

## SERIES AP5103 DIN-Rail DC Strain Gage Conditioner

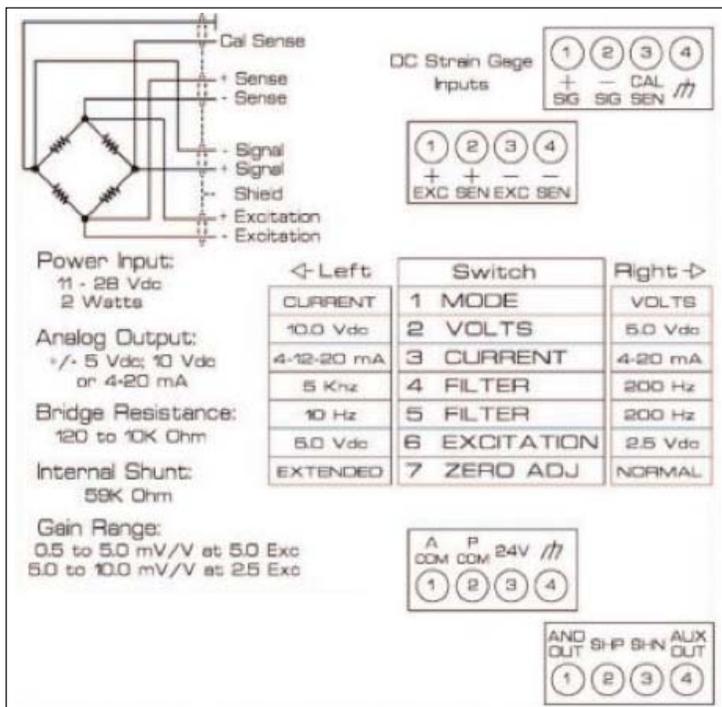


ISO 9001:2000

## GENERAL DESCRIPTION AND SPECIFICATIONS

The Series AP5103 is a single-channel DIN Mount instrument which is easily configured, rugged, analog based signal conditioner made to operate with traditional Wheatstone mv/V stain gage bridge sensors used to measure force, pressure, torque and other DC strain gage related measurements. The Series AP5103 has an extremely wide DC power input range with user selectable gain, zero and analog output making it adaptable to any users sensor application that requires stable, repeatable and noise free analog signals for control or data acquisition.

The Series AP5103 is best calibrated by means of a “two-point (dead-weight)” or shunt-calibration technique, which is outlined in section three. The supplied calibration resistor is 59 kilohms, 1% which is located internally to the AP5103 case.



View of Side Label of the Series AP5103 Strain Gage Module

### Series AP5103 DC Strain Gage Module

Access switch settings via the front panel of the AP5103 by gently pulling the clear plastic cover (from the bottom side) so the cover rotates open from or without power to the unit. Once completed, return the cover to the the top. Use a small tool or finger to place the switches to the left or right position as you face the front of the module. This process can be done with original position.

### DC Strain Gage Symmetry Operation

For applications requiring precision in both tension and compression (CW & CCW for torque cells), the AP5103 contains a symmetry adjustment which corrects for negative span or slope of the transducer.

