

Micro Motion™ 3000 MVD Transmitters and Controllers

Configuration and Use Manual



Contents

Chapter 1	Before You Begin	1
1.1	About this manual	1
1.2	Safety	1
1.3	European installations	2
1.4	Environmental standards compliance	2
1.5	Terminology	2
1.6	Communication tools	3
1.7	Using this manual	3
1.8	Other documentation	4
1.9	Micro Motion customer service	5
Chapter 2	Installation	7
2.1	Overview	7
2.2	Installation procedure	7
2.3	Replacing an RFT9739 rack-mount transmitter	7
2.4	Model 3350 or Model 3700 safety precautions	8
2.5	Environmental requirements	8
2.6	Ingress protection for Model 3300 controller	8
2.7	Frequency input cable length	8
2.8	Model 3350 or Model 3700 display cover orientation (optional)	9
2.9	Installing the remote core processor	10
2.10	Sensor wiring	10
	2.10.1 Cable types	10
	2.10.2 Cable glands in remote core processor with remote transmitter installations	11
2.11	I/O wiring	11
	2.11.1 Terminals and terminal block locations	11
	2.11.2 Grounding	13
	2.11.3 Installing relays	13
2.12	Digital communications wiring	13
Chapter 3	Digital Communications Setup	15
3.1	About this chapter	15
3.2	Supported protocols	15
	3.2.1 Obtaining the components	15
	3.2.2 RS-485 signal converter	15
	3.2.3 Bell 202 signal converter	16
3.3	Setting up RS-485 communications	16
3.4	Setting up Bell 202 communications	19

Chapter 4	Using the Display and Menu System	25
4.1	About this chapter	25
4.2	Startup display	25
4.3	Menu systems	26
4.3.1	Accessing management functions	27
4.3.2	Shortcuts	28
4.4	Using the function buttons	28
4.5	Using the cursor control buttons	30
4.5.1	Selecting from a list	30
4.5.2	Changing a variable value	30
4.5.3	Cursor control example	30
4.5.4	Process monitor	30
4.6	Scientific notation	30
Chapter 5	Configuring Security and Language	33
5.1	About this chapter	33
5.2	Security menu	33
5.3	Security	34
5.3.1	Management menu access	34
5.3.2	Write-protecting the device configuration	34
5.3.3	Controlling process totalizer and process inventory reset	35
5.4	Language menu	35
Chapter 6	Configuring System Data	37
6.1	About this chapter	37
6.2	System menu	37
6.3	System parameters	38
6.3.1	Alarm severity	38
Chapter 7	Configuring Inputs	39
7.1	About this chapter	39
7.2	Inputs menu	39
7.3	Configuring the core processor parameters	41
7.3.1	Enabling and disabling core processor inputs	42
7.3.2	Configuring process variables	42
7.3.3	Sensor calibration data	53
7.3.4	Sensor information	56
7.3.5	Discrete inputs	56
7.4	Configuring the frequency input	57
7.5	Configuring the discrete inputs	58
7.6	Configuring the external inputs	59
Chapter 8	Configuring Outputs	61
8.1	About this chapter	61
8.2	Outputs menu	61
8.3	Configuring the discrete outputs	63
8.3.1	Polarity	63
8.3.2	Source variable assignment	64
8.3.3	Fault indication	65

Contents

8.4	Configuring the milliamp outputs	66
8.4.1	Milliamp output	66
8.4.2	Fault indication	66
8.4.3	Process variable	67
8.4.4	Calibration span	67
8.5	Configuring the frequency output	70
8.5.1	Frequency = flow	71
8.5.2	Maximum pulse width	72

Chapter 9 Configuring the Petroleum Measurement Application 75

9.1	About this chapter	75
9.2	API menu	75
9.3	About petroleum measurement	76
9.3.1	Definitions	76
9.3.2	CTL derivation methods	76
9.4	Configuring petroleum measurement parameters	76
9.4.1	Reference tables	77
9.4.2	Temperature data	78

Chapter 10 Configuring Discrete Events 79

10.1	About this chapter	79
10.2	Discrete events menu	79
10.3	About discrete events	79
10.4	Discrete event configuration procedure	80

Chapter 11 Configuring the Discrete Batch Application 83

11.1	About this chapter	83
11.2	Discrete batch menu	83
11.3	Batching configuration overview	84
11.4	Flow source	85
11.5	Control options	86
11.5.1	One-stage versus two-stage batching	88
11.6	Configure presets	88
11.6.1	Batch preset examples	89
11.7	Batch control methods	90
11.7.1	Special cases in batch control	92

Chapter 12 Configuring the Process Monitor. 93

12.1	About this chapter	93
12.2	Monitoring menu	93
12.3	Process monitor screens	94
12.4	Process monitor variables	94
12.5	Update period	95

Chapter 13	Configuring Digital Communications	97
13.1	About this chapter	97
13.2	Digital communication menu	97
13.3	Configuring RS-485 parameters	99
13.3.1	Configuring HART, Modbus RTU, or Modbus ASCII protocol	99
13.3.2	Configuring printer protocol	101
13.4	Configuring Bell 202 parameters	102
13.4.1	Loop current mode	103
13.4.2	Burst mode	103
13.4.3	Communicating with a remote device	104
13.5	Configuring device parameters	104
Chapter 14	Configuring Custody Transfer	105
14.1	About this chapter	105
14.2	About custody transfer	105
14.3	Configuration options	106
14.4	Configuring custody transfer (NTEP)	107
14.5	Configuring custody transfer (OIML) and custody transfer (OIML/batch)	108
14.6	Setting the security switch	111
14.6.1	Panel-mount devices	111
14.6.2	Rack-mount devices	112
14.6.3	Field-mount devices	113
14.7	Installing the weights and measures seal	115
Chapter 15	Ticket Formatting and Printing	117
15.1	About this chapter	117
15.2	Ticket overview	117
15.3	Standard tickets	119
15.3.1	Formatting	119
15.3.2	Printing	120
15.4	Batch tickets	121
15.4.1	Formatting	121
15.4.2	Printing	122
15.5	Batch (NTEP) tickets	123
15.5.1	Formatting	123
15.5.2	Printing	124
15.6	Transfer (OIML) tickets	125
15.6.1	Formatting	125
15.6.2	Printing	127
15.7	Batch (OIML) tickets	129
15.7.1	Formatting	129
15.7.2	Printing	131
Chapter 16	Startup Procedures	133
16.1	About this chapter	133
16.2	Applying power	133
16.2.1	Communication methods after power-up	134

Contents

16.3	Sensor zero	134
16.3.1	Zero failure and restoring zero values	135
16.3.2	Preparing for sensor zero calibration	135
16.3.3	Performing the sensor zero calibration	135
16.3.4	Diagnosing sensor zero failure	138
16.4	Testing the inputs and outputs	138
16.4.1	Reading and testing the discrete inputs	139
16.4.2	Reading and testing the frequency input	139
16.4.3	Reading and testing the pressure and external temperature	139
16.4.4	Setting and testing outputs	139
16.5	Milliamp output trim	140

Chapter 17 Operation Mode 143

17.1	About this chapter	143
17.2	Startup and display test	143
17.3	Initial startup	143
17.4	Process monitor operation mode	144
17.5	Using the View menu	145
17.5.1	Active alarm log	146
17.5.2	Process monitoring	147
17.5.3	Preset selections	147
17.5.4	Batch inventory	147
17.5.5	Process totalizers and inventories	147
17.5.6	Diagnostic monitor	148
17.5.7	LCD options	148
17.5.8	Density curves	148
17.5.9	Applications list	148

Chapter 18 Operation Mode – Batch 149

18.1	About this chapter	149
18.2	About discrete batching	149
18.3	Batch process screen	150
18.3.1	Function buttons	151
18.3.2	Cursor control buttons	153
18.4	Batch processing sequences	153
18.5	Special cases in batch processing	157
18.5.1	Cleaning/purging the tubes	157
18.5.2	Ending a batch while flow is present	157
18.6	Batch AOC calibration	157

Chapter 19 Operation Mode – Custody Transfer 159

19.1	About this chapter	159
19.2	Identifying a security breach	159
19.3	Secured versus unsecured	159
19.4	Custody transfer (NTEP)	163
19.4.1	BOL number	163
19.4.2	Executing a custody transfer (NTEP) transaction	163
19.4.3	Batch (NTEP) tickets and ticket printing	163
19.4.4	General use of Series 3000 device	164
19.4.5	Inventories	164

19.5	Custody transfer (OIML) and custody transfer (OIML/batch)	164
19.5.1	BOL numbers	164
19.5.2	Executing a custody transfer (OIML) transaction	164
19.5.3	Executing a custody transfer (OIML/batch) transaction.	165
19.5.4	Transfer (OIML) and batch (OIML) tickets and ticket printing	166
19.5.5	Transfer log	167
19.5.6	General use of Series 3000 device	168
19.6	Clearing a security breach	170
19.7	Reconfiguring the Series 3000 device	170
19.8	Audit trail	170
19.8.1	Using the audit trail	171

Chapter 20 Using Totalizers and Inventories 173

20.1	About this chapter.	173
20.2	Overview	173
20.3	Totalizer management	174
20.4	Process totalizers	176
20.5	Process inventories.	176
20.6	Batch inventories	176

Chapter 21 Measurement Performance 179

21.1	Overview	179
21.2	Meter verification, meter validation, and calibration	179
21.2.1	Meter verification	180
21.2.2	Meter validation and meter factors	181
21.2.3	Calibration	181
21.2.4	Comparison and recommendations.	182
21.3	Performing meter verification	183
21.3.1	Preparing for the meter verification test.	183
21.3.2	Running the meter verification test, original version	184
21.3.3	Running Smart Meter Verification	186
21.3.4	Reading and interpreting meter verification test results	190
21.3.5	Setting up automatic or remote execution of the meter verification test	195
21.4	Performing meter validation	196
21.5	Performing density calibration.	197
21.5.1	Preparing for density calibration	197
21.5.2	Density calibration procedures	199
21.6	Performing temperature calibration.	201

Chapter 22 Diagnostics and Troubleshooting 203

22.1	About this chapter.	203
22.2	Checking process variables	203
22.3	Meter fingerprinting.	206
22.4	Sensor simulation mode	207
22.5	Updates, upgrades, and master resets.	208
22.6	Alarm types and handling	208
22.6.1	Alarm severity	208
22.6.2	Fault timeout	209
22.6.3	Alarm categories	209
22.6.4	Alarm occurrences and logs	209
22.6.5	Help system.	211

Contents

22.7	Alarm listings by category	212
22.7.1	Electronics alarms	212
22.7.2	Sensor alarms	215
22.7.3	Process alarms	216
22.7.4	Configuration alarms	222
22.8	Restoring a working configuration	224
22.9	A009/A026 alarms on Model 3300 or Model 3500 panel-mount.	224
22.10	I/O problems	225
22.11	Diagnosing wiring problems	227
22.11.1	Checking the power supply wiring	227
22.11.2	Checking the sensor-to-transmitter wiring	228
22.11.3	Checking grounding	228
22.11.4	Checking the HART communication loop	228
22.11.5	Checking for RF interference	228
22.11.6	Checking the output wiring and receiving device.	229
22.11.7	Checking the Loop Current Mode parameter.	229
22.12	Checking the sensor tubes	229
22.13	Checking the flow measurement unit	229
22.14	Checking the calibration span	229
22.15	Checking the frequency output scale and method	229
22.16	Checking the characterization	229
22.17	Checking the calibration	230
22.18	Checking the test points	230
22.18.1	Obtaining the test points	230
22.18.2	Evaluating the test points.	230
22.18.3	Excessive drive gain	231
22.18.4	Erratic drive gain	231
22.18.5	Low pickoff voltage	232
22.19	Checking the core processor	232
22.19.1	Checking the core processor LED	232
22.19.2	Core processor resistance test (standard core processor only)	234
22.20	Checking sensor coils and RTD	235
22.20.1	Remote core processor with remote transmitter installation	235
22.20.2	4-wire remote installation.	236

Appendix A Specifications – Model 3300 and Model 3500. 241

A.1	Housing and mounting	241
A.1.1	Panel-mount.	241
A.1.2	Rack-mount	241
A.2	Interface/display	241
A.3	Weight	241
A.4	Dimensions	241
A.5	Electrical connections	246
A.5.1	Panel-mount.	246
A.5.2	Rack-mount	246
A.6	Inputs and outputs.	246
A.6.1	Intrinsically safe input signals	246
A.6.2	Non-intrinsically safe input signals.	246
A.6.3	Non-intrinsically safe output signals.	247
A.6.4	Digital communications	248
A.7	Power supply options	248
A.7.1	Model 3300 controller	248
A.7.2	Model 3500 transmitter	248
A.8	Environmental limits	249

Contents

A.9	Environmental effects	249
A.10	Hazardous area classifications	249
	A.10.1 ATEX	249
	A.10.2 UL and CSA	249
A.11	Performance specifications	249
A.12	Cleaning instructions	249

Appendix B Specifications – Model 3350 and Model 3700 251

B.1	Compartmentalized housing	251
B.2	Interface/display	251
B.3	Weight	251
B.4	Dimensions	251
B.5	Electrical connections	255
B.6	Inputs and outputs	255
	B.6.1 Intrinsically safe input signals	255
	B.6.2 Non-intrinsically safe input signals	255
	B.6.3 Non-intrinsically safe output signals	255
	B.6.4 Digital communications	256
B.7	Power supply options	257
B.8	Environmental limits	257
B.9	Environmental effects	257
B.10	Hazardous area classifications	257
	B.10.1 ATEX	257
	B.10.2 UL and CSA	257
B.11	Performance specifications	258
B.12	Cleaning instructions	258

Appendix C Specifications – Model 3100 259

C.1	Overview	259
C.2	Relay packs	259
C.3	Hazardous area classifications	259
	C.3.1 ATEX	259
	C.3.2 UL and CSA	259

Appendix D Installing Relays 261

D.1	About this appendix	261
D.2	Relay types	261
	D.2.1 Power	261
D.3	Hazardous area installations	261
	D.3.1 Model 3100 relays	261
	D.3.2 User-supplied relays	262
D.4	Replacing relays	262
D.5	Using relays with the Series 3000 device	262
	D.5.1 Series 3000 discrete outputs	262
D.6	Installing the Model 3100 relay module	263
D.7	Installing user-supplied relays	269

Appendix E Default Values and Ranges 273

E.1	Overview	273
E.2	Most frequently used defaults and ranges	273

- Appendix F Series 3000 Menu Flowcharts 277**
 - F.1 Overview 277
 - F.2 Process monitor 277
 - F.3 Menu access 278
 - F.4 View menu 279
 - F.5 Management menus 281

- Appendix G ProLink II and Pocket ProLink 289**
 - G.1 Overview 289
 - G.2 Requirements 289
 - G.3 ProLink II configuration upload/download 290
 - G.4 Connecting from a PC to a Series 3000 device 290
 - G.5 ProLink II menu flowcharts 291

- Appendix H 375 Field Communicator 297**
 - H.1 Overview 297
 - H.2 DD requirements 297
 - H.3 Connecting from the 375 Field Communicator to a Series 3000 device 297
 - H.4 Communicator menu flowcharts 297

- Appendix I Sample Tickets 305**
 - I.1 Overview 305
 - I.2 Standard tickets 306
 - I.3 Batch tickets 309
 - I.4 Batch (NTEP) tickets 309
 - I.5 Transfer (OIML) tickets 310
 - I.6 Batch (OIML) tickets 313

- Appendix J Label Maintenance and Replacement 315**
 - J.1 Maintaining and replacing labels 315
 - J.2 Labels on the device 315

- Appendix K Return Policy 317**
 - K.1 General guidelines 317
 - K.2 New and unused equipment 317
 - K.3 Used equipment 317

- Appendix L NE 53 History 319**
 - L.1 Overview 319
 - L.2 Software change history 319

- Index 323**

Chapter 1

Before You Begin

1.1 About this manual

This manual explains how to install, configure, and use the following Micro Motion® Series 3000 devices:

- Model 3500 or Model 3700 transmitter
- Model 3300 or Model 3350 controller

This manual also discusses the following optional applications:

- Discrete batching
- Petroleum measurement (API feature)
- Custody transfer

This manual does not discuss the Series 3000 Net Oil Computer. For information on this product and application, see the *Series 3000 Net Oil Computer Manual*, available on the Micro Motion web site (www.micromotion.com).

This manual does not discuss the enhanced density application. For information on enhanced density, see the manual entitled *Enhanced Density Application: Theory, Configuration, and Use*, available on the Micro Motion web site (www.micromotion.com).

This manual does not discuss the Marine Bunker Transfer Package. For information on this product and application, see the manual entitled *Series 3000 Transmitters: Marine Bunker Transfer Package Supplement*, available on the Micro Motion web site (www.micromotion.com).

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.

WARNING

Improper installation in a hazardous area can cause an explosion.

For information about hazardous applications, refer to Micro Motion hazardous area installation instructions, shipped with the Series 3000 device or available from the Micro Motion web site.

⚠ CAUTION

Improper installation could cause measurement error or flowmeter failure.

Follow all instructions to ensure Series 3000 device will operate correctly.

1.3 European installations

This Micro Motion product complies with all applicable European directives when properly installed in accordance with the instructions in this manual. Refer to the EC declaration of conformity for directives that apply to this product.

The EC declaration of conformity, with all applicable European directives, and the complete *ATEX Installation Drawings and Instructions* are available on the internet at www.micromotion.com/atex or through your local Micro Motion support center.

1.4 Environmental standards compliance

To comply with EU Battery Directive 2006/66/EC, this device has been designed for safe removal of the batteries at end of life by a waste treatment facility.

1.5 Terminology

The following terms are used in this manual:

- *Series 3000* – refers to all Model 3300, 3350, 3500, or 3700 devices.
- *MVD* – Multi Variable Digital, Micro Motion’s advanced method of analyzing and reporting process variables.
- *Application* – a specific use of the flowmeter technology, and the specialized software or hardware required for implementation. Sample applications include enhanced density, batching, and custody transfer.
- *Platform* – refers to any component that can run an application. The component may be a transmitter or a controller (see below).
- *Sensor* – provides measurement functions.
- *Core processor* – refers to the component which provides memory and preprocessing functions on process variable data received from the sensor. There are two versions: the *standard core processor* and the *enhanced core processor*. To check your core processor type, use the Applications List (see Section 17.5.9).
- *Transmitter* – refers to the component that accepts process variable data from the core processor, performs additional processing, and transmits the processed data to a remote device. In this manual, the Model 3500 and Model 3700 devices are transmitters.
- *Controller* – refers to the Model 3300 and Model 3350 devices. Controllers receive processed data from a transmitter such as an IFT9701, use these data in an application that is installed on the device, and send the results to a remote device. Controllers are not connected to a sensor or core processor.

1.6 Communication tools

You can communicate with a Series 3000 device using any of the following communication tools:

- The local display
- ProLink II v2.5 and higher (ProLink II v2.9 or higher recommended), or Pocket ProLink v1.3 and higher
- 375 Field Communicator with the appropriate DD: **Micro Motion 3000 Mass flo v7 DD v2** or higher

This manual focuses on the use of the local display. Detailed menu flowcharts for the local display are provided in Appendix F.

For information on using ProLink II or the Communicator with a Series 3000 device, see Appendix G or Appendix H. These appendices also provide flowcharts for the most commonly used menus and procedures.

1.7 Using this manual

If the Marine Bunker Transfer Package is installed, use the manual entitled *Series 3000 Transmitters: Marine Bunker Transfer Package Supplement* as your first guide to installation, configuration, and use.

If the Marine Bunker Transfer Package is not installed, follow the general task sequence described below to install, configure, and use the Series 3000 device.

1. Install the Series 3000 device (Chapter 2).
2. Set up digital communications (Chapter 3).
3. Learn to use the display and menu system (Chapter 4).
4. Configure the platform (Chapters 5 through 15).

Failure to perform configuration tasks in the proper sequence could result in an incomplete configuration. Perform the configuration procedures in this order:

- a. Configure security and language (Chapter 5).
- b. Configure system data (Chapter 6).
- c. Configure inputs (Chapter 7).
- d. Configure petroleum measurement parameters, if the petroleum measurement application (API feature) is installed (see Chapter 9), or enhanced density parameters, if the enhanced density application is installed (see the enhanced density manual, available on the Micro Motion web site).

Note: The Series 3000 device does not support simultaneous use of the petroleum measurement application and the enhanced density application. If you ordered either of these applications, it should already be installed on your Series 3000 device, but not configured or enabled.

- e. Configure discrete events (Chapter 10).
- f. Configure the discrete batch application, if it is present (Chapter 11).
- g. Configure outputs (Chapter 8).
- h. Configure the process monitor (Chapter 12).
- i. Configure digital communications (Chapter 13).
- j. Configure custody transfer (Chapter 14).
- k. Configure ticket formatting and ticket printing (Chapter 15).

Before You Begin

5. Perform startup procedures (Chapter 16).
6. Learn to use the Series 3000 device in operation mode (Chapters 17 through 19).
7. Learn how to view, start and stop, and reset totalizers (Chapter 20).
8. Establish a meter verification baseline, and calibrate the Series 3000 device, if required (Chapter 21).
9. Learn how to respond to alarms (Chapter 22).

1.8 Other documentation

See Table 1-1 for a list of other manuals that may be useful or required to install, configure, or operate the Series 3000 device.

Table 1-1 Additional documentation for Series 3000 devices

Topic	Manual / QRG title	Location
Device installation: • Model 3300 panel-mount • Model 3500 panel-mount	<i>Model 3500 Transmitter (MVD) or Model 3300 Peripheral: Installation Instructions for Panel-Mount</i> (Quick Reference Guide)	• Micro Motion documentation CD • Micro Motion web site
Device installation: • Model 3300 rack-mount • Model 3500 rack-mount	<i>Model 3500 Transmitter (MVD) or Model 3300 Peripheral: Installation Instructions for Rack-Mount</i> (Quick Reference Guide)	• Micro Motion documentation CD • Micro Motion web site
Device installation: • Model 3350 field-mount • Model 3700 field-mount	<i>Model 3700 Transmitter (MVD) or Model 3350 Peripheral: Installation Instructions for Field-Mount</i> (Quick Reference Guide)	• Micro Motion documentation CD • Micro Motion web site
Sensor installation	Varies	• Micro Motion documentation CD • Micro Motion web site
Hazardous area installation	Varies	• Micro Motion documentation CD • Micro Motion web site
Enhanced density application	<i>Enhanced Density Application: Theory, Configuration, and Use</i>	• Micro Motion documentation CD • Micro Motion web site
Marine Bunker Transfer Package	<i>Series 3000 Transmitters: Marine Bunker Transfer Package Supplement</i>	• Micro Motion documentation CD • Micro Motion web site
Using ProLink II with the Series 3000 device	<i>Using ProLink II Software with Micro Motion Transmitters</i>	• ProLink II installation media • Micro Motion documentation CD • Micro Motion web site

1.9 Micro Motion customer service

For customer service, phone the support center nearest you:

- In the U.S.A., phone **800-522-MASS** (800-522-6277) (toll-free)
- In Canada and Latin America, phone +1 303-527-5200
- In Asia:
 - In Japan, phone 3 5769-6803
 - In other locations, phone +65 6777-8211 (Singapore)
- In Europe:
 - In the U.K., phone 0870 240 1978 (toll-free)
 - In other locations, phone +31 (0) 318 495 555 (The Netherlands)

Customers outside the U.S.A. can also email Micro Motion customer service at flow.support@emerson.com.

Chapter 2

Installation

2.1 Overview

This chapter provides supplemental installation information for all Series 3000 devices.

2.2 Installation procedure

To install your Series 3000 device:

1. Obtain the appropriate Quick Reference Guide (QRG), as listed in Table 2-1.
2. Review the specifications for your device:
 - Model 3300 or Model 3500 – see Appendix A
 - Model 3350 or Model 3700 – see Appendix B
3. Review the supplemental information provided in this chapter.
4. Follow the installation instructions in the QRG, making all applicable changes to your installation procedure.

Table 2-1 Series 3000 installation QRGs


Series 3000 device	Quick Reference Guide
Model 3300 controller (panel-mount) Model 3500 transmitter (panel-mount)	<i>Model 3500 Transmitter (MVD) or Model 3300 Peripheral: Installation Instructions for Panel-Mount</i>
Model 3300 controller (rack-mount) Model 3500 transmitter (rack-mount)	<i>Model 3500 Transmitter (MVD) or Model 3300 Peripheral: Installation Instructions for Rack-Mount</i>
Model 3350 controller (field-mount) Model 3700 transmitter (field-mount)	<i>Model 3700 Transmitter (MVD) or Model 3350 Peripheral: Installation Instructions for Field-Mount</i>

2.3 Replacing an RFT9739 rack-mount transmitter

Micro Motion can provide a special installation kit for installing a Model 3500 transmitter in a rack as a replacement for an RFT9739 rack-mount transmitter. Part number 3500EXTENDEDMD extends the housing of the Series 3000 device to fit an RFT9739 rack. Contact Micro Motion for information about obtaining this kit.

2.4 Model 3350 or Model 3700 safety precautions

 WARNING
<p>Explosion Hazard.</p> <p>Do not open wiring compartments when an explosive gas atmosphere is present.</p> <p>Do not remove the compartment covers in an explosive atmosphere within three minutes after power is disconnected.</p>

 WARNING
<p>Using a dry cloth to clean the display cover can cause static discharge, which could result in an explosion in an explosive atmosphere.</p> <p>To prevent an explosion, use a clean, damp cloth to clean the display cover in an explosive atmosphere.</p>

2.5 Environmental requirements

Note: This section applies to all Series 3000 devices.

In addition to the temperature requirements described in the QRG, the following environmental requirements apply:

- Humidity: 5 to 95% relative humidity, non-condensing at 140 °F (60 °C)
- Vibration: Meets IEC 68.2.6, endurance sweep, 5 to 2000 Hz, 50 sweep cycles at 1.0 g

If possible, install the Series 3000 device in a location that will prevent the heating effects of direct exposure to sunlight.

2.6 Ingress protection for Model 3300 controller

Note: This section applies only to Model 3300 controllers.

If you are installing the Model 3300 in a panel cutout, it may be installed outdoors, if it is installed in a panel providing a degree of ingress protection IP 65 according to EN 50529 (IEC 529).

If you are installing the Model 3300 in a rack, it should be installed in a rack providing a degree of ingress protection NEMA 4X according to EN 50529 (IEC 529).

2.7 Frequency input cable length

Note: This section applies only to Model 3300 or Model 3350 controllers.

The maximum length of the frequency input cable has been increased. The maximum length is now 1000 feet (300 meters) of typical 18 AWG (0,80 mm²) instrumentation cable, rather than 500 feet (150 meters) as documented in the QRGs.

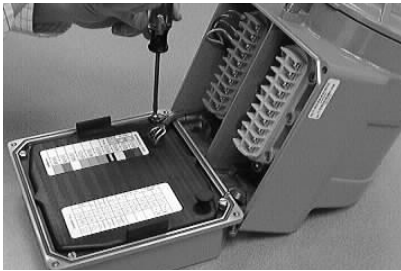
2.8 Model 3350 or Model 3700 display cover orientation (optional)

Note: This section applies only to Model 3350 or Model 3700 devices.

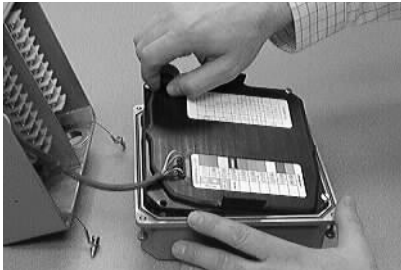
If desired, you can reposition the display on the Model 3350 or Model 3700 device for easier reading and use. You can rotate it 90°, 180°, or 270°. To do this, follow the instructions below.



1. Use a flat-head screwdriver to loosen the captive screws that secure the display cover to the housing.



2. Use a flat-head screwdriver to loosen the captive screws that secure the back cover to the display cover. Take note of which screw attaches the ground wire to the back cover.



3. Pull up on the pressure relief valve while removing the back cover. In this picture, the operator's right hand is touching the pressure relief valve.



4. Rotate the display cover to any desired position.



5. Without touching the circuit board, tuck the wiring out of the way of the circuit board to prevent the wiring from crimping, then reinstall the back cover.



6. Pull up on the pressure relief valve while pressing the back cover into place. Be sure to attach the ground wire to the back cover using the correct screw. Attaching the ground wire to the wrong screw may result in crimping of the ground wire.
7. Tuck the wiring out of the way of the connectors to keep the wiring from crimping, then reinstall the display cover.

2.9 Installing the remote core processor

Note: This section applies only to Model 3500 or Model 3700 devices in remote core processor with remote transmitter installations.

For dimensions of the remote core processor, see Figure A-4 or Figure B-4.

When mounting the core processor, you can reorient it on the bracket if desired. To do this:

1. Loosen each of the four cap screws (4 mm).
2. Rotate the bracket so that the core processor is oriented as desired.
3. Tighten the cap screws, torquing to 30 to 38 in-lbs (3 to 4 N-m).

Be sure to ground the core processor according to applicable local standards, using either the internal or external ground screw.

2.10 Sensor wiring

Note: This section applies only to Model 3500 or Model 3700 transmitters.

2.10.1 Cable types

All installation types require 4-wire cable. Micro Motion offers two types of 4-wire cable: shielded and armored. Both types contain shield drain wires.

User-supplied 4-wire cable must meet the following requirements:

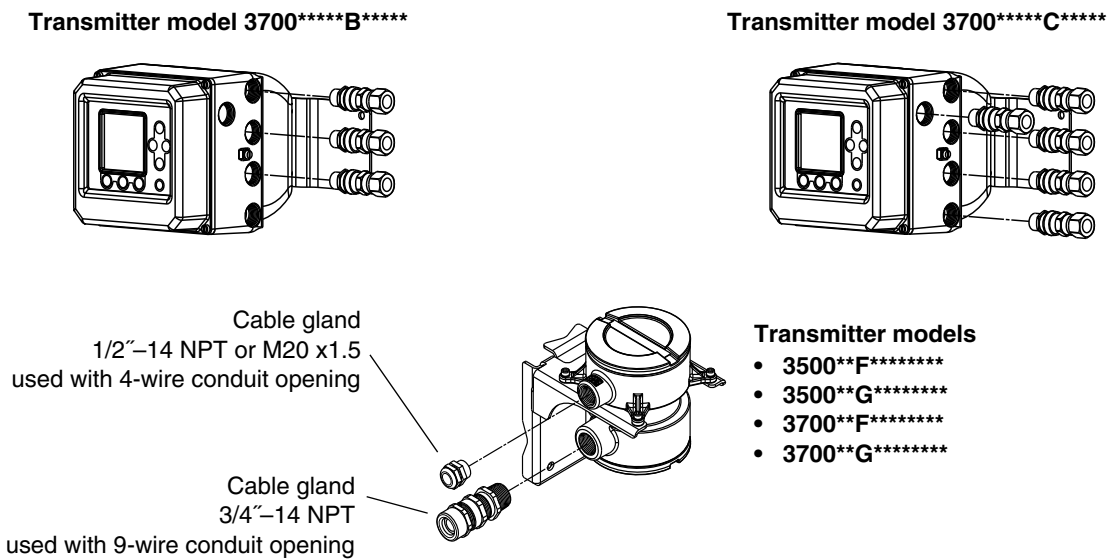
- Twisted pair construction
- The gauge requirements as described in the installation QRG
- The applicable hazardous area requirements, if the device is installed in a hazardous area (see the ATEX, UL, or CSA documents shipped with the transmitter or available on the Micro Motion web site)

Remote core processor with remote transmitter installations also require 9-wire cable. Micro Motion offers three types of 9-wire cable: jacketed, shielded, and armored. Refer to Micro Motion's *9-Wire Flowmeter Cable Preparation and Installation Manual* for detailed descriptions of these cable types and for assistance in selecting the appropriate cable for your installation.

2.10.2 Cable glands in remote core processor with remote transmitter installations

Depending on your transmitter model, several different cable glands may be shipped with the transmitter and core processor. Refer to Figure 2-1 to identify the cable glands supplied by Micro Motion. Be sure to use the appropriate cable gland for each component and location.

Figure 2-1 Cable glands supplied by Micro Motion



2.11 I/O wiring

Note: This section applies to all Series 3000 devices.

2.11.1 Terminals and terminal block locations

To locate the I/O terminal blocks on your Series 3000 platform, see Figure 2-2. To identify the I/O terminals, see the appropriate terminal label in Figure 2-3.

Installation

Figure 2-2 I/O terminal locations

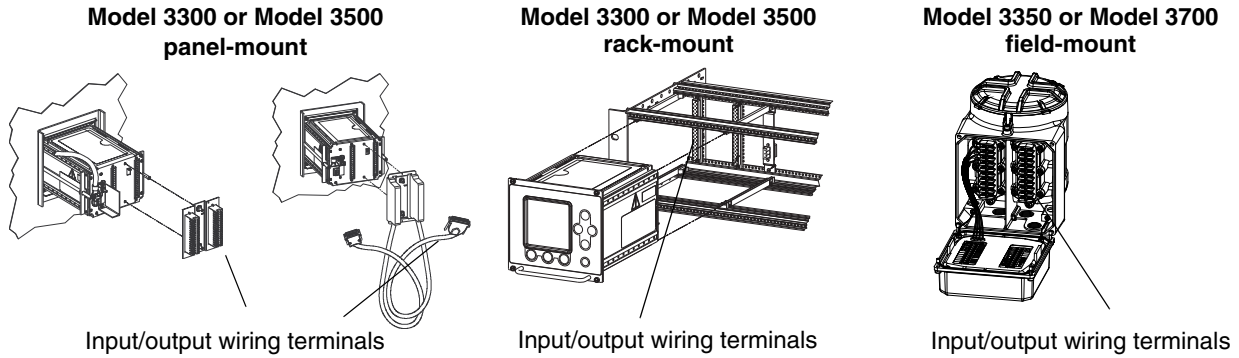


Figure 2-3 I/O terminal labels

Card for Model 3300 or Model 3500 with screw-type or solder-tail terminals

	c	a	
2	+	-	4-20 mA HART
4	+	-	4-20 mA
6	+	-	
8	+	-	Discrete 1
10	+	-	Discrete 2
12	+	-	
14	+	-	Discrete 1
16	+	-	Discrete 2
18	+	-	Discrete 3
20			
22			
24			
26			● Comm 1
			● Comm 2
28			● Comm 3
30			
32	B	A	RS 485

Label for Model 3300 or Model 3500 with I/O cables

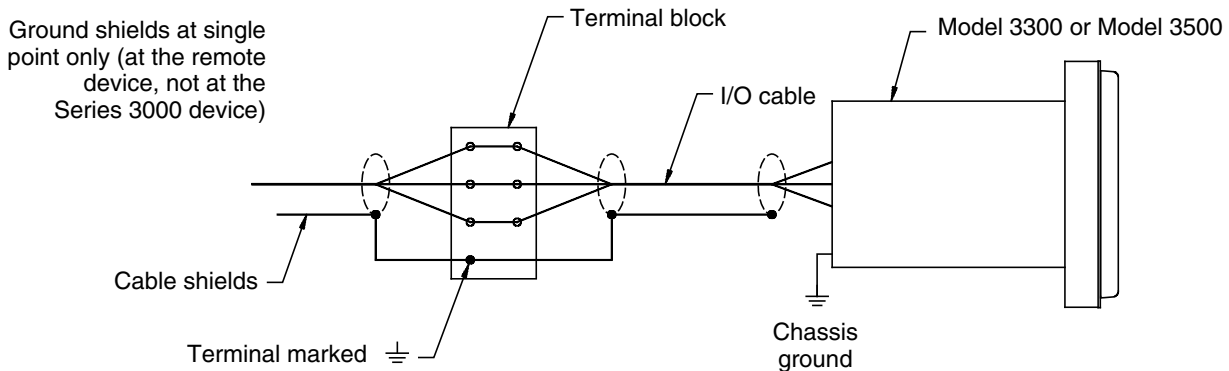
+	4-20 mA		Discrete
-	2		Discrete
+	3		Discrete
-	4		Discrete
+	5		Discrete
-	6		Discrete
+	7		Discrete
-	8		Discrete
+	9		Discrete
-	10		Discrete
+	11		Discrete
-	12		Discrete
+	13		Discrete
-	14		Discrete
+	15		Discrete
-	16		Discrete
+	17		Discrete
-	18		Discrete
+	19		Discrete
-	20		Discrete
+	21		Discrete
-	22		Discrete
+	23		Discrete
-	24		Discrete
+	25		Discrete
-	26		Discrete
+	27		Discrete
-	28		Discrete
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-	30		Discrete
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-	32		Discrete
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-	36		Discrete
+	37		Discrete
-	38		Discrete
+	39		Discrete
-	40		Discrete
+	41		Discrete
-	42		Discrete
+	43		Discrete
-	44		Discrete
+	45		Discrete
-	46		Discrete
+	47		Discrete
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-	50		Discrete
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+	103		Discrete
-	104		Discrete
+	105		Discrete
-	106		Discrete
+	107		Discrete
-	108		Discrete
+	109		Discrete
-	110		Discrete
+	111		Discrete
-	112		Discrete
+	113		Discrete
-	114		Discrete
+	115		Discrete
-	116		Discrete
+	117		Discrete
-	118		Discrete
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-	122		Discrete
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-	124		Discrete
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-	128		Discrete
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-	142		Discrete
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-	146		Discrete
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-	148		Discrete
+	149		Discrete
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+	151		Discrete
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+	155		Discrete
-	156		Discrete
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-	162		Discrete
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-	164		Discrete
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-	168		Discrete
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-	170		Discrete
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+	223		Discrete
-	224		Discrete
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+	265		Discrete
-	266		Discrete
+	267		Discrete
-	268		Discrete
+	269		Discrete
-	270		Discrete
+	271		Discrete
-	272		Discrete
+	273		Discrete
-	274		Discrete
+	275		Discrete
-	276		

2.11.2 Grounding

For all Series 3000 devices, the shields from the I/O wires should be grounded at a single point. Ground the shields at the remote device, not at the Series 3000 device.

