AE Series Strain Indicator Calibrator

Model AE-120 / AE-350

User's Manual

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INSTRUCTION MANUAL

AE Series Strain Indicator Calibrator

Model AE-120 / AE-350

MODEL AE
STRAIN INDICATOR CALIBRATOR

SECTION 1: DESCRIPTION

GENERAL

The AE Strain Indicator Calibrator is a passive instrument designed to simulate strain gage circuits for the purpose of statically calibrating the indicator or conditioner to which they would be connected.

True Wheatstone bridges circuits: quarter-, half- and full bridge of both 120Ω (model AE-120) and 350Ω (model AE-350) can precisely be simulated by the AE Calibrator.

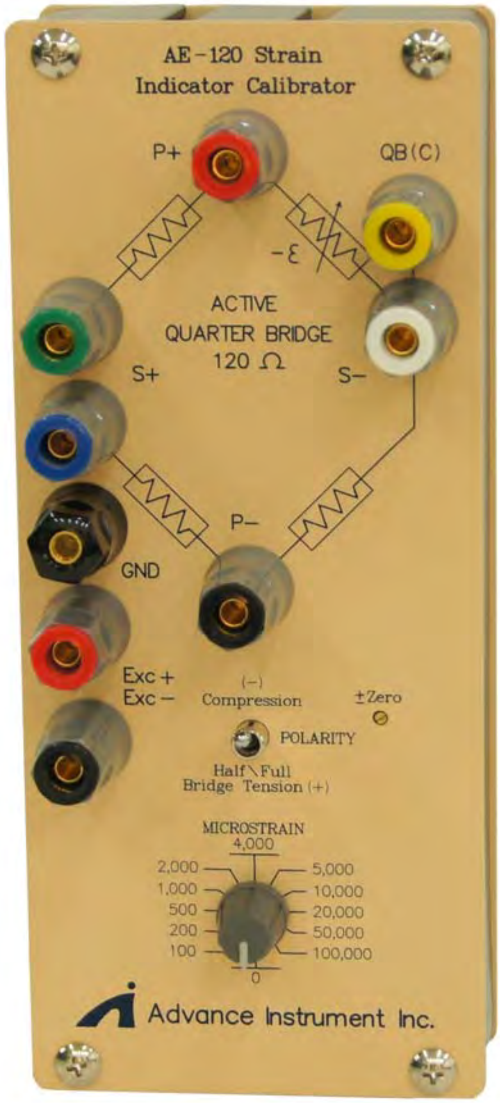
Output selection is by 12-position rotary switch, plus a reversing switch (for half and full bridge), so that any strain up to ±100,000με can be selected; no range change or rewiring is necessary over this full range. The instrument is direct-reading in microstrain for full or half bridges or quarter bridges, calibrated at GF = 2.

Strain gage transducers can be simulated to an output range of ±50 mV/V by 12-position rotary switch.

SPECIFICATIONS

Accuracy	0.3% of setting ± 3με (0.0015 mV/V), max.
Repeatability	± 3με (0.0015 mV/V), max.
Stability	(0.3% of setting ± 3με) /℃, max.
Thermal emf	1.0μv per volt of excitation, max.
Bridge Resistances	AE-120 for 120Ω AE-350 for 350Ω
Circuit	True -ΔR in one adjacent arm, plus three fixed arms for bridge completion.
Simulation	One active arm
Range	One active arm: @ G. F. = 2.000 Quarter bridge: 0, -100, -200, -500, -1000, -2000, -4,000, -5,000, -10,000, -20,000, -50,000, -100,000 με Half and Full bridge: 0, ±100, ±200, ±500, ±1000, ±2000, ±4,000, ±5,000, ±10,000, ±20,000, ±50,000, ±100,000 με Half and Full bridge: transducer: 0.000, ±0.050, ±0.100, ±0.250, ±0.501, ±1.002, ±2.008, ±2.513, ±5.051, ±10.204, ±26.316, ±55.556 mV/V
Output @ 0	150με (0.075 mV/V), max.
Excitation	To meet accuracy and repeatability specifications: 120Ω: 0-7V ac or dc 350Ω: 0-10V ac or dc Maximum permissible: 120Ω: 10V ac or dc 350Ω: 17V ac or dc
Environment ***	Temperature: +10°C to +38°C (+ 50°F to +100°F) Humidity: up to 70% RH, non-condensing
Size	202 × 87 × 60 mm 8 Lx 3.5 W x 2.4 H inches
Weight	1.3 kg (2.9 lb)

