Configuration and Use Manual
MMI-20016855, Rev AD
June 2019

Micro Motion® 9739 MVD Transmitters

MICRO MOTION™

EMERSON™

Safety and approval information

This Micro Motion product complies with all applicable European directives when properly installed in accordance with the instructions in this manual. Refer to the EU declaration of conformity for directives that apply to this product. The EU declaration of conformity, with all applicable European directives, and the complete ATEX Installation Drawings and Instructions are available on the internet at www.emerson.com or through your local Micro Motion support center.

Information affixed to equipment that complies with the Pressure Equipment Directive, can be found on the internet at www.emerson.com.

For hazardous installations in Europe, refer to standard EN 60079-14 if national standards do not apply.

Other information

Full product specifications can be found in the product data sheet. Troubleshooting information can be found in the configuration manual. Product data sheets and manuals are available from the Micro Motion web site at www.emerson.com.

Return policy

Follow Micro Motion procedures when returning equipment. These procedures ensure legal compliance with government transportation agencies and help provide a safe working environment for Micro Motion employees. Micro Motion will not accept your returned equipment if you fail to follow Micro Motion procedures.

Return procedures and forms are available on our web support site at www.emerson.com, or by phoning the Micro Motion Customer Service department.

Emerson Flow customer service

Email:

- Worldwide: flow.support@emerson.com
- Asia-Pacific: APflow.support@emerson.com

Telephone:

North and South America		Europe and Middle East		Asia Pacific	
United States	800-522-6277	U.K.	0870 240 1978	Australia	800 158 727
Canada	+1 303-527-5200	The Netherlands	+31 (0) 704 136 666	New Zealand	099 128 804
Mexico	+41 (0) 41 7686 111	France	0800 917 901	India	800 440 1468
Argentina	+54 11 4837 7000	Germany	0800 182 5347	Pakistan	888 550 2682
Brazil	+55 15 3413 8000	Italy	8008 77334	China	+86 21 2892 9000
		Central & Eastern	+41 (0) 41 7686 111	Japan	+81 3 5769 6803
		Russia/CIS	+7 495 981 9811	South Korea	+82 2 3438 4600
		Egypt	0800 000 0015	Singapore	+65 6 777 8211
		Oman	800 70101	Thailand	001 800 441 6426
		Qatar	431 0044	Malaysia	800 814 008
		Kuwait	663 299 01		
		South Africa	800 991 390		
		Saudi Arabia	800 844 9564		
		UAE	800 0444 0684		

Contents

1 Before you begin

1.1 About this manual

This manual helps you configure, commission, use, maintain, and troubleshoot the 9739 MVD transmitter.

Important
This manual assumes that the following conditions apply:

- The transmitter has been installed correctly and completely according to the instructions in the transmitter installation manual
- The installation complies with all applicable safety requirements
- The user is trained in government and corporate safety standards

1.2 Supported protocols

The 9739 MVD transmitter supports the following protocols.

Communication tool	Supported protocols
ProLink III	• HART/RS-485 • HART/Bell 202 • Modbus/RS-485 • Service port
Field Communicator	HART/Bell 202

For information about how to use the communication tools, see the appendices in this manual.

Tip
You may be able to use other communications tools, such as AMS Suite: Intelligent Device Manager, or the Smart Wireless THUM™ Adapter. Use of AMS or the Smart Wireless THUM Adapter is not discussed in this manual. For more information on the Smart Wireless THUM Adapter, refer to the documentation available at www.emerson.com.

1.3 Related documentation

You can find all product documentation on the product documentation DVD shipped with the product or at www.emerson.com.

See any of the following documents for more information:

- *Micro Motion Model 9739 Transmitters with MVD Technology Product Data Sheet*
- *Micro Motion 9739 MVD Transmitters: Installation Manual*
- *Micro Motion 9739 MVD Transmitter Electronics Module Installation Guide*
- For hazardous area installation, see the approval documentation shipped with the transmitter, or download the appropriate documentation from www.emerson.com

- Sensor documentation

2 Quick start

2.1 Power up the transmitter

The transmitter must be powered up for all configuration and commissioning tasks, or for process measurement.

Procedure

1. Ensure that all transmitter and sensor covers and seals are closed.

   DANGER

   To prevent ignition of flammable or combustible atmospheres, ensure that all covers and seals are tightly closed. For hazardous area installations, applying power while housing covers are removed or loose can cause an explosion.

2. Turn on the electrical power at the power supply.
   The transmitter will automatically perform diagnostic routines. The transmitter is self-switching and will automatically detect the supply voltage. When using DC power, a minimum of 1.5 amps of startup current is required. During this period, Alert 009 is active. The diagnostic routines should complete in approximately 30 seconds. The status LED will turn green when the startup diagnostics are complete. If the status LED exhibits different behavior, an alert is active.

Postrequisites

Although the sensor is ready to receive process fluid shortly after power-up, the electronics can take up to 10 minutes to reach thermal equilibrium. Therefore, if this is the initial startup, or if power has been off long enough to allow components to reach ambient temperature, allow the electronics to warm up for approximately 10 minutes before relying on process measurements. During this warm-up period, you may observe minor measurement instability or inaccuracy.

2.2 Check meter status

Check the meter for any error conditions that require user action or that affect measurement accuracy.

Procedure

1. Wait approximately 10 seconds for the power-up sequence to complete.

   Immediately after power-up, the transmitter runs through diagnostic routines and checks for error conditions. During the power-up sequence, Alert A009 is active. This alert should clear automatically when the power-up sequence is complete.

2. Check the status LED on the transmitter.

2.2.1 Transmitter status reported by LED

Table 2-1: Status LED states

LED behavior	Alarm condition	Description
Solid green	No alarm	Normal operation

Table 2-1: Status LED states *(continued)*

LED behavior	Alarm condition	Description
Flashing yellow	No alarm	• Zero calibration procedure is in progress • Loop test is in progress
Solid yellow	Low-severity alarm	Alarm condition that will not cause measurement error (outputs continue to report process data)
Solid red	High-severity alarm	Alarm condition that will cause measurement error (outputs in fault)

2.3 Make a startup connection to the transmitter

For all configuration tools except the display, you must have an active connection to the transmitter to configure the transmitter. Follow this procedure to make your first connection to the transmitter.

Procedure

Identify the connection type to use, and follow the instructions for that connection type in the appropriate appendix. Use the default communications parameters shown in the appendix.

Communications tool	Connection type to use	Instructions
ProLink III	Modbus/RS-485	Using ProLink III with the transmitter
Field Communicator	HART	Using a Field Communicator with the transmitter

2.4 Characterize the flowmeter (if required)

Display	Not available
ProLink III	**Device Tools** → **Calibration Data**
Field Communicator	**Configure** → **Manual Setup** → **Characterize**

Characterizing the flowmeter adjusts your transmitter to match the unique traits of the sensor it is paired with. The characterization parameters (also called calibration parameters) describe the sensor's sensitivity to flow, density, and temperature. Depending on your sensor type, different parameters are required. Values for your sensor are provided by Micro Motion on the sensor tag or the calibration certificate.

Tip
If your flowmeter was ordered as a unit, it has already been characterized at the factory. However, you should still verify the characterization parameters.

Procedure

1. Specify **Sensor Type**.
   - Straight-tube (T-Series)
   - Curved-tube (all sensors except T-Series)
2. Set the flow characterization parameters. Be sure to include all decimal points.
   - For straight-tube sensors, set **FCF** (**Flow Cal** or **Flow Calibration Factor**), **FTG**, and **FFQ**.

- For curved-tube sensors, set **Flow Cal** (**Flow Calibration Factor**).

3. Set the density characterization parameters.
   - For straight-tube sensors, set **D1**, **D2**, **DT**, **DTG**, **K1**, **K2**, **FD**, **DFQ1**, and **DFQ2**.
   - For curved-tube sensors, set **D1**, **D2**, **TC**, **K1**, **K2**, and **FD**. (**TC** is sometimes shown as **DT**.)

2.4.1 Sample sensor tags

Figure 2-1: Tag on newer curved-tube sensors (all sensors except T-Series)

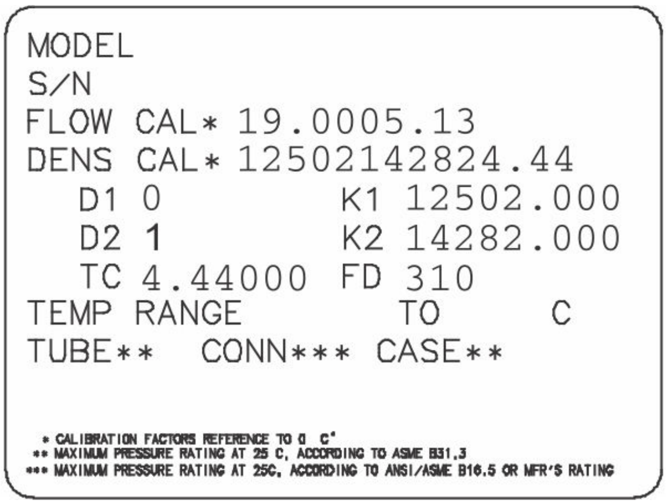


Figure 2-2: Tag on older straight-tube sensor (T-Series)

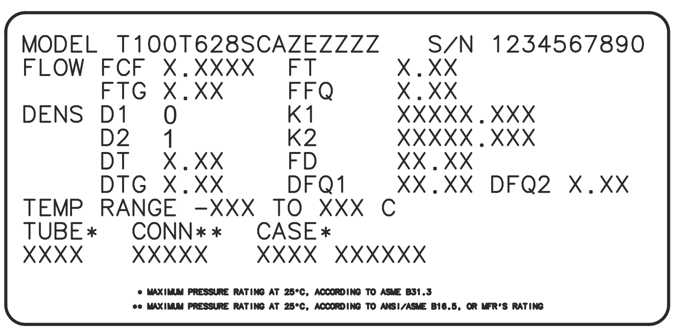
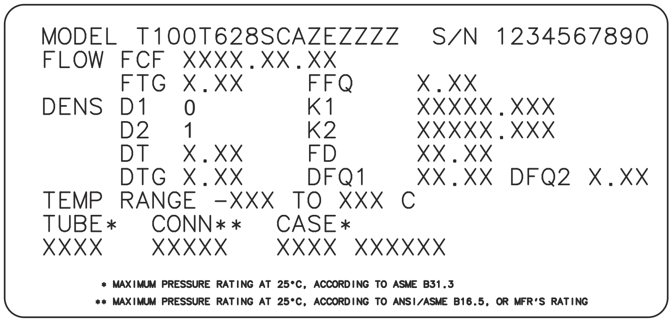


Figure 2-3: Tag on newer straight-tube sensor (T-Series)



2.4.2 Flow calibration parameters (FCF, FT)

Two separate values are used to describe flow calibration: a 6-character FCF value and a 4-character FT value. They are provided on the sensor tag.

Both values contain decimal points. The 10-character string is called either **Flowcal** or **FCF**.

If your sensor tag shows the **FCF** and the **FT** values separately and you need to enter a single value, concatenate the two values to form the single parameter value, retaining both decimal points.

2.4.3 Density calibration parameters (D1, D2, K1, K2, FD, DT, TC)

Density calibration parameters are typically on the sensor tag and the calibration certificate.

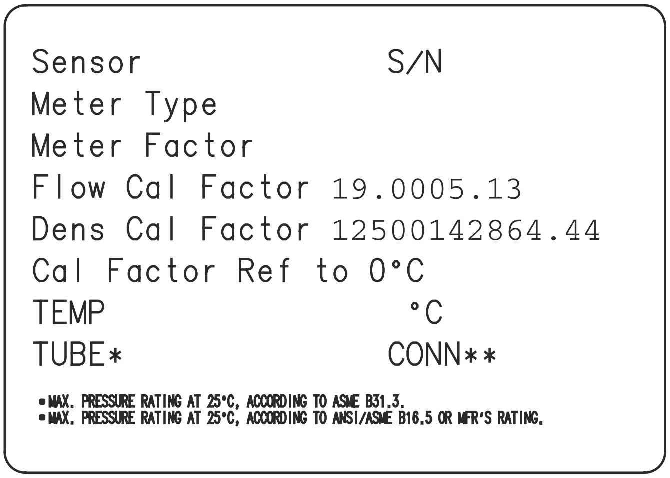
If your sensor tag does not show a **D1** or **D2** value:

- For **D1**, enter the Dens A or **D1** value from the calibration certificate. This value is the line-condition density of the low-density calibration fluid. Micro Motion uses air. If you cannot find a Dens A or **D1** value, enter `0.001` g/cm^3.
- For **D2**, enter the Dens B or **D2** value from the calibration certificate. This value is the line-condition density of the high-density calibration fluid. Micro Motion uses water. If you cannot find a Dens B or **D2** value, enter `0.998`g/cm^3 .

If your sensor tag does not show a **K1** or **K2** value:

- For **K1**, enter the first 5 digits of the density calibration factor. In this sample tag, this value is shown as 12500.
- For **K2**, enter the second 5 digits of the density calibration factor. In this sample tag, this value is shown as 14286.

Figure 2-4: K1, K2, and TC values in the density calibration factor



If your sensor does not show an **FD** value, contact customer service.

If your sensor tag does not show a **DT** or **TC** value, enter the last 4 characters of the density calibration factor. In the sample tag shown above, the value is shown as 4.44.

Do not confuse the **Meter Factor** line on the pictured sensor tag with any meter factor settings discussed in this manual.

The **Meter Type** value is not relevant on a 9739 MVD transmitter.

2.5 Verify mass flow measurement

Check to see that the mass flow rate reported by the transmitter is accurate. You can use any available method.

Procedure

- Read the value for **Mass Flow Rate** on the transmitter display.
- Connect to the transmitter with ProLink III and read the value for **Mass Flow Rate** in the **Process Variables** panel.
- Connect to the transmitter with the Field Communicator and read the value for **Mass Flow Rate**.

Postrequisites

If the reported mass flow rate is not accurate:

- Check the characterization parameters.
- Review the troubleshooting suggestions for flow measurement issues.

Related information

Flow measurement problems

2.6 Verify the zero

Verifying the zero helps you determine if the stored zero value is appropriate to your installation, or if a field zero can improve measurement accuracy.

The zero verification procedure analyzes the Live Zero value under conditions of zero flow, and compares it to the Zero Stability range for the sensor. If the average Live Zero value is within a reasonable range, the zero value stored in the transmitter is valid. Performing a field calibration will not improve measurement accuracy.

Important
In most cases, the factory zero is more accurate than the field zero. Do not zero the meter unless one of the following is true:
- The zero is required by site procedures.
- The stored zero value fails the zero verification procedure.

Procedure

1. Allow the flowmeter to warm up for at least 20 minutes after applying power.
2. Run the process fluid through the sensor until the sensor temperature reaches the normal process operating temperature.
3. Stop flow through the sensor by shutting the downstream valve, and then the upstream valve if available.
4. Verify that the sensor is blocked in, that flow has stopped, and that the sensor is completely full of process fluid.
5. From ProLink III, choose **Device Tools** → **Calibration** → **Zero Verification and Calibration** → **Verify Zero** and wait until the procedure completes.
6. Observe the drive gain, temperature, and density readings. If they are stable, check the **Live Zero** or **Field Verification Zero** value. If the average value is close to 0, you should not need to zero the meter.
7. If the zero verification procedure fails:
   a) Confirm that the sensor is completely blocked in, that flow has stopped, and that the sensor is completely full of process fluid.
   b) Verify that the process fluid is not flashing or condensing, and that it does not contain particles that can settle out.
   c) Remove or reduce sources of electromechanical noise if appropriate.
   d) Repeat the zero verification procedure.
   e) If it fails again, zero the meter.

Postrequisites

Restore normal flow through the sensor by opening the valves.

Related information

Zero the meter

2.6.1 Terminology used with zero verification and zero calibration

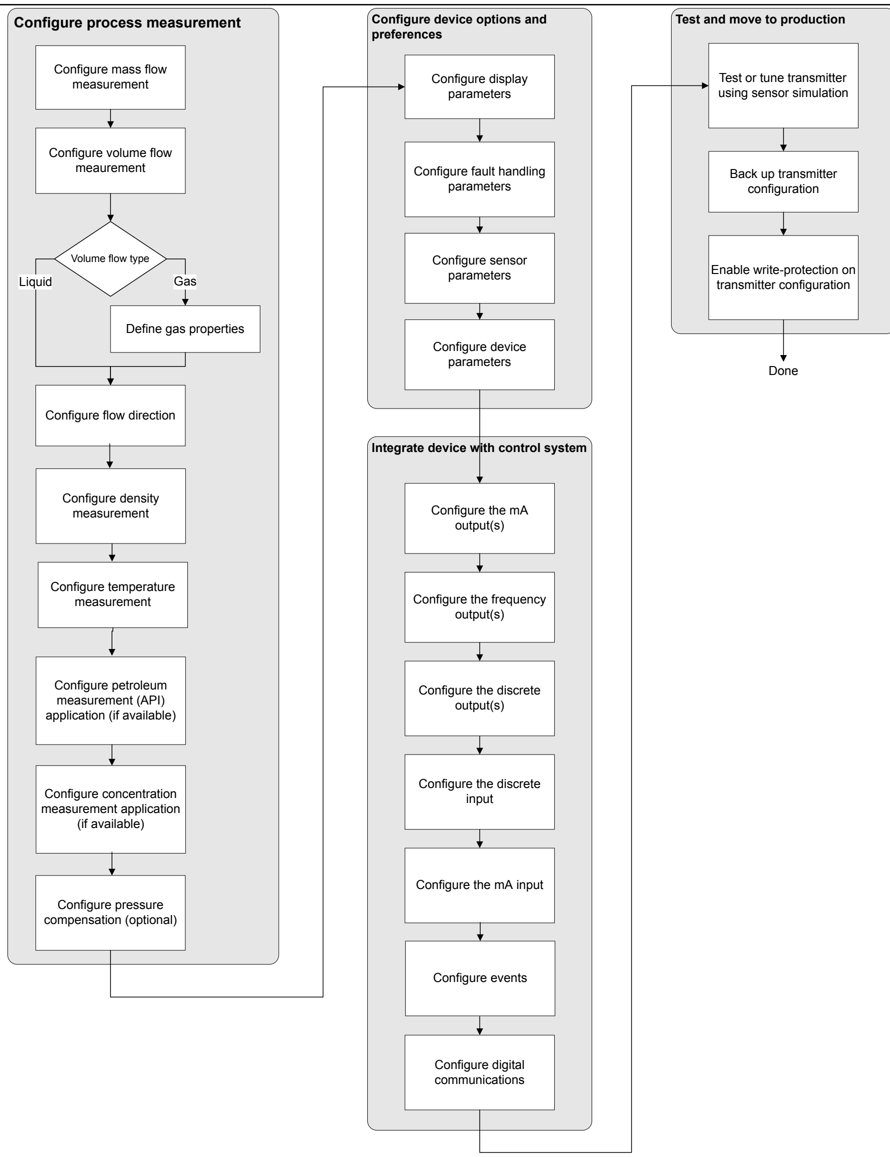
Term	Definition
Zero	In general, the offset required to synchronize the left pickoff and the right pickoff under conditions of zero flow. Unit = microseconds.
Factory Zero	The zero value obtained at the factory, under laboratory conditions.
Field Zero	The zero value obtained by performing a zero calibration outside the factory.
Prior Zero	The zero value stored in the transmitter at the time a field zero calibration is begun. May be the factory zero or a previous field zero.
Manual Zero	The zero value stored in the transmitter, typically obtained from a zero calibration procedure. It may also be configured manually. Also called “mechanical zero” or “stored zero”.
Live Zero	The real-time bidirectional mass flow rate with no flow damping or mass flow cutoff applied. An adaptive damping value is applied only when the mass flow rate changes dramatically over a very short interval. Unit = configured mass flow measurement unit.
Zero Stability	A laboratory-derived value used to calculate the expected accuracy for a sensor. Under laboratory conditions at zero flow, the average flow rate is expected to fall within the range defined by the Zero Stability value (0 ± Zero Stability). Each sensor size and model has a unique Zero Stability value. Statistically, 95% of all data points should fall within the range defined by the Zero Stability value.
Zero Calibration	The procedure used to determine the zero value.
Zero Time	The time period over which the Zero Calibration procedure is performed. Unit = seconds.
Field Verification Zero	A 3-minute running average of the Live Zero value, calculated by the transmitter. Unit = configured mass flow measurement unit.
Zero Verification	A procedure used to evaluate the stored zero and determine whether or not a field zero can improve measurement accuracy.

3 Introduction to configuration and commissioning

3.1 Configuration flowchart

Use the following flowchart as a general guide to the configuration and commissioning process.

Some options may not apply to your installation. Detailed information is provided in the remainder of this manual.



3.2 Default values and ranges

See Default values and ranges to view the default values and ranges for the most commonly used parameters.

3.3 Enable access to the off-line menu of the display

Display	**OFF-LINE MAINT → OFF-LINE CONFG → DISPLAY → OFFLN**
ProLink III	**Device Tools → Configuration → Transmitter Display → Display Security**
Field Communicator	Not available

By default, access to the off-line menu of the display is enabled. If it is disabled, you must enable it if you want to use the display to configure the transmitter.

Restriction

You cannot use the display to enable access to the off-line menu. You must make a connection from another tool.

3.4 Disable write-protection on the transmitter configuration

Display	**OFF-LINE MAINT → CONFG → LOCK**
ProLink III	**Device Tools → Configuration → Write-Protection**

If the transmitter is write-protected, the configuration is locked and you must unlock it before you can change any configuration parameters. By default, the transmitter is not write-protected.

Tip

Write-protecting the transmitter prevents accidental changes to configuration. It does not prevent normal operational use. You can always disable write-protection, perform any required configuration changes, then re-enable write-protection.

3.5 Disable HART security

If you plan to use HART protocol to configure the device, HART security must be disabled. HART security is disabled by default, so you may not need to do this.

Prerequisites

Check the setting of the HART security switch. You do not have to remove the housing cover to check the setting.

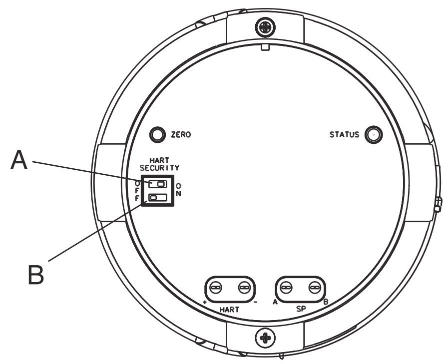
Procedure

1. Power down the device.

CAUTION
If the transmitter is in a hazardous area, you must power down the device before removing the transmitter housing cover. Removing the housing cover while the device is powered could cause an explosion.

2. Remove the transmitter housing cover.
3. Move the HART security switch to the OFF position.

Figure 3-1: HART security switch (on blank display)



A. HART security switch
B. Unused

4. Replace the transmitter housing cover.
5. Power up the device.

3.6 Restore the factory configuration

Display	Not available
ProLink III	**Device Tools → Configuration Transfer → Restore Factory Configuration**
Field Communicator	**Service Tools → Maintenance → Reset/Restore → Restore Factory Configuration**

Restoring the factory configuration returns the transmitter to the same configuration it had when it left the factory. This may be useful if you experience problems during configuration.

Tip
Restoring the factory configuration is not a common action. You may want to contact customer support to see if there is a preferred method to resolve any issues.

4 Configure process measurement

4.1 Configure mass flow measurement

The mass flow measurement parameters control how mass flow is measured and reported.

4.1.1 Configure Mass Flow Measurement Unit

Display	**OFF-LINE MAINT → OFF-LINE CONFG → UNITS → MASS**
ProLink III	**Device Tools → Configuration → Process Measurement → Flow**
Field Communicator	**Configure → Manual Setup → Measurements → Flow → Mass Flow Unit**

Mass Flow Measurement Unit specifies the unit of measure that will be used for the mass flow rate. The unit used for mass total and mass inventory is derived from this unit.

Procedure

Set **Mass Flow Measurement Unit** to the unit you want to use.

The default setting for **Mass Flow Measurement Unit** is g/sec (grams per second).

Tip
If the measurement unit you want to use is not available, you can define a special measurement unit.

Options for Mass Flow Measurement Unit

The transmitter provides a standard set of measurement units for **Mass Flow Measurement Unit**, plus one user-defined special measurement unit. Different communications tools may use different labels for the units.

Unit description	Label		
	Display	**ProLink III**	**Field Communicator**
Grams per second	G/S	g/sec	g/s
Grams per minute	G/MIN	g/min	g/min
Grams per hour	G/H	g/hr	g/h
Kilograms per second	KG/S	kg/sec	kg/s
Kilograms per minute	KG/MIN	kg/min	kg/min
Kilograms per hour	KG/H	kg/hr	kg/h
Kilograms per day	KG/D	kg/day	kg/d
Metric tons per minute	T/MIN	mTon/min	MetTon/min
Metric tons per hour	T/H	mTon/hr	MetTon/h
Metric tons per day	T/D	mTon/day	MetTon/d
Pounds per second	LB/S	lbs/sec	lb/s
Pounds per minute	LB/MIN	lbs/min	lb/min

Unit description	Label		
	Display	**ProLink III**	**Field Communicator**
Pounds per hour	LB/H	lbs/hr	lb/h
Pounds per day	LB/D	lbs/day	lb/d
Short tons (2000 pounds) per minute	ST/MIN	sTon/min	STon/min
Short tons (2000 pounds) per hour	ST/H	sTon/hr	STon/h
Short tons (2000 pounds) per day	ST/D	sTon/day	STon/d
Long tons (2240 pounds) per hour	LT/H	lTon/hr	LTon/h
Long tons (2240 pounds) per day	LT/D	lTon/day	LTon/d
Special unit	SPECL	special	Spcl

Define a special measurement unit for mass flow

Display	Not available
ProLink III	**Device Tools → Configuration → Process Measurement → Flow → Special Units**
Field Communicator	**Configure → Manual Setup → Measurements → Special Units → Mass Special Units**

A special measurement unit is a user-defined unit of measure that allows you to report process data, totalizer data, and inventory data in a unit that is not available in the transmitter. A special measurement unit is calculated from an existing measurement unit using a conversion factor.

Note

Although you cannot define a special measurement unit using the display, you can use the display to select an existing special measurement unit, and to view process data using the special measurement unit.

Procedure

1. Specify **Base Mass Unit**.

   Base Mass Unit is the existing mass unit that the special unit will be based on.

2. Specify **Base Time Unit**.

   Base Time Unit is the existing time unit that the special unit will be based on.

3. Calculate **Mass Flow Conversion Factor** as follows:
   a) x base units = y special units
   b) **Mass Flow Conversion Factor** = x ÷ y

      The original mass flow rate value is divided by this value.

4. Enter **Mass Flow Conversion Factor**.
5. Set **Mass Flow Label** to the name you want to use for the mass flow unit.
6. Set **Mass Total Label** to the name you want to use for the mass total and mass inventory unit.

The special measurement unit is stored in the transmitter. You can configure the transmitter to use the special measurement unit at any time.

Defining a special measurement unit for mass flow

You want to measure mass flow in ounces per second (oz/sec).

1. Set **Base Mass Unit** to Pounds (lb).
2. Set **Base Time Unit** to Seconds (sec).
3. Calculate **Mass Flow Conversion Factor**:
    a. 1 lb/sec = 16 oz/sec
    b. **Mass Flow Conversion Factor** = 1 ÷ 16 = 0.0625
4. Set **Mass Flow Conversion Factor** to `0.0625`.
5. Set **Mass Flow Label** to `oz/sec`.
6. Set **Mass Total Label** to `oz`.

4.1.2 Configure Flow Damping

Display	Not available
ProLink III	**Device Tools → Configuration → Process Measurement → Flow**
Field Communicator	**Configure → Manual Setup → Measurements → Flow → Flow Damping**

Damping is used to smooth out small, rapid fluctuations in process measurement. **Damping Value** specifies the time period (in seconds) over which the transmitter will spread changes in the process variable. At the end of the interval, the internal value will reflect 63% of the change in the actual measured value.

Procedure

Set **Flow Damping** to the value you want to use.

- The default value is 0.8 seconds.
- The flow damping range is 0 to 51.2 seconds when **Update Rate** is set to Normal.
- The flow damping range is 0 to 10.24 seconds when **Update Rate** is set to Special.

Tip

- A high damping value makes the process variable appear smoother because the reported value changes slowly.
- A low damping value makes the process variable appear more erratic because the reported value changes more quickly.
- The combination of a high damping value and rapid, large changes in flow rate can result in increased measurement error.
- Whenever the damping value is non-zero, the reported measurement will lag the actual measurement because the reported value is being averaged over time.
- In general, lower damping values are preferable because there is less chance of data loss, and less lag time between the actual measurement and the reported value.

The value you enter is automatically rounded down to the nearest valid value.

If **Flow Damping** is set to Normal, the valid values are: 0, 0.2, 0.4, 0.8, 1.6, 3.2, 6.4, 12.8, 25.6, and 51.2.

If **Flow Damping** is set to Special, the valid values are: 0, 0.04, 0.08, 0.16, 0.32, 0.64, 1.28, 2.56, 5.12, and 10.24.

Effect of flow damping on volume measurement

Flow damping affects volume measurement for liquid volume data. Flow damping also affects volume measurement for gas standard volume data. The transmitter calculates volume data from the damped mass flow data.

Interaction between Flow Damping and mA Output Damping

In some circumstances, both **Flow Damping** and **mA Output Damping** are applied to the reported mass flow value.

Flow Damping controls the rate of change in flow process variables. **mA Output Damping** controls the rate of change reported via the mA Output. If **mA Output Process Variable** is set to Mass Flow Rate, and both **Flow Damping** and **mA Output Damping** are set to non-zero values, flow damping is applied first, and the added damping calculation is applied to the result of the first calculation.

4.1.3 Configure Mass Flow Cutoff

Display	Not available
ProLink III	**Device Tools → Configuration → Process Measurement → Flow**
Field Communicator	**Configure → Manual Setup → Measurements → Flow → Mass Flow Cutoff**

Mass Flow Cutoff specifies the lowest mass flow rate that will be reported as measured. All mass flow rates below this cutoff will be reported as 0.

Procedure

Set **Mass Flow Cutoff** to the value you want to use.

The default value for **Mass Flow Cutoff** is 0.0 g/sec or a sensor-specific value set at the factory. The recommended value is 0.5% of the nominal flow rate of the attached sensor. See the sensor specifications. Leaving **Mass Flow Cutoff** at 0 is not recommended.

Effect of Mass Flow Cutoff on volume measurement

Mass Flow Cutoff does not affect volume measurement. Volume data is calculated from the actual mass data rather than the reported value.

Volume flow has a separate Volume Flow Cutoff that is not affected by the Mass Flow Cutoff value.

Interaction between Mass Flow Cutoff and mA Output Cutoff

Mass Flow Cutoff defines the lowest mass flow value that the transmitter will report as measured. **mA Output Cutoff** defines the lowest flow rate that will be reported via the mA Output. If **mA Output Process**

Variable is set to Mass Flow Rate, the mass flow rate reported via the mA Output is controlled by the higher of the two cutoff values.

Mass Flow Cutoff affects all reported values and values used in other transmitter behavior (e.g., events defined on mass flow).

mA Output Cutoff affects only mass flow values reported via the mA Output.

Cutoff interaction with mA Output Cutoff lower than Mass Flow Cutoff

Configuration:

- **mA Output Process Variable**: Mass Flow Rate
- **Frequency Output Process Variable**: Mass Flow Rate
- **mA Output Cutoff**: `10` g/sec
- **Mass Flow Cutoff**: `15` g/sec

Result: If the mass flow rate drops below 15 g/sec, mass flow will be reported as 0, and 0 will be used in all internal processing.

Cutoff interaction with mA Output Cutoff higher than Mass Flow Cutoff

Configuration:

- **mA Output Process Variable**: Mass Flow Rate
- **Frequency Output Process Variable**: Mass Flow Rate
- **mA Output Cutoff**: `15` g/sec
- **Mass Flow Cutoff**: `10` g/sec

Result:

- If the mass flow rate drops below 15 g/sec but not below 10 g/sec:
  - The mA Output will report zero flow.
  - The Frequency Output will report the actual flow rate, and the actual flow rate will be used in all internal processing.
- If the mass flow rate drops below 10 g/sec, both outputs will report zero flow, and 0 will be used in all internal processing.

4.2 Configure volume flow measurement for liquid applications

The volume flow measurement parameters control how liquid volume flow is measured and reported.

Restriction
You cannot implement both liquid volume flow and gas standard volume flow at the same time. Choose one or the other.

4.2.1 Configure Volume Flow Type for liquid applications

Display	**OFF-LINE MAINT → OFF-LINE CONFG → VOL → VOL TYPE LIQUID**

ProLink III	**Device Tools → Configuration → Process Measurement → Flow**
Field Communicator	**Configure → Manual Setup → Measurements → Gas Standard Volume → Volume Flow Type → Liquid**

Volume Flow Type controls whether liquid or gas standard volume flow measurement will be used.

Restriction

Gas standard volume measurement is incompatible with some applications. Set **Volume Flow Type** to Liquid if you are using any of the following applications:

- Petroleum measurement
- Concentration measurement

Procedure

Set **Volume Flow Type** to Liquid.

4.2.2 Configure Volume Flow Measurement Unit for liquid applications

Display	**OFF-LINE MAINT → OFF-LINE CONFG → UNITS → VOL**
ProLink III	**Device Tools → Configuration → Process Measurement → Flow**
Field Communicator	**Configure → Manual Setup → Measurements → Flow → Volume Flow Unit**

Volume Flow Measurement Unit specifies the unit of measurement that will be displayed for the volume flow rate. The unit used for the volume total and volume inventory is based on this unit.

Prerequisites

Before you configure **Volume Flow Measurement Unit**, be sure that **Volume Flow Type** is set to Liquid.

Procedure

Set **Volume Flow Measurement Unit** to the unit you want to use.

To read US gallons, select that unit from this menu. G/MIN stands for grams per minute (USGPM), not gallons per minute. The default setting for **Volume Flow Measurement Unit** is l/sec (liters per second).

Tip

If the measurement unit you want to use is not available, you can define a special measurement unit.

Options for Volume Flow Measurement Unit for liquid applications

The transmitter provides a standard set of measurement units for **Volume Flow Measurement Unit**, plus one user-defined measurement unit. Different communications tools may use different labels for the units.

	Label		
Unit description	**Display**	**ProLink III**	**Field Communicator**
Cubic feet per second	CUFT/S	ft3/sec	Cuft/s
Cubic feet per minute	CUF/MN	ft3/min	Cuft/min

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

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

Define a special measurement unit for volume flow

Display	Not available
ProLink III	**Device Tools → Configuration → Process Measurement → Flow → Special Units**

Field Communicator	**Configure → Manual Setup → Measurements → Special Units → Volume Special Units**

A special measurement unit is a user-defined unit of measure that allows you to report process data, totalizer data, and inventory data in a unit that is not available in the transmitter. A special measurement unit is calculated from an existing measurement unit using a conversion factor.

Note
Although you cannot define a special measurement unit using the display, you can use the display to select an existing special measurement unit, and to view process data using the special measurement unit.

Procedure

1. Specify **Base Volume Unit**.

   Base Volume Unit is the existing volume unit that the special unit will be based on.

2. Specify **Base Time Unit**.

   Base Time Unit is the existing time unit that the special unit will be based on.

3. Calculate **Volume Flow Conversion Factor** as follows:

   a) x base units = y special units

   b) **Volume Flow Conversion Factor** = x ÷ y

4. Enter **Volume Flow Conversion Factor**.

   The original volume flow rate value is divided by this conversion factor.

5. Set **Volume Flow Label** to the name you want to use for the volume flow unit.
6. Set **Volume Total Label** to the name you want to use for the volume total and volume inventory unit.

The special measurement unit is stored in the transmitter. You can configure the transmitter to use the special measurement unit at any time.

Defining a special measurement unit for volume flow

You want to measure volume flow in pints per second (pints/sec).

1. Set **Base Volume Unit** to Gallons (gal).
2. Set **Base Time Unit** to Seconds (sec).
3. Calculate the conversion factor:

   a. 1 gal/sec = 8 pints/sec

   b. **Volume Flow Conversion Factor** = 1 ÷ 8 = 0.1250

4. Set **Volume Flow Conversion Factor** to `0.1250`.
5. Set **Volume Flow Label** to `pints/sec`.
6. Set **Volume Total Label** to `pints`.

4.2.3 Configure Volume Flow Cutoff

Display	Not available

ProLink III	**Device Tools → Configuration → Process Measurement → Flow**
Field Communicator	**Configure → Manual Setup → Measurements → Flow → Volume Flow Cutoff**

Volume Flow Cutoff specifies the lowest volume flow rate that will be reported as measured. All volume flow rates below this cutoff are reported as 0.

Procedure

Set **Volume Flow Cutoff** to the value you want to use.

The default value for **Volume Flow Cutoff** is 0.0 l/sec (liters per second). The lower limit is 0. Leaving the volume flow cutoff at 0 is not recommended.

Interaction between Volume Flow Cutoff and mAO Cutoff

Volume Flow Cutoff defines the lowest liquid volume flow value that the transmitter will report as measured. **mAO Cutoff** defines the lowest flow rate that will be reported via the mA Output. If **mA Output Process Variable** is set to Volume Flow Rate, the volume flow rate reported via the mA Output is controlled by the higher of the two cutoff values.

Volume Flow Cutoff affects both the volume flow values reported via the outputs and the volume flow values used in other transmitter behavior (e.g., events defined on the volume flow).

mAO Cutoff affects only flow values reported via the mA Output.

Cutoff interaction with mAO Cutoff lower than Volume Flow Cutoff

Configuration:

- **mA Output Process Variable**: Volume Flow Rate
- **Frequency Output Process Variable**: Volume Flow Rate
- **AO Cutoff**: `10` l/sec
- **Volume Flow Cutoff**: `15` l/sec

Result: If the volume flow rate drops below 15 l/sec, volume flow will be reported as 0, and 0 will be used in all internal processing.

