INSTRUCTION MANUAL

LEVEL-LANCE

MODEL 5000A

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Industrial Products

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SECTION I
DESCRIPTION

1.1 GENERAL

The Model 5000A Level-Lance is a microprocessor-based level measurement device employing a pulse frequency modulation (PFM) measuring system. Changing level conditions at the sensing probe cause a change in the pulse frequency output of the miniature transmitter mounted at the probe. This frequency change is transmitted to the controller portion of the system over two ordinary wires. The controller is then capable of converting this change into a continuous level signal for control or display purposes, and actuating the output relays at the point or points preset by the operator.

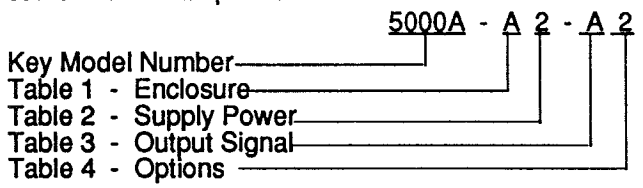
The 5000A may be used with standard sensing probes for control/display of liquids, granular products or powders. Numerous probe styles and options are available to "tailor" the installation to individual process requirements. The Model 5000A Level-Lance has various options for optimizing the installation capabilities. Some of these are:

1. The Smart-Chip TM. This option permits linearizing or characterizing of non-linear signals such as flow in Parshall Flumes or Weirs and volume characterization of horizontal cylindrical of other oddly shaped vessels.

2. Serial Interface. This option gives the user the capability of having the Model 5000A communicate directly with other computers, etc. The standard RS-232-C configuration is used.

1.2 MODEL IDENTIFICATION

Identify instrument models in accordance with the description and variations listed in each table. Dashes are used in the model number only in those spaces as indicated in the example below.



Key Model Number

Model No.	Description
5000A	Microprocessor-based continuous level measurement system includes the remote mounted digital display, 2 DPDT relays, and the direct mounted PFM transmitter that is in an explosion-proof enclosure.

Table 1 - Enclosure

Designation	Description
A	NEMA 4 with window
B	Explosion-proof blind (without window)
C	Explosion-proof with window
D	NEMA 4X stainless steel with window
E	NEMA 4X glass reinforced polyester w/window

Table 2 - Supply Power

Designation	Description
1	18 to 30 VDC
2	120 VAC, ±10%
3	240 VAC, ±10%

Table 3 - Output Signal

Designation	Description
A	None
C	4 to 20 MADC, isolated
D*	Serial Interface, RS-232-C
E	Combination of C & D

Table 4 - Options

Designation	Description
1	None
2	Non-Linear Characterization (Smart - Chip)
4**	Remote PFM transmitter (15 feet maximum)
6	Combination of 2 & 4 above

NOTE

* For Serial Interface Output, consult supplement manual 909 GF 258.

** Remote-mounted standard PFM transmitter requires cable #032 KC 030-XX and condulet #909 SD 029.

SECTION II
SPECIFICATIONS

2.1 ENVIRONMENTAL

Operating Temperature Range ..... -40 to +140 °F (-40 to +60 °C)

Storage Temperature Range..... -40 to +180 °F (-40 to +82 °C)

Ambient Temperature Effect..... 0.005 Pf/°F (0.01Pf/°C) or .005%/°F (0.01%/°C) whichever is greater.

2.2 ELECTRICAL

Supply Voltages ..... 120 VAC, ±10% Std. 240 VAC, ±10% Opt. 18-30 VDC Opt.

Power Required ..... Less than 15 watts

Supply Variation Effect ..... None

2.3 PERFORMANCE

Span Range ..... 10 to 6000 Pf.

Linearity ..... ± 0.5%

Electromechanical Relays..... DPDT, 10 amp @ 120 VAC, 240 VAC, or 28 VDC Non-inductive

Adjustable Differential ..... to 100%

Adjustable Time Delay ..... 0.1- 25 seconds

Maximum distance between PFM transmitter and the controller..... one mile

Type interconnection cable ..... Standard 2 wire twisted pair (shielded or in grounded metal conduit).

2.4 OPTIONS

Current Output	4-20 MADC Isolated, 1000 ohm max load resistance.
Serial Interface	RS-232C Compatible

2.5 ENCLOSURE

Weather-tight	NEMA 4
Explosion-Proof	NEMA 7C & D, 9E, F & G
Weather-tight/ corrosion proof	NEMA 4X Stainless Steel NEMA 4X glass reinforced polyester

PFM - Suitable for Class I, Div.1, Groups C & D; Class II,Div. I Groups E, F, G.

5000 - optional NEMA 4 or explosion proof:
FM approved for Class I, Groups C,D; Class II, Groups E,F,G; Class III.

CSA certified for Class I, Group D; Class II, Groups E,F,G; Class III.

SECTION III
INSTALLATION

3.1 GENERAL

Examine the instrument for possible shipping damage. **IMPORTANT:** If for any reason it is determined that parts should be returned to the factory, please notify the nearest Robertshaw Controls Company sales representative prior to shipment. Each unit must be properly packaged to prevent damage. Robertshaw assumes no responsibility for equipment damaged in return shipment due to improper packaging.

Choose the location for installation in accordance with good instrument practice, avoiding extremes of temperature, humidity, and vibration. (See SPECIFICATIONS, Section II.)

3.2 PROBE MOUNTING

Robertshaw probes are purchased separately in a variety of sizes and types for specific applications involving liquids or granular materials. Insulated probes are used for liquid solutions or liquid interface detection whether the product is electrically conductive or nonconductive. Bare type probes can be used on nonconductive materials only. Concentric probes should be used when measuring nonconductive liquids in non-linear vessels (ie, horizontal cylinders). Alternately, a standard probe may be centered in a grounded metal stilling well, provided it will not move inside the well.

Vertically mounted rod-type and concentric probes should be installed in either the top or bottom of the vessel. Vertically installed probes allow a variation in calibration points up and down the length of the probe by means of the instrument "Auto Set" adjustment.

Flexible probes should be vertically mounted from the top of the vessel. Depending on the application, it may be desirable to install an anchor between the bottom of the flexible probe and bottom of the vessel.

3.3 INSTRUMENT MOUNTING

3.3.1 DISPLAY UNIT

The Model 5000A Level-Lance is designed for mounting remotely from the probe assembly and may be mounted or oriented in any position. See Figure 3-1, 3-2, 3-3 & 3-4 for mounting dimensions. The unit should always be mounted in its factory supplied enclosure. If this is not possible, then make certain that the electronic chassis is properly shielded from electrical interference caused by devices such as motor starters, relays, etc.

3.3.2 PFM TRANSMITTER

The PFM transmitter is normally mounted directly to the probe. The following procedure should be followed (ref. figure 3-5):

A. Remove cover from transmitter assembly. Remove banana pin kit and printed circuit assembly with bracket.
B. Install banana pin in center rod of probe. Do not overtighten.
C. Install transmitter enclosure by screwing onto 1/2" NPT threads of probe.Align hubs as required.
D. Install printed circuit assembly. Verify that banana pin makes good electrical contact with the mating jack.
E. Install cover.

Optionally, the transmitter may be mounted remote from the probe to a maximum distance of 15 feet. The remote mount option must have been specified at the time of order, a cable and condulet are required (see Section I). See figure 3-6 for mounting dimensions.

3.4 ELECTRICAL CONNECTIONS

All electrical connections should be made in accordance with Figure 3-5, 3-6, and 3-7. See SPECIFICATIONS for control relay contact ratings. The unit must be grounded for proper operation.

WARNING

SEAL FITTINGS MUST BE INSTALLED IN ALL EXPLOSION-PROOF INSTALLATIONS.

3.4.1 INTERCONNECTION CABLE

The PFM transmitter at the probe is connected to the Model 5000A Display Unit by means of ordinary twisted pair within a grounded metal conduit. There should be no power lines in this conduit. As an alternate, use shielded twisted pair if power lines are present or the wires are not mounted in metal conduit. The use of color-coded wire is recommended.

3.4.2 RELAY CONTACT TERMINALS

Arc suppression networks are provided with the unit for installation across or parallel to the load when switching inductive loads such as relay and solenoid coils, motors, valves, etc. It is important that these networks be used to prevent problems caused by interference generated by arcing contacts.

3.4.3 REMOTE PFM TRANSMITTER OPTION

The remote mounted PFM transmitter must be wired to the probe using coaxial cable. Refer to figure 3-6 for wiring information.

WEATHER-TIGHT ENCLOSURE

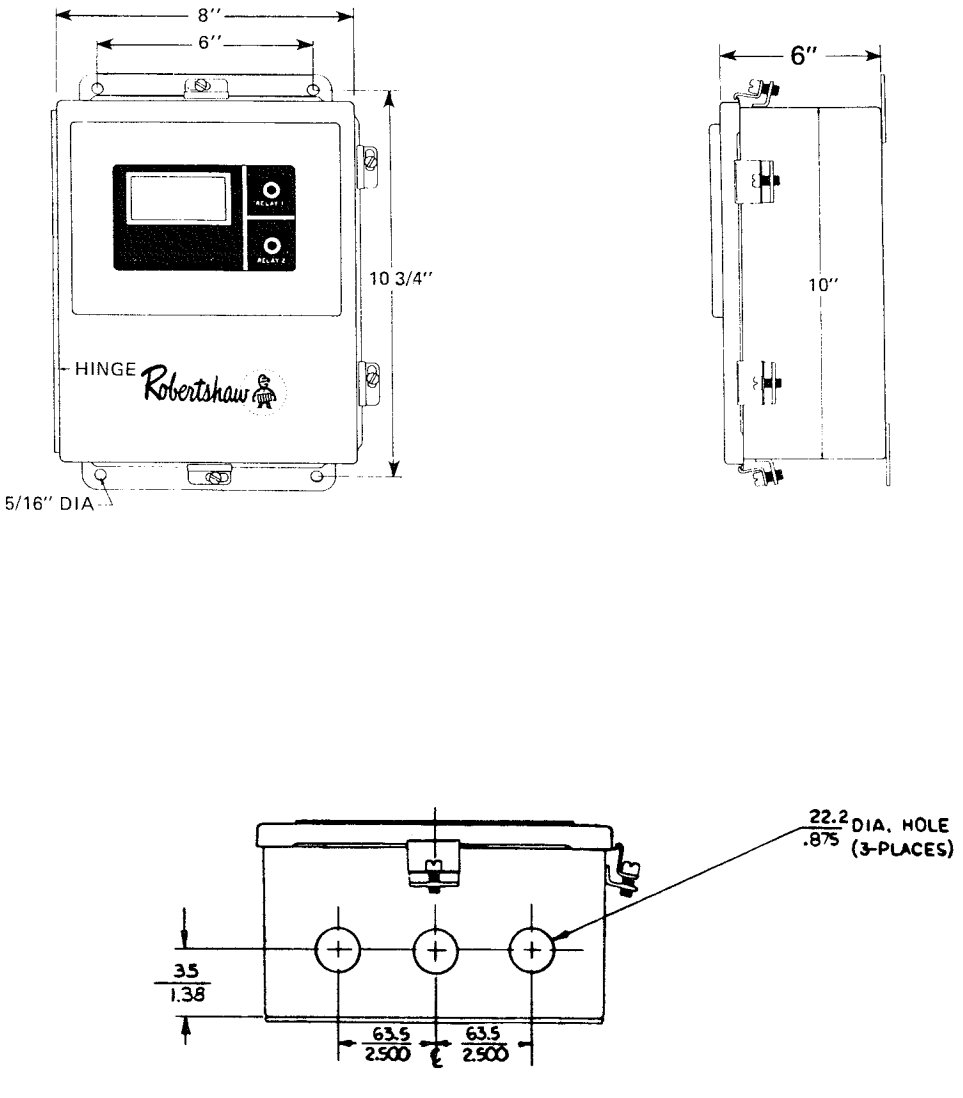


Figure 3-1 Mounting Dimensions, Display Unit, Weather-tight, NEMA 4 Painted Steel or NEMA 4X Stainless Steel.

