Instruction Manual
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Micro Motion® LF-Series Transmitters with FOUNDATION™ Fieldbus

Configuration and Use Manual

Micro Motion™

EMERSON™
Process Management

Contents

Chapter 1
Starting the Flowmeter

1.1 Overview

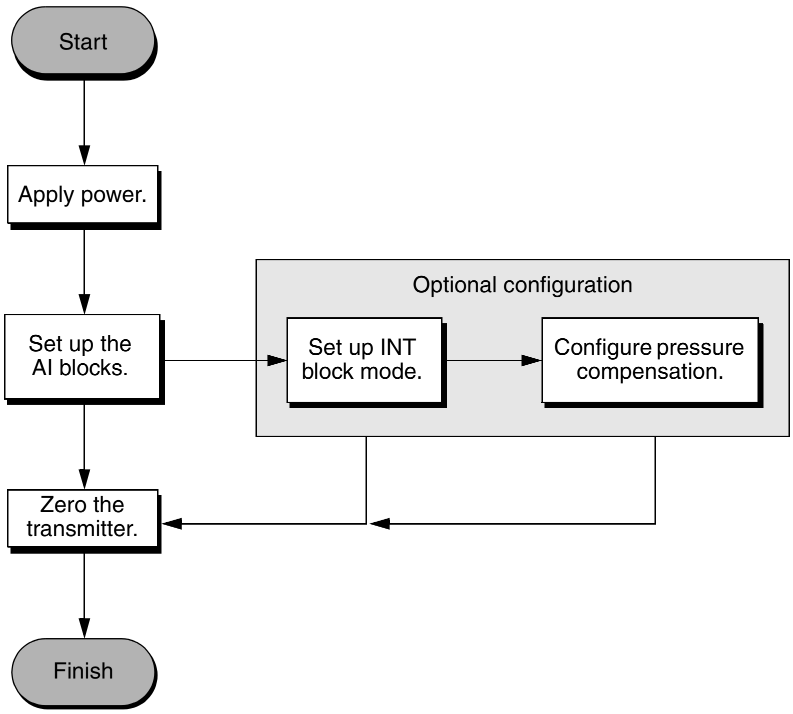
This chapter describes the procedures you should perform the first time you start up the flowmeter. You do not need to use these procedures every time you cycle power to the flowmeter.

The procedures in this section will enable you to:

- Apply power to the flowmeter
- Assign analog input (**AI**) function blocks to transducer block channels
- Assign the integrator (**INT**) function block mode (optional)
- Zero the flowmeter

Figure 1-1 summarizes the startup procedure.

Figure 1-1 **Overview of the startup procedure**



Note: All ProLink II procedures provided in this section assume that your computer is already connected to the transmitter and you have established communication. See Appendix A.

⚠ WARNING

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

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

1.2 Applying power

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

⚠ WARNING

Operating the flowmeter without covers in place creates electrical hazards that can cause death, injury, or property damage.

Make sure safety barrier partition and covers for the field-wiring, circuit board compartments, electronics module, and housing are in place before applying power to the transmitter.

Turn on the electrical power at the power supply. The flowmeter will automatically perform diagnostic routines. If the transmitter has a display, the status LED will turn green and begin to flash when the transmitter has finished its startup diagnostics.

1.3 Assigning function block channels

The four **AI** function blocks and the **AO** function block may be assigned to one transducer block channel each. The available transducer block channels are shown in Table 1-1.

Table 1-1 Available transducer block channels

Channel Number	Process Variable	Function Block
1	Mass Flow	Analog Input
2	Temperature	Analog Input
3	Density	Analog Input
4	Volume Flow	Analog Input
5	Drive Gain	Analog Input
6	Pressure	Analog Output
19(1)	Gas Standard Volume	Analog Input

(1) Channel 19 is selectable only if the GSV_GAS_DENS parameter in the MEASUREMENT transducer block is nonzero.

To assign an **AI** or A**O** function block to a transducer block channel:

1. Select an **AI** or **AO** function block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *out-of-service* (*O/S*).
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **CHANNEL** parameter to the transducer block channel you want to set up.
5. Set the **UNITS** value of the **XD_SCALE** parameter.
6. Set the **UNITS** value of the **OUT_SCALE** to match the **UNITS** value of the **XD_SCALE** parameter.
7. Set the **L_TYPE** parameter to *Direct*.
8. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto* and write to the transmitter.

1.4 Assigning the integrator function block mode

The **INT** function block can be set up to measure the totalizer in fifteen different ways. Except for standard mode, each mode causes the **INT** function block to report the value of a specific transducer block parameter.

Table 1-2 lists the available modes for the **INT** block.

Table 1-2 INT function block modes

	Reports the value of this parameter:	
Mode	Transducer block	Parameter
Standard	None	None — standard FOUNDATION fieldbus INT block behavior
Internal mass total	MEASUREMENT	MASS_TOTAL
Internal volume total	MEASUREMENT	VOLUME_TOTAL
Internal mass inventory	MEASUREMENT	MASS_INVENTORY
Internal volume inventory	MEASUREMENT	VOLUME_INVENTORY
Internal gas volume total	MEASUREMENT	GSV_VOL_TOTAL
Internal gas volume inventory	MEASUREMENT	GSV_VOL_INV
Internal API volume total	API	API_CORR_VOL_TOTAL
Internal API volume inventory	API	API_CORR_VOL_INV
Internal ED standard volume total	ENHANCED DENSITY	ED_STD_VOL_TOTAL
Internal ED standard volume inventory	ENHANCED DENSITY	ED_STD_VOL_INV
Internal ED net mass total	ENHANCED DENSITY	ED_NET_MASS_TOTAL
Internal ED net mass inventory	ENHANCED DENSITY	ED_NET_MASS_INV
Internal ED net volume total	ENHANCED DENSITY	ED_NET_VOL_TOTAL
Internal ED net volume inventory	ENHANCED DENSITY	ED_NET_VOL_INV

The **INTEGRATOR_FB_CONFIG** parameter of the **MEASUREMENT** transducer block controls the **INT** function block mode of operation.

To assign the **INT** function block mode:

1. Select the **MEASUREMENT** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **INTEGRATOR_FB_CONFIG** parameter to the desired **INT** function block mode.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

1.4.1 Assigning the integrator function block type

The **INT** function block can be set up for manual resetting of the total or automatic resetting of the total when a set point is reached. To assign the integrator function block type:

1. Select the **INT** function block.
2. Set the **TARGET** value of the **MODE_BLK** to *O/S*.
3. Write to the transmitter and wait until the actual value of the **MODE_BLK** parameter is *O/S*.
4. Set the **INTEG_TYPE** parameter to the type of reset you want.
5. Set the **TARGET** value of the **MODE_BLK** to *Auto*.

1.5 Zeroing the flowmeter

Zeroing the flowmeter establishes the flowmeter's point of reference when there is no flow.

When you zero the flowmeter, you may need to adjust the zero time parameter. *Zero time* is the length 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 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 first, then zero the flowmeter. You may zero the flowmeter if a low severity alarm is active. See Section 4.4 for information about responding to alarms.

You can zero the flowmeter with device description methods, a fieldbus host, ProLink II software, or the display. If the zero procedure fails, see Section 5.6 for troubleshooting information.

1.5.1 Preparing for the zeroing procedure

To prepare for the zeroing 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 and the flow through the sensor has completely stopped.

⚠ CAUTION

If fluid is flowing through the sensor, the sensor zero 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.

1.5.2 Zeroing with device description methods

To zero the flowmeter with a fieldbus host that supports device description (DD) methods:

1. Run the **Start Sensor Zero** method.
2. Click **OK** (twice).
3. Type a new zero time in the text box provided or accept the default value.
4. Click **OK**. A **Calibration in Progress** dialog box appears.
5. If a failure dialog box appears, click OK and see Section 5.6.
6. If a dialog box appears containing the **ZERO_OFFSET** and **ZERO_STD_DEV** parameter values, the zero procedure succeeded.
7. Click **OK**.

1.5.3 Zeroing with a fieldbus host

To zero the flowmeter using a fieldbus host:

1. Select the **CALIBRATION** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Inspect the **ZERO_TIME** parameter.
5. Type a new zero time in the **ZERO_TIME** parameter or accept the default value.
6. Set the **ZERO_CAL** method parameter to *Zero Cal*.
7. Inspect the **XD_ERROR** parameter. During the zeroing procedure, this parameter will indicate an alarm. When the alarm clears, the zero procedure is complete.
8. If the **XD_ERROR** parameter does not clear, the zeroing procedure failed. For more information about the cause of failure, select the **DIAGNOSTICS** transducer block and inspect the bits of the **ALARM4_STATUS** parameter. Refer to Section 5.6 for the probable causes of zero failure.

9. If you want to know the results of the zero procedure, view the **ZERO_OFFSET** and **ZERO_STD** parameters.
10. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

1.5.4 Zeroing with ProLink II software

To zero the flowmeter with ProLink II software:

1. Choose **ProLink > Calibration > Zero Calibration**.
2. If you want to change the zero time, type a new zero time in the **Zero Time** box and click **Apply**. The default zero time of 20 seconds is appropriate for most applications.
3. Click **Zero**. The flowmeter will begin zeroing.
4. The **Calibration in Progress** light will turn red while the zeroing procedure is in progress.
5. If the **Calibration in Progress** light returns to green, the zero procedure succeeded. If the **Calibration Failure** light remains red, the zero procedure has failed. See Section 5.6 for possible causes of zero failure.
6. Click **Close**.

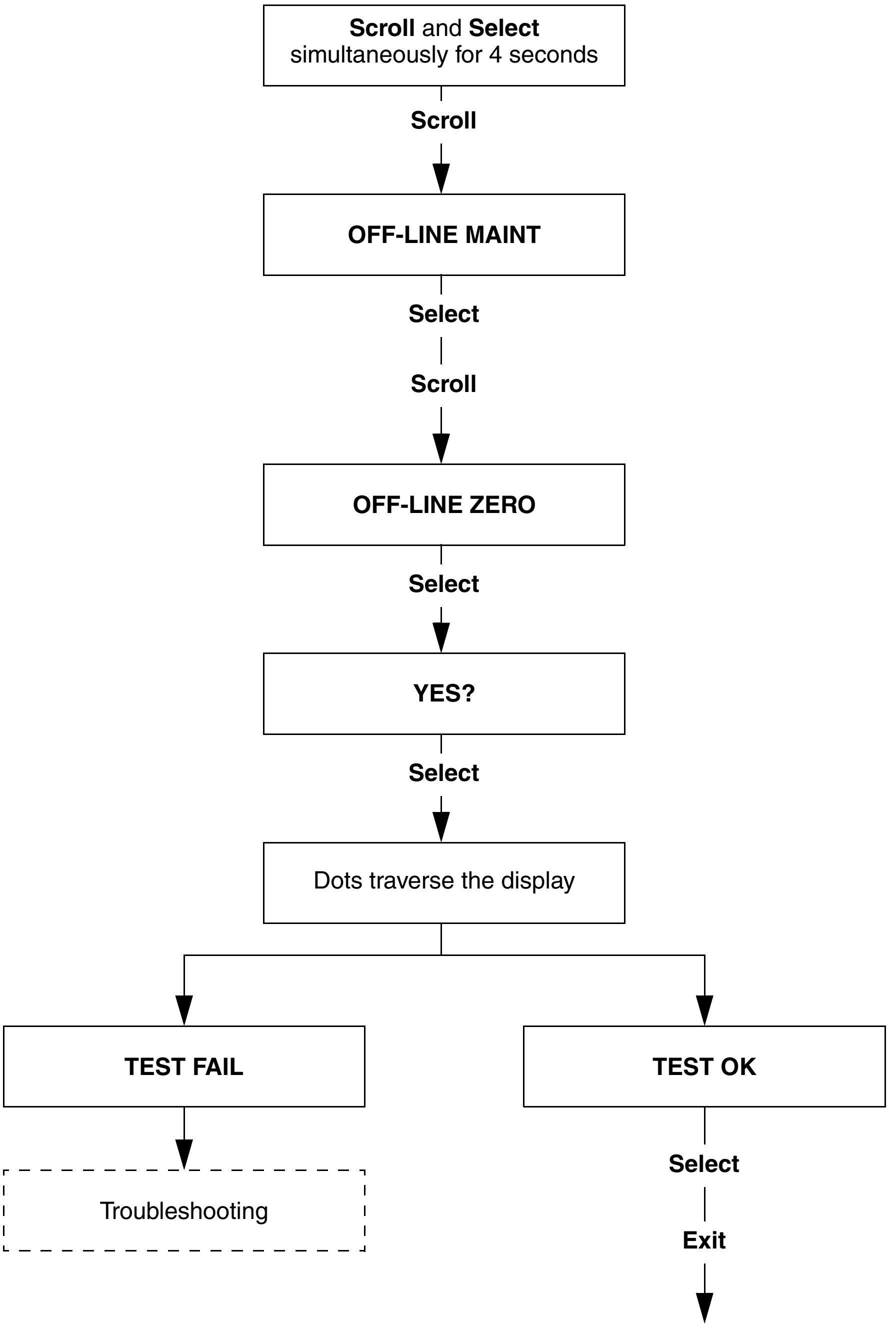
1.5.5 Zeroing with the display

See Figure 1-2 for the zeroing procedure.

Note the following:

- If the off-line menu has been disabled, you will not be able to zero the transmitter with the display. For information about enabling or disabling the off-line menu, see Section 3.15.
- You cannot change the zero time with the display. If you need to change the zero time, you must use a fieldbus host or ProLink II software.

Figure 1-2 **Display menu — zeroing the flowmeter**



Chapter 2
Calibrating the Flowmeter

2.1 Overview

The flowmeter measures process variables based on fixed points of reference. *Calibration* adjusts those points of reference. This chapter provides instructions for performing density calibration and temperature calibration.

Note: All ProLink II procedures provided in this section assume that your computer is already connected to the transmitter and you have established communication. See Appendix A.

> **⚠ WARNING**
>
> **Using the service port to communicate with the transmitter in a hazardous area can cause an explosion.**
>
> Before using ProLink II software via the service port to communicate with the transmitter in a hazardous area, make sure the atmosphere is free of explosive gases.

2.2 When to calibrate

The transmitter is factory calibrated and does not normally need to be calibrated in the field. Calibrate the transmitter only if you must do so to meet regulatory requirements.

Note: Micro Motion recommends using meter factors, rather than calibration, to prove the meter against a regulatory standard or to correct measurement error. Contact Micro Motion before calibrating your flowmeter. For information on meter factors, see Section 3.10.

2.3 Density calibration

Density calibration includes the following calibration points:

- Point one (low density calibration)
- Point two (high density calibration)

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 device description methods, a fieldbus host, or ProLink II software.

2.3.1 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.

2.3.2 Density calibration with device description methods

Perform the following steps to calibrate the flowmeter for density with a fieldbus host that supports DD methods.

Step 1: Point one (low density calibration)

To perform the low density calibration:

1. Run the **Start Low Density Calibration** method.
2. Click **OK**.
3. Close the shutoff valve downstream from the sensor.
4. Click **OK**.
5. Fill the sensor completely with a low density fluid (e.g., air).
6. Click **OK**.
7. Type the density of the calibration fluid in the text box provided.
8. Click **OK**. A **Calibration in Progress** dialog box appears.
   - If a dialog box appears when the calibration is complete, the calibration failed. Click **OK** and refer to Section 5.6.
   - If a **Low Density Calibration Successful** dialog box appears when the calibration is complete, click **OK** and proceed to the high density calibration procedure.

Step 2: Point two (high density calibration)

To perform the high density calibration:

1. Run the **Start High Density Calibration** method.
2. Click **OK**.
3. Close the shutoff valve downstream from the sensor.
4. Click **OK**.
5. Fill the sensor completely with a high density fluid (e.g., water).
6. Click **OK**.
7. Type the density of the calibration fluid in the text box provided.

8. Click **OK**. A **Calibration in Progress** dialog box appears.
   - If a dialog box appears when the calibration is complete, the calibration failed. Click **OK** and refer to Section 5.6.
   - If a **High Density Calibration Successful** dialog box appears when the calibration is complete, click **OK**.

2.3.3 Density calibration with a fieldbus host

Perform the following steps to calibrate the flowmeter for density with a fieldbus host.

Step 1: Point one (low density calibration)

To perform the low density calibration:

1. Select the **CALIBRATION** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Close the shutoff valve downstream from the sensor.
5. Fill the sensor completely with a low density fluid (e.g., air).
6. Verify that the sensor is experiencing zero flow (e.g., by looking at the display or inspecting the **MFLOW** parameter of the **MEASUREMENT** transducer block).
7. Set the **D1** parameter to the density of the calibration fluid.
8. Set the **LOW_DENSITY_CAL** method parameter to *Low Density Cal*.
9. Write to the transmitter.
10. Inspect the **XD_ERROR** parameter. During the calibration procedure, this parameter will indicate an alarm.
    - When the alarm clears, the calibration procedure is complete.
    - If the **XD_ERROR** parameter does not clear, the calibration procedure failed. For more information about the cause of failure, select the **DIAGNOSTICS** transducer block and inspect the bits of the **ALARM4_STATUS** parameter. Refer to Section 5.6 for the probable causes of calibration failure.
11. Inspect the **K1** parameter for the results of the calibration, and proceed to the high density calibration procedure.

Step 1 Step 2: Point two (high density calibration)

To perform the high density calibration:

1. Select the **CALIBRATION** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Close the shutoff valve downstream from the sensor.
5. Fill the sensor completely with a high density fluid (e.g., water).
6. Verify that the sensor is experiencing zero flow (e.g., by looking at the display or inspecting the **MFLOW** parameter of the **MEASUREMENT** transducer block).
7. Set the **D2** parameter to the density of the calibration fluid.

8. Set the **HIGH_DENSITY_CAL** method parameter to *High Density Cal*.
9. Write to the transmitter.
10. Inspect the **XD_ERROR** parameter. During the calibration procedure, this parameter will indicate an alarm.
    - When the alarm clears, the calibration procedure is complete.
    - If the **XD_ERROR** parameter does not clear, the calibration procedure failed. For more information about the cause of failure, select the **DIAGNOSTICS** transducer block and inspect the bits of the **ALARM4_STATUS** parameter. Refer to Section 5.6 for the probable causes of calibration failure.
11. Inspect the **K2** parameter for the results of the calibration.
12. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto* and write to the transmitter.

2.3.4 Density calibration with ProLink II software

Perform the following procedures to calibrate the transmitter for density with ProLink II software.

Step 1: Point one (low density calibration)

To perform the low density calibration:

1. Choose **ProLink > Calibration > Density Cal - Point 1**.
2. Close the shutoff valve downstream from the sensor.
3. Fill the sensor completely with a low density fluid (e.g., air).
4. Type the density of the low density fluid in the **Enter Actual Density** box.
5. Click **Do Cal**.
6. The **Calibration in Progress** light turns red while the calibration is in proress.
    - If the **Calibration in Progress** light returns to green, the calibration procedure succeeded. Read the results of the calibration in the **K1** box and click **Done**.
    - If the **Calibration in Progress** light remains red, the calibration procedure failed. See Section 5.6.

Step 2: Point two (high density calibration)

To perform the high density calibration:

1. Choose **ProLink > Calibration > Density Cal - Point 2**.
2. Close the shutoff valve downstream from the sensor.
3. Fill the sensor completely with a high density fluid (e.g., water).
4. Type the density of the high density fluid in the **Enter** box.
5. Click **Do Cal**.
6. The **Calibration in Progress** light turns red while the calibration is in proress.
    - If the **Calibration in Progress** light returns to green, the calibration procedure succeeded. Read the results of the calibration in the **K2** box and click **Done**.
    - If the **Calibration in Progress** light remains red, the calibration procedure failed. See Section 5.6.

2.4 How to calibrate for temperature

Temperature calibration is a two-point procedure. The entire procedure must be completed without interruption.

You can calibrate for temperature with device description methods, a fieldbus host or ProLink II software.

2.4.1 Temperature calibration with device description methods

To perform a temperature calibration with a fieldbus host that supports DD methods:

1. Run the **Start Temperature Calibration** DD method.
2. Click **OK**.
3. Fill the sensor with a low-temperature fluid, and allow the sensor to achieve thermal equilibrium.
4. Click **OK**.
5. Type the temperature of the low-temperature fluid in the text box provided.
6. Click **OK**.
   - If a dialog box containing a reason for failure appears, click **OK** and refer to Section 5.6.
   - If a **Low Temperature Calibration Successful** dialog box appears, click **OK**.
7. Fill the sensor with a high-temperature fluid, and allow the sensor to achieve thermal equilibrium.
8. Click **OK**.
9. Type the temperature of the high-temperature fluid in the text box provided.
10. Click **OK**.
    - If a dialog box containing a reason for failure appears, click **OK** and refer to Section 5.6.
    - If a **High Temperature Calibration Successful** dialog box appears, click **OK**. A dialog box containing the results of the temperature calibration appears.
11. Click **OK**.

2.4.2 Temperature calibration with fieldbus parameters

To perform a temperature calibration with a fieldbus host:

1. Select the **CALIBRATION** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Fill the sensor with a low-temperature fluid and allow the sensor to achieve thermal equilibrium.
5. Set the **TEMP_VALUE** parameter to the temperature of the calibration fluid.
6. Set the **TEMP_LOW_CAL** method parameter to *Temp Low Calibration*.
7. Write to the transmitter.

8. Inspect the **XD_ERROR** parameter. During the calibration procedure, this parameter will indicate an alarm.
   - When the alarm clears, the calibration procedure is complete.
   - If the **XD_ERROR** parameter does not clear, the calibration procedure failed. For more information about the cause of failure, select the **DIAGNOSTICS** transducer block and inspect the bits of the **ALARM4_STATUS** parameter. Refer to Section 5.6 for the probable causes of calibration failure.
9. Fill the sensor with a high-temperature fluid, and allow the sensor to achieve thermal equilibrium.
10. Set the **TEMP_VALUE** parameter to the temperature of the calibration fluid.
11. Set the **TEMP_HIGH_CAL** method parameter to *Temp High Calibration*.
12. Write to the transmitter.
13. Inspect the **XD_ERROR** parameter. During the calibration procedure, this parameter will indicate an alarm.
    - When the alarm clears, the calibration procedure is complete.
    - If the **XD_ERROR** parameter does not clear, the calibration procedure failed. For more information about the cause of failure, select the **DIAGNOSTICS** transducer block and inspect the bits of the **ALARM4_STATUS** parameter. Refer to Section 5.6 for the probable causes of calibration failure.
14. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto* and write to the transmitter.

2.4.3 Temperature calibration with ProLink II software

To perform a temperature calibration with ProLink II software:

1. Choose **ProLink > Calibration > Temp Offset Cal**.
2. Fill the sensor with a low-temperature fluid and allow the sensor to achieve thermal equilibrium.
3. Type the temperature of the low-temperature fluid in the **Enter Actual Temp** box.
4. Click **Do Cal**.
5. If a dialog box appears containing a reason for failure, the calibration procedure failed. See Section 5.6.
6. Click **Done**.
7. Choose **ProLink > Calibration > Temp Slope Cal**.
8. Fill the sensor with a high-temperature fluid and allow the sensor to achieve thermal equilibrium.
9. Type the temperature of the high-temperature fluid in the **Enter Actual Temp** box.
10. Click **Do Cal**.
11. If a dialog box appears containing a reason for failure, the calibration procedure failed. See Section 5.6.
12. Click **Done**.

Chapter 3
Configuring the Transmitter

Startup

Calibration

Configuration

Operation

3.1 Overview

This chapter describes how to change the operating settings of the transmitter. The transmitter was configured at the factory, so changing these settings is not normally necessary.

The procedures in this chapter will enable you to:

- Change the measurement units
- Create special measurement units
- Change the output scale
- Change the linearization
- Change process alarm settings
- Change the damping
- Adjust meter factors
- Change slug-flow parameters
- Change the low-flow cutoff
- Change the flow direction parameter
- Change the software tag
- Change the display functionality

Note: All ProLink II procedures provided in this section assume that your computer is already connected to the transmitter and you have established communication. See Appendix A.

⚠ WARNING

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

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

3.2 Configuration map

Use the map in Table 3-1 to guide you through a complete or partial configuration of the transmitter.

Table 3-1 Configuration map

Topic	Subtopics	Page
Measurement units		Page 16
Special measurement units	Mass-flow units, volume-flow units	Page 17
Output scale		Page 20
Linearization		Page 21
Process alarms	Alarm values, alarm priorities, alarm hysteresis	Page 21
Damping	Flow damping, density damping, temperature damping	Page 24
Meter factors		Page 26
Slug flow	Slug flow limits, slug flow duration	Page 27
Cutoffs	Mass flow cutoff, volume flow cutoff, density cutoff	Page 29
Flow direction		Page 30
Software tag		Page 31
Display functionality	Display functions, scroll rate, display password, display variables	Page 32

3.3 Changing the measurement units

You can change the measurement units for each process variable with a fieldbus host or ProLink II software.

With a fieldbus host

The **AI** function blocks control the measurement units for the process variables they measure. To change the measurement units of an **AI** function block:

1. Select the **AI** function block whose measurement units you want to change.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **UNITS** value of the **XD_SCALE** parameter to a new measurement unit.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto* and write to the transmitter.

With ProLink II software

⚠ CAUTION

If you change the measurement units for a process variable with ProLink II software, you must also change the units used by the appropriate AI function block with a fieldbus host. If you do not change the units in the AI function block, the AI block will get a configuration error.

To change the density measurement unit with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Density** tab.

3. Select a measurement unit from the **Dens Units** drop-down list.
4. Click **Apply**.

To change the volume-flow measurement unit with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Flow** tab.
3. Select a measurement unit from the **Vol Flow Units** drop-down list.
4. Click **Apply**.

To change the mass-flow measurement unit with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Flow** tab.
3. Select a measurement unit from the **Mass Flow Units** drop-down list.
4. Click **Apply**.

To change the temperature measurement unit with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Temperature** tab.
3. Select a measurement unit from the **Temp Units** drop-down list.
4. Click **Apply**.

3.4 Creating special measurement units

If you need to use a non-standard unit of measure, you can create one special measurement unit for mass flow and one special measurement unit for volume flow. Special measurement units consist of:

- *Base unit* — A combination of:
  - *Base mass* or *base volume unit* — A standard measurement unit that the transmitter already recognizes (e.g., kg, m^3)
  - *Base time unit* — A unit of time that the transmitter already recognizes (e.g., seconds, days)
- *Conversion factor* — The number by which the base unit will be divided to convert to the special unit
- *Special unit* — A non-standard volume-flow or mass-flow unit of measure that you want to be reported by the transmitter.

The terms above are related by the following formulae:

$$x[\text{Base units}] = y[\text{Special units}]$$

$$\text{Conversion factor} = \frac{x[\text{Base units}]}{y[\text{Special units}]}$$

To create a special unit, you must:

1. Identify the simplest base volume or mass and base time units for your special unit. For example, to create the special volume flow unit *pints per minute*, the simplest base units are gallons per minute:
   a. Base volume unit: *gallon*
   b. Base time unit: *minute*

2. Calculate the conversion factor:

$$\frac{\text{1 gallon per minute}}{\text{8 pints per minute}} = 0.125$$

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

Note: Special measurement unit names can be up to 8 characters long, but only the first 5 characters appear on the display.

3.4.1 Using special measurement units with AI function blocks

If you want an **AI** function block to use special measurement units, you must change the linearization of the **AI** function block. See Section 3.6 for more information about linearization.

3.4.2 Special mass flow units

You can create a special mass-flow measurement unit with a fieldbus host or ProLink II software.

