

## Signal Conditioning Amplifier



### FEATURES

- Accepts all strain gage inputs (foil and piezoresistive), potentiometers, DCDT's, etc
- Selectable bridge excitation, 0.7 to 15Vdc (11 steps), plus 0.2 to 7Vdc continuously variable
- Fully adjustable calibrated gain from 1 to 11 000
- Dual-range ( $\pm 5000\mu\epsilon$  and  $\pm 25\ 000\mu\epsilon$ ) automatic bridge balance, with "keep-alive" power to preserve balance for months without external power
- All bridge completion built in, including 120- or 1000- and 350-ohm dummies
- Dual polarity two-step double shunt calibration
- Bandpass:
  - 76kHz (-0.5dB)
  - 155kHz (-3dB)
- Switchable active filter - a 6-pole Butterworth is standard
- Two simultaneous buffered outputs
- Playback mode to filter and observe or re-record previously recorded low-level data
- Input impedance above 100 megohms

### DESCRIPTION

The 2300 System conditions and amplifies low-level signals to high-level outputs for multiple-channel, simultaneous dynamic recording and display on external devices.

Among its features, each 2310B Module includes a built-in power supply, active filtering, two simultaneous outputs, playback mode, wide frequency response, and voltage injection bridge balance.

Up to ten 2310B Modules can be mounted in a Model 2350 Rack Adapter; or up to four modules in a Model 2360B Portable Enclosure; or, a single 2310B can serve as a stand-alone unit using the 2310-A20 Line Cord and Stabilizer.

## Signal Conditioning Amplifier

**MODEL 2310B SIGNAL CONDITIONING AMPLIFIER**

The 2310B Conditioner/Amplifier Modules accept inputs from strain gages, load/pressure/dc displacement transducers, potentiometers, RTD's and nickel temperature sensors, without any internal modification.

Controls on the 2310B are arranged in sections, permitting easy setup. Clearly marked push-button and single-purpose switches minimize the possibility of operator error during use. With the exception of the playback switch, all operational and monitor controls are on the front panel. Switches for selecting remote sense and specific shunt calibration configurations are located on the printed circuit board inside the unit.

**Front Panel**

- Calibration: Momentary two-position switches,  $\pm A$  and  $\pm B$ , control shunt calibration levels; 4 point.
- LED Display: Set up indicator for amplifier balance, bridge balance and for monitoring the output polarity.
- Filter Section: Push-button controls for activating appropriate low- and high-pass active filters.
- Electronic Bridge Balance Section: Three-position switch--OFF, ON, RESET--for electronic bridge balance; auto ranging up to  $\pm 25\,000\mu\epsilon$  with nonvolatile zero storage; yellow light indicates high-range operation or over range condition.
- Vernier trim control is used to refine bridge balance when desired.
- AC IN: Capacitive coupling in the amplifier; eliminates static component of the signal.
- Bridge Excitation: ON-OFF switch for removing bridge excitation from the strain gage or transducer for noise documentation.
- Amplifier Balance: Adjusts amplifier offset.
- Excitation Level: Twelve-position switch; values arranged for doubling power with each step, with one 0.2 to 7Vdc continuously variable.
- Amplifier Gain Section: Continuously variable potentiometer (1.00 to 11.00) plus push-button course gain multipliers control amplifier gain; direct-reading.
- Battery Test: Momentary push button determines battery level for bridge zero storage.
- Main Power: Turns unit on/off; LED pilot light.
- Pin Jacks: Monitoring of Excitation, Unamplified Input, Amplified Output

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### Rear Panel



- AC Line Switch: Selects nominal 115 or 230Vac operation.
- Playback Section: Slide switch activates playback operating mode. Connects the input to the filter circuits and post amplifiers. BNC input connector.
- Low-level Output: Full-scale  $\pm 1.4V$  level available at this BNC connector for driving various recording devices and low-level analog-to-digital converters.
- High-Level Output: Full-scale  $\pm 10V$  level available at this BNC connector for driving an oscilloscope, digital voltmeter, analog-to-digital converter, etc.
- Input Receptacle: All sensor inputs made through this 15-pin quarter-turn connector. Pin selection determines mode of operation (mating plug included).
- Power Connector: Main power input from the rack adapter, portable enclosure or individual line plug. Additional pins for optional remote operation of shunt calibration, bridge excitation (ON/OFF), and electronic bridge balance.

