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**Reference Manual**
00809-0100-4108, Rev BA
March 2014

# Rosemount® 2088 Pressure Transmitter

## with HART® Revision 5 and 7 Selectable Protocol





HART COMMUNICATION PROTOCOL

ROSEMOUNT

EMERSON. Process Management

# Rosemount 2088 Pressure Transmitter

## ⚠ WARNING

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

For technical assistance, contacts are listed below:

Customer Central
Technical support, quoting, and order-related questions.

United States - 1-800-999-9307 (7:00 am to 7:00 pm CST)

Asia Pacific- 65 777 8211

Europe/ Middle East/ Africa - 49 (8153) 9390

North American Response Center
Equipment service needs.

1-800-654-7768 (24 hours—includes Canada)

Outside of these areas, contact your local Emerson Process Management representative.

## ⚠ CAUTION

The products described in this document are NOT designed for nuclear-qualified applications. Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact your local Emerson Process Management Sales Representative.

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## 1.1 Using this manual

The sections in this manual provide information on installing, operating, and maintaining the Rosemount 2088. The sections are organized as follows:

Section 2: Configuration provides instruction on commissioning and operating Rosemount 2088 Transmitters. Information on software functions, configuration parameters, and online variables is also included.

Section 3: Hardware installation contains mechanical installation instructions, and field upgrade options.

Section 4: Electrical installation contains electrical installation instructions, and field upgrade options.

Section 5: Operation and maintenance provides detailed information on calibrating and changing HART Revisions.

Section 6: Troubleshooting provides troubleshooting techniques for the most common operating problems.

Appendix A: Specifications and reference data supplies reference and specification data, as well as ordering information.

Appendix B: Product Certifications contains intrinsic safety approval information, European ATEX directive information, and approval drawings.

Appendix C: Field communicator menu trees and Fast Keys provides full menu trees and abbreviated Fast Key sequences for commissioning tasks.

Appendix D: Local operator interface provides detailed LOI menu trees.

# 1.2 Models covered

The following Rosemount 2088 Pressure Transmitters are covered by this manual:

## 1.2.1 Rosemount 2088G Gage Pressure Transmitter

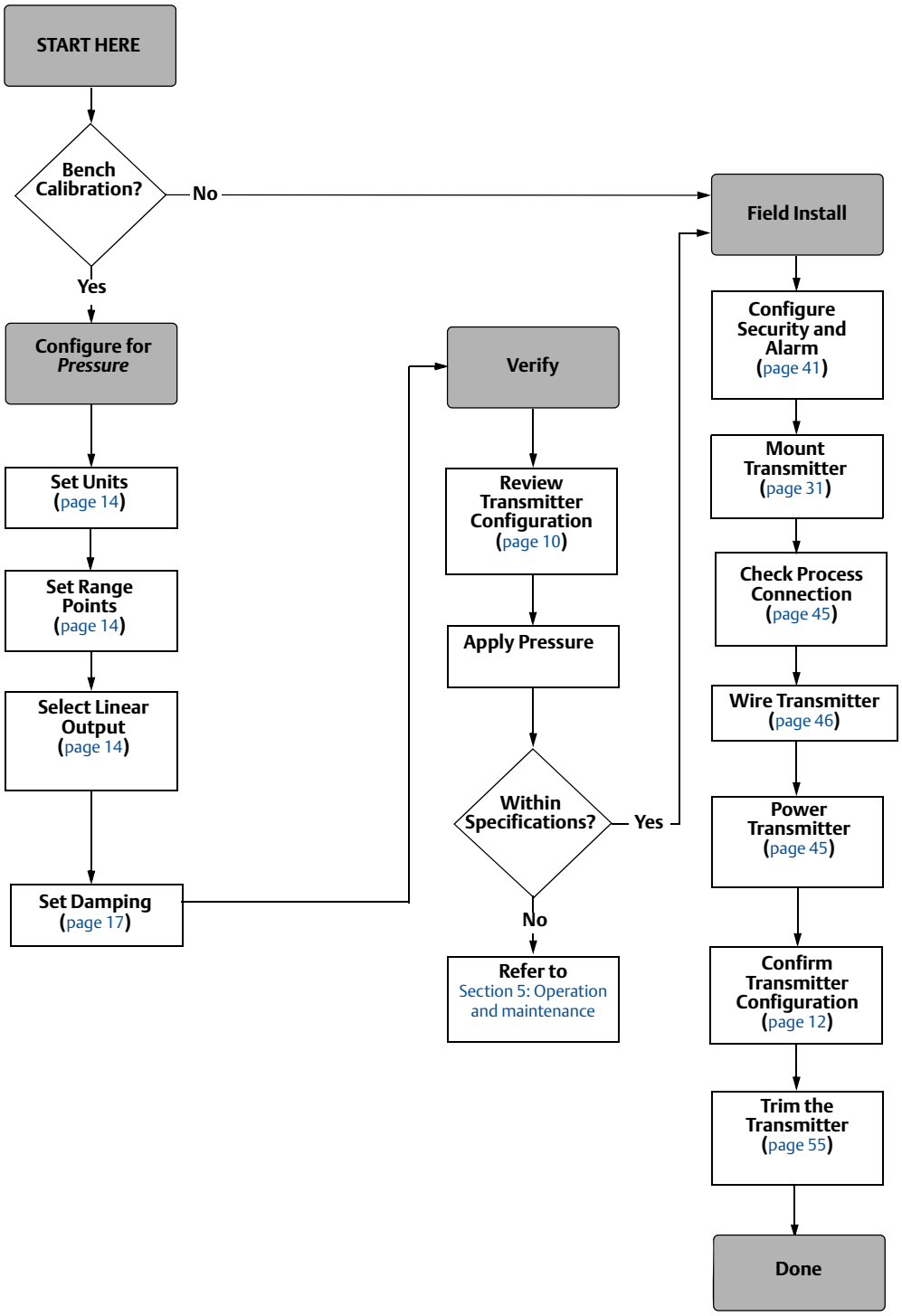
- Measures gage pressure up to 4000 psi (275,8 bar).

## 1.2.2 Rosemount 2088A Absolute Pressure Transmitter

- Measures absolute pressure up to 4000 psi (275,8 bar).

# 1.3 HART installation flowchart

**Figure 1-1. HART installation flowchart**



# 1.4 Transmitter overview

The Rosemount 2088G and Rosemount 2088A are offered for Gage Pressure (GP) and Absolute Pressure (AP) measurements. The Rosemount 2088 utilizes piezoresistive sensor technology for AP and GP measurements.

The major components of the Rosemount 2088 are the sensor module and the electronics housing. The sensor module contains the oil filled sensor system (isolating diaphragm, oil fill system, and sensor) and the sensor electronics. The sensor electronics are installed within the sensor module and include a temperature sensor, a memory module, and the analog to digital signal converter (A/D converter). The electrical signals from the sensor module are transmitted to the output electronics in the electronics housing. The electronics housing contains the output electronics board, the optional external configuration buttons, and the terminal block. The basic block diagram of the Rosemount 2088 is illustrated in Figure 1-3 on page 5.

For the Rosemount 2088, pressure is applied to the isolating diaphragm. The oil deflects the sensor which then changes its capacitance or voltage signal. This signal is then changed to a digital signal by the Signal Processing. The microprocessor then takes the signals from the Signal Processing and calculates the correct output of the transmitter. This signal is then sent to the D/A converter, which converts the signal back to the analog signal, then superimposes the HART signal on the 4-20 mA output.

An optional LCD display can be ordered that connects directly to the interface board which maintains direct access to the signal terminals. The display indicates output and abbreviated diagnostic messages. A glass display cover is provided. For 4-20 mA HART output, the LCD display features a two-line display. The first line displays the actual measured value, the second line of six characters displays the engineering units. The LCD display can also display diagnostic messages.

**Note**
LCD display utilizes a 5x6 character display and can display output and diagnostic messages. The LOI display uses an 8x6 character display and can display output, diagnostic messages, and LOI menu screens. The LOI display comes with 2 buttons mounted on the front of the display board. See Figure 1-2.

**Figure 1-2. LCD display/LOI display**

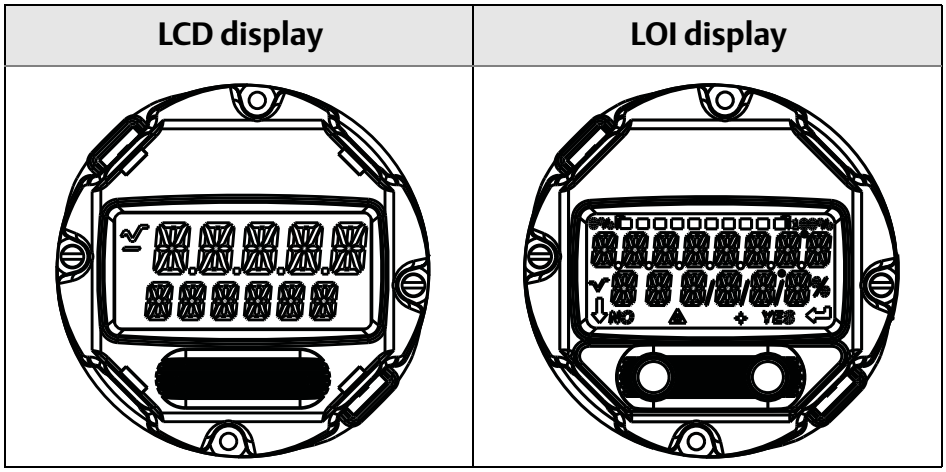
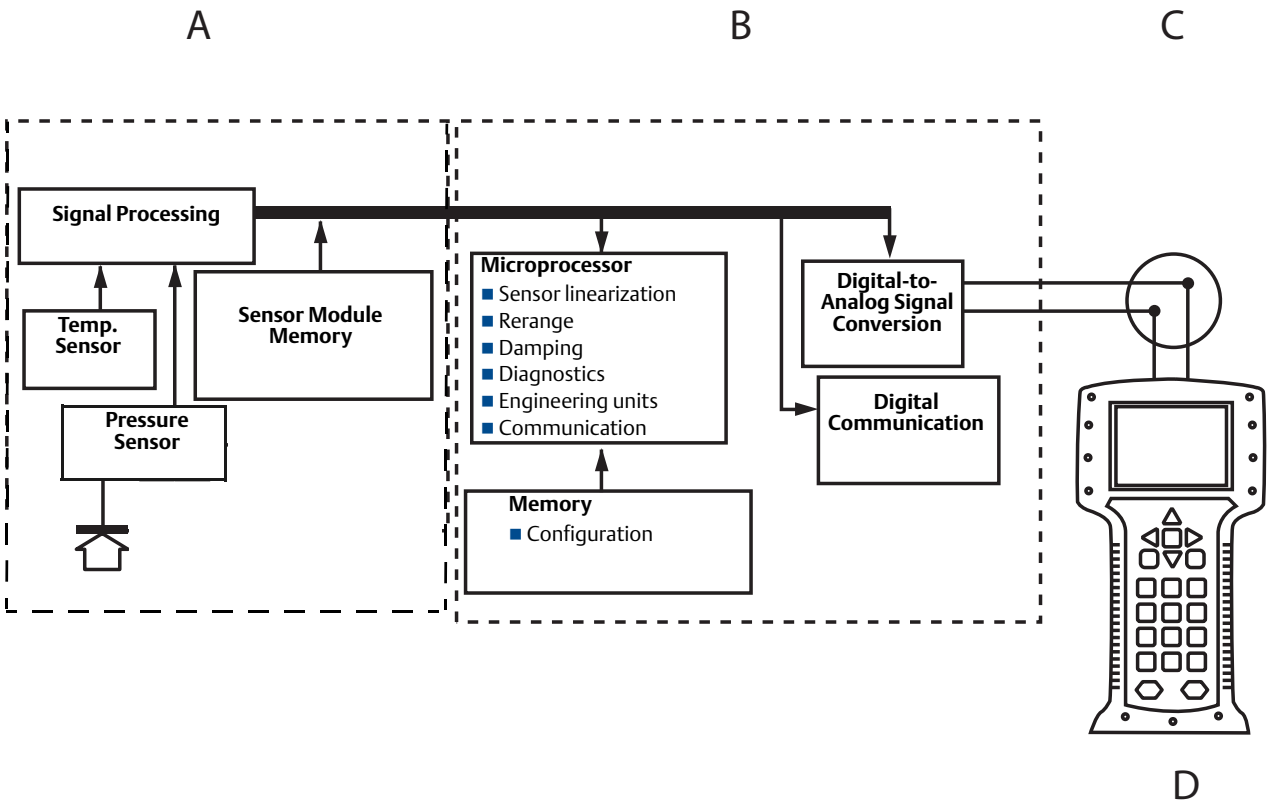



**Figure 1-3. Block diagram of operation**




**A. Sensor Module**
**B. Electronics Board**
**C. 4-20 mA Signal to Control System**
**D. Field Communicator**

## 1.5 Service support

Within the United States, call the Emerson Process Management Instrument and Valve Response Center using the 1-800-654-RSMT (7768) toll-free number. This center, available 24 hours a day, will assist you with any needed information or materials.

The center will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. The center will also ask for the process material to which the product was last exposed.

For inquiries outside of the United States, contact the nearest Emerson Process Management representative for RMA instructions.

To expedite the return process outside of the United States, contact the nearest Emerson Process Management representative.

**⚠ CAUTION**

Individuals who handle products exposed to a hazardous substance can avoid injury if they are informed of and understand the hazard. The product being returned will require a copy of the required Material Safety Data Sheet (MSDS) for each substance must be included with the returned goods.

Emerson Process Management Instrument and Valve Response Center representatives will explain the additional information and procedures necessary to return goods exposed to hazardous substances.

## 1.6 Product recycling/disposal

Recycling of equipment and packaging should be taken into consideration and disposed of in accordance with local and national legislation/regulations.

# Section 2 Configuration

Configuration overview . . . . . page 7
Safety messages . . . . . page 7
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Configuring burst mode . . . . . page 25
Establishing multidrop communication . . . . . page 27

## 2.1 Configuration overview

This section contains information on commissioning and tasks that should be performed on the bench prior to installation, as well as tasks performed after installation as described in "Performing transmitter tests" on page 24.

Field Communicator, AMS™ Device Manager, and Local Operator Interface (LOI) instructions are given to perform configuration functions. For convenience, Field Communicator Fast Key sequences are labeled "Fast Keys," and abbreviated LOI menus are provided for each function below.

Full Field Communicator menu trees and Fast Key sequences are available in Appendix C: Field communicator menu trees and Fast Keys . Local Operator Interface menu trees are available in Appendix D: Local operator interface .

## 2.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol ( ⚠ ). Refer to the following safety messages before performing an operation preceded by this symbol.

**⚠ WARNING**

Explosions could result in death or serious injury.

Installation of this transmitter in an explosive environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of the Rosemount 2088 reference manual for any restrictions associated with a safe installation.

- Before connecting a field communicator in an explosive atmosphere, ensure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- In an explosion-proof/flameproof installation, do not remove the transmitter covers when power is applied to the unit.

Process leaks may cause harm or result in death.

- Install and tighten process connectors before applying pressure.

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

# 2.3 System readiness

- If using HART based control or asset management systems, confirm the HART capability of such systems prior to commissioning and installation. Not all systems are capable of communicating with HART revision 7 devices.
- For instructions on how to change the HART revision of your transmitter, see "Switching HART revision" on page 61.

## 2.3.1 Confirm correct device driver

Verify the latest Device Driver (DD/DTM) is loaded on your systems to ensure proper communications.

1. Download the latest DD at www.emersonprocess.com or www.hartcomm.org.
2. In the Browse by Member dropdown menu, select Rosemount business unit of Emerson Process Management.
3. Select desired Product
   a. Within Table 2-1, use the HART Universal Revision and Device Revision numbers to find the correct Device Driver

**Table 2-1. Rosemount 2088 device revisions and files**

| Software release date | Identify device | | Find device driver | | Review instructions | Review functionality |
|---|---|---|---|---|---|---|
| | NAMUR software revision(1) | HART software revision(2) | HART universal revision | Device revision(3) | Manual document number | Changes to software |
| January 2013 | 1.0.0 | 01 | 7 | 10 | 00809-0100-4108 | See footnote (4) for list of changes. |
| | | | 5 | 9 | | |
| January 1998 | N/A | 178 | 5 | 3 | 00809-0100-4690 | N/A |

*(1) NAMUR Software Revision is located on the hardware tag of the device.*
*(2) HART Software Revision can be read using a HART capable configuration tool.*
*(3) Device Driver file names use Device and DD Revision, e.g. 10_01. HART Protocol is designed to enable legacy device driver revisions to continue to communicate with new HART devices. To access new functionality, the new Device Driver must be downloaded. It is recommended to download new Device Driver files to ensure full functionality.*
*(4) HART Revision 5 and 7 Selectable, Local Operator Interface, Scaled Variable, Configurable Alarms, Expanded Engineering Units.*

# 2.4 Configuration basics

**⚠ CAUTION**

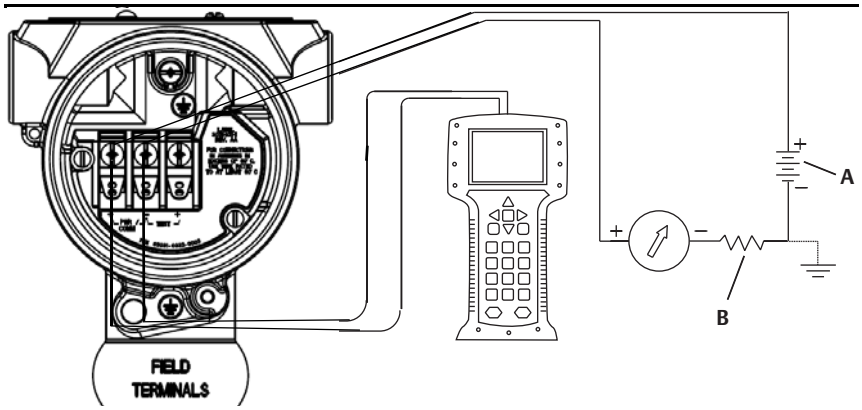
Set all transmitter hardware adjustments during commissioning to avoid exposing the transmitter electronics to the plant environment after installation.

The Rosemount 2088 can be configured either before or after installation. Configuring the transmitter on the bench using either a field communicator, AMS Device Manager, or Local Operator Interface (LOI) ensures all transmitter components are in working order prior to installation. Verify that the security switch is set in the unlock position ( ) in order to proceed with configuration. See Figure 4-2 on page 41 for switch location.

## 2.4.1 Configuring on the bench

To configure on the bench, required equipment includes a power supply, and a field communicator, AMS Device Manager, or an LOI (option M4). Wire equipment as shown in Figure 2-1 below. To ensure successful HART communication, a resistance of at least 250 Ωs must be present between the transmitter and the power supply, see “Power supply” on page 45 for details. Connect the field communicator leads to the terminals labeled “COMM” on the terminal block or 1-5V configuration, wire as shown in Figure 2-1 on page 10. The Field communicator is connected to the terminals labeled VOUT/COMM.

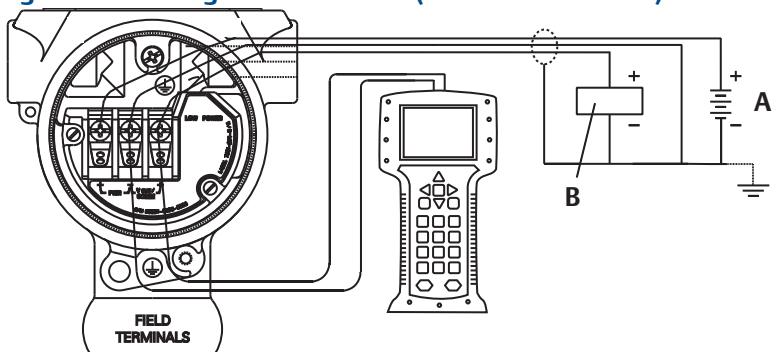
**Figure 2-1. Wiring the transmitter (4-20 mA HART)**




**A. Vdc supply**
**B. $R_L \geq 250$ (necessary for HART communication only)**

## 2.4.2 Configuration tools

**Figure 2-2. Wiring the transmitter (1-5 Vdc Low Power)**



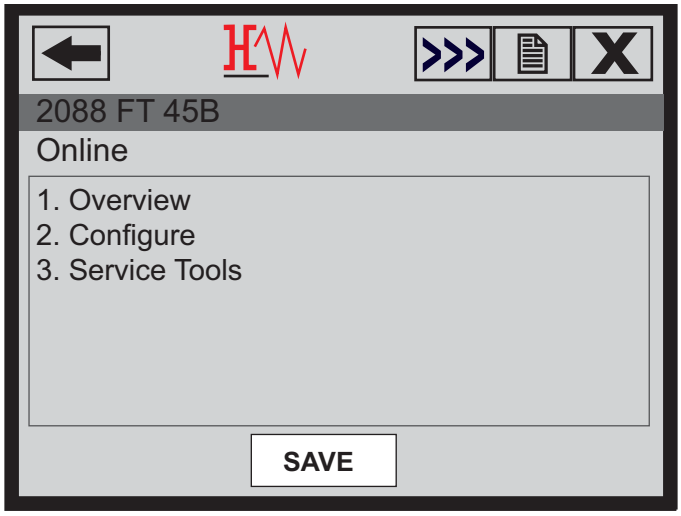

**A. DC power supply**
**B. Voltmeter**

### Configuring with a field communicator

There are two interfaces available with the Field Communicator: Traditional and Dashboard interfaces. All steps using a field communicator will be described using Dashboard interfaces. Figure 2-3 on page 11 shows the Device Dashboard interface. As stated in Section 2.3-System readiness , it is critical that the latest DD's are loaded into the Field Communicator. Visit www.emersonprocess.com or www.hartcomm.org to download latest DD library.

Field Communicator menu trees and Fast Keys are available in Appendix C: Field communicator menu trees and Fast Keys .

**Figure 2-3. Device dashboard**




## Configuring with AMS Device Manager

Full configuration capability with AMS Device Manager requires loading the most current Device Descriptor (DD) for this device. Download the latest DD at www.emersonprocess.com or www.hartcomm.org.

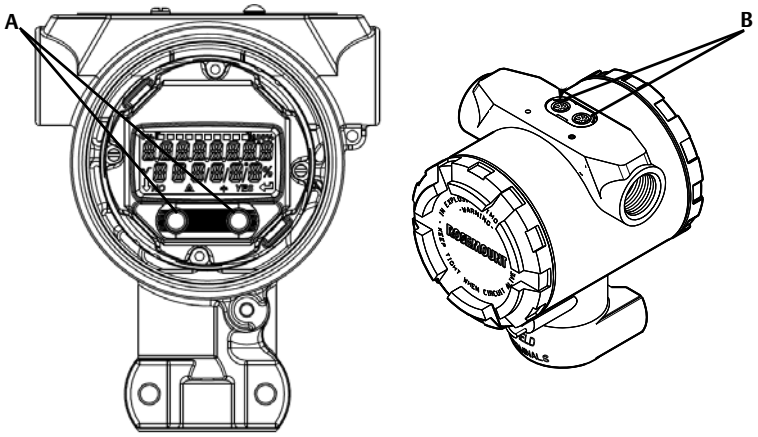
**Note**
All steps using AMS Device Manager will be described using version 11.5.

## Configuring with a local operator interface

The LOI requires option code M4 to be ordered. To activate the LOI push either configuration button. Configuration buttons are located on the LCD display (must remove housing cover to access), or underneath the top tag of the transmitter. See Table 2-2 for configuration button functionality and Figure 2-4 for configuration button location. When using the LOI for configuration, several features require multiple screens for a successful configuration. Data entered will be saved on a screen-by-screen basis; the LOI will indicate this by flashing “SAVED” on the LCD display each time.

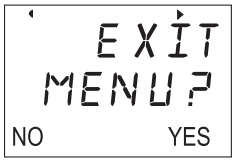
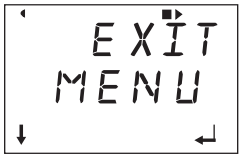
Local Operator Interface menu trees are available in Appendix D: Local operator interface .

**Figure 2-4. LOI configuration buttons**




**A. Internal configuration buttons**
**B. External configuration buttons**

**Table 2-2. LOI button operation**

| Button |  |  |
|---|---|---|
| Left | No | SCROLL |
| Right | Yes | ENTER |

## 2.4.3 Setting the loop to manual

⚠ Whenever sending or requesting data that would disrupt the loop or change the output of the transmitter, set the process application loop to manual control. The Field Communicator, AMS Device Manager, or the LOI will prompt you to set the loop to manual when necessary. The prompt is only a reminder; acknowledging this prompt does not set the loop to manual. It is necessary to set the loop to manual control as a separate operation.

# 2.5 Verify configuration

It is recommended that various configuration parameters are verified prior to installation into the process. The various parameters are detailed out for each configuration tool. Depending on what configuration tool(s) are available follow the steps listed relevant to each tool.

## 2.5.1 Verifying configuration with field communicator

Configuration parameters listed in Table 2-3 are to be reviewed prior to transmitter installation. A Full list of configuration parameters that can be reviewed and configured using a field communicator are located in Appendix C: Field communicator menu trees and Fast Keys .

Fast key sequences for the latest DD are shown in Table 2-3. For Fast Key sequences for legacy DD's contact your local Emerson Process Representative.

**Table 2-3. Rosemount 2088 device dashboard Fast Key sequence**

From the *HOME* screen, enter the Fast Key sequences listed

| Function | Fast Key sequence | |
|---|---|---|
| | HART 7 | HART 5 |
| Alarm and Saturation Levels | 2, 2, 2, 5 | 2, 2, 2, 5 |
| Damping | 2, 2, 1, 1, 5 | 2, 2, 1, 1, 5 |
| Primary Variable | 2, 1, 1, 4, 1 | 2, 1, 1, 4, 1 |
| Range Values | 2, 1, 1, 4 | 2, 1, 1, 4 |
| Tag | 2, 2, 7, 1, 1 | 2, 2, 7, 1, 1 |
| Transfer Function | 2, 2, 1, 1, 6 | 2, 2, 1, 1, 6 |
| Units | 2, 2, 1, 1, 4 | 2, 2, 1, 1, 4 |

## 2.5.2 Verifying configuration with AMS Device Manager

Right click on the device and select **Configuration Properties** from the menu. Navigate the tabs to review the transmitter configuration data.

## 2.5.3 Verifying configuration with local operator interface

Press any configuration button to activate the LOI. Select **VIEW CONFIG** to review the below parameters. Use the configuration buttons to navigate through the menu. The parameters to be reviewed prior to installation include:

- Tag
- Units
- Transfer Function
- Alarm and Saturation Levels
- Primary Variable
- Range Values
- Damping

## 2.5.4 Verifying process variables configuration

This section describes how to verify that the correct process variables are selected.

### Verifying process variables with a field communicator

From the *HOME* screen, enter the Fast Key sequence

| | |
|---|---|
| **Device Dashboard Fast Keys** | 3, 2, 1 |

### Verifying process variables with AMS Device Manager

1. Right click on the device and select **Overview** from the menu.
2. Click the **All Variables** button to display the primary, secondary, tertiary and quaternary variables.

# 2.6 Basic setup of the transmitter

This section goes through the necessary steps for basic setup of a pressure transmitter.

## 2.6.1 Setting pressure units

⚠ The pressure unit command sets the unit of measure for the reported pressure.

### Setting pressure units with a field communicator

From the *HOME* screen, enter the Fast Key sequence

| | |
|---|---|
| **Device Dashboard Fast Keys** | 2, 2, 1, 1, 4 |

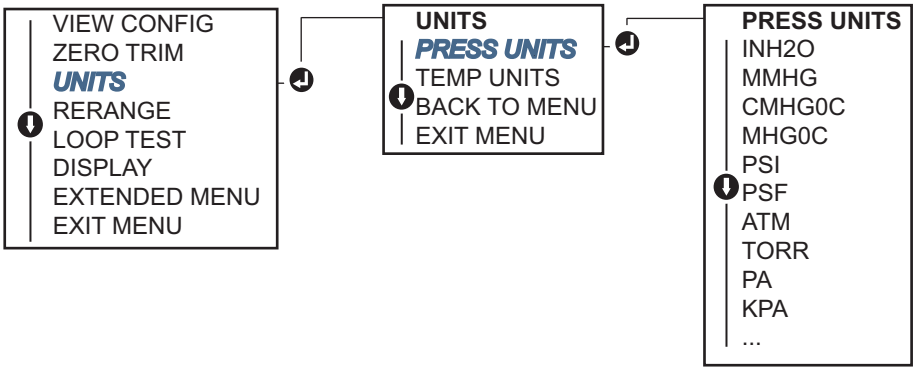
### Setting pressure units with AMS Device Manager

1. Right click on the device and select **Configure**.
2. Click **Manual Setup** and select desired units from *Pressure Units* dropdown menu.
3. Click **Send** when complete.

### Setting pressure units with a local operator interface

Follow Figure 2-5 on page 14 to select desired pressure and temperature units. Use the **SCROLL** and **ENTER** buttons to select desired unit. Save by selecting **SAVE** as indicated on the LCD display screen.

**Figure 2-5. Selecting Units with LOI**




## 2.6.2 Rerange the transmitter

⚠ The Range Values command sets each of the lower and upper range analog values (4 and 20 mA/1-5 Vdc points) to a pressure. The lower range point represents 0% of range and the upper range point represents 100% of range. In practice, the transmitter range values may be changed as often as necessary to reflect changing process requirements. For a complete listing of Range & Sensor limits, refer to "Functional specifications" on page 72.

Select from one of the methods below to rerange the transmitter. Each method is unique; examine all options closely before deciding which method works best for your process.

- Rerange by manually setting range points with a field communicator, AMS Device Manager, or Local Operator Interface.
- Rerange with a pressure input source and a field communicator, AMS Device Manager, Local Operator Interface, or local zero and span buttons

## Manually rerange the transmitter by entering range points

### Entering range points with a field communicator

From the *HOME* screen, enter the Fast Key sequence

| | |
|---|---|
| **Device Dashboard Fast Keys** | 2, 2, 2, 1 |

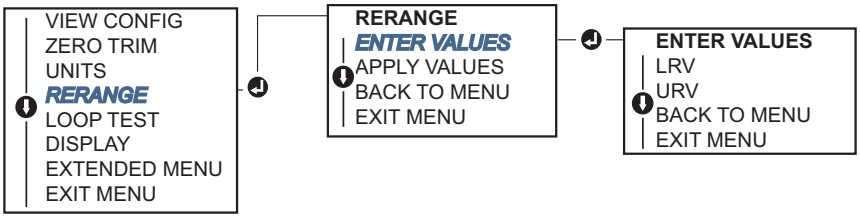
### Entering range points with AMS Device Manager

1. Right click on the device and select **Configure**.
2. Click **Manual Setup** and select **Analog Output**.
3. Enter upper and lower range values in the *Range Limits* box and click **Send.**
4. Carefully read the warning and click **Yes** if it is safe to apply the changes.

### Entering range points with a local operator interface

Reference Figure 2-6 on page 15 to rerange the transmitter using the Local Operator Interface. Enter values using **SCROLL** and **ENTER** buttons.

