

## FEATURES

- Voltage & current excitation with remote sensing
- Gains 1 to 5,000
- 50 kHz bandwidth, 100 kHz optional
- Automatic zero and balance
- Eight-pole, low-pass filter
- Optional continuously programmable filter
- Voltage & shunt calibration
- Two analog outputs
- Program monitoring of output and excitation



## AUTOMATED TRANSDUCER SIGNAL CONDITIONING

Series 6100 is an automated, transducer signal conditioning amplifier system. The basic mainframe holds 32 channels, which is expandable to 1,024 channels using slave enclosures. It is available with RS-232, IEEE-488 or Ethernet interface and software for Windows 2000 and XP.

The 6120 is a two-channel transducer amplifier-filter module. Each channel has dual inputs, 50 kHz or 100 kHz bandwidth and two outputs that can be filtered or wideband.

The bridge input is eight-wire shielded; input (2), excitation (2), sense (2) and shunt calibration (2) with programmable constant voltage or constant current excitation. Programmable bridge completion eliminates plug-in jumpers, loose resistors and component soldering. Automatic bridge balancing ahead of the instrumentation amplifier accommodates large unbalances without limiting gain or dynamic range.

The auxiliary input is for voltage-mode charge, dynamic strain and other transducers that require AC coupling. Constant current excitation is provided for voltage-mode charge transducers. As delivered it is configured for 6 mA, 24 Volt compliance but may be user adjusted for 1 to 20 mA. Use requires Option PS1 for the mainframe and slave enclosures.

The differential instrumentation amplifier has programmable gains from 1 to 5,000 and automatic zero. The standard filter is an eight-pole Bessel with four programmable bandwidths and wideband. An optional four-pole Bessel filter has continuously programmable bandwidth with 1 Hz resolution below 1 kHz and 5 Hz above 1 kHz. Each channel has two buffered,  $\pm 10$  Volt outputs and two sets of programmable alarm levels. The output and excitation can be digitally monitored using any of the supported interfaces.

The basic 6120 contains two-step, resistive shunt calibration that may be applied by program selection to internal or external bridge arms. Four-step shunt calibration of external bridge arm is an option. Voltage substitution employing an external, traceable standard is provided for gain calibration. Automatic gain calibration is implemented in PI610 software.

The mainframe interfaces are IEEE-488, RS-232, USB and Ethernet. The basic 6100 has both the IEEE-488 and RS-232 interfaces. The 6000E has an Ethernet interface adapter and the 6000U has a USB 2.0 interface. Programmed operating parameters and the balance and calibration settings are saved and automatically loaded during power-up and by Reset.

User programming is facilitated by a high-level instruction set. The 6120 is programmed by text strings sent from the user's application. Optional Windows application software, PI610, is fully configured and ready to use. It provides menu programming of operating parameters or can download parameters from an Access compatible database file. It includes a window that graphically displays amplifier excitation and output. PI660 may also be used as a component module DLL with LabView, Visual Basic, Excel or other windows programming language to design custom control and operator interfaces.

PANEL60 is maintenance and calibration software for all Series 6000 products. It is a beneficial tool that enables the technician to verify amplifier settings and configuration and make adjustments to gain, zero, balance and other calibrated parameters. It features a "scope" window that displays output voltage, excitation voltage and current and an interactive, graphical amplifier block diagram.

A calibration system, ACS2000, is available to automatically calibrates amplifier gain and excitation and certifies the amplifier to the published specification with an archived record of measured performance.

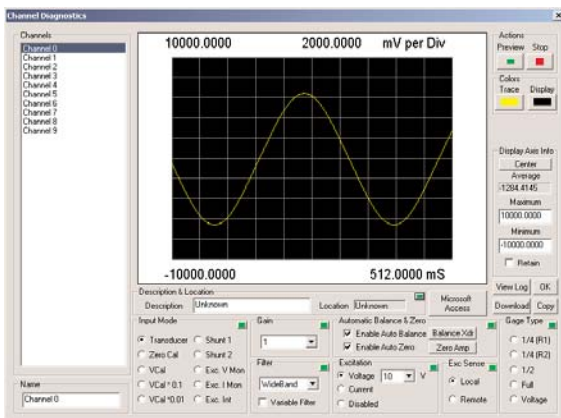


## SYSTEM

- Fully programmable, no manual controls
- Thirty-two channels per enclosure, up to 1,024 channels per system
- Operating parameters are automatically saved and re-loaded at power-up and by Reset
- Two sets of high and low-level alarms with the capability for controlling external equipment
- Integral tray routes input and output cables to exit from the rear
- One hundred percent computer calibrated
- Choice of IEEE-488, RS232, USB 2.0 or Ethernet interface for programming and control

