Configuration and Use Manual
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Micro Motion®
Model 2400S Transmitters with Analog Outputs

Configuration and Use Manual

Micro Motion®

EMERSON™
Process Management

Contents

Chapter 1
Before You Begin

1.1 Overview

This chapter provides an orientation to the use of this manual, and includes a pre-configuration worksheet. This manual describes the procedures required to start, configure, use, maintain, and troubleshoot the Model 2400S transmitter with analog outputs (the Model 2400S AN transmitter).

If you do not know what transmitter you have, see Section 1.3 for instructions on identifying the transmitter type from the model number on the transmitter's tag.

Note: Information on configuration and use of Model 2400S transmitters with different output options is provided in separate manuals. See the manual for your transmitter.

1.2 Safety

Safety messages are provided throughout this manual to protect personnel and equipment. Read each safety message carefully before proceeding to the next step.

1.3 Determining transmitter information

Transmitter type, user interface option, and output options are encoded in the model number located on the transmitter tag. The model number is a string of the following form:

2400S*X*X****

In this string:

- **2400S** identifies the transmitter family.
- The first **X** (the seventh character) identifies the output option:
  - **A** = Analog outputs
- The second **X** (the ninth character) identifies the user interface option:
  - **1** = Display with glass lens
  - **3** = No display
  - **4** = Display with non-glass lens

1.4 Determining version information

Table 1-1 lists the version information that you may need and describes how to obtain the information.

Table 1-1 Obtaining version information

Component	With ProLink II	With Communicator	With Display
Transmitter software	View/Installed Options/ Software Revision	Review/Device info/ Software rev	OFF-LINE MAINT/VER
ProLink II	Help/About ProLink II	Not applicable	Not applicable
Communicator device description	Not applicable	See Section 4.2	Not applicable

1.5 Flowmeter documentation

Table 1-2 lists documentation sources for additional information.

Table 1-2 Flowmeter documentation resources

Topic	Document
Sensor installation	Sensor documentation
Transmitter installation	*Micro Motion® Model 2400S Transmitters: Installation Manual*
Hazardous area installation	See the approval documentation shipped with the transmitter, or download the appropriate documentation from the Micro Motion web site (www.micromotion.com)

1.6 Communication tools

Most of the procedures described in this manual require the use of a communication tool. The following communication tools can be used:

- Transmitter display, if the transmitter was ordered with a display
- ProLink® II software, v2.4 and later
- Pocket ProLink® software, v1.2 and later
- 375 Field Communicator

In this manual:

- Basic information on using the display is provided in Chapter 2.
- Basic information on using ProLink II or Pocket ProLink, and connecting ProLink II or Pocket ProLink to your transmitter, is provided in Chapter 3. For more information, see the ProLink II or Pocket ProLink manual, available on the Micro Motion web site (www.micromotion.com).
- Basic information on the 375 Field Communicator and connecting the Communicator to your transmitter is provided in Chapter 4. For more information, see the Field Communicator documentation available on the Micro Motion web site (www.micromotion.com).

You may be able to use other tools from Emerson Process Management, such as AMS Suite: Intelligent Device Manager. Use of AMS is not discussed in this manual; however, the user interface that AMS provides is similar to the ProLink II user interface.

1.7 Planning the configuration

The pre-configuration worksheet in Section 1.8 provides a place to record information about your flowmeter (transmitter and sensor) and your application. This information will affect your configuration options as you work through this manual. Fill out the pre-configuration worksheet and refer to it during configuration. You may need to consult with transmitter installation or application process personnel to obtain the required information.

If you are configuring multiple transmitters, make copies of this worksheet and fill one out for each individual transmitter.

1.8 Pre-configuration worksheet

Item		Configuration data	
Sensor type		☐ T-Series ☐ Other	
Transmitter model number		________________	
Transmitter software version		________________	
Outputs	Terminals 1 & 2 (Channel A)	☐ Milliamp ☐ Used for HART/Bell 202 digital communications	☐ Internal power ☐ External power
	Terminals 3 & 4 (Channel B)	☐ Frequency ☐ Discrete output ☐ Discrete input	☐ Internal power ☐ External power
Process variable or assignment	Terminals 1 & 2 (Channel A)	________________	
	Terminals 3 & 4 (Channel B)	________________	
Measurement units	Mass flow	________________	
	Volume flow	________________	
	Density	________________	
	Pressure	________________	
	Temperature	________________	
Installed applications		☐ Micro Motion Smart Meter Verification ☐ Meter verification application, original version	
ProLink II version		________________	
Communicator device description version		________________	

1.9 Micro Motion customer service

For customer service, phone the support center nearest you:

- In the U.S.A., phone **800-522-MASS** (800-522-6277) (toll-free)
- In Canada and Latin America, phone +1 303-527-5200
- In Asia:
  - In Japan, phone 3 5769-6803
  - In other locations, phone +65 6777-8211 (Singapore)
- In Europe:
  - In the U.K., phone 0870 240 1978 (toll-free)
  - In other locations, phone +31 (0) 318 495 555 (The Netherlands)

Customers outside the U.S.A. can also email Micro Motion customer service at *flow.support@emerson.com*.

Chapter 2
Using the Transmitter User Interface

2.1 Overview

This chapter describes the user interface of the Model 2400S AN transmitter. The following topics are discussed:

- Transmitters without or with display – see Section 2.2
- Removing and replacing the transmitter housing cover – see Section 2.3
- Using the **Scroll** and **Select** optical switches – see Section 2.4
- Using the LCD – see Section 2.5
- Using the HART security switch – see Section 2.6

2.2 User interface without or with display

The user interface of the Model 2400S AN transmitter depends on whether it was ordered with or without a display:

- If ordered without a display, there is no LCD on the user interface. Either ProLink II or the Communicator is required for transmitter configuration and other functions. The transmitter housing cover must be removed to access the user interface. The user interface provides the following features and functions:
  - Viewing the status LED
  - Connecting from ProLink II or the Communicator
  - Zeroing the flowmeter with the zero button
  - Setting the HART security switch
- If ordered with a display, the user interface includes an LCD which displays process variable data, and also provides access to the off-line menu for basic configuration and management. Note that the off-line menu does not provide access to all transmitter functionality; for access to all transmitter functionality, either ProLink II or the Communicator must be used.

  The following functions may be performed with the transmitter housing cover in place (i.e., through the lens of the transmitter housing cover):
  - Viewing the LCD
  - Viewing the status LED
  - Using the **Select** and **Scroll** optical switches
  - Connecting through the infrared port

  All other functions require removal of the transmitter housing cover.

Figures 2-1 and 2-2 show the user interface of the Model 2400S AN transmitter without and with a display. In both illustrations, the transmitter housing cover has been removed.

Figure 2-1 User interface – Transmitters without display

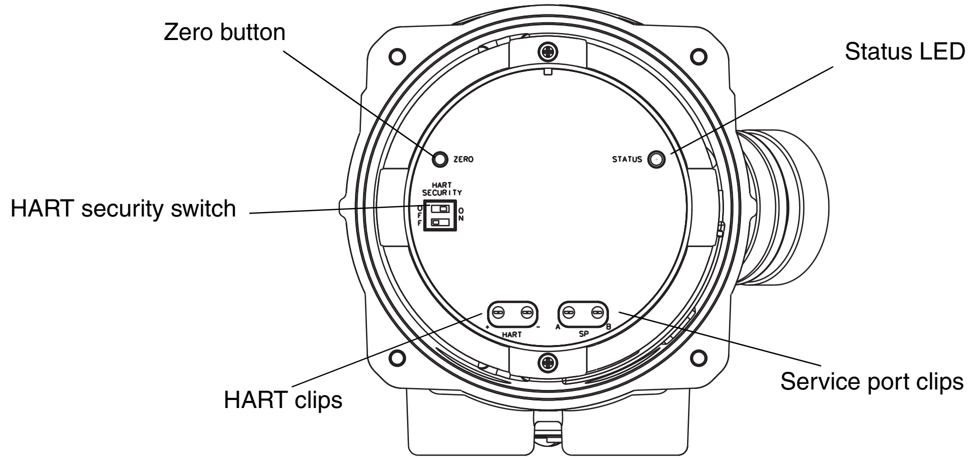
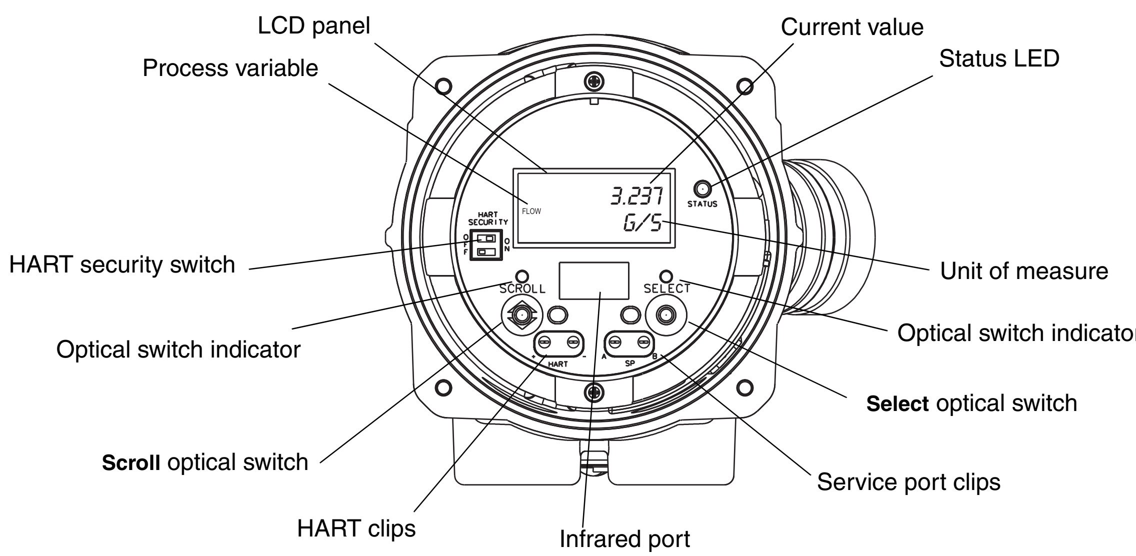


Figure 2-2 User interface – Transmitters with display



For information on the status LED, see Chapter 7.

For information on making a HART connection, see Chapter 4.

For information on making a service port connection, either through the service port clips or through the infrared port, see Chapter 3.

For information on using the zero button, see Chapter 5.

2.3 Removing and replacing the transmitter housing cover

For some procedures, you must remove the transmitter housing cover. To remove the transmitter housing cover:

1. If the transmitter is in a Division 2 or Zone 2 area, remove power from the unit.

> ⚠ **WARNING**
>
> **Removing the transmitter housing cover in a Division 2 or Zone 2 area while the transmitter is powered up can cause an explosion.**
>
> To avoid the risk of an explosion, remove power from the transmitter before removing the transmitter housing cover.

2. Loosen the four captive screws.
3. Lift the transmiter housing cover away from the transmitter.

When replacing the transmitter housing cover, first grease the gasket, then replace the cover. Tighten the screws so that no moisture can enter the transmitter housing.

2.4 Using the optical switches

Note: This section applies only to transmitters with a display.

The **Scroll** and **Select** optical switches are used to navigate transmitter menus. To activate an optical switch, touch the lens in front of the optical switch or move your finger over the optical switch close to the lens. There are two optical switch indicators: one for each switch. When an optical switch is activated, the associated optical switch indicator is a solid red.

> ⚠ **CAUTION**
>
> **Attempting to activate an optical switch by inserting an object into the opening can damage the equipment.**
>
> To avoid damage to the optical switches, do not insert an object into the openings. Use your fingers to activate the optical switches.

2.5 Using the display

Note: This section applies only to transmitters with a display.

The display can be used to view process variable data or to access the transmitter menus for configuration or maintenance.

2.5.1 Display language

The display can be configured for the following languages:

- English
- French
- Spanish
- German

Due to software and hardware restrictions, some English words and terms may appear in the non-English display menus. For a list of the codes and abbreviations used on the display, see Appendix D.

For information on configuring the display language, see Section 8.10.

In this manual, English is used as the display language.

2.5.2 Viewing process variables

In ordinary use, the **Process variable** line on the LCD shows the configured display variables, and the **Units of measure** line shows the measurement unit for that process variable.

- See Section 8.10.5 for information on configuring the display variables.
- See Appendix D for information on the codes and abbreviations used for display variables.

If more than one line is required to describe the display variable, the **Units of measure** line alternates between the measurement unit and the additional description. For example, if the LCD is displaying a mass inventory value, the **Units of measure** line alternates between the measurement unit (for example, **G**) and the name of the inventory (for example, **MASSI**).

Auto Scroll may or may not be enabled:

- If Auto Scroll is enabled, each configured display variable will be shown for the number of seconds specified for Scroll Rate.
- Whether Auto Scroll is enabled or not, the operator can manually scroll through the configured display variables by activating **Scroll**.

For more information on using the LCD to view process variables or manage totalizers and inventories, see Chapter 7.

2.5.3 Using display menus

Note: The display menu system provides access to basic transmitter functions and data. It does not provide access to all functions and data. To access all functions and data, use either ProLink II or the 375 Field Communicator.

To enter the display menu system, activate **Scroll** and **Select** simultaneously. Hold **Scroll** and **Select** until the words **SEE ALARM** or **OFF-LINE MAINT** appear.

Note: Access to the display menu system may be enabled or disabled. If disabled, the OFF-LINE MAINT option does not appear. For more information, see Section 8.10.

For entry into certain sections of the display menu:

- If a password has been enabled, you will be prompted to enter it. See Section 2.5.4.
- If a display password is not required, you will be prompted to activate the optical switches in a pre-defined sequence (**Scroll-Select-Scroll**). This feature is designed to prevent unintentional entry to the menu caused by variations in ambient lighting or other environmental factors.

If no optical switch activity occurs for two minutes, the transmitter will exit the off-line menu system and return to the process variable display.

To move through a list of options, activate **Scroll**.

To select from a list or to enter a lower-level menu, scroll to the desired option, then activate **Select**. If a confirmation screen is displayed:

- To confirm the change, activate **Select**.
- To cancel the change, activate **Scroll**.

To exit a menu without making any changes

- Use the **EXIT** option if available.
- Otherwise, activate **Scroll** at the confirmation screen.

2.5.4 Display password

Some of the display menu functions, such as accessing the off-line menu, can be protected by a display password. For information about enabling and setting the display password, refer to Section 8.10.

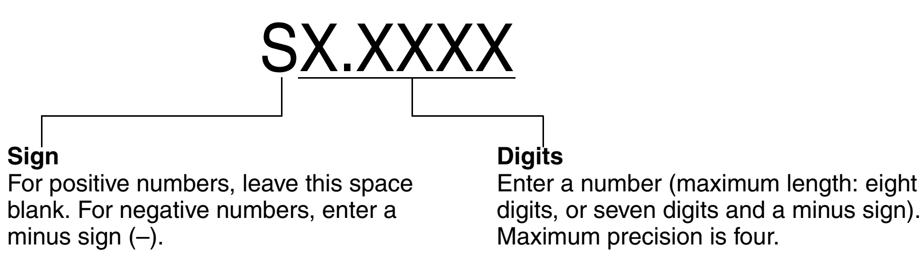
If a password is required, the word **CODE?** appears at the top of the password screen. Enter the digits of the password one at a time by using **Scroll** to choose a number and **Select** to move to the next digit.

If you encounter the display password screen but do not know the password, wait 60 seconds without activating any of the display optical switches. The password screen will time out automatically and you will be returned to the previous screen.

2.5.5 Entering floating-point values with the LCD

Certain configuration values, such as meter factors or output ranges, are entered as floating-point values. When you first enter the configuration screen, the value is displayed in decimal notation (as shown in Figure 2-3) and the active digit is flashing.

Figure 2-3 **Numeric values in decimal notation**



To change the value:

1. **Select** to move one digit to the left. From the leftmost digit, a space is provided for a sign. The sign space wraps back to the rightmost digit.
2. **Scroll** to change the value of the active digit: **1** becomes **2**, **2** becomes **3**, ..., **9** becomes **0**, **0** becomes **1**. For the rightmost digit, an **E** option is included to switch to exponential notation.

To change the sign of a value:

1. **Select** to move to the space that is immediately left of the leftmost digit.
2. Use **Scroll** to specify – (for a negative value) or [blank] (for a positive value).

In decimal notation, you can change the position of the decimal point up to a maximum precision of four (four digits to the right of the decimal point). To do this:

1. **Select** until the decimal point is flashing.
2. **Scroll.** This removes the decimal point and moves the cursor one digit to the left.

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3. **Select** to move one digit to the left. As you move from one digit to the next, a decimal point will flash between each digit pair.
4. When the decimal point is in the desired position, **Scroll.** This inserts the decimal point and moves the cursor one digit to the left.

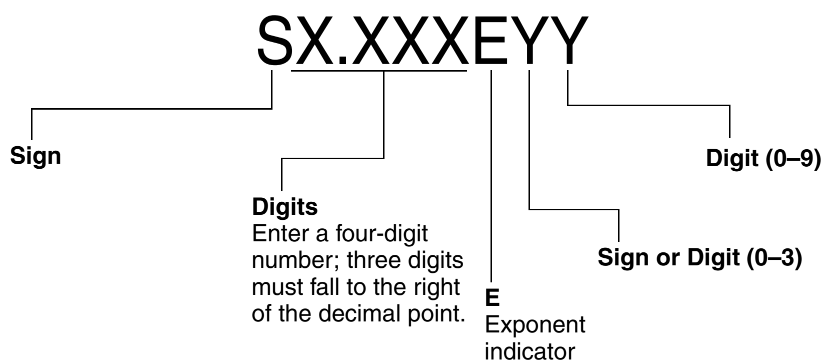
To change from decimal to exponential notation (see Figure 2-4):

1. **Select** until the rightmost digit is flashing.
2. **Scroll** to **E**, then **Select**. The display changes to provide two spaces for entering the exponent.
3. To enter the exponent:
   a. **Select** until the desired digit is flashing.
   b. **Scroll** to the desired value. You can enter a minus sign (first position only), values between 0 and 3 (for the first position in the exponent), or values between 0 and 9 (for the second position in the exponent).
   c. **Select**.

Note: When switching between decimal and exponential notation, any unsaved edits are lost. The system reverts to the previously saved value.

Note: While in exponential notation, the positions of the decimal point and exponent are fixed.

Figure 2-4 **Numeric values in exponential notation**



To change from exponential to decimal notation:

1. **Select** until the **E** is flashing.
2. **Scroll** to **d**.
3. **Select**. The display changes to remove the exponent.

To exit the menu:

- If the value has been changed, **Select** and **Scroll** simultaneously until the confirmation screen is displayed.
  - **Select** to apply the change and exit.
  - **Scroll** to exit without applying the change.
- If the value has not been changed, **Select** and **Scroll** simultaneously until the previous screen is displayed.

2.6 Using the HART security switch

The HART security switch is the upper switch at the left side of the display (see Figures 2-1 and 2-2).

Note: The lower switch is not used by the Model 2400S AN transmitter.

When the HART security switch is set to the On (right) position, HART protocol cannot be used to perform any action that requires writing to the transmitter. For example, you will not be allowed to change configuration, reset totalizers, perform calibration, etc., using the Communicator or using ProLink II with a HART/Bell 202 connection.

Note: The HART security switch does not affect Modbus communications. These functions are still available via Modbus.

When the HART security switch is set to the Off (left) position, no functions are disabled.

To change the setting of the HART security switch:

1. Remove power from the transmitter.
2. Remove the transmitter housing cover.
3. Move the switch to the desired position.
4. Replace the transmitter housing cover.
5. Restore power to the transmitter.

⚠ WARNING

Removing the transmitter housing cover or resetting the HART security switch in a Division 2 or Zone 2 area while the transmitter is powered up can cause an explosion.

To avoid the risk of an explosion, remove power from the transmitter before removing the transmitter housing cover or resetting the HART security switch.

Chapter 3
Connecting with ProLink II or Pocket ProLink Software

3.1 Overview

ProLink II is a Windows-based configuration and management tool for Micro Motion transmitters. It provides complete access to transmitter functions and data. Pocket ProLink is a version of ProLink II that runs on a Pocket PC.

This chapter provides basic information for connecting ProLink II or Pocket ProLink to your transmitter. The following topics and procedures are discussed:

- Requirements – see Section 3.2
- Configuration upload/download – see Section 3.3
- Connecting to a Model 2400S AN transmitter – see Section 3.4

The instructions in this manual assume that users are already familiar with ProLink II or Pocket ProLink software. For more information on using ProLink II, see the ProLink II manual. For more information on using Pocket ProLink, see the Pocket ProLink manual. Both manuals are available on the Micro Motion web site (www.micromotion.com).

3.2 Requirements

To use ProLink II, v2.4 or later is required. In addition, you must have either the ProLink II installation kit appropriate to your PC and connection type, or the equivalent equipment. See the ProLink II manual or quick reference guide for details.

To use Pocket ProLink, v1.2 or later is required. In addition:

- If you will connect to the service port clips, you must have either the Pocket ProLink installation kit or the equivalent equipment. See the Pocket ProLink manual or quick reference guide for details.
- If you will connect using the infrared port, no additional equipment is required.

3.3 Configuration upload/download

ProLink II and Pocket ProLink provide a configuration upload/download function which allows you to save configuration sets to your PC. This allows:

- Easy backup and restore of transmitter configuration
- Easy replication of configuration sets

Micro Motion recommends that all transmitter configurations be downloaded to a PC as soon as the configuration is complete. See the ProLink II or Pocket ProLink manual for details.

3.4 Connecting from a PC to a Model 2400S AN transmitter

Protocol options for ProLink II or Pocket ProLink connections to the Model 2400S AN transmitter are listed in Table 3-1.

Note: Due to the design of HART protocol, connections made using HART protocol are slower than connections that use Modbus protocol. If you use HART protocol, you cannot open more than one ProLink II window at a time.

Note: If you connect using HART protocol, your actions may be restricted by the setting of the HART security switch. See Section 2.6.

Table 3-1 Protocol options for Model 2400S AN transmitters

Connection	Physical layer	Protocol
Service port (see Section 3.4.1)	RS-485	Modbus RTU Modbus ASCII
HART clips, mA output (Channel A), or HART multidrop network (see Section 3.4.2)	Bell 202	HART

3.4.1 Service port connections

If you are connecting to the transmitter with ProLink II or Pocket ProLink, and you are making a point-to-point connection, use the Service Port connection type. Service port connections are preconfigured in these two communications tools. Follow the instructions provided in *Making the connection*.

If you are connecting with a different communications tool, ensure that your communications tool is configured to use communications parameters within the auto-detection limits described in Table 3-2. The service port always responds to all the listed protocols, communications parameters, and addresses. Then follow the instructions provided in *Making the connection*.

Auto-detection

To minimize configuration requirements, the service port uses an auto-detection scheme when responding to connection requests. The service port will accept all connection requests within the limits described in Table 3-2.

Table 3-2 Service port auto-detection limits

Parameter	Option
Protocol	Modbus ASCII or Modbus RTU(1)
Address	Responds to both: • Service port address (111) • Configured Modbus address (default=1)
Baud rate	Standard rates between 1200 and 38,400
Stop bits	0, 1
Parity	Even, odd, none

(1) Service port support for Modbus ASCII may be disabled. See Section 8.11.1.

See Section 8.11.1 for information on configuring the HART address and the Modbus address.

Making the connection

To connect to the service port:

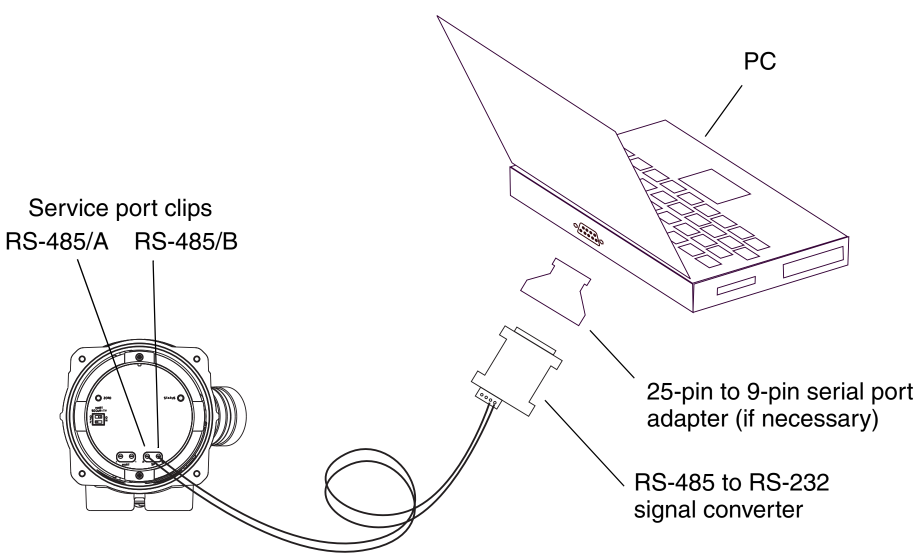
1. If you are using the infrared port, position the infrared device for communication with the infrared port (see Figure 2-2). You do not need to remove the transmitter housing cover.

Note: The infrared port is typically used with Pocket ProLink. To use the infrared port with ProLink II, a special device is required; the infrared port built into many laptop PCs is not supported. For more information on using the infrared port with ProLink II, contact Micro Motion customer service.

2. If you are not using the infrared port:
   a. Attach the signal converter to the serial or USB port of your PC, using a 25-pin to 9-pin adapter if required.
   b. Remove the transmitter housing cover from the transmitter (see Section 2.3), then connect the signal converter leads to the service port clips. See Figure 3-1.

> **⚠ WARNING**
>
> **Removing the transmitter housing cover in a hazardous area can cause an explosion.**
>
> Because the transmitter housing cover must be removed to connect to the service port clips, the service port clips should be used only for temporary connections, for example, for configuration or troubleshooting purposes.
>
> When the transmitter is in an explosive atmosphere, use a different method to connect to your transmitter.

Figure 3-1 Service port connections to service port clips



3. Start ProLink II or Pocket ProLink software. From the Connection menu, click on **Connect to Device**. In the screen that appears, specify:
   - **Protocol**: as appropriate for your connection type
   - **COM Port**: as appropriate for your PC
   - **Address**: if required by your connection type

   No other parameters are required.
4. Click **Connect**. The software will attempt to make the connection.

Note: While you are connected to the infrared port, both optical switch indicators will flash red, and both the Scroll and Select optical switches are disabled.

5. If an error message appears:
   a. For connections to the service port clips, swap the leads between the two service port terminals and try again.
   b. Ensure that you are using the correct COM port.
   c. Check all the wiring between the PC and the transmitter.

3.4.2 Connecting to the HART clips or to a HART multidrop network

⚠ WARNING

Removing the transmitter housing cover in a hazardous area can cause an explosion.

Because the transmitter housing cover must be removed to connect to the HART clips, the HART clips should be used only for temporary connections, for example, for configuration or troubleshooting purposes.

When the transmitter is in an explosive atmosphere, use a different method to connect to your transmitter.

⚠ CAUTION

Connecting a HART device to the transmitter's mA output terminals or HART clips could cause transmitter output error.

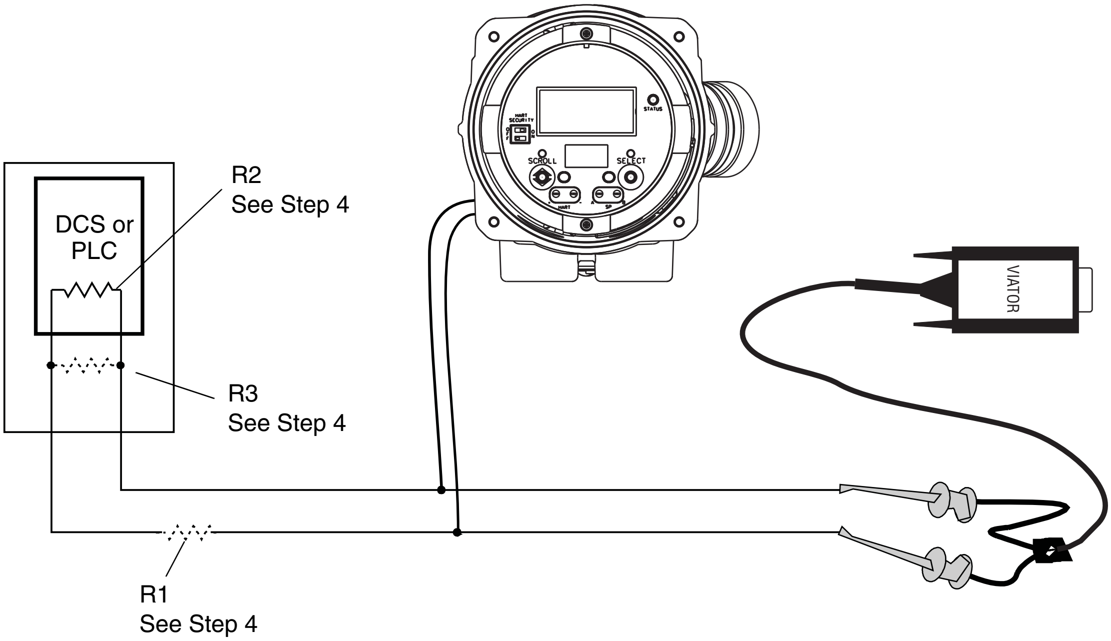
If the mA output is being used for continuous control, connecting a HART interface to the output loop could cause the transmitter's 4–20 mA output to change, which would affect final control devices.

Set control devices for manual operation before connecting a HART interface to the transmitter's mA output loop.

To connect to the HART clips or to a HART multidrop network:

1. Attach the HART interface to the serial or USB port of your PC.
2. To connect to a HART multidrop network, connect the HART interface leads to any point on the network (see Figure 3-2).

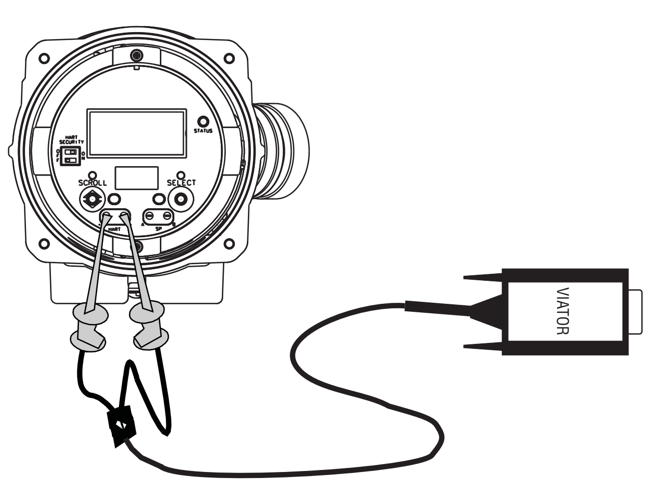
Figure 3-2 HART/Bell 202 connections to HART network



3. To connect to the HART clips:
   a. Remove the transmitter housing cover (see Section 2.3).
   b. Connect the HART interface leads to the HART clips on the face of the transmitter (see Figure 3-3).

Note: The HART clips on the face of the transmitter are connected to the transmitter's mA/HART terminals. You may connect directly to the mA/HART terminals (terminals 1 and 2) if you have removed the user interface module.

Figure 3-3 HART/Bell 202 connections to HART clips



4. Add resistance as required. The Viator HART interface must be connected across a resistance of 250–600 Ω. To meet the resistance requirements, you may use any combination of resistors R1, R2, and R3 (see Figure 3-2).

5. Start ProLink II or Pocket ProLink software. From the Connection menu, click on **Connect to Device**.
6. In the screen that appears:
   a. Set **Protocol** to **HART Bell 202**. **Baud rate**, **Stop bits**, and **Parity** are automatically set to the values required by HART protocol.
   b. Set the **Address/Tag** value to the HART address configured for the transmitter. The default HART address is 0. See Section 8.11 for information on the HART address.
   c. Set the **COM Port** value to the PC COM port assigned to this connection.
   d. Set **Master** as appropriate:
      - If another host such as a DCS is on the network, set **Master** to Secondary.
      - If no other host is on the network, set **Master** to Primary.

Note: The 375 Field Communicator is not a host.

Note: The ProLink II HART master implementation does not perform bus arbitration. If another device is on the HART bus, ProLink II will not connect to the transmitter.

Note: ProLink II will not connect to the transmitter if burst mode is enabled on the transmitter. For information about burst mode, see Section 8.11.6.

7. Click the **Connect** button. The software will attempt to make the connection.
8. If an error message appears:
   a. You may be using incorrect connection parameters.
      - Ensure you are using the correct COM port.
      - If you are unsure of the transmitter's address, use the **Poll** button in the **Connect** window to return a list of all devices on the network.
   b. Check all the wiring between the PC and the transmitter.
   c. Increase or decrease resistance.

Note: For more troubleshooting information, see Section 11.14.4.

3.5 ProLink II language

ProLink II can be configured for several different languages. To configure the ProLink II language, use the Tools menu. See Figure C-1.

In this manual, English is used as the ProLink II language.

Chapter 4
Connecting with the 375 Field Communicator

4.1 Overview

The 375 Field Communicator is a handheld configuration and management tool for HART-compatible devices, including Micro Motion transmitters. It provides complete access to transmitter functions and data.

This chapter provides basic information for connecting the 375 Field Communicator to your transmitter. The following topics and procedures are discussed:

- Connecting to a transmitter – see Section 4.3
- Conventions used in this manual – see Section 4.4
- Safety messages and notes – see Section 4.5

The instructions in this manual assume that users are already familiar with the Communicator and can perform the following tasks:

- Turn on the Communicator
- Navigate the Communicator menus
- Establish communication with HART-compatible devices
- Transmit and receive configuration information between the Communicator and HART-compatible devices
- Use the alpha keys to type information

If you are unable to perform the tasks listed above, consult the Communicator manual before attempting to use the software. The documentation is available on the Micro Motion web site (www.micromotion.com).

Note: Actions allowed via the Communicator may be restricted by the setting of the HART security switch. See Section 2.6.

4.2 Communicator device descriptions

The device description appropriate to your transmitter must be installed on the Communicator. The Model 2400S transmitter with analog outputs uses the following device description: **2400SMass flo**.

To view the device descriptions that are installed on your Communicator:

1. At the HART application menu, select **Utility**.
2. Select **Available Device Descriptions**.
3. Select **Micro Motion**.

4.3 Connecting to a transmitter

You can connect the Communicator to the transmitter's HART clips or to a point on a HART network.

Note: The HART clips on the face of the transmitter are connected to the transmitter's mA/HART terminals. You may connect directly to the mA/HART terminals (terminals 1 and 2) if you have removed the user interface module.

Note: If you are using the mA/HART terminals to report a process variable and also for HART communications, see the transmitter installation manual for wiring diagrams.

4.3.1 Connecting to HART clips

To connect the Communicator to the transmitter's HART clips:

⚠ CAUTION

Connecting a HART device to the transmitter's mA output terminals or HART clips could cause transmitter output error.

If the mA output is being used for continuous control, connecting a HART interface to the output loop could cause the transmitter's 4–20 mA output to change, which would affect final control devices.

Set control devices for manual operation before connecting a HART interface to the transmitter's mA output loop.

1. Remove the transmitter housing cover (see Section 2.3).

⚠ WARNING

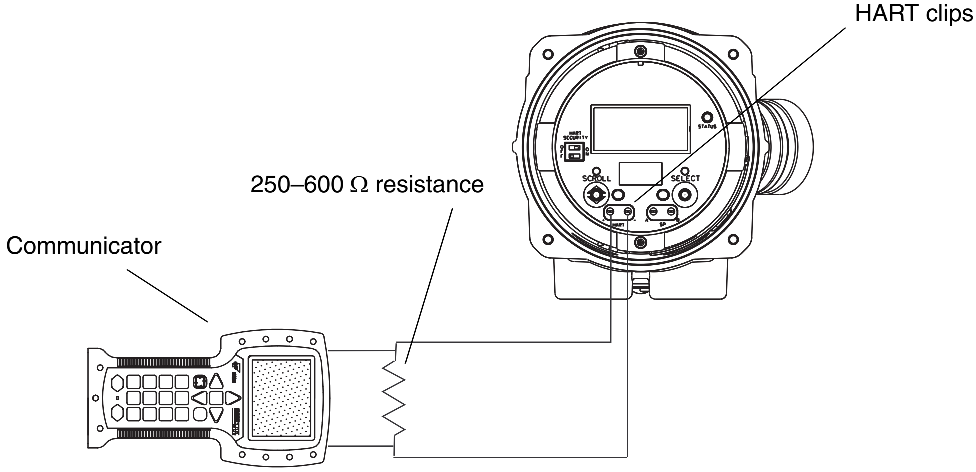
Removing the transmitter housing cover in a hazardous area can cause an explosion.

Because the transmitter housing cover must be removed to connect to the HART clips, the HART clips should be used only for temporary connections, for example, for configuration or troubleshooting purposes.

When the transmitter is in an explosive atmosphere, use a different method to connect to your transmitter.

2. Connect the Communicator leads to the HART clips on the face of the transmitter. See Figure 4-1.
3. The Communicator must be connected across a resistance of 250–600 Ω. Add resistance to the connection. See Figure 4-1.

Figure 4-1 **Connecting to HART clips**

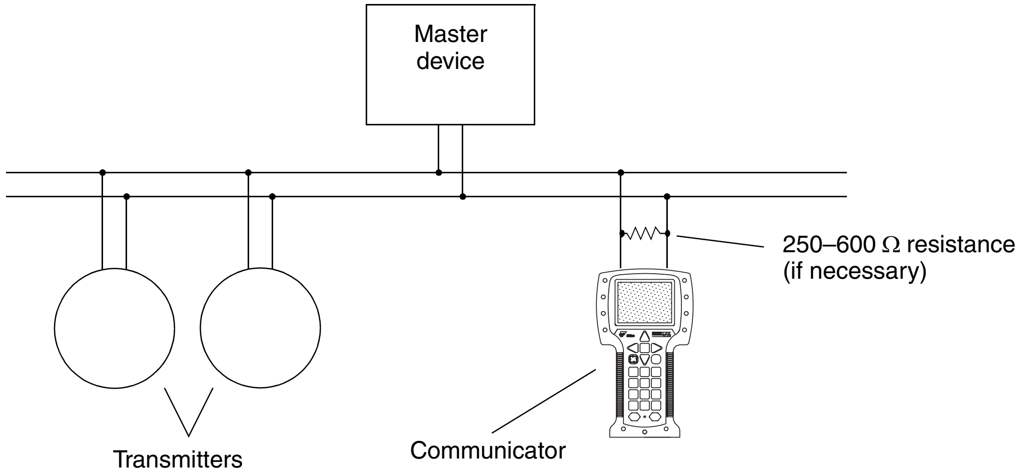


4.3.2 Connecting to a multidrop network

The Communicator can be connected to any point in a multidrop network. See Figure 4-2.

The Communicator must be connected across a resistance of 250–600 Ω. Add resistance to the connection if necessary.

Figure 4-2 **Connecting to a multidrop network**



4.4 Conventions used in this manual

All Communicator procedures assume that you are starting at the on-line menu. "Online" appears on the top line of the Communicator main menu when the Communicator is at the on-line menu.

4.5 Communicator safety messages and notes

Users are responsible for responding to safety messages (e.g., warnings) and notes that appear on the Communicator. Safety messages and notes that appear on the Communicator are not discussed in this manual.

Chapter 5
Flowmeter Startup

5.1 Overview

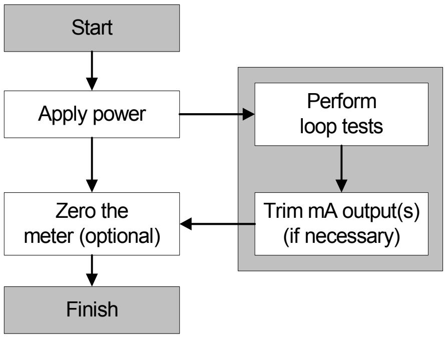
This chapter describes the procedures you should perform the first time you start the flowmeter system. You do not need to use these procedures every time you cycle power to the transmitter.

The following procedures are discussed:

- Applying power to the transmitter – see Section 5.2
- Performing a loop test on the transmitter outputs – see Section 5.3
- Trimming the mA output – see Section 5.4
- Zeroing the meter (optional) – see Section 5.5

Figure 5-1 provides an overview of the startup procedures.

Figure 5-1 Startup procedures



Note: All ProLink II procedures provided in this chapter assume that your computer is already connected to the transmitter and you have established communication. All ProLink II procedures also assume that you are complying with all applicable safety requirements. See Chapter 3 for more information.

Note: If you are using Pocket ProLink or AMS, the interface is similar to the ProLink II interface described in this chapter.

Note: All Communicator procedures provided in this chapter assume that you are starting from the "Online" menu. See Chapter 4 for more information.

5.2 Applying power

Before you apply power to the flowmeter, close and tighten all covers.

> ⚠ **WARNING**
>
> **Operating the flowmeter without covers in place creates electrical hazards that can cause death, injury, or property damage.**
>
> To avoid electrical hazards, ensure that the warning flap and transmitter housing cover are in place before applying power to the transmitter.

> ⚠ **WARNING**
>
> **Using the service port or HART clips to communicate with a Model 2400S AN transmitter in a hazardous area can cause an explosion.**
>
> Before using the service port or HART clips to communicate with the transmitter in a hazardous area, make sure the atmosphere is free of explosive gases.

Turn on the electrical power at the power supply. The flowmeter will automatically perform diagnostic routines. When the flowmeter has completed its power-up sequence, the status LED will turn green. If the status LED exhibits different behavior, an alarm condition is present or transmitter calibration is in progress. See Section 7.4.

5.3 Performing a loop test

A *loop test* is a means to:

- Verify that analog outputs (mA and frequency) are being sent by the transmitter and received accurately by the receiving devices
- Determine whether or not you need to trim the mA output
- Select and verify the discrete output voltage
- Read the discrete input

Perform a loop test on all inputs and outputs available on your transmitter. Before performing the loop tests, ensure that your transmitter terminals are configured for the input/outputs that will be used in your application (see Section 6.3).

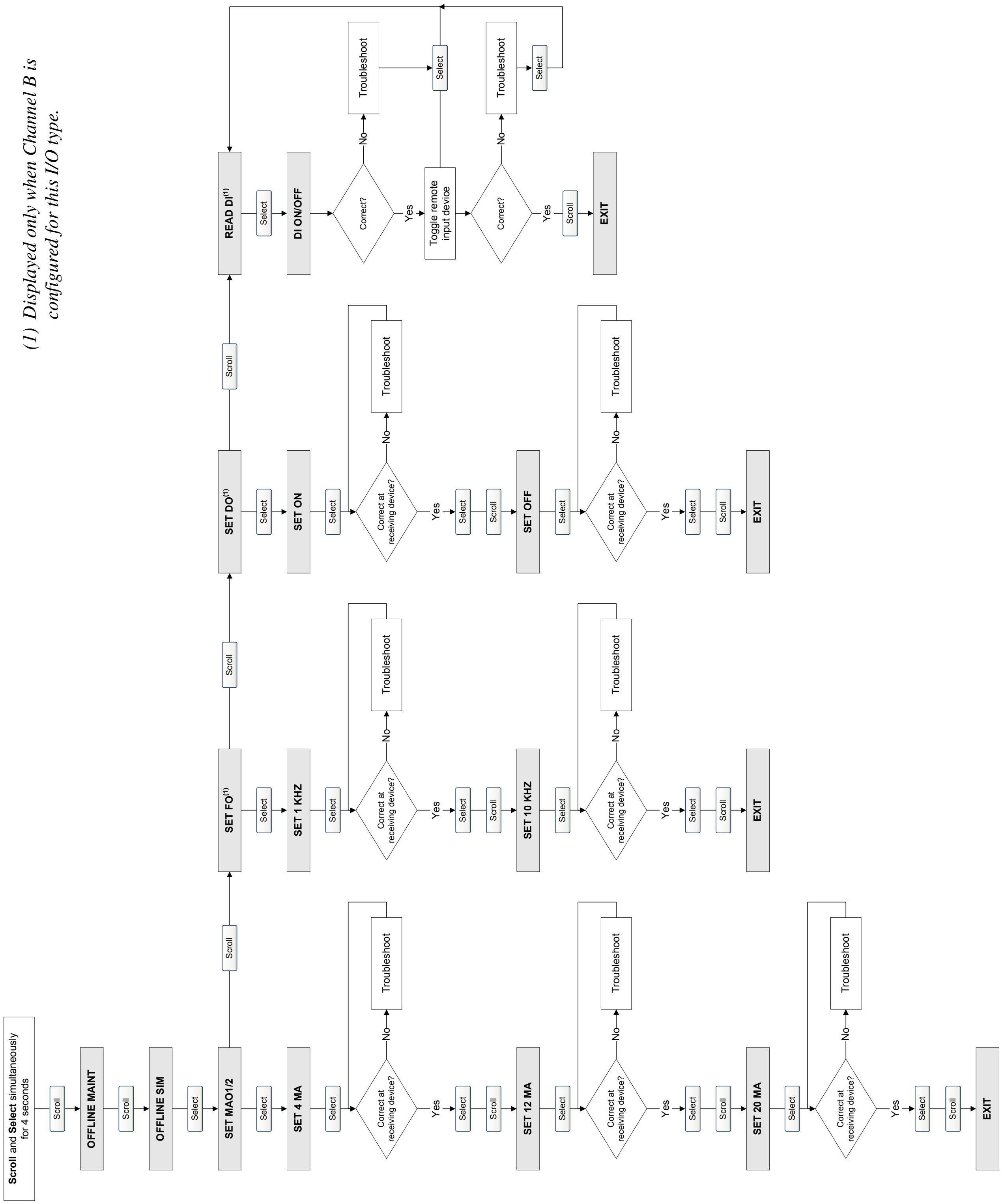
To perform a loop test:

- Using the display, see Figure 5-2. While the output is fixed, dots traverse the top line of the display and the status LED is yellow. When the output is unfixed, the dots disappear and the status LED returns to its previous state.
- Using ProLink II, see Figure 5-3.
- Using the Communicator, see Figure 5-4.

Note the following:

- If your transmitter does not have a display, you must use ProLink II or the Communicator.
- The Communicator does not provide a loop test for the discrete input.
- The mA reading does not need to be exact. You will correct differences when you trim the mA output. See Section 5.4.
- If you are connected to the transmitter via HART/Bell 202, the HART/Bell 202 signal will affect the reading. Disconnect from the transmitter before reading the output, then reconnect and resume the loop test after taking the reading. If you are using any other protocol, this is not required.

Figure 5-2 Display – Loop test procedure



(1) Displayed only when Channel B is configured for this I/O type.

Figure 5-3 **ProLink II – Loop test procedure**

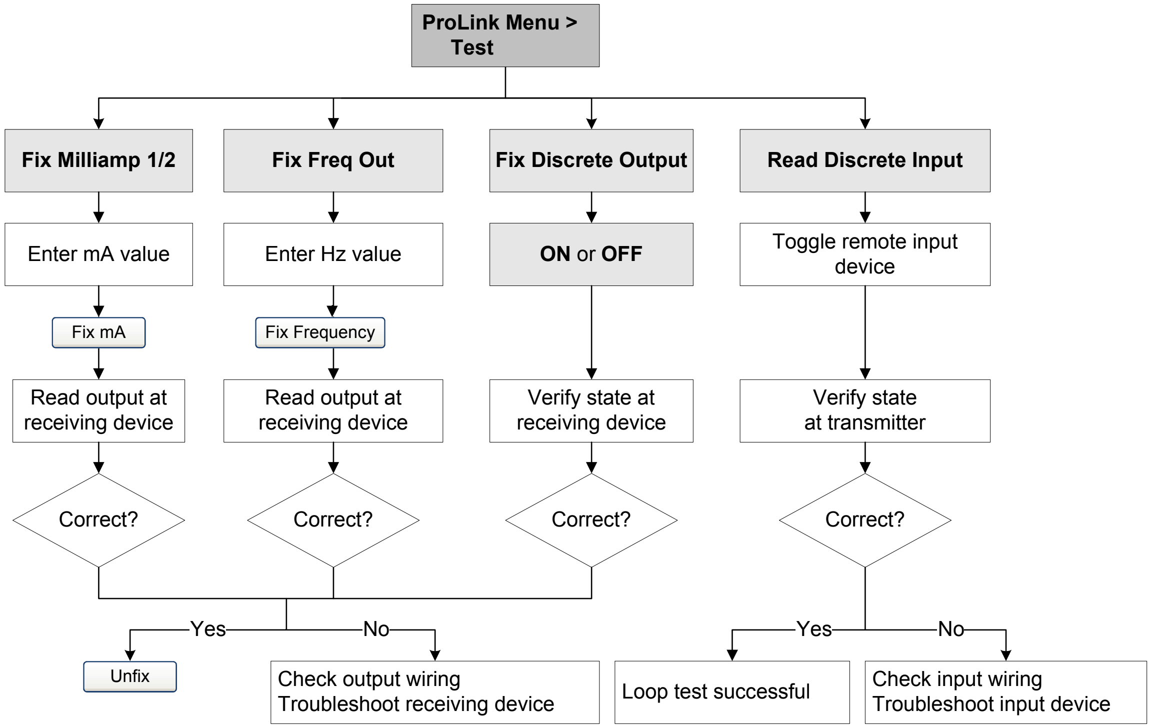
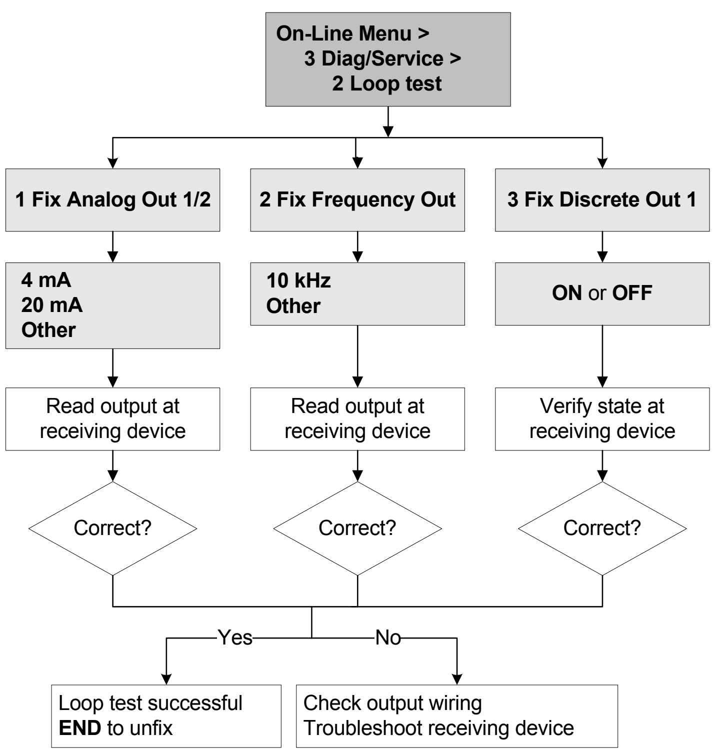


Figure 5-4 **Communicator – Loop test procedure**



5.4 Trimming the milliamp output

Trimming the mA output creates a common measurement range between the transmitter and the device that receives the mA output. For example, a transmitter might send a 4 mA signal that the receiving device reports incorrectly as 3.8 mA. If the transmitter output is trimmed correctly, it will send a signal appropriately compensated to ensure that the receiving device actually indicates a 4 mA signal.

