27454 QUAD-CHANNEL CONDITIONER BALANCED CURRENT EXCITATION

±10 V Common Mode; 255 or 510 Cutoff Frequencies

PRECISION FILTERS, INC.

SYSTEM 27000 FEATURES

- Graphical User Interface (GUI) 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

27000 SIGNAL CONDITIONING WIZARD

The 27000 Signal Conditioning Wizard™ provides all the power you need to manage your test measurements:

- Mix transducers in a single system
- Condition signals for immediate data conversion
- Manage hundreds of channels and a mix of sensors
- Assure system integrity before performing measurements
- Reduce life-cycle costs
- Upgrade and expand equipment as requirements change
- Count on unsurpassed performance and reliability

The Precision 27000 makes it easy to manage a test with hundreds of channels and a mix of transducers. Choose charge, voltage (filter amplifier), strain, thermocouple, RTD, potentiometer, current, frequency, or other transducers. There are 27000 cards to condition them.

The Wizard employs a management system of structured data bases (sensors and equipment), a graphical user interface, and a collection of algorithms to help you manage your measurements. The data bases keep records of the sensors and equipment which can be imported when you are designing or setting up a test. The GUI provides control panels for configuration, setup, operation, and tests. And the Wizard's algorithms transmute tedious and complex engineering calculations into simple setup entries. It's as simple as using a spreadsheet. Just change one parameter and the algorithm makes all other relevant calculations. System scaling becomes easy. Best of all, you won't have to pore over filter plots to calculate the tradeoffs between cutoff frequency, sampling rate, and attenuation of aliases. The filter algorithm does it for you, in the blink of an eye.

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 27000 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 Wizard has thought of ways to help you save time and money over the life of the system.

PRECISION 27454 APPLICATIONS

- Static or dynamic strain gage conditioner
- Full bridge conditioner
- RTD conditioner
- Low level AC or DC amplifier (<1 mV to 10 V inputs)
- Anti-aliasing filter/amplifier

PRECISION 27454 FEATURES

- 4 channels per card, 64 channels per chassis
- Balanced differential constant current source with 20 V compliance
- Programmable AC or DC coupled input
- 51 kHz bandwidth
- 2 or 4 wire input plus shield per channel
- Manual or automatic zero suppress
- Sensor open and short detection
- Excitation current monitor
- Voltage substitution test signals
- AC current test mode for verifying transducer, cabling and frequency response
- Programmable amplifier: x1/16 to x8,192 with 0.05% vernier
- 4, 6 or 8-pole anti-alias filters with filter bypass (wide-band)
- 1° phase matching between any channels
- Overload detection
- Precise digital calibration
- Hot swap

27454 DESCRIPTION

The 27454 is a member of the Precision 27000 family of signal conditioners. It provides conditioning for strain gages, RTDs, or other resistive non-self-generating transducers with 2-wire or 4-wire (Kelvin) connections.

The 27454 is equipped with Precision Filters' proprietary balanced differential constant current excitation. This topology is especially useful for reducing pickup from interfering sources as compared with traditional unbalanced current sources. The gage health monitor circuits indicate open or shorted gages and the input overload detector reports overloads by out-of-band signals which could cause in-band distortion.

Balanced Constant Current Excitation

Balanced constant current excitation provides a true balanced input for rejection of common-mode signals. Using a proprietary constant current source, the 27454 is able to deliver accurate excitation to the gage. Programmable excitation provides 0 to ±25.5 mA of constant current with an "excitation off" mode

27454 DESCRIPTION (Continued)

to detect self-induced signals. Gage open/short detection is also provided.

For dynamic strain conditioning applications, the 27454 can provide accurate measurements with only two wires by AC coupling the input. For best AC or DC measurements (required for RTD type transducers), the 27454 provides a 4-wire Kelvin connection for remote sense.

Suppression of the gage DC operating point is performed automatically using the zero suppress feature of the 27454. Zero suppress allows the use of more gain to emphasize small gage fluctuations.

Excitation current flows through an accurate sense resistor in the current loop allowing for direct monitoring of the excitation current. The current source output may be modulated to allow AC current injection in the loop. The frequency and amplitude of the AC current is user controlled. This allows the user to simulate changes in gage resistance in the loop and provides direct AC input stimulation to the signal conditioner for end-to-end system calibration.

