INTERTECHNOLOGY INC.
1-800-465-1600
1 Scarsdale Road, Don Mills, Ontario, M3B 2R2
Tel: 416-445-5500, Fax: 416-445-1170
Montreal: 514-333-0930, Ottawa: 613-723-1828, Winnipeg: 204-895-2037, Calgary: 403-254-0095, Vancouver: 604-270-9538
E-Mail: sales@intertechnology.com, Website: www.intertechnology.com

P-3500

Portable Strain Indicator



VISHAY MEASUREMENTS GROUP

Featuring advanced electronic design and unique easy-to-understand operating controls for making accurate and reliable measurements



The Model P-3500 Strain Indicator is a portable, battery-powered instrument with unique features for use in stress analysis testing and for use with strain gauge based transducers. The P-3500 offers a choice of LCD or LED readouts and incorporates many unique operating features that make it the most advanced and easy-to-use instrument of its kind. In use, the operator follows a logical sequence of setup steps by activating color-coded push-button controls to prepare the instrument for making accurate and reliable measurements.

The P-3500 also incorporates a highly stable DC amplifier, precisely regulated bridge excitation supply and precisely settable gauge factor controls.

Static measurements are displayed directly on the indicator's readout with 1 microstrain resolution. An analog output with a -3 dB bandwidth of 4 kHz is provided to drive an external oscilloscope or recorder for dynamic measurements. The instrument will accept full-, half-, or quarter-bridge strain gauge inputs and all required bridge completion components for 120, 350 and 1,000 Ohm gauges are built -in.

Bridge excitation is 2 Vdc, resulting in low gauge power and negligible drift due to gauge self-heating. The P-3500 operates in fully ratiometric mode. Minute changes in bridge excitation due to drift or battery deterioration do not affect accuracy of reading.

Gauge factor is precisely settable (to a resolution of 0.001) by a front-panel 10-turn potentiometer and is displayed on the digital readout when the gauge factor push button is depressed.

The P-3500 operates from an internal battery pack consisting of 6 "D" cells, which arereadily available worldwide when replacement is required. Battery life is approximately 250 to 300 hours of continuous use (approx. 200 hours with LED readout). Battery condition is monitored by a miniature front-panel meter while the instrument is on. An external line-voltage adapter is also available (115 or 230 Vac, 50 to 60 Hz).

An optional transducer input connector facilitates connection of four- or six-wire strain gauge based transducers. The P-3500's unique remote-sense feature is operational whenever the remote-sense leads are connected and no switching is required. A remote calibration resistor is also accessible via a contact closure at the transducer connector.

FEATURES

- **Choice of 4-1/2 Digit LCD or LED Readout**
- **Direct Reading of Strain, Pressure, Torque, Load and Other Engineering Variables**
- **Battery or Line-Voltage Operation**
- **Convenient Color-Coded Push-Button Controls**
- **Gauge Factor Setting (to 4 significant digits) Displayed on Readout**
- **Quarter-, Half- and Full-Bridge Circuits**
- **Built-in 120/1,000 Ohm and 350 Ohm Bridge Completion**
- **Separate Bridge Excitation On/Off Control**
- **Transducer Connector with Remote-Sense**
- **Balance by Voltage Injection**
- **Analog Output**
- **ANSI/SEM Color-Coded Bridge Connection Terminals**
- **Portable, Lightweight, Rugged for Field Use**

MODEL SB-10

COMPANION SWITCH AND BALANCE UNIT FOR THE MODEL P-3500



The SB-10 Switch and Balance Unit features gold-plated push/clamp binding posts to allow fast, convenient and reliable connection of input circuits and individual 10-turn potentiometers with turns-counting dial for fine-balance adjustments.

The channel switch of the SB-10 has an OPEN position to allow the use of additional SB-10's with a single P-3500 Strain Indicator. The SB-10 also incorporates a common dummy position for use with other than 120, 350 or 1,000 Ohm gauges.