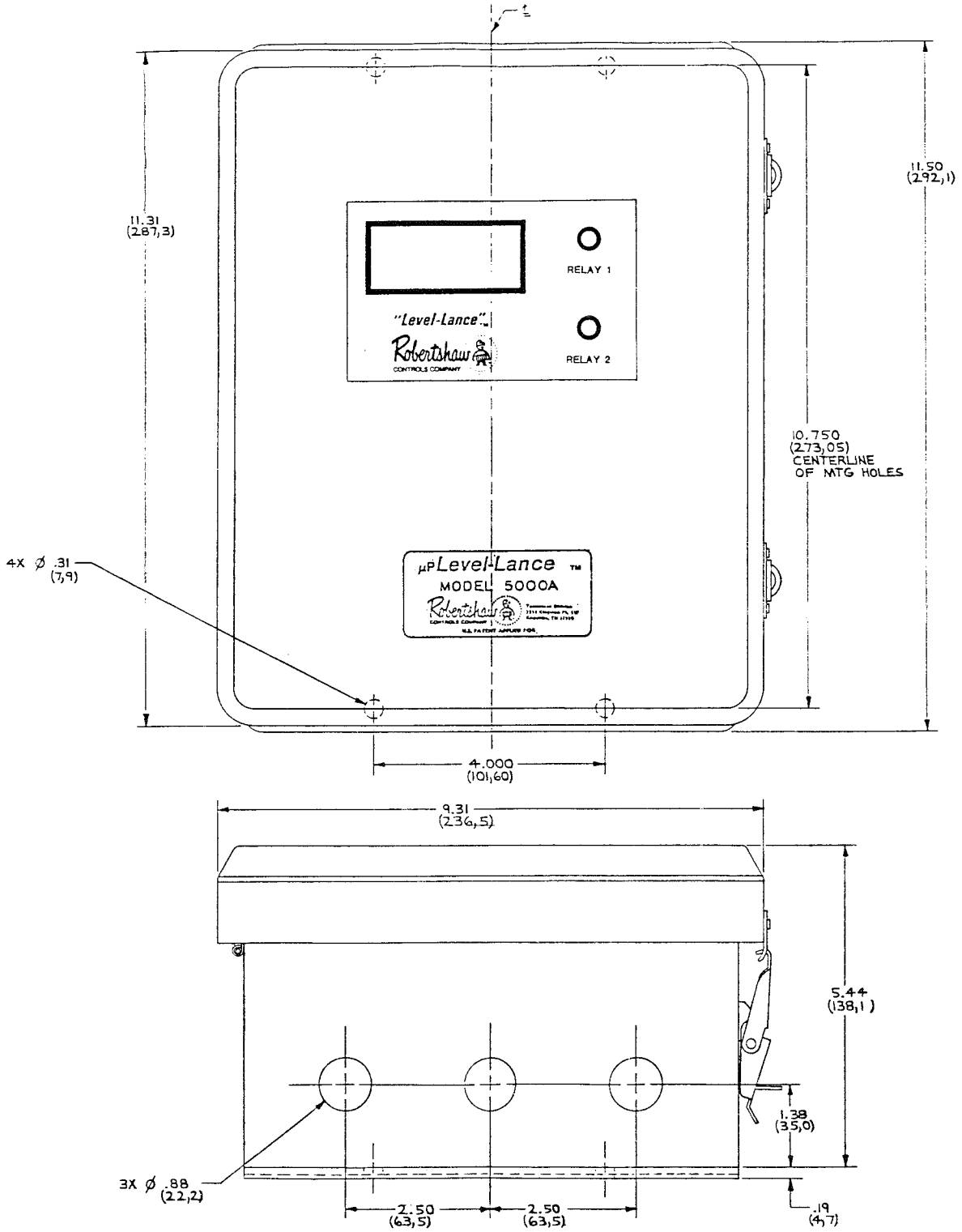


Figure 3-2 Mounting Dimensions, Display Unit, NEMA 4X Glass Reinforced Polyester.

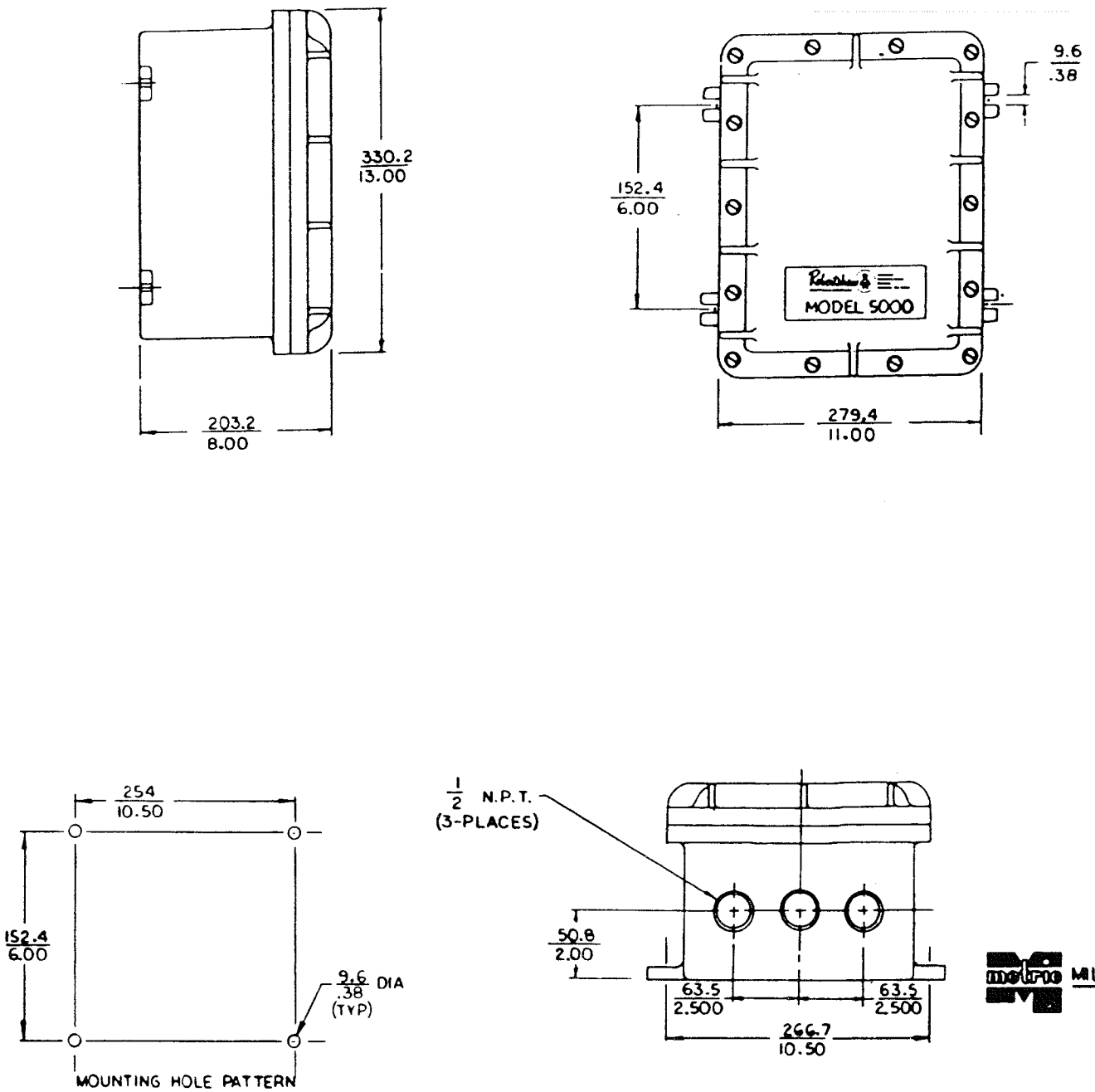


Figure 3-3 Mounting Dimensions, Display Unit, Explosion-Proof Blind.

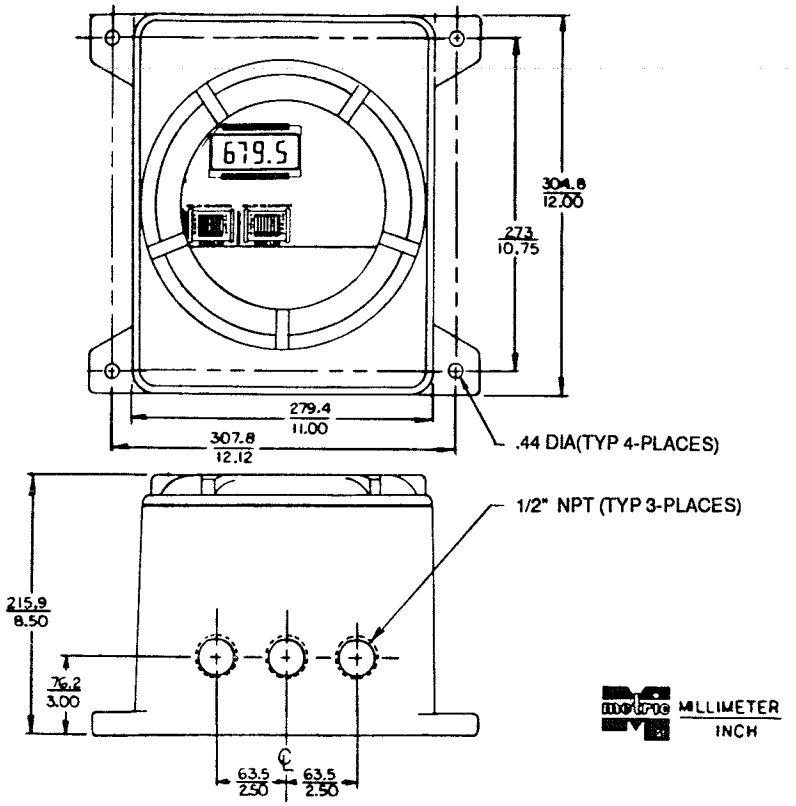


Figure 3-4 Mounting Dimensions, Display Unit, Explosion-Proof with window.