With a fieldbus host

The parameters in the **MEASUREMENT** transducer block which hold the special mass flow measurement unit values are:

- MFLOW_SPECIAL_UNIT_BASE
- MFLOW_SPECIAL_UNIT_TIME
- MFLOW_SPECIAL_UNIT_CONV
- MFLOW_SPECIAL_UNIT_STR
- MASS_TOT_INV_SPECIAL_STR

Whenever the **MFLOW_SPECIAL_UNIT_CONV** value equals 1, the transmitter will use normal mass units. If the **MFLOW_SPECIAL_UNIT_CONV** value does not equal 1, the transmitter will use the special mass flow units.

To create a special mass-flow measurement unit with a fieldbus host:

1. Select the **MEASUREMENT** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **MFLOW_SPECIAL_UNIT_BASE** parameter to a base mass unit.
5. Set the **MFLOW_SPECIAL_UNIT_TIME** parameter to a base time unit.
6. Type the conversion factor into the **MFLOW_SPECIAL_UNIT_CONV** parameter.
7. Type the name of the special unit in the **MFLOW_SPECIAL_UNIT_STR** parameter. The name can be up to 8 characters in length, though only the first 5 are displayed.
8. Type the name of the totalizer for the special unit in the **MASS_TOT_INV_SPECIAL_STR** parameter. The name can be up to 8 characters in length, though only the first 5 are displayed.
9. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

With ProLink II software

To create a special mass-flow measurement unit with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Special Units** tab.
3. Select a base mass unit from the **Base Mass Unit** drop-down list.
4. Select a base time unit from the **Base Mass Time** drop-down list.
5. Type the conversion factor in the **Mass Flow Conv Fact** box.
6. Type the name of the special unit in the **Mass Flow Text** box. The name can be up to 8 characters in length, though only 5 are displayed.
7. Type the name of the totalizer for the special unit in the **Mass Total Text** box.
8. Click **Apply**.

3.4.3 Special volume flow units

You can create a special volume-flow measurement unit with a fieldbus host or ProLink II software.

With a fieldbus host

The parameters in the **MEASUREMENT** transducer block which hold the special volume flow measurement unit values are:

- VOL_SPECIAL_UNIT_BASE
- VOL_SPECIAL_UNIT_TIME
- VOL_SPECIAL_UNIT_CONV
- VOL_SPECIAL_UNIT_STR
- VOLUME_TOT_INV_SPECIAL_STR

Whenever the **VOL_SPECIAL_UNIT_CONV** value equals 1, the transmitter will use normal volume units. If the **VOL_SPECIAL_UNIT_CONV** value does not equal 1, the transmitter will use the special volume flow units.

To create a special volume-flow measurement unit with a fieldbus host:

1. Select the **MEASUREMENT** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **VOL_SPECIAL_UNIT_BASE** parameter to a base volume unit.
5. Set the **VOL_SPECIAL_UNIT_TIME** parameter to a base time unit.
6. Type the conversion factor into the **VOL_SPECIAL_UNIT_CONV** parameter.
7. Type the name of the special unit in the **VOL_SPECIAL_UNIT_STR** parameter. The name can be up to 8 characters in length, though only 5 are displayed.
8. Type the name of the totalizer for the special unit in the **VOLUME_TOT_INV_SPECIAL_STR** parameter. The name can be up to 8 characters in length, though only the first 5 are displayed.
9. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

With ProLink II software

To create a special volume-flow measurement unit with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Special Units** tab.
3. Select a volume unit from the **Base Vol Units** drop-down list.
4. Select a time unit from the **Base Vol Time** drop-down list.
5. Type the conversion factor in the **Vol Flow Conv Fact** box.
6. Type the name of the special unit in the **Vol Flow Text** box. The name can be up to 8 characters in length, though only 5 are displayed.
7. Type the name of the totalizer for the special unit in the **Vol Total Text** box.
8. Click **Apply**.

3.5 Changing the output scale

The *output scale* is the scope of output values between specified high and low limits. The output scale is established by indicating a value at 0% of output and a value at 100% of output. Process values are converted to a number along this scale.

The **OUT_SCALE** parameter in each **AI** function block holds the output scale values. Note the following about changing the **OUT_SCALE** parameter:

- The value of the **OUT** parameter of the **AI** block may differ from the value of the same process variable in the **MEASUREMENT** transducer block.
- If your transmitter has a display, the value of the **OUT** parameter of the **AI** block may differ from the same process variable as shown on the display.

Example	The AI block set to channel 3 (density) is scaled so that 0% = 0.5 g/cm^3 and 100% = 1.5 g/cm^3. When the actual density is 0.5 g/cm^3, the outputs of the AI block, the DENSITY parameter of the MEASUREMENT transducer block, and the display would be like those below. • AI block: 0.0 g/cm^3 • DENSITY parameter: 0.5 g/cm^3 • Display: 0.5 g/cm^3

If you need the output of the **AI** block and the display to agree, use special measurement units instead of output scaling. A special unit can be scaled to meet your needs and will be used identically in the **AI** block and on the display. See Section 3.4 for more information about special units.

You can change the output scale only with a fieldbus host. To change the output scale of an **AI** function block:

1. Select the **AI** function block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL value** of the **MODE_BLK** parameter is *O/S*.
4. Set the **EU_0** value of the **OUT_SCALE** parameter to the output value at 0% of scale.

5. Set the **EU_100** value of the **OUT_SCALE** parameter to the output value at 100% of scale.
6. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

3.6 Changing the linearization

Linearization translates a process variable into different measurement units and onto a new scale. The measurement units and the output scale are not directly affected by a change in the linearization parameter. See Section 3.3 and Section 3.5, above, for information about changing the measurement units and output scale directly.

The **L_TYPE** parameter of each **AI** function block holds the linearization information. The transmitter supports the following values for the **L_TYPE** parameter:

- *Direct*—Use direct linearization whenever you are using standard units of measure (e.g., kg/hr, g/cm^3).
- *Indirect*—Use indirect linearization whenever you are using a special unit of measure (see Section 3.4).
- *Indirect square root*—Do not use indirect square root linearization.

You can change the linearization setting only with a fieldbus host.

To change the linearization:

1. Select the **AI** block for which you want to change the linearization value.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **L_TYPE** parameter to a new linearization value.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

3.7 Changing process alarms

The transmitter sends *process alarms* to indicate that a process value has exceeded its user-defined limits. The transmitter maintains four alarm values for each process variable. Each alarm value has a priority associated with it. In addition, the transmitter has an alarm hysteresis function to prevent erratic alarm reports.

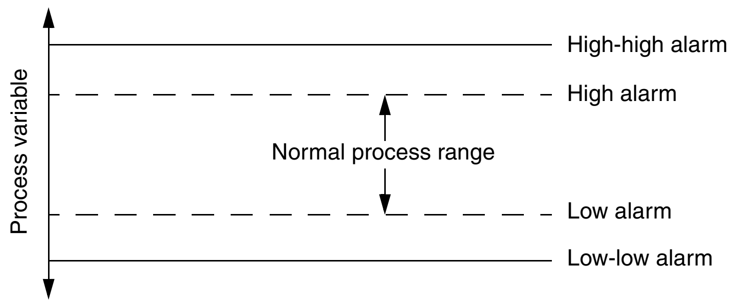
Note: Process alarms are only posted through the AI function block and are NOT shown on the display.

3.7.1 Alarm values

The *process alarm values* are the limits for process variables. Whenever a process variable exceeds a process alarm value, the transmitter broadcasts an alarm to the fieldbus network.

Each **AI** function block has four process alarm values: high alarm, high-high alarm, low alarm, and low-low alarm. See Figure 3-1. The high and low process alarm values represent normal process limits. The high-high and low-low process alarm values are used for more complex alarm signals (e.g., to indicate a more severe problem than a regular process alarm indicates).

Figure 3-1 Alarm values



The **HI_LIM**, **HI_HI_LIM**, **LO_LIM**, and **LO_LO_LIM** parameters in each **AI** function block hold the alarm values. You can change the alarm values only with a fieldbus host.

To change the alarm values for an **AI** function block:

1. Select the **AI** function block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **HI_HI_LIM** parameter to a new value.
5. Set the **HI_LIM** parameter to a new value.
6. Set the **LO_LIM** parameter to a new value.
7. Set the **LO_LO_LIM** parameter to a new value.
8. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

3.8 Alarm priorities

Each process alarm is assigned an alarm priority. A *process alarm priority* is a number from 0 to 15. Higher numbers indicate higher alarm priorities. The **HI_PRI**, **HI_HI_PRI**, **LO_PRI**, and **LO_LO_PRI** parameters of each **AI** function block hold the process alarm priority values. You can change the process alarm priority values only with a fieldbus host.

To change the process alarm priority value for a specific **AI** function block:

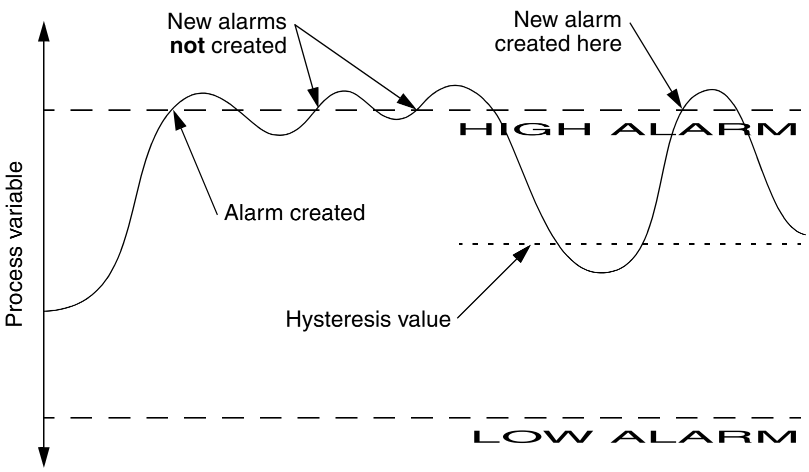
1. Select the **AI** function block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **HI_HI_PRI** parameter to a new value.
5. Set the **HI_PRI** parameter to a new value.
6. Set the **LO_PRI** parameter to a new value.
7. Set the **LO_LO_PRI** parameter to a new value.
8. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

3.8.1 Alarm hysteresis

The *alarm hysteresis* value is a percentage of the output scale. After a process alarm is created, the transmitter will not create new alarms unless the process first returns to a value within the range of the alarm hysteresis percentage. Figure 3-2 shows the transmitter's alarm behavior with an alarm hysteresis value of 50%.

- A low hysteresis value allows the transmitter to broadcast a new alarm every time or nearly every time the process variable crosses over the alarm limit.
- A high hysteresis value prevents the transmitter from broadcasting new alarms unless the process variable first returns to a value sufficiently below the high alarm limit or above the low alarm limit.

Figure 3-2 High versus low alarm hysteresis values



You can change the alarm hysteresis value only with a fieldbus host. The **ALARM_HYS** parameter in each **AI** function block holds the alarm hysteresis value.

To change the alarm hysteresis value for an **AI** function block:

1. Select the **AI** function block containing the alarm hysteresis value you want to change.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **ALARM_HYS** parameter to a percentage of the output scale.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

3.9 Changing 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 can change more quickly.

You can change the damping values for flow, density, and temperature.

Note: Damping values will be automatically rounded down to the nearest valid damping value.

3.9.1 Flow damping

Flow damping affects mass flow and volume flow. You can change the flow damping value with a fieldbus host or ProLink II software.

With a fieldbus host

The **FLOW_DAMPING** parameter in the transducer block holds the mass flow and volume flow damping value. There is an additional damping parameter called **PV_FTIME** in each **AI** block. In order to avoid applying two damping values, Micro Motion recommendeds setting the **PV_FTIME** parameter to zero. This is described in the procedure below.

To change the flow damping value with a fieldbus host:

1. Select the **MEASUREMENT** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **FLOW_DAMPING** parameter to a new damping value.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto* and write to the transmitter.
6. Select the **AI** function block that measures transducer block channel 1 (mass flow).
7. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
8. Write to the transmitter and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
9. Set the **PV_FTIME** parameter to 0.
10. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.
11. Write to the transmitter.
12. Repeat Steps 6 through 11 for the **AI** block that measures transducer block channel 4 (volume flow).

With ProLink II software

To change the flow damping value with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Flow** tab.
3. Type a new damping value in the **Flow Damp** box.
4. Click **Apply**.

3.9.2 Density damping

You can change the density damping value with a fieldbus host or ProLink II software.

With a fieldbus host

The **DENSITY_DAMPING** parameter in the transducer block holds the density damping value. There is an additional damping parameter called **PV_FTIME** in each **AI** block. In order to avoid applying two damping values, Micro Motion recommendeds setting the **PV_FTIME** parameter to zero. This is described in the procedure below.

To change the density damping value with a fieldbus host:

1. Select the **MEASUREMENT** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **DENSITY_DAMPING** parameter to a new damping value.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto* and write to the transmitter.
6. Select the **AI** function block that measures transducer block channel 3 (density).
7. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
8. Write to the transmitter and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
9. Set the **PV_FTIME** parameter to 0.
10. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.
11. Write to the transmitter.

With ProLink II software

To change the density damping value with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Density** tab.
3. Type a new damping value in the **Dens Damping** box.
4. Click **Apply**.

3.9.3 Temperature damping

You can change the temperature damping value with a fieldbus host or ProLink II software.

With a fieldbus host

The **TEMPERATURE_DAMPING** parameter in the transducer block holds the temperature damping value. There is an additional damping parameter called **PV_FTIME** in each **AI** block. In order to avoid applying two damping values, Micro Motion recommendeds setting the **PV_FTIME** parameter to zero. This is described in the procedure below.

To change the temperature damping value with a fieldbus host:

1. Select the **MEASUREMENT** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.

4. Set the **TEMPERATURE_DAMPING** parameter to a new damping value.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.
6. Select the **AI** function block that measures transducer block channel 2 (temperature).
7. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
8. Write to the transmitter and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
9. Set the **PV_FTIME** parameter to 0.
10. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.
11. Write to the transmitter.

With ProLink II software

To change the temperature damping value with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Temperature** tab.
3. Type a new damping value (in seconds) in the **Temp Damping** box.
4. Click **Apply**.

3.10 Adjusting meter factors

Meter factors allow you to modify the transmitter's output so that it matches an external measurement standard. Meter factors are used for proving the flowmeter against a Weights & Measures standard. You may need to calculate and configure meter factors periodically to comply with regulations.

You can adjust meter factors for mass flow, volume flow, and density. Only values between 0.8 and 1.2 can be entered. If the calculated meter factor exceeds these limits, contact Micro Motion Customer Service.

3.10.1 Calculating meter factors

Use the following formula to calculate a meter factor:

$$\text{NewMeterFactor} = \text{ConfiguredMeterFactor} \times \frac{\text{External standard}}{\text{ActualTransmitterMeasurement}}$$

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: $$\text{MassFlowMeterFactor} = 1 \times \frac{250}{250.27} = 0.9989$$ The first 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: $$\text{MassFlowMeterFactor} = 0.9989 \times \frac{250.25}{250.07} = 0.9996$$ The new mass flow meter factor is 0.9996.

3.10.2 Adjusting meter factors with a fieldbus host

To adjust the mass flow, volume flow, or density meter factor:

1. Select the **MEASUREMENT** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the desired meter factor parameter to the value required to make the transmitter match an external measurement standard. Meter factor parameters are listed in Table 3-2.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

Table 3-2 Meter factor parameters

Meter factor	Transducer block parameter
Mass flow	MFLOW_M_FACTOR
Volume flow	VOL_M_FACTOR
Density	DENSITY_M_FACTOR

3.11 Changing slug flow limits and duration

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

Slug flow parameters are as follows:

- *Low slug flow limit* — the point below which a condition of slug flow will exist. Typically, this is the lowest density you expect to observe for your process. The default value is 0.0 g/cm^3. The valid range is 0.0–10.0 g/cm^3.
- *High slug flow limit* — the point above which a condition of slug flow will exist. Typically, this is the highest density you expect to observe for your process. The default value is 5.0 g/cm^3. The valid range is 0.0–10.0 g/cm^3.
- *Slug flow duration* — the number of seconds the transmitter waits for a slug flow condition to clear. If the transmitter detects slug flow, it will post a slug flow alarm and hold its last "pre-slug" flow rate until the end of the slug flow duration. If slugs are still present after the slug flow duration has expired, the transmitter will report a flow rate of zero. The default value for slug flow duration is 0.0 seconds. The valid range is 0.0–60.0 seconds.

Note: Raising the low slug flow limit or lowering the high slug flow limit will increase the possibility that slug flow conditions will be detected by the transmitter.

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

3.11.1 Slug flow limits

You can change the slug flow limits with a fieldbus host or ProLink II software.

With a fieldbus host

The **DIAGNOSTICS** transducer block holds the parameters relevant to slug flow limits:

- SLUG_LOW_LIMIT
- SLUG_HIGH_LIMIT

To change the slug flow limits with a fieldbus host:

1. Select the **DIAGNOSTICS** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **SLUG_LOW_LIMIT** and **SLUG_HIGH_LIMIT** parameters to the desired densities.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

With ProLink II software

To change the low slug flow limit with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Density** tab.
3. Type a new low slug flow limit in the **Slug Low Limit** box. The value must be between 0.0 and 10.0 g/cm^3.
4. Type a new low slug flow limit in the **Slug High Limit** box. The value must be between 0.0 and 10.0 g/cm^3.
5. Click **Apply**.

3.11.2 Slug flow duration

You can set the slug flow duration with a fieldbus host or ProLink II software.

With a fieldbus host

The **SLUG_TIME** parameter in the **DIAGNOSTICS** transducer block holds the slug flow duration.

To set the slug flow duration:

1. Select the **DIAGNOSTICS** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **SLUG_TIME** parameter to a value between 0.0 and 60.0 seconds.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

With ProLink II software

To change the slug flow duration with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Density** tab.
3. Type a new slug flow duration in the **Slug Duration** box (between 0.0 and 60.0 seconds).
4. Click **Apply**.

3.12 Configuring cutoffs

Cutoffs are user-defined values below which the transmitter reports a value of zero for the specified process variable. Cutoffs can be configured for mass flow, volume flow, or density. Table 3-3 lists the default values and relevant comments for each cutoff.

Table 3-3 Cutoff default values and comments

Cutoff	Default value	Comments
Mass	0.0 g/s	Micro Motion recommends a mass flow cutoff value of 0.5–1.0% of the sensor's rated maximum flow rate.
Volume	0.0 L/s	The lower limit for volume flow cutoff is 0. The upper limit for volume flow cutoff is the sensor's flow calibration factor, in L/s, multiplied by 0.2.
Density	0.2 g/cm^3	The range for density cutoff is 0.0–0.5 g/cm^3

3.12.1 Configuring cutoffs with a fieldbus host

The **MEASUREMENT** transducer block holds the cutoff parameters:

- MASS_LOW_CUT
- VOLUME_LOW_CUT
- DENSITY_LOW_CUT

To configure the cutoffs with a fieldbus host:

1. Select the **MEASUREMENT** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.

3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **MASS_LOW_CUT**, **VOLUME_LOW_CUT**, and **DENSITY_LOW_CUT** parameters to the desired values.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

3.12.2 Configuring cutoffs with ProLink II software

The mass and volume flow cutoffs are located on the **Flow** tab of the ProLink II configuration screen. The density cutoff is located on the **Density** tab.

1. Choose **ProLink > Configuration**.
2. If you want to configure mass or volume flow cutoffs, click the **Flow** tab.
   a. To change the mass flow cutoff, type a new mass flow cutoff value in the **Mass Flow Cutoff** box.
   b. To change the volume flow cutoff, type a new volume flow cutoff value in the **Volume Flow Cutoff** box.
   c. Click **Apply**.
3. If you want to confiure the density cutoff, click the **Density** tab.
   a. Type a new value in the **Density Cutoff** box.
   b. Click **Apply**.

3.13 Changing the flow direction parameter

The *flow direction* parameter defines whether the transmitter reports a positive or negative flow rate and how the flow is added to or subtracted from the totalizers.

Table 3-4 shows the possible values for the flow direction parameter and the transmitter's behavior when the flow is positive or negative.

- *Forward flow* moves in the direction of the arrow on the sensor.
- *Reverse flow* moves in the direction opposite of the arrow on the sensor.

Table 3-4 Transmitter behavior for each flow direction value

	Forward flow		Reverse flow	
Flow direction value	**Flow totals**	**Flow values on display or via digital comm.**	**Flow totals**	**Flow values on display or via digital comm.**
Forward only	Increase	Read positive	No change	Read negative
Reverse only	No change	Read positive	Increase	Read negative
Bidirectional	Increase	Read positive	Decrease	Read negative
Absolute value	Increase	Read positive(1)	Increase	Read positive(1)
Negate/forward only	No change	Read negative	Increase	Read positive
Negate/bidirectional	Decrease	Read negative	Increase	Read positive

(1) Refer to the digital communications status bits for an indication of whether flow is positive or negative.

You can change the flow direction parameter with a fieldbus host or ProLink II software.

With a fieldbus host

The **FLOW_DIRECTION** parameter in the **MEASUREMENT** transducer block holds the flow direction value.

To change the flow direction parameter with a fieldbus host:

1. Select the **MEASUREMENT** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **FLOW_DIRECTION** parameter to a new value. See Table 3-4.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

With ProLink II software

To change the flow direction parameter with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Flow** tab.
3. Click the arrow in the **Flow Direction** box, and select a flow direction value from the list. See Table 3-4.
4. Click **Apply**.

3.14 Changing the software tag

The transmitter is capable of holding a software tag in its memory. The *software tag* is a short name or identifier for the transmitter. You can change the software tag with a fieldbus host or ProLink II software.

With a fieldbus host

To change the software tag with a fieldbus host, use the host's tag setting feature.

With ProLink II software

To change the software tag with ProLink II software:

1. Choose **ProLink II > Configuration**.
2. Click the **Device (Fieldbus)** tab.
3. Type a new name in the **Tag** box.
4. Click **Apply**.

3.15 Changing the display functionality

You can restrict the display functionality or change the variables that are shown on the display.

3.15.1 Enabling and disabling display functions

Each display function and its associated parameter is listed in Table 3-5.

Table 3-5 Display functions and parameters

Display function	Enabled	Disabled	LOCAL DISPLAY transducer block parameter
Totalizer reset	Resetting mass and volume totalizers is permitted.	Resetting mass and volume totalizers is not possible.	EN_LDO_TOT_RESET
Totalizer start/stop	Operator can start and stop totalizers from the display.	Operate cannot start or stop totalizers.	EN_LDO_TOT_START_STOP
Auto scroll	Display automatically scrolls through each process variable.	Operator must **Scroll** to view process variables.	EN_LDO_AUTO_SCROLL
Off-line menu	Operator has access to the off-line menu.	No access to the off-line menu.	EN_LDO_OFFLINE_MENU
Off-line password	Password required for off-line menu. See Section 3.15.3.	Off-line menu accessible without a password.	EN_LDO_OFFLINE_PWD
Alarm menu	Operator has access to alarm menu.	No access to the alarm menu.	EN_LDO_ALARM_MENU
Acknowledge all alarms	Operator can acknowledge all current alarms at once.	Alarms must be acknowledged individually.	EN_LDO_ACK_ALL_ALARMS

You can enable and disable the display parameters with a fieldbus host or ProLink II software.

With a fieldbus host

Each transducer block parameter listed in Table 3-5 holds the enable or disable value for its associated display function.

To enable or disable display functions with a fieldbus host:

1. Select the **LOCAL DISPLAY** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Select a parameter (see Table 3-5) and set its value to *Enabled* or *Disabled*.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

With ProLink II software

To enable or disable display functions with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Display Config** tab.
3. Enable or disable display functions by selecting and deselecting the checkboxes.
4. Click **Apply**.

3.15.2 Changing the scroll rate

The *scroll rate* is used to control the speed of scrolling when auto scroll is enabled. Scroll rate defines how long each display variable 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).

You can change the scroll rate with a fieldbus host or ProLink II software.

With a fieldbus host

The **LDO_SCROLL_RATE** parameter in the **LOCAL DISPLAY** transducer block holds the scroll rate.

To change the scroll rate with a fieldbus host:

1. Select the **LOCAL DISPLAY** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Set the **LDO_SCROLL_RATE** parameter to a new value (in seconds).
4. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

With ProLink II software

To change the scroll rate with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Display Config** tab.
3. Type the desired scroll rate (between 1 and 10 seconds) in the **Auto Scroll Rate** box.
4. Click **Apply**.

3.15.3 Changing the off-line password

The off-line password prevents unauthorized users from gaining access to the off-line menu. You can change the offline password with a fieldbus host or ProLink II software.

With a fieldbus host

The **LDO_OFFLINE_PWD** in the **LOCAL DISPLAY** transducer block holds the off-line password.

To change the off-line password with a fieldbus host:

1. Select the **LOCAL DISPLAY** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Type the new password in the **LDO_OFFLINE_PWD** parameter. Display passwords are numeric and range from 0000–9999.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

With ProLink II software

To change the off-line password with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **Display Config** tab.
3. Type the desired off-line password in the **Offline Password** box. Display passwords are numeric and range from 0000–9999.
4. Click **Apply**.

3.15.4 Using the backlight

To turn on and off the display backlight with a fieldbus host:

1. Select the **LOCAL DISPLAY** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set the **LDO_BACKLIGHT_ON** parameter to *On* or *Off*.
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

3.15.5 Changing the display variables

The display can scroll through up to 15 process variables in any order. You can select the process variables you wish to see and the order in which they should appear.

Table 3-6 shows an example of a display variable configuration. Notice that you can repeat variables, and you can choose a value of “None.” The actual appearance of each process variable on the display is described in Appendix B.

Table 3-6 Example of a display variable configuration

Display variable	Process variable
Display variable 1	Mass flow
Display variable 2	Volume flow
Display variable 3	Density
Display variable 4	Mass flow
Display variable 5	Volume flow
Display variable 6	Mass totalizer
Display variable 7	Mass flow
Display variable 8	Temperature
Display variable 9	Volume flow
Display variable 10	Volume totalizer
Display variable 11	Density
Display variable 12	Temperature
Display variable 13	None
Display variable 14	None
Display variable 15	None

You can change the display variables with a fieldbus host or ProLink II software.

Note: Display Variable 1 is fixed at the mass-flow process variable and cannot be changed.

With a fieldbus host

The **LOCAL DISPLAY** transducer block holds the parameters that control the display variables. The parameters are named **LDO_VAR_1_CODE** through **LDO_VAR_15_CODE**. (Note that **LDO_VAR_1_CODE** cannot be changed.)

To change the display variables:

1. Select the **LOCAL DISPLAY** transducer block.
2. Set the **TARGET** value of the **MODE_BLK** parameter to *O/S*.
3. Write to the transmitter, and wait until the **ACTUAL** value of the **MODE_BLK** parameter is *O/S*.
4. Set each display variable parameter to one of the process variables (see example in Table 3-6).
5. Set the **TARGET** value of the **MODE_BLK** parameter to *Auto*.

With ProLink II software

To change the display variables with ProLink II software:

1. Choose **ProLink > Configuration**.
2. Click the **LDO Config** tab.
3. Select a process variable from each drop-down list.
4. Click **Apply**.

Chapter 4
Operation

4.1 Overview

This chapter describes how to use the transmitter in everyday operation. The procedures in this section will enable you to use a fieldbus host, the display, or ProLink II software to:

- View process variables
- Use simulation mode
- Respond to alarms
- Use the totalizers and inventories

Note: All ProLink II procedures provided in this section assume that your computer is already connected to the transmitter and you have established communication. See Appendix A.