Cutoff interaction with mAO Cutoff higher than Volume Flow Cutoff

Configuration:

- **mA Output Process Variable**: Volume Flow Rate
- **Frequency Output Process Variable**: Volume Flow Rate
- **AO Cutoff**: `15` l/sec
- **Volume Flow Cutoff**: `10` l/sec

Result:

- If the volume flow rate drops below 15 l/sec but not below 10 l/sec:
  - The mA Output will report zero flow.
  - The Frequency Output will report the actual flow rate, and the actual flow rate will be used in all internal processing.

- If the volume flow rate drops below 10 l/sec, both outputs will report zero flow, and 0 will be used in all internal processing.

4.3 Configure GSV flow measurement

The gas standard volume (GSV) flow measurement parameters control how volume flow is measured and reported in a gas application.

Restriction
You cannot implement both liquid volume flow and gas standard volume flow at the same time. Choose one or the other.

4.3.1 Configure Volume Flow Type for gas applications

Display	**OFF-LINE MAINT → OFF-LINE CONFG → VOL → VOL TYPE GAS**
ProLink III	**Device Tools → Configuration → Process Measurement → Flow**
Field Communicator	**Configure → Manual Setup → Measurements → Gas Standard Volume → Volume Flow Type → GSV**

Volume Flow Type controls whether liquid or gas standard volume flow measurement is used.

Restriction
Gas standard volume measurement is incompatible with some applications. Set **Volume Flow Type** to Liquid if you are using any of the following applications:

- Petroleum measurement
- Concentration measurement

Procedure

Set **Volume Flow Type** to Gas Standard Volume.

4.3.2 Configure Standard Density of Gas

Display	Not available
ProLink III	**Device Tools → Configuration → Process Measurement → Flow**
Field Communicator	**Configure → Manual Setup → Measurements → Gas Standard Volume → Gas Density**

The **Standard Density of Gas** value is the gas density at standard reference conditions. Use it to convert the measured mass flow data to volume flow at reference conditions.

Prerequisites

Ensure that **Density Measurement Unit** is set to the measurement unit you want to use for **Standard Density of Gas**.

Procedure

Set **Standard Gas Density** to the standard reference density of the gas you are measuring.

4.3.3 Configure Gas Standard Volume Flow Unit

Display	**OFF-LINE MAINT → OFF-LINE CONFG → UNITS → VOL**
ProLink III	**Device Tools → Configuration → Process Measurement → Flow**
Field Communicator	**Configure → Manual Setup → Measurements → Gas Standard Volume → Gas Vol Flow Unit**

Gas Standard Volume Flow Unit specifies the unit of measure that will be displayed for the gas standard volume flow. The measurement unit used for the gas volume total and the gas volume inventory is derived from this unit.

Prerequisites

Before you configure **Gas Standard Volume Flow Unit**, be sure that **Volume Flow Type** is set to Gas Standard Volume.

Procedure

Set **Gas Standard Volume Flow Unit** to the unit you want to use.

The default setting for **Gas Standard Volume Flow Unit** is SCFM (Standard Cubic Feet per Minute).

Tip
If the measurement unit you want to use is not available, you can define a special measurement unit.

Options for Gas Standard Volume Flow Unit

The transmitter provides a standard set of measurement units for **Gas Standard Volume Flow Unit**, plus one user-defined special measurement unit. Different communications tools may use different labels for the units.

Unit description	Label		
	Display	**ProLink III**	**Field Communicator**
Normal cubic meters per second	NM3/S	Nm3/sec	Nm3/sec
Normal cubic meters per minute	NM3/MN	Nm3/sec	Nm3/min
Normal cubic meters per hour	NM3/H	Nm3/hr	Nm3/hr
Normal cubic meters per day	NM3/D	Nm3/day	Nm3/day
Normal liters per second	NLPS	NLPS	NLPS
Normal liters per minute	NLPM	NLPM	NLPM
Normal liters per hour	NLPH	NLPH	NLPH
Normal liters per day	NLPD	NLPD	NLPD
Standard cubic feet per second	SCFS	SCFS	SCFS
Standard cubic feet per minute	SCFM	SCFM	SCFM
Standard cubic feet per hour	SCFH	SCFH	SCFH
Standard cubic feet per day	SCFD	SCFD	SCFD
Standard cubic meters per second	SM3/S	Sm3/sec	Sm3/sec
Standard cubic meters per minute	SM3/MN	Sm3/min	Sm3/min

Unit description	Label		
	Display	**ProLink III**	**Field Communicator**
Standard cubic meters per hour	SM3/H	Sm3/hr	Sm3/hr
Standard cubic meters per day	SM3/D	Sm3/day	Sm3/day
Standard liters per second	SLPS	SLPS	SLPS
Standard liters per minute	SLPM	SLPM	SLPM
Standard liters per hour	SLPH	SLPH	SLPH
Standard liters per day	SLPD	SLPD	SLPD
Special measurement unit	SPECL	special	Special

Define a special measurement unit for gas standard volume flow

Display	Not available
ProLink III	**Device Tools → Configuration → Process Measurement → Flow → Special Units**
Field Communicator	**Configure → Manual Setup → Measurements → Special Units → Volume Special Units**

A special measurement unit is a user-defined unit of measure that allows you to report process data, totalizer data, and inventory data in a unit that is not available in the transmitter. A special measurement unit is calculated from an existing measurement unit using a conversion factor.

Note

Although you cannot define a special measurement unit using the display, you can use the display to select an existing special measurement unit, and to view process data using the special measurement unit.

Procedure

1. Specify **Base Gas Standard Volume Unit**.

   Base Gas Standard Volume Unit is the existing gas standard volume unit that the special unit will be based on.

2. Specify **Base Time Unit**.

   Base Time Unit is the existing time unit that the special unit will be based on.

3. Calculate **Gas Standard Volume Flow Conversion Factor** as follows:

   a) x base units = y special units

   b) **Gas Standard Volume Flow Conversion Factor** = x ÷ y

4. Enter the **Gas Standard Volume Flow Conversion Factor**.

   The original gas standard volume flow value is divided by this conversion factor.

5. Set **Gas Standard Volume Flow Label** to the name you want to use for the gas standard volume flow unit.

6. Set **Gas Standard Volume Total Label** to the name you want to use for the gas standard volume total and gas standard volume inventory unit.

The special measurement unit is stored in the transmitter. You can configure the transmitter to use the special measurement unit at any time.

Defining a special measurement unit for gas standard volume flow

You want to measure gas standard volume flow in thousands of standard cubic feet per minute.

1. Set **Base Gas Standard Volume Unit** to SCF.
2. Set **Base Time Unit** to minutes (min).
3. Calculate the conversion factor:
    a. 1 thousands of standard cubic feet per minute = 1000 cubic feet per minute
    b. **Gas Standard Volume Flow Conversion Factor** = 1 ÷ 1000 = 0.001 standard
4. Set **Gas Standard Volume Flow Conversion Factor** to `0.001`.
5. Set **Gas Standard Volume Flow Label** to `MSCFM`.
6. Set **Gas Standard Volume Total Label** to `MSCF`.

4.3.4 Configure Gas Standard Volume Flow Cutoff

Display	Not available
ProLink III	**Device Tools → Configuration → Process Measurement → Flow**
Field Communicator	**Configure → Manual Setup → Measurements → Gas Standard Volume → GSV Cutoff**

Gas Standard Volume Flow Cutoff specifies the lowest gas standard volume flow rate that will reported as measured. All gas standard volume flow rates below this cutoff will be reported as 0.

Procedure

Set **Gas Standard Volume Flow Cutoff** to the value you want to use.

The default value for **Gas Standard Volume Flow Cutoff** is 0.0. The lower limit is 0.0. There is no upper limit. The recommended value is 0.5% of the nominal flow rate of the attached sensor. See the sensor specifications.

Interaction between Gas Standard Volume Flow Cutoff and mA Output Cutoff

Gas Standard Volume Flow Cutoff defines the lowest Gas Standard Volume flow value that the transmitter will report as measured. **mA Output Cutoff** defines the lowest flow rate that will be reported via the mA Output. If **mA Output Process Variable** is set to Gas Standard Volume Flow Rate, the volume flow rate reported via the mA Output is controlled by the higher of the two cutoff values.

Gas Standard Volume Flow Cutoff affects both the gas standard volume flow values reported through outputs and the gas standard volume flow values used in other transmitter behavior (for example, events defined on gas standard volume flow).

mA Output Cutoff affects only flow values reported via the mA Output.

Cutoff interaction with mA Output Cutoff lower than Gas Standard Volume Flow Cutoff

Configuration:

- **mA Output Process Variable** for the primary mA Output: Gas Standard Volume Flow Rate
- **Frequency Output Process Variable**: Gas Standard Volume Flow Rate
- **mA Output Cutoff** for the primary mA Output: `10` SLPM (standard liters per minute)
- **Gas Standard Volume Flow Cutoff**: `15` SLPM

Result: If the gas standard volume flow rate drops below 15 SLPM, the volume flow will be reported as 0, and 0 will be used in all internal processing.

Cutoff interaction with mA Output Cutoff higher than Gas Standard Volume Flow Cutoff

Configuration:

- **mA Output Process Variable** for the primary mA Output: Gas Standard Volume Flow Rate
- **Frequency Output Process Variable**: Gas Standard Volume Flow Rate
- **mA Output Cutoff** for the primary mA Output: `15` SLPM (standard liters per minute)
- **Gas Standard Volume Flow Cutoff**: `10` SLPM

Result:

- If the gas standard volume flow rate drops below 15 SLPM but not below 10 SLPM:
  - The primary mA Output will report zero flow.
  - The Frequency Output will report the actual flow rate, and the actual flow rate will be used in all internal processing.
- If the gas standard volume flow rate drops below 10 SLPM, both outputs will report zero flow, and 0 will be used in all internal processing.

4.4 Configure Flow Direction

Display	Not available
ProLink III	**Device Tools → Configuration → Process Measurement → Flow**
Field Communicator	**Configure → Manual Setup → Measurements → Flow → Flow Direction**

Flow Direction controls how forward flow and reverse flow affect flow measurement and reporting.

Flow Direction is defined with respect to the flow arrow on the sensor:

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

Tip
Micro Motion sensors are bidirectional. Measurement accuracy is not affected by actual flow direction or the setting of the **Flow Direction** parameter.

Procedure

Set **Flow Direction** to the value you want to use.

The default setting is Forward.

4.4.1 Options for Flow Direction

Flow Direction setting		
ProLink III	**Field Communicator**	**Relationship to Flow Direction arrow on sensor**
Forward	Forward	Appropriate when the Flow Direction arrow is in the same direction as the majority of flow.
Reverse	Reverse	Appropriate when the Flow Direction arrow is in the opposite direction from the majority of flow.
Absolute Value	Absolute Value	Flow Direction arrow is not relevant.
Bidirectional	Bi directional	Appropriate when both forward and reverse flow are expected, and forward flow will dominate, but the amount of reverse flow will be significant.
Negate Forward	Negate/Forward Only	Appropriate when the Flow Direction arrow is in the opposite direction from the majority of flow.
Negate Bidirectional	Negate/Bi-directional	Appropriate when both forward and reverse flow are expected, and reverse flow will dominate, but the amount of forward flow will be significant.

Effect of Flow Direction on mA Outputs

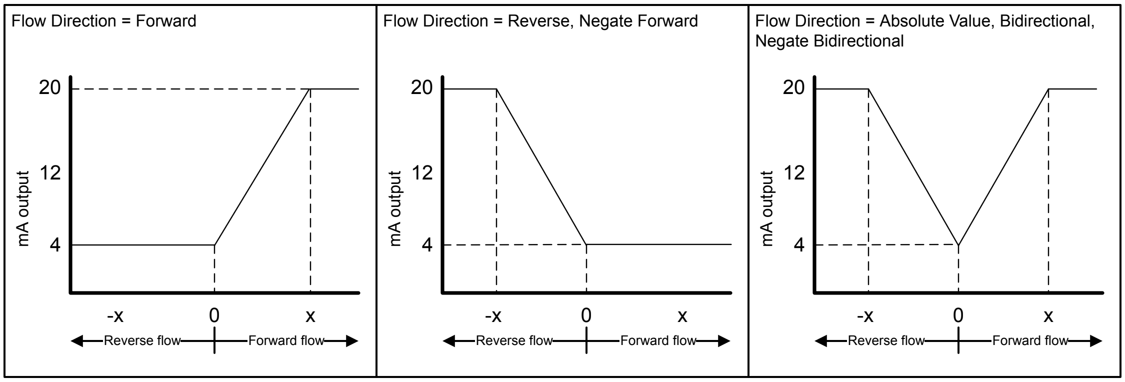
Flow Direction affects how the transmitter reports flow values via the mA Outputs. The mA Outputs are affected by **Flow Direction** only if **mA Output Process Variable** is set to a flow variable.

Flow Direction and mA Outputs

The effect of Flow Direction on the mA Outputs depends on Lower Range Value configured for the mA Output:

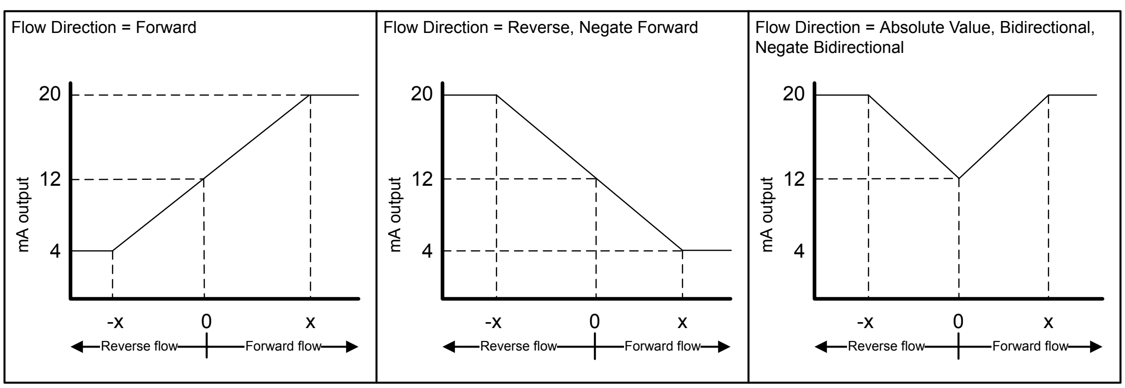
- If **Lower Range Value** is set to 0, see Figure 4-1.
- If **Lower Range Value** is set to a negative value, see Figure 4-2.

Figure 4-1: Effect of Flow Direction on the mA Output: Lower Range Value = 0



- **Lower Range Value** = 0
- **Upper Range Value** = x

Figure 4-2: Effect of Flow Direction on the mA Output: Lower Range Value < 0



- **Lower Range Value** = −x
- **Upper Range Value** = x

Flow Direction = Forward and Lower Range Value = 0

Configuration:

- **Flow Direction** = Forward
- **Lower Range Value** = 0 g/sec
- **Upper Range Value** = 100 g/sec

Result:

- Under conditions of zero flow, the mA Output is 4 mA.
- Under conditions of forward flow, up to a flow rate of 100 g/sec, the mA Output varies between 4 mA and 20 mA in proportion to the flow rate.
- Under conditions of forward flow, if the flow rate equals or exceeds 100 g/sec, the mA Output will be proportional to the flow rate up to 20.5 mA, and will be level at 20.5 mA at higher flow rates.

Flow Direction = Forward and Lower Range Value < 0

Configuration:

- **Flow Direction** = Forward
- **Lower Range Value** = −100 g/sec
- **Upper Range Value** = +100 g/sec

Result:

- Under conditions of zero flow, the mA Output is 12 mA.
- Under conditions of forward flow, for flow rates between 0 and +100 g/sec, the mA Output varies between 12 mA and 20 mA in proportion to (the absolute value of) the flow rate.
- Under conditions of forward flow, if (the absolute value of) the flow rate equals or exceeds 100 g/sec, the mA Output is proportional to the flow rate up to 20.5 mA, and will be level at 20.5 mA at higher flow rates.
- Under conditions of reverse flow, for flow rates between 0 and −100 g/sec, the mA Output varies between 4 mA and 12 mA in inverse proportion to the absolute value of the flow rate.
- Under conditions of reverse flow, if the absolute value of the flow rate equals or exceeds 100 g/sec, the mA Output is inversely proportional to the flow rate down to 3.8 mA, and will be level at 3.8 mA at higher absolute values.

Flow Direction = Reverse

Configuration:

- **Flow Direction** = Reverse
- **Lower Range Value** = 0 g/sec
- **Upper Range Value** = 100 g/sec

Result:

- Under conditions of zero flow, the mA Output is 4 mA.
- Under conditions of reverse flow, for flow rates between 0 and +100 g/sec, the mA Output level varies between 4 mA and 20 mA in proportion to the absolute value of the flow rate.
- Under conditions of reverse flow, if the absolute value of the flow rate equals or exceeds 100 g/sec, the mA Output will be proportional to the absolute value of the flow rate up to 20.5 mA, and will be level at 20.5 mA at higher absolute values.

Effect of flow direction on Frequency Outputs

Flow direction affects how the transmitter reports flow values via the Frequency Outputs. The Frequency Outputs are affected by flow direction only if **Frequency Output Process Variable** is set to a flow variable.

Table 4-1: Effect of the flow direction parameter and actual flow direction on Frequency Outputs

Flow Direction setting	Actual flow direction		
	Forward	**Zero flow**	**Reverse**
Forward	Hz > 0	0 Hz	0 Hz
Reverse	0 Hz	0 Hz	Hz > 0
Bidirectional	Hz > 0	0 Hz	Hz > 0
Absolute Value	Hz > 0	0 Hz	Hz > 0
Negate Forward	0 Hz	0 Hz	Hz > 0
Negate Bidirectional	Hz > 0	0 Hz	Hz > 0

Effect of flow direction on Discrete Outputs

The flow direction parameter affects the Discrete Output behavior only if **Discrete Output Source** is set to Flow Direction.

Table 4-2: Effect of the flow direction parameter and actual flow direction on Discrete Outputs

Flow Direction setting	Actual flow direction		
	Forward	**Zero flow**	**Reverse**
Forward	OFF	OFF	ON
Reverse	OFF	OFF	ON
Bidirectional	OFF	OFF	ON
Absolute Value	OFF	OFF	ON
Negate Forward	ON	OFF	OFF
Negate Bidirectional	ON	OFF	OFF

Effect of flow direction on digital communications

Flow direction affects how flow values are reported via digital communications. The following table describes the effect of the flow direction parameter and actual flow direction on flow values reported via digital communications.

Table 4-3: Effect of the flow direction on flow values

Flow Direction setting	Actual flow direction		
	Forward	**Zero flow**	**Reverse**
Forward	Positive	0	Negative
Reverse	Positive	0	Negative
Bidirectional	Positive	0	Negative

Table 4-3: Effect of the flow direction on flow values *(continued)*

Flow Direction setting	Actual flow direction		
	Forward	**Zero flow**	**Reverse**
Absolute Value	Positive(1)	0	Positive(1)
Negate Forward	Negative	0	Positive
Negate Bidirectional	Negative	0	Positive

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

Effect of flow direction on flow totals

Flow direction affects how flow totals and inventories are calculated.

Flow Direction setting	Actual flow direction		
	Forward	**Zero flow**	**Reverse**
Forward	Totals increase	Totals do not change	Totals do not change
Reverse	Totals do not change	Totals do not change	Totals increase
Bidirectional	Totals increase	Totals do not change	Totals decrease
Absolute Value	Totals increase	Totals do not change	Totals increase
Negate Forward	Totals do not change	Totals do not change	Totals increase
Negate Bidirectional	Totals decrease	Totals do not change	Totals increase

4.5 Configure density measurement

The density measurement parameters control how density is measured and reported.

4.5.1 Configure Density Measurement Unit

Display	**OFF-LINE MAINT → OFF-LINE CONFG → UNITS → DENS**
ProLink III	**Device Tools → Configuration → Process Measurement → Density**
Field Communicator	**Configure → Manual Setup → Measurements → Density → Density Unit**

Density Measurement Unit controls the measurement units that will be used in density calculations and reporting.

Procedure

Set **Density Measurement Unit** to the option you want to use.

The default setting for **Density Measurement Unit** is g/cm3 (grams per cubic centimeter).

Options for Density Measurement Unit

The transmitter provides a standard set of measurement units for **Density Measurement Unit**. Different communications tools may use different labels.

Unit description	Label		
	Display	**ProLink III**	**Field Communicator**
Specific gravity(1)	SGU	SGU	SGU
Grams per cubic centimeter	G/CM3	g/cm3	g/Cucm
Grams per liter	G/L	g/l	g/L
Grams per milliliter	G/mL	g/ml	g/mL
Kilograms per liter	KG/L	kg/l	kg/L
Kilograms per cubic meter	KG/M3	kg/m3	kg/Cum
Pounds per U.S. gallon	LB/GAL	lbs/Usgal	lb/gal
Pounds per cubic foot	LB/CUF	lbs/ft3	lb/Cuft
Pounds per cubic inch	LB/CUI	lbs/in3	lb/CuIn
Degrees API	D API	degAPI	degAPI
Short ton per cubic yard	ST/CUY	sT/yd3	STon/Cuyd

(1) *Non-standard calculation. This value represents line density divided by the density of water at 60 °F.*

4.5.2 Configure two-phase flow parameters

Display	Not available
ProLink III	**Device Tools** → **Configuration** → **Process Measurement** → **Density**
Field Communicator	**Configure** → **Manual Setup** → **Measurements** → **Density** → **Slug Low Limit** **Configure** → **Manual Setup** → **Measurements** → **Density** → **Slug High Limit** **Configure** → **Manual Setup** → **Measurements** → **Density** → **Slug Duration**

The two-phase flow parameters control how the transmitter detects and reports two-phase flow (gas in a liquid process or liquid in a gas process).

Note
Two-phase flow is also referred to as *slug flow*.

Procedure

1. Set **Two-Phase Flow Low Limit** to the lowest density value that is considered normal in your process.

   Values below this will cause the transmitter to post Alert A105 (Two-Phase Flow).

   Tip
   Gas entrainment can cause your process density to drop temporarily. To reduce the occurrence of two-phase flow alerts that are not significant to your process, set **Two-Phase Flow Low Limit** slightly below your expected lowest process density.

You must enter **Two-Phase Flow Low Limit** in g/cm^3, even if you configured another unit for density measurement.

The default value for **Two-Phase Flow Low Limit** is 0.0 g/cm^3. The range is 0.0 to 10.0 g/cm^3.

2. Set **Two-Phase Flow High Limit** to the highest density value that is considered normal in your process.

   Micro Motion recommends leaving **Two-Phase Flow High Limit** at the default value.

   Values above this will cause the transmitter to post Alert A105 (Two-Phase Flow).

   You must enter **Two-Phase Flow High Limit** in g/cm^3, even if you configured another unit for density measurement.

   The default value for **Two-Phase Flow High Limit** is 5.0 g/cm^3. The range is 0.0 to 10.0 g/cm^3.

3. Set **Two-Phase Flow Timeout** to the number of seconds that the transmitter will wait for a two-phase flow condition to clear before posting the alert.

   The default value for **Two-Phase Flow Timeout** is 0.0 seconds, meaning that the alert will be posted immediately. The range is 0.0 to 60.0 seconds.

   The Two-Phase Flow alert is set immediately. The flow rate will hold the last measured value for the Timeout time. Then the flow rate will report zero flow. If the density goes back in range, the error clears immediately.

Detecting and reporting two-phase flow

Two-phase flow (gas in a liquid process or liquid in a gas process) can cause a variety of process control issues. By configuring the two-phase flow parameters appropriately for your application, you can detect process conditions that require correction.

Micro Motion recommends leaving **Two-Phase Flow High Limit** at the default value.

A two-phase flow condition occurs whenever the measured density goes below **Two-Phase Flow Low Limit** or above **Two-Phase Flow High Limit**. If this occurs:

- A two-phase flow alert is posted to the active alert log.
- All outputs that are configured to represent flow rate hold their last *pre-alert* value for the number of seconds configured in **Two-Phase Flow Timeout**.

If the two-phase flow condition clears before **Two-Phase Flow Timeout** expires:

- Outputs that represent flow rate revert to reporting actual flow.
- The two-phase flow alert is deactivated, but remains in the active alert log until it is acknowledged.

If the two-phase flow condition does not clear before **Two-Phase Flow Timeout** expires, the outputs that represent flow rate report a flow rate of 0.

If **Two-Phase Flow Timeout** is set to 0.0 seconds, the outputs that represent flow rate will report a flow rate of 0 as soon as two-phase flow is detected.

4.5.3 Configure Density Damping

Display	Not available

ProLink III	**Device Tools → Configuration → Process Measurement → Density**
Field Communicator	**Configure → Manual Setup → Measurements → Density → Density Damping**

Density Damping controls the amount of damping that will be applied to the line density value.

Damping is used to smooth out small, rapid fluctuations in process measurement. **Damping Value** specifies the time period (in seconds) over which the transmitter will spread changes in the process variable. At the end of the interval, the internal value will reflect 63% of the change in the actual measured value.

Procedure

Set **Density Damping** to the value you want to use.

The default value is 1.6 seconds. For most applications, the default density damping setting is sufficient. The range depends on the core processor type and the setting of **Update Rate**, as shown in the following table:

Update Rate setting	Damping range
Normal	0 to 51.2 seconds
Special	0 to 40.96 seconds

Tip

- A high damping value makes the process variable appear smoother because the reported value changes slowly.
- A low damping value makes the process variable appear more erratic because the reported value changes more quickly.
- Whenever the damping value is non-zero, the reported measurement will lag the actual measurement because the reported value is being averaged over time.
- In general, lower damping values are preferable because there is less chance of data loss, and less lag time between the actual measurement and the reported value.

The value you enter is automatically rounded off to the nearest valid value. The valid values for **Density Damping** depend on the setting of **Update Rate**.

Update Rate setting	Valid damping values
Normal	0.0, 0.2, 0.4, 0.8, 1.6, 3.2, 6.4, 12.8, 25.6, 51.2
Special	0.0, 0.04, 0.08, 0.16, 0.32, 0.64, 1.28, 2.56, 5.12, 10.24, 20.48, 40.96

Effect of Density Damping on volume measurement

Density Damping affects liquid volume measurement. Liquid volume values are calculated from the damped density value rather than the measured density value. **Density Damping** does not affect gas standard volume measurement.

Interaction between Density Damping and Added Damping

When the mA Output is configured to report density, both **Density Damping** and **Added Damping** are applied to the reported density value.

Density Damping controls the rate of change in the value of the process variable in transmitter memory. **Added Damping** controls the rate of change reported via the mA Output.

If **mA Output Process Variable** is set to Density, and both **Density Damping** and **Added Damping** are set to non-zero values, density damping is applied first, and the added damping calculation is applied to the result of the first calculation. This value is reported over the mA Output.

4.5.4 Configure Density Cutoff

Density Cutoff specifies the lowest density value that will be reported as measured. All density values below this cutoff will be reported as 0.

Procedure

Set **Density Cutoff** to the value you want to use.

For most applications, the default setting (0.2 g/cm^3) is sufficient. The range is 0.0 g/cm^3 to 0.5 g/cm^3.

Effect of Density Cutoff on volume measurement

Density Cutoff affects liquid volume measurement. If the density value goes below **Density Cutoff**, the volume flow rate is reported as 0. **Density Cutoff** does not affect gas standard volume measurement. Gas standard volume values are always calculated from the value configured for **Standard Gas Density** or polled value if configured for polled base density.

4.6 Configure temperature measurement

The temperature measurement parameters control how temperature data from the sensor is reported.

4.6.1 Configure Temperature Measurement Unit

Display	**OFF-LINE MAINT → OFF-LINE CONFG → UNITS → TEMP**
ProLink III	**Device Tools → Configuration → Process Measurement → Temperature**
Field Communicator	**Configure → Manual Setup → Measurements → Temperature → Temperature Unit**

Temperature Measurement Unit specifies the unit that will be used for temperature measurement.

Procedure

Set **Temperature Measurement Unit** to the option you want to use.

The default setting is Degrees Celsius.

Tip
If you are configuring the mA Input to receive temperature data from an external measurement device, you must set the measurement unit to match the temperature measurement unit at the external measurement device.

Options for Temperature Measurement Unit

The transmitter provides a standard set of units for **Temperature Measurement Unit**. Different communications tools may use different labels for the units.

	Label		
Unit description	**Display**	**ProLink III**	**Field Communicator**
Degrees Celsius	°C	°C	degC
Degrees Fahrenheit	°F	°F	degF
Degrees Rankine	°R	°R	degR
Kelvin	°K	°K	Kelvin

4.6.2 Configure Temperature Damping

Display	Not available
ProLink III	**Device Tools → Configuration → Temperature**
Field Communicator	**Configure → Manual Setup → Measurements → Temperature → Temp Damping**

Temperature Damping controls the amount of damping that will be applied to the line temperature value, when the on-board temperature data is used (RTD).

Damping is used to smooth out small, rapid fluctuations in process measurement. **Damping Value** specifies the time period (in seconds) over which the transmitter will spread changes in the process variable. At the end of the interval, the internal value will reflect 63% of the change in the actual measured value.

Tip
Temperature Damping affects all process variables, compensations, and corrections that use temperature data from the sensor.

Procedure

Enter the value you want to use for **Temperature Damping**.

The default value is 4.8 seconds. For most applications, the default temperature damping setting is sufficient. The range is 0.0 to 38.4 seconds.

Tip
- A high damping value makes the process variable appear smoother because the reported value changes slowly.
- A low damping value makes the process variable appear more erratic because the reported value changes more quickly.

- Whenever the damping value is non-zero, the reported measurement will lag the actual measurement because the reported value is being averaged over time.
- In general, lower damping values are preferable because there is less chance of data loss, and less lag time between the actual measurement and the reported value.

The value you enter is automatically rounded off to the nearest valid value. Valid values for **Temperature Damping** are 0, 0.6, 1.2, 2.4, 4.8, 9.6, 19.2, and 38.4.

4.6.3 Effect of Temperature Damping on process measurement

Temperature Damping affects all processes and algorithms that use temperature data from the internal sensor RTD.

Temperature compensation

Temperature compensation adjusts process measurement to compensate for the effect of temperature on the sensor tubes.

Petroleum measurement

Temperature Damping affects petroleum measurement process variables only if the transmitter is configured to use temperature data from the sensor. If an external temperature value is used for petroleum measurement, **Temperature Damping** does not affect petroleum measurement process variables.

Concentration measurement

Temperature Damping affects concentration measurement process variables only if the transmitter is configured to use temperature data from the sensor. If an external temperature value is used for concentration measurement, **Temperature Damping** does not affect concentration measurement process variables.

4.6.4 Configure Temperature Input

Temperature data from the on-board temperature sensor (RTD) is always available. Optionally, you can set up an external temperature device and use external temperature data.

Procedure

Choose **Device Tools** → **Configuration** → **Process Measurement** → **Temperature** → **Source**.

4.7 Configure the petroleum measurement application

The petroleum measurement application corrects line density to reference temperature according to American Petroleum Institute (API) standards. The resulting process variable is *referred density*.

4.7.1 Configure petroleum measurement using ProLink III

The petroleum measurement parameters specify the API table, measurement units, and reference values to be used in referred density calculations.

Prerequisites

You will need API documentation for the API table that you select.

Depending on your API table, you may need to know the thermal expansion coefficient (TEC) for your process fluid.

You must know the reference temperature that you want to use.

Procedure

1. Choose **Device Tools** → **Configuration** → **Process Measurement** → **Petroleum Measurement**.
2. Specify the API table to use to calculate referred density.

   Each API table is associated with a specific set of equations.

   a) Set **Process Fluid** to the API table group that your process fluid belongs to.

API table group	Process fluids
A tables	Generalized crude and JP4
B tables	Generalized products: Gasoline, jet fuel, aviation fuel, kerosene, heating oils, fuel oils, diesel, gas oil
C tables	Liquids with a constant base density or known thermal expansion coefficient (TEC). You will be required to enter the TEC for your process fluid.
D tables	Lubricating oils

   b) Set **Referred Density Measurement Unit** to the measurement units that you want to use for referred density.

   c) Click **Apply**.

   These parameters uniquely identify the API table to be used to calculate referred density. The selected API table is displayed, and the meter automatically changes the density unit, temperature unit, pressure unit, and reference pressure to match the API table.

   Your choice also determines the API table that will be used to calculate the correction factor for volume (CTL).

   ### Restriction
   Not all combinations are supported by the petroleum measurement application. See the list of API tables in this manual.

3. Refer to the API documentation and confirm your table selection.

   a) Verify that your process fluid falls within range for line density, line temperature, and line pressure.

   b) Verify that the referred density range of the selected table is adequate for your application.

4. If you chose a C table, enter **Thermal Expansion Coefficient (TEC)** for your process fluid.
5. Set **Reference Temperature** to the temperature to which density will be corrected in referred density calculations. If you choose Other, select the temperature measurement unit and enter the reference temperature.

4.7.2 Set up temperature data for petroleum measurement using ProLink III

The petroleum measurement application uses temperature data in its calculations. You must decide how to provide this data, then perform the required configuration and setup.

Tip
Fixed values for temperature are not recommended. Using a fixed temperature value may produce inaccurate process data.

Prerequisites

If you are using an external temperature device, it must use the temperature unit that is configured in the transmitter.

Procedure

1. Choose **Device Tools** → **Configuration** → **Process Measurement** → **Petroleum Measurement**.
2. Choose the method to be used to supply temperature data, and perform the required setup.

Option	Description	Setup
Internal RTD temperature data	Temperature data from the on-board temperature sensor (RTD) is used.	a. Set **Line Temperature Source** to Internal RTD. b. Click **Apply**.
Digital communications	A host writes temperature data to the meter at appropriate intervals. This data will be available in addition to the internal RTD temperature data.	a. Set **Line Temperature Source** to Fixed Value or Digital Communications. b. Click **Apply**. c. Perform the necessary host programming and communications setup to write temperature data to the meter at appropriate intervals.

Postrequisites

If you are using external temperature data, verify the external temperature value displayed in the **Inputs** group on the ProLink III main window.

Need help?
If the value is not correct:

- Ensure that the external device and the meter are using the same measurement unit.
- For digital communications:
  - Verify that the host has access to the required data.
  - Verify that the host is writing to the correct register in memory, using the correct data type.

4.7.3 Configure petroleum measurement using the Field Communicator

Procedure

1. Choose **Online** → **Configure** → **Manual Setup** → **Measurements** → **Set Up Petroleum**.
2. Specify the API table to use.
   a) Open the **Petroleum Measurement Source** menu and select the API table number.
   Depending on your choice, you may be prompted to enter a reference temperature or a thermal expansion coefficient.
   b) Enter the API table letter.

   These two parameters uniquely specify the API table.
3. Determine how the transmitter will obtain temperature data for the petroleum measurement calculations, and perform the required setup.

Option	Setup
Temperature data from the sensor	a. Choose **Online** → **Configure** → **Manual Setup** → **Measurements** → **External Pressure/Temperature** → **Temperature**. b. Set **External Temperature** to Disabled.
A user-configured static temperature value	a. Choose **Online** → **Configure** → **Manual Setup** → **Measurements** → **External Pressure/Temperature** → **Temperature**. b. Set **External Temperature** to Enabled. c. Set **Correction Temperature** to the value to be used.
A value written by digital communications	a. Choose **Online** → **Configure** → **Manual Setup** → **Measurements** → **External Pressure/Temperature** → **Temperature**. b. Set **External Temperature** to Enabled. c. Perform the necessary host programming and communications setup to write temperature data to the transmitter at appropriate intervals.

4.7.4 API tables supported by the petroleum measurement application

The API tables listed here are supported by the petroleum measurement application.

Table 4-4: API tables, process fluids, measurement units, and default reference values

Process fluid	API tables (calculations)(1)		Referred density (API): unit and range	Default reference temp	Default reference pressure	API standard
	Referred density(2)	CTL or CTPL(3) (4)				
Generalized crude and JP4	5A	6A	Unit: °API Range: 0 to 100 °API	60 °F	0 psi (g)	API MPMS 11.1
	23A	24A	Unit: SGU Range: 0.6110 to 1.0760 SGU	60 °F	0 psi (g)	
	53A	54A	Unit: kg/m^3 Range: 610 to 1075 kg/m^3	15 °C	0 kPa (g)	
Generalized products (gasoline, jet fuel, aviation fuel, kerosene, heating oils, fuel oils, diesel, gas oil)	5B	6B	Unit: °API Range: 0 to 85 °API	60 °F	0 psi (g)	API MPMS 11.1
	23B	24B	Unit: SGU Range: 0.6535 to 1.0760 SGU	60 °F	0 psi (g)	
	53B	54B	Unit: kg/m^3 Range: 653 to 1075 kg/m^3	15 °C	0 kPa (g)	
Liquids with a constant density base or known thermal expansion coefficient(5)	N/A	6C	Unit: °API	60 °F	0 psi (g)	API MPMS 11.1
	N/A	24C	Unit: SGU	60 °F	0 psi (g)	
	N/A	54C	Unit: kg/m^3	15 °C	0 kPa (g)	
Lubricating oils	5D	6D	Unit: °API Range: −10 to +40 °API	60 °F	0 psi (g)	API MPMS 11.1
	23D	24D	Unit: SGU Range: 0.8520 to 1.1640 SGU	60 °F	0 psi (g)	
	53D	54D	Unit: kg/m^3 Range: 825 to 1164 kg/m^3	15 °C	0 kPa (g)	

(1) *Each API table represents a specialized equation defined by the American Petroleum Institute for a specific combination of process fluid, line conditions, and output.*
(2) *Referred density is calculated from line density. You must specify this table, either directly or by selecting the process fluid and base density measurement unit.*
(3) *You do not need to specify this table. It is invoked automatically as a result of the previous table selection.*

(4) *CTL or CTPL is calculated from the result of the referred density calculation. A, B, C, and D tables calculate CTPL, which is a correction factor based on both line pressure and line temperature. E tables calculate CTL, which is a correction factor based on line temperature and pressure at saturation conditions (bubble point or saturation vapor pressure).*
(5) *The Thermal Expansion Coefficient (TEC) replaces the referred density calculation. Use the CTL/CTPL table instead.*

4.8 Set up concentration measurement

This section guides you through loading and setting up a concentration matrix used for measurement. It does not cover building a concentration matrix.

