Configuration and Use Manual
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Micro Motion®
Model 1500 Transmitters with the Filling and Dosing Application

Configuration and Use Manual

Micro Motion®

EMERSON™
Process Management

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Chapter 1
Before You Begin

1.1 Overview

This chapter provides an orientation to the use of this manual, and includes a pre-configuration worksheet. This manual describes the procedures required to start, configure, use, maintain, and troubleshoot the Model 1500 transmitter with the filling and dosing application.

1.2 Safety

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

1.3 Version

Different configuration options are available with different versions of the components. Table 1-1 lists the version information that you may need and describes how to obtain the information.

Table 1-1 Obtaining version information

Component	With ProLink II
Transmitter software	View > Installed Options > Software Revision
Core processor software	ProLink > Core Processor Diagnostics > CP SW Rev

1.4 Flowmeter documentation

Table 1-2 lists documentation sources for additional information.

Table 1-2 Flowmeter documentation resources

Topic	Document
Sensor installation	Sensor documentation
Transmitter installation	*Transmitter Installation: Model 1500 and 2500 Transmitters*

1.5 Communication tools

Most of the procedures described in this manual require the use of a communication tool. To configure and use the Model 1500 transmitter with the filling and dosing application, you must use ProLink II v2.3 or later, or a customer-written program that uses the transmitter's Modbus interface. For certain features, ProLink II v2.5 or later is required; this is noted where applicable.

Basic information on ProLink II and connecting ProLink II to your transmitter is provided in Chapter 2. For more information, see the ProLink II manual, installed with the ProLink II software or available on the Micro Motion web site (www.micromotion.com).

For information on the transmitter's Modbus interface, see:

- *Using Modbus Protocol with Micro Motion Transmitters*, November 2004, P/N 3600219, Rev. C (manual plus map)
- *Modbus Mapping Assignments for Micro Motion Transmitters*, October 2004, P/N 20001741, Rev. B (map only)

Both of these manuals are available on the Micro Motion web site.

1.6 Planning the configuration

The pre-configuration worksheet in Section 1.7 provides a place to record information about your flowmeter (transmitter and sensor) and your application. This information will affect your configuration options as you work through this manual. Fill out the pre-configuration worksheet and refer to it during configuration. You may need to consult with transmitter installation or application process personnel to obtain the required information.

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

1.7 Pre-configuration worksheet

Item		Configuration data	
Sensor type		☐ T-Series ☐ Other	
Installation type		☐ 4-wire remote ☐ Remote core processor with remote transmitter	
Transmitter software version		______________________	
Core processor type		☐ Standard ☐ Enhanced	
Core processor software version		______________________	
Outputs	Channel A (Terminals 21 & 22)	Milliamp	
	Channel B (Terminals 23 & 24)	Discrete output	☐ Internal power ☐ External power
	Channel C (Terminals 31 & 32)	☐ Discrete output ☐ Discrete input	☐ Internal power ☐ External power
Assignment	Channel A (Terminals 21 & 22)	☐ Process variable ____________ ☐ Primary valve control ☐ Secondary valve control ☐ 3-position analog valve control	
	Channel B (Terminals 23 & 24)	______________________ ☐ Active high	☐ Active low
	Channel C (Terminals 31 & 32)	______________________ ☐ Active high	☐ Active low
Measurement units	Mass flow	______________________	
	Volume flow	______________________	
	Density	______________________	
	Pressure	______________________	
	Temperature	______________________	
ProLink II version		______________________	

1.8 Micro Motion customer service

For customer service, phone the support center nearest you:

- In the U.S.A., phone **800-522-MASS** (800-522-6277) (toll-free)
- In Canada and Latin America, phone +1 303-527-5200
- In Asia:
  - In Japan, phone 3 5769-6803
  - In other locations, phone +65 6777-8211 (Singapore)
- In Europe:
  - In the U.K., phone 0870 240 1978 (toll-free)
  - In other locations, phone +31 (0) 318 495 670 (The Netherlands)

Customers outside the U.S.A. can also email Micro Motion customer service at *International.Support@EmersonProcess.com*.

Chapter 2
Connecting with ProLink II Software

2.1 Overview

ProLink II is a Windows-based configuration and management tool for Micro Motion transmitters. It provides complete access to transmitter functions and data.

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

- Requirements (see Section 2.2)
- Configuration upload/download (see Section 2.3)
- Connecting to a Model 1500 transmitter (see Section 2.4)

The instructions in this manual assume that users are already familiar with ProLink II software. For more information on using ProLink II, or for detailed instructions on installing ProLink II, see the ProLink II software manual, which is automatically installed with ProLink II, and is also available on the Micro Motion web site (www.micromotion.com).

2.2 Requirements

To use ProLink II with a Model 1500 transmitter with the filling and dosing application, the following are required:

- ProLink II v2.3 or later, for access to the filling and dosing application
- ProLink II v2.5 or later, for access to meter verification
- The appropriate signal converter and cables: RS-485 to RS-232 or USB to RS-232
    - For RS-485 to RS-232, the Black Box® Async RS-232 <-> 2-wire RS-485 Interface Converter (Code IC521A-F) signal converter is available from Micro Motion.
    - For USB to RS-232, the Black Box USB Solo (USB–>Serial) (Code IC138A-R2) converter can be used.
- 25-pin to 9-pin adapter (if required by your PC)

2.3 ProLink II configuration upload/download

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

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

Micro Motion recommends that all transmitter configurations be downloaded to a PC as soon as the configuration is complete.

Parameters specific to the filling and dosing application are not included in the upload or download.

To access the configuration upload/download function:

1. Connect ProLink II to your transmitter as described in this chapter.
2. Open the **File** menu.
   - To save a configuration file to a PC, use the **Load from Xmtr to File** option.
   - To restore or load a configuration file to a transmitter, use the **Send to Xmtr from File** option.

2.4 Connecting from a PC to a Model 1500 transmitter

ProLink II software can communicate with a Model 1500 transmitter using Modbus protocol on the RS-485 physical layer. There are two connection types:

- RS-485 configurable connection
- SP (service port) non-configurable (standard) connection

Both connection types use the RS-485 terminals (terminals 33 and 34). These terminals are available in service port mode for 10 seconds after transmitter power-up. After this interval, the terminals revert to RS-485 mode.

- To make a service port connection, you must configure ProLink II appropriately and connect during the 10-second interval after transmitter power-up. Once a service port connection is made, the terminals will remain in service port mode. You may disconnect and reconnect as often as required, as long as you continue to use service port mode.
- To make an RS-485 connection, you must configure ProLink II appropriately, wait for the 10-second interval to expire, then connect. The terminals will now remain in RS-485 mode, and you may disconnect and reconnect as often as required, as long as you continue to use RS-485 mode.
- To change from service port mode to RS-485 mode, or vice versa, you must cycle power to the transmitter and reconnect using the desired connection type.

To connect a PC to the RS-485 terminals or an RS-485 network:

1. Attach the signal converter to the serial port of your PC, using a 25-pin to 9-pin adapter if required.
2. To connect to the RS-485 terminals, connect the signal converter leads to terminals 33 and 34. See Figure 2-1.
3. To connect to an RS-485 network, connect the signal converter leads to any point in the network. See Figure 2-2.
4. For long-distance communication, or if noise from an external source interferes with the signal, install 120-ohm, 1/2-watt resistors in parallel with the output at both ends of the communication segment.
5. Ensure that the transmitter is disconnected from a host PLC.

Figure 2-1 RS-485 terminal connections to Model 1500

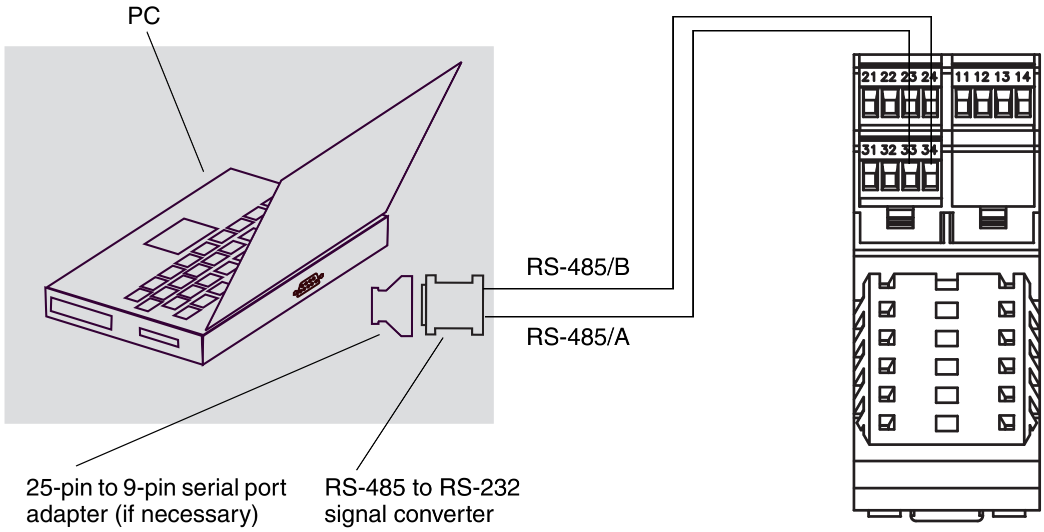
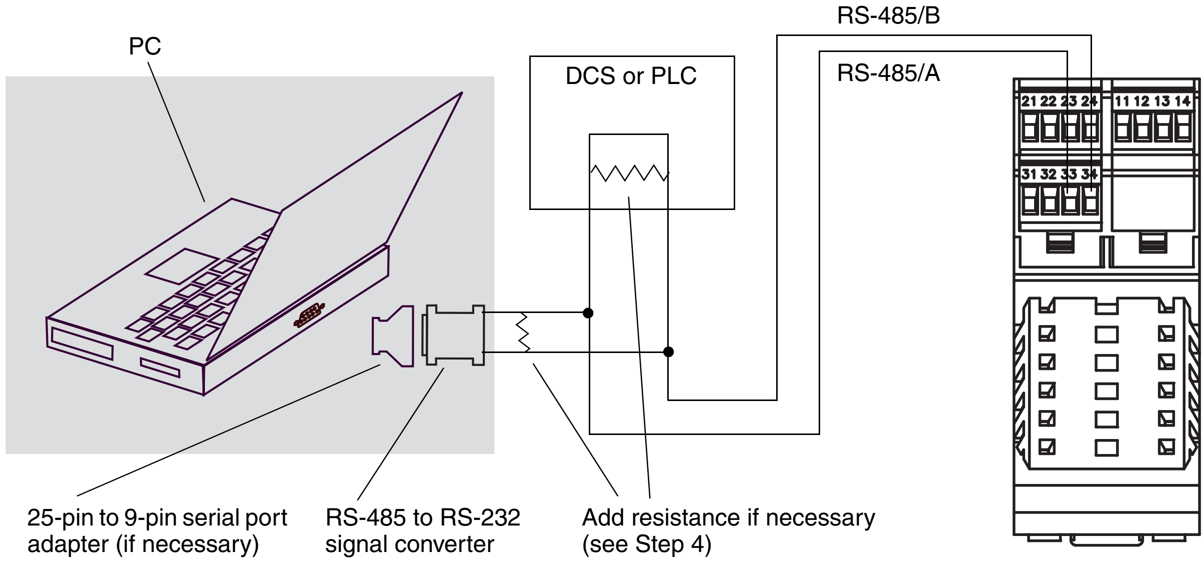


Figure 2-2 RS-485 network connections to Model 1500



6. Start ProLink II software. From the **Connection** menu, click on **Connect to Device**. In the screen that appears, specify connection parameters appropriate to your connection:
   - For service port mode, set **Protocol** to Service Port, and set **COM port** to the appropriate value for your PC. **Baud rate**, **Stop bits**, and **Parity** are set to standard values and cannot be changed. See Table 2-1.
   - For RS-485 mode, set the connection parameters to the values configured in your transmitter. See Table 2-1.

Table 2-1 Modbus connection parameters for ProLink II

	Connection type	
Connection parameter	**Configurable (RS-485 mode)**	**SP standard (service port mode)**
Protocol	As configured in transmitter (default = Modbus RTU)	Modbus RTU[(1)]
Baud rate	As configured in transmitter (default = 9600)	38,400[(1)]
Stop bits	As configured in transmitter (default = 1)	1[(1)]
Parity	As configured in transmitter (default = odd)	none[(1)]
Address/Tag	Configured Modbus address (default = 1)	111[(1)]
COM port	COM port assigned to PC serial port	COM port assigned to PC serial port

(1) Required value; cannot be changed by user.

7. Click the **Connect** button. ProLink II will attempt to make the connection.
8. If an error message appears:
   a. Swap the leads between the two terminals and try again.
   b. Ensure you are using the correct COM port.
   c. If you are in RS-485 mode, you may be using incorrect connection parameters.
      - Connect in service port mode and check the RS-485 configuration. If required, change the configuration or change your RS-485 connection parameters to match the existing configuration.
      - If you are unsure of the transmitter's address, use the **Poll** button in the **Connect** window to return a list of all devices on the network.
   d. Check all the wiring between the PC and the transmitter.

Chapter 3
Flowmeter Startup

3.1 Overview

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

The following procedures are discussed:

- Applying power to the flowmeter (see Section 3.2)
- Performing a loop test on the transmitter outputs (see Section 3.3)
- Trimming the mA output (see Section 3.4)
- Zeroing the flowmeter (see Section 3.5)

Note: All ProLink II procedures provided in this chapter assume that your computer is already connected to the transmitter and you have established communication. All ProLink II procedures also assume that you are complying with all applicable safety requirements. See Chapter 2 for more information.

3.2 Applying power

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

Turn on the electrical power at the power supply. The flowmeter will automatically perform diagnostic routines. When the flowmeter has completed its power-up sequence, the status LED will turn green if conditions are normal. If the status LED exhibits different behavior, an alarm condition is present (see Section 5.4) or configuration of the filling and dosing application is not complete.

⚠ WARNING

Upon transmitter startup or abnormal power reset, any external device controlled by a discrete output may be momentarily activated.

Upon transmitter startup or abnormal power reset, discrete output states are unknown. As a result, an external device controlled by a discrete output may receive current for a brief period.

When using Channel B as a discrete output:

- You can prevent current flow upon normal startup by setting Channel B polarity to active low (see Section 4.6).
- There is no programmatic method to prevent current flow for Channel B upon abnormal power reset. You must design the system so that a brief current flow to the external device controlled by Channel B cannot cause negative consequences.

When using Channel C as a discrete output, there is no programmatic method to prevent current flow upon either transmitter startup or abnormal power reset. You must design the system so that a brief current flow to the external device controlled by Channel C cannot cause negative consequences.

3.3 Performing a loop test

A *loop test* is a means to:

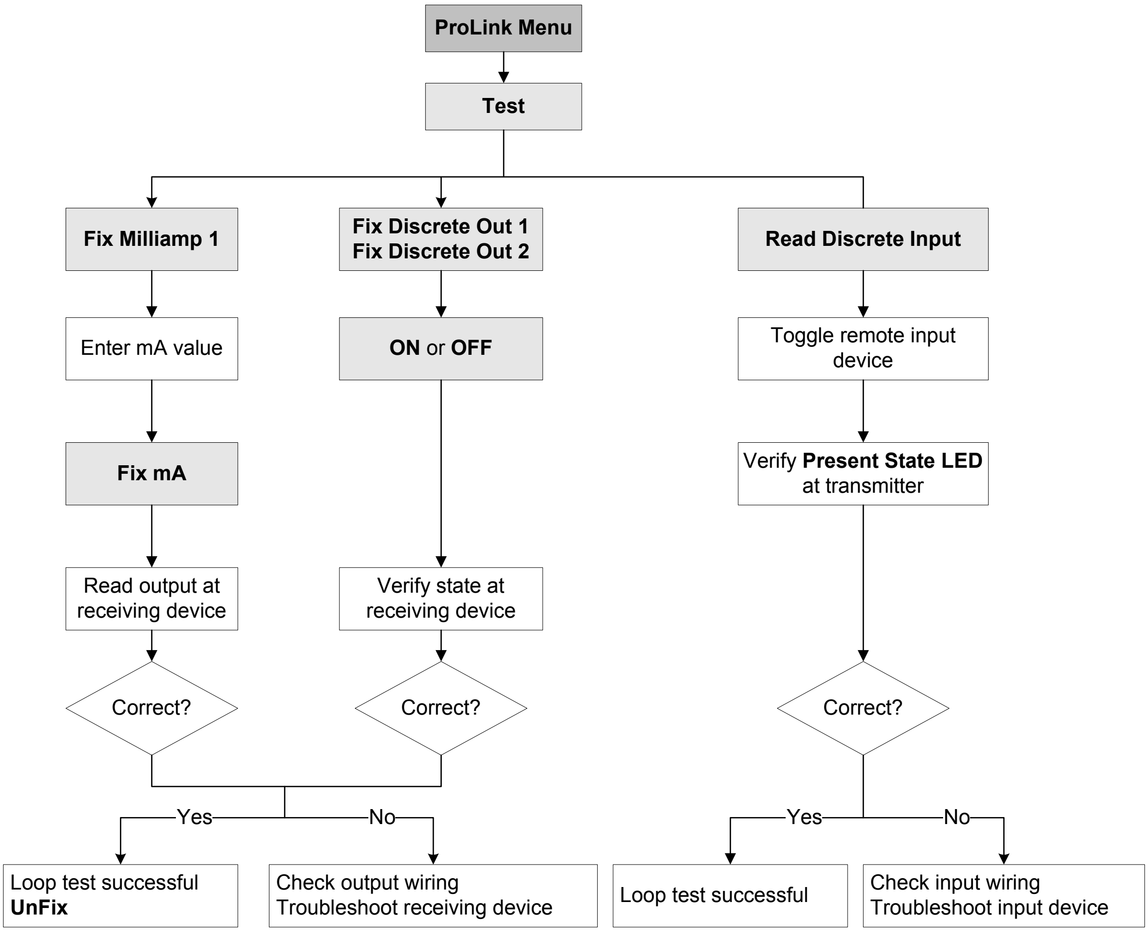
- Verify that the mA outupt is being sent by the transmitter and received accurately by the receiving device
- Determine whether or not you need to trim the mA output
- Select and verify the discrete output voltage
- Read the discrete input

Perform a loop test on all inputs and outputs available on your transmitter. Before performing the loop tests, ensure that your transmitter terminals are configured for the input/outputs that will be used in your application (see Section 4.3).

ProLink II is used for loop testing. See Figure 3-1 for the loop test procedure. Note the following:

- The mA reading does not need to be exact. You will correct differences when you trim the mA output. See Section 3.4.

Figure 3-1 **ProLink II – Loop test procedure**



3.4 Trimming the milliamp output

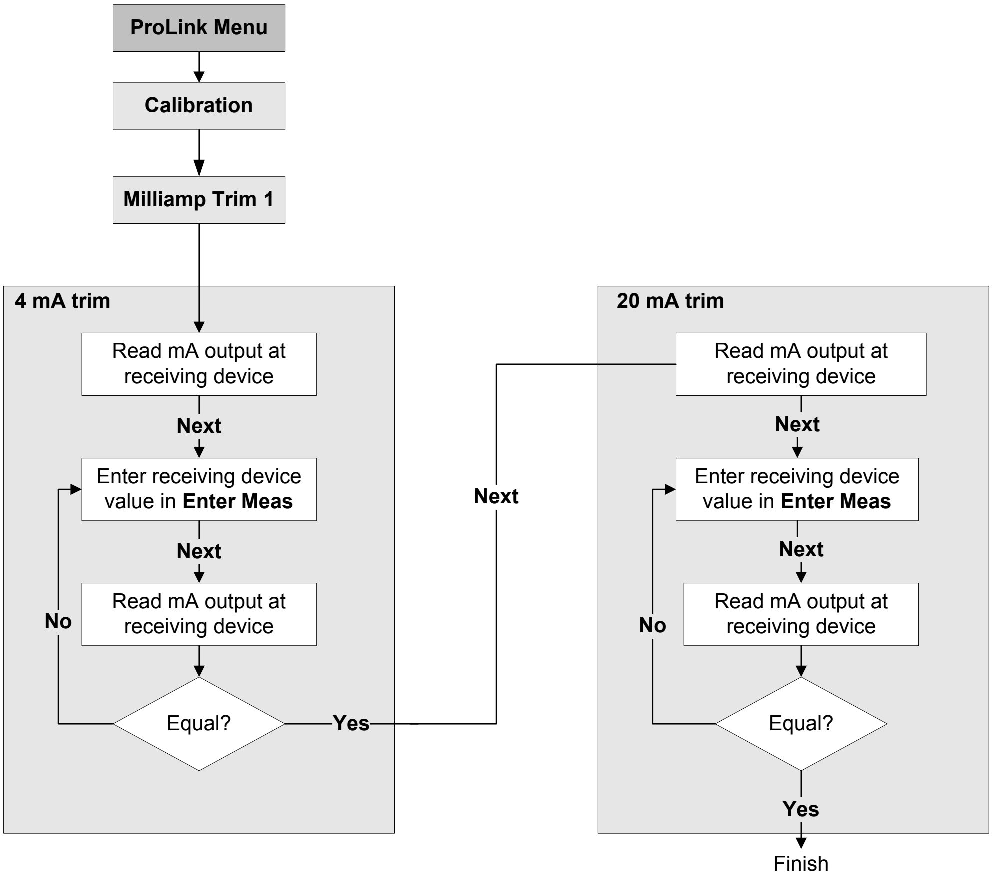
Trimming the mA output creates a common measurement range between the transmitter and the device that receives the mA output. For example, a transmitter might send a 4 mA signal that the receiving device reports incorrectly as 3.8 mA. If the transmitter output is trimmed correctly, it will send a signal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

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

ProLink II is used to trim the mA output. See Figure 3-2 for the mA output trim procedure. Note the following:

- Any trimming performed on the output should not exceed ± 200 microamps. If more trimming is required, contact Micro Motion customer support.

Figure 3-2 ProLink II – mA output trim procedure



3.5 Zeroing the flowmeter

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

Note: Do not zero the flowmeter if a high severity alarm is active. Correct the problem, then zero the flowmeter. You may zero the flowmeter if a low severity alarm is active. See Section 5.4 for information on viewing transmitter status and alarms.

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

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

The default zero time is 20 seconds. For most applications, the default zero time is appropriate.

You can zero the flowmeter with ProLink II or with the zero button on the transmitter.

If the zero procedure fails, see Section 11.6 for troubleshooting information.

Additionally, if you have the enhanced core processor and you are using ProLink II to zero the flowmeter, you can also restore the prior zero immediately after zeroing (e.g., an “undo” function), as long as you have not closed the Calibration window or disconnected from the transmitter. Once you have closed the Calibration window or disconnected from the transmitter, you can no longer restore the prior zero.

3.5.1 Preparing for zero

To prepare for the zero procedure:

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

⚠ CAUTION

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

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

3.5.2 Zero procedure

To zero the transmitter:

- With ProLink II, see Figure 3-3.
- With the zero button, see Figure 3-4. Note the following:
  - You cannot change the zero time with the zero button. If you need to change the zero time, you must use ProLink II.
  - The zero button is located on the front panel of the transmitter. To press the zero button, use a fine-pointed object that will fit into the opening (0.14 in [3.5 mm]). Hold the button down until the status LED on the front panel begins to flash yellow.

Figure 3-3 ProLink II – Flowmeter zero procedure

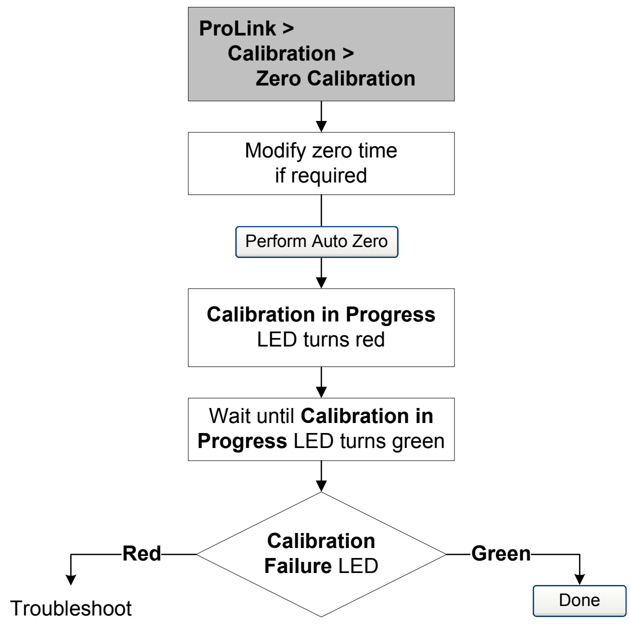
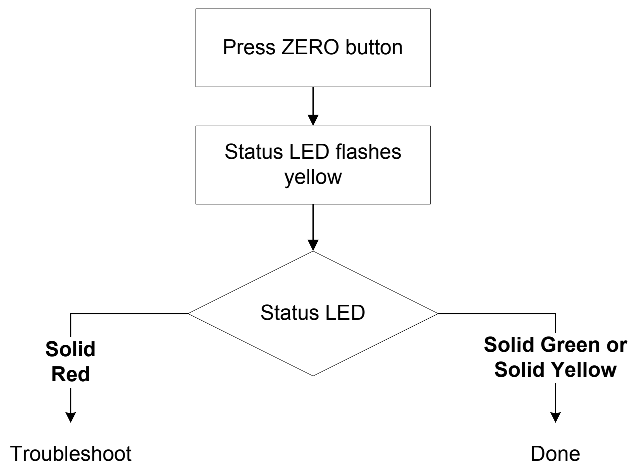


Figure 3-4 Zero button – Flowmeter zero procedure

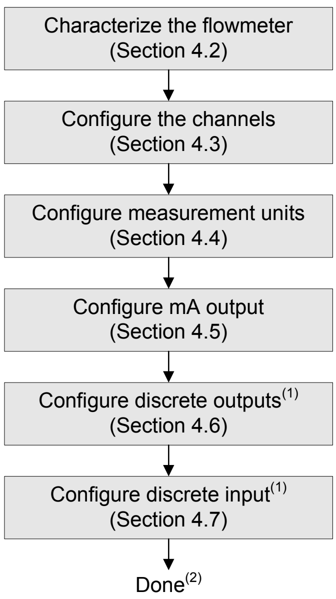


Chapter 4
Required Transmitter Configuration

4.1 Overview

This chapter describes the configuration procedures that are usually required when a transmitter is installed for the first time. The procedures in this chapter should be performed in the order shown in Figure 4-1.

Figure 4-1 Required configuration procedures in order



(1) Only the input or outputs that have been assigned to a channel need to be configured.
(2) If the meter verification option has been purchased, the final configuration step should be to establish a meter verification baseline (see Section 4.8).

This chapter provides basic flowcharts for each procedure. For more detailed flowcharts, see the ProLink II flowcharts, provided in Appendix C.

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

For optional transmitter configuration parameters and procedures, see Chapter 6. For configuration of the filling and dosing application, see Chapter 7.

Note: All ProLink II procedures provided in this chapter assume that your computer is already connected to the transmitter and you have established communication. All ProLink II procedures also assume that you are complying with all applicable safety requirements. See Chapter 2 for more information.

4.2 Characterizing the flowmeter

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

4.2.1 When to characterize

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

4.2.2 Characterization parameters

The characterization parameters that must be configured depend on your flowmeter's sensor type: "T-Series" or "Other" (also referred to as "Straight Tube" and "Curved Tube," respectively), as listed in Table 4-1. The "Other" category includes all Micro Motion sensors except T-Series.

The characterization parameters are provided on the sensor tag. The format of the sensor tag varies depending on your sensor's date of purchase. See Figures 4-2 and 4-3 for illustrations of newer and older sensor tags.

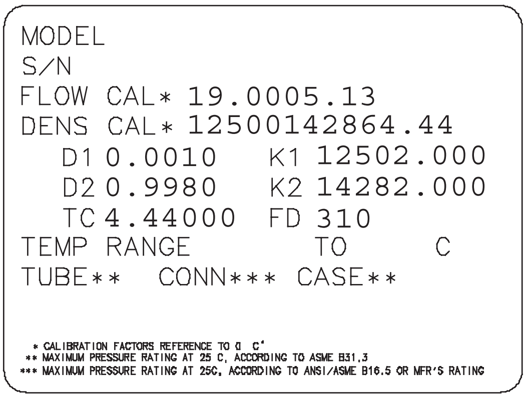
Table 4-1 Sensor calibration parameters

	Sensor type	
Parameter	**T-Series**	**Other**
K1	✓	✓(1)
K2	✓	✓(1)
FD	✓	✓(1)
D1	✓	✓(1)
D2	✓	✓(1)
Temp coeff (DT)(2)	✓	✓(1)
Flowcal		✓(3)
FCF and FT	✓(4)	
FCF	✓(5)	
FTG	✓	
FFQ	✓	
DTG	✓	
DFQ1	✓	
DFQ2	✓	

(1) See the section entitled "Density calibration factors."
(2) On some sensor tags, shown as TC.
(3) See the section entitled "Flow calibration values."
(4) Older T-Series sensors. See the section entitled "Flow calibration values."
(5) Newer T-Series sensors. See the section entitled "Flow calibration values."

Figure 4-2 **Sample calibration tags – All sensors except T-Series**

Newer tag



Older tag

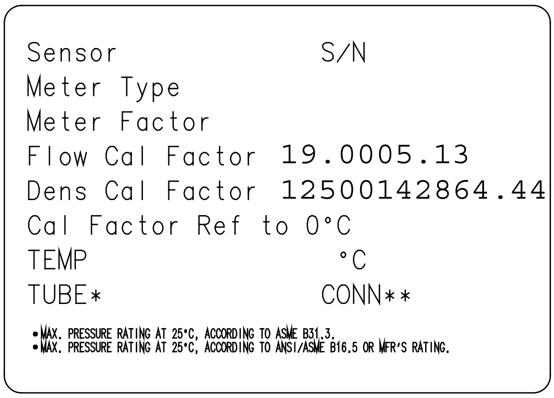
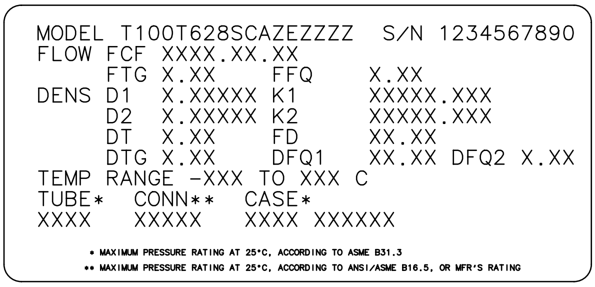
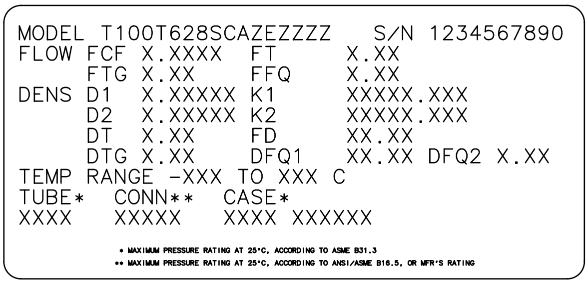


Figure 4-3 **Sample calibration tags – T-Series sensors**

Newer tag



Older tag



Density calibration factors

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.
- 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 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 in Figure 4-2, this value is shown as **12500**.
- For K2, enter the second 5 digits of the density calibration factor. In the sample tag in Figure 4-2, this value is shown as **14286**.

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

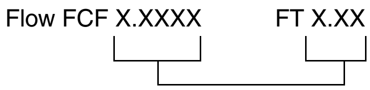
If your sensor tag does not show a DT or TC value, enter the last 3 digits of the density calibration factor. In the sample tag in Figure 4-2, this value is shown as **4.44**.

Flow calibration values

Two separate values are used to describe flow calibration: a 6-character FCF value and a 4-character FT value. Both values contain decimal points. During characterization, these are entered as a single 10-character string that includes two decimal points. In ProLink II, this value is called the Flowcal parameter.

To obtain the required value:

- For older T-Series sensors, concatenate the FCF value and the FT value from the sensor tag, as shown below.



