



Model 7210DIF
Four Channel Differential
Voltage Preamplifier

Instruction Manual
224382-A-MNL-A

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GENERAL SAFETY PRECAUTIONS

The equipment described in this manual has been designed in accordance with EN61010 "Safety requirements for electrical equipment for measurement, control and laboratory use", and has been supplied in a safe condition. To avoid injury to an operator or service technician the safety precautions given below, and throughout the manual, must be strictly adhered to whenever the equipment is operated, serviced or repaired. For specific safety details, please refer to the relevant sections within the manual.

The equipment is intended solely for electronic measurement and should be used for no other purpose. **SIGNAL RECOVERY** accepts no responsibility for accidents or damage resulting from any failure to comply with these precautions.

Grounding

To minimise the hazard of electrical shock, it is essential that the PS0110-MD power supply (if used) be connected to a protective ground through the AC supply cable. The continuity of the ground connection should be checked periodically. The 7210DIF product itself does not require a safety earth connection for safe operation.

AC Supply Voltage

Never operate the PS0110-MD power supply from a line voltage or frequency in excess of that specified. Otherwise, the insulation of internal components may break down and cause excessive leakage currents and **POTENTIAL RISK OF ELECTRICAL SHOCK**. System to be used with an IEC 60799 compliant (or other suitable accredited approval) mains supply cord, rated for the correct voltage and power rating as detailed on the power supply case.

DC Supply Voltage

Never operate the 7210DIF from a DC voltage outside of the product specifications, as detailed in this document.

Fuses

The 7210DIF and PS0110-MD power supply do not contain replaceable MAINS fuses.

Explosive Atmospheres

This equipment must **NEVER BE OPERATED** in a potentially explosive atmosphere. The equipment is NOT designed for use in these conditions and could possibly cause an explosion.

Safety Symbols

The 7210DIF product contains no safety symbols (not required).

The PS0110-MD power supply contains the following safety symbols:

<i>Symbol</i>	<i>Meaning</i>
	General safety hazard. CAUTION – Do not open PS0110-MD power supply case, risk of electric shock. This product is not internally serviceable.
	Electrical safety hazard. See above.

Accessories and Ancillary Equipment

Only use accessories and ancillary equipment either delivered as part of the system or pre-approved for use with the system directly by AMT. Use of unapproved accessories and ancillary equipment could cause damage and potentially form an electrical hazard.

Notes and Cautions

For the guidance and protection of the user, Notes and Cautions appear throughout the manual. The significance of these is as follows:

Notes highlight important information for the reader's special attention.

Cautions guide the reader in avoiding damage to the equipment.

Avoid Unsafe Equipment

The equipment may be unsafe if any of the following statements apply:

- Equipment shows visible damage.
- Equipment has failed to perform an intended operation.
- Equipment has been stored in unfavorable conditions.
- Equipment has been subjected to severe physical stress.

If in any doubt as to the serviceability of the equipment, don't use it. Get it properly checked out by a qualified service technician.

Live Conductors

The PS0110-MD power supply contains MAINS 'LIVE' conductors (internal). The PS0110-MD case should not be opened by under any circumstances. The PS0110-MD contains no user serviceable parts.

Caution: Whilst the 7210DIF does not contain MAINS 'LIVE' conductors, power should be disconnected BEFORE making changing any jumper settings. Failure to do so may result in damage to the equipment. Adjustments, maintenance or repair must only be done by qualified personnel, who should refer to the relevant maintenance documentation.

Equipment Modification

To avoid introducing safety hazards, never install non-standard parts in the equipment, or make any unauthorized modification. To maintain safety, always return the equipment to your

SIGNAL RECOVERY service provider for service and repair.

European WEEE Directive

This product is subject to Directive 2002/96/EC of the European Parliament and the Council of the European Union on waste electrical and electronic equipment (WEEE) and in jurisdictions adopting that Directive, is marked as being put on the market after August 13, 2005, and should not be disposed of as unsorted municipal waste. Please use your local WEEE collection facilities for the disposal of this product and otherwise observe all applicable requirements.

FCC Notice

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause harmful interference with radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user is required to correct the interference.

