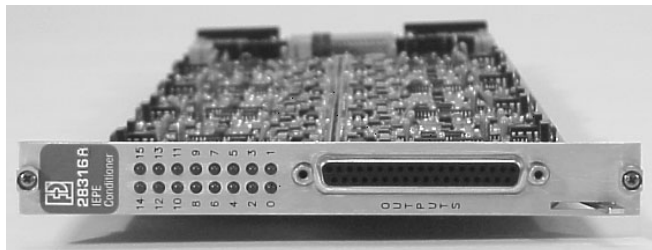


28316A 16-CHANNEL TEDS, IEPE ACCELEROMETER CONDITIONER

For the 28000 Signal Conditioning System



28316A Card

SYSTEM 28000 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
- Rigorous factory acceptance test for maintenance
- Field swappable AC or DC power supplies
- Built-in temperature and power supply monitoring with alarms
- Backward compatible with 27000 signal conditioning modules

28000 SIGNAL CONDITIONING SYSTEM

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 performance checks 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, set-up, operation, maintenance and upgrading—the Precision 28000 offers ways to help you save time and money over the life of the system.

PRECISION 28316A APPLICATIONS

- IEPE accelerometer conditioner
- Condition charge accels w/ remote charge converter (RCC)
- AC amplifier/filter

28316A FEATURES

- 16 channels per card; 256 channels per chassis
- TEDS (Transducer Electronic Data Sheet) compliant
- Gain x0.5 to x128 with 0.05% resolution
- Auto-ranging gain for best ADC dynamic range
- Programmable 4-pole filters: BE4, BU4, EL4, and TD4
- Programmable corner frequency settings
- Current settings of 0, 1, 2, 4, or 8 mA (programmable, selected per card)
- Sensor fault detector, open and short
- Sensor bias detector, in-range or out-of-range
- AC test current checks sensor, cable and signal conditioner health
- Overload detection
- Output monitor, selects any one of 256 outputs
- Test input for each channel
- Bank switch options switches the 256 output in banks of 16, 32, 64 or 128 channels to mate with various size data acquisition systems

28316A DESCRIPTION

The 28316A provides a mixed mode transducer interface in conformance with IEEE 1451.4 Smart Transducer Interface. The mixed mode interface supports IEPE (Integrated Electronic Piezo-Electric) sensors powered by current source and TEDS (Transducer Electronic Data Sheet) capable sensors. TEDS information such as manufacturer name, serial number, calibration data, etc. are readable by the system for use in system scaling, identification, bookkeeping, troubleshooting and other functions.

For IEPE sensors or remote charge preamps, a programmable current source with 26 V compliance is provided.

The 28316A provides a selection of 4-pole filter characteristics with -5% corner frequencies. Filter bypass allows amplified wide-band representation of input signals. Test inputs (voltage and current), along with output monitor, make the system ready to work with the 28000 test subsystem hardware to support Go/No-Go tests and Factory Acceptance tests. The Output Bank Switch option allows the 28316A to work with data acquisition systems with a smaller number of channels.

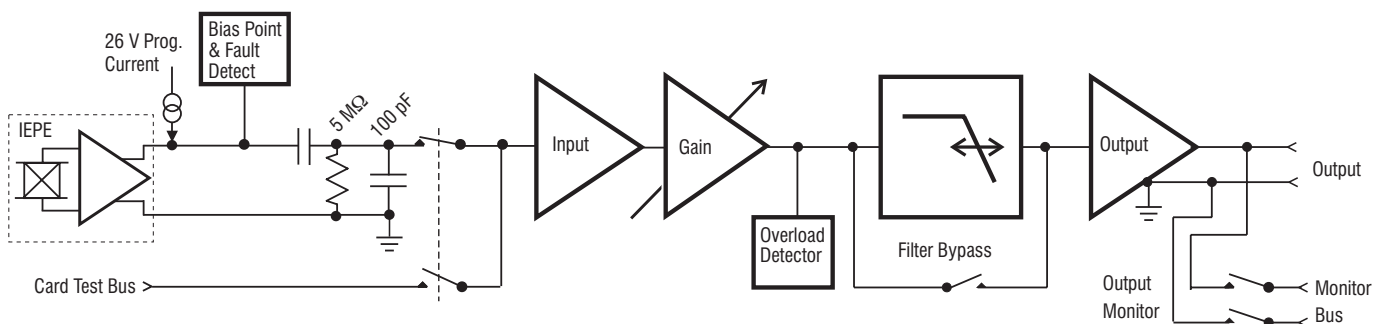
SENSOR AND CABLE HEALTH

Traditional Go/No-Go tests for an IEPE sensor allow insertion of a test signal to check the signal conditioning channel. It is also standard to provide open and short detection on the sensor cables.

