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# Installation and Operating Instructions

Series 505-1800

Continuous Ultrasonic Transmitter  
using 405-1800 Electronics

*(215) 674-1234 Outside North America  
1-800-527-6297 US and Canada  
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Series 505-1800  
Continuous Ultrasonic Transmitter  
using 405-1800 Electronics



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## SECTION 1 INTRODUCTION

### 1.1 Product Description

The Drexelbrook Series 505-1800 Liquid/ Solid Interface Level Transmitter accurately measures interface level up to a range of 40 feet, using ultrasonic technology. The level measurement output is a 4-20 mA DC signal.

The ultrasonic sensing element does not contain moving components. It is not affected by electrical or physical parameters and has a wide range of temperature operation. The sensing element is made of CPVC for compatibility with a wide range of process materials.

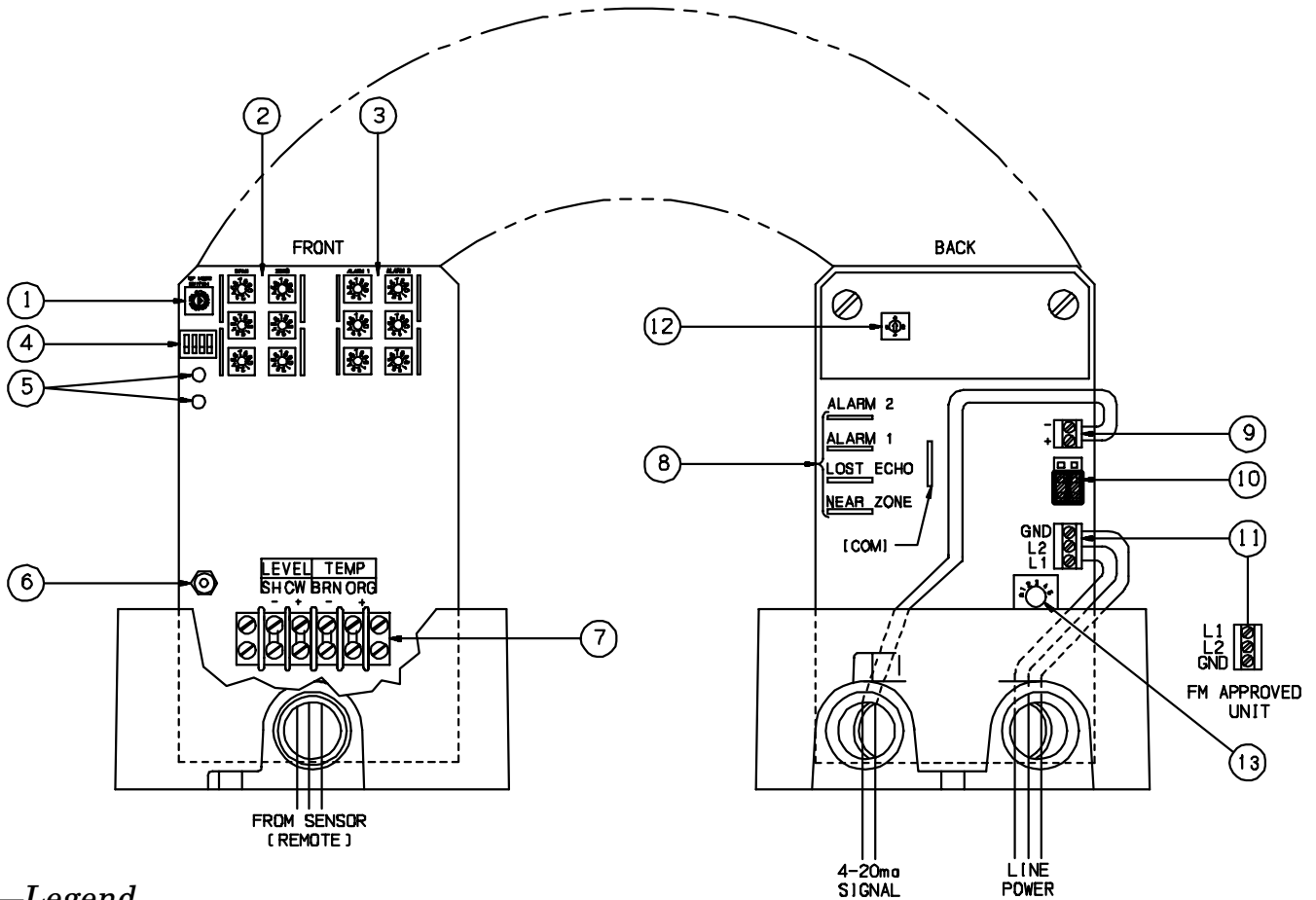
### 1.2 Models Available

5 0 5 - 1 8 X 0 - X 0 2 - Continuous Ultrasonic  
Transmitter with 4-20 mA

Configuration options:  
0 - Integral Electronics  
7 - Remote Electronics

Electronic Unit options:  
1 - High Discrimination Electronic Unit  
2 - Electronic Unit with Adjustable Gain  
3 - Electronic Unit with High Discrimination  
and Adjustable Gain

The diagram on the following page identifies the components of the 405-1800 Series Ultrasonic Transmitter.



—Legend

- ① Operating Mode Switch  
(Time Delay)  
see section 3.1
- ② Calibration Switches  
see sections 3.1, 4.2, and 4.3
- ③ Optional Setpoint Switches  
see section 4.4
- ④ Switch 8  
see sections 3.1, 4.2, and 4.3
- ⑤ Near Zone and Lost Echo LEDs  
see sections 2.2 and 3.1
- ⑥ Calibration Pushbutton  
and System Reset  
see sections 3.1 and 4.3
- ⑦ Transducer Terminal Strip  
see section 2.3
- ⑧ 24 vdc Alarm Outputs  
see sections 3.1
- ⑨ Signal Loop Terminals  
see section 2.3
- ⑩ Sink/Source Mode Selector  
Jumper Block  
see section 2.3
- ⑪ Power Terminals  
see section 2.3
- ⑫ High Discrimination Curve Select  
see section 3.4
- ⑬ Step Gain Switch  
see section 3.3

### 1.3 Key Terms

**Zero:** The distance from the transducer face down to the level that you wish to designate 0% (4 mA).

**Span:** The distance from the zero point up to the level that you wish to designate 100% (20 mA).

**Range:** Maximum distance from the transducer face.

### 1.4 Types of Output

#### Level

**Mode:** Output current increases as level increases.

#### Distance

**Mode:** Output current decreases as level increases.

Level mode output is the most common type of ultrasonic measurement.

### SECTION 2 INSTALLATION

#### 2.1 Unpacking

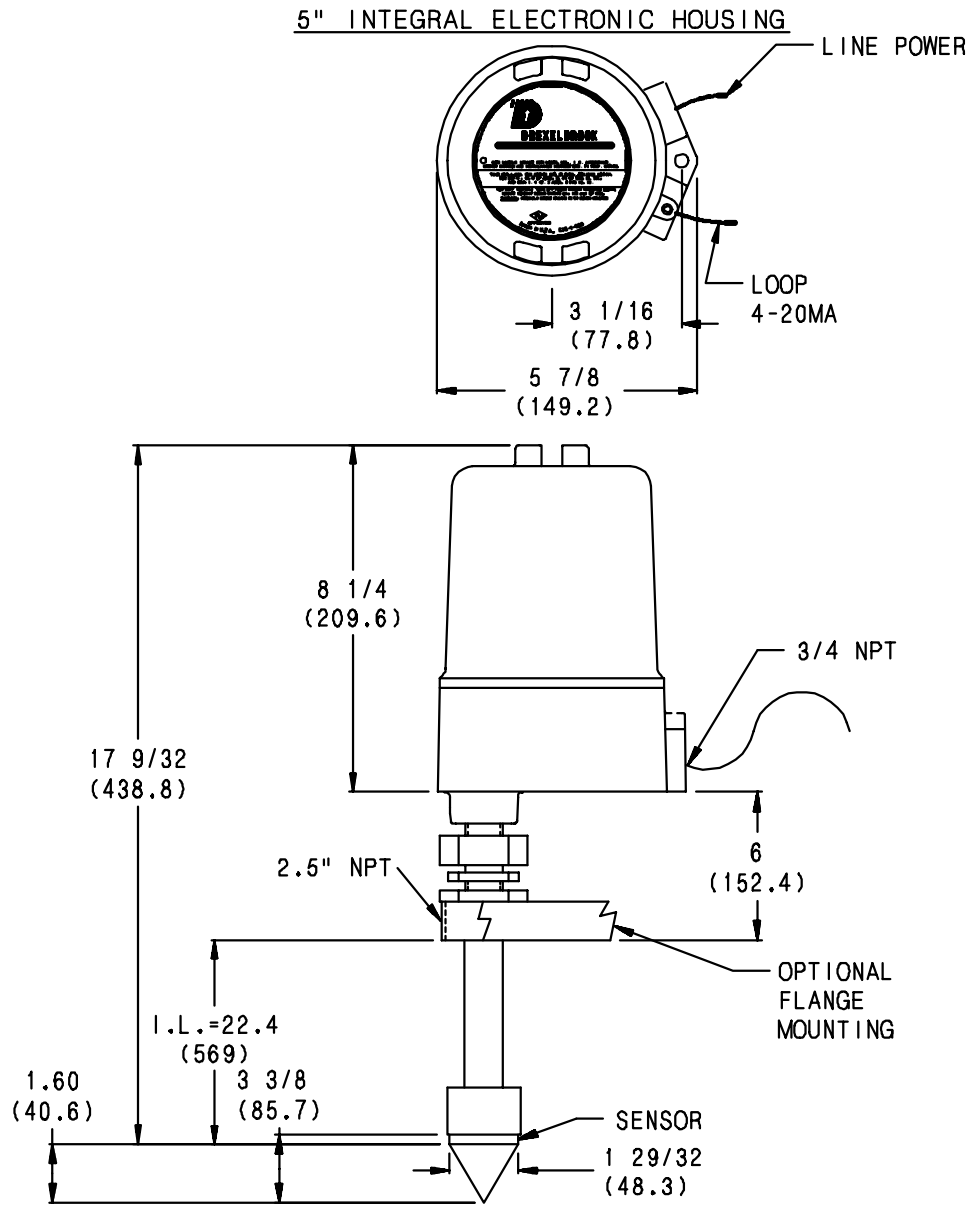
Carefully remove the contents of the shipping carton and check each item against the packing list before destroying any packing material. If there is any shortage or damage, report it to the factory immediately.

