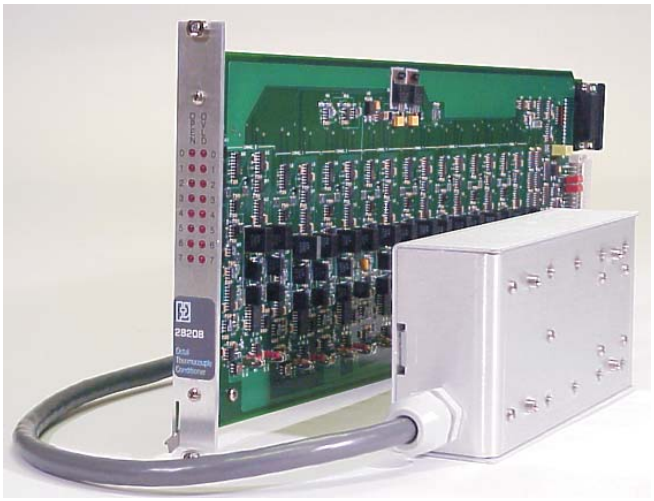
28208 OCTAL THERMOCOUPLE CONDITIONER

PRECISION FILTERS, INC.



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 28208 APPLICATIONS

- Static (DC) or dynamic (AC) temperature measurement
- Low-level DC or AC filter amplifier (<1 mV to 10 V inputs)

PRECISION 28208 FEATURES

- 8 channels per plug-in card
- 128 channels per 28016 chassis, 64 channels per 28008 chassis
- Low offset temp coefficient: 0.5 μV/°C max
- Open thermocouple detection
- Overload detection
- Programmable 3-pole Bessel low-pass filter (1, 10, 100 Hz and wideband)
- Precise cold junction compensation for type B, E, J, K, N, R, S and T thermocouples
- Automatic adjustment of DC offset
- Programmable gain: x1, 10, 100, 1000 with out-band reserve settings of x1, 10, or 100
- Remote isothermal block with digital temperature sensor

28208 DESCRIPTION

The 28208 is a member of the Precision 28000 family of signal conditioners. It provides eight channels of conditioning for thermocouples or other DC and AC voltage inputs.

The 28208 channel consists of a low-drift programmable differential pre-amplifier, a 3-pole programmable filter and a programmable post-amplifier. Overall gain may be programmed to x1, 10, 100 or 1000. A programmable reserve setting of x1, 10 or 100 is provided for protection against out of band signals. For example, a reserve setting of 100 with a gain of 1000 will program the pre-amplifier to 10 and the post amplifier to 100, allowing the filter to reject out of band energy before all of the gain is applied.

An open thermocouple condition or a channel overload condition is automatically detected and reported to the graphical user interface (GUI) software. Additionally, these fault conditions are indicated by 28208 front panel LEDs.

A 3-pole programmable Bessel filter is provided with cutoff frequency settings of 1, 10 and 100 Hz. The filter may be bypassed to provide wide-band operation.

A single-ended output stage is standard. The 28208 may be optionally fitted with a differential output.

Isothermal Block

The 28208-1-ITB Isothermal Block provides a reference junction for a single 28208 card (8-channels). Removable 3-pole terminal connectors allow for easy wiring of the thermocouples. The 28208-1-ITB has a 4-foot cable which mates directly with the 28208 input connector. Extension cables are available to locate the block remotely from the 28000 System. A removable cover provides a more stable environment while protecting the block.

For accurate cold junction compensation, the temperature of the isothermal block must be converted to the thermocouple thermoelectric voltage that would be generated if the junction were heated to the temperature that is measured. Thermocouple thermoelectric voltage has a non-linear relationship with temperature that is commonly referred to as "bowing". If a straight-line approximation to the thermoelectric voltage versus temperature were used, reference junction errors of over 1° C would result for a J-type thermocouple and over 2° for a T-type thermocouple.

A digital temperature sensor on the 28208-1-ITB provides an accurate reading of the block temperature. The block temperature is interrogated once every 10 seconds. To remove errors caused by the bowing, a microcomputer in the 28208 sets a cold junction compensation DAC by calculating the correction voltage for the measured temperature based on NIST coefficients[1]. Overall reference junction compensation accuracy is better than 0.6 degrees.

28208 INPUT CHARACTERISTICS

Type: 3-wire Differential (High, low, shield) DC coupled
Offset Temp Coef.: 0.5 μV/°C max.
Input Impedance: 1,000 MΩ//100 pF per side
Protection: ±40 V
Common Mode V: ±10 Vpk
Common Mode Rejection: 106 dB for input gain > x100 (DC - 100 Hz)
Max Input: ±10 Vpk to 2.5 kHz
±10 Vpk * (2.5 kHz/f), f > 2.5 kHz
Noise: (0.1 Hz to 100 Hz)

Gain	Reserve	Noise RTI (μV rms)
1	1	35
10	1	3.5
100	1	0.5
1000	1	0.3
10	10	12
100	10	1.3
1000	10	0.3
100	100	8
1000	100	1

Shield: Switch selectable to open, grounded or driven. Switch setting displayed on GUI.