If you are installing a Model 3300 or Model 3500 panel-mount device with I/O cables, the terminal block ground is available for continuation of user cable shielding to I/O cable shielding. The cable connector does not connect the I/O cable shielding to the chassis ground. See Figure 2-4.

Figure 2-4 Shield wiring for I/O cable to field device



2.11.3 Installing relays

If you will install a relay to connect the Series 3000 device's discrete outputs to control devices, see Appendix D for installation instructions.

Specifications for the Model 3100 relay (supplied by Micro Motion) are provided in Appendix C.

2.12 Digital communications wiring

If you will use digital communications between your Series 3000 device and a remote device (e.g., a ticket printer, a PLC, a temperature or pressure sensor, or a PC running ProLink II), see Chapter 3 for wiring instructions.

Chapter 3

Digital Communications Setup

3.1 About this chapter

This chapter explains how to install wiring for digital communications between the Series 3000 device and a remote device. The following are typical remote devices:

- Ticket printer
- Any PLC or control system
- PC running ProLink II
- 375 Field Communicator
- Temperature or pressure sensor
- HART Tri-Loop

Note: This chapter does not discuss configuration of digital communications. To configure digital communications, see Chapter 13.

3.2 Supported protocols

Table 3-1 describes the digital communications support provided on the Series 3000 device. HART/Bell 202 is superimposed on the primary mA output, while all RS-485 protocols are implemented on a dedicated terminal pair.

Table 3-1 Series 3000 terminals, physical layers, and protocols

Terminals	Physical layer	Protocol
Primary mA output terminals	Bell 202	HART
RS-485 terminals	RS-485	Modbus HART Printer

3.2.1 Obtaining the components

Identify and obtain the required components according to the physical layers and protocols you will use.

3.2.2 RS-485 signal converter

RS-232 or USB conversion

If you need to convert the RS-485 signal to an RS-232 or USB signal, signal converters are available from Micro Motion (part number PLKUSB485KIT or PLK485KIT). Contact Micro Motion for information about ordering these converters.

You may also order the IC521A-F signal converter with a ticket printer. Contact Micro Motion for the appropriate ETO (engineered-to-order) number.

Depending on your remote device, you may also need a 9-pin to 25-pin adapter.

Note: The ProLink PC Interface Adaptor (PCIA) cannot be used with the Series 3000 device. Because the PCIA does not control the ready-to-send (RTS) line, communication between the Series 3000 device and the remote device cannot be initiated.

Other conversion

If you need to convert the RS-485 signal to another signal, you must supply the appropriate signal converter.

3.2.3 Bell 202 signal converter

RS-232 conversion

If you need to convert the Bell 202 signal to an RS-232 signal, as used by a PC's serial port, signal converters are available from Micro Motion (part number PLKUSB202KIT or PLK202KIT). Contact Micro Motion for information about ordering these converters.

You may also need a Bell 202 cable or a 9-pin to 25-pin adapter.

Other conversion

If you need to convert the Bell 202 signal to another signal, you must supply the appropriate signal converter or HART interface.

3.3 Setting up RS-485 communications

Follow the steps below to set up RS-485 communications between the Series 3000 device and a remote device.

1. Locate and identify the RS-485 terminals on the Series 3000 device. Refer to Table 3-2 and Figure 2-2. Additionally, the Series 3000 device has a label or card that shows input/output wiring terminal designations. See Figure 2-3.

Note: The terminals labeled Comm 1, Comm 2, and Comm 3 are not for I/O wiring. These terminals are for Micro Motion internal use only.

Table 3-2 RS-485 wiring terminals

Model	RS-485 terminals location/description	RS-485 terminals	
		A	B
Model 3300 or Model 3500 with screw-type or solder-tail connectors	Input/output wiring terminal block	a 32	c 32
Model 3300 or Model 3500 with I/O cable	I/O terminal block on DIN rail	25	24
Model 3350 or Model 3700	Gray terminal block, non-intrinsically safe wiring compartment	12	11

2. Using twisted-pair shielded cable, and a signal converter if required, connect the remote device to the RS-485 output terminals on the Series 3000 device. Maximum cable length between the Series 3000 and remote device is 4000 feet (1200 meters).
 - Model 3300 or Model 3500 with screw-type or solder-tail terminals: see Figure 3-1
 - Model 3300 or Model 3500 with I/O cables: see Figure 3-2
 - Model 3350 or Model 3700: see Figure 3-3
3. Add resistance if required.
4. Configure RS-485 communications as described in Section 13.3.

Figure 3-1 Model 3300 or Model 3500 with RS-485 signal converter – Screw-type or solder-tail connectors

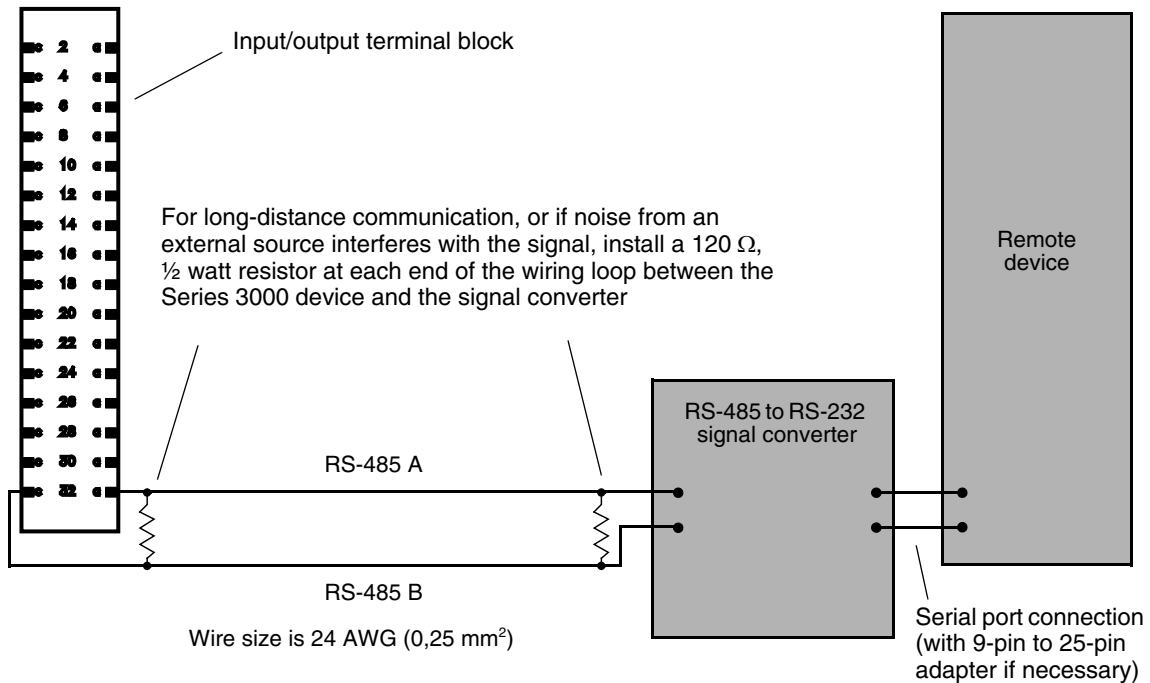


Figure 3-2 Model 3300 or Model 3500 with RS-485 signal converter – I/O cables

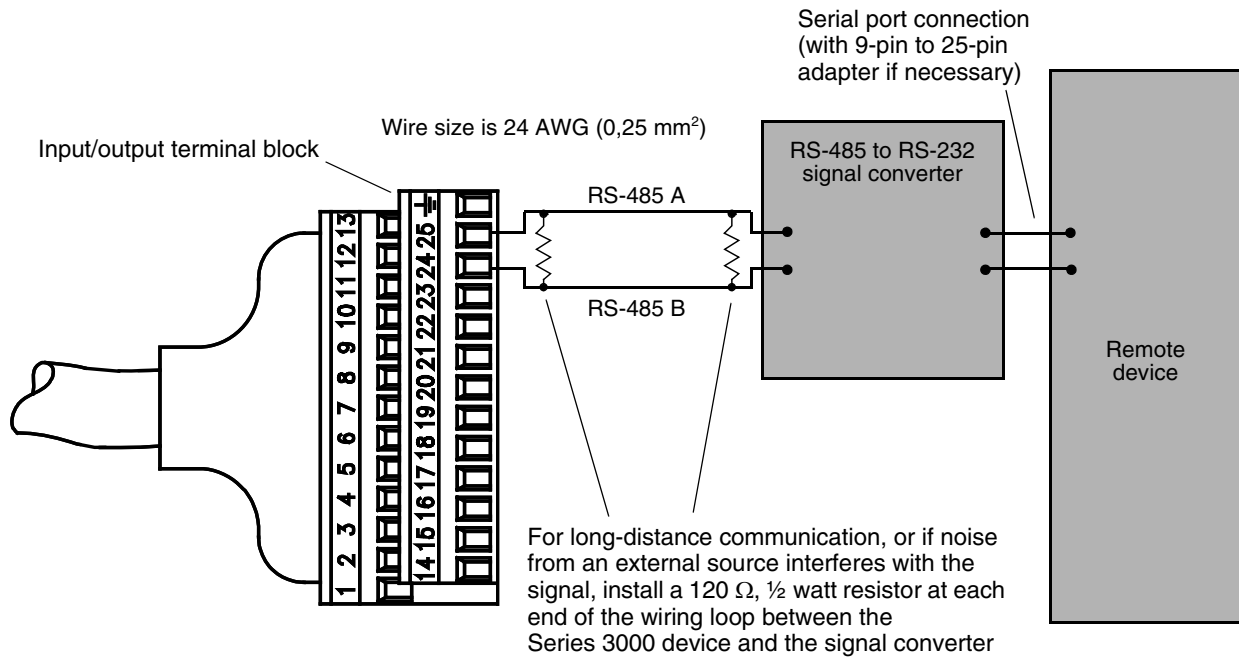
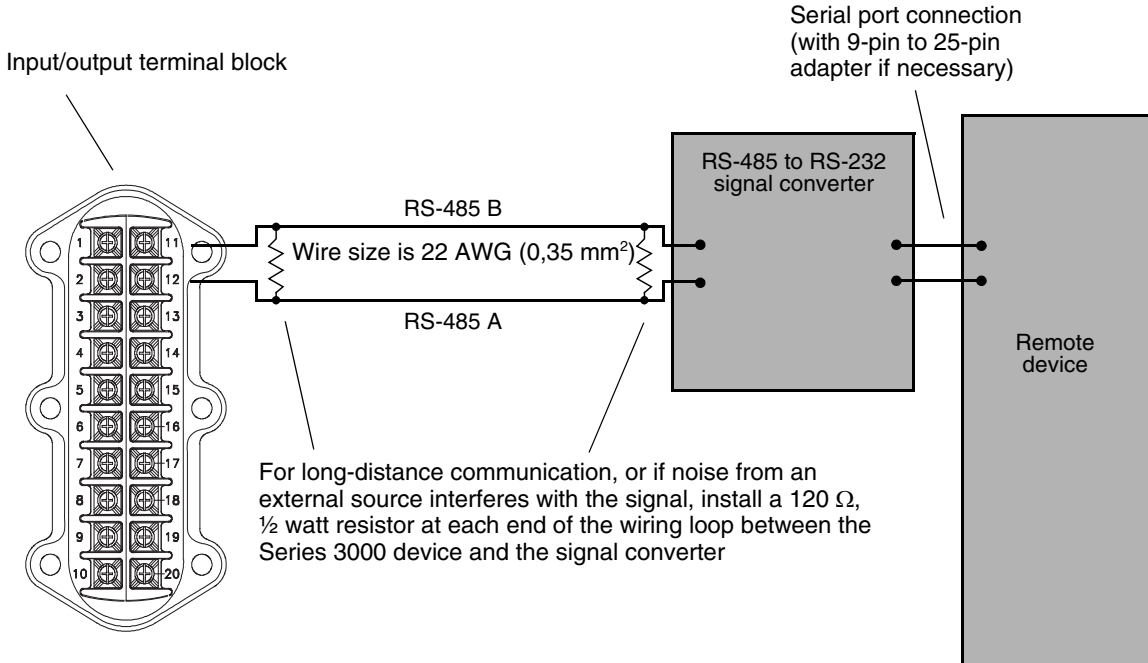


Figure 3-3 Model 3350 or Model 3700 with RS-485 signal converter



3.4 Setting up Bell 202 communications

Follow the steps below to set up Bell 202 communications between the Series 3000 device and a remote device.

1. Locate and identify the primary mA output terminals on the Series 3000 device. Refer to Table 3-3 and Figure 2-2. Additionally, the Series 3000 device has a label or card that shows input/output wiring terminal designations. See Figure 2-3.

Table 3-3 Bell 202 wiring terminals

Model	Primary mA output terminals location/description	Primary mA terminals	
		+	-
Model 3300 or Model 3500 with screw-type or solder-tail connectors	Input/output wiring terminal block	c 2	a 2
Model 3300 or Model 3500 with I/O cable	I/O terminal block on DIN rail	14	15
Model 3350 or Model 3700	Gray terminal block, non-intrinsically safe wiring compartment	2	1

2. Determine if the primary mA output will be used to report both analog (mA) process data and HART digital data. It may already be wired for analog output.
3. Using twisted-pair shielded cable, and a signal converter if required, connect the remote device to the Series 3000 device's primary mA output terminals. Maximum cable length between the Series 3000 device and the remote device is 4000 feet (1200 meters).

If the output will be used for HART digital communications only, see the following:

- Model 3300 or Model 3500 with screw-type or solder-tail terminals: Figure 3-4
- Model 3300 or Model 3500 with I/O cables: Figure 3-5
- Model 3350 or Model 3700: Figure 3-6

Additionally, the following wiring examples are provided:

- Using the primary mA outputs for both digital communication and analog output (HART/analog single-loop wiring) – see Figure 3-7
- Wiring the Series 3000 device to a HART multidrop network – see Figure 3-8
- Wiring for pressure or external temperature compensation – see Figure 3-9
- Wiring the Series 3000 device to a HART Tri-Loop – see Figure 3-10
- Wiring for pressure or external temperature compensation with HART Tri-Loop – see Figure 3-11

Note: The HART loop is not polarity-sensitive.

4. The HART interface must be connected across a resistance of 250–600 Ω. Add resistance to the connection if necessary.
5. Configure Bell 202 communications as described in Section 13.4.

Figure 3-4 Model 3300 or Model 3500 with HART interface – Screw-type or solder-tail connectors

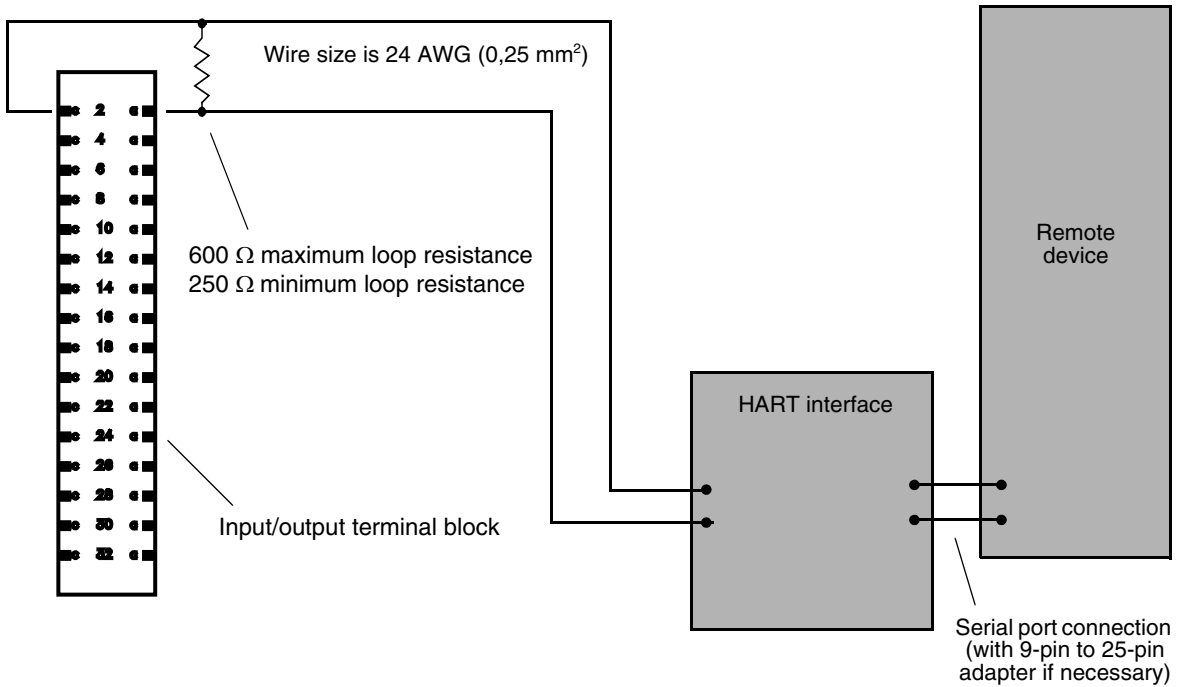


Figure 3-5 Model 3300 or Model 3500 with HART interface – I/O cables

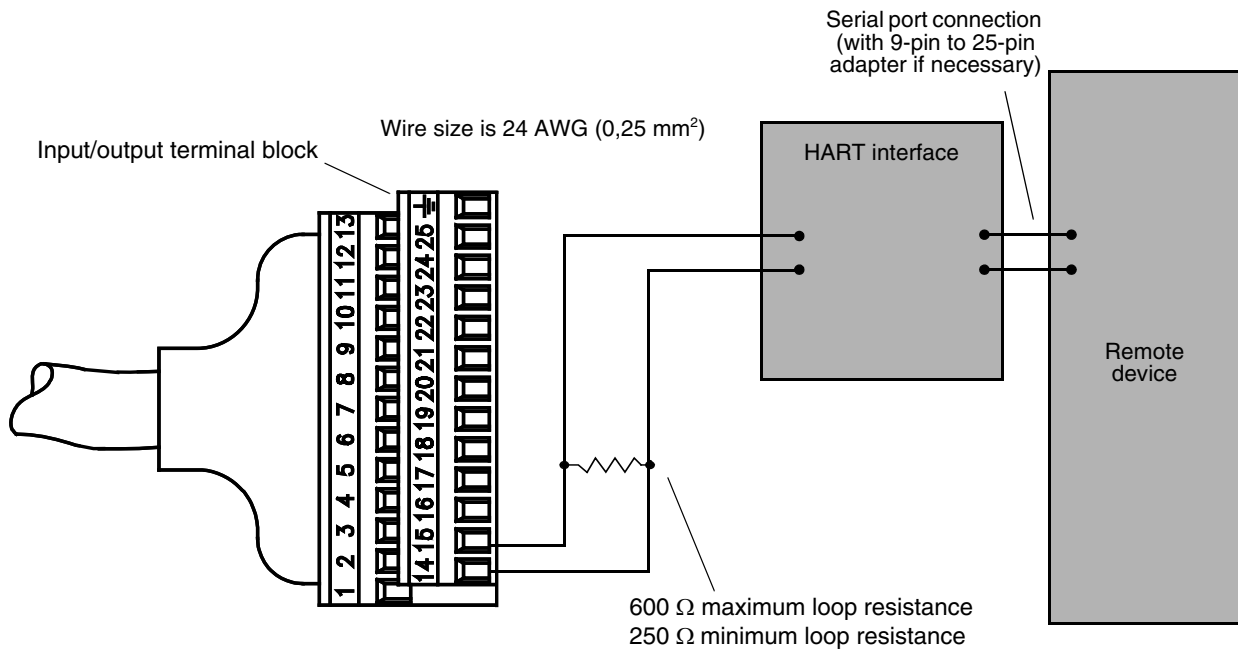


Figure 3-6 Model 3350 or Model 3700 with HART interface

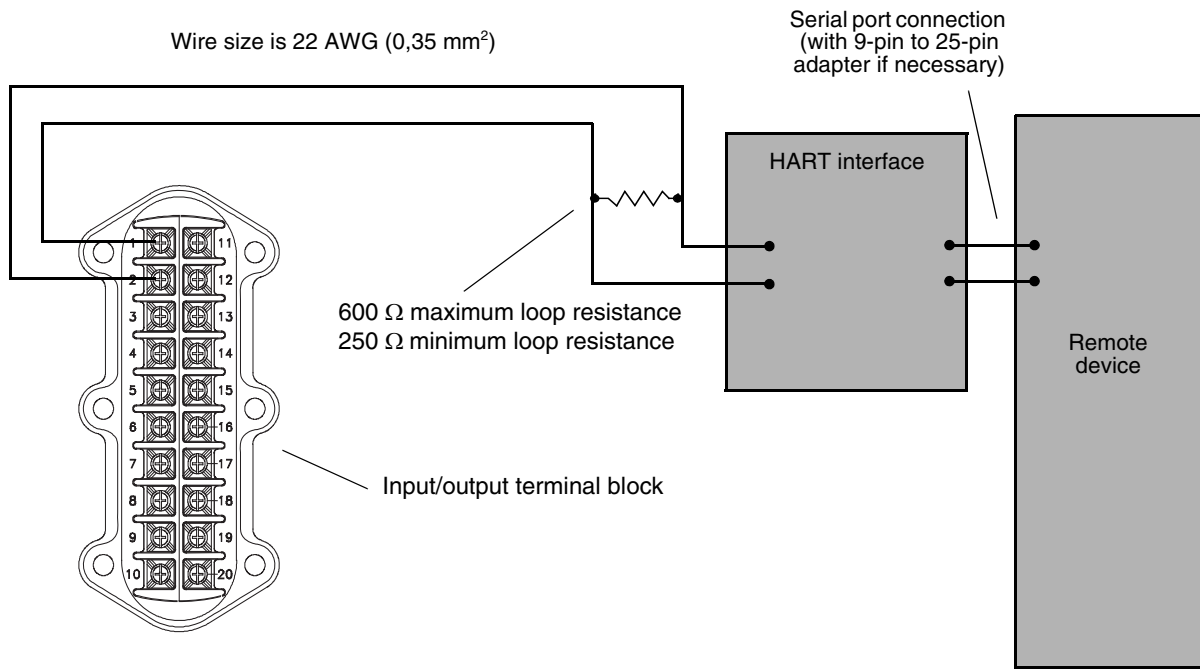


Figure 3-7 HART/analog single-loop wiring

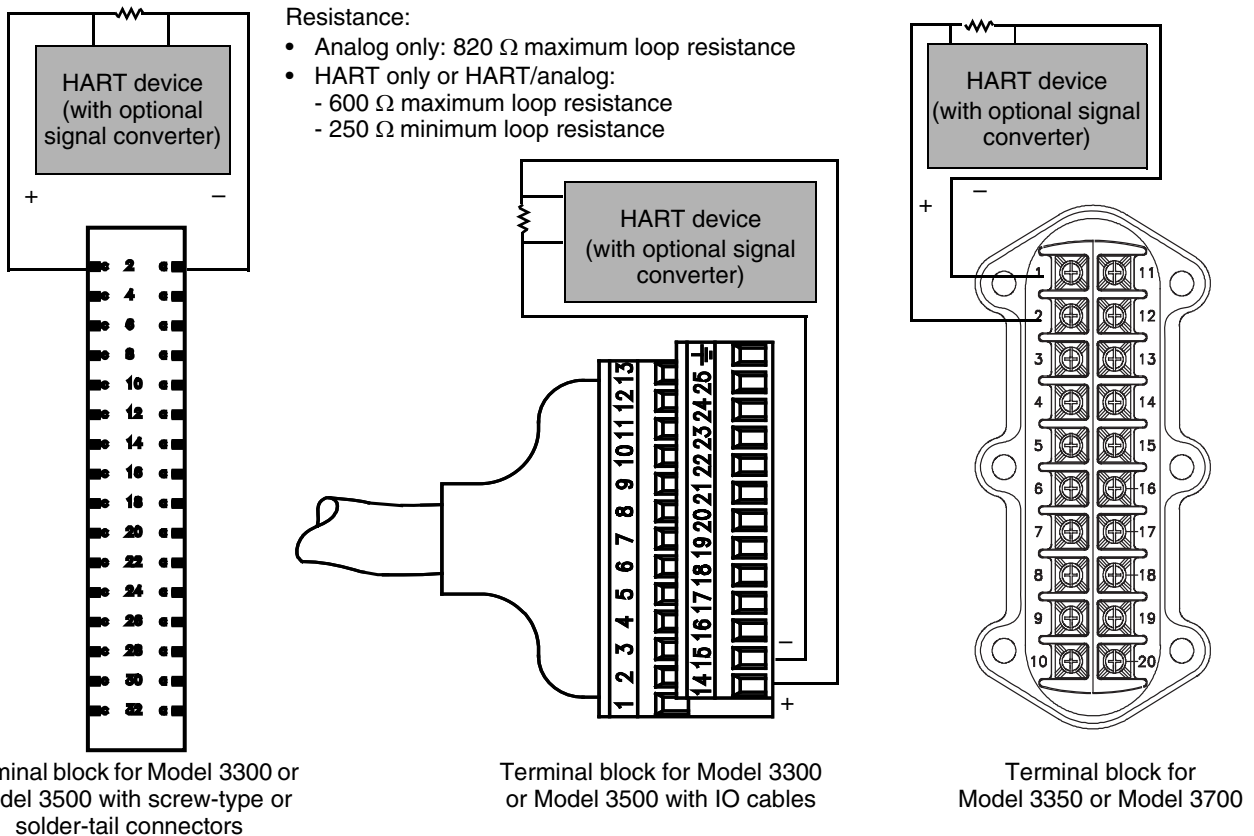


Figure 3-8 HART multidrop wiring with SMART FAMILY™ transmitters and a configuration tool

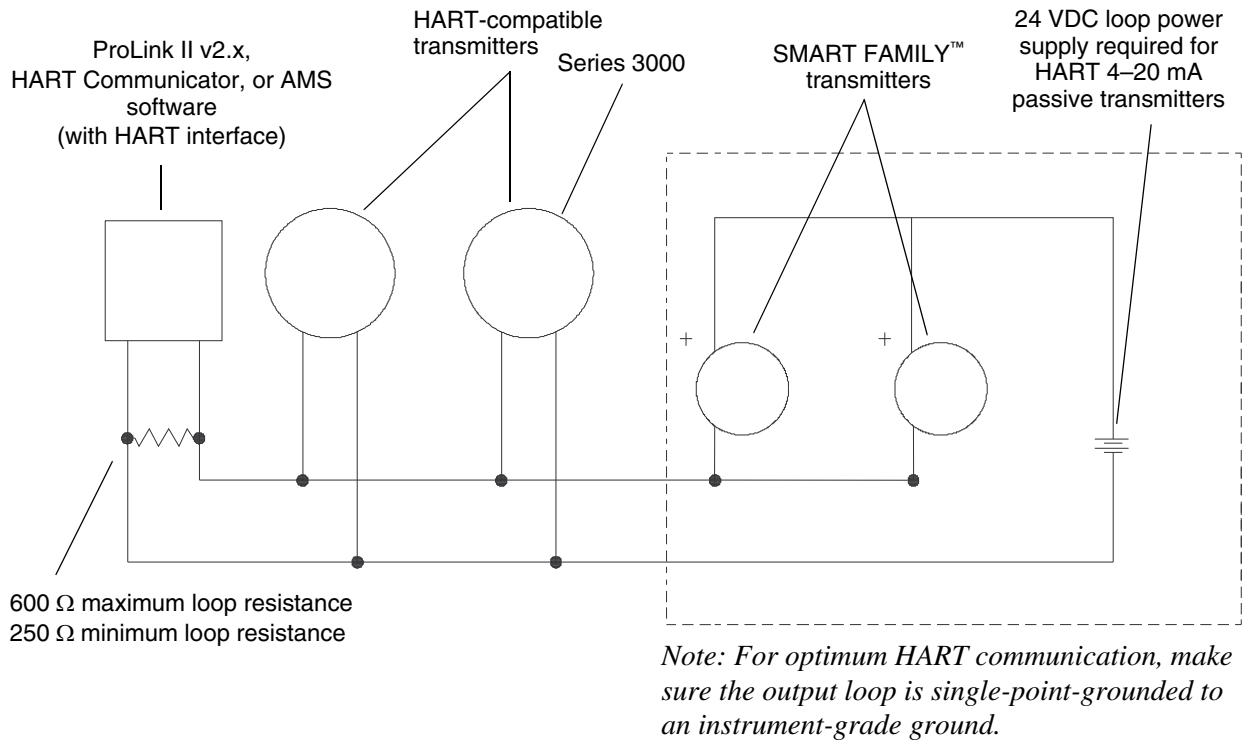


Figure 3-9 Wiring for pressure or external temperature compensation

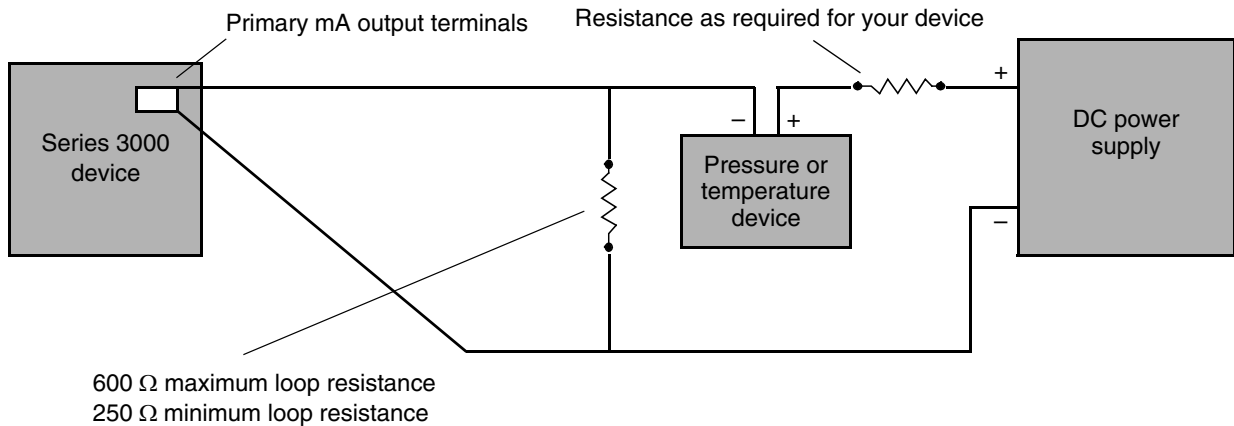


Figure 3-10 Wiring for HART Tri-Loop

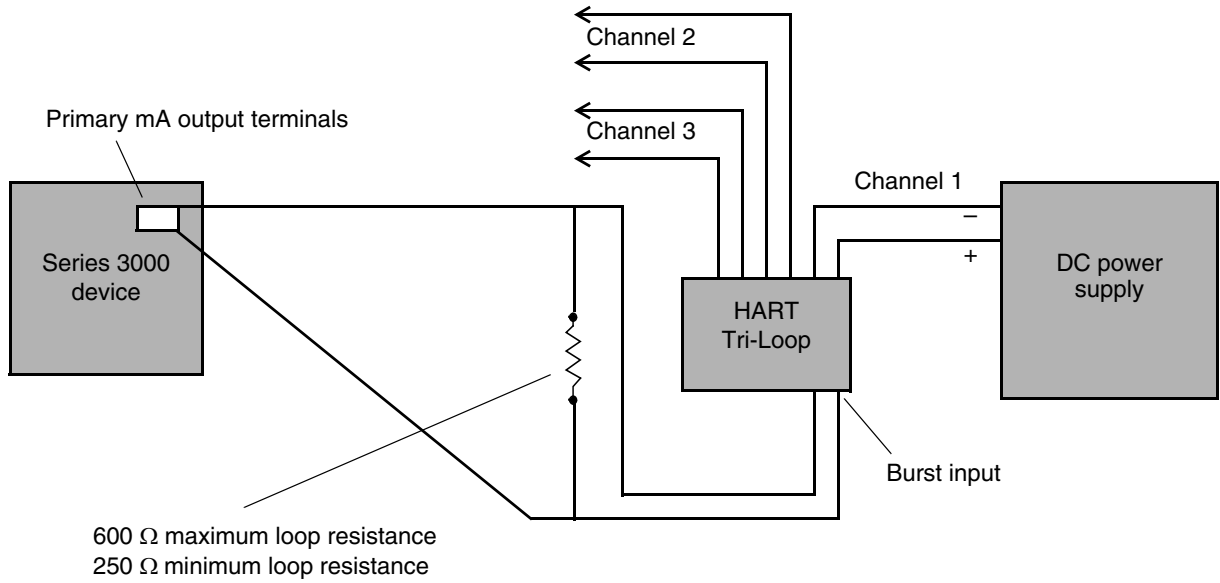
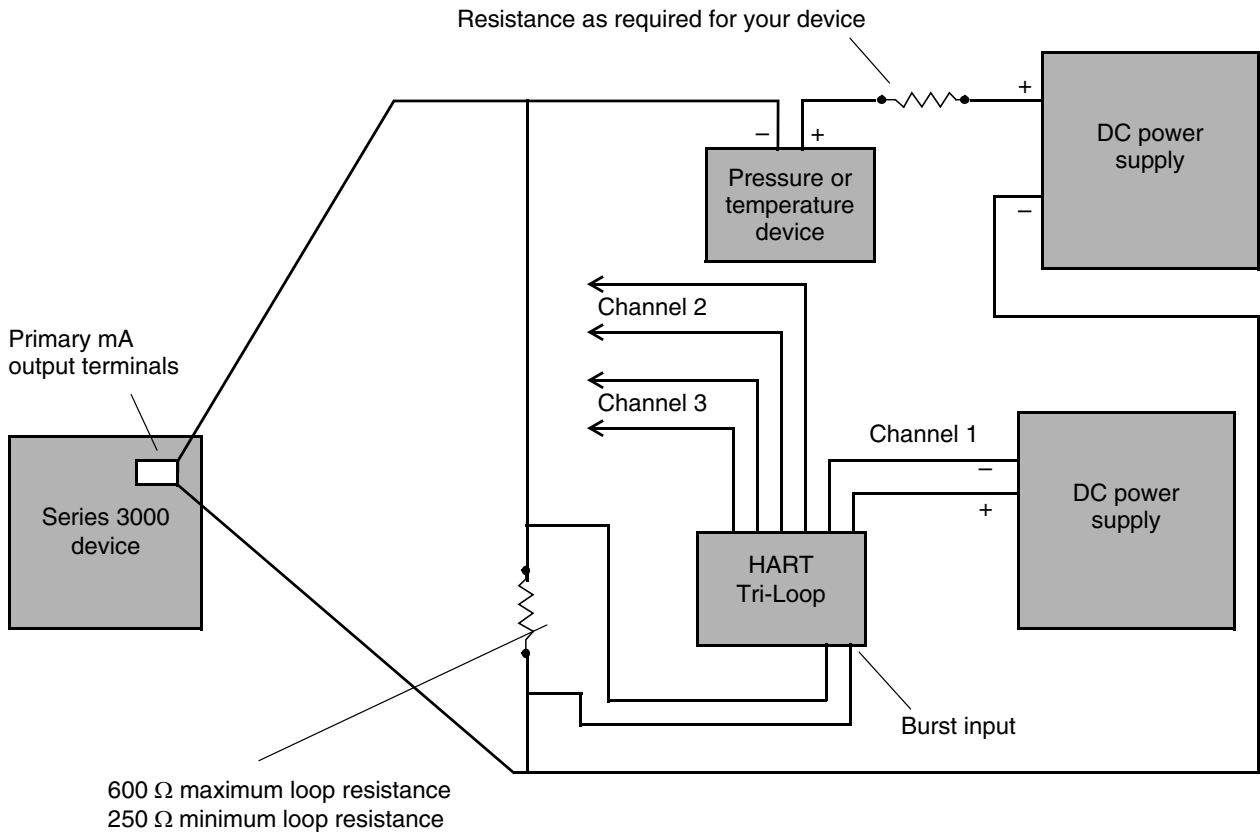


Figure 3-11 Wiring for pressure or external temperature compensation with HART Tri-Loop



Chapter 4

Using the Display and Menu System

4.1 About this chapter

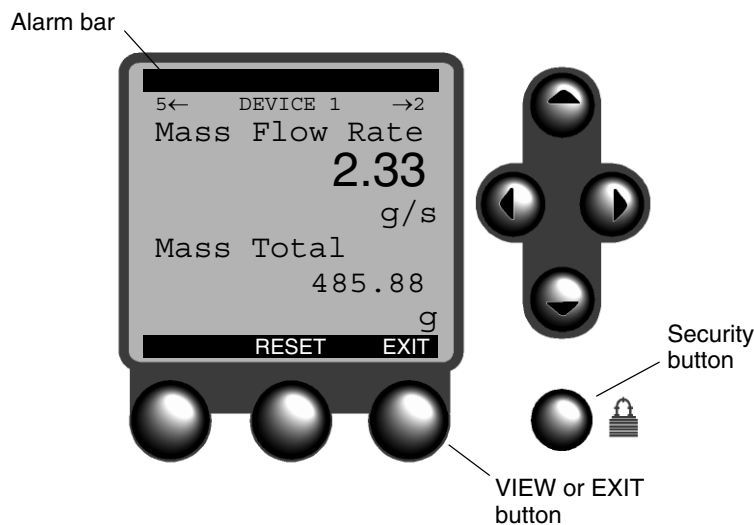
This chapter explains how to use the Series 3000 display and menu system. Using the display, you can move through the menus, configure the application, monitor and control the application, and perform maintenance and diagnostic tasks.

