Installation and Operating Instructions

Series 505-2X00
UniversalSonic™ Level Transmitter using 405-2100 and 405-2400 Electronics
Series 505-2X00
UniversalSonic™ Level Transmitter
using
405-2100 and 405-2400 Electronics
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SECTION 1
INTRODUCTION

1.1 Product Description

The Drexelbrook Series 505-2X00 UniversalSonic™ instrument is a two-wire integral assembly that accurately measures continuous level up to a range of 30 feet, using ultrasonic technology. The level measurement output is a 4-20 mA current signal or HART® communications.

1.2 Models Available

The 505-2X00 UniversalSonic is identified by the model number on the side label of the electronic unit.

5 0 5 - 2 X 0 0 - X 0 X - Continuous UniversalSonic Transmitter with 4-20 mA

<table>
<thead>
<tr>
<th>Transducer material:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 316 SS</td>
</tr>
<tr>
<td>2 - CPVC</td>
</tr>
<tr>
<td>6 - PFA and 316 SS</td>
</tr>
<tr>
<td>7 - PFA Sealtyte™</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System options:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - Integral Electronics</td>
</tr>
<tr>
<td>7 - Remote Electronics</td>
</tr>
</tbody>
</table>

Type of unit:

1 - High Resolution Unit equipped with a set of switches to calibrate in tenths of inches for open channel flow and small span applications.

4 - Standard unit with a 30-foot range.

The diagram on the following page identifies the components of the 405-2X00 UniversalSonic instrument.
—Legend

① Rotary Switch S1
Time Delay/Rep Rate/Units Selection
see section 3.1

② Calibration Switches (Zero/Span)
see sections 3.5 and 3.6

③ Slide Switch S2
Near Zone/Lost Echo Fault /Diagnostic
see section 3.2

④ Acquire Button for Return Signal

⑤ Level Sensor and Temperature Sensor
Connections
see section 2.4

⑥ Rotary Switch S3
High Discrimination Mode/Gain
Adjustment
see section 3.3

⑦ 4-20 mA Loop Connections
see section 2.4

⑧ Slide Switch S4
HART® Communication
see section 3.4 and section 4
1.3 Definition of Terms

Zero: The point at which the output is to equal 4 mA\(^1\) (0\% level) measured from the transducer face down ().

Span: The point at which 20 mA\(^2\) (100\%) occurs measured from the zero point.

Range: Maximum distance from the transducer face.

Near Zone: The distance just below the transducer face where the transmitter cannot make a level measurement (12 inches).

Lost Echo: A condition that occurs when the ultrasonic energy is not being returned to the transducer. Loss of echo may occur when large amounts of foam are present.

1.4 Types of Output

Level Mode: Output increases as level increases. Level mode output is the most common type of output measurement. (Forward-acting)

Distance Mode: Output decreases as level increases. (Reverse-acting)

Fault Indication: Output goes to 3.7 or 22 mA. (field-selectable)

\(^1\)In HART® communication mode, the 4 mA point is measured from the bottom of the vessel.

\(^2\)In HART® communication mode, the 20 mA point is measured from the bottom of the vessel.
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 505-2X00 Series transmitter is available with the electronic unit and transducer as either a single integral assembly or connected by two coaxial cables in the remote configuration. Extended sensing element lengths and special mountings can be provided to fit specific mounting applications. Refer to Figures 2-2 and 2-3 for standard mounting dimensions.

• The 505-2X00 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 when adjusting, place the electronic unit in a reasonably accessible location. Ambient temperature should be between -40°F and 160°F (-40°C to 70°C).

2.3 Mounting the Transducer

• The transducer axis must be mounted perpendicular to the liquid surface.

• When mounting the transducer, consideration must be given to the 12-inch Near Zone. If the level rises to within 12 inches of the sensing element face, a 3.7 or 22 mA signal will be generated. See 3.2 Slide Switch S2, Near Zone.

• Refer to Appendix A for further examples of installation guidelines.
Figure 2-1
Mounting Recommendations
(Also refer to Appendix A)
All dimensions in inches (mm).

Figure 2-2
505-2X00 Series Mounting Dimensions
Integral Electronic Housing
Figure 2-3
505-2X00 Series Mounting Dimensions
Remote Electronic Housing

All dimensions in inches (mm).
2.4 Wiring the Transmitter

**CAUTION**

If the Series 505-2X00 instrument 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 hazard level.

Refer to Figures 2-4 and 2-5 for the wiring diagrams of the 505-2X00 transmitter.

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.

**Wiring to PLC or DCS with Non-isolated Inputs**

The negative side of loop is grounded to the chassis (housing) at the electronic unit. If connecting this product to an instrument that is grounded OTHER THAN at the negative input terminal, contact Drexelbrook Service Department at 1-800-527-6297 (US & Canada; all others call 1-215-674-1234).

![Figure 2-4](image-url)

*Figure 2-4 Loop Wiring*
Figure 2-5
Sensing Element Wiring Connections, Remote Transmitter
2.5 Digital Integral Meter

An optional digital integral meter (DIM) (401-44-1) can be used with the UniversalSonic instrument for local indication. When purchased with the instrument, a housing with viewport is supplied. The meter display is visible through the viewport.

If the meter is added as a retrofit to an existing installation, a new housing dome with viewport (260-2-222) is required and supplied as part of the retrofit package.

To install the meter:
- remove the top label from the transmitter to expose two threaded holes and ribbon cable socket,
- plug the mini ribbon cable into the socket,
- secure meter to top of electronic unit with screws.

The meter is not inserted into the 4-20 mA loop. The meter receives power and data directly from the smart transmitter via attached mini ribbon cable. See Figure 2-6.

When a smart transmitter is powered down or the ribbon cable is disconnected, there is a 1 minute delay before the DIM begins to display.

The meter is configured using the Drexelbrook PC software (Configure Meter).

Figure 2-6
Digital Meter in Housing with Viewport
Calibration with Drexelbrook PC Software

The UniversalSonic instrument can be configured and calibrated using one of three methods.

- Analog Rotary Switches
- HART® Communications using PC Software
- HART® Communications using HART Communicator

Section 3 (Blue)
Section 4 (Yellow)
Section 5 (Green)
Section 3.1 describes the switches and selection of settings. Section 3.2 describes calibrating the 505-2400 instrument in inches using the calibration switches. Section 3.3 describes calibrating the 505-2100 instrument in tenths of inches using the calibration switches.

3.1 Switch Settings

3.1.1 Rotary Switch S1

—Rotary Switch S1 controls:
  • repetition rate
  • time delay
  • selection of English (inches) or metric (centimeters) units

The unit is shipped with S1 in the default setting: switch position zero which sets no time delay, 250 msec repetition rate, and English units (inches).

—Time Delay/Repetition Rate

An application might require time delay or a longer repetition rate depending on the type of vessel and material being measured. For instance:

• 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.

• Increasing the repetition rate to 400 ms is required any time that the tank roof is curved (domed tanks). A longer repetition rate ensures that transmitter is not affected by reflected sound waves from the curved roof.

• A lengthened repetition rate may help reduce loss of echo due to foam.

If your application is similar to one described above, change the time delay or repetition rate using a small screwdriver and switch S1. Table 3-1 details the switch settings. Each setting controls both time delay and repetition rate.

—Units Selection

The 505-2X00 UniversalSonic transmitter can be used in English or metric modes of operation.

• When S1 is in position 0-5, the zero and span calibration switches are set in inches.