Input Stage

The 27454 input stage provides 80 dB of common-mode rejection and may be either AC or DC coupled. AC coupling is useful for dynamic applications where the DC bias on the transducer that can limit dynamic range can be coupled out of the signal. With the input DC coupled, low drift and ultra low noise ($<$ -163 dBV/$\sqrt{Hz}$) is provided by the 27454 input stage. The input stage may be shorted to verify signal conditioner channel noise and DC offsets.

A switch at the input stage is provided to connect the amplifier to the 27000 system test bus. The test bus is used to inject signals for performance verification. In addition, both drive and sink current levels may be monitored separately making it possible to detect excitation current leakage conditions in the external current loop.

Amplifier and Filter

Programmable pre- and post-filter gain provides gain of 8192. Gain is distributed both before and after the filter to provide protection from large out of band signals or transients that could cause clipping in the filter, distorting the data. The Gain Wizard allows the user to set a gain reserve and then apportions the gain between the input and output. This provides input gain for best noise performance yet conforms to the limitations of the user's worst case estimate of outband or transient signals.

The 27454 has a wide range of anti-aliasing filter characteristics including 4, 6 and 8-pole Butterworth, Bessel, Elliptic and time delay filters. Choose from a wide selection of cutoff frequency settings to 51 kHz. These real anti-aliasing filters make the 27454 data acquisition ready.

27454 PROGRAMMABLE FEATURES

- Excitation level (0 to 25.5 mA in 50 μA steps)
- Excitation sense (local or remote)
- Automatic zero suppress
- AC/DC coupling
- Input short detection threshold
- Test Modes: Amp short, Excitation off, Voltage Substitution, Excitation Drive Current Monitor, Excitation Sink Current Monitor, AC Current Inject
- Output Monitor
- Gain (x1/16 to x8192 with 0.05% resolution)
- Cutoff frequency (1 Hz to 51 kHz)
- Wide-band or filtered operation
- Shield (guarded, open, grounded)

GRAPHICAL USER INTERFACE DISPLAY

All programmable features in addition to:
- Auto-suppress status
- Input wiring
- Transducer sensitivity
- System scaling in engineering units
- Overload, input short and input open status
- Gain Wizard
- Filter Wizard
- Group Control

27454 CONDITIONER CARDS

The detailed description and specifications for the 27454 card are organized as follows in the sections below.

- Card Model Number Structure
- Input Wiring
- Excitation Supply
- Input Characteristics and Options
- Amplifier Characteristics
- Test Modes
- Filter Cutoff Frequency Settings
- Filter Type Characteristics
- Filter Specifications
- Output Characteristics
- Mainframes and Accessories

27454 CARD MODEL NUMBER

The 27454 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.

27454-X-YYY-?

Options:
    6 Programmable AC/DC Input cplg

Filter Type:
    EL8, TD8, BU8, BE8
    LP1, TD6, BU6, BE6
    EL4, TD4, BU4, BE4

    See the Filter Type section below
    for more information.

Cutoff Frequency:
    C or E for Dual prog. frequency range
    F8??? for Single prog. frequency range
    XXXX for single fixed frequency

    See Filter Cutoff Frequency Settings
   section below for more information.

27454 INPUT WIRING

Input Connector: 26-pin D-shell (2 ea.)
Input Wires: I_{DRIVE} (1)
    I_{SINK} (1)
    $\pm$SIGNAL (2)
    Shield (1)

27454 EXCITATION SUPPLY

Type:	Balanced differential constant current excitation
Total Gage Voltage:	± 20 V (AC+DC)
Maximum Output:	25.55 mA
Steps:	0 to 25.55 mA in 50 μA steps
Input Impedance:	100 kΩ nominal per side
CMRR (DC to 1 kHz):	80 dB for 120Ω gage
	70 dB for 350Ω gage
	60 dB for 1kΩ gage
Initial Accuracy:	5 μA + 0.05% of setting
Temp. Drift:	40 nA +0.0024% of setting per $^{\circ}$C
Noise:	150 pA/$\sqrt{Hz}$ at 1 kHz
Bandwidth:	± 0.05 dB to 50 kHz ($R_{GAGE} < 1$ kHz)

