

Model 5182

Low-Noise Current Preamplifier

Instruction Manual

222514-A-MNL-D

FCC Notice

This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with this manual, may cause interference to radio communications. As temporarily permitted by regulation, operation of this equipment in a residential area is likely to cause interference, in which case the user at his own facility will be required to take whatever measures may be required to correct the interference.

Company Names

SIGNAL RECOVERY is part of Advanced Measurement Technology, Inc, a division of AMETEK, Inc. It includes the businesses formerly trading as EG&G Princeton Applied Research, EG&G Instruments (Signal Recovery), EG&G Signal Recovery and PerkinElmer Instruments (Signal Recovery)

Declaration of Conformity

This product conforms to EC Directives 89/336/EEC Electromagnetic Compatibility Directive, amended by 92/31/EEC and 93/68/EEC, and Low Voltage Directive 73/23/EEC amended by 93/68/EEC.

This product has been designed in conformance with the following IEC/EN standards:

EMC: BS EN55011 (1991) Group 1, Class A (CSPIR 11:1990)
 BS EN50082-1 (1992):
 IEC 801-2:1991
 IEC 801-3:1994
 IEC 801-4:1988

Safety: BS EN61010-1: 1993 (IEC 1010-1:1990+A1:1992)

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Appendix A, Specifications

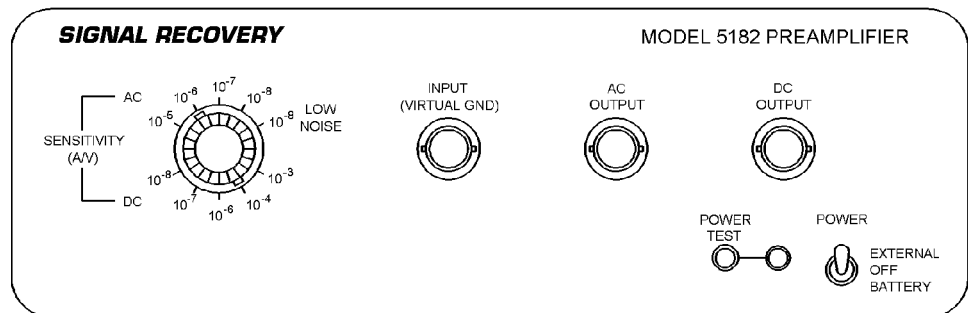
Appendix B, External Power Supply

Warranty	End of Manual
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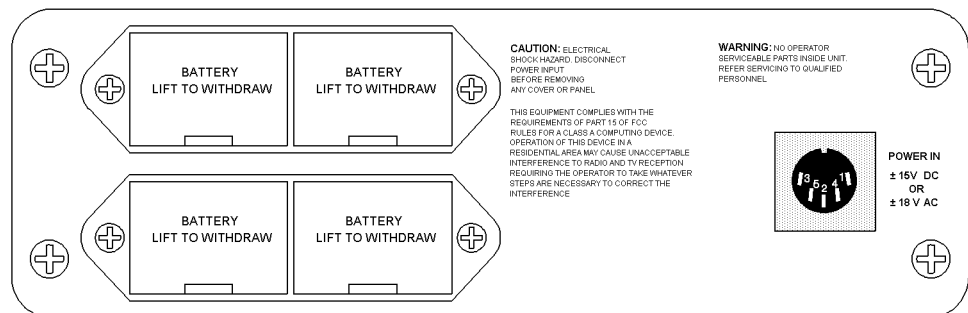
1.1 Description

The 5182 is a current input preamplifier designed for use whenever the signal source is a current source - for example, with electron multipliers, ion collectors, photo multipliers and photo diodes. The sensitivity is switch selectable with five settings enabling the amplifier, on its most sensitive range, to detect fractions of a picoamp without noise degradation, while on its least sensitive range it can sink currents up to 9 mA without overload.