FUNCTIONAL DESCRIPTION



☐ BINDING Posts

The active bridge is between P+ and S-, while a fixed resistor
is in between P- and S-. A fixed resistor is also in between each P post and each S+ post respectively, these forms a half bridge if the shorting link at S+ is closed.

☐ QB (C)

The QB (C) post makes it convenient to connect the AE-120 in three wire quarter-bridge circuits.

☐ GND Post

GND post provide a convenient grounding point. This post eliminate or reduce electrical noise picked by connecting the GND to the ground of the strain indicator chassis.

☐ EXC + and EXC - Posts

Excitation input posts for use with half or full bridge connections.

☐ POLARITY Switch

The polarity toggle switch reverses the polarity of the excitation voltage applied to the P + and P - posts.
This enables the user to simulate tension and compression loads on half and full bridge connections

☐ ±ZERO Adjustments

The trim pot enables the user to trim the networks to eliminate zero-crossing errors (that is, so that the outputs at " + " and " - " are identical).

☐ 12-Position Rotary Switch

This 12-position rotary switch sets the desire output of strain simulation.

SECTION 2: INDICATOR CALIBRATION

2-1 While the following instructions explain proper use of this instrument in detail, a brief instructions found on the instrument rear lid will normally be adequate for subsequent use.

CONNECTIONS

2-2 Check proper calibrator requirement: AE-120 for 120Ω resistance, while AE-350 for 350Ω. Choose the circuit arrangement desired, and bridge configuration (see Fig. 1). Place the S+ shorting link as shown and connect the leads to the indicator. SHOW QB (C) ON FIGURE 1 BELOW.

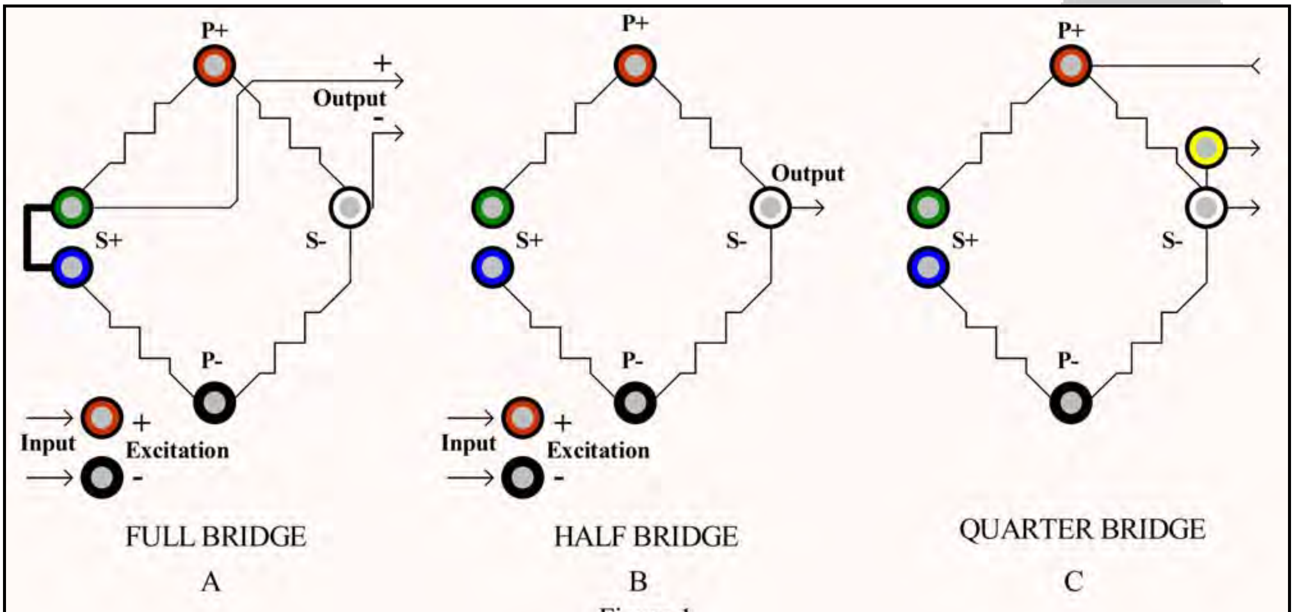


Figure 1

☐ Full Bridge (Fig. 1A):
Connect the indicator as shown in Figure 1A (note that the S+ shorting link must be closed).