You must trim the mA output at both the 4 mA and 20 mA points to ensure appropriate compensation across the entire output range.

To trim the output:

- Using ProLink II, see Figure 5-5.
- Using the Communicator, see Figure 5-6.

Additionally, if you are using a Communicator, you can perform a scaled AO trim. The scaled AO trim is used when the reference meter's low and high values are not 4 and 20 mA. To perform a scaled AO trim, see Figure 5-7.

Note the following:

- If you are connected to the transmitter via HART/Bell 202, the HART/Bell 202 signal will affect the reading. Disconnect from the transmitter before reading the output, then reconnect and resume the trim after taking the reading. If you are using any other protocol, this is not required.
- Any trimming performed on the output should not exceed ± 200 microamps. If more trimming is required, contact Micro Motion customer support.
- If you are using the Communicator, the receiving device value can contain up to two decimal places.

Figure 5-5 ProLink II – mA output trim procedure

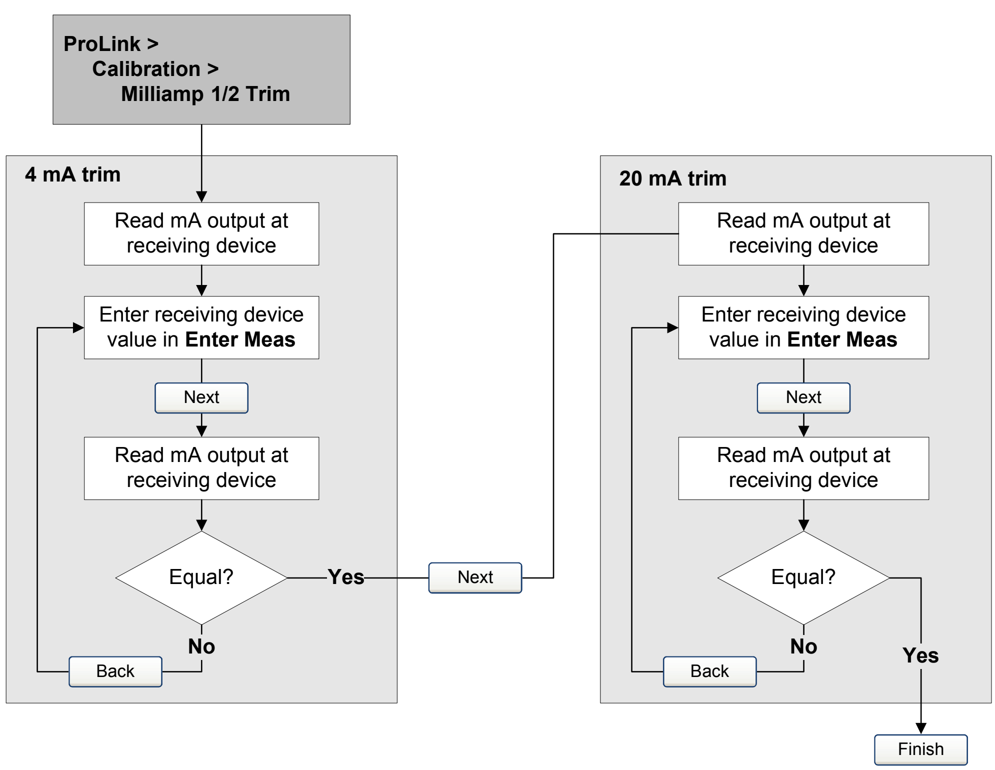


Figure 5-6 Communicator – mA output trim procedure

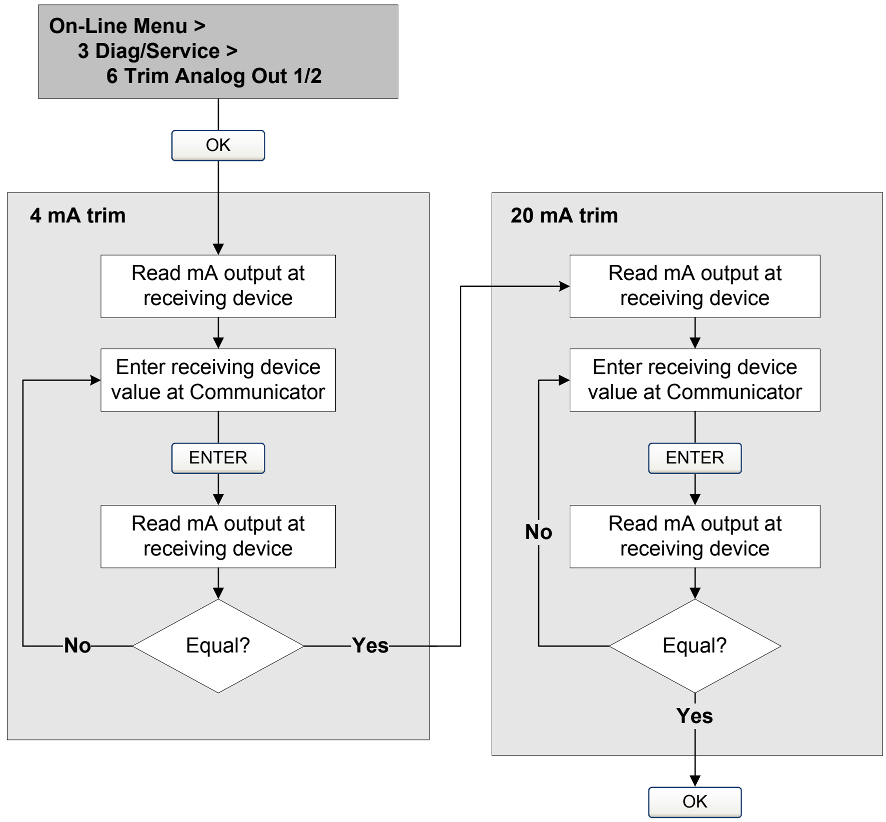
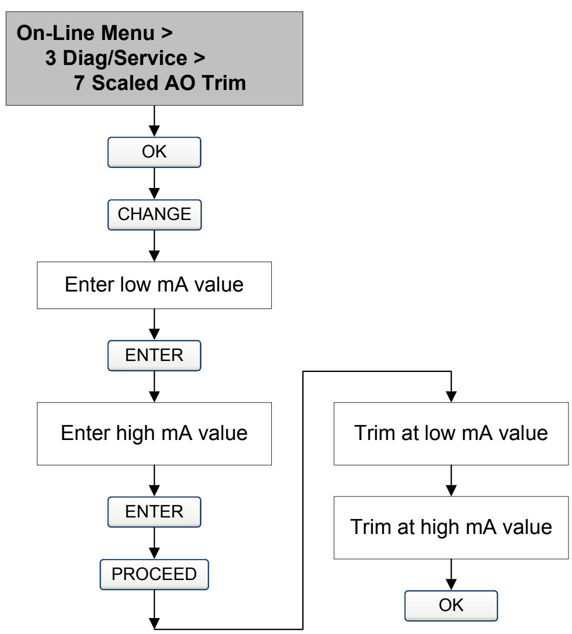


Figure 5-7 Communicator – Scaled AO trim procedure



5.5 Zeroing the flowmeter

Zeroing the flowmeter establishes the flowmeter's point of reference when there is no flow. The meter was zeroed at the factory, and should not require a field zero. However, you may wish to perform a field zero to meet local requirements or to confirm the factory zero.

When you zero the flowmeter, you may need to adjust the zero time parameter. *Zero time* is the amount of time the transmitter takes to determine its zero-flow reference point. The default zero time is 20 seconds.

- A *long* zero time may produce a more accurate zero reference but is more likely to result in a zero failure. This is due to the increased possibility of noisy flow, which causes incorrect calibration.
- A *short* zero time is less likely to result in a zero failure but may produce a less accurate zero reference.

For most applications, the default zero time is appropriate.

Note: Do not zero the flowmeter if a high severity alarm is active. Correct the problem, then zero the flowmeter. You may zero the flowmeter if a low severity alarm is active. See Section 7.4 for information on viewing transmitter status and alarms.

If the zero procedure fails, two recovery functions are provided:

- Restore prior zero
- Restore factory zero

If desired, you can use one of these functions to return the meter to operation while you are troubleshooting the cause of the zero failure (see Section 11.6). Both functions are available through ProLink II. Restoring the factory zero is available through the display. Neither function is available through the Communicator.

5.5.1 Preparing for zero

To prepare for the zero procedure:

1. Apply power to the flowmeter. Allow the flowmeter to warm up for approximately 20 minutes.
2. Run the process fluid through the sensor until the sensor temperature reaches the normal process operating temperature.
3. Close the shutoff valve downstream from the sensor.
4. Ensure that the sensor is completely filled with fluid.
5. Ensure that the process flow has completely stopped.

⚠ CAUTION

If fluid is flowing through the sensor during zero calibration, the calibration may be inaccurate, resulting in inaccurate process measurement.

To improve the sensor zero calibration and measurement accuracy, ensure that process flow through the sensor has completely stopped.

5.5.2 Zero procedure

To zero the flowmeter:

- Using the display menu, see Figure 5-8. For a complete illustration of the display zero menu, see Figure C-16.
- Using the zero button, see Figure 5-9.
- Using ProLink II, see Figure 5-10.
- Using the Communicator, see Figure 5-11.

Note the following:

- If the transmitter was ordered with a display:
  - The zero button is not available.
  - If the off-line menu has been disabled, you will not be able to zero the transmitter with the display. For information about enabling and disabling the off-line menu, see Section 8.10.3.
  - You cannot change the zero time with the display. If you need to change the zero time, you must use the Communicator or ProLink II.
- If the transmitter was ordered without a display, the zero button is available.
  - You cannot change the zero time with the zero button. If you need to change the zero time, you must use the Communicator or ProLink II.
  - The zero button is located on the user interface board, beneath the transmitter housing cover (see Figure 2-2). For instructions on removing the transmitter housing cover, see Section 2.3.
  - To press the zero button, use a fine-pointed object such as the end of a paperclip. Hold the button down until the status LED on the user interface module begins to flash yellow.
- During the zero procedure, the status LED on the user interface module flashes yellow.

Figure 5-8 **Display menu – Flowmeter zero procedure**

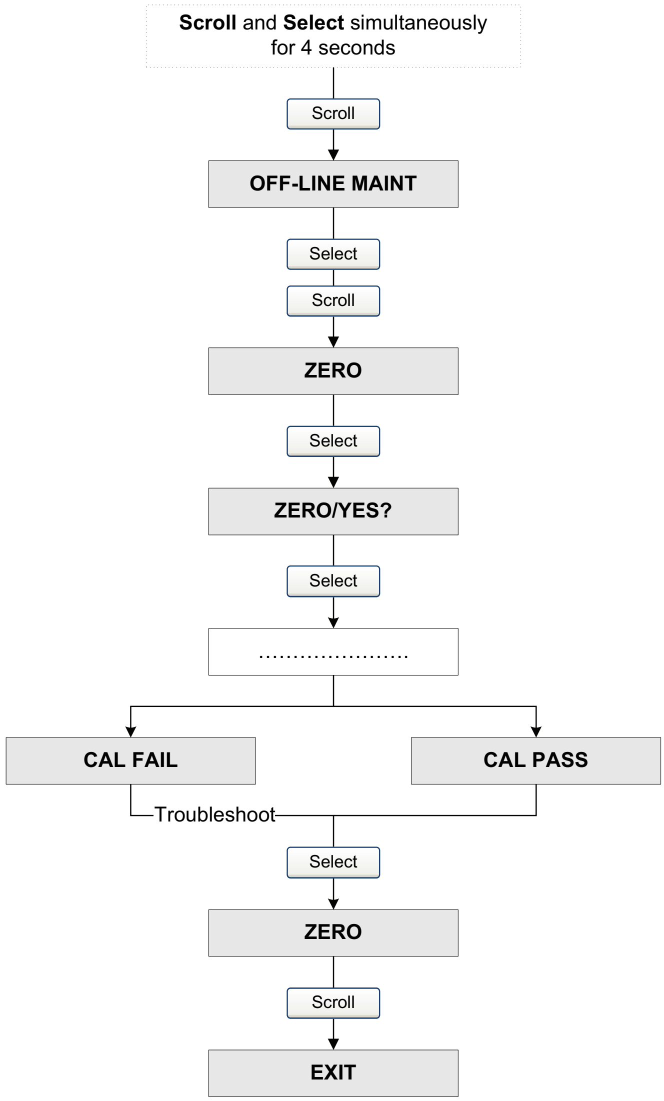


Figure 5-9 **Zero button – Flowmeter zero procedure**

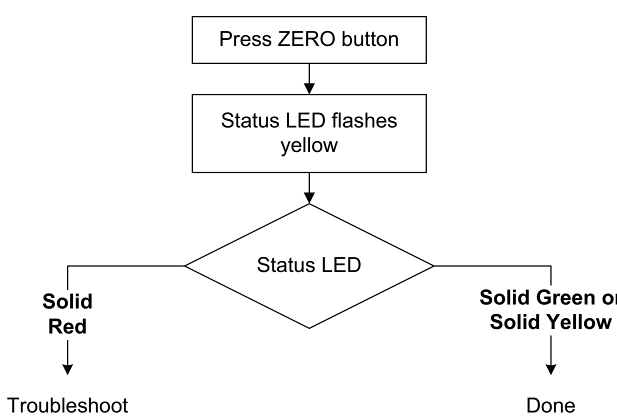


Figure 5-10 **ProLink II – Flowmeter zero procedure**

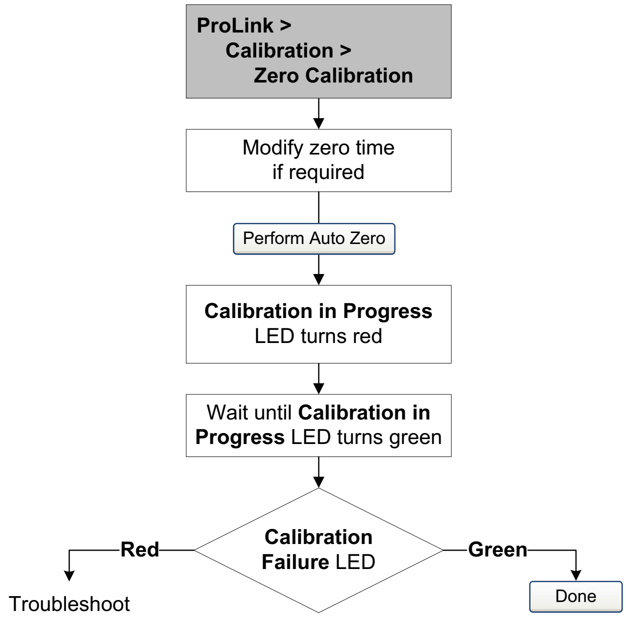
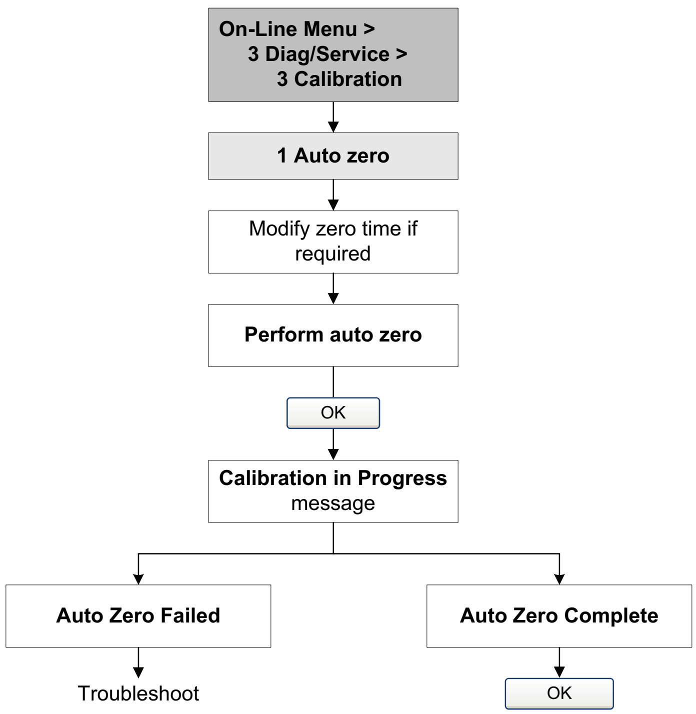


Figure 5-11 **Communicator – Flowmeter zero procedure**



Chapter 6
Required Transmitter Configuration

6.1 Overview

This chapter describes the configuration procedures that are usually required when a transmitter is installed for the first time.

The following procedures are discussed:

- Characterizing the flowmeter – see Section 6.2
- Configuring transmitter channels – see Section 6.3
- Configuring measurement units – see Section 6.4
- Configuring the mA output – see Section 6.5
- Configuring the frequency output – see Section 6.6
- Configuring the discrete output – see Section 6.7
- Configuring the discrete input – see Section 6.8

This chapter provides basic flowcharts for each procedure. For more detailed flowcharts, see the flowcharts for your transmitter and communication tool, provided in the appendices to this manual.

Default values and ranges for the parameters described in this chapter are provided in Appendix A.

For optional transmitter configuration parameters and procedures, see Chapter 8.

Note: All ProLink II procedures provided in this chapter assume that your computer is already connected to the transmitter and you have established communication. All ProLink II procedures also assume that you are complying with all applicable safety requirements. See Chapter 3 for more information.

Note: If you are using Pocket ProLink or AMS, the interface is similar to the ProLink II interface described in this chapter.

Note: All Communicator procedures provided in this chapter assume that you are starting from the “Online” menu. See Chapter 4 for more information.

6.2 Characterizing the flowmeter

Characterizing the flowmeter adjusts the transmitter to compensate for the unique traits of the sensor it is paired with. The characterization parameters, or calibration parameters, describe the sensor's sensitivity to flow, density, and temperature.

6.2.1 When to characterize

If the transmitter and sensor were ordered together, then the flowmeter has already been characterized. You need to characterize the flowmeter only if the transmitter and sensor are being paired together for the first time.

6.2.2 Characterization parameters

The characterization parameters that must be configured depend on your flowmeter's sensor type: "T-Series" or "Other" (also referred to as "Straight Tube" and "Curved Tube," respectively), as listed in Table 6-1. The "Other" category includes all Micro Motion sensors except T-Series.

The characterization parameters are provided on the sensor tag. See Figure 6-1 for illustrations of sensor tags.

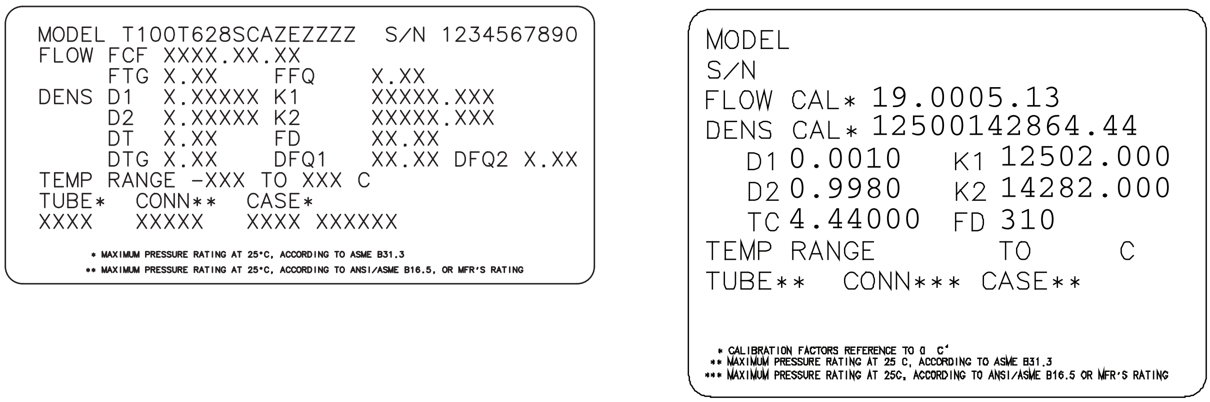
Table 6-1 Sensor calibration parameters

	Sensor type	
Parameter	**T-Series**	**Other**
K1	✓	✓
K2	✓	✓
FD	✓	✓
D1	✓	✓
D2	✓	✓
Temp coeff (DT)(1)	✓	✓
Flowcal		✓(2)
FCF	✓	
FTG	✓	
FFQ	✓	
DTG	✓	
DFQ1	✓	
DFQ2	✓	

(1) On some sensor tags, shown as TC.
(2) See the section entitled "Flow calibration values."

Figure 6-1 Sample calibration tags

T-Series | **Other sensors**



Flow calibration values

The flow calibration factor is a 10-character string that includes two decimal points. In ProLink II, this value is called the Flowcal parameter; in the Communicator, it is called the FCF for T-Series sensors, and Flowcal for other sensors.

To configure the flow calibration factor:

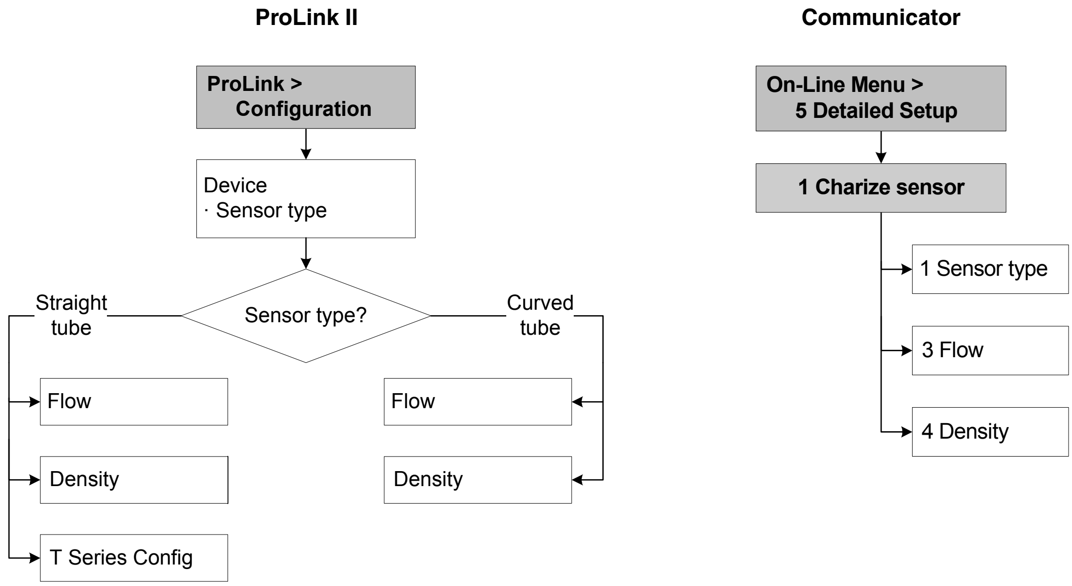
- For T-Series sensors, use the FCF value from the sensor tag. The value should be entered exactly as shown, including the decimal points.
- For all other sensors, use the Flow Cal value from the sensor tag. The value should be entered exactly as shown, including the decimal points.

6.2.3 How to characterize

To characterize the flowmeter:

1. See the menu flowcharts in Figure 6-2.
2. Ensure that the correct sensor type is configured.
3. Set required parameters, as listed in Table 6-1.

Figure 6-2 Characterizing the flowmeter



6.3 Configuring transmitter channels

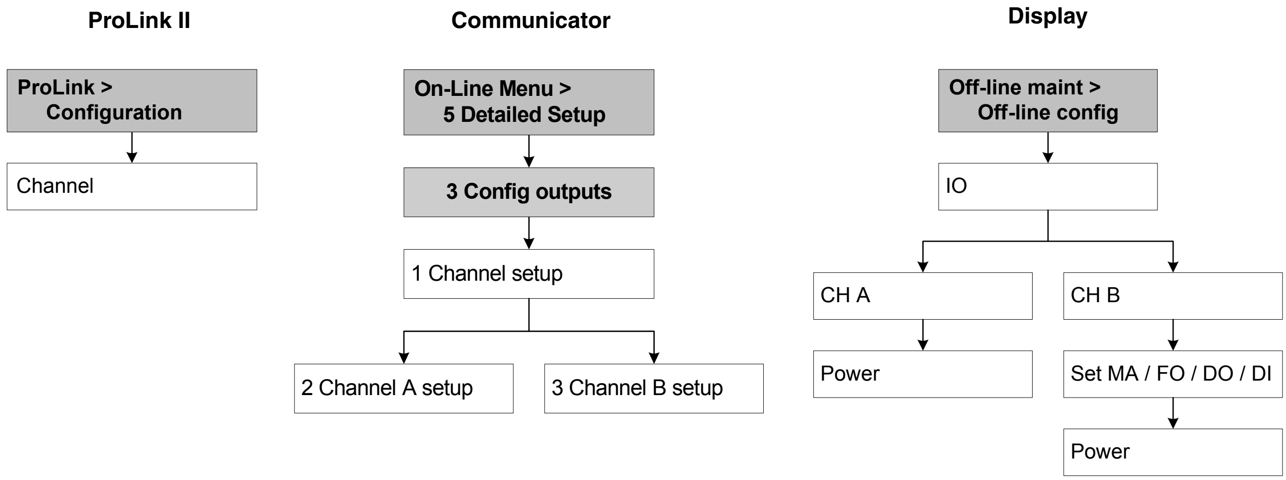
Both Channel A and Channel B can be powered internally (by the transmitter) or externally (by an external power source). You must configure the channel power source to match the output wiring (see the transmitter installation manual for wiring information).

Note: If you are connected to the transmitter via the HART clips or a HART multidrop network, and you reconfigure the power source for Channel A, you will lose the connection. You must change the wiring to match the software configuration, then reconnect. Alternatively, if your transmitter has a display, you can use the display to reset the power source to the previous setting and then reconnect. If you are connected to the transmitter via a Modbus or service port connection, your connection will not be affected.

Additionally, Channel B can function as a frequency/pulse output, a discrete output, or a discrete input. Because this configuration has consequences for many following configuration options, it is important to set Channel B correctly at the beginning of transmitter configuration.

To configure the channels, see the menu flowcharts in Figure 6-3.

Figure 6-3 Configuring the channels



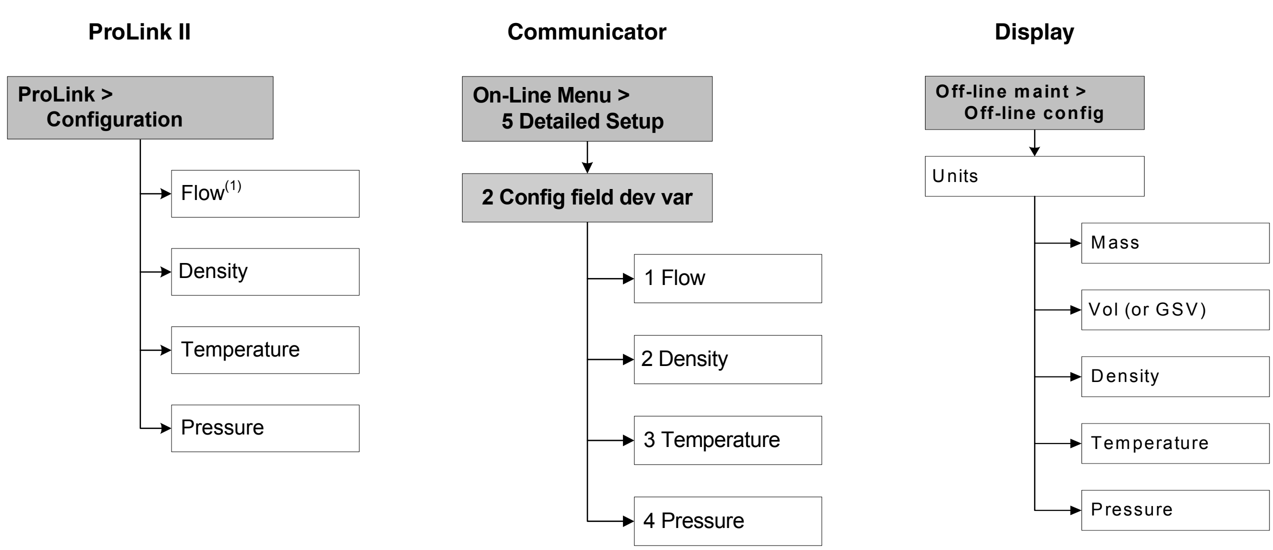
6.4 Configuring the measurement units

For each process variable, the transmitter must be configured to use the measurement unit appropriate to your application.

To configure measurement units, see the menu flowcharts in Figure 6-4. For details on measurement units for each process variable, see Sections 6.4.1 through 6.4.4.

Note: Pressure unit configuration is required only if you are using pressure compensation with polling. See Section 9.2.

Figure 6-4 Configuring measurement units



6.4.1 Mass flow units

The default mass flow measurement unit is **g/s**. See Table 6-2 for a complete list of mass flow measurement units.

If the mass flow unit you want to use is not listed, you can define a special measurement unit for mass flow (see Section 8.3).

Table 6-2 **Mass flow measurement units**

Mass flow unit			
Display	**ProLink II**	**Communicator**	**Unit description**
G/S	g/s	g/s	Grams per second
G/MIN	g/min	g/min	Grams per minute
G/H	g/hr	g/h	Grams per hour
KG/S	kg/s	kg/s	Kilograms per second
KG/MIN	kg/min	kg/min	Kilograms per minute
KG/H	kg/hr	kg/h	Kilograms per hour
KG/D	kg/day	kg/d	Kilograms per day
T/MIN	mTon/min	MetTon/min	Metric tons per minute
T/H	mTon/hr	MetTon/h	Metric tons per hour
T/D	mTon/day	MetTon/d	Metric tons per day
LB/S	lbs/s	lb/s	Pounds per second
LB/MIN	lbs/min	lb/min	Pounds per minute
LB/H	lbs/hr	lb/h	Pounds per hour
LB/D	lbs/day	lb/d	Pounds per day
ST/MIN	sTon/min	STon/min	Short tons (2000 pounds) per minute
ST/H	sTon/hr	STon/h	Short tons (2000 pounds) per hour
ST/D	sTon/day	STon/d	Short tons (2000 pounds) per day
LT/H	lTon/hr	LTon/h	Long tons (2240 pounds) per hour
LT/D	lTon/day	LTon/d	Long tons (2240 pounds) per day
SPECL	special	Spcl	Special unit (see Section 8.3)

6.4.2 Volume flow units

The default volume flow measurement unit is **L/s**. Two different sets of volume flow measurement units are provided:

- Units typically used for liquid volume – see Table 6-3
- Units typically used for gas volume– see Table 6-4

By default, only liquid volume flow units are listed. To access the gas volume flow units, you must first use ProLink II to configure Vol Flow Type. See Section 8.2.

Note: The Communicator cannot be used to configure gas volume flow units. If a volume flow unit for gas is configured, the Communicator will display "Unknown Enumerator" for the units label.

If the volume flow unit you want to use is not listed, you can define a special measurement unit for volume flow (see Section 8.3).

Table 6-3 Volume flow measurement units – Liquid

Volume flow unit			
Display	ProLink II	Communicator	Unit description
CUFT/S	ft3/sec	Cuft/s	Cubic feet per second
CUF/MN	ft3/min	Cuft/min	Cubic feet per minute
CUFT/H	ft3/hr	Cuft/h	Cubic feet per hour
CUFT/D	ft3/day	Cuft/d	Cubic feet per day
M3/S	m3/sec	Cum/s	Cubic meters per second
M3/MIN	m3/min	Cum/min	Cubic meters per minute
M3/H	m3/hr	Cum/h	Cubic meters per hour
M3/D	m3/day	Cum/d	Cubic meters per day
USGPS	US gal/sec	gal/s	U.S. gallons per second
USGPM	US gal/min	gal/min	U.S. gallons per minute
USGPH	US gal/hr	gal/h	U.S. gallons per hour
USGPD	US gal/d	gal/d	U.S. gallons per day
MILG/D	mil US gal/day	MMgal/d	Million U.S. gallons per day
L/S	l/sec	L/s	Liters per second
L/MIN	l/min	L/min	Liters per minute
L/H	l/hr	L/h	Liters per hour
MILL/D	mil l/day	ML/d	Million liters per day
UKGPS	Imp gal/sec	Impgal/s	Imperial gallons per second
UKGPM	Imp gal/min	Impgal/min	Imperial gallons per minute
UKGPH	Imp gal/hr	Impgal/h	Imperial gallons per hour
UKGPD	Imp gal/day	Impgal/d	Imperial gallons per day
BBL/S	barrels/sec	bbl/s	Barrels per second(1)
BBL/MN	barrels/min	bbl/min	Barrels per minute(1)
BBL/H	barrels/hr	bbl/h	Barrels per hour(1)
BBL/D	barrels/day	bbl/d	Barrels per day(1)
BBBL/S	Beer barrels/sec	bbbl/s	Beer barrels per second(2)
BBBL/MN	Beer barrels/min	bbbl/min	Beer barrels per minute(2)
BBBL/H	Beer barrels/hr	bbbl/h	Beer barrels per hour(2)
BBBL/D	Beer barrels/day	bbbl/d	Beer barrels per day(2)
SPECL	special	Spcl	Special unit (see Section 8.3)

(1) Unit based on oil barrels (42 U.S gallons).
(2) Unit based on beer barrels (31 U.S gallons).

Table 6-4 Volume flow measurement units – Gas

Volume flow unit			
Display	**ProLink II**	**Communicator**	**Unit description**
NM3/S	Nm3/sec	Not available	Normal cubic meters per second
NM3/MN	Nm3/min	Not available	Normal cubic meters per minute
NM3/H	Nm3/hr	Not available	Normal cubic meters per hour
NM3/D	Nm3/day	Not available	Normal cubic meters per day
NLPS	NLPS	Not available	Normal liter per second
NLPM	NLPM	Not available	Normal liter per minute
NLPH	NLPH	Not available	Normal liter per hour
NLPD	NLPD	Not available	Normal liter per day
SCFS	SCFS	Not available	Standard cubic feet per second
SCFM	SCFM	Not available	Standard cubic feet per minute
SCFH	SCFH	Not available	Standard cubic feet per hour
SCFD	SCFD	Not available	Standard cubic feet per day
SM3/S	Sm3/S	Not available	Standard cubic meters per second
SM3/MN	Sm3/min	Not available	Standard cubic meters per minute
SM3/H	Sm3/hr	Not available	Standard cubic meters per hour
SM3/D	Sm3/day	Not available	Standard cubic meters per day
SLPS	SLPS	Not available	Standard liter per second
SLPM	SLPM	Not available	Standard liter per minute
SLPH	SLPH	Not available	Standard liter per hour
SLPD	SLPD	Not available	Standard liter per day
SPECL	special	Spcl	Special unit (see Section 8.3)

6.4.3 Density units

The default density measurement unit is **g/cm3**. See Table 6-2 for a complete list of density measurement units.

Table 6-5 Density measurement units

Density unit			
Display	**ProLink II**	**Communicator**	**Unit description**
SGU	SGU	SGU	Specific gravity unit (not temperature corrected)
G/CM3	g/cm3	g/Cucm	Grams per cubic centimeter
G/L	g/l	g/L	Grams per liter
G/ML	g/ml	g/mL	Grams per milliliter
KG/L	kg/l	kg/L	Kilograms per liter
KG/M3	kg/m3	kg/Cum	Kilograms per cubic meter
LB/GAL	lbs/Usgal	lb/gal	Pounds per U.S. gallon
LB/CUF	lbs/ft3	lb/Cuft	Pounds per cubic foot
LB/CUI	lbs/in3	lb/CuIn	Pounds per cubic inch
ST/CUY	sT/yd3	STon/Cuyd	Short ton per cubic yard

6.4.4 Temperature units

The default temperature measurement unit is °**C**. See Table 6-6 for a complete list of temperature measurement units.

Table 6-6 Temperature measurement units

Temperature unit			
Display	**ProLink II**	**Communicator**	**Unit description**
°C	°C	degC	Degrees Celsius
°F	°F	degF	Degrees Fahrenheit
°R	°R	degR	Degrees Rankine
°K	°K	Kelvin	Kelvin

6.4.5 Pressure units

The flowmeter does not measure pressure. You need to configure the pressure units if either of the following is true:

- You will configure pressure compensation (see Section 9.2). In this case, configure the pressure unit to match the pressure unit used by the external pressure device.
- You will use the Gas Wizard, you will enter a reference pressure value, and you need to change the pressure unit to match the reference pressure value (see Section 8.2.1).

If you do not know whether or not you will use pressure compensation or the Gas Wizard, you do not need to configure a pressure unit at this time. You can always configure the pressure unit later.

The default pressure measurement unit is **PSI**. See Table 6-7 for a complete list of pressure measurement units.

Table 6-7 Pressure measurement units

Pressure unit			
Display	**ProLink II**	**Communicator**	**Unit description**
FTH2O	Ft Water @ 68°F	ftH2O	Feet water @ 68 °F
INW4C	In Water @ 4°C	inH2O @4DegC	Inches water @ 4 °C
INW60	In Water @ 60°F	inH2O @60DegF	Inches water @ 60 °F
INH2O	In Water @ 68°F	inH2O	Inches water @ 68 °F
mmW4C	mm Water @ 4°C	mmH2O @4DegC	Millimeters water @ 4 °C
mmH2O	mm Water @ 68°F	mmH2O	Millimeters water @ 68 °F
mmHG	mm Mercury @ 0°C	mmHg	Millimeters mercury @ 0 °C
INHG	In Mercury @ 0°C	inHg	Inches mercury @ 0 °C
PSI	PSI	psi	Pounds per square inch
BAR	bar	bar	Bar
mBAR	millibar	mbar	Millibar
G/SCM	g/cm2	g/Sqcm	Grams per square centimeter
KG/SCM	kg/cm2	kg/Sqcm	Kilograms per square centimeter
PA	pascals	Pa	Pascals
KPA	Kilopascals	kPa	Kilopascals

Table 6-7 Pressure measurement units *continued*

Pressure unit			
Display	**ProLink II**	**Communicator**	**Unit description**
MPA	megapascals	MPa	Megapascals
TORR	Torr @ 0C	torr	Torr @ 0 °C
ATM	atms	atms	Atmospheres

6.5 Configuring the mA output

The Model 2400S AN transmitter has one mA output. Table 6-8 lists the parameters that must be set for the mA output, and shows the names used for each parameter by the display, ProLink II, and the Communicator.

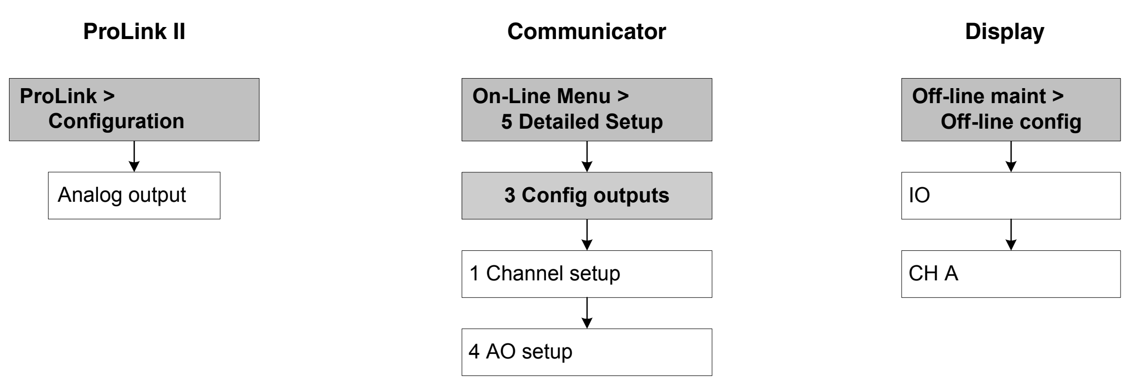
Table 6-8 mA output configuration parameters

Parameter name		
ProLink II	**Communicator**	**Display**
Primary variable	PV	SRC
Lower range value	PV LRV	4 MA
Upper range value	PV URV	20 MA
AO cutoff	PV AO cutoff	Not applicable
AO added damp	PV AO added damp	Not applicable
AO fault action	AO1 fault indicator	Not applicable
AO fault level	mA1 fault value	Not applicable

To configure the mA output, see the menu flowcharts in Figure 6-5. For details on mA output parameters, see Sections 6.5.1 through 6.5.4.

Note: If you use the display to configure the mA output, you can configure only the process variable and the range. To configure other mA output parameters, use ProLink II or the Communicator.

Figure 6-5 Configuring the mA output



6.5.1 Configuring the process variable

You can configure the process variable to be reported through the mA output. Table 6-9 lists the process variables that can be assigned to the mA output.

Table 6-9 mA output process variable assignments

Process variable	ProLink II code	Communicator code	Display code
Mass flow rate	Mass Flow	Mass flo	MFLOW
Volume flow rate	Vol Flow	Vol flo	VFLOW
Gas standard volume flow rate	Gas Std Vol Flow Rate	Gas vol flo	GSV F
Temperature	Temp	Temp	TEMP
External temperature	External temperature	External temperature	EXT T
External pressure	External pressure	External pres	EXT P
Density	Density	Dens	DENS
Drive gain	Drive Gain	Drive gain	DGAIN

Note: The process variable assigned to the mA output is always the PV (primary variable) defined for HART communications. You can specify this process variable either by configuring the mA output or by configuring the PV (see Section 8.11.7). If you change the process variable assigned to the mA output, the PV assignment is changed automatically, and vice versa.

6.5.2 Configuring the mA output range (LRV and URV)

The mA output uses a range of 4 to 20 mA to represent the assigned process variable. You must specify:

- The lower range value (LRV) – the value of the process variable that will be indicated when the mA output produces 4 mA
- The upper range value (URV) – the value of the process variable that will be indicated when the mA output produces 20 mA

Enter values in the measurement units that are configured for the assigned process variable (see Section 6.4).

Note: The URV can be set below the LRV; for example, the URV can be set to 0 and the LRV can be set to 100.

6.5.3 Configuring the AO cutoff

The AO (analog output) cutoff specifies the lowest mass flow or volume flow value that will be reported through the mA output. Any mass flow or volume flow values below the AO cutoff will be reported as zero.

AO cutoff can be configured only if the process variable assigned to the mA output is mass flow or volume flow. If an mA output has been configured for a process variable other than mass flow or volume flow, the AO cutoff menu option is not displayed for that output.

Note: For most applications, the default AO cutoff is used. Contact Micro Motion customer support before changing the AO cutoff.

Multiple cutoffs

Cutoffs can also be configured for the mass flow and volume flow process variables (see Section 8.4). If mass flow or volume flow has been assigned to the mA output, a non-zero value is configured for the flow cutoff, and the AO cutoff is also configured, the cutoff occurs at the highest setting, as shown in the following examples.

Example

Configuration:

- mA output: Mass flow
- Frequency output: Mass flow
- AO cutoff for mA output: 10 g/sec
- Mass flow cutoff: 15 g/sec

As a result, if the mass flow rate drops below 15 g/sec, all outputs representing mass flow will report zero flow.

Example

Configuration:

- mA output: Mass flow
- Frequency output: Mass flow
- AO cutoff for mA output: 15 g/sec
- Mass flow cutoff: 10 g/sec

As a result:

- If the mass flow rate drops below 15 g/sec but not below 10 g/sec:
  - The mA output will report zero flow.
  - The frequency output will report nonzero flow.
- If the mass flow rate drops below 10 g/sec, both outputs will report zero flow.

6.5.4 Configuring added damping

A *damping* value is a period of time, in seconds, over which the process variable value will change to reflect 63% of the change in the actual process. Damping helps the transmitter smooth out small, rapid measurement fluctuations:

- A high damping value makes the output appear to be smoother because the output must change slowly.
- A low damping value makes the output appear to be more erratic because the output changes more quickly.

The Added Damping parameter specifies damping that will be applied to the mA output. It affects the measurement of the process variable assigned to the mA output, but does not affect the frequency or digital outputs.

Note: For most applications, the default added damping value is used. Contact Micro Motion customer support before changing the Added Damping parameter.

Multiple damping parameters

Damping can also be configured for the flow (mass and volume), density, and temperature process variables (see Section 8.5). If one of these process variables has been assigned to the mA output, a non-zero value is configured for its damping, and added damping is also configured for the mA output, the effect of damping the process variable is calculated first, and the added damping calculation is applied to the result of that calculation. See the following example.

Example

Configuration:

- Flow damping: 1
- mA output: Mass flow
- Frequency output: Mass flow
- mA output added damping: 2

As a result:

- A change in mass flow will be reflected in the mA output over a time period that is greater than 3 seconds. The exact time period is calculated by the transmitter according to internal algorithms which are not configurable.
- The frequency output level changes over a 1-second time period (the flow damping value). It is not affected by the added damping value.

6.5.5 Configuring the fault indicator and fault value

If the transmitter encounters an internal fault condition, it will indicate the fault by sending a preprogrammed output level to the receiving device. You can specify the output level by configuring the fault indicator. Options are shown in Table 6-10.

Note: By default, the transmitter immediately reports a fault when a fault is encountered. You can delay reporting faults by changing the fault timeout. See Section 8.9.

Table 6-10 mA output fault indicators and values

Fault indicator	Fault output value
Upscale	21–24 mA (user-configurable; default: 22 mA)
Downscale	1.0–3.6 mA (user-configurable; default: 2.0 mA)
Internal zero	The value associated with 0 (zero) flow, as determined by URV and LRV values
None	Tracks data for the assigned process variable; no fault action

⚠ CAUTION

Setting the fault indicator to NONE may result in process error due to undetected fault conditions.

To avoid undetected fault conditions when the fault indicator is set to NONE, use some other mechanism such as digital communication to monitor device status.

6.6 Configuring the frequency output

Note: This section is applicable only if Channel B has been configured as a frequency output. See Section 6.3.

The frequency output generates two voltage levels:

- 0 V
- A site-specific voltage, determined by the power supply, pull-up resistor, and load (see the installation manual for your transmitter)

If Channel B is configured as a frequency output, you must configure the parameters listed in Table 6-11. Table 6-11 also shows the names used for each parameter by the display, ProLink II, and the Communicator.

Table 6-11 Frequency output configuration parameters

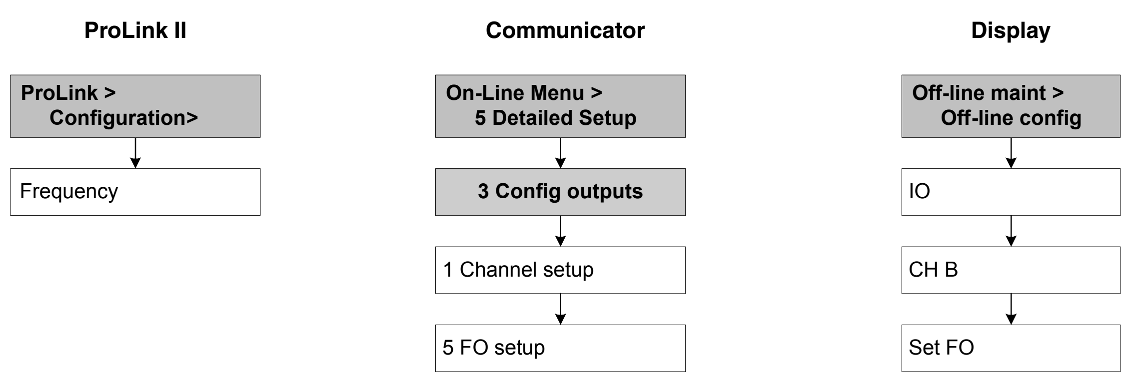
Parameter name		
ProLink II	**Communicator**	**Display**
Tertiary variable	TV	SRC
Scaling method • Freq = flow • Freq factor[1] • Rate factor[1] • Pulses/unit • Units/pulse	FO scale method • Freq = flow • TV freq factor[1] • TV rate factor[1] • TV pulses/unit • TV units/pulse	Not applicable
Freq pulse width	Max pulse width	Not applicable
Freq output polarity	FO polarity	POLAR
Freq fault action	FO fault indicator	Not applicable

(1) Displayed only if Scaling Method is set to Freq = Flow.

To configure the frequency output, see the menu flowcharts in Figure 6-6. For details on frequency output parameters, see Sections 6.6.1 through 6.6.5.

Note: If you use the display to configure the frequency output, you can configure only the process variable and the parameters used by the Frequency = Flow scaling method. To configure other frequency output parameters, use ProLink II or the Communicator.

Figure 6-6 Configuring the frequency output



6.6.1 Configuring the process variable

Table 6-12 lists the process variables that can be assigned to the frequency output.

Table 6-12 Frequency output process variable assignments

Process variable	ProLink II code	Communicator code	Display code
Mass flow	Mass Flow	Mass flo	MFLOW
Volume flow	Vol Flow	Vol flo	VFLOW

Note: The process variable assigned to the frequency output is always the TV (tertiary variable) defined for HART communications. You can specify this process variable either by configuring the frequency output or by configuring the TV (see Section 8.11.7). If you change the process variable assigned to the frequency output, the TV assignment is changed automatically, and vice versa.

If your transmitter does not have a frequency output, the TV assignment must be configured directly (see Section 8.11.7), and the value of the TV must be queried through a HART connection.

6.6.2 Configuring the output scale

The frequency *output scale* defines the relationship between output pulse and flow units. You can select one of three output scale methods, as listed in Table 6-13.

