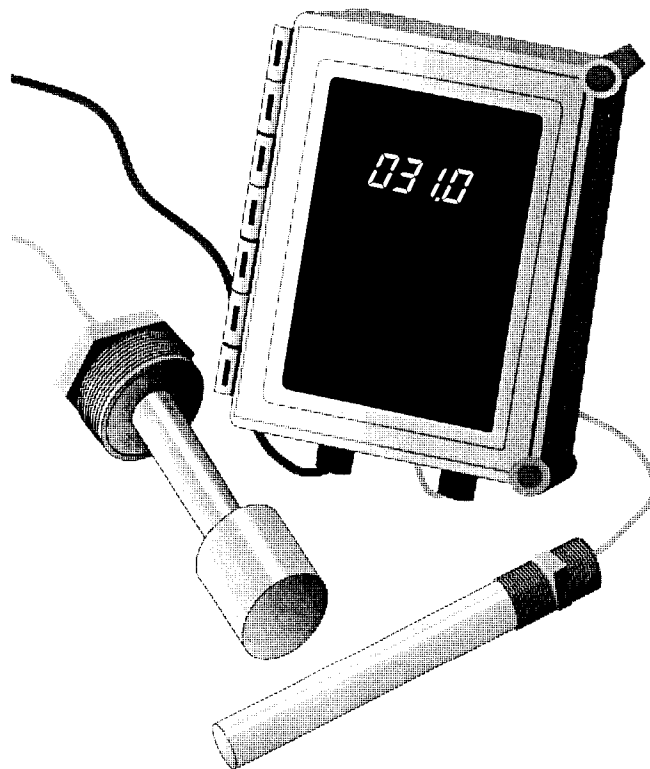


 **LVU-1000**

 **Ultrasonic Level Measurement
System**



Operator's Manual



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- LVU-1000 Ultrasonic Level Measurement System (1)
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1 System Description

System Description

The OMEGA Model LVU-1000 series liquid level system is a state-of-the-art level measurement instrument. Based on the latest ultrasonic technologies, the LVU-1000 series provides an efficient, reliable and cost effective means of level control.

The LVU-1000 series consists of 2 major components: a non-contacting ultrasonic sensor and a compact, remote electronic control.

The LVU-1000 series is available in a variety of sizes and materials to suit virtually any application. Standard mounting configurations include a 3/4" and 2" NPT fittings. Flange mounting is also available to meet user specifications. Sensor materials of construction include CPVC, 316 SS, Kynar or Teflon.



System Description



Principles of Operation

Principles of Operation

In operation, the electronics generates an electronic signal which is converted by the sensor (mounted on top of the vessel) to a burst of ultrasonic pulses. These pulses are transmitted through the air towards the liquid surface. As the pulses reach the liquid surface, they are reflected back to the sensor. These received echoes are converted back to an electronic signal, which is then sent to the microprocessor. The microprocessor uses the return signals to calculate the time it takes for the pulses to travel to the liquid surface and back. This "Time of Flight" is directly proportional to the distance of the liquid surface from the sensor. The microprocessor then compares these calculated values with user programmed system parameters to provide the required control outputs.

Control Unit Installation

1. Open control unit enclosure and remove the printed circuit board.
2. Replace printed circuit board, and route power and control wiring to the enclosure. Observe all applicable local electrical codes and wiring procedures.
3. Connect power and control wiring to the control unit as shown in the wiring diagram (see figure 1).
4. Be sure that all wiring is carefully dressed to prevent pinching between the housing and the cover.

Sensor Installation

The sensor is mounted on the top of the vessel with the sensor facing downward. A clear path, free of any obstructions, must be provided between the sensor and the liquid surface. Due to the narrow sensor beam pattern, vertical-axis positioning of the sensor is important. The sensor must be installed so as to maintain perpendicularity to the liquid surface.