☐ Half Bridge (Fig. 1B):
Connect the indicator as shown in Figure 1B (note that the S+ shorting link must be open).

☐ Quarter Bridge (Fig. 1C):
This arrangement simulates a single active strain gage where the balance of the bridge exists within the indicator. To essentially eliminate zero drift due to the temperature effects on the lead-wires, the 3-wire circuit shown should be used; for connections to the indicator refer to the instructions for that indicator.

2-3 The resistance of the lead-wires between the calibrator and indicator is somewhat critical and can produce several effects:

a. Reduced calibrator output (usually called lead-wire desensitization).

b. Unstable zero due to changes in lead resistance with ambient temperature.

c. Span errors when the indicator is "calibrated" by shunt-calibration of arms external to the indicator.

All the above effects are proportional to the ratio of the lead resistance to the gage (or bridge arm) resistance. Using relatively heavy leads (AWG #18 or 1 mm diameter) will minimize errors; this is especially important when using the 120Ω circuit. However, if the purpose is to simulate an actual gage or transducer installation, use lead-wires of the same size and length as would be used in the actual installation.

Good zero stability with temperature requires complete symmetry in the total bridge. To achieve this with the quarter or half bridge, use nearly identical wires for all leads (size and length) and keep them grouped together to minimize temperature differentials.

CALIBRATOR SET-UP

2-4 Rotate the switch to "0". ◦

2-5 Apply bridge excitation. Excellent stability will be achieved with normal excitations (up to 7V on AE-120 or 10V on AE-350). Maximum permissible excitation (AE-120 10V and AE-350 15V, respectively) may produce some warm-up drift; readings should not be recorded until stable, which may take up to a couple minutes at each selected output under extreme conditions.

2-6 If it is anticipated that readings on half and full bridge will be taken through zero (that is, both POLARITY buttons will be used), check that "+0" and "-0" both yield the same reading. If not, adjust ±ZERO slightly to achieve this.

INDICATOR SET-UP

2-7 Where an initial zero or bridge balance control is provided on the indicator, it would be normal practice to set this to achieve a zero reading so that data need not be corrected for initial offset.

Note: An unbalance of up to 50με (0.025 mV/V) can be encountered with the AE Calibrator where no indicator balance control is used.

2-8 Set the indicator scale factor as desired.

a. A strain indicator would usually be set for a gage factor of exactly 2.000 to achieve direct-reading calibration. If it is set for any other gage factor, data reduction will be necessary (see paragraph 2-9).

b. A transducer indicator may read directly in mV/V, percent input for a fixed or settable span, or it may read directly in engineering units (pounds, Newton, etc.) for a selected transducer. Any indicator above can be accurately calibrated with the AE calibrator, although some simple data reduction is generally necessary (see paragraph 2-10).

DATA REDUCTION

2-9 Strain Indicator:

a. If set for GF = 2.000 and, no data reduction is necessary: the indicator reading and calibrator can be directly compared. Some non-linearity in the indicator would be expected at the higher readings.

b. If set for any gage factor other than 2.000, the following relationship applies:
Ideal indicator reading = calibrator setting multiplied by 2.0 / GF
where GF = The gage factor of the strain gage connected to the users indicator.
again, some non-linearity would be expected.

For example:

GF = 2.1 , calibrator setting =1000

Ideal indicator reading = 1000×(2.000 / 2.1) = 952.4

2-10 Transducer Indicator (full bridge input)

a. mV/V Readout: mV / V
Ideal mV/V reading = calibrator setting
(See the far right column of Table 2 for the calibrator setting)

b. Percent Readout:
Ideal percent reading = calibrator setting / k x 100%
where k = full-scale output of transducer in mV/V.

c. Direct-reading in Engineering Units.
Ideal reading = calibrator setting x TR / k
where TR = rated input to transducer in engineering units (pounds, newtons, etc.)
k = transducer output in mV/V at rated input.