DECLARATION OF CONFORMITY

The directives covered by this declaration

- 73/23/EEC Low Voltage Equipment Directive, amended by 93/68/EEC
89/336/EEC Electromagnetic Compatibility Directive, amended by 92/31/EEC
& 93/68/EEC

Product(s)

Model 7210DIF Differential Voltage Preamplifier

Basis on which conformity is being declared

The product(s) identified above comply with the requirements of the EU directives by meeting the following standards:

- BS EN61326-1:2013 Electrical equipment for measurement control and laboratory use - EMC requirements – Class A.
BS EN61010-1:2010 Safety requirements for electrical equipment for measurement, control and laboratory use.

Accordingly the CE mark has been applied to this product.

Signed



For and on behalf of **SIGNAL RECOVERY**

Authority:

Product Manager

Date:

August 2015



1.1 Description

The model 7210DIF (see figures 1-1 and 1-2) is a high-impedance, AC-coupled, four-channel differential voltage preamplifier. It has an operating frequency range of 0.1 Hz to 100 kHz, selectable gains of 0, 10, 40 and 60 dB ($\times 1$, $\times 10$, $\times 100$ and $\times 1000$) and a total input noise of $6.9 \text{ nV}/\sqrt{\text{Hz}}$ at 1 kHz ($G = \times 100$, $R_S = 1 \text{ k}\Omega$, see Appendix A).

The unit is a general purpose differential voltage preamplifier which can be connected to grounded sources in a manner that breaks ground loops. In addition, its true differential input means it can be used to measure floating sources, such as the output from an AC bridge, without imposing an asymmetrical load on the source.

With four independent channels that allow the differential amplification of up to four separate signals, it is ideally suited for use with the **SIGNAL RECOVERY** Model 7210 Multichannel Lock-in Amplifier, or simply as a general purpose differential preamplifier.

The model 7210DIF is powered from an external DC power supply ($\pm 15 \text{ V DC}$). This can be provided by the model PS0110-MD desktop power supply (option 7210DIF-P), or directly from most **SIGNAL RECOVERY** lock-in amplifiers via the DIN PRE-AMP POWER connector on the rear panel of the instrument using the supplied cable (option 7210DIF/86). Note that a second power cable is also supplied with the 7210DIF/86 option which allows multiple preamplifiers to be powered from a single power source.

Alternatively customers may power the unit using their own power source; see Appendix A and Appendix B for details about power supply tolerances and connector requirements.

CAUTION: *Application of power supply voltages greater than those specified may result in damage to the instrument.*

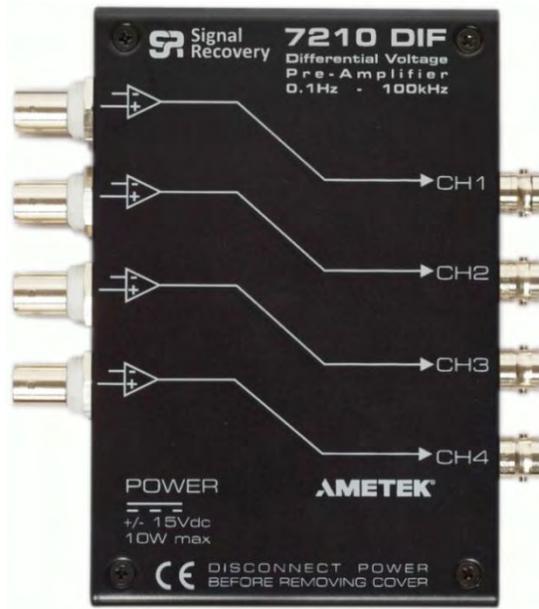


Figure 1-1, Model 7210DIF Top View



Figure 1-2, Model 7210DIF Side View

1.2 Ordering Options

The model 7210DIF is supplied in one of two options:

Model 7210DIF/86 7210DIF Four Channel Differential Voltage Preamplifier with DIN power cable and daisy chain cable for used with **SIGNAL RECOVERY** lock-in amplifiers.

Model 7210DIF-P 7210DIF Four Channel Differential Voltage Preamplifier with PS0110-MD desktop power supply.

2.1 Introduction

The following procedure is provided to facilitate initial performance checking of the Model 7210DIF. In general, the procedure should be performed after inspecting the instrument for shipping damage, but before using it experimentally. If any damage is noted, **SIGNAL RECOVERY** should be notified immediately and a claim filed with the carrier. The shipping container should be saved for inspection by the carrier.