> **⚠ WARNING**
>
> **Using the service port to communicate with the transmitter in a hazardous area can cause an explosion.**
>
> Before using ProLink II software via the service port to communicate with the transmitter in a hazardous area, make sure the atmosphere is free of explosive gases.

4.2 Viewing process variables

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

You can view process variables with a fieldbus host, the display, or ProLink II software.

With a fieldbus host

The transmitter has four fieldbus **AI** function blocks. Each **AI** function block reports the value of one process variable, the associated units of measure, and a status value that indicates measurement quality. For more information on the function blocks, see Appendix C.

To view a process variable, select the **AI** function block that measures that variable, and read the OUT parameter.

You can also view each process variable by reading the **MEASUREMENT** transducer block parameter for each process variable. Table 4-1 lists the process variables that correspond to each **MEASUREMENT** transducer block parameter.

Table 4-1 Process variable parameters in the MEASUREMENT transducer block

Process variable	Transducer block parameter
Mass-flow rate	MFLOW
Volume-flow rate	VOL_FLOW
Temperature	TEMPERATURE
Density	DENSITY
Gas standard volume(1)	GSV_VOL_FLOW

(1) Gas standard volume is not available if either the petroleum measurement application (API) or the enhanced density application is enabled.

With the display

The display reports the abbreviated name of the process variable (e.g., **DENS** for density — see Appendix B for a complete list), the current value of that process variable, and the associated units of measure (e.g., g/cm^3).

To view a process variable with the display, **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

With ProLink II software

To view process variables with ProLink II software, choose **ProLink > Process Variables**.

4.3 Enabling simulation mode

The transmitter has a "Simulate Enable" switch, which enables the transmitter to function in simulation mode as defined in the FOUNDATION fieldbus function block specification. This switch is software-selectable via ProLink II software or the display.

Note: Cycling power to the transmitter will disable simulation mode.

With ProLink II software

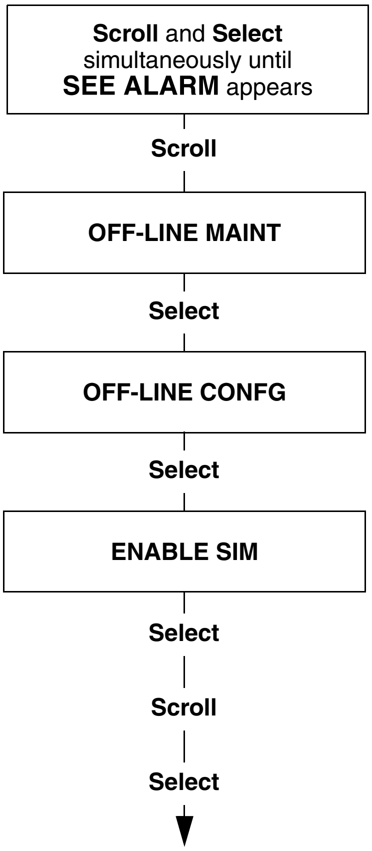
To enable simulation mode with ProLink II software:

1. Choose **ProLink II > Configuration**.
2. Click the **Device (Fieldbus)** tab.
3. Select the **Simulate Mode** checkbox.
4. Click **Apply**.

With the display

To enable simulation mode using the display, see Figure 4-1.

Figure 4-1 Display menu — enabling simulation mode



4.4 Responding to alarms

The transmitter broadcasts alarms when a process variable exceeds its defined limits or the transmitter detects a fault condition. For instructions regarding all the possible alarms, see Section 5.9.

4.4.1 Viewing alarms

You can view alarms with a fieldbus host, the display, or ProLink II software.

With a fieldbus host

The transmitter sets its fieldbus output status to *bad* or *uncertain* whenever an alarm condition occurs. When the output status is bad or uncertain, you can view an alarm by reading the following alarm parameters:

- Each **AI** function block contains an **ALARM_SUM** parameter that contains the alarm bits for that **AI** block.
- The **DIAGNOSTICS** transducer block contains four parameters named ALARM1_STATUS through ALARM4_STATUS. Each of these parameters has a short list of alarm bits.

With the display

The display reports alarms in two ways:

- With a status LED, which reports only that one or more alarms has occurred
- Through the alarm queue, which reports each specific alarm

Note: If access to the alarm menu from the display has been disabled (see Section 3.15), then the display will not list alarm codes in an alarm queue and the status LED will not flash. The status LED will indicate status using solid green, yellow, or red.

The status LED is located at the top of the display (Figure 4-2). The status LED can be in one of six possible states, as listed in Table 4-2.

Figure 4-2 Display alarm menu

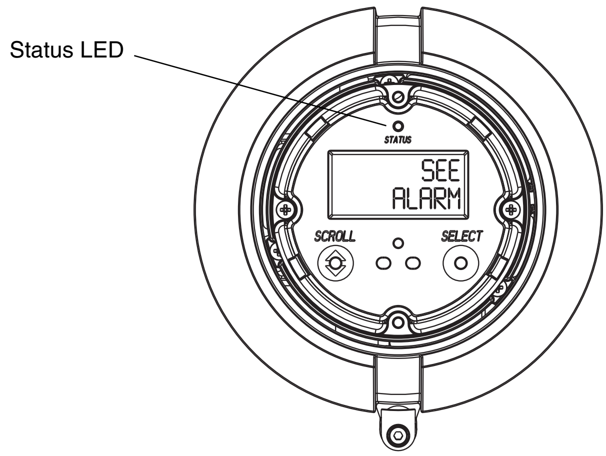


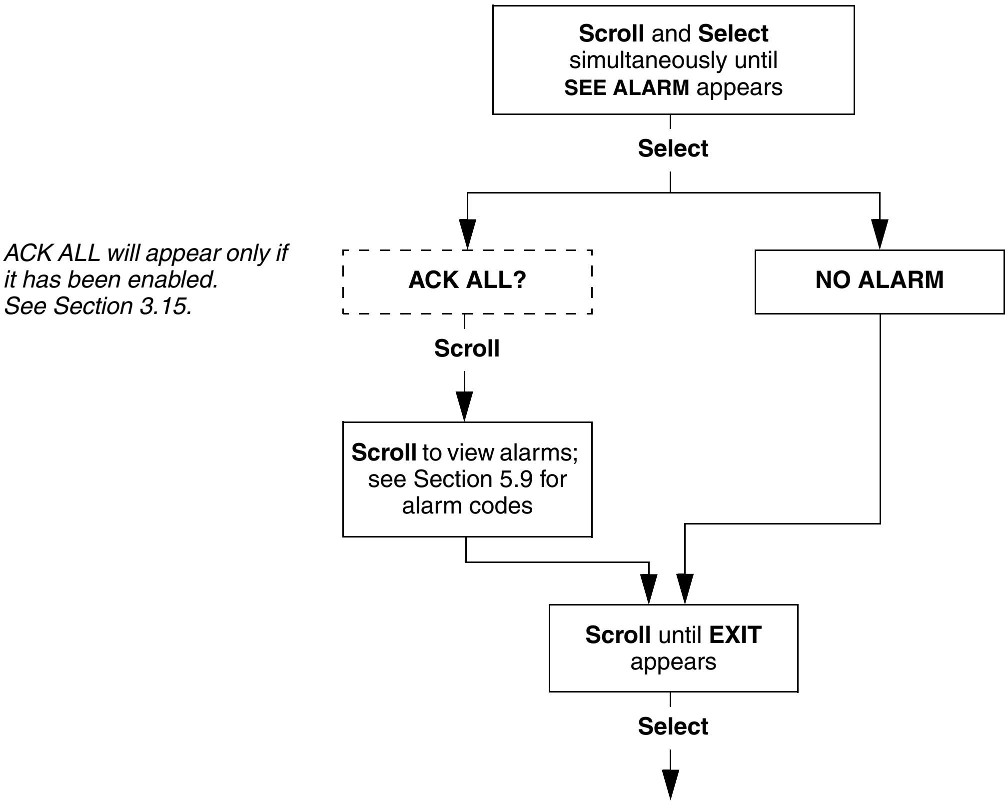
Table 4-2 Priorities reported by the status LED

Status LED state	Alarm priority
Green	No alarm—normal operating mode
Flashing green(1)	Unacknowledged corrected condition
Yellow	Acknowledged low severity alarm
Flashing yellow(1)	Unacknowledged low severity alarm
Red	Acknowledged high severity alarm
Flashing red(1)	Unacknowledged high severity alarm

(1) If the display alarm menu has been disabled, alarms cannot be acknowledged. In this case, the status LED will never flash.

Alarms in the alarm queue are arranged according to priority. To view specific alarms in the queue, see Figure 4-3.

Figure 4-3 **Display menu — viewing alarms**



With ProLink II software

To view alarms with ProLink II software:

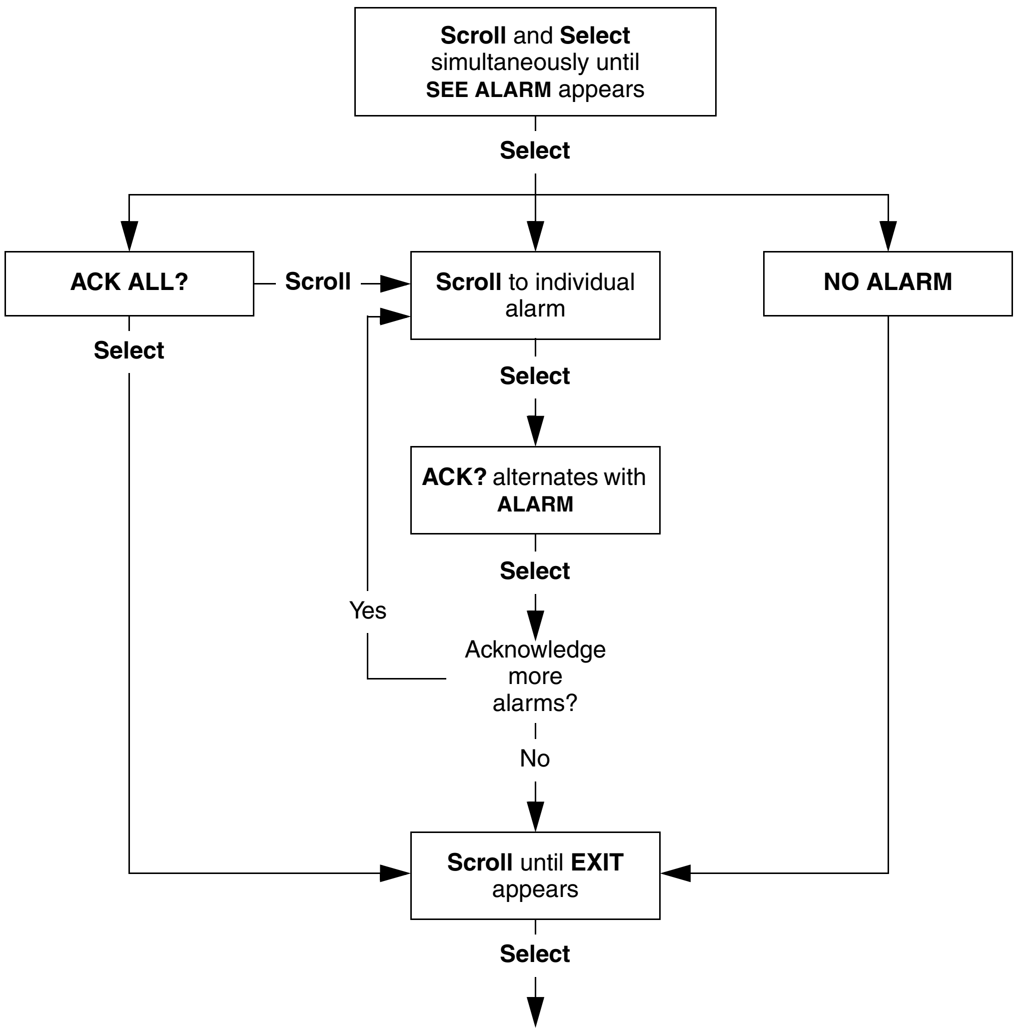
1. Choose **ProLink > Status**.
2. The status indicators are divided into three categories: Critical, Informational, and Operational. To view the indicators in a category, click on the appropriate tab.
   - A tab is red if one or more status indicators in that category is on.
   - On each tab, current alarms are shown by red status indicators.

4.4.2 Acknowledging alarms

Acknowledging alarms is a display function. It is required only for transmitters that have a display, and only when access to the display alarm menu has been enabled. If the alarm menu has been disabled, the status LED (Figure 4-2) will show a solid green, yellow, or red (i.e., it will not flash).

To acknowledge an alarm with the display, see Figure 4-4. If it is enabled, the ACK ALL function will allow you to acknowledge all unacknowledged alarms at once. See Section 3.15 for information about configuring display options.

Figure 4-4 Display menu — acknowledging alarms



4.5 Using the totalizers and inventories

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

The *inventories* track the same values as the totalizers but can be reset separately. Because the inventories and totals are reset separately, you can keep a running total of mass or volume across multiple totalizer resets.

4.5.1 Viewing the totalizers and inventories

You can view the current value of the mass totalizer, volume totalizer, mass inventory, and volume inventory with a fieldbus host, the display, or ProLink II software.

With a fieldbus host

If you have set up the **INT** function block to report the status of one of the internal totalizers or inventories (see Section 1.4), you can simply read the **OUT** parameter of the **INT** function block.

You can view any of the internal totalizers or inventories by inspecting their respective transducer block parameters. See Table 4-3.

Table 4-3 Totalizer and inventory parameter names

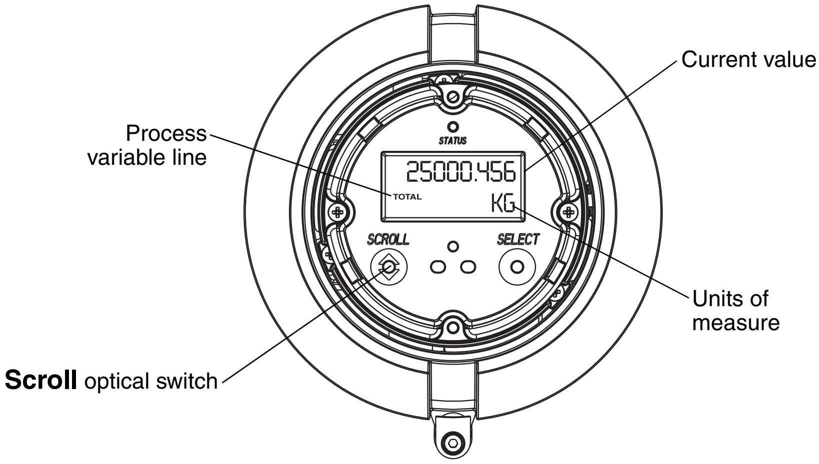
Totalizer/inventory	Transducer block	Parameter name
Mass totalizer	MEASUREMENT	MASS_TOTAL
Volume totalizer	MEASUREMENT	VOLUME_TOTAL
Mass inventory	MEASUREMENT	MASS_INVENTORY
Volume Inventory	MEASUREMENT	VOLUME_INVENTORY
Reference volume gas total	MEASUREMENT	GSV_VOL_TOT
Reference volume gas inventory	MEASUREMENT	GSV_VOL_INV

With the display

You cannot view totalizers or inventories with the display unless the display has been configured to show them. See Section 3.15.

To view totalizer values, **Scroll** until the totalizer or inventory you want to view appears on the display. Generally, the word **TOTAL** appears for totalizers, **MASSI** appears for mass inventory, and **LVOLI** appears for volume inventory. For a complete list of labels used by the display, see Appendix B.

Figure 4-5 Display totalizer



With ProLink II software

To view the current value of the totalizers and inventories with ProLink II software, choose either **ProLink > Process Variables** or **ProLink > Totalizer Control**.

4.5.2 Controlling the totalizers and inventories

Table 4-4 shows all of the totalizer functions and which configuration tools you can use to control them.

Table 4-4 Totalizer and inventory control methods

Function Name	Fieldbus host	ProLink II Software	Display
Stop all totalizers and inventories	Yes	Yes	Yes(1)
Start all totalizers and inventories	Yes	Yes	Yes(1)
Reset individual totalizer	Yes	Yes	Yes(1)
Reset all totalizers	Yes	Yes	No
Reset all inventories	Yes	Yes(2)	No

(1) If enabled for the display. See Section 3.15.
(2) If enabled in the ProLink II preferences.

With device description methods

Table 4-5 shows how you can control the totalizers and inventories using a fieldbus host that supports device description methods.

Table 4-5 Totalizer/inventory control with device description methods

To accomplish this	Do this
Stop all totalizers and inventories	Run the **Stop Totals** DD method.
Start all totalizers and inventories	Run the **Start Totals** DD method.
Reset mass totalizer	Run the **Reset Mass Total** DD method.
Reset volume totalizer	Run the **Reset Volume Total** DD method.
Simultaneously reset all totalizers	Run the **Reset Totals** DD method.
Simultaneously reset all inventories	Run the **Reset Inventories** DD method.

With a fieldbus host

If you have set up the **INT** function block to report the status of one of the internal totalizers (see Section 1.4), you can reset that totalizer by selecting the **INT** function block and setting the **OP_CMD_INT** method parameter to *Reset*.

Table 4-6 shows how you can control the totalizers and inventories using a fieldbus host.

Table 4-6 **Totalizer/inventory control with a fieldbus host**

To accomplish this	Do this
Stop all totalizers and inventories	Select the MEASUREMENT transducer block, set the START_STOP_TOTALS method parameter to *Stop Totals*, then write to the transmitter.
Start all totalizers and inventories	Select the MEASUREMENT transducer block, set the START_STOP_TOTALS method parameter to *Start Totals*, then write to the transmitter.
Reset mass totalizer	Select the MEASUREMENT transducer block, set the RESET_MASS_TOTAL method parameter to *Reset*, then write to the transmitter.
Reset volume totalizer	Select the MEASUREMENT transducer block, set the RESET_VOLUME_TOTAL method parameter to *Reset*, then write to the transmitter.
Simultaneously reset all totalizers	Select the MEASUREMENT transducer block, set the RESET_TOTALS method parameter to *Reset Totals*, then write to the transmitter.
Simultaneously reset all inventories	Select the MEASUREMENT transducer block, set the RESET_INVENTORIES method parameter to *Reset Inventories*, then write to the transmitter.

With ProLink II software

Table 4-7 shows how you can control the totalizers and inventories using ProLink II software. To get to the Totalizer Control screen, choose **ProLink > Totalizer Control**.

Table 4-7 **Totalizer/inventory control with ProLink II software**

To accomplish this	On the Totalizer Control screen...
Stop all totalizers and inventories	Click **Stop**
Start all totalizers and inventories	Click **Start**
Reset mass totalizer	Click **Reset Mass Total**
Reset volume totalizer	Click **Reset Volume Total**
Simultaneously reset all totalizers	Click **Reset**
Simultaneously reset all inventories[(1)]	Click **Reset Inventories**

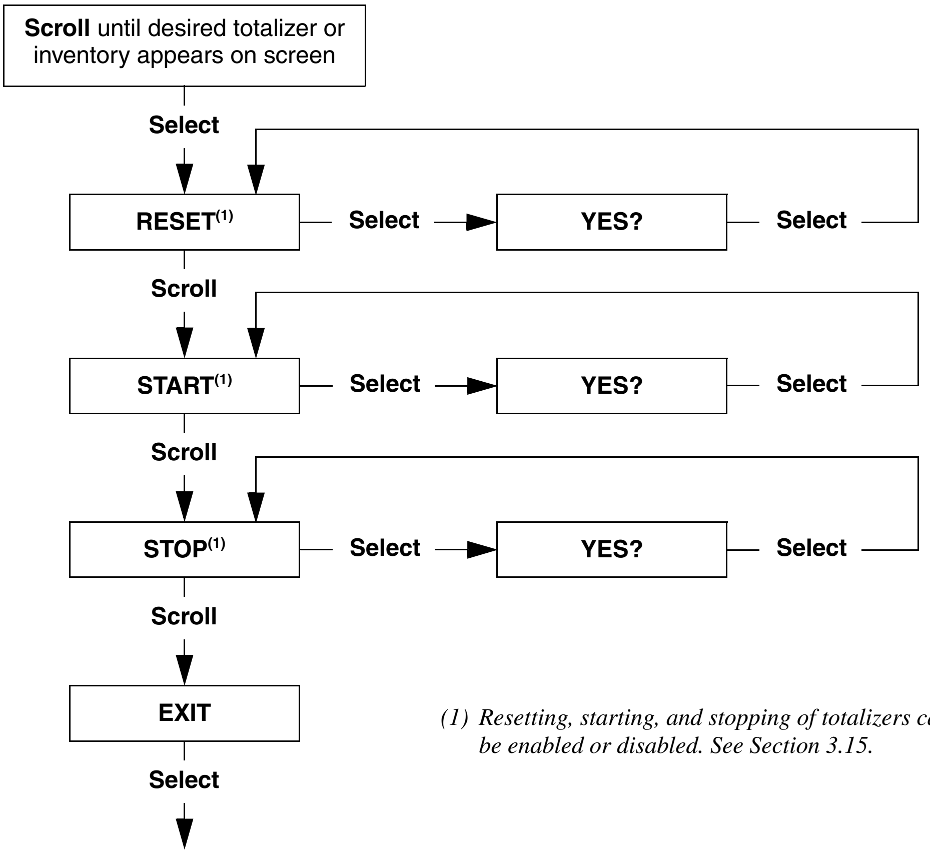
(1) If enabled in the ProLink II preferences.

With the display

Figure 4-6 shows how you can control the totalizers and inventories with the display.

- Starting or stopping totalizers and inventories will start or stop all totalizers and inventories simultaneously.
- Resetting totalizers resets only the totalizer for which the reset is selected. Inventories cannot be reset using the display.

Figure 4-6 Display menu — controlling totalizers and inventories



(1) Resetting, starting, and stopping of totalizers can be enabled or disabled. See Section 3.15.

Troubleshooting Using ProLink II Using Display Function Blocks

Chapter 5
Troubleshooting

5.1 Overview

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

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

Note: All ProLink II procedures provided in this section assume that your computer is already connected to the transmitter and you have established communication. See Appendix A.

5.2 Micro Motion customer service

Micro Motion provides an online troubleshooting system. To use it, go to www.expert2.com.

To speak to a customer service representative, phone the support center nearest you:

- In the U.S.A., phone 1-800-522-MASS (1-800-522-6277)
- In Canada and Latin America, phone (303) 527-5200
- In Asia, phone (65) 6770-8155
- In the U.K., phone 0800 - 966 180 (toll-free)
- Outside the U.K., phone +31 (0) 318 495 670

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.

5.3 Guide to troubleshooting topics

Refer to Table 5-1 for a list of troubleshooting topics discussed in this chapter.

Table 5-1 Troubleshooting topics

Topic	Section
Transmitter does not operate	Section 5.4
Transmitter does not communicate	Section 5.5
Zero or calibration failure	Section 5.6
Unexpected output problems	Section 5.7
Lost static data alarm	Section 5.8
Status alarms	Section 5.9
Wiring problems	Section 5.10

Table 5-1 Troubleshooting topics *continued*

Topic	Section
Slug flow	Section 5.11
Test points	Section 5.12
Checking the sensor	Section 5.13

5.4 Transmitter does not operate

If the transmitter is receiving power but all blocks are out of service, see Section 5.8.

If the transmitter is not receiving power and cannot communicate over the network or display, then perform all of the procedures under Section 5.10. If the wiring checks do not indicate a problem with electrical connections, contact Micro Motion Customer Service.

5.5 Transmitter does not communicate

- Make sure that the entire fieldbus network is grounded only once (individual segments should not be grounded).
- Perform the procedures under Section 5.10.4.
- If you are using a National Instruments® Configurator, perform the procedures under Section 5.5.1.
- Verify the software version by reading the display at power up.
- Verify the transmitter has fieldbus software loaded into it. At power up, the local display will briefly flash the revision level. For revision 1.0, 1.0 is displayed. For other revisions, x.x F is displayed.

5.5.1 National Instruments basic information

To verify the Dlme Basic Info:

1. Launch the National Instruments Interface Configuration Utility.
2. Select the appropriate port, usually **Port 0**.
3. Click **Edit**.
4. Click **Advanced**.
5. Verify the following information:
   - **Slot Time** equals *8*
   - **Max Response Time** equals *10*
   - **Dlpdu Ph1 Overhead** equals *4*
   - **Min Inter-Pdu Delay** equals *12*
   - **Time Sync Class** equals *1 ms*

If none of these checks indicates a problem, contact the DeltaV™ Response Center at 1-888-367-3774.

5.6 Zero or calibration failure

If a zero or calibration procedure fails, the transmitter will send one or more status alarms indicating the cause of failure. Refer to Table 5-3 for descriptions of status alarms and possible remedies.

5.7 Output problems

Micro Motion suggests that you make a record of the process variables listed below, under normal operating conditions. This will help you recognize when the process variables are unusually high or low.

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

For troubleshooting, check the process variables under both normal flow and tubes-full no-flow conditions. Except for flow rate, you should see little or no change between flow and no-flow conditions. If you see a significant difference, record the values and contact Micro Motion Customer Service for assistance.

Unusual values for process variables may indicate a variety of different problems. Table 5-2 lists several possible problems and remedies.

Table 5-2 Output problems and possible remedies

Symptom	Cause	Possible remedies
AI block fault	Measurement units mismatch	Make sure the UNITS value of the XD_SCALE parameter matches the units specified in the transducer block for that process variable.
No output or incorrect process variable	CHANNEL parameter set incorrectly	Verify the CHANNEL parameter in the AI block matches the correct transducer block measurement channels (1–18).
Steady non-zero flow rate under no-flow conditions	Misaligned piping (especially in new installations)	Correct the piping.
	Open or leaking valve	Check or correct the valve mechanism.
	Bad sensor zero	Rezero the flowmeter. See Section 1.5.

Table 5-2 Output problems and possible remedies *continued*

Symptom	Cause	Possible remedies
Erratic non-zero flow rate under no-flow conditions	Wiring problem	Verify all sensor-to-transmitter wiring and ensure the wires are making good contact.
	Noise in fieldbus wiring	Verify that the wiring is properly shielded against noise.
	Incorrectly set or bad power conditioner	See Section 5.7.5.
	Vibration in pipeline at rate close to sensor frequency	Check the environment and remove the source of vibration.
	Leaking valve or seal	Check pipeline.
	Inappropriate measurement unit	Check measurement units using a fieldbus host.
	Inappropriate damping value	Check damping. See Section 5.7.1.
	Slug flow	See Section 5.11.
	Plugged flow tube	Check drive gain and frequency. Purge the flow tubes.
	Mounting stress on sensor	Check sensor mounting. Ensure that: • Sensor is not being used to support pipe. • Sensor is not being used to correct misaligned pipe. • 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	Output wiring problem	Verify fieldbus wiring.
	Inappropriate measurement unit	Check measurement units using a fieldbus tool.
	Inappropriate damping value	Check damping. See Section 5.7.1.
	Excessive or erratic drive gain	See Sections 5.12.3 and 5.12.4.
	Slug flow	See Section 5.11.
	Plugged flow tube	Check drive gain and tube frequency. Purge the flow tubes.
	Wiring problem	Verify all sensor-to-transmitter wiring and ensure the wires are making good contact.
Inaccurate flow rate	Inappropriate measurement unit	Check measurement units using a fieldbus host.
	Bad sensor zero	Rezero the flowmeter. See Section 1.5.
	Bad flowmeter grounding	See Section 5.10.3.
	Slug flow	See Section 5.11.
	Incorrectly set linearization	See Section 5.7.6.
	Wiring problem	Verify all sensor-to-transmitter wiring and ensure the wires are making good contact.

