

**Model 9302
Amplifier-Discriminator
Operating and Service Manual**

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.

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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:

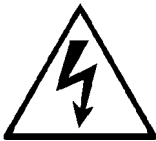
- DANGER** Indicates a hazard that could result in death or serious bodily harm if the safety instruction is not observed.
- WARNING** Indicates a hazard that could result in bodily harm if the safety instruction is not observed.
- CAUTION** Indicates a hazard that could result in property damage if 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.

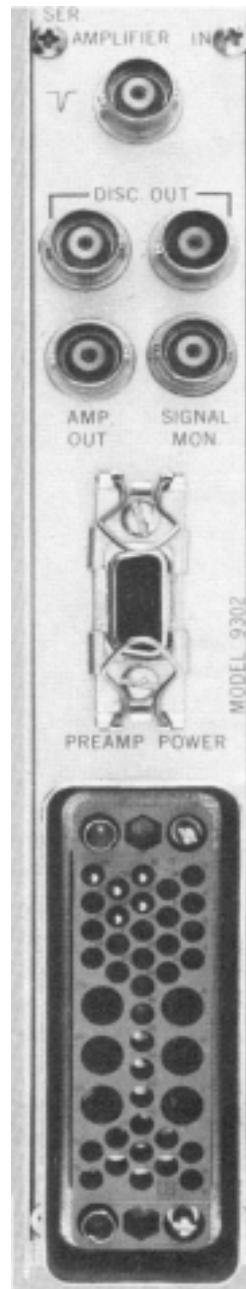
Cleaning Instructions

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 9302 AMPLIFIER-DISCRIMINATOR

1. DESCRIPTION

1.1. GENERAL

The ORTEC 9302 is a fast amplifier and discriminator in a single-wide NIM-standard module designed for use with photomultiplier or electron multiplier tubes in photon, ion, or electron counting applications. Features of the 9302 include a wideband, high-gain amplifier and an integral discriminator capable of counting rates up to 100 MHz.

Incorporated in the module is a rate monitor system that can be used to perform external switching when the pulse counting rate is modulated. At counting rates above those set by the front panel selector switch, a voltage of greater than 2.0 V will be present at the signal monitor connector. At counting rates below the rate selected, 0 ± 0.2 V will be present at the signal monitor connector.

1.2. INPUT SIGNALS

The input signals are dc-coupled into an impedance of 50Ω . The maximum amplitude range of the

amplifier to retain linearity is 50 mV when the gain switch is set at X20 and is 5 mV when the gain switch is set at X200. Protection is provided for input voltages of up to ± 100 V at a 10% duty cycle.

1.3. OUTPUTS

The linear amplifier output connector is located on the rear panel of the module and has an output impedance of 50Ω . Use of this output requires 50Ω coaxial cable and 50Ω termination.

Two discriminator output connectors are also located on the rear panel of the module. They are isolated from each other and produce a negative current pulse of 16 mA into a 50Ω load impedance. The output pulse width is ≤ 5.0 ns.

The rear panel signal monitor connector produces a positive dc voltage when the counting rate after the discriminator is greater than the rate selected on the front panel for the monitor rate discriminator. When the counting rate is below the selected rate, 0 ± 0.2 V appears at the signal monitor output.

2. SPECIFICATIONS

2.1. PERFORMANCE

AMPLIFIER

Voltage Range 0 to 50 mV.

Rise Time Typically 3.0 ns.

Noise ≤ 10 μ V for maximum gain.

Gain Switch-selectable, X20 or X200.

Nonlinearity $\leq \pm 1\%$.

Temperature Instability Gain, $< 0.1\%/^{\circ}\text{C}$; dc drift, < 50 μ V/ $^{\circ}\text{C}$.

DISCRIMINATOR

Threshold Range 50 mV to 1 V.

Walk ≤ 2.0 ns from X2 to X20 threshold.

Pulse Pair Resolution < 10 ns; 9 ns typically.

2.2. CONTROLS

Gain Slide switch for selection of X20 or X200.

Disc Level Multiturn control adjusts the discriminator level from 50 mV to 1 V.

Monitor Rate Disc Front panel potentiometer selects 1 kHz, 10 kHz, 100 kHz, or 1 MHz, which determines the rate above which a logic level will be produced.

2.3. INPUT

Amplifier In BNC connector on rear panel accepts negative input signals; protected to ± 100 V at 10% duty factor; $Z_{in} = 50\Omega$.

2.4. OUTPUTS

Amp Out Rear panel BNC connector provides linear analog output; $Z_o = 50\Omega$.

