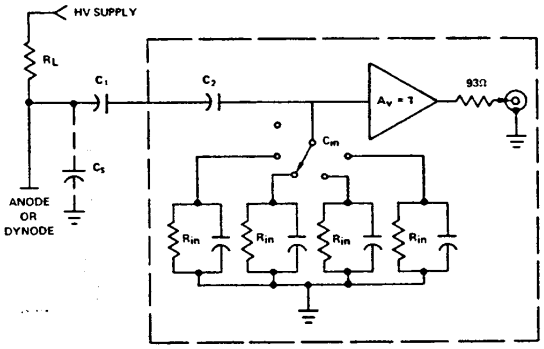

Fig. 4.1. Functional Diagram of the 113 Preamplifier.

From the above equations it can be seen that the pulse amplitude can be varied by varying C_{in}, which can be varied by steps with switch S1 on the front panel. The input capacity of the 113 is approximately 45 pF plus the capacity selected by S1. R_{in} was selected to produce a fall time constant of 50 µsec, assuming a driving source impedance of 1 X 10^6 Ω. If a pole-zero-cancelled amplifier is used following the 113, it will be necessary to adjust the pole-zero trim on the amplifier each time a different input capacitance is selected for the 113.

5. MAINTENANCE INSTRUCTIONS

5.1. TESTING PERFORMANCE

Insert a voltage pulse in the Input connector and monitor the output with an oscilloscope. The output pulse should be equal to the input pulse when the output is not loaded and equal to one-half the input pulse when it is loaded with 93Ω and R16 plus R24 is equal to 93Ω. Perform this test with both positive and negative input pulses.

Insert a voltage pulse into the Test Pulse input connector and monitor the output pulse with an oscilloscope. For each volt input an output voltage of approximately 135 mV should be obtained when an input capacity of 100 pF is selected by S1. The output pulse should decrease in amplitude as the input capacity is increased.

5.2. SUGGESTIONS FOR TROUBLESHOOTING

Perform the tests outlined in Section 5.1. If an output pulse of the proper magnitude is not obtained, check all dc voltages and compare them with the values tabulated below.

5.3. DC VOLTAGES

The voltages listed below will help to locate defective components. All voltages are measured with respect to ground.

Typical dc Voltages

LOCATION	DC VOLTAGES
+24 V Supply	+24
- 24 V Supply	- 24
Q1e	- 1.0
Q1b	- 0.5
Q1c	+13.3
Q2e	+13.8
Q2c	- 1.65
Q3e	- 13.2
Q3b	- 12.6

5.4. FACTORY REPAIR

This instrument can be returned to the ORTEC factory for service and repair at a nominal cost. Our standard procedure for repair ensures the same quality control and checkout that are used for a new instrument. Always contact Customer Services at ORTEC, (865) 482-4411, before sending in an instrument for repair to obtain shipping instructions and so that the required Return Authorization Number can be assigned to the unit. Write this number on the address label and on the package to ensure prompt attention when it reaches the ORTEC factory.