Model 5113

Low Noise Preamplifier

Instruction Manual

222144-A-MNL-F

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 or her 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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Introduction

Chapter 1

1.1 Model 5113 Preamplifier

The Model 5113 Low-Noise Preamplifier provides high gain, low-noise amplification of wideband signals from DC to 1 MHz, well suited for use with both ***SIGNAL RECOVERY*** and other manufacturers' signal processing instruments. Adjustable high and low frequency rolloffs allow the bandwidth to be reduced. Two inputs, with switchable coupling, allow either differential or single-ended operation. Coarse gain is selectable from ×5 to ×50,000 in a 1-2-5 sequence with a fine gain control extending the range to ×l to ×10,000. An uncalibrated vernier allows finer adjustment of the gain.

The unit may be powered either from an external DC power supply or from its internal sealed and maintenance-free lead-acid batteries. These batteries recharge automatically when a suitable external power supply is connected. Other features include an overload fast-recovery button, a front-panel DC zero screwdriver control, and a battery test facility.

1.2 Why use a Preamplifier?

Difficulties encountered with the measurement of analog signals can often be traced to the interface between the signal source and the measurement system, especially when insufficient attention has been devoted to this connection.

Consider some of the problems:

- Incompatibility of source output impedance with the amplifier's input impedance.
- The sensitivity of the measuring system may be too low to recover the signal of interest.
- The signal source may generate a differential output voltage whereas the measuring system might have only a single-ended input.

In these cases and many others the use of an appropriate preamplifier can result in a marked improvement in signal measurement capabilities. For example:

- The input impedance can be matched to the source to achieve the lowest possible noise.
- The preamplifier can increase the sensitivity of the measuring system.
- Differential input preamplifiers have the ability to reject pick-up noise, offering a high degree of isolation to floating sources and avoiding the problems often caused by ground loops.

Installation & Initial Checks

Chapter 2

2.1 Installation

2.1.01 Introduction

The model 5113 is very easy to use, generally simply requiring the connection of a single cable from the detector or signal source to its input and a single connection from its output to the following instrument. All the controls are located on the front-panel, and the back-lit LCD screen allows all the important control settings to be seen at a glance.

The unit is line powered via the supplied model PS0108 power supply, but can also be run from its own internal batteries, which automatically recharge when the power supply is connected. A battery level indicator ensures that the user can be sure that there will be sufficient power left to complete an experiment, thereby avoiding the irritation that would be caused by battery failure during a key measurement.

2.1.02 Inspection

Upon receipt the model 5113 preamplifier should be inspected for shipping damage. If any 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.

2.2 Initial Checks

2.2.01 Introduction

The following procedure checks the performance of the model 5113. In general, this procedure should be carried out after inspecting the instrument for obvious shipping damage.

NOTE: Any damage must be reported to the carrier and to SIGNAL RECOVERY immediately; take care to save the shipping container for inspection by the carrier.

Note that this procedure is intended to demonstrate that the unit has arrived in good working order, not that it meets specifications. Each preamplifier receives a careful and thorough checkout before leaving the factory, and normally, if no shipping damage has occurred, will perform within the limits of the quoted specifications. If any problems are encountered in carrying out these checks, contact ***SIGNAL RECOVERY*** or the nearest authorized representative for assistance.

2.2.02 Equipment Required

1) General purpose laboratory oscilloscope.

2) Signal generator capable of providing a 0.2 V pk-pk sine wave at 10 Hz, 1 kHz, and 100 kHz.

2.2.03 Procedure

1) Make sure that the voltage selector switch on the model PS0108 external power supply is in the position indicating the line voltage to be used (110 V AC or 240 V AC).

2) Plug the line cord into the external power supply and the external power supply's power output cable plug into the instrument power socket.

3) Press the power switch upwards and release. The switch should spring back to its center position and the power indicator should remain lighted.

4) By reference to Chapter 3, set the controls on the 5113 to the following settings:

Gain:	×10
Input coupling:	
A Input:	AC
B Input:	GND (Displayed as A AC)
Filter mode:	Bandpass
Low Frequency Rolloff:	10 Hz
High Frequency Rolloff:	100 kHz

5) Connect the oscilloscope input to the BNC output connector.

6) Set the signal generator to 10 Hz, 0.2 V pk-pk, and connect it to the **A** input. Use the oscilloscope to make the signal generator amplitude settings so as to obtain consistency between input settings and output readings.

7) Using the oscilloscope, check that the output level is 1.4 V pk-pk.

8) Set the signal generator to 1 kHz, 0.2 V pk-pk. Check that the output level is 2 V pk-pk.

9) Set the signal generator to 100 kHz, 0.2 V pk-pk. Check that the output level is 1.4 V pk-pk.

10) Press the power switch down and release. The switch should return to its center position and the power indicator should no longer be lighted.

This completes the initial checks. If the indicated results where obtained then the user can be reasonably sure that the 5113 incurred no hidden damage in shipment and is in good working order.