## CHANNEL MODULES

- Programmable bridge completion, no jumpers or rewiring to change gage types
- Versatile 8-wire shielded input handles all gages
- Remote sensing and excitation measurement improves accuracy
- High-resolution gain and excitation programming
- Two or four-step shunt calibration
- Automatic balance, zero and calibration make test setup quick and easy
- Auxiliary AC coupled input for dynamic strain and voltage-mode charge transducers



## PI610 SOFTWARE

- Ready to run or component module DLL software
- Design a custom GUI using Visual Basic, LabView, Access or Excel
- Use spreadsheet, database or built-in screens to program channel settings
- Copy function makes adding channels quick and easy
- Simplify calibration using automatic procedures.
- Controls external voltage standard for traceable gain calibration
- Real-time output and excitation monitor displays detect wiring problems

### Constant Voltage

Voltage	Programmable from 0.1 to 10.24 Volts with 2.5 mV resolution. Calibrated 1-Volt steps $\pm 0.1\%$ .
Remote Sense	Programmable local or remote sense, sense current less than 10 $\mu$ A.
Current	50mA limited to 70mA maximum.
Regulation	$\pm 0.01\%$ over input voltage range and no-load to full-load.
Stability	$\pm 0.01\%$ for 30 days. Temperature coefficient less than $\pm 0.005\%/^{\circ}\text{C}$
Noise	200 $\mu$ V peak-to-peak, DC to 10 kHz
Monitor	Excitation voltage or current is read by a program instruction. Accuracy is $\pm 0.2\%$ .

### Constant Current

Output Range	Programmable 0.1mA to 51.2 mA with 12.5 $\mu$ A resolution. Calibrated 5 mA steps $\pm 0.1\%$ .
Compliance	0.1 to 10 Volts.
Regulation	$\pm 0.01\%$ or $\pm 0.1\mu\text{A}$ for 10% line change.
Noise	2 $\mu$ A or 5 $\mu$ V peak-to-peak DC to 10 kHz.
Stability	$\pm 0.01\%$ or $\pm 2 \mu\text{A}$ for 30 days. Temperature coefficient is less than $\pm 0.005\%$ or $\pm 1 \mu\text{A}/^{\circ}\text{C}$ .
Monitor	Excitation voltage or current is read by a program instruction. Accuracy is $\pm 0.2\%$ .

### Input - Bridge

Configuration	2 to 8 wire plus shield; input (2), excitation (2), sense (2) and shunt calibration (2). Programmable bridge completion for half bridges and 120 Ohm and 350 Ohm quarter bridges. Other gage resistances by request.
Bridge Balance	Automatic by program control. Balance accuracy $\pm 0.05\%$ of range, $\pm 1$ mV RTO. Stability $\pm 0.02\%$ for 8 hours, $\pm 0.005\%/^{\circ}\text{C}$ . Range set by resistor up to 25 mV/V, 2.5 mV/V (350 Ohms) installed.
Impedance	50 Megohms, shunted by 500 pF.
Protection	$\pm 50$ Volts differential, $\pm 30$ Volts common mode.

### Input - Auxiliary

Configuration	AC-coupled, 2-wire with shield. High-pass <1 Hz.
ICP Transducer	Current source 1 to 20 mA, 6 mA supplied. Requires 28 Volt DC power option in the enclosure.
Input Impedance	$\approx 100\text{K}$ Ohms.
Input Protection	$\approx \pm 50$ Volts.

### Calibration

Shunt (Standard)	Two steps of single shunt. Calibration resistors are installed on terminals. Program selection of internal or external shunt connection. Installed shunt resistors provide 0.502 and 0.250, $\pm 1\%$ mV/V for 350 Ohm bridge. Customer specified, 0.01% shunt resistors are available.
Shunt (6020-S4)	Four-steps of single shunt. Calibration resistors mounted on a plug-in card. May be wired for local shunt at the input connector.
Voltage	Alternate input for external calibration source. Programmable 1, 0.1 and 0.01, attenuation with $\pm 0.02\%$ accuracy. Attenuator output may be connected to output bus for accuracy check.
Zero Calibration	Amplifier input disconnected and shorted for zero calibration.

### Amplifier

Range	$\pm 2$ mV to $\pm 10$ Volts full scale.
Gain	Programmable from 1 to 5,000 with 0.05% resolution.

