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WORLD'S FIRST SYSTEM FRIENDLY CONDITIONERS



PRECISION 6000 UPDATE

PRECISION FILTERS, INC.



System Friendly Contents

Open door policy on selection 4
Installation 6
Configuration 8
Operation 10
Calibration 12
Programming 13
Mainframes and controls 14
Filters 18
Filter options 20
Filter selection guides 22
Frequency band translators 26
Gain Rangers 31
Amplifiers 36
Buffered I/Os 38
Switch matrix 40
Customizing 42
Futures 44

Friendly new 2 MHz filter

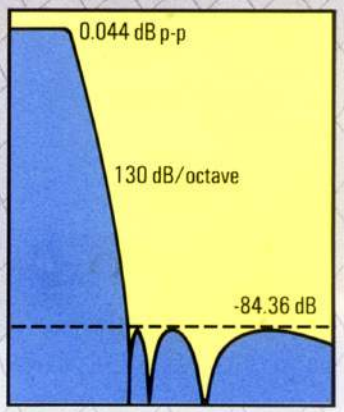
We have a tradition of leading the way to higher frequency filters. Now, we announce the industry's first programmable 2.048 MHz filters. 80 dB/octave attenuation. Time delay filters superior to Bessel. It's the friendly advance you've asked for.

See pages 18-25 for details.

New friendly elliptics as sharp as 130 dB/octave

Precision was first to offer elliptics with 80 dB/octave attenuation slope. Now, we're first to add the sharper option of 130 dB/octave with 1° phase match all the way up to the cutoff frequency. Passband ripple is 0.044 dB p-p. Available to 204.7 kHz. Friendly is extending your choice to match needs precisely.

See pages 18-25 for details on all filters available in Precision 6000.



COME BEYOND USER FRIENDLY TO SYSTEM FRIENDLY



Come to a system that integrates filters, amplifiers, frequency-band translators and other signal conditioners into one unified system. Come to new convenience in programming and control, in calibration and operation. Come to new filters with new levels of performance. Welcome to new Precision 6000. Welcome to system friendly.

New friendly open door policy on configuration

Not only can you mix various types of filters, you can also add a variety of preamps, post-amps and gain-ranging amplifiers, as well as frequency-band translators. You can also add strain, charge, voltage and current input conditioning, with more hardware to come.

For hardware building block selection, see pages 4-5.

It's a simple matter to select and install the hardware building blocks you need. It's simple to configure their control for convenient operation. Calibration is available as an optional subsystem. That's system friendly a lot of different ways.

For hardware installation, see pages 6-7.
For control configuration, see pages 8-9.
For calibration, see page 12.

Friendly language brings down old barriers

No longer do you have to be concerned about the programming idiosyncrasies of a number of instruments. All Precision 6000 asks is familiarity with a few basics. You set up from the Precision 6000 front panel with prompting and cuing from its program. You string your setups together for the test routine required. One command up-loads set-ups to the host computer. Friendly is letting you all but forget programming, so you can concentrate on measurement problems.

See pages 10-11 for operation.
See page 13 for programming.

Now, custom systems at friendly off-the-shelf prices

Yesterday's custom systems are configured with today's standard hardware and software. Yesterday's unaffordable becomes very affordable today. You need only buy for today, because it's easy to update and change for tomorrow when new instruments will operate in today's mainframe. That's friendly to your budget. That's system friendly with futures.

Our tradition of innovation continues

All these new advances with Precision 6000 join all the features Precision has introduced over the last decade. 80 dB/octave attenuation with 1° phase match. Time delay filters superior to Bessel. Choice of serial, parallel or GPIB computer interfaces. And our innovation will continue.

NEW OPEN DOOR POLICY ON SELECTION

Now, you can start with what you need, instead of what a particular instrument permits. Precision 6000 fully integrates • Filters • Preamps • Post-amps • Auto gain-ranging amps • Frequency-band translators • Charge, strain, voltage, current amplifiers • More to come. Buy what you need now. Change and update later.



Until now, high performance signal conditioning had to draw on many individual instrumentation packages. They usually came from different manufacturers, with different configuration and programming schemes. You not only had to figure out how to use dissimilar systems, you had to hard wire them together.

Our open door policy on selection changes all that. You can now draw on our standard hardware building blocks that help integrate a wide variety of instrumentation functions into one *unified* system housed in one mainframe case. You can even have breadboard cards so you can assemble your own custom circuits to be controlled by the system.

Precision 6000 is first to give you this wide choice, and that's the first way we've made it system friendly. Just select the building blocks you need—the filters, preamplifiers, post-amplifiers, automatic gain-ranging amplifiers, as well as frequency-band translators and input conditioners.

You get wide flexibility. You can combine building blocks to form a single multi-channel system, or you can form disparate instruments in the same mainframe.

Building blocks come on cards, for which there are 16 positions in the mainframe, plus a dedicated position for the control card. Filters and other building blocks come one, two, four or eight per card.

You can arrange and rearrange the cards about any way you want in the mainframe. Add new cards as you need them or as new building blocks become available. System friendly flexibility to change is all yours.



Application example

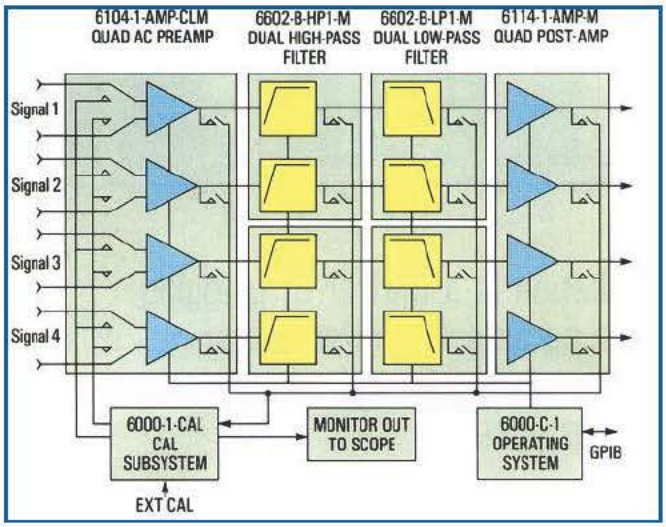
Requirement: Condition four coherent low-level signals in the presence of large out-of-band signals for digitizing by A/D converters.

- Four low-level (15 μV) coherent signals in the 10 Hz to 40 kHz range are to be digitized by 10 volt A/D converters.
- There are larger (10 mV) out-of-band signals that will limit the pre-filter gain.
- A variable band-pass filter, consisting of cascaded high-pass and low-pass filters, is needed to reject the out-of-band signals and allow the post-amplifier to raise the signal level for the A/D converters.
- During operation, the filters will be set to pass the signal and reject out-of-band signals. To maintain phase match—coherence—all high-pass filters must be set to the same cutoff frequency. Similarly, all low-pass filters must be set to the same cutoff frequency.
- Sometimes, the system will operate with identical channel gains. Other times, the gain will vary between signal channels. A convenient method of monitoring is needed to assure proper operation.
- An expedient means for calibration is needed, because the system will be operated almost continuously. You need a way to measure each channel's output as part of a simple go/no-go calibration sequence.
- Initially, the system will be operated from the front panel. After more experience, operation will be under control of a computer via the GPIB.

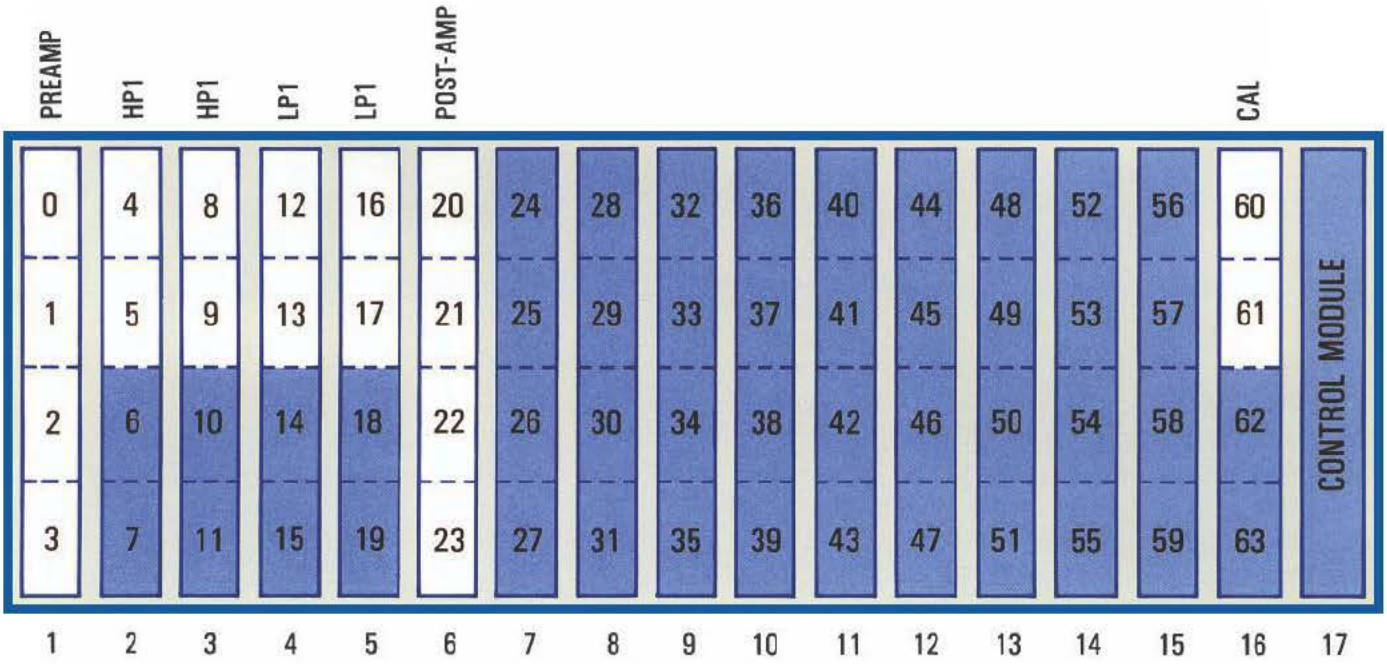
Building block selections

- Quad, low-noise differential ac amplifiers with calibration and monitor options used as the preamplifiers. The programmable low frequency rolloff option is selected to provide prewhitening of the input signal. (6104-1-AMP-CLM)
- Dual programmable high-pass filters with monitor option. (6602-B-HP1-M)
- Dual programmable low-pass filters with monitor option. (6602-B-LP1-M)
- Quad post-amplifiers with monitor option to amplify the output signal for the A/D converters. (6114-1-AMP-M)
- Control module to provide the operating system and GPIB interface. (6000-C-1)
- Calibration subsystem with sources and measuring devices, along with calibration sequencing. (6000-1-CAL)
- Mainframe selected with 4 coaxial BNC inputs and outputs per card and a front panel for manual control and display. (MF64-00-1)

Select the Building Blocks



SYSTEM FRIENDLY INSTALLATION



Installation is a matter of plugging in the cards selected and interconnecting inputs and outputs at the rear panel.

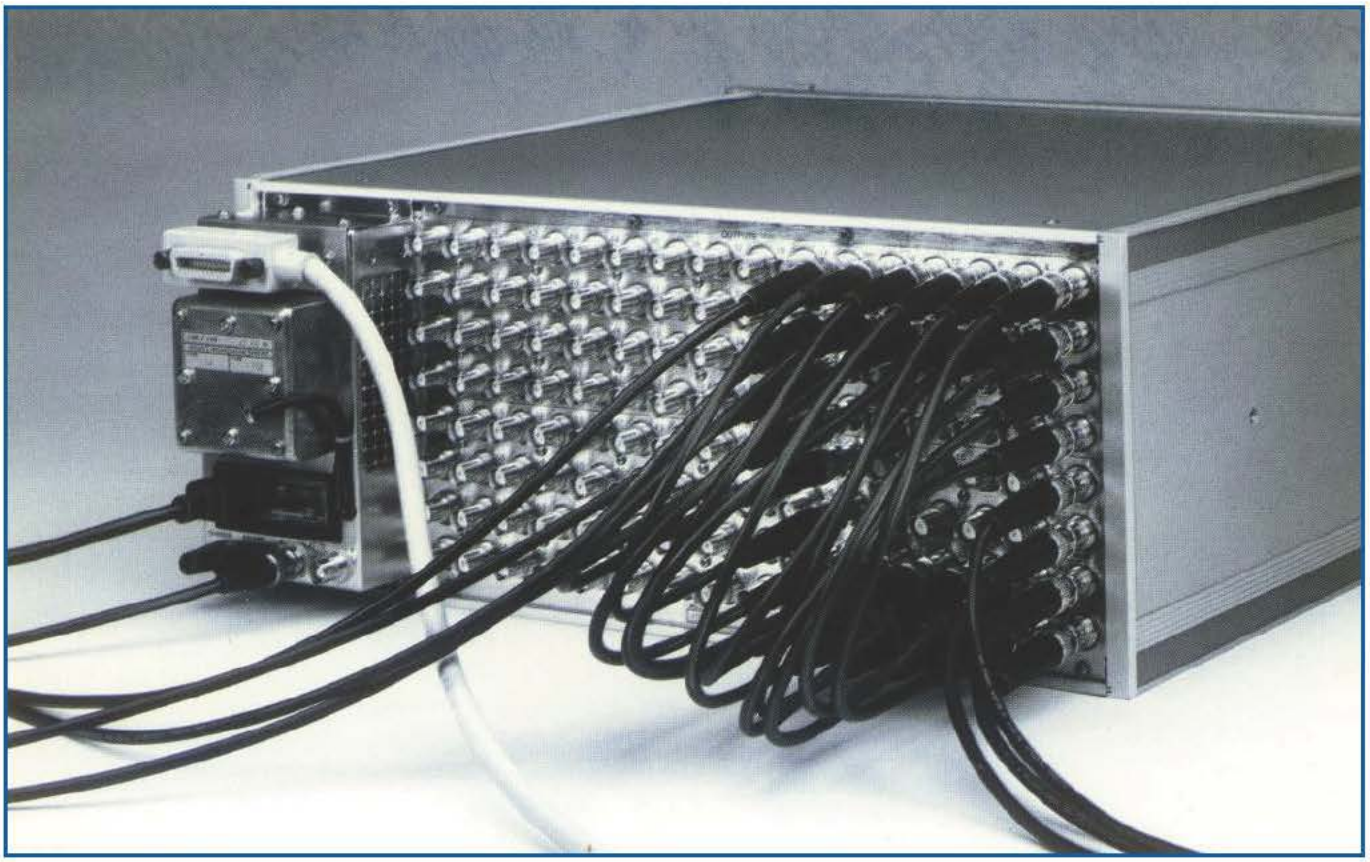
Select card locations, and plug in the building blocks. Using a block diagram, write in the locations of your building blocks.

When the number of channels per card is entered into the system menu, the system will assign that number of locations to each card.

Unused locations will be ignored by the system. When the system assigns four locations per card to a dual channel card, for example, the first two indicate the actual channels and the second pair is ignored.

The rear panel I/O connectors are numbered to correspond with the building block location numbers. It's a simple matter to do the next step: Wire the building blocks to connect as shown on your block diagram.

At power up, the operating system reads the ROM on each card and prepares menus for each installed building block. You're ready to configure the system for control.



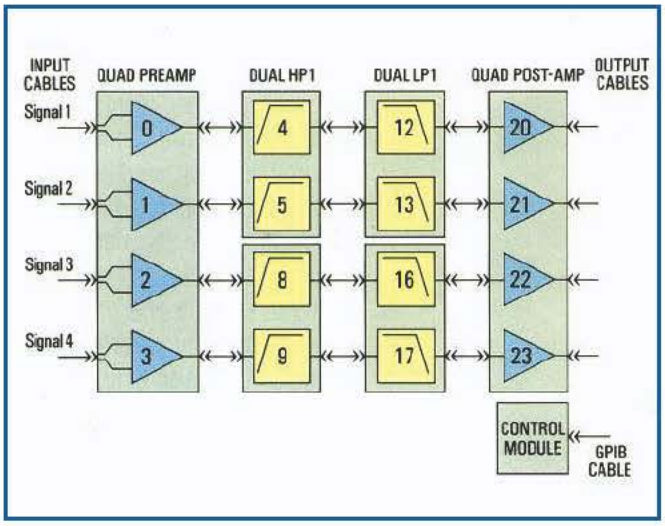
Application example continued

Install the building blocks in any of the first 16 card slots and install the control module in the dedicated 17th card slot.

Locations are as designated on the drawing. There are four preamplifiers per card, and they are designated 0-3. Dual filter channel cards use the first two locations in the slot, as you can see with the high-pass and low-pass filters. The quad post-amplifiers are designated 20-23.

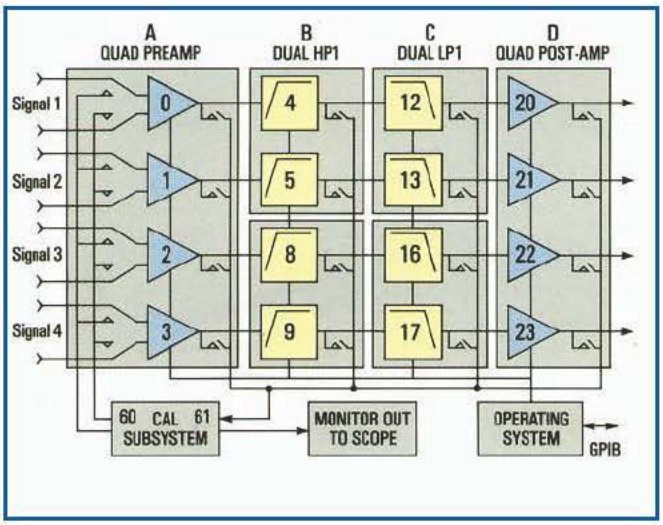
Connect inputs and outputs according to the block diagram.

System Connection



SYSTEM FRIENDLY CONFIGURATION

Not only is it simple to select and install building blocks, it's simple to configure their control from the front panel. You can control by channel. You can control by groups organized functionally for your convenience.