Table 6-13 Frequency output scale methods and required parameters

Method	Description	Required parameters
Frequency = flow	• Frequency calculated from flow rate as described below	• *TV frequency factor* • *TV rate factor*
Pulses per unit	• A user-specified number of pulses represents one flow unit	• *TV pulses/unit*
Units per pulse	• A pulse represents a user-specified number of flow units	• *TV units/pulse*

Frequency=flow

If you specify Frequency = Flow, you must also specify TV Frequency Factor and TV Rate Factor. TV Rate Factor is defined as the maximum flowrate appropriate to your application. TV Frequency Factor can then be calculated using the following formula:

$$\text{FrequencyFactor} = \frac{\text{Rate}}{\text{T}} \times \text{N}$$

where:

- Rate = maximum appropriate flowrate (TV Rate Factor in configuration)
- T = factor to convert selected flow time base to seconds
- N = number of pulses per flow unit, as configured in the receiving device

The resulting TV Frequency Factor value must be within the range of the frequency output (0 to 10,000 Hz).

- If the TV Frequency Factor value is less than 1 Hz, reconfigure the receiving device for a higher pulses/unit setting.
- If the TV Frequency Factor value is greater than 10,000 Hz, reconfigure the receiving device for a lower pulses/unit setting.

Example

Maximum appropriate flowrate (TV Rate Factor) is 2000 lbs/min.

Receiving device is configured for 10 pulses/pound.

Solution:

$$\text{FrequencyFactor} = \frac{\text{Rate}}{T} \times N$$

$$\text{FrequencyFactor} = \frac{2000}{60} \times 10$$

$$\text{FrequencyFactor} = 333.33$$

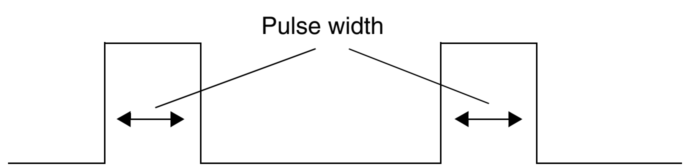
Configuration:

- TV Frequency Factor = 333.33
- TV Rate Factor = 2000

6.6.3 Configuring the maximum pulse width

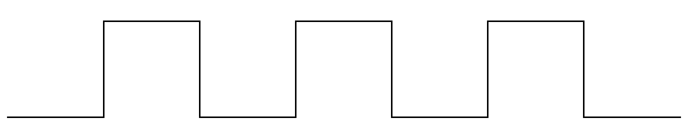
The frequency output *maximum pulse width* defines the maximum duration of each pulse the transmitter sends to the frequency receiving device, as shown in Figure 6-7.

Figure 6-7 Pulse width



Maximum Pulse Width can be set to 0, or to values between 0.01 and 655.35 milliseconds, in 0.01 millisecond increments. If Maximum Pulse Width is set to 0 (the default), the output will have a 50% duty cycle, no matter what the frequency is. A 50% duty cycle is illustrated in Figure 6-8.

Figure 6-8 50% duty cycle



If Maximum Pulse Width is set to a non-zero value, the duty cycle is controlled by the *crossover frequency*. The crossover frequency is calculated as follows:

$$\text{Crossover frequency} = \frac{1}{2 \times \text{max pulse width}}$$

- At frequencies below the crossover frequency, the duty cycle is determined by the pulse width and the frequency.
- At frequencies above the crossover frequency, the output changes to a 50% duty cycle.

You can change the setting for Maximum Pulse Width so that the transmitter will output a pulse width appropriate to your receiving device:

- High-frequency counters such as frequency-to-voltage converters, frequency-to-current converters, and Micro Motion peripherals usually require approximately a 50% duty cycle.
- Electromechanical counters and PLCs that have low-scan cycle rates generally use an input with a fixed nonzero state duration and a varying zero state duration. Most low-frequency counters have a specified requirement for Maximum Pulse Width.

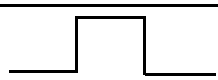
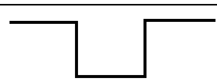
Note: For typical applications, the default pulse width is used.

Example	The frequency output is wired to a PLC with a specified pulse width requirement of 50 ms. The crossover frequency is 10 Hz. Solution: • Set Max Pulse Width to 50 ms. • For frequencies less than 10 Hz, the frequency output will have a 50 msec ON state, and the OFF state will be adjusted as required. For frequencies higher than 10 Hz, the frequency output will be a square wave with a 50% duty cycle.

6.6.4 Configuring the frequency output polarity

The frequency output *polarity* controls how the output indicates the active (ON) state. See Table 6-14. The default value, Active High, is appropriate for most applications. Active Low may be required by applications that use low-frequency signals.

Table 6-14 Polarity settings and frequency output levels

Polarity		Reference voltage (OFF)	Pulse voltage (ON)
Active high		0	As determined by power supply, pull-up resistor, and load (see the installation manual for your transmitter)
Active low		As determined by power supply, pull-up resistor, and load (see the installation manual for your transmitter)	0

6.6.5 Configuring the fault indicator

If the transmitter encounters an internal fault condition, it will indicate the fault by sending a preprogrammed output level to the receiving device. You can specify the output level by configuring the fault indicator. See Table 6-15.

Note: By default, the transmitter immediately reports a fault when a fault is encountered. You can delay reporting faults by changing the fault timeout. See Section 8.9.

Table 6-15 **Frequency output fault indicators and values**

Fault indicator	Fault output value
Upscale	10–15,000 Hz (user-configurable; default: 15,000 Hz)
Downscale	0 Hz
Internal zero	0 Hz
None	Tracks the data for the assigned process variable; no fault action

⚠ CAUTION

Setting the fault indicator to NONE may result in process error due to undetected fault conditions.

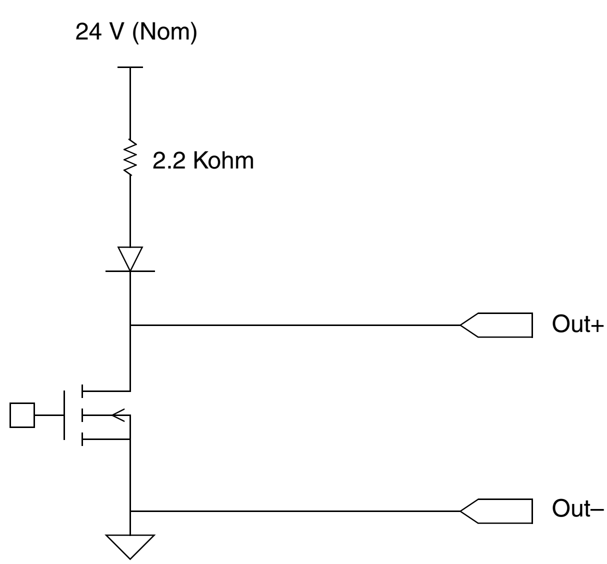
To avoid undetected fault conditions when the fault indicator is set to NONE, use some other mechanism such as digital communication to monitor device status.

6.7 Configuring the discrete output

Note: This section is applicable only if Channel B has been configured as a discrete output. See Section 6.3.

The discrete output generates two voltage levels to represent ON or OFF states. The voltage levels depend on the output's polarity, as shown in Table 6-17. Figure 6-9 shows a diagram of a typical discrete output circuit.

Figure 6-9 **Discrete output circuit**



If Channel B is configured as a discrete output, you must configure the parameters listed in Table 6-16. Table 6-16 also shows the names used for each parameter by the display, ProLink II, and the Communicator.

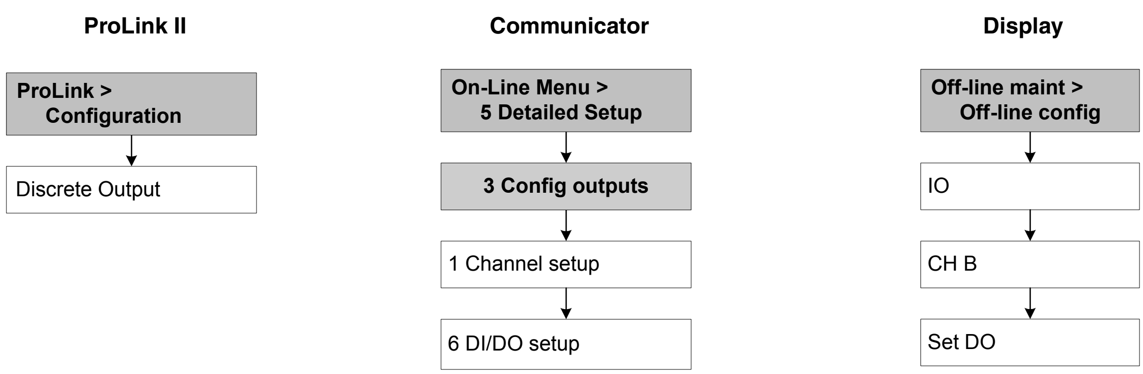
Table 6-16 Discrete output configuration parameters

Parameter name		
ProLink II	**Communicator**	**Display**
DO1 assignment	DO 1 is	SRC
Flow switch variable(1)	Flow switch variable(1)	SOURCE FL SW
Flow switch setpoint(1)	Flow switch setpoint(1)	SETPOINT FL SW
DO1 polarity	DO 1 polarity	POLAR
DO fault action	DO fault indication	Not applicable

(1) Displayed only if flow switch is assigned to the discrete output.

To configure the discrete output, see the menu flowcharts in Figure 6-10. For details on discrete output parameters, see Sections 6.7.1 through 6.7.3.

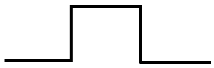
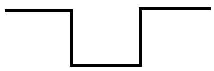
Figure 6-10 Configuring the discrete output



6.7.1 Polarity

Polarity controls how voltage levels are used to indicate the ON and OFF states of the output, as described in Table 6-17.

Table 6-17 Discrete output polarity

Polarity	Output power supply	Description
Active high 	Internal	• When asserted (condition tied to DO is true), the circuit provides a pull-up to 24 V. • When not asserted (condition tied to DO is false), the circuit provides 0 V.
	External	• When asserted (condition tied to DO is true), the circuit provides a pull-up to a site-specific voltage, maximum 30 V. • When not asserted (condition tied to DO is false), the circuit provides 0 V.
Active low 	Internal	• When asserted (condition tied to DO is true), the circuit provides 0 V. • When not asserted (condition tied to DO is false), the circuit provides a pull-up to 24 V.
	External	• When asserted (condition tied to DO is true), the circuit provides 0 V. • When not asserted (condition tied to DO is false), the circuit provides a pull-up to a site-specific voltage, to a maximum of 30 V.

6.7.2 Assignment

The discrete output can be used to report the conditions described in Table 6-18.

Table 6-18 Discrete output assignments and output levels

Assignment	ProLink II code	Communicator code	Display code	Condition	Discrete output level(1)
Discrete events 1 – 5 (see Section 8.7)	Discrete Event *x*	Discrete Event *x*	EVNT*x*	ON	Site-specific
				OFF	0 V
Flow switch	Flow Switch Indication	Flow Switch	FL SW	ON	Site-specific
				OFF	0 V
Flow direction	Forward/Reverse Indication	Forward/Reverse	FLDIR	Forward	0 V
				Reverse	Site-specific
Calibration in progress	Cal in Progress	Calibration in progress	ZERO	ON	Site-specific
				OFF	0 V
Fault(2)	Fault Condition Indication	Fault	FAULT	ON	Site-specific
				OFF	0 V
Meter verification fault(3)	Meter Verification Fault	Not available	Not available	ON	Site-specific
				OFF	0 V

(1) Voltage descriptions in this column assume that Polarity is set to Active High. If Polarity is set to Active Low, the voltages are reversed.
(2) Voltage descriptions for Fault assume that the fault indicator is set to Upscale. See Section 6.7.3 for more information.
(3) Requires Smart Meter Verification.

Flow switch

Flow switch refers to the flow rate moving past a user-configured setpoint, in either direction. For example, if the setpoint is 100 lb/min, a flow switch occurs if the flow rate changes from 101 lb/min to 99 lb/min, or from 99 lb/min to 101 lb/min.

The flow switch has a 5% hysteresis. For example, if the setpoint is 100 lb/min, the flow switch will be triggered when the flow rate falls below 100 lb/min, but not turned off until a 5% (5 lb/min) change occurs (i.e., the flow rate rises to 105 lb/min).

If Flow Switch is assigned to the discrete output, you must specify the flow variable that the switch will represent, and you must configure the flow switch setpoint.

6.7.3 Fault action

If the transmitter encounters an internal fault condition, it can set the discrete output to either ON or OFF. See Table 6-19.

Note: By default, the transmitter immediately reports a fault when a fault is encountered. You can delay reporting faults by changing the fault timeout. See Section 8.9.

Table 6-19 Discrete output fault actions

			Discrete output voltage	
ProLink II	**Communicator**	**Fault state**	**Polarity = Active high**	**Polarity = Active low**
Upscale	Upscale	Fault	ON (site-specific voltage)	ON (0 V)
		No fault	Discrete output is controlled by its assignment	
Downscale	Downscale	Fault	OFF (0 V)	OFF (ste-specific voltage)
		No fault	Discrete output is controlled by its assignment	
None (default)	None (default)	Not applicable	Discrete output is controlled by its assignment	

6.8 Configuring the discrete input

Note: This section is applicable only if Channel B has been configured as a discrete input. See Section 6.3.

The discrete input is used to initiate a transmitter action from a remote input device.

If Channel B is configured as a discrete input, you must configure the parameters listed in Table 6-20. Table 6-20 also shows the names used for each parameter by the display, ProLink II, and the Communicator.

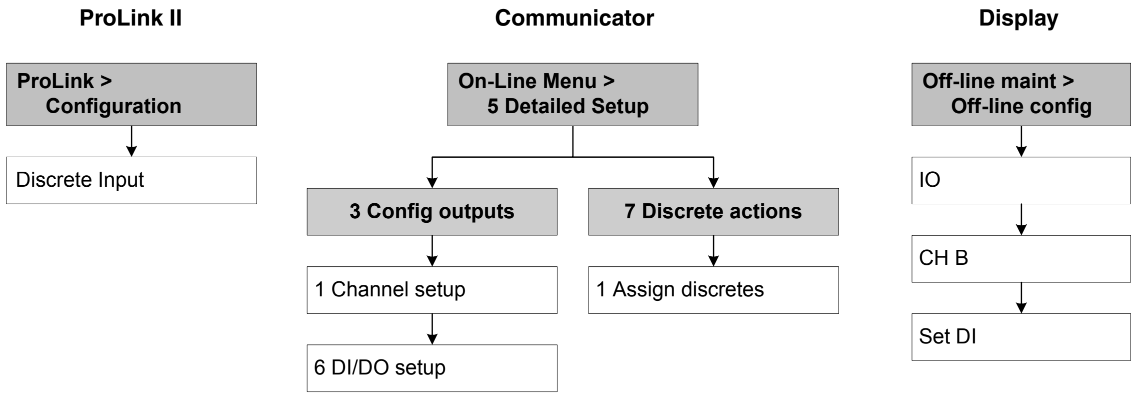
Table 6-20 Discrete input configuration parameters

Parameter name		
ProLink II	**Communicator**	**Display**
Assignment	Discretes	ACT
Polarity	DI 1 polarity	POLAR

To configure the discrete input, see the menu flowcharts in Figure 6-11. For details on discrete input parameters, see Sections 6.8.1 and 6.8.2.

Note: The ProLink II and Communicator menus described here are also used to assign actions to events. To configure events, see Section 8.7.

Figure 6-11 Configuring the discrete input



6.8.1 Assignment

If your transmitter has been configured for a discrete input, the actions listed in Table 6-21 may be assigned to the discrete input. You may assign more than one action to the discrete input.

Table 6-21 Discrete input assignments

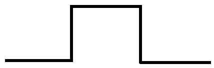
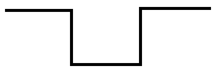
Assignment	ProLink II code	Communicator code	Display code
None (default)	None	None	NONE
Start zero procedure	Start Sensor Zero	Start sensor zero	START ZERO
Reset mass total	Reset Mass Total	Reset mass total	RESET MASS
Reset volume total	Reset Volume Total	Reset volume total	RESET VOL
Reset all totals	Reset All Totals	Reset all totals	RESET ALL
Start/stop all totalizers	Start/Stop All Totalization	Start/stop totals	START/STOP
Reset gas standard volume total	Reset Gas Std Volume Total	Reset gas standard volume total	RESET GSVT
Start a meter verification test[1]	Start Meter Verification	Not available	START VERFY

(1) Requires Smart Meter Verification.

6.8.2 Polarity

Polarity controls which voltage levels are used to indicate the ON and OFF states of the input, as described in Table 6-17.

Table 6-22 Discrete input polarity

Polarity	Input power supply	DI status	Description
Active high 	Internal	ON	Voltage across terminals is high
		OFF	Voltage across terminals is zero
	External	ON	Voltage applied across terminals is 3–30 VDC
		OFF	Voltage applied across terminals is <0.8 VDC
Active low 	Internal	ON	Voltage across terminals is zero
		OFF	Voltage across terminals is high
	External	ON	Voltage applied across terminals is <0.8 VDC
		OFF	Voltage applied across terminals is 3–30 VDC

Chapter 7
Using the Transmitter

7.1 Overview

This chapter describes how to use the transmitter in everyday operation. The following topics and procedures are discussed:

- Recording process variables – see Section 7.2
- Viewing process variables – see Section 7.3
- Viewing transmitter status and alarms – see Section 7.4
- Handling status alarms – see Section 7.5
- Viewing and using the totalizers and inventories – see Section 7.6

Note: All ProLink II procedures provided in this section assume that your computer is already connected to the transmitter and you have established communication. All ProLink II procedures also assume that you are complying with all applicable safety requirements. See Chapter 3 for more information.

Note: If you are using Pocket ProLink or AMS, the interface is similar to the ProLink II interface described in this chapter.

Note: All Communicator key sequences in this section assume that you are starting from the "Online" menu. See Chapter 4 for more information.

7.2 Recording process variables

Micro Motion suggests that you make a record of the process variables listed below, under normal operating conditions. This will help you recognize when the process variables are unusually high or low, and may help in fine-tuning transmitter configuration.

Record the following process variables:

- Flow rate
- Density
- Temperature
- Tube frequency
- Pickoff voltage
- Drive gain

For information on using this information in troubleshooting, see Section 11.13.

7.3 Viewing process variables

Process variables include measurements such as mass flow rate, volume flow rate, mass total, volume total, temperature, and density.

You can view process variables with the display (if your transmitter has a display), ProLink II, or the Communicator.

7.3.1 With the display

By default, the display shows the mass flow rate, mass total, volume flow rate, volume total, temperature, density, and drive gain. If desired, you can configure the display to show other process variables. See Section 8.10.3.

The LCD reports the abbreviated name of the process variable (e.g., **DENS** for density), the current value of that process variable, and the associated unit of measure (e.g., **G/CM3**). See Appendix D for information on the codes and abbreviations used for display variables.

To view a process variable with the display, press **Scroll** until the name of the desired process variable either:

- Appears on the process variable line, or
- Begins to alternate with the units of measure

See Figure 2-2.

7.3.2 With ProLink II

To view process variables with ProLink II:

1. The **Process Variables** window opens automatically when you first connect to the transmitter.
2. If you have closed the **Process Variables** window:
   a. Open the **ProLink** menu.
   b. Select **Process Variables**.

7.3.3 With the Communicator

To view process variables with the Communicator:

1. Press **2**, **1**.
2. Scroll through the list of process variables by pressing **Down Arrow**.

7.4 Viewing transmitter status

You can view transmitter status using the status LED, ProLink II, or the Communicator. Depending on the method chosen, different information is displayed.

7.4.1 Using the status LED

All Model 2400S AN transmitters have a status LED. The status LED is located on the user interface board (see Figures 2-1 and 2-2).

- For transmitters with a display, the status LED can be viewed with the transmitter housing cover in place.
- For transmitters without a display, the transmitter housing cover must be removed to view the status LED (see Section 2.3).

The status LED shows transmitter status as described in Table 7-1. Note that the status LED does not report event status or alarm status for alarms configured as Ignore (see Section 8.9.1).

Table 7-1 Transmitter status LED

Status LED state	Alarm priority	Definition
Green	No alarm	Normal operating mode
Flashing yellow	A104 alarm	Zero or calibration in progress
Yellow	Low severity (information) alarm	• Alarm condition: will not cause measurement error • Outputs continue to report process data
Red	High severity (fault) alarm	• Alarm condition: will cause measurement error • Outputs go to configured fault indicators

7.4.2 Using ProLink II

ProLink II provides two windows that display status information. The Status window displays:

- Device (alarm) status
- Event status
- Discrete output status
- Discrete input status
- Assorted other transmitter data (e.g., burst mode enabled)

The Output Levels window displays:

- Event status
- Discrete output status

7.4.3 Using the Communicator

You can use either the Status option in the Process Variables menu or the Test/Status option in the Diag/Service menu to view:

- All active alarms
- All events that are on

7.5 Handling status alarms

Specific process or flowmeter conditions cause status alarms. Each status alarm has an alarm code.

Status alarms are classified into three severity levels: Fault, Information, and Ignore. Severity level controls how the transmitter responds to the alarm condition.

Note: Some status alarms can be reclassified, i.e., configured for a different severity level. For information on configuring severity level, see Section 8.9.1.

Note: For detailed information on status alarms, including possible causes and troubleshooting suggestions, see Table 11-4. Before troubleshooting status alarms, first acknowledge all alarms. This will remove inactive alarms from the list so that you can focus troubleshooting efforts on active alarms.

The transmitter maintains two status flags for each alarm:

- The first status flag indicates “active” or “inactive.”
- The second status flag indicates “acknowledged” or “unacknowledged.”

When the transmitter detects an alarm condition:

- An alarm is posted for the corresponding alarm:
  - The first status flag is set to “active.”
  - The second status flag is set to “unacknowledged.”
- The transmitter checks the severity level for the specific alarm:
  - If the severity level is Fault, outputs go to their configured fault indicator (after the configured fault timeout has expired).
  - If the severity level is Information or Ignore, outputs are not affected. They continue to report process data.

When the transmitter detects that the alarm condition has cleared:

- The first status flag is set to “inactive.”
- The second status flag is not changed.
- Outputs return to reporting process data (Fault alarms only).

Operator action is required to return the second status flag to “acknowledged.” Alarm acknowledgment is not necessary.

7.5.1 Using the display menus

All active Fault or Information alarms are listed in the display alarm menu. The transmitter automatically filters out Ignore alarms.

To view or acknowledge alarms using the display menus, see the menu flowchart in Figure C-19.

If the transmitter does not have a display, or if operator access to the alarm menu is disabled *(*see Section 8.10.3*)*, alarms can be viewed and acknowledged using ProLink II or the Communicator. Alarm acknowledgment is not required.

Additionally, the display may be configured to enable or disable the Ack All function. If disabled, the Ack All screen is not displayed and alarms must be acknowledged individually.

7.5.2 Using ProLink II

ProLink II provides two ways to view alarm information:

- The Status window displays the current status of all possible alarms, including Ignore alarms. A green LED indicates “inactive” and a red LED indicates “active.” The acknowledgment status bit is not shown, and you cannot acknowledge alarms from the Status window. Alarms are organized into three categories: Critical, Informational, and Operational.
- The Alarm Log window lists all active and all inactive but unacknowledged Fault and Information alarms. The transmitter automatically filters out Ignore alarms. A green LED indicates “inactive but unacknowledged” and a red LED indicates “active.” Alarms are organized into two categories: High Priority and Low Priority. You can view and acknowledge alarms from the Alarm Log window.

Note: The term “alarm log” as used in ProLink II is not the same as the alarm log maintained by the Communicator. In ProLink II, the alarm log lists active and unacknowledged alarms. In the Communicator, the alarm log contains alarm history, independent of current alarm status.

Note: The location of alarms in the Status window or the Alarm Log window is not affected by the configured alarm severity. Alarms are predefined as Critical, Informational, or Operational, or as High Priority or Low Priority.

To use the Status window:

1. Click **ProLink**.
2. Select **Status**.
3. Alarms are displayed on three panels: Critical, Informational, and Operational.

   To view the indicators in a category, click on the tab.

   - A tab is red if one or more status indicators in that category is on.
   - Within the tabs, active status alarms are shown by red status indicators.

To use the Alarm Log window:

1. Click **ProLink**.
2. Select **Alarm log**. Entries in the alarm log are divided into two categories: High Priority and Low Priority, corresponding to the default Fault and Information alarm severity levels. Within each category:
   - All active alarms are listed with a red status indicator.
   - All alarms that are “cleared but unacknowledged” are listed with a green status indicator.
3. For each alarm that you want to acknowledge, check the **ACK** checkbox.

7.5.3 Using the Communicator

To view or acknowledge alarms with the Communicator, see the menu flowchart in Figure C-5. Note the following:

- To view all active Fault and Information alarms, use the Test/Status menu. (You can also use the Process Variables menu shown in Figure C-4.) The transmitter automatically filters out Ignore alarms.
- To acknowledge a single alarm, use the Config Alarms menu. You must enter the alarm code.
- To acknowledge all alarms with one action, use the Perform Diagnostic Action menu. You do not need to enter alarm codes.

The Communicator also maintains an alarm log. The alarm log contains one record for each of the fifty most recent active Fault and Information status alarms. Ignore alarms are not listed. Each record contains:

- The alarm code
- The alarm status (e.g., cleared but unacknowledged)
- The timestamp, which is the number of seconds that this alarm has been active, while the transmitter has been powered on.

Note: The timestamp value is not reset during a transmitter power cycle. To reset this value, you must perform a master reset or use a Modbus command. Contact Micro Motion customer support.

Note: The term "alarm log" as used in the Communicator is not the same as the ProLink II alarm log. In ProLink II, the alarm log lists active and unacknowledged alarms. In the Communicator, the alarm log contains alarm history, independent of current alarm status.

To view records in the alarm log, use the Config Alarms menu. To clear the alarm log, use the Perform Diagnostic Action menu.

7.6 Using the totalizers and inventories

The *totalizers* keep track of the total amount of mass or volume measured by the transmitter over a period of time. The totalizers can be started and stopped, and the totals can be viewed and reset.

The *inventories* track the same values as the totalizers, but inventory values can be reset separately. This allows you to keep a running total of mass or volume across multiple resets.

The transmitter can store totalizer and inventory values up to 2^{64}. Values larger than this cause the internal totalizer to go into overflow.

7.6.1 Viewing current totals for totalizers and inventories

You can view current totals for the totalizers and inventories with the display (if your transmitter has a display), ProLink II, or the Communicator.

With the display

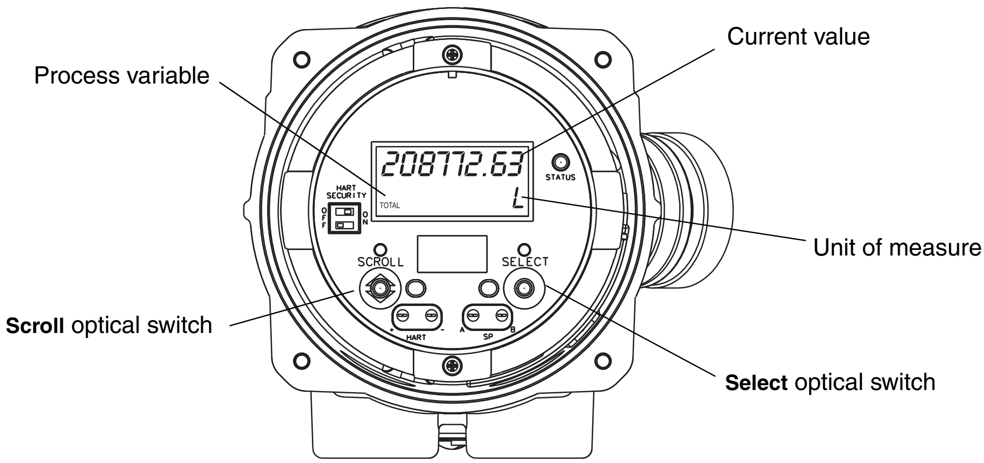
You cannot view current totals with the display unless the display has been configured to show them. See Sections 8.10.3 and 8.10.5.

1. To view totalizer values, **Scroll** until the process variable **TOTAL** appears and the units of measure are:
    - For the mass totalizer, mass units (e.g., kg, lb)
    - For the volume totalizer, volume units (e.g., gal, cuft, scf, nm3)

    See Figure 7-1. Read the current value from the top line of the display.
2. To view inventory values, **Scroll** until the process variable **TOTAL** appears and:
    - For the mass inventory, the word **MASSI** (Mass Inventory) begins to alternate with the units of measure
    - For the volume inventory, the word **LVOLI** (Line Volume Inventory) begins to alternate with the units of measure
    - For gas volume inventory, the word **GSVI** (Gas Standard Volume Inventory) begins to alternate with the units of measure

    See Figure 7-1. Read the current value from the top line of the display.

Figure 7-1 **Totalizer values on display**



With ProLink II

To view current totals for the totalizers and inventories with ProLink II:

1. Click **ProLink**.
2. Select **Process Variables** or **Totalizer Control**.

With the Communicator

To view current totals for the totalizers and inventories with the Communicator:

1. Press **2**, **1**.
2. Scroll through the list of process variables by pressing **Down Arrow**.
3. Press the number corresponding to the totalizer or inventory you wish to view, or highlight it in the list and press **Right Arrow**.

7.6.2 Controlling totalizers and inventories

Table 7-2 shows all of the totalizer and inventory functions and which configuration tools you can use to control them.

Note: You can also assign some totalizer and inventory functions to the discrete input or to a discrete event. For information on configuring the discrete input, see Section 6.7.2. For information on configuring events, see Section 8.7.

Table 7-2 Totalizer and inventory control methods

Function name	Communicator	ProLink II	Display(1)
Start/stop all totalizers and inventories	Yes	Yes	Yes(2)
Reset mass totalizer value only	Yes	Yes	Yes(2)
Reset volume (liquid or gas) totalizer only	Yes	Yes	Yes(2)
Simultaneously reset all totalizer values	Yes	Yes	Yes(2)
Simultaneously reset all inventory values	No	Yes(3)	No
Reset mass inventory value only	No	Yes(3)	No
Reset volume (liquid or gas) inventory value only	No	Yes(3)	No

(1) Transmitters with display only.
(2) If enabled. See Section 8.10.3.
(3) If enabled in the ProLink II Preferences window.

With the display

Table 7-3 shows how you can control the totalizers and inventories with the display.

Table 7-3 Totalizer and inventory control with the display

To accomplish this	Press this sequence of buttons
Stop all totalizers and inventories(1)	• **Scroll** until a totalizer value appears (the word **TOTAL** appears in the lower left corner of the display). It does not matter whether the total is mass or volume. • **Select.** • **Scroll** until **STOP** appears beneath the current totalizer value. • **Select** (**YES** alternates with **STOP**). • **Select** (all totalizers and inventories stop). • **Scroll** to **EXIT**.
Start all totalizers and inventories(1)	• **Scroll** until a totalizer value appears (the word **TOTAL** appears in the lower left corner of the display). It does not matter whether the total is mass or volume. • **Select.** • **Scroll** until **START** appears beneath the current totalizer value. • **Select** (**YES** alternates with **START**). • **Select** (all totalizers and inventories start). • **Scroll** to **EXIT**. • **Select.**
Reset mass totalizer(1)	• **Scroll** until the mass totalizer value appears. • **Select.** • **Scroll** until **RESET** appears beneath the current totalizer value. • **Select** (**YES** alternates with **RESET**). • **Select** (mass totalizer resets). • **Scroll** to **EXIT**. • **Select.**
Reset volume (liquid or gas) totalizer(1)	• **Scroll** until the volume totalizer value appears. • **Select.** • **Scroll** until **RESET** appears beneath the current totalizer value. • **Select** (**YES** alternates with **RESET**). • **Select** (volume totalizer resets). • **Scroll** to **EXIT**. • **Select.**

(1) This feature may be enabled or disabled. See Section 8.10.3.

With ProLink II

Table 7-4 shows how you can control the totalizers and inventories using ProLink II.

Table 7-4 Totalizer and inventory control with ProLink II

To accomplish this	On the totalizer control screen...
Stop all totalizers and inventories	Click **Stop**
Start all totalizers and inventories	Click **Start**
Reset mass totalizer	Click **Reset Mass Total**
Reset volume (liquid or gas) totalizer	Click **Reset Volume Total** or **Reset Gas Volume Total**
Simultaneously reset all totalizers	Click **Reset**
Simultaneously reset all inventories(1)	Click **Reset Inventories**
Reset mass inventory only(1)	Click **Reset Mass Inventory**
Reset volume (liquid or gas) inventory only(1)	Click **Reset Volume Inventory** or **Reset Gas Volume inventory**

(1) If enabled in the ProLink II Preferences window.

To enable inventory reset using ProLink II:

1. Click **View > Preferences**.
2. Check the **Enable Inventory Totals Reset** checkbox.
3. Click **Apply**.

To get to the Totalizer Control screen:

1. Click **ProLink**.
2. Select **Totalizer Control**.

With the Communicator

Table 7-5 shows how you can control the totalizers and inventories with the Communicator.

Table 7-5 Totalizer and inventory control with a Communicator

To accomplish this	Press this sequence of buttons
Stop all totalizers and inventories	• **2** (Process Variables) • **4** (Totalizer cntrl) • **4** (Stop totalizer)
Start all totalizers and inventories	• **2** (Process Variables) • **4** (Totalizer cntrl) • **3** (Start totalizer)
Reset mass totalizer	• **2** (Process Variables) • **4** (Totalizer cntrl) • **6** (Reset mass total)
Reset volume totalizer	• **2** (Process Variables) • **4** (Totalizer cntrl) • **7** (Reset volume total)
Reset all totalizers	• **2** (Process Variables) • **4** (Totalizer cntrl) • **5** (Reset all totals)

Chapter 8
Optional Configuration

8.1 Overview

This chapter describes transmitter configuration parameters that may or may not be used, depending on your application requirements. For required transmitter configuration, see Chapter 6.

Table 8-1 lists the parameters that are discussed in this chapter. Default values and ranges for the most commonly used parameters are provided in Appendix A.

Table 8-1 Configuration map

		Tool			
Topic	**Subtopic**	**ProLink II**	**Communicator**	**Display**	**Section**
Volume flow measurement for gas		✓			8.2
Special measurement units	Mass flow	✓	✓		8.3
	Volume flow	✓	✓		
	Gas standard volume flow	✓			
Cutoffs		✓	✓		8.4
Damping		✓	✓		8.5
Flow direction		✓	✓		8.6
Events		✓	✓		8.7
Slug flow		✓	✓		8.8
Fault timeout		✓	✓		8.9
Status alarm severity		✓	✓		8.9.1
Display functionality[1]	Update period	✓	✓	✓	8.10.1
	Display language	✓		✓	8.10.2
	Totalizer start/stop	✓	✓	✓	8.10.3
	Totalizer reset	✓	✓	✓	
	Auto scroll	✓	✓	✓	
	Scroll rate	✓	✓	✓	
	Offline menu	✓	✓	✓	
	Password	✓	✓	✓	
	Alarm menu	✓	✓	✓	
	Ack all	✓	✓	✓	
	Backlight on/off	✓	✓	✓	8.10.4
	Backlight intensity	✓	✓		
	Display variables	✓	✓		8.10.5
	Display precision	✓	✓		

Table 8-1 Configuration map *continued*

Topic	Subtopic	Tool: ProLink II	Tool: Communicator	Tool: Display	Section
Digital communication settings	Modbus address	✓	✓	✓	8.11.1
	Modbus ASCII support	✓	✓		
	HART address	✓	✓		
	Loop current mode	✓			
	Infrared port write-protect	✓	✓	✓	8.11.2
	Floating-point byte order	✓			8.11.3
	Additional communications response delay	✓			8.11.4
	Digital fault indicator	✓	✓		8.11.5
	Burst mode	✓	✓		8.11.6
	PV, SV, TV, QV assignments	✓	✓ (partial)		8.11.7
Device settings		✓	✓		8.12
Sensor parameters		✓	✓		8.13

(1) These parameters apply only to transmitters with a display.

8.2 Configuring volume flow measurement for gas

Note: Volume flow measurement for gases cannot be configured using the Communicator. If the flowmeter is configured to use a gas standard volume flow unit, the Communicator will display the correct value, but will display "Unknown Enumerator" for the units label.

The display cannot be used to configure Vol Flow Type. However, after Vol Flow Type has been configured using ProLink II, the volume flow unit can be configured.

Special functionality is provided in ProLink II for measuring the volume flow of gases. To access this functionality:

1. Click **ProLink > Configure > Flow**.
2. Set **Vol Flow Type** to **Std Gas Volume**.
3. Select the measurement unit you want to use from the **Std Gas Vol Flow Units** dropdown list. The default is **SCFM**.

Note: When Vol Flow Type is set to Std Gas Volume, this list contains the units that are most frequently used for gas measurement. If Liquid Volume is configured, gas measurement units are not available.

4. Configure the **Std Gas Vol Flow Cutoff** (see Section 8.4). The default is **0**.
5. If you know the standard density of the gas that you are measuring, enter it in the **Std Gas Density** field. If you do not know the standard density, you can use the Gas Wizard. See the following section.

Note: The term "standard density" refers to the density of the gas at reference conditions.

Note: Ensure that the values entered here are correct, and that fluid composition is stable. If either of these conditions is not met, gas flow measurement accuracy will be degraded.

8.2.1 Using the Gas Wizard

The Gas Wizard is used to calculate the standard density of the gas that you are measuring.

To use the Gas Wizard:

1. Click **ProLink > Configure > Flow**.
2. Click the **Gas Wizard** button.
3. If your gas is listed in the **Choose Gas** dropdown list:
   a. Enable the **Choose Gas** radio button.
   b. Select your gas.
4. If your gas is not listed, you must describe its properties.
   a. Enable the **Enter Other Gas Property** radio button.
   b. Enable the method that you will use to describe its properties: **Molecular Weight**, **Specific Gravity Compared to Air**, or **Density**.
   c. Provide the required information. Note that if you selected **Density**, you must enter the value in the configured density units and you must provide the temperature and pressure at which the density value was determined.
5. Click **Next**.
6. Verify the reference temperature and reference pressure. If these are not appropriate for your application, click the **Change Reference Conditions** button and enter new values for reference temperature and reference pressure.
7. Click **Next**. The calculated standard density value is displayed.
   - If the value is correct, click **Finish**. The value will be written to transmitter configuration.
   - If the value is not correct, click **Back** and modify input values as required.

Note: The Gas Wizard displays density, temperature, and pressure in the configured units. If required, you can configure the transmitter to use different units. See Section 6.4.

8.3 Creating special measurement units

If you need to use a non-standard unit of measure, you can create one special measurement unit for mass flow and one special measurement unit for volume flow. The special measurement unit for volume flow can be defined for liquid volume measurement or gas standard volume measurement.

8.3.1 About special measurement units

Special measurement units consist of:

- Base unit – A combination of:
  - Base mass or base volume unit – A measurement unit that the transmitter already recognizes (e.g., **kg**, **m3**, **l**, **SCF**)
  - Base time unit – A unit of time that the transmitter already recognizes (e.g., seconds, days)
- Conversion factor – The number by which the base unit will be divided to convert to the special unit
- Special unit – The non-standard volume flow or mass flow unit of measure that you want the transmitter to use when reporting process data

The preceding terms are related by the following formulae:

$$x[\text{BaseUnit(s)}] = y[\text{SpecialUnit(s)}]$$

$$\text{ConversionFactor} = \frac{x[\text{BaseUnit(s)}]}{y[\text{SpecialUnit(s)}]}$$

To create a special unit, you must:

1. Identify the simplest base volume or mass and base time units for your special mass flow or volume flow unit. For example, to create the special volume flow unit *pints per minute*, the simplest base units are gallons per minute:
   - Base volume unit: *gallon*
   - Base time unit: *minute*
2. Calculate the conversion factor using the formula below:

$$\frac{1\ \text{(gallon per minute)}}{8\ \text{(pints per minute)}} = \mathbf{0.125}\ \text{(conversion factor)}$$

Note: 1 gallon per minute = 8 pints per minute

3. Name the new special mass flow or volume flow measurement unit and its corresponding totalizer measurement unit:
   - Special volume flow measurement unit name: *Pint/min*
   - Volume totalizer measurement unit name: *Pints*

Note: Special measurement unit names can be up to 8 characters long (i.e., 8 numbers or letters), but only the first 5 characters appear on the display.

4. To apply the special measurement unit to mass flow or volume flow measurement, select **Special** from the list of measurement units (see Section 6.4.1 or 6.4.2).

8.3.2 Special measurement unit for mass flow

To create a special measurement unit for mass flow;

- Using ProLink II, see Figure C-3.
- Using the Communicator, see Figure C-7.

Note: You cannot create a special measurement unit for mass flow with the display, but you can view the special measurement unit for mass flow on the display.

The following general steps are required:

1. Specify the base mass unit.
2. Specify the base time unit.
3. Specify the mass flow conversion factor.
4. Assign a name to the new special measurement unit for mass flow.
5. Assign a name to the unit to be used for the associated mass flow totalizer and inventory.

8.3.3 Special measurement unit for liquid volume flow

To create a special measurement unit for liquid volume flow:

- Using ProLink II, see Figure C-3. Before configuring the special measurement unit, ensure that **Vol Flow Type** is set to **Liquid Volume** (see Figure C-2).
- Using the Communicator, see Figure C-7.

Note: You cannot create a special measurement unit for liquid volume flow with the display, but you can view the special measurement unit for liquid volume flow on the display.

The following general steps are required:

1. Specify the base volume unit.
2. Specify the base time unit.
3. Specify the volume flow conversion factor.
4. Assign a name to the new special measurement unit for volume flow
5. Assign a name to the unit to be used for the associated volume flow totalizer and inventory.

8.3.4 Special measurement unit for gas standard volume flow

To create a special volume flow measurement unit for gas standard volume, ProLink II is required. Configure the special measurement unit as follows:

1. Click **ProLink > Configure > Flow** and set **Vol Flow Type** to **Gas Std Volume**.
2. Click the **Special Units** tab.
3. Specify the base gas volume unit.
4. Specify the base gas volume time unit.
5. Specify the gas volume flow conversion factor.
6. Assign a name to the new special measurement unit for gas standard volume flow.
7. Assign a name to the unit to be used for the associated gas standard volume flow totalizer and inventory.

Note: You cannot create a special volume flow measurement unit with the display, but you can view the special volume flow measurement on the display.

Note: You cannot create a special measurement unit for gas standard volume flow with the Communicator. If you configure the transmitter to use a special measurement unit for gas standard volume flow, the Communicator will display the correct value, but will display "Unknown Enumerator" for the units label.

8.4 Configuring cutoffs

Cutoffs are user-defined values below which the transmitter reports a value of zero for the specified process variable. Cutoffs can be set for mass flow, volume flow, gas standard volume flow, and density.

See Table 8-2 for cutoff default values and related information. See Sections 8.4.1 and 8.4.2 for information on how the cutoffs interact with other transmitter measurements.

To configure cutoffs:

- Using ProLink II, see Figure C-2.
- Using the Communicator, see Figure C-7.

Note: This functionality is not available via the display menus.

Table 8-2 Cutoff default values

Cutoff type	Default	Comments
Mass flow	0.0 g/s	Recommended setting: 5% of the sensor's rated maximum flowrate
Volume flow	0.0 L/s	Limit: the sensor's flow calibration factor, in units of L/s, multiplied by 0.2
Gas standard volume flow	0.0	No limit
Density	0.2 g/cm^3	Range: 0.0–0.5 g/cm^3

8.4.1 Cutoffs and volume flow

If you are using liquid volume flow units (**Vol Flow Type** is set to **Liquid**):

- The density cutoff is applied to the volume flow calculation. Accordingly, if the density drops below its configured cutoff value, the volume flow rate will go to zero.
- The mass flow cutoff is not applied to the volume flow calculation. Even if the mass flow drops below the cutoff, and therefore the mass flow indicators go to zero, the volume flow rate will be calculated from the actual mass flow process variable.

If you are using gas standard volume flow units (**Vol Flow Type** is set to **Std Gas Volume**), neither the mass flow cutoff nor the density cutoff is applied to the volume flow calculation.

8.4.2 Interaction with the AO cutoff

The mA output has a cutoff called the AO cutoff. If the mA output is configured for mass flow, volume flow, or gas standard volume flow:

- And the AO cutoff is set to a greater value than the mass, volume, or gas standard volume cutoff, the mA output will report zero flow when the AO cutoff is reached.
- And the AO cutoff is set to a lower value than the mass, volume, or gas standard volume cutoff, when the mass, volume, or gas standard volume cutoff is reached, all outputs representing that process variable will report zero flow.

See Section 6.5.3 for more information on the AO cutoff.

8.5 Configuring the damping values

A damping value is a period of time, in seconds, over which the process variable value will change to reflect 63% of the change in the actual process. Damping helps the transmitter smooth out small, rapid measurement fluctuations.

- A high damping value makes the output appear to be smoother because the output must change slowly.
- A low damping value makes the output appear to be more erratic because the output changes more quickly.

Damping can be configured for flow, density, and temperature.

When you specify a new damping value, it is automatically rounded down to the nearest valid damping value. Valid damping values are listed in Table 8-3.

Note: For gas applications, Micro Motion recommends a minimum flow damping value of 2.56.

Before setting the damping values, review Sections 8.5.1 and 8.5.2 for information on how the damping values interact with other transmitter measurements and parameters.

To configure damping values:

- Using ProLink II, see Figure C-2.
- Using the Communicator, see Figure C-7.

Note: This functionality is not available via the display menus.

Table 8-3 Valid damping values

Process variable	Valid damping values
Flow (mass and volume)	0, 0.04, 0.08, 0.16, ... 40.96
Density	0, 0.04, 0.08, 0.16, ... 40.96
Temperature	0, 0.6, 1.2, 2.4, 4.8, ... 76.8

8.5.1 Damping and volume measurement

When configuring damping values, note the following:

- Liquid volume flow is derived from mass and density measurements; therefore, any damping applied to mass flow and density will affect liquid volume measurement.
- Gas standard volume flow is derived from mass flow measurement, but not from density measurement. Therefore, only damping applied to mass flow will affect gas standard volume measurement.

Be sure to set damping values accordingly.

8.5.2 Interaction with the added damping parameter

The mA output has a damping parameter called Added Damping. If damping is configured for flow, density, or temperature, the same process variable is assigned to the mA output, and added damping is also configured for the mA output, the effect of damping the process variable is calculated first, and the added damping calculation is applied to the result of that calculation.

See Section 6.5.4 for more information on the added damping parameter.

8.6 Configuring the flow direction parameter

The *flow direction* parameter controls how the transmitter reports flow rate and how flow is added to or subtracted from the totalizers, under conditions of forward flow, reverse flow, or zero flow.

- *Forward (positive) flow* moves in the direction of the arrow on the sensor.
- *Reverse (negative) flow* moves in the direction opposite of the arrow on the sensor.

Options for flow direction include:

- Forward only
- Reverse only
- Absolute value
- Bidirectional
- Negate/Forward only
- Negate/Bidirectional

For the effect of flow direction on the mA output (i.e., flow variable has been assigned to the mA output):

- See Figure 8-1 if the 4 mA value of the mA output is set to 0 (zero flow).
- See Figure 8-2 if the 4 mA value of the mA output is set to a negative value.

For a discussion of these figures, see the examples following the figures.

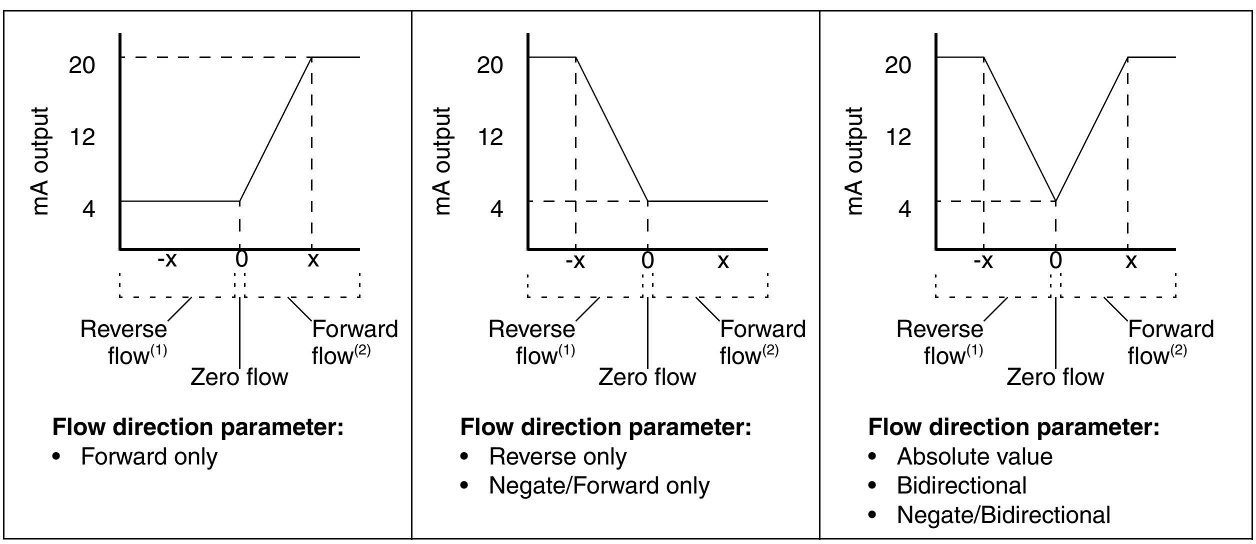
To configure flow direction:

- Using ProLink II, see Figure C-2.
- Using the Communicator, see Figure C-7.

Note: This functionality is not available via the display menus.

For the effect of flow direction on the frequency output, totalizers, and flow values reported via digital communication, see Table 8-4.

Figure 8-1 Effect of flow direction on mA output: 4 mA value = 0

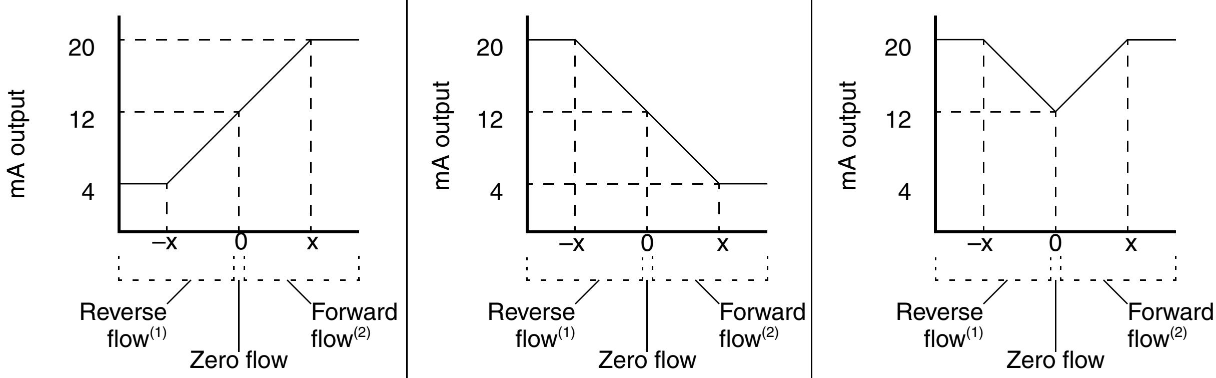


mA output configuration:
- 20 mA value = x
- 4 mA value = 0

To set the 4 mA and 20 mA values, see Section 6.5.2.