**Figure 2-6. Rerange with LOI**




## Rerange the transmitter with applied pressure source

Reranging using an applied pressure source is a way of reranging the transmitter without entering specific 4 and 20 mA (1-5 Vdc) points.

### Rerange with an applied pressure source using a field communicator

From the *HOME* screen, enter the Fast Key sequence

| | |
|---|---|
| **Device Dashboard Fast Keys** | 2, 2, 2, 2 |

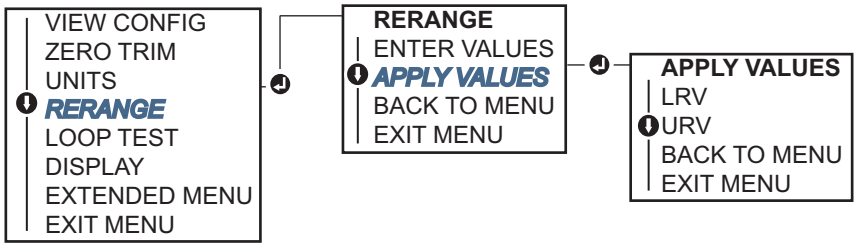
## Rerange with an applied pressure source using AMS Device Manager

1. Right click on the device, select **Configure**.
2. Select the **Analog Output** tab.
3. Click **Range by Applying Pressure** button and follow the screen prompts range the transmitter.

## Rerange with an applied pressure source using a field communicator

Use Figure 2-7 to manually rerange the device using an applied pressure source with an LOI.

**Figure 2-7. Rerange with applied pressure using LOI**




## Rerange with an applied pressure source using local zero and span buttons

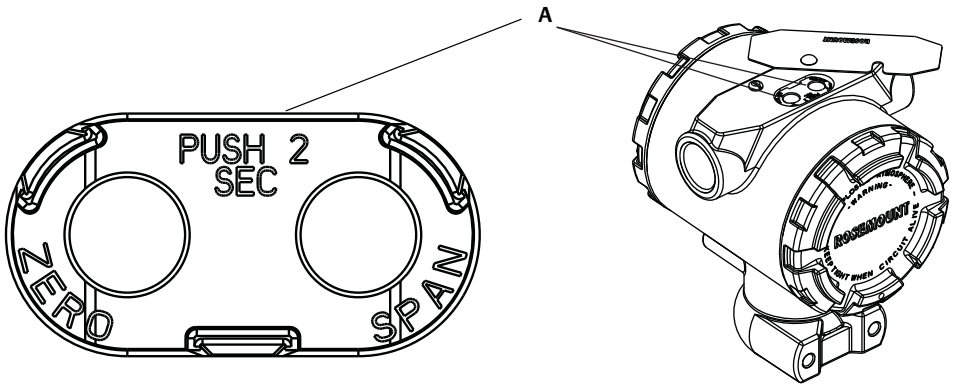
If ordered, local zero and span buttons (option code D4) can be used to rerange the transmitter with an applied pressure. Refer to Figure 2-8 on page 17 for analog zero and span button location.

To rerange the transmitter using the span and zero buttons, perform the following procedure:

1. Loosen the screw holding the top tag of the transmitter housing. Rotate the label to expose the zero and span buttons.
2. Confirm device has local zero and span buttons by verifying blue retainer under the tag.
3. Apply transmitter pressure.
4. Rerange the transmitter.
   a. To change the zero (4mA/1V point) while maintaining the span: press and hold zero button for at least two seconds then release.
   b. To change the span (20mA/5V point) while maintaining the zero point: press and hold the span button for at least two seconds and then release.

**Note**
4mA and 20mA points must maintain the minimum span defined in Appendix A: Specifications and reference data .

**Figure 2-8. Analog zero and span buttons**




**A. Zero and span buttons**

**Note**

- If the transmitter security is on, adjustments to the zero and span will not be able to be made. Refer to "Configuring transmitter security" on page 41 for security information.
- The span is maintained when the 4mA/1V point is set. The span changes when the 20mA 5V point is set. If the lower range point is set to a value that causes the upper range point to exceed the sensor limit, the upper range point is automatically set to the sensor limit, and the span is adjusted accordingly.
- Regardless of the range points, the Rosemount 2088 will measure and report all readings within the digital limits of the sensor. For example, if the 4 and 20 mA(1-5 Vdc) points are set to 0 and 10 in$H_2O$, and the transmitter detects a pressure of 25 in$H_2O$, it digitally outputs the 25 in$H_2O$ reading and a 250% of range reading.

## 2.6.3 Damping

⚠ The damping command changes the response time of the transmitter; higher values can smooth variations in output readings caused by rapid input changes. Determine the appropriate damping setting based on the necessary response time, signal stability, and other requirements of the loop dynamics within your system. The damping command utilizes floating point configuration allowing the user to input any damping value within 0.0-60.0 seconds.

### Damping with a field communicator

From the *HOME* screen, enter the Fast Key sequence

| | |
|---|---|
| **Device Dashboard Fast Keys** | 2, 2, 1, 1, 5 |

Enter desired Damping Value and select **APPLY**.

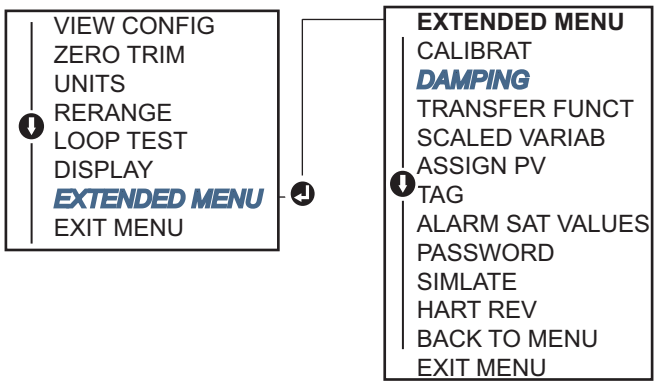
## Damping with AMS Device Manager

1. Right click on the device and select **Configure**.
2. Select **Manual Setup**.
3. Within the *Pressure Setup* box, enter desired damping value and click **Send**.
4. Carefully read the warning and click **Yes** if it is safe to apply the changes.

## Damping with a local operator interface

Reference Figure 2-9 to enter damping values using an LOI.

**Figure 2-9. Damping with LOI**




# 2.7 Configuring the LCD display

The LCD display configuration command allows customization of the LCD display to suit application requirements. The LCD display will alternate between the selected items.

- Pressure Units
- % of Range
- Scaled Variable
- Sensor Temperature
- mA/Vdc Output

In the following instructions, the LCD display can also be configured to display configuration information during the device startup. Select **Review Parameters at Startup** to enable or disable this functionality.

Reference Figure 1-2 on page 5 LCD display with Local Operator Interface for image of LCD display screen.

### Configuring LCD display with a field communicator

From the *HOME* screen, enter the Fast Key sequence

| | |
|---|---|
| **Device Dashboard Fast Keys** | 2, 2, 4 |

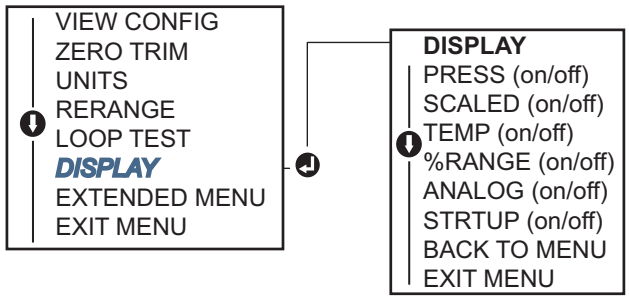
### Configuring LCD display with AMS Device Manager

1. Right click on the device and select **Configure**.
2. Click **Manual Setup**, select the **Display** tab.
3. Select desired display options and click **Send.**

### Configuring LCD display with a local operator interface

Refer to Figure 2-10 for LCD display configuration using a LOI.

**Figure 2-10. Display with LOI**




## 2.8 Detailed transmitter setup

### 2.8.1 Configuring alarm and saturation levels

In normal operation, the transmitter will drive the output in response to pressure from the lower to upper saturation points. If the pressure goes outside the sensor limits, or if the output would be beyond the saturation points, the output will be limited to the associated saturation point.

The Rosemount 2088 transmitter automatically and continuously performs self-diagnostic routines. If the self-diagnostic routines detect a failure, the transmitter drives the output to configured alarm and value based on the position of the alarm switch. See “Setting transmitter alarm” on page 43.

**Table 2-4. Rosemount alarm and saturation values**

| Level | 4–20 mA saturation | 4–20 mA alarm |
|---|---|---|
| Low | 3.90 mA (0.97 V) | ≤ 3.75 mA (0.95 V) |
| High | 20.80 mA (5.20 V) | ≥ 21.75 mA (5.40 V) |

**Table 2-5. NAMUR-Compliant alarm and saturation values**

| Level | 4–20 mA saturation | 4–20 mA alarm |
|---|---|---|
| Low | 3.80 mA (0.95 V) | ≤ 3.60 mA (0.90 V) |
| High | 20.50 mA (5.13 V) | ≥22.50 mA (5.63 V) |

**Table 2-6. Custom alarm and saturation values**

| Level | 4–20 mA saturation | 4–20 mA alarm |
|---|---|---|
| Low | 3.70 mA - 3.90 mA | 3.60 mA - 3.80 mA |
| High | 20.10 mA - 22.90 mA | 20.20 mA - 23.00 mA |

Failure mode alarm and saturation levels can be configured using a field communicator, AMS Device Manager, and the LOI. The following limitations exist for custom levels:

- Low alarm level must be less than the low saturation level
- High alarm level must be higher than the high saturation level
- Alarm and saturation levels must be separated by at least 0.1 mA

The configuration tool will provide an error message if the configuration rule is violated.

**Note**
Transmitters set to HART multidrop mode send all saturation and alarm information digitally; saturation and alarm conditions will not affect the analog output. See also "Establishing multidrop communication" on page 27.

## Configuring alarm and saturation levels using a field communicator

From the *HOME* screen, enter the Fast Key sequence

| | |
|---|---|
| **Device Dashboard Fast Keys** | 2, 2, 2, 5 |

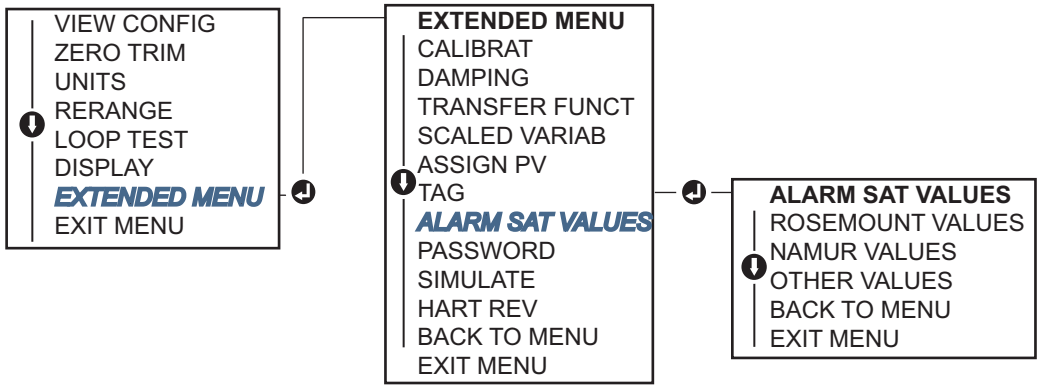
## Configuring alarm and saturation levels with AMS Device Manager

1. Right click on the device, and select **Configure**.
2. Click **Configure Alarm and Saturation Levels** button.
3. Follow screen prompts to configure Alarm and Saturation Levels.

## Configuring alarm and saturation levels using local operator interface

Refer to Figure 2-11 for instructions to configure alarm and saturation levels.

**Figure 2-11. Configuring alarm and saturation with local operator interface**




## 2.8.2 Configuring scaled variable

The Scaled Variable configuration allows the user to create a relationship/conversion between the pressure units and user-defined/custom units. There are two use cases for Scaled Variable. The first use case is to allow custom units to be displayed on the transmitter's LCD display/LOI Display. The second use case is to allow custom units to drive the transmitter's 4-20 mA output.

If the user desires custom units to drive the 4-20 mA (1-5 Vdc) output, Scaled Variable must be re-mapped as the primary variable. Refer to "Re-mapping device variables" on page 22.

The Scaled Variable configuration defines the following items:

- Scaled Variable units - Custom units to be displayed.
- Scaled data options - Defines the transfer function for the application
- Pressure value position 1 - Lower known value point with consideration of linear offset.
- Scaled Variable value position 1 - Custom unit equivalent to the lower known value point.
- Pressure value position 2 - Upper known value point
- Scaled Variable value position 2 - Custom unit equivalent to the upper known value point
- Linear offset - The value required to zero out pressures effecting the desired pressure reading.

## Configuring scaled variable using a field communicator

From the *HOME* screen, enter the Fast Key sequence

| Device Dashboard Fast Keys | 2, 1, 4, 7 |
|---|---|

1. Follow the screen prompts to configure Scaled Variable.
   a. Select **Linear** under *Select Scaled data options*.

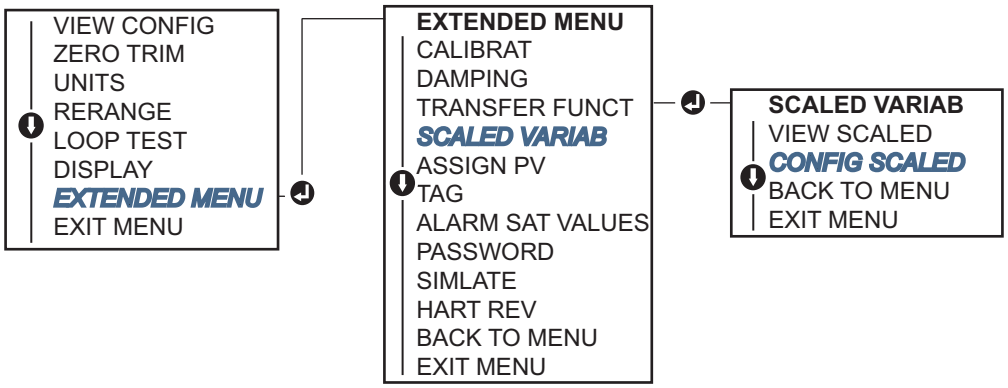
## Configuring scaled variable using AMS Device Manager

1. Right click on the device and, select **Configure**.
2. Select the **Scaled Variable** tab and click the **Scaled Variable** button.
3. Follow screen prompts to configure Scaled Variable
   a. Select **Linear** under *Select Scaled data options*.

## Configuring scaled variable using a local operator interface

Refer to Figure 2-12 on page 22 for instructions to configure Scaled Variable using a Local Operator Interface.

**Figure 2-12. Configuring scaled variable using a local operator interface**




# 2.8.3 Re-mapping device variables

⚠ The re-mapping function allows the transmitter primary, secondary, tertiary, and quaternary variables (PV, 2V, 3V, and 4V) to be configured as desired. The PV can be remapped with a field communicator, AMS Device Manager, or a LOI. Variables (2V, 3V, and 4V) can only be re-mapped via Field Communicator or AMS Device Manager.

**Note**
The variable assigned to the primary variable drives the 4-20mA (1-5 Vdc) output. This value can be selected as Pressure or Scaled Variable. The 2, 3, and 4 variables only apply if HART burst mode is being used.

## Re-mapping using a field communicator

From the *HOME* screen, enter the Fast Key sequence

| Fast Keys | 2, 1, 1, 3 |
|---|---|

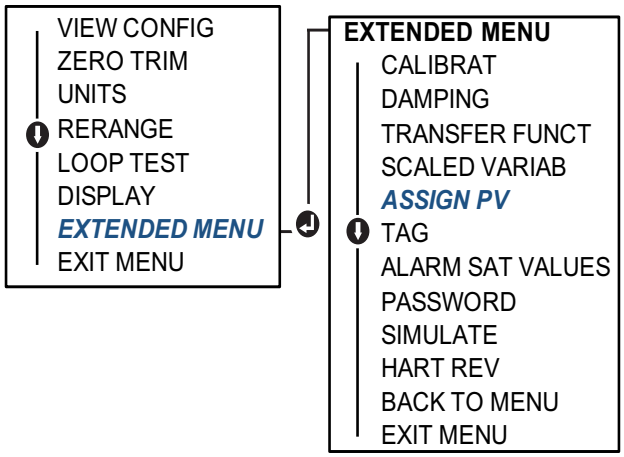
## Re-mapping using AMS Device Manager

1. Right click on the device and select **Configure**.
2. Select **Manual Setup** and click on the **HART** tab.
3. Assign Primary, secondary, tertiary, and quaternary variables under *Variable Mapping*.
4. Click **Send**.
5. Carefully read the warning and click **Yes** if it is safe to apply the changes.

## Re-mapping using local operator interface

Refer to Figure 2-13 for instructions to remap the primary variable using a Local Operator Interface.

**Figure 2-13. Re-mapping with local operator interface**



# 2.9 Performing transmitter tests

## 2.9.1 Verifying alarm level

If the transmitter electronics board, sensor module, or LCD display/LOI display is repaired or replaced, verify the transmitter alarm level before returning the transmitter to service. This is useful in testing the reaction of the control system to a transmitter in an alarm state. Thus ensuring the control system recognizes the alarm when activated. To verify the transmitter alarm values, perform a loop test and set the transmitter output to the alarm value (see Table 2-4, 2-5, and 2-6 on page 20, and "Verifying alarm level" on page 24).

**Note**
Before returning transmitter to service, verify security switch is set to the correct position. Refer to "Verify configuration" on page 12.

## 2.9.2 Performing an analog loop test

⚠ The Analog Loop Test command verifies the output of the transmitter, the integrity of the loop, and the operations of any recorders or similar devices installed in the loop. It is recommended that the 4-20 mA (1-5 Vdc) points in addition to alarm levels when installing, repairing, or replacing a transmitter.

The host system may provide a current measurement for the 4-20 mA (1-5 Vdc) HART output. If not, connect a reference meter to the transmitter by either connecting the meter to the test terminals on the terminal block, or shunting transmitter power through the meter at some point in the loop. For 1-5V output, voltage measurement is directly measured from Vout to (-) terminals.

### Performing a analog loop test using a field communicator

From the *HOME* screen, enter the Fast Key sequence

| | |
|---|---|
| **Device Dashboard Fast Keys** | 3, 5, 1 |

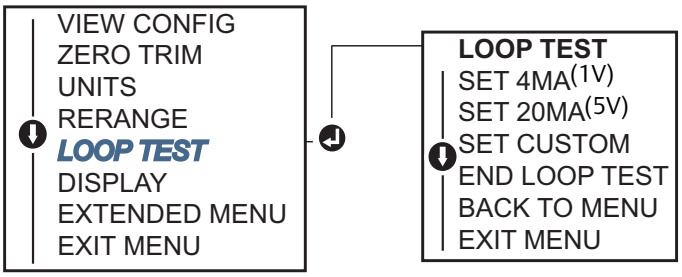
### Performing a analog loop test using AMS Device Manager

1. Right click on the device and, within the *Methods* drop down menu, move cursor over *Diagnostics and Test*. In the *Diagnostics and Test* drop down menu select **Loop Test**.
2. Click **Next** after setting the control loop to manual.
3. Follow Screen prompts to perform a Loop Test.
4. Select **Finish** to acknowledge the method is complete.

### Performing analog loop test using a local operator interface

To perform an analog loop test using the LOI, the 4mA (1 V), 20mA (5V), and custom mA point may be set manually. Reference Figure 2-14 for instructions on how to perform a transmitter loop test using an LOI.

**Figure 2-14. Performing an analog loop test using an LOI**




## 2.9.3 Simulate device variables

It is possible to temporarily set the Pressure, Sensor Temperature, or Scaled Variable to a user-defined fixed value for testing purposes. Once the simulated variable method is left, the process variable will be automatically returned to a live measurement. Simulate device variables is only available in HART Revision 7 mode.

### Simulate digital signal with a field communicator

From the *HOME* screen, enter the Fast Key sequence

| | |
|---|---|
| **Device Dashboard Fast Keys** | 3, 5 |

### Simulate digital signal with AMS Device Manager

1. Right click on the device and select **Service Tools**.
2. Click **Simulate.**
3. Under *Device Variables* select a digital value to simulate.
   a. Pressure
   b. Sensor Temperature
   c. Scaled Variable
4. Follow the screen prompts to simulate selected digital value.

# 2.10 Configuring burst mode

Burst mode is compatible with the analog signal. Because the HART protocol features simultaneous digital and analog data transmission, the analog value can drive other equipment in the loop while the control system is receiving the digital information. Burst mode applies only to the transmission of dynamic data (pressure and temperature in engineering units, pressure in percent of range, Scaled Variable, and/or analog output), and does not affect the way other transmitter data is accessed. However, when activated, bust mode can slow down communication of non-dynamic data to the host by 50%.

Access to information other than dynamic transmitter data is obtained through the normal poll/response method of HART communication. A field communicator, AMS Device Manager, or

the control system may request any of the information that is normally available while the transmitter is in burst mode. Between each message sent by the transmitter, a short pause allows the Field Communicator, AMS Device Manager, or a control system to initiate a request.

## Choosing burst mode options in HART 5

Message content options:

- PV only
- Percent of Range
- PV, 2V, 3V, 4V
- Process Variables
- Device Status

## Choosing burst mode options in HART 7

Message content options:

- PV only
- Percent of Range
- PV, 2V, 3V, 4V
- Process Variables and Status
- Process Variables
- Device Status

## Choosing a HART 7 trigger mode

When in HART 7 mode, the following trigger modes can be selected.

- Continuous (same as HART5 burst mode)
- Rising
- Falling
- Windowed
- On Change

**Note**
Consult your host system manufacturer for burst mode requirements.

## Configuring burst mode using a field communicator

From the *HOME* screen, enter the Fast Key sequence

| Device Dashboard Fast Keys | 2, 2, 5, 3 |
|---|---|

## Configuring burst mode using AMS Device Manager

1. Right click on the device and select **Configure**.
2. Select the **HART** tab.
3. Enter the configuration in Burst Mode Configuration fields.

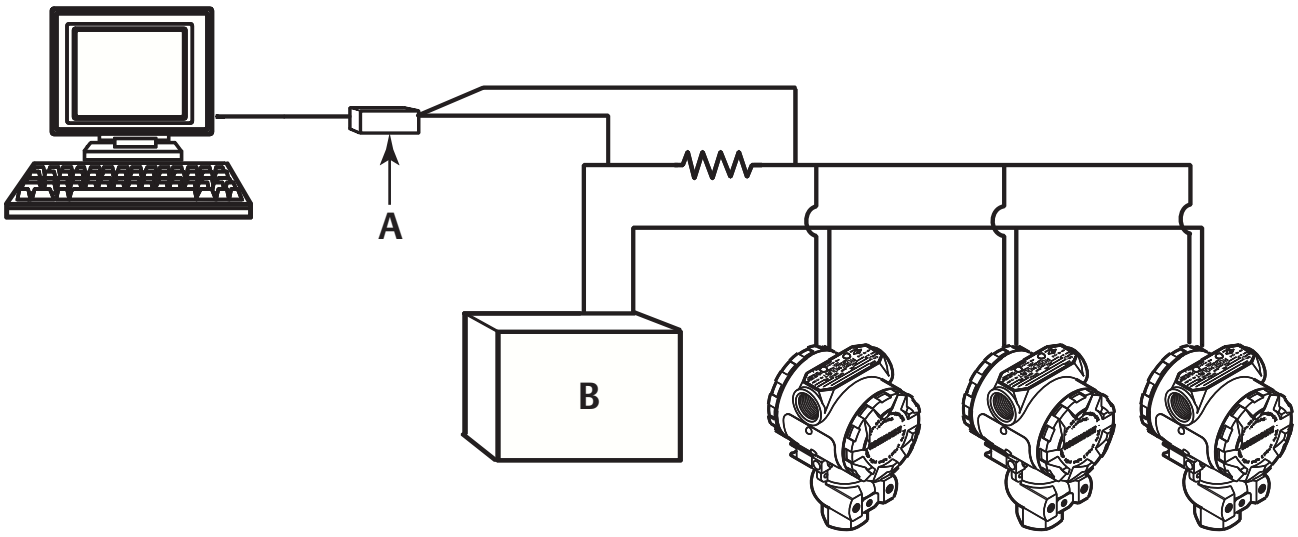
# 2.11 Establishing multidrop communication

Multidropping transmitters refers to the connection of several transmitters to a single communications transmission line. Communication between the host and the transmitters takes place digitally with the analog output of the transmitters deactivated.

Multidrop installation requires consideration of the update rate necessary from each transmitter, the combination of transmitter models, and the length of the transmission line. Communication with transmitters can be accomplished with HART modems and a host implementing HART protocol. Each transmitter is identified by a unique address and responds to the commands defined in the HART protocol. Field Communicators and AMS Device Manager can test, configure, and format a multidropped transmitter the same way as a transmitter in a standard point-to-point installation.

Figure 2-15 shows a typical multidrop network. This figure is not intended as an installation diagram.

**Figure 2-15. Typical multidrop network (4-20 mA only)**




**A. HART Modem**
**B. Power Supply**

The Rosemount 2088 is set to address zero (0) at the factory, which allows operation in the standard point-to-point manner with a 4–20 mA output signal. To activate multidrop communication, the transmitter address must be changed to a number from 1 to 15 for HART Revision 5, or 1-63 for HART Revision 7. This change deactivates the 4–20 mA analog output, sending it to 4 mA. It also disables the failure mode alarm signal, which is controlled by the upscale/downscale switch position. Failure signals in multidropped transmitters are communicated through HART messages.

## 2.11.1 Changing a transmitter address

To activate multidrop communication, the transmitter poll address must be assigned a number from 1 to 15 for HART Revision 5, and 1-63 for HART Revision 7. Each transmitter in a multidropped loop must have a unique poll address.

### Changing transmitter address using a field communicator

| From the *HOME* screen, enter the Fast Key sequence | HART Revision 5 | HART Revision 7 |
|---|---|---|
| **Device Dashboard Fast Keys** | 2, 2, 5, 2, 1 | 2, 2, 5, 2, 2 |

### Changing transmitter address using AMS Device Manager

1. Right click on the device and select **Configure**.
2. In HART Revision 5 mode:
   a. Click on **Manual Setup**, select the **HART** tab.
   b. In the Communication Settings box enter polling address in the **Polling Address** box, click **Send**.
3. In HART Revision 7 mode:
   a. Click on **Manual Setup**, select the **HART** tab and click the **Change Polling Address** button.
4. Carefully read the warning and click **Yes** if it is safe to apply the changes.

## 2.11.2 Communicating with a multidropped transmitter

To communicate with a multidrop transmitter, the Field Communicator or AMS Device Manager has to be set up for Polling.

### Communicating with a multidropped transmitter using a field communicator

1. Select **Utility** and **Configure HART Application**.
2. Select **Polling Addresses.**
3. Enter **0-63.**

### Communicating with a multidropped transmitter using AMS device manager

# Section 3 Hardware installation

Overview . . . . . page 29
Safety messages . . . . . page 29
Considerations . . . . . page 31
Installation procedures . . . . . page 31
Rosemount 306 Manifold . . . . . page 37

## 3.1 Overview

The information in this section covers installation considerations for the Rosemount 2088 with HART protocols. A Quick Installation Guide (document number 00825-0100-4108) is shipped with every transmitter to describe recommended pipe-fitting and wiring procedures for initial installation. Dimensional drawings for each Rosemount 2088 variation and mounting configuration are included on page 31.

**Note**
For transmitter disassembly and reassembly refer to "Disassembly procedures" on page 68, and "Reassembly procedures" on page 69.

## 3.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operation. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

**⚠ WARNING**

Explosions could result in death or serious injury.

Installation of this transmitter in an explosive environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of the Rosemount 2088 reference manual for any restrictions associated with a safe installation.

- Before connecting a Field Communicator in an explosive atmosphere, ensure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- In an Explosion-Proof/Flameproof installation, do not remove the transmitter covers when power is applied to the unit.

Process leaks may cause harm or result in death.

- Install and tighten process connectors before applying pressure.

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

**⚠ WARNING**

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals.

Process leaks could result in death or serious injury.

- Install and tighten all four flange bolts before applying pressure.
- Do not attempt to loosen or remove flange bolts while the transmitter is in service.

Replacement equipment or spare parts not approved by Emerson Process Management for use as spare parts could reduce the pressure retaining capabilities of the transmitter and may render the instrument dangerous.

- Use only bolts supplied or sold by Emerson Process Management as spare parts.

Improper assembly of manifolds to traditional flange can damage sensor module.

- For safe assembly of manifold to traditional flange, bolts must break back plane of flange web (i.e., bolt hole) but must not contact sensor module housing.

# 3.3 Considerations

## 3.3.1 Installation considerations

Measurement accuracy depends upon proper installation of the transmitter and impulse piping. Mount the transmitter close to the process and use a minimum of piping to achieve best accuracy. Keep in mind the need for easy access, personnel safety, practical field calibration, and a suitable transmitter environment. Install the transmitter to minimize vibration, shock, and temperature fluctuation.

**Important**
Install the enclosed pipe plug (found in the box) in unused housing conduit opening with a minimum of five threads of engagement to comply with explosion-proof requirements.

For material compatibility considerations, see document number 00816-0100-3045 on www.emersonprocess.com/rosemount.

## 3.3.2 Environmental considerations

Best practice is to mount the transmitter in an environment that has minimal ambient temperature change. The transmitter electronics temperature operating limits are –40 to 185 °F (–40 to 85 °C). Refer to Appendix A: Specifications and reference data that lists the sensing element operating limits. Mount the transmitter so that it is not susceptible to vibration and mechanical shock and does not have external contact with corrosive materials.

## 3.3.3 Mechanical considerations

### Steam service

For steam service or for applications with process temperatures greater than the limits of the transmitter, do not blow down impulse piping through the transmitter. Flush lines with the blocking valves closed and refill lines with water before resuming measurement. Refer to Figure 3-2 on page 35 through Figure 3-4 on page 35 for correct mounting orientation.

# 3.4 Installation procedures

## 3.4.1 Mount the transmitter

The Rosemount 2088 Transmitter weighs approximately 2.44lb. (1,11 kg). In many cases its compact size and light weight makes it possible to mount directly to the impulse line without using an additional mounting bracket. When this is not desirable, mount directly to a wall, panel, or two-inch pipe using the optional mounting bracket (see Figure 3-1 on page 33).

For dimensional drawing information refer to Appendix A: Specifications and reference data on page 71.

**Note**
Most transmitters are calibrated in the upright position. Mounting the transmitter in any other position will shift the zero point to the equivalent amount of liquid head pressure caused by the varied mounting position. To reset zero point, refer to "Sensor trim overview" on page 55.

## Electronics housing clearance

Mount the transmitter so the terminal side is accessible. Clearance of 0.75 in. (19 mm) is required for cover removal. Use a conduit plug in the unused conduit opening. Three inches of clearance is required for cover removal if a meter is installed.

