Reference Manual
00809-0100-4108, Rev CD
August 2024

Rosemount™ 2088, 2090P, and 2090F Pressure Transmitters

with HART® and 1-5 Vdc Low Power Protocol

CE HART COMMUNICATION PROTOCOL

ROSEMOUNT™

EMERSON™

Safety messages

This guide provides basic guidelines for this product. It does not provide instructions for configuration, diagnostics, maintenance, service, troubleshooting, explosion-proof, flameproof, or Intrinsically Safe (IS) installations.

⚠ 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. Review the approvals section of this manual for any restrictions associated with a safe installation.

Before connecting a communication device 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.

Do not attempt to loosen or remove flange bolts while the transmitter is in service.

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.

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

⚠ WARNING

Replacement equipment or spare parts not approved by Emerson 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 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.

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

NOTICE

The products described in this document are NOT designed for nuclear-qualified applications. Using non-nuclear qualified products in applications that require nuclearqualified hardware or products may cause inaccurate readings. For information on Rosemount nuclear-qualified products, contact your local Emerson Sales Representative.

Table of Contents

1 Introduction

1.1 Models covered

The following Rosemount Pressure Transmitters are covered by this manual:

Rosemount 2088G Gage Pressure Transmitter

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

Rosemount 2088A Absolute Pressure Transmitter

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

Rosemount 2090F Hygienic Pressure Transmitter

Rosemount 2090FG - Gage Pressure Transmitter

- Measures gage pressure up to 300 psi (20,7 bar)

Rosemount 2090FA - Absolute Pressure Transmitter

- Measures absolute pressure up to 300 psi (20,7 bar)

Rosemount 2090P Pulp and Paper Pressure Transmitter

Rosemount 2090PG - Gage Pressure Transmitter

- Measures gage pressure up to 300 psi (20,7 bar)

Rosemount 2090PA - Absolute Pressure Transmitter

- Measures gage pressure up to 300 psi (20,7 bar)

1.2 Product recycling/disposal

Consider recycling equipment and packaging.

Dispose of the product and packaging in accordance with local and national legislation.

2 Configuration

2.1 System readiness

- If using HART®-based control or AMS, 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.

2.1.1 Confirm correct device driver

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

Procedure

1. Download the latest DD at Software and Drivers or FieldCommGroup.org.
2. Click Device Driver.
3. Select desired product.
   a) Within Table 2-1, use the HART® Universal Revision and Device Revision numbers to find the correct DD.

Table 2-1: Rosemount 2088 and 2090 with 4–20 mA HART Protocol Device Revisions and Files

Release date	Device identification			Device driver identification		Review instructions	Review function
	NAMUR hardware revision(1)	NAMUR software revision (1)	HART software revision(2)	HART universal revision	Device revision (3)	Manual document number	Change description
Aug-16	1.1.xx	1.0.xx	3	7	10	00809-0100-4108 (2088) 00809-0100-4690 (2090)	(4)
				5	9		(5)
Jan-13	N/A	1.0.xx	1	7	10		N/A
				5	9		
Jan-98	N/A	N/A	178	5	3		

(1) *NAMUR revision is located on the hardware tag of the device. Differences in level 3 changes, signified above by xx, represent minor product changes as defined per NE53. Compatibility and functionality are preserved and product can be used interchangeability.*
(2) *HART software revision can be read using a HART capable configuration tool. Value shown is minimum revision that could correspond to NAMUR revisions.*
(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 DD must be downloaded. It is recommended to download new DD files to ensure full functionality.*

(4) Updated electronics hardware design. Intrinsic Safety temperature classification change.
(5) HART revision 5 and 7 selectable, LOI, configurable alarms, expanded engineering units.

Table 2-2: Rosemount 2088 with 1–5 Vdc Low Power HART Protocol Device Revisions and Files

Release date	Device identification			Device driver identification		Review instructions	Review function
	NAMUR hardware revision(1)	NAMUR software revision (1)	HART software revision(2)	HART universal revision	Device revision (3)	Manual document number	Change description
Jan-13	N/A	1.0.2	3	7		00809-0100-4108 (2088)	(4)
				5	9	00809-0100-4690 (2090)	
Jan-98	N/A	N/A	178	5	3		N/A

(1) NAMUR revision is located on the hardware tag of the device. Differences in level 3 changes, signified above by xx, represent minor product changes as defined per NE53. Compatibility and functionality are preserved and product can be used interchangeability.
(2) HART software revision can be read using a HART capable configuration tool. Value shown is minimum revision that could correspond to NAMUR revisions.
(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 DD must be downloaded. It is recommended to download new DD files to ensure full functionality.
(4) HART revision 5 and 7 selectable, LOI, configurable alarms, expanded engineering units.

2.2 HART® installation flowchart

Procedure

1. Does the installation require bench calibration?
   - If yes, then refer to Step 2.
   - If no, then refer to Step 3.
2. To configure for pressure, set the units. See Setting pressure units.
   a. Set **Range Points**. See Reranging the transmitter.
   b. Select **Linear Output**.
   c. Set **Damping**. See Damping.
   d. To verify, review **Transmitter Configuration**. See Configuring LCD display with AMS Device Manager.
   e. Apply pressure.
   f. Is it within specifications?

- If yes, then refer to Step 3.
- If no, then refer to Recommended calibration tasks.

3. To Field Install, configure **Security** and **Alarm**. See Detailed transmitter setup
    a. Mount the transmitter. See Mount the transmitter.
    b. Check the process connection. See Mount the transmitter.
    c. Wire the transmitter. See Wiring the transmitter.
    d. Power the transmitter. See Wiring the transmitter.
    e. Confirm the transmitter configuration. See Verifying configuration.
    f. Trim the transmitter.

2.3 Transmitter overview

The Rosemount 2088 uses piezoresistive sensor technology for absolute pressure (AP) and GP measurements.

The major components of the transmitter 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 transmitter is illustrated in Figure 2-2.

When pressure is applied to the isolating diaphragm, the oil deflects the sensor which then changes its 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 digital-to-analog D/A converter, which converts the signal back to the analog signal, and then superimposes the HART® signal on the 4–20 mA or 1-5 Vdc output.

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

Note
The LCD display uses a 5 × 6 character display and can display output and diagnostic messages. The local operator interface (LOI) display uses an 8 × 6 character display and can display output, diagnostic messages, and LOI menu screens. The LOI display comes with two buttons mounted on the front of the display board. See Figure 2-1.

Figure 2-1: LCD/LOI display

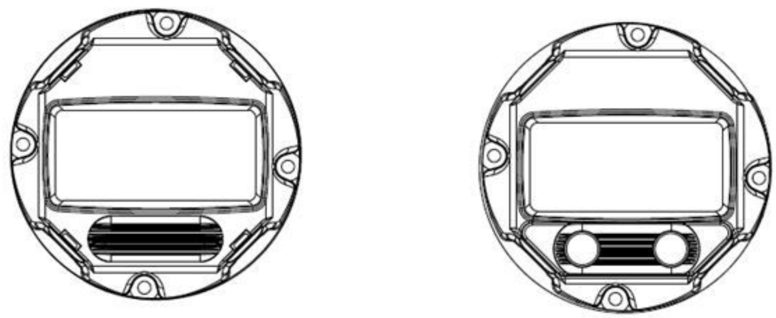
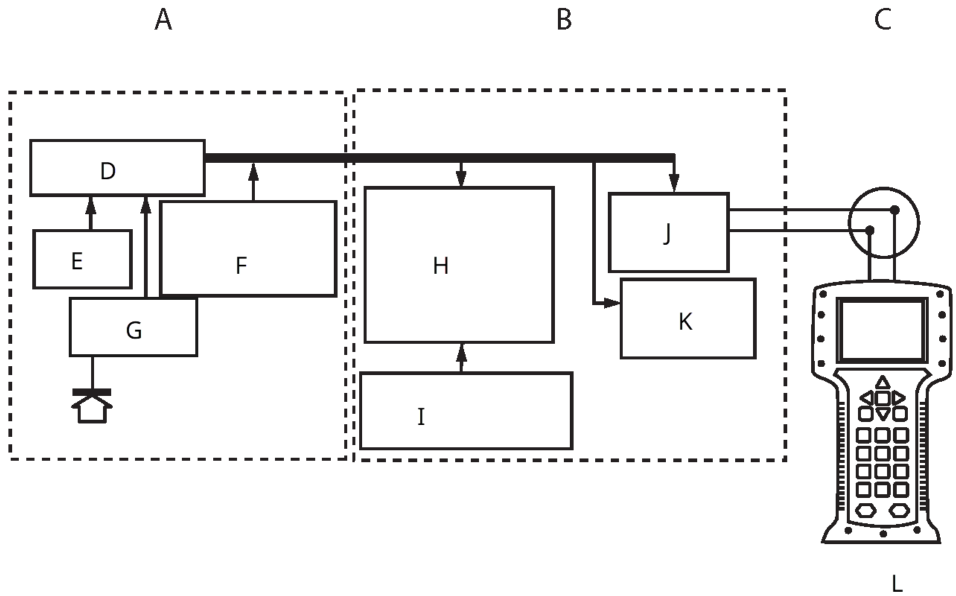


Figure 2-2: Block diagram of operation



A. *Sensor module*
B. *Electronics board*
C. *4-20 mA signal to control system*
D. *Signal processing*
E. *Temperature sensor*
F. *Sensor module memory*
G. *Pressure sensor*
H. *Microprocessor*
    - *Sensor linearization*
    - *Rerange*
    - *Damping*
    - *Diagnostics*
    - *Engineering units*
    - *Communication*
I. *Memory*
    - *Configuration*
J. *Digital-to-analog signal conversion*
K. *Digital communication*
L. *Communication device*

2.4 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.

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

Full communication device menu trees and Fast Key sequences are available in Communication device menu trees and fast keys. LOI menu trees are available in Local operator interface (LOI) menu.

2.5 Configuration basics

NOTICE

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

You can configure the transmitter either before or after installation. Configuring the transmitter on the bench using either a communication device, 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.

Refer to Figure 4-2 for switch location.

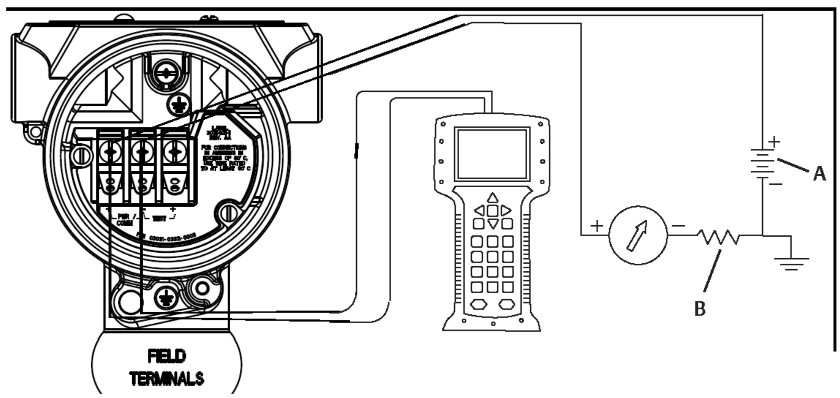
Note
LOI is available with the Rosemount 2088 (option M4) but is not available with the Rosemount 2090F or 2090P.

2.5.1 Configuring on the bench

To configure on the bench, required equipment includes a power supply and a communication device, AMS Device Manager, or a local operator interface (LOI) (option `M4`).

Wire equipment as shown in Figure 2-3. To ensure successful HART® communication, a resistance of at least 250 Ωs must be present between the transmitter and the power supply. Connect the communication device leads to the terminals labeled `COMM` on the terminal block or 1–5 V configuration, wire as shown in Figure 2-3. Connect the communication device to the terminals labeled `VOUT/COMM`.

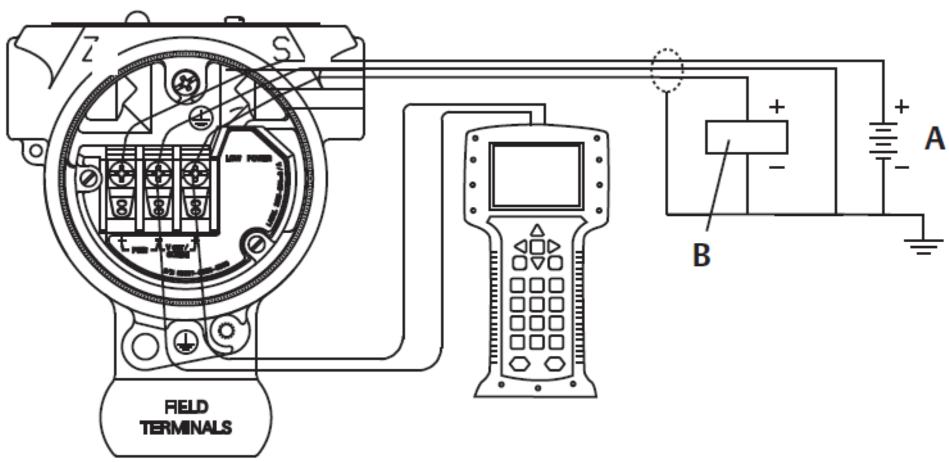
Figure 2-3: Wiring the transmitter (4–20 mA HART)



A. Vdc supply
B. R_L ≥ 250 (necessary for HART communication only)

2.5.2 Configuration tools

Figure 2-4: Wiring the transmitter (1–5 Vdc low power)



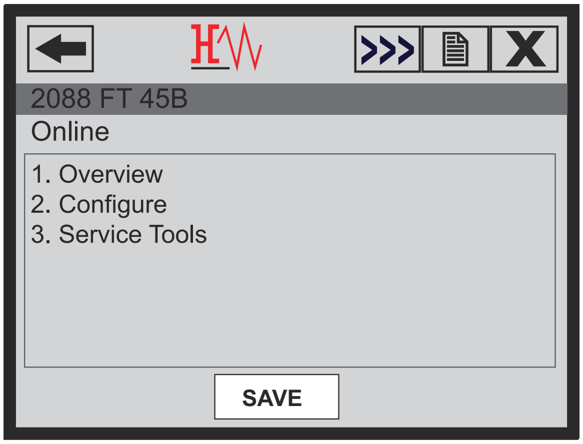
A. DC power supply
B. Voltmeter

Configuring with a communication device

There are two interfaces available with the communication device: Traditional and Dashboard interfaces. This section describes all steps using a communication device using Dashboard interfaces.

Figure 2-5 shows the Device Dashboard interface. It is critical that the latest device descriptors (DDs) are loaded into the communication device. Refer to either Software & Drivers or FieldCommGroup.org to download latest DD library.

Figure 2-5: 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 Software & Drivers or FieldCommGroup.org.

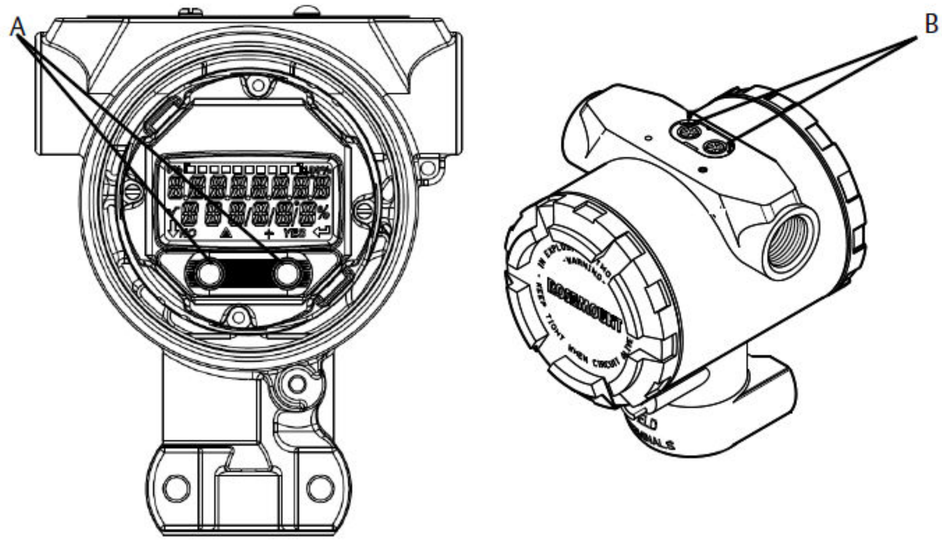
Note
This document describes all steps using AMS Device Manager using version 11.5.

Configuring with a local operator interface (LOI)

Use option code `M4` to order a transmitter with an LOI.

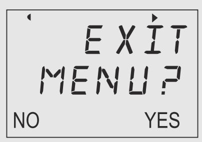
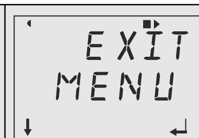
To activate the LOI, push either configuration button. Configuration buttons are located on the LCD display (must remove housing cover to access), or underneath the top tag of the transmitter. See Table 2-3 for configuration button functionality and Figure 2-6 for configuration button location. When 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.

