Instruction Manual

Model 450D

transducers
and instrumentation by

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Instructions for

THE SENSOTEC MODEL 450D SIGNAL CONDITIONING SYSTEM

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1.0 DESCRIPTION

The Model 450D is a 4-1/2 digit single channel strain gage transducer amplifier and digital indicator. The instrument utilizes separate scaling adjustments to provide a digital readout in engineering units with a corresponding 0-5 VDC output. The unit also contains a field selectable 5 or 10 VDC bridge excitation. The options available include dual limits, peak-and-hold, track-and-hold, RS232, BCD, 4-20 ma output, active filtering, dual scaling, and a printer interface.

2.0 SPECIFICATIONS

GENERAL	
# Channels	1
Material	Steel Case
ABSOLUTE MAXIMUM SPECIFICATIONS	
Temperature Storage	-20 F to 200 F
Temperature Operating	0 F to 150 F
TRANSDUCER INTERFACE	
Transducer Excitation	5 or 10VDC
Std. accepted inputs	.5-5mv/v, 5-50mv/v, 0-5V, 4-20ma
Transducer Current Drive	60ma
Input Gain Range	1-1000
Push Button Shunt Cal	Yes
Calibration Method	Manual (front panel)
Zero Balance	+/-15% F.S. min
Noise and Ripple	30 microvolts
AMPLIFIER CHARACTERISTICS	
Full Scale Outputs Available	Any full scale 0-5V
Output Impedance	<1 ohm
Non-Linearity (%F.S. max)	.02%
Drift (max. zero and span)	+/-5mv
Stability - Zero (% F.S./yr.)	0.1%
Stability - Span (% F.S./yr.)	0.1%
Frequency Response	3000 Hz.
Common Mode Rejection	100 db
Fine Span Adj. (% Range)	+/-15%
Coarse Span Adj. (%Range)	+/-80% min.
Fine Zero Adj. (%Range)	+/-15%

Coarse Zero Adj. (%Range)	+/-100%
Short Circuit Protection	Yes

DIGITAL DISPLAY CHARACTERISTICS

# Display characters	4 1/2 (dummy digit avail.)
Conversions/second	3
Scaling	0-19,999
Scaling Method	Potentiometer
Polarity Indications	Yes
Decimal Pts. Selection	Manual Hard Wired
Display Size	0.56"
Overrange Indication	Flashing Display
Resolution	1/20000
Type	LED
Maximum Sensitivity	.25 uv/ct

SPECIAL FEATURES

LIMITS

High/Low Limits Type	Solid State (optional relays)
Limits - Latching/Non-Latching	Non-Latching
Limit Response Time	1ms
Limits Output	Open Collector

PEAK-AND-HOLD

Peak and Hold Type	Analog
Range of Peaks	± 5V
Input Risetime	<.5ms for 5V peak
Output Decay Rate	.01%/second for 5V peak
Output Protection	Short Circuit (indefinite)

OTHER

Active filter - # of poles	2
Printer Output parallel	BCD
Serial Output (RS-232 Option)	ASCII

PHYSICAL CHARACTERISTICS

Output Connector type	24 pin - TRW 252-12-30-160
Weight	5 lbs.
Mounting	Bench, Panel, or Rack (optional)

POWER SUPPLY

Recommended	115/220VAC
Accepted	100-130/200-250VAC
Fuse	.35A - 250VAC

3.0 INSTALLATION AND WIRING

The Model 450D is shipped in a single container. Prior to energizing it, inspect the unit for damage by gently shaking and listening for loose components. Report shipping damage to the carrier; it is their responsibility to safely transport the unit to the customer. If there is transportation damage and you have

difficulty getting proper adjustment, contact SENSOTEC at (614) 486-7723. We will attempt to assist in resolving the situation.

3.1 Mounting The Unit

The dimensions of the Model 450D are shown in Figure 3.1. The unit can be bench, rack, or panel mounted.

