Configuration and Use Manual
P/N MMI-20007739, Rev. B
July 2008

Micro Motion®
Model 2400S Transmitters
for DeviceNet™

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 configuration overview flowchart and a pre-configuration worksheet. This manual describes the procedures required to start, configure, use, maintain, and troubleshoot the Micro Motion® Model 2400S transmitter for DeviceNet™ (the Model 2400S DN 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 I/O 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 I/O option:
  - **C** = DeviceNet
- 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 DeviceNet functionality

The Model 2400S DN transmitter implements the following DeviceNet functionality:

- Baud rates:
  - 125 kBaud
  - 250 kBaud
  - 500 kBaud
- I/O slave messaging:
  - Polling
  - Cyclic
- Configuration methods:
  - Hardware switches
  - EDS
  - Custom software

1.5 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 DeviceNet tool(1)	With display
Transmitter software revision(2)	ProLink II title bar or View/Installed Options/ Software Revision	Identity Object (0x01) Instance 1 Attribute 198	OFF-LINE MAINT/VER
Software revision corresponding to revision specified on ODVA certificate	Not available	Identity Object (0x01) Instance 1 Attribute 4	Not available
Hardware revision	Not available	Identity Object (0x01) Instance 1 Attribute 105	Not available

(1) See Chapter 5 for more information.
(2) Also represents the core processor version.

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. The display provides only partial configuration functionality.
- ProLink® II software, v2.5 and later. ProLink II provides complete configuration functionality for the transmitter, but does not provide DeviceNet configuration functionality.
- Pocket ProLink software, v1.3 and later. Pocket ProLink provides complete configuration functionality for the transmitter, but does not provide DeviceNet configuration functionality.
- Customer-supplied DeviceNet tool. Capabilities depend on the tool.

In this manual:

- Basic information on using the transmitter's user interface is provided in Chapter 3.
- Basic information on using ProLink II or Pocket ProLink, and connecting ProLink II or Pocket ProLink to your transmitter, is provided in Chapter 4. For more information, see the ProLink II or Pocket ProLink manual, available on the Micro Motion web site (www.micromotion.com).
- Basic information on using a customer-supplied DeviceNet tool is provided in Chapter 5. For more information, see the documentation provided with the tool.

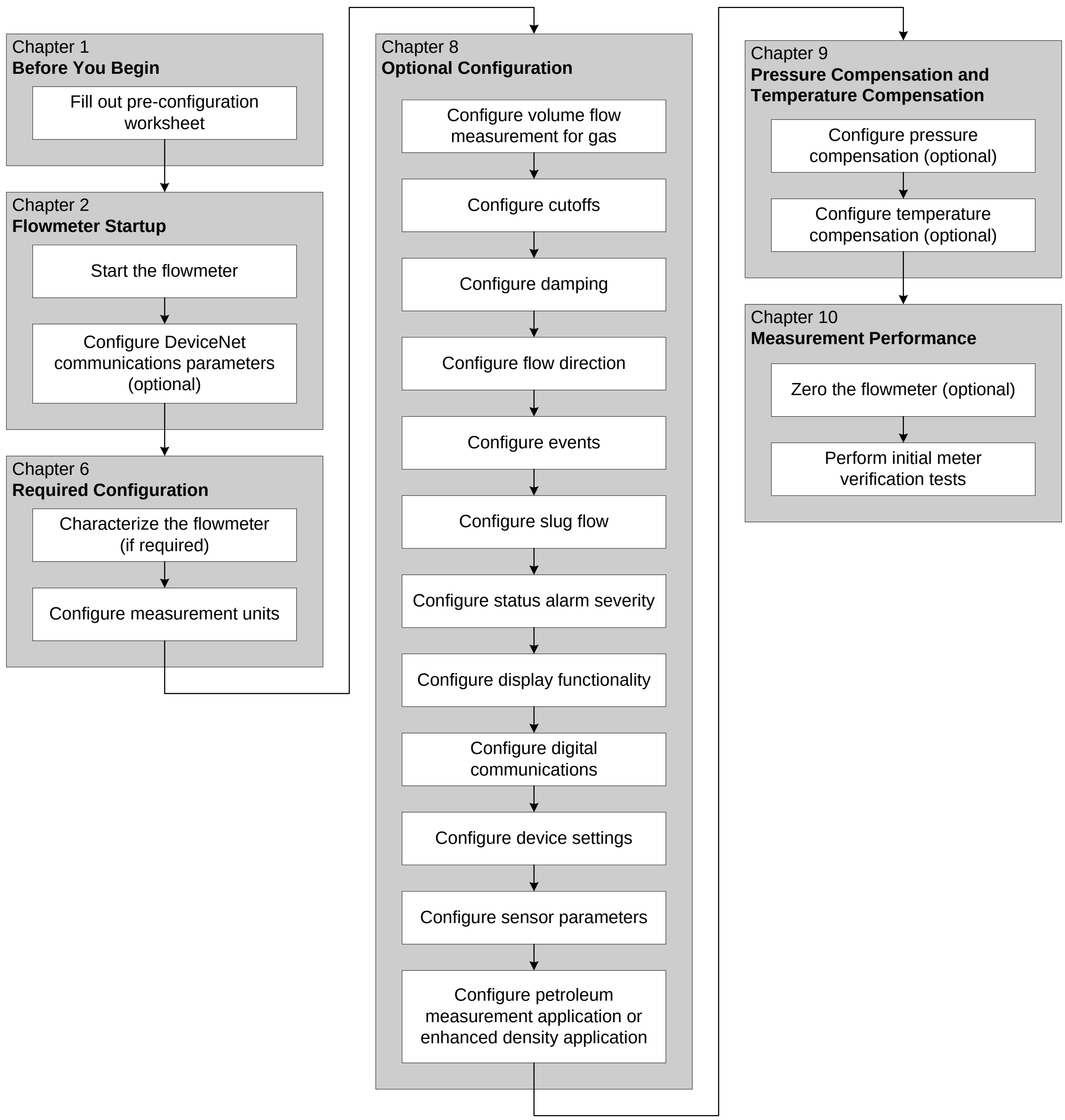
1.7 Planning the configuration

Refer to the configuration overview flowchart in Figure 1-1 to plan transmitter configuration. In general, perform configuration steps in the order shown here.

Note: Depending on your installation and application, some configuration tasks may be optional.

Note: This manual provides information on topics that are not included in the configuration overview flowchart, e.g.: using the transmitter, troubleshooting, and calibration procedures. Be sure to review these topics as required.

Figure 1-1 Configuration overview



1.8 Pre-configuration worksheet

The pre-configuration worksheet provides a place to record basic information about your flowmeter (transmitter and sensor) and your application. This information will affect your configuration options as you work through this manual. 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.

Pre-configuration worksheet		Transmitter ____________________
Item		**Configuration data**
Transmitter model number		______________________________
Core processor (transmitter) software revision		______________________________
DeviceNet node address		______________________________
DeviceNet baud rate		______________________________
Measurement units	Mass flow	______________________________
	Volume flow	______________________________
	Density	______________________________
	Pressure	______________________________
	Temperature	______________________________
Installed applications		☐ Meter verification software ☐ Petroleum measurement application ☐ Enhanced density application

1.9 Flowmeter documentation

Table 1-2 lists documentation sources for additional information.

Table 1-2 Flowmeter documentation resources

Topic	Document
DeviceNet device profile	*Micro Motion Model 2400S Transmitters for DeviceNet: Device Profile* shipped with the product or available on the Micro Motion web site (www.micromotion.com)
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)

1.10 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 *International.MMISupport@EmersonProcess.com*.

Chapter 2
Flowmeter Startup

2.1 Overview

This chapter describes the following procedures:

- Setting the DeviceNet node address and baud rate – see Section 2.2
- Bringing the transmitter online – see Section 2.3

2.2 Setting the DeviceNet node address and baud rate

The default node address for the Model 2400S DN transmitter is **63**. The default baud rate is **125 kBaud**.

If desired, you can use the hardware switches on the face of the device to change these two settings before bringing the transmitter online. See Sections 8.10.1 and 8.10.2 for more information.

Note: When the transmitter is online, you can change the node address and baud rate using a DeviceNet tool. See Sections 8.10.1 and 8.10.2.

2.3 Bringing the transmitter online

The DeviceNet cable used to connect the Model 2400S DN transmitter to the network provides both power and communications. The transmitter is prewired with a male sealed Micro Connector (Eurofast).

To bring the transmitter online:

1. Follow appropriate procedures to ensure that the process of configuring and commissioning the Model 2400S DN transmitter does not interfere with existing measurement and control loops.
2. Ensure that all transmitter and sensor covers and seals are closed.

⚠ 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 transmitter housing cover and all other covers are in place before connecting the transmitter to the network.

3. Insert an appropriate DeviceNet cable into the connector on the transmitter.

   When the transmitter receives power, it will automatically perform diagnostic routines, and the module LED flashes red and green. When the flowmeter has completed its power-up sequence, the status LED will show a solid green. See Section 7.4 for information on LED behavior. If the status LED exhibits different behavior, an alarm condition is present. See Section 7.5.

4. Ensure that the transmitter is visible on the network. For information on establishing communications between the Model 2400S DN transmitter and a DeviceNet tool, see Chapter 5.

Note: If this is the initial startup, or if power has been off long enough to allow components to reach ambient temperature, the flowmeter is ready to receive process fluid approximately one minute after power-up. However, it may take up to ten minutes for the electronics in the flowmeter to reach thermal equilibrium. During this warm-up period, you may observe minor measurement instability or inaccuracy.

Chapter 3
Using the Transmitter User Interface

3.1 Overview

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

- Transmitters without or with display – see Section 3.2
- Removing and replacing the transmitter housing cover – see Section 3.3
- Using the **Scroll** and **Select** optical switches – see Section 3.4
- Using the display – see Section 3.5

3.2 User interface without or with display

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

- If ordered without a display, there is no LCD panel on the user interface. The user interface provides the following features and functions:
  - Three LEDs: a status LED, a module LED, and a network LED
  - Digital communications hardware switches, used to set the DeviceNet node address and baud rate
  - Service port clips
  - Zero button

  For all other functions, either ProLink II or a customer-supplied DeviceNet tool is required.
- If ordered with a display, no zero button is provided (you must zero the transmitter with the display menu, ProLink II, or a DeviceNet tool) and the following features are added:
  - An LCD panel, which displays process variable data and also provides access to the off-line menu for basic configuration and management. Optical switches are provided for LCD control.
  - An IrDA port which provides wireless access to the service port

Note: The off-line menu does not provide access to all transmitter functionality; for access to all transmitter functionality, either ProLink II or a DeviceNet tool must be used.

Figures 3-1 and 3-2 show the user interface of the Model 2400S DN transmitter without and with a display. In both illustrations, the transmitter housing cover has been removed.

Figure 3-1 User interface – Transmitters without display

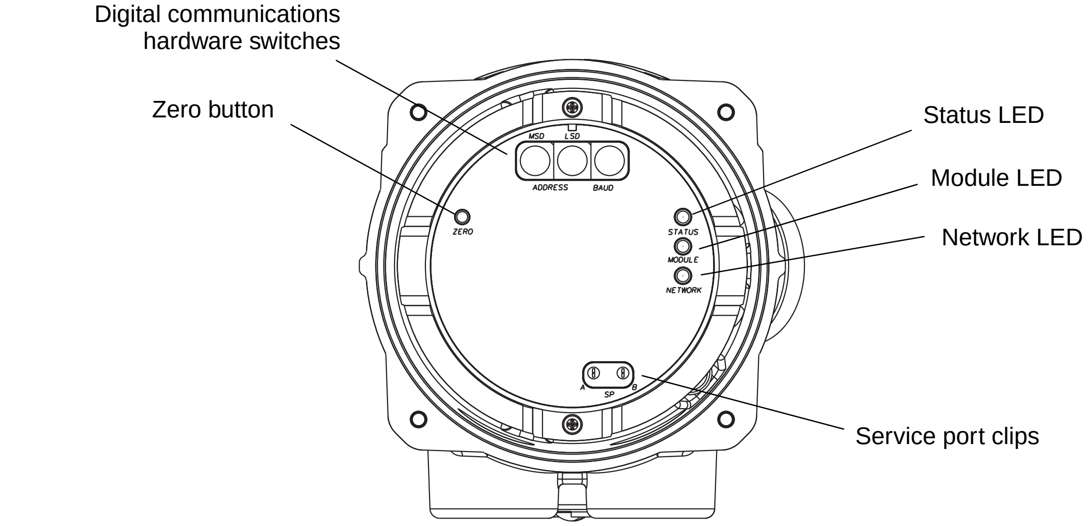
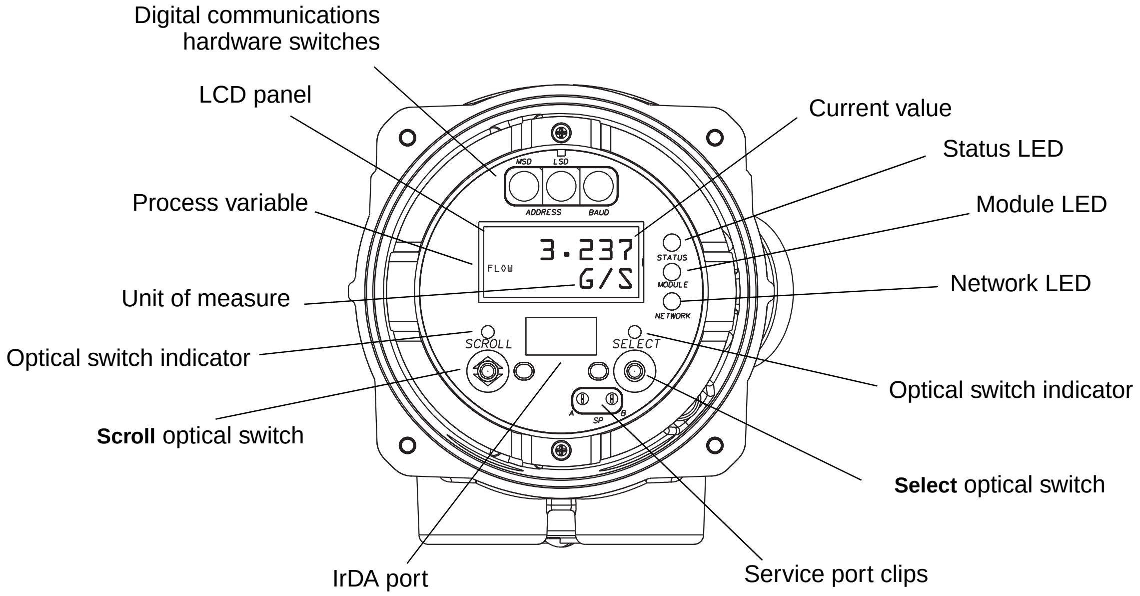


Figure 3-2 User interface – Transmitters with display



If the transmitter does not have a display, the transmitter housing cover must be removed to access all user interface features and functions.

If the transmitter has a display, the transmitter housing cover has a lens. All of the features shown in Figure 3-2 are visible through the lens, and the following functions may be performed through the lens (i.e., with the transmitter housing cover in place):

- Viewing the LEDs
- Viewing the LCD panel
- Using the **Select** and **Scroll** optical switches
- Making a service port connection via the IrDA port

All other functions require removal of the transmitter housing cover.

For information on:

- Using the digital communications hardware switches, see Section 8.10.
- Using the LEDs, see Section 7.4.
- Making a service port connection, see Chapter 4.
- Using the zero button, see Section 10.5.

3.3 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, disconnect the DeviceNet cable to 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, disconnect the DeviceNet cable to remove power from the transmitter before removing the transmitter housing cover.

2. Loosen the four captive screws.
3. Lift the transmitter 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.

3.4 Using the optical switches

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

The **Scroll** and **Select** optical switches are used to navigate the display 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.

3.5 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.

3.5.1 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 8.9.

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

3.5.2 Viewing process variables

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

- See Section 8.9.5 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 panel 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**.

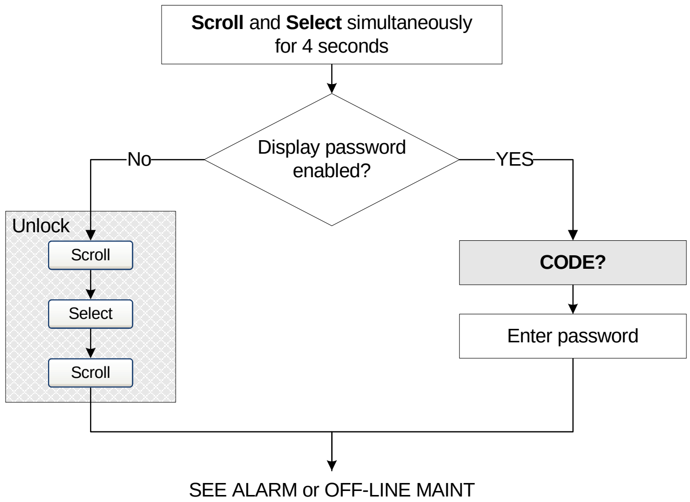
For more information on using the display to view process variables or manage totalizers and inventories, see Chapter 7.

3.5.3 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 a customer-supplied DeviceNet tool.

To enter the display menu system, see the flowchart shown in Figure 3-3.

Figure 3-3 Entering the display menu system



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 8.9.

The unlock sequence prevents unintentional entry to the offline menu. A prompt is shown for each step, and the user has 10 seconds to perform the action.

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.

3.5.4 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 8.9.

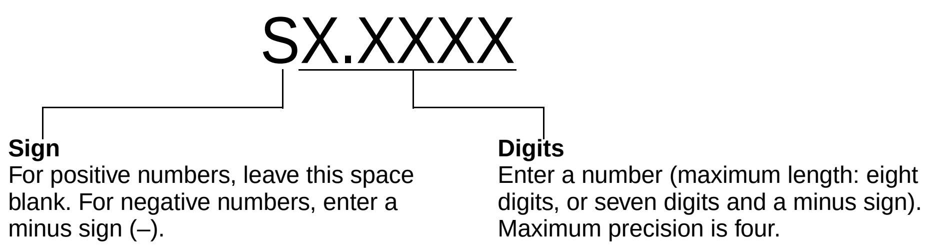
If a password is required, the word **CODE?** appears at the top of the password screen. Enter the digits of the password one at a time by using **Scroll** to choose a number and **Select** to move to the next digit.

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.

3.5.5 Entering floating-point values with the display

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 3-4) and the active digit is flashing.

Figure 3-4 **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.
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.

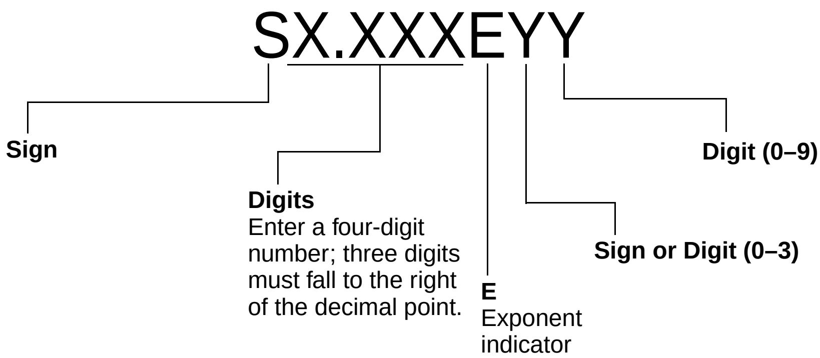
To change from decimal to exponential notation (see Figure 3-5):

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 3-5 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.

Chapter 4
Connecting with ProLink II or Pocket ProLink Software

4.1 Overview

ProLink II is a Windows-based configuration and management tool for Micro Motion transmitters. It provides access to most 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 4.2
- Configuration upload/download – see Section 4.3
- Connecting to a Model 2400S DN transmitter – see Section 4.4

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. Instructions in this manual will refer only to ProLink II.

4.2 Requirements

To use ProLink II with the Model 2400S DN transmitter, ProLink II v2.5 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, v1.3 or later is required. In addition:

- If you will connect to the transmitter via 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 via the IrDA port, no additional equipment is required.

4.3 Configuration upload/download

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

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

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

4.4 Connecting to a Model 2400S DN transmitter

To connect to the Model 2400S DN transmitter using ProLink II or Pocket ProLink, you must use a service port connection.

4.4.1 Connection options

The service port can be accessed via the service port clips or the IrDA port.

The service port clips have priority over the IrDA port:

- If there is an active connection via the service port clips, access via the IrDA port is disabled.
- If there is an active connection via the IrDA port and a connection attempt is made via the service port clips, the IrDA connection is terminated.

Additionally, access via the IrDA port may be disabled altogether. In this case, it is not available for connections at any time. By default, access via the IrDA port is disabled. See Section 8.10.6 for more information.

4.4.2 Service port connection parameters

The service port uses default connection parameters. Both ProLink II and Pocket ProLink automatically use these default parameters when Protocol is set to Service Port.

Additionally, to minimize configuration requirements, the service port employs an auto-detection scheme when responding to connection requests. The service port will accept all connection requests within the limits described in Table 4-1. If you are connecting to the service port from another tool, ensure that configuration parameters are set within these limits.

Table 4-1 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)(2)
Baud rate(3)	Standard rates between 1200 and 38,400
Stop bits	1, 2
Parity	Even, odd, none

(1) Service port support for Modbus ASCII may be disabled. See Section 8.10.5.
(2) See Section 8.10.4 for information on configuring the Modbus address.
(3) This is the baud rate between the service port and the connecting program. It is not the DeviceNet baud rate.

4.4.3 Connecting via the service port clips

To connect to the service port via the service port clips:

1. Attach the signal converter to the serial or USB port of your PC, using the appropriate connectors or adapters (e.g., a 25-pin to 9-pin adapter or a USB connector).
2. Remove the transmitter housing cover from the transmitter (see Section 3.3), then connect the signal converter leads to the service port clips. See Figure 4-1.

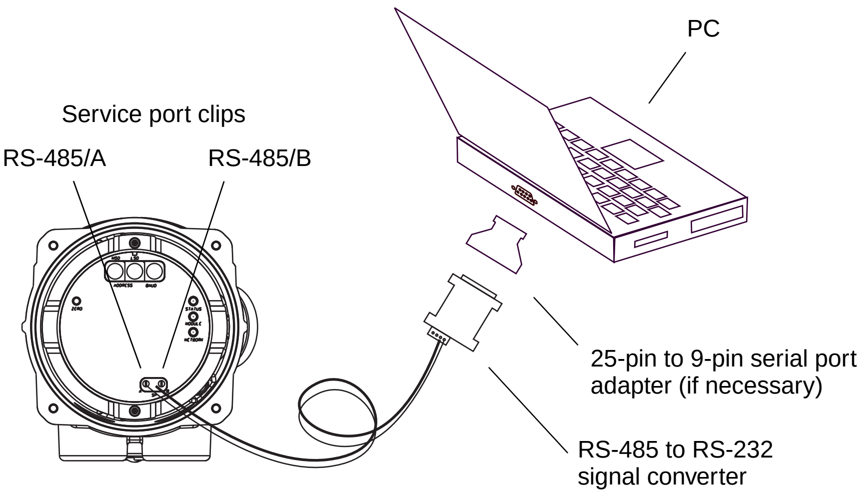
⚠ WARNING

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, e.g., for configuration or troubleshooting purposes.

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

Figure 4-1 **Serial port connections to service port clips**



3. Start ProLink II or Pocket ProLink. In the Connection menu, click **Connect to Device**. In the screen that appears, specify:
   - **Protocol**: **Service Port**
   - **COM Port**: as appropriate

   No other parameters are required.
4. Click **Connect**. The software will attempt to make the connection.
5. If an error message appears:
   a. Swap the leads between the two service port clips and try again.
   b. Ensure that you are using the correct COM port.
   c. Check all the wiring between the PC and the transmitter.
   d. Verify the RS-485 to RS-232 signal converter.

4.4.4 Connecting via the IrDA port

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

To connect to the service port via the IrDA port:

1. Ensure that the IrDA port is enabled (see Section 8.10.6). By default, the IrDA port is disabled.
2. Ensure that there is no connection via the service port clips.

Note: Connections via the service port clips have priority over connections via the IrDA port. If you are currently connected via the service port clips, you will not be able to connect via the IrDA port.

3. Position the IrDA device for communication with the IrDA port (see Figure 3-2). You do not need to remove the transmitter housing cover.
4. Start Pocket ProLink software. In the Connection menu, click **Connect to Device**. In the screen that appears, specify:
   - **Protocol: Service Port**
   - **IrDA Port**

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

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

6. If an error message appears:
   a. Ensure that you are using the correct port.
   b. Ensure that the IrDA port is enabled.

4.5 ProLink II language

ProLink II can be configured for the following languages:

- English
- French
- German

To configure the ProLink II language, use the Tools menu. See Figure B-1.

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

Chapter 5
Using a DeviceNet Tool

5.1 Overview

A customer-supplied DeviceNet tool can be used to communicate with the Model 2400S DN transmitter. This chapter provides basic information on using a customer-supplied DeviceNet tool.

However, because there are a variety of DeviceNet tools available, this chapter does not provide detailed information for using any one tool. For detailed information on your DeviceNet tool, see the documentation supplied with the tool.

5.2 Connecting to the Model 2400S DN transmitter

To connect to the Model 2400S DN transmitter:

1. Default connection values for this transmitter are as follows:
    - DeviceNet node address = **63**
    - Baud rate = **125 kBaud**

    If required, use the digital communications hardware switches on the device to set the DeviceNet node address and baud rate for this transmitter. To do this, see Sections 8.10.1 and 8.10.2.
2. Connect to the network where the transmitter is installed.
3. Using the same methods that you use for other DeviceNet devices, establish a connection to the Model 2400S DN transmitter, using the appropriate node address and baud rate.

5.3 Using the DeviceNet device profile

All DeviceNet devices employ a device profile with an object-instance-attribute structure.

In general, process and configuration data is stored in attributes, and operational functions are performed by using services or setting attributes to specific values.

Two standard services are used to read or write single attributes:

- The Get Single Attribute service (0x0E) performs an explicit read and returns a single value from the transmitter.
- The Set Single Attribute service (0x10) performs an explicit write and writes a single value to the transmitter.

In this manual, these two services are referenced as the Get and Set services.

Other services are used to reset values to **0**, start or stop calibrations, to acknowledge alarms, etc. These services are identified by name and by service code (a hexadecimal label).

Input assemblies are used to publish multiple values to the DeviceNet bus. A summary of the input assemblies is provided in Table 7-2. Output assemblies can be used to read data from the DeviceNet bus or to perform totalizer and inventory control. Summaries of the output assemblies are provided in Tables 7-9 and 9-1.

For complete documentation of the Model 2400S DN transmitter's device profile, including input and output assemblies, see the manual entitled *Micro Motion Model 2400S Transmitters for DeviceNet: Device Profile*.

5.4 Using a DeviceNet tool

Micro Motion supplies an Electronic Data Sheet (EDS) for the Model 2400S transmitter. The EDS file is named **MMI2400S-MassFlow.eds**. The EDS presents the device profile in a format designed to be read and interpreted by other devices.

DeviceNet tools fall into two basic categories:

- Type A: Tools that use the EDS to build a unique user interface for the specific device
- Type B: Tools that do not use the EDS, and instead rely on the user to supply the object-instance-attribute information required to interact with the device

5.4.1 Type A tools

If you are using a Type A tool:

1. Use your tool's standard methods to read or import the supplied EDS into the network configuration tool (e.g., RSLinx).
2. Use your tool's standard user interface to configure, view, and manage the transmitter.
3. If you want to perform a function that isn't available through your tool, see the instructions for Type B tools.

5.4.2 Type B tools

If you are using a Type B tool, or if you want to access features that are not available through your tool's user interface, you must reference the feature by class, instance, and attribute, use the appropriate service, and supply an attribute value if required. Depending on the attribute, the value may be a numeric or character value or a code. Values must be entered in the data type appropriate to the attribute.

For example:

- To configure the mass flow cutoff, you must:
  a. Specify the Analog Input Point class.
  b. Specify the Mass Flow instance.
  c. Specify the cutoff attribute.
  d. Use the Set service to set the attribute value to the desired cutoff.
- To read the mass flow process variable, you can use either of the following methods:
  - Use the Get service to read the value of the corresponding attribute.
  - Use one of the input assemblies that contains the mass flow process variable.

This manual provides class, instance, attribute, data type, and service information for most configuration parameters and for all procedures. Complete documentation of the Model 2400S DN transmitter's device profile is provided in the manual entitled *Micro Motion Model 2400S Transmitters for DeviceNet: Device Profile*.

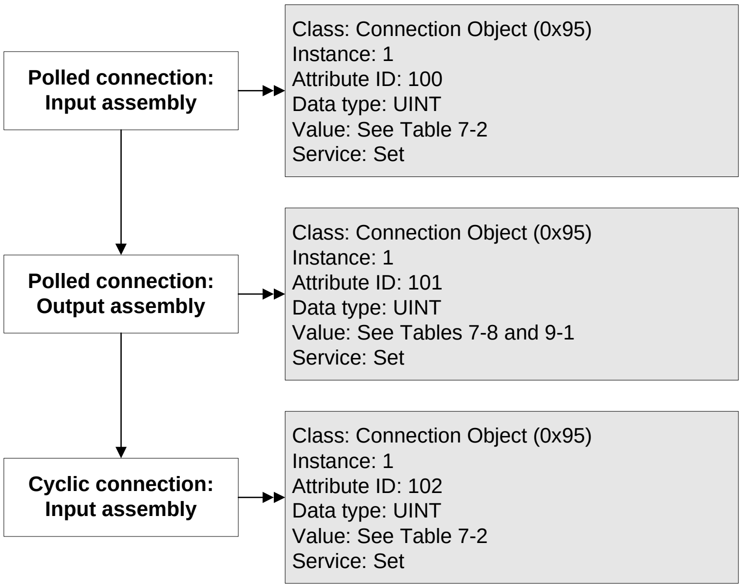
5.5 Default assemblies

The default assemblies used by the Model 2400S DN transmitter are listed and described in Table 5-1. To change the default assemblies, see the flowchart in Figure 5-1.

Table 5-1 Default DeviceNet assemblies

Connection type	Assembly type	Instance ID	Description	Size (bytes)	Data type
Polled	Input	6	Status Mass flow Mass total Mass inventory Temperature Density	21	BOOL REAL REAL REAL REAL REAL
	Output	54	Reset all totalizer values	1	BOOL
Cyclic	Input	6	Status Mass flow Mass total Mass inventory Temperature Density	21	BOOL REAL REAL REAL REAL REAL

Figure 5-1 Changing the default DeviceNet assemblies



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 measurement units – see Section 6.3

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

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

Note: All ProLink II procedures provided in this chapter assume that you have established communication between ProLink II and the Model 2400S DN transmitter and that you are complying with all applicable safety requirements. See Chapter 4 for more information.

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

Note: All DeviceNet tool procedures provided in this chapter assume that you have established communication between the DeviceNet tool and the Model 2400S DN transmitter and that you are complying with all applicable safety requirements. See Chapter 5 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 factors, 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.

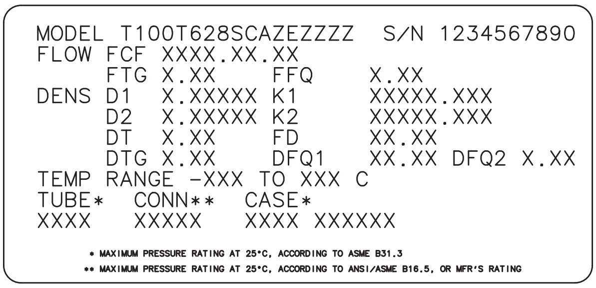
Table 6-1 Sensor calibration parameters

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

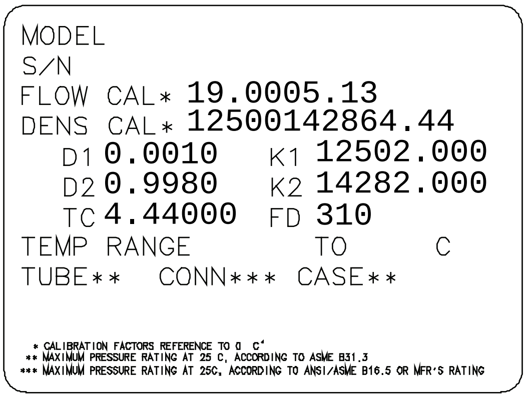
(1) On some sensor tags, shown as TC.
(2) See the section entitled "Flow calibration values."

Figure 6-1 Sample calibration tags

T-Series



Other sensors



Flow calibration values

Two factors are used to define flow calibration:

- The flow calibration factor, which is a 6-character string (five numbers and a decimal point)
- The temperature coefficient for flow, which is a 4-character string (three numbers and a decimal point)

These values are concatenated on the sensor tag, but different labels are used for different sensors. As shown in Figure 6-1:

- For T-Series sensors, the value is called the FCF value.
- For other sensors, the value is called the Flow Cal value.