28208 INPUT CHARACTERISTICS (Continued)

Input Test Modes

Open Thermocouple Detection (Standard):
Open thermocouple condition is indicated on GUI and by front panel LEDs

Input Short (Standard):
A switch at the amplifier input is used to ground the input stage to measure amplifier noise and DC offset. The ITB block correction voltage is set to 0 V when the input short switch is activated.

Test Input (Standard):
Test input allows for injection of a test signal. An external test signal or the 28000-2-TEST test subsystem may be connected at the rear panel. The ITB block correction voltage is set to 0 V when the test input switch is activated. Refer to the 28000-2-TEST specification for more information

10 VDC Cal: A switch at the input connects a precision 10 VDC calibration reference to the input amplifier.

10 VDC Ref Output: 10 V ± 0.2%
10 VDC Ref Temp Coef.: 20 ppm/°C

28208 TRANSFER CHARACTERISTICS

The 28208 amplifier consists of pre-filter gain and post-filter gain stages. The gain distribution is set by the programmed Reserve. DC accuracy is as follows:

Gain	Reserve	Pre-Filter Gain	Post-Filter Gain	Gain Tol (%)	Temp Coef. (ppm/°C)
1	1	1	1	0.1	30
10	1	10	1	0.1	30
100	1	100	1	0.1	30
1000	1	1000	1	0.1	30
10	10	1	10	0.1	30
100	10	10	10	0.1	30
1000	10	100	10	0.1	30
100	100	1	100	0.25	30
1000	100	10	100	0.25	30

DC Linearity: ±0.005% re fullscale, relative to best straight line

Freq. Response: Typical small signal –3 dB bandwidth 650 Hz for Gain/Reserve of 1000/1; 1 kHz for all other gain settings