## Environmental seal for housing

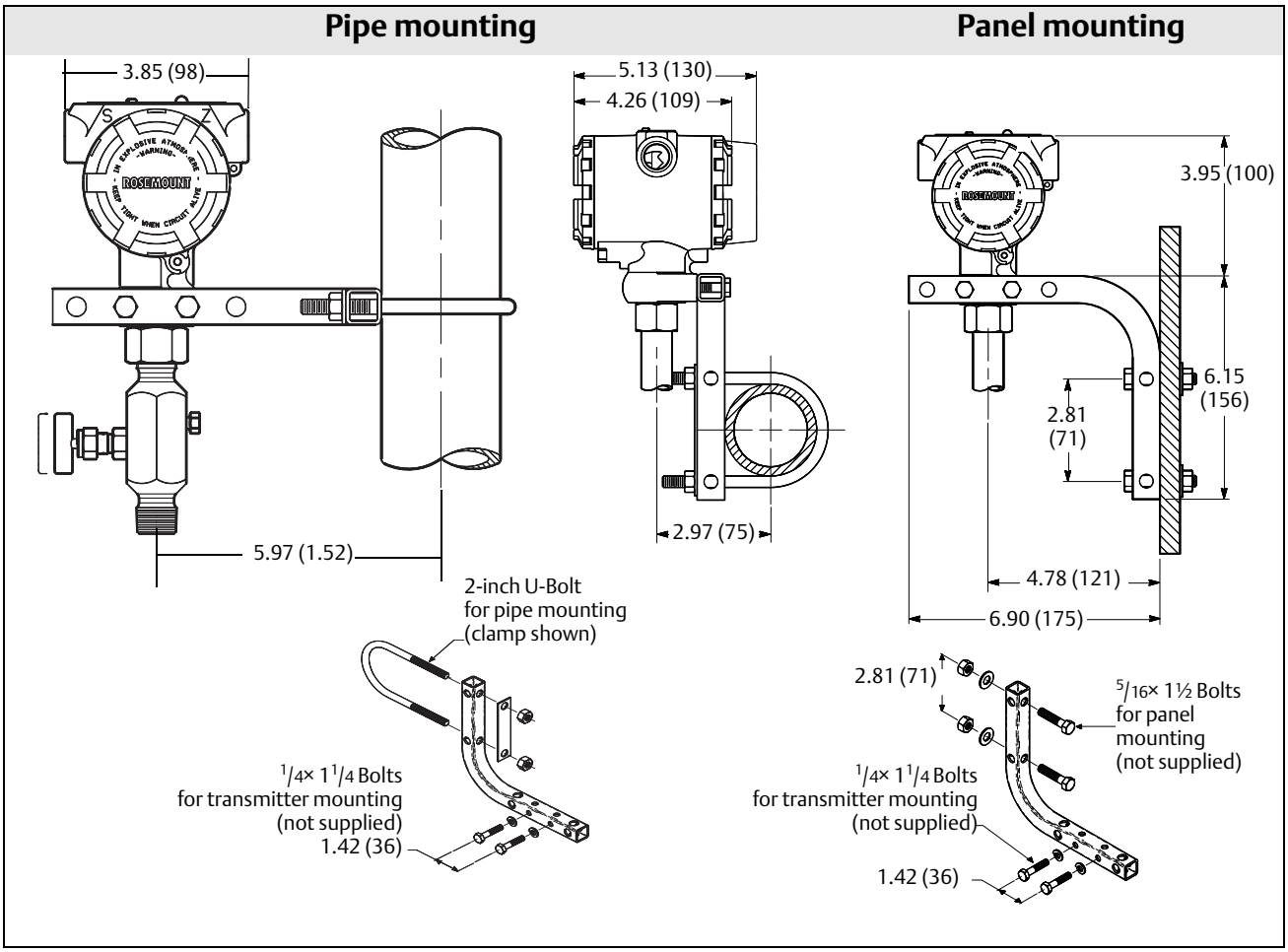
For NEMA 4X, IP66, and IP68 requirements, use thread seal (PTFE) tape or paste on male threads of conduit to provide a watertight seal.

Always ensure a proper seal by installing the electronics housing cover(s) so that metal contacts metal. Use Rosemount O-rings.

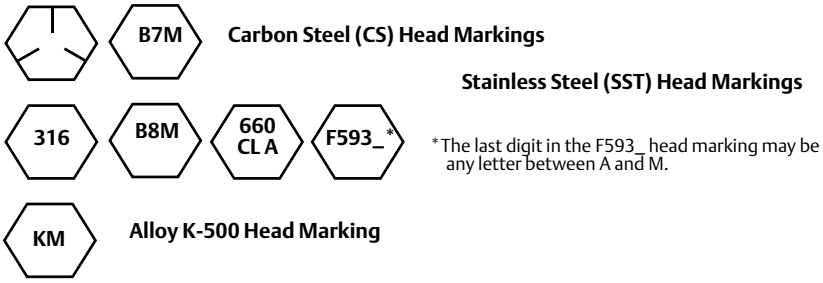
## Mounting brackets

Rosemount 2088 transmitters may be panel-mounted or pipe-mounted via an optional mounting bracket (option code B4). See Figure 3-1 on page 33 and for dimensional and mounting configuration information.

**Figure 3-1. Mounting bracket option code B4**




Dimensions are in inches (millimeters).




## 3.4.2 Impulse piping

### Mounting requirements

Impulse piping configurations depend on specific measurement conditions. Refer to Figure 3-2 on page 35 through Figure 3-4 on page 35 for examples of the following mounting configurations:

#### Liquid measurement

- Place taps to the side of the line to prevent sediment deposits on the transmitter's process isolator.
- Mount the transmitter beside or below the taps so gases can vent into the process line.
- Mount drain/vent valve upward to allow gases to vent.

#### Gas measurement

- Place tap in the top or side of the line.
- Mount the transmitter beside or above the tap so liquid will drain into the process line.

#### Steam measurement

- Place tap to the side of the line.
- Mount the transmitter below the taps to ensure that the impulse piping will stay filled with condensate.
- In steam service above 250 °F (121 °C), fill impulse line with water to prevent steam from contacting the transmitter directly and to ensure accurate measurement start-up.

**Note**
For steam or other elevated temperature services, it is important that temperatures at the process connection do not exceed the transmitter's process temperature limits.

**Figure 3-2. Liquid applications installation example**

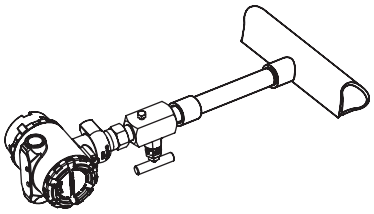


**Figure 3-3. Gas applications installation example**

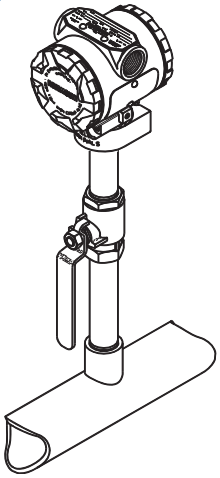
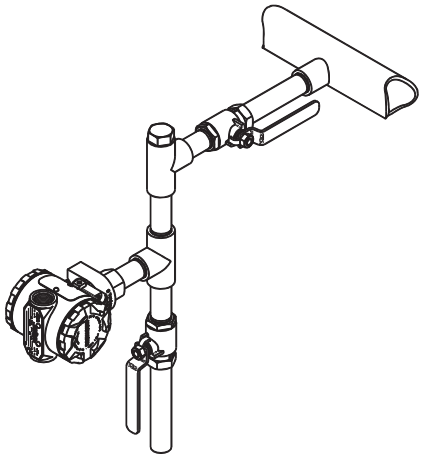


**Figure 3-4. Steam applications installation example**



## Best practices

The piping between the process and the transmitter must accurately transfer the pressure to obtain accurate measurements. There are five possible sources of error: pressure transfer, leaks, friction loss (particularly if purging is used), trapped gas in a liquid line, liquid in a gas line, and density variations between the legs.

The best location for the transmitter in relation to the process pipe is dependent on the process. Use the following guidelines to determine transmitter location and placement of impulse piping:

- Keep impulse piping as short as possible.
- For liquid service, slope the impulse piping at least 1 in./foot (8 cm/m) upward from the transmitter toward the process connection.
- For gas service, slope the impulse piping at least 1 in./foot (8 cm/m) downward from the transmitter toward the process connection.
- Avoid high points in liquid lines and low points in gas lines.
- Use impulse piping large enough to avoid friction effects and blockage.
- Vent all gas from liquid piping legs.
- When purging, make the purge connection close to the process taps and purge through equal lengths of the same size pipe. Avoid purging through the transmitter.
- Keep corrosive or hot [above 250 °F (121 °C)] process material out of direct contact with the sensor module and flanges.
- Prevent sediment deposits in the impulse piping.
- Avoid conditions that might allow process fluid to freeze within the process flange.

# 3.4.3 Process connections

# 3.4.4 Inline process connection

## Inline gage transmitter orientation

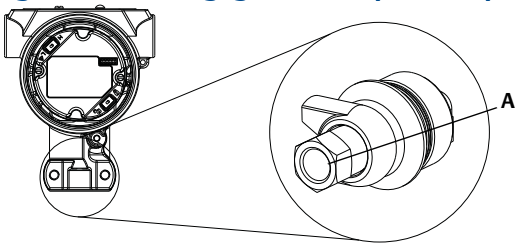
**⚠ CAUTION**

Interfering or blocking the atmospheric reference port will cause the transmitter to output erroneous pressure values.

The low side pressure port on the inline gage transmitter is located in the neck of the transmitter, behind the housing. The vent path is 360 degrees around the transmitter between the housing and sensor (See Figure 3-5).

Keep the vent path free of any obstruction, such as paint, dust, and lubrication by mounting the transmitter so that the process can drain away.

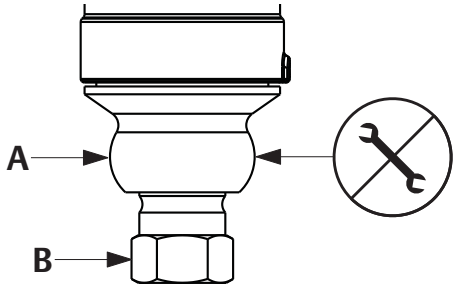
**Figure 3-5. Inline gage low side pressure port**




**A. Low side pressure port (atmospheric reference)**

**⚠ WARNING**

Do not apply torque directly to the sensor module. Rotation between the sensor module and the process connection can damage the electronics. To avoid damage, apply torque only to the hex-shaped process connection.

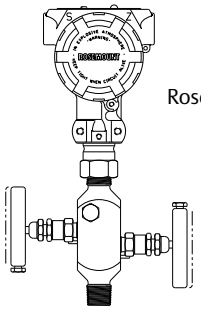



**A. Sensor Module**
**B. Process Connection**

# 3.5 Rosemount 306 Manifold

The 306 Integral Manifold is used with the Rosemount 2088 in-line transmitters to provide block-and-bleed valve capabilities of up to 10000 psi (690 bar).

**Figure 3-6. Manifolds**



Rosemount 2088 and 306
In-line

## 3.5.1 Rosemount 306 Integral Manifold installation procedure

⚠ Assemble the 306 Manifold to the Rosemount 2088 In-line transmitter with a thread sealant.

# Section 4 Electrical installation

Overview . . . . . page 39
Safety messages . . . . . page 39
LCD display/LOI display . . . . . page 40
Configuring transmitter security . . . . . page 41
Setting transmitter alarm . . . . . page 43
Electrical considerations . . . . . page 44
Transient protection terminal block grounding . . . . . page 49

## 4.1 Overview

The information in this section covers installation considerations for the Rosemount 2088. A Quick Installation Guide is shipped with every transmitter to describe pipe-fitting, wiring procedures, and basic configuration for initial installation.

**Note**
For transmitter disassembly and reassembly refer to sections "Disassembly procedures" on page 89, and "Reassembly procedures" on page 91.

## 4.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol ( ⚠ ). Refer to the following safety messages before performing an operation preceded by this symbol.

**⚠ WARNING**

Explosions could result in death or serious injury.

Installation of this transmitter in an explosive environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of the Rosemount 2088 reference manual for any restrictions associated with a safe installation.

- In an Explosion-Proof/Flameproof installation, do not remove the transmitter covers when power is applied to the unit.

Process leaks may cause harm or result in death.

- Install and tighten process connectors before applying pressure.

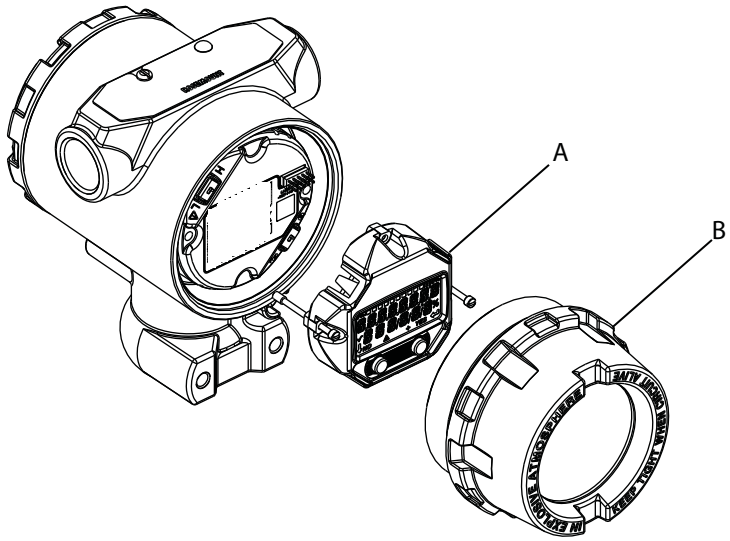
Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

# 4.3 LCD display/LOI display

Transmitters ordered with the LCD display option (M5) or LOI option (M4) are shipped with the display installed. Installing the display on an existing Rosemount 2088 transmitter requires a small instrument screwdriver. Carefully align the desired display connector with the electronics board connector. If connectors don't align, the display and electronics board are not compatible.

**Figure 4-1. LOI display assembly**




**A. LCD display/LOI display**
**B. Extended cover**

## 4.3.1 Rotating LCD display/LOI display

⚠ 1. Secure the loop to manual control and remove power to transmitter.

2. Remove transmitter housing cover.

3. Remove screws form the LCD display/LOI display and rotate to desired orientation.

   a. Insert 10 pin connector into the display board for the correct orientation. Carefully align pins for insertion into the output board.

4. Re-insert screws.

5. Reattach transmitter housing cover; cover must be fully engaged to comply with explosion proof requirements.

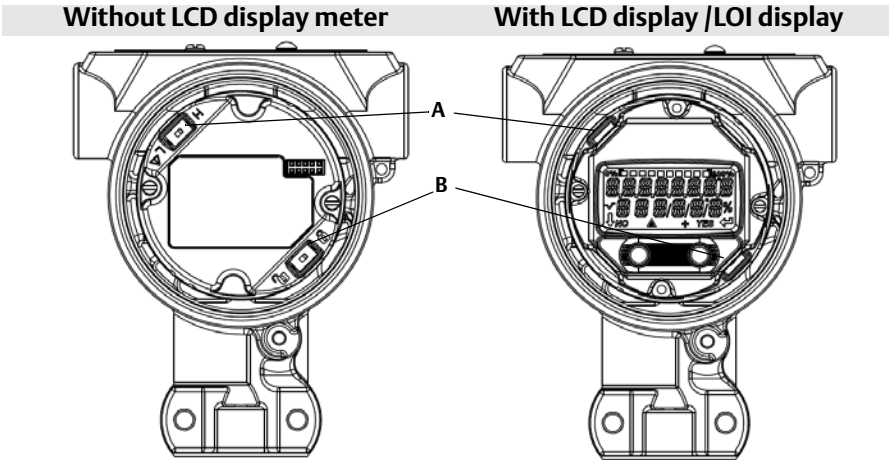
6. Re-attach power and return loop to automatic control.

# 4.4 Configuring transmitter security

There are four security methods with the Rosemount 2088 transmitter.

- Security switch
- HART Lock
- Configuration Buttons lock
- LOI password

**Figure 4-2. 4-20 mA electronics board**




**A. Alarm**
**B. Security**

**Note**
1-5 Vdc Alarm and Security switches are located in the same location as 4-20 mA output boards.

## 4.4.1 Setting security switch

The security switch is used to prevent changes to the transmitter configuration data. If the security switch is set to the locked location ( 🔒 ), any transmitter configuration requests sent via HART, LOI, or local configuration buttons will be rejected by the transmitter and the transmitter configuration data will not be modified. Reference Figure 4-2 for the location of the security switch. Follow the steps below to enable the security switch.

⚠ 1. Set loop to manual and remove power.

2. Remove transmitter housing cover.

3. Use a small screwdriver to slide the switch to the lock ( 🔒 ) position.

4. Replace transmitter housing cover; cover must be fully engaged to comply with explosion proof requirements.

## 4.4.2 HART Lock

The HART Lock prevents changes to the transmitter configuration from all sources; all changes requested via HART, LOI, and local configuration buttons will be rejected. The HART Lock can only be set via HART communication, and is only available in HART Revision 7 mode. The HART Lock can be enabled or disabled with a field communicator or AMS Device Manager.

### Configuring HART lock using field communicator

From the *HOME* screen, enter the Fast Key sequence

| | |
|---|---|
| **Device Dashboard Fast Keys** | 2, 2, 6, 4 |

#### Configuring HART lock using AMS Device Manager

1. Right click on the device and select **Configure.**
2. Under *Manual Setup* select the **Security** tab.
3. Click **Lock/Unlock** button under *HART Lock (Software)* and follow the screen prompts.

## 4.4.3 Configuration button lock

The configuration button lock disables all local button functionality. Changes to the transmitter configuration from the LOI and local buttons will be rejected. Local external keys can be locked via HART communication only.

### Configuring configuration button lock using a field communicator

From the *HOME* screen, enter the Fast Key sequence

| | |
|---|---|
| **Device Dashboard Fast Keys** | 2, 2, 6, 3 |

#### Configuring configuration button lock using AMS Device Manager

1. Right click on the device and select **Configure.**
2. Under *Manual Setup* select the **Security** tab.
3. Within the *Configuration Buttons* dropdown menu select **Disabled** to lock external local keys.
4. Click **Send**.
5. Confirm service reason and click **Yes**.

## 4.4.4 Local operator interface password

A Local Operator Interface Password can be entered and enabled to prevent review and modification of device configuration via the LOI. This does not prevent configuration from HART or external keys (analog zero and span; Digital Zero Trim). The LOI password is a 4 digit code that is to be set by the user. If the password is lost or forgotten the master password is “9307”.

The LOI password can be configured and enabled/disabled by HART communication via a field communicator, AMS Device Manager, or the LOI.

### Configuring LOI password with field communicator

From the *HOME* screen, enter the Fast Key sequence

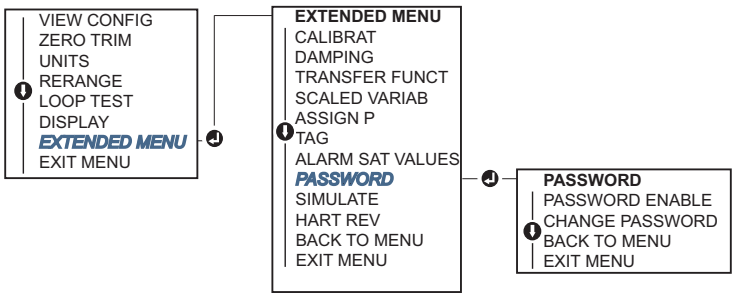
| | |
|---|---|
| **Device Dashboard Fast Keys** | 2, 2, 6, 5, 2 |

### Configuring LOI password with AMS Device Manager

1. Right click on the device and select **Configure.**
2. Under *Manual Setup* select the **Security** tab.
3. Within the *Local Operator Interface* click the **Configure Password** button and follow the screen prompts.

### Configuring LOI password using local operator interface

**Figure 4-3. Local operator interface password**




## 4.5 Setting transmitter alarm

On the electronics board is an alarm switch, reference Figure 4-2 on page 43 for switch location. Follow the steps below to change the alarm switch location.

1. Set loop to manual and remove power.
2. Remove transmitter housing cover.
3. Use a small screwdriver to slide switch to desired position.
4. Replace transmitter cover; cover must be fully engaged to comply with explosion proof requirements.

# 4.6 Electrical considerations

**Note**
Make sure all electrical installation is in accordance with national and local code requirements.

**⚠ CAUTION**

Do not run signal wiring in conduit or open trays with power wiring or near heavy electrical equipment.

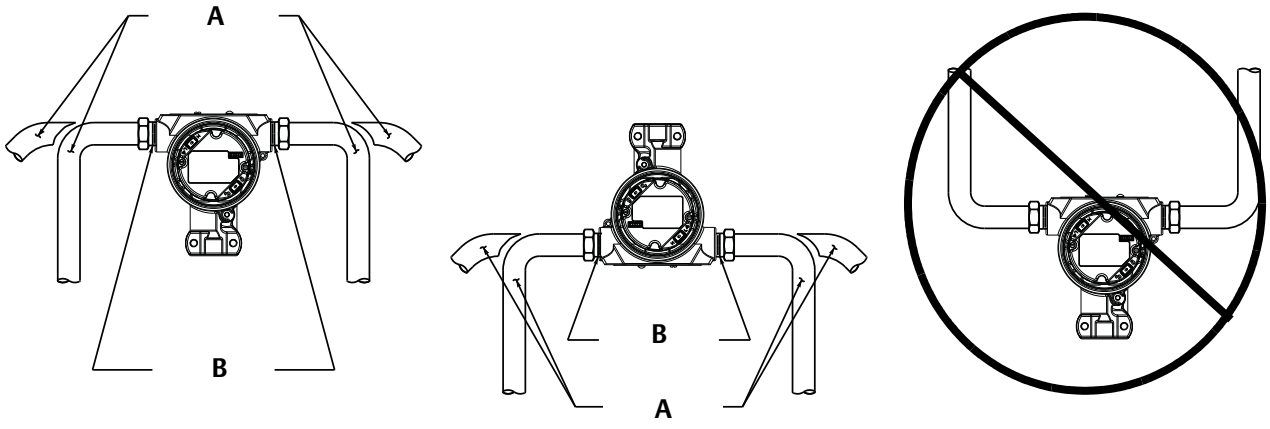
## 4.6.1 Conduit installation

**⚠ CAUTION**

If all connections are not sealed, excess moisture accumulation can damage the transmitter. Make sure to mount the transmitter with the electrical housing positioned downward for drainage. To avoid moisture accumulation in the housing, install wiring with a drip loop, and ensure the bottom of the drip loop is mounted lower than the conduit connections of the transmitter housing.

Recommended conduit connections are shown in Figure 4-4.

**Figure 4-4. Conduit installation diagrams.**




**A. Possible conduit line positions**
**B. Sealing compound**

# 4.6.2 Power supply

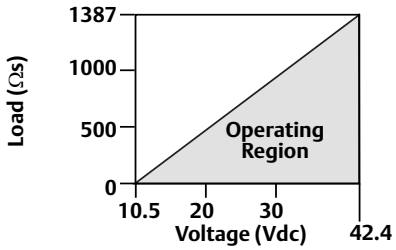
## 4-20 mA HART (option code S)

Transmitter operates on 10.5-42.4 Vdc at the terminal of the transmitter. The dc power supply should provide power with less than two percent ripple. A minimum of 16.6V is required for loops with a 250 Ω resistance.

**Note**
A minimum loop resistance of 250 Ωs is required to communicate with a field communicator. If a single power supply is used to power more than one Rosemount 2088 transmitter, the power supply used, and circuitry common to the transmitters, should not have more that 20 Ωs of impedance at 1200 Hz.

**Figure 4-5. Load limitation**

Maximum Loop Resistance = 43.5 * (Power Supply Voltage – 10.5)




*The field communicator requires a minimum loop resistance of 250Ω for communication.*

The total resistance load is the sum of the resistance of the signal leads and the load resistance of the controller, indicator, I.S. Barriers, and related pieces. If intrinsic safety barriers are used, the resistance and voltage drop must be included.

## 1-5 Vdc low power HART (output code N)

Low power transmitters operate on 9-28 Vdc. The dc power supply should provide power with less than 2 percent ripple. The $V_{out}$ load should be 100 kΩ or greater.

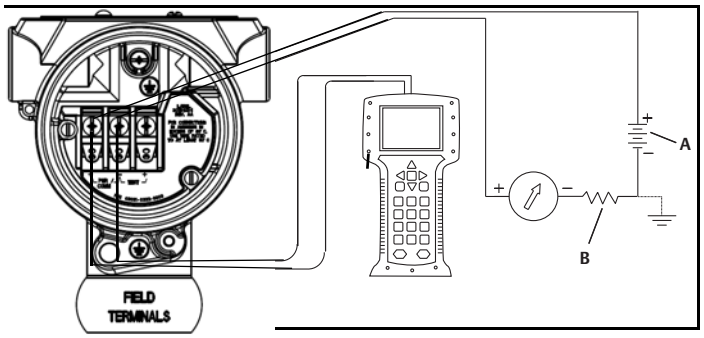
## 4.6.3 Wiring the transmitter

**⚠ CAUTION**

Do not connect the power signal wiring to the test terminals. Incorrect wiring can damage test circuit.

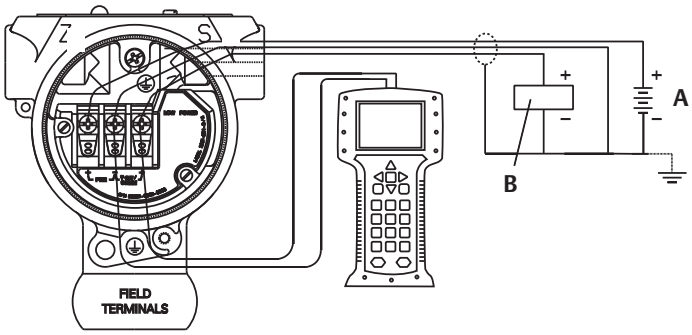
**Note**
Use shielded twisted pairs to yield best results. To ensure proper communication, use 24 AWG or larger wire and do not exceed 5000 feet (1500 meters). For 1-5V 500 feet (150meters) maximum are recommended. unpaired three conductor or two twisted pairs is recommended.

**Figure 4-6. Wiring the transmitter (4-20 mA HART)**




**A. DC power supply**
**B. $R_L \geq 250$ (necessary for HART communication only)**

**Figure 4-7. Wiring the transmitter (1-5 Vdc Low Power)**




**A. DC power supply**
**B. Voltmeter**

Perform the following procedure to make wiring connections:

⚠ 1. Remove the housing cover on terminal compartment side. Do not remove the cover in explosive atmospheres when the circuit is live. Signal wiring supplies all power to the transmitter.

⚠ 2. For 4-20 mA HART output, connect the positive lead to the terminal marked (pwr/comm+) and the negative lead to the terminal marked (pwr/comm -). Do not

connect the powered signal wiring to the test terminals. Power could damage the test diode.

a. For 1-5 Vdc HART Output, connect the positive lead to (PWR +) and the negative to the (PWR -). Do not connect the powered signal wiring to the test terminals. Power could damage the test diode.

3. Plug and seal unused conduit connection on the transmitter housing to avoid moisture accumulation in the terminal side.

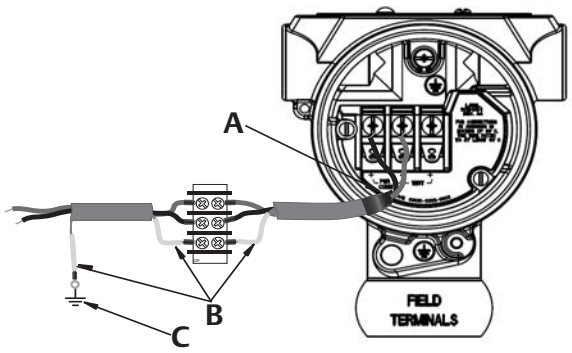
## 4.6.4 Grounding the transmitter

### Signal cable shield grounding

Signal cable shield grounding is summarized in Figure 4-8 on page 47. The signal cable shield and unused shield drain wire must be trimmed and insulated, ensuring that the signal cable shield and drain wire do not come in contact with the transmitter case. See "Transmitter case grounding" on page 48 for instructions on grounding the transmitter case. Follow the steps below to correctly ground the signal cable shield.

1. Remove the Field Terminals Housing Cover.
2. Connect the signal wire pair at the field terminals as indicated in Figure 4-6.
3. At the field terminals, the cable shield and shield drain wire should be trimmed close and insulated from transmitter housing.
4. Reattach the Field Terminals Housing Cover; cover must be fully engaged to comply with explosion proof requirements.
5. At terminations outside the transmitter housing, the cable shield drain wire should be continuously connected.
   a. Prior to the termination point, any exposed shield drain wire should be insulated as shown in Figure 4-8 (B).
6. Properly terminate the signal cable shield drain wire to an earth ground at or near the power supply.

**Figure 4-8. Wiring pair and ground**



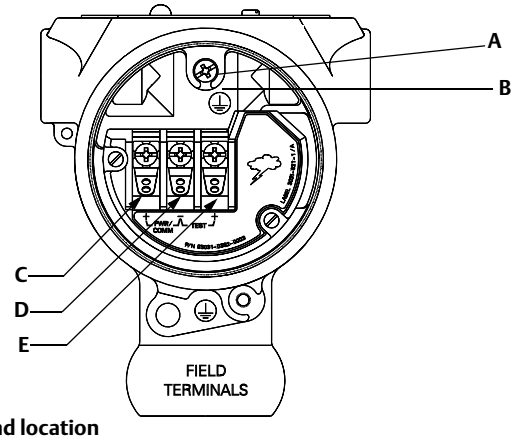

**A. Insulate shield and shield drain wire**
**B. Insulate exposed shield drain wire**
**C. Terminate cable shield drain wire to earth ground**

## Transmitter case grounding

Always ground the transmitter case in accordance with national and local electrical codes. The most effective transmitter case grounding method is a direct connection to earth ground with minimal impedance. Methods for grounding the transmitter case include:

- Internal Ground Connection: The Internal Ground Connection screw is inside the FIELD TERMINALS side of the electronics housing. This screw is identified by a ground symbol (⏚). The ground connection screw is standard on all Rosemount 2088 transmitters. Refer to Figure 4-9 on page 48.
- External ground connection: The external ground connection is located on the exterior of the transmitter housing. Refer to Figure  on page 48. This connection is only available with option T1.

**Figure 4-9. Internal ground connection**




**A. Internal ground location**
**B. External ground location**
**C. Positive**
**D. Negative**
**E. Test**

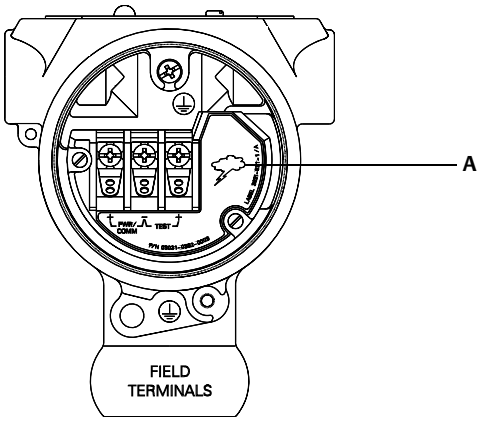
**Note**
Grounding the transmitter case via threaded conduit connection may not provide sufficient ground continuity.

