

**Models 5188A &
5188B
Optical Input Preamplifiers**

Instruction Manual

190185-A-MNL-C

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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Table of Contents

Chapter One, Description

1.1 Description	1-1
1.2 Options	1-2

Chapter Two, Initial Checks

2.1 Introduction	2-1
2.2 Equipment Needed	2-1
2.3 Procedure.....	2-1

Chapter Three, Operating Instructions

3.1 Introduction	3-1
3.1.01 Power Switch	3-1
3.1.02 Inputs.....	3-1
3.1.03 Sensitivity Switch.....	3-1
3.1.04 Outputs	3-2
3.2 Operating the Model 5188.....	3-2
3.2.01 Introduction.....	3-2
3.2.02 Signal Voltage and Gain	3-2
3.3 Battery Operation.....	3-2
3.4 External Supply Operation	3-3

Appendix A, Specifications

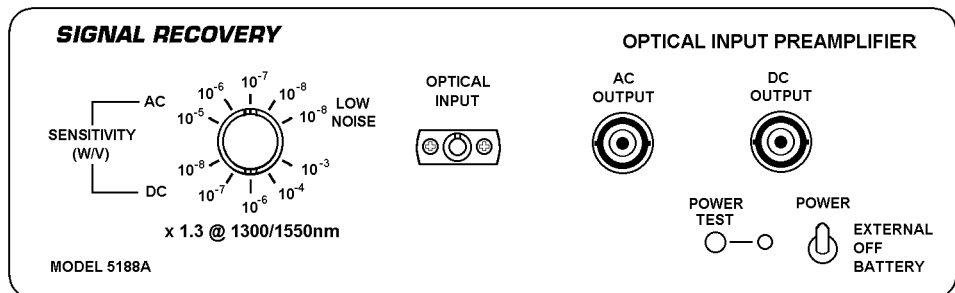
Appendix B, External Power Supply

Warranty.....	End of Manual
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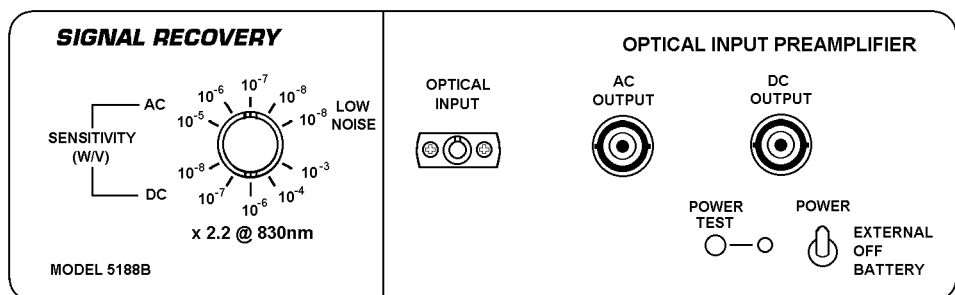
1.1 Description

The Model 5188 preamplifier has an optically sensitive input and is designed to be used as a light to voltage converter in situations where the signals to be amplified are derived from an optical source. There are two versions of the product, differing only by the nature of the input detection device. The model 5188A has an InGaAs device which responds to near infra-red radiation while that in the model 5188B is a silicon device and operates in the visible region of the electromagnetic spectrum. Sensitivity is switch selectable, with a choice of five settings, which enables the amplifier to detect fractions of a picowatt, without noise degradation, on its most sensitive range, while being able to accept optical power up to 18 mW on its least sensitive range without overload.