A series of menus helps configure and operate your system.

You can control by channel. You can control by groups that the group configuration menus help you create and modify to suit your convenience.

Precision 6000 gives you great flexibility in grouping functions and settings, so you can control them as a unit. By the same token, you can exclude functions where their control is inappropriate. Being able to do it your way makes it all system friendly.

The system provides 19 control groups, numbered 1-19, with up to 6 subgroups for each, lettered A-F, to configure control of the building blocks.

Stored sequences

Programming menus let you create and store sequences of commands, entered either at the front panel or a remote interface. The sequences can be edited as needed. Invoking stored sequences is particularly helpful for calibration, so you only have to define the steps once.

Additional functions and their menus can be added to the system by plugging in appropriate cards. Available subsystems include calibration, monitor, status multiplexer/demultiplexer and auto ranging.

Application example continued

Six control requirements are inherent in our application, and they can be organized thi way:

1. Group 1 will control gain for signal No. 1.
2. Group 2 will control gain for signal No. 2.
3. Group 3 will control gain for signal No. 3.
4. Group 4 will control gain for signal No. 4.
5. Group 5 will control the cutoff frequencies for all signals.
6. Group 6 will control the gain and cutoff frequencies for all signals.

The schematic shows the group and subgroup designations for the building blocks. Only one type of building block can be included in a subgroup, because there is only one set of menus for each subgroup.

Subgroup A denotes preamplifier.

Subgroup B denotes high-pass filter.

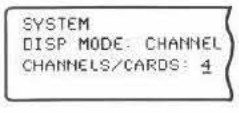
Subgroup C denotes low-pass filter.

Subgroup D denotes post-amplifier.

Next step in configuration is to assign building block locations to each subgroup:

Subgroup	Control requirement	Channels
1A	Preamplifier gain for Signal No. 1	0
1B	HP1 gain for Signal No. 1—no gain option	none
1C	LP1 gain for Signal No. 1—no gain option	none
1D	Post-amplifier gain for Signal No. 1	20
2A	Preamplifier gain for Signal No. 2	1
2B	HP1 gain for Signal No. 2—no gain option	none
2C	LP1 gain for Signal No. 2—no gain option	none
2D	Post-amplifier gain for Signal No. 2	21
3A	Preamplifier gain for Signal No. 3	2
3B	HP1 gain for Signal No. 3—no gain option	none
3C	LP1 gain for Signal No. 3—no gain option	none
3D	Post-amplifier gain for Signal No. 3	22
4A	Preamplifier gain for Signal No. 4	3
4B	HP1 gain for Signal No. 4—no gain option	none
4C	LP1 gain for Signal No. 4—no gain option	none
4D	Post-amplifier gain for Signal No. 4	23
5A	Preamplifier cutoff freq. for all —no F_C	none
5B	HP1 cutoff frequency for all signals	4, 5, 8, 9
5C	LP1 cutoff frequency for all signals	12, 13, 16, 17
5D	Post-amplifier cutoff freq. for all—no F_C	none
6A	Preamplifier gain for all signals	0, 1, 2, 3
6B	HP1 cutoff frequency for all signals	4, 5, 8, 9
6C	LP1 cutoff frequency for all signals	12, 13, 16, 17
6D	Post-amplifier gain for all signals	20, 21, 22, 23

Now that we've decided how we want the system configured, it's a simple matter to do it. First call up the system menu and enter the number of channels per card—in this case, it's 4.



Now add the channel location of building blocks in each subgroup.

Group 1A, for example, gets channel 0.



Groups 1B and 1C get no channels, and the system will ignore them.

Group 1D gets channel 20.



Groups 2, 3 and 4, with their subgroups, are all treated in a similar manner.

Group 5A gets none.

Group 5B gets channels 4, 5, 8 and 9.

Group 5C gets 12, 13, 16 and 17.

Group 5D gets none.

Group 6A gets channels 0,1, 2 and 3, so it can control the gain for all four preamplifiers.



Group 6B similarly gets channels 4, 5, 8 and 9, so it can control cutoff frequency for all four high-pass filters.



Group 6C gets channels 12, 13, 16 and 17, so it can control cutoff frequency for all four low-pass filters.

Group 6D gets channels 20, 21, 22 and 23, so it can control gain for all four post-amplifiers.

The final stage of configuration is to exclude undesirable control fields.

Group 1A, for example, is intended for control of the gain only for signal No. 1 preamplifier. To prevent inadvertent selection, we exclude the low frequency rolloff option from this control group.

An asterisk is displayed next to a field's label to indicate that it has been excluded.



Similarly, we exclude control of the low frequency rolloff option for Groups 2A, 3A, 4A and 6A.

SYSTEM FRIENDLY OPERATION



Set up your tests from the front panel, cued by the system. Control by channel or control by group according to your configuration.

In routine day to day use, the Precision 6000 prompts and cues you, so it's an easy matter to set up from the front panel.

You have at your fingertips all the available settings. Just use the cursor keys to scroll through the values and make selections. It's system friendly all the way.

At power up, the system creates an operating menu for each building block, using information stored on the card.

Some fields on the menu display programmable parameters. Others display nonprogrammable parameters. What's programmable depends on the building block and options selected.

Certain features are common to all building block menus. Whenever gain is displayed, for example, it is accompanied by a programmable units field. The units field allows you to select gain in dB or as a gain factor. For instance, unity gain can be displayed either as 0 dB or as 1x.

Similarly, frequency values can be set to display in mHz, Hz, kHz or MHz.

In changing a programmable field, just use the cursor keys to preview values and select the appropriate one. If the field has a numerical value, such as for gain or frequency, you can enter the new value directly with the numeric keypad.

Application example continued



You can control each building block separately by addressing its location by channel number. Or you can control the system by the control groups we set up on previous pages under System Friendly Configuration. To make the decision, just enter the system menu and select the group mode.

Group 6A calls up the preamplifier menu, which controls the gain for all preamplifiers, and we enter 40 dB for *all* preamplifiers.



Group 6B displays the HP1 filter menu, and we enter 500 Hz into *all* high-pass filters.



Group 6C displays the LP1 filter menu, and we enter 1200 Hz into *all* low-pass filters.



Group 6D displays the post-amplifier menu, and we enter 38 dB into *all* post-amplifiers.



Group 1A controls the preamplifier gain for signal No. 1. That gain is too high, so we change it to 30 dB.

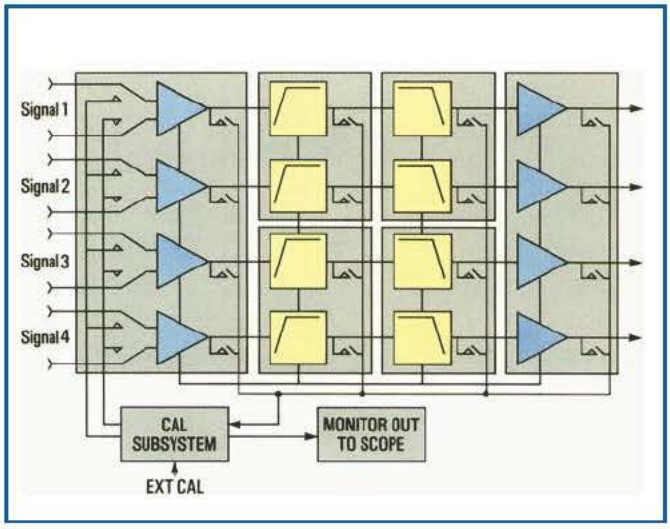


Group 1D controls the post-amplifier gain for signal No. 1. The gain is too low, so we change it to 48 dB.



Similarly, other values can be set or changed.

SYSTEM FRIENDLY CALIBRATION



Optional subsystem lets you generate calibration signals, measure performance and make a go/no-go decision to run the test.

You can assure your Precision 6000 is operating correctly by specifying the optional single card calibration subsystem and by *also* specifying calibration and monitor options on all building blocks.

A calibration step consists of entering:

1. *Signal sources and levels.* Sine, random and dc calibration sources are available.
2. *Locations to inject the cal signal.* The menu lists channels that are to be connected to the calibration bus.
3. *Location to measure.* The cal menu lists the channel to be monitored, since only one at a time can be measured. A list of channels is interpreted as a sequence of identical measurements to be made on each channel listed.
4. *Measuring device and its settings.* You can select measurements for DC and RMS voltage, as well as amplitude and phase match and enter the appropriate settings.
5. *Expected measurement level and acceptable error for each step.* The acceptable error is entered in absolute units, % or dB.
6. *Measurement duration.* This is the time allowed for the settling of the system or measuring device before making a go/no-go decision.

The go/no-go decision that results from a calibration set-up is reported.

Calibration steps can be programmed and stepped through from the front panel or the computer interface.

SYSTEM FRIENDLY PROGRAMMING



You don't need any programming knowledge to operate this system. Programming it is as easy as operating it, whether from the host computer or by calling up stored set-ups.

You don't have to learn the program code. You need very little programming knowledge at all.

If you can operate the system from the front panel, you can program it. Your set-ups are simply up-loaded to the host computer.

The Precision 6000 can also be programmed by commands sent from the host computer via the computer interface. The commands in plain English are almost identical to the front panel menu.

If the stored set-up is required again in the future, it can be down-loaded from the host computer, eliminating programming effort altogether.

SYSTEM FRIENDLY MAINFRAMES AND CONTROLS

It's your choice on computer interfaces—GPIB, serial or parallel. It's also your choice on front panel controls, as well as rear panel inputs and outputs.

Precision Filters pioneered a choice of standard interfaces to link signal conditioners to your computer. Friendly is keeping all your options open with a four-way choice of control modules.

All control modules provide for manual control from the front panel. All are equipped with a non-volatile memory and real-time clock, powered by 2-year alkaline manganese battery.

6000-C-0. Offers full control of system from front panel, but provides *no* remote interface.

6000-C-1. Plug-compatible with general purpose interface bus—GPIB—or IEEE-Std-488. Just connect a standard GPIB cable to the rear panel remote control connector, set the address switches located on the control module and begin programming.

6000-C-2. Plug-compatible with minicomputers and microprocessors with a serial asynchronous communication port conforming to EIA standard RS-232C. You can select baud, character length and number of stop bits. Mating connector: Cannon parts DBC-25P connector, DB110963-3 shell, D20419-21 screw lock assembly.

6000-C-3. For transfer of data through 16 parallel data lines and a one or two-line handshake. The control signals and data lines are compatible with TTL logic levels. Switches on the control module accommodate various computer handshake protocols. Multiple systems are controlled by a single buffered I/O by bussing lines. Mating connector: Cannon parts DBC-25P connector, DB110963-3 shell, D20419-21 screw lock assembly.

Control module options

Option C. Calibration with external input signal is made possible by buffer and firmware on the control module.

Option M. Monitor output is provided by a buffer and firmware on the control module.

Option 9. Change control format lets you use non-standard hardware or software modifications.

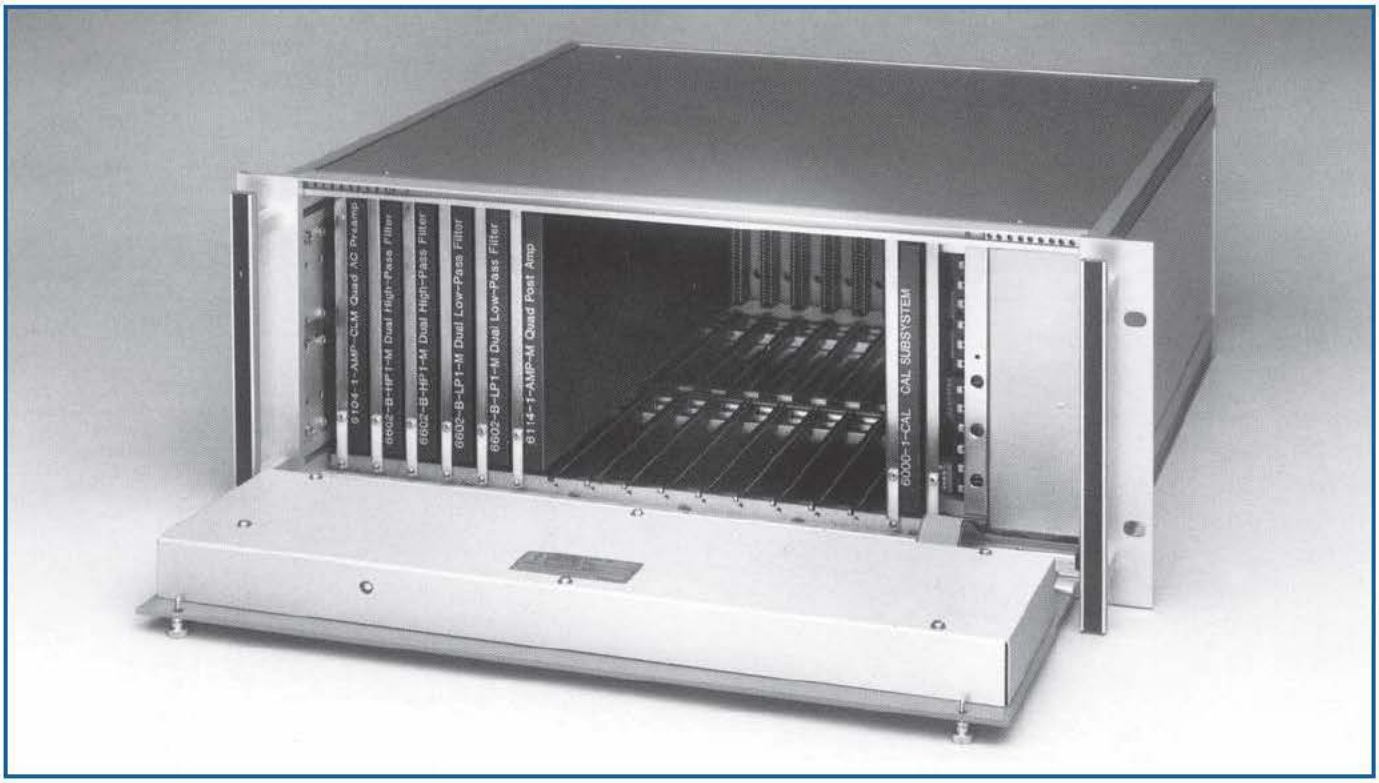
Option R. Provides stable timing information needed for frequency-band translator cards.

Selecting your mainframe

Your choice will depend on the front panel control you need as well as the number and type of inputs and outputs required.

Each Precision 6000 mainframe comes in a housing 7 inches high for mounting in a standard 19-inch RETMA rack. Each mainframe includes a card cage, a back plane for interconnection, a power supply, a rear panel and a front panel.

Lowering the front panel provides access to the card cage assembly. Sixteen slots are provided for the hardware building blocks—filters, amplifiers and others. A 17th slot is dedicated for the control module.


6104-1-AMP-CLM Quad AC Preamp
6602-B-HP1-M Dual High-Pass Filter
6602-B-HP1-M Dual High-Pass Filter
6602-B-LP1-M Dual Low-Pass Filter
6602-B-LP1-M Dual Low-Pass Filter
8114-1-AMP-M Quad Post Amp
6000-1-CAL CAL SUBSYSTEM

Three front panels

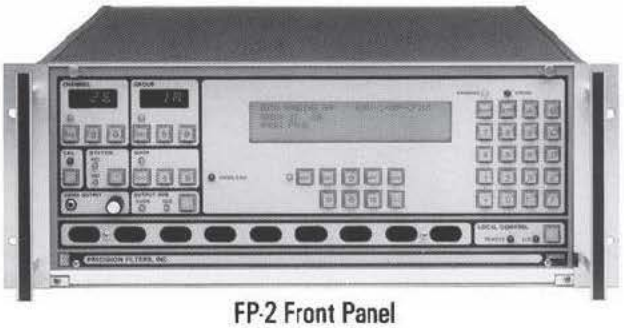
FP-0. Blank front panel. Appropriate only where the system will be under full-time computer control and manual front panel control will never be required or for a system of fixed frequency filters where controls are unnecessary.

FP-1. Standard front panel. You can select all system functions using front panel controls, indicators and displays. A high-contrast, back-lit LCD displays operating menus.



FP-1 Front Panel

FP-2. Incorporates all the features of the FP-1. Also provides the additional status, gain, audio output and scope monitor functions required for the Precision 6201 gain-ranging amplifier system.



FP-2 Front Panel

Friendly power supply

The standard Precision 6000 power supply lets you select operation at 100, 120, 220 or 240 Vac. Voltage variation of ± 10% is accommodated, and frequency may range from 47 to 66 Hz. With Option 1, the frequency may range from 47 to 440 Hz.

Power supply is fused for 3 amps at 100/120 V and 1½ amps at 220/240 V. Binding posts are provided for connecting circuit and chassis grounds.

The power supply comes with two rear panel BNC connectors. PSI/O-A is the output for the monitor buffer, and PSI/O-B is the input for external cal signals to the cal buffer. Both buffers are located on the control module.

How to read a general purpose mainframe model number

MF??-IO-F-?

- Options: 1 = 47-440 Hz power supply
- Front panel: 0 = Blank; 1 = Standard front panel; 2 = Special front panel for Precision 6201
- Output connector type: 0 = Coaxial BNC; 1 = Twinaxial BNC; 2 = Multipin; 3 = 3-Position LEMO; 4 = Multipin (128 ch)
- Input connector type: 0 = Coaxial BNC; 1 = Twinaxial BNC; 2 = Multipin; 3 = 3-Position LEMO; 4 = Multipin (128 ch)
- Number of inputs/outputs

Special purpose mainframe numbers

6201-R-1-?

