

# **LPU-2428 & RST-4001 User Manual**

# Table of Contents

|                                                                      |            |
|----------------------------------------------------------------------|------------|
| <b>Introduction .....</b>                                            | <b>iii</b> |
| <b>Warranty and Warranty Restrictions .....</b>                      | <b>iv</b>  |
| <b>Chapter 1: Specifications and Options.....</b>                    | <b>1</b>   |
| Dimensions .....                                                     | 1          |
| Specifications .....                                                 | 2          |
| <b>Chapter 2: Installation and Removal Procedures and Notes.....</b> | <b>3</b>   |
| Tools Needed.....                                                    | 3          |
| Installation Notes .....                                             | 3          |
| Mounting Instructions .....                                          | 4          |
| Electrical Installation .....                                        | 4          |
| Software Installation.....                                           | 5          |
| Removal Instructions .....                                           | 5          |
| <b>Chapter 3: Maintenance .....</b>                                  | <b>5</b>   |
| General Care .....                                                   | 5          |
| Troubleshooting .....                                                | 6          |
| Calibration .....                                                    | 6-7        |
| Repair and Returns.....                                              | 7          |
| <b>Chapter 4: Programming and Parameter Configuration .....</b>      | <b>7</b>   |
| RST-4001 User Interface .....                                        | 7          |
| RST-4001 Menu Navigation .....                                       | 8-11       |
| Software User Interface.....                                         | 12         |
| Programming the LPU-2428 .....                                       | 13         |
| Basic Setup Menu (BASICSET) .....                                    | 14-15      |
| App. Setup Menu (APPLICAT).....                                      | 16-34      |
| 4-20 Setup Menu (4-20 SET).....                                      | 34-36      |
| Calibration (CALIBRAT) .....                                         | 36-37      |
| Advanced (ADVANCED) .....                                            | 37-39      |
| Utilities (UTILITIE).....                                            | 39-40      |
| Totalization (TOTALIZE).....                                         | 41         |
| <b>Chapter 5: Hazardous Location Drawing and Certification .....</b> | <b>42</b>  |
| Intrinsically Safe Wiring Diagram .....                              | 42         |
| Hazardous Location Wiring Diagram .....                              | 43         |
| CSA Certificate of Compliance .....                                  | 44-47      |

**i** IMPORTANT: The LPU-2428 software will only operate in a 32-bit Windows environment. It WILL NOT operate on a 64-bit Windows machine.

# Introduction

Thank you for purchasing an LPU-2428 ultrasonic sensor and RST-4001 programming module from APG. We appreciate your business! Please take a few minutes to familiarize yourself with your LPU-2428, RST-4001, and this manual.

The LPU-2428 loop-powered ultrasonic sensor provides a low-power, non-contact level measurement solution rated for hazardous locations and suitable for harsh chemical environments. The RST-4001 offers a two-line by eight-character LCD display and five-button keypad or USB connection for programming your sensor.

The default Application setting for the LPU-2428 is Distance, which will work in a wide variety of settings. The LPU-2428 has several additional Application settings that can be configured to meet your needs.

## Reading your label

Every APG instrument comes with a label that includes the instrument's model number, part number, serial number, and a wiring pinout table. Please ensure that the part number and pinout table on your label match your order. The following electrical ratings and approvals are also listed on the label. Please refer to the Certificate of Compliance at the back of this manual for further details.

## Electrical ratings



Input: 12 to 28 Volts DC; Output: 4-20mA

Class I Division 1; Groups C, D T3

Class I, Zone 0, Group IIB

AEx ia IIB T3 (USA): Ta: -40°C to 60°C; IP65

Ex ia IIB T3 (Canada): Ta: -40°C to 60°C; IP65

$V_{max} U_i = 28VDC$ ,  $I_{max} I_i = 130mA$ ,  $P_{max} P_i = 0.91W$ ,  $C_i = 0nF$ ,  $L_i = 110\mu H$

Install in accordance with drawing 9002747 (page 42).



Input: 12 to 28 Volts DC; Output: 4-20mA

Class I Division 2; Groups C, D T6

Class I, Zone 2, Group IIB

AEx nA IIB T6: Ta: -40°C to 60°C; IP65

Ex nA IIB T6: Ta: -40°C to +60°C; IP65

Install in accordance with drawing 9002745 (page 43).

**i** IMPORTANT: Your LPU-2428 MUST be installed according to drawing 9002747 as indicated above to meet Intrinsically Safe approvals. Faulty installation will invalidate all safety approvals and ratings.

# Warranty and Warranty Restrictions

APG warrants its products to be free from defects of material and workmanship and will, without charge, replace or repair any equipment found defective upon inspection at its factory, provided the equipment has been returned, transportation prepaid, within 24 months from date of shipment from factory.

THE FOREGOING WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES NOT EXPRESSLY SET FORTH HEREIN, WHETHER EXPRESSED OR IMPLIED BY OPERATION OF LAW OR OTHERWISE INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

No representation or warranty, express or implied, made by any sales representative, distributor, or other agent or representative of APG which is not specifically set forth herein shall be binding upon APG. APG shall not be liable for any incidental or consequential damages, losses or expenses directly or indirectly arising from the sale, handling, improper application or use of the goods or from any other cause relating thereto and APG's liability hereunder, in any case, is expressly limited to the repair or replacement (at APG's option) of goods.

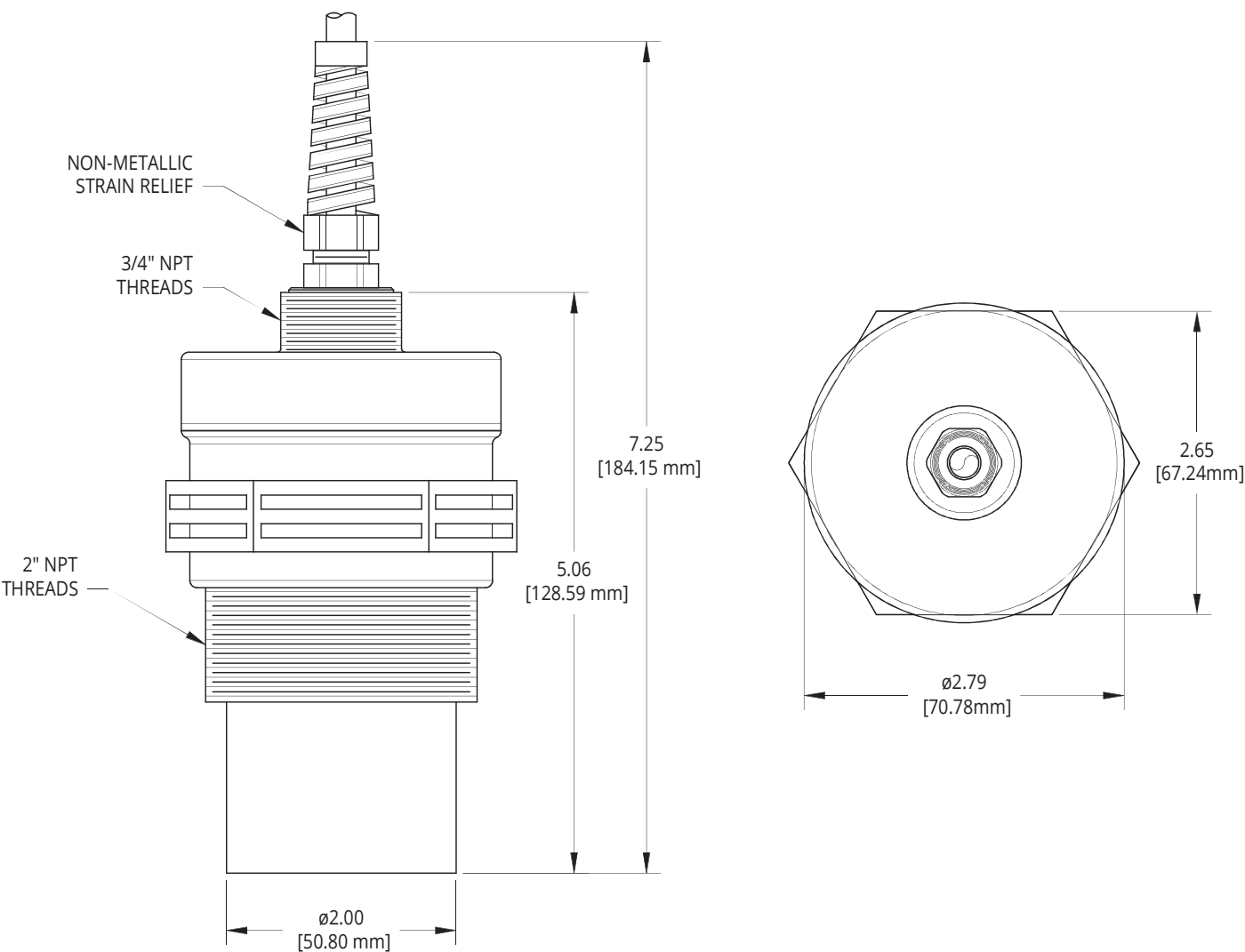
Warranty is specifically at the factory. Any on site service will be provided at the sole expense of the Purchaser at standard field service rates.

All associated equipment must be protected by properly rated electronic/electrical protection devices. APG shall not be liable for any damage due to improper engineering or installation by the Purchaser or third parties. Proper installation, operation and maintenance of the product becomes the responsibility of the user upon receipt of the product.

Returns and allowances must be authorized by APG in advance. APG will assign a Return Material Authorization (RMA) number which must appear on all related papers and the outside of the shipping carton. All returns are subject to the final review by APG. Returns are subject to restocking charges as determined by APG's "Credit Return Policy".

# Chapter 1: Specifications and Options

- Dimensions



## • Specifications

### Performance

|                        |                                                                                                      |
|------------------------|------------------------------------------------------------------------------------------------------|
| Operating Range        | 1 - 25 ft. (0.3 - 7.6 m) on liquids and hard, flat surfaces<br>1 - 10 ft. (0.3 - 3 m) on bulk solids |
| Analog Output (Sensor) | 4-20 mA                                                                                              |
| Analog Output (Module) | USB                                                                                                  |
| Beam Pattern           | 9° off axis                                                                                          |
| Frequency              | 69 kHz                                                                                               |
| Response Time          | 0.6 - 3 seconds (dependent on output range)                                                          |
| Sample Rate            | 3 seconds @ 4 mA<br>0.6 seconds @ 20 mA                                                              |

### Accuracy

|            |                          |
|------------|--------------------------|
| Accuracy   | ±0.25% of detected range |
| Resolution | 0.1 inch (2.54 mm)       |

### Environmental

|                                   |                            |
|-----------------------------------|----------------------------|
| Operating Temperature             | -40 to 60°C (-40 to 140°F) |
| Internal Temperature Compensation | Yes                        |
| Enclosure Protection              | IP65                       |
| NEMA rating (Sensor)              | 4X                         |

### Electrical

|                            |                                        |
|----------------------------|----------------------------------------|
| Supply Voltage (at sensor) | 12-28 VDC                              |
| Current Draw               | 22 mA max                              |
| Output Signal              | 3-30 mA max                            |
| Load Resistance            | 150Ω max @ 12 VDC<br>600Ω max @ 24 VDC |
| Cable Connection (Sensor)  | 2-wire cable included                  |
| Cable Connection (Module)  | 2-terminal Phoenix connector, USB      |

### Materials of Construction

|                        |               |
|------------------------|---------------|
| Transducer Housing     | PVDF (Kynar®) |
| Upper Housing (Sensor) | PC/PBT        |
| Housing (Module)       | ABS PA-756    |

## Chapter 2: Installation and Removal Procedures and Notes

### • Tools Needed

Tools are not necessary for installing the LPU itself. If you are using a stand pipe to mount your LPU, you will probably need tools to install the stand pipe, but not for the LPU.

### • Installation Notes

- Mount your LPU sensor so that it has a clear, perpendicular sound path to the surface being monitored. Your sensor should be mounted away from tank or vessel walls and inlets. See Figure 2.1.
- The sound path should be free from obstructions and as open as possible for the 9° off axis beam pattern.
- If you are using a stand pipe, please see our guide to stand pipes on our website:  
<http://www.apgsensors.com/about-us/blog/how-to-install-a-stand-pipe>.

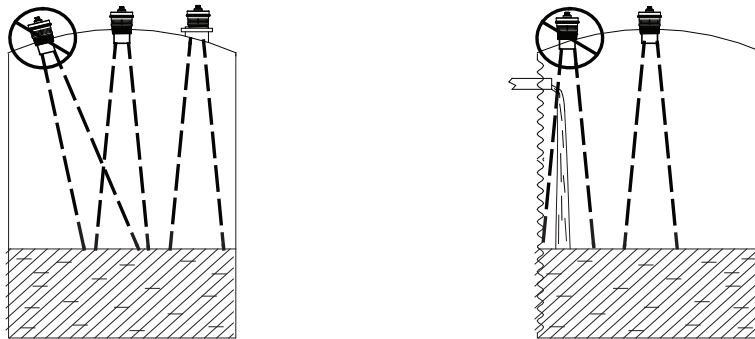


Figure 2.1

 **NOTE:** Do not mount the sensor where the beam will intersect objects such as fill streams, pipes, ladder rungs, wall seams, or corrugated tank walls.

## • Mounting Instructions

Mounting your LPU is easy if you follow a few simple steps:

- Never over-tighten the sensor.
- Always screw in your sensor by hand to avoid cross-threading. Thread failure can be a problem if you damage threads by over-tightening them or by crossing threads.

**i** IMPORTANT: Do not over tighten! The sensor should be threaded in only hand tight.

## • Electrical Installation

For normal operation, connect the provided cable to your control system:

- Connect the red wire to +24 VDC.
- Connect the black wire to 4-20 mA input. Circuit load resistance + input resistance must be greater than 150Ω. 249Ω is recommended for optimal signal transmission.
- Refer to drawing 9002747 (page 42) for Intrinsically Safe installation.
- Refer to drawing 9002745 (page 43) for hazardous location installation.

For programming:

- Connect (+) terminal of RST-4001 to +24 VDC supply of sensor (red wire).
- Connect (-) terminal of RST-4001 to 4-20 mA signal from sensor (black wire).
- Ensure that load resistor is between RST-4001 and control network or PLC, rather than between sensor and RST-4001. (See Figure 2.2)

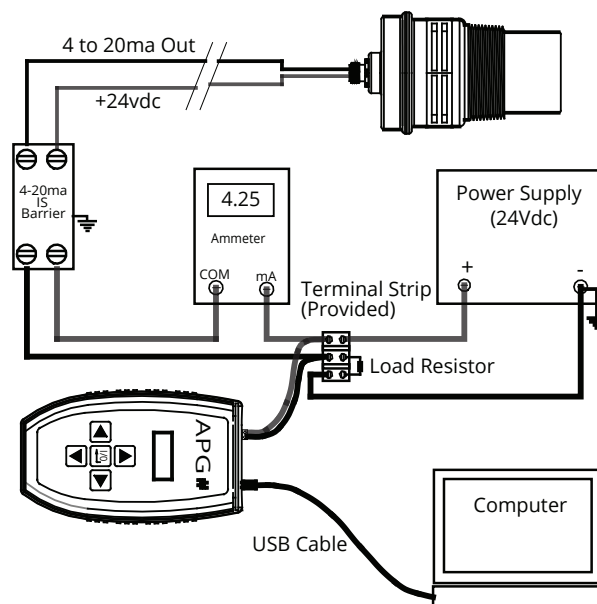


Figure 2.2



- **Software Installation**

- Download the software zip file from <http://apgsensors.com/support>.
- Open the zip file.
- Choose "Install" from the options at the top of the zip file window.
- The installation process will prompt you as needed to complete the installation.
- The software will create and run from a folder in your start menu titled "APG".

**i** IMPORTANT: The LPU-2428 software will only operate in a 32-bit Windows environment. It WILL NOT operate on a 64-bit Windows machine.

- **Removal Instructions**

- Ensure that power to the sensor is off.
- Disconnect the cable from the sensor.
- Remove the sensor and store it in a dry place, at a temperature between -40° F and 180° F.
- If the sensor was installed in a hazardous location, ensure that the cable will not be energized while the sensor is disconnected.

**⚠** DANGER: Do not disconnect equipment installed in hazardous locations unless power has been switched off or area is known to be non-hazardous.

## Chapter 3: Maintenance

- **General Care**

Your LPU-2428 ultrasonic sensor is very low maintenance and will need little care as long as it was installed correctly. However, in general, you should:

- Avoid applications for which the sensor was not designed, such as extreme temperatures, contact with incompatible corrosive chemicals and fumes, or other damaging environments.
- Inspect the threads whenever you remove the sensor from duty or change its location.

## • Trouble Shooting

Should you have problems with your LPU-2428, here are some troubleshooting steps.

- Check the received signal strength (just to left of the three Help buttons in the lower right corner. See Figure 4.32). If the signal strength is low, alternately increase Pulses and Sensitivity (Figure 4.30) until the signal strength improves.
- Ensure Temperature Compensation (Figure 4.30) is turned on.
- Set the Gain Control to AutoSense (Figure 4.30).
- Ensure that Blanking (Figure 4.30) is accurately set to account for any unwanted targets between the sensor and the closest acceptable target.
- Ensure that the LPU-2428 software is installed in a 32-bit Windows environment. Although the software will install in a 64-bit environment, it will not operate.

**i** **IMPORTANT:** The LPU-2428 software will only operate in a 32-bit Windows environment. It WILL NOT operate on a 64-bit Windows machine.

## • Calibration

This procedure uses targets at known distances to calibrate the sensor's accuracy. A wall or other large, flat object is recommended for the long range target.

- Point the sensor at a target at a known distance near the maximum range of the sensor, 25' for a single solid object (See Figure 3.1).
- Adjust the Multiplier value until the distance reading on the sensor matches the actual measured distance to the target (See Figure 4.29).
- Point the sensor at a target near the minimum measurement range, 1' plus any Blanking distance (See Figure 3.2).
- Adjust the Offset value until the distance reading on the sensor matches the actual measured distance to the target (See Figure 4.29).
- Repeat previous two steps until no further adjustment is required.