# AP5103 SPECIFICATIONS

**Measurement Range:** Adjustable 0.5 mV/V to 10.0 mV/V; nominal full-scale

**Transducer Types:** Conventional 4-arm strain gage bridges, 120 to 10 k ohm

**Excitation:** 2.5 or 5.0, selectable - up to 70mA

**Power Supply :** 11 - 28 Vdc regulated; 2 watts max.

**Analog Output :** selectable;  $\pm 0$  to 5,  $\pm 0$  to 10 Vdc, 4-12-20 or 4-20mA  
(20% over-range, voltage only)

**Operating Temperature :** -10 to +70 Degrees C, 5 to 95% relative humidity, non-condensing

## Amplifier

**Common - Mode Range :**  $\pm 3$  V operating;  $\pm 30$  V without instrument damage

**Common - Mode Rejection Ratio :** - 60 dB @ 1/2 excitation

**Input Impedance :** Differential and Common-Mode > 10,000 M $\Omega$

**Offset :** user adjustable; vs. Temperature:  $\pm 30$  ppm / $^{\circ}$ C; vs. Time:  $\pm 10$  ppm/month

**Gain Accuracy :** Limited only by calibration accuracy

**Gain Stability :** vs. Temperature:  $\pm 30$  ppm/ $^{\circ}$ C; vs. Time:  $\pm 10$  ppm/month

**Linearity :** better than  $\pm 0.03\%$  of full scale

**Filter:** 3-pole modified Butterworth; 3 dB down at 10 Hz, 200 Hz or 5kHz; selectable

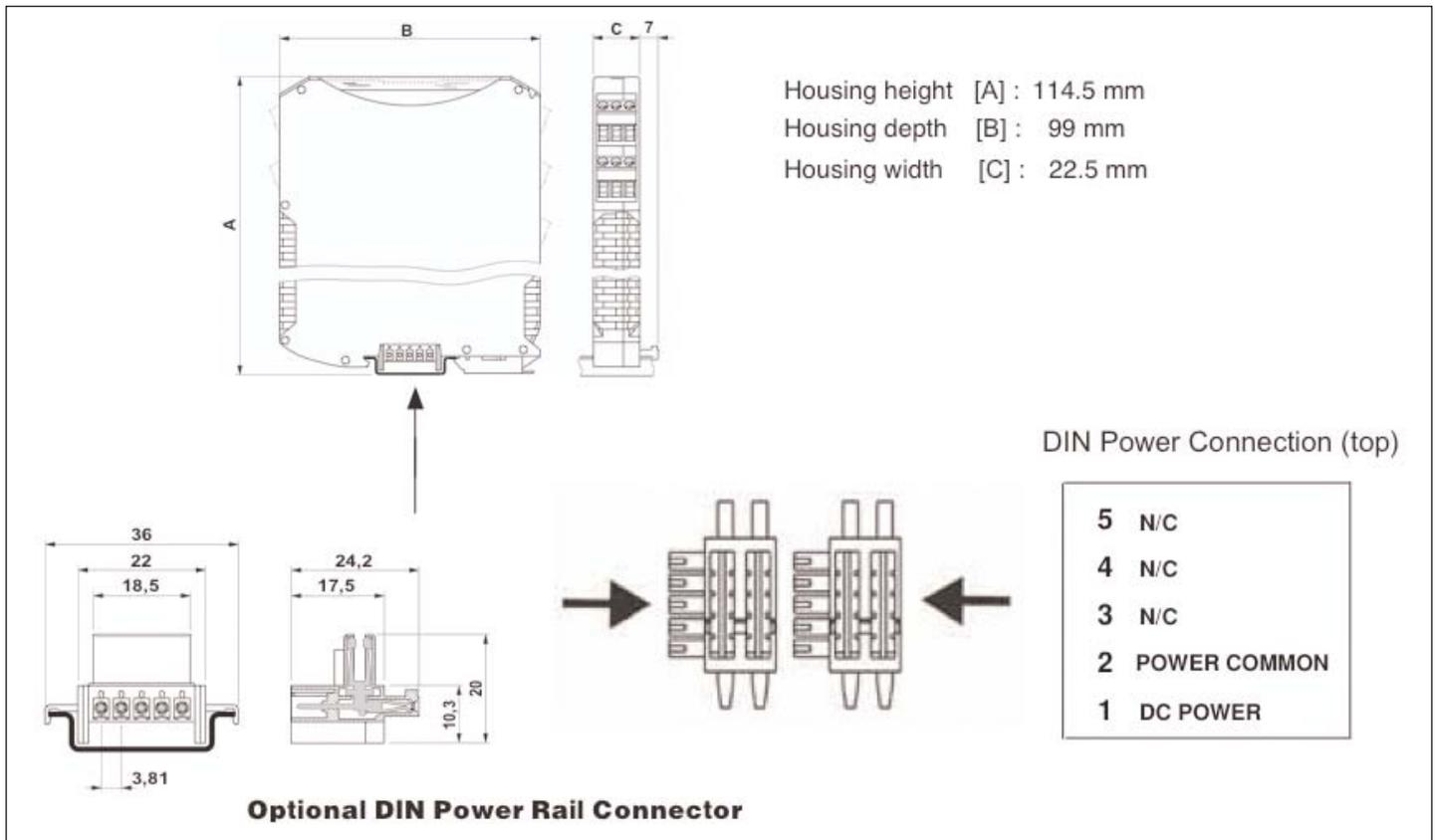
### Step-Response Settling Time (Full-Scale Output @ 10 Hz):