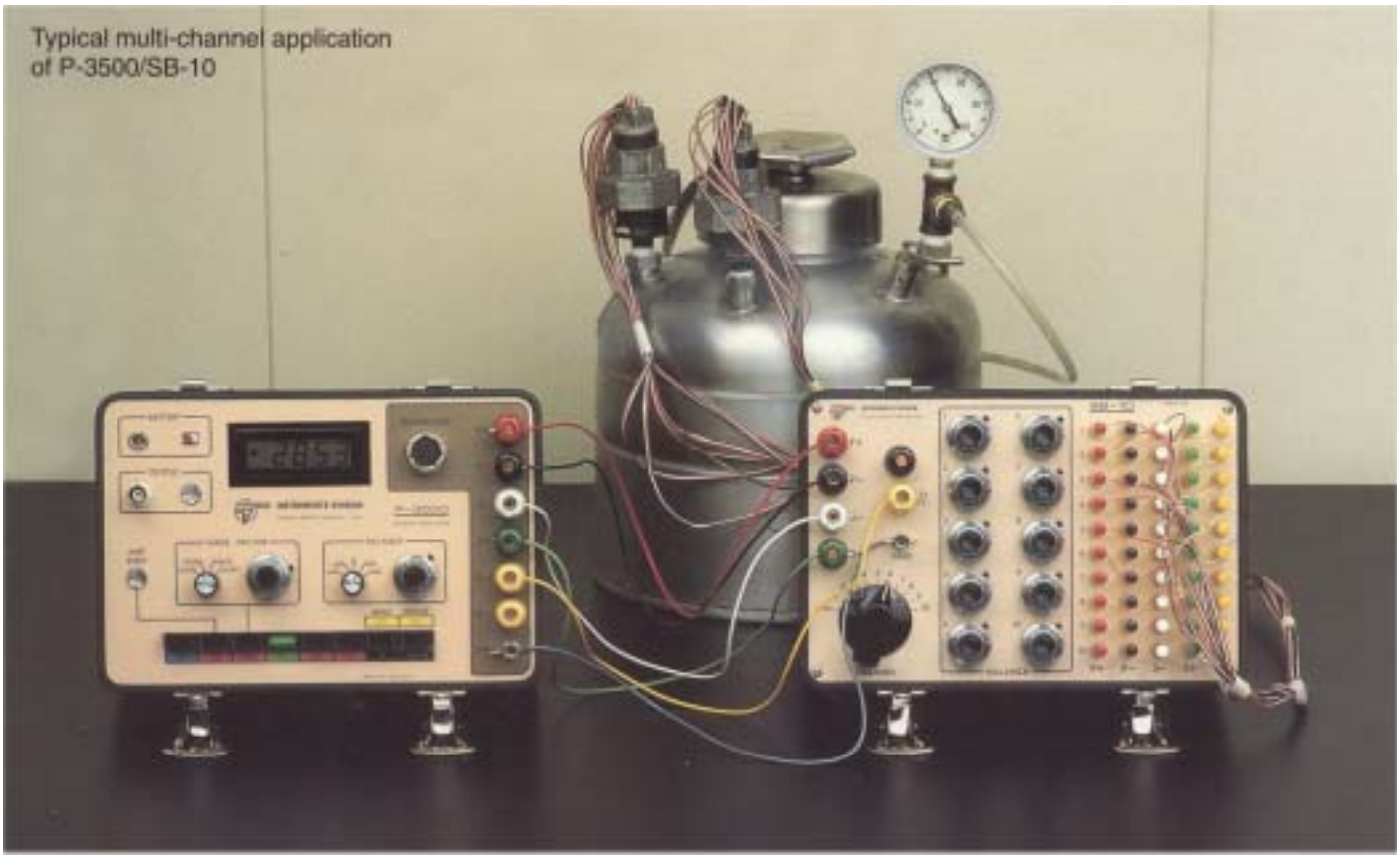
The combination of a P-3500 and SB-10 allows the operator to intermix, in a single 10-channel system, quarter-, half- and full-bridge circuits. This feature is not found in most portable strain gauge instrumentation.

Quarter and half bridges of the same resistance (e.g., all 120 or all 350 Ohm) can be intermixed in any combination without alteration of either instrument. If the installation makes use of both 120 and 350 Ohm gauges, it is necessary only to connect to the dummy binding post corresponding to the selected gauge resistance as the channel is changed.