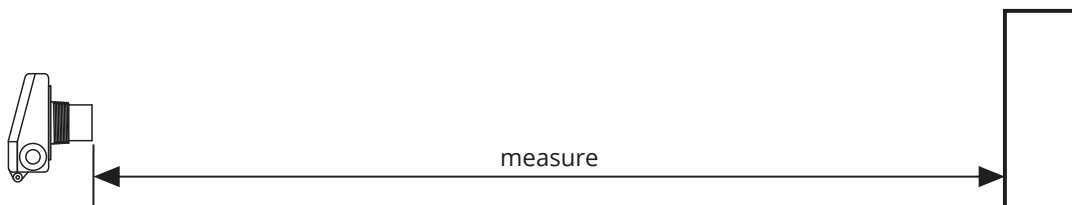


Figure 3.1

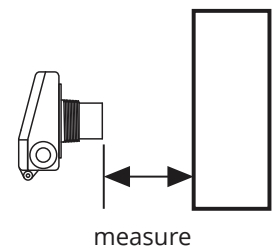


Figure 3.2

 **NOTE:** The Reset parameter in the Utilities Menu (Figure 4.31) will reset the LPU-2428 to factory default settings.

## • **Repair and Returns**

Should your LPU-2428 ultrasonic sensor require service, please contact the factory via phone, email, or online chat. We will issue you a Return Material Authorization (RMA) number with instructions.

- Phone: 888-525-7300
- Email: [sales@apgsensors.com](mailto:sales@apgsensors.com)
- Online chat at [www.apgsensors.com](http://www.apgsensors.com)

Please have your LPU-2428's part number and serial number available. See Warranty and Warranty Restrictions for more information.

# Chapter 4: Programming and Parameter Configuration

## • **RST-4001 User Interface**

The RST-4001 user interface is made up of a two-line by eight-character LCD screen and five buttons. (See Figure 4.1)

The LCD display shows the current measurement (Distance is the default Application setting). The display is also used to navigate menus, and view and edit parameters when programming. Menus appear on the top line in ALL CAPS. Parameters cycle on the bottom line with Initial Caps. Parameter values are shown on the top line, and are numeric values or ALL CAPS.

The LPU has five programming or navigation buttons, LEFT Arrow, RIGHT Arrow, UP Arrow, DOWN Arrow, and I/O (Enter). The arrow buttons allow the user to move through the menus in order to access and change parameters. Pressing the I/O button saves the displayed value of a parameter.



**Figure 4.1**

## • RST-4001 Menu Navigation

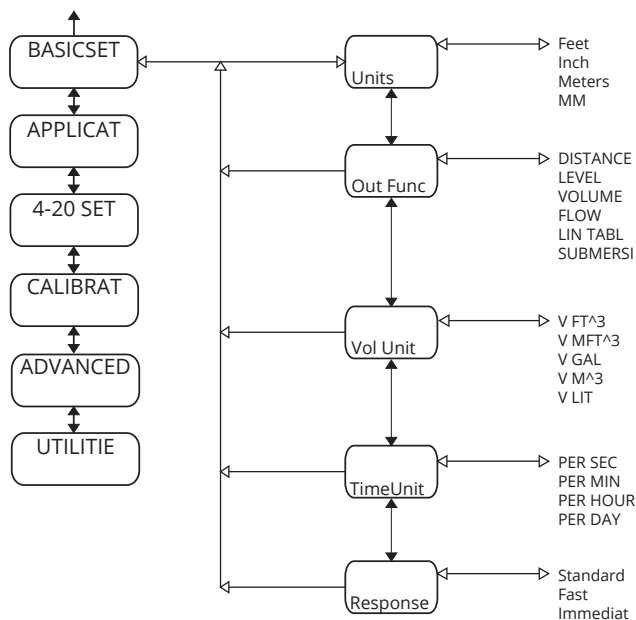
To select a menu, press the UP Arrow or DOWN Arrow button until the desired menu is displayed. Press the Right arrow to move into that menu. Then press the UP or DOWN Arrow button to move to the desired parameter.

To view or change a parameter value, press the RIGHT Arrow button. The display will show the name of this parameter on the lower line and the current value on the upper line of the display. To change the parameter's value, press the UP Arrow or DOWN Arrow button until the desired value is displayed.

To store or save the changed value, press the I/O button once. At this point, the parameter value has been saved to the LPU. The values are stored in nonvolatile memory, and will not be lost when power is turned off.

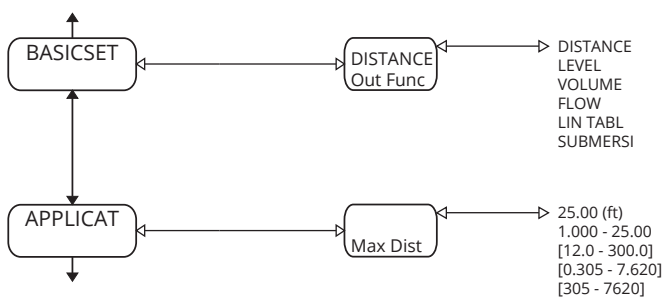
For a full explanation of each menu and parameter, see pages 13 - 41.

