STELLAR TECHNOLOGY
INCORPORATED

TECHNICAL MANUAL

SERIES AP5104
DIN-Rail AC LVDT Conditioner

ISO 9001:2000

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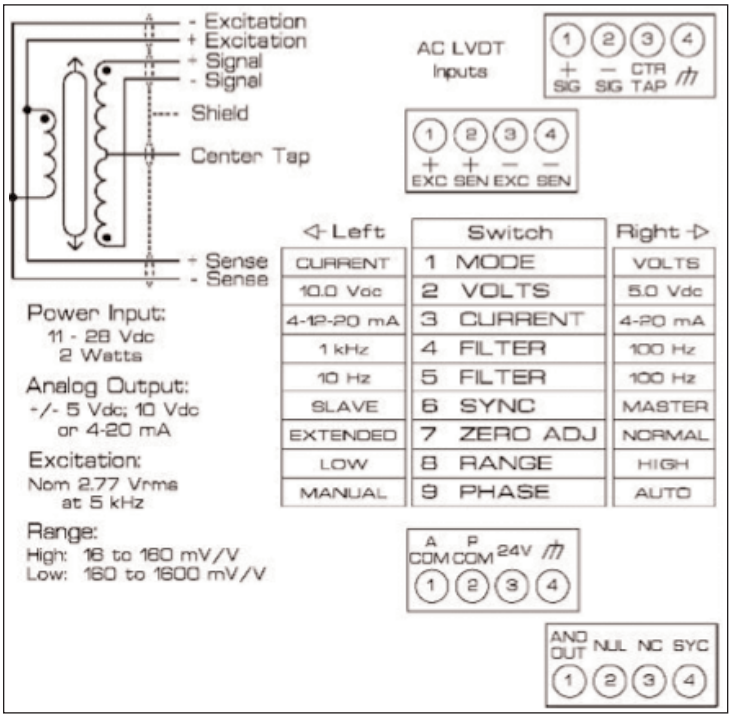
GENERAL DESCRIPTION AND SPECIFICATIONS

The Series AP5104 is a single-channel conditioner of phase-sensitive carrier-amplifier design. Intended for applications involving linear variable differential transformer (LVDT) sensors or with the addition of two completion resistors, variable reluctance transducers can be accommodated. The AP5104 will condition and provide a calibrated analog ouptut signal for the measurement of force, load, pressure, displacement and other parameters associated with AC based LVDT sensors. The AP5104 can be used with short or long stroke LVDTs with user selectable gain, zero, automatic or manual phase control and selectable analog output of voltage or current.

The Series AP5104 is calibrated by the “two-point (dead-weight)” process involving known displacement standards, which is outlined in section three.



View of Side Label of the Series AP5104 Strain Gage Module

Series AP5104
AC LVDT Module

Access switch settings via the front panel of the AP5104 by gently pulling the clear plastic cover (from the bottom side) so the cover rotates open from 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 or without power to the unit. Once completed, return the cover to the original position.

AC LVDT Phase Operation

Due to the AC modulated aspects of the AP5104 AC Voltage excitation circuit, the AP5104 contains a Manual or Automatic selection for transducer Phase adjustment which aligns the transducer’s return output signal to the conditioner's demodulator. When the demodulator is aligned properly through calibration, maximum amplitude and accuracy are achieved.