Should any difficulty be encountered in carrying out these checks, then contact the factory or a **SIGNAL RECOVERY** representative.

2.2 Equipment Needed

- 1) General purpose laboratory oscilloscope.
- 2) Signal generator capable of providing a 10 mV, 100 mV and 1 V pk-pk sine wave at 1 kHz.
- 3) T-junction BNC splitter and BNC cables.
- 4) 50Ω BNC terminator.

2.3 Procedure

- 1) Connect the power to the preamplifier via the PWR IN connector:
 - If using the PS0110-MD power supply, power the supply using an AC line cord from a suitable wall power socket.
 - If using the power cable supplied with the 7210DIF/86 option, plug the DIN connector end of the cable into the PRE-AMP POWER connector on the lock-in amplifier.
- 2) The associated indicator on the preamplifier should light, indicating that it is powered and functioning properly.
- 3) Connect the oscilloscope to the OUTPUT BNC connector of CH 1.
- 4) Set the signal generator to 1 kHz, 10 mV pk-pk and connect it to the model 7210DIF CH 1 + (A) input BNC connector. Also monitor the output of the signal generator with an oscilloscope using a T-junction BNC splitter so as to obtain consistency between input settings and output readings.
- 5) Connect a 50Ω BNC terminator to the CH 1 – (B) input connector.
- 6) Monitor the preamplifier CH 1 output; the output level should be 1 V pk-pk.

- 7) Repeat steps 3 to 6 for CH 2.
- 8) Repeat steps 3 to 6 for CH 3.
- 9) Repeat steps 3 to 6 for CH 4.

This completes the initial checks. If the instrument performed as indicated, the user can be reasonably sure that the preamplifier has arrived in good working order and is functioning properly.

If required, further checks can be made by:

- 1) Swapping the BNC terminator and signal source connections on each amplifier, and repeating steps 3 to 9 above. This verifies operation of the inverting (-) inputs.
- 2) Repeating the measurements above at gains of $\times 1$, $\times 10$ or $\times 1000$ (see Chapter 3 for how to set gain of each amplifier). Note that the input signal level will need adjustment to ensure that a suitable output voltage can be achieved.

3.1 Introduction

The Model 7210DIF Preamplifier can be powered from an external power source or from a direct connection to the preamplifier power connector on **SIGNAL RECOVERY** lock-in amplifier models 7210, 7265, 7225, 7270, 7124, or 7280. In operation, the signal to be measured is connected differentially to the INPUT + (A) and INPUT – (B) BNC connectors. The amplified signal, given by the expression $(A - B) \times \text{Amplifier Gain}$, is provided at the corresponding output BNC connector. If single-ended operation is desired, a 50Ω BNC terminator should be fitted to the unused input BNC connector.

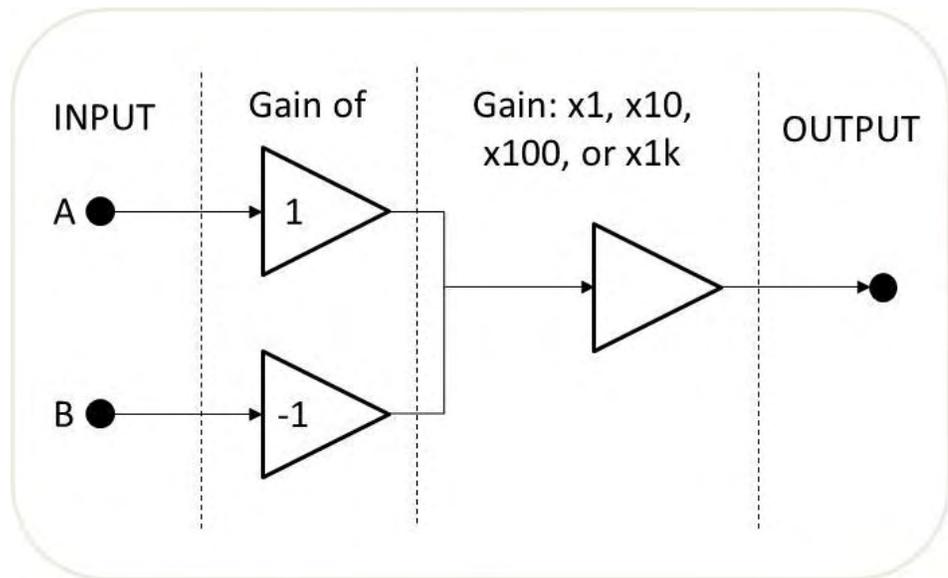


Figure 3-1, Model 7210DIF Signal Flow Diagram

3.1.1 Installation

The Model 7210DIF preamplifier should be positioned on a bench top face up (see figures 1-1 and 1-2) during operation, or mounted directed to the input BNCs of a model 7210 lock-in amplifier using four BNC male-male 50Ω adaptors.