### Main Menus and BASICSET Menu

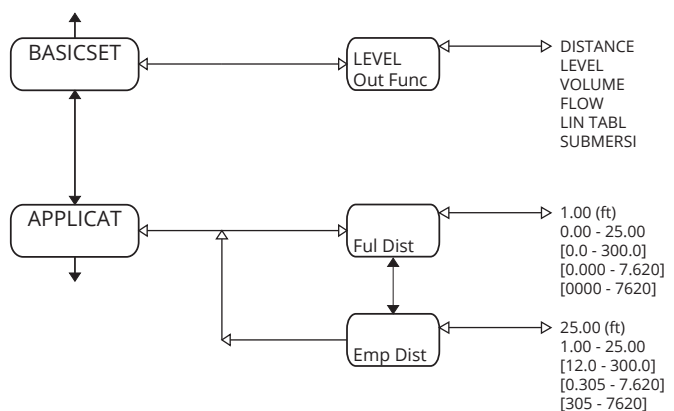


**NOTE:** Menu options change dynamically based on selected Out Func. See menu explanations on page 15.

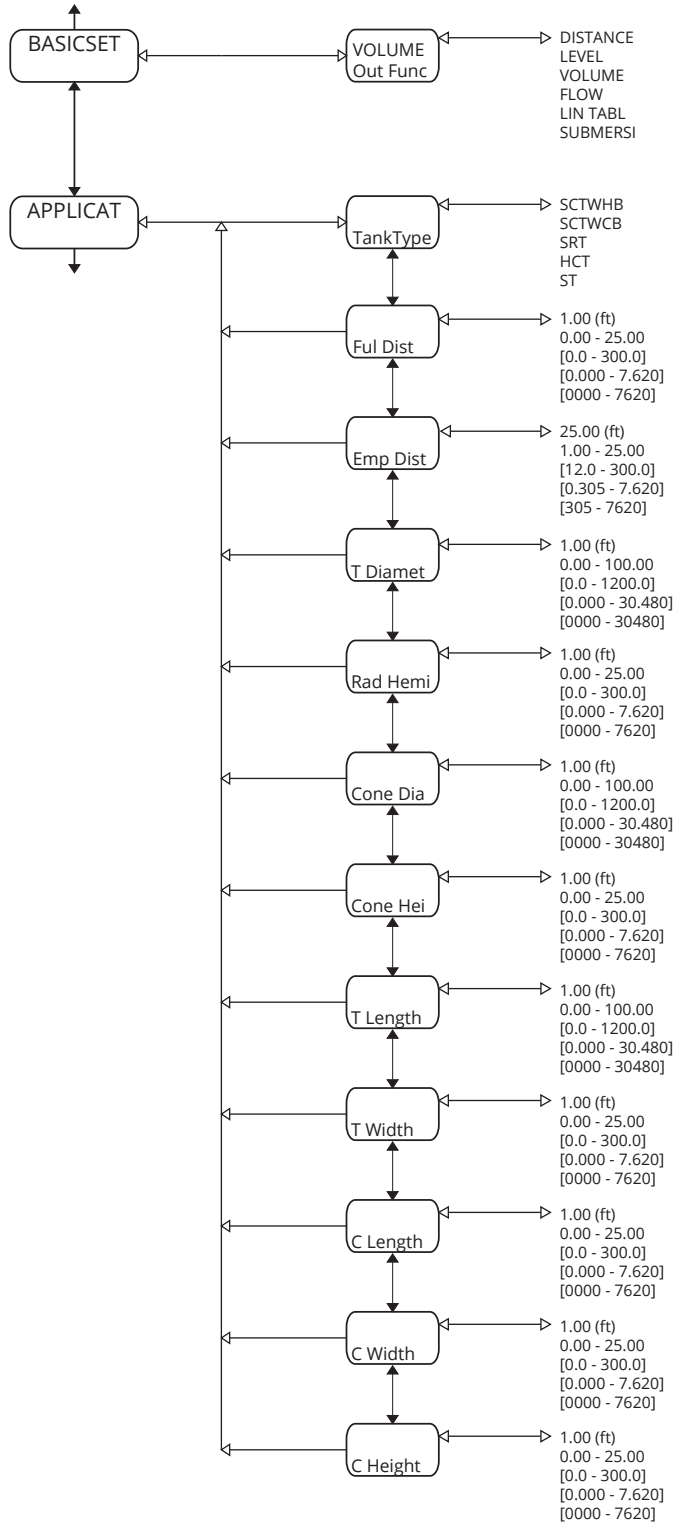
### Distance APPLICAT Menu



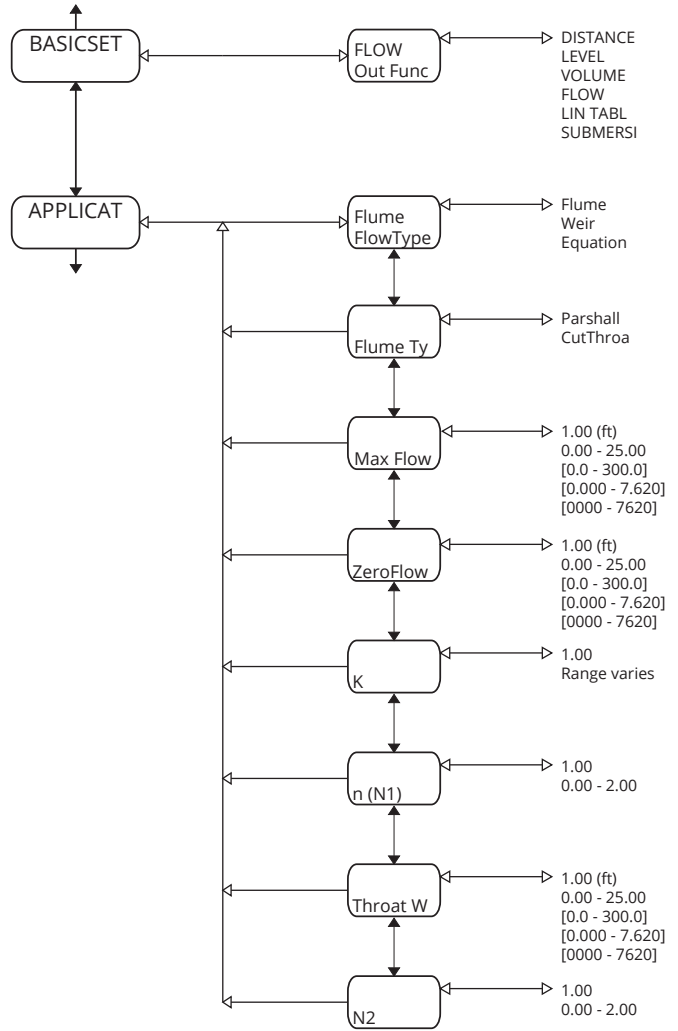
### Level APPLICAT Menu



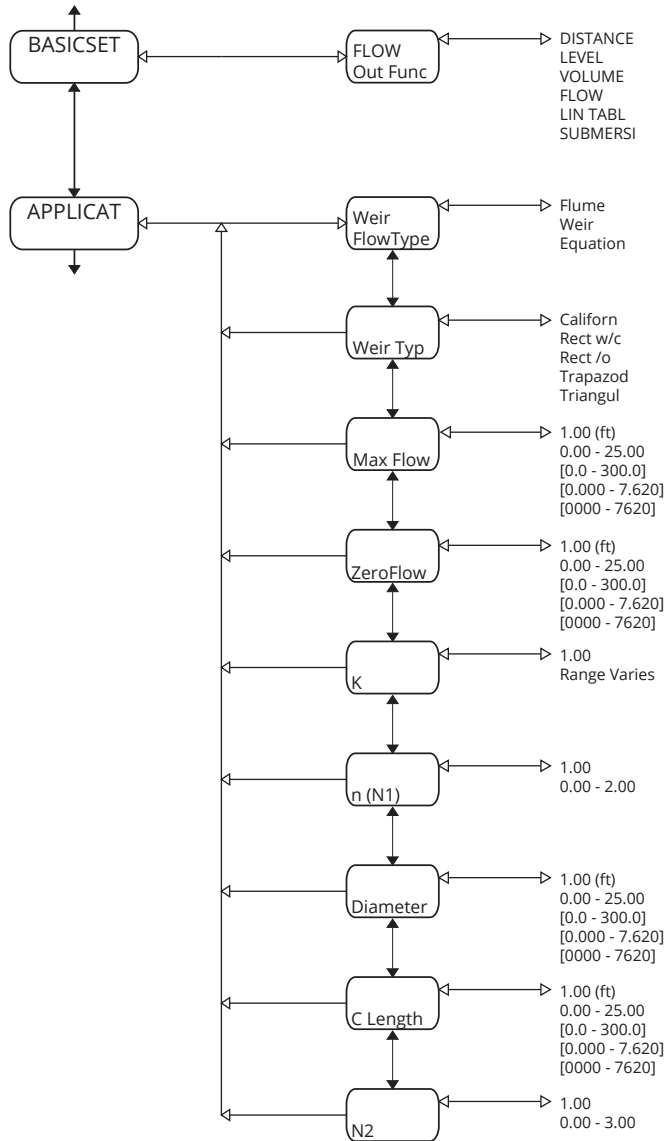
## Volume APPLICAT Menu



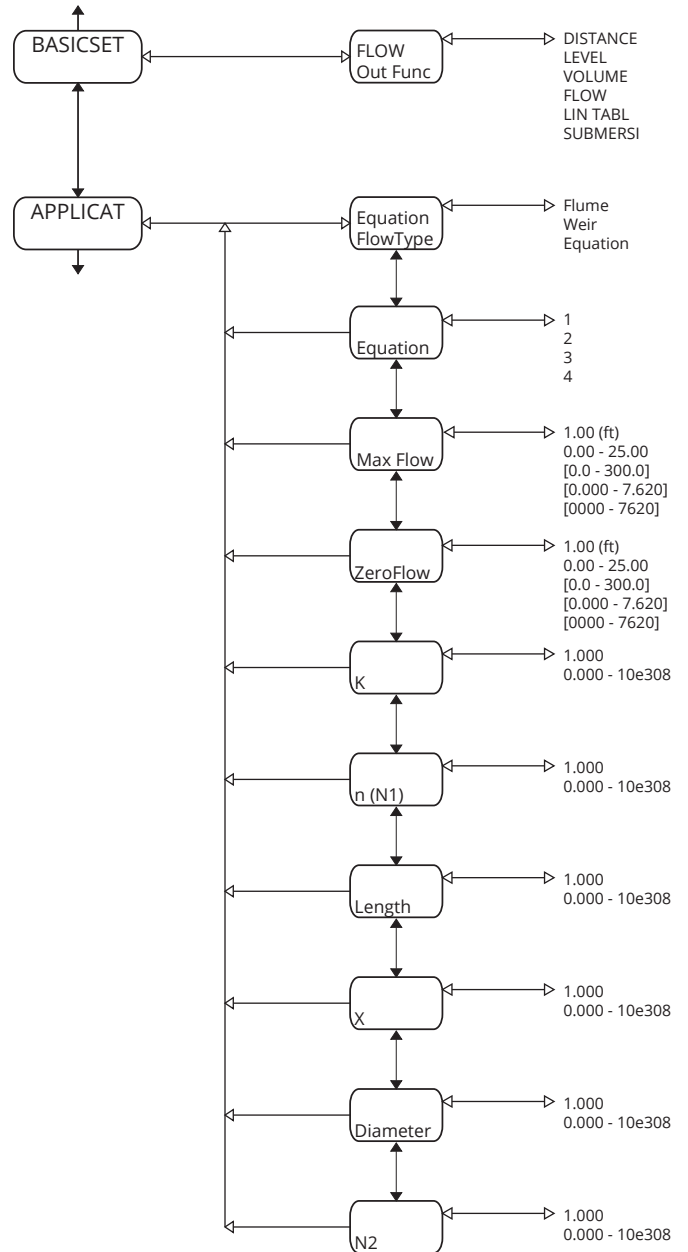
## Flow - Flume APPLICAT Menu



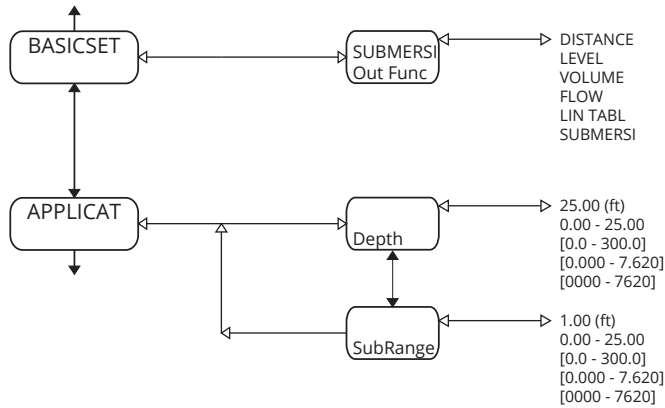
## Flow - Weir APPLICAT Menu



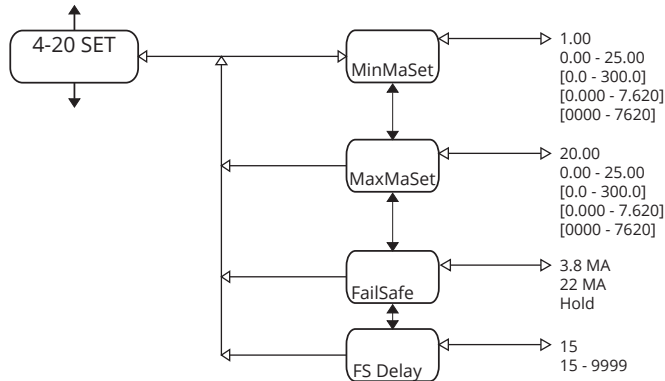
## Flow - Equation APPLICAT Menu



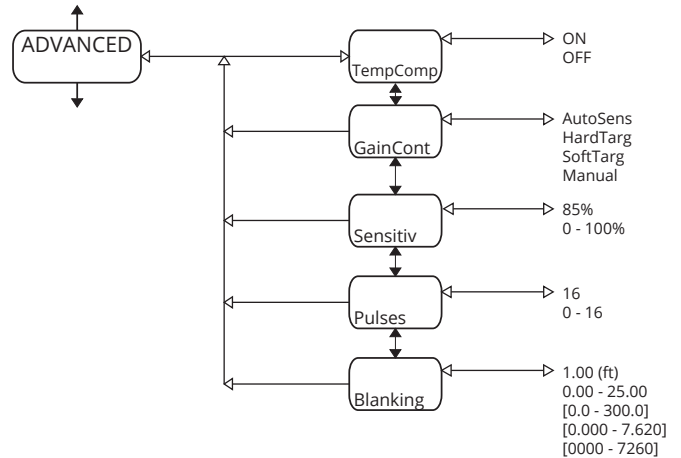
## Submersible APPLICAT Menu



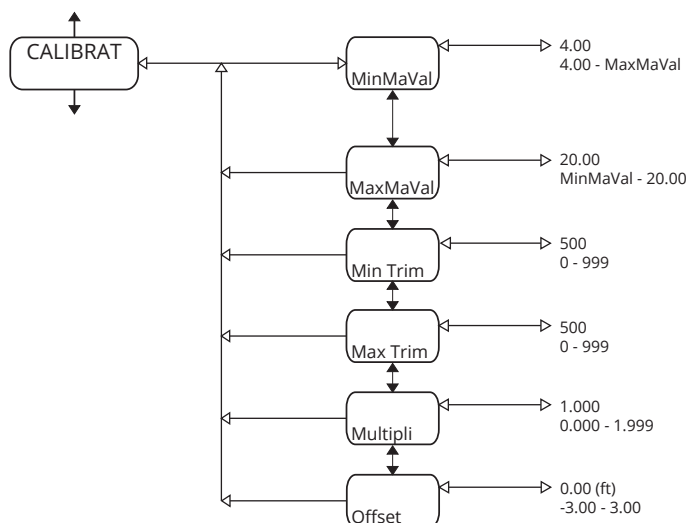
## 4-20 SET Menu



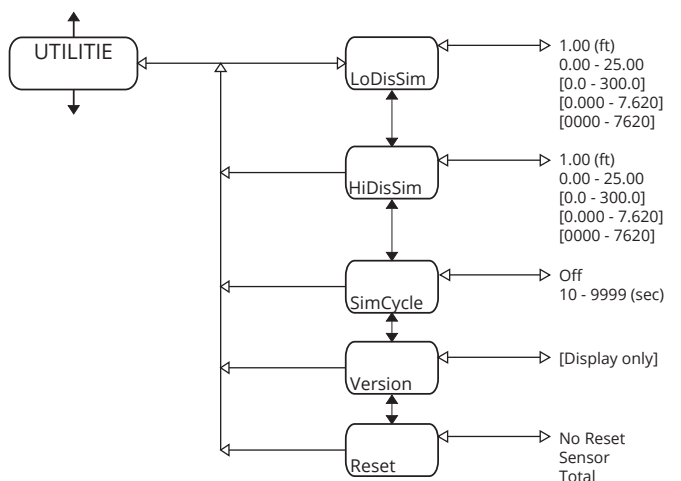
## ADVANCED Menu



## CALIBRAT Menu



## UTILITIE Menu



- **Software User Interface**

The LPU-2428 software user interface is one screen with five primary areas (See Figure 4.2). In the upper left are seven Menu Buttons. These buttons control the information viewed in the Display Area. Below the Menu Buttons and Display Area are six Status Boxes in two columns. Under the right hand column of Status Boxes are three Control Buttons. Three Help Buttons are located in the lower right hand corner of the screen.

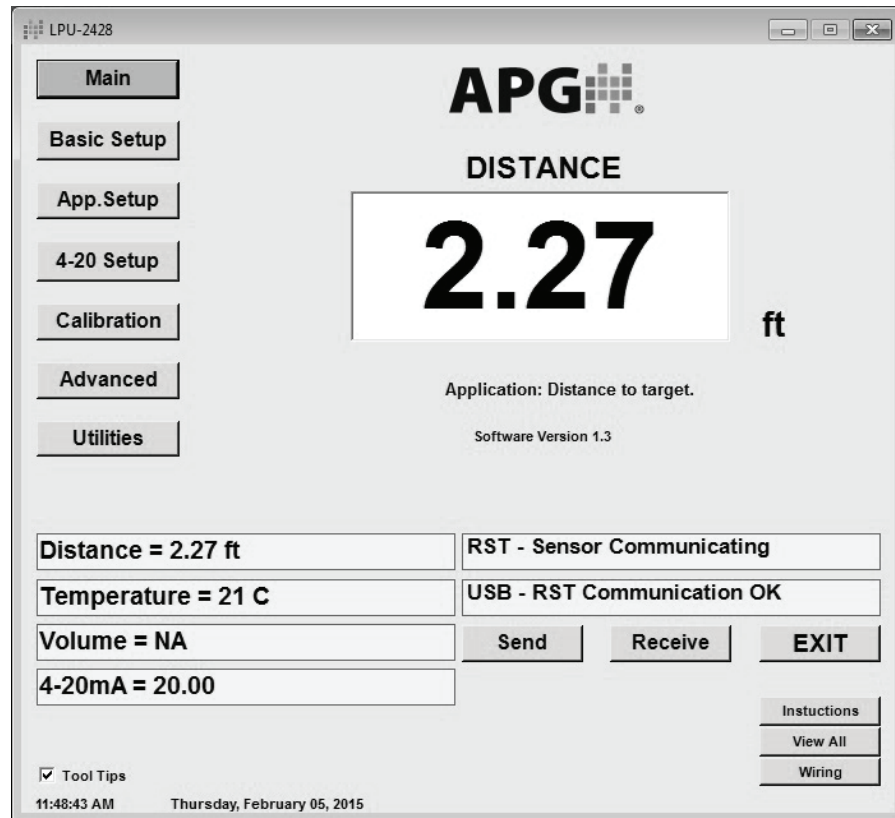


Figure 4.2

The two Status Boxes in the right column show the status of communication between the RST-4001 and the sensor, and between the LPU-2429 software and the RST-4001 (See Figure 4.3).

If an error is indicated, then check for proper connections. Allow a moment for the communication to be established while watching the status box to indicate “Sensor Communicating”. If this fails to establish communication, plug the USB cable into another USB port on the computer. After communication is established, click on the “Receive” button to load the sensor settings into the software.

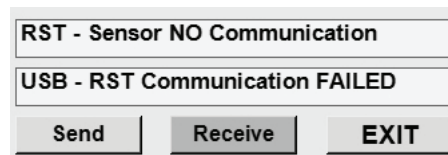


Figure 4.3



- **Programming the LPU-2428**

The following menus are used to program the LPU-2428 whether you use the RST-4001 alone, or in conjunction with the LPU-2428 software. As described in the RST-4001 User Interface section above, menus are navigated on the RST-4001 using the UP Arrow and DOWN Arrow, and selected with the RIGHT Arrow. In the LPU-2427 software, menus are navigated by clicking on the desired Menu Buttons on the left side of the screen.

**Main:**

Displays distance, level, volume, or flow. A graphical representation is displayed for level, volume, or flow.

**Basic Setup:**

Menu contains Units, Application, Flow/Volume Units, Flow Rate, and Response Time.

**App. Setup:**

Menu contains parameters specific to the current Application selected in Basic Setup. These include Volume Tank Type, Flow Type, Max/Full Distance, Zero/Empty Distance, and values for flow or volume.

**4-20 Setup:**

Menu contains Min & Max mA Setpoints, Fail Safe, and Fail Safe Delay.

**Calibration (not required on most applications):**

Menu contains Min & Max mA Value, Min & Max mA Trim, Multiplier, and Offset.

**Advanced:**

Menu contains Temperature Compensation, Gain Control, Sensitivity, Pulses, and Blanking.

**Utilities:**

Menu contains Low & High Distance Simulation, Simulation Cycle Time, Reset, File System, and Software Version.

- **Basic Setup Menu (BASICSET)**

Figure 4.4

| Menu        | Parameter               | RST-4001 Options | Software Options |
|-------------|-------------------------|------------------|------------------|
| Basic Setup | <i>Units</i><br>(Units) | Default = Feet   | Default = Feet   |
|             |                         | Feet             | Feet             |
|             |                         | Inch             | Inches           |
|             |                         | Meters           | Meters           |
|             |                         | MM               | Millimeters      |

*Units* (*Units* on the RST-4001) selects the units of measurement that will be used throughout the setup process and also for display. The selected units also determines the resolution of the display and the outputs. The resolution is: feet 0.01, inches 0.1, 0.000 meters, and millimeters 1.

**NOTE:** All parameter settings use the units selected in *Units*.

| Menu  | Parameter          | RST-4001 Options   | Software Options    |
|-------|--------------------|--------------------|---------------------|
| Basic | <i>Application</i> | Default = DISTANCE | Default = Distance  |
| Setup | <i>(Out Func)</i>  | DISTANCE           | Distance            |
|       |                    | LEVEL              | Level               |
|       |                    | VOLUME             | Volume              |
|       |                    | FLOW               | Flow                |
|       |                    | LIN TABL           | Linearization Table |
|       |                    | SUBMERSI           | Submersible         |

*Application (Out Func)* on the RST-4001) selects the measurement function of LPU-2428. Parameters for each application are configured in the App. Setup (APPLICAT) menu (See Figure 4.5). The selected application is displayed on the Main Screen under the measurement (See Figure 4.2).

| Menu  | Parameter           | RST-4001 Options | Software Options     |
|-------|---------------------|------------------|----------------------|
| Basic | <i>Volume Units</i> | Default = V FT^3 | Default = Cubic Feet |
| Setup | <i>(Vol Unit)</i>   | V FT^3           | Cubic Feet           |
|       |                     | V MFT^3          | Million Cubic Feet   |
|       |                     | V GAL            | Gallons              |
|       |                     | V M^3            | Cubic Meters         |
|       |                     | V LIT            | Liters               |

*Volume Units (Vol Unit)* on the RST-4001) selects the units for volume measurement. *Vol Unit* is only displayed on the RST-4001 when *Out Func* is set to VOLUME or FLOW. Similarly, *Volume Units* is greyed out in the LPU-2428 software unless *Application* is set to Volume or Flow.

| Menu  | Parameter         | RST-4001 Options  | Software Options     |
|-------|-------------------|-------------------|----------------------|
| Basic | <i>Flow Rate</i>  | Default = PER SEC | Default = Per Minute |
| Setup | <i>(TimeUnit)</i> | PER SEC           | Per Second           |
|       |                   | PER MIN           | Per Minute           |
|       |                   | PER HOUR          | Per Hour             |
|       |                   | PER DAY           | Per Day              |

*Flow Rate (TimeUnit)* on the RST-4001) selects the units for flow rate measurement. *TimeUnit* is only displayed on the RST-4001 when *Out Func* is set to FLOW. Similarly, *Volume Units* is greyed out in the LPU-2428 software unless *Application* is set to Flow.

| Menu  | Parameter            | RST-4001 Options   | Software Options   |
|-------|----------------------|--------------------|--------------------|
| Basic | <i>Response Time</i> | Default = Standard | Default = Standard |
| Setup | <i>(Response)</i>    | Standard           | Standard           |
|       |                      | Fast               | Fast               |
|       |                      | Immediat           | Immediate          |

*Response Time (Response)* on the RST-4001) selects the desired response time of the LPU-2428. The response time represents the maximum rate of change in target level that the sensor will accurately display. A faster response time correlates to a less stable output.

- **App. Setup Menu (APPLICAT)**

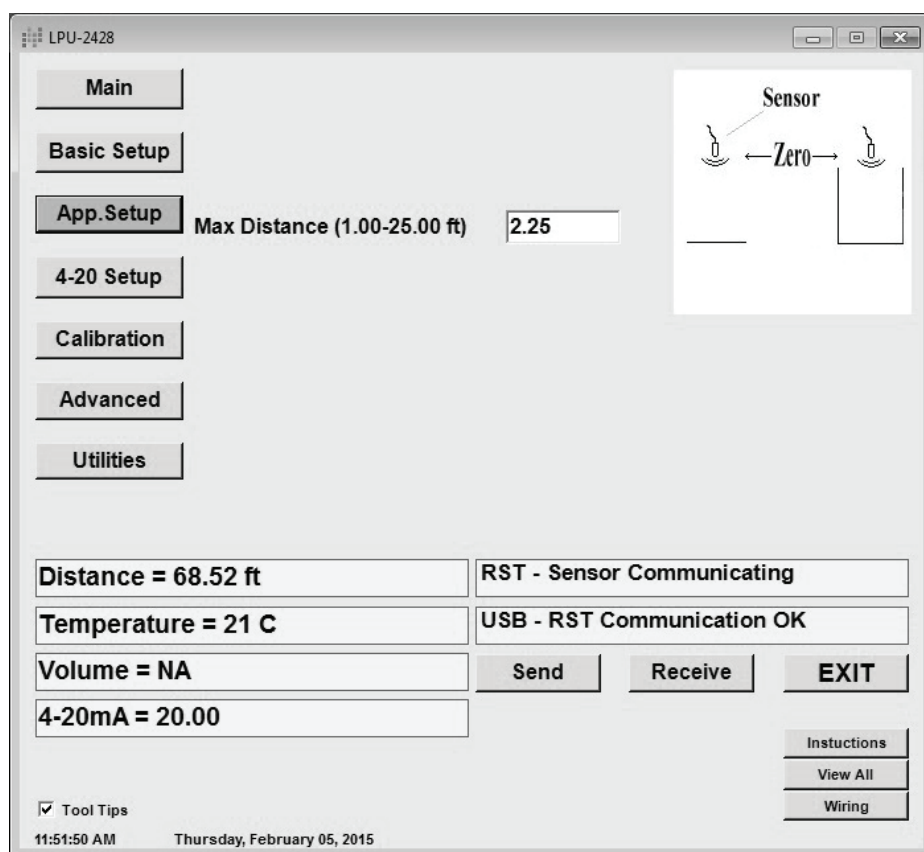


Figure 4.5

### App/Out

| Func     | Parameter                                  | RST-4001 Options     | Software Options       |
|----------|--------------------------------------------|----------------------|------------------------|
| Distance | <i>Max Distance</i><br>( <i>Max Dist</i> ) | Default = 25.00 (ft) | Default = 25.00 Feet   |
|          |                                            | 1.00 - 25.00 Feet    | 1.00 - 25.00 Feet      |
|          |                                            | 12.0 - 300.0 Inch    | 12.0 - 300.0 Inches    |
|          |                                            | 0.305 - 7.620 Meters | 0.305 - 7.620 Meters   |
|          |                                            | 305 - 7620 MM        | 305 - 7620 Millimeters |

*Max Distance* (*Max Dist* on the RST-4001) sets the maximum operating range for the LPU-2428. 25 feet is the physical limit of the LPU-2428. (See Figure 4.5)

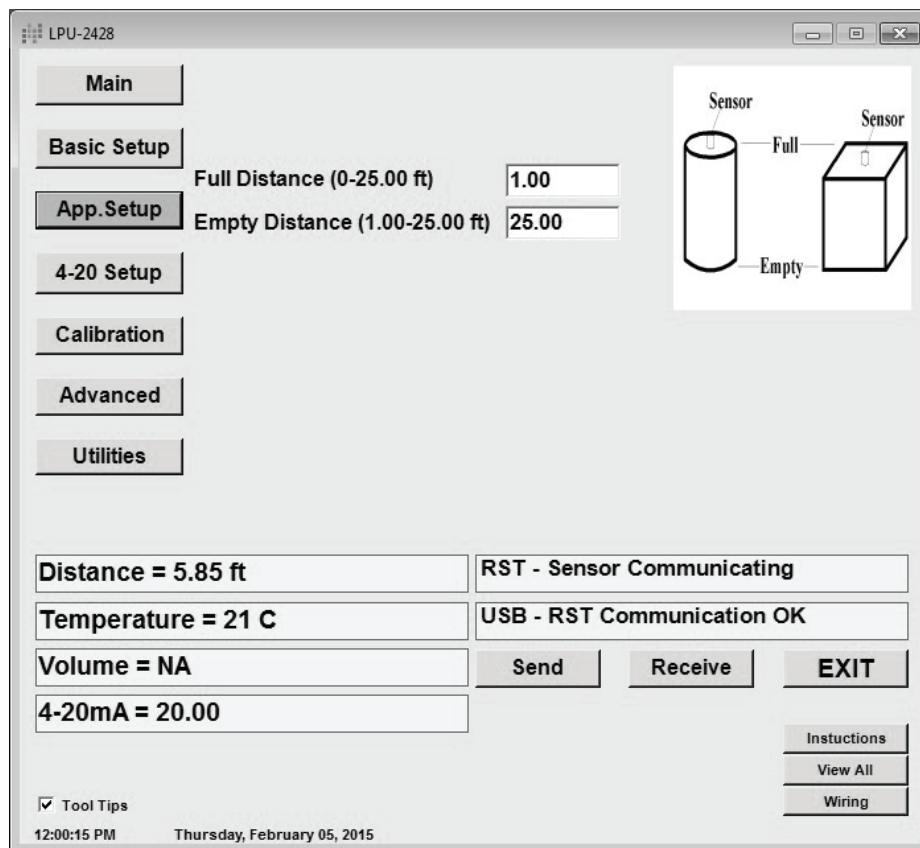


Figure 4.6

#### App/Out

| Func  | Parameter                                   | RST-4001 Options                                                                                      | Software Options                                                                                                  |
|-------|---------------------------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Level | <i>Full Distance</i><br>( <i>Ful Dist</i> ) | Default = 1.00 (ft)<br>0.00 - 25.00 Feet<br>0.0 - 300.0 Inch<br>0.000 - 7.620 Meters<br>000 - 7620 MM | Default = 1.00 Feet<br>0.00 - 25.00 Feet<br>00.0 - 300.0 Inches<br>0.000 - 7.620 Meters<br>000 - 7620 Millimeters |