# Transient protection terminal block grounding

The transmitter can withstand electrical transients of the energy level usually encountered in static discharges or induced switching transients. However, high-energy transients, such as those induced in wiring from nearby lightning strikes, can damage the transmitter.

The transient protection terminal block can be ordered as an installed option (Option Code T1) or as a spare part to retrofit existing Rosemount 2088 transmitters in the field. See "Spare parts" on page 171 for part numbers. The lightning bolt symbol shown in Figure 4-10 on page 49 identifies the transient protection terminal block.

**Figure 4-10. Transient protection terminal block**




**A. Lightning bolt location**

**Note**
The transient protection terminal block does not provide transient protection unless the transmitter case is properly grounded. Use the guidelines to ground the transmitter case. Refer to Figure 4-9 on page 48.

# Section 5 Operation and maintenance

Overview . . . . . page 51
Safety messages . . . . . page 51
Calibration overview . . . . . page 52
Trim the pressure signal . . . . . page 55
Trim the analog output . . . . . page 58
Switching HART revision . . . . . page 61

## 5.1 Overview

This section contains information on calibrating Rosemount 2088 Pressure Transmitters.

Field Communicator, AMS Device Manager and Local Operator Interface (LOI) instructions are given to perform configuration functions.

## 5.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol ( ⚠ ). Refer to the following safety messages before performing an operation preceded by this symbol.

### 5.2.1 Warnings

**⚠ WARNING**

Explosions could result in death or serious injury.

Installation of this transmitter in an explosive environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of the Rosemount 2088 reference manual for any restrictions associated with a safe installation.

- Before connecting a field communicator in an explosive atmosphere, ensure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- In an Explosion-Proof/Flameproof installation, do not remove the transmitter covers when power is applied to the unit.

Process leaks may cause harm or result in death.

- Install and tighten process connectors before applying pressure.

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

# 5.3 Recommended calibration tasks

**⚠ CAUTION**

Absolute pressure transmitters (Rosemount 2088A) are calibrated at the factory. Trimming adjusts the position of the factory characterization curve. It is possible to degrade performance of the transmitter if any trim is done improperly or with inaccurate equipment.

**Table 5-1. Basic and full calibration tasks**

| Field installation tasks | Bench calibration tasks |
|---|---|
| 1. Perform Sensor zero/lower Trim: Compensate for mounting pressure effects<br>a. Refer to Section 3.5 for manifold operation instructions to properly drain/vent valves<br>2. Set/check basic configuration parameters<br>a. Output units<br>b. Range points<br>c. Output type<br>d. Damping Value | 1. Perform optional 4-20mA 1-5 Vdc Output Trim<br>2. Perform a Sensor Trim<br>a. Zero/lower trimpage 64 using line pressure effect correction. Reference Section 3.5 for manifold drain/vent valve operation instructions.<br>b. Optional full scale trim. Sets the span of the device and requires accurate calibration equipment<br>c. Set/check basic configuration parameters. |

# 5.4 Calibration overview

The Rosemount 2088 Pressure Transmitter is an accurate instrument that is fully calibrated in the factory. Field calibration is provided to the user to meet plant requirements or industry standards. Complete calibration of the Rosemount 2088 can be split into two halves: Sensor Calibration and Analog Output Calibration.

Sensor Calibration allows the user to adjust the pressure (digital value) reported by the transmitter to be equal to a pressure standard. The Sensor Calibration can adjust the pressure offset to correct for mounting conditions or line pressure effects. This correction is recommended. The calibration of the pressure range (pressure span or gain correction) requires accurate pressure standards (sources) to provide a full calibration.

Like the Sensor Calibration, the analog output can be calibrated to match the user measurement system. The Analog Output Trim (4-20mA/ 1-5 V Output Trim) will calibrate the loop at the 4mA (1 V) and 20mA (5 V) points.

The Sensor Calibration and the Analog Output Calibration combine to match the transmitter's measurement system to the plant standard.

## Calibrate the sensor

- Sensor Trim (page 56)
- Zero Trim (page 57)

## Calibrate the 4-20 mA output

- 4-20 mA/ 1-5V Output Trim (page 59)
- 4-20 mA/ 1-5V Output Trim using other scale (page 60)

# 5.4.1 Determining necessary sensor trims

Bench calibrations allow for calibrating the instrument for its desired range of operation. Straight forward connections to pressure source allow for a full calibration at the planned operating points. Exercising the Transmitter over the desired pressure range allows for verification of the analog output. Trim the pressure signal on page 55 discusses how the trim operations change the calibration. It is possible to degrade the performance of the transmitter if a trim is done improperly or with inaccurate equipment. The transmitter can be set back to factory settings using the Recall Factory Trim command in Recall factory trim—sensor trim on page 57.

Determine the necessary trims with the following steps.

1. Apply pressure.
2. Check digital pressure, if the digital pressure does not match the applied pressure, perform a digital trim. See Perform a sensor trim on page 56.
3. Check reported analog output against the live analog output. If they do not match, perform an analog output trim. See Performing digital-to-analog trim (4-20mA/ 1-5 V output trim) on page 59.

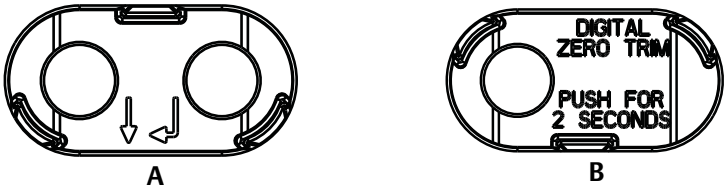
## Trimming with configuration buttons

Local configuration buttons are external buttons located underneath the top tag of the transmitter. There are two possible sets of local configuration buttons that can be ordered and used to perform trim operations: Digital Zero Trim and Local Operator Interface. To access the buttons, loosen screw and rotate top tag until buttons are visible.

- **Local Operator Interface (M4):** Can perform both digital Sensor Trim and the 4-20mA Output Trim (analog output trim). Follow the same procedures listed in trimming with Field Communicator or AMS Device Manager listed below.
- **Digital Zero Trim (DZ):** Used for performing a sensor zero trim. See Determining calibration frequency on page 54 for trim instructions.

All configuration changes should be monitored by a display or by measuring the loop output. Figure 5-1 shows the physical differences between the two sets of buttons.

**Figure 5-1. Local configuration button options**




**A. Local Operator Interface - green retainer**
**B. Digital Zero Trim- blue retainer**

## 5.4.2 Determining calibration frequency

Calibration frequency can vary greatly depending on the application, performance requirements, and process conditions. Use the following procedure to determine calibration frequency that meets the needs of your application.

1. Determine the performance required for your application.
2. Determine the operating conditions.
3. Calculate the Total Probable Error (TPE).
4. Calculate the stability per month.
5. Calculate the calibration frequency.

### Sample calculation for Rosemount 2088

Step 1: Determine the performance required for your application.

| | |
|---|---|
| Required Performance: | 0.50% of span |

Step 2: Determine the operating conditions.

| | |
|---|---|
| Transmitter: | Rosemount 2088G, Range 1 [URL = 30 psi (2,1 bar)] |
| Calibrated Span: | 30 psi (2,1 bar) |
| Ambient Temperature Change: | ± 50 °F (28 °C) |

Step 3: Calculate total probable error (TPE).

$$TPE = \sqrt{(ReferenceAccuracy)^2 + (TemperatureEffect)^2 + (StaticPressureEffect)^2} = 0.309\% \text{ of span}$$

Where:

| | |
|---|---|
| Reference Accuracy = | ± 0.075% of span |
| Ambient Temperature Effect = | ± (0.15% URL + 0.15% of span) per 50 °F = ± 0.3% of span |

Step 4: Calculate the stability per month.

$$Stability = \pm\left[\frac{(0.100 \times URL)}{Span}\right]\% \text{ of span for 3 years} = \pm 0.0028\% \text{ of URL for 1 month}$$

Step 5: Calculate calibration frequency.

$$\text{Cal. Freq.} = \frac{(\text{Req. Performance} - \text{TPE})}{\text{Stability per Month}} = \frac{(0.5\% - 0.309\%)}{0.0028\%} = 68 \text{ months}$$

# 5.5 Trim the pressure signal

## 5.5.1 Sensor trim overview

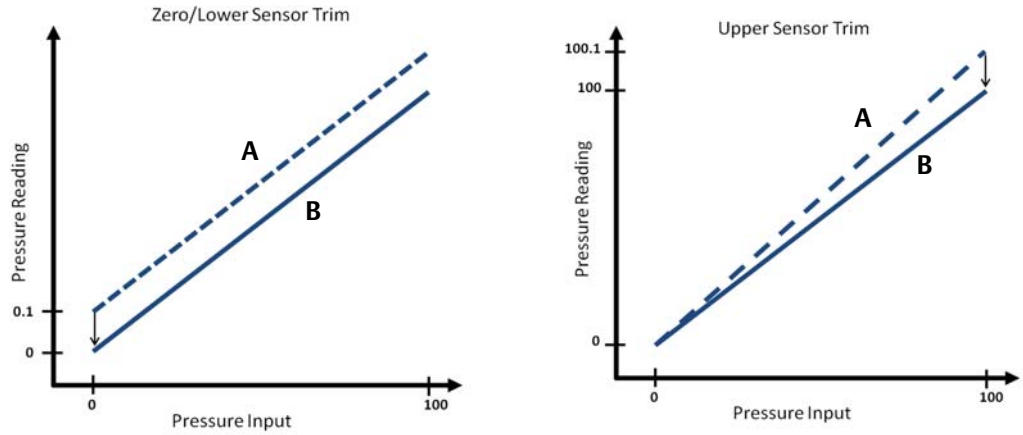
A sensor trim corrects the pressure offset and pressure range to match a pressure standard. The upper Sensor Trim corrects the pressure range and the lower Sensor trim (Zero Trim) corrects the pressure offset. An accurate pressure standard is required for full calibration. A zero trim can be performed if the process is vented.

Zero trim is a single-point offset adjustment. It is useful for compensating for mounting position effects and is most effective when performed with the transmitter installed in its final mounting position. Since this correction maintains the slope of the characterization curve, it should not be used in place of a Sensor Trim over the full sensor range.

**Note**
Do not perform a zero trim on Rosemount 2088A Absolute Pressure Transmitters. Zero trim is zero based, and absolute pressure transmitters reference absolute zero. To correct mounting position effects on a Rosemount 2088A Absolute Pressure Transmitter, perform a low trim within the sensor trim function. The low trim function provides an offset correction similar to the zero trim function, but it does not require zero-based input.

Upper and lower sensor trim is a two-point sensor calibration where two end-point pressures are applied, all output is linearized between them, and requires an accurate pressure source. Always adjust the low trim value first to establish the correct offset. Adjustment of the high trim value provides a slope correction to the characterization curve based on the low trim value. The trim values help optimize performance over a specific measurement range.

**Figure 5-2. Sensor trim example**




**A. Before Trim**
**B. After Trim**

## 5.5.2 Perform a sensor trim

When performing a sensor trim, but the upper and lower limits can be trimmed. If both upper and lower trims are to be performed, the lower trim must be done prior to the upper time.

**Note**
Use a pressure input source that is at least four times more accurate than the transmitter, and allow the input pressure to stabilize for 10 seconds before entering any values.

### Performing a sensor trim with a field communicator

From the *HOME* screen, enter the Fast Key sequence and follow the steps within the Field Communicator to complete the sensor trim.

| Device Dashboard Fast Keys | 3, 4, 1 |
|---|---|

To calibrate the sensor with a field communicator using the sensor trim function, perform the following procedure:

1. Select **2: Lower Sensor Trim**.

**Note**
Select pressure points so that lower and upper values are equal to or outside the expected process operation range. This can be done by going to Rerange the transmitter on page 14 of Section 2.

2. Follow the commands provided by the Field Communicator to complete the adjustment of the lower value.
3. Select **3: Upper Sensor Trim**.
4. Follow the commands provided by the Field Communicator to complete the adjustment of the upper value.

### Performing a sensor trim with AMS Device Manager

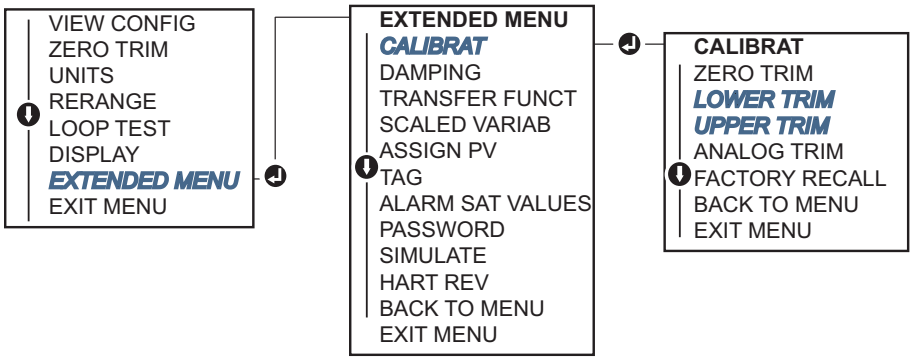
Right click on the device and, under the *Method* drop down menu, move cursor over *Calibrate* and, under *Sensor Trim*, select **Lower Sensor Trim**.

1. Follow the screen prompts to perform a Sensor Trim using AMS Device Manager.
2. If desired, right click on the device and under the *Method* drop down menu, move cursor over *Calibrate* and under *Sensor Trim* and select **Upper Sensor Trim**

### Performing a sensor trim using local operator interface

Perform an upper and lower Sensor Trim by referencing Figure 5-3.

**Figure 5-3. Sensor trim with local operator interface**




## Performing a digital zero trim (option DZ)

A Digital Zero Trim (option DZ) provides the same function as a zero/lower sensor trim, but can be completed in hazardous areas at any given time by simply pushing the Zero Trim button when the transmitter is at zero pressure. If the transmitter is not close enough to zero when the button is pushed, the command may fail due to excess correction. If ordered, a digital zero trim can be performed by utilizing external configuration buttons located underneath the top tag of the transmitter, see Figure 5-1 on page 54 for DZ button location.

1. Loosen the top tag of the transmitter to expose buttons.
2. Press and hold the Digital zero button for at least two seconds, then release to perform a digital zero trim.

# 5.5.3 Recall factory trim—sensor trim

The Recall Factory Trim—Sensor Trim command allows the restoration of the as-shipped factory settings of the sensor trim. This command can be useful for recovering from an inadvertent zero trim of an absolute pressure unit or inaccurate pressure source.

## Recalling factory trim with a field communicator

From the *HOME* screen, enter the Fast Key sequence and follow the steps within the Field Communicator to complete the sensor trim.

| | |
|---|---|
| **Device Dashboard Fast Keys** | 3, 4, 3 |

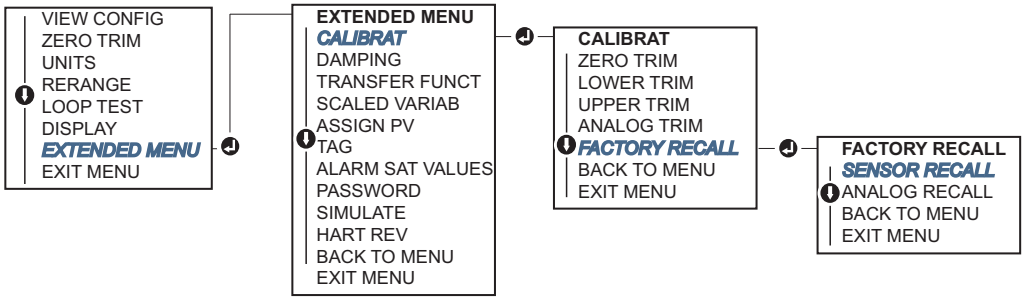
## Recalling factory trim with AMS Device Manager

1. Right click on the device and, under the *Method* drop down menu, move cursor over *Calibrate* and select **Restore Factory Calibration**.
2. Set the control loop to manual.
3. Click **Next**.
4. Select **Sensor Trim** under *Trim to recall* and click **Next**.
5. Follow the screen prompts to recall sensor trim.

## Recalling factory trim - sensor trim using local operator interface

Refer to Figure 5-4 to recall factory Sensor Trim.

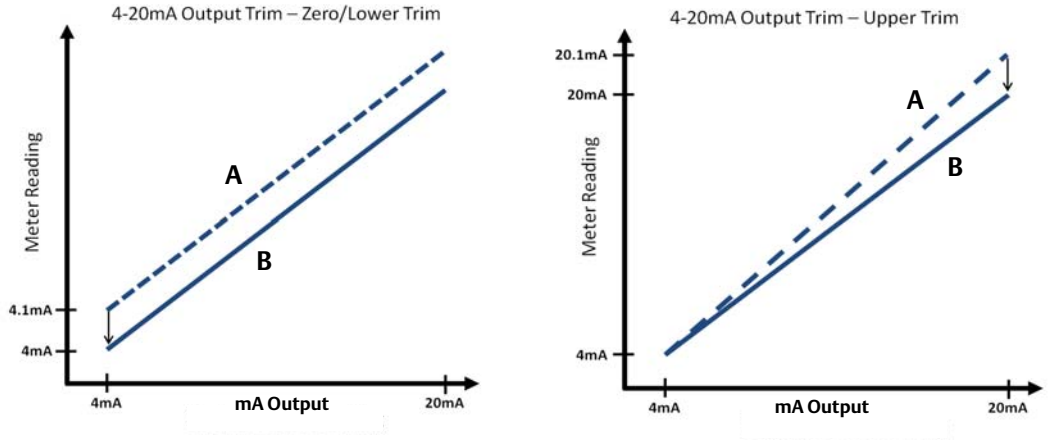
**Figure 5-4. Recall factory trim - sensor trim with local operator interface**




# 5.6 Trim the analog output

The Analog Output Trim commands allow you to adjust the transmitter's current output at the 4 and 20 mA points to match the plant standards. This trim is performed after the digital to analog conversion so only the 4-20mA analog signal will be affected. Figure 5-5 graphically shows the two ways the characterization curve is affected when an analog output trim is performed.

**Figure 5-5. Analog output trim example**




**A. Before trim**
**B. After Trim**

## 5.6.1 Performing digital-to-analog trim (4-20mA/ 1-5 V output trim)

**Note**
If a resistor is added to the loop, ensure that the power supply is sufficient to power the transmitter to a 20 mA output with additional loop resistance. Refer to Power supply on page 45.

### Performing a 4-20 mA/ 1-5 V output trim with a field communicator

From the *HOME* screen, enter the Fast Key sequence and follow the steps within the Field Communicator to complete the 4-20 mA output trim.

| | |
|---|---|
| **Device Dashboard Fast Keys** | 3, 4, 2, 1 |

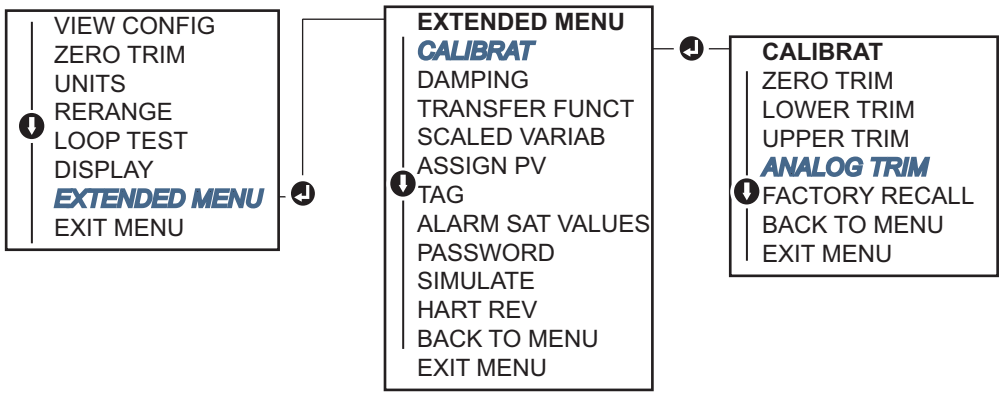
### ⚠ Performing a 4-20 mA/ 1-5 V output trim with AMS Device Manager

Right click on the device and, under the *Method* drop down menu, move cursor over *Calibrate* and select **Analog Calibration**.

1. Select **Digital to Analog Trim.**
2. Follow the screen prompts to perform a 4-20 mA output trim.

## Performing 4-20mA/ 1-5 V output trim using local operator interface

**Figure 5-6. 4-20mA output trim using local operator interface**




# 5.6.2 Performing digital-to-analog trim (4-20mA/ 1-5 V output trim) using other scale

The Scaled 4-20 mA output Trim command matches the 4 and 20 mA points to a user selectable reference scale other than 4 and 20 mA (for example, 2 to 10 volts if measuring across a 500 Ω load, or 0 to 100 percent if measuring from a Distributed Control System (DCS)). To perform a scaled 4-20 mA output trim, connect an accurate reference meter to the transmitter and trim the output signal to scale, as outlined in the Output Trim procedure.

## Performing a 4-20/ 1-5 V mA output trim using other scale with a field communicator

From the *HOME* screen, enter the Fast Key sequence and follow the steps within the Field Communicator to complete the 4-20 mA output trim using other scale.

| | |
|---|---|
| **Device dashboard Fast Keys** | 3, 4, 2, 2 |

## ⚠ Performing a 4-20 mA/ 1-5 V output trim using other scale with AMS Device Manager

1. Right click on the device and under the *Method* drop down menu, move cursor over *Calibrate* and select **Analog Calibration**.
2. Select **Scaled Digital to Analog Trim**.
3. Follow screen prompts to perform a 4-20mA/ 1-5 V output trim.

## 5.6.3 Recalling factory trim—analog output

⚠ The Recall Factory Trim—Analog Output command allows the restoration of the as-shipped factory settings of the analog output trim. This command can be useful for recovering from an inadvertent trim, incorrect Plant Standard or faulty meter.

### Recalling factory trim - analog output with a field communicator

From the *HOME* screen, enter the Fast Key sequence and follow the steps within the Field Communicator to complete the digital to analog trim using other scale.

| | |
|---|---|
| **Device dashboard Fast Keys** | 3, 4, 3 |

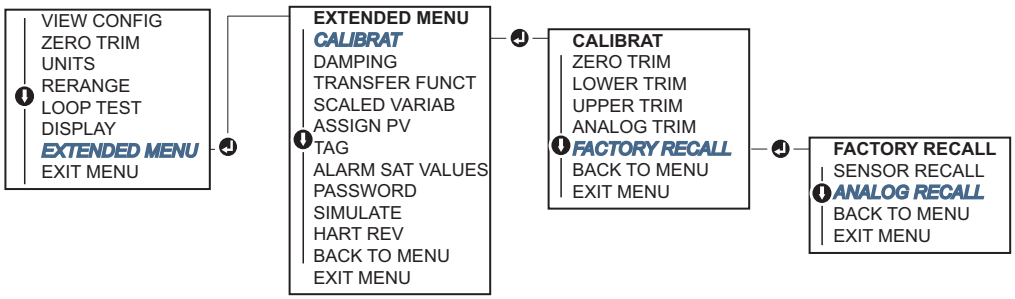
### Recalling factory trim - analog output with AMS Device Manager

1. Right click on the device and, under the *Method* drop down menu, move cursor over *Calibrate* and select **Restore Factory Calibration**.
2. Click **Next** to set the control loop to manual.
3. Select **Analog Output Trim** under *Select trim to recall* and click **Next**.
4. Follow screen prompts to recall analog output trim.

### Recalling factory trim - analog output with local operator interface

Reference Figure 5-7 for LOI instructions.

**Figure 5-7. Recall factory trim – analog output with local operator interface**




# 5.7 Switching HART revision

Some systems are not capable of communicating with HART Revision 7 devices. The following procedures list how to change HART revisions between HART Revision 7 and HART Revision 5.

## 5.7.1 Switching HART revision with generic menu

If the HART configuration tool is not capable of communicating with a HART Revision 7 device, it should load a Generic Menu with limited capability. The following procedures allow for switching between HART Revision 7 and HART Revision 5 from a Generic Menu.

1. Locate “Message” field.
   a. To change to HART Revision 5, Enter: **HART5** in the message field.
   b. To change to HART Revision 7, Enter: **HART7** in the message field.

## 5.7.2 Switching HART revision with field communicator

From the HOME screen, enter the Fast Key sequence and follow steps within the Field Communicator to complete the HART revision change.

| From the *HOME* screen, enter the Fast Key sequence | HART5 | HART7 |
|---|---|---|
| **Device Dashboard Fast Keys** | 2, 2, 5, 2, 4 | 2, 2, 5, 2, 3 |

## 5.7.3 Switching HART revision with AMS Device Manager

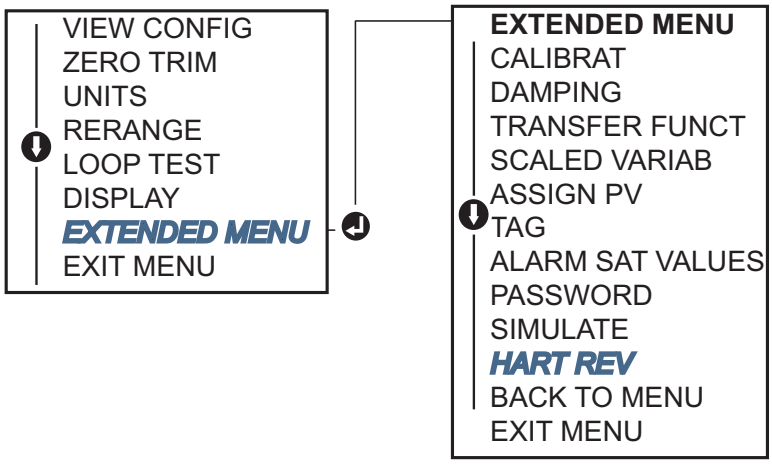
1. Click on **Manual Setup** and select **HART.**
2. Select **Change HART Revision,** then follow the on screen prompts.

**Note**
AMS Device Manager versions 10.5 or greater are compatible with HART Revision 7.

## 5.7.4 Switching HART revision with local operator interface

Navigate to *HART REV* within the extended menu and select either *HART REV 5* or *HART REV 7*. Use Figure 5-8 below to change HART Revision.

**Figure 5-8. Change HART revision with local operator interface**



# Section 6 Troubleshooting

Overview . . . . . page 63
Safety messages . . . . . page 63
Diagnostic messages . . . . . page 65
Disassembly procedures . . . . . page 68
Reassembly procedures . . . . . page 69

## 6.1 Overview

Table 6-1 provides summarized maintenance and troubleshooting suggestions for the most common operating problems.

If you suspect malfunction despite the absence of any diagnostic messages on the Field Communicator display, consider using Section 6.3 on page 65 to identify any potential problem.

## 6.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

### 6.2.1 Warnings

**⚠ WARNING**

Explosions could result in death or serious injury.

Installation of this transmitter in an explosive environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of the Rosemount 2088 reference manual for any restrictions associated with a safe installation.

- Before connecting a field communicator in an explosive atmosphere, ensure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- In an Explosion-Proof/Flameproof installation, do not remove the transmitter covers when power is applied to the unit.

Process leaks may cause harm or result in death.

- Install and tighten process connectors before applying pressure.

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

### Table 6-1. Rosemount 2088 troubleshooting table for 4-20 mA output

| Symptom | Corrective actions |
|---|---|
| Transmitter milliamp reading is zero | Verify terminal voltage is 10.5 to 42.4 Vdc at signal terminals |
| | Check power wires for reversed polarity |
| | Check that power wires are connected to signal terminals |
| | Check for open diode across test terminal |
| Transmitter Not Communicating with Field Communicator | Verify terminal voltage is 10.5 to 42.4 Vdc |
| | Check loop resistance, 250Ω minimum (PS voltage -transmitter voltage/loop current) |
| | Check that power wires are connected to signal terminals and not test terminals |
| | Verify clean DC Power to transmitter (Max AC noise 0.2 volts peak to peak) |
| | Verify the output is between 4 and 20 mA or saturation levels |
| | Have Field Communicator poll for all addresses |
| Transmitter milliamps reading is low or high | Verify applied pressure |
| | Verify 4 and 20 mA range points |
| | Verify output is not in alarm condition |
| | Perform analog trim |
| | Check that power wires are connected to the correct signal terminals (positive to positive, negative to negative) and not the test terminal |
| Transmitter will not respond to changes in applied pressure | Check impulse piping or manifold for blockage |
| | Verify applied pressure is between the 4 and 20 mA points |
| | Verify the output is not in alarm condition |
| | Verify transmitter is not in loop test mode |
| | Verify transmitter is not in multidrop mode |
| | Check test equipment |
| Digital Pressure Variable reading is low or high | Check impulse piping for blockage or low fill in wet leg |
| | Verify transmitter is calibrated properly |
| | Check test equipment (verify accuracy) |
| | Verify pressure calculations for application |
| Digital Pressure Variable reading is erratic | Check application for faulty equipment in pressure line |
| | Verify transmitter is not reacting directly to equipment turning on/off |
| | Verify damping is set properly for application |
| Milliamps reading is erratic | Verify power source to transmitter has adequate voltage and current |
| | Check for external electrical interference |
| | Verify transmitter is properly grounded |
| | Verify shield for twisted pair is only grounded at one end |

# 6.3 Diagnostic messages

Listed in the below sections are detailed table of the possible messages that will appear on either the LCD display/LOI display, a field communicator, or an AMS Device Manager system. Use the tables below to diagnose particular status messages.