Open/Short Detection: Gage open and short detection. Short detection threshold is programmable.
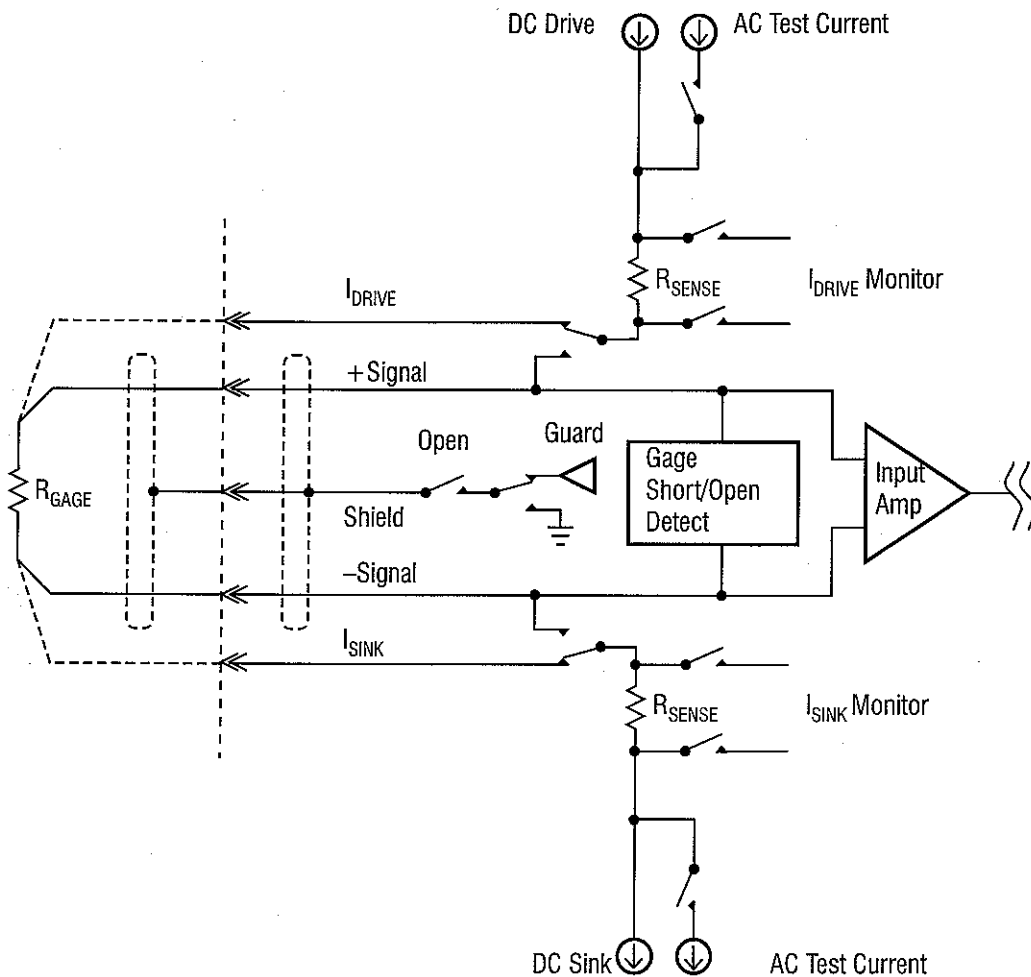
27454 INPUT CHARACTERISTICS

Common Mode Voltage: ±10 V operating
CMRR: 120 dB, DC to 60 Hz, with input gain of x8 or greater
Input Protection: ±50 V
Input Impedance: 15 MΩ//100 pF per side
30 MΩ//50 pF differential
1000 MΩ//24 pF common mode
Max Level: ±10 Vpk for f≤50 kHz;
±10 Vpk (50 kHz/f) for f>50 kHz
Offset Drift: 1 μV/°C, typical
Noise: 7 nV/√Hz RTI at 1 kHz and gain >x64
Shield: Programmable (driven, open, or grounded)

Gage Completion: Plug-on completion card provides 4-wire 100 Ω ± 0.01% current sense resistors and 2 & 4 wire connections to gage. Programmable local (gage) or remote (instrument) sense.