*Full Distance* (*Ful Dist* on the RST-4001) sets the distance from the sensor to the full level of the vessel being monitored. (See Figure 4.6)

#### App/Out

| Func  | Parameter                                    | RST-4001 Options                                                                                        | Software Options                                                                                                   |
|-------|----------------------------------------------|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Level | <i>Empty Distance</i><br>( <i>Emp Dist</i> ) | Default = 25.00 (ft)<br>1.00 - 25.00 Feet<br>12.0 - 300.0 Inch<br>0.305 - 7.620 Meters<br>305 - 7620 MM | Default = 25.00 Feet<br>1.00 - 25.00 Feet<br>12.0 - 300.0 Inches<br>0.305 - 7.620 Meters<br>305 - 7620 Millimeters |

*Empty Distance* (*Emp Dist* on the RST-4001) sets the distance from the sensor to the empty level of the vessel being monitored. (See Figure 4.6)

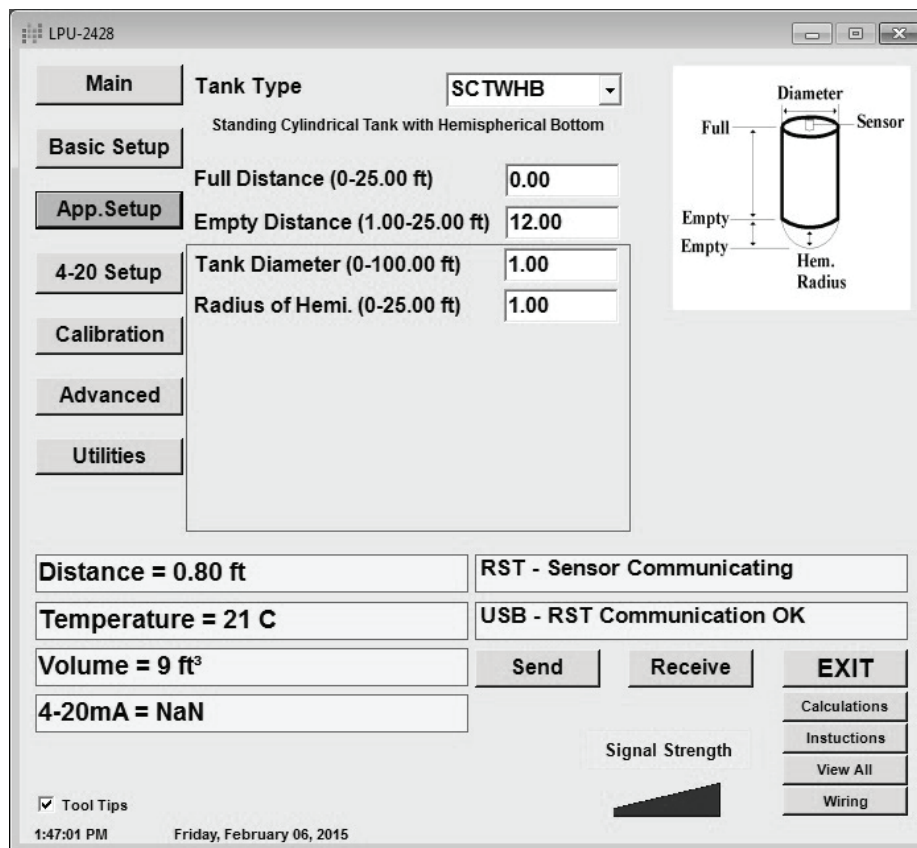


Figure 4.7

#### App/Out

| Func   | Parameter                               | RST-4001 Options                               | Software Options                               |
|--------|-----------------------------------------|------------------------------------------------|------------------------------------------------|
| Volume | <i>Tank Type</i><br>( <i>TankType</i> ) | Default = SCTWHB<br>SCTWCB<br>SRT<br>HCT<br>ST | Default = SCTWHB<br>SCTWCB<br>SRT<br>HCT<br>ST |

*Tank Type* (*Tank Type* on the RST-4001) selects the general geometry of the tank. (See Figures 4.7-4.11)

#### App/Out

| Func   | Parameter                                   | RST-4001 Options                                                                                      | Software Options                                                                                                  |
|--------|---------------------------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Volume | <i>Full Distance</i><br>( <i>Ful Dist</i> ) | Default = 1.00 (ft)<br>0.00 - 25.00 Feet<br>0.0 - 300.0 Inch<br>0.000 - 7.620 Meters<br>000 - 7620 MM | Default = 1.00 Feet<br>0.00 - 25.00 Feet<br>00.0 - 300.0 Inches<br>0.000 - 7.620 Meters<br>000 - 7620 Millimeters |

*Full Distance* (*Ful Dist* on the RST-4001) sets the distance from the sensor to the full level of the tank being monitored. (See Figures 4.7-4.11)

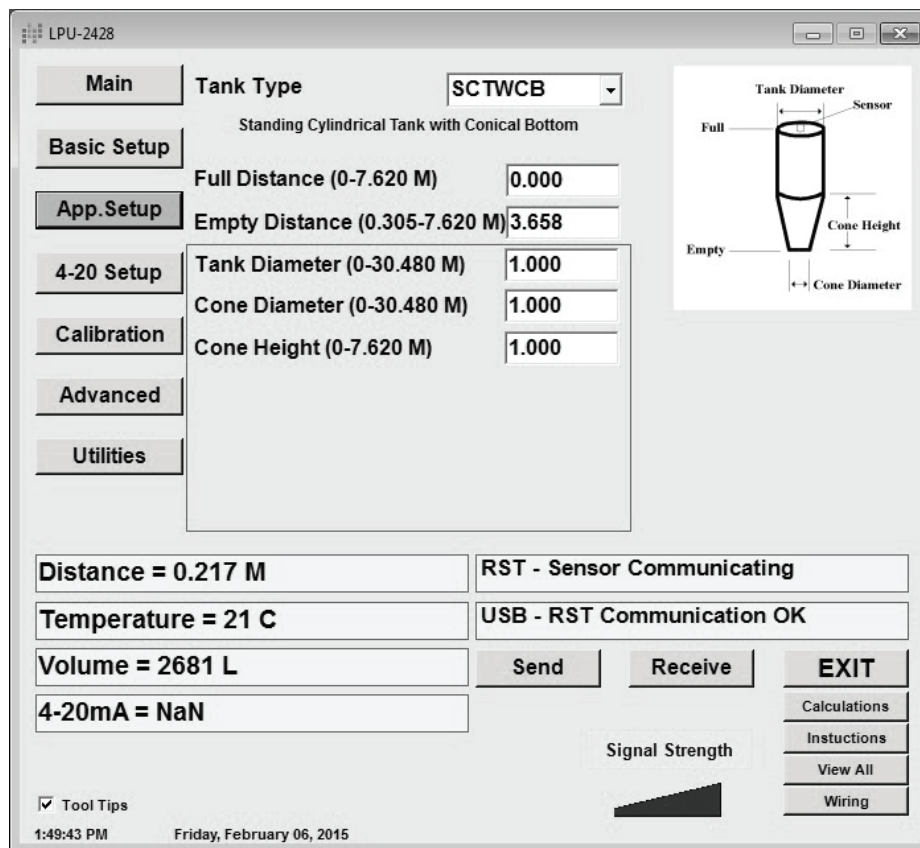


Figure 4.8

#### App/Out

| Func   | Parameter                    | RST-4001 Options                                                                                        | Software Options                                                                                                   |
|--------|------------------------------|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Volume | Empty Distance<br>(Emp Dist) | Default = 25.00 (ft)<br>1.00 - 25.00 Feet<br>12.0 - 300.0 Inch<br>0.305 - 7.620 Meters<br>305 - 7620 MM | Default = 25.00 Feet<br>1.00 - 25.00 Feet<br>12.0 - 300.0 Inches<br>0.305 - 7.620 Meters<br>305 - 7620 Millimeters |

Empty Distance (Emp Dist on the RST-4001) sets the distance from the sensor to the empty level of the tank being monitored. (See Figures 4.7-4.11)

#### App/Out

| Func   | Parameter     | RST-4001 Options      | Software Options        |
|--------|---------------|-----------------------|-------------------------|
| Volume | Tank Diameter | Default = 1.00        | Default = 1.00          |
| SCTWHB | (T Diamet)    | 0.00 - 100.00 Feet    | 0.00 - 100.00 Feet      |
| SCTWCB |               | 0.0 - 1200.0 Inch     | 00.0 - 1200.0 Inches    |
| HCT    |               | 0.000 - 30.480 Meters | 0.000 - 30.480 Meters   |
| ST     |               | 000 - 30480 MM        | 000 - 30480 Millimeters |

Tank Diameter (T Diamet on the RST-4001) sets the diameter of cylindrical (SCTWHB, SCTWCB, HCT) or spherical (ST) tank. (See Figures 4.7, 4.8, 4.10, and 4.11)

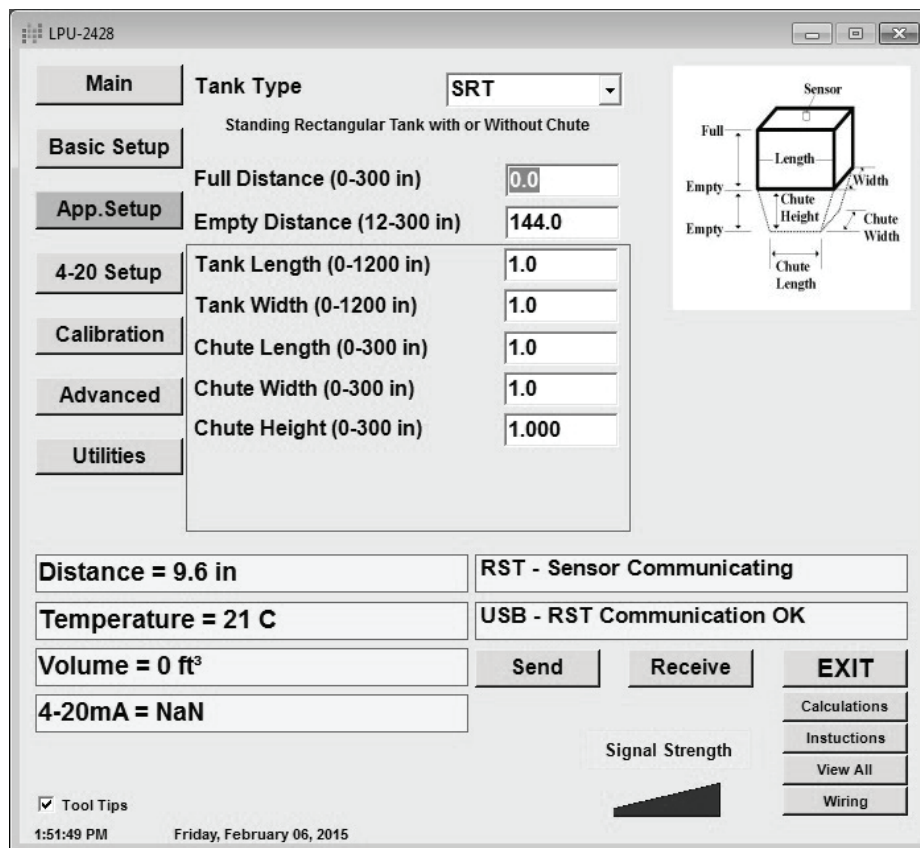


Figure 4.9

#### App/Out

| Func   | Parameter             | RST-4001 Options     | Software Options       |
|--------|-----------------------|----------------------|------------------------|
| Volume | <i>Radius of Hemi</i> | Default = 1.00       | Default = 1.00         |
| SCTWHB | <i>(Rad Hemi)</i>     | 0.00 - 25.00 Feet    | 0.00 - 25.00 Feet      |
| HCT    |                       | 0.0 - 300.0 Inch     | 00.0 - 300.0 Inches    |
|        |                       | 0.000 - 7.620 Meters | 0.000 - 7.620 Meters   |
|        |                       | 000 - 7620 MM        | 000 - 7620 Millimeters |

*Radius of Hemi* (*Rad Hemi* on the RST-4001) sets the radius of the hemisphere on the bottom (SCTWHB) or end (HCT) of a standing or horizontal cylindrical tank. (See Figures 4.7 and 4.10)

#### App/Out

| Func   | Parameter            | RST-4001 Options      | Software Options        |
|--------|----------------------|-----------------------|-------------------------|
| Volume | <i>Cone Diameter</i> | Default = 1.00        | Default = 1.00          |
| SCTWCB | <i>(Cone Dia)</i>    | 0.00 - 100.00 Feet    | 0.00 - 100.00 Feet      |
|        |                      | 0.0 - 1200.0 Inch     | 00.0 - 1200.0 Inches    |
|        |                      | 0.000 - 30.480 Meters | 0.000 - 30.480 Meters   |
|        |                      | 000 - 30480 MM        | 000 - 30480 Millimeters |

*Cone Diameter* (*Cone Dia* on the RST-4001) sets the lower diameter of the cone chute on a standing cylindrical tank (SCTWCB). (See Figure 4.8)



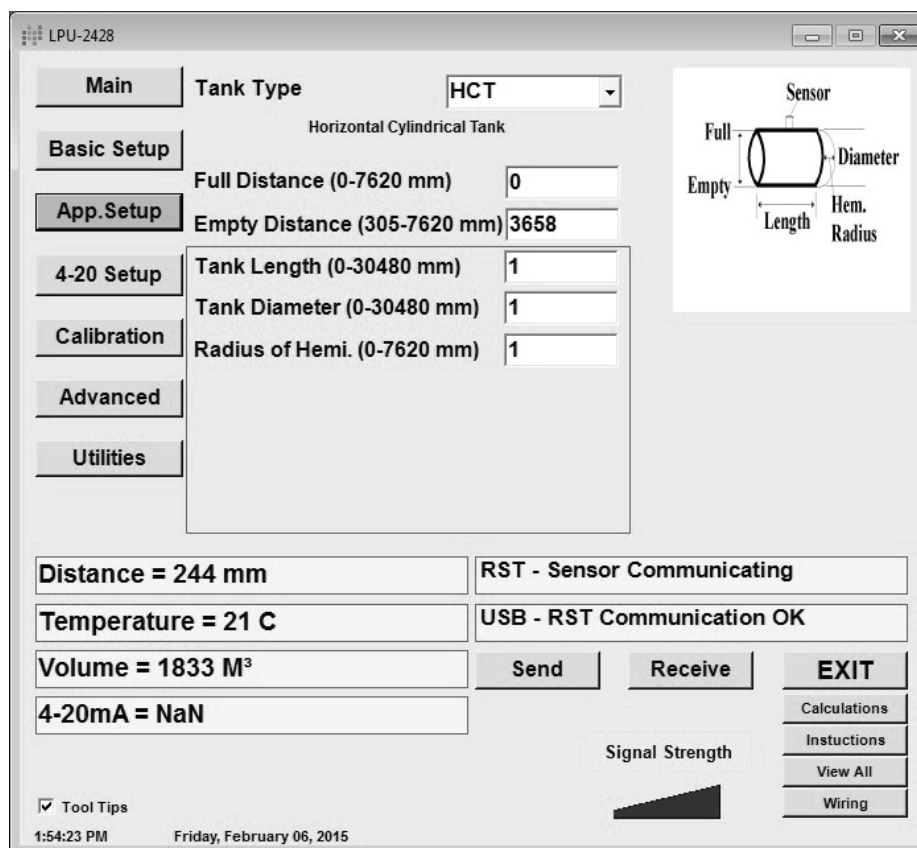


Figure 4.10

#### App/Out

| Func   | Parameter          | RST-4001 Options     | Software Options       |
|--------|--------------------|----------------------|------------------------|
| Volume | <i>Cone Height</i> | Default = 1.00       | Default = 1.00         |
| SCTWCB | <i>(Cone Hei)</i>  | 0.00 - 25.00 Feet    | 0.00 - 25.00 Feet      |
|        |                    | 0.0 - 300.0 Inch     | 00.0 - 300.0 Inches    |
|        |                    | 0.000 - 7.620 Meters | 0.000 - 7.620 Meters   |
|        |                    | 000 - 7620 MM        | 000 - 7620 Millimeters |

*Cone Height* (*Cone Hei* on the RST-4001) sets the height of the cone chute on a SCTWCB. (See Figure 4.8)

#### App/Out

| Func   | Parameter          | RST-4001 Options      | Software Options        |
|--------|--------------------|-----------------------|-------------------------|
| Volume | <i>Tank Length</i> | Default = 1.00        | Default = 1.00          |
| SRT    | <i>(T Length)</i>  | 0.00 - 100.00 Feet    | 0.00 - 100.00 Feet      |
| HCT    |                    | 0.0 - 1200.0 Inch     | 00.0 - 1200.0 Inches    |
|        |                    | 0.000 - 30.480 Meters | 0.000 - 30.480 Meters   |
|        |                    | 000 - 30480 MM        | 000 - 30480 Millimeters |

*Tank Length* (*T Length* on the RST-4001) sets the length of a rectangular (SRT) or horizontal cylindrical (HCT) tank. (See Figures 4.9 and 4.10)