Disc Out 2 independent BNC connectors on rear panel provide negative current pulse of 16 mA into 50Ω ; width, ≤ 5 ns; rise time, 1.5 ns.

Signal Mon BNC connector on rear panel provides 0 ± 0.2 V when discriminator count rate is below threshold and $\geq +2.0$ V when it is above threshold.

Preamp Power Amphenol type 17-10090 connector on rear panel; provides necessary power for 9301 Fast Preamplifier.

2.5. ELECTRICAL AND MECHANICAL

Power Required

-24V, 90 mA; -12V, 205 mA;
+24V, 85mA; +12V, 140 mA.

Dimensions NIM-standard single-width module (1.35 by 8.714 in.) per TID-20893.

3. INSTALLATION

3.1. GENERAL

Since the 9302, in conjunction with an ORTEC 4001A/ 4002A Bin and Power Supply, is intended for rack mounting, vacuum tube equipment operating in the same rack must be sufficiently cooled with circulating air to prevent any localized heating of the all-transistorized circuitry used throughout the 9302. The temperature of equipment mounted in racks can easily exceed the recommended maximum limit of 120°F (50°C) unless these precautions are taken.

3.2. CONNECTION TO POWER

The 9302 contains no internal power supply, and must obtain the necessary dc operating power from the 4001A/ 4002A Bin and Power Supply in which it is installed for operation. Always turn off power on

the Power Supply before inserting or removing modules. The ORTEC 9000 Series of modular instruments is designed so that the Power Supply cannot be overloaded when there is a full complement of modules in the Bin. Since, however, this may not be true when the Bin contains modules other than those of ORTEC design, use the convenient test points on the front panel of the 4001A/4002A to check each Power Supply voltage level after all modules have been inserted.

3.3. INPUT/OUTPUT CONNECTIONS

The low input impedance (50Ω) and low output impedance (50Ω) of the 9302 permit it to be used in a system using only 50Ω cable. The low output impedance requires that the output cable be terminated by the characteristic impedance of the cable at the remote cable end.

4. MAINTENANCE

4.1. CORRECTIVE MAINTENANCE

The ORTEC 9302 should require no regular maintenance other than replacement of components that have failed due to age. Always ensure that the replacement components are equivalent to the original parts, designated in schematic 9302-0101-S1. No internal trimming or adjustment is necessary with the 9302.

To aid in the identification of a malfunctioning component, typical stage-by-stage dc voltages are shown in Table 4.1. These voltages are typical values, and may vary through a narrow range without indicating a fault.

4.2. FACTORY REPAIR SERVICE

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 the Customer Service Department at ORTEC, (865) 483-2231, before sending in an instrument for repair for shipping instructions and so that the required Return Authorization Number can be assigned to the unit. This number should be written on the address label and on the package.

Table 4.1. dc Bias Points (Nominal Values).

Test Point	Voltage (V)	Test Point	Voltage (V)
Q1 B	0	Q26 B	-1.2
E	-0.7	E	-1.5
Q2 B	0	Q28 B	-1.2
E	-0.7	E	-1.5
Q4 B	+0.7	IC1(10)	-1.25
E	0	IC1(11)	-1.25
Q5 B	0	IC1(14)	-1.2
E	-0.7	IC1(15)	-1.6
Q6 B	0	IC1(2)	-1.6
E	-0.7	IC1(3)	-0.8
Q8 B	+0.7	IC3(12)	-1.1
E	0	IC3(13)	-1.6
Q15 B	-5.6	IC3(9)	-0.8
E	-6.3	IC3(15)	-1.6
Q21 B	-0.05	IC3(6)	-1.6
E	-0.75	IC3(3)	-0.8
Q22 B	-0.25	IC3(8)	-5.2
E	-0.75	IC4(14)	5.0
Q23 B	5.6	IC4(7)	0
E	6.0	IC5(4)	5.0
Q24 B	5.3	IC5(11)	0
E	6.0		

5. APPLICATIONS

There are a number of different applications for the 9302 Amplifier-Discriminator. However, since the unit was designed primarily for ion, electron, and photon counting, system block diagrams for this type of usage are given.

Figure 5.1 is a block diagram of a system that might be used to perform atomic or molecular fluorescence measurements. Pulses from the photomultiplier tube are applied to the 9302, where they are first amplified. Following amplification, the pulses enter the discriminator section of the 9302, where those pulses whose amplitudes correspond to photons are accepted. Pulses that correspond to

interdyode noise are of a lower voltage amplitude and are rejected. The discriminator output is then applied to the ORTEC 9349 Log/Lin Ratemeter. The 9349 measures the average count rate of the input pulses and also provides an analog output for the y-deflection of the x-y recorder.