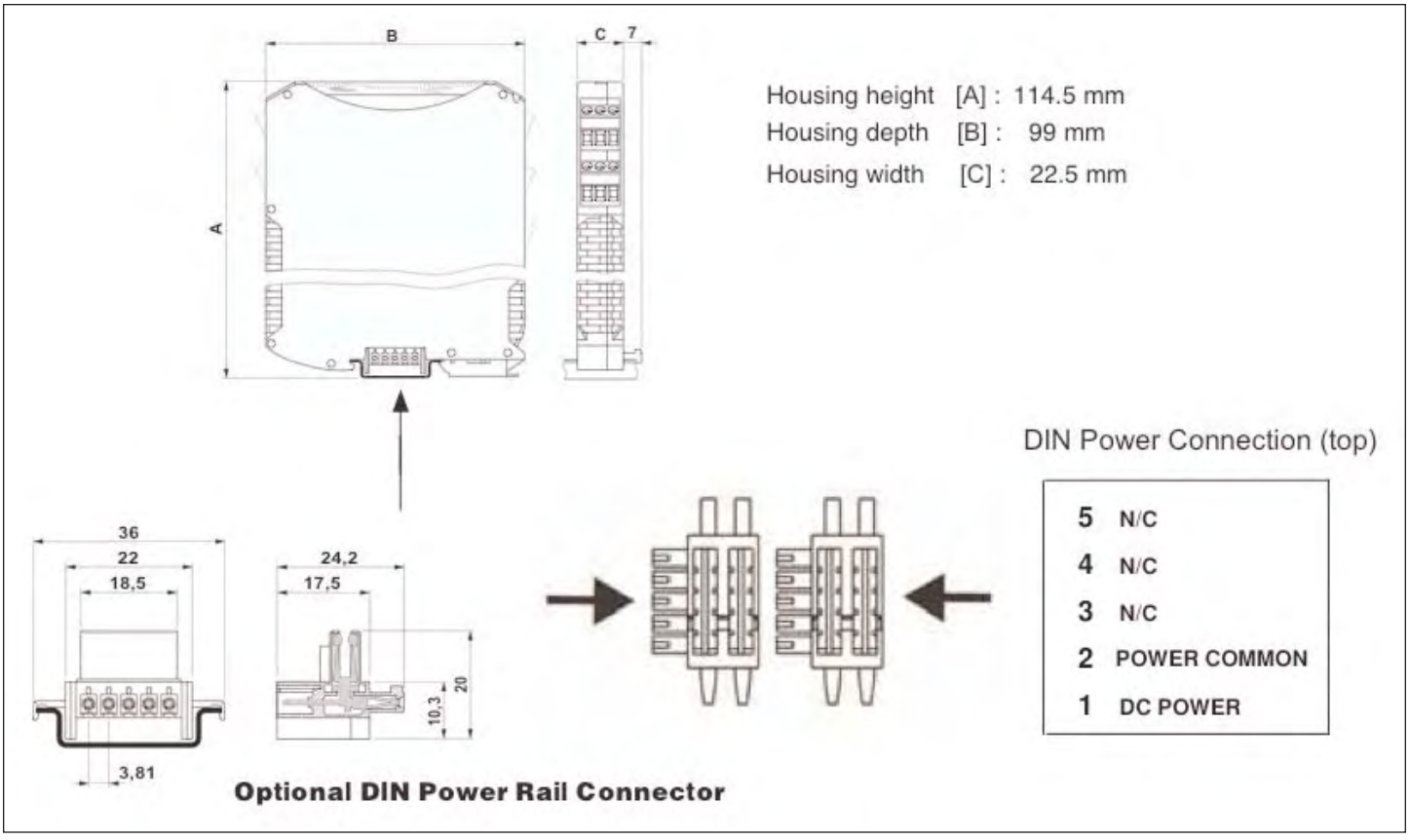
AP5104 SPECIFICATIONS

Measurement Range: Adjustable; 16 to 160 or 160 to 1600 mV/V; nominal full-scale
Transducer Types: 4 or 5 wire AC LVDT, or Variable Reluctance with the additon of two completion resistors (1k Ohm) as shown in Fig. 2
Excitation: 5.00 KHz; Nominal 2.77 Vac rms up to 70 mA, sensed
Power Supply : 11 - 28 Vdc regulated; 2 watts max.
Analog Ouput : selectable; ± 0 to 5, ± 0 to 10 Vdc, 4-20mA or 4-12-20mA (20% overrange in voltage mode only)
Operating Temperature : -10 to +70 Degrees C, 5 to 95% relative humidity, non-condensing

Amplifier
Normal - Mode Range : ±5 V rms operating; ±28 V without instrument damage
Input Impedance : Differential 200 kΩ
Offset : vs. Temperature: ±30 ppm μV/°C; vs. Time: ±10 ppm/month
Gain Accuracy : Limited only by calibration accuracy
Gain Stability : vs. Temperature: ±30 ppm/°C; vs. Time: ±10 ppm/month
Linearity : better than ± 0.03% of full scale

Filter: 3-pole modified Butterworth; 3 dB down at 10 Hz, 100 Hz or 1 kHz; selectable
Step-Response Settling Time (Full-Scale Output @ 10 Hz):
To 1% of final value: 0.08 sec; (0.008 sec @ 100 Hz) (0.0008 sec @ 1 kHz)
To 0.1% of final value: 0..095 sec; (0.0095 sec @ 100 Hz) (0.00095 sec @ 1 kHz)
To 0.02% of final value: 0.100 sec; (0.010 sec @ 100 Hz) (0.0012 sec @ 1 kHz)

Dimensions



TRANSDUCER CONNECTIONS

The Series AP5104 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 AP5104 screw terminals - as a minimum. Table 2 denotes screw terminal assignments.