4.2 Startup display

When the Series 3000 device is powered on, it automatically tests its display. During display testing, the screen darkens for approximately five seconds. After the display test is completed:

1. The Micro Motion logo is displayed for two to three seconds.
2. An application list is displayed for two to three seconds.
3. The device enters operation mode:
 - If the discrete batch application is not installed, the process monitor screen is displayed, as shown in Figure 4-1.
 - If the discrete batch application is installed, the batch process screen is displayed (see Figure 18-1).

Figure 4-1 Process Monitor screen



4. If there are any active alarms, the alarm category will be displayed in the alarm bar. To view, acknowledge, or respond to the alarms, see Chapter 22.

4.3 Menu systems

Most Series 3000 display functions are organized into two menu systems:

- The Management menu allows you to perform configuration and maintenance tasks.
- The View menu allows you to monitor and control the process.

Figures 4-2 and 4-3 show high-level views of these menu systems. For complete menu flowcharts, see Appendix F.

Figure 4-2 Management menu

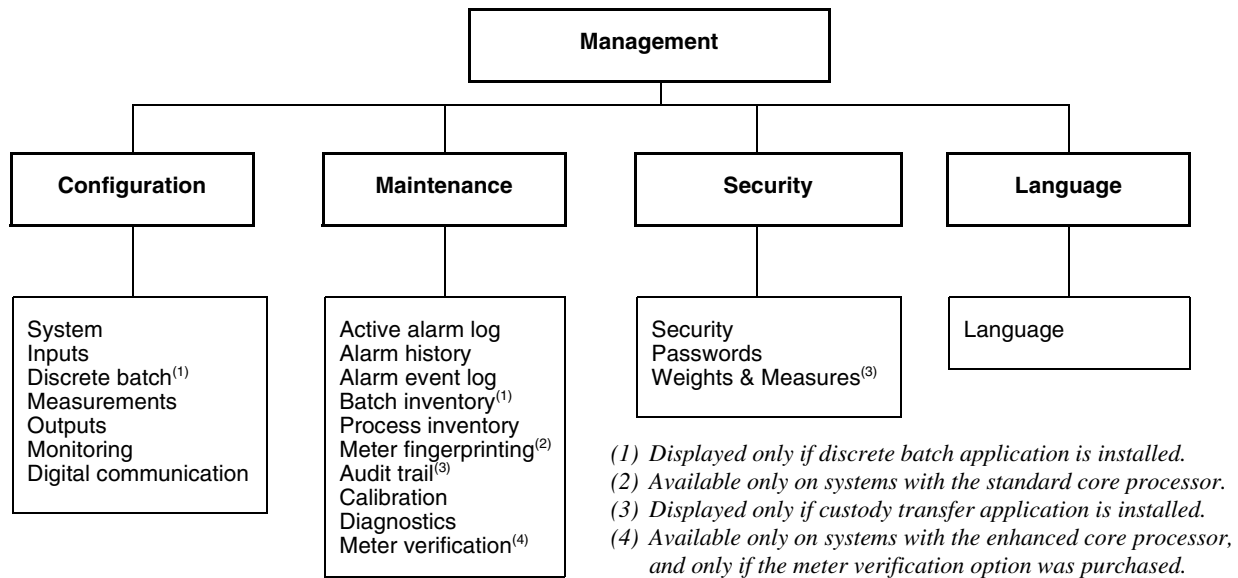
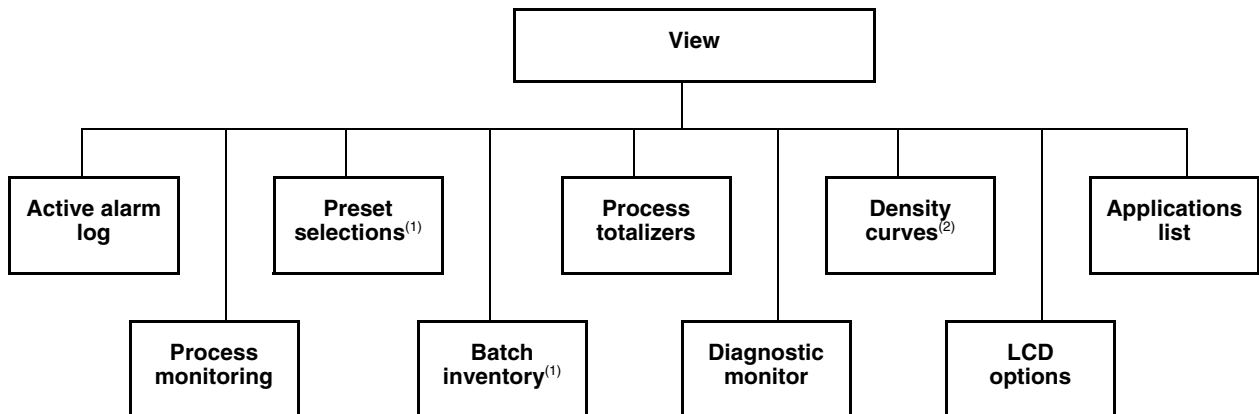


Figure 4-3 View menu



To enter the menus:

- To enter the Management menu system, press the **Security** button. The **Security** button is in the lower right corner of the display, marked with a padlock icon (see Figure 4-1). You may or may not be required to enter a password (see the following section).
- To enter the View menu system, press the **VIEW** or **EXIT** button (see Figure 4-1).

4.3.1 Accessing management functions

You can use the **Security** button to access management functions from any point in the Series 3000 menus. When the **Security** button is pressed:

- If security is disabled, the Management menu will be displayed immediately. See Figure 4-4. By default, security is disabled.
- If security has been enabled, you will be prompted to enter a password. See Figure 4-5. There are two passwords:
 - The configuration password enables access to all functions. When it is entered, the Management menu is displayed.
 - The maintenance password enables access to the maintenance functions. When it is entered, the Maintenance menu is displayed.

Both passwords consist of a sequence of four cursor control button presses. To enter a password:

1. Press the four cursor control buttons in the correct sequence.
2. Press **SEL**.

To configure and enable security, see Chapter 5.

Figure 4-4 Pressing Security button from Process Monitor screen – Security disabled

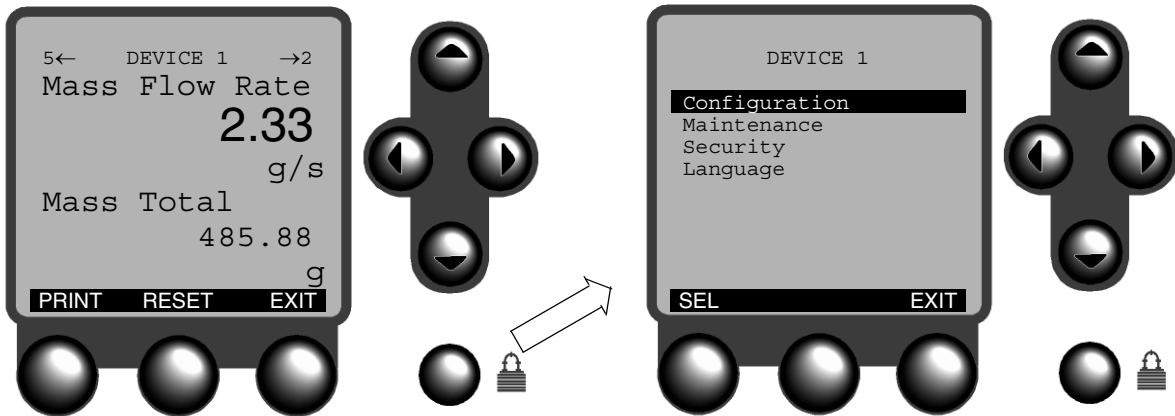
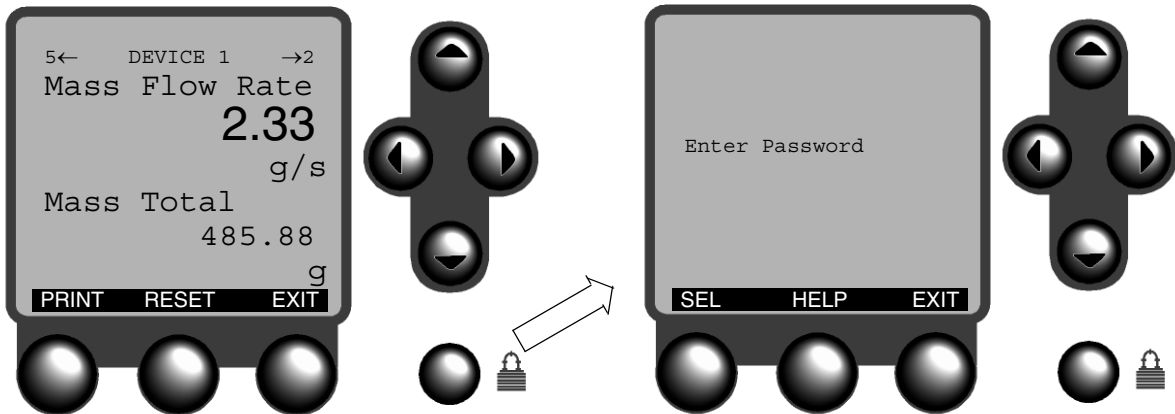


Figure 4-5 Pressing Security button from Process Monitor screen – Security enabled



4.3.2 Shortcuts

From any point in the menu system, you can:

- Return to the Management menu (if security is disabled) or the password entry screen (if security is enabled) by pressing the **Security** button, as described in the previous section.
- Return to the operating screen by pressing the **Security** button, then pressing the **EXIT** button.

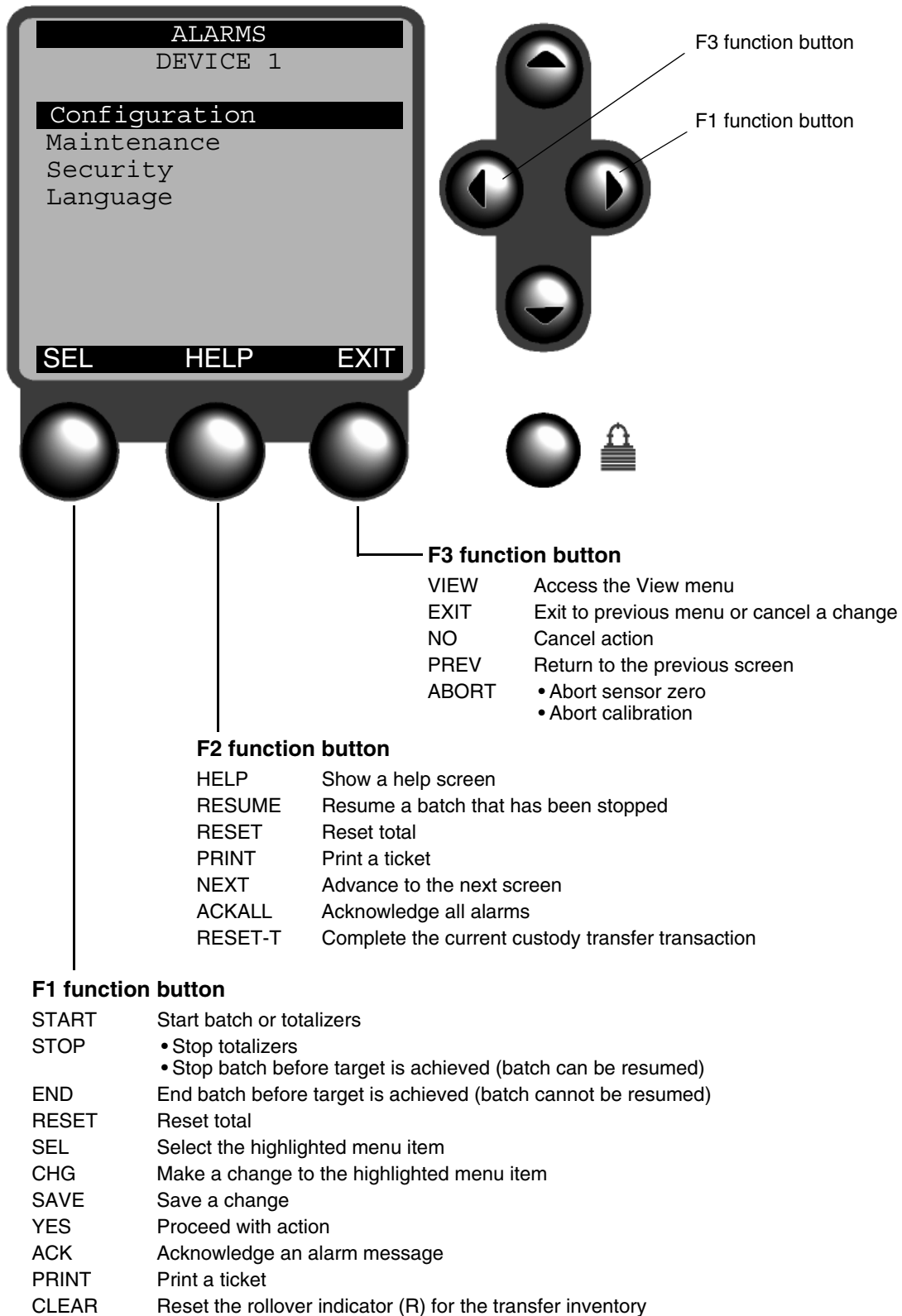
4.4 Using the function buttons

The buttons at the bottom of the display are the function buttons. The functions performed by the buttons vary, depending on the screen and the current state of the application. The function currently assigned to the button is always displayed on the screen, above the button. The buttons are sometimes referred to as F1, F2, and F3. See Figure 4-6.

Note: The left and right cursor control buttons may also be used as function buttons. See Figure 4-6.

If a cursor is shown on the display, the action performed by the function button applies to the item where the cursor is located. Before pressing a function button, be sure the cursor is located correctly. See Section 4.5.

Figure 4-6 Function buttons



4.5 Using the cursor control buttons

The cursor control buttons move the cursor around the display menus. In menus, the cursor is a reverse-video highlight bar.

- Use the **Up** and **Down** buttons to locate the cursor at the menu item you want to select or change.
- After locating the cursor at the desired menu item, press **SEL** or **CHG**, or the **Right** button, to select or change the item.

4.5.1 Selecting from a list

For enumerated lists, pressing **CHG** will display a separate screen from which you can choose the desired option. From that screen:

- Press **SAVE** to save the change and return to the previous screen, or
- Press **EXIT** or the **Left** button to return to the previous screen without saving.

4.5.2 Changing a variable value

If you need to change the value of a variable, the cursor appears as a line under a character in the current value.

- If the variable has a value of Yes or No, all cursor control buttons toggle between the two choices.
- If the variable has a numeric or character value, press the **Up** and **Down** cursor control buttons to increase or decrease the value of the character at the cursor.
- If the variable has more than one digit or character, press the **Left** and **Right** cursor control buttons to move the cursor to the next or previous character.

When the value is correct, press **SAVE**.

Press **EXIT** to return to the previous screen without saving.

4.5.3 Cursor control example

Figure 4-7 shows a typical configuration sequence involving both a menu item and a variable. Pressing **HELP** produces a screen that has help for the item at the cursor.

4.5.4 Process monitor

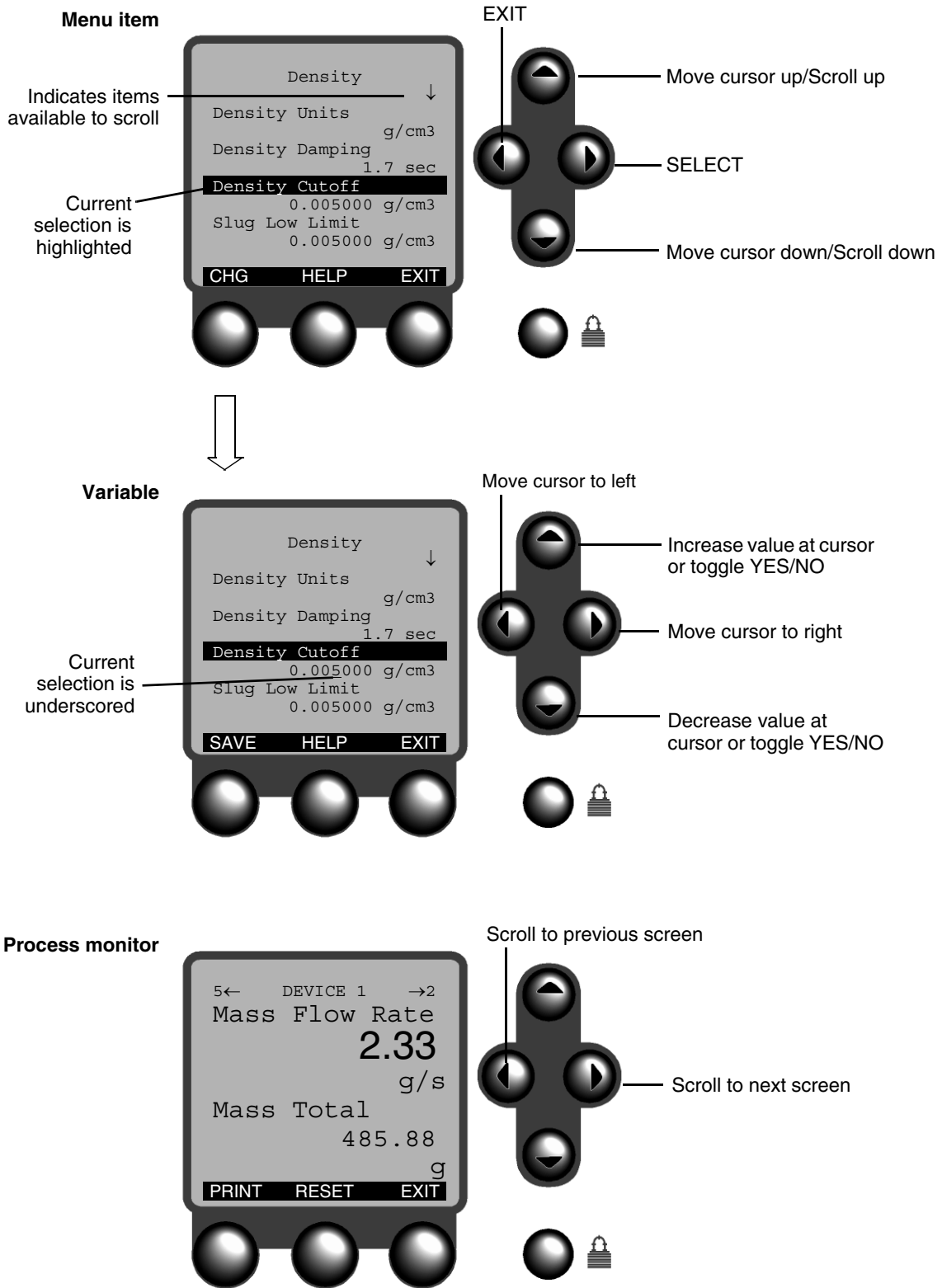
In the process monitor, use the **Left** and **Right** cursor control buttons to scroll from one screen to the next or previous screen. There are five screens.

- Press the **Right** button to scroll to the next screen.
- Press the **Left** button to scroll to the previous screen.
- To assign variables to each process monitor screen, see Chapter 12.

4.6 Scientific notation

Scientific notation is used on some screens for displaying values that contain more digits than the display can show, or that exceed the precision of the floating point data type. For example, the value **1234000.000** would be displayed as **1.234E6** or **1.234+6**.

Figure 4-7 Cursor control buttons



Chapter 5

Configuring Security and Language

5.1 About this chapter

This chapter explains how to configure security and select the language for the Series 3000 display. Security and language parameters are listed in Figures 5-1 and 5-2.

Failure to perform configuration tasks in the proper sequence could result in an incomplete configuration. See Section 1.7 for the recommended configuration sequence.

⚠ CAUTION

Changing configuration can affect device operation.

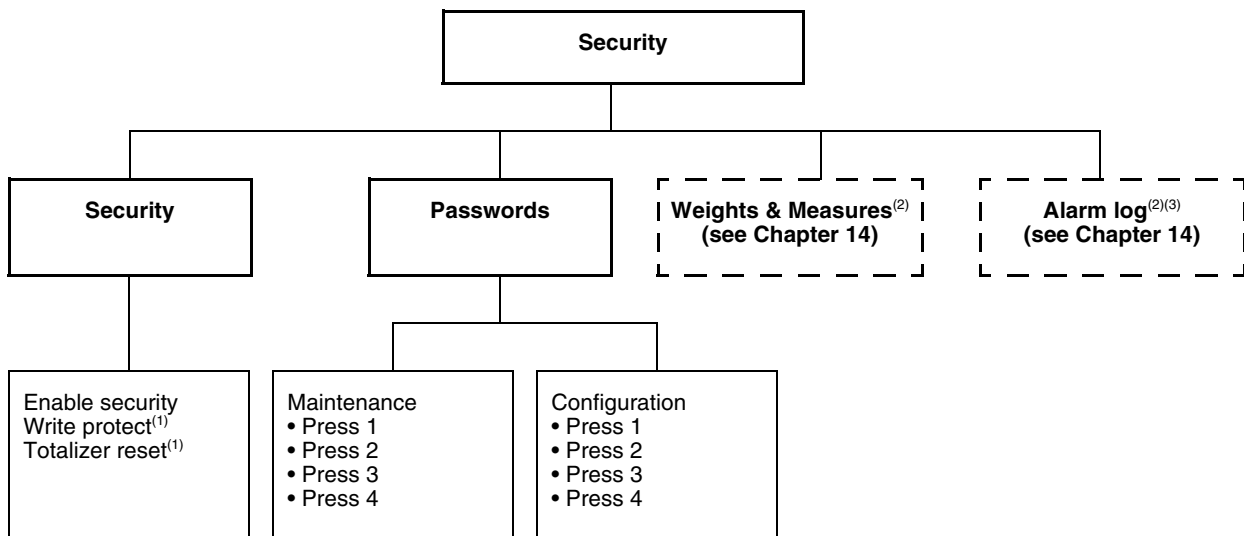
Set control devices for manual operation before changing device configuration.

5.2 Security menu

Use the Security menu, shown in Figure 5-1, to access and configure security and passwords. The Security menu is accessed through the Management menu, as described in Chapter 4.

To configure security for weights and measures (custody transfer) applications, see Chapter 14.

Figure 5-1 Security menu



(1) Displayed only if the custody transfer application is not installed.
 (2) Displayed only if the custody transfer application is installed.
 (3) Displayed only if World Area is set to OIML.

5.3 Security

Security can be used for the following three functions:

- To control access to the Management menu
- To write-protect the Series 3000 device configuration
- To control how process totalizers and inventories can be reset

Note: If custody transfer is implemented, the write-protection and totalizer reset control functions are handled by the custody transfer application, and are not available here. See Chapter 14.

Note: If custody transfer (OIML) is implemented, you can also define an alarm log password to control access to the active alarm log, the alarm event log, and alarm history. See Chapter 14.

5.3.1 Management menu access

Access to the Management menu can be controlled by two passwords:

- The configuration password enables access to all Management menus
- The maintenance password enables access to the Maintenance portion of the Management menu system

When the Security button is pressed (see Section 4.3.1):

- If security is enabled, you will be prompted to enter a password. Depending on the password you enter, either the Management menu or the Maintenance menu is displayed.
- If security is disabled, the Management menu is displayed immediately.

The configured passwords are stored even if security is disabled, so you can re-enable them at any time.

It is not possible to activate only the configuration password or only the maintenance password.

To enable security for the Management menu, set **Enable Security** to **Enable**.

To disable security for the Management menu, set **Enable Security** to **Disable**.

The passwords are a combination of four button presses, using any of the four cursor control buttons: **Up**, **Down**, **Left**, and **Right**.

To set a password:

1. Use the menu to select the password you are defining.
2. For **Press 1** through **Press 4**, specify which cursor control button must be pressed.

To enter a password:

1. Press the four cursor control buttons in the correct sequence.
2. Press **SEL**.

5.3.2 Write-protecting the device configuration

When the device is in write-protect mode, the configuration data stored in the device and core processor cannot be changed until write-protect mode is disabled.

To enable write-protection, set **Write Protect** to **Enable**.

To disable write-protection, set **Write Protect** to **Disable**.

Note: If write-protection is enabled, process totalizers cannot be reset unless the flow rate is zero.

5.3.3 Controlling process totalizer and process inventory reset

This feature allows you to specify the methods that can be used to reset process totalizers and process inventories:

- **No Reset** – Cannot be reset using either the display or remote communications (e.g., ProLink II or a HART or Modbus tool).
- **Display Only** – Can be reset only via the display on the Series 3000 device.
- **Remote Only** – Can be reset only via remote communications (e.g., ProLink II or a HART or Modbus tool).
- **Display & Remote** – Can be reset using any communications method.

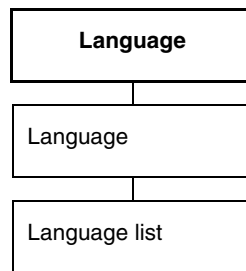
For definitions of process totalizers, process inventories, and other totalizer types, and additional information on managing totalizers and inventories, see Chapter 20.

5.4 Language menu

Use the Language menu, shown in Figure 5-2, to access and configure language parameters. The Language menu is accessed through the Management menu, as described in Chapter 4.

The configured language will be used for all Series 3000 screens. The display changes immediately.

Figure 5-2 Language menu



Your choice of language affects the notation used for various units. If English is selected, English notation is used. If French or German is selected, European notation is used.

Chapter 6

Configuring System Data

6.1 About this chapter

This chapter explains how to configure system data. System parameters are listed in Figure 6-1. Failure to perform configuration tasks in the proper sequence could result in an incomplete configuration. See Section 1.7 for the recommended configuration sequence.

⚠ CAUTION

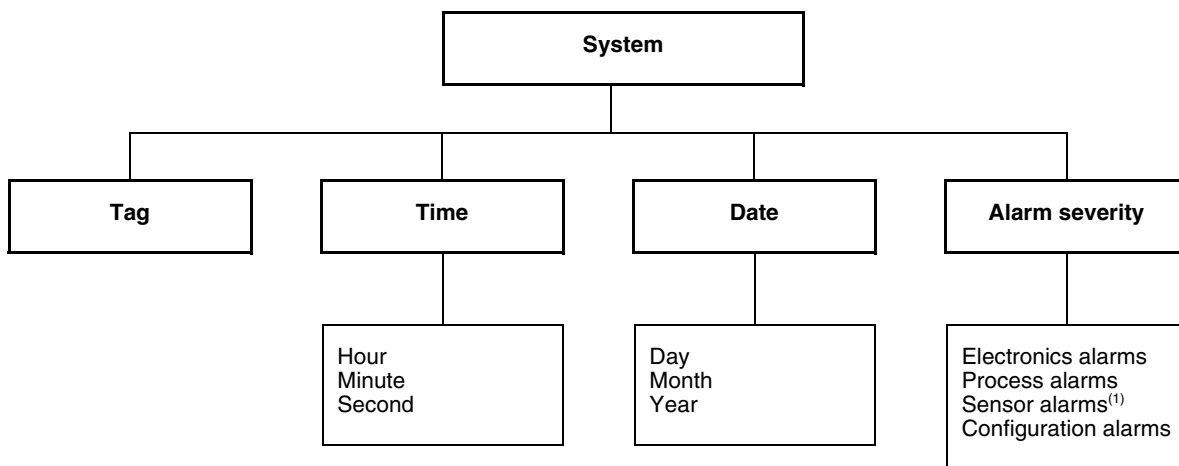
Changing configuration can affect device operation.

Set control devices for manual operation before changing device configuration.

6.2 System menu

Use the System menu, shown in Figure 6-1, to access and configure system parameters. The System menu is accessed through the Configuration option of the Management menu. To access the Management menu, see Chapter 4.

Figure 6-1 System menu



(1) Displayed only if you are configuring a Model 3500 or Model 3700 transmitter.

Configuring System Data

6.3 System parameters

System parameters are defined in Table 6-1.

Table 6-1 System parameters

Variable	Default	Description
Tag ⁽¹⁾	Device 1	<ul style="list-style-type: none">• Enter up to 8 digits and/or characters that uniquely identify this platform• The tag will appear on operation screens
Time	Current time	Enter 2 digits for hours, 2 digits for minutes, and 2 digits for seconds
Date	Current date	Enter 4 digits for the year, a character code for the month, and 2 digits for the day
Alarm severity		Select alarm to be reclassified. See Section 6.3.1, below.

(1) This tag is also known as the HART tag or the software tag. It is not the HART polling address (also called the HART slave address). To configure the HART polling address, see Section 13.4.

6.3.1 Alarm severity

Alarms are organized into four categories. Within each category, alarms are classified into three levels of severity. The *severity level* controls device behavior when the alarm condition occurs. See Table 6-2.

Table 6-2 Alarm severity levels

Severity level	Device action
Fault	If this condition occurs, an alarm will be generated and all outputs go to their configured fault levels. See Chapter 8.
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).

Some alarms can be reclassified. For example:

- The default severity level for Alarm A020 (cal. factors missing) is Fault, but you can reconfigure it to either Informational or Ignore.
- The default severity level for Alarm A102 (drive over-range) is Informational, but you can reconfigure it to either Ignore or Fault.

If an alarm can be reclassified, the **CHG** function is assigned to the F1 button. If an alarm cannot be reclassified, the F1 button is unassigned. The alarm listings in Section 22.7 also provide information on which alarms can be reclassified.

Chapter 7

Configuring Inputs

7.1 About this chapter

This chapter explains how to configure inputs. Inputs include all the software parameters listed in Figures 7-1 and 7-2.

Failure to perform configuration tasks in the proper sequence could result in an incomplete configuration. See Section 1.7 for the recommended configuration sequence.

CAUTION

Changing configuration can affect device operation.

Set control devices for manual operation before changing device configuration.

7.2 Inputs menu

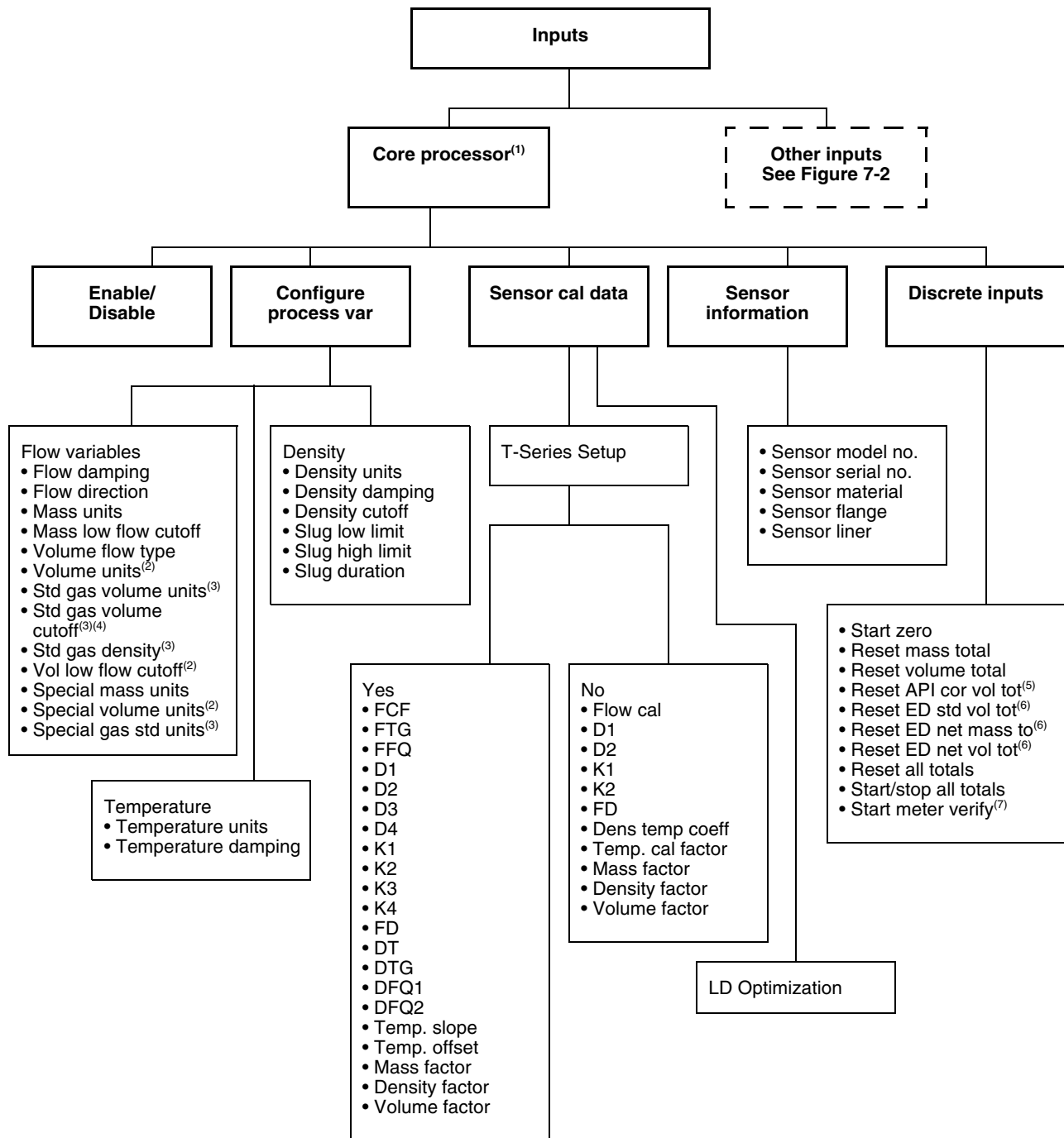
Use the Inputs menu, shown in Figures 7-1 and 7-2, to access and configure input parameters. The Inputs menu is accessed through the Configuration option of the Management menu. To access the Management menu, see Chapter 4.