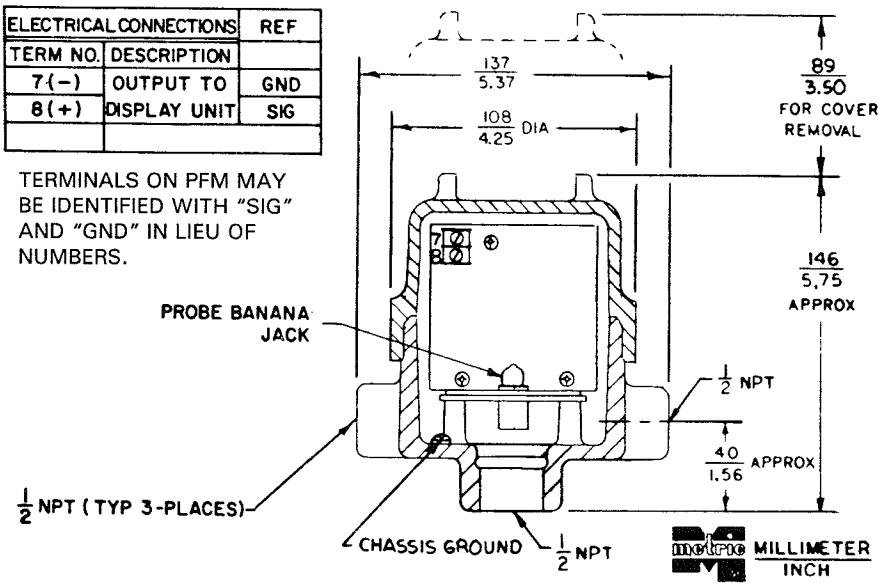
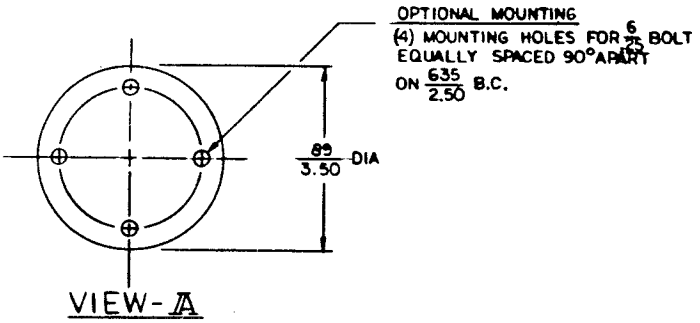
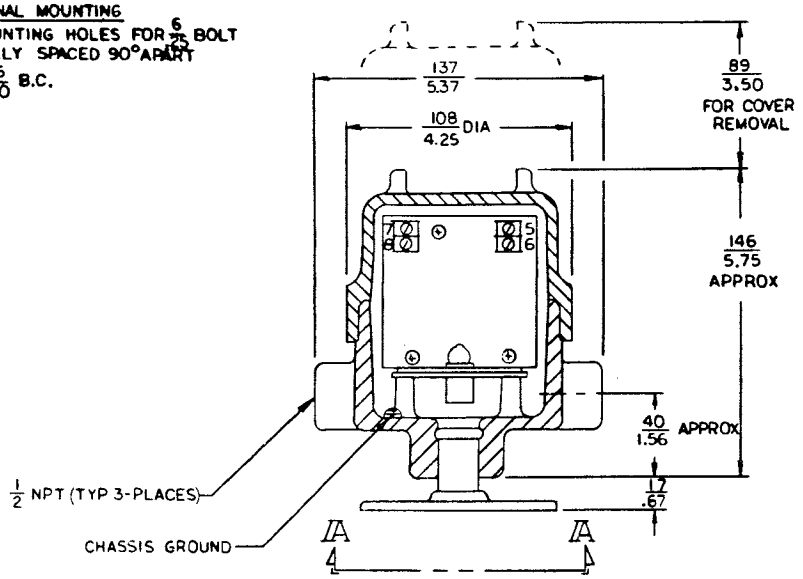


Figure 3-5 Mounting Dimensions and Electrical Connections, Probe Mounted PFM Tranmitter.

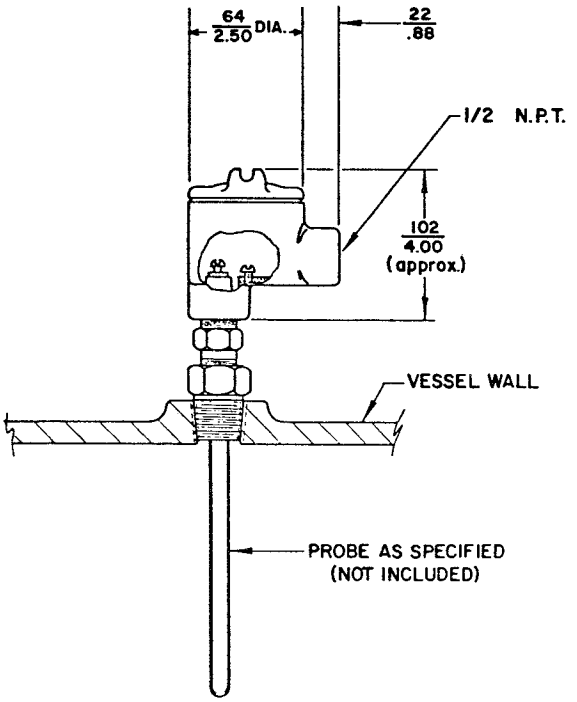


ELECTRICAL CONNECTIONS		REF
TERM NO.	DESCRIPTION	
7	OUTPUT TO DISPLAY UNIT	GND
8		SIG
5	INPUT FROM PROBE	GND
6		PROBE

TERMINALS ON PFM MAY BE IDENTIFIED WITH "SIG", "GND" AND "PROBE" IN LIEU OF NUMBERS.



MILLIMETER / INCH



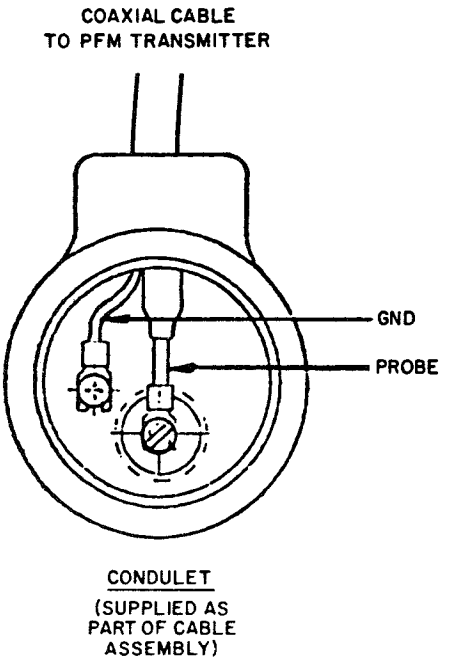


Figure 3-6 Mounting Dimensions and Electrical Connections, Remote Mounted PFM Transmitter.

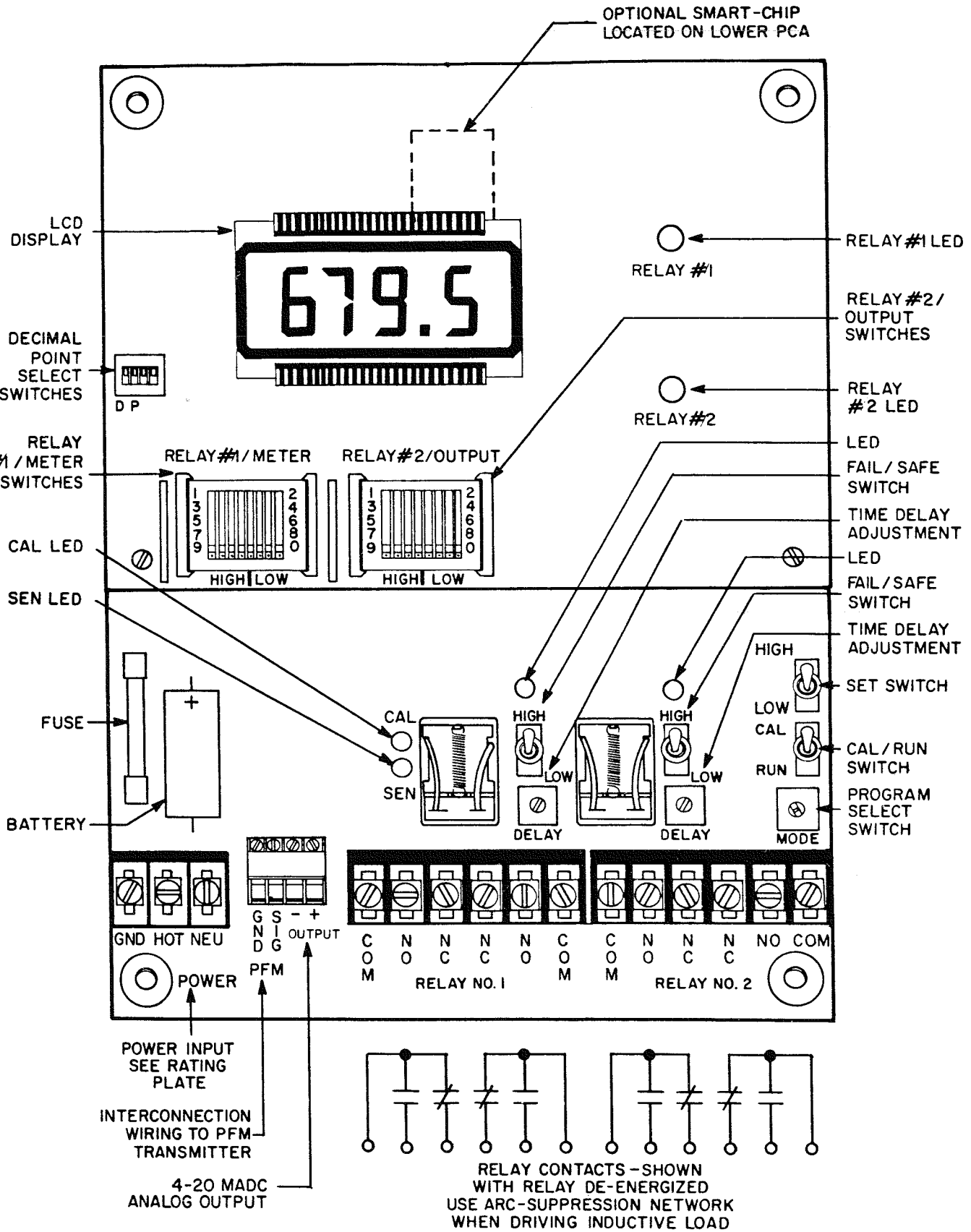


Figure 3-7 Electrical Connections and Adjustment Locations, Display Unit.