The concentration measurement application calculates concentration data from process temperature and density. Micro Motion provides a set of concentration matrices that provide the reference data for several standard industry applications and process fluids. If desired, you can build a custom matrix for your process fluid, or purchase a custom matrix from Micro Motion.

Note
Concentration matrices can be made available on your transmitter either by loading an existing matrix from a file or by building a new matrix. Up to six matrices can be available on your transmitter, but only one can be used for measurement at any given time. See the *Micro Motion Enhanced Density Application Manual* for detailed information on building a matrix.

Prerequisites

Before you can configure concentration measurement:

- The concentration measurement application must be purchased on your transmitter.
- The concentration matrix you want to use must be available on your transmitter, or it must be available as a file on your computer.
- You must know the derived variable that your matrix is designed for.
- You must know the density unit used by your matrix.
- You must know the temperature unit used by your matrix.
- The concentration measurement application must be unlocked.

4.8.1 Configure concentration measurement using ProLink III

Procedure

1. Choose **Device Tools** → **Configuration** → **Process Measurement** → **Density** and set **Density Unit** to the density unit used by your matrix.
2. Choose **Device Tools** → **Configuration** → **Process Measurement** → **Temperature** and set **Temperature Unit** to the temperature unit used by your matrix.
3. Choose **Device Tools** → **Configuration** → **Process Measurement** → **Concentration Measurement**.
4. Set **Derived Variable** to the derived variable that your matrix is designed for, and click **Apply**.

   Important
   - All concentration matrices on your transmitter must use the same derived variable. If you are using one of the standard matrices from Micro Motion, set **Derived Variable** to Mass Concentration (Density). If you are using a custom matrix, see the reference information for your matrix.

- If you change the setting of **Derived Variable**, all existing concentration matrices will be deleted from transmitter memory. Set **Derived Variable** before loading concentration matrices.

---

5. Load one or more matrices.
    a) Set **Matrix Being Configured** to the location to which the matrix will be loaded.
    b) Click **Load Matrix from a File**, navigate to the matrix file on your computer, and load it.
    c) Repeat until all required matrices are loaded.
6. Configure or review matrix data.
    a) If necessary, set **Matrix Being Configured** to the matrix you want to configure or review, and click **Change Matrix**.
    b) Set **Concentration Unit** to the label that will be used for the concentration unit.
    c) If you set **Concentration Unit** to Special, enter the custom label.
    d) If desired, change the matrix name.
    e) Review the data points for this matrix.
    f) Do not change **Reference Temperature** or **Curve Fit Maximum Order**.
    g) If you changed any matrix data, click **Apply**.
7. Set up extrapolation alarms.

    Each concentration matrix is built for a specific density range and a specific temperature range. If process density or process temperature goes outside the range, the transmitter will extrapolate concentration values. However, extrapolation may affect accuracy. Extrapolation alarms are used to notify the operator that extrapolation is occurring.
    a) If necessary, set **Matrix Being Configured** to the matrix you want to view, and select **Change Matrix**.
    b) Set **Extrapolation Alarm Limit** to the point, in percent, at which an extrapolation alarm will be posted.
    c) Enable or disable the high and low limit alarms for temperature and density, as desired, and select **Apply**.

    Example

    If **Extrapolation Alarm Limit** is set to 5%, **High Extrapolation Limit (Temperature)** is enabled, and the matrix is built for a temperature range of 40 °F (4.4 °C) to 80 °F (26.7 °C), an extrapolation alarm will be posted if process temperature goes above 82 °F (27.8 °C).
8. If you chose RTD, no more configuration is required. Select **Apply** and exit.
9. If you chose to use a static temperature value, set **External Temperature** to the value to use, and select **Apply**.
10. If you want to use digital communications, select **Apply**, then perform the necessary host programming and communications setup to write temperature data to the transmitter at appropriate intervals.
11. Set **Active Matrix** to the matrix to be used for measurement.

Concentration process variables are now available on the transmitter. You can view and report them in the same way that you view and report other process variables.

4.8.2 Configure concentration measurement using the Field Communicator

Procedure

1. Choose **Online** → **Configure** → **Manual Setup** → **Measurements** → **Density** and set **Density Unit** to match the density unit used by your matrix.
2. Choose **Online** → **Configure** → **Manual Setup** → **Measurements** → **Temperature** and set **Temperature Unit** to match the temperature unit used by your matrix.
3. Choose **Online** → **Configure** → **Manual Setup** → **Measurements** and click **Concentration Measurement**.
4. Enable or disable matrix switching, as desired.
5. Set up extrapolation alerts.

   Each concentration matrix is built for a specific density range and a specific temperature range. If process density or process temperature goes outside the range, the transmitter will extrapolate concentration values. However, extrapolation may affect accuracy. Extrapolation alerts are used to notify the operator that extrapolation is occurring.

   a) Click **Next**.
   b) On the **Matrix Configuration** page, set **Matrix Being Configured** to the matrix that you want to configure.
   c) Modify the matrix name if desired.
   d) Set **Extrapolation Alert Limit** to the point, in percent, at which an extrapolation alert will be posted.
   e) Choose **Online** → **Configure** → **Alert Setup** → **CM Alerts**.

   #### Example

   If **Alarm Limit** is set to 5%, the high-temperature extrapolation alert is enabled, and the matrix is built for a temperature range of 40 °F (4.4 °C) to 80 °F (26.7 °C), an extrapolation alarm will be posted if process temperature goes above 82 °F (27.8 °C).
6. Select the label that will be used for the concentration unit.
   a) Click **Next**.
   b) On the **Concentration Measurement** page, set **Concentration Units** to the desired label.
   c) Set **Concentration Units** to the desired label.
   d) If you set **Units** to Special, enter the custom label.
   e) Click **Finish**.
7. Determine how the transmitter will obtain temperature data for the concentration measurement calculations, and perform the required setup.

Option	Setup
Temperature data from the sensor	a. Choose **Online** → **Configure** → **Manual Setup** → **Measurements**. b. Click **External Inputs**. c. Click **Next**. d. Disable **External Temperature**.
A user-configured static temperature value	a. Choose **Online** → **Configure** → **Manual Setup** → **Measurements**. b. Click **External Inputs**. c. Click **Next**. d. Enable **External Temperature**. e. Set **Correction Temperature** to the value to be used.
A value written by digital communications	a. Choose **Online** → **Configure** → **Manual Setup** → **Measurements** → **External Pressure/Temperature** → **Temperature**. b. Enable **External Temperature**. c. Perform the necessary host programming and communications setup to write temperature data to the transmitter at appropriate intervals.

8. Choose **Online** → **Configure** → **Manual Setup** → **Measurements** → **Conc Measurement (CM)** → **CM Configuration** and set **Active Matrix** to the matrix to be used for measurement.

Concentration process variables are now available on the transmitter. You can view and report them in the same way that you view and report other process variables.

4.8.3 Standard matrices for the concentration measurement application

The standard concentration matrices available from Micro Motion are applicable for a variety of process fluids. These matrices are included in the ProLink III installation.

Tip
If the standard matrices are not appropriate for your application, you can build a custom matrix or purchase a custom matrix from Micro Motion.

Matrix name	Description	Density unit	Temperature unit	Derived variable
Deg Balling	Matrix represents percent extract, by mass, in solution, based on °Balling. For example, if a wort is 10 °Balling and the extract in solution is 100% sucrose, the extract is 10% of the total mass.	g/cm^3	°F	Mass Concentration (Density)

Matrix name	Description	Density unit	Temperature unit	Derived variable
Deg Brix	Matrix represents a hydrometer scale for sucrose solutions that indicates the percent by mass of sucrose in solution at a given temperature. For example, 40 kg of sucrose mixed with 60 kg of water results in a 40 °Brix solution.	g/cm^3	°C	Mass Concentration (Density)
Deg Plato	Matrix represents percent extract, by mass, in solution, based on °Plato. For example, if a wort is 10 °Plato and the extract in solution is 100% sucrose, the extract is 10% of the total mass.	g/cm^3	°F	Mass Concentration (Density)
HFCS 42	Matrix represents a hydrometer scale for HFCS 42 (high-fructose corn syrup) solutions that indicates the percent by mass of HFCS in solution.	g/cm^3	°C	Mass Concentration (Density)
HFCS 55	Matrix represents a hydrometer scale for HFCS 55 (high-fructose corn syrup) solutions that indicates the percent by mass of HFCS in solution.	g/cm^3	°C	Mass Concentration (Density)
HFCS 90	Matrix represents a hydrometer scale for HFCS 90 (high-fructose corn syrup) solutions that indicates the percent by mass of HFCS in solution.	g/cm^3	°C	Mass Concentration (Density)

4.8.4 Derived variables and calculated process variables

The concentration measurement application calculates a different set of process variables from each derived variable. The process variables are then available for viewing or reporting.

Derived variable	Description	Calculated process variables					
		Density at reference temp	Standard volume flow rate	Specific gravity	Concentra tion	Net mass flow rate	Net volume flow rate
Density at Reference	Mass/unit volume, corrected to a given reference temperature	✓	✓				

Derived variable	Description	Calculated process variables					
		Density at reference temp	**Standard volume flow rate**	**Specific gravity**	**Concentra tion**	**Net mass flow rate**	**Net volume flow rate**
Specific Gravity	The ratio of the density of a process fluid at a given temperature to the density of water at a given temperature The two given temperature conditions do not need to be the same. **Note** The two given temperature conditions do not need to be the same.	✓	✓	✓			
Mass Concentration (Density)	The percent mass of solute or of material in suspension in the total solution, derived from reference density	✓	✓		✓	✓	
Mass Concentration (Specific Gravity)	The percent mass of solute or of material in suspension in the total solution, derived from specific gravity	✓	✓	✓	✓	✓	
Volume Concentration (Density)	The percent volume of solute or of material in suspension in the total solution, derived from reference density	✓	✓		✓		✓
Volume Concentration (Specific Gravity)	The percent volume of solute or of material in suspension in the total solution, derived from specific gravity	✓	✓	✓	✓		✓
Concentration (Density)	The mass, volume, weight, or number of moles of solute or of material in suspension in proportion to the total solution, derived from reference density	✓	✓		✓		

Derived variable	Description	Calculated process variables: Density at reference temp	Standard volume flow rate	Specific gravity	Concentration	Net mass flow rate	Net volume flow rate
Concentration (Specific Gravity)	The mass, volume, weight, or number of moles of solute or of material in suspension in proportion to the total solution, derived from specific gravity	✓	✓	✓	✓		

4.9 Configure pressure compensation

Pressure compensation adjusts process measurement to compensate for the pressure effect on the sensor. The pressure effect is the change in the sensor's sensitivity to flow and density caused by the difference between the calibration pressure and the process pressure.

Tip
Not all sensors or applications require pressure compensation. The pressure effect for a specific sensor model can be found in the product data sheet located at www.emerson.com. If you are uncertain about implementing pressure compensation, contact customer service.

Prerequisites

You will need the flow factor, density factor, and calibration pressure values for your sensor.

- For the flow factor and density factor, see the product data sheet for your sensor.
- For the calibration pressure, see the calibration sheet for your sensor. If the data is unavailable, use 20 PSI.

4.9.1 Configure pressure compensation using ProLink III

Procedure

1. Choose **Device Tools** → **Configuration** → **Process Measurement** → **Pressure Compensation**.
2. Set **Pressure Compensation Status** to Enabled.
3. Set **Pressure Unit** to the appropriate unit.

   If you will use an external pressure value, set **Pressure Unit** to match the pressure unit used by the external pressure device.

4. Enter **Flow Calibration Pressure** for your sensor.

   The calibration pressure is the pressure at which your sensor was calibrated, and defines the pressure at which there is no pressure effect. If the data is unavailable, enter `20` PSI.

5. Enter **Flow Factor** for your sensor.

   The flow factor is the percent change in the flow rate per PSI. When entering the value, reverse the sign.

Example

If the flow factor is 0.000004 % per PSI, enter `-0.000004 % per PSI`.

6. Enter **Density Factor** for your sensor.

   The density factor is the change in fluid density, in g/cm^3/PSI. When entering the value, reverse the sign.

   Example

   If the density factor is 0.000006 g/cm^3/PSI, enter `-0.000006` g/cm3/PSI.

Postrequisites

If you are receiving pressure data over the mA Input, ensure that the mA Input is configured for your application.

If you are using an external pressure value, verify the setup by checking the **External Pressure** value displayed in the **Inputs** area of the main window.

4.9.2 Configure pressure compensation using the Field Communicator

Procedure

1. Choose **Online** → **Configure** → **Manual Setup** → **Measurements** → **External Pressure/Temperature** → **Pressure**.
2. Set **Pressure Compensation** to Enabled.
3. Enter **Flow Cal Pressure** for your sensor.

   The calibration pressure is the pressure at which your sensor was calibrated, and defines the pressure at which there is no pressure effect. If the data is unavailable, enter `20` PSI.

4. Enter **Flow Press Factor** for your sensor.

   The flow factor is the percent change in the flow rate per PSI. When entering the value, reverse the sign.

   Example

   If the flow factor is 0.000004 % per PSI, enter `-0.000004` % per PSI.

5. Enter **Dens Press Factor** for your sensor.

   The density factor is the change in fluid density, in g/cm^3/PSI. When entering the value, reverse the sign.

   Example

   If the density factor is 0.000006 g/cm^3/PSI, enter `-0.000006` g/cm3/PSI.

6. Determine how the transmitter will obtain pressure data, and perform the required setup.

Option	Setup
A user-configured static pressure value	a. Set **Pressure Unit** to the desired unit. b. Set **Compensation Pressure** to the desired value.
A value written by digital communications	a. Set **Pressure Unit** to the desired unit. b. Perform the necessary host programming and communications setup to write pressure data to the transmitter at appropriate intervals.

Postrequisites

If you are receiving pressure data over the mA Input, ensure that the mA Input is configured for your application.

If you are using an external pressure value, verify the setup by choosing **Service Tools** → **Variables** → **External Variables** and checking the value displayed for **External Pressure**.

4.9.3 Options for Pressure Measurement Unit

The transmitter provides a standard set of measurement units for **Pressure Measurement Unit**. Different communications tools may use different labels for the units. In most applications, **Pressure Measurement Unit** should be set to match the pressure measurement unit used by the remote device.

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

Unit description	Label		
	Display	**ProLink III**	**Field Communicator**
Atmospheres	ATM	atms	atms

5 Configure device options and preferences

5.1 Configure the transmitter display

You can control the process variables shown on the display and a variety of display behaviors.

5.1.1 Configure the language used for the display

Display	**OFF-LINE MAINT → OFF-LINE CONFG → DISPLAY → LANG**
ProLink III	**Device Tools → Configuration → Transmitter Display → General**
Field Communicator	Not available

Display Language controls the language used for process data and menus on the display.

Procedure

Select the language you want to use.
The languages available depend on your transmitter model and version.

5.1.2 Configure the process variables and diagnostic variables shown on the display

Display	Not available
ProLink III	**Device Tools → Configuration → Transmitter Display → Display Variables**
Field Communicator	**Configure → Manual Setup → Display → Display Variables**

You can control the process variables and diagnostic variables shown on the display, and the order in which they appear. The display can scroll through up to 15 variables in any order you choose. In addition, you can repeat variables or leave slots unassigned.

Note

If you configure a display variable as a volume process variable and then change **Volume Flow Type**, the display variable is automatically changed to the equivalent process variable. For example, Volume Flow Rate would be changed to Gas Standard Volume Flow Rate.

Procedure

For each display variable you want to change, assign the process variable you want to use.

Default display variable configuration

Display variable	Process variable assignment
Display Variable 1	Mass flow
Display Variable 2	Mass total
Display Variable 3	Volume flow
Display Variable 4	Volume total

Display variable	Process variable assignment
Display Variable 5	Density
Display Variable 6	Temperature
Display Variable 7	Drive gain
Display Variable 8	None
Display Variable 9	None
Display Variable 10	None
Display Variable 11	None
Display Variable 12	None
Display Variable 13	None
Display Variable 14	None
Display Variable 15	None

Configure Display Variable 1 to track the primary mA Output

You can configure **Display Variable 1** to track **mA Output Process Variable** for the primary mA Output. When tracking is enabled, you can control **Display Variable 1** from the display menu.

Tip
This feature is the only way to configure a display variable from the display menus, and it applies only to **Display Variable 1**.

Procedure

Configure **Display Variable 1** to track the primary mA Output.

Display Variable 1 will automatically be set to match **mA Output Process Variable** for the primary mA Output. If you change the configuration of **mA Output Process Variable**, **Display Variable 1** will be updated automatically.

5.1.3 Configure the number of decimal places (precision) shown on the display

Display	Not available
ProLink III	**Device Tools → Configuration → Transmitter Display → Display Variables**
Field Communicator	**Configure → Manual Setup → Display → Decimal Places → For Process Variables**

You can specify the number of decimal places (precision) that are shown on the display for each process variable or diagnostic variable. You can set the precision independently for each variable.

The display precision does not affect the actual value of the variable or the value used in calculations.

Procedure

1. Select a variable.

2. Set **Number of Decimal Places** to the number of decimal places you want shown when the process variable or diagnostic variable appears on the display.

   For temperature and density process variables, the default value is 2 decimal places. For all other variables, the default value is 4 decimal places. The range is 0 to 5.

   Tip
   The lower the precision, the greater the change must be for it to be reflected on the display. Do not set the precision too low or too high to be useful.

5.1.4 Configure the refresh rate of data shown on the display

Display	**OFF-LINE MAINT → OFF-LINE CONFG → DISPLAY → RATE**
ProLink III	**Device Tools → Configuration → Transmitter Display → Display Variables**
Field Communicator	**Configure → Manual Setup → Display → Update Period**

You can set **Refresh Rate** to control how frequently data is refreshed on the display.

Procedure

Set **Refresh Rate** to the desired value.

The default value is 200 milliseconds. The range is 100 milliseconds to 10,000 milliseconds (10 seconds).

5.1.5 Enable or disable automatic scrolling through the display variables

Display	**OFF-LINE MAINT → OFF-LINE CONFG → DISPLAY → AUTO SCRLL**
ProLink III	**Device Tools → Configuration → Transmitter Display → General**
Field Communicator	Not available

You can configure the display to automatically scroll through the configured display variables or to show a single display variable until the operator activates **Scroll**. When you set automatic scrolling, you can also configure the length of time each display variable is displayed.

Procedure

1. Enable or disable **Auto Scroll** as desired.

Option	Description
Enabled	The display automatically scrolls through each display variable as specified by **Scroll Rate**. The operator can move to the next display variable at any time using **Scroll**.
Disabled (default)	The display shows **Display Variable 1** and does not scroll automatically. The operator can move to the next display variable at any time using **Scroll**.

2. If you enabled **Auto Scroll**, set **Scroll Rate** as desired.

   The default value is 10 seconds.

Tip
Scroll Rate may not be available until you apply **Auto Scroll**.

5.1.6 Enable or disable the display backlight

Display	**OFF-LINE MAINT → OFF-LINE CONFG → DISPLAY → BKLT**
ProLink III	**Device Tools → Configuration → Transmitter Display → General**
Field Communicator	Not available

You can enable or disable the display backlight.

Procedure

Enable or disable **Backlight**.

The default setting is Enabled.

5.2 Enable or disable operator actions from the display

You can configure the transmitter to let the operator perform specific actions using the display.

5.2.1 Enable or disable Totalizer Start/Stop from the display

Display	**OFF-LINE MAINT → OFF-LINE CONFG → DISPLAY → TOTALS STOP**
ProLink III	**Device Tools → Configuration → Totalizer Control Methods**
Field Communicator	Not available

You can control whether or not the operator is able to start and stop totalizers and inventories from the display.

Restriction

- You cannot start and stop totalizers individually from the display. All totalizers are started or stopped together.
- You cannot start or stop inventories separately from totalizers. When a totalizer is started or stopped, the associated inventory is also started or stopped.
- If the petroleum measurement application is installed, the operator must enter the off-line password to perform this function, even if the off-line password is not enabled.

Procedure

1. Ensure that at least one totalizer is configured as a display variable.
2. Enable or disable **Totalizer Reset** as desired.

Option	Description
Enabled	Operators can start and stop totalizers and inventories from the display, if at least one totalizer is configured as a display variable.

Option	Description
Disabled (default)	Operators cannot start and stop totalizers and inventories from the display.

5.2.2 Enable or disable Totalizer Reset from the display

Display	**OFF-LINE MAINT → OFF-LINE CONFG → DISPLAY → TOTALS RESET**
ProLink III	**Device Tools → Configuration → Totalizer Control Methods**
Field Communicator	Not available

You can configure whether or not the operator is able to reset totalizers from the display.

Restriction

- This parameter does not apply to inventories. You cannot reset inventories from the display.
- You cannot use the display to reset all totalizers as a group. You must reset totalizers individually.
- If the petroleum measurement application is installed, the operator must enter the off-line password to perform this function, even if the off-line password is not enabled.

Procedure

1. Ensure that the totalizers you want to reset have been configured as display variables.
   If the totalizer is not configured as a display variable, the operator will not be able to reset it.
2. Enable or disable resetting the totalizer as desired.

Option	Description
Enabled	Operators can reset a totalizer from the display, if the totalizer is configured as a display variable.
Disabled (default)	Operators cannot reset totalizers from the display.

5.2.3 Enable or disable the Acknowledge All Alerts display command

Display	**OFF-LINE MAINT → OFF-LINE CONFG → DISPLAY → ALARM**
ProLink III	**Device Tools → Configuration → Transmitter Display → Ack All**
Field Communicator	Not available

You can configure whether or not the operator can use a single command to acknowledge all alerts from the display.

Procedure

1. Ensure that the alert menu is accessible from the display.
   To acknowledge alerts from the display, operators must have access to the alert menu.

2. Enable or disable **Acknowledge All Alerts** as desired.

Option	Description
Enabled (default)	Operators can use a single display command to acknowledge all alerts at once.
Disabled	Operators cannot acknowledge all alerts at once. Each alert must be acknowledged separately.

5.3 Configure security for the display menus

Display	**OFF-LINE MAINT → OFF-LINE CONFG → DISPLAY → OFFLN**
ProLink III	**Device Tools → Configuration → Transmitter Display → Display Security**
Field Communicator	Not available

You can control operator access to different sections of the display off-line menu. You can also configure a password to control access.

Procedure

1. To control operator access to the maintenance section of the off-line menu, enable or disable **Off-Line Menu**.

Option	Description
Enabled (default)	Operator can access the maintenance section of the off-line menu. .This access is required for configuration and calibration, but is not required to view alerts.
Disabled	Operator cannot access the maintenance section of the off-line menu.

2. To control operator access to the alert menu, enable or disable **Alert Menu**.

Option	Description
Enabled (default)	Operator can access the alert menu. This access is required to view and acknowledge alerts, but is not required for configuration or calibration.
Disabled	Operator cannot access the alert menu.

Note
The transmitter status LED changes color to indicate that there are active alerts, but does not show specific alerts.

3. To require a password for access to the maintenance section of the off-line menu , enable or disable **Off-Line Password**.

Option	Description
Enabled	Operator is prompted for the off-line password at entry to the maintenance section of the off-line menu.

Option	Description
Disabled (default)	No password is required for entry to the maintenance section of the off-line menu.

4. To require a password to access the alert menu, enable or disable **Alert Password**.

Option	Description
Enabled	Operator is prompted for the off-line password at entry to the alert menu.
Disabled (default)	No password is required for entry to the alert menu.

If both **Off-Line Password** and **Alert Password** are enabled, the operator is prompted for the off-line password to access the off-line menu, but is not prompted thereafter.

5. Set **Off-Line Password** to the desired value.

The default value is 1234. The range is 0000 to 9999.

The same value is used for both the off-line password and the alert password.

Tip
Record your password for future reference.

5.4 Configure response time parameters

You can configure the rate at which process data is polled and process variables are calculated.

5.4.1 Configure Update Rate

Display	Not available
ProLink III	**Device Tools** → **Configuration** → **Process Measurement** → **Response** → **Update Rate**
Field Communicator	Not available

Update Rate controls the rate at which process data is polled and process variables are calculated. **Update Rate** = Special produces faster and “noisier” response to changes in the process. Do not use Special mode unless required by your application.

Prerequisites

Before setting **Update Rate** to Special:

- Check the effects of Special mode on specific process variables.
- Contact customer support.

Procedure

Set **Update Rate** as desired.

Option	Description
Normal	All process data is polled at the rate of 20 times per second (20 Hz). All process variables are calculated at 20 Hz. This option is appropriate for most applications.
Special	A single, user-specified process variable is polled at the rate of 100 times per second (100 Hz). Other process data is polled at 6.25 Hz. Some process, diagnostic, and calibration data is not polled. All available process variables are calculated at 100 Hz. Use this option only if required by your application.

If you change **Update Rate**, the settings for **Flow Damping**, and **Density Damping** are automatically adjusted.

Effects of Update Rate = Special

Incompatible features and functions

Special mode is not compatible with the following features and functions:

- Enhanced events. Use basic events instead.
- All calibration procedures.
- Zero verification.
- Restoring the factory zero or the prior zero.

If required, you can switch to Normal mode, perform the desired procedures, and then return to Special mode.

Process variable updates

Some process variables are not updated when Special mode is enabled.

Table 5-1: Special mode and process variable updates

Always polled and updated	Updated only when the petroleum measurement application is disabled	Never updated
• Mass flow • Volume flow • Gas standard volume flow • Density • Temperature • Drive gain • LPO amplitude • Status [contains Event 1 and Event 2 (basic events)] • Mass total • Volume total • Live zero • Gas standard volume total • Temperature-corrected volume total • Temperature-corrected density • Temperature-corrected volume flow • Batch-weighted average temperature • Batch-weighted average density	• RPO amplitude • Core input voltage • Mass inventory • Volume inventory • Gas standard volume inventory	All other process variables and calibration data. They retain the values held at the time you enabled Special mode.

5.5 Configure alert handling

The alert handling parameters control the transmitter’s response to process and device conditions.

5.5.1 Configure Fault Timeout

Display	Not available
ProLink III	**Device Tools → Configuration → Fault Processing**
Field Communicator	**Configure → Alert Setup → Alert Severity → Fault Timeout**

Fault Timeout controls the delay before fault actions are performed.

Restriction
Fault Timeout is applied only to the following alerts (listed by Status Alert Code): A003, A004, A005, A008, A016, A017, A033. For all other alerts, fault actions are performed as soon as the alert is detected.

Procedure

- Set **Fault Timeout** as desired.

  The default value is 0 seconds. The range is 0 to 60 seconds.

  If you set **Fault Timeout** to 0, fault actions are performed as soon as the alert condition is detected.

  The fault timeout period begins when the transmitter detects an alert condition. During the fault timeout period, the transmitter continues to report its last valid measurements.

  If the fault timeout period expires while the alert is still active, the fault actions are performed. If the alert condition clears before the fault timeout expires, no fault actions are performed.

5.5.2 Configure Status Alert Severity

Display	Not available
ProLink III	**Device Tools → Configuration → Alert Severity**
Field Communicator	**Configure → Alert Setup → Alert Severity → Set Alert Severity**

Use **Status Alert Severity** to control the fault actions that the transmitter performs when it detects an alert condition.

Restriction

- For some alerts, **Status Alert Severity** is not configurable.
- For some alerts, **Status Alert Severity** can be set only to two of the three options.

Tip

Use the default settings for **Status Alert Severity** unless you have a specific requirement to change them.

Procedure

1. Select a status alert.
2. For the selected status alert, set **Status Alert Severity** as desired.

Option	Description
Fault	Actions when fault is detected: • The alert is posted to the Alert List. • Outputs go to the configured fault action (after **Fault Timeout** has expired, if applicable). • Digital communications go to the configured fault action (after **Fault Timeout** has expired, if applicable). • The status LED (if available) changes to red or yellow (depending on alert severity). Actions when alert clears: • Outputs return to normal behavior. • Digital communications return to normal behavior. • The status LED (if available) returns to green and may or may not flash.

Option	Description
Informational	Actions when fault is detected: • The alert is posted to the Alert List. • The status LED (if available) changes to red or yellow (depending on alert severity). Actions when alert clears: • The status LED (if available) returns to green and may or may not flash.
Ignore	No action

Status alerts and options for Status Alert Severity

Table 5-2: Status alerts and Status Alert Severity

Alert code	Status message	Default severity	Notes	Configurable?
A001	EEPROM Error (Core Processor)	Fault		No
A002	RAM Error (Core Processor)	Fault		No
A003	No Sensor Response	Fault		Yes
A004	Temperature Overrange	Fault		No
A005	Mass Flow Rate Overrange	Fault		Yes
A006	Characterization Required	Fault		Yes
A008	Density Overrange	Fault		Yes
A009	Transmitter Initializing/ Warming Up	Fault		Yes
A010	Calibration Failure	Fault		No
A011	Zero Calibration Failed: Low	Fault		Yes
A012	Zero Calibration Failed: High	Fault		Yes
A013	Zero Calibration Failed: Unstable	Fault		Yes
A014	Transmitter Failure	Fault		No
A016	Sensor RTD Failure	Fault		Yes
A020	No Flow Cal Value	Fault		Yes
A021	Incorrect Sensor Type (K1)	Fault		No
A026	Sensor/Transmitter Communications Failure	Fault		No
A027	Security Breach	Fault		No
A102	Drive Overrange	Informational		Yes

Table 5-2: Status alerts and Status Alert Severity *(continued)*

Alert code	Status message	Default severity	Notes	Configurable?
A104	Calibration in Progress	Informational	Can be set to either Informational or Ignore, but cannot be set to Fault.	Yes
A105	Slug Flow	Informational		Yes
A107	Power Reset Occurred	Informational	Normal transmitter behavior; occurs after every power cycle.	Yes
A113	mA Output 2 Saturated	Informational	Can be set to either Informational or Ignore, but cannot be set to Fault.	Yes
A114	mA Output 2 Fixed	Informational	Can be set to either Informational or Ignore, but cannot be set to Fault.	Yes
A120	Curve Fit Failure (Concentration)	Informational	Applies only to transmitters with the concentration measurement application.	No
A121	Extrapolation Alarm (Concentration)	Informational	Applies only to transmitters with the concentration measurement application.	Yes

5.6 Configure informational parameters

The informational parameters can be used to identify or describe your meter. They are not used in process measurement and they are not required.

5.6.1 Configure Sensor Serial Number

Display	Not available
ProLink III	**Device Tools → Configuration → Informational Parameters → Sensor**
Field Communicator	**Configure → Manual Setup → Info Parameters → Sensor Information → Transmitter Serial Number**

Sensor Serial Number lets you store the serial number of the sensor component of your flowmeter in transmitter memory. This parameter is not used in processing and is not required.

Procedure

1. Obtain the sensor serial number from your sensor tag.
2. Enter the serial number in the **Sensor Serial Number** field.

5.6.2 Configure Sensor Material

Display	Not available
ProLink III	**Device Tools → Configuration → Informational Parameters → Sensor**
Field Communicator	**Configure → Manual Setup → Info Parameters → Sensor Information → Tube Wetted Material**

Sensor Material lets you store the type of material used for your sensor's wetted parts in transmitter memory. This parameter is not used in processing and is not required.

Procedure

1. Obtain the material used for your sensor's wetted parts from the documents shipped with your sensor, or from a code in the sensor model number.
   To interpret the model number, refer to the product data sheet for your sensor.
2. Set **Sensor Material** to the appropriate option.

5.6.3 Configure Sensor Liner Material

Display	Not available
ProLink III	**Device Tools → Configuration → Informational Parameters → Sensor**
Field Communicator	**Configure → Manual Setup → Info Parameters → Sensor Information → Tube Lining**

Sensor Liner Material lets you store the type of material used for your sensor liner in transmitter memory. This parameter is not used in processing and is not required.

Procedure

1. Obtain your sensor's liner material from the documents shipped with your sensor, or from a code in the sensor model number.
   To interpret the model number, refer to the product data sheet for your sensor.
2. Set **Sensor Liner Material** to the appropriate option.

5.6.4 Configure Sensor Flange Type

Display	Not available
ProLink III	**Device Tools → Configuration → Informational Parameters → Sensor**
Field Communicator	**Configure → Manual Setup → Info Parameters → Sensor Information → Sensor Flange**

Sensor Flange Type lets you store your sensor's flange type in transmitter memory. This parameter is not used in processing and is not required.

Procedure

1. Obtain your sensor's flange type from the documents shipped with your sensor, or from a code in the sensor model number.
   To interpret the model number, refer to the product data sheet for your sensor.
2. Set **Sensor Flange Type** to the appropriate option.

5.6.5 Configure Descriptor

Display	Not available
ProLink III	**Device Tools → Configuration → Informational Parameters → Transmitter**
Field Communicator	**Configure → Manual Setup → Info Parameters → Transmitter Info → Descriptor**

Descriptor lets you store a description in transmitter memory. The description is not used in processing and is not required.

Procedure

Enter a description for the transmitter or device
You can use up to 16 characters for the description.

5.6.6 Configure Message

Display	Not available
ProLink III	**Device Tools → Configuration → Informational Parameters → Transmitter**
Field Communicator	**Configure → Manual Setup → Info Parameters → Transmitter Info → Message**

Message lets you store a short message in transmitter memory. This parameter is not used in processing and is not required.

Procedure

Enter a short message for the transmitter or device.
Your message can be up to 32 characters long.

5.6.7 Configure Date

Display	Not available
ProLink III	**Device Tools → Configuration → Informational Parameters → Transmitter**
Field Communicator	**Configure → Manual Setup → Info Parameters → Transmitter Info → Date**

Date lets you store a static date (not updated by the transmitter) in transmitter memory. This parameter is not used in processing and is not required.

Procedure

Enter the date you want to use, in the form `mm/dd/yyyy`.

Tip
ProLink III provides a calendar tool to help you select the date.

6 Integrate the meter with the control system

6.1 Configure the mA Output

The mA Output is used to report the configured process variable. The mA Output parameters control how the process variable is reported.

Your transmitter has two mA Outputs.

Important
Whenever you change an mA Output parameter, verify all other mA Output parameters before returning the meter to service. In some situations, the transmitter automatically loads a set of stored values, and these values may not be appropriate for your application.

6.1.1 Configure mA Output Process Variable

Display	**OFF-LINE MAINT → OFF-LINE CONFG → IO → AO 1 → SRC** **OFF-LINE MAINT → OFF-LINE CONFG → IO → AO 2 → SRC**
ProLink III	**Device Tools → Configuration → I/O → Outputs → mA Output**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → mA Output 1 → Primary Variable** **Configure → Manual Setup → Inputs/Outputs → mA Output 2 → Secondary Variable**

Use **mA Output Process Variable** to select the variable that is reported over the mA Output. This variable is applied automatically to the Frequency Output.

Prerequisites

- If you plan to configure the output to report volume flow, ensure that you have set **Volume Flow Type** as desired: Liquid or Gas Standard Volume.
- If you plan to configure an output to report a concentration measurement process variable, ensure that the concentration measurement application is configured so that the desired variable is available.
- If you are using the HART variables, be aware that changing the configuration of **mA Output Process Variable** will change the configuration of the HART Primary Variable (PV) and/or the HART Secondary Variable (SV).

Procedure

Set **mA Output Process Variable** as desired.

Default settings are as follows:

- Primary mA Output: Mass Flow Rate
- Secondary mA Output: Density

Postrequisites

If you changed the setting of **mA Output Process Variable**, verify the settings of **Lower Range Value** (LRV) and **Upper Range Value** (URV).

Options for mA Output Process Variable

The transmitter provides a basic set of options for **mA Output Process Variable**, plus several application-specific options. Different communications tools may use different labels for the options.

Process variables	Label		
	Display	**ProLink III**	**Field Communicator**
Standard			
Mass flow rate	MFLOW	Mass Flow Rate	Mass flo
Volume flow rate	VFLOW	Volume Flow Rate	Vol flo
Gas standard volume flow rate	GSV F	Gas Standard Volume Flow Rate	Gas vol flo
Temperature	TEMP	Temperature	Temp
Density	DENS	Density	Dens
External pressure	EXT P	External Pressure	External pres
External temperature	EXT T	External Temperature	External temp
Drive gain	DGAIN	Drive Gain	Driv signl
Petroleum measurement			
Temperature-corrected density	TCDEN	Density at Reference Temperature	TC Dens
Temperature-corrected (standard) volume flow rate	TCVOL	Volume Flow Rate at Reference Temperature	TC Vol
Average corrected density	AVE D	Average Density	TC Avg Dens
Average temperature	AVE T	Average Temperature	TC Avg Temp
Concentration measurement			
Density at reference	RDENS	Density at Reference Temperature	ED Dens at Ref
Specific gravity	SGU	Density (Fixed SG Units)	ED Dens (SGU)
Standard volume flow rate	STD V	Volume Flow Rate at Reference Temperature	ED Std Vol flo
Net mass flow rate	NET M	Net Mass Flow Rate	ED Net Mass flo
Net volume flow rate	NET V	Net Volume Flow Rate	ED Net Vol flo
Concentration	CONC	Concentration	ED Concentration
Baume	BAUME	Baume	ED Dens (Baume)

6.1.2 Configure Lower Range Value (LRV) and Upper Range Value (URV)

Display	**OFF-LINE MAINT → OFF-LINE CONFG → IO → AO 1/2 → 4 mA** **OFF-LINE MAINT → OFF-LINE CONFG → IO → AO 1/2 → 20 mA**

ProLink III	**Device Tools → Configuration → I/O → Outputs → mA Output**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → mA Output X → mA Output Settings → PV/SV LRV** **Configure → Manual Setup → Inputs/Outputs → mA Output X → mA Output Settings → PV/SV URV**

The **Lower Range Value** (LRV) and **Upper Range Value** (URV) are used to scale the mA Output, that is, to define the relationship between **mA Output Process Variable** and the mA Output level.