Figure 2-6: LOI configuration buttons



A. Internal configuration buttons
B. External configuration buttons

Table 2-3: LOI button operation

Button		
Left	No	SCROLL
Right	Yes	ENTER

2.5.3 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 communication device, AMS Device Manager, or the local operator interface (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.

2.6 Verifying configuration

Emerson recommends verifying various configuration parameters prior to installation into the process.

This section details the various parameters for each configuration tool. Depending on what configuration tool(s) are available, follow the steps listed.

2.6.1 Verify configuration using a communication device

Review configuration parameters listed in Table 2-4 prior to transmitter installation.

Fast key sequences for the latest device descriptors (DDs) are shown in Table 2-4. For fast key sequences for legacy DDs, contact your local Emerson Representative.

Table 2-4: Device Dashboard fast key sequence

From the ***HOME*** screen, enter the fast key sequences listed:

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

2.6.2 Verifying configuration with AMS Device Manager

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

2.6.3 Verifying configuration with LOI

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**

2.6.4 Verifying process variables configuration

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

Verifying process variables with a communication device

From the ***HOME*** screen, enter the Fast Key sequence: 3, 2, 1

Verifying process variables with AMS Device Manager

Procedure

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

2.7 Basic setup of the transmitter

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

2.7.1 Setting pressure units

The Pressure Unit variable sets the unit of measure for the reported pressure.

Setting pressure units with a communication device

From the ***HOME*** screen, enter the Fast Key sequence: 2, 2, 1, 1, 4

Setting pressure units with AMS Device Manager

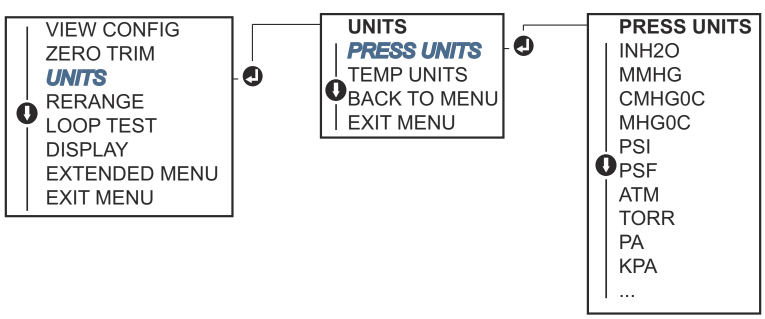
Procedure

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

Setting pressure units with a LOI

Follow Figure 2-7 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 2-7: Selecting Units with LOI



2.7.2 Reranging 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 percent of range, and the upper range point represents 100 percent of range. In practice, the transmitter range values may be changed as often as necessary to reflect changing process requirements.

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 communication device, AMS Device Manager, or local operator interface (LOI).
- Rerange with a pressure input source and a communication device, AMS Device Manager, LOI, or local **Zero** and **Span** buttons.

Manually rerange the transmitter by entering range points

Entering range points with a communication device

From the ***HOME*** screen, enter the Fast Key sequence: 2, 2, 2, 1.

Entering range points with AMS Device Manager

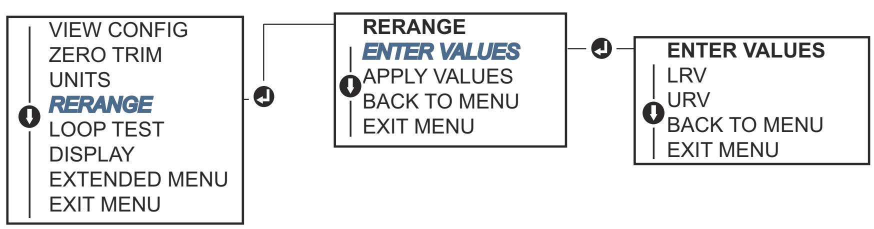
Procedure

1. Right select the device and select **Configure**.
2. Select **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 LOI

Reference Figure 2-8 to rerange the transmitter using the LOI. Enter values using **SCROLL** and **ENTER** buttons.

Figure 2-8: Rerange with LOI



Reranging 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 communication device

From the ***HOME*** screen, enter the Fast Key sequence: 2, 2, 2, 2.

Rerange with an applied pressure source using AMS Device Manager

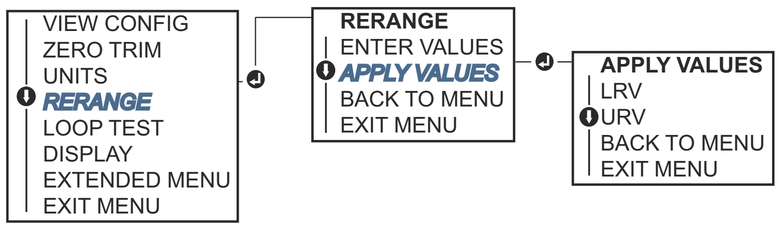
Procedure

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

   Rerange with an applied pressure source using a communication device.

Use Figure 2-9 to manually rerange the device using an applied pressure source with an LOI.

Figure 2-9: Rerange with Applied Pressure Using LOI

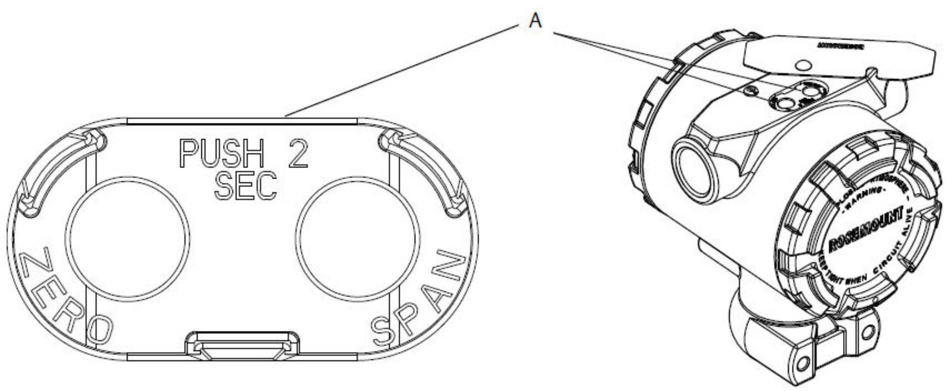


Rerange with an applied pressure source using local Zero and Span buttons

If you ordered the transmitter with option code `D4`, you can use the local **Zero** and **Span** buttons to rerange the transmitter with an applied pressure.

Refer to Figure 2-10 for analog **Zero** and **Span** button location.

Figure 2-10: Analog Zero and Span buttons



A. ***Zero** and **Span** buttons*

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.
   - To change the zero (4 mA/1 V point) while maintaining the span: Press and hold **Zero** button for at least two seconds and then release.
   - To change the span (20 mA/5 V point) while maintaining the zero point: Press and hold the **Span** button for at least two seconds and then release.

Note
4 mA and 20 mA points must maintain the minimum span.

Note

- If the transmitter security is on, you will not be able to adjust the zero or span points.
- The span is maintained when the 4 mA/1 V point is set. The span changes when the 20 mA 5 V 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 transmitter 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 inH_2O, and the transmitter detects a pressure of 25 inH_2O, it digitally outputs the 25 inH_2O reading and a 250 percent of range reading.

2.7.3 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 using a communication device

Procedure

1. From the ***HOME*** screen, enter the fast key sequence: 2, 2, 1, 1, 5.
2. Enter desired **Damping** value and select **APPLY**.

Damping with AMS Device Manager

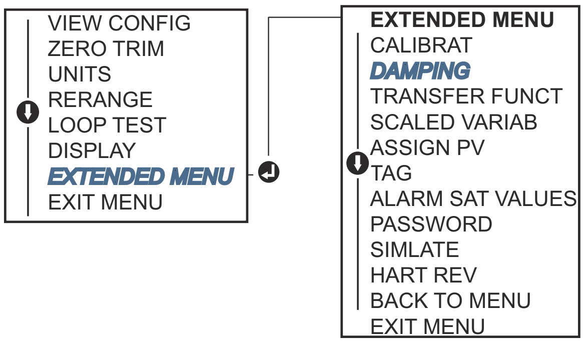
Procedure

1. Right select 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 using a local operator interface (LOI)

Reference Figure 2-11 to enter damping values using an LOI.

Figure 2-11: Damping using LOI



2.8 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**

You can also configure the LCD display to display configuration information during the device startup. Select `Review Parameters` at start-up to enable or disable this functionality.

2.8.1 Configure LCD display using a communication device

Procedure

From the ***HOME*** screen, enter the fast key sequence: 2, 2, 4.

2.8.2 Configuring LCD display with AMS Device Manager

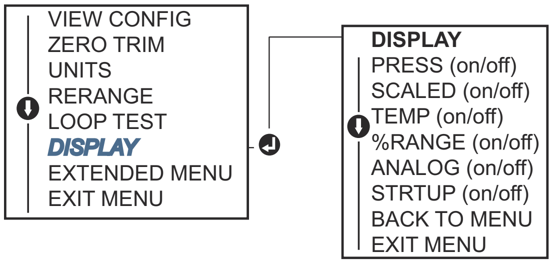
Procedure

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

2.8.3 Configure LCD display with a local operator interface (LOI)

Refer to Figure 2-12 for LCD display configuration using an LOI.

Figure 2-12: Display with LOI



2.9 Detailed transmitter setup

2.9.1 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 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.

Table 2-5: Rosemount alarm and saturation values

Level	4–20 mA (1–5 Vdc) saturation	4–20 mA (1–5 Vdc 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 2-6: NAMUR-compliant alarm and saturation values

Level	4–20 mA (1–5 Vdc) saturation	4–20 mA (1–5 Vdc) alarm
Low	3.80 mA (0.95 V)	≤ 3.60 mA (0.90 V) (.90 –.95 V)
High	20.50 mA (5.13 V)	≥22.50 mA (5.63 V) (5.05 –5.75 V)

Table 2-7: Custom alarm and saturation values

Level	4–20 mA (1–5 Vdc) saturation	4–20 mA (1–5 Vdc) alarm
Low	3.70 mA– 3.90 mA (.90 –.95 V)	3.60–3.80 mA (.90 –.95 V)
High	20.10 mA –22.90 mA (5.025 –5.725 V)	20.20 mA – 23.00 mA (5.05 –5.75 V)

You can configure failure mode alarm and saturation levels using a communication device, AMS Device Manager, or the local operator interface (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 (0.025 Vdc)

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.

Configuring alarm and saturation levels using a communication device

From the ***HOME*** screen, enter the Fast Key sequence: 2, 2, 2, 5.

Configuring alarm and saturation levels with AMS Device Manager

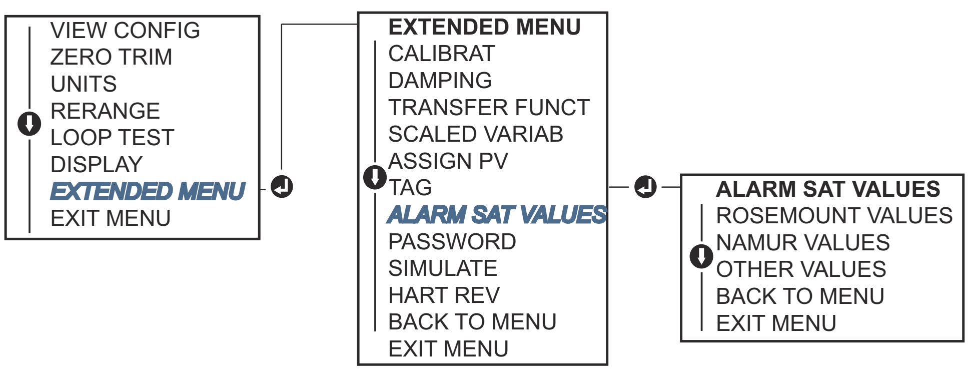
Procedure

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

Configuring alarm and saturation levels using LOI

Refer to Figure 2-13 for instructions to configure alarm and saturation levels.

Figure 2-13: Configuring Alarm and Saturation with LOI



2.9.2 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/LOI display. The second use case is to allow custom units to drive the transmitter's 4–20 mA (1–5 Vdc) 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.

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 (linear and square root)

- **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.
- **Low flow cutoff:** The point at which output is driven to zero to prevent problems caused by process noise. It is highly recommended to use the low flow cutoff function in order to have a stable output and avoid problems due to process noise at a low flow or no flow condition. A low flow cutoff value that is practical for the flow element in the application should be entered.

Configuring scaled variable using a communication device

From the ***HOME*** screen, enter the Fast Key sequence: 2, 1, 4, 7.

Procedure

Follow the screen prompts to configure Scaled Variable.

a) When configuring for level, select **Linear** under ***Select Scaled data options***.

b) When configuring for flow, select **Square Root** under ***Select Scaled data options***.

Configuring scaled variable using AMS Device Manager

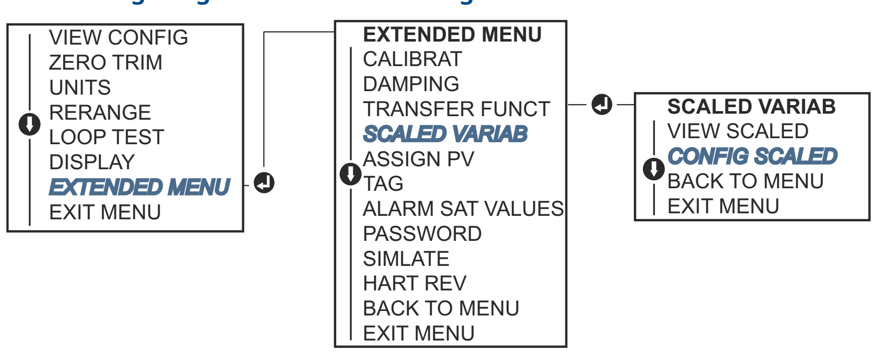
Procedure

1. Right select on the device and, select **Configure**.
2. Select the ***Scaled Variable*** tab and select the **Scaled Variable** button.
3. Follow screen prompts to configure Scaled Variable
   a) When configuring for level applications, select **Linear** under ***Select Scaled data options***.
   b) When configuring for flow applications, select **Square Root** under ***Select Scaled data options***.

Configuring scaled variable using a LOI

Refer to Figure 2-14 for instructions to configure Scaled Variable using a LOI.

Figure 2-14: Configuring Scaled Variable Using a LOI



2.9.3 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 communication device, AMS Device Manager, or a LOI. Variables (2V, 3V, and 4V) can only be re-mapped via communication device or AMS Device Manager.

Note
The variable assigned to the primary variable drives the 4–20 mA (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 communication device

From the ***HOME*** screen, enter the Fast Key sequence: 2, 1, 1, 3.

Re-mapping using AMS Device Manager

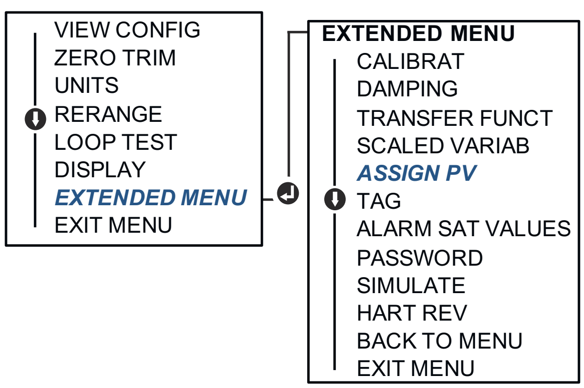
Procedure

1. Right select 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. Select **Send**.
5. Carefully read the warning and select **Yes** if it is safe to apply the changes.

Re-mapping using LOI

Refer to Figure 2-15 for instructions to remap the primary variable using a LOI.

Figure 2-15: Re-mapping with LOI



2.10 Performing transmitter tests

2.10.1 Verifying alarm level

If the transmitter 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.

Note
Before returning transmitter to service, verify security switch is set to the correct position.

2.10.2 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 1–5 V output, voltage measurement is directly measured from Vout to (–) terminals.

Performing an analog loop test using a communication device

From the ***HOME*** screen, enter the Fast Key sequence: 3, 5, 1.

Performing an analog loop test using AMS Device Manager

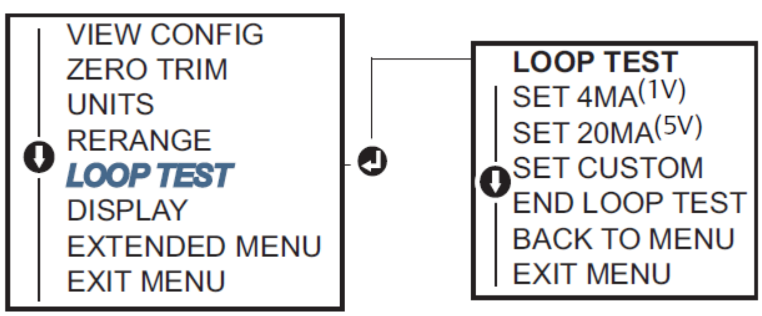
Procedure

1. Right select on the device and, within the ***Methods*** dropdown menu, move cursor over Diagnostics and Test. In the ***Diagnostics and Test*** dropdown menu, select **Loop Test**.
2. Select **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 LOI

To perform an analog loop test using the LOI, the 4 mA (1 V), 20 mA (5 V), and custom mA point may be set manually. Reference Figure 2-16 for instructions on how to perform a transmitter loop test using an LOI.