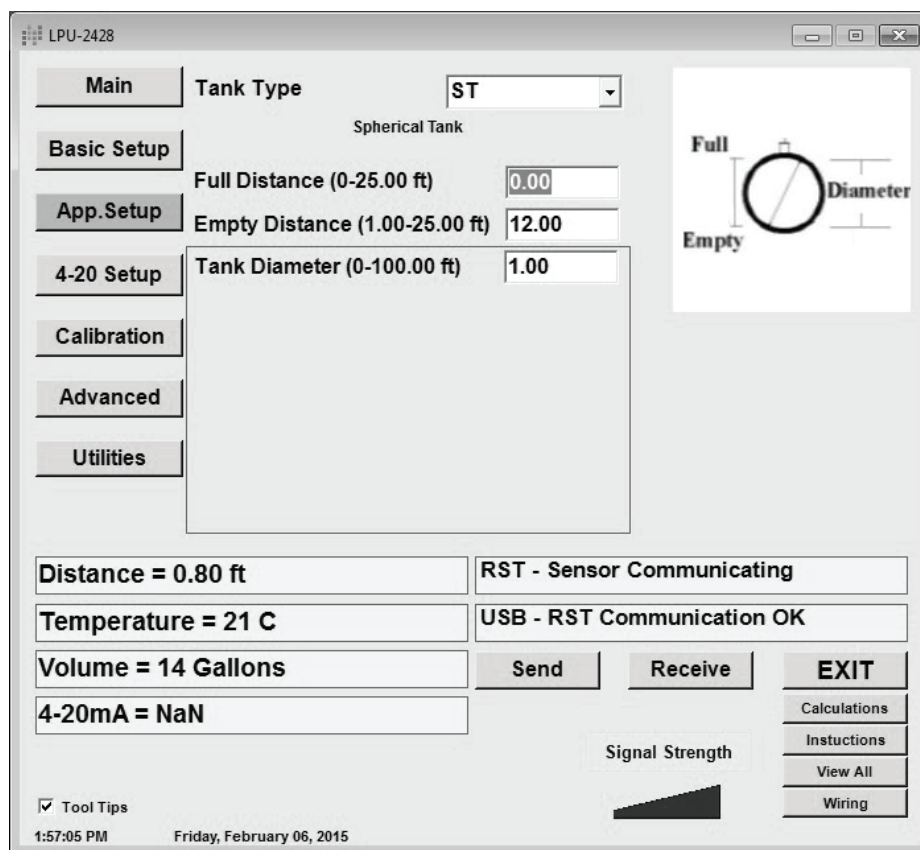


Figure 4.11

#### App/Out

| Func   | Parameter         | RST-4001 Options     | Software Options       |
|--------|-------------------|----------------------|------------------------|
| Volume | <i>Tank Width</i> | Default = 1.00       | Default = 1.00         |
| SRT    | <i>(T Width)</i>  | 0.00 - 25.00 Feet    | 0.00 - 25.00 Feet      |
|        |                   | 0.0 - 300.0 Inch     | 00.0 - 300.0 Inches    |
|        |                   | 0.000 - 7.620 Meters | 0.000 - 7.620 Meters   |
|        |                   | 000 - 7620 MM        | 000 - 7620 Millimeters |

*Tank Width* (*T Width* on the RST-4001) sets the width of a rectangular (SRT) tank. (See Figure 4.9)

#### App/Out

| Func   | Parameter           | RST-4001 Options     | Software Options       |
|--------|---------------------|----------------------|------------------------|
| Volume | <i>Chute Length</i> | Default = 1.00       | Default = 1.00         |
| SRT    | <i>(C Length)</i>   | 0.00 - 25.00 Feet    | 0.00 - 25.00 Feet      |
|        |                     | 0.0 - 300.0 Inch     | 00.0 - 300.0 Inches    |
|        |                     | 0.000 - 7.620 Meters | 0.000 - 7.620 Meters   |
|        |                     | 000 - 7620 MM        | 000 - 7620 Millimeters |

*Chute Length* (*C Length* on the RST-4001) sets the length of a chute under a rectangular (SRT) tank. The length of the chute is in the same direction as the length of the tank. (See Figure 4.9)

**App/Out**

| <b>Func</b> | <b>Parameter</b>   | <b>RST-4001 Options</b>                                                        | <b>Software Options</b>                                                                    |
|-------------|--------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| Volume      | <i>Chute Width</i> | Default = 1.00                                                                 | Default = 1.00                                                                             |
| SRT         | ( <i>C Width</i> ) | 0.00 - 25.00 Feet<br>0.0 - 300.0 Inch<br>0.000 - 7.620 Meters<br>000 - 7620 MM | 0.00 - 25.00 Feet<br>00.0 - 300.0 Inches<br>0.000 - 7.620 Meters<br>000 - 7620 Millimeters |

*Chute Width* (*C Width* on the RST-4001) sets the width of a chute under a rectangular (SRT) tank. The width of the chute is in the same direction as the width of the tank. (See Figure 4.9)

**App/Out**

| <b>Func</b> | <b>Parameter</b>    | <b>RST-4001 Options</b>                                                        | <b>Software Options</b>                                                                    |
|-------------|---------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| Volume      | <i>Chute Height</i> | Default = 1.00                                                                 | Default = 1.00                                                                             |
| SRT         | ( <i>C Height</i> ) | 0.00 - 25.00 Feet<br>0.0 - 300.0 Inch<br>0.000 - 7.620 Meters<br>000 - 7620 MM | 0.00 - 25.00 Feet<br>00.0 - 300.0 Inches<br>0.000 - 7.620 Meters<br>000 - 7620 Millimeters |

*Chute Height* (*C Height* on the RST-4001) sets the height of a chute under a rectangular (SRT) tank. (See Figure 4.9)

**App/Out**

| <b>Func</b> | <b>Parameter</b>                        | <b>RST-4001 Options</b>                      | <b>Software Options</b>                      |
|-------------|-----------------------------------------|----------------------------------------------|----------------------------------------------|
| Flow        | <i>Flow Type</i><br>( <i>FlowType</i> ) | Default = Flume<br>Flume<br>Weir<br>Equation | Default = Flume<br>Flume<br>Weir<br>Equation |

*Flow Type* (*FlowType* on the RST-4001) selects the type of flow being monitored. (See Figures 4.12-4.22)

**App/Out**

| <b>Func</b> | <b>Parameter</b>                         | <b>RST-4001 Options</b>                    | <b>Software Options</b>                      |
|-------------|------------------------------------------|--------------------------------------------|----------------------------------------------|
| Flume       | <i>Flume Type</i><br>( <i>Flume Ty</i> ) | Default = Parshall<br>Parshall<br>CutThroa | Default = Parshall<br>Parshall<br>Cut Throat |

*Flume Type* (*Flume Ty* on the RST-4001) selects the type of flume being monitored. (See Figure 4.12-4.13)

**App/Out**

| <b>Func</b> | <b>Parameter</b>                        | <b>RST-4001 Options</b>                                                        | <b>Software Options</b>                                                                                                          |
|-------------|-----------------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Weir        | <i>Weir Type</i><br>( <i>Weir Typ</i> ) | Default = Californ<br>Californ<br>Rect w/c<br>Rect w/o<br>Trapazod<br>Triangul | Default = California Pipe<br>California Pipe<br>Rectangle w/Const<br>Rectangle w/o Const<br>Trapazoidal<br>Triangular or V-Notch |

*Weir Type* (*Weir Typ* on the RST-4001) selects the type of weir being monitored. (See Figure 4.14-4.18)

MPE

**Main** Flow Type **Flume**

**Basic Setup** Flume Type **Parshall**

**App.Setup** Max Flow (0-25.00 ft) **0.00**

Zero Flow (1.00-25.00 ft) **25.00**

**4-20 Setup** Constant K (0-89766) **1795.00**

Exponent n (0-2) **1.522**

**Calibration**

**Advanced**

**Utilities**

**Totalization**

Distance = 1.00 ft , 4.28 ft

Temperature = 21 C

Flow = 11 Gallons Per Min

4-20mA = NaN , NaN

RST - Sensor Com

USB - RST Commu

Send Receive EXIT

Signal Strength

Units = Feet  
Flow Units= Gallons  
Flow Rate = Per Minute

Select Width

1 ft 1 ft 2 ft 3 ft 4 ft 5 ft 6 ft 7 ft 8 ft

Insert

$Q=KH^n$

Diagram: A cross-section of a Parshall flume with a sensor at the throat. The width is labeled.

2:09:03 PM Friday, February 06, 2015

Figure 4.12

MPE

**Main** Flow Type **Flume**

**Basic Setup** Flume Type **Cut Throat**

**App.Setup** Max Flow (0-25.00 ft) **0.00**

Zero Flow (1.00-25.00 ft) **25.00**

**4-20 Setup** Constant K (0-3591) **1795.00**

Exponent n1 (0-2) **1.522**

**Calibration** Throat Width (0-25.00 ft) **1.000** ft

**Advanced** Exponent n2 (0-2) **0.003**

**Utilities**

**Totalization**

Distance = 1.00 ft , 4.42 ft

Temperature = 21 C

Flow = 11 Gallons Per Min

4-20mA = NaN , NaN

RST - Sensor Com

USB - RST Communication OK

Send Receive EXIT

Signal Strength

Units = Feet  
Flow Units= Gallons  
Flow Rate = Per Minute

Select Length\_Width

Cut Throat 9 ft (L) 1 ft (W) 9 ft (L) 2 ft (W) 9 ft (L) 4 ft (W) 9 ft (L) 6 ft (W) 4.5 ft (L) 0.25 ft (W) 4.5 ft (L) 0.5 ft (W) 4.5 ft (L) 1 ft (W) 4.5 ft (L) 2 ft (W)

Insert

$Q=KW^{n1}H^{n2}$

Diagram: A cross-section of a Cut Throat flume with a sensor at the throat. The width and length are labeled.

2:11:24 PM Friday, February 06, 2015

Figure 4.13

LPU-2428

**Main** Flow Type Weir

**Basic Setup** Weir Type California Pipe

**App.Setup** Max Flow (0-25.00 ft) 0.00

Zero Flow (1.00-25.00 ft) 25.00

**4-20 Setup** Constant K (0-8977) 1795.0

Exponent n1 (0-2) 1.522

**Calibration** Diameter of Pipe (0-25.00 ft) 1.000 ft

**Advanced** Exponent n2 (0-3) 0.003

**Utilities**

**Totalization**

Distance = 1.00 ft RST - Sensor Communicating

Temperature = 21 C USB - RST Communication OK

Flow = 1795 Gallons Per Min Send Receive EXIT

4-20mA = NaN

☒ Tool Tips

2:17:10 PM Friday, February 06, 2015

Signal Strength

**Diagram:** Pipe Diameter, Sensor, Max, Zero

$Q=K(H/D)^{n1}D^{n2}$

Units = Feet  
Flow Units= Gallons  
Flow Rate = Per Minute

Default Parameters  
K=3900 n1=1.88 n2=2.48 Insert

**Calculations**  
**Instructions**  
**View All**  
**Wiring**

Figure 4.14

#### App/Out

| Func     | Parameter              | RST-4001 Options | Software Options        |
|----------|------------------------|------------------|-------------------------|
| Equation | Equation<br>(Equation) | Default = 1      | Default = $Q=KH^n$      |
|          |                        | 1                | $Q=KH^n$                |
|          |                        | 2                | $Q=KLH^n$               |
|          |                        | 3                | $Q=K[L-XH]H^n$          |
|          |                        | 4                | $Q=K[B-A/D]^{n1}P^{n2}$ |

Equation (Equation on the RST-4001) selects the equation that best models the flow being monitored. (See Figure 4.19-4.22)

#### App/Out

| Func | Parameter              | RST-4001 Options     | Software Options       |
|------|------------------------|----------------------|------------------------|
| Flow | Max Flow<br>(Max Flow) | Default = 1.00       | Default = 1.00         |
|      |                        | 0.00 - 25.00 Feet    | 0.00 - 25.00 Feet      |
|      |                        | 0.0 - 300.0 Inch     | 00.0 - 300.0 Inches    |
|      |                        | 0.000 - 7.620 Meters | 0.000 - 7.620 Meters   |
|      |                        | 000 - 7620 MM        | 000 - 7620 Millimeters |

Max Flow (Max Flow on the RST-4001) sets the distance from the sensor to the maximum height of the flow. (See Figures 4.12-4.22)



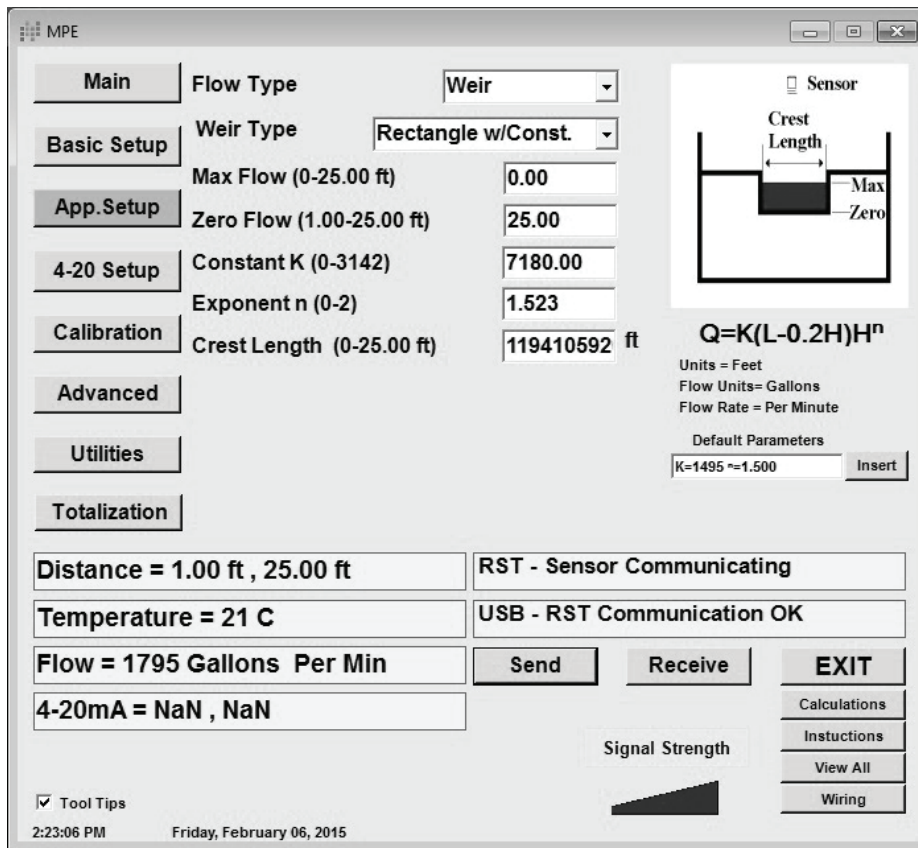


Figure 4.15

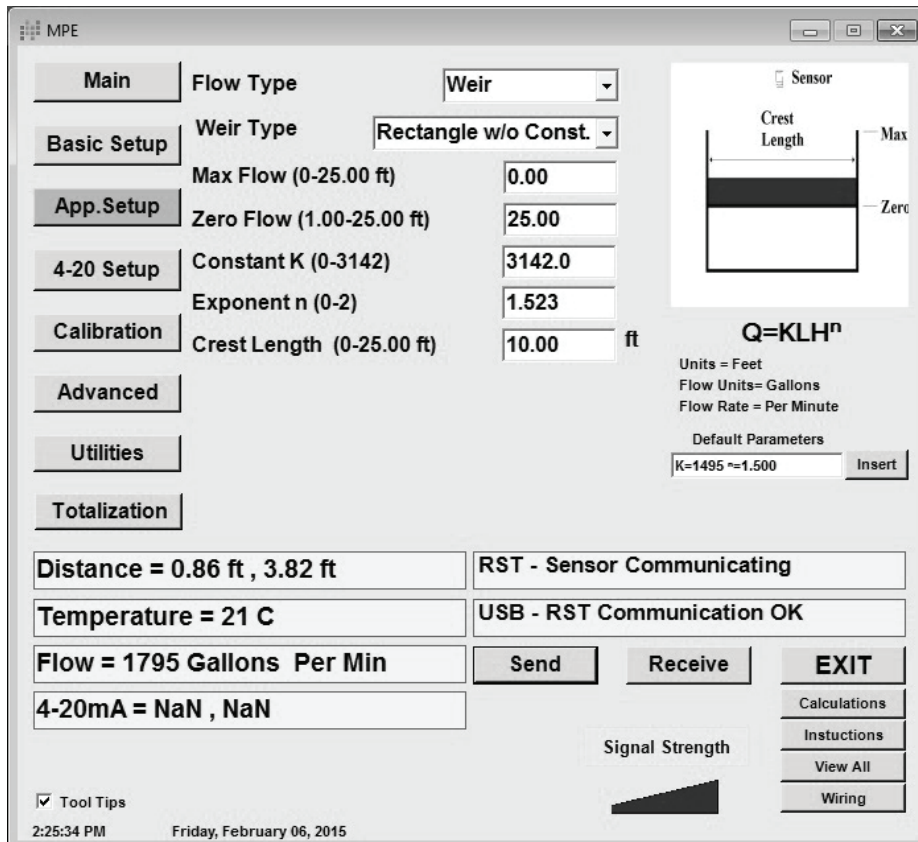


Figure 4.16

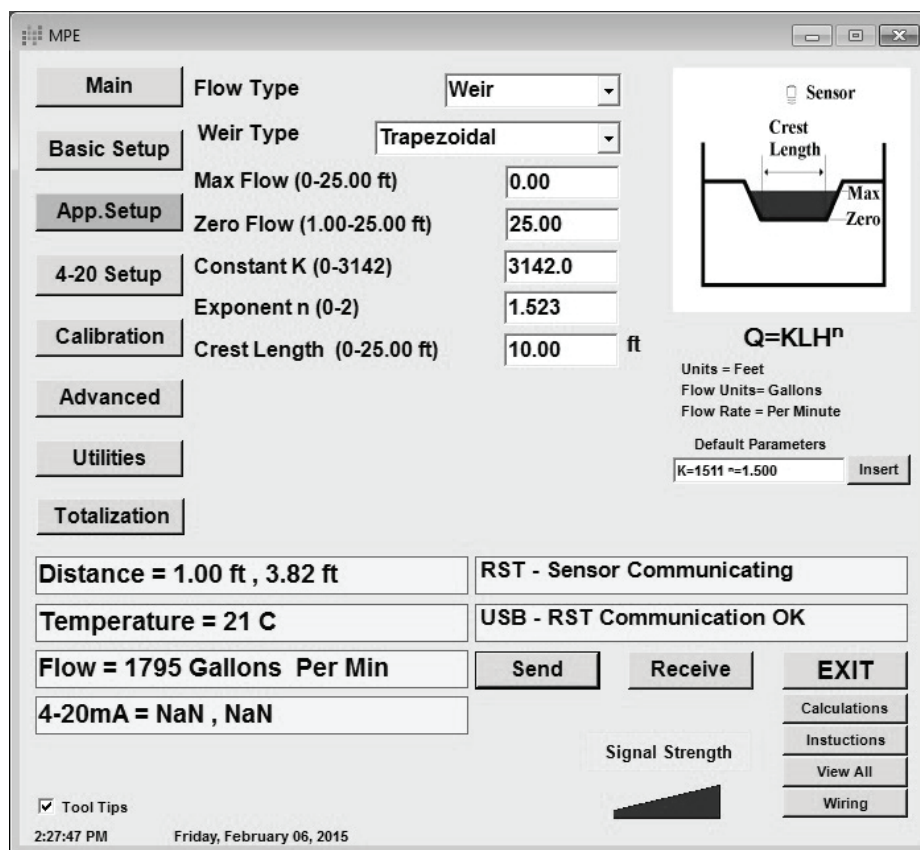


Figure 4.17

#### App/Out

| Func | Parameter               | RST-4001 Options                                                                                 | Software Options                                                                                             |
|------|-------------------------|--------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Flow | Zero Flow<br>(ZeroFlow) | Default = 1.00<br>0.00 - 25.00 Feet<br>0.0 - 300.0 Inch<br>0.000 - 7.620 Meters<br>000 - 7620 MM | Default = 1.00<br>0.00 - 25.00 Feet<br>00.0 - 300.0 Inches<br>0.000 - 7.620 Meters<br>000 - 7620 Millimeters |