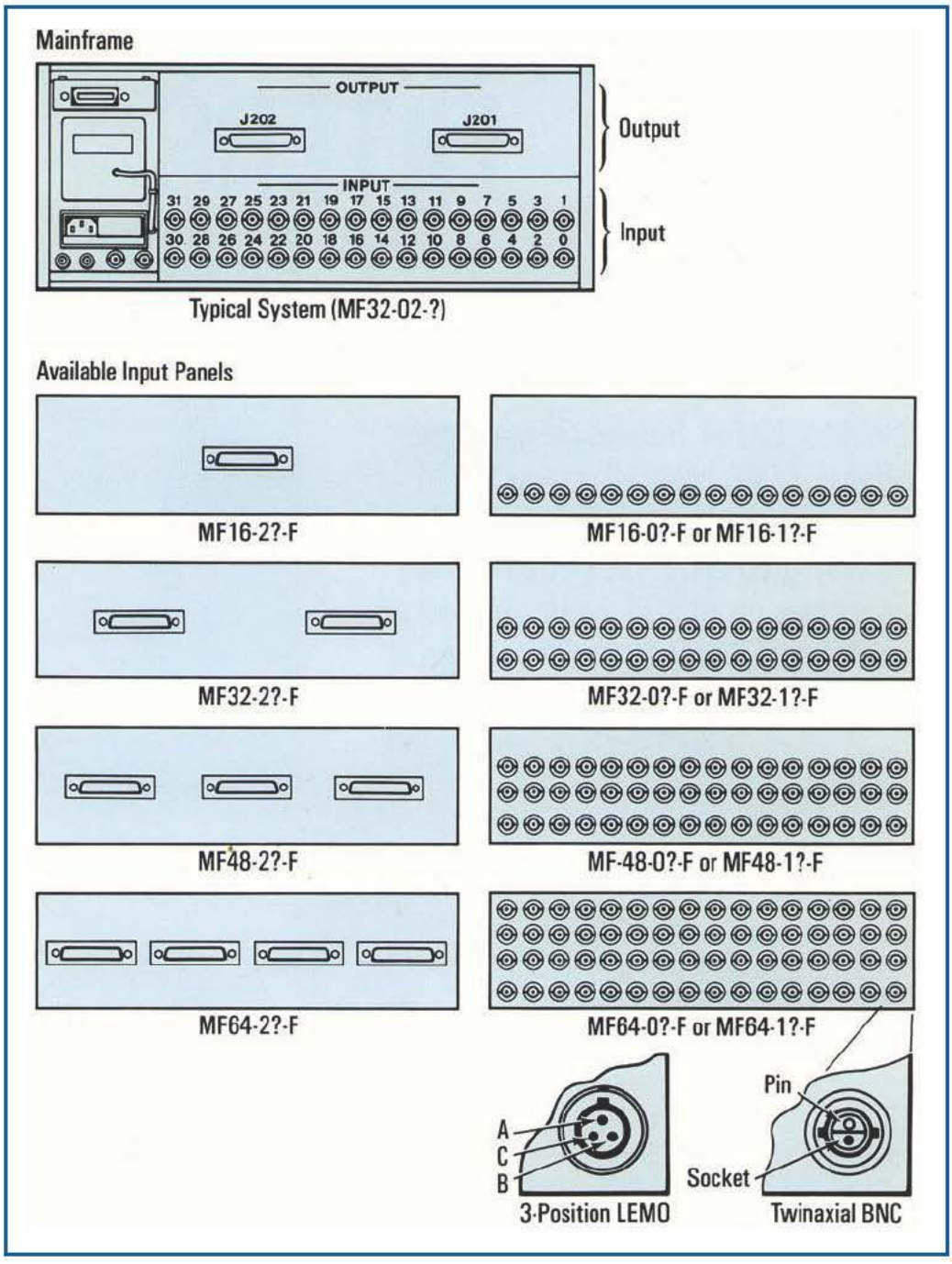
- Options
- Version
- Mainframe
- System Model

Your I/O choice

You can have one, two, three, four or eight input/output connector pairs for each of the 16 cards. Or put another way, you can have 16, 32, 48, 64 or 128 input/output connector pairs. What you need, of course, depends on the hardware building blocks in your system, initially or anticipated later.

For your connectors, you can choose coaxial BNC, twinaxial BNC, multipin or 3-position LEMO connectors. Mating connectors are supplied for multipin, *not* for the others.

All input and output connectors are isolated from chassis ground. The shields are connected to circuit ground at the analog cards, and circuit ground is isolated from the chassis power ground.

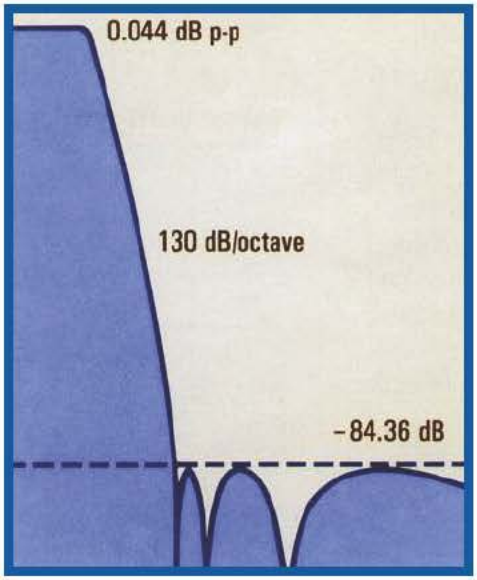


Mainframe specifications

Dimensions		Net weights	
Height	7" (17.8 cm)	Mainframe	38.5 lb. (17.5 Kg)
Width	19" (48.3 cm)	Filter card	2.88 lb. (1.3 Kg)
Depth	20" (50.8 cm)	System card	2.88 lb. (1.3 Kg)
		Control module	3.5 lb. (1.6 Kg)

SYSTEM FRIENDLY FILTERS

You asked for higher frequencies, and we now offer a 2.048 MHz filter. You asked for sharper cutoffs, and we now provide elliptics with 130 dB/octave attenuation for frequencies up to 204.7 kHz. You asked, and we've packed more performance with greater density. We welcome you to the friendliest array of high performance filters ever offered.



You want analog data to come clean before digital conversion.

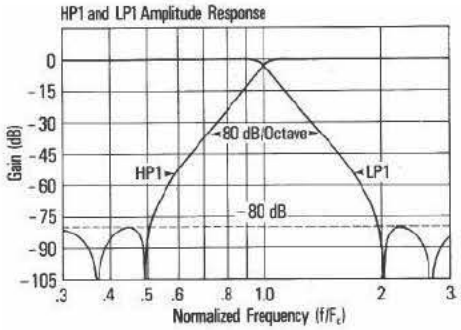
We keep extending your choice of friendly Precision HP, LP, TD, BP, BR, notch, ⅓ octave and anti-alias filters.

All are programmable. Time delay filters superior to Bessel. Elliptics now come as sharp as 130 dB/octave. Frequencies can range as high as 2.048 MHz. All Precision filters offer the option of fixed frequencies for economy. All have phase match of 1° or better.

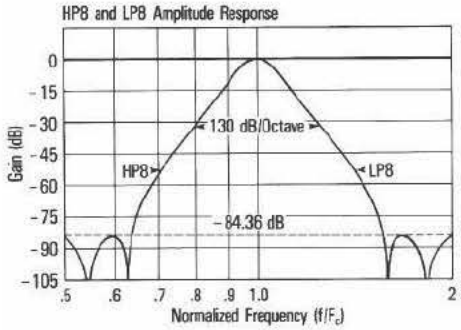
Individually, they provide different cost-performance parameters and options to provide the friendly system you need.

A filter for every need.

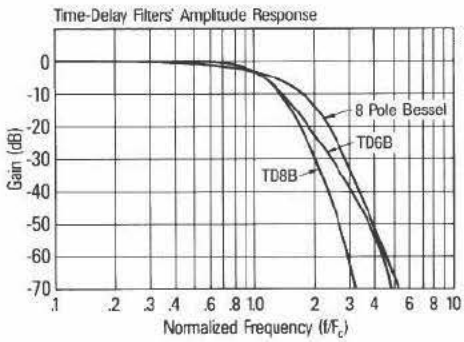
For the frequency domain, there are Cauer (elliptic) high-pass and low-pass filters. The HP1 and LP1 have 0.1 dB p-p pass-band ripple and 80 dB stop-band attenuation with 80 dB/octave attenuation



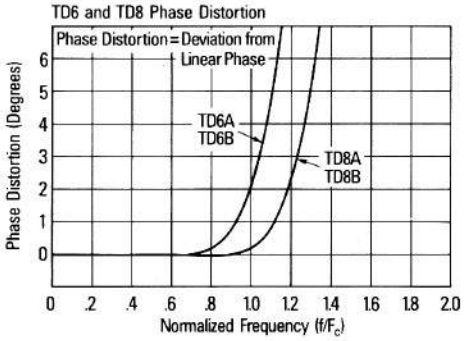
slope. The HP8 and LP8 have 0.044 dB p-p pass-band ripple and 84 dB stop-band attenuation with 130 dB/octave attenuation slope.

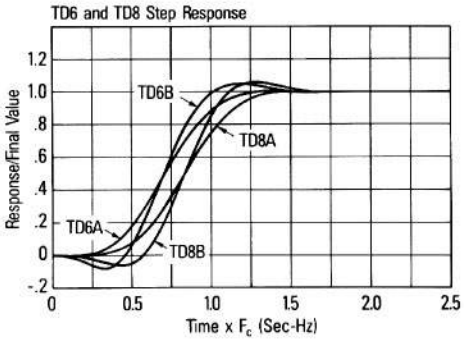


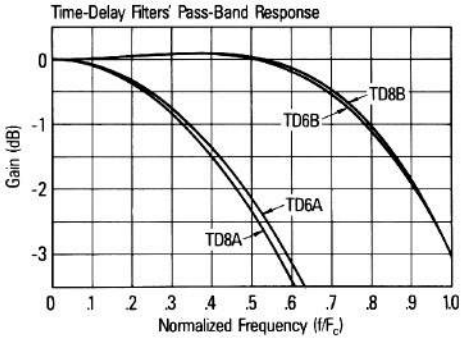
For the time domain, there are the TD6 and TD8 time delay filters—two friendly



choices with different trade-offs of phase linearity, transient response and amplitude response. The TD6 and TD8 have two different responses selectable from the front panel. Data shown in the four graphs help select the best time delay filter for your application.

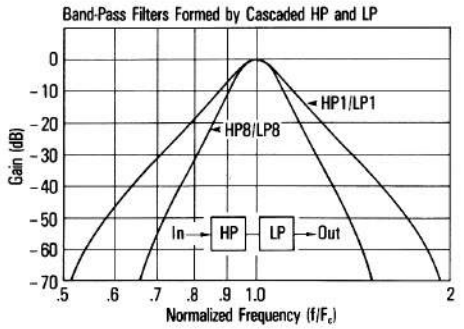






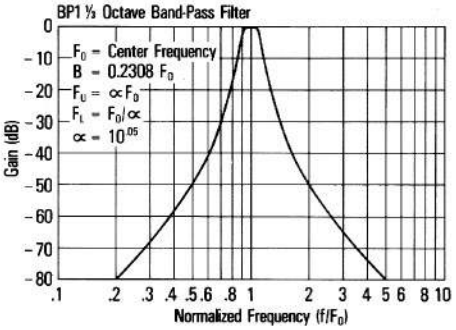
In any case, you get a tightly controlled elliptic or linear phase filter with phase match better than 1° and usually better than ½°.

For band-pass operation, cascade a high-

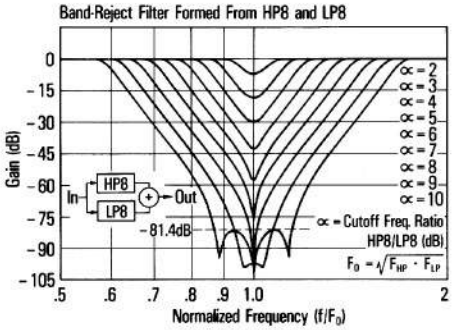


pass and low-pass filter to form a band-pass filter.

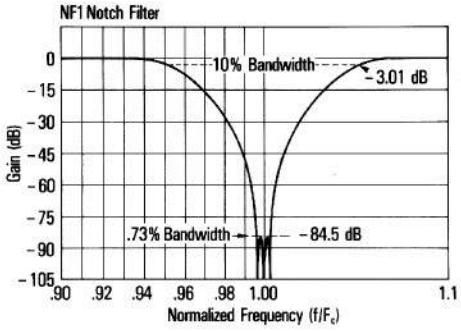
Or use our BP1 one-third octave band-pass filter.



For band-reject operation, parallel the inputs of a high-pass and low-pass filter

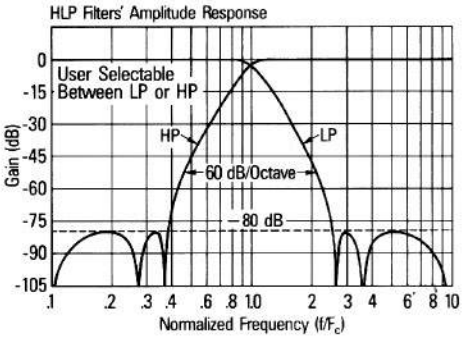


and add their outputs to form a band-reject filter. Or use our NF1 notch filter.



For tough anti-alias applications, use LP8 filters to provide 80 dB of attenuation at 1.56 times the cutoff frequency.

For lowest cost solutions, we provide fixed frequency filters with blank front panel and no control module.



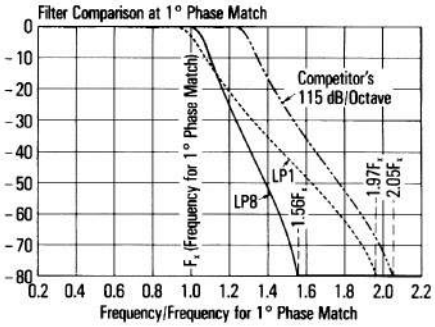
For applications requiring versatility, the HLP is a 6 pole, 6 zero filter with 0.1 dB p-p pass-band ripple and 60 dB/octave attenuation slope. Plugs on the card allow configuration as either a high-pass or low-pass filter.

How to compare filter specs

If all you compare is attenuation slope, you could be misled. In addition, you should compare phase match, pass-band ripple and whether the phase match is usable up to the cutoff frequency.

The LP8, for example, is a *true* 130 dB/octave filter, and its phase and amplitude match of 1° is specified throughout its pass-band from dc through the cutoff frequency.

Compare it to a filter offered by one of our competitors with a 115 dB/octave rating, and you are in for a surprise. The maker specifies the phase and amplitude match to only 80% of the cutoff frequency. In reality, the filter is no better than an 80 dB/octave filter with its phase and amplitude match specified throughout its pass-band such as our LP1.



The 115 dB/octave attenuation slope crosses −80 dB at 1.64 F_C, but if you need 1° phase match (specified to 0.8 F_C), the filter must be set to 1.25 times the highest signal frequency. The attenuation of 80 dB is 1.64 x 1.25 or 2.05 times the highest signal frequency—*80 dB in one octave*—so the sampling frequency must be three times the highest frequency of interest. In reality the competition's 115 dB/octave filter requires a slightly higher sampling rate than the Precision 80 dB/octave filter. The LP8 attenuates the out-band signal by 80 dB at 1.56 F_C, so you need a sampling frequency of only 2.56 F_C.

SYSTEM FRIENDLY FILTER OPTIONS

Precision 6000 lets you customize filters with a host of options to do your job your way. Programmable gain. Input buffers. Cal and monitoring. Overload detection. Zero suppress. Choice of input and output types. Fixed input gain. Just read your choices arranged in the same order as the block diagram.

Calibration input—Option C

A pair of relay contacts disconnects the signal and connects the input to the calibration bus.

AC/DC coupling—Options 1, 2, 5, 6

Single-ended DC coupling is standard. AC coupling to block DC signals is available for single-ended and differential inputs (Options 1 and 2). And a programmable AC/DC coupling is available (Options 5 and 6).

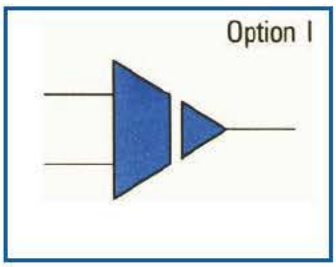
Zero suppress—Option Z

Together with Option D, zero suppress provides a means of programming DC voltage at the differential amp input. When filter gain is limited by DC offsets in the signal, Option Z can be used to suppress the offset to zero. When the system control is equipped with auto-suppress, the input can be suppressed to zero automatically. This feature is useful in strain gage bridges. Zero suppress voltage: ±0.005 V to ±10.23 V in 0.005 V steps.

Input buffers—Options D, I, L

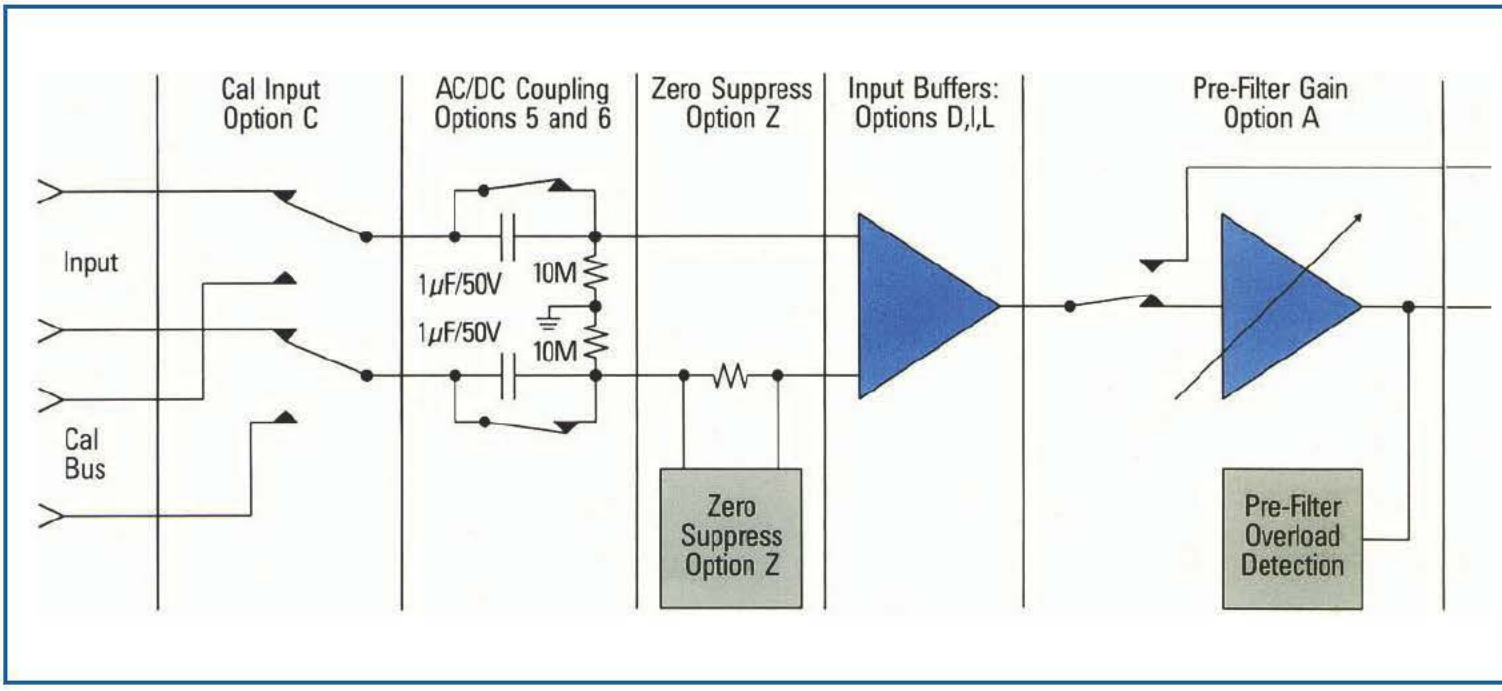
Standard. Hi-Z, single-ended, DC-coupled input.