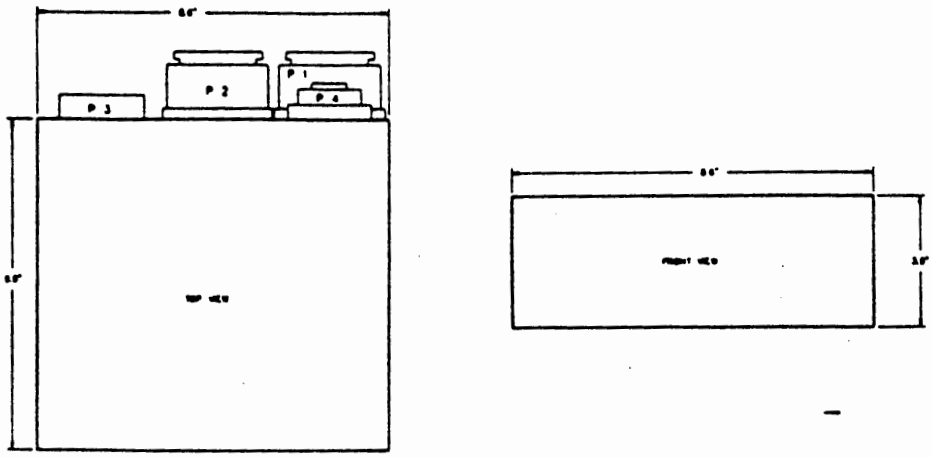

Figure 3.1 - Model 450D Dimensions

3.2 Connectors

The Model 450D utilizes four separate connectors: P1, P2, P3, and P4. Connector P1 supports the limits, peak-and-hold, and 4-20ma options along with signal input and excitation output. The BCD option is obtained from Connector P2 while the RS-232 option is obtained from connector plug P4. Connector P3 provides AC power to the unit. Figure 3.2 shows the connector locations on the rear of the 450D along with the pin configurations of connectors P1, P2, and P3. All connections to P1 and P2 should be soldered on while connections to P3 can be secured with screws.

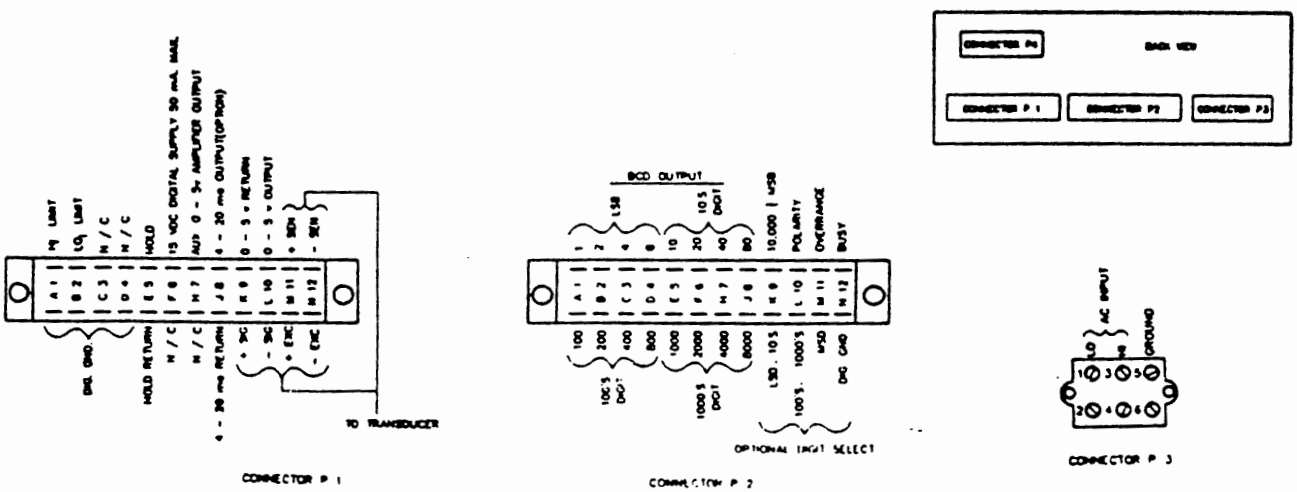

Figure 3.2 - Model 450D Connectors

3.3 Wiring

3.3.1 Power

Connect wiring from the AC line (110VAC, 60HZ or optional 220VAC, 50HZ) to connector P3, pins 1(LO), 3(HI), and 5(GROUND).