## SPECIFICATIONS

All specifications are nominal or typical at  $+23^{\circ}C$  unless noted. Performance may be degraded in the presence of high-level electromagnetic fields.

### INPUT:

**Strain gages:** quarter, half or full bridge (50 to 1000 $\Omega$ ). Built-in 120 $\Omega$  and 350 $\Omega$  dummy gages; 1000 $\Omega$  dummy capability.

**Transducers:** foil or piezoresistive strain gage types; DCDT displacement transducers; potentiometers.

### EXCITATION:

**Eleven fixed settings:** 0.7, 1, 1.4, 2, 2.7, 3.5, 5, 7, 10, 12 and 15Vdc  $\pm 1\%$  max.

**One variable setting:** 0.2 to 7Vdc

**Current:** 0-100mA, min, limited at 175mA, max.

**Regulation (0-100mA  $\pm 10\%$  line change):**  $\pm 0.5mV$   $\pm 0.04\%$ , max measured at remote sense points. (Local sense: -5mV, typical, @ 100mA, measured at plug.)

**Remote sense error:** 0.0005% per  $\Omega$  of lead resistance (350 $\Omega$  load).

**Noise and ripple:** 0.05% p-p, max (dc to 10kHz).

**Stability:**  $\pm 0.02\%/^{\circ}C$ .

**Level:** normally symmetrical about ground; either side may be grounded with no effect on performance.

### BRIDGE BALANCE:

**Method:** counter-emf injection at pre-amp; automatic electronic; dual range; can be disabled on front panel.

#### Ranges (auto ranging):

$\pm 5000\mu\epsilon$  ( $\pm 1\%$  bridge unbalance or  $\pm 2.5mV/V$ ), resolution 2.5 $\mu\epsilon$  (0.0012mV/V).

$\pm 25\ 000\mu\epsilon$  ( $\pm 5\%$  bridge unbalance or  $\pm 12.5mV/V$ ), resolution 12.5 $\mu\epsilon$  (0.006mV/V).

**Balance time:** 2 seconds, typical.

**Manual vernier balance range:** 100 $\mu\epsilon$  (0.050mV/V).

## Signal Conditioning Amplifier

**Interaction:** essentially independent of excitation and amplifier gain.

**Storage:** non-volatile digital storage without line power for up to two years.

**SHUNT CALIBRATION:**

**Circuit (two-level, dual polarity):** Single-shunt (for stress analysis) across any bridge arm, including dummy gage.

Double-shunt (for transducers) across opposite bridge arms.

Provision for four dedicated leads to shunt external arms.

CAL circuit selected by switches on p.c. board.

**Standard factory-installed resistors ( $\pm 0.1\%$ ) simulate:**  
 $\pm 200$  and  $\pm 1000\mu\Omega$  @  $GF=2$  across dummy half bridge;  
 $\pm 1000\mu\Omega$  @  $GF=2$  across dummy gage (120 $\Omega$  and 350 $\Omega$ ).  
 $\pm 1mV/V$  (double shunt) for 350 $\Omega$  transducer

**Remote-operation relays (Option Y):** four relays (plus remote-reset relay for bridge balance and relay for excitation on/off). Each relay requires 10mA @ 5Vdc, except excitation on/off 25mA.

**AMPLIFIER:**

**Gain:** 1 to 11 000 continuously variable. Direct reading,  $\pm 1\%$  max. 10-turn counting knob (X1 to X11) plus decade multiplier (X1 to X1000)

**Frequency response, all gains full output:**

dc coupled: dc to 145kHz, -3dB max.

dc to 60kHz, -0.5dB max.

ac coupled: 1.7Hz typ. to 150kHz, -3dB max.

**Frequency response versus gain, full output:**

GAIN	-0.5dB	-3dB
1-11	130kHz	300kHz
10-110	110kHz	250kHz
100-1100	80kHz	160kHz
1000-11000	76kHz	155kHz

**Slew rate:** 7.8V/ $\mu$ s typical

**Input impedance:** 100m $\Omega$ , min, differential or common-mode, including bridge balance circuit.

**Bias current:**  $\pm 40nA$ , typical max., each input.

**Source impedance:** 0 to 1000 $\Omega$  each input.

**Common-mode voltage:**  $\pm 10V$ .

**Common-mode rejection (gain over X100):**

Shorted input: 100dB, min, at dc to 60Hz;

90dB, min, dc to 1kHz;

350 $\Omega$  balanced input: 90dB, typical, dc to 1kHz.