Zero Flow (ZeroFlow on the RST-4001) sets the distance from the sensor to the level of minimum flow. (See Figure 4.12-4.22)

#### App/Out

| Func | Parameter         | RST-4001 Options | Software Options |
|------|-------------------|------------------|------------------|
| Flow | Constant K<br>(K) | Default = 1.00   | Default = Varies |

Constant K (K on the RST-4001) sets the flow coefficient K for the channel being monitored. The range for K varies for each application. Flume configurations have selectable widths that provide appropriate K values. Weir configurations include suggested K values on the right side of the screen. (See Figures 4.12-4.22)

MPE

**Main** Flow Type **Weir**

**Basic Setup** Weir Type **Triangular or V-Notch**

**App.Setup** Max Flow (0-25.00 ft) **0.00**

Zero Flow (1.00-25.00 ft) **25.00**

**4-20 Setup** Constant K (0-2020) **3142.0**

Exponent n (0-3) **1.523**

**Calibration**

**Advanced**

**Utilities**

**Totalization**

**Distance = 1.00 ft , 3.82 ft** **RST - Sensor Com**

**Temperature = 21 C** **USB - RST Communication OK**

**Flow = 1795 Gallons Per Min** **Send** **Receive** **EXIT**

**4-20mA = NaN , NaN**

**Signal Strength**

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2:28:51 PM Friday, February 06, 2015

**Sensor**

**Angle**

**Max**

**Zero**

**$Q=KH^n$**

Units = Feet  
Flow Units= Gallons  
Flow Rate = Per Minute

Select Degree of Weir

**V Notch** **Insert**

22.5 Degree  
30.0 Degree  
45.0 Degree  
60.0 Degree  
90.0 Degree  
120.0 Degree

**Calculations**

**Instructions**

**View All**

**Wiring**

Figure 4.18

MPE

**Main** Flow Type **Equation**

**Basic Setup** Equation  **$Q=KH^n$**

**App.Setup** Max Flow (0-25.00 ft) **0.00**

Zero Flow (1.00-25.00 ft) **25.00**

**4-20 Setup** Constant K (0-10e308) **3142.00**

Exponent n (0-10e308) **1.523**

**Calibration**

**Advanced**

**Utilities**

**Totalization**

**Distance = 35.41 ft , 4.30 ft** **RST - Sensor Communicating**

**Temperature = 21 C** **USB - RST Communication OK**

**Flow = 1795 Gallons Per Min** **Send** **Receive** **EXIT**

**4-20mA = NaN , NaN**

**Signal Strength**

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2:32:18 PM Friday, February 06, 2015

**$Q=KH^n$**

Units = Feet  
Flow Units= Gallons  
Flow Rate = Per Minute

**Calculations**

**Instructions**

**View All**

**Wiring**

Figure 4.19



**MPE**

**Main** Flow Type **Equation**

**Basic Setup** Equation **Q=KLH<sup>n</sup>**

**App.Setup** Max Flow (0-25.00 ft) **0.00**

Zero Flow (1.00-25.00 ft) **25.00**

**4-20 Setup** Constant K (0-10e308) **3142.00**

Exponent n (0-10e308) **1.523**

**Calibration** Length (0-10e308) **10.000**

**Advanced**

**Utilities**

**Totalization**

**Q=KLH<sup>n</sup>**  
 Units = Feet  
 Flow Units= Gallons  
 Flow Rate = Per Minute

Distance = 1.00 ft , 4.30 ft RST - Sensor Communicating

Temperature = 21 C USB - RST Communication OK

Flow = 1795 Gallons Per Min Send Receive EXIT

4-20mA = NaN , NaN

Signal Strength

☒ Tool Tips

2:35:39 PM Friday, February 06, 2015

Calculations  
 Instructions  
 View All  
 Wiring

Figure 4.20

### App/Out

| Func | Parameter                                                 | RST-4001 Options | Software Options |
|------|-----------------------------------------------------------|------------------|------------------|
| Flow | Exponent <i>n</i> / <i>n1</i><br>( <i>n</i> / <i>N1</i> ) | Default = 1.00   | Default = varies |

Exponent *n* or *n1* (*n* or *N1* on the RST-4001) sets the value of the (first) exponent for the channel being monitored. The range for *n* or *n1* varies for each application. Flume configurations have selectable widths that provide appropriate *n* or *n1* values. Weir configurations include suggested *n* or *n1* values on the right side of the screen. (See Figures 4.12-4.22)

### App/Out

| Func | Parameter          | RST-4001 Options | Software Options |
|------|--------------------|------------------|------------------|
| Flow | Exponent <i>n2</i> | Default = 1.00   | Default = varies |

Cutthroat (*N2*)  
 Cal. Pipe  
 $Q=K[B-A/D]^{n1}P^{n2}$

Exponent *n2* (*N2* on the RST-4001) sets the value of the second exponent for Cutthroat flume and California pipe weirs being monitored. The range for *n2* varies for each application. Flume configurations have selectable widths that provide appropriate *n2* values. Weir configurations include suggested *n2* values on the right side of the screen. (See Figures 4.13, 4.14, and 4.22)

MPE

**Main** Flow Type Equation

**Basic Setup** Equation  $Q=K[L-XH]H^n$

**App.Setup** Max Flow (0-25.00 ft) 0.00

Zero Flow (1.00-25.00 ft) 25.00

**4-20 Setup** Constant K (0-10e308) 3142.00

Exponent n (0-10e308) 1.523

**Calibration** Length (0-10e308) 10.000 ft  $Q=K(L-XH)H^n$

**Advanced** Constant X (0-10e308) 0.005

Units = Feet  
Flow Units= Gallons  
Flow Rate = Per Minute

**Utilities**

**Totalization**

Distance = 1.00 ft , 4.30 ft RST - Sensor Communicating

Temperature = 21 C USB - RST Communication OK

Flow = 1795 Gallons Per Min Send Receive EXIT

4-20mA = NaN , NaN

Signal Strength

☒ Tool Tips

2:36:19 PM Friday, February 06, 2015

Calculations  
Instructions  
View All  
Wiring

Figure 4.21

MPE

**Main** Flow Type Equation

**Basic Setup** Equation  $Q=k[B-A/D]^{n1}P^{n2}$

**App.Setup** Max Flow (0-25.00 ft) 0.00

Zero Flow (1.00-25.00 ft) 25.00

**4-20 Setup** Constant K (0-10e308) 3142.00

Exponent n1 (0-10e308) 1.523

**Calibration** Constant D (0-10e308) 10.000

**Advanced** Exponent n2 (0-10e308) 0.005

$Q=K(B-A/D)^{n1}P^{n2}$

Units = Feet  
Flow Units= Gallons  
Flow Rate = Per Minute

**Utilities**

**Totalization**

Distance = 1.00 ft , 4.30 ft RST - Sensor Communicating

Temperature = 21 C USB - RST Communication OK

Flow = 1795 Gallons Per Min Send Receive EXIT

4-20mA = NaN , NaN

Signal Strength

☒ Tool Tips

2:37:01 PM Friday, February 06, 2015

Calculations  
Instructions  
View All  
Wiring

Figure 4.22

**App/Out**

| <b>Func</b>  | <b>Parameter</b>    | <b>RST-4001 Options</b> | <b>Software Options</b> |
|--------------|---------------------|-------------------------|-------------------------|
| Flow - Flume | <i>Throat Width</i> | Default = 1.00          | Default = 1.00          |
| Cut Throat   | <i>(Throat W)</i>   | 0.00 - 25.00 Feet       | 0.00 - 25.00 Feet       |
|              |                     | 0.0 - 300.0 Inch        | 00.0 - 300.0 Inches     |
|              |                     | 0.000 - 7.620 Meters    | 0.000 - 7.620 Meters    |
|              |                     | 000 - 7620 MM           | 000 - 7620 Millimeters  |

*Throat Width* (*Throat W* on the RST-4001) sets the width of a Cut Throat flume. Length and width combinations can be selected from the right side of the screen. (See Figure 4.13)

**App/Out**

| <b>Func</b> | <b>Parameter</b>        | <b>RST-4001 Options</b> | <b>Software Options</b> |
|-------------|-------------------------|-------------------------|-------------------------|
| Flow - Weir | <i>Diameter of Pipe</i> | Default = 1.00          | Default = 1.00          |
| Calif. Pipe | <i>(Diameter)</i>       | 0.00 - 25.00 Feet       | 0.00 - 25.00 Feet       |
|             |                         | 0.0 - 300.0 Inch        | 00.0 - 300.0 Inches     |
|             |                         | 0.000 - 7.620 Meters    | 0.000 - 7.620 Meters    |
|             |                         | 000 - 7620 MM           | 000 - 7620 Millimeters  |

*Diameter of Pipe* (*Diameter* on the RST-4001) sets the diameter of a California Pipe type weir. (See Figure 4.14)

**App/Out**

| <b>Func</b>  | <b>Parameter</b>    | <b>RST-4001 Options</b> | <b>Software Options</b> |
|--------------|---------------------|-------------------------|-------------------------|
| Flow - Weir  | <i>Crest Length</i> | Default = 1.00          | Default = 1.00          |
| Rect w/cst   | <i>(C Length)</i>   | 0.00 - 25.00 Feet       | 0.00 - 25.00 Feet       |
| Rect w/o cst |                     | 0.0 - 300.0 Inch        | 00.0 - 300.0 Inches     |
| Trapezoidal  |                     | 0.000 - 7.620 Meters    | 0.000 - 7.620 Meters    |
|              |                     | 000 - 7620 MM           | 000 - 7620 Millimeters  |

*Crest Length* (*C Length* on the RST-4001) sets the crest length for Rectangular (with and without constriction) and Trapezoidal weirs. (See Figures 4.15, 4.16, and 4.17)

**App/Out**

| <b>Func</b>    | <b>Parameter</b> | <b>RST-4001 Options</b> | <b>Software Options</b> |
|----------------|------------------|-------------------------|-------------------------|
| Flow - Eq      | <i>Length</i>    | Default = 1.000         | Default = 10.000        |
| $Q=KLH^n$      | <i>(Length)</i>  |                         | 0 - 10e308 (ft)         |
| $Q=K[L-XH]H^n$ |                  |                         |                         |

*Length* (*Length* on the RST-4001) sets the value of the L variable in the flow equations. Length can be set using the RST-4001, but can only be adjusted by 0.001 increments using the UP and DOWN arrows. (See Figures 4.20, 4.21, and 4.1)

**App/Out**

| <b>Func</b>    | <b>Parameter</b>  | <b>RST-4001 Options</b> | <b>Software Options</b> |
|----------------|-------------------|-------------------------|-------------------------|
| Flow - Eq      | <i>Constant X</i> | Default = 1.000         | Default = 0.006         |
| $Q=K[L-XH]H^n$ | <i>(X)</i>        |                         | 0 - 10e308              |

*Constant X* (*X* on the RST-4001) sets the value of the X constant in the flow equation  $Q=K[L-XH]H^n$ . X can be set using the RST-4001, but can only be adjusted by 0.001 increments using the UP and DOWN arrows. (See Figures 4.21 and 4.1)

**App/Out**

| <b>Func</b>                                                                                                                                                                                                                                                                        | <b>Parameter</b>                            | <b>RST-4001 Options</b> | <b>Software Options</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-------------------------|-------------------------|
| Flow - Eq                                                                                                                                                                                                                                                                          | <i>Constant D</i>                           | Default = 1.000         | Default = 10.000        |
|                                                                                                                                                                                                                                                                                    | $Q=K[B-A/D]^{n1}P^{n2}$ ( <i>Diameter</i> ) |                         | 0 - 10e308              |
| <i>Constant D</i> ( <i>Diameter</i> on the RST-4001) sets the value of the D constant in the flow equation $Q=K[B-A/D]^{n1}P^{n2}$ . Diameter can be set using the RST-4001, but can only be adjusted by 0.001 increments using the UP and DOWN arrows. (See Figures 4.22 and 4.1) |                                             |                         |                         |

**App/Out**

| <b>Func</b> | <b>Parameter</b>    | <b>RST-4001 Options</b> | <b>Software Options</b>                                                                                           |
|-------------|---------------------|-------------------------|-------------------------------------------------------------------------------------------------------------------|
| Lin. Tab.   | <i>Max Distance</i> | -----                   | Default = 1.00 Feet<br>0.00 - 25.00 Feet<br>00.0 - 300.0 Inches<br>0.000 - 7.620 Meters<br>000 - 7620 Millimeters |

*Max Distance* (not configurable on the RST-4001) sets the distance from the sensor to the point of maximum volume for a linear table. (See Figure 4.23)

**App/Out**

| <b>Func</b> | <b>Parameter</b>     | <b>RST-4001 Options</b> | <b>Software Options</b>                                                                                            |
|-------------|----------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------|
| Lin. Tab    | <i>Zero Distance</i> | -----                   | Default = 20.00 Feet<br>1.00 - 25.00 Feet<br>12.0 - 300.0 Inches<br>0.305 - 7.620 Meters<br>305 - 7620 Millimeters |

*Zero Distance* (not configurable on the RST-4001) sets the distance from the sensor to the point of zero volume for a linear table. (See Figure 4.23)

**App/Out**

| <b>Func</b> | <b>Parameter</b>                                | <b>RST-4001 Options</b>                                                                               | <b>Software Options</b>                                                                                           |
|-------------|-------------------------------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Submers     | <i>Submersible Range</i><br>( <i>SubRange</i> ) | Default = 1.00 (ft)<br>0.00 - 25.00 Feet<br>0.0 - 300.0 Inch<br>0.000 - 7.620 Meters<br>000 - 7620 MM | Default = 1.00 Feet<br>0.00 - 25.00 Feet<br>00.0 - 300.0 Inches<br>0.000 - 7.620 Meters<br>000 - 7620 Millimeters |

*Sumersible Range* (*Sub Range* on the RST-4001) sets distance from the sensor to point at which a hypothetical pressure transducer would be submerged. (See Figure 4.24)

**App/Out**

| <b>Func</b> | <b>Parameter</b>                          | <b>RST-4001 Options</b>                                                                                | <b>Software Options</b>                                                                                            |
|-------------|-------------------------------------------|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Submers     | <i>Depth Distance</i><br>( <i>Depth</i> ) | Default = 25.00 (ft)<br>0.00 - 25.00 Feet<br>0.0 - 300.0 Inch<br>0.000 - 7.620 Meters<br>000 - 7620 MM | Default = 20.00 Feet<br>0.00 - 25.00 Feet<br>00.0 - 300.0 Inches<br>0.000 - 7.620 Meters<br>000 - 7620 Millimeters |

*Depth Distance* (*Depth* on the RST-4001) represents the equivalent depth for the 20mA output setting of the sensor. (See Figures 4.24 and 4.25)

LPU-2428

**Main**

**Linear Table**

**Basic Setup**

**App.Setup**

Max Distance (0-25.00 ft)

Zero Distance (1.00-25.00 ft)

| Loc | Distance (ft) | Value |
|-----|---------------|-------|
| 1   | 1.00          | 1000  |
| 2   | 1.50          | 1500  |
| 3   | 2.00          | 2000  |
| 4   | 2.50          | 2500  |
| 5   | 3.00          | 3000  |
| 6   | 3.50          | 3500  |
| 7   | 4.00          | 4000  |

**4-20 Setup**

| Loc | Distance (ft) | Value |
|-----|---------------|-------|
| 1   | 0.00          | 0     |
| 2   | 0.00          | 0     |
| 3   | 0.00          | 0     |
| 4   | 0.00          | 0     |
| 5   | 0.00          | 0     |
| 6   | 0.00          | 0     |
| 7   | 0.00          | 0     |
| 8   | 0.00          | 0     |

**Calibration**

**Advanced**

**Utilities**

**Totalization**

Distance = 5.86 ft

Temperature = 21 C

Flow = 0 ft<sup>3</sup> Per Min

4-20mA = 20.00

RST - Sensor Communicating

USB - RST Communication OK

**Send** **Receive** **EXIT**

**Instructions**

**View All**

**Wiring**

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12:14:38 PM Thursday, February 05, 2015

Figure 4.23

LPU-2428

**Main**

**Basic Setup**

**App.Setup**

Submersible Range (0-25.00 ft)

Depth Distance (1.00-25.00 ft)

**4-20 Setup**

**Calibration**

**Advanced**

**Utilities**

**Sensor**

**Zero**

Distance = 7.57 ft

Temperature = 21 C

Volume = NA

4-20mA = NaN

RST - Sensor Communicating

USB - RST Communication OK

**Send** **Receive** **EXIT**

**Instructions**

**View All**

**Wiring**

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12:20:10 PM Thursday, February 05, 2015