1. For sensors provided with an NPT threaded fitting, drill a suitable hole in the vessel top and tap for the correct NPT thread. In thin walled vessels, or vessels constructed of material not suitable for tapping, weld or braze a bushing to accept the sensor.
2. Screw the sensor into the threaded fitting, being careful not to cross thread the sensor. When possible, the use of a pipe compound or sealing tape is recommended. **Avoid over tightening!**
3. For flange mounted sensors, simply bolt the sensor/flange assembly to the proper mating flange connection.
4. Route the sensor cable to the electronic control unit and connect per the Wiring diagram (see figure 1).

IF ROUTING THE SENSOR CABLE THROUGH CONDUIT, A DEDICATED CONDUIT SHOULD BE UTILIZED. AVOID ROUTING THE SENSOR CABLE IN CLOSE PROXIMITY TO ANY SOURCE OF ALTERNATING CURRENT OR RFI.

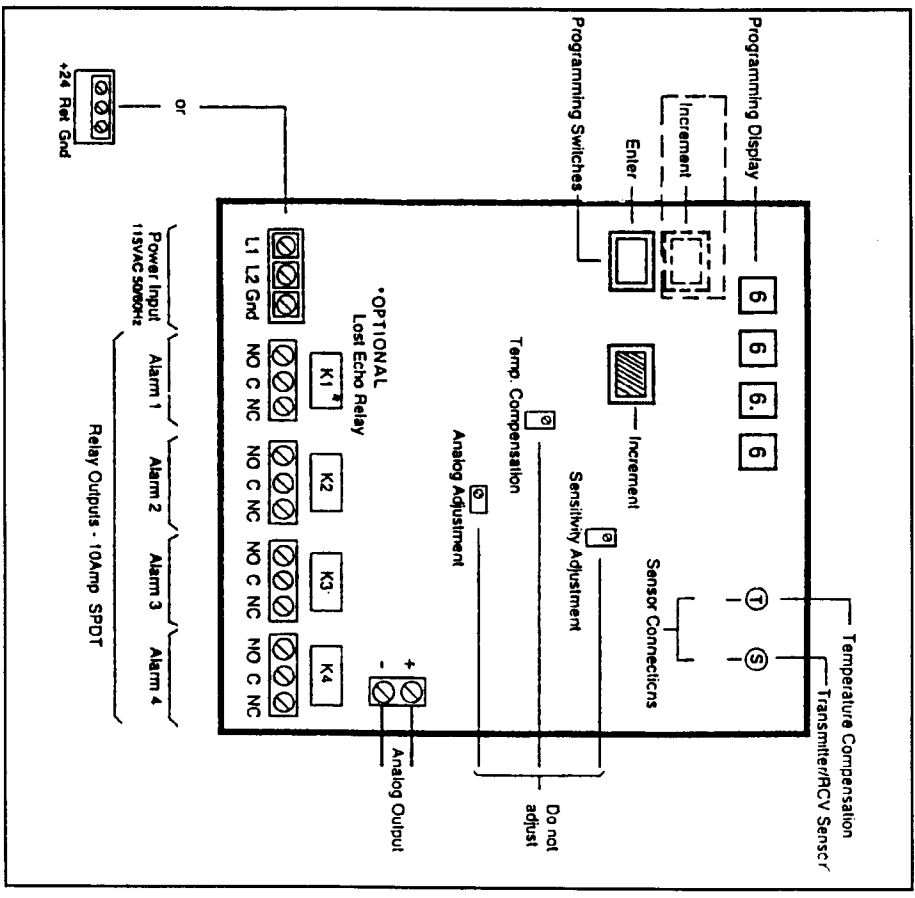
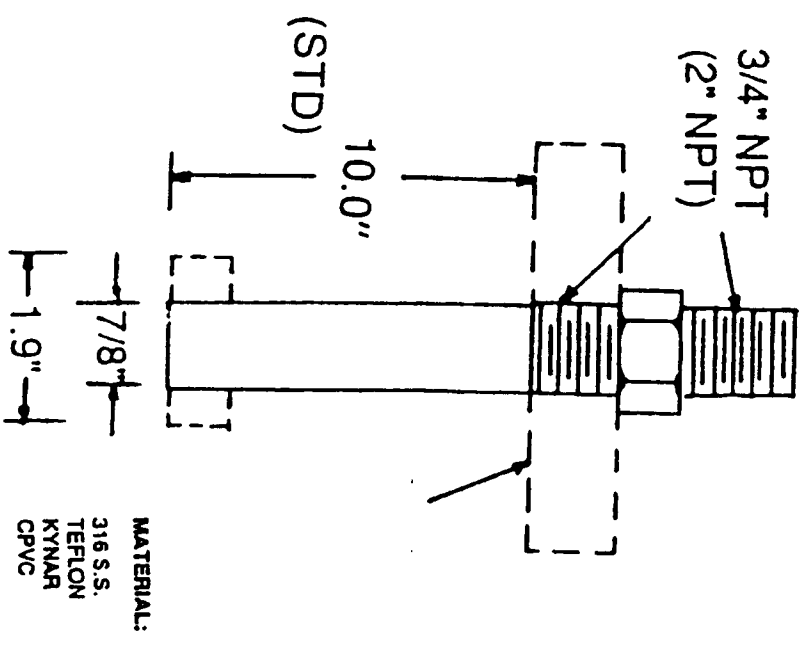


