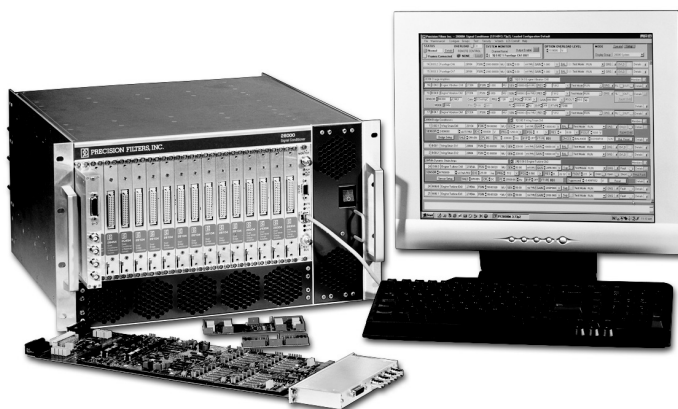


28134 QUAD-CHANNEL WIDEBAND BRIDGE CONDITIONER

10 V Common Mode; 200 kHz Filtered/500 kHz Wideband Bandwidth

 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 28134 APPLICATIONS

- Strain gage conditioner
- Load cell conditioner
- Pressure transducer conditioner
- Potentiometer conditioner
- Low level AC or DC amplifier (<1 mV to 10 V inputs)
- Anti-aliasing filter/amplifier

PRECISION 28134 FEATURES

- 4 channels per card, 64 channels per chassis
- Balanced programmable constant voltage source with remote sense
- Up to 10 V (100 mA) excitation delivered to the bridge
- ± 10 V_{cm} operation
- Up to 200 kHz “filtered” bandwidth or 500 kHz “wide-band” bandwidth
- 2- to 10-wire plus shield transducer input interface
- Automatic bridge balance
- 4096 step bipolar shunt cal or single step bipolar resistive shunt cal; Shunt any bridge arm
- Selectable bridge configuration (1-arm, 2-arm, or 4-arm) with read back
- Programmable AC/DC input coupling
- Programmable amplifier: x1 to x12000
- 4 or 6-pole anti-alias filters with filter bypass (wide-band)
- 1° phase matching between any channels, DC to F_c
- Overload detection
- Precise automatic calibration
- Auxiliary front panel output connection to support the use of custom output modules

28134 DESCRIPTION

The 28134 is a member of the Precision 28000 family of signal conditioners. The 28134 provides four channels of conditioning for transducers requiring a Wheatstone bridge. Up to sixteen 28134 cards may reside in the 28000 system to provide up to 64 channels per chassis. In addition, the 28134 may be mixed with other conditioners in the 28000 family to meet your unique signal conditioning requirements.

The 28134 provides constant voltage excitation and conditioning for 1-, 2-, and 4-arm resistive bridges. The 28134 features automatic calibration of gain and offset for the entire channel, including the amplifier, filter, and excitation supply. The 2- to 10-wire input connection provides 6 wires for the bridge, 2 wires for shunt calibration, 1 wire for the shield, and 1 wire for single-arm bridges.

28134 DESCRIPTION (Continued)

Precision bridge configuration resistors are contained on a plug-on module located on each 28134 card. The resistors may be set to complete the bridge for quarter, half, or full bridge configurations. ID registers are provided to read back bridge configuration and resistance.

Automatic balance of the bridge is accomplished by inserting a voltage ratiometric with the excitation supply to the amplifier input stage. This balance method provides outstanding stability without loading the bridge. A wide range of unbalanced conditions may be accommodated.

Two methods of shunt calibration are available. The BC1 voltage insertion technique provides 4096 steps of bipolar shunt calibration that may be used to simulate a bridge unbalance. The BC2 shunt calibration supports the use of precision resistors for bipolar single-step shunt cal. For either technique, the 28134 supports the use of dedicated shunt cal lines to the bridge that allow the user to perform the shunt cal on non-current carrying leads. Single shunt calibration of any arm of the bridge and the double shunt calibration of opposing bridge arms are supported. Also, since the bridge balance technique is non-invasive to the bridge, shunt calibration results are unaffected by bridge balance circuitry.

Balanced Voltage Excitation

The 28134 features a programmable constant voltage excitation supply that can source up to 10 volts to the bridge. Balanced constant voltage excitation offers a number of advantages over single-ended excitation. It enables a true balanced instrumentation amplifier input for outstanding rejection of high frequency common-mode signals. Single-ended voltage excitation to balanced bridges produces a relatively large common-mode voltage at half the excitation supply. The instrumentation amplifier must reject this signal. Balanced voltage excitation applied to balanced bridges results in lower common mode input voltages to the amplifier input stage.

The excitation supply has automatic amplitude and offset correction that may be run on the unit in place at any time. Dedicated remote sense lines allow the excitation supply regulator to deliver an accurate voltage to the bridge.