Front and Rear Panels

Chapter 3

3.1 Front Panel

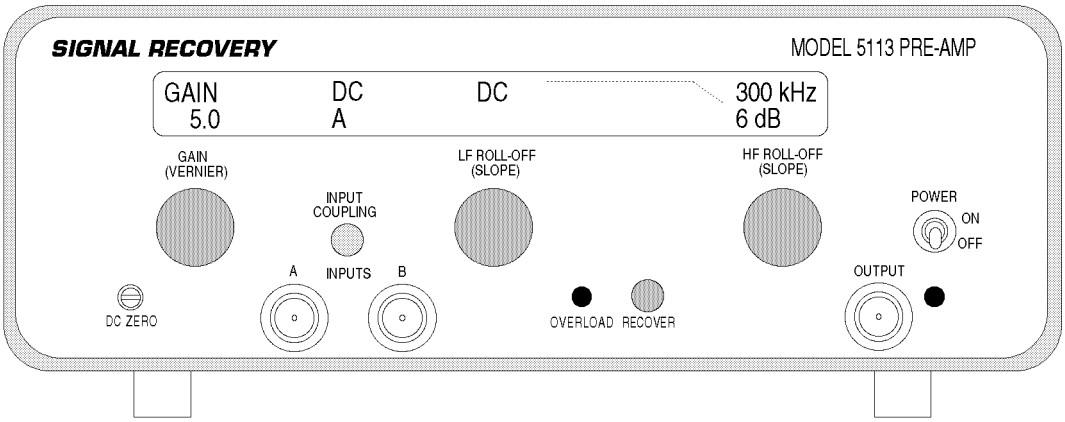

Figure 3-1, Model 5113 Front Panel

As shown in figure 3-1 above, the front panel of the model 5113 has three BNC connectors, three dual function rotary/push buttons, a power switch, input selector button, overload recovery button and zero offset control. It also has back-lit rectangular LCD display, overload and power LEDs. All these items are described in the following sections.

3.1.01 INPUT Connectors

The **A** input connector is used for single-ended and differential voltage input modes and the **B** input connector is used for differential voltage input mode measurements.

3.1.01 INPUT COUPLING Button

The input coupling button, located above the two input connectors, cycles through four input modes. The mode selected is displayed on the LCD above the button, and are as follows:

A	AC
A	DC
A-B	AC
A-B	DC

When using AC coupling, the display will show either

AC-1 s

or
AC-10 s,

depending on the time constant selected. Refer to section 4.2.09 for information on how to change the time constant.

3.1.03 RECOVER/Sleep Button

The push button located below the center and right hand knobs has two functions.

Overload Recover
When an overload is indicated by the adjacent **OVERLOAD** LED being lit, pushing the button initiates an overload recovery operation. At low filter setting frequencies the time to recover from an overload condition can be decreased by the use of this button. At higher filter setting frequencies the unit recovers so fast that the use of this button is unnecessary.

Sleep
When the adjacent **OVERLOAD** indicator is not lit, pushing and releasing this button removes power from the LCD and puts the processor into a low power mode. This stops all internal clocks and oscillators, preventing any digital pick-up. The amplifier continues to work with all the previous settings still valid. The processor can be reactivated, in order to view the display or change the settings, by pressing any of the five front panel push buttons. The processor can also be reactivated by sending a character via the RS232 port, refer to Chapter 5, Commands.

3.1.04 GAIN (VERNIER) Control

The left hand knob controls all the gain functions. Pressing the knob cycles through three gain modes which are displayed on the LCD above the knob. These modes are:

COARSE GAIN	(displayed as COARSE)
FINE GAIN	(displayed as FINE)
GAIN VERNIER	(displayed as a bargraph)

Rotating the knob in COARSE mode adjusts the calibrated gain displayed directly above the knob in a 1-2-5 sequence and removes any uncalibrated vernier. Rotating the knob in FINE mode also adjusts the calibrated gain displayed directly above the knob and removes any uncalibrated vernier. Rotating the knob in the vernier mode adjusts the uncalibrated vernier, shown by a moving bargraph.

Whenever there is any uncalibrated vernier applied, the numerical value of the calibrated gain shows + after it to indicate that the gain is greater than that indicated by the numerical value. The + is the UNCAL indicator.

It is important to note that the displayed gain is for no filters switched in. The gain when the filters are in use is of course a function of frequency and the filter response figures in appendix A can be used to calculate the gain for any particular frequency.

For example, if both filters are tuned to the same frequency and bandpass mode is selected, then the gain of each filter section taken from the response figures is ×0.707, so the overall gain at the tuned frequency is 0.707 * 0.707 = 0.5 (-6 dB), or half the displayed gain value.

3.1.05 LF ROLL-OFF (SLOPE) Control

This knob has two main functions. When pressed, it changes the overall filter mode, and when turned, it controls the lower roll-off frequency, or in other words the roll-off frequency for the *high-pass* filter.

Each push of the LF roll-off knob advances the filter mode through the five settings in the following list.

Bandpass
High-pass, 6 dB
High-pass, 12 dB
High-pass, 6/12 dB
Flat

Each mode is represented graphically in the center section of the LCD.

When any mode other than Flat is active, turning the knob changes the lower roll-off frequency in a 1-3-10 sequence from 0.03 Hz to 300 kHz. Turning the knob clockwise increases the frequency setting and turning it anti-clockwise decreases it. When the high-pass 6/12 dB mode is selected, it controls the lower one of the two high-pass roll-off frequencies, with the HF ROLL-OFF knob controlling the upper roll-off frequency.

3.1.06 HF ROLL-OFF (SLOPE) Control

This knob functions in a similar way to the LF ROLL-OFF control described above. When pressed, it changes the overall filter mode, and when turned, it controls the upper roll-off frequency, or in other words the roll-off frequency for the *low-pass* filter.

Each push of the HF roll-off knob advances the filter mode through selects the next filter mode, of which there are five, as follows:

Bandpass
Low-pass, 6 dB
Low-pass, 12 dB
Low-pass, 6/12 dB
Flat

Each mode is represented graphically in the right hand section of the LCD.

When any mode other than Flat is active, turning the knob changes the upper roll-off frequency in a 1-3-10 sequence from 0.03 Hz to 300 kHz. Turning the knob clockwise increases the frequency setting and turning it anti-clockwise decreases it. When the low-pass 6/12 dB mode is selected, it controls the upper one of the two low-pass roll-off frequencies. , with the LF ROLL-OFF knob controlling the lower roll-off frequency.

3.1.06 POWER Switch

The power switch has a momentary action, biased to the center. To turn the power on, press the switch up and release. The power indicator LED will light and the LCD will briefly display the start-up message. Once the start-up message disappears, the display will show the instrument's configuration. All settings are retained in non-volatile memory except for the backlight status, which always defaults to OFF to conserve battery power and reduce battery charging time.

To turn the power off, press the switch down and release. The power indicator LED will extinguish.

