MODEL HM

PRECISION SIGNAL
CONDITIONER-INDICATOR

SENSOTEC

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Model HM Precision Signal Conditioner-Indicator
Instruction Manual
Docment Number: 008-0258-00
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IMPORTANT! IT IS RECOMMENDED THAT YOU READ THIS DOCUMENT THOROUGHLY BEFORE APPLYING POWER TO THIS UNIT. THIS DOCUMENT CONTAINS INFORMATION ON WIRING, CALIBRATION, AND USE OF FEATURES.

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Chapter 1
Introduction

SENSOTEC's Model HM Precision Digital Indicator is a complete 4-1/2 digit signal conditioner and indicator housed in a 1/8 DIN case. The Model HM is a member of the GM family of indicators, and incorporates many features of this line:

- Full 4-1/2 digit, 0.56-inch display
- Display in any engineering unit desired
- Full 20,000 count resolution
- 0 - 5 volt analog output
- 110- or 220-volt AC power
- 1/8 DIN "panel-meter size" cases
- Panel-mounting feature standard
- Bench-mount adapter available

Additionally, the HM has these features:

- Zero-tracking
- Tare capability
- RS-232 output with selectable baud rates
- Optional linearizing capability

Chapter 2
Description

2.1 Configuration

Within the Model HM's enclosure are five printed circuit boards. The Main Board contains the circuitry for the power supply, analog-to-digital converter, a portion of the display hardware, and the SCALING potentiometer. The Display Board solders to the Main Board and contains the displays and their drive circuits. The Amplifier Board contains necessary circuitry to drive the transducer, the signal conditioning amplifier, and referencing circuits. Adjustments for COARSE and FINE ZERO and SPAN, plus calibration switching are also located on the Amplifier Board. The Microprocessor Board and the Interfacing Board contain the RS-232, zero-tracking, tare, and linearizing circuits. Access to most adjustments may be obtained by through holes in the front panel. The remaining adjustments may be made by snapping off the front panel bezel and lens. The unit may be quickly rack- or panel-mounted by use of the panel jacks.

2.2 Specifications

General:

No. of Channels	1
Case Material	Noryl Plastic

Environmental:

Temperature, Storage:	-20 deg. F to 200 deg. F
Temperature, Operating:	30 deg. F to 130 deg. F

Transducer Interface:

Transducer Excitation:	5 or 10 VDC
Types of Inputs Accepted:	0.5 mV/V to 5.0 mV/V or 5 mV/V to 50 mV/V
Transducer Current Drive:	50 mA.
Input Gain Range:	10 - 1000
Push Button Shunt Cal:	Yes
Calibration Method:	Manual (front panel)
Zero Balance:	+/- 15% F.S. Min.
Noise and Ripple:	< 100 microvolts
Transducer Minimum Impedance:	350 ohms

Amplifier Characteristics:

Full-scale Output:	5 volts
Output Impedance:	< 2 ohms
Accuracy:	+/- 0.02%
Frequency Response:	0 - 250 Hz.
Common Mode Rejection:	> 80 dB.
Tare Range:	20% of F.S.

Display Characteristics:

No. of Characters Displayed:	4-1/2
Conversions per second:	3
Scaling Range:	0 - 19999
Scaling Method:	Potentiometer
Decimal Point Selection:	Plug-in Jumper
Display Size:	0.56"

Overrange Indication:	Flashing Display
Resolution:	1/20,000
Type:	LED

Physical Characteristics:

Connector:	6-Pin Modular Phone
Weight:	3 lbs.
Mounting:	Bench, Panel or Rack
DIN Size:	1/8 DIN
Size:	3.8" W x 1.9" H x 4.4" D

Power Supply Characteristics:

Power Requirements:	115VAC/220VAC (factory set, field changeable)

Chapter 3
Installation

3.1 Unpacking

The HM is shipped in a single container. Inspect the unit for shipping damage, and gently shake and listen for loose components prior to energizing it. Report shipping damage to the carrier; it is his responsibility to safely transport the unit. If there is transportation damage and you have difficulty getting the problem resolved, contact SENSOTEC. We will attempt to assist in resolving the situation.

3.2 Selecting Excitation Voltage

The Model HM provides a 5- or 10-VDC strain-gage transducer power supply. These units are normally set for 10 VDC at the factory. To check or change the excitation voltage, proceed as follows:

1. Remove the bezel and front panel with a small screwdriver.
2. Carefully remove the Main Board from the unit. All boards will slide out simultaneously.
3. The board farthest to the right is the Amplifier Board. Locate the two sets of three-pin standoffs at the left end of this board. The board itself may be removed from the Main Board if desired, by gently pulling on it vertically. Check the jumper location for excitation voltage setup. See Figure 7-1.
4. Replace the Amplifier Board onto the Main Board and slide the board assembly into the case.
5. Reinstall the front panel and bezel.

3.3 Mounting the Unit

For panel mounting, cut a rectangular hole 3.58" in width by 1.73" in height. Remove the panel mounting brackets by unsnapping them from the sides of the Model HM. Place the HM through the panel cutout, and reattach the panel mounting brackets to the sides of the case. Use a small screwdriver to tighten the bracket-adjusting screws until the case is pulled tightly into the panel. Recommended panel thickness is 0.090 to 0.250 inches. See Figure 3-2.