Input Stage

The 28134 input stage has 120 dB of common-mode rejection, low DC drift and ultra-low noise ($< -163 \text{ dBV}/\sqrt{\text{Hz}}$). The input can be equipped with programmable AC/DC coupling. AC coupling is useful in applications where DC levels that limit dynamic range can be coupled out of the signal.

A programmable switch at the input stage is provided to connect the amplifier to the 28000 system test bus. The test bus is used to inject signals for performance verification. In addition, the excitation supply may be connected to the input stage for direct verification of the excitation supply level.

28134 DESCRIPTION (Continued)

Amplifier and Filter

Programmable pre- and post-filter amplifiers provide an overall gain of 12000. 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. Overload detectors alert the user to over-voltage conditions. A fully buffered output having over 20 mA of drive capability may be used to drive long output cable runs.

The 28134 has a wide range of anti-alias filter characteristics available including 4- and 6-pole Butterworth, Bessel, Elliptic and time delay filters. Cutoffs are programmable from 1 Hz to 200 kHz.

28134 PROGRAMMABLE FEATURES

- Excitation level (0 to 10.2375 V in 2.5 mV steps)
- Excitation sense (local or remote)
- Bridge configuration (1-arm, 2-arm, and 4-arm)
- Automatic balance
- AC/DC coupling
- Test Modes: Amp Short, Excitation Off, Voltage Substitution, Shunt Calibration, Excitation Monitor, Output Monitor
- Gain (x1 to x12000)
- Cutoff frequency (1 Hz to 200 kHz)
- Wide-band (500 kHz) or filtered operation
- Shield (driven, open, grounded)

GRAPHICAL USER INTERFACE DISPLAY

All programmable features in addition to:

- Bridge configuration and resistance readback
- Balance status
- Input wiring
- Overload status
- Group Control

28134 CONDITIONER CARDS

The detailed description and specifications for the 28134 card are organized as follows in the sections below.

- Card Model Number Structure
- Bridge Configuration and Shunt Cal Options
- Bridge Resistor Modules
- Bridge Wiring
- Excitation Supply
- Input Characteristics and Options
- Amplifier Characteristics
- Test Modes
- Filter Type Characteristics
- Filter Cutoff Frequency Settings
- Filter Specifications
- Output Characteristics

28134 CARD MODEL NUMBER

The 28134 card model number describes the configuration of the four channels on the card. The model number identifies:

- The cutoff frequency, fixed or programmable, of the filters.
- The filter characteristic, or filter type, of the low-pass filters.
- Options included on the card, including the identification of the installed Bridge Completion configuration option.

28134-X-YYY-?

Options:

- 6 Programmable AC/DC Input Cplg.
- T Differential Output

Filter Type:

- LP1, TD6, BU6, BE6
- EL4, TD4, BU4, BE4

See the Filter Type section below for more information.

Cutoff Frequency:

- FX01, FX02 prog. frequency range
- XXXX for single fixed frequency

See Filter Cutoff Frequency Settings section below for more information.

BRIDGE CONFIGURATION & SHUNT CAL MODULE

One plug-on bridge configuration and one shunt cal module must be specified for each 28134 card (except that bridge configuration modules are not required for 4-arm bridge configurations with no shunt calibration).

The bridge configuration cards provide selectable or hardwired bridge configuration. Three versions are available: BC1 for 4096-step shunt cal, BC2 for resistive shunt cal, and BC0 for no shunt cal. The GUI reads back and reports the model number from the plug-on card.

BC1 Shunt Cal provides shunt calibration utilizing voltage insertion at the bridge, providing 4096 steps of shunt calibration. Single shunt of any bridge arm or double shunt of opposing arms may be selected. The shunt may be applied at the gage (if additional cable wires are used) or at the signal conditioner via program control. Double shunt sensitivity is set by a precision resistor on the BR1 resistor completion card and is programmable to ± 16 mV/V in steps of $7.8125 \mu\text{V/V}$. This simulates compression or tension on the gage.

BC2 Shunt Cal provides single-step bipolar shunt cal using a precision resistor installed on the BR2 resistor completion card. Programmable GUI selections allow the shunt to be applied at the gage (if additional cable wires are used) or at the signal conditioner. Single shunt of any bridge arm, or double shunt of opposing bridge arms may be selected. Upscale (tension) and downscale (compression) calcs are selectable from the GUI.

The standard BC2 shunt cal supplied with 120 Ω , 350 Ω and 1K Ω cards produces 5 mV/V single shunt or 10 mV/V double shunt in bridge output with accuracy better than 0.01%. Custom shunt resistor values may be specified, or the user can install shunt resistor values.

Note: Bridge configuration modules are not required for 4-arm bridge configurations with no shunt calibration.