You will be:

- Configuring core processor parameters:
 - Enabling or disabling core processor inputs
 - Configuring process variables
 - Configuring sensor calibration data
 - Configuring sensor information
 - Assigning discrete inputs to actions
- Configuring the frequency input
- Configuring the discrete inputs
- Configuring external inputs
- Configuring LD Optimization

Note: If you are configuring a Model 3300 or Model 3350 controller, the core processor parameters and external inputs parameters are not displayed. To assign a discrete input to an action on these platforms, use the frequency input menu shown in Figure 7-2.

Figure 7-1 Inputs menu – Core processor parameters



(1) Displayed only if you are configuring a Model 3500 or Model 3700 transmitter.

(2) Displayed only if Volume Flow Type = Liquid Volume.

(3) Displayed only if Volume Flow Type = Gas Standard Volume.

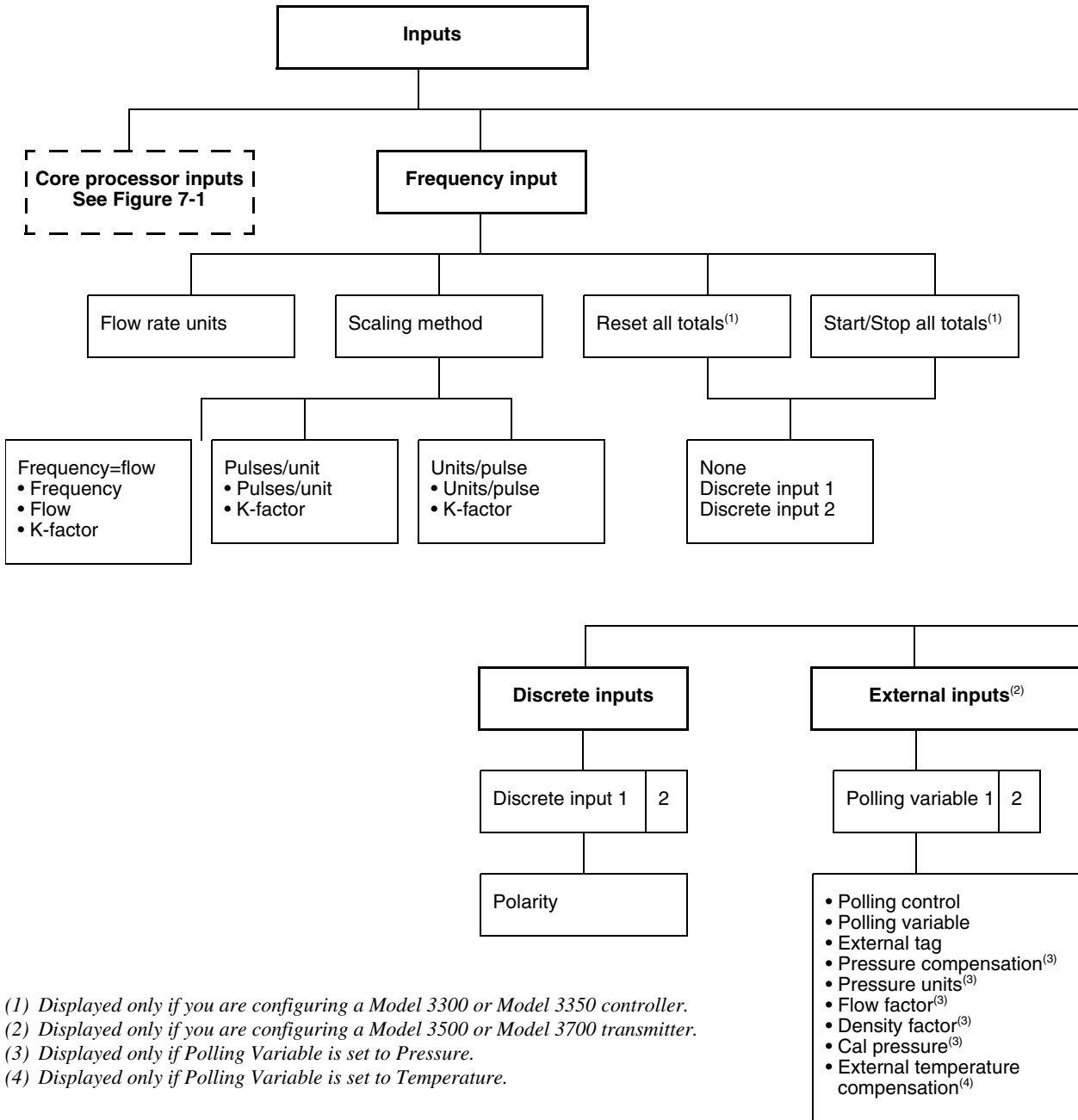
(4) Displayed only on systems with the enhanced core processor.

(5) Displayed only if petroleum measurement application is installed.

(6) Displayed only if enhanced density application is installed.

(7) Displayed only if Smart Meter Verification is installed.

Figure 7-2 Inputs menu – Frequency input, discrete input, external inputs



(1) Displayed only if you are configuring a Model 3300 or Model 3350 controller.
 (2) Displayed only if you are configuring a Model 3500 or Model 3700 transmitter.
 (3) Displayed only if Polling Variable is set to Pressure.
 (4) Displayed only if Polling Variable is set to Temperature.

7.3 Configuring the core processor parameters

Core processor parameters include:

- Core processor inputs
- Process variables
- Sensor calibration data
- Sensor information

Configuring Inputs

7.3.1 Enabling and disabling core processor inputs

Core processor inputs are enabled by default. By disabling the core processor, you disable all core processor input signals and alarms. Disabling them might be desirable while you are connecting the sensor, or if you are using only the frequency input to measure flow.

Table 7-1 describes the core processor input options.

Table 7-1 Enabling or disabling inputs and alarms

Variable	Default	Description
Enable core processor	Yes	If set to No: <ul style="list-style-type: none">• The platform will not use input signals from the sensor to measure flow, density, or temperature.• The platform will not produce the following alarms: warming up, cal in progress, drive overrange, temperature overrange, temperature failure, sensor failure, transmitter failure, density overrange, density failure, mass flow overrange, volume overrange, calibration failure, calibration complete, calibration aborted, RTD failure, charize required, slug flow, slug timeout⁽¹⁾.

(1) For more information about alarms, see Chapter 22.

7.3.2 Configuring process variables

Process variables include mass flow, volume flow, density, and temperature. For each process variable, several parameters can be configured.

Mass flow and volume flow parameters

Mass flow and volume flow parameters are listed and defined in Table 7-2. Note that you can configure the transmitter to measure either liquid volume flow or gas standard volume flow, depending on the setting of Volume Flow Type.

Details about the Flow Direction parameter are provided in Table 7-3. Units for mass flow and volume flow parameters are listed in Tables 7-4 through 7-6. Special units for mass and volume are defined and described in the section entitled *Special units* later in this chapter.

Table 7-2 Flow parameters

Variable	Default	Description
Flow damping	0.8 sec	<ul style="list-style-type: none">• Damping filters out noise or the effects of rapid changes in the flow rate without affecting measurement accuracy. See the section entitled <i>Damping</i> later in this chapter. For gas applications, Micro Motion recommends a minimum flow damping value of 2.56 seconds. Range is 0.0–51.2 seconds.• Milliamp outputs have an additional damping parameter. See Section 8.4.4.
Flow direction	Forward	<ul style="list-style-type: none">• Controls how flow through the sensor will affect outputs and totalizers.• For the effect of flow direction on milliamp outputs, see Figure 7-3 if the 4 mA value of the milliamp output is set to 0, and see Figure 7-4 if the 4 mA value of the milliamp output is set to a negative value. For a discussion of these figures, see the examples following the figures. For information on setting the 4 mA value, see Section 8.4.4.• For the effect of flow direction on frequency outputs, totalizers, and flow values reported via digital communication, see Table 7-3.
Mass units	g/s	<ul style="list-style-type: none">• Select the desired unit of mass flow. See Table 7-4.• Mass flow outputs and displays will indicate mass flow in the selected unit. The mass totalizer and inventory will use the corresponding mass unit.
Mass low flow cutoff	0.00000 g/s	<ul style="list-style-type: none">• Enter the mass flow rate below which mass flow outputs and displays will indicate zero flow. See the section entitled <i>Cutoffs</i> later in this chapter.• Milliamp outputs have an additional cutoff parameter. See Section 8.4.4.

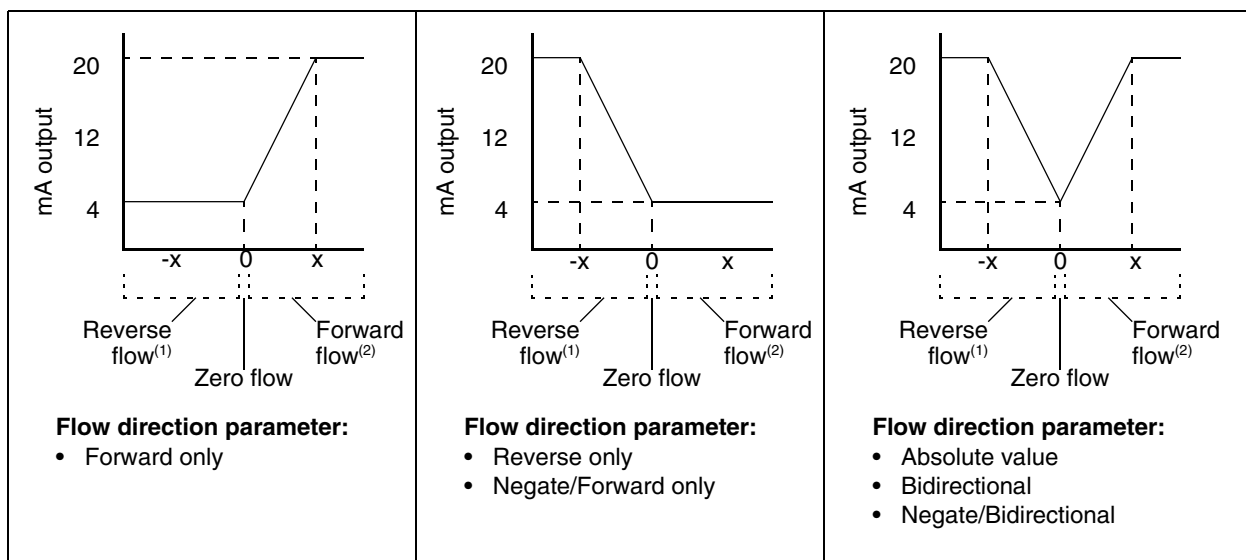
Configuring Inputs

Table 7-2 Flow parameters *continued*

Variable	Default	Description
Volume flow type	Liquid	<ul style="list-style-type: none"> Select the desired volume flow type. - If you select Liquid, only liquid volume units are available for measurement - If you select Gas, only gas standard volume units are available for measurement. See the section entitled <i>Gas standard volume flow and standard density</i>. - If you are using the enhanced density application or the petroleum measurement application, select Liquid.
Volume units ⁽¹⁾	l/s	<ul style="list-style-type: none"> Select the desired unit of liquid volume flow. See Table 7-5. The liquid volume totalizer and inventory will use the corresponding volume unit.
Volume low flow cutoff ⁽¹⁾	0.00000 l/s	<ul style="list-style-type: none"> Enter the liquid volume flow rate below which volume flow outputs and displays will indicate zero flow. See the section entitled <i>Cutoffs</i> later in this chapter. Milliamp outputs have an additional cutoff parameter. See Section 8.4.4.
Standard gas volume units ⁽²⁾	SCFM	<ul style="list-style-type: none"> Select the desired unit of gas standard volume flow. See Table 7-6. The gas standard totalizer and inventory will use the corresponding volume unit.
Standard gas volume cutoff ⁽³⁾⁽²⁾	0.0000 SCFM	<ul style="list-style-type: none"> Enter the volume flow rate below which volume flow outputs and displays will indicate zero flow. See the section entitled <i>Cutoffs</i> later in this chapter. Milliamp outputs have an additional cutoff parameter. See Section 8.4.4.
Standard gas density ⁽²⁾	0.10000 g/cm ³	<ul style="list-style-type: none"> Enter the standard density of the gas you are measuring. See the section entitled <i>Gas standard volume flow and standard density</i>

- (1) Displayed only if Volume Flow Type = Liquid.
 (2) Displayed only if Volume Flow Type = Gas Standard.
 (3) Available only on systems with the enhanced core processor.

Figure 7-3 Effect of flow direction on milliamp outputs: 4 mA value = 0



Milliamp output configuration:

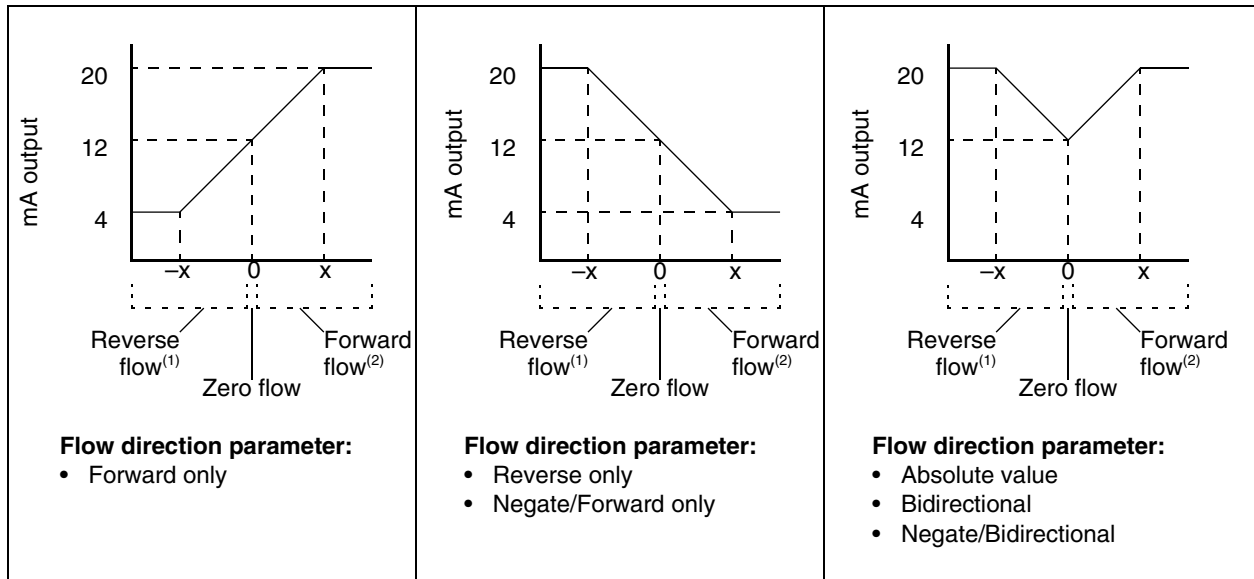
- 20 mA value = x
- 4 mA value = 0

To set the 4 mA and 20 mA values, see Section 8.4.4.

- (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.

Configuring Inputs

Figure 7-4 Effect of flow direction on milliamp outputs: 4 mA value < 0



Milliamp output configuration:

- 20 mA value = x
- 4 mA value = -x
- -x < 0

To set the 4 mA and 20 mA values, see Section 8.4.4.

(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 only
- mA output: 4 mA = 0 g/s; 20 mA = 100 g/s

(See the first graph in Figure 7-3.)

As a result:

- Under conditions of reverse flow or zero flow, the mA output is 4 mA.
- Under conditions of forward flow, up to a flow rate of 100 g/s, the mA output 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 only
- mA output: 4 mA = 0 g/s; 20 mA = 100 g/s

(See the second graph in Figure 7-3.)

As a result:

- Under conditions of forward flow or zero flow, the mA output is 4 mA.
- Under conditions of reverse flow, up to a flow rate of 100 g/s, the mA output 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 only
- mA output: 4 mA = -100 g/s; 20 mA = 100 g/s

(See the first graph in Figure 7-4.)

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.
 - 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.
 - 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.

Configuring Inputs

Table 7-3 Effect of flow direction on frequency outputs, discrete outputs, totalizers, and digital communications

Forward flow ⁽¹⁾				
Flow direction value	Frequency outputs	Discrete outputs ⁽²⁾	Flow totals	Flow values via digital comm.
Forward only	Increase	OFF	Increase	Positive
Reverse only	0 Hz	OFF	No change	Positive
Bidirectional	Increase	OFF	Increase	Positive
Absolute value	Increase	OFF	Increase	Positive ⁽³⁾
Negate/Forward only	Zero ⁽³⁾	ON	No change	Negative
Negate/Bidirectional	Increase	ON	Decrease	Negative
Zero flow				
Flow direction value	Frequency output	Discrete outputs	Flow totals	Flow values via digital comm.
All	0 Hz	OFF	No change	0
Reverse flow ⁽⁴⁾				
Flow direction value	Frequency outputs		Flow totals	Flow values via digital comm.
Forward only	0 Hz	ON	No change	Negative
Reverse only	Increase	ON	Increase	Negative
Bidirectional	Increase	ON	Decrease	Negative
Absolute value	Increase	OFF	Increase	Positive ⁽³⁾
Negate/Forward only	Increase	OFF	Increase	Positive
Negate/Bidirectional	Increase	OFF	Increase	Positive

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

(2) Applies only if the discrete output has been configured to indicate flow direction. See Section 8.3.2.

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

(4) Process fluid flowing in opposite direction from flow direction arrow on sensor.

Table 7-4 Mass flow units

Unit	Software label
Grams per second	g/s
Grams per minute	g/min
Grams per hour	g/hr
Kilograms per second	kg/s
Kilograms per minute	kg/min
Kilograms per hour	kg/hr
Kilograms per day	kg/day
Metric tons (1000 kg) per minute	t/min
Metric tons (1000 kg) per hour	t/hr
Metric tons (1000 kg) per day	t/day
Pounds per second	lb/s

Table 7-4 Mass flow units *continued*

Unit	Software label
Pounds per minute	lb/min
Pounds per hour	lb/hr
Pounds per day	lb/day
Short tons (2000 lb) per minute	STon/min
Short tons (2000 lb) per hour	STon/hr
Short tons (2000 lb) per day	STon/day
Long tons (2240 lb) per hour	LTon/hr
Long tons (2240 lb) per day	LTon/day
Special unit (see the following section entitled <i>Special units</i>)	Special

Table 7-5 Volume flow units – Liquid

Unit	Software label
Cubic feet per second	cuft/s
Cubic feet per minute	cuft/min
Cubic feet per hour	cuft/hr
Cubic feet per day	cuft/day
Cubic meters per second	cum/s
Cubic meters per minute	cum/min
Cubic meters per hour	cum/hr
Cubic meters per day	cum/day
U.S. gallons per second	Usgps
U.S. gallons per minute	Usgpm
U.S. gallons per hour	Usgph
U.S. gallons per day	Usgpd
Million U.S. gallons per day	MilGal/day
Liters per second	l/s
Liters per minute	l/min
Liters per hour	l/hr
Million liters per day	MilL/day
Imperial gallons per second	UKgps
Imperial gallons per minute	UKgpm
Imperial gallons per hour	UKgph
Imperial gallons per day	UKgpd
Barrels ⁽¹⁾ per second	bbl/s
Barrels ⁽¹⁾ per minute	bbl/min
Barrels ⁽¹⁾ per hour	bbl/hr
Barrels ⁽¹⁾ per day	bbl/day
Beer barrels ⁽²⁾ per second	b bbl/s
Beer barrels ⁽²⁾ per minute	b bbl/min

Table 7-5 Volume flow units – Liquid *continued*

Unit	Software label
Beer barrels ⁽²⁾ per hour	b bbl/h
Beer barrels ⁽²⁾ per day	b bbl/d
Special unit (see the following section entitled <i>Special units</i>)	Special

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

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

Table 7-6 Volume flow units – Gas standard

Unit	Software label
Standard liters per second	Sl/s
Standard liters per minute	Sl/min
Standard liters per hour	Sl/h
Standard liters per day	Sl/d
Normal cubic meters per second	Nm ³ /s
Normal cubic meters per minute	Nm ³ /min
Normal cubic meters per hour	Nm ³ /h
Normal cubic meters per day	Nm ³ /d
Standard cubic feet per second	SCFS
Standard cubic feet per minute	SCFM
Standard cubic feet per hour	SCFH
Standard cubic feet per day	SCFD
Standard cubic meters per second	Sm ³ /s
Standard cubic meters per minute	Sm ³ /min
Standard cubic meters per hour	Sm ³ /h
Standard cubic meters per day	Sm ³ /d
Special unit (see the following section entitled <i>Special units</i>)	Special

Gas standard volume flow and standard density

If you set Volume Flow Type to Gas Standard Volume, you must enter the *standard density* of the gas you are going to measure (i.e., the density of the gas at reference conditions):

- If you know the standard density, you can enter that value in the Standard Gas Density field. For optimal measurement accuracy, be sure the standard density you enter is correct and fluid composition is stable.
- If you do *not* know the standard density of the gas, and you can connect to the Series 3000 device using ProLink II, you can use the Gas Wizard.

To use the Gas Wizard:

1. Click **ProLink > Configure > Flow**.
2. Click **Gas Wizard**.
3. If your gas is listed in the **Choose Gas** list:
 - a. Select the **Choose Gas** radio button.
 - b. Select your gas.

4. If your gas is not listed, you must describe its properties.
 - a. Select the **Enter Other Gas Property** radio button.
 - b. Select the method that you will use to describe its properties: **Molecular Weight, Specific Gravity Compared to Air**, or **Density**.
 - c. Provide the required information. Note that if you selected **Density**, you must enter the value in the configured density units and you must provide the temperature and pressure at which the density value was determined, using the configured temperature and pressure units.
5. Click **Next**.
6. Verify the reference temperature and reference pressure. If these are not appropriate for your application, click **Change Reference Conditions** and enter new values for reference temperature and reference pressure.
7. Click **Next**. The calculated standard density value is displayed.
 - If the value is correct, click **Finish**. The value will be written to transmitter configuration.
 - If the value is not correct, click **Back** and modify input values as required.

Note: The Gas Wizard displays density, temperature, and pressure in the configured units. If required, you can configure the transmitter to use different units.

Special units

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

Note: If you create a special measurement unit for liquid volume flow and another for gas standard volume flow, the Series 3000 will store both definitions. However, only one is available at a time.

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, m³)
 - *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

These terms are related by the following formula:

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

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

Configuring Inputs

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/minute = 8 pints/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*

Special unit parameters are listed and defined in Table 7-7.

Table 7-7 Special unit parameters

Variable	Default	Description
Base mass unit	g	Enter the base unit to be used for the special unit for mass flow.
Base mass time	Sec	Enter the base time unit to be used for the special unit for mass flow.
Mass flow conversion factor	1.0000	Enter the conversion factor that will be used to calculate the special unit for mass flow.
Mass flow text	NONE	Enter the name to be used for the special unit for mass flow. The name can contain up to 8 characters.
Mass total text	NONE	Enter the name to be used for the mass totalizer. The name can contain up to 8 characters.
Base volume unit	l	Enter the base unit to be used for the special unit for liquid volume flow.
Base volume time	Sec	Enter the base time unit to be used for the special unit for liquid volume flow.
Volume flow conversion factor	1.0000	Enter the conversion factor that will be used to calculate the special unit for liquid volume flow.
Volume flow text	NONE	Enter the name to be used for the special unit for liquid volume flow. The name can contain up to 8 characters.
Volume total text	NONE	Enter the name to be used for the special unit for the liquid volume totalizer. The name can contain up to 8 characters.
Base gas volume unit	SCF	Enter the base unit to be used for the special unit for gas standard volume flow.
Base gas volume time	Min	Enter the base time unit to be used for the special unit for gas standard volume flow.
Gas volume flow conversion factor	1.0000	Enter the conversion factor that will be used to calculate the special unit for gas standard volume flow.
Gas volume flow text	NONE	Enter the name to be used for the special unit for gas standard volume flow. The name can contain up to 8 characters.
Gas volume total text	NONE	Enter the name to be used for the special unit for the gas standard volume totalizer. The name can contain up to 8 characters.

Density parameters

Density parameters are listed and defined in Table 7-8. Density units are listed in Table 7-9.

Table 7-8 Density parameters

Variable	Default	Description
Density units	g/cm ³	<ul style="list-style-type: none"> Select the desired unit of density. See Table 7-9. Density outputs and displays will indicate density in the selected unit.
Density damping	1.6 sec	<ul style="list-style-type: none"> Damping filters out noise or the effects of rapid changes in density without affecting measurement accuracy. See the section entitled <i>Damping</i> later in this chapter. Range is 0.0–51.2 seconds. Milliamp outputs have an additional damping parameter. See Section 8.4.4.
Density cutoff	0.2 g/cm ³	<ul style="list-style-type: none"> Enter the density value below which density outputs and displays will indicate zero density. See the section entitled <i>Cutoffs</i> later in this chapter.
Slug low limit	0.000000 g/cm ³	<ul style="list-style-type: none"> Enter the desired low limit, in g/cm³, for the process density. Range is 0.0–10.0 g/cm³. The entered value is the density below which a slug flow alarm will be generated. For more information about slug flow, see <i>Slug flow alarms</i> in Section 22.7.3.
Slug high limit	5.000000 g/cm ³	<ul style="list-style-type: none"> Enter the desired high limit, in g/cm³, for the process density. Range is 0.0–10.0 g/cm³. The entered value is the density above which a slug flow alarm will be generated. For more information about slug flow, see <i>Slug flow alarms</i> in Section 22.7.3.
Slug duration	0.0 sec	<ul style="list-style-type: none"> Enter the number of seconds for which flow outputs will hold their last measured flow rate while density is outside the range specified by the slug low limit and slug high limit. Range is 0.0–60.0 seconds. If a value of 0.0 is entered, flow outputs will go to the level that indicates zero flow as soon as slug flow is detected. For more information about slug duration, see <i>Slug flow alarms</i> in Section 22.7.3.

Table 7-9 Density units

Unit	Software label
Specific gravity unit	SGU (not temperature corrected)
Grams per cubic centimeter	g/cm3
Kilograms per cubic meter	kg/m3
Pounds per U.S. gallon	lb/gal
Pounds per cubic foot	lb/cuft
Grams per milliliter	g/mL
Kilograms per liter	kg/L
Grams per liter	g/L
Pounds per cubic inch	lb/CuIn
Short ton per cubic yard	STon/CuYd
Degrees API	deg API

Configuring Inputs

Temperature parameters

Temperature parameters are listed and defined in Table 7-10.

Table 7-10 Temperature parameters

Variable	Default	Description
Temperature units	degC	<ul style="list-style-type: none">• Select °Celsius, °Fahrenheit, °Rankine, or °Kelvin.• Temperature outputs and displays will indicate temperature in the selected unit.
Temperature damping	4.8 sec	<ul style="list-style-type: none">• Damping filters out noise or the effects of rapid changes in temperature without affecting measurement accuracy. See the section entitled <i>Damping</i> later in this chapter. Range is 0.0–38.4 seconds.• Milliamp outputs have an additional damping parameter. See Section 8.4.4.

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.

You can change the damping values for flow (mass and volume), density, and temperature.

When configuring damping values, note the following:

- Liquid volume flow is derived from mass and density measurements; therefore, any damping applied to mass flow and density will affect liquid volume measurement.
- Gas standard volume flow is derived from mass flow measurement, but not from density measurement. Therefore, only damping applied to mass flow will affect gas standard volume measurement.
- You can also configure damping specifically for the milliamp outputs (see Section 8.4.4). If damping is configured for flow, density, or temperature, the same process variable is assigned to a milliamp output, and added damping is also configured for the milliamp output, the effect of damping the process variable is calculated first, and the added damping calculation is applied to the result of that calculation.

Be sure to set damping values accordingly.

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 7-11.

Table 7-11 Valid damping values

Process variable	Valid damping values
Flow (mass and volume)	0, .2, .4, .8, ... 51.2
Density	0, .2, .4, .8, ... 51.2
Temperature	0, .6, 1.2, 2.4, 4.8, ... 38.4

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.

When setting cutoffs, keep the following points in mind:

- 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.
- The density cutoff is applied to the volume flow calculation. Accordingly, if the density drops below its configured cutoff value, the volume flow rate will go to zero.
- Both mA outputs have cutoffs (see Section 8.4.4). If the mA outputs are configured for mass or volume flow, and these cutoffs are set to a greater value than the mass and volume cutoffs, the flow indicators will go to zero when the mA cutoff is reached. If the mA cutoffs are 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.

Be sure to set cutoff values accordingly.

7.3.3 Sensor calibration data

Note: This section is not applicable to the Model 3300 or Model 3350 controller.

Sensor calibration data describe the sensor's sensitivity to flow, density, and temperature. The term "characterization" is frequently used to refer to the process of configuring the transmitter with this information. The characterization procedure depends on whether or not the transmitter is currently attached to a sensor, and if it is, the sensor type: **T-Series** or **Other**.

- If a sensor is currently attached, the transmitter will automatically display the appropriate calibration parameters for the sensor type.
- If no sensor is currently attached, you must select **T-Series Setup** and specify:
 - **Yes** – if you want to configure T-Series calibration factors
 - **No** – if you want to configure calibration factors for any other sensor

See Figure 7-1 for a list of the sensor calibration parameters required for your sensor.

Preconfigured calibration data

If the core processor and sensor in your Series 3000 system 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.

Calibration data on sensor tags

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 7-5 and 7-6 for illustrations of newer and older sensor tags.

Note: On some sensors, the Temperature Coefficient (DT) is shown as TC.

Figure 7-5 Sample calibration tags – T-Series sensors

Newer tag

```

MODEL T100T628SCAZEZZZ S/N 1234567890
FLOW FCF XXXX.XX.XX
FTG X.XX FFQ X.XX
DENS D1 X.XXXXX K1 XXXXX.XXX
D2 X.XXXXX K2 XXXXX.XXX
DT X.XX FD XX.XX
DTG X.XX DFQ1 XX.XX DFQ2 X.XX
TEMP RANGE -XXX TO XXX C
TUBE* CONN** CASE*
XXXX XXXX XXXX XXXXXX
    
```

* MAXIMUM PRESSURE RATING AT 25°C, ACCORDING TO ASME B31.3
** MAXIMUM PRESSURE RATING AT 25°C, ACCORDING TO ANSI/ASME B16.5, OR MFR'S RATING

Older tag

```

MODEL T100T628SCAZEZZZ S/N 1234567890
FLOW FCF X.XXXX FT X.XX
FTG X.XX FFQ X.XX
DENS D1 X.XXXXX K1 XXXXX.XXX
D2 X.XXXXX K2 XXXXX.XXX
DT X.XX FD XX.XX
DTG X.XX DFQ1 XX.XX DFQ2 X.XX
TEMP RANGE -XXX TO XXX C
TUBE* CONN** CASE*
XXXX XXXX XXXX XXXXXX
    
```

* MAXIMUM PRESSURE RATING AT 25°C, ACCORDING TO ASME B31.3
** MAXIMUM PRESSURE RATING AT 25°C, ACCORDING TO ANSI/ASME B16.5, OR MFR'S RATING

Figure 7-6 Sample calibration tags – All sensors except T-Series

Newer tag

```

MODEL
S/N
FLOW CAL* 19.0005.13
DENS CAL* 12502142824.44
D1 0.0010 K1 12502.000
D2 0.9980 K2 14282.000
TC 4.44000 FD 310
TEMP RANGE TO C
TUBE** CONN*** CASE**
    
```

* CALIBRATION FACTORS REFERENCE TO 0 °C
** MAXIMUM PRESSURE RATING AT 25 °C, ACCORDING TO ASME B31.3
*** MAXIMUM PRESSURE RATING AT 25°C, ACCORDING TO ANSI/ASME B16.5 OR MFR'S RATING

Older tag

```

Sensor S/N
Meter Type
Meter Factor
Flow Cal Factor 19.0005.13
Dens Cal Factor 12500142864.44
Cal Factor Ref to 0°C
TEMP °C
TUBE* CONN**
    
```

• MAX. PRESSURE RATING AT 25°C, ACCORDING TO ASME B31.3.
• MAX. PRESSURE RATING AT 25°C, ACCORDING TO ANSI/ASME B16.5 OR MFR'S RATING.

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 7-6, this value is shown as **12500**.
- For K2, enter the second 5 digits of the density calibration factor. In the sample tag in Figure 7-6, this value is shown as **14286**.

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

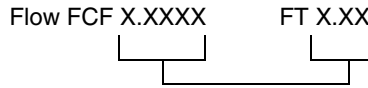
If your sensor tag does not show a DT or TC value, enter the last 3 digits of the density calibration factor. In the sample tag in Figure 7-6, this value is shown as **4.44**.

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.

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.

Other calibration values

Temperature calibration factors are described in Table 7-12.

Meter factors allow you to modify the transmitter’s output so that it matches an external measurement standard. See Chapter 21 for more information.

All other values are configured exactly as they are shown on the sensor tag. Note the following:

- D3 and D4 density factors* are used only if a D3 or D4 density calibration has been performed in the field (see Section 21.5).
- K3 and K4 factors* represent the calibration values at D3 and D4 respectively, and are configured only when the D3 and D4 density factors are configured.

Table 7-12 Temperature calibration values

Variable			
T-Series sensors	Other sensors	Default	Description
Temperature slope	Temp cal (first 7 characters)	1.000000	<ul style="list-style-type: none"> This value represents the temperature slope. The default value is used for most applications. If you perform a temperature calibration, this value is updated automatically. To perform a temperature calibration, see Section 21.6. Contact Micro Motion customer service before performing a temperature calibration.
Temperature offset	Temp cal (last 6 characters)	0.000000	<ul style="list-style-type: none"> This value represents the temperature offset. The default value is used for most applications. If you perform a temperature calibration, this value is updated automatically. To perform a temperature calibration, see Section 21.6. Contact Micro Motion customer service before performing a temperature calibration.