SECTION IV

OPERATION

4.1 DESCRIPTION OF CONTROLS AND ADJUSTMENTS

4.1.1 MAIN (LOWER) PRINTED CIRCUIT ASSEMBLY

Refer to figure 3-7 for location of the following controls:

4.1.1.1 PROGRAM SELECT SWITCH:

This ten position rotary switch is used to select the OPERATING PROGRAM as follows:

POSITION "0" - TEST PROGRAM (See section 4.2)

POSITION "1-8" - NOT USED

POSITION "9" - NORMAL OPERATION (See section4.3)

4.1.1.2 CAL/RUN SWITCH:

This toggle switch allows the unit to be switched between the run (normal) and calibrate modes in the normal operation program. See section 4.3.

4.1.1.3 SET SWITCH:

This switch is used to "set" the low and high points when the unit is in the calibrate mode. It is not used in the run mode. The switch is a spring loaded "Momentary ON" - "OFF" - "Momentary ON" type. See section 4.3.3.

4.1.1.4 "CAL" LED:

In the run mode, this light emitting diode indicates a calibration error. See section 4.3.6.1. In the calibrate mode, the LED indicates that the calibration data was accepted. See section 4.3.3.

4.1.1.5 "SEN" LED:

In the normal operation program, this LED indicates a problem with the probe, the PFM transmitter, or the interconnection wiring. See section 4.3.6.2.

4.1.1.6 RELAY #1 & RELAY #2 FAIL-SAFE SWITCH:

This toggle switches are used to select the fail-safe mode for relay #1 of relay #2 respectively. See section 4.3.5.1.

4.1.1.7 RELAY #1 & RELAY #2 LED:

These LED's light when relay #1 or relay #2 are de-energized.

4.1.1.8 RELAY #1 & RELAY #2 TIME DELAY ADJUSTMENT:

These potentiometers adjust the time delay for relay #1 and #2 respectively. These delays occur only when the relay is to drop out (de-energize). Pull-in of the relays occur within 0.1 second. The delays are adjustable from 0.1 to 25 seconds, with full clockwise rotation giving maximum delay. See section 4.3.5.3.

4.1.1.9 "SMART-CHIP TM":

This optional integrated circuit is used for linearizing the Model 5000A display and output when volume or flow conversion is desired. This IC is factory programmed as specified at time of order.

4.1.1.10 BATTERY:

The battery is used to maintain calibration data in the event of power failure. 5.1.

4.1.2 DISPLAY PRINTED CIRCUIT ASSEMBLY

Refer to figure 3-7 for location of the following controls:

4.1.2.1 DECIMAL POINT SELECT SWITCHES:

These switches are used to set the decimal point position for the LCD Display. See section 4.3.4.

4.1.2.2

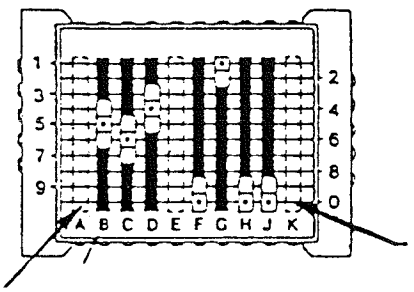
To obtain access to the DECIMAL POINT SELECT SWITCHES, the RELAY NO. 1/METER SWITCHES and the RELAY NO. 2/OUTPUT SWITCHES it will be necessary to remove the panel which is secured to the top circuit board with four (4) NYLON SCREWS.

To remove the PANEL loosen the four (4) NYLON SCREWS two (2) or three (3) turns. Slide the PANEL up as far as it will go. Then pull the bottom of the PANEL out slightly and slide it down over the heads of the two (2) lower NYLON SCREWS. The PANEL should now be removed.

After all calibrations and adjustments have been made reassemble the PANEL by first sliding the PANEL under the heads of the two (2) upper NYLON SCREWS and then under the heads of the two (2) lower NYLON SCREWS.

Tighten the NYLON SCREWS by first bottoming out the screws and then tighten an additional 1/3 to 1/2 turn.

RELAY #1/METER SWITCHES and RELAY #2 OUTPUT SWITCHES:
These switches have ten (10) positions but only eight (8) are used. Disregard positions A and K.



4-1 Relay #1/Meter Switches and Relay #2/ Output Switches.

4.1.2.3 RELAY #1/METER SWITCHES:

This is a bank of switches whose function depends upon the operating mode. In the run mode, the switches set the high and low trip points for relay #1 (See section 4.3.5). In the calibration mode, the switches are used to enter the high and low readouts corresponding to the high and low calibration points (See section 4.3.3). In the example shown in figure 4-2, the high point is set to 2039,while the low point is set to 433.

4.1.2.4 RELAY #2/OUTPUT SWITCHES:

This bank of switches is similar to the RELAY #1/METER SWITCHES.

In the run mode, the switches set the high and low trip points for relay #2 (See section 4.3.5). In the calibrate mode, the switches are used to enter the readouts corresponding to 20 MA (HIGH) output and 4 MA (LOW) output (See section 4.3.3). In the example shown in figure 4-3, the high point is set to 4903, while the low point is set to 0.

4.1.2.5 RELAY #1 AND #2 LED:

These are two-color (red/green) LED's. They light green when their respective relay is energized and red when their respective relay is de-energized.

4.1.2.6 LCD DISPLAY:

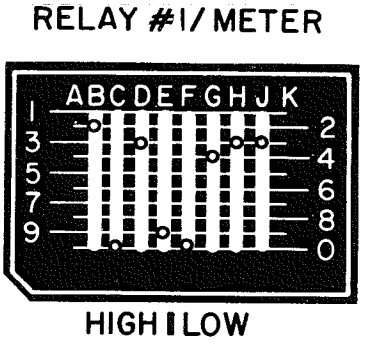
This is a four digit display which can read from -999 to 9999.

4.1.3 ANALOG (4-20 MADC) OUTPUT PRINTED CIRCUIT ASSEMBLY

Refer to figure 4-4 for location of the following controls:

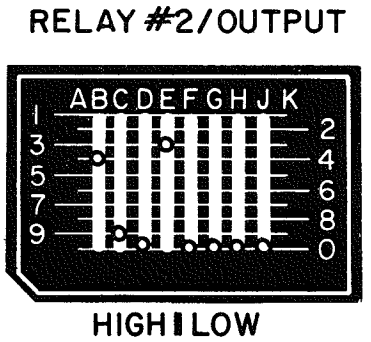
4.1.3.1 FINE ZERO ADJUSTMENT:

This factory-set trimmer is used to adjust the 4 MADC output. Refer to section 5.2.



NOTE
Positions A and K are NOT used.

Figure 4-2 Relay #1/Meter Switches



NOTE
Positions A and K are NOT used.

Figure 4-3 Relay #2/Output Switches

4.1.3.2 FINE SPAN ADJUSTMENT:

This factory-set trimmer is used to adjust the 20 MADC output. Refer to section 5.2.

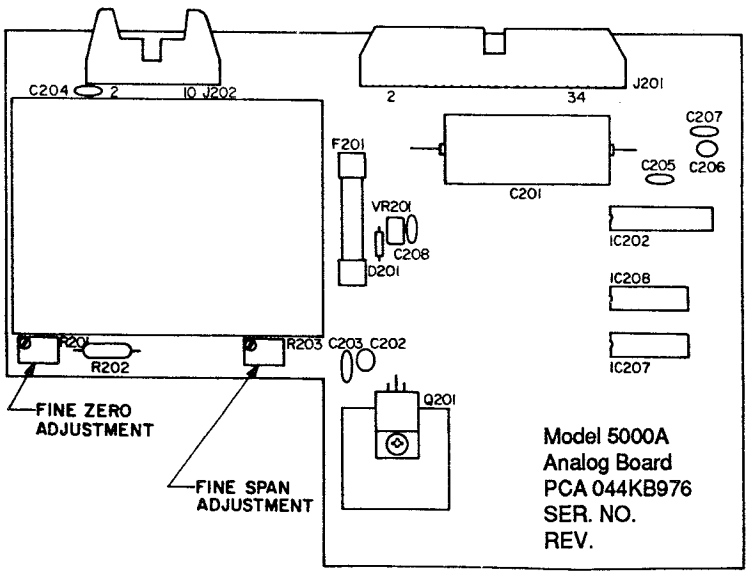


Figure 4-4 Analog Output PCA

4.2 THE TEST PROGRAM

The Test Program is useful for checking the operation of several parts of the Model 5000A Level-Lance. It is recommended that the user operate the unit in the test program to familiarize himself with the operation of the controls and adjustments.

To enter the test program, Place the PROGRAM SELECT switch in position 0.

4.2.1 CAL AND SEN LED TEST:

At all times in the test program the CAL and SEN LED's should be lighted. This verifies operation of the lamps and associated circuitry.

4.2.2 RELAY OPERATION TEST:

A. Set the PROGRAM SELECT switch to position 0.

B. Place the CAL/RUN switch in the RUN position.

C. Adjust both TIME DELAY adjustments fully counter-clockwise.

D. Place both FAIL-SAFE switches in the LOW position. Both relays should be energized, the RELAY LED's on the main PCA should be off, and the RELAY LED's on the display PCA should be green.