- Good
- Failed – fix now
- Maintenance – fix soon
- Advisory

## 6.3.1 Diagnostic message: failed - fix now

**Table 6-2. Status: failed – fix now**

| Alert name | LCD display screen | LOI screen | Problem | Recommended action |
|---|---|---|---|---|
| No Pressure Updates | NO P UPDATE | NO PRESS UPDATE | There are no pressure updates from the sensor to the electronics | 1. Ensure the sensor cable connection to the electronics is tight.<br>2. Replace the pressure transmitter. |
| Electronics Board Failure | FAIL BOARD | FAIL BOARD | A failure has been detected in the electronics circuit board | 1. Replace the electronics board. |
| Critical Sensor Data Error | MEMRY ERROR | MEMORY ERROR | A user written parameter does not match the expected value | 1. Confirm and correct all parameters listed in Device Information.<br>2. Perform a Device Reset.<br>3. Replace Pressure Transmitter. |
| Critical Electronics Data Error | | | A user written parameter does not match the expected value | 1. Confirm and correct all parameters listed in Device Information.<br>2. Perform a Device Reset.<br>3. Replace electronics board. |
| Sensor Failure | FAIL SENSOR | FAIL SENSOR | A failure has been detected in the pressure sensor | 1. Replace pressure transmitter. |
| Incompatible Electronics and Sensor | XMTR MSMTCH | XMTR MSMTCH | The pressure sensor is incompatible with the attached electronics | 1. Replace the electronics board or sensor with compatible hardware. |

## 6.3.2 Diagnostic message: maintenance - fix soon

**Table 6-3. Status: maintenance – fix soon**

| Alert name | LCD display screen | LOI screen | Problem | Recommended action |
|---|---|---|---|---|
| No Temperature Updates | NO T UPDATE | NO TEMP UPDATE | There are no temperature updates from the sensor to the electronics | 1. Ensure the sensor cable connection to the electronics is tight.<br>2. Replace the pressure transmitter. |
| Pressure Out of Limits | PRES LIMITS | PRES OUT LIMITS | The pressure is either above or below the sensor limits | 1. Check the transmitter pressure connection to ensure it is not plugged or the isolating diaphragms are not damaged.<br>2. Replace the pressure transmitter. |
| Sensor Temperature Beyond Limits | TEMP LIMITS | TEMP OUT LIMITS | The sensor temperature has exceeded its safe operating range | 1. Check the process and ambient conditions are within -85 to 194 °F (-65 to 90 °C).<br>2. Replace the pressure transmitter. |
| Electronics Temperature Beyond Limits | | | The temperature of the electronics has exceeded its safe operating range. | 1. Confirm electronics temperature is within limits of -85 to 194 °F (-65 to 90 °C).<br>2. Replace electronics board. |
| Electronics Board Parameter Error | MEMRY WARN (also in advisory) | MEMORY WARN (also in advisory) | A device parameter does not match the expected value. The error does not affect transmitter operation or analog output. | 1. Replace the electronics board. |
| Configuration Buttons Operator Error | STUCK BUTTON | STUCK BUTTON | Device is not responding to button presses. | 1. Check configuration buttons are not stuck.<br>2. Replace the electronics board. |

## 6.3.3 Diagnostic message: advisory

**Table 6-4. Status: advisory**

| Alert name | LCD display screen | LOI screen | Problem | Recommended action |
|---|---|---|---|---|
| Non-Critical User Data Warning | MEMRY WARN | MEMORY WARN | A user written parameter does not match expected value. | 1. Confirm and correct all parameters listed in Device Information.<br>2. Perform a Device Reset.<br>3. Replace Electronics Board. |
| Sensor Parameter Warning | | | A user written parameter does not match expected value. | 1. Confirm and correct all parameters listed in Device Information.<br>2. Perform a Device Reset.<br>3. Replace pressure transmitter. |
| LCD Display Update Failure | [If display is not updating] | [If display is not updating] | The LCD display is not receiving updates from the pressure sensor. | 1. Check the connection between the LCD display and the circuit board.<br>2. Replace the LCD display.<br>3. Replace the electronics board. |
| Configuration Changed | [none] | [none] | A recent change has been made the device by a secondary HART master such as a handheld device. | 1. Verify that the configuration change of the device was intended and expected.<br>2. Clear this alert by selecting Clear Configuration Changed Status.<br>3. Connect a HART master such as AMS Device Manager or similar which will automatically clear it. |
| Analog Output Fixed | ANLOG FIXED | ANALOG FIXED | The analog output is fixed and does not represent the process measurement. This may be caused by other conditions in the device, or because the device has been set to loop test or multidrop mode. | 1. Take action on any other notifications from the device.<br>2. If the device is in loop test, and should no longer be, disable or momentarily remove power.<br>3. If the device is in multidrop mode and should not be, re-enable loop current by setting the polling address to 0. |
| Simulation Active | [none] | [none] | The device is in simulation mode and may not be reporting actual information. | 1. Verify that simulation is no longer required.<br>2. Disable simulation mode in service tools.<br>3. Perform a Device Reset. |
| Analog Output Saturated | ANLOG SAT | ANALOG SAT | The analog output is saturated either high or low due to the pressure either above or below the range values. | 1. Check the pressure applied to ensure it is between the 4-20mA points.<br>2. Check the transmitter pressure connection to make sure it is not plugged or isolating diaphragms are not damaged.<br>3. Replace the pressure transmitter. |

# 6.4 Disassembly procedures

⚠ Do not remove the instrument cover in explosive atmospheres when the circuit is live.

## 6.4.1 Removing from service

1. Follow all plant safety rules and procedures.
2. Power down device.
3. Isolate and vent the process from the transmitter before removing the transmitter from service.
4. Remove all electrical leads and disconnect conduit.
5. Remove the transmitter from the process connection.
   a. The Rosemount 2088 Transmitter is attached to the process by a single hex nut process connection. Loosen the hex nut to separate the transmitter from the process.

**Note**
Do not wrench on neck of transmitter. See warning in “Inline process connection” on page 49.

6. Do not scratch, puncture, or depress the isolating diaphragms.
7. Clean isolating diaphragms with a soft rag and a mild cleaning solution, and rinse with clear water.

## 6.4.2 Removing terminal block

Electrical connections are located on the terminal block in the compartment labeled “FIELD TERMINALS.”

1. Remove the housing cover from the field terminal side.
2. Loosen the two small screws located on the assembly in the 9 o’clock and 5 o’clock positions relative to the top of the transmitter.
3. Pull the entire terminal block out to remove it.

## 6.4.3 Removing the electronics board

The transmitter electronics board is located in the compartment opposite the terminal side. To remove the electronics board see Figure 4-1 on page 40 and perform following procedure:

1. Remove the housing cover opposite the field terminal side.
2. If you are disassembling a transmitter with a LCD display/LOI display, loosen the two captive screws that are visible (See Figure 4-3 on page 43 for screw locations). The two screws anchor the LCD display/LOI display to the electronics board and the electronics board to the housing.

⚠ See "Safety messages" on page 63 for complete warning

**Note**
The electronics board is electrostatically sensitive; observe handling precautions for static-sensitive components

3. Using the two captive screws, slowly pull the electronics board out of the housing. The sensor module ribbon cable holds the electronics board to the housing. Disengage the ribbon cable by pushing the connector release.

**Note**
If an LCD display/LOI is installed, use caution as there is an electronic pin connector that interfaces between the LCD display/LOI and electronics board.

### 6.4.4 Removing sensor module from the electronics housing

1. Remove the electronics board. Refer to "Removing the electronics board" on page 68.

**Important**
To prevent damage to the sensor module ribbon cable, disconnect it from the electronics board before you remove the sensor module from the electrical housing.

2. Carefully tuck the cable connector completely inside of the internal black cap.

**Note**
Do not remove the housing until after you tuck the cable connector completely inside of the internal black cap. The black cap protects the ribbon cable from damage that can occur when you rotate the housing.

3. Using a $^{5}/_{64}$-inch hex wrench, loosen the housing rotation setscrew one full turn.
4. Unscrew the module from the housing, making sure the black cap on the sensor module and sensor cable do not catch on the housing.

## 6.5 Reassembly procedures

1. Inspect all cover and housing (non-process wetted) O-rings and replace if necessary. Lightly grease with silicone lubricant to ensure a good seal.
2. Carefully tuck the cable connector completely inside the internal black cap. To do so, turn the black cap and cable counterclockwise one rotation to tighten the cable.
3. Lower the electronics housing onto the module. Guide the internal black cap and cable on the sensor module through the housing and into the external black cap.
4. Turn the module clockwise into the housing.

**Important**
Make sure the sensor ribbon cable and internal black cap remain completely free of the housing as you rotate it. Damage can occur to the cable if the internal black cap and ribbon cable become hung up and rotate with the housing.

⚠ 5. Thread the housing completely onto the sensor module. The housing must be no more than one full turn from flush with the sensor module to comply with explosion proof requirements.

6. Tighten the housing rotation setscrew using a $^{5}/_{64}$-inch hex wrench.

## 6.5.1 Attaching electronics board

1. Remove the cable connector from its position inside of the internal black cap and attach it to the electronics board.

2. Using the two captive screws as handles, insert the electronics board into the housing. Make sure the power posts from the electronics housing properly engage the receptacles on the electronics board.

**Note**
Do not force. The electronics board should slide gently on the connections.

3. Tighten the captive mounting screws.

⚠ 4. Replace the electronics housing cover. The transmitter covers must be engaged metal-to-metal to ensure a proper seal and to meet Explosion-Proof requirements.

## 6.5.2 Installing terminal block

⚠ 1. Gently slide the terminal block into place, making sure the two power posts from the electronics housing properly engage the receptacles on the terminal block.

2. Tighten the captive screws.

3. Replace the electronics housing cover. The transmitter covers must be fully engaged to meet Explosion-Proof requirements.

## 6.5.3 Installing drain/vent valve

1. Apply sealing tape to the threads on the seat. Starting at the base of the valve with the threaded end pointing toward the installer, apply five clockwise turns of sealing tape.

2. Tighten the drain/vent valve seat to 250 in-lb. (28.25 N-m).

3. Take care to place the opening on the valve so that process fluid will drain toward the ground and away from human contact when the valve is opened.

# Appendix A Specifications and reference data

Performance specifications . . . . . page 71
Functional specifications . . . . . page 72
Physical specifications . . . . . page 75
Dimensional drawings . . . . . page 76
Ordering information . . . . . page 77
Options . . . . . page 81

## A.1 Performance specifications

For zero-based spans, reference conditions, silicone oil fill, 316L SST isolating diaphragm.

### A.1.1 Reference accuracy

±0.075% of calibrated span. Includes combined effects of linearity, hysteresis, and repeatability
±0.065% of calibrated span (high accuracy option - P8)
For spans less than 10:1, accuracy $= \pm \left[ 0.009 \left( \frac{URL}{Span} \right) \right]$ % of Span

#### Ambient temperature effect

Expressed as a total effect per 50 ℉ (28 ℃)
Total effect includes zero and span effects.
± (0.15% URL + 0.15% of span)

#### Stability

Ranges 2-4: ±0.10% of URL for 3 years
Range 1: ±0.10% of URL for 1 year

#### Vibration effect

Less than ±0.1% of URL when tested per the requirements of IEC60770-1 field or pipeline with high vibration level (10-60 Hz 0.21 mm displacement peak amplitude / 60-2000 Hz 3g).

#### Power supply effect

Less than ±0.005% of calibrated span per volt change in voltage at the transmitter terminals.

#### Mounting position effect

Zero shifts to ±2.5 in$H_2O$ (6,22 mbar), which can be zeroed Span: no effect.

### A.1.2 Transient protection limits

#### IEEE 587 Category B

Tested in accordance with IEEE C62.41.2-2002,
Location Category B
6 kV crest (0.5 ms - 100 kHz)
3 kA crest (8 × 20 microseconds)
6 kV crest (1.2 × 50 microseconds)

### A.1.3 General specifications

Tested to IEC 801-3

## A.2 Functional specifications

**Table 1. 2088 Range Values**

| Range | Minimum span | Upper (URL) | Lower (LRL) | Lower[(1)] (LRL) (gage) |
|---|---|---|---|---|
| 1 | 0.60 psi (41,37 mbar) | 30.00 psi (2,07 bar) | 0 psia (0 bar) | –14.70 psig (–1,01 bar) |
| 2 | 3.00 psi (206,85 mbar) | 150.00 psi (10,34 bar) | 0 psia (0 bar) | –14.70 psig (–1,01 bar) |
| 3 | 16.00 psi (1,11 bar) | 800.00 psi (55,16 bar) | 0 psia (0 bar) | –14.70 psig (–1,01 bar) |
| 4 | 80.00 psi (5,52 bar) | 4000.00 psi (275,79 bar) | 0 psia (0 bar) | –14.70 psig (–1,01 bar) |

(1) Assumes atmospheric pressure of 14.70 psia (1,01 bar-a).

### A.2.1 Output

Code S: 4–20 mA
Code N: 1-5 volt dc, low power
(Outputs are directly proportional to the input pressure)

#### Selectable HART

Digital communications based on HART Revision 5 (default) or Revision 7 (option code HR7) protocol can be selected. The HART revision can be switched in the field using any HART based configuration tool or the optional local operator interface (LOI).

### A.2.2 Service

Liquid, gas, and vapor applications

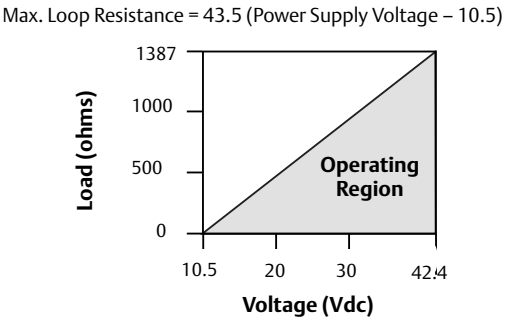
### A.2.3 Power supply

External power supply required. Transmitter operates on 10.5–42.4 Vdc with no load (5.8-28 V for Low Power). Reverse polarity protection is standard.

## A.2.4 Load limitations

Reverse polarity protection is standard. Maximum loop resistance is determined by the power supply voltage as described by the following equations:

**Figure A-1. Maximum loop resistance**




***The Field communicator requires a minimum loop resistance of 250Ω for communication.***

### Indication

Optional two line LCD display/LOI display.

### Zero and span adjustment requirements

Zero and span values can be set anywhere within the range limits stated in Table 1 on page 72. Span must be greater than or equal to the minimum span stated in Table 1 on page 72.

### Local operator interface

The LOI utilizes a 2 button menu with internal and external configuration buttons. Internal buttons are always configured for Local Operator Interface. External buttons can be configured for either LOI, (option code M4), Analog Zero and Span (option code D4) or Digital Zero Trim (option 0100-4108) for LOI configuration menu.

### Current draw

Output Code N: ≤ 3 mA

### Overpressure limits

Range 1: 120 psig max
All other ranges: two times the URL

### Burst pressure

11,000 psi for all ranges

### Zero elevation and suppression

Zero can be suppressed between atmosphere for gage transmitters or 0 psia for absolute transmitters and upper range limit, provided the calibrated span is equal to or greater than the minimum span, and the upper range value does not exceed the upper range limit.

## Dynamic performance

Total Response Time: 145 milliseconds
Update rate: 20 times per second minimum

# A.2.5 Temperature limits

### Ambient:

–40 to 185 °F (–40 to 85 °C)
–With LCD display[(1)]: -40 to 176 °F (–40 to 80 °C)[(1)]

### Storage[(1)]:

–50 to 185 °F (–46 to 85 °C)
–With LCD display: –40 to 185 °F (–40 to 85 °C)

## Process

Silicone fill sensor: –40 to 250 °F (–40 to 121 °C)[(2)]
Inert fill sensor: –22 to 250 °F (–30 to 121 °C)[(2)]

Process temperatures above 185 °F (85 °C) require derating the ambient limits by a 1.5:1 ratio. For example, for process temperature of 195 °F (91 °C), new ambient temperature limit is equal to 170 °F (77 °C). This can be determined as follows: (195 °F - 185 °F) x 1.5 = 15 °F, 185 °F - 15 °F = 170 °F

## Humidity limits

0–100% relative humidity

## Volumetric displacement

Less than 0.0005 $in^3$ (0,008 $cm^3$)

## Damping

Analog output response time to a step change is user-selectable from 0 to 60 seconds for one time constant. Software damping is in addition to sensor module response time.

## Turn-on time

2.0 seconds, no warm-up required

## Transmitter security

Activating the transmitter security function prevents changes to the transmitter configuration, including local zero and span adjustments. Security is activated by an internal switch.

## Failure mode alarm

If self-diagnostics detect a sensor or microprocessor failure, the analog signal will be driven either high or low to alert the user. High or low failure mode is user-selectable with a jumper on the transmitter. The values to which the transmitter drives its output in failure mode depend on whether it is factory-configured to *standard* or *NAMUR-compliant* operation. The values for each are as follows:

*(1) If storage temperature is above 85 °C, perform a sensor trim prior to installation.*
*(2) 220 °F (104 °C) limit in vacuum service; 130 °F (54 °C) for pressures below 0.5 psia.*

| Standard operation | | | |
|---|---|---|---|
| **Output code** | **Linear output** | **Fail high** | **Fail low** |
| S | 3.9 ≤ I ≤ 20.8 | I ≥ 21.75 mA | I ≤ 3.75 mA |
| N | 0.97 ≤ V ≤ 5.2 | V ≥ 5.4 V | V ≤ 0.95 V |

| NAMUR-compliant operation | | | |
|---|---|---|---|
| **Output code** | **Linear output** | **Fail high** | **Fail low** |
| S | 3.8 ≤ I ≤ 20.5 | I ≥ 22.5 mA | I ≤ 3.6 mA |

# A.3 Physical specifications

## Electrical connections

1/2–14 NPT, M20 × 1.5 (CM20), or
G 1/2 female (PF 1/2 female) conduit entry

## Process connections

1/2–14 NPT female, DIN 16288 G 1/2 male, RC 1/2 female

(PT 1/2 female), M20 × 1.5 (CM20) male

## A.3.1 Process-wetted parts

### Isolating diaphragm

316L SST (UNS S31603), Alloy C-276 (UNS N10276)

### Process connector

316L stainless steel CF-3M (Cast version of 316L SST, material per ASTM_A743) or Alloy C-276

## A.3.2 Non-wetted parts

### Electronics housing

Low-copper aluminum, NEMA 4X, IP65, IP67, CSA enclosure Type 4X

### Paint for aluminum housing

Polyurethane

### Cover O-rings

Buna-N

### Fill fluid

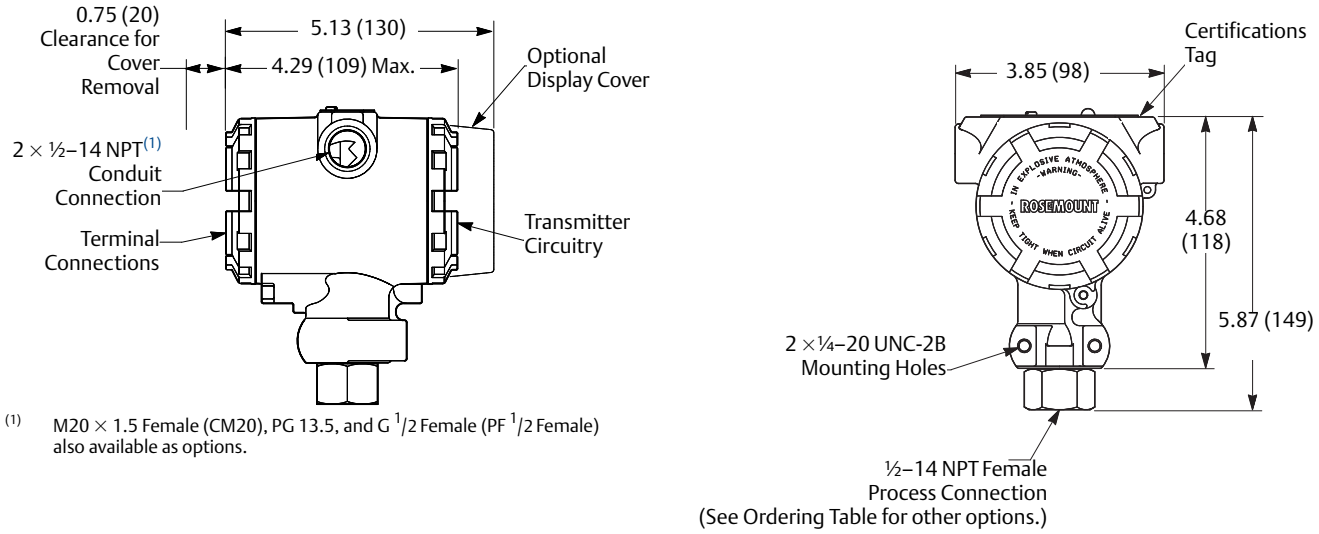
Silicone or inert fill

### Weight

Output Code S and N: Approximately 2.44 lb (1,11 kg)

# A.4 Dimensional drawings

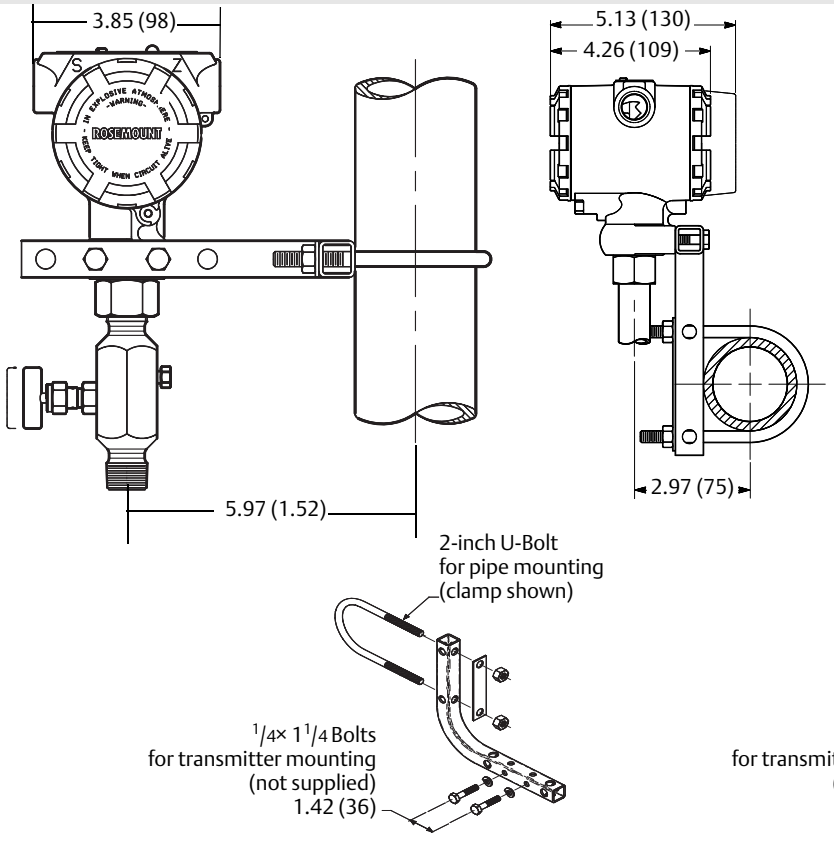
## Rosemount 2088



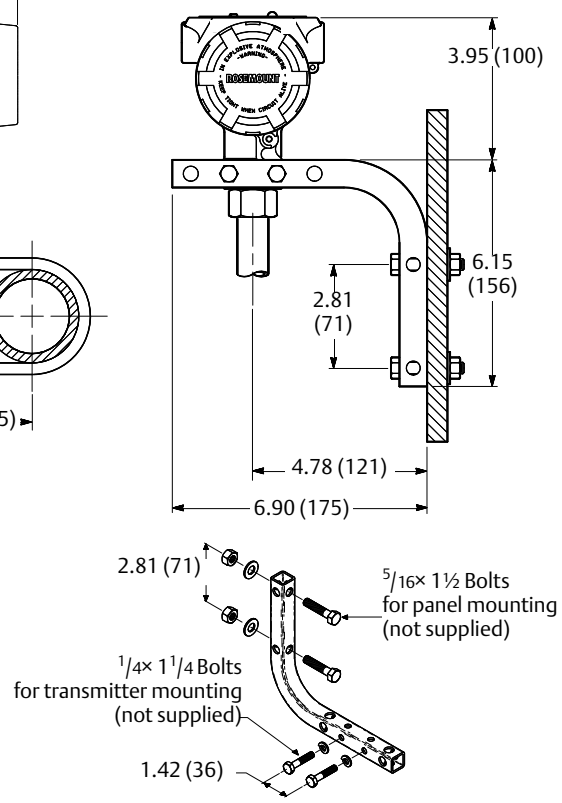

(1) M20 × 1.5 Female (CM20), PG 13.5, and G 1/2 Female (PF 1/2 Female) also available as options.

## Mounting configurations with optional mounting brackets

### Pipe mounting




### Panel mounting




Dimensions are in inches (millimeters).

# A.5 Ordering information

**Table 2. Rosemount 2088 Pressure Transmitter ordering information**

**★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.**
**The Expanded offering is manufactured after receipt of order and is subject to additional delivery lead time.**

| Model | Product description | | | |
|---|---|---|---|---|
| **Standard** | | | | **Standard** |
| 2088 | Pressure Transmitter | | | ★ |
| **Code** | **Measurement type** | | | |
| **Standard** | | | | **Standard** |
| A | Absolute | | | ★ |
| G | Gage | | | ★ |
| **Code** | **Pressure ranges** | | | |
| **Standard** | | | | **Standard** |
| | **2088G** | | **2088A** | |
| 1 | -14.7 to 30 psi /(-1,01 to 2,1 bar) | | 0 to 30 psi (0 to 2,1 bar) | ★ |
| 2 | -14.7 to 150 psi (-1,01 to 10,3 bar) | | 0 to 150 psi (0 to 10,3 bar) | ★ |
| 3 | -14.7 to 800 psi (-1,01 to 55,2 bar) | | 0 to 800 psi (0 to 55,2 bar) | ★ |
| 4 | -14.7 to 4,000 psi (-1,01 to 275,8 bar) | | 0 to 4,000 psi (0 to 275,8 bar) | ★ |
| **Code** | **Transmitter output** | | | |
| **Standard** | | | | **Standard** |
| S[(1)] | 4–20 mA dc/Digital HART Protocol | | | ★ |
| N[(1)] | 1-5 Vdc Low Power/ Digital HART protocol | | | ★ |
| **Code** | **Materials of construction** | | | |
| **Standard** | | | | **Standard** |
| | **Process connection** | **Isolating diaphragm** | **Fill Fluid** | |
| 22[(2)] | 316L SST | 316L SST | Silicone | ★ |
| 33[(2)] | Alloy C-276 | Alloy C-276 | Silicone | ★ |
| **Expanded** | | | | |
| 2B[(2)] | 316L SST | 316L SST | Inert | |
| **Code** | **Process connection** | | | |
| **Standard** | | | | **Standard** |
| A | ½–14 NPT Female | | | ★ |
| B[(3)] | DIN 16288 G ½ Male | | | ★ |
| D[(3)(4)] | M20 × 1.5 Male | | | ★ |
| **Expanded** | | | | |
| C[(3)(4)] | RC ½ Female | | | |
| **Code** | **Conduit entry** | | | |
| **Standard** | | | | **Standard** |
| 1 | ½–14 NPT | | | ★ |
| 2[(3)] | M20 × 1.5 | | | ★ |

### Table 2. Rosemount 2088 Pressure Transmitter ordering information

**★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.**

**The Expanded offering is manufactured after receipt of order and is subject to additional delivery lead time.**

| Code | Conduit entry | |
|---|---|---|
| **Expanded** | | |
| 4[3] | G ½ | |

## Options (Include with selected model number)

| **Diaphragm seal assemblies** | | |
|---|---|---|
| **Standard** | | **Standard** |
| S1[5][6] | Assemble to one Rosemount 1199 diaphragm seal | ★ |
| **Display and interface** | | |
| **Standard** | | **Standard** |
| M4 | LCD display with Local Operator Interface | ★ |
| M5 | LCD display, configured for Engineering Units | ★ |
| **Configuration buttons** | | |
| **Standard** | | **Standard** |
| D4 | Analog Zero and Span | ★ |
| DZ | Digital Zero Trim | ★ |
| **Mounting brackets** | | |
| **Standard** | | **Standard** |
| B4 | SST mounting bracket with SST Bolts | ★ |
| **Product certifications** | | |
| **Standard** | | **Standard** |
| C6 | CSA Explosion-Proof, Intrinsically Safe, and non-Incendive | ★ |
| E2 | INMETRO Flameproof | ★ |
| E3 | China Flameproof | ★ |
| E4[3][7] | TIIS Flameproof | ★ |
| E5 | FM Explosion-Proof, Dust Ignition-proof | ★ |
| E7 | IECEx Flameproof | ★ |
| ED | ATEX Flameproof | ★ |
| I1[3] | ATEX Intrinsic Safety | ★ |
| I2 | INMETRO Intrinsic Safety | ★ |
| I3 | China Intrinsic Safety | ★ |
| I5 | FM Intrinsically safe, Division 2 | ★ |
| I7 | IECEx Intrinsic Safety | ★ |
| K1 | ATEX Flameproof, Intrinsic Safety, Type n, Dust | ★ |
| K2 | INMETRO Flameproof, Intrinsic Safety | ★ |
| K5 | FM Explosion-Proof, Dust Ignition-proof, Intrinsically Safe, Division 2 | ★ |
| K6[3] | ATEX and CSA Explosion-Proof, Dust Ignition-proof, Intrinsically Safe, Division 2 | ★ |
| K7 | IECEx Flameproof, Intrinsic Safety, Type n, Dust | ★ |
| KB | FM and CSA Explosion-Proof, Dust Ignition-proof, Intrinsically Safe, Division 2 | ★ |

### Table 2. Rosemount 2088 Pressure Transmitter ordering information

**★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.**
**The Expanded offering is manufactured after receipt of order and is subject to additional delivery lead time.**

| **Product certifications** | | |
|---|---|---|
| **Standard** | | **Standard** |
| KH[3] | FM Approvals and ATEX Explosion-Proof and Intrinsically Safe | ★ |
| N1[3] | ATEX Type n | ★ |
| N3 | China Type n | ★ |
| N7 | IECEx Type n | ★ |
| ND[3] | ATEX Dust | ★ |
| NK | IECEx Dust | ★ |
| **Shipboard approvals** | | |
| **Standard** | | **Standard** |
| SBS | American Bureau of Shipping (ABS) Type Approval | ★ |
| SBV | Bureau Veritas (BV) Type Approval | ★ |
| SDN | Det Norske Veritas (DNV) Type Approval | ★ |
| SLL | Lloyd's Register (LR) Type Approval | ★ |
| **Pressure testing** | | |
| **Expanded** | | |
| P1 | Hydrostatic testing | |
| **Terminal blocks** | | |
| **Standard** | | **Standard** |
| T1 | Transient protection | ★ |
| **Special cleaning** | | |
| **Expanded** | | |
| P2 | Cleaning for special service | |
| **Calibration certificate** | | |
| **Standard** | | **Standard** |
| Q4 | Calibration certificate | ★ |
| **Quality calibration certificate traceability certification** | | |
| **Standard** | | **Standard** |
| Q8 | Material Traceability Certification per EN 10204 3.1 | ★ |
| Q15 | Certificate of Compliance to NACE MR0175/ISO 15156 for wetted materials | ★ |
| Q25 | Certificate of Compliance to NACE MR0103 for wetted materials | ★ |
| **Digital signal** | | |
| **Standard** | | **Standard** |
| C4[3] | NAMUR alarm and saturation levels, high alarm | ★ |
| CN[3] | NAMUR alarm and saturation levels, low alarm | ★ |
| C5[8][9] | Custom alarm and saturation levels, high alarm, (Requires C9 and Configuration Data Sheet) | ★ |
| C7[8][9] | Custom alarm and saturation levels, low alarm (Requires C9 and Configuration Data Sheet) | ★ |
| C8[9] | Low alarm (Standard Rosemount Alarm and Saturation Levels) | ★ |

## Table 2. Rosemount 2088 Pressure Transmitter ordering information

**★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.**

**The Expanded offering is manufactured after receipt of order and is subject to additional delivery lead time.**

| **Configuration** | | |
|---|---|---|
| **Standard** | | **Standard** |
| C9 | Software configuration | ★ |
| **Manifold assemblies** | | |
| **Standard** | | **Standard** |
| S5[5][6] | Assemble to Rosemount 306 integral manifold | ★ |
| **Calibration accuracy** | | |
| **Standard** | | **Standard** |
| P8[10] | 0.065% accuracy to 10:1 turndown | ★ |
| **Water approval** | | |
| **Standard** | | **Standard** |
| DW[11] | NSF drinking water approval | ★ |
| **Surface finish** | | |
| **Standard** | | **Standard** |
| Q16 | Surface finish certification for sanitary remote seals | ★ |
| **Toolkit total system performance reports** | | |
| **Standard** | | **Standard** |
| QZ | Remote Seal System Performance Calculation Report | ★ |
| **HART Revision configuration** | | |
| **Standard** | | **Standard** |
| HR 5[9][12] | Configured for HART Revision 5 | ★ |
| HR7[9][13] | Configured for HART Revision 7 | ★ |
| **Typical model number: 2088 G 2 S 22 A 1 B4 M5** | | |

(1) HART Revision 5 is the default HART output. The 2088 with selectable HART can be factory or field configured to HART Revision 7. To order HART Revision 7 factory configured, add option code HR7.

