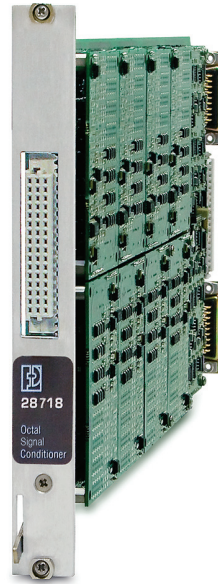




Precision 28718 Octal-Channel Signal Conditioner for Voltage, RTD, and 4-20 mA Sensors

28718 Octal-Channel Signal Conditioner offers eight channels of universal signal conditioning for RTDs, silicon diodes, 4-20 mA output sensors, or any voltage output device up to 60 V. The balanced differential input, low-noise gain stages, and programmable 4-pole filter remove aliases and maximize dynamic range for an attached A/D converter system. The dual mode-excitation supply provides either +24 V to power external pre-amplifiers, or a precision 100 μ A constant current source to excite RTDs or silicon diodes.



28718

Applications

- RTD conditioning
- Silicone diode conditioning
- Internally amplified pressure or accelerometer conditioning
- Measure 4-20 mA sensors
- Low-level AC or DC amplifier (< 1 mV to 10 V inputs)
- High-level inputs to 60 V
- Anti-aliasing filter/amplifier

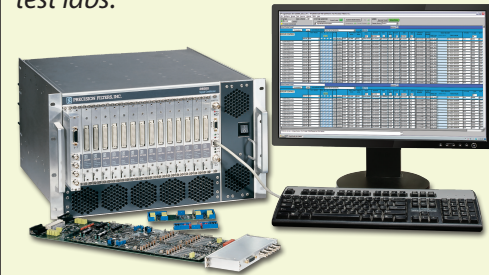
Precision 28718 Features

- Eight channels per card, 128 channels per 28016 chassis
- Dual-mode excitation supply: +24 V or 100 μ A precision constant current
- ± 10 V, ± 60 V, or 4-20 mA input modes
- Up to 30 kHz filtered bandwidth or 190 kHz wideband
- 5-wire plus shield input interface
- DC-coupled amplifier with programmable gain of x1, x2, x5, x10, x20, x50, x100, x200, x500, and x1000 with 0.1% accuracy
- 4-pole low-pass filters with programmable pulse/flat characteristics in two cutoff frequency ranges:
 - FX01: 100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz
 - FX02: 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz
- 2° phase match between any channels
- Pre-filter overload detection
- Two rear-panel 26-pin high-density D input connectors with machined gold-plated pins
- Outputs on 26-pin D connector that is integral to the 28000 system M5 chassis
- Auxiliary front panel output connection to support multiple buffered outputs or RMS to DC using plug-on adapter modules

Overview

28000 Analog Signal Conditioning System

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



The Precision 28000 signal conditioning system provides all the flexibility you need to manage your test measurements.

The Precision 28000 makes it easy to manage a test, with hundreds of channels and a mix of transducers. Choose charge, IEPE w/TEDS, voltage (filter amplifier), strain, thermocouple, RTD, potentiometer, current, frequency, or other transducers.

The built-in test hardware and software (optional) provide quick Go/No-Go tests, which can be run before each test, and rigorous Factory Acceptance Tests to assure you that the 28000 meets your most stringent requirements for critical applications. It won't be long before these tests earn a permanent place in your maintenance routine. And since they are traceable to NIST, they eliminate the need for off-site calibration.

In every phase of your tests—record keeping, installation, design, setup, operation, maintenance, and upgrading—the Precision 28000 offers ways to help you save time and money over the life of the system.