#### 2.2 Mounting the Transmitter

The 505-1800 Series transmitter is available with the electronic unit and transducer as either a single integral assembly or separated by 2 coaxial cables in the remote configuration. Extended sensing element lengths and special mountings can be provided to fit specific mounting applications. Refer to Figure 2-1 for standard mounting dimensions and Figure 2-2 for mounting recommendations.

- The 505-1800 Series transmitter is designed for field mounting, but it should be mounted in a location as free as possible from vibration, corrosive atmospheres, and any possibility of mechanical damage.
- For convenience at start-up, place the instrument in a reasonably accessible location. Ambient temperature should be between -40°F and 160°F (-40°C to 70°C).
- The transducer must be mounted perpendicular to the interface level and the transducer face must be submerged in the upper phase at all times.
- Ensure that the sensing element face is not recessed into a mounting nozzle, as stray reflections can cause faulty operation.
- When mounting the transducer, consideration must be given to the 12-inch Near Zone. If the interface rises to within 12 inches of the sensing element face, a 20 mA signal will be generated; the Near Zone LED will light; and the Near Zone Alarm Output will drop from 24 vdc to 0 vdc.
- The typical conical beam angle of the ultrasonic signal is 8°. Therefore, it is necessary to ensure that a tank wall, ladder, or other obstruction is not within this beam, and is not causing erroneous reflections that can affect the system operation. As a rule of thumb, allow 1 inch per foot of distance. For example:
  - If maximum range distance is 40 feet:  
 $1 \times 40 = 40$  inches
  - Transducer should be located at least 40 inches from the side of the wall or another object.

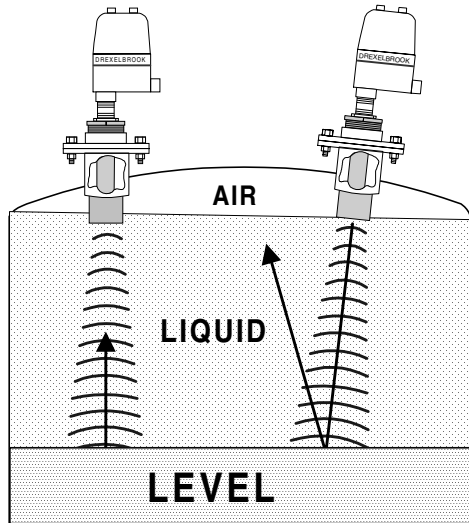




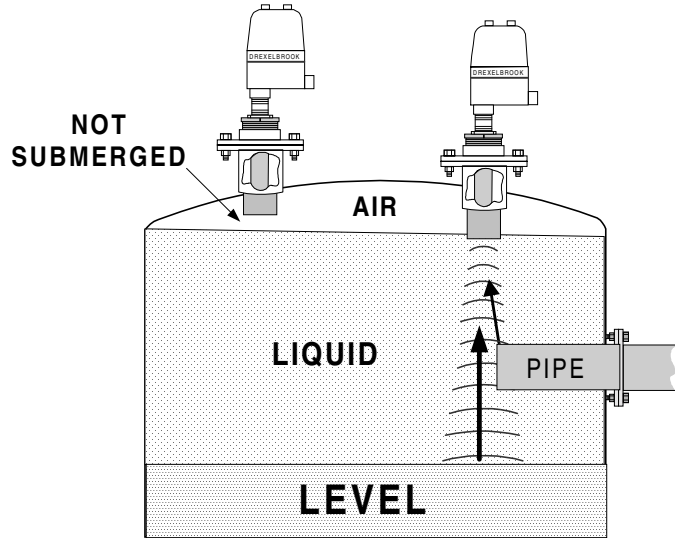
All dimensions in inches (mm).

Figure 2-1  
505-1800 Series Mounting Dimensions  
(Integral Unit Only)

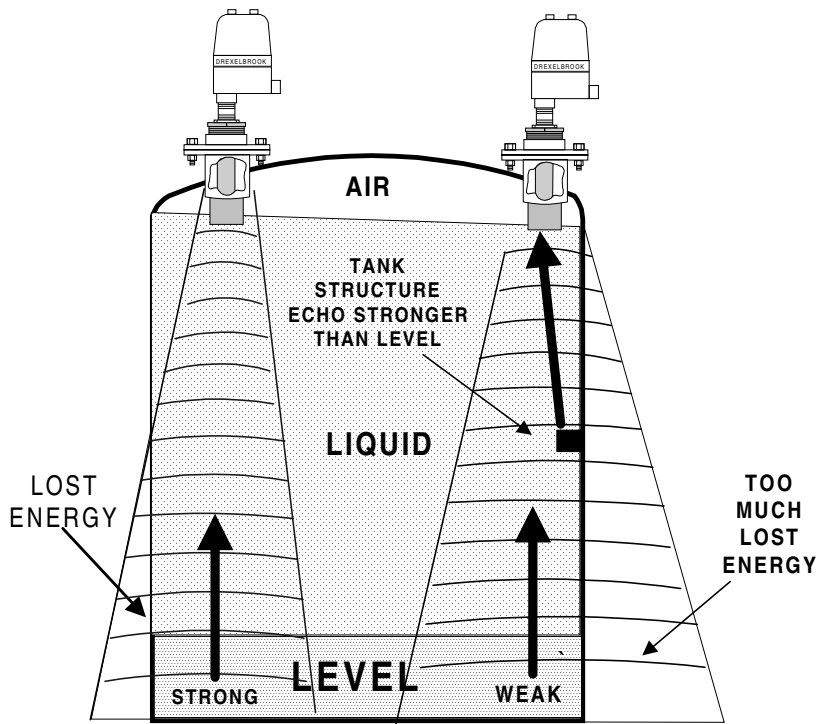
**CORRECT INCORRECT**



**INCORRECT INCORRECT**

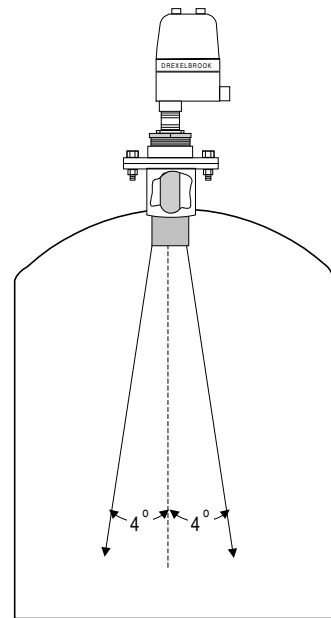


**CORRECT INCORRECT**



**OK**

**TOO CLOSE TO WALL**



**8° BEAM ANGLE**

*Figure 2-2  
Mounting Recommendations*

### 2.3 Wiring the Transmitter

#### *CAUTION*

If the Series 505-1800 is located in a hazardous environment, do not open the enclosure cover or make/break any electrical connections without first disconnecting electrical power at the source. Ensure that the wiring, electrical fittings and conduit connections conform to the electrical codes for the specific location and environment.