Figure 4.24

| Transducer PSI to Milliamp Chart |          |      |          |          |      |          |          |      |           |          |       |
|----------------------------------|----------|------|----------|----------|------|----------|----------|------|-----------|----------|-------|
| 0-5 PSI                          | milliamp | Feet | 0-10 PSI | milliamp | Feet | 0-15 PSI | milliamp | Feet | 0-100 PSI | milliamp | Feet  |
| 0                                | 4.0      | 0.0  | 0        | 4.0      | 0.0  | 0        | 4.0      | 0.0  | 0         | 4.0      | 0.0   |
| 1                                | 7.2      | 2.3  | 1        | 5.6      | 2.3  | 1        | 5.1      | 2.3  | 5         | 4.8      | 11.6  |
| 2                                | 10.4     | 4.6  | 2        | 7.2      | 4.6  | 2        | 6.1      | 4.6  | 10        | 5.6      | 23.1  |
| 3                                | 13.6     | 6.9  | 3        | 8.8      | 6.9  | 3        | 7.2      | 6.9  | 15        | 6.4      | 34.7  |
| 4                                | 16.8     | 9.2  | 4        | 10.4     | 9.2  | 4        | 8.3      | 9.2  | 20        | 7.2      | 46.2  |
| 5                                | 20.0     | 11.6 | 5        | 12.0     | 11.6 | 5        | 9.3      | 11.6 | 25        | 8.0      | 57.8  |
|                                  |          |      | 6        | 13.6     | 13.9 | 6        | 10.4     | 13.9 | 30        | 8.8      | 69.3  |
|                                  |          |      | 7        | 15.2     | 16.2 | 7        | 11.5     | 16.2 | 35        | 9.6      | 80.9  |
|                                  |          |      | 8        | 16.8     | 18.5 | 8        | 12.5     | 18.5 | 40        | 10.4     | 92.4  |
|                                  |          |      | 9        | 18.4     | 20.8 | 9        | 13.6     | 20.8 | 45        | 11.2     | 104.0 |
|                                  |          |      | 10       | 20.0     | 23.1 | 10       | 14.7     | 23.1 | 20        | 7.2      | 46.2  |
|                                  |          |      |          |          |      | 11       | 15.7     | 25.4 | 22        | 7.5      | 50.8  |
|                                  |          |      |          |          |      | 12       | 16.8     | 27.7 | 60        | 13.6     | 138.6 |
|                                  |          |      |          |          |      | 13       | 17.9     | 30.0 | 65        | 14.4     | 150.2 |
|                                  |          |      |          |          |      | 14       | 18.9     | 32.3 | 70        | 15.2     | 161.7 |
|                                  |          |      |          |          |      | 15       | 20.0     | 34.7 | 75        | 16.0     | 173.3 |
|                                  |          |      |          |          |      |          |          |      | 80        | 16.8     | 184.8 |
|                                  |          |      |          |          |      |          |          |      | 85        | 17.6     | 196.4 |
|                                  |          |      |          |          |      |          |          |      | 90        | 18.4     | 207.9 |
|                                  |          |      |          |          |      |          |          |      | 95        | 19.2     | 219.5 |
|                                  |          |      |          |          |      |          |          |      | 100       | 20.0     | 231.0 |

Figure 4.25

## • 4-20 Setup Menu (4-20 SET)

| Menu  | Parameter              | RST-4001 Options     | Software Options        |
|-------|------------------------|----------------------|-------------------------|
| 4-20  | <i>Min mA Setpoint</i> | Default = 1.00 (ft)  | Default = 1.00 Feet     |
| Setup | <i>(MinMaSet)</i>      | 0.00 - 25.00 Feet    | 0.00 - 25.00 Feet       |
|       |                        | 0.0 - 300.0 Inch     | 0.0 - 300.0 Inches      |
|       |                        | 0.000 - 7.620 Meters | 0.000 - 7.620 Meters    |
|       |                        | 0000 - 7620 MM       | 0000 - 7620 Millimeters |

*Min mA Setpoint (MinMaSet on the RST-4001)* sets the distance from the sensor to level corresponding to minimum output (4mA). (See Figures 4.26 - 4.28)

| Menu  | Parameter              | RST-4001 Options     | Software Options        |
|-------|------------------------|----------------------|-------------------------|
| 4-20  | <i>Max mA Setpoint</i> | Default = 20.00 (ft) | Default = 20.00 Feet    |
| Setup | <i>(MaxMaSet)</i>      | 0.00 - 25.00 Feet    | 0.00 - 25.00 Feet       |
|       |                        | 0.0 - 300.0 Inch     | 0.0 - 300.0 Inches      |
|       |                        | 0.000 - 7.620 Meters | 0.000 - 7.620 Meters    |
|       |                        | 0000 - 7620 MM       | 0000 - 7620 Millimeters |

*Min mA Setpoint (MinMaSet on the RST-4001)* sets the distance from the sensor to level corresponding to maximum output (20mA). (See Figures 4.26 - 4.28)



LPU-2428

**Main** Min mA Setpoint 1.00 (0 - 20.00 ft)

**Basic Setup** Max mA Setpoint 1.00 (0 - 20.00 ft)

**App. Setup** Fail Safe Hold

**4-20 Setup** Fail Safe Delay 15 15-9999 Sec

**Calibration**

**Advanced**

**Utilities**

Distance = 5.29 ft RST - Sensor Communicating

Temperature = 21 C USB - RST Communication OK

Volume = NA Send Receive EXIT

4-20mA = NaN

Instructions

View All

Wiring

☒ Tool Tips

12:21:44 PM Thursday, February 05, 2015

Figure 4.26

| Menu  | Parameter  | RST-4001 Options | Software Options |
|-------|------------|------------------|------------------|
| 4-20  | Fail Safe  | Default = 3.8 MA | Default = Hold   |
| Setup | (FailSafe) | 3.8 MA           | Hold             |
|       |            | 22 MA            | 3.8 mA           |
|       |            | Hold             | 22mA             |

*Fail Safe* (*FailSafe* on the RST-4001) sets the output condition that the sensor will revert to in the event of a loss of echo condition. If Fail Safe is set to Hold, the sensor will hold the last reading until the signal is regained. (See Figure 4.26)

| Menu  | Parameter       | RST-4001 Options   | Software Options |
|-------|-----------------|--------------------|------------------|
| 4-20  | Fail Safe Delay | Default = 15 (sec) | Default = 15 sec |
| Setup | (FS Delay)      | 15 - 9999          | 15 - 9999 sec    |

*Fail Safe* (*FailSafe* on the RST-4001) sets the delay, in seconds, before the output shows the loss of echo condition set in Fail Safe. When this time has expired, the output will change to the Fail Safe settings. (See Figure 4.26)

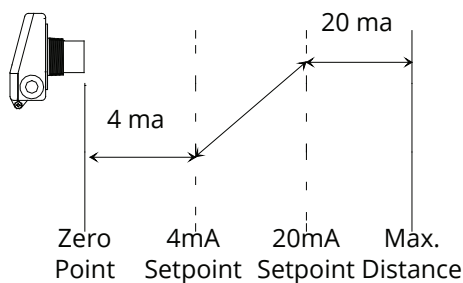


Figure 4.27

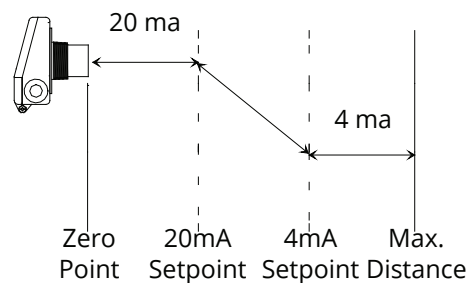


Figure 4.28

## • Calibration (CALIBRAT)

| Menu   | Parameter                  | RST-4001 Options                  | Software Options                      |
|--------|----------------------------|-----------------------------------|---------------------------------------|
| Calib. | Min mA Value<br>(MinMaVal) | Default = 4.00<br>4.00 - MaxMaVal | Default = 4.00<br>4.00 - Max mA Value |

Min mA Value (MinMaVal on the RST-4001) sets the minimum current output of the sensor. (See Figure 4.29)

| Menu   | Parameter                  | RST-4001 Options                    | Software Options                        |
|--------|----------------------------|-------------------------------------|-----------------------------------------|
| Calib. | Max mA Value<br>(MaxMaVal) | Default = 20.00<br>MinMaVal - 20.00 | Default = 20.00<br>Min mA Value - 20.00 |

Max mA Value (MaxMaVal on the RST-4001) sets the maximum current output of the sensor. (See Figure 4.29)

| Menu   | Parameter                 | RST-4001 Options         | Software Options         |
|--------|---------------------------|--------------------------|--------------------------|
| Calib. | Min mA Trim<br>(Min Trim) | Default = 500<br>0 - 999 | Default = 500<br>0 - 999 |

Min mA Trim (Min Trim on the RST-4001) fine tunes the minimum current output of the sensor. (See Figure 4.29)

| Menu   | Parameter                 | RST-4001 Options         | Software Options         |
|--------|---------------------------|--------------------------|--------------------------|
| Calib. | Max mA Trim<br>(Max Trim) | Default = 500<br>0 - 999 | Default = 500<br>0 - 999 |

Max mA Trim (Max Trim on the RST-4001) fine tunes the maximum current output of the sensor. (See Figure 4.29)

| Menu   | Parameter                | RST-4001 Options                 | Software Options                 |
|--------|--------------------------|----------------------------------|----------------------------------|
| Calib. | Multiplier<br>(Multipli) | Default = 1.000<br>0.000 - 1.999 | Default = 1.000<br>0.000 - 1.999 |

Multiplier (Multipli on the RST-4001) calibrates the sensor for variations in the speed of sound due to variations in atmospheres. The default of 1.000 is used for most applications. (See Figure 4.29)

| Menu   | Parameter          | RST-4001 Options                     | Software Options                     |
|--------|--------------------|--------------------------------------|--------------------------------------|
| Calib. | Offset<br>(Offset) | Default = 0.00<br>- 3.00 - 3.00 (ft) | Default = 0.00<br>- 3.00 - 3.00 (ft) |

Offset (Offset on the RST-4001) is used to change the Zero Point of the sensor. This not the zero output (4 mA) point of the sensor. The Zero Point of the sensor is the point from which the calculated distance is measured. (See Figures 4.27, 4.28, and 4.29)



The screenshot shows the LPU-2428 software interface. On the left is a vertical menu with buttons: Main, Basic Setup, App. Setup, 4-20 Setup, Calibration, Advanced, and Utilities. The main area displays configuration parameters for each menu. Under 'Main', 'Min mA Value ( 4.00 - MaxMa Value)' is set to 20.00. Under 'Basic Setup', 'Max mA Value (MinMa Value - 20.00 )' is 20.00. Under 'App. Setup', 'Min mA Trim ( 0 - 999 )' is 400 and 'Max mA Trim ( 0 - 999 )' is 500. Under '4-20 Setup', 'Multiplier ( 0 - 1.999 )' is 1.000. Under 'Calibration', 'Offset (-3ft to +3ft )' is 0.00. The 'Advanced' menu is currently selected. At the bottom, status information is displayed: 'Distance = 5.86 ft', 'Temperature = 21 C', 'Volume = NA', and '4-20mA = NaN'. To the right of this is a box showing 'RST - Sensor Communicating' and 'USB - RST Communication OK'. Below the status box are 'Send', 'Receive', and 'EXIT' buttons. At the bottom right are buttons for 'Instructions', 'View All', and 'Wiring'. At the bottom left, there is a 'Tool Tips' checkbox (checked) and a timestamp '12:22:21 PM Thursday, February 05, 2015'.

Figure 4.29

- **Advanced (ADVANCED)**

| Menu   | Parameter                 | RST-4001 Options         | Software Options         |
|--------|---------------------------|--------------------------|--------------------------|
| Advncd | Temp. Comp.<br>(TempComp) | Default = ON<br>ON / OFF | Default = ON<br>ON / OFF |

*Temperature Compensation (TempComp on the RST-4001)* activates or deactivates the internal temperature compensation circuit. The speed of sound changes with changes in temperature, therefore changes in temperature can affect distance measurements. (See Figure 4.30)

| Menu   | Parameter                  | RST-4001 Options                                                 | Software Options                                                         |
|--------|----------------------------|------------------------------------------------------------------|--------------------------------------------------------------------------|
| Advncd | Gain Control<br>(GainCont) | Default = AutoSens<br>AutoSens<br>HardTarg<br>SoftTarg<br>Manual | Default = AutoSense<br>Manual<br>AutoSense<br>Hard Target<br>Soft Target |

*Gain Control (GainCont on the RST-4001)* selects the control mode for the sensor's gain settings (Sensitivity and Pulses). In AutoSense, the sensor automatically adjusts the sensitivity and pulses for the best quality return signal. Manual, Hard Target, and Soft Target are user controlled scenarios. In Manual, the user is in full control of sensitivity and pulses. For Hard and Soft Target, the user sets sensitivity and pulses, but the overall gain is either ramped up slowly (Hard Target) or quickly (Soft Target) by the sensor. (See Figure 4.30)

Figure 4.30

| Menu   | Parameter                                 | RST-4001 Options          | Software Options           |
|--------|-------------------------------------------|---------------------------|----------------------------|
| Advncd | <i>Sensitivity</i><br>( <i>Sensitiv</i> ) | Default = 85%<br>0 - 100% | Default = 100%<br>0 - 100% |

*Sensitivity* (*Sensitiv* on the RST-4001) sets the amount of gain applied to the recieved signal. For gain control settings Auto Sense, Hard Target, and Soft Target, this setting limits the maximum gain applied by the sensor. (See Figure 4.30)

| Menu   | Parameter                          | RST-4001 Options       | Software Options       |
|--------|------------------------------------|------------------------|------------------------|
| Advncd | <i>Pulses</i><br>( <i>Pulses</i> ) | Default = 16<br>0 - 16 | Default = 16<br>0 - 16 |

*Pulses* (*Pulses* on the RST-4001) sets number ultrasonic pulses per transmission burst. For gain control settings Auto Sense, Hard Target, and Soft Target, this setting limits the maximum number of pulses used by the sensor. The more pulses that are sent in a burst, the stronger the returning echo. When operating in Manual, increase the strength of the transmission by increasing the number of pulses for detecting soft targets in damping environments. In acoustically active environments or small enclosed areas, decrease the number of pulses to reduce multiple echoes. (See Figure 4.30)

| Menu   | Parameter                              | RST-4001 Options                                                                                       | Software Options                                                                                                  |
|--------|----------------------------------------|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Advncd | <i>Blanking</i><br>( <i>Blanking</i> ) | Default = 1.00 (ft)<br>0.00 - 25.00 Feet<br>0.0 - 300.0 Inch<br>0.000 - 7.620 Meters<br>0000 - 7620 MM | Default = 1.00 (ft)<br>1.00 - 25.00 Feet<br>12.0 - 300.0 Inches<br>0.305 - 7.620 Meters<br>305 - 7620 Millimeters |

*Blanking* (*Blanking* on the RST-4001) sets the Blanking distance, which is the zone from the sensor to a point where the first echo will be accepted. Blanking distance is used to ignore unwanted targets -- such as welds, seams, pipe fittings, or gaskets -- between the sensor and the closest acceptable target level. Because of the physical properties of an ultrasonic sensor, objects cannot be detected closer than approximately 1 foot from the face of the transducer. This distance varies according to how much energy is being transmitted and the installation. Low pulses and soft mounting may allow target detection as close as 6 inches. (See Figure 4.30)

## • Utilities (UTILITIE)

| Menu      | Parameter                                             | RST-4001 Options                                                                                       | Software Options                                                                                                  |
|-----------|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Utilities | <i>Low Distance Simulation</i><br>( <i>LoDisSim</i> ) | Default = 1.00 (ft)<br>0.00 - 25.00 Feet<br>0.0 - 300.0 Inch<br>0.000 - 7.620 Meters<br>0000 - 7620 MM | Default = 1.00 (ft)<br>1.00 - 25.00 Feet<br>12.0 - 300.0 Inches<br>0.305 - 7.620 Meters<br>305 - 7620 Millimeters |

*Low Distance Simulation* (*LoDisSim* on the RST-4001) sets the low distance point for simulation. (See Figure 4.31)

| Menu      | Parameter                                              | RST-4001 Options                                                                                       | Software Options                                                                                                  |
|-----------|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Utilities | <i>High Distance Simulation</i><br>( <i>HiDisSim</i> ) | Default = 1.00 (ft)<br>0.00 - 25.00 Feet<br>0.0 - 300.0 Inch<br>0.000 - 7.620 Meters<br>0000 - 7620 MM | Default = 1.00 (ft)<br>1.00 - 25.00 Feet<br>12.0 - 300.0 Inches<br>0.305 - 7.620 Meters<br>305 - 7620 Millimeters |

*High Distance Simulation* (*HiDisSim* on the RST-4001) sets the high distance point for simulation. (See Figure 4.31)

| Menu      | Parameter                                           | RST-4001 Options                               | Software Options                                               |
|-----------|-----------------------------------------------------|------------------------------------------------|----------------------------------------------------------------|
| Utilities | <i>Simulation Cycle Time</i><br>( <i>SimCycle</i> ) | Default = Off<br>Off<br>10 - 9999 seconds = On | Default = Off<br>0 - 9 seconds = Off<br>15 - 9999 seconds = On |

*Simulation Cycle Time* (*SimCycle* on the RST-4001) sets the running time for a cycle simulation between the low distance point and high distance point set above. (See Figure 4.31)

| Menu      | Parameter                        | RST-4001 Options                                  | Software Options                               |
|-----------|----------------------------------|---------------------------------------------------|------------------------------------------------|
| Utilities | <i>Reset</i><br>( <i>Reset</i> ) | Default = No Reset<br>No Reset<br>Sensor<br>Total | Default = No Reset<br>No Reset<br>Sensor Reset |

*Reset* (*Reset* on the RST-4001) resets the sensor to factory defaults. (See Figure 4.31)

The screenshot shows the LPU-2428 software interface. On the left, there are tabs for Main, Basic Setup, App. Setup, 4-20 Setup, Calibration, Advanced, and Utilities. The main area contains several configuration fields: Low Distance Simulation (1.00 - 20.00 ft), High Distance Simulation (2.25 - 20.00 ft), Simulation Cycle Time (9, 15-9999 Sec), Reset (No Reset), File System (Select), and Software Version (1). At the bottom, there are status fields for Distance (5.86 ft), Temperature (21 C), Volume (NA), and 4-20mA (NaN). To the right of these are status indicators for RST - Sensor Communicating and USB - RST Communication OK. There are also buttons for Send, Receive, EXIT, Instructions, View All, and Wiring. A checkbox for Tool Tips is checked, and the date/time is Thursday, February 05, 2015, 12:24:31 PM.

