PRECISION FILTERS, INC.

On the ***New Frontiers*** *of* ***Precision***

Precision PF-1UA-FA Filter/Amplifier System

Precision PF-1UA-FA

High Performance 8 or 16-Channel Filter/Amplifier Systems

PF-1UA-FA High Performance Multi-Channel Programmable Filter/Amplifier System is ideal for conditioning low-level voltage inputs in front of high-resolution digital data acquisition systems. Fully programmable 8-channel and 16-channel configurations are available; offering a choice of either 4 or 8-pole flat or pulse low-pass filters with programmable gain up to 8,192.

PF-1UA-FA Description

The PF-1UA-FA series is a multi-channel programmable filter/amplifier system in a compact rack mountable or bench top package. A choice of 4 or 8-pole low-pass filters or 8-pole band-pass filters is available. Cutoff settings from 1 Hz to 204.6 kHz are supported. The low-pass filters may operate in either a "flat" mode for maximally flat pass-band amplitude response with sharp roll-off or in a "pulse" mode for low phase distortion and optimized transient response.

The "flat" mode provides passband characteristics nearly identical to a Butterworth filter while providing a much sharper roll-off. This mode is a good choice for applications such as spectral analysis. The "pulse" mode has time domain response similar to the Bessel filter yet provides superior amplitude response characteristics. The "pulse" mode is ideal for time domain applications including transient (shock) measurements and waveform analysis.

Programmable pre- and post-filter amplifiers provide an overall gain of 8,192. Gain is distributed both before and after the filter to provide protection from large out-of-band energy or transients that could cause clipping before the filter, distorting the data. The post-filter gain has resolution of better than 0.05% to enable system scaling of the outputs to match the full-scale input of the external recording device. Overload detectors alert the user to over-voltage conditions. Precise, automated digital calibration of gain and DC offset are provided.

Other features of the PF-1UA-FA include a test input for injection of calibration signals into the channel input and a monitor output that allows for convenient monitoring of any channel output via a single BNC.

The system includes an Ethernet remote interface and is supplied with a Graphical User Interface (GUI) for local control.

Applications

- Spectral analysis
- Time domain wave analysis
- Transient shock measurements
- Anti-aliasing filters with programmable amplifiers
- Automatic test equipment
- Data acquisition
- Signal conditioning
- Production test equipment
- Reconstruction filters
- Industrial process control
- Programmable band-pass filters

Salient Features

Number of Channels:

- 16 (PF-1UA-16FA)
- 8 (PF-1UA-8FA)

Input Connectors:

- Individual isolated BNC's at front panel

Output Connectors:

- Individual BNC's at rear panel

Inputs:

- Balanced differential with programmable AC/DC coupling

Zero Suppress:

- Programmable DC voltage is inserted at channel input

Pre-Filter Gain:

- x1 to x512 in x2 steps with input overload detection

Post-Filter Gain:

- x0.25 to x16 with 0.05% resolution

Filters:

- Choice of 4 or 8-pole low-pass filters or 8-pole band-pass filters

Cutoff Frequency:

- Pulse Mode programmable from 1 Hz to 102.3 kHz
- Flat Mode programmable from 2 Hz to 204.6 kHz
- Wideband 500 kHz, typical

Outputs:

- DC coupled, single-ended

Test Support:

- Test input and monitor output busses

Physical:

- 1U high, standard 19-inch RETMA width, 19-inch depth

Input Power:

- 12 to 24 VDC external AC to DC power supply provided with unit

Control:

- Ethernet remote control
- Local control via supplied Window based Graphical User Interface (GUI)
- Store up to four setups in non-volatile RAM allowing pre-configured applications

PF-1UA-8FA 8-Channel Filter/Amplifier System

PF-1UA-FA Filter Characteristics

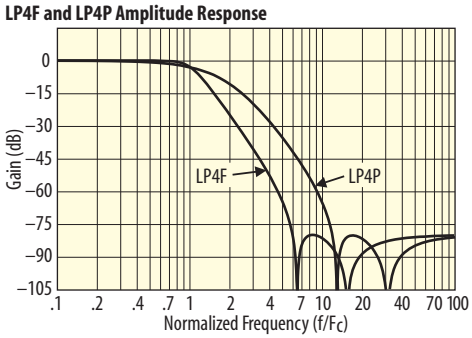
You want your analog data to come clean before digital conversion.

