MICRO MEASUREMENTS
A VPG Brand

Signal Conditioning Amplifier

FEATURES

- Plug-in amplifier design; amplifiers are removable from the front panel without rear access
- Selectable constant-voltage or constant-current excitation: 0.5 to 15 V or 0.5 to 30 mA; selectable by single internal switch
- Calibrated gain from 1 to 3300; adjustable front-panel gain switch and calibrated front-panel ten turn potentiometer
- Front-panel monitoring of: ±10 V output; excitation; automatic balance status; and amplifier balance
- Automatic wide-range bridge balance with battery backup to retain balance in power-off condition
- Input coupling: selectable AC or DC by internal jumpers
- Fully grounded input amplifier: ±350 VDC or peak AC common-mode operating voltage
- Full-power bandwidth of 100 kHz at all gain settings; slew rate of 6.3 V/µs
- Built-in four-pole Bessel low-pass filter with cutoff frequencies of 1 Hz, 10 Hz, 100 Hz, 1 kHz and 10 kHz; front-panel frequency selection switch
- Two simultaneous buffered outputs: ±10 V and tape 1.0 VRMS; will drive up to 0.15 µF without instability
- Stable, proprietary bridge completion module for quarter and half bridge 120 and 350 Ω strain gage and transducer circuits
- 120 Ω dummy easily configured for 1000 Ω completion
- Built-in shunt calibration circuits; internal user-selectable configurations to provide two-point shunting of any bridge component or two-point double shunt calibration of transducers
- Optically isolated shunt calibration relays provided as standard; built-in power supply for relay operation is provided in ten-channel rack adapter and four-channel enclosure

DESCRIPTION

The 2200 Signal Conditioning System incorporates, as standard, all the features necessary for precise conditioning of strain gage and transducer inputs in the most severe operating environments.

The 2210B Amplifiers plug in from the front of the ten-channel 2250A Rack Adapter or four-channel 2260B Portable Enclosure without removing the rear-panel input connections.

Among the features of the 2210B Amplifier are isolated constant-voltage/constant-current excitation, guarded input structure with ±350 V common-mode capability, ±10 V and tape outputs, automatic wide-range bridge balance and four-pole Bessel low-pass filter.

Operating controls of the 2210B Amplifier are conveniently arranged and clearly marked to minimize the possibility of operator error. Constant-voltage or constant-current excitation, calibration configuration, and other optional operating modes are selected by easily accessible internal switches or jumpers.

ADDITIONAL DETAILS

A floating, guarded input environment maximizes the rejection of common-mode voltages up to ±350 V (operating). The input amplifier can also be AC-coupled for situations where only dynamic signals are of interest.

The independent, isolated bridge excitation system provides either constant-voltage or constant-current excitation. A front-panel LED serves as a supervisory indicator, and a front-panel switch removes bridge excitation to assist in evaluation of circuit integrity.

An automatic balance circuit is used to provide wide balance range and electronic injection of balance voltage. This feature eliminates transducer loading and assures

sufficient balance capability for practically all input configurations. The automatic balance circuit can be disabled from the front panel to allow measurement of initial unbalance, input noise, thermal offsets or zero shifts.

The four-pole Bessel low-pass filter provides five selectable bandwidths from 1 Hz to 10 kHz. The 1 Hz or 10 Hz positions can be used for quasi-static data with excellent rejection of line frequency (60 Hz) noise. The output of the low-pass filter can be routed to either the standard or tape output, or either output can be wideband.

Wide bandwidth and high slew rate at all gain settings and at full output (±10 V). This characteristic ensures that integrity of the system's performance is not compromised when higher gain settings are required.

A standard (±10 V) and a tape (1.0 VRMS) output are provided for each channel. The outputs are isolated from the guarded input and from chassis (system) ground. This feature gives the user complete independence to establish a high-quality instrumentation ground system at the recording or data acquisition site. Both outputs can drive long (high capacitance) coaxial cables without instability.

The system provides optically isolated shunt calibration circuits on each channel. Any desired calibration configuration can be selected by internal switches. External contact closures are also accessible via the input connector to facilitate double-shunt (two-level) transducer calibration. Calibration resistors can easily be changed to any special values. No soldering is required.