28000 System Features

- Graphical user interface (GUI) and Ethernet network interface for system control
- Intelligent gain and system scaling algorithms
- Test input and output monitor busses
- Go/No-Go test with diagnostics to be used before tests
- Rigorous Factory Acceptance Test for maintenance
- Field-swappable AC power supplies
- Built-in temperature and power supply monitoring with alarms

28718 Details and Specifications

28718 Conditioner Cards

The detailed description and specifications for the 28718 are organized in the following sections:

- Sensor Wiring
- Excitation Supply
- Input Characteristics and Options
- Amplifier Characteristics
- Test Modes
- Filter Type Characteristics
- Output Characteristics
- General Card Characteristics
- Accessories
- Ordering Information

Sensor Wiring

Input Connector:

26-pin D-shell (2 ea.)

Input Wires:

24 V EXC (1)
100 μ A EXC (1)
EXC Return (1)
 \pm SIGNAL (2)
SHIELD (1)

28718 Excitation Supply

24 VDC Sensor Excitation:

Accuracy:

\pm 5% of setting

Current:

40 mA

Short Circuit Protection:

Output current limited to 50 mA. Current limit status continuously monitored and indicated on the GUI panel or remote interface.

100 μ A Constant Current Sensor

Excitation:

Type:

Single-ended, 2-, 3-, or 4-wire modes supported via wiring to input connector

Level:

100 μ A \pm 0.035%

Drift:

10 ppm/ $^{\circ}$ C

Compliance:

10 V ($R_{load} = 100$ k Ω max)

Spectral Noise:

1.2 pA/ $\sqrt{\text{Hz}}$ @ 1 kHz
0.1-10 Hz Pk-Pk Noise: 400 pA

28718 Input Characteristics

Type:

DC coupled, balanced differential input w/ shield

Input Operating Modes:

\pm 10 V, \pm 60 V, 4-20 mA (500 Ω sense)

\pm 10 V Mode:

Input Impedance:

10 M Ω //50 pF per side

Input Protection:

60 VDC continuous

Common-Mode Level:

\pm 10 V

CMRR:

100 dB, DC to 440 Hz, input gain > x10

Max Level at Diff Amp Input:

\pm 10 Vpk for $f \leq 100$ kHz; \pm 10 Vpk x (100 kHz/f) for $f > 100$ kHz

DC Offset Drift:

1 μ V/ $^{\circ}$ C, typical

Noise:

15 nV/ $\sqrt{\text{Hz}}$ at 1 kHz and gain ≥ 100 (max)

\pm 60 V Mode:

Fixed Input Attenuator:

1/10, \pm 0.2% DC accuracy

Input Impedance:

100 k Ω per side

Input Protection:

60 VDC continuous

Common-Mode Level:

\pm 60 V

CMRR:

50 dB, DC to 440 Hz

Max Input:

\pm 60 Vpk for $f \leq 100$ kHz; \pm 60 Vpk x (100 kHz/f) for $f > 100$ kHz

4-20 mA Sense Mode:

Resistance:

500 Ω , 0.035% sense resistor

Total Input Impedance:

500 Ω

Voltage on Input Terminals:

Input current (4-20 mA) x 500 Ω

Drift:

17 μ V/ $^{\circ}$ C, typical

28718 Programmable Features

- Excitation type (24 VDC or 100 μ A constant current)
- Test Modes: Amp Short, Voltage Substitution, Excitation Monitor (100 μ A mode), Excitation Load Resistance (100 μ A mode)
- Output Monitor
- Gain: x1, x2, x5, x10, x20, x50, x100, x200, x500, and x1000 with 0.1% accuracy
- Filter type: 4-pole pulse or flat
- Cutoff frequency:
FX01: 100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz
FX02: 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz
- Wideband (190 kHz) or filtered operation

28718 Graphical User Interface Display

All programmable features in addition to:

- Input wiring
- Overload status
- Filter Wizard
- Group Control

28718 Details and Specifications

28718 Amplifier Specifications

Gain Settings:

x1, x2, x5, x10, x20, x50, x100, x200, x500, and x1000

Overload Detection:

±10.2 Vpk threshold (pre-filter)

Overall Gain Accuracy:

0.1% (includes gain stages and filter; excludes attenuator accuracy)

28718 Mute Mode

In harsh test environments, a sensor or input cable can become faulty or intermittent during a critical test. With high-gain signal conditioning, this can be troublesome if large signal swings on input or output cabling cross-couple to other channels. The 28718 Mute control places the channel in a quiet operational state to minimize system noise in the event of a failed sensor. Mute mode is also useful to terminate unused channels in a safe and quiet state.