The 28316A provides two additional tests to verify sensor health. The operating bias point of an IEPE sensor may change before failing, so measuring the bias point is a means of monitoring the sensor health. The 28316A provides a bias point detector with user specified limits. The second check is a measure of the output impedance of the sensor buffer which may shift suddenly with a damaged sensor. A small AC current is superimposed on the DC IEPE supply. The small AC voltage developed across the sensor's output stage can be used to infer the device's output impedance. Also, the small output voltage can be used to provide an end-to-end check of the sensor, cable and signal conditioning system.

28316A INPUT CHARACTERISTICS

- Transducer Types: IEPE transducer with and without TEDS and remote charge coupler (RCC)
- Constant Current Exc.: 0, 1, 2, 4, 8 mA \pm 0.5 mA
- Compliance Voltage: 26 VDC
- Sensor Bias Detector: The sensor bias detector measures the sensor bias and determines if it is within limits; Status is indicated by the front panel LED
- Max. Input Voltage: <22 V (AC+DC component)
- Input Impedance: 5 M Ω // 100 pF (includes current source output Z)
- Connectors: 2 ea. 26-pin D shell
- Mating Connector: 26-pin D female mating connector CONN-IN-26D (PF pn A6864G2) or CONN-IN-26D-SC (PF pn A6864G10)



28316A Channel Block Diagram

28316A OUTPUT CHARACTERISTICS

- Output Type: Single-ended with one side connected to ground
- Max. Output: \pm 10 Vpk into 2 k Ω
- DC Offset: \pm 15 mV maximum
- Protection: Short circuit protected
- Output Connector: One 37-pin D Shell
- Output Mating Conn.: 37-pin D male mating connector (CONN-OUT-37D, PF pn B9676G1)
- Impedance: 20 Ω //100 pF

28316A TRANSFER CHARACTERISTICS

- Gain: Programmable: x0.5 to x128 with 0.05% resolution
- Gain Accuracy: 0.5% at 1 kHz for all gains
- Gain Tempco: 50 ppm/ $^{\circ}$ C
- Frequency Response: \pm 5%, 1.3 Hz and 30 kHz in Bypass mode
 \pm 0.5%, 4.8 Hz to 10 kHz in Bypass Mode
-3 dB at 0.45 Hz and 100 kHz in Bypass
- Channel Match, 5 Hz to 40 kHz (Bypass On)
- Amplitude Match: 0.5% max, 0.1% typical
- Phase Match: 1.0 $^{\circ}$ max, 0.2 $^{\circ}$ typical
- Linearity: \pm 0.1% of fullscale, best fit at 1 kHz
- Crosstalk: -80 dB (Test conditions: signal in any one channel with gain set to x1, input shunted with 250 Ω and gain x128)
- Amplifier Noise: 500 μ V RTO at max gain and Fc
13 nV/ $\sqrt{\text{Hz}}$ RTI at 1 kHz
- IEPE Supply Noise: 65 nA RTI (10 kHz BW)
300 pA/ $\sqrt{\text{Hz}}$ at 1 kHz

TEST INPUT—OUTPUT MONITOR

Test Input (Std.): External test sources are buffered and applied to the test bus which can be accessed by all signal conditioner cards. All channels or any group of channels can select the test signal for calibration purposes.

Output Monitor (Std.): Output monitor circuit can select any one of the 256 channel outputs. The selected output signal is buffered and connected to a BNC at the front of the 28000B-BIF1-T backplane interface card.