Refer to Figure 2-3 for the wiring diagram of the 505-1800 transmitter (120 vac). Figure 2-4 shows the wiring for the 24 vdc unit.

- Connect input power and output leads to terminal block (TB1 and TB2) as shown.
- The 505-1800 is shipped with the Output Select jumper block set to source (the unit will supply all power to the signal loop.)
- If an external power supply is used, jumper should be moved to sink position.
- Section 3 - Operation describes the other indicators and controls.

For integral transmitters, the level measuring cable and temperature compensation wires are prewired. Figure 2-5 shows the customer wiring of the level and temperature cables for remote-mounted units.

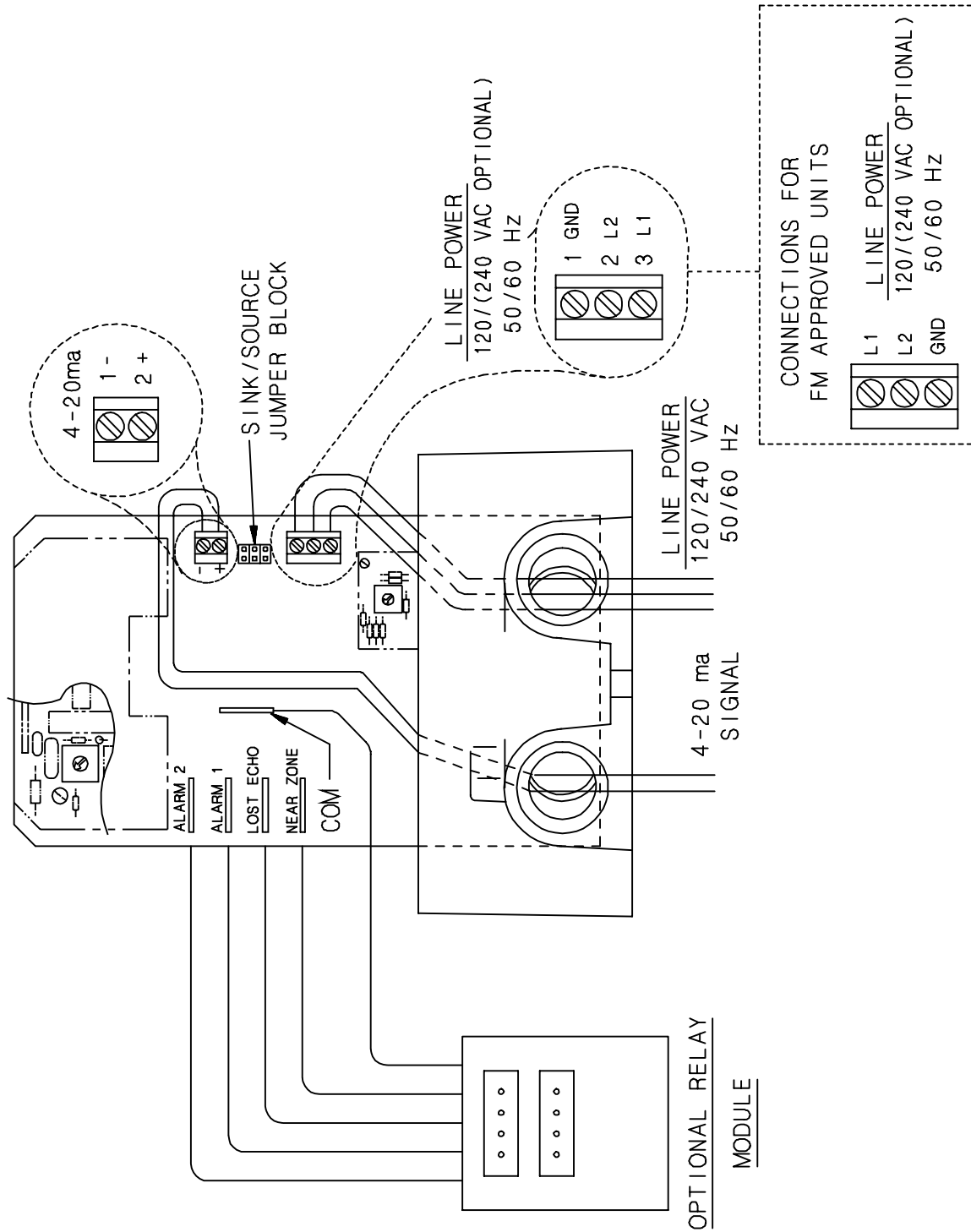
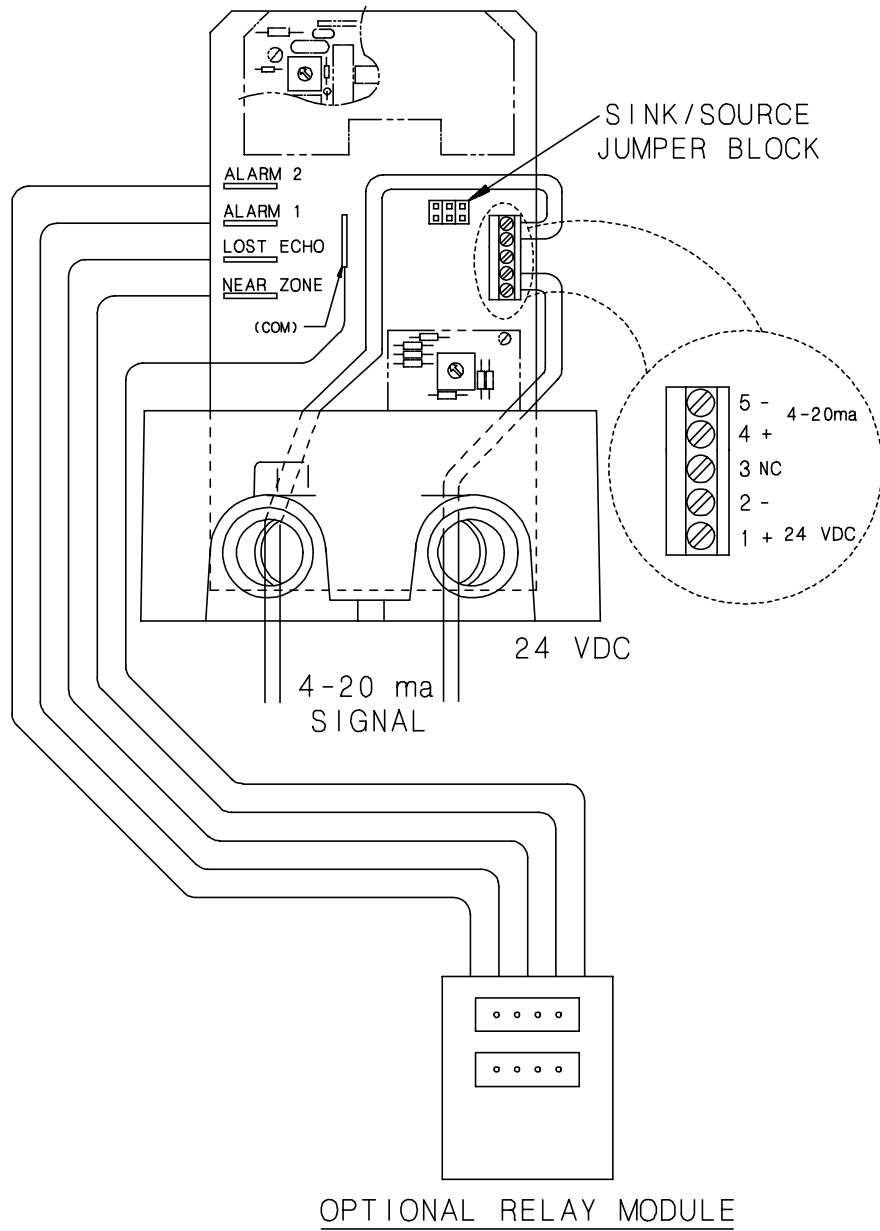
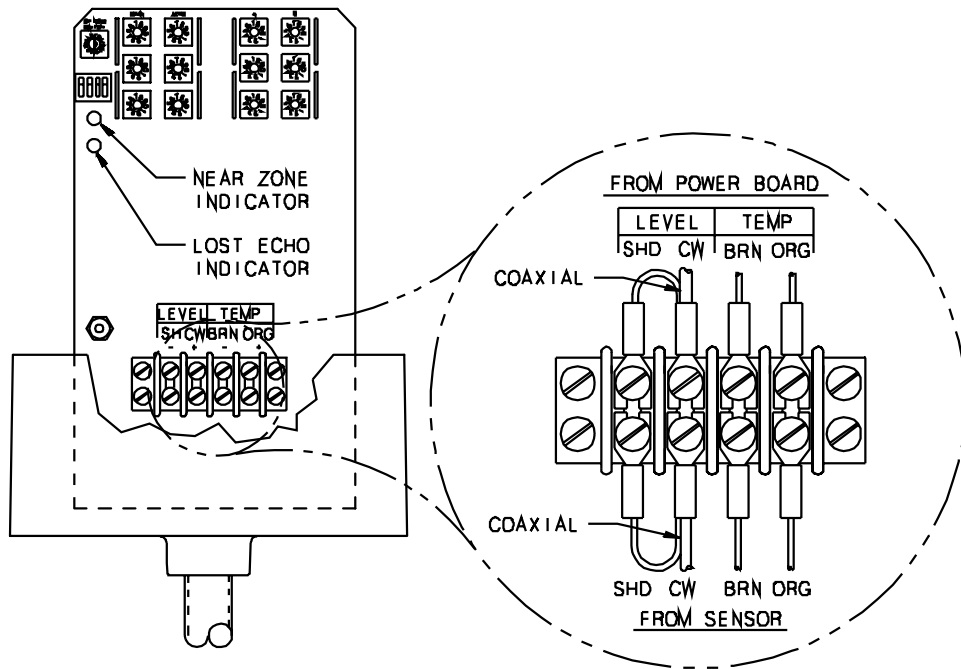