Option D. Hi-Z, differential, DC-coupled input. Used to buffer balanced lines or to reduce ground loops.

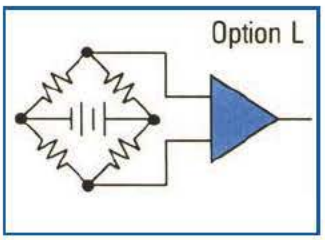


Option I. Highly-isolated differential, DC-coupled input. Used where extreme isolation is required or for applications with large common-mode signals (300 V).

Option L. Low drift, differential, DC-coupled input. Employs low-drift, low-noise, bi-polar input stage to buffer low level, low-Z sources, such as thermocouples or

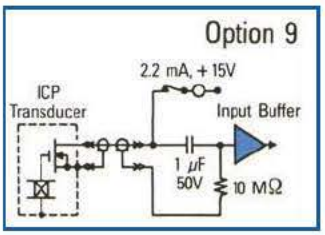


strain gages. DC drift less than 1μV/°C at gains greater than 100.



Current source to power IC piezoelectric transducers—Option 9

Option 9 provides AC-coupled input to a single-ended buffer with a programmably selected 2.2 mA current source to provide power for remote ICP transducers.



Fixed input gains—Options 7, 8

For applications requiring additional gain at the input. A fixed gain between 1 and 10 can be accommodated.

Pre-filter gain—Option A

Pre-filter gain is used to raise low-level signals above the filter noise (200 μV). You have the choice of linear or decibel gain for most filters. Refer to the option selection guide for details. Pre-filter overload detection is included in 6602, 6612, 6622 and 6632 filters.

Filter bypass—Option B

The signal from the input buffer bypasses the pre-filter amplifier, filter and post-filter amplifier and drives the output buffer. Bypass has unity gain regardless of the gain settings. Standard on many models.

Post-filter gain—Option G

Post-filter gain is required in applications where large out-of-band signals limit the pre-filter gain. These out-of-band signals are rejected by the filter and the post-filter gain raises the in-band signals to levels suitable for A/D conversion or other signal processing.

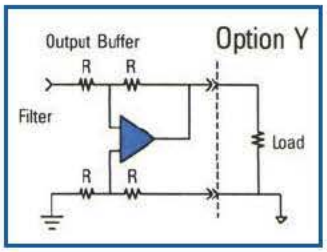
The vernier setting for the post-filter gain also makes it useful in other applications. You have the choice of linear or decibel gain for most filters. Refer to the option selection guide for details.

Output buffer—Options Y, T, O

Standard. Single-ended DC coupled output.

Option Y. Output ground reference. The amplifier output can be referenced to the ground at the load to reduce output ground loops. The system can drive numerous loads with slightly different grounds without generating ground loops. Standard on many models.

Option T. Differential DC-coupled output. A differential output stage following the output buffer is available for driving balanced output lines.

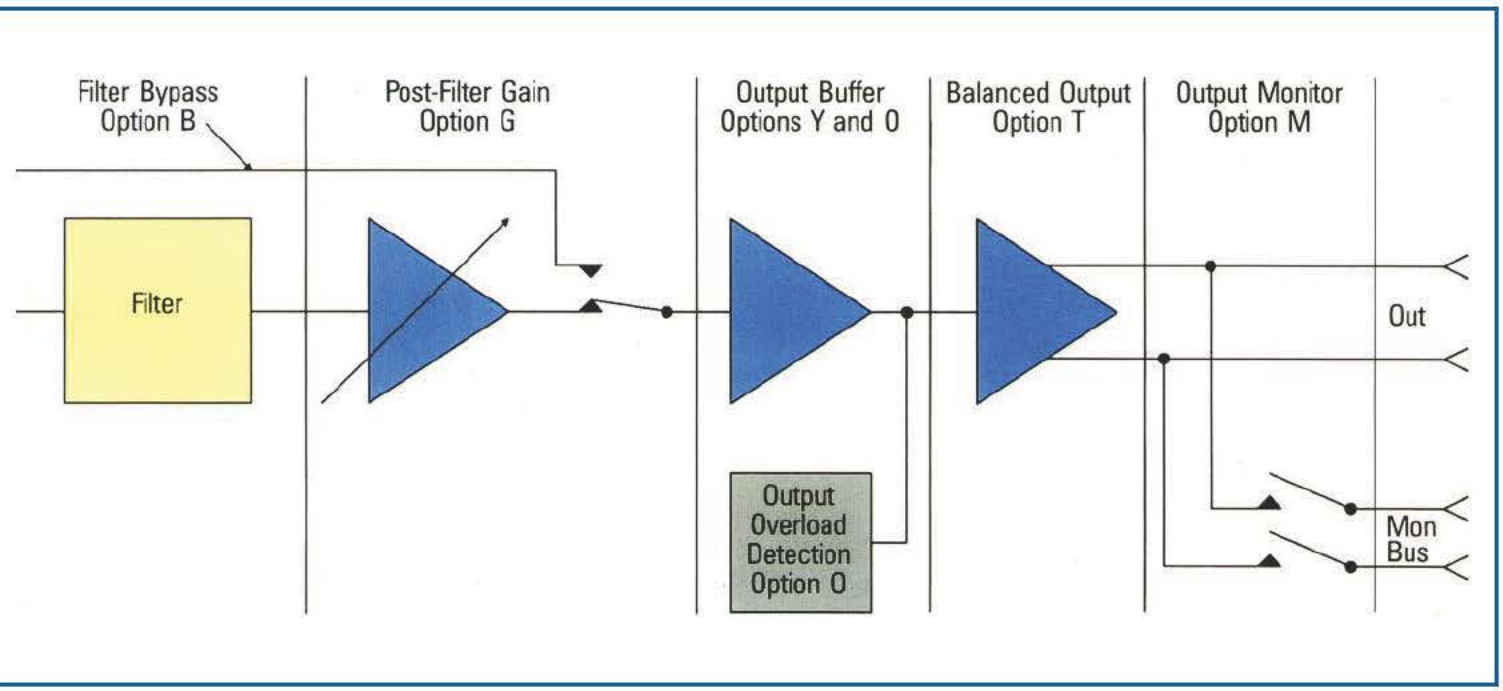


It reduces crosstalk and electromagnetic and electrostatic pickup.

Option O. Output overload detection provides a means of setting an overload limit between 0.1 and 10 Vpk. The limit can be set remotely over the computer interface or from the front panel. Signals which exceed the preset limit are reported as overloads via the computer interface and at the front panel overload LED.

Output monitor—Option M

The output of one channel can be selected for the monitor bus and used to drive an external scope or to be measured by the calibration subsystem. Standard on many models.



Filter card selection guide

	6602B	6604B	6611A	6612A	6614	6618	6622	6624	6632	6694
Channels per system	32	64	16	32	64	128	32	64	32	64
Channels per card	2	4	1	2	4	8	2	4	2	4
Max cutoff freq (Hz)	204.7k	25.575k	2.048M	204.7k	32k	20k	204.7k	25.575k	204.7k	25.594k
Min cutoff freq (Hz)	0.1	0.1	20	0.1	1.0	1	0.1	0.1	0.1	0.25*
Phase match (^{0} max)	0.5, 1†	1	1, 3, 4‡	1	1	1	1	1	1	1.5
Amplitude match (dB/max)	0.1	0.1	0.1, .25, 0.5‡	0.1	0.2	0.1	0.1	0.1	0.1	0.15
Cutoff accuracy (%)	0.25	0.25	0.25, 1, 3‡	0.25	0.25	0.25	0.25	0.25	0.25	0.5
Bits in a range	10, 11§	10	10	10, 11§	4	2	10, 11§	10	10, 11§	12
Filter types	HP1 LP1 TD6 HLP	HP1 LP1 TD6 HLP	HP1 LP1 TD6	HP8 LP8 TD8	HP1 LP1 TD6 HLP	HP1 LP1 LP2 TD6	HP1 LP1 TD6 HLP	HP1 LP1 TD6 HLP	HP8 LP8 TD8	NF1

* Limited use to 25 Hz. Specified performance at 25 Hz to maximum cutoff frequency.
† 1^0 above 100 kHz.
‡ 3^0, 0.25 dB, and 1.0% on high range for 6611A-B; 4^0, 0.5 dB, and 3% on high range for 6611A-A.
§ 11 bits on Model 6602B, 6612A, 6622, and 6632, ranges -A and -E.
Note: Models 6032, 6064B, 6602, 6602A, 6604, 6611 and 6612 are not recommended for new designs.
Customers with these filter cards who wish to purchase additional equipment should consult the factory.

Filter selection guide

	HLP	HP1	HP8	LP1	LP8	TD6A	TD6B	TD8A	TD8B
Filter type	HP/LP	HP	HP	LP	LP	LP	LP	LP	LP
Function	*	Cauer	Cauer	Cauer	Cauer	Bessel w/Z	†	Bessel w/Z	‡
Number of poles, zeros	6p,6z	6p,6z	8p,6z	6p,6z	8p,6z	6p,4z	6p,6z	8p,6z	8p,8z
Pass-band ripple (dB p-p)	0.1	0.1	0.044	0.1	0.044	–	0.2	–	0.2
Pass-band frequency	1.192/0.839 F_c	1.081 F_c	F_c	0.925 F_c	F_c	–	0.582 F_c	–	0.569 F_c
Cutoff freq amplitude (dB)	–2.40	–3.01	–0.044	–3.01	–0.044	–9.61	–3.01	–10.06	–3.01
Cutoff freq phase (^{0})	±270.0	+358.5	+410.2	–358.5	–410.2	–255.3	–255.3	–301.9	–301.9
Stop-band frequency	0.383/2.61 F_c	0.508 F_c	0.637 F_c	1.971 F_c	1.569 F_c	3.535 F_c	4.893 F_c	–	3.335 F_c
Stop-band attn (dB)	80	80.07	84.36	80.07	84.36	–	70.0	–	80.28
Attn slope (dB/oct)	59.5	81.8	130	81.8	130	39.1	30.0	33.7	46.3
Phase distortion (^{0})	60.00	–	–	111.34	114.88	2.11	2.11	0.23	0.23
Group delay (s)	0.583/F_c	–	–	0.687/F_c	0.820/F_c	0.715/F_c	0.715/F_c	0.839/F_c	0.843/F_c
1% Settling time (s)	2.81/F_c	5.21/F_c	9.20/F_c	4.64/F_c	7.11/F_c	1.21/F_c	1.46/F_c	1.34/F_c	1.54/F_c
10% - 90% Rise time (s)	0.440/F_c	–	–	0.469/F_c	0.543/F_c	0.591/F_c	0.384/F_c	0.610/F_c	0.383/F_c

* Unity normalized natural frequencies; Plug programmable for high-pass or low-pass.
† TD6B: 6 Pole Bessel with 4 stop-band zeros and 2 pass-band zeros.
‡ TD8B: 8 Pole Bessel with 6 stop-band zeros and 2 pass-band zeros.

Option selection guide

Option	6602B	6604B	6611A	6612A	6614	6618	6622	6624	6632	6694
AC coupling for S.E. Input	1	1	1	1	1	–	1	1	1	1
AC coupling for Diff input *	2	2	2	2	2	–	2	2	2	2
Differential input	D	D	D	D	D	‡	D	D	D	D
Prog AC/DC for S.E. input	5	5	5	5	5	–	5	5	5	5
Prog AC/DC for Diff input *	6	6	6	6	6	6	6	6	6	6
Fixed input gain for S.E. input	7	7	7	7	7	–	7	7	7	7
Fixed input gain for Diff input *	8	8	8	8	8	8	8	8	8	8
Low-drift differential input	–	L	–	–	L	–	–	L	–	–
ICP transducer current source	9	9	–	9	9	–	9	9	9	9
Pre-filter gain										
(0-40 dB, 10 dB steps)	A†	A	–	A†	–	–	–	–	–	–
(–10,0,10 & 20 dB)	–	–	A	–	–	–	–	–	–	–
(0,12 & 24 dB)	–	–	–	–	–	A	–	–	–	–
(1,2,4,8,16,32,64 & 128)	–	–	–	–	A	–	A†	A	A†	A
Post-filter gain										
(–9.9 dB - 20 dB, 0.1 dB steps)	G	G	–	G	–	–	–	–	–	–
(0 - 22 dB, 2 dB steps)	–	–	G	–	–	–	–	–	–	–
(0 - 36 dB, 6 dB steps)	–	–	–	–	–	G	–	–	–	–
(0.001 - 4.095, 0.001 steps and 4.0975 - 10.2375, 0.0025 steps)	–	–	–	–	G	–	G	G	G	G
Filter bypass	‡	‡	B	‡	‡	–	‡	‡	‡	‡
Calibration input	C	C	C	C	C	‡	C	C	C	C
Isolated preamp input	–	I	–	–	I	–	–	I	–	–
Output monitor	‡	‡	–	‡	‡	‡	‡	‡	‡	‡
Output overload detector	O	–	–	O	–	–	O	–	O	–
Differential output	T	T	T	T	T	–	T	T	T	–
Output ground reference §	‡	‡	–	‡	‡	‡	‡	‡	‡	‡
Special F_c range	FX	FX	FX	FX	FX	–	FX	FX	FX	–
Zero suppress *	Z	Z	–	Z	Z	–	Z	Z	Z	–

* Requires Option D, differential input.
† Option A also provides input overload detection.
‡ Standard option, no charge.
§ Output ground reference is known as Output Sense; Previously known as Option 4 on some models; Not available with Option T.

6604B & 6624—Quad filter/amplifiers—80 dB/octave—25.575 kHz

- Four filters per card
- 80 dB/octave attenuation slope
- Your choice of LP1, HP1, TD6 filters
- Programmable zero suppress
- Frequency range
  A: 25,575:1
  B: 102,300:1
- Maximum frequency, 25.575 kHz
- Minimum frequency, 0.1 Hz
- Low drift preamp option

6604B Programmable decibel gain
- Pre-filter gain, 0 to 40 dB
- Post-filter gain, −9.9 to 20 dB

6624 Programmable binary gain
- Pre-filter gain, 1, 2, 4, ... 128
- Post-filter gain, 0.001 to 10.2375

Model number	Low range (Hz)			High range (Hz)		
	Min	Max	Step	Min	Max	Step
6604B-A & 6624-A	1.0	1023.0	1.0	1025	25,575	25
6604B-B & 6624-B	0.1	102.3	0.1	110	10,230	10
6604B-K & 6624-K	25	25,575	25			
6604B-L & 6624-L	10	10,230	10			
6604B-M & 6624-M	1.0	1,023	1.0			
6604B-N & 6624-N	0.1	102.3	0.1			

6614—Quad filter/amplifier—80 dB/octave—32 kHz—Limited frequency settings

- Low-cost—limited cutoff frequencies
- Four filters per card
- 80 dB/octave attenuation slope
- Your choice of LP1, HP1, TD6 filters
- Low drift preamplifier option
- Programmable zero suppress
- Maximum frequency, 32 kHz
- Minimum frequency, 1 Hz

6614 Programmable binary gain
- Pre-filter gain, 1, 2, 4, ... 128
- Post-filter gain, 0.001 to 10.2375

Range number	Cutoff frequency (Hz)			Range number	Cutoff frequency (Hz)		
	Min	Max	Step		Min	Max	Step
6614-F04	1	16	1	6614-F10	100	1600	100
6614-F05	2	32	2	6614-F11	200	3200	200
6614-F06	5	80	5	6614-F12	500	8000	500
6614-F07	10	160	10	6614-F13	1k	16k	1k
6614-F08	20	320	20	6614-F14	2k	32k	2k
6614-F09	50	800	50				

6602B & 6622—Dual filter/amplifiers—80 dB/octave—204.7 kHz

- Two filters per card
- 80 dB/octave attenuation slope
- Your choice of LP1, HP1, TD6 filters
- Frequency range, 204,700:1
- Maximum frequency, 204.7 kHz
- Minimum frequency, 0.1 Hz
- Programmable zero suppress
- Pre- and post-filter overload detection
- Phase match, 1/2°

6602B Programmable decibel gain
- Pre-filter gain, 0 to 40 dB
- Post-filter gain, −9.9 to 20 dB

6622 Programmable binary gain
- Pre-filter gain, 1, 2, 4, ...128
- Post-filter gain, 0.001 to 10.2375

Model number	Low range (Hz)			High range (Hz)		
	Min	Max	Step	Min	Max	Step
6602B-A & 6622-A	1.0	2047.0	1.0	2100	204,700	100
6602B-B & 6622-B	1.0	1023.0	1.0	1100	102,300	100
6602B-C & 6622-C	0.1	102.3	0.1	110	10,230	10
6602B-E & 6622-E	0.1	204.7	0.1	210	20,470	10
6602B-I & 6622-I				100	204,700	100
6602B-J & 6622-J				100	102,300	100