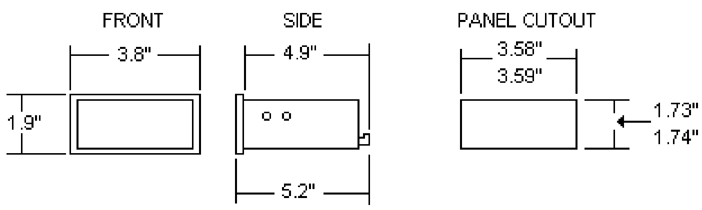
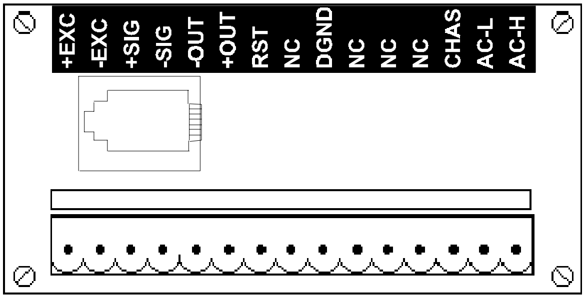


Figure 3-2 -- Dimensions

3.4 Wiring to the Sensor

All connections to the Model HM are made through the rear-panel 15-pin connector. The leftmost terminal as viewed from the rear is (+)Excitation, followed by (-)Excitation, (+)Signal, and (-)Signal. See Figure 3-3 for terminal designations. The transducer's (+)Output and (-)Output are wired to the Model HM's (+)Signal and (-)Signal terminals respectively. The Model HM will accept strain-gage transducers with bridge impedances of 350 ohms or greater. Wires from the transducer may be pushed into the terminals using a small screwdriver.



Pin Label	Function	Direction
+EXC	(+)Excitation	out
-EXC	(-)Excitation	out
+SIG	(+)Signal	in
-SIG	(-)Signal	in
-OUT	(-)Output	out
+OUT	(+)Output	out
RST	Reset Instrument	in
NC	No Connection	-
DGND	Digital Ground	-
NC	No Connection	-
NC	No Connection	-
NC	No Connection	-
CHAS	AC power ground	in
AC-L	AC power low (neutral)	in
AC-H	AC power high (line)	in

Figure 3-3 -- Terminal Designations

3.5 Wiring the Output

If the 0-5V output of the Model HM is to be used, wire to the (+)Output and (-)Output terminals (see Figure 3-3). Observe the correct polarity.

3.6 Wiring to the RS-232 Output

For operation with the RS-232 option, a 6-pin telephone connector is provided. Only 4 of its pins are used for RS-232. The topmost pin is Pin 1. TABLE 3-1 specifies pin designations for this connector.

As is usual in RS-232, a signal level of -3 volts or less is considered to be a "1" while a signal level of +3 volts or greater is a logic "0."

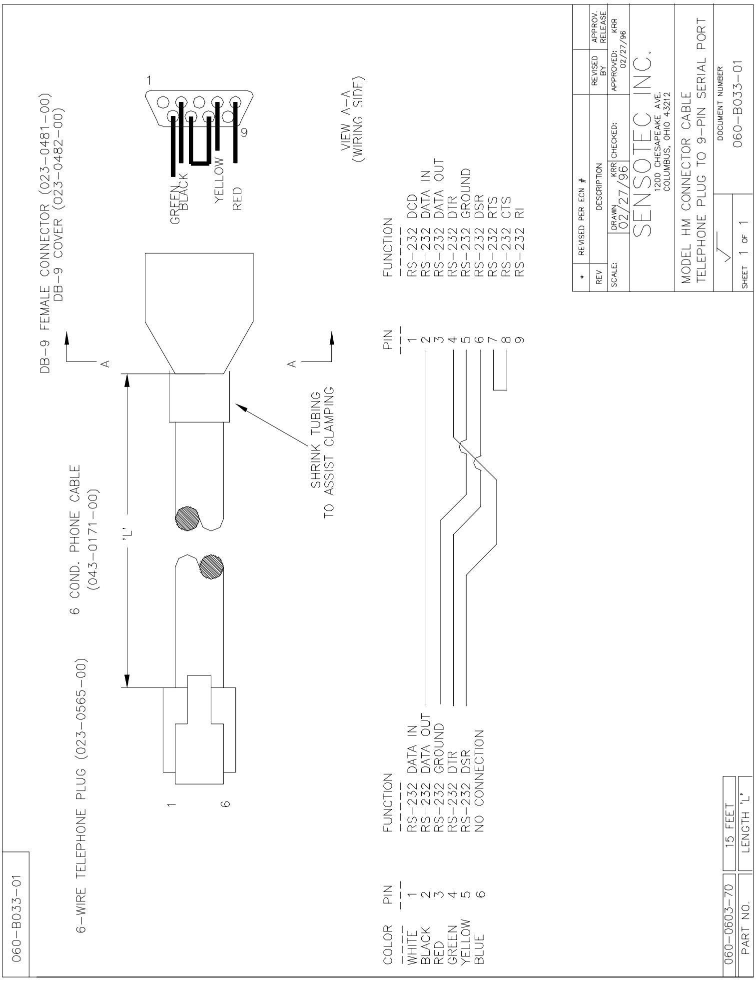
The DTR signal serves to indicate that the HM is up and running. A logic "0" here (which is +12 volts) indicates that the HM is ready to transmit data.

