Configuration and Use Manual
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Micro Motion® Filling Mass Transmitters with Modbus

Configuration and Use Manual

Micro Motion®

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Process Management

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1 Introduction to filling with the Filling Mass Transmitter

Topics covered in this chapter:

1.1 The Filling Mass Transmitter from Micro Motion

The Filling Mass Transmitter is designed for any process that requires high-speed high-accuracy filling or dosing.

The Filling Mass Transmitter, paired with a Coriolis sensor from Micro Motion, enables mass-based measurement that is immune to variations in process fluid, temperature, or pressure. Integrated-valve-control fills are implemented via high-precision discrete outputs, for the fastest possible valve response. Automatic Overshoot Compensation adjusts the system to minimize processing delays in valve control. Volume-based filling is also available.

The Filling Mass Transmitter implements all of the advanced digital signal processing algorithms, diagnostics, and features of the Micro Motion family of transmitters.

1.2 Fill types and fill options

Depending on your purchase option, the Filling Mass Transmitter supports either integrated-valve-control fills or external-valve-control fills. For integrated-valve-control installations, there are five types of integrated-valve-control fills and three fill options. Each fill type and combination has different output requirements and is configured differently.

Table 1-1: Fill types and descriptions

Transmitter model code	Supported fill types	Description
FMT*P FMT*Q	External valve control	The transmitter measures flow and sends flow data to a host over the frequency/pulse output. The host opens and closes the valves and performs fill measurement. The transmitter is unaware of the filling application.
FMT*R FMT*S FMT*T	Integrated valve control	The host inititates the fill. The transmitter resets the fill total, opens the valves, performs fill measurement, and closes the valves.

Table 1-1: Fill types and descriptions *(continued)*

Transmitter model code	Supported fill types	Description
FMT*U FMT*V	One-stage discrete	The fill is controlled by a single discrete (ON/OFF) valve. The valve opens completely when the fill begins, and closes completely when Fill Target is reached, or the fill is paused or ended.
	Two-stage discrete	The fill is controlled by two discrete valves: a primary valve and a secondary valve. One valve must open at the beginning of the fill; the other opens at a user-defined point. One valve must stay open until the end of the fill; the other closes at a user-defined point.
	Timed	The valve is open for the specified number of seconds.
	Dual-fillhead	Fill sequence: 1. Container #1 is moved into position. 2. Fillhead #1 begins filling Container #1, and Container #2 is moved into position. 3. Fill #1 ends. Fillhead #2 begins filling Container #2. Container #1 is replaced by a new container. Standard one-stage filling control is implemented for both fills: The valve opens completely when the fill begins, and closes completely when Fill Target is reached, or the fill is paused or ended.
	Dual-fillhead timed	Fill sequence: 1. Container #1 is moved into position. 2. Fillhead #1 begins filling Container #1, and Container #2 is moved into position. 3. Fill #1 ends. Fillhead #2 begins filling Container #2. Container #1 is replaced by a new container. Timed control is implemented for both fills: Each valve is open for the specified number of seconds.

Table 1-2: Fill options and descriptions

Option	Description	Compatibility
Purge	The Purge feature is used to control an auxiliary valve that can be used for any non-filling purpose. For example, it can be used for adding water or gas to the container after the fill ends, or "padding." Flow through the auxiliary valve is not measured by the transmitter.	Compatible with: • One-stage discrete fills • Two-stage discrete fills • Timed fills
Pump	The Pump feature is used to increase pressure during the fill by starting an upstream pump just before the fill begins.	Compatible with: • One-stage discrete fills
Automatic Overshoot Compensation (AOC)	Automatic Overshoot Compensation (AOC) is used to adjust fill timing to compensate for the time required to transmit the valve close command or for the valve to close completely.	Compatible with: • One-stage discrete fills • Two-stage discrete fills • Dual-fillhead fills

1.2.1 I/O requirements

To implement a specific fill type and fill option, the transmitter outputs must be wired to the appropriate valves or devices, and configured appropriately.

Table 1-3: I/O requirements for fill types and fill options

Fill type		Precision DO1	Precision DO2	Channel B operating as DO	mA output	Frequency output
External valve control		N/A	N/A	As desired	N/A	To host
Integrated valve control	One-stage discrete	Primary valve	N/A	N/A	As desired	N/A
	One-stage discrete with purge	Primary valve	N/A	Purge valve	As desired	N/A
	One-stage discrete with pump	Primary valve	Pump	As desired	As desired	N/A
	Two-stage discrete	Primary valve	Secondary valve	As desired	As desired	N/A
	Two-stage discrete with purge	Primary valve	Secondary valve	Purge valve	As desired	N/A
	Timed	Primary valve	N/A	As desired	As desired	N/A
	Timed with purge	Primary valve	N/A	Purge valve	As desired	N/A
	Dual-fillhead	Valve in Fillhead #1	Valve in Fillhead #2	As desired	As desired	N/A
	Timed dual-fillhead	Valve in Fillhead #1	Valve in Fillhead #2	As desired	As desired	N/A

1.3 Options for user interface

Your options for user interface and fill operation depend on the protocol supported by your transmitter. Your transmitter's model code identifies the protocol.

Table 1-4: Transmitter protocol and user interface options

Transmitter model code	Supported protocol	User interface options	
		Configuration, maintenance, and troubleshooting	Fill operation
FMT*P FMT*R FMT*S FMT*T	Modbus	• ProLink II • Modbus utility	• ProLink II • Modbus host

Table 1-4: Transmitter protocol and user interface options *(continued)*

Transmitter model code	Supported protocol	User interface options	
		Configuration, maintenance, and troubleshooting	Fill operation
FMT*Q FMT*U FMT*V	PROFIBUS-DP	• ProLink II • EDD • Bus parameters	• ProLink II • EDD • GSD • Bus parameters

2 Quick start using ProLink II

Topics covered in this chapter:

- *Power up the transmitter*
- *Check flowmeter status*
- *Connect from ProLink II to the transmitter*
- *Complete the configuration and commissioning process*

2.1 Power up the transmitter

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

1. Follow appropriate procedures to ensure that a new device on the network does not interfere with existing measurement and control loops.
2. Ensure that the cables are connected to the transmitter, as described in *Micro Motion Filling Mass Transmitters: Installation Manual* .
3. Ensure that all transmitter and sensor covers and seals are closed.

   ⚠ **CAUTION!**

   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.

4. Turn on the electrical power at the power supply.

   The transmitter will automatically perform diagnostic routines. During this period, Alarm 009 is active. The diagnostic routines should complete in approximately 30 seconds.

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 is 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 flowmeter status

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

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, Alarm A009 is active. This alarm should clear automatically when the power-up sequence is complete.
2. Connect to the transmitter and check for active alarms.

Postrequisites

For information on viewing the list of active alarms, see *Section 14.3*.

For information on individual alarms and suggested resolutions, see *Section 16.1*.

2.3 Connect from ProLink II to the transmitter

Making a connection from ProLink II allows you to view process data, use ProLink II to configure the transmitter, perform maintenance and troubleshooting tasks, or run a fill.

Prerequisites

You must have the following installed and ready to use:

- ProLink II v2.91 or later
- ProLink II installation kit for Modbus/RS-485 connections

Procedure

1. Attach the leads of your signal converter to the wires that are attached to the RS-485 or service port pins on the transmitter. See *Micro Motion Filling Mass Transmitters: Installation Manual* for more information.
2. Start ProLink II and choose Connect > Connect to Device.
3. In the Connection dialog box, enter parameters as shown here, then click Connect.

	Transmitter protocol	
Connection parameter	**Modbus**	**PROFIBUS-DP**
Protocol	Modbus RTU	Service Port
COM Port	The port on your PC that you are using for this connection	The port on your PC that you are using for this connection
Address	Transmitter's configured Modbus address (default = 1)	N/A

Note
The transmitter automatically analyzes the incoming connection request and responds to all connection requests with any setting for parity and stop bits, and all network speeds between 1200 and 38,400 baud. You do not need to set values for these connection parameters.

If the connection is successful, ProLink II displays the Process Variables screen.

Need help? If an error message is displayed:

- Ensure that you have specified the correct COM port.
- Check all the wiring between your PC and the transmitter.
- Add 120-Ω, 1/2-watt terminating resistors at both ends of the segment.

2.4 Complete the configuration and commissioning process

Use the following procedure as a general guideline to complete transmitter configuration and commissioning.

1. Configure the fill.
   - For integrated-valve-control fills, see *Chapter 5*.
   - For external-valve-control fills, see *Chapter 9*.
2. Perform any required transmitter configuration that is not specifically related to filling.

   See *Chapter 11*, *Chapter 12*, and *Chapter 13*.
3. Test or tune your system using sensor simulation.

   See *Section 2.4.1*.
4. Back up the transmitter configuration to a file on your PC.

   See *Section 2.4.2*.

Need help? At any time, you can restore the factory configuration to return the transmitter to a known operational configuration. See *Section 2.4.3*.

2.4.1 Test or tune the system using sensor simulation

Use sensor simulation to test the system's response to a variety of process conditions, including boundary conditions, problem conditions, or alarm conditions, or to tune the loop.

Prerequisites

Before enabling sensor simulation, ensure that your process can tolerate the effects of the simulated process values.

Procedure

1. Navigate to the sensor simulation menu.

Communications tool	Menu path
ProLink II	ProLink > Configuration > Sensor Simulation
ProLink III	Device Tools > Diagnostics > Testing > Sensor Simulation

2. Enable sensor simulation.
3. For mass flow, set Wave Form as desired and enter the required values.

Option	Required values
Fixed	Fixed Value
Sawtooth	Period Minimum Maximum
Sine	Period Minimum Maximum

4. For density, set Wave Form as desired and enter the required values.

Option	Required values
Fixed	Fixed Value
Sawtooth	Period Minimum Maximum
Sine	Period Minimum Maximum

5. For temperature, set Wave Form as desired and enter the required values.

Option	Required values
Fixed	Fixed Value
Sawtooth	Period Minimum Maximum
Sine	Period Minimum Maximum

6. Observe the system response to the simulated values and make any appropriate changes to the transmitter configuration or to the system.
7. Modify the simulated values and repeat.

8. When you have finished testing or tuning, disable sensor simulation.

Sensor simulation

Sensor simulation allows you to test the system or tune the loop without having to create the test conditions in your process. When sensor simulation is enabled, the transmitter reports the simulated values for mass flow, density, and temperature, and takes all appropriate actions. For example, the transmitter might apply a cutoff, activate an event, or post an alarm.

When sensor simulation is enabled, the simulated values are stored in the same memory locations used for process data from the sensor. The simulated values are then used throughout transmitter functioning. For example, sensor simulation will affect:

- All mass flow rate, temperature, and density values shown on the display or reported via outputs or digital communications
- The mass total and mass inventory values
- All volume calculations and data, including reported values, volume totals, and volume inventories
- All mass, temperature, density, or volume values logged to Data Logger

Sensor simulation does not affect any diagnostic values.

Unlike actual mass flow rate and density values, the simulated values are not temperature-compensated (adjusted for the effect of temperature on the sensor's flow tubes).

2.4.2 Back up transmitter configuration

ProLink II and ProLink III provide 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. It is also a convenient way to replicate a configuration across multiple devices.

Prerequisites

One of the following:

- An active connection from ProLink II
- An active connection from ProLink III

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

Procedure

- To back up the transmitter configuration using ProLink II:

  1. Choose File > Load from Xmtr to File.
  2. Specify a name and location for the backup file, and click Save.

3. Select the options that you want to include in the backup file, and click Download Configuration.

- To back up the transmitter configuration using ProLink III:

1. Choose Device Tools > Configuration Transfer > Save or Load Configuration Data.
2. In the Configuration groupbox, select the configuration data you want to save.
3. Click Save, then specify a file name and location on your computer.
4. 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.

2.4.3 Restore the factory configuration

ProLink II	ProLink > Configuration > Device > Restore Factory Configuration
ProLink III	Device Tools > Configuration Transfer > Restore Factory Configuration

Overview

Restoring the factory configuration returns the transmitter to a known operational configuration. 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 Micro Motion to see if there is a preferred method to resolve any issues.

3 Quick start using Modbus

Topics covered in this chapter:

3.1 Power up the transmitter

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

1. Follow appropriate procedures to ensure that a new device on the network does not interfere with existing measurement and control loops.
2. Ensure that the cables are connected to the transmitter, as described in *Micro Motion Filling Mass Transmitters: Installation Manual* .
3. Ensure that all transmitter and sensor covers and seals are closed.

   ⚠ **CAUTION!**

   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.

4. Turn on the electrical power at the power supply.

   The transmitter will automatically perform diagnostic routines. During this period, Alarm 009 is active. The diagnostic routines should complete in approximately 30 seconds.

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 is 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.

3.2 Check flowmeter status

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

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, Alarm A009 is active. This alarm should clear automatically when the power-up sequence is complete.
2. Connect to the transmitter and check for active alarms.

Postrequisites

For information on viewing the list of active alarms, see *Section 14.3*.

For information on individual alarms and suggested resolutions, see *Section 16.1*.

3.3 Set up the Modbus Interface Tool (MIT)

The Micro Motion Modbus Interface Tool (MIT) is a utility that documents all Modbus coils and registers on the transmitter. The MIT provides necessary information on Modbus addresses, datatypes, integer codes, etc. Additional features allow you to search for coils and registers by keyword, and prepare and print transmitter-specific or feature-specific lists.

Prerequisites

The MIT requires Microsoft Excel 2007 or later.

To support the Filling Mass Transmitter, v4 or later of the MIT is required.

Procedure

1. Download the installation package for the Modbus Installation Tool from the Micro Motion web site (www.micromotion.com), or copy it from the Micro Motion documentation CD.
2. Unzip the installation package and run Setup.
3. Launch the MIT and refer to the MIT manual (installed with the utility) for more information.

3.4 Make a Modbus connection to the transmitter

Making a Modbus connection allows you to use a Modbus utility or program to view process data, configure the transmitter, perform maintenance and troubleshooting tasks, or run a fill.

Prerequisites

- Any standard Modbus program or utility

- An RS-485 physical connection to the transmitter's RS-485 terminals

Procedure

1. In your Modbus program, enter the transmitter's configured Modbus address.

   The default Modbus address is 1. The range is 1 to 127, excluding 111.
2. In your Modbus program, enter any other required connection parameters.

   The transmitter accepts all Modbus connection requests within the following parameter ranges:

Parameter	Range
Protocol	Modbus RTU (8-bit)
Baud	All standard rates between 1200 and 38,400
Parity	Even, Odd, None
Stop Bits	1 or 2

3.5 Complete the configuration and commissioning process

Use the following procedure as a general guideline to complete transmitter configuration and commissioning.

1. Configure the fill.
   - For integrated-valve-control fills, see *Chapter 7*.
   - For external-valve-control fills, see *Chapter 10*.
2. Perform any required transmitter configuration that is not specifically related to filling.

   See *Chapter 11*, *Chapter 12*, and *Chapter 13*.
3. Test or tune your system using sensor simulation.

   See *Section 3.5.1*.

Need help? At any time, you can restore the factory configuration to return the transmitter to a known operational configuration. See *Section 3.5.2*.

3.5.1 Test or tune the system using Modbus and sensor simulation

Use sensor simulation to test the system's response to a variety of process conditions, including boundary conditions, problem conditions, or alarm conditions, or to tune the loop.

Prerequisites

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Before enabling sensor simulation, ensure that your process can tolerate the effects of the simulated process values.

Procedure

1. Configure simulation for mass flow rate
   a. Write the code for the waveform to Register 3171.
   b. If you selected Fixed, write the fixed value to Registers 3175–3176.
   c. If you selected Sawtooth or Sine , write the minimum amplitude to Registers 3177–3178, the maximum amplitude to Registers 3179–3180, and the wave period to Registers 3181–3182.
2. Configure simulation for temperature.
   a. Write the code for the waveform to Register 3172.
   b. If you selected Fixed, write the fixed value to Registers 3183–3184.
   c. If you selected Sawtooth or Sine , write the minimum amplitude to Registers 3185–3186, the maximum amplitude to Registers 3187–3188, and the wave period to Registers 3189–3190.
3. Configure simulation for density.
   a. Write the code for the waveform to Register 3173.
   b. If you selected Fixed, write the fixed value to Registers 3191–3192.
   c. If you selected Sawtooth or Sine , write the minimum amplitude to Registers 3193–3194, the maximum amplitude to Registers 3195–3196, and the wave period to Registers 3197–3198.
4. Write 1 to Coil 255 to enable sensor simulation.
5. Observe the system response to the simulated values and make any appropriate changes to the transmitter configuration or to the system.
6. Modify the simulated values and repeat.
7. When you have finished testing or tuning, write 0 to Coil 255 to disable sensor simulation.

Sensor simulation

Sensor simulation allows you to test the system or tune the loop without having to create the test conditions in your process. When sensor simulation is enabled, the transmitter reports the simulated values for mass flow, density, and temperature, and takes all appropriate actions. For example, the transmitter might apply a cutoff, activate an event, or post an alarm.

When sensor simulation is enabled, the simulated values are stored in the same memory locations used for process data from the sensor. The simulated values are then used throughout transmitter functioning. For example, sensor simulation will affect:

- All mass flow rate, temperature, and density values shown on the display or reported via outputs or digital communications
- The mass total and mass inventory values
- All volume calculations and data, including reported values, volume totals, and volume inventories
- All mass, temperature, density, or volume values logged to Data Logger

Sensor simulation does not affect any diagnostic values.

Unlike actual mass flow rate and density values, the simulated values are not temperature-compensated (adjusted for the effect of temperature on the sensor's flow tubes).

3.5.2 Restore the factory configuration using Modbus

Restoring the factory configuration returns the transmitter to a known operational configuration. This may be useful if you experience problems during configuration.

Prerequisites

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

Procedure

Write 1 to Coil 247.

Part II

Configure and operate integrated-valve-control fills

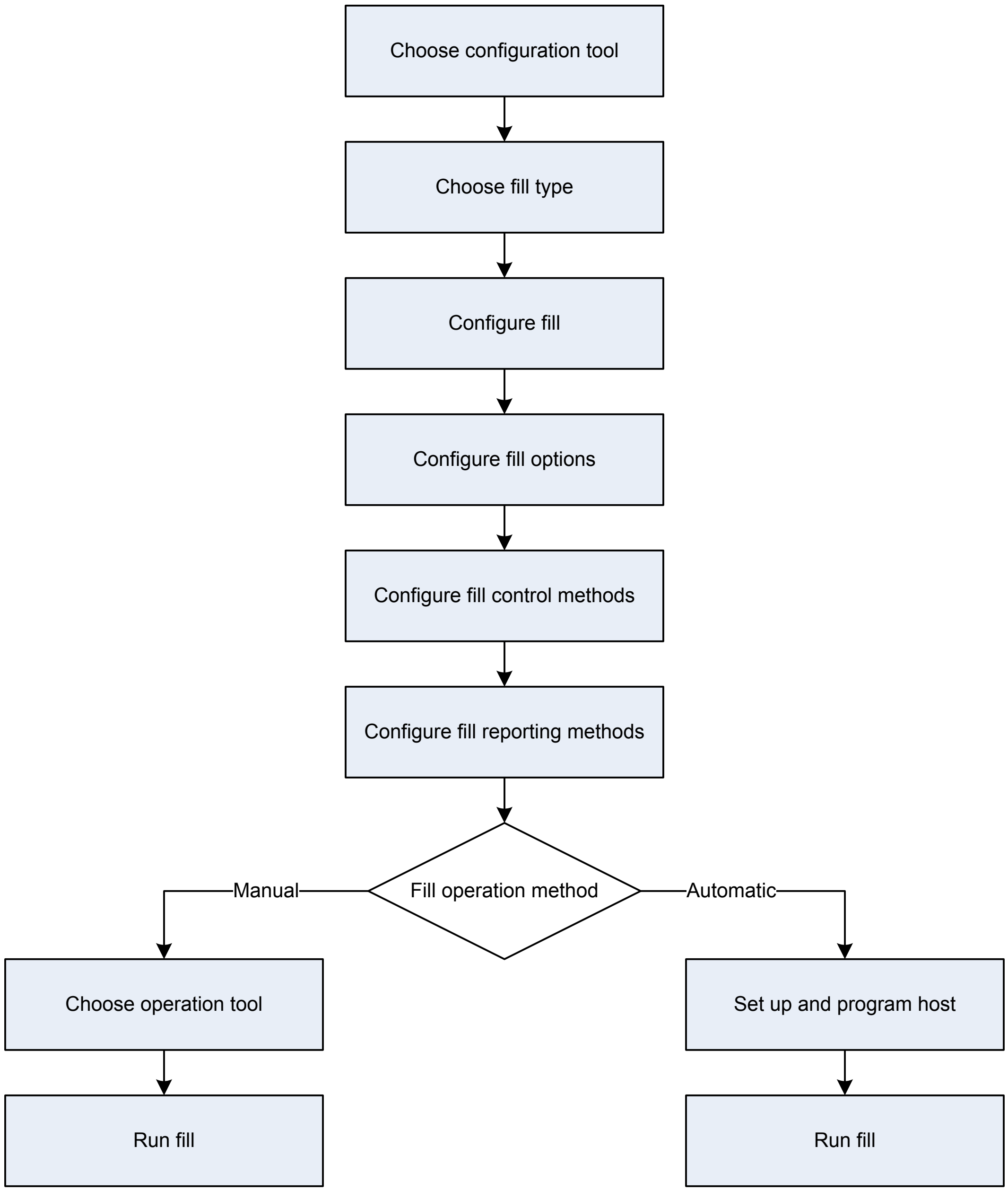
Chapters covered in this part:

4 Preparing to configure an integrated-valve-control fill

Topics covered in this chapter:

4.1 General procedure for configuring and running an integrated-valve-control fill

Figure 4-1: Configuring and running an integrated-valve-control fill



4.2 Tips and tricks for configuring an integrated-valve-control fill

Before beginning your fill configuration, review the following:

- When you configure a fill, start with the factory-default settings. If you do not, the transmitter may reject certain parameter combinations. See *Section 4.2.1*.
- The setting of Mass Flow Cutoff or Volume Flow Cutoff is important for fill accuracy. Be sure to set the appropriate cutoff before running a fill, or before performing AOC calibration. If you are using mass to measure the fill, see *Section 11.2.3*. If you are using volume to measure the fill, see *Section 11.3.2*.
- The setting of Flow Direction controls how your fill total is measured. For integrated-valve-control fills, see *Effect of Flow Direction on the fill total*.
- Fill measurement and operation may be affected by other transmitter parameters. Review the general configuration information in *Chapter 11*, *Chapter 12*, and *Chapter 13*.
- You can change the fill configuration or general transmitter configuration while a fill is running. The configuration change will take effect after the fill ends.

4.2.1 Factory-default settings for basic fill parameters

When you configure a fill, start with the factory-default settings listed here. If you do not, the transmitter may reject certain parameter combinations.

Table 4-1: Basic fill parameters and factory-default settings

Parameter	Factory-default setting
Enable Filling Option	Enabled
Enable Dual Fill	Disabled
Enable AOC	Enabled
Enable Purge	Disabled
Enable Timed Fill	Disabled
Fill Type	One Stage Discrete
Count Up	Enabled
Configure By	% Target

5 Configure an integrated-valve-control fill using ProLink II

Topics covered in this chapter:

5.1 Configure an integrated-valve-control fill using ProLink II

Configure the fill type that is appropriate for your application.

Tip

A one-stage discrete fill is appropriate for most applications. Use this fill type unless you have specific requirements for another fill type. In most cases, the transmitter is configured for a one-stage discrete fill at the factory, and will be operational with a minimum of site configuration.

5.1.1 Configure a one-stage discrete fill using ProLink II

Configure a one-stage discrete fill when you want to fill a single container from a single valve. The valve will be open until Fill Target is reached.

Prerequisites

Ensure that you are starting from the factory-default configuration.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Configure the precision discrete output(s):

   a. Choose ProLink > Configuration > Discrete Output.

   b. Set Precision DO1 to Primary Valve.

   c. Set Precision DO1 Polarity as appropriate for your installation.

   Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC

Option	Signal from transmitter	Voltage
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

2. Configure flow measurement:

   a. Open the Flow panel.

   b. Set Flow Direction to the option appropriate for your installation.

Option	Description
Forward	Process fluid flows in one direction only, matching the direction of the arrow on the sensor.
Bidirectional	Process fluid can flow in either direction. Most of the flow matches the direction of the arrow on the sensor.
Negate Forward	Process fluid flows in one direction only, in the opposite direction of the arrow on the sensor.
Negate Bidirectional	Process fluid can flow in either direction. Most of the flow is in the opposite direction of the arrow on the sensor.

Restriction
All other options for Flow Direction are invalid, and will be rejected by the transmitter.

   c. Set Mass Flow Units as desired.

   If you set Flow Source to Mass Flow Rate, the corresponding mass unit is used to measure your fill.

   d. Set Volume Flow Units as desired.

   If you set Flow Source to Volume Flow Rate, the corresponding volume unit is is used to measure your fill.

   e. Set other flow options as desired.

Tip
The default value of Flow Damping is 0.04 seconds. This is the optimum value for most filling applications, and is typically not changed.

3. Open the Filling panel.
4. Set Flow Source to the process variable to be used to measure this fill.

Option	Description
Mass Flow Rate	The mass flow process variable, as measured by the transmitter

Option	Description
Volume Flow Rate	The volume flow process variable, as measured by the transmitter

5. Set or verify the following parameters:

Parameter	Setting
Enable Filling Option	Enabled
Enable Dual Fill	Disabled
Enable AOC	Enabled
Enable Purge	Disabled
Enable Timed Fill	Disabled
Fill Type	One Stage Discrete

Tip
Micro Motion strongly recommends implementing Automatic Overshoot Compensation (AOC). When enabled and calibrated, AOC increases fill accuracy and repeatability.

6. Set Count Up as desired.

   Count Up controls how the fill total is calculated and displayed.

Option	Description
Enabled	The fill total starts at 0 and increases toward Fill Target.
Disabled	The fill total starts at Fill Target and decreases toward 0.

7. Set Fill Target to the quantity at which the fill will be complete.

   Enter the value in the measurement units configured for Flow Source.
8. Set Max Fill Time to the number of seconds at which the fill will time out.

   If the fill does not complete normally before this time has elapsed, the fill is aborted and fill timeout error messages are posted.

   To disable the fill timeout feature, set Max Fill Time to 0.

   The default value for Max Fill Time is 0 (disabled). The range is 0 seconds to 800 seconds.
9. Set Measured Fill Time as desired.

   Measured Fill Time controls how the fill duration will be measured.

Option	Description
Flow Stops	The fill duration will be incremented until the transmitter detects that flow has stopped, after valve closure.
Valve Closes	The fill duration will be incremented until the transmitter sets the discrete output as required to close the valve.

Postrequisites

Options for one-stage discrete fills include:

- Configuring Automatic Overshoot Compensation (AOC). If AOC is enabled, ensure that AOC is appropriately configured and calibrated for your application.
- Implementing the Purge feature.
- Implementing the Pump feature.

5.1.2 Configure a two-stage discrete fill using ProLink II

Configure a two-stage discrete fill when you want to fill a single container from two valves.

Prerequisites

Ensure that you are starting from the factory-default configuration.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Configure the precision discrete output(s):

   a. Open the Discrete Output panel.

   b. Set Precision DO1 to Primary Valve.

   c. Set Precision DO1 Polarity as appropriate for your installation.

   Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

   d. Set Precision DO2 to Secondary Valve.

   e. Set Precision DO2 Polarity as appropriate for your installation.

   Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

2. Configure flow measurement:

   a. Open the Flow panel.

   b. Set Flow Direction to the option appropriate for your installation.

Option	Description
Forward	Process fluid flows in one direction only, matching the direction of the arrow on the sensor.
Bidirectional	Process fluid can flow in either direction. Most of the flow matches the direction of the arrow on the sensor.
Negate Forward	Process fluid flows in one direction only, in the opposite direction of the arrow on the sensor.
Negate Bidirectional	Process fluid can flow in either direction. Most of the flow is in the opposite direction of the arrow on the sensor.

Restriction
All other options for Flow Direction are invalid, and will be rejected by the transmitter.

   c. Set Mass Flow Units as desired.

   If you set Flow Source to Mass Flow Rate, the corresponding mass unit is used to measure your fill.

   d. Set Volume Flow Units as desired.

   If you set Flow Source to Volume Flow Rate, the corresponding volume unit is is used to measure your fill.

   e. Set other flow options as desired.

Tip
The default value of Flow Damping is 0.04 seconds. This is the optimum value for most filling applications, and is typically not changed.

3. Open the Filling panel.
4. Set Flow Source to the process variable to be used to measure this fill.

Option	Description
Mass Flow Rate	The mass flow process variable, as measured by the transmitter
Volume Flow Rate	The volume flow process variable, as measured by the transmitter

5. Set or verify the following parameters:

Parameter	Setting
Enable Filling Option	Enabled
Enable Dual Fill	Disabled
Enable AOC	Enabled
Enable Purge	Disabled
Enable Timed Fill	Disabled
Fill Type	Two Stage Discrete

Tip
Micro Motion strongly recommends implementing Automatic Overshoot Compensation (AOC). When enabled and calibrated, AOC increases fill accuracy and repeatability.

6. Set Count Up as desired.

Count Up controls how the fill total is calculated and displayed.

Option	Description
Enabled	The fill total starts at 0 and increases toward Fill Target.
Disabled	The fill total starts at Fill Target and decreases toward 0.

7. Set Configure By as desired.

Configure By controls how valve control timing is configured.

Option	Description
% Target	Valve Open and Valve Close timing is configured as a percentage of Fill Target. For example: • Valve Open = 0%: The valve opens when the current fill total is 0% of Fill Target. • Valve Close = 90%: The valve closes when the current fill total is 90% of Fill Target.
Quantity	Valve Open and Valve Close timing is configured in terms of the configured measurement unit. For example: • Valve Open = 0 g: The valve opens when the current fill total is 0 g. • Valve Close = 50 g: The valve closes when the current fill total is 50 g less than Fill Target.

8. Set Fill Target to the quantity at which the fill will be complete.

   Enter the value in the measurement units configured for Flow Source.

9. Set Max Fill Time to the number of seconds at which the fill will time out.

   If the fill does not complete normally before this time has elapsed, the fill is aborted and fill timeout error messages are posted.

   To disable the fill timeout feature, set Max Fill Time to 0.

   The default value for Max Fill Time is 0 (disabled). The range is 0 seconds to 800 seconds.

10. Set Measured Fill Time as desired.

    Measured Fill Time controls how the fill duration will be measured.

Option	Description
Flow Stops	The fill duration will be incremented until the transmitter detects that flow has stopped, after valve closure.
Valve Closes	The fill duration will be incremented until the transmitter sets the discrete output as required to close the valve.

11. Set Open Primary, Open Secondary, Close Primary, and Close Secondary as desired.

    These values control the point in the fill at which the primary and secondary valves open and close. They are configured either by quantity or by percent of the target, as controlled by the Configure By parameter.

    Either Open Primary or Open Secondary must be set to open at the beginning of the fill. Both can open at the beginning of the fill if desired. If you set one to open later, the other one is automatically reset to open at the beginning.

    Either Close Primary or Close Secondary must be set to close at the end of the fill. Both can close at the end of the fill if desired. If you set one to close earlier, the other one is automatically reset to close at the end.

Postrequisites

Options for two-stage discrete fills include:

- Configuring Automatic Overshoot Compensation (AOC). If AOC is enabled, ensure that AOC is appropriately configured and calibrated for your application.
- Implementing the Purge feature.

Valve opening and closing sequences for two-stage discrete fills

The following figures illustrate the opening and closing of the primary and secondary valves, as controlled by the configuration of Open Primary, Open Secondary, Close Primary, and Close Secondary.

These illustrations assume that the fill runs from beginning to end without interruption.

Figure 7-1: Open Primary first, Close Primary first

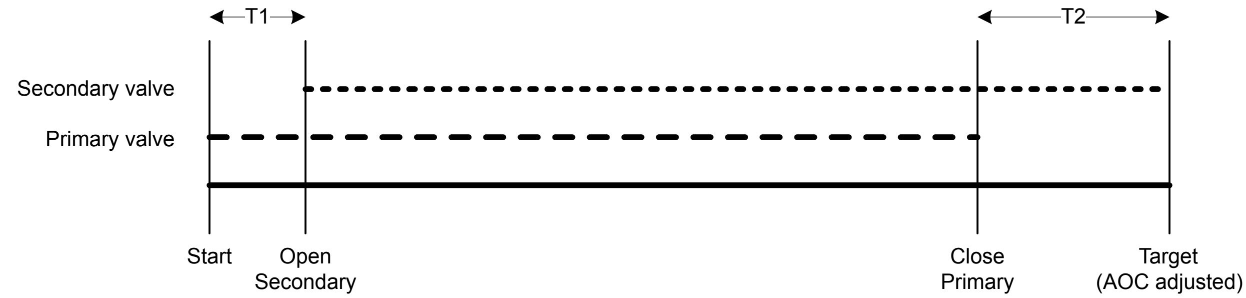


Figure 7-2: Open Primary first, Close Secondary first

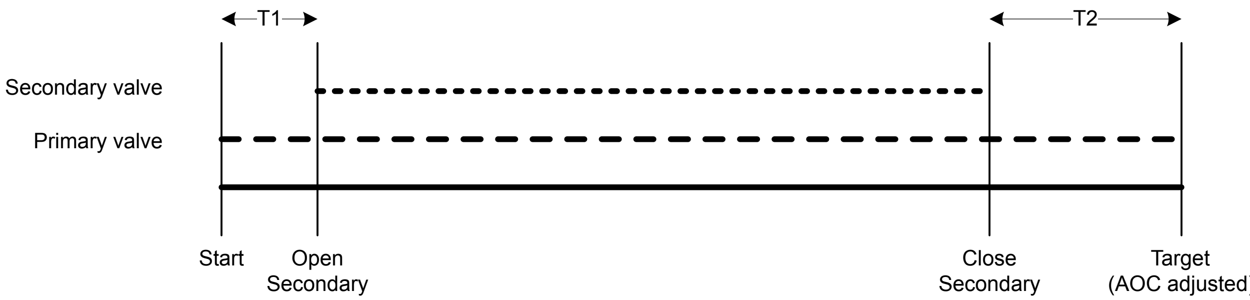


Figure 7-3: Open Secondary first, Close Primary first

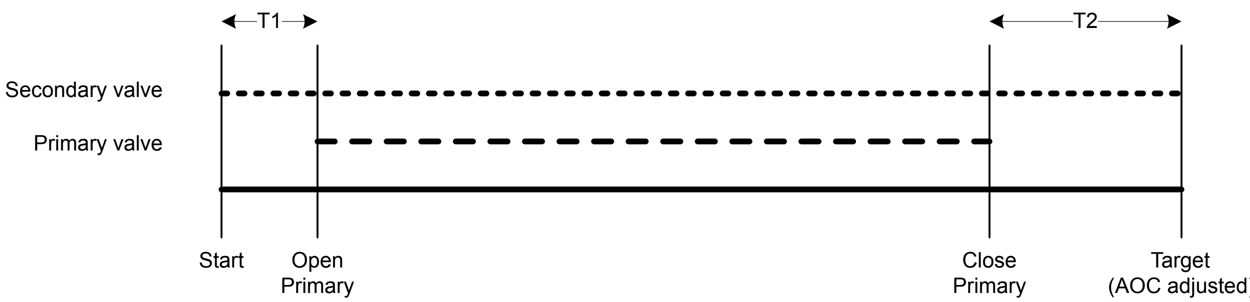
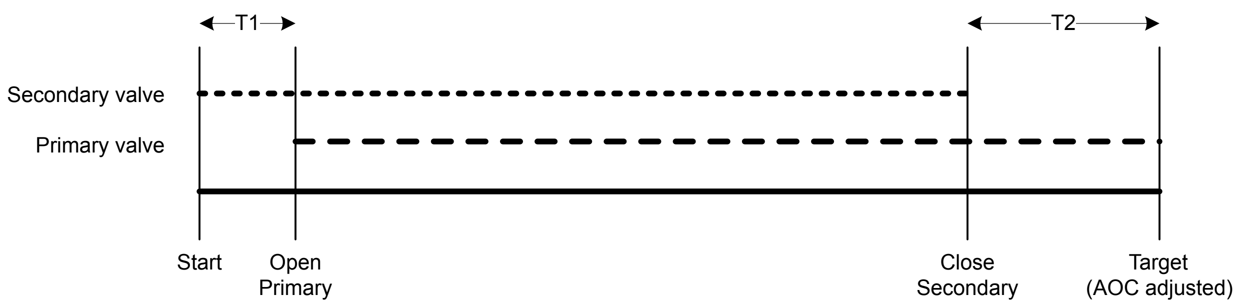


Figure 7-4: Open Secondary first, Close Secondary first



Effects of Configure By on valve opening and closing

Configure By controls how the Open Primary, Open Secondary, Close Primary, and Close Secondary values are configured and applied.

- When Configure By = % Target, the transmitter adds the configured Valve Open and Valve Close values to 0%.
- When Configure By = Quantity, the transmitter adds the configured Valve Open values to 0, and subtracts the configured Valve Close values from Fill Target.

Example: Configure By and valve open/close commands

Fill Target = 200 g. You want the primary valve to open at the beginning of the fill and close at the end of the fill. You want the secondary valve to open after 10 g has been delivered, and close after 190 g has been delivered. See *Table 7-1* for the settings that will produce this result.

Table 7-1: Configure By and valve configuration

Configure By	**Valve Open and Valve Close values**
% Target	• Open Primary = 0% • Open Secondary = 5% • Close Secondary = 95% • Close Primary = 100%
Quantity	• Open Primary = 0 g • Open Secondary = 10 g • Close Secondary = 10 g • Close Primary = 0 g

5.1.3 Configure a timed fill using ProLink II

Configure a timed fill when you want to fill a single container from a single valve. The valve will be open for the specified number of seconds.

Prerequisites

Ensure that you are starting from the factory-default configuration.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Configure the precision discrete output(s):
   a. Choose ProLink > Configuration > Discrete Output.
   b. Set Precision DO1 to Primary Valve.
   c. Set Precision DO1 Polarity as appropriate for your installation.

      Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

2. Configure flow measurement:

   a. Open the Flow panel.

   b. Set Flow Direction to the option appropriate for your installation.

Option	Description
Forward	Process fluid flows in one direction only, matching the direction of the arrow on the sensor.
Bidirectional	Process fluid can flow in either direction. Most of the flow matches the direction of the arrow on the sensor.
Negate Forward	Process fluid flows in one direction only, in the opposite direction of the arrow on the sensor.
Negate Bidirectional	Process fluid can flow in either direction. Most of the flow is in the opposite direction of the arrow on the sensor.

Restriction
All other options for Flow Direction are invalid, and will be rejected by the transmitter.

   c. Set Mass Flow Units as desired.

   If you set Flow Source to Mass Flow Rate, the corresponding mass unit is used to measure your fill.

   d. Set Volume Flow Units as desired.

   If you set Flow Source to Volume Flow Rate, the corresponding volume unit is is used to measure your fill.

   e. Set other flow options as desired.

Tip
The default value of Flow Damping is 0.04 seconds. This is the optimum value for most filling applications, and is typically not changed.

3. Set or verify the following parameters:

Parameter	Setting
Enable Filling Option	Enabled

Parameter	Setting
Count Up	Enabled
Enable Dual Fill	Disabled
Enable AOC	Disabled
Enable Purge	Disabled
Enable Timed Fill	Enabled
Fill Type	One Stage Discrete

4. Set Target Time to the number of seconds that the fill will run.

Postrequisites

The following option is available for timed fills:

- Implementing the Purge feature.

5.1.4 Configure a dual-fillhead fill using ProLink II

Configure a dual-fillhead fill when you want to fill two containers alternately, using two fillheads. Each valve will be open until Fill Target is reached.

Important
The configured Fill Target is applied to both fillheads.

Prerequisites

Ensure that you are starting from the factory-default configuration.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Configure the precision discrete output(s):

   a. Choose ProLink > Configuration > Discrete Output.

   b. Set Precision DO1 to Primary Valve.

   c. Set Precision DO1 Polarity as appropriate for your installation.

   Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

   d. Set Precision DO2 to Secondary Valve.

e. Set Precision DO2 Polarity as appropriate for your installation.

Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

2. Configure flow measurement:

a. Open the Flow panel.

b. Set Flow Direction to the option appropriate for your installation.

Option	Description
Forward	Process fluid flows in one direction only, matching the direction of the arrow on the sensor.
Bidirectional	Process fluid can flow in either direction. Most of the flow matches the direction of the arrow on the sensor.
Negate Forward	Process fluid flows in one direction only, in the opposite direction of the arrow on the sensor.
Negate Bidirectional	Process fluid can flow in either direction. Most of the flow is in the opposite direction of the arrow on the sensor.

Restriction
All other options for Flow Direction are invalid, and will be rejected by the transmitter.

c. Set Mass Flow Units as desired.

If you set Flow Source to Mass Flow Rate, the corresponding mass unit is used to measure your fill.

d. Set Volume Flow Units as desired.

If you set Flow Source to Volume Flow Rate, the corresponding volume unit is is used to measure your fill.

e. Set other flow options as desired.

Tip
The default value of Flow Damping is 0.04 seconds. This is the optimum value for most filling applications, and is typically not changed.

3. Open the Filling panel.

4. Set Flow Source to the process variable to be used to measure this fill.

Option	Description
Mass Flow Rate	The mass flow process variable, as measured by the transmitter
Volume Flow Rate	The volume flow process variable, as measured by the transmitter

5. Set or verify the following parameters:

Parameter	Setting
Enable Filling Option	Enabled
Count Up	Enabled
Enable Dual Fill	Enabled
Enable AOC	Enabled
Enable Purge	Disabled
Enable Timed Fill	Disabled
Fill Type	One Stage Discrete

Tip
Micro Motion strongly recommends implementing Automatic Overshoot Compensation (AOC). When enabled and calibrated, AOC increases fill accuracy and repeatability.

6. Set Fill Target to the quantity at which the fill will be complete.

Note
The configured Fill Target is applied to both fillheads.

7. Set Max Fill Time to the number of seconds at which the fill will time out.

   If the fill does not complete normally before this time has elapsed, the fill is aborted and fill timeout error messages are posted.

   To disable the fill timeout feature, set Max Fill Time to 0.

   The default value for Max Fill Time is 0 (disabled). The range is 0 seconds to 800 seconds.

8. Set Measured Fill Time as desired.

   Measured Fill Time controls how the fill duration will be measured.

Option	Description
Flow Stops	The fill duration will be incremented until the transmitter detects that flow has stopped, after valve closure.

Option	Description
Valve Closes	The fill duration will be incremented until the transmitter sets the discrete output as required to close the valve.

Postrequisites

Options for dual-fillhead fills include:

- Configuring Automatic Overshoot Compensation (AOC). If AOC is enabled, ensure that AOC is appropriately configured and calibrated for your application.

5.1.5 Configure a dual-fillhead timed fill using ProLink II

Configure a dual-fillhead timed fill when you want to fill two containers alternately, using two fillheads. Each valve will be open for the specified number of seconds.

Important
The configured Target Time is applied to both fillheads.

Prerequisites

Ensure that you are starting from the factory-default configuration.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Configure the precision discrete output(s):

    a. Choose ProLink > Configuration > Discrete Output.

    b. Set Precision DO1 to Primary Valve.

    c. Set Precision DO1 Polarity as appropriate for your installation.

    Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

    d. Set Precision DO2 to Secondary Valve.

    e. Set Precision DO2 Polarity as appropriate for your installation.

    Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

2. Configure flow measurement:
   a. Open the Flow panel.
   b. Set Flow Direction to the option appropriate for your installation.

Option	Description
Forward	Process fluid flows in one direction only, matching the direction of the arrow on the sensor.
Bidirectional	Process fluid can flow in either direction. Most of the flow matches the direction of the arrow on the sensor.
Negate Forward	Process fluid flows in one direction only, in the opposite direction of the arrow on the sensor.
Negate Bidirectional	Process fluid can flow in either direction. Most of the flow is in the opposite direction of the arrow on the sensor.

Restriction
All other options for Flow Direction are invalid, and will be rejected by the transmitter.

   c. Set Mass Flow Units as desired.

   If you set Flow Source to Mass Flow Rate, the corresponding mass unit is used to measure your fill.

   d. Set Volume Flow Units as desired.

   If you set Flow Source to Volume Flow Rate, the corresponding volume unit is is used to measure your fill.

   e. Set other flow options as desired.

Tip
The default value of Flow Damping is 0.04 seconds. This is the optimum value for most filling applications, and is typically not changed.

3. Open the Filling panel.
4. Set Flow Source to the process variable to be used to measure this fill.

Option	Description
Mass Flow Rate	The mass flow process variable, as measured by the transmitter
Volume Flow Rate	The volume flow process variable, as measured by the transmitter

5. Set or verify the following parameters:

Parameter	Setting
Enable Filling Option	Enabled
Count Up	Enabled
Enable Dual Fill	Enabled
Enable AOC	Disabled
Enable Purge	Disabled
Enable Timed Fill	Enabled
Fill Type	One Stage Discrete

6. Set Target Time to the number of seconds that the fill will run.

Note
The configured Target Time is applied to both fillheads.

5.2 Configure fill options using ProLink II

Depending on your fill type, you can configure and implement Automatic Overshoot Compensation, the Purge feature, or the Pump feature.

5.2.1 Configure and implement Automatic Overshoot Compensation (AOC) using ProLink II

Automatic Overshoot Compensation (AOC) is used to adjust fill timing to compensate for the time required to transmit the valve close command or for the valve to close completely.

Prerequisites

Before setting up AOC, ensure that all other fill parameters are correctly configured.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Choose ProLink > Configuration > Filling.
2. Choose the type of AOC that you want to implement.

Option	Description
Fixed	The valve will close at the point defined by Fill Target, minus the quantity specified in Fixed Overshoot Comp. Use this option only if the "prewarn" value is already known.
Overfill	Defines the direction used by the AOC algorithm to approach the target. The AOC algorithm starts by estimating an overfill amount, and reduces the overfill in successive calibration fills.
Underfill	Defines the direction used by the AOC algorithm to approach the target. The AOC algorithm starts by estimating an underfill amount, and reduces the underfill in successive calibration fills.

Tip

The Fixed option is typically not used. If you choose Fixed, the transmitter will operate like a legacy batch controller. In typical applications, the other AOC options provide enhanced accuracy and repeatability.

Restriction

The Fixed and Overfill options are not supported for dual-fillhead fills.

3. To implement Fixed AOC:
   a. Disable Enable AOC.
   b. Set AOC Algorithm to Fixed.
   c. Set Fixed Overshoot Comp as desired.

      The default value is 0, measured in process units.

      The transmitter will close the valve when the current fill total is equal to Fill Target minus the specified value (in process units).
4. To implement Overfill or Underfill:
   a. Ensure that Enable AOC is enabled.
   b. Set AOC Algorithm to either Overfill or Underfill.
   c. Set AOC Window Length to the number of fills that will be used for AOC calibration.

      The default is 10. The range is 2 to 32.

      Tip

      Micro Motion recommends using the default value unless you have special application requirements.

Important

Do not change the values of AOC Change Limit or AOC Convergence Rate unless you are working with Micro Motion customer service. These parameters are used to adjust the operation of the AOC algorithm for special application requirements.

Postrequisites

If you set AOC Algorithm to Overfill or Underfill, you must perform an AOC calibration.

Perform AOC calibration using ProLink II

AOC calibration is used to calculate the AOC (Automatic Overshoot Compensation) value from actual fill data. If you set AOC Algorithm to Overfill or Underfill, you must perform AOC calibration.

There are two types of AOC calibration:

- Standard: The calibration is performed manually. The AOC coefficient is calculated from fill data obtained during this calibration, and the same AOC coefficient is applied until the calibration is repeated.
- Rolling: The calibration is performed continuously and automatically, and the AOC coefficient is updated continuously based on fill data from the last set of fills.

Tip

For stable processes, Micro Motion recommends standard AOC calibration. If required, test both methods and choose the method that yields the best results.

Perform standard AOC calibration

Standard AOC calibration is used to generate a constant AOC coefficient.

Prerequisites

AOC Window Length must be set appropriately. Micro Motion recommends using the default value (10) unless you have special application requirements.

Mass Flow Cutoff or Volume Flow Cutoff must be set appropriately for your environment.

- If Flow Source is set to Mass Flow Rate, see *Section 11.2.3*.
- If Flow Source is set to Volume Flow Rate, see *Section 11.3.2*.

Your system must be ready to run fills, and you must know how to run fills.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Choose ProLink > Run Filler.
2. To calibrate the primary valve (all fill types):
   a. Click Start AOC Cal.
   b. Run two or more calibration fills, up to the number specified in AOC Window Length.

Note
You can run more calibration fills if you choose. The AOC coefficient is calculated from the most recent fills.

Tip
In common use, the first few fills are slightly overfilled or underfilled due to factory-default settings. As the calibration proceeds, the fills will converge on Fill Target.

c. When the fill totals are consistently satisfactory, click Save AOC Cal.

3. To calibrate the secondary valve (dual-fillhead fills):

   a. Click Start Secondary AOC Cal.

   b. Run two or more calibration fills, up to the number specified in AOC Window Length.

      The transmitter automatically runs fills through the secondary valve.

Note
You can run more calibration fills if you choose. The AOC coefficient is calculated from the most recent fills.

Tip
In common use, the first few fills are slightly overfilled or underfilled due to factory-default settings. As the calibration proceeds, the fills will converge on Fill Target.

   c. When the fill totals are consistently satisfactory, click Save Secondary AOC Cal.

The current AOC coefficient is displayed in the Run Filler window. If you are running a dual-fillhead fill, the Run Filler window displays the AOC coefficient for both the primary and the secondary valve. These coefficients will be applied to fills as long as AOC is enabled.

Note
For two-stage discrete fills, the AOC value is applied to the valve that closes when the target is reached. If the fill is configured to close both valves when the target is reached, the AOC value is applied to both.

Tip
Micro Motion recommends repeating the AOC calibration if any of the following are true:

- Equipment has been replaced or adjusted.
- The flow rate has changed significantly.
- Fill accuracy is consistently lower than expected.
- Mass Flow Cutoff or Volume Flow Cutoff has been changed.

Set up rolling AOC calibration

Rolling AOC calibration is used to update the AOC coefficient continuously, based on fill data from the last set of fills.

Prerequisites

AOC Window Length must be set appropriately. Micro Motion recommends using the default value (10) unless you have special application requirements.

Your system must be ready to run fills, and you must know how to run fills.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Choose ProLink > Run Filler.
2. To calibrate the primary valve (all fill types), click Start AOC Cal. To calibrate the secondary valve (dual-fillhead fills), click Start Secondary AOC Cal.

   You can set up rolling AOC calibration for either valve or both valves.
3. Begin production filling.

The transmitter recalculates the AOC coefficient(s) after each fill, based on the last *x* fills where *x* is the number specified in AOC Window Length. Current values are displayed in the Run Filler window. If the configuration has changed or if process conditions have changed, rolling AOC calibration will compensate for the change. However, the adjustment will take place over several fills; that is, AOC will take a few fills to catch up.

Tip

At any time while AOC calibration is running, you can click Save AOC Cal or Save Secondary AOC Cal. The current AOC coefficient will be saved and applied to all subsequent fills through the corresponding valve. In other words, this action changes the AOC calibration method for that valve from rolling to standard.

5.2.2 Configure the Purge feature using ProLink II

The Purge feature is used to control an auxiliary valve that can be used for any non-filling purpose. For example, it can be used for adding water or gas to the container after the fill ends, or “padding.” Flow through the auxiliary valve is not measured by the transmitter. You can configure the Purge feature for automatic or manual purge control. If you choose automatic control, the auxiliary valve is opened after each fill, and closed after the configured purge time has elapsed.

Restriction

The Purge feature is not supported for dual-fillhead fills or dual-fillhead timed fills.

Prerequisites

The discrete outputs must be wired appropriately for your fill type and fill options.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Configure Channel B to operate as a discrete output:
   a. Choose ProLink > Configuration > Channel.
   b. Set Channel B Type Assignment to Discrete Output.
   c. Open the Discrete Output panel.
   d. Set DO1 Assignment to Discrete Batch: Purge Valve.
   e. Set DO1 Polarity as appropriate for your installation.

   Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

   f. Set DO1 Fault Action as appropriate for your installation.

Option	Description
Upscale	The discrete output will be set to ON (valve open) if a fault occurs.
Downscale	The discrete output will be set to OFF (valve closed) if a fault occurs.
None	No action will be taken if a fault occurs. The discrete output will remain in the state it was in before the fault occurred.

2. Configure the purge:
   a. Choose ProLink > Configuration > Filling.
   b. Enable Enable Purge.
   c. Set Purge Mode as desired.

Option	Description
Auto	A purge is performed automatically after each fill.
Manual	Purges must be started and stopped manually.

Tip

When Purge Mode is set to Auto, manual control of the purge valve is still possible. You can start a purge manually and stop it manually, or you can let the transmitter stop it after Purge Time has expired. If a purge is started automatically, you can stop it manually.

d. If you set Purge Mode to Auto, set Purge Delay to the number of seconds that the transmitter will wait, after the fill has ended, to open the purge valve.

   The default value for Purge Delay is 2 seconds.

e. If you set Purge Mode to Auto, set Purge Time to the number of seconds that the transmitter will keep the purge valve open.

   The default value for Purge Time is 1 second. The range is 0 seconds to 800 seconds.

Tip

The next fill cannot start until the purge valve is closed.

5.2.3 Configure the Pump feature using ProLink II

The Pump feature is used to increase pressure during the fill by starting an upstream pump just before the fill begins.

Restriction

The Pump feature is not supported for two-stage discrete fills, dual-fillhead fills, timed fills, or dual-fillhead timed fills.

Prerequisites

The discrete outputs must be wired appropriately for your fill type and fill options.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Configure the precision discrete output(s):

   a. Open the Discrete Output panel.
   b. Set Precision DO2 to Pump.
   c. Set Precision DO2 Polarity as appropriate for your installation.

   Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC

Option	Signal from transmitter	Voltage
	OFF	Site-specific up to 30 VDC

2. Choose ProLink > Configuration > Filling.
3. Set Pump to Valve Delay to the number of seconds that the pump will run before the valve is opened.

   The default value is 10 seconds. The range is 0 seconds to 30 seconds.

When the Begin Filling command is received, the transmitter starts the pump, waits for the number of seconds specified in Pump to Valve Delay, then opens the valve. The pump runs until the fill is ended.

5.3 Configure fill control using ProLink II (optional)

In a typical production environment, fill control (beginning and ending the fill) is performed by the host or PLC. If you choose, you can set up the system so that you can begin, end, pause, and resume the fill from the discrete input (if available). You can also define an event to begin, end, pause, or resume the fill.

5.3.1 Configure the discrete input for fill control using ProLink II

If Channel B is available, you can configure it as a discrete input and use it to begin and end the fill, or to pause and resume a fill in progress. You can also configure it to reset the mass total, volume total, or all totals. When the discrete input is activated, all assigned actions will be performed.

Prerequisites

Channel B must be wired to operate as a discrete input.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Configure Channel B to operate as a discrete input.
   a. Choose ProLink > Configuration > Channel.
   b. Set Type Assignment for Channel B to Discrete Input.
2. Assign fill control actions to the discrete input.
   a. Open the Discrete Input panel.
   b. Select the action or actions to be performed when the discrete input is activated.

Action	Description	Comments
Begin Filling	Starts a fill using the current fill configuration. The fill total is automatically reset before the fill begins.	If a fill is in progress, the command is ignored. If an automatic purge is in progress, the beginning-of-fill functions are executed when the purge is complete.
End Filling	Ends the current fill and performs end-of-fill functions. The fill cannot be resumed.	Executed while a fill is running or paused, and during a purge or purge delay. For dual-fillhead fills and dual-fillhead timed fills, the command always ends the currently active fill.
Pause Filling	Timed fills, dual-fillhead fills, and dual-fillhead timed fills: Same as End Filling.	
	One-stage discrete fills and two-stage discrete fills: Temporarily stops the fill. The fill can be resumed if the fill total is less than Fill Target.	If a purge or purge delay is in progress, the command is ignored.
Resume Filling	Restarts a fill that has been paused. Counting resumes from the total or time at which the fill was paused.	Executed only when a one-stage discrete fill or a two-stage discrete fill has been paused. Ignored at all other times.
Reset Mass Total	Resets the value of the mass totalizer to 0.	Executed only when a fill is not running (between fills or when a fill has been paused). Ignored at all other times.
Reset Volume Total	Resets the value of the volume totalizer to 0.	Executed only when a fill is not running (between fills or when a fill has been paused). Ignored at all other times.
Reset All Totals	Resets the value of the mass totalizer and volume totalizer to 0, and resets the fill total to 0.	Executed only when a fill is not running (between fills or when a fill has been paused). Ignored at all other times.

c. For each selected action, open the dropdown list and select Discrete Input 1.

3. Set DI1 Polarity as appropriate for your installation.

   Ensure that the ON signal sent by the discrete input is read as ON, and vice versa.

Option	Voltage applied across terminals	Transmitter reads
Active High	3 to 30 VDC	ON
	<0.8 VDC	OFF
Active Low	<0.8 VDC	ON
	3 to 30 VDC	OFF

5.3.2 Set up an event to perform fill control using ProLink II

You can assign an event to start, stop, pause, or resume a fill. You can also assign the event to reset the mass total, volume total, or all totals. When the event transitions to ON, all assigned actions will be performed.

Prerequisites

All events that you want to use must be configured. You can configure them before or after you assign actions to them.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Assign fill control actions to the event.
   a. Choose ProLink > Configuration > Discrete Events.
   b. Identify the action or actions to be performed when Discrete Event 1 occurs.

Action	Description	Comments
Begin Filling	Starts a fill using the current fill configuration. The fill total is automatically reset before the fill begins.	If a fill is in progress, the command is ignored. If an automatic purge is in progress, the beginning-of-fill functions are executed when the purge is complete.
End Filling	Ends the current fill and performs end-of-fill functions. The fill cannot be resumed.	Executed while a fill is running or paused, and during a purge or purge delay. For dual-fillhead fills and dual-fillhead timed fills, the command always ends the currently active fill.
Pause Filling	Timed fills, dual-fillhead fills, and dual-fillhead timed fills: Same as End Filling.	
	One-stage discrete fills and two-stage discrete fills: Temporarily stops the fill. The fill can be resumed if the fill total is less than Fill Target.	If a purge or purge delay is in progress, the command is ignored.
Resume Filling	Restarts a fill that has been paused. Counting resumes from the total or time at which the fill was paused.	Executed only when a one-stage discrete fill or a two-stage discrete fill has been paused. Ignored at all other times.
Reset Mass Total	Resets the value of the mass totalizer to 0.	Executed only when a fill is not running (between fills or when a fill has been paused). Ignored at all other times.
Reset Volume Total	Resets the value of the volume totalizer to 0.	Executed only when a fill is not running (between fills or when a fill has been paused). Ignored at all other times.
Reset All Totals	Resets the value of the mass totalizer and volume totalizer to 0, and resets the fill total to 0.	Executed only when a fill is not running (between fills or when a fill has been paused). Ignored at all other times.

2. Repeat for Discrete Events 2–5.

Example: Events monitor process and pause or end fill

The acceptable density range for your process is 1.1 g/cm^3 to 1.12 g/cm^3. The acceptable temperature range is 20 °C to 25 °C. You want to pause the fill if the density goes out of range. You want to end the fill if the temperature goes out of range.

Event configuration:

- Discrete Event 1:
  - Event Type: Out of Range
  - Process Variable: Density
  - Low Setpoint (A): 1.1 g/cm^3
  - High Setpoint (B): 1.12 g/cm^3
- Discrete Event 2:
  - Event Type: Out of Range
  - Process Variable: Temperature
  - Low Setpoint (A): 20 °C
  - High Setpoint (B): 25 °C

Action assignments:

- Pause Fill: Discrete Event 1
- End Fill: Discrete Event 2

Postrequisites

If you have assigned actions to events that are not configured, you must configure those events before you can implement this fill control method.

5.3.3 Multiple actions assigned to a discrete input or event

If multiple actions are assigned to a discrete input or event, the transmitter performs only the actions that are relevant in the current situation. If two or more of the actions are mutually exclusive, the transmitter performs actions according to the priority scheme defined in the transmitter firmware.

The following examples show three configurations that Micro Motion recommends, and two configurations that are not recommended.

Example: Using the discrete input or event to begin and end the fill (recommended)

Action assignments:

- Begin Fill
- End Fill
- Reset Mass Total

- Reset Volume Total

Result of activation:

- If no fill is running, the mass totalizer and volume totalizer are reset and a fill is started.
- If a fill is running, it is ended and the mass totalizer and volume totalizer are reset.

Example: Using the discrete input or event to begin, pause, and resume the fill (recommended)

Action assignments:

- Begin Fill
- Pause Fill
- Resume Fill

Result of activation:

- If no fill is running, a fill is started.
- If a fill is running and not paused, it is paused.
- If a fill is paused, it is resumed.

Example: Using the discrete input to begin the fill and reset the volume flow (recommended)

Action assignments:

- Begin Fill
- Reset Volume Total

Result of activation:

- If no fill is running, the volume totalizer is reset and a fill is started.
- If a fill is running, the volume totalizer is reset.

Tip

This configuration is useful if you have configured your fill in terms of mass but you would also like to know the volume total for the fill. In this case, do not activate the discrete input while the fill is in progress. At the end of the fill, read the volume total. Then continue with the next fill.

Example: Incompatible assignments (not recommended)

Action assignments:

- Begin Fill
- End Fill
- Pause Fill
- Resume Fill

Result of activation:

- If no fill is running, a fill is started.

- If a fill is running, it is ended.

In this example, the discrete input or event will never pause the fill because the End Fill action takes priority.

Example: Incompatible assignments (not recommended)

Action assignments:

- End Fill
- Reset All Totals

Result of activation:

- If no fill is running, all totals, including the fill total, are reset.
- If a fill is running, it is ended and all totals, including the fill total, are reset.

The result of this combination is that the fill total is reset before the data can be retrieved.

5.4 Configure fill reporting using ProLink II (optional)

You can configure the transmitter to report the fill ON/OFF state over Channel B (if it is available), and percent of fill delivered over the mA output.

5.4.1 Configure Channel B to operate as a discrete output and report the fill ON/OFF state using ProLink II

If Channel B is available, you can use it to report whether or not a fill is running.

Prerequisites

ProLink II must be running and must be connected to the transmitter.

Channel B must be wired to operate as a discrete output.

Procedure

1. Choose ProLink > Configuration > Channel.
2. Set Channel B Type Assignment to Discrete Output.
3. Open the Discrete Output panel.
4. Set DO1 Assignment to Discrete Batch: Batching/Filling In Progress
5. Set DO1 Polarity as appropriate for your installation.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC

Option	Signal from transmitter	Voltage
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

6. Set DO1 Fault Action as appropriate for your installation.

Option	Description
Upscale	The discrete output will be set to ON (valve open) if a fault occurs.
Downscale	The discrete output will be set to OFF (valve closed) if a fault occurs.
None	No action will be taken if a fault occurs. The discrete output will remain in the state it was in before the fault occurred.

Tip

When the discrete output is used for fill reporting, Micro Motion recommends setting DO1 Fault Action to None.

5.4.2 Configure the mA output to report percentage of fill delivered using ProLink II

You can configure the mA output to report the percentage of Fill Target that has been delivered. In a typical configuration, the current increases from 4 mA to 20 mA as the fill total moves from 0% to 100%.

Prerequisites

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Choose ProLink > Configuration > Analog Output.
2. Set Secondary Variable Is to Discrete Batch: Percent Fill.
3. Set Lower Range Value to the percentage of the fill to be represented by 4 mA.
4. Set Upper Range Value to the percentage of the fill to be represented by 20 mA.
5. Set AO Fault Action as desired.

If Lower Range Value is set to 0% and Upper Range Value is set to 100%: When the fill starts, the mA output will generate a current of 4 mA (0% of Fill Target). The current will increase in proportion to the fill total, up to a current of 20 mA (100% of Fill Target).

Note

If Flow Direction is set to Bidirectional or Negate Bidirectional, the fill total may decrease under certain flow conditions. If this occurs, the current generated by the mA output will decrease proportionally.

6 Fill operation using ProLink II

Topics covered in this chapter:

6.1 Run an integrated-valve-control fill using ProLink II

You can use ProLink II to start a fill, monitor the fill, pause and resume the fill, and end a fill.

Prerequisites

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Choose ProLink > Run Filler.
2. (Optional) If desired, enter a different value for Fill Target (one-stage discrete fills, two-stage discrete fills, or dual-fillhead fills), or for Target Time (timed fills or dual-fillhead timed fills).
3. (Optional) If Automatic Overshoot Compensation (AOC) is enabled, you can enter a different value for AOC Coeff.

Tip

In production use, Micro Motion recommends leaving AOC Coeff at the value determined during AOC calibration. If you are running AOC calibration fills and you have an AOC Coeff value available from a similar device, you can use that value as the "first approximation" value on the current device. This may be helpful if you want to prevent or minimize spilling.

---

4. Click Begin Filling.

   The fill total is reset automatically and the valve(s) are opened. The Filling In Progress indicator should be On. If it is not, and the Start Not Okay indicator or the AOC Flow Rate Too High indicator is On instead, troubleshoot the fill configuration and try again.

5. Monitor the fill using the Current Total and Percent Fill values and the Fill Status indicators.

Fill progress values	Description
Current Total	Fill quantity at the current time. This value is affected by Count Up: • If Count Up is enabled, Current Total begins at 0 and increases to Fill Target. • If Count Up is disabled, Current Total begins at Fill Target and decreases to 0.
Percent Fill	Percentage of Fill Target that has been measured up to the current time. This value is not affected by Count Up.

Fill Status indicator	Description
Filling in Progress	A fill is currently being performed through the primary valve. This indicator is active even when the fill is paused.
Secondary Fill in Progress	A fill is currently being performed through the secondary valve. This indicator is active even when the fill is paused. It applies only to dual-fillhead fills.
Max Fill Time Exceeded	The current fill has exceeded the current setting for Max Fill Time. The fill is aborted.
Primary Valve	The primary valve is open.
Secondary Valve	The secondary valve is open.
Pump	The pump is running.
Purge In Progress	A purge has been started, either manually or automatically.
Purge Delay Phase	An automatic purge cycle is in progress, and is currently in the delay period between the completion of the fill and the start of the purge.
Purge Valve	The purge valve is open.

6. (Optional) Pause the fill if desired.

   While the fill is paused, you can change the value of Current Target, end the fill manually with End Filling, or restart the fill with Resume Filling. The fill resumes at the current value of Current Total and Percent Fill.

   Restriction
   You cannot pause a timed fill or a dual-fillhead timed fill.

   Important
   For two-stage discrete fills, the effects of pausing and resuming the fill depend on the timing of the valve open and valve close commands, and on the point at which the fill is paused.

7. (Optional) Use End Filling to end the fill manually if desired.

   Once the fill is ended, it cannot be restarted.

Tip

In most cases, you should allow the fill to end automatically. End the fill manually only when you are planning to discard the fill.

6.1.1 If the fill fails to start

If the fill fails to start, check the Start Not Okay and AOC Flow Rate Too High indicators.

If the Start Not Okay indicator is On, check the following:

- Ensure that filling is enabled.
- Ensure that the previous fill has been ended.
- Ensure that Fill Target or Target Time is set to a positive number.
- Ensure that all outputs have been assigned to the valve or pump appropriate for the fill type and fill option.
- Ensure that there are no active fault conditions at the transmitter.
- For dual-fillhead fills and dual-fillhead timed fills, ensure that no fill is running on either fillhead.

If the AOC Flow Rate Too High indicator is on, the last measured flow rate is too high to allow the fill to start. In other words, the AOC coefficient, compensated for the flow rate, specifies that the valve close command should be issued before the fill has begun. This can happen if the flow rate has increased significantly since the AOC coefficient was calculated. Micro Motion recommends the following recovery procedure:

1. Perform any setup that is required to perform AOC calibration.
2. In the Run Filler window, click Override Blocked Start.
3. Perform AOC calibration.
4. Return your system to production filling, using the new AOC coefficient.

6.1.2 If the fill did not run to completion

If your fill terminated abnormally, check the transmitter and the Max Fill Time Exceeded indicator.

If a fault occurs during the fill, the transmitter automatically terminates the fill.

If the Max Fill Time Exceeded indicator is On, the fill did not reach its target before the configured Max Fill Time. Consider the following possibilities or actions:

- Increase the flow rate of your process.
- Check for entrained gas (slug flow) in your process fluid.
- Check for blockages in the flow.
- Ensure that the valves are able to close at the expected speed.
- Set Max Fill Time to a higher value.
- Disable Max Fill Time by setting it to 0.

6.1.3 Effects of Pause and Resume on two-stage discrete fills

For two-stage discrete fills, the effects of pausing and resuming the fill depend on where the Pause and Resume actions occur in relation to the opening and closing of the primary and secondary valves.

Open Primary first, Close Primary first

In the following illustrations:

- The primary valve opens at the beginning of the fill.
- The secondary valve opens at the user-configured point during the fill. *T* represents the time or quantity configured for Open Secondary.
- The primary valve closes before the end of the fill.
- The secondary valve closes at the end of the fill.

Figure 8-1: Case A

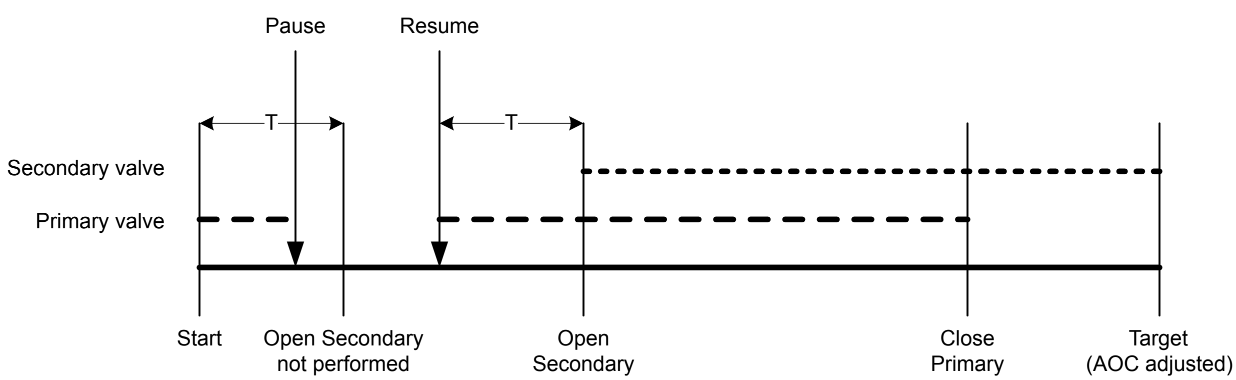


Figure 8-2: Case B

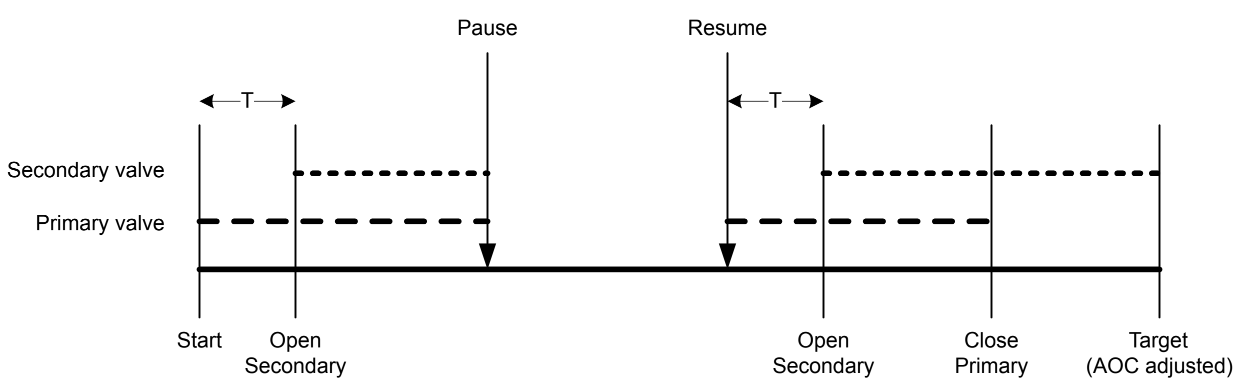


Figure 8-3: Case C

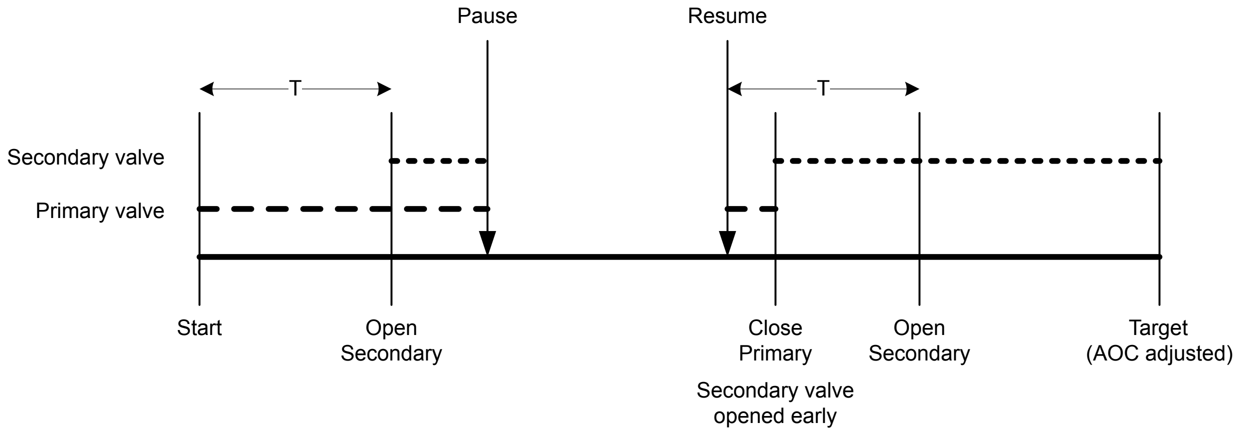
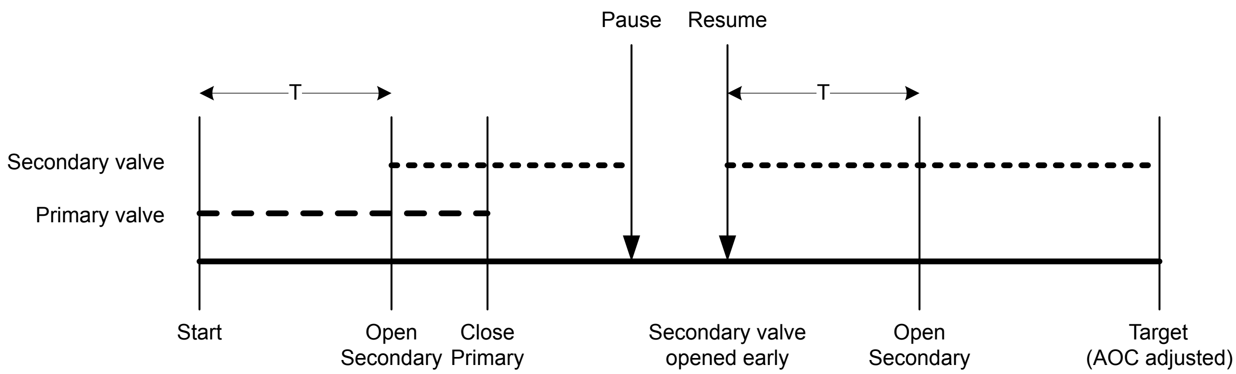


Figure 8-4: Case D



Open Primary first, Close Secondary first

In the following illustrations:

- The primary valve opens at the beginning of the fill.
- The secondary valve opens at the user-configured point during the fill. *T* represents the time or quantity configured for Open Secondary.
- The secondary valve closes before the end of the fill.
- The primary valve closes at the end of the fill.

Figure 8-5: Case E

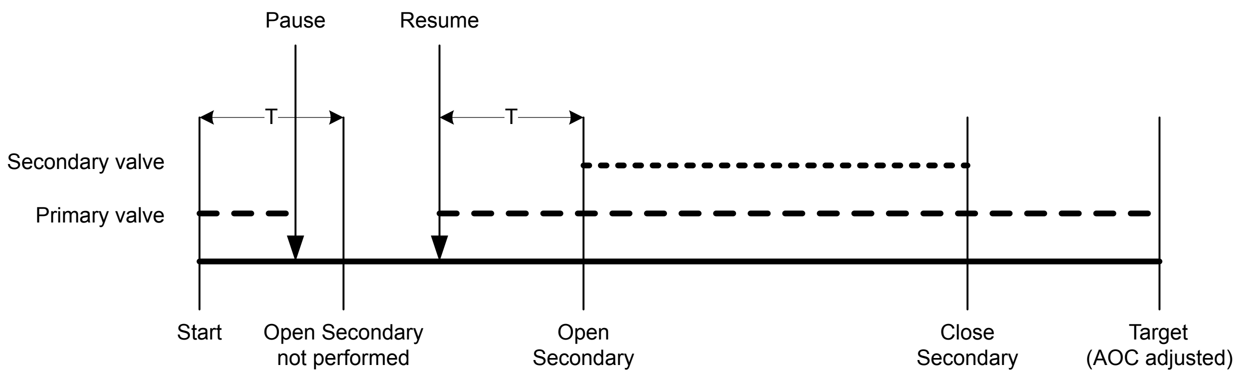


Figure 8-6: Case F

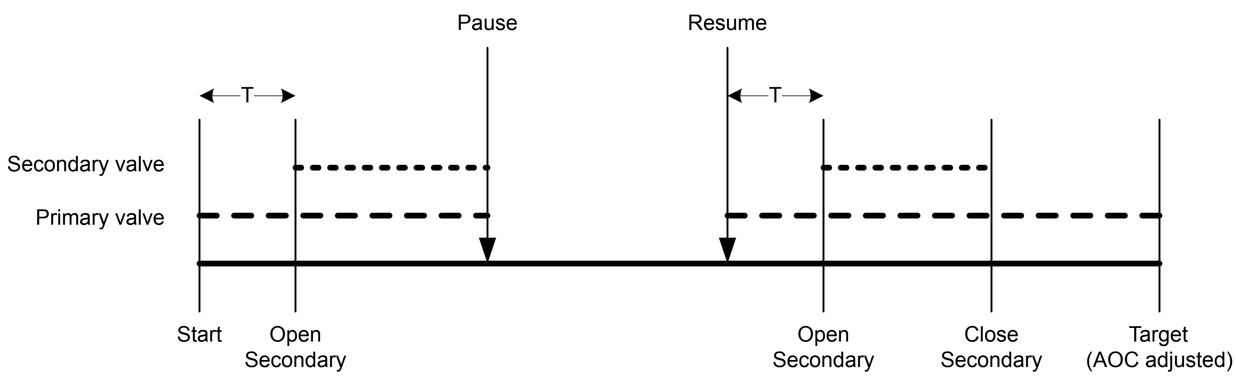


Figure 8-7: Case G

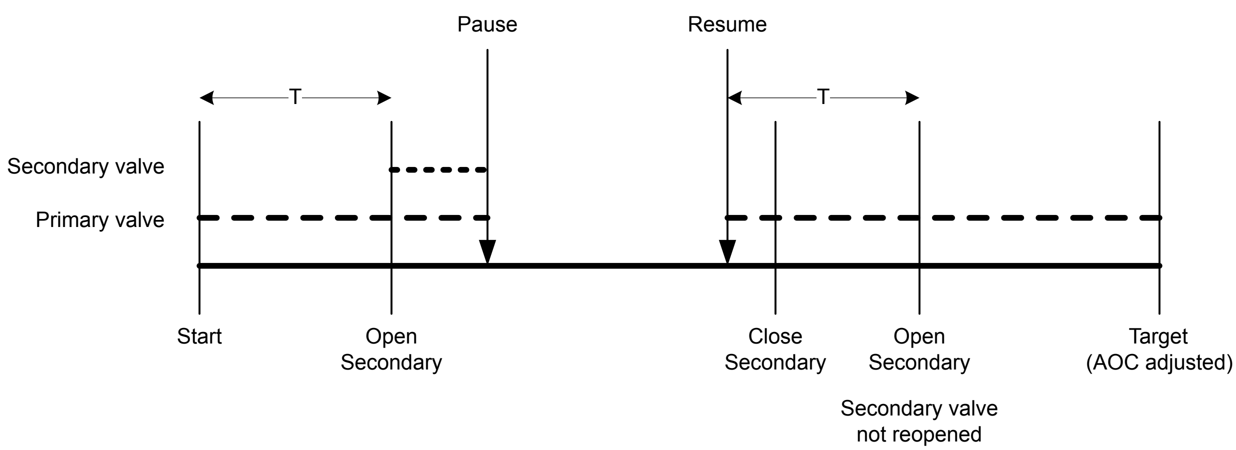
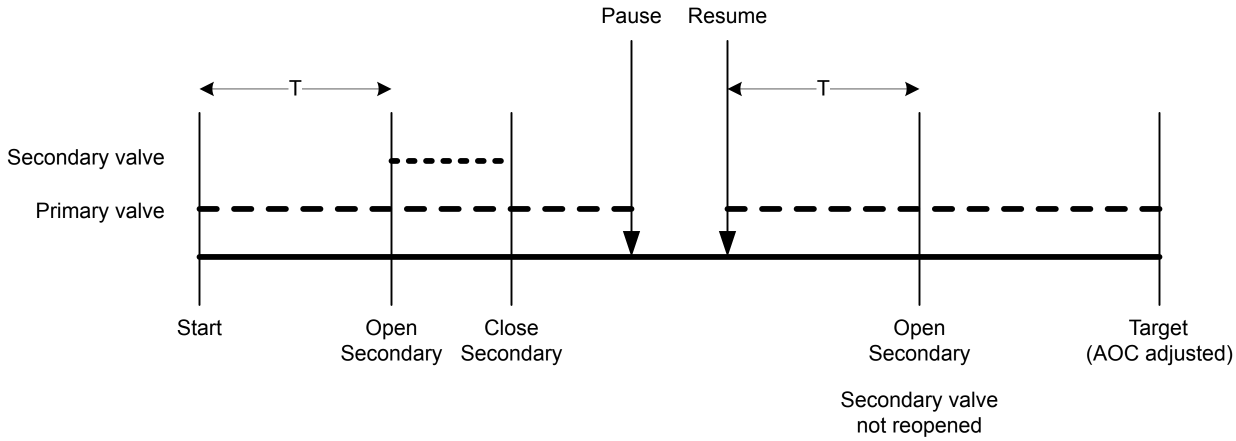


Figure 8-8: Case H



Open Secondary first, Close Primary first

In the following illustrations:

- The secondary primary opens at the beginning of the fill.
- The primary valve opens at the user-configured point during the fill. *T* represents the time or quantity configured for Open Primary.
- The primary valve closes before the end of the fill.
- The secondary valve closes at the end of the fill.