To 1% of final value: 0.068 sec; (0.0034 sec @ 200 Hz) (0.00015 sec @ 5 kHz)

To 0.1% of final value: 0.090 sec; (0.0046 sec @ 200 Hz) (0.00018 sec @ 5 kHz)

To 0.02% of final value: 0.100 sec; (0.0054 sec @ 200 Hz) (0.0002 sec @ 5 kHz)

## Dimensions



# TRANSDUCER CONNECTIONS

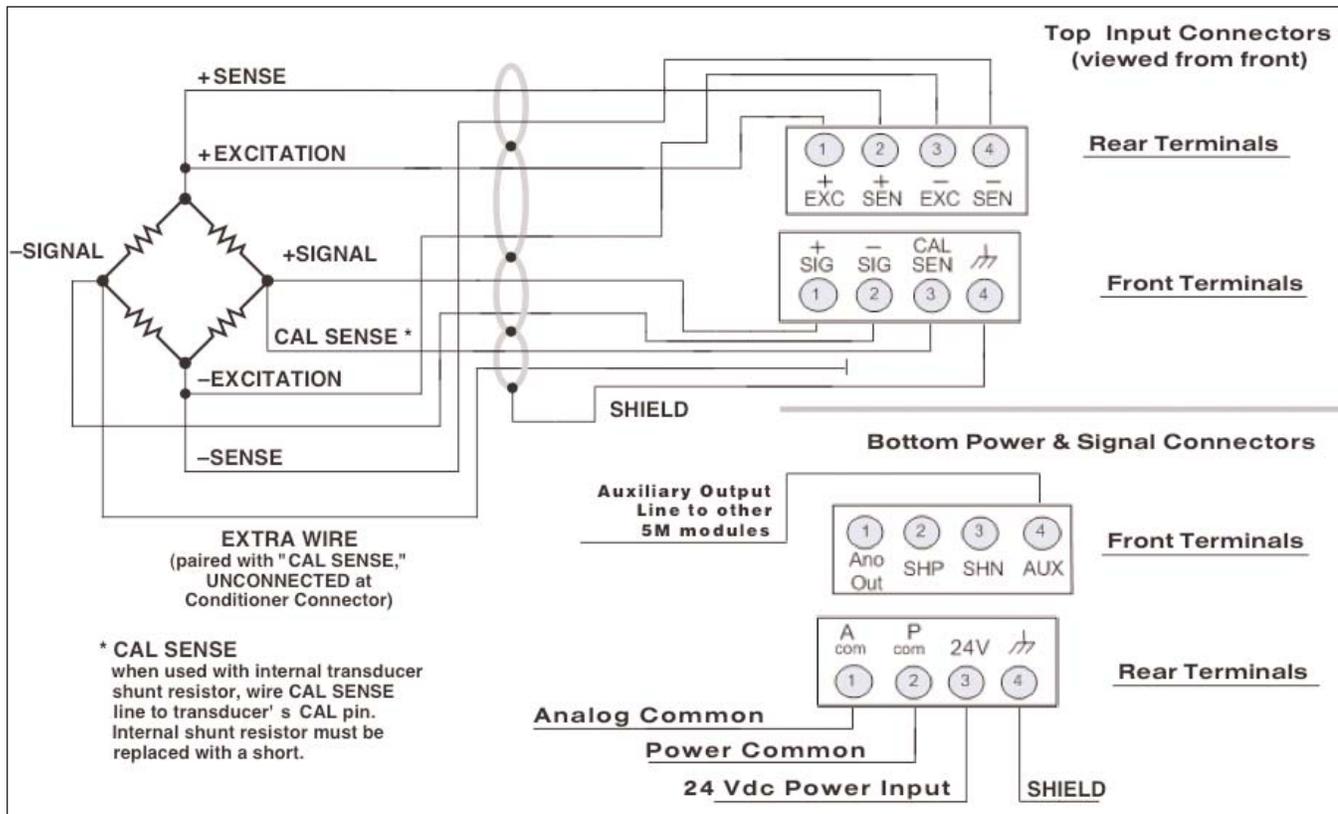
The Series AP5103 I/O CONNECTIONS are via non-removable screw terminals which will accept wire sizes from AWG 12 to 26. NOTE: The recommended transducer cabling would be eight wire, individually shielded, twisted pair - wired as indicated (Fig. 1) Sense lines must be connected at the transducer (as recommended) or at the AP5103 screw terminals - as a minimum. Table 2 denotes screw terminal assignments.