E. Place the RELAY #1 FAIL-SAFE switch in the HIGH position. Relay #1 should immediately de-energize, the RELAY #1 LED on the main PCA should light, and the RELAY #1 LED on the display PCA should be red.

F. Return the RELAY #1 FAIL-SAFE switch to the LOW position. Relay #1 should immediately energize, the RELAY #1 LED on the main PCA should go off, and the RELAY #1 LED on the display should be green.

G. Turn the RELAY #1 TIME DELAY adjustment fully clockwise.

H. Place the RELAY #1 FAIL-SAFE switch in the HIGH position. The RELAY #1 LED on the display PCA should immediately turn red. After about 25 seconds, relay #2 should de-energize and the RELAY #1 LED on the main PCA should light.

I. Return the RELAY #1 FAIL-SAFE switch to the LOW position. RELAY #1 should immediately energize, the RELAY #1 LED on the main PCA should go off, and the RELAY #1 LED on the display PCA should be green.

J. Turn the RELAY #1 TIME DELAY adjustment fully counter-clockwise.

K. Repeat steps E through J for relay #2.

4.2.3 DISPLAY TEST:

A. Set the PROGRAM SELECT switch to position 0.

B. Place the CAL/RUN switch in the RUN position.

C. Enter a number from 0000 to 9999 into the HIGH side of the RELAY #1/METER switches on the display PCA. The LCD display should read the same number.

4.2.4 ANALOG OUTPUT TEST:

A. Set the PROGRAM SELECT switch to position 0.

B. Place the CAL/RUN switch in the RUN position.

C. Connect a milliammeter, in series with the load, to the output terminals on the main PCA.

D. Set the HIGH side of the RELAY #2/OUTPUT switches to 0000. The output should be 4.00 ± .04 MADC.

E. Set the switches to 0250. The output should be 8.00 ± .04 MADC.

F. Set the switches to 0500. The output should be 12.00 ± .04 MADC

G. Set the switches to 0750. The output should be 16.00 ± .04 MADC.

H. Set the switches to 1000. The output should be 20.00 ± .04 MADC.

4.2.5 PROBE/TRANSMITTER TEST:

A. Set the PROGRAM SELECT switch to position 0.

B. Place the CAL/RUN switch in the CAL position.

C. After several seconds, the LCD DISPLAY should display a positive number (zero or a negative number indicates a problem).

D. If the unit is installed in a vessel, raising and lowering the level should cause an increase or decrease, respectively, of the number displayed.

4.3 NORMAL OPERATION

Normal operation is selected by placing the PROGRAM SELECT switch in position 9.

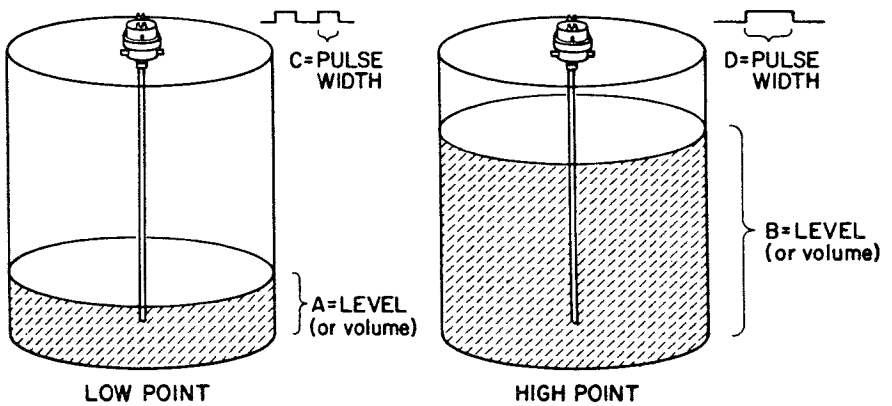


Figure 4-5 Normal Operation

4.3.1 DEFINITIONS:

The following definitions are helpful in understanding the operation of the Model 5000A Level-Lance:

CALIBRATION POINT - One of two different product levels to which the unit will be calibrated.

LOW POINT - The lower of the two calibration points.

HIGH POINT - The higher of the two calibration points.

A	The display value (level or volume) in desired engineering units corresponding to the LOW POINT.
B	The display valve (level or volume) in desired engineering units corresponding to the HIGH POINT.
C	The width of the pulses at the output of the PFM transmitter when the level is at the LOW POINT.
D	The width of the pulses at the output of the PFM transmitter when the level is at the HIGH POINT.
E	The display value at which a 4 MADC output is desired.
F	The display value at which a 20 MADC output is desired.
X	The width of the pulses at the output of the PFM transmitter at the current product level.
Y	The current display value.
Z	The current output (0000 = 4 MADC, 1000 = 20 MADC).

LOOKUP TABLE - A series of memory locations, 0 through 1023, in the Smart-Chip TM. These locations contain linearized display value, 0-9999, corresponding to 0 through 102.3% level in the vessel.

SET-POINT - The point at which a relay changes state. Each relay has two set points, an upper and a lower.

DIFFERENTIAL - the difference between the upper and lower SET-POINT. This is sometimes referred to as DEAD-BAND.

FAIL-SAFE - A relay is said to be fail-safe when it is set to de-energize to indicate an abnormal, or alarm, condition. The relay will be energized during normal conditions, and will de-energize when an abnormal condition occurs. It will also de-energize upon power failure and certain other failure conditions as detected by the Level-Lance Model 5000A.

LOW FAIL-SAFE - Relay energizes when the set-point is exceeded and de-energizes when the level is below the set point.

HIGH FAIL-SAFE - Opposite of LOW FAIL-SAFE.

DIRECT ACTING - Display (or output) increases upon increase in level.

REVERSE ACTING - Display (or output) decreases upon increase in level.

4.3.2 GENERAL DESCRIPTION

4.3.2.1 DISPLAY VALUE (without Smart-Chip TM):

The value to be displayed is determined from the following formula:

$$Y = \frac{A + (B-A)(X-C)}{(D-C)}$$

If Y thus determined is less than -999 or greater than 9999, Y is set at 0 and a calibration failure alarm initiated (see section 4.3.6.1).

4.3.2.2 DISPLAY VALUE, with Smart-Chip TM:

When a Smart-Chip TM is installed, the unit first calculates Y as in 4.3.2.1, then checks that Y is between 0 and 1023. If it is not, Y is set to 0 or 1023, depending upon whether it was too high or low. Then, Y is used as a memory address to access a value in the LOOKUP TABLE. Y is then set to this value.

4.3.2.3 ANALOG OUTPUT:

After Y is determined, the analog output is calculated as follows:

$$Z = \frac{Y-E}{F-E} \quad (1000)$$

If Z is less than 0, it is set to 0. If Z exceeds 1023, it is set to 1023 (corresponding to 20.368 MADC maximum output).

4.3.2.4 RELAY OPERATION:

The state of a relay set for LOW FAIL-SAFE is given by:

NEW STATE =
- ENERGIZED IF Y > UPPER SET-POINT
- PREVIOUS STATE IF Y IS BETWEEN UPPER AND LOWER SET-POINT
- DE-ENERGIZE IF Y < LOWER SET-POINT

For a HIGH FAIL-SAFE relay, the formula is:

NEW STATE=
- DE-ENERGIZE IF Y > UPPER SET-POINT
- PREVIOUS STATE IF Y IS BETWEEN UPPER AND LOWER SET-POINT
- ENERGIZED IF Y < LOWER SET-POINT

As can be seen, the DIFFERENTIAL defines a range of display values over which the state of the relay will not change. This is useful, for example, in cyclic control of a pump. The pump could be set to turn on at the upper set-point and would remain on until the lower set-point was reached. If a relay is to be used as an alarm only, a minimum differential is usually desired.

Each relay has an adjustable time delay. This delay is active only when the relay is to de-energize. The relay will energize instantaneously regardless of the setting of the TIME DELAY adjustment.

4.3.3 CALIBRATION

4.3.3.1 GENERAL:

Before the Model 5000A Level-Lance is placed in service, it must be calibrated.

This process consists of establishing two different product levels (CALIBRATION POINTS) in the vessel, entering the correct values on the RELAY #1/METER and RELAY #2/OUTPUT switches, and operating the SET switch. At each calibration point, three pieces of information are stored in the memory of the Model 5000A as indicated in chart below.

4.3.3.2 HELPFUL INFORMATION:

A. The unit must be calibrated with the probe installed in the vessel. Calibration in a bucket, etc., or by raising and lowering the probe may give inaccurate results. (Exception - concentric shielded probes may be calibrated outside the vessel). The actual product to be measured must be used. (Exception - one conductive liquid (ex - water) may usually be substituted for another (ex - acid) with negligible error.)

B. Calibration is not complete until the unit is set to both a high point and a low point. If the unit is returned to the RUN mode after only one point is calibrated, the display and output will be unpredictable.

C. Either the high point or the low point may be set first. Also, either point may be changed without changing the other point.

D. When setting the low point, the high sides of the RELAY #1/METER and RELAY #2/OUTPUT switches are ignored. When setting the high point, the low sides are ignored.

E. A unique feature of the Model 5000A Level-Lance is the ability to calibrate the unit without completely emptying and filling the vessel. However, the low and high points should be as far apart as possible. The inaccuracy of the system is inversely proportional to the difference between the high and low points as a percentage of overall level. Since, for example, the basic linearity is ±0.5%, if the high and low points differ by only 10% inaccuracy of ±5% should be expected.

F. The unit cannot measure off the bottom of the probe. If the low point is to be set when the vessel is empty, it should be assumed for calibration purposes that the level is at the end of the active section of the probe (See probe installation drawing). See example #1.

G. The 4-20 MADC output is calibrated to the displayed values. If the unit is set to display in gallons, for example, the output must be calibrated in gallons.

H. The display may be calibrated as direct acting or reverse acting. The 4-20 MADC output may be calibrated over any portion of the range of displayed values and may be set as direct acting or reverse acting. The same calibration procedure is followed in all cases, the type of operation depending on the values entered into the RELAY #1/METER and RELAY #2/OUTPUT switches. See the examples below.

I. Calibration cannot be accomplished if the SEN LED is lit. This indicates a problem in the probe or transmitter which must be corrected first.

J. Calibration of the display of units with the Smart-Chip TM option is done in percent of level (0000 = 0.0%, 1000 = 100%) and not in volume. If the low point is set with the vessel empty, a level at the end of the active section of the probe must be assumed (see probe installation drawing). **DO NOT assume 0% level!** The 4-20 MADC output is calibrated to the displayed values (usually volume), not the level.