Configuring Inputs

LD Optimization is a special compensation that is specifically for hydrocarbon liquids. LD Optimization should not be used with any other process fluids. LD Optimization is available only with certain large sensor sizes. If your sensor can benefit from LD Optimization, the enable/disable option will appear in ProLink II or on the display.

CAUTION

If you send the transmitter to a calibration facility to perform a water calibration, either during startup or any time thereafter, LD Optimization must be disabled. When you have completed the calibration, re-enable LD Optimization.

7.3.4 Sensor information

Sensor information includes parameters that serve as references without affecting calibration parameters, totalizers, or outputs. These parameters are informational and not required.

Sensor information parameters are listed and defined in Table 7-13.

Table 7-13 Sensor information parameters

Variable	Default	Description
Sensor model no.	Uninitialized	Automatically set based on calibration data, and cannot be changed.
Sensor serial no.	0	Enter the serial number that is on the sensor serial number tag.
Sensor material	Unknown	Select the appropriate sensor flow tube material.
Sensor flange	Unknown	Select the appropriate flange.
Sensor liner	None	Select the appropriate liner material for the sensor flow tubes.

7.3.5 Discrete inputs

Note: Be sure to distinguish these discrete input parameters from the discrete input parameters described in Section 7.5, which are used to describe the discrete input signal.

The discrete input parameters allow you to specify a transmitter action that will occur when:

- An ON signal is received from a discrete input (see Section 7.5 for information on configuring the discrete input signal)
- A discrete event occurs (see Chapter 10 for information on configuring discrete events)

You can assign one or more actions to a single discrete input or discrete event. All assigned actions will be performed. Actions and assignments for discrete inputs and discrete events are listed and defined in Table 7-14.

Note: If you are configuring a Model 3300 or Model 3350 controller, refer to Section 7.4 to assign an action to a discrete input.

Note: To assign a batch control function to a discrete input or a discrete event, see Chapter 11. To assign a print function to a discrete input or discrete event, see Chapter 15.

Configuring Inputs

Table 7-14 Discrete input actions and assignments

Action	Default	Assignment	Description
Start zero	None	None	Starts the sensor zero process. See Section 16.3.
Reset mass total	None	Discrete input 1	Resets the value of the mass totalizer to zero.
Reset volume total	None	Discrete input 2	Resets the value of the liquid volume totalizer to zero.
Reset GStd vol total	None	Discrete event 1	Resets the value of the gas standard volume totalizer to zero.
Reset API corrected volume total ⁽¹⁾	None	Discrete event 2	Resets the value of the API corrected volume totalizer to zero.
Reset ED standard volume total ⁽²⁾	None	Discrete event 3	Resets the value of the ED standard volume totalizer to zero.
Reset ED net mass total ⁽²⁾	None	Discrete event 4	Resets the value of the ED net mass totalizer to zero.
Reset ED net volume total ⁽²⁾	None	Discrete event 5	Resets the value of the ED net volume totalizer to zero.
Reset all totals	None		Resets the value of all totalizers to zero.
Start/stop all totals	None		<ul style="list-style-type: none"> • If totalizers are stopped, starts all totalizers. • If totalizers are started, stops all totalizers.
Start meter verify ⁽³⁾	None		<ul style="list-style-type: none"> • Starts a Smart Meter Verification test. See Section 21.2.1.

(1) Displayed only if petroleum measurement application is installed.

(2) Displayed only if enhanced density application is installed.

(3) Displayed only on systems with Smart Meter Verification.

7.4 Configuring the frequency input

Frequency input parameters define how the frequency input is used to represent process data.

Frequency input parameters are listed and defined in Table 7-15.

Table 7-15 Frequency input parameters

Variable	Default	Description
Flow rate units	kg/min	Select the desired unit of mass flow or volume flow. See Table 7-4.
Scaling method	Frequency = flow	<ul style="list-style-type: none"> • Select frequency = flow, pulses/unit, or units/pulse. • The frequency input has a range of 0 to 20,000 Hz.
Frequency	1000.000 Hz	If Frequency = flow is selected as the scaling method, enter the frequency (or pulse rate), in Hz, that represents the configured flow rate.
Flow	999.9999 kg/min	If Frequency = flow is selected as the scaling method, enter the flow rate that is represented by the configured frequency.
Pulses	60.00 pulses	If Pulses/unit is selected as the scaling method, enter the number of input pulses that represents one mass or volume unit.
Units	0.0167 kg	If Units/pulse is selected as the scaling method, enter the number of mass or volume units that is represented by one input pulse.
K-factor	1.0000	<ul style="list-style-type: none"> • The K-factor is used for proving a Model 3300 or Model 3350 controller, for which meter factors are not available. To calculate the K-factor, see the following example. The resulting value must be between 0.0001 and 2.0000. • The entered value serves as a scaling factor for flow rate outputs and displays.

Configuring Inputs

Table 7-15 Frequency input parameters *continued*

Variable	Default	Description
Reset all totals ⁽¹⁾	None	Specify the discrete input or discrete event that will trigger this action.
Start/Stop all totals ⁽¹⁾	None	Specify the discrete input or discrete event that will trigger this action.

(1) Displayed only if you are configuring a Model 3300 or Model 3350 controller.

Example

A Model 3300 controller indicates a flow rate of 5483 grams per minute. Calibration of the reference flow element reveals that the actual flow rate is 5482 grams per minute.

Use the following formula to calculate the K-factor:

$$\text{K-factor} = \frac{\text{Reference flow rate}}{\text{Indicated flow rate}}$$

$$\text{K-factor} = \frac{5482 \text{ g/min}}{5483 \text{ g/min}} = 0.9998$$

Enter a K-factor of 0.9998.

For more assistance on configuring the frequency input parameters, see the information provided for configuring the frequency output parameters, in Section 8.5.

7.5 Configuring the discrete inputs

Note: Be sure to distinguish these discrete input parameters from the discrete input parameters described in Section 7.3.5, which are used to assign actions to discrete inputs and discrete events.

These parameters allow you to describe the signal used by the discrete inputs. You can configure each discrete input separately. Discrete input options are listed and defined in Table 7-16. See Section 7.3.5, Section 11.7, and Chapter 15 for a discussion of the different actions that can be triggered by a discrete input.

Table 7-16 Discrete input parameters

Polarity	Default	Description
Active low	Active low	<ul style="list-style-type: none"> The input is considered active when the input level is between 0.0 and 0.8 V. The input is considered inactive when the input level is between 3.0 and 30.0 V.
Active high		<ul style="list-style-type: none"> The input is considered active when the input level is between 3.0 and 30.0 V. The input is considered inactive when the input level is between 0.0 and 0.8 V.

Configuring Inputs

7.6 Configuring the external inputs

External input parameters are used to configure polling. Polling is used to retrieve temperature or pressure data from an external device over a HART/Bell 202 connection. You may poll for either temperature or pressure, or both.

Note: Pressure compensation and external temperature are optional. Configure pressure compensation only if your sensor is subject to pressure effect and if the operating pressure is significantly different from calibration pressure. External temperature compensation is used to provide an external temperature value for the petroleum measurement application or the enhanced density application. If you have core processor v2.1 or earlier, the external temperature data is used for all calculations that require temperature values. If you have core processor v2.2 or later, the external temperature data is used only for calculation of the derived variable in enhanced density applications or the CTL (Correction for Temperature on volume of Liquids) value in petroleum measurement applications. To determine your core processor version, use the Applications List from the View menu (see Section 17.5.9).

Note: If you poll for temperature or pressure, ensure that the external measurement device is accurate and reliable.

To set up polling, you must configure the external input parameters and you must also ensure that the primary milliamp output has been wired for HART protocol (see Section 3.4). The external input parameters are listed and defined in Table 7-17.

Table 7-17 External input parameters

Variable	Default	Description
Polling control	Do not poll	You can configure polling control for an external temperature device, an external pressure device, or both: <ul style="list-style-type: none"> • Do not poll – polling will not occur. • Poll as primary – The Series 3000 device will poll the external HART device as a primary master. Choose this option if the external device will probably be accessed by another device acting as a secondary master (e.g., a HART Communicator). • Poll as secondary – The Series 3000 device will poll the external HART device as a secondary master. Choose this option if the external device will probably be accessed by another device acting as a primary master. If polling both a temperature device and a pressure device, you must configure the same polling control method for both. In other words, you cannot poll one external device as a primary master and the other external device as a secondary master. However, you can disable polling for one device, then poll the other device as either a primary or secondary master.
Polling variable	None	Select the process data to be polled through this polling variable: <ul style="list-style-type: none"> • Temperature • Pressure • None
External tag	NONE	Enter the HART tag of the external device to be polled for temperature or pressure.
Pressure compensation ⁽¹⁾	Disable	<ul style="list-style-type: none"> • Select Enable to enable pressure compensation. • Select Disable to disable pressure compensation.
Pressure units	PSI	Select the pressure unit that is used by the remote device that you are polling for pressure.
Flow factor ⁽¹⁾	0.0000 % per PSI	The percent change in the flow rate per PSI. Not all sensors or applications require a pressure correction factor for flow. For the value to be used, see the product data sheet for your sensor, then reverse the sign of the value listed for pressure effect for flow (e.g., if the pressure effect is 0.000004 % per PSI, enter a pressure correction factor of –0.000004 % per PSI).

Configuring Inputs

Table 7-17 External input parameters *continued*

Variable	Default	Description
Density factor ⁽¹⁾	0.0000 g/cm ³ per PSI	The change in fluid density per PSI. Not all sensors or applications require a pressure correction factor for density. For the value to be used, see the product data sheet for your sensor, then reverse the sign of the value listed for pressure effect for density (e.g., if the pressure effect is 0.000004 % per PSI, enter a pressure correction factor of –0.000004 % per PSI).
Calibration pressure ⁽¹⁾	0.0000 PSI	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.
External temperature compensation ⁽²⁾	Disable	<ul style="list-style-type: none">• Select Enable to enable external temperature compensation.• Select Disable to disable external temperature compensation.

(1) Displayed only if Polling Variable is set to Pressure.

(2) Displayed only if Polling Variable is set to Temperature.

Chapter 8

Configuring Outputs

8.1 About this chapter

This chapter explains how to configure outputs. Outputs include all the software parameters listed in Figure 8-1.

Failure to perform configuration tasks in the proper sequence could result in an incomplete configuration. See Section 1.7 for the recommended configuration sequence.

CAUTION

Changing configuration can affect device operation.

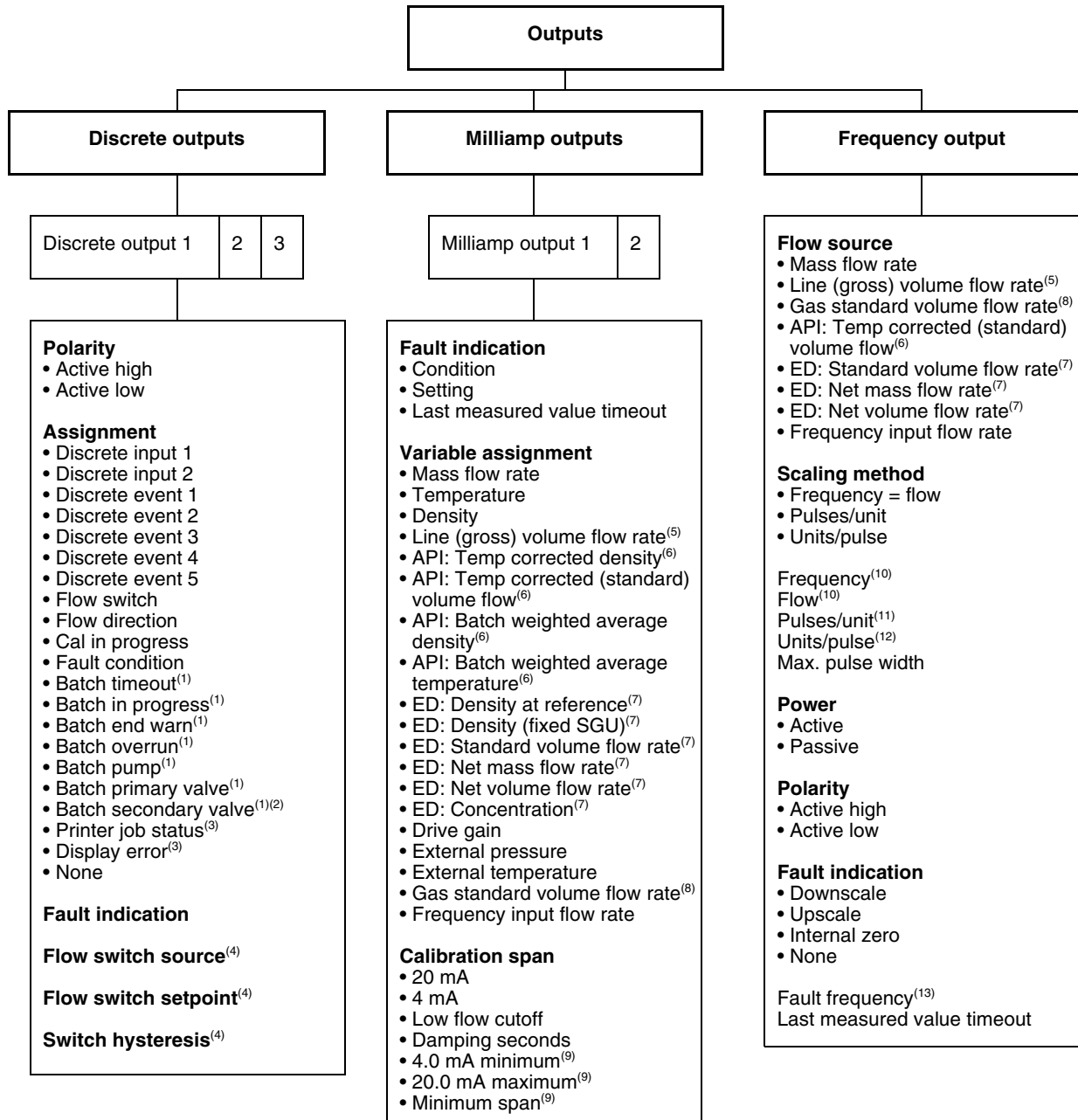
Set control devices for manual operation before changing device configuration.

8.2 Outputs menu

Use the Outputs menu, shown in Figure 8-1, to access and configure output parameters. The Outputs menu is accessed through the Configuration option of the Management menu. To access the Management menu, see Chapter 4. You will be configuring:

- Discrete outputs
- Milliamp (mA) outputs
- Frequency output

Figure 8-1 Outputs menu



- (1) Displayed only if discrete batch application is installed. May also require corresponding batch control function enabled.
- (2) Displayed only if No. of Stages is set to 2.
- (3) Displayed only if custody transfer application is installed and World Area is set to OIML
- (4) Displayed only if Flow Switch is selected.
- (5) Displayed only if Volume Flow Type is set to Liquid.
- (6) Displayed only if petroleum measurement application is installed.
- (7) Displayed only if enhanced density application is installed.
- (8) Displayed only if Volume Flow Type is set to Gas Standard.
- (9) Read-only; calculated by transmitter according to sensor model.
- (10) Displayed only if Frequency = Flow is selected.
- (11) Displayed only if Pulses/unit is selected.
- (12) Displayed only if Units/pulse is selected.
- (13) Displayed only if Fault Indication is set to Upscale.

8.3 Configuring the discrete outputs

You can configure one, two, or three discrete outputs. For each discrete output, you will configure:

- Polarity
- Assignment
- Fault indication

Discrete outputs can be connected to factory-supplied or user-supplied relays. For relay installation instructions, see Appendix D. For specifications of the Model 3100 relay supplied by Micro Motion, see Appendix C.

8.3.1 Polarity

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 8-1. Figure 8-2 shows a diagram of a typical discrete output circuit.

Table 8-1 Discrete output polarity

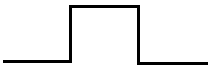

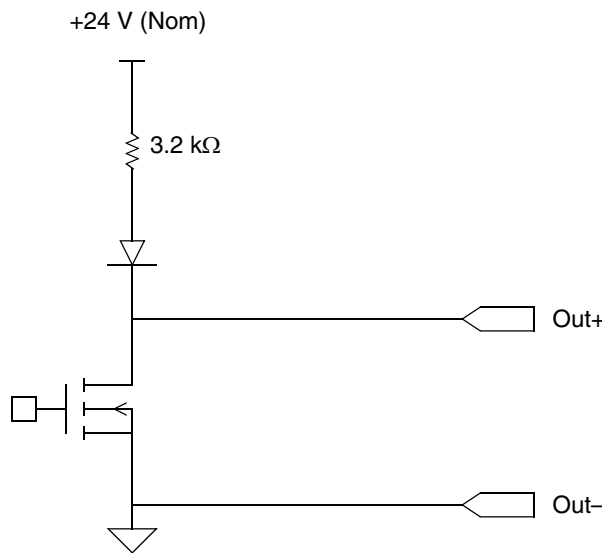
Polarity	Description
 <p>Active high</p>	<ul style="list-style-type: none"> • The circuit provides a pull-up to 24 V when asserted (when condition tied to DO is true). • The circuit provides 0 V when not asserted (when condition tied to the DO is false).
 <p>Active low</p>	<ul style="list-style-type: none"> • The circuit provides 0 V when asserted (when condition tied to DO is true). • The circuit provides a pull-up to 24 V when not asserted (when condition tied to the DO is false).

Figure 8-2 Discrete output circuit



8.3.2 Source variable assignment

The ON/OFF states of the discrete output are controlled by the discrete input, discrete event, or process condition assigned to the discrete output as a source variable. See Table 8-2.

When the discrete batch application is installed, one or more of the discrete outputs must be used to control the pump, primary valve, or secondary valve. See the following section entitled *Discrete batch requirements*.

CAUTION

If “batch in progress” is assigned to a discrete output, connecting the output to a system pump can cause batch overrun or a deadhead pump.

To avoid batch overrun or a deadhead pump, do not connect a discrete output to a pump if “batch in progress” is assigned to the output.

Table 8-2 Discrete output source variables

Source variable	Default	Description
None	None	The discrete output is inactive.
Discrete input 1		The discrete output will be controlled by discrete input 1.
Discrete input 2		The discrete output will be controlled by discrete input 2.
Discrete event 1		The discrete output will be controlled by discrete event 1.
Discrete event 2		The discrete output will be controlled by discrete event 2.
Discrete event 3		The discrete output will be controlled by discrete event 3.
Discrete event 4		The discrete output will be controlled by discrete event 4.
Discrete event 5		The discrete output will be controlled by discrete event 5.
Flow switch		The discrete output will be controlled by the occurrence of a flow switch. See the section entitled <i>Flow switch</i> later in this chapter.
Flow direction		The discrete output will be controlled by the flow direction.
Calibration in progress		The discrete output ON state will indicate calibration in progress.
Fault condition		The discrete output will indicate any condition that produces a fault alarm. For information about fault alarms, see Section 22.6.
Batch timeout		At start of batch or at any time before batch completion, the discrete output will be active if no flow has been measured for the amount of time configured for time out.
Batch in progress		The discrete output will indicate the batch is in progress. <ul style="list-style-type: none"> • “Batch in progress” is a status indicator only. • Because “batch in progress” remains active until the batch is completed or ended, using “batch in progress” to control a pump can cause batch overrun or a deadhead pump.
Batch end warn		The discrete output will indicate when the batch total has exceeded the percent of target or quantity subtracted from target that is configured for batch end warn.
Batch overrun		The discrete output will indicate when the batch total has exceeded the amount configured for batch overrun.
Batch pump		The discrete output will control the system pump. The pump remains on while the primary or secondary valve is open.
Batch primary valve		The discrete output will control the primary valve.

Table 8-2 Discrete output source variables *continued*

Source variable	Default	Description
Batch secondary valve		The discrete output will control the secondary valve.
Printer job status ⁽¹⁾		<p>If Printer Type is set to FDW, the discrete output will be activated if either of the following is true:</p> <ul style="list-style-type: none"> • The last ticket print request failed. • Flow rate is not zero. <p>If Printer Type is set to Epson, the discrete output will be activated if either of the following is true:</p> <ul style="list-style-type: none"> • The printer is out of paper. • Flow rate is not zero. <p>Printer job status is not supported for other printer types.</p>
Display error		The discrete output will indicate when a display error has occurred (custody transfer only).

(1) *Displayed only if custody transfer application is installed and World Area is set to OIML.*

Flow switch

Flow switch is used to indicate that the flow rate of the *flow switch source* (e.g., mass flow, liquid volume flow) has dropped below the *flow switch setpoint*.

The flow switch source specifies the flow variable that will be monitored. Any flow variable, including gas standard volume flow and petroleum measurement or enhanced density flow variables, can be assigned as the flow switch source.

The flow switch has a user-configurable *hysteresis*. Hysteresis defines a range around the setpoint within which the flow switch will not change. The default hysteresis value is 5%. The valid range is 0.1% to 10%. At startup, the flow switch is OFF.

For example, if the flow switch setpoint is 100 g/sec and the first reading is below 95 g/sec, the flow switch turns ON and will stay ON until the flow rate rises above 105 g/sec. At this point it turns OFF, and will stay off until the flow rate drops below 95 g/sec.

Note: It is possible to assign flow switch to more than one discrete output, but they will all use the same setpoint and hysteresis.

Discrete batch requirements

If discrete batching is enabled, there are specific requirements for discrete output assignment:

- If 1-stage operation is specified, one discrete output must be assigned to either Batch Pump or Primary Valve.
- If 2-stage operation is specified:
 - One discrete output must be assigned to Primary Valve.
 - One discrete output must be assigned to Secondary Valve.
 - One discrete output may optionally be assigned to Batch Pump.

8.3.3 Fault indication

The Fault Indication parameter specifies the state of the discrete output if a fault occurs. Options for Fault Indication are shown in Table 8-4.

Table 8-3 Discrete output fault indication and values

Condition	Discrete output state	
	Polarity = Active High	Polarity = Active Low
Upscale	<ul style="list-style-type: none"> • Fault: DO is ON (site-specific voltage) • No fault: DO is controlled by its assignment 	<ul style="list-style-type: none"> • Fault: DO is OFF (0 V) • No fault: DO is controlled by its assignment
Downscale	<ul style="list-style-type: none"> • Fault: DO is OFF (0 V) • No fault: DO is controlled by its assignment 	<ul style="list-style-type: none"> • Fault: DO is ON (site-specific voltage) • No fault: DO is controlled by its assignment
None	DO is controlled by its assignment	

Note: The Fault Indication parameter is designed to put the discrete output in a safe state during a fault condition, and not to indicate that a fault condition is present. If you want to use the discrete output to indicate faults, assign Fault Condition to the discrete output as described in Section 8.3.2, and set Fault Indication to None. If you do this, the logical state of the discrete output will be ON whenever a fault condition is active, and OFF otherwise.

8.4 Configuring the milliamp outputs

Configuring milliamp outputs includes the following procedures:

- Specifying the milliamp output to be configured
- Configuring fault indication
- Assigning a process variable to the output
- Configuring the calibration span

8.4.1 Milliamp output

Select Milliamp Output 1 or Milliamp Output 2.

8.4.2 Fault indication

To configure fault indication, you must specify:

- Condition
- Setting (only if Condition is set to Upscale or Downscale)
- Last Measured Value Timeout

The Condition parameter specifies the fault indication, or the state of the milliamp output if a fault occurs. Options for Condition are shown in Table 8-4.

CAUTION

Using Internal zero or None may hamper identification of fault outputs.

To make sure fault outputs can be identified, select Downscale or Upscale.

If Upscale or Downscale is specified, you must also configure the fault indication Setting. Setting ranges and defaults are shown in Table 8-4.

Configuring Outputs

By default, the Series 3000 device immediately reports a fault when a fault is encountered. You can delay reporting faults by changing the fault timeout. Last Measured Value Timeout specifies the time, in seconds, that the milliamp output will report its last valid measurement after a fault condition has been detected. After the timeout has expired, the milliamp output will report its configured fault condition.

Table 8-4 Fault indication parameters for milliamp outputs

Parameter	Default	Description	Setting ⁽¹⁾
Condition / Upscale	Downscale	<ul style="list-style-type: none"> If Condition is set to Upscale, and a fault condition occurs, the milliamp output will transmit this level of current. 	Range: 21.0 to 24.0 mA Default: 22.0 mA
Condition / Downscale		<ul style="list-style-type: none"> If Condition is set to Downscale, and a fault condition occurs, the milliamp output will transmit this level of current. 	Range: 1.0 to 3.6 mA Default: 2.0 mA
Condition / Internal zero		<ul style="list-style-type: none"> Goes to the mA value that represents a value of 0.0 for the process variable. An apparent value of 0.0 for the process variable could indicate a fault. 	Not applicable
Condition / None		<ul style="list-style-type: none"> The milliamp output never indicates a fault condition. The milliamp output always transmits process variable data. 	Not applicable
Last measured value timeout	0 sec	<ul style="list-style-type: none"> Enter the value, in seconds, that the Series 3000 device will continue to report its last valid measurement after a fault condition has been detected. Range is 0.0–60.0 seconds.⁽²⁾ 	Not applicable

(1) The Setting parameter is displayed only if Condition is set to Upscale or Downscale.

(2) This parameter can also be set in the frequency output menu. Only one value is stored. If you change the fault timeout in the mA output menu, the value displayed in the frequency output menu is changed, and vice versa.

8.4.3 Process variable

For the selected milliamp output, select a process variable. The milliamp output level will vary according to the value of this process variable, within the limits defined by the calibration span parameters (see the following section).

⚠ CAUTION

Changing the process variable assignment without verifying the milliamp output range can produce process error.

When the process variable assignment is changed, the milliamp output range parameters will be changed automatically. The new output range may or may not be appropriate for the process. To avoid causing process error, always verify the milliamp output range parameters (LRV and URV) after changing the process variable assignment. See Section 8.4.4.

8.4.4 Calibration span

Calibration span defines the range, scale, and related parameters for the milliamp output. See Table 8-5.

Table 8-5 Calibration span variables

Variable	Default	Description
20 mA	Sensor limit for selected process variable	(Upper range value, or URV) Enter the value the output will represent at 20.0 mA. See the section entitled <i>LRV and URV</i> .
4 mA		(Lower range value, or LRV) Enter the value the output will represent at 4.0 mA. See the section entitled <i>LRV and URV</i> .
Low flow cutoff ⁽¹⁾	0.0 for all flow variables	<ul style="list-style-type: none"> • If a flow variable is assigned to the output, the low flow cutoff is the flow rate below which the output will indicate zero flow. • If the value entered here is less than the value configured for mass or volume low flow cutoff, this value will have no effect. See the section entitled <i>Multiple cutoffs</i>.
Damping seconds ⁽²⁾	0 sec	<ul style="list-style-type: none"> • Select the amount of added damping for the milliamp output. • Damping is added to damping that has been configured for flow, density, or temperature. See the section entitled <i>Multiple damping parameters</i>.
4.0 mA minimum	Not applicable (read-only)	The lowest value that can be represented by the output, as determined by sensor limit.
20.0 mA maximum		The highest value that can be represented by the output, as determined by sensor limit.
Minimum span		The smallest allowable difference between the value represented at 4.0 mA and the value represented at 20.0 mA, as determined by sensor limit.

(1) For most applications, the Low Flow Cutoff default value is used. Contact Micro Motion customer service before changing the Low Flow Cutoff parameter.

(2) For most applications, the Damping Seconds default value is used. Contact Micro Motion customer service before changing the Damping Seconds parameter.

LRV and URV

Each process variable that can be assigned to a milliamp output has its own 20 mA and 4 mA value (URV and LRV). If you assign a different process variable to a milliamp output, the corresponding LRV and URV are loaded and used. Default LRV and URV settings are listed in Table 8-6.

Table 8-6 Default LRV and URV

Process variable	LRV	URV
All mass flow variables	-200.000 g/s	200.000 g/s
All liquid volume flow variables	-0.200 l/s	0.200 l/s
All density variables	0.000 g/cm ³	10.000 g/cm ³
All temperature variables	-240.000 °C	450.000 °C
Drive gain	0.000%	100.000%
Gas standard volume flow	-423.78 SCFM	423.78 SCFM
External temperature	-240.000 °C	450.000 °C
External pressure	0.000 bar	100.000 bar
Enhanced density concentration	0%	100%
Enhanced density Baume	0	10
Enhanced density specific gravity	0	10

Note: Beginning with rev7.0 of the transmitter software, if the LRV and URV are changed from the defaults, and the milliamp output source is later changed, the LRV and URV will not be reset to their default values. For example, if mass flow is assigned to the milliamp output, and the LRV and URV for mass flow are changed, then density is assigned to the milliamp output, and finally mass flow is reassigned to the milliamp output, the LRV and URV for mass flow are reset to the configured values. In earlier versions of the transmitter software, the LRV and URV were reset to factory default values.

Multiple cutoffs

Cutoffs can be configured for the mA output and also for the mass flow and volume flow process variables. If mass flow or volume flow has been assigned to an mA output, a non-zero value is configured for the flow cutoff (see Section 7.3), and the mA output's Low Flow Cutoff is also configured, the cutoff occurs at the highest setting, as shown in the following examples.

Example

Configuration:

- Primary mA output: Mass flow
- Frequency output: Mass flow
- AO cutoff for primary mA output: 10 g/sec
- Mass flow cutoff: 15 g/sec

As a result, if the mass flow rate drops below 15 g/sec, all outputs representing mass flow will report zero flow.

Example

Configuration:

- Primary mA output: Mass flow
- Frequency output: Mass flow
- AO cutoff for primary mA output: 15 g/sec
- Mass flow cutoff: 10 g/sec

As a result:

- If the mass flow rate drops below 15 g/sec but not below 10 g/sec:
 - The primary mA output will report zero flow.
 - The frequency output will report nonzero flow.
- If the mass flow rate drops below 10 g/sec, both outputs will report zero flow.

See Section 7.3 for information on the mass flow, volume flow, and density cutoffs.

Multiple damping parameters

Damping can be configured for the mA output and also for the mass flow, volume flow, density, and temperature process variables. If damping has been configured for the process variable assigned to an mA output (see Section 7.3), and a non-zero value is configured for Damping Seconds for the same mA output, the effect of damping the process variable is calculated first, and the Damping Seconds calculation is applied to the result of that calculation. See the following example.

Example

Configuration:

- Flow damping: 1
- Primary mA output: Mass flow
- Frequency output: Mass flow
- Primary milliamp output damping seconds: 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 Series 3000 device according to internal algorithms which are not configurable.
- The frequency output level changes over a 1-second time period (the Flow Damping value). It is not affected by the Damping Seconds parameter.

8.5 Configuring the frequency output

Table 8-7 lists and defines the parameters that can be set for the frequency output.

CAUTION

Using Internal zero or None may hamper identification of fault outputs.

To make sure fault outputs can be identified, select Downscale or Upscale.

Table 8-7 Frequency output variables

Variable	Default	Description
Flow source	Mass flow rate	Specifies the process variable that the frequency output will represent. Select one of the following: <ul style="list-style-type: none"> • Frequency input flow rate • Mass flow rate • Volume flow rate (liquid)⁽¹⁾ • Gas standard volume flow rate⁽¹⁾ • API corr volume flow (available only if petroleum measurement application is installed) • Std vol flow (available only if enhanced density application is installed and configured to indicate standard volume flow) • Net mass flow (available only if enhanced density application is installed and configured to indicate net mass flow) • Net vol flow (available only if enhanced density application is installed and configured to indicate net volume flow) The output received at the external device can be totalized or used to control the process.
Scaling method	Frequency = flow	Select Frequency = flow, Pulses/unit, or Units/pulse.
Frequency ⁽²⁾	1000.000 Hz	<ul style="list-style-type: none"> • Enter the value, in Hz, that will represent the value configured for Flow. To calculate the Frequency value, see Section 8.5.1. • The frequency output has a range of 0 to 10,000 Hz.
Flow ⁽²⁾	16666.6699 g/sec	Enter the maximum flow rate that is appropriate to your application. See Section 8.5.1.
Pulses/unit ⁽³⁾	0.0600	Enter the number of output pulses that will represent one mass or volume unit.

Table 8-7 Frequency output variables *continued*

Variable	Default	Description
Units/pulse ⁽⁴⁾	16.6700 g	Enter the number of mass or volume units that will be represented by one output pulse.
Maximum pulse width	277 ms	<ul style="list-style-type: none"> The pulse width can be configured for output frequencies below 500 Hz. Enter the desired pulse width in milliseconds: minimum value is 0.5 ms, maximum value is 277.2352 ms. For more information, see Section 8.5.2.
Power	Active	Select Active or Passive operation for the frequency output. <ul style="list-style-type: none"> Voltage is 24 VDC nominal for active operation, 30 VDC applied maximum for passive operation. Sourcing current is 10 mA at 3 VDC for active operation. Sinking current is 500 mA for active or passive operation.
Polarity	Active high	Specifies how the frequency output will represent an active state. <ul style="list-style-type: none"> Active high – The active state is represented by the frequency output's high value. Active low – The active state is represented by the frequency output's low value.
Fault indication	Downscale	<ul style="list-style-type: none"> Downscale: Output goes to 0 Hz. Upscale: Output goes to configured Fault frequency value. Internal zero: <ul style="list-style-type: none"> Output goes to 0 Hz. An apparent no-flow condition could indicate a fault. None: <ul style="list-style-type: none"> The frequency output never indicates a fault condition. The frequency output always transmits process variable data.
Fault frequency	15000.000	<ul style="list-style-type: none"> Enter the value, in Hz, that will be transmitted during fault conditions if the fault indicator is set to Upscale. Minimum value is 10.000, maximum value is 15000.000.
Last measured value timeout	0 sec	<ul style="list-style-type: none"> Enter the value, in seconds, that the Series 3000 device will continue to report its last valid measurement after a fault condition has been detected.⁽⁵⁾

(1) Either liquid or gas standard volume flow rate is available, depending on the setting of Volume Flow Type (see Section 7.3.2).

(2) Displayed only if Scaling Method is set to Frequency = Flow.

(3) Displayed only if Scaling Method is set to Pulses/unit.

(4) Displayed only if Scaling Method is set to Units/pulse.

(5) This parameter can also be set in the milliamp output menu. Only one value is stored. If you change the fault timeout in the milliamp output menu, the value displayed in the frequency output menu is changed, and vice versa.

8.5.1 Frequency = flow

If you specify Frequency = Flow, you must also specify Frequency and Flow. Flow is defined as the maximum flowrate appropriate to your application. Frequency can then be calculated using the following formula:

$$\text{Frequency} = \frac{\text{Flow}}{T} \times N$$

Configuring Outputs

where:

- $Flow$ = maximum appropriate flowrate (Flow in configuration)
- T = factor to convert selected flow time base to seconds
- N = number of pulses per flow unit, as configured in the receiving device

The resulting Frequency value must be within the range of the frequency output (0 to 10,000 Hz).

- If the Frequency value is less than 1 Hz, reconfigure the receiving device for a higher pulses/unit setting.
- If the Frequency value is greater than 10,000 Hz, reconfigure the receiving device for a lower pulses/unit setting.

Example

Maximum appropriate flowrate (**Flow**) is 2000 lbs/min.

Receiving device is configured for 10 pulses/pound.