Table 3-1: RS-232 CONNECTOR WIRING

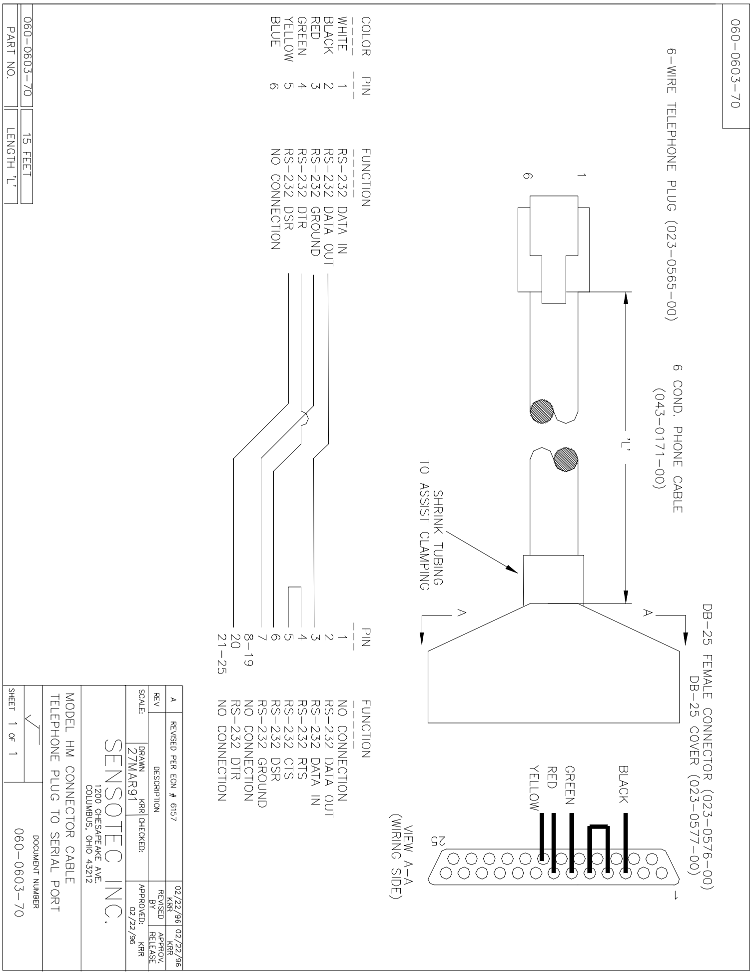
Pin	Function
1	No Connection
2	Data Out
3	Data Signal Ground
4	Data Terminal Ready (DTR)
5	Data Set Ready (DSR)
6	No Connection

The DSR signal serves to indicate that the equipment to which the HM is connected is ready to receive data. If this terminal is more positive than +3 volts (logic "0") the data terminal is ready to receive data. When the HM is ready to transmit data, the DTR signal will become more positive than +3V (logic "0"), indicating that data will be transmitted upon command. If a jumper is installed interconnecting the DSR and DTR signals, data will be transmitted once each second continuously.

Drawing 060-B033-01 illustrates how to construct a communications cable to connect the HM to a 9-pin RS-232 serial port. When connecting the HM to a 25-pin RS-232 serial port, use drawing 060-0603-70. These cables are also available from the factory.



060-B033-01
6-WIRE TELEPHONE PLUG (023-0565-00)
6 COND. PHONE CABLE
(043-0171-00)
DB-9 FEMALE CONNECTOR (023-0481-00)
DB-9 COVER (023-0482-00)
'L'
A
A
1
6
1
9
GREEN
BLACK
YELLOW
RED
SHRINK TUBING
TO ASSIST CLAMPING
VIEW A-A
(WIRING SIDE)
COLOR PIN FUNCTION
WHITE 1 RS-232 DATA IN
BLACK 2 RS-232 DATA OUT
RED 3 RS-232 GROUND
GREEN 4 RS-232 DTR
YELLOW 5 RS-232 DSR
BLUE 6 NO CONNECTION
PIN FUNCTION
1 RS-232 DCD
2 RS-232 DATA IN
3 RS-232 DATA OUT
4 RS-232 DTR
5 RS-232 GROUND
6 RS-232 DSR
7 RS-232 RTS
8 RS-232 CTS
9 RS-232 RI
060-0603-70
PART NO.
15 FEET
LENGTH 'L'
REV
REVISED PER ECN #
DESCRIPTION
REVISED BY
APPROV. RELEASE
SCALE:
DRAWN KRR 02/27/96
CHECKED:
APPROVED: KRR 02/27/96
SENSOTEC INC.
1200 CHESAPEAKE AVE.
COLUMBUS, OHIO 43212
MODEL HM CONNECTOR CABLE
TELEPHONE PLUG TO 9-PIN SERIAL PORT
DOCUMENT NUMBER
060-B033-01
SHEET 1 OF 1