Modules without Shunt Cal Options

BC0/124	Selectable bridge configuration, no shunt cal
BC0/1	Hardwired for 1-arm (R1) bridge, no shunt cal
BC0/2	Hardwired for 2-arm (R1/R2) bridge, no shunt cal

Modules with Shunt Cal Options

BC1/124	4096-step shunt cal with selectable bridge configuration
BC1/1	4096-step shunt cal, hardwired for 1-arm (R1) bridge
BC1/2	4096-step shunt cal, hardwired for 2-arm (R1/R2) bridge
BC1/4	4096-step shunt cal, hardwired for 4-arm bridge
BC2/124	Single-step bipolar resistive shunt with selectable bridge configuration
BC2/1	Single-step bipolar resistive shunt, hardwired for 1-arm (R1) bridge
BC2/2	Single-step bipolar resistive shunt, hardwired for 2-arm (R1/R2) bridge
BC2/4	Single-step bipolar resistive shunt, hardwired for 4-arm bridge

BRIDGE RESISTOR MODULES

Optional plug-on bridge resistor completion modules provide high stability completion resistors for standard bridges. This plug-on also provides the shunt cal scaling resistor for models with 4096-step shunt for BC1 models, or the precision shunt resistor for BC2 models. Resistor values can be read back and displayed on the GUI.

The Bridge Resistor modules are not included with the 28134 card and must be specified separately. The module provides the completion and shunt cal resistors for four channels.

There are three base models: BR1 for use with BC1 configuration cards, BR2 for use with BC2 configuration cards, and BR0 for configurations with no shunt calibration.

Note: Bridge resistor modules are not required for hardwired 4-arm bridge configurations with no shunt calibration.

BRIDGE RESISTOR MODULES (Continued)

Resistor Temp. Coef.: ± 4 ppm/ $^{\circ}\text{C}$
 Resistor Accuracy: $\pm 0.01\%$

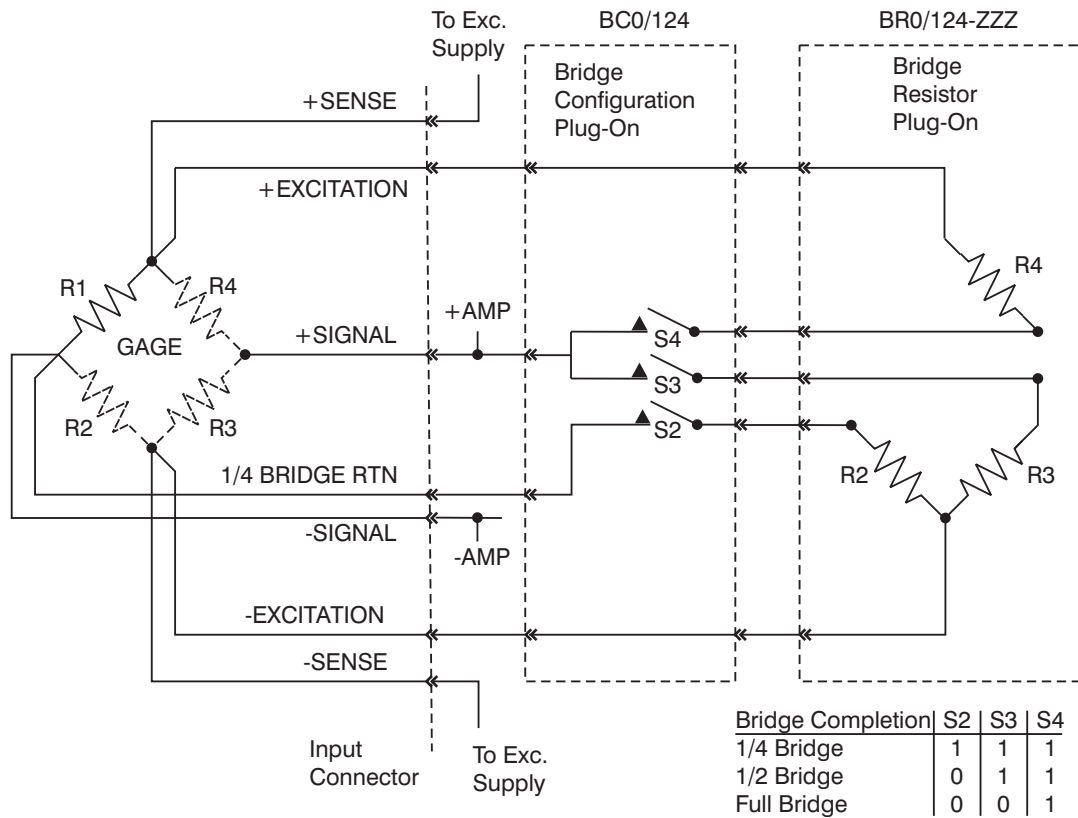
- BR0/124-120 120 Ω completion for 1, 2, or 4-arm bridges. No shunt cal.
- BR0/124-350 350 Ω completion for 1, 2, or 4-arm bridges. No shunt cal.
- BR0/124-1K0 1 k Ω completion for 1, 2, or 4-arm bridges. No shunt cal.
- BR0/124-ZZZ Custom completion for 1, 2, or 4-arm bridges. No shunt cal.