Table 5-2 Output problems and possible remedies *continued*

Symptom	Cause	Possible remedies
Inaccurate density reading	Problem with process fluid	Use standard procedures to check quality of process fluid.
	Wiring problem	Verify all sensor-to-transmitter wiring and ensure the wires are making good contact.
	Bad flowmeter grounding	See Section 5.10.3.
	Slug flow	See Section 5.11.
	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.
Temperature reading significantly different from process temperature	RTD failure	Check for alarm conditions and follow troubleshooting procedure for indicated alarm.
Temperature reading slightly different from process temperature	Temperature calibration required	Perform temperature calibration. See Section 2.4.
Unusually high density reading	Plugged flow tube	Check drive gain and tube frequency. Purge the flow tubes.
Unusually low density reading	Slug flow	See Section 5.11.
Unusually high tube frequency	Sensor erosion	Contact Micro Motion Customer Service.
Unusually low tube frequency	Plugged flow tube	Check drive gain and tube frequency. Purge the flow tubes.
Unusually low pickoff voltages	Several possible causes	See Section 5.12.5.
Unusually high drive gain	Several possible causes	See Section 5.12.3.

5.7.1 Damping

An incorrectly set damping value may make the transmitter's output appear too sluggish or too jumpy. Adjust the FLOW_DAMPING, TEMPERATURE_DAMPING, and DENSITY_DAMPING parameters in the transducer block to achieve the damping effect you want. See Section 3.9.

Other damping problems

If the transmitter appears to be applying damping values incorrectly or the damping effects do not appear to be changed by adjustments to the DAMPING parameters, then the PV_FTIME parameter in an AI function block may be improperly set. Inspect each AI function block, and ensure that the PV_FTIME parameter is set to zero.

5.7.2 Flow cutoff

If the transmitter is sending an output of zero unexpectedly, then one of the cutoff parameters may be set incorrectly. See Section 3.12 for more information about configuring cutoffs.

5.7.3 Output scale

An incorrectly configured output scale can cause the transmitter to report unexpected output levels. Verify that the XD_SCALE values are set up correctly for each AI block. See Section 3.5.

5.7.4 Calibration

Improper calibration may cause the transmitter to send unexpected output values. However, you should suspect an improper calibration only if the transmitter has been field-calibrated recently. Refer to Section 2.1 for more information about calibration.

Note: Micro Motion recommends using meter factors, rather than calibration, to prove the meter against a regulatory standard or to correct measurement error. Contact Micro Motion before calibrating your flowmeter. Refer to Section 3.10 for information about meter factors.

5.7.5 Fieldbus network power conditioner

An incorrectly set or bad power conditioner can cause inappropriate communication from the transmitter. For the MTL power conditioner, the red switch (dual redundancy) should be set to *Normal Mode*. The yellow switch (termination) should be set to *Termination In*. If you suspect further problems with the power conditioner, contact Micro Motion Customer Service for assistance.

5.7.6 Linearization

The linearization parameter in each AI function block can affect the transmitter's output. Verify that the L_TYPE parameter is set to *Direct* or *Indirect*. For an explanation of each value, see Section 3.6.

5.8 Lost static data alarm

After performing an EEPROM init using the Micro Motion Load Utility, the resource block may be out of service and indicating a lost static data alarm. (This will cause all the rest of the function blocks to also be out of service.)

This behavior is normal for an EEPROM initalization. Cycle power to the transmitter to clear the condition.

5.9 Status alarms

Status alarms are reported by a fieldbus host, the display, and ProLink II software. Remedies for the alarm states appear in Table 5-3.

Table 5-3 Status alarms and remedies

Display code	Fieldbus	ProLink II software	Possible remedies
A1	EEPROM error (CP)	EEPROM checksum	Cycle power to the transmitter.
			The flowmeter might need service. Contact Micro Motion Customer Service.
A2	RAM error (CP)	RAM error	Cycle power to the transmitter.
			The flowmeter might need service. Contact Micro Motion Customer Service.
A3	Sensor Fail	Sensor failure	Check the test points. See Section 5.12.
			Check wiring to sensor. See Section 5.10.2.
			Check for slug flow. See Section 5.11.
			Check sensor tubes.

Table 5-3 **Status alarms and remedies** *continued*

Display code	Fieldbus	ProLink II software	Possible remedies
A4	Temp. Overrange	Temperature overrange	Check the test points. See Section 5.12.
			Check wiring to sensor. See Section 5.10.2.
			Verify process temperature range is within limits for sensor and transmitter.
			Contact Micro Motion Customer Service.
A5	Input overrange	Input overrange	Check the test points. See Section 5.12.
			Verify process conditions.
			Verify that transmitter is configured to use appropriate measurement units. See Section 3.3.
			Re-zero the flowmeter. See Section 1.5.
A6	Unconfig – FloCal Unconfig – K1	Not configured	Contact Micro Motion Customer Service.
A7	RTI failure	RTI failure	Cycle power to the transmitter.
			The flowmeter might need service. Contact Micro Motion Customer Service.
A8	Dens. Overrange	Density overrange	Check the test points. See Section 5.12.
			Check for air in flow tubes, tubes not filled, foreign material in tubes, coating in tubes.
A9	Xmitter Init	Transmitter initializing	Allow the transmitter to warm up. The error should disappear from the status words once the transmitter is ready for normal operation.
A10	Cal Failed	Calibration failure	If alarm appears during zero, ensure there is no flow through the sensor, then retry.
			Cycle power to the flowmeter, then retry.
A11	Cal Fail: Low	Zero too low	Ensure there is no flow through sensor, then retry.
			Cycle power to the flowmeter, then retry.
A12	Cal Fail: High	Zero too high	Ensure there is no flow through sensor, then retry.
			Cycle power to the flowmeter, then retry.
A13	Cal Fail: Noisy	Zero too noisy	Remove or reduce sources of electromechanical noise, then attempt the calibration or zero procedure again. Possible sources of noise include: • Mechanical pumps • Electrical interference • Vibration effects from nearby machinery
			Cycle power to the flowmeter, then retry.
A14	Transmitter Fail	Transmitter fail	Cycle power to the transmitter.
			The transmitter might need service. Contact Micro Motion Customer Service.
A16	Line RTD Over	Line temp out-of-range	Check the test points. See Section 5.12.
			Check wiring to sensor. See Section 5.10.2.
			Contact Micro Motion Customer Service.
A17	Meter RTD Over	Meter temp out-of-range	Check the test points. See Section 5.12.
			Contact Micro Motion Customer Service.

Table 5-3 Status alarms and remedies *continued*

Display code	Fieldbus	ProLink II software	Possible remedies
A18	EEPROM err (2700)	EEPROM checksum	Cycle power to the transmitter.
			The transmitter might need service. Contact Micro Motion Customer Service.
A19	RAM err (2700)	RAM error	Cycle power to the transmitter.
			The transmitter might need service. Contact Micro Motion Customer Service.
A20	Unconfig – FloCal	Cal factor unentered	Contact Micro Motion Customer Service.
A21	Unconfigured—need K1	Incorrect sensor type	Contact Micro Motion Customer Service.
A22	EEPROM error (CP)	Configuration corrupt	The flowmeter needs service. Contact Micro Motion Customer Service.
A23	EEPROM error (CP)	Totals corrupt	The flowmeter needs service. Contact Micro Motion Customer Service.
A24	EEPROM error (CP)	CP program corrupt	The flowmeter needs service. Contact Micro Motion Customer Service.
A25	Boot Fail (CP)	Boot sector fault	The flowmeter needs service. Contact Micro Motion Customer Service.
A26	Sns/Xmitter comm fault	Sensor/transmitter comm. failure	Check wiring between transmitter and sensor (see Section 5.10.2). The wires may be swapped. After swapping wires, cycle power to the flowmeter.
			Check for noise in wiring or transmitter environment.
			Check sensor LED. See Section 5.13.1.
			Perform the sensor resistance test. See Section 5.13.2.
A102	Drive Overrange	Drive overrange	Excessive or erratic drive gain. See Section 5.12.3.
A103	Data Loss Possible	Data loss possible	Cycle power to the transmitter.
			The transmitter might need service. Contact Micro Motion Customer Service.
A104	Cal in Progress	Calibration in progress	Allow the flowmeter to complete calibration.
A105	Slug Flow	Slug flow	Allow slug flow to clear from the process.
			See Section 5.11.
A107	Power Reset	Power reset	No action is necessary.

5.10 Diagnosing wiring problems

Use the procedures in this section to check the transmitter installation for wiring problems.

⚠ WARNING

Removing the wiring compartment covers in explosive atmospheres while the power is on can cause an explosion.

Before removing the field wiring compartment cover in explosive atmospheres, shut off the power and wait five minutes.

5.10.1 Checking the power supply wiring

To check the power supply wiring:

1. Verify that the correct external fuse is used. An incorrect fuse can limit current to the transmitter and keep it from initializing.
2. Power down the transmitter.
3. If the transmitter is in a hazardous area, wait five minutes.
4. Ensure that the power supply wires are connected to the correct terminals. Refer to the installation manual.
5. Verify that the power supply wires are making good contact and are not clamped to the wire insulation.
6. Inspect the voltage label on the inside of the field-wiring compartment. Verify that the voltage supplied to the transmitter matches the voltage specified on the label.
7. Use a voltmeter to test the voltage at the transmitter's power supply terminals. Verify that it is within specified limits. For DC power, you may need to size the cable. Refer to the installation manual for information about the transmitter power supply.

5.10.2 Checking the sensor-to-transmitter wiring

To check the sensor-to-transmitter wiring, verify that:

- The transmitter is connected to the sensor according to the wiring information provided in the transmitter installation manual.
- The wires are making good contact with the terminals.
- The mating connector between the sensor and the transmitter is securely plugged into its socket.

If the wires are incorrectly connected, power down the transmitter (wait five minutes before opening the transmitter compartment if the transmitter is in a hazardous area), correct the wiring, then restore power to the transmitter.

5.10.3 Checking the grounding

The sensor and the transmitter must be grounded. The transmitter is grounded via the shielded cable between the sensor and the transmitter. The sensor mounting plate must be grounded to earth. See the installation manual.

5.10.4 Checking the communication wiring

To check the communication wiring, verify that:

- Communication wires and connections meet FOUNDATION fieldbus wiring standards.
- Wires are connected according to instructions provided in the transmitter installation manual.
- Wires are making good contact with the terminals.

5.11 Checking slug flow

The dynamics of slug flow are described in Section 3.11. If the transmitter is reporting a slug flow alarm, first check the process and possible mechanical causes for the alarm:

- Actual changes in process density
- Cavitation or flashing
- Leaks

If there are no mechanical causes for the slug flow alarm, the slow flow limits and duration may be set too high or too low. The high limit is set by default to 5.0 g/cm^3, and the low limit is set by default to 0.0 g/cm^3. Lowering the high limit or raising the low limit will cause the transmitter to be more sensitive to changes in density. If you expect occasional slug flow in your process, you may need to increase the slug flow duration. A longer slug flow duration will make the transmitter more tolerant of slug flow.

5.12 Checking the test points

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.

5.12.1 Obtaining the test points

You can obtain the test points with a fieldbus host or ProLink II software.

With a fieldbus host

To obtain the test points with a fieldbus host:

1. Select the **DIAGNOSTICS** transducer block.
2. Write down the values of the **DRIVE_GAIN**, **LEFT_PICKOFF_VOLTAGE**, **RIGHT_PICKOFF_VOLTAGE**, and **TUBE_FREQUENCY** parameters.

With ProLink II software

To obtain the test points with ProLink II software:

1. Choose **ProLink > Diagnostic Information**.
2. Write down the value you find in the **Tube Frequency** box, the **Left Pickoff** box, the **Right Pickoff** box, and the **Drive Gain** box.

5.12.2 Evaluating the test points

Use the following guidelines to evaluate the test points:

- If the drive gain is at 100%, refer to Section 5.12.3.
- If the drive gain is unstable, refer to Section 5.12.4.
- The pickoff value for LF-Series sensors is 800 mV peak-to-peak.
  - If the value for the left or right pickoff does not match this value, refer to Section 5.12.5.
  - If the pickoff values match this value, record your troubleshooting data and contact the Micro Motion Customer Service Department for assistance.

5.12.3 Excessive drive gain

The causes and possible solutions of excessive drive gain are listed in Table 5-4.

Table 5-4 Excessive drive gain causes and solutions

Cause	Solution
Excessive slug flow	Eliminate slugs.
Plugged flow tube	Purge the flow tubes.
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.
Drive board or module failure, cracked flow tube, or sensor imbalance	Contact Micro Motion Customer Service.
Mechanical binding at sensor	Ensure sensor is free to vibrate.
Open drive or left pickoff sensor coil	Contact Micro Motion Customer Service.
Flow rate out of range	Ensure flow rate is within sensor limits.

5.12.4 Erratic drive gain

The causes and possible solutions of erratic drive gain are listed in Table 5-5.

Table 5-5 Erratic drive gain causes and solutions

Cause	Solution
Polarity of pick-off reversed or polarity of drive reversed	Contact Micro Motion Customer Service.
Slug flow	Verify flow tubes are completely filled with process fluid, and that slug flow limits and duration are properly configured. See Section 5.11.
Foreign material caught in flow tubes	Purge flow tubes.

5.12.5 Bad pickoff voltage

The causes and possible solutions of bad pickoff voltage are listed in Table 5-6.

Table 5-6 Bad pickoff voltage causes and solutions

Cause	Solution
Process flow rate beyond the limits of the sensor	Verify that the process flow rate is not out of range of the sensor.
Slug flow	Verify the flow tubes are completely filled with process fluid, and that slug flow limits and duration are properly configured. See Section 5.11.
No tube vibration in sensor	Check for plugging.
	Ensure sensor is free to vibrate (no mechanical binding).
	Verify wiring.
Process beyond the limits of the sensor	Verify that the process flow rate is not out of range of the sensor.
Moisture in the sensor electronics	Eliminate the moisture in the sensor electronics.
The sensor is damaged	Contact Micro Motion Customer Service.

5.13 Checking the sensor

Two sensor procedures are available:

- You can check the sensor LED. The sensor has an LED that indicates different flowmeter conditions.
- You can perform the sensor resistance test to check for a damaged sensor.

5.13.1 Checking the sensor LED

To check the sensor LED:

1. Maintain power to the transmitter.
2. Check the sensor LED against the conditions described in Table 5-7.

Table 5-7 Sensor LED behavior, flowmeter conditions, and remedies

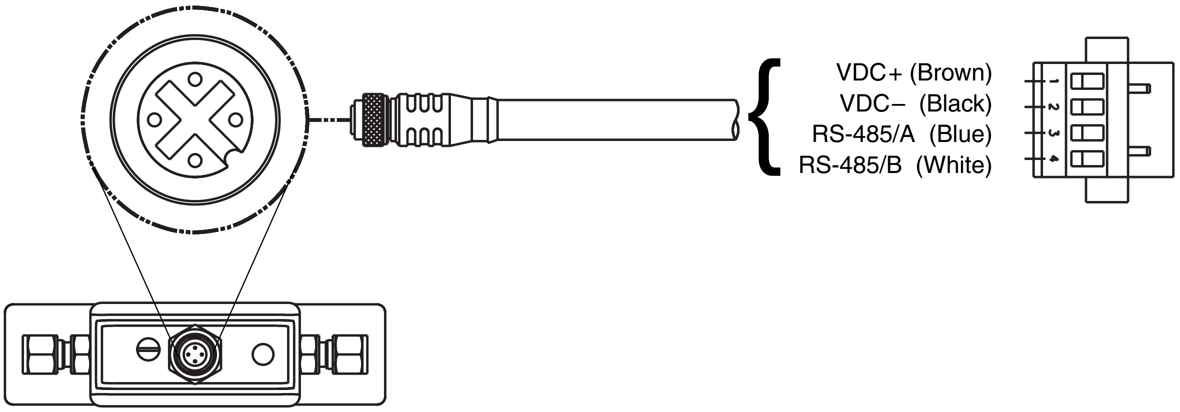
LED behavior	Condition	Possible remedy
1 flash per second (75% off, 25% on)	Normal operation	No action required.
1 flash per second (25% off, 75% on)	Slug flow	See Section 5.11.
Solid on	Zero or calibration in progress	If zero or calibration procedure is in progress, no action is required. If these procecures are not in progress, contact Micro Motion Customer Service.
	Sensor receiving between 11.5 and 5 volts	Check power supply to transmitter. See Section 5.10.1.
3 rapid flashes followed by a pause	Broken pin	Contact Micro Motion Customer Service.
4 flashes per second	Fault condition	Check alarm status.
OFF	Sensor receiving less than 5 volts	Verify power supply wiring to sensor. Refer to transmitter installation manual.
		If status LED is lit, transmitter is receiving power. Check voltage across terminals 1 (VDC+) and 2 (VDC–) in sensor. Normal reading is approximately 14 VDC. If reading is normal, internal sensor failure is possible — contact Micro Motion Customer Service. If reading is 0, internal transmitter failure is possible — contact Micro Motion Customer Service. If reading is less than 1 VDC, verify power supply wiring to sensor. Wires may be switched. Refer to transmitter installation manual.
		If status LED is not lit, transmitter is not receiving power. Check power supply. If power supply is operational, internal transmitter, display, or LED failure is possible. Contact Micro Motion Customer Service.
	Sensor internal failure	Contact Micro Motion Customer Service.

5.13.2 Sensor resistance test

To perform the sensor resistance test:

1. At the transmitter, disconnect the 4-wire sensor cable from the mating connector. See Figure 5-1.

Figure 5-1 Sensor resistance test and wire pairs



2. Measure the resistance between the following wire pairs:
   - Blue and white (RS-485/A and RS-485/B). Resistance should be 40 kΩ to 50 kΩ.
   - Black and blue (VDC– and RS-485/A). Resistance should be 20 kΩ to 25 kΩ.
   - Black and white (VDC– and RS-485/B). Resistance should be 20 kΩ to 25 kΩ.
3. If any resistance measurements are lower than specified, the sensor may not be able to communicate with a transmitter. Contact Micro Motion.
4. To return to normal operation, reconnect the 4-wire sensor cable to the mating connector.

Appendix A
Using ProLink II Software

A.1 Overview

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

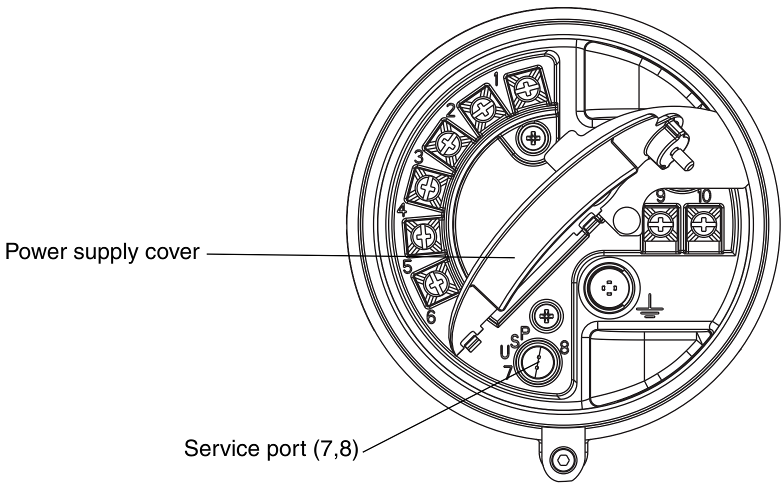
- Start and navigate in ProLink II software
- Establish communication between ProLink II software and compatible devices
- Transmit and receive configuration information between ProLink II software and compatible devices

If you are unable to perform the tasks listed above, consult the ProLink II software manual before attempting to use the software to configure a transmitter.

A.2 Connecting to a transmitter

You can temporarily connect a personal computer (PC) to the transmitter's service port. The service port is located in the power supply compartment, beneath the cover. See Figure A-1.

Figure A-1 Service port



To connect to the service port:

1. Open the cover to the wiring compartment.

⚠ WARNING

Opening the wiring compartment in a hazardous area can cause an explosion.

Because the wiring compartment must be open to make a connection to the service port, the service port should only be used for temporary connections.

When the transmitter is in an explosive atmosphere, do not use the service port to connect to the transmitter.

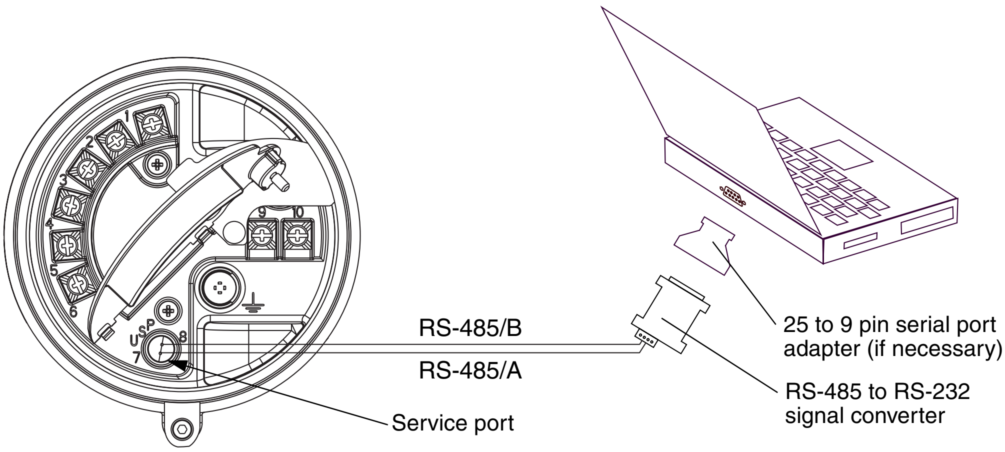
2. Open the transmitter's power supply cover.
3. Connect one end of the signal converter leads to the RS-485 terminals on the signal converter.
4. Connect the other end of the signal converter leads to the service-port terminals. See Figure A-2.

⚠ WARNING

Opening the power supply compartment can expose the operator to electric shock.

To avoid the risk of electric shock, do not touch the power supply wires or terminals while using the service port.

Figure A-2 Connecting to the service port



Appendix B
Using the Display

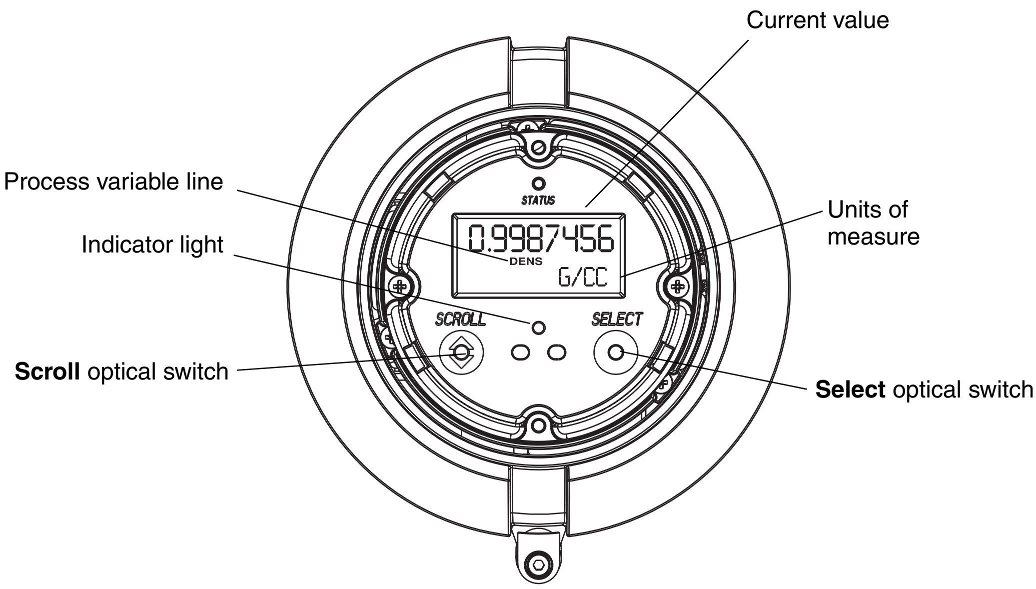
B.1 Overview

This appendix describes the basic use of the display.

B.2 Components

Figure B-1 illustrates the display components.

Figure B-1 Display components



The **Scroll** and **Select** optical switches are used to navigate the transmitter display. To activate an optical switch, touch the glass in front of the optical switch or move your finger over the optical switch close to the glass. The optical switch indicator will be solid red when a single switch is activated, and will flash red when both switches are activated simultaneously.

B.3 Display password

Some of the display functions, such as the off-line menu and resetting totalizers, can be protected by a password. For information about setting the password, refer to Section 3.15.3.

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 the display detectors. The password screen will time out automatically and you will be returned to the previous screen.

B.4 Abbreviations

The display uses a number of abbreviations. Table B-1 lists the abbreviations used by the display.

Table B-1 **Display abbreviations**

Abbreviation	Definition
ACK	Acknowledge
AVE_D	Average density
AVE_T	Average temperature
BRD_T	Board temperature
CONC	Concentration
CONFG	Configure (or configuration)
DENS	Density
DGAIN	Drive gain
DISBL	Disable
DRIVE%	Drive gain
DSPLY	Display
ENABL	Enable
EXT_T	External temperature
FLDIR	Flow direction
FLSWT	Flow switch
LPO_A	Left pickoff amplitude
LVOLI	Volume inventory
LZERO	Live zero flow
MAINT	Maintenance
MASS	Mass flow
MASSI	Mass inventory
MFLOW	Mass flow
MTR_T	Case temperature (T-Series sensors only)
NET M	ED net mass flow rate
NET V	ED net volume flow rate

Abbreviation	Definition
NETMI	ED net mass inventory
NETVI	ED net volume inventory
OFFLN	Offline
PASSW	Password
PWRIN	Input voltage
r.	Revision
RDENS	Density at reference temperature
RPO_A	Right pickoff amplitude
SGU	Specific gravity units
SIM	Simulated
SPECL	Special
STD M	Standard mass flow rate
STD V	Standard volume flow rate
STDVI	Standard volume inventory
TCDENS	Temperature-corrected density
TCORI	Temperature-corrected inventory
TCORR	Temperature-corrected total
TCVOL	Temperature-corrected volume
TEMPR	Temperature
TUBEF	Raw tube frequency
VFLOW	Volume flow
VOL	Volume flow
WTAVE	Weighted average
XMTR	Transmitter

Appendix C
FOUNDATION Fieldbus Function Block Reference

C.1 FOUNDATION fieldbus technology and fieldbus function blocks

This appendix introduces fieldbus systems that are common to all fieldbus devices, including AI, AO, INT, and PID function blocks. The transducer function blocks present in the Micro Motion LF-Series transmitter are documented in Appendix D.

C.1.1 Introduction

A fieldbus system is a distributed system composed of field devices and control and monitoring equipment integrated into the physical environment of a plant or factory. Fieldbus devices work together to provide I/O and control for automated processes and operations. The Fieldbus Foundation provides a framework for describing these systems as a collection of physical devices interconnected by a fieldbus network. One of the ways the physical devices are used is to perform their portion of the total system operation by implementing one or more function blocks.

Function blocks

Function blocks within the fieldbus device perform the various functions required for process control. Because each system is different, the mix and configuration of functions are different. Therefore, the Fieldbus Foundation has designed a range of function blocks, each addressing a different need.