Figure 1 Wiring Diagram

CAUTION

Do not attempt to remove a threaded sensor from the vessel with the cable attached to the control unit, otherwise cable may be damaged.



MATERIAL:
 316 S.S.
 TEFLON
 KYNAR
 CPVC

Figure 2 Sensor Diagram

System Features and Operating Modes

General

The LVU-1000 series is an extremely versatile instrument. It's many standard programmable features and available options can be utilized to perform a wide variety of control functions. In many cases, a single LVU-1000 can accomplish control functions which would otherwise only be possible through the use of multiple instruments or expensive computer based systems.

Standard Features

1. Automatic temperature compensation compensates for sound velocity errors (due to temperature variations) over the entire sensor temperature range.
2. Simple 2 button programming.
3. Four programmable Alarm point relays.
4. User selectable Height or Distance operating mode.
5. Fully isolated analog output with programmable output offset.
6. Three "Lost Echo" condition modes (user selectable).
7. Internal 4-digit display provides programming prompts, system heartbeat, and "Lost Echo" feedback.
8. Enhanced noise rejection algorithm ignores spurious signals and other noise sources such as 60 cycle and RFI.

Optional Features

1. External (front covered mounted) 4 digit display for local indication.
2. Optional "Lost Echo" alarm relay, in place of alarm relay 1.
3. Customized response times and output damping to meet special application requirements. Call factory for application assistance.

General

The LVU-1000 series is calibrated via push-button entry switches (Enter and Increment) and an onboard digital display, which provides the necessary programming prompts. All data entered during the calibration procedure is stored in a nonvolatile memory to prevent loss of data in the event of a power failure.

During the calibration procedure, you may wish to refer to the Programming Prompt List and the Calibration Diagram found elsewhere within this manual.

NOTE

During the Calibration procedure, if no button is pressed for more than 60 seconds, the system will automatically return to the Operating Mode, saving only those parameter values already entered.

Upon completion of the Calibration procedure, the Analog Output may be verified by following the Calibration Verification Procedure (see step 11).

Calibration Procedure

1. Open control unit enclosures and simultaneously depress and hold the Enter and Increment buttons. After approximately 3 seconds, the onboard programming display will issue the prompt "CODE". Release both Enter and Increment and then press the Enter button once to bypass this prompt (this prompt is for factory use only, and is not user accessible).
2. The onboard display will issue the prompt "SLdH". Press Enter once and the display will read either "H" for Height Mode of operation, or "d" for Distance Mode of operation, depending on the previously programmed mode. Pressing the Increment button now will toggle the display between "H" and "d". The Height Mode of operation will provide an analog output proportional to the liquid level, while the Distance Mode will provide an inverse