Individual amplifiers are removable from the front panel without disconnecting the input or output wiring. This gives the user the option of dedicated rack or enclosure wiring, sharing of amplifiers, and ease of amplifier replacement under emergency conditions.

SPECIFICATIONS

All specifications are nominal or typical at +73°F (+23°C) unless noted.

MODEL 2210B - SIGNAL CONDITIONING AMPLIFIER

PARAMETER	SPECIFICATION
INPUT	
Input Impedance: DC-coupled: AC-coupled: Low frequency cutoff (3 dB): Source Current:	 22 MΩ shunted by 250 pF 1.1 µF in series with 20 kΩ 8 Hz norm. ±10 nA typical; ±20 nA maximum
Input configuration:	2 to 10 wire plus guard shield accepts quarter, half, or full bridge strain gage or transducer inputs. Internal half bridge, dummy 120 Ω and 350 Ω completion resistors, remote sense and four-wire calibration capability provided. 1000 Ω completion capability also provided. Accepts inputs from ground-referenced or isolated devices.
Maximum Differential Input:	±50 VDC or peak AC
Maximum Common-Mode Input:	±350 VDC or peak AC
Guard Impedance:	Greater than 250 kΩ to output common; Greater than 1000 MΩ to power and rack ground
AMPLIFIER	
Gain:	1 to 3300; continuously variable; direct reading. Gain steps X1, X10, X100, X300; With 10-turn counting knob, X1 to X11. Accuracy ±0.5%
Linearity:	±0.01% of full scale at DC
Frequency Response: DC to 100 kHz: DC to 50 kHz:	 3±0.2 dB at all gain settings and full output 0.5 dB max at all gain settings and full output

Signal Conditioning Amplifier

PARAMETER	SPECIFICATION		
Gain Step vs Frequency Response (3 dB):	X300	100 kHz X 10	135 kHz
	X100	120 kHz X 1	240 kHz
Slew Rate:	6.3 V/µsec min at all gain settings		
Noise (350 Ω source impedance, DC-coupled): Referred-to-Input (RTI): Referred-to-Output (RTO):	 1 µV 0.1 Hz to 10 Hz p-p; 2 µV 0.1 Hz to 100 Hz p-p 3 µV 0.1 Hz to 100 kHz RMS Output related noise is a function of the setting of the gain multiplier potentiometer		
Zero Stability:	±2 µV RTI, ±200 µV RTO at constant temperature		
Temperature Coefficient of Zero:	±1 µV/°C RTI, ±100 µV/°C RTO; –10°C to 60°C		
Common-Mode Rejection	Gain	CMR (dB)	
	X1	82	
	X10	102	
	X100	122	
	X300	135	
Maximum Operating Common Mode Voltage	±350 VDC or peak AC		
Standard Output:	±10 V @ 10 mA max		
Tape Output	1.0 VRMS @ 10 mA max, or		
Output AC-coupled	±10 V @ 10 mA max (7 Hz, 3 dB)		
Output Monitor	±10 V standard monitored via front-panel jacks		
Output Isolation	>1000 MΩ from power and rack ground		
Output Protection	Protected against continuous short		
Capacitive Loading	Up to 0.15 µF		
Low Pass Filter	Four-pole Bessel low-pass filter with selectable 3 dB bandwidths of 1 Hz, 10 Hz, 100 Hz, 1 kHz and 10 kHz		
CONSTANT VOLTAGE EXCITATION			
Range :	0.50 to 15.0 VDC @ 85 mA max.		
Noise :	100 µV +0.002% of excitation p-p max DC to 20 kHz		
Line Regulation:	200 µV +0.01% of excitation max for line voltage change of 10% from nominal		
Load Regulation:	200 µV +0.01% of excitation max for load variation of 10% of 90% of full load		
Stability:	±0.01%/°C or 100 µV/°C, whichever is greater		
Remote Sense:	Error <0.0005%/Ω of lead resistance		
Monitoring:	Front-panel monitoring jacks		
Isolation:	Isolated from power ground and output common; floats with guard		