Auto Zero Suppress: 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: −160 mV to +160 mV in 78 μV steps
−1.28 V to +1.28 V in 625 μV steps
−10.24 V to +10.24 V in 5 mV steps
Accuracy: 0.25% of setting +5 mV
DC Drift: ±(Input drift +13.5 μV/°C)
Auto Suppress Time: Less than 15 seconds per system of 64 channels

Option 6: Programmable AC/DC input coupling (1 Hz)

Note: Specs below apply to AC coupled setting. Specs are unchanged from above for the DC-coupled setting.

Impedance: (0.1 μF &1.58 MΩ)//100 pF per side (1 Hz)
Common Mode Z: 0.2 μF & 30 MΩ
CMRR: 120 dB, 60 Hz and input gain of x8 or greater
Noise: 14 nV/√Hz RTI at 1 kHz and gain > x64

27454 AMPLIFIER CHARACTERISTICS

Pre-filter Gain: x1 to x512 in binary steps with overload detection (10.5 Vpk threshold)
Post-filter Gain: x1/16 to x16 in binary steps with vernier adjustment of 0.05% of setting
Calibration: DC Gain is automatically adjusted to better than 0.1% at any setting at user's command.
DC Accuracy: 0.1% after auto adjust at any gain setting
Stability: ±0.02% for 6 months
Temp Coeff: ±0.004%/°C
DC Linearity: ±0.005% re Fullscale, relative to the best straight line
Freq. Response: DC to 51 kHz, 0 dB ±0.1 dB

27454 TEST MODES

AC Current Inject: A small AC current is injected into the current loop to evaluate end to end system frequency response. The AC current is generated from a voltage on the test bus. Frequency and amplitude of the AC current may be controlled by changing the frequency and amplitude of the test bus signal.

AC Current Ampl.: $100\ \mu A \pm 0.2\%$ per volt of test bus signal

I Drive: The excitation drive current is measured and verified by connecting the input amplifier to a precision sense resistor ($100\ \Omega$, 0.01%, 1 ppm).

I Sink: The excitation sink current is measured and verified by connecting the input amplifier to a precision sense resistor ($100\ \Omega$, 0.01%, 1 ppm).

I Zero: The excitation current is set to zero (open circuit).

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 27000B-?-TEST Test Subsystem may be connected at the rear panel. Refer to the 27000B-?-TEST Test Subsystem specification for more information.

CUTOFF FREQUENCY SETTINGS

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

Fixed Frequency Filters

27454-XXXX-YYY   Single fixed frequency
YYY = Filter Type Characteristic
XXXX = Single fixed frequency, from 1 Hz to 51 kHz
Examples:
XXXX=0100 is Fc = 100 Hz
XXXX=25K5 is Fc = 25.5 kHz
XXXX=1K25 is Fc = 1.25 kHz

Programmable Filters

27454-F8???-YYY   Single programmable frequency range.
YYY = Filter Type Characteristic
??? Hz to 255*??? Hz in ??? steps
where ??? = 1, 10, 100 or 200
F8001 = 1 Hz to 255 Hz, 1 Hz steps
F8010 = 10 Hz to 2.55 kHz, 10 Hz steps
F8100 = 100 Hz to 25.5 kHz, 1 kHz steps
F8200 = 200 Hz to 51 kHz, 200 Hz steps