An analogous application to low-level light measurements is ion counting. This technique can be applied to mass spectrometry, and has the same sensitivity advantages with an electron or ion multiplier that are obtained by other detectors such as photomultiplier tubes. A typical system that could be used is shown in Fig. 5.2.

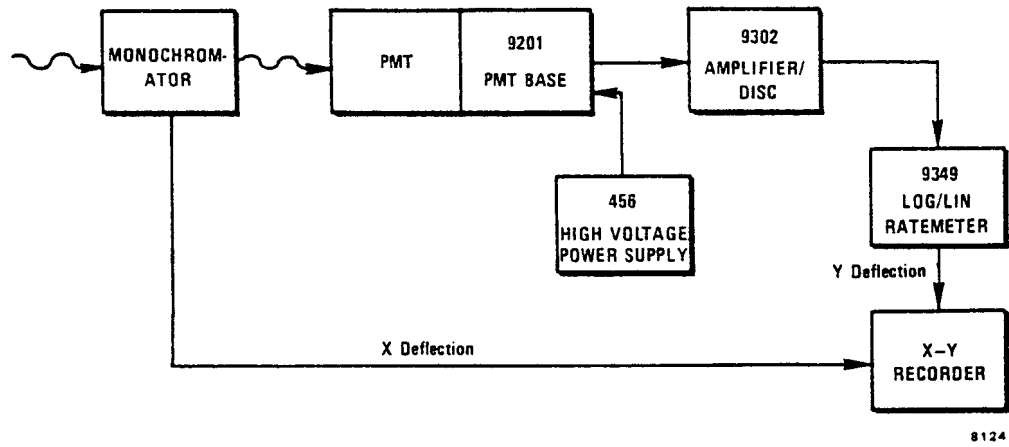


Fig. 5.1. Block Diagram of a Typical 1 MHz Ratemeter System.

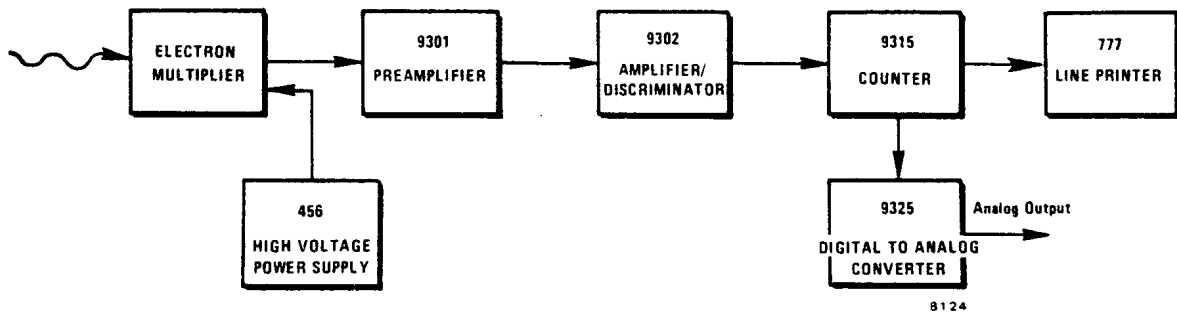


Fig. 5.2. Ion Counting System with Digital and Analog Outputs.

**Bin/Module Connector Pin Assignments
For Standard Nuclear Instrument
Modules per DOE/ER-0457T.**

Pin	Function	Pin	Function
1	+3 V	23	Reserved
2	- 3 V	24	Reserved
3	Spare bus	25	Reserved
4	Reserved bus	26	Spare
5	Coaxial	27	Spare
6	Coaxial	*28	+24 V
7	Coaxial	*29	- 24 V
8	200 V dc	30	Spare bus
9	Spare	31	Spare
*10	+6 V	32	Spare
*11	- 6 V	*33	117 V ac (hot)
12	Reserved bus	*34	Power return ground
13	Spare	35	Reset (Scaler)
14	Spare	36	Gate
15	Reserved	37	Reset (Auxiliary)
*16	+12 V	38	Coaxial
*17	- 12 V	39	Coaxial
18	Spare bus	40	Coaxial
19	Reserved bus	*41	117 V ac (neutral)
20	Spare	*42	High-quality ground
21	Spare	G	Ground guide pin
22	Reserved		

Pins marked (*) are installed and wired in ORTEC's 4001A and 4001C Modular System Bins.