• When S1 is in position 6-9, the zero and span switches are set in centimeters.
### Table 3-1

**Time Delay, Repetition Rate, and Units Selection Switch (S1) Settings**

<table>
<thead>
<tr>
<th>Switch S1 Position</th>
<th>Time Delay</th>
<th>Pulse Rate</th>
<th>Units Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 seconds</td>
<td>250 msec</td>
<td>english</td>
</tr>
<tr>
<td>1</td>
<td>15 seconds</td>
<td>250 msec</td>
<td>english</td>
</tr>
<tr>
<td>2</td>
<td>45 seconds</td>
<td>250 msec</td>
<td>english</td>
</tr>
<tr>
<td>3</td>
<td>0 seconds</td>
<td>400 msec</td>
<td>english</td>
</tr>
<tr>
<td>4</td>
<td>15 seconds</td>
<td>400 msec</td>
<td>english</td>
</tr>
<tr>
<td>5</td>
<td>45 seconds</td>
<td>400 msec</td>
<td>english</td>
</tr>
<tr>
<td>6</td>
<td>0 seconds</td>
<td>250 msec</td>
<td>metric</td>
</tr>
<tr>
<td>7</td>
<td>15 seconds</td>
<td>250 msec</td>
<td>metric</td>
</tr>
<tr>
<td>8</td>
<td>45 seconds</td>
<td>250 msec</td>
<td>metric</td>
</tr>
<tr>
<td>9</td>
<td>0 seconds</td>
<td>400 msec</td>
<td>metric</td>
</tr>
<tr>
<td>A</td>
<td>15 seconds</td>
<td>400 msec</td>
<td>metric</td>
</tr>
<tr>
<td>B</td>
<td>45 seconds</td>
<td>400 msec</td>
<td>metric</td>
</tr>
<tr>
<td>C-F</td>
<td>not used</td>
<td>not used</td>
<td>not used</td>
</tr>
</tbody>
</table>
3.1.2 Slide Switch S2

—Slide Switch S2 controls:
  • level/distance mode (S2-1)
  • near zone fault output (S2-2)
  • lost echo fault output (S2-3)
  • diagnostics (S2-4)

—Level or Distance Mode
The selection of either level or distance mode is accomplished by changing the position of the slide switch S2-1.

• When S2-1 is switched to the left, the unit will measure in the level mode.

• When S2-1 is in switched to the right, the unit will measure in the distance mode.

Level and distance modes are explained in sections 1.4, 3.2 and 3.3.
3.2 Slide Switch S2 (cont.)

—Near Zone Fault Output

Slide switch S2-2 determines the output current of a near zone fault condition.

• When S2-2 is switched to the left, the unit will output 22 mA during a near zone condition.

• When S2-2 is switched to the right, the unit will output 3.7 mA during a near zone condition.

See Table 3-2 for application information when setting near zone and lost echo switches.

![Near Zone High (22 mA)](image1)

![Near Zone Low (3.7 mA)](image2)

### Table 3-2

**Application Notes for Near Zone and Lost Echo Settings**

<table>
<thead>
<tr>
<th>Applications</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application requires Overfill Prevention (no spills)</td>
<td>Low Level Prevention (pump will not run dry)</td>
</tr>
<tr>
<td>Material cannot go over high point</td>
<td>Material cannot go below low point</td>
</tr>
<tr>
<td><strong>Near Zone</strong></td>
<td><strong>Lost Echo</strong></td>
</tr>
<tr>
<td>Typically set 22 mA</td>
<td>Typically set 22 mA</td>
</tr>
<tr>
<td><strong>Lost Echo</strong></td>
<td>Typically set 3.7 mA</td>
</tr>
</tbody>
</table>
3.1.2 Slide Switch S2 (cont.) —Lost Echo Fault Output
Slide switch S2-3 determines the output current of a lost echo fault condition.

- When S2-3 is switched to the left, the transmitter will produce 22 mA output during a lost echo condition.

- When S2-3 is switched to the right, the transmitter will produce 3.7 mA output during a lost echo condition.

See Table 3-2 for application information when setting near zone and lost echo switches.

—Diagnostics
Slide switch S2-4 runs a diagnostic program, discussed in Section 6 Troubleshooting.

3.1.3 Rotary Switch S3
—Rotary Switch S3 controls:
  - high discrimination mode
  - gain adjustment settings

—High Discrimination
Position zero on rotary switch S3 activates the high discrimination mode.

- High discrimination mode automatically reduces the effect of nuisance echos created when mounting the transducer in a nozzle or mounting the transducer inside a pipe up to 14 inches above the tank opening.

- The high discrimination mode lessens any effect from agitator blades and/or small obstructions and reduces interference caused by electrical noise.

- The high discrimination mode should not be used in applications where foam is present.
3.1.3 Rotary Switch S3 (cont.)

---Gain Adjustment
The step gain positions can be used to decrease the ultrasonic return signal and avoid noise interference.

For example, the power produced to shoot the 30-foot signal could possibly cause nuisance reflections from irregular sidewalls, tank obstructions, or agitator blades. By reducing the gain of the transmitter using the step gain switch positions, the effect of nuisance reflections can be eliminated.

See Table 3-3 for gain settings using rotary switch S3.

### Table 3-3
**High Discrimination and Gain Adjustment**

<table>
<thead>
<tr>
<th>Switch S3 Position</th>
<th>Mode/Gain Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>high discrimination (automatic gain control)</td>
</tr>
<tr>
<td>1</td>
<td>100% gain</td>
</tr>
<tr>
<td>2</td>
<td>84% gain</td>
</tr>
<tr>
<td>3</td>
<td>67% gain</td>
</tr>
<tr>
<td>4</td>
<td>50% gain</td>
</tr>
<tr>
<td>5</td>
<td>32% gain</td>
</tr>
<tr>
<td>6</td>
<td>17% gain</td>
</tr>
<tr>
<td>7</td>
<td>8% gain</td>
</tr>
<tr>
<td>8-9</td>
<td>not used</td>
</tr>
<tr>
<td>A-F</td>
<td>not used</td>
</tr>
</tbody>
</table>

3.1.4 Slide Switch S4

---HART® Communication
Slide switch S4, position 4 determines the communication mode of the transmitter.
See Section 4, HART® Communication.
Two-Wire UniversalSonic™ Switch Function Quick Reference

Rotary Switch S1
<table>
<thead>
<tr>
<th>Position</th>
<th>Time Delay</th>
<th>Repetition Rate</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>#0 =</td>
<td>None</td>
<td>250 ms</td>
<td>inches</td>
</tr>
<tr>
<td>#1 =</td>
<td>15 seconds</td>
<td>250 ms</td>
<td>inches</td>
</tr>
<tr>
<td>#2 =</td>
<td>45 seconds</td>
<td>250 ms</td>
<td>inches</td>
</tr>
<tr>
<td>#3 =</td>
<td>None</td>
<td>400 ms</td>
<td>inches</td>
</tr>
<tr>
<td>#4 =</td>
<td>15 seconds</td>
<td>400 ms</td>
<td>inches</td>
</tr>
<tr>
<td>#5 =</td>
<td>45 seconds</td>
<td>400 ms</td>
<td>inches</td>
</tr>
<tr>
<td>#6 =</td>
<td>None</td>
<td>250 ms</td>
<td>centimeters</td>
</tr>
<tr>
<td>#7 =</td>
<td>15 seconds</td>
<td>250 ms</td>
<td>centimeters</td>
</tr>
<tr>
<td>#8 =</td>
<td>45 seconds</td>
<td>250 ms</td>
<td>centimeters</td>
</tr>
<tr>
<td>#9 =</td>
<td>None</td>
<td>400 ms</td>
<td>centimeters</td>
</tr>
<tr>
<td>#A =</td>
<td>15 seconds</td>
<td>400 ms</td>
<td>centimeters</td>
</tr>
<tr>
<td>#B =</td>
<td>45 seconds</td>
<td>400 ms</td>
<td>centimeters</td>
</tr>
<tr>
<td>C-F =</td>
<td>Future</td>
<td>Future</td>
<td>Future</td>
</tr>
</tbody>
</table>

When rotary switch S1 is set on position 6, through 9, A, B, the Zero and Span settings are in centimeters.

Rotary Switch S3
| #0 =     | High Discrimination |
| #1 =     | 100% Gain           |
| #2 =     | 84% Gain            |
| #3 =     | 67% Gain            |
| #4 =     | 50% Gain            |
| #5 =     | 32% Gain            |
| #6 =     | 17% Gain            |
| #7 =     | 8% Gain             |
| #8,9 =   | Future              |
| #A-F =   | Future              |

Rotary Switch S1, when set on position 6, through 9, A, B, the Zero and Span settings are in centimeters.