(1) Process fluid flowing in opposite direction from flow direction arrow on sensor.
(2) Process fluid flowing in same direction as flow direction arrow on sensor.

Figure 8-2 Effect of flow direction on mA output: 4 mA value < 0



Flow direction parameter: • Forward only	**Flow direction parameter:** • Reverse only • Negate/Forward only	**Flow direction parameter:** • Absolute value • Bidirectional • Negate/Bidirectional

mA output configuration:
- 20 mA value = x
- 4 mA value = –x
- –x < 0

To set the 4 mA and 20 mA values, see Section 6.5.2.

(1) Process fluid flowing in opposite direction from flow direction arrow on sensor.
(2) Process fluid flowing in same direction as flow direction arrow on sensor.

Example 1

Configuration:
- Flow direction = Forward only
- mA output: 4 mA = 0 g/s; 20 mA = 100 g/s

(See the first graph in Figure 8-1.)

As a result:
- Under conditions of zero flow, the mA output level is 4 mA, Under conditions of reverse flow, the mA output saturates at 3.8 mA.
- Under conditions of forward flow, up to a flow rate of 100 g/s, the mA output level varies between 4 mA and 20 mA in proportion to (the absolute value of) the flow rate.
- Under conditions of forward flow, if (the absolute value of) the flow rate equals or exceeds 100 g/s, the mA output will be proportional to the flow rate up to 20.5 mA, and will be level at 20.5 mA at higher flow rates.

Example 2	Configuration: • Flow direction = Reverse Only • mA output: 4 mA = 0 g/s; 20 mA = 100 g/s (See the second graph in Figure 8-1.) As a result: • Under conditions of forward flow or zero flow, the mA output level is 4 mA. • Under conditions of reverse flow, up to a flow rate of 100 g/s, the mA output level varies between 4 mA and 20 mA in proportion to the absolute value of the flow rate. • Under conditions of reverse flow, if the absolute value of the flow rate equals or exceeds 100 g/s, the mA output will be proportional to the absolute value of the flow rate up to 20.5 mA, and will be level at 20.5 mA at higher absolute values.

Example 3	Configuration: • Flow direction = Forward Only • mA output: 4 mA = –100 g/s; 20 mA = 100 g/s (See the first graph in Figure 8-2.) As a result: • Under conditions of zero flow, the mA output is 12 mA. • Under conditions of forward flow, up to a flow rate of 100 g/s, the mA output varies between 12 mA and 20 mA in proportion to (the absolute value of) the flow rate. • Under conditions of forward flow, if (the absolute value of) the flow rate equals or exceeds 100 g/s, the mA output is proportional to the flow rate up to 20.5 mA, and will be level at 20.5 mA at higher flow rates. • Under conditions of reverse flow, up to a flow rate of 100 g/s, the mA output varies between 4 mA and 12 mA in inverse proportion to the absolute value of the flow rate. • Under conditions of reverse flow, if the absolute value of the flow rate equals or exceeds 100 g/s, the mA output is inversely proportional to the flow rate down to 3.8 mA, and will be level at 3.8 mA at higher absolute values.

Table 8-4 Effect of flow direction on frequency output, discrete output, totalizers, and digital communications

	Forward flow(1)			
Flow direction value	**Frequency output**	**Discrete output(2)**	**Flow totals**	**Flow values via digital comm.**
Forward only	Increase	Forward	Increase	Positive
Reverse only	0 Hz	Forward	No change	Positive
Bidirectional	Increase	Forward	Increase	Positive
Absolute value	Increase	Forward	Increase	Positive(3)
Negate/Forward	Zero(3)	Reverse	No change	Negative
Negate/Bidirectional	Increase	Reverse	Decrease	Negative
	Zero flow			
Flow direction value	**Frequency output**	**Discrete output**	**Flow totals**	**Flow values via digital comm.**
All	0 Hz	Reverse	No change	0
	Reverse flow(4)			
Flow direction value	**Frequency output**	**Discrete output**	**Flow totals**	**Flow values via digital comm.**
Forward only	0 Hz	Reverse	No change	Negative
Reverse only	Increase	Reverse	Increase	Negative
Bidirectional	Increase	Reverse	Decrease	Negative
Absolute value	Increase	Forward	Increase	Positive(3)
Negate/Forward	Increase	Forward	Increase	Positive
Negate/Bidirectional	Increase	Forward	Increase	Positive

(1) Process fluid flowing in same direction as flow direction arrow on sensor.
(2) Applies only if the discrete output has been configured to indicate flow direction. See Section 6.7.2.
(3) Refer to the digital communications status bits for an indication of whether flow is positive or negative.
(4) Process fluid flowing in opposite direction from flow direction arrow on sensor.

8.7 Configuring events

An *event* occurs if the real-time value of a user-specified process variable varies above or below a user-specified value, or inside or outside a user-specified range.

Events can be used to initiate specific transmitter actions. Possible actions include:

- Start zero
- Reset mass total
- Reset volume total
- Reset gas standard volume total
- Reset all totalizers
- Start/stop all totalizers

Up to five events can be configured. You can define more than one event on a single process variable if desired.

You can configure an event to initiate multiple actions, e.g., you can configure Event 1 to reset both the mass total and the volume total.

Additionally, if your transmitter has a discrete output, you can configure a discrete output so that it is active if the event is ON, and inactive if the event is OFF (see Section 6.7). For example, the discrete output can open or close a valve according to event status.

8.7.1 Defining events

To define an event:

- Using ProLink II, see Figure C-3.
- Using the Communicator, see Figure C-9.

The following general steps are required:

1. Select the event to define.
2. Specify the Event Type. Event Type options are defined in Table 8-5.

Table 8-5 Event types

Type	Description
High (> A)	Default. Discrete event will occur if the assigned variable is greater than the setpoint (A).(1)
Low (< A)	Discrete event will occur if the assigned variable is less than the setpoint (A).(1)
In Range	Discrete event will occur if the assigned variable is greater than or equal to the low setpoint (A) *and* less than or equal to the high setpoint (B).(2)
Out of Range	Discrete event will occur if the assigned variable is less than or equal to the low setpoint (A) *or* greater than or equal to the high setpoint (B).(2)

(1) An event does not occur if the assigned variable is equal to the setpoint.
(2) An event occurs if the assigned variable is equal to the setpoint.

3. Assign a process variable to the event.
4. Specify the event's setpoint(s) – the value(s) at which the event will occur or switch state (ON to OFF, or vice versa).
   - If Event Type is High or Low, only one setpoint is used.
   - If Event Type is In Range or Out of Range, two setpoints are required.

Note: If a mass or volume total has been assigned to Event 1 or Event 2 and also configured as a display variable, the event type is High or Low, and the transmitter has been configured to allow resetting totalizers from the display, you can use the display to define or change the high setpoint (Setpoint A). See Figure C-10.

5. Use the discrete input interface (see Section 6.8) to assign one or more actions to the event, i.e., specify the action(s) that the transmitter will perform if the event occurs.

Example	Define Event 1 to stop all totalizers when the mass flow rate in forward or backward direction is less than 2 lb/min. 1. Specify lb/min as the mass flow unit. See Section 6.4.1. 2. Configure the Flow Direction parameter for bidirectional flow. See Section 8.6. 3. Select Event 1. 4. Configure: • Event Type = Low • Process Variable (PV) = Mass Flow Rate • Low Setpoint (A) = 2 5. Assign Start/stop All Totals to discrete event 1. See Section 6.8.

8.7.2 Checking and reporting event status

There are several ways that event status can be determined:

- If your transmitter has a discrete output, the discrete output can be configured to switch states according to event status (see Section 6.7).
- Event status can be queried using digital communications:
  - ProLink II automatically displays event information on the **Informational** panel of the **Status** window, and also in the **Output Levels** window.
  - The Communicator reports active events in **Process Variables > View Status** or **Diag/Service > Test/Status**.

8.8 Configuring slug flow limits and duration

Slugs – gas in a liquid process or liquid in a gas process – occasionally appear in some applications. The presence of slugs can significantly affect the process density reading. The slug flow parameters can help the transmitter suppress extreme changes in process variables, and can also be used to identify process conditions that require correction.

Slug flow parameters are as follows:

- *Low slug flow limit* – the point below which a condition of slug flow will exist. Typically, this is the lowest density point in your process's normal density range. Default value is 0.0 g/cm^3; range is 0.0–10.0 g/cm^3.
- *High slug flow limit* – the point above which a condition of slug flow will exist. Typically, this is the highest density point in your process's normal density range. Default value is 5.0 g/cm^3; range is 0.0–10.0 g/cm^3.
- *Slug flow duration* – the number of seconds the transmitter waits for a slug flow condition (*outside* the slug flow limits) to return to normal (*inside* the slug flow limits).

If the transmitter detects slug flow:

- A slug flow alarm is posted immediately.
- During the slug duration period, the transmitter holds the mass flow rate at the last measured pre-slug value, independent of the mass flow rate measured by the sensor. All outputs that report mass flow rate and all internal calculations that include mass flow rate will use this value.
- If slugs are still present after the slug duration period expires, the transmitter forces the mass flow rate to 0, independent of the mass flow rate measured by the sensor. All outputs that report mass flow rate and all internal calculations that include mass flow rate will use 0.
- When process density returns to a value within the slug flow limits, the slug flow alarm is cleared and the mass flow rate reverts to the actual measured value.

To configure slug flow parameters:

- Using ProLink II, see Figure C-2.
- Using the Communicator, see Figure C-7.

Note: This functionality is not available via the display menus.

Note: The slug flow limits must be entered in g/cm^3, even if another unit has been configured for density. Slug flow duration is entered in seconds.

Note: Raising the low slug flow limit or lowering the high slug flow limit will increase the possibility of slug flow conditions. Conversely, lowering the low slug flow limit or raising the high slug flow limit will decrease the possibility of slug flow conditions.

Note: If slug flow duration is set to 0, the mass flow rate will be forced to 0 as soon as slug flow is detected.

8.9 Configuring fault handling

There are three ways that the Model 2400S transmitter can report faults:

- By setting outputs to their configured fault levels (see Sections 6.5.5, 6.6.5, and 6.7.3)
- By configuring a discrete output to indicate fault status
- By posting an alarm to the active alarm log

Status alarm severity controls which of these methods is used. For some faults only, *fault timeout* controls when the fault is reported.

8.9.1 Status alarm severity

Status alarms are classified into three levels of severity. The *severity level* controls transmitter behavior when the alarm condition occurs. See Table 8-6.

Table 8-6 Alarm severity levels

Severity level	Transmitter action
Fault	If this condition occurs, an alarm will be generated and all outputs go to their configured fault levels. See Chapter 6.
Informational	If this condition occurs, an alarm will be generated but output levels are not affected.
Ignore	If this condition occurs, no alarm will be generated (no entry is added to the active alarm log) and output levels are not affected.

Some alarms can be reclassified. For example:

- The default severity level for Alarm A20 (calibration factors unentered) is **Fault**, but you can reconfigure it to either **Informational** or **Ignore**.
- The default severity level for Alarm A102 (drive over-range) is **Informational**, but you can reconfigure it to either **Ignore** or **Fault**.

For a list of all status alarms and default severity levels, see Table 8-7. (For more information on status alarms, including possible causes and troubleshooting suggestions, see Table 11-4.)

To configure alarm severity:

- Using ProLink II, see Figure C-3.
- Using the Communicator, see Figure C-5.

Note: This functionality is not available via the display menus.

Table 8-7 Status alarms and severity levels

Alarm code	Communicator message / ProLink II message	Default severity	Configurable	Affected by fault timeout
A001	EEprom Checksum Error (Core Processor)	Fault	No	No
	(E)EPROM Checksum Error (CP)			
A002	RAM Test Error (Core Processor)	Fault	No	No
	RAM Error (CP)			
A003	Sensor Not Responding (No Tube Interrupt)	Fault	Yes	Yes
	Sensor Failure			
A004	Temperature sensor out of range	Fault	No	Yes
	Temperature Sensor Failure			
A005	Input Over-Range	Fault	Yes	Yes
	Input Overrange			
A006	Transmitter Not Characterized	Fault	Yes	No
	Not Configured			
A008	Density Outside Limits	Fault	Yes	Yes
	Density Overrange			
A009	Transmitter Initializing/Warming Up	Fault	Yes	No
	Transmitter Initializing/Warming Up			
A010	Calibration Failure	Fault	No	No
	Calibration Failure			
A011	Excess Calibration Correction, Zero too Low	Fault	Yes	No
	Zero Too Low			
A012	Excess Calibration Correction, Zero too High	Fault	Yes	No
	Zero Too High			
A013	Process too Noisy to Perform Auto Zero	Fault	Yes	No
	Zero Too Noisy			
A014	Transmitter Failed	Fault	No	No
	Transmitter Failed			

Table 8-7 Status alarms and severity levels *continued*

Alarm code	Communicator message / ProLink II message	Default severity	Configurable	Affected by fault timeout
A016	Line RTD Temperature Out-Of-Range Line RTD Temperature Out-of-Range	Fault	Yes	Yes
A017	Meter RTD Temperature Out-Of-Range Meter RTD Temperature Out-of-Range	Fault	Yes	Yes
A020	Calibration Factors Unentered Calibration Factors Unentered (FlowCal)	Fault	Yes	No
A021	Unrecognized/Unentered Sensor Type Incorrect Sensor Type (K1)	Fault	No	No
A029	Internal Communication Failure PIC/Daughterboard Communication Failure	Fault	No	No
A030	Hardware/Software Incompatible Incorrect Board Type	Fault	No	No
A031	Undefined Low Power	Fault	No	No
A032[(1)]	Meter Verification Fault Alarm Meter Verification/Outputs In Fault	Fault	No	No
A032[(2)]	Outputs Fixed during Meter Verification Meter Verification In Progress and Outputs Fixed	Varies[(3)]	No	No
A033	Tube Not Full Tube Not Full	Fault	No	Yes
A034[(2)]	Meter Verification Failed Meter Verification Failed	Info	Yes	No
A035[(2)]	Meter Verification Aborted Meter Verification Aborted	Info	Yes	No
A100	Primary mA Output Saturated Primary mA Output Saturated	Info	Yes[(4)]	No
A101	Primary mA Output Fixed Primary mA Output Fixed	Info	Yes[(4)]	No
A102	Drive Over-Range Drive Overrange	Info	Yes	No
A104	Calibration-In-Progress Calibration in Progress	Info	Yes[(4)]	No
A105	Slug Flow Slug Flow	Info	Yes	No
A106	Burst Mode Enabled Burst Mode Enabled	Info	Yes[(4)]	No
A107	Power Reset Occurred Power Reset Occurred	Ignore	Yes	No

Table 8-7 Status alarms and severity levels *continued*

Alarm code	Communicator message / ProLink II message	Default severity	Configurable	Affected by fault timeout
A110	Frequency Output Saturated	Info	Yes(4)	No
	Frequency Output Saturated			
A111	Frequency Output Fixed	Info	Yes(4)	No
	Frequency Output Fixed			
A115	External Input Error	Info	Yes	No
	External Input Error			
A118	Discrete Output 1 Fixed	Info	Yes(4)	No
	Discrete Output 1 Fixed			
A131(1)	Meter Verification Info Alarm	Info	Yes	No
	Meter Verification/Outputs at Last Value			
A131(2)	Meter Verification in Progress	Info	Yes	No
	Meter Verification In Progress			
A132	Simulation Mode Active	Info	Yes(4)	No
	Simulation Mode Active			

(1) Applies only to systems with the original version of the meter verification application.
(2) Applies only to systems with Smart Meter Verification.
(3) If outputs are set to Last Measured Value, severity is Info. If outputs are set to Fault, severity is Fault.
(4) Can be set to either Info or Ignore, but cannot be set to Fault.

8.9.2 Fault timeout

If a fault is detected, the transmitter always sets the “alarm active” status bit immediately. For some faults only (see Table 8-7), fault actions for the transmitter outputs and digital communications are not implemented until the fault timeout expires. During the fault timeout, outputs continue to report their last measured value.

The default fault timeout value is **0**.

To configure fault timeout:

- Using ProLink II, see Figure C-2. You may use either the Analog Output panel or the Frequency Output panel. Only one value is stored. If you change the fault timeout in one panel, the value displayed in the other panel is changed automatically.
- Using the Communicator, see Figure C-8.

Note: This functionality is not available via the display menus.

8.10 Configuring the display

If your transmitter has a display, you can configure a variety of parameters that control the display functionality.

8.10.1 Update period

The Update Period (or Display Rate) parameter controls how often the display is refreshed with current data. The default is 200 milliseconds; the range is 100 milliseconds to 10,000 milliseconds (10 seconds).

To configure Update Period:

- Using ProLink II, see Figure C-3.
- Using the Communicator, see Figure C-9.
- Using the display menus, see Figure C-14.

8.10.2 Language

The display can be configured to use any of the following languages for data and menus:

- English
- French
- German
- Spanish

To set the display language:

- Using ProLink II, see Figure C-3.
- Using the display menus, see Figure C-14.

Note: This functionality is not available via the Communicator.

8.10.3 Enabling and disabling display parameters

Table 8-8 lists the display parameters and describes their behavior when enabled (shown) or disabled (hidden).

Table 8-8 Display parameters

Parameter	Enabled (shown)	Disabled (hidden)
Totalizer start/stop	Operators can start or stop totalizers using the display.	Operators cannot start or stop totalizers using the display.
Totalizer reset	Operators can reset the mass and volume totalizers using the display.	Operators cannot reset the mass and volume totalizers using the display.
Auto scroll	The display automatically scrolls through each process variable at a configurable rate.	Operators must **Scroll** to view process variables.
Off-line menu	Operators can access the off-line menu (zero, simulation, and configuration).	Operators cannot access the off-line menu.
Off-line password	Operators must use a password to access the off-line menu.	Operators can access the off-line menu without a password.
Alarm menu	Operators can access the alarm menu (viewing and acknowledging alarms).	Operators cannot access the alarm menu.
Acknowledge all alarms	Operators are able to acknowledge all current alarms at once.	Operators must acknowledge alarms individually.

To configure these parameters:

- Using ProLink II, see Figure C-3.
- Using the Communicator, see Figure C-9.
- Using the display menus, see Figure C-14.

Note the following:

- If you use the display to disable access to the off-line menu, the off-line menu will disappear as soon as you exit the menu system. If you want to re-enable access, you must use ProLink II or the Communicator.
- Scroll Rate is used to control the speed of scrolling when Auto Scroll is enabled. Scroll Rate defines how long each display variable (see Section 8.10.5) will be shown on the display. The time period is defined in seconds; e.g., if scroll rate is set to 10, each display variable will be shown on the display for 10 seconds.

  If you are using the Communicator or the display, you must enable Auto Scroll before you can configure the scroll rate (see Section 8.10.3).
- The off-line password prevents unauthorized users from gaining access to the off-line menu.

  The password can contain up to four numbers.

  If you are using the Communicator or the display, you must enable the off-line password before you can configure it (see Section 8.10.3).

8.10.4 Configuring the LCD backlight

The LCD panel on the display can be turned on or off. To control the backlight:

- Using ProLink II, see Figure C-3.
- Using the Communicator, see Figure C-9
- Using the display menus, see Figure C-14.

In addition, ProLink II and the Communicator allows you to control the intensity of the backlight. You can specify any value between 0 and 63; the higher the value, the brighter the backlight.

8.10.5 Configuring the display variables and display precision

The display can scroll through up to 15 process variables in any order. You can configure the process variables to be displayed and the order in which they should appear.

Additionally, you can configure display precision for each display variable. Display precision controls the number of digits to the right of the decimal place. Precision can be set to any value from 0 to 5.

To configure display variables or display precision:

- Using ProLink II, see Figure C-3.
- Using the Communicator, see Figure C-9.

Note: This functionality is not available via the display menus.

Table 8-9 shows an example of a display variable configuration. Notice that you can repeat variables, and you can also specify None for any display variable except Display Var 1. For information on how the display variables will appear on the display, see Appendix D.

Table 8-9 Example of a display variable configuration

Display variable	Process variable
Display variable 1[(1)]	Mass flow
Display variable 2	Mass totalizer
Display variable 3	Volume flow
Display variable 4	Volume totalizer

Table 8-9 Example of a display variable configuration *continued*

Display variable	Process variable
Display variable 5	Density
Display variable 6	Temperature
Display variable 7	External temperature
Display variable 8	External pressure
Display variable 9	Mass flow
Display variable 10	None
Display variable 11	None
Display variable 12	None
Display variable 13	None
Display variable 14	None
Display variable 15	None

(1) Display variable 1 cannot be set to None.

8.11 Configuring digital communications

The digital communications parameters control how the transmitter will communicate using digital communications. The following digital communications parameters can be configured:

- The Modbus address (used for service port or Modbus connection types)
- Modbus ASCII support
- The HART address (used only for HART connection types)
- Loop current mode
- Infrared port write-protect
- Floating-point byte order
- Additional communications response delay
- Digital fault indicator
- Burst mode
- PV, SV, TV, and QV assignments

8.11.1 Configuring addresses and related parameters

Two addresses can be used to identify or connect to the transmitter: the Modbus address and the HART address. You may configure either or both, or leave them at default values.

Note that the service port always responds to either of the following addresses:

- The service port address (111)
- The configured Modbus address (default=1)

Configuring the Modbus address

The set of valid Modbus addresses depends on whether or not support for Modbus ASCII is enabled or disabled (see following section). Valid Modbus addresses are as follows:

- Modbus ASCII enabled: 1–15, 32–47, 64–79, 96–110
- Modbus ASCII disabled: 0–127

To configure the Modbus address:

- Using ProLink II, see Figure C-3.
- Using the Communicator, see Figure C-8.
- Using the display, see Figure C-14.

Enabling or disabling Modbus ASCII support

When support for Modbus ASCII is enabled, the service port can accept connection requests that use either Modbus ASCII or Modbus RTU. When support for Modbus ASCII is disabled, the service port cannot accept connection requests that use Modbus ASCII. Only Modbus RTU connections are accepted.

The primary reason to disable Modbus ASCII support is to allow a wider range of Modbus addresses for the service port.

To enable or disable Modbus ASCII support:

- Using ProLink II, see Figure C-3.
- Using the Communicator, see Figure C-8.
- Using the display, see Figure C-14.

Configuring the HART address

The transmitter's HART address is used by devices on a network to identify and communicate with the transmitter using HART protocol. The HART address must be unique on the network.

Valid HART addresses are 0–15.

To configure the HART address:

- Using ProLink II, see Figure C-3.
- Using the Communicator, see Figure C-8.

Note: This functionality is not available via the display menus.

Note: Devices using HART protocol to communicate with the transmitter may use either the HART address or the HART tag (see Section 8.12) . You may configure either or both, as required by your other HART devices.

Note: If you change the HART address, you may also want to change the Loop Current Mode parameter. See the following section.

Configuring the Loop Current Mode parameter

The Loop Current Mode parameter is used to fix or unfix the mA output:

- If the Loop Current Mode parameter is disabled: The mA output is fixed at 4 mA, and therefore cannot be used to report process data.
- If the Loop Current Mode parameter is enabled: The mA output will report process data as configured.

You must use ProLink II to configure the Loop Current Mode parameter. See Figure C-3.

Note: Whenever you use ProLink II to set the HART address to 0, ProLink II also enables the Loop Current Mode parameter (places a check in the checkbox). Whenever you use ProLink II to set the HART address to any other value, ProLink II also disables the Loop Current Mode parameter. You may accept this change or uncheck the checkbox before clicking OK or Apply.

8.11.2 Infrared port write-protection

The infrared port (IrDA) on the display can be write-protected or released from write-protection. To do this:

- Using ProLink II, see Figure C-3.
- Using the Communicator, see Figure C-5.
- Using the display menus, see Figure C-14.

8.11.3 Floating-point byte order

Four bytes are used to transmit floating-point values. For contents of bytes, see Table 8-10.

Table 8-10 Byte contents in Modbus commands and responses

Byte	Bits	Definitions
1	S E E E E E E E	S = Sign E = Exponent
2	E M M M M M M M	E = Exponent M = Mantissa
3	M M M M M M M M	M = Mantissa
4	M M M M M M M M	M = Mantissa

The default byte order for the Model 2400S transmitter is 3–4–1–2. You may need to reset byte order to match the byte order used by a remote host or PLC. Byte order codes are listed in Table 8-11.

To configure byte order using ProLink II, see Figure C-3.

Note: This parameter affects only Modbus communications. HART communications are not changed.

Note: This functionality is not available via the display menus or the Communicator.

Table 8-11 Byte order codes and byte orders

Byte order code	Byte order
0	1–2–3–4
1	3–4–1–2
2	2–1–4–3
3	4–3–2–1

8.11.4 Additional communications response delay

Some hosts or PLCs operate at slower speeds than the transmitter. In order to synchronize communication with these devices, you can configure an additional time delay to be added to each response the transmitter sends to the remote host.

Note: This parameter affects only Modbus communications. HART communications are not changed.

The basic unit of delay is in terms of 2/3 of one character time as calculated for the current serial port baud rate setting and character transmission parameters. This basic delay unit is multiplied by the configured value to arrive at the total additional time delay. You can specify a value in the range 1 to 255.

To configure additional communications response delay using ProLink II, see Figure C-3.

Note: This functionality is not available via the display menus or the Communicator.

8.11.5 Configuring the digital fault indicator

The transmitter can indicate fault conditions using a digital fault indicator. Table 8-12 lists the options for the digital fault indicator.

Table 8-12 Digital communication fault output indicators and values

ProLink II fault indicator options	Communicator fault indicator options	Fault output value
Upscale	Upscale	• Process variables indicate that the value is greater than the upper sensor limit. • Totalizers stop incrementing.
Downscale	Downscale	• Process variables indicate that the value is less than the lower sensor limit. • Totalizers stop incrementing.
Zero	IntZero-All 0	• Flow rate variables go to the value that represents zero flow. Density is reported as zero. • Temperature is reported as 0 °C, or the equivalent if other units are used (e.g., 32 °F). • Totalizers stop incrementing.
Not-A-Number (NAN)	Not-a-Number	• Process variables report IEEE NAN. • Drive gain is reported as measured. • Modbus scaled integers are reported as Max Int. • Totalizers stop incrementing.
Flow to Zero	IntZero-Flow 0	• Flow rate variables go to the value that represents zero flow; • Other process variables are reported as measured. • Totalizers stop incrementing.
None (default)	None	• Process variables are reported as measured. • Totalizers increment if they are running.

To configure the digital fault indicator:

- Using ProLink II, see Figure C-3.
- Using the Communicator, see Figure C-8.

Note: By default, the transmitter immediately reports a fault when a fault is encountered. You can delay reporting faults by changing the fault timeout. See Section 8.9.

Note: This functionality is not available via the display menus.

8.11.6 Configuring burst mode

Burst mode is a specialized mode of communication during which the transmitter regularly broadcasts HART digital information over the mA output. Burst mode is ordinarily disabled, and should be enabled only if another device on the network requires burst mode communication.

To configure burst mode:

- Using ProLink II, see Figure C-3.

Note: If you are using ProLink II with a HART/Bell 202 connection to the transmitter, you will lose the connection when burst most is enabled. You may want to use a different connection type, or use the Communicator.

- Using the Communicator, see Figure C-8.

Note: This functionality is not available via the display menus.

The following general steps are required:

1. Enable burst mode.
2. Specify the burst mode output. Options are described in Table 8-13.

Table 8-13 Burst mode output options

Parameter		
ProLink II label	**Communicator label**	**Definition**
Primary variable	PV	The transmitter repeats the primary variable (in measurement units) in each burst (e.g., 14.0 g/s, 13.5 g/s, 12.0 g/s).
PV current & % of range	% range/current	The transmitter sends the PV's percent of range and the PV's actual mA level in each burst (e.g., 25%, 11.0 mA).
Dynamic vars & PV current(1)	Process variables/current	The transmitter sends PV, SV, TV, and quaternary variable (QV) values in measurement units and the PV's actual milliamp reading in each burst (e.g., 50 lb/min, 23 °C, 50 lb/min, 0.0023 g/cm^3, 11.8 mA).
Transmitter vars	Fld dev var	The transmitter sends four process variables in each burst. See Step 3.
Read device variables with status	Not available	The transmitter sends four process variables in each burst, plus the status of each variable. See Step 3.

(1) This burst mode setting is typically used with the HART Tri-Loop™ signal converter. See the Tri-Loop manual for additional information.

3. If you specified **Transmitter vars** or **Fld dev var** in Step 2, specify the four process variables to be sent in each burst.

8.11.7 Configuring the PV, SV, TV, and QV assignments

In the transmitter, four variables are defined for HART communications: the PV (primary variable), the SV (secondary variable), the TV (tertiary variable), and the QV (quaternary variable). A process variable such as mass flow is assigned to each HART variable.

The values of the assigned process variables can be reported or read in several ways:

- The PV is automatically reported through the mA output. It can also be queried via digital communications or reported via burst mode. If you change the PV, the process variable assigned to the mA output is changed automatically, and vice versa. See Section 6.5.1.
- The SV is not reported through an output. It can be queried via digital communications or reported via burst mode.
- The TV is automatically reported through the frequency output, if the transmitter has a frequency output. It can also be queried via digital communications or reported via burst mode. If you change the TV, the process variable assigned to the frequency output is changed automatically, and vice versa. See Section 6.6.1.
- The QV is not reported through an output. It can be queried via digital communications or reported via burst mode.

Table 8-13 lists the valid assignments for the PV, SV, TV, and QV on the Model 2400S AN transmitter. To configure the assignments:

- Using ProLink II, see Figure C-3.
- Using the Communicator, only the PV, TV, and QV can be configured. To configure the PV and TV, see Figure C-8. To configure the QV, see Figure C-4 and use the **View QV** option.

Note: This functionality is not available via the display menus.

Table 8-14 Process variable assignments for PV, SV, TV, and QV

Process variable	PV	SV	TV	QV
Mass flow rate	✓	✓	✓	✓
Volume flow rate	✓	✓	✓	✓
Temperature	✓	✓		✓
Density	✓	✓		✓
Gas standard volume flow rate	✓	✓	✓	✓
Drive gain	✓	✓		✓
Mass total				✓
Volume total				✓
Mass inventory				✓
Vol inventory				✓
External pressure	✓	✓		✓
External temperature	✓	✓		✓
Board temperature				✓
Gas standard volume inventory				✓
Gas standard volume total				✓
LPO amplitude				✓
RPO amplitude				✓
Meter temperature (T-Series sensors only)				✓
Raw tube frequency				✓
Live zero flow				✓

8.12 Configuring device settings

The device settings are used to describe the flowmeter components. Table 8-15 lists and defines the device settings.

Note: The HART device ID, which is displayed in some menus, can be set only once, and is usually set at the factory to the device serial number. If the HART device ID has not been set, its value is 0.

Table 8-15 Device settings

Parameter	Description
HART tag(1)	Also called the "software tag." Used by other devices on the network to identify and communicate with this transmitter via HART protocol. The HART tag must be unique on the network. If the transmitter will not be accessed using HART protocol, the HART tag is not required. Maximum length: 8 characters.
Descriptor	Any user-supplied description. Not used in transmitter processing, and not required. Maximum length: 16 characters.
Message	Any user-supplied message. Not used in transmitter processing, and not required. Maximum length: 32 characters.
Date	Any user-selected date. Not used in transmitter processing, and not required.

(1) Devices using HART protocol to communicate with the transmitter may use either the HART address (see Section 8.11.1) or the HART tag. You may configure either or both, as required by your other HART devices.

To configure device settings:

- Using ProLink II, see Figure C-3.
- Using the Communicator, see Figure C-8.

Note: This functionality is not available via the display menus.

If you are entering a date:

- With ProLink II, use the left and right arrows at the top of the calendar to select the year and month, then click on a date.
- With a Communicator, enter a value in the form *mm/dd/yyyy.*

8.13 Configuring sensor parameters

The sensor parameters are used to describe the sensor component of your flowmeter. They are not used in transmitter processing, and are not required. The following sensor parameters can be changed:

- Serial number
- Sensor material
- Liner material
- Flange

To configure sensor parameters:

- Using ProLink II, see Figure C-3.
- Using the Communicator, see Figure C-8.

Note: This functionality is not available via the display menus.

Chapter 9
Pressure Compensation, Temperature Compensation, and Polling

9.1 Overview

This chapter describes the following procedures:

- Configuring pressure compensation – see Section 9.2
- Configuring external temperature compensation – see Section 9.3
- Configuring polling – see Section 9.4

Note: All ProLink II procedures provided in this section assume that your computer is already connected to the transmitter and you have established communication. All ProLink II procedures also assume that you are complying with all applicable safety requirements. See Chapter 3 for more information.

Note: All Communicator key sequences in this section assume that you are starting from the "Online" menu. See Chapter 4 for more information.

9.2 Pressure compensation

The Model 2400S AN transmitter can compensate for the effect of pressure on the sensor flow tubes. *Pressure effect* is defined as the change in sensor flow and density sensitivity due to process pressure change away from calibration pressure.

Note: Pressure compensation is an optional procedure. Perform this procedure only if required by your application.

9.2.1 Options

There are two ways to configure pressure compensation:

- If the operating pressure is a known static value, you can enter the external pressure in the software, and not poll a pressure measurement device.
- If the operating pressure varies significantly, you configure the transmitter to poll for an updated pressure value from an external pressure measurement device. Polling requires HART/Bell 202 communications over the mA output.

Note: If you configure a static pressure value, ensure that it is accurate. If you configure polling for pressure, ensure that the pressure measurement device is accurate and reliable.

9.2.2 Pressure correction factors

When configuring pressure compensation, you must provide the flow calibration pressure – the pressure at which the flowmeter was calibrated (which therefore defines the pressure at which there will be no effect on the calibration factor). Enter 20 PSI unless the calibration document for your sensor indicates a different calibration pressure.

Two additional pressure correction factors may be configured: one for flow and one for density. These are defined as follows:

- Flow factor – the percent change in the flow rate per psi
- Density factor – the change in fluid density, in $g/cm^3/psi$

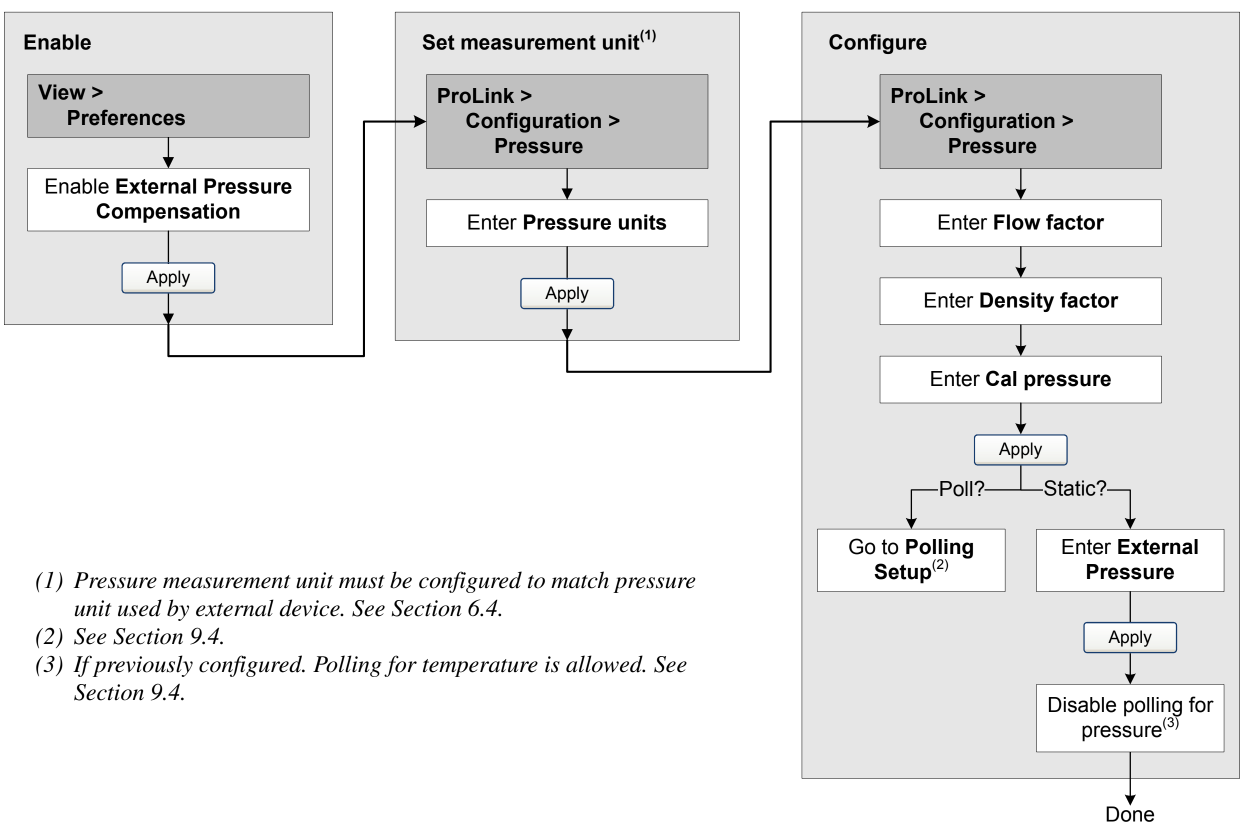
Not all sensors or applications require pressure correction factors. For the pressure correction values to be used, obtain the pressure effect values from the product data sheet for your sensor, then reverse the signs (e.g., if the flow factor is 0.000004 % per PSI, enter a pressure correction flow factor of –0.000004 % per PSI).

9.2.3 Configuration

To enable and configure pressure compensation:

- With ProLink II, see Figure 9-1.
- With the Communicator, see Figure 9-2.

Figure 9-1 Configuring pressure compensation with ProLink II

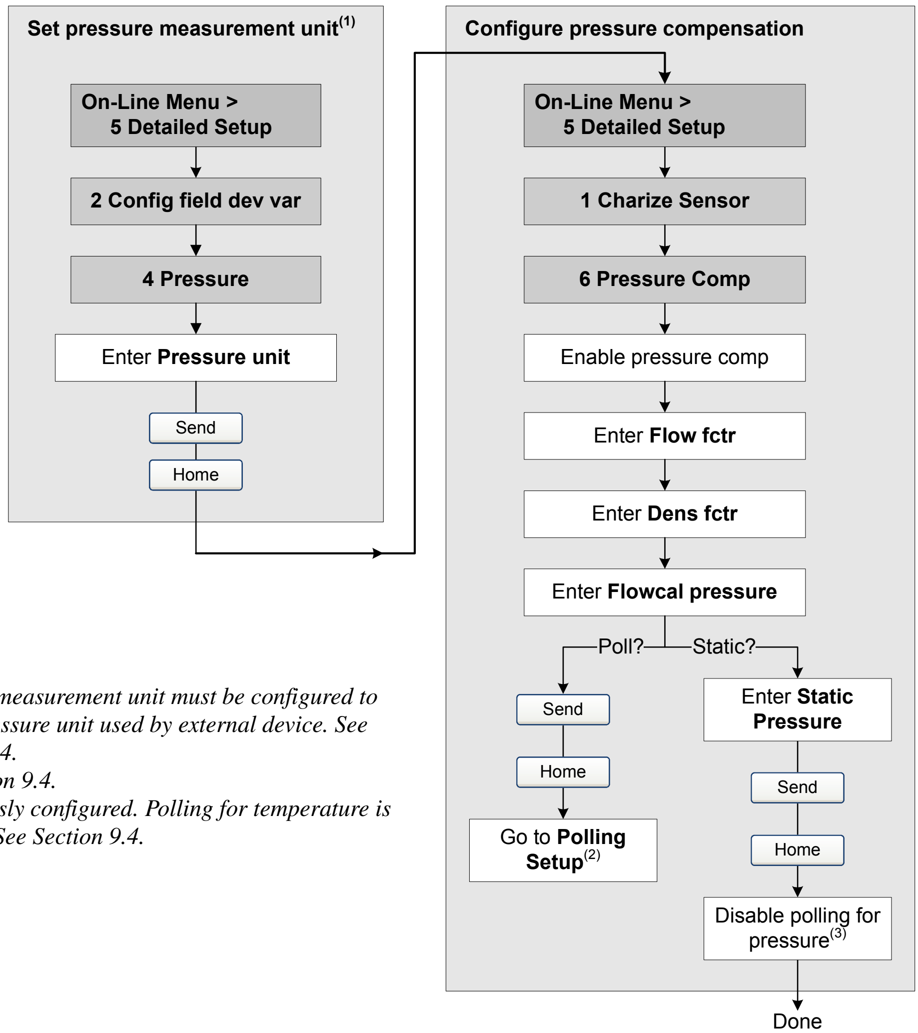


(1) Pressure measurement unit must be configured to match pressure unit used by external device. See Section 6.4.

(2) See Section 9.4.

(3) If previously configured. Polling for temperature is allowed. See Section 9.4.

Figure 9-2 **Configuring pressure compensation with the Communicator**



(1) Pressure measurement unit must be configured to match pressure unit used by external device. See Section 6.4.
(2) See Section 9.4.
(3) If previously configured. Polling for temperature is allowed. See Section 9.4.

9.3 External temperature compensation

External temperature compensation can be used with the petroleum measurement application or the enhanced density application.

There are two ways to configure external temperature compensation:

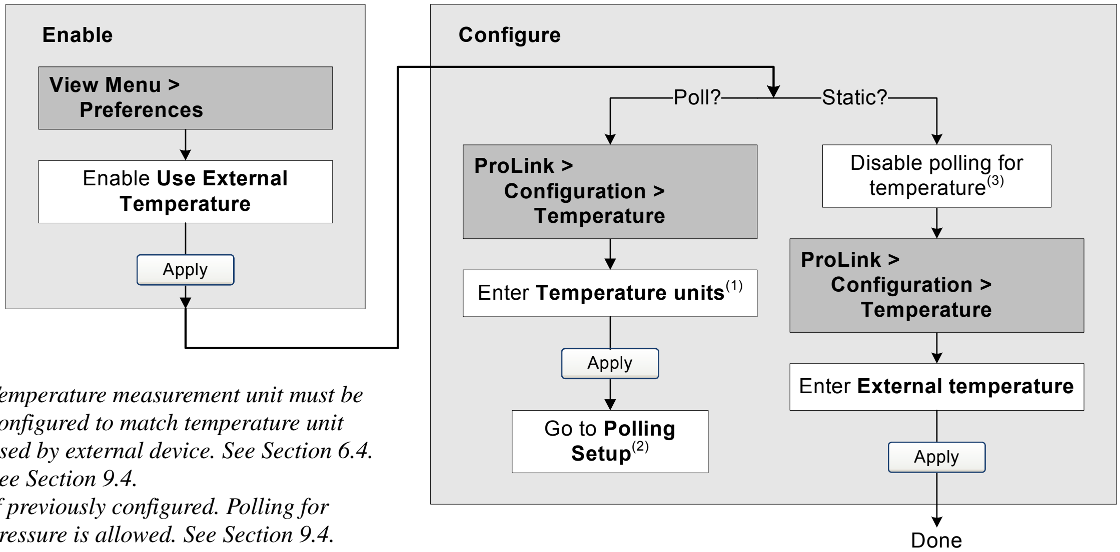
- If the operating temperature is a known static value, you can enter the operating temperature in the software, and not poll a temperature measurement device.
- If the operating temperature varies significantly, you configure the transmitter to poll for an updated temperature value from an external temperature measurement device. Polling requires HART/Bell 202 communications over the mA output.

Note: If you configure a static temperature value, ensure that it is accurate. If you configure polling for temperature, ensure that the external temperature measurement device is accurate and reliable.

To enable and configure external temperature compensation:

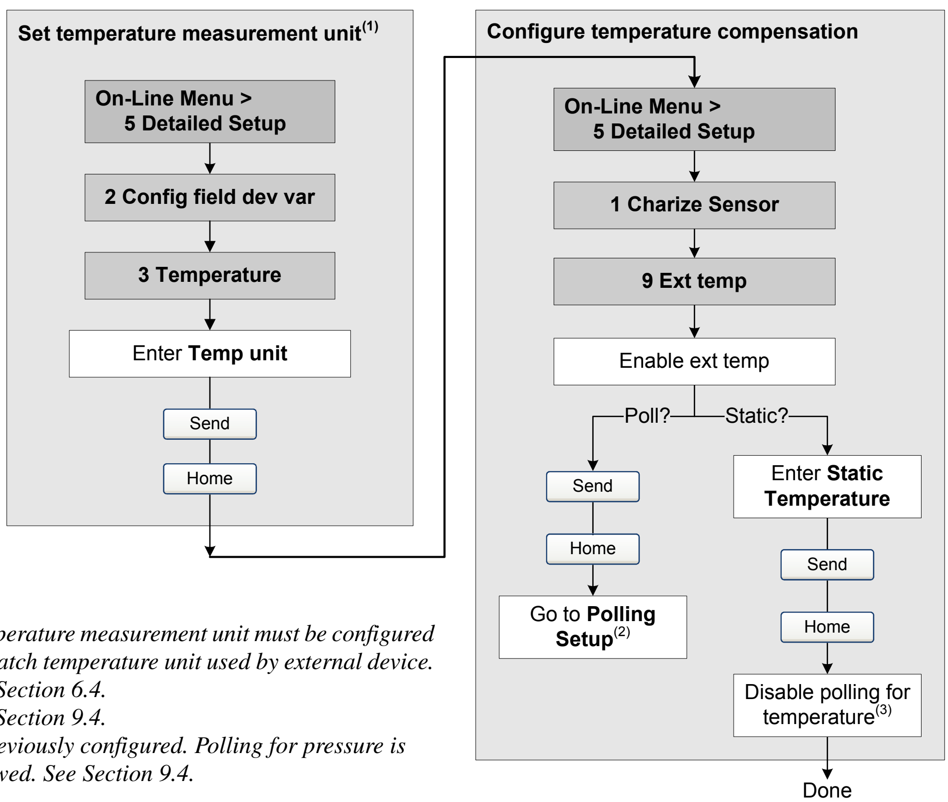
- With ProLink II, see Figure 9-3.
- With the Communicator, see Figure 9-4.

Figure 9-3 Configuring external temperature compensation with ProLink II



(1) Temperature measurement unit must be configured to match temperature unit used by external device. See Section 6.4.
(2) See Section 9.4.
(3) If previously configured. Polling for pressure is allowed. See Section 9.4.

Figure 9-4 Configuring external temperature compensation with the Communicator



(1) Temperature measurement unit must be configured to match temperature unit used by external device. See Section 6.4.
(2) See Section 9.4.
(3) If previously configured. Polling for pressure is allowed. See Section 9.4.

9.4 Polling setup

Polling is used to retrieve temperature or pressure data from an external device. You may query one or two external devices. That is, you can poll for temperature, pressure, or both temperature and pressure.

Note: The polled temperature value is used only for calculation of the derived variable in enhanced density applications or the CTL value in petroleum measurement applications. The temperature value from the sensor is used for all other calculations that require a temperature value.

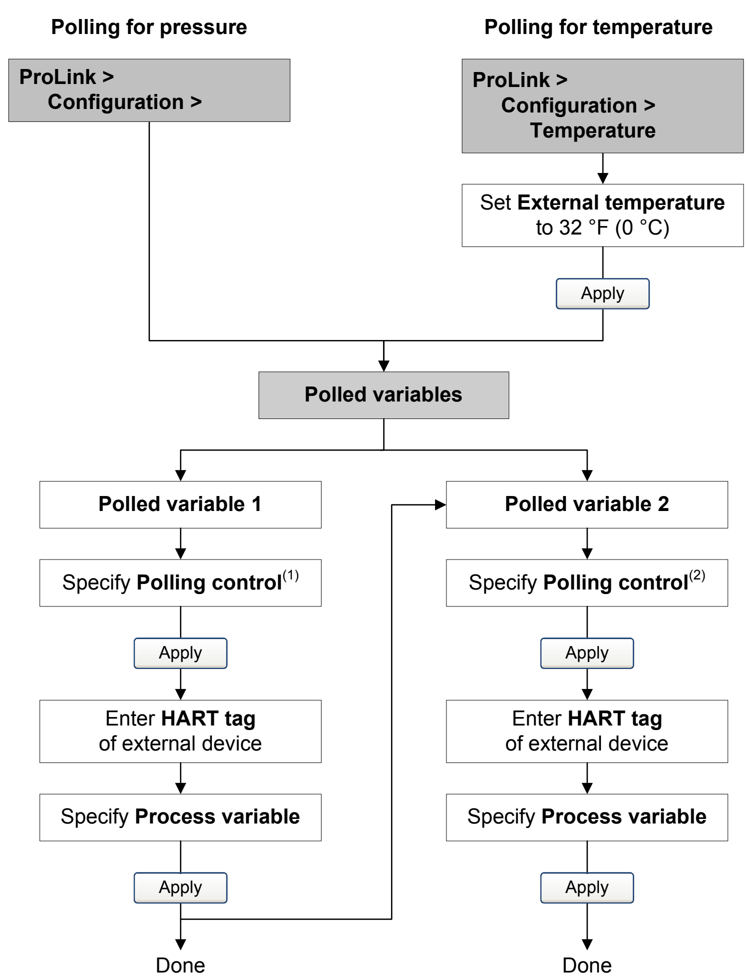
Polling requires HART protocol over the Bell 202 physical layer. You must ensure that the primary mA output has been wired for HART protocol. See the installation manual for your transmitter.

To configure polling:

- With ProLink II, see Figure 9-5.
- With the Communicator, see Figure 9-6.

Note: Before setting up polling, verify that pressure compensation or external temperature compensation has been enabled as required (see Section 9.2 and Section 9.3).