Figure 2-3  
505-1800 Wiring Diagram  
Integral Unit, 120 vac



**Figure 2-4**  
**505-1800 Wiring Diagram**  
**Integral Unit, 24 vdc**



*Figure 2-5*  
*505-1800 Wiring Connections*  
*Remote Transmitter*

## SECTION 3 OPERATION

### 3.1 Indicators and Controls

#### —*SW8 Level or Distance Mode*

Normal operation, and the selection of either “level” or “distance” mode is accomplished by changing the position of switch 4 on SW8. See section 1.4.

#### —*Time Delay/Rep Rate Control (Operating Mode Switch)*

The time delay/repetition rate control is located above SW8. The time delay can be set to 0,15, or 45 seconds and the repetition rate (time between ultrasonic pulse transmissions) can be set to 140 milliseconds.

A 0-second time delay (position 0) is the factory-set default. Refer also to section 3.2.

#### —*Zero and Span Calibration Switches*

The zero and span are each set using three, ten-position rotary switches. Zero and span settings are made in inches with 1-inch resolution. Zero and span switches are used to calibrate the unit, discussed in section 4.2.

#### —*LED Indicators*

Two LED indicators are located on the transmitter to alert the user to a “near zone” or “lost echo” condition or improper calibration.

#### —*Calibration Pushbutton*

The calibration pushbutton is used in conjunction with SW8 for maximum calibration accuracy. See section 4.3 for the optimal calibration procedure. This button can also be used as a system reset.

#### —*Alarm Relays*

Outputs (24 volts @ 35 mA) for “Near Zone,” “Lost Echo” and 2 alarm setpoints are provided to activate external relays or alarms. A separate relay package can be purchased as an option.

#### —*Step Gain Switch*

Changes the gain of the ultrasonic transmitter to lessen any effect due to noise or obstruction. Certain applications may require a change of gain.

#### —*High Discrimination Curve Select*

Reduces the effect of false echos.

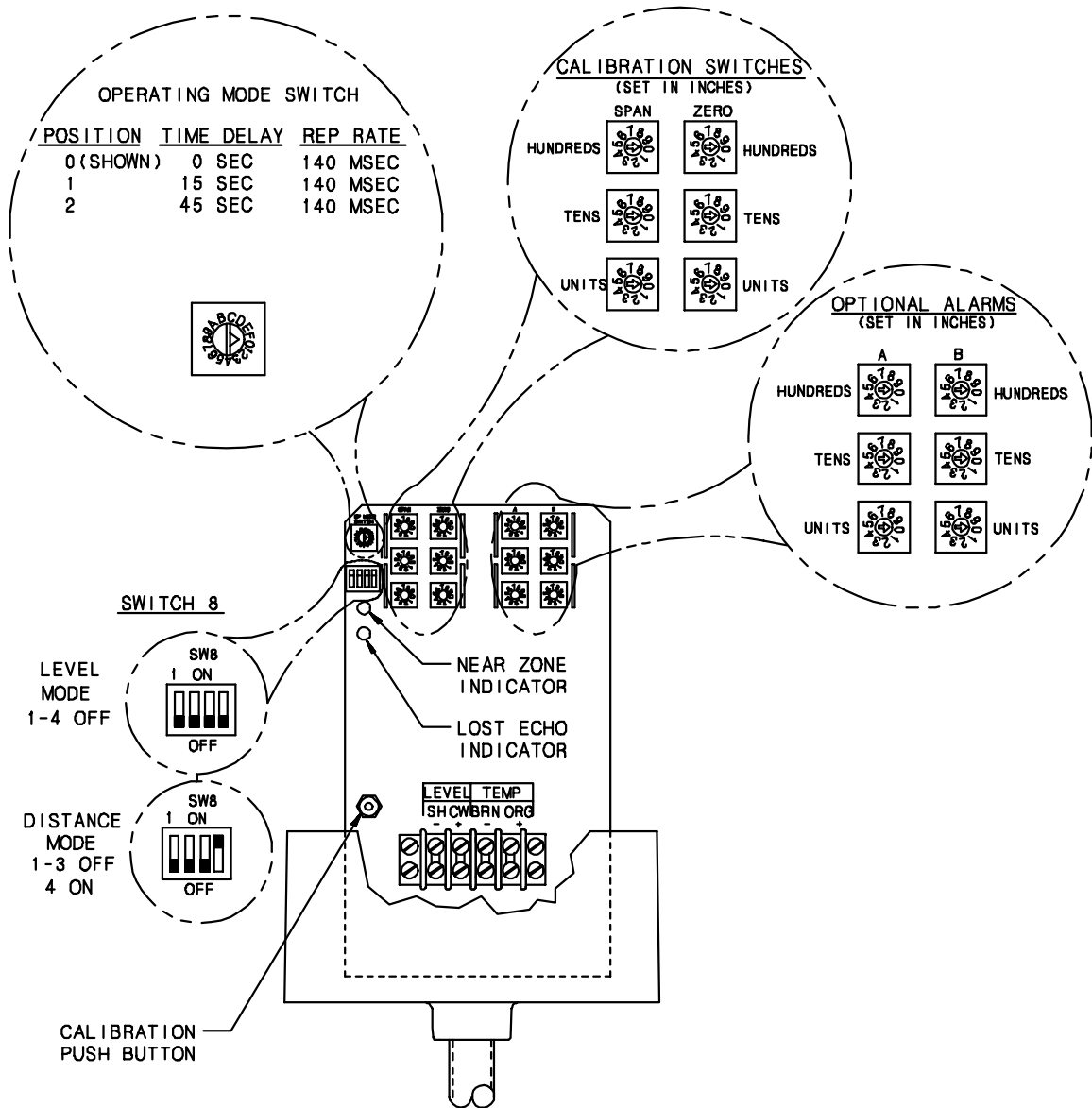


Figure 3-1  
Indicators and Controls



3.2 Time Delay and Repetition Rate

Certain applications may require a change of time delay.

- Increasing time delay to either 15 or 45 seconds will smooth out a jumpy output signal caused by wave action or turbulence in the tank.

You can change the time delay using a small screwdriver and switch SW4. Table 3-1 details the switch settings.



*Table 3-1  
Time Delay and Repetition Rate  
Switch (SW4) Settings*

Switch Position	Time Delay	Repetition Rate
0	0 seconds	140 msec
1	15 seconds	140 msec
2	45 seconds	140 msec
3-9	not used	not used
A-F	not used	not used

3.3 Step Gain Switch

A step gain switch is available on standard 505-1800 units. The step gain switch can be used to decrease the acoustic signal and avoid noise interference.

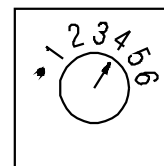
For example, the standard chassis has enough power to shoot a distance of greater than 40 feet. Since many applications are less than 40 feet, the excess power may cause nuisance reflections from irregular sidewalls or tank obstructions. By reducing the gain of the chassis using the step gain switch, the effect of nuisance reflections can be eliminated.

*The factory setting is position 4.*

This setting should be adequate for most applications. If false high readings occur, **decrease** the gain.