The instrument has a bandwidth of 25 kHz on its most sensitive range (10^{-8} A/V) and 1 MHz on its least sensitive range (10^{-5} A/V), while still maintaining low input current noise ranging from 45 fA / $\sqrt{\text{Hz}}$ on the 10^{-8} A/V range to 10 pA / $\sqrt{\text{Hz}}$ on the 10^{-5} A/V range. An additional low noise range is provided - denoted 10^{-8} A/V Low Noise, which features a reduced bandwidth of 10 kHz but with even lower noise.



Front Panel



Rear Panel

Figure 1-1, Model 5182 Low-Noise Current Preamplifier

1.2 Options

The model 5182 is supplied complete with four 9 V alkaline batteries. The following optional extras are available.

- | | |
|---------------------|--|
| Model PS0108 | Remote Line Power Supply for the model 5182. See Appendix B for details of this unit. |
| Model PS0109 | Pack of 20 alkaline batteries for the model 5182 |
| Model C0218 | Power cable. This cable allows the user to power the model 5182 from any one of the following SIGNAL RECOVERY (formerly EG&G/PerkinElmer) Lock-in Amplifiers: Model 5102, 5104, 5109, 5110, 5205, 5206, 5207, 5208, 5209, 5210, 5302, 7220, 7225, 7260, 7265 or 7280. |
| Model K0304 | Rack mounting kit. This allows 1 or 2 model 5182 preamplifiers to be mounted in a standard 19" rack. |

2.1 Introduction

The following procedure is provided to facilitate initial performance checking of the Model 5182. In general, the procedure should be performed after inspecting the instrument for shipping damage (any noted to be reported to the carrier and to **SIGNAL RECOVERY**), but before using it experimentally. Should any difficulty be encountered in carrying out these checks, contact the factory or one of its representatives.

2.2 Equipment Needed

- 1) General purpose laboratory oscilloscope.
- 2) Signal generator capable of providing a 10 V, 1 V, 100 mV and 10 mV pk-pk sine wave at 1 kHz, with a variable DC output offset facility.
- 3) A 1 M Ω resistor mounted inside a screened enclosure and connected between the inner connecting pins of male and female BNC connectors. The outer shield, or ground, terminals of these connectors should be connected together.

2.3 Procedure

- 1) Set the front-panel **POWER** switch to the down (**BATTERY**) position. Then press the adjacent **POWER TEST** button. The associated indicator should light, indicating that the internal batteries are installed and functioning properly. If the **POWER TEST** indicator doesn't light, refer to section 3.3 for a discussion of the 5182's battery requirements.

Note: Those users who have purchased the **SIGNAL RECOVERY** external power supply option model PS0108 can use the external supply to perform the initial checks, in which case step 1 is replaced by the following operations.

- a) Make sure that the voltage selector switch on the external power supply is in the position indicating the line voltage to be used (110 V AC or 240 V AC).
 - b) Plug the line cord into the external power supply and the external power supply into the instrument power socket.
 - c) Set the **POWER** switch to the up (**EXTERNAL**) position. Then press the adjacent **POWER TEST** button. The associated indicator should light, indicating that the external supply is functioning properly.
- 2) Select the AC sensitivity to 10^{-5} A/V.
 - 3) Connect the oscilloscope to the **AC OUTPUT** BNC connector.

- 4) Set the signal generator to 1 kHz, 10 V pk-pk, and connect it via the 1 M Ω BNC module to the **IINPUT** BNC connector. Use the oscilloscope to monitor the signal generator amplitude settings so as to obtain consistency between input settings and output readings.
- 5) Monitor the output; the output level should be 1 V pk-pk.
- 6) Set the signal generator to 1 kHz, 1 V pk-pk. Then set the 5182 AC sensitivity to **10⁻⁶A/V** and monitor the output; the output level should be 1 V pk-pk.
- 7) Set the signal generator to 1 kHz, 100 mV pk-pk. Then set the 5182 AC sensitivity to **10⁻⁷A/V** and monitor the output; the output level should be 1 V pk-pk.
- 8) Apply a 5 V DC offset to signal generator output signal and monitor the **DC OUTPUT** BNC connector with the oscilloscope; the output level should be 5 V DC.
- 9) Remove the DC offset from the signal generator output and reconnect the oscilloscope to the **AC OUTPUT** BNC connector.
- 10) Set the signal generator to 1 kHz, 10 mV pk-pk. Then set the 5182 AC sensitivity to **10⁻⁸A/V** and monitor the output; the output level should be 1 V pk-pk.
- 11) Set the signal generator to 1 kHz, 10 mV pk-pk. Then set the 5182 AC sensitivity to **10⁻⁸A/V LOW NOISE** and monitor the output; the output level should be 1 V pk-pk.
- 12) Return the power switch to the center (**OFF**) position.