Figure 2-16: Performing an Analog Loop Test Using an LOI



2.10.3 Simulating device variables

You can 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 communication device

From the ***HOME*** screen, enter the Fast Key sequence: 3, 5.

Simulate digital signal with AMS Device Manager

Procedure

1. Right select on the device and select **Service Tools**.
2. Select **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.

2.11 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, `burst` mode can slow down communication of non-dynamic data to the host by 50 percent.

Use the normal poll/response method of HART communication to access information other than dynamic transfer data. A communication device, 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 communication device, AMS Device Manager, or a control system to initiate a request.

2.11.1 Choosing burst mode options in HART® 5

Message content options:

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

2.11.2 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**

2.11.3 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.

2.11.4 Configuring burst mode using a communication device

From the ***HOME*** screen, enter the Fast Key sequence: 2, 2, 5, 3.

2.11.5 Configuring burst mode using AMS Device Manager

Procedure

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

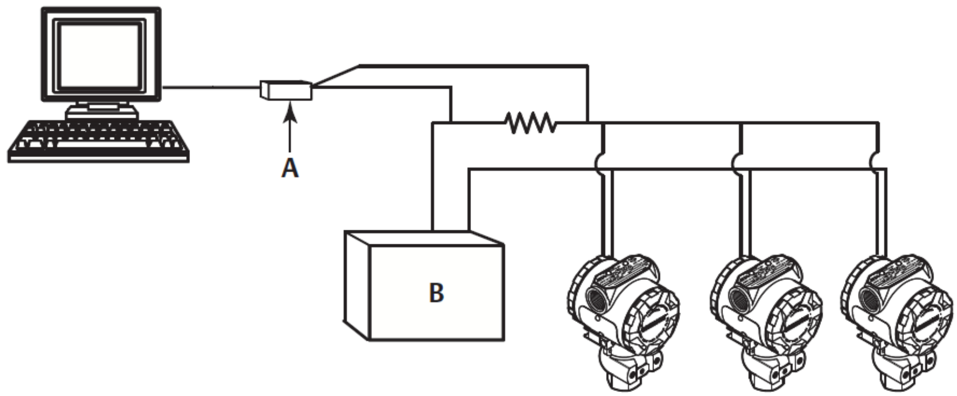
2.12 Establishing multidrop communication

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

For multidrop installation, you need to consider the update rate necessary from each transmitter, the combination of transmitter models, and the length of the transmission line. You can establish communication with transmitters using 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. Communication devices 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 2-17 shows a typical multidrop network. This figure is not intended as an installation diagram.

Figure 2-17: Typical multidrop network (4–20 mA only)



A. HART modem
B. Power supply

Emerson sets the product to address zero (0) at the factory, which allows operation in the standard point-to-point manner with a 4–20 mA (1–5 Vdc) output signal. To activate multidrop communication, change the transmitter address 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 (1–5 Vdc) analog output, sending it to 4 mA (1 Vdc). 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.

2.12.1 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 communication device

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

HART Revision 5	2, 2, 5, 2, 1
HART Revision 7	2, 2, 5, 2, 2

Changing transmitter address using AMS Device Manager

Procedure

1. Right select on the device and select **Configure**.
2. In HART® Revision 5 mode:
    a) Select **Manual Setup**, select the ***HART*** tab.
    b) In the Communication Settings box enter polling address in the **Polling Address** box, select **Send**.
3. In HART Revision 7 mode:

a) Select **Manual Setup**, select the ***HART*** tab and select the **Change Polling Address** button.

4. Carefully read the warning and click **Yes** if it is safe to apply the changes.

2.12.2 Communicating with a multidropped transmitter

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

Communicating with a multidropped transmitter using a communication device

Procedure

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

Communicate with a multidropped transmitter using AMS Device Manager

Procedure

Select the HART® modem icon and select **Scan All Devices**.

3 Hardware installation

3.1 Overview

The information in this section covers installation considerations for the Rosemount™ 2088, 2090F, and 2090P, 2090F, and 2090P with HART® protocols. A Quick Start Guide is shipped with every transmitter to describe recommended pipe-fitting and wiring procedures for initial installation.

Note
For transmitter disassembly and reassembly refer to Disassembly procedures, and Reassembly procedures.

3.2 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. Also, consider 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.

⚠ WARNING

Install the enclosed pipe plug (found in the box) in unused conduit opening with a minimum of five threads engaged to comply with explosion-proof requirements. For tapered threads, install the plug wrench tight. For material compatibility considerations, see Material Selection and Compatibility Considerations for Rosemount Pressure Transmitter Technical Note on Emerson.com/Global.

3.2.1 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). Mount the transmitter so that it is not susceptible to vibration and mechanical shock and does not have external contact with corrosive materials.

3.2.2 Mechanical considerations

Steam service

NOTICE

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.

3.3 Installation procedures

3.3.1 Mount the transmitter

The following are approximate weights of each transmitter:

- Rosemount 2088 2.44 lb (1,11 kg)
- Rosemount 2090F 2.74 lb (1.24 kg)
- Rosemount 2090P 2.96 lb (1.34 kg)

In many cases its compact size and light weight makes it possible to mount directly to the respective apparatus 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).

For dimensional drawing information refer to the 2088 Absolute and Gauge Pressure Transmitter Product Data Sheet.

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.

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

Thread sealing (PTFE) tape or paste on male threads of conduit is required to provide a water/dust tight conduit seal and meets requirements of NEMA® Type 4X, IP66, and IP68. Consult factory if other Ingress Protection ratings are required.

For M20 threads, install conduit plugs to full thread engagement or until mechanical resistance is met.

Mounting brackets

You can panel mount or pipe mount the transmitter through an optional mounting bracket. Refer to Table 3-1 for the complete offering and see Figure 3-1 through Figure 3-4 for dimensions and mounting configurations.

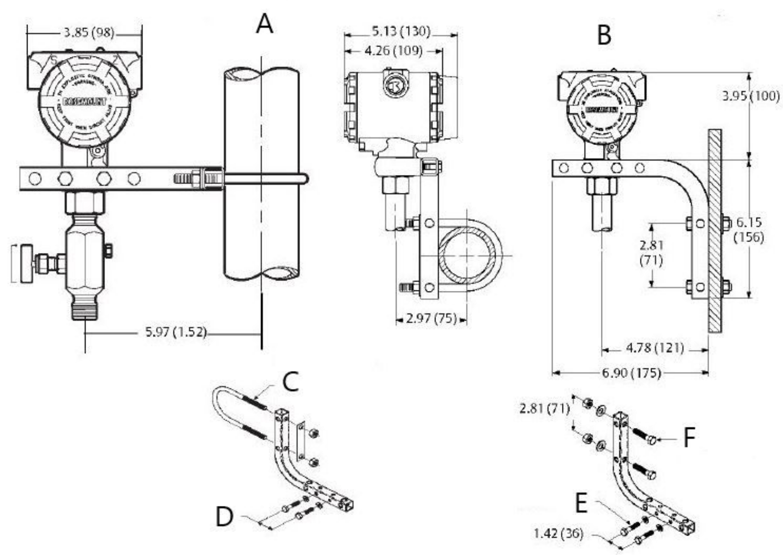
Table 3-1: Mounting brackets

Option code	Process connections			Mounting			Materials			
	Coplanar™	In-line	Traditional	Pipe mount	Panel mount	Flat panel mount	CS bracket	SST bracket	CS bolts	SST bolts
B4	✓	✓	N/A	✓	✓	✓	N/A	✓	N/A	✓
B1	N/A	N/A	✓	✓	N/A	N/A	✓	N/A	✓	N/A
B2	N/A	N/A	✓	N/A	✓	N/A	✓	N/A	✓	N/A
B3	N/A	N/A	✓	N/A	N/A	✓	✓	N/A	✓	N/A
B7	N/A	N/A	✓	✓	N/A	N/A	✓	N/A	N/A	✓

Table 3-1: Mounting brackets *(continued)*

Option code	Process connections			Mounting			Materials			
	Coplanar™	In-line	Traditional	Pipe mount	Panel mount	Flat panel mount	CS bracket	SST bracket	CS bolts	SST bolts
B8	N/A	N/A	✓	N/A	✓	N/A	✓	N/A	N/A	✓
B9	N/A	N/A	✓	N/A	N/A	✓	✓	N/A	N/A	✓
BA	N/A	N/A	✓	✓	N/A	N/A	N/A	✓	N/A	✓
BC	N/A	N/A	✓	N/A	N/A	✓	N/A	✓	N/A	✓

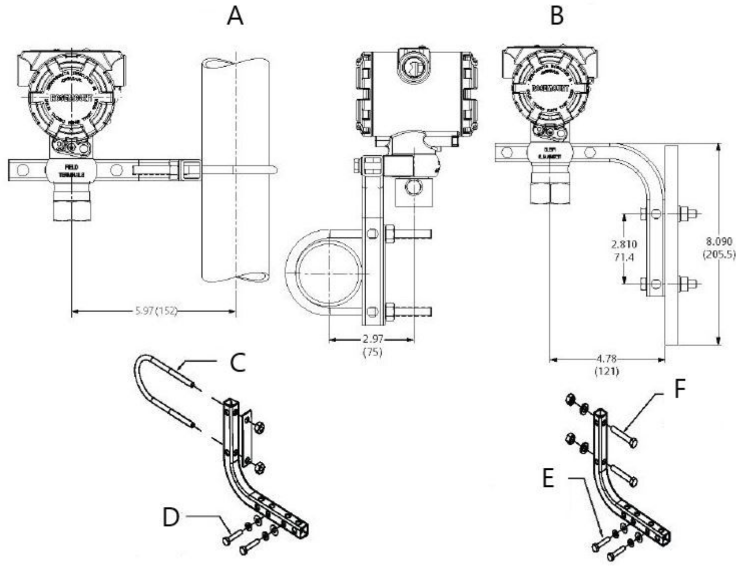
Figure 3-1: Mounting Bracket Option Code B4



A. Pipe mounting
B. Panel mounting
C. 2-in. U-Bolt for pipe mounting (clamp shown)
D. ¼ x 1 ¼ Bolts for transmitter mounting (not supplied)
E. ¼ x 1 ¼ Bolts for transmitter mounting (not supplied)
F. 5/16 x 1 ½ Bolts for panel mounting (not supplied)

Note
Dimensions are in inches (millimeters).

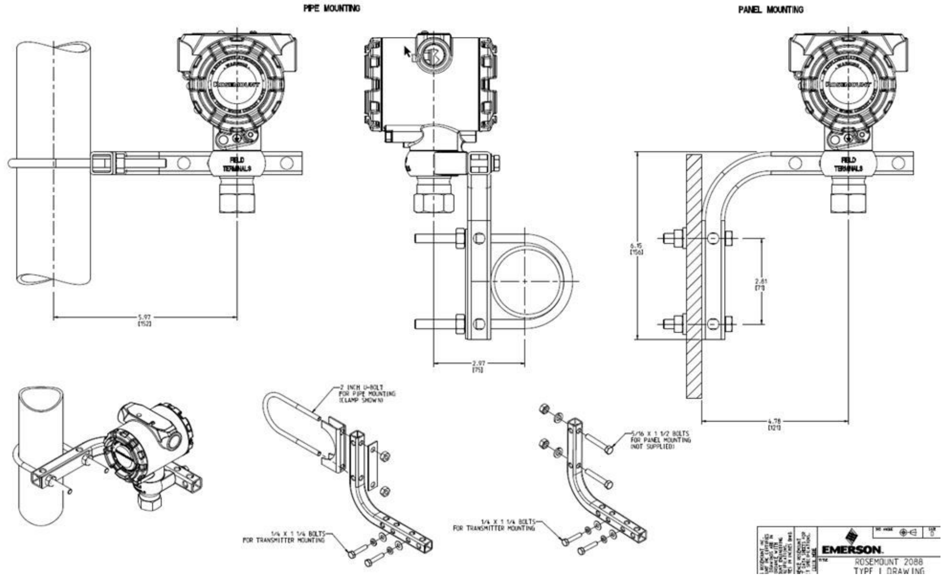
Figure 3-2: Mounting Bracket Option Code B4



A. *Pipe mounting*
B. *Panel mounting*
C. *2-in. U-Bolt for pipe mounting (clamp shown)*
D. *¼ x 1 ¼ Bolts for transmitter mounting (not supplied)*
E. *¼ x 1 ¼ Bolts for transmitter mounting (not supplied)*
F. *5/16 x 1 ½ Bolts for panel mounting (not supplied)*

Note
Dimensions are in inches (millimeters).

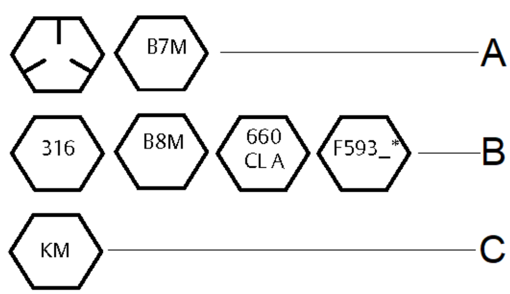
Figure 3-3: Mounting Bracket Option Code B4



A. Pipe mounting
B. Panel mounting
C. 2-in. U-Bolt for pipe mounting (clamp shown)
D. ¼ x 1 ¼ Bolts for transmitter mounting (not supplied)
E. ¼ x 1 ¼ Bolts for transmitter mounting (not supplied)
F. 5/16 x 1 ½ Bolts for panel mounting (not supplied)

Note
Dimensions are in inches (millimeters).

Figure 3-4: Head Markings



* The last digit in the F593 heading marking may be any letter between A and M.

A. Carbon Steel (CS) Head Markings
B. Stainless Steel (SST) Head Markings
C. Alloy K-500 Head Markings

3.3.2 Impulse piping

Mounting requirements

Impulse piping configurations depend on specific measurement conditions.

Refer to Figure 3-5 for examples of the following mounting configurations:

Liquid flow measurement

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

Gas flow measurement

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

Steam flow measurement

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

NOTICE

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. See Temperature Limits in the 2088 Product Data Sheet for details.

Figure 3-5: Liquid applications installation example

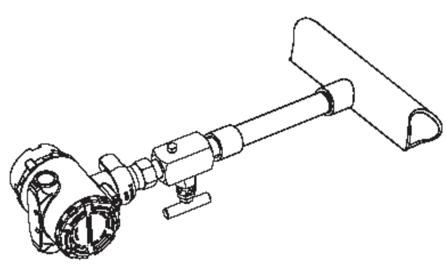


Figure 3-6: Gas applications installation example

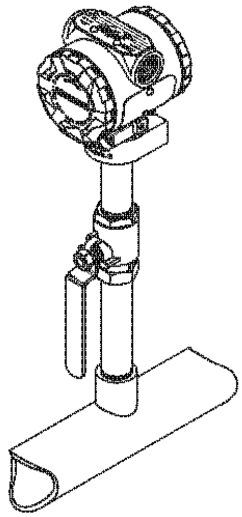


Figure 3-7: Steam applications installation example

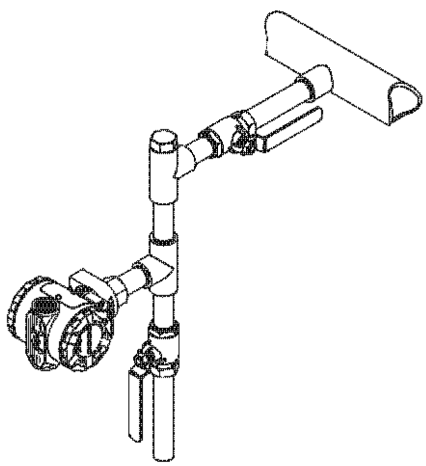
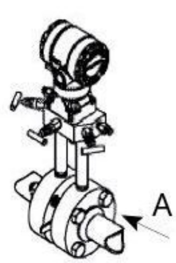


Figure 3-8: Gas installation example



A. Flow

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./ft (8 cm/m) upward from the transmitter toward the process connection.
- For gas service, slope the impulse piping at least 1 in./ft (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.

3.3.3 Inline process connection

Inline gauge transmitter orientation

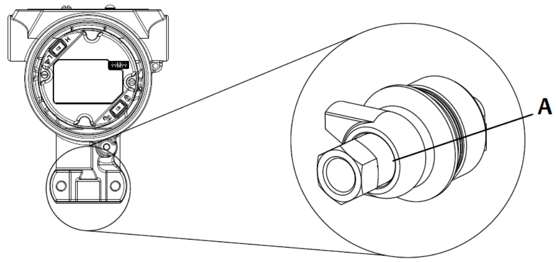
⚠ CAUTION

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

The low side pressure port on the inline gauge 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 3-9).