060-0603-70
6-WIRE TELEPHONE PLUG (023-0565-00)
6 COND. PHONE CABLE
(043-0171-00)
'L'
SHRINK TUBING
TO ASSIST CLAMPING
DB-25 FEMALE CONNECTOR (023-0576-00)
DB-25 COVER (023-0577-00)
A
A
1
6
1
25
BLACK
GREEN
RED
YELLOW
VIEW A-A
(WIRING SIDE)
COLOR PIN FUNCTION
WHITE 1 RS-232 DATA IN
BLACK 2 RS-232 DATA OUT
RED 3 RS-232 GROUND
GREEN 4 RS-232 DTR
YELLOW 5 RS-232 DSR
BLUE 6 NO CONNECTION
PIN FUNCTION
1 NO CONNECTION
2 RS-232 DATA OUT
3 RS-232 DATA IN
4 RS-232 RTS
5 RS-232 CTS
6 RS-232 DSR
7 RS-232 GROUND
8-19 NO CONNECTION
20 RS-232 DTR
21-25 NO CONNECTION
060-0603-70 PART NO.
15 FEET LENGTH 'L'
A REVISED PER ECN # 6157 02/22/96 KRR 02/22/96 KRR
REV DESCRIPTION REVISED BY APPROV. RELEASE
SCALE: DRAWN 27MAR91 KRR CHECKED: APPROVED: KRR 02/22/96
SENSOTEC INC.
1200 CHESAPEAKE AVE.
COLUMBUS, OHIO 43212
MODEL HM CONNECTOR CABLE
TELEPHONE PLUG TO SERIAL PORT
DOCUMENT NUMBER
060-0603-70
SHEET 1 OF 1

The configuration transmitted is as indicated in TABLE 3-2.

Table 3-2: RS-232 CONFIGURATION

Start Bits	1
Data Bits	8
Stop Bits	1
Parity	none

The most significant digit of the HM is transmitted first, followed by the other digits in order. The decimal point is transmitted at the desired fixed location. A sample output string transmitted from the HM is "+1234.5" followed by the line-feed (ASCII code decimal 10) and carriage-return (ASCII code decimal 13) characters.

Baud rate can be changed by following the procedure in “Checking and Changing Baud Rate” on page 29.

3.7 Power Connections

AC power for the HM is applied by plugging in the power cord to a 110 volts, 60 Hz. power source. This is normal power for the HM but 220 volts, 50 Hz. may be used if proper jumpering is done on the Main Board. SENSOTEC will wire your HM for the power specified at the time of its order. If you desire to change the HM to work with the other power choice, contact SENSOTEC for instructions regarding the modification.

When wiring the power cord to the 15-pin connector, follow the color coding in the table below.

Pin Label	Function	Color code	
		North American	European
CHAS	ground	green	green-yellow
AC-L	neutral	white	blue
AC-H	line	black	brown

Chapter 4
Initial Adjustments/Setup

4.1 Setting up the Amplifier

The following instructions will serve to zero and calibrate the Amplifier circuits, located on the Amplifier Board. See Figure 4-1.

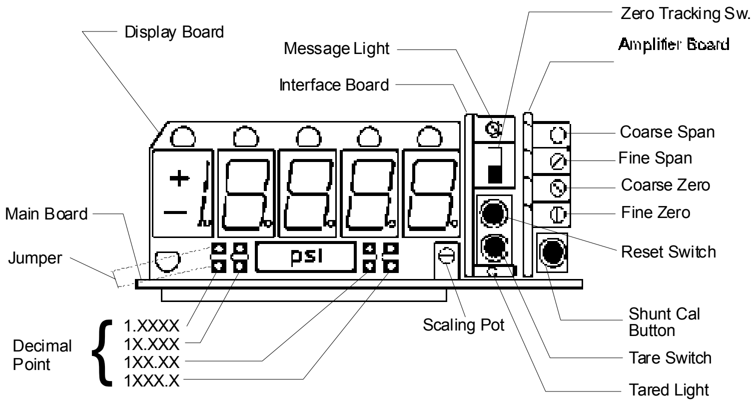


Figure 4-1 -- Adjustment Locations

4.1.1 Zero Adjustment

The adjustment of the no-signal zero condition is made first. For all of the adjustments that follow, the transducer attached to the unit should not have any applied pressure or load. 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 (approximately 14.7 psi) and adjustment cannot be made using the ZERO adjustment only.

1. Remove the front panel and bezel with a small screw driver.
2. Apply power to the HM, and allow about 10 minutes warmup.
3. Adjust the COARSE ZERO potentiometer (see Figure 4-1) to give an output voltage of about 0 volts. Then adjust the FINE ZERO potentiometer to bring this value exactly to 0 volts.