The Fieldbus Foundation has established the function blocks by defining a small set of parameters used in all function blocks called universal parameters. They have also published definitions for transducer blocks commonly used with standard function blocks. Examples include temperature, pressure, level, and flow transducer blocks.

A block is a tagged logical processing unit. The tag is the name of the block. System management services locate a block by its tag. Thus the service personnel need only know the tag of the block to access or change the appropriate block parameters. Function blocks are also capable of performing short-term data collection and storage for reviewing blocks and their parameters.

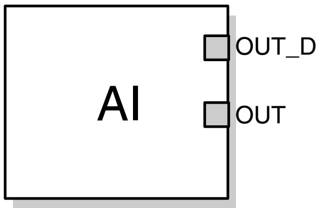
C.1.2 Block operation

In addition to function blocks, fieldbus devices contain two other block types to support the function blocks. These are the resource block and the transducer block. The resource block contains the hardware specific characteristics associated with a device. Transducer blocks couple the function blocks to local I/O functions.

C.2 Analog input function block

The analog input (AI) function block processes field device measurements and makes them available to other function blocks. The output value from the AI block is in engineering units and contains a status indicating the quality of the measurement. The measuring device may have several measurements or derived values available in different channels. Use the channel number to define the variable that the AI block processes.

Figure C-1 Analog input function block



- OUT—The block ouput value and status
- OUT_D—Discrete output that signals a selected alarm condition

The AI block supports alarming, signal scaling, signal filtering, signal status calculation, mode control, and simulation. In Automatic mode, the block's output parameter (OUT) reflects the process variable (PV) value and status. In Manual mode, OUT may be set manually. The Manual mode is reflected on the output status. A discrete output (OUT_D) is provided to indicate whether a selected alarm condition is active. Alarm detection is based on the OUT value and user specified alarm limits. Table C-1 lists the AI block parameters and their units of measure, descriptions, and index numbers. AI block timing is illustrated in Figure C-2.

Table C-1 Definitions of analog input function block system parameters

Parameter	Index Number	Units	Description
ACK_OPTION	23	None	Used to set auto acknowledgment of alarms
ALARM_HYS	24	%	The amount the alarm value must return within the alarm limit before the associated active alarm condition clears
ALARM_SEL	38	None	Used to select the process alarm conditions that will cause the OUT_D parameter to be set
ALARM_SUM	22	None	The summary alarm is used for all process alarms in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
ALERT_KEY	04	None	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.

Table C-1 Definitions of analog input function block system parameters *continued*

Parameter	Index Number	Units	Description
BLOCK_ALM	21	None	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
BLOCK_ERR	06	None	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
CHANNEL	15	None	The CHANNEL value is used to select the measurement value. Refer to the appropriate device manual for information about the specific channels available in each device. You must configure the CHANNEL parameter before you can configure the XD_SCALE parameter.
FIELD_VAL	19	%	The value and status from the transducer block or from the simulated input when simulation is enabled
GRANT_DENY	12	None	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device.
HI_ALM	34	None	The HI alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm
HI_HI_ALM	33	None	The HI HI alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm
HI_HI_LIM	26	EU of PV_SCALE	The setting for the alarm limit used to detect the HI HI alarm condition
HI_HI_PRI	25	None	The priority of the HI HI alarm
HI_LIM	28	EU of PV_SCALE	The setting for the alarm limit used to detect the HI alarm condition
HI_PRI	27	None	The priority of the HI alarm
IO_OPTS	13	None	Allows the selection of I/O options used to alter the PV. Low cutoff enabled is the only selectable option.
L_TYPE	16	None	Linearization type. Determines whether the field value is used directly (Direct), is converted linearly (Indirect), or is converted with the square root (Indirect Square Root).
LO_ALM	35	None	The LO alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm

Table C-1 Definitions of analog input function block system parameters *continued*

Parameter	Index Number	Units	Description
LO_LIM	30	EU of PV_SCALE	The setting for the alarm limit used to detect the LO alarm condition
LO_LO_ALM	36	None	The LO LO alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm
LO_LO_LIM	32	EU of PV_SCALE	The setting for the alarm limit used to detect the LO LO alarm condition
LO_LO_PRI	31	None	The priority of the LO LO alarm
LO_PRI	29	None	The priority of the LO alarm
LOW_CUT	17	%	If percentage value of transducer input fails below this, PV = 0.
MODE_BLK	05	None	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
OUT	08	EU of OUT_SCALE	The block output value and status
OUT_D	37	None	Discrete output to indicate a selected alarm condition
OUT_SCALE	11	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with OUT
PV	07	EU of XD_SCALE	The process variable used in block execution
PV_FTIME	18	Seconds	The time constant of the first-order PV filter. It is the time required for a 63% change in the IN value.
SIMULATE	09	None	A group of data that contains the current transducer value and status, the simulated transducer value and status, and the enable/disable bit
STRATEGY	03	None	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ST_REV	01	None	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
TAG_DESC	02	None	The user description of the intended application of the block
UPDATE_EVT	20	None	This alert is generated by any change to the static data.

Table C-1 Definitions of analog input function block system parameters *continued*

Parameter	Index Number	Units	Description
VAR_INDEX	39	% of OUT Range	The average absolute error between the PV and its previous mean value over that evaluation time defined by VAR_SCAN
VAR_SCAN	40	Seconds	The time over which the VAR_INDEX is evaluated
XD_SCALE	10	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with the channel input value. The XD_SCALE units code must match the units code of the measurement channel in the transducer block. If the units do not match, the block will not transition to MAN or AUTO.

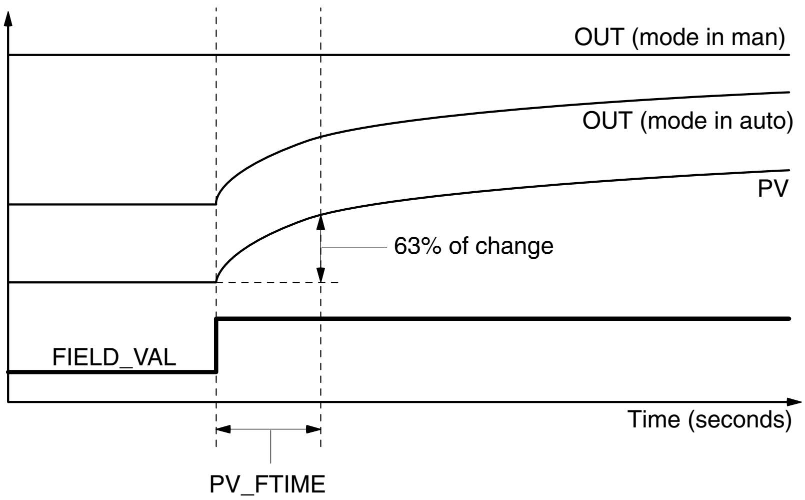
C.2.1 Simulation

To support testing, you can either change the mode of the block to manual and adjust the output value, or you can enable simulation through the configuration tool and manually enter a value for the measurement value and its status. In both cases, you must first set the ENABLE jumper on the field device.

Note: All fieldbus instruments have a simulation jumper. As a safety measure, the jumper has to be reset every time there is a power interruption. This measure is to prevent devices that went through simulation in the staging process from being installed with simulation enabled.

With simulation enabled, the actual measurement value has no impact on the OUT value or the status.

Figure C-2 Analog input function block timing



C.2.2 Filtering

The filtering feature changes the response time of the device to smooth variations in output readings caused by rapid changes in input. You can adjust the filter time constant (in seconds) using the PV_FTIME parameter. Set the filter time constant to zero to disable the filter feature.

C.2.3 Signal conversion

You can set the signal conversion type with the Linearization Type (L_TYPE) parameter. You can view the converted signal (in percent of XD_SCALE) through the FIELD_VAL parameter.

$$\text{FIELDVAL} = \frac{100 \times (\text{ChannelValue} - \text{EU}^{*} @ 0\%)}{\text{EU}^{*} @ 100\% - \text{EU} @ 0\%}$$

*XD_SCALE values

You can choose from direct, indirect, or indirect square root signal conversion with the L_TYPE parameter.

Direct

Direct signal conversion allows the signal to pass through the accessed channel input value (or the simulated value when simulation is enabled).

Indirect

Indirect signal conversion converts the signal linearly to the accessed channel input value (or the simulated value when simulation is enabled) from its specified range (XD_SCALE) to the range and units of the PV and OUT parameters (OUT_SCALE).

$$\text{PV} = \left(\frac{\text{FIELD\_VAL}}{100}\right) \times (\text{EU}^{**} @ 100\% - \text{EU}^{**} @ 0\%) + \text{EU}^{**} @ 0\%$$

**OUT_SCALE values

Indirect square root

Indirect square root signal conversion takes the square root of the value computed with the indirect signal conversion and scales it to the range and units of the PV and OUT parameters.

$$\text{PV} = \sqrt{\frac{\text{FIELD\_VAL}}{100}} \times (\text{EU}^{**} @ 100\% - \text{EU}^{**} @ 0\%) + \text{EU}^{**} @ 0\%$$

**OUT_SCALE values

When the converted input value is below the limit specified by the LOW_CUT parameter, and the low cutoff I/O option (IO_OPTS) is enabled (True), a value of zero is used for the converted value (PV). This option is useful to eliminate false readings when the differential pressure measurement is close to zero, and it may also be useful with zero-based measurement devices such as flowmeters.

Note: Low cutoff is the only I/O option supported by the AI block. You can set the I/O option in manual or out of service mode only.

C.2.4 Block errors

Table C-2 lists conditions reported in the BLOCK_ERR parameter. Conditions in *italics* are inactive for the AI block and are given here only for your reference.

Table C-2 BLOCK_ERR conditions

Condition Number	Condition Name and Description
0	*Other*
1	Block Configuration Error: The selected channel carries a measurement that is incompatible with the engineering units selected in XD_SCALE, the L_TYPE parameter is not configured, or CHANNEL = zero.
2	*Link Configuration Error*
3	Simulate Active: Simulation is enabled and the block is using a simulated value in its execution.
4	*Local Override*
5	*Device Fault State Set*
6	*Device Needs Maintenance Soon*
7	Input Failure/Process Variable has Bad Status: The hardware is bad, or a bad status is being simulated.
8	Output Failure: The output is bad based primarily upon a bad input.
9	*Memory Failure*
10	*Lost Static Data*
11	*Lost NV Data*
12	*Readback Check Failed*
13	Device Needs Maintenance Now
14	Power Up
15	Out of Service: The actual mode is out of service.

C.2.5 Modes

The AI function Block Supports three modes of operation as defined by the MODE_BLK parameter:

- **Manual (Man)**—The block output (OUT) may be set manually.
- **Automatic (Auto)**—OUT reflects the analog input measurement or the simulated value when simulation is enabled.
- **Out of Service (O/S)**—The block is not processed. FIELD_VAL and PV are not updated and the OUT status is set to Bad: Out of Service. The BLOCK_ERR parameter shows Out of Service. In this mode, you can make changes to all configured parameters.The target mode of a block may be restricted to one or more of the supported modes.

C.2.6 Alarm detection

A block alarm will be generated whenever the BLOCK_ERR has an error bit set. The types of block error for the AI block are defined in Table C-2.

Process alarm detection is based on the OUT value. You can configure the alarm limits of the following standard alarms:

- High (HI_LIM)
- High high (HI_HI_LIM)
- Low (LO_LIM)
- Low low (LO_LO_LIM)

In order to avoid alarm chattering when the variable is oscillating around the alarm limit, an alarm hysteresis in percent of the PV span can be set using the ALARM_HYS parameter. The priority of each alarm is set in the following parameters:

- HI_PRI
- HI_HI_PRI
- LO_PRI
- LO_LO_PRI

Table C-3 shows the five alarm priority levels.

Table C-3 Alarm priority levels

Priority Number	Priority Description
0	The priority of an alarm condition changes to 0 after the condition that caused the alarm is corrected.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator, but does not require operator attention. Examples include diagnostics and system alerts.
3–7	Alarm conditions of priority 3 to 7 are advisory alarms of increasing priority.
8–15	Alarm conditions of priority 8 to 15 are critical alarms of increasing priority.

C.2.7 Status handling

Normally, the status of the PV reflects the status of the measurement value, the operating condition of the I/O card, and any active alarm condition. In Auto mode, OUT reflects the value and status quality of the PV. In Man mode, the OUT status constant limit is set to indicate that the value is a constant and the OUT status is *Good*.

The **Uncertain**—EU range violation status is always set, and the PV status is set high- or low-limited if the sensor limits for conversion are exceeded.

In the STATUS_OPTS parameter, you can select from the following options to control the status handling:

- **BAD if Limited**—Sets the OUT status quality of *Bad* when the value is higher or lower than the sensor limits
- **Uncertain if Limited**—Sets the OUT status quality to *Uncertain* when the value is higher or lower than the sensor limits
- **Uncertain if in Manual mode**—The status of the Output is set to *Uncertain* when the mode is set to Manual

Note: The instrument must be in Manual or Out of Service mode to set the status option.

Note: The AI block supports only the BAD if Limited option. Unsupported options are not grayed out; they appear on the screen in the same manner as supported options.

C.2.8 Advanced features

The AI function block provided with Fisher-Rosemount fieldbus devices provides added capability through the addition of the following parameters:

- **ALARM_TYPE**—Allows one or more of the process alarm conditions detected by the AI function block to be used in setting its OUT_D parameter.
- **OUT_D**—Discrete output of the AI function block based on the detection of process alarm condition(s). This parameter may be linked to other function blocks that require a discrete input based on the detected alarm condition.
- **VAR_SCAN**—Time period in seconds over which the variability index (VAR_INDEX) is computed.
- **VAR_INDEX**—Process variability index measured as the integral of average absolute error between PV and its mean value over the previous evaluation period. This index is calculated as a percent of OUT span and is updated at the end of the time period defined by VAR_SCAN.

C.2.9 Troubleshooting

Refer to Table C-4 to troubleshoot any problems that you encounter with the AI function block.

Table C-4 Troubleshooting the AI function block

Symptom	Possible Causes	Corrective Action
Mode will not leave OOS	Target mode not set	Set target mode to something other than OOS.
	Configuration error	BLOCK_ERR will show the configuration error bit set. The following are parameters that must be set before the block is allowed out of OOS: • CHANNEL must be set to a valid value and cannot be left at initial value of 0. • XD_SCALE.UNITS_INDX must match the units in the transducer block channel value. • L_TYPE must be set to Direct, Indirect, or Indirect Square Root and cannot be left at initial value of 0.
	Resource Block	The actual mode of the Resource block is OOS.
	Schedule	Block is not scheduled and therefore cannot execute to go to Target Mode. Schedule the block to execute.

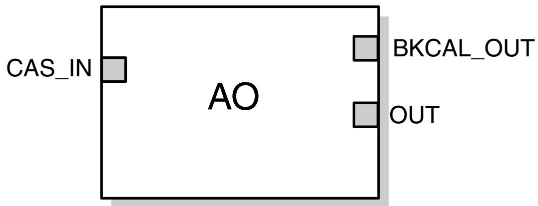
Table C-4 Troubleshooting the AI function block

Symptom	Possible Causes	Corrective Action
Process and/or block alarms will not work	Features	FEATURES_SEL does not have Alerts enabled. Enable the Alerts bit.
	Notification	LIM_NOTIFY is not high enough. Set equal to MAX_NOTIFY.
	Status Options	STATUS_OPTS has Propagate Fault Forward bit set. This should be cleared to cause an alarm to occur.
Cannot set HI_LIMIT, HI_HI_LIMIT, LO_LIMIT, LO_LO_LIMIT Values	Scaling	Limit values are outside the OUT_SCALE.EUO and OUT_SCALE.EU100 values. Change OUT_SCALE or set values within range.

C.3 Analog output function block

The analog Output (AO) function block assigns an output value to a field device through a specified I/O channel. The block supports mode control, signal status calculation, and simulation.

Figure C-3 Analog output function block



- CAS_IN—The remote setpoint value from another function block
- BKCAL_OUT—The value and status required by the BKCAL_IN input of another block to prevent reset windup and to provide bumpless transfer to closed loop control
- OUT—The block output and status

Table C-5 lists the definitions of the system parameters. AO block timing is illustrated in Figure C-3.

Table C-5 Analog output function block system parameters

Parameters	Units	Description
BKCAL_OUT	EU of PV_SCALE	The value and status required by the BKCAL_IN input of another block to prevent reset windup and to provide bumpless transfer to closed loop control
BLOCK_ERR	None	The summary of active error conditions associated with the block. The block errors for the AO block are Simulate Active, Input Failure/Process Variable has *Bad* Status, Output Failure, Read back Failed, and Out of Service.
CAS_IN	EU of PV_SCALE	The remote setpoint value from another function block
IO_OPTS	None	Allows you to select how the I/O signals are processed. The supported I/O options for the AO function block are SP_PV Track in Man, Increase to Close, and Use PV for BKCAL_OUT.
CHANNEL	None	Defines the output that drives the field device

Table C-5 Analog output function block system parameters *continued*

Parameters	Units	Description
MODE	None	Enumerated attribute used to request and show the source of the setpoint and/or output used by the block
OUT	EU of XD_SCALE	The primary value and status calculated by the block in Auto mode. OUT may be set manually in Man mode
PV	EU of PV_SCALE	The process variable used in block execution. This value is converted from READBACK to show the actuator position in the same units as the setpoint value.
PV_SCALE	None	The high and low scale values, the engineering units code, and the number of digits to the right of the decimal point associated with the PV
READBACK	EU of XD_SCALE	The measured or implied actuator position associated with the OUT value
SIMULATE	EU of XD_SCALE	Enables simulation and allows you to enter an input value and status.
SP	EU of PV_SCALE	The target block output value (setpoint)
SP_HI_LIM	EU of PV_SCALE	The highest setpoint value allowed
SP_LO_LIM	EU of PV_SCALE	The lowest setpoint value allowed
SP_RATE_DN	EU of PV_SCALE per second	Ramp rate for downward setpoint changes. When the ramp rate is set to 0, the setpoint is used immediately.
SP_RATE_UP	EU of PV_SCALE per second	Ramp rate for upward setpoint changes. When the ramp rate is set to zero, the setpoint is used immediately.
SP_WRK	EU of PV_SCALE	The working setpoint of the block. It is the result of setpoint rate-of-change limiting. The value is converted to percent to obtain the block's OUT value.

C.3.1 Setting the output

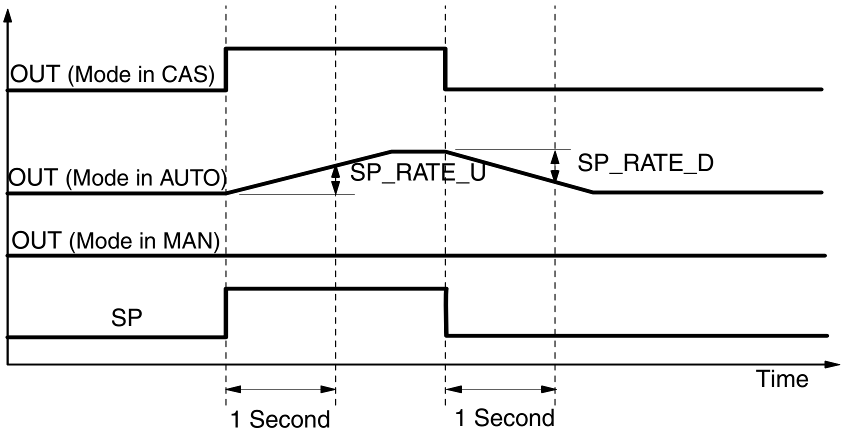
To set the output for the AO block, you must first set the mode to define the manner in which the block determines its setpoint. In Manual mode the value of the output attribute (OUT) must be set manually by the user, and is independent of the setpoint. In Automatic mode, OUT is set automatically based on the value specified by the setpoint (SP) in engineering units and the I/O options attribute (IO_OPTS). In addition, you can limit the SP value and the rate at which a change in the SP is passed to OUT.

In Cascade mode, the cascade input connection (CAS_IN) is used to update the SP. The back calculation output (BKCAL_OUT) is wired to the back calculation input (BKCAL_IN) of the upstream block that provides CAS_IN. This provides bumpless transfer on mode changes and windup protection in the upstream block. The OUT attribute or an analog readback value, such as valve position, is shown by the process value (PV) attribute in engineering units.

To support testing, you can enable simulation, which allows you to manually set the channel feedback. There is no alarm detection in the AO function block.

To select the manner of processing the SP and the channel output value, configure the setpoint limiting options, the tracking options, and the conversion and status calculations.

Figure C-4 Analog output function block timing



C.3.2 Setpoint selection and limiting

To select the source of the SP value use the **MODE** attribute. In Auto mode, the local, manually-entered SP is used. In Cascade (Cas) mode, the SP comes from another block through the CAS_IN input connector. In Remote Cascade (RCas) mode, the SP comes from a host computer that writes to RCAS_IN. The range and units of the SP are defined by the **PV_SCALE** attribute.

In Man mode the SP automatically tracks the PV value when you select the **SP_PV Track in Man** I/O option. The SP value is set equal to the PV value when the block is in manual mode, and is enabled (True) as a default. You can disable this option in Man or O/S mode only.

The SP value is limited to the range defined by the setpoint high limit attribute (SP_HI_LIM) and the setpoint low limit attribute (SP_LO_LIM)

In Auto mode, the rate at which a change in the SP is passed to OUT is limited by the values of the setpoint upward rate limit attribute (SP_RATE_UP) and the setpoint downward rate limit attribute (SP_RATE_DN). A limit of zero prevents rate limiting, even in Auto mode.

C.3.3 Conversion and status calculation

The working setpoint (SP_WRK) is the setpoint value after limiting. You can choose to reverse the conversion range, which will reverse the range of **PV_SCALE** to calculate the **OUT** attribute, by selecting the **Increase to Close** I/O option. This will invert the OUT value with respect to the setpoint based on the **PV_SCALE** and XD_SCALE.

In Auto mode, the converted SP value is stored in the **OUT** attribute. In Man mode, the **OUT** attribute is set manually, and is used to set the analog output defined by the **CHANNEL** parameter.

You can access the actuator position associated with the output channel through the **READBACK** parameter (in **OUT** units) and in the PV attribute (in engineering units). If the actuator does not support position feedback, the PV and **READBACK** values are based on the **OUT** attribute.

The working setpoint (SP_WRK) is the value normally used for the **BKCAL_OUT** attribute. However, for those cases where the **READBACK** signal directly (linearly) reflects the **OUT** channel, you can choose to allow the PV to be used for **BKCAL_OUT** by selecting the Use PV for **BKCAL_OUT** I/O option.

Note: SP_PV Track in Man, Increase to Close, and Use PV for BKCAL_OUT are the only I/O options that the AO block supports. You can set I/O options in Manual or Out of service mode only.

C.3.4 Simulation

When simulation is enabled, the last value of **OUT** is maintained and reflected in the field value of the **SIMULATE** attribute. In this case, the **PV** and **READBACK** values and statuses are based on the **SIMULATE** value and the status that you enter.

C.3.5 Action on fault detection

To define the state to which you wish the valve to enter when the CAS_IN input detects a bad status and the block is in CAS mode, configure the following parameters:

- **FSTATE_TIME:** The length of time that the AO block will wait to position the **OUT** value to the **FSTATE_VAL** value upon the detection of a fault condition. When the block has a target mode of CAS, a fault condition will be detected if the **CAS_IN** has a **BAD** status or an **Initiate Fault State** substatus is received from the upstream block.
- **FSTATE_VAL:** The value to which the **OUT** value transitions after **FSTATE_TIME** elapses and the fault condition has not cleared. You can configure the channel to hold the value at the start of the failure action condition or to go to the failure action value (FAIL_ACTION_VAL).

C.3.6 Block errors

The following conditions are reported in the BLOCK_ERR attribute:

- **Input failure/process variable has** *Bad* **status**—The hardware is bad, the Device Signal Tag (DST) does not exist, or a **BAD** status is being simulated.
- **O/S**—The block is in Out of Service mode.
- **Output failure**—The output hardware is bad.
- **Readback failed**—The readback failed
- **Simulate active**—Simulation is enabled and the block is using a simulated value in its execution.

C.3.7 Modes

The analog output function block supports the following modes:

- **Man**—You can manually set the output to the I/O channel through the OUT attribute. This mode is used primarily for maintenance and troubleshooting.
- **Auto**—The block output (OUT) reflects the target operating pint specified by the setpoint (SP) attribute.
- **Cas**—The SP attribute is set by another function block through a connection to CAS_IN. The SP value is used to set the **OUT** attribute automatically.
- **RCas**—The SP is set by a host computer by writing to the RCAS_IN parameter. The SP value is used to set the **OUT** attribute automatically.
- **O/S**—The block is not processed. The output channel is maintained at the last value and the status of OUT is set to *Bad: Out of Service*. The **BLOCK_ERR** attribute shows *Out of Service*.
- **Initialization Manual (Iman)**—The path to the output hardware is broken and the output will remain at the last position.
- **Local Override (LO)**—The output of the block is not responding to **OUT** because the resource block has been placed into LO mode or fault state action is active.

The target mode of the block may be restricted to one or more of the following modes: Man, Auto, Cas, RCas, or O/S.

C.3.8 Status handling

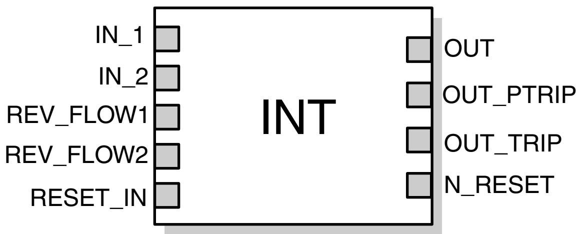
Output or readback fault detection are reflected in the status of PV, OUT, and BKCAL_OUT. A limited SP condition is reflected in the BKCAL_OUT status. When simulation is enabled through the SIMULATE attribute, you can set the value and status for PV and READBACK.

When the block is in Cas mode and the CAS_IN input goes bad, the block sheds mode to the next permitted mode.

C.4 Integrator function block

The **INT** function block integrates one or two variables over time. The block compares the integrated or accumulated value to pre-trip and trip limits and generates discrete output signals when the limits are reached.

Figure C-5 Integrator function block



- IN_1—The first input value and status
- IN_2—The second input value and status
- REV_FLOW1—The discrete input that specifies whether IN_1 is positive or negative
- REV_FLOW2—The discrete input that specifies whether IN_2 is positive or negative
- RESET_IN—The discrete input that resets the integrator and holds reset until released
- OUT—The integration output value and status.
- OUT_PTRIP—A discrete value that is set when the trip target value (setpoint) is reached
- N_RESET—The number of times the integrator function block is initialized or rest

The **INT** function block supports mode control, demand reset, a reset counter, and signal status calculation. There is no process alarm detection in the block. Table C-6 lists the system parameters.

Table C-6 Integrator function block system parameters

Index	Parameter	Definition
1	ST_REV	The revision level of the static data associated with the function block
2	TAG_DESC	The user description of the intended application of the block
3	STRATEGY	The strategy field can be used to identify grouping of the block.
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms.
5	MODE_BLK	The actual, target, permitted, and normal modes of the block
6	BLOCK_ERR	The summary of active error conditions associated with the block. The block error for the Integrator function block is Out of service.