Figure 8-9: Case I

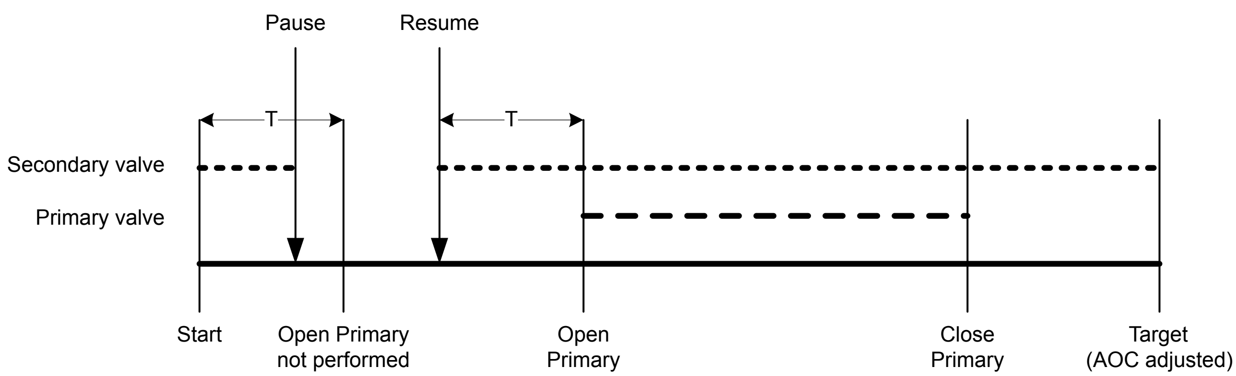


Figure 8-10: Case J

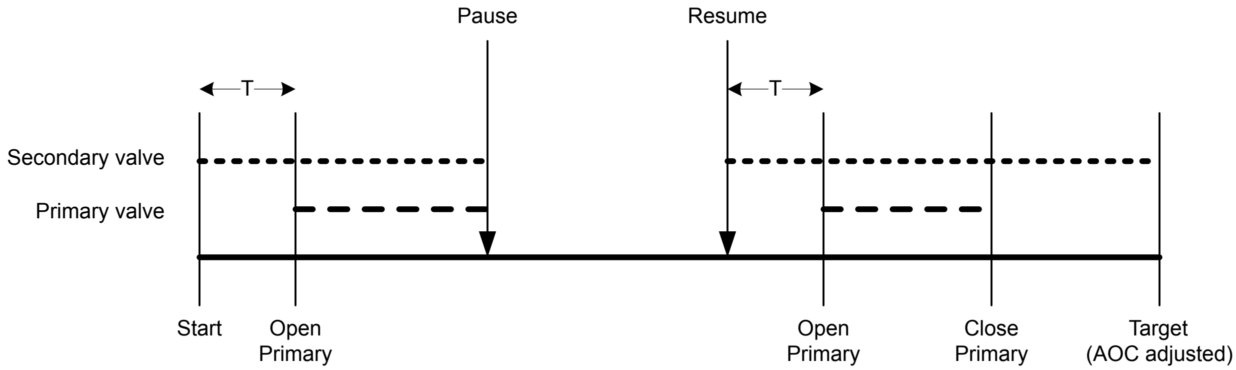


Figure 8-11: Case K

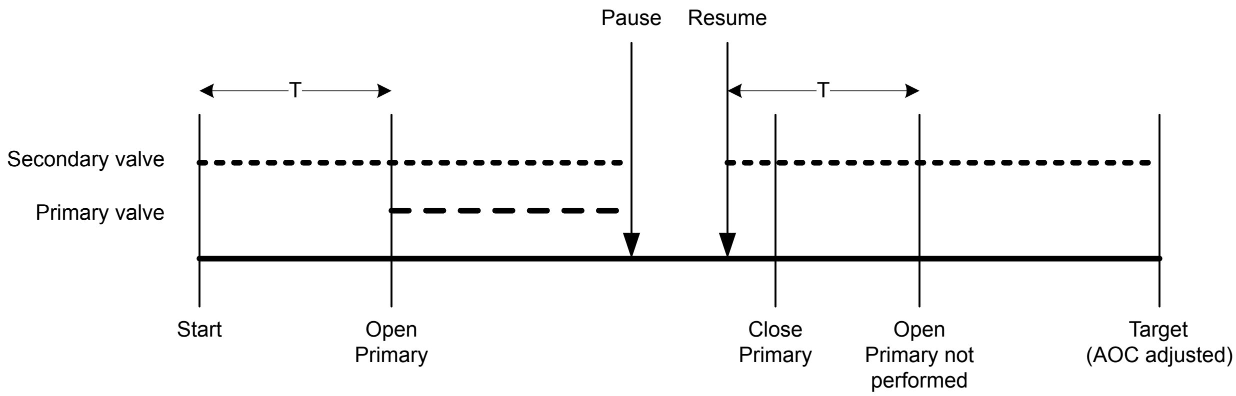
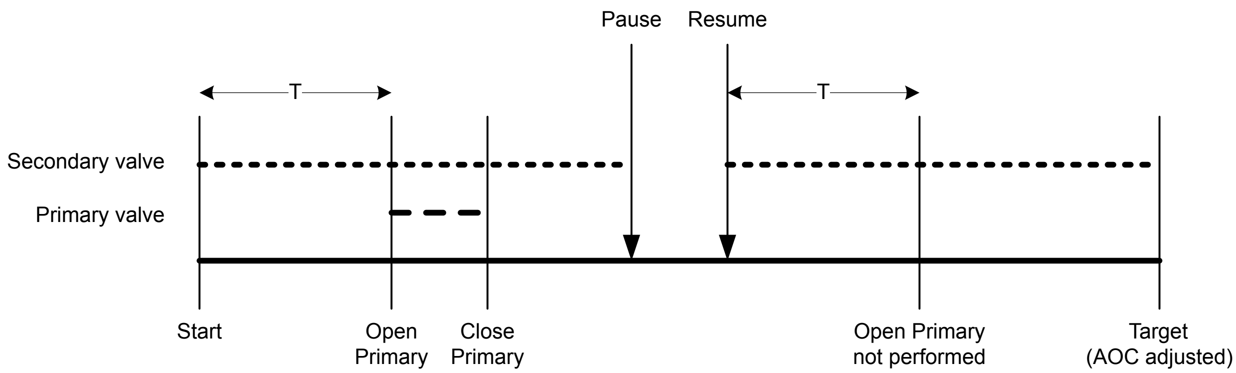


Figure 8-12: Case L



Open Secondary first, Close Secondary first

In the following illustrations:

- The secondary primary opens at the beginning of the fill.

- The primary valve opens at the user-configured point during the fill. *T* represents the time or quantity configured for Open Primary.
- The secondary valve closes before the end of the fill.
- The primary valve closes at the end of the fill.

Figure 8-13: Case M

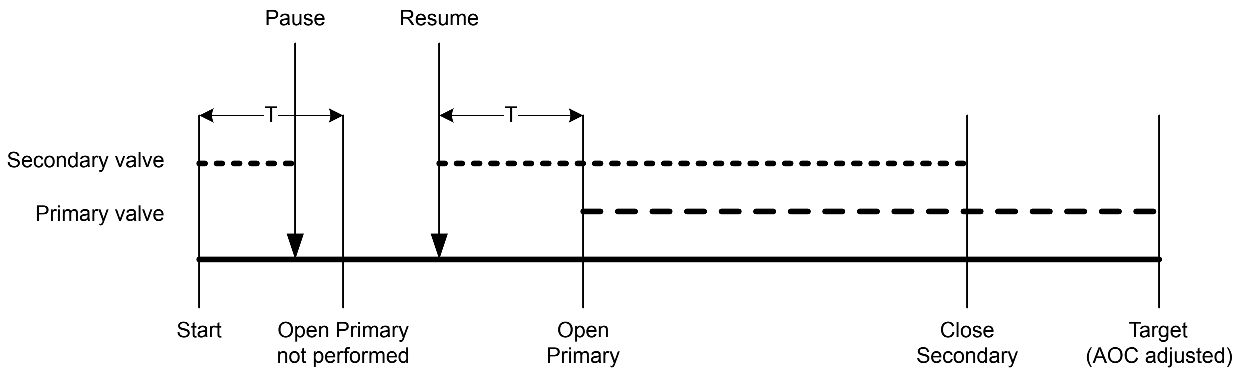


Figure 8-14: Case N

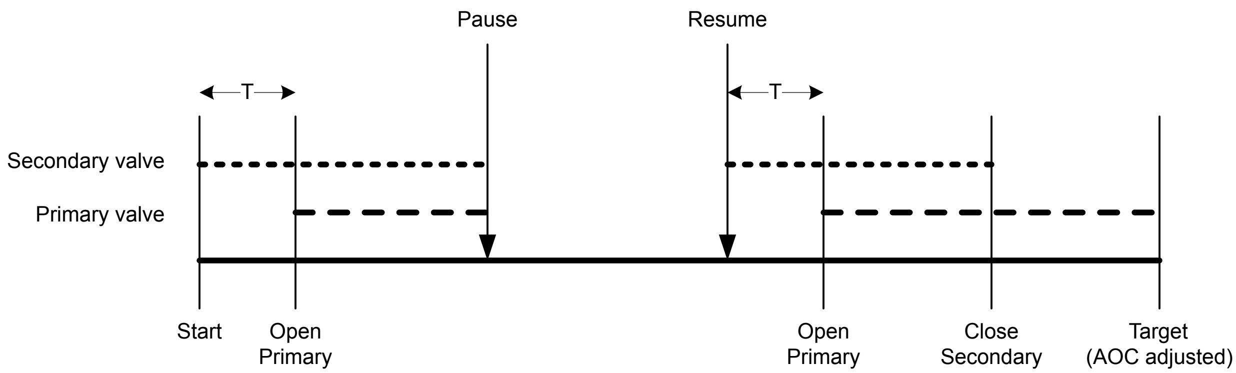


Figure 8-15: Case O

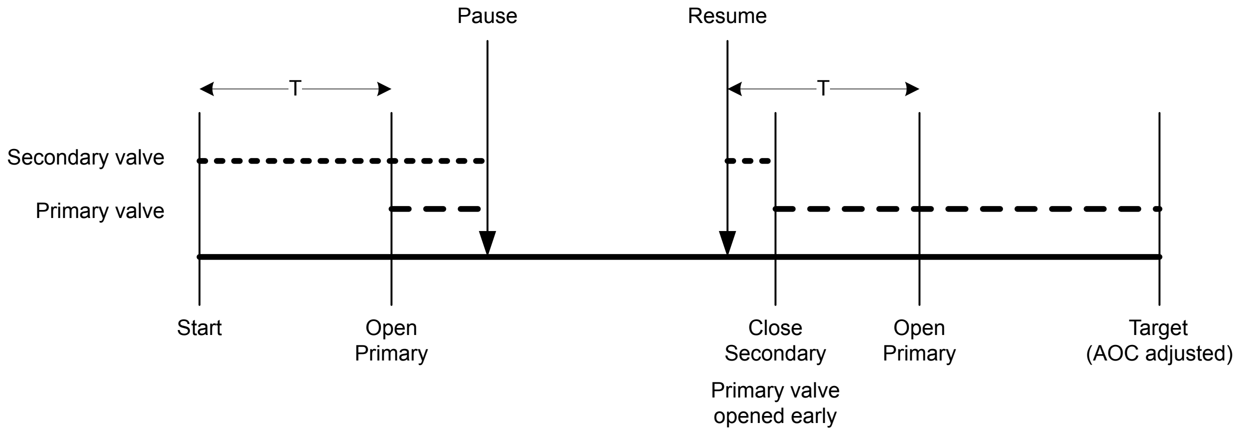
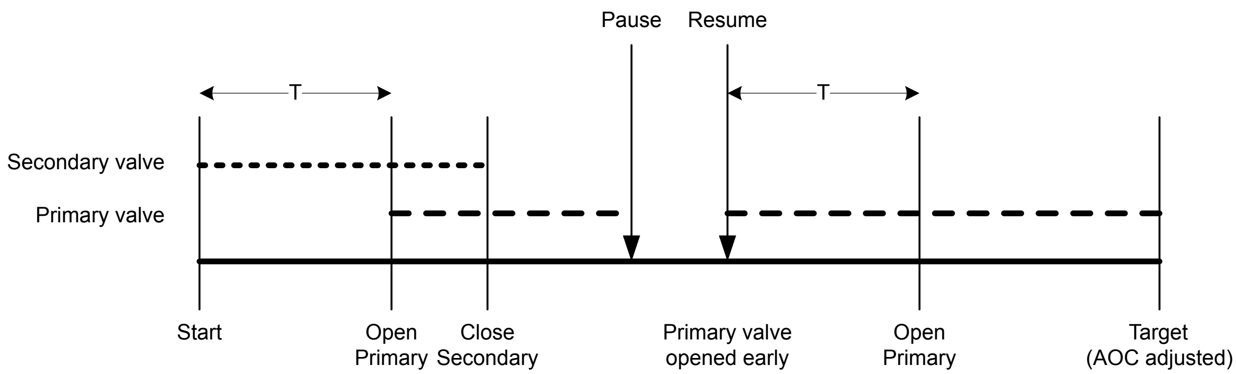


Figure 8-16: Case P



6.2 Perform a manual purge using ProLink II

The Purge feature is used to control an auxiliary valve that can be used for any non-filling purpose. For example, it can be used for adding water or gas to the container after the fill ends, or "padding." Flow through the auxiliary valve is not measured by the transmitter.

Prerequisites

The Purge feature must be implemented on your system.

The previous fill must be ended.

The auxiliary valve must be connected to the fluid you want to use, e.g., air, water, nitrogen.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Choose ProLink > Run Filler.
2. Click Begin Purge.

   The Purge In Progress indicator and the Purge Valve indicator turn on.

3. Allow the purge fluid to flow for the appropriate amount of time.
4. Click End Purge

   The Purge In Progress indicator and the Purge Valve indicator turn off.

6.3 Perform Clean In Place (CIP) using ProLink II

The Clean In Place (CIP) function is used to force a cleaning fluid through the system. CIP allows you to clean the interior surfaces of pipes, valves, nozzles, etc., without having to disassemble the equipment.

Prerequisites

No fill can be running.

The cleaning fluid must be available for running through the system.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Replace the process fluid with the cleaning fluid.
2. Choose ProLink > Run Filler.
3. Click Begin Cleaning.

   The transmitter opens the primary valve, and the secondary valve if it is used for filling. If the Pump feature is enabled, the pump is started before the valve is opened. The Cleaning In Progress indicator turns on.

4. Allow the cleaning fluid to flow through your system for the appropriate amount of time.
5. Click End Cleaning

   The transmitter closes all open valves, and stops the pump if applicable. The Cleaning In Progress indicator turns off.

6. Replace the cleaning fluid with the process fluid.

6.4 Monitor and analyze fill performance using ProLink II

You can collect detailed flow data for a single fill, and you can compare data across multiple fills.

6.4.1 Collect detailed fill data for a single fill using ProLink II

When fill logging is enabled, detailed data for the most recent fill is stored on the transmitter. You can retrieve it for analysis using digital communications. The detailed data can be used for tuning or troubleshooting your production environment.

Restriction

Although you can use ProLink II to enable and disable fill logging, you cannot view the fill log with ProLink II. To view the fill log, you must use a Modbus or PROFIBUS connection.

Prerequisites

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Choose ProLink > Configuration > Filling.
2. Enable Enable Fill Logging.
3. Run a fill.
4. Disable Enable Fill Logging when you are finished with data collection.

The fill log contains data records from a single fill, from the beginning of the fill until 50 milliseconds after flow stops, or until the maximum log size is reached. Data records are written every 10 milliseconds. Each data record contains the current value of Flow Source (the process variable used to measure the fill). The fill log is limited to 1000 records, or 10 seconds of filling. When the maximum size is reached, logging stops but the data is available on the transmitter until the next fill starts. The fill log is cleared each time a fill starts.

6.4.2 Analyze fill performance using fill statistics and ProLink II

The transmitter automatically records a variety of data about each fill. This data is available to assist you in tuning your system.

Prerequisites

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Choose ProLink > Run Filler.
2. (Optional) Click Reset Fill Statistics to start your analysis with a fresh set of fill data.

3. Run fills and observe the fill data.

Fill data	Fill type	Description
Fill Total Average	One-stage discrete fills, two-stage discrete fills, and timed fills	Calculated average of all fill totals since fill statistics were reset.
	Dual-fillhead fills and dual-fillhead timed fills	Calculated average of all fill totals through Fillhead #1 since fill statistics were reset.
Fill Total Variance	One-stage discrete fills, two-stage discrete fills, and timed fills	Calculated variance of all fill totals since fill statistics were reset.
	Dual-fillhead fills and dual-fillhead timed fills	Calculated variance of all fill totals through Fillhead #1 since fill statistics were reset.
Secondary Fill Total Average	Dual-fillhead fills and dual-fillhead timed fills only	Calculated average of all fill totals through Fillhead #2 since fill statistics were reset.
Secondary Fill Total Variance	Dual-fillhead fills and dual-fillhead timed fills only	Calculated variance of all fill totals through Fillhead #2 since fill statistics were reset.

7 Configure an integrated-valve-control fill using Modbus

Topics covered in this chapter:

7.1 Configure an integrated-valve-control fill using Modbus

Configure the fill type that is appropriate for your application.

Tip

A one-stage discrete fill is appropriate for most applications. Use this fill type unless you have specific requirements for another fill type. In most cases, the transmitter is configured for a one-stage discrete fill at the factory, and will be operational with a minimum of site configuration.

7.1.1 Configure a one-stage discrete fill using Modbus

Configure a one-stage discrete fill when you want to fill a single container from a single valve. The valve will be open until Fill Target is reached.

Prerequisites

Ensure that you are starting from the factory-default configuration.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. Configure the precision discrete output(s):
   a. Set Precision DO1 to Primary Valve.
   b. Set Precision DO1 Polarity as appropriate for your installation.

      Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

2. Configure flow measurement:

   a. Set Flow Direction to the option appropriate for your installation.

Option	Description
Forward	Process fluid flows in one direction only, matching the direction of the arrow on the sensor.
Bidirectional	Process fluid can flow in either direction. Most of the flow matches the direction of the arrow on the sensor.
Negate Forward	Process fluid flows in one direction only, in the opposite direction of the arrow on the sensor.
Negate Bidirectional	Process fluid can flow in either direction. Most of the flow is in the opposite direction of the arrow on the sensor.

Restriction
All other options for Flow Direction are invalid, and will be rejected by the transmitter.

   b. Set Mass Flow Units as desired.

      If you set Flow Source to Mass Flow Rate, the corresponding mass unit is used to measure your fill.

   c. Set Volume Flow Units as desired.

      If you set Flow Source to Volume Flow Rate, the corresponding volume unit is is used to measure your fill.

   d. Set other flow options as desired.

Tip
The default value of Flow Damping is 0.04 seconds. This is the optimum value for most filling applications, and is typically not changed.

3. Set Flow Source to the process variable to be used to measure this fill.

Option	Description
Mass Flow Rate	The mass flow process variable, as measured by the transmitter
Volume Flow Rate	The volume flow process variable, as measured by the transmitter

4. Set or verify the following parameters:

Parameter	Setting
Enable Filling Option	Enabled
Enable Dual Fill	Disabled
Enable AOC	Enabled
Enable Purge	Disabled
Enable Timed Fill	Disabled
Fill Type	One Stage Discrete

Tip
Micro Motion strongly recommends implementing Automatic Overshoot Compensation (AOC). When enabled and calibrated, AOC increases fill accuracy and repeatability.

5. Set Count Up as desired.

   Count Up controls how the fill total is calculated and displayed.

Option	Description
Enabled	The fill total starts at 0 and increases toward Fill Target.
Disabled	The fill total starts at Fill Target and decreases toward 0.

6. Set Fill Target to the quantity at which the fill will be complete.

   Enter the value in the measurement units configured for Flow Source.
7. Set Max Fill Time to the number of seconds at which the fill will time out.

   If the fill does not complete normally before this time has elapsed, the fill is aborted and fill timeout error messages are posted.

   To disable the fill timeout feature, set Max Fill Time to 0.

   The default value for Max Fill Time is 0 (disabled). The range is 0 seconds to 800 seconds.
8. Set Measured Fill Time as desired.

   Measured Fill Time controls how the fill duration will be measured.

Option	Description
Flow Stops	The fill duration will be incremented until the transmitter detects that flow has stopped, after valve closure.
Valve Closes	The fill duration will be incremented until the transmitter sets the discrete output as required to close the valve.

Example: Configuring a one-stage discrete fill

Important
This example uses standard or typical settings for the required parameters. Your application may require different settings. Refer to the MIT for information on data types and integer codes.

Location	Value	Description
Register 2489	110	Sets Precision DO1 to Primary Valve
Register 2490	1	Sets Precision DO1 Polarity to Active High
Register 17	0	Sets Flow Direction to Forward
Register 39	70	Sets Mass Flow Units to g/sec
Register 42	28	Sets Volume Flow Units to m3/sec
Register 1251	0	Sets Flow Source to Mass Flow Rate
Coil 266	0	Sets Enable Dual Fill to Disabled
Coil 267	0	Sets Enable Timed Fill to Disabled
Register 1253	1	Sets Fill Type to One Stage Discrete
Coil 203	1	Sets Count Up to Enabled
Registers 1289–1290	100	Sets Fill Target to 100 g
Register 1305	1	Sets Max Fill Time to 1 sec
Coil 347	0	Sets Measured Fill Time to Flow Stops

Postrequisites

Options for one-stage discrete fills include:

- Configuring Automatic Overshoot Compensation (AOC). If AOC is enabled, ensure that AOC is appropriately configured and calibrated for your application.
- Implementing the Purge feature.
- Implementing the Pump feature.

7.1.2 Configure a two-stage discrete fill using Modbus

Configure a two-stage discrete fill when you want to fill a single container from two valves.

Prerequisites

Ensure that you are starting from the factory-default configuration.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. Configure the precision discrete output(s):
   a. Set Precision DO1 to Primary Valve.
   b. Set Precision DO1 Polarity as appropriate for your installation.

   Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

   c. Set Precision DO2 to Secondary Valve.
   d. Set Precision DO2 Polarity as appropriate for your installation.

   Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

2. Configure flow measurement:
   a. Set Flow Direction to the option appropriate for your installation.

Option	Description
Forward	Process fluid flows in one direction only, matching the direction of the arrow on the sensor.
Bidirectional	Process fluid can flow in either direction. Most of the flow matches the direction of the arrow on the sensor.
Negate Forward	Process fluid flows in one direction only, in the opposite direction of the arrow on the sensor.
Negate Bidirectional	Process fluid can flow in either direction. Most of the flow is in the opposite direction of the arrow on the sensor.

Restriction
All other options for Flow Direction are invalid, and will be rejected by the transmitter.

b. Set Mass Flow Units as desired.

If you set Flow Source to Mass Flow Rate, the corresponding mass unit is used to measure your fill.

c. Set Volume Flow Units as desired.

If you set Flow Source to Volume Flow Rate, the corresponding volume unit is is used to measure your fill.

d. Set other flow options as desired.

Tip
The default value of Flow Damping is 0.04 seconds. This is the optimum value for most filling applications, and is typically not changed.

3. Set Flow Source to the process variable to be used to measure this fill.

Option	Description
Mass Flow Rate	The mass flow process variable, as measured by the transmitter
Volume Flow Rate	The volume flow process variable, as measured by the transmitter

4. Set or verify the following parameters:

Parameter	Setting
Enable Filling Option	Enabled
Enable Dual Fill	Disabled
Enable AOC	Enabled
Enable Purge	Disabled
Enable Timed Fill	Disabled
Fill Type	Two Stage Discrete

Tip
Micro Motion strongly recommends implementing Automatic Overshoot Compensation (AOC). When enabled and calibrated, AOC increases fill accuracy and repeatability.

5. Set Count Up as desired.

Count Up controls how the fill total is calculated and displayed.

Option	Description
Enabled	The fill total starts at 0 and increases toward Fill Target.
Disabled	The fill total starts at Fill Target and decreases toward 0.

6. Set Configure By as desired.

Configure By controls how valve control timing is configured.

Option	Description
% Target	Valve Open and Valve Close timing is configured as a percentage of Fill Target. For example: • Valve Open = 0%: The valve opens when the current fill total is 0% of Fill Target. • Valve Close = 90%: The valve closes when the current fill total is 90% of Fill Target.
Quantity	Valve Open and Valve Close timing is configured in terms of the configured measurement unit. For example: • Valve Open = 0 g: The valve opens when the current fill total is 0 g. • Valve Close = 50 g: The valve closes when the current fill total is 50 g less than Fill Target.

7. Set Fill Target to the quantity at which the fill will be complete.

   Enter the value in the measurement units configured for Flow Source.

8. Set Max Fill Time to the number of seconds at which the fill will time out.

   If the fill does not complete normally before this time has elapsed, the fill is aborted and fill timeout error messages are posted.

   To disable the fill timeout feature, set Max Fill Time to 0.

   The default value for Max Fill Time is 0 (disabled). The range is 0 seconds to 800 seconds.

9. Set Measured Fill Time as desired.

   Measured Fill Time controls how the fill duration will be measured.

Option	Description
Flow Stops	The fill duration will be incremented until the transmitter detects that flow has stopped, after valve closure.
Valve Closes	The fill duration will be incremented until the transmitter sets the discrete output as required to close the valve.

10. Set Open Primary, Open Secondary, Close Primary, and Close Secondary as desired.

    These values control the point in the fill at which the primary and secondary valves open and close. They are configured either by quantity or by percent of the target, as controlled by the Configure By parameter.

    Either Open Primary or Open Secondary must be set to open at the beginning of the fill. Both can open at the beginning of the fill if desired. If you set one to open later, the other one is automatically reset to open at the beginning.

    Either Close Primary or Close Secondary must be set to close at the end of the fill. Both can close at the end of the fill if desired. If you set one to close earlier, the other one is automatically reset to close at the end.

Example: Configuring a two-stage discrete fill

Important

This example uses standard or typical settings for the required parameters. Your application may require different settings. Refer to the MIT for information on data types and integer codes.

Location	Value	Description
Register 2489	110	Sets Precision DO1 to Primary Valve
Register 2490	1	Sets Precision DO1 Polarity to Active High
Register 2491	111	Sets Precision DO2 to Secondary Valve
Register 2492	1	Sets Precision DO2 Polarity to Active High
Register 17	0	Sets Flow Direction to Forward
Register 39	70	Sets Mass Flow Units to g/sec
Register 42	28	Sets Volume Flow Units to m3/sec
Register 1251	0	Sets Flow Source to Mass Flow Rate
Coil 266	0	Sets Enable Dual Fill to Disabled
Coil 267	0	Sets Enable Timed Fill to Disabled
Register 1253	2	Sets Fill Type to Two Stage Discrete
Coil 203	1	Sets Count Up to Enabled
Register 1255	0	Sets Configure By to % Target
Registers 1289-1290	100	Sets Fill Target to 100 g
Register 1305	1	Sets Max Fill Time to 1 sec
Coil 347	0	Sets Measured Fill Time to Flow Stops
Registers 1277–1278	0	Sets Open Primary to 0% of Fill Target
Registers 1281–1282	80	Sets Close Primary to 80% of Fill Target
Registers 1279–1280	50	Sets Open Secondary to 50% of Fill Target
Registers 2517–2518	100	Sets Close Secondary to 100% of Fill Target

Postrequisites

Options for two-stage discrete fills include:

- Configuring Automatic Overshoot Compensation (AOC). If AOC is enabled, ensure that AOC is appropriately configured and calibrated for your application.

Valve opening and closing sequences for two-stage discrete fills

The following figures illustrate the opening and closing of the primary and secondary valves, as controlled by the configuration of Open Primary, Open Secondary, Close Primary, and Close Secondary.

These illustrations assume that the fill runs from beginning to end without interruption.

Figure 7-1: Open Primary first, Close Primary first

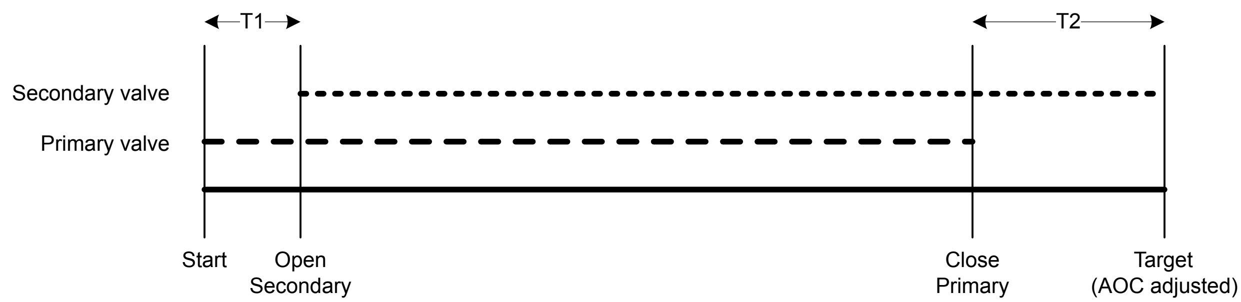


Figure 7-2: Open Primary first, Close Secondary first

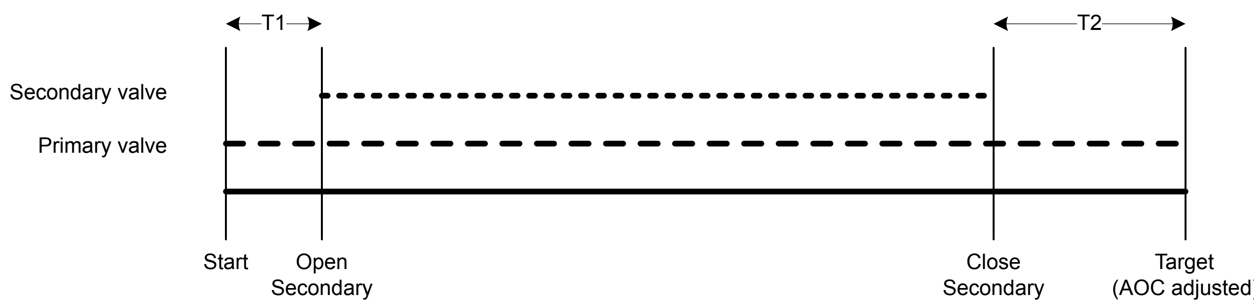


Figure 7-3: Open Secondary first, Close Primary first

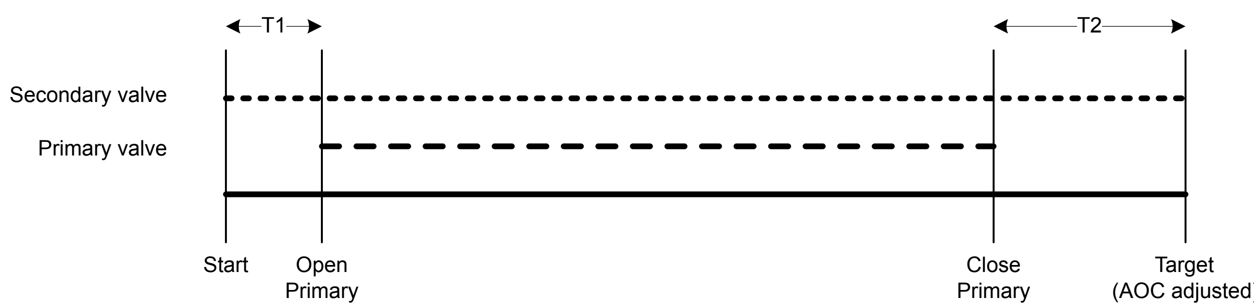
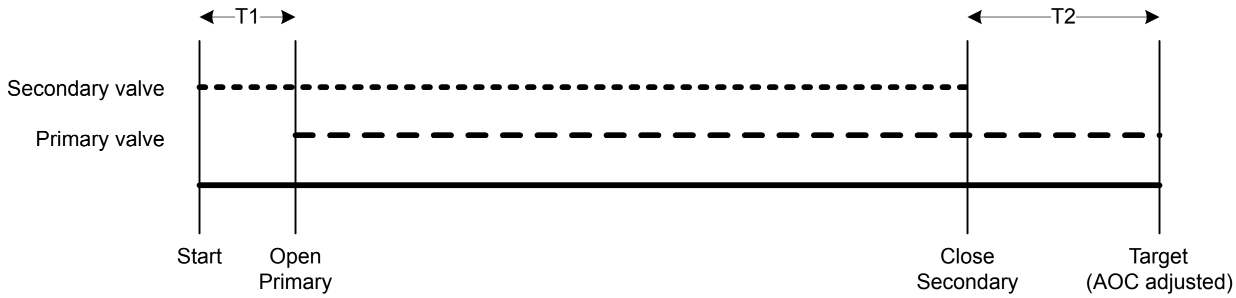


Figure 7-4: Open Secondary first, Close Secondary first



Effects of Configure By on valve opening and closing

Configure By controls how the Open Primary, Open Secondary, Close Primary, and Close Secondary values are configured and applied.

- When Configure By = % Target, the transmitter adds the configured Valve Open and Valve Close values to 0%.
- When Configure By = Quantity, the transmitter adds the configured Valve Open values to 0, and subtracts the configured Valve Close values from Fill Target.

Example: Configure By and valve open/close commands

Fill Target = 200 g. You want the primary valve to open at the beginning of the fill and close at the end of the fill. You want the secondary valve to open after 10 g has been delivered, and close after 190 g has been delivered. See *Table 7-1* for the settings that will produce this result.

Table 7-1: Configure By and valve configuration

Configure By	**Valve Open and Valve Close values**
% Target	• Open Primary = 0% • Open Secondary = 5% • Close Secondary = 95% • Close Primary = 100%
Quantity	• Open Primary = 0 g • Open Secondary = 10 g • Close Secondary = 10 g • Close Primary = 0 g

7.1.3 Configure a timed fill using Modbus

Configure a timed fill when you want to fill a single container from a single valve. The valve will be open for the specified number of seconds.

Prerequisites

Ensure that you are starting from the factory-default configuration.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. Configure the precision discrete output(s):
   a. Set Precision DO1 to Primary Valve.
   b. Set Precision DO1 Polarity as appropriate for your installation.

      Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

2. Configure flow measurement:
   a. Set Flow Direction to the option appropriate for your installation.

Option	Description
Forward	Process fluid flows in one direction only, matching the direction of the arrow on the sensor.
Bidirectional	Process fluid can flow in either direction. Most of the flow matches the direction of the arrow on the sensor.
Negate Forward	Process fluid flows in one direction only, in the opposite direction of the arrow on the sensor.
Negate Bidirectional	Process fluid can flow in either direction. Most of the flow is in the opposite direction of the arrow on the sensor.

Restriction
All other options for Flow Direction are invalid, and will be rejected by the transmitter.

   b. Set Mass Flow Units as desired.

      If you set Flow Source to Mass Flow Rate, the corresponding mass unit is used to measure your fill.
   c. Set Volume Flow Units as desired.

If you set Flow Source to Volume Flow Rate, the corresponding volume unit is is used to measure your fill.

d. Set other flow options as desired.

Tip
The default value of Flow Damping is 0.04 seconds. This is the optimum value for most filling applications, and is typically not changed.

3. Set or verify the following parameters:

Parameter	Setting
Enable Filling Option	Enabled
Count Up	Enabled
Enable Dual Fill	Disabled
Enable AOC	Disabled
Enable Purge	Disabled
Enable Timed Fill	Enabled
Fill Type	One Stage Discrete

4. Set Target Time to the number of seconds that the fill will run.

Example: Configuring a timed fill

Important
This example uses standard or typical settings for the required parameters. Your application may require different settings. Refer to the MIT for information on data types and integer codes.

Location	Value	Description
Register 2489	110	Sets Precision DO1 to Primary Valve
Register 2490	1	Sets Precision DO1 Polarity to Active High
Register 17	0	Sets Flow Direction to Forward
Register 39	70	Sets Mass Flow Units to g/sec
Register 42	28	Sets Volume Flow Units to m3/sec
Register 1251	0	Sets Flow Source to Mass Flow Rate
Coil 266	0	Sets Enable Dual Fill to Disabled
Coil 267	1	Sets Enable Timed Fill to Enabled
Register 1253	1	Sets Fill Type to One Stage Discrete
Coil 203	1	Sets Count Up to Enabled
Registers 1307–1308	15	Sets Target Time to 15 sec

Postrequisites

The following option is available for timed fills:

- Implementing the Purge feature.

7.1.4 Configure a dual-fillhead fill using Modbus

Configure a dual-fillhead fill when you want to fill two containers alternately, using two fillheads. Each valve will be open until Fill Target is reached.

Important
The configured Fill Target is applied to both fillheads.

Prerequisites

Ensure that you are starting from the factory-default configuration.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. Configure the precision discrete output(s):

   a. Set Precision DO1 to Primary Valve.

   b. Set Precision DO1 Polarity as appropriate for your installation.

   Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

   c. Set Precision DO2 to Secondary Valve.

   d. Set Precision DO2 Polarity as appropriate for your installation.

   Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC

Option	Signal from transmitter	Voltage
	OFF	Site-specific up to 30 VDC

2. Configure flow measurement:

   a. Set Flow Direction to the option appropriate for your installation.