**Table 2 Series AP5103 Pin Assignments**

I/O Connector Pin Number	Screw Terminal	Terminal Label	Conditioner Line Function
Top Rear 1	1	+ EXC	+ EXCITATION
Top Rear 2	2	+ SEN	+ SENSE
Top Rear 3	3	- EXC	- EXCITATION
Top Rear 4	4	- SEN	- SENSE
Top Front 1	1	+ SIG	+ SIGNAL Input
Top Front 2	2	- SIG	- SIGNAL Input
Top Front 3	3	CAL SEN	CALIBRATION SENSE
Top Front 4	4	⏏	SHIELD
Bottom Front 1	1	Ano Out	ANALOG Output
Bottom Front 2	2	SHP	Shunt Positive
Bottom Front 3	3	SHN	Shunt Negative
Bottom Front 4	4	AUX	AUXILIARY Output *
Bottom Rear 1	1	Acom	Analog Common
Bottom Rear 2	2	Pcom	Power Common
Bottom Rear 3	3	24 V	24 Vdc Power
Bottom Rear 4	4	⏏	SHIELD

\* AUXILIARY Output is used for future 5M module interfacing only

**Fig. 1 Series AP5103 Transducer Cabling**



## CALIBRATION

Calibration of the AP5103 is accomplished by the conventional shunt technique, using an internally installed calibration resistor, or via the "dead-weight" method.

**Calibration Resistor.** If a fixed resistor is shunted across one arm of a strain gage bridge, it produces an unbalance equivalent to that of a particular value of mechanical input. If this Equivalent Input value is accurately known, it can be used as a reference point for shunt calibration of the system. Upon completion of installation of the transducer and its associated cabling, the user can:

1. Perform an overall dead weight calibration using a precisely known value of mechanical input. The calibration can then be transferred to the installed calibration resistor for convenience in subsequent checking.
2. Replace the installed calibration resistor with one (or an equivalent resistance value) supplied by the transducer manufacturer to achieve a precisely known Equivalent Input allowing the instrument sensitivity to be adjusted correctly.
3. Determine the Equivalent Input value for the installed calibration resistor, knowing the transducer sensitivity, and adjust the instrument sensitivity accordingly.

A one percent, 59-kilohm calibration resistor is installed in the AP5103 at the factory. The installed resistor can usually be used even though the transducer calibration data mentions some other resistance value. In Section 4 of this manual, the techniques described above are demonstrated. If, however, the installed value of calibration resistor is not appropriate for the transducer and measurement range to be used, the 59-kilohm resistor should be replaced at this time. The calibration resistor is mounted on terminals located internally to the AP5103 conditioner's printed-circuit board. It can be accessed by removing the instrument case (Fig. 5).

*Note: A variety of DC Load Cells and Slip Ring Torque Transducers are supplied with the appropriate calibration resistor integral to the transducer. When this type of transducer is used it will be necessary to place a short across the 59-kilohm resistor internal to the instrument. The transducer calibration resistor can be appropriately connected to the AP5103 calibration circuit via the transducer cabling. Refer to cabling diagram section of this manual in the area of CAL SENSE.*

This section contains the instructions for calibrating the AP5103. Included is a functional description of the instrument front-panel (see Figure 2). To perform calibration, proceed as follows with the sensor or calibration standard connected.

- A. Turn power ON to the AP5103 DC Power input terminal (11 to 28 Vdc input) The front-panel indicator should light green to indicate the application of dc power. Allow 10 minutes of warmup for stabilization of transducer characteristics. Set the Coarse Zero and Span controls label marked position.