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PARAMETER	SPECIFICATION		
CONSTANT CURRENT EXCITATION			
Range :	0.50 to 15.0 mA DC or 1.00 to 30.0 mA DC Compliance voltage: 0.50 to 16.0 V		
Noise :	(1 µA + 10 µV) p-p; DC to 20 kHz		
Line Regulation:	±1 µA ±0.01% max for line voltage change of ±10% from nominal		
Load Regulation:	±1 µA ±0.01% max for 100% load change		
Stability:	±0.01%/°C or 1 µA/°C, whichever is greater		
Monitoring:	Front-panel monitoring jacks; 10 mV/mA Isolation Isolated from power ground and output common; floats with guard		
BALANCE			
Method:	Electronically injected automatic balance		
Range:	±15,000 µε (7.5 mV/V) RTI (X2 with internal jumper)		
Resolution:	0.50 µε RTI (X2 with internal jumper)		
Balance time:	4 seconds typical, 8 seconds max.		
Accuracy:	±2 mV RTO; ±2 µε RTI		
Balance trim:	±375 µε (188 µV/V) RTI		
Storage:	Digital with battery backup. Battery life 3-5 years.		
Activation:	Activated by front-panel switch or by optically isolated remote switch or low TTL level		
SHUNT CALIBRATION	Four internal shunt calibration resistors, ±0.1% tolerance		
	174.8 K	1000 µε (0.50 mV/V)	350 Ω bridge
	874.8 K	200 µε (0.10 mV/V)	350 Ω bridge
	59.94 K	1000 µε (0.50 mV/V)	120 Ω bridge
Activation:	Activated by front-panel switch, or by optically isolated remote contact closure or low TTL level. Internal selector switches for selection of two-point unipolar, bipolar, or two-point double shunt calibration circuits Calibration resistors plug into fixed terminals (no soldering)		
SIZE	7 H x 1.71 W x 17.88 D in (178 x 43 x 454 mm)		
WEIGHT	3.7 lb (1.67 kg)		

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MODEL 2250A - RACK ADAPTER

A prewired rack adapter which accepts up to ten Model 2210B plug-in amplifier modules. The Model 2250A also fits standard 19-in (483-mm) mainframe electronic equipment racks so that multi-channel system configurations can be conveniently housed. The Model 2250A contains all built-in wiring for connecting one rack adapter to another.

PARAMETER	SPECIFICATION
INPUT	Input plugs are provided for up to ten channels; Bendix PT06A-14-15 (SR)
OUTPUT	Standard ±10 V, BNC receptacle (10 ea) Tape 1.0 VRMS, BNC receptacle (10 ea)
REMOTE	Provides access to remote calibration and remote balance functions of 2210B Amplifiers. The required +5 V power supply is an integral part of the 2250A Rack Adapter.
POWER	115/230 VAC, 50-60 Hz, 120 W max.
SIZE	7 H x 19 W x 18.87 D in (178 x 483 x 479 mm)
WEIGHT	13.8 lb (6.25 kg)

MODEL 2260B - PORTABLE ENCLOSURE

A self-contained prewired rack/enclosure which accepts up to four 2210B Amplifiers. All input/output connectors are provided on the rear panel of the enclosure. A carrying handle allows convenient portability, and a snap-down bail support on the bottom is used to elevate the 2260B for work efficiency during bench-top operation.

PARAMETER	SPECIFICATION
INPUT	Input plugs are provided for up to four channels; Bendix PT06A-14-15 (SR)
OUTPUT	Standard ±10 V, BNC receptacle (4 ea) Tape 1.0 VRMS, BNC receptacle (4 ea)
REMOTE	Provides access to remote calibration and remote balance functions of 2210B Amplifiers. The required +5 V power supply is an integral part of the 2260A Portable Enclosure.
POWER	115/230 VAC, 50-60 Hz, 50 W max.
SIZE	7.31 H x 7.20 W x 20.16 D in (186 x 183 x 512 mm)
WEIGHT	8.1 lb (3.67 kg)

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