**Step Gain Switch**

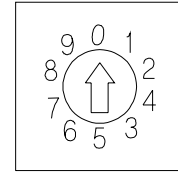
6	100% gain
5	79 % gain
4	69% gain
3	49% gain
2	36% gain
1	28% gain
●	20% gain



**3.4 High  
Discrimination  
Units**

High Discrimination chassis (405-1803) contains an additional switch that automatically reduces the effect of nuisance echos.

*The factory setting is position 0.*



**High Discrimination Switch**

- 0 Not Used
- 1 HD curve
- 2 Adjustable gain 8% of the maximum gain
- 3 Adjustable gain 17% of the maximum gain
- 4 Adjustable gain 32% of the maximum gain
- 5 Adjustable gain 50% of the maximum gain
- 6 Adjustable gain 67% of the maximum gain
- 7 Adjustable gain 84% of the maximum gain
- 8 Maximum gain (100%)
- 9 Maximum gain (100%)

## SECTION 4 CALIBRATION

### 4.1 Introduction

The 505-1800 Series transmitters are set at the factory to operate, in most applications, with minimal calibration. However, it is still necessary to set the Zero and Span switches for your actual vessel. This procedure is outlined in paragraph 4.2. Once this procedure is accomplished, the level reading should be within approximately 1% accuracy of range.

### 4.2 Initial Calibration

Use this procedure to set the Zero and Span for your vessel. Choose Level or Distance mode:

#### —*Level Mode*

With the power off, verify that all four switches on SW8 are OPEN (down). Refer to Figure 4-1.

Set the Zero calibration switches to equal the **distance** in inches from the sensing element face to the minimum level (0% or 4 mA). Refer to the calibration example in Figure 4-2a. The switches are set to 1-6-8 starting with the top switch.

Set the Span calibration switches to equal the **distance** in inches from the minimum level to the maximum level—100% point or 20 mA (e.g. 1-5-6 starting with top switch).

#### —*Distance Mode*

With the power off, verify SW8 is configured properly. Switches 1-3 are OPEN (down) and switch 4 is ON (up). See Figure 4-1.

Set the Zero calibration switches to equal the distance in inches from the sensing element face to the maximum level (0% or 4 mA). Refer to the calibration example in Figure 4-2b. The switches are set to 0-1-2 starting with the top switch.

Set the Span calibration switches to equal the distance in inches from the maximum level to the minimum level—100% or 20 mA (e.g. 1-5-6 starting with the top switch).

#### **NOTE**

The maximum level point must be at least 12 inches from the sensing element (near zone).

Apply power; the 4-20 mA should now represent the amount of material in the vessel within approximately 1%.

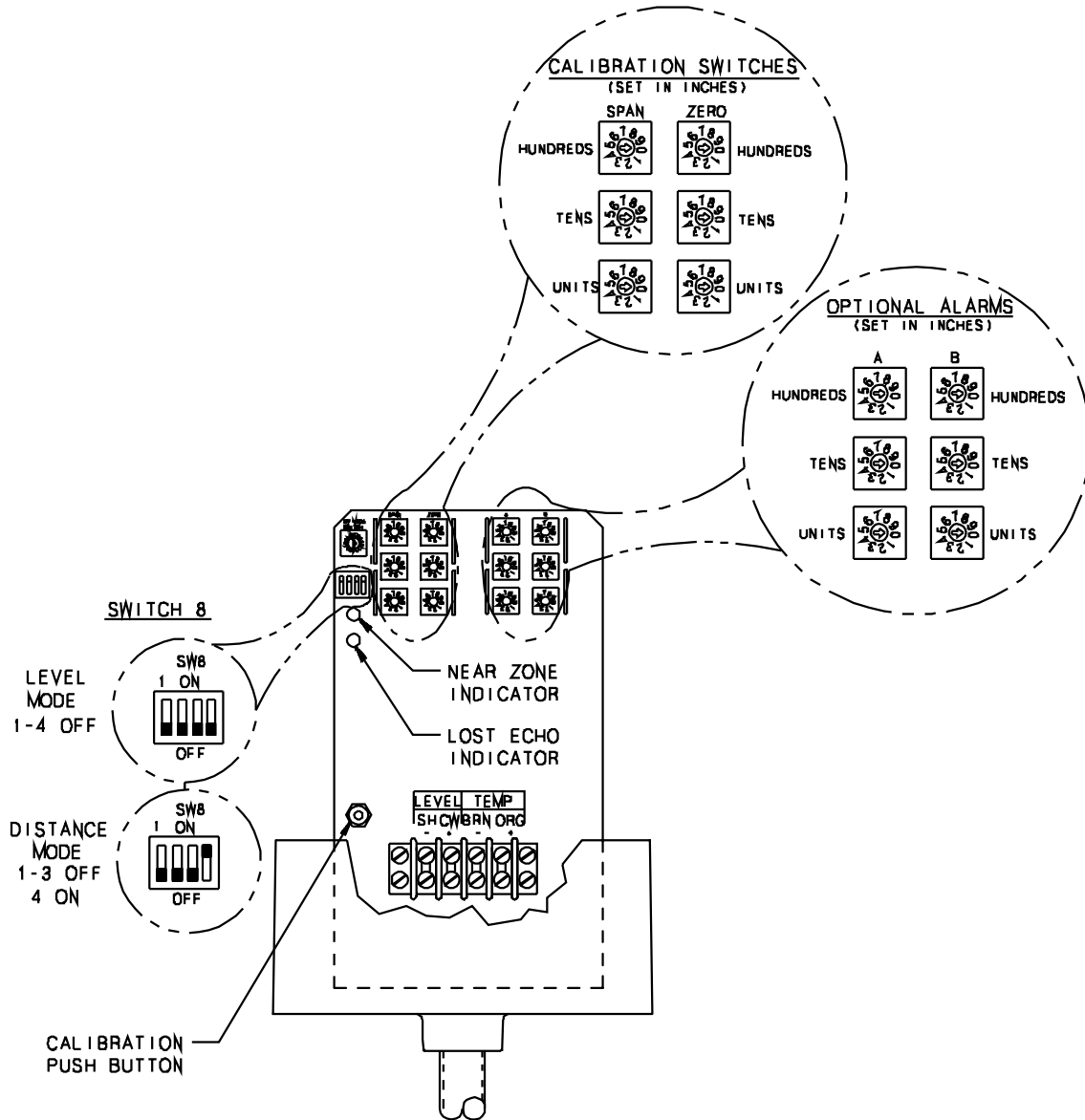


Figure 4-1  
Calibration and Relay Switches

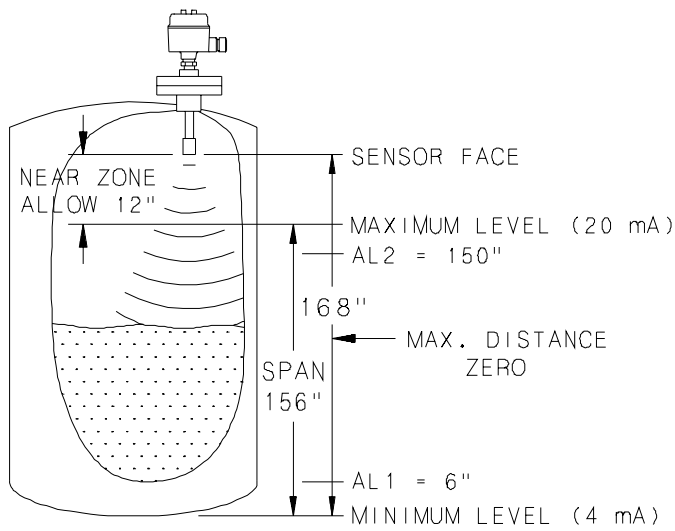
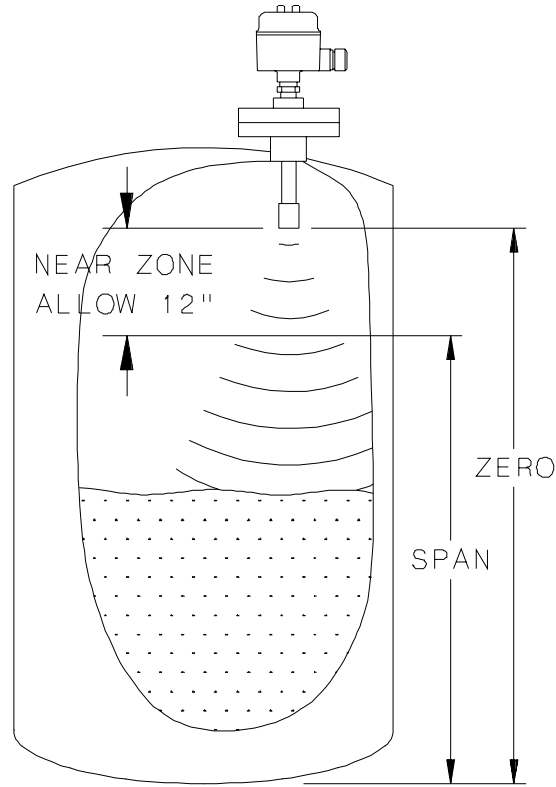