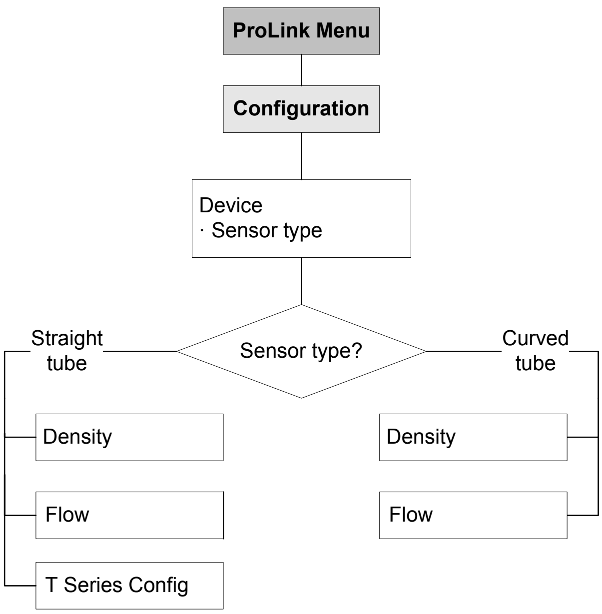
- For newer T-Series sensors, the 10-character string is represented on the sensor tag as the FCF value. The value should be entered exactly as shown, including the decimal points. No concatenation is required.
- For all other sensors, the 10-character string is represented on the sensor tag as the Flow Cal value. The value should be entered exactly as shown, including the decimal points. No concatenation is required.

4.2.3 How to characterize

To characterize the flowmeter:

1. See the menu flowchart in Figure 4-4.
2. Ensure that the correct sensor type is configured.
3. Set required parameters, as listed in Table 4-1.

Figure 4-4 **Characterizing the flowmeter**



4.3 Configuring the channels

The six input/output terminals provided on the Model 1500 are organized into three pairs. These pairs are called Channels A, B, and C. The channels should be configured before doing any other I/O configuration.

⚠ CAUTION

Changing the channel configuration without verifying I/O configuration can produce process error.

When the configuration of a channel is changed, the channel's behavior will be controlled by the I/O configuration that is stored for the new channel type, which may or may not be appropriate for the process. To avoid causing process error:

- Configure the channels before configuring the I/O.
- When changing channel configuration, be sure that all control loops affected by this channel are under manual control.
- Before returning the loop to automatic control, ensure that the channel's I/O is correctly configured for your process. See Sections 4.5, 4.6, and 4.7.

The outputs and variable assignments are controlled by the channel configuration. Table 4-2 shows how each channel may be configured and the power options for each channel.

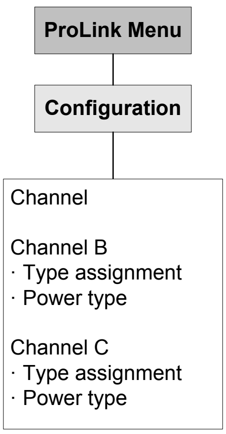
Table 4-2 Channel configuration options

Channel	Terminals	Configuration Option	Power
A	21 & 22	mA output (not configurable)	Internal (not configurable)
B	23 & 24	Discrete output 1 (DO1)	Internal or external[1]
C	31 & 32	Discrete output 2 (DO2)	Internal or external[1]
		Discrete input (DI)	

(1) If set to external power, you must provide power to the outputs.

To configure the channels, see the menu flowchart in Figure 4-5.

Figure 4-5 Configuring the channels

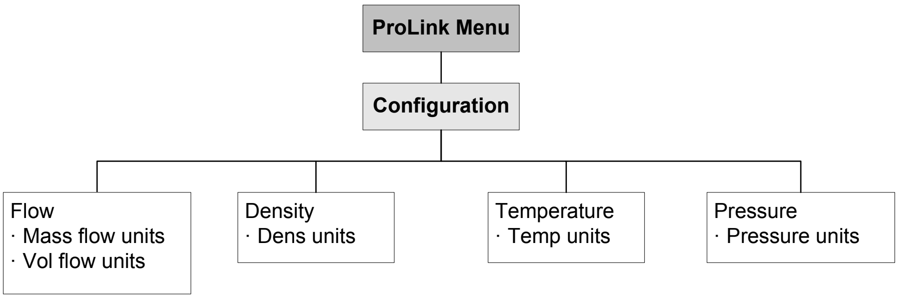


4.4 Configuring the measurement units

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

To configure measurement units, see the menu flowchart in Figure 4-6. For details on measurement units for each process variable, see Sections 4.4.1 through 4.4.5.

Figure 4-6 **Configuring measurement units**



4.4.1 Mass flow units

The default mass flow measurement unit is **g/s**. See Table 4-3 for a complete list of mass flow measurement units.

If the mass flow unit you want to use is not listed, you can define a special measurement unit for mass flow (see Section 6.4).

Table 4-3 **Mass flow measurement units**

ProLink II label	Unit description
g/s	Grams per second
g/min	Grams per minute
g/hr	Grams per hour
kg/s	Kilograms per second
kg/min	Kilograms per minute
kg/hr	Kilograms per hour
kg/day	Kilograms per day
mTon/min	Metric tons per minute
mTon/hr	Metric tons per hour
mTon/day	Metric tons per day
lbs/s	Pounds per second
lbs/min	Pounds per minute
lbs/hr	Pounds per hour
lbs/day	Pounds per day
sTon/min	Short tons (2000 pounds) per minute
sTon/hr	Short tons (2000 pounds) per hour
sTon/day	Short tons (2000 pounds) per day

Table 4-3 **Mass flow measurement units** *continued*

ProLink II label	Unit description
lTon/hr	Long tons (2240 pounds) per hour
lTon/day	Long tons (2240 pounds) per day
special	Special unit (see Section 6.4)

4.4.2 Volume flow units

The default volume flow measurement unit is **L/s**. See Table 4-4 for a complete list of volume flow measurement units.

If the volume flow unit you want to use is not listed, you can define a special measurement unit for volume flow (see Section 6.4).

Table 4-4 **Volume flow measurement units**

ProLink II label	Unit description
ft3/sec	Cubic feet per second
ft3/min	Cubic feet per minute
ft3/hr	Cubic feet per hour
ft3/day	Cubic feet per day
m3/sec	Cubic meters per second
m3/min	Cubic meters per minute
m3/hr	Cubic meters per hour
m3/day	Cubic meters per day
US gal/sec	U.S. gallons per second
US gal/min	U.S. gallons per minute
US gal/hr	U.S. gallons per hour
US gal/day	U.S. gallons per day
mil US gal/day	Million U.S. gallons per day
l/sec	Liters per second
l/min	Liters per minute
l/hr	Liters per hour
mil l/day	Million liters per day
Imp gal/sec	Imperial gallons per second
Imp gal/min	Imperial gallons per minute
Imp gal/hr	Imperial gallons per hour
Imp gal/day	Imperial gallons per day
barrels/sec	Barrels per second(1)
barrels/min	Barrels per minute(1)
barrels/hr	Barrels per hour(1)
barrels/day	Barrels per day(1)
special	Special unit (see Section 6.4)

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

4.4.3 Density units

The default density measurement unit is **g/cm3**. See Table 4-3 for a complete list of density measurement units.

Table 4-5 **Density measurement units**

ProLink II label	Unit description
SGU	Specific gravity unit (not temperature corrected)
g/cm3	Grams per cubic centimeter
g/l	Grams per liter
g/ml	Grams per milliliter
kg/l	Kilograms per liter
kg/m3	Kilograms per cubic meter
lbs/Usgal	Pounds per U.S. gallon
lbs/ft3	Pounds per cubic foot
lbs/in3	Pounds per cubic inch
degAPI	API gravity
sT/yd3	Short ton per cubic yard

4.4.4 Temperature units

The default temperature measurement unit is **degC**. See Table 4-6 for a complete list of temperature measurement units.

Table 4-6 **Temperature measurement units**

ProLink II label	Unit description
degC	Degrees Celsius
degF	Degrees Fahrenheit
degR	Degrees Rankine
degK	Degrees Kelvin

4.4.5 Pressure units

Configuring the pressure unit is required only if pressure compensation will be implemented. See Section 9.2.

4.5 Configuring the mA output

The mA output can be used either to report the mass flow or volume flow process variable or to control a valve for the filling and dosing application.

Configuring the mA output for valve control is discussed in Section 7.4.

Note: If the mA output is configured for valve control, it cannot be used to report alarm status, and the mA output will never go to fault levels.

⚠ CAUTION

Changing the channel configuration without verifying I/O configuration can produce process error.

When the configuration of a channel is changed, the channel's behavior will be controlled by the configuration that is stored for the new channel type, which may or may not be appropriate for the process. To avoid causing process error:

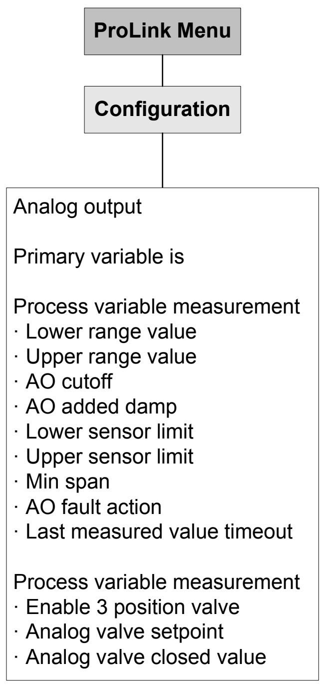
- Configure the channels before configuring the mA output (see Section 4.3).
- When changing the mA output configuration, be sure that all control loops affected by this output are under manual control.
- Before returning the loop to automatic control, ensure that the mA output is correctly configured for your process.

If the mA output is used to report mass flow or volume flow, the following parameters must be configured:

- Primary variable
- Upper range value (URV) and lower range value (LRV)
- AO (analog output) cutoff
- AO added damping
- Fault action and fault value
- Last measured value timeout

To configure the mA output, see the menu flowchart in Figure 4-7. For details on mA output parameters, see Sections 4.5.1 through 4.5.5.

Figure 4-7 Configuring the mA output



4.5.1 Configuring the primary variable

The primary variable is the process variable to be reported through the mA output. Table 4-7 lists the process variables that can be assigned to the mA outputs.

Table 4-7 mA output process variable assignments

Process variable	ProLink II label
Mass flow	Mass Flow Rate
Volume flow	Volume Flow Rate

Note: The process variable assigned to the mA output is always the PV (primary variable).

4.5.2 Configuring the mA output range (LRV and URV)

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

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

Enter values in the measurement units that are configured for the assigned process variable (see Section 4.4).

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

4.5.3 Configuring the AO cutoff

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

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

Multiple cutoffs

Cutoffs can also be configured for the mass flow and volume flow process variables (see Section 6.5). If mass flow or volume flow has been assigned to the mA output, a non-zero value is configured for the flow cutoff, and the AO cutoff is also configured, the cutoff occurs at the highest setting, as shown in the following example.

Example

Configuration:

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

As a result, if the mass flow rate drops below 15 g/sec, the mA output will report zero flow.

4.5.4 Configuring the fault action, fault value, and last measured value timeout

Note: If the mA output is configured for valve control, it cannot be used to report alarm status, and the mA output will never go to fault levels.

If the transmitter encounters an internal fault condition, it can indicate the fault by sending a preprogrammed output level to the receiving device. You can specify the output level by configuring the fault action. Options are shown in Table 4-8.

By default, the transmitter immediately reports a fault when a fault is encountered. You can configure the transmitter to delay reporting a fault by changing the last measured value timeout to a non-zero value. During the fault timeout period, the transmitter continues to report its last valid measurement.

Table 4-8 mA output fault actions and values

Fault action	Fault output value
Upscale	21–24 mA (default: 22 mA)
Downscale	1.0–3.6 mA (default: 2.0 mA)
Internal zero	The value associated with 0 (zero) flow, as determined by URV and LRV values
None(1)	Tracks data for the assigned process variable; no fault action

(1) If the mA output fault action is set to None, the digital communications fault action should also be set to None. See Section 6.12.1.

⚠ CAUTION

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

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

4.5.5 Configuring added damping

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

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

The added damping parameter specifies damping that will be applied to the mA output. It affects the measurement of the process variable assigned to the mA output, but does not affect other outputs.

When you specify a new added damping value, it is automatically rounded down to the nearest valid value. Note that added damping values are affected by the Update Rate parameter (see Section 6.7).

Note: Added damping is not applied if the mA output is fixed (i.e., during loop testing) or is reporting a fault.

Multiple damping parameters

Damping can also be configured for the mass flow and volume flow process variables (see Section 6.6). If one of these process variables has been assigned to the mA output, a non-zero value is configured for its damping, and added damping is also configured for the mA output, the effect of damping the process variable is calculated first, and the added damping calculation is applied to the result of that calculation. See the following example.

Example	Configuration: • Flow damping: 1 • mA output: Mass flow • Added damping: 2 As a result: • A change in mass flow will be reflected in the primary 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.

4.6 Configuring the discrete output(s)

Note: Configure the transmitter channels for the required output types before configuring individual outputs. See Section 4.3.

⚠ CAUTION

Changing the channel configuration without verifying I/O configuration can produce process error.

When the configuration of a channel is changed, the channel's behavior will be controlled by the configuration that is stored for the new channel type, which may or may not be appropriate for the process. To avoid causing process error:

- Configure the channels before configuring the discrete output (see Section 4.3).
- When changing the discrete output configuration, be sure that all control loops affected by this output are under manual control.
- Before returning the loop to automatic control, ensure that the discrete output is correctly configured for your process.

The discrete outputs generate two voltage levels to represent ON or OFF states. The voltage levels depend on the output's polarity, as shown in Table 4-9. Figure 4-8 shows a diagram of a typical discrete output circuit.

Table 4-9 Discrete output polarity

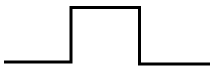
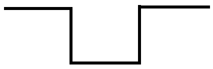
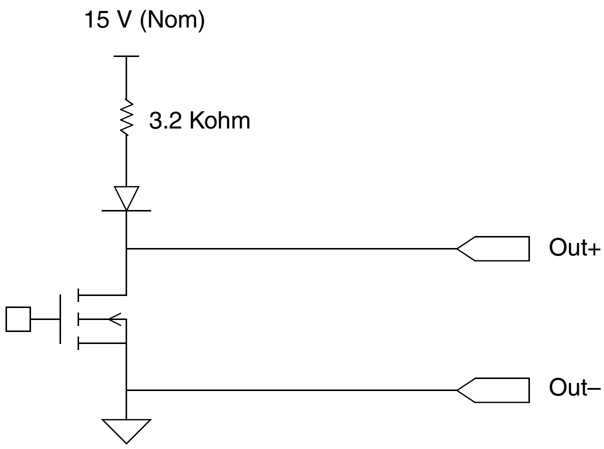
Polarity	Output power supply	Description
Active high 	Internal	• When asserted, the circuit provides a pull-up to 15 V. • When not asserted, the circuit provides 0 V.
	External	• When asserted, the circuit provides a pull-up to a site-specific voltage, maximum 30 V. • When not asserted, circuit provides 0 V.
Active low 	Internal	• When asserted, the circuit provides 0 V. • When not asserted, the circuit provides a pull-up to 15 V.
	External	• When asserted, the circuit provides 0 V. • When not asserted, the circuit provides a pull-up to a site-specific voltage, to a maximum of 30 V.

Figure 4-8 Discrete output circuit



The discrete outputs can be used to indicate a fault, to indicate filling in progress, or to control the primary or secondary valves, as described in Table 4-10.

Note: Before you can assign a discrete output to valve control, the Fill Type parameter must be configured. See Chapter 7 and Figure 7-3.

⚠ WARNING

Upon transmitter startup or abnormal power reset, any external device controlled by a discrete output may be momentarily activated.

Upon transmitter startup or abnormal power reset, discrete output states are unknown. As a result, an external device controlled by a discrete output may receive current for a brief period.

When using Channel B as a discrete output:

- You can prevent current flow upon normal startup by setting Channel B polarity to active low.
- There is no programmatic method to prevent current flow for Channel B upon abnormal power reset. You must design the system so that a brief current flow to the external device controlled by Channel B cannot cause negative consequences.

When using Channel C as a discrete output, there is no programmatic method to prevent current flow upon either transmitter startup or abnormal power reset. You must design the system so that a brief current flow to the external device controlled by Channel C cannot cause negative consequences.

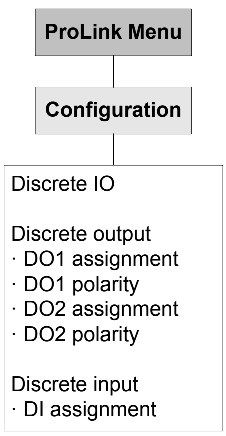
Table 4-10 Discrete output assignments and output levels

Assignment	Condition	Discrete output level(1)
Primary valve (DO1 only) Secondary valve (DO2 only)	Open	Site-specific
	Closed	0 V
Fill in progress (DO2 only)	ON	Site-specific
	OFF	0 V
Fault indication (DO2 only)	ON	Site-specific
	OFF	0 V

(1) Voltage descriptions in this column assume that Polarity is set to Active High. If Polarity is set to Active Low, the voltages are reversed.

To configure the discrete output, see the menu flowchart in Figure 4-9.

Figure 4-9 Configuring the discrete output(s)



4.7 Configuring the discrete input

Note: Configure the transmitter channels for the required input/output types before configuring the discrete input. See Section 4.3.

⚠ CAUTION

Changing the channel configuration without verifying I/O configuration can produce process error.

When the configuration of a channel is changed, the channel's behavior will be controlled by the configuration that is stored for the new channel type, which may or may not be appropriate for the process. To avoid causing process error:

- Configure the channels before configuring the discrete output (see Section 4.3).
- When changing the discrete output configuration, be sure that all control loops affected by this output are under manual control.
- Before returning the loop to automatic control, ensure that the discrete output is correctly configured for your process.

The discrete input is used to initiate a transmitter action from a remote input device. If your transmitter has been configured for a discrete input, the following actions may be assigned to the discrete input:

- Begin fill
- End fill
- Pause fill
- Resume fill
- Reset fill total
- Reset mass total
- Reset volume total
- Reset all totals

Note: If the filling and dosing application is active, the Reset All Totals function includes resetting the fill total.

To configure the discrete input, see the menu flowchart in Figure 4-9.

4.8 Establishing a meter verification baseline

Note: This procedure applies only if your transmitter is connected to an enhanced core processor and you have ordered the meter verification option. In addition, ProLink II v2.5 or later is required.

Meter verification is a method of establishing that the flowmeter is performing within factory specifications. See Chapter 10 for more information about meter verification.

Micro Motion recommends performing meter verification several times over a range of process conditions after the transmitter's required configuration procedures have been completed. This will establish a baseline for how widely the verification measurement varies under normal circumstances. The range of process conditions should include expected temperature, pressure, density, and flow rate variations.

View the trend chart for these initial tests. By default, the specification uncertainty limit is set at ±4.0%, which will avoid false Fail/Caution results over the entire range of specified process conditions. If you observe a structural integrity variation greater than 4% due to normal process conditions, you may adjust the specification uncertainty limit to match your process variation. To avoid false Fail/Caution results, it is advisable to set the specification uncertainty limit to approximately twice the variation due to the effect of normal process conditions.

In order to perform this baseline analysis, you will need the enhanced meter verification capabilities of ProLink II v2.5 or later. Refer to the manual entitled *ProLink® II Software for Micro Motion® Transmitters: Installation and Use*, P/N 20001909, Rev D or later.

Chapter 5
Using the Transmitter

5.1 Overview

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

- Recording process variables (see Section 5.2)
- Viewing process variables (see Section 5.3)
- Viewing transmitter status and alarms, and the alarm log (see Section 5.4)
- Viewing and using the totalizers and inventories (see Section 5.5)

For information on using the filling and dosing application, see Chapter 8.

Note: All ProLink II procedures provided in this section assume that your computer is already connected to the transmitter and you have established communication. All ProLink II procedures also assume that you are complying with all applicable safety requirements. See Chapter 2 for more information.

5.2 Recording process variables

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

Record the following process variables:

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

For information on using this information in troubleshooting, see Section 11.11.

5.3 Viewing process variables

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

To view process variables with ProLink II software:

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

5.4 Viewing transmitter status and alarms

You can view transmitter status using the status LED or ProLink II.

The transmitter broadcasts alarms whenever a process variable exceeds its defined limits or the transmitter detects a fault condition. Using ProLink II, you can view active alarms and you can view the alarm log. For information regarding all the possible alarms, see Table 11-4.

5.4.1 Using the status LED

The status LED is located on the front panel. This LED shows transmitter status as described in Table 5-1.

Table 5-1 Transmitter status reported by the status LED

Status LED state	Alarm priority	Definition
Green	No alarm	Normal operating mode
Flashing yellow	No alarm	Zero in progress
Yellow	Low severity alarm	• Alarm condition: will not cause measurement error • Outputs continue to report process data • This alarm may indicate “Fill not ready” condition, e.g., target set to 0, no flow source configured, no valves configured.
Red	High severity (critical fault) alarm	• Alarm condition: will cause measurement error • Outputs go to configured fault indicators

5.4.2 Using ProLink II software

To view current status and alarms with ProLink II software:

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

To view the alarm log:

1. Click **ProLink**.
2. Select **Alarm log**. Entries in the alarm log are divided into two categories: High Priority and Low Priority. Within each category:
   - All currently active alarms are listed, with a red status indicator.
   - All alarms that are no longer active are listed, with a green status indicator.
3. To remove an inactive alarm from the list, click the **ACK** checkbox, then click **Apply**.

The alarm log is cleared and regenerated with every transmitter power cycle.

Note: The location of alarms in the Status or Alarm Log window is not affected by the configured alarm severity (see Section 6.11.1). Alarms in the Status window are predefined as Critical, Informational, or Operational. Alarms in the Alarm Log window are predefined as High Priority or Low Priority.

5.5 Using the totalizers and inventories

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

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

Note: Mass and volume totalizer and inventory values are held across transmitter power cycles. The fill total is not held across power cycles.

Note: If the Special update rate is configured, no inventories are available. See Section 6.7.

To view the current value of the totalizers and inventories with ProLink II software:

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

Table 5-2 shows how you can control the totalizers and inventories using ProLink II software. To get to the Totalizer Control screen:

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

Note: The fill total can be reset independently from the Run Filler window (see Section 8.3.1). It cannot be reset independently from the Totalizer window.

Table 5-2 Totalizer and inventory control with ProLink II software

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

(1) If enabled in the ProLink II preferences. Click View > Preferences, and set the Enable Inventory Totals Reset checkbox as desired.

Chapter 6
Optional Transmitter Configuration

6.1 Overview

This chapter describes transmitter configuration parameters that may or may not be used, depending on your application requirements. For required transmitter configuration, see Chapter 4.

The following configuration parameters and options are described in this chapter:

- Special measurement units (see Section 6.4)
- Cutoffs (see Section 6.5)
- Damping (see Section 6.6)
- Update rate (see Section 6.7)
- Flow direction (see Section 6.8)
- Events (see Section 6.9)
- Slug flow (see Section 6.10)
- Fault handling (see Section 6.11)
- Digital communications settings (see Section 6.12)
- Variable mapping (see Section 6.13)
- Device settings (see Section 6.14)
- Sensor parameters (see Section 6.15)

6.2 Default values

Default values and ranges for the most commonly used parameters are provided in Appendix A.

6.3 Parameter location within ProLink II

For information on parameter location within the ProLink II interface, see Appendix C.

6.4 Creating special measurement units

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

6.4.1 About special measurement units

Special measurement units consist of:

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

The terms above are related by the following formula:

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

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

To create a special unit, you must:

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

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

Note: 1 gallon per minute = 8 pints per minute

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

   Names can be up to 8 characters long.
4. To apply the special measurement unit to mass flow or volume flow measurement, select **Special** from the list of measurement units (see Section 4.4.1 or 4.4.2).

6.4.2 Special mass flow unit

To create a special mass flow measurement unit:

1. Specify the base mass unit.
2. Specify the base time unit.
3. Specify the mass flow conversion factor.
4. Assign a name to the new special mass flow measurement unit.
5. Assign a name to the mass totalizer measurement unit.

6.4.3 Special volume flow unit

To create a special volume flow measurement unit:

1. Specify the base volume unit.
2. Specify the base time unit.
3. Specify the volume flow conversion factor.
4. Assign a name to the new special volume flow measurement unit.
5. Assign a name to the volume totalizer measurement unit.

6.4.4 Special unit for gas

For many gas applications, standard or normal volume flow rate is used as the quasi mass flow rate. Standard or normal volume flow rate is calculated as the mass flow rate divided by the density of the gas at a reference condition.

To configure a mass flow special unit that represents standard or normal volume flow rate, you must calculate the mass flow conversion factor from the density of the gas at a reference temperature, pressure, and composition.

ProLink II offers a Gas Unit Configurator tool to calculate this mass flow conversion factor. The tool will automatically update the mass flow conversion factor in the **Special Units** tab. If ProLink II is not available, special mass units can be used to set up standard or normal volume flow units for gas applications.

Note: Micro Motion recommends that you do not use the flowmeter to measure actual volume flow of a gas (volumetric flow at line conditions). If you need to measure actual volume flow, contact Micro Motion customer support.

⚠ CAUTION

The flowmeter should not be used for measuring the actual volume of gases.

Standard or normal volume is the traditional unit for gas flow. Coriolis flowmeters measure mass. Mass divided by standard or normal density yields standard or normal volume units.

To use the Gas Unit Configurator:

1. Start ProLink II and connect to your transmitter.
2. Open the **Configuration** window.
3. Click the **Special Units** tab.
4. Click the **Gas Unit Configurator** button.
5. Select the **Time Unit** that your special unit will be based on.
6. Click a radio button to specify that your special unit will be defined in terms of **English Units** or **SI** (*Système International*) **Units**.
7. Click **Next**.

8. Define the standard density to be used in calculations.
   - To use a fixed standard density, click the top radio button, enter a value for standard density in the **Standard Density** textbox, and click **Next**.
   - To use a calculated standard density, click the second radio button and click **Next**. Then enter values for **Reference Temperature**, **Reference Pressure**, and **Specific Gravity** on the next panel, and click **Next**.
9. Check the values displayed.
   - If they are appropriate for your application, click **Finish**. The special unit data will be written to the transmitter.
   - If they are not appropriate for your application, click **Back** as many times as necessary to return to the relevant panel, correct the problem, then repeat the above steps.

6.5 Configuring cutoffs

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

See Table 6-1 for cutoff default values and related information. See Sections 6.5.1 and 6.5.2 for information on how the cutoffs interact with other transmitter measurements.

Table 6-1 **Cutoff default values**

Cutoff type	Default	Comments
Mass flow	0.0 g/s	Recommended setting: 0.5–1.0% of the sensor's rated maximum flowrate
Volume flow	0.0 L/s	Lower limit: 0 Upper limit: the sensor's flow calibration factor, in units of L/s, multiplied by 0.2
Density	0.2 g/cm^3	Range: 0.0–0.5 g/cm^3

6.5.1 Cutoffs and volume flow

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

However, the density cutoff is applied to the volume flow calculation. Accordingly, if the density drops below its configured cutoff value, both the reported density and the reported volume flow rate will go to zero.

6.5.2 Interaction with the AO cutoff

The mA output also has a cutoff – the AO cutoff. If the mA output is configured for mass or volume flow:

- And the AO cutoff is set to a greater value than the mass and volume cutoffs, the flow indicators will go to zero when the AO cutoff is reached.
- And the AO cutoff is set to a lower value than the mass or volume cutoff, the flow indicator will go to zero when the mass or volume cutoff is reached.

See Section 4.5.3 for more information on the AO cutoff.

6.6 Configuring the damping values

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

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

When you specify a new damping value, it is automatically rounded down to the nearest valid damping value. Flow, density, and temperature have different valid damping values. Valid damping values are listed in Table 6-2.

For the Model 1500 transmitter with the filling and dosing application, the default damping value for flow has been set to 0.04 seconds. For most filling and dosing applications, the default flow damping value is used. Contact Micro Motion customer support before changing the flow damping value.

Before setting the damping values, review Sections 6.6.1 through 6.6.3 for information on how the damping values interact with other transmitter measurements and parameters.

Table 6-2 Valid damping values

Process variable	Update rate(1)	Valid damping values
Flow (mass and volume)	Normal (20 Hz)	0, .2, .4, .8, ... 51.2
	Special (100 Hz)	0, .04, .08, .16, ... 10.24
Density	Normal (20 Hz)	0, .2, .4, .8, ... 51.2
	Special (100 Hz)	0, .04, .08, .16, ... 10.24
Temperature	Not applicable	0, .6, 1.2, 2.4, 4.8, ... 76.8

(1) See Section 6.6.3.

6.6.1 Damping and volume measurement

When configuring damping values, be aware that volume measurement is derived from mass and density measurements; therefore, any damping applied to mass flow and density will affect volume measurements. Be sure to set damping values accordingly.

6.6.2 Interaction with the added damping parameter

The mA output has a damping parameter – added damping. If damping is configured for flow, the mA output is configured for mass flow or volume flow, and added damping is also configured for the mA output, the effect of damping the process variable is calculated first, and the added damping calculation is applied to the result of that calculation.

See Section 4.5.5 for more information on the added damping parameter.

6.6.3 Interaction with the update rate

Flow and density damping values depend on the configured Update Rate (see Section 6.7). If you change the update rate, the damping values are automatically adjusted. Damping rates for Special are 20% of Normal damping rates. See Table 6-2.

Note: The specific process variable selected for the Special update rate is not relevant; all damping values are adjusted as described.

6.7 Configuring the update rate

The *update rate* is the rate at which the sensor reports process variables to the transmitter. This affects transmitter response time to changes in the process.

There are two settings for Update Rate: **Normal** and **Special**.

- When **Normal** is configured, most process variables are polled at the rate of 20 times per second (20 Hz).
- When **Special** is configured, a single, user-specified process variable is reported at a faster rate, and all others are reported at a slower rate. If you set the update rate to **Special**, you must also specify which process variable will be updated at 100 Hz. Polling for some process variables and diagnostic/calibration data is dropped (see Section 6.7.1), and the remaining process variables are polled a minimum of 6 times per second (6.25 Hz).

Not all process variables can be used as the 100 Hz variable. Only the following process variables can be selected:

- Mass flow rate
- Volume flow rate

For the Model 1500 transmitter with the filling and dosing application, **Special** is the default, and the 100 Hz variable is automatically set to the variable configured as the fill flow source (mass flow rate or volume flow rate).

For filling and dosing applications, Micro Motion recommends:

- Use **Special** for all “short” applications (fill duration less than 15 seconds).
- Use **Normal** for all “long” applications (fill duration of 15 or more seconds).

For all other applications, Micro Motion recommends using the **Normal** update rate. Contact Micro Motion before using the **Special** update rate for other applications.

Note: If you change the Update Rate setting, the setting for damping is automatically adjusted. See Section 6.6.3.

6.7.1 Effects of Special mode

In Special mode:

- Not all process variables are updated. The process variables listed below are always updated:
  - Mass flow
  - Volume flow
  - Density
  - Temperature
  - Drive gain
  - LPO amplitude
  - RPO amplitude
  - Status (contains Event 1 and Event 2)
  - Raw tube frequency
  - Mass total
  - Volume total
  - Board temperature
  - Core input voltage
  - Mass inventory
  - Volume inventory

  All other process variables are not polled at all. The omitted process variables will remain at the values they held before **Special** mode was implemented.
- Calibration data is not refreshed.

Micro Motion recommends the following:

- If **Special** mode is required, ensure that all required data is being updated.
- Do not perform any calibrations while in **Special** mode.

6.8 Configuring the flow direction parameter

Note: If the mA output is configured for valve control, this parameter has no effect.

