The model 5113 is a high performance, low noise voltage preamplifier with continuously adjustable gain and selectable high, low or bandpass filtering. Its input can be configured for either single-ended or true differential operation with either DC or AC coupling, and its output will deliver up to 1 V pk-pk into a 50 Ω load.

All the principal instrument controls are operated via the three front-panel rotary knobs with a back-lit LCD display to show their present settings. The instrument also includes an optically isolated bi-directional RS232 interface allowing remote operation and interrogation of all controls. Since in some experiments even the very low levels of noise introduced by the internal microprocessor that supports these capabilities may cause problems, the unit includes a "sleep" function whereby every source of digital noise is turned off after a predetermined interval. When in the sleep mode the preamplifier "wakes up" as soon as any control is adjusted and goes back to sleep when adjustment is complete.

The instrument can either be continuously line-powered from the model PS0108 power supply supplied with it, or be run from the internal rechargeable batteries which are charged whenever the power supply is connected. Battery operation often allows troublesome line frequency pick-up to be eliminated, as well as permitting operation away from a source of line power.

If the signal of interest is limited to a single frequency or narrow range of frequencies then the filters allow selective signal amplification, making subsequent signal measurement, for example on an oscilloscope or a lock-in amplifier, easier. The filters can of course be switched out of use to give a flat frequency response.

Noise Figure Contours (Typical)
Gain = x1000, AC Coupling, 10 s coupling time-constant, Flat filter mode
Preamplifiers

The model 5113 will be of use in applications as diverse as radio astronomy, audiometry, test and measurement, process control and general purpose signal amplification as well as being ideally suited to work with our range of lock-in amplifiers.

Specifications

General
DC or AC coupled voltage amplifier with adjustable gain and a 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 switched into circuit to give an overall low-pass, high-pass, bandpass or flat response.

Computer control via optically isolated RS232 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 1

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

<table>
<thead>
<tr>
<th>Coarse Gain</th>
<th>Max Peak Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 to 25</td>
<td>Low Filter Reserve 1 V</td>
</tr>
<tr>
<td>50 to 500</td>
<td>100 mV</td>
</tr>
<tr>
<td>1000 to 5000</td>
<td>10 mV</td>
</tr>
<tr>
<td>10000 to 50000</td>
<td>10 mV</td>
</tr>
</tbody>
</table>

Common Mode Rejection Ratio, C.M.R.R.
DC to 1 kHz >120 dB
1 kHz to 1 MHz -6 dB/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

Voltage Noise
Typically 4 nV√Hz at 1 kHz referred to input - see also noise contours on page 11

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 (Figure 1)
High-pass -3 dB frequency selectable from 0.03 Hz to 300 kHz in a 1-3-10 sequence (Figure 2)

Figure 1, Low-Pass Filter
Amplitude vs. Normalized Freq. Response

Figure 2, High-Pass Filter
Amplitude 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
Referred to Output
Coarse gain only 75 µV/°C
With Fine Gain 250 µV/°C maximum
DC Input Offset control
Front-panel screwdriver control provides for DC zeroing

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. An LCD display page provides information on their state of charge.

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° plug

Dimensions
Model 5113
Width 8.25” (210 mm)
Depth 11” (279 mm)
Height 3.5” (89 mm)

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
One or two model 5113’s and their associated power supplies may be rack mounted in the model K0304 rack mounting kit.

Why should you choose SIGNAL RECOVERY products?

Model 5113 Voltage Preamplifier

<table>
<thead>
<tr>
<th>SIGNAL RECOVERY Product Features</th>
<th>Benefit to you</th>
</tr>
</thead>
<tbody>
<tr>
<td>No digital noise when in sleep mode</td>
<td>Digital noise cannot exist when processor is turned off</td>
</tr>
<tr>
<td>Unit wakes up as soon as a control setting is change</td>
<td>Easy to change settings</td>
</tr>
<tr>
<td>Gain is defined by switches and relays rather than by a cheaper multiplying DAC, as used in competing instruments</td>
<td>Bandwidth remains stable even as gain is changed, so gain changes do not change the shape of the signal being measured as happens in units using a multiplying DAC</td>
</tr>
<tr>
<td>RS232 control is bidirectional</td>
<td>Programs can check that settings are correct and can even allow for manual interaction</td>
</tr>
<tr>
<td>Excellent LabVIEW driver available</td>
<td>Saves programming time</td>
</tr>
<tr>
<td>RS232 Interface is opto-isolated</td>
<td>Removes one potential ground-loop, reducing line frequency pick-up</td>
</tr>
<tr>
<td>Rotary knobs allow a wider range of filter settings</td>
<td>Better selection of the wanted signal</td>
</tr>
</tbody>
</table>

LabVIEW Driver Software
A LabVIEW driver for the model 5113 is available from the www.signalrecovery.com website, offering example VIs for all the controls, as well as the usual Getting Started and Utility VIs. It also includes an example soft-front panel built using these VIs, demonstrating how you can incorporate them in more complex LabVIEW programs.