Slide Switch S2
1 Left = Level
1 Right = Distance
2 Left = Near Zone High (22mA)
2 Right = Near Zone Low (3.5mA)
3 Left = Lost Echo High (22mA)
3 Right = Lost Echo Low (3.5mA)
4mA forced (1L, 2R, 3R, 4R)
20mA forced (1L, 2L, 3R, 4R)

Slide Switch S4
Slide #1 - Left = Display in percent / Right = Display in distance.
Slide #2 - not used.
Slide #3 - Scaled Percent Output.
Left = Percent Output Scaled 0 to 1.
Right = Percent Output Scaled 0 to 100. (Some DCS systems require this setting.)
Slide #4 Left = Non-HART cal / Right = HART cal using laptop PC
Note: For calibration with HART 275 Hand Held Field Communicator, slide #4 to the LEFT and set all zero and span rotary switches to 0.
3.2 Calibrating the 405-2400 Instrument using the Rotary Switches

Use this procedure to set the Zero and Span switches for calibration of a standard 405-2400 electronic unit. See 3.3 Calibrating with Higher Resolution for calibrating the instrument with a higher resolution (tenths of inches) using the rotary switches.

—Level Mode (Forward-acting)

Verify that slide switch S2-1 is set to the left. Refer to section 3.1.2.

Set the Zero rotary switches to equal the distance in inches (or centimeters) from the transducer face down to the minimum level (usually tank bottom–0% or 4 mA). Refer to the calibration example in Figure 3-1. For this example, the switches are set to 1-6-8 starting with the top switch.

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

—Distance Mode (Reverse-acting)

Verify slide switch S2-1 is set to the right. Refer to section 3.1.2.

Set the Zero rotary switches to equal the distance in inches (or centimeters) from the sensing element face to the maximum level (0% or 4 mA). Refer to the calibration example in Figure 3-1. For this example, the switches are set to 0-1-2 starting with the top switch.

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

NOTE

For linear outputs, it is possible to calibrate into the near zone. However, unit will fault when level gets within 12 inches of transducer face.
505-2400 Series UniversalSonic™ Transmitter

Figure 3-1
Calibration Example
3.3 Calibrating with High Resolution using the Calibration Switches

Certain applications require a higher resolution for calibration of the Zero and Span. The 405-2100 can be set in tenths of inches for applications that require a higher resolution.

—Level Mode (Forward-acting)

Verify that slide switch S2-1 is set to the left. Refer to section 3.2.

Set the Zero rotary switches to equal the distance in tenths of inches from the transducer face down to the minimum level (usually tank bottom—0% or 4 mA). Refer to the calibration example in Figure 3-2. For this example, the switches are set to 2-2-5 starting with the top switch.

Set the Span rotary switches to equal the distance in tenths of inches from the minimum level to the maximum level—100% point or 20 mA (e.g. 1-0-5 starting with top switch).

—Distance Mode (Reverse-acting)

Verify slide switch S2-1 is set to the right. Refer to section 3.2.

Set the Zero rotary switches to equal the distance in tenths of inches from the sensing element face to the maximum level (0% or 4 mA). Refer to the calibration example in Figure 3-2. For this example, the switches are set to 1-2-0 starting with the top switch.

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

NOTE
For linear outputs, it is possible to calibrate into the near zone. However, unit will fault when level gets within 12 inches of transducer face.
Figure 3-2
Calibration Example
The UniversalSonic instrument can be configured and calibrated using one of three methods.

- Analog Rotary Switches
- HART® Communications using PC Software
- HART® Communications using HART Communicator

Section 3 (Blue)  
Section 4 (Yellow)  
Section 5 (Green)
SECTION 4
HART® COMMUNICATION using PC SOFTWARE

To use the UniversalSonic instrument in the HART® mode, place S4-4 to the right.

Table 4-1
Switch 4 HART® Communication

<table>
<thead>
<tr>
<th>Switch Position</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S4-1</td>
<td>Meter Display</td>
<td>Output in percent. (S4-1 to the left). Output in distance in inches. (S4-1 to the right).</td>
</tr>
<tr>
<td>S4-2</td>
<td>Reserved for Future</td>
<td></td>
</tr>
<tr>
<td>S4-3¹</td>
<td>Communication Mode</td>
<td>In HART mode, normal communication. (S4-3 to the left). In HART mode, DCS communication. (S4-3 to the right).</td>
</tr>
<tr>
<td>S4-4²</td>
<td>Communication Mode</td>
<td>Switch mode. (S4-4 to the left). HART mode. (S4-4 to the right).</td>
</tr>
</tbody>
</table>

¹When S4-3 is in the HART® communication and DCS mode, output is percent multiplied by 100.

²When S4-4 is in the HART® communication mode, configuration is programmable through the PC software, the switches are no longer used for configuration.

Switch shown in Normal HART communication mode and Distance selected as meter display. See Table 4-1.
4.1 Drexelbrook PC Software

The 401-700-20 Software package allows the use of any Windows®-based personal, laptop, or notebook computer to program the HART® protocol transmitter.

4.1.1 Software Model Number

401-0700-02X

X=1 Programmed Disk Software Package includes Modem Assembly shown in Figure 4-1 and cable.

X=2 Programmed Disk Software Package includes Modem Assembly shown in Figure 4-1, cable, and four software 3½-inch floppy disks. (One disk for DOS software version 6.0 and three disks for Windows® software HARTWin version 2.0).

401-0700-031

Programmed Disk Software 3½-inch disks only (four disks).

---

![Figure 4-1](image)

**Figure 4-1**

Modem Assembly and Loop Connection
505-2400 Series UniversalSonic™ Transmitter

4.1.2 System Requirements

—**PC Requirements**
Windows 95, Windows NT or higher. It is recommended that the software be installed on a hard drive with 0.5 megabytes or more of space available.

—**Input to Modem**
RS232 from the COM1 or COM2 serial port. The PC provides operating power for the modem but not for the transmitter.

—**Output (to Transmitter being Calibrated)**
4-20 mA in HART® Protocol

—**Cable (included with Modem)**
5-foot modem to transmitter loop connection.

4.1.3 Connect the Modem

Refer to Figure 4-1 for a connection diagram and use the following procedure to install the hardware that is necessary to run the PC software.

a. Connect the Drexelbrook Modem 401-700-002 to the COM1 or COM2 serial port of the computer.

b. Connect the 4-20 mA loop connectors to the transmitter loop. Modem is not polarity sensitive.

c. Turn on the computer.

4.1.4 Install the Software

Use the disk or disk(s) of the software version, compatible with your system requirements (i.e. DOS or HARTWin).

4.1.4.1 Windows Version HARTWin 2.0

a. Place the 401-700-031 software Disk 1 (of 3) into the disk drive (usually drive a:).

b. Double-click My Computer > 3½ Floppy (A:) > Setup

c. Follow screen instructions in Setup to create program file.

d. Double click HARTWin icon and the program should run under a window.

e. Click on COM Port 1 or 2 (if known) or click on SEEK to find which COM port the modem is connected to.
### 4.1.4.1 Windows Version
**HARTWin 2.0 (cont.)**

- The software starts communicating with the HART protocol transmitter and returns with Tag ID and all default or existing configuration information. Press **F1** at any time for on-line Help.

- Press **F3** to read the present database. It takes several seconds to load the information from the transmitter. When the load is complete, the screen shows the database parameters, except any user-defined strapping table information. (**F3** must be pressed when connecting to another transmitter.)

### 4.1.4.2 DOS Version 6.0

- Place the 401-700-006 (DOS version) software Disk 1 into the disk drive (usually drive a:).

- Double-click **My Computer > 3½ Floppy (A:) > Setup**

- Follow screen instructions in **Setup** to create program file.

- Double click icon and the program should run under a window.

- Click on COM Port 1 or 2 (if known) or click on **SEEK** to find which COM port the modem is connected to.

- The software starts communicating with the HART protocol transmitter and returns with Tag ID and all default or existing configuration information. Press **F1** at any time for on-line Help.

- Press **F3** to read the present database. It takes several seconds to load the information from the transmitter. When the load is complete, the screen shows the database parameters, except any user-defined strapping table information. (**F3** must be pressed when connecting to another transmitter. should run under a window.)
4.2 Description of Function Buttons

Figure 4-2 shows a PC calibration software menu screen. The following paragraphs describe the function buttons. The data fields are described in section 4.3 Configuring the Ultrasonic Transmitter.

**NOTE**

If the data field has been edited but not sent to the transmitter (Write to Transmitter), the data field is shown in red.

**Read Transmitter**

Reads all pertinent data from the transmitter and displays it on the screen. The Read function also updates the real time window.
Write to Transmitter
Sends new or edited configuration data to the transmitter. Data field that has been edited but not sent to the transmitter is displayed in red.