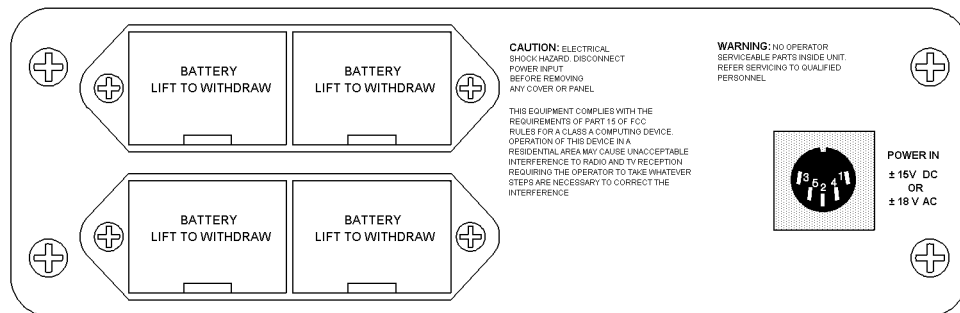
The instrument has bandwidths from 25 kHz on its most sensitive range, 10^{-8} W/V, to 1 MHz on its least sensitive range, 10^{-5} W/V. Input noise ranges from 70 fW/ $\sqrt{\text{Hz}}$ to 15 pW/ $\sqrt{\text{Hz}}$ for the model 5188A, and 180 fW/ $\sqrt{\text{Hz}}$ to 25 pW/ $\sqrt{\text{Hz}}$ for the model 5188B, dependent on the sensitivity setting selected. An additional low-noise range, denoted 10^{-8} W/V Low Noise, is also provided, this setting having a reduced bandwidth of 10 kHz but with even lower noise.



Model 5188A Front Panel



Model 5188B Front Panel



Rear Panel

Figure 1-1, Models 5188A & 5188B Optical Input Preamplifiers

1.2 Options

The model 5188 is supplied complete with four 9 V alkaline batteries. The following optional extras are available.

- Model PS0108** Remote Line Power Supply for the model 5188. See Appendix B for details of this unit.
- Model PS0109** Pack of 20 alkaline batteries for the model 5188
- Model C0218** Power cable. This cable allows the user to power the model 5188 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 5188 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 5188. 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) An light source suitable for the wavelength range of the 5188 complete with variable power output and a facility for it to be modulated by a 1 kHz sinusoidal signal.
- 4) Suitable fiber patchcord with an FC/PC connector at one (or both ends).

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 5188'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) Connect the oscilloscope to the **AC OUTPUT** BNC connector.

- 3) Connect the light source to the model 5188's **OPTICAL INPUT** connector, taking care to clean the fiber connectors prior to use. For reasons of laser safety, ensure the connection is completed before the light source is switched on.
- 4) Set the signal generator to 1 kHz with an amplitude as required by the light source to be used, and connect to the light source modulation input.

Use the oscilloscope to monitor the signal generator amplitude settings so as to obtain consistency between input settings and output readings.

- 5) Set the model 5188 **AC SENSITIVITY** switch to **10⁻⁸ W/V LOW NOISE** and monitor the signal at the **AC OUTPUT** connector. Adjust the light source output and DC offset to give a sinusoidal signal at the **AC OUTPUT** of 5 V pk-pk at 1 kHz with no distortion visible.
- 6) Connect the oscilloscope to monitor the level present at the **DC OUTPUT** connector. Note the DC level present.
- 7) Set the model 5188 **AC SENSITIVITY** switch to **10⁻⁸ W/V**. The DC output level should be one tenth of the level observed in section 6) above.
- 8) Reconnect the oscilloscope to monitor the level present at the **AC OUTPUT** connector. The AC output level should be 5 V pk-pk at 1 kHz.
- 9) Set the model 5188 **AC SENSITIVITY** switch to **10⁻⁷ W/V**. The AC output level should be 500 mV pk-pk at 1 kHz.
- 10) Set the model 5188 **AC SENSITIVITY** switch to **10⁻⁶ W/V**. The AC output level should be 50 mV pk-pk at 1 kHz.
- 11) Set the model 5188 **AC SENSITIVITY** switch to **10⁻⁵ W/V**. The AC output level should be 5 mV pk-pk at 1 kHz.
- 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 5188 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 coupled to the optical input connector via a length of suitable fiber. The output is cabled directly to the input of the lock-in amplifier or other instrument with which the 5188 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 5188 from an external power source, set the switch to the up position. To operate the 5188 from internal batteries, set the switch to the down position. In the center position, the 5188 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 model 5188 Input has an FC/PC optical interface connector. The optical source should be connected to the **OPTICAL INPUT** by means of a suitable optical patchcord fitted with an FC/PC connector at one (or both) ends. To avoid bend induced optical power loss ensure that all patchcord bend radii are greater than 40 mm. Note that the operating wavelength of the input is dependent on which version is being used.