Prerequisites

Ensure that **mA Output Process Variable** is set to the desired process variable. Each process variable has its own set of **LRV** and **URV** values. When you change the values of **LRV** and **URV**, you are configuring values for the currently assigned mA Output process variable.

Ensure that the measurement unit for the configured process variable has been set as desired.

Note
If you change **LRV** and **URV** from the factory default values, and you later change **mA Output Process Variable**, **LRV** and **URV** will not be reset to the default values. For example, if you set **mA Output Process Variable** to Mass Flow Rate and change the **LRV** and **URV**, then you set **mA Output Process Variable** to Density, and finally you change **mA Output Process Variable** back to Mass Flow Rate, **LRV** and **URV** for Mass Flow Rate are reset to the values that you configured.

Procedure

Set **LRV** and **URV** as desired.

- **LRV** is the value of **mA Output Process Variable** represented by an output of 0 or 4 mA. The default value for **LRV** depends on the setting of **mA Output Process Variable**. Enter **LRV** in the measurement units that are configured for **mA Output Process Variable**.
- **URV** is the value of **mA Output Process Variable** represented by an output of 20 mA. The default value for **URV** depends on the setting of **mA Output Process Variable**. Enter **URV** in the measurement units that are configured for **mA Output Process Variable**.

Tip
For best performance:

- Set **LRV** ≥ **LSL** (lower sensor limit).
- Set **URV** ≤ **USL** (upper sensor limit).
- Set these values so that the difference between **URV** and **LRV** is ≥ **Min Span** (minimum span).

Defining **URV** and **LRV** within the recommended values for **Min Span**, **LSL**, and **USL** ensures that the resolution of the mA Output signal is within the range of the bit precision of the D/A converter.

The mA Output uses a range of 4–20 mA or 0–20 mA to represent **mA Output Process Variable**. Between **LRV** and **URV**, the mA Output is linear with the process variable. If the process variable drops below **LRV** or rises above **URV**, the transmitter posts an output saturation alert.

6.1.3 Default values for **Lower Range Value** (LRV) and **Upper Range Value** (URV)

Each option for **mA Output Process Variable** has its own **LRV** and **URV**. If you change the configuration of **mA Output Process Variable**, the corresponding **LRV** and **URV** are loaded and used.

Table 6-1: Default values for Lower Range Value (LRV) and Upper Range Value (URV)

Process variable	LRV	URV
All mass flow variables	−200.000 g/sec	200.000 g/sec
All liquid volume flow variables	−0.200 l/sec	0.200 l/sec
Gas standard volume flow	−423.78 SCFM	423.78 SCFM
Concentration	0%	100%
Baume	0	10
Specific gravity	0	10

6.1.4 Configure Added Damping

Display	Not available
ProLink III	**Device Tools → Configuration → I/O → Outputs → mA Output**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → mA Output 1 → mA Output Settings → PV Added Damping** **Configure → Manual Setup → Inputs/Outputs → mA Output 2 → mA Output Settings → PV Added Damping**

Added Damping controls the amount of damping that will be applied to the mA Output.

Damping is used to smooth out small, rapid fluctuations in process measurement. **Damping Value** specifies the time period (in seconds) over which the transmitter will spread changes in the process variable. At the end of the interval, the internal value will reflect 63% of the change in the actual measured value.

Added Damping affects the reporting of **mA Output Process Variable** through the mA Output only. It does not affect the reporting of that process variable via any other method (e.g., a Frequency Output or digital communications), or the value of the process variable used in calculations.

Note
Added Damping is not applied if the mA Output is fixed (for example, during loop testing) or if the mA Output is reporting a fault. **Added Damping** is applied while sensor simulation is active.

Procedure

Set **Added Damping** to the desired value.

The default value is 0.0 seconds. The range is 0.0 to 440 seconds.

When you specify a value for **Added Damping**, the transmitter automatically rounds the value down to the nearest valid value.

Table 6-2: Valid values for Added Damping

Valid values for Added Damping
0.0, 0.1, 0.3, 0.75, 1.6, 3.3, 6.5, 13.5, 27.5, 55, 110, 220, 440

Interaction between mA Output Damping and process variable damping

When **mA Output Source** is set to a flow rate variable, density, or temperature, **mA Output Damping** interacts with **Flow Damping**, **Density Damping**, or **Temperature Damping**. If multiple damping parameters are applicable, the effect of damping the process variable is calculated first, and the mA Output damping calculation is applied to the result of that calculation.

Damping interaction

Configuration:

- **Flow Damping** = 1 second
- **mA Output Source** = Mass Flow Rate
- **mA Output Damping** = 2 seconds

Result: A change in the mass flow rate will be reflected in the mA Output over a time period that is greater than 3 seconds. The exact time period is calculated by the transmitter according to internal algorithms which are not configurable.

6.1.5 Configure mA Output Fault Action and mA Output Fault Level

Display	Not available
ProLink III	**Device Tools → Configuration → Fault Processing**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → mA Output 1 → MA01 Fault Settings** **Configure → Manual Setup → Inputs/Outputs → mA Output 2 → MA02 Fault Settings**

mA Output Fault Action controls the behavior of the mA Output if the transmitter encounters an internal fault condition.

Note
For some faults only: If **Fault Timeout** is set to a non-zero value, the transmitter will not implement the fault action until the timeout has elapsed.

Procedure

1. Set **mA Output Fault Action** to the desired value.

   The default setting is Downscale.

   Restriction
   If **Digital Communications Fault Action** is set to NAN (not a number), you cannot set **mA Output Fault Action** or **Frequency Output Fault Action** to None. If you try to do this, the transmitter will not accept the configuration.

2. If you set **mA Output Fault Action** to Upscale or Downscale, set **mA Output Fault Level** as desired.

Postrequisites

CAUTION
If you set **mA Output Fault Action** or **Frequency Output Fault Action** to None, be sure to set **Digital Communications Fault Action** to None. If you do not, the output will not report actual process data, and this may result in measurement errors or unintended consequences for your process.

Options for mA Output Fault Action and mA Output Fault Level

Option	mA Output behavior	mA Output Fault Level
Upscale	Goes to the configured fault level	Default: 22.0 mA Range: 21.0 to 24.0 mA
Downscale (default)	Goes to the configured fault level	Default: 2.0 mA Range: 1.0 to 3.6 mA
Internal Zero	Goes to the mA Output level associated with a process variable value of 0 (zero), as determined by **Lower Range Value** and **Upper Range Value** settings	Not applicable
None	Tracks data for the assigned process variable; no fault action	Not applicable

6.2 Configure the Frequency Output

The Frequency Output is used to report a process variable for mass or volume flow. Frequency Output does not report density, temperature, or differential pressure. The Frequency Output parameters control how the process variable is reported.

Important
Whenever you change a Frequency Output parameter, verify all other Frequency Output parameters before returning the flowmeter to service. In some situations, the transmitter automatically loads a set of stored values, and these values may not be appropriate for your application.

6.2.1 Configure Frequency Output Power Source

Display	**OFF-LINE MAINT → OFF-LINE CONFG → IO → FO → POWER**
ProLink III	**Device Tools → Configuration → I/O → Channels**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Frequency Output → FO Settings → Power Source**

Use **Frequency Output Power Source** to set the power source for the Frequency Output. The power configuration must match the wiring for the Frequency Output.

Procedure

Set **Frequency Output Power Source** as desired.

Option	Description
Internal	The output is powered by the transmitter.

Option	Description
External	The output is powered by an external power source.

6.2.2 Configure Frequency Output Process Variable

Display	**OFF-LINE MAINT → OFF-LINE CONFG → IO → FO**
ProLink III	**Device Tools → Configuration → I/O → Outputs → Frequency Output**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Frequency Output**

Frequency Output Process Variable controls the variable that is reported over the Frequency Output.

Prerequisites

If you plan to configure the output to report volume flow, ensure that you have set **Volume Flow Type** as desired: Liquid or Gas Standard Volume.

If you plan to configure an output to report a concentration measurement process variable, ensure that the concentration measurement application is configured so that the desired variable is available.

Procedure

Set **Frequency Output Process Variable** as desired.

The default setting is Mass Flow Rate.

Options for Frequency Output Process Variable

The transmitter provides a basic set of options for **Frequency Output Process Variable**, plus several application-specific options. Different communications tools may use different labels for the options.

6.2.3 Configure Frequency Output Polarity

Display	**OFF-LINE MAINT → OFF-LINE CONFG → IO → FO → POLAR**
ProLink III	**Device Tools → Configuration → I/O → Outputs → Frequency Output**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Frequency Output → FO Settings → FO Polarity**

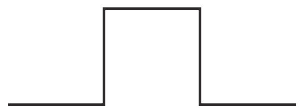
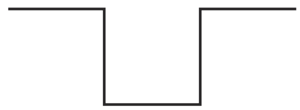
Frequency Output Polarity controls how the output indicates the ON (active) state. The default value, Active High, is appropriate for most applications. Your receiving device might require an Active Low setting.

Procedure

Set **Frequency Output Polarity** as desired.

The default setting is Active High.

Options for Frequency Output Polarity

Polarity option		Reference voltage (OFF)	Pulse voltage (ON)
Active High		0	As determined by power supply, pull-up resistor, and load. See the installation manual for your transmitter.
Active Low		As determined by power supply, pull-up resistor, and load. See the installation manual for your transmitter.	0

6.2.4 Configure Frequency Output Scaling Method

Display	**OFF-LINE MAINT → OFF-LINE CONFG → IO → FO → SCALE**
ProLink III	**Device Tools → Configuration → I/O → Outputs → Frequency Output**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Frequency Output → FO Scaling**

Frequency Output Scaling Method defines the relationship between output pulse and flow units. Set **Frequency Output Scaling Method** as required by your frequency receiving device.

Procedure

1. Set **Frequency Output Scaling Method**.

Option	Description
Frequency=Flow (default)	Frequency calculated from flow rate
Pulses/Unit	A user-specified number of pulses represents one flow unit
Units/Pulse	A pulse represents a user-specified number of flow units

2. Set additional required parameters.
   - If you set **Frequency Output Scaling Method** to Frequency=Flow, set **Rate Factor** and **Frequency Factor**.
   - If you set **Frequency Output Scaling Method** to Pulses/Unit, define the number of pulses that will represent one flow unit.
   - If you set **Frequency Output Scaling Method** to Units/Pulse, define the number of units that each pulse will indicate.

   For all scaling methods, the transmitter puts out a fixed number of pulses per unit, and at the same time, the Frequency Output signal varies in proportion to flowrate.

Calculate frequency from flow rate

The Frequency=Flow option is used to customize the Frequency Output for your application when you do not know appropriate values for Units/Pulse or Pulses/Unit.

If you specify Frequency=Flow, you must provide values for **Rate Factor** and **Frequency Factor**:

Rate Factor The maximum flow rate that you want the Frequency Output to report.

Frequency Factor A value calculated as follows:

$$FrequencyFactor \frac{RateFactor}{T} \times N$$

where:

T Factor to convert selected time base to seconds

N Number of pulses per flow unit, as configured in the receiving device

The resulting **Frequency Factor** must be within the range of the Frequency Output 0 to 10,000 Hz :

- If **Frequency Factor** is less than1 Hz, reconfigure the receiving device for a higher pulses/unit setting.
- If **Frequency Factor** is greater than 10,000 Hz, reconfigure the receiving device for a lower pulses/unit setting.

Configure Frequency=Flow

You want the Frequency Output to report all flow rates up to 2000 kg/min.

The frequency receiving device is configured for 10 pulses/kg.

Solution:

$$FrequencyFactor \frac{RateFactor}{T} \times N$$

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

$$FrequencyFactor = 333.33$$

Set parameters as follows:

- **Rate Factor**: `2000`
- **Frequency Factor**: `333.33`

6.2.5 Configure Frequency Output Fault Action and Frequency Output Fault Level

Display	Not available
ProLink III	**Device Tools → Configuration → Fault Processing**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Frequency Output → FO Fault Parameters → FO Fault Action** **Configure → Manual Setup → Inputs/Outputs → Frequency Output → FO Fault Parameters → FO Fault Level**

Frequency Output Fault Action controls the behavior of the Frequency Output if the transmitter encounters an internal fault condition.

Note
For some faults only: If **Fault Timeout** is set to a non-zero value, the transmitter will not implement the fault action until the timeout has elapsed.

Procedure

1. Set **Frequency Output Fault Action** as desired.
   The default value is Downscale (0 Hz).
2. If you set **Frequency Output Fault Action** to Upscale, set **Frequency Fault Level** to the desired value.
   The default value is 15000 Hz. The range is 10 to 15000 Hz.

Options for Frequency Output Fault Action

Table 6-3: Options for Frequency Output Fault Action

Label	Frequency Output behavior
Upscale	Goes to configured Upscale value: • Range: 10 Hz to 15000 Hz • Default: 15000 Hz
Downscale	0 Hz
Internal Zero	0 Hz
None (default)	Tracks data for the assigned process variable; no fault action

CAUTION
If you set **mA Output Fault Action** or **Frequency Output Fault Action** to None, be sure to set **Digital Communications Fault Action** to None. If you do not, the output will not report actual process data, and this may result in measurement errors or unintended consequences for your process.

Restriction
If **Digital Communications Fault Action** is set to NAN (not a number), you cannot set **mA Output Fault Action** or **Frequency Output Fault Action** to None. If you try to do this, the transmitter will not accept the configuration.

6.3 Configure the Discrete Output

The Discrete Output is used to report specific meter or process conditions. The Discrete Output parameters control which condition is reported and how it is reported.

Important
Whenever you change a Discrete Output parameter, verify all other Discrete Output parameters before returning the meter to service. In some situations, the transmitter automatically loads a set of stored values, and these values may not be appropriate for your application.

6.3.1 Configure Discrete Output Power Source

Display	**OFF-LINE MAINT → OFF-LINE CONFG → IO → DO → POWER**
ProLink III	**Device Tools → Configuration → I/O → Channels**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Discrete Output → Power Source**

Use **Discrete Output Power Source** to set the output power source for the Discrete Output. The power configuration must match the wiring for the Discrete Output.

Procedure

Set **Discrete Output Power Source** as desired.

Option	Description
Internal	The output is powered by the transmitter
External	The output is powered by an external power source.

6.3.2 Configure Discrete Output Source

Display	**OFF-LINE MAINT → OFF-LINE CONFG → IO → DO → SRC**
ProLink III	**Device Tools → Configuration → I/O → Outputs → Discrete Output**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Discrete Output → DO Assignment**

Discrete Output Source controls which device condition or process condition is reported via the Discrete Output.

Procedure

Set **Discrete Output Source** to the desired option.

The default setting for **Discrete Output Source** is Flow Direction.

Options for Discrete Output Source

Option	Label			State	Discrete Output voltage
	Display	ProLink III	Field Communicator		
Discrete Event 1–5 (1)	D EV x	Enhanced Event 1 Enhanced Event 2 Enhanced Event 3 Enhanced Event 4 Enhanced Event 5	Discrete Event x	ON	Site-specific
				OFF	0 V
Event 1–2 (2)	EVNT1 EVNT2 E1OR2	Event 1 Event 2 Event 1 or Event 2 Status	Event 1 Event 2 Event 1 or Event 2	ON	Site-specific
				OFF	0 V
Flow Switch	FL SW	Flow Switch Indication	Flow Switch	ON	Site-specific
				OFF	0 V
Flow Direction	FLDIR	Forward/Reverse Indication	Forward/Reverse	Forward flow	0 V
				Reverse flow	Site-specific
Calibration in Progress	ZERO	Calibration in Progress	Calibration in Progress	ON	Site-specific
				OFF	0 V

Option	Label			State	Discrete Output voltage
	Display	ProLink III	Field Communicator		
Fault	FAULT	Fault Indication	Fault	ON	Site-specific
				OFF	0 V

(1) Events configured using the enhanced event model.
(2) Events configured using the basic event model.

Important
If you assign Flow Switch to the Discrete Output, you should also configure **Flow Switch Variable**, **Flow Switch Setpoint**, and **Hysteresis**.

Related information

Configure an enhanced event
Fault indication with a Discrete Output

Configure Flow Switch parameters

Display	**OFF-LINE MAINT → OFF-LINE CONFG → IO → DO → CONFIG FL SW**
ProLink III	**Device Tools → Configuration → I/O → Outputs → Discrete Output**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Discrete Output → DO Assignment** **Configure → Manual Setup → Inputs/Outputs → Discrete Output → Flow Switch Source** **Configure → Manual Setup → Inputs/Outputs → Discrete Output → Flow Switch Setpoint**

Flow Switch is used to indicate that the flow rate (measured by the configured flow variable) has moved past the configured setpoint, in either direction. The flow switch is implemented with a user-configurable hysteresis.

Procedure

1. Set **Discrete Output Source** to Flow Switch, if you have not already done so.
2. Set **Discrete Output Source** to Velocity Switch, if you have not already done so.
3. Set **Flow Switch Variable** to the flow variable that you want to use to control the flow switch.
4. Set **Flow Switch Setpoint** to the value at which the flow switch will be triggered (after **Hysteresis** is applied).
   - If the flow rate is below this value, the Discrete Output is ON.
   - If the flow rate is above this value, the Discrete Output is OFF.
5. Set **Hysteresis** to the percentage of variation above and below the setpoint that will operate as a deadband.

   Hysteresis defines a range around the setpoint within which the flow switch will not change. The default is 5%. The valid range is 0.1% to 10%.

Example

If **Flow Switch Setpoint** = `100` g/sec and **Hysteresis** = `5%`, and the first measured flow rate is above 100 g/sec, the Discrete Output is OFF. It will remain OFF unless the flow rate drops below 95 g/sec. If this happens, the Discrete Output will turn ON, and remain ON until the flow rate rises above 105 g/sec. At this point it turns OFF and will remain OFF until the flow rate drops below 95 g/sec.

6.3.3 Configure Discrete Output Polarity

Display	Not available
ProLink III	**Device Tools → Configuration → I/O → Outputs → Discrete Output**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Discrete Output → DO Polarity**

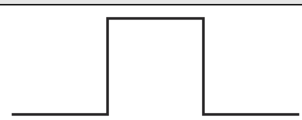
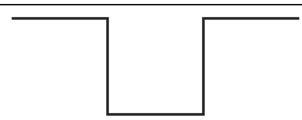
Discrete Outputs have two states: ON (active) and OFF (inactive). Two different voltage levels are used to represent these states. **Discrete Output Polarity** controls which voltage level represents which state.

Procedure

Set **Discrete Output Polarity** as desired.

The default setting is Active High.

Options for Discrete Output Polarity

Polarity option		Discrete output power supply	Description
Active High		Internal	• When asserted (condition tied to DO is true), the circuit provides a pull-up to 15 V. • When not asserted (condition tied to DO is false), the circuit provides 0 V.
		External	• When asserted (condition tied to DO is true), the circuit provides a pull-up to a site-specific voltage, maximum 30 V. • When not asserted (condition tied to DO is false), the circuit provides 0 V.
Active Low		Internal	• When asserted (condition tied to DO is true), the circuit provides 0 V. • When not asserted (condition tied to DO is false), the circuit provides a pull-up to 15 V.

Polarity option		Discrete output power supply	Description
		External	• When asserted (condition tied to DO is true), the circuit provides 0 V. • When not asserted (condition tied to DO is false), the circuit provides a pull-up to a site-specific voltage, to a maximum of 30 V.

6.3.4 Configure Discrete Output Fault Action

Display	Not available
ProLink III	**Device Tools → Configuration → Fault Processing**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Discrete Output → DO Fault Action**

Discrete Output Fault Action controls the behavior of the Discrete Output if the transmitter encounters an internal fault condition.

Note
For some faults only: If **Fault Timeout** is set to a non-zero value, the transmitter will not implement the fault action until the timeout has elapsed.

CAUTION
Do not use **Discrete Output Fault Action** as a fault indicator. If you do, you may not be able to distinguish a fault condition from a normal operating condition. If you want to use the Discrete Output as a fault indicator, set **Discrete Output Source** to Fault and set **Discrete Output Fault Action** to None.

Procedure

Set **Discrete Output Fault Action** as desired.

The default setting is None.

Related information

Fault indication with a Discrete Output

Options for Discrete Output Fault Action

Label	Discrete Output behavior
Upscale	• Fault: Discrete Output is ON (site-specific voltage) • No fault: Discrete Output is controlled by its assignment
Downscale	• Fault: Discrete Output is OFF (0 V) • No fault: Discrete Output is controlled by its assignment
None (default)	Discrete Output is controlled by its assignment

Fault indication with a Discrete Output

To indicate faults via a Discrete Output, set **Discrete Output Source** to Fault. Then, if a fault occurs, the Discrete Output is always ON and the setting of **Discrete Output Fault Action** is ignored.

6.4 Configure the Discrete Input

The Discrete Input is used to initiate one or more transmitter actions from a remote input device. Your transmitter has one Discrete Input.

The Discrete Input parameters include:

- **Discrete Input Action**
- **Discrete Input Polarity**

Important
Whenever you change a Discrete Input parameter, verify all other Discrete Input parameters before returning the flowmeter to service. In some situations, the transmitter automatically loads a set of stored values, and these values may not be appropriate for your application.

6.4.1 Configure Discrete Input Action

Display	**OFF-LINE MAINT → OFF-LINE CONFG → IO → DI → DI ACT**
ProLink III	**Device Tools → Configuration → I/O → Action Assignment**
Field Communicator	**Configure → Alert Setup → Discrete Events → Assign Discrete Action**

Discrete Input Action controls the action or actions that the transmitter will perform when the Discrete Input transitions from OFF to ON.

Important
Before assigning actions to an enhanced event or Discrete Input, check the status of the event or the remote input device. If it is ON, all assigned actions will be performed when the new configuration is implemented. If this is not acceptable, wait until an appropriate time to assign actions to the event or Discrete Input.

Procedure

1. Select an action.
2. Select the Discrete Input that will perform the selected action.
3. Repeat until you have assigned all the actions to be performed by the Discrete Input.

Options for Discrete Input Action

Action	Label		
	Display	**ProLink III**	**Field Communicator**
Standard			
None (default)	NONE	None	None
Start sensor zero	START ZERO	Start Sensor Zero	Perform auto zero
Start/stop all totalizers	START STOP	Start/Stop All Totalization	Start/stop totals

Action	Label		
	Display	**ProLink III**	**Field Communicator**
Reset mass total	RESET MASS	Reset Mass Total	Reset mass total
Reset volume total	RESET VOL	Reset Volume Total	Reset volume total
Reset gas standard volume total	RESET GSVT	Reset Gas Std Volume Total	Reset gas standard volume total
Reset all totals	RESET ALL	Reset All Totals	Reset totals
Petroleum measurement			
Reset volume total at reference temperature	TCVOL	Reset Volume Total at Reference Temperature	Reset corrected volume total
Concentration measurement			
Reset CM reference volume total	RESET STD V	Reset Volume Total at Reference Temperature	Not available
Reset CM net mass total	RESET NET M	Reset Net Mass Total	Not available
Reset CM net volume total	RESET NET V	Reset Net Volume Total	Not available
Increment CM matrix	INCr CURVE	Increment Concentration Matrix	Not available

Important

Before assigning actions to an enhanced event or Discrete Input, check the status of the event or the remote input device. If it is ON, all assigned actions will be performed when the new configuration is implemented. If this is not acceptable, wait until an appropriate time to assign actions to the event or Discrete Input.

6.4.2 Configure Discrete Input Polarity

Display	**OFF-LINE MAINT → OFF-LINE CONFG → IO → DI → DI POLAR**
ProLink III	**Device Tools → Configuration → I/O → Inputs → Discrete Input**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Discrete Input → Polarity**

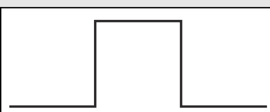
The Discrete Input has two states: ON and OFF. **Discrete Input Polarity** controls how the transmitter maps the incoming voltage level to the ON and OFF states.

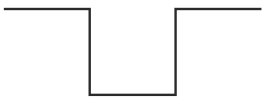
Procedure

Set **Discrete Input Polarity** as desired.

The default setting is Active Low.

Options for Discrete Input Polarity

Polarity option		Discrete Input power supply	Voltage	Status of discrete input at transmitter
Active High		Internal	Voltage across terminals is high	ON

Polarity option		Discrete Input power supply	Voltage	Status of discrete input at transmitter
			Voltage across terminals is 0 VDC	OFF
		External	Voltage applied across terminals is 3–30 VDC	ON
			Voltage applied across terminals is <0.8 VDC	OFF
Active Low		Internal	Voltage across terminals is 0 VDC	ON
			Voltage across terminals is high	OFF
		External	Voltage applied across terminals is <0.8 VDC	ON
			Voltage applied across terminals is 3–30 VDC	OFF

6.5 Configure the mA Input

Display	**OFF-LINE MAINT → OFF-LINE CONFG → IO → MAI**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Milliamp Input**

The mA Input is used to receive pressure or temperature data from an external measurement device.

The mA Input parameters include:

- **mA Input Process Variable**
- **Lower range value** (LRV)
- **Upper range value** (URV)

Important
Whenever you change an mA Input parameter, verify all other mA Input parameters before returning the flowmeter to service. In some situations, the transmitter automatically loads a set of stored values, and these values may not be appropriate for your application.

6.5.1 Configure mA Input Process Variable

Display	**OFF-LINE MAINT → OFF-LINE CONFG → IO → MAI → AI SRC**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Milliamp Input → mA Input Variable Assignment**

mA Input Process Variable specifies the type of process data that you are receiving from the external measurement device.

Procedure

1. Set **mA Input Process Variable** as desired.

Option	Description
None	No external data
External pressure	The remote device measures pressure.
External temperature	The remote device measures temperature.

The default setting is **None**.

2. Configure the transmitter's measurement units to match the measurement units used by the remote device.
   - To configure pressure measurement units:
     - Using the display, choose **OFF-LINE MAINT** → **OFF-LINE CONFG** → **UNITS** → **PRESS**
     - Using ProLink III, choose **ProLink** → **Configuration** → **Pressure** → **Pressure Units**
     - Using the Field Communicator, press **Configure** → **Manual Setup** → **Measurements** → **External Compensation** → **Pressure Unit**
   - To configure temperature measurement units, see the section on configuring the temperature measurement unit.

6.5.2 Configure Lower Range Value (LRV) and Upper Range Value (URV)

Display	**OFF-LINE MAINT** → **OFF-LINE CONFG** → **IO** → **MAI** → **AI 4 mA** **OFF-LINE MAINT** → **OFF-LINE CONFG** → **IO** → **MAI** → **AI 20 mA**
Field Communicator	mA Input LRV: **Configure** → **Manual Setup** → **Inputs/Outputs** → **Milliamp Input** → **mA Input LRV** mA Input URV: **Configure** → **Manual Setup** → **Inputs/Outputs** → **Milliamp Input** → **mA Input URV**

The **Lower Range Value** (LRV) and **Upper Range Value** (URV) are used to scale the readings received from the external measurement device, i.e., to define the relationship between **mA input Process Variable** and the mA Input level received. Between **LRV** and **URV**, the mA Input is linear with the process variable. If the process variable drops below **LRV** or rises above **URV**, the transmitter posts an external input error.

Prerequisites

Verify that you have set the measurement units for the pressure or temperature to match the units configured at the external measurement device. For example, if the external measurement device is set to send pressure data in PSI, you must set the pressure measurement units to be PSI at your transmitter.

Procedure

1. Set **LRV** as desired.

   Tip
   Set the **LRV** to match the lower range value at the remote device.

2. Set **URV** as desired.

   Tip
   Set the **URV** to match the upper range value at the remote device.

6.6 Configure events

An event occurs when the real-time value of a user-specified process variable moves past a user-defined setpoint. Events are used to provide notification of process changes or to perform specific transmitter actions if a process change occurs.

Your transmitter supports two event models:

- Basic event model
- Enhanced event model

6.6.1 Configure a basic event

Display	Not available
ProLink III	**Device Tools → Configuration → Events → Basic Events**
Field Communicator	**Configure → Alert Setup → Discrete Events**

A basic event is used to provide notification of process changes. A basic event occurs (is ON) if the real-time value of a user-specified process variable moves above (Active High) or below (Active Low) a user-defined setpoint. You can define up to two basic events. Event status can be queried via digital communications, and a Discrete Output can be configured to report event status.

Procedure

1. Select the event that you want to configure.
2. Specify **Type**.

Option	Description
Active High	$x > A$ The event occurs when the value of the assigned process variable (x) is greater than the setpoint (**Setpoint A**), endpoint not included.
Active Low	$x < A$ The event occurs when the value of the assigned process variable (x) is less than the setpoint (**Setpoint A**), endpoint not included.

3. Assign a process variable to the event.
4. Set a value for **Setpoint A**.
5. Optional: Configure a Discrete Output to switch states in response to the event status.

6.6.2 Configure an enhanced event

Display	Not available
ProLink III	**Device Tools → Configuration → Events → Enhanced Events**
Field Communicator	**Configure → Alert Setup → Discrete Events → Discrete Events 1–5**

An enhanced event is used to provide notification of process changes and, optionally, to perform specific transmitter actions if the event occurs. An enhanced event occurs (is ON) if the real-time value of a user-specified process variable moves above (HI) or below (LO) a user-defined setpoint, or in range (IN) or out of range (OUT) with respect to two user-defined setpoints. You can define up to five enhanced events.

Procedure

1. Select the event that you want to configure.
2. Specify **Event Type**.

Option	Description
HI	$x > A$ The event occurs when the value of the assigned process variable (*x*) is greater than the setpoint (**Setpoint A**), endpoint not included.
LO	$x < A$ The event occurs when the value of the assigned process variable (*x*) is less than the setpoint (**Setpoint A**), endpoint not included.
IN	$A \le x \le B$ The event occurs when the value of the assigned process variable (*x*) is *in range,* that is, between **Setpoint A** and **Setpoint B**, endpoints included.
OUT	$x \le A$ or $x \ge B$ The event occurs when the value of the assigned process variable (*x*) is *out of range,* that is, less than **Setpoint A** or greater than **Setpoint B**, endpoints included.

3. Assign a process variable to the event.
4. Set values for the required setpoints.
   - For HI and LO events, set **Setpoint A**.
   - For IN and OUT events, set **Setpoint A** and **Setpoint B**.
5. Optional: Configure a Discrete Output to switch states in response to the event status.

6.7 Configure digital communications

The digital communications parameters control how the transmitter will communicate using digital communications.

Your transmitter supports the following types of digital communications:

- HART/Bell 202 over the primary mA terminals
- HART/RS-485 over the RS-485 terminals
- Modbus/RS-485 over the RS-485 terminals
- Modbus RTU via the service port

Note
The service port responds automatically to a wide range of connection requests. It is not configurable.

Important
The service port clips on the user interface of the transmitter are directly connected to the RS-485 terminals (26 and 27). If you wire the transmitter for RS-485 digital communications, you cannot use the service port clips for communication with the transmitter.

6.7.1 Configure HART/Bell 202 communications

HART/Bell 202 communications parameters support HART communications with the transmitter's primary mA terminals over a HART/Bell 202 network.

Configure basic HART parameters

Basic HART parameters include the HART address, HART tags, and the operation of the primary mA Output.

HART/Bell 202 communications parameters support HART communication with the transmitter's primary mA terminals over a HART/Bell 202 network. The HART/Bell 202 communications parameters include:

- HART Address (Polling Address)
- mA Output Action
- Burst Parameters (optional)
- HART Variables (optional)

Procedure

1. Set **HART Address** to a value that is unique on your network.
   - Default: 0
   - Range: 0 to 15

   Tip
   - The default address is typically used unless you are in a multidrop environment.
   - Devices using HART protocol to communicate with the transmitter may use either **HART Address** or **HART Tag (Software Tag)** to identify the transmitter. Configure either or both, as required by your other HART devices.

2. Ensure that **mA Output Action** is configured appropriately.

Option	Description
Enabled (Live)	The primary mA Output reports process data as configured.
Disabled (Fixed)	The primary mA Output is fixed at 4 mA and does not report process data.

Important
If you use ProLink III to set **HART Address** to `0`, the program automatically enables **mA Output Action**. If you use ProLink III to set **HART Address** to any other value, the program automatically disables **mA Output Action**. This is designed to make it easier to configure the transmitter for legacy behavior. Always verify **mA Output Action** after setting **HART Address**.

Configure burst parameters

Display	Not available
ProLink III	**Device Tools → Configuration → Communications → Communications (HART)**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Communications → HART Burst Mode**

Burst mode is a mode of communication during which the transmitter regularly broadcasts HART digital information over the primary mA Output. The burst parameters control the information that is broadcast when burst mode is enabled.

Tip

In typical installations, burst mode is disabled. Enable burst mode only if you are using a HART Triloop.

Procedure

1. Enable **Burst Mode**.
2. Set **Burst Mode Output** as desired.

Label		Description
ProLink III	**Field Communicator**	
Source (Primary Variable)	PV	The transmitter sends the primary variable (PV) in the configured measurement units in each burst (e.g., 14.0 g/sec, 13.5 g/sec, 12.0 g/sec.
Primary Variable (Percent Range/Current)	% range/current	The transmitter sends the PV's percent of range and the PV's actual mA level in each burst (e.g., 25%, 11.0 mA.
Process Variables/Current	Process variables/current	The transmitter sends PV, SV, TV, and QV values in measurement units and the PV's actual milliamp reading in each burst (e.g., 50 g/sec, 23 °C, 50 g/sec, 0.0023 g/cm3, 11.8 mA.
Transmitter variables	Fld dev var	The transmitter sends four user-specified process variables in each burst.

3. Ensure that the burst output variables are set appropriately.
   - If you set **Burst Mode Output** to send four user-specified variables, set the four process variables to be sent in each burst.
   - If you set **Burst Mode Output** to any other option, ensure that the HART variables are set as desired.

Configure HART variables (PV, SV, TV, QV)

Display	Not available
ProLink III	**Device Tools → Configuration → Communications → Communications (HART)**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Variable Mapping**

The HART variables are a set of four variables predefined for HART use. The HART variables include the Primary Variable (PV), Secondary Variable (SV), Tertiary Variable (TV), and Quaternary Variable (QV). You can assign specific process variables to the HART variables, and then use standard HART methods to read or broadcast the assigned process data.

Tip
The Tertiary Variable and Quaternary Variable are also called the Third Variable (TV) and Fourth Variable (FV).

Options for HART variables

Process variable	Primary Variable (PV)	Secondary Variable (SV)	Third Variable (TV)	Fourth Variable (QV)
Standard				
Mass flow rate	✓	✓	✓	✓
Line (Gross) Volume flow rate	✓	✓	✓	✓
Temperature	✓	✓		✓
Density	✓	✓		✓
Drive gain	✓	✓		✓
Mass total				✓
Line (Gross) Volume total				✓
Mass inventory				✓
Line (Gross) Volume inventory				✓
Tube frequency				✓
Meter temperature (T-Series)				✓
Meter temperature				✓
LPO amplitude				✓
RPO amplitude				✓
Board temperature				✓
External pressure	✓	✓		✓
External temperature	✓	✓		✓
Gas standard volume flow rate	✓	✓	✓	✓
Gas standard volume total				✓
Gas standard volume inventory				✓
Live zero				✓
Petroleum measurement				
API density	✓	✓		✓
API volume flow rate	✓	✓	✓	✓
API volume total				✓
API volume inventory				✓
API average density	✓	✓		✓
API average temperature	✓	✓		✓
API CTL				✓

Process variable	Primary Variable (PV)	Secondary Variable (SV)	Third Variable (TV)	Fourth Variable (QV)
Concentration measurement				
CM density at reference temperature	✓	✓		✓
ED density at reference temperature	✓	✓		✓
CM specific gravity	✓	✓		✓
ED specific gravity	✓	✓		✓
CM standard volume flow rate	✓	✓	✓	✓
ED standard volume flow rate	✓	✓	✓	✓
CM standard volume total				✓
ED standard volume total				✓
CM standard volume inventory				✓
ED standard volume inventory				✓
CM net mass flow rate	✓	✓	✓	✓
ED net mass flow rate	✓	✓	✓	✓
CM net mass total				✓
ED net mass total				✓
CM net mass inventory				✓
ED net mass inventory				✓
CM net volume flow rate	✓	✓	✓	✓
ED net volume flow rate	✓	✓	✓	✓
CM net volume total				✓
ED net volume total				✓
CM net volume inventory				✓
ED net volume inventory				✓
CM concentration	✓	✓		✓
ED concentration	✓	✓		✓
CM Baume	✓	✓		✓
ED Baume	✓	✓		✓

Interaction of HART variables and transmitter outputs

The HART variables are automatically reported through specific transmitter outputs. They may also be reported through HART burst mode, if enabled on your transmitter.

Table 6-4: HART variables and transmitter outputs

HART variable	Reported via	Comments
Primary Variable (PV)	Primary mA output	If one assignment is changed, the other is changed automatically, and vice versa.
Secondary Variable (SV)	Secondary mA Output	If one assignment is changed, the other is changed automatically, and vice versa. If your transmitter is not configured for a secondary mA Output, the SV must be configured directly, and the value of the SV is available only via digital communications.
Tertiary Variable (TV)	Frequency Output	If one assignment is changed, the other is changed automatically, and vice versa.
Quaternary Variable (QV)	Not associated with an output	The QV must be configured directly, and the value of the QV is available only via digital communications.

6.7.2 Configure HART/RS-485 communications

Display	Not available
ProLink III	**Device Tools → Configuration → Communications → Communications (HART)**
Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Communications → Setup RS-485 Port**

HART/RS-485 communications parameters support HART communication with the transmitter's RS-485 terminals.