When configuring the flow calibration factor:

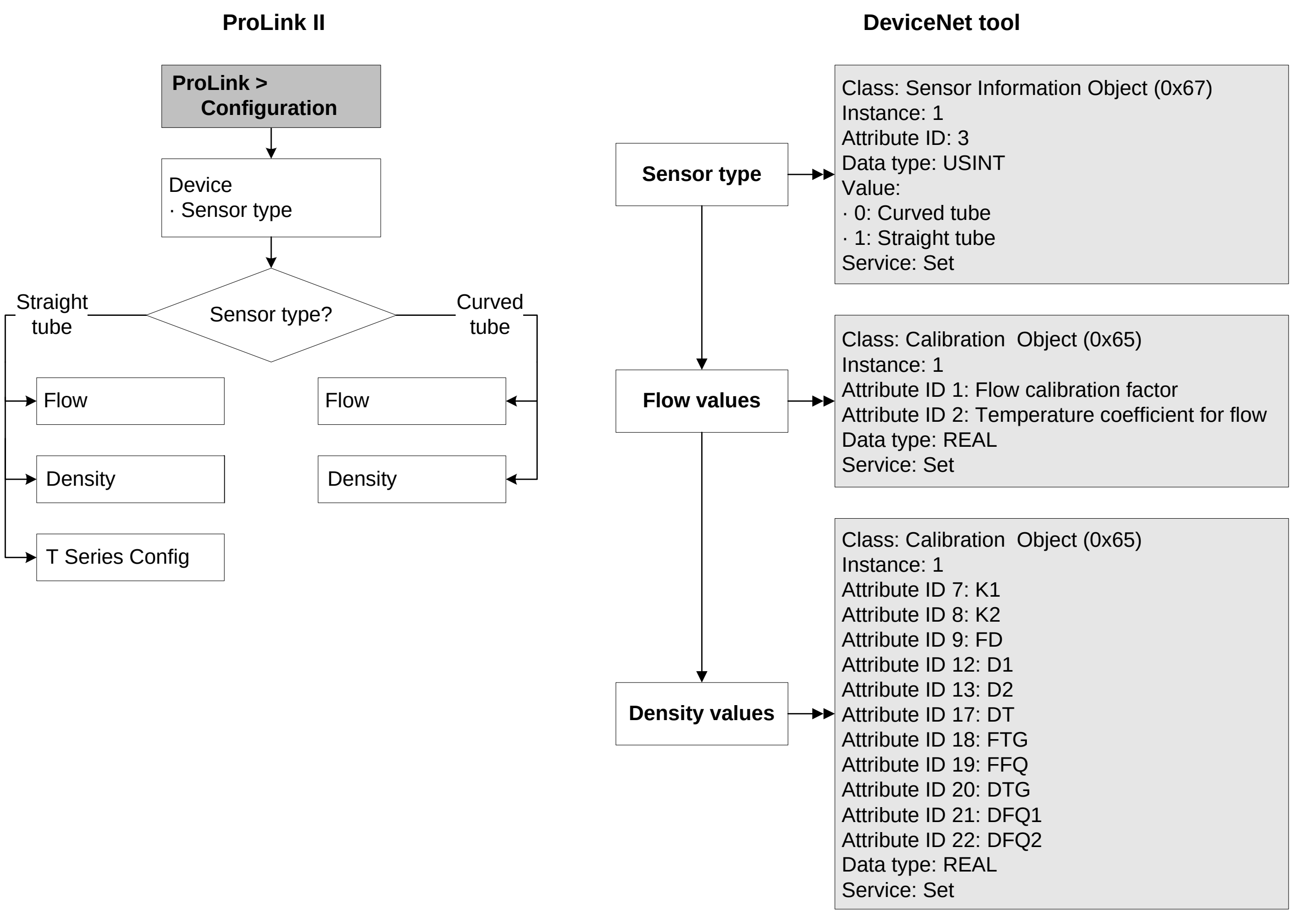
- With ProLink II, enter the concatenated 10-character string exactly as shown, including the decimal points. For example, using the Flow Cal value from Figure 6-1, enter **19.0005.13**.
- With a DeviceNet tool, enter the two factors separately, i.e., enter a 6-character string and a 4-character string. Include the decimal point in both strings. For example, using the Flow Cal value from Figure 6-1:
  - Enter **19.000** for the flow calibration factor.
  - Enter **5.13** for the temperature coefficient for flow.

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 the measurement units

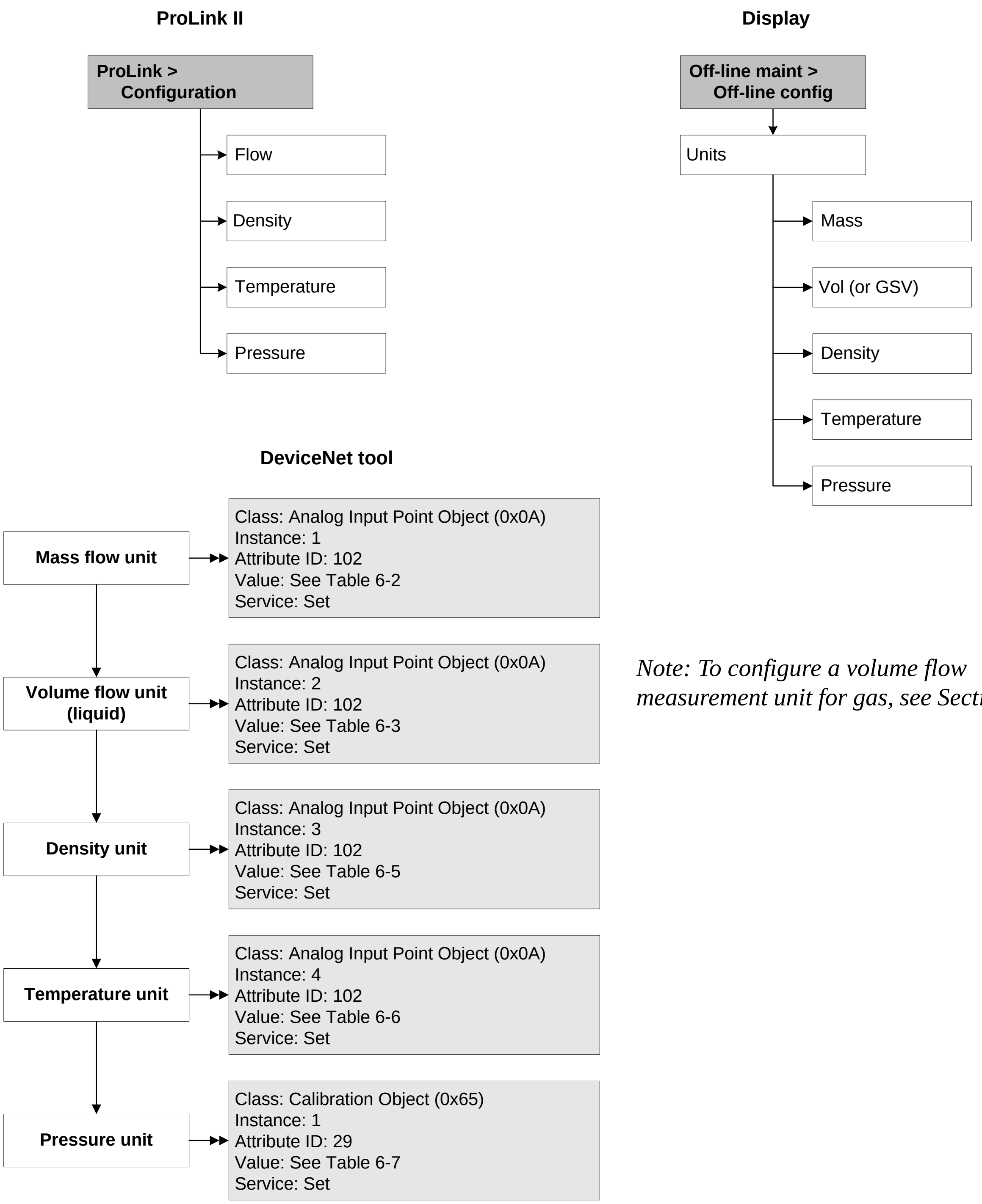
For each process variable, the transmitter must be configured to use the measurement unit appropriate to your application.

To configure measurement units for process variables, see the menu flowcharts in Figure 6-3. For details on measurement units for each process variable, see Sections 6.3.1 through 6.3.4.

The measurement units used for totalizers and inventories are assigned automatically, based on the measurement unit configured for the corresponding process variable. For example, if **kg/hr** (kilograms per hour) is configured for mass flow, the unit used for the mass flow totalizer and mass flow inventory is **kg** (kilograms). DeviceNet codes used for the measurement units are listed in Tables C-12 through C-14.

Note: Pressure unit configuration is required only if you are using pressure compensation (see Section 9.2) or you are using the Gas Wizard and you need to change the pressure units (see Section 8.2).

Figure 6-3 Configuring measurement units



Note: To configure a volume flow measurement unit for gas, see Section 8.2.

6.3.1 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.

Table 6-2 Mass flow measurement units

Mass flow unit				
Display	**ProLink II**	**DeviceNet tool**	**DeviceNet code**	**Unit description**
G/S	g/s	g/s	0x0800	Grams per second
G/MIN	g/min	g/min	0x140F	Grams per minute
G/H	g/hr	g/hr	0x0801	Grams per hour
KG/S	kg/s	kg/s	0x0802	Kilograms per second
KG/MIN	kg/min	kg/min	0x0803	Kilograms per minute
KG/H	kg/hr	kg/hr	0x1410	Kilograms per hour
KG/D	kg/day	kg/day	0x0804	Kilograms per day
T/MIN	mTon/min	MetTon/min	0x0805	Metric tons per minute
T/H	mTon/hr	MetTon/hr	0x0806	Metric tons per hour
T/D	mTon/day	MetTon/day	0x0807	Metric tons per day
LB/S	lbs/s	lb/s	0x140B	Pounds per second
LB/MIN	lbs/min	lb/min	0x140C	Pounds per minute
LB/H	lbs/hr	lb/hr	0x140D	Pounds per hour
LB/D	lbs/day	lb/day	0x0808	Pounds per day
ST/MIN	sTon/min	ShTon/min	0x0809	Short tons (2000 pounds) per minute
ST/H	sTon/hr	ShTon/hr	0x080A	Short tons (2000 pounds) per hour
ST/D	sTon/day	ShTon/dayr	0x080B	Short tons (2000 pounds) per day
LT/H	lTon/hr	LTon/h	0x080C	Long tons (2240 pounds) per hour
LT/D	lTon/day	LTon/day	0x080D	Long tons (2240 pounds) per day

6.3.2 Volume flow units

The default volume flow measurement unit is **l/s** (liters per second).

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 standard volume – see Table 6-4

By default, only liquid volume flow units are listed. To access the gas standard volume flow units, you must first configure Volume Flow Type, and additional configuration is required. See Section 8.2 for more information.

Table 6-3 Volume flow measurement units – Liquid

Volume flow unit				
Display	**ProLink II**	**DeviceNet tool**	**DeviceNet code**	**Unit description**
CUFT/S	ft3/sec	ft^3/s	0x0814	Cubic feet per second
CUF/MN	ft3/min	ft^3/min	0x1402	Cubic feet per minute
CUFT/H	ft3/hr	ft^3/hr	0x0815	Cubic feet per hour

Table 6-3 Volume flow measurement units – Liquid *continued*

Volume flow unit				
Display	**ProLink II**	**DeviceNet tool**	**DeviceNet code**	**Unit description**
CUFT/D	ft3/day	ft^3/day	0x0816	Cubic feet per day
M3/S	m3/sec	m^3/s	0x1405	Cubic meters per second
M3/MIN	m3/min	m^3/min	0x080F	Cubic meters per minute
M3/H	m3/hr	m^3/hr	0x0810	Cubic meters per hour
M3/D	m3/day	m^3/day	0x0811	Cubic meters per day
USGPS	US gal/sec	gal/s	0x1408	U.S. gallons per second
USGPM	US gal/min	gal/min	0x1409	U.S. gallons per minute
USGPH	US gal/hr	gal/hr	0x140A	U.S. gallons per hour
USGPD	US gal/d	gal/day	0x0817	U.S. gallons per day
MILG/D	mil US gal/day	MillionGal/dday	0x0820	Million U.S. gallons per day
L/S	l/sec	l/s	0x1406	Liters per second
L/MIN	l/min	l/min	0x0812	Liters per minute
L/H	l/hr	l/hr	0x0813	Liters per hour
MILL/D	mil l/day	MillionL/day	0x0821	Million liters per day
UKGPS	Imp gal/sec	ImpGal/s	0x0818	Imperial gallons per second
UKGPM	Imp gal/min	ImpGal/min	0x0819	Imperial gallons per minute
UKGPH	Imp gal/hr	ImpGal/hr	0x081A	Imperial gallons per hour
UKGPD	Imp gal/day	ImpGal/day	0x081B	Imperial gallons per day
BBL/S	barrels/sec	bbl/s	0x081C	Barrels per second(1)
BBL/MN	barrels/min	bbl/min	0x081D	Barrels per minute(1)
BBL/H	barrels/hr	bbl/hr	0x081E	Barrels per hour(1)
BBL/D	barrels/day	bbl/day	0x081F	Barrels per day(1)
BBBL/S	Beer barrels/sec	Beer bbl/s	0x0853	Beer barrels per second(2)
BBBL/MN	Beer barrels/min	Beer bbl/min	0x0854	Beer barrels per minute(2)
BBBL/H	Beer barrels/hr	Beer bbl/hr	0x0855	Beer barrels per hour(2)
BBBL/D	Beer barrels/day	Beer bbl/day	0x0856	Beer barrels per day(2)

(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**	**DeviceNet tool**	**DeviceNet code**	**Unit description**
NM3/S	Nm3/sec	Nml m^3/s	0x0835	Normal cubic meters per second
NM3/MN	Nm3/min	Nml m^3/min	0x0836	Normal cubic meters per minute
NM3/H	Nm3/hr	Nml m^3/hr	0x0837	Normal cubic meters per hour
NM3/D	Nm3/day	Nml m^3/day	0x0838	Normal cubic meters per day
NLPS	NLPS	Nml l/s	0x083D	Normal liter per second

Table 6-4 Volume flow measurement units – Gas *continued*

Volume flow unit				
Display	**ProLink II**	**DeviceNet tool**	**DeviceNet code**	**Unit description**
NLPM	NLPM	Nml l/min	0x1401	Normal liter per minute
NLPH	NLPH	Nml l/hr	0x083E	Normal liter per hour
NLPD	NLPD	Nml l/day	0x083F	Normal liter per day
SCFS	SCFS	Std ft^3/s	0x0831	Standard cubic feet per second
SCFM	SCFM	Std ft^3/min	0x0832	Standard cubic feet per minute
SCFH	SCFH	Std ft^3/hr	0x0833	Standard cubic feet per hour
SCFD	SCFD	Std ft^3/day	0x0834	Standard cubic feet per day
SM3/S	Sm3/S	Std m^3/s	0x0839	Standard cubic meters per second
SM3/MN	Sm3/min	Std m^3/min	0x083A	Standard cubic meters per minute
SM3/H	Sm3/hr	Std m^3/hr	0x083B	Standard cubic meters per hour
SM3/D	Sm3/day	Std m^3/day	0x083C	Standard cubic meters per day
SLPS	SLPS	Std l/s	0x0840	Standard liter per second
SLPM	SLPM	Std l/min	0x0841	Standard liter per minute
SLPH	SLPH	Std l/hr	0x0842	Standard liter per hour
SLPD	SLPD	Std l/day	0x0843	Standard liter per day

6.3.3 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**	**DeviceNet tool**	**DeviceNet code**	**Unit description**
SGU	SGU	SGU	0x0823	Specific gravity unit (not temperature corrected)
G/CM3	g/cm3	g/cm^3	0x2F08	Grams per cubic centimeter
G/L	g/l	g/l	0x0828	Grams per liter
G/ML	g/ml	g/ml	0x0826	Grams per milliliter
KG/L	kg/l	kg/l	0x0827	Kilograms per liter
KG/M3	kg/m3	kg/m^3	0x2F07	Kilograms per cubic meter
LB/GAL	lbs/Usgal	lb/gal	0x0824	Pounds per U.S. gallon
LB/CUF	lbs/ft3	lb/ft^3	0x0825	Pounds per cubic foot
LB/CUI	lbs/in3	lb/in^3	0x0829	Pounds per cubic inch
ST/CUY	sT/yd3	ShTon/yd^3	0x082A	Short ton per cubic yard
D API	degAPI	degAPI	0x082B	Degrees API

6.3.4 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**	**DeviceNet tool**	**DeviceNet code**	**Unit description**
°C	°C	degC	0x1200	Degrees Celsius
°F	°F	degF	0x1201	Degrees Fahrenheit
°R	°R	degR	0x1202	Degrees Rankine
°K	°K	Kelvin	0x1203	Kelvin

6.3.5 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).

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**	**DeviceNet tool**	**DeviceNet code**	**Unit description**
FTH2O	Ft Water @ 68°F	FtH2O(68F)	0x082D	Feet water @ 68 °F
INW4C	In Water @ 4°C	InH2O(4C)	0x0858	Inches water @ 4 °C
INW60	In Water @ 60°F	InH2O(60F)	0x0859	Inches water @ 60 °F
INH2O	In Water @ 68°F	InH2O(68F)	0x082C	Inches water @ 68 °F
mmW4C	mm Water @ 4°C	mmH2O(4C)	0x085A	Millimeters water @ 4 °C
mmH2O	mm Water @ 68°F	mmH2O(68F)	0x082E	Millimeters water @ 68 °F
mmHG	mm Mercury @ 0°C	mmHg(0C)	0x1303	Millimeters mercury @ 0 °C
INHG	In Mercury @ 0°C	InHg(0C)	0x1304	Inches mercury @ 0 °C
PSI	PSI	psi	0x1300	Pounds per square inch
BAR	bar	bar	0x1307	Bar
mBAR	millibar	mbar	0x1308	Millibar
G/SCM	g/cm2	g/cm^2	0x082F	Grams per square centimeter
KG/SCM	kg/cm2	kg/cm^2	0x0830	Kilograms per square centimeter
PA	pascals	PA	0x1309	Pascals
KPA	Kilopascals	kPA	0x130A	Kilopascals

Table 6-7 Pressure measurement units *continued*

	Pressure unit			
Display	**ProLink II**	**DeviceNet tool**	**DeviceNet code**	**Unit description**
MPA	megapascals	MPA	0x085B	Megapascals
TORR	Torr @ 0C	torr	0x1301	Torr @ 0 °C
ATM	atms	ATM	0x130B	Atmospheres

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 7.5
- Handling status alarms – see Section 7.6
- Viewing and controlling the totalizers and inventories – see Section 7.7

Note: All ProLink II procedures provided in this chapter assume that you have established communication between ProLink II and the Model 2400S DN transmitter and that you are complying with all applicable safety requirements. See Chapter 4 for more information.

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

Note: All DeviceNet tool procedures provided in this chapter assume that you have established communication between the DeviceNet tool and the Model 2400S DN transmitter and that you are complying with all applicable safety requirements. See Chapter 5 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

To view these values, see Section 7.3. 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 a DeviceNet tool.

Note: If the petroleum measurement application is enabled, two of the API process variables are averages: Batch Weighted Average Density and Batch Weighted Average Temperature. For both of these, the averages are calculated for the current totalizer period, i.e., since the last reset of the API volume totalizer.

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 8.9.5.

The LCD panel 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:

- If Auto Scroll is enabled, wait until the desired process variable appears on the LCD panel.
- If Auto Scroll is not enabled, **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 3-2.

The display precision can be configured separately for each process variable (see Section 8.9.5). This affects only the value shown on the display, and does not affect the actual value as reported by the transmitter via digital communications.

Process variable values are displayed using either standard decimal notation or exponential notation:

- Values smaller than 100,000,000 are displayed in decimal notation (e.g., **1234567.89**).
- Values greater than 100,000,000 are displayed using exponential notation (e.g., **1.000E08**).
  - If the value is less than the precision configured for that process variable, the value is displayed as **0** (i.e., there is no exponential notation for fractional numbers).
  - If the value is too large to be displayed with the configured precision, the displayed precision is reduced (i.e., the decimal point is shifted to the right) as required so that the value can be displayed.

7.3.2 With ProLink II

The Process Variables window opens automatically when you first connect to the transmitter. This window displays current values for the standard process variables (mass, volume, density, temperature, external pressure, and external temperature).

To view the standard process variables with ProLink II, if you have closed the Process Variables window, click **ProLink > Process Variables**.

To view API process variables (if the petroleum measurement application is enabled), click **ProLink > API Process Variables**.

To view enhanced density process variables (if the enhanced density application is enabled), click **ProLink > ED Process Variables**. Different enhanced density process variables are displayed, depending on the configuration of the enhanced density application.

7.3.3 With a DeviceNet tool

There are two methods that can be used to view process variables with a DeviceNet tool:

- You can execute Gets to read the current values of individual process variables from the appropriate objects. Table 7-1 lists the most commonly used process variables, by class, instance, attribute, and data type. For more information, see the manual entitled *Micro Motion Model 2400S Transmitters for DeviceNet: Device Profile*.
- You can use the predefined input assemblies. The predefined input assemblies are summarized in Table 7-2. For more information, see the manual entitled *Micro Motion Model 2400S Transmitters for DeviceNet: Device Profile*.

Table 7-1 Process data in DeviceNet objects

Class	Instance	Attribute ID	Data type	Description
Analog Input Point Object (0x04)	1 (mass)	3	REAL	Mass flow rate
		100	REAL	Mass total
		101	REAL	Mass inventory
		102	UINT	Mass flow measurement unit
		103	UINT	Mass total and mass inventory measurement unit
	2 (liquid volume)	3	REAL	Liquid volume flow rate
		100	REAL	Liquid volume total
		101	REAL	Liquid volume inventory
		102	UINT	Liquid volume flow measurement unit
		103	UINT	Liquid volume total and liquid volume inventory measurement unit
	3 (density)	3	REAL	Density
		102	UINT	Density measurement unit
	4 (temperature)	3	REAL	Temperature
		102	UINT	Temperature measurement unit
Gas Standard Volume Object (0x64)	1 (gas standard volume)	1	REAL	Gas standard volume flow rate
		2	REAL	Gas standard volume total
		3	REAL	Gas standard volume inventory
		5	REAL	Gas standard volume flow measurement unit
		6	REAL	Gas standard volume total and gas standard volume inventory measurement unit

Table 7-1 Process data in DeviceNet objects *continued*

Class	Instance	Attribute ID	Data type	Description
API Object (0x69)[1]	1	1	REAL	Temperature-corrected density
		2	REAL	Temperature-corrected (standard) volume flow
		3	REAL	Temperature-corrected (standard) volume total
		4	REAL	Temperature-corrected (standard) volume inventory
		5	REAL	Batch weighted average density
		6	REAL	Batch weighted average temperature
		7	REAL	CTL
Enhanced Density Object (0x6A)[2]	1	1	REAL	Density at reference temperature
		2	REAL	Density (fixed SG units)
		3	REAL	Standard volume flow rate
		4	REAL	Standard volume flow total
		5	REAL	Standard volume flow inventory
		6	REAL	Net mass flow rate
		7	REAL	Net mass flow total
		8	REAL	Net mass flow inventory
		9	REAL	Net volume flow rate
		10	REAL	Net volume flow total
		11	REAL	Net volume flow inventory
		12	REAL	Concentration
		13	REAL	Density (fixed Baume units)

(1) Requires petroleum measurement application. See Section 8.13
(2) Requires enhanced density application. See Section 8.14.

Table 7-2 Summary of input assemblies

Instance ID	Data description	Size (bytes)	Data type	Description
1	• Status • Mass flow	5	• BOOL • REAL	Mass flow
2[1]	• Status • Volume flow	5	• BOOL • REAL	Volume flow
3	• Status • Mass flow • Mass total	9	• BOOL • REAL • REAL	Mass flow and total
4[1]	• Status • Volume flow • Volume total	9	• BOOL • REAL • REAL	Volume flow and total
5[1]	• Status • Mass flow • Temperature • Density • Volume flow • Drive gain	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Basic process variables

Table 7-2 Summary of input assemblies *continued*

Instance ID	Data description	Size (bytes)	Data type	Description
6	• Status • Mass flow • Mass total • Mass inventory • Temperature • Density	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Mass flow, mass totals, and other process variables
7(1)	• Status • Volume flow • Volume total • Volume inventory • Temperature • Density	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Volume flow, volume totals, and other process variables
8(2)	• Status • Mass flow • Mass total • Temperature • Gas standard volume flow • Gas standard volume total	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Gas standard volume flow
9(2)	• Status • Mass flow • Temperature • Gas standard volume flow • Gas standard volume total • Gas standard volume inventory	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Gas standard volume flow
10(2)	• Status • Temperature • Drive gain • Gas standard volume flow • Gas standard volume total • Gas standard volume inventory	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Gas standard volume flow
11(2)	• Status • Gas standard volume flow	5	• BOOL • REAL	Gas standard volume flow
12(2)	• Status • Gas standard volume flow • Gas standard volume total • Gas standard volume inventory	13	• BOOL • REAL • REAL • REAL	Gas standard volume flow
13(1)(3)	• Status • Volume flow • Volume total • Volume inventory • API temperature-corrected volume flow • API temperature-corrected volume total	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Petroleum measurement application
14(1)(3)	• Status • Volume flow • Volume total • API temperature-corrected density • API temperature-corrected volume flow • API temperature-corrected volume inventory	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Petroleum measurement application
15(1)(3)	• Status • Mass flow • Mass total • Volume flow • Volume total • API temperature-corrected density	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Petroleum measurement application

Table 7-2 Summary of input assemblies *continued*

Instance ID	Data description	Size (bytes)	Data type	Description
16(1)(3)	• Status • API temperature-corrected density • API temperature-corrected volume flow • API temperature-corrected volume inventory • API average temperature-corrected density • API average temperature	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Petroleum measurement application
17(1)(4)	• Status • Mass flow • Volume flow • Temperature • Enhanced density reference density • Enhanced density specific gravity	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Enhanced density application
18(1)(4)	• Status • Mass flow • Volume flow • Temperature • Density • Enhanced density concentration	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Enhanced density application
19(1)(4)	• Status • Mass flow • Volume flow • Temperature • Density • Enhanced density Baume	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Enhanced density application
20(4)	• Status • Temperature • Density • Enhanced density net mass flow • Enhanced density net mass total • Enhanced density net mass inventory	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Enhanced density application
21(4)	• Status • Temperature • Density • Enhanced density net volume flow • Enhanced density net volume total • Enhanced density net volume inventory	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Enhanced density application
22(4)	• Status • Mass Flow • Temperature • Density • Enhanced density reference density • Enhanced density net mass flow	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Enhanced density application
23(1)(4)	• Status • Volume flow • Temperature • Density • Enhanced density reference density • Enhanced density net volume flow	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Enhanced density application

Table 7-2 Summary of input assemblies *continued*

Instance ID	Data description	Size (bytes)	Data type	Description
24(1)(4)	• Status • Mass flow • Volume flow • Density • Enhanced density reference density • Enhanced density standard volume flow	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Enhanced density application
25(4)	• Status • Mass flow • Temperature • Density • Enhanced density reference density • Enhanced density concentration	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Enhanced density application
26(5)	• Status • User-specified variable 1 • User-specified variable 2 • User-specified variable 3 • User-specified variable 4 • User-specified variable 5	21	• BOOL • REAL • REAL • REAL • REAL • REAL	Configurable assembly

(1) Available only if Gas Standard Volume is not enabled.
(2) Available only if Gas Standard Volume is enabled.
(3) Requires the petroleum measurement application.
(4) Requires the enhanced density application.
(5) Default variables are mass flow, temperature, density, volume flow, and drive gain, respectively. See Section 8.10.3 for information on specifying the variables.

7.4 Using the LEDs

The user interface module provides three LEDs: a status LED, a module LED, and a network LED (see Figures 3-1 and 3-2).

- For transmitters with a display, the LEDs 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 LEDs (see Section 3.3).

For more information:

- On using the module LED, see Section 7.4.1.
- On using the network LED, see Section 7.4.2.
- On using the status LED, see Section 7.5.1.

7.4.1 Using the module LED

The module LED indicates whether or not the transmitter has power and is operating properly. Table 7-3 lists the different states of the module LED, defines each state, and provides recommendations for correcting problem states.

Table 7-3 Module LED states, definitions, and recommendations

Module LED state	Definition	Recommendations
Off	No power	Check the connection to the DeviceNet network.
Solid green	No processor faults	No action required.
Flashing green	Needs DeviceNet configuration; may be in Standby state	Indicates an A006 alarm. Characterization parameters are missing. See Section 6.2.
Solid red	Non-recoverable fault	Power cycle the transmitter. If condition does not clear, call Micro Motion customer service.
Flashing red	Recoverable fault	Check for any status alarms.
Flashing red/green	Device in self-test	Wait until self-test is complete. Check the Identity Object (0x01) for device states.

7.4.2 Using the network LED

The behavior of the network LED is standard, and is defined by the DeviceNet protocol. Table 7-4 lists the different states of the network LED and defines each state.

Table 7-4 Network LED states, definitions, and recommendations

Network LED state	Definition	Recommendations
Off	Device not online	The device is not connected to the network.(1) Check the wiring if this LED is lit.
Solid green	Device online and connected	No action required.
Flashing green	Device online but not connected	The device is connected to the network, but has not been allocated by a host. No action required.
Solid red	Critical link failure	The most common cause is duplicate MAC IDs (node addresses) on the network. Check for duplicate MAC IDs. Other causes include incorrect baud rate setting or other network failure.
Flashing red	Connection timeout	Power cycle the device, or release and re-allocate the device from the DeviceNet master. If desired, increase the timeout value (Expected Packet Rate) in the DeviceNet Object (0x03).
Flashing red/green	Communication faulted state	Not implemented in the Model 2400S DN transmitter.

(1) If the transmitter is the only device on the network, and there is no host on the network, this is the expected LED state, and no action is required.

7.5 Viewing transmitter status

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

7.5.1 Using the status LED

The status LED shows transmitter status as described in Table 7-5. Note that the status LED does not report event status or alarm status for alarms with severity level set to Ignore (see Section 8.8).

Table 7-5 Transmitter status LED

Status LED state	Alarm priority	Definition
Green	No alarm	Normal operating mode
Flashing yellow	A104 alarm	Zero or calibration in progress
Solid yellow	Low severity (information) alarm	• Alarm condition: will not cause measurement error • Digital communications report process data
Red	High severity (fault) alarm	• Alarm condition: will cause measurement error • Digital communications go to configured fault indicator (see Section 8.10.7)

7.5.2 Using ProLink II

ProLink II provides a Status window that displays:

- Device (alarm) status
- Event status
- Assorted other transmitter data

7.5.3 Using a DeviceNet tool

Status information is located in the Diagnostics Object (0x66), Instance 1. This Object includes, among other data:

- Alarm status (Attributes 12–17, Attributes 40–41)
- Event status (Attribute 11)
- Drive gain (Attribute 20)
- Tube frequency (Attribute 21)
- Left and right pickoff voltages (Attributes 23 and 24)

Use the Get service to read the required data. See Table C-7, or see the manual entitled *Micro Motion Model 2400S Transmitters for DeviceNet: Device Profile* for detailed information.

7.6 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 8.8.

Note: For detailed information on a specific status alarm, including possible causes and troubleshooting suggestions, see Table 11-2. 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.”

In addition, the transmitter maintains alarm history for the 50 most recent alarm occurrences. Alarm history includes:

- The alarm code
- The “alarm active” timestamp
- The “alarm inactive” timestamp
- The “alarm acknowledged” timestamp

When the transmitter detects an alarm condition, it checks the severity level of the specific alarm and performs the actions described in Table 7-6.

Table 7-6 Transmitter responses to status alarms

	Transmitter response		
Alarm severity level(1)	**Status flags**	**Alarm history**	**Digital communications fault action**
Fault	• “Alarm active” status flag set immediately • “Alarm unacknowledged” status flag set immediately	“Alarm active” record written to alarm history immediately	Activated after configured fault timeout has expired (if applicable)(2)
Informational	• “Alarm active” status flag set immediately • “Alarm unacknowledged” status flag set immediately	“Alarm active” record written to alarm history immediately	Not activated
Ignore	• “Alarm active” status flag set immediately • “Alarm unacknowledged” status flag set immediately	No action	Not activated

(1) See Section 8.8 for information on setting the alarm severity level.
(2) See Sections 8.10.7 and 8.10.8 for more information on digital communications fault action and fault timeout.

When the transmitter detects that the alarm condition has cleared:

- The first status flag is set to “inactive.”
- Digital communications fault action is deactivated (Fault alarms only).
- The “alarm inactive” record is written to alarm history (Fault and Informational alarms only).
- The second status flag is not changed.

Operator action is required to return the second status flag to “acknowledged.” Alarm acknowledgment is not necessary. If the alarm is acknowledged, the “alarm acknowledged” record is written to alarm history.

7.6.1 Using the display

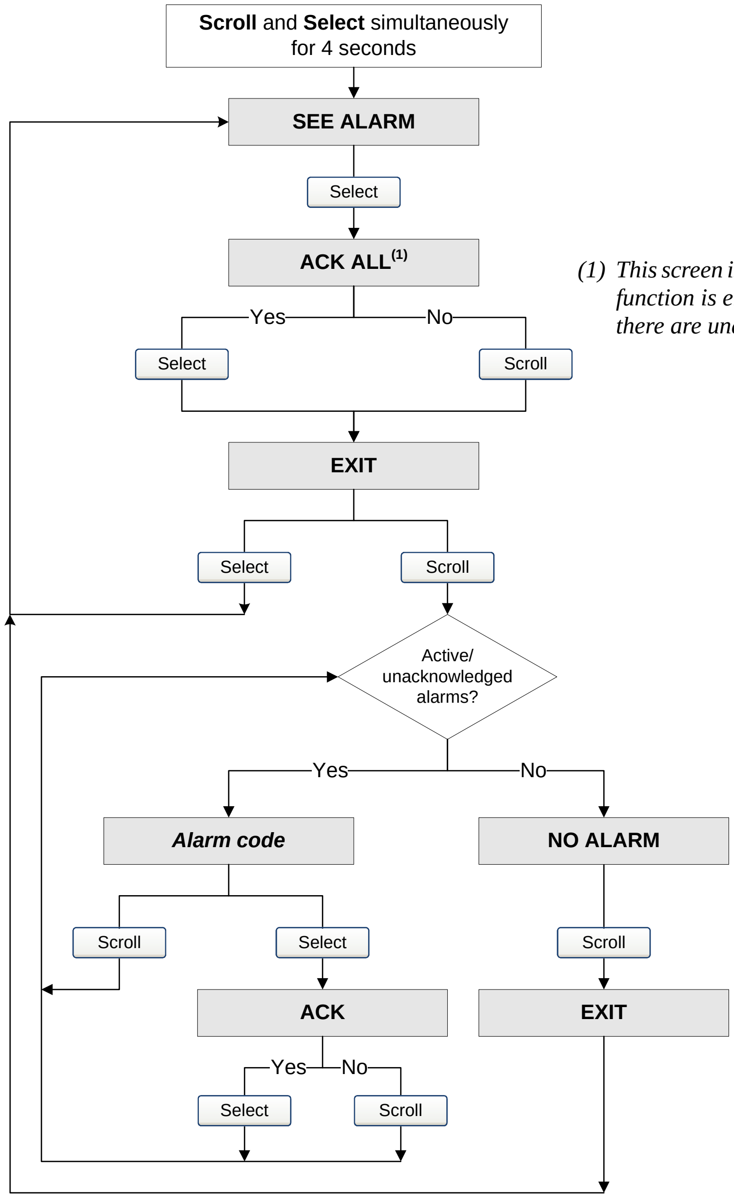
The display shows information only about active Fault or Informational alarms, based on alarm status bits. Ignore alarms are filtered out, and you cannot access alarm history via the display.