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 3-9: Inline gauge low side pressure port

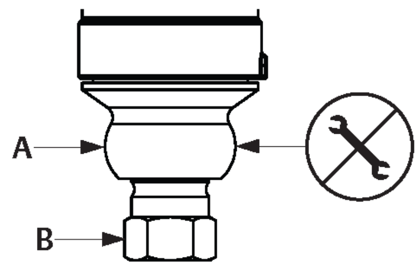


A. Low side pressure port (atmospheric reference)

NOTICE

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

3.4 Process connections

3.4.1 Rosemount 2090P

Installing the Rosemount 2090P transmitter involves attaching a weld spud to the tapped process vessel, attaching the transmitter to the weld spud, and making electrical connections. If you intend to use an existing weld spud, proceed to the transmitter section of this installation procedure.

Note
The Rosemount 2090P isolating diaphragm can be mounted flush with the inside diameter of any vessel larger than three inches in diameter.

NOTICE

Installation of the weld spud must be performed by a skilled welder using a TIG welder. Improper installation may result in weld spud distortion.

3.4.2 Weld spud

Procedure

1. Using the appropriate size hole saw, cut a hole in the process vessel to accept the weld spud. The diameter for a weld spud with heat isolator groove is 2.37-in. (60 mm); when compatible with 1-in. PMC® process connection style spud, the diameter is 1.32 in. (33,4 mm) and when compatible with G1 process connection, the diameter is 2.00 inches (51 mm).
   The hole will produce a tight, uniform fit when coupled with the weld spud.
2. Bevel the edge of the vessel hole to accept filler material.
3. Remove the weld spud from the transmitter and remove the PTFE gasket from the weld spud.

   NOTICE

   Excessive heat will distort the weld spud. Weld in sections, as shown in Figure 3-10, cooling each section with a wet cloth. Allow adequate cooling between passes. To reduce the chances of distorting the weld spud (for 1.5-in. connection), use a heat sink—Rosemount Part Number 02088-0196-0001. For G1 connection, Rosemount Part Number 02088-0196-0007.

4. Position the weld spud in the vessel hole, place heat sink and tack spud in place using the welding sequence shown in Figure 3-12. Cool each section with a wet cloth before proceeding to the next section.
5. Weld the spud in place using 0.030 to 0.045-in. (0,762 to 1,143 mm) stainless steel rod as filler in the beveled area. Using between 100 and 125 amps., adjust the amperage for 0.080-in. (2,032 mm) penetration.

3.4.3 Transmitter

Procedure

1. After the weld spud has cooled, remove the heat sink and install the PTFE gasket into the weld spud. Ensure that the gasket is properly positioned within the weld spud.

   NOTICE

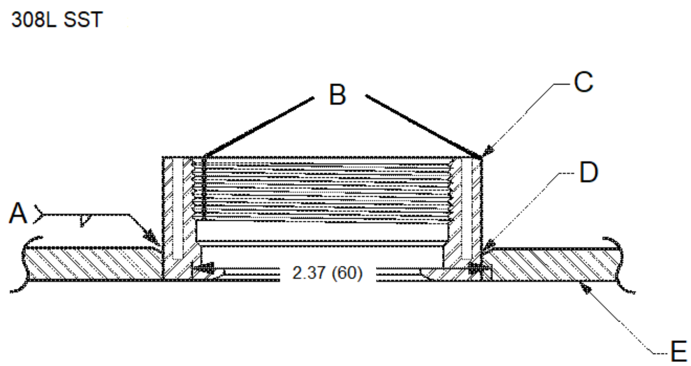
   Improper placement could cause a process leak.

2. Position the transmitter into the spud and begin to engage the threads. Rotate the transmitter prior to seating the threads completely to enable access to the housing compartments, the conduit entry, and the LCD display.
3. Hand tighten the transmitter using the knurled retaining ring, then snug an additional 1/8 turn with adjustable pliers.

Example

Note
Do not over-tighten the retaining ring. A spanner wrench hole is located on the knurled portion of the retaining ring to assist in transmitter removal if it is over-tightened.

Figure 3-10: PTFE Installing the Weld Spud



Code "C" in Model Structure or P/N 02088-0195-0005

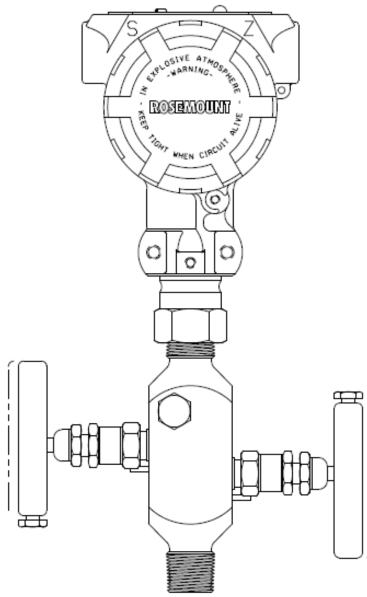
A. *100–125 Amps recommended*
B. *Heat isolation grooves*
C. *Weld spud*
D. *Bevelled edge*
E. *Process*

Note
Dimensions are in inches (mm).

3.5 Rosemount 306 Manifold

The Rosemount 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 3-11: Rosemount 2088 and 306 In-line Manifold



3.5.1 Rosemount 306 Integral Manifold installation procedure

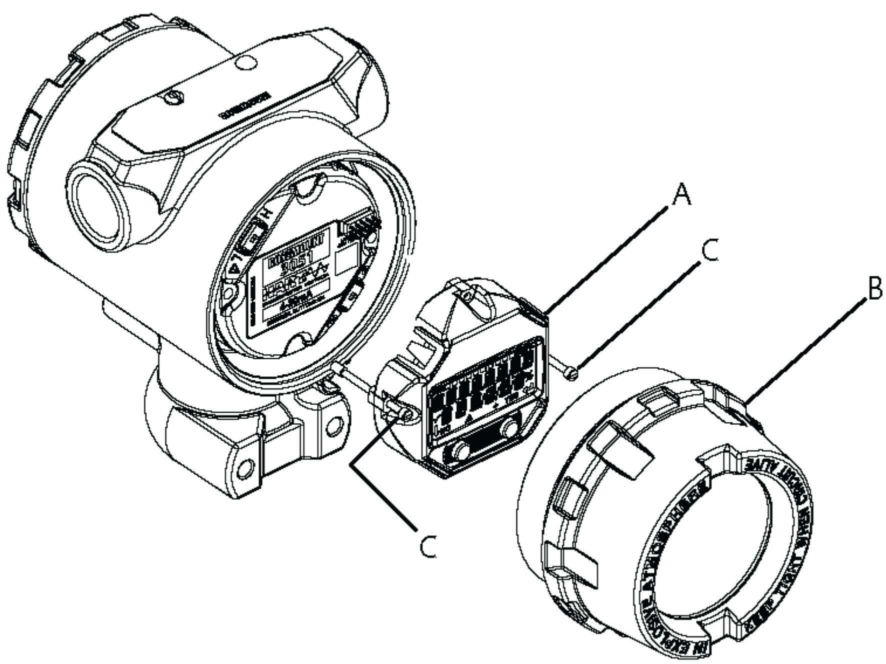
Assemble the Rosemount 306 Manifold to the Rosemount 2088 In-line transmitter with a thread sealant.

4 Electrical Installation

4.1 LCD display

Transmitters ordered with the LCD display option (M5) are shipped with the display installed. Installing the display on an existing 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: LCD Display Assembly



A. LCD display
B. Extended Cover
C. Captive Screws

4.1.1 Rotate local operator interface (LOI)/LCD display

Procedure

1. Secure the loop to manual control and remove power to transmitter.
2. Remove transmitter housing cover.
3. Remove screws from the LCD display and rotate to desired orientation.
4. Insert 10-pin connector into the display board for the correct orientation. Carefully align pins for insertion into the output board.
5. Re-insert screws.
6. Reattach transmitter housing cover

⚠ WARNING

Emerson recommends tightening the cover until there is no gap between the cover and housing to comply with explosion-proof requirements.

7. Re-attach power and return loop to **automatic** control.

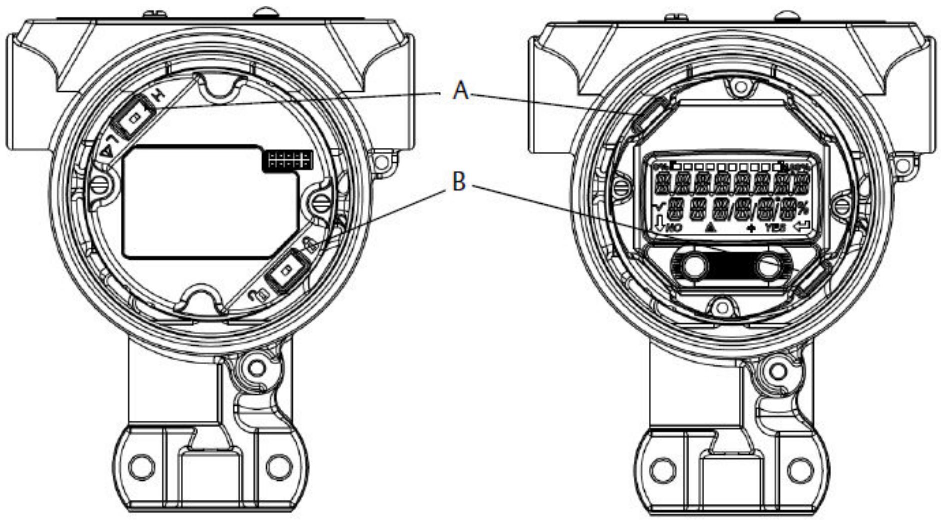
4.2 Configuring transmitter security

There are four security methods with the Rosemount 2088, 2090F, and 2090P transmitters:

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

Figure 4-2: 4–20 mA electronics board

Without LCD display meter | With LCD display /LOI display



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

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

4.2.1 Setting **security** switch

- The **simulate** switch enables or disables simulated alerts and simulated AI Block status and values. The default **simulate** switch position is enabled.

- The **Security** switch allows (unlocked symbol) or prevents (locked symbol) any configuration of the transmitter.
  - Default **security** is off (unlocked symbol).
  - The **security** switch can be enabled or disabled in software.

To change the switch configuration:

Procedure

1. If the transmitter is installed, secure the loop, and remove power.
2. Remove the housing cover opposite the field terminal side.

   ⚠ WARNING

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

3. Slide the security and simulate switches into the preferred position.
4. Reattach transmitter housing cover.

   ⚠ WARNING

   Emerson recommends tightening the cover until there is no gap between the cover and housing to comply with explosion-proof requirements.

4.2.2 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 communication device or AMS Device Manager.

Configuring HART® lock using communication device

From the ***HOME*** screen, enter the Fast Key sequence: 2, 2, 6, 4.

Configuring HART® lock using AMS Device Manager

Procedure

1. Right select the device and select **Configure**.
2. Under **Manual** setup select the ***Security*** tab.
3. Select **Lock/Unlock** button under `HART Lock (Software)` and follow the screen prompts.

4.2.3 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 communication device

From the ***HOME*** screen, enter the Fast Key sequence: 2, 2, 6, 3.

Configuring configuration button lock using AMS Device Manager

Procedure

1. Right select 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. Select **Send**.
5. Confirm service reason and click **Yes**.

4.2.4 LOI 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 four 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 communication device, AMS Device Manager, or the LOI.

Configure password using a communication device

Procedure

From the ***HOME*** screen, enter the fast key sequence: 2, 2, 6, 5, 2.

Configuring password with AMS Device Manager

Procedure

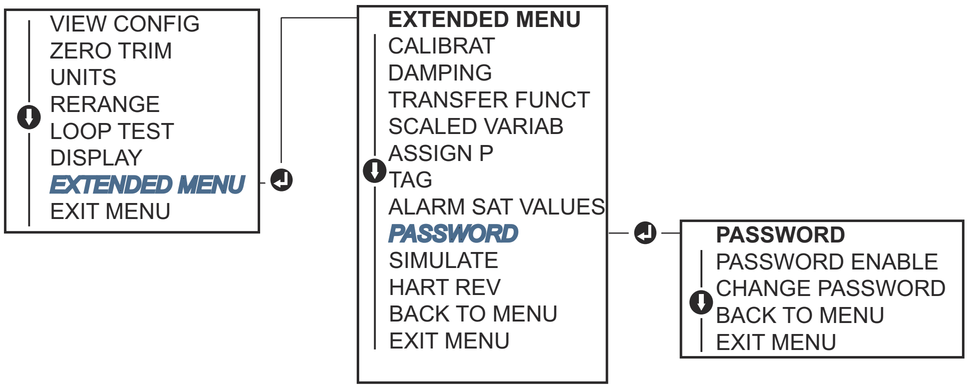
1. Right select the device and select **Configure**.
2. Under **Manual** setup, select the ***Security*** tab.
3. Within the LOI, select the **Configure Password** button and follow the screen prompts.

Configure local operator interface (LOI) password using LOI

Procedure

Go to **EXTENDED MENU → PASSWORD**.

Figure 4-3: LOI password



4.3 Set transmitter alarm

There is an **Alarm** switch on the electronics board.

See Figure 4-2 for switch location.

To change the **Alarm** switch location:

Procedure

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.

⚠ WARNING

Fully engage cover to comply with explosion-proof requirementa.

4.4 Electrical considerations

⚠ WARNING

Ensure all electrical installation is in accordance with national and local code requirements.

Electrical shock

Electrical shock can result in death or serious injury.

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

4.4.1 Conduit installation

NOTICE

Transmitter damage

If all connections are not sealed, excess moisture accumulation can damage the transmitter.

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.

Figure 4-4 shows recommended conduit connections.

Figure 4-4: Conduit installation diagrams

A. Possible conduit line positions
B. Sealing compound
C. Incorrect

4.4.2 Power supply

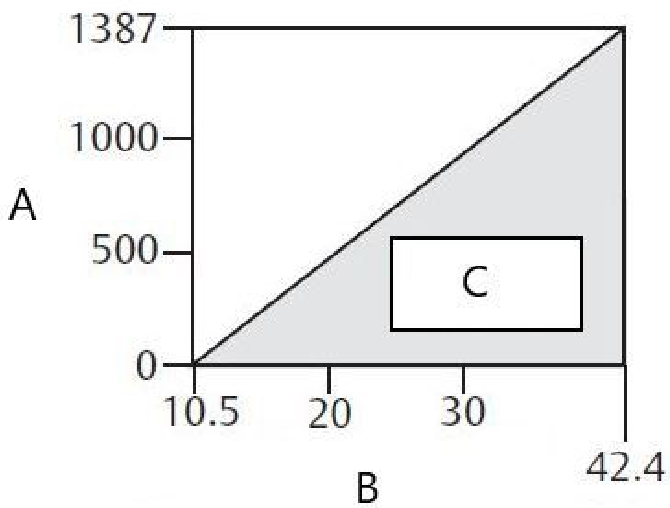
The transmitter requires between 9 and 32 Vdc (9 and 30 Vdc for intrinsic safety and 9 and 17.5 Vdc for FISCO intrinsic safety) to operate and provide complete functionality.

4–20 mA HART® (option code S)

The 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 16.6 V is required for loops with a 250 Ω resistance.

Note
A minimum loop resistance of 250 Ω is required to communicate with a communication device. If a single power supply is used to power more than one Rosemount Transmitter, the power supply used, and circuitry common to the transmitters must not have more that 20 Ω of impedance at 1200 Hz.

Figure 4-5: Load Limitation



A. *Load (Ωs)*
B. *Voltage (VDC)*
C. *Operating region*

- Maximum loop resistance = 43.5 × (power supply voltage – 10.5)
- The communication device requires a minimum loop resistance of 250 Ω 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 5.8 Vdc. The Dc power supply should provide power with less than 2 percent ripple. The V_{out} load should be 100 k Ω or greater.