Option	Description
Forward	Process fluid flows in one direction only, matching the direction of the arrow on the sensor.
Bidirectional	Process fluid can flow in either direction. Most of the flow matches the direction of the arrow on the sensor.
Negate Forward	Process fluid flows in one direction only, in the opposite direction of the arrow on the sensor.
Negate Bidirectional	Process fluid can flow in either direction. Most of the flow is in the opposite direction of the arrow on the sensor.

Restriction
All other options for Flow Direction are invalid, and will be rejected by the transmitter.

   b. Set Mass Flow Units as desired.

   If you set Flow Source to Mass Flow Rate, the corresponding mass unit is used to measure your fill.

   c. Set Volume Flow Units as desired.

   If you set Flow Source to Volume Flow Rate, the corresponding volume unit is is used to measure your fill.

   d. Set other flow options as desired.

Tip
The default value of Flow Damping is 0.04 seconds. This is the optimum value for most filling applications, and is typically not changed.

3. Set Flow Source to the process variable to be used to measure this fill.

Option	Description
Mass Flow Rate	The mass flow process variable, as measured by the transmitter
Volume Flow Rate	The volume flow process variable, as measured by the transmitter

4. Set or verify the following parameters:

Parameter	Setting
Enable Filling Option	Enabled
Count Up	Enabled
Enable Dual Fill	Enabled
Enable AOC	Enabled
Enable Purge	Disabled
Enable Timed Fill	Disabled
Fill Type	One Stage Discrete

Tip

Micro Motion strongly recommends implementing Automatic Overshoot Compensation (AOC). When enabled and calibrated, AOC increases fill accuracy and repeatability.

5. Set Fill Target to the quantity at which the fill will be complete.

Note

The configured Fill Target is applied to both fillheads.

6. Set Max Fill Time to the number of seconds at which the fill will time out.

   If the fill does not complete normally before this time has elapsed, the fill is aborted and fill timeout error messages are posted.

   To disable the fill timeout feature, set Max Fill Time to 0.

   The default value for Max Fill Time is 0 (disabled). The range is 0 seconds to 800 seconds.

7. Set Measured Fill Time as desired.

   Measured Fill Time controls how the fill duration will be measured.

Option	Description
Flow Stops	The fill duration will be incremented until the transmitter detects that flow has stopped, after valve closure.
Valve Closes	The fill duration will be incremented until the transmitter sets the discrete output as required to close the valve.

Example: Configuring a dual-fillhead fill

Important

This example uses standard or typical settings for the required parameters. Your application may require different settings. Refer to the MIT for information on data types and integer codes.

Location	Value	Description
Register 2489	110	Sets Precision DO1 to Primary Valve
Register 2490	1	Sets Precision DO1 Polarity to Active High
Register 2491	111	Sets Precision DO2 to Secondary Valve
Register 2492	1	Sets Precision DO2 Polarity to Active High
Register 17	0	Sets Flow Direction to Forward
Register 39	70	Sets Mass Flow Units to g/sec
Register 42	28	Sets Volume Flow Units to m3/sec
Register 1251	0	Sets Flow Source to Mass Flow Rate
Register 1253	1	Sets Fill Type to One Stage Discrete
Coil 266	1	Sets Enable Dual Fill to Enabled
Coil 267	0	Sets Enable Timed Fill to Disabled
Coil 203	1	Sets Count Up to Enabled
Registers 1289-1290	100	Sets Fill Target to 100 g
Register 1305	1	Sets Max Fill Time to 1 sec
Coil 347	0	Sets Measured Fill Time to Flow Stops

Postrequisites

Options for dual-fillhead fills include:

- Configuring Automatic Overshoot Compensation (AOC). If AOC is enabled, ensure that AOC is appropriately configured and calibrated for your application.

7.1.5 Configure a dual-fillhead timed fill using Modbus

Configure a dual-fillhead timed fill when you want to fill two containers alternately, using two fillheads. Each valve will be open for the specified number of seconds.

Important
The configured Target Time is applied to both fillheads.

Prerequisites

Ensure that you are starting from the factory-default configuration.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. Configure the precision discrete output(s):
   a. Set Precision DO1 to Primary Valve.
   b. Set Precision DO1 Polarity as appropriate for your installation.

   Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

   c. Set Precision DO2 to Secondary Valve.
   d. Set Precision DO2 Polarity as appropriate for your installation.

   Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

2. Configure flow measurement:
   a. Set Flow Direction to the option appropriate for your installation.

Option	Description
Forward	Process fluid flows in one direction only, matching the direction of the arrow on the sensor.
Bidirectional	Process fluid can flow in either direction. Most of the flow matches the direction of the arrow on the sensor.
Negate Forward	Process fluid flows in one direction only, in the opposite direction of the arrow on the sensor.
Negate Bidirectional	Process fluid can flow in either direction. Most of the flow is in the opposite direction of the arrow on the sensor.

Restriction
All other options for Flow Direction are invalid, and will be rejected by the transmitter.

b. Set Mass Flow Units as desired.

   If you set Flow Source to Mass Flow Rate, the corresponding mass unit is used to measure your fill.

c. Set Volume Flow Units as desired.

   If you set Flow Source to Volume Flow Rate, the corresponding volume unit is is used to measure your fill.

d. Set other flow options as desired.

Tip

The default value of Flow Damping is 0.04 seconds. This is the optimum value for most filling applications, and is typically not changed.

3. Set Flow Source to the process variable to be used to measure this fill.

Option	Description
Mass Flow Rate	The mass flow process variable, as measured by the transmitter
Volume Flow Rate	The volume flow process variable, as measured by the transmitter

4. Set or verify the following parameters:

Parameter	Setting
Enable Filling Option	Enabled
Count Up	Enabled
Enable Dual Fill	Enabled
Enable AOC	Disabled
Enable Purge	Disabled
Enable Timed Fill	Enabled
Fill Type	One Stage Discrete

5. Set Target Time to the number of seconds that the fill will run.

Note

The configured Target Time is applied to both fillheads.

Example: Configuring a dual-fillhead timed fill

Important

This example uses standard or typical settings for the required parameters. Your application may require different settings. Refer to the MIT for information on data types and integer codes.

Location	Value	Description
Register 2489	110	Sets Precision DO1 to Primary Valve
Register 2490	1	Sets Precision DO1 Polarity to Active High
Register 2491	111	Sets Precision DO2 to Secondary Valve
Register 2492	1	Sets Precision DO2 Polarity to Active High
Register 17	0	Sets Flow Direction to Forward
Register 39	70	Sets Mass Flow Units to g/sec
Register 42	28	Sets Volume Flow Units to m3/sec
Register 1251	0	Sets Flow Source to Mass Flow Rate
Coil 266	1	Sets Enable Dual Fill to Enabled
Coil 267	1	Sets Enable Timed Fill to Enabled
Register 1253	1	Sets Fill Type to One Stage Discrete
Coil 203	1	Sets Count Up to Enabled
Registers 1307–1308	15	Sets Target Time to 15 sec

7.2 Configure fill options using Modbus

Depending on your fill type, you can configure and implement Automatic Overshoot Compensation, the Purge feature, or the Pump feature.

7.2.1 Configure and implement Automatic Overshoot Compensation (AOC) using Modbus

Automatic Overshoot Compensation (AOC) is used to adjust fill timing to compensate for the time required to transmit the valve close command or for the valve to close completely.

Prerequisites

Before setting up AOC, ensure that all other fill parameters are correctly configured.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. Choose the type of AOC that you want to implement.

Option	Description
Fixed	The valve will close at the point defined by Fill Target, minus the quantity specified in Fixed Overshoot Comp. Use this option only if the "prewarn" value is already known.
Overfill	Defines the direction used by the AOC algorithm to approach the target. The AOC algorithm starts by estimating an overfill amount, and reduces the overfill in successive calibration fills.
Underfill	Defines the direction used by the AOC algorithm to approach the target. The AOC algorithm starts by estimating an underfill amount, and reduces the underfill in successive calibration fills.

Tip
The Fixed option is typically not used. If you choose Fixed, the transmitter will operate like a legacy batch controller. In typical applications, the other AOC options provide enhanced accuracy and repeatability.

Restriction
The Fixed and Overfill options are not supported for dual-fillhead fills.

2. To implement Fixed AOC:
   a. Disable Enable AOC.
   b. Set AOC Algorithm to Fixed.
   c. Set Fixed Overshoot Comp as desired.

      The default value is 0, measured in process units.

      The transmitter will close the valve when the current fill total is equal to Fill Target minus the specified value (in process units).
3. To implement Overfill or Underfill:
   a. Ensure that Enable AOC is enabled.
   b. Set AOC Algorithm to either Overfill or Underfill.
   c. Set AOC Window Length to the number of fills that will be used for AOC calibration.

      The default is 10. The range is 2 to 32.

      Tip
      Micro Motion recommends using the default value unless you have special application requirements.

Important
Do not change the values of AOC Change Limit or AOC Convergence Rate unless you are working with Micro Motion customer service. These parameters are used to adjust the operation of the AOC algorithm for special application requirements.

Example: Configuring AOC

Important
This example uses standard or typical settings for the required parameters. Your application may require different settings. Refer to the MIT for information on data types and integer codes.

- Fixed AOC:

Location	Value	Description
Coil 205	0	Sets Enable AOC to Disabled
Register 1309	2	Sets AOC Algorithm to Fixed
Registers 2515–2516	0	Sets Fixed Overshoot Comp to 0

- Overfill or Underfill AOC:

Location	Value	Description
Coil 205	1	Sets Enable AOC to Enabled
Register 1309	0	Sets AOC Algorithm to Overfill
Register 1310	10	Sets AOC Window Length to 10 fills

Postrequisites

If you set AOC Algorithm to Overfill or Underfill, you must perform an AOC calibration.

Perform AOC calibration using Modbus

AOC calibration is used to calculate the AOC (Automatic Overshoot Compensation) value from actual fill data. If you set AOC Algorithm to Overfill or Underfill, you must perform AOC calibration.

There are two types of AOC calibration:

- Standard: The calibration is performed manually. The AOC coefficient is calculated from fill data obtained during this calibration, and the same AOC coefficient is applied until the calibration is repeated.
- Rolling: The calibration is performed continuously and automatically, and the AOC coefficient is updated continuously based on fill data from the last set of fills.

Tip
For stable processes, Micro Motion recommends standard AOC calibration. If required, test both methods and choose the method that yields the best results.

Perform standard AOC calibration

Standard AOC calibration is used to generate a constant AOC coefficient.

Prerequisites

AOC Window Length must be set appropriately. Micro Motion recommends using the default value (10) unless you have special application requirements.

Mass Flow Cutoff or Volume Flow Cutoff must be set appropriately for your environment.

- If Flow Source is set to Mass Flow Rate, see *Section 11.2.3*.
- If Flow Source is set to Volume Flow Rate, see *Section 11.3.2*.

Your system must be ready to run fills, and you must know how to run fills.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. To calibrate the primary valve (all fill types):
   a. Write 1 to Start AOC Cal (Coil 209).
   b. Run two or more calibration fills, up to the number specified in AOC Window Length.

      Note
      You can run more calibration fills if you choose. The AOC coefficient is calculated from the most recent fills.

      Tip
      In common use, the first few fills are slightly overfilled or underfilled due to factory-default settings. As the calibration proceeds, the fills will converge on Fill Target.

   c. When the fill totals are consistently satisfactory, write 1 to Save AOC Cal (Coil 210).

2. To calibrate the secondary valve (dual-fillhead fills):
   a. Write 1 to Start Secondary AOC Cal (Coil 342).
   b. Run two or more calibration fills, up to the number specified in AOC Window Length.

      The transmitter automatically runs fills through the secondary valve.

      Note
      You can run more calibration fills if you choose. The AOC coefficient is calculated from the most recent fills.

Tip

In common use, the first few fills are slightly overfilled or underfilled due to factory-default settings. As the calibration proceeds, the fills will converge on Fill Target.

c. When the fill totals are consistently satisfactory, write 1 to Save Secondary AOC Cal (Coil 343).

The current AOC coefficient is displayed in the Run Filler window. If you are running a dual-fillhead fill, the Run Filler window displays the AOC coefficient for both the primary and the secondary valve. These coefficients will be applied to fills as long as AOC is enabled.

Note

For two-stage discrete fills, the AOC value is applied to the valve that closes when the target is reached. If the fill is configured to close both valves when the target is reached, the AOC value is applied to both.

Tip

Micro Motion recommends repeating the AOC calibration if any of the following are true:

- Equipment has been replaced or adjusted.
- The flow rate has changed significantly.
- Fill accuracy is consistently lower than expected.
- Mass Flow Cutoff or Volume Flow Cutoff has been changed.

Set up rolling AOC calibration

Rolling AOC calibration is used to update the AOC coefficient continuously, based on fill data from the last set of fills.

Prerequisites

AOC Window Length must be set appropriately. Micro Motion recommends using the default value (10) unless you have special application requirements.

Your system must be ready to run fills, and you must know how to run fills.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. To calibrate the primary valve (all fill types), write 1 to Start AOC Cal (Coil 209). To calibrate the secondary valve (dual-fillhead fills), write 1 to Start Secondary AOC Cal (Coil 342).

   You can set up rolling AOC calibration for either valve or both valves.
2. Begin production filling.

The transmitter recalculates the AOC coefficient(s) after each fill, based on the last *x* fills where *x* is the number specified in AOC Window Length. Current values are displayed in the Run Filler window. If the configuration has changed or if process conditions have changed, rolling AOC calibration will compensate for the change. However, the adjustment will take place over several fills; that is, AOC will take a few fills to catch up.

Tip

At any time while AOC calibration is running, you can write 1 to Save AOC Cal (Coil 210) or write 1 to Save Secondary AOC Cal (Coil 343). The current AOC coefficient will be saved and applied to all subsequent fills through the corresponding valve. In other words, this action changes the AOC calibration method for that valve from rolling to standard.

7.2.2 Configure the Purge feature using Modbus

The Purge feature is used to control an auxiliary valve that can be used for any non-filling purpose. For example, it can be used for adding water or gas to the container after the fill ends, or “padding.” Flow through the auxiliary valve is not measured by the transmitter. You can configure the Purge feature for automatic or manual purge control. If you choose automatic control, the auxiliary valve is opened after each fill, and closed after the configured purge time has elapsed.

Restriction

The Purge feature is not supported for dual-fillhead fills or dual-fillhead timed fills.

Prerequisites

The discrete outputs must be wired appropriately for your fill type and fill options.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. Configure Channel B to operate as a discrete output:
   a. Set Channel B Type Assignment to Discrete Output.
   b. Set DO1 Assignment to Discrete Batch: Purge Valve.
   c. Set DO1 Polarity as appropriate for your installation.

      Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC

Option	Signal from transmitter	Voltage
	OFF	Site-specific up to 30 VDC

d. Set DO1 Fault Action as appropriate for your installation.

Option	Description
Upscale	The discrete output will be set to ON (valve open) if a fault occurs.
Downscale	The discrete output will be set to OFF (valve closed) if a fault occurs.
None	No action will be taken if a fault occurs. The discrete output will remain in the state it was in before the fault occurred.

2. Configure the purge:

a. Enable Enable Purge.

b. Set Purge Mode as desired.

Option	Description
Auto	A purge is performed automatically after each fill.
Manual	Purges must be started and stopped manually.

Tip

When Purge Mode is set to Auto, manual control of the purge valve is still possible. You can start a purge manually and stop it manually, or you can let the transmitter stop it after Purge Time has expired. If a purge is started automatically, you can stop it manually.

c. If you set Purge Mode to Auto, set Purge Delay to the number of seconds that the transmitter will wait, after the fill has ended, to open the purge valve.

The default value for Purge Delay is 2 seconds.

d. If you set Purge Mode to Auto, set Purge Time to the number of seconds that the transmitter will keep the purge valve open.

The default value for Purge Time is 1 second. The range is 0 seconds to 800 seconds.

Tip

The next fill cannot start until the purge valve is closed.

Example: Configuring the Purge feature

Important
This example uses standard or typical settings for the required parameters. Your application may require different settings. Refer to the MIT for information on data types and integer codes.

Location	Value	Description
Register 1167	4	Sets Type Assignment for Channel B Discrete Output
Register 1151	110	Sets DO1 Assignment to Primary Valve
Register 1152	1	Sets DO1 Polarity to Active High
Register 2615	4	Sets DO1 Fault Action to None
Coil 111	1	Enables Enable Purge
Coil 200	0	Sets Purge Mode to Auto
Registers 1311–1312	3	Sets Purge Delay to 3 seconds
Registers 1313–1314	2	Sets Purge Time to 2 seconds

7.2.3 Configure the Pump feature using Modbus

The Pump feature is used to increase pressure during the fill by starting an upstream pump just before the fill begins.

Restriction
The Pump feature is not supported for two-stage discrete fills, dual-fillhead fills, timed fills, or dual-fillhead timed fills.

Prerequisites

The discrete outputs must be wired appropriately for your fill type and fill options.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. Configure the precision discrete output(s):
    a. Set Precision DO2 to Pump.
    b. Set Precision DO2 Polarity as appropriate for your installation.

       Ensure that the ON signal opens the valve and the OFF signal closes the valve.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

2. Set Pump to Valve Delay to the number of seconds that the pump will run before the valve is opened.

   The default value is 10 seconds. The range is 0 seconds to 30 seconds.

When the Begin Filling command is received, the transmitter starts the pump, waits for the number of seconds specified in Pump to Valve Delay, then opens the valve. The pump runs until the fill is ended.

Example: Configuring the Pump feature

Important
This example uses standard or typical settings for the required parameters. Your application may require different settings. Refer to the MIT for information on data types and integer codes.

Location	Value	Description
Register 2491	109	Sets Precision DO2 to Pump
Register 2492	1	Sets Precision DO2 Polarity to Active High
Registers 2493–2494	15	Sets Pump to Valve Delay to 15 seconds

7.3 Configure fill control using Modbus (optional)

In a typical production environment, fill control (beginning and ending the fill) is performed by the host or PLC. If you choose, you can set up the system so that you can begin, end, pause, and resume the fill from the discrete input (if available). You can also define an event to begin, end, pause, or resume the fill.

7.3.1 Configure the discrete input for fill control using Modbus

If Channel B is available, you can configure it as a discrete input and use it to begin and end the fill, or to pause and resume a fill in progress. You can also configure it to reset the mass total, volume total, or all totals. When the discrete input is activated, all assigned actions will be performed.

Prerequisites

Channel B must be wired to operate as a discrete input.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. Configure Channel B to operate as a discrete input.
   a. Set Type Assignment for Channel B to Discrete Input.
2. Assign fill control actions to the discrete input.
   a. Select the action or actions to be performed when the discrete input is activated.

Action	Description	Comments
Begin Filling	Starts a fill using the current fill configuration. The fill total is automatically reset before the fill begins.	If a fill is in progress, the command is ignored. If an automatic purge is in progress, the beginning-of-fill functions are executed when the purge is complete.
End Filling	Ends the current fill and performs end-of-fill functions. The fill cannot be resumed.	Executed while a fill is running or paused, and during a purge or purge delay. For dual-fillhead fills and dual-fillhead timed fills, the command always ends the currently active fill.
Pause Filling	Timed fills, dual-fillhead fills, and dual-fillhead timed fills: Same as End Filling.	
	One-stage discrete fills and two-stage discrete fills: Temporarily stops the fill. The fill can be resumed if the fill total is less than Fill Target.	If a purge or purge delay is in progress, the command is ignored.
Resume Filling	Restarts a fill that has been paused. Counting resumes from the total or time at which the fill was paused.	Executed only when a one-stage discrete fill or a two-stage discrete fill has been paused. Ignored at all other times.
Reset Mass Total	Resets the value of the mass totalizer to 0.	Executed only when a fill is not running (between fills or when a fill has been paused). Ignored at all other times.
Reset Volume Total	Resets the value of the volume totalizer to 0.	Executed only when a fill is not running (between fills or when a fill has been paused). Ignored at all other times.
Reset All Totals	Resets the value of the mass totalizer and volume totalizer to 0, and resets the fill total to 0.	Executed only when a fill is not running (between fills or when a fill has been paused). Ignored at all other times.

3. Set DI1 Polarity as appropriate for your installation.

   Ensure that the ON signal sent by the discrete input is read as ON, and vice versa.

Option	Voltage applied across terminals	Transmitter reads
Active High	3 to 30 VDC	ON
	<0.8 VDC	OFF
Active Low	<0.8 VDC	ON
	3 to 30 VDC	OFF

Example: Configuring the discrete input for fill control

Important

This example uses standard or typical settings for the required parameters. Your application may require different settings. Refer to the MIT for information on data types and integer codes.

Location	Value	Description
Register 1167	5	Sets Type Assignment for Channel B to Discrete Input
Register 1329	98	Assigns Begin Filling to Discrete Input
Register 1178	1	Sets DI1 Polarity to Active High

7.3.2 Set up an event to perform fill control using Modbus

You can assign an event to start, stop, pause, or resume a fill. You can also assign the event to reset the mass total, volume total, or all totals. When the event transitions to ON, all assigned actions will be performed.

Prerequisites

All events that you want to use must be configured. You can configure them before or after you assign actions to them.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. Assign fill control actions to the event.

   a. Identify the action or actions to be performed when Discrete Event 1 occurs.

Action	Description	Comments
Begin Filling	Starts a fill using the current fill configuration. The fill total is automatically reset before the fill begins.	If a fill is in progress, the command is ignored. If an automatic purge is in progress, the beginning-of-fill functions are executed when the purge is complete.

Action	Description	Comments
End Filling	Ends the current fill and performs end-of-fill functions. The fill cannot be resumed.	Executed while a fill is running or paused, and during a purge or purge delay. For dual-fillhead fills and dual-fillhead timed fills, the command always ends the currently active fill.
Pause Filling	Timed fills, dual-fillhead fills, and dual-fillhead timed fills: Same as End Filling.	
	One-stage discrete fills and two-stage discrete fills: Temporarily stops the fill. The fill can be resumed if the fill total is less than Fill Target.	If a purge or purge delay is in progress, the command is ignored.
Resume Filling	Restarts a fill that has been paused. Counting resumes from the total or time at which the fill was paused.	Executed only when a one-stage discrete fill or a two-stage discrete fill has been paused. Ignored at all other times.
Reset Mass Total	Resets the value of the mass totalizer to 0.	Executed only when a fill is not running (between fills or when a fill has been paused). Ignored at all other times.
Reset Volume Total	Resets the value of the volume totalizer to 0.	Executed only when a fill is not running (between fills or when a fill has been paused). Ignored at all other times.
Reset All Totals	Resets the value of the mass totalizer and volume totalizer to 0, and resets the fill total to 0.	Executed only when a fill is not running (between fills or when a fill has been paused). Ignored at all other times.

2. Repeat for Discrete Events 2–5.

Example: Events monitor process and pause or end fill

The acceptable density range for your process is 1.1 g/cm^3 to 1.12 g/cm^3. The acceptable temperature range is 20 °C to 25 °C. You want to pause the fill if the density goes out of range. You want to end the fill if the temperature goes out of range.

Event configuration:

- Discrete Event 1:

Location	Value	Description
Register 609	0	Selects Discrete Event 1
Register 610	3	Sets Event Type to Out of Range
Register 615	3	Sets Process Variable to Density
Registers 611–612	1.10	Sets Low Setpoint (A) to 1.1 g/cm^3
Registers 613–614	1.12	Sets High Setpoint (B) to 1.12 g/cm^3

- Discrete Event 2:

Location	Value	Description
Register 609	2	Selects Discrete Event 2
Register 610	3	Sets Event Type to Out of Range
Register 615	1	Sets Process Variable to Temperature
Registers 611–612	20	Sets Low Setpoint (A) to 20 °C
Registers 613–614	25	Sets High Setpoint (B) to 25 °C

- Action assignments:

Location	Value	Description
Register 1330	57	Assigns Pause Fill to Discrete Event 1
Register 1324	58	Assigns End Fill to Discrete Event 2

Postrequisites

If you have assigned actions to events that are not configured, you must configure those events before you can implement this fill control method.

7.3.3 Multiple actions assigned to a discrete input or event

If multiple actions are assigned to a discrete input or event, the transmitter performs only the actions that are relevant in the current situation. If two or more of the actions are mutually exclusive, the transmitter performs actions according to the priority scheme defined in the transmitter firmware.

The following examples show three configurations that Micro Motion recommends, and two configurations that are not recommended.

Example: Using the discrete input or event to begin and end the fill (recommended)

Action assignments:

- Begin Fill
- End Fill
- Reset Mass Total
- Reset Volume Total

Result of activation:

- If no fill is running, the mass totalizer and volume totalizer are reset and a fill is started.

- If a fill is running, it is ended and the mass totalizer and volume totalizer are reset.

Example: Using the discrete input or event to begin, pause, and resume the fill (recommended)

Action assignments:

- Begin Fill
- Pause Fill
- Resume Fill

Result of activation:

- If no fill is running, a fill is started.
- If a fill is running and not paused, it is paused.
- If a fill is paused, it is resumed.

Example: Using the discrete input to begin the fill and reset the volume flow (recommended)

Action assignments:

- Begin Fill
- Reset Volume Total

Result of activation:

- If no fill is running, the volume totalizer is reset and a fill is started.
- If a fill is running, the volume totalizer is reset.

Tip

This configuration is useful if you have configured your fill in terms of mass but you would also like to know the volume total for the fill. In this case, do not activate the discrete input while the fill is in progress. At the end of the fill, read the volume total. Then continue with the next fill.

Example: Incompatible assignments (not recommended)

Action assignments:

- Begin Fill
- End Fill
- Pause Fill
- Resume Fill

Result of activation:

- If no fill is running, a fill is started.
- If a fill is running, it is ended.

In this example, the discrete input or event will never pause the fill because the End Fill action takes priority.

Example: Incompatible assignments (not recommended)

Action assignments:

- End Fill
- Reset All Totals

Result of activation:

- If no fill is running, all totals, including the fill total, are reset.
- If a fill is running, it is ended and all totals, including the fill total, are reset.

The result of this combination is that the fill total is reset before the data can be retrieved.

7.4 Configure fill reporting using Modbus (optional)

You can configure the transmitter to report the fill ON/OFF state over Channel B (if it is available), and percent of fill delivered over the mA output.

7.4.1 Configure Channel B to operate as a discrete output and report the fill ON/OFF state using Modbus

If Channel B is available, you can use it to report whether or not a fill is running.

Prerequisites

Channel B must be wired to operate as a discrete output.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. Set Channel B Type Assignment to Discrete Output.
2. Set DO1 Assignment to Discrete Batch: Batching/Filling In Progress
3. Set DO1 Polarity as appropriate for your installation.

Option	Signal from transmitter	Voltage
Active High	ON	Site-specific up to 30 VDC
	OFF	0 VDC
Active Low	ON	0 VDC
	OFF	Site-specific up to 30 VDC

4. Set DO1 Fault Action as appropriate for your installation.

Option	Description
Upscale	The discrete output will be set to ON (valve open) if a fault occurs.
Downscale	The discrete output will be set to OFF (valve closed) if a fault occurs.
None	No action will be taken if a fault occurs. The discrete output will remain in the state it was in before the fault occurred.

Tip

When the discrete output is used for fill reporting, Micro Motion recommends setting DO1 Fault Action to None.

Example: Configuring the discrete output to report the fill ON/OFF state

Location	Value	Description
Register 1167	4	Sets Type Assignment for Channel B Discrete Output
Register 1151	106	Sets DO1 Assignment to Discrete Batch: Batch/Filling in Progress
Register 1152	1	Sets DO1 Polarity to Active High
Register 2615	4	Sets DO1 Fault Action to None

7.4.2 Configure the mA output to report percentage of fill delivered using Modbus

You can configure the mA output to report the percentage of Fill Target that has been delivered. In a typical configuration, the current increases from 4 mA to 20 mA as the fill total moves from 0% to 100%.

Prerequisites

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. Set Secondary Variable Is to Discrete Batch: Percent Fill.
2. Set Lower Range Value to the percentage of the fill to be represented by 4 mA.
3. Set Upper Range Value to the percentage of the fill to be represented by 20 mA.
4. Set AO Fault Action as desired.

If Lower Range Value is set to 0% and Upper Range Value is set to 100%: When the fill starts, the mA output will generate a current of 4 mA (0% of Fill Target). The current will increase in proportion to the fill total, up to a current of 20 mA (100% of Fill Target).

Note

If Flow Direction is set to Bidirectional or Negate Bidirectional, the fill total may decrease under certain flow conditions. If this occurs, the current generated by the mA output will decrease proportionally.

Example: Configuring the mA output to report percentage of fill delivered

Location	Value	Description
Register 13	207	Sets Secondary Variable Is to Discrete Batch: Percent Fill
Registers 221–222	10.00	Sets Lower Range Value to 10 percent
Registers 219–220	80.00	Sets Upper Range Value to 80 percent
Register 1114	4	Sets AO Fault Action to None

8 Fill operation using Modbus

Topics covered in this chapter:

8.1 Run an integrated-valve-control fill using Modbus

You can use Modbus digital communications to start a fill, monitor the fill, pause and resume the fill, and end a fill.

Prerequisites

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. (Optional) If desired, enter a different value for Fill Target (one-stage discrete fills, two-stage discrete fills, or dual-fillhead fills), or for Target Time (timed fills or dual-fillhead timed fills).
2. (Optional) If Automatic Overshoot Compensation (AOC) is enabled, you can enter a different value for AOC Coeff.

   Tip
   In production use, Micro Motion recommends leaving AOC Coeff at the value determined during AOC calibration. If you are running AOC calibration fills and you have an AOC Coeff value available from a similar device, you can use that value as the "first approximation" value on the current device. This may be helpful if you want to prevent or minimize spilling.

3. Start the filling operation.

   The fill total is reset automatically and the valve(s) are opened. The Filling In Progress indicator should be On. If it is not, and the Start Not Okay indicator or the AOC Flow Rate Too High indicator is On instead, troubleshoot the fill configuration and try again.

4. Monitor the fill using the Current Total and Percent Fill values and the Fill Status indicators.

Fill progress values	Description
Current Total	Fill quantity at the current time. This value is affected by Count Up: • If Count Up is enabled, Current Total begins at 0 and increases to Fill Target. • If Count Up is disabled, Current Total begins at Fill Target and decreases to 0.
Percent Fill	Percentage of Fill Target that has been measured up to the current time. This value is not affected by Count Up.

Fill Status indicator	Description
Filling in Progress	A fill is currently being performed through the primary valve. This indicator is active even when the fill is paused.
Secondary Fill in Progress	A fill is currently being performed through the secondary valve. This indicator is active even when the fill is paused. It applies only to dual-fillhead fills.
Max Fill Time Exceeded	The current fill has exceeded the current setting for Max Fill Time. The fill is aborted.
Primary Valve	The primary valve is open.
Secondary Valve	The secondary valve is open.
Pump	The pump is running.
Purge In Progress	A purge has been started, either manually or automatically.
Purge Delay Phase	An automatic purge cycle is in progress, and is currently in the delay period between the completion of the fill and the start of the purge.
Purge Valve	The purge valve is open.

5. (Optional) Pause the fill if desired.

   While the fill is paused, you can change the value of Current Target, end the fill manually with End Filling, or restart the fill with Resume Filling. The fill resumes at the current value of Current Total and Percent Fill.

   Restriction
   You cannot pause a timed fill or a dual-fillhead timed fill.

   Important
   For two-stage discrete fills, the effects of pausing and resuming the fill depend on the timing of the valve open and valve close commands, and on the point at which the fill is paused.

6. (Optional) Use End Filling to end the fill manually if desired.

   Once the fill is ended, it cannot be restarted.

Tip

In most cases, you should allow the fill to end automatically. End the fill manually only when you are planning to discard the fill.

Example: Running an integrated-valve-control fill

Important

This example uses standard or typical settings for the required parameters. Your application may require different settings. Refer to the MIT for information on data types and integer codes.

Location	Value	Description
Registers 1289–1290	100	Sets Fill Target to 100 g (for one-stage discrete fills, two-stage discrete fills, or dual-fillhead fills)
Registers 1307–1308	15	Sets Target Time to 15 sec (for timed fills or dual-fillhead timed fills)
Coil 100	1	Starts the filling operation
Coil 222	1	The Filling In Progress indicator
Register 2496, Bits 0 and 1	0	The Start Not Okay and AOC Flow Rate Too High indicators
Registers 1291–1292	70	The Current Total value
Register 2505	70	The Percent Fill value
Register 1256	3	The Fill State indicator
Coil 107	1	Pauses the filling operation
Coil 101	1	Resumes the filling operation from a paused state
Coil 100	0	Ends the filling operation

8.1.1 If the fill fails to start

If the fill fails to start, check the Start Not Okay and AOC Flow Rate Too High indicators.

If the Start Not Okay indicator is On, check the following:

- Ensure that filling is enabled.
- Ensure that the previous fill has been ended.
- Ensure that Fill Target or Target Time is set to a positive number.
- Ensure that all outputs have been assigned to the valve or pump appropriate for the fill type and fill option.
- Ensure that there are no active fault conditions at the transmitter.
- For dual-fillhead fills and dual-fillhead timed fills, ensure that no fill is running on either fillhead.

If the AOC Flow Rate Too High indicator is on, the last measured flow rate is too high to allow the fill to start. In other words, the AOC coefficient, compensated for the flow rate, specifies that the valve close command should be issued before the fill has begun. This can happen if the flow rate has increased significantly since the AOC coefficient was calculated. Micro Motion recommends the following recovery procedure:

1. Perform any setup that is required to perform AOC calibration.
2. Write 1 to Coil 110 (Override Blocked Start).
3. Perform AOC calibration.
4. Return your system to production filling, using the new AOC coefficient.

Example: Values to check if a fill fails to start

Important
This example uses standard or typical settings for the required parameters. Your application may require different settings. Refer to the MIT for information on data types and integer codes.

Location	Description
Registers 1289–1290	Check that Fill Target is a non-negative number
Registers 1307–1308	Check that Target Time is a non-negative number
Register 2496, Bits 0 and 1	Check the Start Not Okay and AOC Flow Rate Too High indicators

8.1.2 If the fill did not run to completion

If your fill terminated abnormally, check the transmitter and the Max Fill Time Exceeded indicator.

If a fault occurs during the fill, the transmitter automatically terminates the fill.

If the Max Fill Time Exceeded indicator is On, the fill did not reach its target before the configured Max Fill Time. Consider the following possibilities or actions:

- Increase the flow rate of your process.
- Check for entrained gas (slug flow) in your process fluid.
- Check for blockages in the flow.
- Ensure that the valves are able to close at the expected speed.
- Set Max Fill Time to a higher value.
- Disable Max Fill Time by setting it to 0.

8.1.3 Effects of Pause and Resume on two-stage discrete fills

For two-stage discrete fills, the effects of pausing and resuming the fill depend on where the Pause and Resume actions occur in relation to the opening and closing of the primary and secondary valves.

Open Primary first, Close Primary first

In the following illustrations:

- The primary valve opens at the beginning of the fill.
- The secondary valve opens at the user-configured point during the fill. *T* represents the time or quantity configured for Open Secondary.
- The primary valve closes before the end of the fill.
- The secondary valve closes at the end of the fill.

Figure 8-1: Case A

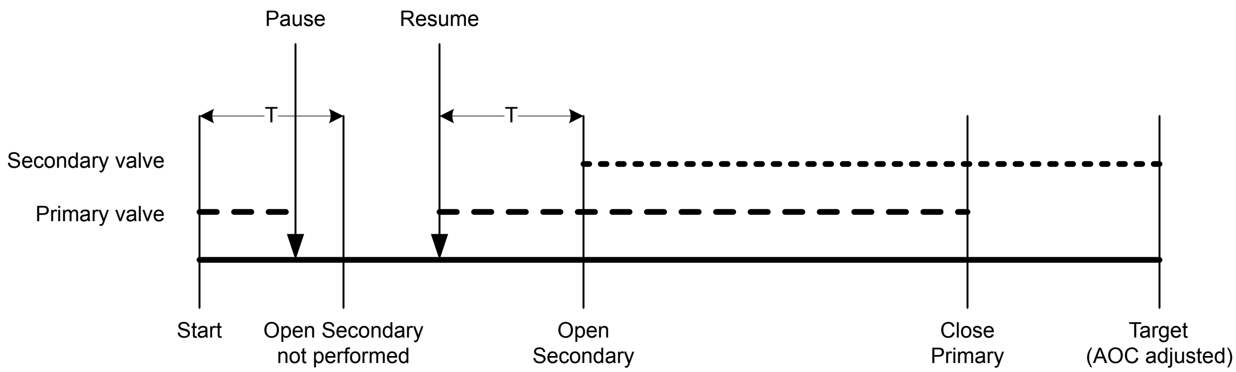


Figure 8-2: Case B

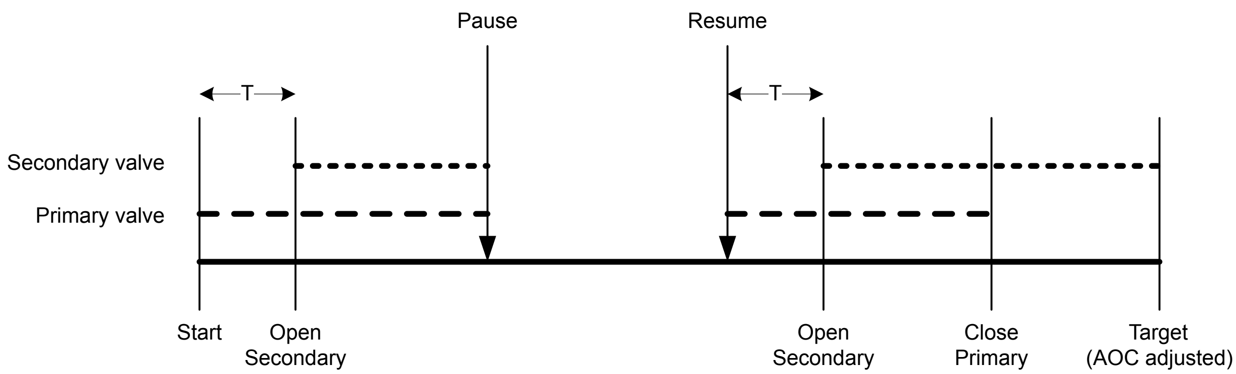


Figure 8-3: Case C

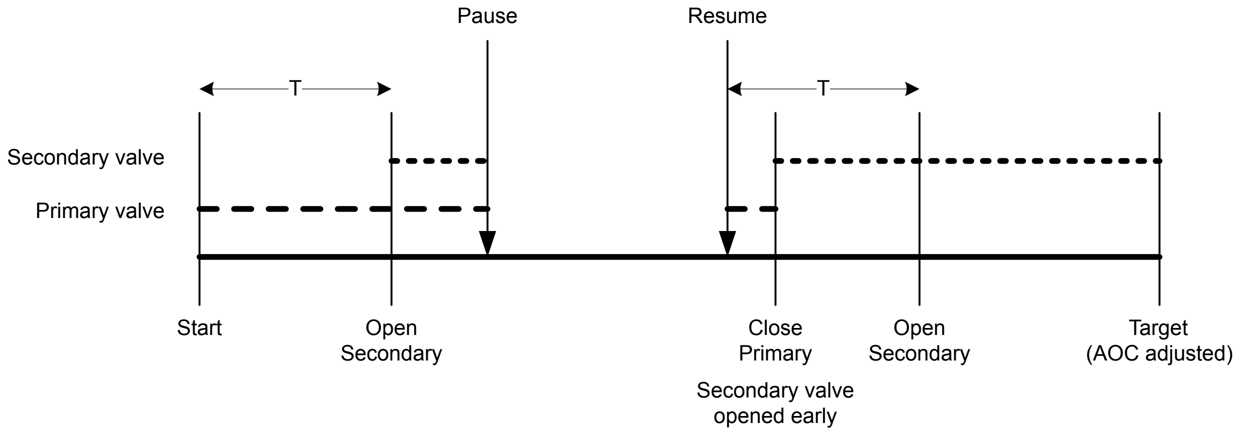
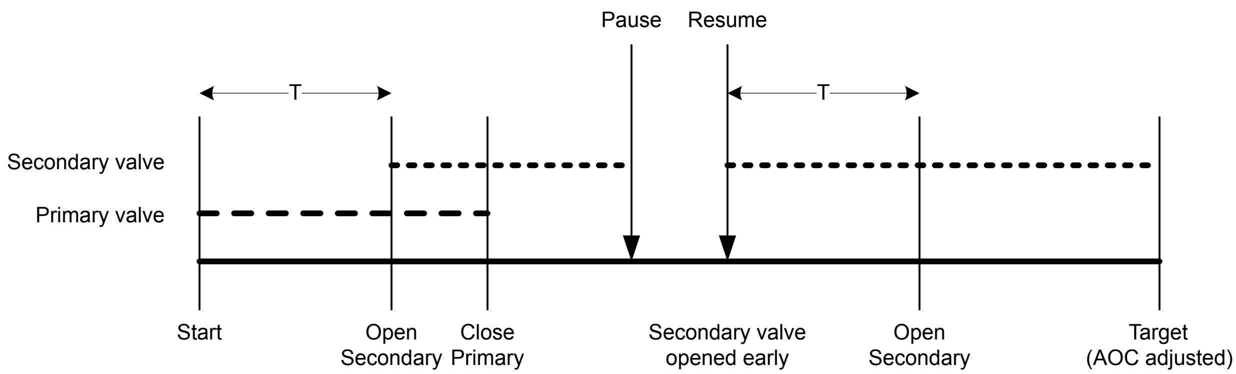


Figure 8-4: Case D



Open Primary first, Close Secondary first

In the following illustrations:

- The primary valve opens at the beginning of the fill.
- The secondary valve opens at the user-configured point during the fill. *T* represents the time or quantity configured for Open Secondary.
- The secondary valve closes before the end of the fill.
- The primary valve closes at the end of the fill.