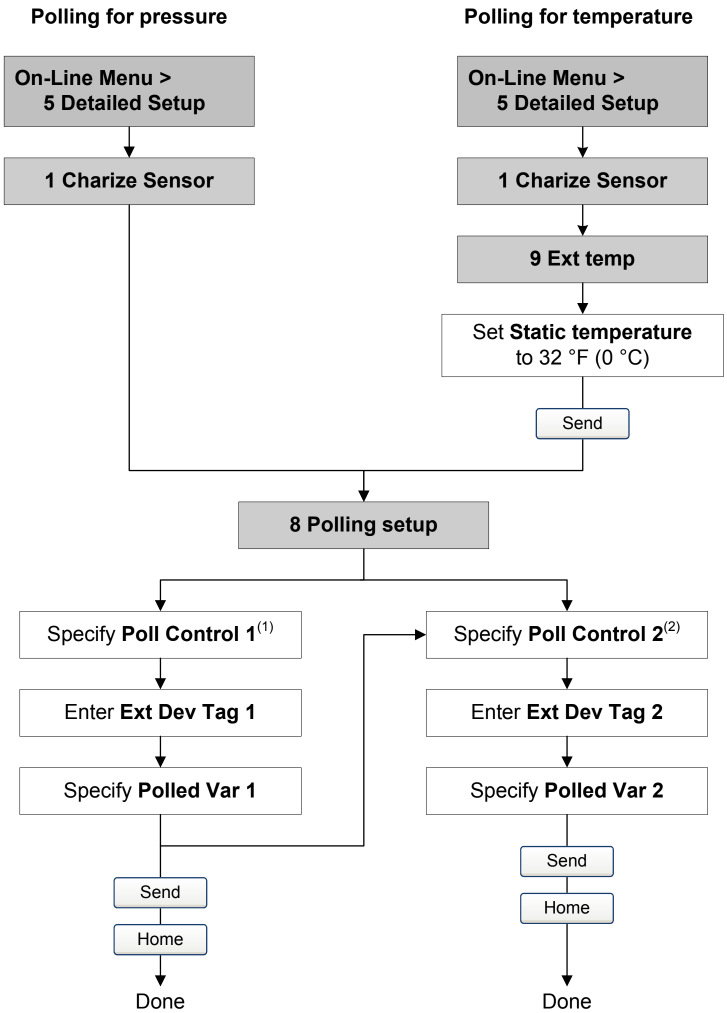
Figure 9-5 Configuring polling with ProLink II



(1) Choose Primary if the external device will probably be accessed by another device acting as a secondary master (e.g., a Communicator). Choose Secondary if the external device will probably be accessed by another device acting as a primary master.

(2) If you are configuring both Polled Variable 1 and Polled Variable 2, use the same Polling Control setting for both. If you do not, Poll as Primary will be used for both devices.

Figure 9-6 Configuring polling with the Communicator



(1) Choose Primary if the external device will probably be accessed by another device acting as a secondary master (e.g., a Communicator). Choose Secondary if the external device will probably be accessed by another device acting as a primary master.

(2) If you are configuring both Polled Variable 1 and Polled Variable 2, use the same Poll Control setting for both. If you do not, Poll as Primary will be used for both devices.

Chapter 10
Measurement Performance

10.1 Overview

This chapter describes the following procedures:

- Meter verification – see Section 10.3
- Meter validation and adjusting meter factors – see Section 10.4
- Density calibration – see Section 10.5
- Temperature calibration – see Section 10.6

Note: All ProLink II procedures provided in this section assume that your computer is already connected to the transmitter and you have established communication. All ProLink II procedures also assume that you are complying with all applicable safety requirements. See Chapter 3 for more information.

Note: All Communicator key sequences in this section assume that you are starting from the "Online" menu. See Chapter 4 for more information.

10.2 Meter validation, meter verification, and calibration

The Model 2400S transmitter supports the following procedures for the evaluation and adjustment of measurement performance:

- Meter verification – establishing confidence in the sensor's performance by analyzing secondary variables associated with flow and density
- Meter validation – confirming performance by comparing the sensor's measurements to a primary standard
- Calibration – establishing the relationship between a process variable (flow, density, or temperature) and the signal produced by the sensor

These three procedures are discussed and compared in Sections 10.2.1 through 10.2.4. Before performing any of these procedures, review these sections to ensure that you will be performing the appropriate procedure for your purposes.

10.2.1 Meter verification

Meter verification evaluates the structural integrity of the sensor tubes by comparing current tube stiffness to the stiffness measured at the factory. Stiffness is defined as the deflection of the tube per unit of load, or force divided by displacement. Because a change in structural integrity changes the sensor's response to mass and density, this value can be used as an indicator of measurement performance. Changes in tube stiffness are typically caused by erosion, corrosion, or tube damage.

Note: Micro Motion recommends performing meter verification at regular intervals.

There are two versions of the meter verification application: the original version and Micro Motion Smart Meter Verification. Table 10-1 lists requirements for each version. Table 10-2 provides a comparison of the two versions.

Note: If you are running an older version of ProLink II or the Communicator device description, you will not be able to access the additional features in Smart Meter Verification. If you are running an updated version of ProLink II or the Communicator with the original version of meter verification, the meter verification procedures will be slightly different from the procedures shown here.

Table 10-1 Version requirements for meter verification application

	Meter verification application	
Requirement type	**Original version**	**Smart Meter Verification**
Transmitter	v1.0	v4.0
ProLink II requirements	v2.5	v2.9
HART DD requirements	375 Field Communicator device rev 1, DD rev 1	375 Field Communicator device rev 4, DD rev 2

Table 10-2 Comparison of meter verification features and functions: original version vs. Smart Meter Verification

	Meter verification application	
Feature or function	**Original version**	**Smart Meter Verification**
Process interruption	No need to halt flow	No need to halt flow
Measurement interruption	Three minutes. Outputs go to: • Last Measured Value • Configured Fault Value	User option: • Continue Measurement. Measurement is not interrupted. Test requires approximately 90 seconds. • Last Measured Value. Outputs fixed and measurement interrupted for approximately 140 seconds. • Configured Fault Value Outputs fixed and measurement interrupted for approximately 140 seconds.
Result storage	Test results stored only for tests run with ProLink II, and stored on the PC	Twenty most recent results stored on the transmitter, independent of tool used to perform the procedure. For tests run with ProLink II, additional result data stored on PC.
Result data on display	Pass/Fail/Abort for current test	For all results stored on transmitter: • Pass/Fail/Abort • Abort code (if relevant) • Stiffness of the right and left pickoffs

Table 10-2 Comparison of meter verification features and functions: original version vs. Smart Meter Verification *continued*

	Meter verification application	
Feature or function	**Original version**	**Smart Meter Verification**
Result data with Communicator	Pass/Caution/Abort for current test	For all results stored on transmitter: • Pass/Caution/Abort • Abort code (if relevant) • Stiffness of the right and left pickoffs • Comparison table for stored results • Comparison plot for stored results
Result data with ProLink II	For all results stored on PC: • Pass/Fail/Abort • Abort code (if relevant) • Stiffness of the right and left pickoffs • Test execution metadata • Comparison graphs • Test reports • Data export and manipulation capabilities	For all results stored on transmitter: • Pass/Fail/Abort • Abort code (if relevant) • Stiffness of the right and left pickoffs • Test execution metadata • Comparison graphs • Test reports • Data export and manipulation capabilities
Startup methods	Manual	Manual Scheduler Event Discrete input(1)

(1) To use this method, Channel B must be configured as a discrete input.

10.2.2 Meter validation and meter factors

Meter validation compares a measurement value reported by the transmitter with an external measurement standard. Meter validation requires one data point.

Note: For meter validation to be useful, the external measurement standard must be more accurate than the sensor. See the sensor's product data sheet for its accuracy specification.

If the transmitter's mass flow, volume flow, or density measurement is significantly different from the external measurement standard, you may want to adjust the corresponding meter factor. A meter factor is the value by which the transmitter multiplies the process variable value. The default meter factors are **1.0**, resulting in no difference between the data retrieved from the sensor and the data reported externally.

Meter factors are typically used for proving the flowmeter against a Weights & Measures standard. You may need to calculate and adjust meter factors periodically to comply with regulations.

10.2.3 Calibration

The flowmeter measures process variables based on fixed points of reference. Calibration adjusts those points of reference. Three types of calibration can be performed:

- Zero, or no flow (see Section 5.5)
- Density calibration
- Temperature calibration

Density and temperature calibration require two data points (low and high) and an external measurement for each. Calibration produces a change in the offset and/or the slope of the line that represents the relationship between process density and the reported density value, or the relationship between process temperature and the reported temperature value.

Note: For density or temperature calibration to be useful, the external measurements must be accurate.

Micro Motion flowmeters with the Model 2400S transmitter are calibrated at the factory, and normally do not need to be calibrated in the field. Calibrate the flowmeter only if you must do so to meet regulatory requirements. Contact Micro Motion before calibrating your flowmeter.

Micro Motion recommends using meter validation and meter factors, rather than calibration, to prove the meter against a regulatory standard or to correct measurement error.

10.2.4 Comparison and recommendations

When choosing among meter verification, meter validation, and calibration, consider the following factors:

- Process and measurement interruption
  - Smart Meter Verification provides an option that allows process measurement to continue during the test.
  - The original version of meter verification requires approximately three minutes to perform. During these three minutes, flow can continue (provided sufficient stability is maintained); however, measurement is halted.
  - Meter validation for density does not interrupt the process or process measurement. However, meter validation for mass flow or volume flow requires process down-time for the length of the test.
  - Calibration requires process down-time. In addition, density and temperature calibration require replacing the process fluid with low-density and high density fluids, or low-temperature and high-temperature fluids.
- External measurement requirements
  - Neither version of meter verification requires external measurements.
  - Zero calibration does not require external measurements.
  - Density calibration, temperature calibration, and meter validation require external measurements. For good results, the external measurement must be highly accurate.
- Measurement adjustment
  - Meter verification is an indicator of sensor condition, but does not change flowmeter internal measurement in any way.
  - Meter validation does not change flowmeter internal measurement in any way. If you decide to adjust a meter factor as a result of a meter validation procedure, only the reported measurement is changed – the base measurement is not changed. You can always reverse the change by returning the meter factor to its previous value.
  - Calibration changes the transmitter's interpretation of process data, and accordingly changes the base measurement. If you perform a zero calibration, you can return to the previous zero or the factory zero. However, if you perform a density calibration or a temperature calibration, you cannot return to the previous calibration factors unless you have manually recorded them.

Micro Motion recommends that you perform meter verification frequently. If verification fails and there is no problem with the sensor or the process, perform meter validation and adjust the meter factors. If this is not sufficient, you may want to perform a field calibration.

10.3 Performing meter verification

10.3.1 Preparing for the meter verification test

Process fluid and process conditions

The meter verification test can be performed on any process fluid. It is not necessary to match factory conditions.

During the test, process conditions must be stable. To maximize stability:

- Maintain a constant temperature and pressure.
- Avoid changes to fluid composition (e.g., two-phase flow, settling, etc.).
- Maintain a constant flow. For higher test certainty, reduce or stop flow.

If stability varies outside test limits, the test will be aborted. Verify the stability of the process and repeat the test.

Transmitter configuration

Meter verification is not affected by any parameters configured for flow, density, or temperature. It is not necessary to change the transmitter configuration.

Control loops and process measurement

If the transmitter outputs will be set to Last Measured Value or Fault during the test, the outputs will be fixed for two minutes (Smart Meter Verification) or three minutes (original version). Disable all control loops for the duration of the test, and ensure that any data reported during this period is handled appropriately.

Specification uncertainty limit

The specification uncertainty limit defines the acceptable degree of variation from factory results, expressed as a percentage. Variation inside the limit is reported as Pass. Variation outside the limit is reported as Fail or Caution.

- In Smart Meter Verification, the specification uncertainty limit is set at the factory and cannot be configured.
- In the original version of meter verification, the specification uncertainty limit is configurable. However, Micro Motion suggests using the default value. Contact Micro Motion Customer Service before changing the specification uncertainty limit.

10.3.2 Running the meter verification test, original version

To perform meter verification:

- Using ProLink II, follow the procedure illustrated in Figure 10-1.
- Using the display menu, follow the procedure illustrated in Figure 10-2. For a complete illustration of the meter verification display menu, see Figure C-17.

Note: If you start a meter verification test from ProLink II, the transmitter display shows the following message:

SENSOR
VERFY/*x*%

Figure 10-1 Meter verification procedure – ProLink II

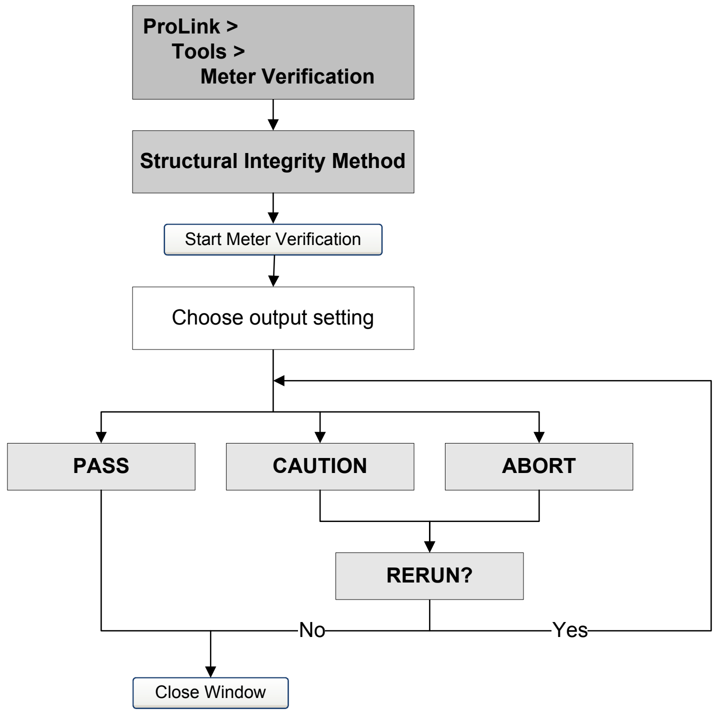
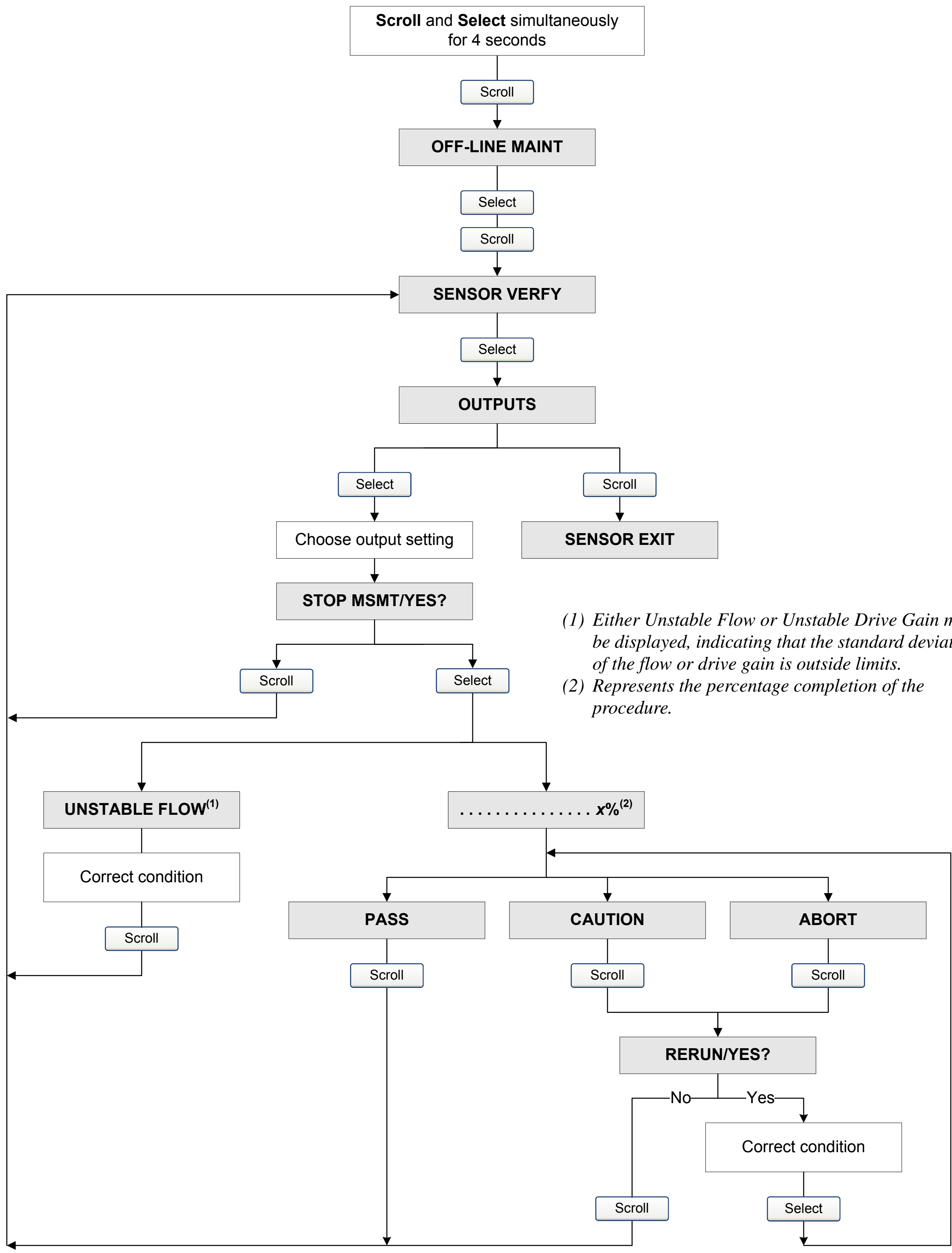


Figure 10-2 Meter verification procedure – Display menu



(1) Either Unstable Flow or Unstable Drive Gain may be displayed, indicating that the standard deviation of the flow or drive gain is outside limits.
(2) Represents the percentage completion of the procedure.

10.3.3 Running Smart Meter Verification

To run a Smart Meter Verification test:

- With ProLink II, see Figure 10-3.
- With the display, see Figures 10-4 and 10-5.
- With the 375 Field Communicator, see Figure 10-6.

Note: If you start a Smart Meter Verification test from ProLink II or the Communicator, and the outputs are set to Last Measured Value or Fault, the transmitter display shows the following message:

SENSOR
VERFY/*x*%

Figure 10-3 Smart Meter Verification test – ProLink II

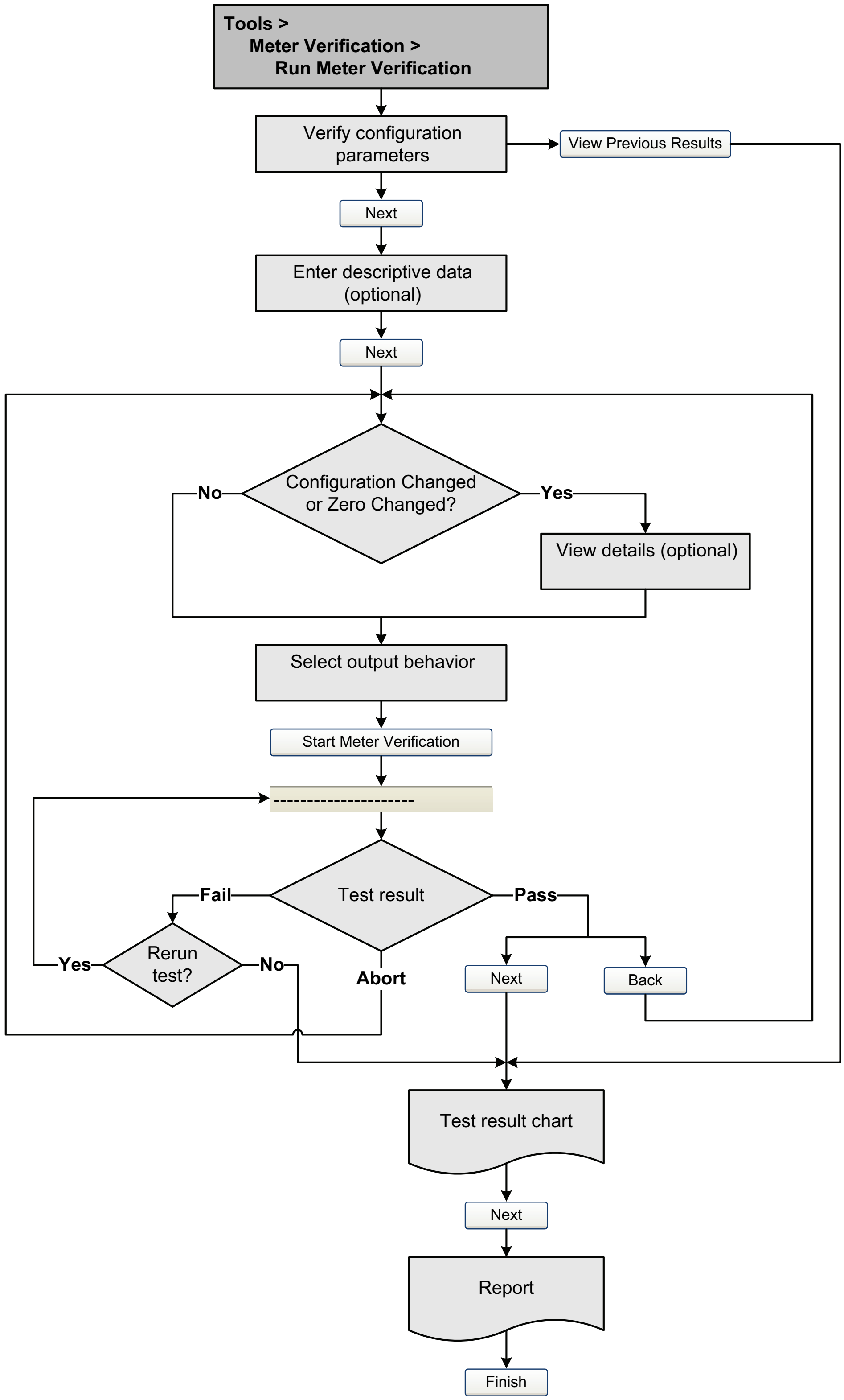


Figure 10-4 **Smart Meter Verification top-level menu – Display**

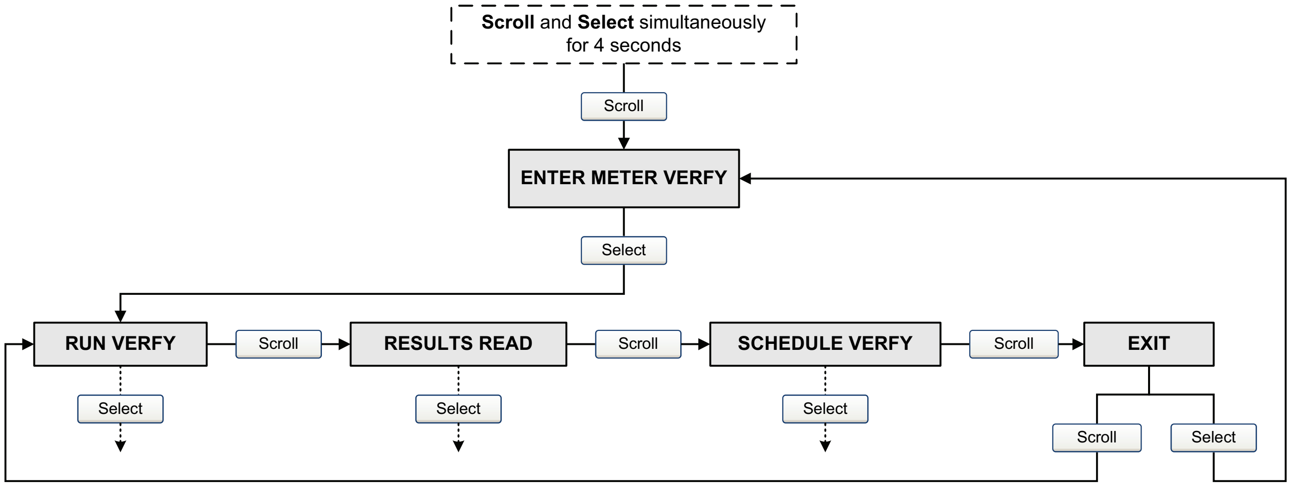


Figure 10-5 Smart Meter Verification test – Display

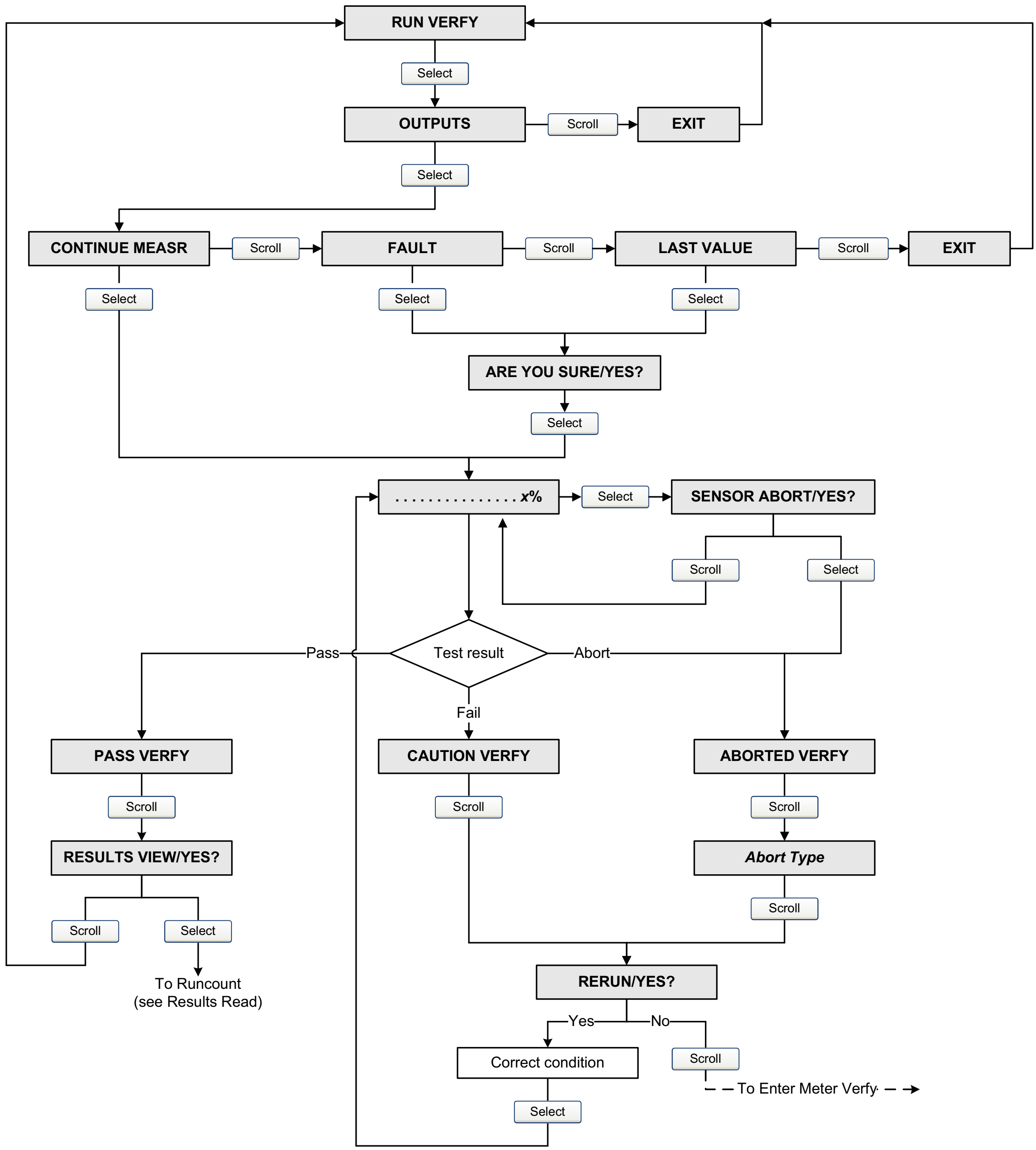
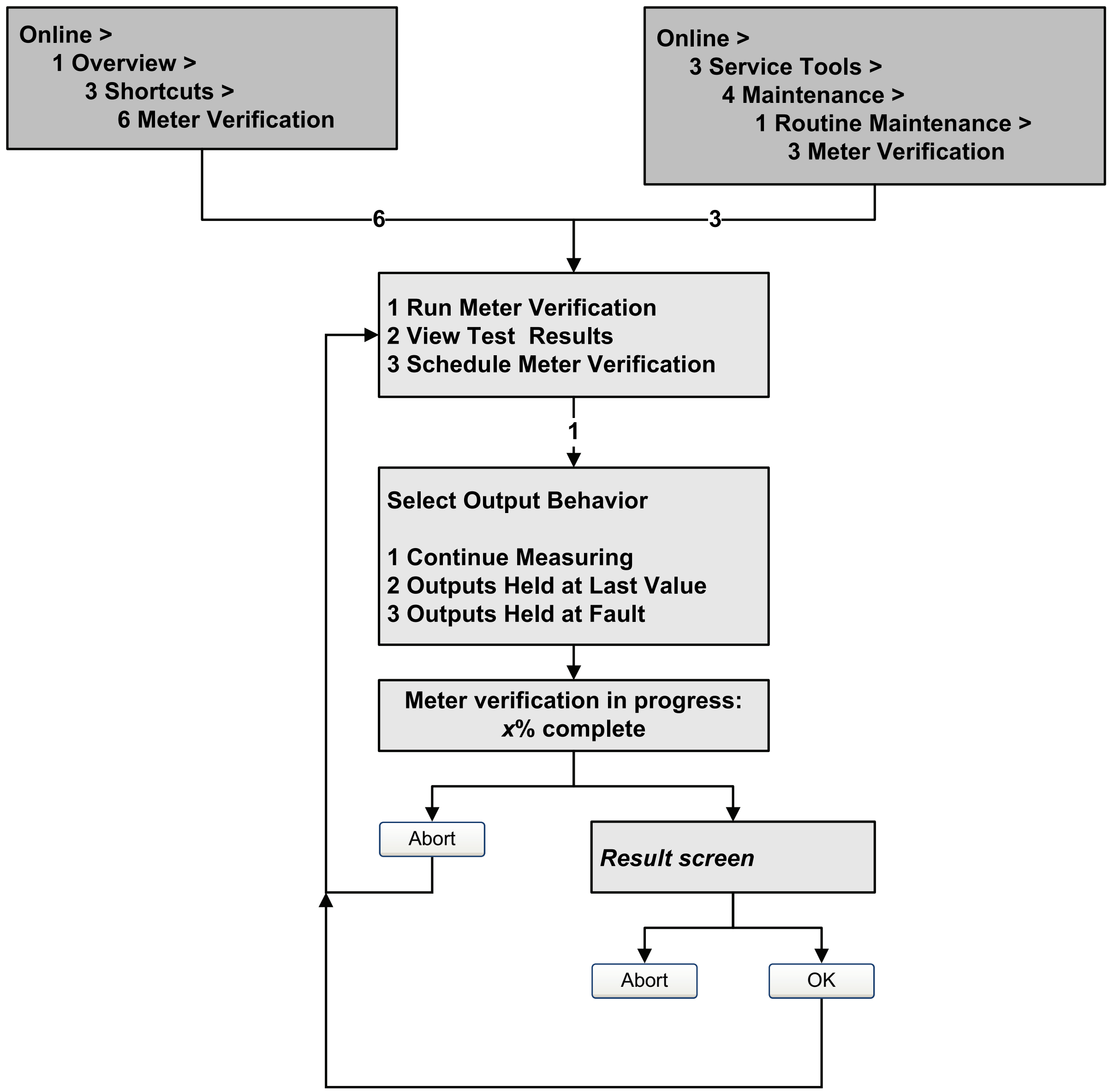


Figure 10-6 **Smart Meter Verification test – Communicator**



10.3.4 Reading and interpreting meter verification test results

Pass/Fail/Abort

When the meter verification test is completed, the result is reported as Pass, Fail or Caution (depending on whether you are using the display, the Communicator, or ProLink II), or Abort:

- *Pass* – The test result is within the specification uncertainty limit. In other words, the stiffness of the left and right pickoffs match the factory values plus or minus the specification uncertain limit. If transmitter zero and configuration match factory values, the sensor will meet factory specifications for flow and density measurement. It is expected that meters will pass meter verification every time the test is run.
- *Fail/Caution* – The test result is not within the specification uncertainty limit. Micro Motion recommends that you immediately repeat the meter verification test. If you were using the Smart Meter Verification, with outputs set to Continue Measurement, change the setting to Last Measured Value or Fault.
  - If the meter passes the second test, the first Fail/Caution result can be ignored.
  - If the meter fails the second test, the flow tubes may be damaged. Use your process knowledge to determine the possibilities for damage and the appropriate actions for each. These actions might include removing the meter from service and physically inspecting the tubes. At minimum, you should perform a flow validation and a density calibration.
- *Abort* – A problem occurred with the meter verification test (e.g., process instability). Abort codes are listed and defined in Table 10-3, and suggested actions are provided for each code.

Table 10-3 Meter verification abort codes

Abort code	Description	Suggested action
1	User-initiated abort	None required. Wait for 15 seconds before starting another test.
3	Frequency drift	Ensure that temperature, flow, and density are stable, and rerun the test.
5	High drive gain	Ensure that flow is stable, minimize entrained gas, and rerun the test.
8	Unstable flow	Review the suggestions for stable flow in Section 10.3.1 and rerun the test.
13	No factory reference data for meter verification test performed on air	Contact Micro Motion customer service and provide the abort code.
14	No factory reference data for meter verification test performed on water	Contact Micro Motion customer service and provide the abort code.
15	No configuration data for meter verification	Contact Micro Motion customer service and provide the abort code.
Other	General abort.	Repeat the test. If the test aborts again, contact Micro Motion customer service and provide the abort code.

Detailed test data with ProLink II

For each test, the following data is stored on the transmitter:

- Powered-on hours at the time of the test (Smart Meter Verification)
- Test result
- Stiffness of the left and right pickoffs, shown as percentage variation from the factory value. If the test aborted, 0 is stored for these values.
- Abort code, if applicable

ProLink II stores additional descriptive information for each test in a database on the local PC, including:

- Timestamp from the PC clock
- Current flowmeter identification data
- Current flow and density configuration parameters
- Current zero values
- Current process values for mass flow rate, volume flow rate, density, temperature, and external pressure
- (Optional) User-entered customer and test descriptions

If you are using Smart Meter Verification and you run a meter verification test from ProLink II, ProLink II first checks for new test results on the transmitter and synchronizes the local database if required. During this step, ProLink II displays the following message:

Synchronizing x out of y
Please wait

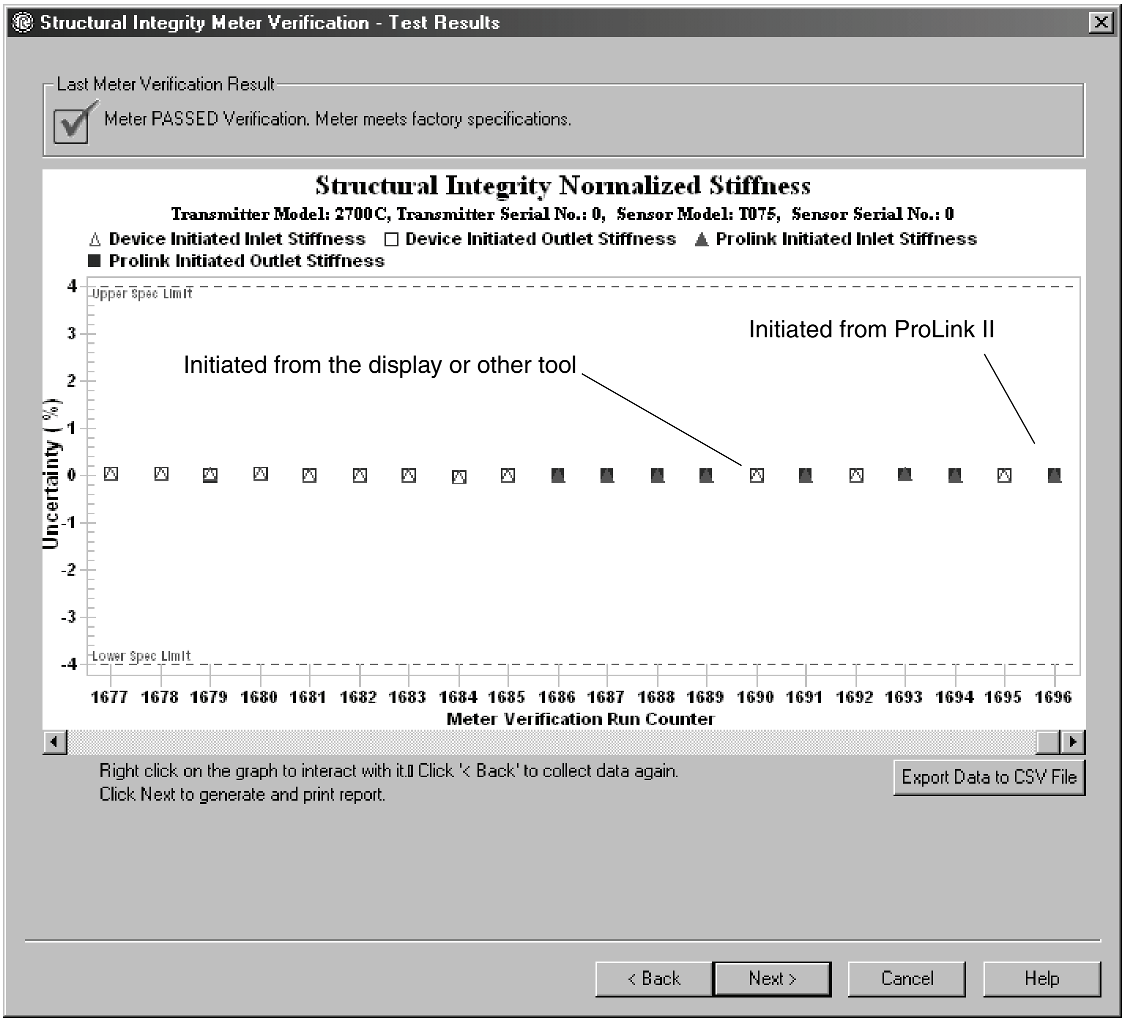
Note: If you request an action while synchronization is in process, ProLink II displays a message asking whether or not you want to complete synchronization. If you choose No, the ProLink II database may not include the latest test results from the transmitter.

Test results are available at the end of each test, in the following forms:

- A test result chart (see Figure 10-7).
- A test report that includes the descriptive information for the current test, the test result chart, and background information about meter verification. You can export this report to an HTML file or print it to the default printer.

Note: To view the chart and the report for the previous test, click View Previous Test Results and Print Report from the first meter verification panel. See Figure 10-3. Test reports are available only for tests initiated from ProLink II.

Figure 10-7 **Test result chart**



The test result chart shows the results for all tests in the ProLink II database, plotted against the specification uncertainty limit. The inlet stiffness and the outlet stiffness are plotted separately. This helps to distinguish between local and uniform changes to the sensor tubes.

This chart supports trend analysis, which can be helpful in detecting meter problems before they become severe.

Note the following:

- The test result chart may not show all test results, and test counters may not be continuous. ProLink II stores information about all tests initiated from ProLink II and all tests available on the transmitter when the test database is synchronized. However, the transmitter stores only the twenty most recent test results. To ensure a complete result set, always use ProLink II to initiate the tests, or synchronize the ProLink II database before overwriting occurs.
- The chart uses different symbols to differentiate between tests initiated from ProLink II and tests initiated using a different tool. A test report is available only for tests that were initiated from ProLink II.
- You can double-click the chart to manipulate the presentation in a variety of ways (change titles, change fonts, colors, borders and gridlines, etc.), and to export the data to additional formats (including “to printer”).
- You can export this chart to a CSV file for use in external applications.

Detailed test data with the display

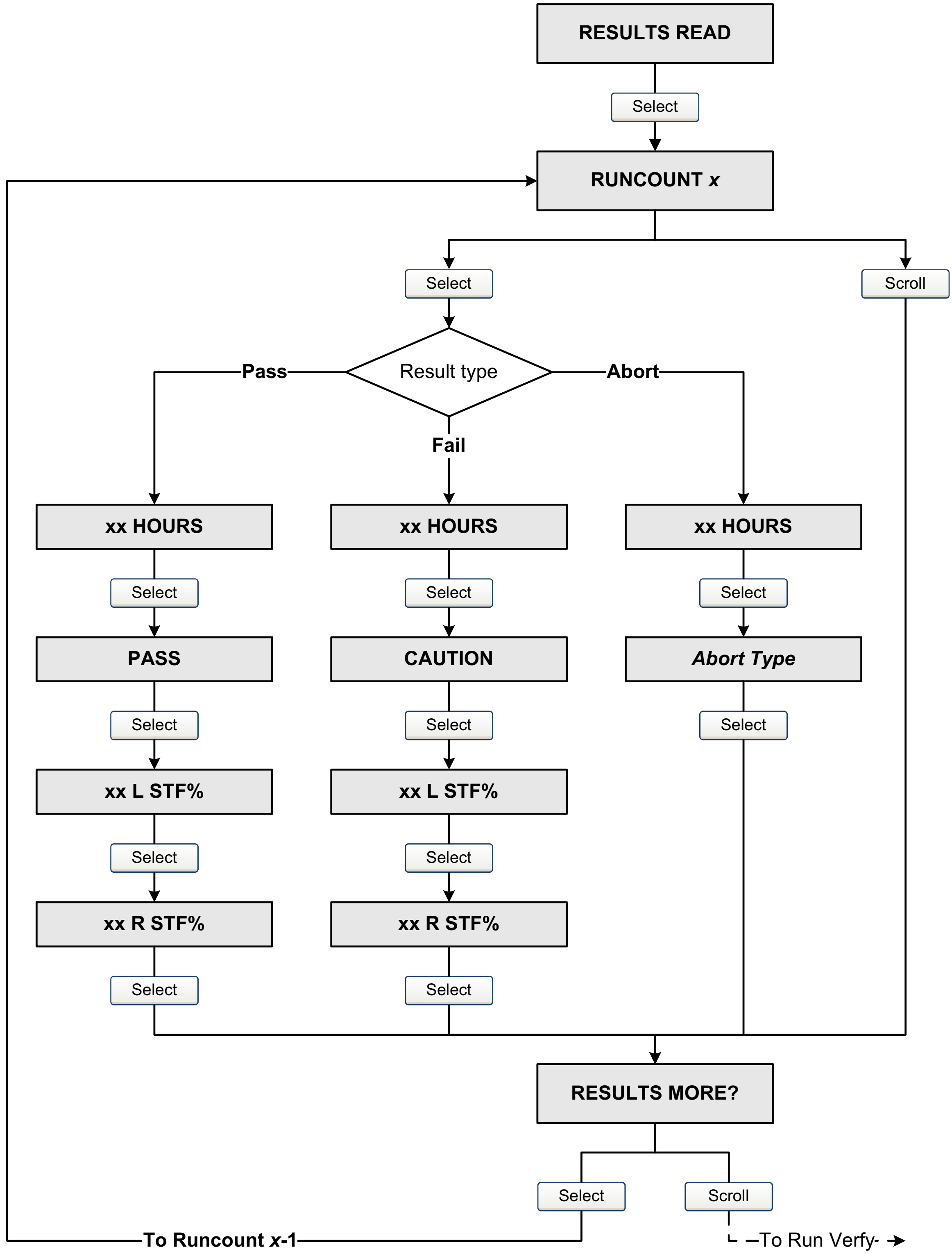
Note: Requires Smart Meter Verification. No detailed test data is available with the original version of the meter verification application.

For each Smart Meter Verification test, the following data is stored on the transmitter:

- Powered-on hours at the time of the test
- Test result
- Stiffness of the left and right pickoffs, shown as percentage variation from the factory value. If the test aborted, 0 is stored for these values.
- Abort code, if applicable

To view this data, see Figures 10-4 and 10-8.

Figure 10-8 Meter verification test data – Display



Detailed test data with the Communicator

Note: Requires Smart Meter Verification. No detailed test data is available with the original version of the meter verification application.

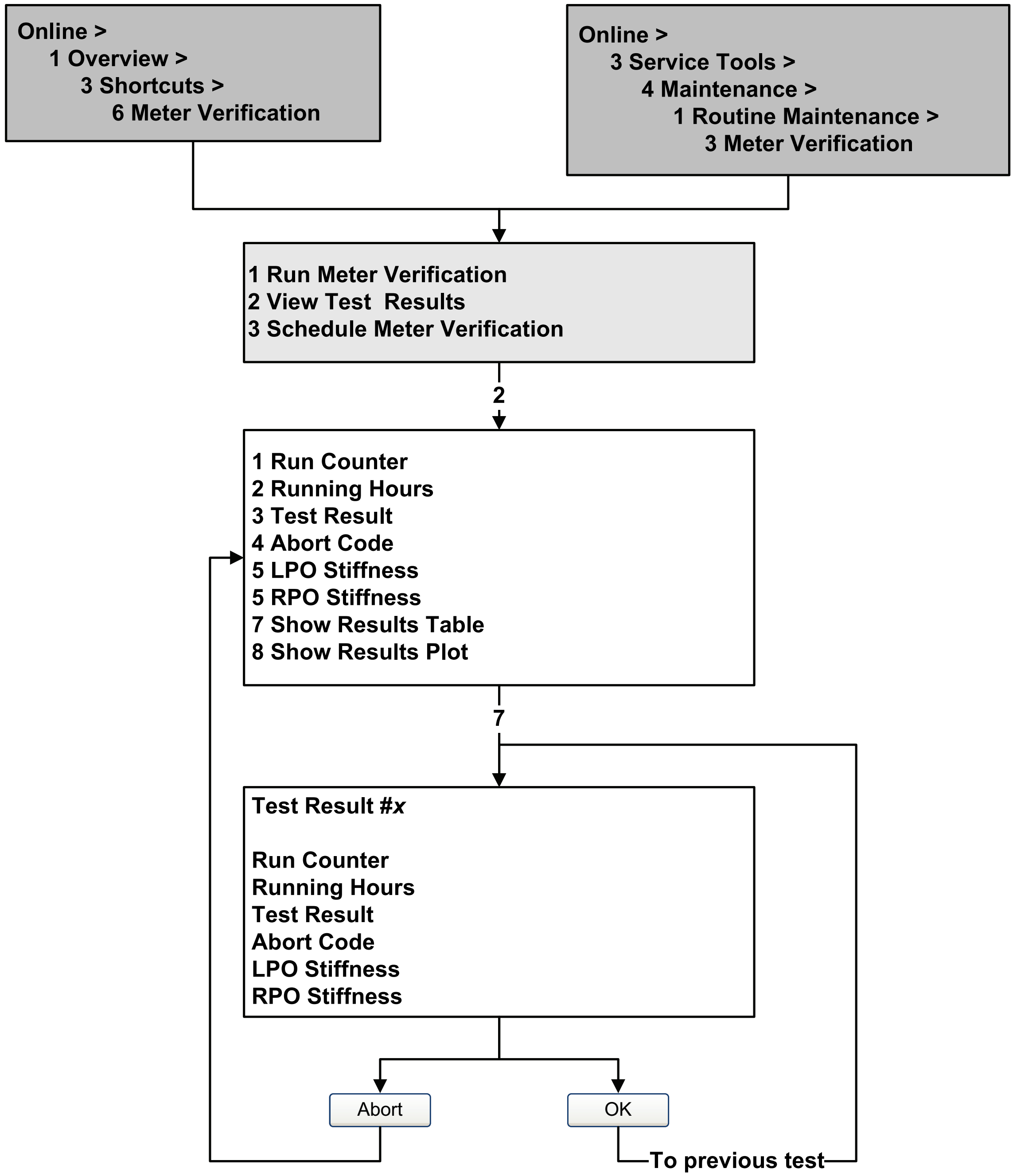
For each Smart Meter Verification test, the following data is stored on the transmitter:

- Powered-on hours at the time of the test
- Test result
- Stiffness of the left and right pickoffs, shown as percentage variation from the factory value. If the test aborted, 0 is stored for these values.
- Abort code, if applicable

The Communicator also provides a trend function that allows you to compare the results of the 20 tests, viewed as either a table or a graph.

To view this data, see Figure 10-9.

Figure 10-9 **Meter verification test data – Communicator**



10.3.5 Setting up automatic or remote execution of the meter verification test

Note: Requires Smart Meter Verification. Scheduling is not available with the original version of the meter verification application.

There are three ways to execute a Smart Meter Verification test automatically:

- Define it as an event action (using the dual-setpoint event model)
- Set up a one-time automatic execution
- Set up a recurring execution

In addition, if your transmitter has a discrete input, you can configure the discrete input to initiate a Smart Meter Verification test remotely.

You can use these methods in any combination. For example, you can specify that a Smart Meter Verification test will be executed three hours from now, every 24 hours starting now, every time a specific discrete event occurs, and every time the discrete input is activated.

- To define meter verification as an event action, see Section 6.8.
- To define meter verification as a discrete input action, see Section 6.8.
- To set up a one-time automatic execution, set up a recurring execution, view the number of hours until the next scheduled test, or delete a schedule:
  - With ProLink II, click **Tools > Meter Verification > Schedule Meter Verification**.
  - With the display, see Figures 10-4 and 10-10.
  - With the Communicator, see Figure 10-11.

Note the following:

- If you are setting up a one-time automatic execution, specify the start time as a number of hours from the present time. For example, if the present time is 2:00 and you specify 3.5 hours, the test will be initiated at 5:30.
- If you are setting up a recurring execution, specify the number of hours to elapse between executions. The first test will be initiated when the specified number of hours has elapsed, and testing will be repeated at the same interval until the schedule is deleted. For example, if the present time is 2:00 and you specify 2 hours, the first test will be initiated at 4:00, the next at 6:00, and so on.

If you delete the schedule, both the one-time execution and the recurring execution settings are deleted.