K. The CAL/RUN switch must be returned to the RUN position when calibration is complete.

4.3.3.3 CALIBRATION PROCEDURE

Calibration consists of two major steps.

A. LOW POINT:

1) Lower the product level to the lowest possible level.

2) Place the PROGRAM SELECT switch in position 9.

3)Place the CAL/RUN switch in the CAL position. The CAL LED should light.

4) Set the LOW side of the RELAY #1/METER switches to the desired display value corresponding to the LOW POINT. If a Smart-Chip TM is installed, set these switches in percent of level (0000 = 0.0%, 1000 = 100.0%).

CALIBRATION POINT	SYMBOL	NAME	SOURCE
LOW	A	DISPLAY VALUE	LOW SIDE OF RELAY #1/METER switches
LOW	C	PULSE WIDTH	PFM transmitter
LOW	E	4 MADC WIDTH	LOW SIDE OF RELAY #2/OUTPUT switches
HIGH	B	DISPLAY VALUE	HIGH SIDE OF RELAY #1/METER switches
HIGH	D	PULSE WIDTH	PFM transmitter
HIGH	F	20 MADC VALUE	HIGH SIDE OF RELAY #2/OUTPUT SWITCHES

5) If the unit has the current (4-20 MADC) output option, set the LOW side of the RELAY #2/OUTPUT switches to the display value at which 4 MADC output is desired. If the output option is not present, skip this step.

6) Push the SET switch down to the LOW position and hold it there until the CAL LED goes out. The value entered in step 4 should appear on the LCD display.

7) Release the SET switch.

B. HIGH POINT:

1) Raise the product level to the highest possible level.

2) Place the PROGRAM SELECT switch in position 9.

3) Place the CAL/RUN switch in the CAL position. The CAL LED should light.

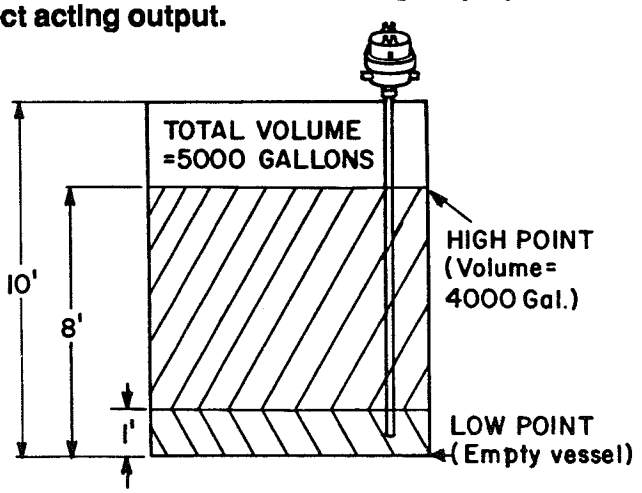
4) Set the HIGH side of the RELAY #1/METER switches to the desired display value corresponding to the HIGH POINT. If a SMART-CHIP TM is installed, set these switches in percent of level (0000 =0.0%, 1000 = 100.0%).

5) If the unit has the current (4-20 MADC) output option, set the HIGH side of the RELAY #2/OUTPUT switches to the display value at which 20 MADC output is desired. If the output option is not present, skip this step.

6) Push the SET switch up to the HIGH position and hold it there until the CAL LED goes out. The value entered in step 4 should appear on the LCD display.

7) Release the SET switch.

4.3.3.4 EXAMPLE 1 - Direct acting display, direct acting output.



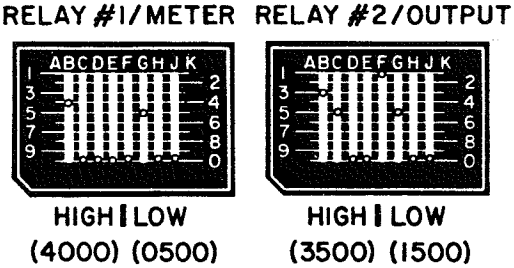


Figure 4-6 Example 1

We Desire To Set The Unit As Follows:

DISPLAY - VOLUME TO 5000 GAL MAX
OUTPUT - 4 MADC AT 1500 GAL
20 MADC AT 3500 GAL
LOW POINT - EMPTY VESSEL
HIGH POINT - VOLUME = 4000 GAL

During Calibration, the Switches Will Be Set As Follows:

LOW POINT (SET LOW SWITCHES)

RELAY #1/METER 0500 (500 GAL)
RELAY #2/OUTPUT 1500 (1500 GAL)

HIGH POINT (SET HIGH SWITCHES)

RELAY #1/METER 4000 (4000 GAL)
RELAY #2/OUTPUT 3500 (3500 GAL)

It should be noted that, since the unit cannot measure off the bottom of the probe , it was necessary to assume a level at the bottom of the probe when calibrating the low point even though the vessel was actually empty. Also note that the output is calibrated in gallons to match the display engineering units. The value entered is independent of the actual vessel level.

4.3.3.5 EXAMPLE 2 - Direct acting display, reverse acting output:

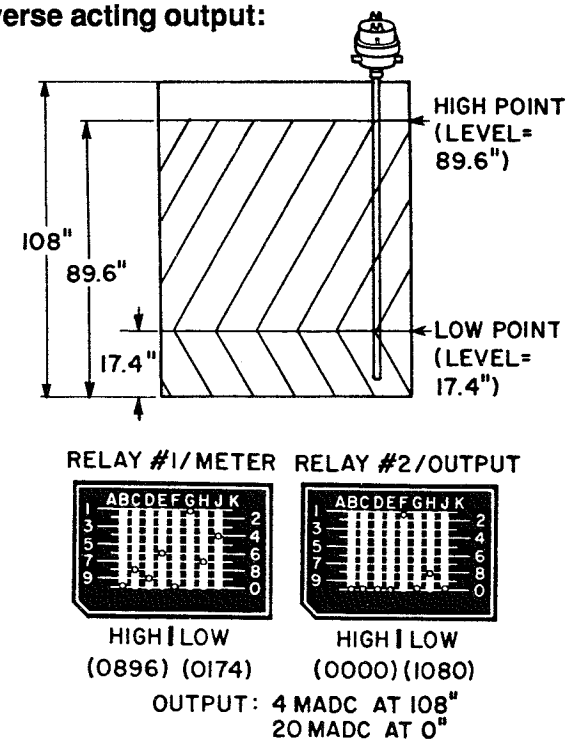


Figure 4-7 Example 2

We Wish To Set The Unit As Follows:

DISPLAY - ..... LEVEL TO 108.0"
OUTPUT - ..... 4 MADC AT 108.0"
20 MADC AT 0.0"
LOW POINT - ..... LEVEL = 17.4"
HIGH POINT - ..... LEVEL = 89.6"

The Switches Will Be Set:

LOW POINT (SET LOW SWITCHES)

RELAY #1/METER ..... **0174** (17.4")

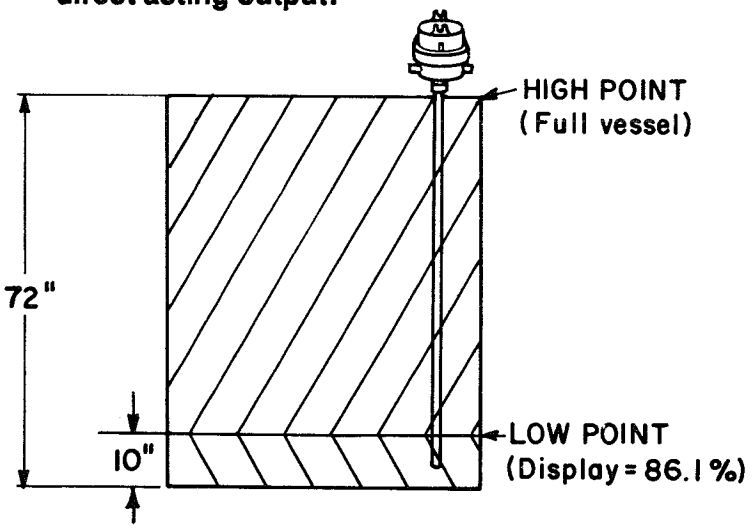
RELAY #2/OUTPUT ..... **1080** (108.0")

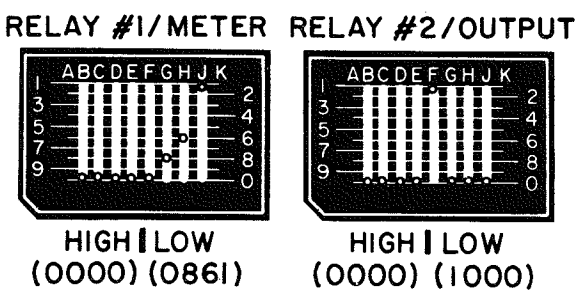
HIGH POINT (SET HIGH SWITCHES)

RELAY #1/METER ..... **0896** (89.6")

RELAY #2/OUTPUT ..... **0000** (0.0")

4.3.3.7 EXAMPLE 3 - Reverse acting display, direct acting output:





OUTPUT: 4 MADC AT 100%
20 MADC AT 0%

Figure 4-8 Example 3

In this example, we want the unit to read backwards! However, we wish the output to be direct acting with respect to the product level. Since the output is derived from the display value, the output must be set to be reverse acting with respect to the display. The Unit Will Be Set Up As Follows:

DISPLAY ..... REVERSE ACTING IN PERCENT

OUTPUT ..... 4 MADC AT 100.0% DISPLAY (EMPTY VESSEL)

20 MADC AT 0.0% DISPLAY (EMPTY VESSEL)

LOW POINT .... DISPLAY = 86.1% (AT 10" LEVEL)

HIGH POINT ... DISPLAY = 0.0% (FULL VESSEL)

The Switches Will Be Set:

LOW POINT (SET LOW SWITCHES)

RELAY #1/METER **0861** (86.1%)