To view or acknowledge alarms using the display menus, see the flowchart in Figure 7-1.

If the transmitter does not have a display, or if operator access to the alarm menu is disabled *(*see Section 8.9.3*)*, alarms can be viewed and acknowledged using ProLink II or a DeviceNet tool. 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.

Figure 7-1 **Viewing and acknowledging alarms with the display**



(1) This screen is displayed only if the ACK ALL function is enabled (see Section 8.9.3) and there are unacknowledged alarms.

7.6.2 Using ProLink II

ProLink II provides two ways to view alarm information:

- The Status window
- The Alarm Log window

Status window

The Status window displays the current status of the alarms considered to be most useful for information, service, or troubleshooting, including Ignore alarms. The Status window reads alarm status bits, and does not access alarm history. The Status window does not display acknowledgment information, and you cannot acknowledge alarms from the Status window.

In the Status window:

- Alarms are organized into three categories: Critical, Informational, and Operational. Each category is displayed on a separate panel.
- If one or more alarms is active on a panel, the corresponding tab is red.
- On a panel, a green LED indicates “inactive” and a red LED indicates “active.”

Note: The location of alarms on the Status panels is pre-defined, and is not affected by alarm severity.

To use the Status window:

1. Click **ProLink > Status**.
2. Click the tab for the alarm category you want to view.

Alarm Log window

The Alarm Log window selects information from alarm history, and lists all alarms of the following types:

- All active Fault and Information alarms
- All inactive but unacknowledged Fault and Information alarms

Ignore alarms are never listed.

You can acknowledge alarms from the Alarm Log window.

In the Alarm Log window:

- The alarms are organized into two categories: High Priority and Low Priority. Each category is displayed on a separate panel.
- On a panel, a green LED indicates “inactive but unacknowledged” and a red LED indicates “active.”

Note: The location of alarms on the Alarm Log panels is pre-defined, and is not affected by alarm severity.

To use the Alarm Log window:

1. Click **ProLink > Alarm Log**.
2. Click the tab for the alarm category you want to view.
3. To acknowledge an alarm, click the **Ack** checkbox. When the transmitter has processed the command:
   - If the alarm was inactive, it will be removed from the list.
   - If the alarm was active, it will be removed from the list as soon as the alarm condition clears.

7.6.3 Using a DeviceNet tool

Using the Diagnostics Object (0x66), you can view the status of a group of preselected alarms, view information about a specific alarm, acknowledge an alarm, and retrieve information from alarm history. For detailed information on the Diagnostics Object, see Table C-7, or see the manual entitled *Micro Motion Model 2400S Transmitters for DeviceNet: Device Profile*.

To view the status of a group of preselected alarms, execute a Get for Attributes 12–17, 40, or 41.

Note: These are the same alarms that are displayed in the ProLink II Status window.

To view information about a single alarm:

1. Execute a Set for Attribute 18, specifying the code for the alarm you want to check.
2. Execute a Get for Attribute 42, and interpret the data using the following codes:
   - 0x00 = Acknowledged and cleared
   - 0x01 = Active and acknowledged
   - 0x10 = Not acknowledged, but cleared
   - 0x11 = Not acknowledged, and active
3. Other information about the indexed alarm is available in the following attributes:
   - Attribute 43: Number of times this alarm has become active
   - Attribute 44: The time this alarm was last posted
   - Attribute 45: The time this alarm was last cleared

To acknowledge an alarm:

1. Execute a Set for Attribute 18, specifying the code for the alarm you want to acknowledge.
2. Execute a Set for Attribute 42, specifying a value of **0x00**.

To retrieve information from alarm history:

1. Execute a Set for Attribute 46, specifying the number of the alarm record you want to check. Valid values are **0–49**.

Note: The alarm history is a circular buffer, and older records are overwritten by newer records. To determine whether a record is newer or older than another record, you must compare their timestamps.

2. Execute Gets for the following attributes:
   - Attribute 47: The alarm type
   - Attribute 49: The time that this alarm changed status
   - Attribute 48: The type of status change:
     - 1 = Alarm posted
     - 2 = Alarm cleared

7.7 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 *inventories* track the same values as the totalizers. Whenever totalizers are started or stopped, all inventories (including the API volume inventory and enhanced density inventories) are started or stopped automatically. However, when totalizers are reset, inventories are not reset automatically – you must reset inventories separately. This allows you to use the inventories to keep running totals across multiple totalizer resets.

You can view all totalizer and inventory values using any of the commmunication tools: the display, ProLink II, or a DeviceNet tool. Specific starting, stopping, and resetting functionality depends on the tool you are using.

Using a DeviceNet Tool
Required Configuration
Using the Transmitter
Optional Configuration

7.7.1 Viewing current values for totalizers and inventories

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

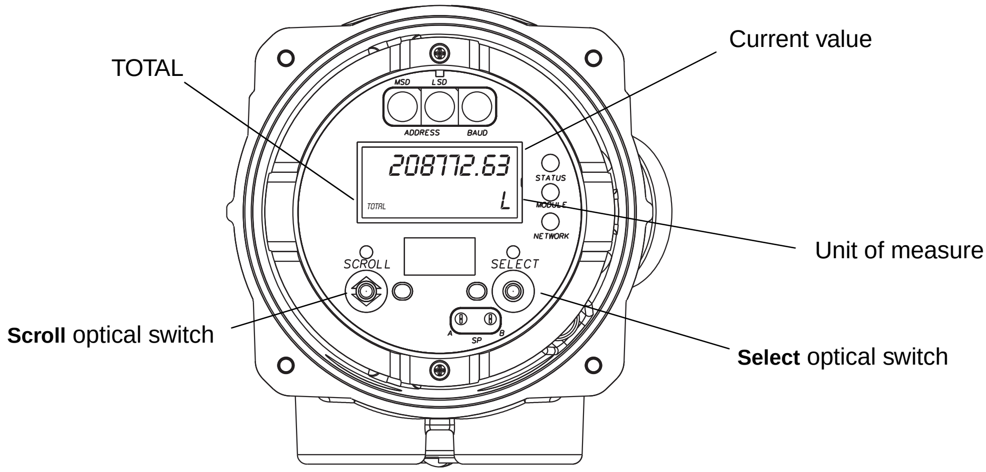
With the display

You cannot view current totalizer or inventory values with the display unless the display has been configured to show them. See Section 8.9.5.

To view a totalizer or inventory value, refer to Figure 7-2 and:

1. Check for the word **TOTAL** in the lower left corner of the LCD panel.
   - If Auto Scroll is enabled, wait until the desired value appears on the LCD panel. You can also **Scroll** until the desired value appears.
   - If Auto Scroll is not enabled, **Scroll** until the desired value appears.
2. Check the unit of measure to identify the process variable being displayed (e.g., mass, liquid volume, gas standard volume).
3. Check the unit of measure line to determine whether you are viewing a totalizer value or an inventory value:
   - Totalizer value: the unit of measure is a steady display.
   - Inventory value: the unit of measure alternates with one of the following:
     - **MASSI** (for Mass Inventory)
     - **LVOLI** (for Liquid Volume Inventory)
     - **GSV I** (for Gas Standard Volume Inventory)
     - **TCORI** (for API Temperature Corrected Inventory)
     - **STDVI** (for ED Standard Volume Inventory)
     - **NETVI** (for ED Net Volume Inventory)
     - **STDMI** (for ED Net Mass Inventory)
4. Read the current value from the top line of the display.

Figure 7-2 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**, **API Process Variables,** or **ED Process Variables.**

With a DeviceNet tool

To view current totals for the totalizers and inventories with a DeviceNet tool, see Section 7.3.3.

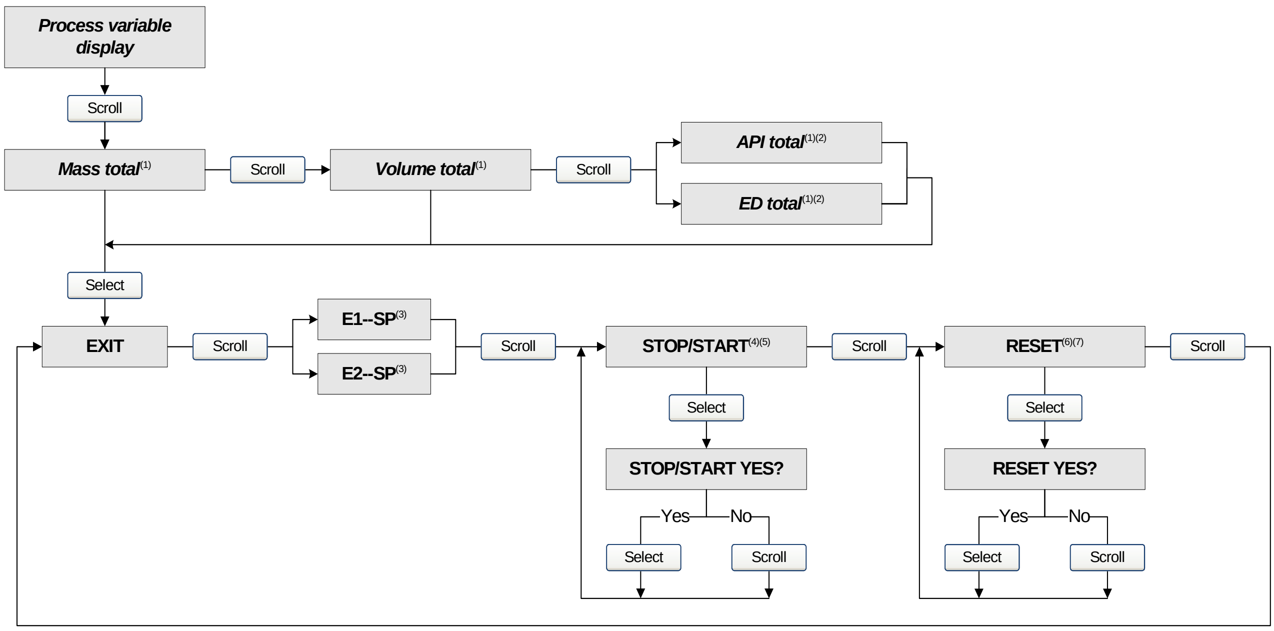
7.7.2 Controlling totalizers and inventories

Specific starting, stopping, and resetting functionality depends on the tool you are using.

With the display

If the required value is shown on the display, you can use the display to start and stop all totalizers and inventories simultaneously, or to reset individual totalizers. See the flowchart in Figure 7-3. You cannot reset any inventories with the display.

Figure 7-3 **Controlling totalizers and inventories with the display**



(1) Displayed only if configured as a display variable.
(2) The petroleum measurement application or enhanced density application must be enabled.
(3) The Event Setpoint screens can be used to define or change Setpoint A for Event 1 or Event 2 only. These screens are displayed only for specific types of events. To change the setpoint for an event defined on mass total, you must enter the totalizer management menu from the mass total screen. To change the setpoint for an event defined on volume total, you must enter the totalizer management menu from the volume total screen. See Section 8.6.3 for more information.
(4) The display must be configured to allow stopping and starting. See Section 8.9.3.
(5) All totalizers and inventories will be stopped and started together, including API and enhanced density totalizers and inventories.
(6) The display must be configured to allow totalizer resetting. See Section 8.9.3.
(7) Only the totalizer currently shown on the display will be reset. No other totalizers will be reset, and no inventories will be reset. Be sure that the totalizer you want to reset is displayed before performing this reset.

With ProLink II

The totalizer and inventory control functions available with ProLink II are listed in Table 7-7. Note the following:

- ProLink II does not support separate resetting of the API volume totalizer and API volume inventory. To reset these, you must reset all totalizers or all inventories.
- By default, the ability to reset inventories from ProLink II is disabled. To enable it:
  a. Click **View > Preferences**.
  b. Check the **Enable Inventory Totals Reset** checkbox.
  c. Click **Apply**.

Table 7-7 Totalizer and inventory control functions supported by ProLink II

		Inventory reset	
Object	**Function**	**Disabled**	**Enabled**
Totalizers and inventories	Starting and stopping as a group	✓	✓
Totalizers	Resetting all	✓	✓
	Resetting mass totalizer separately	✓	✓
	Resetting volume totalizer separately	✓	✓
	Resetting enhanced density totalizers separately	✓	✓
	Resetting API volume totalizer separately	Not supported	Not supported
Inventories	Resetting all		✓
	Resetting mass inventory separately		✓
	Resetting volume inventory separately		✓
	Resetting enhanced density inventories separately		✓
	Resetting API volume inventory separately	Not supported	Not supported

To start or stop all totalizers and inventories:

1. Click **ProLink > Totalizer Control** or **ProLink > ED Totalizer Control** (if the enhanced density application is enabled).
2. Click the All Totals **Start** or All Totals **Stop** button.

Note: The All Totals functions are replicated in these two windows for convenience. You can start or stop all totalizers and inventories from either window.

To reset all totalizers:

1. Click **ProLink > Totalizer Control** or **ProLink > ED Totalizer Control** (if the enhanced density application is enabled).
2. Click the All Totals **Reset** button.

To reset all inventories:

1. Click **ProLink > Totalizer Control** or **ProLink > ED Totalizer Control** (if the enhanced density application is enabled).
2. Click the All Totals **Reset Inventories** button.

To reset an individual totalizer or inventory:

1. Click **ProLink > Totalizer Control** or **ProLink > ED Totalizer Control** (if the enhanced density application is enabled).
2. Click the appropriate button (e.g., **Reset Mass Total**, **Reset Volume Inventory**, **Reset Net Mass Total**).

With a DeviceNet tool

Using a DeviceNet tool, three methods are available for totalizer and inventory control:

- EDS – If you have imported the EDS into your DeviceNet tool, you can perform the following functions from the EDS user interface:
  - Reset mass totalizer
  - Reset mass inventory
  - Reset liquid volume totalizer
  - Reset liquid volume inventory
  - Reset API reference volume total
  - Reset API reference volume inventory
  - Reset gas standard volume totalizer
  - Reset gas standard volume inventory
  - Reset ED standard volume total
  - Reset ED net mass total
  - Reset ED net volume total
  - Reset ED standard volume inventory
  - Reset ED net mass inventory
  - Reset ED net volume inventory
- Explicit write – Using a Set, a Reset Total, or a Reset Inventory service, you can perform the functions listed in Table 7-8.
- Output assemblies – Five output assemblies are provided, supporting the functions listed in Table 7-9. See the manual entitled *Micro Motion Model 2400S Transmitters for DeviceNet: Device Profile* for detailed information.

Table 7-8 Totalizer and inventory control with a DeviceNet tool using explicit write

To accomplish this	Use this device profile data
Stop all totalizers and inventories	Analog Input Point Object (0x0A) Instance: 0 Attribute ID: 100 Service: Set Value: 0
Start all totalizers and inventories	Analog Input Point Object (0x0A) Instance: 0 Attribute ID: 100 Service: Set Value: 1
Reset all totalizers	Analog Input Point Object (0x0A) Instance: 0 Attribute ID: 101 Service: Set Value: 1

Table 7-8 Totalizer and inventory control with a DeviceNet tool using explicit write *continued*

To accomplish this	Use this device profile data
Reset all inventories	Analog Input Point Object (0x0A) Instance: 0 Attribute ID: 102 Service: Set Value: 1
Reset mass totalizer	Analog Input Point Object (0x0A) Instance: 1 Service: Reset Total (0x32)
Reset mass inventory	Analog Input Point Object (0x0A) Instance: 1 Service: Reset Inventory (0x33)
Reset liquid volume totalizer	Analog Input Point Object (0x0A) Instance: 2 Service: Reset Total (0x32)
Reset liquid volume inventory	Analog Input Point Object (0x0A) Instance: 2 Service: Reset Inventory (0x33)
Reset gas standard volume totalizer	Gas Standard Volume Object (0x64) Instance: 1 Service: Reset Total (0x4B)
Reset gas standard volume inventory	Gas Standard Volume Object (0x64) Instance: 1 Service: Reset Inventory (0x4C)
Reset API reference volume total	API Object (0x69) Instance: 1 Service: Reset Total (0x4B)
Reset API reference volume inventory	API Object (0x69) Instance: 1 Service: Reset Inventory (0x4C)
Reset ED standard volume total	Enhanced Density Object (0x6A) Instance: 1 Service: Reset Total (0x4B)
Reset ED net mass total	Enhanced Density Object (0x6A) Instance: 1 Service: Reset Total (0x4C)
Reset ED net volume total	Enhanced Density Object (0x6A) Instance: 1 Service: Reset Total (0x4D)
Reset ED standard volume inventory	Enhanced Density Object (0x6A) Instance: 1 Service: Reset Inventory (0x4F)
Reset ED net mass inventory	Enhanced Density Object (0x6A) Instance: 1 Service: Reset Inventory (0x50)
Reset ED net volume inventory	Enhanced Density Object (0x6A) Instance: 1 Service: Reset Inventory (0x51)

Table 7-9 Output assemblies used for totalizer and inventory control

Instance ID	Data description	Size (bytes)	Data type
53	• Start/stop all totalizers and inventories	1	• BOOL
54	• Reset all totalizer values	1	• BOOL
55	• Reset all inventory values	1	• BOOL
56	• Start/stop all totalizers and inventories • Reset all totalizer values	2	• BOOL • BOOL
57	• Start/stop all totalizers and inventories • Reset all totalizer values • Reset all inventory values	3	• BOOL • BOOL • BOOL

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.

Note: All ProLink II procedures provided in this chapter assume that you have established communication between ProLink II and the Model 2400S DN transmitter and that you are complying with all applicable safety requirements. See Chapter 4 for more information.

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

Note: All DeviceNet tool procedures provided in this chapter assume that you have established communication between the DeviceNet tool and the Model 2400S DN transmitter and that you are complying with all applicable safety requirements. See Chapter 5 for more information.

Table 8-1 Configuration map

		Tool			
Topic	**Subtopic**	**ProLink II**	**DeviceNet tool**	**Display**	**Section**
Volume flow measurement for gas		✓	✓		8.2
Cutoffs		✓	✓		8.3
Damping		✓	✓		8.4
Flow direction		✓	✓		8.5
Events		✓	✓		8.6
Slug flow		✓	✓		8.7
Status alarm severity		✓	✓		8.8

Table 8-1 Configuration map *continued*

Topic	Subtopic	Tool: ProLink II	Tool: DeviceNet tool	Tool: Display	Section
Display(1)	Update period	✓	✓	✓	8.9.1
	Display language	✓	✓	✓	8.9.2
	Totalizer start/stop	✓	✓	✓	8.9.3
	Totalizer reset	✓	✓	✓	
	Auto scroll	✓	✓	✓	
	Scroll rate	✓	✓	✓	
	Offline menu	✓	✓	✓	
	Password	✓	✓	✓	
	Alarm menu	✓	✓	✓	
	Ack all	✓	✓	✓	
	Backlight on/off	✓	✓	✓	8.9.4
	Backlight intensity	✓	✓		
	Display variables	✓	✓		8.9.5
	Display precision	✓	✓		
Digital communication	DeviceNet node address		✓	(2)	8.10.1
	DeviceNet baud rate		✓	(2)	8.10.2
	DeviceNet configurable input assembly		✓		8.10.3
	Modbus address	✓	✓	✓	8.10.4
	Modbus ASCII support	✓	✓	✓	8.10.5
	IrDA port usage	✓	✓	✓	8.10.6
	Digital communications fault action	✓	✓		8.10.78.10.7
	Fault timeout	✓	✓		8.10.8
Device settings		✓	✓		8.11
Sensor parameters		✓	✓		8.12
Petroleum measurement application		✓	✓		8.13
Enhanced density application		✓	✓		8.14

(1) These parameters apply only to transmitters with a display.
(2) Cannot be set with the display menus, but can be set with digital communications hardware switches on the face of the transmitter.

8.2 Configuring volume flow measurement for gas

Two types of volume flow measurement are available:

- Liquid volume (the default)
- Gas standard volume

Only one type of volume flow measurement can be performed at a time (i.e., if liquid volume flow measurement is enabled, gas standard volume flow measurement is disabled, and vice versa). Different sets of volume flow measurement units are available, depending on which type of volume flow measurement is enabled (see Tables 6-3 and 6-4). If you will use a gas standard volume flow unit, additional configuration is required.

Note: If you will use the petroleum measurement application or the enhanced density application, liquid volume flow measurement is required.

The method used to configure volume flow measurement for gas depends on the tool you are using: ProLink II or a DeviceNet tool.

Note: For complete configuration of volume flow measurement for gas, you must use either ProLink II or a DeviceNet tool. Using the display, you can only select a volume measurement unit from the set available for the configured volume flow type.

8.2.1 Using ProLink II

To configure volume flow measurement for gas using ProLink II:

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**.
4. Configure the **Std Gas Vol Flow Cutoff** (see Section 8.3). 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.

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.

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

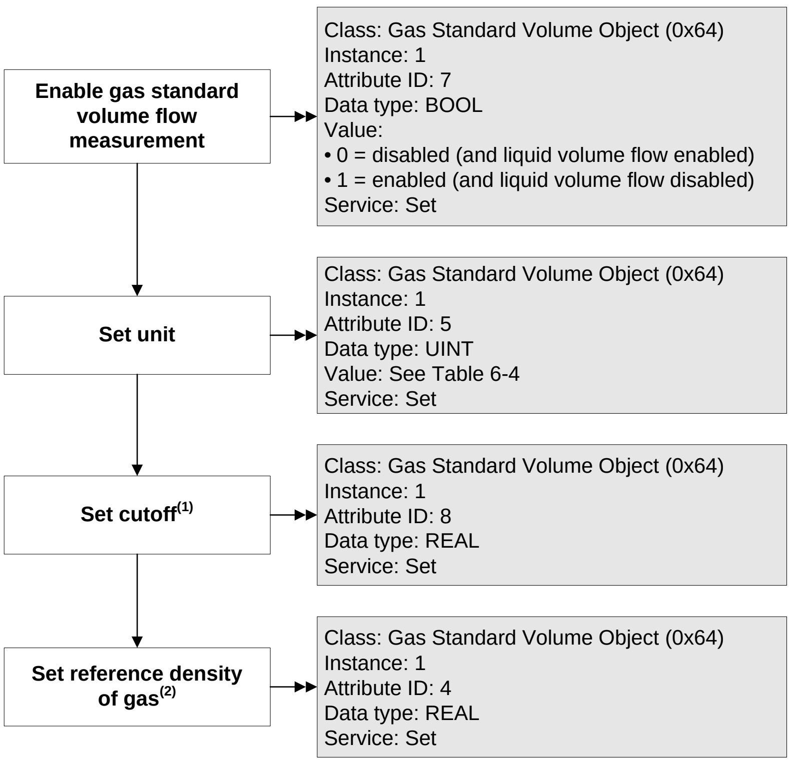
5. Click **Next**.
6. Verify the reference temperature and reference pressure. If these are not appropriate for your application, click the **Change Reference Conditions** button and enter new values for reference temperature and reference pressure.
7. Click **Next**. The calculated standard density 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 6.3.

8.2.2 Using a DeviceNet tool

The Gas Standard Volume Object is used to configure volume flow measurement for gas. See the flowchart in Figure 8-1.

Figure 8-1 Gas standard volume flow measurement – DeviceNet tool



(1) See Section 8.3.
(2) The Gas Wizard is provided only with ProLink II. If you are not using ProLink II, you must supply the required reference density.

8.3 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, liquid volume flow, gas standard volume flow, and density.

See Table 8-2 for cutoff default values and related information. See Section 8.3.1 for information on how the cutoffs interact with other transmitter measurements.

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
Liquid volume flow	0.0 L/s	Limit: the sensor's flow calibration factor in liters per second, 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

To configure cutoffs:

- Using ProLink II, see Figure B-2.
- Using a DeviceNet tool, see Tables C-1, C-2, C-3, and C-5.

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

8.3.1 Cutoffs and volume flow

If you are using liquid volume flow measurement:

- 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 measurement, neither the mass flow cutoff nor the density cutoff is applied to the volume flow calculation.

8.4 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 change the damping value, the specified value 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 Section 8.4.1 for information on how the damping values affect other transmitter measurements.

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

To configure damping values:

- Using ProLink II, see Figure B-2.
- Using a DeviceNet tool, see Tables C-1, C-3, and C-4.

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

8.4.1 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 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 flow totals and flow values, see Table 8-4.

Table 8-4 **Effect of flow direction on totalizers and flow values**

	Forward flow[1]	
Flow direction value	**Flow totals**	**Flow values**
Forward only	Increase	Positive
Reverse only	No change	Positive
Bidirectional	Increase	Positive
Absolute value	Increase	Positive[2]
Negate/Forward only	No change	Negative
Negate/Bidirectional	Decrease	Negative
	Reverse flow[3]	
Flow direction value	**Flow totals**	**Flow values**
Forward only	No change	Negative
Reverse only	Increase	Negative
Bidirectional	Decrease	Negative
Absolute value	Increase	Positive[2]
Negate/Forward only	Increase	Positive
Negate/Bidirectional	Increase	Positive

(1) Process fluid flowing in same direction as flow direction arrow on sensor.
(2) Refer to the digital communications status bits for an indication of whether flow is positive or negative.
(3) Process fluid flowing in opposite direction from flow direction arrow on sensor.

To configure flow direction:

- Using ProLink II, see Figure B-2.
- Using a DeviceNet tool, see Table C-1.

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

8.6 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. You can configure up to five events.

You may optionally specify one or more actions that will occur if the event occurs. For example, if Event 1 occurs, you may specify that the transmitter will stop all totalizers and inventories and reset the mass totalizer.

8.6.1 Defining events

To define an event:

- Using ProLink II, see Figure B-3.
- Using a DeviceNet tool, event specifications reside in the Diagnostics Object (0x66), Instance 1. See Table C-7.

The following general steps are required:

1. Select the event to define (Attribute 6).
2. Specify the event type (Attribute 7). Event Type options are defined in Table 8-5.

3. Assign a process variable to the event (Attribute 10).
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 Setpoint A is used (Attribute 8)
   - If Event Type is In Range or Out of Range, both Setpoint A and Setpoint B (Attributes 9 and 10) are required.
5. Assign the event to an action or actions, if desired. Possible actions are listed in Table 8-6. To do this:
   - Using ProLink II, open the Discrete Input panel in the Configuration window, identify the action to be performed, then specify the event using the dropdown list. See Figure B-3.

Note: For consistency with other Micro Motion products, the Discrete Input panel is used here even though the Model 2400S DN transmitter does not provide a discrete input.

   - Using the display, see Figure B-6 and use the ACT submenu.
   - Using a DeviceNet tool, refer to Table C-7, use Attribute 84 to specify the action to be performed, and set Attribute 85 to specify which event will initiate the action.

Table 8-5 Event types

Type	DeviceNet code	Description
High (> A)	0	Default. Discrete event will occur if the assigned variable is greater than the setpoint (A).(1)
Low (< A)	1	Discrete event will occur if the assigned variable is less than the setpoint (A).(1)
In Range	2	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	3	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.

Table 8-6 Event actions

ProLink II label	Display label	DeviceNet code	Description
Start sensor zero	START ZERO	1	Initiates a zero calibration procedure
Reset mass total	RESET MASS	2	Resets the value of the mass totalizer to 0
Reset volume total	RESET VOL	3	Resets the value of the liquid volume totalizer to 0(1)
Reset gas std volume total	RESET GSV	21	Resets the value of the gas standard volume totalizer to 0(2)
Reset API ref vol total	RESET TCORR	4	Resets the value of the API temperature-corrected volume totalizer to 0(3)
Reset ED ref vol total	RESET STD V	5	Resets the value of the ED standard volume totalizer to 0(4)
Reset ED net mass total	RESET NET M	6	Resets the value of the ED net mass totalizer to 0(4)
Reset ED net vol total	RESET NET V	7	Resets the value of the ED net volume totalizer to 0(4)

Table 8-6 Event actions *continued*

ProLink II label	Display label	DeviceNet code	Description
Reset all totals	RESET ALL	8	Resets the value of all totalizers to 0
Start/stop all totalization	START STOP	9	If totalizers are running, stops all totalizers If totalizers are not running, starts all totalizers
Increment current ED curve	INCR CURVE	18	Changes the active enhanced density curve from 1 to 2, from 2 to 3, etc.(4)

(1) Displayed only if Volume Flow Type = Liquid.
(2) Displayed only if Volume Flow Type = Gas.
(3) Available only if the petroleum measurement application is installed.
(4) Available only if the enhanced density application is installed.

Example

Define Event 1 to be active when the mass flow rate in forward or backward direction is less than 2 lb/min. Additionally, if this occurs, all totalizers should be stopped.

Using ProLink II:

1. Specify lb/min as the mass flow unit. See Section 6.3.1.
2. Configure the Flow Direction parameter for bidirectional flow. See Section 8.5.
3. Select Event 1.
4. Configure:
   - Event Type = Low
   - Process Variable (PV) = Mass Flow Rate
   - Low Setpoint (A) = 2
5. In the Discrete Input panel, open the dropdown list for Start/Stop All Totalization and select Discrete Event 1.

Using a DeviceNet tool:

1. Specify lb/min as the mass flow unit. See Section 6.3.1.
2. Configure the Flow Direction parameter for bidirectional flow. See Section 8.5.
3. In the Diagnostics Object (0x66), Instance 1, set the following attributes:
   - Discrete event index (Attribute 6) = 0
   - Discrete event action (Attribute 7) = 1
   - Discrete event process variable (Attribute 10) = 0
   - Discrete event setpoint A (Attribute 8) = 2
   - Discrete event action code (Attribute 84) = 9
   - Discrete event assignment (Attribute 85) = 57

8.6.2 Checking and reporting event status

There are several ways that event status can be determined:

- ProLink II automatically displays event information on the Informational panel of the Status window.
- The status of each event is stored in the Diagnostics Object (0x66), Instance 1, Attribute 11. For more information, see Table C-7, or see the manual entitled *Micro Motion Model 2400S Transmitters for DeviceNet: Device Profile*.

8.6.3 Changing event setpoints from the display

For Event 1 or Event 2 only, the value of Setpoint A can be changed from the display, under the following circumstances:

- Mass total or volume total (gas or liquid) must be assigned to the event.
- The event type must be either High or Low.
- Mass total or volume total must be configured as a display variable (see Section 8.9.5).

Then, to reset Setpoint A from the display:

1. Referring to the totalizer management flowchart in Figure 7-3, **Scroll** to the appropriate display screen:
   - To reset the setpoint for an event defined on mass total, **Scroll** to the mass total screen.
   - To reset the setpoint for an event defined on volume total, **Scroll** to the volume total screen.
2. **Select**.
3. Enter the new setpoint value. See Section 3.5.5 for instructions on entering floating-point values with the display.

8.7 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:

- *Slug flow low 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**.
- *Slug flow high 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/cm3**; 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). Default value is **0.0 sec**; range is **0.0–60.0 sec**.

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. The reported mass flow value is set to this value, 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. Mass flow rate is reported as **0** 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, use the Density panel in the Configuration window. See Figure B-2.
- Using a DeviceNet tool, set Attributes 3, 4, and 5 in the Diagnostics Object (0x66), Instance 1. See Table 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.

8.8 Configuring status alarm severity

The Model 2400S transmitter can report faults in the following ways:

- Setting the “alarm active” status bit
- Writing an “alarm active” record to alarm history
- Implementing the digital communications fault action (see Section 8.10.7)

Status alarm severity determines which methods the transmitter will use when a specific alarm condition occurs, as described in Table 8-7. (See Section 7.6 for a more detailed discussion.)

Table 8-7 Alarm severity levels and fault reporting

	Transmitter action if condition occurs		
Severity level	**“Alarm active” status bit set?**	**“Alarm active” record written to history?**	**Digital communications fault action activated? (1)**
Fault	Yes	Yes	Yes
Informational	Yes	Yes	No
Ignore	Yes	No	No

(1) *For some alarms, the digital communications fault action will not begin until the fault timeout has expired. To configure fault timeout, see Section 8.10.8. Other fault reporting methods occur as soon as the fault condition is recognized. Table 8-8 includes information on which alarms are affected by the fault timeout*

Some alarms can be reclassified. For example:

- The default severity level for Alarm A020 (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 8-8. (For more information on status alarms, including possible causes and troubleshooting suggestions, see Table 11-2.)

To configure alarm severity:

- Using ProLink II, see Figure B-3.
- Using a DeviceNet tool, refer to Table C-7 and:
  a. Set the alarm index (Attribute 18).
  b. Set the severity for that alarm (Attribute 19).