Real Time View
Displays the real time values of level, capacity, distance, temperature, loop current, percentage, and status.

Point Calibration
Calibrates the HART® protocol transmitter using Point calibration. See 4.4 Calibration. Enter the low point of level for an accurate calibration.

D/A Trim
Allows a field reference meter to be connected to the transmitter for adjusting transmitter output current.

Strapping Table
Displays the values of the input to level and output to volume in percent in a 21-point table. Allows points to be changed to accommodate irregularly shaped vessels. See Section 4.6 (for open flow, see Section 4.7)

Configure Meter
Configures the optional Digital Integral Meter (440-44-1) used for local indication. See 4.5 Digital Integral Meter.

Ultrasonic Configuration
Provides necessary configuration data for ultrasonic measurement.

- Meter Output
- Repetition Rate
- Near Zone
- Lost Echo
- Gain

Refer to 4.3 Configuring the Ultrasonic Transmitter.
4.3 Configuring the Ultrasonic Transmitter

• Configuration involves downloading information to the HART® protocol transmitter that is specific to the application and vessel that is being measured.

• Calibration requires entering a low point of level. See 4.4 Ultrasonic Calibration.

a. Begin configuration by using Tag ID (8 characters) to identify the unit or vessel. Use the Scratchpad (32 characters) to record the date of calibration or other similar notes. Press Tab or Enter.

b. Select Level or Vessel in the Analog Loop Assign selection box. Press Tab or Enter.

• Level configuration sets the output to follow the level of the material being measured.

• Vessel configuration sets the output to follow the strapped level of the vessel. For example, gallons in a horizontal vessel.

c. Edit Damping Time from 0-90 seconds, if desired.

d. Click on Write to Transmitter.

e. Move to the Level Configuration section of the menu.

4.3.1 Level Configuration

a. Select Level Units. The default selection is feet. Choose the units that correspond to the level measurement.

b. Enter a Tank Height value that defines the actual height of the tank.
4.3.1 Level Configuration (cont.)

c. Enter a **Sensor Offset** value.

The software calculates the maximum tank volume based on the value entered in the **Tank Height** field. With **0.0** entered as the **Sensor Offset** value, the software assumes that the transducer face is mounted flush with the top of the tank (**Tank Height**).

**Sensor Offset** is used to tell the software the amount above or below the top of the tank that the transducer is located in order to calculate the tank volume.

*Application Note*

**Sensor Offset** can be applied in cases where:

• the transducer protrudes below the top of the tank or,
• the transducer is mounted above the top of the tank or,
• a pipe extension is installed to raise the transducer face 12 inches above the tank height to compensate for the 12-inch Near Zone.

• See Figures 4-3a and 4-3b.

• If the transducer is mounted above the top of the vessel, a positive value is entered in **Sensor Offset**.

• If the transducer is mounted below the top of the tank, a negative value is entered in **Sensor Offset**.

d. Click on **Write to Transmitter**.
Figure 4-3a
Positive Sensor Offset

Figure 4-3b
Negative Sensor Offset
4.3.2 Vessel Configuration

a. Select **Vessel Units**. The default is gallons. Press *Enter* and choose the units that correspond to the vessel measurement. The units include both weight and volume outputs. Default selection is **gallons**. Press *Tab* or *Enter*.

![Units Selection](image)

b. Edit the **Maximum Capacity** of the vessel. Enter 100 for percent if the weight or volume units are not known or needed. Press *Tab* or *Enter*.

c. Select **Vessel Type**. Default selection is **Vertical**.

![Vessel Type Selection](image)

d. Click on **Write to Transmitter**.

4.3.3 Lower Range Value (LRV) and Upper Range Value (URV)

a. Enter a Lower Range Value (LRV). See Table 4-1.

b. Enter an Upper Range Value (URV) See Table 4-1.

c. Click on **Write to Transmitter**.

**Table 4-1**

**LRV and URV Definitions**

*(see Examples on following page)*

<table>
<thead>
<tr>
<th>URV</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>LRV</td>
<td>Distance of 4 mA point measured from the bottom of the tank.</td>
</tr>
<tr>
<td>URV</td>
<td>Distance of 20 mA point measured from the bottom of the tank.</td>
</tr>
</tbody>
</table>
4.3.3 Lower Range Value (LRV) and Upper Range Value (URV) (cont.)

Entering LRV and URV in the Level Mode (Forward Acting)

**Example #1**
Tank is 12 feet tall. Set Maximum Level to 12 feet.
LRV (4 mA point) is 0 feet (bottom of tank).
URV (20 mA point) is 11 feet. (Bottom of tank to transducer face minus 12 inch near zone.)

Maximum Level

<table>
<thead>
<tr>
<th>LRV (4 mA)</th>
<th>URV (20 mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 ft</td>
<td>11.00 ft</td>
</tr>
</tbody>
</table>

**Example #2**
Tank is 31 feet tall (one foot farther than range of transmitter). Set Maximum Level to 31 feet.
LRV (4 mA point) is 1 foot. (Tank height of 31 feet minus maximum range of 30 feet equals 1 foot.)
URV (20 mA point) is 30 feet (Bottom of tank to transducer face minus 12 inch near zone.)

Maximum Level

<table>
<thead>
<tr>
<th>LRV (4 mA)</th>
<th>URV (20 mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00 ft</td>
<td>30 ft</td>
</tr>
</tbody>
</table>
4.3.3 Lower Range Value (LRV) 
and Upper Range Value (URV) 
(cont.)

Entering LRV and URV in the Distance Mode (Reverse Acting)

**Example #1**
Tank is 10 feet tall. Set Maximum Level to 10 feet.
LRV (4 mA point) is 9 feet as measured from the bottom of the tank. (Tank height of 10 feet minus near zone of one foot equals 9 feet.)
URV (20 mA point) is 0 feet (bottom of the tank).

**Example #2**
Tank is 34 feet tall (4 feet farther than maximum range of transmitter). Set Maximum Level to 34 feet.
LRV (4 mA point) is 33 feet as measured from the bottom of the tank. (Tank height of 34 feet minus near zone of one foot equals 33 feet.)
URV (20 mA point) is 4 feet as measured from the bottom of the tank. (Tank height of 34 feet minus maximum range of 30 feet equals 4 feet.)
4.3 Configuring the Ultrasonic Transmitter (cont.)

Figure 4-4 shows the Ultrasonic Configuration menu screen, accessed by the Ultrasonic Config. button.

**Figure 4-5**

*Ultrasonic Configuration Menu Screen*

—Repetition Rate
An application might require a longer repetition rate depending on the type of vessel and material being measured. For instance:

• Increasing the repetition rate to 400 ms is required any time that the tank roof is curved. A longer repetition rate ensures that transmitter is not affected by reflected sound waves from the curved roof.

• A lengthened repetition rate also helps reduce loss of echo due to foam.
4.3 Configuring the Ultrasonic Transmitter (cont.)

—Near Zone and Lost Echo Fault Outputs
 Select the output current of a Near Zone and Lost Echo fault condition.

| Low Current: 3.7 mA |
| High Current: 22 mA |

Table 4-1
Application Notes for Near Zone and Lost Echo Settings

| Application requires Overfill Prevention (no spills) | Application requires Low Level Prevention (pump will not run dry) |
| Material cannot go over high point | Material cannot go below low point |
| Near Zone typically set 22 mA Lost Echo typically set 22 mA | Near Zone typically set 22 mA Lost Echo typically set 3.7 mA |

—Gain
Select the gain setting for the ultrasonic instrument.

a. HD II B (High Discrimination)
  • High discrimination mode automatically reduces the effect of nuisance echos created when mounting the transducer in a nozzle or mounting the transducer inside a pipe up to 14 inches above the tank opening.
  • The high discrimination mode reduces any effect from agitator blades and/or small obstructions. It also reduces system interference caused by electrical noise.
  • The high discrimination mode should not be used in applications where foam is present.
4.3 Configuring the Ultrasonic Transmitter (cont.)

b. **Standard Gain**
   Accesses step gain selection.

   The step gain settings can be used to decrease the ultrasonic return signal and avoid noise interference.