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

3.1 Introduction

The Model 5182 has been designed to be extremely easy to setup and use. It can be powered from an external source or from internal alkaline cells as selected from a front-panel switch. In operation, the signal to be measured is to the input BNC connector. The output is cabled directly to the input of the lock-in amplifier or other instrument with which the 5182 is to be used.

3.1.01 Power Switch

The three-position power switch allows **EXTERNAL**, **OFF**, or **BATTERY** to be selected. To operate the Model 5182 from an external power source, set the switch to the up position. To operate the 5182 from internal batteries, set the switch to the down position. In the center position, the 5182 is unpowered. The status of the selected power source can be ascertained at a glance by pressing the **POWER TEST** button; the adjacent LED will light if the power source voltage, whether the external supply or internal batteries, is above the minimum required value for reliable operation.

3.1.02 Inputs

The 5182 **INPUT** connector is at virtual ground. It is DC coupled and is capable of sinking considerably more DC current than the AC current which it is measuring. The current source should be connected to the input by means of a low noise coaxial cable and BNC connector. Since cable capacitance can cause frequency response peaking, the cable length should be kept as short as possible, particularly on the more sensitive ranges.

3.1.03 Sensitivity Switch

The five position sensitivity switch provides a trade-off facility between sensitivity, noise, bandwidth and DC overload capability. AC sensitivity is switchable in decade steps from 10^{-5} A/V to 10^{-8} A/V with an additional low noise 10^{-8} A/V setting. The corresponding DC sensitivity ranges from 10^{-3} A/V to 10^{-8} A/V.

3.1.04 Outputs

Two BNC output connectors are provided; one representing the AC signal current and one representing the DC signal current. The AC Output can deliver >10 V pk-pk into loads >100 k Ω . The 450 Ω output impedance provides a convenient 10:1 output attenuator if the amplifier is loaded with 50 Ω , which can be useful if the 5182 is required to drive coaxial cable lengths of greater than one meter at signal frequencies approaching 1 MHz. The DC output provides a useful bias current monitor in several applications. It can output > ± 9 V from an output resistance of 10 k Ω into loads >1 M Ω .

3.2 Operating the Model 5182

3.2.01 Introduction

The instrument is powered as required either from the self-contained batteries, from the preamplifier power-socket of a compatible lock-in amplifier (Models 7265, 7220, 5110, 5210, etc), or from an external power supply, and the signal to be amplified is applied to the input connector; the amplified signal is available at the **AC OUTPUT** BNC connector through a resistance of 450 Ω .

Note: Before operating from the external power supply (Appendix A), make sure the voltage selector switch on the external power supply is in the position indicating the line voltage to be used, and be sure the proper size line fuse is installed (200 mA for 110 V operation or 100 mA for 240 V operation). Operating from too high a line voltage will blow the line fuse and possibly damage the power transformer and circuit components.

3.2.02 Signal Voltage and Gain

The gain selector accurately sets the gain to the indicated level. The maximum output that the amplifier can provide is 10 V pk-pk into a high impedance load. For maximum input currents, refer to the specifications.

3.3 Battery Operation

In battery powered operation, the 5182 requires four 9 V alkaline cells (type NEDA 1604, PP3 or equivalent). Each battery fits into its own removable tray accessible from the rear panel. When they are exhausted, all four batteries should be replaced together. Care should be taken when exchanging the batteries to observe the correct polarity which is marked on the inside of the battery trays and the top of the batteries. The batteries will provide up to fifteen hours operation at 1 V rms. output level.