Table C-6 Integrator function block system parameters *continued*

Index	Parameter	Definition
7	TOTAL_SP	The set point for a batch totalization
8	OUT	The block output value and status
9	OUT_RANGE	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with OUT
10	GRAND_DENY	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block (not used by the device).
11	STATUS_OPTS	Allows you to select option for status handling and processing. The supported status option for the Integrator block is: “Uncertain if Manual mode.”
12	IN_1	The block input value and status
13	IN_2	The block input value and status
14	OUT_TRIP	The first discrete output
15	OUT_PTRIP	The second discrete output
16	TIME_UNIT1	Converts the rate time, units in seconds
17	TIME_UNIT2	Converts the rate time, units in seconds
18	UNIT_CONV	Factor to convert the engineering units of IN_2 into the engineering units of IN_1.
19	PULSE_VAL1	Determines the mass, volume or energy per pulse
20	PULSE_VAL2	Determines the mass, volume or energy per pulse
21	REV_FLOW1	Indicates reverse flow when “true;” 0- Forward, 1- Reverse
22	REV_FLOW2	Indicates reverse flow when “true;” 0- Forward, 1- Reverse
23	RESET_IN	Resets the totalizers
24	STOTAL	Indicates the snapshot of OUT just before a reset
25	RTOTAL	Indicates the totalization of “bad” or “bad” and “uncertain” inputs, according to INTEG_OPTIONS
26	SRTOTAL	The snapshot of RTOTAL just before a reset
27	SSP	The snapshot of TOTAL_SP
28	INTEG_TYPE	Defines the type of counting (up or down and the type of resetting (demand or periodic)
29	INTEG_OPTIONS	A bit string to configure the type of input (rate or accumulative) used in each input, the flow direction to be considered in the totalization, the status to be considered in TOTAL and if the totalization residue should be used in the next batch (only when INTEG_TYPE = UP_AUTO or DN_AUTO).
30	CLOCK_PER	Establishes the period for periodic reset, in hours
31	PRE_TRIP	Adjusts the amount of mass, volume or energy that should set OUT_PTRIP when the integration reaches (TOTAL_SP-PRE_TRIP) when counting up or PRE_TRIP when counting down.
32	N_RESET	Counts the number of resets. It cannot be written or reset.
33	PCT_INC	Indicates the percentage of inputs with “good” status compared to the ones with “bad” or “uncertain” and “bad” status
34	GOOD_LIMIT	Sets the limit for PCT_INC. Below this limit OUT receives the status “good”

Table C-6 Integrator function block system parameters *continued*

Index	Parameter	Definition
35	UNCERTAIN_LIMIT	Sets the limit for PCT_INC. Below this limit OUT receives the status “uncertain”
36	OP_CMD_INT	Resets the totalizer
37	OUTAGE_LIMIT	The maximum tolerated duration for power failure
38	RESET_CONFIRM	Momentary discrete value that can be written by a host to enable further resets, if the option “Confirm reset” in INTEG_OPTIONS is chosen.
39	UPDATE_EVT	This alert is generated by any changes to the static data.
40	BLOCK_ALM	Used for all configuration, hardware, connection failure, or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the active status in the status parameter. As soon as the unreported status is cleared by the alert reporting task other block alerts may be reported without clearing the Active status, if the subcode has changed.

C.4.1 Block execution

The **INT** function block integrates a variable over time. The integrated or accumulated value (OUT) is compared to pre-trip and trip limits. When the limits are reached, discrete output signals are generated (OUT_PTRIP and OUT_TRIP). You can choose one of six integrator types that determine whether the integrated value increases from zero or decreases from the trip value. The block has two inputs and can integrate positive, negative, or net flow. This capability is useful to calculate volume or mass variation in vessels, or as an optimization tool for flow ratio control.

The transfer equation used in the Integrator function block is:

$$\text{Current\_Ingetral} = \left(\frac{\Delta t}{2}\right) \times (x + y + OUT[t-1])$$

Where

- Δt: the elapsed time since the previous cycle (in seconds)
- x: the converten IN_1 value (based on the options you configure)
- y: the converten IN_2 value (based on the options you configure), or zero if you select not to use a second input

You can choose integration type options that define the integrate up, integrate down, and reset characteristics of the block. When you select the SP to 0 - auto reset or SP to 0 - demand reset integration type option:

$$\text{Integral} = \text{Integral} + \text{Current Integral}$$
$$\text{OUT} = \text{SP} - \text{Integral}$$

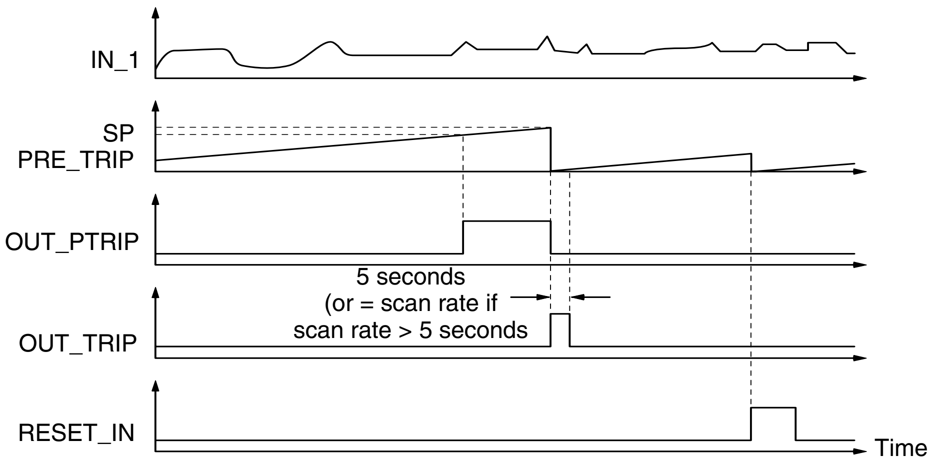
For all other integration types:

$$\text{OUT} = \text{Integral}$$

Figure C-6 illustrates the relationship between the SP, PRE_TRIP, OUT_PTRIP, OUT_TRIP, and RESET_IN parameters in the **INT** function block.

To specify the execution of the **INT** block, configure input flow and rate time variables, integration type and carryover options, and trip and pre-trip action.

Figure C-6 Integrator function block timing



C.4.2 Specifying rate tIme base

The time unit parameters (TIME_UNIT1 and TIME_UNIT2) specify the rate time base of the inputs (IN_1 and IN_2, respectively). The block uses the following equations to compute the integration increment:

$$x = \frac{IN\_1}{TIME\_UNIT1} \qquad y = \frac{IN\_2}{TIME\_UNIT2}$$

Where

- x: the converted IN_1 value (based on the options you configure)
- y: the converted IN_2 value (based on the options you configure), or zero if you select not to use a second input
- OUT[t-1]: the value of OUT from the previous cycle

The block supports the following options for TIME_UNIT1 and TIME_UNIT2:

- For seconds, TIME_UNIT = 1
- For minutes, TIME_UNIT = 60
- For hours, TIME_UNIT = 3600
- For days, TIME_UNIT = 86400

C.4.3 Setting reverse flow at the inputs

Reverse flow is determined by either the sign of the value at IN_1 or IN_2, or the discrete inputs REV_FLOW1 and REV_FLOW_2. When the REV_FLOW input is True, the block interprets the associated IN value as negative.

C.4.4 Calculating net flow

Net flow is calculated by adding the increments calculated for each IN. When ENABLE_IN2 is False, the increment value for IN_2 is considered zero. When ENABLE_IN2 is True, the value of IN_2 is used in the calculation.

To determine the net flow direction that is to be included in the integration, configure the **Flow Forward** and **Flow Reverse** integration options attribute (INTEG_OPTS). When **Flow Forward** is *True*, positive increments are included. When **Flow Reverse** is *True*, negative increments are included. When both **Flow Forward** and **Flow Reverse** are *True*, positive and negative increments are included.

C.4.5 Integration types

The integration type attribute (INTEG_TYPE) defines the integrate up, integrate down, and reset characteristics of the block. Choose from the following options:

- **0 to SP - auto reset as ST**—Integrates from zero to the setpoint (SP) and automatically resets when the SP is reached
- **0 to SP - demand reset**—Integrates from zero to the SP and resets when RESET_IN or the operator command to reset the integrator (OP_CMT_INT) transitions to True (1)
- **SP to 0 - auto reset at SP**—Integrates from the SP to zero and automatically resets when zero is reached
- **SP to 0 - demand reset**—Integrates from the SP to zero and resets when RESET_IN or OP_CMD_INT transitions to True
- **0 to ? - periodic reset**—Counts upward and resets periodically. The period is set by the CLOCK_PER attribute.
- **0 to ? - demand reset**—Counts upward and is reset when RESET_IN or OP_CMD_INT transitions to True
- **0 to ? - periodic & demand reset**—Counts upward and is reset periodically or by RESET_IN

Trip and pre-trip action

When the integration value reaches SP - PRE_TRIP (or 0 - PRE_TRIP, depending on the INTEG_TYPE), OUT_PTRIP is set. When the integration value reaches the trip target value (SP or 0), OUT_TRIP is set. OUT_PTRIP remains set until SP or 0 is reached.

Integration carryover

When the **0 to SP - auto reset at SP** or the **SP to 0 - auto reset at SP** integration type is set, you can enable the **Carry** integration option to carry the excess past the trip point into the next integration cycle as the initial value of the integrator.

C.4.6 Modes

The integrator function block supports the following modes:

- **Man**—The integration calculations are not performed. OUT, OUT_TRIP, and OUT_PTRIP may be set manually.
- **Auto**—The integration algorithm is performed and the result is written to OUT. Reset actions depend on the integration type attribute (INTEG_TYPE) and the inputs.
- **O/S**—The block does not execute. OUT status is set to *Bad: Out of Service*. The BLOCK_ERR attribute show **Out of service**.

The integrator initializes with the value in OUT when the mode changes from **Man** to **Auto**. The **Man, Auto,** and **O/S** modes may be configured as permitted modes for operator entry.

C.4.7 Status handling

The output status calculation is based on the accumulation of input statuses. The calculation includes the accumulations for both input channels when IN_2 is enabled.

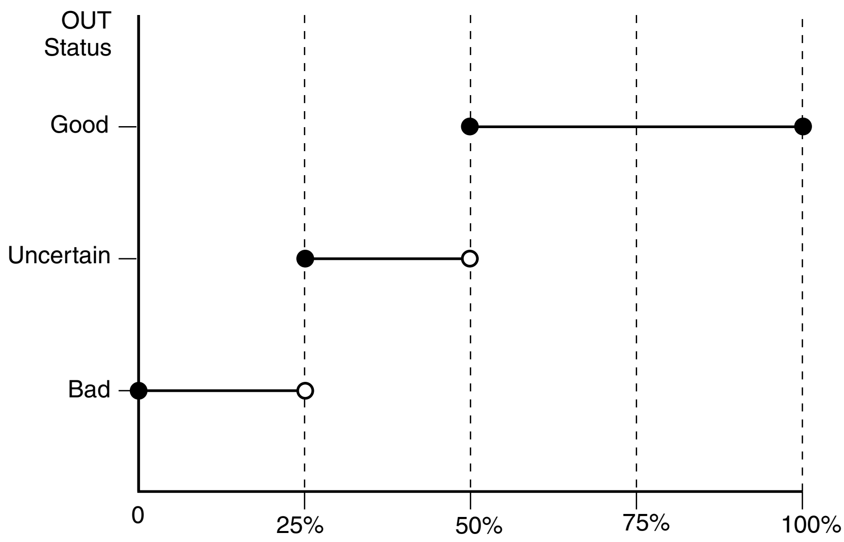
The input statuses are accumulated in *Good* and *Bad* groups. An input status of *Uncertain* is interpreted as a *Bad* status for the output status calculation. Each time the function block executes, the input status is incremented in the appropriate group. The input status accumulation is reset when the integrator is reset.

The output status is determined with the following logic:

- When less than 25% of the input status accumulation is *Good*, OUT status is set to *Bad*.
- When 25% to less than 50% of the input status accumulation is *Good*, OUT status is set to *Uncertain*.
- When 50% or more of the input status accumulation is *Good*, OUT status is set to *Good*.

Figure C-7 illustrates output status designations.

Figure C-7 **Integrator function block output status determination**

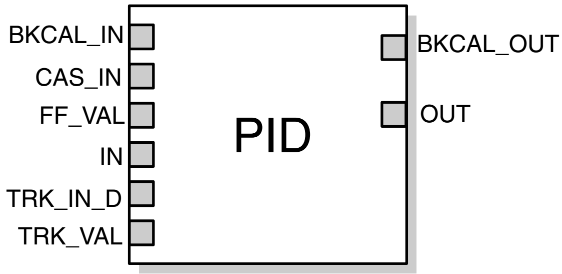


Note: Default values and data type information for the parameters are available by expanding the Attribute View window.

C.5 Proportional/integral/derivative function block

The PID function block combines all of the necessary logic to perform proportional/integral/derivative (PID) control. The block supports mode control, signal scaling and limiting, feedforward control, override tracking, alarm limit detection, and signal status propagation.

Figure C-8 Proportional/integral/derivative function block



- BKCAL_IN—The analog input value and status from another block's BKCAL_OUT–Output that is used for backward output tracking for bumpless transfer and to pass limit status
- CAS_IN—The remote setpoint value from another function block
- FF_VAL—The feedforward control input value and status
- IN—The connection for the process variable from another function block
- TRK_IN_D—Initiates the external tracking function
- TRK_VAL—The value after scaling applied to OUT in Local Override mode
- BKCAL_OUT—The value and status required by the BKCAL_IN input of another function block to prevent reset windup and to provide bumpless transfer to closed loop control
- OUT—The block output and status

The block supports two forms of the PID equation: Standard and Series. You can choose the appropriate equation using the FORM parameter. The Standard ISA PIK equation is the default selection.

$$\text{StandardOut} = GAIN \times e \times \left(1 + \frac{1}{\tau_r s + 1} + \frac{\tau_d s}{\alpha \times \tau_d s \times 1}\right) + F$$

$$\text{SeriesOut} = GAIN \times e \times \left[\left(1 + \frac{1}{\tau_r s}\right) + \left(\frac{\tau_d s + 1}{\alpha \times \tau_d s + 1}\right)\right] + F$$

Where
- Gain: proportional gain value
- τ_r: integral action time constant (RATE parameter) in seconds
- s: laplace operator
- τ_d: derivative action time constant (RATE parameter)
- α: fixed smoothing factor of 0.1 applied to RATE
- F: feedforward control contribution from the feedforward input (FF_VAL parameter)
- e: error between setpoint and process variable

To further customize the block for use in your application, you can configure filtering, feedforward inputs, tracking inputs, setpoint and output limiting, PID equation structures, and block output action. Table C-7 lists the PID block parameters and their descriptions, units of measure, and index numbers.

Table C-7 PID function block system parameters

Parameter	Index Number	Units	Description
ACK_OPTION	46	None	Used to set auto acknowledgment of alarms
ALARM_HYS	47	%	The amount the alarm value must return to within the alarm limit before the associated active alarm condition clears
ALARM_SUM	45	None	The summary alarm is used for all process alarms in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
ALERT_KEY	04	None	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
ALG_TYPE	74	None	Selects filtering algorithm as Backward or Bilinear
BAL_TIME	25	Seconds	The specified time for the internal working value of bias to return to the operator-set bias. Also used to specify the time constant at which the integral term will move to obtain balance when the output is limited and the mode is AUTO, CAS, or RCAS.
BIAS	66	EU of OUT_SCALE	The bias value used to calculate output for a PD type controller
BKCAL_HYS	30	%	The amount that the output value must change away from its output limit before limit status is turned off, expressed as a percent of the span of the output
BKCAL_IN	27	EU of OUT_SCALE	The analog input value and status from another block's BKCAL_OUT output that is used for backward output tracking for bumpless transfer and to pass limit status
BKCAL_OUT	31	EU of PV_SCALE	The value and status required by the BKCAL_IN input of another block to prevent reset windup and to provide bumpless transfer of closed loop control
BLOCK_ALM	44	None	The block alarm is used for all configuration, hardware, connection failure, or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the active status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
BLOCK_ERR	06	None	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string so that multiple errors may be shown.
BYPASS	17	None	Used to override the calculation of the block. When enabled, the SP is sent directly to the output.
CAS_IN	18	EU of PV_SCALE	The remote setpoint value from another block
CONTROL_OPTS	13	None	Allows you to specify control strategy options. The supported control options for the PID block are Track enable, Track in Manual, SP-PV Track in Man, SP-PV Track in LO or IMAN. Use PV for BKCAL_OUT and Direct Acting.
DV_HI_ALM	64	None	The DV HI alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm
DV_HI_LIM	57	EU of PV_SCALE	The setting for the alarm limit used to detect the deviation high alarm condition

Table C-7 PID function block system parameters *continued*

Parameter	Index Number	Units	Description
DV_HI_PRI	56	None	The priority of the deviation high alarm
DV_LO_ALM	65	None	The DV LO alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm
DV_LO_LIM	59	EU of PV_SCALE	The setting for the alarm limit used to detect the deviation low alarm condition
DV_LO_PRI	58	None	The priority of the deviation low alarm
ERROR	67	EU of PV_SCALE	The error (SP-PV) used to determine the control action
FF_ENABLE	70	None	Enables the use of feedforward calculations
FF_GAIN	42	None	The feedforward gain value. FF_VAL is multiplied by FF_GAIN before it is added to the calculated control output.
FF_SCALE	41	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with the feedforward value (FF_VAL)
FF_VAL	40	EU of FF_SCALE	The feedforward control input value and status
GAIN	23	None	The proportional gain value. This value cannot = 0.
GRANT_DENY	12	None	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by the device.
HI_ALM	61	None	The HI alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm
HI_HI_ALM	60	None	The HI HI alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm
HI_HI_LIM	49	EU of PV_SCALE	The setting for the alarm limit used to detect the HI HI alarm condition
HI_HI_PRI	48	None	The priority of the HI HI alarm
HI_LIM	51	EU of PV_SCALE	The setting for the alarm limit used to detect the HI alarm condition
HI_PRI	50	None	The priority of the HI alarm
IN	15	EU of PV_SCALE	The connection for the PV input from another block
LO_ALM	62	None	The LO alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm
LO_LIM	53	EU of PV_SCALE	The setting for the alarm limit used to detect the LO alarm condition
LO_LO_ALM	63	None	The LO LO alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm
LO_LO_LIM	55	EU of PV_SCALE	The setting for the alarm limit used to detect the LO LO alarm condition
LO_LO_PRI	54	None	The priority of the LO LO alarm
LO_PRI	52	None	The priority of the LO alarm
MATH_FORM	73	None	Selects equation form (series or standard)
MODE_BLK	05	None	The actual, target, permitted, and normal modes of the block Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target

Table C-7 PID function block system parameters *continued*

Parameter	Index Number	Units	Description
OUT	09	EU of OUT_SCALE	The block input value and status
OUT_HI_LIM	28	EU of OUT_SCALE	The maximum output value allowed
OUT_LO_LIM	29	EU of OUT_SCALE	The minimum output value allowed
OUT_SCALE	11	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with OUT
PV	07	EU of PV_SCALE	The process variable used in block execution
PV_FTIME	16	Seconds	The time constant of the first-order PV filter. It is the time required for a 63 percent change in the IN value.
PV_SCALE	10	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with PV
RATE	26	Seconds	The derivative action time constant
RCAS_IN	32	EU of PV_SCALE	Target setpoint and status that is provided by a supervisory host. Used when mode is RCAS.
RCAS_OUT	35	EU of PV_SCALE	Block setpoint and status after ramping, filtering, and limiting that is provided to a supervisory host for back calculation to allow action to be taken under limiting conditions or mode change. Used when mode is RCAS.
RESET	24	Seconds per repeat	The integral action time constant
ROUT_IN	33	EU of OUT_SCALE	Target output and status that is provided by a supervisory host. Used when mode is ROUT.
ROUT_OUT	36	EU of OUT_SCALE	Block output that is provided to a supervisory host for a back calculation to allow action to be taken under limiting conditions or mode change. Used when mode is RCAS.
SHED_OPT	34	None	Defines action to be taken on remote control device timeout
SP	08	EU of PV_SCALE	The target block setpoint value. It is the result of setpoint limiting and setpoint rate of change limiting.
SP_FTIME	69	Seconds	The time constant of the first-order SP filter. It is the time required for a 63 percent change in the IN value.
SP_HI_LIM	21	EU of PV_SCALE	The highest SP value allowed
SP_LO_LIM	22	EU of PV_SCALE	The lowest SP value allowed
SP_RATE_DN	19	EU of PV_SCALE per second	Ramp rate for downward SP changes. When the ramp rate is set to zero, the SP is used immediately.
SP_RATE_UP	20	EU of PV_SCALE	Ramp rate for upward SP changes. When the ramp rate is set to zero, the SP is used immediately.
SP_WORK	68	EU of PV_SCALE	The working setpoint of the block after limiting and filtering is applied
STATUS_OPTS	14	None	Allows you to select options for status handling and processing. The supported status option for the PID block is Target to Manual is Bad IN.

Table C-7 PID function block system parameters *continued*

Parameter	Index Number	Units	Description
STRATEGY	03	None	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ST_REV	01	None	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
STRUCTURE.CONFIG	75	None	Defines PID equation structure to apply controller action
TAG_DESC	02	None	The user description of the intended application of the block
TRK_IN_D	38	None	Discrete input that initiates external tracking
TRK_SCALE	37	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with the external tracking value (TRK_VAL)
TRK_VAL	39	EU of TRK_SCALE	The value (after scaling from TRK_SCALE) APPLIED to OUT in LO mode
UBETA	72	%	Used to set disturbance rejection vs. tracking response action for a 2.0 degree of freedom PID
UGAMMA	71	%	Used to set disturbance rejection vs. tracking response action for a 2.0 degree of freedom PID
UPDATE_EVT	43	None	This alert is generated by any changes to the static data.

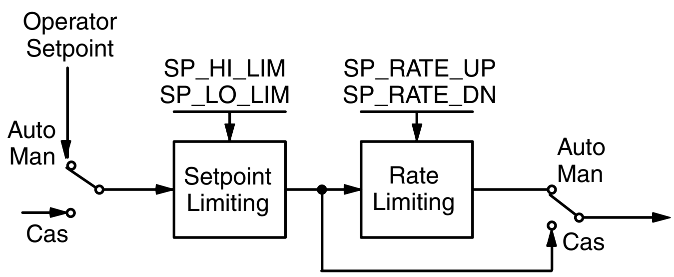
C.5.1 Setpoint selection and limiting

The setpoint of the PID block is determined by the mode. You can configure the SP_HI_LIM and SP_LO_LIM parameters to limit the setpoint.

- In **Cascade** or **RemoteCascade** mode, the setpoint is adjusted by another function block or by a host computer, and the output is computed based on the setpoint.
- In **Automatic** mode, the setpoint is entered manually by the operator, and the output is computed based on the setpoint. In Auto mode, you can also adjust the setpoint limit and the setpoint rate of change using the SP_RATE_UP and SP_RATE_DN parameters.
- In **Manual** mode the output is entered manually by the operator, and is independent of the setpoint. In **RemoteOutput** mode, the output is entered by a host computer, and is independent of the setpoint.

Figure C-9 illustrates the method for setpoint selection.

Figure C-9 PID function block setpoint



C.5.2 Filtering

The filtering feature changes the response time of the device to smooth variations in output reading caused by rapid changes in input. You can configure the filtering feature with the FILTER_TYPE parameter, and you can adjust the filter time constant (in seconds) using the PV_FTIME or SP_FTIME parameters. Set the filter time constant to zero to disable the filter feature.

C.5.3 Feedforward calculation

The feedforward value (FF_VAL) is scaled (FF_SCALE) to a common range for compatibility with the output scale (OUT_SCALE). A gain value (FF_GAIN) is applied to achieve the total feedforward contribution.

C.5.4 Tracking

You enable the use of output tracking through the control options. You can set control options in Manual or Out of Service mode only.

The **Track Enable** control option must be set to *True* for the track function to operate. When the Track in Manual control option is set to *True*, tracking can be activated and maintained only when the block is in **Manual** mode. When **Track in Manual** is *False*, the operator can override the tracking function when the block is in **Manual** mode. Activating the track function causes the block's actual mode to revert to **Local Override**.

The TRK_VAL parameter specifies the value to be converted and tracked into the output when the track function is operating. The TRK_SCALE parameter specifies the range of TRK_VAL.

When the TRK_IN_D parameter is *True* and the **Track Enable** control option is *True*, the TRK_VAL input is converted to the appropriate value and output in units of OUT_SCALE.

C.5.5 Output selection and limiting

Output selection is determined by the mode and the setpoint. In **Automatic, Cascade,** or **Remote Cascade** mode, the output is computed by the PID control equation. In **Manual** and **RemoteOutput** mode, the output may be entered manually. You can limit the output by configuring the OUT_HI_LIM and OUT_LO_LIM parameters.

C.5.6 Bumpless transfer and setpoint tracking

You can configure the method for tracking the setpoint by configuring the following control options (CONTROL_OPTS):

- **SP-PV Track in Man**—Permits the SP to track the PV when the target mode of the block is Man.
- **SP-PV Track in Local Override (LO) or IMan**—Permits the SP to track the PV when the actual mode of the block is LO or IMan.

When one of these options is set, the SP value is set to the PV value while in the specified mode.

You can select the value that a master controller uses for tracking by configuring the **Use PV for BKCAL_OUT** control option. The BKCAL_OUT value tracks the PV value. BKCAL_IN on a master controller connected to BKCAL_OUT on the PID block in an open cascade strategy forces its OUT to match BKCAL_IN, thus tracking the PV from the slave PID block into its cascade input connection (CAS_IN). If the **Use PV for BKCAL_OUT** option is not selected, the working setpoint (SP_WRK) is used for BKCAL_OUT.

You can set control options in **Manual** or **O/S** mode only. When the mode is set to **Auto**, the SP will remain at the last value (it will no longer follow the PV).

C.5.7 PID equation structures

Configure the STRUCTURES parameter to select the PID equation structure. You can select one of the following choices:

- PI Action on Error, D Action on PV
- PID Action on Error
- I Action on Error, PD Action on PV

Set RESET to zero to configure the PID block to perform integral only control regardless of the STRUCTURE parameter selection. When RESET equals zero, the equation reduces to an integrator equation with a gain value applied to the error:

$$\frac{GAIN \times e(s)}{s}$$

Where

- Gain: proportional gain value
- e: error
- s: laplace operator

C.5.8 Reverse and direct action

To configure the block output action, enable the **Direct Acting** control option. This option defines the relationship between a change in PV and the corresponding change in output. With **Direct Acting** enabled (True), an increase in PV results in an increase in the output.

You can set control options in **Manual** or **O/S** mode only.

Note: Track Enable, Track in Manual, SP-PV Track in Man, SP-PV Track in LO or IMan, Use PV for BKCAK_OUT, and Direct Acting are the only control options supported by the PID function block. Unsupported options are not grayed out; they appear on the screen in the same manner as supported options.

C.5.9 Reset limiting

The PID function block provides a modified version of feedback reset limiting that prevents windup when output or input limits are encountered, and provides the proper behavior in selector applications.

C.5.10 Block errors

Table C-8 lists conditions reported in the BLOCK_ERR parameter. Conditions in *italics* are inactive for the PID block and are given here only for your reference.