It is important to observe cleanliness when connecting the fiber patchcord to the model 5188 and to the source(s). The fiber patchcord is best cleaned with a lint-free wipe, lens tissue or cotton bud soaked in isopropyl alcohol (IPA) using a gentle wiping action across the ferrule connector end face. To reduce the risk of contamination of the preamplifier's detector, it is recommended that the cleaning procedure is performed each time a connection is made.

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} W/V to 10^{-8} W/V with an additional low-noise 10^{-8} W/V setting. Each setting of the AC sensitivity has a corresponding DC sensitivity as follows;

AC Sensitivity (W/V)	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-8} LOW NOISE
DC Sensitivity (W/V)	10^{-3}	10^{-4}	10^{-6}	10^{-7}	10^{-8}

(Note there is no 10^{-5} setting on the DC range.)

3.1.04 Outputs

Two BNC output connectors are provided; one representing the AC signal power and one representing the DC signal power. 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 5188 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 impedance of 10 k Ω into loads >1 M Ω . The time constant of the DC output is approximately 0.1 second.

3.2 Operating the Model 5188

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, 7225, 5110, 5210, etc), or from an external power supply, and the optical signal to be detected and 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 optical input powers, refer to the specifications in appendix A.

3.3 Battery Operation

In battery powered operation, the 5188 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.

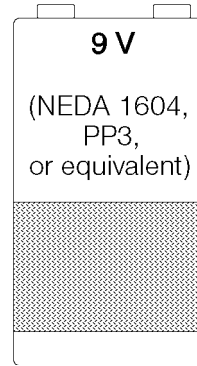


Figure 3-1, Required Battery Type

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 5188.

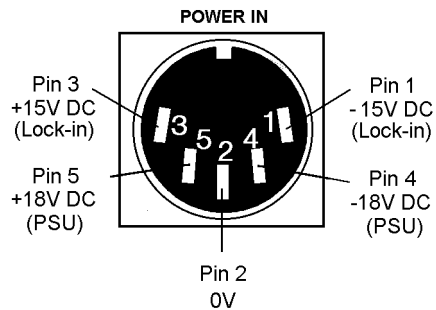


Figure 3-2, External Power Input Connector Pinout

Specifications

General

DC coupled optical power to voltage amplifier with adjustable conversion ratio and a maximum frequency response extending from DC to 1 MHz. FC/PC optical connector input and single-ended DC and AC coupled outputs via BNC connectors.

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

Input

Connector	FC/PC
Device	
5188A	InGaAs
5188B	Si
Operating Wavelength	
5188A	1000 nm to 1650 nm
5188B	400 nm to 1000 nm
Sensitivity	
Switch selectable (5 settings)	
AC Output	10^{-5} , 10^{-6} , 10^{-7} , 10^{-8} , 10^{-8} low noise W/V
DC Output	10^{-3} , 10^{-4} , 10^{-6} , 10^{-7} , 10^{-8} W/V
Calibration Factor	
5188A	Sensitivity setting \times 1.3 at 1300/1550 nm
5188B	Sensitivity setting \times 2.2 at 830 nm
Accuracy	$\pm 2\%$
Stability	± 300 ppm/ $^{\circ}$ C
Frequency Response	
10^{-5} W/V setting	0.5 Hz to 1 MHz
10^{-6} W/V setting	0.5 Hz to 800 kHz
10^{-7} W/V setting	0.5 Hz to 200 kHz
10^{-8} W/V setting	0.5 Hz to 25 kHz
10^{-8} W/V low noise setting	0.5 Hz to 10 kHz
Max Optical Power at input	
10^{-5} W/V setting	5188A: 10 mW; 5188B: 18 mW
10^{-6} W/V setting	5188A: 1 mW; 5188B: 1.8 mW
10^{-7} W/V setting	5188A: 10 μ W; 5188B: 18 μ W
10^{-8} W/V setting	5188A: 1 μ W; 5188B: 1.8 μ W
10^{-8} W/V low noise setting	5188A: 100 nW; 5188B: 180 nW
Noise, rms. referred to input	
10^{-5} W/V setting	5188A: 15 pW/ $\sqrt{\text{Hz}}$; 5188B: 25 pW/ $\sqrt{\text{Hz}}$
10^{-6} W/V setting	5188A: 8 pW/ $\sqrt{\text{Hz}}$; 5188B: 15 pW/ $\sqrt{\text{Hz}}$
10^{-7} W/V setting	5188A: 200 fW/ $\sqrt{\text{Hz}}$; 5188B: 350 fW/ $\sqrt{\text{Hz}}$
10^{-8} W/V setting	5188A: 70 fW/ $\sqrt{\text{Hz}}$; 5188B: 180 fW/ $\sqrt{\text{Hz}}$
10^{-8} W/V low noise setting	5188A: 40 fW/ $\sqrt{\text{Hz}}$; 5188B: 150 fW/ $\sqrt{\text{Hz}}$