Gain Steps	Sixteen calibrated gain steps are provided: 1, 2, 3, 5, 10, 20, 30, 50, 100, 200, 300, 500, 1,000, 2,000, 3,000 and 5,000 with $\pm 0.05\%$ accuracy.
Gain Stability	$\pm 0.02\%$ for 30 days, $\pm 0.005\%/^{\circ}\text{C}$ .
Linearity	$\pm 0.01\%$ for gains to 1000, $\pm 0.02\%$ above 1000.
Common Mode	60 dB plus gain in dB to 120 dB for balanced input and 110 dB for a 350 Ohm source unbalance, DC to 60 Hz.
CM Voltage	$\pm 10$ Volts.
Zero	Automatic zero to $\pm 2 \mu\text{V}$ RTI or $\pm 1.0$ mV RTO whichever is greater.
Zero Stability	$\pm 5 \mu\text{V}$ RTI, $\pm 1\text{mV}$ RTO at constant temperature, $\pm 1 \mu\text{V}$ RTI, $\pm 0.2$ mV RTO/ $^{\circ}\text{C}$ .
Source Current	$\pm 25$ nA, $\pm 0.05$ nA/ $^{\circ}\text{C}$ .
Noise (10 kHz)	2.0 $\mu\text{V}$ RTI plus 0.3 mV RTO, RMS.
Bandwidth	50 kHz (-3 dB) for gains 1 to 1,000, 20kHz (-3 dB) for gains above 1,000.
Bandwidth (HF)	100 kHz (-3 dB) for gains 1 to 1,000, 50 kHz (-3 dB) for gains above 1,000.
Overload Recovery	120 $\mu\text{s}$ to within $\pm 0.1\%$ for a 10 times overload to $\pm 10$ Volts.
Monitor	Output is read by a program instruction. Resolution is $\pm 0.003\%$ .
Output	Two $\pm 10$ Volt full scale buffered outputs. Each may be program selected for filtered or wideband response.

### Filter (Standard)

Type	Eight-pole, low-pass Bessel (48dB/octave).
Frequency	Four programmable filter bandwidths, 150 Hz, 625 Hz, 2.5 kHz, 10 kHz and wideband.
Frequency (HF)	Four programmable filter bandwidths, 300 Hz, 1.25 kHz, 5 kHz, 20 kHz and wideband.

### Filter (Options)

Type	Four-pole, low-pass Bessel (24 dB/octave).
Freq. (PFBE2)	4 Hz to 1 kHz, 1 Hz resolution, 1 kHz to 10 kHz, 5 Hz resolution, $\pm 2\%$ accuracy.
Freq. (PHFBE2)	10 Hz to 1 kHz, 1 Hz resolution, 1 kHz to 20 kHz, 5 Hz resolution, $\pm 2\%$ accuracy.

### Interface Connectors

All connectors for input and output of analog and control signals are mounted on the front edge of the 6120 module. All mating connectors, except BNC type, are furnished.

Transducer	Each channel has a 15-pin Type D input connector
Output	One output on individual 3.5 mm audio jack second output for both channels in a 9-pin Type D.

### Enclosures and Interface

The rack enclosures provide slots for 16 modules, 32 channels using the 6160. They contain a channel controller and power supply that operates on 115 or 230 VAC. The basic 6100 Mainframe enclosure includes IEEE-488 and RS232 interfaces. One 6100 mainframe will control up to thirty-one 6001 slave enclosures. Ethernet is provided by an adapter on the 6100. The 6100U has a USB 2.0 interface. USB hubs are used to support multiple 6100U enclosures.

### Indicators

Pwr/Adr	Indicates power is applied to the enclosure. Blinks when a channel in the enclosure is being addressed by a program instruction.
Reset	Indicates that enclosure reset is being asserted.
Calibration	Indicates that one or more channels are in a calibration mode.

### Program Instructions

The following program instructions are provided to implement system programming and operation.

- Address .....Selects single channel or group of channels for subsequent programming.
- Reset .....Stops any operation in process, sets all programmable parameters to the stored settings. Autozeros all channels.
- Gain.....Program gain of channel, followed by autozero.
- Filter .....Program filter steps and wideband for a channel, followed by autozero.
- Auto-Balance .....Initiate automatic balance, preceded by autozero.
- Cal Enable .....Enables or disables selected calibration mode.
- Calibration .....Selects calibration mode and step.
- Excitation.....Select voltage or current excitation, set voltage or current level and select remote or local sensing.
- Verification .....Read back channel status and parameters.
- Read Excitation ....Returns value of excitation voltage or current.
- Read Output .....Return value of channel output.