For example:

TR=1000N , k =1.964mv/v at 1000N

calibrator setting 1.002mV/V, (calibrator setting =2000με)

Ideal indicator reading = 1.002×1000/1.964 = 510.2N

Table 1. Bridge Non-Linearity with Error Range

MICROSTRAIN	One Active Arm Simulate Strain	One Active Arm Simulate Strain	Bridge Output
Rotary Switch position	Standard	Include Error Range	Non-Linearity
με (μm/m)	με (μm/m)	0.3% Setting ± 3με	με (μm/m)
0	0	0	0
100	-100	-100 ± 3.3	-100
200	-200	-200 ± 3.6	-200
500	-500	-500 ± 4.5	-500
1,000	-1,000	-1,000 ± 6	-1,001
2,000	-2,000	-2,000 ± 9	-2,004
4,000	-4,000	-4,000 ± 15	-4,016
5,000	-5,000	-5,000 ± 18	-5,025
10,000	-10,000	-10,000 ± 33	-10,101
20,000	-20,000	-20,000 ± 63	-20,408
50,000	-50,000	-50,000 ± 153	-52,632
100,000	-100,000	-100,000 ± 303	-111,111

Table 2. Simulate strain with mV/V

MICROSTRAIN	Quarter Bridge	Half or Full Bridge one Active Arm		Half or Full Bridge one Active Arm	
Rotary Switch position	Polarity Switch -% only	Polarity Switch -%	Polarity Switch +%	Polarity Switch -%	Polarity Switch +%
με (μm/m)	Simulate με (μm/m)	Simulate με (μm/m)	Simulate με (μm/m)	Output - mV/V	Output + mV/V
0	0	0	0	0.000	0.000
100	-100	-100	100	-0.050	0.050
200	-200	-200	200	-0.100	0.100
500	-500	-500	500	-0.250	0.250
1,000	-1,000	-1,000	1,000	-0.501	0.501
2,000	-2,000	-2,000	2,000	-1.002	1.002
4,000	-4,000	-4,000	4,000	-2.008	2.008
5,000	-5,000	-5,000	5,000	-2.513	2.513
10,000	-10,000	-10,000	10,000	-5.051	5.051
20,000	-20,000	-20,000	20,000	-10.204	10.204
50,000	-50,000	-50,000	50,000	-26.316	26.316
100,000	-100,000	-100,000	100,000	-55.556	55.556

AE AS PRECISION ATTENUATOR

2-11The AE Strain Indicator Calibrator is simply a passive network in a real Wheatstone bridge configuration with an output/input ratio from 0 to 0.05 in 100, linear steps. It therefore has application where large but precise attenuations are required.

For example it can be used to check the linearity of low-input instruments.

If the AE is excited (at P+ and P-) with a stable and accurate 2V source 3.3 outputs of 0 to 100 mV can be generated between S+ and S- in increments of 0.1 mV. The step resolution will always be one part in 20,000 of the excitation?

The user is cautioned on two limitations:

a. The output at "000" may be up to half the value of the smallest step: (0.0025% of excitation) unless some external means are provided to balance the AE calibrator. This could be a 10k potentiometer across P+ and P- with the slider connected to S+ via a resistor of some 500Ω; the pot would be set as required to achieve zero output.

b. Either the power supply output must be floating (not grounded) or the instrument must be able to accept a differential input, since the level at the output will be half the excitation voltage, measured from the P- binding post.

SECTION 3: SERVICING

3.1 The AE Strain Indicator Calibrator is a completely passive device consisting of only switches and precision resistors. Routine or preventive maintenance is not required. In view of the intended purpose of this instrument as a "standard," it should be accorded more than the normal care in handling. Avoid storing in areas of unusual environment, such as extremes temperature, high humidity, or areas containing corrosive atmospheres.