3.3.2 Transducer

If the transducer hook-up line is less than twenty feet, then first, on connector P1, short the +EXC(M) and +SENSE(11) terminals together and the -EXC(N) and the -SENSE(12) terminals together. Next, connect strain-gage transducers to connecter P1, pins K(+SIGNAL), L(-SIGNAL), M(+EXC), and N(-EXC).

For twenty feet and longer hook-up lines utilize a 6-wire sensing hook-up to compensate for line losses. Make connections to P1 via pins K(+SIGNAL), L(-SIGNAL), M(+EXC), N(-EXC), 11(+SENSE), and 12(-SENSE).

3.3.3 Output

The analog 0-5VDC output can be obtained from connector P1, pins 9(OUTPUT) and 10(RETURN).

4.0 INITIAL SETUP AND CALIBRATION

The Model 450D may be set up for operation by adjusting the ZERO, SPAN, and SCALING potentiometers along with setting the input range and transducer excitation. The input range and transducer excitation can be obtained from the Transducer Calibration Record which was shipped with the transducer. If a transducer was purchased with the unit, then the unit was set up for the transducer at the plant. Refer to section 6.0 to change the input range or excitation. Figure 4.1 shows the control locations on the 450D with the front panel removed.

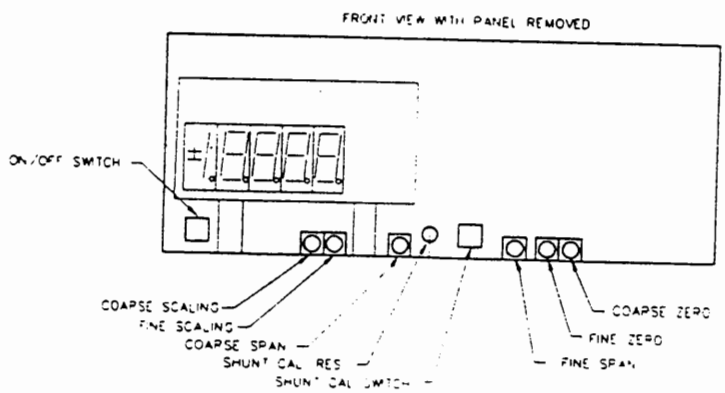

Figure 4.1 - Model 450D Control Locations

4.1 Initial Adjustments

For all the adjustments that follow, the transducer attached to the unit should not have any applied pressure or load unless noted otherwise. If the transducer is an absolute pressure unit, it should be calibrated under a vacuum. Otherwise, the unit will read the present local barometric pressure (approx. 14.7 psi). Also, the front panel should be removed. This can be done by unscrewing the four black screws located on the front of the unit. Before proceeding, make sure that:

1. The input range and excitation are properly set. (Section 4.0).

2. Connector P1 is properly wired. (Section 3.3).

3. The correct shunt cal resistor is installed. Refer to The Transducer Calibration Record. In order to change see Section 6.0.

4.1.1 Zero Adjustment

1. Apply power to the Model 450D and allow to warm up for ten minutes.

2. Adjust the COARSE ZERO potentiometer for a reading close to 0000 on the display or zero volts between pins 9(OUTPUT) and 10(RETURN). Next, adjust the FINE ZERO potentiometer to bring this value to exactly zero.

