

Model 9305 Fast Preamplifier Operating and Service Manual

This manual applies to instruments marked
"Rev 03" on rear panel.

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.

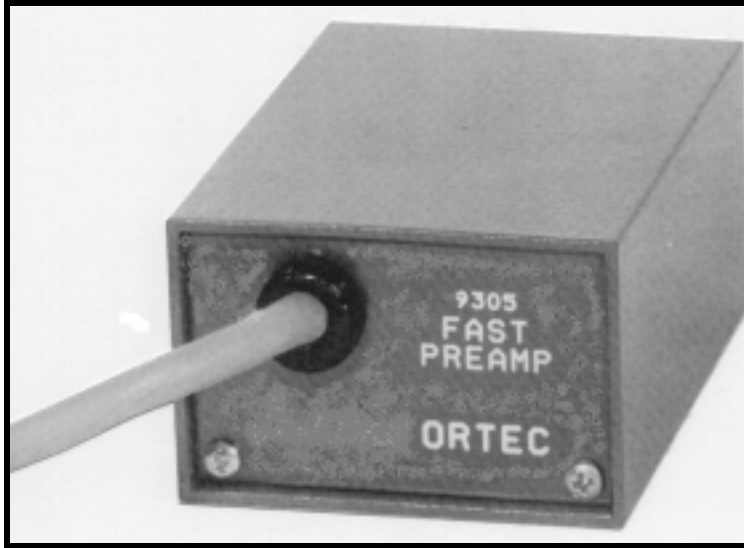
Cleaning Instructions

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 9305 FAST PREAMPLIFIER

1. DESCRIPTION

The ORTEC 9305 Fast Preamplifier contains a direct-coupled wideband hybridized amplifier suitable for use with photomultipliers, electron multipliers, and other detectors used in photon counting, ion counting, or fast timing applications.

In addition to the fast rise time (3 ns), the 9305 has a variable voltage gain of 5-10 and can drive ± 5 V into a 50Ω load. The 9305 also features excellent dc and gain stability along with low noise and <5 -ns, overload recovery time. Overload input protection is provided. Hybrid circuit technology gives the 9305 high performance and reliability. For operator convenience, independent bandwidth (BDW), output dc offset (DC), and fine gain (Gain) adjustments are included. Also, because of its compact size and lightweight, the 9305 is ideal for mounting directly to, or close to, a detector. Consequently, low-level signals which would

otherwise be susceptible to pickup of noise or interference are amplified to a suitable level for cable connection to the main amplifier. Connection to a power supply is through a 10-ft-long captive cable that is furnished with the 9305. (Other cable lengths are available by special order.)

Power for the 9305 is supplied through this 10-ft cable and can be furnished from a variety of sources, such as the ORTEC 114 Preamp Power Supply or any time- or energy-spectroscopy amplifier. The 9305 Fast Preamplifier includes an Amphenol 17-20090 plug at the remote end of the power cable, which is wired to accept +12 V through pin 4, -12 V through pin 9, and ground through pins 1 and 2. This plug is directly compatible with any ORTEC standard NIM that has a preamplifier power connector on the rear panel.

2. SPECIFICATIONS

2.1. PERFORMANCE

NOMINAL VOLTAGE GAIN 5-10; noninverting.

RISE TIME <3 ns to ± 5 V into 50Ω ; bandwidth >120 MHz.

NOISE <25 μ V referred to the input measured with an HP3400A true rms voltmeter. Wideband noise (200 MHz) <30 μ V referred to the input.

INTEGRAL NONLINEARITY Typically $\leq \pm 1\%$ for output to ± 5 V.

PULSE OVERLOAD RECOVERY Typically <5 ns for a X10 overload.

GAIN INSTABILITY Typically $\leq \pm 0.05\%/^{\circ}\text{C}$.

DC INSTABILITY Typically $\leq \pm 150$ μ V/ $^{\circ}\text{C}$ referred to the output.

INPUT IMPEDANCE 50Ω , dc-coupled.

OUTPUT IMPEDANCE $<1 \Omega$, dc-coupled.

OUTPUT LINEAR RANGE ± 5 V into 50Ω .

OPERATING TEMPERATURE RANGE 0 to 50°C .

2.2. CONTROLS

BDW 20-turn potentiometer adjusts the output bandwidth and overshoot. Front panel mounted.

DC 20-turn potentiometer adjusts the output dc offset. Front panel mounted.

GAIN 20-turn potentiometer adjusts the voltage gain from typically 5 to 10. Front panel mounted.

2.3. ELECTRICAL AND MECHANICAL

POWER REQUIRED +12 V, 67 mA; -12 V, 67 mA.

WEIGHT

Net 0.32 kg (12 oz).

Shipping 1.25 kg (2 lb 12 oz).

DIMENSIONS 3.81 x 6.1 x 8.89 cm (1.5 x 2.4 x 3.5 in.).