SENSOR BIAS POINT DETECTOR—OVERLOAD DETECTOR

Sensor Bias Point

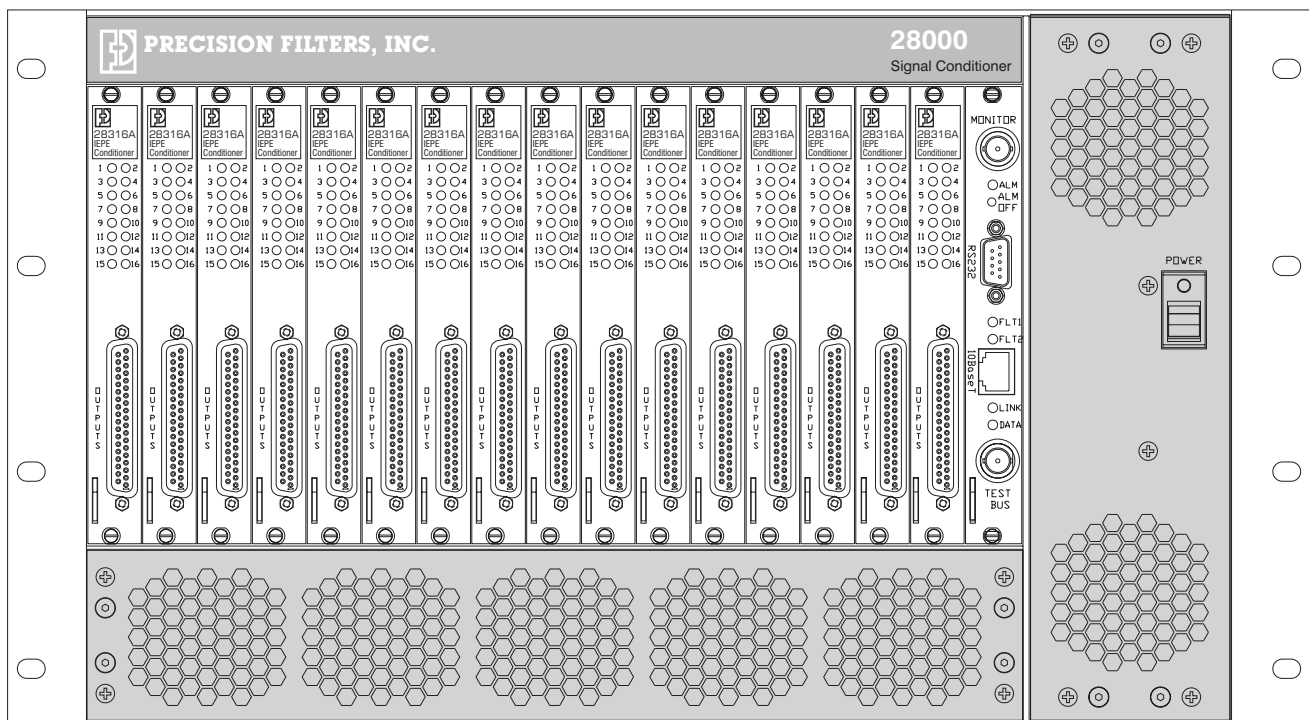
Detector (Std.): Sensor bias detector determines if the sensor bias voltage is within limits and indicates status on the front panel LED display and GUI panel.

Bias detector upper and lower thresholds are user specified to work with any IEPE sensor type.

Overload

Detector (Std.): An overload detector is provided for each channel and can be set for continuous or latched operation. The overload detector is located after all channel gain and before the filter so that it can detect large out-of-band signals which the filter might remove. The overload level is programmable from 0 to 10.23 Vpk.

The overloads are indicated on the 28316A front panel LED, GUI panel and logged in the system controller. The channel overload detector is also used in auto-ranging the channel gain.



28016-M3 Mainframe with 28316A Cards

28316A FILTER CHARACTERISTICS

4-Pole Filters

EL4	4-pole, 4-zero Elliptic low-pass filter.
TD4	4-pole, 4-zero constant time delay (linear phase) low-pass filter.
BU4	4-pole Butterworth low-pass characteristic.
BE4	4-pole Bessel low-pass characteristic.

CORNER FREQUENCY SETTINGS

Corner frequencies may be programmed to the settings indicated. The filter response is -5% (-0.445 dB) at the corner frequency (F-5%)

Fixed Frequency Models

FFF FFF denotes a fixed corner frequency in the range between 1 Hz and 50 kHz. Custom frequency ranges are available. Consult Factory.

Programmable Models

FX01	Programmable corner frequency settings of 100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, Bypass.
FX02	Programmable corner frequency settings of 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, Bypass.

For custom frequency ranges, consult factory.