Figure 10-10 **Smart Meter Verification scheduler – Display**

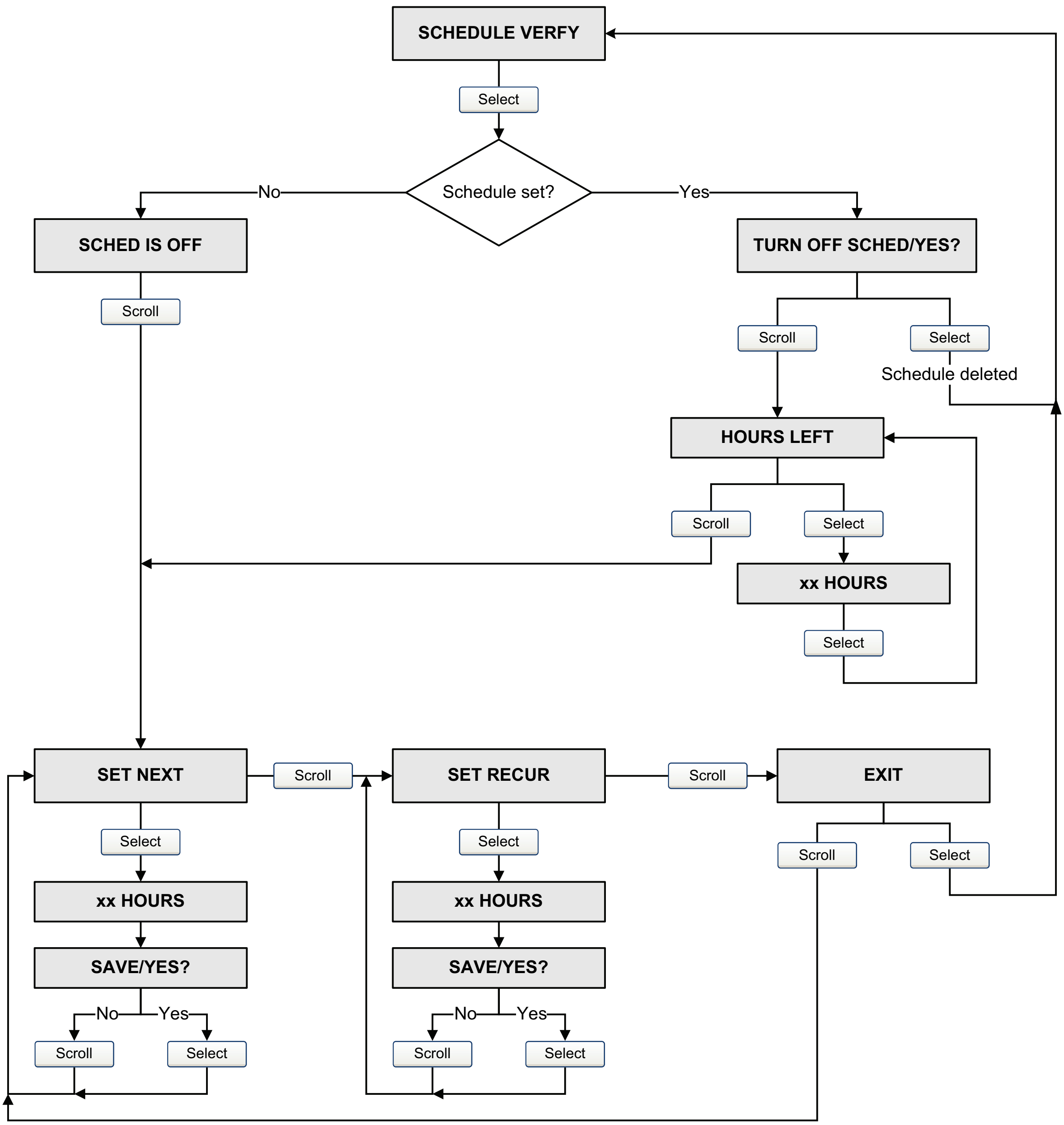
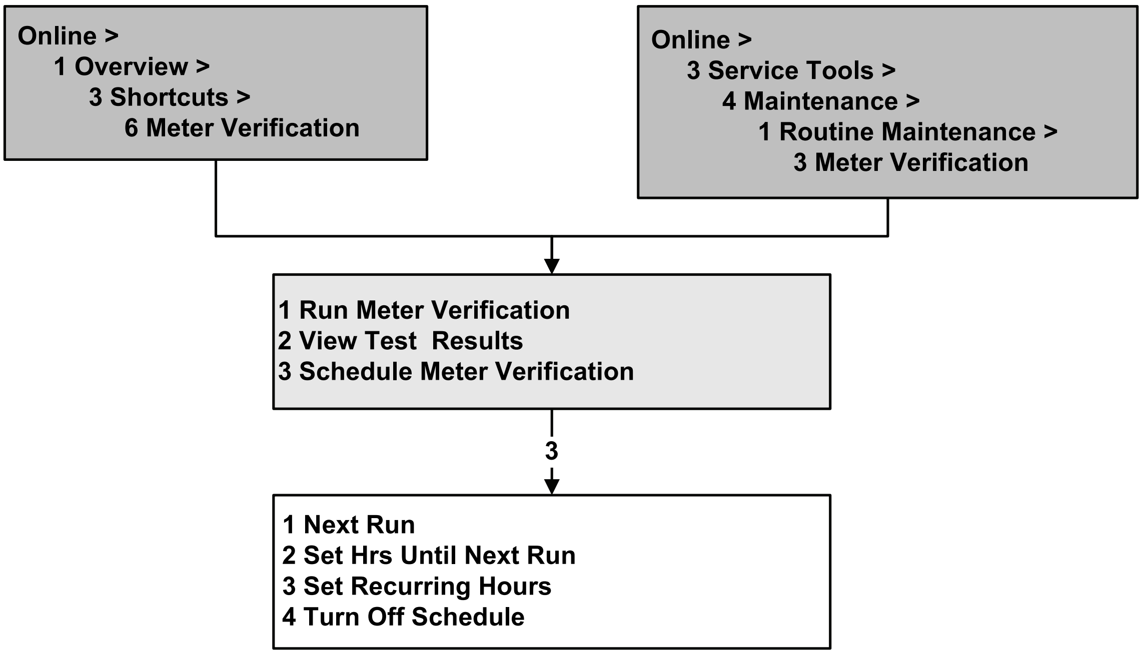


Figure 10-11 **Smart Meter Verification scheduler – Communicator**



10.4 Performing meter validation

To perform meter validation, measure a sample of the process fluid and compare the measurement with the flowmeter’s reported value.

Use the following formula to calculate a meter factor:

$$\text{NewMeterFactor} = \text{ConfiguredMeterFactor} \times \frac{\text{ExternalStandard}}{\text{ActualTransmitterMeasurement}}$$

Valid values for meter factors range from **0.8** to **1.2**. If the calculated meter factor exceeds these limits, contact Micro Motion customer service.

To configure meter factors:

- Using ProLink II, see Figure C-2.
- Using the Communicator, see Figure C-7.
- Using the display menus, see Figure C-14.

Example	The flowmeter is installed and proved for the first time. The flowmeter mass measurement is 250.27 lb; the reference device measurement is 250 lb. A mass flow meter factor is determined as follows: $$MassFlowMeterFactor = 1 \times \frac{250}{250.27} = 0.9989$$ The first mass flow meter factor is 0.9989. One year later, the flowmeter is proved again. The flowmeter mass measurement is 250.07 lb; the reference device measurement is 250.25 lb. A new mass flow meter factor is determined as follows: $$MassFlowMeterFactor = 0.9989 \times \frac{250.25}{250.07} = 0.9996$$ The new mass flow meter factor is 0.9996.

10.5 Performing density calibration

Density calibration includes the following calibration points:

- All sensors:
  - D1 calibration (low-density)
  - D2 calibration (high-density)
- T-Series sensors only:
  - D3 calibration (optional)
  - D4 calibration (optional)

For T-Series sensors, the optional D3 and D4 calibrations could improve the accuracy of the density measurement. If you choose to perform the D3 and D4 calibration:

- Do not perform the D1 or D2 calibration.
- Perform D3 calibration if you have one calibrated fluid.
- Perform both D3 and D4 calibrations if you have two calibrated fluids (other than air and water).

The calibrations that you choose must be performed without interruption, in the order listed here.

Note: Before performing the calibration, record your current calibration parameters. If you are using ProLink II, you can do this by saving the current configuration to a file on the PC. If the calibration fails, restore the known values.

You can calibrate for density with ProLink II or the Communicator.

10.5.1 Preparing for density calibration

Before beginning density calibration, review the requirements in this section.

Sensor requirements

During density calibration, the sensor must be completely filled with the calibration fluid, and flow through the sensor must be at the lowest rate allowed by your application. This is usually accomplished by closing the shutoff valve downstream from the sensor, then filling the sensor with the appropriate fluid.

Density calibration fluids

D1 and D2 density calibration require a D1 (low-density) fluid and a D2 (high-density) fluid. You may use air and water. If you are calibrating a T-Series sensor, the D1 fluid must be air and the D2 fluid must be water.

> **⚠ CAUTION**
>
> **For T-Series sensors, the D1 calibration must be performed on air and the D2 calibration must be performed on water.**

For D3 density calibration, the D3 fluid must meet the following requirements:

- Minimum density of 0.6 g/cm^3
- Minimum difference of 0.1 g/cm^3 between the density of the D3 fluid and the density of water. The density of the D3 fluid may be either greater or less than the density of water

For D4 density calibration, the D4 fluid must meet the following requirements:

- Minimum density of 0.6 g/cm^3
- Minimum difference of 0.1 g/cm^3 between the density of the D4 fluid and the density of the D3 fluid. The density of the D4 fluid must be greater than the density of the D3 fluid
- Minimum difference of 0.1 g/cm^3 between the density of the D4 fluid and the density of water. The density of the D4 fluid may be either greater or less than the density of water

10.5.2 Density calibration procedures

To perform a D1 and D2 density calibration:

- With ProLink II, see Figure 10-12.
- With a Communicator, see Figure 10-13.

To perform a D3 density calibration or a D3 and D4 density calibration:

- With ProLink II, see Figure 10-14.
- With a Communicator, see Figure 10-15.

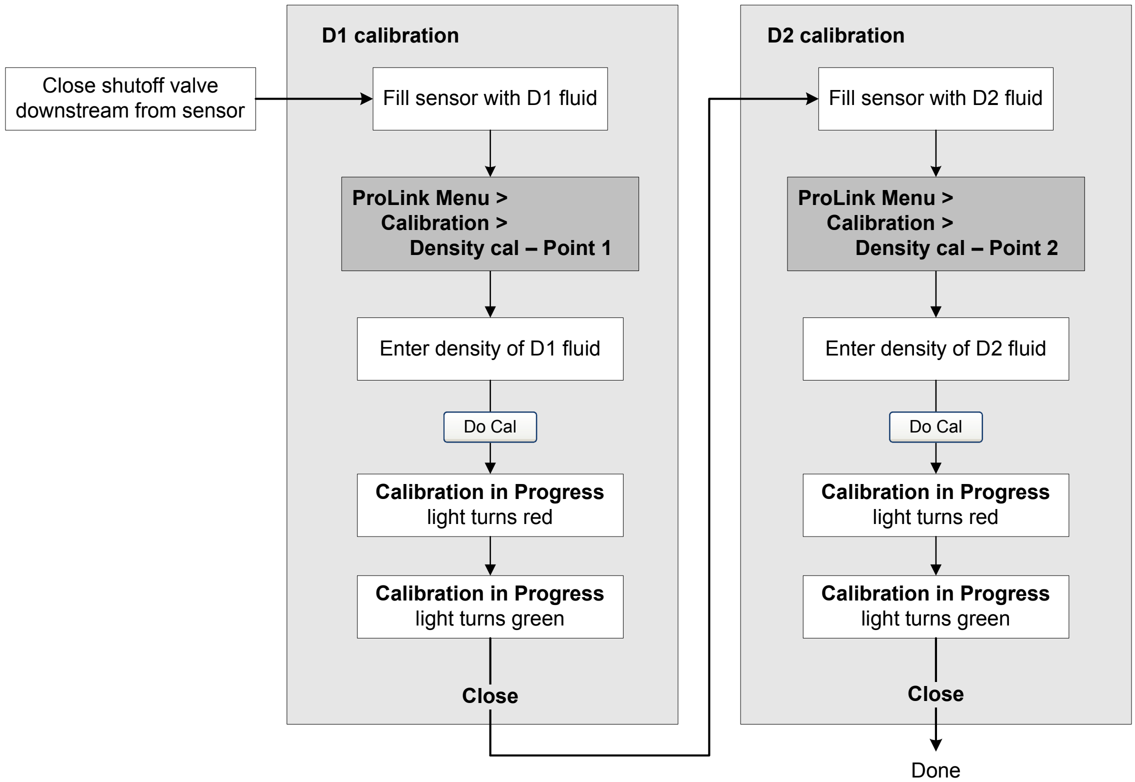


Figure 10-12 **D1 and D2 density calibration – ProLink II**

Figure 10-13 **D1 and D2 density calibration – Communicator**

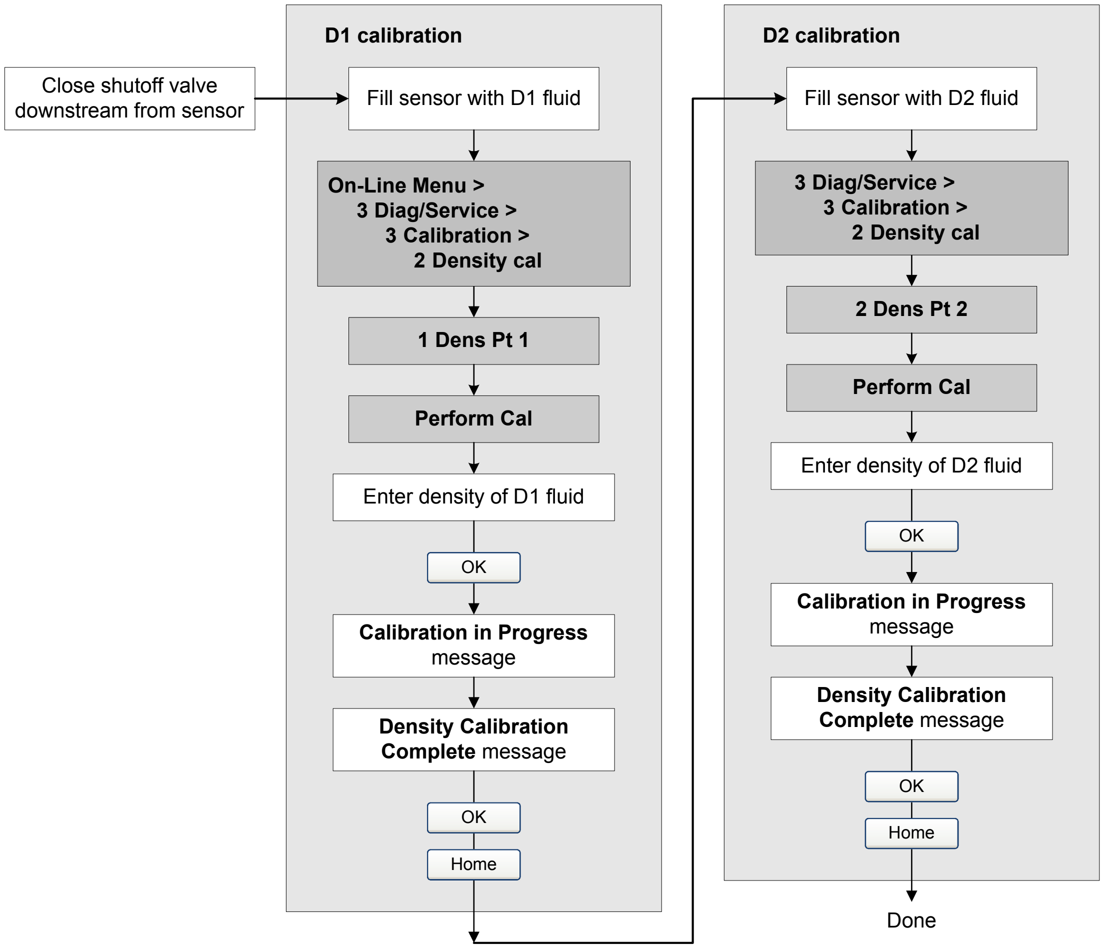


Figure 10-14 D3 or D3 and D4 density calibration – ProLink II

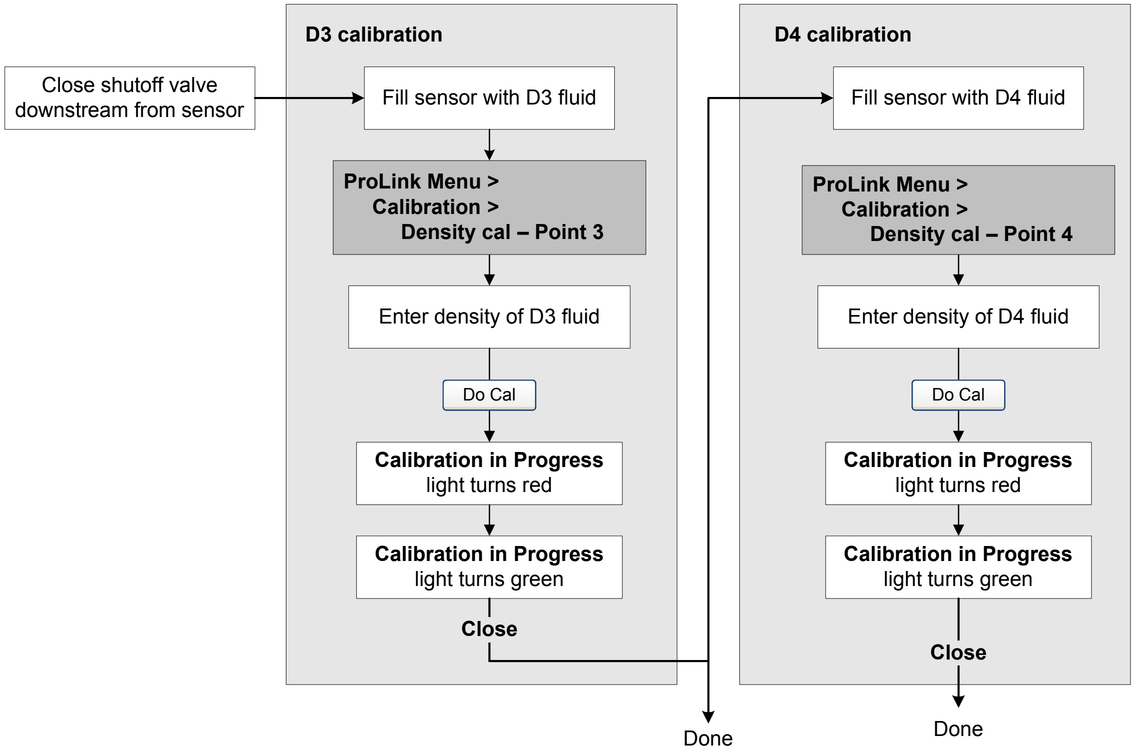
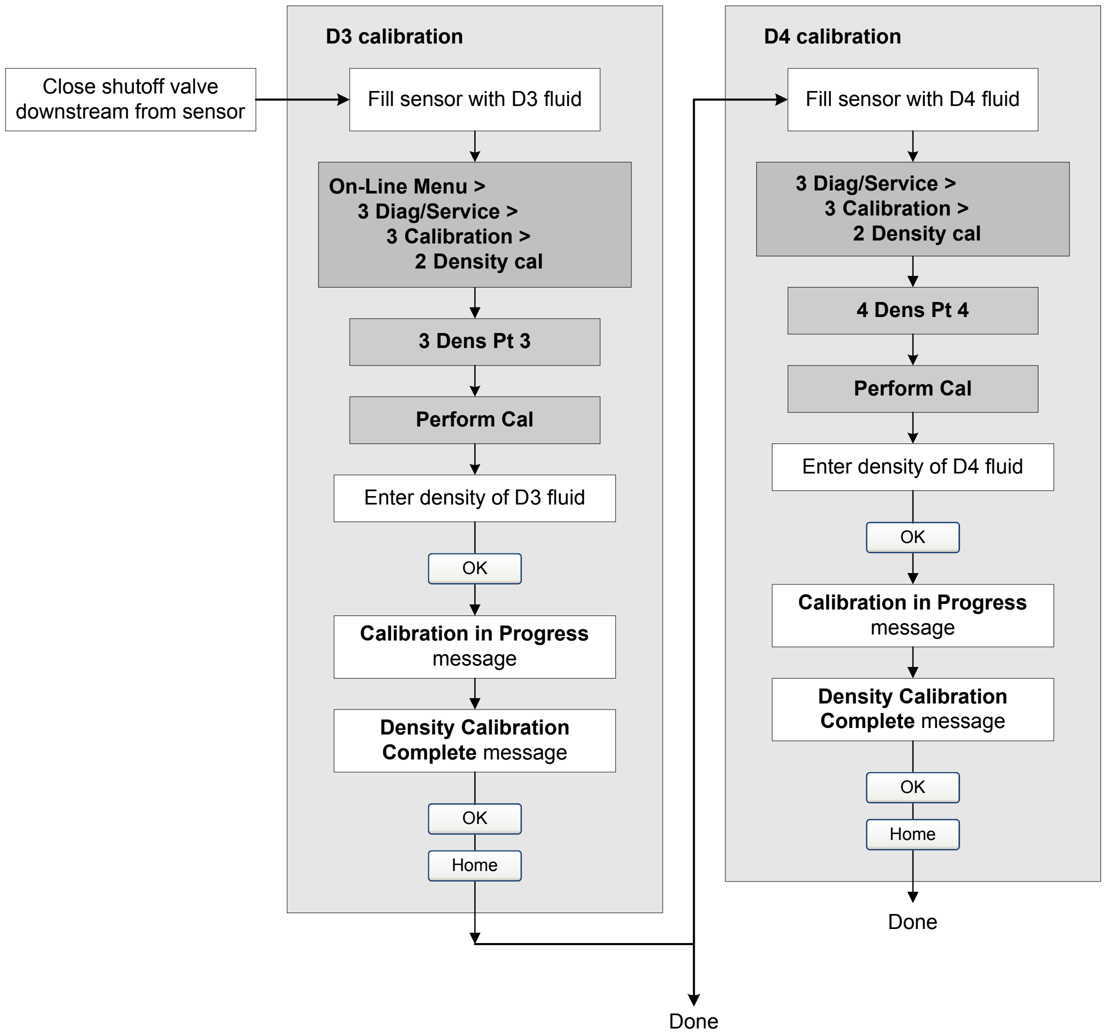


Figure 10-15 **D3 or D3 and D4 density calibration – Communicator**

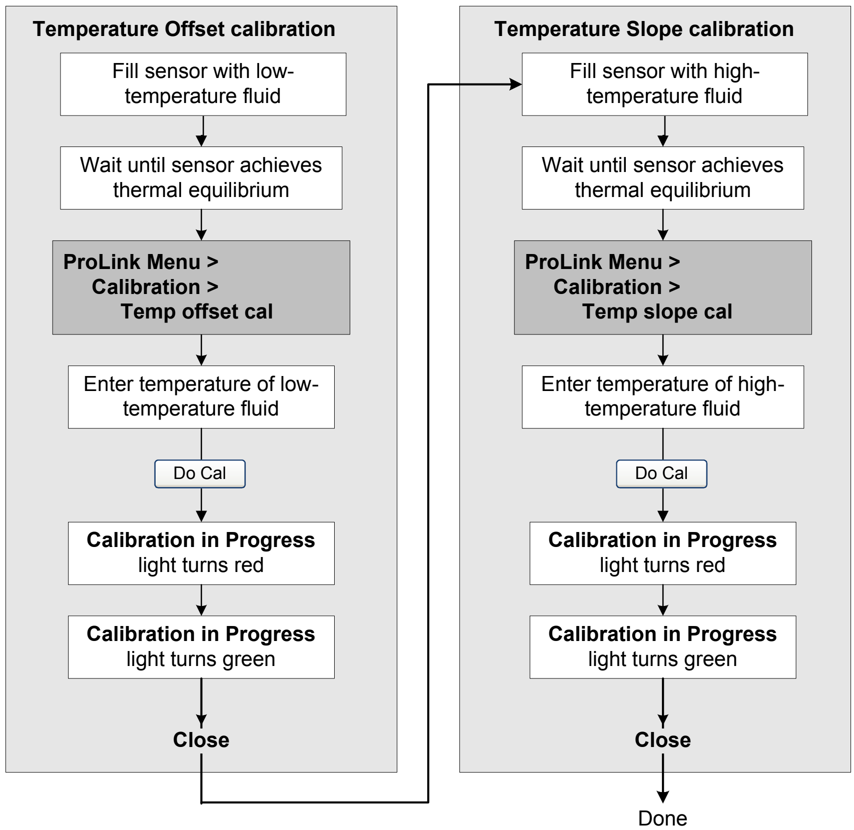


10.6 Performing temperature calibration

Temperature calibration is a two-part procedure: temperature offset calibration and temperature slope calibration. The entire procedure must be completed without interruption.

You can calibrate for temperature with ProLink II software. See Figure 10-16.

Figure 10-16 Temperature calibration – ProLink II



Chapter 11
Troubleshooting

11.1 Overview

This chapter describes guidelines and procedures for troubleshooting the flowmeter. The information in this chapter will enable you to:

- Categorize the problem
- Determine whether you are able to correct the problem
- Take corrective measures (if possible)
- Contact the appropriate support agency

Note: All ProLink II procedures provided in this section assume that your computer is already connected to the transmitter and you have established communication. All ProLink II procedures also assume that you are complying with all applicable safety requirements. See Chapter 3 for more information.

⚠ WARNING

Using the service port clips to communicate with the transmitter in a hazardous area can cause an explosion.

Before using the service port clips to communicate with the transmitter in a hazardous area, make sure the atmosphere is free of explosive gases.

Note: All Communicator key sequences in this section assume that you are starting from the "Online" menu. See Chapter 4 for more information.

11.2 Guide to troubleshooting topics

Refer to Table 11-1 for a list of troubleshooting topics discussed in this chapter.

Table 11-1 Troubleshooting topics and locations

Section	Topic
Section 11.4	*Transmitter does not operate*
Section 11.5	*Transmitter does not communicate*
Section 11.6	*Zero or calibration failure*
Section 11.7	*Fault conditions*
Section 11.8	*HART output problems*
Section 11.9	*I/O problems*
Section 11.10	*Simulation mode*

Table 11-1 Troubleshooting topics and locations *continued*

Section	Topic
Section 11.11	*Transmitter status LED*
Section 11.12	*Status alarms*
Section 11.13	*Checking process variables*
Section 11.14	*Diagnosing wiring problems*
Section 11.14.1	*Checking the power supply wiring*
Section 11.14.2	*Checking grounding*
Section 11.14.3	*Checking for RF interference*
Section 11.14.4	*Checking the HART communication loop*
Section 11.15	*Checking the communication device*
Section 11.16	*Checking the output wiring and receiving device*
Section 11.17	*Checking slug flow*
Section 11.19	*Checking output saturation*
Section 11.20	*Checking the HART address and Loop Current Mode parameter*
Section 11.21	*Checking the flow measurement configuration*
Section 11.22	*Checking the characterization*
Section 11.23	*Checking the calibration*
Section 11.24	*Checking the test points*
Section 11.25	*Checking sensor circuitry*

11.3 Micro Motion customer service

To speak to a customer service representative, contact the Micro Motion customer service department. Contact information is provided in Section 1.9.

Before contacting Micro Motion customer service, review the troubleshooting information and procedures in this chapter, and have the results available for discussion with the technician.

11.4 Transmitter does not operate

If the transmitter does not operate at all (i.e., the transmitter is not receiving power and cannot communicate, or the status LED is not lit), perform all of the procedures in Section 11.14.

If the procedures do not indicate a problem with the electrical connections, contact the Micro Motion customer service department.

11.5 Transmitter does not communicate

If the transmitter does not appear to be communicating, the wiring may be faulty or the communications device may be incompatible.

- For HART network communications, perform the procedures in Section 11.14.4.
- For communication using a communication device, check the wiring and the communication device. See Chapter 3 for ProLink II and Pocket ProLink, or Chapter 4 for the 375 Field Communicator.

If you are using HART protocol and you can read data from the transmitter but cannot write data (e.g., you cannot start, stop or reset totalizers or change transmitter configuration), check the HART security switch. See Section 2.6. You may see response code #7: In Write Protect Mode.

If you are trying to communicate via the infrared port, ensure that the port is not write-protected. See Section 8.11.2.

11.6 Zero or calibration failure

If a zero or calibration procedure fails, the transmitter will send a status alarm indicating the cause of failure. See Section 11.12 for specific remedies for status alarms indicating calibration failure.

11.7 Fault conditions

If the analog or digital outputs indicate a fault condition (by transmitting a fault indicator), determine the exact nature of the fault by checking the status alarms with a Communicator or ProLink II, or the display if available on your transmitter. Once you have identified the status alarm(s) associated with the fault condition, refer to Section 11.12.

Some fault conditions can be corrected by cycling power to the transmitter. A power cycle can clear the following:

- Loop test
- Zero failure
- Stopped internal totalizer

11.8 HART output problems

HART output problems include inconsistent or unexpected behavior that does not trigger status alarms. For example, the Communicator might show incorrect units of measure or respond sluggishly. If you experience HART output problems, verify that the transmitter configuration is correct.

If you discover that the configuration is incorrect, change the necessary transmitter settings. See Chapter 6 and Chapter 8 for the procedures to change the appropriate transmitter settings.

If you confirm that all the settings are correct, but the unexpected outputs continue, the transmitter or sensor could require service. See Section 11.3.

11.9 I/O problems

If you are experiencing problems with the mA output, frequency output, discrete output, or discrete input, use Table 11-2 to identify an appropriate remedy. Simulation mode may also be helpful (see Section 11.10).

Table 11-2 I/O problems and remedies

Symptom	Possible cause	Possible remedy
No output Loop test failed	Power supply problem	• Check power supply and power supply wiring. See Section 11.14.1.
	Channel not configured for desired output	• Verify channel configuration for associated output terminals. See Section 6.3.
	Incorrect internal/external power configuration	• Internal means that the transmitter will supply power. External means that an external pull-up resistor and source are required. Refer to your transmitter installation manual for wiring, and verify configuration (see Section 6.3).
	Output not powered	• Check transmitter wiring. See the transmitter installation manual.
mA output < 4 mA	Process condition below LRV	• Verify process. • Change the LRV. See Section 6.5.2.
	Fault condition if fault indicator is set to internal zero or downscale	• Check the fault indicator settings to verify whether or not the transmitter is in a fault condition. See Section 6.5.5. • If a fault condition is present, see Section 11.7.
	Open in wiring	• Verify all connections.
	Bad mA receiving device	• Check the mA receiving device or try another mA receiving device. See Section 11.16. • Perform output simulation to locate the problem. See Section 11.10.
	Bad output circuit	• Measure DC voltage across output to verify that output is active. • Perform output simulation to locate the problem. See Section 11.10.
	Incorrect internal/external power configuration	• Internal means that the transmitter will supply power. External means that an external pull-up resistor and source are required. Refer to your transmitter installation manual for wiring, and verify configuration (see Section 6.3).
	Output not powered	• Check transmitter wiring. See the transmitter installation manual.

Table 11-2 **I/O problems and remedies** *continued*

Symptom	Possible cause	Possible remedy
No frequency output	Process condition below cutoff	• Verify process. • Change the cutoff. See Section 8.4.
	Fault condition if fault indicator is set to downscale or internal zero	• Check the fault indicator settings to verify whether or not the transmitter is in a fault condition. See Section 6.6.5. • If a fault condition is present, see Section 11.7.
	Slug flow	• See Section 11.17.
	Flow in reverse direction from configured flow direction parameter	• Verify process. • Check flow direction parameter. See Section 8.6. • Verify sensor orientation. Ensure that flow direction arrow on sensor case matches process flow.
	Bad frequency receiving device	• Check the frequency receiving device or try another frequency receiving device. See Section 11.16. • Perform output simulation to locate the problem. See Section 11.10.
	Output level not compatible with receiving device	• See the transmitter installation manual. Verify that the output level and the required receiving input level are compatible.
	Bad output circuit	• Perform loop test. See Section 5.3. • Perform output simulation to locate the problem. See Section 11.10.
	Incorrect internal/external power configuration	• Internal means that the transmitter will supply power. External means that an external pull-up resistor and source are required. Refer to your transmitter installation manual for wiring, and verify configuration (see Section 6.3).
	Incorrect pulse width configuration	• Verify maximum pulse width setting. See Section 6.6.3.
	Output not powered	• Check transmitter wiring. See the transmitter installation manual.
Constant mA output	Non-zero HART address	• Set HART address to zero or enable the Loop Current Mode parameter. See Section 11.20.
	Output is fixed in a test mode	• Exit output from test mode. See Section 5.3.
	Zero calibration failure	• Cycle power. • Stop flow and rezero. See Section 5.5.
mA output consistently out of range	Fault condition if fault indicator is set to upscale or downscale	• Check the fault indicator settings to verify whether or not the transmitter is in a fault condition. See Section 6.5.5. • If a fault condition is present, see Section 11.7.
	LRV and URV not set correctly	• Check the LRV and URV. See Section 11.21.
Consistently incorrect mA measurement	Output not trimmed correctly	• Trim the output. See Section 5.4.
	Incorrect flow measurement unit configured	• Verify flow measurement unit configuration. See Section 11.21.
	Incorrect process variable configured	• Verify process variable assigned to mA output. See Section 6.5.1.
	LRV and URV not set correctly	• Check the LRV and URV. See Section 11.19.
mA reading correct at low currents but wrong at higher currents	mA loop resistance may be too high	• Verify mA output load resistance is below maximum supported load (see installation transmitter manual).

Table 11-2 I/O problems and remedies *continued*

Symptom	Possible cause	Possible remedy
Consistently incorrect frequency measurement	Output not scaled correctly	• Check frequency output scale and method. See Section 11.19. Verify voltage and resistance match the frequency output load resistance value chart (see your transmitter installation manual).
	Incorrect flow measurement unit configured	• Verify flow measurement unit configuration. See Section 11.21.
Erratic frequency measurement	RF (radio frequency) interference from environment	• See Section 11.14.3.
Cannot zero with zero button	Not pressing zero button for sufficient interval	• Button must be depressed for 0.5 seconds to be recognized. Depress button until LED starts to flash yellow, then release button.
	Transmitter in fault mode	• Correct transmitter faults and retry.
DI is fixed and does not respond to input switch	Possible internal/external power configuration error	• Internal means that the transmitter will supply power. External means that an external pull-up resistor and source are required. Refer to your transmitter installation manual for wiring, and verify configuration (see Section 6.3).

11.10 Simulation mode

Simulation allows you to set the outputs to simulate process data for mass flow, temperature, and density. Simulation mode has several uses:

- It can help determine if a problem is located in the transmitter or elsewhere in the system. For example, signal oscillation or noise is a common occurrence. The source could be the PLC, the meter, improper grounding, or a number of other factors. By setting up simulation to output a flat signal, you can determine the point at which the noise is introduced.
- It can be used to analyze system response or to tune the loop.

If simulation mode is active, the simulated values are stored in the same memory locations used for process data from the sensor. Therefore, the simulated values will be used throughout transmitter functioning. For example, simulation will affect:

- All mass flow, temperature, or density values shown on the display or reported via transmitter outputs or digital communications
- The mass total and inventory values
- All volume calculations and data, including reported values, volume total, and volume inventory
- All related values logged by Data Logger (a ProLink II utility)

Accordingly, do not enable simulation when your process cannot tolerate these effects, and be sure to disable simulation when you have finished testing.

Note: Unlike actual mass flow and density values, the simulated values are not temperature-compensated.

Note: Simulation does not change any diagnostic values.

Simulation mode is available via ProLink II (**ProLink > Configuration > Sensor Simulation**) or the Communicator (**Detailed Setup > Set up Simulation Mode**). To set up simulation mode, follow the steps below:

1. Enable simulation mode.

2. For mass flow:
   a. Specify the type of simulation you want: fixed value, triangular wave, or sine wave.
   b. Enter the required values.
      - If you specified fixed value simulation, enter a fixed value.
      - If you specified triangular wave or sine wave simulation, enter a minimum amplitude, maximum amplitude, and period.
3. Repeat Step 2 for temperature and density.

To use simulation mode for problem location, enable simulation mode and check the signal at various points between the transmitter and the receiving device.

11.11 Transmitter status LED

The user interface board includes a LED that indicates transmitter status. You may need to remove the transmitter housing cover. See Table 11-3 for a list of possible status LED states.

If the status LED indicates an alarm condition:

1. View the alarm code using the procedures described in Section 7.4.
2. Identify the alarm (see Section 11.12).
3. Correct the condition.
4. If desired, acknowledge the alarm using the procedures described in Section 7.5.

Table 11-3 Transmitter status reported by the status LED

Status LED state	Alarm priority
Green	No alarm – normal operating mode
Yellow	Low severity (informational) alarm
Flashing yellow	Calibration in progress
Red	High severity (fault) alarm

11.12 Status alarms

Status alarm codes are reported on the LCD (for transmitters that have displays), and status alarms can be viewed with ProLink II or the Communicator. A list of status alarms with the message displayed, possible causes, and suggested remedies is provided in Table 11-4.

Note: Status alarms are not displayed for alarms with Alarm Severity = Ignore, even if the alarm condition is active. See Section 8.9.1 for information on configuring status alarm severity.

Before troubleshooting status alarms, first acknowledge all alarms (see Section 7.5). This will remove inactive alarms from the list so that you can focus troubleshooting efforts on active alarms.

Table 11-4 Status alarms and remedies

Alarm code	Communicator / ProLink II	Cause	Suggested remedy
A001	EEprom Checksum Error (Core Processor) (E)EPROM Checksum Error (CP)	An uncorrectable checksum mismatch has been detected.	• Cycle power to the flowmeter. • The flowmeter might need service. Contact Micro Motion. See Section 11.3.
A002	RAM Test Error (Core Processor) RAM Error (CP)	ROM checksum error or a RAM location cannot be written to.	• Cycle power to the flowmeter. • The flowmeter might need service. Contact Micro Motion. See Section 11.3.
A003	Sensor Not Responding (No Tube Interrupt) Sensor Failure	Continuity failure of drive circuit, LPO, or RPO, or LPO-RPO mismatch when driving.	• Check for slug flow. See Section 11.17. • Check the test points. See Section 11.24. • Check the sensor circuitry. See Section 11.25. • Check sensor tubes for plugging. • If the problem persists, contact Micro Motion. See Section 11.3.
A004	Temperature sensor out of range Temperature Sensor Failure	Combination of A16 and A17	• Check the sensor RTD circuitry. See Section 11.25. • Verify that process temperature is within range of sensor and transmitter. • If the problem persists, contact Micro Motion. See Section 11.3.
A005	Input Over-Range Input Overrange	The measured flow has exceeded the maximum flow rate of the sensor ($\Delta T > 200\ \mu s$)	• If other alarms are present (typically, A003, A006, A008, A102, or A105), resolve those alarm conditions first. If the A005 alarm persists, continue with the suggestions here. • Verify process and check for slug flow. See Section 11.17. • Check the test points. See Section 11.24. • Check the sensor circuitry. See Section 11.25. • Check the sensor tubes for erosion. See Section 11.18. • If the problem persists, contact Micro Motion. See Section 11.3.
A006	Transmitter Not Characterized Not Configured	Combination of A020 and A021	• Check the characterization. Specifically, verify the FCF and K1 values. See Section 6.2. • If the problem persists, contact Micro Motion. See Section 11.3.
A008	Density Outside Limits Density Overrange	The measured density has exceeded 0–10 g/cm^3	• If other alarms are present (typically, A003, A006, A102, or A105), resolve those alarm conditions first. If the A008 alarm persists, continue with the suggestions here. • Verify process. Check for air in the flow tubes, tubes not filled, foreign material in tubes, or coating in tubes (see Section 11.18). • Check for slug flow. See Section 11.17. • Check the sensor circuitry. See Section 11.25. • Verify calibration factors in transmitter configuration. See Section 6.2. • Check the test points. See Section 11.24. • If the problem persists, contact Micro Motion. See Section 11.3.

Table 11-4 Status alarms and remedies *continued*

Alarm code	Communicator / ProLink II	Cause	Suggested remedy
A009	Transmitter Initializing/Warming Up Transmitter Initializing/Warming Up	Transmitter in power-up mode.	• Allow the flowmeter to warm up (approximately 30 seconds). The error should disappear once the flowmeter is ready for normal operation. • If alarm does not clear, make sure that the sensor is completely full or completely empty. • Check the sensor circuitry. See Section 11.25.
A010	Calibration Failure Calibration Failure	Mechanical zero: The resulting zero was greater than 3 µs. Temperature/Density Cals: many possible causes.	• If alarm appears during a transmitter zero, ensure that there is no flow through the sensor, then retry. • Cycle power to the flowmeter, then retry. • If appropriate, restore the factory zero to return the flowmeter to operation.
A011	Excess Calibration Correction, Zero too Low Zero Too Low	See A10	• Ensure that there is no flow through the sensor, then retry. • Cycle power to the flowmeter, then retry. • If appropriate, restore the factory zero to return the flowmeter to operation.
A012	Excess Calibration Correction, Zero too High Zero Too High	See A10	• Ensure that there is no flow through the sensor, then retry. • Cycle power to the flowmeter, then retry. • If appropriate, restore the factory zero to return the flowmeter to operation.
A013	Process too Noisy to Perform Auto Zero Zero Too Noisy	See A10.	• Remove or reduce sources of electromechanical noise, then retry. Sources of noise include: - Mechanical pumps - Pipe stress at sensor - Electrical interference - Vibration effects from nearby machinery • Cycle power to the flowmeter, then retry. • If appropriate, restore the factory zero to return the flowmeter to operation.
A014	Transmitter Failed Transmitter Failed	Many possible causes.	• Cycle power to the flowmeter. • The transmitter might need service. Contact Micro Motion. See Section 11.3.
A016	Line RTD Temperature Out-Of-Range Line RTD Temperature Out-of-Range	The value computed for the resistance of the Line RTD is outside limits	• Check the sensor RTD circuitry. See Section 11.25. • Verify that process temperature is within range of sensor and transmitter. • If the problem persists, contact Micro Motion. See Section 11.3.
A017	Meter RTD Temperature Out-Of-Range Meter RTD Temperature Out-of-Range	The value computed for the resistance of the Meter/Case RTD is outside limits	• Check the sensor RTD circuitry. See Section 11.25. • Verify that process temperature is within range of sensor and transmitter. • If the problem persists, contact Micro Motion. See Section 11.3. • Check the characterization. Specifically, verify the FCF and K1 values. See Section 6.2.
A020	Calibration Factors Unentered Calibration Factors Unentered (FlowCal)	The flow calibration factor and/or K1 has not been entered since the last master reset.	• Check the characterization. Specifically, verify the FCF and K1 values. See Section 6.2. • If the problem persists, contact Micro Motion. See Section 11.3.

Table 11-4 Status alarms and remedies *continued*

Alarm code	Communicator / ProLink II	Cause	Suggested remedy
A021	Unrecognized/ Unentered Sensor Type	The sensor is recognized as a straight tube but the K1 value indicates a curved tube, or vice versa.	• Check the characterization. Specifically, verify the FCF and K1 values. See Section 6.2. • Check the sensor RTD circuitry. See Section 11.25. • If the problem persists, contact Micro Motion. See Section 11.3.
	Incorrect Sensor Type (K1)		
A029	Internal Communication Failure	Transmitter electronics failure	• Cycle power to the flowmeter. • Contact Micro Motion. See Section 11.3.
	PIC/Daughterboard Communication Failure		
A030	Hardware/Software Incompatible	The loaded software is not compatible with the programmed board type.	• Contact Micro Motion. See Section 11.3.
	Incorrect Board Type		
A031	Undefined	The transmitter is not receiving enough power.	• Check power supply to transmitter. See Section 11.14.1.
	Low Power		
A032[1]	Meter Verification Fault Alarm	Meter verification in progress, with outputs set to fault.	• Allow the procedure to complete. • If desired, abort the procedure and restart with outputs set to last measured value.
	Meter Verification/Outputs In Fault		
A032[2]	Outputs Fixed during Meter Verification	Meter verification in progress, with outputs set to Fault or Last Measured Value.	• Allow the procedure to complete. • If desired, abort the procedure and restart with outputs set to Continue Measurement.
	Meter Verification In Progress and Outputs Fixed		
A033	Tube Not Full	No signal from LPO or RPO, suggesting that sensor tubes are not vibrating.	• Verify process. Check for air in the flow tubes, tubes not filled, foreign material in tubes, or coating in tubes (see Section 11.18).
	Tube Not Full		
A034[2]	Meter Verification Failed	Test results were not within acceptable limits.	Rerun the test. If the test fails again, see Section 10.3.4.
	Meter Verification Failed		
A035[2]	Meter Verification Aborted	The test did not complete, possibly due to manual abort.	If desired, read the abort code, see Section 10.3.4, and perform the appropriate action.
	Meter Verification Aborted		
A100	Primary mA Output Saturated	The calculated amount of current output is outside of the linear range.	• See Section 11.19.
	Primary mA Output Saturated		
A101	Primary mA Output Fixed	Non-zero HART address configured, or user has fixed the mA output.	• Check the HART address. If non-zero, enable Loop Current Mode parameter. See Section 11.20. • Exit mA output trim. See Section 5.4. • Exit mA output loop test. See Section 5.3. • Check to see if the output has been fixed via digital communication.
	Primary mA Output Fixed		

Table 11-4 Status alarms and remedies *continued*

Alarm code	Communicator / ProLink II	Cause	Suggested remedy
A102	Drive Over-Range / Drive Overrange	The drive power (current/voltage) is at its maximum	• Excessive drive gain. See Section 11.24.3. • Check the sensor circuitry. See Section 11.25. • If this is the only active alarm, it can be ignored. If desired, reconfigure the alarm severity to Ignore (see Section 8.9.1).
A103	Data Loss Possible / Data Loss Possible	Totalizers are not properly saved.	• Check power supply to transmitter. See Section 11.14.1. • If the alarm persists, contact Micro Motion. See Section 11.3.
A104	Calibration-In-Progress / Calibration in Progress	A calibration procedure is in progress.	• Allow the flowmeter to complete calibration. • For zero calibration procedures, you may abort the calibration, set the zero time parameter to a lower value, and restart the calibration.
A105	Slug Flow / Slug Flow	The density has exceeded the user-defined slug (density) limits.	• See Section 11.17.
A106	Burst Mode Enabled / Burst Mode Enabled	Device is in HART burst mode.	• No action required. • If desired, reconfigure the alarm severity to Ignore (see Section 8.9.1).
A107	Power Reset Occurred / Power Reset Occurred	The transmitter has been restarted.	• No action required. • If desired, reconfigure the alarm severity to Ignore (see Section 8.9.1).
A110	Frequency Output Saturated / Frequency Output Saturated	The calculated frequency output is outside of the linear range.	• See Section 11.19.
A111	Frequency Output Fixed / Frequency Output Fixed	User has fixed the frequency output.	• Exit frequency output loop test.
A115	External Input Error / External Input Error	No response received from polled device.	• HART polling connection to external device has failed. Ensure that external device is available: - Verify device operation. - Verify wiring. • Verify polling configuration. See Section 9.4.
A118	Discrete Output 1 Fixed / Discrete Output 1 Fixed	The user has fixed the discrete output.	• Exit discrete output loop test. See Section 5.3.
A131[(1)]	Meter Verification Info Alarm / Meter Verification/Outputs at Last Value	Meter verification in progress, with outputs set to last measured value.	• Allow the procedure to complete. • If desired, abort the procedure and restart with outputs set to fault.

Table 11-4 Status alarms and remedies *continued*

Alarm code	Communicator / ProLink II	Cause	Suggested remedy
A131[(2)]	Meter Verification in Progress Meter Verification in Progress	Meter verification in progress, with outputs set to continue reporting process data.	• Allow the procedure to complete.
A132	Simulation Mode Active Simulation Mode Active	Simulation mode is enabled.	• Disable output simulation. See Section 11.10.

(1) Applies only to systems with the original version of the meter verification application.
(2) Applies only to systems with Smart Meter Verification.

11.13 Checking process variables

Micro Motion suggests that you make a record of the process variables listed below, under normal operating conditions. This will help you recognize when the process variables are unusually high or low.

- Flow rate
- Density
- Temperature
- Tube frequency
- Pickoff voltage
- Drive gain

For troubleshooting, check the process variables under both normal flow and tubes-full no-flow conditions. Except for flow rate, you should see little or no change between flow and no-flow conditions. If you see a significant difference, record the values and contact Micro Motion customer service for assistance. See Section 11.3.

Unusual values for process variables may indicate a variety of different problems. Table 11-5 lists several possible problems and suggested remedies.

Table 11-5 Process variables problems and remedies

Symptom	Cause	Suggested remedy
Steady non-zero flow rate under no-flow conditions	Misaligned piping (especially in new installations)	• Correct the piping.
	Open or leaking valve	• Check or correct the valve mechanism.
	Bad sensor zero	• Rezero the flowmeter. See Section 5.5.

Table 11-5 **Process variables problems and remedies** *continued*

Symptom	Cause	Suggested remedy
Erratic non-zero flow rate under no-flow conditions	Leaking valve or seal	• Check pipeline.
	Slug flow	• See Section 11.17.
	Plugged flow tube	• Check drive gain and tube frequency. Purge the flow tubes.
	Incorrect sensor orientation	• Sensor orientation must be appropriate to process fluid. See the installation manual for your sensor.
	Wiring problem	• Check the sensor circuitry. See Section 11.25.
	Vibration in pipeline at rate close to sensor tube frequency	• Check environment and remove source of vibration.
	Damping value too low	• Check configuration. See Section 6.5.4 and Section 8.5.
	Mounting stress on sensor	• Check sensor mounting. Ensure: - Sensor is not being used to support pipe. - Sensor is not being used to correct pipe misalignment. - Sensor is not too heavy for pipe.
	Sensor cross-talk	• Check environment for sensor with similar (±0.5 Hz) tube frequency.
Erratic non-zero flow rate when flow is steady	Slug flow	• See Section 11.17.
	Damping value too low	• Check configuration. See Section 6.5.4 and Section 8.5.
	Plugged flow tube	• Check drive gain and tube frequency. Purge the flow tubes.
	Excessive or erratic drive gain	• See Section 11.24.3
	Output wiring problem	• Verify wiring between transmitter and receiving device. See the installation manual for your transmitter.
	Problem with receiving device	• Test with another receiving device.
	Wiring problem	• Check the sensor circuitry. See Section 11.25.
Inaccurate flow rate or batch total	Bad flow calibration factor	• Verify characterization. See Section 6.2.
	Inappropriate measurement unit	• Check configuration. See Section 11.21.
	Bad sensor zero	• Rezero the flowmeter. See Section 5.5.
	Bad density calibration factors	• Verify characterization. See Section 6.2.
	Bad flowmeter grounding	• See Section 11.14.2.
	Slug flow	• See Section 11.17.
	Problem with receiving device	• See Section 11.16.
	Wiring problem	• Check the sensor circuitry. See Section 11.25.