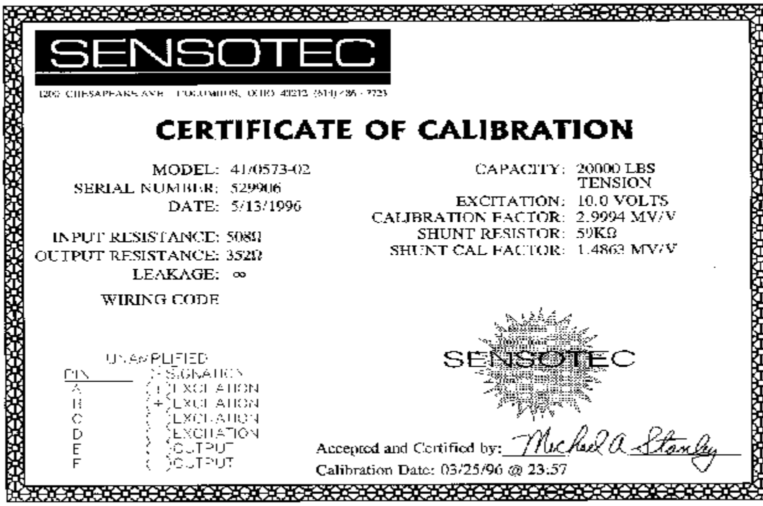
4.1.2 Span Adjustment

Span adjustment calibrates the gain of the amplifier section of the Amplifier Board to provide the proper voltage output for a given transducer signal. The shunt calibration feature allows the span to be properly set up without applying a known pressure or load to the transducer. This form of span adjustment will be described first, followed by a method for calibration when the shunt calibration value has not been determined.

4.1.3 Span Adjustment with Shunt Calibration

A Transducer Calibration Record is normally shipped by all manufacturers with their products. (See example, Figure 4-2.) This record indicates the full scale output and the shunt calibration output of unamplified transducers in millivolts per volt (mV/V). These two values are used to calculate the proper output of the Model HM under shunt calibration conditions. Calculate as follows:

$$\frac{\text{Shunt Cal Output in mV/V}}{\text{Full-Scale Output in mV/V}} \times \text{Full-Scale Output} = \text{Output Voltage}$$


SENSOTEC

CERTIFICATE OF CALIBRATION

MODEL: 41/0573-02
SERIAL NUMBER: 529906
DATE: 5/13/1996

INPUT RESISTANCE: 508Ω
OUTPUT RESISTANCE: 352Ω
LEAKAGE: ∞

CAPACITY: 20000 LBS TENSION
EXCITATION: 10.0 VOLTS
CALIBRATION FACTOR: 2.9994 MV/V
SHUNT RESISTOR: 59KΩ
SHUNT CAL FACTOR: 1.4863 MV/V

WIRING CODE

UNAMPLIFIED

PIN	SIGNATION
A	(-) EXCITATION
B	(+) EXCITATION
C	( ) EXCITATION
D	( ) EXCITATION
E	( ) OUTPUT
F	( ) OUTPUT

SENSOTEC

Accepted and Certified by: Michael A. Stanley

Calibration Date: 03/25/96 @ 23:57

Figure 4-2 -- Sample Transducer Calibration Record

Using the sample data given in Figure 4-2 and the full-scale output of the Model HM (5V) provides:

$$\frac{1.4863 \text{ mV/V}}{2.9994 \text{ mV/V}} \times 5\text{V} = 2.4777 \text{ volts}$$

After this calculation has been made, proceed as follows:

1. Connect a digital voltmeter to the (+)Output and (-)Output terminals on the rear connector.

2. Depress the SHUNT CAL switch (see Figure 4-1).

3. Adjust the COARSE SPAN control to give the approximate shunt calibration output voltage calculated above.

4. Adjust the FINE SPAN control to give the exact value for shunt calibration output voltage calculated above.

After making these adjustments, a full-scale pressure or load on the transducer will produce a 5-volt output from the Model HM.

Note: The Shunt Cal Output provided by the Transducer Calibration Record is determined using a particular value of Shunt Cal resistor. That value is also specified on the Transducer Calibration Record. It is necessary that the same value of resistor be installed to produce the same results. The normal value used by SENSOTEC for transducers is 59,000 ohms (59K). This value is installed in the pin jacks provided on the Amplifier Board. If the transducer being used has a different value specified for its shunt cal resistor, it will be necessary to install a resistor of this value in the jacks provided on the Amplifier Board. A procedure for accomplishing this is given in "Changing the Shunt Calibration Resistor" on page 35.

4.1.4 Span Adjustment without Shunt Calibration

If the transducer shunt calibration output is not specified or not known, span can still be adjusted, but a known pressure or load must be applied to the transducer. The applied pressure or load should be as close to full-scale as possible, so that tiny errors in slope are not amplified by the ratio of full-scale to calibration point values. Calculate the expected output of the Model HM as follows:

$$\frac{\text{Known Pressure or Load}}{\text{Full-scale Pressure or Load}} \times \text{Full-scale Output} = \text{Output Voltage}$$

Once this calculation is made, proceed as follows:

1. Connect a digital voltmeter to the (+)Output and (-)Output terminals on the rear connector.
2. Apply the known pressure or load to the transducer.
3. Adjust the COARSE SPAN control to give the approximate output voltage calculated above.
4. Adjust the FINE SPAN control to give the exact value calculated above.

4.1.5 Scaling Adjustment

Scaling adjustment permits the HM to display values in engineering units desired by the customer. Scaling adjustment establishes the ratio between the voltage output of the HM and its displayed value. The SCALING potentiometer is located on the Main Board, as shown in Figure 4-1. Again, adjustment can be made either with shunt calibration or with a known pressure or load on the transducer. Perform the scaling adjustment right after the span is adjusted, using the same output voltage to assist in calibration of scaling.