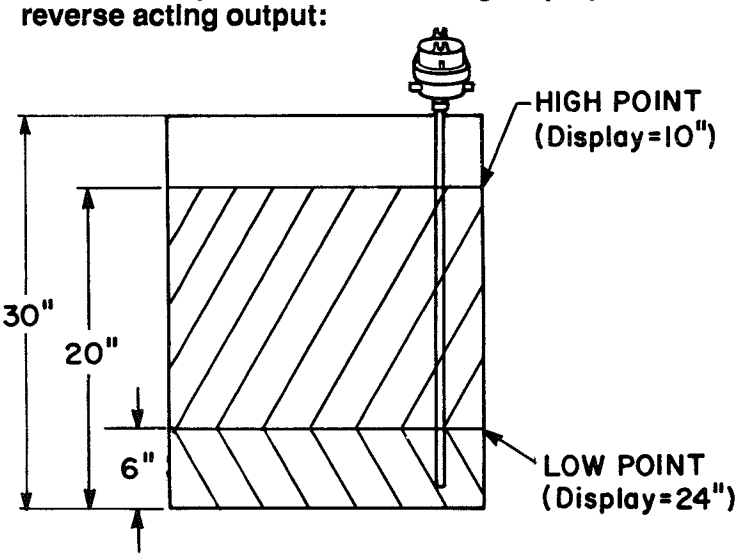
RELAY #2/OUTPUT **1000** (100.0%)

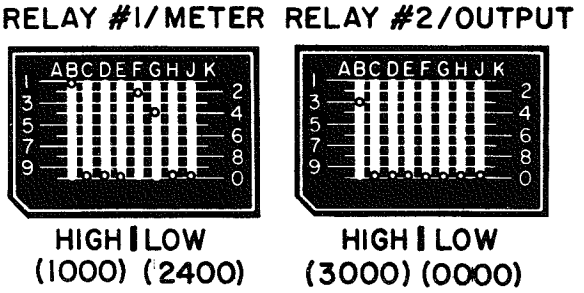
HIGH POINT (SET HIGH SWITCHES)

RELAY #1/METER **0000** (0.0%)

RELAY #2/OUTPUT **0000** (0.0%)

4.3.3.7 Example 4 - Reverse acting display, reverse acting output:





OUTPUT: 4 MADC AT 0"
20 MADC AT 30"

Figure 4-9 Example 4

In this example, both the display and the output are reverse acting with respect to product level. The Unit Will Be Set For The Following Conditions:

DISPLAY ..... REVERSE ACTING IN INCHES TO 30"

OUTPUT ..... 4 MADC AT 0.00" DISPLAY (FULL VESSEL)

20 MADC AT 30.00" DISPLAY (EMPTY VESSEL)

LOW POINT .... DISPLAY = 24.00" (AT 6" LEVEL)

HIGH POINT ... DISPLAY = 10.00" (AT 20" LEVEL)

The Switches Should Be Set As Follows:

LOW POINT (SET LOW SWITCHES)

RELAY #1/METER.....**2400** (24.00")

RELAY #2/OUTPUT.....**0000** (0.00")

HIGH POINT (SET HIGH SWITCHES)

RELAY #1/METER.....**1000** (10.00")

RELAY #2/OUTPUT.....**3000** (30.00")

Note that to obtain an output which is reverse acting with respect to level, it was necessary to set it as direct acting with respect to the display.

4.3.3.8 EXAMPLE 5 - SMART-CHIP™

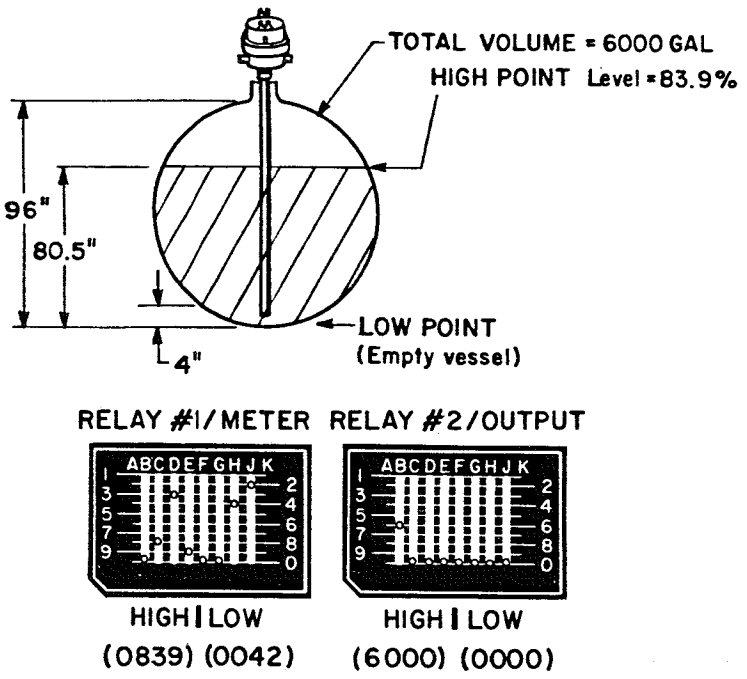


Figure 4-10 Example 5

This example shows a unit with a Smart-Chip ™ containing a lookup table for a 6000 gallon horizontal, cylindrical vessel. Some important points:

A. The display is calibrated in percent of level, not in gallons. When calibration is completed and the unit returned to the run mode, the display will switch to gallons.

B. The 4-20 MADC output is calibrated in gallons. The output, as well as the display, is linearized.

C. Since the low point in this example is off the end of the probe, we must enter the low level as though it were at the bottom of the probe.

The Unit Will Be Set For The Following Conditions:

DISPLAY:.....LEVEL TO 100.0% (will switch to gallons when in RUN mode.)

OUTPUT:.....4 MADC AT 0 GAL
20 MADC AT 6000 GAL

LOW POINT:....EMPTY VESSEL

HIGH POINT: ..LEVEL = 83.9% (at 80.5")

The Switches Should Be Set As Follows:

LOW POINT (SET LOW SWITCHES)

RELAY #1/METER **0042** (4.2%)

RELAY #2/OUTPUT ..... **0000** (0 GAL)

HIGH POINT (SET HIGH SWITCHES)

RELAY #1/METER **0839** (83.9%)

RELAY #2/OUTPUT ..... **6000** (6000 GAL)

4.3.4 DECIMAL POINT SELECTION.

There are four switches in the DECIMAL POINT SELECT switch bank but only the first three are used for selection of the decimal point placement. The positions of the decimal point may be selected by setting the switches as follows:

Desired Reading	Switch #1	Switch #2	Switch #3
XXXX	ON	ON	ON
XXX.X	ON	ON	OFF
XX.XXX	OFF	ON	ON
X.XXX	ON	OFF	ON

4.3.5 SETTING THE RELAYS

4.3.5.1 FAIL-SAFE SELECTION

Each of the two relays in the Model 5000A Level-lance may be set for high or low fail safe action. This selection, and the resulting relay operation, is based on the displayed value.

When high fail-safe action is selected, the relay will energize when the displayed value is below the lower set-point. When the displayed value exceeds the upper set-point, the relay will de-energize. In the event of power failure and certain other conditions (see Section 4.3.6) the relay will de-energize. This simulates a high condition.

When low fail-safe action is selected, the relay will de-energize when the displayed value is below the lower set-point. When the level exceeds the upper set-point, the relay will energize. In the event of power failure and certain other conditions (see Section 4.3.6) the relay will de-energize. This simulates a low condition.

Select the desired fail-safe action for each relay using the corresponding FAIL-SAFE switch.

4.3.5.2 SET-POINT ADJUSTMENT

The relay set-points are adjusted using the RELAY #1/METER and RELAY #2/OUTPUT switches. This adjustment is made when the unit is in the run mode. Do not attempt to adjust relay set-points while the unit is in the calibration mode - calibration data may be lost! TO adjust the set points:

A. Place PROGRAM SELECT switch in position 9.

B. Place the CAL/RUN switch in the RUN position.

C. Enter the upper set-point into the HIGH side of the RELAY #1/METER or RELAY #2/OUTPUT switches.

D. Enter the lower set-point into the LOW side of the switches.

4.3.5.3 TIME DELAY ADJUSTMENT

Each relay has a TIME DELAY adjustment which provides a delay of up to 25 seconds before the relay will de-energize. This delay is used to eliminate relay chatter due to splashing or turbulence in the vessel. Turn the adjustment clockwise to increase the delay.

4.3.5.4 EXAMPLE 6 - ALARM

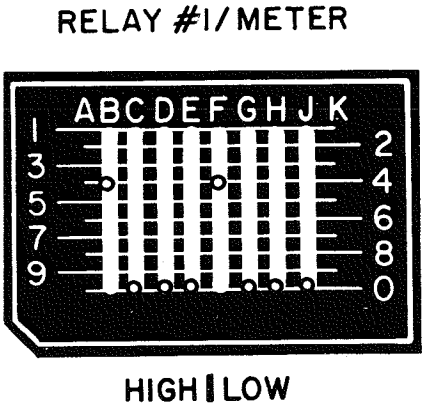


Figure 4-11 Example 6

In this example, the unit has been previously calibrated as in example 1 for a 5000 gallon vessel. Relay #1 will be used as a high alarm at 4000 gallons. Since no differential is desired, both the HIGH and LOW side of the RELAY #1/METER switches are set to 4000. The RELAY #1 FAIL-SAFE switch is set to HIGH. Relay #2 will be used as a low alarm, again without differential. Both sides of the RELAY #2/OUTPUT switches are set to 1000 and the FAIL-SAFE switch is set to LOW. This provides a low alarm at 1000 gallons.

4.3.5.5 EXAMPLE 7 - CYCLIC CONTROL

In this example, based on the calibration in example 6, relay #1 will be used to control a pump. This pump will turn on when the display reaches 5000 gallons and will continue to pump until the display is reduced to 1000 gallons. The HIGH side of the RELAY #1/METER switches is set to 5000, while the low side is set to 1000.

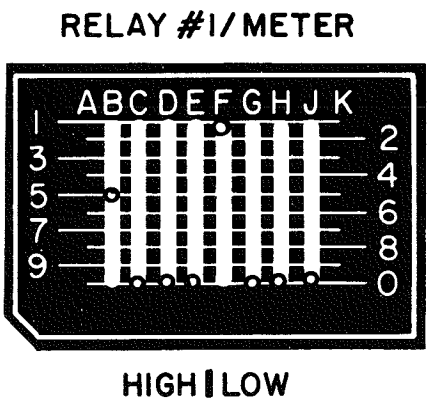


Figure 4-12 Example 7

The relay is set to low fail-safe to prevent the pump from running dry in the event of power failure. The pump is powered through the NORMALLY OPEN contacts of relay #1. Relay #2 is not used.

4.3.6 Failure modes

The following failure indications may occur when the PROGRAM SELECT switch is in position 9.