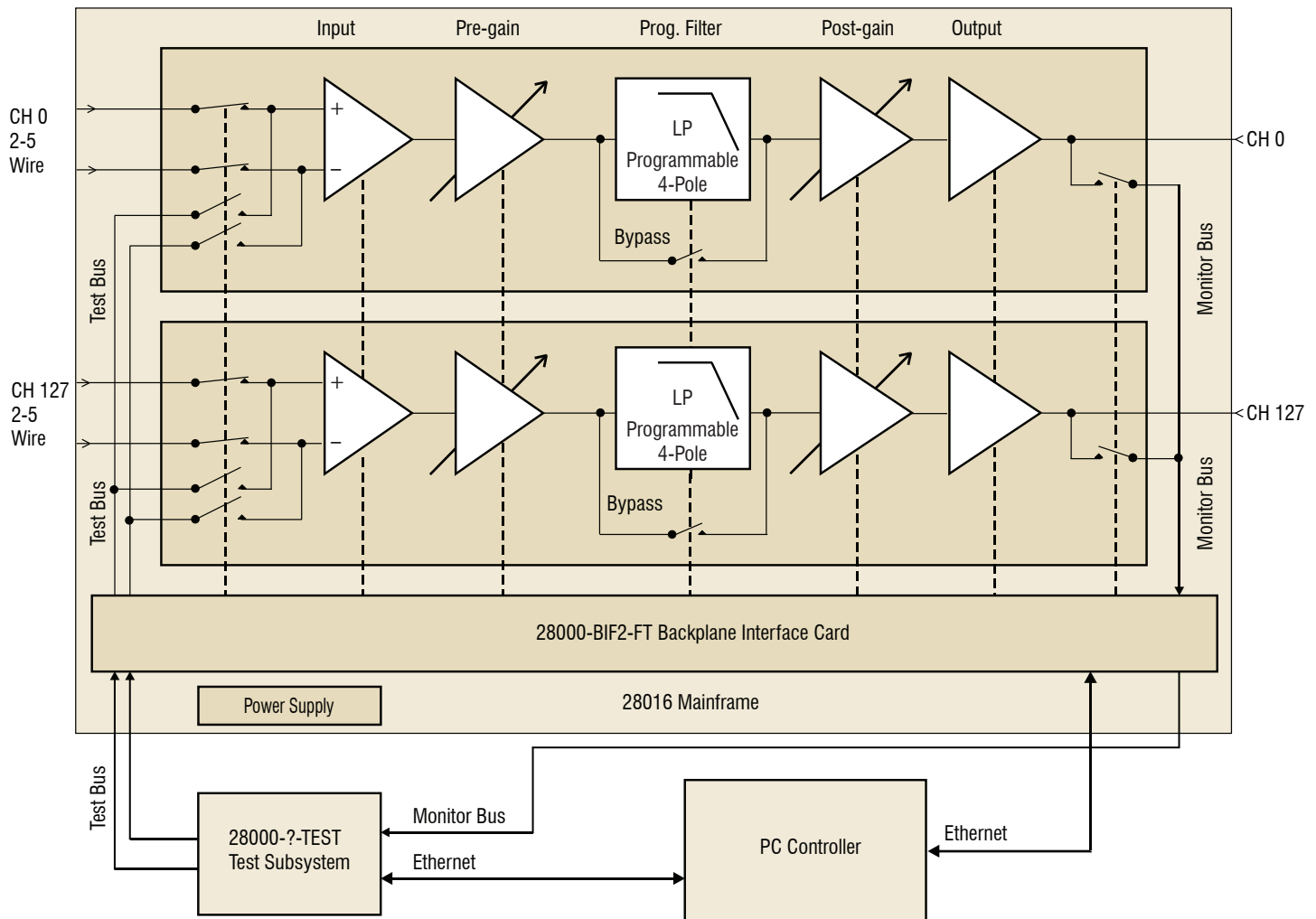
28718 Test Modes

Amplifier Short:

A switch at the amplifier input is utilized to ground the input stage for measurement of noise and DC offset.