3.1.07 OUTPUT Connector

The amplifier's output is provided at this connector. The output impedance is 50 Ω and the maximum output voltage is 2 V pk-pk ahead of this impedance. Hence if the output is terminated into a 50 Ω load, the maximum voltage available across the load will be 1 V pk-pk.

3.2 Rear Panel

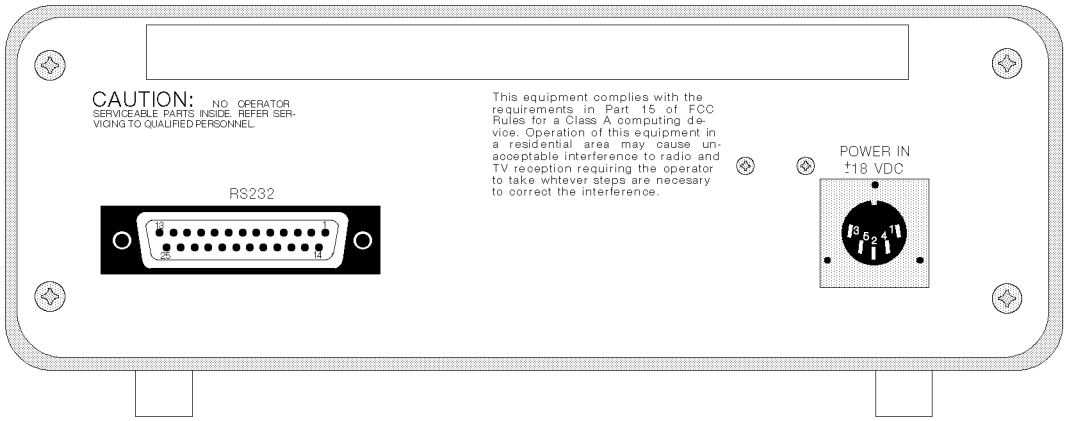

Figure 3-2, Model 5113 Rear Panel

The rear panel of the instrument, shown above in figure 3-2, has only two connectors, the pinouts for which are given in Appendix B.

Front Panel Operation

Chapter 4

4.1 Introduction

The Model 5113 has been designed to be extremely easy to setup and use. With rotary and push button controls and an 80 character LCD (liquid crystal display), adjustments are quick to make and the display of information comprehensive. The display enables the operator to determine the instrument's status at a glance.

4.2 Operation

4.2.01 Power

The instrument is powered as required either from the self-contained batteries or from the external power supply, and the signal to be amplified is applied to the input connector(s); the amplified signal is available at the OUTPUT BNC connector through a resistance of 50 Ω.

Note: Before operating from the external power supply, make sure the external power supply voltage selector switch 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.

4.2.02 Signal Grounding

The signal ground side of the input connectors is connected to chassis ground through a 47 Ω resistor.

Caution: The power rating of the 47 Ω resistor is ½ watt. Avoid excessive ground-to-ground current to avoid burning out this resistor. When the signal is applied to the input via a transformer, operate the amplifier single-ended. That is, repeatedly press the input select button until A AC is displayed on the LCD and connect the transformer to the A Input; connect one transformer lead to the outer shell of the BNC connector and connect the other transformer lead to the center conductor of the connector. Connecting this way avoids the problem of static charge build-up at the inputs due to no ground return.

4.2.03 Signal Voltage and Gain

With the variable gain control in the calibrated position, the gain selector accurately sets the gain to the indicated level. Intermediate levels of gain may be obtained by use of the vernier gain control..

It is important to note that the displayed gain is for no filters switched in. The gain when the filters is in use is of course a function of frequency and the filter response figures in appendix A can be used to calculate the gain for any particular frequency.

For example, if both filters are tuned to the same frequency and bandpass mode is selected, then the gain of each filter section taken from the response figures is ×0.707, so the overall gain at the tuned frequency is 0.707 × 0.707 = 0.5 (-6 dB), or half the displayed gain value.

The maximum output that the amplifier can provide is 2 V peak-to-peak (through 50 Ω into an open circuit). For maximum input voltages, refer to the specifications in Appendix A.

4.2.04 DC Zero Adjustment

When the instrument is operated in the DC coupled mode, the DC zero trimmer may need to be adjusted as the gain is changed.

4.2.05 Overload Fast Recovery

Pressing the overload recover button when the overload indicator is lighted causes fast discharge of the capacitors so that normal operation can be resumed immediately. Note this button has the secondary function of putting the processor to sleep if pressed when no overload is indicated.

4.2.06 Input Mode Selection

The amplifier may be operated differentially or single-ended. For single-ended operation, repeatedly press the input selector button until either A AC or A DC appears on the display, as appropriate. For differential operation, repeatedly press the input selector button until either A-B AC or A-B DC appear on the display, as appropriate.

Remember that the two signal grounds (tied together internally) are connected to chassis ground through a 47 Ω resistor. For maximum ground-loop rejection, avoid shorting the signal ground to chassis ground.

4.2.07 Filter Selection

The 5113 contains two filters that can be independently switched in or out of circuit., giving seven filter modes plus flat response, as follows:

Low-pass with 6 dB roll-off,
Low-pass with 12 dB roll-off,
Low-pass with 6/12 dB roll-off,
Bandpass,
High-pass with 6 dB roll-off,
High-pass with 12 dB roll-off,
High-pass with 6/12 dB roll-off.

If both filters are switched into circuit, set up as low pass and tuned to the same frequency, then a low pass 12 dB per octave filter is formed. If the two filters are not tuned to the same frequency, then a (6/12 dB) per octave filter is formed. The filter starts to roll-off at 6 dB per octave at the lower of the two tuned frequencies. Above

the higher of the two tuned frequencies the filters combine to produce 12 dB per octave roll-off.

If one filter is configured as high pass the other as low pass, then a bandpass filter is formed.