Figure 8-5: Case E

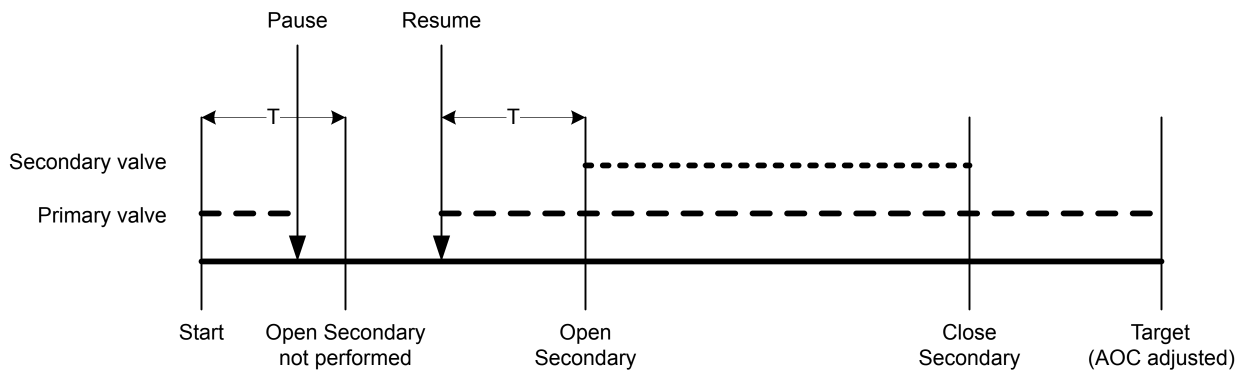


Figure 8-6: Case F

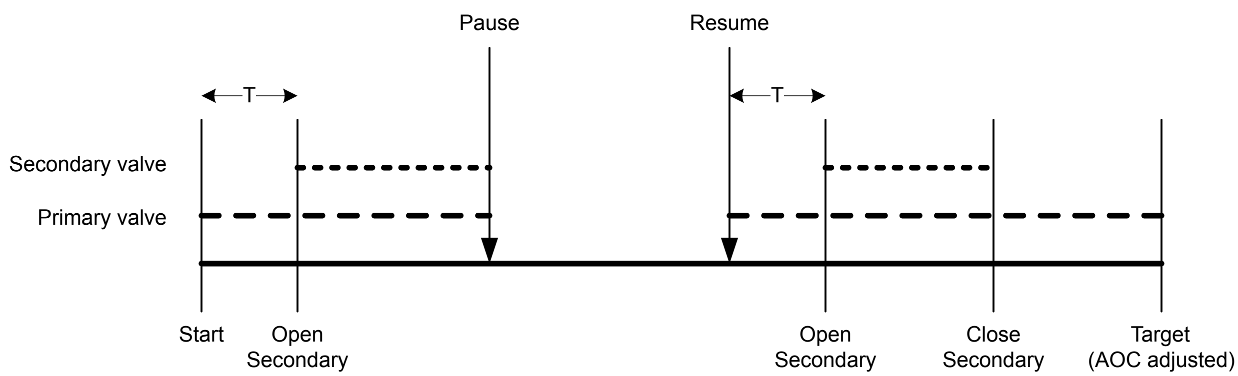


Figure 8-7: Case G

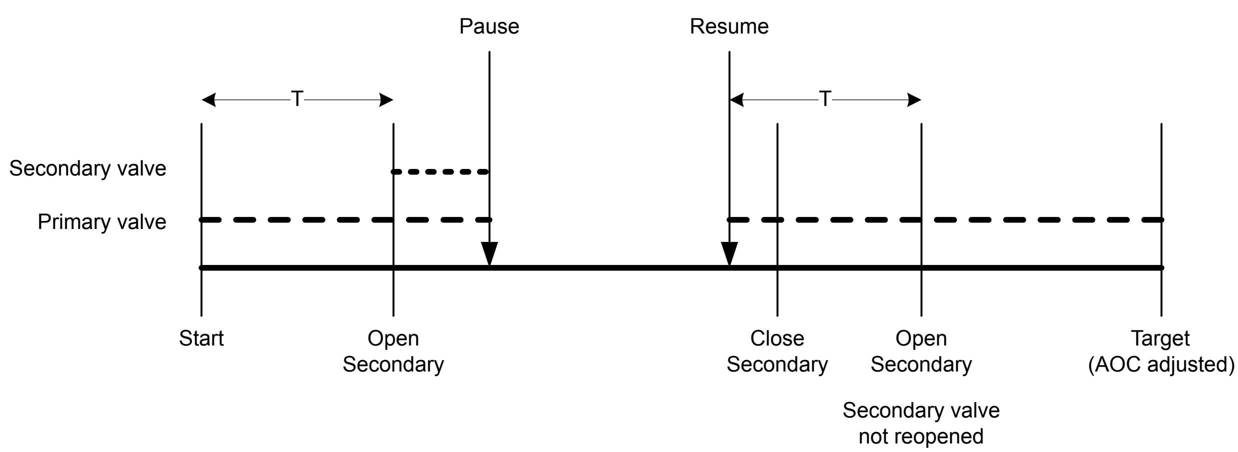
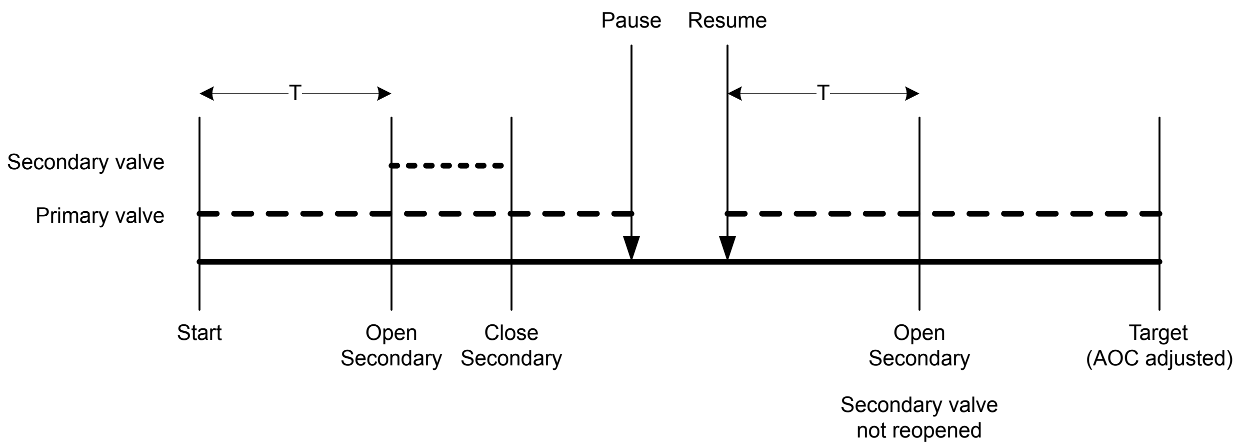


Figure 8-8: Case H



Open Secondary first, Close Primary first

In the following illustrations:

- The secondary primary opens at the beginning of the fill.
- The primary valve opens at the user-configured point during the fill. *T* represents the time or quantity configured for Open Primary.
- The primary valve closes before the end of the fill.
- The secondary valve closes at the end of the fill.

Figure 8-9: Case I

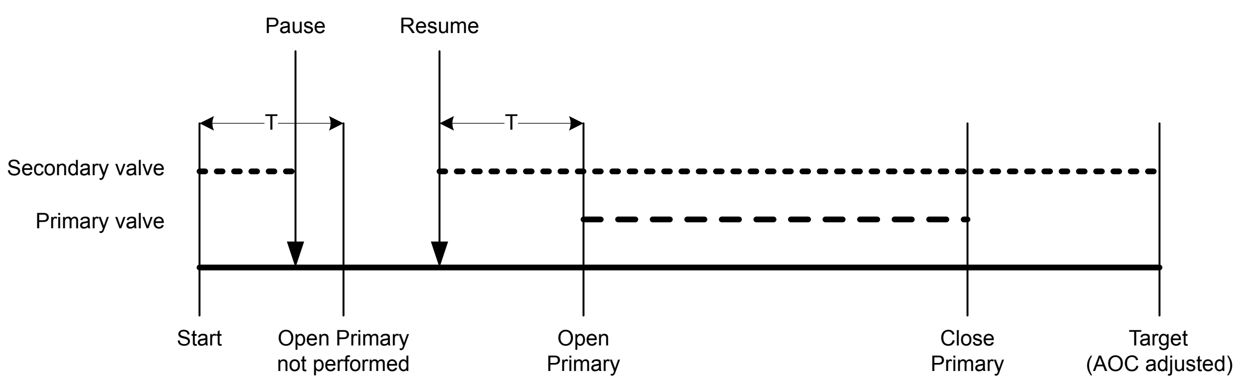


Figure 8-10: Case J

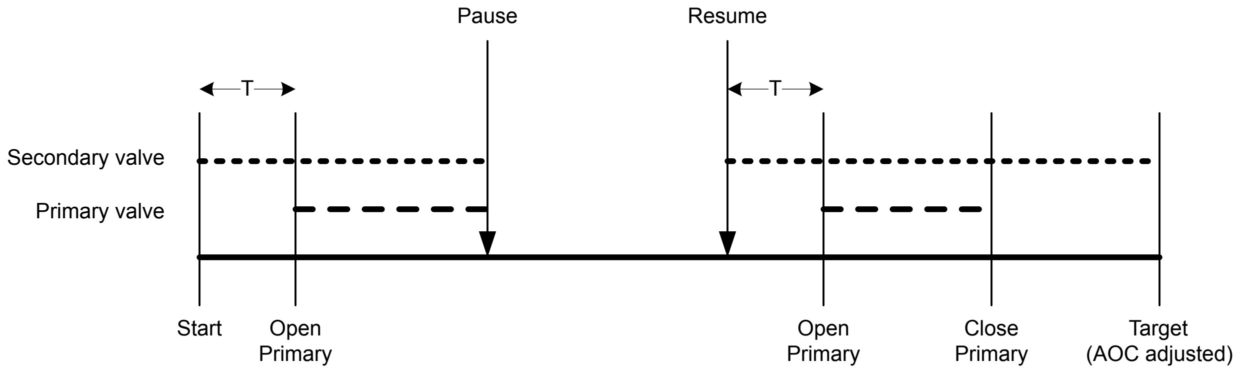


Figure 8-11: Case K

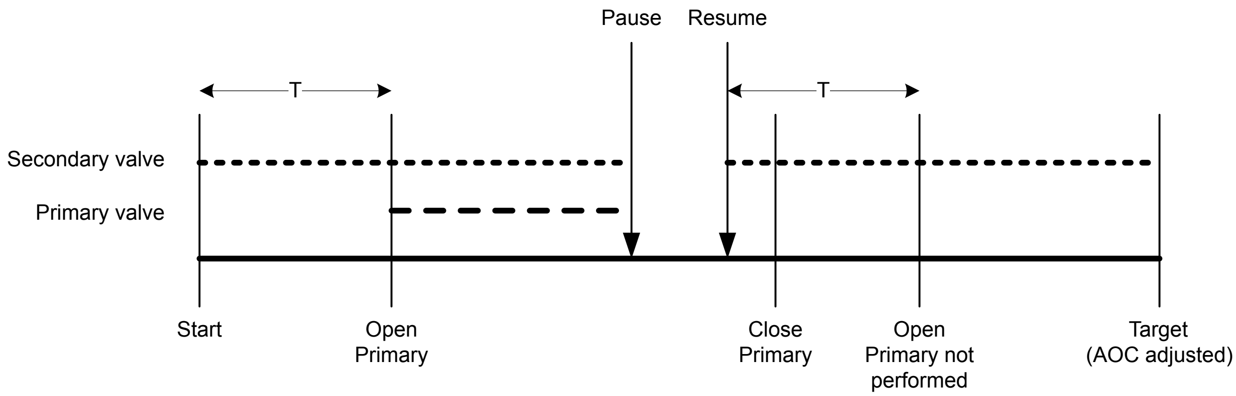
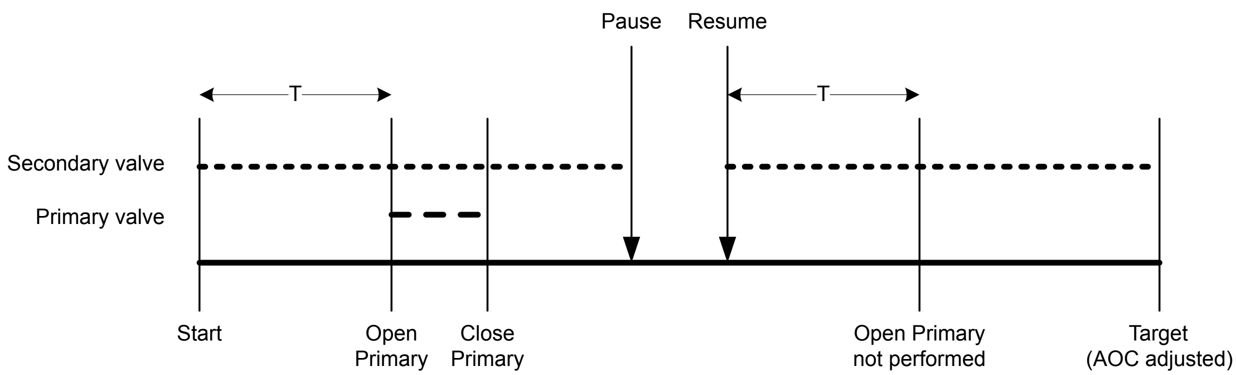


Figure 8-12: Case L



Open Secondary first, Close Secondary first

In the following illustrations:

- The secondary primary opens at the beginning of the fill.

- The primary valve opens at the user-configured point during the fill. *T* represents the time or quantity configured for Open Primary.
- The secondary valve closes before the end of the fill.
- The primary valve closes at the end of the fill.

Figure 8-13: Case M

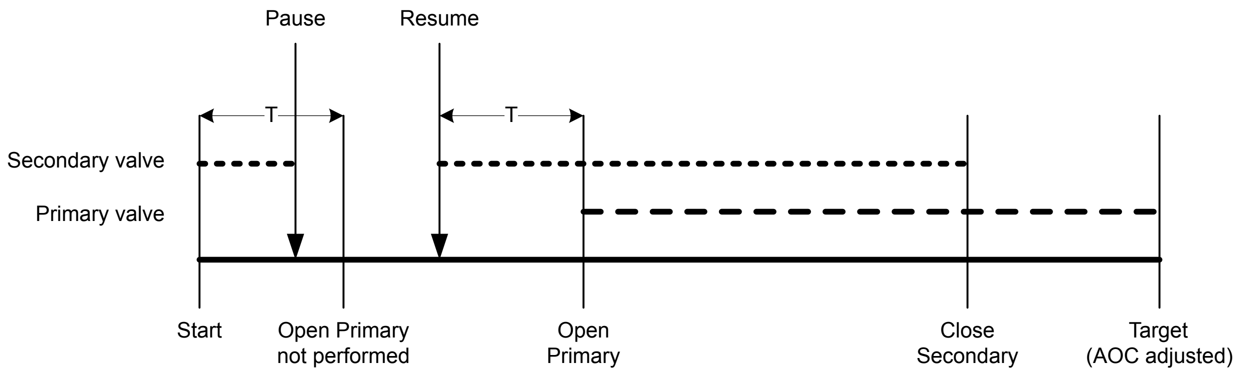


Figure 8-14: Case N

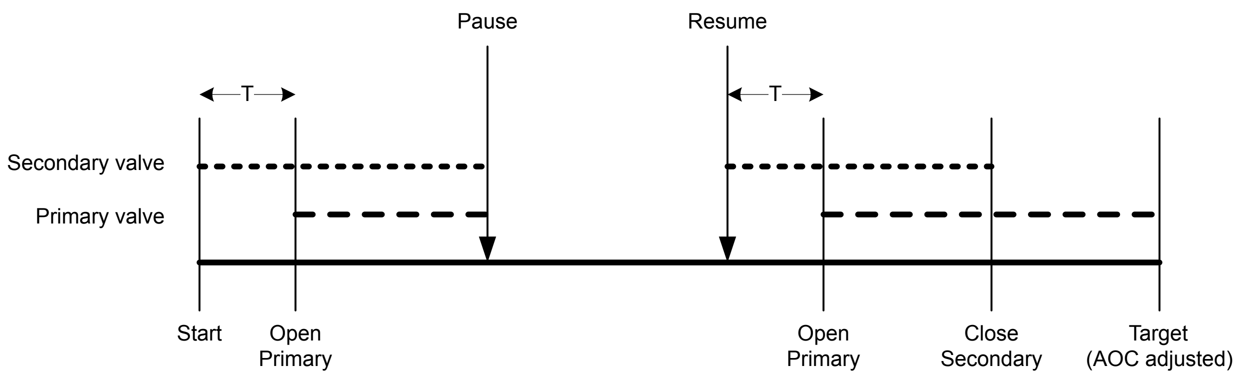


Figure 8-15: Case O

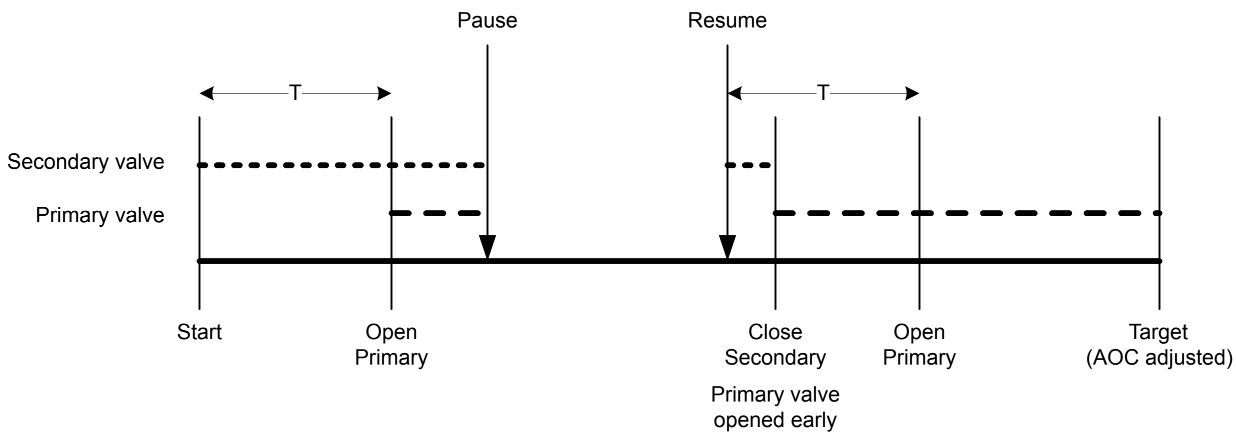
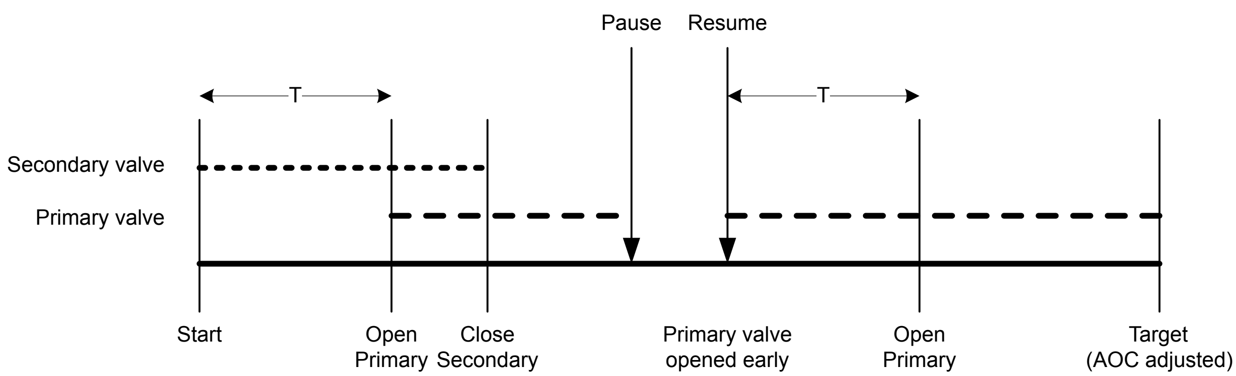


Figure 8-16: Case P



8.2 Perform a manual purge using Modbus

The Purge feature is used to control an auxiliary valve that can be used for any non-filling purpose. For example, it can be used for adding water or gas to the container after the fill ends, or "padding." Flow through the auxiliary valve is not measured by the transmitter.

Prerequisites

The Purge feature must be implemented on your system.

The previous fill must be ended.

The auxiliary valve must be connected to the fluid you want to use, e.g., air, water, nitrogen.

You must have the Modbus Interface Tool (MIT) installed on your PC.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

Procedure

1. Write 1 to Coil 416 (Begin Purge).

   In Register 2495, the Purge In Progress indicator (Bit 3) and the Purge Valve indicator (Bit 7) turn on.

2. Allow the purge fluid to flow for the appropriate amount of time.
3. Write 1 to Coil 417 (End Purge).

   In Register 2495, the Purge In Progress indicator (Bit 3) and the Purge Valve indicator (Bit 7) turn off.

8.3 Perform Clean In Place (CIP) using Modbus

The Clean In Place (CIP) function is used to force a cleaning fluid through the system. CIP allows you to clean the interior surfaces of pipes, valves, nozzles, etc., without having to disassemble the equipment.

Prerequisites

No fill can be running.

The cleaning fluid must be available for running through the system.

You must have the Modbus Interface Tool (MIT) installed on your PC.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

Procedure

1. Replace the process fluid with the cleaning fluid.
2. Write 1 to Coil 418 (Begin Cleaning).

   The transmitter opens the primary valve, and the secondary valve if it is used for filling. If the Pump feature is enabled, the pump is started before the valve is opened. In Register 2495, the Cleaning In Progress indicator (Bit 4) turns on.

3. Allow the cleaning fluid to flow through your system for the appropriate amount of time.
4. Write 1 to Coil 419 (End Cleaning).

   The transmitter closes all open valves, and stops the pump if applicable. In Register 2495, the Cleaning In Progress indicator (Bit 4) turns off.

5. Replace the cleaning fluid with the process fluid.

8.4 Monitor and analyze fill performance using Modbus

You can collect detailed flow data for a single fill, and you can compare data across multiple fills.

8.4.1 Collect detailed fill data for a single fill using Modbus

When fill logging is enabled, detailed data for the most recent fill is stored on the transmitter. You can retrieve it for analysis using digital communications. The detailed data can be used for tuning or troubleshooting your production environment.

Prerequisites

You must have the Modbus Interface Tool (MIT) installed on your PC.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

Procedure

1. Write 1 to Coil 340 (Enable Fill Logging).
2. Run a fill.
3. Write 0 to Coil 340 (Enable Fill Logging) when you are finished with data collection.
4. Read the fill log.
   a. Write a fill log index to Register 2498.

      Fill log index values range from 0 to 1000, representing the last 1000 log records.
   b. Read the log information for that index from Registers 2499–2500.

The fill log contains data records from a single fill, from the beginning of the fill until 50 milliseconds after flow stops, or until the maximum log size is reached. Data records are written every 10 milliseconds. Each data record contains the current value of Flow Source (the process variable used to measure the fill). The fill log is limited to 1000 records, or 10 seconds of filling. When the maximum size is reached, logging stops but the data is available on the transmitter until the next fill starts. The fill log is cleared each time a fill starts.

8.4.2 Analyze fill performance using fill statistics and Modbus

The transmitter automatically records a variety of data about each fill. This data is available to assist you in tuning your system.

Prerequisites

You must have the Modbus Interface Tool (MIT) installed on your PC.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

Procedure

1. (Optional) Write 1 to Coil 108 (Reset Fill Statistics) to start your analysis with a fresh set of fill data.
2. Run fills and observe the fill data.

Fill data	Location	Fill type	Description
Fill Total Average	Registers 2519–2520	One-stage discrete fills, two-stage discrete fills, and timed fills	Calculated average of all fill totals since fill statistics were reset.
		Dual-fillhead fills and dual-fillhead timed fills	Calculated average of all fill totals through Fillhead #1 since fill statistics were reset.
Fill Total Variance	Registers 2521–2522	One-stage discrete fills, two-stage discrete fills, and timed fills	Calculated variance of all fill totals since fill statistics were reset.
		Dual-fillhead fills and dual-fillhead timed fills	Calculated variance of all fill totals through Fillhead #1 since fill statistics were reset.
Secondary Fill Total Average	Register 2501	Dual-fillhead fills and dual-fillhead timed fills only	Calculated average of all fill totals through Fillhead #2 since fill statistics were reset.
Secondary Fill Total Variance	Register 2503	Dual-fillhead fills and dual-fillhead timed fills only	Calculated variance of all fill totals through Fillhead #2 since fill statistics were reset.

Part III
Configure and operate external-valve-control fills

Chapters covered in this part:

9 Configure and set up external-valve-control fills using ProLink II

Topics covered in this chapter:

- *Configure an external-valve-control fill using ProLink II*
- *Set up and run an external-valve-control fill*

9.1 Configure an external-valve-control fill using ProLink II

Configuring an external-valve-control fill includes configuring the frequency output and several flow parameters. When the fill is configured, the host will use flow data from the transmitter's frequency output to measure the fill and close the valves.

Prerequisites

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Choose ProLink > Configuration > Frequency.
2. Set Tertiary Variable to the process variable that the host will use to measure the fill: Mass Flow Rate or Volume Flow Rate.
3. Set the following as appropriate for your application: FO Scaling Method and related parameters, Frequency Output Polarity, and Fault Action.
4. Open the Flow panel.
5. If you set Tertiary Variable to Mass Flow Rate:
   a. Set Mass Flow Units to the mass flow units used by the host.
   b. Set Mass Flow Cutoff to the lowest flow rate that will be measured and reported to the host. All flow rates below this will be reported as 0.
6. If you set Tertiary Variable to Volume Flow Rate:
   a. Set Volume Flow Units to the volume flow units used by the host.
   b. Set Volume Flow Cutoff to the lowest flow rate that will be measured and reported to the host. All flow rates below this will be reported as 0.
7. Set Flow Damping as desired.

Tip

The default value of Flow Damping is 0.04 seconds. This is the optimum value for most filling applications, and is typically not changed.

---

8. Set Flow Direction to the option appropriate for your installation.

Option	Description
Forward	Process fluid flows in one direction only, matching the direction of the arrow on the sensor.
Bidirectional	Process fluid can flow in either direction. Most of the flow matches the direction of the arrow on the sensor.
Negate Forward	Process fluid flows in one direction only, in the opposite direction of the arrow on the sensor.
Negate Bidirectional	Process fluid can flow in either direction. Most of the flow is in the opposite direction of the arrow on the sensor.

Restriction

All other options for Flow Direction are invalid, and will be rejected by the transmitter.

Postrequisites

Ensure that your host is configured appropriately. For example, ensure that your host is using the appropriate measurement unit and that it can convert flow rate into flow total if required.

9.2 Set up and run an external-valve-control fill

The host must receive flow data from the transmitter, perform required calculations, and open and close valves to manage the fill.

1. Ensure that the host is receiving flow data over the transmitter's frequency output.
2. Ensure that the host is correctly interpreting and processing the data from the transmitter.
3. Perform any required wiring and configuration so that the host can open and close valves at the appropriate times.
4. Initiate the program that starts and manages filling.

10 Configure and set up external-valve-control fills using Modbus

Topics covered in this chapter:

10.1 Configure an external-valve-control fill using Modbus

Configuring an external-valve-control fill includes configuring the frequency output and several flow parameters. When the fill is configured, the host will use flow data from the transmitter's frequency output to measure the fill and close the valves.

Prerequisites

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

1. Set Tertiary Variable to the process variable that the host will use to measure the fill: Mass Flow Rate or Volume Flow Rate.
2. Set the following as appropriate for your application: FO Scaling Method and related parameters, Frequency Output Polarity, and Fault Action.
3. If you set Tertiary Variable to Mass Flow Rate:
   a. Set Mass Flow Units to the mass flow units used by the host.
   b. Set Mass Flow Cutoff to the lowest flow rate that will be measured and reported to the host. All flow rates below this will be reported as 0.
4. If you set Tertiary Variable to Volume Flow Rate:
   a. Set Volume Flow Units to the volume flow units used by the host.
   b. Set Volume Flow Cutoff to the lowest flow rate that will be measured and reported to the host. All flow rates below this will be reported as 0.
5. Set Flow Damping as desired.

Tip

The default value of Flow Damping is 0.04 seconds. This is the optimum value for most filling applications, and is typically not changed.

6. Set Flow Direction to the option appropriate for your installation.

Option	Description
Forward	Process fluid flows in one direction only, matching the direction of the arrow on the sensor.
Bidirectional	Process fluid can flow in either direction. Most of the flow matches the direction of the arrow on the sensor.
Negate Forward	Process fluid flows in one direction only, in the opposite direction of the arrow on the sensor.
Negate Bidirectional	Process fluid can flow in either direction. Most of the flow is in the opposite direction of the arrow on the sensor.

Restriction
All other options for Flow Direction are invalid, and will be rejected by the transmitter.

Example: Configuring an external-valve-control fill

Important
This example uses standard or typical settings for the required parameters. Your application may require different settings. Refer to the MIT for information on data types and integer codes.

Location	Value	Description
Register 14	0	Sets Tertiary Variable to Mass Flow Rate
Register 1108	0	Sets FO Scaling Method to Frequency=Flow
Registers 1223–1224	333.33	Sets Frequency Factor to 333.33
Registers 1225–1226	2000	Sets Rate Factor to 2000
Register 1197	1	Sets Frequency Output Polarity to Active High
Register 1107	1	Sets Fault Action to Downscale
Register 39	70	Sets Mass Flow Units to g/sec
Registers 195–196	3	Sets Mass Flow Cutoff to 3 g/sec
Register 42	28	Sets Volume Flow Units to m3/sec
Registers 197–198	0.03	Sets Volume Flow Cutoff to 0.03 m^3/sec
Register 17	0	Sets Flow Direction to Forward

Postrequisites

Ensure that your host is configured appropriately. For example, ensure that your host is using the appropriate measurement unit and that it can convert flow rate into flow total if required.

10.2 Set up and run an external-valve-control fill

The host must receive flow data from the transmitter, perform required calculations, and open and close valves to manage the fill.

1. Ensure that the host is receiving flow data over the transmitter's frequency output.
2. Ensure that the host is correctly interpreting and processing the data from the transmitter.
3. Perform any required wiring and configuration so that the host can open and close valves at the appropriate times.
4. Initiate the program that starts and manages filling.

Part IV
General transmitter configuration

Chapters covered in this part:

11 Configure process measurement

Topics covered in this chapter:

11.1 Characterize the flowmeter (if required)

ProLink II	ProLink > Configuration > Device > Sensor Type ProLink > Configuration > Flow > Flow Cal ProLink > Configuration > Density > D1 ProLink > Configuration > Density > D2 ProLink > Configuration > Density > Temp Coeff (DT) ProLink > Configuration > Density > K1 ProLink > Configuration > Density > K2 ProLink > Configuration > Density > FD
ProLink III	Device Tools > Calibration Data
Modbus	Sensor type: Register 1139 Flow calibration factor (FCF): Registers 407-408 Flow temperature coefficient (FT) : Registers 409-410 D1: Registers 155-156 D2: Registers 157-158 Density temperature coefficient (TC): Registers 163-164 K1: Registers 159-160 K2: Registers 161-162 FD: Registers 303-304

Overview

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

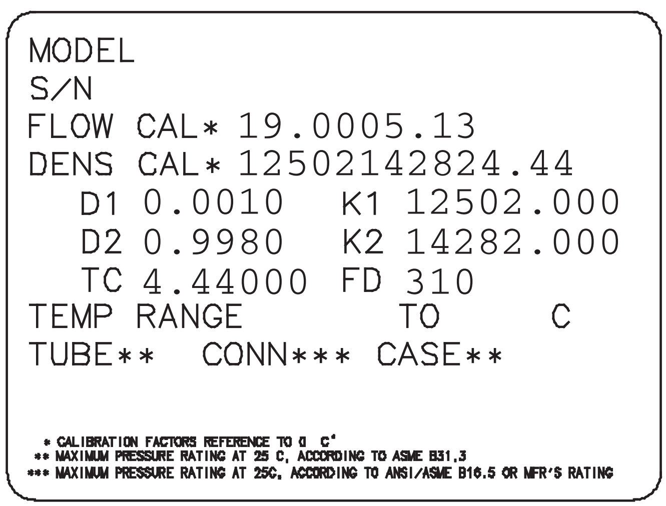
If your flowmeter was ordered as a unit, it has already been characterized at the factory. However, you should still verify the characterization parameters.

Procedure

1. Specify Sensor Type.
   - Curved-tube (all sensors except T-Series)
2. Set the flow characterization parameters. Be sure to include all decimal points.
   - For curved-tube sensors, set Flow Cal (Flow Calibration Factor).
3. Set the density characterization parameters.
   - For curved-tube sensors, set D1, D2, TC, K1, K2, and FD. (TC is sometimes shown as DT.)

11.1.1 Sample sensor tags

Figure 11-1: Tag on newer curved-tube sensors (all sensors except T-Series)



11.1.2 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. During characterization, these may be entered as two values or as a single 10-character string. 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.

If your sensor tag shows a concatenated Flowcal or FCF value and you need to enter the FCF and the FT values separately, split the concatenated value:

- FCF = The first 6 characters, including the decimal point
- FT = The last 4 characters, including the decimal point

Example: Concatenating FCF and FT

```
FCF = x.xxxx
FT = y.yy
Flow calibration parameter: x.xxxxy.yy
```

Example: Splitting the concatenated Flowcal or FCF value

```
Flow calibration parameter: x.xxxxy.yy
FCF = x.xxxx
FT = y.yy
```

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

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

If your sensor tag does not show a DT or TC value, enter the last 3 digits of the density calibration factor. In the sample tag, this value is shown as 4.44.

11.2 Configure mass flow measurement

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

The mass flow measurement parameters include:

- Mass Flow Measurement Unit
- Flow Damping
- Mass Flow Cutoff

11.2.1 Configure Mass Flow Measurement Unit

ProLink II	ProLink > Configuration > Flow > Mass Flow Units
ProLink III	Device Tools > Configuration > Process Measurement > Flow
Modbus	Register 39

Overview

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.

Table 11-1: Options for Mass Flow Measurement Unit

Unit description	Label	
	ProLink II	**ProLink III**
Grams per second	g/sec	g/sec
Grams per minute	g/min	g/min

Table 11-1: Options for Mass Flow Measurement Unit *(continued)*

Unit description	Label	
	ProLink II	ProLink III
Grams per hour	g/hr	g/hr
Kilograms per second	kg/sec	kg/sec
Kilograms per minute	kg/min	kg/min
Kilograms per hour	kg/hr	kg/hr
Kilograms per day	kg/day	kg/day
Metric tons per minute	mTon/min	mTon/min
Metric tons per hour	mTon/hr	mTon/hr
Metric tons per day	mTon/day	mTon/day
Pounds per second	lbs/sec	lbs/sec
Pounds per minute	lbs/min	lbs/min
Pounds per hour	lbs/hr	lbs/hr
Pounds per day	lbs/day	lbs/day
Short tons (2000 pounds) per minute	sTon/min	sTon/min
Short tons (2000 pounds) per hour	sTon/hr	sTon/hr
Short tons (2000 pounds) per day	sTon/day	sTon/day
Long tons (2240 pounds) per hour	lTon/hr	lTon/hr
Long tons (2240 pounds) per day	lTon/day	lTon/day
Special unit	special	special

11.2.2 Configure Flow Damping

ProLink II	ProLink > Configuration > Flow > Flow Damp
ProLink III	Device Tools > Configuration > Process Measurement > Flow
Modbus	Registers 189-190

Overview

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 reported process variable. At the end of the interval, the reported process variable 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 0.04 seconds. The range is 0 to 40.96 seconds.

Tips

- 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.
- Micro Motion recommends using the default value of 0.04 seconds.

The value you enter is automaticaly rounded down to the nearest valid value. The valid values for Flow Damping are: 0, 0.04, 0.08, 0.16, ... 40.96.

Effect of Flow Damping on volume measurement

Flow Damping affects volume measurement for liquid volume data. The transmitter calculates volume data from the damped mass flow data.

Interaction between Flow Damping and Added Damping

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

Flow Damping controls the rate of change in flow process variables. Added 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 Added 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.

11.2.3 Configure Mass Flow Cutoff for filling applications

ProLink II	ProLink > Configuration > Flow > Mass Flow Cutoff
ProLink III	Device Tools > Configuration > Process Measurement > Flow
Modbus	Registers 195-196

Overview

If you are performing an integrated-valve-control fill with Flow Source set to the Mass Flow Rate, you must set Mass Flow Cutoff to a value that masks the effects of vibration and other environmental factors. This is necessary because the transmitter will not complete fill processing until it detects a zero flow.

If Flow Source is set to the Volume Flow Rate, Mass Flow Cutoff does not affect filling.

Prerequisites

Ensure that the zero value in the transmitter is accurate.

Procedure

1. Set the Mass Flow Cutoff to 0.
2. Stop flow through the sensor.
3. Power up the filling machine and any other sources of vibration.
4. Observe the reported mass flow rate.
5. Set the Mass Flow Cutoff to a value slightly above the reported mass flow rate.
6. Verify that the mass flow rate is reported as 0.

Postrequisites

Important
Changes in Mass Flow Cutoff affect Automatic Overshoot Compensation (AOC). If you have implemented standard AOC, you must repeat the AOC calibration whenever you change the setting of Mass Flow Cutoff. This requirement does not apply to a rolling AOC or fixed AOC.

11.2.4 Configure Mass Flow Cutoff

ProLink II	ProLink > Configuration > Flow > Mass Flow Cutoff
ProLink III	Device Tools > Configuration > Process Measurement > Flow
Modbus	Registers 195-196

Overview

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.

Note
If you are configuring Mass Flow Cutoff for an integrated-valve-control filling application, and Flow Source is set to the Mass Flow Rate, see *Section 11.2.3*.

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 setting is 0.05% of the sensor's rated maximum flow rate or a value below the highest expected flow rate. Do not set Mass Flow Cutoff to 0.0 g/sec.

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.

Interaction between Mass Flow Cutoff and AO Cutoff

Mass Flow Cutoff defines the lowest mass flow value that the transmitter will report as measured. AO 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).

AO Cutoff affects only mass flow values reported via the mA output.

Example: Cutoff interaction with AO Cutoff lower than Mass Flow Cutoff

Configuration:

- mA Output Process Variable: Mass Flow Rate
- Frequency Output Process Variable: Mass Flow Rate
- AO 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.

Example: Cutoff interaction with AO Cutoff higher than Mass Flow Cutoff

Configuration:

- mA Output Process Variable: Mass Flow Rate
- Frequency Output Process Variable: Mass Flow Rate
- AO 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.