6611A—Filter/amplifier (single channel)—80 dB/octave—2.048 MHz

- Maximum frequency, 2.048 MHz
- 80 dB/octave attenuation slope
- Your choice of HP1, LP1, TD6 filters
- Frequency range
  6611A-A: 102,400:1
  6611A-B: 51,200:1
- Minimum frequency, 20 Hz
- Programmable input Z, 50 Ω or 100 kΩ

6611A Programmable decibel gain
- Pre-filter gain, −10 to 20 dB
- Post-filter gain, 0 to 22 dB

Model number	Frequency range (Hz)		Cutoff frequencies (Hz)		
			Step size		
	Min	Max	20	200	2k
6611A-A	20	2.048M	20 - 20.48k	20.6k - 204.8k	206k - 2.048M
6611A-B	20	1.024M	20 - 10.24k	10.4k - 102.4k	104k - 1.024M

6612A & 6632—Dual filter/amplifiers—130 dB/octave—204.7 kHz

- 130 dB/octave attenuation slope
- Your choice of HP8, LP8, TD8 filters
- Frequency range, 204,700:1
- Minimum frequency, 0.1 Hz
- Phase match (max), 1°
- Programmable zero suppress
- Amplitude accuracy, 0.1 dB
- Two filters per card

6612A Programmable decibel gain
- Pre-filter gain, 0 to 40 dB
- Post-filter gain, −9.9 to 20 dB

6632 Programmable binary gain
- Pre-filter gain, 1, 2, 4, ...128
- Post-filter gain, 0.001 to 10.2375

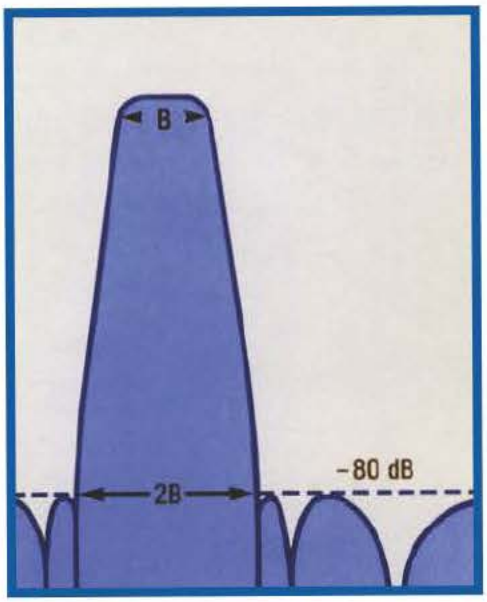
Model number	Low range (Hz)			High range (Hz)		
	Min	Max	Step	Min	Max	Step
6612A-A & 6632-A	1.0	2047.0	1.0	2100	204,700	100
6612A-B & 6632-B	1.0	1023.0	1.0	1100	102,300	100
6612A-C & 6632-C	0.1	102.3	0.1	110	10,230	10
6612A-E & 6632-E	0.1	204.7	0.1	210	20,470	10

6618 – Octal filter/amplifier – 80 dB/octave – 20 kHz – Limited frequency settings

- Low-cost
- Standard cutoff frequencies
- Custom cutoff frequencies
- Eight filters per card
- Your choice of HP1, LP1, LP2 or TD6
- Pre-filter gain, 0, 12 & 24 dB
- Post-filter gain, 0 to 36 dB
- Auto-offset zero

Model number	Cutoff frequency (Hz)			Model number	Cutoff frequency (Hz)		
	Min	Max	Step		Min	Max	Step
6618-F1	1	4	1	6618-F5	500	2k	500
6618-F2	10	40	10	6618-F6	1k	4k	1k
6618-F3	100	400	100	6618-F7	2k	8k	2k
6618-F4	200	800	200	6618-F8	5k	20k	5k

SYSTEM FRIENDLY TRANSLATORS



Precision frequency-band translators. As super spectrum slicers, they cut far more sharply than conventional band-pass filters can. As super zoomers, they extend the capability of equipment for spectrum analysis, modal analysis and beam forming.

The original Precision 1776 was the industry's first multi-channel programmable frequency-band translator system for signal conditioning. It drew heavily on our advanced filter technology to provide usefulness not previously associated with frequency-band translators.

Now, in an updated form, Precision 1776B is available as building blocks in the system friendly Precision 6000.

Spectrum slicer

You can cut far more sharply than any conventional band-pass filter. In fact, the filter can be nearly perfect, obtaining 80 dB/*bandwidth-octave* skirts. Q can go higher than 10,000.

Super Zoomer

As an analog zoom, Precision 1776B frequency-band translators make existing equipment do more work.

Ahead of an FFT spectrum analyzer, Precision translators extend frequency range, while making possible much finer resolution.

For modal analysis and beam forming, you can discard unwanted noise and lower the sampling frequency. Old limits for computer speed, memory and A/D conversion are overcome. Sampling rates are decreased. Dynamic range and signal-to-noise ratio are enhanced.

Features

- Programmable center frequency, 10 Hz-409.5 kHz
- Programmable bandwidth, 1 Hz-51 kHz
- Phase match, 2° maximum, 1° typical
- Wide dynamic range
- Pass-band ripple, 0.2 dB p-p
- Outband rejection, 80 dB
- Hum, –100 dB, re fullscale
- Noise, < –100 dB, re fullscale
- Intermodulation, < –70 dB, re fullscale
- $\frac{-60\ dB\ bandwidth}{-3\ dB\ bandwidth} < 1.8$

How the system works

Operation

Select a band, B, of frequencies centered at the origination frequency, O.

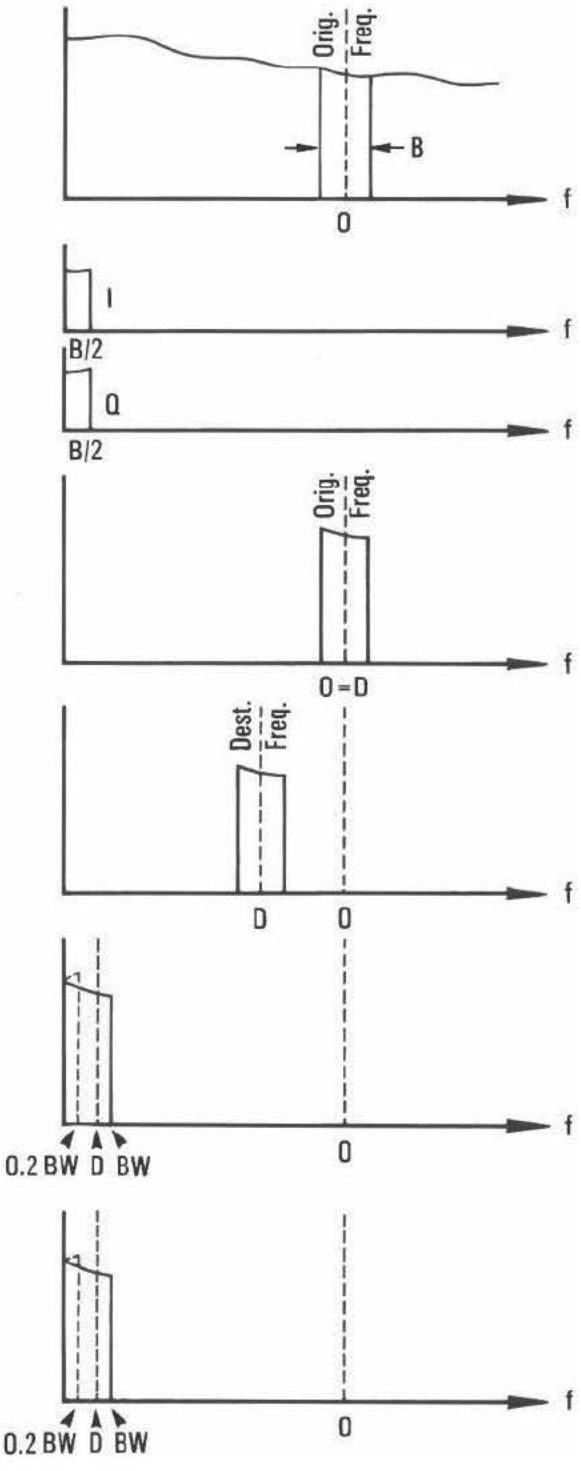
Base-band translator.
Translates (downshifts) to base-band to obtain two signals in quadrature with one-half the bandwidth around zero frequency.

Super spectrum slicer.
Translates (upshifts) to the origination frequency, O.

Band-pass translator.
Translates (upshifts) the frequency band to be centered at the destination frequency, D.

Frequency range extender.
For frequencies greater than analyzer bandwidth, BW, set B = 0.8 BW, D = 0.6 BW, O = Center of band.

Super zoomer.
Select FFT bandwidth:
$BW \geq \frac{5B}{4}$
Set D = 0.6 BW
Set O = Center of band.



O = Center of untranslated data band.
D = Center of translated data band.
B = Width of selected data band.
BW = Analyzer bandwidth.

Application

A complex FFT can be performed on the I and Q outputs with reduced sampling rate, reduced memory size and better S/N ratio.

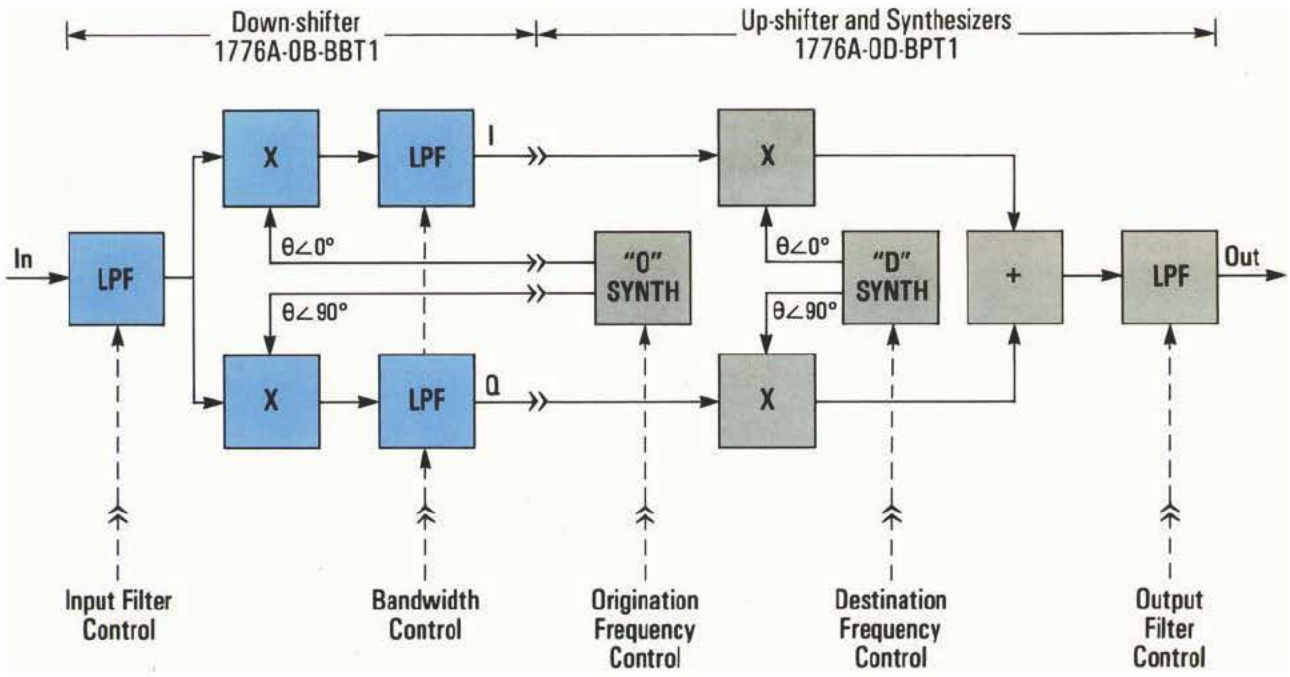
To obtain a super band-pass filter with 80 dB/bandwidth octave, i.e., 80 dB attenuation one bandwidth either side of center frequency. Independent control of O and B.

To translate the frequency band into the bandwidth of existing analysis equipment. Independent control of O, D and B.

Extend the frequency range of an FFT analyzer.

To zoom in on the bandwidth with an existing FFT. Greater resolution results.

Building blocks



BBT1. Think of this base-band translator as the down-shifter. It translates a frequency band, centered at the origination frequency, O, down to zero frequency. There, the in-phase and quadrature components are presented with a bandwidth of B/2. The sharp bandwidth filters operate as anti-alias filters. Each output can be sampled at 3xB/2 samples/second (with 80 dB attenuation of aliases) in order to form a complex FFT. With translation, the channel sampling rate is 3B Hz rather than three times the origination frequency. At the same time, the bandwidth filters reject out-of-band signals, providing improved signal to noise ratio and dynamic range.

The origination synthesizer is provided either by the BPT1, a separate synthesizer card, SYN1, or an external synthesizer.

Option /4 is required on the BBT1 when paired with a BPT1 to form a single-channel band-pass translator. Any translator array (multi-channel system using a common clock) must not have the /4 option.

BPT1. Think of this band-pass translator as the up-shifter. It retranslates and combines the in-phase and quadrature components of a band at zero frequency—generated by the BBT1—to a band centered at the destination frequency, D. When the destination frequency is the same as the origination frequency, the BPT1 operates as an almost perfect band-pass filter with programmable center frequency and bandwidth. The ratio of −60 dB bandwidth to −3 dB bandwidth is only 1.8, and the pass-band ripple is only 0.2 dB p-p.

Building model numbers

1776B-0B-BBT1-XX-YY-ZZ

- Insert option designations
- Designates base-band translator
- Insert bandwidth (1-5) from Table II
- Insert origination frequency range (1-5) from Table I

1776B-0D-BPT1-XX-YY-ZZ

- Insert option designations
- Designates band-pass translator
- Insert destination frequency range (1-5) from Table I
- Insert origination frequency range (1-5) from Table I

Frequency range choices

Standard Precision 1776B building blocks meet requirements for frequency-band translation from 10 Hz to 409.5 kHz. Custom ranges are also available.

Table I

Origination and destination frequency ranges

Range (O,D)	Frequency (Hz)	Steps (Hz)
6	41,000 - 409,500	100
	4,100 - 40,950	10
	410 - 4,095	1
	20 - 409.5	0.1
1	20,500 - 204,700	100
	2,050 - 20,470	10
	205 - 2,047	1
	10 - 204.7	0.1
2	20,500 - 102,300	100
	2,050 - 20,470	10
	205 - 2,047	1
	10 - 204.7	0.1
3	20,500 - 51,700	100
	2,050 - 20,470	10
	205 - 2,047	1
	10 - 204.7	0.1
4	2,050 - 20,470	10
	205 - 2,047	1
	10 - 204.7	0.1
5	2,050 - 10,230	10
	205 - 2,047	1
	10 - 204.7	0.1

Table II

Bandwidth ranges

Range (B)	Bandwidth (Hz)	Steps (Hz)
6	5,200 - 51,000	200
	520 - 5,100	20
	32 - 510	2
	2* - 30*	2
1	2,600 - 25,500	100
	260 - 2,550	10
	16 - 255	1
	1* - 15*	1
2	1,300 - 12,750	50
	130 - 1,275	5
	8 - 127.5	0.5
	0.5* - 7.5*	0.5
3	520 - 5,100	20
	52 - 510	2
	3.2 - 51.0	0.2
	0.2* - 3.0*	0.2
4	260 - 2,550	10
	26 - 255	1
	1.6 - 25.5	0.1
	0.1* - 1.5*	0.1
5	130 - 1,275	5
	13 - 127.5	0.5
	0.8 - 12.75	0.05
	0.05* - 0.75*	0.05

*Indicates reduced performance

Synthesizer card

SYN1. The synthesizer card provides origination and destination frequencies for translator arrays. The synthesizer frequency range covers all translator card frequency ranges. System software restricts the synthesizer range to the range of the translator cards in the mainframe.

1776B-OD-SYN1 Origination and destination synthesizers
1776B-O9-SYN1 Origination synthesizer only
1776B-9D-SYN1 Destination synthesizer only

Options for BBT1 (down-shifter) cards

Option 1. AC coupled, single-ended input.
Option 2. AC coupled, differential input.
Option 5. Prog. AC/DC coupled, single-ended input.
Option 6. Prog. AC/DC coupled, differential input.
Option 9. AC coupled, diff input with ICP current source.
Option /4. Divide-by-four. Synthesizer frequency inputs to the base-band translator card must be exactly four times the desired origination frequency. Option /4 is required on the BBT1 when paired with a BPT1 to form a single-channel band-pass translator. Any translator array (multi-channel system using a common clock) must not have Option /4.
Option A. Array. Configures BBT1 card for operation in a translator array.
Option C. Calibration. When cal is enabled, a cal signal is injected.
Option M. Monitor. Allows 1-of-3 signals to be placed on the monitor bus. Origination filter output, I output or Q output.

Options for BPT1 (up-shifter) cards

Option A. Array. Configures the BPT1 card for operation in a translator array.
Option C. Calibration. When cal is enabled, the modulator clock is stopped and the cal signal is applied to the I or Q input.
Option M. Monitor. Allows one of several signals to be placed on the monitor bus.
Option DS. Delete Destination synthesizer. A single external synthesizer replaces the internal destination frequency synthesizers. Savings result.
Option OS. Delete origination synthesizer. A single external synthesizer replaces the internal origination frequency synthesizers. Savings result.
Option VS. Vector sum. Provides an output that is proportional to the energy content of the signal band.
Option VSL. Vector sum log. Provides an output that is proportional to the log of the energy content of the signal band.