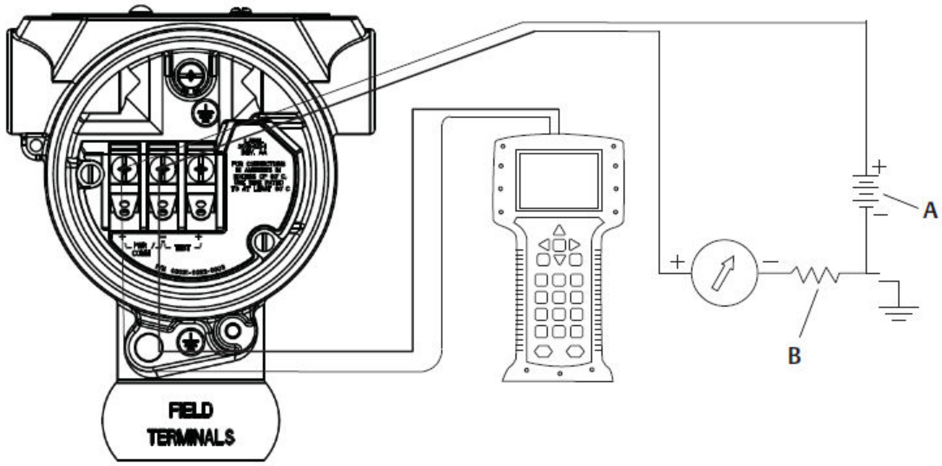
4.4.3 Wiring the transmitter

NOTICE

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

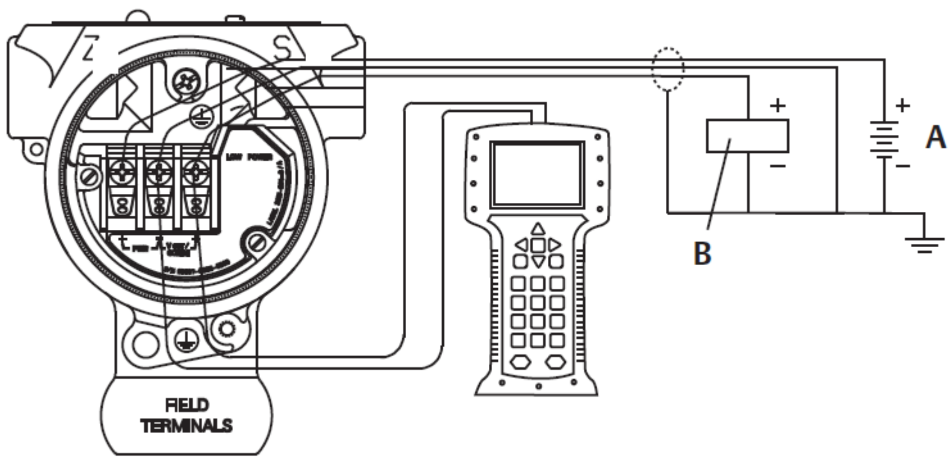
Note
Use shielded twisted pairs to yield best results. To ensure proper communication, use 24 AWG or larger wire and do not exceed 5000 ft. (1500 m). For 1–5 V 500 ft. (150 m) maximum are recommended. Emerson recommends unpaired three conductor or two twisted pairs.

Figure 4-6: Wiring the Transmitter (4–20 mA HART®)



A. DC power supply
B. R_L ≥ 250 (necessary for HART communication only)

Figure 4-7: Wiring the Transmitter (1–5 Vdc Low Power)



A. DC power supply
B. Voltmeter

To make wiring connections:

Procedure

1. Remove the housing cover on terminal compartment side. Signal wiring supplies all power to the transmitter.

   ⚠ WARNING

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

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–).

NOTICE

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–).

NOTICE

Do not connect the powered signal wiring to the test terminals. Power could damage the test diode.

3. Ensure full contact with Terminal Block screw and washer. When using a direct wiring method, wrap wire clockwise to ensure it is in place when tightening the terminal block screw.

Note
The use of a pin or ferrule wire terminal is not recommended as the connection may be more susceptible to loosening over time or under vibration.

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

4.4.4 Grounding the transmitter

Signal cable shield grounding

Signal cable shield grounding is summarized in Figure 4-8. 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 for instructions on grounding the transmitter case.

To correctly ground the signal cable shield:

Procedure

1. Remove the field terminals housing cover.
2. Connect the signal wire pair at the field terminals as indicated in Figure 4-8.

Note
At the field terminals, the cable shield and shield drain wire must be trimmed close and insulated from transmitter housing.

3. Reattach the field terminals housing cover.

⚠ WARNING

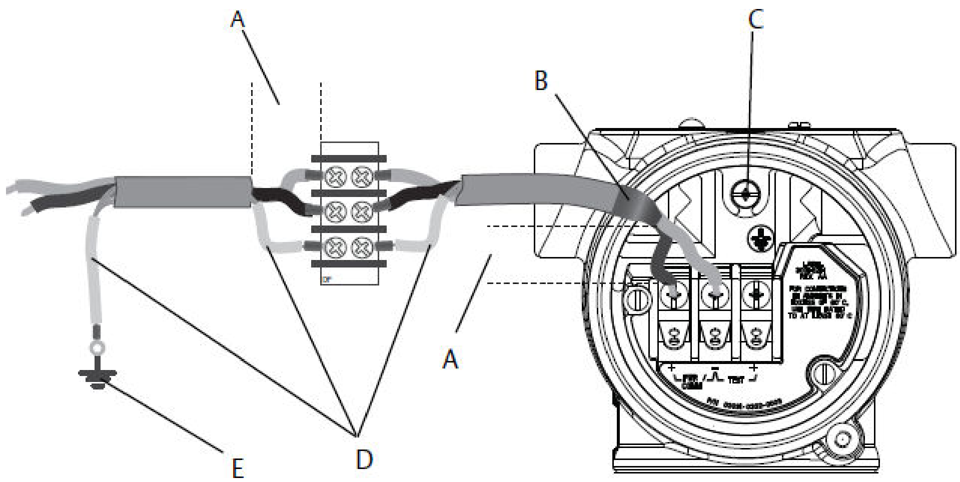
Cover must be fully engaged to comply with explosion-proof requirements.

4. At terminations outside the transmitter housing, the cable shield drain wire must be continuously connected.
   a) Prior to the termination point, any exposed shield drain wire should be insulated as shown in Figure 4-8 (B).

5. Properly terminate the signal cable shield drain wire to an earth ground at or near the power supply.

Example

Figure 4-8: Wiring Pair and Ground



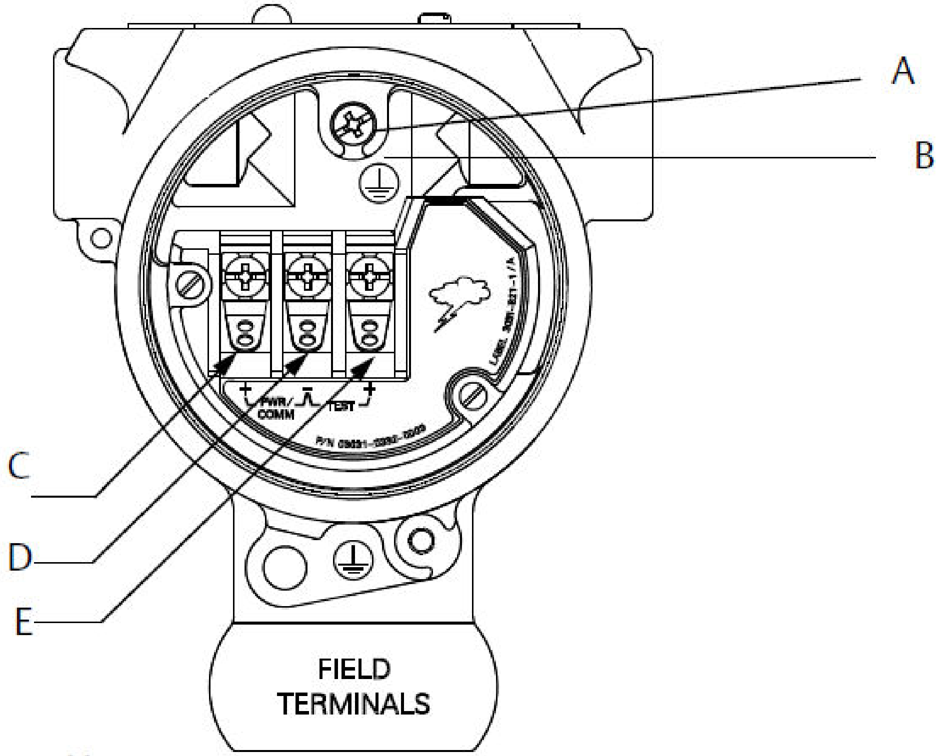
A. Minimize distance
B. Trim shield and insulate
C. Protective grounding terminal
D. Insulate shield
E. Connect shield back to the power supply

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, 2090F, 2090P transmitters. Refer to Figure 4-9.
- External ground connection: The external ground connection is located on the exterior of the transmitter housing. Refer to Figure 4-9. 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

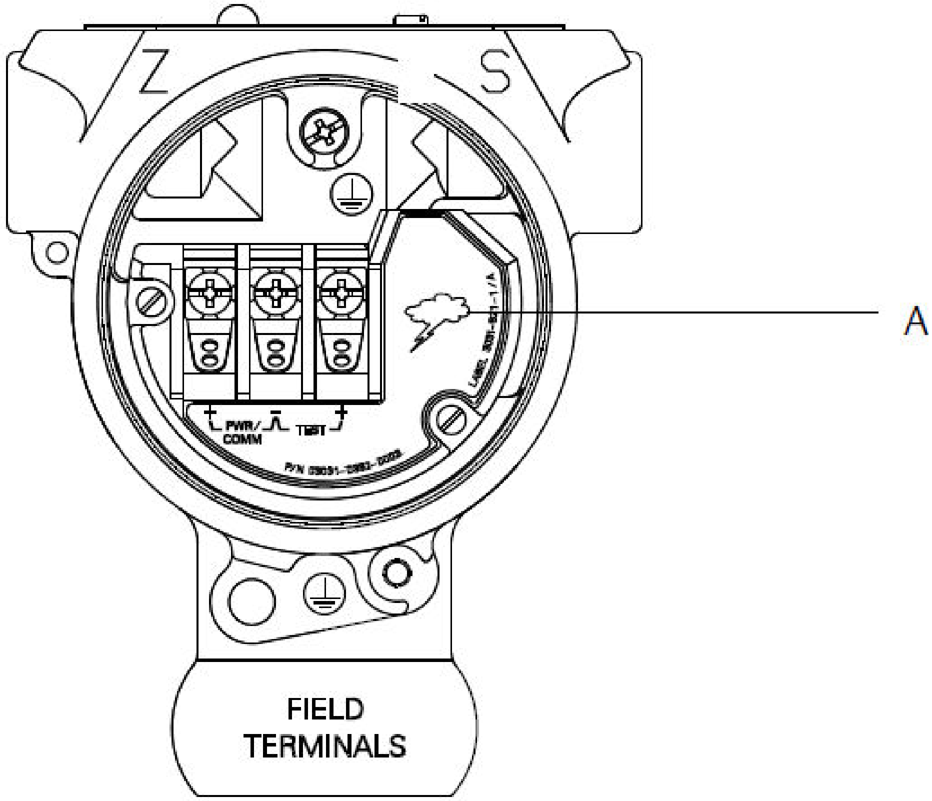
The transmitter can withstand electrical transients of the energy level usually encountered in static discharges or induced switching transients.

NOTICE

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, 2090F, and 2090P transmitters in the field. See 2088 Absolute and Gauge Pressure Transmitter Product Data Sheet for part numbers. The lightning bolt symbol shown in Figure 4-10 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.

5 Operation and maintenance

5.1 Overview

This section contains information on calibrating Rosemount 2088 Pressure Transmitters.

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

5.2 Recommended calibration tasks

NOTICE

Emerson calibrates absolute pressure transmitters 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.

5.2.1 Calibrate transmitter in the field

Procedure

1. Perform sensor zero/lower trim to compensate for mounting pressure effects
2. Set/check basic configuration parameters:
    a) Output units
    b) Range points
    c) Output type
    d) Damping value

5.2.2 Bench calibration tasks

Procedure

1. Perform optional 4–20 mA 1–5 Vdc output trim.
2. Perform a sensor trim:
    a) Zero/lower trim using line pressure effect correction.
    b) Optional full scale trim. Sets the span of the device and requires accurate calibration equipment.
    c) Set/check basic configuration parameters.

5.3 Calibration overview

Emerson fully calibrates the pressure transmitter at the factory. You can also calibrate in the field to meet plant requirements or industry standards.

Complete calibration of the transmitter can be split into two tasks:

- Sensor calibration
- Analog output calibration

Sensor calibration allows you 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. Emerson recommends the correction. 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, you can calibrate the analog output to match the user measurement system. The analog output trim (4–20 mA/ 1–5 V output trim) will calibrate the loop at the 4 mA (1 V) and 20 mA (5 V) points.

The sensor calibration and the analog output calibration combine to match the transmitter's measurement system to the plant standard.

5.3.1 Calibrating the sensor

- **Sensor trim**: Performing a sensor trim
- **Zero trim**: Perform a digital zero trim (option DZ)

5.3.2 Calibrating the 4–20 mA output

- 4–20 mA/1–5V Output trim: Performing digital-to-analog trim (4–20 mA/1–5 V output trim)
- 4–20 mA/1–5V Output trim using other scale: Performing digital-to-analog trim (4–20 mA/1–5 V output trim) using other scale

5.3.3 Determine necessary sensor trims

Bench calibrations allow for calibrating the instrument for its desired range of operation.

Straightforward 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.

NOTICE

It is possible to degrade the performance of the transmitter if a trim is done improperly or with inaccurate equipment.

For transmitters that are field installed, the manifolds allow the differential transmitter to be zeroed using the zero trim function. This field calibration will eliminate any pressure offsets caused by mounting effects (head effect of the oil fill) and static pressure effects of the process.

To determine the necessary trims:

Procedure

1. Apply pressure.
2. Check digital pressure; if the digital pressure does not match the applied pressure, perform a digital trim.
3. Check reported analog output against the live analog output. If they do not match, perform an analog output trim.

5.3.4 Trimming using configuration buttons

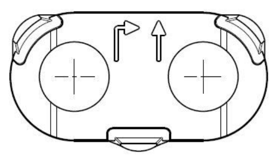
Local configuration buttons are external buttons located underneath the top tag of the transmitter. There are two possible sets of local configuration buttons that can be ordered with the transmitter and used to perform trim operations: **Digital Zero Trim** and **LOI** (Local Operator Interface).

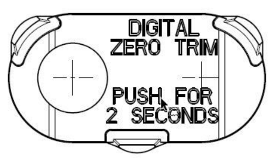
Procedure

1. To access the buttons, loosen screw and rotate top tag until buttons are visible.
2. Use the appropriate button:
   - LOI (`M4`): Can perform both digital sensor trim and the 4–20 mA output trim (analog output trim).
   - Digital zero trim (`DZ`): Used for performing a sensor zero trim.
3. Monitor all configuration changes 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. LOI - green retainer
B. Digital Zero Trim - blue retainer

5.4 Determining calibration frequency

Calibration frequency can vary greatly depending on the application, performance requirements, and process conditions.

To determine calibration frequency that meets the needs of your application:

Procedure

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.

5.4.1 Sample calculation for Rosemount 2088

Procedure

1. Determine the performance required for your application.

   Required Performance: 0.50% of span

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)

3. Calculate total probable error (TPE).

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

   Static Pressure Effect = 0% (does not apply to in-line products)

4. Calculate the stability per month.

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

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 Trimming 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. You can perform a zero trim if the process is vented or the high and low side pressure are equal (for differential pressure transmitters).

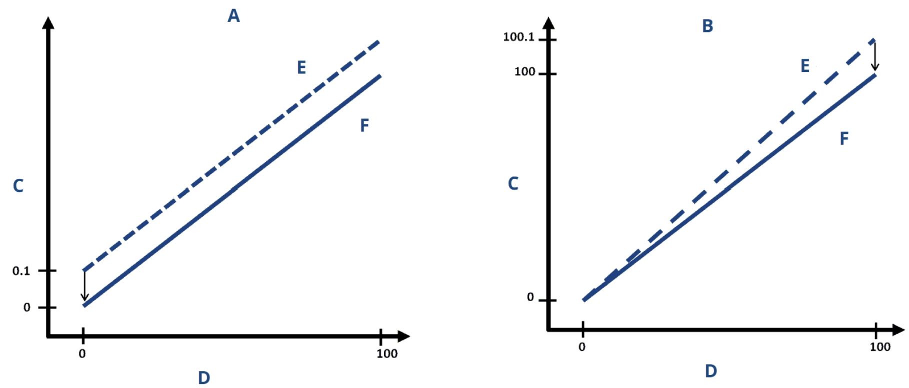
Zero trim is a single-point offset adjustment. It is useful for compensating for mounting position effects and is most effective when performed with the transmitter installed in its final mounting position. Since this correction maintains the slope of the characterization curve, it should not be used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

When performing a zero trim, ensure the equalizing valve is open and all wet legs are filled to the correct levels. Apply line pressure to the transmitter during a zero trim to eliminate line pressure errors.

Note
Do not perform a **zero trim** on Rosemount 2088 Absolute Pressure Transmitters. **Zero trim** is zero-based, and absolute pressure transmitters reference absolute zero. To correct mounting position effects on an 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 and all output is linearized between them; these trims require 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. Zero/lower sensor trim
B. Upper sensor trim
C. Pressure reading
D. Pressure input
E. Before trim
F. After trim

5.5.2 Performing a sensor trim

When performing a sensor trim, you can trim both the upper and lower limits.