First, determine the desired full-scale value. For example, the load cell in Figure 4-2 is a 15,000 pound unit. The desired full-scale value would be 15,000 since a 4-1/2 digit indicator is capable of indicating a maximum of 19,999 counts. Calculate the expected display value based on the voltage calculated in the span adjustment steps "Span Adjustment with Shunt Calibration" on page 22 or "Span Adjustment without Shunt Calibration" on page 24 as follows:

$$\frac{\text{Shunt Cal Output in mv/v}}{\text{Full-Scale Output in mv/v}} \times \text{Full-Scale Display} = \text{Shunt Cal Display Value}$$

Using the data in Figure 4-2 gives:

$$\frac{1.4863 \text{ mV/V}}{2.9994 \text{ mV/V}} \times 15{,}000 \text{ lbs} = 7433 \text{ lbs.}$$

After this calculation is made, proceed as follows:

1. Depress the SHUNT CAL switch.
2. Adjust the SCALING potentiometer to yield the displayed value calculated above (7433 in the example).
3. Place the jumper in the proper place on the Display Board to locate the decimal point as illustrated in Figure 4-1.

4.Reinstall the front panel and bezel.

4.2 Microprocessor and Interface Board Adjustments

There are three potentiometer adjustments to be made on the Interface Board, if a full setup is to be made. Refer to Figure 4-3 for the location of the potentiometers and test points on the Interface Board. In general, these adjustments will not need to be made, except in the event of a complete realignment of the HM.

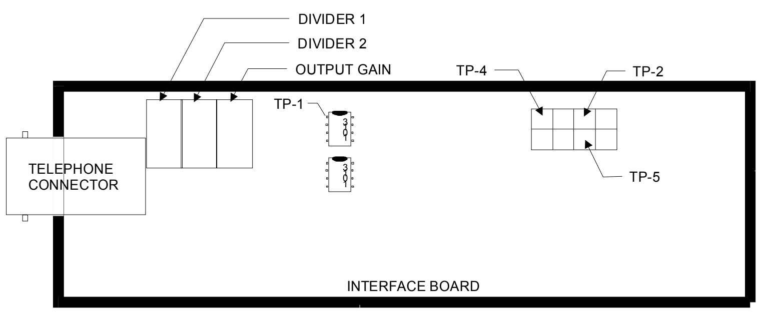


Figure 4-3 -- Interface Board Adjustments

4.2.1 Interface Board Output Amplifier Adjustment

The Interface Board output amplifier must have a gain of 2. (Its output voltage must be twice its input voltage.) This adjustment is made with the OUTPUT GAIN potentiometer, while monitoring the voltage on TP-1.

1. Put the reference (ground) lead of the voltmeter on the (-)Output terminal on the rear of the HM.
2. Locate TP-1 on the Interface Board. This point is difficult to use, so care must be exercised to be certain that the voltmeter lead is on this terminal (Pin 1 of an LT1013), and that the voltmeter lead is not shorting this point to another. Attach (or hold) the voltmeter lead on this point.
3. Apply a pressure or load or use the SHUNT CAL switch to get a voltage of at least 1 volt at TP-1. Record this voltage.
4. Adjust the OUTPUT GAIN potentiometer so that the analog output voltage of the HM is exactly twice that which was noted in Step 3. For this step, put the voltmeter + lead on the (+)Output terminal, and its - lead on the (-)Output terminal on the rear connector.
5. Remove the voltmeter leads.

4.2.2 Divider 1 Adjustment

It is necessary for the uncorrected analog output voltage from the Amplifier Board to be twice as much as the voltage going to the microprocessor's A/D converter input.

1. Put the reference (ground) lead of the voltmeter on the (-)Output terminal on the rear of the HM.
2. With the voltmeter, measure the voltage on TP-4. If this volt-

age is not at least two volts, apply sufficient pressure or load, or activate the SHUNT CAL switch on the HM to get two or more volts here. Record this voltage.

3. Move the voltmeter lead to TP-5. Adjust the DIVIDER 1 potentiometer to give a voltage exactly half that measured in Step 2.

4.2.3 Divider 2 Adjustment

The DIVIDER 2 adjustment establishes a voltage of 1.024 volts at TP-2.

1. Put the reference (ground) lead of the voltmeter on the (-)Output terminal on the rear of the HM.

2. With the voltmeter, measure the voltage on TP-2. Adjust the DIVIDER 2 potentiometer to give 1.024 volts at TP-2.

4.3 Amplifier Adjustments

Operative amplifier adjustments include "tweeking" the FINE ZERO and FINE SPAN controls.

4.3.1 FINE ZERO Adjustment

Transducers usually have some small amount of zero drift, usually the result of temperature change at the transducer itself. The HM employs a Zero Tracking circuit which removes such drift every ten seconds. However, it may be beneficial to electronically reestablish the true zero from time to time. Do the following steps to accomplish this.

1. Referring to Figure 4-1, move the ZERO TRACKING switch to

its lower (off) position. If the TARED light is on, press the TARE switch, so that the light goes out.

2. Remove all pressure or load from the transducer. There will likely be a small count displayed on the HM. This is the zero offset of the system.
3. Adjust the FINE ZERO potentiometer so that the display reads 0000.
4. Return the ZERO TRACKING switch to its upper (on) position.