Table 11-5 Process variables problems and remedies *continued*

Symptom	Cause	Suggested remedy
Inaccurate density reading	Problem with process fluid	• Use standard procedures to check quality of process fluid.
	Bad density calibration factors	• Verify characterization. See Section 6.2.
	Wiring problem	• Check the sensor circuitry. See Section 11.25.
	Bad flowmeter grounding	• See Section 11.14.2.
	Slug flow	• See Section 11.17.
	Sensor cross-talk	• Check environment for sensor with similar (±0.5 Hz) tube frequency.
	Plugged flow tube	• Check drive gain and tube frequency. Purge the flow tubes.
	Incorrect sensor orientation	• Sensor orientation must be appropriate to process fluid. See the installation manual for your sensor.
	RTD failure	• Check for alarm conditions and follow troubleshooting procedure for indicated alarm.
	Physical characteristics of sensor have changed	• Check for corrosion, erosion, or tube damage. See Section 11.18.
Temperature reading significantly different from process temperature	RTD failure	• Check for alarm conditions and follow troubleshooting procedure for indicated alarm. • Verify "Use external temperature" configuration and disable if appropriate. See Section 9.3.
Temperature reading slightly different from process temperature	Sensor leaking heat	• Insulate the sensor.
Unusually high density reading	Plugged flow tube	• Check drive gain and tube frequency. Purge the flow tubes.
	Incorrect K2 value	• Verify characterization. See Section 6.2.
Unusually low density reading	Slug flow	• See Section 11.17.
	Incorrect K2 value	• Verify characterization. See Section 6.2.
Unusually high tube frequency	Sensor erosion	• Contact Micro Motion. See Section 11.3.
Unusually low tube frequency	Plugged flow tube, corrosion, or erosion	• Purge the flow tubes. • Perform meter verification. See Section 11.18.
Unusually low pickoff voltages	Several possible causes	• See Section 11.24.4.
Unusually high drive gain	Several possible causes	• See Section 11.24.3.

11.14 Diagnosing wiring problems

Use the procedures in this section to check the transmitter installation for wiring problems.

⚠ WARNING

Removing the transmitter housing cover in explosive atmospheres while the power is on can subject the transmitter to environmental conditions that can cause an explosion.

Before removing the transmitter housing cover in explosive atmospheres, be sure to shut off the power and wait five minutes.

11.14.1 Checking the power supply wiring

To check the power supply wiring:

1. Verify that the correct external fuse is used. An incorrect fuse can limit current to the transmitter and keep it from initializing.
2. Power down the transmitter.
3. If the transmitter is in a hazardous area, wait five minutes.
4. Ensure that the power supply wires are connected to the correct terminals. Refer to Appendix B for diagrams.
5. Verify that the power supply wires are making good contact, and are not clamped to the wire insulation.
6. Inspect the voltage label on the inside of the field-wiring compartment. Verify that the voltage supplied to the transmitter matches the voltage specified on the label.
7. Use a voltmeter to test the voltage at the transmitter's power supply terminals. Verify that it is within the specified limits. For DC power, you may need to size the cable. Refer to Appendix B for diagrams, and see your transmitter installation manual for power supply requirements.

11.14.2 Checking grounding

The sensor / transmitter assembly must be grounded. See your sensor installation manual for grounding requirements and instructions.

11.14.3 Checking for RF interference

If you are experiencing RF (radio frequency) interference on your frequency output or discrete output, use one of the following solutions:

- Eliminate the RF source. Possible causes include a source of radio communications, or a large transformer, pump, motor, or anything else that can generate a strong electrical or electromagnetic field, in the vicinity of the transmitter.
- Move the transmitter.
- Use shielded cable for the output.
  - Terminate output cable shielding at the input device. If this is not possible, terminate the output shielding at the cable gland or conduit fitting.
  - Do not terminate shield inside the wiring compartment.
  - 360° termination of shielding is not necessary.

11.14.4 Checking the HART communication loop

To check the HART communication loop:

1. Verify that the loop wires are connected as shown in the wiring diagrams in the transmitter installation manual.
2. Ensure that the internal/external power configuration matches the wiring. If external power is being used, verify power supply to the output.
3. Remove analog loop wiring.
4. Install a 250 Ω resistor across the mA terminals.
5. Check for voltage drop across the resistor (4–20 mA = 1–5 VDC). If voltage drop < 1 VDC, add resistance to achieve voltage drop > 1 VDC.
6. Connect the Communicator directly across the resistor and attempt to communicate (poll).

If your HART network is more complex than the wiring diagrams in the transmitter installation manual, either:

- Contact Micro Motion. See Section 11.3.
- Contact the HART Communication Foundation or refer to the *HART Application Guide*, available from the HART Communication Foundation on the Internet at www.hartcomm.org.

11.15 Checking the communication device

Ensure that your communication device is compatible with your transmitter.

Communicator

The 375 Field Communicator is required, and must contain the appropriate device description. The device description for the Model 2400S transmitter with analog outputs is **2400SMass flo**.

To check the device descriptions:

1. Turn on the Communicator, but do not connect it to the transmitter.
2. When the words **No device found** appear, press **OK**.
3. Select **OFFLINE**.
4. Select **New Configuration**.
5. Select **Micro Motion**.
6. Ensure that the correct device description for your transmitter is listed.

If the correct device description is not found, a Generic Device menu is displayed. Contact Micro Motion to obtain the correct device description.

ProLink II

ProLink II v2.4 or later is required. To check the version of ProLink II:

1. Start ProLink II.
2. Open the **Help** menu.
3. Click on **About ProLink**.

Pocket ProLink

Pocket ProLink II v1.2 or later is required. To check the version of Pocket ProLink:

1. Start Pocket ProLink.
2. Tap the Information icon (the question mark) at the bottom of the main screen.

11.16 Checking the output wiring and receiving device

If you receive an inaccurate frequency or mA reading, there may be a problem with the output wiring or the receiving device.

- Check the output level at the transmitter.
- Check the wiring between the transmitter and the receiving device.
- Perform a loop test.
- If appropriate, trim the mA output.
- Try a different receiving device.
- Perform output simulation to locate the problem. See Section 11.10.

11.17 Checking slug flow

A slug flow alarm is posted whenever the measured process density is outside the configured slug flow limits (i.e., density is higher or lower than the configured normal range). Slug flow is typically caused by gas in a liquid process or liquid in a gas process. See Section 8.8 for a discussion of slug flow functionality.

If slug flow occurs:

- Check the process for cavitation, flashing, or leaks.
- Change the sensor orientation.
- Monitor density.
- If desired, enter new slug flow limits (see Section 8.8).
  - Raising the low slug flow limit or lowering the high slug flow limit will increase the possibility of slug flow conditions.
  - Lowering the low slug flow limit or raising the high slug flow limit will decrease the possibility of slug flow conditions.
- If desired, increase slug duration (see Section 8.8).

11.18 Checking the sensor tubes

Corrosion, erosion, or damage to the sensor tubes can affect process measurement. To check for these conditions, perform the meter verification procedure. See Chapter 10.

11.19 Checking output saturation

If an output variable exceeds the upper range limit or goes below the lower range limit, the transmitter produces an output saturation alarm. The alarm can mean:

- The process is outside normal operational limits.
- Sensor flow tubes are not filled with process fluid.
- Sensor flow tubes are plugged.

If an output saturation alarm occurs:

- Check the process.
- Bring the flow rate within the sensor limit.
- Check the sensor:
  - Ensure that flow tubes are full.
  - Purge flow tubes.
- For the mA output, verify or change the mA URV and LRV (see Section 6.5.2).
- For the frequency output, verify or change the scaling (see Section 6.6).

11.20 Checking the HART address and Loop Current Mode parameter

If the transmitter's HART address is set to a non-zero number, the mA output may be fixed at 4 mA. In this situation:

- The mA output will not report process variable data.
- The mA output will not indicate fault conditions.

To resolve this problem, try the following:

- Set the HART address to zero. See Section 8.11.1.
- Enable the Loop Current Mode parameter. See Section 8.11.1.

11.21 Checking the flow measurement configuration

Using an incorrect flow measurement unit can cause the transmitter to produce unexpected output levels, with unpredictable effects on the process. Make sure that the configured flow measurement unit is correct. Check the abbreviations; for example, *g/min* represents grams per minute, not gallons per minute. See Section 6.4.

If the LRV or URV is set incorrectly, flow will be reported accurately but interpreted incorrectly by the receiving device. Ensure that the LRV and URV are set correctly for your process and your receiving device. See Section 6.4.

11.22 Checking the characterization

A transmitter that is incorrectly characterized for its sensor might produce inaccurate output values. Both the K1 and FlowCal (FCF) values must be appropriate for the sensor. If these values are incorrect, the sensor may not drive correctly or may send inaccurate process data.

If you discover that any of the characterization data are wrong, perform a complete characterization. See Section 6.2.

11.23 Checking the calibration

Improper calibration can cause the transmitter to send unexpected output values. If the transmitter appears to be operating correctly but sends inaccurate output values, an improper calibration may be the cause.

Micro Motion calibrates every transmitter at the factory. Therefore, you should suspect improper calibration only if the transmitter has been calibrated after it was shipped from the factory. Before performing a calibration, consider meter validation or meter verification and select the appropriate procedure (see Section 10.2). Contact Micro Motion customer service for assistance.

11.24 Checking the test points

Some status alarms that indicate a sensor failure or overrange condition can be caused by problems other than a failed sensor. You can diagnose sensor failure or overrange status alarms by checking the flowmeter test points. The *test points* include left and right pickoff voltages, drive gain, and tube frequency. These values describe the current operation of the sensor.

11.24.1 Obtaining the test points

You can obtain the test points with a Communicator or ProLink II.

With a Communicator

To obtain the test points with a Communicator:

1. Select **Diag/Service**.
2. Select **Test Points**.
3. Record the values displayed for **Drive**, **LPO**, **RPO**, and **Tube**

With ProLink II

To obtain the test points with ProLink II:

1. Select **Diagnostic Information** from the **ProLink** menu.
2. Record the values displayed for **Tube Frequency**, **Left Pickoff**, **Right Pickoff**, and **Drive Gain**.

11.24.2 Evaluating the test points

Use the following guidelines to evaluate the test points:

- If the drive gain is erratic, negative, or saturated, refer to Section 11.24.3.
- If the value for the left or right pickoff does not equal the appropriate value from Table 11-6, based on the sensor flow tube frequency, refer to Section 11.24.4.
- If the values for the left and right pickoffs equal the appropriate values from Table 11-6, based on the sensor flow tube frequency, record your troubleshooting data and contact the Micro Motion customer service department. See Section 11.3.

Table 11-6 Sensor pickoff values

Sensor[(1)]	Pickoff value
ELITE® CMF sensors	3.4 mV peak-to-peak per Hz based on sensor flow tube frequency
F025, F050, F100 sensors	3.4 mV peak-to-peak per Hz based on sensor flow tube frequency
F200 sensors	2.0 mV peak-to-peak per Hz based on sensor flow tube frequency
H025, H050, H100 sensors	3.4 mV peak-to-peak per Hz based on sensor flow tube frequency
H200 sensors	2.0 mV peak-to-peak per Hz based on sensor flow tube frequency
R025, R050, or R100 sensors	3.4 mV peak-to-peak per Hz based on sensor flow tube frequency
R200 sensors	2.0 mV peak-to-peak per Hz based on sensor flow tube frequency
T-Series sensors	0.5 mV peak-to-peak per Hz based on sensor flow tube frequency
CMF400 I.S. sensors	2.7 mV peak-to-peak per Hz based on sensor flow tube frequency

(1) If your sensor is not listed, contact Micro Motion. See Section 11.3.

11.24.3 Drive gain problems

Problems with drive gain can appear in several different forms:

- Saturated or excessive (near 100%) drive gain
- Erratic drive gain (e.g., rapid shifting from positive to negative)
- Negative drive gain

See Table 11-7 for a list of possible problems and remedies.

Table 11-7 Drive gain problems, causes, and remedies

Cause	Possible remedy
Excessive slug flow	• See Section 11.17.
Cavitation or flashing	• Increase inlet or back pressure at the sensor. • If a pump is located upstream from the sensor, increase the distance between the pump and sensor.
Plugged flow tube	• Purge the flow tubes.
Mechanical binding of sensor tubes	• Ensure sensor tubes are free to vibrate. Possible problems include: - Pipe stress. Check for pipe stress and eliminate if present. - Lateral tube shift due to hammer effect. If this is a possibility, contact Micro Motion. See Section 11.3. - Warped tubes caused by overpressurization. If this is a possibility, contact Micro Motion.
Incorrect sensor type configured	• Verify sensor type configuration, then verify sensor characterization. See Section 6.2.
Open drive or left pickoff sensor coil	• Contact Micro Motion. See Section 11.3.
Drive board or module failure, cracked flow tube, or sensor imbalance	• Contact Micro Motion. See Section 11.3.

11.24.4 Low pickoff voltage

Low pickoff voltage can be caused by several problems. See Table 11-8.

Table 11-8 Low pickoff voltage causes and remedies

Cause	Possible remedy
Slug flow	• See Section 11.17.
No tube vibration in sensor	• Check for plugging.
Moisture in the sensor electronics	• Eliminate the moisture in the sensor electronics.
Damaged sensor	• Ensure sensor is free to vibrate (no mechanical binding). Possible problems include: - Pipe stress. Check for pipe stress and eliminate if present. - Lateral tube shift due to hammer effect. If this is a possibility, contact Micro Motion. See Section 11.3. - Warped tubes caused by overpressurization. If this is a possibility, contact Micro Motion. • Test sensor circuitry. See Section 11.25. • Contact Micro Motion.

11.25 Checking sensor circuitry

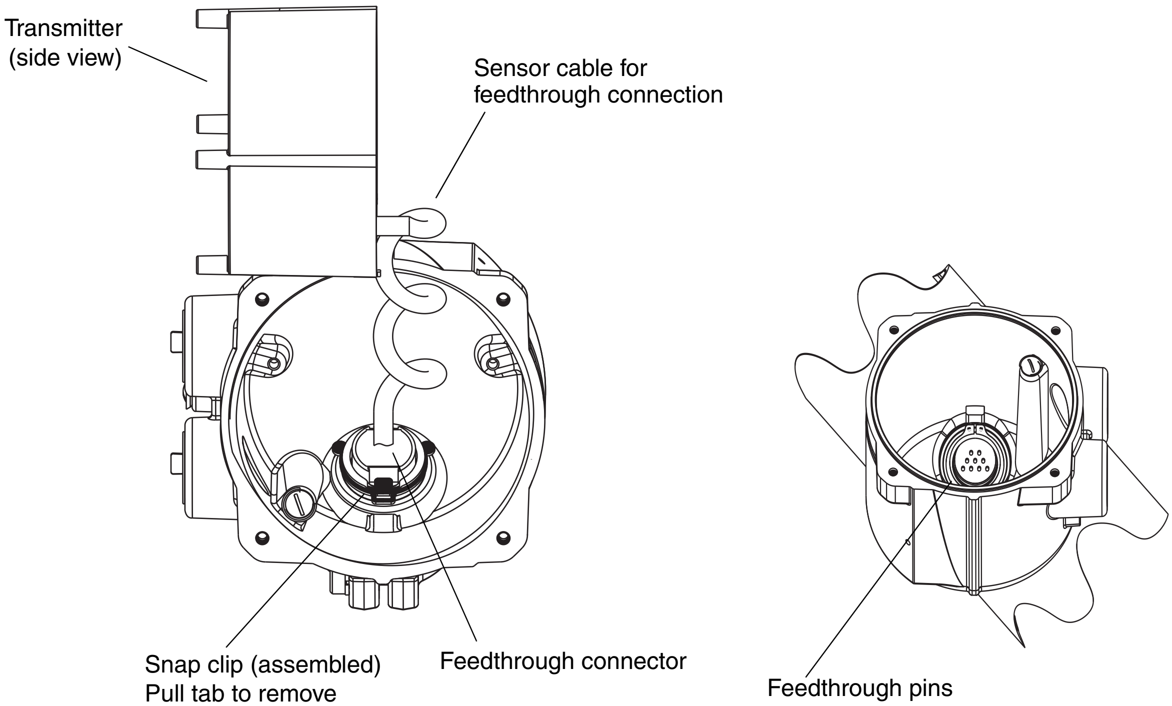
Problems with sensor circuitry can cause several alarms, including sensor failure and a variety of out-of-range conditions. Testing involves:

- Inspecting the cable that connects the transmitter to the sensor
- Measuring the resistances of the sensor's pin pairs and RTDs
- Ensuring that the circuits are not shorted to each other or to the sensor case

Note: To check the sensor circuitry, you must remove the transmitter from the sensor. Before performing this test, ensure that all other applicable diagnostics have been performed. Diagnostic capabilities of the Model 2400S transmitter have been greatly enhanced, and may provide more useful information than these tests.

1. Follow appropriate procedures to ensure that the process of checking the sensor circuitry does not interfere with existing measurement and control loops.
2. Power down the transmitter.
3. If the transmitter is in a hazardous environment, wait five minutes.
4. Check the sensor cable and sensor connection:
   a. Referring to Figure B-1, loosen the four captive transmitter housing cover screws and remove the transmitter housing cover.
   b. Loosen the two captive user interface screws.
   c. Gently lift the user interface module, disengaging it from the connector on the transmitter.
   d. Two captive screws (2.5 mm hex head) hold the transmitter in the housing. Loosen the screws and gently lift the transmitter away from the housing. Allow the transmitter to hang temporarily.
   e. Ensure that the cable is fully plugged in and making a good connection. If it was not, reseat the cable, reassemble the transmitter and sensor, and check operation.
   f. If the problem is not resolved, unplug the cable from the feedhrough by removing the snap clip (see Figure 11-1), then pulling the connector away from the feedthrough. Set the transmitter aside.
   g. Check the cable for any signs of damage. If the cable is damaged, contact Micro Motion.

Figure 11-1 Accessing the feedthrough pins



5. Using a digital multimeter (DMM), check the sensor internal resistances for each flowmeter circuit. Table 11-9 defines the flowmeter circuits and the resistance range for each. Refer to Figure 11-2 to identify the feedthrough pins. For each circuit, place the DMM leads on the pin pairs and record the values.

Note: In order to access all feedthrough pins, you may need to remove the clamp and rotate the transmitter to a different position.

In this test:

- There should be no open circuits, i.e., no infinite resistance readings.
- Nominal resistance values vary 40% per 100 °C. However, confirming an open or shorted circuit is more important than any slight deviation from the resistance values shown here.
- The LPO and RPO circuit readings should be the same or very close (± 10%).
- The readings across pin pairs should be steady.
- Actual resistance values depend on the sensor model and date of manufacture. Contact Micro Motion for more detailed data.

If a problem appears, or if any resistance is out of range, contact Micro Motion (see Section 11.3).

Table 11-9 Nominal resistance ranges for flowmeter circuits

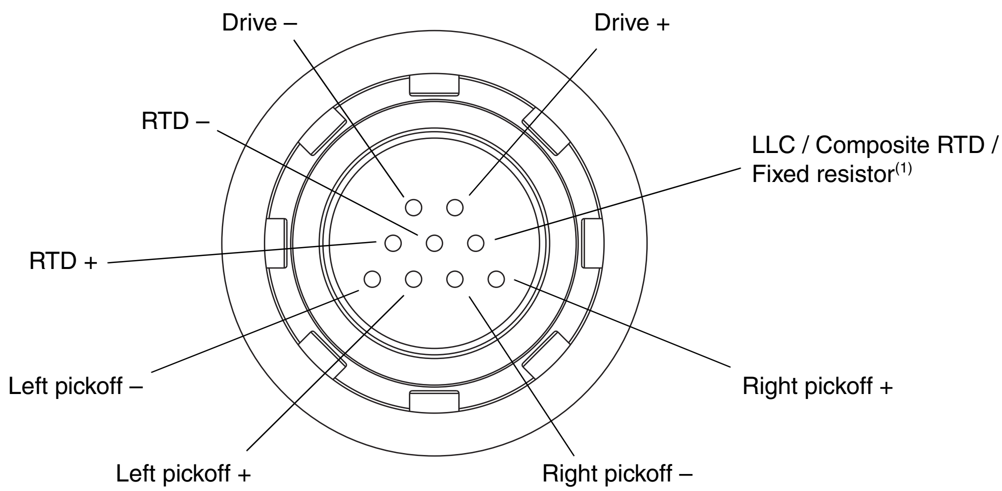
Circuit	Pin pairs	Nominal resistance range(1)
Drive	Drive + and –	8–1500 Ω
Left pickoff	Left pickoff + and –	16–1000 Ω
Right pickoff	Right pickoff + and –	16–1000 Ω

Table 11-9 Nominal resistance ranges for flowmeter circuits

Circuit	Pin pairs	Nominal resistance range(1)
Flow tube temperature sensor	RTD + and RTD –	100 Ω at 0 °C + 0.38675 Ω / °C
LLC/RTD		
• T-Series sensors	RTD – and composite RTD	300 Ω at 0 °C + 1.16025 Ω / °C
• CMF400 I.S. sensors	RTD – and fixed resistor	39.7–42.2 Ω
• F300 sensors • H300 sensors • F025A sensors • F050A sensors • F100A sensors • CMFS sensors	RTD – and fixed resistor	44.3–46.4 Ω
• All other sensors	RTD – and LLC	0

(1) Actual resistance values depend on the sensor model and date of manufacture. Contact Micro Motion for more detailed data.

Figure 11-2 Feedthrough pins



(1) Functions as fixed resistor for the following sensors: F300, H300, F025A, F050A, F100A, CMF400 I.S., CMFS. Functic as composite RTD for T-Series sensors. For all other sensors, functions as lead length compensator (LLC).

6. Using the DMM, check each pin as follows:
   a. Check between the pin and the sensor case.
   b. Check between the pin and other pins as described below:
      - Drive + against all other pins except Drive –
      - Drive – against all other pins except Drive +
      - Left pickoff + against all other pins except Left pickoff –
      - Left pickoff – against all other pins except Left pickoff +
      - Right pickoff + against all other pins except Right pickoff –
      - Right pickoff – against all other pins except Right pickoff +
      - RTD + against all other pins except RTD – and LLC/RTD
      - RTD – against all other pins except RTD + and LLC/RTD
      - LLC/RTD against all other pins except RTD + and RTD –

   With the DMM set to its highest range, there should be infinite resistance on each lead. If there is any resistance at all, there is a short to case or a short between pins. See Table 11-10 for possible causes and solutions. If the problem is not resolved, contact Micro Motion (see Section 11.3).

Table 11-10 Sensor and cable short to case causes and remedies

Cause	Possible remedy
Moisture inside the transmitter housing	• Make sure that the transmitter housing is dry and no corrosion is present.
Liquid or moisture inside the sensor case	• Contact Micro Motion. See Section 11.3.
Internally shorted feedthrough (sealed passage for wiring from sensor to transmitter)	• Contact Micro Motion. See Section 11.3.
Faulty cable connecting sensor to transmitter	• Visually inspect the cable for damage. To replace cable, contact Micro Motion. See Section 11.3.

To return to normal operation:

1. Follow appropriate procedures to ensure that reconnecting the transmitter does not interfere with existing measurement and control loops.
2. Reach inside the transmitter housing and install the transmitter's sensor connection onto the feedthrough:
   a. Rotate the connector until it engages the pins.
   b. Push down until the connector shoulder is flush with the feedthrough notch.
   c. Replace the snap clip by sliding the clip tab over the connector shoulder (see instruction label).
3. Replace the transmitter in the transmitter housing, and tighten the screws.
4. Reconnect the power wires, lower the Warning flap, and tighten the Warning flap screw.
5. Plug the user interface module onto the transmitter. There are four possible positions; select the position that is most convenient.
6. Tighten the user interface screws.
7. Replace the transmitter housing cover on the user interface module, and tighten the screws.
8. Power up the transmitter.

Appendix A
Default Values and Ranges

A.1 Overview

This appendix provides information on the default values for most transmitter parameters. Where appropriate, valid ranges are also defined.

These default values represent the transmitter configuration after a master reset. Depending on how the transmitter was ordered, certain values may have been configured at the factory.

A.2 Most frequently used defaults and ranges

The table below contains the default values and ranges for the most frequently used transmitter settings.

Table A-1 Transmitter default values and ranges

Type	Setting	Default	Range	Comments
Flow	Flow direction	Forward		
	Flow damping	0.64 sec	0.0 – 40.96 sec	User-entered value is corrected to nearest lower value in list of preset values. For gas applications, Micro Motion recommends a minimum value of 2.56.
	Mass flow units	g/s		
	Mass flow cutoff	0.0 g/s		Recommended setting is 5% of the sensor's rated maximum flowrate.
	Volume flow type	Liquid		
	Volume flow units	L/s		
	Volume flow cutoff	0/0 L/s	0.0 – *x* L/s	*x* is obtained by multiplying the flow calibration factor by 0.2, using units of L/s.
Meter factors	Mass factor	1.00000		
	Density factor	1.00000		
	Volume factor	1.00000		

Table A-1 Transmitter default values and ranges *continued*

Type	Setting	Default	Range	Comments
Density	Density damping	1.28 sec	0.0 – 40.96 sec	User-entered value is corrected to nearest value in list of preset values.
	Density units	g/cm^3		
	Density cutoff	0.2 g/cm^3	0.0 – 0.5 g/cm^3	
	D1	0.00000		
	D2	1.00000		
	K1	1000.00		
	K2	50,000.00		
	FD	0.00000		
	Temp Coefficient	4.44		
Slug flow	Slug flow low limit	0.0 g/cm^3	0.0 – 10.0 g/cm^3	
	Slug flow high limit	5.0 g/cm^3	0.0 – 10.0 g/cm^3	
	Slug duration	0.0 sec	0.0 – 60.0 sec	
Temperature	Temperature damping	4.8 sec	0.0 – 38.4 sec	User-entered value is corrected to nearest lower value in list of preset values.
	Temperature units	Deg C		
	Temperature calibration factor	1.00000T0.0000		
Pressure	Pressure units	PSI		
	Flow factor	0.00000		
	Density factor	0.00000		
	Cal pressure	0.00000		
T-Series sensor	D3	0.00000		
	D4	0.00000		
	K3	0.00000		
	K4	0.00000		
	FTG	0.00000		
	FFQ	0.00000		
	DTG	0.00000		
	DFQ1	0.00000		
	DFQ2	0.00000		
Special units	Base mass unit	g		
	Base mass time	sec		
	Mass flow conversion factor	1.00000		
	Base volume unit	L		
	Base volume time	sec		
	Volume flow conversion factor	1.00000		
Variable mapping	Primary variable	Mass flow		
	Secondary variable	Density		
	Tertiary variable	Mass flow		
	Quaternary variable	Volume flow		

Table A-1 Transmitter default values and ranges *continued*

Type	Setting	Default	Range	Comments
mA output	Primary variable	Mass flow		
	LRV	–200.00000 g/s		
	URV	200.00000 g/s		
	AO cutoff	0.00000 g/s		
	AO added damping	0.00000 sec		
	LSL	–200 g/s		Read-only
	USL	200 g/s		Read-only
	MinSpan	0.3 g/s		Read-only
	Fault action	Downscale		
	AO fault level – downscale	2.0 mA	1.0 – 3.6 mA	
	AO fault level – upscale	22 mA	21.0 – 24.0 mA	
	Last measured value timeout	0.00 sec		
Frequency output	Tertiary variable	Mass flow		
	Frequency factor	1,000.00 Hz	.00091 – 10,000.00 Hz	
	Rate factor	16,666.66992 g/s		
	Frequency pulse width	0 (50% duty cycle)	0.01 – 655.35 millisec	
	Scaling method	Freq=Flow		
	Frequency fault action	Downscale		
	Frequency fault level – upscale	15,000 Hz	10.0 – 15,000 Hz	
	Frequency output polarity	Active high		
	Last measured value timeout	0.0 seconds	0.0 – 60.0 sec	

Table A-1 Transmitter default values and ranges *continued*

Type	Setting	Default	Range	Comments
Display	Backlight on/off	On		
	Backlight intensity	63	0 – 63	
	Update period	200 milliseconds	100 – 10,000 milliseconds	
	Variable 1	Mass flow rate		
	Variable 2	Mass total		
	Variable 3	Volume flow rate		
	Variable 4	Volume total		
	Variable 5	Temperature		
	Variable 6	Density		
	Variable 7	Drive gain		
	Variable 8–15	None		
	Display totalizer start/stop	Disabled		
	Display totalizer reset	Disabled		
	Display auto scroll	Disabled		
	Display offline menu	Enabled		
	Display offline password	Disabled		
	Display alarm menu	Enabled		
	Display acknowledge all alarms	Enabled		
	Offline password	1234		
	Auto scroll rate	10 sec		

Appendix B
Flowmeter Installation Types and Components

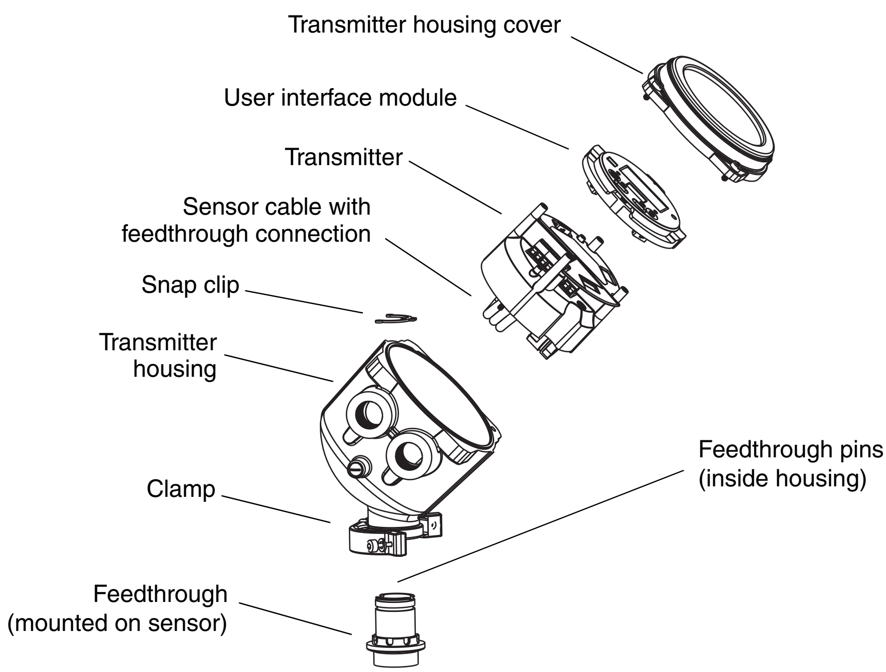
B.1 Overview

This appendix provides illustrations of transmitter components and wiring, for use in troubleshooting. For detailed information on installation and wiring procedures, see the transmitter installation manual.

B.2 Transmitter components

The Model 2400S AN transmitter is mounted on a sensor. Figure B-1 provides an exploded view of the Model 2400S AN transmitter and its components.

Figure B-1 Model 2400S AN transmitter – Exploded view



B.3 Terminal diagrams

Figure B-2 shows the transmitter's power supply terminals. The power supply terminals are beneath the Warning flap. The transmitter housing cover and the Warning flap screw must be removed to access the power supply terminals.

Figure B-3 shows the I/O wiring terminals. The transmitter housing cover must be removed to access the I/O wiring terminals.

Figure B-2 Power supply terminals

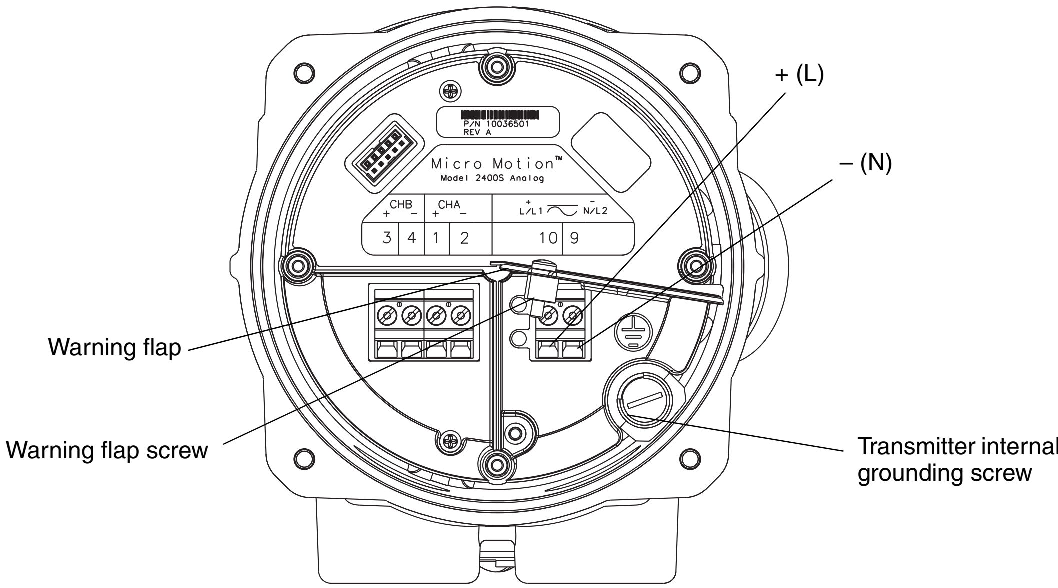
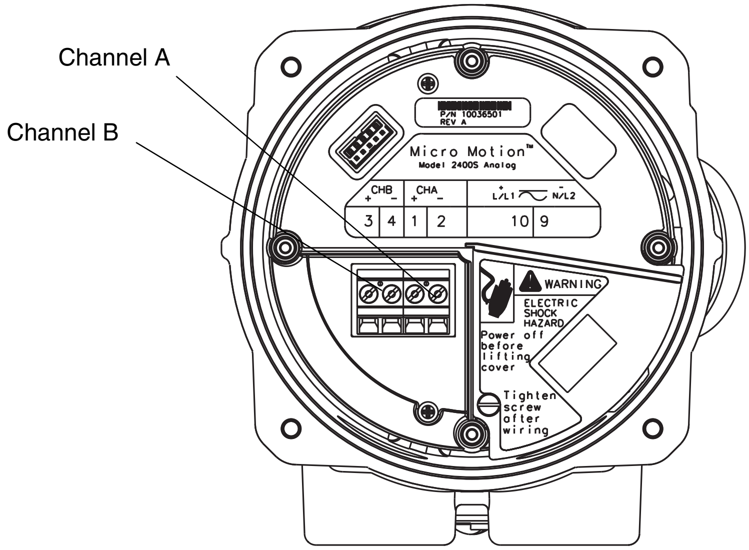


Figure B-3 I/O terminals



Appendix C
Menu Flowcharts – Model 2400S AN Transmitters

C.1 Overview

This appendix provides the following menu flowcharts for the Model 2400S AN transmitter:

- ProLink II menus
  - Main menu – see Figure C-1
  - Configuration menu – see Figures C-2 and C-3
- Communicator menus – see Figures C-4 through C-9
- Display menus
  - Managing totalizers and inventories – see Figure C-10
  - Off-line maintenance menu: Top level – see Figure C-11
  - Off-line maintenance menu: Version information – see Figure C-12
  - Off-line maintenance menu: Configuration – see Figures C-13 and C-14
  - Off-line maintenance menu: Simulation (loop testing) – see Figure C-15
  - Off-line maintenance menu: Zero – see Figure C-16

  For information on the codes and abbreviations used on the display, see Appendix D.

For flowmeter zero, loop testing, and mA output trim procedures, see Chapter 5.

For meter verification and calibration procedures, see Chapter 10.

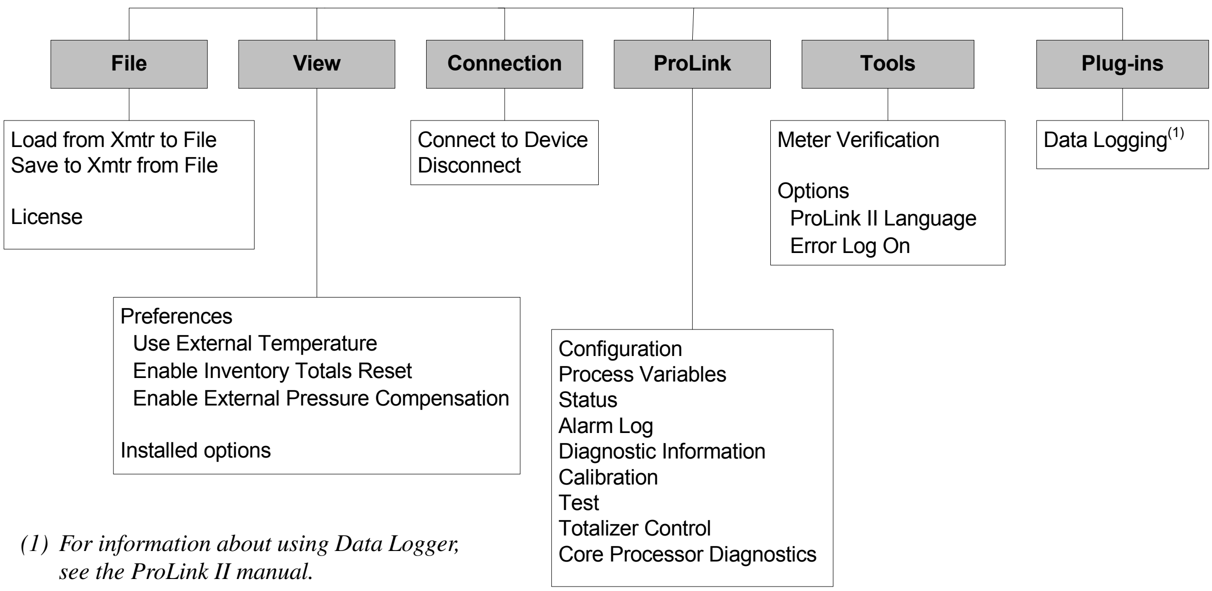
C.2 Version information

These menu flowcharts are based on:

- Transmitter software v1.0
- ProLink II v2.4
- 375 Field Communicator Device Description revision 1

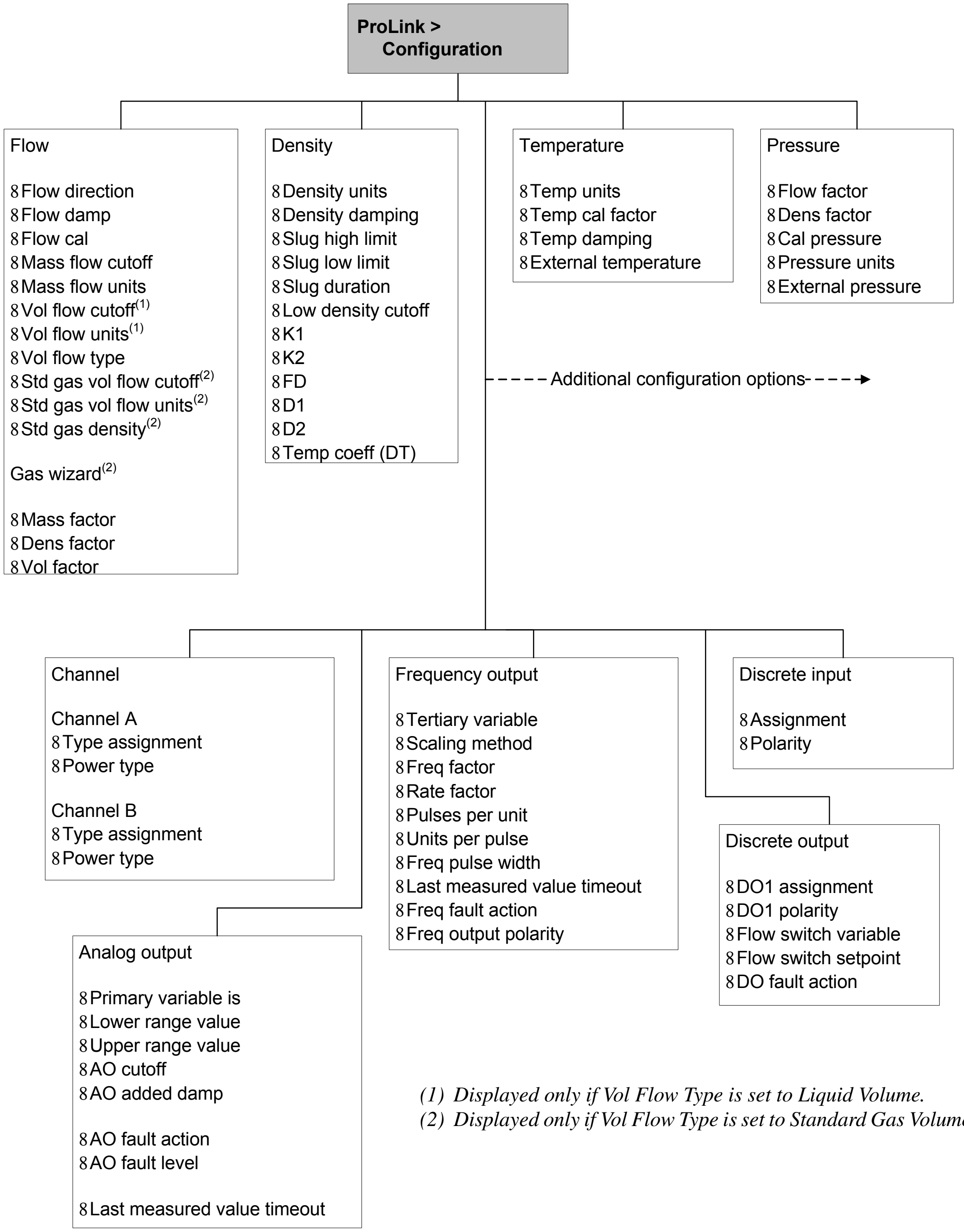
Menus may vary slightly for different versions of these components.

Figure C-1 ProLink II main menu



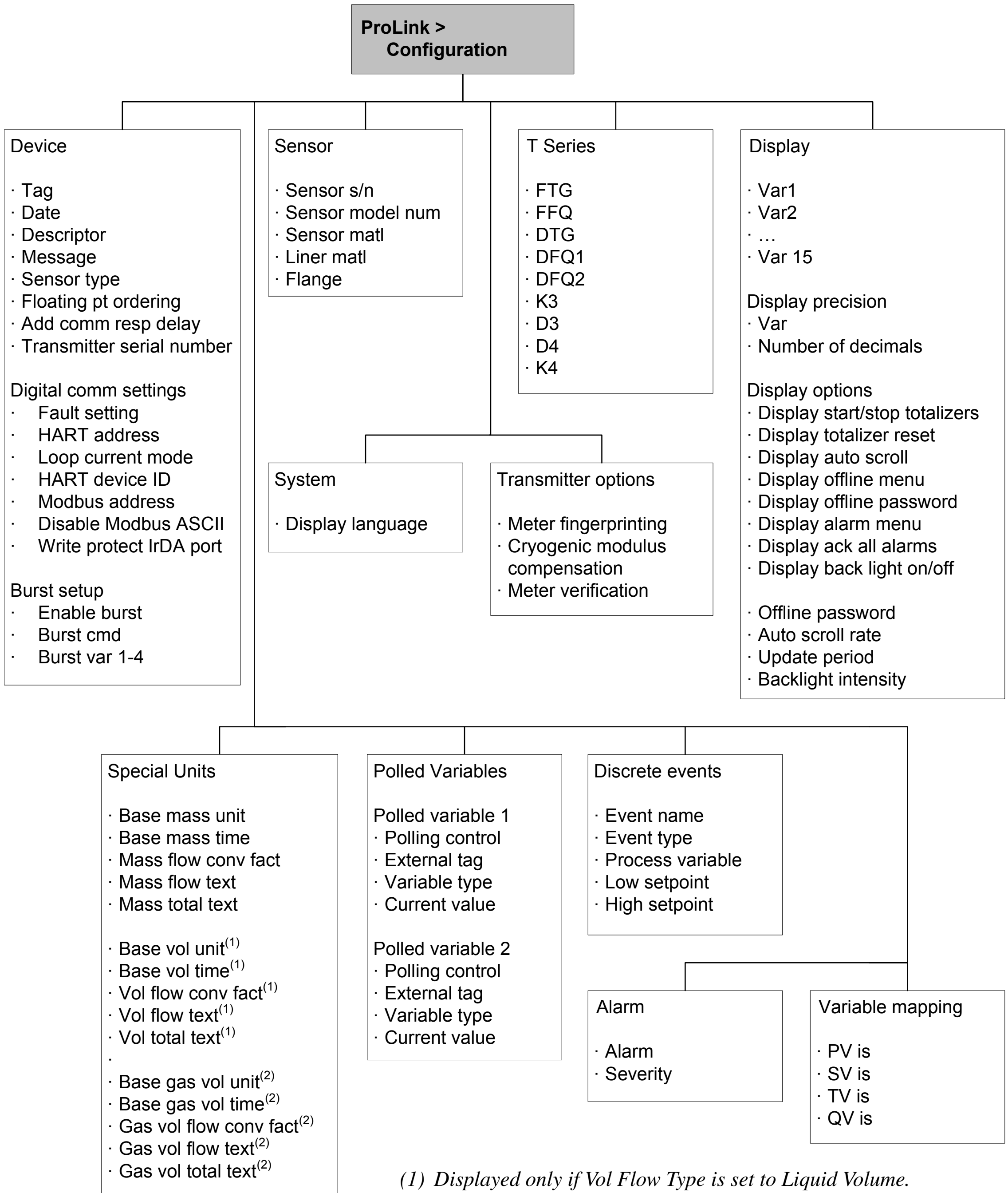
(1) For information about using Data Logger, see the ProLink II manual.

Figure C-2 ProLink II configuration menu



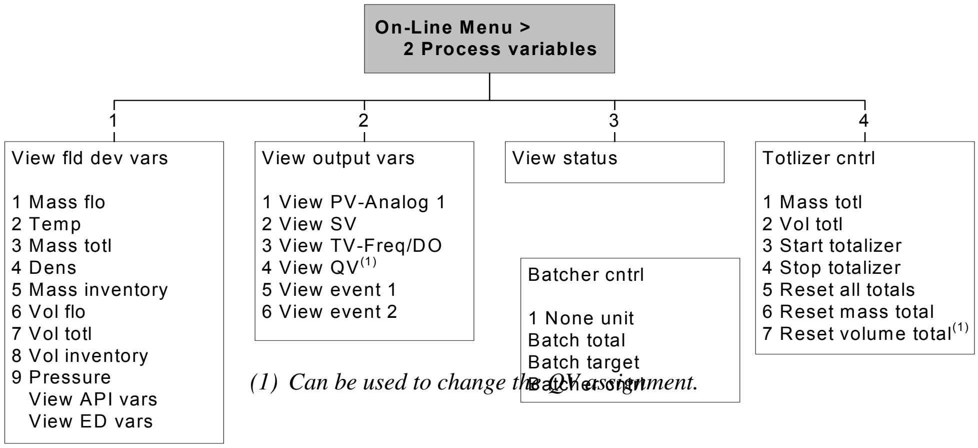
(1) Displayed only if Vol Flow Type is set to Liquid Volume.
(2) Displayed only if Vol Flow Type is set to Standard Gas Volume.

Figure C-3 ProLink II configuration menu *continued*



(1) Displayed only if Vol Flow Type is set to Liquid Volume.
(2) Displayed only if Vol Flow Type is set to Standard Gas Volume.

Figure C-4 Communicator process variables menu



(1) Can be used to change the QV assignment.

Figure C-5 Communicator diagnostics/service menu

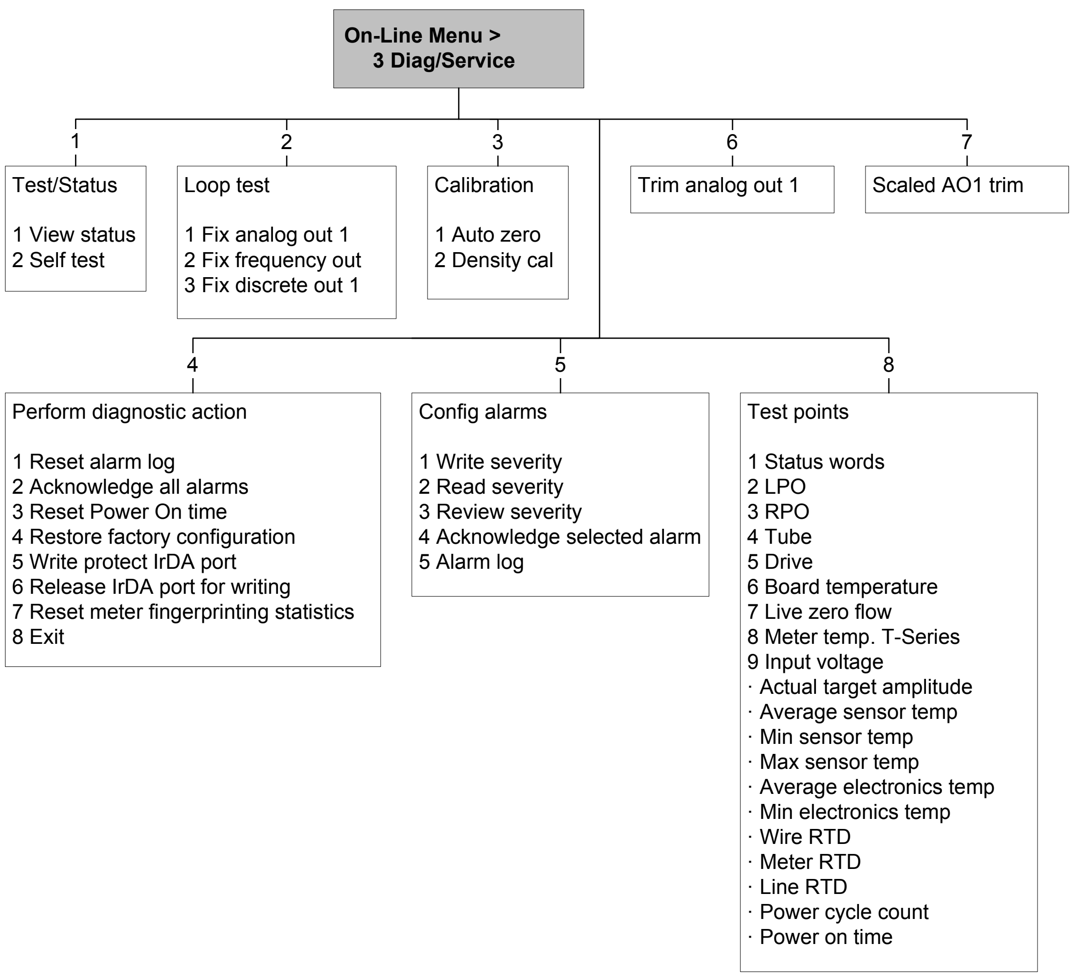
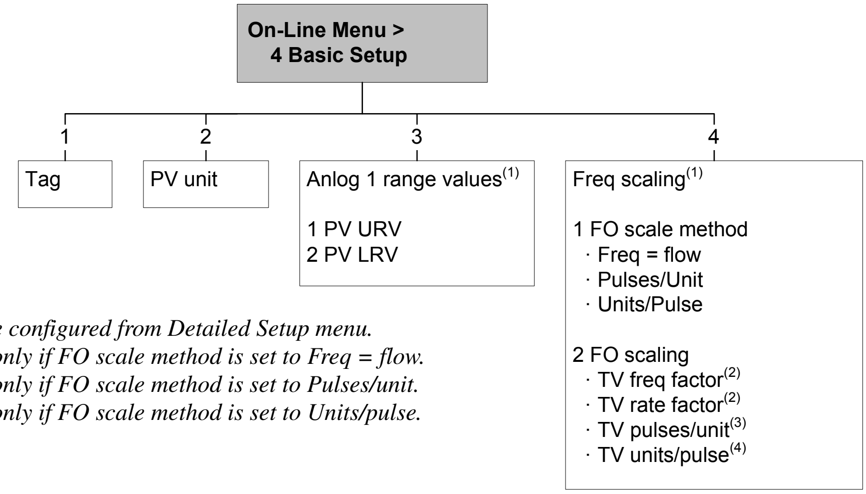


Figure C-6 Communicator basic setup menu



(1) Can also be configured from Detailed Setup menu.
(2) Displayed only if FO scale method is set to Freq = flow.
(3) Displayed only if FO scale method is set to Pulses/unit.
(4) Displayed only if FO scale method is set to Units/pulse.