3.1.2 Connections

Differential input signals should be applied to the + and – INPUT, whilst output signals should be measured from the corresponding channel OUTPUT connector. All signal inputs and outputs are standard BNC type.

The instrument requires ± 15 V DC power supply which can be provided by the model PS0110-MD desktop power supply, or direct from a **SIGNAL RECOVERY** lock-in amplifier via the cable provided (as previously detailed). Alternatively customers may power the preamplifier using their own power source; see Appendix A and Appendix B for details on power supply tolerances and connector requirements.

3.1.3 Power Indicator

The Power LED is lit when power is connected, indicating that the unit is ready for use.

3.1.4 Outputs

The Model 7210DIF can provide up to 9V pk-pk through its 50 Ω output impedance. It can amplify signals using gain levels of $\times 1$, $\times 10$, $\times 100$, or $\times 1000$, with the gain level being set, individually for each channel, using internal jumpers. The frequency range at each gain setting is:

$G = \times 1$	0.1 Hz – 1 MHz
$G = \times 10$	0.1 Hz – 1 MHz
$G = \times 100$	0.1 Hz – 1 MHz
$G = \times 1000$	0.1 Hz – 0.1 MHz

3.2 Gain Settings

The 7210DIF preamplifier is supplied with the gain of each channel set to $\times 100$. Internal jumpers can be moved in order to change this setting.

CAUTION: *Ensure power to the preamplifier is disconnected before removal of the cover to prevent possible damage to the instrument.*

3.2.1 Jumper Locations

Each channel has its own set of gain levels and an associated jumper. The pins of gain levels $\times 10$, $\times 100$, and $\times 1k$ are labeled. The gain level of $\times 1$ can be set by not using the jumper, but the jumper should be retained for possible future use.