Options for Precision 6000 control module

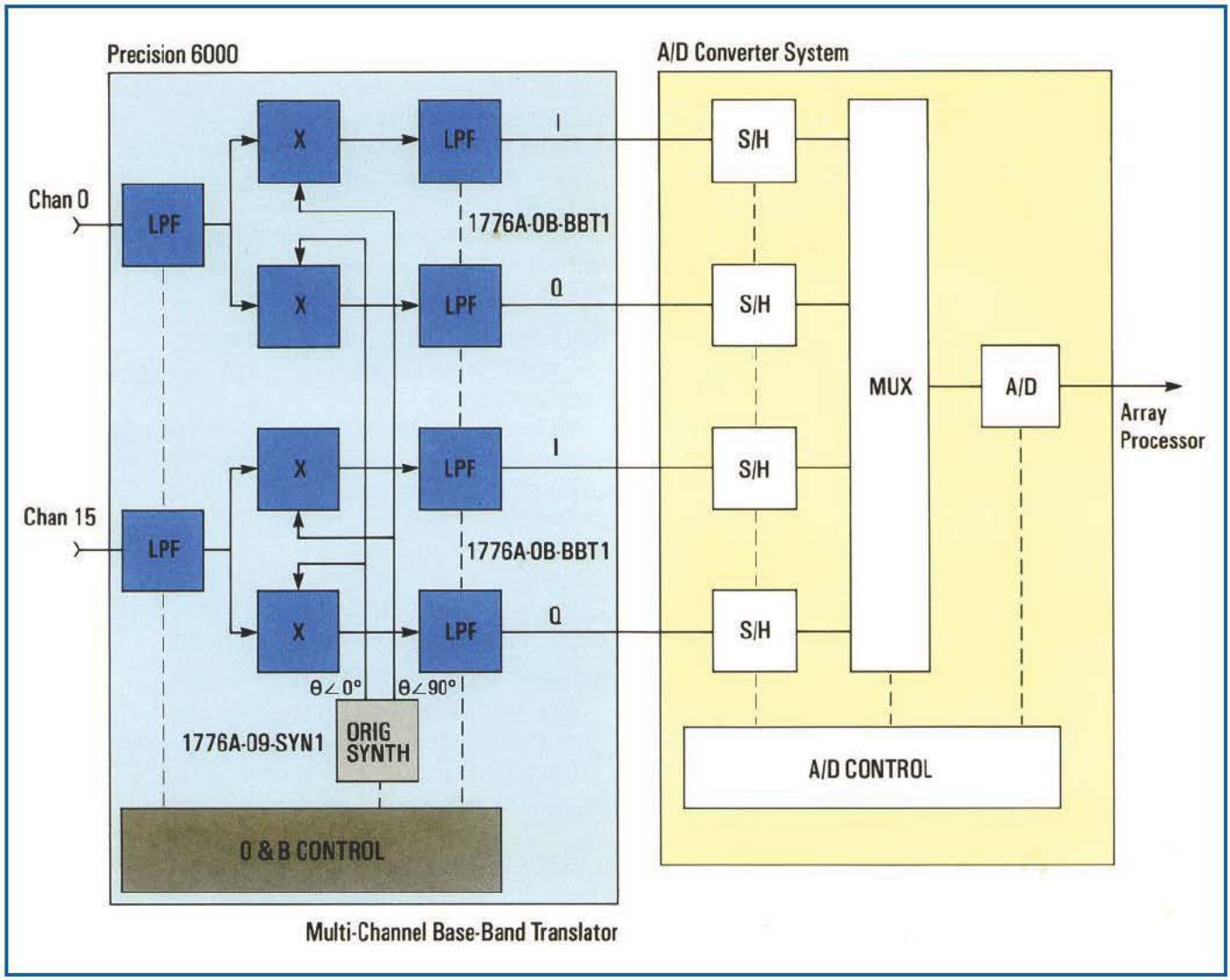
Option R. Reference clock required for the 1776B. Provides a precise timing signal.
Option D. Divide-by-four driver for an external frequency source driving an array of BPT1's. Specify Option DS on BPT1's.
Option O. Divide-by-four driver for an external frequency source driving an array of BBT1's. Specify Option OS on BPT1's.

Typical application for multiple channel base-band translator

Application. Processing signals from a multi-channel hydrophone array.

Implementation. A base-band translator, 1776B-0B-BBT1 downshifter for each channel. A common origination synthesizer, 1776B-09-SYN1. An A/D converter system with simultaneous sample and hold.

Benefits. Channels phase and amplitude match is ±2°. Reduced sampling rate (only 3B Hz), memory size and computation time. Increased dynamic range in the presence of larger out-band signals. No additional anti-alias filters required for the A/D conversion systems.



SYSTEM FRIENDLY GAIN RANGERS

This instrument helps you record data of extremely wide dynamic range within the limits of magnetic recording tape. Designated the Precision 6201, this gain ranging amplifier system is available with Precision 6000 building blocks.

Our Gain Rangers provide all the features you need to accurately, efficiently and automatically record data of wide dynamic range within the limited dynamic range of magnetic recording tape. The Precision 6201 and its predecessor are proven in thousands of underwater acoustic tests.

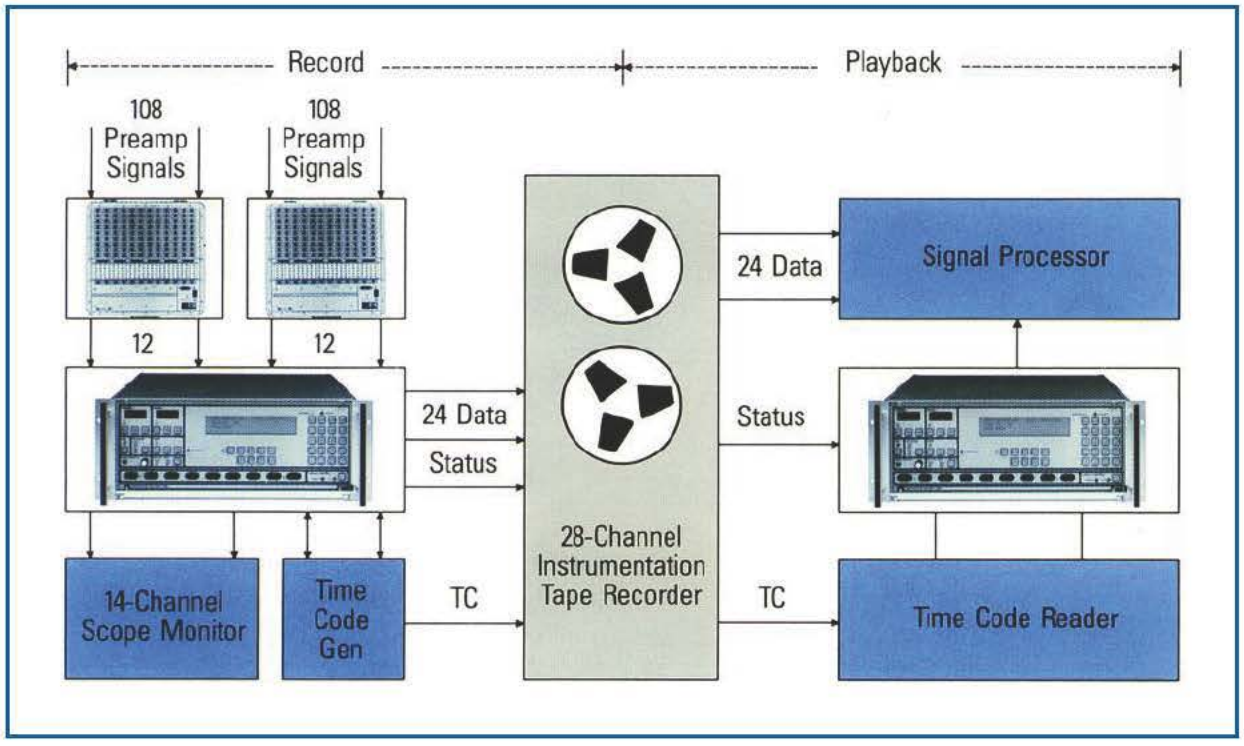
The instrument incorporates programmable band-limiting filters to eliminate out-band signals, programmable equalization networks to pre-whiten signals, and automatic gain ranging to compress signals of wide dynamic range to the limited range of analog tape recording.

A system status multiplexor/demultiplexor polls all system functions and formats them into a serial PCM pulse stream suitable for recording on tape. During playback, the demultiplexor reads the data and sends it to a computer via the interface.

A calibration subsystem is available for go/no-go calibration sequences in the field. Calibration signals can be recorded on tape along with the calibration subsystem status information.

For monitoring the output signals, connections are provided for a 14-channel monitor scope that can be set to monitor either odd or even amplifier channels. In addition, single channels can be individually monitored by scope through a monitor jack and audibly through a headphone jack.

Two switch matrices will handle 216 preamp inputs (9 banks of 24 each). The bank address is multiplexed along with the system status into the PCM pulse stream.



Features

- 28 channels in 7" mainframe
- 16 gain settings, −12 dB-78 dB in 6 dB steps
- Bandwidth, 1 Hz-150 kHz
- Dynamic range, 120 dB
- Max output, 10 Vpk
- Broadband noise, 3.5 μV rms @ max gain
- Phase match, 1° 10 Hz-100 kHz
- LFRO, 5 low frequency rolloff settings
- HFRO, 5 high frequency rolloff settings
- LP filter choices:
  - —F1, 10 kHz-150 kHz in 10 kHz steps
  - —F2, 1 kHz-15 kHz in 1 kHz steps
  - —F3, 100 Hz-1.5 kHz in 100 Hz steps.
- Input, AC-coupled, differential
- CMRR, 100 dB
- Overload detection
- Calibration subsystem
- Signal monitors
- Gain control:
  - —Programmable or manual
  - —Gain-ranging
  - —Master/slave
  - —Host computer via remote interface
  - —Stored gain sequences

Recording data of wide dynamic range

The measurement, transmission or recording of almost any signal is restricted to lie between some upper and lower level.

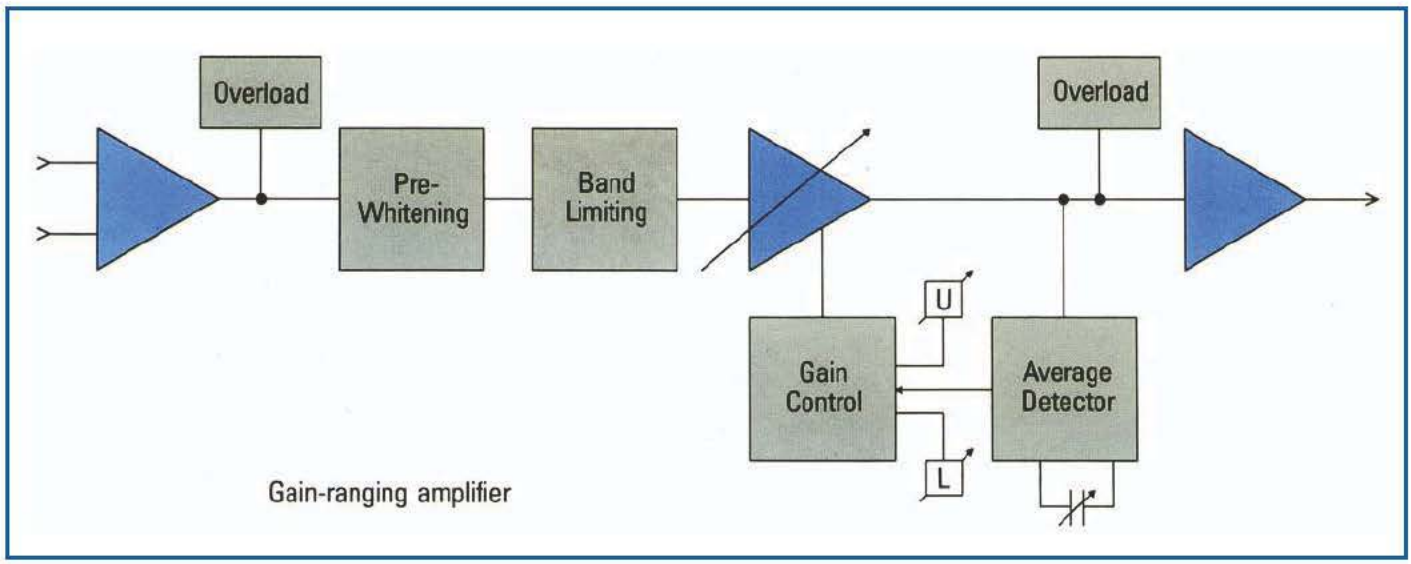
The upper level is limited by such device non-linearity as amplifier limits, tape saturation or the fullscale limits of an A/D converter. If the signal level exceeds the upper level, an unsatisfactory amount of signal non-linearity or inter-modulation will result.

The lower level may be limited by noise or non-linearity—the recording threshold set by the coercive force of the magnetic medium or the quantizing level of the A/D converter. If the signal falls below the lower level, an unsatisfactory signal-to-noise ratio or non-linearity will result.

These levels set the dynamic range of the process:

$$\text{Dynamic range (dB)} = 20 \log_{10} \left[\frac{\text{Max satisfactory level}}{\text{Min satisfactory level}} \right]$$

In many cases, the dynamic range of the signal is larger than the dynamic range of the recording device. In such cases, a number of techniques may be employed to improve the quality of the recording process.



Gain-ranging amplifier

Band-limiting

In almost every measurement, there is a frequency beyond which there is no appreciable interest. The noise level and the intermodulation distortion is roughly a fixed percentage of the peak useful level. If out-band frequencies have substantial power, the level of in-band signals will be reduced. Band-limiting filters reject out-of-band signals, so the signals of interest operate nearer the peak useful level.

Pre-whitening

Pre-whitening is also referred to as pre-emphasis and equalization. In many cases, the signal level varies across the frequency spectrum. One portion of the spectrum may have a substantial signal level. Another, also of interest, may have a relatively low signal level. And the low level signal is degraded. By pre-emphasizing the low level signals before recording, you can improve the overall quality.

Careful tailoring of the frequency response is often a crucial part of a measuring or recording process. In fact, it may not be possible to record some wide-band signals, such as acoustic signals, using a poorly tailored frequency response.

The background level of underwater acoustic signals, for example, varies widely with frequency (approximately inversely proportional to the frequency, 1/f, or 6 dB/octave). The high level signal at 10 Hz is 60 dB larger than that portion of the signal at 10 kHz. If the portion of the signal at 10 kHz is just as important as that at 10 Hz, it would be helpful to introduce a 6 dB/octave low-frequency rolloff to make the spectrum "white." If the pre-emphasis is precisely defined, the post-processing signal can be accurately corrected or de-emphasized.

Pre-whitening—equalization—band-limiting

Type	Slope	Mathematical description	Application
HFRO	–6 dB/octave	Single integration	Pre-whitening signals with amplitude spectrum α F Acceleration → velocity; velocity → displacement
HFRO	–12 dB/octave	Double integration	Pre-whitening signals with amplitude spectrum α F^2 Acceleration → displacement
LPF	M dB/octave	–	Band limiting signal spectrum (rejecting high frequencies)
LFRO	+6 dB/octave	Differentiation	Pre-whitening signals whose amplitude spectrum α 1/F Background sea state noise
HPF	N dB/octave	–	Band limiting signal spectrum (rejecting low frequencies)

Notes: HFRO: high frequency rolloff (low-pass filter)
LFRO: low frequency rolloff (high-pass filter)
LPF: low-pass filter (M dB/octave)
HPF: high-pass filter (N dB/octave)

Amplitude compression by gain-ranging

Signal amplitude compression is used to reduce the signal dynamic range to an acceptable level by introducing gain or attenuation into the signal path.

One method is to use a gain-ranging amplifier that adjusts its gain to maintain an output level between two preset levels. If the output exceeds the upper level, gain is automatically decreased by one step. If the output level goes below the lower level, gain is automatically increased by one step. In this way, the gain-ranging amplifier can accept a signal with wide dynamic range at its input and compress the signal to a limited dynamic range at the output.

Refer to Figures 1 and 2, for example. If the amplifier is allowed to gain-range continuously, it will maintain an output level between the gain decrease (D) threshold and the gain increase (I) threshold.

Continuous gain-ranging is not often used in data acquisition systems, because to reduce the data, the gain and signal output is needed at all times. And many data analysis systems require constant gain during the analysis period. One solution to this problem is to continuously update the gain change registers, but only allow the amplifier to change gain periodically.