Nickel-cadmium rechargeable batteries can be used if preferred, but there will be a penalty of a reduction in the operating time obtained. In addition it will be necessary to recharge these batteries in an external charger.

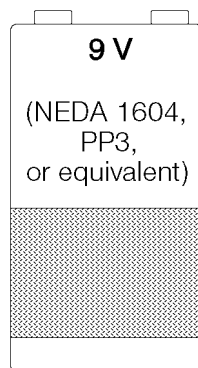


Figure 3-1, Required Battery Type

3.4 External Supply Operation

External power can be provided by a stand-alone external power supply (see Appendix B) providing ± 18 V DC, or the Preamplifier Power Output of most **SIGNAL RECOVERY** lock-in amplifiers which provide ± 15 V DC. Connection is by a DIN 5-way socket on the rear panel of the 5182.

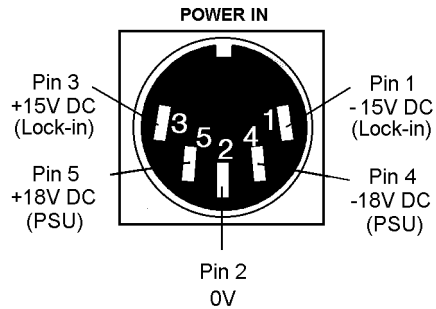


Figure 3-2, External Power Input Connector Pinout

Specifications

General

DC coupled current to voltage amplifier with adjustable sensitivity and a maximum frequency response extending from DC to 1 MHz. Single-ended virtual ground input and single-ended DC and AC coupled outputs via BNC connectors.

Battery powered from internal alkaline batteries or external DC power supplies.

Inputs

Mode	Single-ended virtual ground
Coupling	DC
Sensitivity	Switch selectable (5 settings)
AC Output	10^{-5} , 10^{-6} , 10^{-7} , 10^{-8} , 10^{-8} low noise A/V
DC Output	10^{-3} , 10^{-4} , 10^{-6} , 10^{-7} , 10^{-8} A/V
Accuracy	$\pm 2\%$
Stability	± 300 ppm/ $^{\circ}$ C
Impedance	see Figure A-1

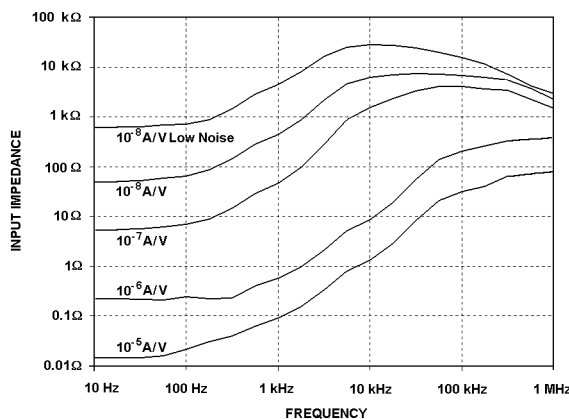


Figure A-1, Input Impedance vs. Frequency

Max input w/o damage	± 15 V DC or 10 V rms. AC @ 50 Hz
Noise	see Table A-1

Sensitivity (A/V)	Max DC Input Current at 1 kHz	Noise Current at 1 kHz
10^{-5}	9 mA	10 pA/ $\sqrt{\text{Hz}}$
10^{-6}	900 μA	5 pA/ $\sqrt{\text{Hz}}$
10^{-7}	9 μA	135 fA/ $\sqrt{\text{Hz}}$
10^{-8}	900 nA	45 fA/ $\sqrt{\text{Hz}}$
10^{-8} , low noise	90 nA	15 fA/ $\sqrt{\text{Hz}}$

Table A-1, Max DC Input and Noise vs. Gain

Frequency Response

lower limit 0.5 Hz, (AC Output) upper limit depends on sensitivity setting, see Figure A-2