4.2.08 Filter Roll-Off

The rotary action of the center and right hand knobs control the filter roll-off frequencies. The roll-off frequency is displayed on the LCD next to the appropriate section of the graphical representation of the filter mode. In 6/12 dB mode, the low frequency roll-off is constrained to always be less than the high frequency roll-off, when adjusted by the LF ROLL-OFF (center) knob. Correspondingly, the high frequency roll-off is constrained to be greater than the low frequency roll-off, when adjusted by the HF ROLL-OFF (right hand) knob. When adjusting the roll-off frequencies in band-pass mode, the low frequency roll-off can be adjusted to be the same as the high frequency roll-off. If the low frequency roll-off is then adjusted upwards, the high frequency roll-off will track, and if the high frequency roll-off is adjusted downwards, the low frequency roll-off will track.

4.2.09 Special Pages

In order not to clutter the display, the remaining control adjustments are made on the SPECIAL PAGES. These are:

LCD contrast
Backlight
Automatic quiet mode
Dynamic reserve
RS232 baud rate
Time constant
Firmware version number
Battery state
Start-up message

To enter the special pages, press the LF ROLL-OFF and HF ROLL-OFF knobs simultaneously. Once in the special pages mode, the LF ROLL-OFF knob acts as the exit button and pressing the HF ROLL-OFF knob advances the display to the next page. A description of each special page follows.

LCD Contrast
Rotating or pressing the LF ROLL-OFF knob adjusts the LCD contrast in 16 steps.

Backlight
Rotating or pressing the LF ROLL-OFF knob turns the LCD backlight on or off. The backlight does not cause any noise pick-up because it consists of an array of LEDs rather than an electroluminescent panel.

Automatic Quiet Mode
The processor can be made to go to sleep automatically a preset number of seconds

after the last front-panel adjustment. The range is 1 to 60 seconds. Alternatively it can be set to OFF and the SLEEP button can be used when required.

Dynamic Reserve
Rotating or pressing the LF ROLL-OFF knob adjusts the filter reserve between high and low (see Table A-1 on page A-1).

Baud Rate
Rotating or pressing the LF ROLL-OFF knob adjusts the RS232 baud rate. The options are:

9600 baud
4800 baud
2400 baud
1200 baud
600 baud
300 baud

The other RS323 parameters are always no parity, 8 data bits and 1 stop bit.

Input and Coupling Time Constants
Rotating or pressing the LF ROLL-OFF knob adjusts the input and two coupling time constants between 1 s and 10 s.

Firmware Version
This page displays the firmware version number for information only.

Battery State
Information is displayed on the state of the batteries.

Start-Up Message
When the Model 5113 is turned on, a start-up message appears briefly on the LCD. This message can be edited from the front panel in order to label the unit as belonging to a particular person, laboratory, etc. When entering this page, the unit start-up message is displayed with a cursor under the top left hand character.

By rotating the HF ROLL-OFF knob, the cursor can be moved to any desired character position. Rotating the LF ROLL-OFF knob then changes the character at the cursor location. The display can be quickly cleared by pressing the center knob for three seconds. Note that a greater variety of characters is available using the LINE command over the RS232 bus.

4.2.10 Battery Operation, Test and Charging

The Model 5113 has rechargeable batteries good for up to 30 hours of operation when fully charged. If they are not fully charged, or if the Model 5113 is driving a load having an impedance of less than 10 Ω, a shorter operating period will result. To operate from battery power, lift and release the Power switch, but do not plug in the external power supply. When the period of battery powered operation is completed, be sure to turn the power off by pressing the Power switch down and releasing it, to

prevent running down the batteries. The Model 5113 contains circuitry to increase battery life and reduce charge time. The state of the batteries is continuously monitored and once they fall below the voltage at which the amplifier no longer performs as specified, the unit automatically turns off. It is also possible to turn the unit off remotely, via the RS232 link, once an experiment has been completed. To check the batteries, push the center and right hand knobs simultaneously to enter the special page mode.

Repeatedly press the right hand knob until the battery page appears where the state of the batteries is indicated. Battery charging takes place whenever a suitable external power supply is connected. Beginning from the fully discharged state, it takes anywhere from 24 to 36 hours to fully recharge the batteries. In general, one should follow each period of battery operation with a charging period of equal or greater duration.

Note: When the unit is switched on, with an external power supply connected, the batteries "trickle charge" at a rate very much lower than that obtained when the unit is switched off.

The batteries used in the Model 5113, should they require replacement, can be ordered from ***SIGNAL RECOVERY***. The part number is 231872.

When the batteries are being recharged (instrument plugged into external power supply but with the unit switched off), there is no time limit, that is, there is no possibility of overcharge with subsequent battery damage due to the charging being maintained for too long a time.

Computer Operation

Chapter 5

5.1 Introduction

Unlike most other preamplifiers, the 5113 may be remotely controlled from a computer via the RS232 interface, allowing it to function as part of complex automated test and measurement system.

All its controls may be set via this interface using simple ASCII command strings. In addition, the present setting of any control can also be determined.

5.2 Operation

5.2.01 Overview

Control of the preamplifier from a computer is accomplished by means of communications over the RS232. The communication activity consists of the computer sending commands to the instrument and the instrument responding, either by sending back some data or by changing the setting of one of its controls. The commands and responses are encoded in standard 7-bit ASCII format, with one or more additional bits as required by the interface (see below).

5.2.02 RS232 Interface - General Features

The RS232 data interface in the model 5113 is implemented with three wires; one carries digital transmissions from the computer to the preamplifier, the second carries digital transmissions from the preamplifier to the computer and the third is the Logic Ground to which both signals are referred. The logic levels are ±12 V referred to Logic Ground. Since the 5113 is configured as a DCE (data communications equipment), the connection may be made via a standard RS232 cable (i.e. a null modem is not required). The pinout of the RS232 connector is shown in appendix B.

The interface port on the instrument is optically isolated from the rest of the circuit to eliminate ground loop problems. However, the isolator requires power to operate, so in addition to the three data lines, the instrument requires that the RTS input be connected and be permanently high to provide this power. If RTS is not available, then a 9V battery connected between pin 4 (+ve) and pin 7 (-ve) will enable the circuit to operate while still maintaining isolation.