(2) Materials of Construction comply with recommendations per NACE MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining environments.

(3) Not available with low-power Transmitter Output code N.

(4) Not available with Alloy C-276, Material of Construction code 33.

(5) Use $^{1}/_{2}$- 14 NPT Female Process Connection code A.

(6) "Assemble-to" items are specified separately and require a completed model number.

(7) Only available with Conduit Thread code 4

(8) Only available with 4-20 mA HART Output (Output Code A).

(9) Select Configuration Buttons (option code D4 or DZ) or Local Operator Interface (option code M4) if local configuration buttons are required.

(10) Requires Transmitter Output code S with either Materials of Construction code 22 or 23.

(11) Requires Materials of Construction code 22 with Process Connection code A.

(12) Configures the HART output to HART Revision 5. The device can be field configured to HART Revision 7 if needed.

(13) Configures the HART output to HART Revision 7. The device can be field configured to HART Revision 5 if needed.

# A.6 Options

## Standard configuration

Unless otherwise specified, transmitter is shipped as follows:

| | |
|---|---|
| **Engineering units** | psi (all ranges) |
| **4 mA (1 Vdc)** | 0 (engineering units) |
| **20 mA (5 Vdc)** | Upper range limit |
| **Output** | Linear |
| **Flange type** | Specified model code option |
| **Flange material** | Specified model code option |
| **O-ring material** | Specified model code option |
| **Drain/vent** | Specified model code option |
| **LCD display** | Installed or none |
| **Alarm** | High |
| **Software tag** | (Blank) |

## Custom configuration

If Option Code C9 is ordered, the customer may specify the following data in addition to the standard configuration parameters.

- Output Information
- Transmitter Information
- LCD display Configuration
- Hardware Selectable Information
- Signal Selection

Refer to the “Rosemount 2088 Configuration Data Sheet” document number 00806-0100-4690.

## Tagging (3 options available)

- Standard SST hardware tag is permanently affixed on transmitter. Tag character height is 0.125 in. (3,18 mm), 84 characters maximum.
- Tag may be wired to the transmitter nameplate upon request, 85 characters maximum.
- For HART protocols, the tag may be stored in transmitter memory (eight characters maximum). Software tag is left blank unless specified.
  - HART Revision 5: 8 characters
  - HART Revision 7: 32 characters

## Optional Rosemount 306 Integral Manifolds

Factory assembled to 2088 transmitters. Refer to Product Data Sheet (document number 00813-0100-4733 for Rosemount 306) for additional information.

## Other seals

Refer to Product Data Sheet (document number 00813-0100-4016 or 00813-0201-4016) for additional information.

## Output information

Output range points must be the same unit of measure. Available units of measure include:

| Pressure units[1] | | |
|---|---|---|
| torr | psf[1] | $cmH_2O@4°C$[1] |
| atm | $inH_2O$ | $mH_2O@4°C$[1] |
| Pa | $inH_2O@4°C$[1] | inHg |
| kPa | $inH_2O@60°F$[1] | mmHg |
| MPa[1] | $ftH_2O$ | cmHG@0°C[1] |
| hPa[1] | $ftH_2O@4°C$[1] | mHG@0°C[1] |
| mbar | $ftH_2O@60°F$[1] | $g/cm^2$ |
| bar | $mmH_2O$ | $kg/m^2$[1] |
| psi | $mmH_2O@4°C$[1] | $kg/cm^2$ |

(1) Field configurable only, not available for factory calibration or custom configuration (option code C9 "Software configuration").

## Display and interface options

**M4** Digital Display with Local Operator Interface (LOI)

- Available for 4-20 mA HART, 4-20 mA HART Low Power

**M5** Digital Display

- 2-Line, 5-Digit LCD for 4-20 mA HART
- 2-Line, 5-Digit LCD for 1-5 Vdc HART Low Power
- Direct reading of digital data for higher accuracy
- Displays user-defined flow, level, volume, or pressure units
- Displays diagnostic messages for local troubleshooting
- 90-degree rotation capability for easy viewing

## Configuration buttons

Rosemount 2088 now offers internal and external configuration button options.

- Choosing option D4 will add external Analog Zero and Span configuration buttons
- Choosing option DZ will add an external Digital Trim configuration button
- Choosing option M4 (LOI) adds both internal and external local configuration buttons.

Certain button options can also be combined as shown below:

| Button configuration | | |
|---|---|---|
| **Option codes** | **Internal** | **External** |
| DZ | N/A | Digital Trim |
| D4 | N/A | Analog Zero & Span |
| M4 | LOI | LOI |
| M4 + DZ | LOI | Digital Trim |
| M4 +D4 | LOI | Analog Zero & Span |

## Rosemount 2088 bracket option

**B4** Bracket for 2-in. Pipe or Panel Mounting

- Bracket for mounting of transmitter on 2-in. pipe or panel
- Stainless steel construction with stainless steel bolts

# Appendix B Product Certifications

Approved Manufacturing Locations . . . . . page 85
European Directive Information . . . . . page 85
Hazardous Locations Certifications . . . . . page 85
Approval drawings . . . . . page 93

## B.1 Approved Manufacturing Locations

Rosemount Inc. — Chanhassen, Minnesota USA

Emerson Process Management GmbH & Co. — Wessling, Germany

Emerson Process Management Asia Pacific Private Limited — Singapore

Beijing Rosemount Far East Instrument Co., LTD — Beijing, China

## B.2 European Directive Information

The EC declaration of conformity for all applicable European directives for this product can be found at www.rosemount.com. A hard copy may be obtained by contacting an Emerson Process Management representative.

***ATEX Directive (94/9/EC)***

Emerson Process Management complies with the ATEX Directive.

***European Pressure Equipment Directive (PED) (97/23/EC)***

2088/2090 Pressure Transmitters — Sound Engineering Practice

***Electro Magnetic Compatibility (EMC) (2004/108/EC)***

EN 61326-1:2006

## B.3 Hazardous Locations Certifications

### North American Certifications

***FM Approvals (FM)***

**E5** Explosion-proof and Dust Ignition Proof
Certificate: 1V2A8.AE
Standards Used: FM Class 3600 - 1998, FM Class 3615 - 1989, FM Class 3810 - 1989
Markings: Explosion-proof for Class I, Division 1, Groups B, C, and D. Dust Ignition-Proof for Class II/III, Division 1, Groups E, F and G.
Temperature Code: T5 ($T_a$ = -40 °C to + 85 °C) Factory Sealed, Enclosure Type 4X.

**I5** Intrinsically Safe and Non-Incendive
Certificate: 0V9A7.AX
Standards Used: FM Class 3600 - 1998, FM Class 3610 - 2010, FM Class 3811 - 2004, FM Class 3810 - 1989.
Markings: Intrinsically safe for use in Class I, Division 1, Groups A, B, C, D; Class II, Division 1, Groups E, F, and G; and Class III, Division 1
Temperature Code: T4 ($T_a$ = 70 °C) in accordance with Rosemount drawing 02088-1018.
Non-incendive for Class I, Division 2, Groups A, B, C, and D.
Temperature Code: T4 ($T_a$ = 85 °C), Enclosure Type 4X.
For input parameters see control drawing 02088-1018.

***Canadian Standards Association (CSA)***

All CSA hazardous approved transmitters are certified per ANSI/ISA 12.27.01-2003.

**C6** Explosion-Proof, Intrinsically Safe, Dust Ignition-Proof and Class I Division 2
Certificate: 1015441
Standards Used: CAN/CSA Std. C22.2 No. 0-M91, CSA Std. C22.2 No. 25 - 1966, CSA Std. C22.2 No. 30 - M1986, CAN/CSA Std. C22.2 No. 94 - M91, CSA Std. C22.2 No. 142 - M1987, CAN/CSA Std. C22.2 No. 157-92, CSA Std. C22.2 No. 213 - M1987, ANSI/ISA 12.27.01-2003.
Markings: Explosion-proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II, Division 1, Groups E, F, G, Class III. Suitable for Class I, Division 2, Groups A, B, C, and D. Intrinsically Safe for Class I, Division 1, Groups A, B, C, and D.
Temperature Code: T3C. Enclosure Type 4X. Factory sealed. Single Seal. See control drawing 02088-1024.

## European certifications

**ED** ATEX Flameproof
Certificate: KEMA97ATEX2378X
Standards Used: EN60079-0:2006, EN60079-1:2007, EN60079-26:2007
Markings: Ⓔx II 1/2 G
Ex d IIC T6 (-40 °C ≤ $T_a$ ≤ 40 °C); T4 (-40 °C ≤ $T_a$ ≤ 80 °C)
CE 1180

***Special Conditions for Safe Use (X):***

1. This device contains a thin wall diaphragm. Installation, maintenance, and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.

2. For information on the dimensions of the flameproof joints the manufacturer shall be contacted.

**I1** ATEX Intrinsic Safety
Certificate: BAS00ATEX1166X
Standards Used: EN60079-0:2012, EN60079-11:2012
Markings: Ⓔx II 1G
Ex ia IIC T5 Ga (-55 °C ≤ $T_a$ ≤ 40 °C)
Ex ia IIC T4 Ga (-55 °C ≤ $T_a$ ≤ 70 °C)
CE 1180

**Table B-1. Input parameters**

| |
|---|
| $U_i$ = 30 V |
| $I_i$ = 200 mA |
| $P_i$ = 0.9 W |
| $C_i$ = 0.012 µF |

***Special Condition for Safe Use (X):***

1. The apparatus is not capable of withstanding the 500V insulation test required by EN60079-11. This must be taken into account when installing the apparatus.

**N1** ATEX Non-incendive/Type n
Certificate: BAS 00ATEX3167X
Standards Used: EN60079-0:2012 EN60079-15:2010
Markings: Ⓔx II 3 G
Ex nA nL IIC T5 (-40 °C ≤ $T_a$ ≤ 70 °C)
$U_i$ = 50 Vdc max
CE 1180

***Special Condition for Safe Use (X):***

1. The apparatus is not capable of withstanding the 500V insulation test required by EN60079-15. This must be taken into account when installing the apparatus.

**ND** ATEX Dust
Certificate: BAS01ATEX1427X
Standards Used: EN60079-0:2012, EN60079-31:2009
Markings: Ⓔx II 1 D
Ex t IIIC T50 °C $T_{500}$ 60 °C Da
$V_{max}$ = 36 Vdc; $I_i$ = 24 mA
CE 1180

***Special Conditions for Safe Use (X):***

1. The user must ensure that the maximum rated voltage and current (36 volts, 24 mA, D.C.) are not exceeded. All connections to other apparatus or associated apparatus shall have control over this voltage and current equivalent to a category “ib” circuit according to EN60079-31.

2. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP66.

3. Unused cable entries must be filled with suitable blanking plugs which maintain the ingress protection of the enclosure to at least IP66.

4. Cable entries and blanking plugs must be suitable for the ambient range of the apparatus and capable of withstanding a 7J impact test.

5. The 2088/2090 sensor module must be securely screwed in place to maintain the ingress protection of the enclosure.

## IECEx certifications

**E7** IECEx Flameproof
Certificate: IECEx KEM 06.0021X
Standards Used: IEC60079-0:2004, IEC60079-1:2003, IEC60079-26:2004
Markings: Ex d IIC T4 (-20 °C ≤ $T_a$ ≤ 80°C)
Ex d IIC T6 (-20 °C ≤ $T_a$ ≤ 40 °C)

**I7** IECEx Intrinsic Safety
Certificate: IECEx BAS 12.0071X
Standards Used: IEC60079-0:2011, IEC60079-11:2011
Markings: Ex ia IIC T5 Ga(-55 °C ≤ $T_a$ ≤ + 40 °C)
Ex ia IIC T4 Ga (-55 °C ≤ $T_a$ ≤ +70 °C)

**Table B-2. Input Parameters**

| |
|---|
| $U_i$ = 30 V |
| $I_i$ = 200 mA |
| $P_i$ = 0.9 W |
| $C_i$ = 0.012 µF |

***Special Condition for Safe Use (X):***

1. The equipment is not capable of withstanding the 500V insulation test required by EN60079-11. This must be taken into account when installing the equipment.

2. The enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion if located in a zone 0 environment.

**N7** IECEx Non-incendive/Type n
Certificate: IECEx BAS 12.0072X
Standards Used: IEC60079-0:2011, IEC60079-15: 2010
Markings: Ex nA IIC T5 Gc (-40 °C ≤ $T_a$ ≤ +70 °C)
$U_i$ =50 Vdc max

***Special Condition for Safe Use (X):***

1. When fitted with a transient suppression terminal block, the Model 2088 is incapable of passing the 500 V isolation test. This must be taking into account during installation.

**NK** IECEx Dust
Certificate: IECEx BAS12.0073X
Standards Used: IEC60079-0:2011, IEC60079-31:2008
Markings: Ex t IIIC T50 °C T 500 60 °C Da
$V_{max}$ = 36 Vdc; $I_i$ = 24 mA

***Special Conditions for Safe Use (X):***

1. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP66.

2. Unused cable entries must be filled with suitable blanking plugs which maintain the ingress protection of the enclosure to at least IP66.

3. Cable entries and blanking plugs must be suitable for the ambient range of the apparatus and capable of withstanding a 7J.

## Japanese certifications

**E4** TIIS Flameproof
Ex d IIC T6 ($T_a$ = 85 °C)

| Certificate | Description |
|---|---|
| TC15874 | 2088 with Alloy C-276 wetted parts (with display) |
| TC15873 | 2088 with SST wetted parts (with display) |
| TC15872 | 2088 with Alloy C-276 wetted parts (no display) |
| TC15871 | 2088 with SST wetted parts (no display) |

## Brazil certifications

**I2** INMETRO Intrinsic Safety
Certificate: UL-BR 13.0246X
Markings: Ex ia IIC T5/T4 Ga
T5 (-55 °C ≤ $T_a$ ≤ +40 °C); T4 (-55 °C ≤$T_a$ ≤ +70 °C)

***Special Conditions for Safe Use (X):***

1. When fitted with a transient suppression terminal block, the model 2088 is incapable of passing the 500 V isolation test. This must be taken into account during installation.
2. The enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion if located in a zone 0 environment.

**E2** INMETRO Flameproof (2088 Series only)
Certificate: CEPEL 97.0076
Markings: Ex d IIC T6/T5 Gb
T6 (-20 °C ≤ $T_a$ ≤ +40 °C); T5 (-20 °C ≤ $T_a$ ≤ +60 °C)

## China certifications

**I3** China Intrinsic Safety
Certificate: GYJ111063X (2088 Series); GYJ111065X (2090 Series)
Standards Used: GB3836.1-2000, GB3836.4-2000
Markings: Ex ia IIC T4/T5
T4 (-55 °C ≤ $T_a$ ≤ +70 °C);T5 (-55 °C ≤ $T_a$ ≤ +40 °C)

**Table B-3. Input parameters**

| |
|---|
| $U_i$ = 30 V |
| $I_i$ = 200 mA |
| $P_i$ = 0.9 W |
| $C_i$ = 0.012 µF |

***Special Conditions for Safe Use (X):***

1. This apparatus is not capable of withstanding the 500 V r.m.s. insulation test required by Clause 6.4.12 of GB3836.4-2000.

2. The ambient temperature is:

| T Code | Ambient temperature |
|---|---|
| T5 | -55 °C ≤ $T_a$ ≤ +40 °C |
| T4 | -55 °C ≤ $T_a$ ≤ +70 °C |

3. Intrinsically safe parameters:

| Maximum input voltage: $U_i$ (V) | Maximum input current: $I_i$ (mA) | Maximum input power: $P_i$ (W) | Maximum internal parameters: | |
|---|---|---|---|---|
| | | | $C_i$ (nF) | $L_i$ (μH) |
| 30 | 200 | 0.9 | 12 | 0 |

4. The product should be used with Ex-certified linear associated apparatus to establish explosion protection system that can be use in explosive gas atmospheres. Wiring and terminals should comply with the instruction manual of the product and associated apparatus.

5. The cables between this product and associated apparatus should be shielded cables (the cables must have insulated shields). The shield has to be grounded reliably in a non-hazardous area.

6. End users are not permitted to change any internal components, but to settle the problem in conjunction with the manufacturer to avoid damage to the product.

7. During installation, use and maintenance of this product, observe the following standards:

   GB3836.13-1997 “Electrical apparatus for explosive gas atmospheres Part 13: Repair and overhaul for apparatus used in explosive gas atmospheres”

   GB3836.15-2000 “Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous area (other than mines)”

   GB3836.16-2006 “Electrical apparatus for explosive gas atmospheres Part 16: Inspection and maintenance of electrical installation (other than mines)”

   GB50257-1996 “Code for construction and acceptance of electric device for explosion atmospheres and fire hazard electrical equipment installation engineering”

**E3** China Flameproof
Certificate: GYJ111062 (2088 Series); GYJ111064 (2090 Series)
Standards Used: GB3836.1-2000, GB3836.2-2000
Markings: Ex d IIC T4/T6
T4 (-20 °C ≤ $T_a$ ≤ +40 °C); T6 (-20 °C ≤ $T_a$ ≤ +80 °C)

***Special Conditions for Safe Use (X):***

1. The ambient temperature range is:

| T Code | Ambient temperature |
|---|---|
| T6 | -20 °C ≤ $T_a$ ≤ +80 °C |
| T4 | -20 °C ≤ $T_a$ ≤ +40 °C |

2. The earth connection facility in the enclosure should be connected reliably.
3. During installation in hazardous locations, cable glands, conduits and blanking plugs certified by state-appointed inspection bodies with Ex d IIC type of protection should be used.
4. During installation, use and maintenance in explosive gas atmospheres; observe the warning “Don't open when energized”.
5. During installation, there should be no mixture present which is harmful to the flameproof housing.
6. End users are not permitted to change any internal components, but to settle the problem in conjunction with the manufacturer to avoid damage to the product.
7. Maintenance should be done in non-hazardous locations.
8. During installation, use and maintenance of this product, observe the instruction manual and the following standards:

   GB3836.13-1997 “Electrical apparatus for explosive gas atmospheres Part 13: Repair and overhaul for apparatus used in explosive gas atmospheres”

   GB3836.15-2000 “Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous area (other than mines)”

   GB3836.16-2006 “Electrical apparatus for explosive gas atmospheres Part 16: Inspection and maintenance of electrical installation (other than mines)”

   GB50257-1996 “Code for construction and acceptance of electric device for explosion atmospheres and fire hazard electrical equipment installation engineering”

**N3** China Type n Non-Sparking
Certificate: GYJ101126X (2088 Series)
Standards Used: GB3836.1-2000, GB3836. 8-2000
Markings: Ex nA nL IIC T5 (-40 °C ≤ $T_a$ ≤ +70 °C)

***Special Conditions for Safe Use (X):***

1. This apparatus is not capable of withstanding the 500 V r.m.s. insulation test required by Clause 6.4.12 of GB3836.4-2000
2. The ambient temperature is: -40 °C ≤ $T_a$≤ 70 °C .
3. Maximum input voltage: 50 V.

4. Metal cable glands or blanking plugs, certified by NEPSI with Ex e or Ex n protection type should be used on external connections and redundant cable entries.

5. Maintenance should be done in non-hazardous locations.

6. End users are not permitted to change any internal components, but to settle the problem in conjunction with the manufacturer to avoid damage to the product.

7. During installation, use and maintenance of this product, observe the following standards:

   GB3836.13-1997 “Electrical apparatus for explosive gas atmospheres Part 13: Repair and overhaul for apparatus used in explosive gas atmospheres”

   GB3836.15-2000 “Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous area (other than mines)”

   GB3836.16-2006 “Electrical apparatus for explosive gas atmospheres Part 16: Inspection and maintenance of electrical installation (other than mines)”

   GB50257-1996 “Code for construction and acceptance of electric device for explosion atmospheres and fire hazard electrical equipment installation engineering”.

## Combinations of certifications

Stainless steel certification tag is provided when optional approval is specified. Once a device labeled with multiple approval types is installed, it should not be reinstalled using any other approval types. Permanently mark the approval label to distinguish it from unused approval types.

**K1** I1, N1, ED, and ND combination

**K2** I2 and E2 combination

**K5** E5 and I5 combination

**K6** C6, I1, and ED combination

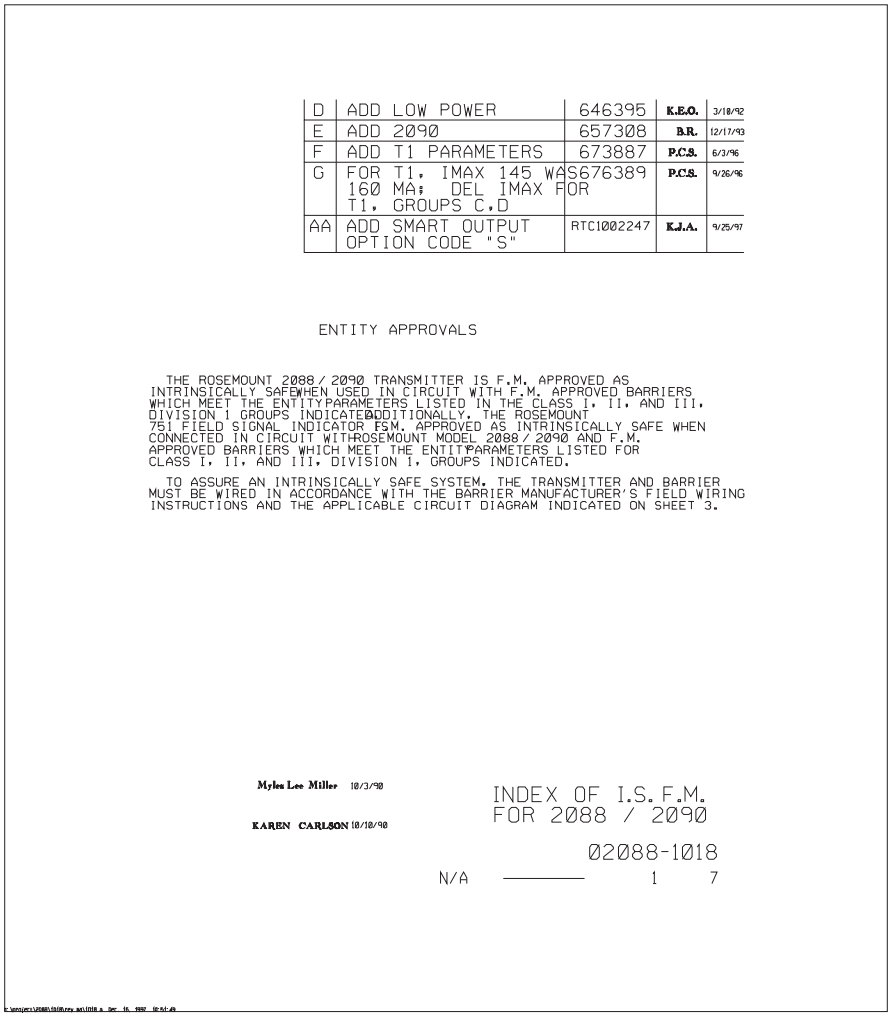
**K7** I7, N7, E7, and NK combination

**KB** K5 and C6 combination

**KH** K5, ED, and I1 combination

# B.4 Approval drawings

## B.4.1 Factory mutual 02088-1018



| | | | | |
|---|---|---|---|---|
| D | ADD LOW POWER | 646395 | K.E.O. | 3/18/92 |
| E | ADD 2090 | 657308 | B.R. | 12/17/93 |
| F | ADD T1 PARAMETERS | 673887 | P.C.S. | 6/3/96 |
| G | FOR T1, IMAX 145 WAS 160 MA; DEL IMAX FOR T1, GROUPS C,D | 676389 | P.C.S. | 9/26/96 |
| AA | ADD SMART OUTPUT OPTION CODE "S" | RTC1002247 | K.J.A. | 9/25/97 |

ENTITY APPROVALS

THE ROSEMOUNT 2088 / 2090 TRANSMITTER IS F.M. APPROVED AS INTRINSICALLY SAFE WHEN USED IN CIRCUIT WITH F.M. APPROVED BARRIERS WHICH MEET THE ENTITY PARAMETERS LISTED IN THE CLASS I, II, AND III, DIVISION 1 GROUPS INDICATED. ADDITIONALLY, THE ROSEMOUNT 751 FIELD SIGNAL INDICATOR FSM. APPROVED AS INTRINSICALLY SAFE WHEN CONNECTED IN CIRCUIT WITH ROSEMOUNT MODEL 2088 / 2090 AND F.M. APPROVED BARRIERS WHICH MEET THE ENTITY PARAMETERS LISTED FOR CLASS I, II, AND III, DIVISION 1, GROUPS INDICATED.

TO ASSURE AN INTRINSICALLY SAFE SYSTEM, THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S FIELD WIRING INSTRUCTIONS AND THE APPLICABLE CIRCUIT DIAGRAM INDICATED ON SHEET 3.