- BR1/4-XXX-3690 4-arm bridge configuration (no completion resistors). 4096-step shunt cal scaling resistor.
- BR1/4-XXX-10762 4-arm bridge configuration (no completion resistors). 4096-step shunt cal scaling resistor.
- BR1/4-XXX-30750 4-arm bridge configuration (no completion resistors). 4096-step shunt cal scaling resistor.
- BR1/4-XXX-YYY 4-arm bridge config. (no completion Resistors).
 YYY = Custom 4096-step shunt cal scaling resistor.

BRIDGE RESISTOR MODULES (Continued)

- BR1/124-120-3690 120 Ω completion for 1, 2, or 4-arm bridges. 4096-step shunt cal scaling resistors.
- BR1/124-350-10762 350 Ω completion for 1, 2, or 4-arm bridges. 4096-step shunt cal scaling resistors.
- BR1/124-1K-30750 1 k Ω completion for 1, 2, or 4-arm bridges. 4096-step shunt cal scaling resistors.
- BR1/124-ZZZ-YYY Custom completion for 1, 2, or 4-arm bridges.
 YYY = custom 4096-step shunt cal scaling resistors.

- BR2/4-XXX-5940 4-arm bridge config. (no completion resistors). Single-step shunt resistors.
- BR2/4-XXX-17325 4-arm bridge config. (no completion resistors). Single-step shunt resistors.
- BR2/4-XXX-49500 4-arm bridge config. (no completion resistors). Single-step shunt resistors.
- BR2/4-XXX-YYY 4-arm bridge config. (no completion resistors).
 YYY = Custom single-step shunt cal scaling resistors.



BRIDGE RESISTOR MODULES (Continued)

- BR2/124-120-5940 120Ω completion for 1, 2, or 4-arm bridges. Single-step shunt cal resistors.
- BR2/124-350-17325 350Ω completion for 1, 2, or 4-arm bridges. Single-step shunt cal resistors.
- BR2/124-1K-49500 1 kΩ completion for 1, 2, or 4-arm bridges. Single-step shunt cal resistors.
- BR2/124-ZZZ-YYY Custom completion for 1, 2, or 4-arm bridges.
YYY = Custom single-step shunt cal scaling resistors.

XXX = No completion resistors

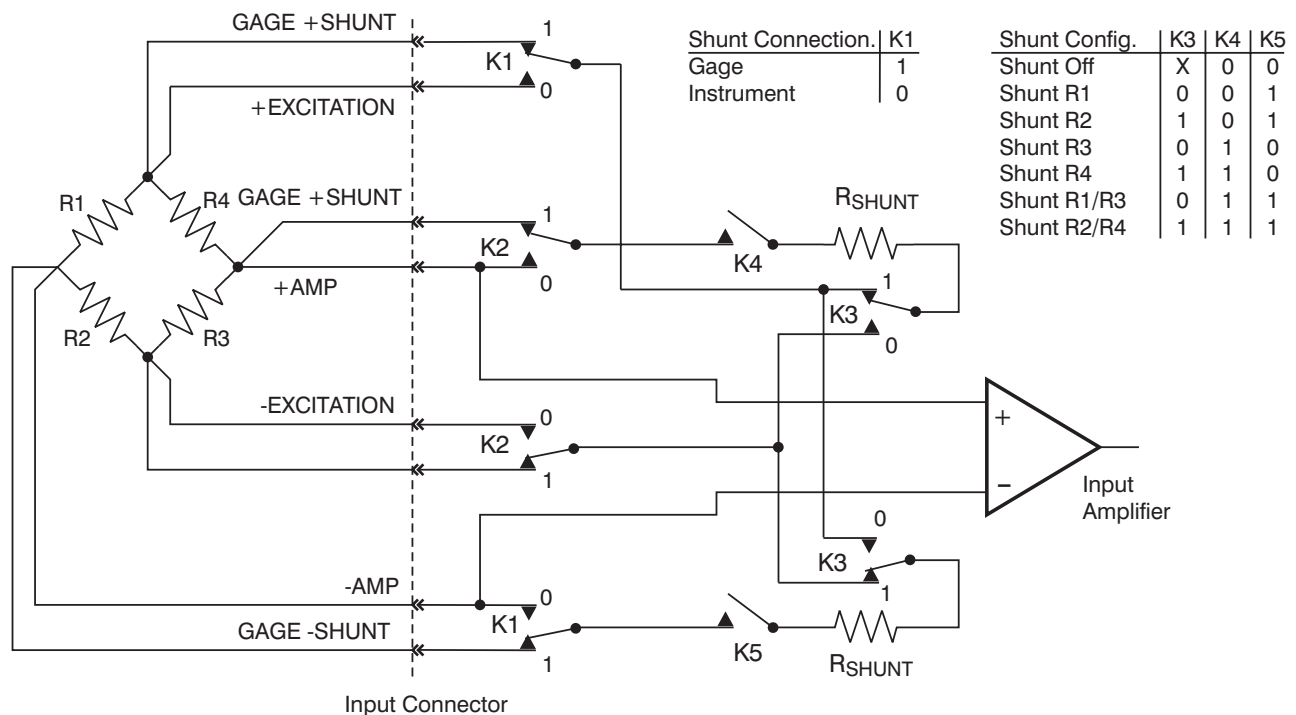
ZZZ = Custom completion resistor, Consult factory