3.2 Should it be necessary to replace any resistors in the networks, it is strongly suggested that such replacements be obtained from Advance Instrument Inc. to maintain the superior quality of these resistors with special regard to stability with time and temperature. All resistors have a tolerance of 0.01 to 0.1%.

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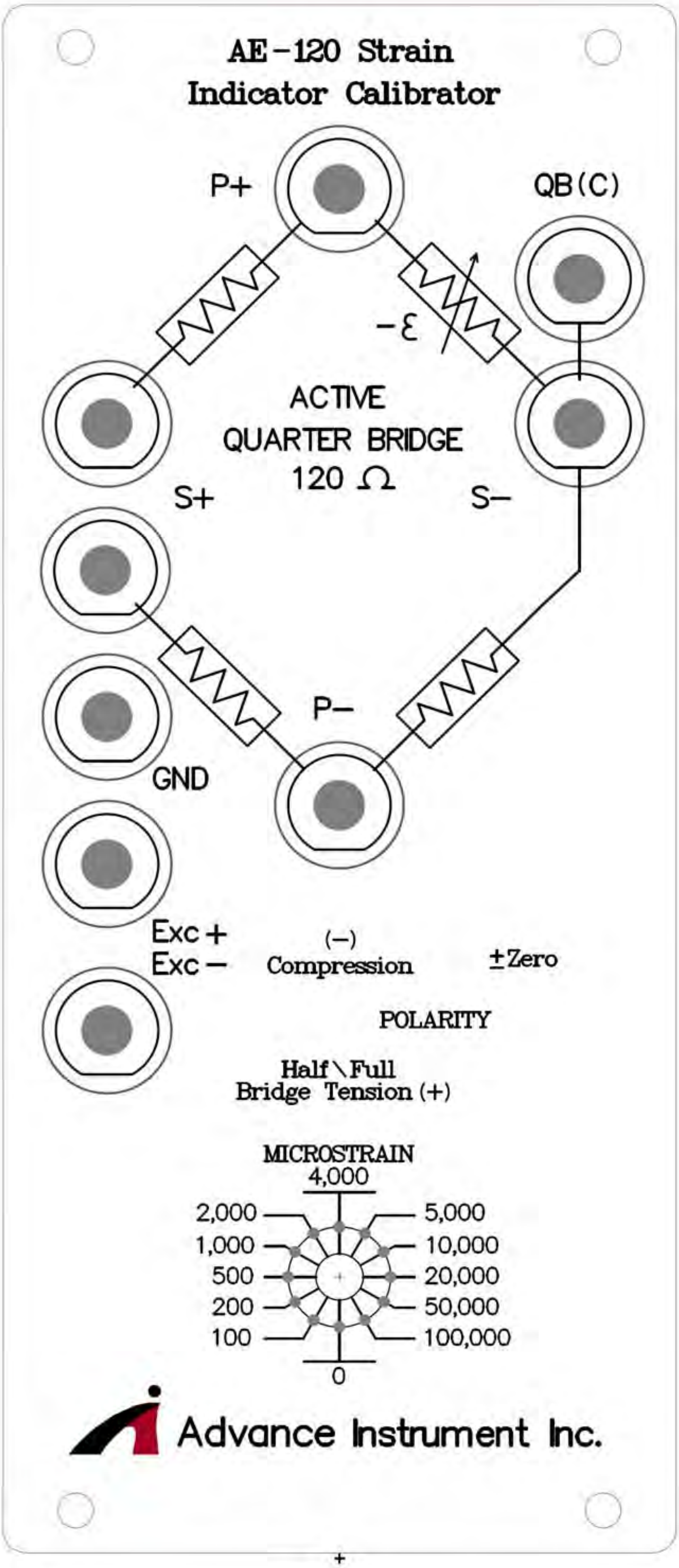
AE-120 Strain
Indicator Calibrator
P+
QB(C)
-ε
ACTIVE
QUARTER BRIDGE
120 Ω
S+
S-
P-
GND
Exc +
Exc -
(-)
Compression
±Zero
POLARITY
Half\Full
Bridge Tension (+)
MICROSTRAIN
4,000
2,000
1,000
500
200
100
5,000
10,000
20,000
50,000
100,000
0
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