Table C-8 BLOCK_ERR conditions

Condition Number	Condition Name and Description
0	*Other*
1	Block Configuration Error: The BY_PASS parameter is not configured and is set to 0, the SP_HI_LIM is less than the SP_LO_LIM, or the OUT_HI_LIM is less than the OUT_LO_LIM.
2	*Link Configuration Error*
3	*Simulate Active*
4	Local Override: The actual mode is LO.
5	*Device Fault State Set*
6	*Device Needs Maintenance Soon*
7	Input Failure/Process Variable has Bad Status: The parameter linked to IN is indicating a Bad status
8	*Output Failure*
9	*Memory Failure*
10	*Lost Static Data*
11	*Lost NV Data*
12	*Readback Check Failed*
13	*Device Needs Maintenance Now*
14	*Power Up*
15	Out of Service: The actual mode is out of service

C.5.11 Modes

The PID function block supports the following modes:

- **Man**—The block output (OUT) may be set manually.
- **Auto**—The SP may be set manually and the block algorithm calculates OUT.
- **Cas**—The SP is calculated in another block and is provided to the PID block through the CAS_IN connection.
- **RCas**—The SP is provided by a host computer that writes to the RCAS_IN parameter.
- **Rout**—The OUT IS provided by a host computer that writes to the ROUT_IN parameter.
- **Local Override** (LO)—The track function is active. OUT is set by TRK_VAL. The BLOCK_ERR parameter shows Local override.
- **IMan**—The output path is not complete (for example, the cascade-to-slave path might not be open). In IMan mode, OUT tracks BKCAL_IN.
- **O/S**—The block is not processed. The Out status is set to *Bad: Out of Service*. The BLOCK_ERR parameter shows Out of service.

You can configure the Man, Auto, Cas and O/S modes as permitted modes for operator entry.

C.5.12 Alarm detection

A block alarm will be generated whenever the BLOCK_ERR has an error bit set. The types of block error for the PID block are defined above.

Process alarm detection is based on the PV value. You can configure the alarm limits of the following standard alarms:

- High (HI_LIM)
- High high (HI_HI_LIM)
- Low (LO_LIM)
- Low low (LO_LO_LIM)

Additional process alarm detection is based on the difference between SP and PV values and can be configured via the following parameters:

- HI_PRI
- HI_HO_PRI
- LO_PRI
- LO_LO_PRI
- DV_HI_PRI
- DV_LO_PRI

Table C-9 shows the five alarm priority levels.

Table C-9 Alarm priority levels

Priority Number	Priority Description
0	The priority of an alarm condition changes to 0 after the condition that caused the alarm is corrected.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator, but does not require operator attention (such as diagnostics and system alerts).
3–7	Alarm conditions of priority 3 to 7 are advisory alarms of increasing priority.
8–15	Alarm conditions of priority 8 to 15 are critical alarms of increasing priority.

C.5.13 Status handling

If the input status on the PID block is *Bad*, the mode of the block reverts to **Manual**. In addition, you can select the **Target to Manually if Bad IN** status option to direct the target mode to revert to manual. You can set the status option in **Manual** or **Out of Service** mode only.

Note: Target to Manual if Bad IN is the only status option supported by the PID function block. Unsupported options are not grayed out; they appear on the screen in the same manner as supported options.

C.5.14 Troubleshooting

Refer to Table C-10 to troubleshoot any problems that you encounter with the PID function block.

Table C-10 Troubleshooting the PID function block

Symptom	Possible Causes	Corrective Action
Mode will not leave OOS	Target mode not set	Set target mode to something other than OOS.
	Configuration error	BLOCK_ERR will show the configuration error bit set. The following are parameters that must be set before the block is allowed out of OOS: • BYPASS must be off or on and cannot be left at initial value of 0. • OUT_HI_LIM must be less than or equal to OUT_LO_LIM. • SP_HI_LIM must be less than or equal to SP_LO_LIM.
	Resource block	The actual mode of the Resource block is OOS.
	Schedule	Block is not scheduled and therefore cannot execute to go to Target Mode. Schedule the block to execute.
Mode will not leave IMAN	Back Calculation	BKCAL_IN • The link is not configured (the status would show “Not Connected”). Configure the BKCAL_IN link to the downstream block. • The downstream block is sending back a Quality of “Bad” or a Status of “Not Invited.”
Mode will not change to CAS	Target mode not set	Set target mode to something other than OOS.
	Cascade	CAS_IN • The link is not configured (the status would show “Not Connected”). Configure the CAS_IN link to the block. • The upstream block is sending back a Quality of “Bad” or a Status of “Not Invited.” See the appropriate up stream block diagnostics for corrective action.
Mode sheds from RCAS to AUTO	Remote Cascade Value	Host system is not writing RCAS_IN with a quality and status of “good cascade” within shed time
	Shed Timer	The mode shed timer, SHED_RCAS in the resource block is set too low. Increase the value
Mode sheds from ROUT to MAN	Remote output value	Host system is not writing ROUT_IN with a quality and status of “good cascade” within shed time
	Shed timer	The mode shed timer, SHED_RCAS, in the resource block is set too low. Increase the value
Process and/or block alarms will not work.	Features	FEATURES_SEL does not have Alerts enabled. Enable the Alerts bit.
	Notification	LIM_NOTIFY is not high enough. Set equal to MAX_NOTIFY.
	Status Options	STATUS_OPTS has Propagate Fault Forward bit set. This should be cleared to cause an alarm to occur.

Appendix D
LF-Series Transducer Blocks Reference

D.1 Overview

The Micro Motion LF-Series transmitter has seven separate transducer blocks. The parameters and views for each of these transducer blocks are listed in Tables D-2 through D-11.

D.2 Transducer block names

Throughout this manual, the transducer blocks are referred to by their tag (e.g., MEASUREMENT). Fieldbus hosts that do not support the use of tags as block names will instead show the name TRANSDUCER followed by a numeric code. The relationship between transducer block tag names and codes is listed in Table D-1.

Table D-1 Transducer block tag names and code names

Tag name	Code name
MEASUREMENT	TRANSDUCER 400
CALIBRATION	TRANSDUCER 500
DIAGNOSTICS	TRANSDUCER 600
DEVICE INFORMATION	TRANSDUCER 700
LOCAL DISPLAY	TRANSDUCER 800

Table D-2 MEASUREMENT transducer block parameters

OD Index	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
	Standard FF Parameters								
0	BLOCK_STRUCTURE	Beginning of the transducer block	VARIABLE	DS_64	5	S	N/A	R/W	N/A
1	ST_REV	The revision level of the static data associated with the function block. Incremented with each write of static store.	VARIABLE	Unsigned16	2	S	0	R	N/A
2	TAG_DESC	The user description of the intended application of the block.	STRING	OCTET STRING	32	S	Spa ces	R/W	Any 32 Characters
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.	VARIABLE	Unsigned16	2	S	0	R/W	N/A

Table D-2 MEASUREMENT transducer block parameters *continued*

OD Index	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.	VARIABLE	Unsigned8	1	S	0	R/W	0 to 255
5	MODE_BLK	The actual, target, permitted and normal modes of the block.	RECORD	DS-69	4	mix	O/S	R/W	See section 2/6 of FF-891
6	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block.	STRING	BIT STRING	2	D/20	-	R	See section 4.8 of FF-903
11	XD_ERROR	Used for all config, H/W, connection failure or system problems in the block.	VARIABLE	Unsigned8	1	D	-	R	18 = Process Error 19 = Configuration Error 20 = Electronics Failure 21 = Sensor Failure
	Process Variables Data								
41	MFLOW	Mass Flow Rate	VARIABLE	DS-65	5	D/20	0	R	N/A
42	MFLOW_UNITS	Standard or special mass flow rate unit	ENUM	Unsigned16	2	S	g/s	R/W	0000 = None 1318 = g/s 1319 = g/min 1320 = g/hr 1322 = kg/s 1323 = kg/min 1324 = kg/hr 1325 = kg/day 1327 = t/min 1328 = t/h 1329 = t/d 1330 = lb/s 1331 = lb/min 1332 = lb/hr 1333 = lb/day 1335 = Ston/min 1336 = Ston/hr 1337 = Ston/day 1340 = Lton/hr 1341 = Lton/day
43	MFLOW_SPECIAL_UNIT_ BASE	Base Mass Unit	ENUM	Unsigned16	2	S	g	R/W	0000 = None 1089 = Grams 1088 = Kilograms 1092 = Metric Tons 1094 = Pounds 1096 = Short tons
44	MFLOW_SPECIAL_UNIT_ TIME	Base time unit for special mass unit	ENUM	Unsigned16	2	S	s	R/W	0000 = None 1058 = Minutes 1054 = Seconds 1059 = Hours 1060 = Days
45	MFLOW_SPECIAL_UNIT_ CONV	Special mass unit conversion factor	VARIABLE	FLOAT	4	S	1	R/W	N/A
46	MFLOW_SPECIAL_UNIT_ STR	Special mass flow unit string	STRING	OCTET STRING	8	S	“”	R/W	Any 8 characters
47	TEMPERATURE	Temperature	VARIABLE	DS-65	5	D/20	0	R	N/A
48	TEMPERATURE_UNITS	Temperature Unit	ENUM	Unsigned16	2	S	C°	R/W	0000 = None 1000 = K 1001 = Deg C 1002 = Deg F 1003 = Deg R
49	DENSITY	Density	VARIABLE	DS-65	5	D/20	0	R	N/A

Table D-2 MEASUREMENT transducer block parameters *continued*

OD Index	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
50	DENSITY_UNITS	Density Unit	ENUM	Unsigned16	2	S	g/cm^3	R/W	0000 = None 1097 = kg/m^3 1100 = g/cm^3 1103 = kg/L 1104 = g/ml 1105 = g/L 1106 = lb/in^3 1107 = lb/ft^3 1108 = lb/gal 1109 = $Ston/yd^3$ 1113 = DegAPI 1114 = SGU
51	VOL_FLOW	Volume flow rate	VARIABLE	DS-65	5	D/20	0	R	N/A
52	VOLUME_FLOW_UNITS	Standard or special volume flow rate unit	ENUM	Unsigned16	2	S	l/s	R/W	0000 = None 1347 = m^3/s 1348 = m^3/min 1349 = m^3/hr 1350 = m^3/day 1351 = L/s 1352 = L/min 1353 = L/hr 1355 = Ml/day 1356 = CFS 1357 = CFM 1358 = CFH 1359 = ft^3/day 1362 = gal/s 1363 = GPM 1364 = gal/hour 1365 = gal/day 1366 = Mgal/day 1367 = ImpGal/s 1368 = ImpGal/min 1369 = ImpGal/hr 1370 = Impgal/day 1371 = bbl/s 1372 = bbl/min 1373 = bbl/hr 1374 = bbl/day
53	VOL_SPECIAL_UNIT_BASE	Base Volume Unit	ENUM	Unsigned16	2	S	l	R/W	0000 = None 1048 = Gallons 1038 = Liters 1049 = Imperial Gallons 1043 = Cubic Feet 1034 = Cubic Meters 1051 = Barrels
54	VOL _SPECIAL_UNIT_TIME	Base time unit for special volume unit	ENUM	Unsigned16	2	S	s	R/W	0000 = None 1058 = Minutes 1054 = Seconds 1059 = Hours 1060 = Days
55	VOL _SPECIAL_UNIT_CONV	Special volume unit conversion factor	VARIABLE	FLOAT	4	S	1	R/W	N/A
56	VOL _SPECIAL_UNIT_STR	Special volume unit string	STRING	OCTET STRING	8	S	“”	R/W	Any 8 characters
	MASS_TOT_INV_SPECIAL_ STR	Special mass total and inventory unit string	STRING	OCTET STRING	8	S	“”	R/W	Any 4 characters
	VOLUME_TOT_INV_ SPECIAL_ STR	Special volume total and inventory unit string	STRING	OCTET STRING	8	S	“”	R/W	Any 4 characters
57	FLOW_DAMPING	Flow rate (Mass and Volume) internal damping (seconds)	VARIABLE	FLOAT	4	S	-	R/W	N/A
58	TEMPERATURE_DAMPING	Temperature internal damping (seconds)	VARIABLE	FLOAT	4	S	-	R/W	N/A
59	DENSITY_DAMPING	Density internal damping (seconds)	VARIABLE	FLOAT	4	S	-	R/W	N/A
60	MFLOW_M_FACTOR	Mass Rate Factor	VARIABLE	FLOAT	4	S	1.0	R/W	N/A
61	DENSITY_M_FACTOR	Density Factor	VARIABLE	FLOAT	4	S	1.0	R/W	N/A
62	VOL_M_FACTOR	Volume Rate Factor	VARIABLE	FLOAT	4	S	1.0	R/W	N/A

Table D-2 MEASUREMENT transducer block parameters *continued*

OD Index	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
79	MASS_LOW_CUT	Mass flow cutoff for internal totalizers	VARIABLE	FLOAT	4	S	0.0	R/W	N/A
80	VOLUME_FLOW_LOW_ CUTOFF	Volume flow cutoff for internal totalizers	VARIABLE	FLOAT	4	S	0.0	R/W	N/A
	DENSITY_LOW_CUTOFF	Density cutoff for internal totalizers	VARIABLE	FLOAT	4	S	0.0	R/W	N/A
	FLOW_DIRECTION	Flow direction	ENUM	Unsigned16	2	S	0	R/W	0 = Forward Only 1 = Reverse Only 2 = Bi-Directional 3 = Absolute Value 4 = Negate/Forward Only 5 = Negate/Bi-Directional
	Totalizers								
88	INTEGRATOR_FB_CONFIG	Configuration of Integrator Function Block	ENUM	Unsigned16	2	S	0	R/W	0 = Standard 1 = Internal Mass Total 2 = Internal Volume Total 3 = Internal Mass Inv. 4 = Internal Volume Inv. 5 = Int Gas Vol Tot 6 = Int Gas Vol Inv 7 = Int API Vol Tot 8 = Int API Vol Inv 9 = Int ED Std Vol Tot 10= Int ED Std Vol Inv 11= Int ED Net Mass Tot 12= Int ED Net Mass Inv 13= Int ED Net Vol Tot 14= Int ED Net Vol Inv
89	START_STOP_TOTALS	Start/Stop all Totalizers	METHOD	Unsigned16	2	-	-	N/A	0x0000 = Stop Totals 0x0001 = Start Totals
90	RESET_TOTALS	Reset all Totals	METHOD	Unsigned16	2	-	-	N/A	0x0000 = None 0x0001 = Reset
91	RESET_INVENTORIES	Reset all Inventories	METHOD	Unsigned16	2	-	-	N/A	0x0000 = None 0x0001 = Reset
92	RESET_MASS_TOTAL	Reset Mass Total	METHOD	Unsigned16	2	-	-	N/A	0x0000 = None 0x0001 = Reset
93	RESET_VOLUME_TOTAL	Reset Volume Total	METHOD	Unsigned16	2	-	-	N/A	0x0000 = None 0x0001 = Reset
94	MASS_TOTAL	Mass Total	VARIABLE	DS-65	5	D/20	0	R	N/A
95	VOLUME_TOTAL	Volume Total	VARIABLE	DS-65	5	D/20	0	R	N/A
96	MASS_INVENTORY	Mass Inventory	VARIABLE	DS-65	5	D/20	0	R	N/A
	VOLUME_INVENTORY	Volume Inventory	VARIABLE	DS-65	5	D/20	0	R	N/A
	MASS_TOT_INV_UNITS	Standard or special mass total and mass inventory unit	ENUM	Unsigned16	2	S	g/s	R	0000 = None 1088 = Kg 1089 = g 1092 = metric tons 1094 = lbs 1095 = short tons 1096 = long tons
	VOLUME_TOT_INV_UNITS	Standard or special volume total or mass inventory unit.	ENUM	Unsigned16	2	S	l/s	R	0000 = None 1034 = m^3 1036 = cm^3 1038 = l 1043 = ft^3 1048 = gal 1049 = ImpGal 1051 = bbl

Table D-2 MEASUREMENT transducer block parameters *continued*

OD Index	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
	Gas Process Variables								
	GSV_Gas_Dens	Gas Density used to calculate Reference Volume Gas Flow and Totals	VARIABLE	FLOAT	4	S	0.0	R/W	N/A
	GSV_Vol_Flow	Reference Volume Gas Flow Rate (not valid when API or ED is enabled)	VARIABLE	DS-65	5	D/20	0	R	N/A
	GSV_Vol_Tot	Reference Volume Gas Total (not valid when API or ED is enabled)	VARIABLE	DS-65	5	D/20	0	R	N/A
	GSV_Vol_Inv	Reference Volume Gas Inventory (not valid when API or ED is enabled)	VARIABLE	DS-65	5	D/20	0	R	N/A

Table D-3 MEASUREMENT transducer block views

OD Index	Parameter Mnemonic	View 1	View 2	View 3	View 4
	Standard FF Parameters				
0	BLOCK_STRUCTURE				
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
11	XD_ERROR	1		1	
	Process Variables Data				
41	MFLOW	5		5	
42	MFLOW_UNITS		2		
43	MFLOW_SPECIAL_UNIT_BASE				2
44	MFLOW_SPECIAL_UNIT_TIME				2
45	MFLOW_SPECIAL_UNIT_CONV				4
46	MFLOW_SPECIAL_UNIT_STR				8
47	TEMPERATURE	5		5	
48	TEMPERATURE_UNITS		2		
49	DENSITY	5		5	
50	DENSITY_UNITS		2		
51	VOL_FLOW	5		5	
52	VOL_FLOW_UNITS		2		
53	VOL_SPECIAL_UNIT_BASE				2
54	VOL _SPECIAL_UNIT_TIME				2
55	VOL _SPECIAL_UNIT_CONV				4
56	VOL _SPECIAL_UNIT_STR				8
	MASS_TOT_INV_SPECIAL_ STR				8
	VOLUME_TOT_INV_ SPECIAL_ STR				8
57	FLOW_DAMPING		4		

Table D-3 MEASUREMENT transducer block views *continued*

OD Index	Parameter Mnemonic	View 1	View 2	View 3	View 4
58	TEMPERATURE_DAMPING		4		
59	DENSITY_DAMPING		4		
60	MFLOW_M_FACTOR		4		
61	DENSITY_M_FACTOR		4		
62	VOL_M_FACTOR		4		
79	MASS_LOW_CUT		4		
80	VOLUME_LOW_CUT		4		
	DENSITY_LOW_CUT		4		
	FLOW_DIRECTION		2		
	Totalizers				
88	INTEGRATOR_FB_CONFIG		2		
89	START_STOP_TOTALS		2		
90	RESET_TOTALS		2		
91	RESET_INVENTORIES		2		
92	RESET_MASS_TOTAL		2		
93	RESET_VOLUME_TOTAL		2		
94	MASS_TOTAL	5		5	
95	VOLUME_TOTAL	5		5	
96	MASS_INVENTORY	5		5	
	VOLUME_INVENTORY	5		5	
	MASS_TOT_INV_UNITS		2		
	VOLUME_TOT_INV_UNITS		2		
	Gas Process Variables				
	GSV_Gas_Dens		4		
	GSV_Vol_Flow	5		5	
	GSV_Vol_Tot	5		5	
	GSV_Vol_Inv	5		5	
	Totals	64	68	64	53

Table D-4 CALIBRATION transducer block parameters

OD Index	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
	Standard FF Parameters								
0	BLOCK_STRUCTURE	Beginning of the transducer block	VARIABLE	DS_64	5	S	N/A	R/W	N/A
1	ST_REV	The revision level of the static data associated with the function block. Incremented with each write of static store.	VARIABLE	Unsigned16	2	S	0	R	N/A
2	TAG_DESC	The user description of the intended application of the block.	STRING	OCTET STRING	32	S	Spac es	R/W	Any 32 Characters
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.	VARIABLE	Unsigned16	2	S	0	R/W	N/A

Table D-4 CALIBRATION transducer block parameters *continued*

OD Index	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.	VARIABLE	Unsigned8	1	S	0	R/W	0 to 255
5	MODE_BLK	The actual, target, permitted and normal modes of the block.	RECORD	DS-69	4	mix	O/S	R/W	See section 2/6 of FF-891
6	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block.	STRING	BIT STRING	2	D/20	-	R	See section 4.8 of FF-903
11	XD_ERROR	Used for all config, H/W, connection failure or system problems in the block.	VARIABLE	Unsigned8	1	D	-	R	18 = Process Error 19 = Configuration Error 20 = Electronics Failure 21 = Sensor Failure
	Calibration								
88	MASS_FLOW_GAIN	Flow calibration factor	VARIABLE	FLOAT	4	S	-	R/W	N/A
89	MASS_FLOW_T_COMP	Temperature coefficient for flow	VARIABLE	FLOAT	4	S	-	R/W	N/A
90	ZERO_CAL	Perform auto zero	METHOD	Unsigned16	2	-	-	N/A	0x0000 = Abort Zero Cal 0x0001 = Start Zero Cal
91	ZERO_TIME	Maximum zeroing time	VARIABLE	Unsigned16	2	S	-	R/W	N/A
92	ZERO_STD_DEV	Standard deviation of auto zero	VARIABLE	FLOAT	4	S	-	R	N/A
93	ZERO_OFFSET	Present flow signal offset at zero flow in μsec	VARIABLE	FLOAT	4	S	-	R	N/A
94	ZERO_FAILED_VAULE	Value of the zero if the zero cal failed	VARIABLE	FLOAT	4	S	-	R	N/A
95	LOW_DENSITY_CAL	Perform low density calibration	METHOD	Unsigned16	2	-	-	N/A	0x0000 = None 0x0001 = Start Cal
96	HIGH_DENSITY_CAL	Perform high-density calibration	METHOD	Unsigned16	2	-	-	N/A	0x0000 = None 0x0001 = Start Cal
	FLOWING_DENSITY_CAL	Perform flowing-density calibration	METHOD	Unsigned16	2	-	-	N/A	0x0000 = None 0x0001 = Start Cal
	D3_DENSITY_CAL	Perform third point calibration	METHOD	Unsigned16	2	-	-	N/A	0x0000 = None 0x0001 = Start Cal
	D4_DENSITY_CAL	Perform fourth point calibration	METHOD	Unsigned16	2	-	-	N/A	0x0000 = None 0x0001 = Start Cal
97	K1	Density calibration constant 1 (msec)	VARIABLE	FLOAT	4	S	-	R/W	N/A
98	K2	Density calibration constant 2 (msec)	VARIABLE	FLOAT	4	S	-	R/W	N/A
	FD	Flowing Density calibration constant	VARIABLE	FLOAT	4	S	-	R/W	N/A
99	K3	Density calibration constant 3 (μsec)	VARIABLE	FLOAT	4	S	-	R/W	N/A
	K4	Density calibration constant 4 (μsec)	VARIABLE	FLOAT	4	S	-	R/W	N/A
100	D1	Density 1 (g/cc)	VARIABLE	FLOAT	4	S	-	R/W	N/A
101	D2	Density 2 (g/cc)	VARIABLE	FLOAT	4	S	-	R/W	N/A
	FD_VALUE	Flowing Density (g/cc)	VARIABLE	FLOAT	4	S	-	R/W	N/A
	D3	Density 3 (g/cc)	VARIABLE	FLOAT	4	S	-	R/W	N/A
	D4	Density 4 (g/cc)	VARIABLE	FLOAT	4	S	-	R/W	N/A
102	DENS_T_COEFF	Density temperature coefficient	VARIABLE	FLOAT	4	S	-	R/W	N/A

Table D-4 CALIBRATION transducer block parameters *continued*

OD Index	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
	T_FLOW_TG_COEFF	T-Series: Flow TG Coefficient (FTG)	VARIABLE	FLOAT	4	S	-	R/W	N/A
	T_FLOW_FQ_COEFF	T-Series: Flow FQ Coefficient (FFQ)	VARIABLE	FLOAT	4	S	-	R/W	N/A
	T_DENSITY_TG_COEFF	T-Series: Density TG Coefficient (DTG)	VARIABLE	FLOAT	4	S	-	R/W	N/A
	T_DENSITY_FQ_COEFF1	T-Series: Density FQ Coefficient #1 (DFQ1)	VARIABLE	FLOAT	4	S	-	R/W	N/A
	T_DENSITY_FQ_COEFF2	T-Series: Density FQ Coefficient #2 (DFQ2)	VARIABLE	FLOAT	4	S	-	R/W	N/A
103	TEMP_LOW_CAL	Perform temperature calibration at the low point (point 1)	METHOD	Unsigned16	2	-	-	N/A	0x0000 = None 0x0001 = Start Cal
104	TEMP_HIGH_CAL	Perform temperature calibration at the high point (point 2)	METHOD	Unsigned16	2	-	-	N/A	0x0000 = None 0x0001 = Start Cal
105	TEMP_VALUE	Temperature Value for temp calibrations (in degC)	VARIABLE	FLOAT	4	S	0	R/W	N/A
106	TEMP_OFFSET	Temperature calibration offset	VARIABLE	FLOAT	4	S	0.0	R/W	N/A
107	TEMP_SLOPE	Temperature calibration slope	VARIABLE	FLOAT	4	S	1.0	R/W	N/A
	Pressure Compensation								
	PRESSURE	Pressure	VARIABLE	DS-65	5	D/20	0	R	N/A
	PRESSURE_UNITS	Pressure Unit	ENUM	Unsigned16	2	S	g/cm^3	R/W	0000 = None 1148 = inch water @ 68F 1156 = inch HG @ 0C 1154 = ft water @ 68F 1151 = mm water @ 68F 1158 = mm HG @ 0C 1141 = psi 1137 = bar 1138 = millibar 1144 = g/cm^2 1145 = kg/cm^2 1130 = pascals 1133 = kilopascals 1139 = torr @ 0C 1140 = atmospheres
	EN_PRESSURE_COMP	Enable/Disable Pressure Compensation	ENUM	Unsigned16	2	S	1	R/W	0x0000 = disabled 0x0001 = enabled
	PRESSURE_FACTOR_ FLOW	Pressure correction factor for flow	VARIABLE	FLOAT	4	S	0.0	R/W	N/A
	PRESSURE_FACTOR_ DENS	Pressure correction factor for density	VARIABLE	FLOAT	4	S	0.0	R/W	N/A
	PRESSURE_FLOW_CAL	Flow calibration pressure	VARIABLE	FLOAT	4	S	0.0	R/W	N/A

Table D-5 CALIBRATION transducer block views

OD Index	Parameter Mnemonic	View 1	View 2	View 3	View 4
	Standard FF Parameters				
0	BLOCK_STRUCTURE				
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1

Table D-5 CALIBRATION transducer block views *continued*

OD Index	Parameter Mnemonic	View 1	View 2	View 3	View 4
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
11	XD_ERROR	1		1	
	Calibration				
88	MASS_FLOW_GAIN		4		
89	MASS_FLOW_T_COMP		4		
90	ZERO_CAL		2		
91	ZERO_TIME		2		
92	ZERO_STD_DEV			4	
93	ZERO_OFFSET			4	
94	ZERO_FAILED_VAULE			4	
95	LOW_DENSITY_CAL		2		
96	HIGH_DENSITY_CAL		2		
	FLOWING_DENSITY_CAL		2		
	D3_DENSITY_CAL		2		
	D4_DENSITY_CAL		2		
97	K1		4		
98	K2		4		
	FD		4		
99	K3		4		
	K4		4		
100	D1		4		
101	D2		4		
	FD_VALUE		4		
	D3		4		
	D4		4		
102	DENS_T_COEFF		4		
	T_FLOW_TG_COEFF		4		
	T_FLOW_FQ_COEFF		4		
	T_DENSITY_TG_COEFF		4		
	T_DENSITY_FQ_COEFF1		4		
	T_DENSITY_FQ_COEFF2		4		
103	TEMP_LOW_CAL		2		
104	TEMP_HIGH_CAL		2		
105	TEMP_VALUE		4		
106	TEMP_OFFSET			4	
107	TEMP_SLOPE			4	
	Pressure Compensation				
	PRESSURE	5		5	
	PRESSURE_UNITS		2		
	EN_PRESSURE_COMP				2
	PRESSURE_FACTOR_FLOW				4
	PRESSURE_FACTOR_DENS				4
	PRESSURE_FLOW_CAL				4
	Totals	14	98	34	19