Solution:

$$\text{Frequency} = \frac{\text{Flow}}{T} \times N$$

$$\text{Frequency} = \frac{2000}{60} \times 10$$

$$\text{Frequency} = 333.33$$

Series 3000 device configuration:

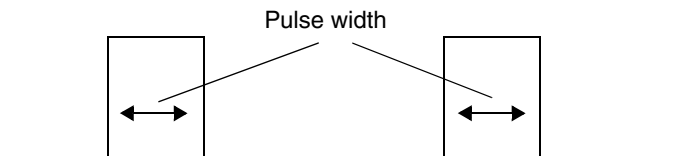
- **Frequency** = 333.33
- **Flow** = 2000

8.5.2 Maximum pulse width

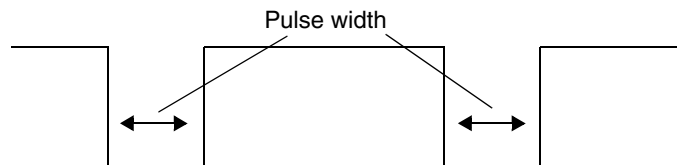
The frequency output *maximum pulse width* defines the maximum duration of the “active” portion of the wave that the Series 3000 device sends to the frequency receiving device. The active portion may be the high voltage or 0.0 V, depending on the polarity setting, as shown in Figure 8-3.

Figure 8-3 Pulse width

Polarity = Active High

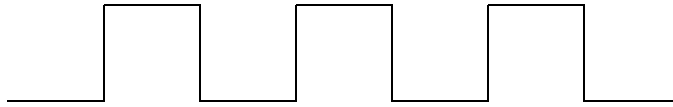


Polarity = Active Low



Maximum Pulse Width can be set to 0, or to values between 0.5 and 277.2352 milliseconds. The user-entered value is adjusted automatically to the nearest valid value. If Maximum Pulse Width is set to 0, the output will have a 50% duty cycle, independent of the output frequency. A 50% duty cycle is illustrated in Figure 8-4.

Figure 8-4 50% duty cycle



If Maximum Pulse Width is set to a non-zero value, the duty cycle is controlled by the *crossover frequency*:

- At frequencies below the crossover frequency, the duty cycle is determined by the pulse width and the frequency.
- At frequencies above the crossover frequency, the output changes to a 50% duty cycle.

The crossover frequency is calculated as follows:

$$\text{Crossover frequency} = \frac{1}{2 \times \text{max pulse width}}$$

You can change the setting for Maximum Pulse Width so that the Series 3000 device will output a pulse width appropriate to your receiving device:

- High-frequency counters such as frequency-to-voltage converters, frequency-to-current converters, and Micro Motion peripherals usually require approximately a 50% duty cycle.
- Electromechanical counters and PLCs that have low-scan cycle rates generally use an input with a fixed non-zero state duration and a varying zero state duration. Most low-frequency counters have a specified requirement for Maximum Pulse Width.

Note: For typical applications, the default pulse width is used.

Example

The frequency output is wired to a PLC with a specified pulse width requirement of 50 ms. The crossover frequency is 10 Hz.

Solution:

- Set Maximum Pulse Width to 50 ms.
- For frequencies less than 10 Hz, the frequency output will have a 50 msec ON state, and the OFF state will be adjusted as required. For frequencies higher than 10 Hz, the frequency output will be a square wave with a 50% duty cycle.

Note: If you are using the Freq = Flow output scale method, and you set Maximum Pulse Width to a non-zero value, Micro Motion recommends setting the frequency factor to a value below 200 Hz. See Section 8.5.1. If you are using the Pulses/unit or Units/pulse output scale method, Maximum Pulse Width must be set to a value that allows crossover to occur.

Chapter 9

Configuring the Petroleum Measurement Application

9.1 About this chapter

This chapter explains how to configure the petroleum measurement application (API feature). The petroleum measurement parameters include all the software parameters listed in Figure 9-1.

Note: The petroleum measurement application is an optional feature of the Series 3000 platform, and may not be installed on your equipment. To verify that it is installed, use the View menu to list all installed applications (see Section 17.5).

Failure to perform configuration tasks in the proper sequence could result in an incomplete configuration. See Section 1.7 for the recommended configuration sequence.

⚠ CAUTION

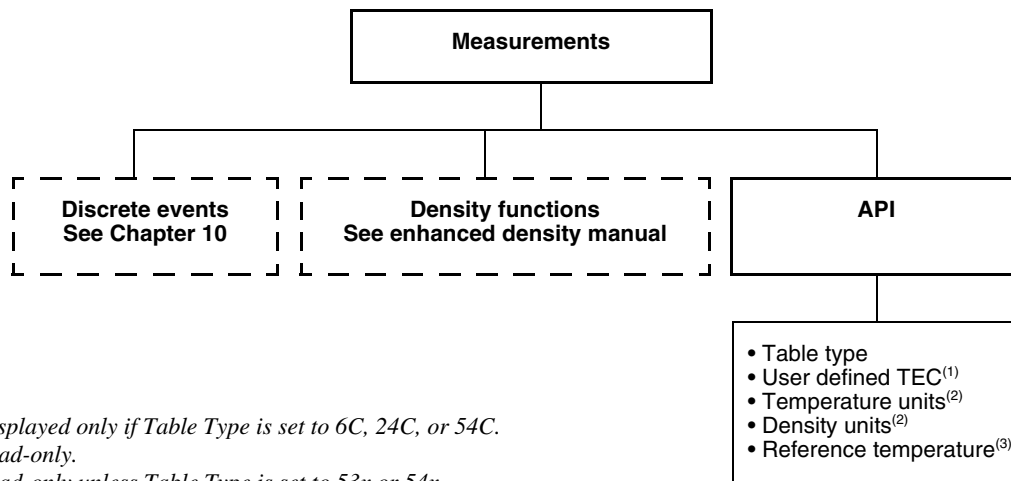
Changing configuration can affect device operation.

Set control devices for manual operation before changing device configuration.

9.2 API menu

Use the API menu, shown in Figure 9-1, to access and configure petroleum measurement parameters. The API menu is a submenu of the Measurements menu, which is accessed through the Configuration option of the Management menu. To access the Management menu, see Chapter 4.

Figure 9-1 API menu



(1) Displayed only if Table Type is set to 6C, 24C, or 54C.

(2) Read-only.

(3) Read-only unless Table Type is set to 53x or 54x.

9.3 About petroleum measurement

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

The *petroleum measurement parameters* determine the values that will be used in API-related calculations. The petroleum measurement parameters are available only if the petroleum measurement application is installed on your Series 3000 device.

9.3.1 Definitions

The following terms and definitions are used in this chapter:

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

9.3.2 CTL derivation methods

There are two derivation methods for CTL:

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

The choice of reference table determines the derivation method to be used, as discussed in Section 9.4.1.

9.4 Configuring petroleum measurement parameters

The petroleum measurement parameters are listed and defined in Table 9-1.

Table 9-1 Petroleum measurement parameters

Variable	Description
Table type	Select the table that matches your requirements. See Section 9.4.1.
User defined TEC ⁽¹⁾	Thermal expansion coefficient. Enter value to be used in CTL calculation.
Temperature units ⁽²⁾	Read-only. Displays the unit used for reference temperature in the reference table.
Density units	Read-only. Displays the unit used for reference density in the reference table.
Reference temperature	Read-only unless Table type is set to 53x or 54x. If configurable: <ul style="list-style-type: none">• Specify the reference temperature to be used in CTL calculation.• Enter reference temperature in °C.

(1) Displayed only if Table Type is set to 6C, 24C, or 54C.

(2) In most cases, the temperature unit used by the API reference table should also be the temperature unit configured for the device to use in general processing. To configure the temperature unit, see Section 7.3.

9.4.1 Reference tables

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

- Reference temperature:
 - If you specify a 5x, 6x, 23x, or 24x table, the default reference temperature is 60 °F, and cannot be changed.
 - If you specify a 53x or 54x table, the default reference temperature is 15 °C. However, you can change the reference temperature, as recommended in some locations (for example, to 14.0 or 14.5 °C).
- CTL derivation method:
 - If you specify an odd-numbered table (5, 23, or 53), CTL will be derived using Method 1 (described in Section 9.3.2).
 - If you specify an even-numbered table (6, 24, or 54), CTL will be derived using Method 2 (described in Section 9.3.2).
- The letters *A*, *B*, *C*, or *D* that are used to terminate table names define the type of liquid that the table is designed for:
 - *A* tables are used with generalized crude and JP4 applications.
 - *B* tables are used with generalized products.
 - *C* tables are used with liquids with a constant base density or known thermal expansion coefficient.
 - *D* tables are used with lubricating oils.
- Different tables use different density units:
 - Degrees API
 - Relative density (SG)
 - Base density (kg/m³)

Table 9-2 summarizes these options.

Table 9-2 API reference temperature tables

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

9.4.2 Temperature data

For the temperature value to be used in CTL calculation, you can use the temperature data from the sensor, or you can poll an external temperature device:

- To use temperature data from the sensor, no action is required.
- To poll an external temperature device, configure polling for temperature as described in Section 7.6. When polling is enabled, the Series 3000 device will automatically use the external temperature value for CTL calculation.

Chapter 10

Configuring Discrete Events

10.1 About this chapter

This chapter explains how to configure discrete events. Discrete events include all the software parameters listed in Figure 10-1.

Failure to perform configuration tasks in the proper sequence could result in an incomplete configuration. See Section 1.7 for the recommended configuration sequence.

CAUTION

Changing configuration can affect device operation.

Set control devices for manual operation before changing device configuration.

10.2 Discrete events menu

Use the Discrete Events menu, shown in Figure 10-1, to access and configure discrete event parameters. The Discrete Events menu is a submenu of the Measurements menu, which is accessed through the Configuration option of the Management menu. To access the Management menu, see Chapter 4.

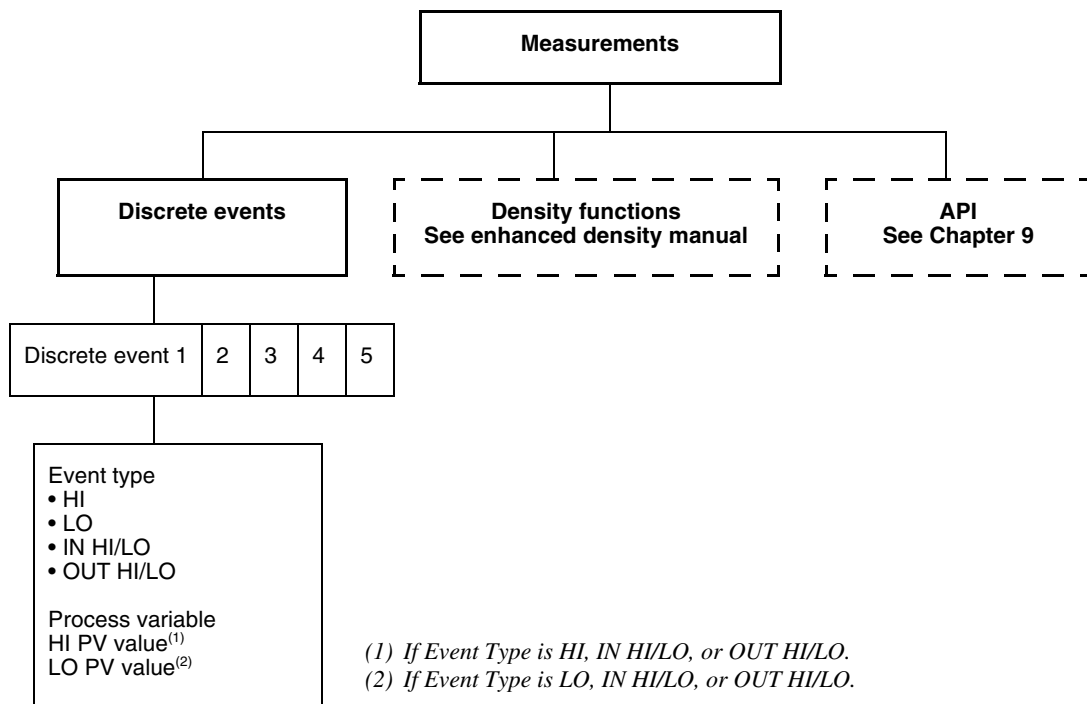
10.3 About discrete events

A *discrete event* occurs if the real-time value of a user-specified process variable varies beyond a user-specified value.

Discrete events are used to perform specific actions on the Series 3000 platform. For example, the discrete event can be defined to activate a discrete output if the flow rate is outside a specified range.

Note: In rev7.0 of the Series 3000 firmware, discrete events are available on all Series 3000 devices. In previous firmware versions, discrete events were available only on the Model 3500 and Model 3700 transmitters; they were not available on the Model 3300 and Model 3350 controllers.

Figure 10-1 Discrete events menu



10.4 Discrete event configuration procedure

You can configure 1 to 5 discrete events, as described in the following steps.

Step 1 Discrete event

Select **Discrete event 1 – 5**.

Step 2 Event type

For the selected discrete event, select one of the event types defined in Table 10-1.

Table 10-1 Event types

Variable	Default	Description
HI	HI	Discrete event will occur if the assigned variable is greater than the high value. ⁽¹⁾
LO		Discrete event will occur if the assigned variable is less than the low value. ⁽¹⁾
IN HI/LO		Discrete event will occur if the assigned variable is greater than the low value <i>and</i> less than the high value. ⁽¹⁾
OUT HI/LO		Discrete event will occur if the assigned variable is less than the low value <i>or</i> greater than the high value. ⁽¹⁾

(1) A discrete event does not occur if the assigned variable is equal to the high or low value.

Step 3 Process variable

For the selected discrete event, select a process variable.

Step 4 High and low values

For the process variable assigned to the selected discrete event, configure a high value, a low value, or high and low values, as required by the event type. Enter values in the unit that is configured for the selected process variable. See Table 10-2 for definitions and descriptions.

Values are *exclusive*. For example, if the event type is HI, and the HI PV value is set to 100 lb/min:

- If the flow rate equals 100 lb/min, the discrete event does not occur.
- If the flow rate exceeds 100 lb/min, the discrete event occurs.

Table 10-2 High and low values of process variables

Variable	Description
HI PV value	<ul style="list-style-type: none"> • If event type is HI or OUT HI/LO, enter the value above which the discrete event will occur. • If event type is IN HI/LO, enter the value below which the discrete event will occur. • If event type is OUT HI/LO or IN HI/LO, you must also enter a LO PV value.
LO PV value	<ul style="list-style-type: none"> • If event type is LO or OUT HI/LO, enter the value below which the discrete event will occur. • If event type is IN HI/LO, enter the value above which the discrete event will occur. • If event type is OUT HI/LO or IN HI/LO, you must also enter a HI PV value.

Step 5 Discrete event actions

To assign an action to a discrete event:

- To assign flowmeter zero, see Section 7.3.5.
- To assign a totalizer control action, see Section 7.3.5.
- To assign a batch control function, see Section 11.7.
- To assign a discrete output, see Section 8.3.2.
- To assign a print function, see Chapter 15.
- To assign a meter verification test, see Section 7.3.5.

If the enhanced density application is installed, you may also assign the “next curve” function.

If more than one action is assigned to a single discrete event, all assigned actions are performed when the discrete event occurs.

Example	<p>Configure discrete event 1 so it will stop all totalizers when the mass flow rate in forward or backward direction is less than 2 lb/min.</p> <ol style="list-style-type: none"> 1. Select lb/min as the mass flow unit. See Section 7.3.2. 2. Configure the flow direction parameter for absolute value. See Section 7.3.2. 3. Configure discrete event 1 so the event type is LO and the process variable is mass flow. 4. Enter a value of 2 for the LO PV value. 5. Exit the Measurements menu. 6. Using the Inputs/Core Processor parameters/Discrete Inputs menu, assign Start/stop all totals to discrete event 1. See Section 7.3.5.
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Chapter 11

Configuring the Discrete Batch Application

11.1 About this chapter

This chapter explains how to configure the discrete batch application. The discrete batch application includes all the software parameters listed in Figure 11-1.

Note: Information on formatting and printing batch tickets is provided in Chapter 15.

Note: Information on operating the discrete batch application is provided in Chapter 18.

Note: The discrete batch application is an optional feature of the Series 3000 platform, and may not be installed on your equipment. To verify that it is installed, use the View menu to list all installed applications (see Section 17.5).

Note: If the discrete batch application will be used with custody transfer, review the information in Chapters 14, 15, and 19 before configuring the discrete batch application.

Failure to perform configuration tasks in the proper sequence could result in an incomplete configuration. See Section 1.7 for the recommended configuration sequence.

CAUTION

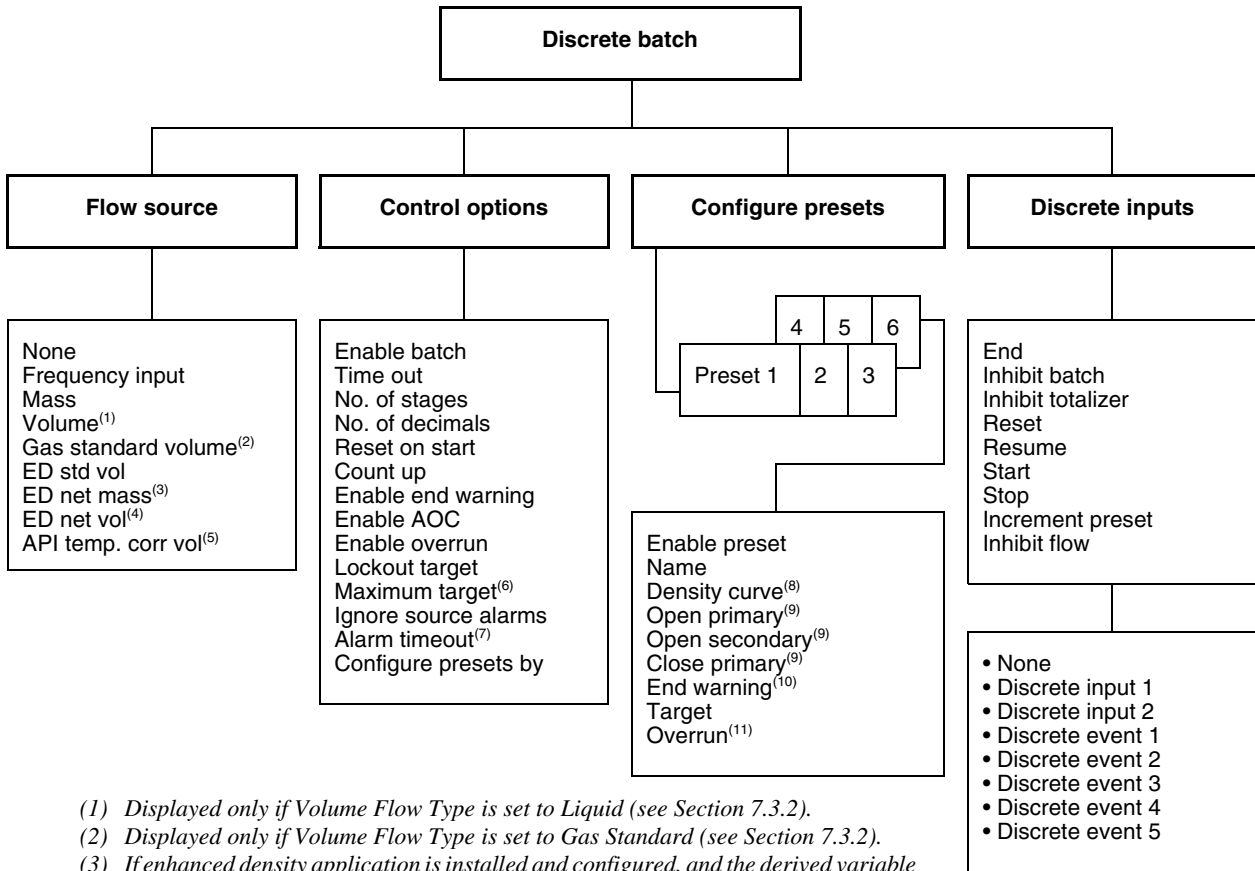
Changing configuration can affect device operation, including batching.

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

11.2 Discrete batch menu

Use the Discrete Batch menu, shown in Figure 11-1, to access and configure batch parameters. The Discrete Batch menu is accessed through the Configuration option of the Management menu. To access the Management menu, see Chapter 4.

Figure 11-1 Discrete batch menu



- (1) Displayed only if Volume Flow Type is set to Liquid (see Section 7.3.2).
 (2) Displayed only if Volume Flow Type is set to Gas Standard (see Section 7.3.2).
 (3) If enhanced density application is installed and configured, and the derived variable is mass-based.
 (4) If enhanced density application is installed and configured, and the derived variable is volume-based.
 (5) If petroleum measurement application is installed.
 (6) If Lockout Target is set to No.
 (7) If Ignore Source Alarms is set to Yes.
 (8) If enhanced density application is installed and configured.
 (9) If No. of Stages is set to 2.
 (10) If Enable End Warning is set to Yes.
 (11) If Enable Overrun is set to Yes.

11.3 Batching configuration overview

To configure batching, the following general steps are required:

1. From the Discrete Batch menu:
 - a. Configure flow source.
 - b. Configure control options.
 - c. Configure one or more presets (optional).
 - d. Configure batch control methods, if desired.

2. From the Discrete Outputs menu, configuring the required discrete outputs:
 - For 1-stage operation, you must configure one discrete output. This output must control either the pump or the primary valve, as appropriate to your application. This discrete output is required.
 - For 2-stage operation, you must configure two or three discrete outputs:
 - One to control the primary valve (required)
 - One to control the secondary valve (required)
 - One to control the pump (optional; only if required by your installation)

You must configure the discrete outputs that are listed as required, whether or not your installation requires them (for example, you may start and stop the pump manually). You will not be able to start a batch until the required discrete outputs have been configured. See Section 8.3 for information on configuring the discrete outputs.

3. If you enabled the Batch AOC control option, you should perform batch AOC (automatic overshoot compensation) calibration. Batch AOC is used to minimize the amount of overshoot per batch. See Section 18.6 for information on performing batch AOC calibration.
4. You may optionally configure the batch ticket and ticket printing. See Chapter 15 for information on configuring tickets and ticket printing.

11.4 Flow source

The flow source specifies the flow variable that will be used for batch measurement. Select one of the flow sources defined in Table 11-1.

Note: If the discrete batch application will be used for custody transfer measurement, ensure that the transfer variable is configured as the batch flow source. See Chapter 14 for more information.

Table 11-1 Flow sources

Flow Source	Default	Description
None	None	<ul style="list-style-type: none"> • Batch controller is disabled. • START button will not appear on display.
Frequency input		<ul style="list-style-type: none"> • Frequency input from a Micro Motion IFT9701 or RFT9739 transmitter • Frequency input from a pulse output device
Mass		Mass flow rate from Model 3500 or Model 3700 transmitter
Volume ⁽¹⁾		Liquid volume flow rate from Model 3500 or Model 3700 transmitter
Gas standard volume ⁽²⁾		Gas standard volume flow rate from Model 3500 or Model 3700 transmitter
ED std vol flow ⁽³⁾		<ul style="list-style-type: none"> • Standard volume flow rate at reference temperature • Standard volume flow is available only if the enhanced density application software is installed and configured to indicate standard volume flow. See the enhanced density manual.

Configuring the Discrete Batch Application

Table 11-1 Flow sources *continued*

Flow Source	Default	Description
ED net mass flow ⁽³⁾		<ul style="list-style-type: none"> • Net mass flow rate • Net mass flow is available only if the enhanced density application software is installed and configured to indicate net mass flow. See the enhanced density manual.
ED net vol flow ⁽³⁾		<ul style="list-style-type: none"> • Net volume flow rate at reference temperature • Net volume flow is available only if the enhanced density application software is installed and configured to indicate net volume flow. See the enhanced density manual.
API temperature-corrected volume flow ⁽⁴⁾		<ul style="list-style-type: none"> • Volume flow adjusted by the calculated volume correction factor • Available only if the petroleum measurement application is installed. See Chapter 9.

(1) Displayed only if Volume Flow Type is set to Liquid. See Section 7.3.2.

(2) Displayed only if Volume Flow Type is set to Gas Standard. See Section 7.3.2.

(3) Displayed only if the enhanced density application is installed.

(4) Displayed only if the petroleum measurement application is installed.

11.5 Control options

Select one of the control options defined in Table 11-2.

Note: Control options apply to all batch presets.

Table 11-2 Control options

Setting	Default	Description
Enable batch	Yes	<ul style="list-style-type: none"> • Select Yes to enable the discrete batch application. • Select No to disable the discrete batch application. The operation mode will default to the process monitor. • If the custody transfer application is installed, with either World Area set to NTEP or World Area set to OIML with batching approved (see Chapter 14), Enable Batch is set to Yes and cannot be changed.
Time out	10.0 sec	<ul style="list-style-type: none"> • The Time Out period specifies how long the batch controller will wait before posting an alarm if flow stops or the batch totalizer or batch flow is inhibited while a batch is running. • Enter a value of 0.0 to 300.0. • Time Out is disabled if set to 0.0 seconds. • A discrete output can be configured to activate if the Time Out period expires. See Section 8.3.2.
No. of stages	1	Enter a value of 1 for 1-stage batch control, or 2 for 2-stage batch control. See the discussion in Section 11.5.1.
No. of decimals	1	<ul style="list-style-type: none"> • Enter a value of 0 to 5. • This value specifies the number of digits to the right of the decimal point on the operation screen.
Reset on start	No	<ul style="list-style-type: none"> • If set to Yes, the batch totalizer resets when the operator starts the batch. • If set to No, the operator must press RESET before starting a new batch • Reset and Start can be assigned to discrete inputs or discrete events. See Section 11.7. • If the custody transfer application is installed, Reset on Start is set to No and cannot be changed if either of the following is true: World Area is set to NTEP, or World Area is set to OIML and the discrete batch application is approved.

Configuring the Discrete Batch Application

Table 11-2 Control options *continued*

Setting	Default	Description
Count up	Yes	<ul style="list-style-type: none"> If set to Yes, the total displayed on screen increases from zero to the target value. If set to No, the total displayed on screen decreases from the target value to zero The setting of the Count Up control option affects only the quantity displayed on screen. It does not affect configuration of presets. If the custody transfer application is installed, with either World Area set to NTEP or World Area set to OIML with batching approved (see Chapter 14), Count Up is set to Yes and cannot be changed.
Enable end warning	No	<ul style="list-style-type: none"> Select Yes to enable the end warning. When End Warning is enabled and an end warning value has been entered for the selected preset, a discrete output can be configured to indicate the end warning. End Warning is a status indicator only, and does not affect valve operation. End Warning will remain active until batch completion.
Enable AOC	Yes	<ul style="list-style-type: none"> Select Yes to enable Automatic Overshoot Compensation (AOC). When batch AOC is enabled and batch AOC calibration has been performed, the batch controller compensates for the time required to close the valve. If Enable AOC is set to Yes, batch AOC calibration is required to provide data for the compensation process. To perform batch AOC calibration, see Section 18.6.
Enable overrun	No	<ul style="list-style-type: none"> Select Yes to enable overrun indication. When Overrun is enabled and an overrun value has been entered for the selected preset, the batch controller produces an overrun alarm when the batch total exceeds the target by more than the programmed overrun amount. Overrun can be assigned to a discrete output. See Section 8.3.2.
Lockout target	No	<ul style="list-style-type: none"> If set to Yes, the current target cannot be changed from the batch operation screen. If set to No, the batch target can be changed from the batch operation screen when a batch is not running.
Maximum target	1.0000E9 kg	If Lockout Target is set to No, enter the maximum target that the operator will be allowed to set in the batch operation mode.
Ignore source alarms	No	<p>A source alarm is any fault-level alarm. If Ignore Source Alarms:</p> <ul style="list-style-type: none"> Is set to Yes, the batch will not stop for the duration of the alarm timeout. Is set to No, the batch is stopped as soon as the alarm condition occurs. <p>If the custody transfer application is installed, with either World Area set to NTEP or World Area set to OIML with batching approved (see Chapter 14), Ignore Source Alarms is set to No and cannot be changed.</p>
Alarm timeout	1 minute	<p>This parameter is applicable only if Ignore source alarms is set to Yes.</p> <ul style="list-style-type: none"> Enter the number of minutes, from 1 to 20, for which source alarms will be ignored. If the alarm condition is present when the alarm timeout expires, the current batch is stopped.
Configure presets by	% of target	<p>Select % of Target or Quantity.</p> <ul style="list-style-type: none"> If set to % of Target, Open Primary, Open Secondary, Close Primary, and End Warning values are each configured as a percent of target. See Example 2 in Section 11.6.1. If set to Quantity, Open Primary and Open Secondary are each configured as a quantity at which the valve should open; Close Primary and End Warning values are each configured as a quantity that is subtracted from the target. See Example 1 in Section 11.6.1. To configure Open Primary, Open Secondary, Close Primary, and End Warning values, see Section 11.6.

11.5.1 One-stage versus two-stage batching

If No. of Stages is set to **1**, a single pump or valve is used to control the batch. (You can assign both a pump and a valve if desired, although only one is necessary.) When the batch is started, the pump starts or the valve opens; at the configured target, the pump stops or the valve closes. Open Primary, Open Secondary, and Close Primary values are not required when configuring the preset (see Section 11.6).

If No. of Stages is set to **2**, two valves are used to control the batch, and the following requirements apply when configuring the preset:

- Both Open Primary and Open Secondary must be configured.
- Either Open Primary or Open Secondary must be set to **0**. Both may be set to **0** if desired.
- Close Primary must be configured.

11.6 Configure presets

You can configure up to six batch presets. Preset 1 cannot be disabled, but you can change its configuration.

Table 11-3 defines the options for configuring presets. To configure a preset, first select the preset to be configured, then define its parameters.

Table 11-3 Presets

Setting	Default	Description
Enable preset	<ul style="list-style-type: none"> • Yes for preset 1 • No for presets 2–6 	<ul style="list-style-type: none"> • If set to Yes, the batch preset can be selected in the View menu. See Section 17.5.3. • If set to No, the batch preset is disabled and cannot be selected. • Preset 1 cannot be disabled.
Name	<ul style="list-style-type: none"> • Preset 1 • Preset 2 • Preset 3 • Preset 4 • Preset 5 • Preset 6 	<ul style="list-style-type: none"> • Enter the name that will appear on operation screens and in preset selection menus. • A maximum of 22 characters can be entered. Only 21 characters are displayed. You can use the left and right cursor control buttons to scroll through and view the entire name.
Density curves	None	<ul style="list-style-type: none"> • If a derived variable is selected as the flow source, you can select a density curve that will apply to this preset. See the enhanced density manual. • The batch total will be based on the density curve for that variable.
Open primary ⁽¹⁾	0.00% of target or 0.0 kg quantity	<ul style="list-style-type: none"> • Enter the quantity or the percent of the target at which the primary valve will open. See the examples later in this section. • 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. • To enable 2-stage batch control, see Section 11.5. • Before a batch can be started, the primary valve must be assigned to a discrete output. See Section 8.3.2.
Open secondary ⁽¹⁾	0.00% of target or 0.0 kg quantity	<ul style="list-style-type: none"> • Enter the quantity or the percent of the target at which the secondary valve will open. See the examples later in this section. • 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. • To enable 2-stage batch control, see Section 11.5. • Before a batch can be started, the secondary valve must be assigned to a discrete output. See Section 8.3.2.
Close primary ⁽¹⁾	80.00% of target or 0.0 kg quantity	<ul style="list-style-type: none"> • Enter the quantity subtracted from the target, or the percent of the target, at which the primary valve will close. See the examples later in this section. • The secondary valve always closes when the target is achieved. • To enable 2-stage batch control, see Section 11.5. • Before a batch can be started, the primary valve must be assigned to a discrete output. See Section 8.3.2.

Table 11-3 Presets *continued*

Setting	Default	Description
End warning ⁽²⁾	80.00% of target or 0.0 kg quantity	<ul style="list-style-type: none"> • If End Warning is enabled as a control option, enter the quantity subtracted from the target, or the percent of the target, at which the end warning will occur. See the examples later in this section. • End Warning can be assigned to a discrete output. See Section 8.3.2. • To enable the end warning, see Section 11.5.
Target ⁽³⁾	0.0 kg	Enter the total at which the batch will be completed.
Overrun ⁽⁴⁾	0.0 kg	<ul style="list-style-type: none"> • If Overrun is enabled as a control option, enter the amount over the target value at which batch overrun will be indicated. For example, if the target is 250 kilograms and overrun should be indicated at 280 kilograms, enter 30. • Overrun can be assigned to a discrete output. See Section 8.3.2. • To enable overrun indication, see Section 11.5

(1) This parameter is displayed only if No. of Stages was set to 2.

(2) This parameter is displayed only if Enable End Warning was set to Yes.

(3) A non-zero value must be configured for Target before a batch can be started.

(4) This parameter is displayed only if Enable Overrun was set to Yes.

11.6.1 Batch preset examples

The following examples describe the batch processing sequence for two different batch preset configurations.

Note: For a detailed presentation of batch processing sequences, including how the STOP and RESUME functions affect processing, see Section 18.4.

Example 1	<p>Configure presets by quantity under the following conditions:</p> <ul style="list-style-type: none"> • The target is 200 kilograms • The primary valve opens at the start of the batch and closes when 180 kilograms have been delivered • The secondary valve opens when 100 kilograms have been delivered • The end warning occurs when 160 kilograms have been delivered <p>Close Primary = 200 kilograms – 180 kilograms = 20</p> <p>Open Secondary = 100 kilograms</p> <p>End Warning = 200 kilograms – 160 kilograms = 40</p>
------------------	--

Example 2

Configure presets by percent of target under the following conditions:

- The target is 200 kilograms
- The primary valve opens at the start of the batch and closes when 180 kilograms have been delivered
- The secondary valve opens when 100 kilograms have been delivered
- The end warning occurs when 160 kilograms have been delivered

$$\text{Close Primary} = \frac{180 \text{ kilograms}}{200 \text{ kilograms}} = 0.90$$

Since 0.90 equals 90%, enter a Close Primary value of 90.

$$\text{Open Secondary} = \frac{100 \text{ kilograms}}{200 \text{ kilograms}} = 0.50$$

Since 0.50 equals 50%, enter an Open Secondary value of 50.

$$\text{End Warning} = \frac{160 \text{ kilograms}}{200 \text{ kilograms}} = 0.80$$

Since 0.80 equals 80%, enter an End Warning value of 80.

11.7 Batch control methods

Batch control functions can be performed in four ways:

- By using the function buttons on the display (see Section 18.3)
- By assigning a discrete input to a batch control function
- By assigning a discrete event to a batch control function
- By using digital communications (e.g., ProLink II)

Table 11-4 lists the batch control functions, and Table 11-5 describes how the batch responds to changes in discrete inputs or discrete events. To assign a discrete input or discrete event to perform a batch control function:

1. Select the batch control function to be performed.
2. Specify the discrete input or discrete event that will perform the batch control function.

Note: For a detailed description of the batch control functions in operation, see Chapter 18.

Note: You can assign one or more actions to a single discrete input or discrete event. All assigned actions that are compatible with the current batch state will be performed, and all others, except for print commands, will be discarded. To assign flowmeter zero or a totalizer control function to a discrete input, discrete event, or batch event, see Section 7.3.5. To assign a print function to a discrete input or discrete event, see Chapter 15.

Table 11-4 Batch control assignments

Function	Default assignment	Assignment options	ON state actions
End	None	Specify the discrete input or discrete event that will perform the batch control function:	<ul style="list-style-type: none"> Ends the batch. The batch cannot be resumed. The batch totalizer must be reset for the next batch.⁽¹⁾
Inhibit batch		<ul style="list-style-type: none"> None Discrete input 1 	<ul style="list-style-type: none"> Batch cannot be started. Inhibit Batch is used for temporary lockout.
Inhibit totalizer		<ul style="list-style-type: none"> Discrete input 2 Discrete event 1 Discrete event 2 	<ul style="list-style-type: none"> Delivers the batch but does not totalize. While totalizing is inhibited, flow measurement continues but batch total is not incremented.
Reset ⁽¹⁾		<ul style="list-style-type: none"> Discrete event 3 Discrete event 4 Discrete event 5 	<ul style="list-style-type: none"> Resets batch total to zero. Batch reset cannot be performed while a batch is running or while a batch is stopped. Before a batch can be reset, the batch target must be reached or the batch must be ended.
Resume			<ul style="list-style-type: none"> Resumes a batch that has been stopped. Counting resumes from the total at which the batch was stopped.
Start			<ul style="list-style-type: none"> Starts the batch by opening the flow control valve(s) and starting the pump.
Stop			<ul style="list-style-type: none"> Stops the batch. The batch can be resumed. If Lockout Target is disabled as a control option, the operator can change the target before resuming. To enable or disable Lockout Target, see Section 11.5.
Increment preset			<ul style="list-style-type: none"> Selects next configured and enabled preset (as listed in the preset menus) for use in the next batch.
Inhibit flow			<ul style="list-style-type: none"> Delivers the batch but does not totalize. Used to allow the batch to end while flow is present.