11.3 Configure volume flow measurement for liquid applications

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

11.3.1 Configure Volume Flow Measurement Unit for liquid applications

ProLink II	ProLink > Configuration > Flow > Vol Flow Units
ProLink III	Device Tools > Configuration > Process Measurement > Flow
Modbus	Register 42

Overview

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.

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.

Table 11-2: Options for Volume Flow Measurement Unit

Unit description	Label	
	ProLink II	ProLink III
Cubic feet per second	ft3/sec	ft3/sec

Table 11-2: Options for Volume Flow Measurement Unit *(continued)*

Unit description	Label	
	ProLink II	ProLink III
Cubic feet per minute	ft3/min	ft3/min
Cubic feet per hour	ft3/hr	ft3/hr
Cubic feet per day	ft3/day	ft3/day
Cubic meters per second	m3/sec	m3/sec
Cubic meters per minute	m3/min	m3/min
Cubic meters per hour	m3/hr	m3/hr
Cubic meters per day	m3/day	m3/day
U.S. gallons per second	US gal/sec	US gal/sec
U.S. gallons per minute	US gal/min	US gal/min
U.S. gallons per hour	US gal/hr	US gal/hr
U.S. gallons per day	US gal/day	US gal/day
Million U.S. gallons per day	mil US gal/day	mil US gal/day
Liters per second	l/sec	l/sec
Liters per minute	l/min	l/min
Liters per hour	l/hr	l/hr
Million liters per day	mil l/day	mil l/day
Imperial gallons per second	Imp gal/sec	Imp gal/sec
Imperial gallons per minute	Imp gal/min	Imp gal/min
Imperial gallons per hour	Imp gal/hr	Imp gal/hr
Imperial gallons per day	Imp gal/day	Imp gal/day
Barrels per second(1)	barrels/sec	barrels/sec
Barrels per minute(1)	barrels/min	barrels/min
Barrels per hour(1)	barrels/hr	barrels/hr
Barrels per day(1)	barrels/day	barrels/day
Beer barrels per second(2)	Beer barrels/sec	Beer barrels/sec
Beer barrels per minute(2)	Beer barrels/min	Beer barrels/min
Beer barrels per hour(2)	Beer barrels/hr	Beer barrels/hr
Beer barrels per day(2)	Beer barrels/day	Beer barrels/day
Special unit	special	special

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

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

11.3.2 Configure Volume Flow Cutoff for filling applications

ProLink II	ProLink > Configuration > Flow > Vol Flow Cutoff
ProLink III	Device Tools > Configuration > Process Measurement > Flow
Modbus	Registers 197-198

Overview

If you are performing an integrated-valve-control fill with Flow Source set to the Volume Flow Rate, you must set Volume Flow Cutoff to a value that masks the effects of vibration and other environmental factors. This is necessary because the transmitter will not complete fill processing until it detects zero flow.

If Flow Source is set to the Mass Flow Rate, Volume Flow Cutoff does not affect filling.

Prerequisites

Ensure that the zero value in the transmitter is accurate.

Procedure

1. Set the Volume Flow Cutoff to 0.
2. Stop flow through the sensor.
3. Power up the filling machine and any other sources of vibration.
4. Observe the reported volume flow rate.
5. Set the Volume Flow Cutoff to a value slightly above the reported volume flow rate.
6. Verify that volume flow rate is reported as 0.

Postrequisites

Important
Changes in Volume Flow Cutoff affect Automatic Overshoot Compensation (AOC). If you have implemented standard AOC, you must repeat AOC calibration whenever you change Volume Flow Cutoff setting. This requirement does not apply to rolling AOC or fixed AOC.

11.3.3 Configure Volume Flow Cutoff

ProLink II	ProLink > Configuration > Flow > Vol Flow Cutoff
ProLink III	Device Tools > Configuration > Process Measurement > Flow
Modbus	Registers 197-198

Overview

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.

Note

If you are configuring Volume Flow Cutoff for an integrated-valve-control filling application, and Flow Source is set to the Volume Flow Rate, see *Section 11.3.2*.

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. The upper limit is the sensor's flow calibration factor, in units of l/sec, multiplied by 0.2.

Interaction between Volume Flow Cutoff and AO Cutoff

Volume Flow Cutoff defines the lowest liquid volume flow value that the transmitter will report as measured. AO 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).

AO Cutoff affects only flow values reported via the mA output.

Example: Cutoff interaction with AO 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.

Example: Cutoff interaction with AO 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.

11.4 Configure Flow Direction

ProLink II	ProLink > Configuration > Flow > Flow Direction
ProLink III	Device Tools > Configuration > Process Measurement > Flow
Modbus	Register 17

Overview

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.

11.4.1 Options for Flow Direction

Table 11-3: Options for Flow Direction

Flow Direction **setting**		**Relationship to Flow Direction arrow on sensor**
ProLink II	**ProLink III**	
Forward	Forward	Appropriate when the Flow Direction arrow is in the same direction as the majority of flow.

Table 11-3: Options for Flow Direction *(continued)*

Flow Direction setting		Relationship to Flow Direction arrow on sensor
ProLink II	**ProLink III**	
Bidirectional	Bidirectional	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	Appropriate when the Flow Direction arrow is in the opposite direction from the majority of flow.
Negate Bidirectional	Negate Bidirectional	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.

Example: 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 reverse flow or 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.

Example: 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.

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 11-4: 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
Bidirectional	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 11-5: 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	OFF
Negate Forward	ON	OFF	OFF

Table 11-5: Effect of the Flow Direction parameter and actual flow direction on discrete outputs *(continued)*

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

Effect of Flow Direction on digital communications

Flow Direction affects how flow values are reported via digital communications.

Table 11-6: Effect of the Flow Direction parameter and actual flow direction on flow values reported via digital communications

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

Effect of Flow Direction on flow totals

Flow Direction affects how flow totals and inventories are calculated.

Table 11-7: Effect of the Flow Direction parameter and actual flow direction on flow totals and inventories

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

Effect of Flow Direction on the fill total

Flow Direction affects how the transmitter measures fills and determines when the fill is complete (the fill total has been achieved).

Table 11-8: Effect of the Flow Direction parameter and actual flow direction on the fill total

Flow Direction **setting**	**Actual flow direction**		
	Forward	**Zero flow**	**Reverse**
Forward	Fill total increases	Fill total does not change	Fill total does not change
Bidirectional	Fill total increases	Fill total does not change	Fill total decreases
Negate Forward	Fill total does not change	Fill total does not change	Fill total increases
Negate Bidirectional	Fill total decreases	Fill total does not change	Fill total increases

Forward flow Flow in same direction as flow direction arrow on sensor

Reverse flow Flow in opposite direction from flow direction arrow on sensor

Tip

If reverse flow could occur in your process and could cause consistency problems, Micro Motion recommends setting Flow Direction to Bidirectional or Negate Bidirectional.

Note

Flow Direction also affects fill reporting over the mA output, the frequency output, and digital communications, and affects flow rate reporting over the mA output, frequency output, and digital communications.

11.5 Configure density measurement

The density measurement parameters control how density is measured and reported. Density measurement (along with mass measurement) is used to determine liquid volume flow.

The density measurement parameters include:

- Density Measurement Unit
- Slug Flow Parameters
- Density Damping
- Density Cutoff

11.5.1 Configure Density Measurement Unit

ProLink II	ProLink > Configuration > Density > Density Units
ProLink III	Device Tools > Configuration > Process Measurement > Density
Modbus	Register 40

Overview

Density Measurement Unit specifies the units of measure that will be displayed for density measurement.

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.

Table 11-9: Options for Density Measurement Unit

Unit description	Label	
	ProLink II	ProLink III
Specific gravity unit (not temperature-corrected)	SGU	SGU
Grams per cubic centimeter	g/cm3	g/cm3
Grams per liter	g/l	g/l
Grams per milliliter	g/ml	g/ml
Kilograms per liter	kg/l	kg/l
Kilograms per cubic meter	kg/m3	kg/m3
Pounds per U.S. gallon	lbs/Usgal	lbs/Usgal
Pounds per cubic foot	lbs/ft3	lbs/ft3
Pounds per cubic inch	lbs/in3	lbs/in3
API gravity	degAPI	degAPI
Short ton per cubic yard	sT/yd3	sT/yd3

11.5.2 Configure slug flow parameters

ProLink II	ProLink > Configuration > Density > Slug High Limit ProLink > Configuration > Density > Slug Low Limit ProLink > Configuration > Density > Slug Duration
ProLink III	Device Tools > Configuration > Process Measurement > Density
Modbus	Slug Low Limit: Registers 201-202 Slug High Limit: Registers 199-200 Slug Duration: Registers 141-142

Overview

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

Procedure

1. Set Slug Low Limit to the lowest density value that is considered normal in your process.

   Values below this will cause the transmitter to perform the configured slug flow action. Typically, this value is the lowest density value in the normal range of your process.

   Tip
   Gas entrainment can cause your process density to drop temporarily. To reduce the occurrence of slug flow alarms that are not significant to your process, set Slug Low Limit slightly below your expected lowest process density.

   You must enter Slug Low Limit in g/cm^3, even if you configured another unit for density measurement.

   The default value for Slug Low Limit is 0.0 g/cm^3. The range is 0.0 to 10.0 g/cm^3.

2. Set Slug High Limit to the highest density value that is considered normal in your process.

   Values above this will cause the transmitter to perform the configured slug flow action. Typically, this value is the highest density value in the normal range of your process.

   Tip
   To reduce the occurrence of slug flow alarms that are not significant to your process, set Slug High Limit slightly above your expected highest process density.

   You must enter Slug High Limit in g/cm^3, even if you configured another unit for density measurement.

The default value for Slug High Limit is 5.0 g/cm^3. The range is 0.0 to 10.0 g/cm^3.

3. Set Slug Duration to the number of seconds that the transmitter will wait for a slug flow condition to clear before performing the configured slug flow action.

   The default value for Slug Duration is 0.0 seconds. The range is 0.0 to 60.0 seconds.

Tip
For filling applications, Micro Motion recommends leaving Slug Duration at the default value.

Slug flow detection and reporting

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

Tip
To decrease the occurrence of slug flow alarms, lower Slug Low Limit or raise Slug High Limit.

A slug flow condition occurs whenever the measured density goes below Slug Low Limit or above Slug High Limit. If this occurs:

- A slug flow alarm is posted to the active alarm log.
- All outputs that are configured to represent flow rate hold their last “pre-slug flow” value for the configured Slug Duration.

If the slug flow condition clears before Slug Duration expires:

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

If the slug flow condition does not clear before Slug Duration expires, the outputs that represent flow rate report a flow rate of 0.

If Slug Duration is set to 0.0 seconds, the outputs that represent flow rate will report a flow rate of 0 as soon as slug flow is detected.

11.5.3 Configure Density Damping

ProLink II	ProLink > Configuration > Density > Density Damping
ProLink III	Device Tools > Configuration > Process Measurement > Density
Modbus	Registers 193-194

Overview

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 reported process variable. At the end of the interval, the reported process variable 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 1.28 seconds. The range is 0 to 40.96 seconds.

Tips

- 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 automaticaly rounded down to the nearest valid value. The valid values for Density Damping are: 0, 0.04, 0.08, 0.16, ... 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.

Interaction between Density Damping and Added Damping

In some circumstances, both Density Damping and Added Damping are applied to the reported density value.

Density Damping controls the rate of change in the density process variable. 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.

11.5.4 Configure Density Cutoff

ProLink II	ProLink > Configuration > Density > Low Density Cutoff
ProLink III	Device Tools > Configuration > Process Measurement > Density
Modbus	Registers 149-150

Overview

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.

The default value for Density Cutoff is 0.2 g/cm^3. 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.

11.6 Configure temperature measurement

The temperature measurement parameters control how temperature data from the sensor is reported. Temperature data is used to compensate for the effect of temperature on the sensor tubes during flow measurement .

The temperature measurement parameters include:

- Temperature Measurement Unit
- Temperature Damping

11.6.1 Configure Temperature Measurement Unit

ProLink II	ProLink > Configuration > Temperature > Temp Units
ProLink III	Device Tools > Configuration > Process Measurement > Temperature
Modbus	Register 41

Overview

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.

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.

Table 11-10: Options for Temperature Measurement Unit

Unit description	Label	
	ProLink II	**ProLink III**
Degrees Celsius	degC	°C
Degrees Fahrenheit	degF	°F
Degrees Rankine	degR	°R
Kelvin	degK	°K

11.6.2 Configure Temperature Damping

ProLink II	ProLink > Configuration > Temperature > Temp Damping
ProLink III	Device Tools > Configuration > Temperature
Modbus	Registers 191-192

Overview

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 reported process variable. At the end of the interval, the reported process variable will reflect 63% of the change in the actual measured value.

Procedure

Enter the value you want to use for Temperature Damping.

The default value is 4.8 seconds. The range is 0.0 to 38.4 seconds.

Tips

- 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 automaticaly rounded down to the nearest valid value. Valid values for Temperature Damping are 0, 0.6, 1.2, 2.4, 4.8, ... 38.4.

Effect of Temperature Damping on process measurement

Temperature Damping affects the response speed for temperature compensation with fluctuating temperatures. Temperature compensation adjusts the process measurement to compensate for the effect of temperature on the sensor tube.

11.7 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

Do not implement pressure compensation for filling applications unless Micro Motion has specifically recommended it. Contact Micro Motion customer service if you have any questions about the effect of pressure on fill measurement.

11.7.1 Configure pressure compensation using ProLink II

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.

Procedure

1. Choose View > Preferences and ensure that Enable External Pressure Compensation is checked.
2. Choose ProLink > Configuration > Pressure.
3. 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.

4. 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.

5. Enter 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.

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 Units to the desired unit. b. Set External Pressure to the desired value.
Polling for pressure(3)	a. Ensure that the primary mA output has been wired to support HART polling. b. Choose ProLink > Configuration > Polled Variables. c. Choose an unused polling slot. d. Set Polling Control to Poll As Primary or Poll as Secondary, and click Apply. e. Set External Tag to the HART tag of the external pressure device. f. Set Variable Type to Pressure. **Tip** • Poll as Primary: No other HART masters will be on the network. • Poll as Secondary: Other HART masters will be on the network. The Field Communicator is not a HART master.
A value written by digital communications	a. Set Pressure Units 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 using an external pressure value, verify the setup by choosing ProLink > Process Variables and checking the value displayed in External Pressure.

11.7.2 Configure pressure compensation using ProLink III

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.

(3) *Not available on all transmitters.*

- For the calibration pressure, see the calibration sheet for your sensor. If the data is unavailable, use 20 PSI.

Procedure

1. Choose Device Tools > Configuration > Process Measurement > Pressure Compensation.
2. Set Pressure Compensation Status to Enabled.
3. 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.
4. 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.

5. 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.

6. Set Pressure Source to the method that the transmitter will use to obtain pressure data.

Option	Description
Poll for external value(4)	The transmitter will poll an external pressure device, using HART protocol over the primary mA output.
Static or Digital Communications	The transmitter will use the pressure value that it reads from memory. • Static: The configured value is used. • Digital Communications: A host writes transmitter data to transmitter memory.

7. If you chose to poll for pressure data:

   a. Select the Polling Slot to use.

   b. Set Polling Control to Poll as Primary or Poll as Secondary, and click Apply.

(4) *Not available on all transmitters.*

Tip

- Poll as Primary: No other HART masters will be on the network.
- Poll as Secondary: Other HART masters will be on the network. The Field Communicator is not a HART master.

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c. Set External Device Tag to the HART tag of the external pressure device, and click Apply.

8. If you chose to use a static pressure value:

   a. Set Pressure Unit to the desired unit.

   b. Set Static or Current Pressure to the value to use, and click Apply

9. If you want to use digital communications, click Apply, then perform the necessary host programming and communications setup to write pressure data to the transmitter at appropriate intervals.

Postrequisites

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.

11.7.3 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.

Table 11-11: Options for Pressure Measurement Unit

Unit description	Label	
	ProLink II	**ProLink III**
Feet water @ 68 °F	Ft Water @ 68°F	Ft Water @ 68°F
Inches water @ 4 °C	In Water @ 4°C	In Water @ 4°C
Inches water @ 60 °F	In Water @ 60°F	In Water @ 60°F
Inches water @ 68 °F	In Water @ 68°F	In Water @ 68°F
Millimeters water @ 4 °C	mm Water @ 4°C	mm Water @ 4°C
Millimeters water @ 68 °F	mm Water @ 68°F	mm Water @ 68°F
Millimeters mercury @ 0 °C	mm Mercury @ 0°C	mm Mercury @ 0°C
Inches mercury @ 0 °C	In Mercury @ 0°C	In Mercury @ 0°C
Pounds per square inch	PSI	PSI
Bar	bar	bar
Millibar	millibar	millibar
Grams per square centimeter	g/cm2	g/cm2

Table 11-11: Options for Pressure Measurement Unit *(continued)*

Unit description	Label	
	ProLink II	ProLink III
Kilograms per square centimeter	kg/cm2	kg/cm2
Pascals	pascals	pascals
Kilopascals	Kilopascals	Kilopascals
Megapascals	megapascals	Megapascals
Torr @ 0 °C	Torr @ 0°C	Torr @ 0°C
Atmospheres	atms	atms

12 Configure device options and preferences

Topics covered in this chapter:

12.1 Configure alarm handling

The alarm handling parameters control the transmitter's response to process and device conditions.

Alarm handling parameters include:

- Fault Timeout
- Status Alarm Severity

12.1.1 Configure Fault Timeout

ProLink II	ProLink > Configuration > Frequency > Last Measured Value Timeout
ProLink III	Device Tools > Configuration > Fault Processing
Modbus	Register 314

Overview

Fault Timeout controls the delay before fault actions are performed.

Restriction

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

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

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

Tip
ProLink II allows you to set Fault Timeout in two locations. However, there is only one parameter, and the same setting is applied to all outputs.

12.1.2 Configure Status Alarm Severity

ProLink II	ProLink > Configuration > Alarm > Alarm ProLink > Configuration > Alarm > Severity
ProLink III	Device Tools > Configuration > Alert Severity
Modbus	Alarm index: Register 1237 Alarm *x* severity: Register 1238

Overview

Use Status Alarm Severity to control the fault actions that the transmitter performs when it detects an alarm condition.

Restrictions
- For some alarms, Status Alarm Severity is not configurable.
- For some alarms, Status Alarm Severity can be set only to two of the three options.

Tip
Micro Motion recommends using the default settings for Status Alarm Severity unless you have a specific requirement to change them.

Procedure

1. Select a status alarm.
2. For the selected status alarm, set Status Alarm Severity as desired.

Option	Description
Fault	Actions when fault is detected: • The alarm is posted to the Alert List. • The fill is ended.(1) • 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 alarm severity). Actions when alarm 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. • Fill is not resumed.(1)
Informational	Actions when fault is detected: • The alarm is posted to the Alert List. • The status LED (if available) changes to red or yellow (depending on alarm severity). • For Alarm A105 only (Slug Flow), the fill is ended when Slug Duration expires.(1) Actions when alarm clears: • The status LED (if available) returns to green and may or may not flash. • For Alarm A105 only (Slug Flow), the fill is not resumed.(1)
Ignore	• For Alarm A105 only (Slug Flow), the fill is ended whenSlug Duration, and is not resumed when the alarm clears.(1) • For all other other alarms: No action.

Status alarms and options for Status Alarm Severity

Table 12-1: Status alarms and Status Alarm Severity

Alarm 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

(1) Integrated-valve-control fills only. For external-valve-control fills, processing is controlled by the host program.

Table 12-1: Status alarms and Status Alarm Severity *(continued)*

Alarm code	Status message	Default severity	Notes	Configurable?
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
A017	T-Series RTD Failure	Fault		Yes
A020	No Flow Cal Value	Fault		Yes
A021	Incorrect Sensor Type (K1)	Fault		No
A029	PIC/Daughterboard Communications Failure	Fault		No
A030	Incorrect Board Type	Fault		No
A031	Low Power	Fault		No
A033	Insufficient Right/Left Pickoff Signal	Fault		Yes
A102	Drive Overrange	Informational		Yes
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
A110	Frequency Output Saturated	Informational	Can be set to either Informational or Ignore, but cannot be set to Fault.	Yes
A111	Frequency Output Fixed	Informational	Can be set to either Informational or Ignore, but cannot be set to Fault.	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
A118	Discrete Output 1 Fixed	Informational	Can be set to either Informational or Ignore, but cannot be set to Fault.	Yes

12.2 Configure informational parameters

The informational parameters can be used to identify or describe your flowmeter but they are not used in transmitter processing and are not required.

The informational parameters include:

- Device parameters
  - Descriptor
  - Message
  - Date
- Sensor parameters
  - Sensor Serial Number
  - Sensor Material
  - Sensor Liner Material
  - Sensor Flange Type

12.2.1 Configure Descriptor

ProLink II	ProLink > Configuration > Device > Descriptor
ProLink III	Device Tools > Configuration > Informational Parameters > Transmitter
Modbus	Registers 96-103

Overview

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.

You can use up to 16 characters for the description.

12.2.2 Configure Message

ProLink II	ProLink > Configuration > Device > Message
ProLink III	Device Tools > Configuration > Informational Parameters > Transmitter
Modbus	Registers 104-119

Overview

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.

Your message can be up to 32 characters long.

12.2.3 Configure Date

ProLink II	ProLink > Configuration > Device > Date
ProLink III	Device Tools > Configuration > Informational Parameters > Transmitter
Modbus	Register 51

Overview

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 II and ProLink III provide a calendar tool to help you select the date.

12.2.4 Configure Sensor Serial Number

ProLink II	ProLink > Configuration > Sensor > Sensor s/n
ProLink III	Device Tools > Configuration > Informational Parameters > Sensor
Modbus	Registers 127-128

Overview

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.

12.2.5 Configure Sensor Material

ProLink II	ProLink > Configuration > Sensor > Sensor Matl
ProLink III	Device Tools > Configuration > Informational Parameters > Sensor
Modbus	Register 130

Overview

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.

12.2.6 Configure Sensor Liner Material

ProLink II	ProLink > Configuration > Sensor > Liner Matl
ProLink III	Device Tools > Configuration > Informational Parameters > Sensor
Modbus	Register 131

Overview

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.

12.2.7 Configure Sensor Flange Type

ProLink II	ProLink > Configuration > Sensor > Flange
ProLink III	Device Tools > Configuration > Informational Parameters > Sensor
Modbus	Register 129

Overview

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.

13 Integrate the meter with the network

Topics covered in this chapter:

13.1 Configure the transmitter channels

ProLink II	ProLink > Configuration > Channel > Channel B > Type Assignment
ProLink III	Device Tools > Configuration > I/O > Channels
Modbus	Register 1167

Overview

You can configure Channel B on your transmitter to operate as a discrete output or a discrete input. The channel configuration must match the wiring at the transmitter terminals.

Prerequisites

To avoid causing process errors:

- Configure the channels before configuring the outputs.
- Before changing the channel configuration, ensure that all control loops affected by the channel are under manual control.

⚠ CAUTION!

Before configuring a channel to operate as a discrete input, check the status of the remote input device and the actions assigned to the discrete input. If the discrete input is ON, all actions assigned to the discrete input will be performed when the new channel configuration is implemented. If this is not acceptable, change the state of the remote device or wait to configure the channel as a discrete input until an appropriate time.

Procedure

Set Channel B as desired.

Option	Description
Discrete output	Channel B will operate as a discrete output.
Discrete input	Channel B will operate as a discrete input.

Postrequisites

For each channel that you configured, perform or verify the corresponding input or output configuration. When the configuration of a channel is changed, the channel's behavior will be controlled by the configuration that is stored for the selected input or output type, and the stored configuration may not be appropriate for your process.

After verifying channel and output configuration, return the control loop to automatic control.

13.2 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 one mA output.

The mA output parameters include:

- mA Output Process Variable
- Lower Range Value (LRV) and Upper Range Value (URV)
- AO Cutoff
- Added Damping
- AO Fault Action and AO Fault Value

Important

Whenever you change an mA output parameter, verify all other mA 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.

13.2.1 Configure mA Output Process Variable

ProLink II	ProLink > Configuration > Analog Output > Secondary Variable
ProLink III	Device Tools > Configuration > I/O > Outputs > mA Output
Modbus	Register 13

Overview

Use mA Output Process Variable to select the variable that is reported over the mA output.

Procedure

Set mA Output Process Variable as desired.

The default setting is Mass Flow Rate.

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.

Table 13-1: Options for mA Output Process Variable

Process variable	Label	
	ProLink II	**ProLink III**
Mass flow rate	Mass Flow Rate	Mass Flow Rate
Volume flow rate	Volume Flow Rate	Volume Flow Rate
Temperature	Temperature	Temperature
Density	Density	Density
Percentage of fill delivered	Discrete Batch: Percent Fill	Discrete Batch: Percent Fill

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

ProLink II	ProLink > Configuration > Analog Output > Lower Range Value ProLink > Configuration > Analog Output > Upper Range Value
ProLink III	Device Tools > Configuration > I/O > Outputs > mA Output
Modbus	LRV: Registers 221-222 URV: Registers 219-220

Overview

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.

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 4 mA. The default value for LRV depends on the setting of mA Output Process Variable. If mA Output Process Variable is set to Discrete Batch: Percent Fill, enter LRV in %.
- 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. If mA Output Process Variable is set to Discrete Batch: Percent Fill, enter URV in %.

Tips

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 range of the bit precision of the D/A converter.

Note

You can set URV below LRV. For example, you can set URV to 50 and LRV to 100.

The mA output uses a range of 4–20 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 alarm.

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 13-2: 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
All density variables	0.000 g/cm^3	10.000 g/cm^3
All temperature variables	−240.000 °C	450.000 °C
Percent fill	0%	100%

13.2.3 Configure AO Cutoff

ProLink II	ProLink > Configuration > Analog Output > AO Cutoff
ProLink III	Device Tools > Configuration > I/O > Outputs > mA Output
Modbus	Registers 217-218

Overview

AO Cutoff (Analog Output Cutoff) specifies the lowest mass flow rate or volume flow rate that will be reported through the mA output. Any flow rates below AO Cutoff will be reported as 0.

Restriction

AO Cutoff is applied only if mA Output Process Variable is set to Mass Flow Rate or Volume Flow Rate. If mA Output Process Variable is set to a different process variable, AO Cutoff is not configurable, and the transmitter does not implement the AO cutoff function.

Procedure

Set AO Cutoff as desired.

The default value for AO Cutoff is 0.0 g/sec.

Tip

For most applications, the default value of AO Cutoff should be used. Contact Micro Motion customer service before changing AO Cutoff.

Interaction between AO Cutoff and process variable cutoffs

When mA Output Process Variable is set to a flow variable (for example, mass flow rate or volume flow rate), AO Cutoff interacts with Mass Flow Cutoff or Volume Flow Cutoff. The transmitter puts the cutoff into effect at the highest flow rate at which a cutoff is applicable.

Example: Cutoff interaction

Configuration:

- mA Output Process Variable = Mass Flow Rate
- AO Cutoff = 10 g/sec
- Mass Flow Cutoff = 15 g/sec

Result: If the mass flow rate drops below 15 g/sec, the mA output will report zero flow.

13.2.4 Configure Added Damping

ProLink II	ProLink > Configuration > Analog Output > AO Added Damp
ProLink III	Device Tools > Configuration > I/O > Outputs > mA Output
Modbus	Registers 215-216

Overview

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 reported process variable. At the end of the interval, the reported process variable will reflect 63% of the change in the actual measured value. Added Damping controls the amount of damping that will be applied to the mA output. It 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., the 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.

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

Table 13-3: 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 Added Damping and process variable damping

When mA Output Process Variable is set to a flow variable, density, or temperature, Added 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 added damping calculation is applied to the result of that calculation.

Example: Damping interaction

Configuration:

- Flow Damping = 1 second
- mA Output Process Variable = Mass Flow Rate
- Added 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.

13.2.5 Configure mA Output Fault Action and mA Output Fault Level

ProLink II	ProLink > Configuration > Analog Output > AO Fault Action ProLink > Configuration > Analog Output > AO Fault Level
ProLink III	Device Tools > Configuration > Fault Processing
Modbus	AO fault action: Register 1114 AO fault level: Registers 1111-1112

Overview

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 Last Measured Value 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.

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

Options for mA Output Fault Action and mA Output Fault Level

Table 13-4: 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 to 24 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

⚠ 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 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.

13.3 Configure the frequency output

The frequency output is used to report a process variable. The frequency output parameters control how the process variable is reported. If you purchased a transmitter for external-valve-control fills, your transmitter has one frequency output. If you purchased a transmitter for integrated-valve-control fills, your transmitter does not have a frequency output.

The frequency output parameters include:

- Frequency Output Polarity
- Frequency Output Scaling Method
- Frequency Output Maximum Pulse Width
- Frequency Output Fault Action and Frequency Output Fault Value

Note

Frequency Output Process Variable was configured during the external-valve-control fill configuration. If you change it, you are changing the process variable that the host uses to measure and control the fill.

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.

13.3.1 Configure Frequency Output Polarity

ProLink II	ProLink > Configuration > Frequency > Freq Output Polarity
ProLink III	Device Tools > Configuration > I/O > Outputs > Frequency Output
Modbus	Register 1197

Overview

Frequency Output Polarity controls how the output indicates the ON (active) state. The default value, Active High, is appropriate for most applications. Active Low may be required by applications that use low-frequency signals.

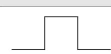
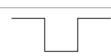
Procedure

Set Frequency Output Polarity as desired.

The default setting is Active High.

Options for Frequency Output Polarity

Table 13-5: Options for Frequency Output Polarity

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

13.3.2 Configure Frequency Output Scaling Method

ProLink II	ProLink > Configuration > Frequency > Scaling Method
ProLink III	Device Tools > Configuration > I/O > Outputs > Frequency Output
Modbus	Register 1108

Overview

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.

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. Above this rate, the transmitter will report A110: Frequency Output Saturated.

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.

Tip

If Frequency Output Scale Method is set to Frequency=Flow, and Frequency Output Maximum Pulse Width is set to a non-zero value, Micro Motion recommends setting Frequency Factor to a value below 200 Hz.

Example: 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:

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

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

$$\text{FrequencyFactor} = 333.33$$

Set parameters as follows:

- Rate Factor: 2000
- Frequency Factor: 333.33

13.3.3 Configure Frequency Output Maximum Pulse Width

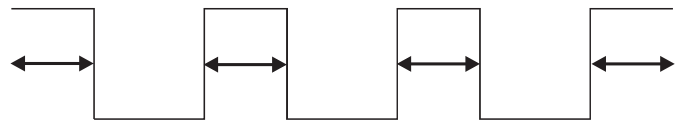
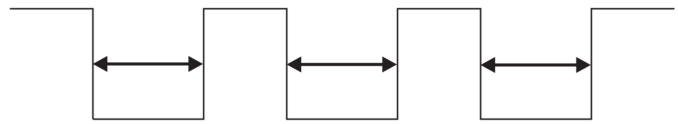
ProLink II	ProLink > Configuration > Frequency > Freq Pulse Width
ProLink III	Device Tools > Configuration > I/O > Outputs > Frequency Output
Modbus	Registers 227-228

Overview

Frequency Output Maximum Pulse Width is used to ensure that the duration of the ON signal is great enough for your frequency receiving device to detect.

The ON signal may be the high voltage or 0.0 V, depending on Frequency Output Polarity.

Table 13-6: Interaction of Frequency Output Maximum Pulse Width and Frequency Output Polarity

Polarity	Pulse width
Active High	
Active Low	

Procedure

Set Frequency Output Maximum Pulse Width as desired.

The default value is 277 milliseconds. You can set Frequency Output Maximum Pulse Width to 0 milliseconds or to a value between 0.5 milliseconds and 277.5 milliseconds. The transmitter automatically adjusts the value to the nearest valid value.

Tip
Micro Motion recommends leaving Frequency Output Maximum Pulse Width at the default value. Contact Micro Motion customer service before changing Frequency Output Maximum Pulse Width.

13.3.4 Configure Frequency Output Fault Action and Frequency Output Fault Level

ProLink II	ProLink > Configuration > Frequency > Freq Fault Action
ProLink III	Device Tools > Configuration > Fault Processing
Modbus	Register 1107

Overview

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 Last Measured Value 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 13-7: 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 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.

13.4 Configure the discrete output

The discrete output is used to report specific flowmeter or process conditions. The discrete output parameters control which condition is reported and how it is reported. Depending on your purchase option and the configuration of Channel B, your transmitter may have zero or one discrete output.

The discrete output parameters include:

- Discrete Output Source
- Discrete Output Polarity
- Discrete Output Fault Action

Note

The precision discrete outputs were configured during fill configuration.

Important
Whenever you change a discrete output parameter, verify all other discrete 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.

13.4.1 Configure Discrete Output Source

ProLink II	ProLink > Configuration > Discrete Output > DO1 Assignment
ProLink III	Device Tools > Configuration > I/O > Outputs > Discrete Output
Modbus	Register 1151

Overview

Discrete Output Source controls which flowmeter condition or process condition is reported via the discrete output.

Procedure

Set Discrete Output Source to the desired option.

Options for Discrete Output Source

Table 13-8: Options for Discrete Output Source

Option	Label in ProLink II	Condition	Discrete output voltage
Fill in progress	Batching/Filling in Progress	Fill in progress (includes paused fills)	0 V
		Fill ended	Site-specific
Purge valve	Discrete Batch: Purge Valve	Purge valve open	Site-specific
		Purge valve closed	0 V
Fault	Fault Condition Indication	One or more active faults	Site-specific
		No active faults	0 V

Important
This table assumes that Discrete Output Polarity is set to Active High. If Discrete Output Polarity is set to Active Low, reverse the voltage values.

13.4.2 Configure Discrete Output Polarity

ProLink II	ProLink > Configuration > Discrete Output > DO1 Polarity
ProLink III	Device Tools > Configuration > I/O > Outputs > Discrete Output
Modbus	Register 1152

Overview

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.

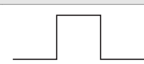
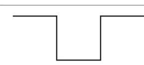
Procedure

Set Discrete Output Polarity as desired.

The default setting is Active High.

Options for Discrete Output Polarity

Table 13-9: Options for Discrete Output Polarity

Polarity		Description
Active High		• When asserted (condition tied to DO is true), the circuit provides a pull-up to 24 V. • When not asserted (condition tied to DO is false), the circuit provides 0 V.
Active Low		• When asserted (condition tied to DO is true), the circuit provides 0 V. • When not asserted (condition tied to DO is false), the circuit provides a pull-up to 24 V.

13.4.3 Configure Discrete Output Fault Action

ProLink II	ProLink > Configuration > Discrete Output > DO1 Fault Action
ProLink III	Device Tools > Configuration > Fault Processing
Modbus	Register 2615

Overview

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 Last Measured Value 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, see *Fault indication with the discrete output*.**

Procedure

Set Discrete Output Fault Action as desired.

The default setting is None.

Options for Discrete Output Fault Action

Table 13-10: Options for Discrete Output Fault Action

Label	Discrete output behavior	
	Polarity=Active High	**Polarity**=Active Low
Upscale	• Fault: discrete output is ON (site-specific voltage) • No fault: discrete output is controlled by its assignment	• Fault: discrete output is OFF (0 V) • 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	• Fault: discrete output is ON (site-specific voltage) • No fault: discrete output is controlled by its assignment
None (default)	Discrete output is controlled by its assignment	

Fault indication with the discrete output

To indicate faults via the discrete output, set parameters as follows:

- Discrete Output Source = Fault
- Discrete Output Fault Action = None

Note
If Discrete Output Source is set to Fault and a fault occurs, the discrete output is always ON. The setting of Discrete Output Fault Action is ignored.

13.5 Configure the discrete input

The discrete input is used to initiate one or more transmitter actions from a remote input device. Your transmitter may have zero or one discrete input, depending on your purchase option and the configuration of Channel B.

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.

13.5.1 Configure Discrete Input Action

ProLink II	ProLink > Configuration > Discrete Input > Assignment > Reset Mass Total ProLink > Configuration > Discrete Input > Assignment > Reset Volume Total ProLink > Configuration > Discrete Input > Assignment > Reset All Totals ProLink > Configuration > Discrete Input > Assignment > Begin Fill ProLink > Configuration > Discrete Input > Assignment > End Fill ProLink > Configuration > Discrete Input > Assignment > Pause Fill ProLink > Configuration > Discrete Input > Assignment > Resume Fill
ProLink III	Device Tools > Configuration > I/O > Action Assignment
Modbus	Reset mass total: Register 1316 Reset volume total: Register 1317 Reset all totals: Register 1322 Begin filling: Register 1329 End filling: Register 1324 Pause filling: Register 1330 Resume filling: Register 1328

Overview

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

⚠ **CAUTION!**

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

Table 13-11: Options for Discrete Input Action or Enhanced Event Action

Action	Label	
	ProLink II	ProLink III
None (default)	None	None
Reset mass total	Reset Mass Total	Reset Mass Total
Reset volume total	Reset Volume Total	Reset Volume Total
Reset all totals	Reset All Totals	Reset All Totals
Begin fill	Begin Fill	Begin Fill
End fill	End Fill	End Fill
Resume fill	Resume Fill	Resume Fill
Pause fill	Pause Fill	Pause Fill

⚠ **CAUTION!**

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.

13.5.2 Configure Discrete Input Polarity

ProLink II	ProLink > Configuration > Discrete Input > Polarity
ProLink III	Device Tools > Configuration > I/O > Inputs > Discrete Input
Modbus	Register 1178

Overview

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.

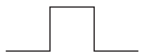
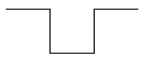
Procedure

Set Discrete Input Polarity as desired.

The default setting is Active Low.

Options for Discrete Input Polarity

Table 13-12: Options for Discrete Input Polarity

Polarity	Voltage	Status of discrete input at transmitter
Active High 	Voltage applied across terminals is 3–30 VDC	ON
	Voltage applied across terminals is <0.8 VDC	OFF
Active Low 	Voltage applied across terminals is <0.8 VDC	ON
	Voltage applied across terminals is 3–30 VDC	OFF

13.6 Configure an enhanced event

ProLink II	ProLink > Configuration > Discrete Events > Event Name ProLink > Configuration > Discrete Events > Event Type ProLink > Configuration > Discrete Events > Process Variable ProLink > Configuration > Discrete Events > Low Setpoint ProLink > Configuration > Discrete Events > High Setpoint
ProLink III	Device Tools > Configuration > Events > Enhanced Events
Modbus	Event *x* (*x* = 0, 1, 2, 3, 4): Register 609 Event type: Register 610 Event process variable: Register 615 Event setpoint A: Registers 611-612 Event setpoint B: Registers 613-614

Overview

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. For each enhanced event, you can assign one or more actions that the transmitter will perform if the enhanced event occurs.

Procedure

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

Options	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 ≤ *x* ≤ 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* ≤ A or *x* ≥ 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. (Optional) Specify the action or actions that the transmitter will perform when the event occurs.
   - With ProLink II: ProLink > Configuration > Discrete Input
   - With ProLink III: Device Tools > Configuration > I/O > Action Assignment
   - With Modbus: Registers 609, 1316, 1317, 1322, 1324, and 1328–1330.

13.6.1 Options for Enhanced Event Action

Table 13-13: Options for Discrete Input Action or Enhanced Event Action

Action	Label	
	ProLink II	ProLink III
None (default)	None	None
Reset mass total	Reset Mass Total	Reset Mass Total
Reset volume total	Reset Volume Total	Reset Volume Total
Reset all totals	Reset All Totals	Reset All Totals
Begin fill	Begin Fill	Begin Fill
End fill	End Fill	End Fill
Resume fill	Resume Fill	Resume Fill

Table 13-13: Options for Discrete Input Action or Enhanced Event Action *(continued)*

Action	Label	
	ProLink II	ProLink III
Pause fill	Pause Fill	Pause Fill

⚠ **CAUTION!**

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.

13.7 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:

- 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.