Table D-6 DIAGNOSTICS transducer block parameters

OD Index	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
	Standard FF Parameters								
0	BLOCK_STRUCTURE	Beginning of the transducer block	VARIABLE	DS_64	5	S	N/A	R/W	N/A
1	ST_REV	The revision level of the static data associated with the function block. Incremented with each write of static store.	VARIABLE	Unsigned16	2	S	0	R	N/A
2	TAG_DESC	The user description of the intended application of the block.	STRING	OCTET STRING	32	S	Spaces	R/W	Any 32 Characters
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.	VARIABLE	Unsigned16	2	S	0	R/W	N/A
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.	VARIABLE	Unsigned8	1	S	0	R/W	0 to 255
5	MODE_BLK	The actual, target, permitted and normal modes of the block.	RECORD	DS-69	4	mix	O/S	R/W	See section 2/6 of FF-891
6	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block.	STRING	BIT STRING	2	D/20	-	R	See section 4.8 of FF-903
11	XD_ERROR	Used for all config, H/W, connection failure or system problems in the block.	VARIABLE	Unsigned8	1	D	-	R	18 = Process Error 19 = Configuration Error 20 = Electronics Failure 21 = Sensor Failure
	Slug Flow Setup								
63	SLUG_TIME	Slug duration (seconds)	VARIABLE	FLOAT	4	S	1.0	R/W	N/A
64	SLUG_LOW_LIMIT	Low Density limit (g/cc)	VARIABLE	FLOAT	4	S	0.0	R/W	N/A
65	SLUG_HIGH_LIMIT	High Density limit (g/cc)	VARIABLE	FLOAT	4	S	5.0	R/W	N/A
	Alarm Status								
81	ALARM1_STATUS	Status Word 1	ENUM	BIT STRING	2	D/20	-	R	0x0001 = Transmitter Fail 0x0002 = Sensor Fail 0x0004 = EEPROM error (CP) 0x0008 = RAM error (CP) 0x0010= Boot Fail (CP) 0x0020 = Uncofig – FloCal 0x0040 = Uncofig – K1 0x0080 = Input Overrange 0x0100 = Temp. Overrange 0x0200 = Dens. Overrange 0x0400 = RTI Failure 0x0800 = Cal Failed 0x1000 = Xmitter Init 0x2000 = Sns/Xmitter comm fault 0x4000 = Other Failure 0x8000 = Not Used

Table D-6 DIAGNOSTICS transducer block parameters *continued*

OD Index	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
82	ALARM2_STATUS	Status Word 2	ENUM	BIT STRING	2	D/20	-	R	0x0001 = Line RTD Over 0x0002 = Meter RTD Over 0x0004 = CP Exception 0x0008 = API: Temp OOL 0x0010 = API:Density OOL 0x0020 = ED: Unable to fit curve data 0x0040 = ED: Extrapolation alarm 0x0080 = Not Used 0x0100 = EEPROM err (2700) 0x0200 = RAM err (2700) 0x0400 = Not Used 0x0800 = Not Used 0x1000= Not Used 0x2000 = Not Used 0x4000 = Not Used 0x8000 = Not Used
83	ALARM3_STATUS	Status Word 3	ENUM	BIT STRING	2	D/20	-	R	0x0001 = Drive Overrange 0x0002 = Slug Flow 0x0004 = Cal in Progress 0x0008 = Data Loss Possible 0x0010 = Upgrade Series 2000 0x0020 = Not Used 0x0040 = Not Used 0x0080 = Not Used 0x0100 = Power Reset 0x0200 = Reverse Flow 0x0400 = Not Used 0x0800 = Not Used 0x1000 = Not Used 0x2000 = Not Used 0x4000 = Not Used 0x8000 = Not Used
84	ALARM4_STATUS	Status Word 4	ENUM	BIT STRING	2	D/20	-	R	0x0001 = Cal Fail: Low 0x0002 = Cal Fail: High 0x0004 = Cal Fail: Noisy 0x0008 = Auto Zero IP 0x0010 = D1 IP 0x0020 = D2 IP 0x0040 = FD IP 0x0080 = Temp slope IP 0x0100 = Temp offset IP 0x0200 = D3 IP 0x0400 = D4 IP 0x0800 = Not Used 0x1000= Not Used 0x2000 = Not Used 0x4000 = Not Used 0x8000 = Not Used
	FAULT_LIMIT	Fault Limit Code	ENUM	Unsigned16	2	S	0	R/W	0 = Upscale 1 = Downscale 2 = Zero 3 = NAN 4 = Flow goes to zero 5 = None
87	LAST_MEASURED_VALUE _FAULT_TIMEOUT	Last Measured Value Fault Timeout	VARIABLE	Unsigned16	2	S	0	R/W	N/A

Table D-6 DIAGNOSTICS transducer block parameters *continued*

OD Index	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
	ALARM_INDEX	Alarm Index	ENUM	Unsigned16	2	S	0	R/W	0 = N/A 1 = EEPROM error (CP) 2 = RAM error (CP) 3 = Sensor Fail 4 = Temp. Overrange 5 = Input Overrange 6 = Uncofig – FloCal 7 = RTI Failure 8 = Dens. Overrange 9 = Xmitter Init 10 = Cal Failed 11= Cal Fail: Low 12 = Cal Fail: High 13 = Cal Fail: Noisy 14 = Transmitter Fail 15 = N/A 16 = Line RTD Over 17= Meter RTD Over 18 = EEPROM err (2700) 19 = RAM err (2700) 20 = Uncofig – K1 21-24 =N/A 25 = Boot Fail (CP) 26 = Sns/Xmitter comm fault 27 = N/A 28 = CP Exception 29-41 = N/A 42 = Drive Overrange 43 = Data Loss Possible 44 = Cal in Progress 45 = Slug Flow 46 = N/A 47 = Power Reset 48-51 = N/A 52 = Upgrade Series 2000 53-55= N/A 56 = API: Temp OOL 57 = API:Density OOL 58-59= N/A 60 = ED: Unable to fit curve data 61 = ED: Extrapolation alarm 62-70 = N/A
	ALARM_SEVERITY	Alarm Severity	ENUM	Unsigned16	2	S	0	R/W	0 = Ignore 1 = Info 2 = Fault
	Diagnostics								
108	DRIVE_GAIN	Drive Gain	VARIABLE	DS-65	5	D/20	0	R	N/A
109	TUBE_FREQUENCY	Raw Tube Period	VARIABLE	FLOAT	4	D/20	0	R	N/A
110	LIVE_ZERO	Live Zero (Mass Flow)	VARIABLE	FLOAT	4	D/20	0	R	N/A
111	LEFT_PICKUP_VOLTAGE	Left Pickoff Voltage	VARIABLE	FLOAT	4	D/20	0	R	N/A
112	RIGHT_PICKUP_VOLTAGE	Right Pickoff Voltage	VARIABLE	FLOAT	4	D/20	0	R	N/A
	BOARD_TEMPERATURE	Board Temperature (degC)	VARIABLE	FLOAT	4	D/20	0	R	N/A
	ELECT_TEMP_MAX	Maximum electronics temperature	VARIABLE	FLOAT	4	D/20	0	R	N/A
	ELECT_TEMP_MIN	Minimum electronics temperature	VARIABLE	FLOAT	4	D/20	0	R	N/A
	ELECT_TEMP_AVG	Average electronics temperature	VARIABLE	FLOAT	4	D/20	0	R	N/A
	SENSOR_TEMP_MAX	Maximum sensor temperature	VARIABLE	FLOAT	4	D/20	0	R	N/A
	SENSOR_TEMP_MIN	Minimum sensor temperature	VARIABLE	FLOAT	4	D/20	0	R	N/A
	SENSOR_TEMP_AVG	Average sensor temperature	VARIABLE	FLOAT	4	D/20	0	R	N/A

Table D-6 DIAGNOSTICS transducer block parameters *continued*

OD Index	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
	RTD_RESISTANCE_CABLE	9-wire cable RTD Resistance (ohms)	VARIABLE	FLOAT	4	D/20	0	R	N/A
	RTD_RESISTANCE_ METER	Meter RTD Resistance (ohms)	VARIABLE	FLOAT	4	D/20	0	R	N/A
	CP_POWER_CYCLE	Number of core processor power cycles	VARIABLE	Unsigned16	2	D	0	R	N/A
	Meter Fingerprinting								
	MFP_SAVE_FACTORY	Save Factory Cal Meter Fingerprint	ENUM	Unsigned16	2	S	?	R/W	0x0000 = no action 0x0001 = save
	MFP_RESET_STATS	Reset Meter Current Fingerprint Statistics	ENUM	Unsigned16	2	S	?	R/W	0x0000 = no action 0x0001 = reset
	EN_MFP	Enable/Disable Meter Fingerprinting	ENUM	Unsigned16	2	S	?	R/W	0x0000 = disabled 0x0001 = enabled
	MFP_UNITS	Meter Fingerprint in SI (0) or English (1) units	ENUM	Unsigned16	2	S	?	R/W	0x0000 = SI 0x0001 = English
	MFP_TV_INDEX	Meter Fingerprint Transmitter Variable Index	VARIABLE	Unsigned16	2	S	?	R/W	0 = Mass Flow Rate 1 = Temperature 3 = Density 5 = Volume Flow Rate 46 = Raw Tube Frequency 47 = Drive Gain 48 = Case Temperature 49 = LPO Amplitude 50 = RPO Amplitude 51 = Board Temperature 52 = Input Voltage 54 = Live Zero
	MFP_TYPE	Fingerprint Type	ENUM	Unsigned16	2	S	?	R/W	0 = Current 1 = Factory Cal 2 = Installation 3 = Last Zero
	MFP_TV_INST	Transmitter Variable, Instantaneous (only valid for Current print)	VARIABLE	FLOAT	4	S	D/ 1/min	R	
	MFP_TV_AVG	Transmitter Variable, Average (1-min rolling)	VARIABLE	FLOAT	4	S	D/ 1/min	R	
	MFP_TV_STD_DEV	Transmitter Variable, Std Dev (1-min rolling)	VARIABLE	FLOAT	4	S	D/ 1/min	R	
	MFP_TV_MAX	Transmitter Variable, Maximum (since last statistics reset)	VARIABLE	FLOAT	4	S	D/ 1/min	R	
	MFP_TV_MIN	Transmitter Variable, Minimum (since last statistics reset)	VARIABLE	FLOAT	4	S	D/ 1/min	R	

Table D-7 DIAGNOSTICS transducer block views

OD Index	Parameter Mnemonic	View 1	View 2	View 3	View 4
	Standard FF Parameters				
0	BLOCK_STRUCTURE				
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	

Table D-7 DIAGNOSTICS transducer block views *continued*

OD Index	Parameter Mnemonic	View 1	View 2	View 3	View 4
11	XD_ERROR	1		1	
	Slug Flow Setup				
63	SLUG_TIME				4
64	SLUG_LOW_LIMIT				4
65	SLUG_HIGH_LIMIT				4
	Alarm Status				
81	ALARM1_STATUS	2		2	
82	ALARM2_STATUS	2		2	
83	ALARM3_STATUS	2		2	
84	ALARM4_STATUS	2		2	
	FAULT_LIMIT_CODE		2		
87	LAST_MEASURED_VALUE_FAULT_TIMEOUT		2		
	ALARM_INDEX				2
	ALARM_SEVERITY				2
	Diagnostics				
108	DRIVE_GAIN	5		5	
109	TUBE_FREQUENCY			4	
110	LIVE_ZERO			4	
111	LEFT_PICKOFF_VOLTAGE			4	
112	RIGHT_PICKOFF_VOLTAGE			4	
	BOARD_TEMPERATURE			4	
	ELECT_TEMP_MAX			4	
	ELECT_TEMP_MIN			4	
	ELECT_TEMP_AVG			4	
	SENSOR_TEMP_MAX			4	
	SENSOR_TEMP_MIN			4	
	SENSOR_TEMP_AVG			4	
	RTD_RESISTANCE_CABLE			4	
	RTD_RESISTANCE_METER			4	
	CP_POWER_CYCLE			2	
	Meter Fingerprinting				
	MFP_SAVE_FACTORY				2
	MFP_RESET_STATS				2
	EN_MFP				2
	MFP_UNITS				2
	MFP_TV_INDEX				2
	MFP_TYPE				2
	MFP_TV_INST			4	
	MFP_TV_AVG			4	
	MFP_TV_STD_DEV			4	
	MFP_TV_MAX			4	
	MFP_TV_MIN			4	
	Totals	22	6	91	33

Table D-8 DEVICE INFORMATION transducer block parameters

OD Index	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
	Standard FF Parameters								
0	BLOCK_STRUCTURE	Beginning of the transducer block	VARIABLE	DS_64	5	S	N/A	R/W	N/A
1	ST_REV	The revision level of the static data associated with the function block. Incremented with each write of static store.	VARIABLE	Unsigned16	2	S	0	R	N/A
2	TAG_DESC	The user description of the intended application of the block.	STRING	OCTET STRING	32	S	Spaces	R/W	Any 32 Characters
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.	VARIABLE	Unsigned16	2	S	0	R/W	N/A
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.	VARIABLE	Unsigned8	1	S	0	R/W	0 to 255
5	MODE_BLK	The actual, target, permitted and normal modes of the block.	RECORD	DS-69	4	mix	O/S	R/W	See section 2/6 of FF-891
6	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block.	STRING	BIT STRING	2	D/20	-	R	See section 4.8 of FF-903
11	XD_ERROR	Used for all config, H/W, connection failure or system problems in the block.	VARIABLE	Unsigned8	1	D	-	R	18 = Process Error 19 = Configuration Error 20 = Electronics Failure 21 = Sensor Failure
	Transmitter Data								
13	SERIAL_NUMBER	Serial number of this device	VARIABLE	Unsigned32	4	S	0	R	≥ 0
14	OPTION_BOARD_CODE	Code of the Output Option Board	ENUM	Unsigned16	2	S	2	R	0 = None 1 = Analog I/0 2 = Foundation Fieldbus
	700_SW_REV	LF-Series sensor software revision	VARIABLE	Unsigned16	2	S	S/W Rev	R	N/A
15	2700_SW_REV	LF-Series transmitter software revision	VARIABLE	Unsigned16	2	S	S/W Rev	R	N/A
	CEQ_NUMBER	LF-Series Transmitter CEQ Number	VARIABLE	Unsigned16	2	S	S/W Rev	R	N/A
	DESCRIPTION	User Text	STRING	OCTET STRING	16	S	“”	R/W	
	Sensor Data								
16	SENSOR_SN	Sensor serial number	VARIABLE	Unsigned32	4	S	0	R	≥ 0
17	SENSOR_TYPE	Sensor type (i.e. F200, CMF025)	STRING	OCTET STRING	16	S	“”	R	
	SENSOR_TYPE_CODE	Sensor type code	ENUM	Unsigned16	2	S	0	R/W	0 = Curve Tube 1 = Straight Tube
18	SENSOR_MATERIAL	Sensor Material	ENUM	Unsigned16	2	S	0	R/W	0 = None 3 = Hastelloy C-22 4 = Model 5 = Tantalum 6 = Titanium 19 = 316L stainless steel 23 = Inconel 252 = Unknown 253 = Special

Table D-8 DEVICE INFORMATION transducer block parameters *continued*

OD Index	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
19	SENSOR_LINER	Liner Material	ENUM	Unsigned16	2	S	0	R/W	0 = None 10 = PTFE (Teflon 11 = Halar 16 = Tefzel 251 = None 252 = Unknown 253 = Special
20	SENSOR_END	Flange Type	ENUM	Unsigned16	2	S	0	R/W	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
23	HIGH_MASS_LIMIT	High mass flow limit of sensor	VARIABLE	FLOAT	4	S	Calc	R/W	N/A
24	HIGH_TEMP_LIMIT	High Temperature limit of sensor	VARIABLE	FLOAT	4	S	Calc	R/W	N/A
25	HIGH_DENSITY_LIMIT	High density limit of sensor (g/cc)	VARIABLE	FLOAT	4	S	Calc	R/W	N/A
26	HIGH_VOLUME_LIMIT	High volume flow limit of sensor	VARIABLE	FLOAT	4	S	Calc	R/W	N/A
27	LOW_MASS_LIMIT	Low mass flow limit of sensor	VARIABLE	FLOAT	4	S	Calc	R/W	N/A
28	LOW_TEMP_LIMIT	Low Temperature limit of sensor	VARIABLE	FLOAT	4	S	Calc	R/W	N/A
29	LOW_DENSITY_LIMIT	Low density limit of sensor (g/cc)	VARIABLE	FLOAT	4	S	Calc	R/W	N/A
30	LOW_VOLUME_LIMIT	Low volume flow limit of sensor	VARIABLE	FLOAT	4	S	Calc	R/W	N/A
31	MASS_MIN_RANGE	Mass flow minimum range	VARIABLE	FLOAT	4	S	Calc	R/W	N/A
32	TEMP_MIN_RANGE	Temperature minimum range	VARIABLE	FLOAT	4	S	Calc	R/W	N/A
33	DENSITY_MIN_RANGE	Density minimum range (g/cc)	VARIABLE	FLOAT	4	S	Calc	R/W	N/A
34	VOLUME_MIN_RANGE	Volume flow minimum range	VARIABLE	FLOAT	4	S	Calc	R/W	N/A

Table D-9 DEVICE INFORMATION transducer block views

OD Index	Parameter Mnemonic	View 1	View 2	View 3	View 4
	Standard FF Parameters				
0	BLOCK_STRUCTURE				
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
11	XD_ERROR	1		1	

Table D-9 DEVICE INFORMATION transducer block views *continued*

OD Index	Parameter Mnemonic	View 1	View 2	View 3	View 4
	Transmitter Data				
13	SERIAL_NUMBER		4		
14	OPTION_BOARD_CODE				2
	700_SW_REV		2		
15	2700_SW_REV		2		
	CEQ_NUMBER		2		
	DESCRIPTION				16
	Sensor Data				
16	SENSOR_SN		4		
17	SENSOR_TYPE				16
	SENSOR_TYPE_CODE				2
18	SENSOR_MATERIAL				2
19	SENSOR_LINER				2
20	SENSOR_END				2
23	HIGH_MASS_LIMIT		4		
24	HIGH_TEMP_LIMIT		4		
25	HIGH_DENSITY_LIMIT		4		
26	HIGH_VOLUME_LIMIT		4		
27	LOW_MASS_LIMIT		4		
28	LOW_TEMP_LIMIT		4		
29	LOW_DENSITY_LIMIT		4		
30	LOW_VOLUME_LIMIT		4		
31	MASS_MIN_RANGE				4
32	TEMP_MIN_RANGE				4
33	DENSITY_MIN_RANGE				4
34	VOLUME_MIN_RANGE				4
	Totals	9	48	9	63

Table D-10 LOCAL DISPLAY transducer block parameters

	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
	Standard FF Parameters								
0	BLOCK_STRUCTURE	Beginning of the transducer block	VARIABLE	DS_64	5	S	N/A	R/W	N/A
1	ST_REV	The revision level of the static data associated with the function block. Incremented with each write of static store.	VARIABLE	Unsigned16	2	S	0	R	N/A
2	TAG_DESC	The user description of the intended application of the block.	STRING	OCTET STRING	32	S	Spaces	R/W	Any 32 Characters
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.	VARIABLE	Unsigned16	2	S	0	R/W	N/A

Table D-10 LOCAL DISPLAY transducer block parameters *continued*

	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.	VARIABLE	Unsigned8	1	S	0	R/W	0 to 255
5	MODE_BLK	The actual, target, permitted and normal modes of the block.	RECORD	DS-69	4	mix	O/S	R/W	See section 2/6 of FF-891
6	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block.	STRING	BIT STRING	2	D/20	-	R	See section 4.8 of FF-903
11	XD_ERROR	Used for all config, H/W, connection failure of system problems in the block.	VARIABLE	Unsigned8	1	D	-	R	18 = Process Error 19 = Configuration Error 20 = Electronics Failure 21 = Sensor Failure
	LDO								
144	EN_LDO_TOT_RESET	Enable/Disable LDO Totalizer Reset	ENUM	Unsigned16	2	S	1	R/W	0x0000 = disabled 0x0001 = enabled
	EN_LDO_TOT_START_STOP	Enable/Disable LDO Totalizer Start/Stop option	ENUM	Unsigned16	2	S	1	R/W	0x0000 = disabled 0x0001 = enabled
145	EN_LDO_AUTO_SCROLL	Enable/Disable LDO Auto Scroll Feature	ENUM	Unsigned16	2	S	0	R/W	0x0000 = disabled 0x0001 = enabled
146	EN_LDO_OFFLINE_MENU	Enable/Disable LDO Offline Menu Feature	ENUM	Unsigned16	2	S	1	R/W	0x0000 = disabled 0x0001 = enabled
147	EN_LDO_OFFLINE_PWD	Enable/Disable LDO Offline Password	ENUM	Unsigned16	2	S	0	R/W	0x0000 = disabled 0x0001 = enabled
148	EN_LDO_ALARM_MENU	Enable/Disable LDO Alarm Menu	ENUM	Unsigned16	2	S	1	R/W	0x0000 = disabled 0x0001 = enabled
149	EN_LDO_ACK_ALL_ALARMS	Enable/Disable LDO Acknowledge All alarms feature	ENUM	Unsigned16	2	S	1	R/W	0x0000 = disabled 0x0001 = enabled
	LDO_OFFLINE_PWD	LDO offline password	VARIABLE	Unsigned16	2	S	-	R/W	0 - 9999
	LDO_SCROLL_RATE	LDO Scroll rate	VARIABLE	Unsigned16	2	S	-	R/W	-
	LDO_BACKLIGHT_ON	LDO Backlight Control	ENUM	Unsigned16	2	S	1	R/W	0x0000 = off 0x0001 = on
	LDO_TOTALIZER_ PRECISION	For Totals, the number of digits to the right of the decimal point to display on LDO	VARIABLE	Unsigned16	2	S	-	R/W	0 to 4
150	LDO_VAR_1_CODE	Display the Variable associated with the code on the LDO	ENUM	Unsigned16	2	S	0	R	

Table D-10 LOCAL DISPLAY transducer block parameters *continued*

	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
151	LDO_VAR_2_CODE	Display the Variable associated with the code on the LDO	ENUM	Unsigned16	2	S	2	R/W	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: Corr Density 16 = API: Corr Vol Flow 17 = API: Corr Vol Total 18 = API: Corr Vol Inv 19 = API: Avg Density 20 = API: Avg Temp 21 = ED: Density At Ref 22 = ED: Density (SGU) 23 = ED: Std Vol Flow Rate 24 = ED: Std Vol Total 25 = ED: Std Vol Inventory 26 = ED: Net Mass Flow 27 = ED: Net Mass Total 28 = ED: Net Mass Inv 29 = ED: Net Vol Flow Rate 30 = ED: Net Vol Total 31 = ED: Net Vol Inventory 32 = ED: Concentration 33 = API: CTL 46 = Raw Tube Frequency 47 = Drive Gain 48 = Case Temperature 49 = LPO Amplitude 50 = RPO Amplitude 51 = Board Temperature 52 = Input Voltage 53 = Ext. Input Pressure 54 = Live Zero 55 = Ext. Input Temp 56 = ED: Density (Baume) 62 = Gas Std Vol Flow 63 = Gas Std Vol Total 64 = Gas Std Vol Inventory 69 = Live Zero 251 = None
152	LDO_VAR_3_CODE	Display the Variable associated with the code on the LDO	ENUM	Unsigned16	2	S	5	R/W	Same as LDO_VAR_2_CODE
153	LDO_VAR_4_CODE	Display the Variable associated with the code on the LDO	ENUM	Unsigned16	2	S	6	R/W	Same as LDO_VAR_2_CODE
154	LDO_VAR_5_CODE	Display the Variable associated with the code on the LDO	ENUM	Unsigned16	2	S	3	R/W	Same as LDO_VAR_2_CODE
155	LDO_VAR_6_CODE	Display the Variable associated with the code on the LDO	ENUM	Unsigned16	2	S	1	R/W	Same as LDO_VAR_2_CODE
156	LDO_VAR_7_CODE	Display the Variable associated with the code on the LDO	ENUM	Unsigned16	2	S	251	R/W	Same as LDO_VAR_2_CODE
157	LDO_VAR_8_CODE	Display the Variable associated with the code on the LDO	ENUM	Unsigned16	2	S	251	R/W	Same as LDO_VAR_2_CODE
158	LDO_VAR_9_CODE	Display the Variable associated with the code on the LDO	ENUM	Unsigned16	2	S	251	R/W	Same as LDO_VAR_2_CODE
159	LDO_VAR_10_CODE	Display the Variable associated with the code	ENUM	Unsigned16	2	S	251	R/W	Same as LDO_VAR_2_CODE
160	LDO_VAR_11_CODE	Display the Variable associated with the code	ENUM	Unsigned16	2	S	251	R/W	Same as LDO_VAR_2_CODE

Table D-10 LOCAL DISPLAY transducer block parameters *continued*

	Parameter Mnemonic	Definition	Message Type	Data Type/ Structure	Size	Store/Rate (HZ)	Initial Value	Access	Enumerated List of Values
161	LDO_VAR_12_CODE	Display the Variable associated with the code	ENUM	Unsigned16	2	S	251	R/W	Same as LDO_VAR_2_CODE
162	LDO_VAR_13_CODE	Display the Variable associated with the code	ENUM	Unsigned16	2	S	251	R/W	Same as LDO_VAR_2_CODE
163	LDO_VAR_14_CODE	Display the Variable associated with the code	ENUM	Unsigned16	2	S	251	R/W	Same as LDO_VAR_2_CODE
164	LDO_VAR_15_CODE	Display the Variable associated with the code on the LDO	ENUM	Unsigned16	2	S	251	R/W	Same as LDO_VAR_2_CODE

Table D-11 LOCAL DISPLAY transducer block views

OD Index	Parameter Mnemonic	View 1	View 2	View 3	View 4
	Standard FF Parameters				
0	BLOCK_STRUCTURE				
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	XD_ERROR	1		1	
	LDO				
8	EN_LDO_TOT_RESET				2
9	EN_LDO_TOT_START_STOP				2
10	EN_LDO_AUTO_SCROLL				2
11	EN_LDO_OFFLINE_MENU				2
12	EN_LDO_OFFLINE_PWD				2
13	EN_LDO_ALARM_MENU				2
14	EN_LDO_ACK_ALL_ALARMS				2
15	LDO_OFFLINE_PWD		2		
16	LDO_SCROLL_RATE				2
17	LDO_BACKLIGHT_ON				2
18	LDO_TOTALIZER_PRECISION				2
19	LDO_VAR_1_CODE				2
20	LDO_VAR_2_CODE				2
21	LDO_VAR_3_CODE				2
22	LDO_VAR_4_CODE				2
23	LDO_VAR_5_CODE				2
24	LDO_VAR_6_CODE				2
25	LDO_VAR_7_CODE				2
26	LDO_VAR_8_CODE				2
27	LDO_VAR_9_CODE				2

Table D-11 LOCAL DISPLAY transducer block views *continued*

OD Index	Parameter Mnemonic	View 1	View 2	View 3	View 4
28	LDO_VAR_10_CODE				2
29	LDO_VAR_11_CODE				2
30	LDO_VAR_12_CODE				2
31	LDO_VAR_13_CODE				2
32	LDO_VAR_14_CODE				2
33	LDO_VAR_15_CODE				2
	Totals	9	4	9	55

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