If performing both upper and lower trims, the lower trim must be done prior to the upper time.

Note
Before entering any values, 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.

Perform a sensor trim with a communication device

Procedure

1. From the ***HOME*** screen, enter the fast key sequence and follow the steps within the communication device to complete the sensor trim.

Fast keys	3, 4, 1

2. 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.

3. Follow the commands provided by the communication device to complete the adjustment of the lower value.
4. Select **3: Upper Sensor Trim**.
5. Follow the commands provided by the communication device to complete the adjustment of the upper value.

Performing a sensor trim with AMS Device Manager

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

Procedure

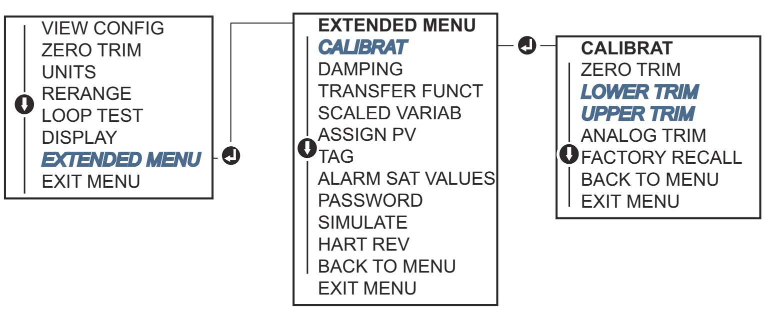
1. Follow the screen prompts to perform a sensor trim using AMS Device Manager.
2. If desired, right select the device and under the ***Method*** drop down menu, move cursor over ***Calibrate*** and under ***Sensor Trim*** and select **Upper Sensor Trim**.

Perform a sensor trim using a local operator interface (LOI)

Procedure

Perform an upper and lower sensor trim by referencing Figure 5-3.

Figure 5-3: Sensor trim using LOI



Perform a digital zero trim (option DZ)

A digital **zero trim** (option `DZ`) provides the same function as a zero/lower sensor trim. However, you can use this option in hazardous areas at any given time by 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 you order the transmitter with external configuration buttons, you can use them to perform a digital zero trim. See Figure 5-1 for **DZ** button location.

Procedure

1. Loosen the top tag of the transmitter to expose buttons.

2. Press and hold the **Digital Zero** button for at least two seconds and 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.

Recall factory trim using a communication device

Procedure

1. From the ***HOME*** screen, enter the fast key sequence: 3, 4, 3.
2. Follow the steps within the communication device to complete the sensor trim.

Recall factory trim using AMS Device Manager

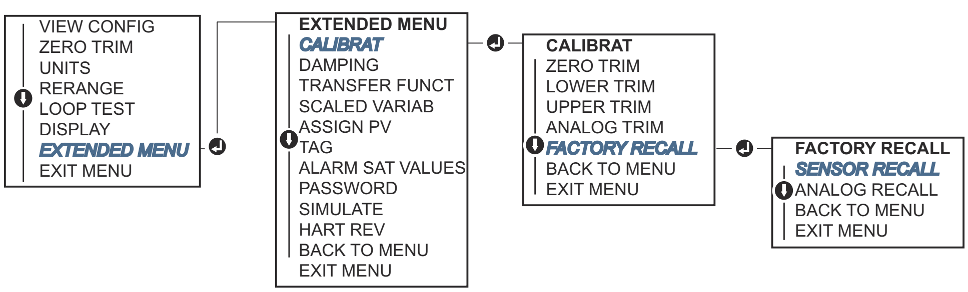
Procedure

1. Right-click the device and go to **Method** → **Calibrate** → **Restore Factory Calibration**.
2. Set the control loop to **Manual**.
3. Select **Next**.
4. Select **Sensor Trim** under ***Trim to recall*** and click **Next**.
5. Follow the screen prompts to recall sensor trim.

Recall factory trim using a local operator interface (LOI)

Refer to Figure 5-4 to recall factory sensor trim.

Figure 5-4: Recall factory trim using LOI

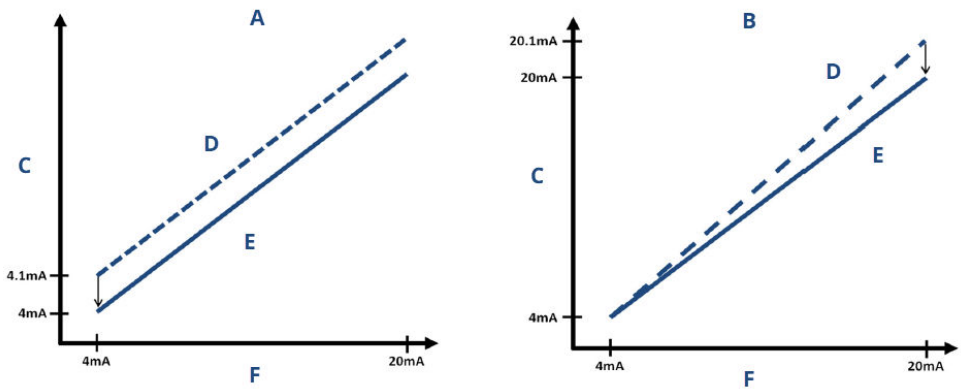


5.6 Trimming the analog output

You can use the `Analog Output Trim` command to adjust the transmitter's current output at the 4 and 20 mA (1 – 5 Vdc) points to match the plant standards.

Perform this trim after the digital to analog conversion so only the 4–20 mA analog (1– 5 Vdc) 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. 4-20 mA output trim - zero/lower trim
B. 4-20 mA output trim - upper trim
C. Meter reading
D. Before trim
E. After trim
F. mA output

5.6.1 Performing digital-to-analog trim (4–20 mA/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.

Perform a 4–20 mA/1–5 V output trim using a communication device

Procedure

1. From the ***HOME*** screen, enter the fast key sequence: 3, 4, 2, 1.
2. Follow the steps within the communication device to complete the 4-20 mA output trim.

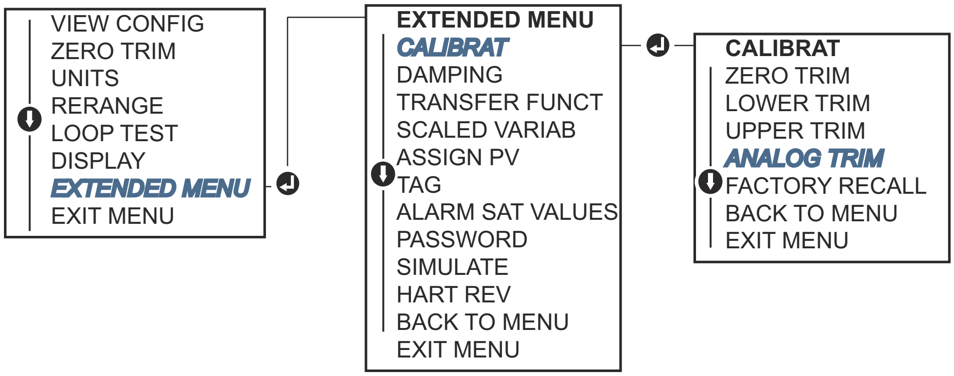
Perform a 4–20 mA/1–5 V output trim using AMS Device Manager

Procedure

1. Right-click the device and go to **Method** → **Calibrate** → **Analog Calibration**.
2. Select **Digital to Analog Trim**.
3. Follow the screen prompts to perform a 4–20 mA output trim.

Perform 4–20 mA/1–5 V output trim using a local operator interface (LOI)

Figure 5-6: 4–20 mA output trim using LOI



5.6.2 Performing digital-to-analog trim (4–20 mA/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, such as 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.

Perform a 4–20/1–5 V mA output trim using other scale using a communication device

Procedure

1. From the ***HOME*** screen, enter the fast key sequence: 3, 4, 2, 2.
2. Follow the steps within the communication device to complete the 4-20 mA output trim using other scale.

Perform a 4–20 mA/ 1–5 V output trim using other scale using AMS Device Manager

Procedure

1. Right-click the device and go to **Method** → **Calibrate** → **Analog Calibration**.
2. Select **Scaled Digital to Analog Trim**.
3. Follow screen prompts to perform a 4–20 mA/ 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.

Recall factory trim - analog output using a communication device

Procedure

1. From the ***HOME*** screen, enter the fast key sequence: 3, 4, 3.
2. Follow the steps within the communication device to complete the digital to analog trim using other scale.

Recall factory trim - analog output using AMS Device Manager

Procedure

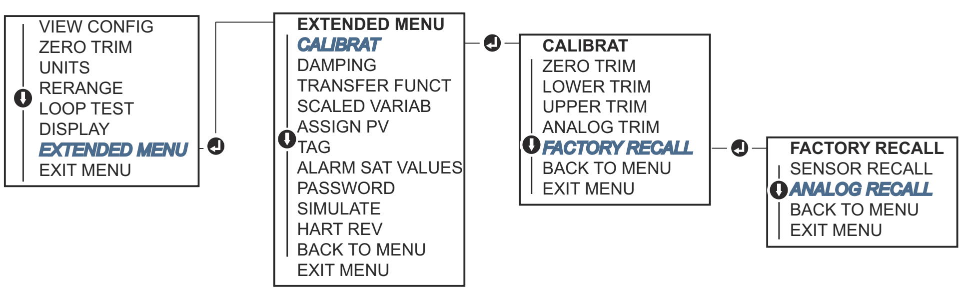
1. Right-click the device and go to **Method** → **Calibrate** → **Restore Factory Calibration**.
2. Select **Next** to set the control loop to **manual**.
3. Select **Analog Output Trim** under ***Select trim to recall*** and click **Next**.
4. Follow screen prompts to recall analog output trim.

Recall factory trim - analog output using a Local Operator Interface (LOI)

Procedure

See Figure 5-7 for LOI instructions.

Figure 5-7: Recall factory trim – analog output using LOI



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 Switch HART® revision using 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 procedure explains how to switch between HART Revision 7 and HART Revision 5 from a generic menu.

Procedure

1. Locate **Message** field.
2. To change to HART Revision 5, enter `HART5` in the **Message** field.
3. To change to HART Revision 7, enter `HART7` in the **Message** field.

5.7.2 Switch HART® revision using a communication device

Procedure

1. From the ***HOME*** screen, enter the fast key sequence:

HART 5	2, 2, 5, 2, 4
HART 7	2, 2, 5, 2, 3

2. Follow steps within the communication device to complete the HART revision change.

5.7.3 Switch HART® revision using AMS Device Manager

Procedure

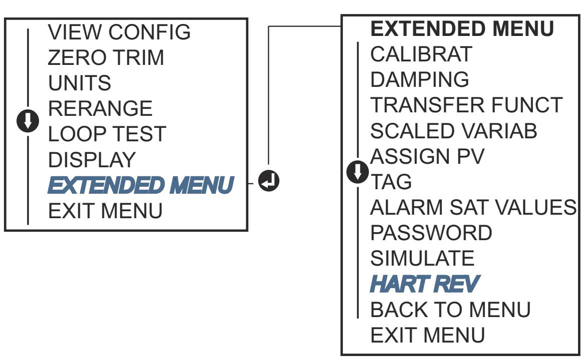
1. Go to **Manual Setup** → **HART**.
2. Select **Change HART Revision** and then follow the screen prompts.

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

5.7.4 Switch HART® revision using a local operator interface (LOI)

Use Figure 5-8 to change HART revision:

Figure 5-8: Change HART revision using LOI



Procedure

1. Go to **EXTENDED MENU** → **HART REV**.

2. Select HART REV 5 or HART Rev 7.

6 Troubleshooting

6.1 Overview

If you suspect malfunction despite the absence of any diagnostic messages on the communication device display, consider using Diagnostic messages to identify any potential problem.

6.2 Rosemount troubleshooting for 4–20 mA output

Cause

Transmitter milliamp reading is zero

Recommended actions

1. Verify terminal voltage is 10.5 to 42.4 Vdc at signal terminals.
2. Check power wires for reversed polarity.
3. Check that power wires are connected to signal terminals.
4. Check for open diode across test terminal.

Cause

Transmitter not communicating with communication device

Recommended actions

1. Verify terminal voltage is 10.5 to 42.4 Vdc.
2. Check loop resistance, 250 Ω minimum (PS voltage -transmitter voltage/loop current).
3. Check that power wires are connected to signal terminals and not test terminals.
4. Verify clean DC Power to transmitter (Max AC noise 0.2 volts peak to peak).
5. Verify the output is between 4 and 20 mA or saturation levels.
6. Have communication device poll for all addresses.

Cause

Transmitter milliamps reading is **low** or **high**

Recommended actions

1. Verify applied pressure.
2. Verify 4 and 20 mA range points.
3. Verify output is not in **alarm** condition.
4. Perform analog trim.
5. Check that power wires are connected to the correct signal terminals (positive to positive, negative to negative) and not the test terminal.

Cause

Transmitter will not respond to changes in applied pressure

Recommended actions

1. Check impulse piping or manifold for blockage.
2. Verify applied pressure is between the 4 and 20 mA points.
3. Verify the output is not in **alarm** condition.
4. Verify transmitter is not in **loop test** mode.
5. Verify transmitter is not in **multidrop** mode.
6. Check test equipment.

Cause

Digital pressure variable reading is **low** or **high**

Recommended actions

1. Check impulse piping for blockage or low fill in wet leg.
2. Verify transmitter is calibrated properly.
3. Check test equipment (verify accuracy).
4. Verify pressure calculations for application.

Cause

Digital pressure variable reading is erratic

Recommended actions

1. Check application for faulty equipment in pressure line.
2. Verify transmitter is not reacting directly to equipment turning **on**/**off**.
3. Verify damping is set properly for application.

Cause

Milliamps reading is erratic

Recommended actions

1. Verify power source to transmitter has adequate voltage and current.
2. Check for external electrical interference.
3. Verify transmitter is properly grounded.
4. Verify shield for twisted pair is only grounded at one end.

6.3 Rosemount troubleshooting for 1–5 Vdc output

Cause

Transmitter voltage reading is zero

Recommended actions

1. Verify terminal voltage is 5.8 to 28.0 Vdc at signal terminals.
2. Check power wires for reversed polarity.
3. Check that power wires are connected to signal terminals.
4. Check for open diode across test terminal.

Cause

Transmitter not communicating with communication device

Recommended actions

1. Verify terminal voltage is 5.8 to 28.0 Vdc.
2. Check loop resistance, 250 Ω minimum (PS voltage -transmitter voltage/loop current).
3. Check that power wires are connected to signal terminals and not test terminals.
4. Verify clean DC Power to transmitter (Max AC noise 0.2 volts peak to peak).
5. Verify the output is between 1–5 Vdc or saturation levels.
6. Have communication device poll for all addresses.

Cause

Transmitter voltage reading is **low** or **high**

Recommended actions

1. Verify applied pressure.
2. Verify 1–5 Vdc range points.
3. Verify output is not in **alarm** condition.
4. Perform analog trim.
5. Check that power wires are connected to the correct signal terminals (positive to positive, negative to negative) and not the test terminal.

Cause

Transmitter will not respond to changes in applied pressure

Recommended actions

1. Check impulse piping or manifold for blockage.
2. Verify applied pressure is between the 1–5 Vdc points.
3. Verify the output is not in **alarm** condition.
4. Verify transmitter is not in **loop test** mode.
5. Verify transmitter is not in **multidrop** mode.
6. Check test equipment.

Cause

Digital pressure variable reading is low or high

Recommended actions

1. Check impulse piping for blockage or low fill in wet leg
2. Verify transmitter is calibrated properly.
3. Check test equipment (verify accuracy).
4. Verify pressure calculations for application.

Cause

Digital pressure variable reading is erratic

Recommended actions

1. Check application for faulty equipment in pressure line.
2. Verify transmitter is not reacting directly to equipment turning **on**/**off**.
3. Verify damping is set properly for application.

Cause

Voltage reading is erratic

Recommended actions

1. Verify power source to transmitter has adequate voltage and current.
2. Check for external electrical interference.
3. Verify transmitter is properly grounded.
4. Verify shield for twisted pair is only grounded at one end.

6.4 Diagnostic messages

Listed in the below sections are detailed descriptions of the possible messages that will appear on either the LCD/local operator interface (LOI) display, a communication device, or an AMS Device Manager system.

Possible statuses are:

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

6.4.1 Status: Failed – Fix Now

Critical Electronics Data Error

Alert

LCD display screen	MEMRY ERROR
LOI screen	MEMORY ERROR

Cause

A user written parameter does not match the expected value.

Recommended actions

1. Confirm and correct all parameters listed in Device Information.
2. Perform a Device Reset.
3. Replace pressure transmitter.