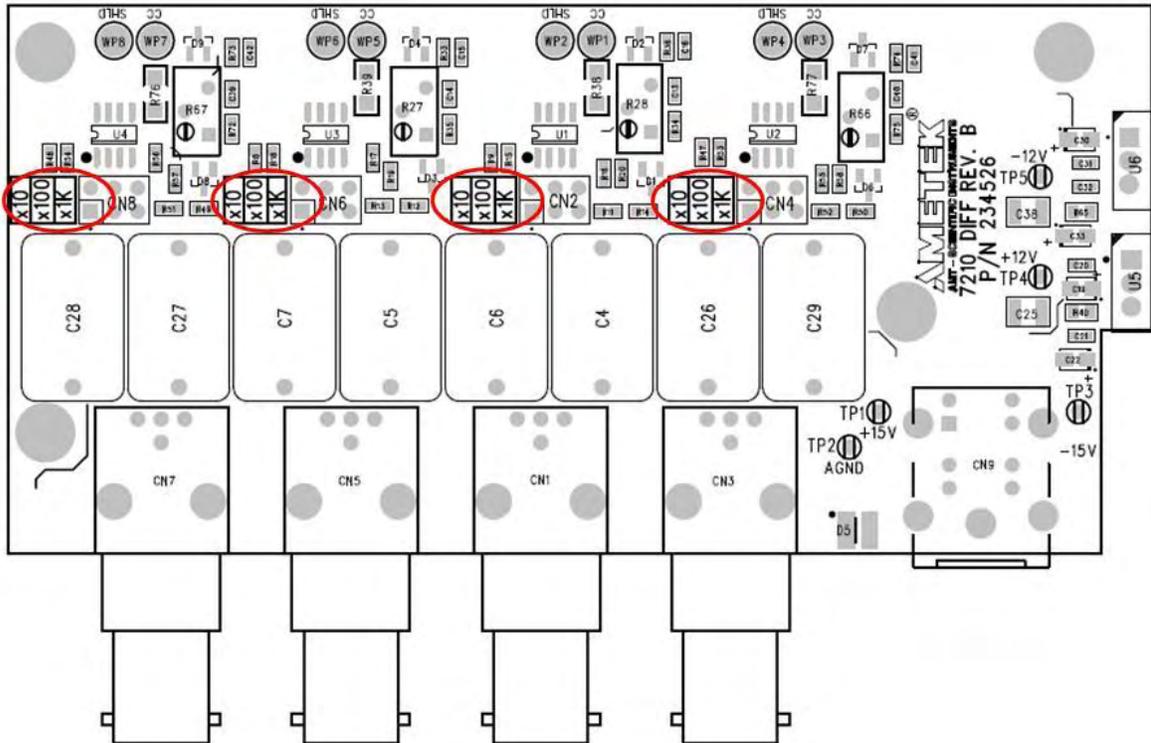


Figure 3-2, Model 7210DIF Jumper locations

3.2.2 Jumper Change Procedure

- 1) Disconnect all inputs, outputs and power connections.
- 2) Use a screwdriver to remove the six externally visible enclosure screws and remove the preamplifier cover. Set all aside.
- 3) Move the jumper of the required channel to cover the two pins next to the gain setting required.

For example, to set the gain of CH 1 to $\times 10$:

- a) Take out the jumper of CH 1 from the circuit board.
 - b) Identify the two pins next to the $\times 10$ label and place the jumper on both pins.
- 4) Replace the instrument cover and refit all six screws.

3.3 Powering Multiple Units

The Model 7210DIF preamplifier can be powered from another 7210DIF unit using the pass-through power cable supplied with the 7210DIF/86 option. There are two power connectors on the 7210DIF, labeled IN and OUT. Using these connectors it is possible to operate up to eight units from one power supply, by connecting the OUT connector of one to the IN connector of the next, using the pass-through power cable.

This is typically used when using two or more 7210DIF preamplifiers on a 32 channel model 7210 lock-in amplifier.

3.4 Model 7210 Signal Connections

Connection to the model 7210 lock-in amplifier will require the use of four BNC male to male adaptors. These are included with the 7210DIF/86 option.

Specifications

General	
Dimensions L x W x H	133.0 mm x 122.0 mm x 39.5 mm
Weight (7210DIF only):	400 g
DC Input (7210DIF):	
Voltage	$\pm 15 \pm 0.5$ V DC
Input Power	10 W max
AC Input (PS0110-MD):	
Line Voltage	100 – 240 V AC, 50 – 60 Hz
Power	42 W max
Fuse Rating	N/A
Safety complies with	BS EN 61010-1:2010
EMC complies with	BS EN 61326-1:2013
RoHS compliant	Yes
Electrical Specifications	
Abs. Max Input Voltage	± 28 V pk
Max Output Voltage	± 9 V pk
Gain Settings	x1, x10, x100 and x1000
Passband Gain Accuracy	0.1% plus 100 ppm/°C
Frequency Range:	
	G = x1 0.1 Hz – 1 MHz
	G = x10 0.1 Hz – 1 MHz
	G = x100 0.1 Hz – 1 MHz
	G = x1000 0.1 Hz – 0.1 MHz
CMRR (@1 kHz)	100 dB at G = x1000
Total Input Voltage Noise F = 1 kHz R _S = 1 kΩ G = x100	6.9 nV/√Hz typical (see table below)
Input Impedance	1 MΩ
Minimum load	1 kΩ
Environmental	
Location	Indoor use only Altitude up to 2000 m Pollution Degree Level 2
Operating Temperature	5° to 40°C
Storage Temperature	-25° to 70°C
IP Rating	N/A
Max Humidity	80% for temperatures up to 31°C, decreasing linearly to 50% relative humidity at 40°C
Max Operating Time	Designed for continuous operation