### PHYSICAL

#### Module

- Size .....0.8 inch wide by 9 inches high by 9 inches deep.
- Weight .....Approximately 13 oz.
- Mounting .....The module slides into the enclosure on card guides accessed through the front door and is secured by locking extractors. Rear access is not required to change modules or input and output connectors.

#### Rack Enclosure (Mainframe & Slave)

- Module Slots .....16.
- Cable Tray .....A built-in tray routes input and output cables to exit from the rear of the enclosure.
- Cooling.....Built-in fan with replaceable filter.
- Size .....19 inches wide by 14 inches tall by 23 inches deep (including mating connectors).
- Weight .....Approximately 60 pounds, with all modules installed.
- Power.....115 or 230 VAC  $\pm 10\%$ , 47 to 63 Hz.

#### Environmental

- Temperature .....Operating, 0°C to +50°C.
- Humidity .....95% without condensation.
- Shock/Vibration.....Normal shipping and handling of laboratory instruments.

### ORDERING INFORMATION

#### Module

- 6120 .....Two-channel transducer amplifier, 50 kHz bandwidth.
- 6120HF .....Two-channel transducer amplifier, 100 kHz bandwidth.

#### Options

- 6000-PFBE2 .....Programmable filter option, 4 Hz to 10 kHz.
- 6000-PHFBE2 .....Programmable filter option, 10 Hz to 20 kHz.
- 6020-S4 .....Four-step shunt calibration with plug-in resistor card (calibration resistors not included).

#### Enclosures

- 6100 .....Mainframe enclosure, 16 slot with IEEE-488 and RS232 interfaces.
- 6100E .....Mainframe enclosure, 16-slot with Ethernet programming and control interface.
- 6100U .....Mainframe enclosure, 16-slot with USB 2.0 programming and control interface.
- 6101 .....Slave enclosure, 16-slot.

#### Enclosure Options

- 6000-E .....Ethernet adapter for 6100 Mainframe.
- PS1 .....Power supply, 28V, 1A (required for 1-20 mA excitation for voltage-mode charge transducers)

#### Software

- PI610 .....Operating software for Windows 98/NT/2000/XP. Supplied as a turnkey application and DLL.
- PANEL60 .....Maintenance and calibration software for Windows 2000/XP.

The 6125 contains two-channels of high-performance, programmable differential instrumentation amplifier and filter with dual outputs. It installs in a 32-channel Mainframe enclosure with IEEE-488, RS-232 or Ethernet programming interface. Slave enclosures, also 32-channel, may be used to expand the system up to 512 channels.

Each amplifier has two inputs. One input is DC coupled. The other input is AC coupled and has 1 to 20 mA constant current excitation for voltage-mode charge and similar transducers. Gain is programmable from 1 to 5,000 in sixteen steps or variable with 0.05% resolution over the entire range. Bandwidth is 50 kHz for the 6125 and 100 kHz for the 6125HF for gains through 1,000. The standard filter is an 8-pole low-pass with four programmable frequencies and wideband. An optional 4-pole, low-pass filter has continuous bandwidth selection.

Voltage substitution using an external traceable standard is provided for gain calibration. Facilities are provided for automatic gain and zerocalibration by software. Each channel has two, independent  $\pm 10$  Volt outputs that can be individually selected for wideband or filtered response. The output and all programmed settings may be read by software.

The 6125 is programmed by text strings written to the interface. PI660 is a Window's based application program for Series 6100 products It comes ready-to-run or may be used as an Application Programmers Interface for designing custom applications.



### FEATURES

- Dual inputs, voltage and voltage mode charge
- Gains 1 to 5,000 with 0.05% accuracy
- Automatic zero and gain calibration
- 50 kHz or 100 kHz bandwidth
- 4 or 8-pole, low-pass filter
- Dual, buffered  $\pm 10$  Volt outputs
- IEEE-488, RS-232 and Ethernet interfaces

### SPECIFICATIONS

#### INPUT

Configuration .....Two-wire with shield.  
 Input Impedance .....50 Megohms, shunted by 500 pF.  
 Input Protection ..... $\pm 50$  Volts, differential  $\pm 30$  Volts common mode without damage.  
 Auxiliary .....AC-coupled -3 dB < 1 Hz, input impedance is 100K Ohms. 1-20 mA current source (6 mA supplied) requires PS1 option for the enclosure.