Figure 4-2a  
Level Mode

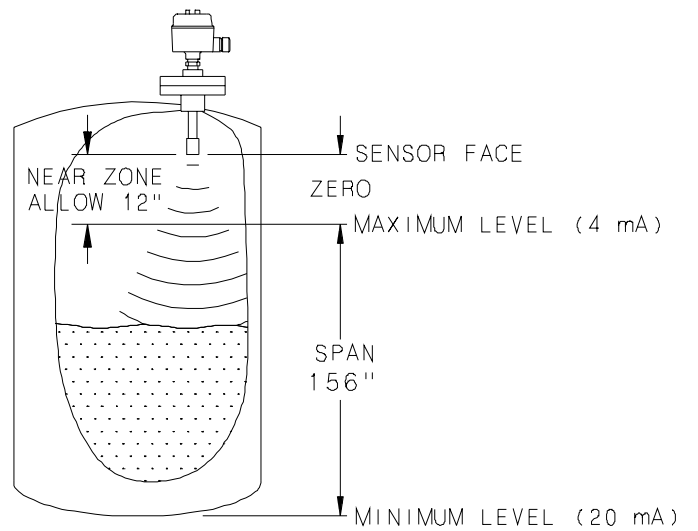


Figure 4-2b  
Distance Mode

Figure 4-2  
Calibration Example

### 4.3 Secondary Calibration

#### *WARNING*

The secondary calibration procedure permanently overwrites the factory calibration. Use this procedure only if unit is not reading within 3% of actual level.

- a. Perform the initial calibration per section 4.2.
- b. Measure the **distance** from the transducer face to the liquid level as accurately as possible (to the nearest 1 inch). Set the Zero calibration switches to this **measured distance**. For example, if you measured 48 inches from the transducer face, set the Zero calibration switches to 0-4-8.
- c. Observe both LEDs flashing.
- d. **Push and hold** the black calibration pushbutton. Place SW8, switch position 1 to the ON (up) position.
- d. Release the black calibration pushbutton, both LED indicators will come on and light steady. Wait approximately 2 minutes until they begin to flash. Flashing LEDs now indicate the memory update is complete.
- e. **Push and hold** the black calibration pushbutton. Place SW8, switch 1 in the OFF (down) position.
- f. Release the black calibration pushbutton.
- g. **Return the Zero switch settings** (if necessary) to the value corresponding to the level which represents 0% (4 mA).
- h. The secondary calibration is now complete.

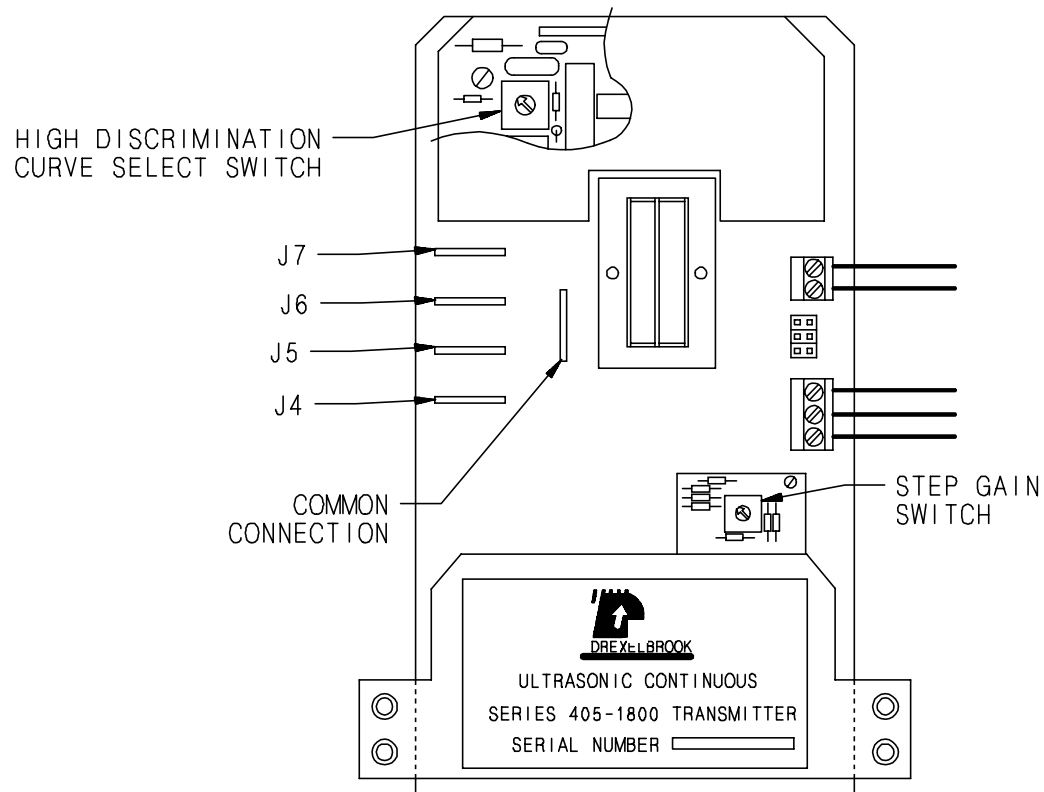
**4.4 Setpoint Calibration**  
 (only for those units equipped with optional 24 vdc outputs)

- a. Refer to Figure 4-1 for location of alarm switches (ALM1 and ALM2).
- b. Alarm points are set directly in inches from the zero point.

Normally, 24 vdc is present on the male pins J4-J7, measured from the pins to common. When a setpoint alarm is exceeded, the voltage drops to 0 VDC.

In the calibration example of Figure 4-2, the low alarm point would be set 6 inches from the zero point or minimum level. Starting with the top switch of ALM1, the settings would be 0-0-6. The high alarm point is 6 inches from the maximum level, which is 156 inches in this example. Starting with the top switch of ALM2, the settings would be 1-5-0 (span — 6 inches).

- c. Alarm settings ALM1 and ALM2 can be set to alarm at any point in the calibrated range.
- d. Connections are made to the transmitter using female connectors to J4, J5, J6, J7 and common connection, as shown in Figure 4-3.

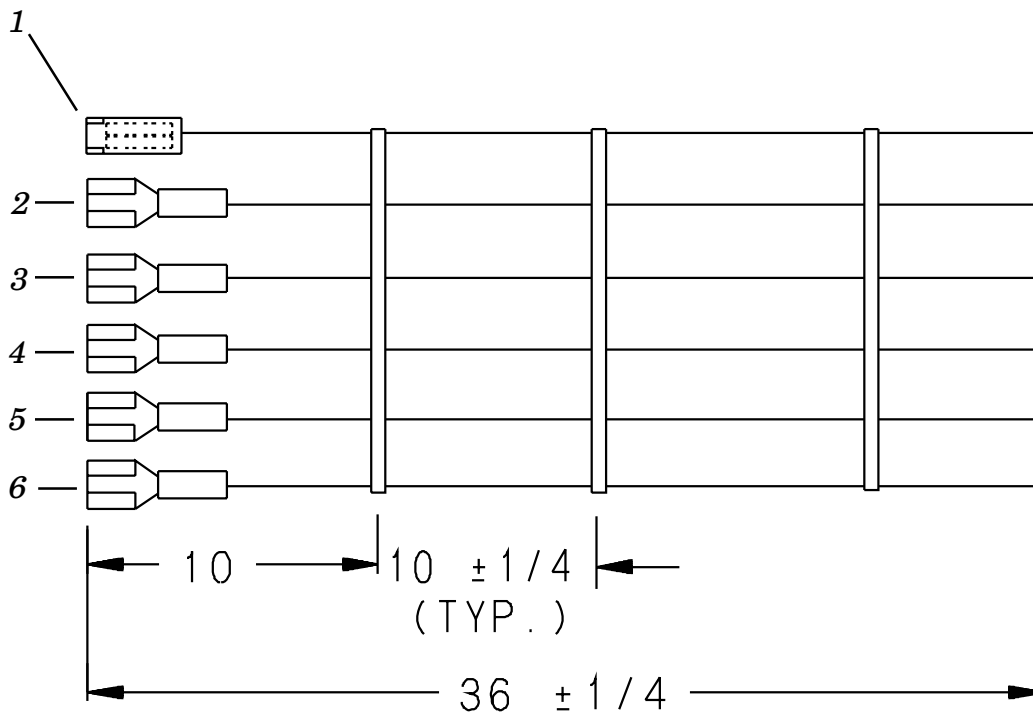


**Figure 4-3**  
**Alarm Relay Connections (J6 and J7)**

**4.5 Relay Package  
(Optional)**

As an option, a 401-600 external relay package is available. This package can provide remote-mounted relay outputs for Alarm 1, Alarm 2, Lost Echo and Near Zone. This package can also be equipped with remote LEDs to indicate Loss of Echo or Near Zone.