YYY = Custom shunt cal resistor, Consult factory

Shunt cal resistors specified for 16 mV/V of excitation fullscale range for double shunt on BC1 shunt cal or 10 mV/V for double shunt on BC2 shunt cal.

BRIDGE WIRING

- Input Connector: 26-pin D-shell (2 ea.)
- Input Wires: ±EXCITATION (2)
±SENSE (2)
±SIGNAL (2)
SHUNT CAL (2)
RETURN (1) Single Arm Bridge
SHIELD (1)



BC2/X Shunt Cal

28134 EXCITATION SUPPLY

Note: Specs at 25°C unless otherwise noted.

Programmable Constant Voltage Excitation

Maximum Output: 10.2375 V, 100 mA (balanced)
Note: System excitation current (sum total of excitation supply currents for all channels in a 28000 chassis) is limited to 3A for a 28016 chassis and 1.5 A for a 28008 chassis.

Steps: Programmable from 0 to 10.2375 in 2.5 mV steps

Excitation Sense: Programmable (local or remote sense)

Accuracy: ±5 mV, ±0.1%, whichever is greater

Current Limit: 120 mA

Load Regulation: ±0.03% or ±200 μV, whichever is greater, no load to full load

Line Regulation: ±0.01% for 10% line variation

Noise: 100 μVrms, 3 Hz to 200 kHz

Temp. Drift: ±0.0025%/°C of setting or ±50 μV/°C, whichever is greater

Sense Current: Less than 10 μA

Calibration: Automatically calibrated for gain and offset. Calibration initiated at the GUI panel.

Excitation Off: The excitation supply is programmed to 0 volts.

Excitation Monitor (Standard)

Excitation Monitor: Under GUI control, the amplifier input is switched from the bridge to the excitation supply to monitor the excitation voltage. Excitation monitor gain is x1.

28134 INPUT CHARACTERISTICS

Note: Specs at 25°C unless otherwise noted.

Common Mode Voltage: ± 10 V operating

Common Mode Rejection Ratio:

Frequency	CMRR (dB) with Full Bridge Input	
	Pre-Gain <8	Pre-Gain ≥ 8
60 Hz	100	120
1 kHz	100	106
10 kHz	86	92
100 kHz	70	72
200 kHz	65	65

Input Protection: ± 35 V

Input Impedance: 10 M Ω //100 pF per side
20 M Ω //50 pF differential
100 M Ω //24 pF common mode

Max Level: ± 10 Vpk for $f \leq 200$ kHz;
 ± 10 Vpk (200 kHz/f) for $f > 200$ kHz

Offset Drift: 2.5 $\mu\text{V}/^\circ\text{C}$, max

Noise: 7 nV/ $\sqrt{\text{Hz}}$ RTI at 1 kHz
and pre-gain $> \times 100$

Shield: Programmable: Driven, Open or
Grounded

Option 6: Programmable AC/DC input coupling
Note: Specs below are for AC-coupled
setting. Specs are unchanged from above
for the DC-coupled setting.

Impedance: (0.1 μF & 10 M Ω)//100 pF per side (1 Hz)

Common Mode Z: 0.2 μF & 20 M Ω

Input Short (Standard)

Input Short: A switch at the amplifier input is
used to ground the input stage to
measure amplifier noise and DC offset.

28134 INPUT CHARACTERISTICS (Cont.)

Test Input (Standard)

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

Auto Bridge Balance/Zero Suppress (Standard)

Auto Bridge

Balance Mode: The bridge is automatically balanced
utilizing voltage insertion at the input
amplifier when bridge balance mode is
selected. The inserted voltage is derived
from and thus tracks the excitation sup-
ply. A successive approximation A/D
converter mechanization is used for
rapid bridge balance.

Balance Range: The bridge balance algorithm selects
the most appropriate range to achieve
balance with finest resolution. Resolu-
tion and range are dependent on pro-
grammed excitation and gain setting.