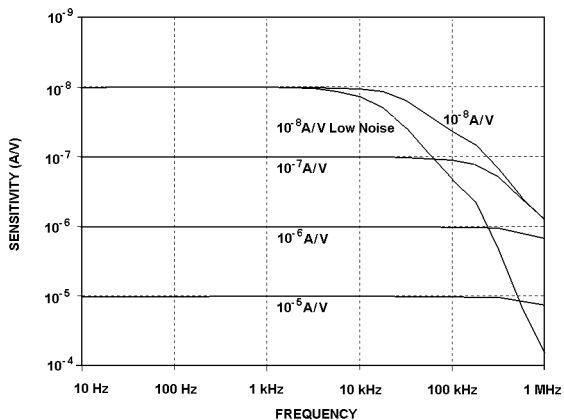


Figure A-2, Frequency Response

Max DC current at input

see Table A-1

Outputs

AC Output

Impedance 450 Ω
 Max voltage swing > 10 V pk-pk
 Slew rate > 22 V/μs

DC Output

Impedance 10 kΩ
 Max voltage swing > ±9 V
 Polarity Current flowing into the input produces positive output voltage

Power

Internal Four 9 V alkaline batteries provide approximately 15 hours of use

External

a) ±15 V or ±18 V DC @ 25 mA
 b) 110 V AC or 240 V AC via optional external model PS0108 power supply

Dimensions

(excluding connectors)

8.25" wide × 11" deep × 3.5" high
 (210 mm wide × 279 mm deep × 89 mm high)

Weight

5.3 lbs. (2.4 kg) excluding optional power supply

Power Supply Unit (Model PS0108)

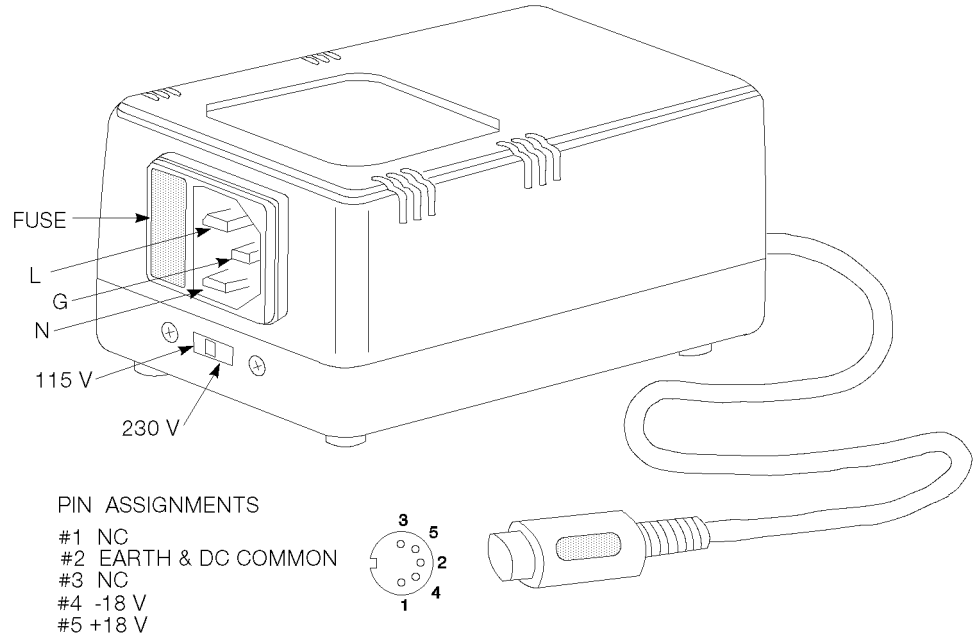


Figure B-1, Model PS0108 External Power Supply

Fuse Rating	
115 V operation	200 mA
230 V operation	100 mA
Fuse Type	5 mm × 20 mm, 250 V, Slow Blow

WARRANTY

AMETEK 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.

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SHOULD YOUR EQUIPMENT REQUIRE SERVICE

- A. Contact your local AMETEK 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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