A short cable (Figure 4-4) is available to connect the 401-600 to the ultrasonic chassis. Cable 380-5000-053 contains 36 inches of ribbon cable with 5 female, colored-crimp connectors (labelled 2 through 6 on Figure 4-4) and 1 special connector (labelled 1 on Figure 4-4). The special connector is only required if using a relay package that contains remote LEDs for indicating Lost Echo or Near Zone.



*Figure 4-4  
Cable to Optional Relay Package*



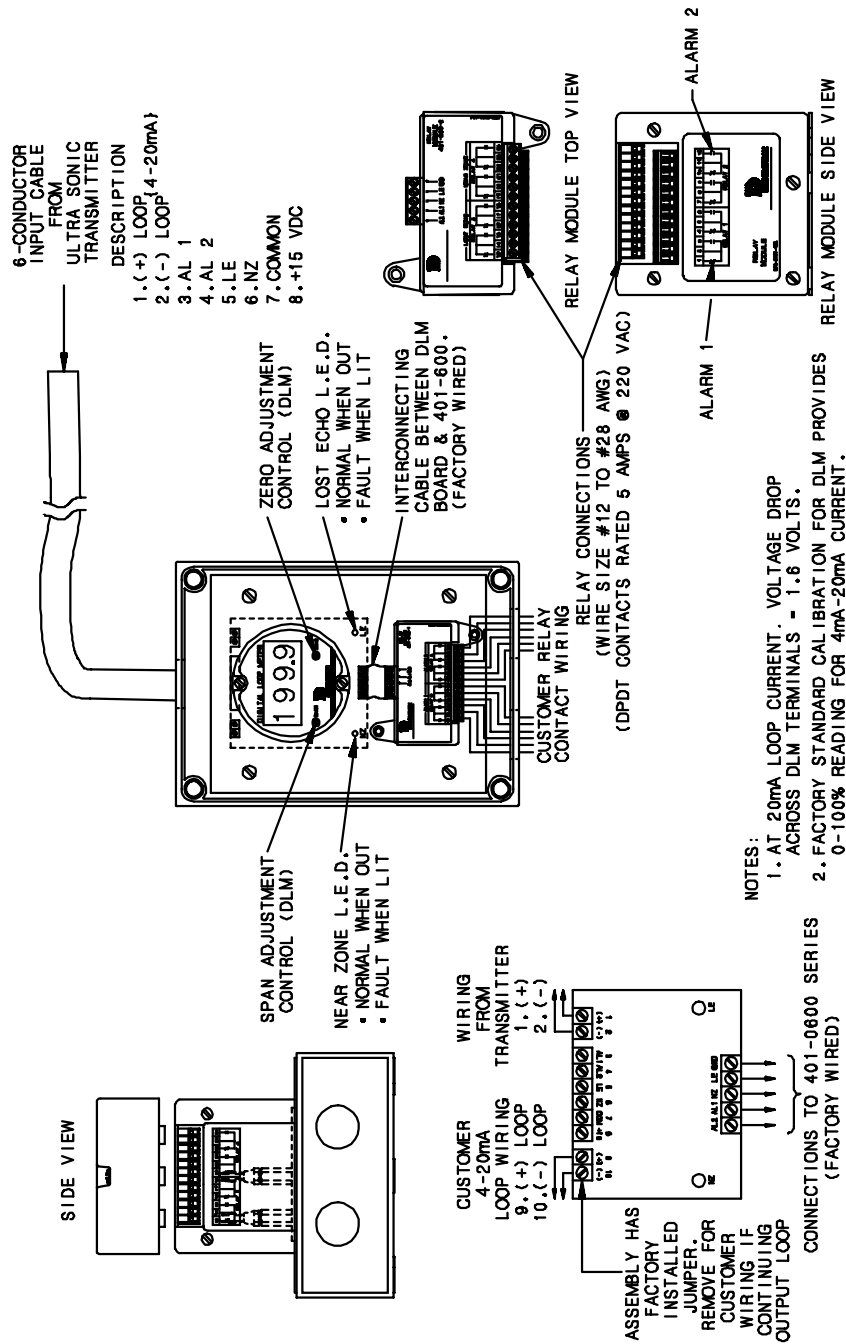
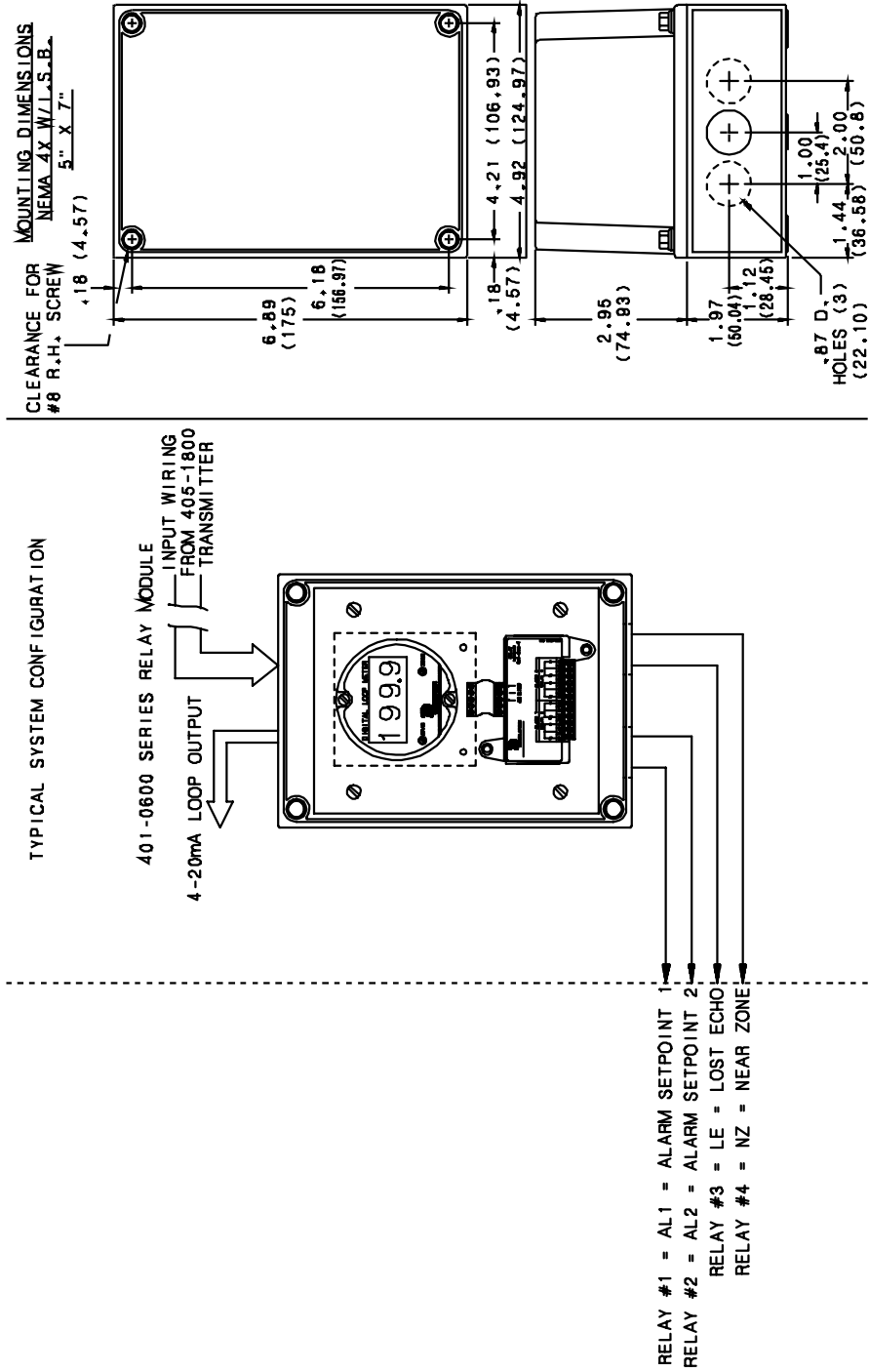


Figure 4-5  
Wiring of Optional Relay Package



All dimensions in inches (mm).