HART/RS-485 communication parameters include:

- **HART Address** (Polling Address)

Procedure

1. Set **Protocol** to HART RS-485.
2. Set **Baud Rate** to match the baud rate that will be used by your HART master.
3. Set **Parity** to match the parity that will be used by your HART master.
4. Set **Stop Bits** to match the stop bits setting that will be used by your HART master.
5. Set **HART Address** to a unique value on your network.

   Valid address values are between 0 and 15. The default address (0) is typically used unless you are in a multidrop environment.

   Tip
   Devices using HART protocol to communicate with the transmitter may use either **HART Address** or **HART Tag** (**Software Tag**) to identify the transmitter. Configure either or both, as required by your other HART devices.

6.7.3 Configure Modbus/RS-485 communications

Display	**OFF-LINE MAINT → OFF-LINE CONFG → MBUS**
ProLink III	**Device Tools → Configuration → Communications → RS-485 Terminals**

Field Communicator	**Configure → Manual Setup → Inputs/Outputs → Communications → Setup RS-485 Port**

Modbus/RS-485 communications parameters control Modbus communication with the transmitter's RS-485 terminals.

Important
To minimize configuration requirements, the transmitter uses an auto-detection scheme when responding to a connection request. With this auto-detect feature, you do not need to enter some Modbus communication parameters.

Procedure

1. Set **Disable Modbus ASCII** as desired.

   Support for Modbus ASCII limits the set of addresses that are available for the transmitter's Modbus address.

Modbus ASCII support	Available Modbus addresses
Disabled	1–127, excluding 111 (111 is reserved to the service port)
Enabled	1–15, 32–47, 64–79, and 96–110

2. Set **Protocol** to match the protocol used by your Modbus/RS-485 host.

Option	Description
Modbus RTU (default)	8–bit communications
Modbus ASCII	7–bit communications

   If support for Modbus ASCII is disabled, you must use Modbus RTU.

3. Set **Modbus Address** to a unique value on the network.
4. Set **Floating-Point Byte Order** to match the byte order used by your Modbus host.

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

   See the following table for the bit structure of bytes 1 through 7.

Table 6-5: Bit structure of floating-point bytes

Byte	Bits	Definition
1	SEEEEEEE	S=Sign E=Exponent

Table 6-5: Bit structure of floating-point bytes *(continued)*

Byte	Bits	Definition
2	EMMMMMMM	E=Exponent M=Mantissa
3	MMMMMMMM	M=Mantissa
4	MMMMMMMM	M=Mantissa

5. (Optional) Set **Additional Communications Response Delay** in *delay units*.

   A delay unit is 2/3 of the time required to transmit one character, as calculated for the port currently in use and the character transmission parameters. Valid values range from 1 to 255.

   Additional Communications Response Delay is used to synchronize Modbus communications with hosts that operate at a slower speed than the transmitter. The value specified here will be added to each response the transmitter sends to the host.

   Tip
   Do not set **Additional Communications Response Delay** unless required by your Modbus host.

6.7.4 Configure Digital Communications Fault Action

Display	Not available
ProLink III	**Device Tools → Configuration → Fault Processing**
Field Communicator	**Configure → Alert Setup → Inputs/Outputs Fault Actions → Digital Communications**

Digital Communications Fault Action specifies the values that will be reported via digital communications if the device encounters an internal fault condition.

Procedure

Set **Digital Communications Fault Action** as desired.

The default setting is None.

Restriction

- If **mA Output Fault Action** or **Frequency Output Fault Action** is set to None, **Digital Communications Fault Action** should also be set to None. If you do not, the output will not report actual process data, and this may result in measurement errors or unintended consequences for your process.
- If you set **Digital Communications Fault Action** to NAN, you cannot set **mA Output Fault Action** or **Frequency Output Fault Action** to None. If you try to do this, the transmitter will not accept the configuration.

Options for Digital Communications Fault Action

Label		Description
ProLink III	**Field Communicator**	
Upscale	Upscale	• Process variable values indicate that the value is greater than the upper sensor limit. • Totalizers stop incrementing.
Downscale	Downscale	• Process variable values indicate that the value is lower than the lower sensor limit. • Totalizers stop incrementing.
Zero	IntZero-All 0	• Flow rate variables go to the value that represents a flow rate of 0 (zero). • Density is reported as `0`. • Temperature is reported as `0 °C`, or the equivalent if other units are used (e.g., `32 °F`. • Drive gain is reported as measured. • Totalizers stop incrementing.
Not a Number	Not-a-Number	• Process variables are reported as `IEEE NAN`. • Drive gain is reported as measured. • Modbus scaled integers are reported as `Max Int`. • Totalizers stop incrementing.
Flow to Zero	IntZero-Flow 0	• Flow rates are reported as `0`. • Other process variables are reported as measured. • Totalizers stop incrementing.
None	None (default)	• All process variables are reported as measured. • Totalizers increment if they are running.

CAUTION

If you set **mA Output Fault Action** or **Frequency Output Fault Action** to None, be sure to set **Digital Communications Fault Action** to None. If you do not, the output will not report actual process data, and this may result in measurement errors or unintended consequences for your process.

Restriction

If **Digital Communications Fault Action** is set to NAN (not a number), you cannot set **mA Output Fault Action** or **Frequency Output Fault Action** to None. If you try to do this, the transmitter will not accept the configuration.

6.8 Set up polling for temperature

Display	Not available
ProLink III	**Device Tools → Configuration → Process Measurement → Temperature**
Field Communicator	**Configure → Manual Setup → Measurements → External Compensation → External Polling**

The transmitter can poll an external temperature device for current temperature data. The external temperature value is used only by the petroleum measurement application or the concentration measurement application. If you do not have one of these applications, do not set up polling for temperature.

Prerequisites

Polling requires HART protocol over the Bell 202 physical layer. Ensure that the primary mA output on your transmitter has been wired for HART protocol, and that the external measurement device is accessible over the HART network.

Tip
To obtain value from using an external temperature value, the external measurement device must be reliable and must provide more accurate data than is available from the sensor.

Procedure

1. Select **Polled Variable 1** or **Polled Variable 2**.
2. Set **Polling Control**.

   Polling Control determines how the transmitter will access the external measurement device.

Option	Description
Primary	The transmitter is the only device that will access the external measurement device as a primary master.
Secondary	Another device on the network will access the external measurement device as a primary master.

   Tip
   If you set up polling for both temperature and pressure, use the same **Polling Control** option for both. If you do not, Primary will be used for both devices.

3. (ProLink II only) Click **Apply** to enable the polling controls.
4. Enter the device tag of the external measurement device.
5. Set **Process Variable** to Temperature.

Postrequisites

Verify that the transmitter is receiving the external data. To do this:

- Using ProLink III, click **ProLink → Process Variables** and check the **External Temperature** value.
- Using the Field Communicator, select **Overview → Primary Purpose Variables**.

Need help?
If the value is not correct:

1. Verify the HART tag of the external device.
2. Verify that the external device is powered up and online.
3. Verify the HART/mA connection between the transmitter and the external measurement device.

6.9 Set up polling for pressure

Display	Not available
ProLink III	**Device Tools → Configuration → Process Measurement → Pressure Compensation**
Field Communicator	**Configure → Manual Setup → Measurements → External Compensation → External Polling**

The transmitter can poll an external pressure device for current pressure data. The pressure value is used only for pressure compensation. If you are not implementing pressure compensation, do not set up polling for pressure.

Prerequisites

Polling requires HART protocol over the Bell 202 physical layer. Ensure that the primary mA output on your transmitter has been wired for HART protocol, and that the external measurement device is accessible over the HART network.

Tip
To obtain value from pressure compensation, the external measurement device must be reliable and accurate.

Procedure

1. Select **Polled Variable 1** or **Polled Variable 2**.
2. Set **Polling Control**.

   Polling Control determines how the transmitter will access the external measurement device.

Option	Description
Primary	The transmitter is the only device that will access the external measurement device as a primary master.
Secondary	Another device on the network will access the external measurement device as a primary master.

   Tip
   If you set up polling for both temperature and pressure, use the same **Polling Control** option for both. If you do not, Primary will be used for both devices.

3. Enter the device tag of the external measurement device.
4. Set **Process Variable** to Pressure.

Postrequisites

Verify that the transmitter is receiving the external data. To do this:

- Using the Field Communicator, select **Overview → Primary Purpose Variables**

Need help?

If the value is not correct:

1. Verify the HART tag of the external device.
2. Verify that the external device is powered up and online.
3. Verify the HART/mA connection between the transmitter and the external measurement device.

7 Complete the configuration

7.1 Back up transmitter configuration

ProLink III provides a configuration upload/download function which allows you to save configuration sets to your PC. This allows you to back up and restore your transmitter configuration. This is also a convenient way to replicate a configuration across multiple devices.

Restriction
This function is not available with any other communications tools.

Procedure

- To back up the transmitter configuration using ProLink III:
    a) Choose **Device Tools** → **Configuration Transfer** → **Save or Load Configuration Data**.
    b) In the **Configuration** groupbox, select the configuration data you want to save.
    c) Click **Save**, then specify a file name and location on your computer.
    d) Click **Start Save**.

The backup file is saved to the specified name and location. It is saved as a text file and can be read using any text editor.

7.2 Enable HART security

When HART security is enabled, HART protocol cannot be used to perform any action that requires writing to the transmitter. This includes configuration, calibration, resetting totalizers, and so on. This is an optional task.

Important
HART security affects both HART/Bell 202 and HART/RS-485. HART security does not affect any other protocol.

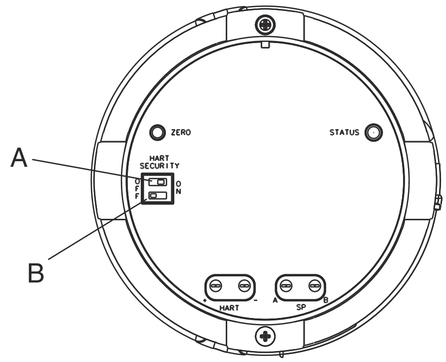
Procedure

1. Power down the device.

    CAUTION
    If the transmitter is in a hazardous area, you must power down the device before removing the transmitter housing cover. Removing the housing cover while the device is powered could cause an explosion.

2. Remove the transmitter housing cover.
3. Move the HART security switch to the ON position.

Figure 7-1: HART security switch (on blank display)



1. *A. HART security switch*
2. *B. Unused*

4. Replace the transmitter housing cover.
5. Power up the device.

7.3 Enable write-protection on the transmitter configuration

Display	**OFF-LINE MAINT → CONFIG → LOCK**
ProLink III	**Device Tools → Configuration → Write-Protection**
Field Communicator	**Configure → Manual Setup → Info Parameters → Transmitter Info → Write Protect**

If the transmitter is write-protected, the configuration is locked and nobody can change it until it is unlocked. This prevents accidental or unauthorized changes to the transmitter configuration parameters.

8 Transmitter operation

8.1 Record the process variables

Emerson suggests that you make a record of specific process variable measurements, including the acceptable range of measurements, under normal operating conditions. This data will help you recognize when the process or diagnostic variables are unusually high or low, and may help you diagnose and troubleshoot application issues.

Procedure

Record the following process and diagnostic variables, under normal operating conditions.

Variable	Measurement		
	Typical average	**Typical high**	**Typical low**
Flow rate			
Density			
Temperature			
Tube frequency			
Pickoff voltage			
Drive gain			

8.2 View process variables

Display	Scroll to the desired process variable. If **AutoScroll** is enabled, you can wait until the process variable is displayed. See View process variables using the display for more information.
ProLink III	View the desired variable on the main screen under **Process Variables**. See View process variables and other data using ProLink III for more information.
Field Communicator	**Overview → Shortcuts → Variables → Process Variables**

Process variables provide information about the state of the process fluid, such as flow rate, density, and temperature, as well as running totals. Process variables can also provide data about flowmeter operation, such as drive gain and pickoff voltage. This information can be used to understand and troubleshoot your process.

8.2.1 View process variables using the display

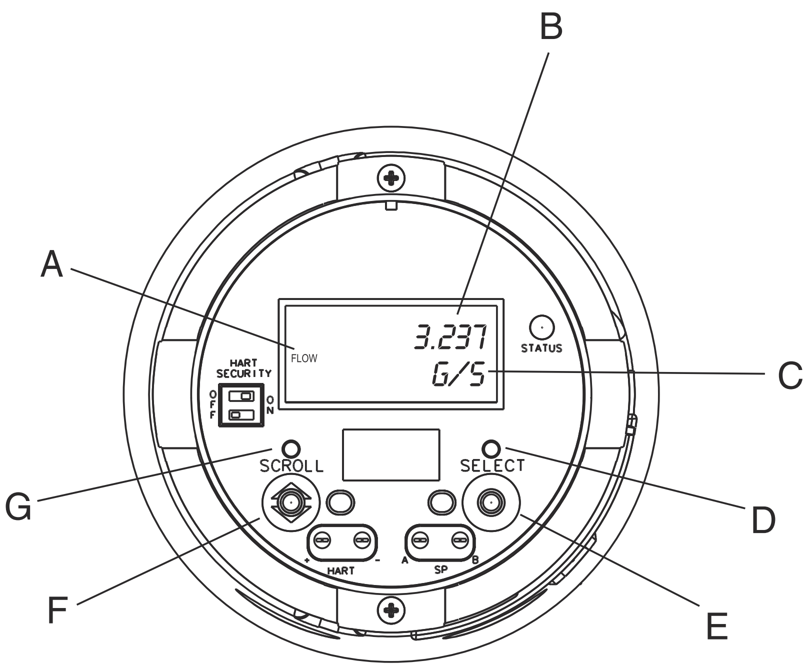
Procedure

View the desired process variables.

The display shows the configured display variables. For each display variable, the display reports the abbreviated name of the process variable (for example, DENS for density), the current value of that process variable, and the associated unit of measure (for example, G/CM3).

If **Auto Scroll** is enabled, the display cycles through the display variables, showing each display variable for a user-specified number of seconds. Whether or not **Auto Scroll** is enabled, you can activate **Select** to move to the next display variable.

Figure 8-1: Transmitter display features



A. Process variable
B. Current value
C. Unit of measure
*D. Optical switch indicator: turns red when **Select** is activated*
*E. Optical switch: **Select***
*F. Optical switch: **Scroll***
*G. Optical switch indicator: turns red when **Scroll** is activated*

8.2.2 View process variables and other data using ProLink III

Monitor process variables, diagnostic variables, and other data to maintain process quality.

ProLink III automatically displays process variables, diagnostic variables, and other data on the main screen.

Tip
ProLink III allows you to choose the process variables that appear on the main screen. You can also choose whether to view data in Analog Gauge view or digital view, and you can customize the gauge settings. For more information, see the *Micro Motion ProLink III User Manual*.

8.2.3 View process variables using the Field Communicator

Monitor process variables to maintain process quality.

Procedure

- To view current values of basic process variables, choose **Overview**.
- To view a more complete set of process variables, plus the current state of the outputs, choose **Service Tools** → **Variables**.

8.3 View transmitter status using the status LED

The status LED shows the current alert condition of the transmitter. The status LED is located on the face of the transmitter.

Procedure

Observe the status LED.

- If your transmitter has a display, you can view the status LED with the transmitter housing cover in place.
- If your transmitter does not have a display, you must remove the transmitter housing cover to view the status LED.

CAUTION

If the transmitter is in a hazardous area, do not remove the housing cover while power is supplied to the unit. Removing the housing cover while power is supplied to the unit could cause an explosion. To view transmitter status in a hazardous environment, use a communications method that does not require removing the transmitter housing cover.

To interpret the status LED, see the following table.

Table 8-1: Status LED states

LED state	Alarm condition	Description
Solid green	No alarm	Normal operation
Flashing yellow	No alarm	• Zero calibration procedure is in progress • Loop test is in progress
Solid yellow	Low-severity alarm	Alarm condition that will not cause measurement error (outputs continue to report process data)
Solid red	High-severity alarm	Alarm condition that will cause measurement error (outputs in fault)

8.4 View and acknowledge status alerts

The transmitter posts status alerts whenever a process variable exceeds its defined limits or the transmitter detects a fault condition. You can view active alerts, and you can acknowledge alerts. Acknowledging alerts is not required.

8.4.1 View and acknowledge alerts using the display

You can view a list containing all alerts that are active, or inactive but unacknowledged.

Prerequisites

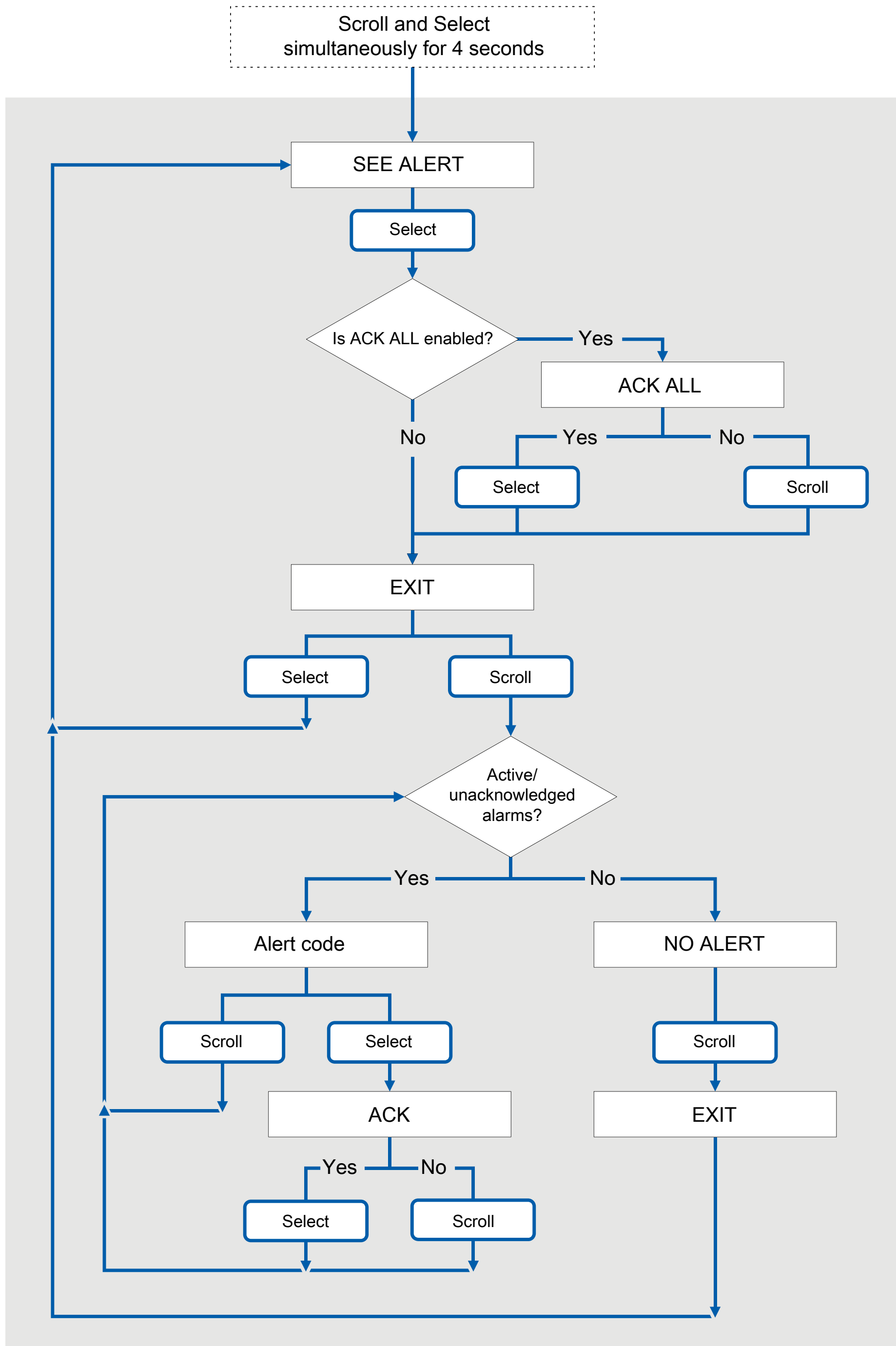
Operator access to the alert menu must be enabled (default setting). If operator access to the alert menu is disabled, you must use another method to view or acknowledge status alerts.

Note
Only Fault and Informational alerts are listed. The transmitter automatically filters out alerts with **Status Alert Severity** set to Ignore.

Procedure

See Figure 8-2.

Figure 8-2: Using the display to view and acknowledge the status alerts (alarms)



Postrequisites

- To clear the following alerts, you must correct the problem, acknowledge the alert, then power-cycle the transmitter:
- For all other alerts:
  - If the alert is inactive when it is acknowledged, it will be removed from the list.
  - If the alert is active when it is acknowledged, it will be removed from the list when the alert condition clears.

Related information

Alert data in transmitter memory

8.4.2 View and acknowledge alerts using ProLink III

You can view a list containing all alerts that are active, or inactive but unacknowledged. From this list, you can acknowledge individual alerts or choose to acknowledge all alerts at once.

Procedure

1. View alerts on the ProLink III **Device Tools** → **Alerts** tab.

   All active or unacknowledged alerts are listed, and displayed according to the following categories:

Category	Description
Failed: Fix Now	A meter failure has occurred and must be addressed immediately.
Maintenance: Fix Soon	A condition has occurred that can be fixed at a later time.
Advisory: Informational	A condition has occurred, but requires no maintenance from you.

   Notes
   - All fault alerts are displayed in the **Failed: Fix Now** category.
   - All information alerts are displayed in either the **Maintenance: Fix Soon** category or the **Advisory: Informational** category. The category assignment is hard-coded.
   - The transmitter automatically filters out alerts with **Alert Severity** set to Ignore.

2. To acknowledge a single alert, check the **Ack** checkbox for that alert. To acknowledge all alerts at once, click **Ack All**.

Postrequisites

- To clear the following alerts, you must correct the problem, acknowledge the alert, then power-cycle the transmitter:
- For all other alerts:
  - If the alert is inactive when it is acknowledged, it will be removed from the list.
  - If the alert is active when it is acknowledged, it will be removed from the list when the alert condition clears.

Related information

Alert data in transmitter memory

8.4.3 View alerts using the Field Communicator

You can view a list containing all alerts that are active, or inactive but unacknowledged.

Procedure

- To view active or unacknowledged alerts, choose **Service Tools** → **Alerts**.

  All active alerts and unacknowledged alerts are listed.

  Note
  Only Fault and Informational alerts are listed. The transmitter automatically filters out alerts with **Status Alert Severity** set to Ignore.

- To refresh the list, choose **Service Tools** → **Alerts** → **Refresh Alerts**.

Related information

Alert data in transmitter memory

8.4.4 Alert data in transmitter memory

The transmitter maintains three sets of data for every alert that is posted.

For each alert occurrence, the following three sets of data are maintained in transmitter memory:

- Alert List
- Alert Statistics
- Recent Alerts

Alert data structure	Transmitter action if condition occurs	
	Contents	**Clearing**
Alert List	As determined by the alert status bits, a list of: • All currently active alerts • All previously active alerts that have not been acknowledged	Cleared and regenerated with every transmitter power cycle
Alert Statistics	One record for each alert (by alert number) that has occurred since the last master reset. Each record contains: • A count of the number of occurrences • Timestamps for the most recent posting and clearing	Not cleared; maintained across transmitter power cycles
Recent Alerts	50 most recent alert postings or alert clearings	Not cleared; maintained across transmitter power cycles

8.5 Read totalizer and inventory values

Display	To read a totalizer or inventory value from the display, it must be configured as a display variable.
ProLink III	View the desired variable on the main screen under **Process Variables**.
Field Communicator	**Service Tools → Variables → Totalizer Control**

Totalizers keep track of the total amount of mass or volume measured by the transmitter since the last totalizer reset. Inventories keep track of the total amount of mass or volume measured by the transmitter since the last inventory reset.

Tip
You can use the inventories to keep a running total of mass or volume across multiple totalizer resets.

8.6 Start and stop totalizers and inventories

Display	See Start and stop totalizers and inventories using the display.
ProLink III	**Device Tools → Totalizer Control → Totalizer and Inventories → Start All Totals** **Device Tools → Totalizer Control → Totalizer and Inventories → Stop All Totals**
Field Communicator	**Service Tools → Variables → Totalizer Control → All Totalizers → Start Totalizers** **Service Tools → Variables → Totalizer Control → All Totalizers → Stop Totalizers**

When you start a totalizer, it tracks process measurement. In a typical application, its value increases with flow. When you stop a totalizer, it stops tracking process measurement and its value does not change with flow. Inventories are started and stopped automatically, when totalizers are started and stopped.

Important
Totalizers and inventories are started or stopped as a group. When you start any totalizer, all other totalizers and all inventories are started simultaneously. When you stop any totalizer, all other totalizers and all inventories are stopped simultaneously. You cannot start or stop inventories directly.

8.6.1 Start and stop totalizers and inventories using the display

Prerequisites

- The Totalizer Start/Stop display function must be enabled.
- At least one totalizer must be configured as a display variable.

Procedure

- To start all totalizers and inventories using the display:

  Note
  If the PLC is connected and communicating, the start/stop and reset totalizers commands might be overriding any totalizer commands from the local display or from ProLink III.

  a) **Scroll** until the word TOTAL appears in the lower left corner of the display.

     Important
     Because all totalizers are started or stopped together, it does not matter which total you use.

b) **Select**.

c) **Scroll** until START appears beneath the current totalizer value.
`Exit` displays beneath the current totalizer value.

d) **Select**.

e) **Select** again to confirm.

f) **Scroll** to EXIT.

- To stop all totalizers and inventories using the display:

a) **Scroll** until the word TOTAL appears in the lower left corner of the display.

Important
Because all totalizers are started or stopped together, it does not matter which total you use.

b) **Select**.

c) **Scroll** until STOP appears beneath the current totalizer value.

d) **Select**.

e) **Select** again to confirm.

f) **Scroll** to EXIT.

8.7 Reset totalizers

Display	See Reset totalizers using the display
ProLink III	**Device Tools → Totalizer Control → Totalizer and Inventories → Reset Mass Total** **Device Tools → Totalizer Control → Totalizer and Inventories → Reset Volume Total** **Device Tools → Totalizer Control → Totalizer and Inventories → Reset Gas Total** **Device Tools → Totalizer Control → Totalizer and Inventories → Reset All Totals**
Field Communicator	**Service Tools → Variables → Totalizer Control → Mass → Mass Total** **Service Tools → Variables → Totalizer Control → Gas Standard Volume → Volume Total** **Service Tools → Variables → Totalizer Control → Gas Standard Volume → GSV Total** **Service Tools → Variables → Totalizer Control → All Totalizers → Reset All Totals**

When you reset a totalizer, the transmitter sets its value to 0. It does not matter whether the totalizer is started or stopped. If the totalizer is started, it continues to track process measurement.

Tip
When you reset a single totalizer, the values of other totalizers are not reset. Inventory values are not reset.

8.7.1 Reset totalizers using the display

Prerequisites

- The Totalizer Reset display function must be enabled.
- The totalizer that you want to reset must be configured as a display variable. For example:

- If you want to reset the mass totalizer, **Mass Total** must be configured as a display variable.
- If you want to reset the volume totalizer, **Volume Total** must be configured as a display variable.

Procedure

- To reset the mass totalizer:
  a) **Scroll** until the mass totalizer value appears.
  b) **Select**.
     `Exit` displays beneath the current totalizer value.
  c) Scroll until `Reset` displays beneath the current totalizer value.
  d) **Select**.
     `Reset` and `Yes?` alternately flash beneath the current totalizer value.
  e) **Select** again to confirm.
  f) **Scroll** to EXIT.
  g) **Select**.
- To reset the volume totalizer:
  a) **Scroll** until the volume totalizer value appears.
  b) **Select**.
     `Exit` displays beneath the current totalizer value.
  c) Scroll until `Reset` displays beneath the current totalizer value.
  d) **Select**.
     `Reset` and `Yes?` alternately flash beneath the current totalizer value.
  e) **Select** again to confirm.
  f) **Scroll** to EXIT.
  g) **Select**.
- To reset the gas standard volume totalizer:
  a) **Scroll** until the gas standard volume totalizer value appears.
  b) **Select**.
     `Exit` displays beneath the current totalizer value.
  c) Scroll until `Reset` displays beneath the current totalizer value.
  d) **Select**.
     `Reset` and `Yes?` alternately flash beneath the current totalizer value.
  e) **Select** again to confirm.
  f) **Scroll** to EXIT.
  g) **Select**.

8.8 Reset inventories

ProLink III	**Device Tools → Totalizer Control → Totalizer and Inventories → Reset Mass Inventory** **Device Tools → Totalizer Control → Totalizer and Inventories → Reset Volume Inventory** **Device Tools → Totalizer Control → Totalizer and Inventories → Reset Gas Inventory** **Device Tools → Totalizer Control → Totalizer and Inventories → Reset All Inventories**

When you reset an inventory, the transmitter sets its value to 0. It does not matter whether the inventory is started or stopped. If the inventory is started, it continues to track process measurement.

Tip
When you reset a single inventory, the values of other inventories are not reset. Totalizer values are not reset.

9 Measurement support

9.1 Options for measurement support

Micro Motion provides several measurement support procedures to help you evaluate and maintain your flowmeter's accuracy.

The following methods are available:

- Meter validation compares flowmeter measurements reported by the transmitter to an external measurement standard. Meter validation requires one data point.
- Calibration establishes the relationship between a process variable and the signal produced at the sensor. You can calibrate the flowmeter for zero, density, and temperature. Density and temperature calibration require two data points (low and high) and an external measurement for each.

Tip

- To prove the meter against a regulatory standard, or to correct measurement error, use meter validation and meter factors.
- Before performing a field calibration, contact customer support to see if there is an alternative. In many cases, field calibrations have a negative effect on measurement accuracy.

9.2 Zero the meter

Display	**OFFLINE MAINT → ZERO → CAL ZERO → CAL/YES?** To restore the zero value set at the factory: **OFFLINE MAINT → ZERO → RESTORE ZERO → RESTORE/YES?**
ProLink III	**Device Tools → Calibration → Zero Verification and Calibration → Calibrate Zero**
Field Communicator	**Service Tools → Maintenance → Zero Calibration → Perform Auto Zero**

Zeroing the meter establishes a baseline for process measurement by analyzing the sensor's output when there is no flow through the sensor tubes. However, it is rarely necessary to zero the meter. If it is necessary, zero the meter only once. If the problem persists, contact customer support.

Prerequisites

Verify the zero and prepare the meter using the procedures in Verify the zero.

Procedure

Zero the meter.

If necessary, modify **Zero Time**. **Zero Time** controls the amount of time the transmitter takes to determine its zero-flow reference point. The default **Zero Time** is 20 seconds. For most applications, the default **Zero Time** is appropriate.

Postrequisites

Restore normal flow through the sensor by opening the valves. Verify that the sensor tubes are full.

Need help?
If the zero fails:

- Verify that there is no flow through the sensor, then retry.
- Remove or reduce sources of electromechanical noise, then retry.
- Set **Zero Time** to a lower value, then retry.
- If the zero continues to fail, contact customer service.

9.3 Validate the meter

Display	**OFF-LINE MAINT → CONFG → UNITS → MTR F**
ProLink III	**Device Tools → Configuration → Process Measurement → Flow** **Device Tools → Configuration → Process Measurement → Density**
Field Communicator	**Configure → Manual Setup → Measurements → Flow** **Configure → Manual Setup → Measurements → Density**

Meter validation compares flowmeter measurements reported by the transmitter to an external measurement standard. If the transmitter value for mass flow, volume flow, or density measurement is significantly different from the external measurement standard, you may want to adjust the corresponding meter factor. The flowmeter's actual measurement is multiplied by the meter factor, and the resulting value is reported and used in further processing.

Prerequisites

Identify the meter factor(s) that you will calculate and set. You may set any combination of the three meter factors: mass flow, volume flow, and density. Note that all three meter factors are independent:

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

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

If you plan to calculate the meter factor for volume flow, be aware that validating volume in the field may be expensive, and the procedure may be hazardous for some process fluids. Therefore, because volume is inversely proportional to density, an alternative to direct measurement is to calculate the meter factor for volume flow from the meter factor for density. See Alternate method for calculating the meter factor for volume flow for instructions on this method.

Obtain a reference device (external measurement device) for the appropriate process variable.

Important
For good results, the reference device must be highly accurate.

Procedure

1. Determine the meter factor as follows:
   a) Set the meter factor to 1 to take a sample measurement.

b) Measure the same sample using the reference device.

c) Calculate the meter factor using the following formula:

$$NewMeterFactor = ConfiguredMeterFactor \times \left(\frac{ReferenceMeasurement}{FlowmeterMeasurement}\right)$$

2. Ensure that the calculated meter factor does not fall outside 0.98 and 1.02. If the meter factor is outside these limits, contact customer service.
3. Configure the meter factor in the transmitter.

Calculating the meter factor for mass flow

The flowmeter is installed and validated for the first time. The mass flow measurement from the transmitter is 250.27 lb. The mass flow measurement from the reference device is 250 lb. The mass flow meter factor is calculated as follows:

$$MeterFactor_{MassFlow} = 1 \times \left(\frac{250}{250.27}\right) = 0.9989$$

The first meter factor for mass flow is 0.9989.

One year later, the flowmeter is validated again. The mass flow measurement from the transmitter is 250.07 lb. The mass flow measurement from the reference device is 250.25 lb. The new mass flow meter factor is calculated as follows:

$$MeterFactor_{MassFlow} = 0.9989 \times \left(\frac{250.25}{250.07}\right) = 0.9996$$

The new meter factor for mass flow is 0.9996.

9.3.1 Alternate method for calculating the meter factor for volume flow

The alternate method for calculating the meter factor for volume flow is used to avoid the difficulties that may be associated with the standard method.

This alternate method is based on the fact that volume is inversely proportional to density. It provides partial correction of the volume flow measurement by adjusting for the portion of the total offset that is caused by the density measurement offset. Use this method only when a volume flow reference is not available, but a density reference is available.

Procedure

1. Calculate the meter factor for density, using the standard method (see Validate the meter).
2. Calculate the meter factor for volume flow from the meter factor for density:

$$MeterFactor_{Volume} = \left(\frac{1}{MeterFactor_{Density}}\right)$$

   The following equation is mathematically equivalent to the first equation. You may use whichever version you prefer.

$$MeterFactor_{Volume} = ConfiguredMeterFactor_{Density} \times \left(\frac{Density_{Flowmeter}}{Density_{ReferenceDevice}}\right)$$

3. Ensure that the calculated meter factor does not fall outside 0.98 and 1.02. If the meter factor is outside these limits, contact customer service.

4. Configure the meter factor for volume flow in the transmitter.

9.4 Perform a (standard) D1 and D2 density calibration

Density calibration establishes the relationship between the density of the calibration fluids and the signal produced at the sensor. Density calibration includes the calibration of the D1 (low-density) and D2 (high-density) calibration points.

Important
Micro Motion flowmeters are calibrated at the factory, and normally do not need to be calibrated in the field. Calibrate the flowmeter only if you must do so to meet regulatory requirements. Contact customer support before calibrating the flowmeter.

Tip
Use meter validation and meter factors, rather than calibration, to prove the meter against a regulatory standard or to correct measurement error.

Prerequisites

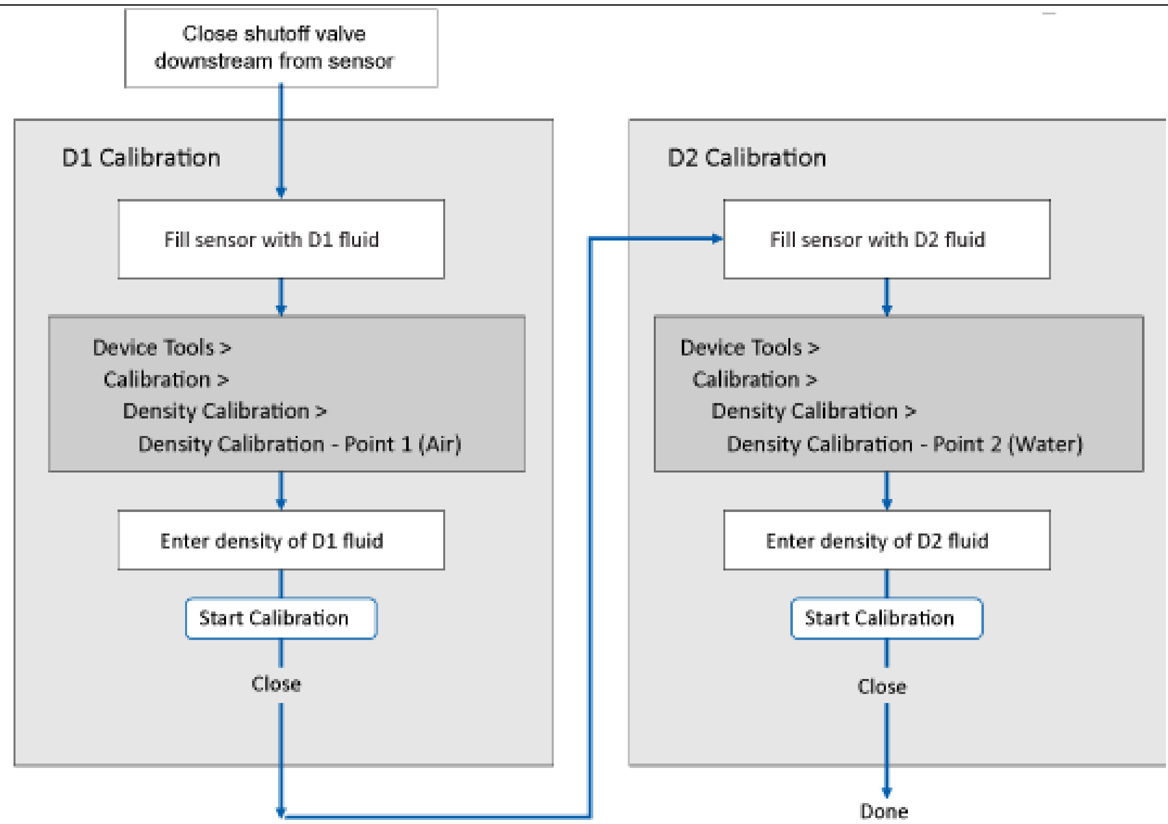
- During density calibration, the sensor must be completely filled with the calibration fluid, and flow through the sensor must be at the lowest rate allowed by your application. This is usually accomplished by closing the shutoff valve downstream from the sensor, then filling the sensor with the appropriate fluid.
- D1 and D2 density calibration require a D1 (low-density) fluid and a D2 (high-density) fluid. You may use air and water.
- The calibrations must be performed without interruption, in the order shown. Make sure that you are prepared to complete the process without interruption.
- Before performing the calibration, record your current calibration parameters. You can do this by saving the current configuration to a file on the PC. If the calibration fails, restore the known values.