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

Table 8-8 Status alarms and severity levels

Alarm code	ProLink II message	Default severity	Configurable?	Affected by fault timeout?
A001	(E)EPROM Checksum Error (CP)	Fault	No	No
A002	RAM Error (CP)	Fault	No	No
A003	Sensor Failure	Fault	Yes	Yes
A004	Temperature Sensor Failure	Fault	No	Yes
A005	Input Overrange	Fault	Yes	Yes
A006	Not Configured	Fault	Yes	No
A008	Density Overrange	Fault	Yes	Yes
A009	Transmitter Initializing/Warming Up	Ignore	Yes	No
A010	Calibration Failure	Fault	No	No
A011	Zero Too Low	Fault	Yes	No
A012	Zero Too High	Fault	Yes	No
A013	Zero Too Noisy	Fault	Yes	No
A014	Transmitter Failed	Fault	No	No
A016	Line RTD Temperature Out-of-Range	Fault	Yes	Yes
A017	Meter RTD Temperature Out-of-Range	Fault	Yes	Yes
A020	Calibration Factors Unentered (FlowCal)	Fault	Yes	No
A021	Incorrect Sensor Type (K1)	Fault	No	No
A029	PIC/Daughterboard Communication Failure	Fault	No	No
A030	Incorrect Board Type	Fault	No	No
A031	Low Power	Fault	No	No
A032	Meter Verification/Outputs In Fault	Fault	No	No
A033	Sensor OK, Tubes Stopped by Process	Fault	Yes	Yes
A102	Drive Overrange/Partially Full Tube	Info	Yes	No
A104	Calibration in Progress	Info	Yes(1)	No
A105	Slug Flow	Info	Yes	No
A107	Power Reset Occurred	Info	Yes	No

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

Alarm code	ProLink II message	Default severity	Configurable?	Affected by fault timeout?
A116	API: Temperature Outside Standard Range	Info	Yes	No
A117	API: Density Outside Standard Range	Info	Yes	No
A120	ED: Unable to Fit Curve Data	Info	No	No
A121	ED: Extrapolation Alarm	Info	Yes	No
A131	Meter Verification/Outputs at Last Value	Info	Yes	No
A132	Simulation Mode Active	Info	Yes	No
A133	PIC UI EEPROM Error	Info	Yes	No

(1) Can be set to either Informational or Ignore, but cannot be set to Fault.

8.9 Configuring the display

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

8.9.1 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 B-3.
- Using the display menus, see Figure B-6.
- Using a DeviceNet tool, see Table C-9.

8.9.2 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 B-3.
- Using the display menus, see Figure B-6.
- Using a DeviceNet tool, see Table C-9.

8.9.3 Enabling and disabling display functions

Table 8-9 lists the display functions and describes their behavior when enabled (shown) or disabled (hidden).

Table 8-9 Display functions

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(1)	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(2)	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.

(1) If enabled, you may want to configure Scroll Rate.
(2) If enabled, the off-line password must also be configured.

To configure these parameters:

- Using ProLink II, see Figure B-3.
- Using the display menus, see Figure B-6.
- Using a DeviceNet tool, see Table C-9.

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 a DeviceNet tool.
- 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 8.9.5) 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.
- 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 display to configure the display:
  - You must enable Auto Scroll before you can configure Scroll Rate.
  - You must enable the off-line password before you can configure the password.

8.9.4 Configuring the LCD backlight

The backlight of the LCD panel on the display can be turned on or off. To turn the backlight on or off,

- Using ProLink II, see Figure B-3.
- Using the display menus, see Figure B-6.
- Using a DeviceNet tool, see Table C-9.

In addition, if you are using ProLink II or a DeviceNet tool, you can control the intensity of the backlight. You can specify any value between **0** and **63**; the higher the value, the brighter the backlight. To control the intensity of the backlight:

- Using ProLink II, see Figure B-3.
- Using a DeviceNet tool, see Table C-9.

8.9.5 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 B-3.
- To configure display variables using a DeviceNet tool, see Table C-9.
- To configure display precision using a DeviceNet tool, refer to Table C-9 and:
  a. Set the process variable index (Attribute 29) to the process variable to be configured.
  b. Set the precision (Attribute 30) for that process variable.

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

Table 8-10 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 8-10 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
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.

8.10 Configuring digital communications

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

- DeviceNet node address (MAC ID)
- DeviceNet baud rate
- DeviceNet configurable input assembly
- Modbus address
- Modbus ASCII support
- IrDA port usage
- Digital communications fault action
- Fault timeout

8.10.1 DeviceNet node address

The default node address for the Model 2400S DN transmitter is **63**. The valid range of node addresses is **0–63**.

The DeviceNet node address can be set using digital communications hardware switches or a DeviceNet tool.

Note: You cannot set the node address from ProLink II or the display.

To set the node address using digital communications hardware switches:

1. Remove the transmitter housing cover as described in Section 3.3.
2. Identify the two addresses switches (the left and center switches) on the user interface module of your transmitter (see Section 3.3). The left switch, labeled **MSD** (Most Significant Digit), sets the first digit of the node address, and the center switch, labeled **LSD** (Least Significant Digit), sets the second digit.
3. For each switch, insert a small blade into the slot to rotate the arrow to the desired position. For example, to set the node address to **60**:
   a. Rotate the arrow in the left switch to point to the digit **6**.
   b. Rotate the arrow in the center switch to point to the digit **0**.
4. Replace the transmitter housing cover.
5. Either power cycle the transmitter or send a Reset service (0x05) to the Identity Object (0x01), Instance 1.

Note: The new node address is not implemented until Step 5 is completed.

To set the node address using a DeviceNet tool:

1. Use the digital communications hardware switches to set the node address to any value in the Program range (values **64–99**). This essentially disables the digital communications hardware switches and allows external control of the node address.
2. Set the MAC ID in the DeviceNet Object (0x03), Instance 1, Attribute 1, data type USINT.
3. Either power cycle the transmitter or send a Reset service (0x05) to the Identity Object (0x01), Instance 1.

Note: If the digital communications hardware switches are not set to 64 or greater, the Set service will return the error code 0x0E (Attribute Not Settable).

Note: The new node address is not implemented until Step 3 is completed.

8.10.2 DeviceNet baud rate

The default baud rate for the Model 2400S DN transmitter is **125 kBaud**. Valid baud rates are listed in Table 8-11.

The baud rate can be set using a digital communications hardware switch or a DeviceNet tool. If the device cannot determine what its baud rate should be, it defaults to 500 kBaud.

Note: You cannot set the baud rate from ProLink II or the display.

To set the baud rate using the digital communications hardware switch:

1. Remove the transmitter housing cover as described in Section 3.3.
2. Identify the baud rate switch (the right switch) on the user interface module of your transmitter. See Section 3.3.
3. Insert a small blade into the slot on the switch and rotate the arrow to the desired position. See Table 8-11 for the baud rate codes. The arrow should point to the code representing the desired baud rate.

Table 8-11 Baud rate codes

Switch position	Baud rate
0	125 kBaud
1	250 kBaud
2	500 kBaud
3–9 (Program range)	Controlled by DeviceNet system

4. Replace the transmitter housing cover.
5. Either power cycle the transmitter or send a Reset service (0x05) to the Identity Object (0x01), Instance 1.

Note: The new baud rate is not implemented until Step 5 is completed.

To set the baud rate using a DeviceNet tool:

1. Use the digital communications hardware switch to set the baud rate to any value in the Program range (values **3–9**). This essentially disables the digital communications hardware switch and allows external control of the baud rate.
2. Set the baud rate in the DeviceNet Object (0x03), Instance 1, Attribute 2, data type USINT.

Note: If the baud rate digital communications hardware switch is not in the Program range, the Set service will return the error code 0x0E (Attribute Not Settable).

3. Either power cycle the transmitter or send a Reset service (0x05) to the Identity Object (0x01), Instance 1.

Note: The new baud rate is not implemented until Step 3 is completed.

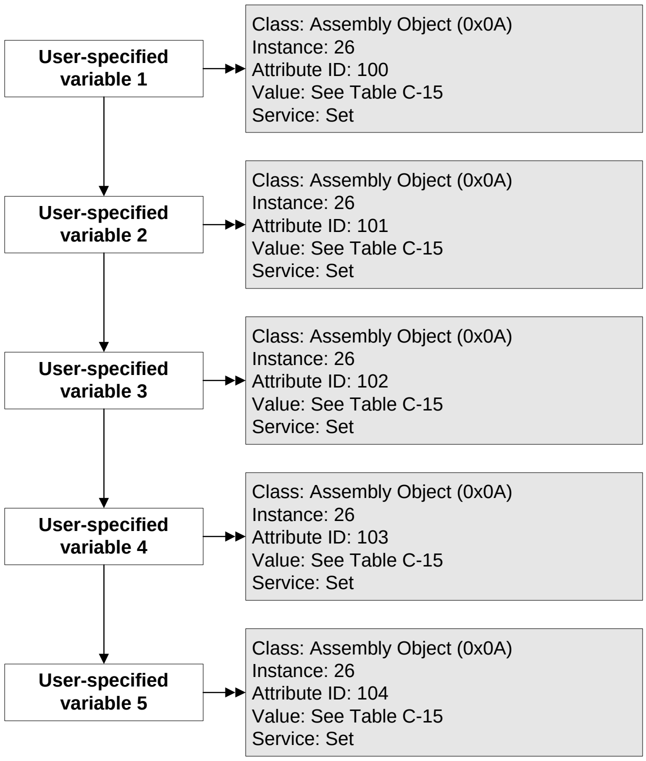
8.10.3 DeviceNet configurable input assembly

The Model 2400S transmitter provides 25 predefined input assemblies and one configurable input assembly. The configurable input assembly allows you to specify five process variables to be published to the network.

Note: For a listing of the predefined input assemblies and the default values for the configurable input assembly, see Table 7-2.

The Assembly Object is used to configure the configurable input assembly. See the flowchart in Figure 8-2.

Figure 8-2 Configurable input assembly – DeviceNet tool



8.10.4 Modbus address

Note: The Modbus address is applicable only when you are connecting to the service port from a tool that uses Modbus protocol. After initial startup, service port connections are typically used only for troubleshooting or for specific procedures such as temperature calibration. ProLink II is typically used for service port connections, and by default ProLink II will use the standard service port address rather than the configured Modbus address. See Section 4.4 for more information.

The set of valid Modbus addresses depends on whether or not support for Modbus ASCII is enabled or disabled (see Section 8.10.5). 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 B-2.
- Using the display menus, see Figure B-6.

8.10.5 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 B-2.
- Using the display menus, see Figure B-6.

8.10.6 IrDA port usage

The IrDA port on the display can be enabled or disabled. If enabled, it can be set for read-only or read/write access.

To enable or disable the IrDA port:

- Using ProLink II, see Figure B-2.
- Using the display menus, see Figure B-6.
- Using a DeviceNet tool, see Table C-9.

To configure the IrDA port for read-only or read-write access:

- Using ProLink II, see Figure B-2.
- Using the display menus, see Figure B-6.
- Using a DeviceNet tool, see Table C-9.

8.10.7 Digital communications fault action

Digital communications fault action controls how digital communications will be affected by fault conditions. Table 8-12 lists the options for digital communications fault action.

Note: Digital communications fault action does not affect the alarm status bits. For example, if digital communications fault action is set to None, the alarm status bits will still be set if an alarm occurs. See Section 7.6 for more information.

Table 8-12 Digital communications fault action options

Option			
ProLink II label	**DeviceNet label**	**DeviceNet code**	**Definition**
Upscale	Upscale	0	Process variables indicate the value is greater than the upper sensor limit. Totalizers stop counting.
Downscale	Downscale	1	Process variables indicate the value is less than the lower sensor limit. Totalizers stop counting.
Zero	Zero	2	Flow rates go to the value that represents zero flow. Density and temperature go to zero. Totalizers stop counting.
Not-A-Number (NAN)	NAN	3	Process variables report IEEE NAN. Totalizers stop counting.
Flow to Zero	Flow goes to zero	4	Flow rates go to the value that represents zero flow; other process variables are not affected. Totalizers stop counting.
None (default)	None	5	Process variables reported as measured.

To configure digital communications fault action:

- Using ProLink II, see Figure B-2.
- Using a DeviceNet tool, see Table C-7.

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

8.10.8 Fault timeout

By default, the transmitter activates the digital communications fault action as soon as the fault is detected. The fault timeout allows you to delay the digital communications fault action for a specified interval, for certain faults only. During the fault timeout period, digital communications behaves normally.

Note: The fault timeout applies only to the digital communications fault action. The "alarm active" status bit is set as soon as the fault is detected (all alarm severity levels), and the "alarm active" record is written to history immediately (Fault and Informational alarms only). For more information on alarm handling, see Section 7.6. For more information on alarm severity, see Section 8.8.

The fault timeout applies only to specific faults. Other faults are reported immediately, regardless of the fault timeout setting. For information on which faults are affected by the fault timeout, see Table 8-8.

To configure fault timeout:

- Using ProLink II, see Figure B-2.
- Using a DeviceNet tool, see Table C-7.

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

8.11 Configuring device settings

The device settings are used to describe the flowmeter components. Table 8-13 lists and defines the device settings.

Table 8-13 Device settings

Parameter	Description
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.

To configure device settings, you must use ProLink II. See Figure B-2. If you are entering a date, use the left and right arrows at the top of the calendar to select the year and month, then click on a date.

Note: This functionality is not available via the display menus or a DeviceNet tool.

8.12 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 (can be set only once)
- Sensor material
- Sensor liner material
- Sensor flange type

To configure sensor parameters:

- Using ProLink II, see Figure B-2.
- Using a DeviceNet tool, see Table C-8.

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

8.13 Configuring the petroleum measurement application

The *API parameters* determine the values that will be used in API-related calculations. The API parameters are available only if the petroleum measurement application is enabled on your transmitter.

Note: The petroleum measurement application requires liquid volume measurement units. If you plan to use API process variables, ensure that liquid volume flow measurement is specified. See Section 8.2.

8.13.1 About the petroleum measurement application

Some applications that measure liquid volume flow or liquid density are particularly sensitive to temperature factors, and must comply with American Petroleum Institute (API) standards for measurement. The petroleum measurement enables *Correction of Temperature on volume of Liquids*, or CTL.

Terms and definitions

The following terms and definitions are relevant to the petroleum measurement application:

- *API* – American Petroleum Institute
- *CTL* – Correction of Temperature on volume of Liquids. The CTL value is used to calculate the VCF value
- *TEC* – Thermal Expansion Coefficient
- *VCF* – Volume Correction Factor. The correction factor to be applied to volume process variables. VCF can be calculated after CTL is derived

CTL derivation methods

There are two derivation methods for CTL:

- Method 1 is based on observed density and observed temperature.
- Method 2 is based on a user-supplied reference density (or thermal expansion coefficient, in some cases) and observed temperature.

API reference tables

Reference tables are organized by reference temperature, CTL derivation method, liquid type, and density unit. The table selected here controls all the remaining options.

- Reference temperature:
  - If you specify a 5*x*, 6*x*, 23*x*, or 24*x* table, the default reference temperature is 60 °F, and cannot be changed.
  - If you specify a 53*x* or 54*x* table, the default reference temperature is 15 °C. However, you can change the reference temperature, as recommended in some locations (for example, to 14.0 or 14.5 °C).
- CTL derivation method:
  - If you specify an odd-numbered table (5, 23, or 53), CTL will be derived using method 1 described above.
  - If you specify an even-numbered table (6, 24, or 54), CTL will be derived using method 2 described above.
- The letters *A*, *B*, *C*, or *D* that are used to terminate table names define the type of liquid that the table is designed for:
  - *A* tables are used with generalized crude and JP4 applications.
  - *B* tables are used with generalized products.
  - *C* tables are used with liquids with a constant base density or known thermal expansion coefficient.
  - *D* tables are used with lubricating oils.
- Different tables use different density units:
  - Degrees API
  - Relative density (SG)
  - Base density (kg/m^3)

Table 8-14 summarizes these options.

Table 8-14 API reference temperature tables

Table	CTL derivation method	Base temperature	Density unit and range		
			Degrees API	Base density	Relative density
5A	Method 1	60 °F, non-configurable	0 to +100		
5B	Method 1	60 °F, non-configurable	0 to +85		
5D	Method 1	60 °F, non-configurable	–10 to +40		
23A	Method 1	60 °F, non-configurable			0.6110 to 1.0760
23B	Method 1	60 °F, non-configurable			0.6535 to 1.0760
23D	Method 1	60 °F, non-configurable			0.8520 to 1.1640
53A	Method 1	15 °C, configurable		610 to 1075 kg/m^3	
53B	Method 1	15 °C, configurable		653 to 1075 kg/m^3	
53D	Method 1	15 °C, configurable		825 to 1164 kg/m^3	
			Reference temperature		**Supports**
6C	Method 2	60 °F, non-configurable	60 °F		Degrees API
24C	Method 2	60 °F, non-configurable	60 °F		Relative density
54C	Method 2	15 °C, configurable	15 °C		Base density in kg/m^3

8.13.2 Configuration procedure

The API configuration parameters are listed and defined in Table 8-15.

Table 8-15 API parameters

Variable	Description
Table type	Specifies the table that will be used for reference temperature and reference density unit. Select the table that matches your requirements. See *API reference tables*.
User defined TEC(1)	Thermal expansion coefficient. Enter the value to be used in CTL calculation.
Temperature units(2)	Read-only. Displays the unit used for reference temperature in the reference table.
Density units	Read-only. Displays the unit used for reference density in the reference table.
Reference temperature	Read-only unless Table Type is set to 53*x* or 54*x*. If configurable: • Specify the reference temperature to be used in CTL calculation. • Enter reference temperature in °C.

(1) Configurable if Table Type is set to 6C, 24C, or 54C.
(2) In most cases, the temperature unit used by the API reference table should also be the temperature unit configured for the transmitter to use in general processing. To configure the temperature unit, see Section 6.3.

To configure the petroleum measurement application:

- Using ProLink II, see Figure B-3.
- Using a DeviceNet tool, see Table C-10.

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

For the temperature value to be used in CTL calculation, you can use the temperature data from the sensor, or you can configure external temperature compensation to use either a static temperature value or temperature data from an external temperature device.

- To use temperature data from the sensor, no action is required.
- To configure external temperature compensation, see Section 9.3.

8.14 Configuring the enhanced density application

Micro Motion sensors provide direct measurements of density, but not of concentration. The enhanced density application calculates enhanced density process variables, such as concentration or density at reference temperature, from density process data, appropriately corrected for temperature.

Note: For a detailed description of the enhanced density application, see the manual entitled Micro Motion Enhanced Density Application: Theory, Configuration, and Use*.*

Note: The enhanced density application requires liquid volume measurement units. If you plan to use enhanced density process variables, ensure that liquid volume flow measurement is specified. See Section 8.2.

8.14.1 About the enhanced density application

The enhanced density calculation calculation requires an enhanced density curve, which specifies the relationship between temperature, concentration, and density for the process fluid being measured. Micro Motion supplies a set of six standard enhanced density curves (see Table 8-16). If none of these curves is appropriate for your process fluid, you can configure a custom curve or purchase a custom curve from Micro Motion.

The derived variable, specified during configuration, controls the type of concentration measurement that will be produced. Each derived variable allows the calculation of a subset of enhanced density process variables (see Table 8-17). The available enhanced density process variables can be used in process control, just as mass flow rate, volume flow rate, and other process variables are used. For example, an event can be defined on an enhanced density process variable.

- For all standard curves, the derived variable is Mass Conc (Dens).
- For custom curves, the derived variable may be any of the variables listed in Table 8-17.

The transmitter can hold up to six curves at any given time, but only one curve can be active (used for measurement) at a time. All curves that are in transmitter memory must use the same derived variable.

Table 8-16 Standard curves and associated measurement units

Name	Description	Density unit	Temperature unit
Deg Balling	Curve represents percent extract, by mass, in solution, based on °Balling. For example, if a wort is 10 °Balling and the extract in solution is 100% sucrose, the extract is 10% of the total mass.	g/cm^3	°F
Deg Brix	Curve represents a hydrometer scale for sucrose solutions that indicates the percent by mass of sucrose in solution at a given temperature. For example, 40 kg of sucrose mixed with 60 kg of water results in a 40 °Brix solution.	g/cm^3	°C
Deg Plato	Curve represents percent extract, by mass, in solution, based on °Plato. For example, if a wort is 10 °Plato and the extract in solution is 100% sucrose, the extract is 10% of the total mass.	g/cm^3	°F

Table 8-16 Standard curves and associated measurement units *continued*

Name	Description	Density unit	Temperature unit
HFCS 42	Curve represents a hydrometer scale for HFCS 42 (high fructose corn syrup) solutions that indicates the percent by mass of HFCS in solution.	g/cm^3	°C
HFCS 55	Curve represents a hydrometer scale for HFCS 55 (high fructose corn syrup) solutions that indicates the percent by mass of HFCS in solution.	g/cm^3	°C
HFCS 90	Curve represents a hydrometer scale for HFCS 90 (high fructose corn syrup) solutions that indicates the percent by mass of HFCS in solution.	g/cm^3	°C

Table 8-17 Derived variables and available process variables

Derived variable – ProLink II label and definition	Available process variables					
	Density at reference temperature	Standard volume flow rate	Specific gravity	Concentration	Net mass flow rate	Net volume flow rate
Density @ Ref *Density at reference temperature* Mass/unit volume, corrected to a given reference temperature	✓	✓				
SG *Specific gravity* The ratio of the density of a process fluid at a given temperature to the density of water at a given temperature. The two given temperature conditions do not need to be the same.	✓	✓	✓			
Mass Conc (Dens) *Mass concentration derived from reference density* The percent mass of solute or of material in suspension in the total solution, derived from reference density	✓	✓		✓	✓	
Mass Conc (SG) *Mass concentration derived from specific gravity* The percent mass of solute or of material in suspension in the total solution, derived from specific gravity	✓	✓	✓	✓	✓	
Volume Conc (Dens) *Volume concentration derived from reference density* The percent volume of solute or of material in suspension in the total solution, derived from reference density	✓	✓		✓		✓

Table 8-17 Derived variables and available process variables *continued*

Derived variable – ProLink II label and definition	Available process variables: Density at reference temperature	Standard volume flow rate	Specific gravity	Concentration	Net mass flow rate	Net volume flow rate
Volume Conc (SG) *Volume concentration derived from specific gravity* The percent volume of solute or of material in suspension in the total solution, derived from specific gravity	✓	✓	✓	✓		✓
Conc (Dens) *Concentration derived from reference density* The mass, volume, weight, or number of moles of solute or of material in suspension in proportion to the total solution, derived from reference density	✓	✓		✓		
Conc (SG) *Concentration derived from specific gravity* The mass, volume, weight, or number of moles of solute or of material in suspension in proportion to the total solution, derived from specific gravity	✓	✓	✓	✓		

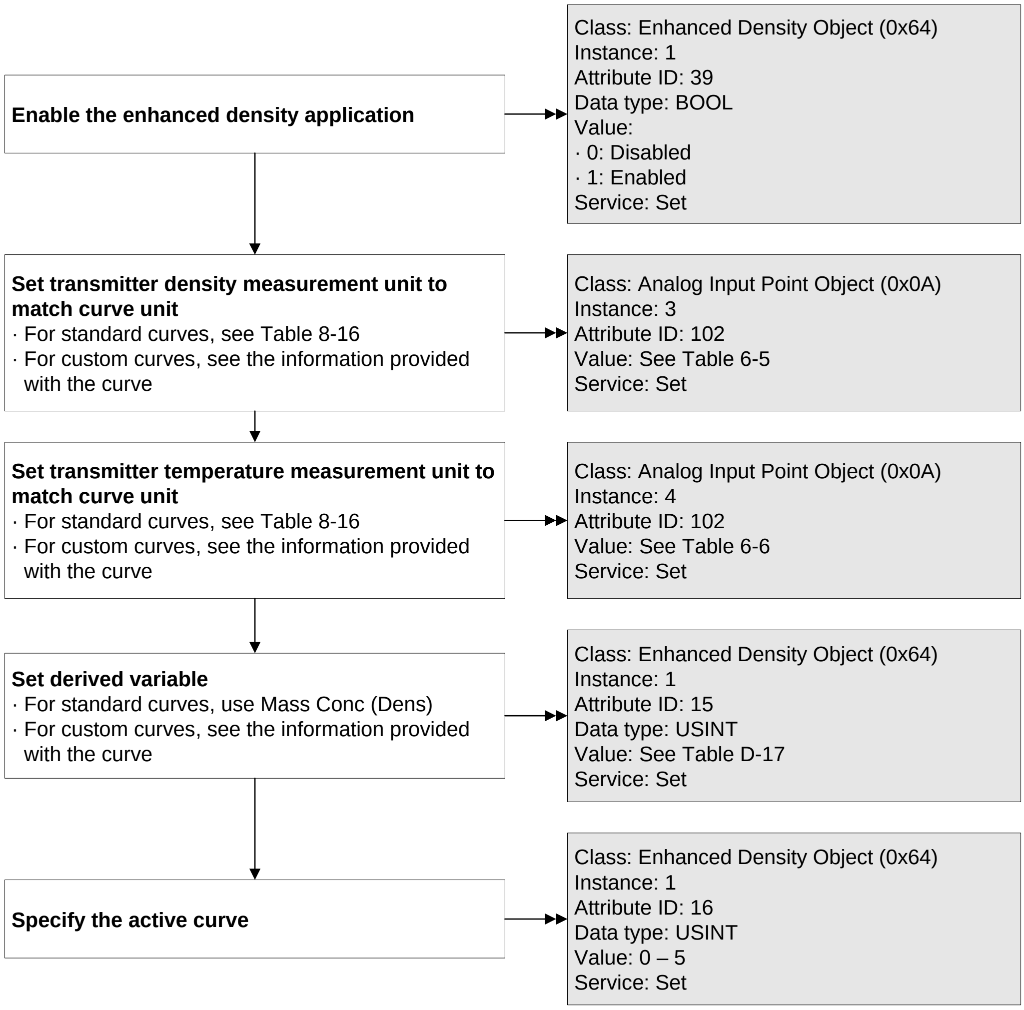
8.14.2 Configuration procedure

Complete configuration instructions for the enhanced density application are provided in the manual entitled *Micro Motion Enhanced Density Application: Theory, Configuration, and Use*. Because of the complexity of this procedure, Micro Motion recommends using ProLink II for detailed configuration.

If it is necessary to use a DeviceNet tool, refer to the enhanced density manual for application information, and to the manual entitled *Micro Motion Model 2400S Transmitters for DeviceNet: Device Profile* for complete device profile information.

Basic information on setting up the enhanced density application using a DeviceNet tool is provided in Figure 8-3.

Figure 8-3 Configuring the enhanced density application – DeviceNet tool



Chapter 9
Pressure Compensation and Temperature Compensation

9.1 Overview

This chapter describes the following procedures:

- Configuring pressure compensation – see Section 9.2
- Configuring external temperature compensation – see Section 9.3
- Obtaining external pressure or temperature data – see Section 9.4

Note: All ProLink II procedures provided in this chapter assume that you have established communication between ProLink II and the Model 2400S DN transmitter and that you are complying with all applicable safety requirements. See Chapter 4 for more information.

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

Note: All DeviceNet tool procedures provided in this chapter assume that you have established communication between the DeviceNet tool and the Model 2400S DN transmitter and that you are complying with all applicable safety requirements. See Chapter 5 for more information.

9.2 Pressure compensation

The Model 2400S DN 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 configure that value in the transmitter.
- If the operating pressure varies significantly, you must write a pressure value to the transmitter at appropriate intervals, using an appropriate output assembly. See Section 9.4.

Note: Ensure that your pressure value is accurate, or that your 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 $g/cm^3/psi$

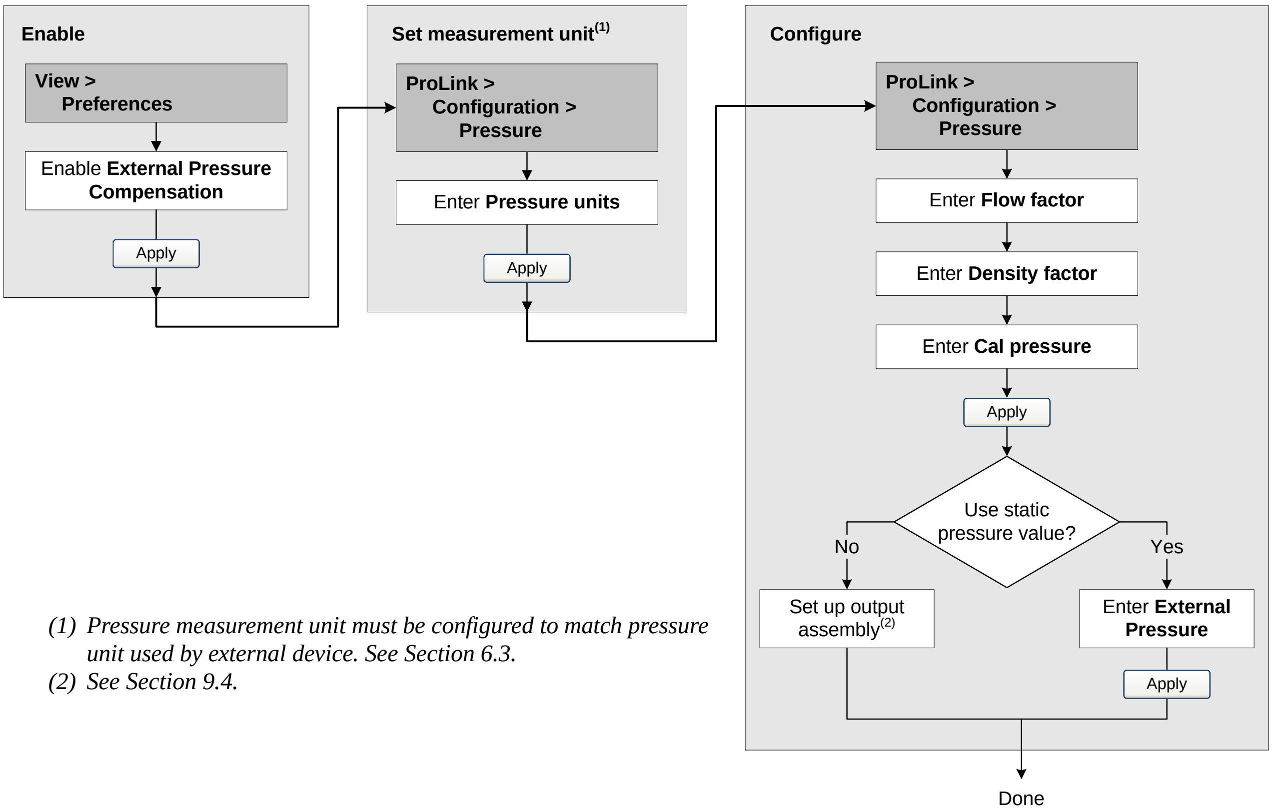
Not all sensors or applications require pressure correction factors. For the pressure correction values to be used, obtain the pressure effect values from the product data sheet for your sensor, then reverse the signs (e.g., if the pressure effect is **0.000004**, enter a pressure correction factor of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

9.2.3 Configuration

To enable and configure pressure compensation:

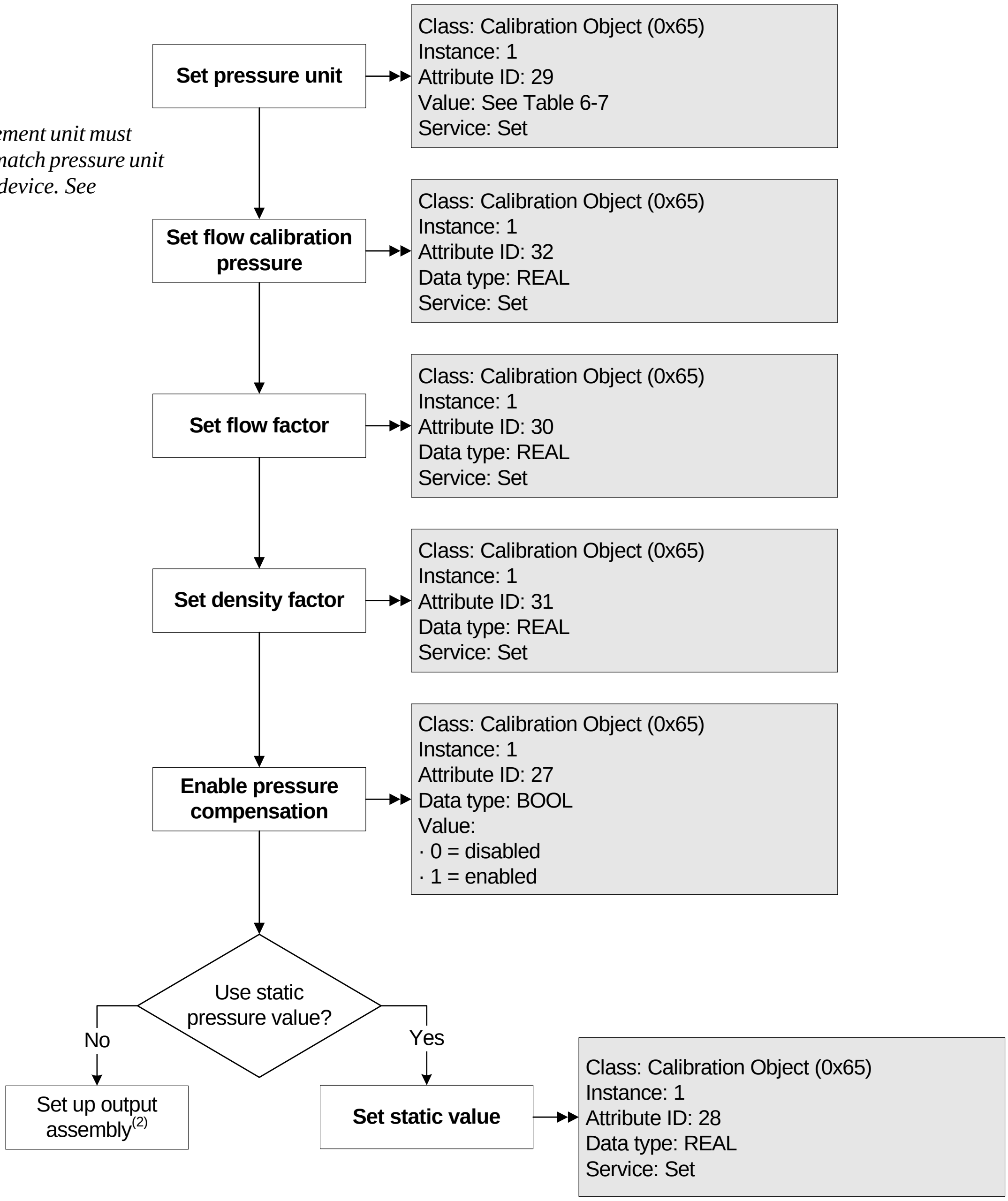
- With ProLink II, see Figure 9-1.
- With a DeviceNet tool, see Figure 9-2.