A single RS232 transmission consists of a start bit followed by 7 or 8 data bits, an optional parity bit, and 1 stop bit. The rate of data transfer depends on the number of bits per second sent over the interface, usually called the baud rate. In the model 5113 the baud rate can be set to a range of different values up to 9,600, corresponding to a minimum time of less than 1 ms for a single character.

Mostly for historical reasons, there are a very large number of different ways in which RS232 communications can be implemented. Apart from the baud rate options, there are choices of data word length (7 or 8 bits), parity check operation (even, odd or none), and number of stop bits (1 or 2). In the model 5113 these are fixed at 8 data bits, 1 stop bit and no parity.

NOTE: In order to achieve satisfactory operation, the RS232 settings must be set to exactly the same values in the terminal or computer as in the preamplifier.

5.2.03 Choice of Baud Rate

Where the preamplifier amplifier is connected to a terminal or to a computer implementing an echo handshake, the highest available baud rate of 9,600 is normally used if, as is usually the case, this rate is supported by the terminal or computer. Lower baud rates may be used in order to achieve compatibility with older equipment or where there is some special reason for reducing the communication rate.

5.2.04 RS232 Interface - Command Format

A transmission to the Model 5113 consists of a command followed by its operand. Commands may be upper-case or lower-case. Each transmission must be followed by a carriage return terminator. Each command consists of one or more characters used to delineate the command plus one or two operands. If a command contains more than one operand, the operand must be separated by a space.

The 5113 always responds to a command with either an * or a ? prompt. An * (asterisk) response indicates that the command has been executed and the unit is ready to accept another command. A ? (question mark) response indicates that an error condition has occurred. There may have been something wrong with the command itself, or it may have caused an error condition such as overload in the 5113. Numbers must be ASCII decimal with the most significant digit transmitted first. Any number of leading spaces are permitted before a command or parameter sent to the model 5113 as long as the entire command including terminator does not exceed 16 characters.

In the event of a command error or parameter error, the 5113 sets bit 1 (invalid command) or bit 2 (parameter error) of the Status Byte. If correct command mnemonics followed by meaningless characters in place of the operand are applied, the 5113 will implement the correct part of the command and ignore the rest.

The commands listed in section 5.3 have one of the following formats:

CMDNAME <CR>
CMDNAME n <CR>
CMDNAME [n] <CR>
CMDNAME n_1 [n_2] <CR>

where CMDNAME is an alphanumeric string that defines the command, n, n_1, n_2 are parameters separated by spaces, and <CR> is the carriage return terminator. When n is not enclosed in square brackets it must be supplied. [n] means that n is optional. n_1 [n_2] means that n_1 is required and may optionally be followed by n_2. Upper-case and lower-case characters are equivalent.
Where the command syntax includes optional parameters and the command is sent without the optional parameters, the response consists of a transmission of the present values of the parameter(s).

5.2 Command Descriptions

This section lists the 5113's commands in alphabetical order.

BL [n] LCD Backlight status

This command sets or reads the LCD backlight status according to the following table:

n	Significance
0	LCD backlight off
1	LCD backlight on

CG [n] Coarse Gain Control

This command sets or reads the coarse gain in a 1-2-5 sequence according to the following table:

n	Gain
0	5
1	10
2	25
3	50
4	100
5	250
6	500
7	1000
8	2500
9	5000
10	10000
11	25000
12	50000

CP [n] Input Coupling Control

This command sets or reads the input coupling mode in accordance with the following table:

n	Significance
0	AC
1	DC

DR [n] Dynamic Reserve

This command sets or reads the filter reserve setting. The low filter reserve setting has the advantage of lower noise.

n	Significance
0	Low noise
1	High filter reserve

FF n_1 [n_2] Filter Frequency Control

This command sets or reads the roll-off frequency setting of the filter selected by parameter n_1

n_1	Significance
0	Low frequency roll-off
1	High frequency roll-off

n_2	Frequency
1	0.03 Hz
2	0.1 Hz
3	0.3 Hz
4	1.0 Hz
5	3.0 Hz
6	10 Hz
7	30 Hz
8	100 Hz
9	300 Hz
10	1.0 kHz
11	3.0 kHz
12	10 kHz
13	30 kHz
14	100 kHz
15	300 kHz

When changing the filter frequencies using the FF command, there is no protection against setting the low frequency roll-off to be greater than the high frequency roll-off. This is to allow the frequencies to be updated in either order by the controlling program. The LCD display will show whatever frequencies have been set up, but if an attempt is made to adjust an "illegal" setting from the front panel, then one of the frequencies will be automatically "corrected".

FG [n] Fine Gain Control

On all but the maximum coarse gain setting, the fine gain extends the coarse gain from ×1 to ×3 in 0.2 increments, i.e. 1.0, 1.2, 1.4, 1.6, etc. On the maximum coarse gain setting of 50,000, the fine gain extends the coarse gain by a maximum of ×2. On the minimum coarse gain setting of ×5 the fine gain has an additional under-range to bring the total gain down to ×1.

n	Significance	Valid Gain
-4	x0.2	x5 only
-3	x0.4	x5 only
-2	x0.6	x5 only
-1	x0.8	x5 only
0	x1.0	all gains
1	x1.2	all gains
2	x1.4	all gains
3	x1.6	all gains
4	x1.8	all gains

n	Significance	Valid Gain
5	x2.0	all gains
6	x2.2	not x50000
7	x2.4	not x50000
8	x2.6	not x50000
9	x2.8	not x50000
10	x3.0	not x50000

FLT [n] Filter mode control

This command sets or reads the filter mode according to the following table:

n	Filter
0	Flat
1	Bandpass
2	Low pass, 6 dB roll-off
3	Low pass, 12 dB roll-off
4	Low pass, 6/12 dB roll-off
5	High pass, 6 dB roll-off
6	High pass, 12 dB roll-off
7	High pass, 6/12 dB roll-off

GV [n] Gain vernier control

This command sets or reads the vernier value. The uncalibrated vernier increases the gain by a maximum of 20% in 15 steps. When the vernier is on (and therefore the gain is uncalibrated) it is indicated on the LCD display by a + after the gain figure.
The range of n is 0 to 15. To turn the vernier off, set n to 0.