- output (refer to the Calibration Diagram). With the desired operating mode displayed, press Enter to select that mode.
- The next prompt to be displayed will be "SLoS" for "select analog offset". The Analog offset determines if the analog output signal is referenced to zero or some offset value (0–20 ma vs. 4–20 ma for a current output, or 0–10 V dc vs. 2–10 V dc for voltage output). Press Enter to display the previously entered selection (either 0 or 1). Pressing Increment now will toggle the display between 0 and 1. Entering "1" will invoke the Analog Offset, while entering a "0" disables the Analog Offset. With the desired selection displayed, press the Enter button to store the selection.
 - The display will now issue the "SL_O" prompt, for "select zero".

NOTE

At this time the analog output is driven to its proper state and may be verified, see step 11.

The Zero Point is the point at which the level will be closest to the sensor (refer to the Calibration Diagram). The minimum Zero Point is normally 12" from the sensor face.

NOTE

In certain applications, the LVU-1000 may be configured to provide a closer Zero Point. Consult factory.

Press Enter now, and the display will indicate the previously programmed Zero value, with the "hundreds" digit flashing. Press Increment to increment the flashing digit to its desired value. With the desired value displayed for the "hundreds" place digit, press Enter to store the value. The next digit (the "Tens" place) will now be flashing. Repeat the above steps for the "Tens", "Inches" and

- "Tenths of inches" places to obtain the desired Zero point as measured in inches from the sensor face.
- Upon entry of the Zero Point, the display will issue the prompt "SL_S" for "select Span".

NOTE

At this time the analog output may be verified, see step 11.

- The Span is the measurement range in inches as measured from the Zero Point. Press Enter now and the display will indicate the current Span value, with the hundreds place digit flashing. Proceed as in step 4 to enter the desired Span in inches from the Zero Point.

- After entering the desired Span, the system will issue the prompt "SLdF" for "select display function". This parameter will define the operation of the operational 4 digit panel-mounted display (if provided). Press Enter now, and the on board programming display will indicate a digit of 0 or 1, depending on the previously entered selection. The Display Function Modes are as follows:

Mode 0: Display reads distance of target from sensor in inches.

Mode 1: Display indicates value of linear range programmable by the user. See the calibration supplement—Linear Characterization Display Scaling for details on programming this mode.

Pressing Increment will toggle the programming display through the above Display Function Modes. Press Enter to store the desired Mode.

If you have selected display mode 1 at the "SLdF" prompt, then you have chosen Custom Display Scaling and the unit proceeds to step 6a in the following manner, otherwise the unit proceeds to step 7.