   For example, the power produced to shoot the 30-foot signal could possibly cause nuisance reflections from irregular sidewalls, tank obstructions, or agitator blades. By reducing the gain of the transmitter using the step gain settings, the effect of nuisance reflections can be eliminated.

c. **Target HD**
   Select Target for use with a target ultrasonic instrument. See Instruction Manual 505-1800-LM.

   Click on **Write to Transmitter** to save the configuration. Click **Cancel** to exit ultrasonic configuration.

   Ultrasonic configuration is now complete.
Point calibration increases the accuracy of the measurement and compensates for atmospheres other than air by using the actual level in the vessel for calibration. Typically, a low point calibration is all that is required for accurate operation.

a. Measure the level from the bottom of the vessel to the surface of the material being measured. For best results, the material should be lowered to the bottom of the vessel.

b. Click on **Point Calibration**.

c. Enter the Low Point level (level measured from bottom of vessel). For example, if level was measured at 2 feet, enter 2 feet.

d. Click on **Write to Transmitter**.
4.5 Digital Integral Meter

A digital integral meter (DIM) (401-44-1) is available as an option for the UniversalSonic instrument. Refer to Section 2.5 for meter installation.

The DIM is a 4½-digit meter used for local indication. The display can be configured to read any engineering units, e.g. 4-20 mA, gallons, inches, feet, etc. Status messages are also displayed on the meter.

To program the meter, click on **Configure Meter**:

![Meter Configuration](image)

The meter is configured by:
- setting the minimum value equal to the value to be displayed at the LRV and,
- setting the maximum value equal to the value to be displayed at the URV.

Factory default settings are:
- Minimum Value = 0.00
- Maximum Value = 100.00

To set the meter display range equal to the calibration range:
- Minimum Value = LRV
- Maximum Value = URV

To set the meter display range equal to percent of level:
- Minimum Value = 0
- Maximum Value = 100
4.5 Digital Integral Meter (cont.)

Table 4-1 provides a list of the error messages displayed on the DIM.

Table 4-1
Error Status Messages Displayed on Meter

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>L.E.</td>
<td>Lost Echo</td>
</tr>
<tr>
<td>-nEAr</td>
<td>Near Zone</td>
</tr>
<tr>
<td>Err.C</td>
<td>Communications error</td>
</tr>
<tr>
<td>Err.E</td>
<td>EEPROM error</td>
</tr>
<tr>
<td>Err.S</td>
<td>Setup error</td>
</tr>
<tr>
<td>CAL.</td>
<td>DAC calibration error</td>
</tr>
<tr>
<td>-4-20</td>
<td>Loop error</td>
</tr>
<tr>
<td>-SEnS</td>
<td>Sensor temperature error</td>
</tr>
<tr>
<td>Err.D</td>
<td>Display error</td>
</tr>
</tbody>
</table>

If the decimal point or hyphen is blinking, the status message is active and the fault should be corrected. If the decimal point or period is not blinking, the meter is locked in an inactive state and should be restarted.

When a smart transmitter is powered down or the ribbon cable is disconnected, there is a 1 minute delay before the DIM begins to display.

If the display becomes garbled:
- remove power from the smart transmitter,
- wait one minute,
- re-apply power to restart the meter.
The strapping table is a 2-point to 21-point table used by the UniversalSonic™ to cause the output current to follow a specified relationship to the level. There are certain strapping tables that are already built in to the transmitter software. These are: Linear (vertical tank); Horizontal Tank with flat ends; Horizontal Tank with dished ends; Horizontal Tank with hemispherical ends; and Spherical Tank. These predefined tables are found in the Vessel Config assignment of the Configuration procedure.

If the output-to-level relationship is not defined by one of these tables, you may create a table in the Strapping Table program. To create a non-linear relationship, you will need at least 3 points and may use as many as 21 points. A 21-point table will define the relationship to about a .1% accuracy. A common example for a simple table would be a Cone Bottom Vertical tank which would require 3 points—the bottom, straight-side break point, and the top. On the other hand, an open channel flow application could benefit from using all 21 available points.

- Plan your table by filling out the form below. You may use the first column which lists every 5% between 0 and 100%, or you may fill in your own values in column 2.

- Fill out column 3 with output values corresponding to those listed in column 1 or 2.

### Strapping Table Example

<table>
<thead>
<tr>
<th>Point Number</th>
<th>Level Std Preset Values % Level</th>
<th>Level Optional Values % Level</th>
<th>Output Values Selected Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The 21-point strapping table feature of AMETEK Drexelbrook PC based configuration software can be defined for the characterization of any primary element (flume / weir type) for open channel flow measurement. Several commercially available publications can be used that will provide flow head height (level) to flow rate conversions.

To accurately characterize the strapping table for head height Vs flow rate, you must first know the actual distance from the Ultrasonic transducer face to the minimum flow level (4mA). This is different for various flumes, check with the flume manufacturer, or call AMETEK Service department at 1-800-527-6297 in North America.

Using the AMETEK Drexelbrook HARTWin PC software follow these steps:

1) Change “Analog Loop Assign” to **Vessel**.

2) Set “Tank Height” to correspond to the maximum head height (20mA).

3) Set “Sensor Offset” to correspond to the difference between the maximum head height and the transducer face (this distance must be greater or equal to 12 inches – the transducers minimum near zone).

4) Set the “Maximum Capacity” to correspond to the maximum flow rate (Max flow at the Max Head Height).

5) Set LRV to 0 (Zero)

6) Set URV to equal Max Capacity

7) Write information to Transmitter by selecting the “Write To Transmitter” button.

8) Select “Strapping Table” button

9) Edit “Level In” column to correspond to head height at selected intervals. Edit “Volume Out” to correspond to flow rate for the given head height in “Level In” Column.
10) Write strapping table to the transmitter by selecting the “Write Strapping Table” button.

11) Transmitter is now calibrated.

Plan your table by filling out the form below. Use the first column to list head height values and use the second column to list the corresponding flow rate values. (Note – Percent Level and Percent Volume shown on strapping table is calculated automatically).

<table>
<thead>
<tr>
<th>Point Number</th>
<th>Level In (Head Height)</th>
<th>Volume Out (Volume Rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.8 **EXAMPLE of Strapping Table for use with Open Channel Flow Characterization**

Head Height vs. Flow Rate Table Configuration Example based on six inch Parshall Flume with six inch maximum head height using 18 points of characterization...

where head height (Level In) is in feet,  
and flow rate (Volume Out) is in cubic feet per second.

<table>
<thead>
<tr>
<th>Point Number</th>
<th>Level In (Head Height)</th>
<th>Volume Out (Volume Rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2</td>
<td>0.02</td>
<td>1.912</td>
</tr>
<tr>
<td>3</td>
<td>0.05</td>
<td>8.134</td>
</tr>
<tr>
<td>4</td>
<td>0.08</td>
<td>17.09</td>
</tr>
<tr>
<td>5</td>
<td>0.11</td>
<td>28.27</td>
</tr>
<tr>
<td>6</td>
<td>0.14</td>
<td>41.38</td>
</tr>
<tr>
<td>7</td>
<td>0.17</td>
<td>56.24</td>
</tr>
<tr>
<td>8</td>
<td>0.20</td>
<td>72.70</td>
</tr>
<tr>
<td>9</td>
<td>0.23</td>
<td>90.67</td>
</tr>
<tr>
<td>10</td>
<td>0.26</td>
<td>110.0</td>
</tr>
<tr>
<td>11</td>
<td>0.29</td>
<td>130.8</td>
</tr>
<tr>
<td>12</td>
<td>0.32</td>
<td>152.8</td>
</tr>
<tr>
<td>13</td>
<td>0.35</td>
<td>176.0</td>
</tr>
<tr>
<td>14</td>
<td>0.38</td>
<td>200.4</td>
</tr>
<tr>
<td>15</td>
<td>0.41</td>
<td>226.0</td>
</tr>
<tr>
<td>16</td>
<td>0.44</td>
<td>252.7</td>
</tr>
<tr>
<td>17</td>
<td>0.47</td>
<td>280.4</td>
</tr>
<tr>
<td>18</td>
<td>0.50</td>
<td>309.2</td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Calibration with HART® Communicator

The UniversalSonic instrument can be configured and calibrated using one of three methods.