27454-X-YYY   Dual programmable frequency range.
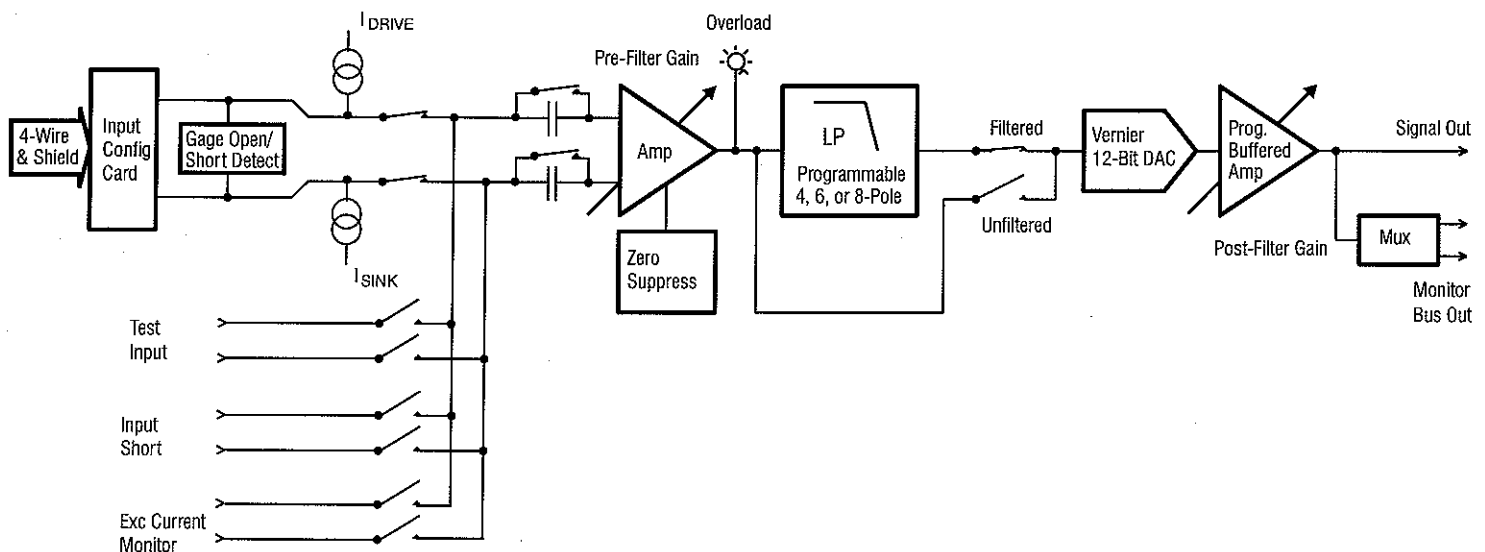YYY = Filter Type Characteristic
X = C or E
C = 1 Hz to 255 Hz in 1 Hz steps and 300 Hz to 25.5 kHz in 100 Hz steps
E = 1 Hz to 255 Hz in 1 Hz steps and 260 Hz to 2.55 kHz in 10 Hz steps

Custom Frequency Ranges

Custom frequency ranges are available. Contact the factory.

27454 Channel Block Diagram

27454 FILTER TYPE CHARACTERISTICS

A wide selection of 8-pole, 6-pole, and 4-pole low-pass anti-alias filter types are offered on the 27454 card. Refer to the detailed filter selection guides on the following pages for detailed specifications on the filter types listed below.

8-Pole Filters

EL8: 8-pole, 8-zero Elliptic low-pass filter.
TD8: 8-pole, 6/8-zero constant time delay (linear phase) low-pass filter. Both the TD8A and TD8B characteristics are provided. Selecting between the TD8A and TD8B is accomplished via front panel or computer control.
BU8: 8-pole Butterworth low-pass characteristic.
BE8: 8-pole Bessel low-pass characteristic.

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.

27454 FILTER SPECIFICATIONS

Cutoff Amplitude: −0.1 dB for EL8
     −3.01 dB for TD8B, BU8, BE8, LP1 TD6B, BU6, BE6, EL4, TD4, BU4, BE4
     −10.06 dB for TD8A
     − 9.61 dB for TD6A

For BU4, BE4, EL4, TD4, BU6, BE6, TD6, BU8, BE8, TD8:

Ampl. Accuracy: (DC to $F_{-3.01\,dB}$) ±0.1 dB max, $Fc \leq 25.5$ kHz
Ampl. Accuracy: (DC to $F_{-3.01\,dB}$) ±0.2 dB max, $Fc > 25.5$ kHz
Ampl. Match: (DC to $F_{-3.01\,dB}$) 0.1 dB max, 0.01 dB typ
Phase Match: (DC to $F_{-3.01\,dB}$) 1^{0} max, 0.1^{0} typ

For LP1, EL8:

Ampl. Accuracy: (DC to $F_{-0.1\,dB}$) ±0.1 dB max, $Fc \leq 25.5$ kHz
Ampl. Accuracy: (DC to $F_{-0.1\,dB}$) ±0.2 dB max, $Fc > 25.5$ kHz
Amplitude Match: (DC to $F_{-0.1\,dB}$) 0.1 dB max, 0.01 dB typ
Phase Match: (DC to $F_{-0.1\,dB}$) 1^{0} max, 0.1^{0} typ