The PF-1UA-FA System has a variety of high performance filter characteristics available for HP, LP or BP Precision filtering.

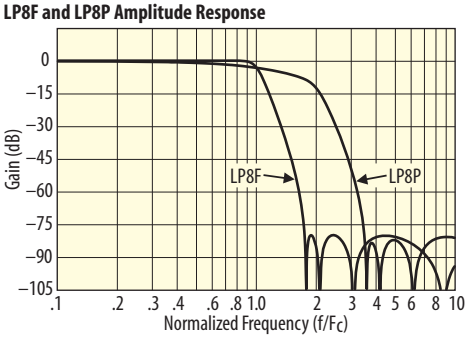
Flat/Pulse Low-Pass Filters

Our new choice of LP4FP 4-pole or LP8FP 8-pole flat/pulse low-pass filters provide the user with the versatility to address applications in either the time or frequency domain and are available on both the 8 and 16-channel systems.

LP4F and LP4P Amplitude Response



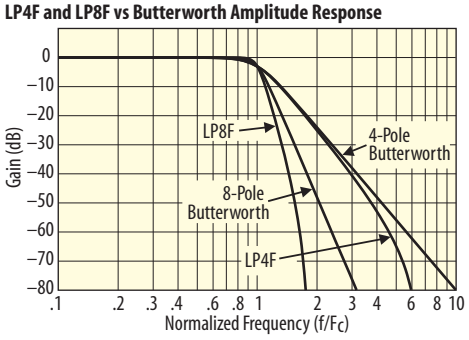
LP8F and LP8P Amplitude Response



Flat Mode Low-Pass Filters

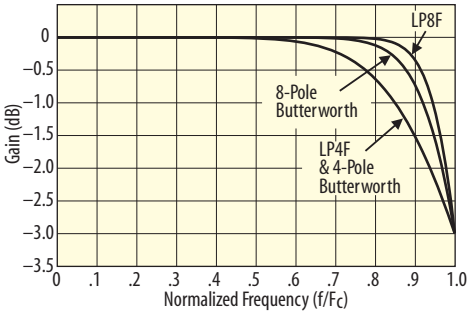
Precision LP4F and LP8F "flat" mode characteristics are specified to have outstanding passband flatness equivalent to the Butterworth yet deliver very sharp roll-off characteristics.

LP4F and LP8F vs Butterworth Amplitude Response



The LP4F and LP8F are a good choice as an anti-aliasing filter and for applications such as spectral analysis. The LP8F has zero passband ripple and over 100 dB/octave attenuation slope.

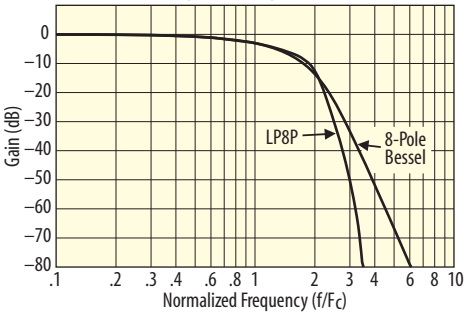
LP4F and LP8F vs Butterworth Passband Response



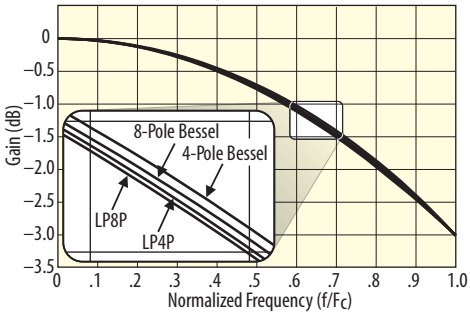
Pulse Mode Low-Pass Filters

For the time domain, there are the LP4P and LP8P "pulse" mode low-pass filters. These filters have excellent transient response and phase linearity making them ideal filters for time domain applications including transient (shock) measurements and time domain waveform analysis … all with roll-off characteristics superior to their Bessel filter counterparts.