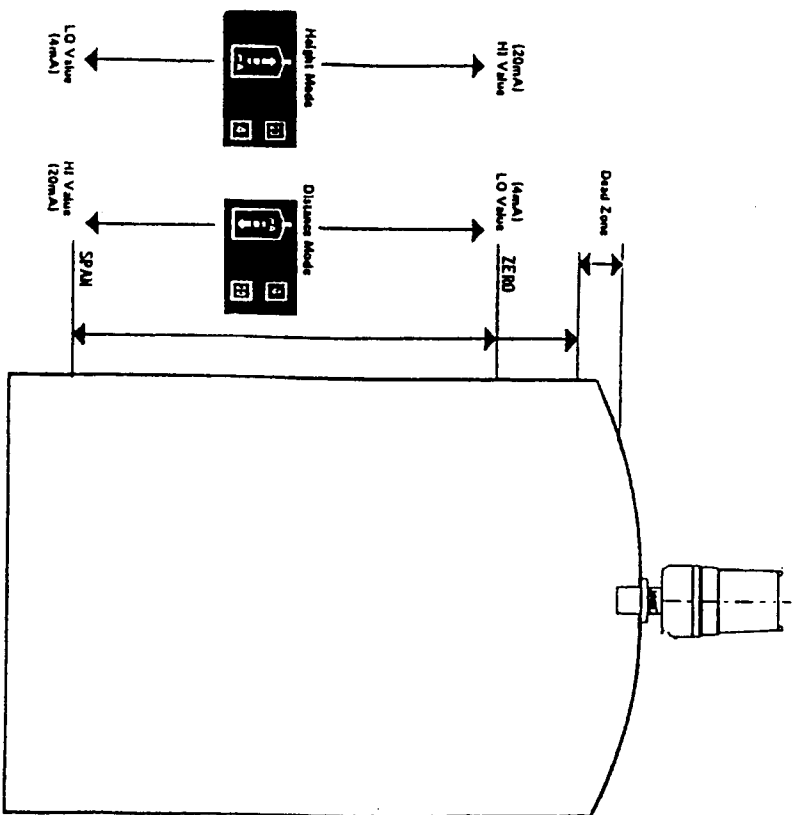


Figure 3 Calibration Diagram

Specifications

Range:	1-12 feet (LVU-1000) 1 to 30 feet (LVU-1010)
Repeatability:	1/4" typical
Accuracy:	Analog output—1/2% of full scale
Temperature Compensation:	Automatic over full range of sensor operating temperature
Input Power:	115 V ac, 50/60 Hz, 24 V dc or 230 V ac optional
Output Signal:	4-20 ma dc (isolated) or 0-10 V dc
Controls:	Programmable zero and span, height and distance mode
Display:	Four digit (optional)
Alarm Setpoints:	Four 10A SPDT relays. Programmable in increments of 0.1" Lost echo indicator/relay (optional)
Temperature Range:	Sensor -22°F to +200°F Electronics -10°F to +160°F
Sensor Pressure Rating:	250 psig - 316 SS (Plastic models limited to 150 psig)
Construction:	316 S.S.
Cable:	20" Std-Max up to 100 ft.
Electronics Enclosures:	NEMA-4X (standard)
Mountings:	3/4": (Range up to 12 ft) 2": (Range up to 30 ft)

Linear Characterization Brief Description:

The LVU-1000 series allows the user to enter a four digit minimum arbitrary value, a four digit maximum arbitrary value, and a decimal position. The display output is then linearly scaled between these two values across the previously programmed Span (Calibration Procedure - step 5). The display always increases or decreases in a manner that is directly proportional to the analog output, which is based on the selection of Height or Distance mode.

6a. The unit issues the "SLLO" prompt for "select LOw" minimum display value. Pressing Enter causes the display to advance and show the previously programmed Low value.

NOTE

Ignore the decimal point on the onboard display—it is fixed and it has no meaning in this mode. Proceed as in the Calibration Procedure—step 4 to enter the desired arbitrary low point.

6b. The unit next issues the "SLHI" prompt for "Select High, maximum display value". Pressing Enter causes the display to advance and show the previously programmed High value.

NOTE

Again, ignore the decimal point on the onboard display. Proceed as the Calibration Procedure—step 4 to enter the desired arbitrary High point.

The unit checks that the LOw value is not greater than the High value. If this error is detected the unit returns to step 6a and the user must re-enter valid LOw and High values.

NOTE

6c. The unit issues the "SLdP" prompt for "Select Decimal Place". Pressing Enter causes the display to advance and show the previously programmed Decimal Place. The display will show a digit from 0 to 3 indicating the desired precision or the number of decimal digits to be displayed. Pressing Increment will step the display through the above decimal place values. Once the desired decimal place is displayed, press Enter to select that value.

Now the unit proceeds with step 7 of this Calibration Procedure. The next prompt issue will be "SLA1" for "Select Alarm Point 1". Press Enter to enable the flashing digits as in step 4 and enter the desired Alarm Point in inches from the sensor face.

NOTE

The Alarm Points are always programmed in inches from the sensor face, regardless of Operating Mode.