- Analog Rotary Switches
- HART® Communications using PC Software
- HART® Communications using HART Communicator

Section 3 (Blue)
Section 4 (Yellow)
Section 5 (Green)
To use the 505-2400 UniversalSonic instrument with the HART Communicator (handheld device), set the Span switches equal to zero and place S4-4 to the Right position.

Using the HART Communicator to configure and calibrate the UniversalSonic instrument requires that both the switches (analog mode) and software communication parameters (HART® mode) be set.

5.1 Analog Switch Settings

The following paragraphs define the switch settings (analog mode) for the UniversalSonic when communicating via the HART® Communicator. The following items are configured using the analog switches:

- repetition rate
- near zone fault
- lost echo fault
- high discrimination mode
- gain setting

5.1.1 Repetition Rate

Rotary Switch S1  Repetition Rate

An application might require a longer repetition rate depending on the type of vessel and material being measured. For instance:

- Increasing the repetition rate to 400 ms is required any time that the tank roof is curved. A longer repetition rate ensures that transmitter is not affected by reflected sound waves from the curved roof.

- A lengthened repetition rate also helps reduce loss of echo due to foam.

If your application is similar to one described above, change the repetition rate using a small screwdriver and switch S1. Table 5-1 details the switch settings.

Table 5-1
Switch (S1) Settings
Repetition Rate

<table>
<thead>
<tr>
<th>Switch S1 Position</th>
<th>Repetition (Pulse) Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>250 msec</td>
</tr>
<tr>
<td>3</td>
<td>400 msec</td>
</tr>
</tbody>
</table>
5.1.2 Near Zone Fault

—Slide Switch S2 controls:
• near zone fault output (S2-2)
• lost echo fault output (S2-3)

—Near Zone Fault Output
Slide switch S2-2 determines the output current of a near zone fault condition.

• When S2-2 is switched to the left, the unit will output 22 mA during a near zone condition.

• When S2-2 is in switched to the right, the unit will output 3.7 mA during a near zone condition.

See Table 5-2 for application information when setting near zone and lost echo switches.

Table 5-2
Application Notes for Near Zone and Lost Echo Settings

<table>
<thead>
<tr>
<th>Application requires Overfill Prevention (no spills)</th>
<th>Application requires Low Level Prevention (pump will not run dry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near Zone typically set 22 mA</td>
<td>Near Zone typically set 22 mA</td>
</tr>
<tr>
<td>Lost Echo typically set 22 mA</td>
<td>Lost Echo typically set 3.7 mA</td>
</tr>
<tr>
<td>Material cannot go over high point</td>
<td>Material cannot go below low point</td>
</tr>
</tbody>
</table>

Near Zone High (22 mA)  Near Zone Low (3.7 mA)
5.1.3 Lost Echo Fault

—Slide Switch S2-3 Lost Echo Fault Output
Slide switch S2-3 determines the output current of a lost echo fault condition.

• When S2-3 is switched to the left, the transmitter will produce 22 mA output during a lost echo condition.

• When S2-3 is switched to the right, the transmitter will produce 3.7 mA output during a lost echo condition.

See Table 5-2 for application information when setting near zone and lost echo switches.

5.1.4 High Discrimination Mode

—Rotary Switch S3 controls:
  • high discrimination mode
  • gain adjustment settings

—High Discrimination
Position zero on rotary switch S3 activates the high discrimination mode.

• High discrimination mode automatically reduces the effect of nuisance echos created when mounting the transducer in a nozzle or mounting the transducer inside a pipe up to 14 inches above the tank opening.

• The high discrimination mode reduces any effect from agitator blades and/or small obstructions. It also reduces interference caused by electrical noise.

• The high discrimination mode should not be used in applications where foam is present.
5.1.5 Gain Adjustment

—Rotary Switch S3  Gain Adjustment

The step gain positions can be used to decrease the ultrasonic return signal and avoid noise interference.

For example, the power produced to shoot the 30-foot signal could possibly cause nuisance reflections from irregular sidewalls, tank obstructions, or agitator blades. By reducing the gain of the transmitter using the step gain switch positions, the effect of nuisance reflections can be eliminated.

See Table 5-3 for gain settings using rotary switch S3.

<table>
<thead>
<tr>
<th>Switch S3 Position</th>
<th>Mode/Gain Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>high discrimination</td>
</tr>
<tr>
<td></td>
<td>(automatic gain control)</td>
</tr>
<tr>
<td>1</td>
<td>100% gain</td>
</tr>
<tr>
<td>2</td>
<td>84% gain</td>
</tr>
<tr>
<td>3</td>
<td>67% gain</td>
</tr>
<tr>
<td>4</td>
<td>50% gain</td>
</tr>
<tr>
<td>5</td>
<td>32% gain</td>
</tr>
<tr>
<td>6</td>
<td>17% gain</td>
</tr>
<tr>
<td>7</td>
<td>8% gain</td>
</tr>
<tr>
<td>8-9</td>
<td>not used</td>
</tr>
<tr>
<td>A-F</td>
<td>not used</td>
</tr>
</tbody>
</table>

5.2 Configuration with the HART® Communicator

After setting the switches, configuration of the UniversalSonic instrument is completed using the HART® Communicator. The following configuration items are entered using the HART® Communicator:

- Tag ID
- PV Units (engineering units)
- Range Values (LRV and URV)
- PV Damp (damping time)
- Low Point Cal
- D/A Trim

The following pages show the menu field hierarchies for MAIN ONLINE, DIAGNOSTICS/SERVICE, BASIC SETUP, and DETAILED SETUP menus.
MAIN ONLINE

1. Device Setup
2. PV
3. PV AO
4. PV LRV
5. PV URV

1. Process Variables
2. Diagnostics/Service
3. Basic Setup
4. Detailed Setup
5. Review

1. Snsr
2. AI % rnge
3. A01

Diagnostics/Service

1. Test Device
2. Loop Test
3. Calibration
4. D/A Trim

1. Self test
2. Performing Self test
1. Apply Values
2. Enter Values
1. PV LRV
2. PV URV
3. PV USL
4. PV LSL

1. 4 mA
2. 20 mA
1. Low Point Cal
2. High Point Cal
3. Exit

Review transmitter setup

Trim 4 mA Point
Trim 20 mA Point
2 BASIC SETUP

1. Tag → Change Transmitter Tag
2. PV Unit → Change PV Units
3. Range Values → Change PV LRV
4. Device Information → Change PV URV
5. PV Transfer Function → View
6. PV Damp → View

View Transmitter Distributor
1. PV LRV
2. PV URV
3. PV LSL
4. PV USL

View Transmitter Model
1. PV LRV
2. PV URV
3. PV LSL
4. PV USL

View Transmitter Serial #
1. Tag
2. Date
3. Write Protect
4. Descriptor
5. Message
6. PV Sensor S/N

Change Transmitter Tag
Change Date
View Write Protect On/Off
Change Descriptor
Change Message
View Transmitter Serial #

View Transmitter Distributor
View Transmitter Model
View Transmitter Serial #

Final Assembly Num
Revision #’s → View Transmitter Serial #
1. Universal Rev
2. FLD DEV REV
3. Software Rev

View
3 DETAILED SETUP

1. Sensors  ➔  1. PV ➔  View PV
2. Signal Condition ➔ 2. PV Sensor Unit ➔  Change PV Units
4. Device Information ➔ 4. USL, LSL, Minimum span

  ➔ 1. Sensor Damp ➔ Change PV Damp Time
  ➔ 2. AI URV ➔ Change PV LRV and URV
  ➔ 3. AI LRV ➔ Change PV LRV and URV
  ➔ 4. XFR FUNCTION ➔ View Transfer Function
  ➔ 5. AI % RNGE ➔ View PV % Range

1. Analog Output ➔ 1. AO1 ➔ View Analog Output
2. Hart Output ➔ 2. AO Alarm Type ➔ View AO Alarm
3. Loop Test ➔ 3. See ①
4. D/A Trim ➔ 4. See ①
5. Scaled D/A Trim ➔ Similar to D/A Trim but can be scaled for any pair of currents

  ➔ 1. Poll Addr ➔ Change Transmitter Polling Address
  ➔ 2. Num req preams ➔ View # of Request Preambles
  ➔ 3. Burst Mode ➔ Turn On/Off Burst Mode
  ➔ 4. Burst Option ➔ Select Burst Option