If further adjustments are to be made, do not replace the lens yet. Otherwise, it may be returned to the front of the HM and snapped in place.

4.3.2 FINE SPAN Adjustment

After the FINE ZERO has been adjusted and zero tracking reestablished, press the SHUNT CAL switch, to determine if the number displayed is the same as that calculated earlier “Scaling Adjustment” on page 25. If it is not, "tweek" the FINE SPAN to give this number.

4.4 Operative Adjustments to the Interface Board

Adjustments possible on the Interface Board are only those associated with the RS-232 output. They include changing baud rate and moving the transmitted decimal point location.

4.4.1 Checking and Changing Baud Rate

A unique system for changing baud rate has been devised, so that the user can alter this rate at the front panel of the HM.

To determine the current baud rate setting, follow these steps:

1. Depress and hold down the TARE switch, while momentarily pressing the RESET switch. Continue to hold down the TARE switch for about 2 seconds. After the TARE switch is released, the TARED light will blink on and off. Count the blinks. You may now determine the baud rate at which the HM is set up from TABLE 5-1.

Table 5-1: BAUD RATES

Blinks	Baud Rate
1	9600
2	4800
3	2400
4	1200
5	600
6	300

To change the baud rate setting,

2. Move the ZERO TRACKING switch to its upper (on) position and back the number of times indicated in TABLE 5-1 for your desired baud rate. Each time you move this switch, the MESSAGE light will blink.
3. Again depress the TARE switch. The HM will now move to its Decimal Point Setup mode.

4.4.2 Decimal Point Adjustment

4. The MESSAGE light will now blink, indicating the decimal point location now being transmitted by the RS-232 circuitry. Count the blinks again. Note: This only affects the transmitted decimal point location. The displayed decimal point location must be manually changed if needed. TABLE 5-2 translates the message.

Table 5-2: DECIMAL POINT LOCATION

Blinks	Decimal
1	1.XXXX
2	1X.XXX
3	1XX.XX
4	1XXX.X
5	No point

If you do not desire to change the transmitted decimal point location, merely press the TARE switch again, and skip to step 6. If you wish to change it,

5. Move the ZERO TRACKING switch to its upper (on) position and back the number of times indicated in TABLE 5-2 for your desired decimal point location. Each time you move this switch, the MESSAGE light will blink.
6. Again press the TARE switch. The TARED light will now blink the setting for baud rate (TABLE 5-1), followed by the MESSAGE light blinking the decimal point location (TABLE 5-2). After the MESSAGE light quits blinking, the HM returns to its operating mode.

Chapter 5
Operation

The normal operating condition of the HM is with the ZERO TRACKING switch in its up (on) position, and untared (TARE light out). These conditions have been established by the factory, but could be changed by field personnel. Some explanation of the function of these switches may be educational.

5.1 Zero Tracking Function

The Zero Tracking function is designed to cancel drift in the sensor and circuits, something that normally occurs in strain-gage transducers.

The drift observed occurs slowly and is small in quantity. The HM assumes that any displayed value under 10 counts is due to transducer drift, and periodically (once each 10 seconds) will null such a count. Signals above this level are assumed to be valid changes in signal and the nulling is not performed. Occasionally some applications may require that drift be observed when it is near zero. If so, the ZERO TRACKING switch (see Figure 4-1) can be moved to its downward (off) position, thus disabling the function.

5.2 Tare Function

The Tare Function permits cancellation of a base-level pressure which is up to 20% of the full-scale transducer range of the HM. When the HM is first energized, or immediately after the RESET switch is pressed, the count momentarily displayed is the maximum value in engineering units that can be tared out by the HM's Tare circuit.

To activate the Tare, perform the following steps:

1. With the signal applied that it is desired to null, press the TARE switch. The display should now count down to zero. If the HM senses that the signal to be tared exceeds its taring capability, the front panel ERROR light (also termed the MESSAGE light) will come on.
2. Replace the front panel (lens).

Chapter 6
Changing the Shunt Calibration Resistor

To change the Shunt Calibration Resistor, it is necessary to remove the Amplifier Board from the Main Board. The steps involved are:

1. Unplug the AC power and remove the rear connector.
2. Remove the bezel and front panel lens.
3. Carefully pull the Main Board out of the unit. All boards will come out simultaneously.
4. Gently remove the Amplifier Board from the Main Board.
5. Remove the Shunt Calibration Resistor from the Amplifier Board (Figure 7-1) and replace it with one of the proper value.
6. Replace the Amplifier Board onto the Main Board.
7. Slide the board assembly into the case.
8. Reinstall the lens and bezel.
9. Reinstall the rear connector and power the unit up.

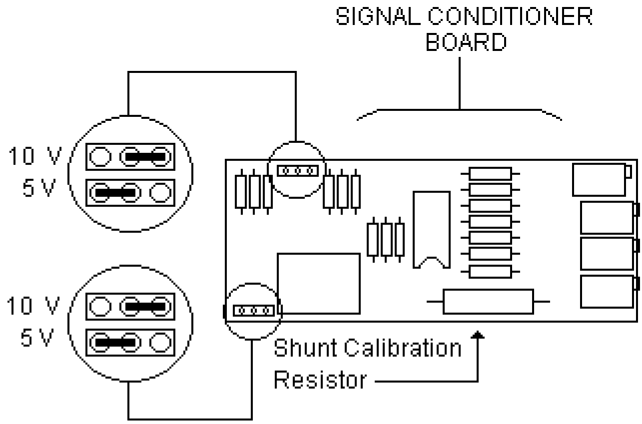


Figure 7-1 -- Amplifier Board Locations

Chapter 7
Options

Two options are available for the HM, the Bench-Mount Adapter and the linearizing option. The Linearizing option is described below.