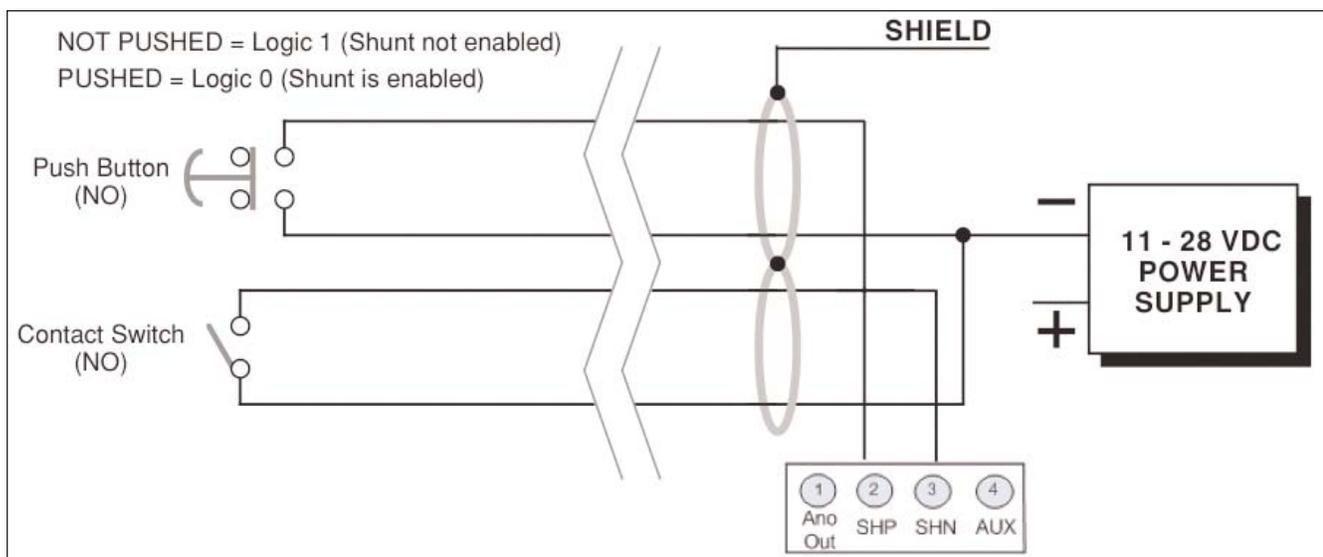
## CALIBRATION (cont.)

- B. Set the Coarse Zero and Span controls to the marked label position (<, Min>).
- C. Position the front panel switches to the desired settings for the application. Refer to Fig. 2 for details. Connect readout device (i.e. voltmeter) to ANO & A Common.
- D. With the transducer unloaded, adjust the Coarse Zero and the Fine Zero control until the desired analog output is achieved. If greater zero authority is desired, place the front panel Switch 7 - "Zero Adj" to the extended range. This will allow the user to obtain 100% zero offset control. The Normal position of switch 7 allows for approx. 25% Zero authority.
- E. Apply a known dead weight value which is greater than one half of full scale in the positive direction or activate the "SHP" terminal (shunt positive) by connecting "SHP" to "Power Common" as described in Fig. 3. Adjust Coarse Span to obtain your nominal full scale analog output. Use Fine Span control to adjust the signal to the precise value required (or for an analog value that corresponds with the appropriate Shunt Calibration value). Unload the transducer and check "Zero" and adjust as necessary. Repeat Span load and verify values. If the transducer is to be also used in the negative realm, load the transducer in the negative direction with the the same dead weight value or activate the "SHN" (shunt negative) and adjust the Symmetry control until you obtain the proper negative output reading.
- F. Repeat step (e) as needed to obtain analog output precision. Note that any Span (gain) adjustments will effect the Zero (balance) value.