HELP

This command causes the 5113 to output to the RS232 interface a brief list of the available commands. It is most useful when operating the unit from an RS232 terminal or terminal emulator.

ID Identification

This command causes the unit to respond with the number 5113.

IN [n] Input mode selector

This command sets or reads the input mode in accordance with the following table:

n	Input mode
0	A
1	A-B

LCD [n] LCD contrast control

This command sets or reads the parameter that controls the LCD contrast or viewing angle and must be in the range of 0 to 15 inclusive.

LINE n CR text Define startup message text

This command can be used to change the message that is displayed briefly on power-up. This is a two-stage command. The first stage is to send either LINE 1
or LINE 2 followed by the carriage return terminator. This causes the unit to

automatically lock out the front panel until the second part of the command is complete. The second part of the command consists of text followed by a carriage return terminator. A maximum of 40 characters is allowed. If 40 characters are sent then the terminator is not required. While the text is being transmitted it is displayed on the LCD display on the relevant line. Once transmission of the text is complete the display reverts to whatever was previously displayed.

OFF Turn instrument OFF

This command turns off power to all but the battery charging circuit. If the external power supply is connected, the battery will continue to charge. If the external power supply is not connected, then no power is taken from the battery. This is equivalent to pressing down and releasing the front-panel power switch. This command is useful in preventing unnecessary discharge of the battery. After a computer has completed an unattended experiment, it can turn the instrument off. Note that because the microprocessor and therefore RS232 interface is not functioning in the OFF state, it is not possible to turn the unit on by remote command.

OR Overload Recover

This command causes the unit to perform an overload recover in the same way as pressing the front panel overload recover button.

REMOTE [n] Remote only (front panel lock-out) control

This command sets or reads the front panel lock-out control in accordance with the following table:

n	Front Panel Status
0	Locked out (RS232 operation only)
1	Normal

SLEEP Oscillator power-down control.

This command causes the Model 5113 t o turn off all the digital oscillators and turn off power to the LCD. This is equivalent to the pressing the front-panel **RECOVER**/sleep push button when no overload is indicated.

ST Status command.

This command requests that the Model 5113 report its status to the host computer. The number reported is the decimal equivalent of the 8-bit Status Byte and refers to the previously applied command.

The Status Byte is defined as follows:

Bit	Meaning
0	Command Done
1	Invalid Command
2	Parameter Error
3	Overload
4	Low Battery
5	Not used
6	Not used
7	Not used

TC [n] Coupling mode time constant control

This command sets or reads the coupling mode time constant control in accordance with the following table:

n	Time Constant
0	1 second
1	10 seconds

VER Firmware version

This command causes the unit to respond with the version number of its operating firmware.

Specifications

Appendix A

Overall Description

DC or AC coupled voltage amplifier with adjustable gain and maximum frequency response extending from DC to 1 MHz. Single-ended or differential high-impedance input, and single-ended output, via BNC connectors,

Signal channel high and low pass filters with variable cut-off frequencies and slope may be optionally switched into circuit to give an overall low-pass, high-pass, band-pass or flat response.

Computer control via RS232 optically isolated interface.

Battery powered from internal rechargeable batteries, which recharge when separate line power supply is connected.

Inputs

Modes	A or A-B
Coupling	AC or DC
Impedance	
AC coupled	either 10 MΩ or 100 MΩ in parallel with 25 pF and in series with 0.1 μF.
DC coupled	either 10 MΩ or 100 MΩ in parallel with 25 pF.
Max Input without Damage	
DC coupled	+10 V, -9 V
AC coupled	Coupling capacitors can withstand 100 V. Transients that pass through coupling capacitors must not exceed DC coupled operation limits.
Max Input for Linear Operation	
Common mode	1 V peak.
Differential mode	See Table A-1

Coarse Gain	Max Peak Input	
	Low Filter Reserve	High Filter Reserve
5 to 25	1 V	1 V
50 to 500	100 mV	1 V
1000 to 5000	10 mV	100 mV
10000 to 50000	10 mV	10 mV

Table A-1. Maximum Input as a function of Filter Reserve and Coarse Gain Setting

Common Mode Rejection Ratio	
DC to 1 kHz	>120 dB
1 kHz to 1 MHz	-6dB/octave
Gain	Coarse gain of ×5 to ×50,000 in 1-2-5 sequence with an accuracy of 1%. Fine gain extends range

	from ×1 to ×100,000 with an accuracy of 2%. An uncalibrated vernier provides gain adjustment of +20% of coarse gain.
Overload Recovery	Front-panel push button or computer command.

Noise

Voltage Noise	4 nV/√Hz at 1 kHz referred to input - see also figure A-1

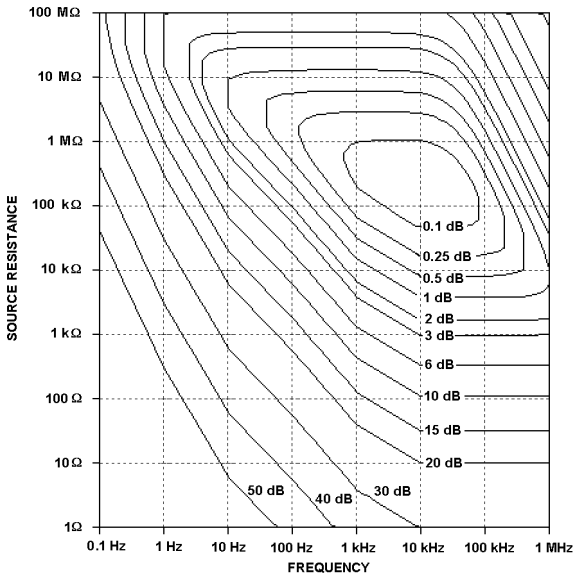

Figure A-1, Typical Noise Figure Contours at Gain = ×1000, AC Coupling and 10s Coupling Time-Constant, Flat Filter Mode