**Stability (gain over X100):**

$\pm 2\mu V/^\circ C$ , max, RTI (referred to input).

**Noise (gain over X100, all outputs):**

0.01 to 10Hz: 1 $\mu V$  p-p RTI.

0.5 to 125kHz: 6 $\mu V$ rms, max, RTI.

**FILTER:****Characteristic:**

Low-pass active six-pole Butterworth standard.

**Frequencies (-3  $\pm$  1dB):** 10, 100, 1000 and 10 000Hz and wide-band.

**Outputs filtered:** either one or both (switch-selected on printed circuit board).

**AMPLIFIER OUTPUTS:**

**Standard output:**  $\pm 10V$  @ 5mA, min.

**Slew Rate:** 7.8V/ $\mu$ s (typical)

**Low-level output:**  $\pm 1.414V$  (1Vrms) @ 5mA, min.

**Linearity @ dc:**  $\pm 0.02\%$ .

Either output can be short-circuited with no effect on the other.

**PLAYBACK:**

**Input:**  $\pm 1.414V$  full scale; input impedance 20k $\Omega$ .

**Gain:** X1 to low-level output; X7.07 to standard output.

**Filter selection:** As specified above.

**Outputs:** Both as specified above.

**OPERATING ENVIRONMENT:**

**Temperature:** 0 $^\circ$  to +50 $^\circ C$ .

**Humidity:** 10 to 90%, noncondensing.

**POWER:**

105 to 125V or 210 to 250V (switch-selected), 50/60Hz, 10 watts, max.

**Keep-alive supply (for bridge balance):** Lithium 3.6V, 1/2AA or equal. Shelf life approximately two years.

**SIZE & WEIGHT:**

**Panel:** 8.75 H x 1.706 W in (222.2 x 43.3mm).

**Case depth behind panel:** 15.9 in (404mm).

**Weight:** 6lb (2.7kg).

## Signal Conditioning Amplifier

### MODEL 2350 RACK ADAPTER



A prewired rack adapter which accepts up to ten Model 2310B plug-in amplifier modules. The Model 2350 also fits standard 19-in (483mm) mainframe electronic equipment racks so that multi-channel system configurations can be conveniently housed

#### SPECIFICATIONS

##### APPLICATION:

Fits standard 19-in (483-mm) electronic equipment rack.

Accepts up to ten 2310B Amplifiers. AC line completely wired.

Wiring for remote calibration with Option Y.

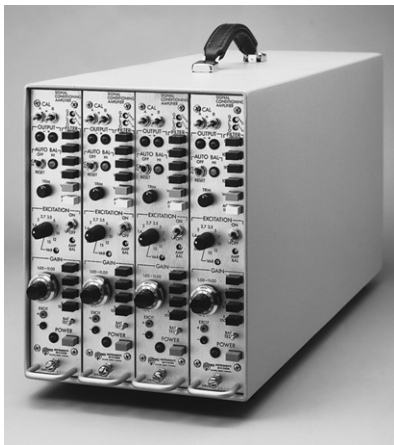
##### POWER:

115 or 230 Vac switch selected in amplifiers, 50/60Hz, 100 Watts max.

##### SIZE & WEIGHT:

8.75 H x 19 W x 19.06 D overall (222 x 483 x 484mm).  
13.5lb (6.1kg).

### MODEL 2360B 4-CHANNEL ENCLOSURE



Model 2360B Portable Enclosure includes all ac wiring. Accepts up to four amplifier modules.

#### SPECIFICATIONS

##### APPLICATION:

Enclosure to accept up to four 2310B Amplifiers.

AC wiring complete.

Wiring for remote calibration with Option Y.

##### POWER:

115 or 230Vac (switch selected in amplifiers), 50/60Hz, 100 Watts max.

##### SIZE & WEIGHT:

9.06 H x 7.20 W x 18.90 D in (229 x 183 x 480mm)  
6.75lb (3.1kg).

## Disclaimer

All product specifications and data are subject to change without notice.

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