Filter Bypass (Std): Bypasses the filter but not the amplifier stages. Specifications when the filter is bypassed:
−3.01 dB Bandwidth: 100 kHz, typ
High Freq. Rolloff: 12 dB/octave
Freq. Response: ±0.1 dB, DC to 51 kHz

8-Pole Filter Selection Guide						
	EL8	**TD8**		**TD8D**	**BU8**	**BE8**
		TD8A	**TD8B**			
Filter Type	LP	LP	LP	LP	LP	LP
Function	Cauer	Bessel w/Z	Bessel w/Z	Bessel w/Z	Butterworth	Bessel
Number of Poles, Zeroes	8p, 8z	8p, 6z	8p, 8z	8p, 8z	8p	8p
Pass-band Ripple (dB p-p)	0.1	n/a	0.2	0.005	n/a	n/a
−0.1 dB Frequency	F_c	0.104 F_c	0.569 F_c	1.093 F_c	0.791 Fc	0.185 F_c
−3.01 dB Frequency	1.099 F_c	0.565 F_c	F_c	1.274 F_c	Fc	F_c
−20 dB Frequency	1.266 F_c	1.345 F_c	1.694 F_c	1.629 F_c	1.333 Fc	2.347 F_c
−40 dB Frequency	1.441 F_c	1.867 F_c	2.340 F_c	2.113 F_c	1.778 Fc	3.337 F_c
−60 dB Frequency	1.618 F_c	2.396 F_c	2.951 F_c	2.624 F_c	2.371 Fc	4.522 F_c
−80 dB Frequency	1.750 F_c	2.915 F_c	3.332 F_c	2.975 F_c	3.162 Fc	6.069 F_c
Stop-band Frequency	1.788 F_c	n/a	3.332 F_c	3.000 F_c	n/a	n/a
Stop-band Atten. (dB)	90.75	n/a	80.28	82.57	n/a	n/a
Phase at F_c (^{0})	−359.20	−301.88	−301.88	−400.50	−360.00	−182.16
Phase Distortion at F_c (^{0})	84.9	0.23	0.23	0.5	66.2	0.00
Overshoot (%)	19.8	0.19	5.56	10.2	16.7	0.34
1% Settling Time (sec)	5.15/F_c	1.34/Fc	1.54/F_c	3.15/F_c	3.45/Fc	0.79/F_c
0.1% Settling Time (sec)	7.97/F_c	1.86/Fc	2.23/F_c	5.15/F_c	5.08/Fc	1.14/F_c

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.
Amin = Minimum stop-band attenuation
of filter or −80 dB for monotonic filters.

for f≤ 100 kHz, attenuation = Amin ±3 dB
for 100 kHz<f<1 MHz, Amin ±5 dB

Type: DC-coupled, single-ended output. Programmable wideband (100 kHz) or filtered.

Z: 50 Ω shunted by 100 pF
Max Output: ±10 Vpk, ±20 mApk
Offset Drift: 1 μV/°C, RTI + 150 μV/°C, RTO, typ
Noise: 2 μVrms RTI + 300 μVrms RTO, typ
0.1 Hz to 51 kHz
Crosstalk: −80 dB, DC to 25 kHz between adjacent channels with the same configuration and programmed settings.

Auto-Offset Adjust (Standard)

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.

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 (°)	−358.50	−255.32	−255.32	−270.00	−154.37
Phase Distortion at F_c (°)	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

27454 CARD GENERAL CHARACTERISTICS

27454 Card Size:	5.68 x 13.15 x 0.75 inches
	14.43 x 33.40 x 1.91 cm
Card Weight:	1.87 lb. net, 3.3 lb. shipping
	(0.85 kg net, 1.5 kg shipping)
Temperature:	0^0 to 40^0 C (operating)
	-20^0 to 70^0 C (storage)

27000 MAINFRAMES

27000D-M0-O3: 16-slot chassis with low-noise linear supply and four DB50 connectors for 27454 outputs. RS-232C remote interface. Compatible with all other 27000 signal conditioning cards. 120 VAC operation, 46-66 Hz.

Option 2: 220 VAC Power Supply
Option 3: 240 VAC Power Supply

Option E: External Excitation Supply. Required when four or more 27104A or 27454 conditioning cards are used in the 27000 chassis.

Option T: Test option hardware. Required for optional built-in FAT and GNG tests.