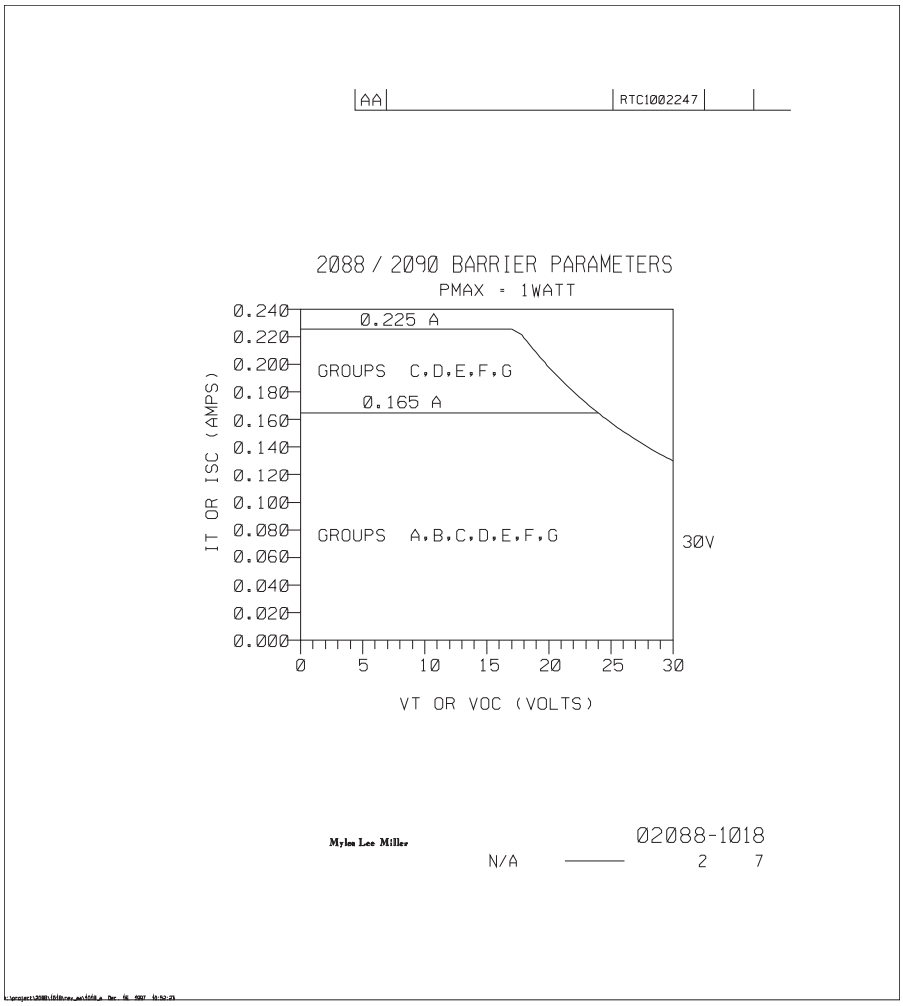
Myles Lee Miller 10/3/90

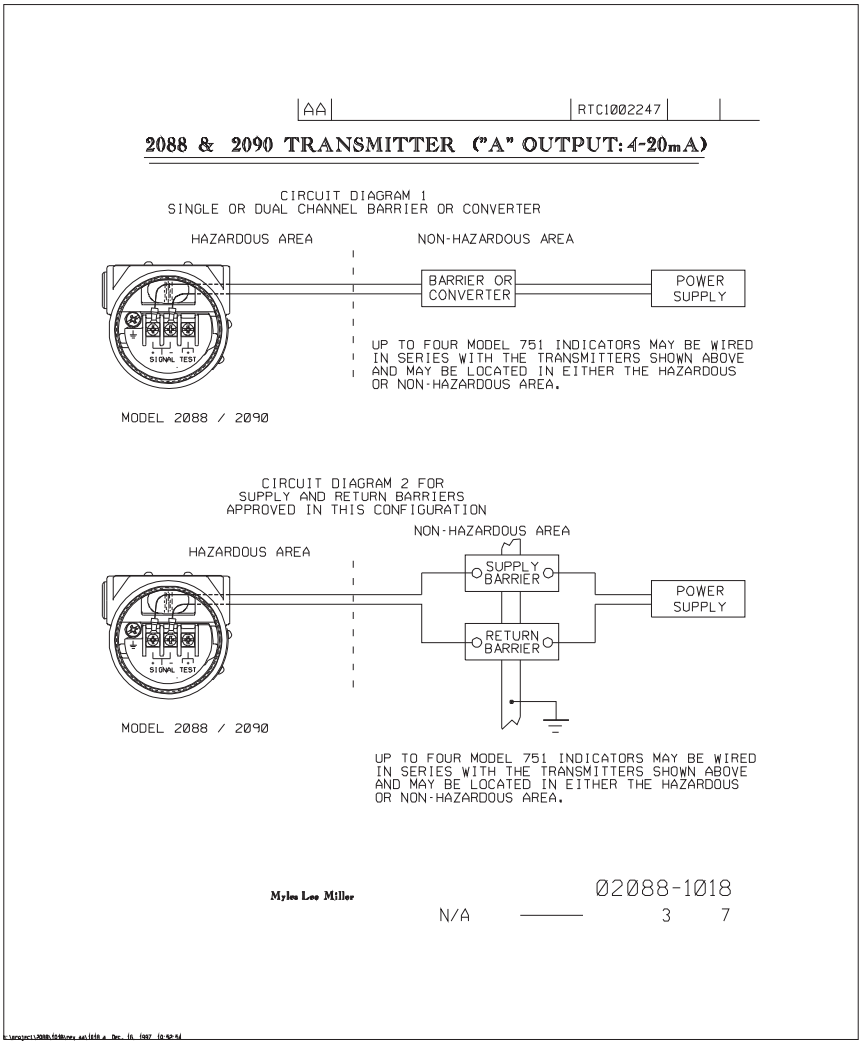
KAREN CARLSON 10/10/90

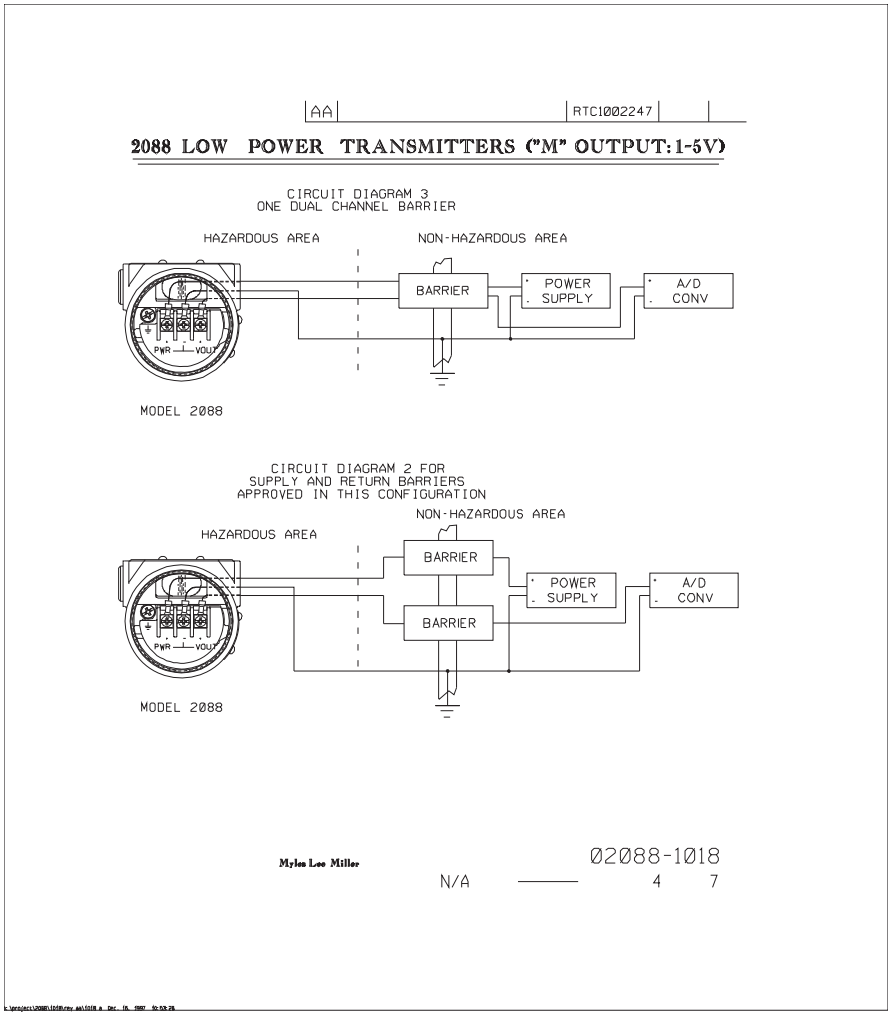
INDEX OF I.S. F.M.
FOR 2088 / 2090

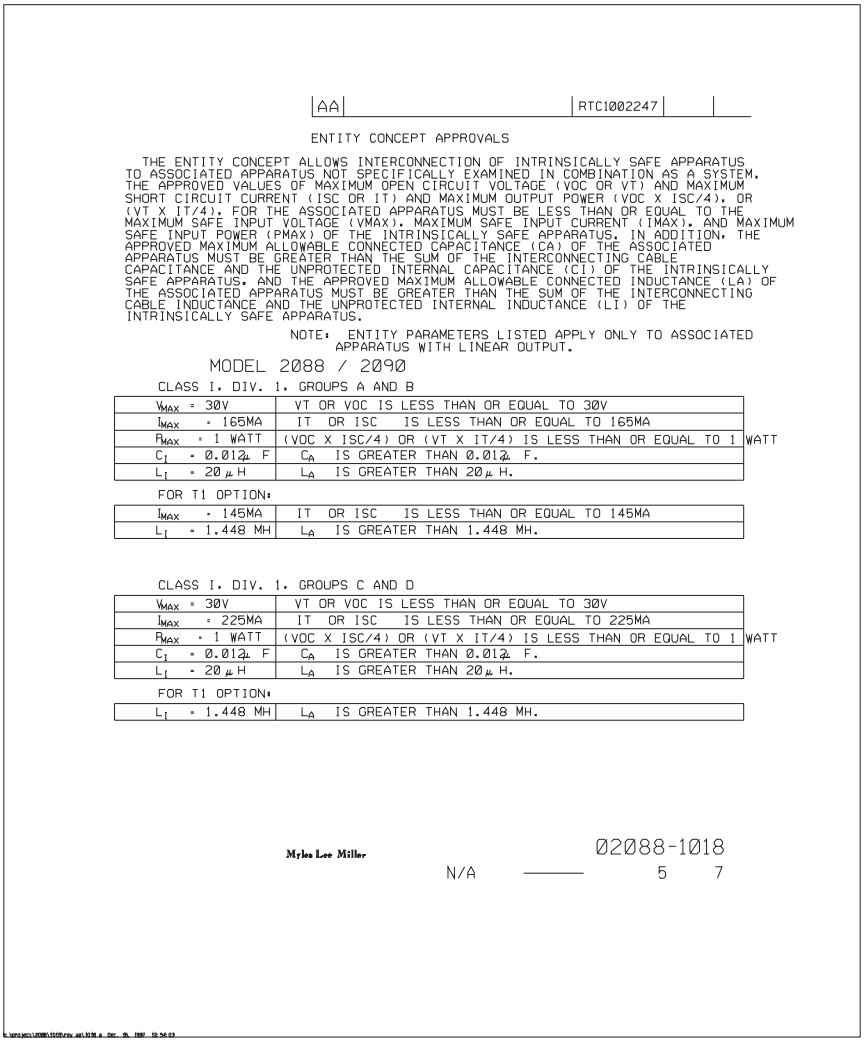
02088-1018

N/A 1 7


AA
RTCI002247
2088 / 2090 BARRIER PARAMETERS
PMAX = 1WATT
0.225 A
GROUPS C,D,E,F,G
0.165 A
GROUPS A,B,C,D,E,F,G
30V
IT OR ISC (AMPS)
0.240
0.220
0.200
0.180
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
0.000
0
5
10
15
20
25
30
VT OR VOC (VOLTS)
Myles Lee Miller
02088-1018
N/A
2
7


AA
RTC1002247
2088 & 2090 TRANSMITTER ("A" OUTPUT: 4-20mA)
CIRCUIT DIAGRAM 1
SINGLE OR DUAL CHANNEL BARRIER OR CONVERTER
HAZARDOUS AREA
NON-HAZARDOUS AREA
BARRIER OR CONVERTER
POWER SUPPLY
SIGNAL TEST
UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA.
MODEL 2088 / 2090
CIRCUIT DIAGRAM 2 FOR
SUPPLY AND RETURN BARRIERS
APPROVED IN THIS CONFIGURATION
NON-HAZARDOUS AREA
HAZARDOUS AREA
SUPPLY BARRIER
RETURN BARRIER
POWER SUPPLY
SIGNAL TEST
MODEL 2088 / 2090
UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA.
Mylas Lee Miller
02088-1018
N/A
3
7


AA
RTC1002247
2088 LOW POWER TRANSMITTERS ("M" OUTPUT: 1-5V)
CIRCUIT DIAGRAM 3
ONE DUAL CHANNEL BARRIER
HAZARDOUS AREA
NON-HAZARDOUS AREA
BARRIER
POWER SUPPLY
A/D CONV
PWR
VOUT
MODEL 2088
CIRCUIT DIAGRAM 2 FOR
SUPPLY AND RETURN BARRIERS
APPROVED IN THIS CONFIGURATION
NON-HAZARDOUS AREA
HAZARDOUS AREA
BARRIER
BARRIER
POWER SUPPLY
A/D CONV
PWR
VOUT
MODEL 2088
Mylen Lee Miller
02088-1018
N/A
4 7



| AA | | RTCI002247 | | |
|---|---|---|---|---|

ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAXIMUM OPEN CIRCUIT VOLTAGE (VOC OR VT) AND MAXIMUM SHORT CIRCUIT CURRENT (ISC OR IT) AND MAXIMUM OUTPUT POWER (VOC X ISC/4). OR (VT X IT/4). FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (VMAX). MAXIMUM SAFE INPUT CURRENT (IMAX). AND MAXIMUM SAFE INPUT POWER (PMAX) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION. THE APPROVED MAXIMUM ALLOWABLE CONNECTED CAPACITANCE (CA) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE CAPACITANCE AND THE UNPROTECTED INTERNAL CAPACITANCE (CI) OF THE INTRINSICALLY SAFE APPARATUS. AND THE APPROVED MAXIMUM ALLOWABLE CONNECTED INDUCTANCE (LA) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE INDUCTANCE AND THE UNPROTECTED INTERNAL INDUCTANCE (LI) OF THE INTRINSICALLY SAFE APPARATUS.

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

MODEL 2088 / 2090

CLASS I. DIV. 1. GROUPS A AND B

| | | |
|---|---|---|
| $V_{MAX}$ = 30V | VT OR VOC IS LESS THAN OR EQUAL TO 30V | |
| $I_{MAX}$ = 165MA | IT OR ISC IS LESS THAN OR EQUAL TO 165MA | |
| $P_{MAX}$ = 1 WATT | (VOC X ISC/4) OR (VT X IT/4) IS LESS THAN OR EQUAL TO 1 | WATT |
| $C_I$ = 0.012 $\mu$ F | $C_A$ IS GREATER THAN 0.012 $\mu$ F. | |
| $L_I$ = 20 $\mu$ H | $L_A$ IS GREATER THAN 20 $\mu$ H. | |

FOR T1 OPTION:

| | |
|---|---|
| $I_{MAX}$ = 145MA | IT OR ISC IS LESS THAN OR EQUAL TO 145MA |
| $L_I$ = 1.448 MH | $L_A$ IS GREATER THAN 1.448 MH. |

CLASS I. DIV. 1. GROUPS C AND D

| | | |
|---|---|---|
| $V_{MAX}$ = 30V | VT OR VOC IS LESS THAN OR EQUAL TO 30V | |
| $I_{MAX}$ = 225MA | IT OR ISC IS LESS THAN OR EQUAL TO 225MA | |
| $P_{MAX}$ = 1 WATT | (VOC X ISC/4) OR (VT X IT/4) IS LESS THAN OR EQUAL TO 1 | WATT |
| $C_I$ = 0.012 $\mu$ F | $C_A$ IS GREATER THAN 0.012 $\mu$ F. | |
| $L_I$ = 20 $\mu$ H | $L_A$ IS GREATER THAN 20 $\mu$ H. | |

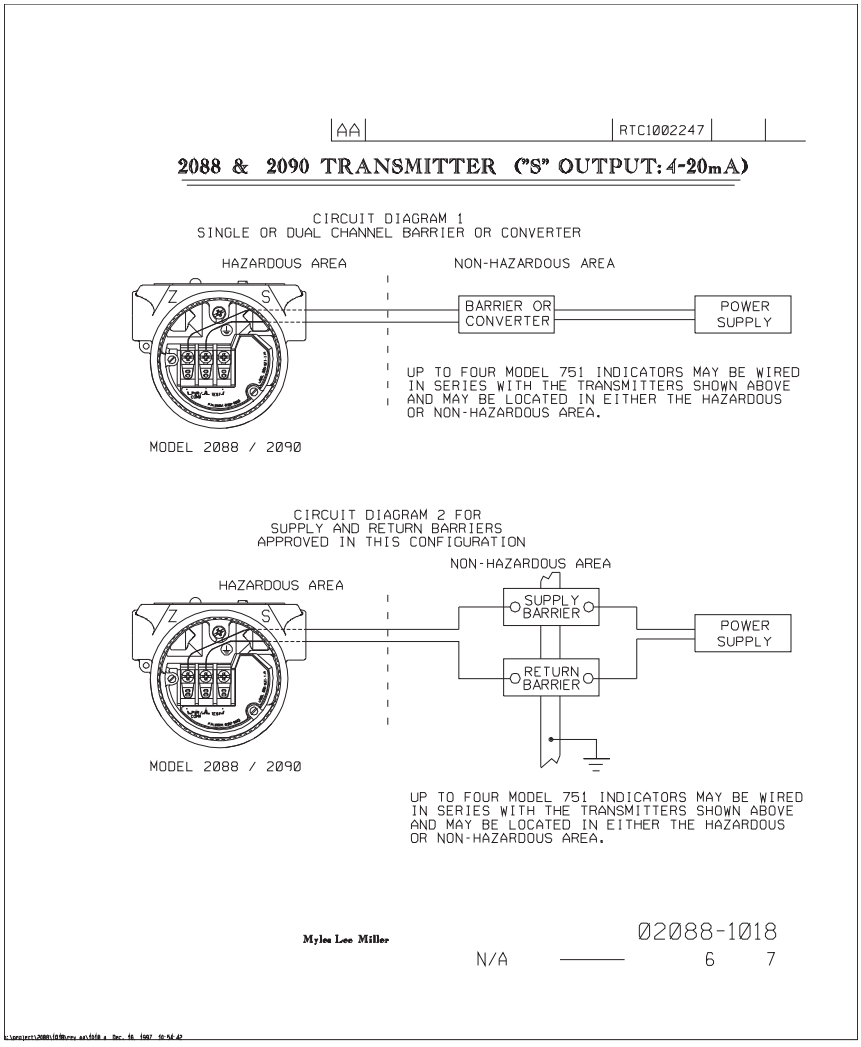
FOR T1 OPTION:

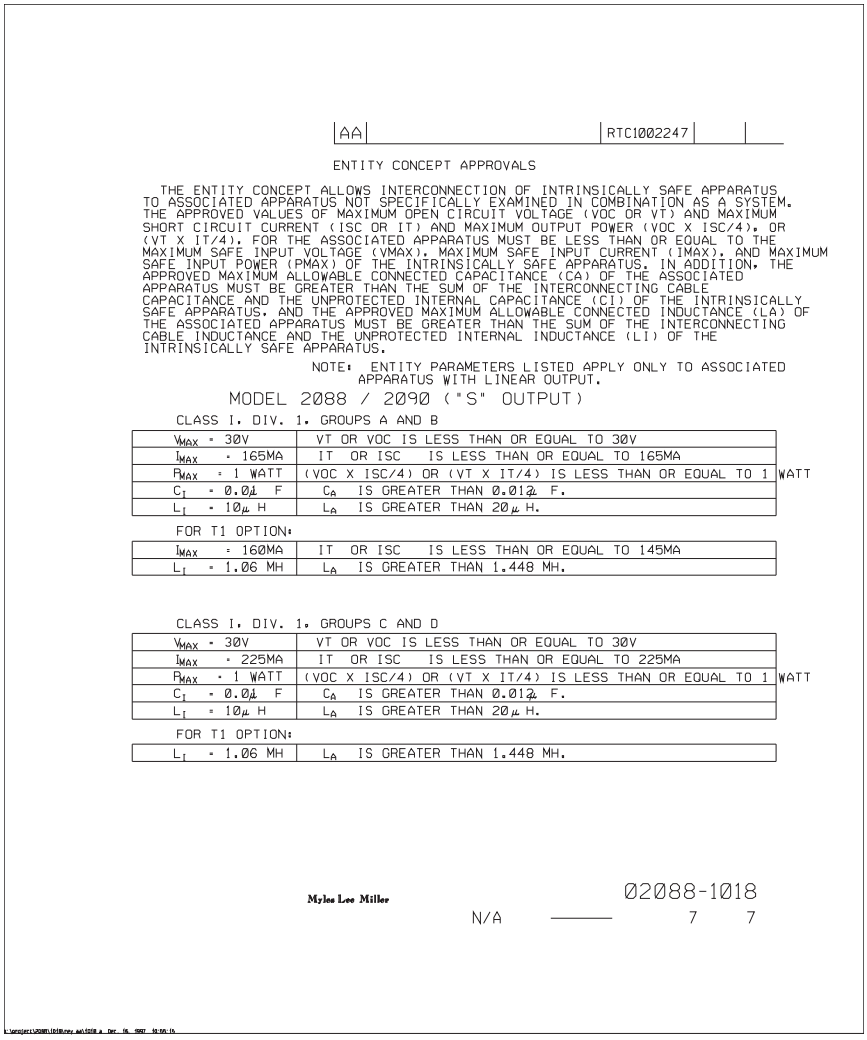
| | |
|---|---|
| $L_I$ = 1.448 MH | $L_A$ IS GREATER THAN 1.448 MH. |

Myles Lee Miller

02088-1018

N/A ——— 5 7


AA
RTC1002247
2088 & 2090 TRANSMITTER ("S" OUTPUT: 4-20mA)
CIRCUIT DIAGRAM 1
SINGLE OR DUAL CHANNEL BARRIER OR CONVERTER
HAZARDOUS AREA
NON-HAZARDOUS AREA
BARRIER OR CONVERTER
POWER SUPPLY
UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA.
MODEL 2088 / 2090
CIRCUIT DIAGRAM 2 FOR
SUPPLY AND RETURN BARRIERS
APPROVED IN THIS CONFIGURATION
NON-HAZARDOUS AREA
HAZARDOUS AREA
SUPPLY BARRIER
RETURN BARRIER
POWER SUPPLY
MODEL 2088 / 2090
UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA.
Mylea Lee Miller
02088-1018
N/A
6 7



| AA | | RTC1002247 | | |
|---|---|---|---|---|

ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAXIMUM OPEN CIRCUIT VOLTAGE (VOC OR VT) AND MAXIMUM SHORT CIRCUIT CURRENT (ISC OR IT) AND MAXIMUM OUTPUT POWER (VOC X ISC/4), OR (VT X IT/4), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (VMAX), MAXIMUM SAFE INPUT CURRENT (IMAX), AND MAXIMUM SAFE INPUT POWER (PMAX) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION, THE APPROVED MAXIMUM ALLOWABLE CONNECTED CAPACITANCE (CA) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE CAPACITANCE AND THE UNPROTECTED INTERNAL CAPACITANCE (CI) OF THE INTRINSICALLY SAFE APPARATUS, AND THE APPROVED MAXIMUM ALLOWABLE CONNECTED INDUCTANCE (LA) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE INDUCTANCE AND THE UNPROTECTED INTERNAL INDUCTANCE (LI) OF THE INTRINSICALLY SAFE APPARATUS.

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

MODEL 2088 / 2090 ("S" OUTPUT)

CLASS I, DIV. 1, GROUPS A AND B

| | | |
|---|---|---|
| $V_{MAX}$ = 30V | VT OR VOC IS LESS THAN OR EQUAL TO 30V | |
| $I_{MAX}$ = 165MA | IT OR ISC IS LESS THAN OR EQUAL TO 165MA | |
| $P_{MAX}$ = 1 WATT | (VOC X ISC/4) OR (VT X IT/4) IS LESS THAN OR EQUAL TO 1 | WATT |
| $C_I$ = 0.0µ F | $C_A$ IS GREATER THAN 0.012µ F. | |
| $L_I$ = 10µ H | $L_A$ IS GREATER THAN 20µ H. | |

FOR T1 OPTION:

| | |
|---|---|
| $I_{MAX}$ = 160MA | IT OR ISC IS LESS THAN OR EQUAL TO 145MA |
| $L_I$ = 1.06 MH | $L_A$ IS GREATER THAN 1.448 MH. |

CLASS I, DIV. 1, GROUPS C AND D

| | | |
|---|---|---|
| $V_{MAX}$ = 30V | VT OR VOC IS LESS THAN OR EQUAL TO 30V | |
| $I_{MAX}$ = 225MA | IT OR ISC IS LESS THAN OR EQUAL TO 225MA | |
| $P_{MAX}$ = 1 WATT | (VOC X ISC/4) OR (VT X IT/4) IS LESS THAN OR EQUAL TO 1 | WATT |
| $C_I$ = 0.0µ F | $C_A$ IS GREATER THAN 0.012µ F. | |
| $L_I$ = 10µ H | $L_A$ IS GREATER THAN 20µ H. | |

FOR T1 OPTION:

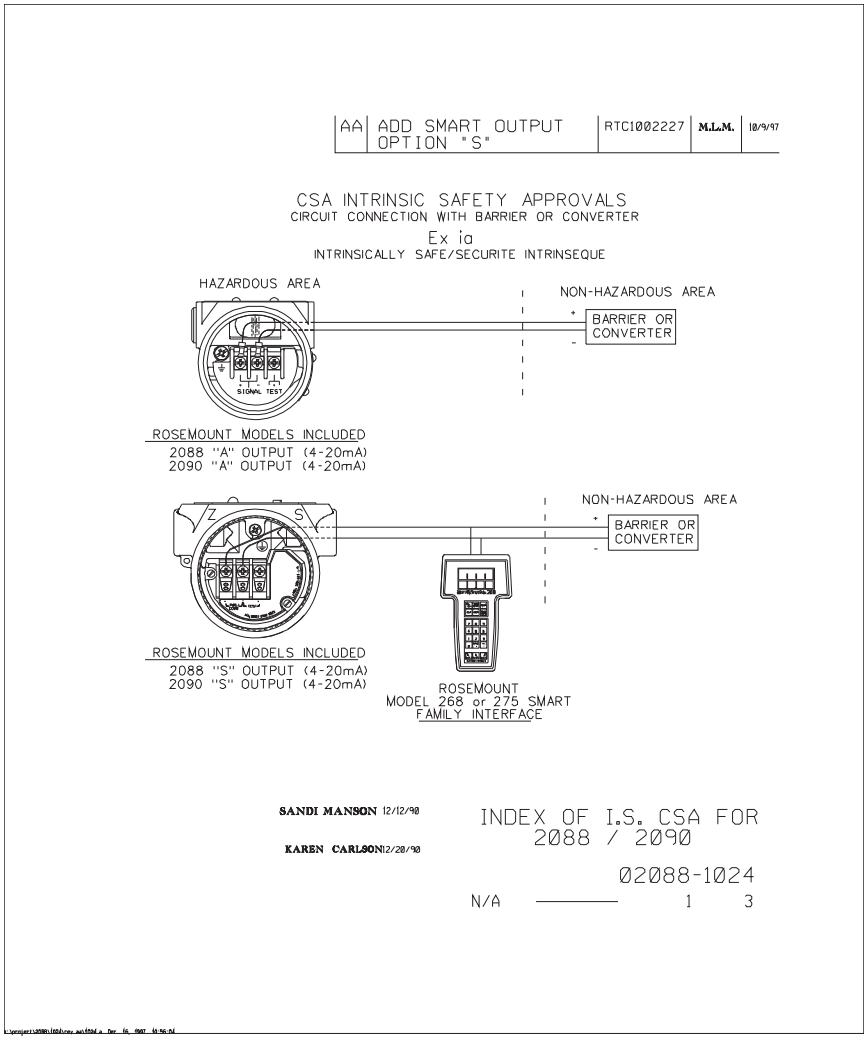
| | |
|---|---|
| $L_I$ = 1.06 MH | $L_A$ IS GREATER THAN 1.448 MH. |

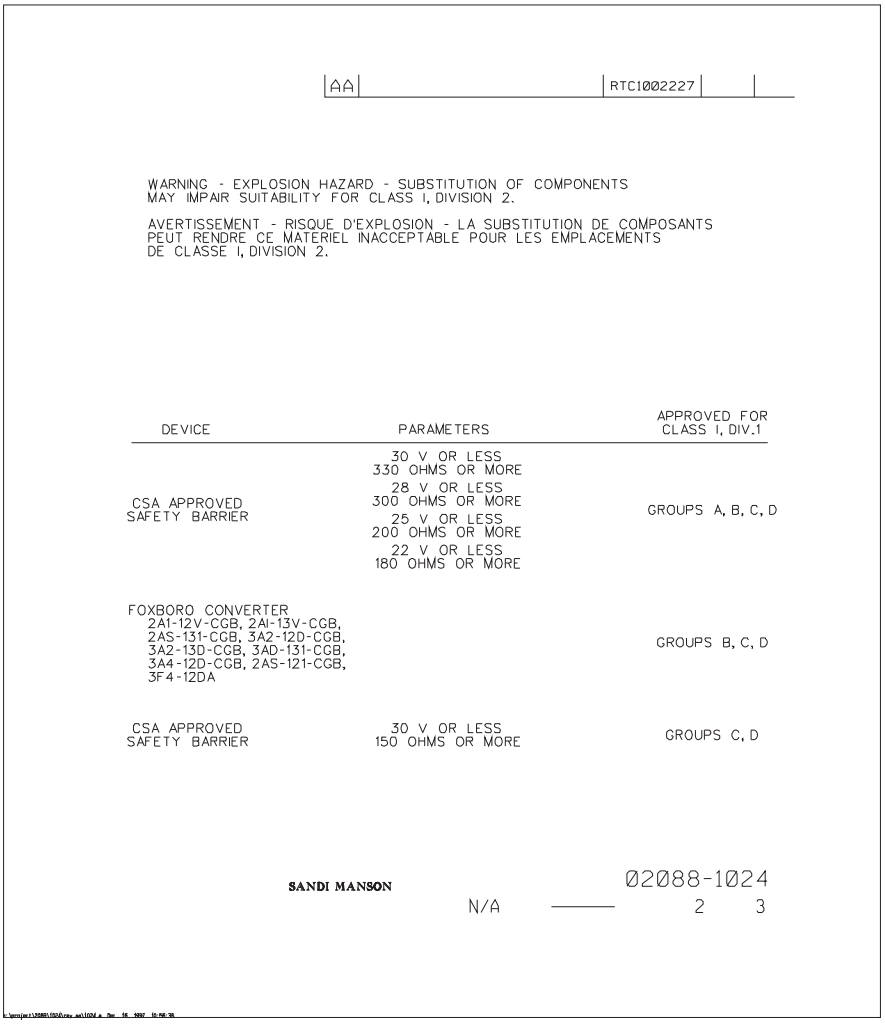
Myles Lee Miller

02088-1018

N/A ——— 7 7

## B.4.2 Canadian standards association (CSA) 02088-1024





AA | RTC1002227

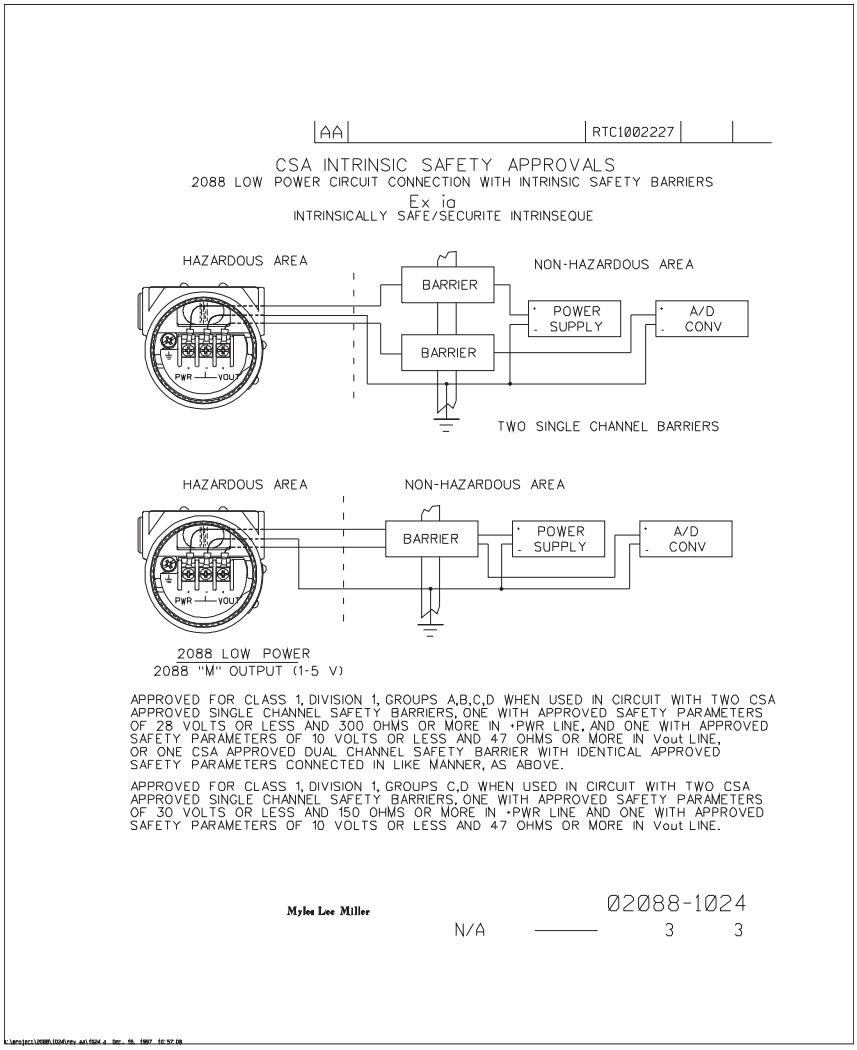
WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.

AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2.

| DEVICE | PARAMETERS | APPROVED FOR CLASS I, DIV.1 |
|---|---|---|
| CSA APPROVED SAFETY BARRIER | 30 V OR LESS 330 OHMS OR MORE<br>28 V OR LESS 300 OHMS OR MORE<br>25 V OR LESS 200 OHMS OR MORE<br>22 V OR LESS 180 OHMS OR MORE | GROUPS A, B, C, D |
| FOXBORO CONVERTER 2A1-12V-CGB, 2AI-13V-CGB, 2AS-131-CGB, 3A2-12D-CGB, 3A2-13D-CGB, 3AD-131-CGB, 3A4-12D-CGB, 2AS-121-CGB, 3F4-12DA | | GROUPS B, C, D |
| CSA APPROVED SAFETY BARRIER | 30 V OR LESS 150 OHMS OR MORE | GROUPS C, D |

SANDI MANSON

N/A ——— 02088-1024 2 3

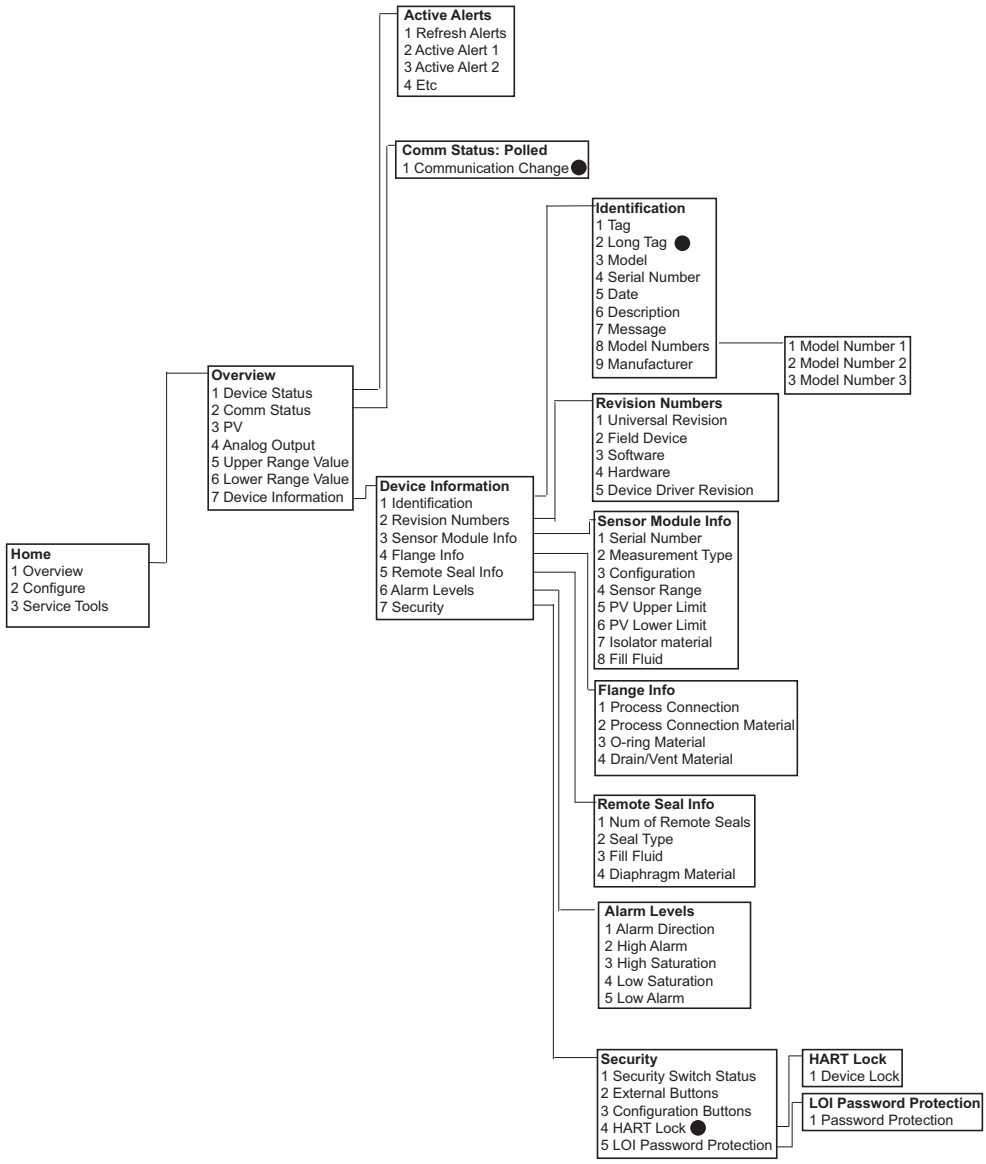

AA
RTC1002227
CSA INTRINSIC SAFETY APPROVALS
2088 LOW POWER CIRCUIT CONNECTION WITH INTRINSIC SAFETY BARRIERS
Ex ia
INTRINSICALLY SAFE/SECURITE INTRINSEQUE
HAZARDOUS AREA
NON-HAZARDOUS AREA
BARRIER
BARRIER
POWER SUPPLY
A/D CONV
PWR
VOUT
TWO SINGLE CHANNEL BARRIERS
HAZARDOUS AREA
NON-HAZARDOUS AREA
BARRIER
POWER SUPPLY
A/D CONV
PWR
VOUT
2088 LOW POWER
2088 "M" OUTPUT (1-5 V)
APPROVED FOR CLASS 1, DIVISION 1, GROUPS A,B,C,D WHEN USED IN CIRCUIT WITH TWO CSA APPROVED SINGLE CHANNEL SAFETY BARRIERS, ONE WITH APPROVED SAFETY PARAMETERS OF 28 VOLTS OR LESS AND 300 OHMS OR MORE IN +PWR LINE, AND ONE WITH APPROVED SAFETY PARAMETERS OF 10 VOLTS OR LESS AND 47 OHMS OR MORE IN Vout LINE, OR ONE CSA APPROVED DUAL CHANNEL SAFETY BARRIER WITH IDENTICAL APPROVED SAFETY PARAMETERS CONNECTED IN LIKE MANNER, AS ABOVE.
APPROVED FOR CLASS 1, DIVISION 1, GROUPS C,D WHEN USED IN CIRCUIT WITH TWO CSA APPROVED SINGLE CHANNEL SAFETY BARRIERS, ONE WITH APPROVED SAFETY PARAMETERS OF 30 VOLTS OR LESS AND 150 OHMS OR MORE IN +PWR LINE AND ONE WITH APPROVED SAFETY PARAMETERS OF 10 VOLTS OR LESS AND 47 OHMS OR MORE IN Vout LINE.
Mylea Lee Miller
Ø2088-1Ø24
N/A
3
3

# Appendix C Field communicator menu trees and Fast Keys

Field communicator menu trees . . . . . page 103
Field communicator Fast Keys . . . . . page 108

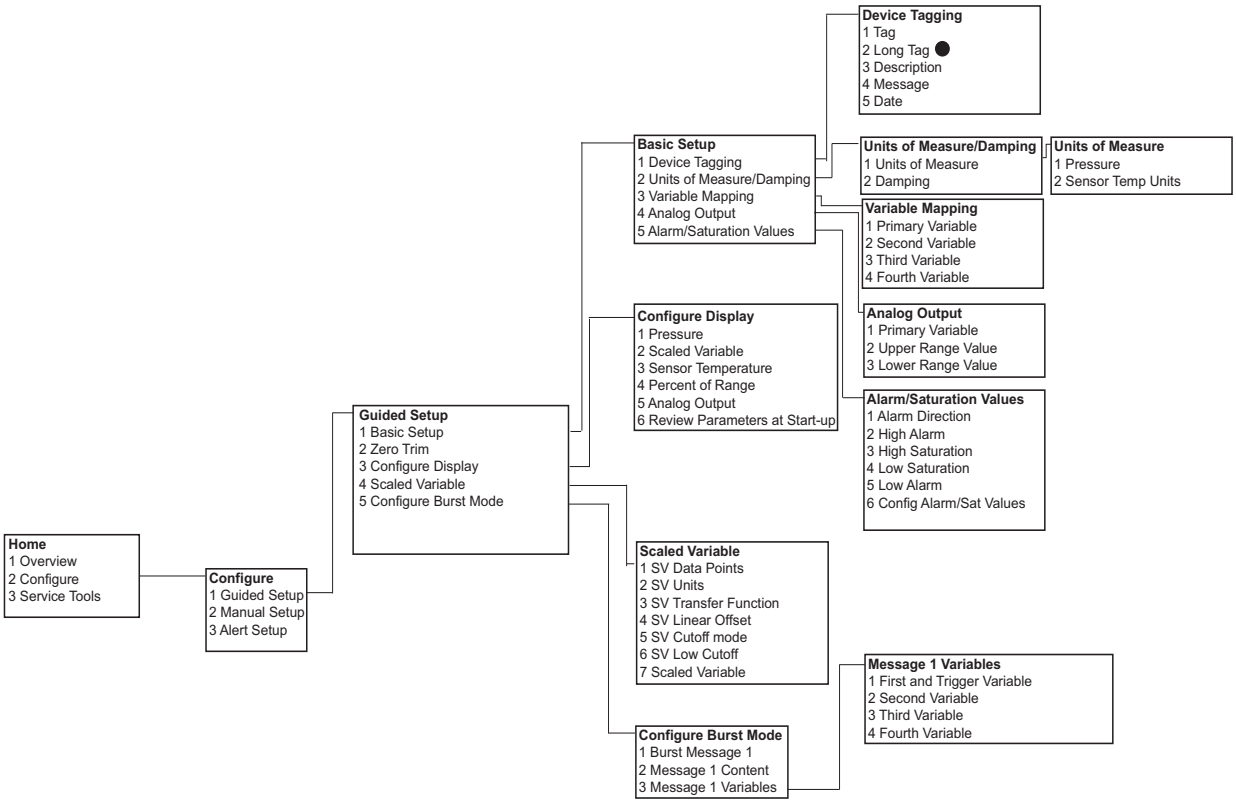
## C.1 Field communicator menu trees

**Figure C-1. Rosemount 2088 Field Communicator menu tree: overview**




**Note**
Selections with black circle are only available in HART Revision 7 mode. Selection will not appear in HART Revision 5 DD.

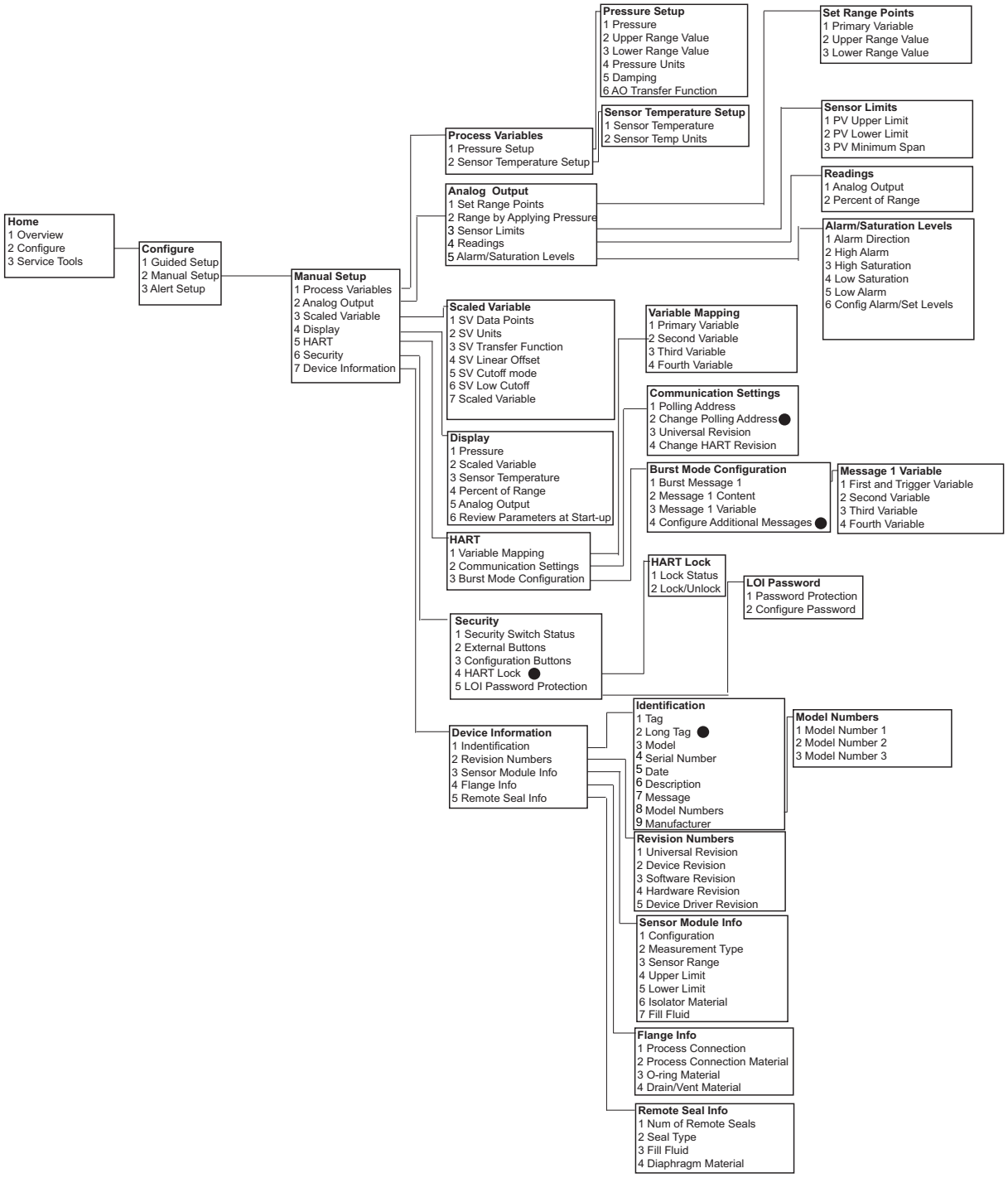
## Figure C-2. Rosemount 4108 Field Communicator menu tree: configure - guided setup




### Note

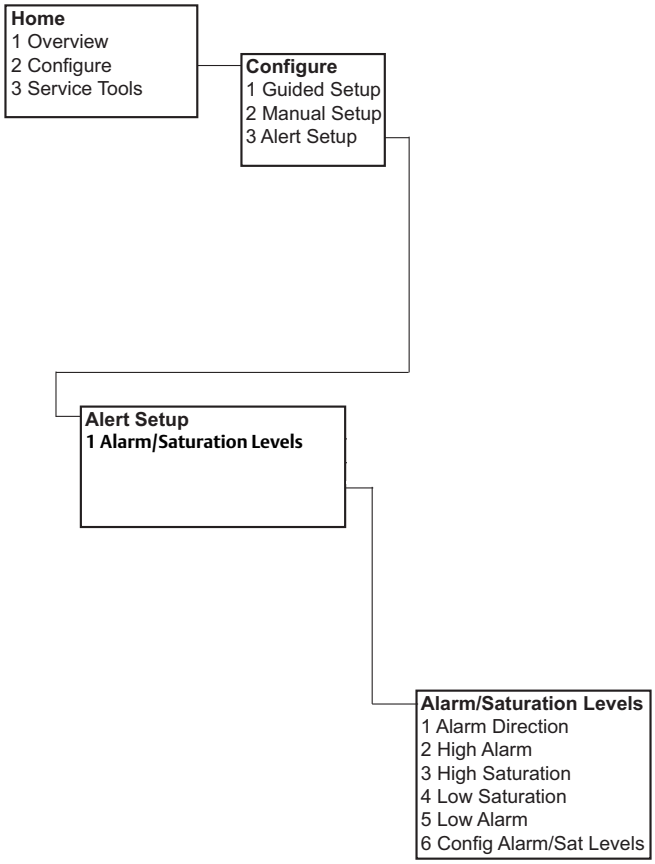
Selections with black circle are only available in HART Revision 7 mode. Selection will not appear in HART Revision 5 DD.

## Figure C-3. Rosemount 2088 Field Communicator menu tree: configure - manual setup




**Note**
Selections with black circle are only available in HART Revision 7 mode. Selection will not appear in HART Revision 5 DD.

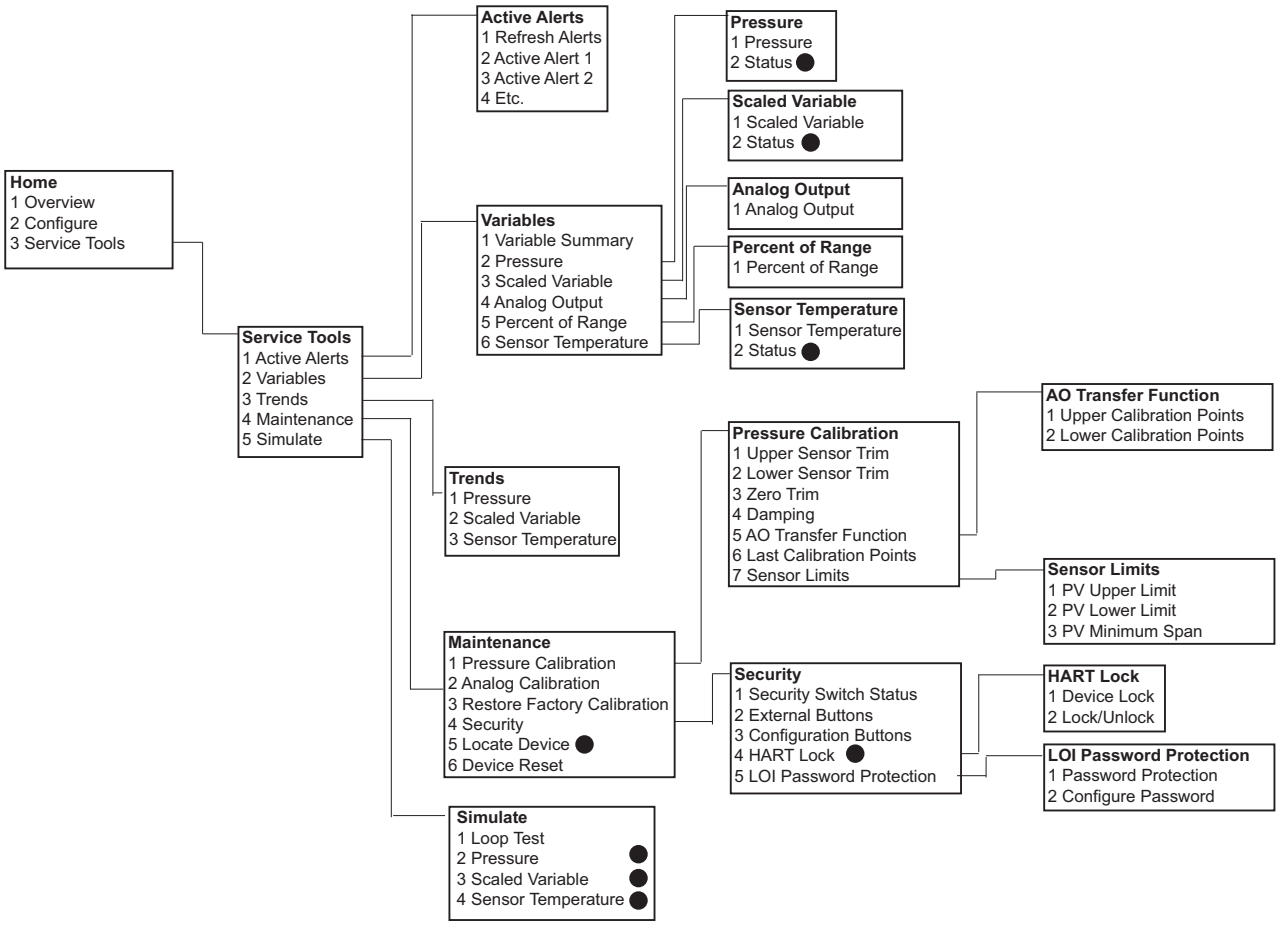
**Figure C-4. Rosemount 2088 Field Communicator menu tree: configure - alert setup**




**Note**

Selections with black circle are only available in HART Revision 7 mode. Selection will not appear in HART Revision 5 DD.

## Figure C-5. Rosemount 2088 Field Communicator menu tree - service tools




### Note

Selections with black circle are only available in HART Revision 7 mode. Selection will not appear in HART Revision 5 DD.

# C.2 Field communicator Fast Keys

- A (✓) indicates the basic configuration parameters. At minimum these parameters should be verified as a part of configuration and startup.
- A (7) indicates availability only in HART revision 7 mode.

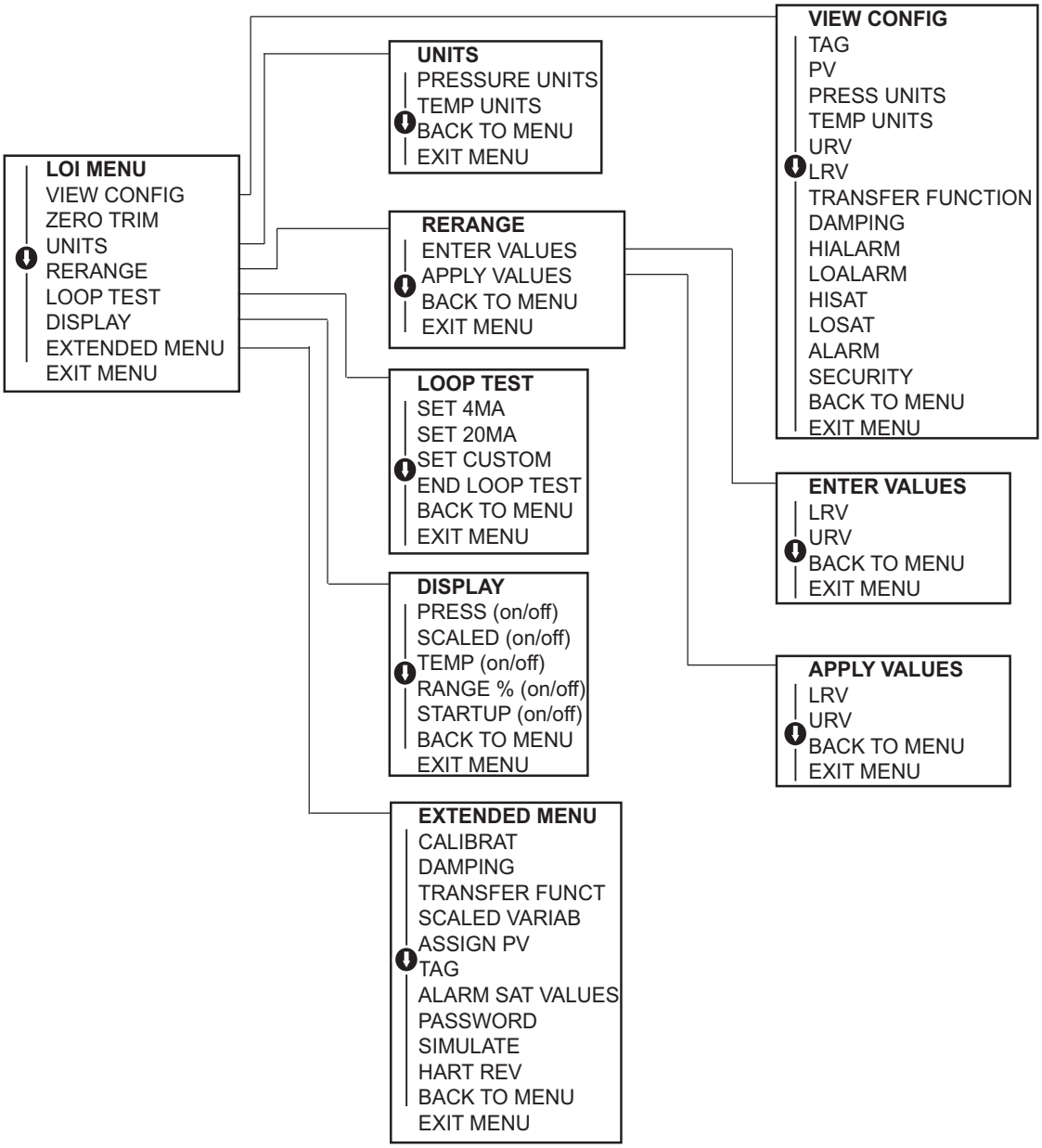
**Table C-1. Device revision 9 and 10 (HART7), DD revision 1 Fast Key sequence**

| | Function | Fast Key sequence | |
|---|---|---|---|
| | | HART 7 | HART 5 |
| ✓ | Alarm and Saturation Levels | 2, 2, 2, 5 | 2, 2, 2, 5 |
| ✓ | Damping | 2, 2, 1, 1, 5 | 2, 2, 1, 1, 5 |
| ✓ | Primary Variable | 2, 2, 5, 1, 1 | 2, 2, 5, 1, 1 |
| ✓ | Range Values | 2, 2, 2, 1 | 2, 2, 2, 1 |
| ✓ | Tag | 2, 2, 7, 1, 1 | 2, 2, 7, 1, 1 |
| ✓ | Transfer Function | 2, 2, 1, 1, 6 | 2, 2, 1, 1, 6 |
| ✓ | Pressure Units | 2, 2, 1, 1, 4 | 2, 2, 1, 1, 4 |
| | Date | 2, 2, 7, 1, 5 | 2, 2, 7, 1, 4 |
| | Descriptor | 2, 2, 7, 1, 6 | 2, 2, 7, 1, 5 |
| | Digital to Analog Trim (4 - 20 mA / 1-5 V Output) | 3, 4, 2, 1 | 3, 4, 2, 1 |
| | Digital Zero Trim | 3, 4, 1, 3 | 3, 4, 1, 3 |
| | Display Configuration | 2, 2, 4 | 2, 2, 4 |
| | LOI Password Protection | 2, 2, 6, 5 | 2, 2, 6, 4 |
| | Loop Test | 3, 5, 1 | 3, 5, 1 |
| | Lower Sensor Trim | 3, 4, 1, 2 | 3, 4, 1, 2 |
| | Message | 2, 2, 7, 1, 7 | 2, 2, 7, 1, 6 |
| | Pressure Trend | 3, 3, 1 | 3, 3, 1 |
| | Rerange with Keypad | 2, 2, 2, 1 | 2, 2, 2, 1 |
| | Scaled D/A Trim (4 - 20 mA / 1-5 V) Output) | 3, 4, 2, 2 | 3, 4, 2, 2 |
| | Scaled Variable | 2, 2, 3 | 2, 2, 3 |
| | Sensor Temperature Trend | 3, 3, 3 | 3, 3, 3 |
| | Switch HART Revision | 2, 2, 5, 2, 4 | 2, 2, 5, 2, 3 |
| | Upper Sensor Trim | 3, 4, 1, 1 | 3, 4, 1, 1 |
| 7 | Long Tag | 2, 2, 7, 1, 2 | |
| 7 | Locate Device | 3, 4, 5 | |
| 7 | Simulate Digital Signal | 3, 5 | |

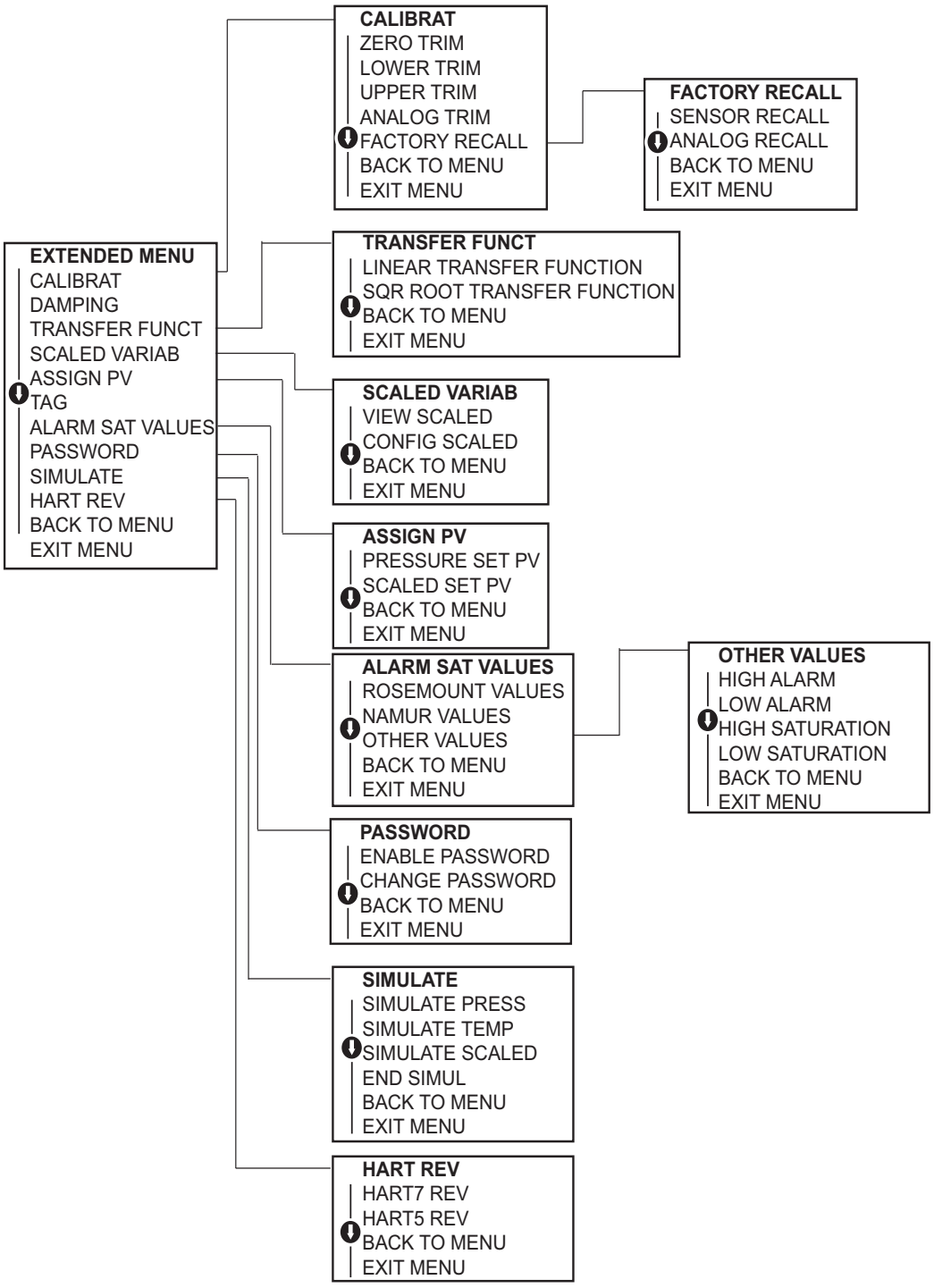
# Appendix D Local operator interface

LOI menu tree . . . . . page 109
LOI menu tree - extended menu . . . . . page 110
Number entry . . . . . page 111
Text entry . . . . . page 112

## D.1 LOI menu tree



# D.2 LOI menu tree - extended menu



# D.3 Number entry

Floating-point numbers can be entered with the LOI. All eight number locations on the top line can be used for number entry. Refer to Table 2-2 on page 12 for LOI button operation. Below is a floating-point number entry example for changing a value of “-0000022” to “000011.2”

| Step | Instruction | Current position (indicated by underline) |
|---|---|---|
| 1 | When the number entry begins, the left most position is the selected position. In this example, the negative symbol, “-“, will be flashing on the screen. | -0000022 |
| 2 | Press the scroll button until the “0” is blinking on the screen in the selected position. | 00000022 |
| 3 | Press the enter button to select the “0” as an entry. The second digit from the left will be blinking. | 00000022 |
| 4 | Press the enter button to select “0” for second digit. The third digit from the left will be blinking. | 00000022 |
| 5 | Press the enter button to select “0” for the third digit. The fourth digit from the left will now be blinking. | 00000022 |
| 6 | Press the enter button to select “0” for the fourth digit. The fifth digit from the left will now be blinking. | 00000022 |
| 7 | Press scroll to navigate through the numbers until the “1” is on the screen. | 00001022 |
| 8 | Press the enter button to select the “1” for the fifth digit. The sixth digit from the left will now be blinking. | 00001022 |
| 9 | Press scroll to navigate through the numbers until the “1”, is on the screen. | 00001122 |
| 10 | Press the enter button to select the “1” for the sixth digit. The seventh digit from the left will now be blinking. | 00001122 |
| 11 | Press scroll to navigate through the numbers until the decimal, “.”, is on the screen. | 000011.2 |
| 12 | Press the enter button to select the decimal, “.”, for the seventh digit. After pressing enter, all digits to the right of the decimal will now be zero. The eighth digit from the left will now be blinking. | 000011.0 |
| 13 | Press the scroll button to navigate through the numbers until the "2", is on the screen. | 000011.2 |
| 14 | Press the enter button to select the “2” for the eighth digit. The number entry will be complete and a “SAVE” screen will be shown. | 000011.2 |

Usage notes:

- It is possible to move backwards in the number by scrolling to the left arrow symbol and pressing enter.
- The negative symbol is only allowed in the left most position.
- Numbers can be entered in scientific notation by placing an “E” in the 7th position.

# D.4 Text entry

1. Text can be entered with the LOI. Depending on the edited item, up to eight locations on the top line can be used for text entry. Text entry follows the same rules as the number entry rules in "LOI menu tree" on page 109, except the following characters are available in all locations: A-Z, 0-9, -, /, space.

Usage note:

- If the current text contains a character the LOI cannot display, it will be shown as an asterisk "*".

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