Restriction
For T-Series sensors, the D1 calibration must be performed on air and the D2 calibration must be performed on water.

9.4.1 Perform a D1 and D2 density calibration using ProLink III

Procedure

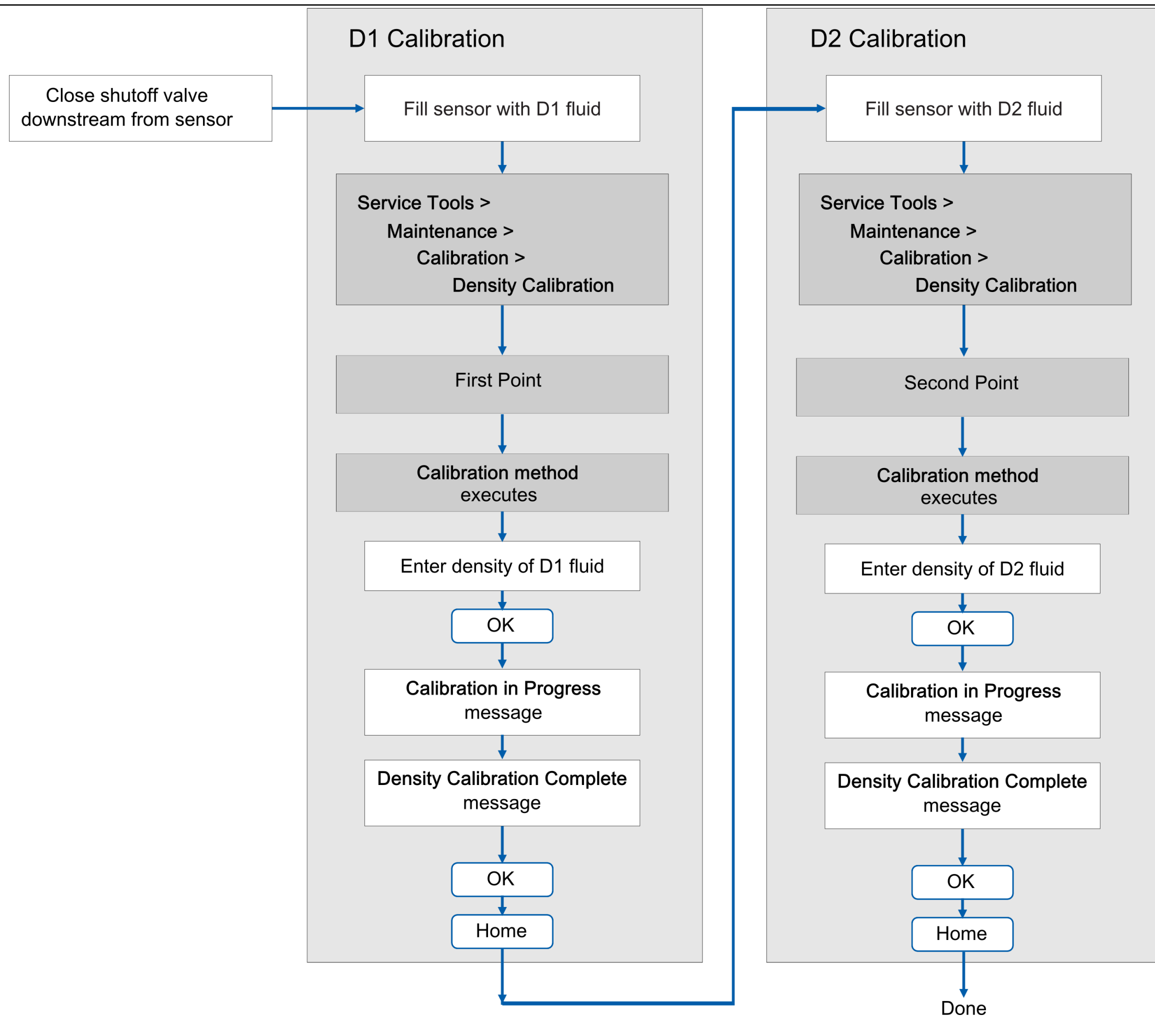
1. Read the Prerequisites in Perform a (standard) D1 and D2 density calibration if you have not already done so.
2. See the following figure.



9.4.2 Perform a D1 and D2 density calibration using the Field Communicator

Procedure

1. Read the Prerequisites in Perform a (standard) D1 and D2 density calibration if you have not already done so.
2. See the following figure.



9.5 Perform a D3 and D4 density calibration (T-Series sensors only)

For T-Series sensors, the optional D3 and D4 calibration could improve the accuracy of the density measurement if the density of your process fluid is less than 0.8 g/cm^3 or greater than 1.2 g/cm^3 .

If you perform the D3 and D4 calibration, note the following:

- Do not perform the D1 and D2 calibration.
- Perform the D3 calibration if you have one calibrated fluid.
- Perform both the D3 and D4 calibrations if you have two calibrated fluids (other than air and water). The calibrations must be performed without interruption, in the order shown. Make sure that you are prepared to complete the process without interruption.

Prerequisites

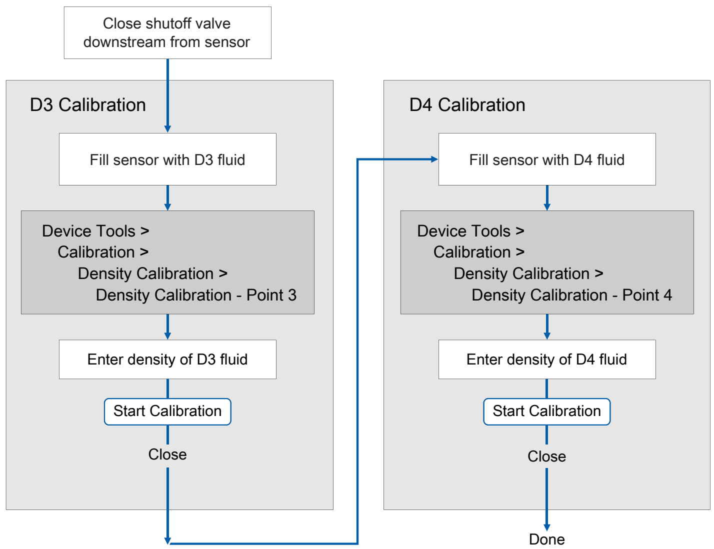
- During density calibration, the sensor must be completely filled with the calibration fluid, and flow through the sensor must be at the lowest rate allowed by your application. This is usually accomplished by closing the shutoff valve downstream from the sensor, then filling the sensor with the appropriate fluid.
- For D3 density calibration, the D3 fluid must meet the following requirements:
  - Minimum density of 0.6 g/cm^3
  - Minimum difference of 0.1 g/cm^3 between the density of the D3 fluid and the density of water. The density of the D3 fluid may be either greater or less than the density of water.
- For D4 density calibration, the D4 fluid must meet the following requirements:
  - Minimum density of 0.6 g/cm^3
  - Minimum difference of 0.1 g/cm^3 between the density of the D4 fluid and the density of the D3 fluid. The density of the D4 fluid must be greater than the density of the D3 fluid.
  - Minimum difference of 0.1 g/cm^3 between the density of the D4 fluid and the density of water. The density of the D4 fluid may be either greater or less than the density of water.
- Before performing the calibration, record your current calibration parameters. You can do this by saving the current configuration to a file on the PC. If the calibration fails, restore the known values.

9.5.1 Perform a D3 or D3 and D4 density calibration using ProLink III

Procedure

See Figure 9-1.

Figure 9-1: D3 or D3 and D4 density calibration using ProLink III

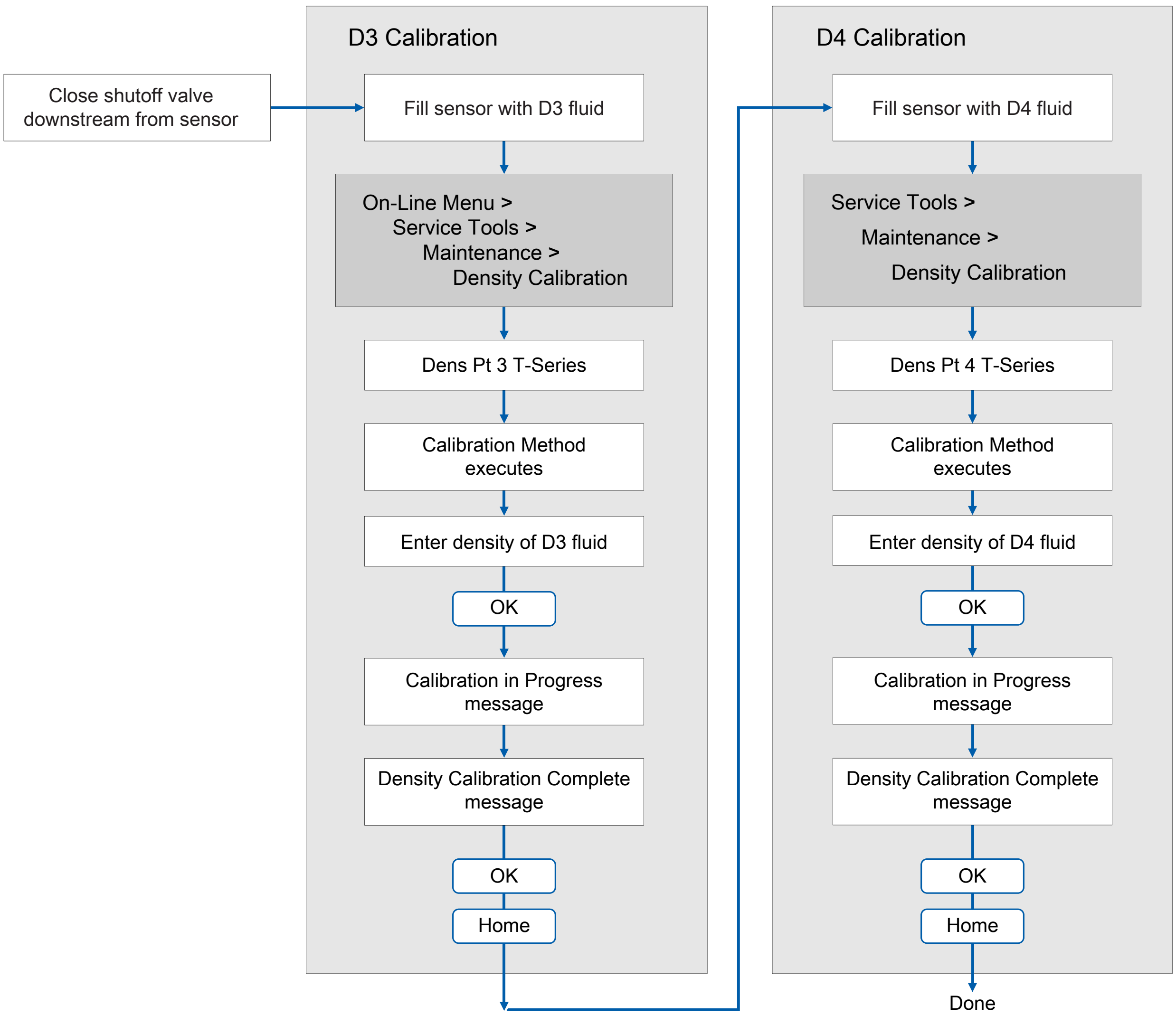


9.5.2 Perform a D3 or D3 and D4 density calibration using the Field Communicator

Procedure

See the following flowchart.

Figure 9-2: D3 or D3 and D4 density calibration using the Field Communicator



9.6 Perform temperature calibration

Temperature calibration establishes the relationship between the temperature of the calibration fluids and the signal produced by the sensor.

Prerequisites

The temperature calibration is a two-part procedure: temperature offset calibration and temperature slope calibration. The two parts must be performed without interruption, in the order shown. Ensure that you are prepared to complete the process without interruption. You will need a low-temperature calibration fluid and a high-temperature calibration fluid. You will not see the effect of the calibration until both the temperature offset calibration and the temperature slope calibration are complete.

Important
Consult customer support before performing a temperature calibration. Under normal circumstances, the temperature circuit is stable and should not need an adjustment.

9.6.1 Perform temperature calibration using the display

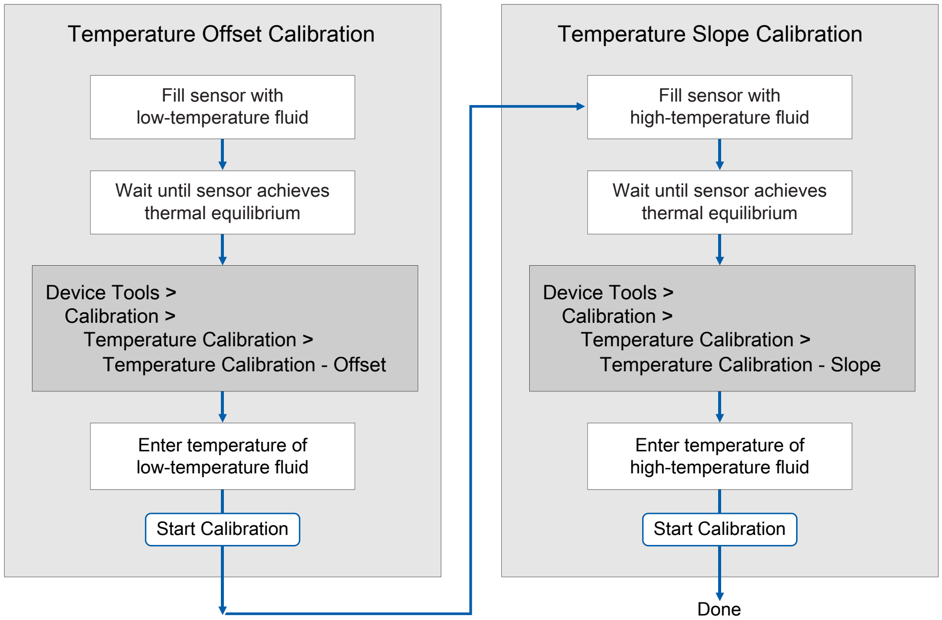
Procedure

1. Fill the sensor with the low-temperature fluid.
2. Wait until the sensor achieves thermal equilibrium.
3. Navigate to the calibration menu and enter it.
   a) Activate **Scroll** and **Select** simultaneously.
   b) Scroll to **OFF-LINE MAINT**and activate **Select**.
   c) Scroll to **OFF-LINE CAL** and activate **Select**.
   d) Scroll to **CAL TEMP** and activate **Select**.
4. Enter the temperature of the low-temperature fluid.
   a) When **CAL OFFSET TEMP** is flashing, activate **Select**.
   b) Enter the temperature value and save it.
5. Fill the sensor with the high-temperature fluid.
6. Wait until the sensor achieves thermal equilibrium.
7. Enter the temperature of the high-temperature fluid.
   a) When **CAL SLOPE TEMP** is flashing, activate **Select**.
   b) Enter the temperature value and save it.
8. Activate **Scroll** to view the new offset and slope values.
9. Activate **Select** to exit.

9.6.2 Perform temperature calibration using ProLink III

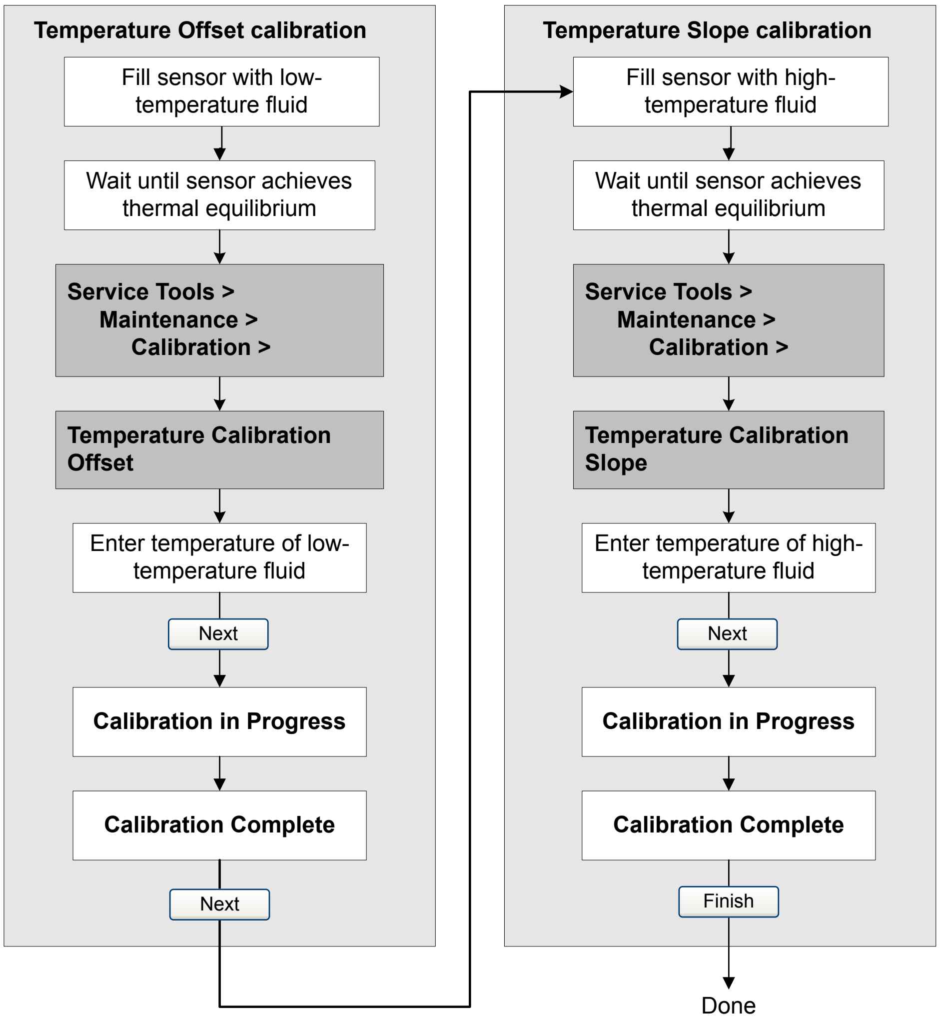
Procedure

See the following figure.


Temperature Offset Calibration
Fill sensor with low-temperature fluid
Wait until sensor achieves thermal equilibrium
Device Tools > Calibration > Temperature Calibration > Temperature Calibration - Offset
Enter temperature of low-temperature fluid
Start Calibration
Temperature Slope Calibration
Fill sensor with high-temperature fluid
Wait until sensor achieves thermal equilibrium
Device Tools > Calibration > Temperature Calibration > Temperature Calibration - Slope
Enter temperature of high-temperature fluid
Start Calibration
Done

9.6.3 Perform temperature calibration using the Field Communicator

Procedure



10 Troubleshooting

10.1 Transmitter status reported by LED

Table 10-1: Status LED states

LED behavior	Alarm condition	Description
Solid green	No alarm	Normal operation
Flashing yellow	No alarm	• Zero calibration procedure is in progress • Loop test is in progress
Solid yellow	Low-severity alarm	Alarm condition that will not cause measurement error (outputs continue to report process data)
Solid red	High-severity alarm	Alarm condition that will cause measurement error (outputs in fault)

10.2 Check the cutoffs

If the transmitter cutoffs are configured incorrectly, the transmitter may report zero flow when flow is present, or very small amounts of flow under no-flow conditions.

There are separate cutoff parameters for mass flow rate, volume flow rate, gas standard volume flow rate (if applicable), and density. There is an independent cutoff for the mA Output on your transmitter. The interaction between cutoffs sometimes produces unexpected results.

Procedure

Verify the configuration of all cutoffs.

Tip
For typical applications, set **Mass Flow Cutoff** between 0.1% and 0.5% of the sensor's maximum rated flow rate. See the sensor specifications for nominal flow rate data.

10.3 Density measurement problems

Problem	Possible causes	Recommended actions
Inaccurate density reading	• Problem with process fluid • Incorrect density calibration factors • Wiring problem • Incorrect grounding • Two-phase flow • Plugged or coated sensor tube • Incorrect sensor orientation • RTD failure • Physical characteristics of sensor have changed	• Check your process conditions against the values reported by the device. • Ensure that all of the calibration parameters have been entered correctly. See the sensor tag or the calibration sheet for your meter. • Check the wiring between the sensor and the transmitter. • Check the grounding of all components. • Verify all of the characterization or calibration parameters. See the sensor tag or the calibration sheet for your meter. • Check for two-phase flow. • If two sensors with similar frequency are too near each other, separate them. • Purge the sensor tubes.
Unusually high density reading	• Plugged or coated sensor tube • Incorrect density calibration factors • Incorrect temperature measurement • RTD problem • In high-frequency meters, this can indicate erosion or corrosion • In low-frequency meters, this can indicate tube fouling	• Ensure that all of the calibration parameters have been entered correctly. See the sensor tag or the calibration sheet for your meter. • Verify all of the characterization or calibration parameters. See the sensor tag or the calibration sheet for your meter. • Purge the sensor tubes. • Check for coating in the flow tubes.
Unusually low density reading	• Two-phase flow • Ensure that all of the calibration parameters have been entered correctly. See the sensor tag or the calibration sheet for your meter. • In low-frequency meters, this can indicate erosion or corrosion	• Check your process conditions against the values reported by the device. • Check for two-phase flow. • Verify all of the characterization or calibration parameters. See the sensor tag or the calibration sheet for your meter. • Check the wiring between the sensor and the transmitter. • Check for tube erosion, especially if the process fluid is abrasive.

10.4 Check the drive gain

Excessive or erratic drive gain may indicate any of a variety of process conditions or sensor problems.

To know whether your drive gain is excessive or erratic, you must collect drive gain data during the problem condition and compare it to drive gain data from a period of normal operation.

Excessive (saturated) drive gain

Table 10-2: Possible causes and recommended actions for excessive (saturated) drive gain

Possible cause	Recommended actions
Bent sensor tube	Check the pickoff voltages (see Check the pickoff voltage). If either of them are close to zero (but neither is zero), the sensor tubes may be bent. The sensor will need to be replaced.
Cavitation or flashing; settling of two-phase or three-phase fluids	• Increase the inlet or back pressure at the sensor. • If a pump is located upstream from the sensor, increase the distance between the pump and sensor. • The sensor may need to be reoriented or repositioned. Consult the installation manual for your sensor.
Cracked sensor tube	Replace the sensor.
Flow rate out of range	Ensure that the flow rate is within sensor limits.
Incorrect sensor characterization	Verify the characterization or calibration parameters.
Open drive or pickoff sensor coil	Contact customer support.
Over-pressurized tubes	Contact customer support.
Plugged sensor tube	A dull, audible hum, and unusually high sensor vibration is usually accompanied by high, even saturated, drive gain. Check the pickoff voltages (see Check the pickoff voltage). If either of them are close to zero (but neither is zero), plugged tubes may be the source of your problem. Purge the tubes. In extreme cases, you may need to replace the sensor.
Sensor case full of process fluid	Replace the sensor.
Sensor imbalance	Contact customer support.
Sensor tubes not completely full	Correct process conditions so that the sensor tubes are full.
Two-phase flow	Check for two-phase flow. See Check for two-phase flow (slug flow).
Vibrating element not free to vibrate	Ensure that the vibrating element is free to vibrate.

Erratic drive gain

Table 10-3: Possible causes and recommended actions for erratic drive gain

Possible cause	Recommended actions
Two-phase flow	Check for two-phase flow. See Check for two-phase flow (slug flow).

Table 10-3: Possible causes and recommended actions for erratic drive gain *(continued)*

Possible cause	Recommended actions
Polarity of pick-off reversed or polarity of drive reversed	Check the wiring between the sensor and the transmitter.
Foreign material caught in sensor tubes	• Purge the sensor tubes. • Replace the sensor.

10.4.1 Collect drive gain data

ProLink III	**Device Tools → Diagnostics → Core Processor Diagnostics**
Field Communicator	**Service Tools → Maintenance → Diagnostic Variables**

Drive gain data can be used to diagnose a variety of process and equipment conditions. Collect drive gain data from a period of normal operation, and use this data as a baseline for troubleshooting.

Procedure

1. Navigate to the drive gain data.
2. Observe and record drive gain data over an appropriate period of time, under a variety of process conditions.

10.5 Check for internal electrical problems

Shorts between sensor terminals or between the sensor terminals and the sensor case can cause the sensor to stop working.

Possible cause	Recommended action
Moisture inside the sensor junction box	Ensure that the junction box is dry and no corrosion is present.
Liquid or moisture inside the sensor case	Contact customer support.
Internally shorted feedthrough	Contact customer support.
Faulty cable	Replace the cable.
Improper wire termination	Verify wire terminations inside the sensor junction box. See *Micro Motion 9-Wire Flowmeter Cable Preparation and Installation Guide*.

10.5.1 Check the sensor coils

Checking the sensor coils can identify a cause for a no sensor response alert.

Procedure

1. Disconnect power to the transmitter.

   DANGER
   If the transmitter is in a hazardous area, wait 5 minutes before continuing.

2. Remove the transmitter housing cover.
3. Unplug the terminal blocks from the terminal board on the core processor.
4. Using a digital multimeter (DMM), check the pickoff coils by placing the DMM leads on the unplugged terminal blocks for each terminal pair. See the following table for a list of the coils. Record the values.

Table 10-4: Coils and test terminal pairs

Coil	Sensor model	Terminal colors
Drive coil	All	Brown to red
Left pickoff coil (LPO)	All	Green to white
Right pickoff coil (RPO)	All	Blue to gray
Resistance temperature detector (RTD)	All	Yellow to violet
Lead length compensator (LLC)	All except T-Series and CMF400 (see note)	Yellow to orange
Composite RTD	All CMFSs, T-Series, H300, and F300	Yellow to orange
Fixed resistor (see note)	CMFS007, CMFS010, CMFS015, CMF400, and F300	Yellow to orange

Note
The fixed resistor on F300/H300/CMF400 sensors adds ~ 40 ohms to the reading between the yellow and orange leads and applies to only specific sensor releases. Contact customer support for more information.

There should be no open circuits, that is, no infinite resistance readings. The left pickoff and right pickoff readings should be the same or very close (±5 Ω). If there are any unusual readings, repeat the coil resistance tests at the sensor junction box to eliminate the possibility of faulty cable. The readings for each coil pair should match at both ends.

5. Test the terminals in the sensor junction box for shorts to case.

   Test results will be inconclusive with nonconductive process fluids such as hydrocarbons.

   a) Leave the terminal blocks disconnected.
   b) Remove the lid of the junction box.
   c) Testing one terminal at a time, place a DMM lead on the terminal and the other lead on the sensor case.

      With the DMM set to its highest range, there should be infinite resistance on each lead. If there is any resistance at all, there is a short to case.

6. Test the resistance of junction box terminal pairs.
   a) Test the brown terminal against all other terminals except the red one.
   b) Test the red terminal against all other terminals except the brown one.
   c) Test the green terminal against all other terminals except the white one.
   d) Test the white terminal against all other terminals except the green one.
   e) Test the blue terminal against all other terminals except the gray one.

f) Test the gray terminal against all other terminals except the blue one.

g) Test the orange terminal against all other terminals except the yellow and violet ones.

h) Test the yellow terminal against all other terminals except the orange and violet ones.

i) Test the violet terminal against all other terminals except the yellow and orange ones.

There should be infinite resistance for each pair. If there is any resistance at all, there is a short between terminals.

Postrequisites

To return to normal operation:

1. Plug the terminal blocks into the terminal board.
2. Replace the transmitter housing cover.
3. Replace the lid on the sensor junction box.

Important
When reassembling the meter components, be sure to grease all O-rings.

10.6 Check Flow Direction

If **Flow Direction** is set inappropriately for your process, the transmitter may report flow data that is not appropriate for your requirements.

The **Flow Direction** parameter interacts with actual flow direction to affect flow values, flow totals and inventories, and output behavior. For the simplest operation, actual process flow should match the flow arrow that is on the side of the sensor case.

Procedure

1. Verify the actual direction of process flow through the sensor.
2. Verify the configuration of **Flow Direction**.

10.7 Flow measurement problems

Problem	Possible causes	Recommended actions
Non-zero flow reading at no-flow conditions or at zero offset	• Misaligned piping (especially in new installations) • Open or leaking valve • Incorrect sensor zero	• If the reading is not excessively high, review the live zero. You may need to restore the factory zero. • Check for open or leaking valves or seals. • Check for mounting stress on the sensor (e.g., sensor being used to support piping, misaligned piping). • Contact customer support.

Problem	Possible causes	Recommended actions
Erratic non-zero flow rate at no-flow conditions	• Leaking valve or seal • Two-phase flow • Incorrect sensor orientation • Wiring problem • Vibration in pipeline at rate close to sensor tube frequency • Damping value too low • Mounting stress on sensor • Empty sensor when reading liquid volume flow	• Verify that the sensor orientation is appropriate for your application (refer to the sensor installation manual). • Check the drive gain and the pickoff voltage. • If the wiring between the sensor and the transmitter includes a 9-wire segment, verify that the 9-wire cable shields are correctly grounded. • Check the wiring between the sensor and the transmitter. • For sensors with a junction box, check for moisture in the junction box. • Purge the sensor tubes. • Check for open or leaking valves or seals. • Check for sources of vibration. • Verify damping configuration. • Verify that the measurement units are configured correctly for your application. • Check for two-phase flow. • Check for radio frequency interference. • Contact customer support.

Problem	Possible causes	Recommended actions
Erratic non-zero flow rate when flow is steady	• Two-phase flow • Damping value too low • Plugged or coated sensor tube • Output wiring problem • Problem with receiving device • Wiring problem	• Verify that the sensor orientation is appropriate for your application (refer to the sensor installation manual). • Check the drive gain and the pickoff voltage. • If the wiring between the sensor and the transmitter includes a 9-wire segment, verify that the 9-wire cable shields are correctly grounded. • Check for air entrainment, tube fouling, flashing, or tube damage. • Check the wiring between the sensor and the transmitter. • For sensors with a junction box, check for moisture in the junction box. • Purge the sensor tubes. • Check for open or leaking valves or seals. • Check for sources of vibration. • Verify damping configuration. • Verify that the measurement units are configured correctly for your application. • Check for two-phase flow. • Check for radio frequency interference. • Contact customer support.
Inaccurate flow rate or batch total	• Wiring problem • Inappropriate measurement unit • Incorrect flow calibration factor • Incorrect meter factor • Incorrect density calibration factors • Incorrect grounding • Two-phase flow • Problem with receiving device • Incorrect sensor zero • Incorrect measurement unit configured for a process variable - for example, selecting g/min instead of USGPM	• Check the wiring between the sensor and the transmitter. • Verify that the measurement units are configured correctly for your application. • Verify all of the characterization or calibration parameters. See the sensor tag or the calibration sheet for your meter. • Perform a bucket test to verify batch totals. • Zero the meter. • Check the grounding of all components. • Check for two-phase flow. • Verify the receiving device, and the wiring between the transmitter and the receiving device. • Check sensor coil resistance and for shorts to case. • Replace the transmitter.

10.8 Frequency Output problems

Table 10-5: Frequency Output problems and recommended actions

Problem	Possible causes	Recommended actions
No Frequency Output	• Stopped totalizer • Process condition below cutoff • Fault condition if **Fault Action** is set to Internal Zero or Downscale • Two-phase flow • Flow in reverse direction from configured flow direction parameter • Bad frequency receiving device • Output level not compatible with receiving device • Bad output circuit (rarely occurs) • Wiring problem	• Verify that the process conditions are below the low-flow cutoff. Reconfigure the low-flow cutoff if necessary. • Check the **Fault Action** settings. • Verify that the totalizers are not stopped. A stopped totalizer will cause the Frequency Output to be locked. • Check for two-phase flow. • Check flow direction. • Verify the receiving device, and the wiring between the transmitter and the receiving device. • Verify that the channel is wired and configured as a Frequency Output. • Verify the power configuration for the Frequency Output (internal vs. external). • Perform a loop test.
Consistently incorrect frequency measurement	• Output not scaled correctly • Incorrect measurement unit configured for process variable	• Check the Frequency Output scaling. • Verify that the measurement units are configured correctly for your application.
Erratic Frequency Output	• Radio frequency interference (RFI) from environment	• Check for radio frequency interference.

10.9 Check Frequency Output Fault Action

The **Frequency Output Fault Action** controls the behavior of the Frequency Output if the transmitter encounters an internal fault condition. If the Frequency Output is reporting a constant value, the transmitter may be in a fault condition.

Procedure

1. Check the status alerts for active fault conditions.
2. If there are active fault conditions, the transmitter is performing correctly. If you want to change its behavior, consider the following options:
   - Change the setting of **Frequency Output Fault Action**.
   - For the relevant status alerts, change the setting of **Alert Severity** to Ignore.

   Restriction
   For some status alerts, **Alert Severity** is not configurable.
3. If there are no active fault conditions, continue troubleshooting.

10.10 Check Frequency Output Scaling Method

If **Frequency Output Scaling Method** is set incorrectly, the Frequency Output may report an incorrect value.

Procedure

1. Verify the configuration of the Frequency Output.
2. If you changed the setting of **Frequency Output Scaling Method**, check the settings of all other Frequency Output parameters.

10.11 Check grounding

The sensor and the transmitter must be grounded.

Prerequisites

You will need an:

- Installation manual for your sensor
- Installation manual for your transmitter (remote-mount installations only)

Procedure

Refer to the sensor and transmitter installation manuals for grounding requirements and instructions.

10.12 Check HART Address and mA Output Action

If the transmitter is producing a fixed current from the mA Output, the **mA Output Action** parameter may be set incorrectly.

When the **mA Output Action** parameter is set to Fixed, the mA Output produces a fixed value, and does not report process data or implement its fault action.

When **HART Address** is changed, some configuration tools will automatically change **mA Output Action**.

Tip
Always verify **mA Output Action** after setting or changing **HART Address**.

Procedure

1. Set **HART Address** as appropriate for your HART network.

   The default address is 0. This is the recommended value unless the transmitter is in a multidrop network.

2. Set **mA Output Action** to Live.

10.13 Check HART burst mode

HART burst mode is normally disabled, and should be enabled only if a HART Triloop is being used.

Procedure

1. Check to see if burst mode is enabled or disabled.

2. If burst mode is enabled, disable it.

10.14 Check the HART communication loop

If you cannot establish or maintain HART communications, the HART loop may be wired incorrectly.

Prerequisites

You will need:

- A copy of your transmitter installation manual
- A 250–600 Ω resistor
- A Field Communicator
- Optional: the *HART Application Guide*, available at www.hartcomm.org

Procedure

1. Verify that the loop wires are connected as shown in the wiring diagrams in the transmitter installation manual.

   If your HART network is more complex than the wiring diagrams in the transmitter installation manual, contact either customer service or the HART Communication Foundation.
2. Disconnect the primary mA Output wiring from the transmitter.
3. Install a 250–600 Ω resistor across the transmitter's primary mA Output terminals.
4. Check the voltage drop across the resistor (4–20 mA = 1–5 VDC for a 250 Ω resistor).
   If voltage drop is less than 1 VDC, add resistance to achieve a voltage drop of greater than 1 VDC .
5. Connect a Field Communicator directly across the resistor and attempt to communicate (poll).
   If communication with the transmitter cannot be established, the transmitter may need service. Contact customer service.

10.15 Locate a device using the HART 7 Squawk feature

The Squawk feature causes the device to show a specific pattern on its display. You can use this to locate or identify a device.

Restriction
The Squawk feature is available only with HART 7 connections from the Field Communicator. It is not available with ProLink III.

Procedure

An 0-0-0-0 pattern is shown on the display.

10.16 Perform loop tests

A loop test is a way to verify that the transmitter and the remote device are communicating properly. A loop test also helps you know whether you need to trim mA Outputs.

Prerequisites

- Follow appropriate procedures to ensure that loop testing will not interfere with existing measurement and control loops.

10.16.1 Perform loop tests using the display

Prerequisites

Before performing a loop test, configure the channels for the transmitter inputs and outputs that will be used in your application.

Follow appropriate procedures to ensure that loop testing will not interfere with existing measurement and control loops.

Procedure

1. Test the mA Output(s).
   a) Read the mA current at the receiving device and compare it to the transmitter output.

      The readings do not need to match exactly. If the values are slightly different, you can correct the discrepancy by trimming the output.

   b) At the transmitter, activate **Select**.
   c) Scroll to and select a high value, e.g., 20 mA.

      Dots traverse the display while the output is fixed.

   d) Read the mA current at the receiving device and compare it to the transmitter output.

      The readings do not need to match exactly. If the values are slightly different, you can correct the discrepancy by trimming the output.

   e) At the transmitter, activate **Select**.
2. Test the Frequency Output(s).
   a) Choose **OFFLINE MAINT** → **SIM** → **FO SIM**, and select the Frequency Output value.

      The Frequency Output can be set to 1, 10, or 15 kHz.

      Dots traverse the display while the output is fixed.

   b) Read the frequency signal at the receiving device and compare it to the transmitter output.
   c) At the transmitter, activate **Select**.
3. Test the Discrete Output(s).
   a) Choose **OFFLINE MAINT** → **SIM** → **DO SIM**, and select **SET ON**.