Outputs

AC Output	
Impedance	450 Ω
Max voltage swing	> 10 V pk-pk
Slew rate	> 22 V/ μ s
DC Output	
Impedance	10 k Ω
Max voltage swing	> \pm 9 V
Polarity	Increased optical power at the input produces increased positive output voltage
Output due to photodiode dark current, max	
10^{-5} W/V setting	5188A: 1 μ V; 5188B: 10 μ V
10^{-6} W/V setting	5188A: 10 μ V; 5188B: 100 μ V
10^{-7} W/V setting	5188A: 1 mV; 5188B: 10 mV
10^{-8} W/V setting	5188A: 10 mV; 5188B: 100 mV
10^{-8} W/V low noise setting	5188A: 100 mV; 5188B: 1 V

Power

Internal	Four 9 V alkaline batteries provide approximately 15 hours of use
External	
a)	\pm 15 V or \pm 18 V DC @ 25 mA
b)	110 V AC or 240 V AC via optional external model PS0108 power supply

Mechanical

Dimensions (excluding connectors)	8.25" wide \times 11" deep \times 3.5" high (210 mm wide \times 279 mm deep \times 89 mm high)
Weight	5.3 lbs. (2.4 kg) excluding optional power supply

Power Supply Unit (Model PS0108)

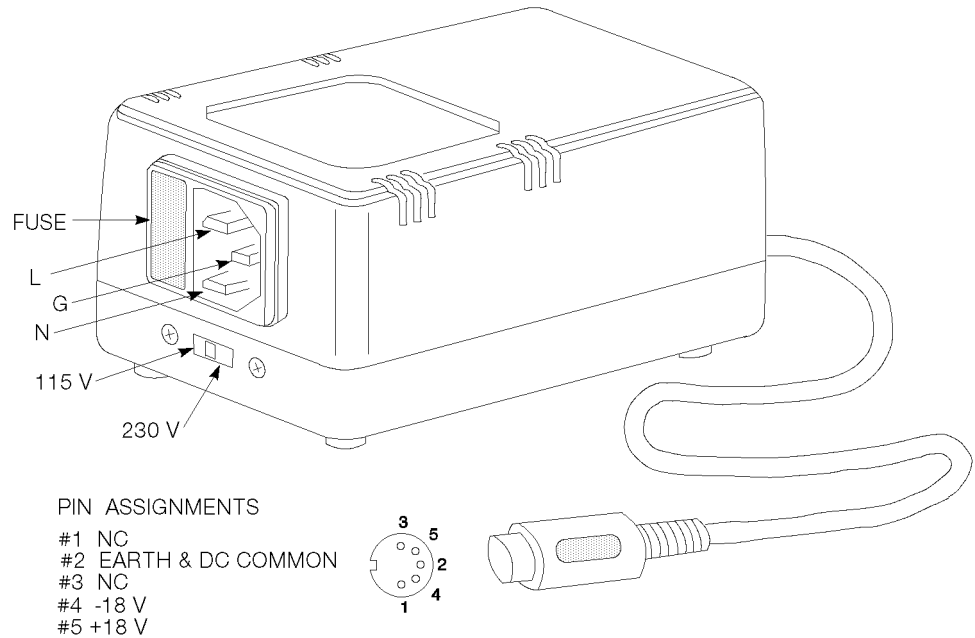


Figure B-1, Model PS0108 External Power Supply

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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