Test Bus:

Test input allows for injection of a test signal. An external test signal or the 28000-?-TEST Test System may be connected at the rear panel. Refer to the 28000-?-TEST Test System specification for more information.



28000 System Block Diagram (Generic Card Model)

28718 Filter Characteristics

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

Flat/Pulse Low-Pass Filters

Our LP4FP 4-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 many 28000 card models.

Flat Mode Low-Pass Filters

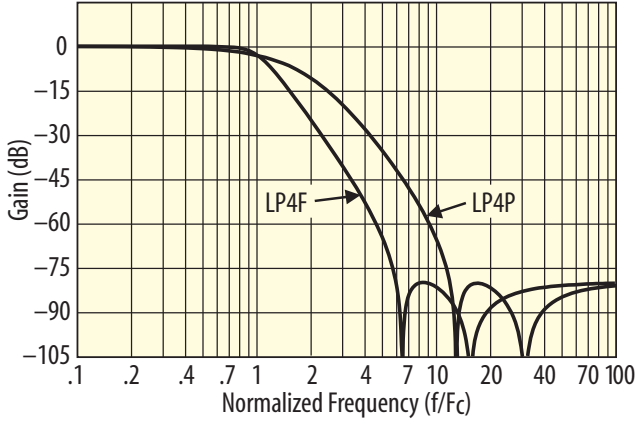
Precision LP4F "flat" mode characteristics are specified to have outstanding passband flatness equivalent to the Butterworth yet deliver very sharp roll-off characteristics.

The LP4F is a good choice as an anti-aliasing filter and for applications such as spectral analysis. The LP4F has zero passband ripple and roll-off superior to the Butterworth.

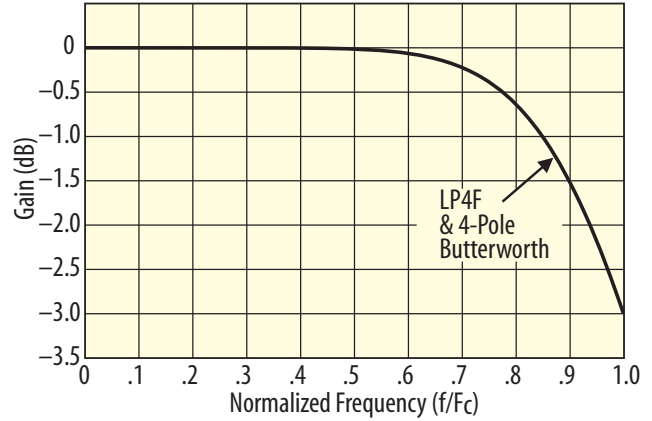
Pulse Mode Low-Pass Filters

For the time domain, program the 28718 low-pass filter to "pulse" mode. 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.