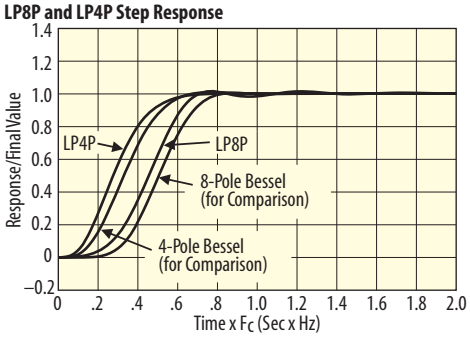
LP8P vs 8-Pole Bessel Amplitude Response



LP8P and LP4P Passband Response



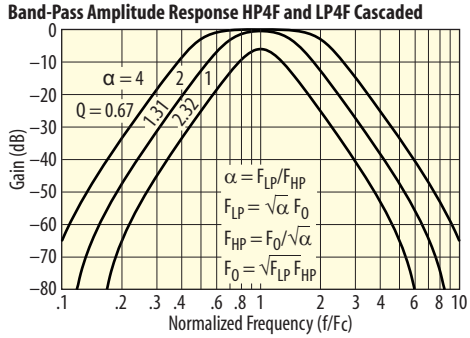
LP8P and LP4P Step Response



High-Pass and Band-Pass Filters

For high-pass filtering, we offer the HP4F 4-pole characteristics. For band-pass filtering, choose the HP4F/LP4FP band-pass characteristic to provide programmable bandwidth and center frequency filters.

Band-Pass Amplitude Response HP4F and LP4F Cascaded

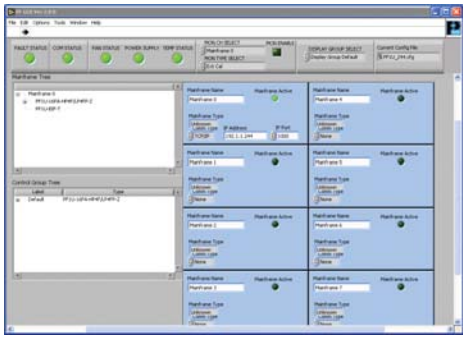


Operating the PF-1UA-FA

System Control

For local control, the PF-1UA-FA system is controlled via an Ethernet interface using the supplied spreadsheet-style GUI application running on a Windows PC. The GUI supports control of all channel and system features and allows for group control of channels. Up to eight PF-1UA-FA systems can be controlled by one GUI. System settings are restored on power-up or after a power fault. The settings are retained when the computer is disconnected even after a power-down and up. This allows the unit to be pre-configured for an application in which a computer may not be available for control.

The PF-1UA-FA system may be controlled remotely via an interactive command line interpreter that allows the PF-1UA-FA to function as a server on the network.



PF-GUI Start-Up Window

Controls, Indicators and Connectors

Front Panel

Analog Input Connectors:

PF-1UA-8FA – Eight coaxial BNC Input connectors provide input connection to channels 0 through 7.

PF-1UA-16FA – Sixteen coaxial BNC Input connectors provide input connection to channels 0 through 15.

Input Overload Indicators:

Overload LEDs, one above each channel input connector, indicate an input overload condition.

Test Input Connector:

The coaxial BNC Test Input Connector provides a means to connect an external test signal from a programmable function generator to the channel inputs without disconnecting input signal cables.

Warning Indicator:

The Warning LED indicates a system fault such as over temperature or a power voltage out of factory specifications.

Power Switch and Indicator:

The On/Off Power Switch is located on the front panel and includes a Power On LED indicating when the system is powered up.

Ethernet Connector:

The RJ45 Ethernet connector provides the control link for a host computer and includes a Status LED indicating the host is communicating with the system.

Rear Panel

Analog Output Connectors:

PF-1UA-8FA – Eight coaxial BNC Output connectors provide output connection to channels 0 through 7.

PF-1UA-16FA – Sixteen coaxial BNC Output connectors provide output connection to channels 0 through 15.

Power In Connector:

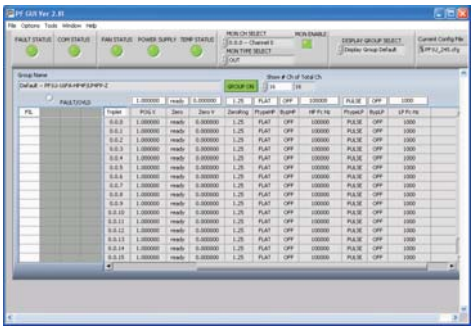
The Power In Connector provides a connection for an external DC power supply.