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

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

Options for flow direction include:

- Forward
- Reverse
- Absolute Value
- Bidirectional
- Negate Forward
- Negate Bidirectional

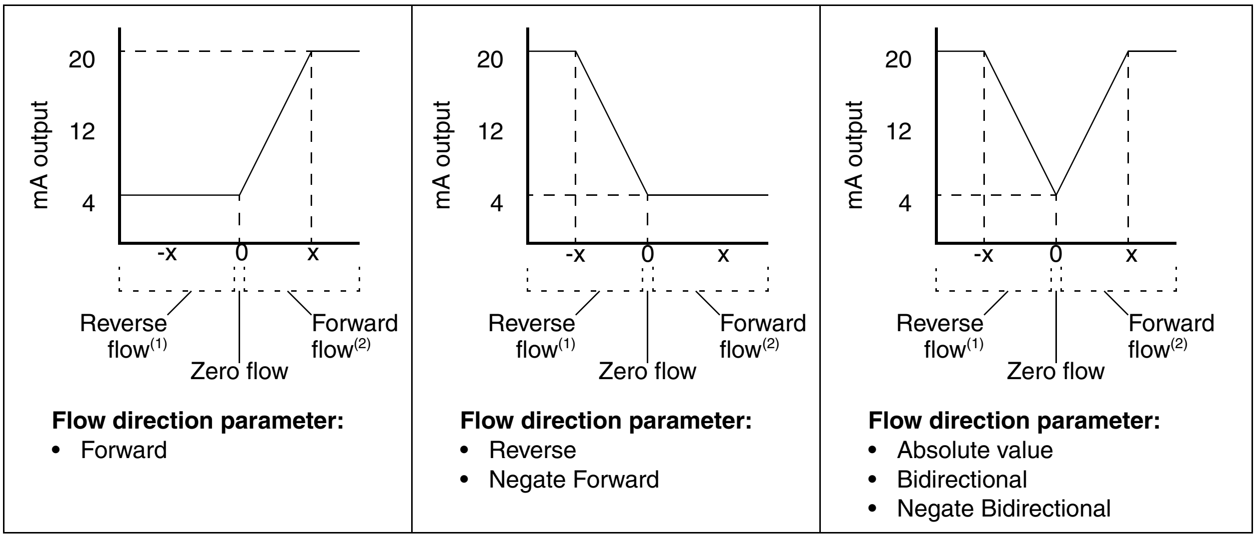
For the effect of flow direction on the mA output:

- See Figure 6-1 if the 4 mA value of the mA output is set to 0.
- See Figure 6-2 if the 4 mA value of the mA output is set to a negative value.

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

For the effect of flow direction on totalizers and flow values reported via digital communication, see Table 6-3.

Figure 6-1 Effect of flow direction on mA outputs: 4mA value = 0

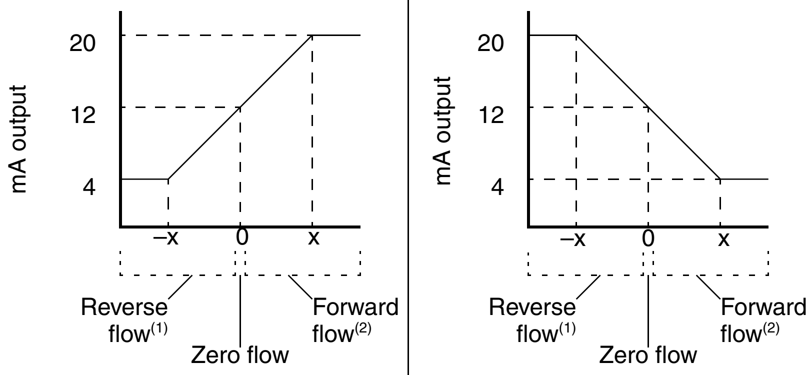


mA output configuration:
- 20 mA value = x
- 4 mA value = 0

To set the 4 mA and 20 mA values, see Section 4.5.2.

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

Figure 6-2 Effect of flow direction on mA outputs: 4mA value < 0



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

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

To set the 4 mA and 20 mA values, see Section 4.5.2.

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

Example 1

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

(See the first graph in Figure 6-1.)

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

Example 2	Configuration: • Flow direction = Reverse • mA output: 4 mA = 0 g/s; 20 mA = 100 g/s (See the second graph in Figure 6-1.) As a result: • Under conditions of forward flow or zero flow, the mA output level is 4 mA. • Under conditions of reverse flow, up to a flow rate of 100 g/s, the mA output level varies between 4 mA and 20 mA in proportion to the absolute value of the flow rate. • Under conditions of reverse flow, if the absolute value of the flow rate equals or exceeds 100 g/s, the mA output will be proportional to the absolute value of the flow rate up to 20.5 mA, and will be level at 20.5 mA at higher absolute values.

Example 3	Configuration: • Flow direction = Forward • mA output: 4 mA = –100 g/s; 20 mA = 100 g/s (See the first graph in Figure 6-2.) As a result: • Under conditions of zero flow, the mA output is 12 mA. • Under conditions of forward flow, up to a flow rate of 100 g/s, the mA output varies between 12 mA and 20 mA in proportion to (the absolute value of) the flow rate. • Under conditions of forward flow, if (the absolute value of) the flow rate equals or exceeds 100 g/s, the mA output is proportional to the flow rate up to 20.5 mA, and will be level at 20.5 mA at higher flow rates. • Under conditions of reverse flow, up to a flow rate of 100 g/s, the mA output varies between 4 mA and 12 mA in inverse proportion to the absolute value of the flow rate. • Under conditions of reverse flow, if the absolute value of the flow rate equals or exceeds 100 g/s, the mA output is inversely proportional to the flow rate down to 3.8 mA, and will be level at 3.8 mA at higher absolute values.

Table 6-3 **Effect of flow direction on totalizers and digital communications**

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

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

6.9 Configuring events

An *event* occurs if the real-time value of a user-specified process variable varies beyond a user-specified value. Events are used to perform specific actions on the transmitter. For example, the event can be defined to activate a discrete output if the flow rate is above a specified value. The discrete output, then, may be configured to close a valve.

Note: Events cannot be used to manage the filling process.

You can define one or two events. You may define the events on a single process variable or on two different process variables. Each event is associated with either a high or a low alarm.

Configuring an event includes the following steps:

1. Selecting Event 1 or Event 2.
2. Assigning a process variable to the event.
3. Specifying the Event Type:
   - *Active High* – alarm is triggered if process variable goes above setpoint
   - *Active Low* – alarm is triggered if process variable goes below setpoint

4. Specifying the setpoint – the value at which the event will occur or switch state (ON to OFF, or vice versa).

Note: Events do not occur if the process variable equals the setpoint. The process variable must be greater than (Active High) or less than (Active Low) the setpoint for the event to occur.

Example	Define Event 1 to indicate that the mass flow rate in forward or backward direction is less than 2 lb/min. 1. Specify lb/min as the mass flow unit. 2. Set Flow Direction to Absolute Value. 3. Select Event 1. 4. Configure: • Variable = Mass Flow Rate • Type = Active Low • Setpoint = 2

ProLink II automatically displays event information on the **Informational** panel of the **Status** window and in the **Output Levels** window.

6.10 Configuring slug flow limits and duration

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

Slug flow parameters are as follows:

- *Low slug flow limit* – the point below which a condition of slug flow will exist. Typically, this is the lowest density point in your process's normal density range. Default value is 0.0 g/cm^3; range is 0.0–10.0 g/cm^3.
- *High slug flow limit* – the point above which a condition of slug flow will exist. Typically, this is the highest density point in your process's normal density range. Default value is 5.0 g/cm^3; range is 0.0–10.0 g/cm^3.
- *Slug flow duration* – the number of seconds the transmitter waits for a slug flow condition (*outside* the slug flow limits) to return to normal (*inside* the slug flow limits). If the transmitter detects slug flow, it will post a slug flow alarm and hold its last "pre-slug flow" flow rate until the end of the slug flow duration. If slugs are still present after the slug flow duration has expired, the transmitter will report a flow rate of zero. Default value for slug flow duration is 0.0 seconds; range is 0.0–60.0 seconds.

If the transmitter detects slug flow:

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

Note: Raising the low slug flow limit or lowering the high slug flow limit will increase the possibility that the transmitter will report slug flow.

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

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

6.11 Configuring fault handling

There are four ways that the transmitter can report faults:

- By setting the mA output to its configured fault level (see Section 4.5.4)
- By configuring a discrete output to indicate fault status (see Section 4.6)
- By setting the digital communications fault indicator (see Section 6.12.1)
- By posting an alarm to the active alarm log

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

6.11.1 Changing status alarm severity

Status alarms are classified into three levels of severity. Severity level controls transmitter behavior when the alarm condition occurs. See Table 6-4.

Table 6-4 Alarm severity levels

Severity level	Transmitter action
Fault	If this condition occurs, an alarm will be generated and all outputs go to their configured fault levels. Output configuration is described in Chapter 4.
Informational	If this condition occurs, an alarm will be generated but output levels are not affected.
Ignore	If this condition occurs, no alarm will be generated (no entry is added to the active alarm log) and output levels are not affected.

You cannot reclassify a **Fault** alarm, or change another alarm to a **Fault** alarm. However, alarms can be reclassified from **Informational** to **Ignore**, or vice versa. For example, the default severity level for the **A118 – DO1 Fixed** alarm is **Information**, but you can set it to **Ignore**.

For a list of all status alarms and default severity levels, see Table 6-5. (For more information on status alarms, including possible causes and troubleshooting suggestions, see Section 11.10.)

Table 6-5 Status alarms and severity levels

Alarm code	ProLink II message	Default severity	Configurable?	Affected by fault timeout?
A001	CP EEPROM Failure	Fault	No	No
A002	CP RAM Failure	Fault	No	No
A003	Sensor Failure	Fault	No	Yes
A004	Temp Out of Range	Fault	No	Yes
A005	Mass Flow Overrange	Fault	No	Yes
A006	Characterize Meter	Fault	No	No
A008	Density Out of Range	Fault	No	Yes
A009	Xmtr Initializing	Fault	No	No
A010	Calibration Failure	Fault	No	No
A011	Cal Fail, Too Low	Fault	No	No
A012	Cal Fail, Too High	Fault	No	No
A013	Cal Fail, Too Noisy	Fault	No	No
A014	Transmitter Error	Fault	No	No
A016	Sensor RTD Error	Fault	No	Yes
A017	Meter RTD Error	Fault	No	Yes
A018	EEPROM Failure	Fault	No	No
A019	RAM Failure	Fault	No	No
A020	Cal Factors Missing	Fault	No	No
A021	Sensor Type Incorrect	Fault	No	No
A022(1)	CP Configuration Failure	Fault	No	No
A023(1)	CP Totals Failure	Fault	No	No
A024(1)	CP Program Corrupt	Fault	No	No
A025(1)	CP Boot Program Fault	Fault	No	No
A026	Xmtr Comm Problem	Fault	No	No
A028	Comm Problem	Fault	No	No
A032(2)	Meter Verification/Outputs In Fault	Fault	No	No
A100	mA 1 Saturated	Info	Yes	No
A101	mA 1 Fixed	Info	Yes	No
A102	Drive Overrange/Partially Full Tube	Info	Yes	No
A103(1)	Data Loss Possible	Info	Yes	No
A104	Cal in Progress	Info	Yes	No
A105	Slug Flow	Info	Yes	No
A107	Power Reset	Info	Yes	No
A108	Event 1 On	Info	Yes	No
A109	Event 2 On	Info	Yes	No
A112	Upgrade Software	Info	Yes	No
A115	External Input Error	Info	Yes	No

Table 6-5 Status alarms and severity levels *continued*

Alarm code	ProLink II message	Default severity	Configurable?	Affected by fault timeout?
A118	DO1 Fixed	Info	Yes	No
A119	DO2 Fixed	Info	Yes	No
A131(2)	Meter Verification/Outputs at Last Value	Info	Yes	No

(1) Applies only to systems with the standard core processor.
(2) Applies only to systems with the enhanced core processor.

6.11.2 Changing the fault timeout

By default, the transmitter immediately reports a fault when a fault is encountered. For specific faults, you can configure the transmitter to delay reporting the fault by changing the fault timeout to a non-zero value. If fault timeout is configured:

- During the fault timeout period, the transmitter continues to report its last valid measurement.
- The fault timeout applies only to the mA output and discrete output. Fault indication via digital communications is unaffected.

The fault timeout is not applicable to all faults. See Table 6-5 for information about which faults are affected by fault timeout.

6.12 Configuring digital communications

The digital communications parameters control how the transmitter will communicate using Modbus/RS-485 protocol.

The following digital communications parameters can be configured:

- Fault indicator
- Modbus address
- RS-485 settings
- Floating-point byte order
- Additional communications response delay

6.12.1 Changing the digital communications fault indicator

The transmitter can indicate fault conditions using a digital communications fault indicator. Table 6-6 lists the options for the digital communications fault indicator.

Note: If an output is configured for valve control, the output will never go to fault levels.

Table 6-6 Digital communications fault indicators and values

Fault indicator options	Fault output value
Upscale	Process variables indicate the value is greater than the upper sensor limit. Totalizers stop counting.
Downscale	Process variables indicate the value is less than the lower sensor limit. Totalizers stop counting.
Zero	Flow rates go to the value that represents zero flow, and density and temperature values are reported as zero. Totalizers stop counting.

Table 6-6 Digital communications fault indicators and values *continued*

Fault indicator options	Fault output value
Not-A-Number (NAN)	Process variables report IEEE NAN and Modbus scaled integers report **Max Int**. Totalizers stop counting.
Flow to Zero	Flow rates go to the value that represents zero flow; other process variables are not affected. Totalizers stop counting.
None (default)	Process variables reported as measured.

6.12.2 Changing the Modbus address

The transmitter's Modbus address is used by devices on a network to identify and communicate with the transmitter using Modbus protocol. The Modbus address must be unique on the network. If the transmitter will not be accessed using Modbus protocol, the Modbus address is not required.

Modbus addresses must be in the range 1–110, inclusive.

If you are connected to the transmitter using an RS-485 connection, and you change the Modbus address, then:

- If you are using ProLink II, ProLink II will automatically switch to the new address and retain the connection.
- If you are using a different host program, the connection will be broken. You must reconnect using the new Modbus address.

Note: Changing the Modbus address does not affect service port connections. Service port connections always use a default address of 111.

6.12.3 Changing the RS-485 parameters

RS-485 parameters control how the transmitter will communicate over its RS-485 terminals. The following parameters can be set:

- Protocol
- Baud rate
- Parity
- Stop bits

To enable RS-485 communications with the transmitter from a remote device:

1. Set the transmitter's digital communications parameters appropriately for your network.
2. Configure the remote device to use the specified parameters.

If you are connected to the transmitter using an RS-485 connection:

- And you change the the baud rate:
  - If you are using ProLink II, ProLink II will automatically switch to the new baud rate and retain the connection.
  - If you are using a different host program, the connection will be broken. You must reconnect using the new baud rate.
- And you change the protocol, parity or stop bits, all host programs will lose the connection. You must reconnect using the new settings.

Note: Changing the RS-485 communication settings does not affect service port connections. Service port connections always use default settings.

6.12.4 Changing the floating-point byte order

Four bytes are used to transmit floating-point values. For contents of bytes, see Table 6-7.

Table 6-7 Byte contents in Modbus commands and responses

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

The default byte order for the transmitter is 3–4–1–2. You may need to reset byte order to match the byte order used by a remote host or PLC. Byte order codes are listed in Table 6-8.

Table 6-8 Byte order codes and byte orders

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

6.12.5 Changing the additional communications response delay

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

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

6.13 Configuring variable mapping

The Variable Mapping panel in the Configuration window provides another way to assign the primary variable (PV). The PV parameter shown on this panel is the same as the Primary Variable parameter in the Analog Output panel (see Section 4.5): if you change the parameter here, it is automatically changed in the Analog Output panel, and vice versa.

The secondary variable (SV), tertiary variable (TV), and quaternary variable (QV) are not used by the Model 1500 transmitter with the filling and dosing application, and cannot be changed.

6.14 Configuring device settings

The device settings are used to describe the flowmeter components. Table 6-9 lists and defines the device settings.

Table 6-9 Device settings

Parameter	Description
Tag	Also called the “software tag.” Used by other devices on the network to identify this transmitter. The tag must be unique on the network. Not used in transmitter processing and not required. Maximum length: 8 characters.
Descriptor	Any user-supplied description. Not used in transmitter processing, and not required. Maximum length: 16 characters.
Message	Any user-supplied message. Not used in transmitter processing, and not required. Maximum length: 32 characters.
Date	Any user-selected date. Not used in transmitter processing, and not required.

If you are entering a date, use the left and right arrows at the top of the calendar to select the year and month, then click on a date.

6.15 Configuring sensor parameters

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

- Serial number
- Model number
- Sensor material
- Liner material
- Flange

Chapter 7
Configuring the Filling and Dosing Application

Using the Transmitter
Optional Configuration
Filler Configuration
Using the Filler

7.1 About this chapter

This chapter explains how to configure the filling and dosing application on the Model 1500 transmitter. For information on using the filling and dosing application, see Chapter 8.

> **⚠ CAUTION**
>
> **Changing configuration can affect transmitter operation, including filling.**
>
> Changes made to filling configuration while a fill is running do not take effect until the fill is ended. Changes made to other configuration parameters may affect filling. To ensure correct filling, do not make any configuration changes while a fill is in progress.

7.2 User interface requirements

ProLink II v2.3 or later is required to configure the filling and dosing application.

Alternatively, configuration can be performed via a customer-written program using the Modbus interface to the Model 1500 transmitter and the filling and dosing application. Micro Motion has published the Modbus interface in the following manuals:

- *Using Modbus Protocol with Micro Motion Transmitters*, November 2004, P/N 3600219, Rev. C (manual plus map)
- *Modbus Mapping Assignments for Micro Motion Transmitters*, October 2004, P/N 20001741, Rev. B (map only)

Both of these manuals are available on the Micro Motion web site.

7.3 About the filling and dosing application

The filling and dosing application is used to begin flow, then end flow automatically when the target amount of process fluid has flowed through the sensor. During a fill, flow may be paused and resumed. A fill may also be ended before the target is reached.

Transmitter outputs change state according to fill status or operator commands. The control system opens or closes valves in response to the signals from the transmitter. The filling and dosing application must be configured for the type of valve used for fill control:

- One-stage discrete – Fill controlled by a single discrete (ON/OFF) valve. The valve opens completely when the fill begins, and closes completely when the fill target is reached (or the fill is paused or ended).
- Two-stage discrete – Fill 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. See Figure 7-1 for illustrations of the different opening and closing options.
- Three-position analog – Fill controlled by one analog valve which can be fully open, fully closed, or partially closed. See Figure 7-2 for an illustration of the three-position analog fill.

The Model 1500 filling transmitter provides three outputs which can be used for valve control:

- Channel B always functions as a discrete output, and can be used to control the primary valve.
- Channel C can function as a discrete output or a discrete input. When used as a discrete output, it can be assigned to control the secondary valve.
- The mA output on Channel A can function as:
  - A discrete output, to control either the primary or secondary valve. When used as a discrete output, an interposing solid-state relay is required.
  - A three-level output, to control a three-position analog valve. When used as a three-level output, the 20 mA output level sets the valve to open full, and two user-specified output levels are used to set the valve to closed and to closed partial.

Note: If Channel A is configured for valve control, the channel cannot be used to report alarm status and the mA output will never go to fault levels.

Accordingly:

- A one-stage discrete fill requires either Channel A or Channel B configured to control the primary valve.
- A two-stage discrete fill requires any valid pair of Channels A, B, and C configured to control the primary and secondary valves.
- A three-position analog fill requires Channel A configured as a three-level output.

Note: See Table 7-1 for detailed information on output options.

Figure 7-1 Two-stage discrete fill

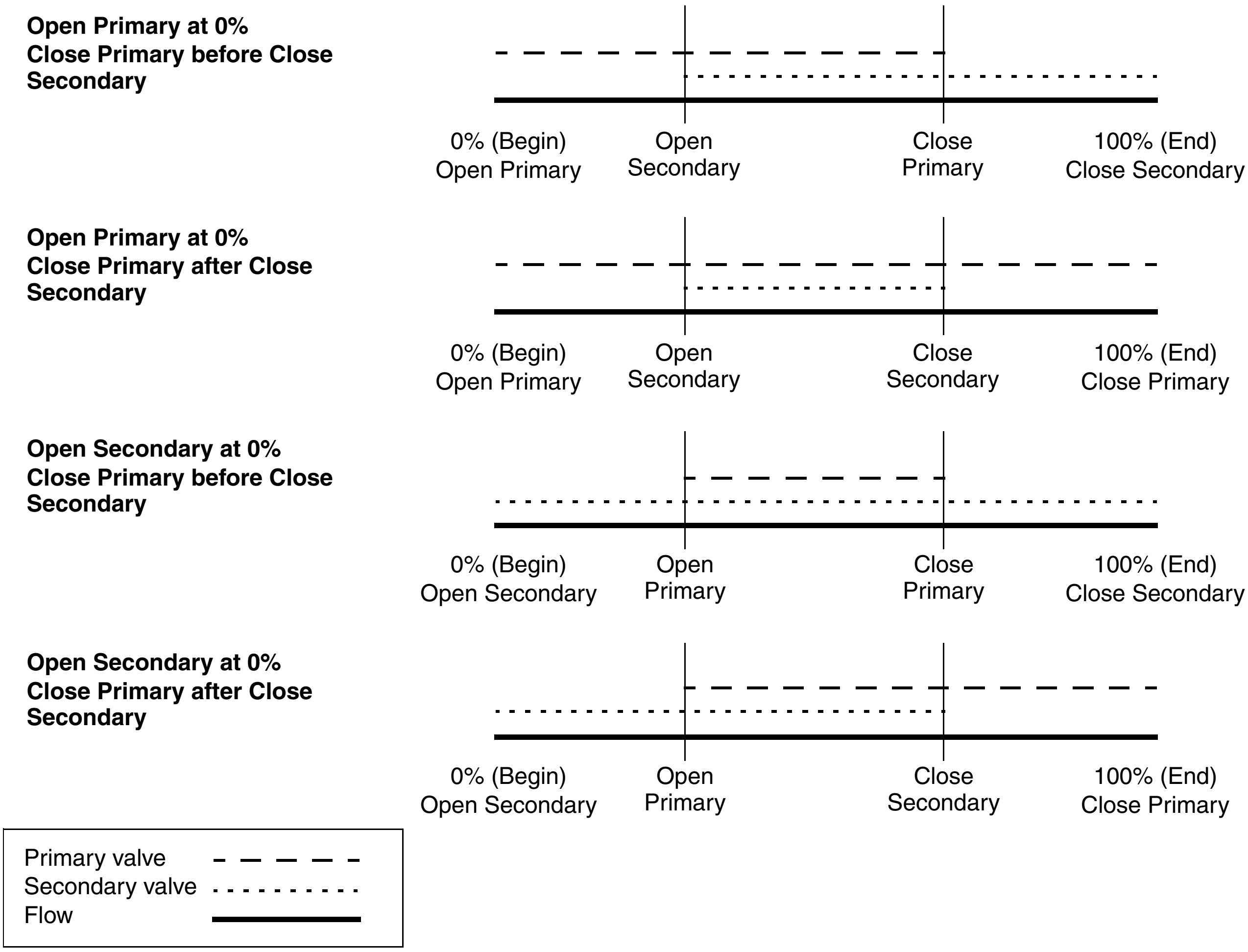
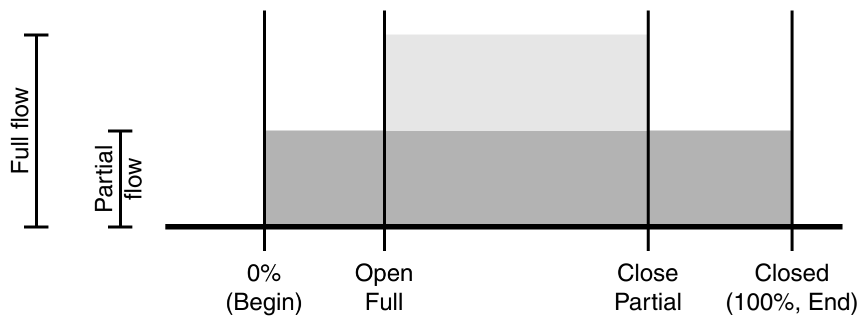


Figure 7-2 Three-position analog fill



7.3.1 Purge

Note: Two-stage discrete filling is not supported if a purge cycle is configured. If this functionality is required, configure the mA output as a three-level output, to control the fill, and configure Channel C as a discrete output, to control the purge.

If purge will be performed, one of the following valve control configurations is required:

- Two discrete outputs (one may be the mA output configured as a discrete output). One must be assigned to the primary valve and the other must be assigned to the secondary valve. The primary valve is used to control the fill, and the secondary valve controls the purge.
- The mA output configured as a three-level output, and Channel C configured as a discrete output assigned to the secondary valve.

The second discrete output is typically set up to control compressed air or a vacuum. These techniques are used to clear any process fluid that may be left in the piping from the previous fill.

There are two purge modes: manual and automatic.

- If **Manual** is configured, the **Begin Purge** and **End Purge** buttons on the **Run Filler** window are used to control the purge. The **End Fill** button also stops a purge.
- If **Auto** is configured, the purge starts automatically after the configured **Purge Delay**, and continues for the configured **Purge Time**. The purge may be stopped manually using the **End Fill** button.

In both cases, the discrete output assigned to the secondary valve transmits an Open signal when the purge begins, and transmits a Closed signal when the purge ends. The primary valve remains closed throughout the purge.

The purge can be stopped at any point, by using the **End Purge** or **End Fill** button.

7.3.2 Cleaning

Cleaning does not require any special valve configuration. When cleaning is started, all valves assigned to the system (except any valves configured for purging, as discussed in the previous section) are opened; when cleaning is stopped, all valves assigned to the system are closed.

Typically, cleaning involves flowing water or air through the system.

7.4 Configuring the filling and dosing application

To configure the filling and dosing application:

1. Open the ProLink II **Configuration** window.
2. Click the **Filling** tab. The panel shown in Figure 7-3 is displayed. In this panel:
   a. Configure the flow source (see Section 7.4.1) and click **Apply**.
   b. Configure **Fill Type** and other filling control options (see Section 7.4.2) and click **Apply**.

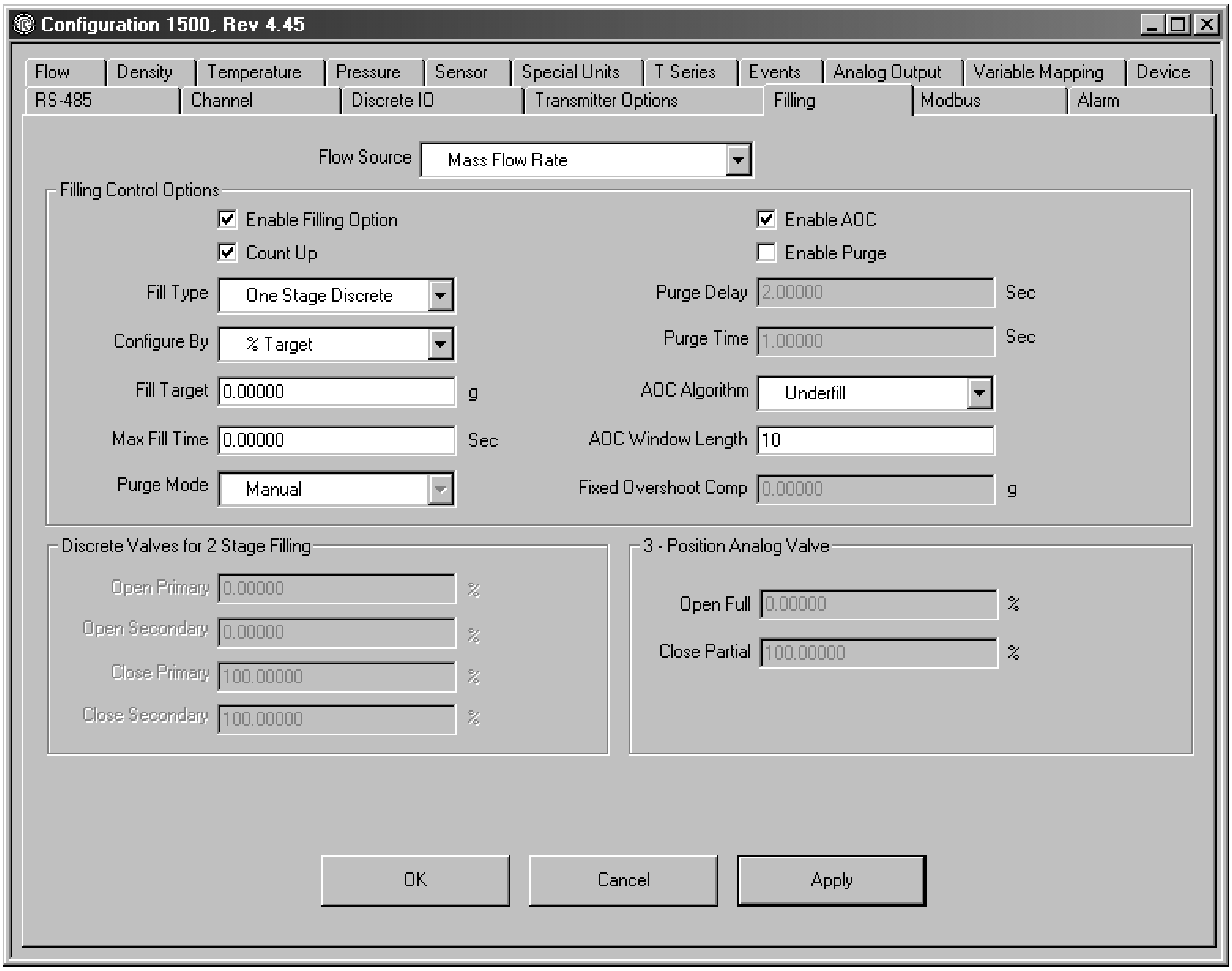
Note: You must configure Fill Type before configuring valve control.

3. Configure valve control as required:
   - If you are configuring a one-stage discrete fill, skip this step and continue with Step 6.
   - If you are configuring a two-stage discrete fill, configure **Open Primary**, **Open Secondary**, **Close Primary**, and **Close Secondary** (see Section 7.4.3 and Table 7-4), then click **Apply**.

Note: Either Open Primary or Open Secondary must be set to 0. Either Close Primary or Close Secondary must be set to 100% (if configured by %) or 0 (if configured by quantity). Settings are adjusted automatically to ensure that these requirements are met.

- If you are configuring a three-position analog fill, configure **Open Full** and **Closed Partial** values (see Section 7.4.3 and Table 7-5), then click **Apply**.

Figure 7-3 **Filling panel**



4. Configure transmitter outputs for the requirements of your filling application. Options are listed in Table 7-1.
   - To configure Channel B or C as a discrete output, use the **Channel Configuration** panel in the ProLink II **Configuration** window (see Section 4.6). To assign a function to Channel B or Channel C, use the **Discrete IO** panel in the ProLink II **Configuration** window (see Figure 7-4).
   - To configure Channel A as a discrete output, use the **Analog Output** panel in the ProLink II **Configuration** window (see Figure 7-5). In this panel:
     - Set **Primary Variable** to **Primary Valve** or **Secondary Valve**.
     - Ensure that **Enable 3 Position Valve** is disabled.

- To configure Channel A as a three-level output, use the **Analog Output** panel and:
  - Set **Primary Variable** to **Primary Valve**.
  - Ensure that **Enable 3 Position Valve** is enabled.
  - Specify the **Setpoint**, which is the mA output level that sets the valve to closed partial.
  - Specify the **Closed Value**, which is the mA output level that sets the valve to closed full. This value must be between 0 and 4 mA, and should be set according to the requirements of the valve.