Table 2 Series AP5104 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	CTR TAP	CENTER TAP (GRD)
Top Front 4	4	⏚	SHIELD
Bottom Front 1	1	Ano Out	ANALOG Output
Bottom Front 2	2	NUL	Null Control
Bottom Front 3	3	NC	No Connection
Bottom Front 4	4	SYC	SYNC - MASTER/SLAVE
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

Fig. 1 Series AP5104 Transducer Cabling - AC LVDT

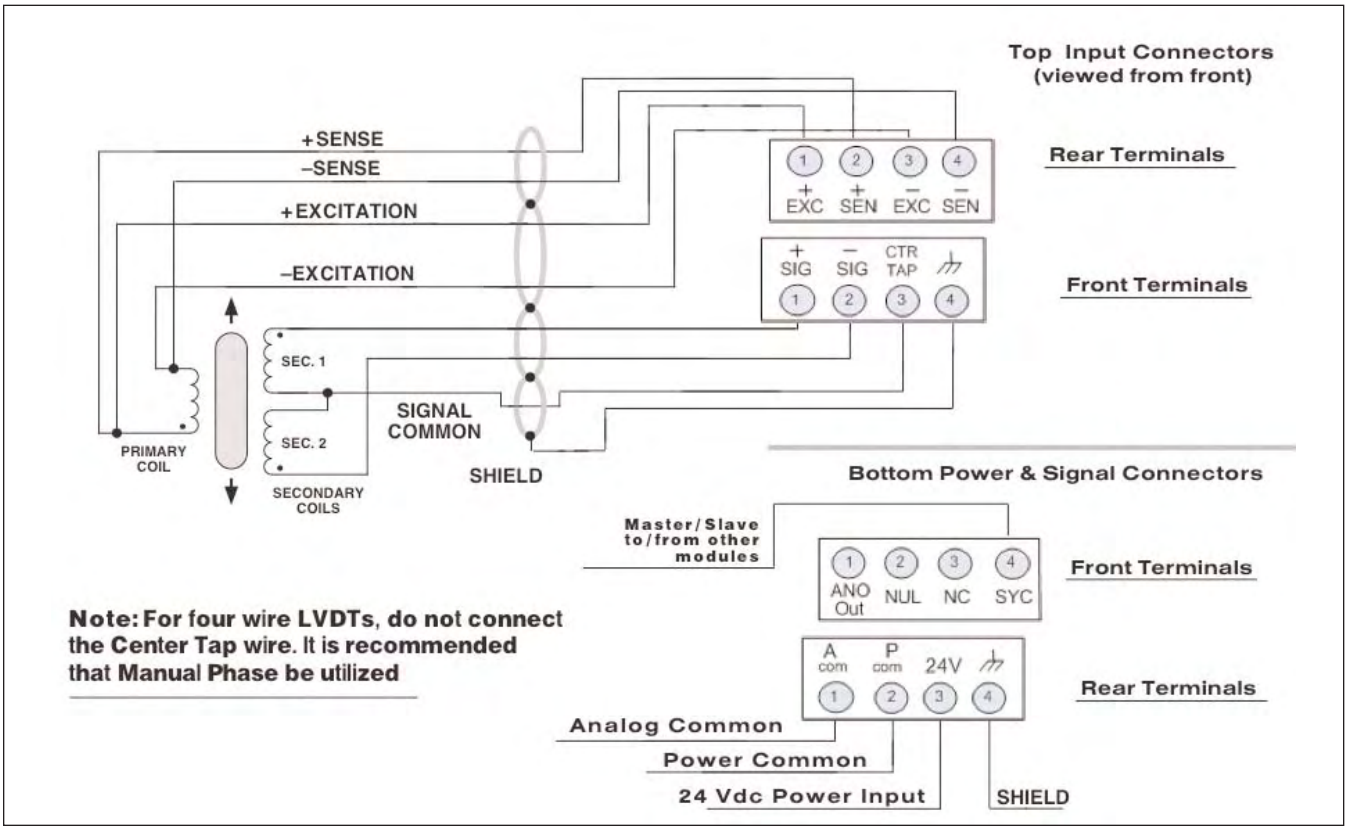


Fig. 2 Series AP5104 Transducer Cabling Variable Reluctance

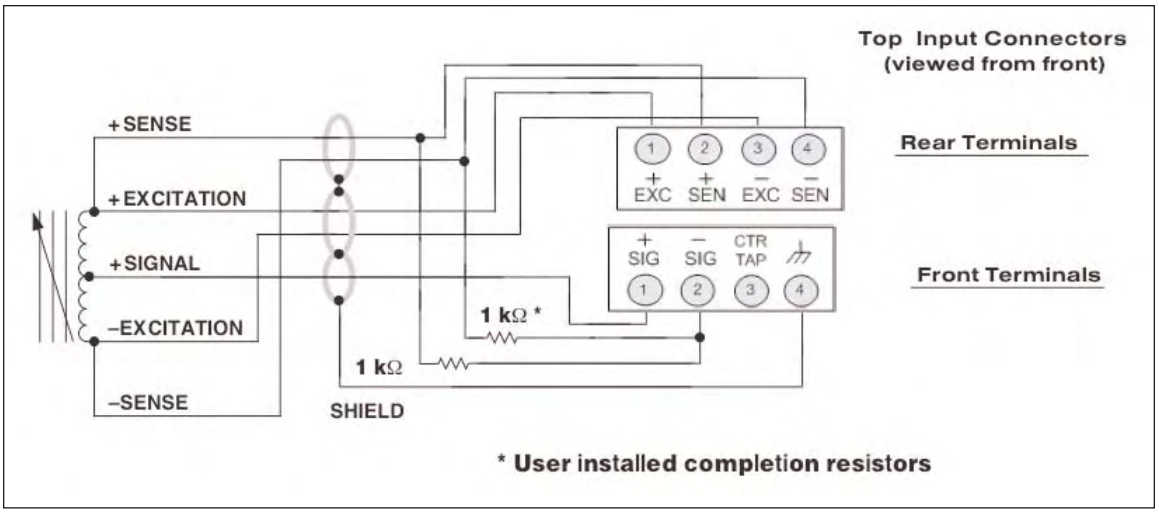
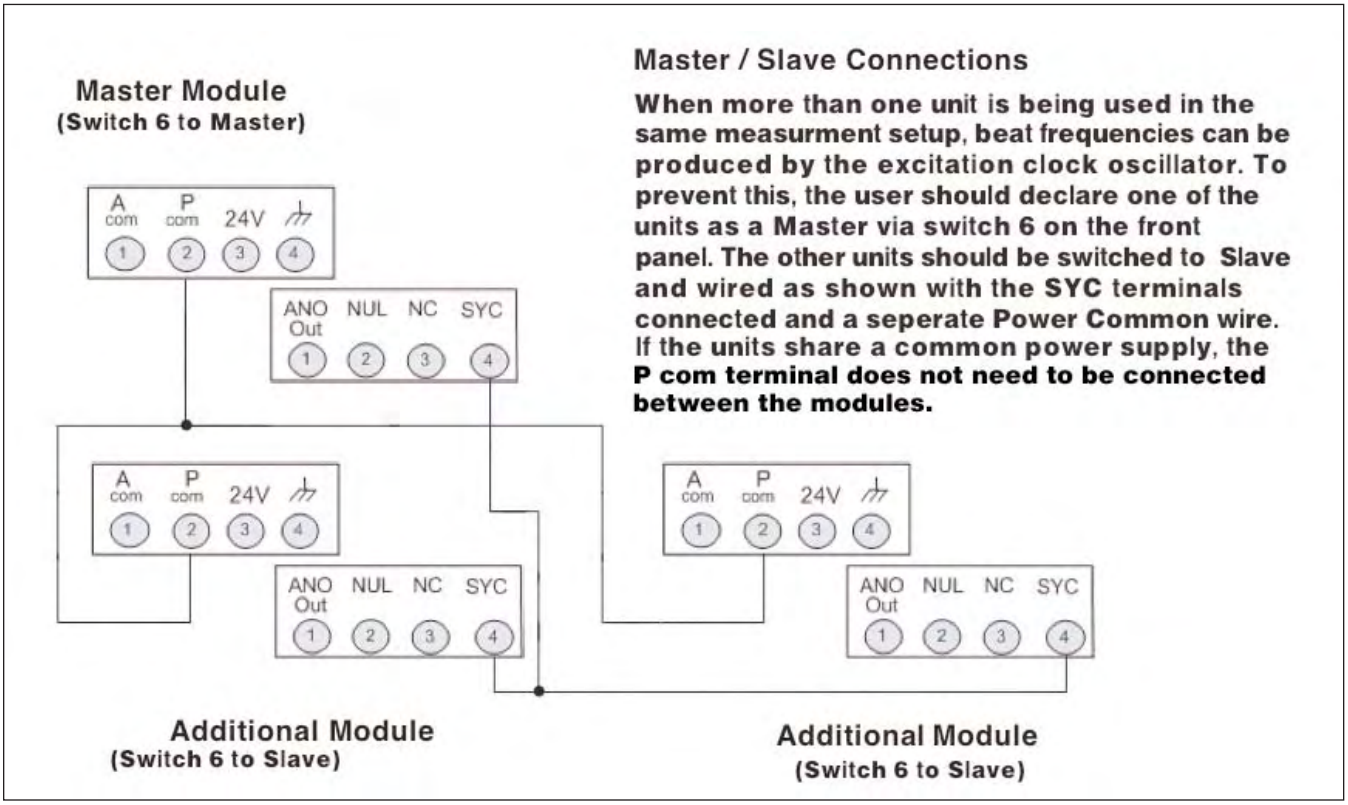