(1) The batch controller can be configured to reset automatically on start. To configure Reset on Start, see Section 11.5.

Table 11-5 Discrete event/discrete input states and batch control functions

Batch control function	Discrete event/discrete input	Result
End	Turns ON	Stops current batch; batch cannot be restarted.
	Turns OFF	No action taken.
Inhibit batch	While ON	Batch cannot be started. If start is attempted, "Start Not Okay" alarm is posted.
	While OFF	Batch can be started.
	Turns OFF	No action taken.
	Any change of state	Does not affect batch in progress.

Table 11-5 Discrete event/discrete input states and batch control functions *continued*

Batch control function	Discrete event/discrete input	Result
Inhibit totalizer	Turns ON	Batch totalizer stops incrementing. <ul style="list-style-type: none"> • If the Time Out batch control option is set to 0, no time out alarm will be posted. • If the Time Out batch control option is set to a non-zero value, a time out alarm will be posted if the time out period expires before batch totalizing resumes.
	While ON	Batch totalizer does not increment.
	Turns OFF	Resumes incrementing.
	While OFF	Batch totalizer increments if flow is detected, whether or not a batch is running.
Reset	Turns ON	Batch total reset to 0.
	Turns OFF	No action taken.
Resume	Turns ON	Resumes current batch.
	Turns OFF	No action taken.
Start	Turns ON	Begins new batch.
	Turns OFF	No action taken.
Stop	Turns ON	Pauses current batch. Batch can be resumed.
	Turns OFF	No action taken.
Increment preset	Turns ON	Sets the batcher to use the next enabled preset for the next batch. Works only if a batch is not running.
	Turns OFF	No action taken.
Inhibit flow ⁽¹⁾	Turns ON	Batch totalizer stops incrementing.
	While ON	Batch totalizer does not increment. The batch in progress remains active, and will end when the batch time out is reached or when an END command is received.
	Turns OFF	Resumes incrementing.
	While OFF	Batch totalizer increments.

(1) Does not work during AOC calibration.

11.7.1 Special cases in batch control

There are two common situations in batch control that may require special configuration:

- Cleaning/purging the sensor tubes

In normal processing, the batch totalizer increments whenever flow through the sensor tubes is detected. If you will want to run fluid through the tubes without incrementing the totalizer, assign a discrete input to the Inhibit Totalizer function.

- Ending the batch while flow is present

In normal processing, you cannot end a batch while flow is present. If you may need to end a batch while flow is present, assign a discrete input to the Inhibit Flow function.

Chapter 12

Configuring the Process Monitor

12.1 About this chapter

This chapter explains how to configure the process monitor. Parameters are listed in Figure 12-1. Failure to perform configuration tasks in the proper sequence could result in an incomplete configuration. See Section 1.7 for the recommended configuration sequence.

⚠ CAUTION

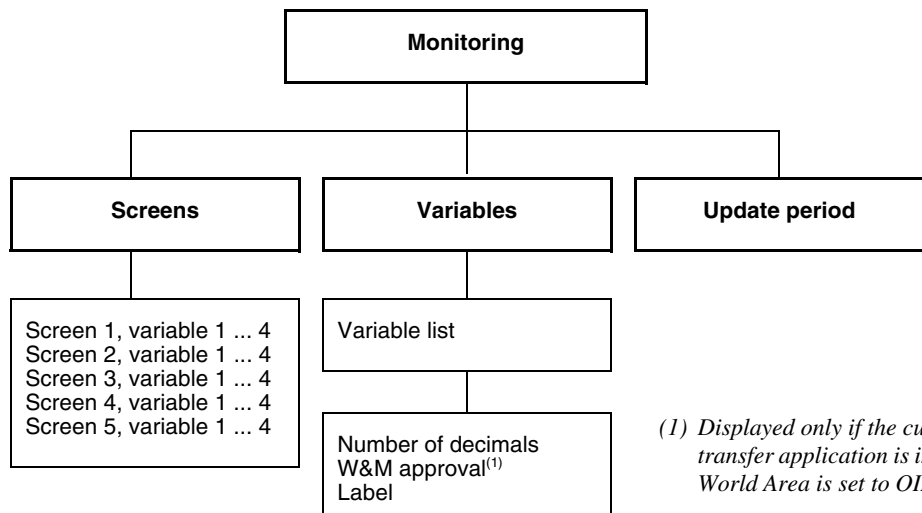
Changing configuration can affect device operation.

Set control devices for manual operation before changing device configuration.

12.2 Monitoring menu

Use the Monitoring menu, shown in Figure 12-1, to access and configure process monitor parameters. The Monitoring menu is accessed through the Configuration option of the Management menu. To access the Management menu, see Chapter 4.

Figure 12-1 Monitoring menu



(1) Displayed only if the custody transfer application is installed and World Area is set to OIML.

Configuring the Process Monitor

12.3 Process monitor screens

The Process Monitor Screens menu allows you to specify the process variable that will appear on the display. You can configure five screens, displaying 0 to 4 variables on each screen. Font size is adjusted according to the number of variables configured for display.

See Table 12-1.

Note: For information about using the process monitor, see Chapter 17.

Table 12-1 Process monitor screen parameters

Variable	Default	Description
Screen 1, Variable 1	Mass flow rate	Select the process variable that will appear on screen 1, line 1.
Screen 1, Variable 2	Mass total	Select the process variable that will appear on screen 1, line 2.
Screen 1, Variable 3	None	Select the process variable that will appear on screen 1, line 3.
Screen 1, Variable 4	None	Select the process variable that will appear on screen 1, line 4.
Screen 2, Variable 1	Volume flow rate	Select the process variable that will appear on screen 2, line 1.
Screen 2, Variable 2	Volume total	Select the process variable that will appear on screen 2, line 2.
Screen 2, Variable 3	None	Select the process variable that will appear on screen 2, line 3.
Screen 2, Variable 4	None	Select the process variable that will appear on screen 2, line 4.
Screen 3, Variable 1	Density	Select the process variable that will appear on screen 3, line 1.
Screen 3, Variable 2	Temperature	Select the process variable that will appear on screen 3, line 2.
Screen 3, Variable 3	None	Select the process variable that will appear on screen 3, line 3.
Screen 3, Variable 4	None	Select the process variable that will appear on screen 3, line 4.
Screen 4, Variable 1	Density	Select the process variable that will appear on screen 4, line 1.
Screen 4, Variable 2	Mass flow rate	Select the process variable that will appear on screen 4, line 2.
Screen 4, Variable 3	None	Select the process variable that will appear on screen 4, line 3.
Screen 4, Variable 4	None	Select the process variable that will appear on screen 4, line 4.
Screen 5, Variable 1	Mass flow rate	Select the process variable that will appear on screen 5, line 1.
Screen 5, Variable 2	Volume flow rate	Select the process variable that will appear on screen 5, line 2.
Screen 5, Variable 3	Density	Select the process variable that will appear on screen 5, line 3.
Screen 5, Variable 4	Temperature	Select the process variable that will appear on screen 5, line 4.

12.4 Process monitor variables

The Process Monitor Variables menu allows you to control the following:

- The precision of the process variable values shown on the display. This does not affect the precision used in internal processing or communicated via digital communications.
- The label to be used for process totalizer and process inventory values on the display.
- The display of the transfer variable (custody transfer applications only).

To change the precision of a process variable:

1. Select it from the list.
2. Specify the number of decimals that will be displayed. The valid range is 0 to 5.

To change the label used for a process totalizer or process inventory value:

1. Select the process totalizer or process inventory from the list.
2. Enter the label to be used. This label will be used on the display and printed on process monitor tickets.

Additionally, if the custody transfer application is installed and World Area is set to OIML, this menu allows you to specify one or more process variables to be marked with asterisks on the transfer ticket and, optionally, the process monitor. This is typically done to identify the process variable used for legal compliance (the transfer variable).

To do this:

1. Select the process variable from the list.
2. Set **W&M Approval** to **Approved** or **Not Approved**, as desired.

Note: For more information, see Section 14.5.

12.5 Update period

The *update period* controls how often the display is refreshed with current data. The default value is 200 msec. The range is 100 to 10,000 msec. The Update Period value applies to all process variables on the display.

Note: Update Period does not affect the values reported by outputs or digital communications.

Chapter 13

Configuring Digital Communications

13.1 About this chapter

This chapter explains how to configure digital communications. Only communication parameters are discussed here; for ticket formatting and printing information, see Chapter 15.

Note: To install wiring for digital communications, see Chapter 3.

Failure to perform configuration tasks in the proper sequence could result in an incomplete configuration. See Section 1.7 for the recommended configuration sequence.

CAUTION

Changing configuration can affect device operation.

Set control devices for manual operation before changing device configuration.

13.2 Digital communication menu

Use the Digital Communication menu, shown in Figures 13-1 through 13-3, to access and configure digital communications parameters. The RS-485 menu displayed depends on several factors:

- Which protocol is configured
- Whether or not the custody transfer application is installed
- If the custody transfer application is installed, whether World Area is set to OIML or NTEP

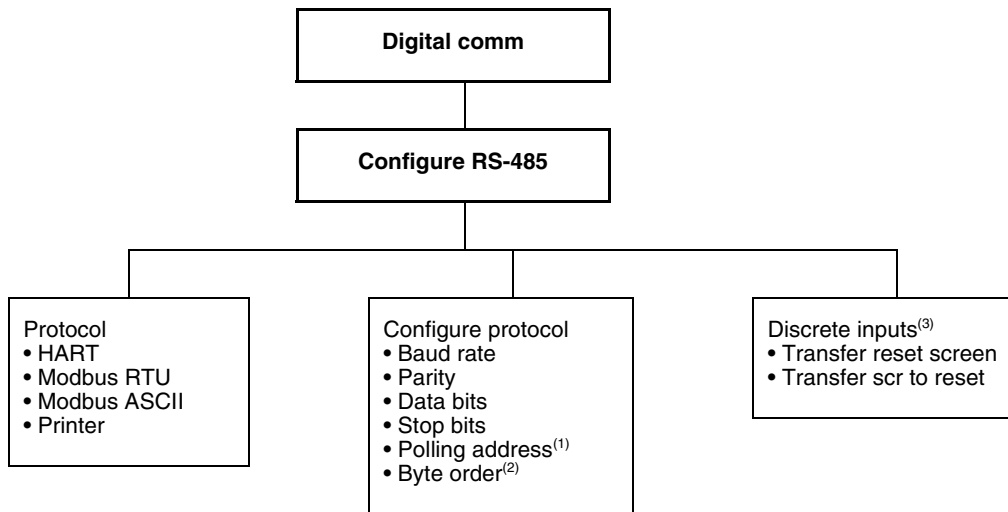
The Digital Communication menu is accessed through the Configuration option of the Management menu. To access the Management menu, see Chapter 4. You will be configuring:

- RS-485 parameters
- Bell 202 parameters
- Device parameters

Note: Before you can use digital communications, the appropriate wiring must be installed. See Chapter 3.

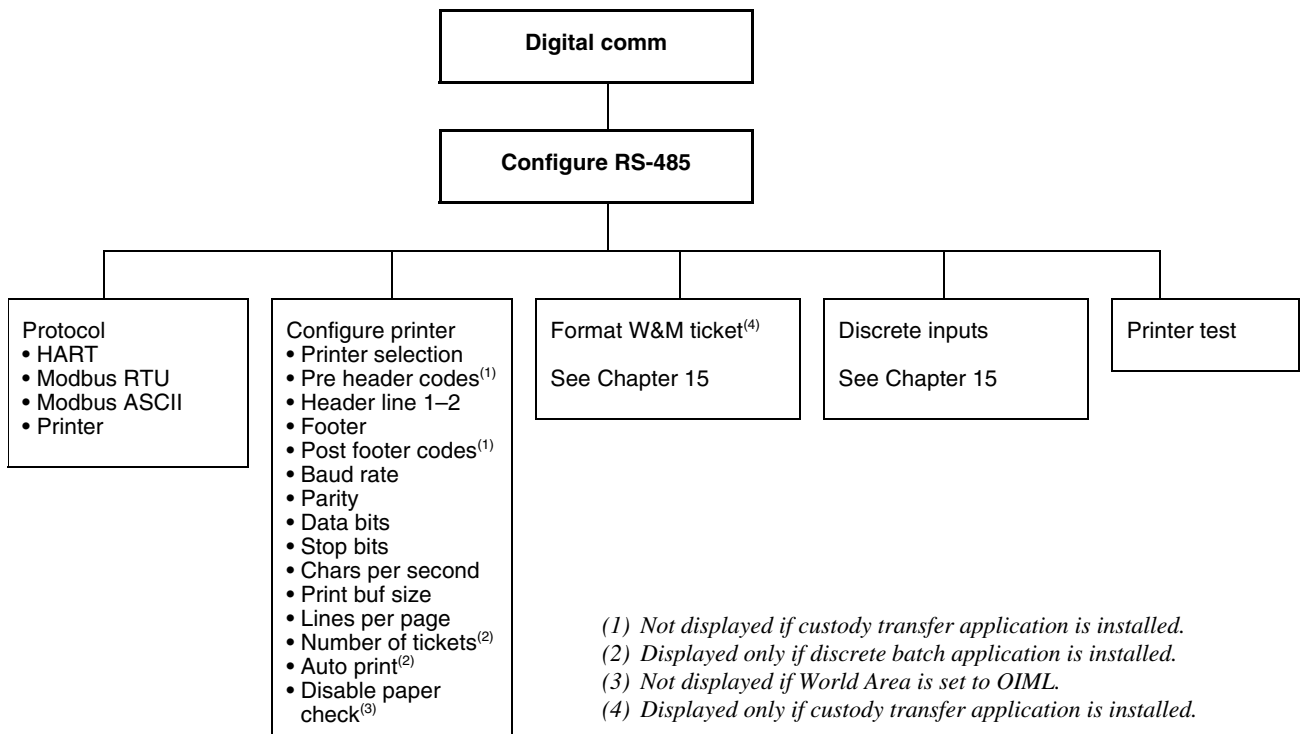
Note: Although the Digital Communication menu is used to configure ticket formatting and printing, these topics are not discussed in this chapter. For information on ticket formatting and printing, see Chapter 15.

Figure 13-1 Digital communication menu – RS-485 (Protocol = HART, Modbus RTU, or Modbus ASCII)



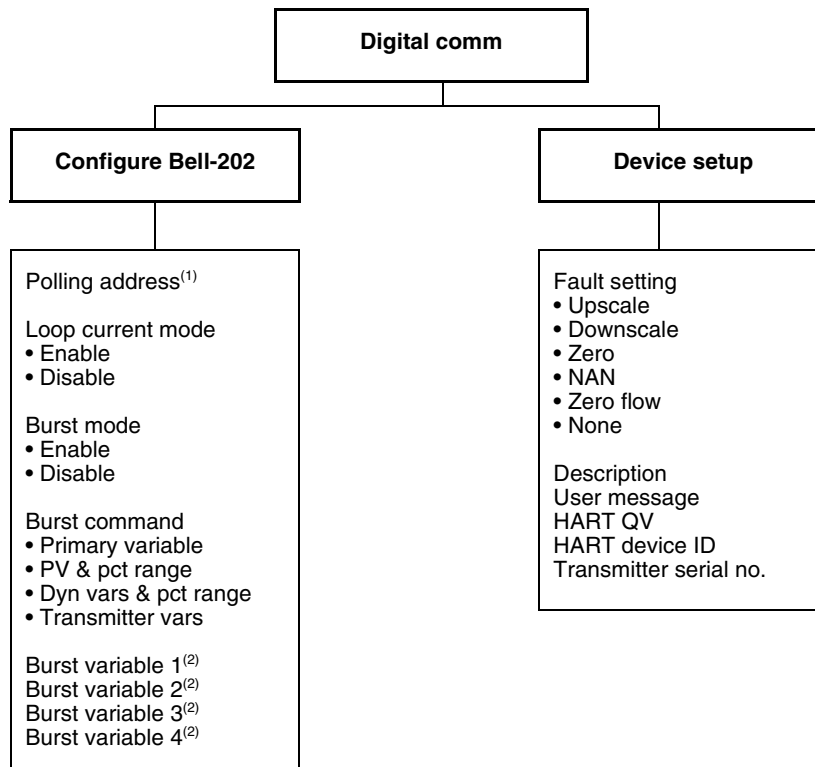
- (1) If HART protocol is configured for RS-485, Polling Address in RS-485 menu and Polling Address in Bell 202 menu are duplicates. See Section 13.3.1.
- (2) Displayed only if Protocol is set to Modbus RTU or Modbus ASCII.
- (3) Displayed only if custody transfer application is installed, World Area is set to OIML, and Protocol is not set to Printer. For more information, see Section 14.5, Step 6.

Figure 13-2 Digital communication menu – RS-485 (Protocol = Printer)



- (1) Not displayed if custody transfer application is installed.
- (2) Displayed only if discrete batch application is installed.
- (3) Not displayed if World Area is set to OIML.
- (4) Displayed only if custody transfer application is installed.

Figure 13-3 Digital communication menu – Bell 202 and Device setup



(1) If HART protocol is configured for RS-485, Polling Address in RS-485 menu and Polling Address in Bell 202 menu are duplicates. See Section 13.3.1.

(2) Displayed only if Burst Command is set to Transmitter Vars.

13.3 Configuring RS-485 parameters

RS-485 parameters specify how the Series 3000 device will communicate via the RS-485 terminals. (To set up RS-485 communications, see Section 3.3.)

The RS-485 terminals can be configured for HART, Modbus RTU, Modbus ASCII protocol, or printer protocol. Different protocol parameters are displayed according to your choice of protocol.

13.3.1 Configuring HART, Modbus RTU, or Modbus ASCII protocol

Parameters used to configure HART, Modbus RTU, and Modbus ASCII protocols are listed and defined in Table 13-1.

Note: If HART is configured, the Polling Address is used for both HART/RS-485 and HART/Bell 202 communications (see the following section). All other parameters specified here apply only to HART/RS-485 communications (via the RS-485 terminals). They do not apply to HART/Bell 202 communications (via the primary mA output terminals).

Table 13-1 HART, Modbus RTU, and Modbus ASCII parameters

Variable	Default	Description
Baud rate	9600 baud	Select the baud rate to be used with the remote device.
Parity	Odd	Select None, Odd, or Even as required by the remote device.
Data bits	8 bits	This parameter is read-only: <ul style="list-style-type: none"> • HART and Modbus RTU – 8 • Modbus ASCII – 7
Stop bits	1 bit	Enter 1 or 2 stop bits as required by the remote device. If HART is the configured protocol, Stop bits must be set to 1.
Polling address	0 (HART) 1 (Modbus)	Enter the polling address to be assigned to the Series 3000 device. <ul style="list-style-type: none"> • If Modbus/RS-485 protocol is configured, enter a Modbus polling address. Valid Modbus polling addresses are in the following ranges: 1–15, 32–47, 64–79, 96–110. • If HART/RS-485 protocol is configured, enter a HART polling address. See the discussion in the following section. Valid HART polling addresses are in the range 0–15. If the HART polling address is set to any value other than 0, the primary mA output is fixed at 4 mA, and will not report process variable data or fault conditions.
Byte order	3–4–1–2	(Modbus RTU or Modbus ASCII only) Specifies the floating point byte order for Modbus communications. Select one of the following: <ul style="list-style-type: none"> • 1–2–3–4 • 3–4–1–2 • 2–1–4–3 • 4–3–2–1

Polling address

Two polling addresses are stored on the Series 3000 device: a Modbus polling address and a HART polling address.

- The Modbus polling address can be configured only in the RS-485 menu, and is used for all Modbus communications.
- The HART polling address can be configured either in the RS-485 menu (if HART protocol is specified) or in the Bell 202 menu. Because only one value can be stored, if Polling Address is set in both menus, the most recent address will be used for HART communication over both the RS-485 terminals and the primary mA/HART terminals.

Communicating with a remote device

After RS-485 communications have been set up (both wiring and configuration), there are two communication methods available:

- Service port mode
- RS-485 mode

Note: Service port connections use standard settings and do not require transmitter configuration. Therefore, they are easy and convenient. However, the standard settings and the address may not be compatible with your network, and the service port cannot be used when the custody transfer application is installed and the transmitter is secured.

Immediately after the Series 3000 device is powered up, the RS-485 terminals are available in service port mode for 10 seconds. To connect during this period, configure your remote device as described in Table 13-2. If a service port connection is made, the terminals will remain in service port mode.

Table 13-2 Connection parameters for service port mode

Connection parameter	Value
Protocol	Modbus RTU
Baud rate	38400
Stop bits	1
Parity	none
Address/Tag	111
COM port	COM port assigned to PC serial port

If no connection is made during the 10-second period, the terminals are automatically reset to RS-485 mode and will remain in that mode. To connect, set the connection parameters to the values configured in your Series 3000 device.

To switch from service port mode to RS-485 mode or vice versa, you must power down the device, then power it up and connect in the desired mode.

If the custody transfer application is installed:

- Service port connections are available only if the custody transfer security switch is OFF (unsecured).
- If the terminals are in service port mode and the custody transfer security switch is then turned ON (secured), the terminals are reset to RS-485 mode. If there is a current service port connection, it is broken. To reconnect in service port mode, you must turn off the security switch and perform a power cycle as described above.

13.3.2 Configuring printer protocol

Printer protocol parameters are used to:

- Configure communications with a printer.
- Test the printer setup.
- Format ticket headers and footers. For more information, see Chapter 15.
- Specify screens to print via a discrete input or discrete event. For more information, see Chapter 15.

Configuring printer communications

The parameters used to configure printer communications are listed and defined in Table 13-3. These parameters control printer communications for all tickets. To access these parameters, refer to Figure 13-1.

Table 13-3 Printer communications parameters

Variable	Default	Description
Printer selection	Generic	Specify the type of printer to be used. The Terminal option is used to specify a dumb terminal or a terminal emulation program. FDW refers to FernDruckWerk, a printer interface device.
Baud rate	9600 baud	Select the baud rate to be used to communicate with the printer.
Parity	Odd	Select None, Odd, or Even as required by the printer.
Data bits	8 bits	Select 7 or 8 as required by the printer.

Table 13-3 Printer communications parameters *continued*

Stop bits	1 bit	Enter 1 or 2 stop bits as required by the printer.
Chars per second	Variable	Enter the number of characters per second to be sent to the printer. The range is 1–1000. The default value for the generic printer is very low, resulting in very slow printing. Micro Motion recommends checking this parameter and setting it appropriately for the printer being used.
Print buf size	Variable	Enter the size of the print buffer, in characters. The range is 32–32768. The default value for the generic printer is very low, resulting in very slow printing. Micro Motion recommends checking this parameter and setting it appropriately for the printer being used.
Lines per page	25	This parameter is read-only, and shown only for user reference. If you are printing more than 25 lines of data, you will need to insert multiple tickets or use a roll of paper.
Disable paper check	Yes	Valid only for the Epson ticket printer. If it is enabled, and an out-of-paper condition is detected: <ul style="list-style-type: none"> • If the custody transfer application is installed and World Area is set to OIML, a print failure message is shown on the Series 3000 display for five seconds. • In all other cases, an A130 alarm is posted. The alarm is cleared when the out-of-paper condition is removed.

Printer test

After configuring the printer, select Printer Test to perform a printer test. A standard test page should be produced at the printer. When the printer test is complete, the display reads “Print Test Complete.”

If printing does not occur:

- Check RS-485 output wiring. See Section 3.3.
- Make sure printer configuration settings are compatible with the selected printer. See the instructions for the selected printer.

13.4 Configuring Bell 202 parameters

The *Bell 202 parameters* are used to configure HART communications over the Bell 202 physical layer. (To set up Bell 202 communications, see Section 3.4.)

When using HART/Bell 202 communications, baud rate, stop bits, parity, and data bits have standard values and cannot be changed. Parameters that can be set for Bell 202 communications are listed and defined in Table 13-4.

Table 13-4 Bell 202 parameters

Variable	Default	Description
Polling address ⁽¹⁾	0	Enter the HART polling address to be assigned to the Series 3000 device. Valid HART polling addresses are in the range 0–15.
Loop current mode ⁽²⁾	Disable	<ul style="list-style-type: none"> • Select Enable to enable Loop Current Mode. • Select Disable to disable Loop Current Mode.
Burst mode ⁽³⁾	Disable	<ul style="list-style-type: none"> • Select Enable to enable burst mode. • Select Disable to disable burst mode.

Table 13-4 Bell 202 parameters *continued*

Variable	Default	Description
Burst command	Transmitter vars	Specify the type of information that will be broadcast via burst mode. Select from: <ul style="list-style-type: none"> • <i>Primary variable</i> – The Series 3000 device repeats the primary variable (PV)⁽⁴⁾, in measurement units, in each burst (e.g., 14.0 g/s, 13.5 g/s, 12.0 g/s). • <i>PV & pct range</i> – The device sends the PV's percent of range and the PV's actual mA level in each burst (e.g., 25%, 11.0 mA). • <i>Dyn vars & Pct range</i> – The device sends PV, SV, TV, and quaternary variable (QV) values in measurement units and the PV's actual milliamp reading in each burst (e.g., 50 lb/min, 23 °C, 50 lb/min, 0.0023 g/cm³, 11.8 mA). • <i>Transmitter vars</i> – In each burst, the device sends the four process variables configured for burst variables 1–4.
Burst variable 1 ⁽⁵⁾	Mass flow rate	<ul style="list-style-type: none"> • Specifies the process variable to be broadcast in position 1. • Select the desired process variable from the list.
Burst variable 2 ⁽⁵⁾	Temperature	<ul style="list-style-type: none"> • Specifies the process variable to be broadcast in position 2. • Select the desired process variable from the list.
Burst variable 3 ⁽⁵⁾	Density	<ul style="list-style-type: none"> • Specifies the process variable to be broadcast in position 3. • Select the desired process variable from the list.
Burst variable 4 ⁽⁵⁾	Mass total	<ul style="list-style-type: none"> • Specifies the process variable to be broadcast in position 4. • Select the desired process variable from the list.

- (1) If HART protocol is configured for RS-485, Polling Address in RS-485 menu and Polling Address in Bell 202 menu are duplicates. See Section 13.3.1.
- (2) See Section 13.4.1.
- (3) See Section 13.4.2.
- (4) The primary variable (PV) is the process variable reported via the primary mA output (MAO1). The secondary variable (SV) is the process variable reported via the secondary mA output (MAO2). The tertiary variable (TV) is the process variable reported via the frequency output. The quaternary variable (QV) is accessible via HART, and can be assigned through the Device Setup menu. See Section 13.5.
- (5) This parameter appears only if Transmitter Vars is specified for Burst Command.

13.4.1 Loop current mode

Loop current mode is used to fix or unfix the mA output:

- If Loop Current Mode is disabled, the mA output is fixed at 4 mA, and therefore cannot be used to report process data.
- If Loop Current Mode is enabled, the mA output will report process data as configured.

13.4.2 Burst mode

Burst mode (or HART burst mode) is a specialized mode of communication during which the Series 3000 device regularly broadcasts process variable data over the primary mA output, using HART protocol. The Burst Command parameter allows you to specify the content and format of the process variable data.

Burst mode is ordinarily disabled, and should be enabled only if another device on the network requires HART burst mode communication.

13.4.3 Communicating with a remote device

After Bell 202 communications have been set up (both wiring and configuration), you can connect to the Series 3000 device using the parameters described in Table 13-5.

Table 13-5 Connection parameters for Bell 202 communications

Connection parameter	Value
Protocol	HART
Baud rate	1200
Stop bits	1
Parity	Odd
Address/Tag	As configured in the Series 3000 device
COM port	COM port assigned to PC serial port

13.5 Configuring device parameters

The *device parameters* are used to describe the device and manage digital communication fault indication. Table 13-6 lists and defines the device parameters.

Table 13-6 Device parameters

Variable	Default	Description
Fault setting	None	The method used to indicate a fault alarm via digital communication. This setting also applies to digital communication from the core processor. Options are as follows: <ul style="list-style-type: none"> • Upscale – Process variables indicate the value is greater than the upper sensor limit. Totalizers stop. • Downscale – Process variables indicate the value is less than the lower sensor limit. Totalizers stop. • Zero – Flow rates, density, and temperature go to their internal zero value. • NAN (Not A Number) – Process variables report IEEE NAN. Totalizers stop. • Zero flow – Flow rates go to their internal zero value; other process variables are not affected. Totalizers do not stop. • None – Process variables reported as measured. Totalizers do not stop. For all options, Modbus scaled integers report Max Int + 1 .
Description	Device-dependent ⁽¹⁾	Any user-supplied description. This parameter is not required. The description may contain up to 16 characters.
User message	Device-dependent ⁽²⁾	Any user-supplied message. This parameter is not required. The description may contain up to 32 characters.
HART QV	Volume flow rate	The process variable to be assigned to the quaternary variable (QV). See the definition of Burst Command in Table 13-4.
HART device ID	0	The HART device ID can be set only once, and is usually set at the factory to the device serial number. If the HART device ID has not been set, its value is 0.
Transmitterserial number	0	The serial number of the Series 3000 device. This parameter is not required.

(1) May be set at the service center to the service center name and the year, month, and day the unit was processed.

(2) May be set at the service center to the service center name and the order ID.

Chapter 14

Configuring Custody Transfer

14.1 About this chapter

This chapter explains how to configure the custody transfer application.

Note: The custody transfer is also known as the weights and measures application. The custody transfer application is an optional feature of the Series 3000 device, and may not be installed on your equipment. To verify that it is installed, use the View menu to list all installed applications (see Section 17.5).

Failure to perform configuration tasks in the proper sequence could result in an incomplete configuration. See Section 1.7 for the recommended configuration sequence.

CAUTION

Changing configuration can affect device operation.

Set control devices for manual operation before changing device configuration.

14.2 About custody transfer

The custody transfer application is designed to allow compliance with weights and measures requirements. While the Series 3000 device is “secured,” all device data can be viewed, but critical device configuration and operation functions (e.g., starting and stopping totalizers) cannot be accessed manually. Operational functions are performed automatically by the device according to existing configuration. To perform these functions manually, the device must be “unsecured.”

In addition:

- A hardware switch and a weights and measures seal are used for physical security.
- A security breach alarm is posted if the hardware switch is toggled or the core processor is replaced.
- For some ticket types, if the ticket is printed while a security breach alarm is active, or while a batch is in progress, a note is added to the ticket.

For a more detailed description of device behavior when the device is “secured” or “unsecured,” see Chapter 19.

14.3 Configuration options

The custody transfer application is designed to comply with three different sets of requirements, as defined by two different regulatory agencies. Before configuring the custody transfer application, review the descriptions below and follow the configuration instructions for the custody transfer system that applies to you.

- National Type Evaluation Program (NTEP) – *Custody transfer (NTEP)* may be used on all Series 3000 devices.

Custody transfer (NTEP) requires the discrete batch application. Only batches, as managed by the discrete batch application, can be used for custody transfer measurement. Accordingly, the process variable used for batch measurement (the batch flow source) serves as the transfer variable (the process variable used for legal compliance), and the transaction is measured and managed by the discrete batch application. See Table 14-1.

To configure custody transfer (NTEP), follow the instructions in Section 14.4.

Note: In previous versions of the Series 3000 software, this configuration type was called World Wide.

- Organisation Internationale de Métrologie Légale (OIML) – *Custody transfer (OIML)* and *custody transfer (OIML/batch)* can be used only on Model 3500 or Model 3700 transmitters; they are not supported on Model 3300 or Model 3350 controllers.
 - In *custody transfer (OIML)* installations, the discrete batch application is not approved for custody transfer use, and the *transfer* is used to define the custody transfer transaction.
 - In *custody transfer (OIML/batch)* installations, the discrete batch application must be approved for custody transfer use, and either the *transfer* or the *batch* may be used to define the custody transfer transaction.

The enhanced density and petroleum measurement applications may or may not be approved for custody transfer use. The options for transfer variable, transaction measurement, and transaction management are described in Table 14-1.

To configure custody transfer (OIML) or custody transfer (OIML/batch), follow the instructions in Section 14.5.

Note: If you are using the custody transfer (OIML) configuration (i.e., the discrete batch application is not approved), you can still install and use the discrete batch application to run batches that are not custody transfer transactions.

Note: In previous versions of the Series 3000 software, the discrete batch application was not approved for OIML compliance. The custody transfer (OIML) configuration is equivalent to the configuration previously known as custody transfer (Europe). The custody transfer (OIML/batch) configuration is new with transmitter software rev7.0.

Table 14-1 Transaction measurement and management

Custody transfer type	Discrete batch application	Method	Transfer variable	Transaction management	Legal receipt
NTEP	Required	Batch	• Batch total	• Measured by batch total • Ended by: - Batch (NTEP) ticket printing, manual or automatic - Batch reset function (manual)	• Batch (NTEP) ticket
OIML	Not installed, or installed but not approved	Transfer	• Mass total • Volume total • API corrected volume total ⁽¹⁾ • ED net mass total ⁽¹⁾	• Measured by transfer total • Ended manually by: - Transfer (OIML) ticket printing - Transfer reset function	• Transfer (OIML) ticket • Transfer log
OIML/batch	Installed and approved	Batch	• Batch total	• Measured by batch total • Ended by: - Batch (OIML) ticket printing (manual or automatic) - Batch reset function (manual)	• Batch (OIML) ticket
		Transfer	• Mass total • Volume total • API corrected volume total ⁽¹⁾ • ED net mass total ⁽¹⁾	• Measured by transfer total • Ended manually by: - Transfer (OIML) ticket printing - Transfer reset function	• Transfer (OIML) ticket • Transfer log

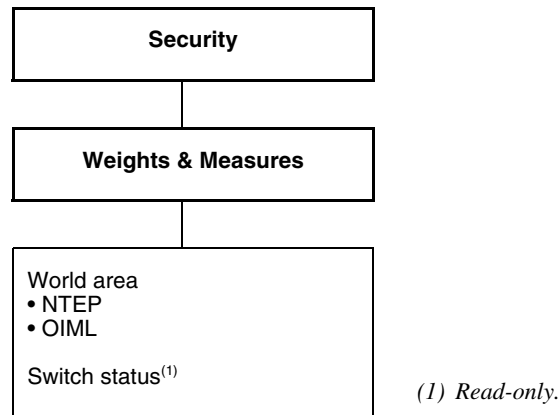
(1) If approved.

14.4 Configuring custody transfer (NTEP)

To configure custody transfer (NTEP):

- Referring to Figure 14-1, set **World Area** to **NTEP**.
- Ensure that the Series 3000 system, including the discrete batch application, is completely configured and tested. Verify that the discrete batch flow source has been set to the process variable to be used for custody transfer measurement (the transfer variable). Only the following process variables are valid:
 - Mass flow
 - Volume flow (liquid)
 - Gas standard volume flow
 - Frequency input
- If you are using a Model 3500 or Model 3700 transmitter, perform a sensor zero. See Section 16.3.
- Referring to Section 13.3, use the Digital Communication menu and set **Protocol** to **Printer**.
- Select **Configure Printer** and configure printer communications (see Section 13.3.2).
- Configure ticket format and ticket printing as described in Section 15.5.
- Set the security switch on your Series 3000 device. The security switch is a hardware switch. Security does not take effect until the security switch is ON. Detailed instructions for the different Series 3000 devices are provided in Section 14.6.
- Contact an authorized agent for installation of the Weights and Measures seal. Detailed instructions for the different Series 3000 devices are provided in Section 14.7.