Chassis Ground and Signal Ground Posts:

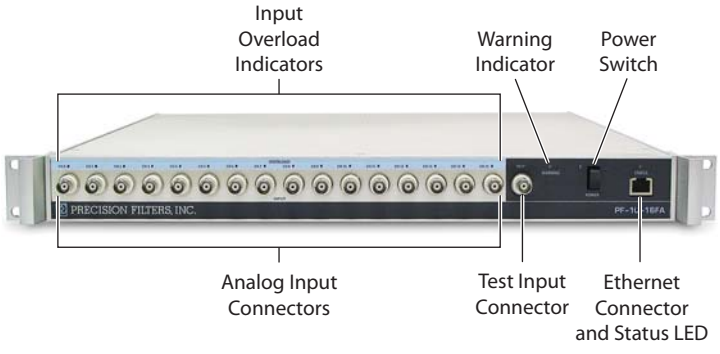
The Chassis Ground post and the Signal Ground post provide a means for coupling the chassis ground to the signal ground.

Monitor Output Connector:

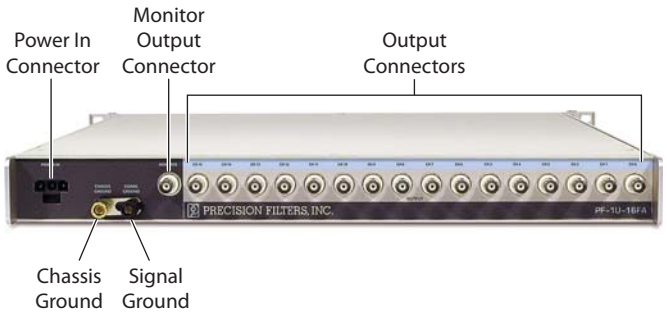
The coaxial BNC Monitor Output connector provides a means for viewing the output of a selected channel using a scope or other measurement device without disconnecting output signal cables.



PF-GUI Groups Window



PF-1UA-16FA Front Panel



PF-1UA-16FA Rear Panel

PF-1UA-FA Details and Specifications

PF-1UA-FA Filter/Amplifier System

The detailed description and specifications for the PF-1UA-FA are organized as follows in the sections below:

- System Model Number Structure
- Input Characteristics
- Amplifier Specifications
- Filter Type Characteristics
- Output Characteristics
- Power Requirements
- PF-1UA-FA General Characteristics
- Accessories
- Ordering Information

Input Characteristics

Type:
Balanced Differential w/ programmable AC/DC input coupling

Input Connector:
Individual BNC's at front panel

Input Impedance:
10 MΩ //100pF per side

Max Level:
(AC + DC + Common Mode)
±10 Vpk for f ≤ 200 kHz
±10 Vpk x (200 kHz/f) for f >200 kHz

Input Protection:
25 V continuous (power on)
60 Vpk transient (1 ms pulse, 50% duty cycle)

Offset Drift:
1 µV/°C, typical

Noise:
7 nV/√Hz at 1 kHz and pre-filter gain > 64, typical

AC Coupling Frequency:
0.25 Hz (–3.01 dB)

CMRR (DC Coupled):
86 dB, DC to 440 Hz and input gain > x8

CMRR (AC Coupled):
80 dB, 10 Hz to 440 Hz

Input Short:

Amplifier inputs may be programmed to ground to measure amplifier noise and DC offset.

Test Input:

A switch at the channel input allows for injection of external test signal via an external front panel BNC connector.

Zero Suppress:

(Standard) Precision programmable DC offset is injected at the channel input stage to suppress the DC operating voltage. Manual or automatic suppression modes are supported.