13.7.1 Configure Modbus/RS-485 communications

ProLink II	ProLink > Configuration > Digital Comm Settings > Modbus Address ProLink > Configuration > Device > Floating Pt Ordering ProLink > Configuration > Device > Add Comm Resp Delay
ProLink III	Device Tools > Configuration > Communications > RS-485 Terminals
Modbus	Modbus address: Register 313 Floating-point byte order: Register 521 Additional communications response delay: Register 522

Overview

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

Modbus/RS-485 communications parameters include:

- Modbus Address (Slave Address)
- Floating-Point Byte Order
- Additional Communications Response Delay

Restriction

To configure Floating-Point Byte Order or Additional Communications Response Delay, you must use ProLink II.

Procedure

1. Set Modbus Address to a unique value on the network.
2. 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 *Table 13-14* for the bit structure of bytes 1, 2, 3, and 4.

Table 13-14: Bit structure of floating-point bytes

Byte	Bits	Definition
1	SEEEEEEE	S=Sign E=Exponent
2	EMMMMMMM	E=Exponent M=Mantissa
3	MMMMMMMM	M=Mantissa
4	MMMMMMMM	M=Mantissa

3. (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.

13.7.2 Configure Digital Communications Fault Action

ProLink II	ProLink > Configuration > Digital Comm Settings > Digital Comm Fault Setting
ProLink III	Device Tools > Configuration > Fault Processing
Modbus	Register 124

Overview

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

Procedure

Set Digital Communications Fault Action as desired.

The default setting is None.

Options for Digital Communications Fault Action

Table 13-15: Options for Digital Communications Fault Action

Label		Description
ProLink II	**ProLink III**	
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 greater than the upper sensor limit. • Totalizers stop incrementing.
Zero	Zero	• 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 (NAN)	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	Flow to Zero	• Flow rates are reported as 0. • Other process variables are reported as measured. • Totalizers stop incrementing.

Table 13-15: Options for Digital Communications Fault Action *(continued)*

Label		
ProLink II	**ProLink III**	**Description**
None (default)	None	• 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 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.

Part V

Operations, maintenance, and troubleshooting

Chapters covered in this part:

14 Transmitter operation

Topics covered in this chapter:

- *Record the process variables*
- *View process variables*
- *View and acknowledge status alarms*
- *Read totalizer and inventory values*
- *Start and stop totalizers and inventories*
- *Reset totalizers*
- *Reset inventories*

14.1 Record the process variables

Micro Motion 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 variables are unusually high or low, and may help you better diagnose and troubleshoot application issues.

Procedure

Record the following process variables, under normal operating conditions:

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

14.2 View process variables

ProLink II	ProLink > Process Variables
ProLink III	View the desired variable on the main screen under Process Variables. See *Section 14.2.1* for more information.
Modbus	Mass flow rate: Registers 247-248 Volume flow rate: Registers 253-254 Density: Registers 249-250 Temperature: Registers 251-252 Tube frequency: Registers 285-286 Left pickoff voltage: Registers 287-288 Right pickoff voltage: Registers 289-290 Drive gain: Registers 291-292

Overview

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.

14.2.1 View process variables using ProLink III

When you connect to a device, the process variables are displayed on the main screen of ProLink III.

Procedure

View the desired process variable(s).

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 ProLink III user manual.

14.3 View and acknowledge status alarms

The transmitter posts status alarms whenever a process variable exceeds its defined limits or the transmitter detects a fault condition. You can view active alarms, and you can acknowledge alarms.

14.3.1 View and acknowledge alarms using ProLink II

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

1. Choose ProLink > Alarm Log.
2. Choose the High Priority or Low Priority panel.

Note
The grouping of alarms into these two categories is hard-coded and is not affected by Status Alarm Severity.

All active or unacknowledged alarms are listed:

- Red indicator: Alarm is currently active.
- Green indicator: Alarm is inactive but unacknowledged.

Note
Only Fault and Informational alarms are listed. The transmitter automatically filters out alarms with Status Alarm Severity set to Ignore.

3. To acknowledge an alarm, check the Ack checkbox.

Postrequisites

- To clear the following alarms, you must correct the problem, acknowledge the alarm, then power-cycle the transmitter: A001, A002, A010, A011, A012, A013, A018, A019, A022, A023, A024, A025, A028, A029, A031.
- For all other alarms:
  - If the alarm is inactive when it is acknowledged, it will be removed from the list.
  - If the alarm is active when it is acknowledged, it will be removed from the list when the alarm condition clears.

14.3.2 View and acknowledge alerts using ProLink III

You can view a list containing all alerts that are active, or inactive and have been unacknowleged. From this list, you can acknowlege individual alerts or choose to acknowledge all alerts at once.

1. View alerts on the ProLink III main screen under Alerts.

All active or unacknowledged alarms 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 alarms, you must correct the problem, acknowledge the alarm, then power-cycle the transmitter: A001, A002, A010, A011, A012, A013, A018, A019, A022, A023, A024, A025, A028, A029, A031.
- For all other alarms:
  - If the alarm is inactive when it is acknowledged, it will be removed from the list.
  - If the alarm is active when it is acknowledged, it will be removed from the list when the alarm condition clears.

14.3.3 Check alarm status and acknowledge alarms using Modbus

You can check the status of an individual alarm, and acknowledge the individual alarm. You can acknowledge all active alarms, and you can obtain more detailed diagnostic information.

Prerequisites

You must have the Modbus Interface Tool (MIT) installed on your PC.

Procedure

- To check the status of an individual alarm:
  1. Write the alarm index to Register 1237.
  2. Read the desired alarm status registers: 1239, 1241-1242, 1243-1244, 1247-1248, 1249-1250, 1240, 1245, 1246.
- To acknowledge an individual alarm:
  1. Write the alarm index to Register 1237.
  2. Write 0 to Bit #1 of Register 1239.
- To acknowledge all alarms, write 1 to Coil 241.
- To obtain more detailed alarm information, read the diagnostic coils and registers.

14.3.4 Alarm data in transmitter memory

The transmitter maintains three sets of data for every alarm that is posted.

For each alarm occurrence, the following three sets of data are maintained in transmitter memory:

- Alert List
- Alert Statistics
- Recent Alerts

Table 14-1: Alarm data in transmitter memory

Alarm data structure	Transmitter action if condition occurs	
	Contents	**Clearing**
Alert List	As determined by the alarm status bits, a list of: • All currently active alarms • All previously active alarms that have not been acknowledged	Cleared and regenerated with every transmitter power cycle
Alert Statistics	One record for each alarm (by alarm 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 alarm postings or alarm clearings	Not cleared; maintained across transmitter power cycles

14.4 Read totalizer and inventory values

ProLink II	ProLink > Totalizer Control
ProLink III	View the desired variable on the main screen under Process Variables.
Modbus	Mass totalizer: Register 8 Volume totalizer: Register 9 Mass inventory: Register 10 Volume inventory: Register 11

Overview

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.

14.5 Start and stop totalizers and inventories

ProLink II	ProLink > Totalizer Control > Start ProLink > Totalizer Control > Stop
ProLink III	Device Tools > Totalizer Control > Totalizer and Inventories > Start All Totals Device Tools > Totalizer Control > Totalizer and Inventories > Stop All Totals
Modbus	Coil 2

Overview

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.

14.6 Reset totalizers

ProLink II	ProLink > Totalizer Control > Reset Mass Total ProLink > Totalizer Control > Reset Volume Total ProLink > Totalizer Control > Reset All Totals
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 All Totals
Modbus	Reset mass totalizer: Coil 56 Reset volume totalizer: Coil 57 Reset all totalizers: Coil 3

Overview

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.

14.7 Reset inventories

ProLink II	ProLink > Totalizer Control > Reset Inventories ProLink > Totalizer Control > Reset Mass Inventory ProLink > Totalizer Control > Reset Volume Inventory
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
Modbus	Reset mass inventory: Coil 192 Reset volume inventory: Coil 193 Reset all inventories: Coil 4

Overview

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.

Prerequisites

To use ProLink II or ProLink III to reset the inventories, the feature must be enabled.

- To enable inventory reset in ProLink II:
  1. Click View > Preferences.
  2. Check the Enable Inventory Totals Reset checkbox.
  3. Click Apply.
- To enable inventory reset in ProLink III:
  1. Choose Tools > Options.
  2. Select Reset Inventories from ProLink III.

15 Measurement support

Topics covered in this chapter:

15.1 Zero the flowmeter

Zeroing the flowmeter establishes a baseline for process measurement by analyzing the sensor's output when there is no flow through the sensor tubes.

Important

In most cases, the factory zero is more accurate than the field zero. Do not zero the flowmeter unless one of the following is true:

- The zero is required by site procedures.
- The stored zero value fails the Zero Verification procedure.

15.1.1 Zero the flowmeter using ProLink II

Zeroing the flowmeter establishes a baseline for process measurement by analyzing the sensor's output when there is no flow through the sensor tubes.

Prerequisites

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Prepare the flowmeter:
   a. Allow the flowmeter to warm up for at least 20 minutes after applying power.
   b. Run the process fluid through the sensor until the sensor temperature reaches the normal process operating temperature.
   c. Stop flow through the sensor by shutting the downstream valve, and then the upstream valve if available.
   d. Verify that the sensor is blocked in, that flow has stopped, and that the sensor is completely full of process fluid.
   e. 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 flowmeter.
2. Choose ProLink > Calibration > Zero Verification and Calibration.

3. Click Calibrate Zero.
4. Modify Zero Time, if desired.

   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.
5. Click Perform Auto Zero.

   The Calibration in Progress light will turn red during the zero procedure. At the end of the procedure:
   - If the zero procedure was successful, the Calibration in Progress light returns to green and a new zero value is displayed.
   - If the zero procedure failed, the Calibration Failure light turns red.

Postrequisites

Restore normal flow through the sensor by opening the valves.

Need help? If the zero fails:
- Ensure 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 Micro Motion.
- If you want to return the flowmeter to operation using a previous zero value:
  - To restore the zero value set at the factory: ProLink > Zero Verification and Calibration > Calibrate Zero > Restore Factory Zero .
  - To restore the most recent valid value from transmitter memory: ProLink > Zero Verification and Calibration > Calibrate Zero > Restore Prior Zero . Restore Prior Zero is available only while the Flow Calibration window is open. If you close the Flow Calibration window, you will no longer be able to restore the prior zero.

Restriction
Restore the factory zero only if your flowmeter was purchased as a unit, it was zeroed at the factory, and you are using the original components.

15.1.2 Zero the flowmeter using ProLink III

Zeroing the flowmeter establishes a baseline for process measurement by analyzing the sensor's output when there is no flow through the sensor tubes.

Prerequisites

ProLink III must be running and must be connected to the transmitter.

Procedure

1. Prepare the flowmeter:

a. Allow the flowmeter to warm up for at least 20 minutes after applying power.
b. Run the process fluid through the sensor until the sensor temperature reaches the normal process operating temperature.
c. Stop flow through the sensor by shutting the downstream valve, and then the upstream valve if available.
d. Verify that the sensor is blocked in, that flow has stopped, and that the sensor is completely full of process fluid.
e. 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 flowmeter.

2. Choose Device Tools > Calibration > Zero Verification and Calibration.
3. Click Calibrate Zero.
4. Modify Zero Time, if desired.

   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.
5. Click Calibrate Zero.

   The Calibration in Progress message is displayed. When the calibration is complete:
   - If the zero procedure was successful, a Calibration Success message and a new zero value are displayed.
   - If the zero procedure failed, a Calibration Failed message is displayed.

Postrequisites

Restore normal flow through the sensor by opening the valves.

Need help? If the zero fails:

- Ensure 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 Micro Motion.
- If you want to return the flowmeter to operation using a previous zero value:
  - To restore the zero value set at the factory: Device Tools > Zero Verification and Calibration > Calibrate Zero > Restore Factory Zero .
  - To restore the most recent valid value from transmitter memory: Device Tools > Zero Verification and Calibration > Calibrate Zero > Restore Prior Zero . Restore Prior Zero is available only while the Flow Calibration window is open. If you close the Flow Calibration window, you will no longer be able to restore the prior zero.

Restriction

Restore the factory zero only if your flowmeter was purchased as a unit, it was zeroed at the factory, and you are using the original components.

15.1.3 Zero the flowmeter using Modbus

Zeroing the flowmeter establishes a baseline for process measurement by analyzing the sensor's output when there is no flow through the sensor tubes.

Prerequisites

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

Important
In many cases, the flowmeter was zeroed at the factory, and should not require a field zero.

Note
Do not verify the zero or zero the flowmeter if a high-severity alarm is active. Correct the problem, then verify the zero or zero the flowmeter. You may verify the zero or zero the flowmeter if a low-severity alarm is active.

Procedure

1. Prepare the flowmeter:
   a. Allow the flowmeter to warm up for at least 20 minutes after applying power.
   b. Run the process fluid through the sensor until the sensor temperature reaches the normal process operating temperature.
   c. Stop flow through the sensor by shutting the downstream valve, and then the upstream valve if available.
   d. Verify that the sensor is blocked in, that flow has stopped, and that the sensor is completely full of process fluid.
   e. 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 flowmeter.
2. Write the desired Zero Time to Register 136.

   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.
3. Write 1 to Coil 5.
4. Read Coil 68 to monitor the zero procedure.

Value	Description
0	Zero complete
1	Zero in progress

5. Read Coil 26 for the outcome of the zero procedure.

Value	Description
0	Zero succeeded
1	Zero failed

Postrequisites

Restore normal flow through the sensor by opening the valves.

Need help? If the zero fails:

- Ensure 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 Micro Motion.
- If you want to return the flowmeter to operation using a previous zero value:
  - To restore the zero value set at the factory: Write 1 to Coil 243.

15.2 Validate the meter

ProLink II	ProLink > Configuration > Flow
ProLink III	Device Tools > Configuration > Process Measurement > Flow Device Tools > Configuration > Process Measurement > Density
Modbus	Mass factor: Registers 279-280 Volume factor: Registers 281-282 Density factor: Registers 283-284

Overview

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.

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 *Section 15.2.1* 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. Use the flowmeter to take a sample measurement.
   b. Measure the same sample using the reference device.
   c. Calculate the meter factor using the following formula:

$$\text{NewMeterFactor} = \text{ConfiguredMeterFactor} \times \frac{\text{ReferenceMeasurement}}{\text{FlowmeterMeasurement}}$$

2. Ensure that the calculated meter factor is between 0.8 and 1.2, inclusive. If the meter factor is outside these limits, contact Micro Motion customer service.
3. Configure the meter factor in the transmitter.

Example: 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:

$$\text{MeterFactor}_{\text{MassFlow}} = 1 \times \frac{250}{250.27} = 0.9989$$

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:

$$MeterFactor_{MassFlow} = 0.9989 \times \frac{250.25}{250.07} = 0.9996$$

The new meter factor for mass flow is 0.9996.

15.2.1 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 *Section 15.2*).
2. Calculate the meter factor for volume flow from the meter factor for density:

$$MeterFactor_{Volume} = \frac{1}{MeterFactor_{Density}}$$

Note

The following equation is mathematically equivalent to the first equation. You may use whichever version you prefer.

$$MeterFactor_{Volume} = ConfiguredMeterFactor_{Density} \times \frac{Density_{Flowmeter}}{Density_{ReferenceDevice}}$$

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3. Ensure that the calculated meter factor is between 0.8 and 1.2, inclusive. If the meter factor is outside these limits, contact Micro Motion customer service.
4. Configure the meter factor for volume flow in the transmitter.

15.3 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 Micro Motion before calibrating the flowmeter.

Tip

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

15.3.1 Perform a D1 and D2 density calibration using ProLink II

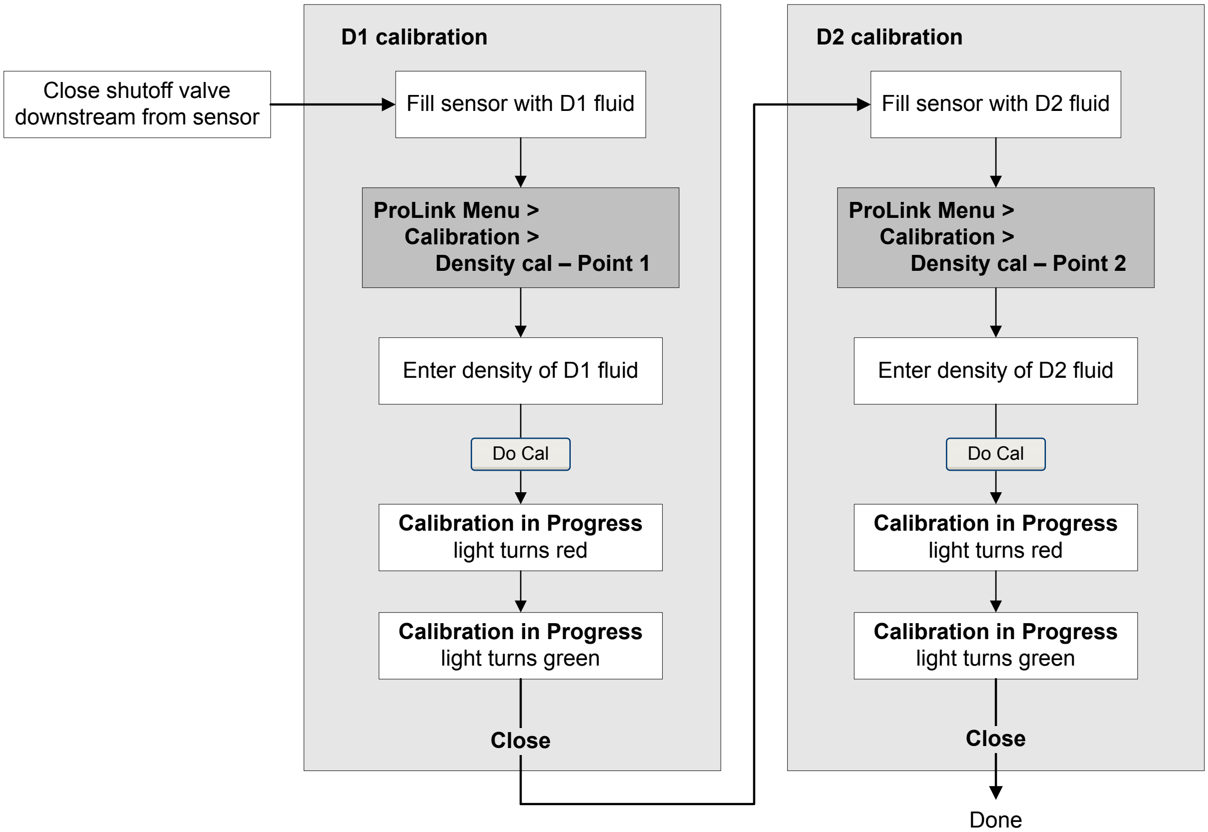
Prerequisites

- 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.

Procedure

See *Figure 15-1*.

Figure 15-1: D1 and D2 density calibration using ProLink II



15.3.2 Perform a D1 and D2 density calibration using ProLink III

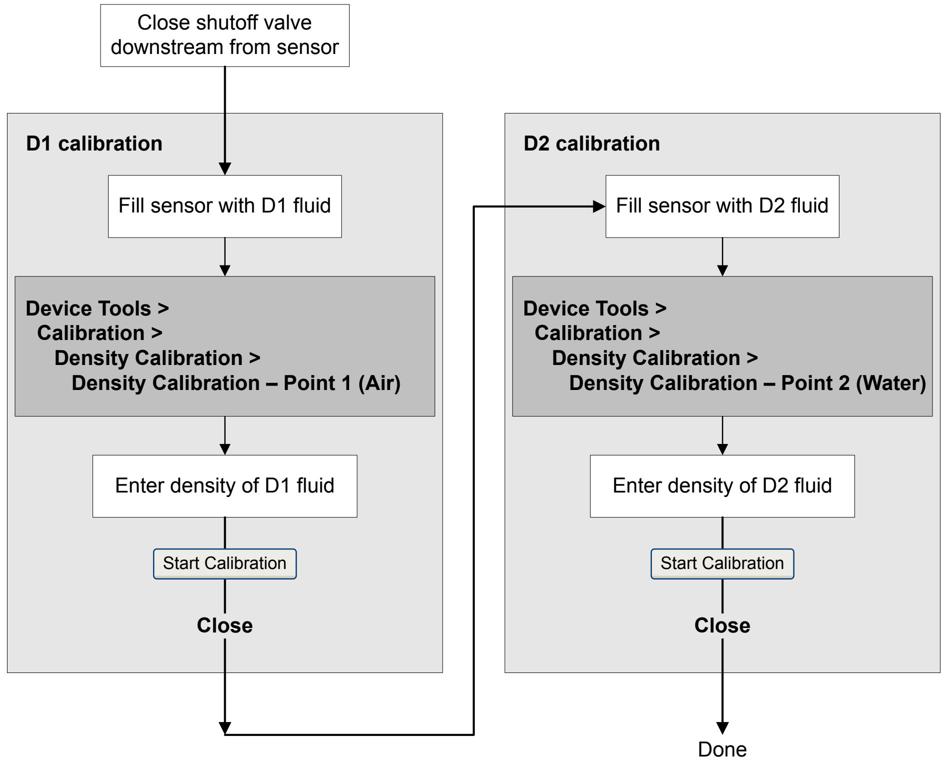
Prerequisites

- 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.

Procedure

See *Figure 15-2*.

Figure 15-2: D1 and D2 density calibration using ProLink III



15.3.3 Perform a D1 and D2 density calibration using Modbus

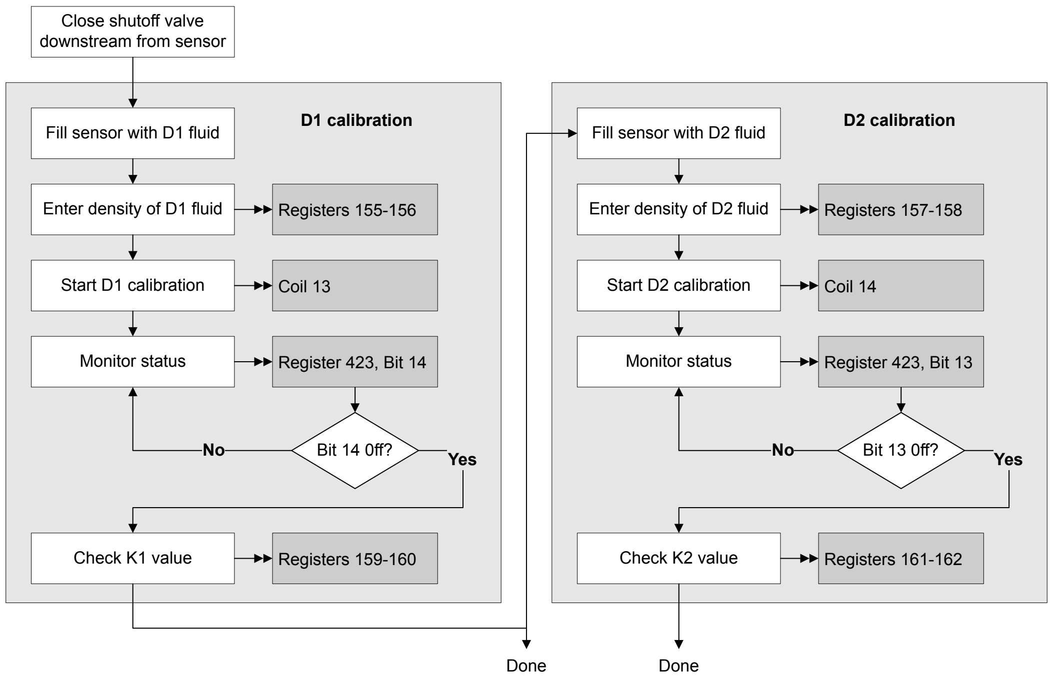
Prerequisites

- 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. If the calibration fails, restore the known values.

Procedure

See *Figure 15-3*.

Figure 15-3: Perform a D1 and D2 density calibration using Modbus



15.4 Perform temperature calibration

Temperature calibration establishes the relationship between the temperature of the calibration fluids and the signal produced by the sensor.

15.4.1 Perform temperature calibration using ProLink II

Temperature calibration establishes the relationship between the temperature of the calibration fluids and the signal produced by the sensor.

Prerequisites

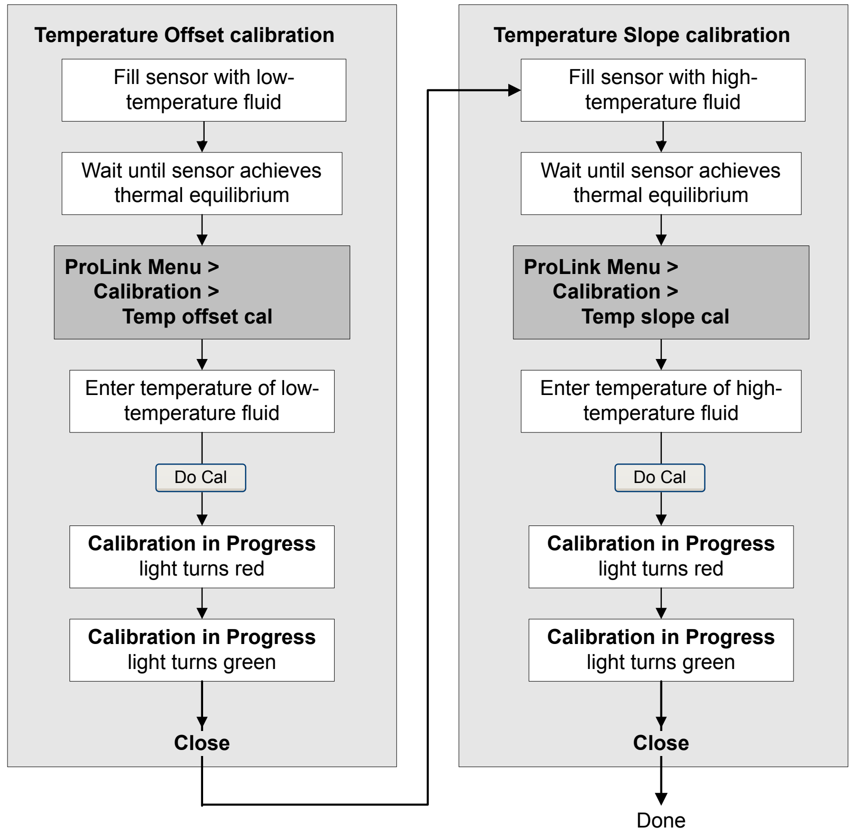
The temperature calibration is a two-part procedure: temperature offset calibration and temperature slope calibration. The two parts must be performed without interruption, in the order shown. Ensure that you are prepared to complete the process without interruption.

Important
Consult Micro Motion before performing a temperature calibration. Under normal circumstances, the temperature circuit is stable and should not need an adjustment.

Procedure

See *Figure 15-4*.

Figure 15-4: Temperature calibration using ProLink II



15.4.2 Perform temperature calibration using ProLink III

Temperature calibration establishes the relationship between the temperature of the calibration fluids and the signal produced by the sensor.

Prerequisites

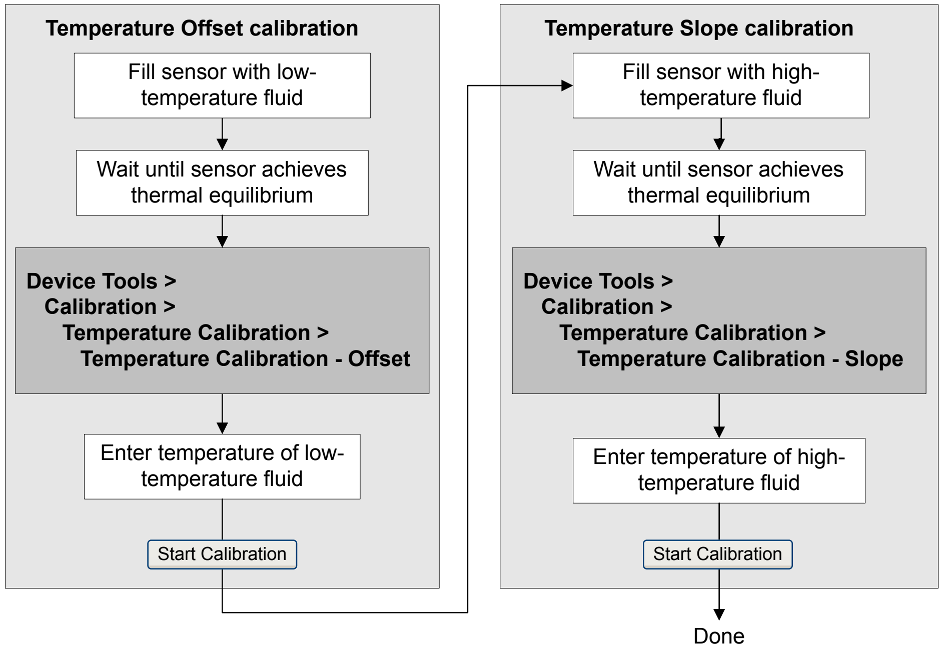
The temperature calibration is a two-part procedure: temperature offset calibration and temperature slope calibration. The two parts must be performed without interruption, in the order shown. Ensure that you are prepared to complete the process without interruption.

Important
Consult Micro Motion before performing a temperature calibration. Under normal circumstances, the temperature circuit is stable and should not need an adjustment.

Procedure

See *Figure 15-5*.

Figure 15-5: Temperature calibration using ProLink III



16 Troubleshooting

Topics covered in this chapter:

16.1 Status alarms

Table 16-1: Status alarms and recommended actions

Alarm code	Description	Cause	Recommended actions
A001	EEPROM Error (Core Processor)	An uncorrectable checksum mismatch has been detected.	• Cycle power to the meter. • Contact Micro Motion.
A002	RAM Error (Core Processor)	ROM checksum error or a RAM location cannot be written to.	• Cycle power to the meter. • Contact Micro Motion.

Table 16-1: Status alarms and recommended actions *(continued)*

Alarm code	Description	Cause	Recommended actions
A003	No Sensor Response	Continuity failure of drive circuit, LPO, or RPO, or LPO-RPO mismatch when driving.	• Check the drive gain and the pickoff voltage. See *Section 16.21* and *Section 16.22*. • Check for electrical shorts. See *Section 16.23*. • Check the integrity of the sensor tubes.
A004	Temperature Overrange	Combination of A016 and A017.	• Verify temperature characterization parameters (Temp Cal Factor). • Check your process conditions against the values reported by the flowmeter. • Contact Micro Motion.
A005	Mass Flow Rate Overrange	The measured flow has exceeded the maximum flow rate of the sensor (ΔT greater than 200 µs).	• If other alarms are present, resolve those alarm conditions first. If the current alarm persists, continue with the recommended actions. • Check your process conditions against the values reported by the flowmeter. • Check for slug flow. See *Section 16.20*. • Check the drive gain and the pickoff voltage. See *Section 16.21* and *Section 16.22*. • Check for electrical shorts. See *Section 16.23*. • Check the integrity of the sensor tubes. • Contact Micro Motion.
A006	Characterization Required	Calibration factors have not been entered and the sensor type is incorrect.	• Verify that all of the characterization parameters match the data on the sensor tag. • Contact Micro Motion.
A008	Density Overrange	The measured density has exceeded 10 g/cm^3.	• If other alarms are present, resolve those alarm conditions first. If the current alarm persists, continue with the recommended actions. • Verify process conditions, checking especially for air in the flow tubes, tubes not filled, foreign material in the tubes, or coating in the tubes. • Check for slug flow. See *Section 16.20*. • If accompanied by an A003 alarm, check for electrical shorts. See *Section 16.23*. • Verify that all of the characterization parameters match the data on the sensor tag. • Check the drive gain and the pickoff voltage. See *Section 16.21* and *Section 16.22*. • Perform a density calibration. • Contact Micro Motion.
A009	Transmitter Initializing/ Warming Up	Transmitter is in power-up mode.	• Allow the meter to warm up. • Verify that the tubes are full of process fluid.

Table 16-1: Status alarms and recommended actions *(continued)*

Alarm code	Description	Cause	Recommended actions
A010	Calibration Failure	Many possible causes, such as too much flow through the sensor during a calibration procedure.	• If this alarm appears during zeroing, verify that there is no flow through the sensor, then retry the procedure. • Cycle power to the meter, then retry the procedure.
A011	Zero Calibration Failed: Low	Many possible causes, such as too much flow – especially reverse flow – through the sensor during a calibration procedure.	• Verify that there is no flow through the sensor, then retry the procedure. • Cycle power to the meter, then retry the procedure.
A012	Zero Calibration Failed: High	Many possible causes, such as too much flow – especially forward flow – through the sensor during a calibration procedure.	• Verify that there is no flow through the sensor, then retry the procedure. • Cycle power to the meter, then retry the procedure.
A013	Zero Calibration Failed: Unstable	There was too much instability during the calibration procedure.	• Remove or reduce sources of electromechanical noise (e.g., pumps, vibration, pipe stress), then retry the procedure. • Cycle power to the meter, then retry the procedure.
A014	Transmitter Failure	Many possible causes.	• Cycle power to the meter. • Contact Micro Motion.
A016	Sensor RTD Failure	The value computed for the resistance of the Line RTD is outside limits.	• Check your process conditions against the values reported by the flowmeter. • Contact Micro Motion.
A017	T-Series RTD Failure	The value computed for the resistance of the Meter/Case RTD is outside limits.	• Check your process conditions against the values reported by the flowmeter. Temperature should be between –200 °F and +400 °F. • Verify that all of the characterization parameters match the data on the sensor tag. • Contact Micro Motion.
A020	No Flow Cal Value	The flow calibration factor and/or K1 has not been entered since the last master reset.	• Verify that all of the characterization parameters match the data on the sensor tag.
A021	Incorrect Sensor Type (K1)	The sensor is recognized as a straight tube but the K1 value indicates a curved tube, or vice versa.	• Verify that all of the characterization parameters match the data on the sensor tag.

Table 16-1: Status alarms and recommended actions *(continued)*

Alarm code	Description	Cause	Recommended actions
A029	PIC/Daughterboard Communications Failure	A communication failure has occurred with a hardware sub-assembly.	• Contact Micro Motion.
A030	Incorrect Board Type		• Contact Micro Motion.
A031	Low Power	The transmitter is not receiving enough power.	• Check the power supply and power supply wiring. See *Section 16.8*.
A033	Insufficient Right/Left Pickoff Signal	No signal from LPO or RPO, suggesting that sensor tubes are not vibrating.	• Verify process conditions, checking especially for air in the flow tubes, tubes not filled, foreign material in the tubes, or coating in the tubes.
A102	Drive Overrange	The drive power (current/voltage) is at its maximum.	• Check the drive gain and the pickoff voltage. See *Section 16.21* and *Section 16.22*. • Check for electrical shorts. See *Section 16.23*.
A104	Calibration in Progress	A calibration procedure is in process.	• Allow the procedure to complete. • For zero calibration, you may abort the calibration, set the zero time parameter to a lower value, and restart the calibration.
A105	Slug Flow	The density has exceeded the user-defined slug (density) limits.	• Check for slug flow. See *Section 16.20*.
A107	Power Reset Occurred	The transmitter has been restarted.	• No action required. • If desired, you can reconfigure the alarm severity level to Ignore.
A110	Frequency Output Saturated	The calculated frequency output is outside of the linear range.	• Check the frequency output scaling. See *Section 16.16*. • Check process conditions. Actual conditions may be outside of the normal conditions for which the output is configured. • Verify process conditions, checking especially for air in the flow tubes, tubes not filled, foreign material in the tubes, or coating in the tubes. • Verify that the measurement units are configured correctly for your application. • Purge the flow tubes.
A111	Frequency Output Fixed	The frequency output has been configured to send a constant value.	• Check whether the output is in loop test mode. If it is, unfix the output. • Check whether the output has been set to a constant value via digital communication.

Table 16-1: Status alarms and recommended actions *(continued)*

Alarm code	Description	Cause	Recommended actions
A113	mA Output 2 Saturated		• Check process conditions. Actual conditions may be outside of the normal conditions for which the output is configured. • Verify process conditions, checking especially for air in the flow tubes, tubes not filled, foreign material in the tubes, or coating in the tubes. • Verify that the measurement units are configured correctly for your application. • Purge the flow tubes. • Check the settings of Upper Range Value and Lower Range Value. See *Section 16.12*.
A114	mA Output 2 Fixed		• Check whether the output is in loop test mode. If it is, unfix the output. • Exit mA output trim, if applicable. • Check whether the output has been set to a constant value via digital communication.
A118	Discrete Output 1 Fixed	The discrete output has been configured to send a constant value.	• Check whether the output is in loop test mode. If it is, unfix the output.
A132	Sensor Simulation Active	Simulation mode is enabled.	• No action required. • Disable sensor simulation.

16.2 Flow measurement problems

Table 16-2: Flow measurement problems and recommended actions

Problem	Possible causes	Recommended actions
Flow indication at no flow conditions or zero offset	• Misaligned piping (especially in new installations) • Open or leaking valve • Incorrect sensor zero	• Verify that all of the characterization parameters match the data on the sensor tag. • If the flow 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 Micro Motion.

Table 16-2: Flow measurement problems and recommended actions *(continued)*

Problem	Possible causes	Recommended actions
Erratic non-zero flow rate under no-flow conditions	• Leaking valve or seal • Slug flow • Plugged or coated flow tube • Incorrect sensor orientation • Wiring problem • Vibration in pipeline at rate close to sensor tube frequency • Damping value too low • Mounting stress on sensor	• Verify that the sensor orientation is appropriate for your application (refer to the sensor installation manual). • Check the drive gain and the pickoff voltage. See *Section 16.21* and *Section 16.22*. • Purge the flow 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 slug flow. See *Section 16.20*. • Check for radio frequency interference. See *Section 16.14*. • Contact Micro Motion.
Erratic non-zero flow rate when flow is steady	• Slug flow • Damping value too low • Plugged or coated flow 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. See *Section 16.21* and *Section 16.22*. • Check for air entrainment, tube fouling, flashing, or tube damage. • Purge the flow 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 slug flow. See *Section 16.20*. • Check for radio frequency interference. See *Section 16.14*. • Contact Micro Motion.
Inaccurate flow rate or batch total	• Wiring problem • Inappropriate measurement unit • Incorrect flow calibration factor • Incorrect meter factor • Incorrect density calibration factors • Incorrect flowmeter grounding • Slug flow • Problem with receiving device	• Verify that the measurement units are configured correctly for your application. • Verify that all of the characterization parameters match the data on the sensor tag. • Perform a bucket test to verify batch totals. • Zero the meter. • Check grounding. See *Section 16.9*. • Check for slug flow. See *Section 16.20*. • Verify that the receiving device, and the wiring between the transmitter and the receiving device. • Check sensor coil resistance and for shorts to case. See *Check the sensor coils*. • Replace the core processor or transmitter.

16.3 Density measurement problems

Table 16-3: Density measurement problems and recommended actions

Problem	Possible causes	Recommended actions
Inaccurate density reading	• Problem with process fluid • Incorrect density calibration factors • Wiring problem • Incorrect flowmeter grounding • Slug flow • Plugged or coated flow tube • Incorrect sensor orientation • RTD failure • Physical characteristics of sensor have changed	• Check grounding. See *Section 16.9*. • Check your process conditions against the values reported by the flowmeter. • Verify that all of the characterization parameters match the data on the sensor tag. • Check for slug flow. See *Section 16.20*. • If two sensors with similar frequency are too near each other, separate them. • Purge the flow tubes.
Unusually high density reading	• Plugged or coated flow tube • Incorrect K2 value • Incorrect temperature measurement • RTD problem • In high frequency meters, this can be an indication of erosion or corrosion • In low frequency meters this can indicate tube fouling	• Verify that all of the characterization parameters match the data on the sensor tag. • Purge the flow tubes. • Check for coating in the flow tubes.
Unusually low density reading	• Slug flow • Incorrect K2 value • In low frequency meters this can indicate erosion or corrosion	• Check your process conditions against the values reported by the flowmeter. • Verify that all of the characterization parameters match the data on the sensor tag. • Check for tube erosion, especially if the process fluid is abrasive.