4.1.2 Span Adjustment with Shunt Calibration

1. A Transducer Calibration Record is normally shipped by all manufacturers of transducers with their products. (See example, Figure 4.2) Obtain the full scale and shunt calibration values (in mv/v) from the Transducer Calibration Record. Use these values to obtain the Shunt Cal Output Voltage (SCOV) and the Shunt Cal Display Value (SCDV) from the following equations:

$$SCOV = \frac{\text{Shunt Cal Output (mv/v)}}{\text{Full Scale Output (mv/v)}} \times \text{Full Scale Output}$$

$$SCDV = \frac{\text{Shunt Cal Output (mv/v)}}{\text{Full Scale Output (mv/v)}} \times \text{Full Scale Display Value}$$

An example of this calculation using data from Figure 4.2 along with the full-scale Model 450D output gives:

$$SCOV = \frac{1.4883 \text{ mv/v}}{1.8888 \text{ mv/v}} \times 5V = 3.939 \text{ volts}$$

$$SCDV = \frac{1.4883 \text{ mv/v}}{1.8888 \text{ mv/v}} \times 15{,}000 \text{ lbs.} = 11{,}819 \text{ lbs.}$$

Transducer Calibration Record
SENSOTEC, INC.
1200 Chesapeake Avenue Columbus, Ohio (614) 486-7723 TWX 810-482-1188

LOAD CELL CALIBRATION RECORD
MODEL NO.: 4738-01
SERIAL NO.: 156091
FULL SCALE CAPACITY: 15000 LBS UNDER COMPRESSION
DATE: 08/08/86

EXCITATION VOLTAGE. 10 VDC CALIBRATION FACTOR 1.8888 MV/V AT FULL SCALE

RESISTANCE:
INPUT = 415 OHMS
OUTPUT = 353 OHMS
LEAKAGE = ∞ OHMS

SHUNT RESISTOR VALUE OF 59K OHMS
ACROSS NEGATIVE OF INPUT/OUTPUT GIVES 1.4883 MV/V

ACCEPTED AND CERTIFIED BY_____

Figure 4.2 - Transducer Calibration Record

2. Press in the SHUNT CAL switch and adjust the COARSE and FINE GAIN potentiometers for the SCOV on pins 9(OUTPUT) and 10(RETURN). Next, adjust the SCALING potentiometers to display the corresponding SCDV.

4.1.3 Span Adjustment with an Applied Stimulus

1. Use a known stimulus to calculate the expected voltage output (EVO) of the Model 450D as follows:

$$EVO = \frac{\text{Known Stimulus}}{\text{Full Scale Stimulus}} \times 5V$$

2. Apply the known stimulus to the transducer and adjust the COARSE and FINE GAIN potentiometers to obtain the EVO on pins 9(OUTPUT) and 10(RETURN). Next, adjust the SCALING potentiometers to give the proper meter reading on the display.

5.0 OPERATIVE ADJUSTMENTS

Since transducers usually have some small amount of zero drift due to temperature change, it may be necessary to occasionally readjust the instrument. This can easily be accomplished through the use of front panel potentiometers without an applied load. First adjust for a zero reading with the FINE ZERO and then use the FINE SPAN to readjust the shunt calibrated output.

6.0 CHANGING THE SHUNT CALIBRATION RESISTOR, EXCITATION VOLTAGE, INPUT RANGE, LIMITS CONFIGURATION, AND RS-232 BAUD RATE

All changes can be made by removing the front panel and case from the Model 450D, locating and changing the necessary item, and then reassembling the unit. Figure 6.1 should be used as an aid to finding the items which need changing.