Full bridges can also be intermixed in any combination. In this case, the operator needs only to depress the P-3500 BRIDGE push button to FULL position when a full-bridge channel is selected.

FEATURES

- **10 Channels plus OPEN Position**
- **Gold-Plated Push/Clamp Binding Posts**
- **Rugged, Lightweight**
- **Intermix Quarter, Half and Full Bridges**
- **Negligible Switching Resistance**
- **Switching Repeatability Better than 1 microstrain**



Typical multi-channel application of P-3500/SB-10

SPECIFICATIONS
MODEL P-3500

Range:
±19,999με at Gauge Factor <6.000.
±6.000 x 19,999με at Gauge Factor >6.000.
GF

Above ranges increased by factor of 10 when using X10 multiplier switch. Example: ±199,990 at Gauge Factor <6.000.

Accuracy:
±0.5% of reading ±3με for Gauge Factor settings of 1.000 to 9.900. ±0.5% of reading ±20με for Gauge Factor settings of 1.000 to 9.900 when using X10 multiplier.

Sensitivity (Resolution):
±1με at all Gauge Factor settings.
±10με when using X10 multiplier.

Gauge Factor:
Range 0.500 to 9.900. Precisely settable to a resolution of 0.001 by 10-turn potentiometer and four-position switch. Gauge Factor accuracy ±0.02% at all settings. Displayed on digital readout.

Balance:
Coarse: 5 switch positions: Off, ±2,000με and ±4,000με (GF=2.000). Tolerance ±1% nominal.
Fine: 10-turn potentiometer with turns-counting dial, ±1,050με min. range (GF=2.000). Zero position of potentiometer calibrated for zero ±2με.
All balance voltages are electronically injected at input of amplifier. No bridge loading by balance controls and no compromise of measurement range.

Bridge Excitation:
2.0 Vdc ±0.1%. Temperature stability better than ±0.02% per °C. Readings are fully ratiometric and not degraded by variation in excitation voltage.

Bridge Configurations:
Quarter-, half- and full-bridge circuits. Internal bridge completion provided for 120/1,000Ω and 350Ω quarter bridges. 60 to 2,000Ω half or full bridges.

Amplifier:
Warm-up drift: Less than ±3 counts at GF=2.000, cold start to ten min.
Random drift at constant ambient temperature: Less than ±1 count at GF=2.000.
Common-mode rejection: Greater than 90 dB, 50 to 60 Hz.
Temperature effect on zero: Less than 1 μV/°C referred to input.
Temperature effect on span: Less than 0.005%/°C.
Input impedance: Greater than 30 MΩ.

Calibration:
Shunt calibration across 120Ω and 350Ω dummy gauges to simulate 5,000με (±0.05%).

Analog Output:
Linear ±2.50V max. Adjustable from 40 μV/με to 440 μV/με, nominal. Output load 2 KΩ min. Bandwidth, DC to 4 kHz, -3 dB nominal. Noise: Less than 400μV rms at 40 μV/με output level.

Remote Sense:
Provided at the transducer connector. Remote-sense error less than ±0.001%/Ω of lead resistance.

Power:
Internal battery pack using 6 “D” cells. Battery life 300 hours nominal (200 hours with LED readout).

Case:
Aluminum.

Size and Weight:
9 x 6 x 6 in *(228 x 152 x 152 mm)*. 6.3 lb. *(2.9 kg)* including batteries.

Accessories:
Line voltage adapter for 115V or 230V, 50 or 60 Hz, 60/30 mA. Transducer input connector.

MODEL SB-10
(when used with Model P-3500)

Circuits:
10 channels plus OPEN position.

Inputs:
Will accept quarter-, half- or full-bridge circuits in any combination, including three-wire quarter bridges.

Balance Range:
Quarter and half bridge: ±2,000με with 350Ω half bridge in strain indciator.
Full bridge: ±2,000με for 350Ω bridge. Range proporational to bridge resistance.

Switching Repeatability:
Better than 1με.

Size and Weight:
9 x 6 x 6 in *(228 x 152 x 152 mm)*. 5.5 lb. *(2.5 kg)*.

All specifications nominal or typical at +23°C unless noted.

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