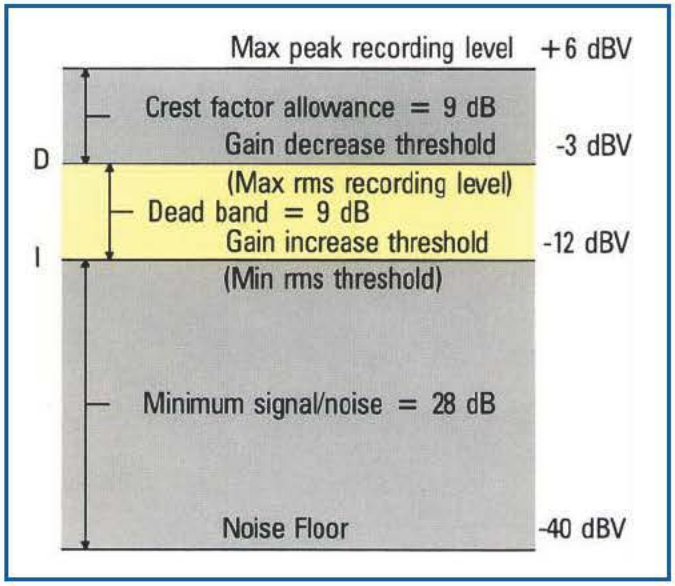


Fig 1 Typical recording levels for continuous gain-ranging

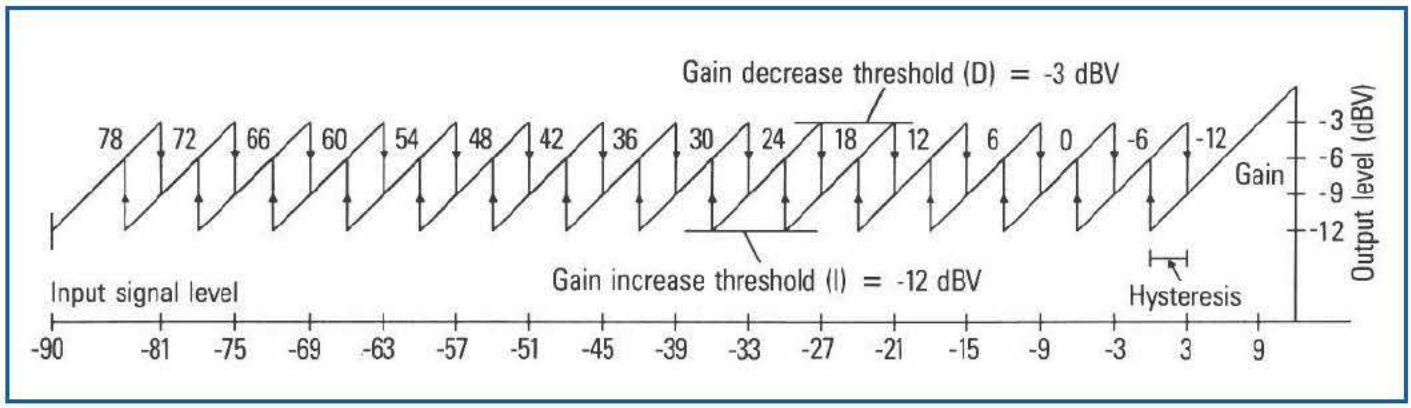


Fig 2 Amplifier input and output signal levels for continuous gain-ranging

Gain-ranging with periodic gain change intervals

Output levels for gain-ranging amplifiers with periodic gain changes are shown in Figure 3. Because the signal can change between gain change periods, there are two additional signal bands—the upper (U) and lower (L) guard bands. The upper guard band is set to allow for the maximum signal increase expected between any gain change period. The lower guard band is set to allow for the maximum signal decrease between any gain change period.

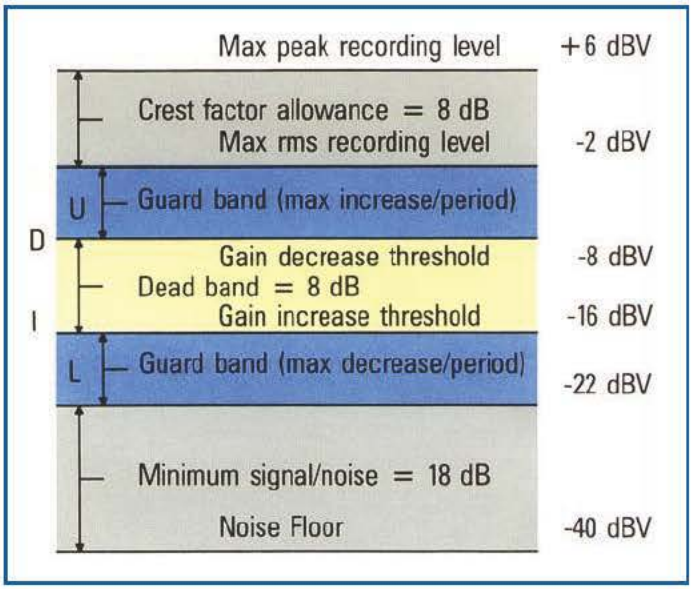


Fig 3 Typical recording levels for gain-ranging with periodic gain change

MX/DMX

The introduction of periodic gain changes provides periods of constant gain, during which the output signal can be analyzed. However, to correct the data for gain, a method of capturing the gain of each amplifier during each gain change period is required.

To capture these gains, the 6201-1-MX/DMX system status multiplexor/demultiplexor is used. It is synchronized to an external time code generator. It polls each amplifier during each gain change period and formats the gain information in a serial PCM stream, which is recorded on one tape channel. The time code is recorded on one channel and the amplified signals are recorded on the other channels. The PCM format has provisions for the MX/DMX, the calibration subsystem, as well as the amplifier and front panel settings.

Status mixer/separator

The 6201-1-M/S provides a means of combining the system status PCM signal and time code signal for recording on a single tape track, rather than two tracks. During playback, the card separates the signals for use by the time code reader and the demultiplexor.

A 6201 system with the 6201-1-M/S can record 27 analog data channels with time code and status recorded on the 28th channel. Option 1 provides a sub-carrier oscillator so the status from two systems can be combined. Option V allows a voice channel to be combined with the system status and time code information for recording on a single track.

Signal selection matrix

The SSX-2 signal selection matrix lets you select from up to 108 input signals, in groups of 12. Two SSX-2's and 24 amplifier channels can condition 216 data channels.

Gain Rangers building blocks

Mainframes

6201-R-1	Mainframe for 28 chan w/FP-2
MF32-IO-F	2 inputs/2 outputs per card
MF48-IO-F	3 inputs/3 outputs per card
MF64-IO-F	4 inputs/4 outputs per card

Control modules & options

6201A-C-0	Manual control only
6201A-C-1	GPIB interface
6201A-C-2	Serial interface
6201A-C-3	Parallel interface
Option C	Calibration buffer & firmware
Option M	Output monitor buffer & firmware

System modules & accessories

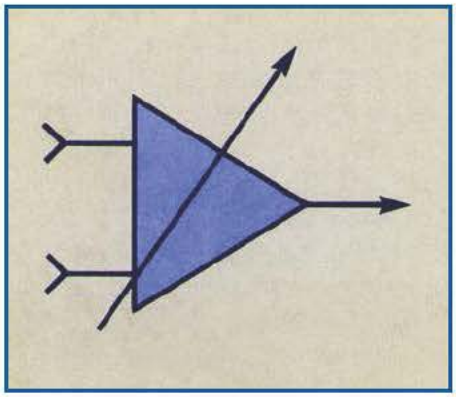
6000A-1-OSC	Calibration oscillator
6000-2-CAL	Calibration subsystem
6201-1-ARM	Gain-ranging module
6201-1-MX/DMX	System status MX/DMX
6201-1-M/S	Mixer/separator
SSX-2	108 x 12 bank switch w/preamp power

Amplifier modules & options

6201-1-AMP	Dual auto/prog AC amplifier
6201-2-AMP	Dual prog AC amplifier
Option C	Calibration input
Option F1	Prog LPF, 3-pole, 10 kHz-150 kHz
Option F2	Prog LPF, 3-pole, 1 kHz-15 kHz
Option F3	Prog LPF, 3-pole, 100 Hz-1.5 kHz
Option H	Prog HFRO
Option L	Prog LFRO
Option M	Output monitor
Option P	Current driver for ICP transducers
Option S	Scope monitor

SYSTEM FRIENDLY AMPLIFIERS

Letting you include both filters and amplifiers in the same system under the same friendly control is among the most popular features of Precision 6000. And you have a wide selection to choose from.



Low-level, wide-band, AC signals

6104 quad low-noise AC differential preamplifier. Employs low-noise FET input stage with rolloff and filter options for amplification of low-level acoustic signals.

Low-cost, wide-band, DC signals

6114 quad DC post-amp. Provides additional gain after other signal conditioning modules.

Low-level, low-frequency signals from low Z sources

6124 quad DC preamplifier. Employs low drift, low-noise, bi-polar input stage for measuring low level, low impedance sources, such as strain gages, thermocouples and the like.

Wide dynamic range acoustic signals

6201-1-AMP dual AC automatic gain ranging amplifier. Employs a low-noise differential input stage, band-limiting, pre-whitening and automatic gain ranging to condition wide-band, wide dynamic range AC signals.

6201-2-AMP dual programmable AC amplifier. Employs a low-noise differential input stage, band-limiting, pre-whitening and programmable gain to condition wide-band, wide dynamic range AC signals.

Friendly amplifier options

- Rolloff, pre-whitening, equalization
- Current sources for remote integrated circuit transducers (ICP)
- Programmable vernier gain
- Overload detectors
- Programmable zero suppression
- Calibration signal injection
- Output monitors

Amplifier selection guide

	DC Amplifiers		AC Amplifiers			
	6114	6124	6104-1	6104-2	6201-1	6201-2
Channels per card/system	4/64	4/64	4/64	4/64	2/28 or 32	2/28 or 32
Amplifier type	Post-amp	Data-amp	Preamp	Preamp	Acoustic	Acoustic
Gain control	Prog	Prog	Prog	Prog	Auto/Prog	Prog
Gain range (dB)	–9.9 to 60	0 to 60	–10 to 60	–10 to 60	–12 to 78	–12 to 78
Gain steps (dB)	0.1	0.1	10	10	6	6
Frequency response (Hz)	DC-100k	DC-10k	0.32-200k	0.32-200k	1-150k	1-150k
Phase match(°)	0.5	1	1	1	1	1
Input coupling	DC	DC	AC	AC	AC	AC
CMRR (dB)	100	120	100	100	100	100
Max input @ 0 dB gain (Vpk)	10	10	5	5	5	5
Drift @ max gain (μV/°C)	25	1	–	–	–	–
BB noise (μV rms/BW)	15/100 kHz	10/100 kHz	6/100 kHz	3.5/100 kHz	3.5/100 kHz	3.5/100 kHz
Spectral noise 100 Hz (nV/√Hz)	60	20	100	30	50	50
Spectral noise 10 kHz (nV/√Hz)	40	12	20	10	12	12
Calibration input option	C	C	C	C	C	C
Filter option	–	–	F	F	F	F
Output monitor option	M	M	M	M	M	M
Overload detector option	–	–	–	–	Standard	Standard
ICP transducer current source option	9	9	I	I	P	P
Zero suppress option	Z	Z	–	–	–	–
Prog AC/DC coupling option	6	–	–	–	–	–
High frequency rolloff options	–	–	H	H	H	H
Low frequency rolloff options	–	–	L	L	L	L

The go-anywhere preamps

Rugged high impedance preamplifiers feature excellent low-noise performance over a frequency response range of 0.2 Hz to 200 kHz.

600A-SE-0	0 dB fixed gain
600A-SE-10	10 dB fixed gain
600A-SE-20	20 dB fixed gain
600A-SE-30	30 dB fixed gain
600A-SE-40	40 dB fixed gain



SYSTEM FRIENDLY BUFFERED I/Os

You can add a parallel interface for reading and writing a byte of slow digital data. Or you can add interface cards to read and control a variety of external devices. At a friendly cost, of course.

Precision 6000-1-BI/O buffered I/O cards let you read the state of external lines or control them. Commands can come from the front panel or the computer via the Precision 6000 interface.

A variety of cards—plug-on daughter cards—configure your Precision 6000 to interface with CMOS, TTL, relay, contact closures and other kinds of signals.

Each BI/O has provisions for eight plug-on 4-bit interface cards, 24 I/O lines and four menus for reading and writing. Each menu can read one byte and write another.

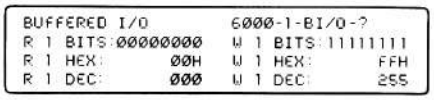
The I/O connection matrix and bus connection matrix let you hard-wire the card to meet specific requirements.

Features

- Four status (read) bytes—3 formats per status byte
  - 8-bit display
  - 2-digit hexadecimal display
  - Decimal 000-255 display
- Four control (write) bytes—3 formats per control byte
  - Bit programmable
  - 2-digit hexadecimal entry
  - Decimal 000-255 entry
- Eight BI/O interface card locations
- 24 I/O lines
- BI/O interface cards

BI/O-R-CMOS?	CMOS receiver (5, 12 and 15 V)
BI/O-R-TTL?	TTL receiver
BI/O-R-COMP?	Comparator receiver
BI/O-R-OPTO?	Opto-isolated receiver
BI/O-R-CONT?	Receiver for contacts
BI/O-D-CMOS?	CMOS driver (5, 12 and 15 V)
BI/O-D-TTL?	TTL driver
BI/O-D-OPEN?	Open collector driver
BI/O-D-RELAY?	Relay contacts
BI/O-1-PROTO	For custom interfaces
BI/O-R/D-CMOS?	Bidirectional CMOS interface (5, 12 and 15 V)

Menus



The 6000-1-BI/O can have one to four channel addresses each with one to four menus. Each menu has fields to read one 8-bit word and control by writing another 8-bit word. You can delete unneeded menus and fields. Each word can be interpreted as an 8-bit binary number (00000000-11111111), a 2-digit hexadecimal number (00-FF), or a decimal number (000-255).

I/O line and I/O connection matrix

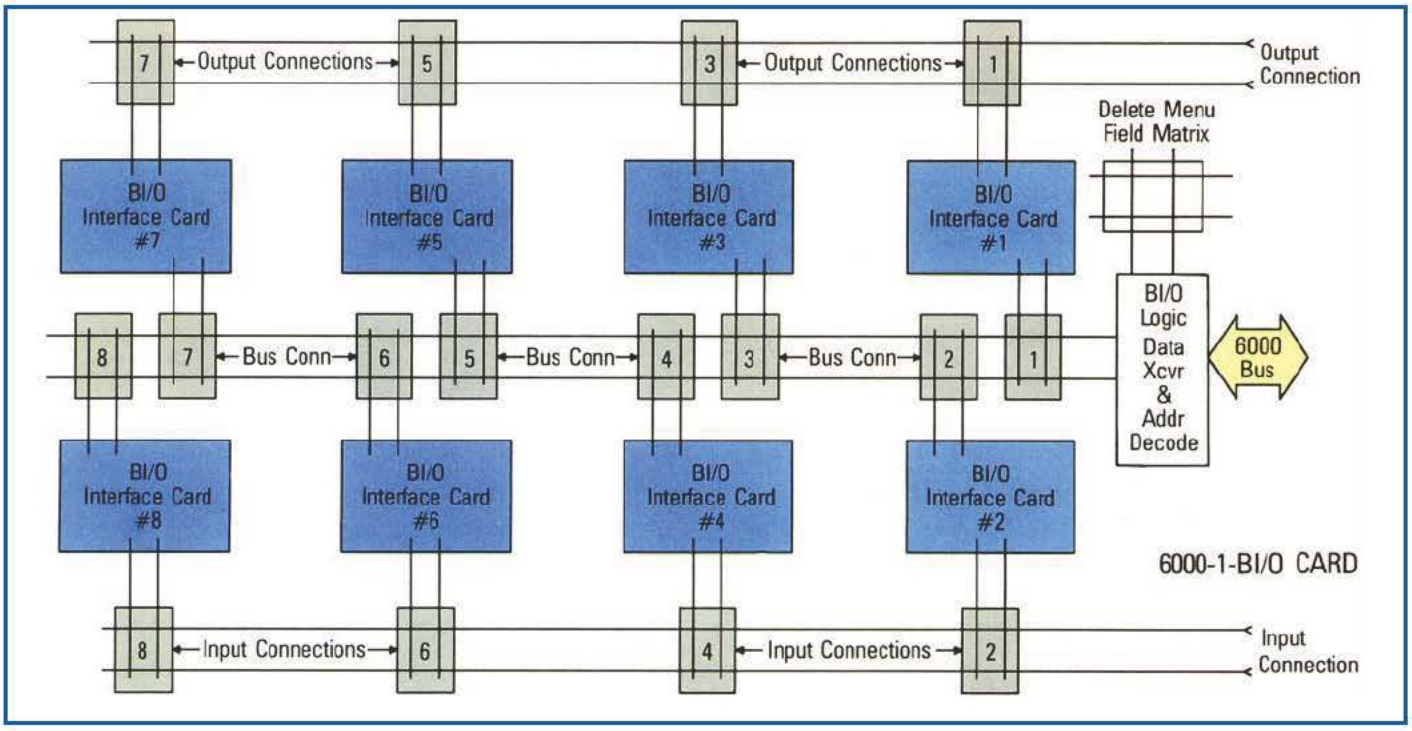
Each BI/O card has 24 I/O lines. Twelve are labeled input, and twelve labeled output. However, the actual number of lines brought to the card depends on the mainframe and its connectors. For an MF64, for example, you can have 16 lines with coaxial BNCs, or 24 lines with twinaxial BNCs, multipin or LEMO connectors.

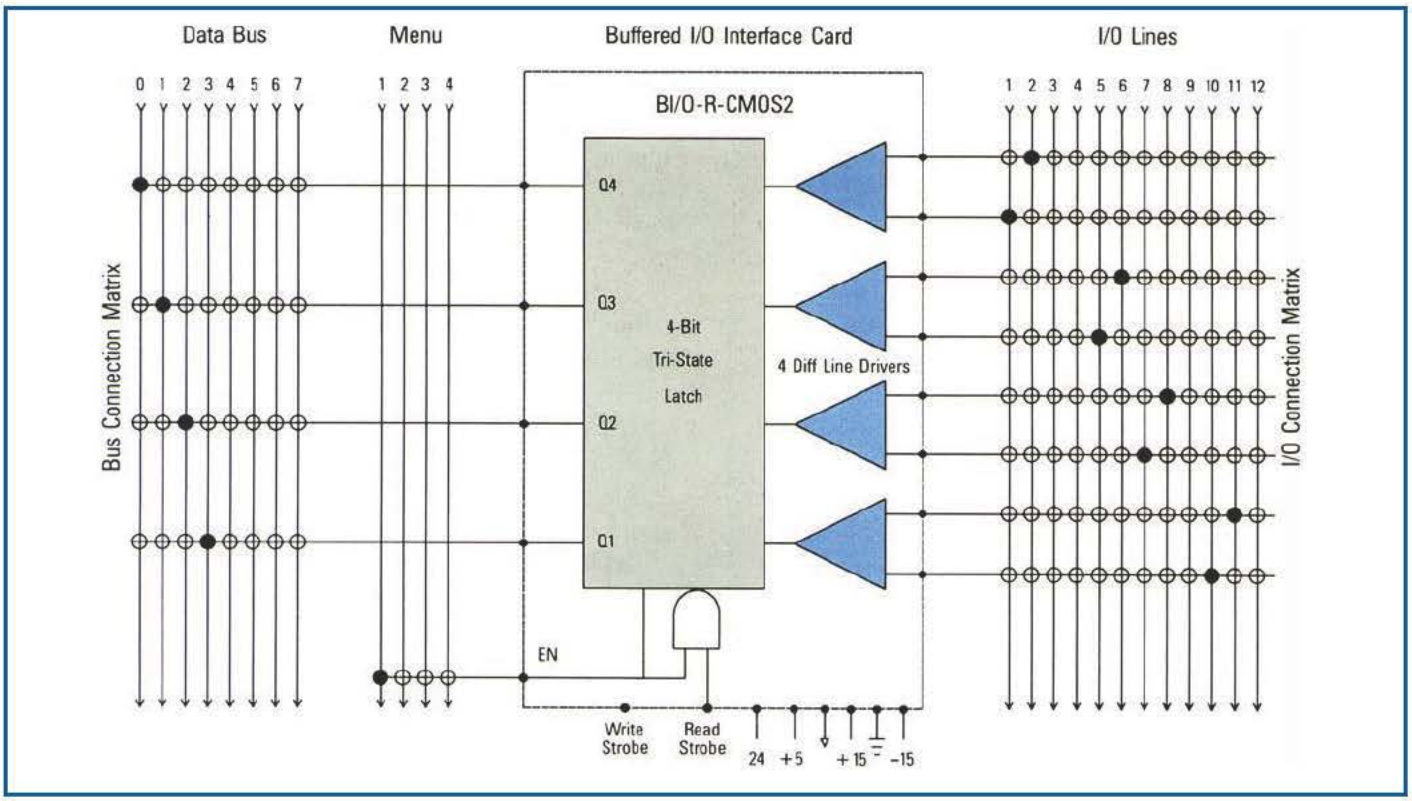
The 12 input lines are bused across four of the interface cards, and the 12 output lines are bused across the other four interface cards. The interface card INPUTS/OUTPUTS is bused across the I/O lines to form an I/O connection matrix. The appropriate cross-point connection is made by a wire stitch.