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 6.3.
(2) See Section 9.4.

Figure 9-2 Configuring pressure compensation with a DeviceNet tool



(1) Pressure measurement unit must be configured to match pressure unit used by external device. See Section 6.3.
(2) 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.

Note: The external 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.

There are two ways to configure external temperature compensation:

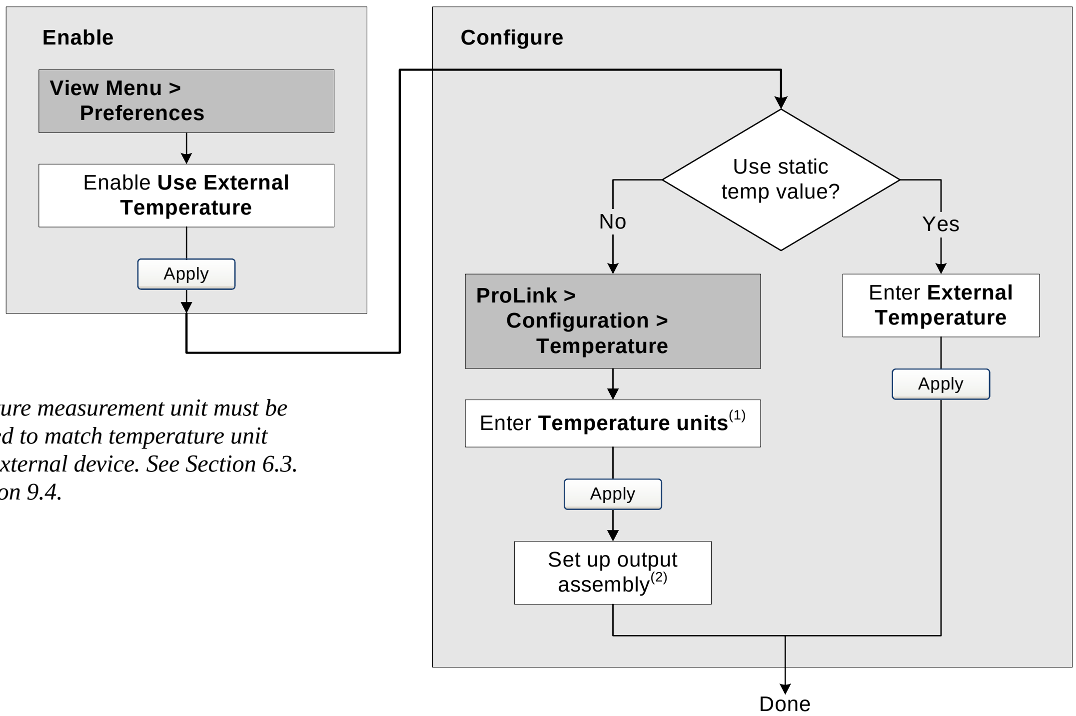
- If the operating temperature is a known static value, you can configure that value in the transmitter.
- If the operating temperature varies significantly, you must write a temperature value to the transmitter at appropriate intervals, using an appropriate output assembly. See Section 9.4.

Note: Ensure that your temperature value is accurate, or that your temperature measurement device is accurate and reliable.

To enable and configure external temperature compensation:

- With ProLink II, see Figure 9-3.
- With a DeviceNet tool, see Figure 9-4.

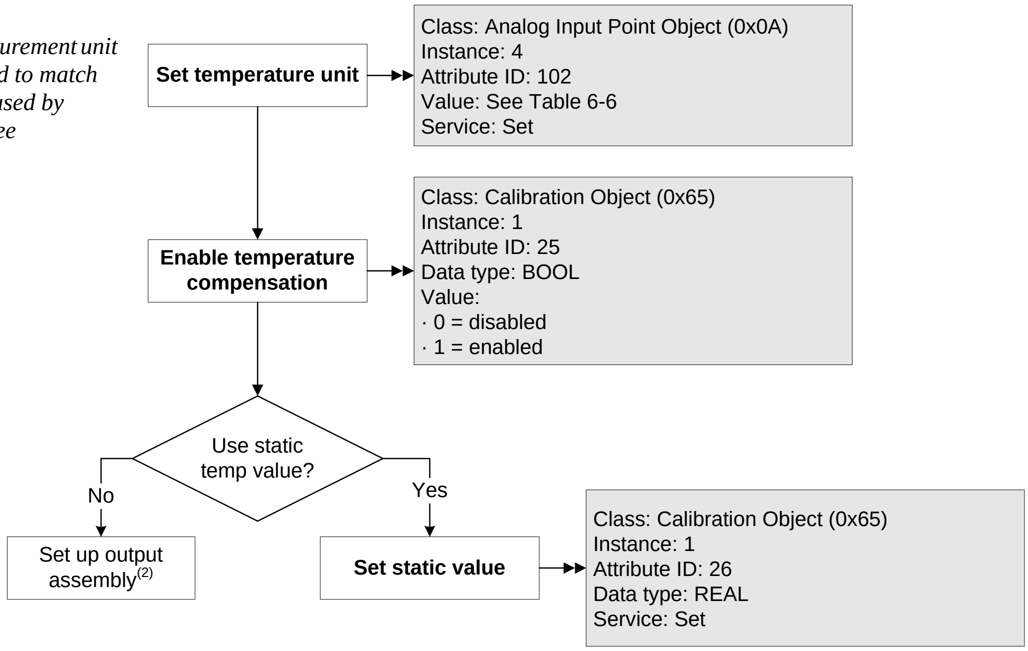
Figure 9-3 Configuring external temperature compensation with ProLink II



(1) Temperature measurement unit must be configured to match temperature unit used by external device. See Section 6.3.
(2) See Section 9.4.

Figure 9-4 Configuring external temperature compensation with a DeviceNet tool

(1) Temperature measurement unit must be configured to match temperature unit used by external device. See Section 6.3.
(2) See Section 9.4.



9.4 Obtaining external pressure and temperature data

The DeviceNet output assemblies used to obtain external pressure and/or temperature data are listed in Table 9-1. Use standard DeviceNet methods to implement the required connection.

Table 9-1 Output assemblies used for pressure or temperature compensation

Instance ID	Data description	Size	Bytes	Data type
50	External pressure	4 bytes	Bytes 0–3	REAL
51	External temperature	4 bytes	Bytes 0–3	REAL
52	External pressure External temperature	8 bytes	Bytes 0–3 Bytes 4–7	REAL REAL

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
- Zero calibration – see Section 10.5
- Density calibration – see Section 10.6
- Temperature calibration – see Section 10.7

Note: All ProLink II procedures provided in this chapter assume that you have established communication between ProLink II and the Model 2400S DN transmitter and that you are complying with all applicable safety requirements. See Chapter 4 for more information.

Note: If you are using Pocket ProLink, the interface is similar to the ProLink II interface described in this chapter, with the exception that the additional meter verification functionality described in Section 10.3.2 is not available.

Note: All DeviceNet tool procedures provided in this chapter assume that you have established communication between the DeviceNet tool and the Model 2400S DN transmitter and that you are complying with all applicable safety requirements. See Chapter 5 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

Meter validation and calibration are available on all Model 2400S DN transmitters. Meter verification is available only if the meter verification option was ordered with the transmitter.

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 load per unit deflection, 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.

Meter verification does not affect measurement in any way. Micro Motion recommends performing meter verification at regular intervals.

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 and 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
- Density calibration
- Temperature calibration

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

Note: 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 interruption
  - Meter verification requires approximately four minutes to perform. During these four minutes, flow can continue (provided sufficient stability is maintained); however, current process data will not be reported.
  - Meter validation for density does not interrupt the process. 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. Zero calibration requires stopping flow through the sensor.
- External measurement requirements
  - Meter verification does not require 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 purchase the meter verification option and perform meter verification frequently.

10.3 Performing meter verification

The meter verification procedure can be performed on any process fluid. It is not necessary to match factory conditions. Meter verification is not affected by any parameters configured for flow, density, or temperature.

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, stop flow.

If stability varies outside test limits, the meter verification procedure will be aborted. Verify the stability of the process and retry the test.

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Defaults

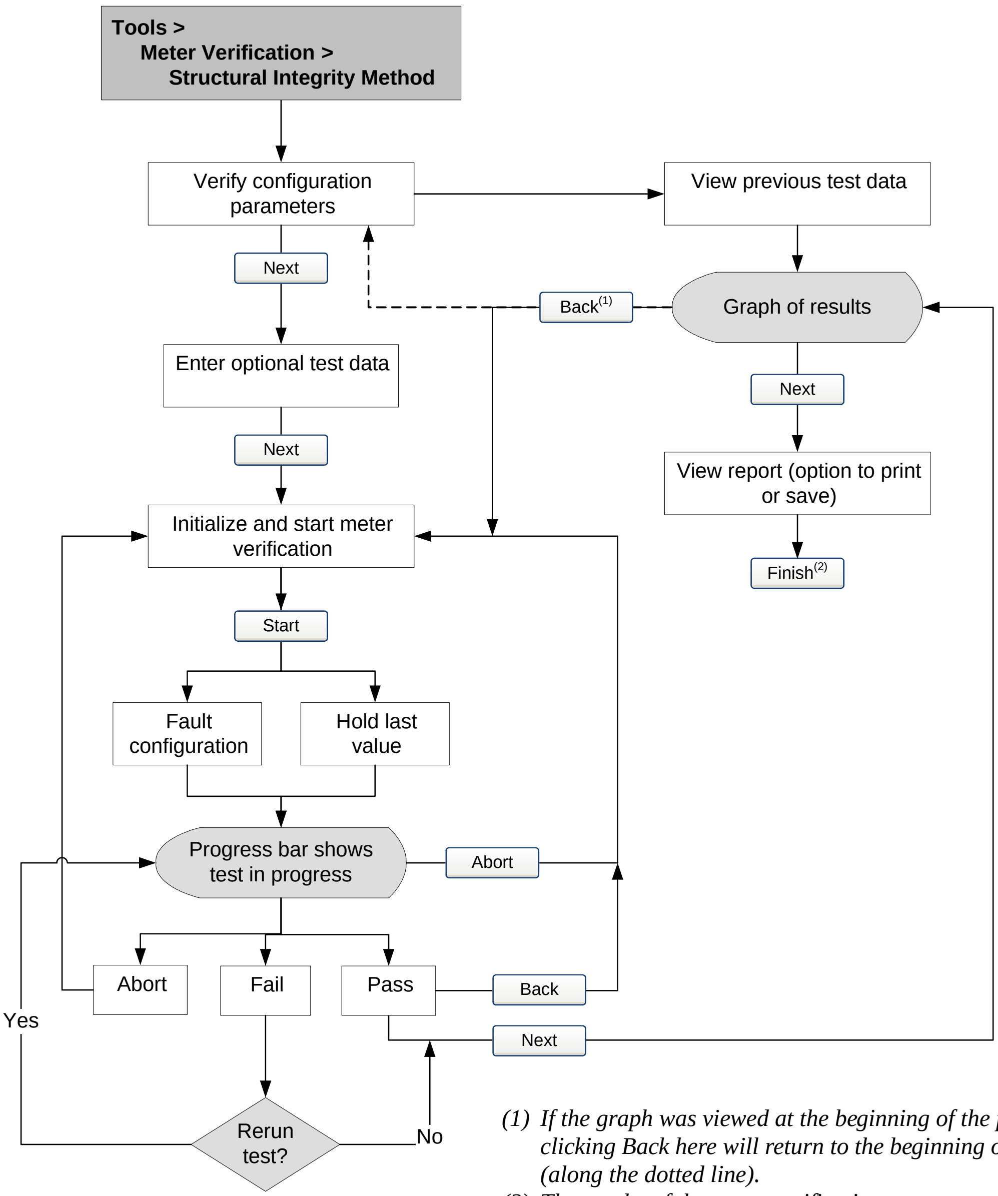
During meter verification, you can choose between setting digital communications process variable values to the configured fault indicator or the last measured value. The values will remain fixed for the duration of the test (approximately four minutes). Disable all control loops for the duration of the procedure, and ensure that any data reported during this period is handled appropriately.

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 B-8.
- Using a DeviceNet tool, follow the procedure illustrated in Figure 10-3.

For a discussion of meter verification results, see Section 10.3.1.

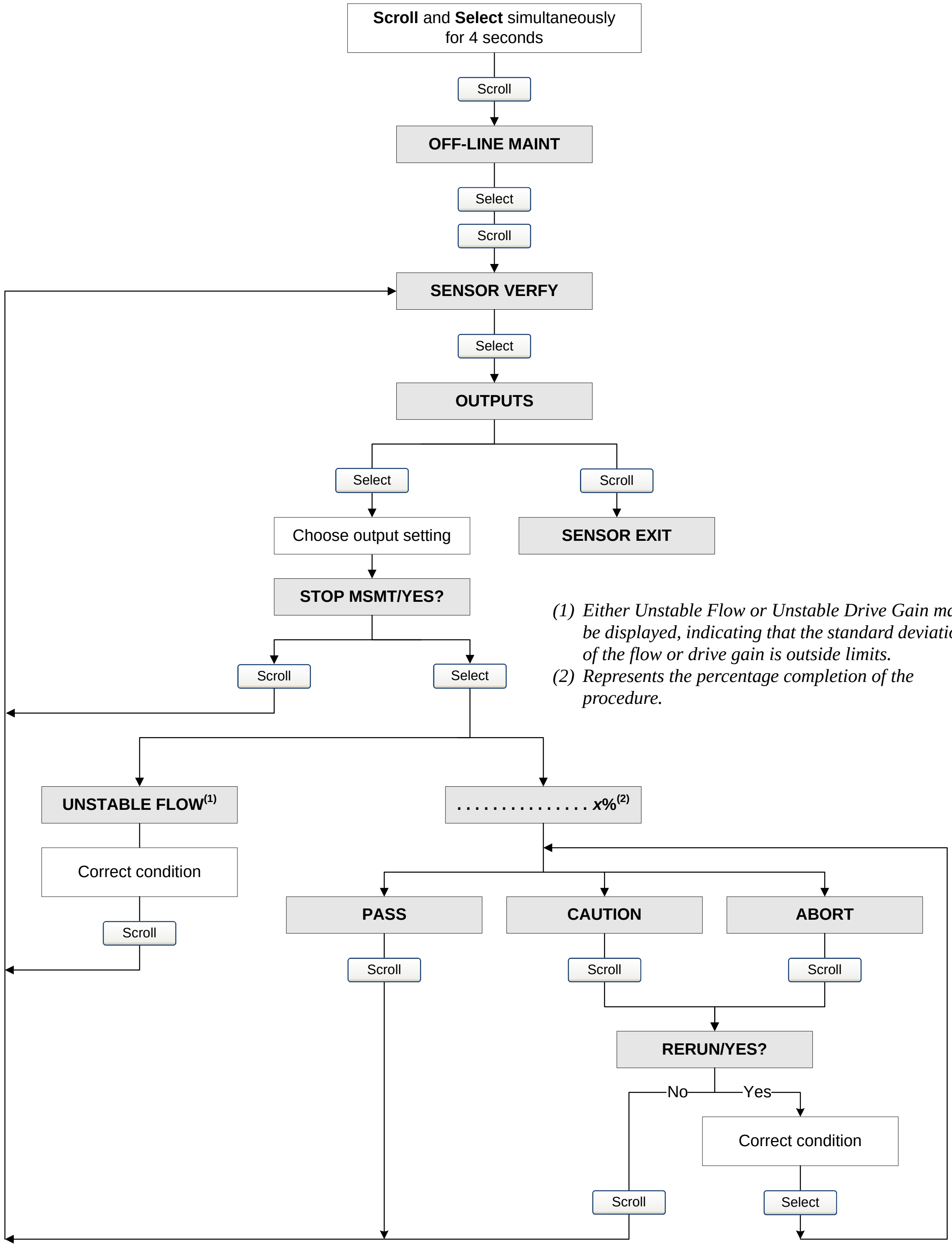
Figure 10-1 Meter verification procedure – ProLink II



(1) If the graph was viewed at the beginning of the procedure, clicking Back here will return to the beginning of the procedure (along the dotted line).

(2) The results of the meter verification test are not saved until Finish is clicked.

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.*

Figure 10-3 Meter verification procedure – DeviceNet tool

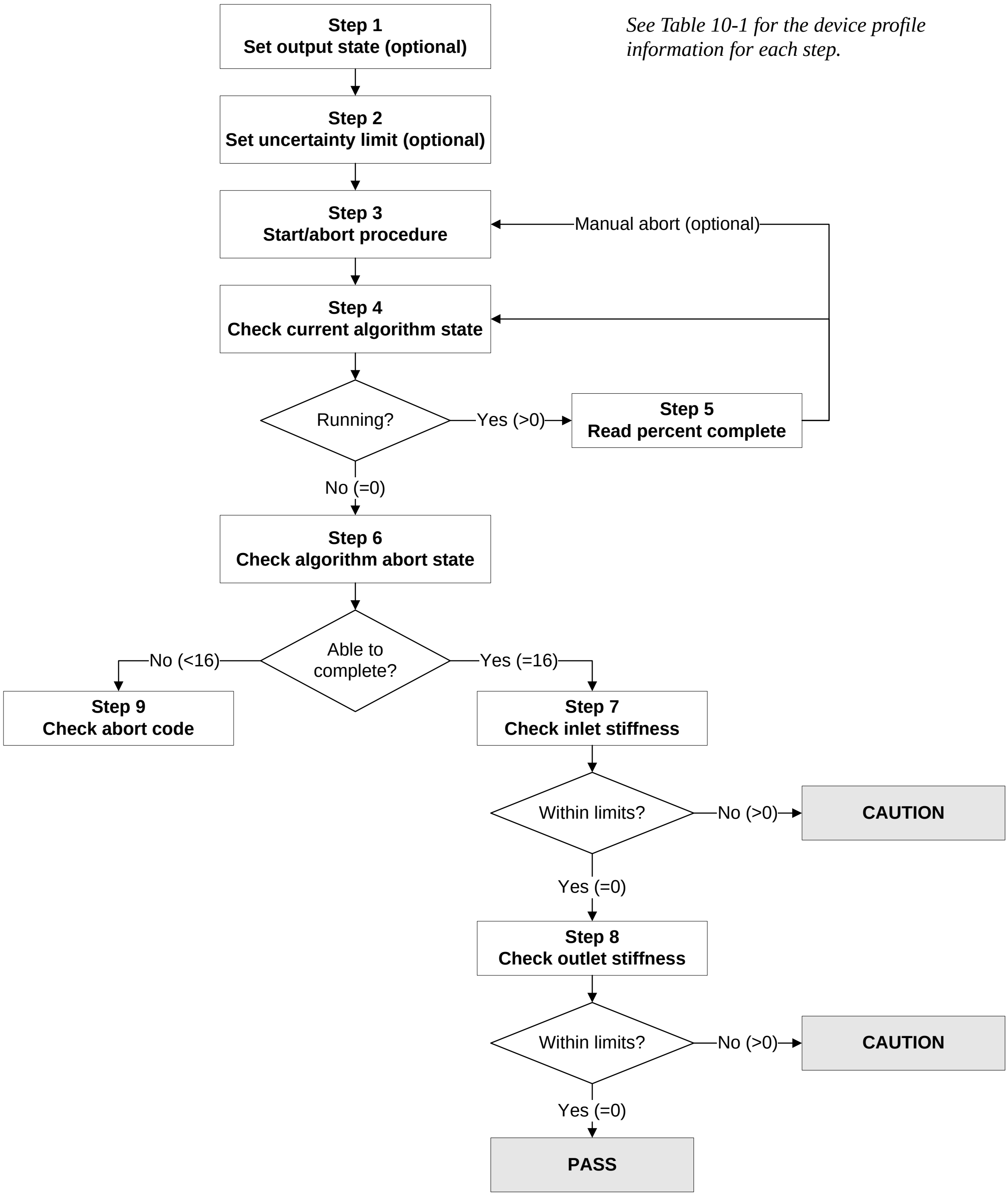


Table 10-1 DeviceNet interface for meter verification

Step number	Step description	Interface
1	Set output state	Class: Diagnostics Object (0x66) Instance: 1 Attribute ID: 58 Data type: USINT Value: • 0: Last measured value (default) • 1: Fault Service: Set
2	Set uncertainty limit	Class: Diagnostics Object (0x66) Instance: 1 Attribute ID: 59 Data type: REAL Range: 0.0025 to 0.05 Default: 0.04 Service: Set
3	Start/abort procedure	Class: Diagnostics Object (0x66) Instance: 1 • 0: Abort • 1: Start Service: 0x50
4	Check current algorithm state	Class: Diagnostics Object (0x66) Instance: 1 Attribute ID: 54 Data type: USINT Service: Get
5	Read percent complete	Class: Diagnostics Object (0x66) Instance: 1 Attribute ID: 57 Data type: USINT Service: Get
6	Check algorithm abort state	Class: Diagnostics Object (0x66) Instance: 1 Attribute ID: 56 Data type: USINT Service: Get
7	Check inlet stiffness	Class: Diagnostics Object (0x66) Instance: 1 Attribute ID: 61 Data type: USINT • 0: Within uncertainty limit • 1: Outside uncertainty limit Service: Get
8	Check outlet stiffness	Class: Diagnostics Object (0x66) Instance: 1 Attribute ID: 62 Data type: USINT • 0: Within uncertainty limit • 1: Outside uncertainty limit Service: Get
9	Read abort code	Class: Diagnostics Object (0x66) Instance: 1 Attribute ID: 55 Data type: USINT Codes: See Table C-7 Service: Get

10.3.1 Uncertainty limit and test results

The result of the meter verification test will be a percent uncertainty of normalized tube stiffness. The default limit for this uncertainty is ±4.0%. This limit is stored in the transmitter, and can be changed with ProLink II or a DeviceNet tool when optional test parameters are entered. For most installations, it is advisable to leave the uncertainty limit at the default value.

When the test is completed, the result will be reported as Pass, Fail/Caution (depending on the tool you are using), or Abort:

- *Pass* – The test result is within the specified uncertainty limit. If transmitter zero and configuration match factory values, the sensor will meet factory specifications for flow and density measurement. It is expected that the meter will pass meter verification every time the test is run.
- *Fail/Caution* – The test result is not within the specified uncertainty limit. Micro Motion recommends that you immediately re-run the meter verification test. 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 the knowledge of your process to consider the type of damage and determine the appropriate action. These actions might include removing the meter from service and physically inspecting the tubes. At minimum, you should perform a flow validation (see Section 10.4) and a density calibration (see Section 10.6).
- *Abort* – A problem occurred with the meter verification test (e.g., process instability). Check your process and retry the test.

ProLink II provides more detailed test data. See Section 10.3.2.

10.3.2 Additional ProLink II tools for meter verification

In addition to the Pass, Fail/Caution, and Abort result provided by the procedure, ProLink II provides the following additional meter verification tools:

- *Test metadata* – ProLink II allows you to enter a large amount of metadata about each test so that past tests can be audited easily. ProLink II will prompt you for this optional data during the test.
- *Visibility of configuration and zero changes* – ProLink II has a pair of indicators that show whether the transmitter's configuration or zero has changed since the last meter verification test. The indicators will be green if configuration and zero are the same, and red otherwise. You can find out more information about changes to configuration and zero by clicking the button next to each indicator.
- *Plotted data points* – ProLink II shows the exact stiffness uncertainty on a graph. This allows you to see not only whether the meter is operating within specification, but also where the results fall within the specified limits. (The results are shown as two data points: Inlet and Outlet. The trending of these two points can help identify if local or uniform changes are occurring to the flow tubes.)
- *Trending* – ProLink II has the ability to store a history of meter verification data points. This history is displayed on the results graph. The rightmost data points are the most recent. This history lets you see how your meter is trending over time, which can be an important way of detecting meter problems before they become severe. You can view the graph of past results at either the beginning or the end of the meter verification procedure. The graph is shown automatically at the end. Click **View Previous Test Data** to view the graph at the beginning.
- *Data manipulation* – You can manipulate the graphed data in various ways by double-clicking the graph. When the graph configuration dialog is open, you can also export the graph in a number of formats (including "to printer") by clicking **Export**.
- *Detailed report form* – At the end of a meter verification test, ProLink II displays a detailed report of the test, which includes the same recommendations for pass/caution/abort results that are found in Section 10.3.1. You have the options of printing the report or saving it to disk as an HTML file.

More information about using ProLink II to perform meter verification can be found in the ProLink II manual and in the on-line ProLink II help system.

Note: Historical data (e.g., previous test results or whether zero has changed) are stored on the computer on which ProLink II is installed. If you perform meter verification on the same transmitter from a different computer, from the display, or from a DeviceNet tool, the historical data will not be visible.

10.4 Performing meter validation

To perform meter validation:

1. Determine the meter factor(s) to use. You may set any combination of the mass flow, volume flow, and density meter factors.

   Note that all three meter factors are independent:

   - The mass flow meter factor affects only the value reported for mass flow.
   - The density meter factor affects only the value reported for density.
   - The volume flow meter factor affects only the value reported for volume flow.

Therefore, to adjust volume flow, you must set the meter factor for volume flow. Setting a meter factor for mass flow and a meter factor for density will not produce the desired result. The volume flow calculations are based on original mass flow and density values, before the corresponding meter factors have been applied.

2. Calculate the meter factor as follows:
   a. Sample the process fluid and record the process variable value reported by the flowmeter.
   b. Measure the sample using an external standard.
   c. Calculate the new meter factor using the following formula:

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

   If you are calculating the volume flow meter factor, note that proving volume in the field may be expensive, and the procedure may be hazardous for some process fluids. Therefore, because volume is inversely proportional to density, an alternative to direct sampling and measurement is to calculate the volume flow meter factor from the density meter factor. This method provides partial correction by adjusting for any portion of the total offset that is caused by density measurement offset. Use this method only when a volume flow reference is not available, but a density reference is available. To use this method:
   a. Calculate the meter factor for density, using the preceding formula.
   b. Calculate the volume flow meter factor from the density meter factor, as shown below:

$$\text{MeterFactor}_{\text{Volume}} = \frac{1}{\text{MeterFactor}_{\text{Density}}}$$

Note: This equation is mathematically equivalent to the equation shown below. You may use whichever equation you prefer.

$$\text{MeterFactor}_{\text{Volume}} = \text{ConfiguredMeterFactor}_{\text{Density}} \times \frac{\text{Density}_{\text{Flowmeter}}}{\text{Density}_{\text{ExternalStandard}}}$$

3. Ensure that the meter factor is between **0.8** and **1.2**, inclusive. If the calculated meter factor is outside these limits, contact Micro Motion customer service.
4. Configure the meter factor in the transmitter. To configure meter factors:
   - Using ProLink II, see Figure B-2.
   - Using the display menus, see Figure B-6.
   - Using a DeviceNet tool, see Tables C-1, C-2, and C-3.

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 zero calibration

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 7.5 for information on viewing transmitter status and alarms.

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

- Restore prior zero, available only from the Calibration dialog box in ProLink II (see Figure B-1), and only if you have not closed the Calibration window or disconnected from the transmitter. Once you have closed the Calibration window or disconnected from the transmitter, you can no longer restore the prior zero.
- Restore factory zero, available via:
  - The display – see Figure B-7
  - ProLink II – see Figure B-1
  - A DeviceNet tool – use the Diagnostics Object (0x66), Instance 1, Service 0x52. For more information, see the manual entitled *Micro Motion Model 2400S Transmitters for DeviceNet: Device Profile*.

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 11.8).

10.5.1 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.

10.5.2 Zero procedure

To zero the flowmeter:

- Using the zero button, see Figure 10-4.
- Using the display menu, see Figure 10-5. For a complete illustration of the display zero menu, see Figure B-7.
- Using ProLink II, see Figure 10-6.
- Using a DeviceNet tool, see Figure 10-7.

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 8.9.3.
  - You cannot change the zero time with the display. If you need to change the zero time, you must use ProLink II or a DeviceNet tool.
- 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 ProLink II or a DeviceNet tool.
  - The zero button is located on the user interface board, beneath the transmitter housing cover (see Figure 3-1). For instructions on removing the transmitter housing cover, see Section 3.3.
  - To press the zero button, use a fine-pointed object that will fit into the opening (0.14 in or 3.5 mm). 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 10-4 **Zero button – Flowmeter zero procedure**

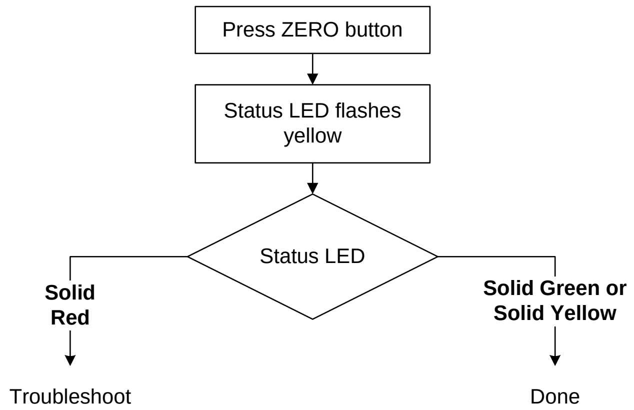


Figure 10-5 **Display menu – Flowmeter zero procedure**

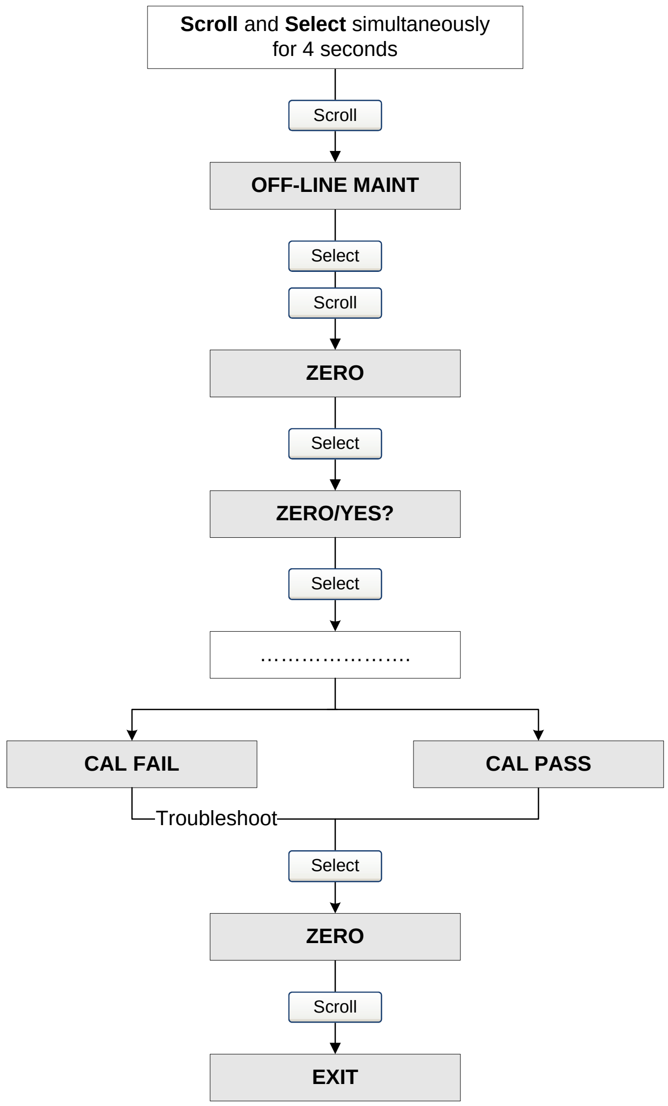


Figure 10-6 ProLink II – Flowmeter zero procedure

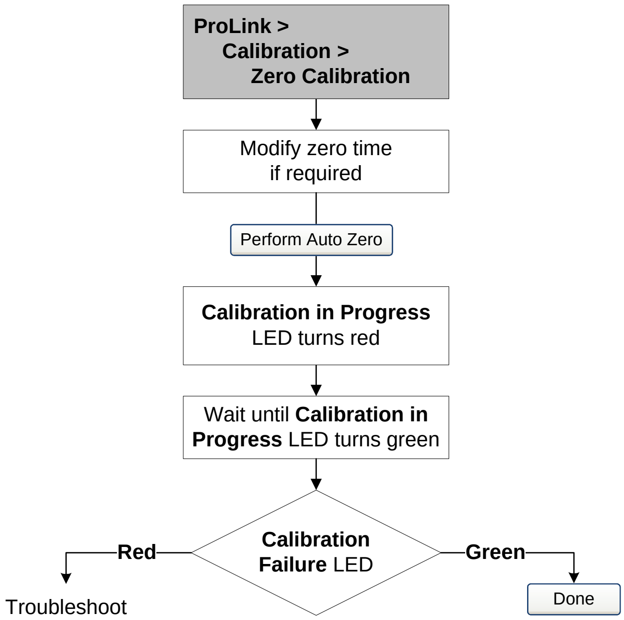
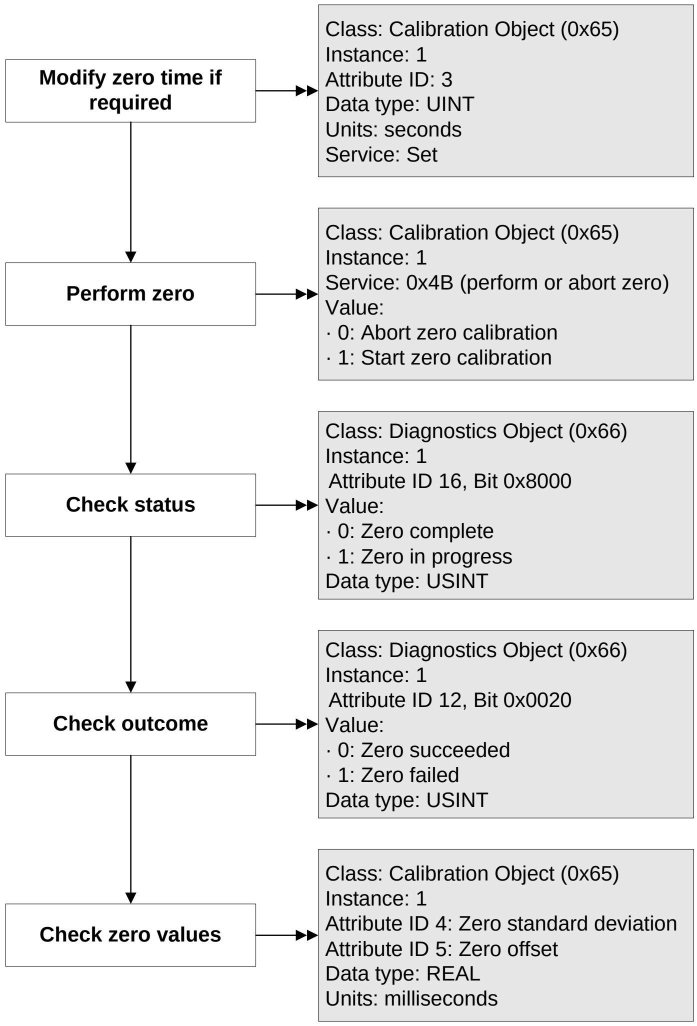


Figure 10-7 DeviceNet tool – Flowmeter zero procedure



10.6 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 a DeviceNet tool.