Filters

Type	One high-pass and one low-pass stage
Mode	Low-pass, High-pass, Bandpass, Flat (No filter)
Slope	
Low pass	6 or 12 dB/octave
High pass	6 or 12 dB/octave
Bandpass	6 dB/octave
Frequency Response	
Flat mode	DC to 1 MHz.
Low-pass	-3 dB frequency selectable from 0.03 Hz to 300 kHz in a 1-3-10 sequence
High-pass	-3 dB frequency selectable from 0.03 Hz to 300 kHz in a 1-3-10 sequence (see also figures A-2 to A-5)

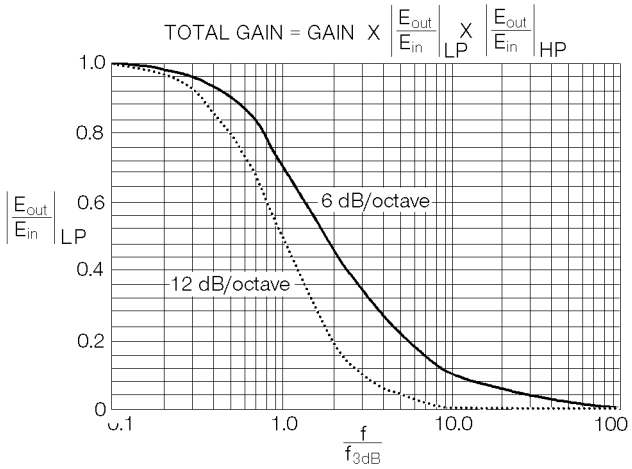

Figure A-2, Low-Pass Filter
Amplitude vs. Normalized Freq. Response

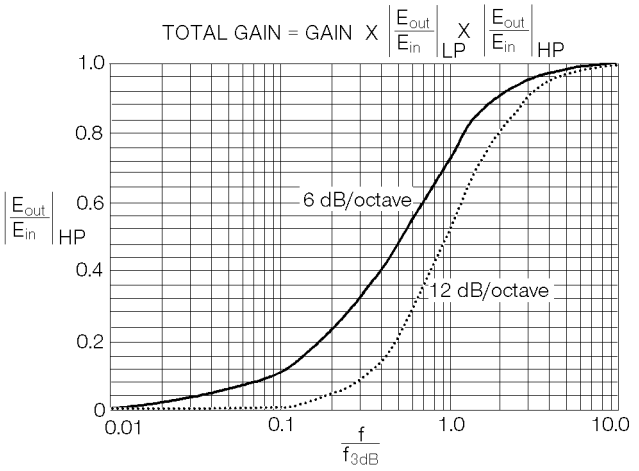

Figure A-2, High-Pass Filter
Amplitude vs. Normalized Freq. Response

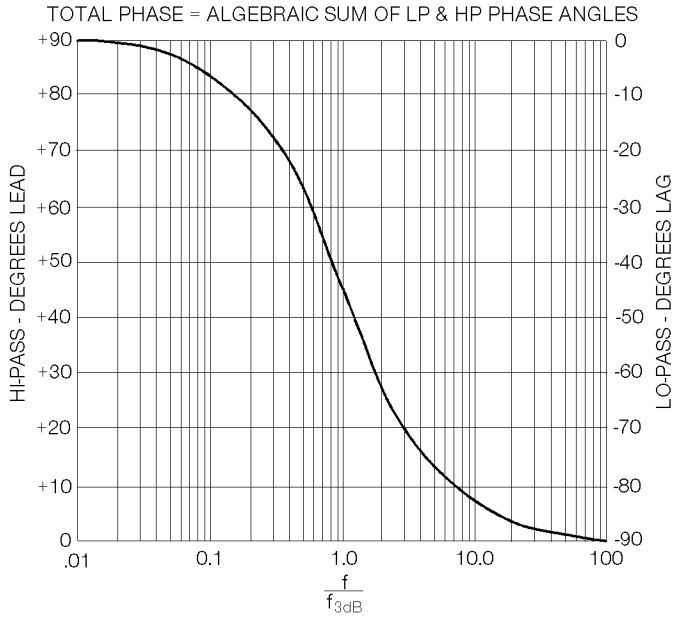

Figure A-4. 6 dB Filter
Phase vs. Normalized Freq. Response

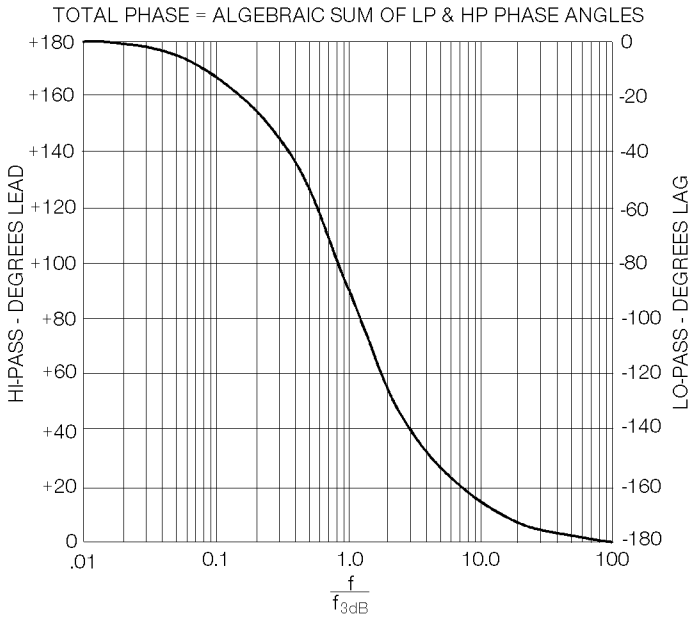

Figure A-5. 12 dB Filter
Phase vs. Normalized Freq. Response

DC Drift

Referred to Input (DC coupling)	maximum 10 µV/° C or less than 10 µV per 24 hours at constant ambient temperature
DC Input Offset control	Front-panel screwdriver control provides for dc zeroing