16.4 Temperature measurement problems

Table 16-4: Temperature measurement problems and recommended actions

Problem	Possible causes	Recommended actions
Temperature reading significantly different from process temperature	• RTD failure • Wiring problem	• Check junction box for moisture or verdigris. • Perform RTD resistance checks and check for shorts to case (see *Check the sensor coils*). • Confirm the temperature calibration factor matches the value on the sensor tag. • Refer to status alarms (especially RTD failure alarms). • Disable external temperature compensation. • Verify temperature calibration.
Temperature reading slightly different from process temperature	• Sensor temperature not yet equalized • Sensor leaking heat	• The RTD has a specification of ±1 °C. If the error is within this range there is no problem. If the temperature measurement is outside the specification for the sensor, contact Micro Motion. • The temperature of the fluid may be changing rapidly. Allow sufficient time for the sensor to equalize with the process fluid. • Insulate the sensor if necessary. • Perform RTD resistance checks and check for shorts to case (see *Check the sensor coils*). • The RTD may not be making good contact with the sensor. The sensor may need to be replaced.

16.5 Milliamp output problems

Table 16-5: Milliamp output problems and recommended actions

Problem	Possible causes	Recommended actions
No mA output	• Wiring problem • Circuit failure	• Check the power supply and power supply wiring. See *Section 16.8*. • Check the mA output wiring. • Check the Fault Action settings. See *Section 16.13*. • Measure DC voltage across output terminals to verify that the output is active. • Contact Micro Motion.
Loop test failed	• Power supply problem • Wiring problem • Circuit failure • Incorrect internal/external power configuration	• Check the power supply and power supply wiring. See *Section 16.8*. • Check the mA output wiring. • Check the Fault Action settings. See *Section 16.13*. • Contact Micro Motion.
mA output below 4 mA	• Open in wiring • Bad output circuit • 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 flowmeter. • Verify that the receiving device, and the wiring between the transmitter and the receiving device. • Check the settings of Upper Range Value and Lower Range Value. See *Section 16.12*. • Check the Fault Action settings. See *Section 16.13*.
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	• Verify the output variable assignments. • View and resolve any existing alarm conditions. • Check to see if a loop test is in process (the output is fixed). • If related to a zero calibration failure, cycle power to the meter and retry the zeroing procedure.
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. See *Section 16.13*. • Check the settings of Upper Range Value and Lower Range Value. See *Section 16.12*. • Check the mA output trim. See *Section 16.11*.

Table 16-5: Milliamp output problems and recommended actions *(continued)*

Problem	Possible causes	Recommended actions
Consistently incorrect mA measurement	• Loop problem • Output not trimmed correctly • Incorrect flow measurement unit configured • Incorrect process variable configured • LRV and URV are not set correctly	• Check the mA output trim. See *Section 16.11*. • 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. See *Section 16.12*.
mA output correct at lower current, but incorrect at higher current	• mA loop resistance may be set too high	• Verify that the mA output load resistance is below maximum supported load (see the installation manual for your transmitter).

16.6 Frequency output problems

Table 16-6: 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 • Slug flow • Flow in reverse direction from configured flow direction parameter • Bad frequency receiving device • Output level not compatible with receiving device • Bad output circuit • Incorrect internal/external power configuration • Incorrect pulse width configuration • Output not powered • 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. See *Section 16.13*. • Verify that the totalizers are not stopped. A stopped totalizer will cause the frequency output to be locked. • Check for slug flow. See *Section 16.20*. • Check flow direction. See *Section 16.18*. • Verify that 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). • Check the pulse width. See *Section 16.15*. • Perform a loop test. See *Section 16.10*.
Consistently incorrect frequency measurement	• Output not scaled correctly • Incorrect flow measurement unit configured	• Check the frequency output scaling. See *Section 16.16*. • Verify that the measurement units are configured correctly for your application.

Table 16-6: Frequency output problems and recommended actions *(continued)*

Problem	Possible causes	Recommended actions
Erratic frequency output	• Radio frequency interference (RFI) from environment	• Check for radio frequency interference. See *Section 16.14*.

16.7 Use sensor simulation for troubleshooting

When sensor simulation is enabled, the transmitter reports user-specified values for mass flow, temperature, and density. 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 flow value. If sensor simulation is enabled and the observed flow rate does not match the simulated value, the source of the problem is likely to be somewhere between the transmitter and the receiving 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.

For more information on using sensor simulation, see *#unique_253*.

16.8 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.

Procedure

1. 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.

2. Verify that the correct external fuse is used.

   An incorrect fuse can limit current to the transmitter and keep it from initializing.

3. Ensure that the power supply wires are connected to the correct terminals.
4. Verify that the power supply wires are making good contact, and are not clamped to the wire insulation.
5. 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.

6. Use a voltmeter to test the voltage at the transmitter's power supply terminals.

   The voltage should be within specified limits. For DC power, you may need to size the cable.

16.9 Check grounding

The sensor and the transmitter must be grounded.

Prerequisites

You will need:

- Installation manual for your sensor
- Installation manual for your transmitter

Procedure

Refer to the sensor and transmitter installation manuals for grounding requirements and instructions.

16.10 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.

16.10.1 Perform loop tests using ProLink II

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

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.

ProLink II must be running and must be connected to the transmitter.

Procedure

1. Test the mA output(s).
    a. Choose ProLink > Test > Fix Milliamp 2.
    b. Enter 4 mA in Set Output 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 mA in Set Output 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 ProLink > Test > Fix Freq Out.
    b. Enter the frequency output value in Set Output To.
    c. Click Fix Frequency.
    d. Read the frequency signal at the receiving device and compare it to the transmitter output.
    e. Click UnFix Freq.
3. Test the discrete output(s).
    a. Choose ProLink > Test > Fix Discrete Output.
    b. Select On.
    c. Verify the signal at the receiving device.
    d. Select Off.
    e. Verify the signal at the receiving device.
    f. Click UnFix.

Postrequisites

- If the mA output reading at the receiving device was slightly inaccurate, you can correct this discrepancy by trimming the output.
- If the mA output reading at the receiving device was significantly inaccurate, or if at any step the reading was faulty, verify the wiring between the transmitter and the remote device, and try again.
- If the discrete output reading is reversed, check the setting of Discrete Output Polarity.

16.10.2 Perform loop tests using ProLink III

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

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.

ProLink III must be running and must be connected to the transmitter.

Procedure

1. Test the mA output(s).
   a. Choose Device Tools > Diagnostics > Testing > mA Output 2 Test .
   b. Enter 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.

Postrequisites

- If the mA output reading at the receiving device was slightly inaccurate, you can correct this discrepancy by trimming the output.
- If the mA output reading at the receiving device was significantly inaccurate, or if at any step the reading was faulty, verify the wiring between the transmitter and the remote device, and try again.
- If the discrete output reading is reversed, check the setting of Discrete Output Polarity.

16.10.3 Perform loop tests using Modbus

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

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.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

Procedure

1. Test mA Output 2.
   a. Write 4 to Registers 145–146.
   b. Write 1 to Coil 11.
   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. Write 20 to Registers 145–146.
   e. Write 1 to Coil 11.
   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. Write 0 to Registers 145–146.
   h. Write 1 to Coil 11.
2. Test the frequency output(s).
   a. Write the test value to Registers 147–148.
   b. Write 1 to Coil 12.
   c. Read the frequency signal at the receiving device and compare it to the transmitter output.
   d. Write 0 to Registers 147–148.
   e. Write 1 to Coil 12.
   f. Verify that the mA output is unfixed by reading Register 423, Bit #2 (value should be 0).
3. Test Discrete Output 1.
   a. Write 1 to Register 1182.
   b. Write 1 to Coil 46.
   c. Verify the signal at the receiving device.

      The discrete output is ON. The actual voltage is determined by the setting of Discrete Output Polarity.

   d. Write 0 to Register 1182.
   e. Write 1 to Coil 46.
   f. Verify the signal at the receiving device.

The discrete output is OFF. The actual voltage is determined by the setting of Discrete Output Polarity.

g. Write 255 to Register 1182.
h. Write 1 to Coil 46.

4. Test Precision Discrete Output 1.
   a. Write 1 to Register 2487.
   b. Write 1 to Coil 405.
   c. Verify the signal at the receiving device.

      The discrete output is ON. The actual voltage is determined by the setting of Precision Discrete Output 1 Polarity.

   d. Write 0 to Register 2487.
   e. Write 1 to Coil 405.
   f. Verify the signal at the receiving device.

      The discrete output is OFF. The actual voltage is determined by the setting of Precision Discrete Output 1 Polarity.

   g. Write 255 to Register 2487.
   h. Write 1 to Coil 405.
5. Test Precision Discrete Output 2.
   a. Write 1 to Register 2488.
   b. Write 1 to Coil 406.
   c. Verify the signal at the receiving device.

      The discrete output is ON. The actual voltage is determined by the setting of Precision Discrete Output 2 Polarity.

   d. Write 0 to Register 2488.
   e. Write 1 to Coil 406.
   f. Verify the signal at the receiving device.

      The discrete output is OFF. The actual voltage is determined by the setting of Precision Discrete Output 2 Polarity.

   g. Write 255 to Register 2488.
   h. Write 1 to Coil 406.
6. Test Discrete Input 1.
   a. Set the remote input device to ON.
   b. Read Register 424, Bit #0.
   c. Set the remote input device to OFF.
   d. Read Register 424, Bit #0.

Postrequisites

- If the mA output reading at the receiving device was slightly inaccurate, you can correct this discrepancy by trimming the output.
- If the mA output reading at the receiving device was significantly inaccurate, or if at any step the reading was faulty, verify the wiring between the transmitter and the remote device, and try again.
- If the discrete output reading is reversed, check the setting of Discrete Output Polarity.

16.11 Trim mA outputs

Trimming an mA output calibrates the transmitter's mA output to the receiving device. If the current trim values are inaccurate, the transmitter will under-compensate or over-compensate the output.

16.11.1 Trim mA outputs using ProLink II

Trimming the mA output establishes a common measurement range between the transmitter and the device that receives the mA output.

Important

You must trim the output at both ends (4 mA and 20 mA) to ensure that it is compensated accurately across the entire output range.

Prerequisites

Ensure that the mA output is wired to the receiving device that will be used in production.

Procedure

1. Choose ProLink > Calibration > Milliamp 2 Trim .
2. Follow the instructions in the guided method.
3. Check the trim values, and contact Micro Motion customer service if any value is less than −200 microamps or greater than +200 microamps.

16.11.2 Trim mA outputs using ProLink III

Trimming the mA output establishes a common measurement range between the transmitter and the device that receives the mA output.

Important

You must trim the output at both ends (4 mA and 20 mA) to ensure that it is compensated accurately across the entire output range.

Prerequisites

Ensure that the mA output is wired to the receiving device that will be used in production.

Procedure

1. Choose Device Tools > Calibration > MA Output Trim > mA Output 2 Trim.
2. Follow the instructions in the guided method.
3. Check the trim values, and contact Micro Motion customer service if any value is less than −200 microamps or greater than +200 microamps.

16.11.3 Trim mA outputs using Modbus

Trimming the mA output establishes a common measurement range between the transmitter and the device that receives the mA output.

Important
You must trim the output at both ends (4 mA and 20 mA) to ensure that it is compensated accurately across the entire output range.

Prerequisites

Ensure that the mA output is wired to the receiving device that will be used in production.

You must have a Modbus utility or tool that allows you to read and write to the transmitter, and an active Modbus connection.

Procedure

1. Trim mA Output 2 at 4 mA.
   a. Write 4 to Registers 145–146.
   b. Write 1 to Coil 11.
   c. Read the output level at the remote device.
   d. Write the output level from the previous step to Registers 145–146.
   e. Write 1 to Coil 8.
   f. Read the output level at the remote device.
   g. If the transmitter's output is close enough to the output at the remote device, write 0 to Registers 145–146, then write 1 to Coil 11. Continue with the 20 mA trim.
   h. If the transmitter's output is not close enough to the output at the remote device, repeat substeps c through f.
2. Trim mA Output 2 at 20 mA.
   a. Write 1 to Coil 11.
   b. Read the output level at the remote device.
   c. Write the output level from the previous step to Registers 145–146.

d. Write 1 to Coil 9.
e. Read the output level at the remote device.
f. If the transmitter's output is close enough to the output at the remote device, write 0 to Registers 145–146, then write 1 to Coil 11. The trim is complete.
g. If the transmitter's output is not close enough to the output at the remote device, repeat substeps c through f.

3. Check the trim values.

mA output	Trim performed on	Modbus registers to read
mA output 2	LRV (4 mA)	1193–1194
	URV (20 mA)	1195–1196

4. If any trim value is less than −200 microamps or greater than +200 microamps, contact Micro Motion customer service.

16.12 Check Lower Range Value and Upper Range Value

If the process conditions fall below the configured Lower Range Value (LRV) or rise above the configured Upper Range Value (URV), the transmitter outputs may send unexpected values.

1. Make a note of your current process conditions.
2. Check the configuration of the LRV and URV.

16.13 Check mA Output Fault Action

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.

1. Check the status alarms for active fault conditons.
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 alarms, change the setting of Alarm Severity to Ignore.
3. If there are no active fault conditions, continue troubleshooting.

16.14 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

- Eliminate the RFI source.
- Move the transmitter.
- Use shielded cable for the frequency output or discrete output.
  - Terminate the shielding at the output 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.

16.15 Check Frequency Output Maximum Pulse Width

If Frequency Output Maximum Pulse Width is set incorrectly, the frequency output may report an incorrect value.

Verify the configuration of Frequency Output Maximum Pulse Width.

For most applications, the default value for Frequency Output Maximum Pulse Width is appropriate. This corresponds to a 50% duty cycle.

16.16 Check Frequency Output Scaling Method

If Frequency Output Scaling Method is set incorrectly, the frequency output may report an incorrect value.

1. Verify the configuration of Frequency Output Scaling Method.
2. If you changed the setting of Frequency Output Scaling Method, check the settings of all other frequency output parameters.

16.17 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.

1. Check the status alarms for active fault conditons.
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 alarms, change the setting of Alarm Severity to Ignore.
3. If there are no active fault conditions, continue troubleshooting.

16.18 Check Flow Direction

If Flow Direction is set inappropriately for your process, the transmitter may report unexpected flow values or totals.
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.

16.19 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 each mA output on your transmitter. The interaction between cutoffs sometimes produces unexpected results.

Procedure

Verify the configuration of the cutoffs.

Tip
For typical applications, Micro Motion recommends setting Mass Flow Cutoff to the zero stability value for your sensor, multiplied by 10. Zero stabiliy values can be found in the Product Data Sheet for your sensor.

16.20 Check for slug flow (two-phase flow)

Slug flow (two-phase flow, entrained gas) can cause spikes in the drive gain. This may cause the transmitter to report zero flow, or to post several different alarms.

1. Check for slug flow alarms.

If the transmitter is not generating slug flow alarms, slug 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 Slug Low Limit, Slug High Limit, and Slug Duration.

Tip

You can reduce the occurrence of slug flow alarms by setting Slug Low Limit to a lower value, Slug High Limit to a higher value, or Slug Duration to a higher value.

16.21 Check the drive gain

Excessive or erratic drive gain may indicate any of a variety of process conditions, sensor problems, or configuration 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 16-7: Possible causes and recommended actions for excessive (saturated) drive gain

Possible cause	Recommended actions
Slug flow	Check for slug flow. See *Section 16.20*.
Partially filled flow tube	Correct process conditions so that the flow tubes are full.
Plugged flow tube	Check the pickoff voltages (see *Section 16.22*). 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.
Cavitation, flashing, or air entrainment; settling of two- 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 reorientated. Consult the installation manual for your sensor for recommended orientations.
Drive board or module failure	Contact Micro Motion.
Bent flow tube	Check the pickoff voltages (see *Section 16.22*). If either of them are close to zero (but neither is zero), the flow tubes may be bent. The sensor will need to be replaced.
Cracked flow tube	Replace the sensor.
Sensor imbalance	Contact Micro Motion.
Mechanical binding at sensor	Ensure sensor is free to vibrate.

Table 16-7: Possible causes and recommended actions for excessive (saturated) drive gain *(continued)*

Possible cause	Recommended actions
Open drive or left pickoff sensor coil	Contact Micro Motion.
Flow rate out of range	Ensure that flow rate is within sensor limits.
Incorrect sensor characterization	Verify the characterization parameters.

Erratic drive gain

Table 16-8: Possible causes and recommended actions for erratic drive gain

Possible cause	Recommended actions
Wrong K1 characterization constant for sensor	Verify the K1 characterization parameter.
Polarity of pick-off reversed or polarity of drive reversed	Contact Micro Motion.
Slug flow	Check for slug flow. See *Section 16.20*.
Foreign material caught in flow tubes	• Purge the flow tubes. • Replace the sensor.

16.21.1 Collect drive gain data

ProLink II	ProLink > Diagnostic Information
ProLink III	Device Tools > Diagnostics > Core Processor Diagnostics
Modbus	Registers 291-292

Overview

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.

16.22 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.

Table 16-9: Possible causes and recommended actions for low pickoff voltage

Possible cause	Recommended actions
Air entrainment	• 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. Consult the installation manual for your sensor for recommended orientations.
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.
Slug flow	Check for slug flow. See *Section 16.20*.
No tube vibration in sensor	• Check for plugging. • Ensure sensor is free to vibrate (no mechanical binding). • Verify wiring.
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.

16.22.1 Collect pickoff voltage data

ProLink II	ProLink > Diagnostic Information
ProLink III	Device Tools > Diagnostics > Core Processor Diagnostics
Modbus	Left pickoff voltage: Registers 287-288 Right pickoff voltage: Registers 289-290

Overview

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.

16.23 Check for electrical shorts

Shorts between sensor terminals or between the sensor terminals and the sensor case can cause the sensor to stop working.

Table 16-10: Possible causes and recommended actions for electrical shorts

Possible cause	Recommended action
Moisture inside the junction box	Ensure that the junction box is dry and no corrosion is present.
Liquid or moisture inside the sensor case	Contact Micro Motion.
Internally shorted feedthrough	Contact Micro Motion.
Faulty cable	Replace the cable.
Improper wire termination	Verify wire terminations inside sensor junction box. The Micro Motion document titled *9-Wire Flowmeter Cable Preparation and Installation Guide* may offer some assistance.

Appendix A
Default values and ranges

A.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. These values also apply to external-valve-control fills. For default values for integrated-valve-control fills, see *Section 4.2.1*.

Table A-1: Transmitter default values and ranges

Type	Parameter	Default	Range	Comments
Flow	Flow direction	Forward		
	Flow damping	0.04 sec	0.0 – 40.96 sec	User-entered value is corrected to nearest lower value in list of preset values. For filling applications, Micro Motion recommends the default value.
	Mass flow units	g/s		
	Mass flow cutoff	0.0 g/s		Recommended setting is 5% of the sensor's rated maximum flowrate.
	Volume flow 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	1.28 sec	0.0 – 40.96 sec	User-entered value is corrected to nearest value in list of preset values.
	Density units	g/cm^3		
	Density cutoff	$0.2\ g/cm^3$	$0.0 – 0.5\ g/cm^3$	
	D1	0		
	D2	1		
	K1	1000		

Table A-1: Transmitter default values and ranges *(continued)*

Type	Parameter	Default	Range	Comments
	K2	50,000.00		
	FD	0		
	Temp Coefficient	4.44		
Slug flow	Slug flow low limit	0.0 g/cm^3	0.0 – 10.0 g/cm^3	
	Slug flow high limit	5.0 g/cm^3	0.0 – 10.0 g/cm^3	
	Slug duration	0.0 sec	0.0 – 60.0 sec	
Temperature	Temperature damping	4.8 sec	0.0 – 38.4 sec	User-entered value is corrected to nearest lower value in list of preset values.
	Temperature units	Deg C		
	Temperature calibration factor	1.00000T0.0000		
Pressure	Pressure units	PSI		
	Flow factor	0		
	Density factor	0		
	Cal pressure	0		
Special units (1)	Base mass unit	g		
	Base mass time	sec		
	Mass flow conversion factor	1		
	Base volume unit	L		
	Base volume time	sec		
	Volume flow conversion factor	1		
mA output	Secondary variable	Mass flow		
	LRV	–200.00000 g/s		
	URV	200.00000 g/s		
	AO cutoff	0.00000 g/s		
	AO added damping	0.00000 sec		
	LSL	–200 g/s		Read-only.
	USL	200 g/s		LSL and USL are 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	0.0 – 3.6 mA	

(1) Not supported by PROFIBUS-DP.

Table A-1: Transmitter default values and ranges *(continued)*

Type	Parameter	Default	Range	Comments
	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	−423.78 SCFM		
	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	.00091 – 10,000.00 Hz	
	Rate factor	16,666.66992 g/s		
	Frequency pulse width	0 (50% duty cycle)	0.01 – 655.35 millisec	
	Scaling method	Freq=Flow		
	Frequency fault action	Downscale		
	Frequency fault level – upscale	15,000 Hz	10.0 – 15,000 Hz	
	Frequency output polarity	Active high		
	Last measured value timeout	0.0 seconds	0.0 – 60.0 sec	
Discrete output	Assignment	Fault		
	Fault Indicator	None		
	Power	Internal		
	Polarity	Active High		
Discrete input	Assignment	None		

Table A-1: Transmitter default values and ranges *(continued)*

Type	Parameter	Default	Range	Comments
	Polarity	Active Low		

Appendix B
Using ProLink II with the transmitter

Topics covered in this appendix:

- *Basic information about ProLink II*
- *Menu maps for ProLink II*

B.1 Basic information about ProLink II

ProLink II is a software tool available from Micro Motion. It runs on a Windows platform and provides complete access to transmitter functions and data.

ProLink II requirements

The transmitter requires ProLink II v2.91 or later.

To install ProLink II, you must have:

- The ProLink II installation media
- The ProLink II installation kit for your connection type

To obtain ProLink II and the appropriate installation kit, contact Micro Motion.

ProLink II documentation

Most of the instructions in this manual assume that you are already familiar with ProLink II or that you have a general familiarity with Windows programs. If you need more information than this manual provides, see the ProLink II manual (*ProLink® II Software for Micro Motion® Transmitters: Installation and Use Manual*).

In most ProLink II installations, the manual is installed with the ProLink II program. Additionally, the ProLink II manual is available on the Micro Motion documentation CD or the Micro Motion web site (www.micromotion.com).

ProLink II features and functions

ProLink II offers complete transmitter configuration and operation functions. ProLink II also offers a number of additional features and functions, including:

- 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
- A commissioning wizard
- A proving wizard
- A gas wizard

These features are documented in the ProLink II manual. They are not documented in the current manual.

ProLink II messages

As you use ProLink II 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 Menu maps for ProLink II

Figure B-1: Main menu

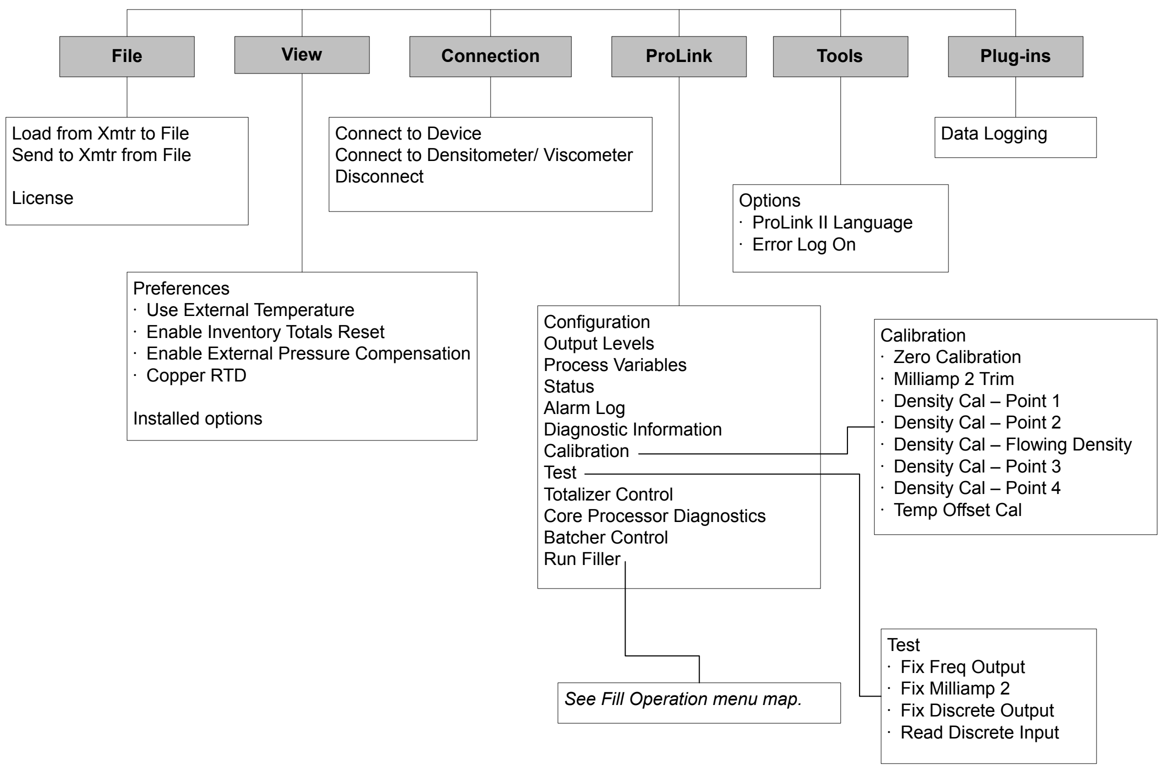


Figure B-2: Fill configuration menu

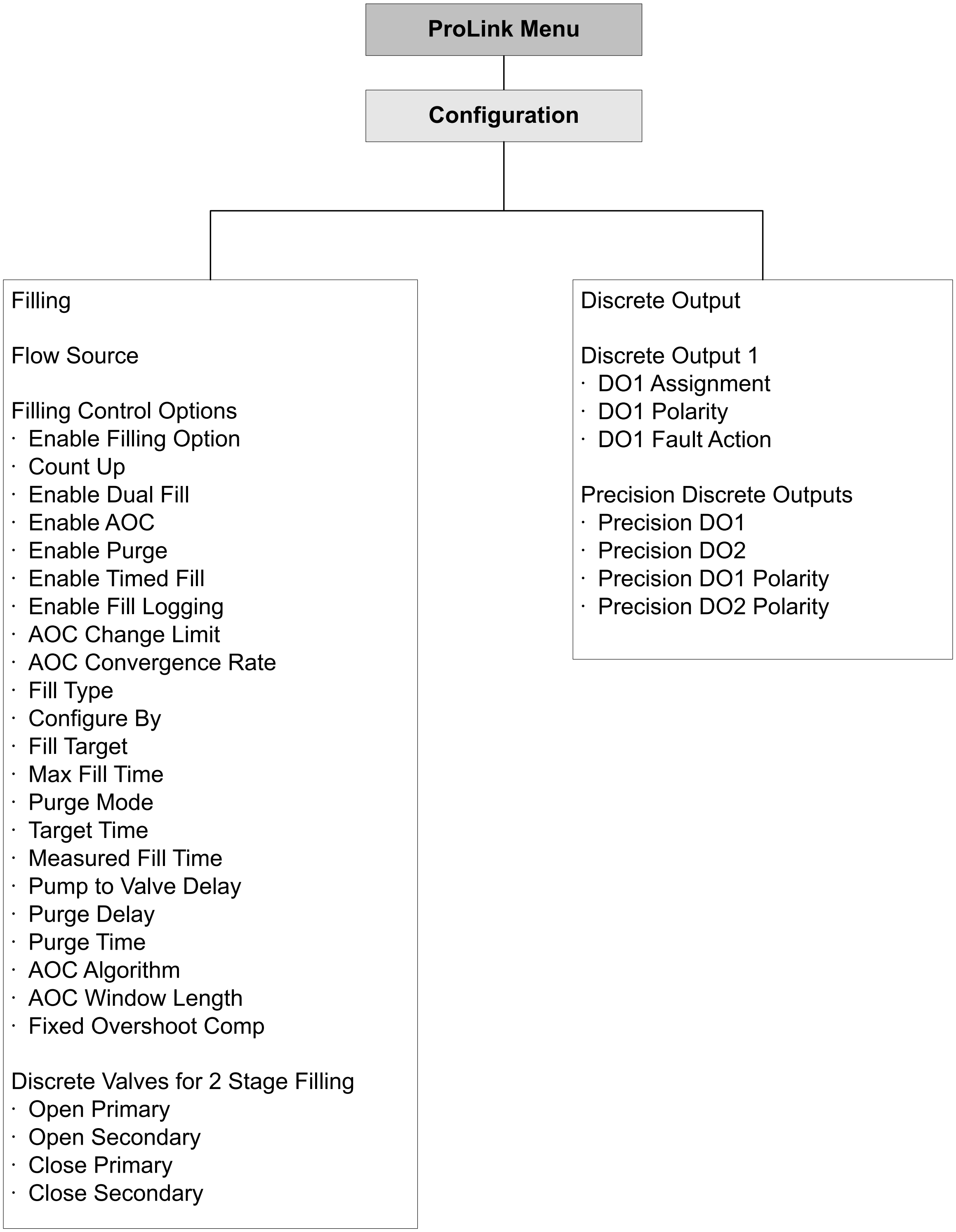


Figure B-3: Fill operation menu

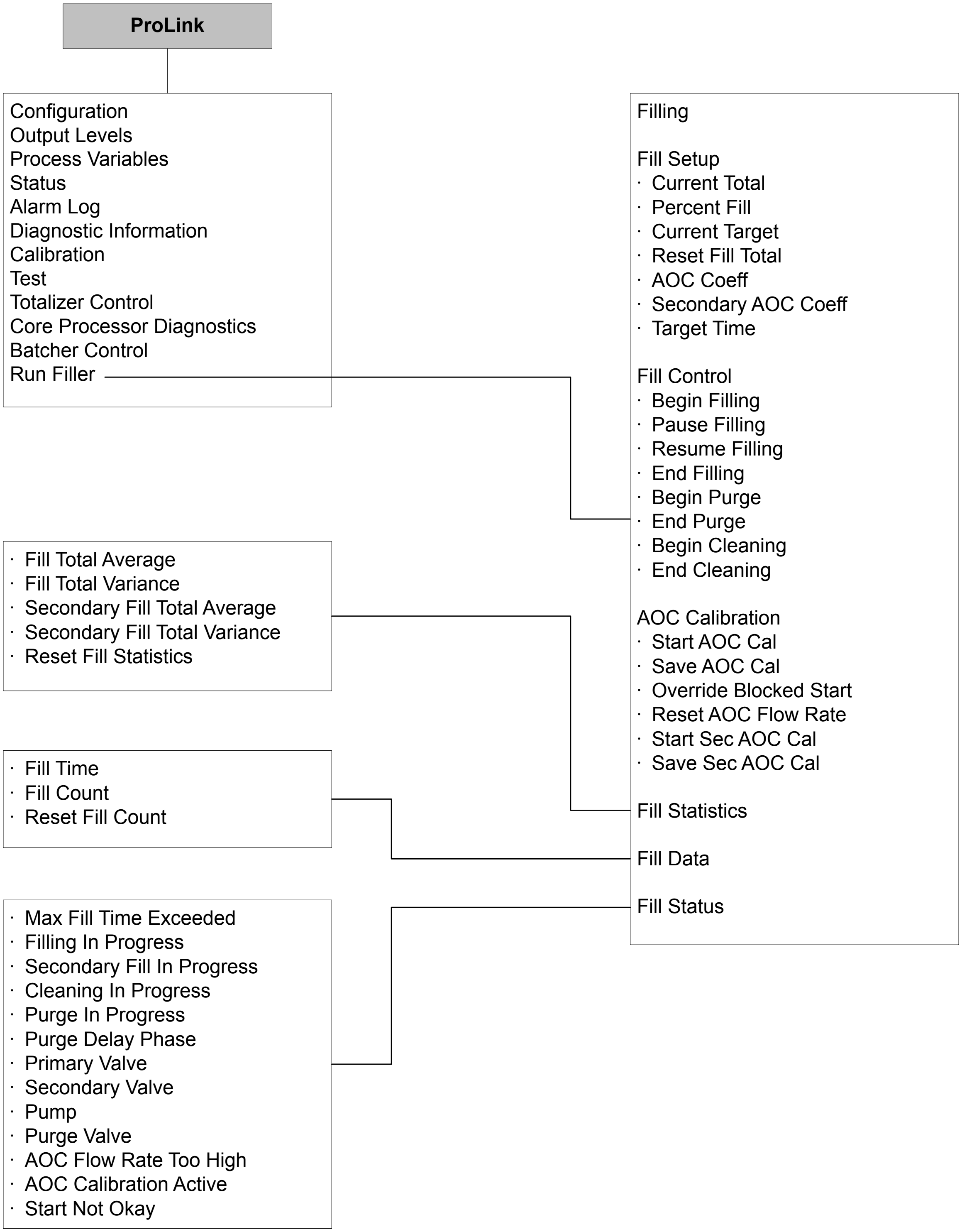


Figure B-4: Configuration menu

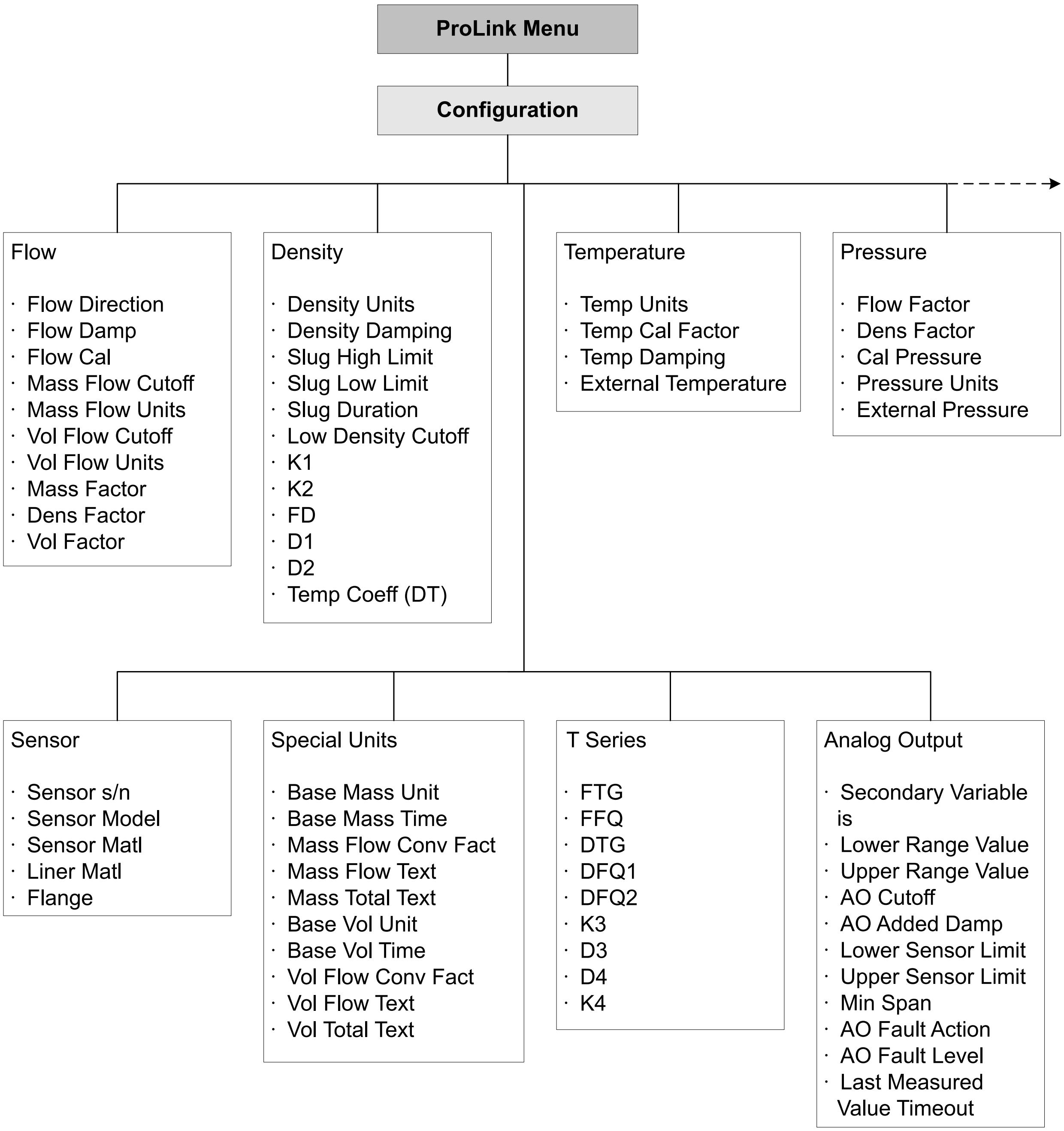
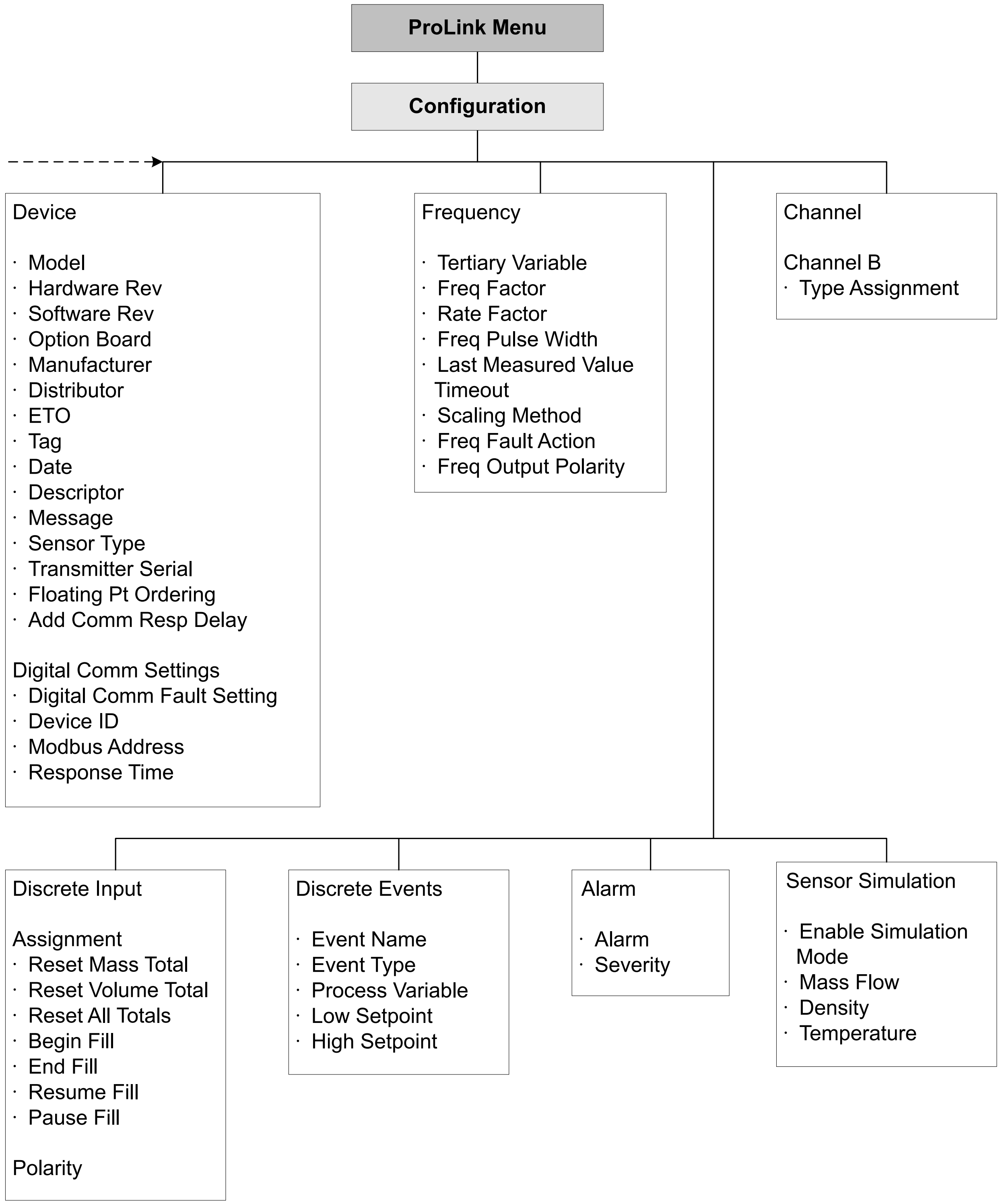


Figure B-5: Configuration menu (continued)



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