Critical Sensor Data Error

Alert

LCD display screen	MEMRY ERROR
LOI screen	MEMORY ERROR

Cause

A user written parameter does not match the expected value

Recommended actions

1. Confirm and correct all parameters listed in Device Information.
2. Perform a Device Reset.
3. Replace Pressure Transmitter.

Electronics Board Failure

Alert

LCD screen	FAIL BOARD
LOI screen	FAIL BOARD

Cause

A failure has been detected in the electronics circuit board.

Recommended actions

Replace the pressure transmitter.

Incompatible Electronics and Sensor

Alert

LCD display screen	XMTR MSMTCH
LOI screen	XMTR MSMTCH

Cause

The pressure sensor is incompatible with the attached electronics.

Recommended actions

Replace the pressure transmitter.

No pressure updates

Alert

LCD display screen	NO P UPDATE
LOI screen	NO PRESS UPDATE

Cause

There are no pressure updates from the sensor to the electronics.

Recommended actions

1. Ensure the sensor cable connection to the electronics is tight.
2. Replace the transmitter.

Sensor Failure

Alert

LCD display screen	FAIL SENSOR
LOI screen	FAIL SENSOR

Cause

A failure has been detected in the pressure sensor.

Recommended actions

Replace pressure transmitter

6.4.2 Status: Maintenance – Fix Soon

Configuration Buttons Operator Error

Alert

LCD display screen	STUCK BUTTON
LOI screen	STUCK BUTTON

Cause

Device is not responding to button presses.

Recommended actions

1. Check configuration buttons are not stuck.
2. Replace the pressure transmitter

Electronics Board Parameter Error

Alert

LCD display screen	MEMRY WARN (also in advisory)
LOI screen	MEMRY WARN (also in advisory)

Cause

A device parameter does not match the expected value. The error does not affect transmitter operation or analog output.

Recommended actions

Replace the pressure transmitter.

Electronics Temperature Beyond Limits

Alert

LCD display screen	TEMP LIMITS

LOI screen	TEMP OUT LIMITS

Cause

The temperature of the electronics has exceeded its safe operating range.

Recommended actions

1. Confirm electronics temperature is within limits of -85 to 194 °F (-65 to 90 °C).
2. Replace the pressure transmitter.

No Temperature Updates

Alert

LCD display screen	NO T UPDATE
LOI screen	NO TEMP UPDATE

Cause

There are no temperature updates from the sensor to the electronics

Recommended actions

1. Ensure the sensor cable connection to the electronics is tight.
2. Replace the pressure transmitter.

Pressure Out of Limits

Alert

LCD display screen	PRES LIMITS
LOI screen	PRES OUT LIMITS

Cause

The pressure is either above or below the sensor limits.

Recommended actions

1. Check the transmitter pressure connection to ensure it is not plugged or the isolating diaphragms are not damaged.
2. Replace the pressure transmitter.

Sensor Temperature Beyond Limits

Alert

LCD display screen	TEMP LIMITS
LOI screen	TEMP OUT LIMITS

Cause

The sensor temperature has exceeded its safe operating range

Recommended actions

1. Check the process and ambient conditions are within -85 to 194 °F (-65 to 90 °C).
2. Replace the pressure transmitter.

6.4.3 Status: Advisory

Analog Output Fixed

Alert

LCD display screen	ANLOG FIXED
LOI screen	ANALOG FIXED

Cause

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**.

Recommended actions

1. Take action on any other notifications from the device.
2. If the device is in loop test, and should no longer be, disable or momentarily remove power.
3. If the device is in multidrop mode and should not be, re-enable loop current by setting the polling address to 0.

Analog Output Saturated

Alert

LCD display screen	ANLOG SAT
LOI screen	ANALOG SAT

Cause

The analog output is saturated either **high** or **low** due to the pressure either above or below the range values.

Recommended actions

1. Check the pressure applied to ensure it is between the 4–20mA points.
2. Check the transmitter pressure connection to make sure it is not plugged or isolating diaphragms are not damaged.
3. Replace the pressure transmitter.

Configuration Changed

Alert

LCD display screen	[None]

LOI screen	[None]

Cause

A recent change has been made the device by a secondary HART® master such as a handheld device.

Recommended actions

1. Verify that the configuration change of the device was intended and expected.
2. Clear this alert by selecting **Clear Configuration Changed Status**.
3. Connect a HART master such as AMS Device Manager or similar which will automatically clear it.

LCD Display Update Failure

Alert

LCD display screen	[If display is not updating.]
LOI screen	[If display is not updating.]

Cause

The LCD display is not receiving updates from the pressure sensor.

Recommended actions

1. Check the connection between the LCD display and the circuit board.
2. Replace the LCD display.
3. Replace the pressure transmitter.

Non-Critical User Data Warning

Alert

LCD display screen	MEMRY WARN
LOI screen	MEMORY WARN

Cause

A user written parameter does not match expected value.

Recommended actions

1. Confirm and correct all parameters listed in Device Information.
2. Perform a Device Reset.
3. Replace the pressure transmitter.

Sensor Parameter Warning

Alert

LCD display screen	MEMRY WARN
LOI screen	MEMORY WARN

Cause

A user written parameter does not match expected value.

Recommended actions

1. Confirm and correct all parameters listed in Device Information.
2. Perform a Device Reset.
3. Replace pressure transmitter.

Simulation Active

Alert

LCD display screen	[None]
LOI screen	[None]

Cause

The device is in **simulation** mode and may not be reporting actual information.

Recommended actions

1. Verify that simulation is no longer required.
2. Disable simulation mode in service tools.
3. Perform a Device Reset.

6.5 Disassembly procedures

⚠ WARNING

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

6.5.1 Removing from service

Procedure

1. Follow all plant safety rules and procedures.
2. Power down device.
3. Before removing the transmitter from service, isolate and vent the process from the transmitter.
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 connection by four bolts and two cap screws. Remove the bolts and screws and separate the transmitter from the process connection. Leave the process connection in place and ready for re-installation.
    b) 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.

NOTICE

Do not wrench on neck of transmitter.

6. Clean isolating diaphragms with a soft rag and a mild cleaning solution, and rinse with clear water.

NOTICE

Do not scratch, puncture, or depress the isolating diaphragms.

6.5.2 Removing terminal block

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

Procedure

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.

6.5.3 Removing the LOI or LCD display

Rosemount 2088 with M4 or M5 option codes have an LOI or LCD display. The transmitter LOI/LCD display is located in the compartment opposite the terminal side.

To remove and/or replace the LOI/LCD display:

Procedure

1. Remove the housing cover opposite the field terminal side.
2. Loosen the two captive screws that are visible (See Configuring transmitter security for screw locations). The two screws anchor the LOI/LCD display to the electronics board and the electronics board to the housing.
3. After the screws are loosened, pull the LOI/LCD display off of the electronics board and out of the housing. Make sure to pull directly backwards so to not bend or damage the connection pins on the electronics board.

NOTICE

Do not attempt to pull out the electronics board from the housing as this could permanently damage the transmitter.

6.6 Reassembly procedures

Procedure

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.

NOTICE

Ensure 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 set screw to no more than 7 in-lbs when desired location is reached.

6.6.1 Installing LOI/LCD Display

Procedure

1. While aligning the captive screws with the respective holes on the electronics board, connect the LCD/LOI display to the electronics board by pressing down firmly.
2. Ensure that the connecting pins on the back of the LCD fully connect to the front of the electronics board.
3. Fully tighten down the captive screws
4. Replace the housing cover.

⚠ WARNING

The transmitter must be fully engaged to meet Explosion-Proof requirements.

A Specifications and Reference Data

A.1 Rosemount 2088 Product Certifications

To view current Rosemount 2088 Product Certifications:

Procedure

1. Go to Emerson.com/Rosemount/2088.
2. Scroll as needed to the green menu bar and click **Documents & Drawings**.
3. Click **Manuals & Guides**.
4. Select the appropriate Quick Start Guide.

A.2 Rosemount 2090P Product Certifications

To view current Rosemount 2090P Product Certifications:

Procedure

1. Go to Emerson.com/Rosemount/2090P.
2. Scroll as needed to the green menu bar and click **Documents & Drawings**.
3. Click **Manuals & Guides**.
4. Select the appropriate Quick Start Guide.

A.3 Rosemount 2090F Product Certifications

To view current Rosemount 2090F Product Certifications:

Procedure

1. Go to Emerson.com/Rosemount/2090F.
2. Scroll as needed to the green menu bar and click **Documents & Drawings**.
3. Click **Manuals & Guides**.
4. Select the appropriate Quick Start Guide.

A.4 Ordering Information, Specifications, and Drawings

To view current Rosemount 2088, 2088P, and 2088F ordering information, specifications, and drawings:

Procedure

1. Go to:
   - Emerson.com/Rosemount/2088
   - Emerson.com/Rosemount/2090P
   - Emerson.com/Rosemount/2090F
2. Scroll as needed to the green menu bar and click **Documents & Drawings**.

3. For installation drawings, click **Drawings & Schematics** and select the appropriate document.
4. For ordering information, specifications, and dimensional drawings, click **Data Sheets & Bulletins** and select the appropriate Product Data Sheet.

B Communication device menu trees and fast keys

B.1 Communication device menu trees

Note
Selections with black circle are only available in HART® Revision 7 mode. Selection will not appear in HART Revision 5 device descriptor (DD).