0.64 V Suppress Ranges:
±0.01 mV to ±10 mV in ±4.88 µV steps
±10.04 mV to ±80 mV in ±39 µV steps
±80.30 mV to ±0.64 V in ±312 µV steps

10.24 V Suppress Ranges
(Gain limited to x 256):
±0.08 mV to ±160 mV in ±78 µV steps
±160.6 mV to ±1.28 V in ±625 µV steps
±1.285 V to ±10.24 V in ±5 mV steps

Accuracy:
±0.25% of setting ±5 mV

Amplifier Specifications

Pre-Filter Gain:
x1 to x512 in x2 steps with overload detection (10.2 Vpk threshold)

Post-Filter Gain:
x0.25 to x16 with 0.05% resolution

DC Accuracy:
0.2% after auto-adjust at any gain setting

Temperature Coefficient:
±0.008% /°C

DC Linearity:
±0.01% re: Fullscale, relative to best straight line

Frequency Response:
DC to 200 kHz; 0 dB ±0.1%;
–3 dB typical at 500 kHz

PF-1UA-FA System Model Number

The PF-1UA-FA System model number describes the configuration of the system, including the number of channels, the filter characteristic of the low-pass and high-pass filters and the programmable zero suppress option (standard).

PF-1UA-??FA-<LP4FP|LP8FP|HP4F/LP4FP>-<Z>

- Zero Suppress (Standard)
- Filter Specification:
  - 4-pole low-pass (LP4FP)
  - 8-pole low-pass (LP8FP)
  - 8-pole band-pass (HP4F/LP4FP)
- 8FA 8-Channel Filter/Amplifier
- 16FA 16-Channel Filter/Amplifier

PF-1UA-FA Details and Specifications

PF-1UA-FA Filter Type Characteristics

Option LP4FP:

4-pole, 4-zero low-pass filter. Programmable for maximally flat pass-band (LP4F) or linear phase with optimized pulse response (LP4P).

Option LP8FP:

8-pole, 8-zero low-pass filter. Programmable for maximally flat pass-band (LP8F) or linear phase with optimized pulse response (LP8P).

Option HP4F/LP4FP:

8-pole, 8-zero band-pass filter. Flat HP4F 4-pole, 4-zero high-pass filter cascaded with a 4-pole, 4-zero low-pass filter. Low-pass filter programmable for maximally flat pass-band (LP4F) or linear phase with optimized pulse response (LP4P).

Cutoff Frequencies:

Flat Mode: LP4F, LP8F, HP4F

2 Hz to 2.046 kHz in 2 Hz steps
2.2 kHz to 204.6 kHz in 200 Hz steps

Pulse Mode: LP4P, LP8P

1 Hz to 1.023 kHz in 1 Hz steps
1.1 kHz to 102.3 kHz in 100 Hz steps

LP4F, LP4P, LP8F, LP8P:

Amplitude Accuracy:

±0.1 dB max, DC to 0.8 Fc
±0.2 dB max, 0.8 Fc to Fc

Amplitude Match:

±0.1 dB max, DC to 0.8 Fc
±0.2 dB max, 0.8 Fc to Fc

Phase Match:

±1° max, DC to 0.8 Fc
±2° max, 0.8 Fc to Fc

HP4F:

Amplitude Accuracy:

±0.1 dB max, 1.2 Fc to 204.6 kHz
±0.2 dB max, Fc to 1.2 Fc

Amplitude Match:

±0.1 dB max, 1.2 Fc to 204.6 kHz
±0.2 dB max, Fc to 1.2 Fc

Phase Match:

±1° max, 1.2 Fc to 204.6 kHz
±2° max, Fc to 1.2 Fc

Bypass:

Bypasses filter but not amplifier stages. Each filter may be independently bypassed for the HP4F/LP4FP band-pass filter.

Bypass Bandwidth:

500 kHz, typical

Specification	LP4F Maximally Flat Low-Pass Filter	LP4P Constant Time Delay Low-Pass Filter	LP8F Maximally Flat Low-Pass Filter	LP8P Constant Time Delay Low-Pass Filter	HP4F Maximally Flat High-Pass Filter
Cutoff Frequency Amplitude	–3.01 dB	–3.01 dB	–3.01 dB	–3.01 dB	–3.01 dB
DC Gain	0.00 dB	0.00 dB	0.00 dB	0.00 dB	–80 dB
Pass-Band Ripple	0.00 dB	0.00 dB	0.00 dB	0.00 dB	0.00 dB
Stop-Band Frequency	5.9465 Fc	11.863 Fc	1.7479 Fc	3.4688 Fc	0.1682 Fc
Cutoff Frequency Phase	–180.0 deg	–101.5 deg	–360 deg	–161.9 deg	180 deg
Phase Distortion (DC to Fc)	< 31.8 deg	<3.7 deg	<102 deg	<0.05 deg	–
Zero Frequency Group Delay	0.4117/Fc	0.2920/Fc	0.7197/Fc	0.4496/Fc	–
Percent Overshoot	11.1%	0.5%	18.9%	1.1%	–
1% Settling Time	1.65/Fc	0.66/Fc	4.03/Fc	1.25/Fc	1.86/Fc
0.1% Settling Time	2.72/Fc	0.77/Fc	7.02/Fc	2.25/Fc	2.92/Fc
–0.1 dB Frequency	0.6348 Fc	0.1816 Fc	0.8538 Fc	0.1800 Fc	1.5753 Fc
–1 dB Frequency	0.8487 Fc	0.5742 Fc	0.9437 Fc	0.5685 Fc	1.1783 Fc
–2 dB Frequency	0.9370 Fc	0.8129 Fc	0.9772 Fc	0.8087 Fc	1.0672 Fc
–3.01 dB Frequency	1.0000 Fc	1.0000 Fc	1.0000 Fc	1.0000 Fc	1.0000 Fc
–20 dB Frequency	1.7412 Fc	3.0248 Fc	1.2149 Fc	2.2342 Fc	0.5743 Fc
–40 dB Frequency	2.9555 Fc	5.6932 Fc	1.4443 Fc	2.7556 Fc	0.3384 Fc
–60 dB Frequency	4.5986 Fc	9.0980 Fc	1.6391 Fc	3.2016 Fc	0.2175 Fc
–80 dB Frequency	5.9465 Fc	11.8629 Fc	1.7479 Fc	3.4688 Fc	0.1682 Fc

PF-1UA-FA Details and Specifications

Output Characteristics

Type:
DC coupled, single ended output

Output Connector:
Individual BNC's at rear panel

Impedance:
10 Ω // 100 pF

Max Output:
±10 Vpk, ±10 mA pk

Offset:
<5 mV after auto-adjust at any gain setting

Offset Drift:
1 µV/°C, RTI + 150 µV/°C RTO

Noise:
2.8 µV rms RTI + 60 µV rms RTO 3 Hz to 100 kHz

Crosstalk:
–90 dB, DC to 100 kHz

Output Monitor:

A switch at the output of each channel allows for multiplexed connection to the chassis output monitor bus BNC connector for viewing the channel output with an external device.

Power Requirements

Power is supplied to the PF-1UA-FA from either the external PF-1U-ACDC1-120W, included with each system, or a direct power source. The input power supply requirements are 12 VDC to 24 VDC, 75 W typical, and is applied at the rear panel POWER IN connector. Power supply mating connectors and pigtail mating connectors are available for custom applications. See Accessories on the last page for description and part numbers.