Ranges: 1V per V of excitation, 125 mV/V and
15.625 mV/V with resolution 0.05% of
range for the following gains:
Gain <10 and Post-Filter Gain = 1
<20 and Post-Filter Gain = 2
<40 and Post-Filter Gain = 4
<80 and Post-Filter Gain = 8

Ranges: 100 mV per V of excitation, 12.5 mV/V
and 1.5625 mV/V with resolution
0.05% of range for the following gains:
Gain ≥ 10 and Post-Filter Gain = 1
 ≥ 20 and Post-Filter Gain = 2
 ≥ 40 and Post-Filter Gain = 4
 ≥ 80 and Post-Filter Gain = 8

Resolution: $\pm 0.05\%$ of span

Temp Coef.: ± 50 ppm/ $^\circ\text{C}$

Auto Balance Time: Less than 15 seconds per system of
64 channels.

28134 INPUT CHARACTERISTICS (Cont.)

Auto Bridge Balance/Zero Suppress (Continued)

Auto Suppress Mode: A programmable DC offset derived from a precision 10 V reference is injected at the channel input stage to suppress the gage DC operating voltage. Manual or automatic suppression modes are supported.

Ranges: ± 10 V, ± 1.25 V and ± 150 mV with resolution 0.05% of range for the following gains:

Gain < 10 and Post-Filter Gain = 1
 < 20 and Post-Filter Gain = 2
 < 40 and Post-Filter Gain = 4
 < 80 and Post-Filter Gain = 8

Ranges: ± 1 V, ± 0.125 V and ± 15 mV with resolution 0.05% of range for the following gains:

Gain ≥ 10 and Post-Filter Gain = 1
 ≥ 20 and Post-Filter Gain = 2
 ≥ 40 and Post-Filter Gain = 4
 ≥ 80 and Post-Filter Gain = 8

Accuracy: 0.25% of setting +5 mV
 DC Drift: Input drift +13.5 $\mu\text{V}/^\circ\text{C}$

Auto Suppress Time: <15 seconds per 64 channel system

28134 AMPLIFIER CHARACTERISTICS

Note: Specs at 25°C unless otherwise noted.

Pre-filter Gain: x1, 1.25, 1.5, 2, 2.5, 3, 4, 5, 6, 8, 10, ... , x1500, with overload detection (10.5 Vpk threshold)

Post-filter Gain: x1, 2, 4, 8

DC Accuracy: 0.12% after auto cal at any gain setting

Stability: $\pm 0.02\%$ for 6 months

Temp Coef.: $\pm 0.004\%/^\circ\text{C}$

DC Linearity: $\pm 0.01\%$ re Fullscale, relative to the best straight line

Freq. Response: DC to 200 kHz, -0.15 dB ± 0.15 dB

-3.01 dB BW: 500 kHz, typical

28134 TEST MODES

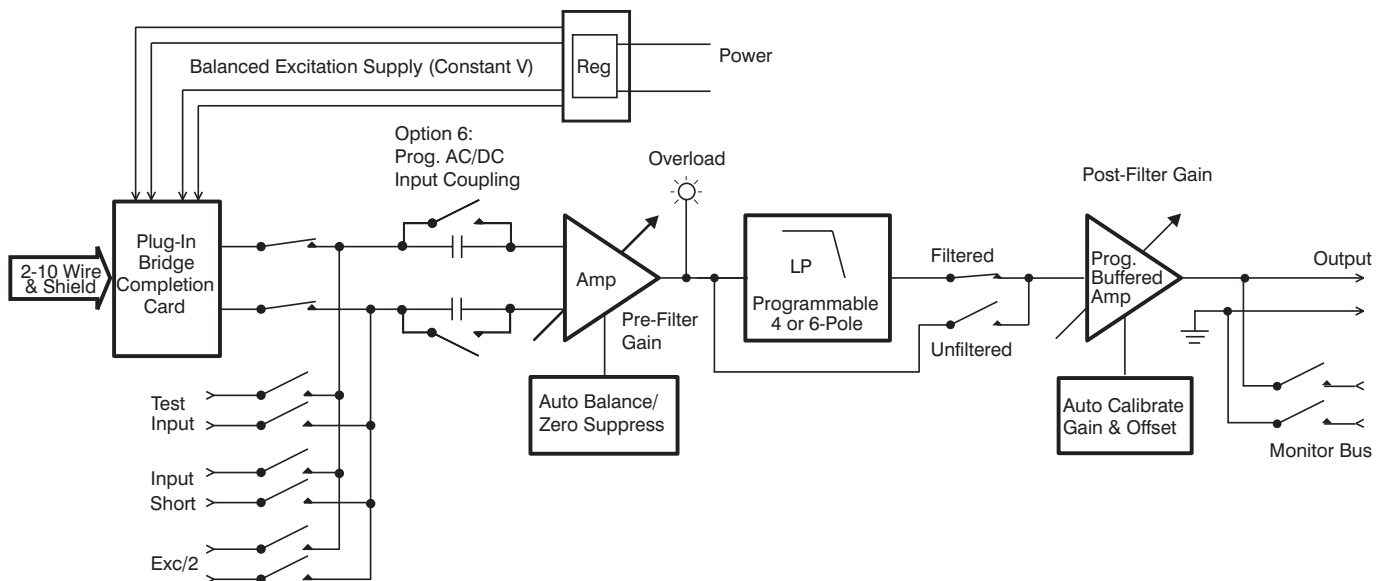
Shunt Cal: Applies shunt to bridge.