Table 7-1 Output requirements and assignments

Fill type	Output requirements	Options	Assignment
One-stage discrete	One discrete output	Channel A	Primary valve
		Channel B	Primary valve
One-stage discrete with purge cycle	Two discrete outputs	Channel A Channel C	Primary valve; 3-position valve disabled Secondary (purge) valve
		Channel B Channel A	Primary valve Secondary (purge) valve with 3-position valve disabled
		Channel B Channel C	Primary valve Secondary(purge) valve
Two-stage discrete	Two discrete outputs	Channel A Channel C	Primary valve with 3-position valve disabled Secondary valve
		Channel B Channel A	Primary valve Secondary valve with 3-position valve disabled
		Channel B Channel C	Primary valve Secondary valve
Three-position analog	One three-level output	Channel A	Primary valve with 3-position valve enabled
Three-position analog with purge cycle	One three-level output and one discrete output	Channel A Channel C	Primary valve with 3-position valve enabled Secondary (purge) valve

Figure 7-4 Discrete IO panel

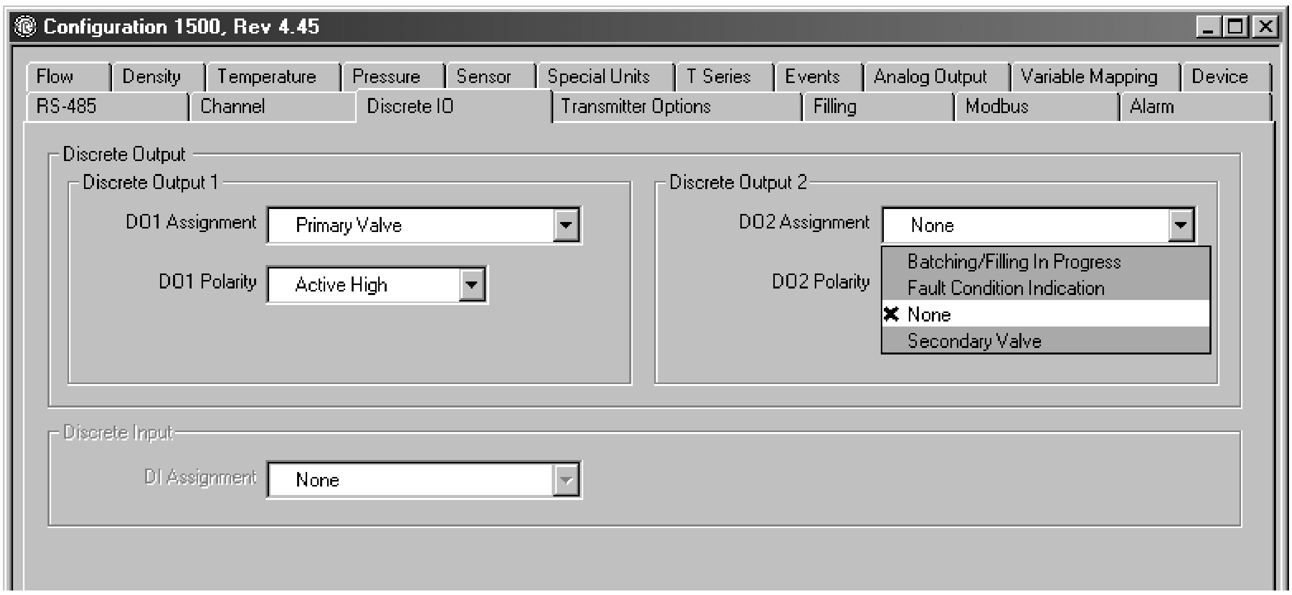
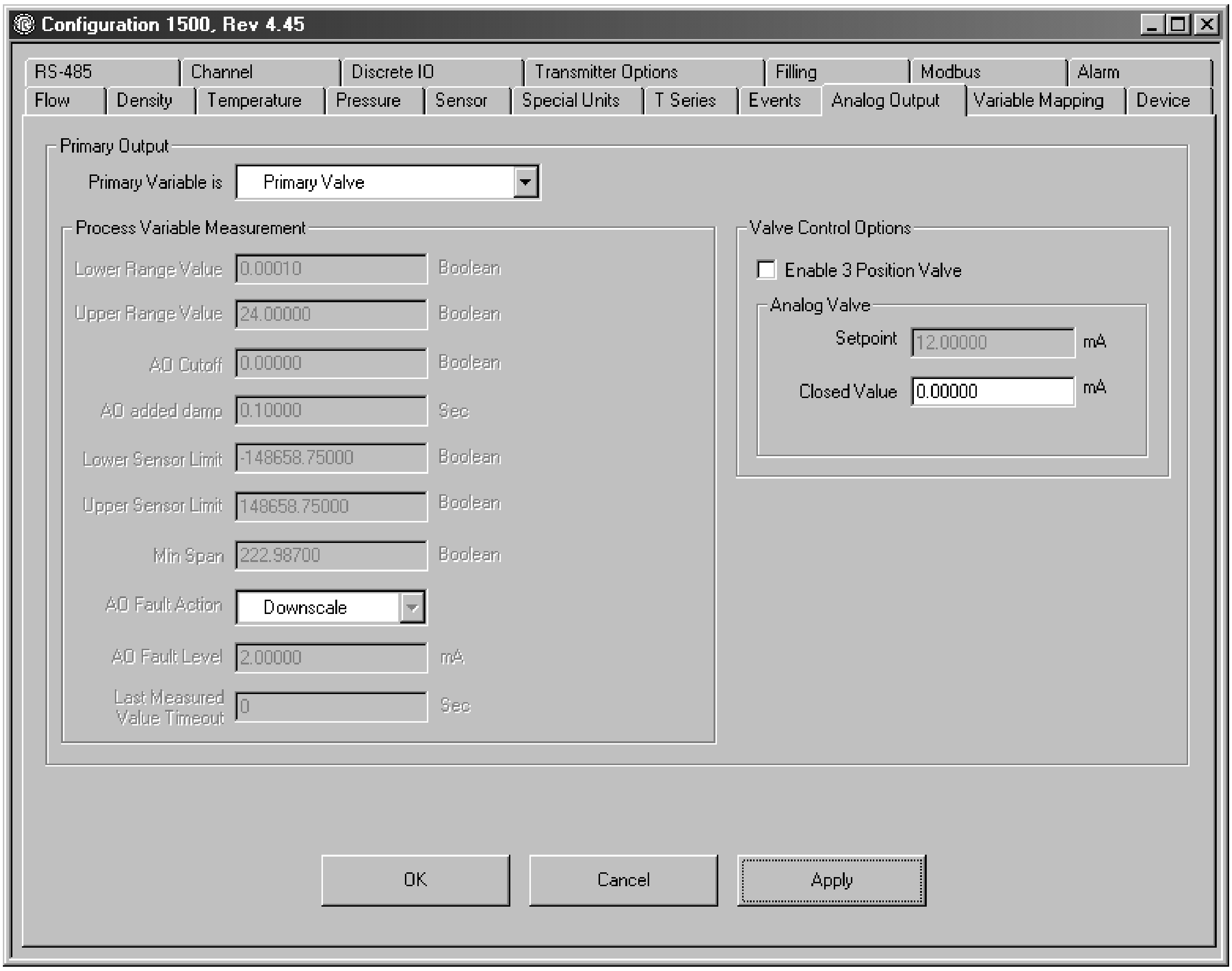


Figure 7-5 **Analog Output panel**



5. If you want to use overshoot compensation, see Section 7.5 for options and configuration instructions. This applies to both fixed and automatic overshoot compensation (AOC).
6. If Channel C has been configured as a discrete input, you can assign a fill control function to this channel. See Section 8.3.2.

7.4.1 Flow source

The flow source specifies the flow variable that will be used to measure fill quantity. Select one of the flow sources defined in Table 7-2.

- If you select **None**, the filling application is automatically disabled.
- If you select **Mass Flow Rate** or **Volume Flow Rate**, that variable will automatically be defined as the 100 Hz variable, and **Update Rate** will automatically be set to **Special**. See Section 6.7 for more information.

Note: If the filling application is enabled, you should not specify any variable other than the flow source variable as the 100 Hz variable.

Table 7-2 Flow sources

Flow source	Default	Description
None		Fill controller is disabled.
Mass flow rate	✓	Mass flow process variable as measured by transmitter
Volume flow rate		Volume flow process variable as measured by transmitter

7.4.2 Filling control options

The filling control options are used to define the fill process. Filling control options are listed and defined in Table 7-3.

Table 7-3 Filling control options

Control option	Default	Description
Enable Filling Option	Enabled	If enabled, the filling application is available for use. If disabled, the filling application is not available for use. However, it is still installed on the transmitter.
Count Up	Enabled	Controls how the fill total is calculated and displayed: • If enabled, fill totals increase from zero to the target value. • If disabled, fill totals decrease from the target value to zero. Does not affect fill configuration.
Enable AOC	Enabled	Automatic Overshoot Compensation (AOC) instructs the fill controller to compensate for the time required to close the valve, using the calculated AOC coefficient. See Section 7.5 for overshoot compensation options.
Enable Purge	Disabled	If enabled, the secondary valve is used for purging. See Section 7.3.1.
Fill Type	One Stage Discrete	Specify One Stage Discrete, Two Stage Discrete, or Three Position Analog. See Section 7.3. If Purge is enabled, you may not specify Two Stage Discrete. See Section 7.3.1.
Configure By	% Target	Select % Target or Quantity. • If set to % Target, Open Primary, Open Secondary, Close Primary, and Close Secondary values are configured as a percentage of the fill target. • If set to Quantity, Open Primary and Open Secondary are each configured as a quantity at which the valve should open; Close Primary and Close Secondary are configured as a quantity that is subtracted from the target.
Fill Target	0.00000 g	Enter the value at which the fill will be complete. • If Mass Flow Rate was specified for flow source, enter the value in the current measurement unit for mass. This unit is derived from the mass flow measurement unit (see Section 4.4.1). • If Volume Flow Rate was specified for flow source, enter the value in the current measurement unit for volume. This unit is derived from the volume flow measurement unit (see Section 4.4.2).
Max Fill Time	0.00000 sec	Enter a value of 0.00000 or any positive number (in seconds). There is no upper limit. If the fill does not reach the target before this time has elapsed, the fill is aborted and fill timeout error messages are posted. If Max Fill Time is set to 0, it is disabled.
Purge Mode	Manual	Select the purge control method: • Auto: A purge cycle occurs automatically after every fill, as defined by the Purge Delay and Purge Time parameters. • Manual: Purge must be started and stopped using the buttons on the Run Filler window. Purge must be enabled before Purge Mode can be configured.
Purge Delay	2.00000 sec	Used only if Purge Mode is set to Auto. Enter the number of seconds that will elapse after a fill is complete before the purge will begin. At this point, the purge (secondary) valve will be opened automatically.

Table 7-3 **Filling control options** *continued*

Control option	Default	Description
Purge Time	1.00000 sec	Used only if Purge Mode is set to Auto. Enter the purge duration, in seconds. When Purge Time has elapsed, the purge (secondary) valve will be closed automatically.
AOC Algorithm	Underfill	Select the type of overshoot compensation to be performed: • Underfill – The actual quantity delivered will never exceed the target quantity. • Overfill – The actual quantity delivered will never be less than the target quantity. • Fixed – The valve will close at the point defined by the target quantity minus the Fixed Overshoot Comp parameter. Underfill and Overfill are available only if AOC is enabled. Fixed is available only if AOC is disabled.
AOC Window Length	10	For standard AOC calibration, specify the maximum number of fills that will be run during calibration. For rolling AOC calibration, specify the number of fills that will be used to calculate AOC.
Fixed Overshoot Comp	0.00000	Used only if AOC is disabled and AOC Algorithm is set to Fixed. Enter the value to be subtracted from the target quantity to determine the point at which the valve will close. Enter the value in mass or volume units, as appropriate to the configured flow source.

7.4.3 Valve control parameters

The valve control parameters are used to open and close the valves at particular points in the fill process.

- Valve control parameters for two-stage discrete filling are listed and defined in Table 7-4.
- Valve control parameters for three-position analog filling are listed and defined in Table 7-5.

Note: Valve control parameters are not used for one-stage discrete filling. In one-stage discrete filling, the valve opens when the fill is started, and closes when the fill target is reached.

Table 7-4 Valve control parameters – Two-stage discrete fill

Flow option	Default	Description
Open Primary	0.00% of target	Enter the quantity or the percent of the target at which the primary valve will open. Either Open Primary or Open Secondary must be set to 0. If one of these parameters is set to a non-zero value, the other is set to 0 automatically. Before a fill of this type can be started, the primary valve must be assigned to a discrete output. See Section 7.4, Step 4.
Open Secondary	0.00% of target	Enter the quantity or the percent of the target at which the secondary valve will open. Either Open Primary or Open Secondary must be set to 0. If one of these parameters is set to a non-zero value, the other is set to 0 automatically. Before a fill of this type can be started, the secondary valve must be assigned to a discrete output. See Section 7.4, Step 4.
Close Primary	100.00% of target	Enter the percent of the target, or the quantity to be subtracted from the target, at which the primary valve will close.(1) Either Close Primary or Close Secondary must be set to close when the target is reached. If one of these parameters is set to a value that is not the target, the other is adjusted accordingly.
Close Secondary	100.00% of target	Enter the percent of the target, or the quantity to be subtracted from the target, at which the secondary valve will close.(1) Either Close Primary or Close Secondary must be set to close when the target is reached. If one of these parameters is set to a value that is not the target, the other is adjusted accordinly.

(1) See the definition of Configure By in Table 7-3.

Table 7-5 Valve control parameters – Three-position analog fill

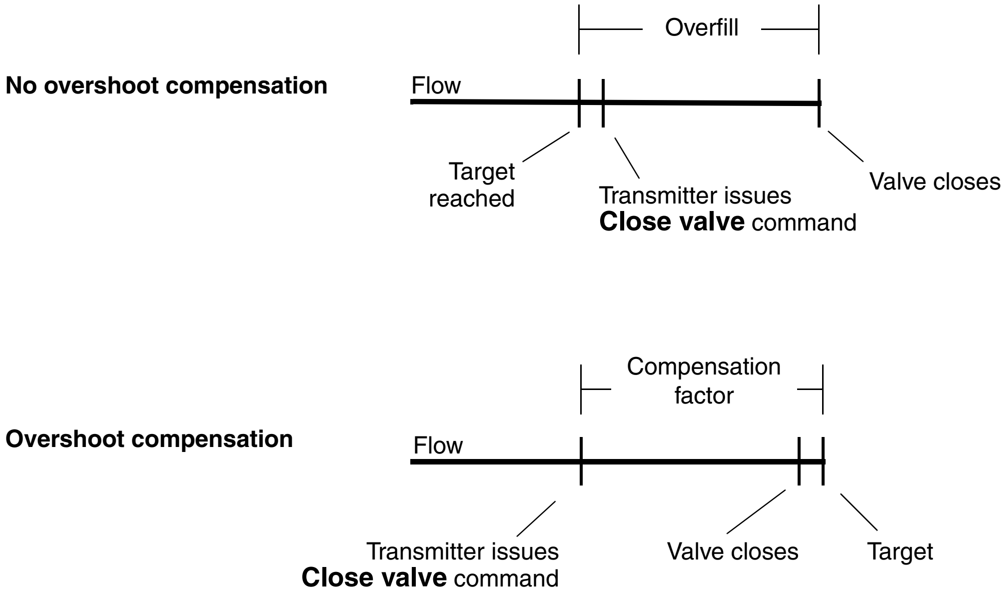
Flow option	Default	Description
Open Full	0.00% of target	Enter the quantity or the percent of the target at which the valve will transition from partial flow to full flow.
Close Partial	100.00% of target	Enter the percent of the target, or the quantity to be subtracted from the target, at which the valve will transition from full flow to partial flow.(1)

(1) See the definition of Configure By in Table 7-3.

7.5 Overshoot compensation

Overshoot compensation keeps the actual quantity delivered as close as possible to the fill target by compensating for the time required to close the valve. Without overshoot compensation, there will always be some amount of overfill because of the time required for the transmitter to observe that the target has been reached and send the command to close the valve, and then for the control system and valve to respond. When overshoot compensation is configured, the transmitter issues the valve close command before the target is reached. See Figure 7-6.

Figure 7-6 Overshoot compensation and flow



Three types of overshoot compensation can be configured:

- *Fixed* – The valve will close at the point defined by the target minus the quantity specified in **Fixed Overshoot Comp**.
- *Underfill* – The valve will close at the point defined by the AOC coefficient calculated during AOC calibration, adjusted to ensure that the actual quantity delivered never exceeds the target. (The initial adjusted target is less than the actual target, and moves upward toward the target during calibration.)
- *Overfill* – The valve will close at the point defined by the AOC coefficient calculated during AOC calibration, adjusted to ensure that the actual quantity delivered is never less than the target. (The variance of the fills is added to the AOC-adjusted target.)

AOC calibration is required only if Underfill or Overfill is configured. There are two forms of AOC calibration:

- *Standard* – Several fills are run during a special "calibration period." The AOC coefficient is calculated from data collected from these fills. See Section 7.5.2 for instructions on the standard AOC calibration procedure.
- *Rolling* – The AOC coefficient is calculated from data collected from the *x* most recent fills, where *x* is the value specified for **AOC Window Length**. There is no special calibration period. For example, if **AOC Window Length** is set to 10, the first AOC coefficient is calculated from the first ten fills. When the eleventh fill is run, the AOC coefficient is recalculated, based on the ten most recent fills, and so on. No special calibration procedure is required.

7.5.1 Configuring overshoot compensation

Fixed overshoot compensation is used if the compensation value is already known. To configure fixed overshoot compensation:

1. Disable the **Enable AOC** checkbox in the **Filling** panel (see Figure 7-3).
2. Set **AOC Algorithm** to **Fixed**.
3. Click **Apply**.
4. Specify the appropriate value for **Fixed Overshoot Comp**. Enter values in the unit used for the flow source.
5. Click **Apply**.

Note: Do not enable the Enable AOC checkbox. The Enable AOC checkbox is enabled only for underfill or overfill.

To configure automatic overshoot compensation for underfill or overfill:

1. Enable the **Enable AOC** checkbox in the **Filling** panel (see Figure 7-3).
2. Set **AOC Algorithm** to **Underfill** or **Overfill**.
3. Set **AOC Window Length**:
   - If standard AOC calibration will be used, specify the maximum number of fills that will be used to calculate the AOC coefficient during calibration.
   - If rolling AOC calibration will be used, specify the number of fills that will be used to calculate the AOC coefficient.
4. Click **Apply**.
5. If standard AOC calibration will be used, follow the instructions in Section 7.5.2. If rolling AOC calibration will be used, follow the instructions in Section 7.5.3.

7.5.2 Standard AOC calibration

Note: In common use, the first training fill will always be slightly overfilled because the default compensation factor is 0. To prevent this, set the AOC Coeff value in the Run Filler window (see Figure 8-1) to a small positive number. This value must be small enough so that when it is multiplied by the flow rate, the resulting value is less than the fill target.

To perform standard AOC calibration:

1. Click **ProLink > Run Filler**. The window shown in Figure 8-1 is displayed.
2. Click **Start AOC Cal**. The **AOC Calibration Active** light turns red, and will remain red while AOC calibration is in progress.
3. Run as many fills as desired, up to the number specified in **AOC Window Length**.

Note: If you run more fills, the AOC coefficient is calculated from the x most recent fills, where x is the value specified for AOC Window Length.

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

The AOC coefficient is calculated from the fills run during this time period, and is displayed in the **Run Filler** window. This factor will be applied to all subsequent fills while AOC is enabled, until another AOC calibration is performed.

Another AOC calibration is recommended:

- If equipment has been replaced or adjusted
- If flow rate has changed significantly
- If fills are consistently missing the target value

7.5.3 Rolling AOC calibration

Note: In common use, the first fill may be slightly overfilled because the default compensation factor is 0.2. To prevent this, increase the AOC Coeff value in the Run Filler window (see Figure 8-1). This value must be small enough so that when it is multiplied by the flow rate, the resulting value is less than the fill target.

To enable rolling AOC calibration:

1. Click **ProLink > Run Filler**. The window shown in Figure 8-1 is displayed.
2. Click **Start AOC Cal**. The **AOC Calibration Active** light turns red.
3. Begin filling. Do not click **Save AOC Cal**. The AOC coefficient is recalculated after each fill, and the current value is displayed in the **Run Filler** window.

At any time, you can click **Save AOC Cal.** The current AOC coefficient will be saved in the transmitter and used for all overshoot compensation during subsequent fills. In other words, this action changes the AOC calibration method from rolling to standard.

Chapter 8
Using the Filling and Dosing Application

8.1 About this chapter

This chapter explains how to use the filling and dosing application on the Model 1500 transmitter. For information on configuring the filling and dosing application, see Chapter 7.

⚠ CAUTION

Changing configuration can affect transmitter operation, including filling.

Changes made to filling configuration while a fill is running do not take effect until the fill is ended. Changes made to other configuration parameters may affect filling. To ensure correct filling, do not make any configuration changes while a fill is in progress.

8.2 User interface requirements

ProLink II can be used to operate the filling and dosing application. If desired, a discrete input can be configured to perform a fill control function.

Alternatively, the filling and dosing application can be operated by a customer-written program using the Modbus interface to the Model 1500 transmitter and the filling and dosing application. Micro Motion has published the Modbus interface in the following manuals:

- *Using Modbus Protocol with Micro Motion Transmitters*, November 2004, P/N 3600219, Rev. C (manual plus map)
- *Modbus Mapping Assignments for Micro Motion Transmitters*, October 2004, P/N 20001741, Rev. B (map only)

Both of these manuals are available on the Micro Motion web site.

8.3 Operating the filling and dosing application from ProLink II

To operate the filling and dosing application from ProLink II, open the ProLink II **Run Filler** window and use the fill control buttons. The following actions may performed:

- Beginning, ending, pausing, and resuming a fill
- Manually starting and stopping a purge
- Manually starting and stopping a clean
- Performing standard AOC calibration (see Section 7.5.2)

In addition, the **Run Filler** window allows you to reset various fill parameters and displays a variety of fill status information.

Figures 8-3 through 8-7 illustrate the various fill sequences for two-stage discrete filling or three-position analog filling when the fill is paused and resumed at different points in the fill.

Note: The fill total is not held across a transmitter power cycle.

8.3.1 Using the Run Filler window

The ProLink II **Run Filler** window is shown in Figure 8-1.

The Fill Setup, Fill Control, AOC Calibration, Fill Statistics, and Fill Data displays and controls are listed and defined in Table 8-1.

The Fill Status fields show the current status of the fill or the filling application:

- A green LED indicates that the condition is inactive or the valve is closed.
- A red LED indicates that the condition is active or the valve is open.

The Fill Status fields are defined in Table 8-2.

Figure 8-1 Run Filler window

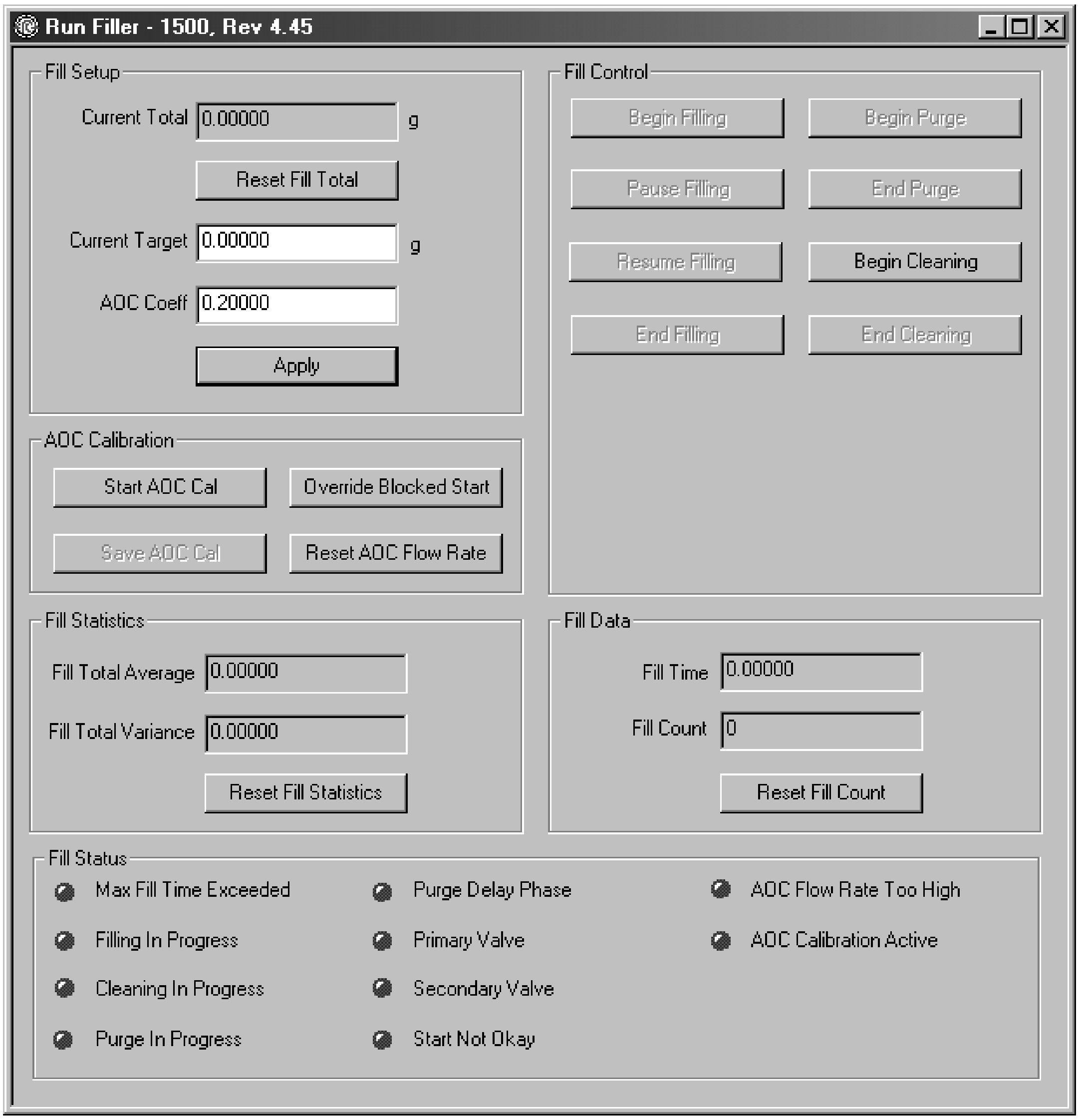


Table 8-1 Run Filler displays and controls

Display/Control		Description
Fill Setup	Current Total	Displays the running fill total, updated periodically, for the current fill. This value is not updated between fills. However, if flow is present while a fill is paused, the value is updated.
	Reset Fill Total	Resets the fill total to 0.
	Current Target	Displays the target quantity for the current fill. • To change this value, enter the new target value and click Apply. • You cannot change the target while a fill is in progress, unless the fill is paused.
	AOC Coeff	Displays the factor used to adjust the target, if AOC is enabled.(1) • To change this value, enter the new AOC value and click Apply. WARNING: Writing to this parameter will overwrite any existing AOC calibration results. • You cannot change the AOC coefficient while a fill is in progress, whether the fill is currently flowing or is paused.
Fill Control	Begin Filling	Starts the fill. The fill total is automatically reset before filling begins.
	Pause Filling	Temporarily stops the fill. The fill can be resumed if the fill total is less than the fill target.
	Resume Filling	Restarts a fill that has been paused. Counting resumes from the total at which the fill was paused.
	End Filling	Permanently stops the fill or purge. The fill cannot be resumed.
	Begin Purge	Begins a manual purge by opening the secondary valve. You cannot begin a purge while a fill is in progress. You cannot begin a fill while a purge is in progress.
	End Purge	Ends a manual purge by closing the secondary valve.
	Begin Cleaning	Opens all valves (except purge valve) that are assigned to a transmitter output. Cleaning cannot be started if a fill or purge is in progress.
	End Cleaning	Closes all valves that are assigned to a transmitter output.
AOC Calibration	Start AOC Cal	Begins AOC calibration.
	Save AOC Cal	Ends AOC calibration and saves the calculated AOC coefficient.
	Override Blocked Start	Enables filling if the fill has been blocked by: • Slug flow • A core processor fault • The last measured flow rate is too high, as indicated by the corresponding status LED (see Table 8-2).
	Reset AOC Flow Rate(2)	Resets the last measured flow rate to zero, to bypass the condition indicated by the AOC Flow Rate Too High status LED (see Table 8-2). If the flow rate is too high, and this is not a one-time condition: • And you are using standard AOC calibration, try resetting the AOC flow rate (see below). If this does not clear the condition, repeat AOC calibration. • And you are using rolling AOC calibration, overriding the blocked start once or twice should correct the condition.

Table 8-1 Run Filler displays and controls *continued*

Display/Control		Description
Fill Statistics	Fill Total Average	Displays the calculated average of all fill totals since fill statistics were reset.
	Fill Total Variance	Displays the calculated variance of all fill totals since fill statistics were reset.
	Reset Fill Statistics	Resets fill total average and fill total variance to zero.
Fill Data	Fill Time	Displays the number of seconds that have elapsed in the current fill. Seconds that the fill was paused are not included in the fill time value.
	Fill Count	Displays the number of fills that have been performed since fill statistics were reset. Only completed fills are counted; fills that were ended before the target was reached are not included in this total. The maximum number is 65535; after that number has been reached, counting resumes with 1.
	Reset Fill Count	Resets the fill counter to zero.

(1) This field displays the result of AOC calibration. If you reset it manually, AOC calibration data is lost. Typically, the only reason to set it manually is to prevent overfill on the first few fills. See Section 7.5.
(2) Applicable only when AOC Algorithm is set to Underfill.

Table 8-2 Fill Status fields

Status LED	Description
Max Fill Time Exceeded	The current fill has exceeded the current setting for Max Fill Time. The fill is aborted.
Filling In Progress	A fill is currently being performed.
Cleaning In Progress	The Start Clean function has been activated, and all valves assigned to transmitter outputs are open (except purge valve)
Purge In Progress	A purge has been started, either automatically or manually.
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.
Primary Valve	The primary valve is open. If a three-position analog valve has been configured, the valve is either open or closed partial.
Secondary Valve	The secondary valve is open.
Start Not Okay	One or more conditions required to start a fill are not met.
AOC Flow Rate Too High	The last measured flow rate is too large 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 with no corresponding change in the AOC coefficient. AOC calibration is recommended. To adjust the AOC value, you can use the Override Blocked Start function to run a fill without AOC (see Table 8-1).
AOC Calibration Active	AOC calibration is in progress.

8.3.2 Using a discrete input

If a discrete input is assigned to a fill control function, the function is triggered when the discrete input is in an ON state.

Table 8-3 lists the fill control functions. To assign a discrete input to trigger a fill function:

1. Ensure that Channel C is configured as a discrete input (see Section 4.3).
2. Open the ProLink II **Configuration** window and click on the **Discrete IO** tab. The panel shown in Figure 8-2 is displayed.
3. Select the fill control function to be triggered. Fill control functions are listed and defined in Table 8-3.