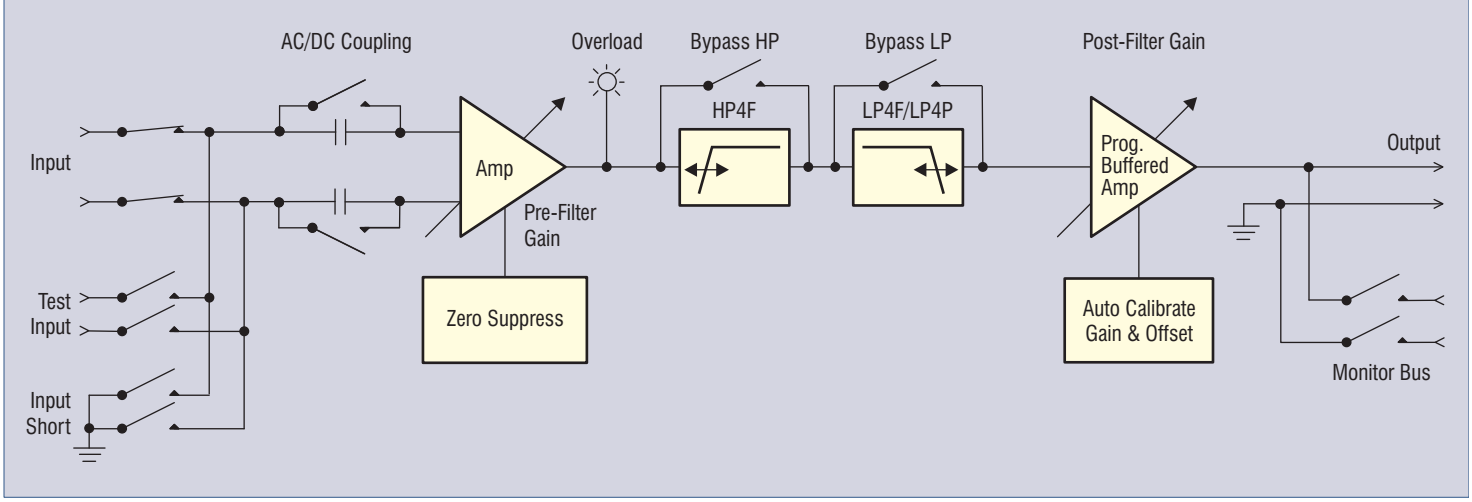
PF-1U-ACDC1 External Power Supply

The compact PF-1U-ACDC1-120W AC to DC external power supply features a thermostatically controlled cooling fan and carries the CE/UL listing marks. One PF-1U-ACDC1-120W is supplied with each PF-1UA system.

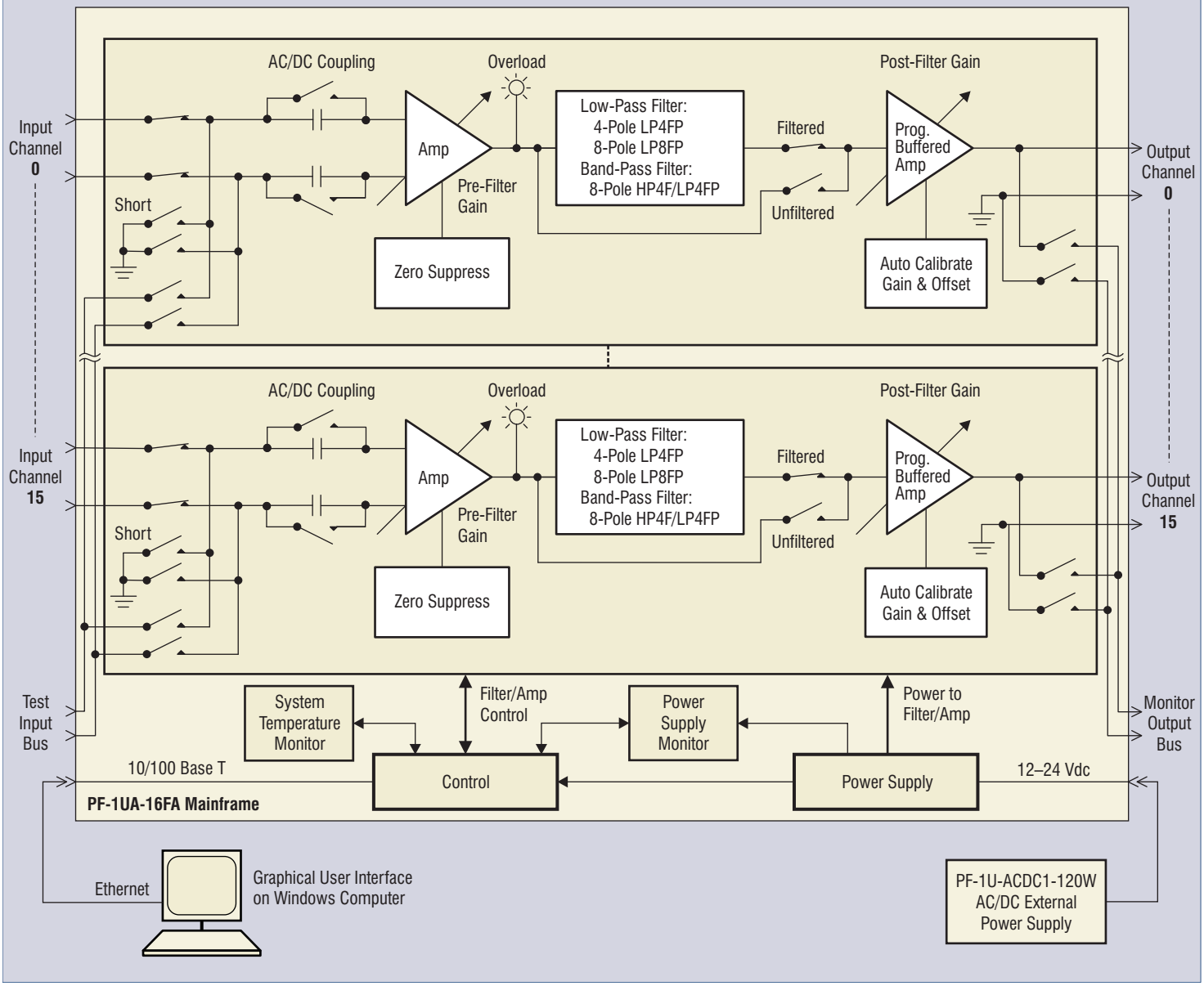
Input Voltage, Frequency
100-240 VAC, 47 to 63 Hz