Noise Specifications (@1kHz)				
Series Resistance	Gain			
	x1	x10	x100	x1000
10 Ω	3.72 nV/ $\sqrt{\text{Hz}}$	5.61 nV/ $\sqrt{\text{Hz}}$	3.92 nV/ $\sqrt{\text{Hz}}$	3.74 nV/ $\sqrt{\text{Hz}}$
100 Ω	4.09 nV/ $\sqrt{\text{Hz}}$	5.86 nV/ $\sqrt{\text{Hz}}$	4.28 nV/ $\sqrt{\text{Hz}}$	4.10 nV/ $\sqrt{\text{Hz}}$
1 k Ω	6.75 nV/ $\sqrt{\text{Hz}}$	7.95 nV/ $\sqrt{\text{Hz}}$	6.87 nV/ $\sqrt{\text{Hz}}$	6.76 nV/ $\sqrt{\text{Hz}}$
10 k Ω	18.48 nV/ $\sqrt{\text{Hz}}$	18.95 nV/ $\sqrt{\text{Hz}}$	18.52 nV/ $\sqrt{\text{Hz}}$	18.48 nV/ $\sqrt{\text{Hz}}$
100 k Ω	63.35 nV/ $\sqrt{\text{Hz}}$	63.49 nV/ $\sqrt{\text{Hz}}$	63.36 nV/ $\sqrt{\text{Hz}}$	63.35 nV/ $\sqrt{\text{Hz}}$

PWR IN / PWR OUT Connector Pinout

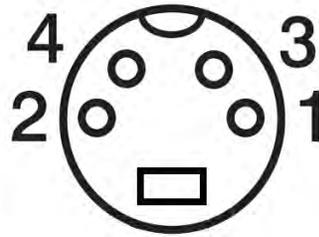


Figure B-1, Power Input and Output Connector

The pin allocation for the 7210DIF **PWR IN** and **PWR OUT** connectors is as follows:

Pin	Function
1	-15 V DC
2	+15 V DC
3	GND (* see note)
4	COMMON

* NOTE: GND is for functional screening only.

The connector type for both **PWR IN** and **PWR OUT** connectors is 4-pin Mini-DIN.

WARRANTY

SIGNAL RECOVERY, a part of AMETEK Advanced Measurement Technology, Inc, warrants each instrument of its own manufacture to be free of defects in material and workmanship for a period of ONE year from the date of delivery to the original purchaser. Obligations under this Warranty shall be limited to replacing, repairing or giving credit for the purchase, at our option, of any instruments returned, shipment prepaid, to our Service Department for that purpose, provided prior authorization for such return has been given by an authorized representative of AMETEK Advanced Measurement Technology, Inc.

This Warranty shall not apply to any instrument, which our inspection shall disclose to our satisfaction, to have become defective or unusable due to abuse, mishandling, misuse, accident, alteration, negligence, improper installation, or other causes beyond our control. This Warranty shall not apply to any instrument or component not manufactured by AMETEK Advanced Measurement Technology, Inc. When products manufactured by others are included AMETEK Advanced Measurement Technology, Inc equipment, the original manufacturers Warranty is extended to AMETEK Advanced Measurement Technology, Inc customers. AMETEK Advanced Measurement Technology, Inc reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. THIS WARRANTY IS IN LIEU OF, AND EXCLUDES ANY AND ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AS WELL AS ANY AND ALL OTHER OBLIGATIONS OR LIABILITIES OF AMETEK ADVANCED MEASUREMENT TECHNOLOGY, INC, INCLUDING, BUT NOT LIMITED TO, SPECIAL OR CONSEQUENTIAL DAMAGES. NO PERSON, FIRM OR CORPORATION IS AUTHORIZED TO ASSUME FOR AMETEK ADVANCED MEASUREMENT TECHNOLOGY, INC ANY ADDITIONAL OBLIGATION OR LIABILITY NOT EXPRESSLY PROVIDED FOR HEREIN EXCEPT IN WRITING DULY EXECUTED BY AN OFFICER OF AMETEK ADVANCED MEASUREMENT TECHNOLOGY, INC.

SHOULD YOUR EQUIPMENT REQUIRE SERVICE

- A. Contact your local **SIGNAL RECOVERY** office, agent, representative or distributor to discuss the problem. In many cases it may be possible to expedite servicing by localizing the problem to a particular unit or cable.
- B. We will need the following information, a copy of which should also be attached to any equipment which is returned for service.
- | | |
|---|---|
| 1. Model number and serial number of instrument | 6. Symptoms (in detail, including control settings) |
| 2. Your name (instrument user) | 7. Your purchase order number for repair charges (does not apply to repairs in warranty) |
| 3. Your address | 8. Shipping instructions (if you wish to authorize shipment by any method other than normal surface transportation) |
| 4. Address to which the instrument should be returned | |
| 5. Your telephone number and extension | |
- C. If you experience any difficulties in obtaining service please contact:

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