Figure 8-2 Discrete IO panel

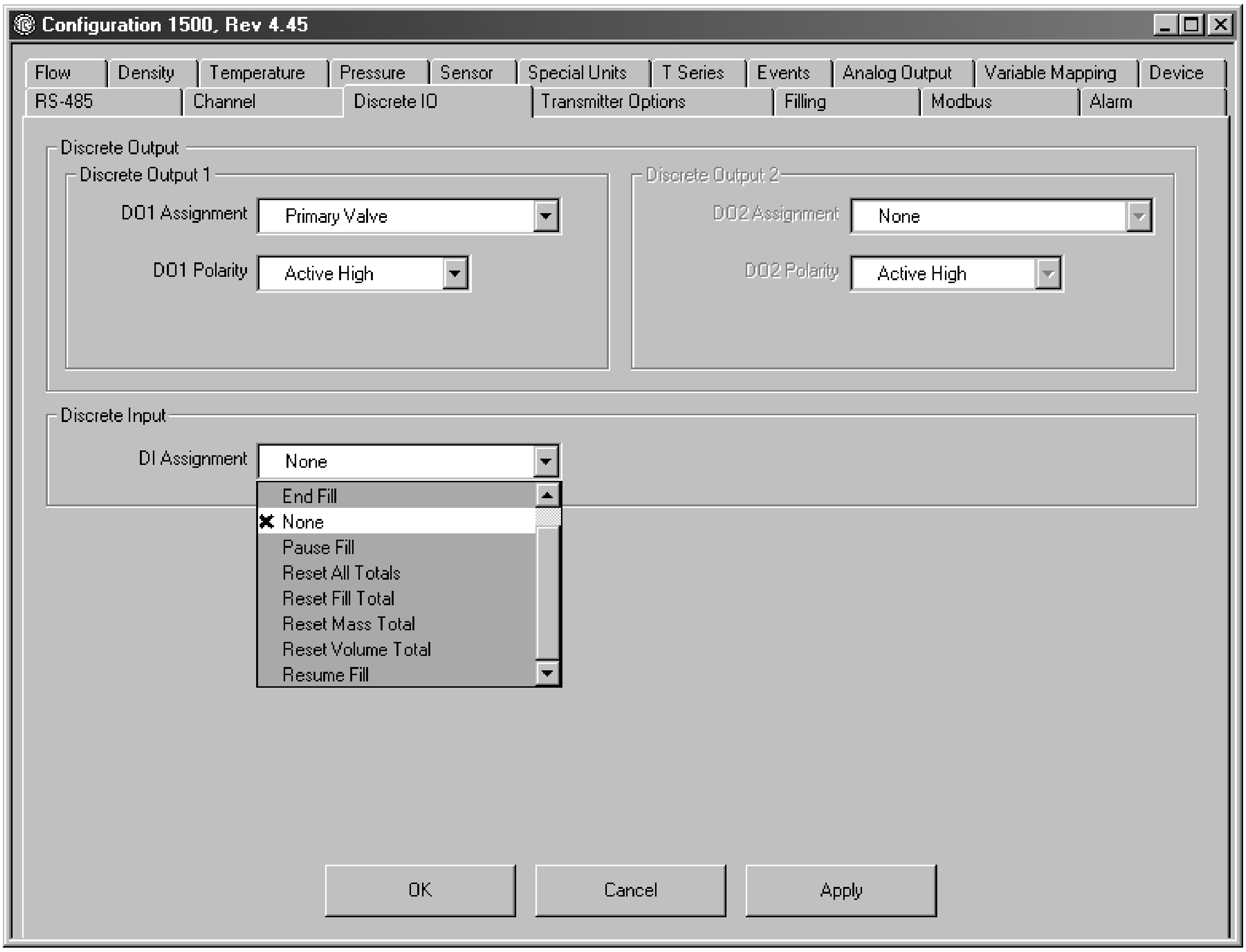


Table 8-3 Fill control functions

Function	ON state actions
Begin fill	• Starts the fill. • The fill total is automatically reset before filling begins.
End fill	• Permanently stops the fill. • The fill cannot be resumed.
Pause fill	• Temporarily stops the fill. • The fill can be resumed if the fill total is less than the fill target.
Resume fill	• Restarts a fill that has been paused. • Counting resumes from the point at which the fill was paused.
Reset fill total	• Resets fill total to zero. • Reset cannot be performed while a fill is running or while a fill is paused. Before a fill can be reset, the fill target must be reached or the fill must be ended.

Note: The Reset All Totals function (see Section 4.7) includes resetting the fill total.

8.3.3 Fill sequences with PAUSE and RESUME

This section provides illustrations of fill sequences when the fill is paused and resumed at different points in the process.

Figure 8-3 Fill sequences: Two-stage discrete fill, Open Primary at 0%, Close Primary First

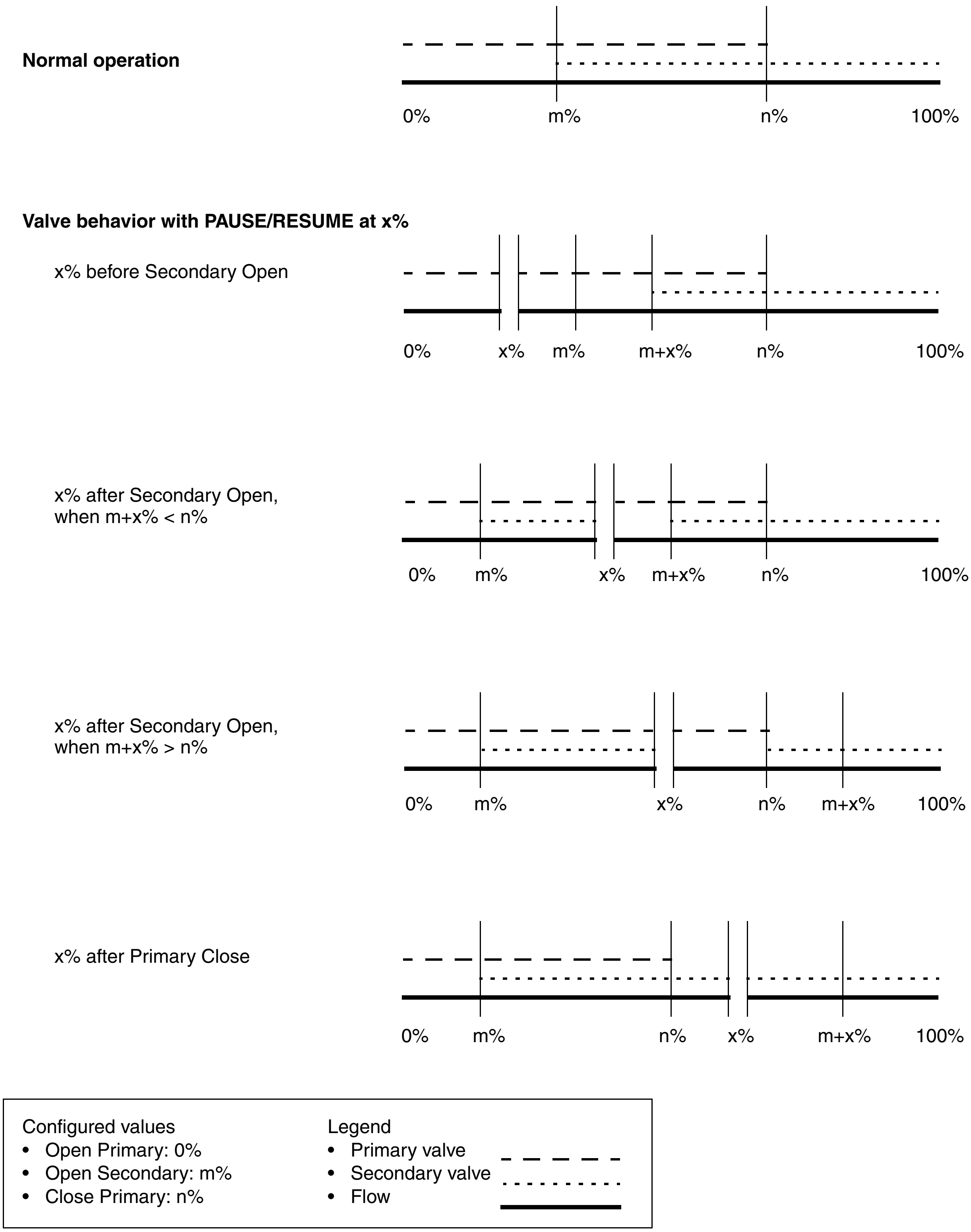


Figure 8-4 Fill sequences: Two-stage discrete fill, Open Primary at 0%, Close Secondary first

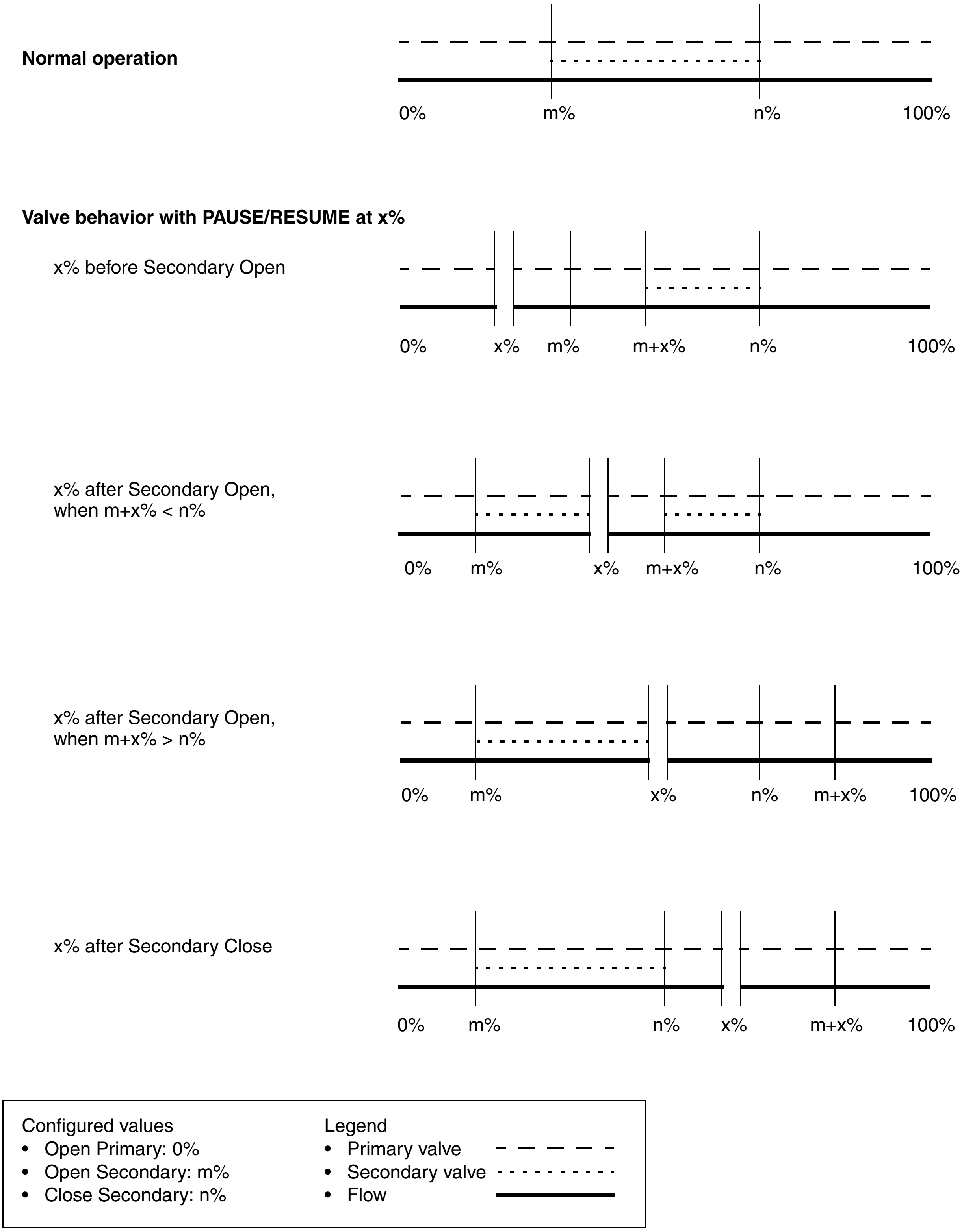


Figure 8-5 Fill sequences: Two-stage discrete fill, Open Secondary at 0%, Close Primary First

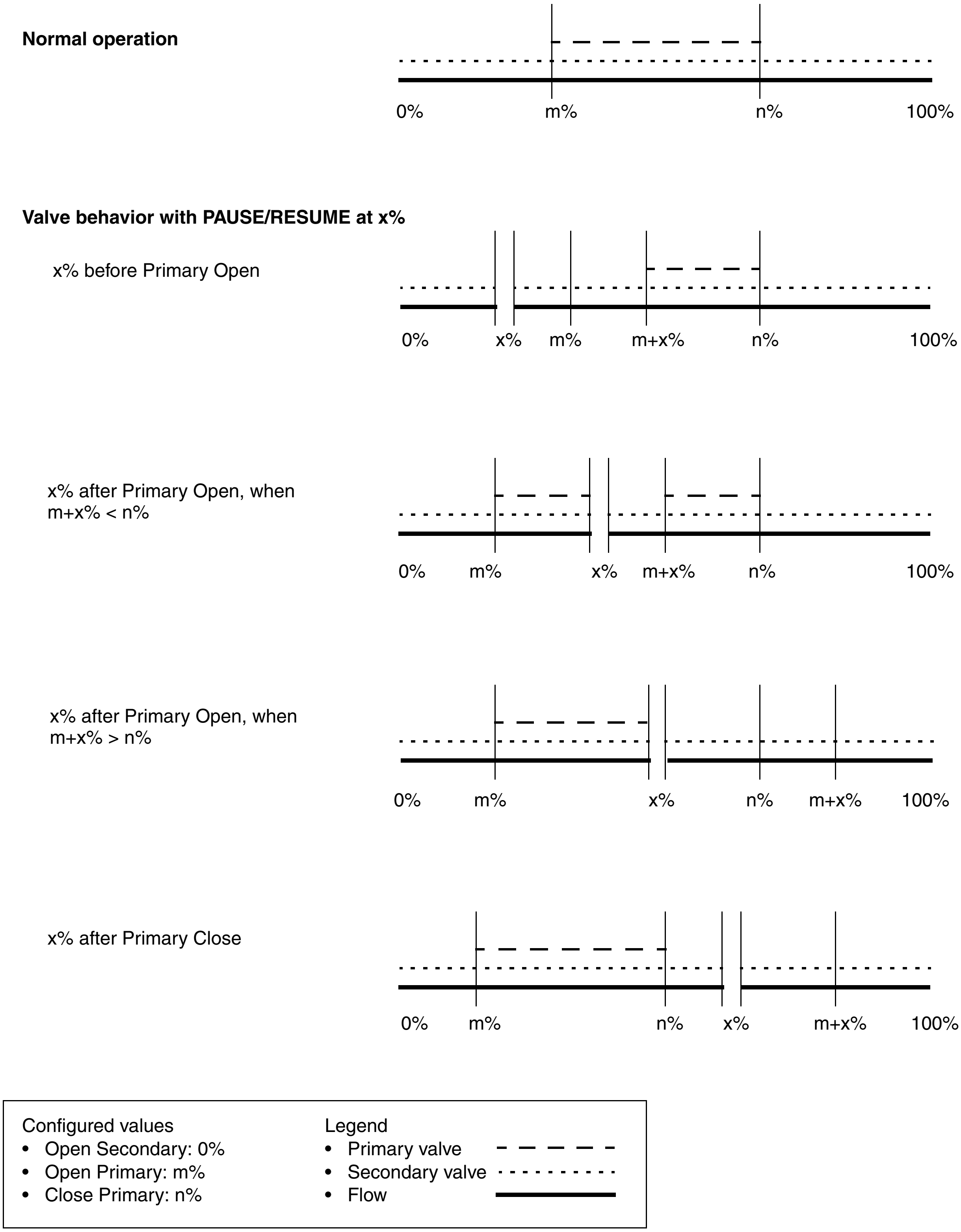


Figure 8-6 Fill sequences: Two-stage discrete fill, Open Secondary at 0%, Close Secondary First

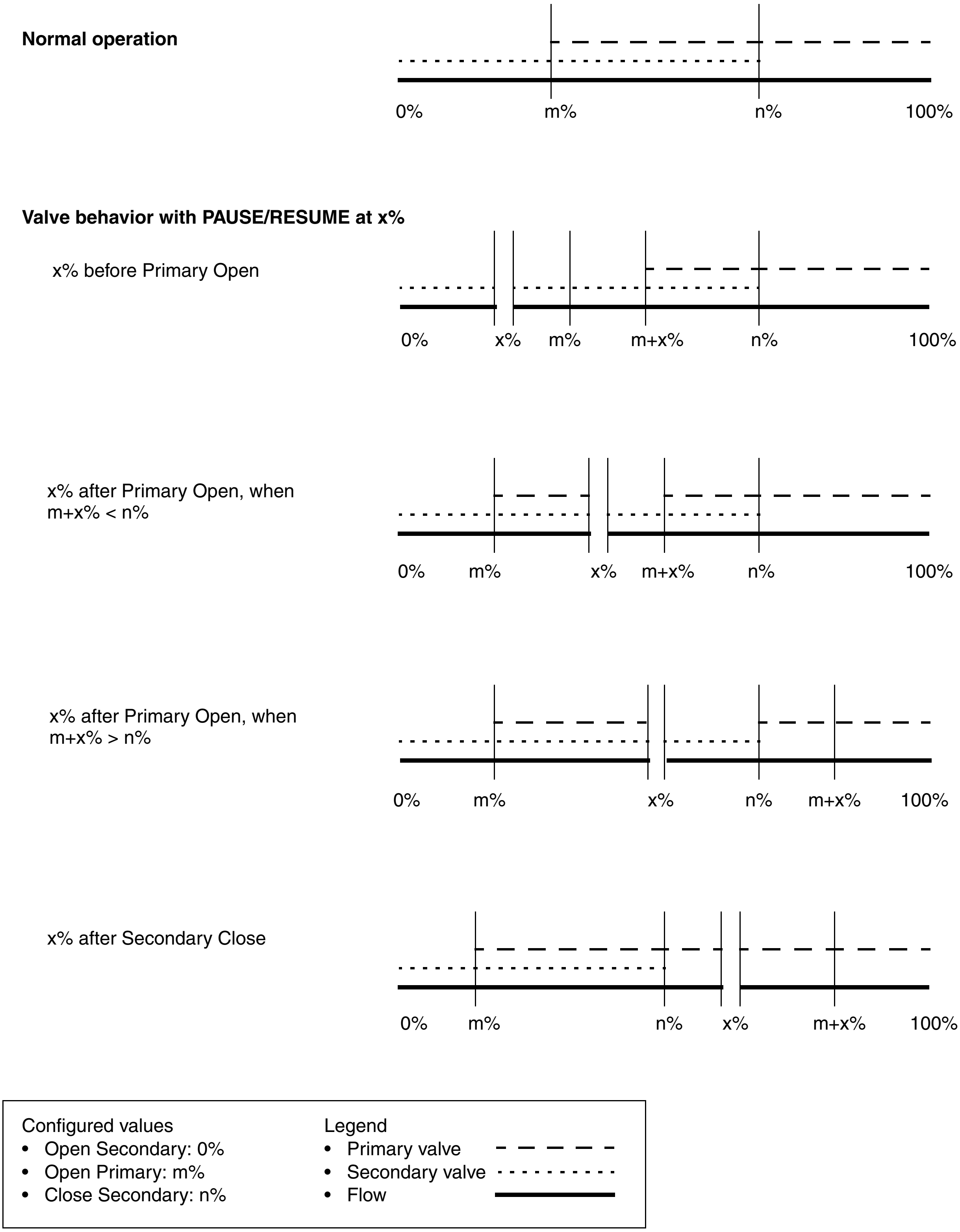
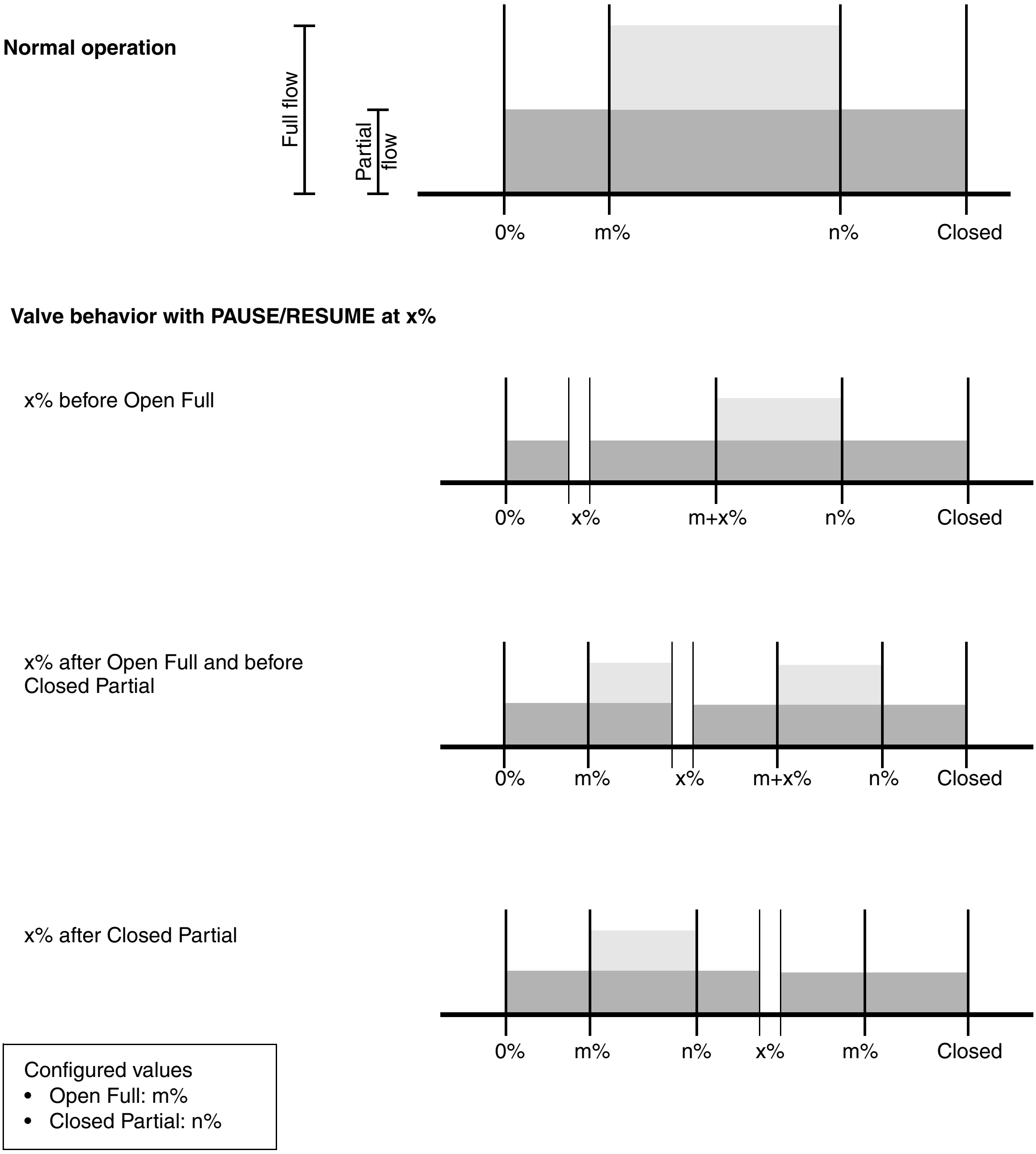


Figure 8-7 Fill sequences: Three-position analog valve



Chapter 9
Pressure Compensation

9.1 Overview

This chapter defines pressure compensation and describes how to configure it.

Note: All procedures provided in this chapter assume that your computer is already connected to the transmitter and you have established communication. All procedures also assume that you are complying with all applicable safety requirements. See Chapter 2 for more information.

9.2 Pressure compensation

The Model 1500 transmitter can compensate for the effect of pressure on the sensor flow tubes. *Pressure effect* is defined as the change in sensor flow and density sensitivity due to process pressure change away from calibration pressure.

Note: Pressure compensation is optional. Configure pressure compensation only if required by your application.

9.2.1 Options

There are two ways to configure pressure compensation:

- If the operating pressure is a known static value, you can enter the external pressure in the software.
- If the operating pressure varies significantly, you can use the transmitter's Modbus interface to write the current pressure value to the transmitter at appropriate intervals.

Note: If you configure a static pressure value, ensure that it is accurate. If you update the pressure via Modbus, ensure that the external pressure measurement device is accurate and reliable.

9.2.2 Pressure correction factors

When configuring pressure compensation, you must provide the flow calibration pressure – the pressure at which the flowmeter was calibrated (which therefore defines the pressure at which there will be no effect on the calibration factor). Refer to the calibration document shipped with your sensor. If the data is unavailable, use 20 psi.

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

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

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

9.2.3 Pressure measurement unit

The default measurement unit for pressure is **PSI**. In other words, the transmitter expects to receive pressure data in psi. If you will use a different pressure measurement unit, you must configure the transmitter to use that measurement unit.

See Table 9-1 for a complete list of pressure measurement units.

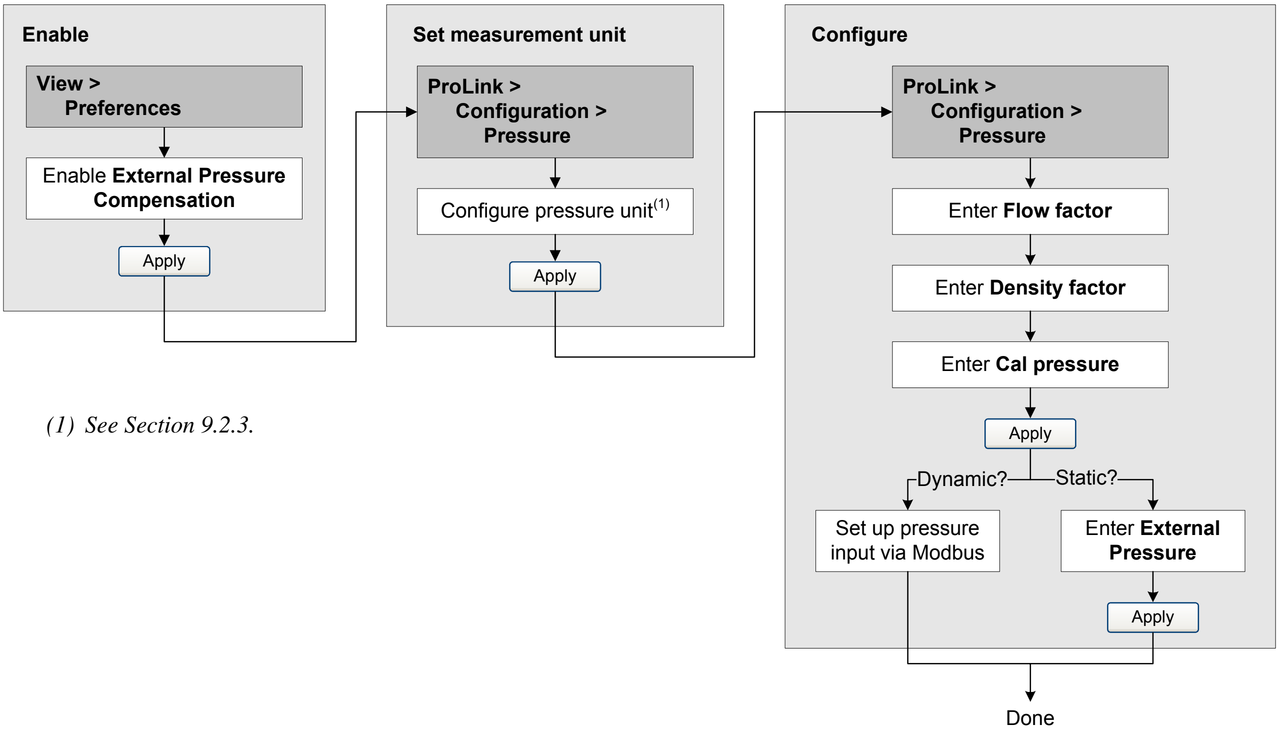
Table 9-1 Pressure measurement units

ProLink II label	Unit description
In Water @ 68F	Inches water @ 68 °F
In Mercury @ 0C	Inches mercury @ 0 °C
Ft Water @ 68F	Feet water @ 68 °F
mm Water @ 68F	Millimeters water @ 68 °F
mm Mercury @ 0C	Millimeters mercury @ 0 °C
PSI	Pounds per square inch
bar	Bar
millibar	Millibar
g/cm2	Grams per square centimeter
kg/cm2	Kilograms per square centimeter
pascals	Pascals
Kilopascals	Kilopascals
Torr @ 0C	Torr @ 0 °C
atms	Atmospheres

9.3 Configuration

To enable and configure pressure compensation with ProLink II, see Figure 9-1.

Figure 9-1 Configuring pressure compensation with ProLink II



(1) See Section 9.2.3.

Note: If at any time you disable pressure compensation, then re-enable it, you must re-enter the external pressure value.

To enable and configure pressure compensation using the Modbus interface, or to write pressure values to the transmitter using the Modbus interface, see the manual entitled *Using Modbus Protocol with Micro Motion Transmitters*, November 2004, P/N 3600219, Rev. C.

Chapter 10
Measurement Performance

10.1 Overview

This chapter describes the following procedures:

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

Note: All procedures discussed in this chapter assume that you have established communication between ProLink II and the Model 1500 transmitter and that you are complying with all applicable safety requirements. See Chapter 2 for more information.

Note: For information on zero calibration, see Section 3.5. For information on AOC calibration, see Chapter 7.

10.2 Meter validation, meter verification, and calibration

The Model 1500 transmitter supports the following procedures for the evaluation and adjustment of measurement performance:

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

To perform meter verification, your flowmeter must use the enhanced core processor and the meter verification option must have been purchased.

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

10.2.1 Meter verification

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

Notes: To use meter verification, the transmitter must be paired with an enhanced core processor, and the meter verification option must be purchased for the transmitter.

Meter verification either holds the last output value or causes the outputs to go to the configured fault values during the procedure (approximately 4 minutes).

Micro Motion recommends that you perform meter verification on a regular basis.

10.2.2 Meter validation and meter factors

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

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

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

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

10.2.3 Calibration

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

- Zero (see Section 3.5)
- Density calibration
- Temperature calibration

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

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

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 your flowmeter.

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

10.2.4 Comparison and recommendations

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

- Process interruption
  - Meter verification requires approximately four minutes to perform. During these four minutes, flow can continue (provided sufficient stability is maintained); however, outputs will not report process data.
  - Meter validation for density does not interrupt the process at all. However, meter validation for mass flow or volume flow requires process down-time for the length of the test.
  - Calibration requires process down-time. In addition, density and temperature calibration require replacing the process fluid with low-density and high density fluids, or low-temperature and high-temperature fluids.
- External measurement requirements
  - Meter verification does not require external measurements.
  - Zero calibration does not require external measurements.
  - Density calibration, temperature calibration, and meter validation require external measurements. For good results, the external measurement must be highly accurate.
- Measurement adjustment
  - Meter verification is an indicator of sensor condition, but does not change flowmeter internal measurement in any way.
  - Meter validation does not change flowmeter internal measurement in any way. If you decide to adjust a meter factor as a result of a meter validation procedure, only the reported measurement is changed – the base measurement is not changed. You can always reverse the change by returning the meter factor to its previous value.
  - Calibration changes the transmitter's interpretation of process data, and accordingly changes the base measurement. If you perform a zero calibration, you can restore the factory zero at a later time. You cannot return to the previous zero (if different from the factory zero), density calibration values, or temperature calibration values unless you have manually recorded them.

Micro Motion recommends obtaining the meter verification transmitter option and performing meter verification on a regular basis.

10.3 Performing meter verification

Note: To use meter verification, the transmitter must be paired with an enhanced core processor, and the meter verification option must be purchased for the transmitter.