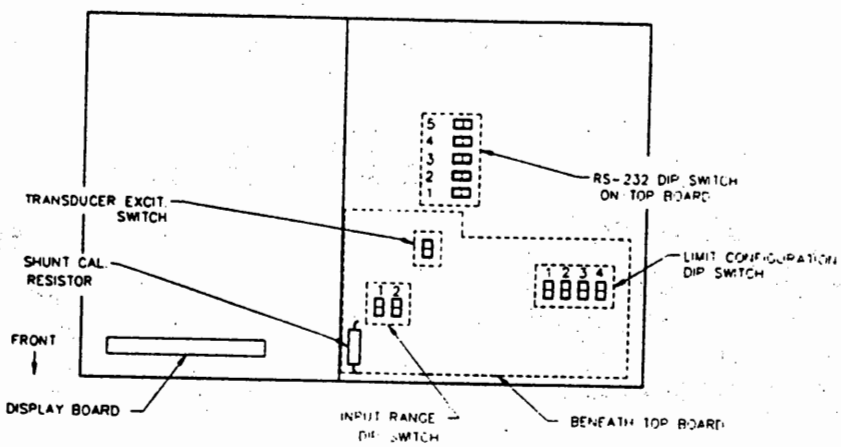

Figure 6.1 - Model 450D Top View With Cover Removed

6.1 Case and Panel Removal

The front panel can be removed by unscrewing the four black Phillips head screws in the corners of the panel. The case can then be removed by unscrewing the seven 6-32 Phillips head screws, four on the bottom, and three along the back, and then gently pulling the cover backward.

6.2 Changing the Shunt Calibration Resistor

1. Remove the old resistor and replace with the value indicated on the Transducer Calibration Record.

6.3 Changing the Excitation Voltage

1. The excitation voltage switch is either a toggle or slide. Locate and identify it.

2. For a slide, move the switch forward for 5VDC excitation and backward for 10VDC excitation.

   For a toggle, move the switch backward for 5VDC excitation and forward for 10VDC excitation.

6.4 Changing the Input Range

1. Table 6-1 gives the switch positions for different input ranges.

TABLE 6-1
Switch Locations for Different Input Ranges

Input Range	Switch Locations	
	1	2
0-50mv	on	off
Above 50mv	off	on

6.5 Changing the Limit Configuration

1. Table 6-2 gives the switch settings for the different limit configurations.

Table 6-2
Limit Configurations

Limit Setup	Switch Setting 1	2	3	4
Standard Fail Safe	off	off	on	off
Ascending relay "off"	on	on	on	off
Ascending relay "on"	on	off	off	off
Descending relay "off"	off	on	on	on
Descending relay "on"	off	off	off	on

6.6 Baud Rate Selection for RS-232

The baud rate is selectable by use of a 5-position DIP switch which is located on the upper board. The baud rates that these switches select are, in order from 1: 150, 300, 1200, 2400, and 9600.

CAUTION: Only one baud switch may be on at a time.

7.0 Options

The following sections describe the most common options available on the 450D. Other available options which are not described in this section will have an insert detailing their use included with their purchase. These options are: 0-5V input, 4-20ma input and/or output, Bridge Completion, Printer Output Interface, and Dual Scaling.

7.1 Limits Option

With the limits option, the transducer signal is continuously compared to two adjustable set points. One set point is called the HI LIMIT because its corresponding relay deenergizes when the signal exceeds the set point, while the other is called the LO LIMIT because its relay deenergizes below the set point. This is fail safe operation for power loss since both relays can't be deenergized with power applied to the unit. The characteristics of the limits option are as follows:

1. To prevent relay "chatter", about 1% of the limit setting point is added to the limit circuit as hysteresis in the opposite direction of the limit action. The signal must fall 1% below the HI LIMIT set point or rise 1% above the LOW LIMIT set point in order to reset.

2. Open drain V-MOS FET transistors are provided to drive external relays for the limits. The user should provide either solid state or dry contact relays requiring 36 volts or less at a current not exceeding 200ma. Figure 7.1 depicts the suggested wiring to the Model 450D. A protection zener diode is mounted across the transistor rated at 43V ± 10% at 1 watt.

3. Front panel LO and HI LIMIT LED's indicate that their respective outputs are energized.

4. To adjust the limit set point, press and hold the LIMIT pushbutton switch and then adjust the corresponding potentiometer until the display reads the desired set point.