10.6.1 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

10.6.2 Density calibration procedures

To perform a D1 and D2 density calibration:

- With ProLink II, see Figure 10-8.
- With a DeviceNet tool, see Figure 10-9.

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

- With ProLink II, see Figure 10-10.
- With a DeviceNet tool, see Figure 10-11.

Figure 10-8 **D1 and D2 density calibration – ProLink II**

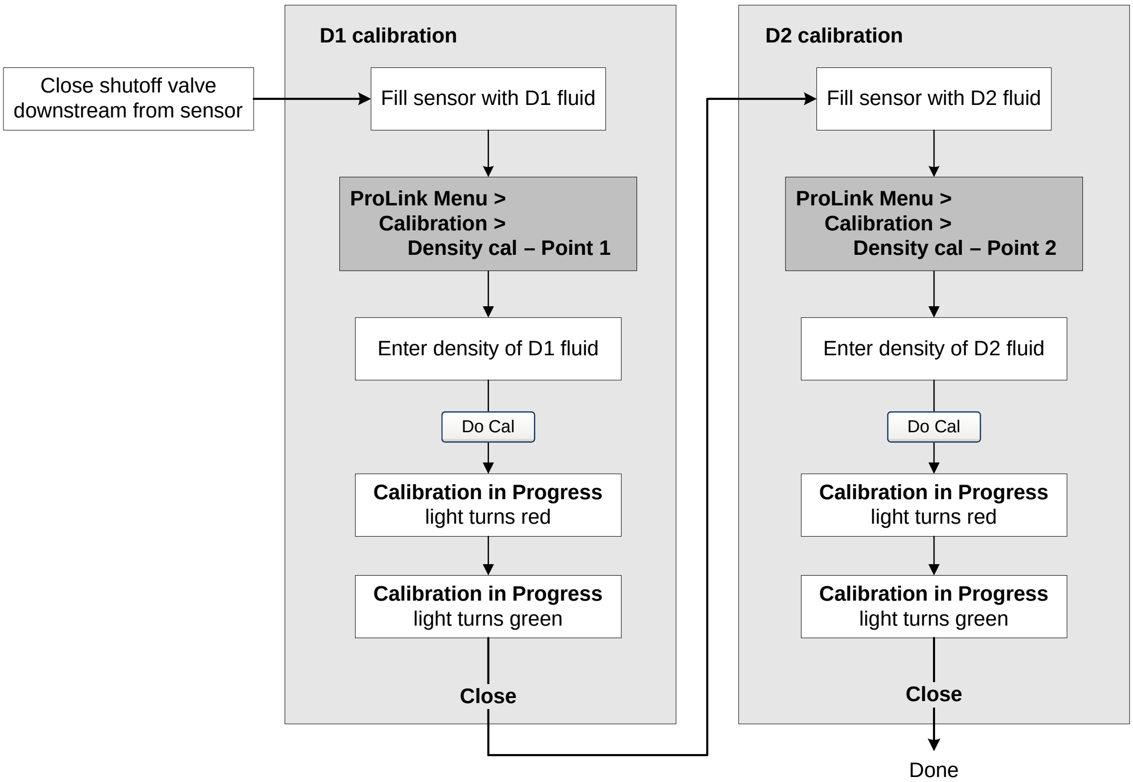


Figure 10-9 **D1 and D2 density calibration – DeviceNet tool**

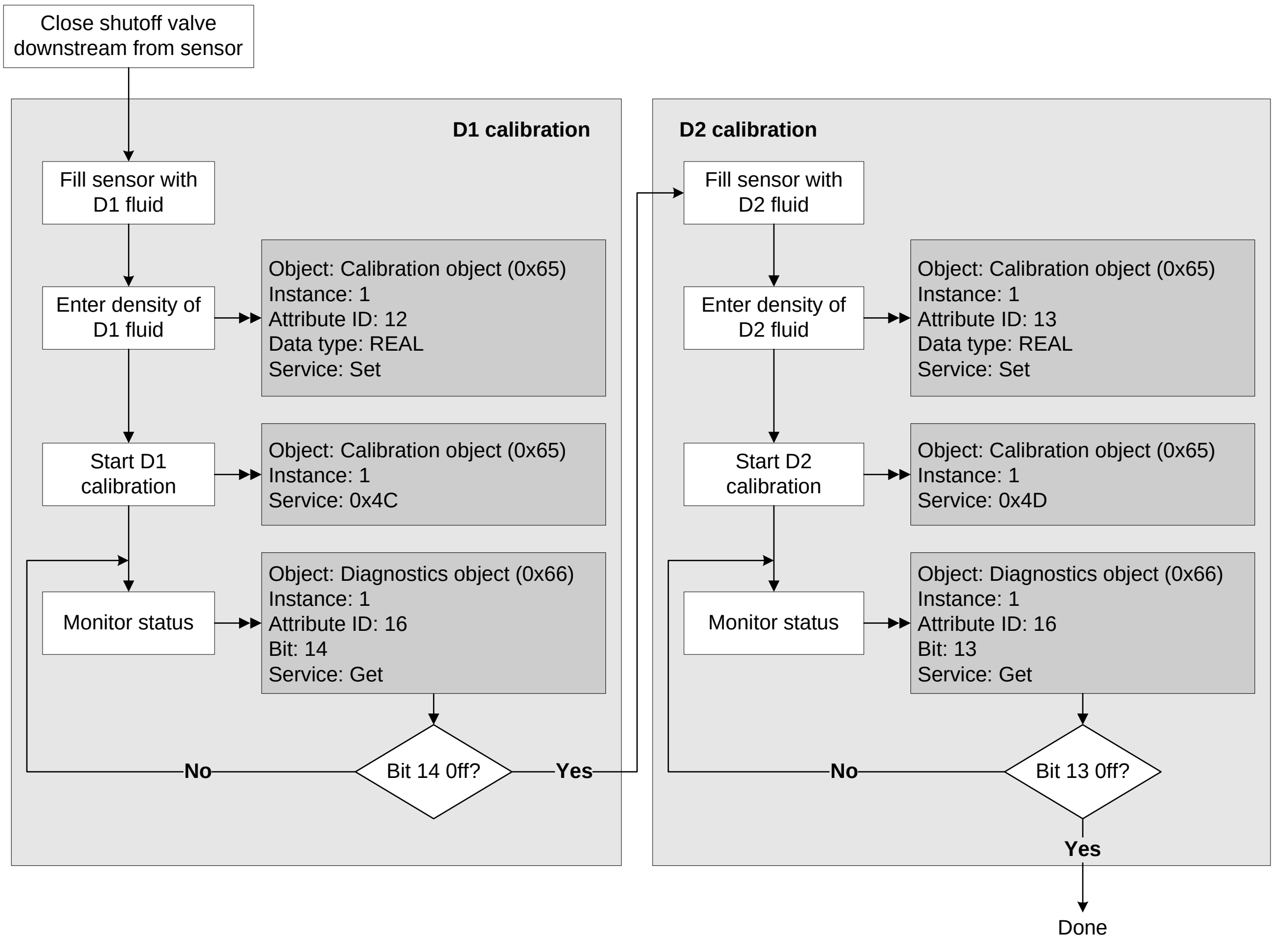


Figure 10-10 **D3 or D3 and D4 density calibration – ProLink II**

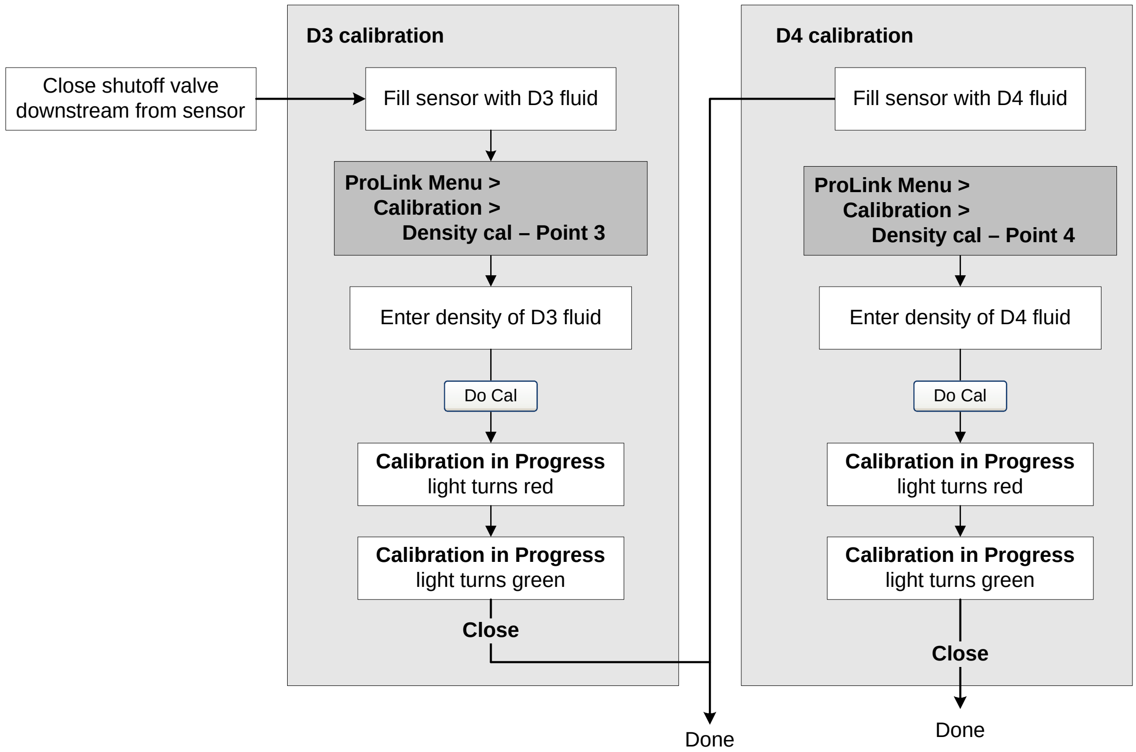
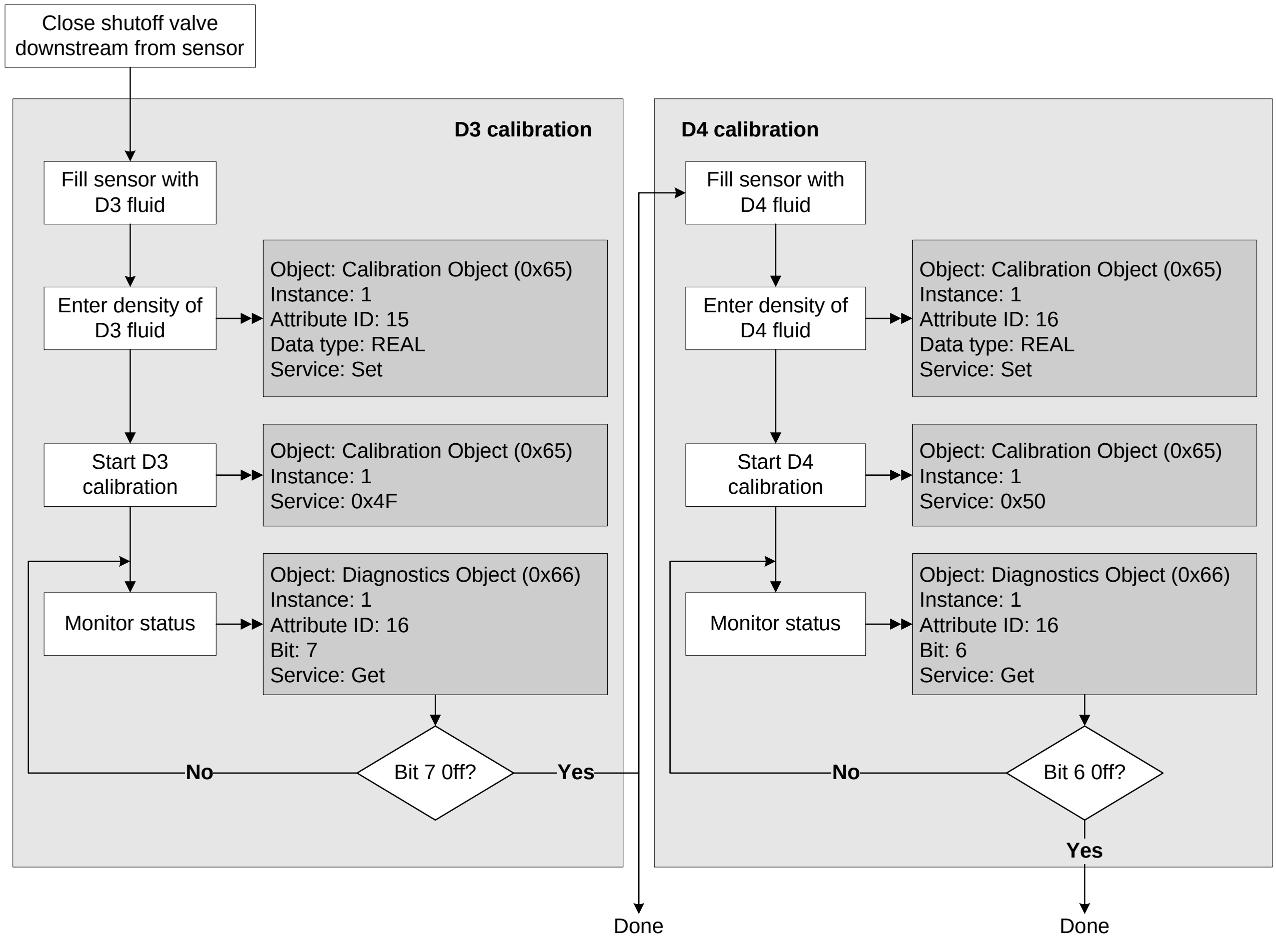


Figure 10-11 D3 or D3 and D4 density calibration – DeviceNet tool

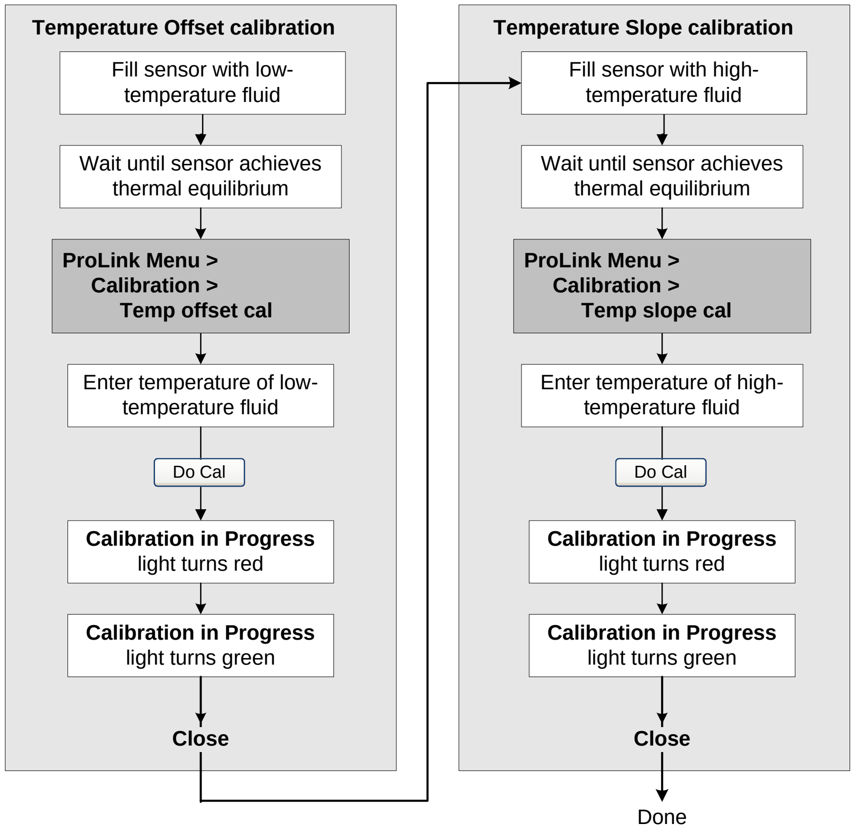


10.7 Performing temperature calibration

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

To perform temperature calibration, you must use ProLink II. See Figure 10-12.

Figure 10-12 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 chapter assume that you have established communication between ProLink II and the Model 2400S DN transmitter and that you are complying with all applicable safety requirements. See Chapter 4 for more information.

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

⚠ 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 DeviceNet tool procedures provided in this chapter assume that you have established communication between the DeviceNet tool and the Model 2400S DN transmitter and that you are complying with all applicable safety requirements. See Chapter 5 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	*Checking the communication device*
Section 11.7	*Diagnosing wiring problems*
Section 11.7.1	*Checking the DeviceNet cable and connector*

Table 11-1 Troubleshooting topics and locations *continued*

Section	Topic
Section 11.7.2	*Checking grounding*
Section 11.8	*Zero or calibration failure*
Section 11.9	*Fault conditions*
Section 11.10	*Simulation mode for process variables*
Section 11.11	*Transmitter LEDs*
Section 11.12	*Status alarms*
Section 11.13	*Checking process variables*
Section 11.14	*Checking slug flow*
Section 11.15	*Checking the sensor tubes*
Section 11.16	*Checking the flow measurement configuration*
Section 11.17	*Checking the characterization*
Section 11.18	*Checking the calibration*
Section 11.19	*Checking the test points*
Section 11.20	*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 1.10.

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 is not receiving power, all three LEDs on the user interface will be off.

1. Check the DeviceNet connector (see Section 11.7.1).
2. Ensure that the network is providing sufficient power to the device.

If at least one LED is lit, perform all of the procedures in Section 11.7.

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. Check the wiring and the communication device. See Chapter 4 for ProLink II and Pocket ProLink, or Chapter 5 for a DeviceNet tool.

If you are trying to communicate via the IrDA port, ensure that the port is enabled, that read-write access is enabled, and that there is no active connection via the service port clips. See Section 8.10.6.

If the transmitter is communicating via the service port but not via DeviceNet, if you are experiencing intermittent DeviceNet communications, or if the transmitter appears to be operating normally but you cannot establish a DeviceNet connection:

1. Verify the DeviceNet node address and baud rate for the transmitter. If necessary, change their values using the digital communications hardware switches on the user interface (see Sections 8.10.1 and 8.10.2), and retry the connection using the new digital communications parameters.
2. Check the DeviceNet cable and connector as described in Section 11.7.1.
3. A variety of network issues can cause communications problems (e.g., bus errors, bus traffic, too many nodes, insufficient power, shield voltage problems, or flat cable shorts). Follow your site's standard procedures for diagnosing and correcting these problems.

11.6 Checking the communication device

Ensure that your communication device is compatible with your transmitter.

ProLink II

ProLink II v2.5 or later is required. To check the version of ProLink II:

1. Start ProLink II.
2. Click **Help > About ProLink**.

Pocket ProLink

Pocket ProLink v1.3 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.

DeviceNet tool

The Model 2400S DN transmitter is compatible with all DeviceNet tools. Check that your DeviceNet tool is correctly configured and can make a connection to other devices on the network.

11.7 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 device is powered can subject the transmitter to environmental conditions that can cause an explosion.**
>
> Before removing the transmitter housing cover in explosive atmospheres, be sure to remove power from the device and wait five minutes.

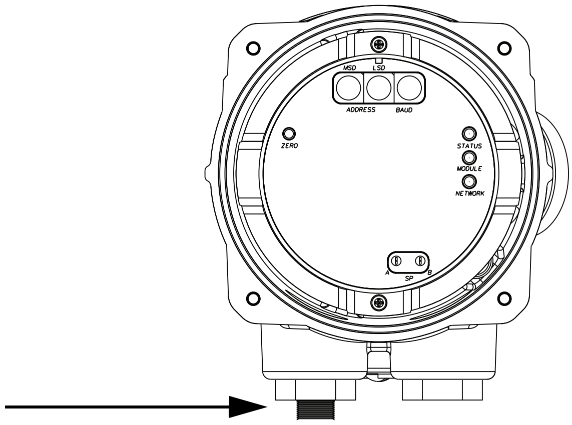
11.7.1 Checking the DeviceNet cable and connector

To check the DeviceNet cable and connector:

1. Follow appropriate procedures to ensure that the process of checking the DeviceNet cable and connector does not interfere with existing measurement and control loops.
2. Disconnect the DeviceNet cable from the connector on the transmitter. See Figure 11-1.

3. Visually inspect the cable and connector. Ensure that contact is good at both ends, that the pins are not bent, the cable is not crimped, and the cable covering is intact.
4. Retry the connection using a different cable.

Figure 11-1 DeviceNet connector



11.7.2 Checking grounding

The sensor / transmitter assembly must be grounded. See your sensor installation manual for grounding requirements and instructions.

11.8 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.

11.9 Fault conditions

If a fault is reported, determine the exact nature of the fault by checking the status alarms (see Section 7.6). 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:

- Zero failure
- Stopped internal totalizer

11.10 Simulation mode for process variables

Simulation allows you to define arbitrary values 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 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.

Simulation does not change any diagnostic values.

Simulation mode is available only via ProLink II. To set up simulation, refer to Figure B-3 and follow the steps below.

1. Enable simulation mode.
2. For mass flow:
   a. Specify the type of simulation you want: fixed value, sawtooth (triangular wave), or sine wave.
   b. Enter the required values.
      - If you specified fixed value simulation, enter a fixed value.
      - If you specified sawtooth or sine wave simulation, enter a minimum value, maximum value, and wave period. Minimum and maximum values are entered in the current measurement units; the wave period is entered in seconds.
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.

Be sure to disable simulation when testing is complete.

11.11 Transmitter LEDs

The user interface board includes three LEDs:

- A status LED. See Table 7-5 for information on status LED behavior. If the status LED indicates an alarm condition:
  a. View the alarm code using the procedures described in Section 7.5.
  b. Identify the alarm (see Section 11.12).
  c. Correct the condition.
  d. If desired, acknowledge the alarm using the procedures described in Section 7.6.
- A module LED. See Table 7-3 for information on the behavior of the module LED and suggestions on user response.
- A network LED. See Table 7-4 for information on the behavior of the network LED. The network LED indicates the state of the device on the network, and does not indicate device status. Troubleshooting should focus on the network rather than the device.

11.12 Status alarms

Status alarm codes are reported on the LCD panel (for transmitters that have a display), and status alarms can be viewed with ProLink II or a DeviceNet tool (see Section 7.6). All possible status alarms are listed in Table 11-2, along with the ProLink II message, possible causes, and suggested remedies.

You may find it useful to acknowledge all alarms before beginning the troubleshooting procedures. This will remove inactive alarms from the list and allow you to focus on active alarms.

Table 11-2 Status alarms and remedies

Alarm code	ProLink II message	Cause	Suggested remedy
A001	(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 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 Failure	Continuity failure of drive circuit, LPO, or RPO, or LPO-RPO mismatch when driving	• Check for slug flow. See Section 11.14. • Check the test points. See Section 11.19. • Check the sensor circuitry. See Section 11.20. • Check sensor tubes for plugging. • If the problem persists, contact Micro Motion. See Section 11.3.
A004	Temperature Sensor Failure	Combination of A016 and A017	• Check the sensor RTD circuitry. See Section 11.20. • Verify that process temperature is within range of sensor and transmitter. • If the problem persists, contact Micro Motion. See Section 11.3.
A005	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 11.14. • Check the test points. See Section 11.19. • Check the sensor circuitry. See Section 11.20. • Check the sensor tubes for erosion. See Section 11.15. • If the problem persists, contact Micro Motion. See Section 11.3.
A006	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 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 11.15). • Check for slug flow. See Section 11.14. • Check the sensor circuitry. See Section 11.20. • Verify calibration factors in transmitter configuration. See Section 6.2. • Check the test points. See Section 11.19. • If the problem persists, contact Micro Motion. See Section 11.3.

Table 11-2 Status alarms and remedies *continued*

Alarm code	ProLink II message	Cause	Suggested remedy
A009	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 11.20.
A010	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	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	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	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	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	The value computed for the resistance of the Line RTD is outside limits	• Check the sensor RTD circuitry. See Section 11.20. • 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	The value computed for the resistance of the Meter/Case RTD is outside limits	• Check the sensor RTD circuitry. See Section 11.20. • Verify that process temperature is within range of sensor and transmitter. • 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.
A020	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.
A021	Incorrect Sensor Type (K1)	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 11.20. • If the problem persists, contact Micro Motion. See Section 11.3.
A029	PIC/Daughterboard Communication Failure	Transmitter electronics failure	• Cycle power to the flowmeter. • Contact Micro Motion. See Section 11.3.

Table 11-2 Status alarms and remedies *continued*

Alarm code	ProLink II message	Cause	Suggested remedy
A030	Incorrect Board Type	The loaded software is not compatible with the programmed board type	• Contact Micro Motion. See Section 11.3.
A031	Low Power	The transmitter is not receiving enough power	• Check power supply to transmitter. See Section 11.4.
A032	Meter Verification/Outputs In Fault	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.
A033	Sensor OK, Tubes Stopped by Process	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 11.15).
A102	Drive Overrange/ Partially Full Tube	The drive power (current/voltage) is at its maximum	• Excessive drive gain. See Section 11.19.3. • Check the sensor circuitry. See Section 11.20. • If this is the only active alarm, it can be ignored. If desired, reconfigure the alarm severity to Ignore (see Section 8.8).
A104	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	The density has exceeded the user-defined slug (density) limits	• See Section 11.14.
A107	Power Reset Occurred	The transmitter has been restarted	• No action required. • If desired, reconfigure the alarm severity to Ignore (see Section 8.8).
A116	API: Temperature Outside Standard Range	The process temperature is outside API-defined extrapolation limits	• Verify process. • Verify API reference table and temperature configuration. See Section 8.13.
A117	API: Density Outside Standard Range	The process density is outside API-defined extrapolation limits	• Verify process. • Verify API reference table and density configuration. See Section 8.13.
A120	ED: Unable to Fit Curve Data	The configured values for density curves do not meet accuracy requirements	• Verify enhanced density configuration. See Section 8.14.
A121	ED: Extrapolation Alarm	Enhanced density calculations are outside the configured data range	• Verify process temperature. • Verify process density. • Verify enhanced density configuration. See Section 8.14.
A131	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.
A132	Simulation Mode Active	Simulation mode is enabled	• Disable simulation mode. See Section 11.10.
A133	PIC UI EEPROM Error	EEPROM data on the user interface module is corrupt	• Contact Micro Motion. See Section 11.3.

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

To view these values:

- With ProLink II, use the Status window and the Diagnostic Information window. Both of these windows are opened from the ProLink menu.
- Using the display, you must configure the display to show them. See Section 8.9.5.
- Using a DeviceNet tool, see Tables C-1 through C-5 and Table C-7.

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 11-3 lists several possible problems and suggested remedies.

Table 11-3 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 or restore the factory zero or prior zero. See Section 10.5.

Table 11-3 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 11.14.
	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 11.20.
	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 8.4.
	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 11.14.
	Damping value too low	• Check configuration. See Section 8.4.
	Plugged flow tube	• Check drive gain and tube frequency. Purge the flow tubes.
	Excessive or erratic drive gain	• See Section 11.19.3.
	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 11.20.
Inaccurate flow rate or batch total	Bad flow calibration factor	• Verify characterization. See Section 6.2.
	Inappropriate measurement unit	• Check configuration. See Section 11.16.
	Bad sensor zero	• Rezero the flowmeter or restore the factory zero or prior zero. See Section 10.5.
	Bad density calibration factors	• Verify characterization. See Section 6.2.
	Bad flowmeter grounding	• See Section 11.7.2.
	Slug flow	• See Section 11.14.
	Wiring problem	• Check the sensor circuitry. See Section 11.20.

Table 11-3 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 11.20.
	Bad flowmeter grounding	• See Section 11.7.2.
	Slug flow	• See Section 11.14.
	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 11.15.
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 11.14.
	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 11.15.
Unusually low pickoff voltages	Several possible causes	• See Section 11.19.4.
Unusually high drive gain	Several possible causes	• See Section 11.19.3.

11.14 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 8.7 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 8.7).
  - 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 8.7).

11.15 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.

11.16 Checking the flow measurement configuration

Using an incorrect flow measurement unit can cause the transmitter to report unexpected process variable values, 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 6.3.

11.17 Checking the characterization

A transmitter that is incorrectly characterized for its sensor might report inaccurate process variable values. Both the K1 and Flow Cal (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.

11.18 Checking the calibration

Improper calibration can cause the transmitter to report unexpected process variable values. If the transmitter appears to be operating correctly but sends unexpected process variable 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.

11.19 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.

11.19.1 Obtaining the test point values

To obtain the test point values:

- With the display, configure the required test points as display variables. See Section 8.9.5.
- With ProLink II
  a. Click **ProLink** > **Diagnostic Information**.
  b. Observe or record the values displayed for **Tube Frequency**, **Left Pickoff**, **Right Pickoff**, and **Drive Gain**.
- With a DeviceNet tool, execute a Get for the attributes listed in Table 11-4.

Table 11-4 Test points with DeviceNet tool

Test point	Class	Instance	Attribute
Drive gain	Diagnostics Object (0x66)	1	20
Tube period			21
Left pickoff			23
Right pickoff			24

11.19.2 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 11.19.3.
- If the value for the left or right pickoff does not equal the appropriate value from Table 11-5, based on the sensor flow tube frequency, refer to Section 11.19.4.
- If the values for the left and right pickoffs equal the appropriate values from Table 11-5, based on the sensor flow tube frequency, record your troubleshooting data and contact Micro Motion customer service. See Section 11.3.

Table 11-5 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.

11.19.3 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 11-6 for a list of possible problems and remedies.

Table 11-6 Drive gain problems, causes, and remedies

Cause	Possible remedy
Excessive slug flow	• See Section 11.14.
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.

11.19.4 Low pickoff voltage

Low pickoff voltage can be caused by several problems. See Table 11-7.

Table 11-7 Low pickoff voltage causes and remedies

Cause	Possible remedy
Slug flow	• See Section 11.14.
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 11.20. • Contact Micro Motion.

11.20 Checking sensor circuitry

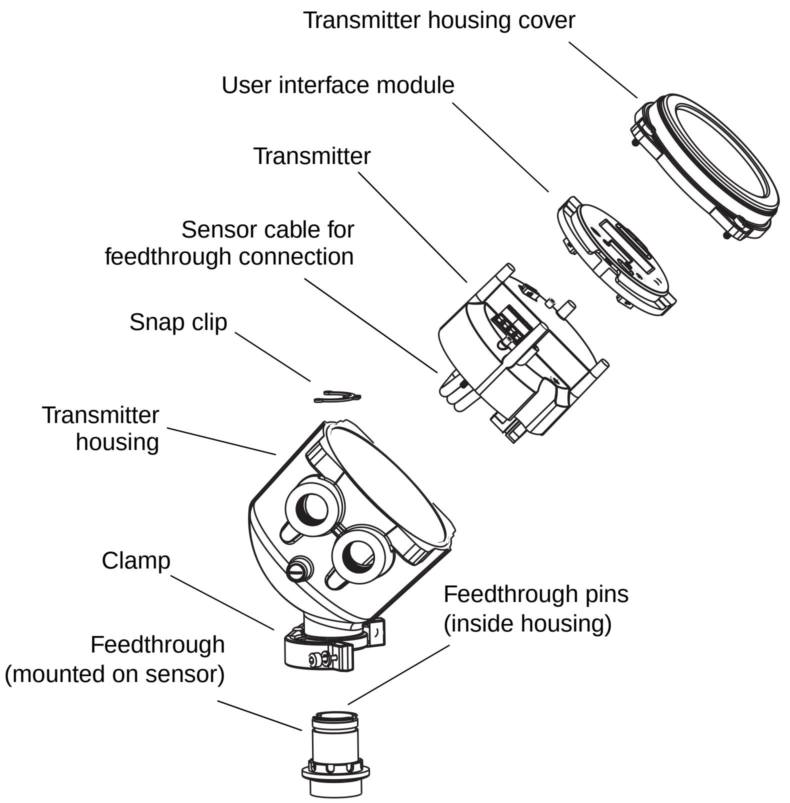
Problems with sensor circuitry can cause several alarms, including sensor failure and a variety of out-of-range conditions. Testing involves:

- 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.