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

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

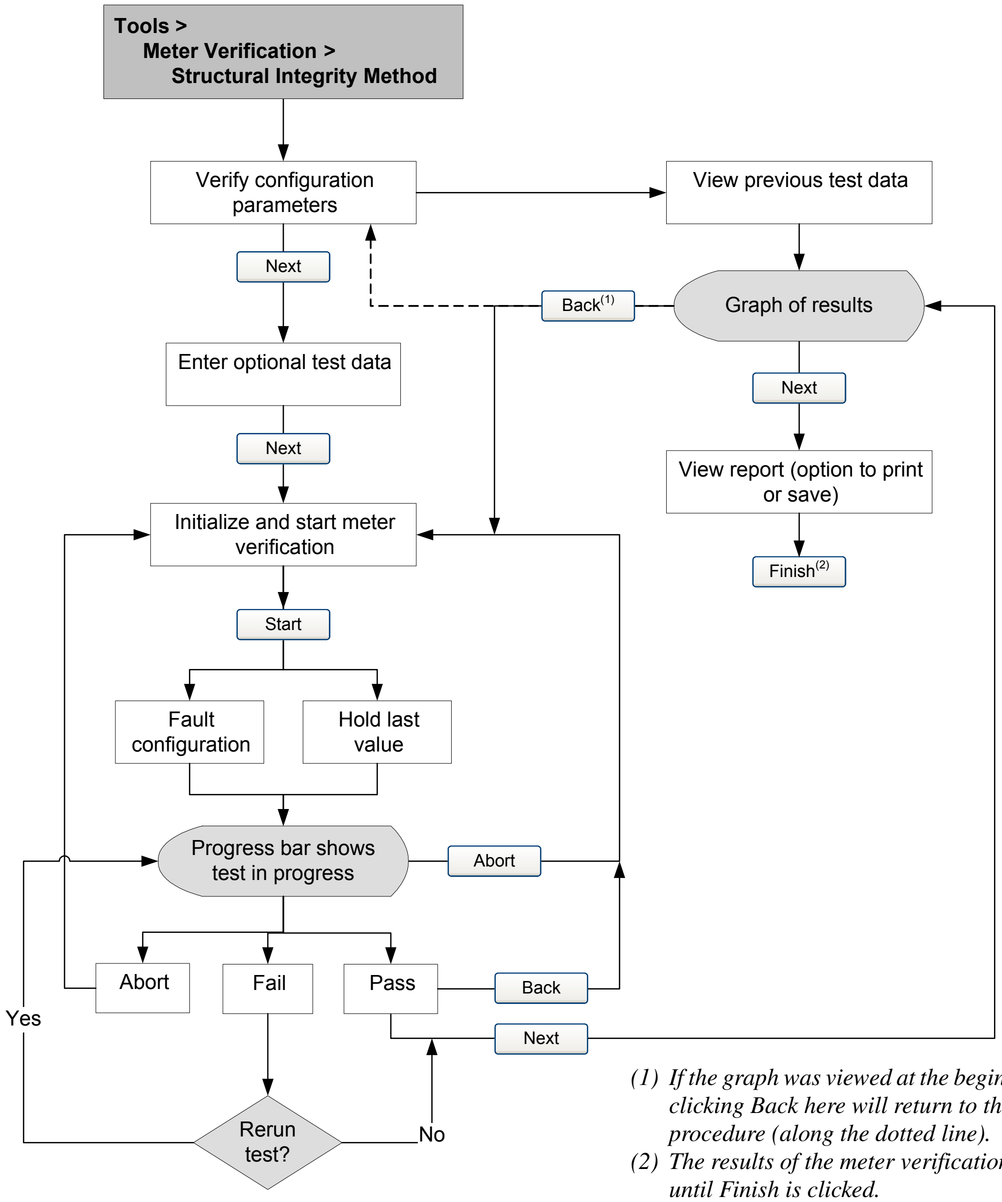
- Maintain a constant temperature and pressure.
- Avoid changes to fluid composition (e.g., two-phase flow, settling, etc.).
- Maintain a constant flow. For higher test certainty, reduce or stop flow.

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

During meter verification, you must choose to fix the outputs at either the configured fault levels or the last measured value. The outputs will remain fixed for the duration of the test (approximately four minutes). Disable all control loops for the duration of the procedure, and ensure that any data reported during this period is handled appropriately.

To perform meter verification, follow the procedure illustrated in Figure 10-1. For a discussion of meter verification results, see Section 10.2.1. For additional meter verification options provided by ProLink II, see Section 10.3.2.

Figure 10-1 Meter verification procedure – ProLink II



(1) If the graph was viewed at the beginning of the procedure, clicking Back here will return to the beginning of the procedure (along the dotted line).
(2) The results of the meter verification test are not saved until Finish is clicked.

10.3.1 Specification uncertainty limit and test results

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

When the test is completed, the result will be reported as Pass, Fail, or Abort:

- *Pass* – The test result is within the specification uncertainty limit. If transmitter zero and configuration match factory values, the sensor will meet factory specifications for flow and density measurement. It is expected that meters will pass meter verification every time the test is run.
- *Fail/Caution* – The test result is not within the specification uncertainty limit. Micro Motion recommends that you immediately re-run the meter verification test. If the meter passes the second test, the first Fail/Caution result can be ignored. If the meter fails the second test, the flow tubes may be damaged. Use the knowledge of your process to consider the type of damage and determine the appropriate action. These actions might include removing the meter from service and physically inspecting the tubes. At minimum, you should perform a flow validation (see Section 10.4) and a density calibration (see Section 10.5).
- *Abort* – A problem occurred with the meter verification test (e.g., process instability). Check your process and retry the test.

10.3.2 Additional ProLink II tools for meter verification

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

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

More information about using ProLink II to perform meter verification can be found in the ProLink II manual (*ProLink II Software for Micro Motion Transmitters*, P/N 20001909, Rev D or later) and in the on-line ProLink II help system.

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

10.4 Performing meter validation

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

Use the following formula to calculate a meter factor:

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

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

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

10.5 Performing density calibration

Density calibration includes the following calibration points:

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

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

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

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

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

You can calibrate for density with ProLink II.

10.5.1 Preparing for density calibration

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

Sensor requirements

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

Density calibration fluids

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

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

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

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

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

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

10.5.2 Density calibration procedures

To perform a D1 and D2 density calibration, see Figure 10-2.

To perform a D3 density calibration or a D3 and D4 density calibration, see Figure 10-3.

Figure 10-2 D1 and D2 density calibration – ProLink II

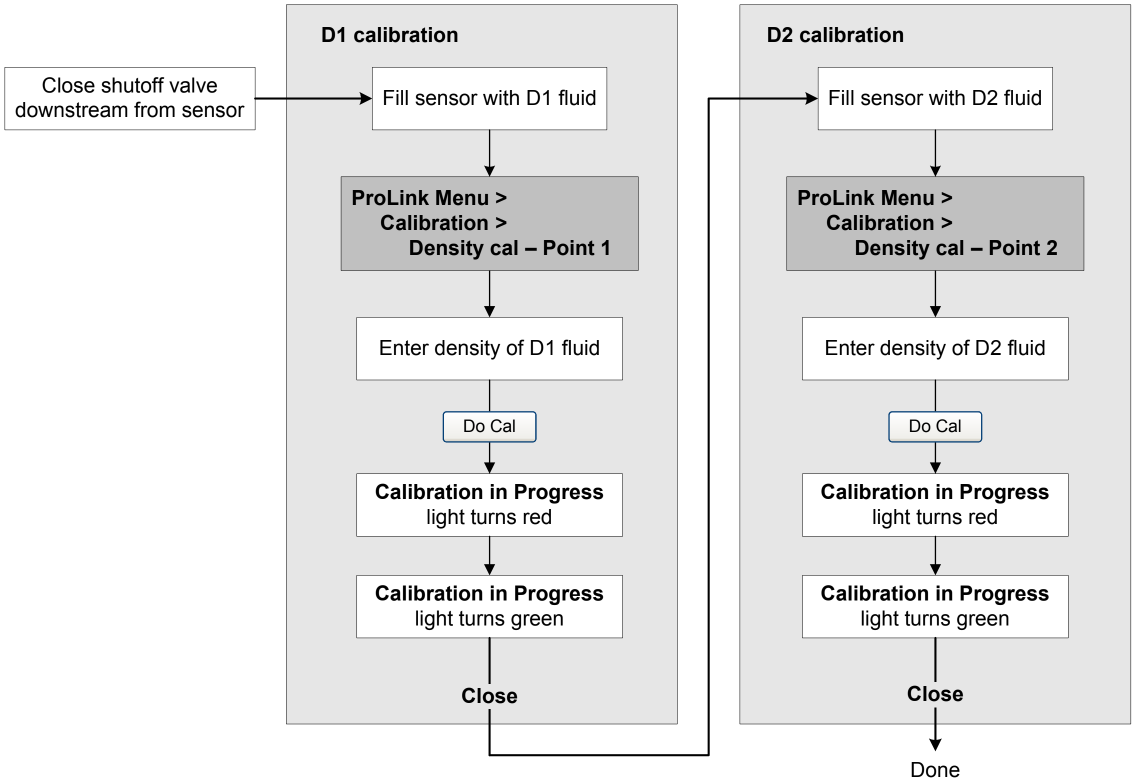
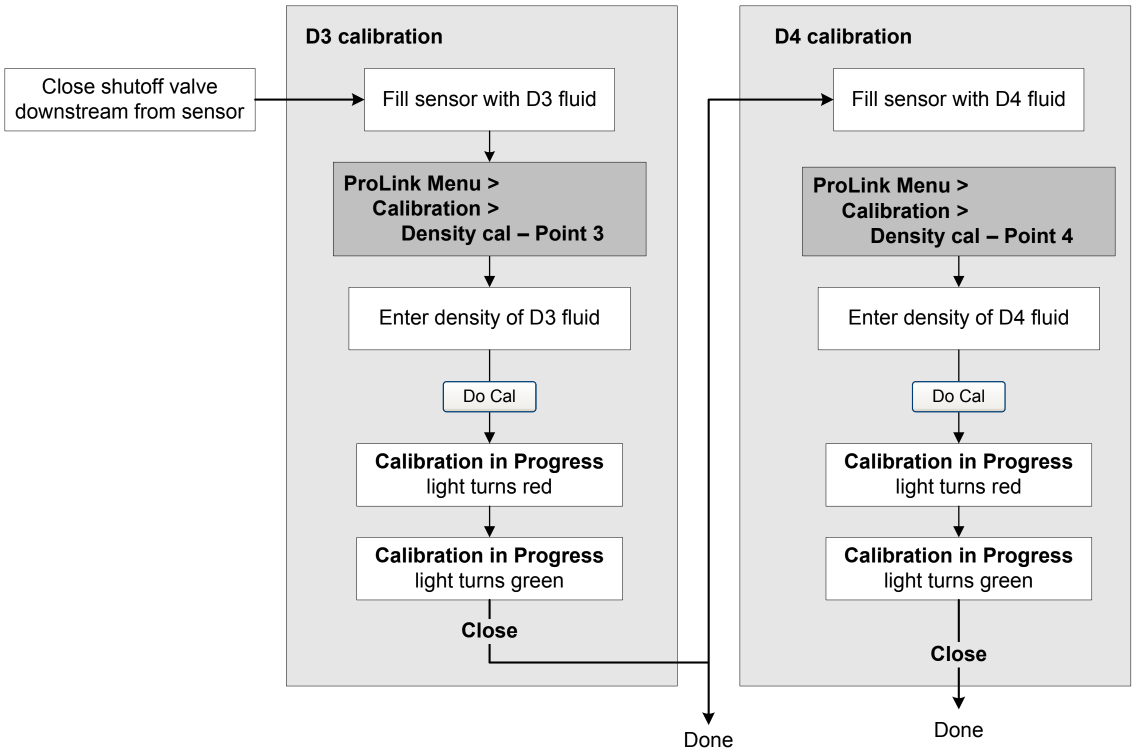


Figure 10-3 D3 or D3 and D4 density calibration – ProLink II

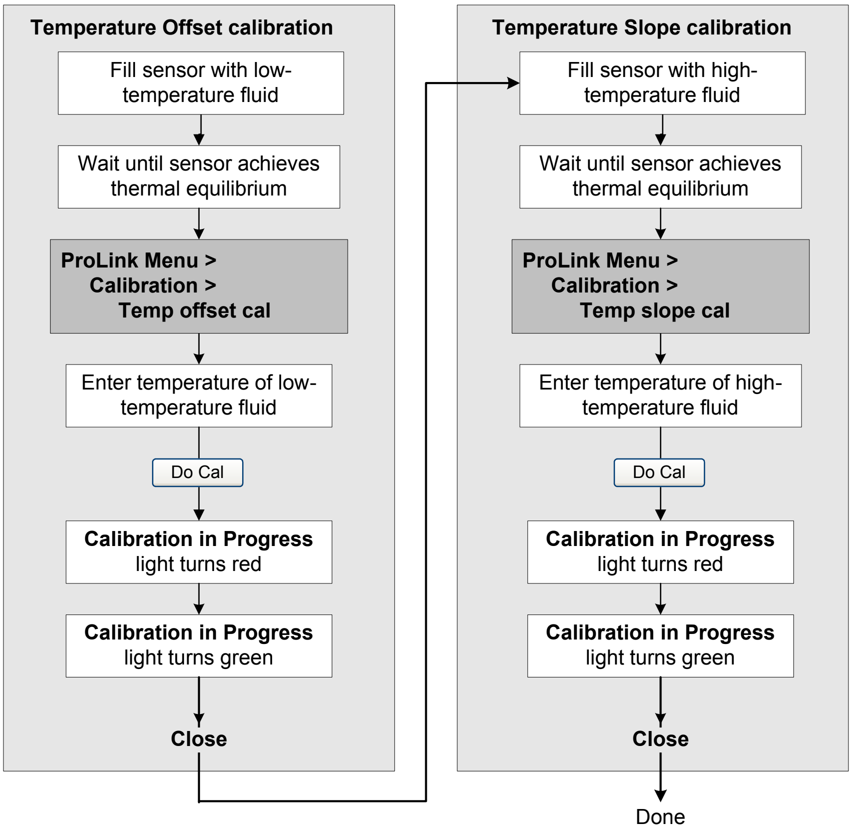


10.6 Performing temperature calibration

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

You can calibrate for temperature with ProLink II. See Figure 10-4.

Figure 10-4 Temperature calibration – ProLink II



Chapter 11
Troubleshooting

11.1 Overview

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

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

Note: All ProLink II procedures provided in this section assume that your computer is already connected to the transmitter and you have established communication. All ProLink II procedures also assume that you are complying with all applicable safety requirements. See Chapter 2 for more information.

11.2 Guide to troubleshooting topics

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

Table 11-1 Troubleshooting topics and locations

Section	Topic
Section 11.4	*Transmitter does not operate*
Section 11.5	*Transmitter does not communicate*
Section 11.6	*Zero or calibration failure*
Section 11.7	*Fault conditions*
Section 11.8	*I/O problems*
Section 11.9	*Transmitter status LED*
Section 11.10	*Status alarms*
Section 11.11	*Checking process variables*
Section 11.12	*Meter fingerprinting*
Section 11.13	*Troubleshooting filling problems*
Section 11.14	*Diagnosing wiring problems*
Section 11.14.1	*Checking the power supply wiring*
Section 11.14.2	*Checking the sensor-to-transmitter wiring*
Section 11.14.3	*Checking for RF interference*
Section 11.14.4	*Checking for RF interference*
Section 11.15	*Checking ProLink II*
Section 11.16	*Checking the output wiring and receiving device*

Table 11-1 Troubleshooting topics and locations *continued*

Section	Topic
Section 11.17	*Checking slug flow*
Section 11.18	*Checking output saturation*
Section 11.19	*Checking the flow measurement unit*
Section 11.20	*Checking the upper and lower range values*
Section 11.21	*Checking the characterization*
Section 11.22	*Checking the calibration*
Section 11.23	*Checking the test points*
Section 11.24	*Checking the core processor*
Section 11.25	*Checking sensor coils and RTD*

11.3 Micro Motion customer service

To speak to a customer service representative, contact the Micro Motion Customer Service Department. Contact information is provided in Section 1.8.

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

11.4 Transmitter does not operate

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

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

11.5 Transmitter does not communicate

If you cannot establish communication with the transmitter:

- Check connections and observe port activity at the host (if possible).
- Verify communications parameters.
- If all parameters appear to be set correctly, try swapping the leads.
- Increase the response delay value (see Section 6.12.5). This parameter is useful if the transmitter is communicating with a slower host.

11.6 Zero or calibration failure

If a zero or calibration procedure fails, the transmitter will send a status alarm indicating the cause of failure. See Section 11.10 for specific remedies for status alarms indicating calibration failure.

11.7 Fault conditions

If the analog or digital outputs indicate a fault condition (by transmitting a fault indicator), determine the exact nature of the fault by checking the status alarms with ProLink II software. Once you have identified the status alarm(s) associated with the fault condition, refer to Section 11.10.

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

- Loop test
- Zero failure
- Stopped internal totalizer

11.8 I/O problems

If you are experiencing problems with an mA output, discrete output, or discrete input, use Table 11-2 to identify an appropriate remedy.

Table 11-2 I/O problems and remedies

Symptom	Possible cause	Possible remedy
No output Loop test failed	Power supply problem	Check power supply and power supply wiring. See Section 11.14.1.
	Fault condition present if fault indicators are set to downscale or internal zero	Check the fault indicator settings to verify whether or not the transmitter is in a fault condition. See Section 4.5.4 to check the mA fault indicator. If a fault condition is present, see Section 11.7.
	Channel not configured for desired output (Channel B or C only)	Verify channel configuration for associated output terminals.
mA output < 4 mA	Process condition below LRV	Verify process. Change the LRV. See Section 4.5.2.
	Fault condition if fault indicator is set to internal zero	Check the fault indicator settings to verify whether or not the transmitter is in a fault condition. See Section 4.5.4. If a fault condition is present, see Section 11.7.
	Open in wiring	Verify all connections.
	Channel not configured for mA operation	Verify channel configuration.
	Bad mA receiving device	Check the mA receiving device or try another mA receiving device. See Section 11.16.
	Bad output circuit	Measure DC voltage across output to verify that output is active.
Constant mA output	Output is fixed in a test mode	Exit output from test mode. See Section 3.3.
	Zero calibration failure	Cycle power. Stop flow and rezero. See Section 3.5.
mA output consistently out of range	Fault condition if fault indicator is set to upscale or downscale	Check the fault indicator settings to verify whether or not the transmitter is in a fault condition. See Section 4.5.4. If a fault condition is present, see Section 11.7.
	LRV and URV not set correctly	Check the LRV and URV. See Section 11.20.
Consistently incorrect mA measurement	Output not trimmed correctly	Trim the output. See Section 3.4.
	Incorrect flow measurement unit configured	Verify flow measurement unit configuration. See Section 11.19.
	Incorrect process variable configured	Verify process variable assigned to mA output. See Section 4.5.1.
	LRV and URV not set correctly	Check the LRV and URV. See Section 11.20.

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

Symptom	Possible cause	Possible remedy
mA reading correct at low currents but wrong at higher currents	mA loop resistance may be too high	Verify that mA output load resistance is below maximum supported load (see installation manual for your transmitter).
Cannot zero with Zero button	Not pressing Zero button for sufficient interval	Button must be pressed for 0.5 seconds to be recognized. Press button until LED starts to flash yellow, then release button.
	Core processor in fault mode	Correct core processor faults and retry.
Cannot connect to terminals 33 & 34 in service port mode	Terminals not in service port mode	Terminals are accessible in service port mode ONLY for a 10-second interval after power-up. Cycle power and connect during this interval.
	Leads reversed.	Switch leads and try again.
	Transmitter installed on multidrop network	All Model 1500 and 2500 devices on network default to address=111 during 10-second service port interval. Disconnect or power down other devices, or use RS-485 communications.
Cannot establish Modbus communication on terminals 33 & 34	Incorrect Modbus configuration	After 10-second interval on power-up, the transmitter switches to Modbus communications. Default settings are: • Address=1 • Baud rate=9600 • Parity=odd Verify configuration. Default settings can be changed using ProLink II v2.0 or higher.
	Leads reversed	Switch leads and try again.
DI is fixed and does not respond to input switch	Possible internal/external power configuration error	Internal means that the transmitter will supply power to the output. External means that an external pull-up resistor and source are required. Verify configuration setting is correct for desired application.

11.9 Transmitter status LED

The Model 1500 transmitter includes a LED that indicates transmitter status. See Table 11-3. If the status LED indicates an alarm condition:

1. View the alarm code using ProLink II.
2. Identify the alarm (see Section 11.10).
3. Correct the condition.

Table 11-3 Model 1500/2500 transmitter status reported by the status LED

Status LED state	Alarm priority	Definition
Green	No alarm	Normal operating mode
Flashing yellow	No alarm	Zero in progress
Yellow	Low severity alarm	• Alarm condition: will not cause measurement error • Outputs continue to report process data • May indicate that the fill is not completely configured
Red	High severity alarm	• Alarm condition: will cause measurement error • Outputs go to configured fault indicators, unless the output is configured for valve control

11.10 Status alarms

Status alarm can be viewed with ProLink II. A list of status alarms and possible remedies is provided in Table 11-4.

Table 11-4 Status alarms and remedies

Alarm code	ProLink II label	Possible remedy
A001	CP EEPROM Failure	Cycle power to the flowmeter.
		The flowmeter might need service. Contact Micro Motion. See Section 1.8.
A002	CP RAM Failure	Cycle power to the flowmeter.
		The flowmeter might need service. Contact Micro Motion. See Section 1.8.
A003	Sensor Failure	Check the test points. See Section 11.23.
		Check the sensor coils. See Section 11.25.
		Check wiring to sensor. See Section 11.14.2.
		Check for slug flow. See Section 11.17.
		Check sensor tubes.
A004	Temp Out of Range	Check the test points. See Section 11.23.
		Check the sensor RTD reading(s). See Section 11.25.
		Check wiring to sensor. See Section 11.14.2.
		Verify flowmeter characterization. See Section 4.2.
		Verify that process temperature is within range of sensor and transmitter.
		Contact Micro Motion. See Section 1.8.
A005	Mass Flow Overrange	Check the test points. See Section 11.23.
		Check the sensor coils. See Section 11.25.
		Verify process.
		Make sure that the appropriate measurement unit is configured. See Section 11.19.
		Verify 4 mA and 20 mA values. See Section 11.20.
		Verify calibration factors in transmitter configuration. See Section 4.2.
		Re-zero the transmitter.
A006	Characterize Meter	Check the characterization. Specifically, verify the FCF and K1 values. See Section 4.2.
		If the problem persists, contact Micro Motion. See Section 1.8.
A008	Density Out of Range	Check the test points. See Section 11.23.
		Check the sensor coils. See Section 11.25.
		Verify process. Check for air in the flow tubes, tubes not filled, foreign material in tubes, or coating in tubes.
		Verify calibration factors in transmitter configuration. See Section 4.2.
		Perform density calibration. See Section 10.5.
A009	Xmtr Initializing	Allow the flowmeter to warm up. The error should disappear once the flowmeter is ready for normal operation. If alarm does not clear, make sure that the sensor is completely full or completely empty. Verify sensor configuration and wiring to sensor.
A010	Calibration Failure	If alarm appears during a transmitter zero, ensure that there is no flow through the sensor, then retry.
		Cycle power to the flowmeter, then retry.

Table 11-4 Status alarms and remedies *continued*

Alarm code	ProLink II label	Possible remedy
A011	Cal Fail, Too Low	Ensure that there is no flow through the sensor, then retry.
		Cycle power to the flowmeter, then retry.
A012	Cal Fail, Too High	Ensure that there is no flow through the sensor, then retry.
		Cycle power to the flowmeter, then retry.
A013	Cal Fail, Too Noisy	Remove or reduce sources of electromechanical noise, then attempt the calibration or zero procedure again. Sources of noise include: • Mechanical pumps • Pipe stress at sensor • Electrical interference • Vibration effects from nearby machinery
		Cycle power to the flowmeter, then retry. See Section 11.22.
A014	Transmitter Error	Cycle power to the flowmeter.
		The transmitter might need service. Contact Micro Motion. See Section 1.8.
A016	Sensor RTD Error	Check the test points. See Section 11.23.
		Check the sensor coils. See Section 11.25.
		Check wiring to sensor. See Section 11.14.2.
		Make sure the appropriate sensor type is configured. See Section 4.2.
		Contact Micro Motion. See Section 1.8.
A017	Meter RTD Error	Check the test points. See Section 11.23.
		Check the sensor coils. See Section 11.25.
		Contact Micro Motion. See Section 1.8.
A018	EEPROM Failure	Cycle power to the flowmeter.
		The transmitter might need service. Contact Micro Motion. See Section 1.8.
A019	RAM Failure	Cycle power to the flowmeter.
		The transmitter might need service. Contact Micro Motion. See Section 1.8.
A020	Cal Factors Missing	Check the characterization. Specifically, verify the FCF value. See Section 4.2.
A021	Sensor Type Incorrect	Check the characterization. Specifically, verify the K1 value. See Section 4.2.
A022[1]	CP Configuration Failure	Cycle power to the flowmeter.
		The transmitter might need service. Contact Micro Motion. See Section 1.8.
A023[1]	CP Totals Failure	Cycle power to the flowmeter.
		The transmitter might need service. Contact Micro Motion. See Section 1.8.
A024[1]	CP Program Corrupt	Cycle power to the flowmeter.
		The transmitter might need service. Contact Micro Motion. See Section 1.8.
A025[1]	CP Boot Program Fault	Cycle power to the flowmeter.
		The transmitter might need service. Contact Micro Motion. See Section 1.8.
A026	Xmtr Comm Problem	Check the wiring between the transmitter and the core processor (see Section 11.14.2). The wires may be swapped. After swapping wires, cycle power to the flowmeter.
		Check for noise in wiring or transmitter environment.
		Check the core processor LED. See Section 11.24.
		Check that the core processor is receiving power. See Section 11.14.1.
		Perform the core processor resistance test. See Section 11.24.2.

Table 11-4 Status alarms and remedies *continued*

Alarm code	ProLink II label	Possible remedy
A028	Comm Problem	Cycle power to the flowmeter.
		The transmitter might need service or upgrading. Contact Micro Motion. See Section 1.8.
A032(2)	Meter Verification/Outputs In Fault	Meter verification in progress, with outputs set to fault. Allow the procedure to complete. If desired, abort the procedure and restart with outputs set to last measured value.
A100	mA 1 Saturated	See Section 11.18.
A101	mA 1 Fixed	Exit mA output trim. See Section 3.4.
		Exit mA output loop test. See Section 3.3.
		Check to see if the output has been fixed via digital communication.
A102	Drive Overrange/ Partially Full Tube	Excessive drive gain. See Section 11.23.3.
		Check the sensor coils. See Section 11.25.
A103(1)	Data Loss Possible	Cycle power to the flowmeter.
		View the entire current configuration to determine what data were lost. Configure any settings with missing or incorrect data.
		The transmitter might need service. Contact Micro Motion. See Section 1.8.
A104	Cal in Progress	Allow the flowmeter to complete calibration.
A105	Slug Flow	See Section 11.17.
A107	Power Reset	No action required.
A108	Event 1 On	Be advised of alarm condition.
		If you believe the event has been triggered erroneously, verify the Event 1 settings. See Section 6.9.
A109	Event 2 On	Be advised of alarm condition.
		If you believe the event has been triggered erroneously, verify the Event 2 settings. See Section 6.9.
A112	Upgrade Software	Contact Micro Motion to get a transmitter software upgrade. See Section 1.8. Note that the device is still functional.
A118	DO1 Fixed	Exit discrete output loop test. See Section 3.3.
A119	DO2 Fixed	Exit discrete output loop test. See Section 3.3.
A131(2)	Meter Verification/Outputs at Last Value	Meter verification in progress, with outputs set to last measured value. Allow the procedure to complete. If desired, abort the procedure and restart with outputs set to fault.

(1) Applies only to systems with the standard core processor.
(2) Applies only to systems with the enhanced core processor.

11.11 Checking process variables

Micro Motion suggests that you make a record of the process variables listed below, under normal operating conditions. This will help you recognize when the process variables are unusually high or low. The meter fingerprinting feature can also provide useful data (see Section 11.12).

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

For troubleshooting, check the process variables under both normal flow and tubes-full no-flow conditions. Except for flow rate, you should see little or no change between flow and no-flow conditions. If you see a significant difference, record the values and contact Micro Motion customer service for assistance. See Section 1.8.

Unusual values for process variables may indicate a variety of different problems. Table 11-5 lists several possible problems and remedies.

Table 11-5 Process variables problems and possible remedies

Symptom	Cause	Possible remedy
Steady non-zero flow rate under no-flow conditions	Misaligned piping (especially in new installations)	Correct the piping.
	Open or leaking valve	Check or correct the valve mechanism.
	Bad sensor zero	Rezero the flowmeter. See Section 3.5.
	Bad flow calibration factor	Verify characterization. See Section 4.2.

Table 11-5 **Process variables problems and possible remedies** *continued*

Symptom	Cause	Possible remedy
Erratic non-zero flow rate under no-flow conditions	RF interference	Check environment for RF interference. See Section 11.14.4.
	Wiring problem	Verify all sensor-to-transmitter wiring and ensure the wires are making good contact.
	Incorrectly grounded 9-wire cable (in remote core processor with remote transmitter installations)	Verify 9-wire cable installation. Refer to Appendix B for diagrams, and see the installation manual for your transmitter.
	Vibration in pipeline at rate close to sensor tube frequency	Check environment and remove source of vibration.
	Leaking valve or seal	Check pipeline.
	Inappropriate measurement unit	Check configuration. See Section 11.19.
	Inappropriate damping value	Check configuration. See Section 4.5.5 and Section 6.6.
	Slug flow	See Section 11.17.
	Plugged flow tube	Check drive gain and tube frequency. Purge the flow tubes.
	Moisture in sensor junction box	Open junction box and allow it to dry. Do not use contact cleaner. When closing, ensure integrity of gaskets and O-rings, and grease all O-rings.
	Mounting stress on sensor	Check sensor mounting. Ensure: • Sensor is not being used to support pipe. • Sensor is not being used to correct pipe misalignment. • Sensor is not too heavy for pipe.
	Sensor cross-talk	Check environment for sensor with similar (±0.5 Hz) tube frequency.
	Incorrect sensor orientation	Sensor orientation must be appropriate to process fluid. See the installation manual for your sensor.
Erratic non-zero flow rate when flow is steady	Output wiring problem	Verify wiring between transmitter and receiving device. See the installation manual for your transmitter.
	Problem with receiving device	Test with another receiving device.
	Inappropriate measurement unit	Check configuration. See Section 11.19.
	Inappropriate damping value	Check configuration. See Section 4.5.5 and Section 6.6.
	Excessive or erratic drive gain	See Section 11.23.3 and Section 11.23.4.
	Slug flow	See Section 11.17.
	Plugged flow tube	Check drive gain and tube frequency. Purge the flow tubes.
	Wiring problem	Verify all sensor-to-transmitter wiring and ensure the wires are making good contact.

Table 11-5 Process variables problems and possible remedies *continued*

Symptom	Cause	Possible remedy
Inaccurate flow rate or fill total	Bad flow calibration factor	Verify characterization. See Section 4.2.
	Inappropriate measurement unit	Check configuration. See Section 11.19.
	Bad sensor zero	Rezero the flowmeter. See Section 3.5.
	Bad density calibration factors	Verify characterization. See Section 4.2.
	Bad flowmeter grounding	See Section 11.14.3.
	Slug flow	See Section 11.17.
	Problem with receiving device	See Section 11.16.
	Wiring problem	Verify all sensor-to-transmitter wiring and ensure the wires are making good contact.
Inaccurate density reading	Problem with process fluid	Use standard procedures to check quality of process fluid.
	Bad density calibration factors	Verify characterization. See Section 4.2.
	Wiring problem	Verify all sensor-to-transmitter wiring and ensure the wires are making good contact.
	Bad flowmeter grounding	See Section 11.14.3.
	Slug flow	See Section 11.17.
	Sensor cross-talk	Check environment for sensor with similar (±0.5 Hz) tube frequency.
	Plugged flow tube	Check drive gain and tube frequency. Purge the flow tubes.
Temperature reading significantly different from process temperature	RTD failure	Check for alarm conditions and follow troubleshooting procedure for indicated alarm. Disable external temperature compensation. See Figure C-1.
Temperature reading slightly different from process temperature	Temperature calibration required	Perform temperature calibration. See Section 10.6.
Unusually high density reading	Plugged flow tube	Check drive gain and tube frequency. Purge the flow tubes.
	Incorrect K2 value	Verify characterization. See Section 4.2.
Unusually low density reading	Slug flow	See Section 11.17.
	Incorrect K2 value	Verify characterization. See Section 4.2.
Unusually high tube frequency	Sensor erosion	Contact Micro Motion. See Section 1.8.
Unusually low tube frequency	Plugged flow tube	Purge the flow tubes.
Unusually low pickoff voltages	Several possible causes	See Section 11.23.5.
Unusually high drive gain	Several possible causes	See Section 11.23.3.