Same as in ②
5.2.1 Tag ID

To name or identify the transmitter, use the 8-character Tag ID. The Tag ID is entered or changed in the following menu.

a) select the ONLINE MAIN menu
b) ⇒ 1 DEVICE SETUP ⇒ ↓ ↓
c) ⇒ 3 BASIC SETUP ⇒
d) ⇒ 1 TAG ⇒
e) change (use alphanumeric keys) Tag ID
f) F4 ENTER
g) F2 SEND
h) F4 OK
i) F4 OK

5.2.2 PV Units

Enter the engineering units using the following menu.

a) select the ONLINE MAIN menu
b) ⇒ 1 DEVICE SETUP ⇒ ↓ ↓
c) ⇒ 3 BASIC SETUP ⇒
d) ⇒ 2 PV UNIT ⇒
e) select engineering units
f) F4 ENTER
g) F2 SEND
h) F4 OK
i) F4 OK

5.2.3 LRV and URV

Enter the range values for LRV and URV using the following menu.

a) select the ONLINE MAIN menu
b) ⇒ 1 DEVICE SETUP ⇒ ↓ ↓
c) ⇒ 3 BASIC SETUP ⇒
d) ⇒ 3 RANGE VALUES ⇒
e) ⇒ 1 PV LRV ⇒ or ⇒ 2 PV URV ⇒
f) enter value that corresponds to 4 mA or 20 mA
g) F4 ENTER
h) F2 SEND
i) F4 OK
j) F4 OK
5.2.3 LRV and URV (cont.)

NOTE

When using the handheld communicator, the LRV and URV settings determine level and distance modes. Level and distance modes are explained in section 1.4.

![Diagram showing LRV and URV settings for level and distance modes.]

NOTE

The maximum level is preset to 30 feet (505-2400) or 99.9 inches (505-2100). When using the handheld communicator for calibration, the LRV and distance to be measured must equal the maximum level.

For example:
5.2.4 Damping Time  

Enter a damping time from 0 to 90.

a) select the ONLINE MAIN menu  
b) ⇒1 DEVICE SETUP ⇒ ↓↓  
c) ⇒3 BASIC SETUP ⇒  
d) ⇒6 PV DAMP ⇒  
e) enter or change PV damping time  
f) F4 ENTER  
g) F2 SEND  
h) F4 OK  
i) F4 OK

5.2.5 Low Point Cal  

Apply a low point cal value by moving the level in the vessel.

a) select the ONLINE MAIN menu  
b) ⇒1 DEVICE SETUP ⇒ ↓↓  
c) ⇒2 DIAGNOSTICS/SERVICE ⇒  
d) ⇒3 CALIBRATION ⇒  
  ⇒1 APPLY VALUES ⇒  
  ⇒14 mA ⇒  
e) enter Low Point Cal value  
f) F4 ENTER  
g) F2 SEND  
h) F4 OK  
i) F4 OK

5.2.6 D/A Trim  

Trim output using DAC reference meter.

a) select the ONLINE MAIN menu  
b) ⇒1 DEVICE SETUP ⇒ ↓↓  
c) ⇒2 DIAGNOSTICS/SERVICE ⇒  
d) ⇒4 D/A TRIM ⇒  
e) ⇒TRIM 4 mA POINT  
f) enter 4 mA trim value  
g) ⇒TRIM 20 mA POINT  
h) enter 20 mA trim value  
h) F4 ENTER  
g) F2 SEND  
h) F4 OK  
i) F4 OK

Configuration and calibration is complete.
SECTION 6
TROUBLESHOOTING

The 505-2400 UniversalSonic instrument is designed to give years of unattended service. No periodic or scheduled maintenance is required.

6.1 Troubleshooting Procedures

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

a. Ensure wiring connections are correct.

b. If the liquid surface has severe turbulence in the area where the ultrasonic beam hits, consider increasing damping time.

c. Splashing of material or condensation on the transducer face could cause unreliable measurements.

d. Any continuous ultrasonic transmitter signal/echo can be adversely affected by significant foam on the liquid level surface. If this condition exists, please consult the factory for further application review and advice.

e. Ensure that the transducer face is not recessed into a mounting nozzle, unless high discrimination setting is used. Spurious reflections from the nozzle can cause faulty operation.

f. To indicate a fault condition, the 4-20 signal locks to 22 mA. If output is locked at 22 mA, check that:
   1) the level of the material has not violated the near zone (12 inches [30 cm]) from the transducer face.
   2) the low calibration setting is not more than 360 inches (610 cm) or 99.9 inches (405-2100 unit).

g. Test for 4 mA and 20 mA.
   S2-1 left \{ forces \} \quad S2-1 left \{ forces \}
   S2-2 right 4 mA. \quad S2-2 left 20 mA.
   S2-3 right \quad S2-3 right
   S2-4 right \quad S2-4 right

h. 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.
6.2 Field Calibration

Slide switch S2-4 runs a field calibration program that allows the calibration to be optimized.

**CAUTION**
The field calibration procedure permanently overwrites the factory calibration.

1. Write down the current zero calibration switch settings.

2. Measure the distance from the transducer face to the tank level.

3. Using a screwdriver, enter this number (step 2) on the three zero calibration switches.

4. Place S2-4 to the right, S2-1 to the right, and rotary switch S1 to zero.

5. Connect instrument to a milliamp meter and observe the 4-20 mA loop current. A 10 mA current indicates field calibration.

6. Press and release the red ACQUIRE button.

7. Observe current.
   • If meter displays 16 mA, unit is operating normally.
   • If meter displays 18 mA, Lost Echo fault exists.
   • If meter displays 14 mA, Near Zone fault exists.
   • If meter displays 12 mA, calibration is incorrect (greater than 25% error).

8. Place the zero calibration switches, S2-1 and S2-4 to the operation mode.

6.3 Checking the Transducer

An ohmmeter test is used to check the transducer crystal. It can also be used to verify that the wires from the transducer to the sensor (on a remote system) are not reversed, shorted, or open.

Using a digital ohmmeter, a reading of 9-13K ohms should be present between CW to SHIELD.

6.4 Checking the Temperature Sensor

—*Resistance Check*

a. Disconnect the temperature transducer wires (brown and orange) leading to the transducer.
6.4 Checking the Temperature Sensor (cont.)

b. Using a digital ohmmeter, a good transducer measures 12 to 35 megohms with the positive test lead on the orange lead and the negative test lead on the brown lead (standard sensor). The negative test lead attaches to the brown and white striped wire on the high temperature sensor (703-6-1).

c. Reverse the meter leads and an open circuit (infinite ohms) should be observed.

6.5 Troubleshooting the Loop Connection

Specific transmitter loop connections vary with each installation, but in generally are connected in a similar manner to the typical transmitter loop in Figure 4-1. When troubleshooting the loop connection, verify the following items.

• Loop devices are wired in series.

• There is at least 250 ohms total loop resistance.

• There is at least 19 Vdc available for the transmitter when a loop current of 4 mA is flowing.

Refer to Figure 6-1.
6.5 Troubleshooting the Loop Connection (cont.)

Start
Modem does not communicate with transmitter.

Is the loop current between 3.7 and 22 mA?

Is there a minimum of 250 ohms loop resistance?

Are you connected to a DCS?

Are you using the Drexelbrook supplied Viator model 1000A modem?

Check:
1. Check Power Supply and loop source resistance (the 250 ohms may be built in as with the Drexelbrook 401-500 series or most DCS inputs).
2. If not there add enough resistance for loop to be at least 250 ohms.

Check:
1. Is the correct Com port selected at startup?
2. Is there any software running that would re-direct the Com Port such as mouse drivers, terminal emulation software, or TSR’s. (This can be tested by booting from the Drexelbrook Calibration software in the A: drive)
3. Possible bad RS-232 cable or defective modem.
4. Check modem connections to the loop per the loop drawing in Figure 6-1.

Make it stop polling or power transmitter from a separate source - then re-check operation.

Check:
1. If loop current is 0 mA, check polarity of loop at transmitter. If it is OK, check for open loop.
2. If loop current is between 0 and 3 mA transmitter is likely bad.
3. Check voltage at transmitter it should be at least 19 volts when 4 mA is flowing in the loop.