*Note: When applying the SHUNT resistor value for calibration, the sensor should be in an "unloaded" condition.*

*When completed, replace the plastic front cover to its original position and ensure connections and proper shielding to the module, and to the DIN rail to which the AP5103 is attached, are correct.*

**Fig. 3 Shunt Connections**



## CALIBRATION (cont.)

If the transducer calibration is unknown, the following calculation is useful to calculate an Equivalent Input value for the factory installed, 59K Ohm shunt resistor. This will approximate the value assuming that the mv/V sensitivity and bridge resistance of the sensor are known.

$$X = \frac{25000 R_b}{K R_c}$$

where **X** = Equivalent Input, % of full scale

**R<sub>b</sub>** = bridge resistance, ohms

**K** = transducer sensitivity, mV/V full scale

**R<sub>c</sub>** = calibration resistance, ohms (59 k installed)

**Sample Calculation: Assume that K = 3.000 mV/V for a 5000-pound loadcell (fullscale) with a bridge resistance of 350 ohms.**

$$X = \frac{25000 \times 350}{59000 \times 3} = 49.4\% \text{ of full scale} = \mathbf{2472 \text{ pounds}}$$

### Remote Calibration Check.

The instrument can be placed in the calibration mode (positive or negative) by shorting pin Power Common and SHP for positive or SHN for negative on the lower I/O connector. Figure 4 indicates two methods of remotely entering the calibration mode (external switch, or push button control). The Remote Cal function provides a convenient method of periodically monitoring calibration of the instrument in the positive or negative realm.

**Fig. 2 Front Panel Settings and Indicators**

1	I	V
2	10.0	5.0
3	12mA	4mA
4	5000	200
5	10	200
6	5.0	2.5
7	EXT	NRM

Coarse Zero	Over Range
Fine Zero	
Coarse Span	Power
Fine Span	
Symmetry	

**Switch 1 - Mode** - selects current (I) or voltage analog output

**Switch 2 - Volts** - selects +/- 5 or +/- 10 Vdc when mode is voltage

**Switch 3 - Current** - selects 4-12-20 or 4-20mA when mode is current

**Switch 4 - Filter** - selects 5 kHz or 200 Hz at 3 db, for 200 Hz switch 5 must be set to the right

**Switch 5 - Filter** - selects 10 Hz or 200 Hz at 3 db, for 200 Hz switch 4 must be set to the right

**Switch 6 - Excitation** - selects excitaton level, 2.5 or 5.0 Vdc - effects mV/V gain

**Switch 7 - Zero Adj.** - selects extended (100%) or normal (20%) zero authority

**Coarse Zero** - 16 position switch adjustment for stepped zero balance control with default calibration indicator.

**Fine Zero** - 16 turn potentiometer for fine zero balance control

**Coarse Span** - 16 position switch adjustment for stepped gain control with default calibration indicator

**Fine Span** - 16 turn potentiometer for fine gain - span control

**Symmetry** - adjust the negative output span to be equal to the positive output

**Over Range** - indicates when the analog output is 2% greater than mode selected

**Power** - indicates the power input voltage is ON

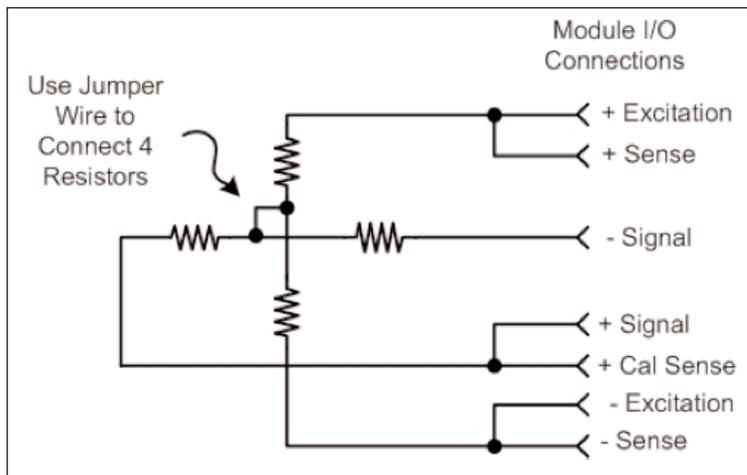
## VERIFICATION OF NORMAL OPERATION

It is the purpose of this section to aid the user in determining, in the event of a malfunction of which the Series AP5103 is suspected of contributing, whether the instrument is functioning normally or whether it is the source of the observed trouble. In the event the unit requires repair, the user may also contact the factory Service Department or the local Daytronic Representative for assistance. Daytronic service information is located on the last page of this document.