Current
3.2 amp, 100-120 VAC,
2 amp, 220-240 VAC

PF-1UA-?FA HP4F/LP4FP-Z Band-pass Filter Channel Block Diagram



PF-1UA-16FA System Block Diagram



PF-1UA-FA Details and Specifications

PRECISION FILTERS, INC.

PF-1UA-FA General Characteristics

PF-1UA-8FA 8-Channel Filter/Amplifier

Size :
19″ x 19″ x 1U (1.75″) WDH

Weight:
10 lb. 2 oz. (with rack mount)

PF-1UA-16FA 16-Channel Filter/Amplifier

Size :
19″ x 19″ x 1U (1.75″) WDH

Weight:
11 lb. 6 oz. (with rack mount)

Operating Temp:
0 to 40°C

Storage Temp:
–25 to 85°C

Power Supply

Input:
12 to 24 VDC provided by supplied external 120W AC/DC power supply

Power Consumption:
75 W, typical

PF-1UA-FA External Supply

Model Number:
PF-1U-ACDC-120W CE/UL Mark

Weight:
2 lb. 8 oz.

Input Power:
110 to 240 VAC, 47-63 Hz

Accessories

Mounting

1U-RM 19-inch Rack Mount Kit:
Rack Mount Kit provides standard 1U height RETMA rack installation (included with system)

PF-1U Rubber Feet Kit:
The PF-1U Rubber Feet Kit provides non-skid feet for desk or table top installation (included with system)

Power Supply

PF-1U-ACDC1-120W:
AC to DC external 120W power supply 110 to 240 VAC, 47-63 Hz with mating connector; CE/UL approved (included with system)

Power Supply Mating Connectors

For alternative power sources, two DC mating connectors are available.

Power Supply Mating Connector:
Three pin mating connector with locking tab (A10551G1)

Power Supply Pigtail Mating Connector:
Pre-wired three pin mating connector with locking tab (A10551G2)

PF-1UA-FA System Model Number

The PF-1UA-FA System model number describes the configuration of the system, including the number of channels, the filter characteristic of the low-pass and high-pass filters and the programmable zero suppress option (standard).

PF-1UA-??FA-<LP4FP|LP8FP|HP4F/LP4FP>-<Z>

- Zero Suppress (Standard)
- Filter Specification:
  - 4-pole low-pass (LP4FP)
  - 8-pole low-pass (LP8FP)
  - 8-pole band-pass (HP4F/LP4FP)
- 8FA 8-Channel Filter/Amplifier
- 16FA 16-Channel Filter/Amplifier

Precision Product Solutions

For over 30 years Precision Filters has been a global provider of instrumentation for test measurements. You can rely on a single source for signal conditioning and switching—*a complete range of instrumentation*—products optimized to work together to provide high performance at reasonable cost.

Precision Products

28000 Analog Signal Conditioning System

The new standard for the world's most discriminating test labs.

The 28000 System makes it easy to manage a test with up to 256 channels of fully programmable transducer conditioning. Choose a mix of bridge, charge, IEPE w/TEDS, voltage (filter/amplifier), strain, thermocouple, RTD/potentiometer, frequency, or other transducers.

464*k*B High Density Programmable Switch Matrix

Computer controlled analog signal switching replaces tedious manual patch panels.

The 464*k*B is a reliable solid-state switch matrix system that provides computer-controlled connection between 256 inputs and 256 outputs, all in a single mainframe. Save time and reduce errors on test system setup. Download switch configurations from the host computer over the network. Built-in self-test with fault diagnostics.

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P8433 Rev -