5. Refer to section 6.4 for other limit configurations.

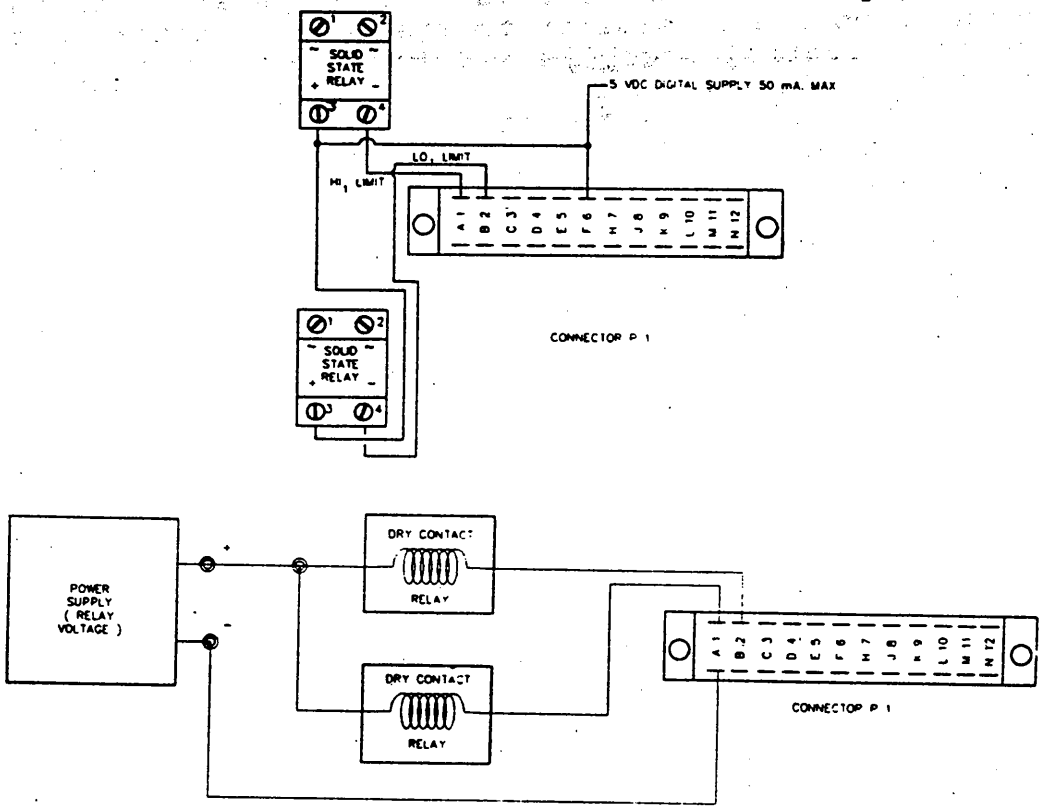

Figure 7.1 - Model 450d Limit Wiring Diagram's

7.2 Peak Detector Option

The Peak Detector Option serves to find and display the greatest signal voltage value which is above a set threshold value. The characteristics of the Peak Detector Option are as follows:

1. After a peak is found, the circuit is reset by either

momentarily closing the PEAK-HOLD switch or shorting together the HOLD(5) and HOLD RETURN(E) on connector P1. As long as pins E(HOLD RETURN) and 5(HOLD) are shorted, the unit will be in the tracking mode and will not hold a peak.

2. The threshold setting can be displayed by holding in the PEAK-HOLD switch.

3. The threshold level can be set by pressing the front panel PEAK-HOLD switch and adjusting the PEAK-HOLD potentiometer for the desired value.

7.3 Track-and-Hold Option

The track-and-hold function causes the display to "track" the input until an external "hold" signal inhibits further tracking and locks the display. The operation of the track-and-hold option is similar to the peak detector, except that the hold control logic is activated by either pushing the front panel hold switch or shorting pins 5(HOLD) and E(HOLD RETURN) together on connector P1. The front panel hold switch must be in the "track" position for the rear panel contacts to work.