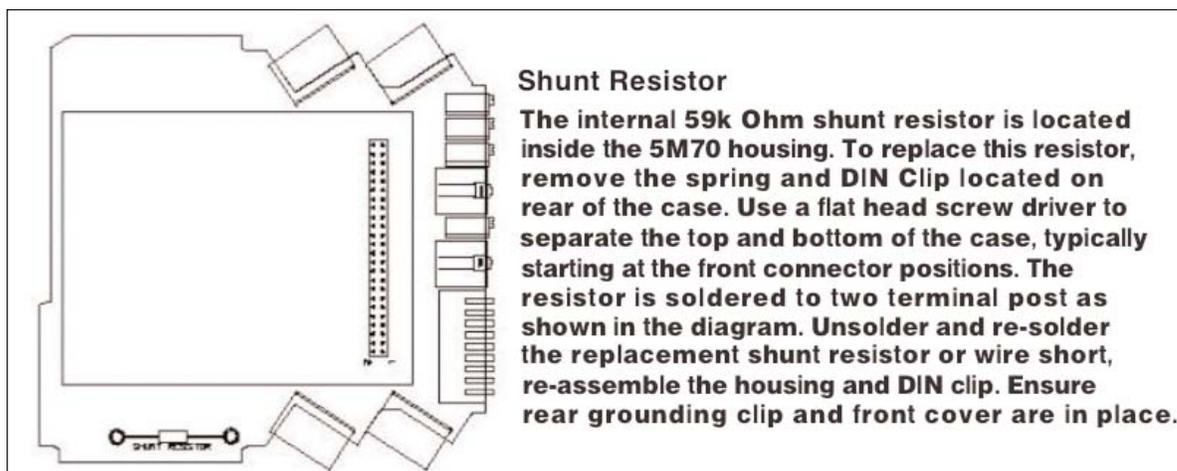
If the instrument is suspected of faulty operation, perform the following steps.

- A. If the unit is totally inoperational (front-panel power indicator does not light), check the primary power input terminals for proper connection. Input power can be from 11 to 28 Vdc and will draw less than 2 watts. If properly connected, the front panel Green LED will be illuminated. Before reapplying power, visually inspect the power supply and the input power connections for any discrepancy which could have caused the overload.
- B. If the transducer has some preloading, the BALANCE controls may not allow successful zeroing of the instrument output. This condition can be remedied by connecting a resistor (50 k- 200 k range, metal-film type) from the +Signal terminal of the transducer to the + or –Excitation Sense terminals. The Excitation terminal to which the connection is made is determined by the direction of the loading or off-zero reading.
- C. The inability to balance correctly, where the instrument output reads totally off scale and the BALANCE controls have no authority, can very likely be the result of a damaged or defective transducer or cable. This possibility can be confirmed (or eliminated) by substituting a transducer and cable known to be in good condition or by simulating a balanced transducer, using either a commercially available transducer simulator or the simple star bridge arrangement shown in Figure 7. The star bridge simulates a conventional four-arm bridge in an exact condition of balance. To construct a star bridge, connect four 10% carbon resistors as shown in Figure 5. Use 180-ohm resistors to simulate a 350-ohm bridge and use 56-ohm resistors to simulate a 120-ohm bridge. Neither the resistor values nor temperature characteristics are critical since the balance condition of a star bridge is not determined by the resistance values. Solder two resistors together, then solder the remaining two resistors together. Next, connect the two junctions together using a separate wire as shown. There is a good reason for this method of construction, and it should be followed. Connect the substitute or simulated transducer to the instrument I/O connector using a short 4-wire cable configuration as shown in Figure 4. Attempt to balance the substitute simulated transducer. If conditions now appear to be normal, the transducer or cable is at fault. If the previous difficulties persist, the AP5103 may be faulty.

**Fig. 4 Star Bridge**



**Fig. 5 Internal Shunt Location**



**WARRANTY:** Stellar Technology warrants that its product shall be free from defective workmanship and/or material for a twelve month period from the date of shipment, provided that Stellar Technology's obligation hereunder shall be limited to correcting any defective material FOB our factory. No allowance will be made for any expenses incurred for correcting any defective workmanship and/or material without written consent by Stellar Technology. This warranty is in lieu of all other warranties expressed or implied.