8. Repeat step 7 for Alarm Points 2, 3, and 4 (prompts SLA2, SLA3, and SLA4).

9. After Alarm Point 4 is entered, the display will then issue the prompt "SLE" for "Select Lost Echo Mode". The Lost Echo mode selection determines the status of the analog output should a loss of valid return echo occur. Press the Enter button now and the display will indicate the current Lost Echo Mode (either 0, 1 or 2). Pressing Increment will toggle the programming display through the Lost Echo Modes listed below. Press Enter to select the desired Lost Echo Mode: The Lost Echo Modes are as follows:

- Mode 0: Analog output goes to minimum output.
 Mode 1: Analog output holds last valid reading.
 Mode 2: Analog output goes to maximum output.
10. Upon entry of the desired Lost Echo Mode, the system will return to the operating mode. The programming displays will display the system "heartbeat", a pulsing "o" character. Calibration is complete.

Analog output calibration verification procedure

11. To verify the analog output of the LVU-1000 series, connect a digital current meter or voltmeter to the Analog Output terminals (refer to Wiring Diagram, page 3-3). Access the Calibration Mode by simultaneously pressing and holding the Enter and Increment buttons, until the "COdE" prompt appears. Release the two buttons, then repeatedly press and release the Enter button until the "SL_0" (Select Zero) prompt is issued. Verify that the Analog output is correct per the selected Operating Mode (Distance or Height Mode, with or without Analog Offset. Also refer to the Calibration Diagram). Continue to repeatedly press and release Enter, until the "SL_S" (Select Span) prompt appears. Verify that the Analog output is correct per the selected Operating Mode. The system will automatically return to the normal operating mode after 60 seconds, displaying heartbeat.

NOTE

The analog output level can be adjusted through the analog adjust multi-turn potentiometer shown in figure 1. With the analog output at its maximum level (20 mA or 10 V dc), adjust this potentiometer until your digital multimeter is precisely at 20 mA or 10 V dc. The analog minimum value requires no adjustment.

Programming Prompt List

Prompt	Definition	Description
SLdH	Select Distance or Height Mode	The Height mode provides an analog output proportional to the liquid level (4-20 ma or 0-10 V dc), and the Distance mode provides an inverse output (20-4 ma or 10-0 V dc). Select "H" for Height Mode or "d" for Distance Mode.
SLOs	Select Analog Offset	Allows for an analog output referenced to Zero or some Offset reference (4-20 ma vs 0-20 ma for a current output, or a 2-10 V dc vs 0-10 V dc for a voltage output). Select 0 to disable the Offset; select 1 to invoke the Offset.
SL_0	Select Zero	Programs the system Zero point as measured from the sensor face in inches. The system Zero is the point at which the level is closest to the sensor face.
SL_S	Select Span	Programs the system Span as measured in inches from the system Zero point.
SLdF	Select Display Function	Defines the operational mode of the optional 4 digit display. Mode "0" displays target distance from sensor in inches. Mode "1" displays user defined Linear scaled output.
SLLo	Select Low or Minimum Value	Linear Characterization sub-mode that defines the minimum value that the display should indicate.
SLHI	Select High or Maximum Value	Linear Characterization sub-mode that defines the maximum value that the display should indicate.
SLdP	Select Decimal Points	Linear Characterization sub-mode that defines the decimal digits to be displayed.
SLA1	Select Alarm 1	Programs Alarm Point 1 as measured in inches from the sensor face.
SLA2	Select Alarm 2	Programs Alarm Point 2 as measured in inches from the sensor face.
SLA3	Select Alarm 3	Programs Alarm Point 3 as measured in inches from the sensor face.
SLA4	Select Alarm 4	Programs Alarm Point 4 as measured in inches from the sensor face.

SLE Select Lost Echo Mode
 Programs the analog output condition in the event of a loss of a valid return echo for more than 8 seconds.

Mode 0 Output goes to minimum.
 Mode 1 Output holds last reading.
 Mode 2 Output goes to maximum.
 In a lost echo condition, the 4 digit display and the onboard display will display "-LE-".