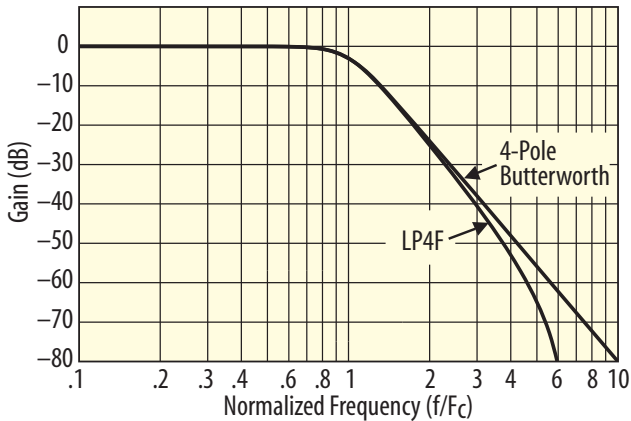
LP4F and LP4P Amplitude Response



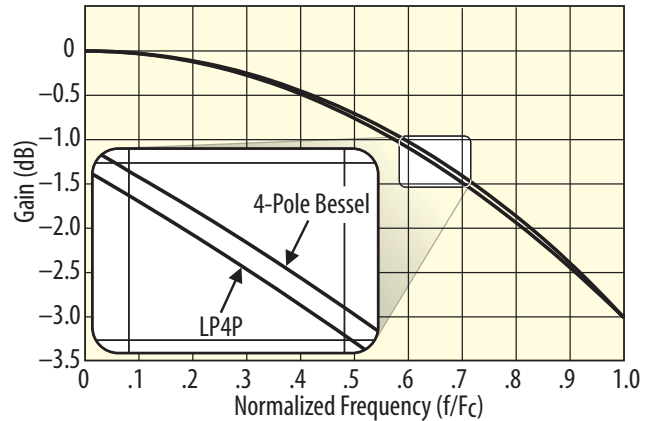
LP4F vs Butterworth Passband Response



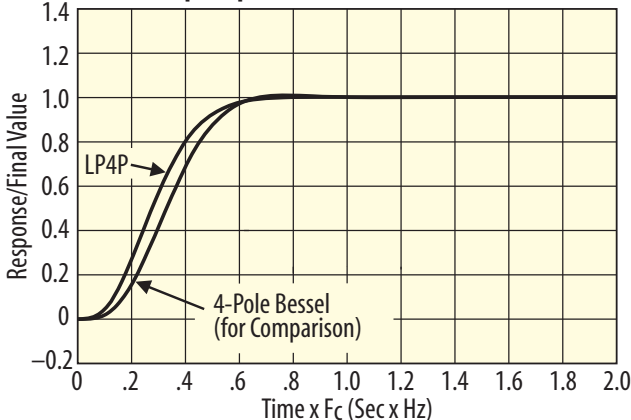
LP4F vs Butterworth Amplitude Response



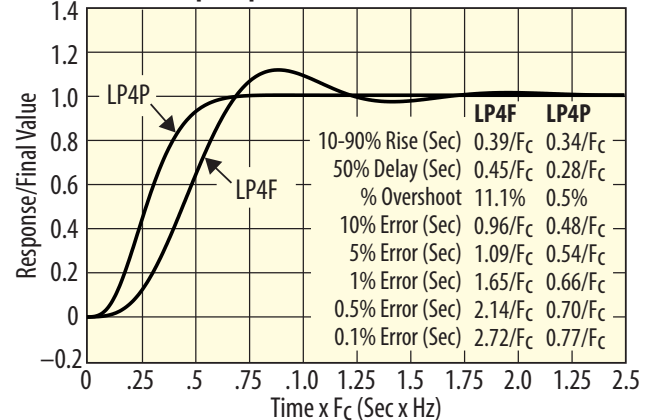
LP4P vs Bessel Passband Response



LP4P vs Bessel Step Response



LP4F and LP4P Step Response



28718 Filter Characteristics

28718 Filter Type Characteristics

Filter Type:

LP4FP: 4-pole, 4-zero low-pass filter.
 Programmable for maximally flat pass-band (LP4F) or linear phase with optimized pulse response (LP4P).