Figure C-7 Communicator detailed setup menu

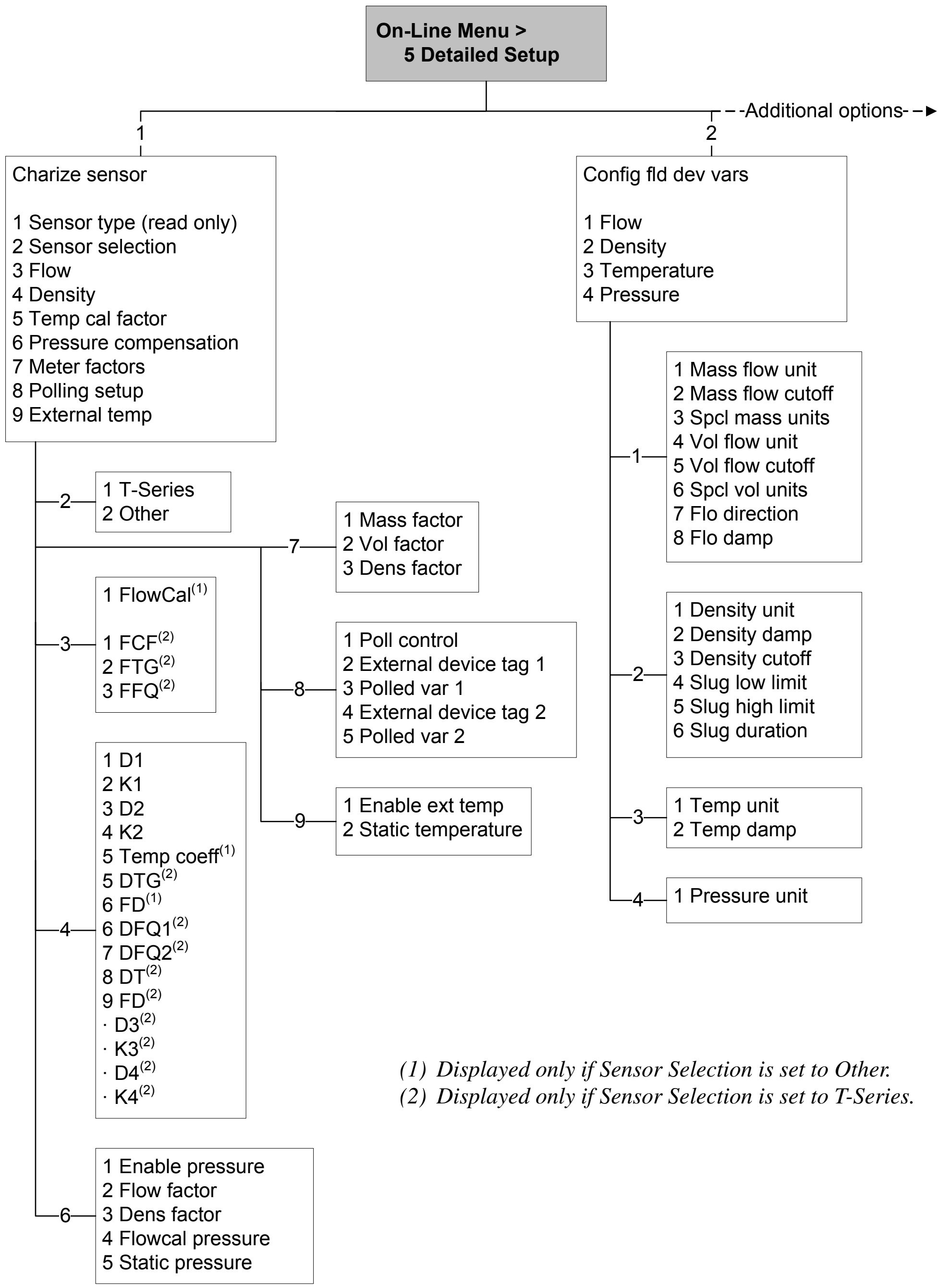
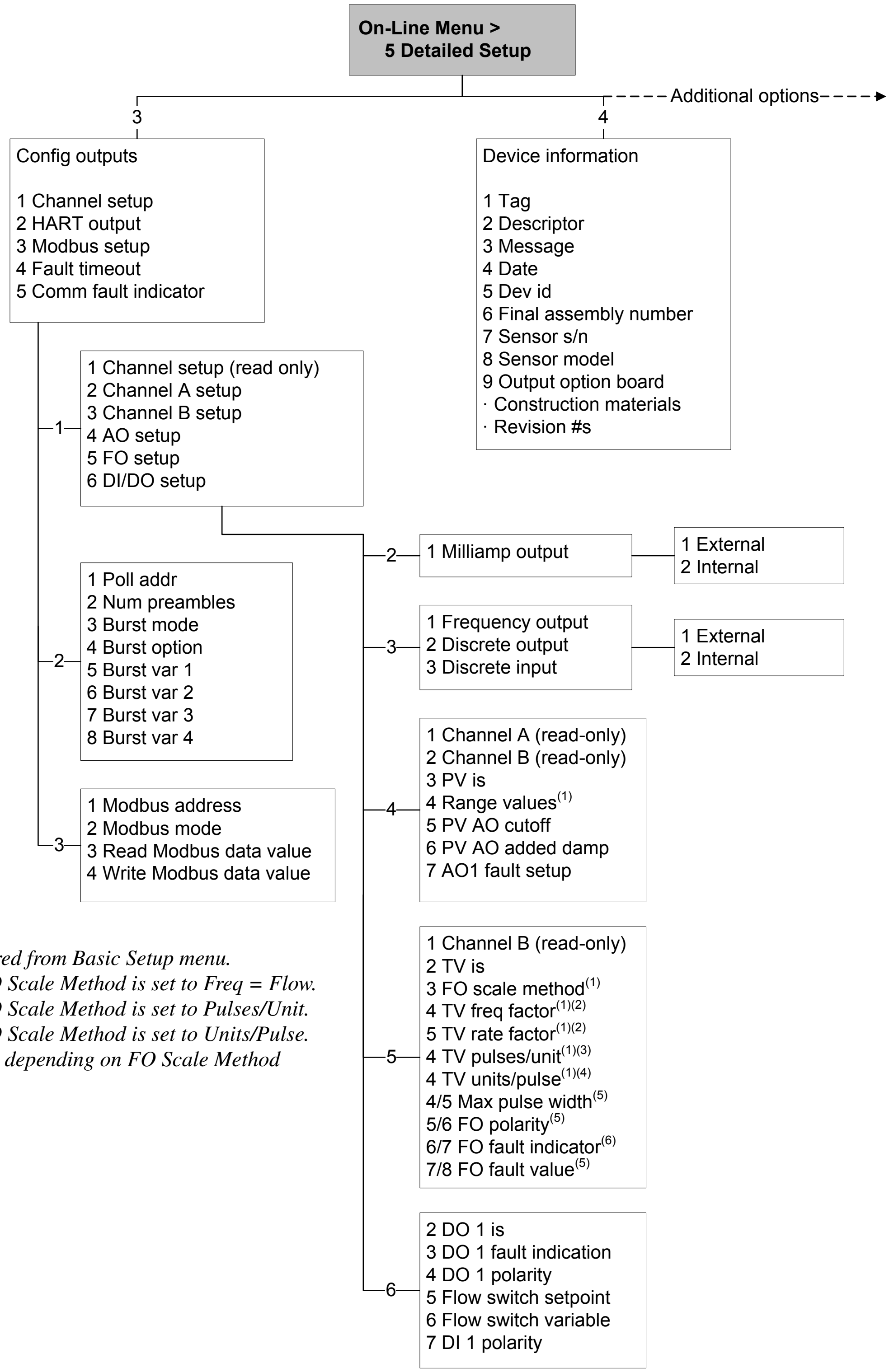
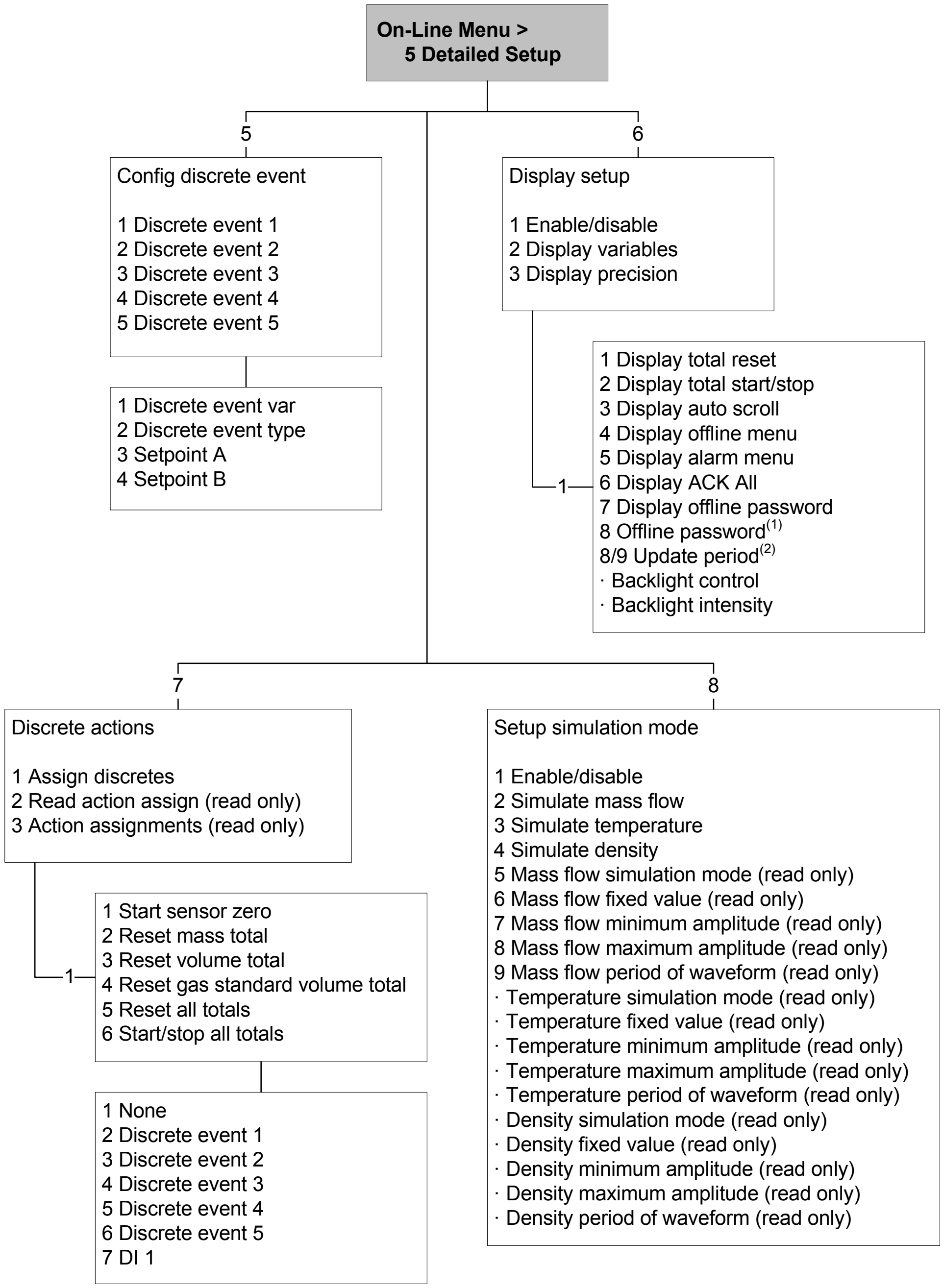


Figure C-8 Communicator detailed setup menu *continued*



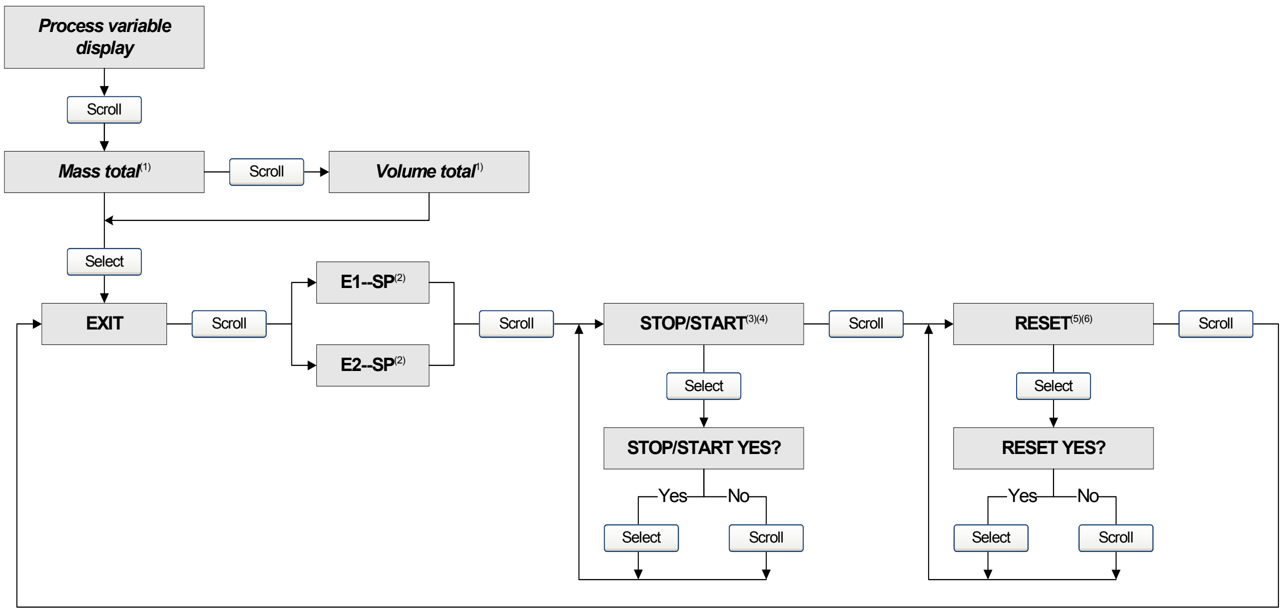
(1) Can also be configured from Basic Setup menu.
(2) Displayed only if FO Scale Method is set to Freq = Flow.
(3) Displayed only if FO Scale Method is set to Pulses/Unit.
(4) Displayed only if FO Scale Method is set to Units/Pulse.
(5) Menu number varies depending on FO Scale Method configuration.

Figure C-9 Communicator detailed setup menu *continued*



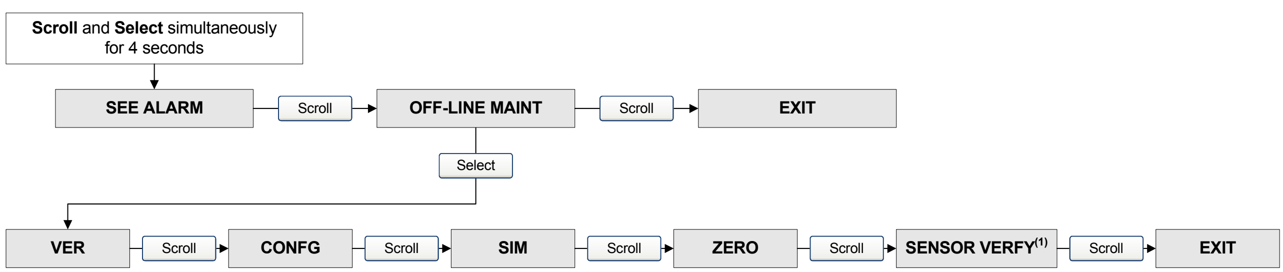
(1) Displayed only if Display Offline Password is enabled.
(2) Menu number varies depending on Display Offline Password configuration.

Figure C-10 Display menu – Managing totalizers and inventories



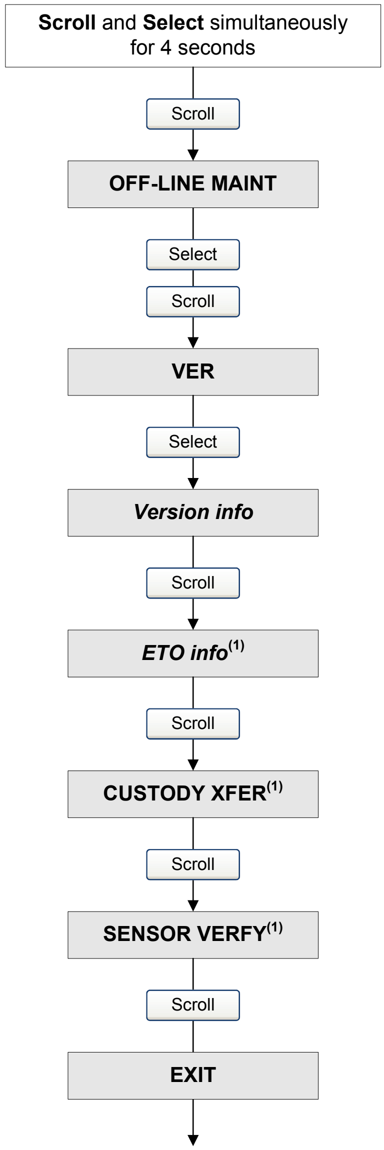
(1) *The transmitter must be configured to allow resetting totalizers from the display. See Section 8.10.3.*
(2) *The transmitter must be configured to allow starting and stopping totalizers from the display. See Section 8.10.3.*
(3) *The Event Setpoint screens can be used to define or change the high setpoint (Setpoint A) for Event 1 or Event 2. These screens are displayed only if the event is defined on mass total or volume total. Otherwise, the Scroll optical switch takes the user directly to the Exit screen.*

Figure C-11 Display menu – Off-line menu, top level



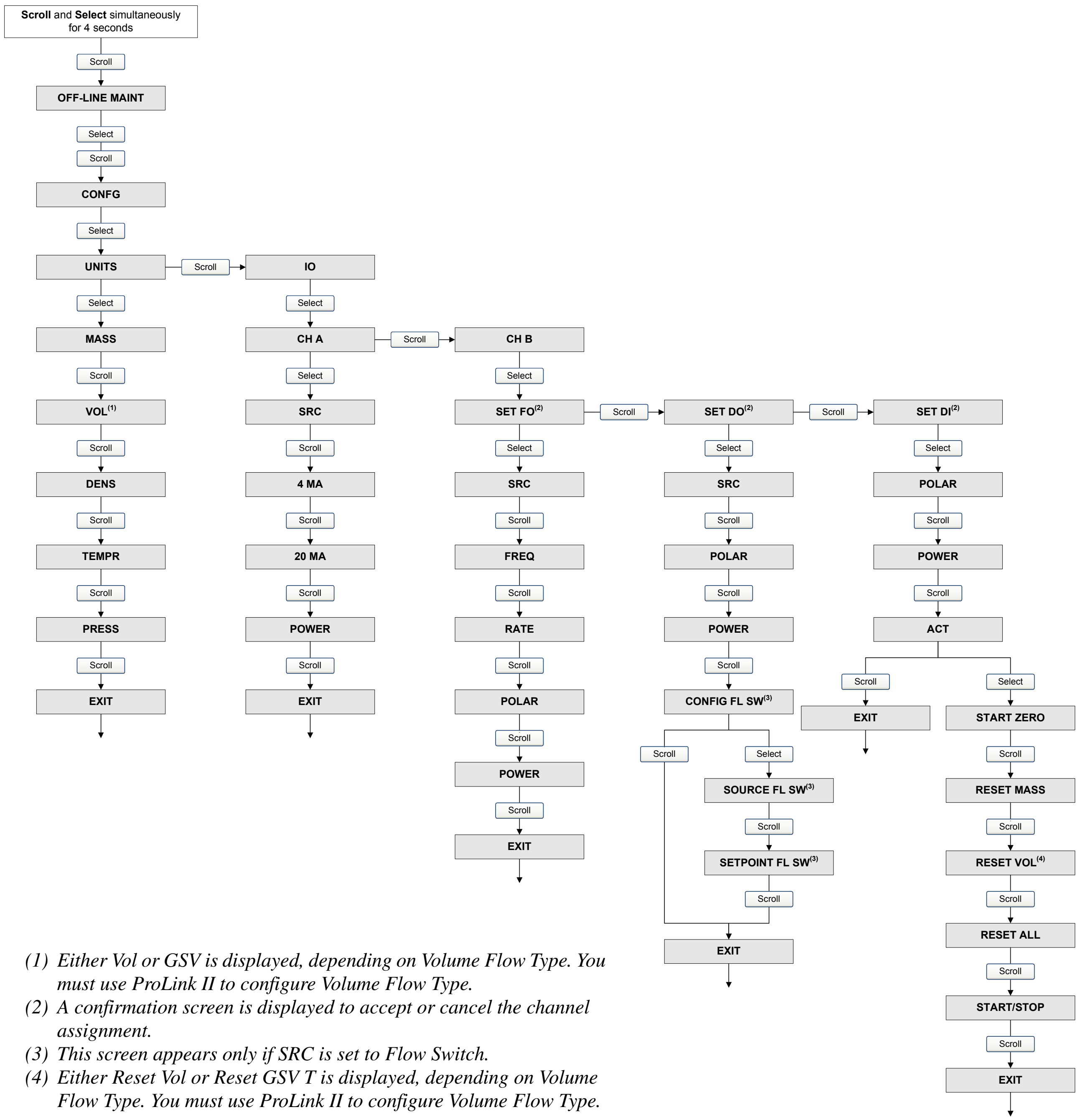
(1) *This option is displayed only if the meter verification software is installed on the transmitter.*

Figure C-12 Display menu – Maintenance – Version information



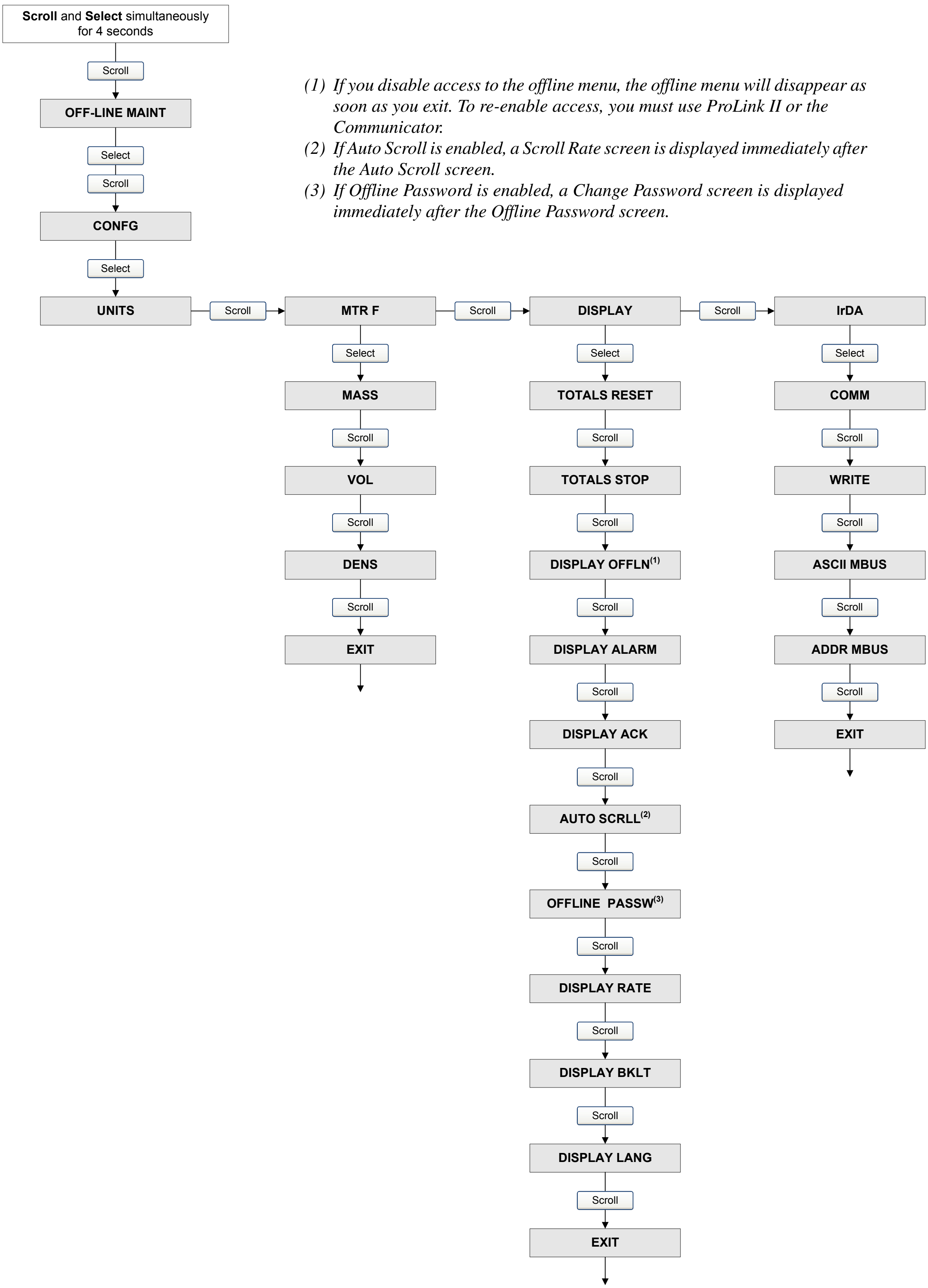
(1) The option is displayed only if the corresponding CEQ or application is installed on the transmitter.

Figure C-13 Display menu – Maintenance – Configuration: I/O



(1) Either Vol or GSV is displayed, depending on Volume Flow Type. You must use ProLink II to configure Volume Flow Type.
(2) A confirmation screen is displayed to accept or cancel the channel assignment.
(3) This screen appears only if SRC is set to Flow Switch.
(4) Either Reset Vol or Reset GSV T is displayed, depending on Volume Flow Type. You must use ProLink II to configure Volume Flow Type.

Figure C-14 Display menu – Maintenance – Configuration: Meter factors, display, digital communications

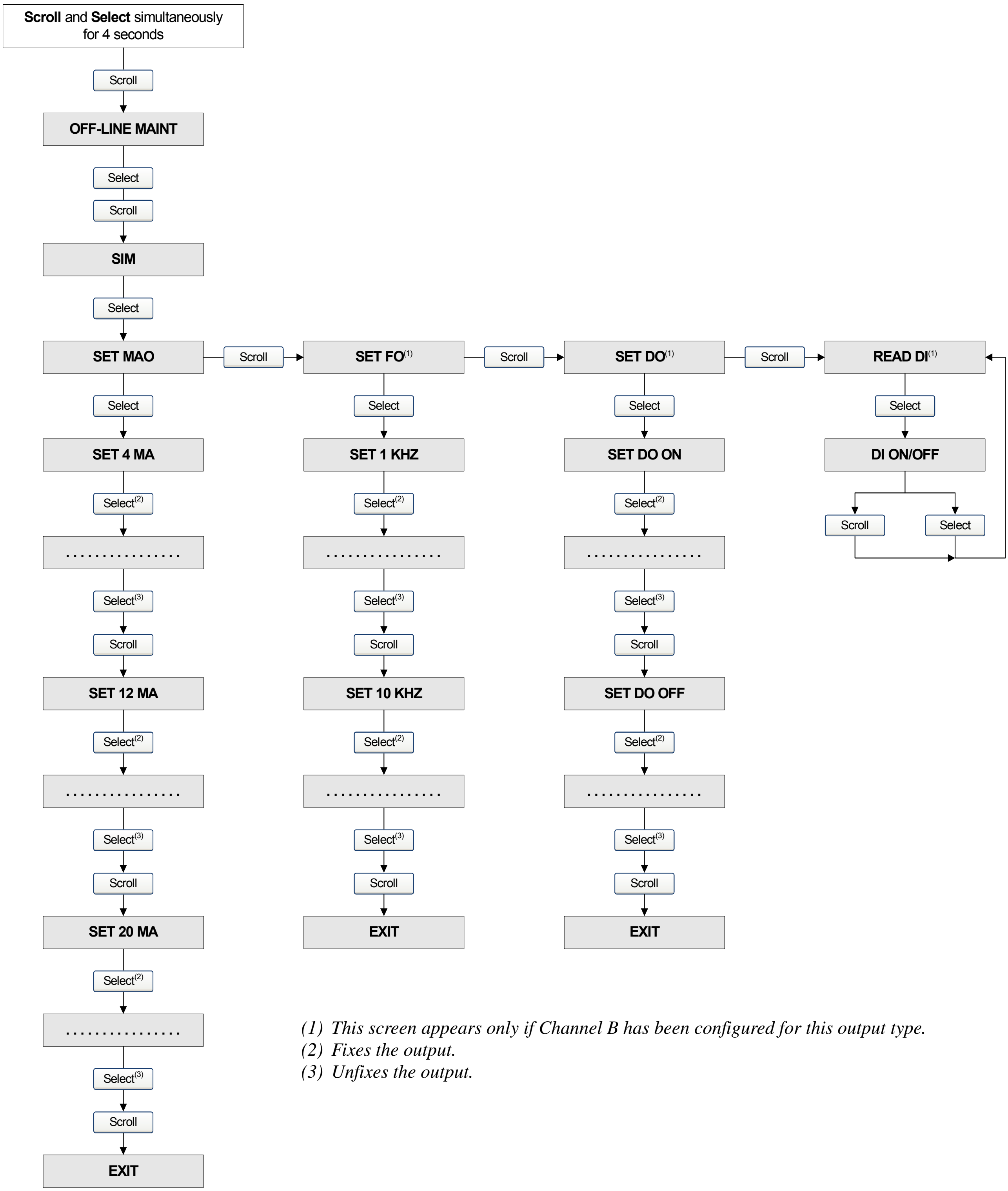


(1) If you disable access to the offline menu, the offline menu will disappear as soon as you exit. To re-enable access, you must use ProLink II or the Communicator.

(2) If Auto Scroll is enabled, a Scroll Rate screen is displayed immediately after the Auto Scroll screen.

(3) If Offline Password is enabled, a Change Password screen is displayed immediately after the Offline Password screen.

Figure C-15 Display menu – Simulation (loop testing)



(1) This screen appears only if Channel B has been configured for this output type.
(2) Fixes the output.
(3) Unfixes the output.

Figure C-16 Display menu – Zero

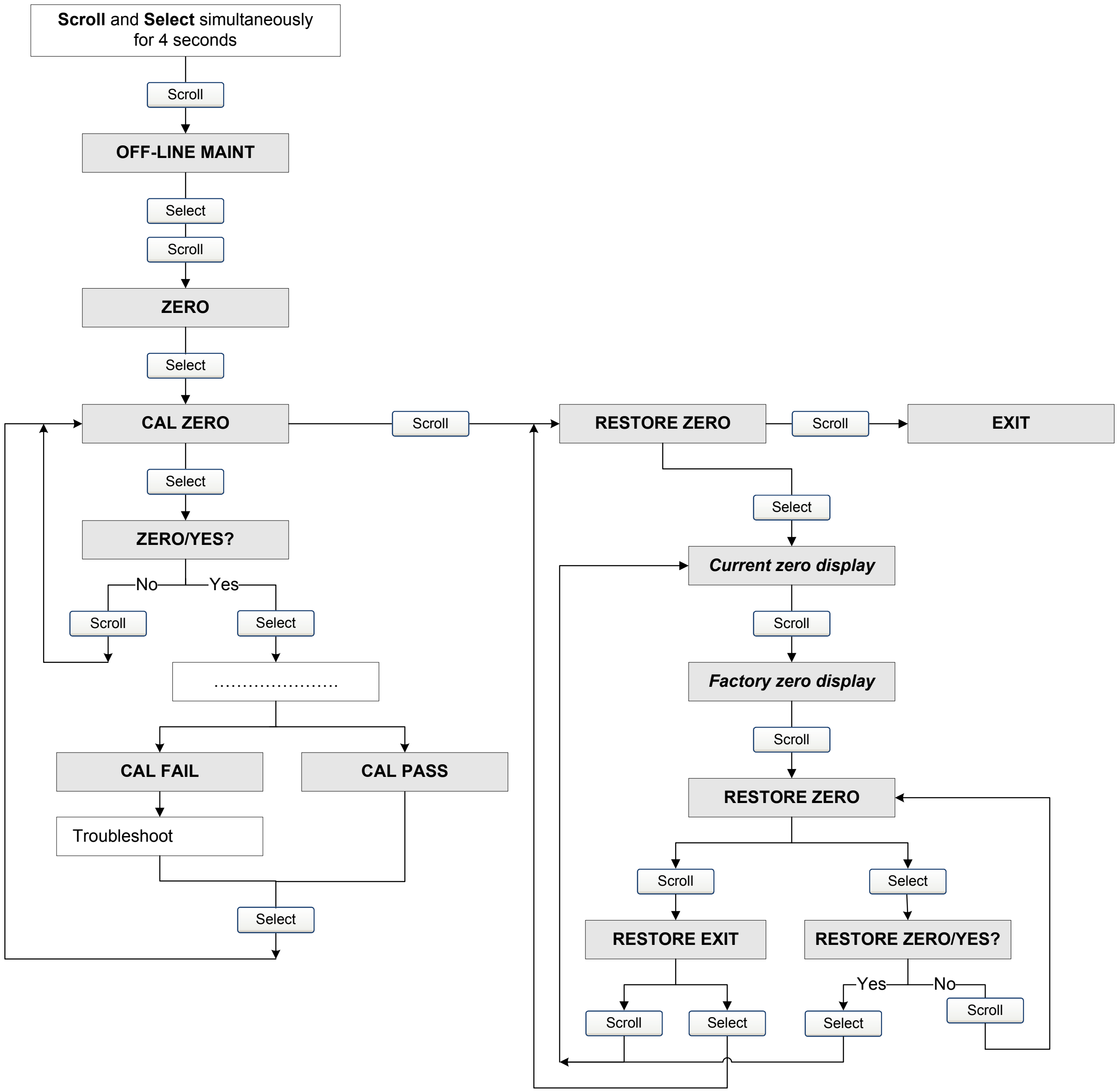
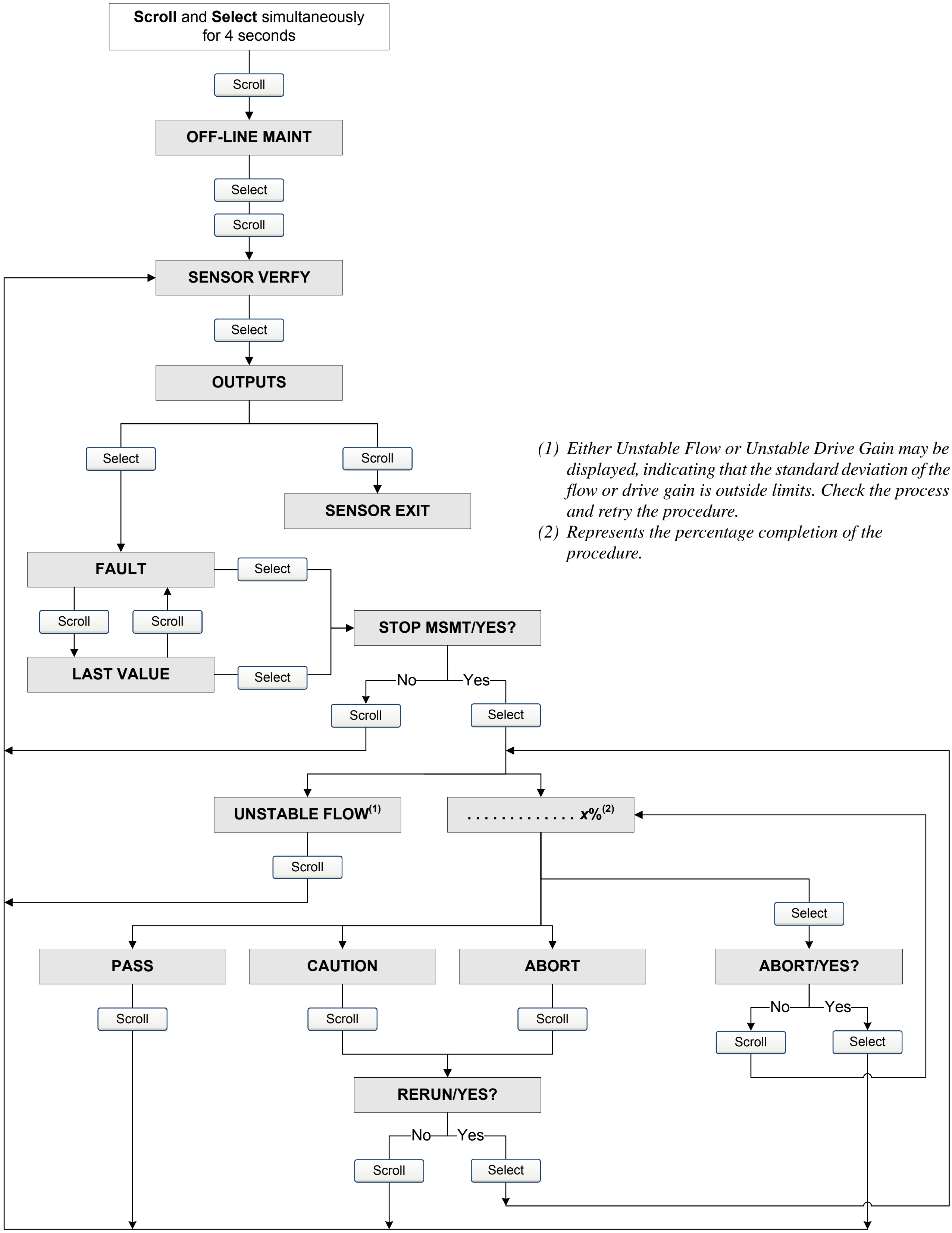


Figure C-17 **Display menu – Meter verification**



(1) Either Unstable Flow or Unstable Drive Gain may be displayed, indicating that the standard deviation of the flow or drive gain is outside limits. Check the process and retry the procedure.

(2) Represents the percentage completion of the procedure.

Figure C-18 Display menu – Discrete input and discrete event assignment

(1) *This menu is entered from the DI Configuration menu (see Figure C-13).*
(2) *More than one action can be assigned to the discrete input or to a discrete event.*
(3) *This screen is displayed only if GSV is enabled.*

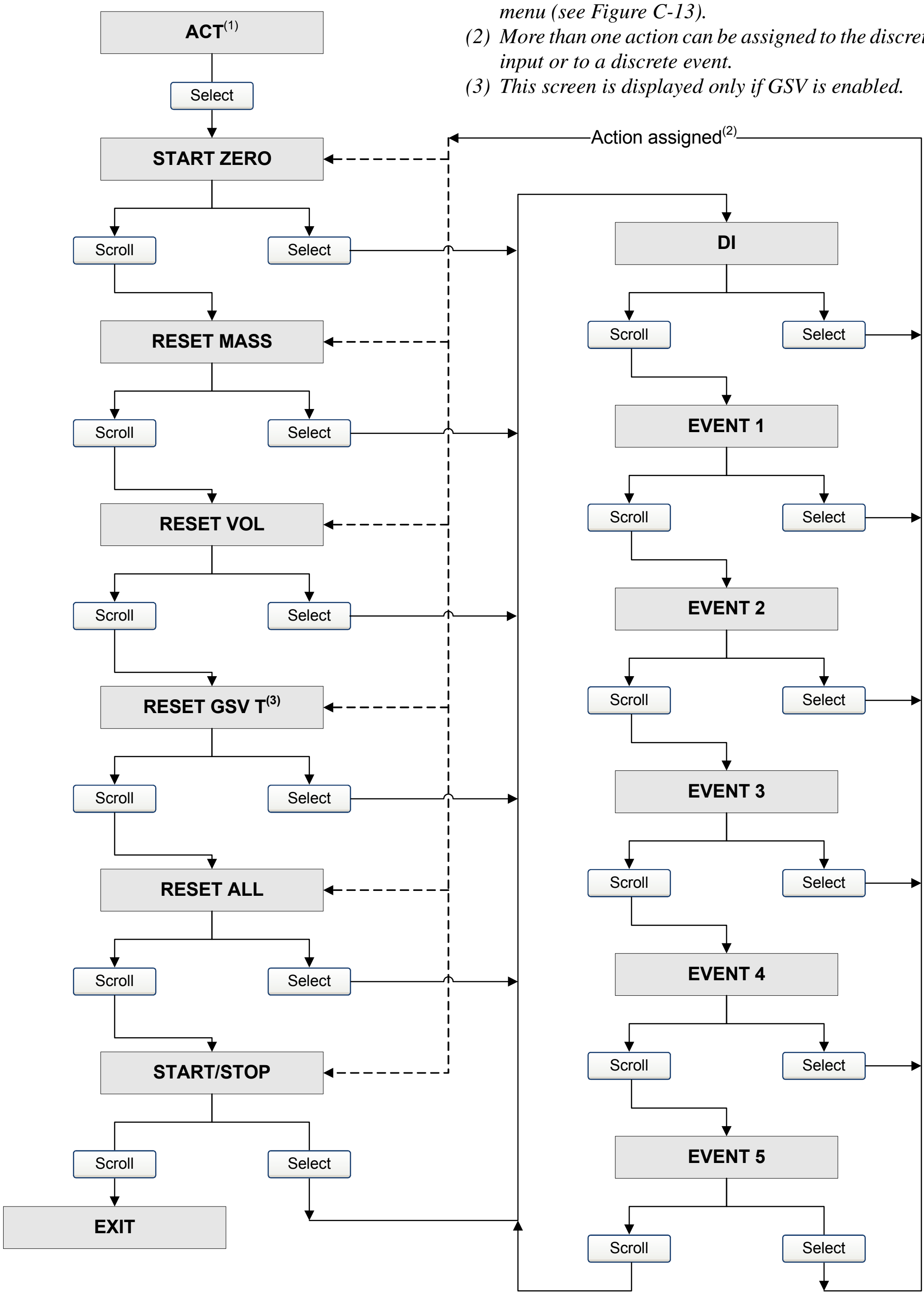
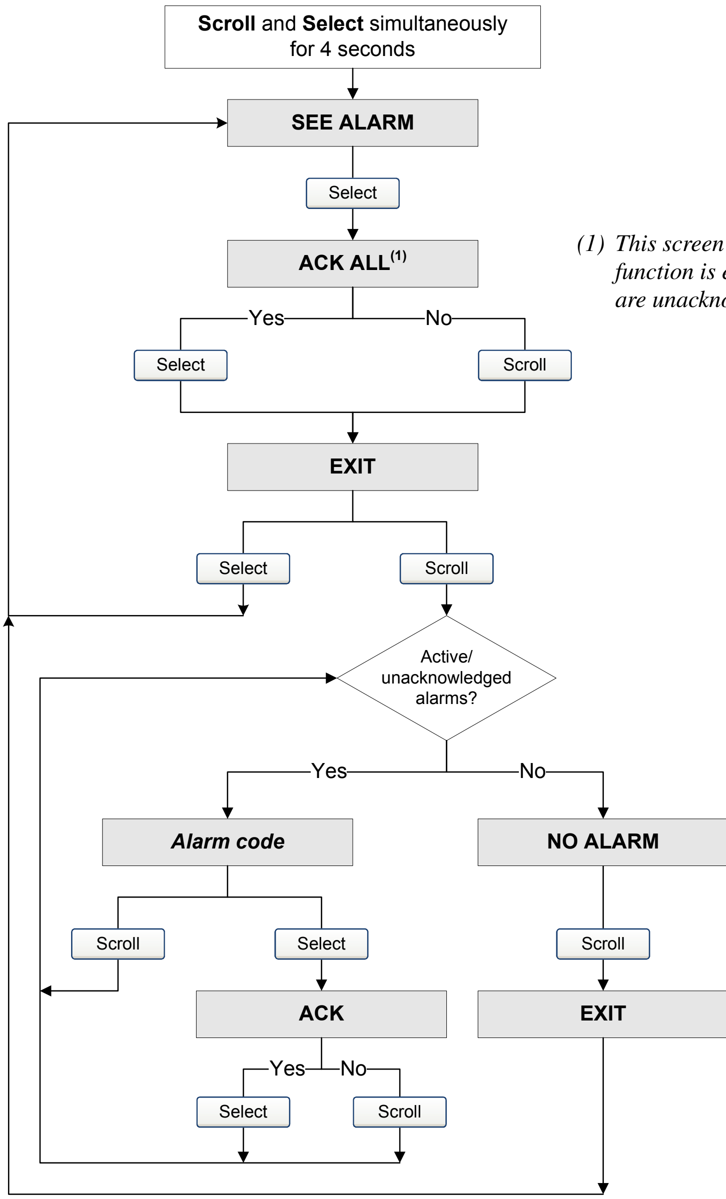


Figure C-19 Display menu – Alarms



(1) This screen is displayed only if the ACK ALL function is enabled (see Section 8.10.3) and there are unacknowledged alarms.

Appendix D
Display Codes and Abbreviations

D.1 Overview

This appendix provides information on the codes and abbreviations used on the transmitter display.

Note: Information in this appendix applies only to transmitters that have a display.

D.2 Codes and abbreviations

Table D-1 lists and defines the codes and abbreviations that are used for display variables (see Section 8.10.5 for information on configuring display variables).

Table D-2 lists and defines the codes and abbreviations that are used in the off-line menu.

Note: These tables do not list terms that are spelled out completely, or codes that are used to identify measurement units. For the codes that are used to identify measurement units, see Section 6.4.

Table D-1 Display codes used for display variables

Code or abbreviation	Definition	Comment or reference
AVE_D	Average density	
AVE_T	Average temperature	
BRD T	Board temperature	
CONC	Concentration	
DGAIN	Drive gain	
EXT P	External pressure	
EXT T	External temperature	
GSV F	Gas standard volume flow	
GSV I	Gas standard volume flow inventory	
LPO_A	Left pickoff amplitude	
LVOLI	Volume inventory	
LZERO	Live zero flow	
MASSI	Mass inventory	
MTR T	Case temperature	
NET M	Net mass flow rate	Enhanced density application only
NET V	Net volume flow rate	Enhanced density application only
NETMI	Net mass inventory	Enhanced density application only
NETVI	Net volume inventory	Enhanced density application only
PWRIN	Input voltage	Refers to power input to the core processor

Table D-1 Display codes used for display variables

Code or abbreviation	Definition	Comment or reference
RDENS	Density at reference temperature	Enhanced density application only
RPO A	Right pickoff amplitude	
SGU	Specific gravity units	
STD V	Standard volume flow rate	Enhanced density application only
STD V	Standard volume flow rate	Enhanced density application only
STDVI	Standard volume inventory	Enhanced density application only
TCDEN	Temperature-corrected density	Petroleum measurement application only
TCORI	Temperature-corrected inventory	Petroleum measurement application only
TCORR	Temperature-corrected total	Petroleum measurement application only
TCVOL	Temperature-corrected volume	Petroleum measurement application only
TUBEF	Raw tube frequency	
WTAVE	Weighted average	

Table D-2 Display codes used in off-line menu

Code or abbreviation	Definition	Comment or reference
ACK	Display Ack All menu	
ACK ALARM	Acknowledge alarm	
ACK ALL	Acknowledge all	
ACT	Action	Action assigned to the discrete input or to a discrete event
AO	Analog output	
ADDR	Address	
BKLT, B LIGHT	Display backlight	
CAL	Calibrate	
CH A	Channel A	
CH B	Channel B	
CHANGE PASSW	Change password	Change the password required for access to display functions
CONFG	Configuration	
CORE	Core processor	
CUR Z	Current zero	
CUSTODY XFER	Custody transfer	
DENS	Density	
DRIVE%, DGAIN	Drive gain	
DI	Discrete input	
DISBL	Disable	**Select** to disable
DO	Discrete output	
DSPLY	Display	

Table D-2 Display codes used in off-line menu

Code or abbreviation	Definition	Comment or reference
E*x*	Event *x*	Refers to Event 1 or Event 2 when setting the setpoint.
ENABL	Enable	**Select** to enable
EXTRN	External	
EVNT*x*	Event *x*	
FAC Z	Factory zero	
FCF	Flow calibration factor	
FLDIR	Flow direction	
FLSWT, FL SW	Flow switch	
FO	Frequency output	
FREQ	Frequency	
GSV	Gas standard volume	
GSV T	Gas standard volume total	
INTRN	Internal	
IO	Inputs/outputs	
IRDA	Infrared	
LANG	Display language	
M_ASC	Modbus ASCII	
M_RTU	Modbus RTU	
MAO	mA output	
MASS	Mass flow	
MBUS	Modbus	
MFLOW	Mass flow	
MSMT	Measurement	
MTR F	Meter factor	
OFF-LINE MAINT	Off-line maintenance menu	
OFFLN	Display off-line menu	
POLAR	Polarity	
PRESS	Pressure	
r.	Revision	
SENSR	Sensor	
SIM	Simulation	
SPECL	Special	
SrC	Source	Variable assignment for outputs
TEMPR	Temperature	
VER	Version	
VERFY	Verify	
VFLOW	Volume flow	
VOL	Volume or volume flow	
WRPRO	Write protect	
XMTR	Transmitter	

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