Figure 4-6  
 Optional Relay Package  
 System Configuration and Mounting Dimensions

### SECTION 5 TROUBLESHOOTING

#### 5.1 Troubleshooting Procedures

The 505-1800 Transmitter is designed to give years of unattended service. No periodic or scheduled maintenance is required.

If a problem should occur with the operation of the transmitter, use the following procedure for troubleshooting.

- a. Ensure wiring connections are correct.
- b. Ensure that the transducer face is submerged in the liquid.
- c. If attempts to locate the difficulty fail, notify the local factory representative, or call the factory toll-free at 1-800-527-6297. To aid in troubleshooting, please complete the information on Table 5-1 before calling the factory service department.

*Table 5-1*  
**ULTRASONIC PHONE TROUBLESHOOTING**

Transmitter Model Number \_\_\_\_\_ Serial Number \_\_\_\_\_

Process Material \_\_\_\_\_ Temperature \_\_\_\_\_ Pressure \_\_\_\_\_

What is the Loop Current? \_\_\_\_\_ Is it stable? \_\_\_\_\_

Test the ability of the electronic unit to produce 4 and 20 mA. Place switch 3 of SW8 to the ON position (up). Now by alternating switch 2, ON (up) position should =4 mA. OFF (down) position should =20 mA.

Are either of the 2 red LEDs illuminated? \_\_\_\_\_ (if yes, which one?) \_\_\_\_\_

Check for correct voltage on TB1 (see Figure 2-4). \_\_\_\_\_

Loop supply voltage is measured at TB2 (with no load) should be 24-30 VDC in source mode.

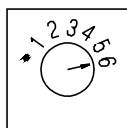
What is the position of the hex switch SW4 (factory setting is zero)? (See Figure 3-1.)

What is the position of the step gain switch (factory setting is 6)? (See Figure 2-3.)

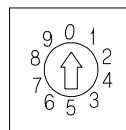
What is the position of the high discrimination curve select switch (factory setting is 0)? (See Figure 2-3.)



SW4



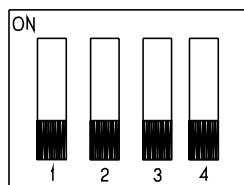
Step  
Gain  
Switch



High  
Discrimination  
Curve Select  
Switch

What are the switch positions of SW8? (See Figure 3-1.)

(All should be DOWN (off) with the exception of position 4—it can be either UP (on) or DOWN (off).



SW8

List the positions of the Span and Zero rotary calibration switches (Figure 3-1.)

SW1, SW2, SW3, SW5, SW6, AND SW7?

SW1 \_\_\_\_\_ SW5 \_\_\_\_\_

In level mode Zero must always be larger than Span.

SW2 \_\_\_\_\_ SW6 \_\_\_\_\_

SW3 \_\_\_\_\_ SW7 \_\_\_\_\_

With sensing element disconnected, a reading of 12K ohm should be present between CW to SHIELD, using an analog meter.

Disconnect the temperature transducer wires (brown and orange) leading to the transducer. Using a digital ohmmeter, a good transducer measures 12-14 megohms with the positive test lead on the orange (+) lead and the negative test lead on the brown lead. Reverse the meter leads and an open circuit (infinite ohms) must be observed.

**5.2 Telephone Assistance**

If you are experiencing difficulty with your Drexelbrook equipment and attempts to locate the problem have failed:

- contact your local Drexelbrook representative,
- call the Service department toll-free at 1-800-527-6297 (in US and Canada) or 1-215-674-1234 (outside North America),
- fax the following information to the Service department at 1-215-674-5117.

To expedite assistance, please provide the following information:

Instrument Model Number \_\_\_\_\_

Sensing Element Model Number and Length \_\_\_\_\_

Coax Cable Length (remote systems) \_\_\_\_\_

Original Purchase Order Number \_\_\_\_\_

Material being measured \_\_\_\_\_

Temperature \_\_\_\_\_

Pressure \_\_\_\_\_

Agitation \_\_\_\_\_

Brief description of the problem \_\_\_\_\_

\_\_\_\_\_

Checkout procedures that have failed \_\_\_\_\_

\_\_\_\_\_

**5.3 Equipment Return**

In order to provide the best service, any equipment being returned for repair or credit must be pre-approved and have a return number issued by the factory.

In many applications, sensing elements are exposed to hazardous materials.

- OSHA mandates that our employees be informed and protected from hazardous chemicals.
- Material Safety Data Sheets (MSDS) listing the hazardous materials that the sensing element has been exposed to **must** accompany any repair.
- It is your responsibility to fully disclose all chemicals and decontaminate the sensing element.

**5.3 Equipment  
Return**

To obtain a return authorization number (RA#), contact the Service department at 1-800-527-6297 (US and Canada) or 1-215-674-1234 (outside North America). Please provide the following information:

Model Number of Return Equipment \_\_\_\_\_

Serial Number \_\_\_\_\_

Original Purchase Order Number \_\_\_\_\_

Process Materials that equipment has been exposed to \_\_\_\_\_

MSDS sheets for any hazardous materials

Billing Address \_\_\_\_\_  
\_\_\_\_\_

Shipping Address \_\_\_\_\_  
\_\_\_\_\_

Purchase Order Number for Repairs \_\_\_\_\_

*Please include a purchase order even if the repair is under warranty. If repair is covered under warranty, you will not be charged.*

**Ship equipment freight prepaid to:**  
DREXELBROOK ENGINEERING CO.  
205 KEITH VALLEY ROAD  
HORSHAM, PA 19044  
COD shipments will not be accepted.

**5.4 Field Service**

Trained field service personnel are available on a time-plus-expense basis to assist in start-ups, diagnosing difficult application problems, or in-plant training of personnel. Preventative Maintenance and Calibration Certification service contracts are also available to maintain plant efficiency. Contact the Service department for further information.

**5.5 Customer  
Training**

Instrument Training Seminars for customers are conducted at the factory. These sessions, guided by Drexelbrook engineers and specialists, provide detailed information on all aspects of level measurement, including theory and practice of instrument operation. Contact the Training Department for further information.

**SECTION 6  
SPECIFICATIONS**

**6.1 Transmitter  
Specifications**

**—Power Requirement**

95-135 Vac, 50/60 Hz  
190-270 Vac, 50/60 Hz  
18-30 Vdc

**—Power Consumption**

6 watts @ 120 Vac

**—Operating Temperature**

-40°F to 160°F (Electronics)  
-40°F to 160°F (CPVC Sensor)

**—Ambient Temperature Effect**

±10% per 100°F

**—Repeatability**

0.1 inch

**—Resolution**

0.1 inch

**—Response Time**

2 seconds

**—Calibration**

Zero and Span: to nearest 1 inch  
Near Zone: 12 inches (0.3 meter)  
Minimum Span: 3 inches (7.62 cm) or 10% of  
range (whichever is greater)  
Maximum Span: 40 feet (12.19 meters)

**—Output**

2-Wire Signal Loop: 4-20 mA DC (isolated)  
source or sink

•Loop Voltage: Source Mode, 24 vdc (standard)  
Sink Mode, 8-60 vdc (field-selectable)

•Loop Resistance: Source Mode, 0-1000 ohms (standard)  
(@ 24 VDC) Sink Mode, 0-725 ohms  
(field-selectable)

**—Linearity**

0.5% of full scale for spans less than 3 feet.  
0.25% of full scale for spans more than 3 feet.

**6.1 Transmitter Specifications (cont.)**

—*Temperature Compensation*  
Automatic (separate temperature sensor is available)

—*Damping*  
0,15, or 45 second response time (field-selectable)

—*Lost Echo*  
LED indication, loop current 4 mA  
Additional output: 24 vdc 35 mA maximum

—*Near Zone*  
LED indication, loop current 20 mA  
Additional output: 24 vdc 35 mA maximum

—*Optional Alarm Outputs*  
2 outputs: 24 vdc 35 mA maximum  
Alarm points are set in inches.

—*Pulse Repetition Rate*  
140 msec

—*Fail Safe*  
Low Level (standard)  
High Level (field-selectable)

—*Alarm Output*  
24 volt drives @ 35 mA for Near Zone and Lost Echo (standard)  
24 volt drives @ 35 mA for 2-alarm setpoint (optional)

**6.2 Transducer Specifications**

—*Sensor*  
Material: CPVC  
Pressure: -10 to 50 PSI

—*Enclosure*  
Explosionproof Housing

—*Beam Angle*  
Conical, 8° typical, 3db down

—*Mounting*  
Integral or Remote  
2" NPT fitting (flange mounts available)



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