Figure 4.31

| Menu      | Parameter        | RST-4001 Options                                  | Software Options                               |
|-----------|------------------|---------------------------------------------------|------------------------------------------------|
| Utilities | Reset<br>(Reset) | Default = No Reset<br>No Reset<br>Sensor<br>Total | Default = No Reset<br>No Reset<br>Sensor Reset |

*Reset* (*Reset* on the RST-4001) resets the sensor to factory defaults. The Total option on the RST-4001 resets the resettable totalizer. (See Figure 4.31)

| Menu      | Parameter   | RST-4001 Options | Software Options                                                                     |
|-----------|-------------|------------------|--------------------------------------------------------------------------------------|
| Utilities | File System | -----            | Default = None<br>Sensor to File<br>File to Sensor<br>Compare Sensor to File<br>None |

*File System* (not configurable on the RST-4001) allows the user to edit, save, and load text files containing sensor parameters. (See Figure 4.31)

| Menu      | Parameter                     | RST-4001 Options | Software Options |
|-----------|-------------------------------|------------------|------------------|
| Utilities | Software Version<br>(Version) |                  |                  |

*Software Version* (*Version* on the RST-4001) displays the current software version running on the sensor. (See Figure 4.31)

- **Totalization (TOTALIZE)**

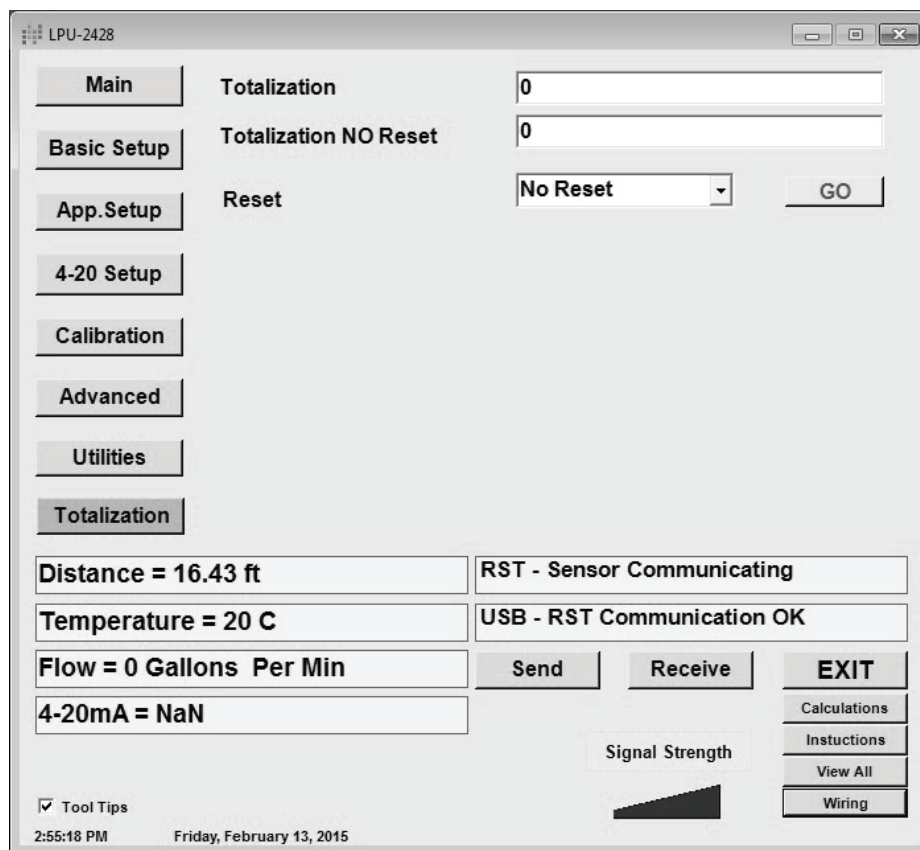
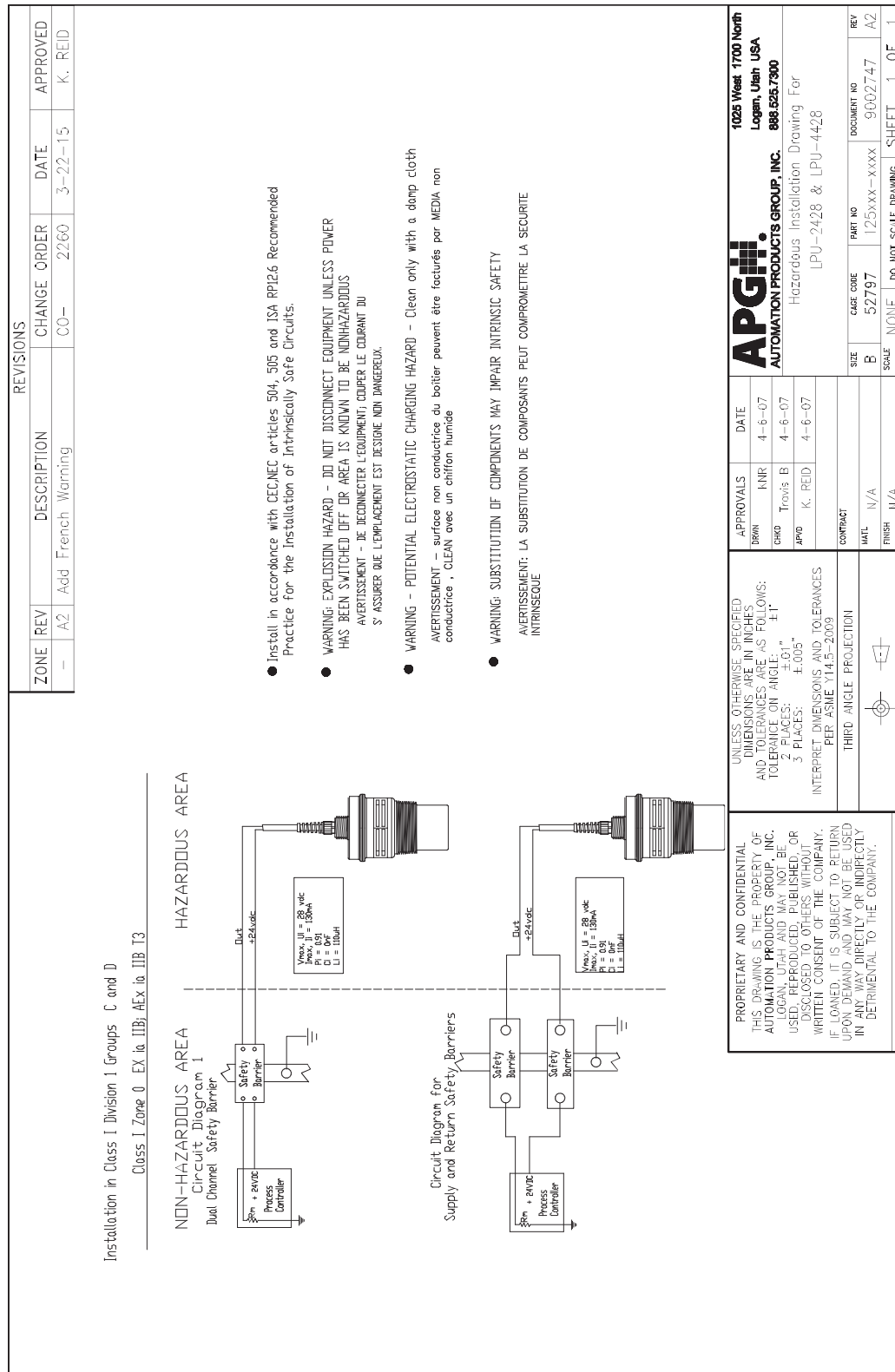


Figure 4.32

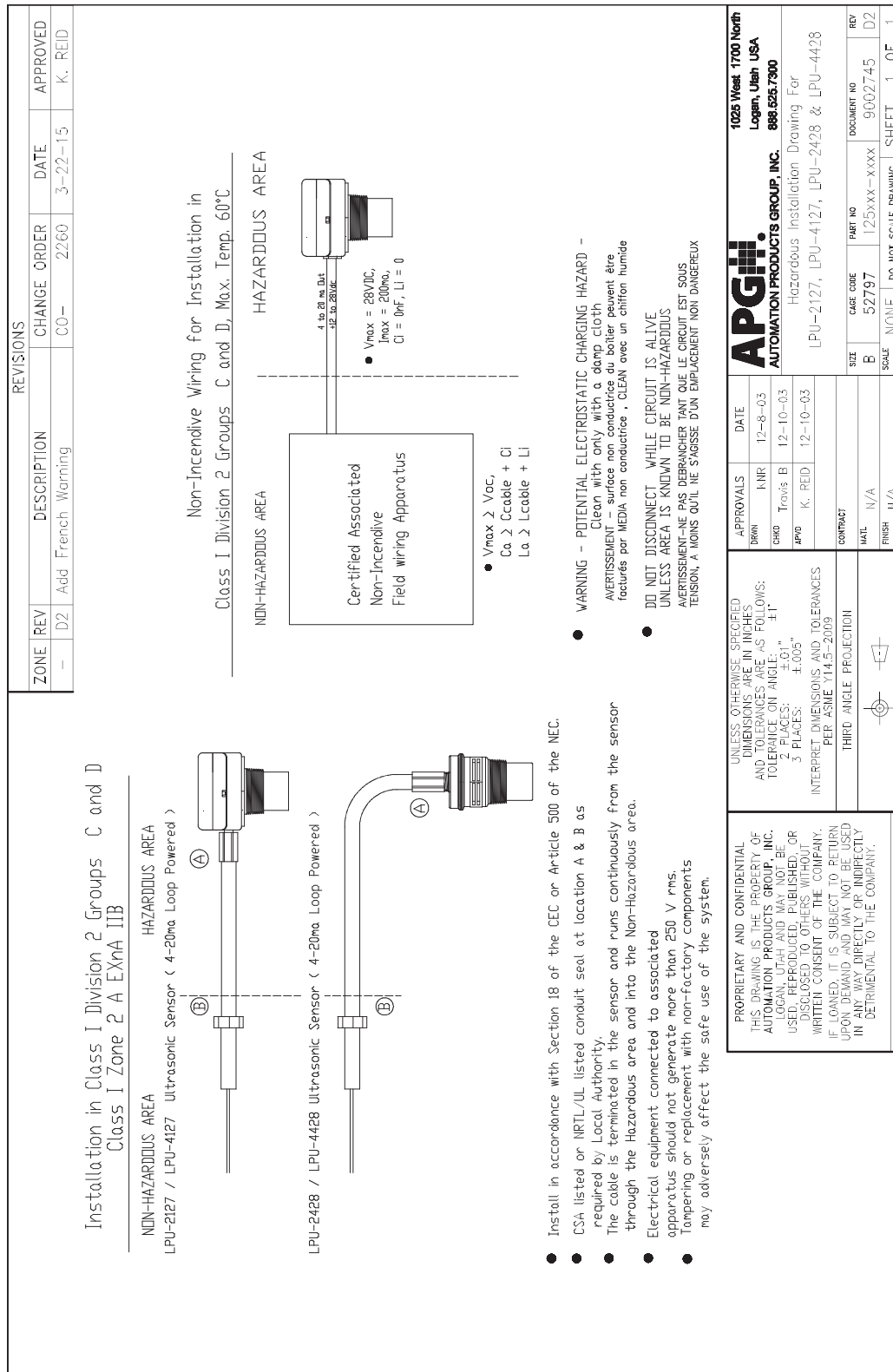
| Menu | Parameter                  | RST-4001 Options              | Software Options                               |
|------|----------------------------|-------------------------------|------------------------------------------------|
| Flow | Totalization<br>(TOTALIZE) | Tot Rese<br>Tot NonR<br>----- | Totalization<br>Totalization NO Reset<br>Reset |

*Totalization (TOTALIZE on the RST-4001)* is a submenu available only when Flow is the selected Application/ OutFunc. The sensor writes to two totalizers--one of which can be reset--and updates the totals to the LPU-2428 software in one minute increments. To reset the resettable totalizer via the RST-4001 use the UTILITIE menu. (See Figure 4.32)

- **Intrinsically Safe Wiring Diagram**



- **Hazardous Location Wiring Diagram**



- **CSA Certificate of Compliance**



# Certificate of Compliance

**Certificate:** 1911747

**Master Contract:** 237484

**Project:** 2386064

**Date Issued:** April 29, 2011

**Issued to:** Automation Products Group Inc

1025 West 1700 North  
Logan, UT 84321  
USA

Attention: Karl Reid

*The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.*



*Rawn Murphy*

**Issued by:** Rawn Murphy

## PRODUCTS

**CLASS 2258 82** - PROCESS CONTROL EQUIPMENT - For Hazardous Locations -  
Certified to US Standards

**CLASS 2258 02** - PROCESS CONTROL EQUIPMENT - For Hazardous Locations

**Class I, Division 2, Groups C and D, T6**

**Ex nA IIB T6; IP65**

**Class I, Zone 2; AEx nA IIB T6; IP65**

LPU Series Ultrasonic Sensors, Models LPU-2127, LPU-4127, LPU-2428 and LPU 4428; Rated input 12 to 28Vdc, Outputs 4-20mA; Ambient temperature range -40°C to +60°C.

LOE Series Ultrasonic Sensors, Models LOE-2126, LOE-6126, and LOE-3136; Rated input 48VDC or 12 to 28Vdc, 200 mA containing two optically-coupled MOSFET solid-state relay outputs rated 1500 Vr.m.s isolation voltage; Ambient temperature range -40°C to +60°C.

Note:

1) The LOE Series shall be powered by a suitable certified Class 2 power supply.





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**CLASS 2258 04 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe, Entity - For Hazardous Locations**

**CLASS 2258 84 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe, Entity - For Hazardous Locations - Certified to US Standards**

**Class I, Division 1, Groups C and D, T3**

**Ex ia IIB, T3 (Canada); IP65**

**Class I, Zone 0; AEx ia IIB, T3 (USA); IP65**

LPU-2428 and LPU-4428 ultrasonic sensors; Rated input 12 to 28VDC, Outputs 4-20mA, Ambient temperature range -40°C to +60°C. Entity Parameters  $V_{max} = 28VDC$ ,  $I_{max} = 130mA$ ,  $P_i = 0.91W$ ,  $C_i = 0nF$ ,  $L_i = 110\mu H$ , intrinsically safe when connected in accordance with Installation drawing 9002747.

#### **APPLICABLE REQUIREMENTS**

|                                     |                                                                                                                                     |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| CAN/CSA Standard C22.2 No. 0-M91    | General Requirements - Canadian Electrical Code, Part II                                                                            |
| CSA Standard C22.2 No.142-M1987     | Process Control Equipment Industrial Products                                                                                       |
| CAN/CSA Standard C22.2 No.157-92    | Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations                                                       |
| CAN/CSA Standard C22.2 No.213-M1987 | Non-incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations Industrial Products                           |
| CAN/CSA Standard E60079-0-02        | Electrical Apparatus for Explosive Gas Atmospheres – Part 0: General Requirements                                                   |
| CAN/CSA Standard E60079-11-02       | Electrical Apparatus for Explosive Gas Atmospheres – Part 11: Intrinsic Safety "i"                                                  |
| CAN/CSA Standard E60079-15-02       | Electrical Apparatus for Explosive Gas Atmospheres - Part 15: Type of Protection "n"                                                |
| CAN/CSA Standard C22.2 No. 60529-05 | Degrees of Protection Provided by Enclosures (IP Code)                                                                              |
| UL Standard 508                     | Industrial Control Equipment                                                                                                        |
| UL Standard 913                     | Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations |



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|                                 |                                                                                                                                           |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| ANSI/ISA Standard 12.12.01-2007 | Nonincendive Electrical Equipment for Use in Class I and II, Division 2, and Class III Divisions 1 and 2 Hazardous (Classified) Locations |
| UL Standard 60079-0             | Electrical Apparatus for Explosive Gas Atmospheres – Part 0: General Requirements                                                         |
| UL Standard 60079-11            | Electrical Apparatus for Explosive Gas Atmospheres Part 11: Intrinsic Safety "i"                                                          |
| UL Standard 60079-15            | Electrical Apparatus for Explosive Gas Atmospheres Part 15: Electrical Apparatus with Type of Protection "n"                              |
| IEC 60529                       | Degrees of Protection Provided by Enclosures (IP Code)                                                                                    |

## MARKINGS

The following markings are provided on CSA-Accepted (Class 7922-01, File number 99316) adhesive label stock Product Number 7871 manufactured by 3M Company, which is suitable for indoor or outdoor use on Plastic Group VII, at a maximum service temperature of 80°C or higher. The label stock shall be printed with one of the approved printer and ink combinations as specified in the manufacturers listing and the finished label is affixed to the housing.

- Manufacturer's name, "Automation Products Group", or CSA Master Contract Number "237484", adjacent to the CSA Mark in lieu of Manufacturer's name.
- Model number: as specified in the PRODUCTS section, above.
- Electrical ratings: as specified in the PRODUCTS section, above.
- Ambient temperature rating: as specified in the PRODUCTS section, above (may be abbreviated).
- Manufacturing date in MMY format, or serial number, traceable to month of manufacture.
- The CSA Mark with "C" and "US" indicators, as shown on the Certificate of Conformity.
- Hazardous Location designation: as specified in the PRODUCTS section, above.
- Temperature Code: as specified in the PRODUCTS section, above (May appear on control drawing).
- Class I Division 1 additional Markings -
  - "Exia" followed by "IIB"
  - "INTRINSICALLY SAFE"
  - "WARNING- EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY" (Equivalent wording is acceptable).
  - "WARNING- TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTIBLE ATMOSPHERES, DISCONNECT POWER BEFORE SERVICING".
  - "Install per Drawing 9002748" (or equivalent): as specified in the PRODUCTS section, above
- Class I Division 2 additional Markings –
  - "Ex nA" followed by "IIB"
  - "WARNING- DO NOT DISCONNECT EQUIPMENT UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS".
  - "WARNING – POTENTIAL ELECTROSTATIC CHARGING HAZARD – SEE INSTRUCTIONS" (or equivalent).



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- 
- For the LPU Series Ultrasonic Sensors, the words “Reference installation drawing number 9002745” (or equivalent): as specified in the PRODUCTS section, above
  - For the LOE Series Ultrasonic Sensors, the words “Reference installation drawing number 9003469” (or equivalent): as specified in the PRODUCTS section, above
  - For the LOE Series Ultrasonic Sensors, the manual shall contain the following words: “WARNING – NONCONDUCTIVE SURFACE OF THE HOUSING MAY BE CHARGED BY NONCONDUCTIVE MEDIA, CLEAN WITH A DAMP CLOTH”

*Note - Jurisdictions in Canada may require these markings to also be provided in French language. It is the responsibility of the manufacturer to provide bilingual marking, where applicable, in accordance with the requirements of the Provincial Regulatory Authorities. It is the responsibility of the manufacturer to determine this requirement and have bilingual wording added to the "Markings".*



**Automation Products Group, Inc.**

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