Bus connection matrix

Each interface receiver has four outputs that must connect to the data bus and be controlled by the bus control lines. Similarly, each interface receiver has four inputs that must connect to the data bus and be controlled by the bus control lines. The menu bits correspond to the data bits. The menu numbers correspond to the control words. And the READ or WRITE strobe is appropriately connected, depending on whether the interface card is a receiver or driver.

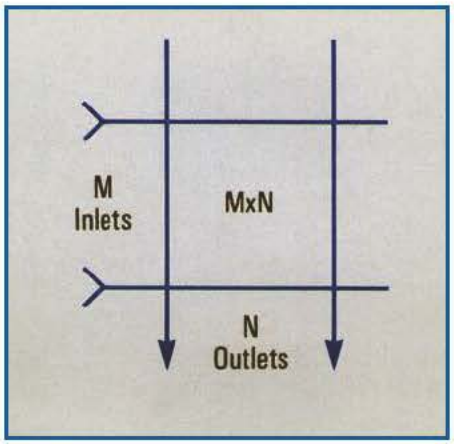
The bus connection matrix lets you use wire stitches to make the four data bus connections and one control word connection.





SYSTEM FRIENDLY SWITCH MATRIX

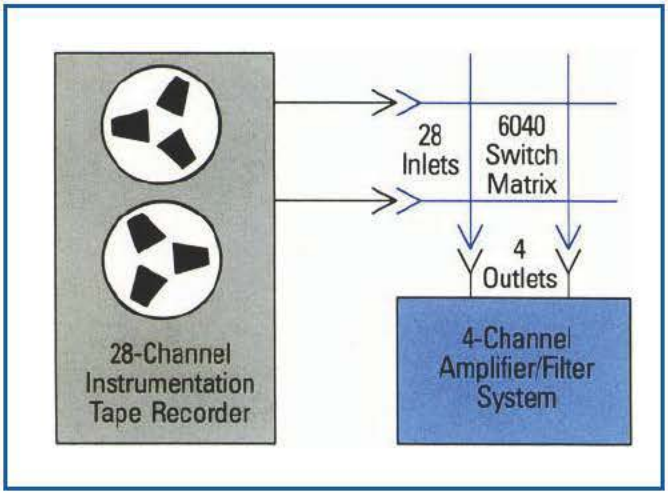
Your Precision 6000 can have a programmable patch panel for signal selection or switches for circuit reconfiguration. And you can have all this for the nominal cost of a few building block cards, instead of buying a separate switching system.



You can make this switch matrix an integrated part of your Precision 6000. And the cost is friendly, because the matrix uses the Precision 6000 mainframe housing, as well as I/O connectors, power supply, control and display. You need buy only a few cards.

Operation is also friendly, because you use the same familiar programming as for the rest of your system. There's computer control available, of course, via the interface. Cal and monitor options, too. And your choices for matrix size are also friendly. Just look at the selection guide.

Applications



You can use this matrix for programmed signal selection. As indicated in the setup shown, for example, you can pick any four signals you need in whatever order you need them from the 28 inputs.

You can also use the matrix as a programmable patch panel or for the programmable reconfiguration of circuits for different measurements.

Your menu

```
SWITCH MODULE          6040-4-SSX
INS PER OUT: ONE       CONFIG: 16 X 16
INLET: 16
INLET CONN: I 15
```

INS-PER-OUT. Select ONE if only one inlet is to be connected to the outlet. Select MANY to allow more than one inlet to be connected to the outlet.

CONFIG indicates the matrix size, inlets x outlets, as in this case 16 x 16. Some cards let you select size using a switch on the card. Others provide only one configuration. See switch matrix selection guide for specifics.

INLET lets you select the inlet number or numbers (1 to n) to be connected to the selected outlet.

INLET CONN displays the rear panel connector designation on the MF64-00-1 mainframe for the selected inlet.

The outlet number corresponds to the channel selected, so the outlet connector number is shown on the LED channel display.

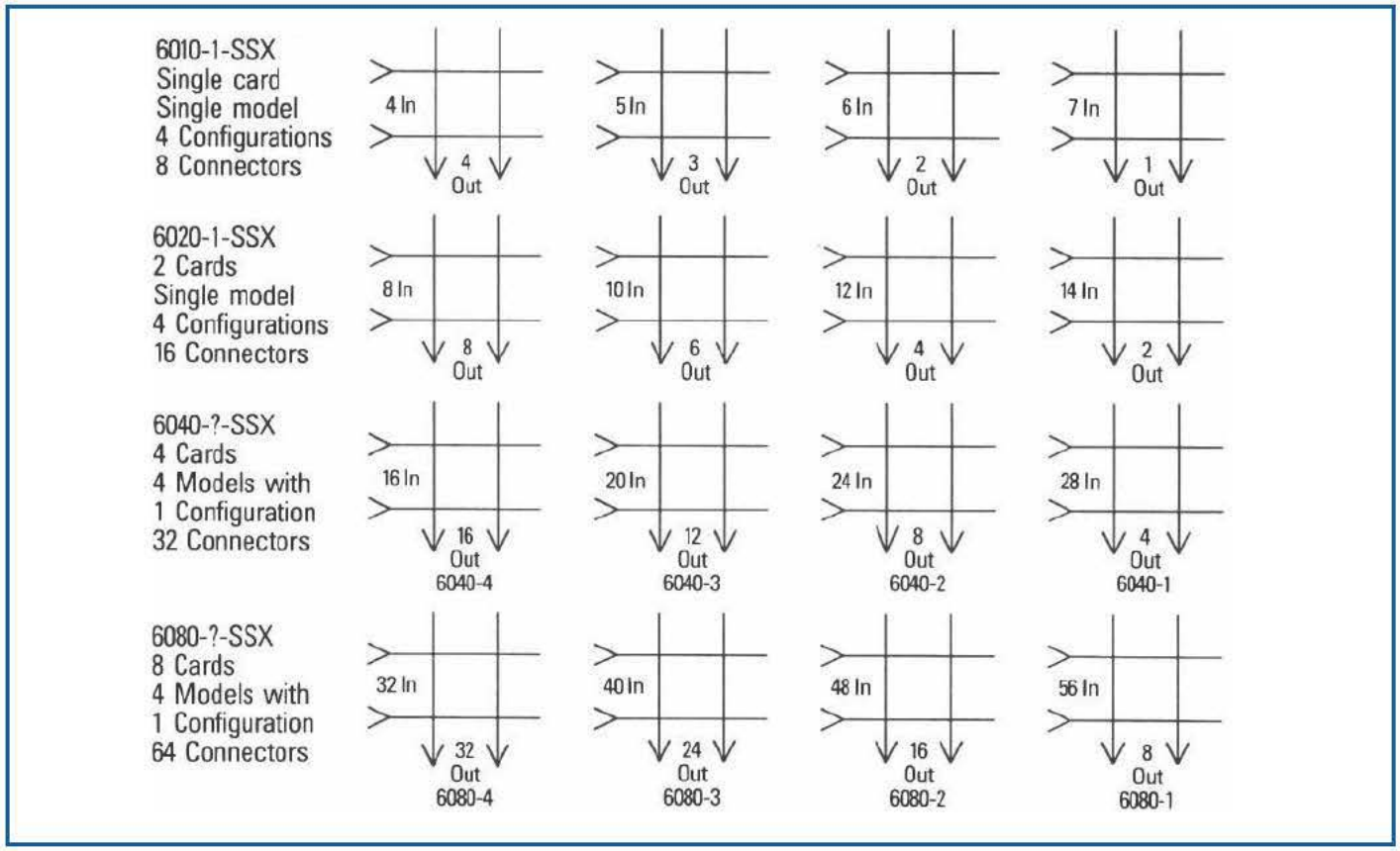
Switch matrix selection guide

Model number	Number of cards	Number of connectors	Matrix size inlets x outlets
6010-1-SSX*	1	8	7 x 1
			6 x 2
			5 x 3
			4 x 4
6020-1-SSX*	2	16	14 x 2
			12 x 4
			10 x 6
			8 x 8
6040-1-SSX	4	32	28 x 4
6040-2-SSX	4	32	24 x 8
6040-3-SSX	4	32	20 x 12
6040-4-SSX	4	32	16 x 16
6080-1-SSX	8	64	56 x 8
6080-2-SSX	8	64	48 x 16
6080-3-SSX	8	64	40 x 24
6080-4-SSX	8	64	32 x 32

* Configuration is selected by a switch on the card.

Specifications

- Frequency range, DC–1 MHz
- Line configurations
  - —Balanced line with common shield
  - —Coaxial line with switched shield
- Switch type, 2 pole dry-reed relay
- Switch speed, < 1 mS
- Switch isolation, > 100 MΩ
- Switch crosstalk, – 80 dB, DC–100 kHz
- Capacitance
  - Across lines, 5 pF
  - Across open reed, 0.5 pF
  - Between inlet and ground, 25 pF max
- Contact ratings
  - Voltage (switching), 100 Vdc max
  - Current (switching), 100 mA max
  - Current (carrying), 3 A max
  - Voltage (breakdown), 200 Vdc
  - Contact resistance, 200 mΩ
  - Voltage x current, 5 W



SYSTEM FRIENDLY CUSTOMIZING

Add your own circuitry. Add the customizing you need. Integrate it with the standard hardware building blocks of Precision 6000. It's all very system friendly. And cost friendly, too.

Our modular prototyping cards provide a removable breadboard on which you construct your own circuitry.

This daughter card plugs onto the card, which takes a single slot in any standard Precision 6000 mainframe.

The card automatically receives power, I/O, control and data lines, system firmware, as well as front panel and computer control. You use the same familiar programming.

And you do all this by adding only one card at nominal cost.

Available features

- Front panel operation or remote computer control via standard interface
- Channels per card, 1–4
- Menus per channel, 1–3
- Fields per menu, 1–6
- Wide selection of field parameters—toggle, 3-, 4-, 10- and 15-bit binary, hexadecimal and other fields
- Ability to delete menus and fields
- Uses I/O connectors on rear panel, which can be coaxial BNC, twinaxial BNC, 50-pin multipin or LEMO three-position input and output connector assemblies
- Compatible with 6000 mainframes
- System power, ±15 V, +20 V, +5 V
- Access to internal calibration and monitor buses
- Custom EPROM optional

Two models

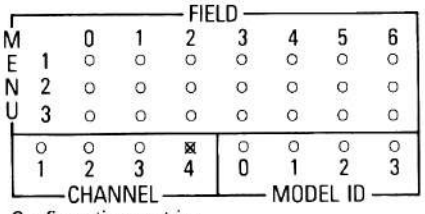
6000-1-PROTO for circuitry that does not require front panel or computer control.

6000-2-PROTO for circuitry you want controlled by the front panel or via the computer interface.

You'll find the proto cards friendly to work with. Each has a variety of printed circuit patterns, so you can readily install IC's and other components.

Card configuration

The 6000-2-PROTO card presents a series of choices that can be exercised by installing wire stitches.



Configuration matrix:
Wire stitches set card configuration

Your first choice is whether to operate your card with 1, 2, 3 or 4 channels. The card comes with a stitch installed in location No. 4 for four channels. To change to 1, 2 or 3 channels, just install a stitch in the 1, 2, or 3 position.

In a similar way, you select the menus and fields you wish to use or delete. Just install the appropriate wire stitches.

Menu Template

PROTO CARD		6000-2-PROTO-?	
FIELD 1:		FIELD 4:	
FIELD 2:		FIELD 5:	
FIELD 3:		FIELD 6:	

Menu 1

PROTO CARD		6000-2-PROTO-?	
10 BIT 1:	1023	TOGGLE 1:	OFF
MAN/EXP 1:	110 E0	3 BIT 1:	0
HEX 1:	0000	4 BIT 1:	00

Menu 2

PROTO CARD		6000-2-PROTO-?	
15 BIT 2:	32,767	TOGGLE 2:	ON
MAN/EXP 2:	1023 E3	3 BIT 2:	7
HEX 2:	7FFF	4 BIT 2:	15

Menu 3

PROTO CARD		6000-2-PROTO-?	
15 BIT 3:	32,767	TOGGLE 3:	OFF
DATA ADDR:	2	3 BIT 3:	0
DATA BYTE:	255	4 BIT 3:	00

Field parameters

Three toggles. Each is a 1-bit binary number displayed as OFF (0) or ON (1). Menu/field: 1/4, 2/4 and 3/4.

Three 3-bit fields. Each is a 3-bit binary number displayed as 0-7. Menu/field: 1/5, 2/5 and 3/5.

Three 4-bit fields. Each is a 4-bit binary number displayed as 0-15. Menu/field: 1/6, 2/6 and 3/6.

One 10-bit field. A 10-bit binary number displayed as 0-1023. Menu/field: 1/1.

Two 15-bit fields. Each is a 15-bit binary number displayed as 0-32,767. Menu/field: 2/1 and 3/1.

Two hex fields. Each is a 4-digit number displayed as 0000-7FFF (15 bits). Menu/field: 1/3 and 2/3.

Two MAN/EXP fields. Each is a number consisting of a 10-bit mantissa, displayed as 0-1023, and a 4-bit exponent. The exponent is decoded as 1-of-4 to display E0, E1, E2 and E3 for powers of 10. Menu/field: 1/2 and 2/2.

One field pair for DATA ADDR and DATA BYTE. The two fields work together to provide a byte of data expressed as 0-255 and an address field, 0-31, to select an address for data. Menu/fields for the DATA ADDR and DATA BYTE are 3/2 and 3/3.

Strobes

The 6000-2-PROTO card provides the strobes for loading data into circuits, using an 8-bit data word with 8 address bits. The address bits are decoded into four channel strobes and 27 field strobes The user "ANDS" the field and channel strobes to obtain the DEVICE SELECT.

Menu field configuration

Field	Title	Display	Code	Strobes	Data bits used
1/1	10 BIT 1:	0-1023	10 bits	1/1A and 1/1B	A: 0-7, B: 0,1
1/2	MAN/EXP 1:	0-1023 E0	10-bit mantissa	1/2A and 1/2B	A: 0-7, B: 0,1
		103-1023 E1	4-bit range		B: 2-5
		103-1023 E2	(1-of-4)		
		103-1023 E3			
1/3	HEX 1:	0000-7FFF	15-bits	1/3A and 1/3B	A: 0-7, B: 0-6
1/4	TOGGLE 1:	OFF/ON	0/1	1/4	0
1/5	3 BIT 1:	0-7	3 bits	1/5	0-2
1/6	4 BIT 1:	0-15	4 bits	1/6	0-3
2/1	15 BIT 2:	0-32,767	15 bits	2/1A and 2/1B	A: 0-7, B: 0-6
2/2	MAN/EXP 2:	0-1023 E0	10-bit mantissa	2/2A and 2/2B	A: 0-7, B: 0,1
		103-1023 E1	4-bit range		B: 2-5
		103-1023 E2	(1-of-4)		
		103-1023 E3			
2/3	HEX 2:	0000-7FFF	15 bits	2/3A and 2/3B	A: 0-7, B: 0-6
2/4	TOGGLE 2:	OFF/ON	0/1	2/4	0
2/5	3 BIT 2:	0-7	3 bits	2/5	0-2
2/6	4 BIT 2:	0-15	4 bits	2/6	0-3
3/1	15 BIT 3:	0-32,767	15 bits	3/1A and 3/1B	A: 0-7, B: 0-6
3/2	DATA ADDR:	0-3		3/2A-3/2D	
3/3	DATA BYTE:	0-255		–	0-7
3/4	TOGGLE 3:	OFF/ON	0/1	3/4	0
3/5	3 BIT 3:	0-7	3 bits	3/5	0-2
3/6	4 BIT 3:	0-15	4 bits	3/6	0-3

SYSTEM FRIENDLY FUTURES

Buy what you need today. Change and add as your future needs change. It's a friendly matter with Precision 6000. And cost effective, too. Meanwhile, new building blocks continue to evolve, so there will be more and more available in your future.

Consider what many believe is the *most* system friendly feature of all. It's an easy matter to add new building blocks, reconfigure and reprogram. Your Precision 6000 can quickly update to fulfill changing requirements.

No need to over-invest today. It's easy to add precisely what you need in the future. No need to buy a new mainframe and software. The one you have will handle changing requirements. Just buy the new cards you need when you need them.

That's system friendly with futures.

Call For More Information

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