Cutoff Frequencies:

FX01: 100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz
 FX02: 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz

Passband Accuracy:

±0.1 dB, DC to $F_{-0.1dB}$
 ±0.15 dB to $F_{-0.5dB}$
 ±0.25 dB to $F_{-3.01dB}$

Filter Bypass:

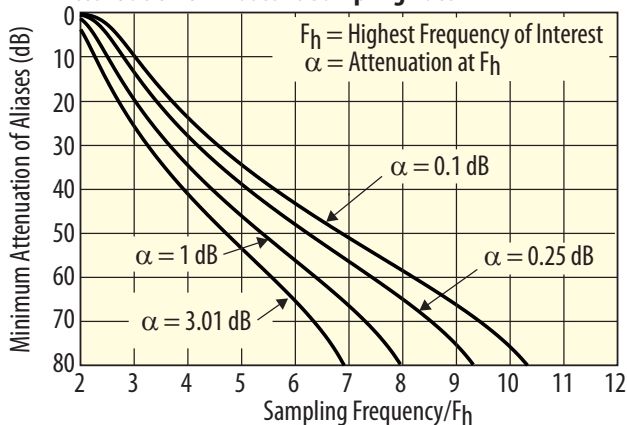
Bypasses filter but not amplifier stages.
 Bypass Bandwidth: 190 kHz, typical

Custom Filters:

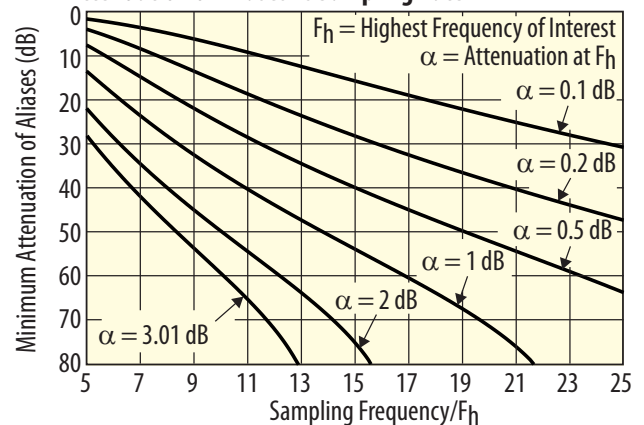
Other filter characteristics and cutoff frequencies are available. Please consult with factory for more information.

Specification	LP4F Maximally Flat Low-Pass Filter	LP4P Constant Time Delay Low-Pass Filter
Cutoff Frequency Amplitude	-3.01 dB	-3.01 dB
DC Gain	0.00 dB	0.00 dB
Pass-Band Ripple	0.00 dB	0.00 dB
Stop-Band Frequency	5.9465 F_c	11.863 F_c
Cutoff Frequency Phase	-180.0 deg	-101.5 deg
Phase Distortion (DC to F_c)	< 31.8 deg	< 3.7 deg
Zero Frequency Group Delay	0.4117/ F_c	0.2920/ F_c
Percent Overshoot	11.1%	0.5%
1% Settling Time	1.65/ F_c	0.66/ F_c
0.1% Settling Time	2.72/ F_c	0.77/ F_c
-0.1 dB Frequency	0.6348 F_c	0.1816 F_c
-1 dB Frequency	0.8487 F_c	0.5742 F_c
-2 dB Frequency	0.9370 F_c	0.8129 F_c
-3.01 dB Frequency	1.0000 F_c	1.0000 F_c
-20 dB Frequency	1.7412 F_c	3.0248 F_c
-40 dB Frequency	2.9555 F_c	5.6932 F_c
-60 dB Frequency	4.5986 F_c	9.0980 F_c
-80 dB Frequency	5.9465 F_c	11.8629 F_c

LP4F Attenuation of Aliases vs Sampling Rate



LP4P Attenuation of Aliases vs Sampling Rate



28718 Details and Specifications

28718 Output Characteristics

Type:

DC-coupled, single-ended output.
Programmable wideband (190 kHz)
or filtered

Impedance:

10 Ω//100 pF

Max Output:

±10 Vpk, ±4 mApk

Offset:

≤5 mV after auto-adjust at any gain
setting

Offset Drift:

1 μV/°C, RTI + 100 μV/°C RTO, typical (17
μV/°C RTO in 4-20 mA mode)

Noise:

5 μV rms RTI + 100 μV rms RTO, typical
3 Hz to 100 kHz

Output Protection:

Short circuit protection (excitation and
signal out)

Auto-Offset Adjust (Standard)

Auto-Offset:

Auto-offset automatically zeroes offset
at the channel output to less than 5 mV
at any gain setting. The auto-offset
cycle is initiated in the GUI. The offset
DAC settings are stored in non-volatile
memory on the card for every gain
setting. Changes in gain result in minimal
disruption of the channel.

Output Monitor (Standard)

Output Monitor:

A programmable switch located at the
output of each channel allows for mul-
tiplexed connection to the mainframe
output monitor bus. The output monitor
bus is available at a connector located
on the controller card at the rear of the
mainframe. The monitor function is used
by the 28000-? TEST Test System and is
available for viewing channel outputs
by the user.

General Characteristics

28718 Card Size:

6.63 x 17.5 x 0.75 inches

Card Weight:

1.4 lb. net

Temperature:

0 °C to 40 °C (operating);
-20 °C to 70 °C (storage)

Input Connectors:

The input connectors are integral to the
28718 card. Cutouts on the 28000 frames
allow the input connector to pass through
the backplane and to directly mate with the
input cables.

Two 26-pin high-density D connectors are
utilized for the eight inputs (4 inputs per
connector). Connectors have high quality
mached gold plated pins/sockets.

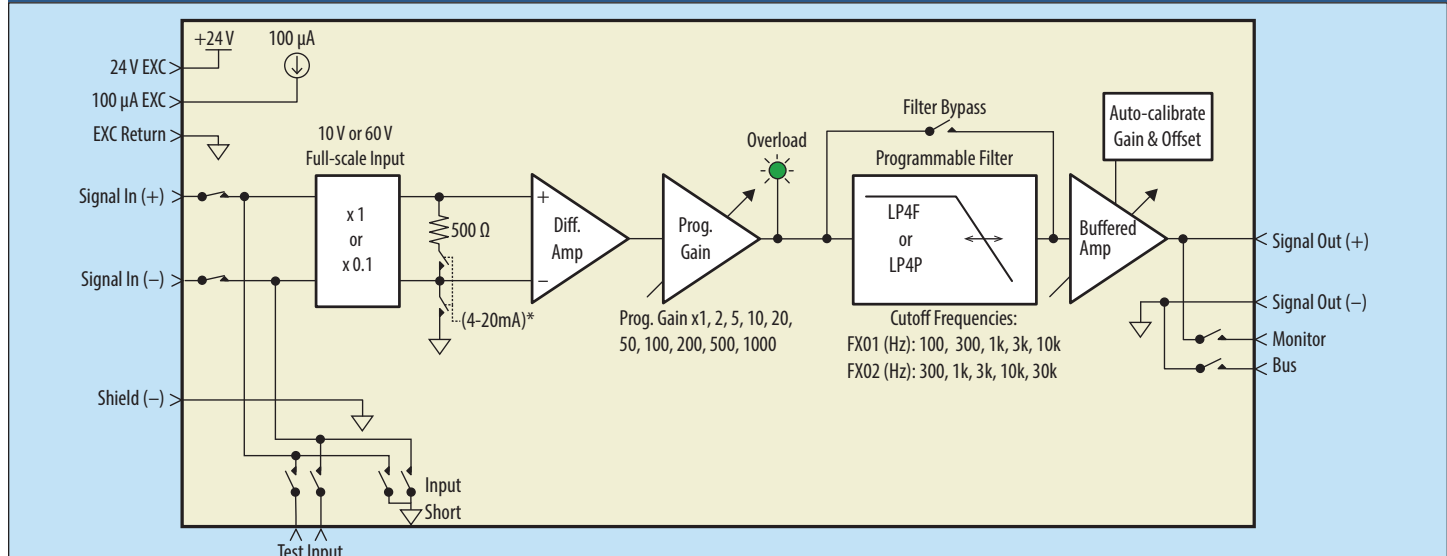
Output Mating Connectors

A summary of 28718 card compatibility with
Precision Filters chassis model numbers is
provided below:

**28016-M5, 28008-M3/M5, 28004-M3/M5
or 28002-M5:** Output connectors are integral
to the 28016-M5, 28008-M3/M5, 28004-M3/
M5 and 28002-M5 chassis rear panels. One
high-density 26-pin connector is provided
per slot to accommodate the eight
28718 outputs.

28016-M3: The 28718 card is not compatible
with the 28016-M3 chassis.

28718 Channel Block Diagram



Accessories

Mating Connectors

Precision Filters mating connectors accommodate up to 22-AWG wire and are supplied with high-quality metal backshells and gold plated screw machined contacts for high reliability connections and long service life.

CONN-IN-26D High-density 26-pin D-shell mating input connector with machined crimp pins and metal backshell with strain relief.

CONN-IN-26D-SC High-density 26-pin D-shell mating input connector with machined solder cup pins and metal backshell with strain relief.

CONN-OUT-26D High-density 26-pin D-shell mating output connector with machined crimp pins and metal backshell with strain relief.

CONN-OUT-26D-SC High-density 26-pin D-shell mating output connector with machined solder cup pins and metal backshell with strain relief.

Test Adapter

28718-TEST-ADAPTER supports FAT testing of the excitation supply and is used to test excitation accuracy under full load, current limit, and offset.

Output Adapters

Measurement systems often require multiple outputs per signal conditioning channel or special functions such as a DC output in proportion to the AC signal level. These outputs may be routed to control systems, tape backup systems, auxiliary data acquisition systems, scope bays, or other destinations.

28718 cards are fitted with front-panel connectors that accept Precision output adapter modules. Adapters plug on to the front of the signal conditioner card and are secured to the card by two screws.

BUFF-8CH/(2)26HD: Octal output buffer for 8-channel cards provides two buffered outputs per channel on 26-pin high-density D-type connectors.

28000-RMS/DC8: Output adapter for octal conditioner cards provides eight channels of RMS to DC conversion. Outputs are fully buffered and provided on a 26-pin high density D-type connector.

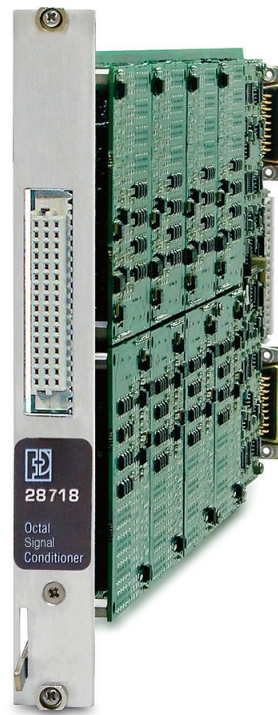
28718 Ordering Information

The 28718 card model number describes the configuration of the eight channels on the card. The model number identifies the filter range.

28718-<Filter Range>-LP4FP

— **FX01:** 100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz

— **FX02:** 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz



28718 with Front-panel Auxiliary Output Connector

Precision PF-1U-FA Multi-Channel Programmable Filter/Amplifier System



Exceptional desktop performance.

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, both offering a choice of either 4 or 8-pole low-pass filters with programmable gain.

High Density Programmable Switch Systems

Computer controlled analog signal switching replaces tedious manual patch panels.



Precision 4164 64x64 Switch Matrix System



Precision 464kC Switch Matrix System

Precision switch systems are reliable solid-state switch matrix systems, providing computer-controlled connection between input and output signals. Configure the 464kC with up to 256 inputs and 256 outputs, all in a single mainframe, or choose the compact 4164 system with 64 inputs and 64 outputs. 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.