7.4 RS-232 Option

The RS-232 option is a serial data transmission technique that is used for remotely sensing the results of the 450D signal conditioning. The specifications are as follows:

1. Baud Rates: 150, 300, 1200, 2400, 9600. An external baud clock may also be used.

2. "1" level: -15V ± 1V
   "0" level: +15V ± 1V

The RS-232 Interface circuit transmits the 450's output of 5 digits in 5 groups of 10 bits each with the Most Significant Digit (MSD) transmitted first. The general form for all digits is given in Table 7-1.

TABLE 7-1
RS-232 DIGIT FORMAT

PULSE NO.	FUNCTION
1	Always 0 (start bit)
2	b0 (LSB of char.)
3	b1
4	b2
5	b3
6	Always 1
7	Always 1
8	Always 0
9	Even parity bit
10	Always 1 (stop bit)

Since the Most Significant Digit (MSD) can only be either a 0 or 1, only bit b0 is needed to transmit this information. The other bits in the MSD are then used to indicate: b1 - Polarity (1 = +), b2 - Overflow (1), b3 - Underflow (1).

Table 7-2 shows how the 25-pin D-Subminature connector P4 is connected.

TABLE 7-2
P4 CONNECTIONS

PIN NO.	FUNCTION
1	Chassis Ground
2	Data Output
4	Busy
7	Digital Signal Ground
15	Clock out/ Clock in

The BUSY signal goes to "1" for the entire transmission of the 5-group data output. The CLOCK signal operates at the selected baud frequency. If an external baud clock is used, pin 15 of connector P4 becomes an input pin. Refer to section 6.6 for the baud rate selection.

7.5 BCD Output Option (TRI-STATE Output)

With the BCD option, a binary-coded-decimal output can be obtained from connector P2. The characteristics of the BCD option are as follows:

1. The outputs of the BCD connector are Tri-State and may be wired as an eight-bit buss. The outputs are normally in the low impedance state, enabling all outputs. If the outputs are to be used as an 8-bit buss, all the enabling pins, except for the one being observed, should be pulled high.

2. Pin K - controls state of LSD and 10's digit.
   Pin L - controls state of 100's and 1000's digit.
   Pin M - controls state of MSD, polarity, and overrange.

3. The POLARITY signal (pin 10) goes positive when the input signal is positive.

4. The OVERRANGE signal (pin 11) goes positive when the input signal exceeds 19999 display counts.

5. The BUSY signal (pin 12) goes positive when the signal integration period begins and stays high until the end of the integrate cycle.

7.6 Active Filter Option

The Model 450D can provide a selectable 2 pole active filter with a 40 db/decade roll off for noisy inputs. The filter is enabled by pushing the front panel switch into the on

position. The cutoff frequencies available are: 1, 5, 10, 100, and 1000HZ.

8.0 Warranty Repair Policy

8.1 Limited Warranty on Products

Any of our products which, under normal operating conditions, proves defective in material or in workmanship within one year from the date of shipment by SENSOTEC, will be repaired or replaced free of charge provided that you obtain a return material authorization from SENSOTEC and send the defective product, transportation charges prepaid with notice of defective product, and establish that the product has been properly installed, maintained, and operated within the limits of rated and normal usage. Replacement or repaired product will be shipped F.O.B. our plant. The terms of this warranty do not extend to any product or part thereof which, under normal usage, has an inherently shorter useful life than one year. The replacement warranty detailed here is the buyer's exclusive remedy, and will satisfy all obligations of SENSOTEC whether based on contract, negligence, or otherwise. SENSOTEC is not responsible for any incidental or consequential loss or damage which might result from a failure of any SENSOTEC product. This express warranty is made in lieu of any and all other warranties, express or implied, including implied warranty of merchantability or fitness for particular purpose. Any unauthorized disassembly or attempt to repair voids this warranty.