7.1 Linearizing Option

Linearizing within the HM can be purchased for two purposes: to improve the linearity of a particular transducer for use with the HM, and to display some non-linear transducer application, such as using a pressure transducer to determine the volume of contents in a horizontal right-circular cylindrical tank.

In the first case, the linearity of a transducer can be improved greatly using the HM. The transducer is first calibrated to determine the linearity error for each of the points in the calibration run. From this, a table is made and burned into the PROM of the HM. The table has 256 values, so there are 256 breakpoints on the linearity curve. For each of these points a correction voltage is issued which is summed with the analog signal from the HM to produce the signal which the HM digitizes and displays. SENSOTEC requires that the customer purchase a 10-point run calibration to insure that there is sufficient data for the required table. In the case where the customer supplies the linearizing data (such as in the case of the right-cylindrical tank) SENSOTEC will program the correction algorithm for a nominal programming fee.

Chapter 8
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 the defect, 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 Customer Service Department, c/o SENSOTEC, Inc., 2080 Arlingate Lane, Columbus, Ohio 43228, or call (614) 850-5000 with: 1) a part number; 2) a serial number for the defective product; 3) a technical description (with information to assist us in understanding the application and the observed difficulty) 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 an 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 SENSO TEC. Before returning the item either write to the Customer Service Department, c/o SENSOTEC, Inc., 2080 Arlingate Lane, Columbus, Ohio 43228, or call (614) 850-5000 with: 1) a part number; 2) a serial number for the defective product; 3) a technical description (with information to assist us in understanding the application and the observed difficulty) of the defect; 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. Shipment to SENSOTEC shall be at 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 date of shipment. This warranty applies only to those items which are found defective and repaired, and 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 or dimensions.

Chapter 9
Glossary of Signal Conditioning Terms

ACCURACY -- The combined error of nonlinearity, repeatability, and hysteresis expressed as a percent of full-scale output.

CHARACTERS DISPLAYED -- The number of digits in a display. Some of the digits may be active (part of the quantizing process), and some may be passive (displaying a constant zero).

COMMON-MODE REJECTION -- The ability of an instrument to reject the effects of signals such as noise, that appear on all signal lines. Expressed as a logarithmic ratio at a particular maximum voltage.

CONVERSIONS PER SECOND -- The number of times per second that an analog-to-digital converter ranges and quantizes a given input.

COUNTS -- The total number of steps of resolution of an instrument.

dB -- 20 times the log to the base 10 of the ratio of two numbers.

DIN (DEUTSCHE INDUSTRIE NORM) -- A 1/8 DIN standard specifies an outer bezel dimension of 96 mm

(3.78") x 48 mm (1.89").

EXCITATION -- The voltage applied to the strain-gage transducer or amplified cell by the signal conditioning device.

FREQUENCY RESPONSE -- The range of frequencies over which the output voltage will follow the sinusoidally-varying stimulus input within the specified accuracy of the instrument.

FULL-SCALE OUTPUT -- The maximum output derived from the signal conditioner when the transducer is at its full scale value. For example, a 100 psi pressure applied to a 100 psi transducer will cause a full-scale output from the signal conditioner. Full-scale output is usually 5 volts.

GAIN RANGE -- The range of signal multiplication factors for a given signal conditioner.

INPUT IMPEDANCE -- The resistance of the input circuit of a signal conditioner. If this value is large, the signal conditioner will not load the transducer output excessively.

LINEARITY -- The maximum deviation of a calibration curve from the best-fit straight line calibration curve, expressed as a percentage of full-scale value.

LSD (LEAST SIGNIFICANT DIGIT) -- The rightmost active digit in a display.

MSD (MOST SIGNIFICANT DIGIT) -- The leftmost digit in a display.

NOISE AND RIPPLE -- Noise is randomly-occuring low-level signal not related to the stimulus. Ripple is periodic noise, usually associated with the signal conditioner power supply. Both noise and ripple limit the ability of a signal conditioner to handle small signals.

RESOLUTION -- The smallest change in input signal which produces a one-digit change in the display.

SHUNT-CAL -- The change in electrical output of a transducer which is caused by momentarily placing a fixed, known resistance between one leg of a strain-gage transducer and one of the ex citation leads. This causes the bridge to become unbalanced by a precise, known amount, and permits the verification of proper gain in the signal conditioning system.

SIGNAL CONDITIONER -- An instrument which provides precise electrical drive to a transducer, and accepts and amplifies the transducer output. It may also digitize and display the output in engineering units.

SPAN ADJUSTMENT -- The ability to adjust the gain of a signal conditioner so that a specified display span in engineering units corresponds to a specified signal span.

ZERO ADJUSTMENT -- The adjustment of the displayed value to zero when no output signal is being issued by the transducer.