#### AMPLIFIER

Input Range ..... $\pm 2$  mV to  $\pm 10$  Volts full scale.  
 Gain .....Programmable from 1 to 5,000 with 0.05% resolution.  
 Gain Steps .....Sixteen calibrated gain steps are provided: 1, 2, 3, 5, 10, 20, 30, 50, 100, 200, 300, 500, 1,000, 2,000, 3,000 and 5,000 with  $\pm 0.1\%$  accuracy.  
 Gain Stability ..... $\pm 0.02\%$  for 30 days,  $\pm 0.005\%/^{\circ}\text{C}$ .  
 Linearity ..... $\pm 0.01\%$  for gains to 1,000,  $\pm 0.02\%$  above 1,000.  
 Voltage Calibration .....Alternate input for external calibration source. Programmable 1, 0.1 and 0.01, attenuation with  $\pm 0.02\%$  accuracy.  
 Common Mode .....60 dB plus gain in dB to 120 dB for balanced input and 110 dB for a 350 Ohm source unbalance, DC to 60 Hz.  
 CM Voltage ..... $\pm 10$  Volts.  
 Zero .....Automatic zero to  $\pm 2$   $\mu\text{V}$  RTI or  $\pm 1.0$  mV RTO whichever is greater.  
 Zero Stability ..... $\pm 5$   $\mu\text{V}$  RTI,  $\pm 1\text{mV}$  RTO at constant temperature,  $\pm 1$   $\mu\text{V}$  RTI,  $\pm 0.2$  mV RTO/ $^{\circ}\text{C}$ .  
 Source Current ..... $\pm 25$  nA,  $\pm 0.05$  nA/ $^{\circ}\text{C}$ .  
 Noise (10 kHz) .....2.0  $\mu\text{V}$  RTI plus 0.3 mV RTO, RMS.  
 Bandwidth .....50 kHz (-3 dB) for gains 1 to 1,000, 20kHz (-3 dB) for gains above 1,000.  
 Bandwidth (HF) .....100 kHz (-3 dB) for gains 1 to 1,000, 50 kHz (-3 dB) for gains above 1,000.  
 Overload Recovery .....120  $\mu\text{s}$  to within  $\pm 0.1\%$  for a 10 times overload to  $\pm 10$  Volts.  
 Monitor .....Output is read by a program instruction. Resolution is  $\pm 0.003\%$ .  
 Output .....Two  $\pm 10$  Volt full scale buffered outputs may be program selected for filtered or wideband response.

#### FILTER (STANDARD)

Type .....Eight-pole, low-pass Bessel (48dB/octave).  
 Frequency .....Four programmable filter bandwidths, 150 Hz, 625 Hz, 2.5 kHz, 10 kHz and wideband.  
 Frequency (HF) .....Four programmable filter bandwidths, 300 Hz, 1.25 kHz, 5 kHz, 20 kHz and wideband.

#### FILTER (OPTION PF, PHF)

Type .....Four-pole, low-pass Bessel (24 dB/octave)  
 Frequency (PF) .....4 Hz to 1 kHz, 1 Hz resolution, 1 kHz to 10 kHz, 5 Hz resolution,  $\pm 2\%$  accuracy.  
 Frequency (PHF) .....10 Hz to 1 kHz, 1 Hz resolution, 1 kHz to 20 kHz, 5 Hz resolution,  $\pm 2\%$  accuracy.  
 Gain .....With this option, specified gain accuracy is for the filtered output. Accuracy of the wideband output is  $\pm 1\%$ .

#### INTERFACE CONNECTORS

Transducer .....Each channel has a 15-pin Type D input connector, mate supplied  
 Output .....One output on individual 3.5 mm audio jack, both outputs of both channels in a 9-pin Type D. Type D mate supplied.

#### ORDERING INFORMATION

6125 .....Two-channel instrumentation amplifier, 50 kHz bandwidth.  
 6125HF .....Two-channel instrumentation amplifier, 100 kHz bandwidth.

#### OPTIONS

6000-PF .....Programmable filter option, 4 Hz to 10 kHz.  
 6000-PHF .....Programmable filter option, 10 Hz to 20 kHz

#### ENCLOSURES

6100 .....Mainframe enclosure, 16 slot, IEEE-488 and RS232 interfaces.  
 6100E .....Mainframe enclosure, 16-slot, Ethernet interface.  
 6001 .....Slave enclosure, 16-slot.  
 PS1 .....Power supply, 28V, 1A.

#### SOFTWARE

PI610 .....Operating software for Windows 98/NT/2000/XP. Supplied as a turnkey application and DLL.  
 PANEL60 .....Maintenance and calibration software for Windows