Fig. 3 Master / Slave Wiring



CALIBRATION

A. Connect Power, Sensor and Analog terminals as required. Turn power ON. The front-panel indicator should light green to indicate the application of DC power. Allow 10 minutes of warmup for stabilization of transducer characteristics. Open the clear plastic front cover of the AP5104 unit.

B. Set the Coarse Zero and Span controls to the default calibration position as indicated (<, MIN>).

C. Position the front panel switches to the desired settings for the application. Refer to Figure 4 for details.

D. If this is the system's first calibration, it is advised to jumper the terminal label "NUL" to "Power Common". This will defeat any conditioner zero and allow the user to reliably find the "Null" or electrical "Zero" position of the LVDT. With the jumper in place, mechanically adjust the LVDT or sensor to its most minimum analog output value. This will be mechanical Null.

E. With mechanical Null established, remove the "NUL" to "Power Common" jumper. Adjust Coarse and Fine Zero for Zero Output. From the mechanical Null reference position, enable your span reference standard (gage block,micrometer, etc.). Adjust the Coarse Span control until you acheive a nominal full scale analog output value. If the AP5104 is in the Manual Phase Mode, adjust the Phase control to obtain the highest magnitude on the analog output. If the AP5104 is in "Auto" Phase mode, this is accomplished automatically. (Due to cable length and typically with long stroke LVDTs, the unit may require Manual Phase adjustment to achieve the desired precision). Once Phase has been accomplished, the AP5104 will not need to be re-phased for subsequent calibrations unless the cable or the transducer are replaced. Adjust Fine Span and Coarse Span, as needed, for the precise full scale analog output desired.

F. Return the sensor to the "Zero" position (which may or may not be Null) and adjust the Coarse Zero and Fine Zero controls for the desired output. If the sensor requires additional Zero authority, place Switch 7 in the Extended position (100% offset) authority (see tech tip note). Normal setting is approx. 25% of span range.

G. Re-apply the Full Scale condition stated in step (E). Adjust Coarse and Fine Span controls to achieve the desired output. Span and Zero re-adjustments may need to be repeated to obtain the desired analog output value. (Note: Changes in Span will effect Zero)

H. For Negative Span adjustment, place the sensor in the opposite full scale position and adjust the Symmetry control for the desired output analog value.

I. Once completed, replace the front plastic cover to the original position and ensure proper shielding and grounding have been done to the module and to the DIN rail used for mounting of the AP5104.

CALIBRATION (cont.)

Null Calibration Check

The instrument can be placed in the calibration mode by shorting "NUL" and Power Common terminals. This will defeat any zero function in the AP5104 to allow the user to establish a true "Null" or electrical zero position of the sensor. From this mechanical / electrical position, Full Scale positive and negative reference points can be obtained allowing the user the full linear operating range of the sensor and the AP5104 conditioner.

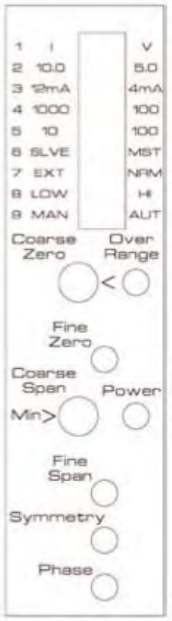
Master/Slave Connections

When more than one AP5104 is being used in a measurement setup (instruments are closely mounted or the transducer cabling is in a common conduit or raceway), beat frequencies may be produced from the 5-kHz oscillators used in the instruments to develop the excitation. To prevent beat frequencies from occurring, one unit can be designated the master, and the remaining units can be driven from the oscillator contained in the master unit. The remaining units are designated as slave instruments. To perform master/slave wiring, refer to Figure 3.