3. INSTALLATION

3.1. CONNECTION TO DETECTOR

Connect the output from the detector to the Input BNC on the 9305 with 50 Ω coaxial cable. This cable should be as short as practical to minimize the physical distance through which the detector output-current pulse has to pass. The amount of noise that will be added to the signal increases with cable length.

An input signal to the 9305 can be of either polarity (e.g., it can originate from the anode or any dynode in a photomultiplier tube circuit). AC-coupling must be used to prevent any high voltage from the detector being applied directly to the 9305 input. An input-protection circuit is included which allows excellent (typically <5 ns) overload recovery. The

output signal from the 9305 will have the same polarity as the input and will be amplified by a factor of 5-10. The linear output range is ± 5 V into a 50 Ω load.

3.2. CONNECTION OF OUTPUT

The output impedance of the 9305 is nominally 1 Ω . Any counter, amplifier, or timing instrument can be driven by the 9305 through 50 Ω cable terminated by a 50 Ω load. If the driving instrument does not have an input impedance of 50 Ω , an external terminating resistor should be added to prevent pulse reflections.

4. OPERATING INSTRUCTIONS

Three operator controls (DC, Gain, and BDW) are provided on the 9305. The DC adjustment permits the setting of the dc-output offset to zero volts. (The input offset voltage is adjusted by an internal potentiometer mounted on a printed wiring board.)

The Gain potentiometer adjusts voltage gain continuously from 5 to 10. The BDW (bandwidth) sets the rise time or overshoot appropriate for the experiment.

5. MAINTENANCE AND CALIBRATION

5.1. PREVENTIVE MAINTENANCE

Give reasonable attention to mechanical details. Keep the signal connectors clean at all times. Periodically remove the cover and inspect the interior of the module for dust accumulation or other undesirable conditions. Clean as often as required by local conditions (normally about once every 12 months).

5.2. CORRECTIVE MAINTENANCE

Corrective maintenance generally consists of replacing defective components (i.e., resistors, capacitors, diodes, transistors, and integrated circuits), replacing missing hardware, and tightening loose hardware. Do not use excessive force when tightening screws or nuts.

When replacing components on a printed wiring board, be sure that the board is not damaged by excessive heating. When unsoldering leads, grip the lead that is to be removed with pliers or some similar tool that acts as a heat sink. Heat the solder joint as little as possible while maintaining a steady pull on the lead to assure its prompt removal. Remove excess solder from the board with a solder-puller. Do not redrill holes in the printed wiring board since many are plated through the board. If the integrity of a plated-through hole is in doubt, solder the component lead on both sides of the board.

When a defective component is to be removed from a printed wiring board, the preferred method is to cut both or all leads to the component and then remove each of the leads from the board.

5.3. CALIBRATION

Follow this procedure to adjust all controls of the 9305:

1. Furnish power to the unit for at least ten minutes.
2. Use 50 Ω cable to connect the In connector of the 9305 to a digital voltmeter. Adjust R4 (mounted on the printed wiring board) as needed to set the input dc level at $0\text{ V} \pm 1\text{ mV}$.
3. Use 50 Ω cable to connect the Out connector of the 9305 to a digital voltmeter. No connection

should be made to the In connector. Adjust R12 (front panel) as needed to set the Out dc level at $0\text{ V} \pm 1\text{ mV}$.

4. Using 50 Ω cable, connect a 1 ns rise time pulser (HP215A Pulser or equivalent) to an oscilloscope with a 500 MHz bandwidth (Tektronix 7904 mainframe and 7A19 vertical plug-in unit or equivalent). Set the oscilloscope input impedance to 50 Ω . Adjust the HP215A output to -500 mV.

5. Using 50 Ω cable, connect the output of the pulser to the In connector of the 9305. Connect the Out connector of the 9305 to the 500 MHz oscilloscope. Set the oscilloscope input impedance to 50 Ω . Adjust the Gain (front panel) potentiometer of the 9305 to produce a -5 V output signal. Adjust the BDW (front panel) potentiometer of the 9305 to produce a 3.1 ns rise time signal. This sets the rise time of the 9305 to 3.0 ns.

6. Reverse the polarity of the pulser and repeat steps 4 and 5 for positive signals.

7. Set the oscilloscope Cal output to some convenient value such as 1 kHz, 0.4 V. Set the oscilloscope vertical input to DC. Observe the oscilloscope Cal signal which should be a square wave. Using 50 Ω cable, connect the Cal signal to the 9305 In connector. Using 50 Ω cable, connect the 9305 Out connector to the oscilloscope input. Adjust R9 (mounted on the printed wiring board), the Tilt Adj, as needed to produce a square wave output from the 9305. The adjustment of R9 equalizes the gain of the fast loop and the slow loop within the hybrid amplifier A1.

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 the Customer Services Department at ORTEC, (865) 483-2231, 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.