Excitation Monitor: The amplifier input is switched from the bridge to the excitation supply to monitor the excitation voltage. Excitation monitor gain is x0.5.

Excitation Off: The excitation supply is programmed to zero volts.

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 Subsystem may be connected at the rear panel. Refer to the 28000-?-TEST Test Subsystem specification for more information.



28134 Channel Block Diagram

28134 FILTER TYPE CHARACTERISTICS

A selection of 6-pole and 4-pole low-pass anti-alias filter types are offered on the 28134 card. Refer to the detailed filter selection guides on the following pages for detailed specifications on the filter types listed below.

6-Pole Filters

- LP1: 6-pole, 6-zero Elliptic low-pass filter.
- TD6: 6-pole, 4/6-zero constant time delay (linear phase) low-pass filter. Both the TD6A and TD6B characteristics are provided. Selecting between TD6A and TD6B is accomplished via front panel or computer control.
- BU6: 6-pole Butterworth low-pass characteristic.
- BE6: 6-pole Bessel low-pass characteristic.

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.

CUTOFF FREQUENCY SETTINGS

A selection of cutoff frequency choices are supported including fixed frequency and programmable cutoff frequency cards.

Fixed Frequency Filters

28134-XXXX-YYY Single fixed frequency
└─┬─┬─┘ YYY = Filter Type Characteristic
└─┬─┬─┘ XXXX= Single fixed frequency, from
└─┬─┬─┘ 1 Hz to 200 kHz

- Examples: XXXX= 100 is $F_c = 100$ Hz
 XXXX=25K5 is $F_c = 25.5$ kHz
 XXXX=1K25 is $F_c = 1.25$ kHz

Programmable Filters

28134-FX01-YYY YYY = Filter Type Characteristic
└─┬─┬─┘ FX01 cutoff frequencies: 1, 2, 4, 5, 10,
└─┬─┬─┘ 20, 40, 50, 100, ... 200 kHz and
└─┬─┬─┘ Bypass (500 kHz)

FX02 cutoff frequencies: 500 Hz, 1k,
 2k, 4k, 5k, 10k, 20k, 40k, 50k, 100k,
 200k, Bypass (500 kHz)

6-Pole Filter Selection Guide					
	LP1	TD6A	TD6B	BU6	BE6
Filter Type	LP	LP	LP	LP	LP
Function	Cauer	Bessel w/Z	Bessel w/Z	Butterworth	Bessel
Number of Poles, Zeroes	6p, 6z	6p, 4z	6p, 6z	6p	6p
Pass-band Ripple (dB p-p)	0.1	n/a	0.2	n/a	n/a
-0.1 dB Frequency	0.925 F_c	0.109 F_c	0.582 F_c	0.731 F_c	0.186 F_c
-3.01 dB Frequency	F_c	0.589 F_c	F_c	F_c	F_c
-20 dB Frequency	1.190 F_c	1.388 F_c	1.882 F_c	1.467 F_c	2.350 F_c
-40 dB Frequency	1.474 F_c	2.113 F_c	3.093 F_c	2.154 F_c	3.640 F_c
-60 dB Frequency	1.776 F_c	3.017 F_c	4.428 F_c	3.162 F_c	5.416 F_c
-80 dB Frequency	1.970 F_c	4.064 F_c	n/a	4.642 F_c	7.990 F_c
Stop-band Frequency	1.970 F_c	n/a	4.893 F_c	n/a	n/a
Stop-band Attenuation (dB)	80	n/a	70	n/a	n/a
Phase at F_c ($^\circ$)	-358.50	-255.32	-255.32	-270.00	-154.37
Phase Distortion at F_c ($^\circ$)	111.3	2.11	2.11	48.6	0.00
Overshoot (%)	19.2	0.60	5.04	14.4	0.64
1% Settling Time (sec)	4.64/ F_c	1.21/ F_c	1.46/ F_c	2.36/ F_c	0.74/ F_c
0.1% Settling Time (sec)	8.45/ F_c	1.94/ F_c	2.21/ F_c	3.89/ F_c	1.16/ F_c

28134 FILTER SPECIFICATIONS

Cutoff Amplitude: -3.01 dB for LP1, TD6B, BU6, BE6,
EL4, TD4, BU4, and BE4
-9.61 dB for TD6A

BU4, BE4, EL4, TD4, BU6, BE6, TD6:

Ampl. Accuracy: (DC to F_{-3.01 dB}) ±0.2 dB max
Ampl. Match: (DC to F_{-3.01 dB}) ±0.1 dB max
Phase Match: (DC to F_{-3.01 dB}) ±1° max

For LP1:

Ampl. Accuracy: (DC to F_{-0.1 dB}) ±0.1 dB max, F_c ≤ 20 kHz
(DC to F_{-0.1 dB}) ±0.15 dB max, F_c > 20 kHz
Ampl. Match: (DC to F_{-0.1 dB}) ±0.2 dB max
Phase Match: (DC to F_{-0.1 dB}) ±2° max

Filter Bypass (Std): Bypasses the filter but not the amplifier stages.