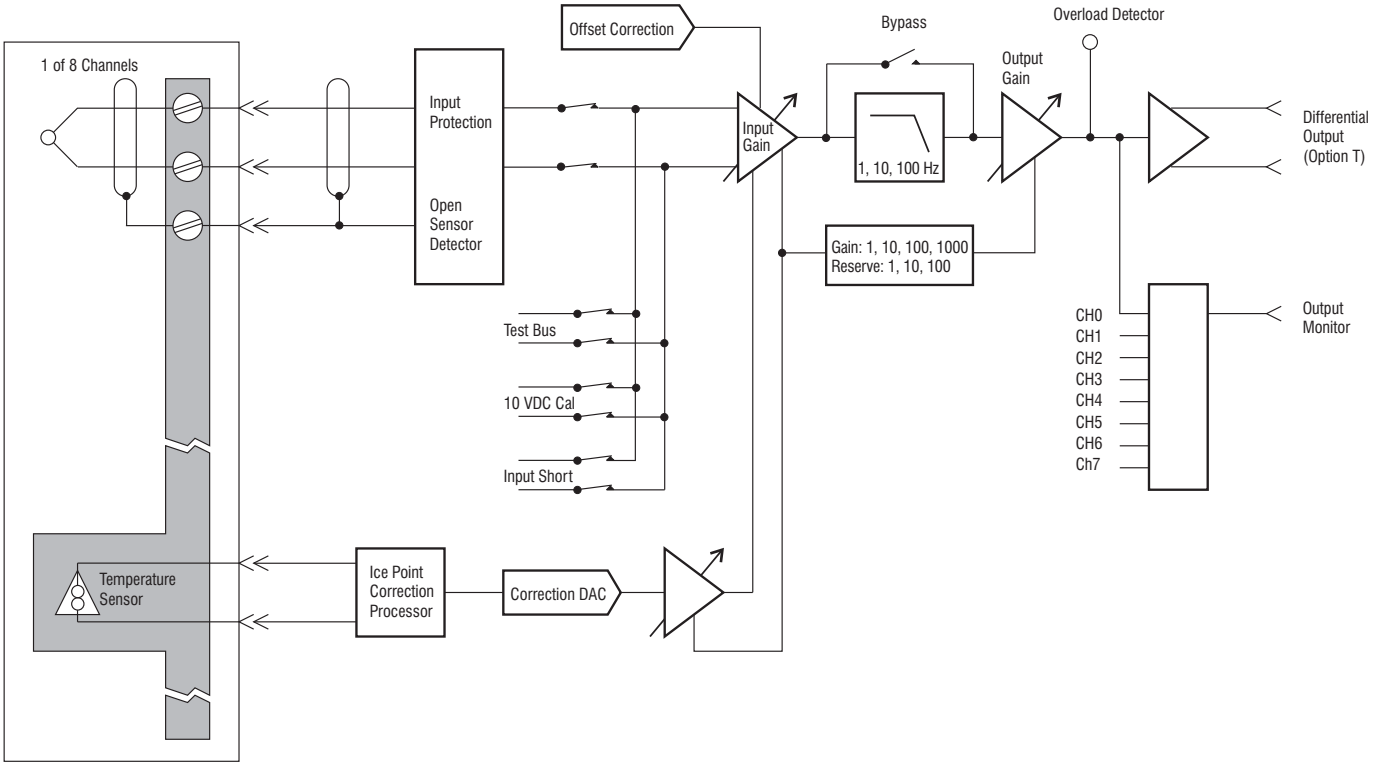
28208 FILTER CHARACTERISTICS

Type:	3-pole Bessel low-pass (BE3)
Cutoff Freq. (Fc):	F01 Range: 1 Hz, 10 Hz, 100 Hz and Wide-band (programmable)
Cutoff Amplitude:	–3.01 dB
Amplitude Accuracy:	±0.1 dB, DC to Fc
Wide Band Frequency Response:	See Transfer Characteristics section

28208 OUTPUT CHARACTERISTICS

Type (Standard):	Single-ended
Level:	±10 Vpk, ±5 mA pk
Output Impedance:	10 ohms
Option T:	Balanced Differential Output
Level:	±5 Vpk, ±5 mA pk per side
Output Impedance:	10 ohms, each side
Drift:	(0.5 µV/°C)*Gain + (15 µV/°C)*Reserve
Offset:	<3 mV typical after auto adjust
Overload Detection:	Overload at channel output is indicated by front panel LEDs and indicators in the GUI. Detection threshold is 11 V ±1%.
Noise:	0.1 Hz to 100 kHz, Fc = 100 Hz, as follows:

Gain	Reserve	Noise RTO (µV rms)
1	1	35
10	1	35
100	1	50
1000	1	250
10	10	115
100	10	130
1000	10	250
100	100	800
1000	100	1000



28208-1-ITB Isothermal Block

28208 Card and Isothermal Block, 1 of 8 Channels Shown

28208-1-ITB ISOTHERMAL BLOCK

The 28208-1-ITB Isothermal Block provides a digital reference junction sensor and screw terminal connections for eight thermocouples (2 wires plus shield). Power to the temperature sensor is provided by the 28208 card. The standard 28208-1-ITB has a 4-foot long cable that interfaces directly to the input connector of the 28208 card. The Isothermal Block may be located remotely using a block (CB-HD26S/HD26P-L) extension cable so as to avoid long thermocouple extension leads. Maximum extension cable length is 150 feet.

28208-1-ITB Isothermal Block

Cold junction compensation may be disabled to enable the 28208 amplifier/filter to be used in applications other than thermocouple conditioning.

Standard Thermocouple Types Supported:
B, E, J, K, N, R, S, T

Hardware Bow Correction:
Polynomial approximation to the thermoelectric voltage of a thermocouple versus temperature is utilized to reduce thermocouple "Bow" errors.
NOTE: Thermocouple non-linearity is not corrected.

Temperature Reading Sampling Period:
10 seconds

Reference Junction Monitor:
Command to support readout of reference junction by user.

Block Sensor Accuracy:
±0.5 deg C, –10 to 85 deg C

Block Temperature Range:
–10 to 100 deg C

28208-1-ITB ISOTHERMAL BLOCK (Cont.)

Overall Cold Junction Compensation Accuracy (including sensor and hardware correction):

Overall Cold Junction Correction Accuracy (Deg. C)					
Gain	**Reserve**	**Type E**	**Type J**	**Type K**	**Type T**
100	1	0.6	0.6	0.6	0.6
1000	1	0.6	0.6	0.6	0.6
100	10	0.9	1.0	1.1	1.1
1000	10	0.6	0.6	0.6	0.6
100	100	3.7	4.4	5.5	5.3
1000	100	0.9	1.0	1.1	1.1

Temperature range for thermocouple is effected by gain setting.

28208 Temperature Range vs. Gain Setting for Various Thermocouples			
Type	**Temp Range**	**Temp. for Gain Setting (Deg C)**	
		x1, x10, x100	**x1000**
B	0 to 1820	0 to 1820	0 to 1490
E	–270 to 1000	–270 to 1000	–270 to 152
J	–210 to 1200	–210 to 1200	–210 to 185
K	–270 to 1372	–270 to 1372	–270 to 246
N	–270 to 1300	–270 to 1300	–270 to 318
R	–50 to 1768	–50 to 1768	–50 to 961
S	–50 to 1768	–50 to 1768	–50 to 1035
T	–270 to 400	–270 to 400	–270 to 213

28208 CARD GENERAL CHARACTERISTICS

28208 Card Size: 6.6 x 17.5 x 0.75 inches

Card Weight: 1.5 lb. net

Temperature: 0^0 to 40^0 C (operating)
-20^0 to 70^0 C (storage)

ORDERING INFORMATION

28208-F01-BE3-?
- Options: Option T, Differential Output
- Filter Type: BE3, 3-pole Bessel
- Cutoff Frequency:
  F01: 1, 10, 100 Hz, or Bypass

CB-HD26S/HD26P-L Extension Cable for Isothermal Block
(L= Length in Feet, max 150 feet)

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