SITE/LOCATION ID: _____

JOB: _____

UNIT SERIAL NUMBER: _____ DATE: _____

PROGRAMMABLE PARAMETERS, PROGRAMMED BY: _____

HEIGHT MODE:

DISTANCE MODE:

ANALOG OFFSET: Y (4-20 mA 2-10 V)
 N (0-20 mA 0-10 V)

DISPLAY MODE: 0 1

LOST ECHO MODE: 0 1 2

ZERO : _____ inches from sensor face

SPAN : _____ inches from zero

ALARM 1 : _____ inches from sensor face

ALARM 2 : _____ inches from sensor face

ALARM 3 : _____ inches from sensor face

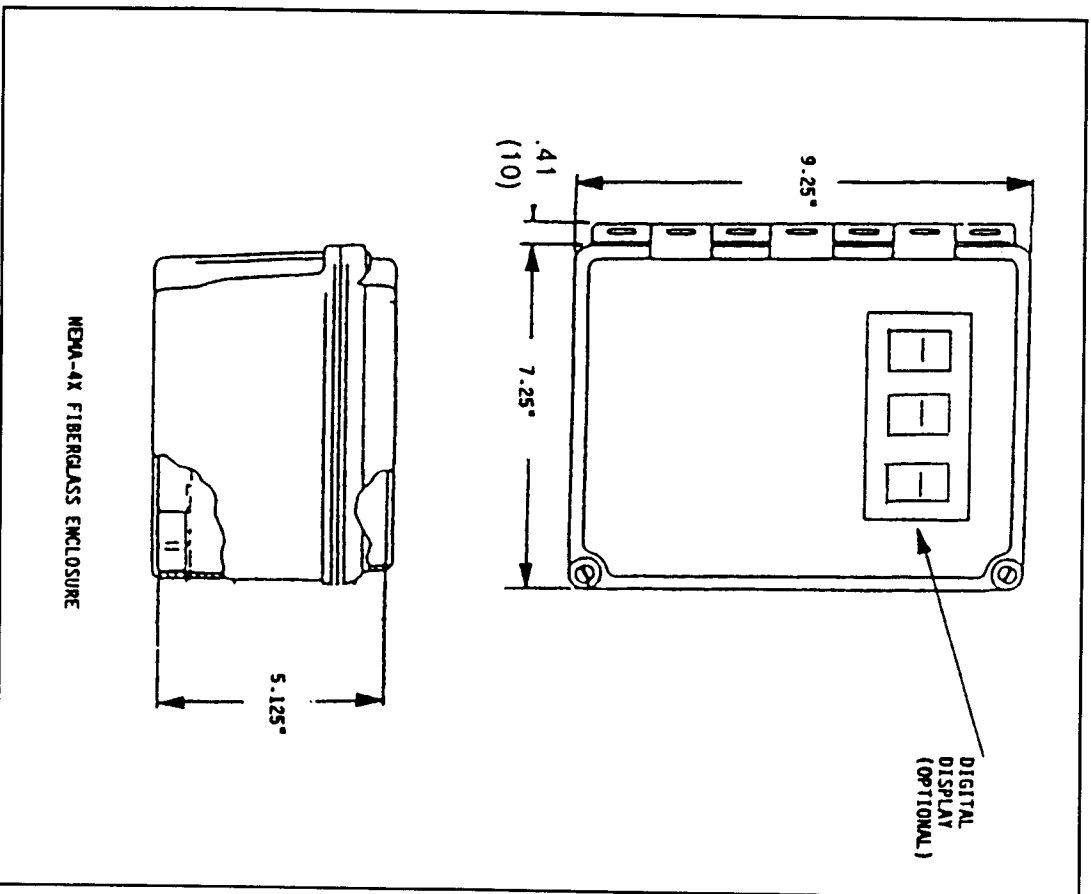
ALARM 4 : _____ inches from sensor face

LINEAR CHARACTERIZATION —DISPLAY

LO VALUE: _____

HI VALUE: _____

DECIMAL PLACE: 0 1 2 3



MEMA-4X FIBERGLASS ENCLOSURE

+



WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion, or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and traces.

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2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

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