11.12 Meter fingerprinting

The meter fingerprinting feature provides snapshots, or "fingerprints," of twelve process variables, at four different points of transmitter operation. See Table 11-6.

Table 11-6 Meter fingerprinting data

Fingerprint time	Description	Process variables recorded	
Current	Present-time values	• Mass flow rate • Volume flow rate • Density • Temperature • Case temperature • Live zero	• Tube frequency • Drive gain • Left pickoff • Right pickoff • Board temperature • Input voltage
Factory	Values at time transmitter left factory		
Installation	Values at time of first sensor zero		
Last zero	Values at time of most recent sensor zero		

For all process variables except Mech Zero, the instantaneous value, 5-minute running average, 5-minute running standard deviation, recorded minimum, and recorded maximum are recorded. For Mech Zero, only the 5-minute running average and 5-minute running standard deviation are recorded.

To use the meter fingerprinting feature:

1. From the **ProLink** menu, select **Finger Print**.
2. Use the **Type** pulldown list to specify the point in time for which you want to view data.
3. Use the **Units** pulldown list to specify SI or English units.

The display is updated continuously.

Note: Due to the continuous updating, the meter fingerprinting feature can have a negative effect on other sensor-transmitter communications. Do not open the meter fingerprinting window unless you plan to use it, and be sure to close it when you no longer need it.

11.13 Troubleshooting filling problems

If the fill cannot be started:

- Check the status LED on the transmitter.
  - If it is solid red, the transmitter is in a fault condition and a fill cannot be started. Correct the fault condition and retry. The cleaning function may be useful.
  - If it is solid yellow, the transmitter is in a low-severity fault condition, such as slug flow, or the fill flow source, target, or discrete outputs are not correctly configured.

Note: A fill can be started under some low-severity fault conditions.

If the system is in slug flow, try using the cleaning function, or pulsing fluid through the sensor by turning the discrete outputs ON and OFF (if the valves are controlled by discrete outputs). The Test Discrete Output function can be used for this.

- Ensure that the fill is correctly and completely configured:
  - A flow source must be specified.
  - A non-zero positive value must be specified for the fill target.
  - All outputs required for valve control must be configured.

If fill accuracy is unsatisfactory or has changed, or if fill variation is too great:

- Implement overshoot compensation (if not already implemented).
- If standard AOC calibration is implemented, repeat the AOC calibration.
- If rolling AOC calibration is implemented, try increasing the AOC Window Length value.
- Check for mechanical problems with the valve.

11.14 Diagnosing wiring problems

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

11.14.1 Checking the power supply wiring

To check the power supply wiring:

1. Verify that the correct external fuse is used. An incorrect fuse can limit current to the transmitter and keep it from initializing.
2. Power down the transmitter.
3. Ensure that the power supply wires are connected to the correct terminals. Refer to Appendix B for diagrams.
4. Verify that the power supply wires are making good contact, and are not clamped to the wire insulation.
5. Use a voltmeter to test the voltage at the transmitter's power supply terminals. Verify that it is within the specified limits. For DC power, you may need to size the cable. Refer to Appendix B for diagrams, and see your transmitter installation manual for power supply requirements.

11.14.2 Checking the sensor-to-transmitter wiring

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

- The transmitter is connected to the sensor according to the wiring information provided in your transmitter installation manual. Refer to Appendix B for diagrams.
- The wires are making good contact with the terminals.

If the wires are incorrectly connected:

1. Power down the transmitter.
2. Correct the wiring.
3. Restore power to the transmitter.

11.14.3 Checking grounding

The sensor and the transmitter must be grounded. If the core processor is installed as part of the sensor, it is grounded automatically. If the core processor is installed separately, it must be grounded separately. See your sensor and transmitter installation manuals for grounding requirements and instructions.

11.14.4 Checking for RF interference

If you are experiencing RF (radio frequency) interference on your discrete output, use one of the following solutions:

- Eliminate the RF source. Possible causes include a source of radio communications, or a large transformer, pump, motor, or anything else that can generate a strong electrical or electromagnetic field, in the vicinity of the transmitter.
- Move the transmitter.
- Use shielded cable for the discrete output.
  - Terminate output cable shielding at the input device. If this is not possible, terminate the output shielding at the cable gland or conduit fitting.
  - Do not terminate shield inside the wiring compartment.
  - 360° termination of shielding is not necessary.

11.15 Checking ProLink II

Ensure that you are using the required version of ProLink II. ProLink II v2.3 or later is required for the Model 1500 transmitter with filling and dosing application. ProLink II v2.5 or later is required for meter verification, and for some of the features and functions described in this manual.

To check the version of ProLink II:

1. Start ProLink II.
2. Open the **Help** menu.
3. Click **About ProLink**.

11.16 Checking the output wiring and receiving device

If you receive an inaccurate mA reading, there may be a problem with the output wiring or the receiving device.

- Check the output level at the transmitter.
- Check the wiring between the transmitter and the receiving device.
- Try a different receiving device.

11.17 Checking slug flow

Slugs – gas in a liquid process or liquid in a gas process – occasionally appear in some applications. The presence of slugs can significantly affect the process density reading. Slug flow limits and duration can help the transmitter suppress extreme changes in reading.

Note: Default slug flow limits are 0.0 and 5.0 g/cm^3. Raising the low slug flow limit or lowering the high slug flow limit will increase the possibility of slug flow conditions.

If slug limits have been configured, and slug flow occurs:

- A slug flow alarm is generated.
- All outputs that are configured to represent flow rate hold their last “pre-slug flow” value for the configured slug flow duration.

If the slug flow condition clears before the slug-flow 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 the slug-flow duration expires, outputs that represent flow rate report a flow rate of zero.

If slug time is configured for 0.0 seconds, outputs that represent flow rate will report zero flow as soon as slug flow is detected.

If slug flow occurs:

- Check process for cavitation, flashing, or leaks.
- Change the sensor orientation.
- Monitor density.
- If desired, enter new slug flow limits (see Section 6.10).
- If desired, increase slug duration (see Section 6.10).

11.18 Checking output saturation

If an output variable exceeds the upper range limit or goes below the lower range limit, the applications platform produces an output saturation alarm. The alarm can mean:

- The output variable is outside appropriate limits for the process.
- The unit of flow needs to be changed.
- Sensor flow tubes are not filled with process fluid.
- Sensor flow tubes are plugged.

If an output saturation alarm occurs:

- Bring flow rate within sensor limit.
- Check the measurement unit. You may be able to use a smaller or larger unit.
- Check the sensor:
  - Ensure that flow tubes are full.
  - Purge flow tubes.
- For the mA outputs, change the mA URV and LRV (see Section 4.5.2).

11.19 Checking the flow measurement unit

Using an incorrect flow measurement unit can cause the transmitter to produce unexpected output levels, with unpredictable effects on the process. Make sure that the configured flow measurement unit is correct. Check the abbreviations; for example, *g/min* represents grams per minute, not gallons per minute. See Section 4.4.

11.20 Checking the upper and lower range values

A saturated mA output or incorrect mA measurement could indicate a faulty URV or LRV. Verify that the URV and LRV are correct and change them if necessary. See Section 4.5.2.

11.21 Checking the characterization

A transmitter that is incorrectly characterized for its sensor might produce inaccurate output values. If the flowmeter appears to be operating correctly but sends inaccurate output values, an incorrect characterization could be the cause.

If you discover that any of the characterization data are wrong, perform a complete characterization. See Section 4.2.

11.22 Checking the calibration

Improper calibration can cause the transmitter to send unexpected output values. If the transmitter appears to be operating correctly but sends inaccurate output values, an improper calibration may be the cause.

Micro Motion calibrates every transmitter at the factory. Therefore, you should suspect improper calibration only if the transmitter has been calibrated after it was shipped from the factory.

The calibration procedures in this manual are designed for calibration to a regulatory standard. See Chapter 10. To calibrate for true accuracy, always use a measurement source that is more accurate than the meter. Contact Micro Motion customer service for assistance.

Note: Micro Motion recommends using meter factors, rather than calibration, to prove the meter against a regulatory standard or to correct measurement error. Contact Micro Motion before calibrating your flowmeter. For information on meter performance, see Chapter 10.

11.23 Checking the test points

Some status alarms that indicate a sensor failure or overrange condition can be caused by problems other than a failed sensor. You can diagnose sensor failure or overrange status alarms by checking the meter test points. The *test points* include left and right pickoff voltages, drive gain, and tube frequency. These values describe the current operation of the sensor.

11.23.1 Obtaining the test points

To obtain the test points with ProLink II software:

1. Select **Diagnostic Information** from the **ProLink** menu.
2. Write down the values you find in the **Tube Frequency** box, the **Left Pickoff** box, the **Right Pickoff** box, and the **Drive Gain** box.

11.23.2 Evaluating the test points

Use the following guidelines to evaluate the test points:

- If the drive gain is unstable, refer to Section 11.23.3.
- If the value for the left or right pickoff does not equal the appropriate value from Table 11-7, based on the sensor flow tube frequency, refer to Section 11.23.5.
- If the values for the left and right pickoffs equal the appropriate values from Table 11-7, based on the sensor flow tube frequency, record your troubleshooting data and contact Micro Motion customer service. See Section 1.8.

Table 11-7 Sensor pickoff values

Sensor[1]	Pickoff value
ELITE Model CMF sensors	3.4 mV peak-to-peak per Hz based on sensor flow tube frequency
Model D, DL, and DT sensors	3.4 mV peak-to-peak per Hz based on sensor flow tube frequency
Model F025, F050, F100 sensors	3.4 mV peak-to-peak per Hz based on sensor flow tube frequency
Model F200 sensors (compact case)	2.0 mV peak-to-peak per Hz based on sensor flow tube frequency
Model F200 sensors (standard case)	3.4 mV peak-to-peak per Hz based on sensor flow tube frequency
Model H025, H050, H100 sensors	3.4 mV peak-to-peak per Hz based on sensor flow tube frequency
Model H200 sensors	2.0 mV peak-to-peak per Hz based on sensor flow tube frequency
Model R025, R050, or R100 sensors	3.4 mV peak-to-peak per Hz based on sensor flow tube frequency
Model R200 sensors	2.0 mV peak-to-peak per Hz based on sensor flow tube frequency
Micro Motion T-Series sensors	0.5 mV peak-to-peak per Hz based on sensor flow tube frequency
CMF400 I.S. sensors	2.7 mV peak-to-peak per Hz based on sensor flow tube frequency
CMF400 sensors with booster amplifiers	3.4 mV peak-to-peak per Hz based on sensor flow tube frequency

(1) If your sensor is not listed, contact Micro Motion. See Section 1.8

11.23.3 Excessive drive gain

Excessive drive gain can be caused by several problems. See Table 11-8.

Table 11-8 Excessive drive gain causes and remedies

Cause	Possible remedy
Excessive slug flow	See Section 11.17.
Plugged flow tube	Purge the flow tubes.
Cavitation or flashing	Increase inlet or back pressure at the sensor.
	If a pump is located upstream from the sensor, increase the distance between the pump and sensor.
Drive board or module failure, cracked flow tube, or sensor imbalance	Contact Micro Motion. See Section 1.8.
Mechanical binding at sensor	Ensure sensor is free to vibrate.
Open drive or left pickoff sensor coil	Contact Micro Motion. See Section 1.8.
Flow rate out of range	Ensure that flow rate is within sensor limits.
Incorrect sensor characterization	Verify characterization. See Section 4.2.

11.23.4 Erratic drive gain

Erratic drive gain can be caused by several problems. See Table 11-9.

Table 11-9 Erratic drive gain causes and remedies

Cause	Possible remedy
Wrong K1 characterization constant for sensor	Re-enter the K1 characterization constant. See Section 4.2.
Polarity of pick-off reversed or polarity of drive reversed	Contact Micro Motion. See Section 1.8.
Slug flow	See Section 11.17.
Foreign material caught in flow tubes	Purge flow tubes.

11.23.5 Low pickoff voltage

Low pickoff voltage can be caused by several problems. See Table 11-10.

Table 11-10 Low pickoff voltage causes and remedies

Cause	Possible remedy
Faulty wiring runs between the sensor and core processor	Verify wiring. Refer to Appendix B for diagrams, and see your transmitter installation manual.
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	See Section 11.17.
No tube vibration in sensor	Check for plugging.
	Ensure sensor is free to vibrate (no mechanical binding).
	Verify wiring.
	Test coils at sensor. See Section 11.25.
Moisture in the sensor electronics	Eliminate the moisture in the sensor electronics.
The sensor is damaged	Contact Micro Motion. See Section 1.8.

11.24 Checking the core processor

The **Core Processor Diagnostics** window displays data for many operational variables that are internal to the core processor. Both current data and lifetime statistics are shown.

To view the core processor data, select **Core Processor Diagnostics** from the **ProLink** menu.

From this window:

- You can reset lifetime statistics by pressing the **Reset Lifetime Stats** button.
- You can also change values for electronic offsent, sensor failure timeout, drive P coefficient, drive I coefficient, target amplitude override, and target frequency. Contact Micro Motion customer service before changing these values.

Additionally, two core processor procedures are available:

- You can check the core processor LED. The core processor has an LED that indicates different flowmeter conditions. See Table 11-11.
- You can perform the core processor resistance test to check for a damaged core processor.

11.24.1 Checking the core processor LED

To check the core processor LED:

1. Maintain power to the transmitter.
2. Remove the core processor lid (see Figure B-2). The core processor is instrinsically safe and can be opened in all environments.
3. Check the core processor LED against the conditions described in Table 11-11 (standard core processor) or Table 11-12 (enhanced core processor).
4. To return to normal operation, replace the lid.

Note: When reassembling the meter components, be sure to grease all O-rings.

Table 11-11 Standard core processor LED behavior, meter conditions, and remedies

LED behavior	Condition	Possible remedy
1 flash per second (ON 25%, OFF 75%)	Normal operation	No action required.
1 flash per second (ON 75%, OFF 25%)	Slug flow	See Section 11.17.
Solid ON	Zero or calibration in progress	If calibration is in progress, no action required. If no calibration is in progress, contact Micro Motion. See Section 1.8.
	Core processor receiving between 11.5 and 5 volts	Check power supply to transmitter. See Section 11.14.1, and refer to Appendix B for diagrams.
3 rapid flashes, followed by pause	Sensor not recognized	Check wiring between transmitter and sensor (remote core processor with remote transmitter installation). Refer to Appendix B for diagrams, and see your transmitter installation manual.
	Improper configuration	Check sensor characterization parameters. See Section 4.2.
	Broken pin between sensor and core processor	Contact Micro Motion. See Section 1.8.
4 flashes per second	Fault condition	Check alarm status.
OFF	Core processor receiving less than 5 volts	• Verify power supply wiring to core processor. Refer to Appendix B for diagrams. • If transmitter status LED is lit, transmitter is receiving power. Check voltage across terminals 1 (VDC+) and 2 (VDC–) in core processor. Normal reading is approximately 14 VDC. If reading is normal, internal core processor failure is possible. Contact Micro Motion. See Section 1.8. If reading is 0, internal transmitter failure is possible. Contact Micro Motion. See Section 1.8. If reading is less than 1 VDC, verify power supply wiring to core processor. Wires may be switched. See Section 11.14.1, and refer to Appendix B for diagrams. • If transmitter status LED is not lit, transmitter is not receiving power. Check power supply. See Section 11.14.1, and refer to Appendix B for diagrams. If power supply is operational, internal transmitter, display, or LED failure is possible. Contact Micro Motion. See Section 1.8.
	Core processor internal failure	Contact Micro Motion. See Section 1.8.

Table 11-12 Enhanced core processor LED behavior, meter conditions, and remedies

LED behavior	Condition	Possible remedy
Solid green	Normal operation	No action required.
Flashing yellow	Zero in progress	If calibration is in progress, no action required. If no calibration is in progress, contact Micro Motion. See Section 1.8.
Solid yellow	Low severity alarm	Check alarm status.
Solid red	High severity alarm	Check alarm status.
Flashing red (80% on, 20% off)	Tubes not full	If alarm A105 (slug flow) is active, see Section 11.17.
		If alarm A033 (tubes not full) is active, verify process. Check for air in the flow tubes, tubes not filled, foreign material in tubes, or coating in tubes.
Flashing red (50% on, 50% off)	Electronics failed	Contact Micro Motion. See Section 1.8.
Flashing red (50% on, 50% off, skips every 4th)	Sensor failed	Contact Micro Motion. See Section 1.8.
OFF	Core processor receiving less than 5 volts	• Verify power supply wiring to core processor. Refer to Appendix B for diagrams. • If transmitter status LED is lit, transmitter is receiving power. Check voltage across terminals 1 (VDC+) and 2 (VDC–) in core processor. If reading is less than 1 VDC, verify power supply wiring to core processor. Wires may be switched. See Section 11.14.1, and refer to Appendix B for diagrams. Otherwise, contact Micro Motion (see Section 1.8). • If transmitter status LED is not lit, transmitter is not receiving power. Check power supply. See Section 11.14.1, and refer to Appendix B for diagrams. If power supply is operational, internal transmitter, display, or LED failure is possible. Contact Micro Motion. See Section 1.8.
	Core processor internal failure	Contact Micro Motion. See Section 1.8.

11.24.2 Core processor resistance test

To perform the core processor resistance test:

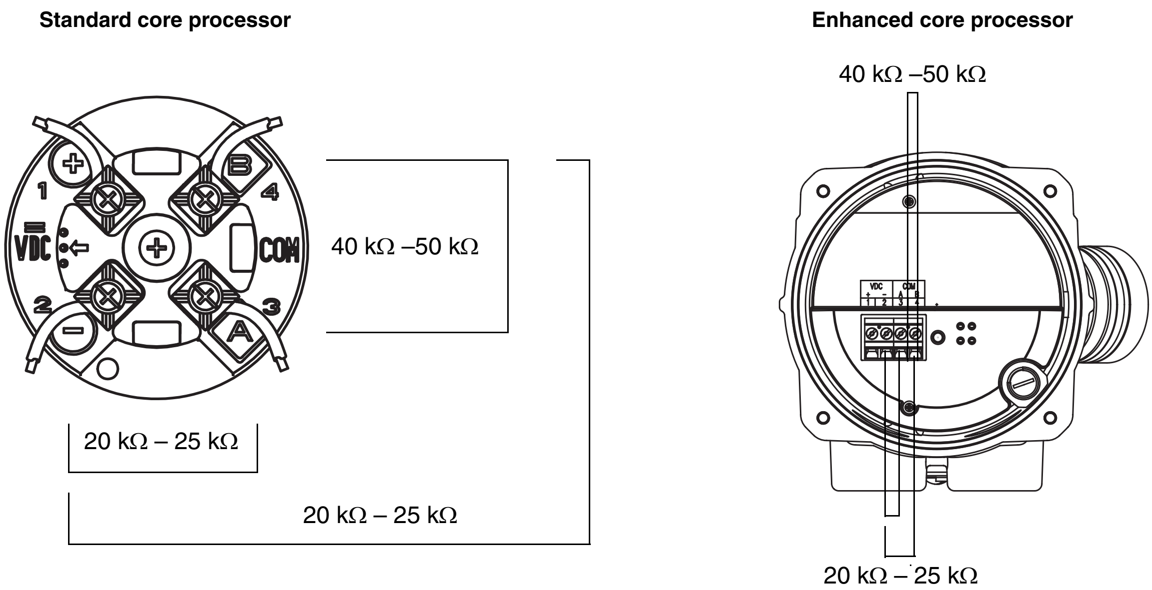
1. Power down the transmitter.
2. Remove the core processor lid.
3. Disconnect the 4-wire cable between the core processor and the transmitter (see Figure B-3 or Figure B-4).
4. Measure the resistance between core processor terminals 3 and 4 (RS-485/A and RS-485/B). See Figure 11-1. Resistance should be 40 kΩ to 50 kΩ.
5. Measure the resistance between core processor terminals 2 and 3 (VDC– and RS-485/A). Resistance should be 20 kΩ to 25 kΩ.
6. Measure the resistance between core processor terminals 2 and 4 (VDC– and RS-485/B). Resistance should be 20 kΩ to 25 kΩ.
7. If any resistance measurements are lower than specified, the core processor may not be able to communicate with a transmitter or a remote host. Contact Micro Motion (see Section 1.8).

To return to normal operation:

1. Reconnect the 4-wire cable between the core processor and the transmitter (see Figure B-3 or Figure B-4).
2. Replace the core processor lid.

Note: When reassembling the meter components, be sure to grease all O-rings.

Figure 11-1 Core processor resistance test



11.25 Checking sensor coils and RTD

Problems with sensor coils can cause several alarms, including sensor failure and a variety of out-of-range conditions. Testing the sensor coils involves testing the terminal pairs and testing for shorts to case.

11.25.1 Remote core processor with remote transmitter installation

If you have a remote core processor with remote transmitter (see Figure B-1):

1. Power down the transmitter.
2. Remove the end-cap from the core processor housing.
3. At the core processor, unplug the terminal blocks from the terminal board.
4. Using a digital multimeter (DMM), check the pickoff coils listed in Table 11-13 by placing the DMM leads on the unplugged terminal blocks for each terminal pair. Record the values.

Table 11-13 Coils and test terminal pairs

Coil	Test terminal pair: Colors	Test terminal pair: Numbers
Drive coil	Brown to red	3 — 4
Left pickoff coil (LPO)	Green to white	5 — 6
Right pickoff coil (RPO)	Blue to gray	7 — 8
Resistance temperature detector (RTD)	Yellow to violet	1 — 2
Lead length compensator (LLC) (all sensors except CMF400 I.S. and T-Series) Composite RTD (T-Series sensors only) Fixed resistor (CMF400 I.S. sensors only)	Yellow to orange	1 — 9

5. There should be no open circuits, i.e., no infinite resistance readings. The LPO and RPO readings should be the same or very close (± 5 Ω). If there are any unusual readings, repeat the coil resistance tests at the sensor junction box to eliminate the possibility of faulty cable. The readings for each coil pair should match at both ends.
6. Leave the core processor terminal blocks disconnected. At the sensor, remove the lid of the junction box and test each sensor terminal for a short to case by placing one DMM lead on the terminal and the other lead on the sensor case. With the DMM set to its highest range, there should be infinite resistance on each lead. If there is any resistance at all, there is a short to case.
7. At the sensor, test terminal pairs as follows:
   a. Brown against all other terminals except Red
   b. Red against all other terminals except Brown
   c. Green against all other terminals except White
   d. White against all other terminals except Green
   e. Blue against all other terminals except Gray
   f. Gray against all other terminals except Blue
   g. Orange against all other terminals except Yellow and Violet
   h. Yellow against all other terminals except Orange and Violet
   i. Violet against all other terminals except Yellow and Orange

Note: D600 sensors and CMF400 sensors with booster amplifiers have different terminal pairs. Contact Micro Motion for assistance (see Section 1.8).

   There should be infinite resistance for each pair. If there is any resistance at all, there is a short between terminals.
8. See Table 11-14 for possible causes and solutions.
9. If the problem is not resolved, contact Micro Motion (see Section 1.8).
10. To return to normal operation:
   a. Plug the terminal blocks into the terminal board.
   b. Replace the end-cap on the core processor housing.
   c. Replace the lid on the sensor junction box.

Note: When reassembling the meter components, be sure to grease all O-rings.

Table 11-14 Sensor and cable short to case possible causes and remedies

Possible cause	Solution
Moisture inside the sensor junction box	Make sure that the junction box is dry and no corrosion is present.
Liquid or moisture inside the sensor case	Contact Micro Motion. See Section 1.8.
Internally shorted feedthrough (sealed passage for wiring from sensor to sensor junction box)	Contact Micro Motion. See Section 1.8.
Faulty cable	Replace cable.
Improper wire termination	Verify wire terminations inside sensor junction box. See Micro Motion's *9-Wire Flowmeter Cable Preparation and Installation Guide* or the sensor documentation.

11.25.2 4-wire remote installation

If you have a 4-wire remote installation (see Figure B-1):

1. Power down the transmitter.
2. Remove the core processor lid.

Note: You may disconnect the 4-wire cable between the core processor and the transmitter, or leave it connected.

3. If you have a standard core processor – Loosen the captive screw (2.5 mm) in the center of the core processor. Carefully remove the core processor from the sensor by grasping it and lifting it straight up. **Do not twist or rotate the core processor**.
4. If you have an enhanced core processor – Loosen the two captive screws (2.5 mm) that hold the core processor in the housing. Gently lift the core processor out of the housing, then disconnect the sensor cable from the feedthrough pins. **Do not damage the feedthrough pins**.

⚠ CAUTION

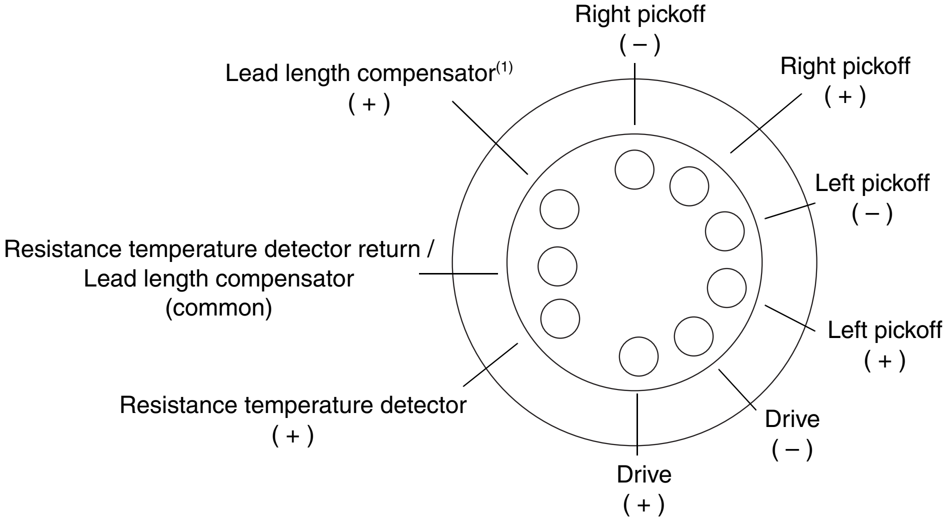
If the core processor (feedthrough) pins are bent, broken, or damaged in any way, the core processor will not operate.

To avoid damage to the core processor (feedthrough) pins:

- Do not twist or rotate the core processor when lifting it.
- When replacing the core processor (or sensor cable) on the pins, be sure to align the guide pins and mount the core processor (or sensor cable) carefully.

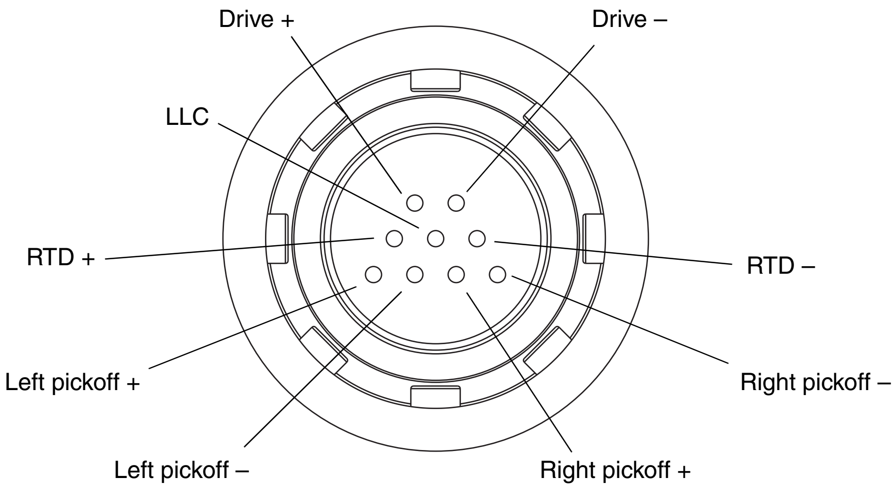
5. Using a digital multimeter (DMM), check the pickoff coil resistances by placing the DMM leads on the pin pairs. Refer to Figure 11-2 (standard core processor) or Figure 11-3 (enhanced core processor) to identify the pins and pin pairs. Record the values.

Figure 11-2 Sensor pins – Standard core processor



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

Figure 11-3 Sensor pins – Enhanced core processor



6. There should be no open circuits, i.e., no infinite resistance readings. The LPO and RPO readings should be the same or very close (± 5 ohms).
7. Using the DMM, check between each pin and the sensor case. With the DMM set to its highest range, there should be infinite resistance on each lead. If there is any resistance at all, there is a short to case. See Table 11-14 for possible causes and solutions.

8. Test terminal pairs as follows:
   a. Drive + against all other terminals except Drive –
   b. Drive – against all other terminals except Drive +
   c. Left pickoff + against all other terminals except Left pickoff –
   d. Left pickoff – against all other terminals except Left pickoff +
   e. Right pickoff + against all other terminals except Right pickoff –
   f. Right pickoff – against all other terminals except Right pickoff +
   g. RTD + against all other terminals except LLC + and RTD/LLC
   h. LLC + against all other terminals except RTD + and RTD/LLC
   i. RTD/LLC against all other terminals except LLC + and RTD +

Note: D600 sensors and CMF400 sensors with booster amplifiers have different terminal pairs. Contact Micro Motion for assistance (see Section 1.8).

   There should be infinite resistance for each pair. If there is any resistance at all, there is a short between terminals. See Table 11-14 for possible causes and solutions.

9. If the problem is not resolved, contact Micro Motion (see Section 1.8).

To return to normal operation:

1. If you have a standard core processor:
   a. Align the three guide pins on the bottom of the core processor with the corresponding holes in the base of the core processor housing.
   b. Carefully mount the core processor on the pins, taking care not to bend any pins.
2. If you have an enhanced core processor:
   a. Plug the sensor cable onto the feedthrough pins, being careful not to bend or damage any pins.
   b. Replace the core processor in the housing.
3. Tighten the captive screw(s) to 6 to 8 in-lbs (0,7 to 0,9 N-m) of torque.
4. Replace the core processor lid.

Note: When reassembling the meter components, be sure to grease all O-rings.

Appendix A
Default Values and Ranges

A.1 Overview

This appendix provides information on the default values for most transmitter parameters. Where appropriate, valid ranges are also defined.

These default values represent the transmitter configuration after a master reset. Depending on how the transmitter was ordered, certain values may have been configured at the factory.

The default values listed here apply to all Version 4.x transmitters using a Version 3.x core processor.

A.2 Default values and ranges

The table below contains the default values and ranges for the most frequently used transmitter settings.