ACCESSORIES

Input Connectors

The input connectors are integral to the 27454. Cutouts on the 27000 Mainframe allow for the input connector to pass through the back-plane to directly mate with the input cable.

27000-IN-26D: High-Density 26-pin D-shell mating connector with crimp pins and back-shell with strain relief. Two connectors required per slot (4 channels).

Output Connectors

The 27000C-M0-O3 mainframe contains 4 50-pin D shell connectors mounted on the rear panel. Sixteen twisted pairs are accommodated per connector.

27000-OUT-50D: 50-pin D-shell mating connector with crimp pins and back-shell with strain relief. One required per 16 channels or up to four per 27000 mainframe.

Cables

CB-DD50P/16BNCM-L: DD50P to 16 channel isolated BNC male output cable. L = length in feet.

CB-DD50P/16BNCF-BH-L:
DD50P to 16 channel isolated BNC female output cable for bulkhead panel mount. L = length in feet.

PNL-32BNCBH-1U: Panel for 32 bulkhead mounted BNC's. Standard 19" rack mount, 1.75" high.

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 (^{0})	−220.35	−107.16	−180.00	−120.82
Phase Distortion at F_c (^{0})	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)	$4.36/F_c$	$1.15/F_c$	$2.73/F_c$	$1.00/F_c$

ACCESSORIES (Continued)

Fan Trays

When greater than four cards are installed in the 27000 main-frame, fan trays are required for system cooling.

27000-FT1: Fan Tray Assembly 115 VAC
27000-FT2: Fan Tray Assembly 220 VAC

Note: Fan trays require 2U of rack space above and 1U of rack space below the 27000 chassis for a total of 5.25 inches of vertical rack space. The fan trays accommodate a rack mounting depth of 17.75 inches to 23.75 inches.
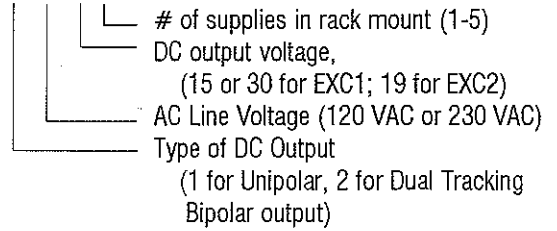
Rack Mount Kits

SM18: Rack mount kit with slides. Accommodates a nominal rack mounting depth of 18 inches.

SM20: Rack mount kit with slides. Accommodates a nominal rack mounting depth of 20 inches.

SM22: Rack mount kit with slides. Accommodates a nominal rack mounting depth of 22 inches.

SM24: Rack mount kit with slides. Accommodates a nominal rack mounting depth of 24 inches.

EXTERNAL EXCITATION SUPPLIES

Note: One excitation supply is required per mainframe.

27000-EXCX-YYY-Z-n

 # of supplies in rack mount (1-5)
 DC output voltage,
  (15 or 30 for EXC1; 19 for EXC2)
 AC Line Voltage (120 VAC or 230 VAC)
 Type of DC Output
  (1 for Unipolar, 2 for Dual Tracking
  Bipolar output)

GRAPHICAL USER INTERFACE

27000-GUI-WIN: Graphical User Interface Software for 27000 system. Requires Pentium Computer, 266 MHz or higher with one serial port, 1024x768 graphics resolution and 64 MB of RAM.

27000-GUI-SL: Site license for 27000 GUI software.

OPTIONAL BUILT-IN TEST

27000-1-TEST: Test instruments required for Factory Acceptance Test (FAT) and Go/No-Go (GNG) tests.

27000-FAT-WIN: Factory Acceptance Test software. Requires Pentium computer as specified for 27000-GUI-WIN. In addition, the 27000-FAT-WIN requires two serial ports or one GPIB port for control of the test instruments.

27000-GNG-WIN: Go/No-Go Test software. Requirements are the same as for the 27000-FAT-WIN

27000-FAT-SL: Site license for 27000 FAT software.

27000-GNG-SL: Site license for 27000 GNG software.

ORDERING INFORMATION

27454-X-YYY-?

Options:	6,
Filter Type:	EL8, TD8, BU8, BE8
	LP1, TD6, BU6, BE6
	EL4, TD4, BU4, BE4
Cutoff Frequency:	C, E, ... etc. See
	Cutoff Frequency
	Settings section

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