Referred to Output (AC coupling)	
Coarse gain only	75 µV/° C
With Fine Gain	250 µV/° C maximum

Output

Max Output Voltage	2 V pk-pk ahead of 50 Ω.
Output Impedance	50 Ω ± 2%

Computer Interface

Type	Opto-isolated RS232
Connector	DB25 25-pin female connector
Baud Rate	300 to 9600 baud
Parameters	No parity, eight data bits and one stop bit

General

Power Requirements

Internal sealed maintenance-free rechargeable lead-acid batteries provide approximately 30 hours operation between charges. A special page on the LCD display provides information on the state of the internal batteries.

External Power Supply Model PS0108

Input Voltage	110/120/220/240 V AC
Frequency	50-60 Hz
Input Connector	IEC line input; matching power cord supplied
Output Voltage	± 18 V DC nominal, unregulated
Output Connector	DIN 5-pin 180°

Dimensions

Model 5113	
Width	8.25" (210 mm)
Depth	11" (279 mm)
Height	3.5" (89 mm)
External Power Supply Model PS0108	
Width	3" (77 mm)
Depth	5.3" (135 mm)
Height	2.4" (61 mm)

Weight

Model 5113	8 lbs. (3.7 kg)
External Power Supply	2.2 lbs. (1.0 kg)

Accessories

The Model 1900 input transformer will increase the gain by a factor of 100 or 1000 and reduce noise referred to the input down to a minimum of 0.03 nV/√Hz.

One or two model 5113's and their associated power supplies may be rack mounted in

the model K0304 rack mounting kit.

All specifications subject to change without notification.

Pinouts

Appendix B

B.1 Power Input Connector

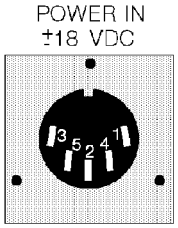

Figure B-1, Power Input Connector

Pin	Function
1	No Connection
2	Ground/Earth
3	No Connection
4	-18 V
5	+18 V

B.2 RS232C Connector

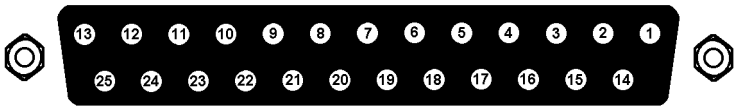

Figure B-2, RS232C Connector (Female)

Pin	Function
2	Data receive
3	Data transmit
4	RTS (must be high)
7	Ground

All other pins are unconnected.
No hardware handshaking is implemented but RTS must be connected and be permanently high in order to power the opto isolator. If RTS is not available, then a 9V battery connected between pin 4 (+ve) and pin 7 (-ve) will enable the circuit to operate while still maintaining isolation.

Power Supply

Appendix C

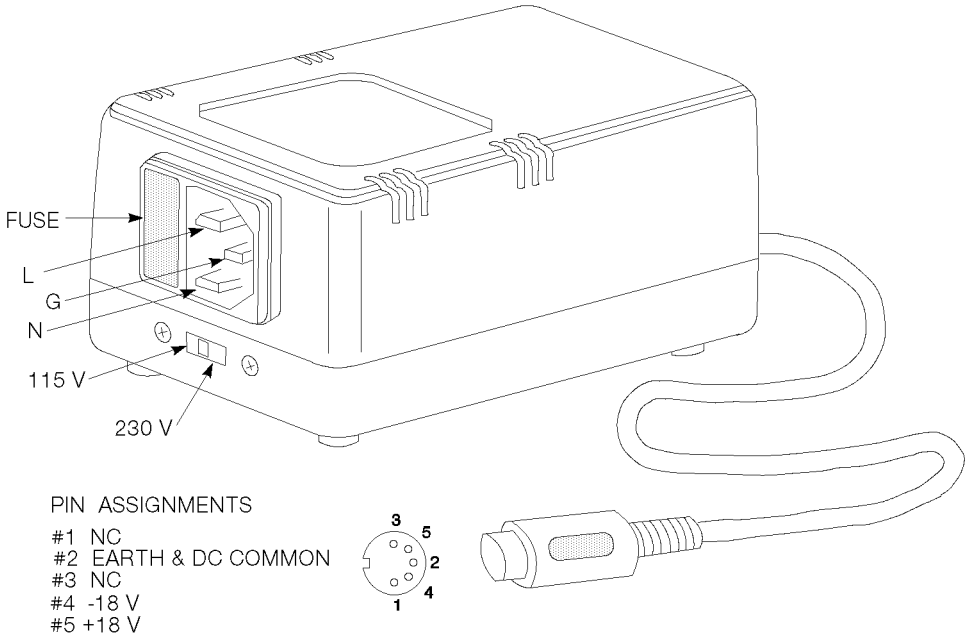

Figure C-1, Model PS0108 Power Supply

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WARRANTY

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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
2. Your name (instrument user)
3. Your address
4. Address to which the instrument should be returned
5. Your telephone number and extension
6. Symptoms (in detail, including control settings)
7. Your purchase order number for repair charges (does not apply to repairs in warranty)
8. Shipping instructions (if you wish to authorize shipment by any method other than normal surface transportation)

C. If you experience any difficulties in obtaining service please contact:

SIGNAL RECOVERY Service
AMETEK Advanced Measurement Technology, Inc
801 South Illinois Avenue
Oak Ridge
TN 37831-2011, USA

Phone: +1 865 483 2121
Fax: +1 865 483 0396
E-mail: service@signalrecovery.com

or

SIGNAL RECOVERY Service
AMETEK Advanced Measurement Technology
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