      Dots traverse the display while the output is fixed.

b) Verify the signal at the receiving device.

c) At the transmitter, activate **Select**.

d) Scroll to and select **SET OFF**.

e) Verify the signal at the receiving device.

f) At the transmitter, activate **Select**.

4. Test the Discrete Input.
   a) Set the remote input device to generate a known fixed current.
   b) At the transmitter, choose **OFFLINE MAINT** → **SIM**, and select **READ DI**.
   c) At the transmitter, activate **Select**.
   d) Verify the signal at the transmitter.
   e) Repeat the procedure for the other signal state.

5. Test the mA Input.
   a) Set the remote input device to generate a known fixed current.
   b) At the transmitter, choose **OFFLINE MAINT** → **SIM**, and select **READ MAI**.
   c) Verify the current value.

Postrequisites

- If the mA Output readings are within 20 microamps of the expected values, you can correct this discrepancy by trimming the output.
- If the discrepancy between the mA Output readings is greater than 20 microamps, or if at any step the reading was faulty, verify the wiring between the transmitter and the remote device, and try again.
- If the mA Input reading was slightly off at the transmitter, calibrate the mA signal at the remote input device.
- If the Discrete Input readings are reversed, check the setting of **Discrete Input Polarity**.

10.16.2 Perform loop tests using ProLink III

Prerequisites

Before performing a loop test, configure the channels for the transmitter inputs and outputs that will be used in your application.

Follow appropriate procedures to ensure that loop testing will not interfere with existing measurement and control loops.

Procedure

1. Test the mA Output(s).
   a) Choose **Device Tools** → **Diagnostics** → **Testing** → **mA Output Test**.
   b) Enter `0` or `4` in **Fix to:**.
   c) Click **Fix mA**.

   d) Read the mA current at the receiving device and compare it to the transmitter output.

      The readings do not need to match exactly. If the values are slightly different, you can correct the discrepancy by trimming the output.

   e) Click **UnFix mA**.
   f) Enter `20` in **Fix to:**.
   g) Click **Fix mA**.
   h) Read the mA current at the receiving device and compare it to the transmitter output.

      The readings do not need to match exactly. If the values are slightly different, you can correct the discrepancy by trimming the output.

   i) Click **UnFix mA**.

2. Test the Frequency Output(s).
   a) Choose **Device Tools** → **Diagnostics** → **Testing** → **Frequency Output Test**.
   b) Enter the Frequency Output value in **Fix to**.
   c) Click **Fix FO**.
   d) Read the frequency signal at the receiving device and compare it to the transmitter output.
   e) Click **UnFix FO**.

3. Test the Discrete Output(s).
   a) Choose **Device Tools** → **Diagnostics** → **Testing** → **Discrete Output Test**.
   b) Set **Fix To:** to ON.
   c) Verify the signal at the receiving device.
   d) Set **Fix To:** to OFF.
   e) Verify the signal at the receiving device.
   f) Click **UnFix**.

4. Test the Discrete Input.
   a) Set the remote input device to ON.
   b) Choose **Device Tools** → **Diagnostics** → **Testing** → **Discrete Input Test**.
   c) Verify the signal at the transmitter.
   d) Set the remote input device to OFF.
   e) Verify the signal at the transmitter.

5. Test the mA Input.
   a) Set the remote input device to generate a known fixed current.
   b) Choose **Device Tools** → **Diagnostics** → **Testing** → **Read MA Input**.

c) Return the remote input device to normal operation.

Postrequisites

- If the mA Output readings are within 20 microamps of the expected values, you can correct this discrepancy by trimming the output.
- If the discrepancy between the mA Output readings is greater than 20 microamps, or if at any step the reading was faulty, verify the wiring between the transmitter and the remote device, and try again.
- If the mA Input reading was slightly off at the transmitter, calibrate the mA signal at the remote input device.
- If the Discrete Input readings are reversed, check the setting of **Discrete Input Polarity**.

10.16.3 Perform loop tests using the Field Communicator

Prerequisites

Before performing a loop test, configure the channels for the transmitter inputs and outputs that will be used in your application.

Follow appropriate procedures to ensure that loop testing will not interfere with existing measurement and control loops.

Procedure

1. Test the mA Output(s).
   a) Choose **Service Tools** → **Simulate** → **Simulate Outputs** → **mA Output 1 Loop Test**or **Service Tools** → **Maintenance** → **Simulate Outputs** → **mA Output 2 Loop Test**, and select **4 mA**.
   b) Choose **Service Tools** → **Simulate** → **Simulate Outputs** → **mA Output Loop Test** and select **4 mA**.
   c) Read the mA current at the receiving device and compare it to the transmitter output.

      The readings do not need to match exactly. If the values are slightly different, you can correct the discrepancy by trimming the output.
   d) Press **OK**.
   e) Select **20 mA**.
   f) Read the mA current at the receiving device and compare it to the transmitter output.

      The readings do not need to match exactly. If the values are slightly different, you can correct the discrepancy by trimming the output.
   g) Press **OK**.
   h) Choose **End**.
2. Test the Frequency Output(s).

   Note
   If the Weights & Measures application with NTEP approval is enabled on the transmitter, it is not possible to perform a loop test of the Frequency Output, even when the transmitter is unsecured.

a) Press **Service Tools** → **Simulate** → **Simulate Outputs** → **Frequency Output Test**, and choose the Frequency Output level.

b) Read the frequency signal at the receiving device and compare it to the transmitter output.

c) Choose **End**.

3. Test the Discrete Output(s).

   a) Choose **Off**.

   b) Verify the signal at the receiving device.

   c) Press **OK**.

   d) Choose **On**.

   e) Verify the signal at the receiving device.

   f) Press **OK**.

   g) Choose **End**.

Postrequisites

- If the mA Output readings are within 20 microamps of the expected values, you can correct this discrepancy by trimming the output.
- If the discrepancy between the mA Output readings is greater than 20 microamps, or if at any step the reading was faulty, verify the wiring between the transmitter and the remote device, and try again.

10.17 Check Lower Range Value and Upper Range Value

If the process variable assigned to the mA Output falls below the configured **Lower Range Value** (LRV) or rises above the configured **Upper Range Value** (URV), the meter will post a saturation alert (A100), then perform the configured fault action.

Procedure

1. Record your current process conditions.
2. Check the configuration of the LRV and URV.

10.18 Milliamp output problems

Table 10-6: Milliamp output problems and recommended actions

Problem	Possible causes	Recommended actions
No mA Output	• Wiring problem • Circuit failure (rarely occurs)	• Check the power supply and power supply wiring. • Verify the output wiring. • Check the **Fault Action** settings. • Contact customer support.

Table 10-6: Milliamp output problems and recommended actions *(continued)*

Problem	Possible causes	Recommended actions
Loop test failed	• Power supply problem • Wiring problem • Circuit failure (rarely occurs) • Incorrect internal/external power configuration	• Check the power supply and power supply wiring. • Verify the output wiring. • Check the **Fault Action** settings. • Verify channel configuration for the affected mA Output. • Contact customer support.
mA Output below 4 mA	• Open in wiring • Bad output circuit (rarely occurs) • Process condition below LRV • LRV and URV are not set correctly • Fault condition if **Fault Action** is set to Internal Zero or Downscale • Bad mA receiving device	• Check your process conditions against the values reported by the device. • Verify the receiving device, and the wiring between the transmitter and the receiving device. • Check the settings of **Upper Range Value** and **Lower Range Value**. • Check the **Fault Action** settings.
Constant mA Output	• Incorrect process variable assigned to the output • Fault condition exists • Non-zero HART address (mA Output 1) • Output is configured for loop test mode • Zero calibration failure • Output is configured for a range that is far in excess of intended range. Reconfigure output. • The process condition is below cutoff.	• Verify the output variable assignments. • View and resolve any existing alert conditions. • Check the HART address. If the HART address is non-zero, you may need to change the setting of **mA Output Action**. • Check to see if a loop test is in process (the output is fixed). • Check HART burst mode configuration. • If related to a zero calibration failure, cycle power to the meter and retry the zeroing procedure. • Process condition is below cutoff. Check and adjust the cutoff setting.
mA Output consistently out of range	• Incorrect process variable or units assigned to output • Fault condition if **Fault Action** is set to Upscale or Downscale • LRV and URV are not set correctly	• Verify the output variable assignments. • Verify the measurement units configured for the output. • Check the **Fault Action** settings. • Check the settings of **Upper Range Value** and **Lower Range Value**. • Check the mA Output trim.

Table 10-6: Milliamp output problems and recommended actions *(continued)*

Problem	Possible causes	Recommended actions
Consistently incorrect mA measurement	• Loop problem • Output not trimmed correctly • Incorrect measurement unit configured for process variable • Incorrect process variable configured • LRV and URV are not set correctly	• Check the mA Output trim. • Verify that the measurement units are configured correctly for your application. • Verify the process variable assigned to the mA Output. • Check the settings of **Upper Range Value** and **Lower Range Value**.
mA Output correct at lower current, but incorrect at higher current	• mA loop resistance may be too high	• Verify that the mA Output load resistance is below the maximum supported load (see the installation manual for your transmitter).

10.19 Check mA Output Fault Action

The **mA Output Fault Action** controls the behavior of the mA Output if the transmitter encounters an internal fault condition. If the mA Output is reporting a constant value below 4 mA or above 20 mA, the transmitter may be in a fault condition.

Procedure

1. Check the status alerts for active fault conditions.
2. If there are active fault conditions, the transmitter is performing correctly. If you want to change its behavior, consider the following options:
   - Change the setting of **mA Output Fault Action**.
   - For the relevant status alerts, change the setting of **Alert Severity** to Ignore.

   Restriction
   For some status alerts, **Alert Severity** is not configurable.
3. If there are no active fault conditions, continue troubleshooting.

10.20 Trim mA Output

Trimming an mA Output calibrates the transmitter's mA Output to the receiving device. If the current trim value is inaccurate, the transmitter will under-compensate or over-compensate the output.

10.20.1 Trim mA Output using ProLink III

Trimming the mA Output establishes a common measurement range between the transmitter and the device that receives the mA Output.

Prerequisites

Ensure that the mA Output is wired to the receiving device that will be used in production.

Important
You must trim the output at both ends (0 mA or 4 mA, and 20 mA to ensure that it is compensated accurately across the entire output range.

Procedure

1. Choose **Device Tools** → **Calibration** → **MA Output Trim** → **mA Output 1 Trim**.
2. Choose **Device Tools** → **Calibration** → **MA Output Trim** → **mA Output 1 Trim** or **Device Tools** → **Calibration** → **MA Output Trim** → **mA Output 2 Trim**.
3. Follow the instructions in the guided method.
4. Check the trim results. If any trim result is less than −20 microamps or greater than +20 microamps, contact customer service.

10.20.2 Trim mA outputs using the Field Communicator

Trimming the mA Output establishes a common measurement range between the transmitter and the device that receives the mA Output.

Prerequisites

Ensure that the mA Output is wired to the receiving device that will be used in production.

Important
You must trim the output at both ends (0 mA or 4 mA, and 20 mA to ensure that it is compensated accurately across the entire output range.

Procedure

1. Follow the instructions in the guided method.
2. Choose **Service Tools** → **Maintenance** → **Routine Maintenance** → **Trim mA Output 2**.
3. Follow the instructions in the guided method.
4. Check the trim results. If any trim result is less than −20 microamps or greater than +20 microamps, contact customer service.

10.21 Check the pickoff voltage

If the pickoff voltage readings are unusually low, you may have any of a variety of process or equipment problems.

To know whether your pickoff voltage is unusually low, you must collect pickoff voltage data during the problem condition and compare it to pickoff voltage data from a period of normal operation.

Drive gain and pickoff voltage are inversely proportional. As drive gain increases, pickoff voltages decrease and vice versa.

Table 10-7: Possible causes and recommended actions for low pickoff voltage

Possible cause	Recommended actions
Cavitation or flashing; settling of two-phase or three-phase fluids	• Increase the inlet or back pressure at the sensor. Increasing back pressure is recommended. Applying back pressure downstream from the sensor can prevent flashing inside the sensor tubes. That way, if the process fluid is going to flash, it will do so downstream from the sensor after it has been measured. • If a pump is located upstream from the sensor, increase the distance between the pump and sensor. • The sensor may need to be reoriented or repositioned. Consult the installation manual for your sensor.
Faulty wiring runs between the sensor and transmitter	Verify wiring between sensor and transmitter.
Process flow rate beyond the limits of the sensor	Verify that the process flow rate is not out of range of the sensor.
Two-phase flow	Check for two-phase flow. See Check for two-phase flow (slug flow).
Sensor tubes are not vibrating	• Check for plugging or deposition. • Ensure that the vibrating element is free to vibrate (no mechanical binding). • Verify wiring. • Test coils at sensor. See Check the sensor coils.
Moisture in the sensor electronics	Eliminate the moisture in the sensor electronics.
The sensor is damaged, or sensor magnets may have become demagnetized	Replace the sensor.

10.21.1 Collect pickoff voltage data

ProLink III	**Device Tools → Diagnostics → Core Processor Diagnostics**
Field Communicator	**Service Tools → Maintenance → Diagnostic Variables**

Pickoff voltage data can be used to diagnose a variety of process and equipment conditions. Collect pickoff voltage data from a period of normal operation, and use this data as a baseline for troubleshooting.

Procedure

1. Navigate to the pickoff voltage data.
2. Observe and record data for both the left pickoff and the right pickoff, over an appropriate period of time, under a variety of process conditions.

10.22 Check power supply wiring

If the power supply wiring is damaged or improperly connected, the transmitter may not receive enough power to operate properly.

Prerequisites

- You will need the installation manual for your transmitter.
-
- The electronics module must be removed from the transmitter housing base.

Procedure

1. Use a voltmeter to test the voltage at the transmitter's power supply terminals.
   - If the voltage is within the specified range, you do not have a power supply problem.
   - If the voltage is low, ensure that the power supply is adequate at the source, the power cable is sized correctly, there is no damage to the power cable, and an appropriate fuse is installed.
   - If there is no power, continue with this procedure.
2. Before inspecting the power supply wiring, disconnect the power source.

   CAUTION
   If the transmitter is in a hazardous area, wait five minutes after disconnecting the power.

3. Ensure that the terminals, wires, and wiring compartment are clean and dry.
4. Ensure that the power supply wires are connected to the correct terminals.
5. Ensure that the power supply wires are making good contact, and are not clamped to the wire insulation.
6. Inspect the voltage label inside the wiring compartment.
   The voltage supplied to the transmitter should match the voltage specified on the label.
7. Reapply power to the transmitter.

   CAUTION
   If the transmitter is in a hazardous area, do not reapply power to the transmitter with the housing cover removed. Reapplying power to the transmitter while the housing cover is removed could cause an explosion.

8. Test the voltage at the terminals.
   If there is no power, contact customer service.

10.23 Check for radio frequency interference (RFI)

The transmitter's Frequency Output or Discrete Output can be affected by radio frequency interference (RFI). Possible sources of RFI include a source of radio emissions, or a large transformer, pump, or motor that can generate a strong electromagnetic field. Several methods to reduce RFI are available. Use one or more of the following suggestions, as appropriate to your installation.

Procedure

- Use shielded cable between the output and the receiving device.
  - Terminate the shielding at the receiving device. If this is impossible, terminate the shielding at the cable gland or conduit fitting.
  - Do not terminate the shielding inside the wiring compartment.
  - 360-degree termination of shielding is unnecessary.
- Eliminate the RFI source.
- Move the transmitter.

10.24 Using sensor simulation for troubleshooting

When sensor simulation is enabled, the transmitter reports user-specified values for basic process variables. This allows you to reproduce various process conditions or to test the system.

You can use sensor simulation to help distinguish between legitimate process noise and externally caused variation. For example, consider a receiving device that reports an unexpectedly erratic density value. If sensor simulation is enabled and the observed density value does not match the simulated value, the source of the problem is likely to be somewhere between the transmitter and the receiving device.

Sensor simulation requires an enhanced core and a communication device.

Important
When sensor simulation is active, the simulated value is used in all transmitter outputs and calculations, including totals and inventories, volume flow calculations, and concentration calculations. Disable all automatic functions related to the transmitter outputs and place the loop in manual operation. Do not enable simulation mode unless your application can tolerate these effects, and be sure to disable simulation mode when you have finished testing.

10.25 Status alerts, causes, and recommendations

Not all of these alerts may apply to your type of transmitter.

10.25.1 A001

Alert

EEPROM Error

Cause

The transmitter has detected a problem communicating with the sensor.

Recommended actions

1. Cycle power to the meter.
2. Replace the core processor.
3. Contact customer support.

10.25.2 A002

Alert

RAM Error

Cause

The transmitter has detected a problem communicating with the sensor.

Recommended actions

1. Cycle power to the meter.
2. Replace the core processor.
3. Contact customer support.

10.25.3 A003

Alert

No Sensor Response

Cause

The transmitter is not receiving one or more basic electrical signals from the sensor.

This alert often occurs in conjunction with Alert 102.

Recommended actions

1. Check the drive gain and the pickoff voltage.
2. Check the wiring between the sensor and the transmitter.
3. Verify that internal wiring is secure and that there are no internal electrical problems.
4. Check the integrity of the sensor tubes.
5. Perform sensor coil resistence checks.

10.25.4 A004

Alert

Temperature Overrange

Cause

The RTD resistance is out of range for the sensor. The tube RTD resistance is out of range for the sensor.

Recommended actions

1. Check your process conditions against the values reported by the device.
2. Verify temperature characterization or calibration parameters.
3. Verify that internal wiring is secure and that there are no internal electrical problems.
4. Check the wiring between the sensor and the transmitter.
5. Contact customer support.

10.25.5 A005

Alert

Mass Flow Rate Overrange

Cause

The measured flow rate is greater than the maximum flow rate of the sensor (ΔT greater than 200 µs).

Recommended actions

1. If other alerts are present, resolve those alert conditions first. If the current alert persists, continue with the recommended actions.
2. Check your process conditions against the values reported by the device.
3. Check for two-phase flow.

10.25.6 A006

Alert

Characterization Required

Cause

- Calibration factors have not been entered
- The sensor type is incorrect
- The calibration factors are incorrect for the sensor type

Recommended actions

1. Verify all of the characterization or calibration parameters.

   See the sensor tag or the calibration sheet for your meter.
2. Verify the setting of the Sensor Type parameter.
3. If **Sensor Type** = **Curved Tube**, ensure that no parameters specific to **Straight Tube** have been set.
4. Verify that internal wiring is secure and that there are no internal electrical problems.
5. Replace the core processor.
6. Contact customer support.

10.25.7 A008

Alert

Density Overrange

Cause

The line density is greater than 10 g/cm^3 (10000 kg/m^3.

Recommended actions

1. If other alerts are present, resolve those alert conditions first. If the current alert persists, continue with the following steps.
2. Check for air in the flow tubes, tubes not filled, foreign material in the tubes, coating in the tubes, or other process problems.
3. Check for two-phase flow.
4. Verify all of the characterization or calibration parameters.

   See the sensor tag or the calibration sheet for your meter.
5. Check the drive gain and the pickoff voltage.
6. Perform Smart Meter Verification.
7. Perform density calibration.
8. Contact customer support.

10.25.8 A009

Alert

Transmitter Initializing/Warming Up

Cause

Transmitter is in power-up mode.

This alert often occurs in conjunction with Alert 14.

Recommended actions

1. Allow the meter to complete its power-up sequence. The alert should clear automatically.
2. If other alerts are present, resolve those alert conditions first. If the current alert persists, continue with the following steps.
3. Verify that the tubes are full of process fluid.
4. Check the wiring between the sensor and the transmitter.
5. Verify that the transmitter is receiving sufficient power. If using DC power, verify that there is a minimum of 1.5 amps of startup current available.

Option	Description
If no	Correct the problem and cycle power to the meter.
If yes	The transmitter probably has an internal power issue. Replace the transmitter.

6. Ensure that the process fluid is stable.

   Check for two-phase flow, high process noise, or a fast transition between two fluids of different densities.

10.25.9 A010

Alert

Calibration Failure

Cause

There are many possible causes. This alert will not clear until you cycle power to the meter.

Recommended actions

1. Ensure that your calibration procedure meets the documented requirements, cycle power to the meter, then retry the procedure.
2. If this alert appears during zeroing:
    a) Verify that there is no flow through the sensor.
    b) Cycle power to the meter.
    c) Retry the procedure.

10.25.10 A011

Alert

Zero Calibration Failed: Low

Cause

There are many possible causes, such as:

- Too much flow, especially reverse flow through the sensor during a calibration procedure
- A zero result occurred that is too low.

This alert is accompanied by A010, and will not clear until you cycle power to the meter.

Recommended actions

1. Verify that there is no flow through the sensor.
2. Cycle power to the meter.
3. Retry the procedure.

10.25.11 A012

Alert

Zero Calibration Failed: High

Cause

There are many possible causes, such as:

- Too much flow, especially forward flow through the sensor during a calibration procedure
- A zero result occurred that is too high.

This alert is accompanied by A010, and will not clear until you cycle power to the meter.

Recommended actions

1. Verify that there is no flow through the sensor.
2. Cycle power to the meter.
3. Retry the procedure.

10.25.12 A013

Alert

Zero Calibration Failed: Unstable

Cause

There was too much process instability during the calibration procedure.

This alert will not clear until you cycle power to the meter.

Recommended actions

1. Remove or reduce sources of electromechanical noise.

   Example

   Pumps, vibration, or pipe stress
2. Cycle power to the meter.
3. Retry the procedure.

10.25.13 A014

Alert

Transmitter Failure

Cause

There are many possible causes.

Recommended actions

1. Ensure that all wiring compartment covers are installed correctly
2. Ensure that all transmitter wiring meets specifications and that all cable shields are properly terminated.
3. Check the grounding of all components.
4. Evaluate the environment for sources of high electromagnetic interference (EMI) and relocate the transmitter or wiring as necessary.
5. Contact customer support.

10.25.14 A016

Alert

Sensor Temperature (RTD) Failure

Cause

The value computed for the resistance of the line RTD is outside limits.

Recommended actions

1. Check your process conditions against the values reported by the device.
2. Check the wiring between the sensor and the transmitter.
3. Verify that internal wiring is secure and that there are no internal electrical problems.
4. Contact customer support.

10.25.15 A017

Alert

Sensor Case Temperature (RTD) Failure

Cause

The values computed for the resistance of the meter and case RTDs are outside limits.

Recommended actions

1. Check your process conditions against the values reported by the device.
   Temperature should be between -200 °F (-129 °C) and +400 °F (+204 °C).
2. Verify all of the characterization or calibration parameters.
   See the sensor tag or the calibration sheet for your meter.
3. Check the wiring between the sensor and the transmitter.
4. Verify that internal wiring is secure and that there are no internal electrical problems.
5. Check the resistance between the yellow and orange leads.
6. Contact customer support.

10.25.16 A020

Alert

Calibration Factors Missing

Cause

Some calibration factors have not been entered or are incorrect.

Recommended actions

1. Verify all of the characterization or calibration parameters.
   See the sensor tag or the calibration sheet for your meter.
2. Verify the setting of the **Sensor Type** parameter.
3. If **Sensor Type** = Curved Tube, ensure that no parameters specific to Straight Tube have been set.

10.25.17 A021

Alert

Transmitter/Sensor/Software Mismatch

Cause

The configured board type does not match the physical board, or the configured sensor type does not match the physical sensor.

Recommended actions

1. Verify all of the characterization or calibration parameters. See the sensor tag or the calibration sheet for your meter.
2. Ensure that the correct board is installed.
3. Verify the setting of the **Sensor Type** parameter.
4. If **Sensor Type**=Curved Tube, ensure that no parameters specific to Straight Tube have been set.

10.25.18 A027

Alert

Security Breach

Cause

- The HART device ID is set to zero.

Recommended actions

1. Return the transmitter to secure mode if changing the configuration is not needed.
2. Check the HART device ID.

10.25.19 A029

Alert

Internal Electronics Failure

Cause

This can indicate a loss of communication between the transmitter and the display module.

Recommended actions

1. Cycle power to the meter.
2. Replace the display module.
3. Contact customer support.

10.25.20 A030

Alert

Incorrect Board Type

Cause

The loaded software is not compatible with the programmed board type.

Recommended actions

Contact customer support.

10.25.21 A033

Alert

Insufficient Pickoff Signal

Cause

The signal from the sensor pickoff(s) is insufficient. This suggests that the sensor tubes or vibrating elements are not vibrating. This alert often occurs in conjunction with Alert 102.

Recommended actions

1. Check for air in the flow tubes, tubes not filled, foreign material in the tubes, coating in the tubes, or other process problems.
2. Check for foreign material in the process gas or fluid, coating, or other process problems.
3. Check for fluid separation by monitoring the density value and comparing the results against expected density values.
4. Ensure that the sensor orientation is appropriate for your application.

   Settling from a two-phase or three-phase fluid can cause this alert even if the flow tubes are full.

10.25.22 A100

Alert

mA Output 1 Saturated

Cause

The calculated mA Output value is outside the configured range.

Recommended actions

1. Check the settings of **Upper Range Value** and **Lower Range Value**.
2. Check process conditions.

   Actual conditions may be outside the normal conditions for which the output is configured.
3. Check for air in the flow tubes, tubes not filled, foreign material in the tubes, coating in the tubes, or other process problems.
4. Verify that the measurement units are configured correctly for your application.

5. Purge the sensor tubes.

10.25.23 A101

Alert

mA Output 1 Fixed

Cause

The HART address is set to a non-zero value, or the mA Output is configured to send a constant value.

Recommended actions

1. Check whether the output is in loop test mode. If it is, unfix the output.
2. Exit mA Output trim, if applicable.
3. Check the HART address. If the HART address is non-zero, you may need to change the setting of **mA Output Action**.
4. Check whether the output has been set to a constant value via digital communication.

10.25.24 A102

Alert

Drive Overrange

Cause

The drive power (current/voltage) is at its maximum.

Recommended actions

1. Check the drive gain and the pickoff voltage.
2. Check the wiring between the sensor and the transmitter.
3. Verify that internal wiring is secure and that there are no internal electrical problems.
4. Check for air in the flow tubes, tubes not filled, foreign material in the tubes, coating in the tubes, or other process problems.
5. Check for fluid separation by monitoring the density value and comparing the results against expected density values.
6. Ensure that the sensor orientation is appropriate for your application. Settling from a two-phase or three-phase fluid can cause this alert even if the flow tubes are full.

10.25.25 A104

Alert

Calibration in Progress

Cause

A calibration procedure is in process.

Recommended actions

1. Allow the procedure to complete.
2. For zero calibration:
    a) Abort the calibration.
    b) Set **Zero Time** to a lower value.
    c) Restart the calibration.

10.25.26 A105

Alert

Two-Phase Flow

Cause

The line density is outside the user-defined two-phase flow limits.

Recommended actions

1. Check for two-phase flow.
2. Check the live density reading against the upper and lower two-phase flow limit settings.

10.25.27 A106

Alert

Burst Mode Enabled

Cause

HART burst mode is enabled.

Recommended actions

1. No action required.
2. If desired, you can set **Alert Severity Level** to Ignore.

10.25.28 A107

Alert

Power Reset Occurred

Cause

The transmitter has been restarted.

Recommended actions

No action is required.
If desired, you can set **Alert Severity Level** to Ignore.

10.25.29 A108

Alert

Basic Event 1 On

Cause

The process has triggered Basic Event 1.

Recommended actions

1. No action is required.
2. Review event configuration if you believe the event was triggered erroneously.

10.25.30 A109

Alert

Basic Event 2 On

Cause

The process has triggered Basic Event 2.

Recommended actions

1. No action is required.
2. Review event configuration if you believe the event was triggered erroneously.

10.25.31 A110

Alert

Frequency Output Saturated

Cause

The calculated Frequency Output is outside the configured range.

Recommended actions

1. Check the Frequency Output scaling.
2. Check process conditions.

   Actual conditions may be outside the normal conditions for which the output is configured.
3. Check for air in the flow tubes, tubes not filled, foreign material in the tubes, coating in the tubes, or other process problems.
4. Verify that the measurement units are configured correctly for your application.
5. Purge the sensor tubes.

10.25.32 A111

Alert

Frequency Output Fixed

Cause

The Frequency Output has been configured to send a constant value.

Recommended actions

1. Cycling power to the meter or restarting totalizers will restore the Frequency Output to normal operation.
2. Check whether the output is in loop test mode. If it is, unfix the output.
3. Check whether the output has been set to a constant value vial digital communication.

10.25.33 A112

Alert

Upgrade Transmitter Software

Cause

The transmitter software is down-level from the core processor software.

Recommended actions

Contact customer support.

10.25.34 A113

Alert

mA Output 2 Saturated

Cause

The calculated mA Output value is outside the configured range.

Recommended actions

1. Check the settings of **Upper Range Value** and **Lower Range Value**.
2. Check process conditions.

   Actual conditions may be outside the normal conditions for which the output is configured.
3. Check for air in the flow tubes, tubes not filled, foreign material in the tubes, coating in the tubes, or other process problems.
4. Verify that the measurement units are configured correctly for your application.
5. Purge the sensor tubes.

10.25.35 A114

Alert

mA Output 2 Fixed

Cause

The mA Output is configured to send a constant value.

Recommended actions

1. Check whether the output is in loop test mode. If it is, unfix the output.
2. Exit mA Output trim, if applicable.
3. Check whether the output has been set to a constant value via digital communication.

10.25.36 A115

Alert

No External Input or Polled Data

Cause

The connection to an external measurement device has failed. No external data is available.

Recommended actions

1. Verify that the external device is operating correctly.
2. Verify the wiring between the transmitter and the external device.
3. Verify the HART polling configuration.
4. Verify the mA Input configuration.

10.25.37 A116

Alert

Temperature Overrange (Petroleum)

Cause

The measured temperature is outside the range of the API table.

Recommended actions

1. Check your process conditions against the values reported by the device.
2. Verify the configuration of the petroleum measurement application and related parameters.
3. Verify the configuration of the API referral application and related parameters.

10.25.38 A117

Alert

Density Overrange (Petroleum)

Cause

The measured density is outside the range of the API table.

Recommended actions

1. Check your process conditions against the values reported by the device.
2. Verify the configuration of the petroleum measurement application and related parameters.
3. Verify the configuration of the API referral application and related parameters.

10.25.39 ts_A117

Alert

Density Overrange (Petroleum)

Cause

The measured density is outside the range of the API table.

Recommended actions

1. Check your process conditions against the values reported by the device.
2. Verify the configuration of the petroleum measurement application and related parameters.
3. Verify the configuration of the API referral application and related parameters.

10.25.40 A120

Alert

Curve Fit Failure (Concentration)

Cause

The transmitter was unable to calculate a valid concentration matrix from the current data.

Recommended actions

Verify the configuration of the concentration measurement application.

10.25.41 Density D[1 - 4] Calibration in Progress

Cause

A D[1 - 4] density calibration is in progress.

Recommended actions

No action required.

10.25.42 Reverse Flow

Cause

Flow through the device is in the reverse direction (against the flow arrow).

Recommended actions

No action is required.

10.25.43 Zero Calibration in Progress

Cause

A zero calibration is in progress.

Recommended actions

No action required.

10.26 Check sensor-to-transmitter wiring

A number of power-supply and output problems may occur if the wiring between the sensor and the transmitter is improperly connected, or if the wiring becomes damaged.

Be sure to check all wiring segments:

- If you have a 4-wire transmitter, check the wiring between the transmitter and the core processor.
- If you have a 9-wire transmitter, check the wiring between the transmitter and the sensor junction box.
- If you have a remote transmitter with remote core processor, check the wiring between the transmitter and the core processor and the wiring between the core processor and the sensor junction box.

Prerequisites

You will need the installation manual for your transmitter.

Procedure

1. Before opening the wiring compartments, disconnect the power source.

   DANGER
   If the transmitter is in a hazardous area, wait five minutes after disconnecting the power.

2. Verify that the transmitter is connected to the sensor according to the information provided in the installation manual.
3. Verify that the wires are making good contact with the terminals.
4. Check the continuity of all wires from the transmitter to the sensor.

10.27 Check for two-phase flow (slug flow)

Two-phase flow can cause rapid changes in the drive gain. This can cause a variety of measurement issues.

Procedure

1. Check for two-phase flow alerts (e.g., A105).
   If the transmitter is not generating two-phase flow alerts, verify that two-phase flow limits have been set. If limits are set, two-phase flow is not the source of your problem.
2. Check the process for cavitation, flashing, or leaks.

3. Monitor the density of your process fluid output under normal process conditions.
4. Check the settings of **Two-Phase Flow Low Limit**, **Two-Phase Flow High Limit**, and **Two-Phase Flow Timeout**.

Tip
You can reduce the occurrence of two-phase flow alerts by setting **Two-Phase Flow Low Limit** to a lower value, **Two-Phase Flow High Limit** to a higher value, or **Two-Phase Flow Timeout** to a higher value.

10.28 Temperature measurement problems

Problem	Possible causes	Recommended actions
Temperature reading significantly different from process temperature	• RTD failure • Incorrect compensation factors • Line temperature in bypass does not match temperature in main line	• Check junction box for moisture or verdigris. • Verify that the temperature compensation factors match the value on the sensor tag or calibration sheet. • If Alert A004, A016, or A017 is active, perform the actions recommended for that alert.
Temperature reading slightly different from process temperature	• Sensor temperature not yet equalized • Sensor leaking heat	• If the error is within the temperature specification for the sensor, there is no problem. If the temperature measurement is outside the specification, contact customer support. • The temperature of the fluid may be changing rapidly. Allow sufficient time for the sensor to equalize with the process fluid. • The electrical connection between the RTD and the sensor may be damaged. This may require replacing the sensor.
Inaccurate temperature data from external device	• Wiring problem • Problem with input configuration • Problem with external device • Problem with input configuration	• Verify the wiring between the transmitter and the external device. • Verify that the external device is operating correctly. • Verify the configuration of the temperature input. • Ensure that both devices are using the same measurement unit.

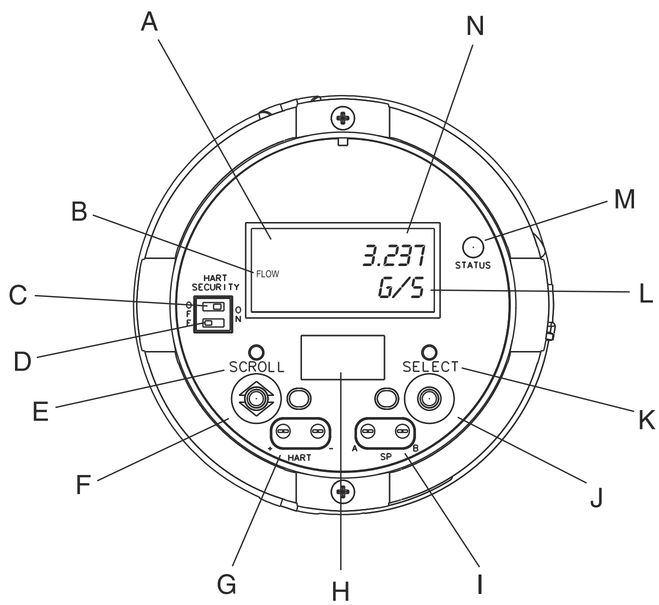
A Using the transmitter display

This section explains how to use the display. Using the display, you can move through the menus, configure the application, monitor and control the application, and perform maintenance and diagnostic tasks.

A.1 Components of the transmitter interface

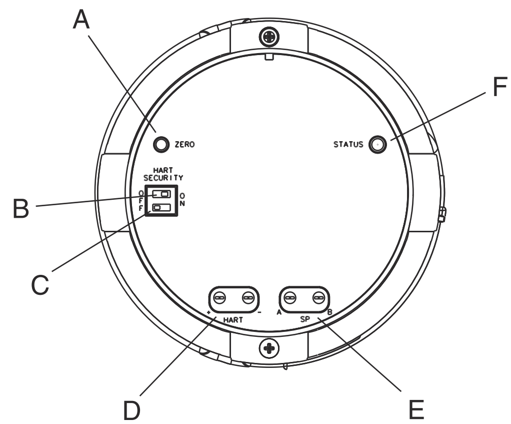
The transmitter interface is available with a display and without a display. If you have a transmitter with a display, you can use the display to view process data and operate the display menus. If you have a transmitter without a display, you must use a communications tool to view process data and configure the transmitter. The transmitter interface includes the status LED, the display (LCD panel), and two optical switches.

Figure A-1: Transmitter interface with display



A. Display (LCD panel)
B. Process variable
C. HART security switch
D. Unused
*E. Optical switch indicator for **Scroll***
*F. **Scroll** optical switch*
G. HART clips
H. Unused
I. Service port clips
*J. **Select** optical switch*
*K. Optical switch indicator for **Select***
L. Unit of measure
M. Status LED
N. Current value

Figure A-2: Transmitter interface without display



A. *Zero button*
B. *HART security switch*
C. *Unused*
D. *HART clips*
E. *Service port clips*
F. *Status LED*

A.2 Use the optical switches

Use the optical switches on the transmitter interface to control the transmitter display. The transmitter has two optical switches: **Scroll** and **Select**.

Procedure

To activate an optical switch, block the light by holding your thumb or finger in front of the opening.

Tip
You can activate the optical switch through the lens. Do not remove the transmitter housing cover.

The optical switch indicator lights up when the transmitter senses that an optical switch has been activated.

Table A-1: Optical switch indicator and optical switch states

Optical switch indicator	State of optical switches
Solid red	One optical switch is activated.
Flickering red	Both optical switches are activated.

A.3 Access and use the display menu system

The display menu system is used to perform various configuration, administrative, and maintenance tasks.

Prerequisites

To access the display menu system, operator access to either the **Off-Line** menu or the **Alert** menu must be enabled. To access the complete menu system, operator access must be enabled for both the **Off-Line** menu and the **Alert** menu.