28316A FILTER SPECIFICATIONS

Corner Frequency Amplitude:	-5%
Ampl. Accuracy (5 Hz to F-5%):	Filter char. ± 0.2 dB max
Ampl. Match (5 Hz to F-5%):	0.1 dB max, 0.02 dB typical
Phase Match (5 Hz to F-5%):	2° max, 0.5° typical
Filter Bypass:	Bypasses the filter but not the amplifier stages. Bypass bandwidth is 0.45 Hz to 100 kHz (-3 dB).

BANK SWITCH, OPTION B

Ideally, the 256-channel signal conditioning system would be mated with a 256-channel data acquisition system. However, the user may have a smaller DAS with 16, 32, 64, or 128 channels. The Bank Switch, Option B, provides a means of mating to a lower channel DAS:

- 16 banks of 16 channels for a 16-channel DAS
- 8 banks of 32 channels for a 32-channel DAS
- 4 banks of 64 channels for a 64-channel DAS
- 2 banks of 128 channels for a 128-channel DAS

The bank switch can be set manually for sixteen, eight, four or two banks. The bank switch outputs are buffered and brought out through the front panel 37-pin connector.

4-Pole Filter Selection Guide

	EL4	TD4	BU4	BE4
Filter Type	Low-pass	Low-pass	Low-pass	Low-pass
Function	Cauer	Bessel w/Zeroes	Butterworth	Bessel
Number of Poles, Zeroes	4p, 4z	4p, 4z	4p	4p
Pass-band Ripple (dB p-p)	0.1	n/a	n/a	n/a
-0.1 dB Frequency	0.942 F-5%	0.475 F-5%	0.826 F-5%	0.475 F-5%
-5% (-0.445 dB) Frequency	1.00 F-5%	1.00 F-5%	1.00 F-5%	1.00 F-5%
-3.01 dB Frequency	1.14 F-5%	2.51 F-5%	1.32 F-5%	2.51 F-5%
-20 dB Frequency	1.70 F-5%	6.34 F-5%	2.35 F-5%	6.39 F-5%
-40 dB Frequency	2.73 F-5%	11.3 F-5%	4.18 F-5%	11.9 F-5%
-60 dB Frequency	4.18 F-5%	17.7 F-5%	7.43 F-5%	21.3 F-5%
-80 dB Frequency	5.37 F-5%	23.0 F-5%	13.2 F-5%	38.0 F-5%
Stop-band Frequency	5.37 F-5%	23.0 F-5%	n/a	n/a
Stop-band Attenuation (dB)	80	80	n/a	n/a
Phase at F-5% (Degrees)	-180	-47.4	-127	-48.2
Phase Distortion at F-5% (Degrees)	-33.2	0.00	-13.3	0.00
Overshoot (%)	13.8	0.80	11.4	1.03
1% Settling Time (sec)	2.4/F-5%	0.25/F-5%	1.3/F-5%	0.26/F-5%
0.1% Settling Time (sec)	3.8/F-5%	0.46/F-5%	2.1/F-5%	0.40/F-5%

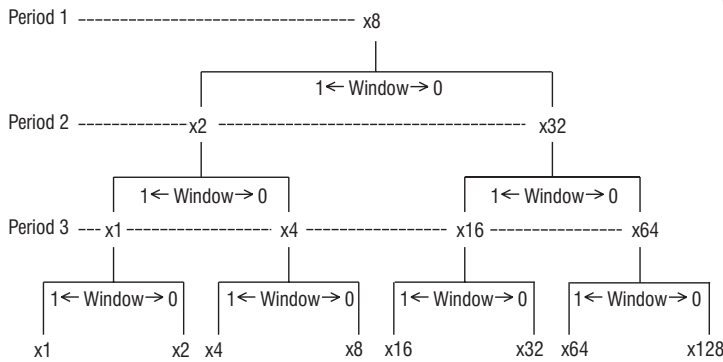
AUTO GAIN RANGING MODE

The auto gain ranging mode provides a means of setting up all 256 channels in three gain ranging periods, where the gain ranging period, T, is selected from 1/8 S to 128 S depending on the signal type (periodic or random) and the response of the structure (narrow-band or wide-band). When the auto-ranging is initiated, all channels are set to a gain of x8 and the output overload detector determines if the channel output exceeded the overload level at any time during the period. If the overload was exceeded the gain is set to x2 and if not the gain is set to x32. The overload detectors are reset and the overload detectors operate for another period (2nd period). At the end of three periods (3T) all 256 channels have been set to the operating gain. See Figure 2, Gain Ranging Decision Tree. The output overload detector is set to allow for crest factor and creep.