Other Specifications

Stop-Band Amplitude Response

Conformance: f = frequency in the stop-band or
where there is greater than 80 dB
attenuation for monotonic filters.
A_{min} = Minimum stop-band attenuation
of filter or -80 dB for monotonic filters.

for f ≤ 100 kHz, attenuation = A_{min} ± 3 dB
for 100 kHz < f < 1 MHz, A_{min} ± 5 dB

28134 OUTPUT CHARACTERISTICS

Type: DC-coupled, single-ended output with
ground reference. Programmable
wideband (500 kHz) or filtered.

Z: 10 Ω shunted by 100 pF
Max Output: ±10 V_{pk}, ±20 mA_{pk}
Offset Drift: 2.5 μV/°C, RTI + 150 μV/°C, RTO
Noise: 5 μV_{rms} RTI + 300 μV_{rms} RTO
0.1 Hz to 200 kHz
Crosstalk: -80 dB, DC to 100 kHz between
adjacent channels with the same config-
uration and programmed settings.

Option T: Balanced differential output
Z: 10 Ω shunted by 100 pF per side
Max Output: ±5 V_{pk} per side (20 mA_{pk})
±10 V_{pk} differential

4-Pole Filter Selection Guide

	EL4	TD4	BU4	BE4
Filter Type	LP	LP	LP	LP
Function	Cauer	Bessel w/Z	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	0.827 F _c	0.189 F _c	0.625 F _c	0.189 F _c
-3.01 dB Frequency	F _c	F _c	F _c	F _c
-20 dB Frequency	1.492 F _c	2.524 F _c	1.776 F _c	2.542 F _c
-40 dB Frequency	2.398 F _c	4.483 F _c	3.162 F _c	4.724 F _c
-60 dB Frequency	3.666 F _c	7.049 F _c	5.623 F _c	8.482 F _c
-80 dB Frequency	4.719 F _c	9.144 F _c	10.00 F _c	15.13 F _c
Stop-band Frequency	4.719 F _c	9.144 F _c	n/a	n/a
Stop-band Attenuation (dB)	80	80	n/a	n/a
Phase at F _c (°)	-220.35	-107.16	-180.00	-120.82
Phase Distortion at F _c (°)	53.26	0.25	30.49	0.28
Overshoot (%)	13.8	0.80	11.4	1.03
1% Settling Time (sec)	2.73/F _c	0.63/F _c	1.66/F _c	0.64/F _c
0.1% Settling Time (sec)	4.36/F _c	1.15/F _c	2.73/F _c	1.00/F _c

28134 OUTPUT CHARACTERISTICS (Cont.)

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 switch located at the output of each channel allows for multiplexed connection to the mainframe output monitor bus. The output monitor bus is available at a connector located in the 17th slot at the rear of the mainframe. The monitor function is used by the Test Subsystem or is available to the user for viewing channel outputs.

Output Adapter Modules

The 28134 card provides a front panel auxiliary output connector to support the use of custom output modules.

28134 CARD GENERAL CHARACTERISTICS

28134 Card Size: 6.6 x 17.5 x 0.75 inches

Card Weight: 1.4 lb. net

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

ACCESSORIES

Input Mating Connectors

The input connectors are integral to the 28134. Cutouts on the 28000 frames allow for the input connector to pass through the backplane to directly mate with the input cable. Two connectors required per slot (4 channels).

CONN-IN-26D: High-Density 26-pin D-shell mating connector with crimp pins and backshell with strain relief.

CONN-IN-26D-SC: High-Density 26-pin D-shell mating connector with solder cup pins and backshell with strain relief.

Output Mating Connectors

The 28000 mainframe contains 50-pin D-shell connectors mounted on the rear panel. Sixteen twisted pairs are accommodated per connector. One output mating connector is required per 16 channels (i.e., set of four card slots). See the 28000 overview spec sheet for more information.

CONN-OUT-50D: 50-pin D-shell mating connector with crimp pins and backshell with strain relief.

CONN-OUT-50D-SC: 50-pin D-shell mating connector with solder cup pins and backshell with strain relief.

ORDERING INFORMATION

28134-X-YYY-?

Options: 6 (AC/DC Input Coupling)
T (Differential Output)

Filter Type: LP1, TD6, BU6, BE6
EL4, TD4, BU4, BE4

Cutoff Frequency:
See Cutoff Frequency
Settings section

* Note: A BR?? Bridge Resistor Module and BC?? Bridge Completion Module must be ordered in addition to the base 28134 card for shunt cal and/or bridge completion resistors.