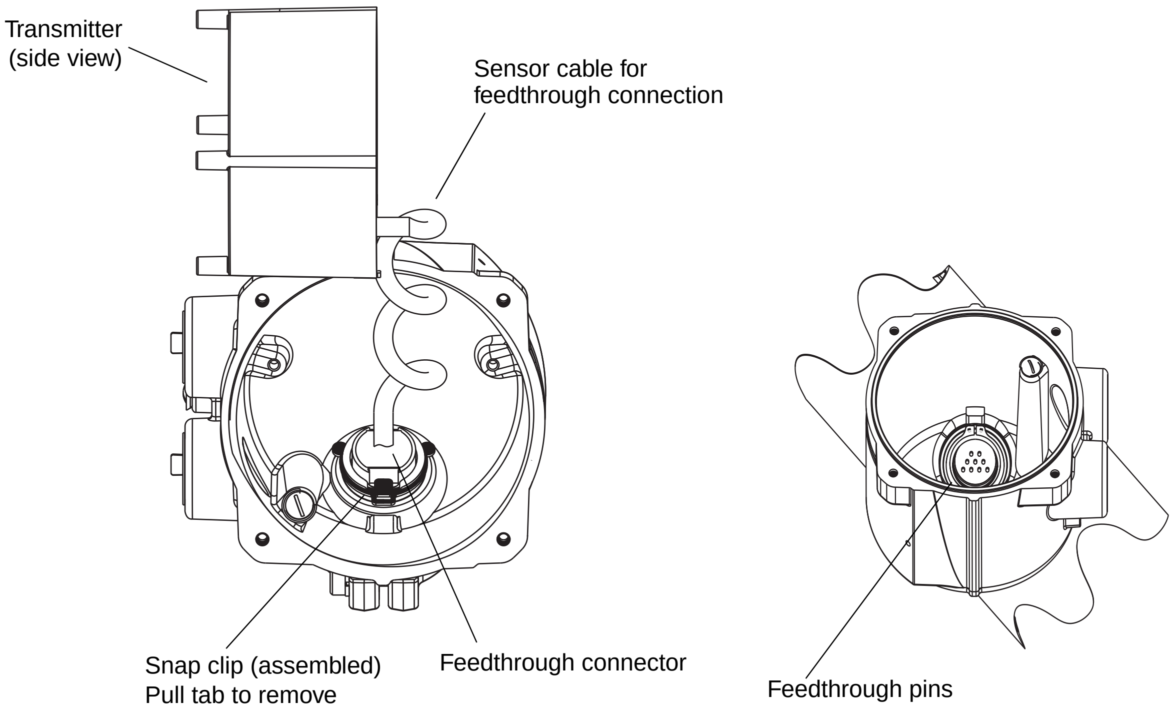
1. Follow appropriate procedures to ensure that the process of checking the sensor circuitry does not interfere with existing measurement and control loops.
2. Disconnect the DeviceNet cable from the DeviceNet connector on the Model 2400S DN transmitter.
3. If the transmitter is in a hazardous environment, wait five minutes.
4. Check the sensor cable and sensor connection:
   a. Referring to Figure 11-2, 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 by the cable.
   e. Check the cable for any signs of damage.
   f. Ensure that the cable is fully plugged in and making a good connection. If it is not, reseat the cable, reassemble the transmitter and sensor, and check operation.

Figure 11-2 Exploded view of transmitter and connection to sensor



5. If the problem is not resolved, unplug the cable from the feedthrough by removing the snap clip (see Figure 11-2), then pulling the connector away from the feedthrough. Set the transmitter aside.

Figure 11-3 Accessing the feedthrough pins



6. Using a digital multimeter (DMM), check the sensor internal resistances for each flowmeter circuit. Table 11-8 defines the flowmeter circuits and the resistance range for each. Refer to Figure 11-4 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 11-8 Nominal resistance ranges for flowmeter circuits

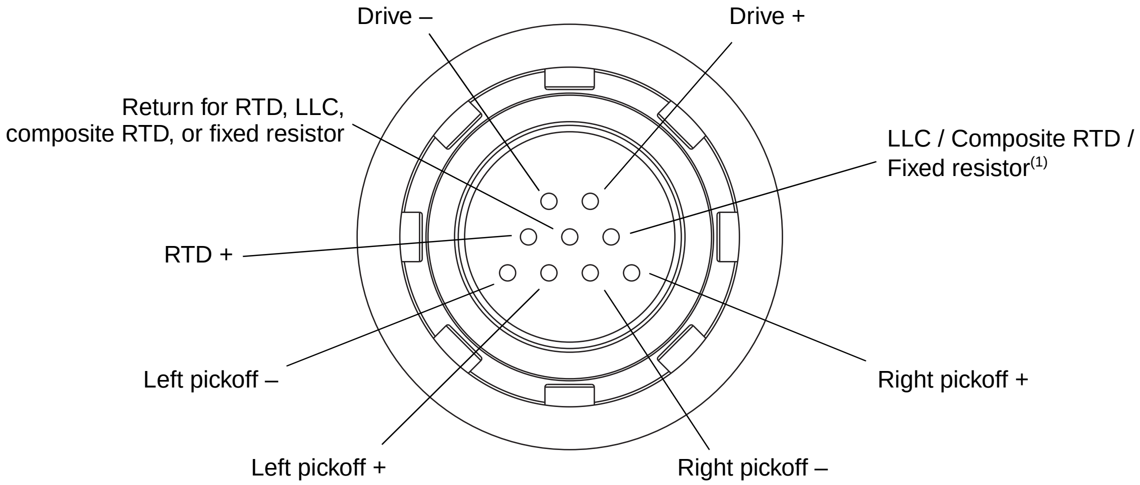
Circuit	Pin pairs	Nominal resistance range(1)
Drive	Drive + and –	8–1500 Ω
Left pickoff	Left pickoff + and –	16–1000 Ω
Right pickoff	Right pickoff + and –	16–1000 Ω

Table 11-8 Nominal resistance ranges for flowmeter circuits *continued*

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	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 11-4 Feedthrough pins



(1) Lead length compensator (LLC) for all sensors except T-Series, CMF400 I.S., and F300. For T-Series sensors, functions as composite RTD. For CMF400 I.S. and F300 sensors, functions as fixed resistor.

7. 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 11-9 for possible causes and solutions. If the problem is not resolved, contact Micro Motion (see Section 11.3).

Table 11-9 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. Plug the user interface module onto the transmitter. There are four possible positions; select the position that is most convenient.
5. Tighten the user interface screws.
6. Replace the transmitter housing cover on the user interface module, and tighten the screws.
7. Reinsert the DeviceNet cable into the DeviceNet connector on 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.
	Flow calibration factor	1.00005.13		For T-Series sensors,this value represents the FCF and FT factors concatenated. See Section 6.2.2.
	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		
	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 liters per second.
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		
Events 1–5	Type	Low		
	Variable	Density		
	Setpoint	0.0		
	Setpoint units	g/cm^3		

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	Density		
	Variable 6	Temperature		
	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		
Digital communi-cations	Fault action	None		
	Fault timeout	0 seconds	0.0–60.0 sec	
	Modbus address	1		
	Modbus ASCII support	Enabled		
	IrDA port enabled/disabled	Disabled		
	IrDA port write-protect	Disabled		
	Floating-point byte order	3–4–1–2		

Appendix B
Menu Flowcharts

B.1 Overview

This appendix provides the following menu flowcharts for the Model 2400S DN transmitter:

- ProLink II menus
  - Main menu – see Figure B-1
  - Configuration menu – see Figures B-2 and B-3
- Display menus
  - Off-line menu: Top level – see Figure B-4
  - Off-line maintenance: Version information – see Figure B-5
  - Off-line maintenance: Configuration – see Figure B-6
  - Off-line maintenance: Zero – see Figure B-7
  - Off-line maintenance: Meter verification – see Figure B-8

  For information on the codes and abbreviations used on the display, see Appendix D.

B.2 Version information

These menu flowcharts are based on:

- Transmitter software v1.0
- ProLink II v2.5

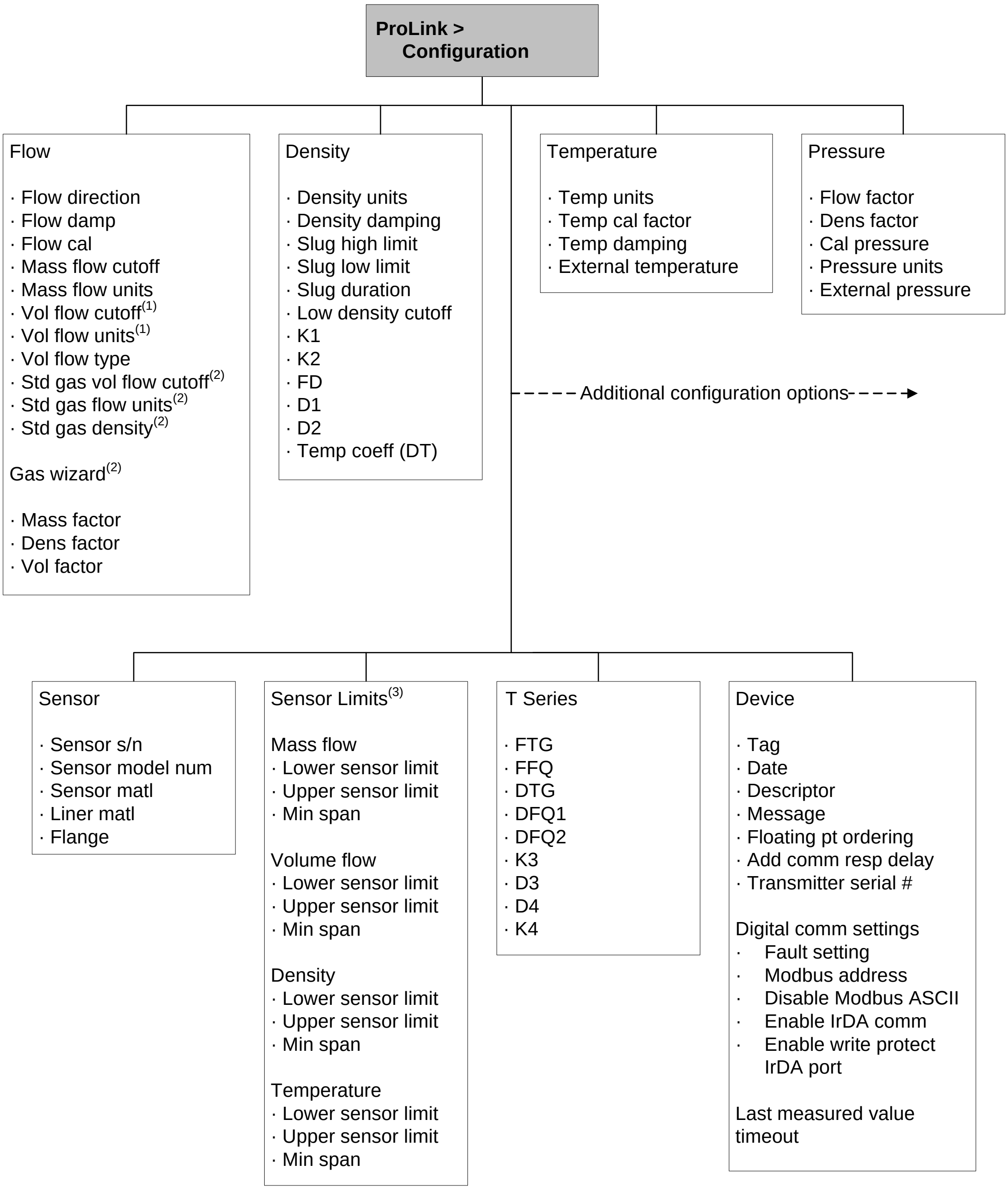
Menus may vary slightly for different versions of these components.

Figure B-1 ProLink II main menu

- **File**
  - Load from Xmtr to File
  - Save to Xmtr from File
  - License
- **View**
  - Preferences
    - · Use External Temperature
    - · Enable Inventory Totals Reset
    - · Enable External Pressure Compensation
    - · Copper RTD
  - Installed options
- **Connection**
  - Connect to Device
  - Disconnect
- **ProLink**
  - Configuration
  - Process Variables
  - Status
  - Alarm Log
  - Diagnostic Information
  - Calibration
  - Test
  - ED Totalizer Control(2)
  - Totalizer Control
  - Core Processor Diagnostics
  - API Process Variables(3)
  - ED Process Variables(2)
- **Tools**
  - Meter Verification
  - Options
    - · ProLink II Language
    - · Error Log On
- **Plug-ins**
  - Data Logging(1)

(1) *For information about using the data logging function, see the ProLink II manual.*
(2) *Available only if the enhanced density application is installed.*
(3) *Available only if the petroleum measurement application is installed.*

Figure B-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.
(3) All values on this panel are read-only, and are displayed only for informational purposes.

Figure B-3 ProLink II configuration menu *continued*

ProLink > Configuration

Display

- Var1
- Var2
- …
- Var 15

Display precision
- Var
- Number of decimals

Display options
- Display start/stop totalizers
- Display totalizer reset
- Display auto scroll
- Display offline menu
- Display offline password
- Display alarm menu
- Display ack all alarms
- Display back light on/off

- Offline password
- Auto scroll rate
- Update period
- Backlight intensity

- Display language

Transmitter options

- Meter fingerprinting
- Cryogenic modulus compensation
- Meter verification

Discrete events

- Event name
- Event type
- Process variable
- Low setpoint
- High setpoint

Discrete input(1)

- Start sensor zero
- Reset mass total
- Reset volume total
- Reset all totals
- Start/stop all totalization
- Reset gas standard volume total
- Reset API reference volume total
- Reset ED reference volume total
- Reset ED net mass total
- Reset ED net volume total
- Increment current ED curve

Alarm

- Alarm
- Severity

Sensor simulation

Enable simulation mode

Mass flow
- Wave form
- Fixed value
- Period
- Minimum
- Maximum

Density
- Wave form
- Fixed value
- Period
- Minimum
- Maximum

Temperatuare
- Fixed value
- Period
- Minimum
- Maximum

API setup(2)

- Table type
- Units

ED setup(3)

Global config
- Active curve
- Derived variable
- Lock/unlock ED curves

Curve specific config
- Curve configured
- Curve name
- Reference temperature
- Water reference temperature
- Water reference density
- Trim slope
- Trim offset

Extrapolation
- Alarm limit
- Enable density low
- Enable density high
- Enable temperature low
- Enable temperature high

Concentration
- Units
- Special unit string

ED curve(3)

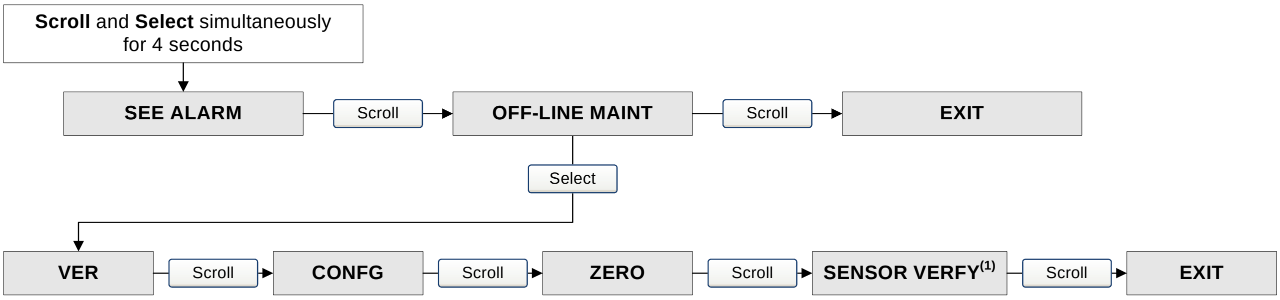
Process fluid density at specified temperature and concentration
- Curve being configured
- Curve fit max order
- Temperature isotherms
- Concentration

Curve fit results
- Accuracy

Process fluid density at reference temperature and specified concentration
- Reference temperature
- Concentration

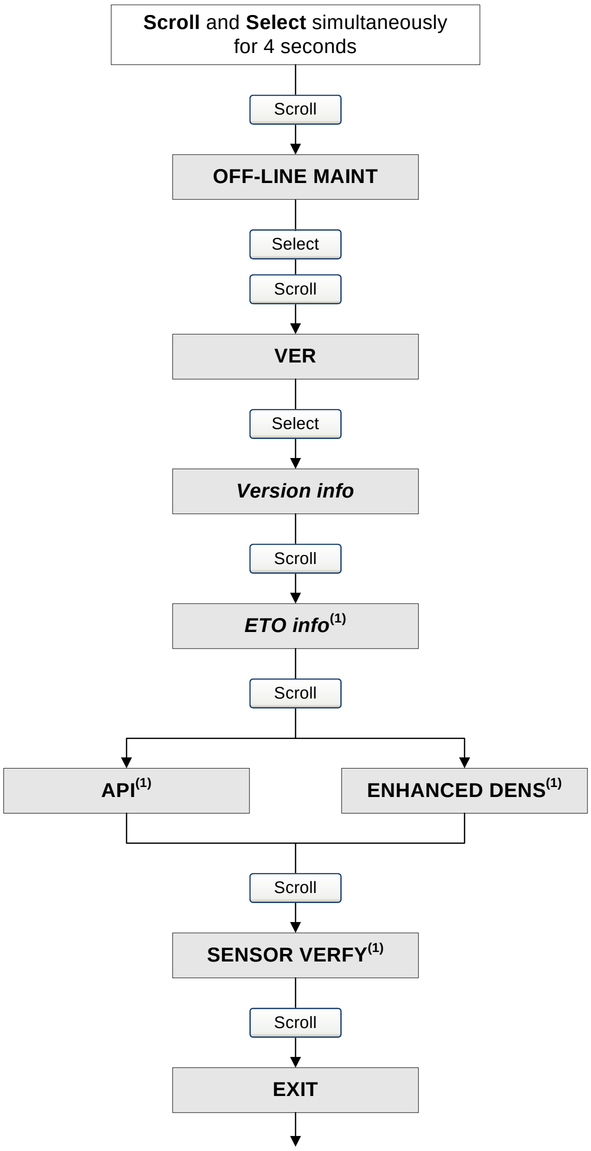
(1) Used to assign events to actions, even though the Model 2400S DN transmitter does not provide a discrete input.
(2) Available only if the petroleum measurement application is installed.
(3) Available only if the enhanced density application is installed.

Figure B-4 Display menu – Off-line menu, top level



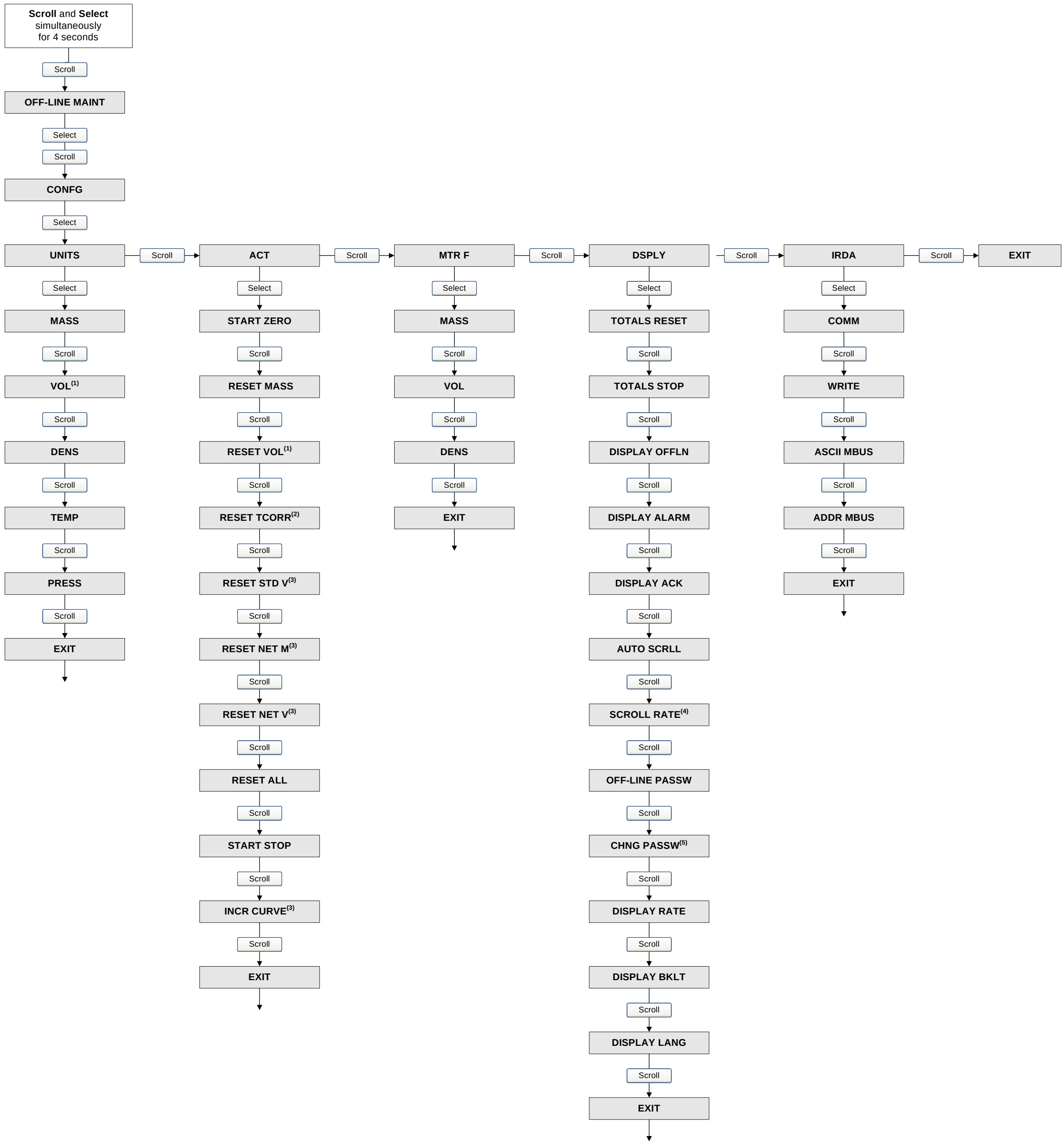
(1) This option is displayed only if the meter verification software is installed on the transmitter.

Figure B-5 Display menu – Off-line maintenance – Version information



(1) The option is displayed only if the corresponding Engineering To Order (ETO) or application is installed on the transmitter.

Figure B-6 Display menu – Off-line maintenance – Configuration



(1) Either Vol or GSV is displayed, depending on Volume Flow Type. See Section 8.2.
(2) Displayed only if the petroleum measurement application is installed.
(3) Displayed only if the enhanced density application is installed.
(4) Displayed only if Auto Scroll is enabled.
(5) Displayed only Off-Line Password is enabled.

Figure B-7 **Display menu – Off-line maintenance – Zero**

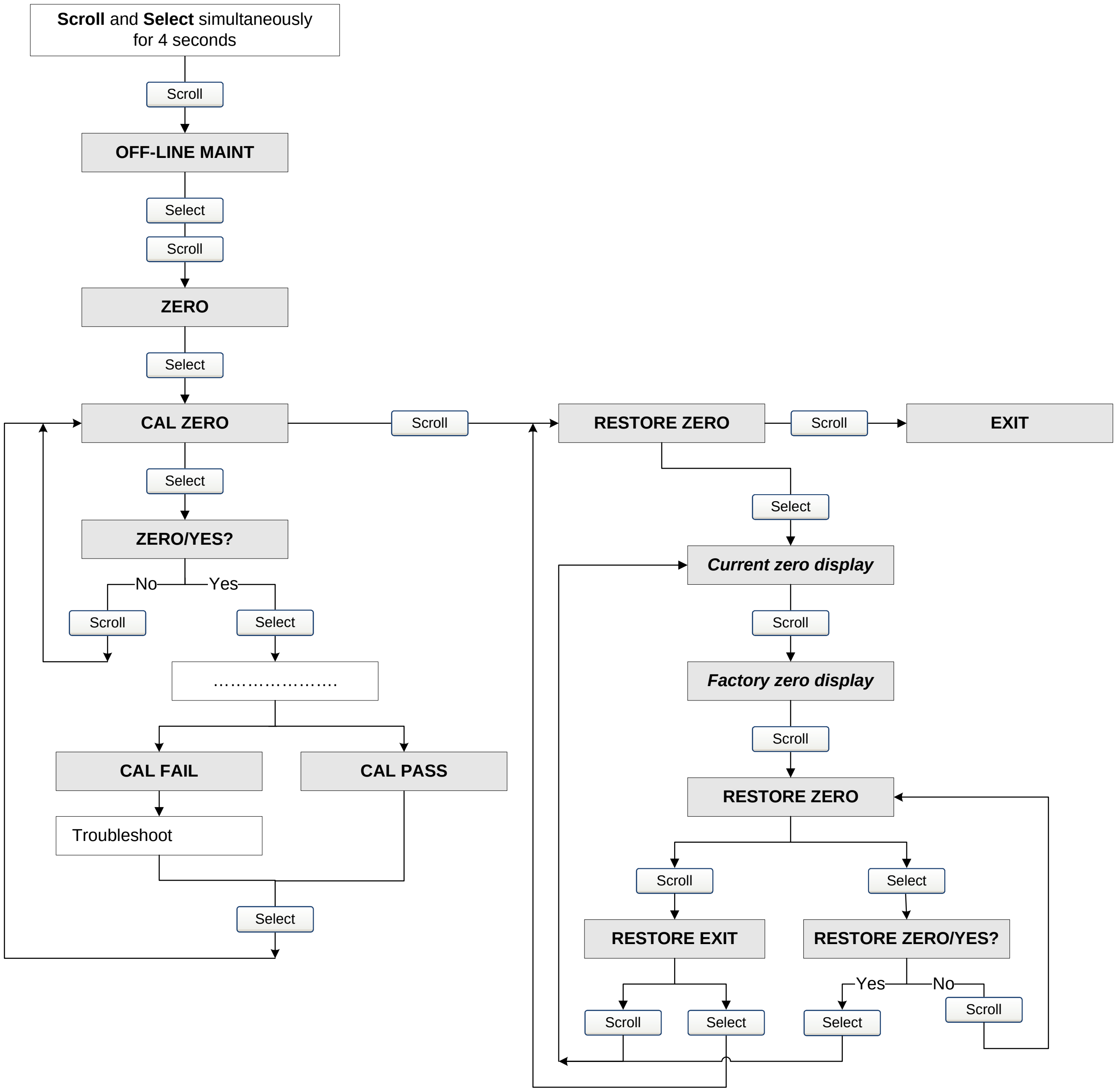
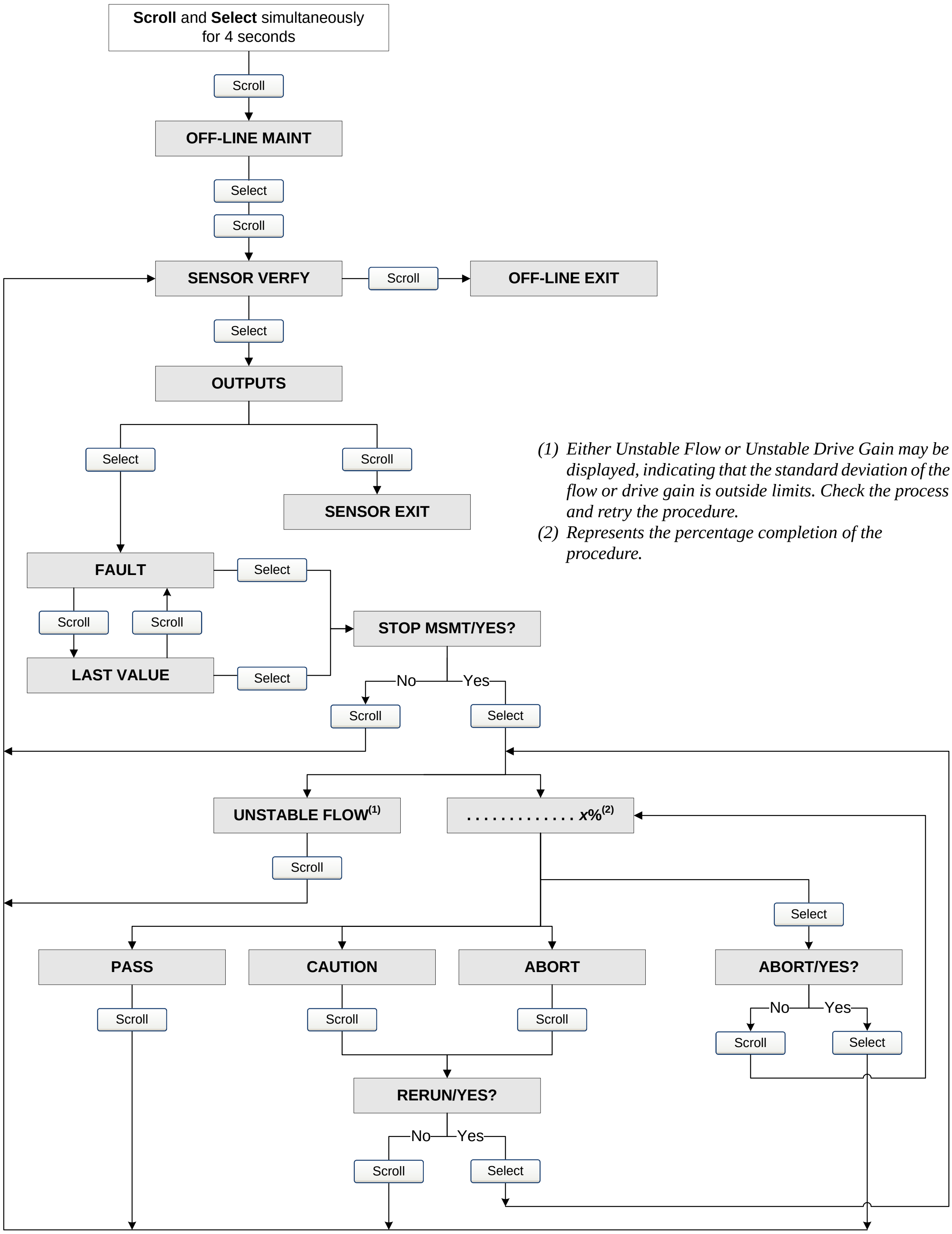


Figure B-8 Display menu – Off-line maintenance – Meter verification



(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.*

Appendix C
Device Profile

C.1 Overview

This appendix documents the most commonly used portions of the Model 2400S DN transmitter's device profile, including class/instance/attribute information and required codes.

The following object classes and instances are documented:

- Analog Input Point Object (0x0A), Instance 1 (mass flow) – see Table C-1
- Analog Input Point Object (0x0A), Instance 2 (liquid volume flow) – see Table C-2
- Analog Input Point Object (0x0A), Instance 3 (density) – see Table C-3
- Analog Input Point Object (0x0A), Instance 4 (temperature) – see Table C-4
- Gas Standard Volume Object (0x64), Instance 1 – see Table C-5
- Calibration Object (0x65), Instance 1 – see Table C-6
- Diagnostics Object (0x66), Instance 1 – see Table C-7
- Sensor Information Object (0x67), Instance 1 – see Table C-8
- Local Display Object (0x68), Instance 1 – see Table C-9
- API Object (0x69), Instance 1 – see Table C-10
- Enhanced Density Object (0x6A), Instance 1 – see Table C-11

Note: The listings for the Sensor Information and Enhanced Density Object instances are not complete: only the most commonly used attributes are shown here.

The following codes are documented:

- Totalizer and inventory measurement unit codes – see Tables C-12 through C-14
- Process variable codes – see Table C-15
- Alarm index codes – see Table C-16

For measurement unit codes used for process variables, see Section 6.3.

For complete documentation of the device profile, see the manual entitled *Micro Motion Model 2400S Transmitters for DeviceNet: Device Profile*.

C.2 Analog Input Point Object (0x0A)

Table C-1 Analog Input Point Object (0x0A) – Instance 1 (mass flow)

Attrib ID	Name	Data type	Service	Mem	Description	Comments
3	Value	REAL	Get	V	Current value of mass flow process variable	Based on Attribute 8
4	Status	BOOL	Get	V	Point status	• 0 = Good • 1 = Alarm state
8	Value data type	USINT	Get	V	Data type used to report mass flow process variable	• 1 = REAL
100	Process total	REAL	Get Reset(1)	V	Current value of mass total	
101	Inventory total	REAL	Get Reset(2)	V	Current value of mass inventory	
102	Value engineering units	UINT	Set	NV	Mass flow measurement unit	See Table 6-2 for unit codes.
103	Total engineering units	UINT	Get	V	Mass total and inventory units	Transmitter automatically determines this based on Attribute 102. See Table C-12 for unit codes.
104	Damping	REAL	Set	NV	Flow damping value	• Unit = seconds • Applied to both mass flow and liquid volume flow
105	Cutoff	REAL	Set	NV	Value below which mass flow will be reported as 0	
106	Meter factor	REAL	Set	NV	A multiplier to the calculated mass flow	
107	Flow direction	USINT	Set	NV	Determines how flow direction affects reported flow rate and flow totals	• 0 = Forward only • 1 = Reverse only • 2 = Bidirectional • 3 = Absolute value • 4 = Negate/forward only • 5 = Negate/ bidirectional
108	Reset mass total	USINT	Set	V	Resets the mass total	• 1 = Reset
109	Reset mass inventory	USINT	Set	V	Resets the mass inventory	• 1 = Reset

(1) Service code 0x4B.
(2) Service code 0x4C.