Figure 6-1
Troubleshooting the Loop
6.6 Telephone Assistance

If you have questions about your Drexelbrook equipment:
• 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 1-215-443-5117.

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 __________
____________________________________________
____________________________________________

6.7 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 transducer has been exposed to must accompany any repair.
• It is your responsibility to fully disclose all chemicals and decontaminate the sensing element.
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:
AMETEK Drexelbrook
205 Keith Valley Road
Horsham, PA 19044
COD shipments will not be accepted.

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.
SECTION 7
SPECIFICATIONS

7.1 Transmitter Specifications

—Power Requirement
Load resistance =
\[
\frac{(V_{\text{supply}} - 12.0)}{0.02}
\]
Minimum supply voltage is 19 volts at 4mA.
For example,
\[V_{\text{supply}} = 24V\] and maximum load resistance = 600 ohms.

—Operating Temperature
-40°F to 185°F (-40°C to 85°C) (Electronics)

—Ambient Temperature Effect
±0.1% per 1°F

—Repeatability
0.1 inch (3mm)

—Resolution
0.125 inch (3mm)

—Response Time
2 seconds (approximate)

—Calibration
Zero and Span: to nearest 1 inch (1 cm)
(standard electronic unit)
to nearest 0.1 inch
(high resolution unit)
Near Zone: 12 inches (0.3 meter)
Minimum Span: 3 inches (7.62 cm)
Maximum Span: 30 feet (9 meters) (405-2400 unit)
99.9 inches (2.5 meters) (405-2100 unit)

—Output
2-Wire Signal Loop: 4-20 mA DC (isolated)

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

—Temperature Compensation
Automatic (separate temperature sensor is available)
### 7.1 Transmitter Specifications (cont.)

--- **Damping**
- 0.15, or 45 seconds (switch mode)
- 0-90 seconds (HART mode)

--- **Lost Echo**
- 22 mA or 3.7 mA field selectable

--- **Near Zone**
- 22 mA or 3.7 mA field selectable

--- **Pulse Repetition Rate**
- 250 or 400 msec (field-selectable)

--- **Fail Safe**
- 22 mA

--- **Approvals**
- FM, CSA, and CE Mark for Explosionproof installations in indoor and outdoor hazardous locations in Class 1, Groups A,B,C,D; Groups E, F, and G; Class III using Enclosure type 1,4,4X,12, and 13.

### 7.2 Transducer Specifications

--- **Sensor**
- Material: CPVC, 316 SS, PFA, PFA Sealtyte
- Pressure: -10 to 50 PSI

--- **Operating Temperature**
- -40°F to 160°F (CPVC Sensor)
- -40°F to 200°F (PFA Sensor)

--- **Enclosure**
- Explosionproof Housing

--- **Beam Angle**
- Conical, 12° typical, 3db down
The following pages give examples of various ultrasonic installations. These installation guidelines are useful for optimal performance of the 505-2400 UniversalSonic system.

When there are no obstructions within the beam area, there is no chance of false echoes or readings.

Smooth wall in beam with no other obstructions will not cause false echoes.

Protrusions from the wall at an angle less than 45 degrees does not cause false echoes.

Protrusion from the wall at an angle greater than 45 degrees may cause false echoes.
When mounted in the center of domed roof tanks, reflected echoes can be redirected back to the transducer. Use 240 mSec. pulse repeat rate to allow these echoes to subside before transmitting the next pulse and/or move the transducer to another location.

When mounted off center in conical bottom tanks, reflected echoes can be redirected back to the transducer. Use 240mSec. pulse repeat rate to allow these echoes to subside before transmitting the next pulse and/or move the transducer to another location.

When mounted off center in conical bottom tanks, reflected echoes can reflect away from the transducer in the conical bottom resulting in a lost echo. Move the transducer to the center of the bin for best results.
Automapping using High Discrimination Setting

This technology allows the system to ignore many objects in the beam which cause false reading with other units.

Mounted close to a wall or obstructions are present. Ability to ignore obstructions will depend on the exact size and location of the obstructions.

Agitators within the beam path

20 feet maximum range in 2”-3” pipe. 30 feet maximum range in 4” pipe.

Still Well Installation
If multiple pipe sections are used, a smooth transition between sections is required.

Recommended mounting when recessed in a nozzle.

12-inch maximum

Optional remote temperature sensor (703-6-1) recommended for best temperature compensation.

Acceptable Pipe joints

Unacceptable gap greater than 0.125"

High Discrimination Setting

2” diameter or larger nozzle

10 feet maximum Use standard electronics with high discrimination setting.
EXPLOSIONPROOF INSTALLATION

705 SERIES SENSOR

CONDUIT SEALS

SENSOR CONNECTIONS

CONDUIT

CONDUIT SEAL

SEE NOTE 2

CONDUIT SEAL

CONDUIT

CONDUIT SEAL

OPTIONAL 705 SERIES SENSOR WITH INTEGRAL ELECTRONICS

APPROVED TRANSMITTERS

405-1abc-de-1-0

a = 1, 3 TRANSMITTER OPTIONS
b = 0, 1, 3, SUPPLY VOLTAGE
c = 0, 1, 2, 3 HIGH DISCRIMINATION, ADJ. GAIN
d = 0, 1, FAIL SAFE
e = 4, 6, 8, 9, HOUSING WHEN 4 = 4, OR 6, 285-1-98 OR 285-1-158 ENCLOSURE REQUIRED FOR SENSOR.
f = 2, 3, 4, RELAY DRIVES

APPROVED SENSORS

705-0a00-b0c-0d

a = 2, CONTINUOUS SENSOR RANGE
b = 0, 3, CONSTRUCTION TYPE STANDARD/SEAL TYPE TYPE
c = 1, 2, 6, STAINLESS STEEL/CPVC/PFA MATERIAL
d = 5, 6, 7, POWER RANGES

NOTES:
1. REMOVE CABLE FITTING SUPPLIED. ALSO CONDUIT SEALS MUST BE WITHIN 2" (50 mm) OF TRANSMITTER HOUSING AND SENSOR HOUSING.

2. FOR RELAY DRIVER CONNECTIONS (OPTIONAL)
   SEE 401-0600-024-CD. 401-0600-028-2-CD. THESE WIRES ARE ALSO IN CONDUIT.

CLASS I, II, III, DIVISION 1 GROUPS A, B, C, D, E, F, G

AMETEK DREXELBROOK

CSA/FM CONTROL DRAWING FOR 405-1100, 1300 ULTRASONIC CONTINUOUS TRANSMITTER

AMETEK DREXELBROOK

205 RITH VALLEY RD

HERSHORNE, PA 19044-9908

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APP'D DATE

OK.

215-674-1224

FAX 215-674-2731

420-0004-025-CD

1 of 2

27-52
EXPLOSIONPROOF INSTALLATION

4-00-214

705 SERIES SENSOR

SENSOR CONNECTIONS

LEVEL

LOCAL HART CONNECTIONS

TEMPERATURE

POWER CONNECTIONS

CONDUIT SEAL

CONDUIT

CONDUIT SEAL

OPTIONAL 705 SERIES SENSOR WITH INTEGRAL ELECTRONICS

APPROVED TRANSMITTERS

405-2a00-10e

a = 1, 4 TRANSMITTER OPTIONS

e = 4, 8, 9, E, F, HOUSING

WHEN a = 4, 6, 285-0001-098 OR 285-0001-158 ENCLOSURE REQUIRED FOR SENSOR.

f = FM/CSA APPROVED

NOTES:
1. REMOVE CABLE FITTING SUPPLIED. ALSO CONDUIT SEALS MUST BE WITHIN 2" (50mm) OF TRANSMITTER HOUSING AND SENSOR HOUSING.

APPROVED SENSORS

705-0a00-b0c-d0

a = 2 CONTINUOUS SENSOR RANGE

b = 0, 3, CONSTRUCTION TYPE STANDARD/SEAL-TYETM

c = 1, 2, 6, STAINLESS STEEL/CPVC/PFA MATERIAL

d = 5, 6, 7, POWER RANGES

CLASS I, II, III, DIVISION 1 GROUPS A, B, C, D, E, F, G

AMETEK
DREXELBROOK

CSA/FM CONTROL DRAWING FOR 405-2100, 2400
ULTRASONIC CONTINUOUS TRANSMITTER

505-2400 Series UniversalSonic Transmitter
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