4.3.6.1 CAL failure

Two Conditions Can Cause This Failure Indication To Occur:

A. Unit has not been calibrated or calibration data has been lost.

B. Improper calibration - result of display calculation is not between -999 and 9999.

The Following Will Occur:

A. CAL LED will light.

B. SEN LED will be off.

C. DISPLAY will read 0.

D. Relays will de-energize.

4.3.6.2 SEN failure

Several Conditions Can Cause This Failure Indication:

A. Interconnection cable open or shorted.

B. Defective PFM transmitter.

C. Defective (shorted) probe.

D. Bare probe used in conductive material.

The Following Will Occur:

A. SEN LED will light.

B. CAL LED may be on or off.

C. DISPLAY will read zero.

D. RELAYS will de-energize.

SECTION V

MAINTENANCE AND TROUBLESHOOTING

5.1 BATTERY TESTING AND REPLACEMENT

The Level-Lance Model 5000A employs a lithium battery for calibration data retention in the event of power failure. This battery has an estimated life of five to ten years, but should be tested periodically with a Voltmeter. To test:

A. Disconnect power from the unit.

B. Measure voltage between the battery terminals. This voltage should exceed 2.75 Volts.

If the battery fails the test it should be replaced. A low wattage pencil type soldering iron is required. Observe polarity.

5.2 FINE ZERO AND SPAN ADJUSTMENT (Analog output PCA)

A digital milliammeter or current loop test set is required to perform this adjustment.

A. Disconnect power from the unit.

B. Remove DISPLAY PCA mounting hardware. Leave the ribbon cable connected to the DISPLAY PCA. This allows access to the adjustments on the ANALOG OUTPUT PCA.

CAUTION

DO NOT ALLOW DISPLAY PCA TO SHORT TO MOUNTING HARDWARE OR CASE

C. Connect milliammeter (or test set) to OUTPUT terminals.

D. Restore power to unit.

E. Place PROGRAM SELECT switch in position 0.

F. Place CAL/RUN switch in RUN position.

G. Set HIGH SIDE of RELAY #2/OUTPUT switches to 0000.

H. Adjust FINE ZERO adjustment to obtain 4.00 ± .02 MADC output.

I. Set HIGH side of switches to 1000.

J. Adjust FINE SPAN adjustment to obtain 20.00 ± .02 MADC output.

K. Repeat steps G through J until no further adjustment is needed.

L. Remove power and reassemble unit.

5.3 TROUBLESHOOTING GUIDE

Locate your symptoms and take the action indicated. An actual remedy may be suggested, or you may be referred to another section.

SYMPTOMS	POSSIBLE CAUSE	REMEDY
NO OPERATION: - BLANK DISPLAY - NO OUTPUT (4-20MA) - RELAYS DE-ENERGIZED - NO LAMPS LIT	NO POWER TO UNIT	CHECK MAINS WIRING & BREAKER
	FUSE BLOWN	REPLACE FUSE
	DEFECTIVE POWER	CONSULT FACTORY SUPPLY
WILL NOT CALIBRATE: - **SEN** LAMP OFF - **CAL** LAMP MAY BE LIT	PROBLEM IN PROBE/ PFM TRANSMITTER CIRCUIT	SEE PROBE CIRCUIT ELECTRICAL CHECKOUT IN SECTION 5.4
WILL NOT CALIBRATE: - **SEN** LAMP OFF - **CAL** LAMP LIT	PROBE NOT CONNECTED TO PFM TRANSMITTER	SEE PROBE/PFM TRANSMITTER TEST IN 4.2.5
	LEVEL IS NOT ON PROBE	REREAD SECTION 4.3.3
	DEFECTIVE DISPLAY UNIT	CONSULT FACTORY
UNIT "LOCKED UP" - SEN LAMP LIT - CAL LAMP MAY BE LIT - RELAYS DEENERGIZED - ALARM LAMPS LIT - STEADY READOUT AND OUTPUT DESPITE LEVEL CHANGE	PROBLEM IN PROBE/ PFM TRANSMITTER CIRCUIT	SEE PROBE CIRCUIT ELECTRICAL CHECKOUT IN SECTION 5.4
UNIT "LOCKED UP" - SEN LAMP OFF - CAL LAMP LIT - RELAYS DEENERGIZED - ALARM LAMPS LIT - STEADY READOUT AND OUTPUT DESPITE LEVEL CHANGE	UNIT NOT CALIBRATED PROPERLY	SEE SECTION 4.3.3
	UNIT LOST CALIBRATION AFTER POWER OUTAGE	CHECK BATTERY. SEE SECTION 5.1
	DEFECTIVE DISPLAY UNIT	CONSULT FACTORY

SYMPTOMS	POSSIBLE CAUSE	REMEDY
UNIT "LOCKED UP" - SEN LAMP OFF - CAL LAMP OFF - STEADY READOUT AND OUTPUT DESPITE LEVEL CHANGE	PFM PROBE NOT CONNECTED TO PFM TRANSMITTER	SEE PROBE/PFM TRANSMITTER TEST IN SECTION 4.2.5
	MALFUNCTION INDUCED BY RFI FROM RELAY CONTACTS WITH INDUCTIVE LOADS	INSTALL SUPPRESSION NETWORKS ACROSS OR PARALLEL TO LOAD
	DEFECTIVE DISPLAY UNIT	CONSULT FACTORY
RELAYS DO NOT OPERATE - NORMAL DISPLAY AND OUTPUT OPERATION	RELAYS NOT CALIBRATED	PERFORM CALIBRATION PROCEDURE
	PROBLEM IN RELAY CIRCUIT	SEE RELAY TEST IN SECTION 4.2.2
	TIME DELAY TOO LONG	REDUCE DELAY
IMPROPER OUTPUT NORMAL DISPLAY AND RELAY OPERATION	OUTPUT NOT CALIBRATED PROPERLY	PERFORM CALIBRATION PROCEDURE
	PROBLEM IN OUTPUT CIRCUIT	SEE OUTPUT TEST IN SECTION 4.2.4
DISPLAY AND OUTPUT WANDERS	HIGH AND LOW POINTS SAME OR TOO CLOSE TOGETHER	SEE SECTION 4.3.3
	PROBE NOT CONNECTED TO PFM TRANSMITTER	SEE SECTIONS 3.3.2 AND 3.4.3
DISPLAY BLACK, OTHER FUNCTIONS NORMAL	DEFECTIVE LCD DISPLAY	REPLACE LCD DISPLAY

5.4 PROBE CIRCUIT ELECTRICAL CHECK

Most series 5000A problems can be traced to the probe, the PFM transmitter, or the associated wiring. When a probe circuit problem is indicated, the following procedure should help to isolate it. A multimeter is needed to perform these tests. Perform the tests in the order given.

MEASUREMENT	READING	REMARKS
ON DISPLAY UNIT, VOLTAGE BETWEEN **GND** AND **SIG** TERMINALS WITH PFM TRANSMITTER DISCONNECTED	11-13 VDC	NORMAL, PROCEED
	LESS THAN 11VDC	DEFECTIVE DISPLAY UNIT
	GREATER THAN 13 VDC	DEFECTIVE DISPLAY UNIT
ON DISPLAY UNIT, VOLTAGE BETWEEN **GND** AND **SIG** TERMINALS WITH PFM TRANSMITTER CONNECTED	10-12 VDC, MAY BE ERRATIC	NORMAL PROCEED
	1-9 VDC	DEFECTIVE PFM TRANSMITTER OR INTERCONNECTION WIRING REVERSED
	0 VDC	INTERCONNECTION WIRING SHORTED
ON DISPLAY UNIT CURRENT BETWEEN THE **SIG** TERMINAL AND ITS WIRE FROM THE PFM TRANSMITTER. **NOTE:** METER IS IN SERIES WITH (+) LEAD AND THE SIG TERMINAL.	APPROXIMATELY 12-15 MA, MAY BE ERRATIC, AND VARY WITH METER USED	NORMAL-PROBLEM IS LIKELY DEFECTIVE DISPLAY UNIT
	0 MA	INTERCONNECTION WIRING OPEN
	STEADY 1-9 MA	ABNORMAL, PROCEED
	STEADY 17-26 MA	ABNORMAL, PROCEED
REMOVE PFM TRANS-MITTER AND MEASURE RESISTANCE BETWEEN CENTER ROD OF PROBE AND GROUND USING HIGHEST SCALE ON METER. DO NOT TOUCH THE PROBE OF METER LEADS AS YOUR BODY RESISTANCE WILL CHANGE THE READING	GREATER THAN 10 MOhm	NORMAL-PROBLEM IS MOST LIKELY DEFECTIVE PFM TRANSMITTER
	LESS THAN 1 MOhm	DEFECTIVE PROBE - SHORTED
	LESS THAN 1 MOhm	BARE PROBE USED IN CONDUCTIVE MATERIAL
	1-10 MOhm	LEAKY PROBE - PROBABLY NOT CAUSING A PROBLEM NOW BUT POSSIBLE FUTURE PROBLEM

SECTION VI
SPARE PARTS

6.1 DISPLAY UNIT

PART NO.	DESCRIPTION	USED ON MODEL NO.
044KB972-01	MAIN PCA	5000A-( )2-( )1 5000A-( )2-( )2 5000A-( )2-( )4 5000A-( )2-( )6
044KB972-02	MAIN PCA	5000A-( )3-( )1 5000A-( )3-( )2 5000A-( )3-( )4 5000A-( )3-( )6
044KB972-03	MAIN PCA	5000A-( )1-( )1 5000A-( )1-( )2 5000A-( )1-( )4 5000A-( )1-( )6
044KB974	DISPLAY PCA	ALL
044KB976	ANALOG OUTPUT PCA	5000A-( ) ( )-C( ) 5000A-( ) ( )-E( )
044KX068	SERIAL OUTPUT PCA	5000A-( ) ( )-D( ) 5000A-( ) ( )-E( )
250KB066	RELAY, DPDT	ALL
016KB010	BATTERY	ALL
130KB006-03	FUSE	ALL
909GM170	KIT, ARC SUPPRESSION	ALL
300KB024	LCD DISPALY	ALL
190KB087	LED, RED/GREEN	ALL
190KB086	LED, RED	ALL

6.2 PFM TRANSMITTER

PART NO.	DESCRIPTION	USED ON MODEL NO.
900GA336-01	PFM TRANSMITTER	5000A-( ) ( )-( )1 5000A-( ) ( )-( )2
900GA336-02	PFM TRANSMITTER	5000A-( ) ( )-( )4 5000A-( ) ( )-( )6
044KX230	PFM PCA	5000A-( ) ( )-( )1 5000A-( ) ( )-( )2 5000A-( ) ( )-( )4 5000A-( ) ( )-( )6
909GM079	PROBE PIN KIT	5000A-( ) ( )-( )1 5000A-( ) ( )-( )2

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