Phase & Signal Reversal

The manual phase signal is derived from the excitation. Therefore signal reversal (typically positive displacement is positive signal) must be accomplished by reversing Signal leads.

Fig. 4 Front Panel Settings and Indicators



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 1kHz or 100 Hz at 3 dB, for 100 Hz switch 5 must be set to the right
Switch 5 · Filter · selects 10 Hz or 100 Hz at 3 dB, for 100 Hz switch 4 must be set to the right
Switch 6 · Sync · selects excitaton clock to slave from a master module or to be master
Switch 7 · Zero Adj. · selects Extended (100%) or Normal (20%) zero authority
Switch 8 · Range · selects gain: Low (160-1600) or High (16 - 160) mV/V sensors
Switch 9 · Phase · selects Automatic or Manual Phase adjustment
Coarse Zero · 16 position switch adjustment for stepped zero balance control default calibration position indicated by "<"
Fine Zero · 18 turn potentiometer for fine zero balance control
Coarse Span · 16 position switch adjustment for stepped gain control default calibration position indicated by "MIN>"
Fine Span · 18 turn potentiometer for fine gain - span control
Symmetry · adjust the negative output span to be equal with the positive output
Phase · adjustment for phasing the AC modulated signal to its highest level at F.S.
Over Range · indicates when the analog output is 2% greater than mode selected
Power · indicates the power input votlage is ON

Tech Tip on use of wide zero values for the AP5104 Conditioner (Switch 7)

If the large zero offset is used to correct for an offset within the transducer, no special calibration considerations need to be used beyond the normal two point calibration. If, however a large offset from the transducer's "native" zero is desired (e.g. -60% to +100% of the transducer mechanical range is to calibrate to 0 to 5 Volts output), the steps below can ease the process considerably. Note also that if the current output is chosen, then using the 4-12-20 ma choice effectively offsets - 100% full scale.

A. Choose the mechanical stimulation end points and calculate their difference in percent of the transducer's full scale range.

B. Multiply the transducer's full scale electrical output by the value obtained in (a) and verify that it does not exceed the allowable signal range for the conditioner.

C. Stimulate the transducer to mechanical zero and use the coarse and fine zero controls to achieve zero output from the conditioner.

D. Stimulate the transducer to a mechanical value of one half of the value obtained in step (a) and use the coarse and fine span controls to set the conditioner output to one half of full scale.

E. Repeat steps (c) and (d) as needed.

F. Stimulate the transducer to the mechanical low end point and use the symmetry control to set the conditioner output to one half times the ratio of the percent of transducer full scale represented by the low end point and the value from step (a).

G. Repeat steps (c), (d), and (f) as needed.

H. Stimulate the transducer to the mechanical low end point again and use the coarse and fine zero controls to set the output to zero.

I. Stimulate the transducer to the mechanical high end point and use the coarse and fine span controls to set the output to full scale.

J. Repeat steps (h) and (i) as needed.

Example for +/- 100% of mechanical transducer range to cause zero to full scale output. Step (a) would be a value of 200%. Step (b), if the transducer outputs +/- 2 mV/V/milli-inch and the stroke is +/- 100 milli-inches then 200% is 400 mV/V which is compatible on the low gain setting. Step (d) one half of that is 100% - set 100 milli-inch positive mechanical stimulation to one half full scale output. Step (f), the mechanical low end point is - 100 miil-inch and the ratio is -100% to +100% thus -1 times 1/2 = -50% or 2.5 Volts out on the 5 Vdc output range of the condtioner.

Example for -60% to +100% of mechanical transducer range to cause zero to full scale output. Step (a) would be a value of 160%. Step (b), if the transducer outputs +/- 2 mV/V/milli-inch and the stroke is +/- 50 milli-inches then 160% is 160 mV/V which is compatible on either gain setting. Step (d) one half of that is 80% - set -40 milli-inch positive mechanical stimulation to one half full scale output. Step (f), the mechanical low end point is - 30 miil-inch and the ratio is -60% to +80% thus -60/80 = .75 times 1/2 = -37.5% or -1.875 Volts out on the 5 Vdc output range of the condtioner.

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.

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