Gain Range Periods: 1/8 second to 128 second in binary steps

Output Overload

Detector Limit: 1 V to 10 V, adjustable



Auto Gain Ranging Decision Tree

28316A GO/NO-GO AND SENSOR TEST

(The 28316A Go/No-Go Test requires a 28000 Test Subsystem and the 28316A-TEST-WIN software.)

A sinewave source is selected for the channels under test. An accurate AC current level is superimposed on the IEPE sensors' DC current. This precise AC current flows through the sensor cable and output impedance at the sensor buffer which develops a signal at the output of the 28316A channel equal to:

$$e_0 = E \sin 2\pi f t (Z_s + R_c) A K$$

Where

E =	Test source amplitude in volts
f =	Test source frequency in Hz
Z _s =	Sensor output impedance in Ohms
R _c =	Cable resistance in Ohms
A =	Channel gain of the 28316A
K =	Conversion factor of voltage to current

The 28316A test software selects the test source amplitude and test source frequency appropriate to the filter type and settings and it uses the current settings of channel gain.



28316A Card Installed in 28016-M3 Frame

TEDS READER/WRITER, OPTION T

TEDS (Transducer Electronic Data Sheet) reader/writer option is available as Option T on the 28316 card. Option T provides the ability to read stored data on TEDS-compliant devices.

The separate TEDS reader/writer program 28000-TEDS-READER is required to support Option T. The reader/writer program is compatible with IEEE 1451.4 V0.9 transducers.

TEDS data is displayed as a spreadsheet that can be displayed and saved as a configuration file. 28316A system information such as channel number and a time stamp of the time that TEDS information for each channel was last read are provided.

Manufacturer's information read from the sensor including manufacturer name, model number, version number and version letter of the sensor together with sensor serial number and cal date are displayed in the table. Accelerometer Template Information in accordance with the IEEE standard is displayed as well as application dependent information. Sensor Sensitivity is used to set channel gains for EU scaling of 28316A outputs.

ORDERING INFORMATION

28316A-XXXX-YYY-?

L	Options:	B, T
	Filter Type:	BE4, BU4, EL4, or TD4
	Corner Frequency:	FFF, FX01, or FX02. See Corner Frequency Settings Section

28316A GENERAL CHARACTERISTICS

28316A 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)

ACCESSORIES

CONN-OUT-37D	37-pin mating output connector with crimp pins
CONN-OUT-37D-SC	37-pin mating output connector with solder cup pins
CB-DC37P/16BNM-L	Output cable: DC37P to 16-channel BNC male. L = length in feet.
CB-DC37P/16BNCF-BH-L	Output cable, DC37P to 16-channel BNC female output for bulkhead panel mount. L = length in feet.
PNL-32BNCBH-1U	Bulkhead panel mount. 1 U height
28316/28416-TEST-ADAPTER	Used to support FAT of 28316 card in conjunction with 28316A-TEST-WIN software and 28000-?-TEST
28000-TEDS-READER	TEDS Reader Software required to support Option T
28316A-TEST-WIN	Factory acceptance test (FAT) and Go/No-Go diagnostic test software for 28316A card.

The screenshot shows the 'PF Teds Reader' application window. It has a menu bar with 'File', 'TEDS', and 'Tools'. Below the menu bar is a 'Read All TEDS' button and an 'OK' button. On the right, it says 'Total TEDS Sensors Displayed 3'. The main area contains a table with the following data:

Ch Number	Time Last Read	Mfg	Model #	Ver #	Ver Let	S/N	Cal Date	Sen @ Fref	Fref	F hp Elec	Pol	Dir	Pos ID	User Data
0.02.08	10/30/03 17:15	Kistler	8772	50	A	194302	1/1/1998	1.046200E-2 V/(m/s²)	9.908354E+1 Hz	1.000226E+0 Hz	Negative	y	70	
0.02.09	10/30/03 17:15	PCB	333	7	M	14400	9/4/2003	1.000369E-2 V/(m/s²)	9.908354E+1 Hz	2.959190E-2 Hz	Positive		0	
0.02.10	10/30/03 17:15	Kistler	8632	10	C	191251	1/1/1998	4.981887E-2 V/(m/s²)	9.908354E+1 Hz	1.000226E+0 Hz	Positive	z	101	

TEDS Data Display Panel