Figure B-1: *Overview*

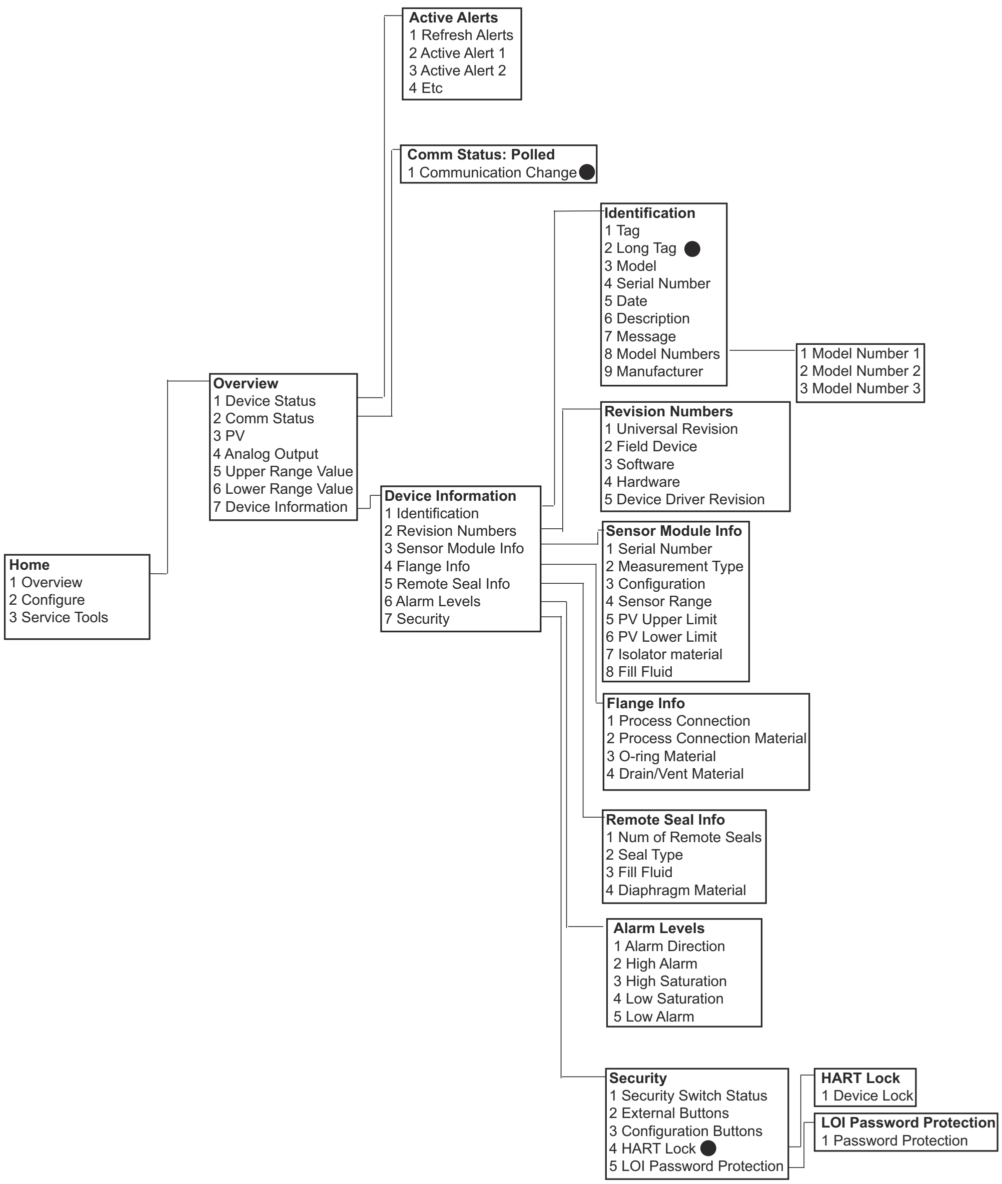


Figure B-2: Configure → Guided Setup

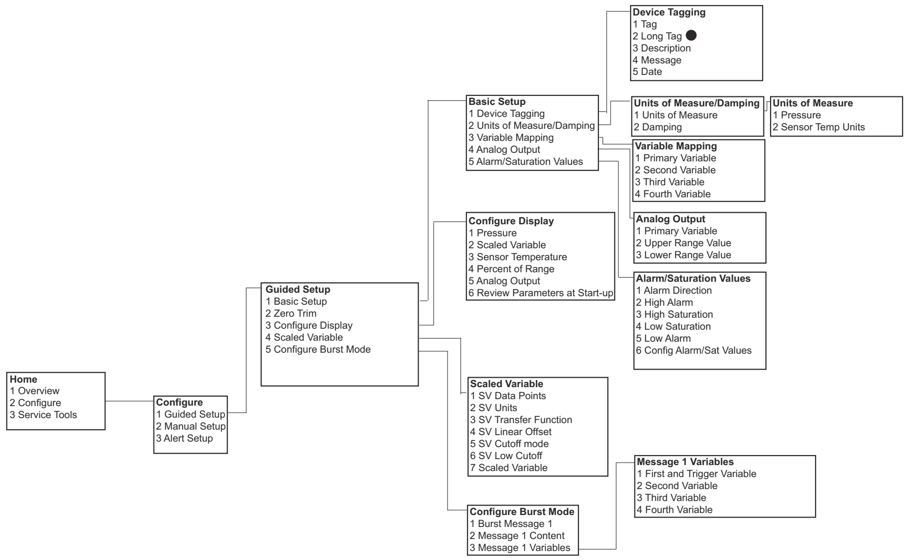


Figure B-3: Configure Manual Setup

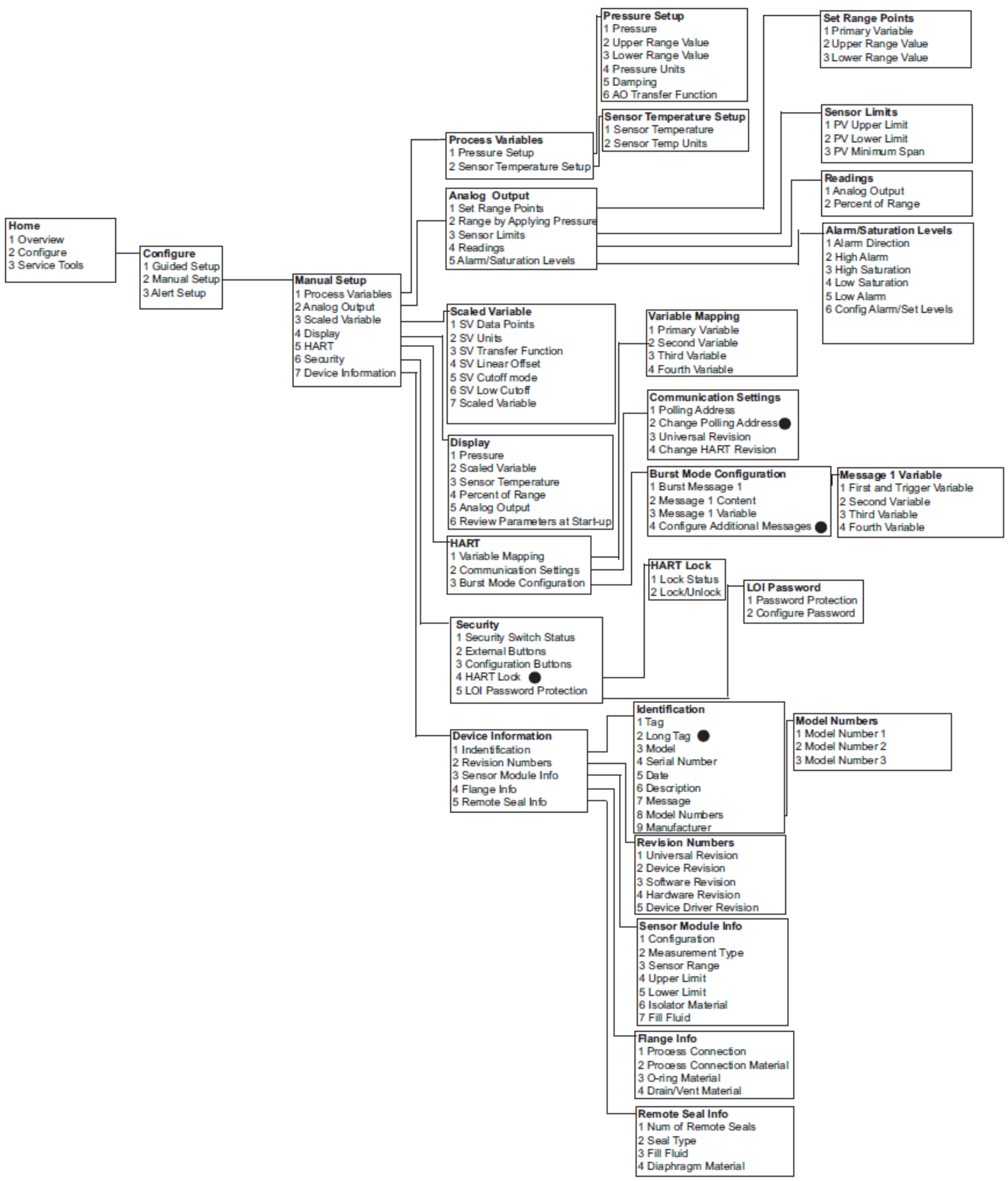


Figure B-4: Configure Alert Setup

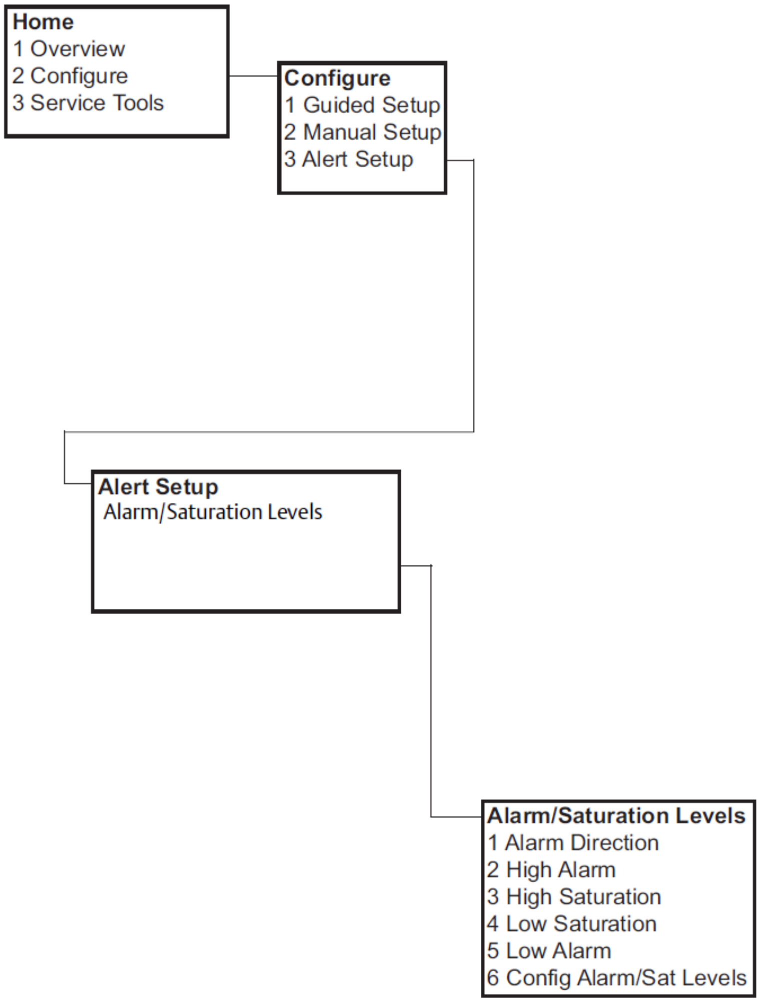
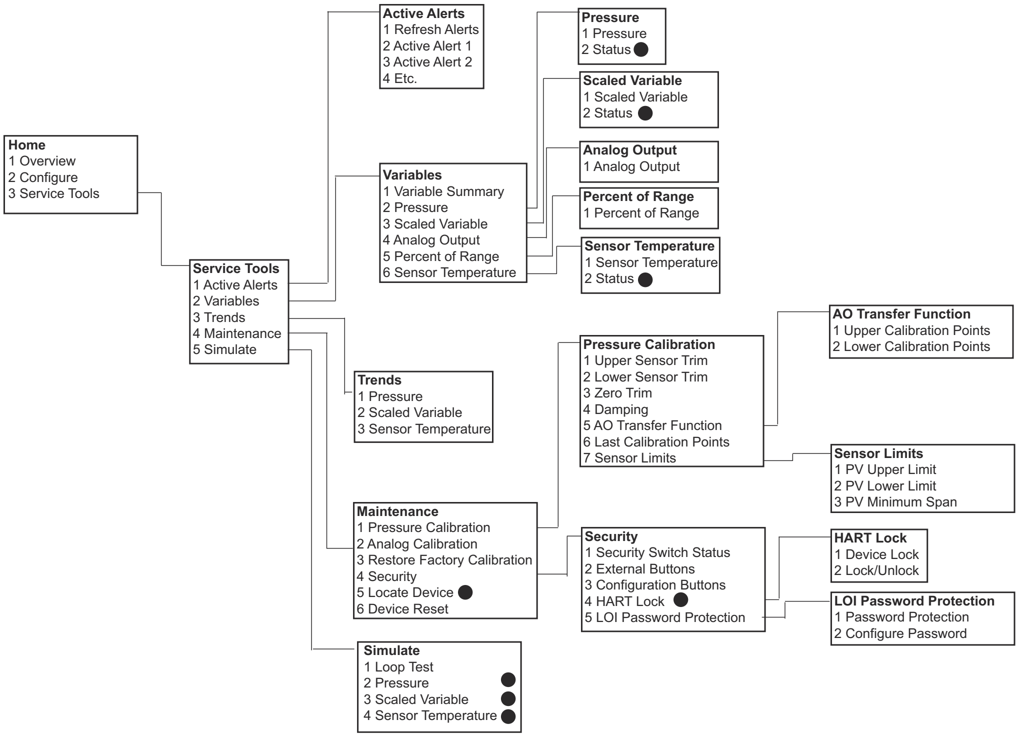


Figure B-5: *Service Tools*



B.2 Communication device fast keys

- A (✓) indicates the basic configuration parameters. At minimum, verify these parameters as a part of configuration and start-up.
- A 7 indicates availability only in HART® revision 7 mode.

Table B-1: Device revision 9 and 10 (HART 7), device descriptor (DD) revision 1 fast key sequence

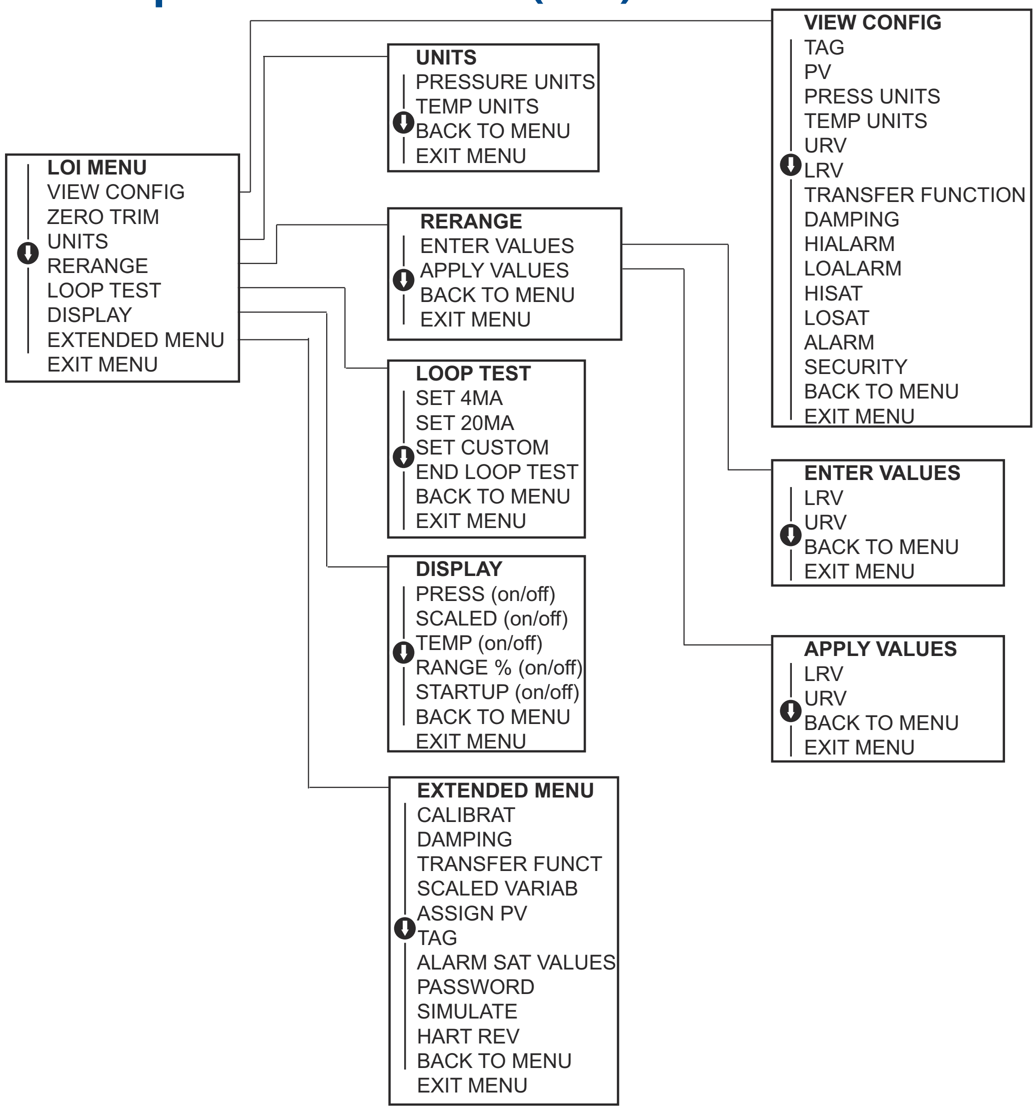
	Function	Fast key sequence	
		HART 7	HART 5
✓	**Alarm** and **Saturation Levels**	2, 2, 2, 5	2, 2, 2, 5
✓	**Damping**	2, 2, 1, 1, 5	2, 2, 1, 1, 5
✓	**Primary Variable**	2, 2, 5, 1, 1	2, 2, 5, 1, 1
✓	**Range Values**	2, 2, 2, 1	2, 2, 2, 1
✓	**Tag**	2, 2, 7, 1, 1	2, 2, 7, 1, 1
✓	**Transfer Function**	2, 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

Table B-1: Device revision 9 and 10 (HART 7), device descriptor (DD) revision 1 fast key sequence *(continued)*

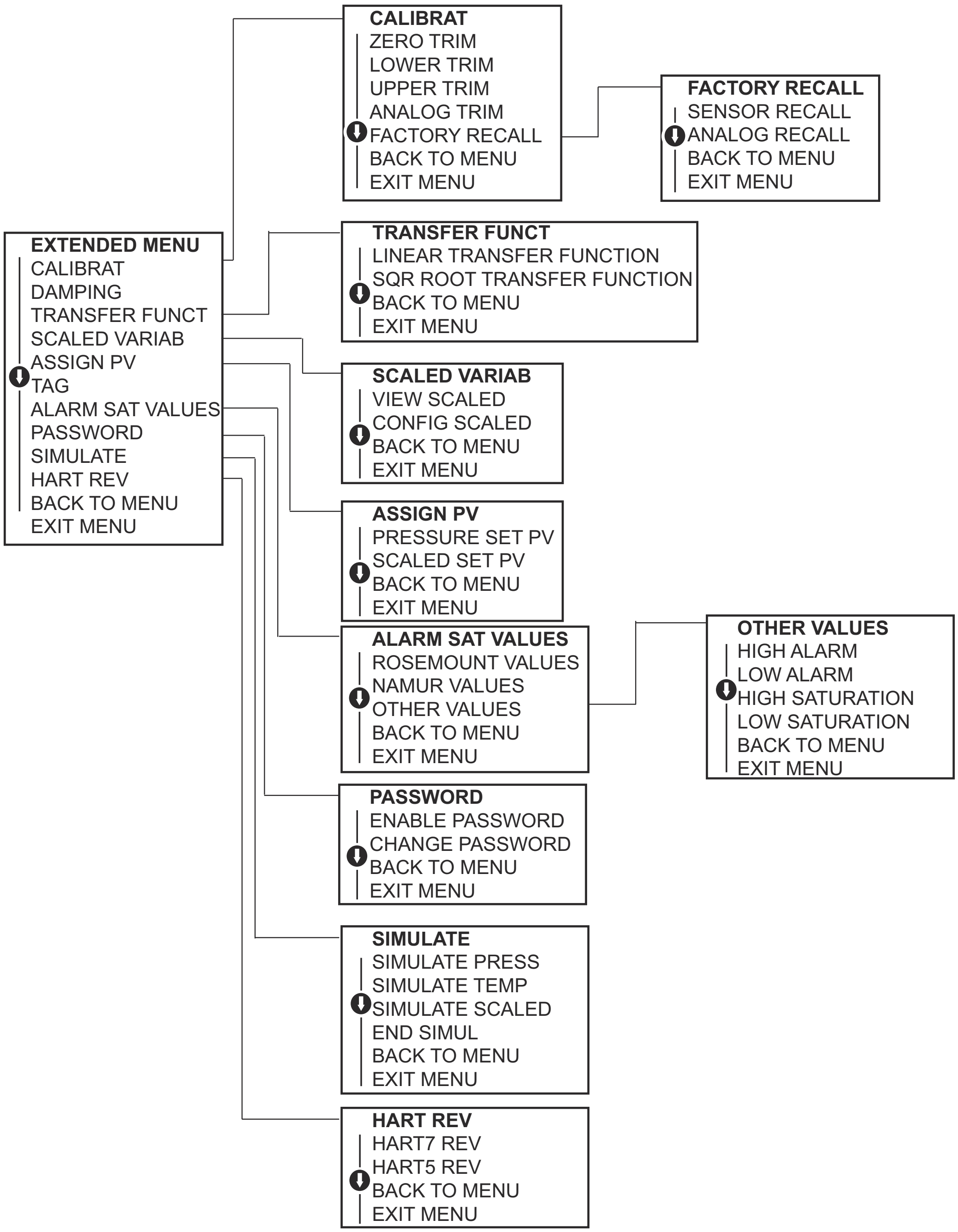
	Function	Fast key sequence	
		HART 7	HART 5
	Display Configuration	2, 2, 4	2, 2, 4
	Local Operator Interface (LOI) Password Protection	2, 2, 6, 5	2, 2, 6, 4
	Loop Test	3, 5, 1	3, 5, 1
	Lower Sensor Trim	3, 4, 1, 2	3, 4, 1, 2
	Message	2, 2, 7, 1, 7	2, 2, 7, 1, 6
	Pressure Trend	3, 3, 1	3, 3, 1
	Rerange 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	

C Local operator interface (LOI) menu

C.1 Local operator interface (LOI) menu tree



C.2 Local operator interface (LOI) menu tree - *EXTENDED MENU*



C.3 Enter numbers

You can enter floating-point numbers with the local operator interface (LOI).

You can use all eight number locations on the top line for number entry. Below is a floating-point number entry example for changing a value of `-0000022` to `000011.2`.

Step	Instruction	Current position (indicated by bold 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.	**0**0000022
3	Press the **enter** button to select the `0` as an entry. The second digit from the left will be blinking.	0**0**000022
4	Press the **enter** button to select `0` for second digit. The third digit from the left will be blinking.	00**0**00022
5	Press the **enter** button to select `0` for the third digit. The fourth digit from the left will now be blinking.	000**0**0022
6	Press the **enter** button to select `0` for the fourth digit. The fifth digit from the left will now be blinking.	0000**0**022
7	Press **scroll** to navigate through the numbers until the `1` is on the screen.	0000**1**022
8	Press the **enter** button to select the `1` for the fifth digit. The sixth digit from the left will now be blinking.	00001**0**22
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.	000011**2**2
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**

Note

- 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.

C.4 Text entry

You can enter text with the local operator interface (LOI).

Depending on the edited item, you can use up to eight locations on the top line for text entry. Text entry follows the same rules as the number entry rules in Local operator interface (LOI) menu tree, except the following characters are available in all locations: A-Z, 0-9, –, /, space.

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

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