Tip
The display menu system does not provide complete configuration, administrative, or maintenance functions. For complete transmitter management, you must use another communications tool.

Procedure

1. At the transmitter display, activate the**Scroll** and **Select** optical switches simultaneously until the display changes.

   You will enter the **Off-Line** menu at any of several locations. If an alert is active and access to the **Alert** menu is enabled, you will see **SEE ALERT**.

2. If **CODE?** appears on the display when you make a choice, enter the value that is configured for **Off-Line Password**.

   a) With the cursor flashing on the first digit, activate **Scroll** until the correct digit is displayed, then activate **Select**.

   b) Repeat this process for the second, third, and fourth digits.

   Tip
   If you do not know the correct value for **Off-Line Password**, wait 30 seconds. The password screen will time out automatically and you will be returned to the previous screen.

   ---

3. Use the **Scroll** and **Select** optical switches to navigate to your destination in the display menu system.
   - Use **Scroll** to move through a list of options.
   - Use **Select** to choose the current option.

4. If **Scroll** flashes on the display, activate the **Scroll** optical switch, then the **Select** optical switch, and then the **Scroll** optical switch again.

   The display will prompt you through this sequence. The **Scroll-Select-Scroll** sequence is designed to guard against accidental activation of the off-line menu. It is not designed as a security measure.

5. To exit a display menu and return to a higher-level menu:
   - Activate **Scroll** until the **EXIT** option is displayed, then activate **Select**.
   - If the **EXIT** option is not available, activate **Scroll** and **Select** simultaneously and hold until the screen returns to the previous display.

6. To exit the display menu system, you can use either of the following methods:
   - Exit each menu separately, working your way back to the top of the menu system.
   - Wait two minutes until the display times out and returns to displaying process variable data.

A.3.1 Enter a floating-point value using the display

Certain configuration values (for example, **Lower Range Value** and **Upper Range Value**) are entered as floating-point values. The display supports both decimal notation and exponential notation for floating-point values.

The display allows you to enter a maximum of 8 characters, including the sign. The decimal point is not counted as a character. Exponential notation is used to enter values that require more than 8 characters.

A.3.1 Enter a floating-point value using decimal notation

Decimal notation allows you to enter values between –9999999 and 99999999. You can use the decimal point to enter values with a precision of 0 through 4 (4 characters to the right of the decimal point).

Decimal values entered via the display must meet the following requirements:

- They can contain a maximum of 8 digits, or 7 digits plus a minus sign (−) to indicate a negative number.
- They can contain a decimal point. The decimal point does not count as a digit. The decimal point must be positioned so that the precision of the value does not exceed 4.

When you first enter the configuration screen, the current configuration value is displayed in decimal notation, and the active character is flashing. If the value is positive, no sign is displayed. If the value is negative, a minus sign is displayed.

Procedure

- To change the value:
  a) Activate **Select** until the digit you want to change is active (flashing).

     Select moves the cursor one position to the left. From the leftmost position, **Select** moves the cursor to the rightmost digit.

  b) Activate **Scroll** to change the value of the active digit.

  c) Repeat until all digits are set as desired.
- To change the sign of the value:
  - If the current value is negative, activate **Select** until the minus sign is flashing, then activate **Scroll** until the space is blank.
  - If the current value is positive and there is a blank space at the left of the value, activate **Select** until the cursor is flashing under the blank space, then activate **Scroll** until the minus sign appears.
  - If the current value is positive and there is no blank space at the left of the value, activate **Select** until the cursor is flashing under the leftmost digit, then activate **Scroll** until the minus sign appears.
- To move the decimal point:
  a) Activate **Select** until the decimal point is flashing.

  b) Activate **Scroll**.
     The decimal point is removed from its current position.

  c) Activate **Select** and watch the position of the decimal point.

     As the cursor moves to the left, the decimal point will flash between each pair of digits, up to a maximum precision of four (four digits to the right of the decimal point).

Tip
If the position is not valid, the decimal point is not displayed. Continue to activate **Select** until the decimal point appears at the right of the displayed value.

---

d) When the decimal point is in the desired position, activate **Scroll**.
The decimal point is inserted at its current position.

- To save the displayed value to transmitter memory, activate **Scroll** and **Select** simultaneously and hold until the display changes.
  - If the displayed value is the same as the value in transmitter memory, you will be returned to the previous screen.
  - If the displayed value is not the same as the value in transmitter memory, **SAVE/YES?** flashes on the display. Activate **Select**.
- To exit the menu without saving the displayed value to transmitter memory, activate **Scroll** and **Select** simultaneously and hold until the display changes.
  - If the displayed value is the same as the value in transmitter memory, you will be returned to the previous screen.
  - If the displayed value is not the same as the value in transmitter memory, **SAVE/YES?** flashes on the display. Activate **Scroll**.

A.3.1 Enter a floating-point value using exponential notation

Exponential notation is used to enter values that are larger than 99999999 or smaller than −9999999.

Exponential values entered via the display must be in the following form: `SX.XXXEYY`. In this string:

- S = Sign. A minus sign (−) indicates a negative number. A blank indicates a positive number.
- X.XXX = The 4-digit mantissa.
- E = The exponent indicator.
- YY = The 2-digit exponent.

Procedure

1. Switch from decimal notation to exponential notation.
   a) Activate **Select** as required until the rightmost digit is flashing.
   b) Activate **Scroll** until `E` is displayed.
   c) Activate **Select**.

Tip
If you have modified the value in decimal notation without saving the changes to transmitter memory, the changes will be lost when you switch to exponential notation. Save the decimal value before switching to exponential notation.

---

2. Enter the exponent.
   The first character may be a minus sign or any digit between 0 and 3. The second character may be any digit between 0 and 9.
   a) Activate **Select** to move the cursor to the rightmost character on the display.

b) Activate **Scroll** until the desired character is displayed.

c) Activate **Select** to move the cursor one position to the left.

d) Activate **Scroll** until the desired character is displayed.

3. Enter the mantissa.

   The mantissa must be a 4-digit value with a precision of 3 (that is, all values between 0.000 and 9.999).

   a) Activate **Select** to move the cursor to the rightmost digit in the mantissa.

   b) Activate **Scroll** until the desired character is displayed.

   c) Activate **Select** to move the cursor one digit to the left.

   d) Activate **Scroll** until the desired character is displayed.

   e) Activate **Select** to move the cursor one digit to the left.

   f) Activate **Scroll** until the desired character is displayed.

   g) Activate **Select** to move the cursor one digit to the left.

   h) Activate **Scroll** until the desired character is displayed.

4. Enter the sign.

   a) Activate **Select** to move the cursor one digit to the left.

   b) Activate **Scroll** until the desired character is displayed.

      For positive numbers, select a blank space.

5. To save the displayed value to transmitter memory, activate **Scroll** and **Select** simultaneously and hold until the display changes.

   - If the displayed value is the same as the value in transmitter memory, you will be returned to the previous screen.
   - If the displayed value is not the same as the value in transmitter memory, **SAVE/YES?** flashes on the display. Activate **Select**.

6. Switch back from exponential notation to decimal notation.

   a) Activate **Select** until the `E` is flashing.

   b) Activate **Select** until `d` is displayed.

   c) Activate **Select**.

A.4 Display codes for process variables

Table A-2: Display codes for process variables

Code	Definition	Comment or reference
AVE_D	Average density	Petroleum measurement application only
AVE_T	Average temperature	Petroleum measurement application only
BRD_T	Board temperature	

Table A-2: Display codes for process variables *(continued)*

Code	Definition	Comment or reference
CONC	Concentration	Concentration measurement application only
DRIVE%	Drive gain	
EXT_P	External pressure	
EXT_T	External temperature	
GSV F	Gas standard volume flow	
GSV I	Gas standard volume inventory	
GSV T	Gas standard volume total	
LPO_A	Left pickoff amplitude	
LVOLI	Volume inventory	
LZERO	Live zero flow	
MASSI	Mass inventory	
MTR_T	Case temperature (T-Series sensors only)	
NET M	Net mass flow rate	Concentration measurement application only
NET V	Net volume flow rate	Concentration measurement application only
NETMI	Net mass inventory	Concentration measurement application only
NETVI	Net volume inventory	Concentration measurement application only
PWRIN	Input voltage	Refers to power input to the core processor
RDENS	Density at reference temperature	Concentration measurement application only
RPO_A	Right pickoff amplitude	
SGU	Specific gravity units	
STD V	Standard volume flow rate	Concentration measurement application only
STDVI	Standard volume inventory	Concentration measurement application only
TCDENS	Temperature-corrected density	Petroleum measurement application only
TCORI	Temperature-corrected inventory	Petroleum measurement application only
TCORR	Temperature-corrected total	Petroleum measurement application only
TCVOL	Temperature-corrected volume	Petroleum measurement application only
TUBEF	Raw tube frequency	
WTAVE	Weighted average	

A.5 Codes and abbreviations used in display menus

Table A-3: Codes and abbreviations used in display menus

Code or abbreviation	Definition	Comment or reference
ACK ALERT	Acknowledge alert	
ACK ALL	Acknowledge all alerts	
ACT	Action	
ADDR	Address	
AO1	Analog output 1 (primary mA Output)	
AO 1 SRC	Fixed to the process variable assigned to the primary output	
AO2	Analog output 2 (secondary mA Output)	
AUTO SCRLL	Auto Scroll	
BKLT B LIGHT	Backlight	
CAL	Calibrate	
CH A	Channel A	
CHANGE PASSW CHANGE CODE	Change password or passcode	Change the password or passcode required for access to display functions
CH B	Channel B	
CH C	Channel C	
CONFG	Configuration	
CORE	Core processor	
CUR Z	Current zero	
DENS	Density	
D EV	Discrete event	Events configured using the enhanced event model
DGAIN, DRIVE %	Drive gain	
DI	Discrete Input	
DISBL	Disable	**Select** to disable
DO1	Discrete Output 1	
DO2	Discrete Output 2	
DSPLY	Display	
E1OR2	Event 1 or Event 2	Events configured using the basic event model
ENABL	Enable	**Select** to enable

Table A-3: Codes and abbreviations used in display menus *(continued)*

Code or abbreviation	Definition	Comment or reference
ENABLE ACK	Enable acknowledge all	Enable or disable the ACK ALL function
ENABLE ALERTS	Enable alert menu	Access to alert menu from display
ENABLE AUTO	Enable Auto Scroll	Enable or disable the Auto Scroll function
ENABLE OFFLN	Enable off-line	Access to off-line menu from display
ENABLE PASSW	Enable password	Enable or disable password protection for display functions
ENABLE RESET	Enable totalizer reset	Enable or disable totalizer reset from display
ENABLE START	Enable totalizer start	Enable or disable totalizer start/stop from display
EVNT1	Event 1	Event configured using the basic event model only
EVNT2	Event 2	Event configured using the basic event model only
EXTRN	External	
FAC Z	Factory zero	
FCF	Flow calibration factor	
FLDIR	Flow direction	
FL SW FLSWT	Flow switch	
FO	Frequency Output	
FO FREQ	Frequency factor	
FO RATE	Rate factor	
FREQ	Frequency	
FR FL	Frequency=Flow	
GSV	Gas standard volume	
HYSTRSIS	Hysteresis	
INTERN	Internal	
IO	Input/output	
LANG	Language	
LOCK	Write-protect	
LOOP CUR	Loop current	
M_ASC	Modbus ASCII	
M_RTU	Modbus RTU	
MAO1	mA Output 1 (primary mA Output)	

Table A-3: Codes and abbreviations used in display menus *(continued)*

Code or abbreviation	Definition	Comment or reference
MAO2	mA Output 2 (secondary mA Output)	
MASS	Mass flow	
MBUS	Modbus	
MFLOW	Mass flow	
MSMT	Measurement	
MTR F	Meter factor	
OFF-LINE MAINT	Off-line maintenance	
OFFLN	Off-line	
P/UNT	Pulses/unit	
POLAR	Polarity	
PRESS	Pressure	
QUAD	Quadrature	
r.	Revision	
SCALE	Scaling method	
SIM	Simulation	Used for loop testing, not simulation mode. Simulation mode is not accessible through the display.
SPECL	Special	
SRC	Source	Variable assignment
TEMP, TEMPR	Temperature	
UNT/P	Units/pulse	
VAR 1	Display Variable 1	
VER	Version	
VERFY	Verify	
VFLOW	Volume flow	
VOL	Volume, volume flow	
XMTR	Transmitter	

B Using ProLink III with the transmitter

B.1 Basic information about ProLink III

ProLink III is a configuration and service tool available from Micro Motion. ProLink III runs on a Windows platform and provides complete access to transmitter functions and data.

Version requirements

For details about ProLink III device support, refer to the `ProLink III ChangeLog.txt` file.

ProLink III requirements

To install ProLink III, you must have:

- The ProLink III installation media
- The ProLink III installation kit for your connection type:

To obtain ProLink III and the appropriate installation kit, contact customer support.

ProLink III documentation

Most of the instructions in this manual assume that you are already familiar with ProLink III or that you have a general familiarity with Windows programs. If you need more information than this manual provides, see the *Micro Motion ProLink III User Manual*.

In most ProLink III installations, the manual is installed with the ProLink III program. Additionally, the ProLink III manual is available on the documentation CD or at www.emerson.com.

ProLink III features and functions

ProLink III offers complete transmitter configuration and operation functions. ProLink III also offers a number of additional features and functions, including:

- A Professional version with expanded features not available on the Basic version.
- The ability to save the transmitter configuration set to a file on the PC, and reload it or propagate it to other transmitters
- The ability to log specific types of data to a file on the PC
- The ability to view performance trends for various types of data on the PC
- The ability to connect to and view information for more than one device
- A guided connection wizard

These features are documented in the ProLink III manual. They are not documented in the current manual.

ProLink III messages

As you use ProLink III with a Micro Motion transmitter, you will see a number of messages and notes. This manual does not document all of these messages and notes.

Important
The user is responsible for responding to messages and notes and complying with all safety messages.

B.2 Connect with ProLink III

A connection from ProLink III to your transmitter allows you to read process data, configure the transmitter, and perform maintenance and troubleshooting tasks.

B.2.1 Connection types supported by ProLink III

Different connection types are available for connecting from ProLink III to the transmitter. Choose the connection type appropriate to your network and the tasks you intend to perform.

The transmitter supports the following ProLink III connection types:

- Service port connections
- HART/Bell 202 connections
- HART/RS-485 connections
- Modbus/RS-485 8-bit connections (Modbus RTU)
- Modbus/RS-485 7-bit connections (Modbus ASCII)

When selecting a connection type, consider the following:

- Service port connections are specialized Modbus/RS-485 connections that use standard connection parameters and a standard address that are already defined in ProLink III. Service port connections are typically used by field service personnel for specific maintenance and diagnostic functions. Use a service port connection only when another connection type does not provide the functionality you need.
- HART/Bell 202 connections use standard HART connection parameters that are already defined in ProLink III. The only parameter you must configure is the transmitter address.
- The service port terminals (A and B) and the RS-485 terminals (26 and 27) use the same internal wiring. If you have wired the transmitter for RS-485 digital communications, you cannot make a service port connection.
- Service port connections require access to the service port terminals, which are located on the transmitter display and accessible only after removing the housing cover. Accordingly, service port connections should be used only for temporary connections, and may require extra safety precautions.
- When you are using a HART connection, ProLink III will not allow you to open more than one window at a time. This is done to manage network traffic and optimize speed.
- You cannot make concurrent Modbus connections if the connections use the same terminals. You can make concurrent Modbus connections if the connections use different terminals.

B.2.2 Connect with ProLink III to the service port

Prerequisites

- ProLink III is installed and licensed on your PC
- One of the following:
  - RS-232 to RS-485 signal converter
  - USB to RS-485 signal converter
- An available serial port or USB port

- Adapters as required (for example, 9-pin to 25-pin)

Procedure

1. Attach the signal converter to the serial port or USB port on your PC.
2. Start ProLink III.
3. Choose **Connect to Physical Device**.
4. Set **Protocol** to Service Port.

   Tip
   Service port connections use standard connection parameters and a standard address. You do not need to configure them here.

5. Set the **PC Port** value to the PC COM port that you are using for this connection.
6. Click **Connect**.

   Need help?
   If an error message appears:
   - Switch the leads and try again.
   - Ensure that you have specified the correct port on your PC.
   - Check the wiring between the PC and the transmitter.

B.2.3 Make a HART/Bell 202 connection

Prerequisites

- ProLink III is installed and licensed on your PC
- One of the following:
  — RS-232 to Bell 202 signal converter
  — USB to Bell 202 signal converter
- An available serial port or USB port
- Adapters as required (for example, 9-pin to 25-pin)

CAUTION
If you connect directly to the mA terminals, the transmitter's mA Output may be affected. If you are using the mA Output for process control, set devices for manual control before connecting directly to the mA terminals.

Procedure

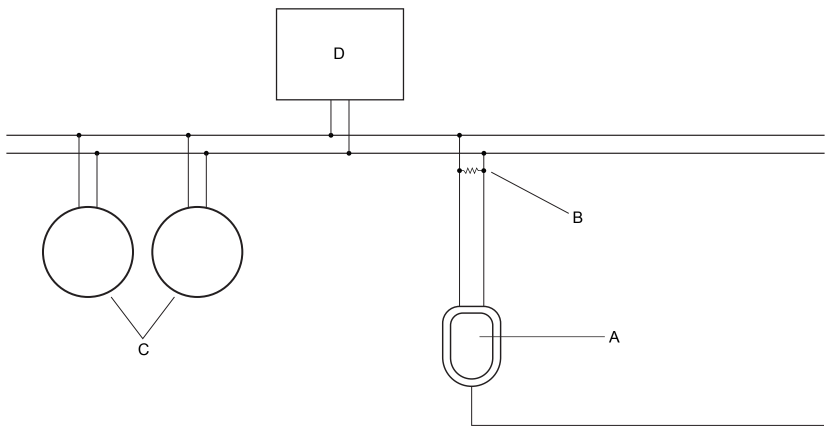
1. Attach the signal converter to the serial port or USB port on your PC.
2. To connect to a point in the local HART loop:
   a) Attach the leads from the signal converter to any point in the loop.
   b) Add resistance as necessary to achieve at least one volt across the connection points.

Important
HART/Bell 202 connections require a voltage drop of 1-5 VDC. To achieve this, add resistance of 250–600 Ω to the connection.

3. To connect over a HART multidrop network:
    a) Attach the leads from the signal converter to any point on the network.
    b) Add resistance as necessary to achieve at least one volt across the connection points.

    Important
    HART/Bell 202 connections require a voltage drop of 1-5 VDC. To achieve this, add resistance of 250–600 Ω to the connection.

Figure B-1: Connection over multidrop network



A. Signal converter
B. 250–600 Ω resistance
C. Devices on the network
D. Master device

4. Start ProLink III.
5. Choose **Connect to Physical Device**.
6. Set **Protocol** to HART Bell 202.

    Tip
    HART/Bell 202 connections use standard connection parameters. You do not need to configure them here.

7. If you are using a USB signal converter, enable **Toggle RTS**.
8. Set **Address/Tag** to the HART polling address configured in the transmitter.

    Tip
    - If this is the first time you are connecting to the transmitter, use the default address: 0.

- If you are not in a HART multidrop environment, the HART polling address is typically left at the default value.
- If you are unsure of the transmitter's address, click **Poll**. The program will search the network and return a list of the transmitters that it detects.

9. Set the **PC Port** value to the PC COM port that you are using for this connection.
10. Set **Master** as appropriate.

Option	Description
Secondary	Use this setting if a primary HART host such as a DCS is on the network.
Primary	Use this setting if no other primary host is on the network. The Field Communicator is a secondary host.

11. Click **Connect**.

Need help?
If an error message appears:

- Verify the HART address of the transmitter, or poll HART addresses 1–15.
- Ensure that you have specified the correct port on your PC.
- Check the wiring between the PC and the transmitter.
- Increase or decrease resistance.
- Ensure that there is no conflict with another HART master. If any other host (DCS or PLC) is connected to the mA Output, temporarily disconnect the DCS or PLC wiring.

C Using a Field Communicator with the transmitter

C.1 Basic information about the Field Communicator

The Field Communicator is a handheld configuration and management tool that can be used with a variety of devices, including Micro Motion transmitters. It provides complete access to transmitter functions and data.

Field Communicator documentation

Most of the instructions in this manual assume that you are already familiar with the Field Communicator and can perform the following tasks:

- Turn on the Field Communicator
- Navigate the Field Communicator menus
- Send configuration data to the device
- Use the alpha keys to enter information

If you are unable to perform these tasks, consult the Field Communicator manual before attempting to use the Field Communicator. The Field Communicator manual is available on the documentation CD or at www.emerson.com.

Device descriptions (DDs)

In order for the Field Communicator to work with your device, the appropriate device description (DD) must be installed: Dev v8 DD v1 9739MVD

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

1. At the HART application menu, press **Utility** → **Available Device Descriptions**.
2. Scroll the list of manufacturers and select **Micro Motion**, then scroll the list of installed device descriptions.

If **Micro Motion** is not listed, or you do not see the required device description, use the Field Communicator Easy Upgrade Utility to install the device description, or contact customer support.

Field Communicator menus and messages

Many of the menus in this manual start with the **On-Line** menu. Ensure that you are able to navigate to the **On-Line** menu.

As you use the Field Communicator with a Micro Motion transmitter, you will see a number of messages and notes. This manual does not document all of these messages and notes.

Important
The user is responsible for responding to messages and notes and complying with all safety messages.

C.2 Connect with the Field Communicator

A connection from the Field Communicator to your transmitter allows you to read process data, configure the transmitter, and perform maintenance and troubleshooting tasks.

Prerequisites

The following HART device description (DD) must be installed on the Field Communicator : 9739MVD, Dev v1, DD v1.

You can connect the Field Communicator to the HART clips on the transmitter, to any point in a local HART loop, or to any point in a HART multidrop network.

CAUTION

If the transmitter is in a hazardous area, do not remove the housing cover while power is being supplied to the unit. Removing the housing cover while power is supplied to the unit could cause an explosion. To access transmitter information in a hazardous environment, use a communication method that does not require removing the transmitter housing cover.

Important

If the HART security switch is set to **ON**, HART protocol cannot be used to perform any action that requires writing to the transmitter. For example, you cannot change the configuration, reset totalizers, or perform calibration using the Field Communicator with a HART connection. When the HART security switch is set to **OFF**, no functions are disabled.

Procedure

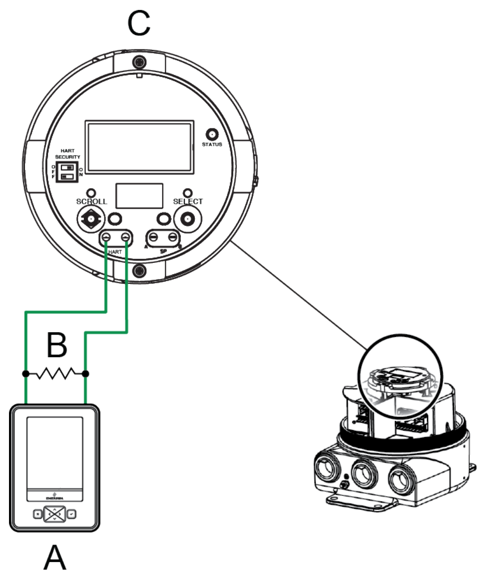
1. To connect to the HART clips:
    a) Remove the transmitter housing cover.
    b) Attach the leads from the Field Communicator to the HART clips on the face of the transmitter and add resistance as necessary.

       The Field Communicator must be connected across a resistance of 250–600 Ω.

       Tip

       HART connections are not polarity-sensitive. It does not matter which lead you attach to which terminal.

Figure C-1: Field Communicator connection to HART clips



A. Field Communicator
B. 250–600 Ω resistance
C. Transmitter

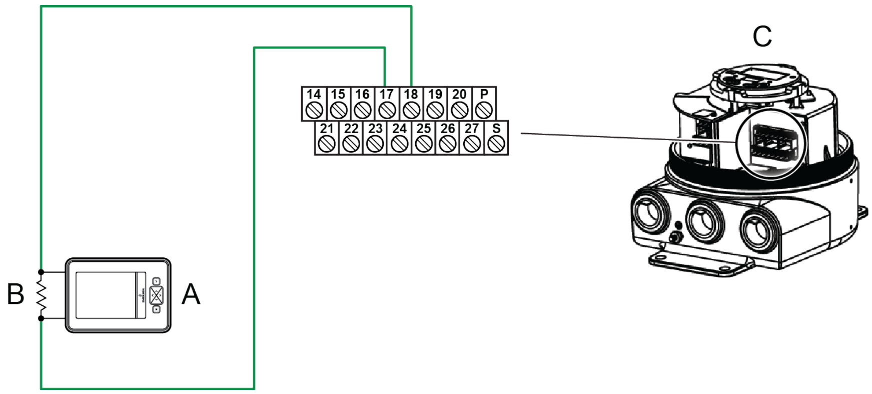
2. To connect to a point in the local HART loop, attach the leads from the Field Communicator to any point in the loop and add resistance as necessary.

   The Field Communicator must be connected across a resistance of 250–600 Ω.

Figure C-2: Field Communicator connection to local HART loop

A. Field Communicator
B. 250–600 Ω resistance

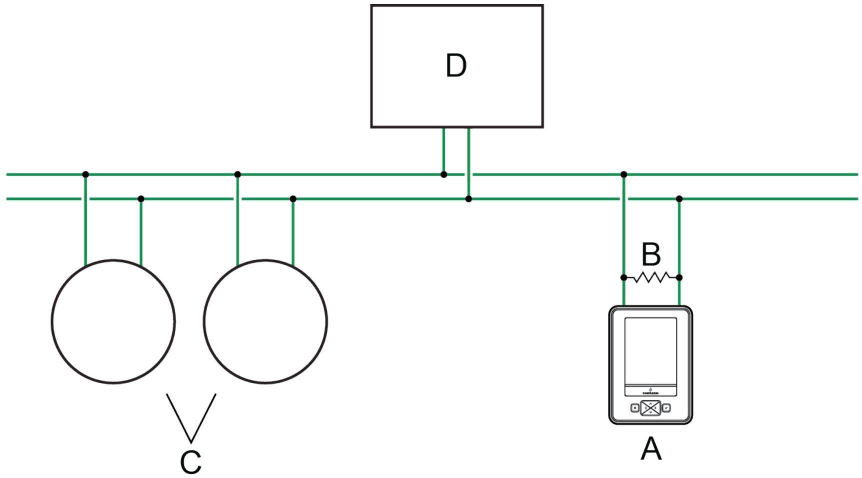
Figure C-3: Field Communicator connection to local HART loop



A. Field Communicator
B. 250–600 Ω resistance
C. Transmitter terminals

3. To connect to a point in the HART multidrop network, attach the leads from the Field Communicator to any point on the network.

Figure C-4: Field Communicator connection to multidrop network



A. Field Communicator
B. 250–600 Ω resistance
C. Devices on the network
D. Master device

4. Turn on the Field Communicator and wait until the main menu is displayed.
5. If you are connecting across a multidrop network:
   - Set the Field Communicator to poll. The device returns all valid addresses.
   - Enter the HART address of the transmitter. The default HART address is 0. However, in a multidrop network, the HART address has probably been set to a different, unique value.

Postrequisites

To navigate to the **Online** menu, choose **HART Application** → **Online**. Most configuration, maintenance, and troubleshooting tasks are performed from the **Online** menu.

Tip

You may see messages related to the DD or active alerts. Press the appropriate buttons to ignore the message and continue.

Need help?

The Field Communicator requires a minimum of 1 VDC across the connection leads to communicate. If necessary, increase the resistance at the connection point until 1 VDC is achieved.

D Default values and ranges

D.1 Default values and ranges

The default values and ranges represent the typical factory transmitter configuration. Depending on how the transmitter was ordered, certain values may have been configured at the factory and are not represented in the default values and ranges.

Table D-1: Transmitter default values and ranges

Type	Parameter	Default	Range	Comments
Flow	Flow direction	Forward		
	Flow damping	0.8 sec	0.0 – 51.2 sec	User-entered value is corrected to the nearest valid value in list of preset values. For gas applications, a minimum value of 2.56 is recommended. The 2.56 value will be automatically rounded up to 3.2 seconds.
	Flow calibration factor	1.00005.13		For sensors, this value represents the FCF and FT factors concatenated.
	Mass flow units	g/s		
	Mass flow cutoff	Sensor-specific value set at factory		The recommended setting is 0.1% to 0.5% of the sensor's maximum rated flowrate. For some applications, such as empty-full-empty batching, a higher value is recommended. Contact customer service for assistance.
	Volume flow type	Liquid		
	Volume flow units	L/s		
	Volume flow cutoff	0/0 L/s	0.0 – x L/s	x is obtained by multiplying the flow calibration factor by 0.2, using units of L/s.
Meter factors	Mass factor	1		
	Density factor	1		
	Volume factor	1		
Density	Density damping	1.6 sec	0.0 – 51.2 sec	User-entered value is corrected to nearest valid value in a list of preset values.
	Density units	g/cm^3		
	Density cutoff	0.2 g/cm^3	0.0 – 0.5 g/cm^3	
	D1	0 g/cm^3		

Table D-1: Transmitter default values and ranges *(continued)*

Type	Parameter	Default	Range	Comments
	D2	1 g/cm^3		
	K1	1000 µsec	1000 – 50,000 µsec	
	K2	50,000 µsec	1000 – 50,000 µsec	
	FD	0		
	Temp Coefficient	4.44		
Two-phase flow	Two-phase flow low limit	0.0 g/cm^3	0.0 – 10.0 g/cm^3	
	Two-phase flow high limit	5.0 g/cm^3	0. 0 – 10.0 g/cm^3	
	Two-phase duration	0.0 sec	0.0 – 60.0 sec	
Temperature	Temperature damping	4.8 sec	0.0 – 38.4 sec	User-entered value is corrected to nearest valid value in a list of preset values.
	Temperature units	Deg C		
	Temperature calibration factor	1.00000T0.0000		
Pressure	Pressure units	PSI		
	Flow factor	0		
	Density factor	0		
	Cal pressure	0		
T-Series sensor	D3	0 g/cm^3		
	D4	0 g/cm^3		
	K3	0 µsec		
	K4	0 µsec		
	FTG	0		
	FFQ	0		
	DTG	0		
	DFQ1	0		
	DFQ2	0		
Special units	Base mass unit	g		
	Base mass time	sec		
	Mass flow conversion factor	1		
	Base volume unit	L		
	Base volume time	sec		

Table D-1: Transmitter default values and ranges *(continued)*

Type	Parameter	Default	Range	Comments
	Volume flow conversion factor	1		
Variable mapping	Primary variable	Mass flow		
	Secondary variable			
	Tertiary variable	Mass flow		
	Quaternary variable	Volume flow		
mA Output 1	Primary variable	Mass flow		
	LRV	–200.00000 g/s		
	URV	200.00000 g/s		
	AO cutoff	0.00000 g/s		
	AO added damping	0.00000 sec		The user-entered value is corrected down to the nearest lower value in a list of preset values.
	LSL	–200 g/s		Read-only. LSL is calculated based on the sensor size and characterization parameters.
	USL	200 g/s		Read only. USL is calculated based on the sensor size and characterization parameters.
	MinSpan	0.3 g/s		Read-only.
	Fault action	Downscale		
	AO fault level – downscale	2.0 mA	1.0 – 3.6 mA	
	AO fault level – upscale	22 mA	21.0 – 24.0 mA	
	Last measured value timeout	0.00 sec		
mA Output 2	Secondary variable	Density		
	LRV	0.00 g/cm3		
	URV	10.00 g/cm3		
	AO cutoff	Not-A-Number		
	AO added damping	0.00000 sec		
	LSL	0.00 g/cm^3		Read-only. LSL is calculated based on the sensor size and characterization parameters.

Table D-1: Transmitter default values and ranges *(continued)*

Type	Parameter	Default	Range	Comments
	USL	10.00 g/cm^3		Read only. USL is calculated based on the sensor size and characterization parameters.
	MinSpan	0.05 g/cm^3		Read-only.
	Fault action	Downscale		
	AO fault level – downscale	2.0 mA	1.0 – 3.6 mA	
	AO fault level – upscale	22 mA	21.0 – 24.0 mA	
	Last measured value timeout	0.00 sec		
LRV	Mass flow rate	−200.000 g/s		
	Volume flow rate	−0.200 L/s		
	Density	0.000 g/cm^3		
	Temperature	−240.000 °C		
	Drive gain	0.000%		
	Gas standard volume flow rate	−423.78SCFM		
	External temperature	−240.000 °C		
	External pressure	0.000 psi		
URV	Mass flow rate	200.000 g/s		
	Volume flow rate	0.200 L/s		
	Density	10.000 g/cm^3		
	Temperature	450.000 °C		
	Drive gain	100.000%		
	Gas standard volume flow rate	423.78 SCFM		
	External temperature	450.000 °C		
	External pressure	100.000 psi		
Frequency Output	Tertiary variable	Mass flow		
	Frequency factor	1,000.00 Hz	0.001 – 10,000 Hz	
	Flow rate factor	1000 kg/min		
	Scaling method	Freq=Flow	0 or 0.5 – 277.5 ms	
	Frequency fault action	Downscale		
	Frequency fault level – upscale	15,000 Hz	10.0 – 15,000 Hz	
	Frequency Output polarity	Active high		

Table D-1: Transmitter default values and ranges *(continued)*

Type	Parameter	Default	Range	Comments
	Last measured value timeout	0.0 seconds	0.0 – 60.0 sec	
Discrete Output	Source	Flow direction		
	Fault Indicator	None		
	Power	Internal		
	Polarity	Active high		
Discrete Output 2	Source	Flow switch		
	Polarity	Active high		
Discrete Input	Actions	None		
	Polarity	Active low		
mA Input	Process Variable (PV)	None		
Display	Backlight on/off	On		
	Refresh rate	200 milliseconds	100 – 10,000 milliseconds	
	Variable 1	Mass flow rate		
	Variable 2	Mass total		
	Variable 3	Volume flow rate		
	Variable 4	Volume total		
	Variable 5	Density		
	Variable 6	Temperature		
	Variable 7	Drive gain		
	Variable 8–15	None		
	Display totalizer start/stop	Disabled		
	Display totalizer reset	Disabled		
	Display auto scroll	Disabled		
	Display offline menu	Enabled		
	Display offline password	Disabled		
	Display alarm menu	Enabled		
	Display acknowledge all alarms	Enabled		
	Offline password	1234		
	Auto scroll rate	10 sec		
Digital comm	Fault action	None		
	Fault timeout	0 seconds	0.0 – 60.0 sec	
	Modbus address	1		

Table D-1: Transmitter default values and ranges *(continued)*

Type	Parameter	Default	Range	Comments
	Modbus ASCII support	Enabled		
	Floating-point byte order	3–4–1–2		
	Double-precision byte order	1-2-3-4-5-6-7-8		

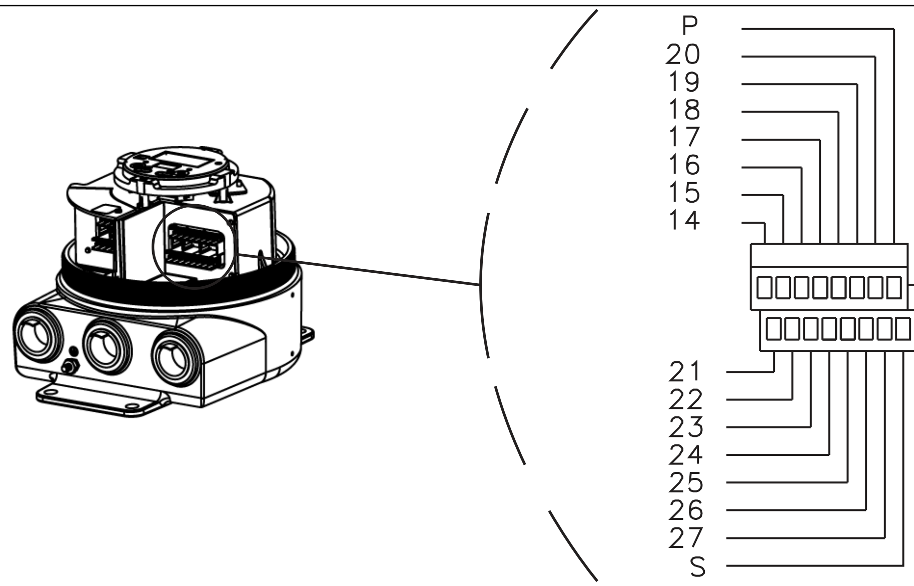
E Transmitter components and installation wiring

E.1 Input/output (I/O) terminals

The I/O terminals are used to connect the transmitter to remote devices such as other transmitters or valves, or to hosts.

CAUTION

Refer to the *Micro Motion 9739 MVD Transmitters: Installation Manual* for all safety and detailed wiring information for the 9739 MVD transmitter. You are responsible for following all safety and wiring instructions documented in the transmitter installation manual, plus any additional site requirements.



Terminal	Function
14	Contact the factory
15	Frequency Output (+)
16	Return (FO, DO, and DI)
17	Primary variable (PV+) mA Output
18	Primary variable (PV–) mA Output
19	Secondary variable (SV+) mA Output
20	Secondary variable (SV–) mA Output
21 and 16	Discrete Input (Zero) (+)
22 and 16	Discrete Output (Control output)
23	Signal ground

Terminal	Function
24 and 23	Temperature output (mV signal) - intended for use with Micro Motion density peripherals (DMS, NOC, and NFC).
25 and 23	Tube period output - intended for use with Micro Motion density peripherals (DMS, NOC, and NFC).
26	RS-485 I/O (A+): shared with **Service port A** on the user interface
27	RS-485 I/O (B–): shared with **Service port B** on the user interface
P	DC power to pressure or DP transmitter
S	mA Input from pressure or DP transmitter

MMI-20016855
Rev. AD
2019

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