Table A-1 Transmitter default values and ranges

Type	Setting	Default	Range	Comments
Flow	Flow direction	Forward		
	Flow damping	0.04 sec	0.0–51.2 sec	User-entered value is corrected to nearest lower value in list of preset values.
	Flow calibration factor	1.00005.13		For T-Series sensors, this value represents the FCF and FT factors concatenated. See Section 4.2.2.
	Mass flow units	g/s		
	Mass flow cutoff	0.0 g/s		Recommended setting is 0.5–1.0% 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	1.00000		
	Density factor	1.00000		
	Volume factor	1.00000		

Table A-1 Transmitter default values and ranges *continued*

Type	Setting	Default	Range	Comments
Density	Density damping	1.6 sec	0.0–51.2 sec	User-entered value is corrected to nearest lower value in list of preset values.
	Density units	g/cm^3		
	Density cutoff	0.2 g/cm^3	0.0–0.5 g/cm^3	
	D1	0.00000		
	D2	1.00000		
	K1	1000.00		
	K2	50,000.00		
	FD	0.00000		
	Temp Coefficient	4.44		
Slug flow	Slug flow low limit	0.0 g/cm^3	0.0–10.0 g/cm^3	
	Slug flow high limit	5.0 g/cm^3	0.0–10.0 g/cm^3	
	Slug duration	0.0 sec	0.0–60.0 sec	
Temperature	Temperature damping	4.8 sec	0.0–38.4 sec	User-entered value is corrected to nearest lower value in list of preset values.
	Temperature units	Deg C		
	Temperature calibration factor	1.00000T0.0000		
Pressure	Pressure units	PSI		
	Flow factor	0.00000		
	Density factor	0.00000		
	Cal pressure	0.00000		
T-Series sensor	D3	0.00000		
	D4	0.00000		
	K3	0.00000		
	K4	0.00000		
	FTG	0.00000		
	FFQ	0.00000		
	DTG	0.00000		
	DFQ1	0.00000		
	DFQ2	0.00000		
Special units	Base mass unit	g		
	Base mass time	sec		
	Mass flow conversion factor	1.00000		
	Base volume unit	L		
	Base volume time	sec		
	Volume flow conversion factor	1.00000		
Event 1	Variable	Density		
	Type	Low alarm		
	Setpoint	0.0		
	Setpoint units	g/cm^3		

Table A-1 Transmitter default values and ranges *continued*

Type	Setting	Default	Range	Comments
Event 2	Variable	Density		
	Type	Low alarm		
	Setpoint	0.0		
	Setpoint units	g/cm^3		
Update Rate	Update rate	Special	Normal or Special	
Analog output	Primary variable	Mass flow		
	LRV	–200.00000 g/s		
	URV	200.00000 g/s		
	AO cutoff	0.00000 g/s		
	AO added damping	0.00000 sec		
	LSL	–200 g/s		Read-only
	USL	200 g/s		Read-only
	MinSpan	0.3 g/s		Read-only
	Fault action	Downscale		
	AO fault level – downscale	2.0 mA	1.0–3.6 mA	
	AO fault level – upscale	22 mA	21.0–24.0 mA	
	Last measured value timeout	0.00 sec		
LRV	Mass flow	–200.000 g/s		
	Volume flow	–0.200 l/s		
URV	Mass flow	200.000 g/s		
	Volume flow	0.200 l/s		
Fill	Flow source	Mass flow rate		
	Enable Filling Option	Enabled		
	Count Up	Enabled		
	Enable AOC	Enabled		
	Enable Purge	Disabled		
	Fill Type	One Stage Discrete		
	Configure By	% Target		
	Fill Target	0.00000 g		
	Max Fill Time	0.00000 sec		
	Purge Mode	Manual		
	Purge Delay	2.00000 sec		
	Purge Time	1.00000 sec		
	AOC Algorithm	Underfill		
	AOC Window Length	10		
	Fixed Overshoot Comp	0.00000		
Valve control – Two-stage discrete fill	Open Primary	0.00% of target	0.00–100 %	
	Open Secondary	0.00% of target	0.00–100 %	
	Close Primary	100.00% of target	0.00–100 %	
	Close Secondary	100.00% of target	0.00–100 %	

Table A-1 Transmitter default values and ranges *continued*

Type	Setting	Default	Range	Comments
Valve control – Three-position analog fill	Open Full	0.00% of target	0.00–100 %	
	Close Partial	100.00% of target	0.00–100 %	
Digital comm	Fault setting	None		
	Floating-point byte order	3–4–1–2		
	Additional communications response delay	0		Configured value is multiplied by 2/3 character time to arrive at real-time value
	Modbus address	1		RS-485 connections only
	Protocol	Modbus RTU		RS-485 connections only
	Baud rate	9,600		RS-485 connections only
	Parity	None		RS-485 connections only
	Stop bits	1		RS-485 connections only

Appendix B
Installation Architectures and Components

B.1 Overview

This appendix provides illustrations of different flowmeter installation architectures and components, for the Model 1500 transmitter with the filling and dosing application.

B.2 Installation diagrams

Model 1500 transmitters can be installed in two different ways:

- 4-wire remote
- Remote core processor with remote transmitter

See Figure B-1.

B.3 Component diagrams

In remote core processor with remote transmitter installations, the core processor is installed stand-alone. See Figure B-2.

B.4 Wiring and terminal diagrams

A 4-wire cable is used to connect the core processor to the transmitter. See Figure B-3 (standard core processor) or Figure B-4 (enhanced core processor).

Figure B-5 shows the transmitter's power supply terminals.

Figure B-6 shows the output terminals for the Model 1500 transmitter with the filling and dosing application.

Figure B-1 Installation architectures

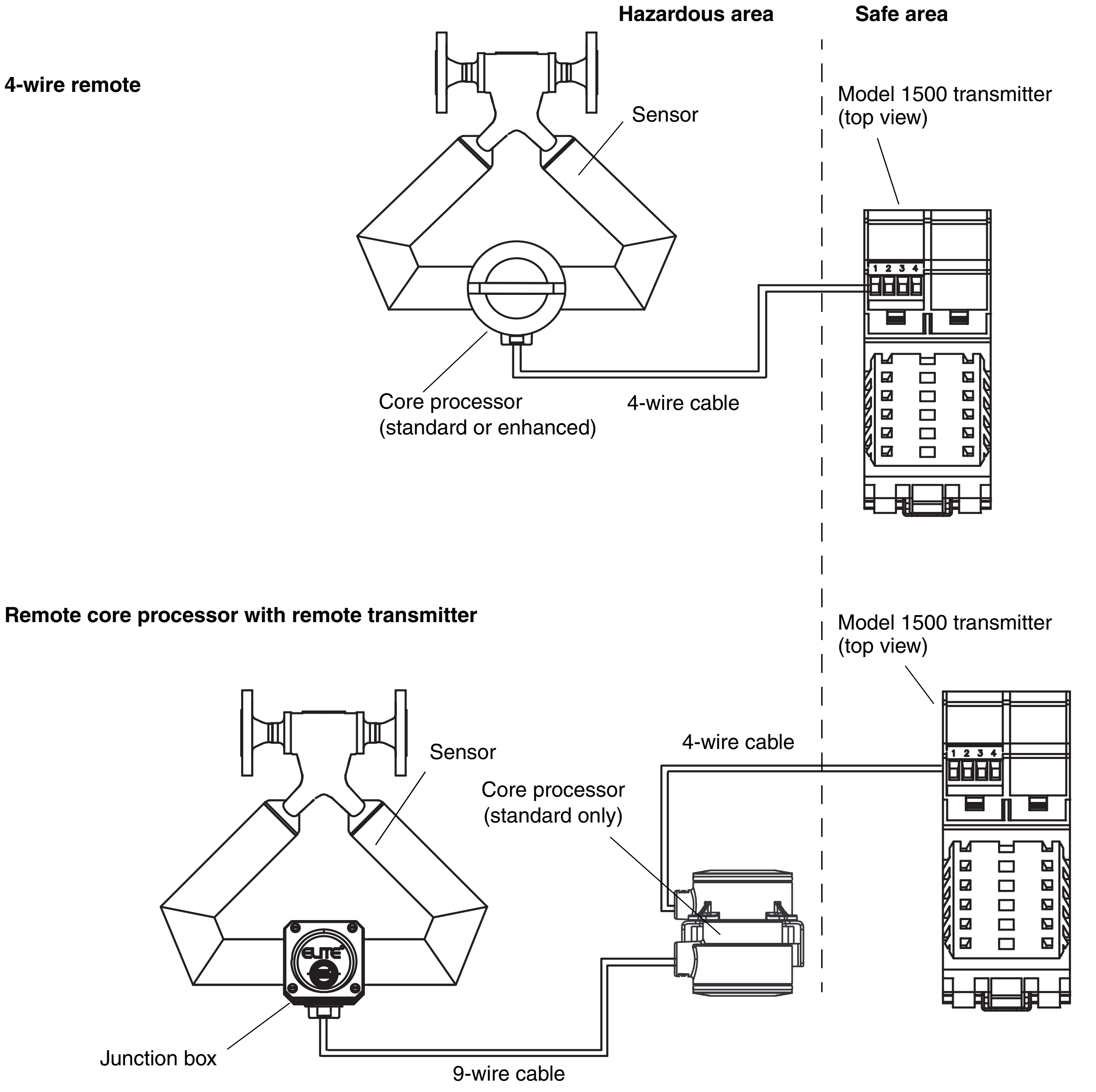


Figure B-2 **Remote core processor components**

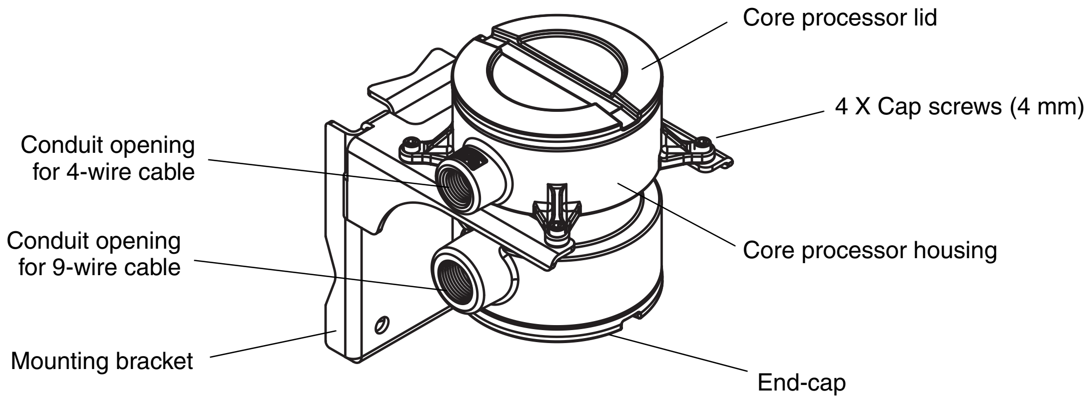


Figure B-3 **4-wire cable between Model 1500 transmitter and standard core processor**

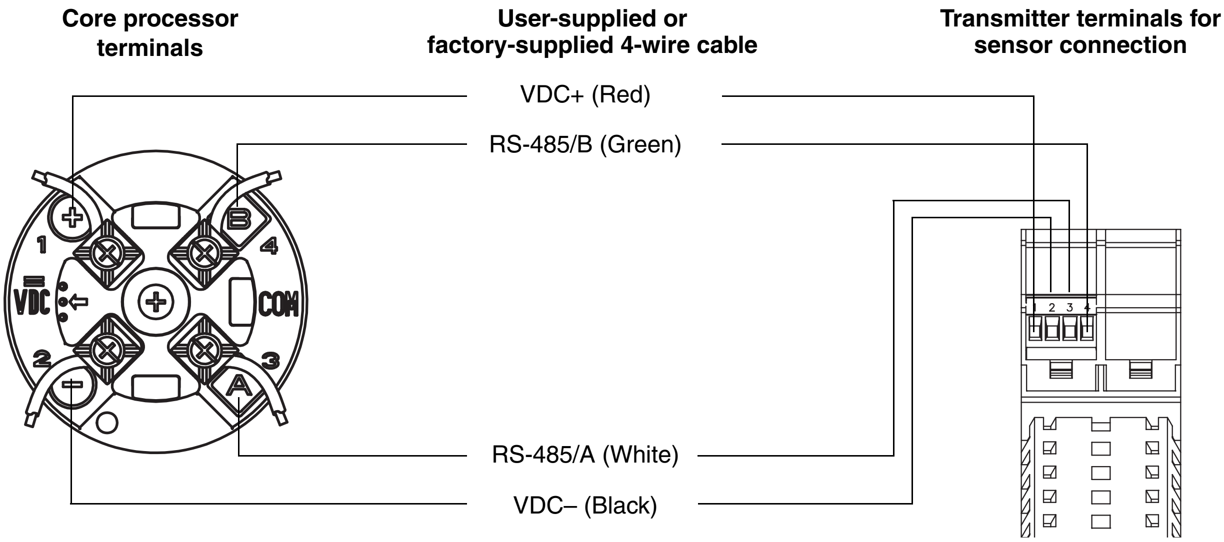


Figure B-4 4-wire cable between Model 1500 transmitter and enhanced core processor

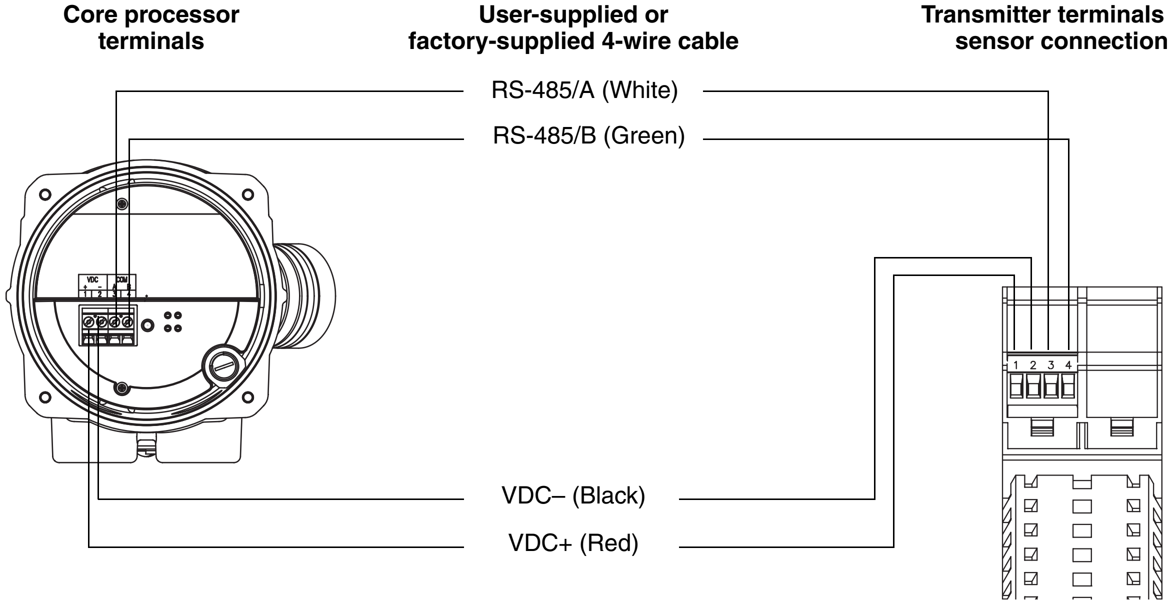


Figure B-5 Power supply terminals

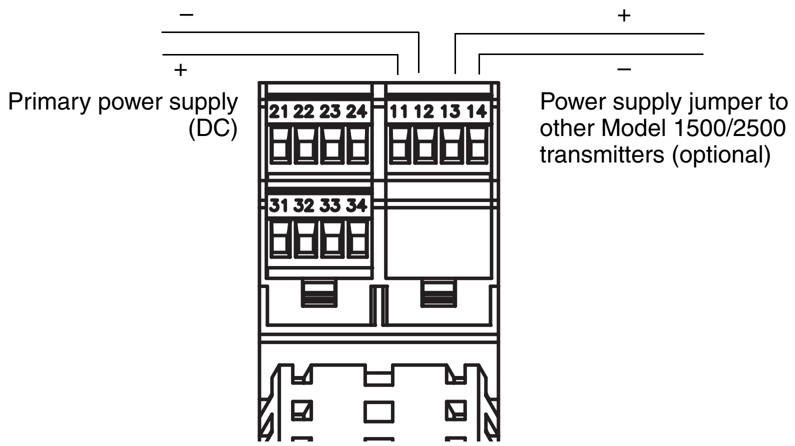
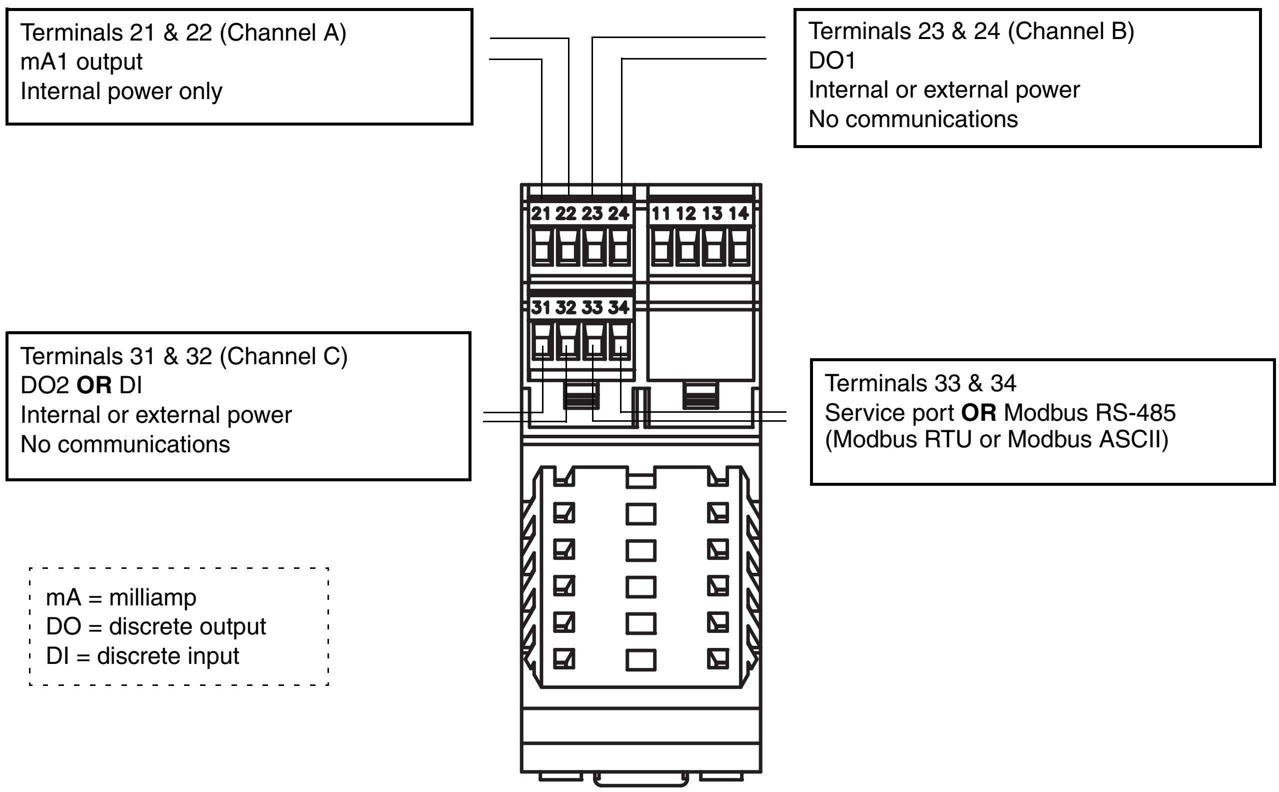


Figure B-6 Terminal configuration



Appendix C
Menu Flowcharts

C.1 Overview

This appendix provides the following ProLink II menu flowcharts for the Model 1500 transmitter with the filling and dosing application:

- Top-level menu – Figure C-1
- Operating menus – Figure C-2
- Configuration menus – Figures C-3 and C-4

C.2 Version information

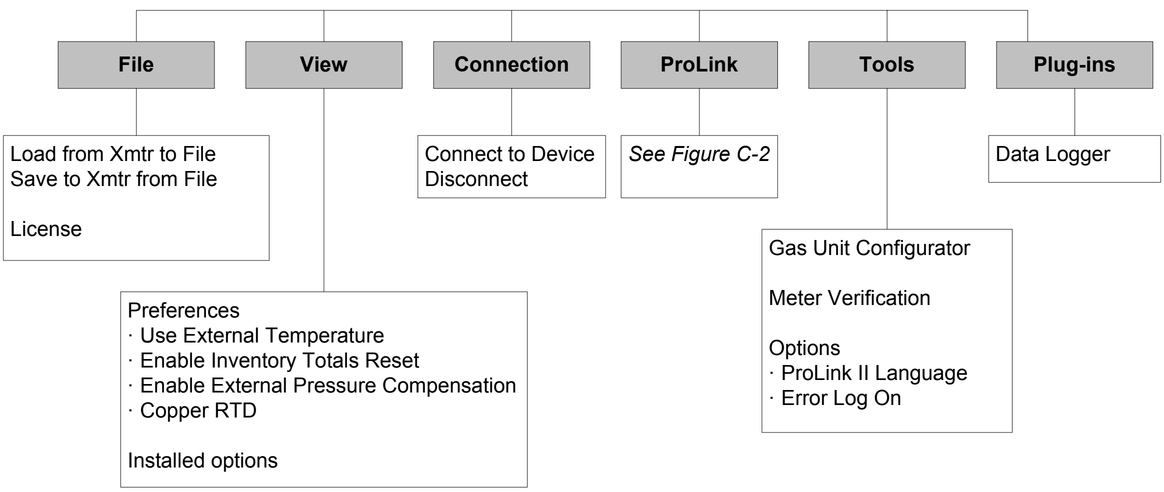
These menu flowcharts are based on:

- Transmitter software rev4.4
- Enhanced core processor software v3.2
- ProLink II v2.5

Menus may vary slightly for different versions of these components.

C.3 Flowcharts

Figure C-1 ProLink II top-level menu



Note: For information on Data Logger, see the ProLink II manual.

Note: The Reset Inventories option is available only if it has been enabled in the ProLink II Preferences menu.

Figure C-2 ProLink II operating menus

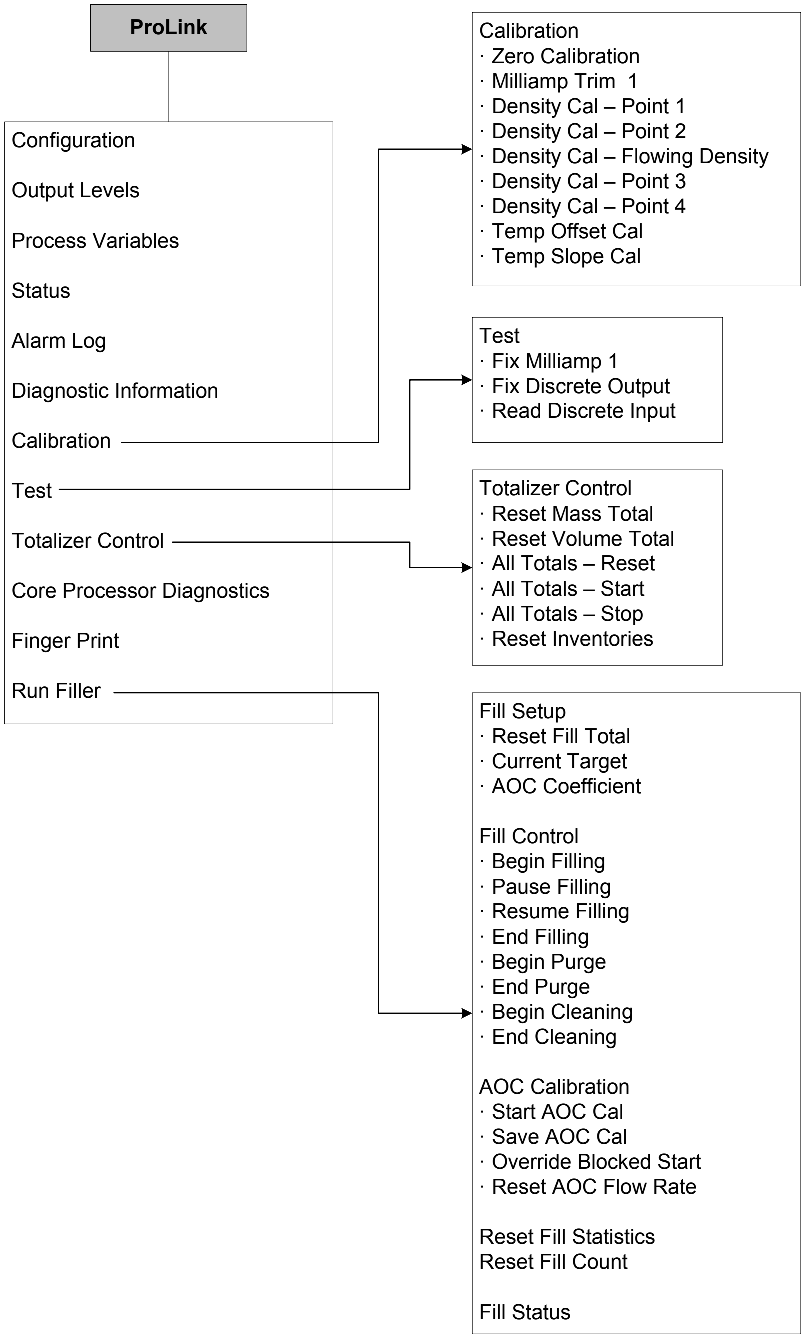


Figure C-3 ProLink II configuration menu

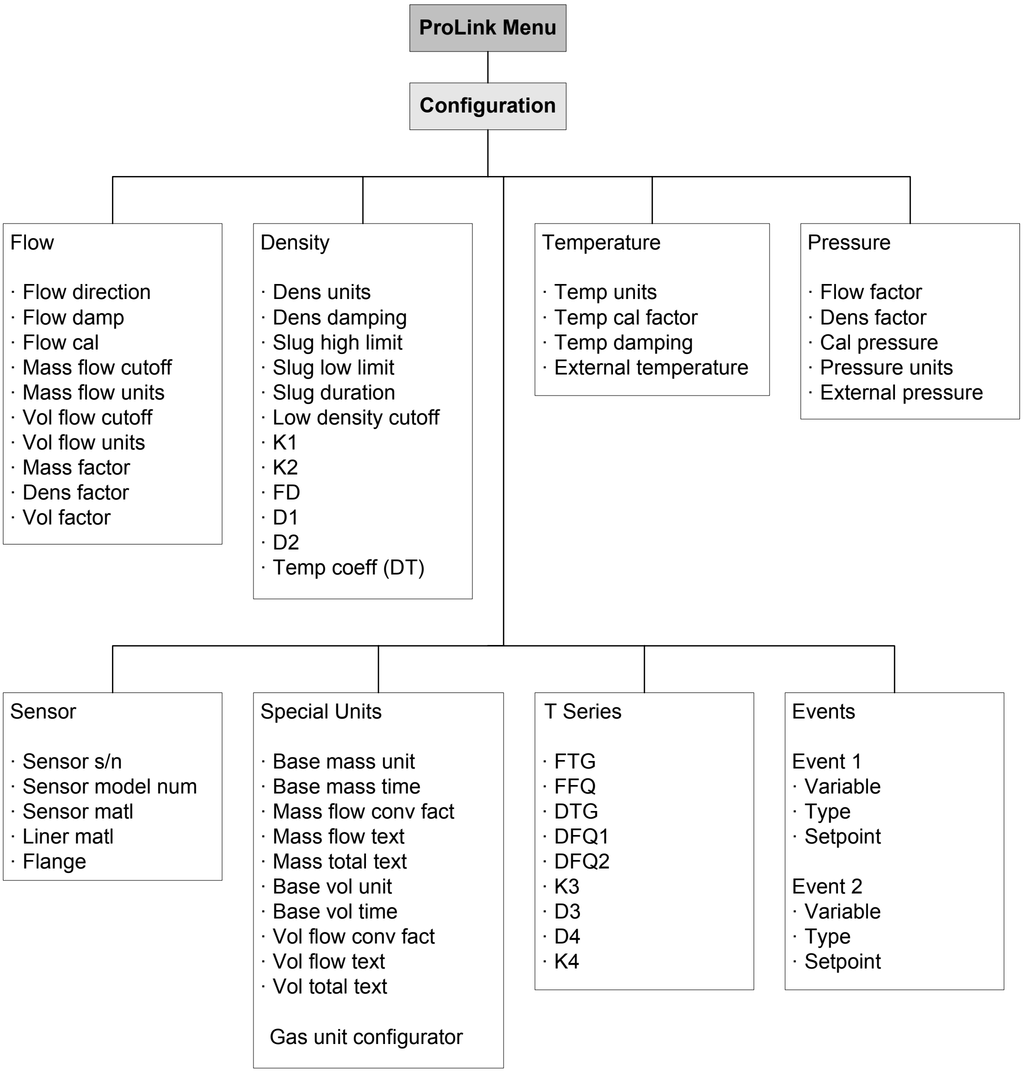
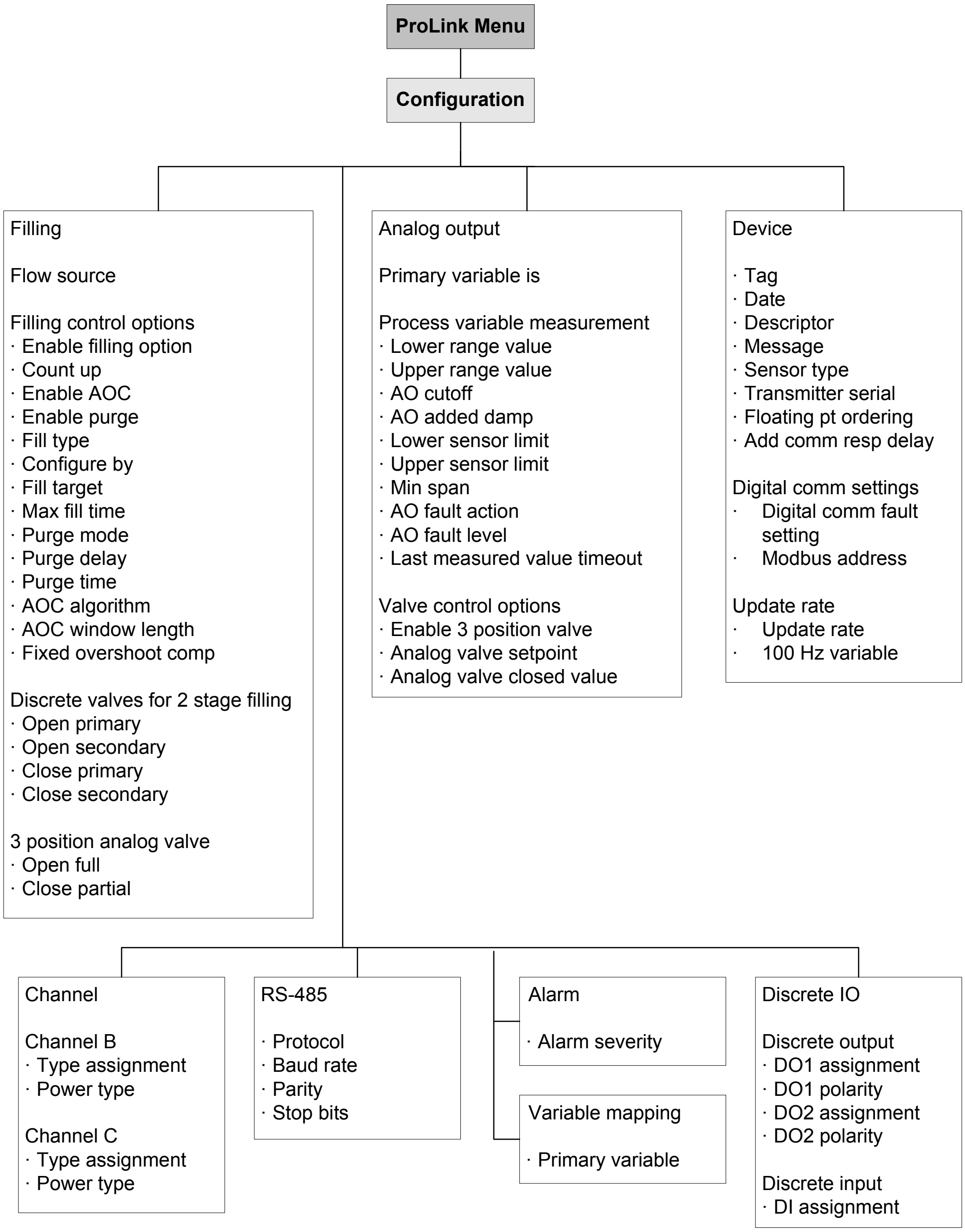


Figure C-4 ProLink II configuration menu *continued*



Note: The DO2 options are available only if Channel C has been configured for discrete output.

Note: The discrete input options are available only if Channel C has been configured for discrete input.

Appendix D
NE53 History

D.1 Overview

This appendix documents the change history of the Model 1500 transmitter software with the filling and dosing application.

D.2 Software change history

Table D-1 describes the change history of the transmitter software. Operating instructions are English versions.

Table D-1 Transmitter software change history

Date	Software version	Changes to software	Operating instructions
04/2005	4.3	*Original release*	20002743 A
10/2006	4.4	*Software expansion*	20002743 B
		Added support for enhanced core processor	
		Added support for batches smaller than 0.01 g	
		Software adjustment	
		Master reset automatically enables Special mode	
		Feature addition	
		Meter verification availability as an option	

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