Table C-2 Analog Input Point Object (0x0A) – Instance 2 (liquid volume flow)

Attrib ID	Name	Data type	Service	Mem	Description	Comments
3	Value	REAL	Get	V	Current value of liquid volume flow process variable	Based on Attribute 8
4	Status	BOOL	Get	V	Point status	• 0 = Good • 1 = Alarm state
8	Value data type	USINT	Get	V	Data type used to report volume flow process variable	1 (REAL)
100	Process total	REAL	Get Reset(1)	V	Current value of liquid volume total	
101	Inventory total	REAL	Get Reset(2)	V	Current value of liquid volume inventory	
102	Value engineering units	UINT	Set	NV	Liquid volume flow measurement unit	See Table 6-3 for unit codes.
103	Total engineering units	UINT	Get	V	Liquid volume total and inventory units	Transmitter automatically determines this based on Attribute 102. See Table C-13 for unit codes.
105	Cutoff	REAL	Set	NV	Value below which liquid volume flow will be reported as 0	
106	Meter factor	REAL	Set	NV	A multiplier to the calculated liquid volume flow	
108	Reset volume total	USINT	Set	V	Resets the volume total	• 1 = Reset
109	Reset volume inventory	USINT	Set	V	Resets the volume inventory	• 1 = Reset

(1) Service code 0x4B.
(2) Service code 0x4C.

Table C-3 Analog Input Point Object (0x0A) – Instance 3 (density)

Attrib ID	Name	Data type	Service	Mem	Description	Comments
3	Value	REAL	Get	V	Current value of density process variable	Based on Attribute 8
4	Status	BOOL	Get	V	Point status	• 0 = Good • 1 = Alarm state
8	Value data type	USINT	Get	V	Data type used to report density process variable	1 (REAL)
102	Value engineering units	UINT	Set	NV	Density measurement unit	See Table 6-5 for unit codes.

Table C-3 Analog Input Point Object (0x0A) – Instance 3 (density) *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
104	Damping	REAL	Set	NV	Density damping value	Unit = seconds
105	Cutoff	REAL	Set	NV	Value below which density will be reported as 0	
106	Meter factor	REAL	Set	NV	A multiplier to the calculated density	

Table C-4 Analog Input Point Object (0x0A) – Instance 4 (temperature)

Attrib ID	Name	Data type	Service	Mem	Description	Comments
3	Value	REAL	Get	V	Current value of temperature process variable	Based on Attribute 8
4	Status	BOOL	Get	V	Point status	• 0 = Good • 1 = Alarm state
8	Value data type	USINT	Get	V	Data type used to report mass flow process variable	• 1 = REAL
102	Value engineering units	UINT	Set	NV	Temperature measurement unit	See Table 6-6 for unit codes.
104	Damping	REAL	Set	NV	Temperature damping value	Unit = seconds

C.3 Gas Standard Volume Object (0x64)

Table C-5 Gas Standard Volume Object (0x64) – Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Comments
1	Gas standard volume flow	REAL	Get	V	Current value of gas standard volume flow process variable	
2	Gas standard volume total	REAL	Get Reset(1)	V	Current value of gas standard volume total	
3	Gas standard volume inventory	REAL	Get Reset(2)	V	Current value of gas standard volume inventory	
4	Reference density	REAL	Set	NV	Reference density of gas being measured	
5	Gas standard volume flow units	UINT	Set	NV	Gas standard volume flow measurement unit	See Table 6-4 for unit codes.
6	Gas standard volume total and inventory units	UINT	Get	V	Gas standard volume total and inventory units	Transmitter automatically determines this based on Attribute 102. See Table C-14 for unit codes.

Table C-5 Gas Standard Volume Object (0x64) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
7	Enable gas standard volume	BOOL	Set	NV	Enable or disable gas standard volume measurement(3)	• 0 = Disabled • 1 = Enabled
8	Gas standard volume low flow cutoff	REAL	Set	NV	Value below which gas standard volume flow will be reported as 0	
9	Reset gas standard volume total	USINT	Set	V	Resets the gas standard volume total	• 1 = Reset
10	Reset gas standard volume inventory	USINT	Set	V	Resets the gas standard volume inventory	• 1 = Reset

(1) Service code 0x4B.
(2) Service code 0x4C.
(3) If gas standard volume measurement is enabled, liquid volume measurement is disabled, and vice versa.

C.4 Calibration Object (0x65)

Table C-6 Calibration Object (0x65) – Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Comments
1	Flow calibration factor	REAL	Set	NV	6-character flow calibration factor	
2	Temperature coefficient for flow	REAL	Set	NV	4-character temperature coefficient	
3	Zero time	UINT	Set	V	Duration of the zero calibration procedure	Unit = seconds
4	Zero standard deviation	REAL	Get	NV	The standard deviation result of the zero calibration service	
5	Zero offset	REAL	Set	NV	The offset result of the zero calibration service	
6	Calibration failed value	REAL	Get	V	The value of the calibration parameter if one of the calibration services fails	
7	K1	REAL	Set	NV	Density calibration constant 1	Unit = milliseconds
8	K2	REAL	Set	NV	Density calibration constant 2	Unit = milliseconds
9	FD	REAL	Set	NV	Flowing density calibration constant	Unit = milliseconds
10	K3	REAL	Set	NV	Density calibration constant 3	Unit = milliseconds
11	K4	REAL	Set	NV	Density calibration constant 4	Unit = milliseconds
12	D1	REAL	Set	NV	The line-condition density of D1 calibration service	Unit = g/cm^3

Table C-6 Calibration Object (0x65) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
13	D2	REAL	Set	NV	The line-condition density of D2 calibration service	Unit = g/cm^3
14	FD	REAL	Set	NV	The line-condition density of FD calibration service	Unit = g/cm^3
15	D3	REAL	Set	NV	The line-condition density of D3 calibration service	Unit = g/cm^3
16	D4	REAL	Set	NV	The line-condition density of D4 calibration service	Unit = g/cm^3
17	Density temperature coefficient	REAL	Set	NV	The DT or TC calibration factor	
18	FTG	REAL	Set	NV	T-Series: flow TG coefficient	
19	FFQ	REAL	Set	NV	T-Series: flow FQ coefficient	
20	DTG	REAL	Set	NV	T-Series: density TG coefficient	
21	DFQ1	REAL	Set	NV	T-Series: density FQ coefficient #1	
22	DFQ2	REAL	Set	NV	T-Series: density FQ coefficient #2	
23	Temperature offset	REAL	Set	NV	Temperature offset	
24	Temperature slope	REAL	Set	NV	Temperature slope	
25	Enable temperature comp	BOOL	Set	NV	Enable or disable temperature compensation	• 0 = Disabled • 1 = Enabled
26	External temperature	REAL	Set	V	The external temperature value from output assembly instance 51 or 52	
27	Enable pressure compensation	BOOL	Set	NV	Enable or disable pressure compensation	• 0 = Disabled • 1 = Enabled
28	External pressure	REAL	Set	V	The external pressure value from output assembly instance 50 or 52	
29	Pressure units	UINT	Set	NV	Units used by external pressure input	See Table 6-7 for unit codes.
30	Pressure factor flow	REAL	Set	NV	The pressure correction factor for flow	
31	Pressure factor density	REAL	Set	NV	The pressure correction factor for density	
32	Flow cal pressure	REAL	Set	NV	The flow calibration pressure	

C.5 Diagnostics Object (0x66)

Table C-7 Diagnostics Object (0x66) – Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Comments
1	Fault behavior	USINT	Set	NV	Specifies the behavior of the process variables when the device is in a fault state	• 0 = Upscale • 1 = Downscale • 2 = Zero • 3 = NAN • 4 = Flow goes to zero • 5 = None
2	Fault timeout	USINT	Set	NV	The amount of time after a fault ocurrs before the fault behavior (Attribute 1) is implemented	Unit = seconds
3	Slug time	REAL	Set	NV	The amount of time the density is outside the slug low limit and slug high limit before a slug flow condition is declared	Unit = seconds
4	Slug low limit	REAL	Set	NV	The lower limit of a slug flow condition	Unit = g/cm^3
5	Slug high limit	REAL	Set	NV	The upper limit of a slug flow condition	Unit = g/cm^3
6	Discrete event index	USINT	Set	V	The index of the discrete event that is being configured. There are 5 discrete events with the index starting at 0.	0, 1, 2, 3, 4
7	Discrete event type	USINT	Set	NV	The type of the selected discrete event	• 0 = Greater than Setpoint A • 1 = Less than Setpoint A • 2 = In Range (A=<*x*<=B) • 3 = Out of Range (A>=*x* or B<=*x*)
8	Discrete event Setpoint A	REAL	Set	NV	Setpoint A of the selected discrete event	
9	Discrete event Setpoint B	REAL	Set	NV	Setpoint B of the selected discrete event	
10	Discrete event process variable	USINT	Set	NV	The process variable on which the selected discrete event is defined	See Table C-15 for process variable codes. All codes are valid except for 52 (Input voltage).
11	Discrete event status	USINT	Get	V	Each bit contains the status of the corresponding discrete event: • 0 = Inactive • 1 = Active	• 0x01 = Event 0 • 0x02 = Event 1 • 0x04 = Event 2 • 0x08 = Event 3 • 0x10 = Event 4

Table C-7 Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
12	Alarm status 1	UINT	Get	V	A collection of status bits	• 0x0001 = NV error (CP) • 0x0002 = RAM error (CP) • 0x0004 = RTI failure • 0x0008 = Sensor failure • 0x0010 = Temperature out of range • 0x0020 = Calibration failed • 0x0040 = Other failure • 0x0080 = Transmitter initializing • 0x0100 = Not used • 0x0200 = Not used • 0x0400 = Simulation mode On • 0x0800 = Not used • 0x1000 = Watchdog error • 0x2000 = Not used • 0x4000 = Not used • 0x8000 = Fault
13	Alarm status 2	UINT	Get	V	A collection of status bits	• 0x0001 = Not used • 0x0002 = Not used • 0x0004 = Not used • 0x0008 = Not used • 0x0010 = Density out of range • 0x0020 = Drive out of range • 0x0040 = CEM communications error • 0x0080 = Not used • 0x0100 = Non-volatile memory error (CP) • 0x0200 = RAM error (CP) • 0x0400 = Sensor failure • 0x0800 = Temperature out of range • 0x1000 = Input out of range • 0x2000 = Not used • 0x4000 = Transmitter not characterized • 0x8000 = RTI failure

Table C-7 Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
14	Alarm status 3	UINT	Get	V	A collection of status bits	• 0x0001 = Not used • 0x0002 = Power reset • 0x0004 = Transmitter initializing • 0x0008 = Transmitter/sensor communications fault (A28) • 0x0010 = Not used • 0x0020 = Not used • 0x0040 = Not used • 0x0080 = Transmitter/sensor communications fault (A26) • 0x0100 = Calibration failed • 0x0200 = Calibration failed: Low • 0x0400 = Calibration failed: High • 0x0800 = Calibration failed: Noisy • 0x1000 = Transmitter failed • 0x2000 = Data loss • 0x4000 = Calibration in progress • 0x8000 = Slug flow

Table C-7 Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
15	Alarm status 4	UINT	Get	V	A collection of status bits	• 0x0001 = API: Temperature out of range • 0x0002 = API: Density out of range • 0x0004 = Line RTD out of range • 0x0008 = Meter RTD out of range • 0x0010= Reverse flow • 0x0020 = Factory data error • 0x0040 = ED: bad curve • 0x0080 = LMV override • 0x0100 = ED: Extrapolation error • 0x0200 = Need calibration factor • 0x0400 = Non-volatile memory error (2700) • 0x0800 = RAM error (2700) • 0x1000= Transmitter not characterized • 0x2000 = Non-volatile memory error (CP) • 0x4000 = Non-volatile memory error (CP) • 0x8000 = Non-volatile memory error (CP)
16	Alarm status 5	UINT	Get	V	A collection of status bits	• 0x0001 = Boot sector (CP) • 0x0002 = Not used • 0x0004 = Not used • 0x0008 = Not used • 0x0010 = Not used • 0x0020 = Not used • 0x0040 = Not used • 0x0080 = Not used • 0x0100 = D3 calibration in progress • 0x0200 = D4 calibration in progress • 0x0400 = Temperature slope calibration in progress • 0x0800 = Temperature offset calibration in progress • 0x1000 = FD calibration in progress • 0x2000 = D2 calibration in progress • 0x4000 = D1 calibration in progress • 0x8000 = Zero calibration in progress

Table C-7 Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
17	Alarm status 6	UINT	Get	V	A collection of status bits	• 0x0001 = Not used • 0x0002 = Not used • 0x0004 = Not used • 0x0008 = Not used • 0x0010 = Not used • 0x0020 = Not used • 0x0040 = Not used • 0x0080 = Not used • 0x0100 = Discrete event 0 active • 0x0200 = Discrete event 1 active • 0x0400 = Discrete event 2 active • 0x0800 = Discrete event 3 active • 0x1000 = Discrete event 4 active • 0x2000 = Not used • 0x4000 = Not used • 0x8000 = Incorrect board type
18	Alarm index	USINT	Set	V	Used to configure or read alarm severity, or to acknowledge alarms	See Table C-16 for alarm index codes.
19	Alarm severity	USINT	Set	NV	The alarm severity of the alarm that corresponds with the alarm index	• 0 = Ignore • 1 = Info • 2 = Fault
20	Drive gain	REAL	Get	V	The drive gain	%
21	Raw tube period	REAL	Get	V	The tube frequency	Unit = Hz
22	Live zero (mass flow)	REAL	Get	V	The unfiltered value of mass flow	Configured mass flow units
23	LPO voltage	REAL	Get	V	The left pickoff voltage	Unit = volts
24	RPO voltage	REAL	Get	V	The right pickoff voltage	Unit = volts
25	Board temperature	REAL	Get	V	The temperature on the board	Unit = °C
26	Maximum electronics temperature	REAL	Get	V	The maximum temperature of the electronics	Unit = °C
27	Minimum electronics temperature	REAL	Get	V	The minimum temperature of the electronics	Unit = °C
28	Average electronics temperature	REAL	Get	V	The average temperature of the electronics	Unit = °C
29	Maximum sensor temperature	REAL	Get	V	The maximum temperature of the sensor	Unit = °C
30	Minimum sensor temperature	REAL	Get	V	The minimum temperature of the sensor	Unit = °C
31	Average sensor temperature	REAL	Get	V	The average temperature of the sensor	Unit = °C

Table C-7 Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
32	9-wire cable RTD resistance	REAL	Get	V	The resistance of the 9-wire cable	Unit = ohms
33	Meter RTD resistance	REAL	Get	V	The resistance of the meter RTD	Unit = ohms
34	Number of power cycles	UINT	Get	V	The number of transmitter power cycles	
35	Power on time	Unsigned 32	Get Reset(1)	V	The cumlative amount of time the tranmitter has been on since the last reset (Class 0x01, Attribute 0x05)	Seconds since last reset
36	Line RTD	REAL	Get	V	The resistance of the process line RTD	Unit = ohms
37	Actual target amplitude	REAL	Get	V	The amplitude the transmitter is attempting to drive the sensor	Unit = mV/HZ
38	Input voltage	REAL	Get	V	The number of volts on the power input terminals	Unit = volts
39	Drive current	REAL	Get	V	The drive current	Unit = milliamps
40	Alarm 7	UINT	Get	V	A collection of status bits	• 0x0001 = K1/FCF Combination Unrecognized • 0x0002 = Warming Up • 0x0004 = Low Power • 0x0008 = Tube not Full • 0x0010 = Meter Ver Fault • 0x0020 = Meter Ver Info • 0x0040 =UI PROM error • 0x0080 = Not Used • 0x0100 = Not Used 0x0200 = Not Used • 0x0400 = Not Used • 0x0800 = Not Used • 0x1000 = Not Used • 0x2000 = Not Used • 0x4000 = Not Used • 0x8000 = Not Used

Table C-7 Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
41	Alarm 8	UINT	Get	V	A collection of status bits	• 0x0001 = Not used • 0x0002 = Not used • 0x0004 = Not used • 0x0008 = Not used • 0x0010 = Not used • 0x0020 = Not used • 0x0040 = Not used • 0x0080 = Not used • 0x0100 = Not used • 0x0200 = Not used • 0x0400 = Not used • 0x0800 = Not used • 0x1000 = Not used • 0x2000 = Not used • 0x4000 = Not used • 0x8000 = Not used
42	Alarm status	USINT	Set	V	The status of the alarm selected in Attribute 18. Write 0x00 to acknowledge the alarm selected in Attribute 18.	• 0x00 = Acked /Cleared • 0x01 = Acked/Active • 0x10 = Not Acked/Cleared • 0x11 = Not Acked/Active
43	Alarm count	UINT	Get	V	The number of inactive-to-active transitions of the alarm selected in Attribute 18	
44	Alarm last posted	Unsigned 32	Get	V	The number of seconds since the last reset that the alarm selected in Attribute 18 was posted	Seconds since last reset
45	Alarm last cleared	Unsigned 32	Get	V	The number of seconds since the last reset that the alarm selected in Attribute 18 was cleared	Seconds since last reset
46	Alarm history index	USINT	Set	V	The entry in the alarm history log	Range: 0–49
47	Alarm history alarm number	USINT	Get	V	The alarm number that corresponds to the alarm history entry selected in Attribute 45	1 = A001, 2 = A002, etc.
48	Alarm history alarm status changed	USINT	Get	V	The alarm status change that corresponds to the alarm history entry selected in Attribute 45	• 1 = Posted • 2 = Cleared
49	Alarm history alarm status changed timestamp	Unsigned 32	Get	V	The timestamp of the alarm status change that corresponds to the alarm history entry selected in Attribute 45	Seconds since last reset
54	Meter verification algorithm state	USINT	Get	V	The current state of the meter verification routine	1–18

Table C-7 Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
55	Meter verification abort code	USINT	Get	V	The reason the meter verification routine aborted	• 0 = No error • 1 = Manual abort • 2 = Watchdog timeout • 3 = Frequency drift • 4 = High peak drive voltage • 5 = High drive current standard deviation • 6 = High drive current mean • 7 = Drive loop reported error • 8 = High Delta T standard deviation • 9 = High Delta T value • 10 = State running • 11 = Verification complete • 12 = Wrong verification enable • 13 = No factory air verification • 14 = No factory water verification • 15 = Parameters not set
56	Meter verification algorithm state at abort	USINT	Get	V	The state of the meter verification routine when it aborted	1–18
57	Meter verification percent complete	USINT	Get	V	The progress of the meter verification routine	%
58	Meter verification outputs state	USINT	Set	NV	The state of the outputs when the meter verification routine is running	• 0 = Last value • 1 = Fault
59	Meter verification stiffness limit	REAL	Set	NV	The setpoint of the stiffness limit. Represents percentage.	Unitless
60	Meter verification validation counter	UINT	Get	NV	Indicates the number of times the meter verification routine has successfully completed	
61	Meter verification inlet stiffness out of limits	USINT	Get	V	Is the inlet stiffness out of limits?	• 0 = No • 1 = Yes
62	Meter verification outlet stiffness out of limits	USINT	Get	V	Is the outlet stiffness out of limits?	• 0 = No • 1 = Yes

Table C-7 Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
63	Meter verification – current inlet stiffness, mean	REAL	Get	NV	The current inlet stiffness calculated as a mean	
64	Meter verification – current outlet stiffness, mean	REAL	Get	NV	The current outlet stiffness calculated as a mean	
65	Meter verification – current damping, mean	REAL	Get	NV	The current damping calculated as a mean	
66	Meter verification – current inlet mass, mean	REAL	Get	NV	The current inlet mass calculated as a mean	
67	Meter verification – current outlet mass, mean	REAL	Get	NV	The current outlet mass calculated as a mean	
68	Meter verification – current inlet stiffness, SD	REAL	Get	NV	The current inlet stiffness calculated as a standard deviation	
69	Meter verification – current outlet stiffness, SD	REAL	Get	NV	The current outlet stiffness calculated as a standard deviation	
70	Meter verification – current damping, SD	REAL	Get	NV	The current damping calculated as a standard deviation	
71	Meter verification – current inlet mass, SD	REAL	Get	NV	The current inlet mass calculated as a standard deviation	
72	Meter verification – current outlet mass, SD	REAL	Get	NV	The current outlet mass calculated as a standard deviation	
73	Meter verification – current inlet stiffness, factory cal of air, mean	REAL	Get	NV	The inlet stiffness calculated as a mean during factory calibration of air	
74	Meter verification – current outlet stiffness, factory cal of air, mean	REAL	Get	NV	The outlet stiffness calculated as a mean during factory calibration of air	
75	Meter verification – current damping, factory cal of air, mean	REAL	Get	NV	The damping calculated as a mean during factory calibration of air	

Table C-7 Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
76	Meter verification – current inlet mass, factory cal of air, mean	REAL	Get	NV	The inlet mass calculated as a mean during factory calibration of air	
77	Meter verification – current outlet mass, factory cal of air, mean	REAL	Get	NV	The outlet mass calculated as a mean during factory calibration of air	
78	Meter verification – current inlet stiffness, factory cal of water, mean	REAL	Get	NV	The inlet stiffness calculated as a mean during factory calibration of water	
79	Meter verification – current outlet stiffness, factory cal of water, mean	REAL	Get	NV	The outlet stiffness calculated as a mean during factory calibration of water	
80	Meter verification – current damping, factory cal of water, mean	REAL	Get	NV	The damping calculated as a mean during factory calibration of water	
81	Meter verification – current inlet mass, factory cal of water, mean	REAL	Get	NV	The inlet mass calculated as a mean during factory calibration of water	
82	Meter verification – current outlet mass, factory cal of water, mean	REAL	Get	NV	The outlet mass calculated as a mean during factory calibration of water	

Table C-7 Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
83	Factory flow signal offset at zero flow	REAL	Get	NV	The flow signal offset at zero flow when calibrated at the factory	Unit = microseconds
84	Discrete event action code	USINT	Set	V	The action that will be performed by the event specified in Attribute 85	• 1 = Start sensor zero • 2 = Reset mass total • 3 = Reset volume total • 4 = Reset API volume total • 5 = Reset ED volume total • 6 = Reset ED net mass total • 7 = Reset ED net volume total • 8 = Reset all totals • 9 = Start/stop all totals • 18 = Increment ED curve • 21 = Reset GSV total
85	Discrete event assignment	USINT	Set	NV	The discrete event that is assigned to the action referenced in Attribute 84	• 57 = Discrete event 1 • 58 = Discrete event 2 • 59 = Discrete event 3 • 60 = Discrete event 4 • 61 = Discrete event 5 • 251 = None

(1) Service code 0x4D.

C.6 Sensor Information Object (0x67)

Table C-8 Sensor Information Object (0x67) – Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Comments
1	Sensor serial number	UDINT	Set	NV	The serial number of the sensor	
2	Sensor type	SHORT STRING	Get	NV	A string that represents the type of sensor	For example, F200, CMF025
3	Sensor type code	USINT	Set	NV	The type of sensor	• 0 = Curved tube • 1 = Straight tube

Table C-8 Sensor Information Object (0x67) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
4	Sensor material	USINT	Set	NV	The material of the sensor's case	• 0 = None • 3 = Hastelloy C-22 • 4 = Monel • 5 = Tantalum • 6 = Titanium • 19 = 316L stainless steel • 23 = Inconel • 252 = Unknown • 253 = Special
5	Liner material	USINT	Set	NV	The material of the sensor's liner	• 0 = None • 10 = PTFE (Teflon) • 11 = Halar • 16 = Tefzel • 251 = None • 252 = Unknown • 253 = Special
6	Flange type	USINT	Set	NV	The type of process connection on the sensor	• 0 = ANSI 150 • 1 = ANSI 300 • 2 = ANSI 600 • 5 = PN 40 • 7 = JIS 10K • 8 = JIS 20K • 9 = ANSI 900 • 10 = Sanitary clamp fitting • 11 = Union • 12 = PN 100 • 252 = Unknown • 253 = Special

C.7 Local Display Object (0x68)

Table C-9 Local Display Object (0x68) – Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Comments
1	Scroll rate	USINT	Set	NV	The rate at which each variable will be displayed	Unit = seconds
2	Backlight control	BOOL	Set	NV	Whether the backlight is on or off	• 0 = Off • 1 = On
3	Backlight intensity	USINT	Set	NV	The brightness of the backlight	0 (off) to 63 (full on)
4	Display variable 1	USINT	Set	V	Displays the variable associated with the code on the local display	See Table C-15 for codes. All codes are valid except for 251 (None).

Table C-9 Local Display Object (0x68) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
5	Display variable 2	USINT	Set	NV	Displays the variable associated with the code on the local display	See Table C-15 for codes. All codes are valid.
6	Display variable 3					
7	Display variable 4					
8	Display variable 5					
9	Display variable 6					
10	Display variable 7					
11	Display variable 8					
12	Display variable 9					
13	Display variable 10					
14	Display variable 11					
15	Display variable 12					
16	Display variable 13					
17	Display variable 14					
18	Display variable 15					
19	Enable start/stop totals	BOOL	Set	NV	Enable or disable the ability to start and stop totals from the local display	• 0 = Disabled • 1 = Enabled
20	Enable reset totals	BOOL	Set	NV	Enable or disable the ability to reset totals from the local display	• 0 = Disabled • 1 = Enabled
21	Enable auto scroll	BOOL	Set	NV	Enable or disable the auto scroll feature. The scroll rate is set using Attribute 1.	• 0 = Disabled • 1 = Enabled
22	Enable offline menu	BOOL	Set	NV	Enable or disable the offline menu	• 0 = Disabled • 1 = Enabled
23	Enable alarm menu	BOOL	Set	NV	Enable or disable the alarm menu	• 0 = Disabled • 1 = Enabled
24	Enable ACK All alarms	BOOL	Set	NV	Enable or disable the ability to acknowledge all the alarms at once	• 0 = Disabled • 1 = Enabled
25	Enable IrDA write protect	BOOL	Set	NV	Enable or disable the write-protect feature on the IrDA port	• 0 = Disabled (reading and writing allowed) • 1 = Enabled (read only)

Table C-9 Local Display Object (0x68) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
26	Enable offline password	BOOL	Set	NV	Enable or disable the password requirement to access the offline menu	• 0 = Disabled • 1 = Enabled
27	Offline password	UINT	Set	NV	The offline password for entering the offline menu	0–9999
28	Update period	UINT	Set	NV	The period in which the display is updated	Unit = milliseconds
29	Process variable index	USINT	Set	V	The process variable in which the precision will be set in Attribute 30	See Table C-15 for codes.
30	Process variable precision	USINT	Set	NV	The number of digits displayed to the right of the decimal point for the process variable selected with Attribute 29	0–5
31	Language	USINT	Set	NV	Display language selection	• 0 = English • 1 = German • 2 = French • 3 = Katakana(1) • 4 = Spanish
32	Enable IrDA port	USINT	Set	NV	Enable or disable the IrDA port	• 0 = Disabled • 1 = Enabled

(1) Not available in this release.

C.8 API Object (0x69)

Table C-10 API Object (0x69) – Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Comments
1	Temperature corrected density	REAL	Get	V	Current value	
2	Temperature corrected (standard) volume flow	REAL	Get	V	Current value	
3	Temperature corrected (standard) volume total	REAL	Get Reset(1)	V	Current value	
4	Temperature corrected (standard) volume inventory	REAL	Get Reset(2)	V	Current value	
5	Batch weighted average density	REAL	Get	V	Current value	
6	Batch weighted average temperature	REAL	Get	V	Current value	

Table C-10 API Object (0x69) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
7	CTL	REAL	Get	V	Current value	
8	API reference temperature	REAL	Set	NV	The reference temperature to use in the API calculations	
9	API thermal expansion coefficient	REAL	Set	NV	The thermal expansion coefficient to use in the API calculations	
10	API 2540 CTL table type	USINT	Set	NV	The table type to use in the API calculations	• 17 = Table 5A • 18 = Table 5B • 19 = Table 5D • 36 = Table 6C • 49 = Table 23A • 50 = Table 23B • 51 = Table 23D • 68 = Table 24C • 81 = Table 53A • 82 = Table 53B • 83 = Table 53D • 100 = Table 54C
11	Reset API reference volume total	USINT	Set	V	Resets the API reference volume total	• 1 = Reset
12	Reset API reference volume inventory	USINT	Set	V	Resets the API reference volume inventory	• 1 = Reset

(1) Service code 0x4B.
(2) Service code 0x4C.

C.9 Enhanced Density Object (0x6A)

Table C-11 Enhanced Density Object (0x6A) – Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Comments
1	Density at reference	REAL	Get	V	Current value	
2	Density (fixed SG units)	REAL	Get	V	Current value	
3	Standard volume flow rate	REAL	Get	V	Current value	
4	Standard volume total	REAL	Get Reset(1)	V	Current value	
5	Standard volume inventory	REAL	Get Reset(2)	V	Current value	
6	Net mass flow rate	REAL	Get	V	Current value	
7	Net mass flow total	REAL	Get Reset(3)	V	Current value	

Table C-11 Enhanced Density Object (0x6A) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
8	Net mass flow inventory	REAL	Get Reset(4)	V	Current value	
9	Net volume flow rate	REAL	Get	V	Current value	
10	Net volume flow total	REAL	Get Reset(5)	V	Current value	
11	Net volume flow inventory	REAL	Get Reset(6)	V	Current value	
12	Concentration	REAL	Get	V	Current value	
13	Density (fixed Baume units)	REAL	Get	V	Current value	
15	Derived variable	USINT	Set	NV		• 0 = None • 1 = Density at reference temperature • 2 = Specific gravity • 3 = Mass concentration (density) • 4 = Mass concentration (specific gravity) • 5 = Volume concentration (density) • 6 = Volume concentration (specific gravity) • 7 = Concentration (density) • 8 = Concentration (specific gravity)
16	Active calculation curve	USINT	Set	NV	The number of the curve that is currently active	0–5
38	$Curve_n$ ASCII string	SHORT STRING	Set	NV	The name of the active curve	24 characters maximum
39	Enable enhanced density application	BOOL	Set	NV		• 0 = Disabled • 1 = Enabled
47	Reset standard volume total	USINT	Set	V	Resets the standard volume total	• 1 = Reset
48	Reset standard volume inventory	USINT	Set	V	Resets the standard volume inventory	• 1 = Reset
49	Reset net mass total	USINT	Set	V	Resets the net mass total	• 1 = Reset

Table C-11 Enhanced Density Object (0x6A) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Comments
50	Reset net mass inventory	USINT	Set	V	Resets the net mass inventory	• 1 = Reset
51	Reset net volume total	USINT	Set	V	Resets the net volume total	• 1 = Reset
52	Reset net volume inventory	USINT	Set	V	Resets the net volume inventory	• 1 = Reset

(1) Service code 0x4B.
(2) Service code 0x4F.
(3) Service code 0x4C.
(4) Service code 0x50.
(5) Service code 0x4D.
(6) Service code 0x51.

C.10 Totalizer and inventory measurement unit codes

Table C-12 Mass totalizer and mass inventory measurement unit codes

Code	Description
0x2501	Gram
0x2500	Kilogram
0x2503	Metric ton
0x2505	Pound
0x2506	Short ton (2000 pounds)
0x080E	Long ton (2240 pounds)

Table C-13 Liquid volume totalizer and liquid volume inventory measurement unit codes

Code	Description
0x2E08	Gallon
0x2E02	Liter
0x0822	Imperial gallon
0x2E01	Cubic meter
0x2E0C	Barrel(1)
0x2E06	Cubic foot
0x0857	Beer barrel(2)

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

Table C-14 Gas standard volume totalizer and gas standard volume inventory measurement unit codes

Code	Description
0x0844	Standard cubic feet
0x0845	Normal cubic meters
0x0846	Standard cubic meters
0x0847	Normal liter
0x0848	Standard liter

C.11 Process variable codes

Table C-15 Process variable codes

Code	Description
0	Mass flow rate
1	Temperature
2	Mass total
3	Density
4	Mass inventory
5	Volume flow rate
6	Volume total
7	Volume inventory
15	API: Temperature-corrected density
16	API: Temperature-corrected (standard) volume flow
17	API: Temperature-corrected (standard) volume total
18	API: Temperature-corrected (standard) volume inventory
19	API: Batch weighted average temperature
20	API: Batch weighted average temperature
21	Enhanced density: Density at reference temperature
22	Enhanced density: Density (fixed SG units)
23	Enhanced density: Standard volume flow rate
24	Enhanced density: Standard volume total
25	Enhanced density: Standard volume inventory
26	Enhanced density: Net mass flow rate
27	Enhanced density: Net mass total
28	Enhanced density: Net mass inventory
29	Enhanced density: Net volume flow rate
30	Enhanced density: Net volume total
31	Enhanced density: Net volume inventory
32	Enhanced density: Concentration
33	API: CTL
46	Tube frequency
47	Drive gain

Table C-15 **Process variable codes** *continued*

Code	Description
48	Case temperature
49	Left pickoff amplitude
50	Right pickoff amplitude
51	Board temperature
52	Input voltage
53	External pressure
55	External temperature
56	Enhanced density: Density (Baume)
62	Gas standard volume flow rate
63	Gas standard volume total
64	Gas standard volume inventory
69	Live zero
251	None

C.12 Alarm index codes

Table C-16 **Alarm index codes**

Code	Description
1	(E)EPROM checksum error (CP)
2	RAM error (CP)
3	Sensor failure
4	Temperature sensor failure
5	Input overrange
6	Not configured
7	RTI failure
8	Density overrange
9	Transmitter initializing/warming up
10	Calibration failure
11	Zero too low
12	Zero too high
13	Zero too noisy
14	Transmitter failed
16	Line RTD Temperature out-of-range
17	Meter RTD temperature out-of-range
20	Incorrect sensor type (K1)
21	Invalid sensor type
22	NV error (CP)
23	NV error (CP)
24	NV error (CP)
25	Boot failure (core processor)

Table C-16 Alarm index codes *continued*

Code	Description
26	Sensor/transmitter communications error
27	Security breach
28	Core processor exception
29	Core processor communications error
30	Invalid board type
31	Low power
32	Meter verification fault alarm
33	Tubes not full
42	Drive overrange
43	Data loss possible
44	Calibration in progress
45	Slug flow
47	Power reset
56	API: Temperature out of limits
57	API: Density out of limits
60	Enhanced density: bad fit
61	Enhanced density: extrapolation alarm
71	Meter verification info alarm
72	Simulation mode active

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 8.9.5 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 6.3.

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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