8.2 Obtaining Service Under Warranty

Advance authorization is required prior to the return to SENSOTEC. Before returning the items, either write to the Repair Department c/o SENSOTEC, Inc., 1200 Chesapeake Avenue, Columbus, Ohio 43212, or call (614) 486-7723 with: 1) a part number; 2) a serial number for the defective product; 3) a technical description* of the defect; 4) a no-charge purchase order number (so products can be returned to you correctly); and 5) ship and bill addresses. Shipment to SENSOTEC shall be at Buyer's expense and repaired or replacement items will be shipped F.O.B. our plant in Columbus, Ohio. Non-verified problems or defects may be subject to a $75 evaluation charge. Please return the original calibration data with the unit.

8.3 Obtaining Non-Warranty Service

Advance authorization is required prior to the return to SENSOTEC. Before returning the item, either write to the Repair Department c/o SENSOTEC, Inc., 1200 Chesapeake Avenue, Columbus, Ohio 43212, or call (614) 486-7723 with: 1) a model number; 2) a serial number for the defective product; 3) a

technical description* of the malfunction; 4) a purchase order number to cover SENSOTEC's repair cost; and 5) ship and bill addresses. After the product is evaluated by SENSOTEC, we will contact you to provide the estimated repair costs before proceeding. The minimum evaluation charge is $75. Shipment to SENSOTEC shall be at the Buyer's expense and repaired items will be shipped to you F.O.B., our plant in Columbus, Ohio. Please return the original calibration data with the unit.

8.4 Repair Warranty

All repairs of SENSOTEC products are warranted for a period of 90 days from the date of shipment. This warranty applies only to those items which were found defective and repaired, it does not apply to products in which no defect was found and returned as is or merely recalibrated. Out of warranty products may not be capable of being returned to the exact original specifications.

*Technical Description of the defect: In order to properly repair a product, it is absolutely necessary for SENSOTEC to receive information specifying the reason the product is being returned. Specific test data, written observations on the failure and the specific corrective action you require are needed.

INSTRUCTIONS FOR CALIBRATING INSTRUMENT USING THE TRANSDUCER SHUNT-CAL DATA

I. SETUP

A. Wire the transducer to the instrument, using the Transducer Calibration Record and the Instrument wiring for proper connections.

B. Apply power to the instrument.

C. Monitor each amplifier output with a voltmeter, on the proper pins.

D. Check the Transducer Calibration Record for transducer full-scale output in mv/v, and the Shunt-Cal output in mv/v.

E. Calculate the voltage output and the display value for the amplifier using the equations below.

F. The Shunt-Cal resistor installed in this instrument is 200 Kn. Compare this value with that shown on the Transducer Calibration Record. They should be the same.

II. PROCEDURE

A. Adjust the ZERO control on the amplifier so that the output voltage equals zero.

B. Press the SHUNT CAL button while adjusting the GAIN or SPAN control to yield an output voltage equal to that calculated in Step E of the SETUP steps above. Then adjust the SCALING control to yield the Display value calculated in the same step.

C. Release the SHUNT CAL button. Check to see if the display and output voltage return to zero.

EQUATIONS

$$\text{Shunt-Cal Output} = \frac{\text{Transducer Shunt-Cal Output (mv/v)}}{\text{Transducer Full-Scale Output (mv/v)}} \times \text{Desired Full Scale Output}$$

$$2.046\text{ V} = \frac{.4230}{1.0337} \times 5.000\text{ V}$$

$$\text{Display Under Shunt-Cal Condition} = \frac{\text{Transducer Shunt-Cal Output (mv/v)}}{\text{Transducer Full-Scale Output (mv/v)}} \times \text{Desired Full Scale in Eng. Units}$$

$$8184\text{ PSI} = \frac{.4230}{1.0337} \times 19999$$

Instrument Serial No. 251301 Transducer Serial No. 279277

Excitation Voltage(s): + 5.001 V - 5.000 V

Supply Voltages: +14.749 VDC -14.775 VDC

Operator's Signature JS Date: 3-1-91