Figure 14-1 Security menu for custody transfer (NTEP)



14.5 Configuring custody transfer (OIML) and custody transfer (OIML/batch)

To configure custody transfer (OIML) or custody transfer (OIML/batch):

1. Referring to Figure 14-2:
 - a. Set **World Area** to **OIML**.
 - b. Set **Discrete Batch** (if displayed) as desired:
 - **Approved:** The discrete batch application can be used for transaction measurement and management.
 - **Not Approved:** The discrete batch application cannot be used for transaction measurement and management.
 - c. Set **API** or **Enhanced Density** (if displayed) as desired:
 - **Approved:** API or enhanced density process variables can be used as the transfer variable.
 - **Not Approved:** API or enhanced density process variables cannot be used as the transfer variable.
2. Ensure that the Series 3000 system, including all special applications (discrete batch, petroleum measurement, enhanced density), is completely configured and tested. Verify the following:
 - **Volume Flow Type** is set to **Liquid**. Gas standard volume flow cannot be used for OIML custody transfer.
 - If you will use the discrete batch application for transaction measurement, verify that the discrete batch flow source has been set to the process variable to be used for custody transfer measurement (the transfer variable). Only the following process variables are valid:
 - Mass flow
 - Volume flow (liquid)
 - API corrected volume flow (if the petroleum measurement application was approved in the previous step)
 - ED net mass flow (if the enhanced density application was approved in the previous step)
3. Perform a sensor zero. See Section 16.3.

4. If desired, you can mark the transfer variable with asterisks that will appear on the transfer (OIML) ticket and in the transfer log, and optionally, the process monitor. To do this, refer to Figure 12-1 and:
 - a. Select the transfer variable and set **W&M Approval** to **Approved**. Data for this process variable will be marked with asterisks on the transfer (OIML) ticket and in the transfer log, and optionally on the process monitor (see Step 5).
 - b. For all other process variables, set **W&M Approval** to **Not Approved**.

Note: The default setting is Not Approved. It is possible to set more than one process variable to Approved. If you do this, all approved variables will be marked with asterisks.

Note: Approved variables are never marked with asterisks on batch (OIML) tickets.

Note: See Section 19.5.5 for a discussion of the transfer log.

5. If desired, you can specify that all process variables configured as approved in Step 4 will be marked with asterisks on the process monitor (if the process variables are configured for display; see Section 12.3). To do this, refer to Figure 14-2 and set **Process Monitoring** as desired:
 - **Approved:** Data for all process variables configured as approved in Step 4a will be marked with asterisks on the process monitor (if the process variables are configured for display; see Section 12.3).
 - **Not Approved:** No data will be marked with asterisks on the process monitor.
6. Determine how you will end the transaction, and perform required configuration. Typically, printing a transfer (OIML) ticket or batch (OIML) ticket ends the transaction. However, if printing is not available, you can end a custody transfer (OIML) transaction by using the transfer reset function, and you can end a custody transfer (OIML/batch) transaction by resetting the batch.
 - If you will print transfer (OIML) or batch (OIML) tickets:
 - a. Referring to Figure 13-2, set **Protocol** to **Printer**.
 - b. Select **Configure Printer** and configure printer communications (see Section 13.3.2).
 - c. Configure ticket format and ticket printing as described in Section 15.6.
 - If you will use the transfer reset function via the **RESET-T** button, refer to Figure 13-1 and set **Protocol** to any value other than **Printer**. The **RESET-T** button will now be available from the Transfer Totalizer screen on the View menu.
 - If you will use the transfer reset function via discrete input 1 or discrete input 2:
 - a. Referring to Figure 13-1, set **Protocol** to any value other than **Printer**.
 - b. Select **Discrete Inputs**.
 - c. Select **Transfer Reset Screen**, then specify the discrete input to be used to complete the transfer.
 - d. Select **Transfer Scr to Reset** and specify the data to be added to the transfer log when the specified discrete input is activated.

Note: These menu options are similar to the Transfer Print Screen and Transfer Screens To Print menu options described in Section 15.6.2, except that if the discrete input is configured here, no attempt will be made to print a ticket when the discrete input is activated, and the other menu allows you to print a ticket containing only inventory data. The discrete input and transfer screens specified here are reflected in the corresponding menu options, and vice versa.

Configuring Custody Transfer

Note: If a single discrete input is assigned to print both a transfer (OIML) ticket and a standard or batch ticket, only the transfer (OIML) ticket will be printed. With the exception of ticket printing and transfer reset, you can assign one or more actions to a single discrete input. All applicable assigned actions will be performed. Other discrete input actions and assignments are listed and defined in Table 7-14.

- If you will use the batch reset function, you can press the **RESET** button from the batch process screen, or you can assign the batch reset function to a discrete input or discrete event (see Section 11.7).
7. If desired, you can define an alarm log password that will be required for the user to access the active alarm log, the alarm history, and the event log. To do this, refer to Figure 14-2 and:
 - a. Define the four button-presses that will be used for the alarm log password.
 - b. Enable the alarm log password.

Note: Once enabled, the alarm log password will be required to re-enter this menu and change or disable the alarm log password.

8. [Measuring Instruments Directive (MID) compliance] Read and document the Field Verification Zero (FVZ) value. To read FVZ, you must configure the process monitor to display it. See Section 12.3.

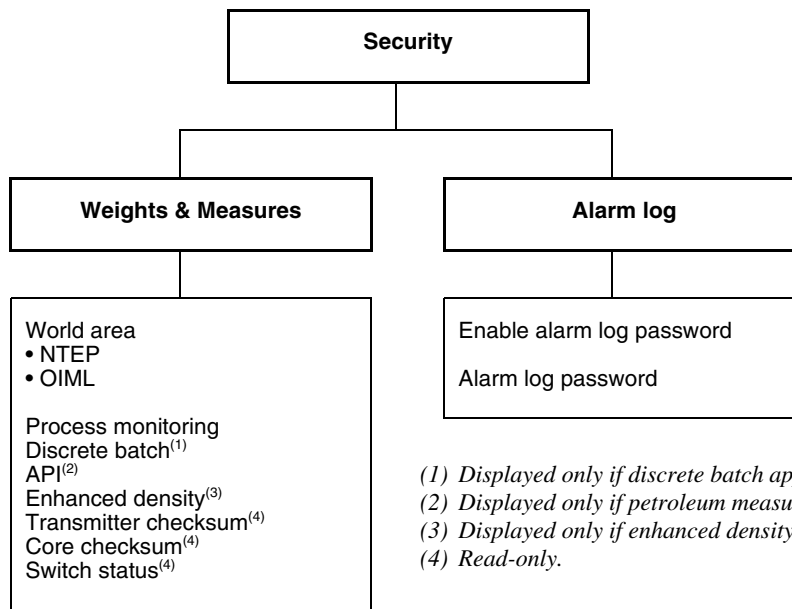
Note: This is required only for systems that include a transmitter. If your custody transfer application is running on a Model 3300 or Model 3350 controller, you do not have an FVZ value.

9. (Gas applications in Germany) Read and document the checksum values for the transmitter and core processor firmware in your flowmeter.

Note: The checksum values may also be useful for MID test reports.

10. Set the security switch on your Series 3000 device. The security switch is a hardware switch. Security does not take effect until the security switch is ON. Detailed instructions for the different Series 3000 devices are provided in Section 14.6.
11. Contact an authorized agent for installation of the Weights and Measures seal. Detailed instructions for the different Series 3000 devices are provided in Section 14.7.

Figure 14-2 Security menu for custody transfer (OIML) and custody transfer (OIML/batch)



14.6 Setting the security switch

Security for custody transfer will not take effect until the security switch has been set to ON. The security switch is a hardware switch.

Note: Current status of the security switch can be viewed using the display, but the display cannot be used to change the security switch setting.

This step provides instructions for:

- Panel-mount devices (Model 3300 or Model 3500)
- Rack-mount devices (Model 3300 or Model 3500)
- Field-mount devices (Model 3350 or Model 3700)

Follow the instructions for your device.

14.6.1 Panel-mount devices

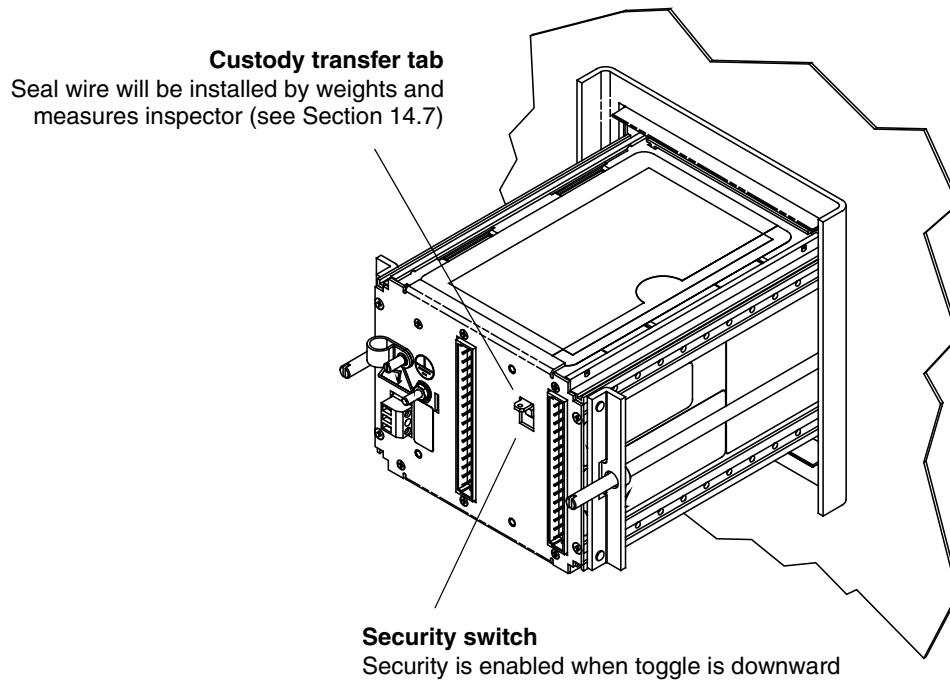
To set the security switch on a Model 3300 or Model 3500 mounted in a panel:

1. Power down the device.

Note: If you set the security switch on a panel-mount device while power is on, communications alarms may be produced.

2. Loosen the captive screws in the bracket that holds the screw-type wiring connectors or I/O cables in place on the back panel of the Series 3000 device.
3. Pull the bracket away from the back panel.
4. The security switch is located on the back panel. To secure the device, set the switch so the toggle is downward. See Figure 14-3.
5. Plug the bracketed wiring connectors or I/O cables onto the terminal strips in the back panel.
6. Tighten the captive screws to secure the bracket to the back panel.
7. Restore power to the device.

Figure 14-3 Security switch on panel-mount Model 3300 or Model 3500



14.6.2 Rack-mount devices

To set the security switch on a Model 3300 or Model 3500 mounted in a rack:

1. Loosen the captive screws that secure the front panel of the Series 3000 device to the rack.
2. Slide the platform out of the rack.
3. Remove the protective mask (see Figure 14-4).
4. The security switch is located on the back panel of the platform. To secure the device, set the switch so the toggle is downward. See Figure 14-4.
5. Reinstall the protective mask.
6. Install a weights and measures seal (see Section 14.7) through the custody transfer tab shown in Figure 14-4. This installation must be performed by a weights and measures inspector.
7. Align the platform with the guide rails in the rack.
8. Slide the platform into the rack. Make sure the pins on the back panel make contact with the wiring connectors.
9. (Optional) Replace the top two or bottom two screws in the front panel of the platform with the supplied lockout screws. See Figure 14-5.
10. Make sure all four front-panel screws are tightly secured to the guide rails in the rack.
11. (Optional) Install a weights and measures seal through the holes in the front panel. See Figure 14-5.

Figure 14-4 Security switch on rack-mount Model 3300 or Model 3500

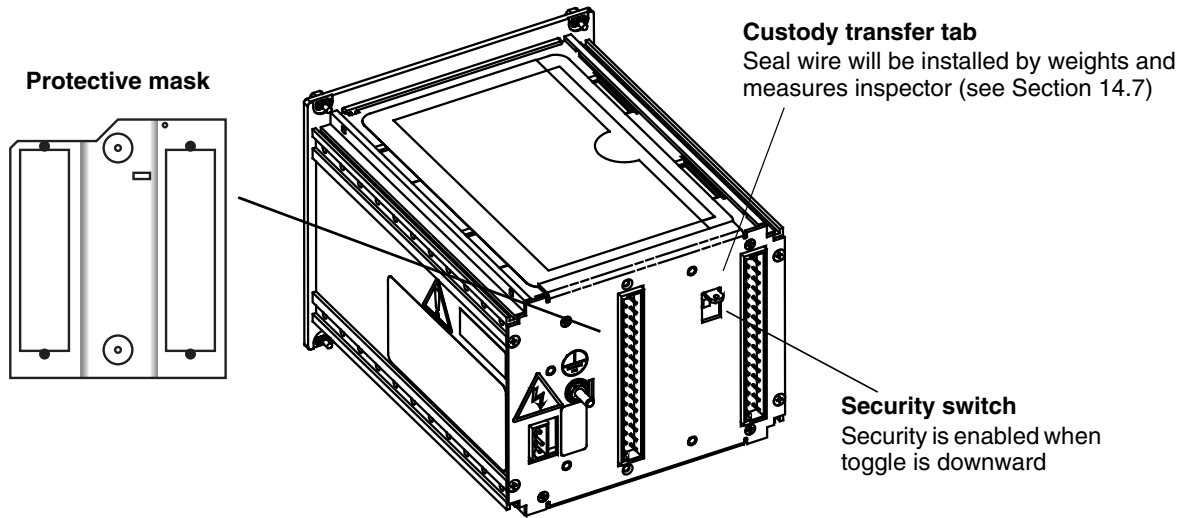
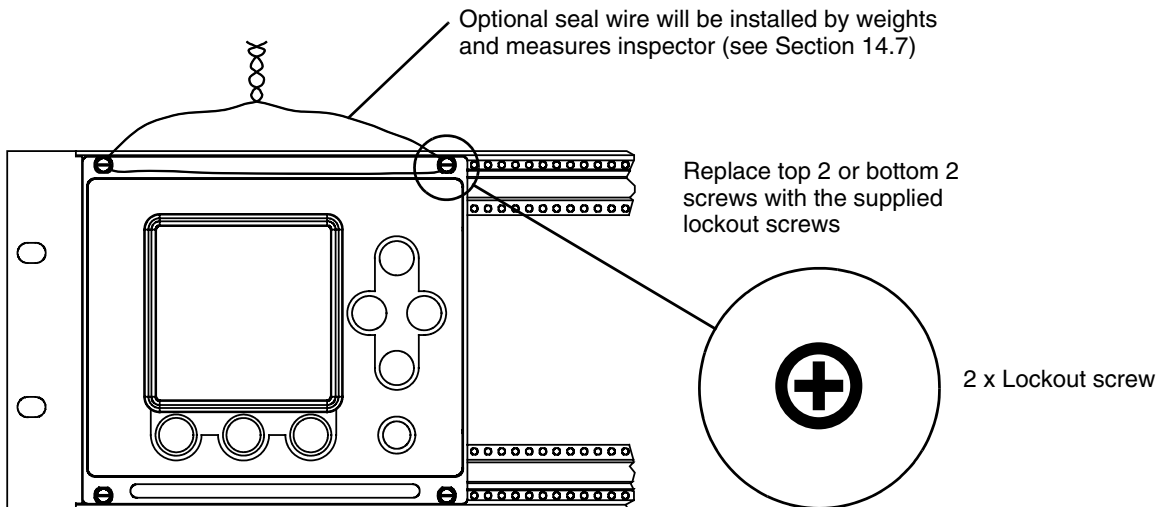


Figure 14-5 Installing lockout screws on rack-mount platform



14.6.3 Field-mount devices

⚠ WARNING

Explosion hazard.

In an explosive atmosphere, do not remove the circuit board compartment cover within 2 minutes after power has been disconnected.

Figure 14-6 identifies the circuit board compartment.

⚠ CAUTION

Improper handling of device components can damage the Series 3000 device.

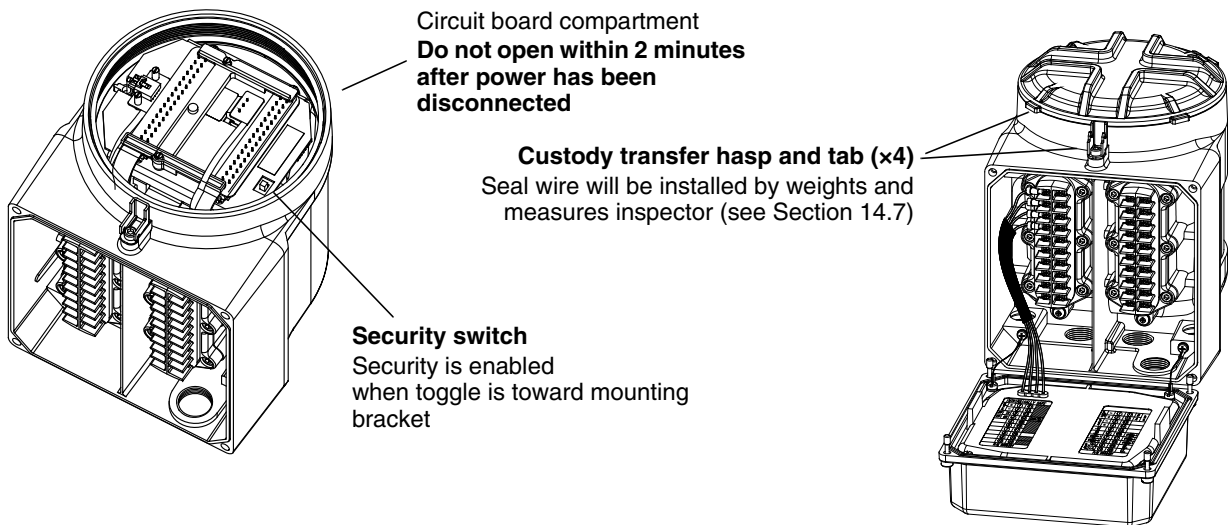
If a breaker bar or other tool is used for loosening the cover of the circuit board compartment:

- Apply steady pressure to avoid chipping the paint. Chipped paint can result in corrosion of the housing. If the paint is chipped, repaint the housing.
- Do not apply excessive torque. Excessive torque can damage the pipeline or the platform.

To set the security switch on the Model 3350 or Model 3700:

1. Unscrew the circuit board compartment cover.
2. The security switch is located on the panel inside the circuit board compartment. To secure the device, set the switch so the toggle is toward the mounting bracket for the Series 3000 device. See Figure 14-6.
3. Reinstall the cover. Tighten the cover to 12 ft-lb (16 N-m) torque.

Figure 14-6 Security switch on Model 3350 or Model 3700



14.7 Installing the weights and measures seal

The weights and measures seal must be installed and secured by a weights and measures inspector or authorized third party.

- On a panel-mount Model 3300 or Model 3500, the inspector runs the wire seal through the custody transfer tab, as shown in Figure 14-3.
- On a rack-mount Model 3300 or Model 3500, two locations are provided for the weights and measures seal:
 - Required: The inspector must run a wire seal through the custody transfer tab, as shown in Figure 14-4.
 - Optional: The inspector may run a wire seal through the holes in the lockout screws on the front panel of the platform, as shown in Figure 14-5.
- On a field-mount Model 3350 or Model 3700, a hasp on the housing is located beside the circuit board compartment cover. The cover has four tabs. The inspector runs the wire seal through the hole in the hasp and the hole in the nearest tab, as shown in Figure 14-6.

Chapter 15

Ticket Formatting and Printing

15.1 About this chapter

This chapter explains how to format and print tickets. To print tickets, digital communication to a printer must be configured. See Section 13.3.2.

Failure to perform configuration tasks in the proper sequence could result in an incomplete configuration. See Section 1.7 for the recommended configuration sequence.

CAUTION

Changing configuration can affect device operation.

Set control devices for manual operation before changing device configuration.

15.2 Ticket overview

There are five ticket types. Different ticket types are available, depending on the discrete batch application and the custody transfer application (see Table 15-1). Contents of each ticket type are listed in Table 15-2.

You can format each ticket type separately. For some ticket types, you can specify that certain types of content will be included or excluded, and you can configure the tickets to print automatically, e.g., at certain points in a discrete batch, or when an event occurs. You can also print tickets manually at certain times, using either the **PRINT** button on the display or a discrete input.

Format only the ticket types that you will use. Formatting of each ticket type is described in Sections 15.3 through 15.6.

Table 15-1 Ticket availability

Special applications	Tickets available				
	Standard	Batch ⁽¹⁾	Batch (NTEP) ⁽²⁾	Transfer (OIML)	Batch (OIML) ⁽³⁾
None	✓				
Discrete batch application	✓	✓			
Custody transfer application (NTEP) (Requires discrete batch application)	✓		✓ ⁽⁴⁾		
Custody transfer application (OIML) (Discrete batch application not installed, or installed but not approved)	✓	✓ ⁽⁵⁾⁽⁶⁾		✓ ⁽⁴⁾	
Custody transfer application (OIML/batch) (Requires discrete batch application installed and approved)	✓			✓ ⁽⁴⁾	✓ ⁽⁴⁾

- (1) Refers to batch tickets when (a) the custody transfer application is not installed, or (b) the custody transfer application is installed, World Area is set to OIML, and the discrete batch application is not approved for custody transfer.
- (2) Refers to batch tickets when the custody transfer application is installed and World Area is set to NTEP.
- (3) Refers to batch tickets when the custody transfer application is installed, World Area is set to OIML, and the discrete batch application is approved for custody transfer.
- (4) Legal receipt.
- (5) Not a legal receipt.
- (6) Available only if the discrete batch application is installed.

Table 15-2 Ticket contents

Ticket type	Header lines	Ticket contents (standard)	Ticket contents (conditional)
Standard	1 and 2 3 and 4 ⁽¹⁾	<ul style="list-style-type: none"> • Depends on ticket (e.g., process monitor data, alarm log, etc.) 	<ul style="list-style-type: none"> • “Approved Measurement” banner
Batch	1 and 2	<ul style="list-style-type: none"> • Batch date and time • Batch data • Print timestamp 	<ul style="list-style-type: none"> • “Not A Legal Receipt” banner⁽²⁾
Batch (NTEP)	1 and 2 3 and 4	<ul style="list-style-type: none"> • Batch date and time • Batch data • Batch BOL number 	<ul style="list-style-type: none"> • “Duplicate Receipt” banner • “Security Breach” banner • “Not A Legal Receipt” banner
Transfer (OIML)	1 and 2 3 and 4	<ul style="list-style-type: none"> • Transfer date and time • Transfer data • Transfer BOL number 	<ul style="list-style-type: none"> • “Not Complete” banner with current flow rate data • “Complete” banner • “Alarm occurred during the Transfer” banner⁽³⁾
Batch (OIML)	1 and 2 3 and 4	<ul style="list-style-type: none"> • Batch date and time • Batch data • Batch BOL number 	<ul style="list-style-type: none"> • “Duplicate Receipt” banner • “Security Breach” banner • “Not A Legal Receipt” banner

- (1) Audit event log tickets only. Lines 3 and 4 are formatted and printed as configured for transfer tickets.
- (2) Appears only when the custody transfer application is installed, World Area is set to OIML, and the discrete batch application is not approved for custody transfer.
- (3) Alarm may or may not have been a security breach.

15.3 Standard tickets

This section describes the formatting and printing of standard tickets.

15.3.1 Formatting

To format standard tickets:

1. In the Digital Communication menu, select **Configure RS-485** and set **Protocol** to **Printer**. The menu shown in Figure 15-1 is displayed.
2. Select **Configure printer**.
3. Set parameters as desired. See Table 15-3.

Note: Other parameters in this menu are defined in Table 13-3.

Note: The Header Line 1, Header Line 2, and Footer parameters are shared with all ticket types. Any formatting defined for standard tickets is applied to all tickets.

Note: Because the audit trail is a custody transfer feature and requires the custody transfer application, audit event log tickets include the Header Line 3 and Header Line 4 parameters configured for transfer tickets (see Section 15.6.1 or Section 15.5.1). In all other respects, audit event log tickets are standard tickets.

Figure 15-1 Ticket configuration menu – Standard tickets

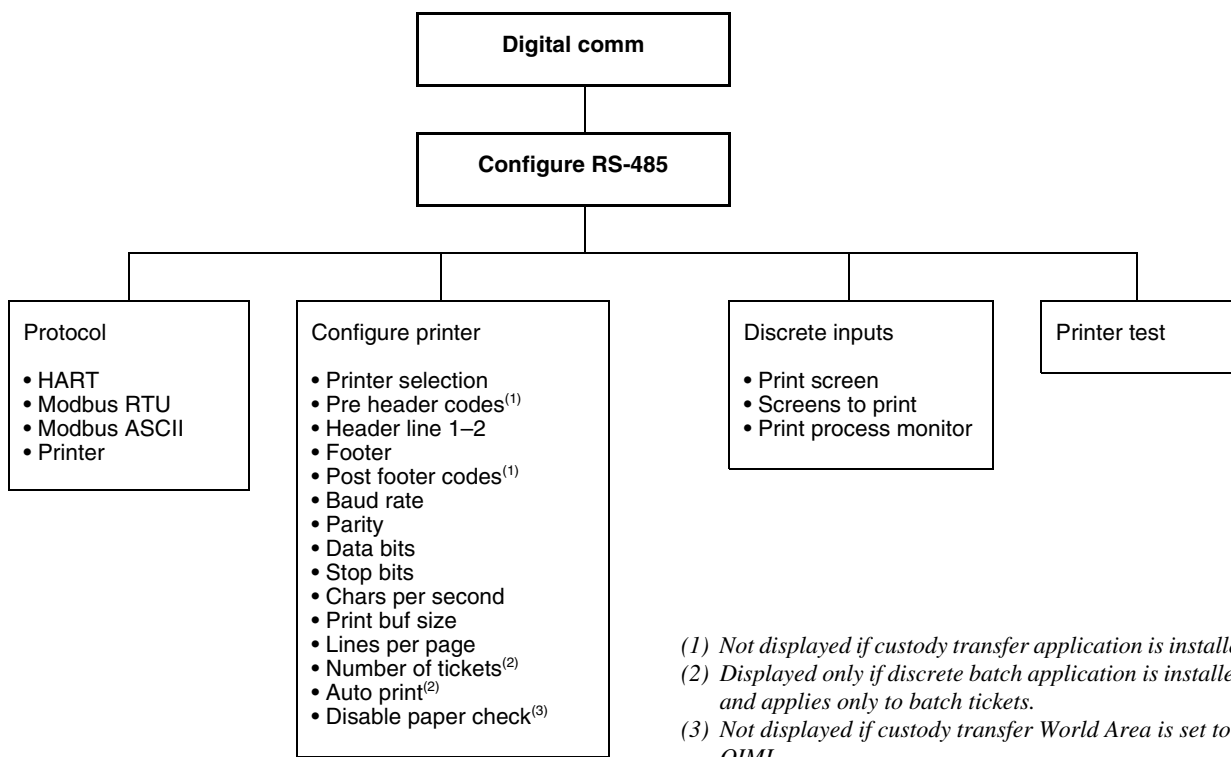


Table 15-3 Ticket parameters for standard tickets

Variable		Default	Description
Pre header codes		None	Printer control codes. Enter any control codes required by your printer, e.g., form feed. ⁽¹⁾
Header line 1	Text	Blank (no text)	Enter the text for this line of the header or for the footer. You may enter up to 22 characters. Scroll as required to view all characters.
Header line 2			
Footer			
	Line feeds	1 line	Enter 1, 2, or 3. This parameter controls the space between the current line and the following line.
	Font size	Normal height	Select normal height or double height. ⁽²⁾

(1) ASCII non-printable control codes are represented by a two-character sequence in hexadecimal format; e.g., the linefeed character is "0A" (zero, A). Leading or trailing spaces are ignored, but spaces must not be inserted between hex codes.

(2) Not all printers are capable of double height. If double height is configured but the printer cannot print double height, normal height will be used.

15.3.2 Printing

You can print standard tickets manually, via the display, or via a discrete input. You can also specify that tickets will be printed automatically if a discrete event occurs. You may use as many of these methods as desired.

Display

To print standard tickets from the display, use the **PRINT** button. The **PRINT** button appears whenever the print function is available. For example, you can print:

- The current process monitor screen
- All configured process monitor screens
- All configuration data
- The active alarm log, alarm history, or alarm event log

If the Series 3000 device is connected to a standard core processor, you can specify whether or not process monitor tickets will include the average, maximum, and minimum values for process variables, when appropriate. To do this, use the Print Process Monitor option described in the following section.

Discrete input or discrete event

You can configure the Series 3000 device so that a standard ticket is printed whenever a discrete input is activated or a discrete event occurs. This ticket can include one or several screens; all assigned screens will be printed. To do this:

1. From the Digital Communication menu (see Figure 15-1), select **Configure RS-485**, then select **Discrete Inputs**.
2. Using the **Print screen** option, select the discrete input or discrete event to which you will assign screens.
3. Using the **Screens to print** option, specify the screens that will be printed when the specified discrete input is activated or the discrete event occurs. You may specify as many screens as desired.
4. (Standard core processor only) If you specified a process monitor screen, use the **Print Process Monitor** option to control whether or not the ticket will include the average, maximum, and minimum values for process variables, when appropriate (**With Stats** or **Without Stats**).

Ticket Formatting and Printing

Note: You can assign one or more actions to a single discrete input or discrete event. Other discrete input and discrete event actions and assignments are listed and defined in Table 7-14. Note that if you assign ticket printing to a discrete input or a discrete event, all standard, batch, batch (NTEP), and batch (OIML) tickets will be printed, but if a transfer (OIML) ticket is assigned with other ticket types, only the transfer (OIML) ticket will be printed. If required, assign the transfer (OIML) ticket to one discrete input and assign all other tickets to the second discrete input.

15.4 Batch tickets

This section describes the formatting and printing of batch tickets.

15.4.1 Formatting

To format batch tickets:

1. In the Digital Communication menu, select **Configure RS-485** and set **Protocol** to **Printer**. The menu shown in Figure 15-2 is displayed.
2. Select **Configure Printer**.
3. Set parameters as desired. See Table 15-4.

Note: Other parameters in this menu are defined in Table 13-3.

Note: The Header Line 1, Header Line 2, and Footer parameters are shared with all ticket types. Any formatting defined for batch tickets is applied to all tickets.

Figure 15-2 Ticket configuration menu – Batch tickets

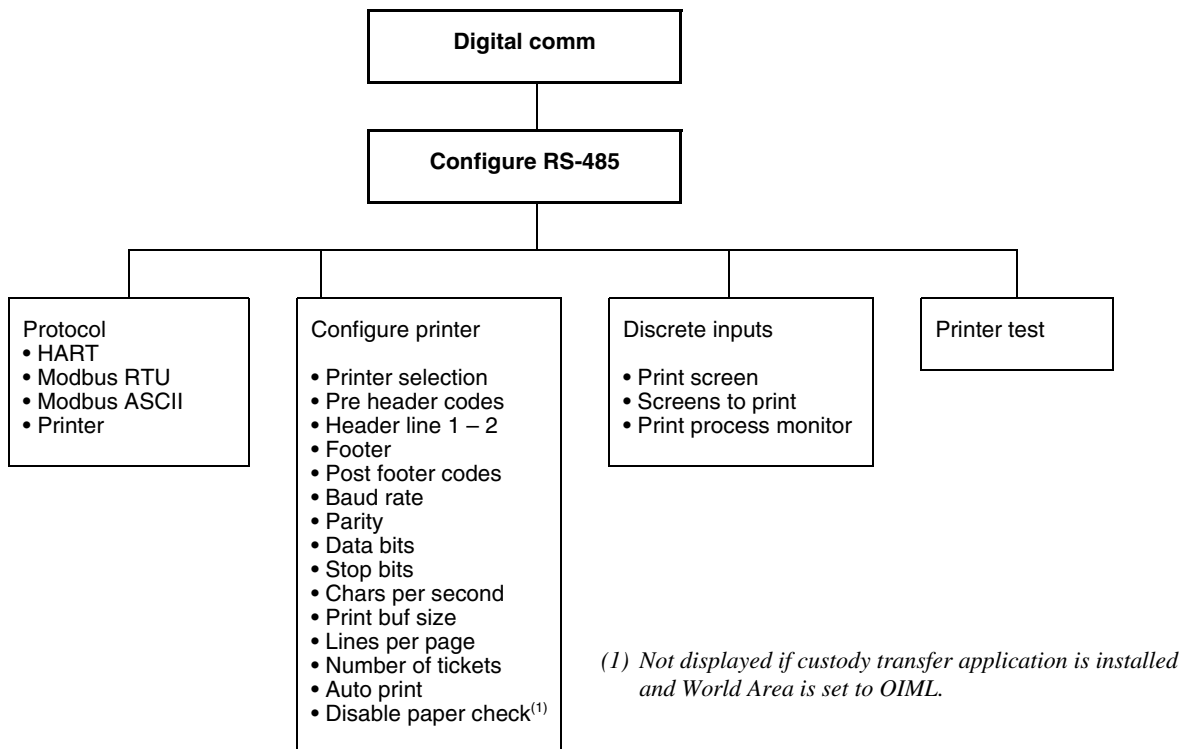


Table 15-4 Ticket parameters for batch tickets

Variable		Default	Description
Pre header codes		None	Printer control codes. Enter any control codes required by your printer, e.g., form feed.
Post footer codes			
Header line 1	Text	Blank (no text)	Enter the text for this line of the header or for the footer. You may enter up to 22 characters. Scroll as required to view all characters.
Header line 2			
Footer			
	Line feeds	1 line	Enter 1, 2, or 3. This parameter controls the space between the current line and the following line.
	Font size	Normal height	Select normal height or double height. ⁽¹⁾
Number of tickets		1	The number of batch tickets to be printed by the Auto Print function (if Auto Print is enabled) or by a manual print request.
Auto print		No	<ul style="list-style-type: none"> • Select Yes if you want batch tickets to be printed automatically at the end of each batch. Tickets will be printed only if the target has been reached and flow is stopped. • Select No if you do not want tickets to be printed automatically at the end of each batch.

(1) Not all printers are capable of double height. If double height is configured but the printer cannot print double height, normal height will be used.

15.4.2 Printing

Batch tickets can be printed in several ways:

- Automatically, when the batch ends or when a discrete event occurs
- Manually, using the display or a discrete input

Note: Information in this section applies only to batch tickets that are not used as custody transfer tickets. For information on printing batch tickets used as custody transfer tickets, see Section 15.5.2 for batch (NTEP) tickets, or Section 15.6.2 for batch (OIML) tickets.

Auto print

To print batch tickets automatically when the batch target is reached, configure the Auto Print and Number of Tickets parameters as required (see Table 15-4).

Display

To print batch tickets from the display, use the **PRINT** button. The **PRINT** button appears only when the batch is ended; it does not appear when the batch is stopped.

Discrete input or discrete event

You can configure the Series 3000 device so that a batch ticket is printed whenever a discrete input is activated or a discrete event occurs. This ticket can include one or several screens in addition to the batch screen; all assigned screens will be printed. To do this:

1. From the Digital Communication menu (see Figure 15-1), select **Configure RS-485**, then select **Discrete Inputs**.
2. Using the **Print Screen** option, select the discrete input or discrete event to which you will assign screens.
3. Using the **Screens to Print** option, specify the screens that will be printed when the specified discrete input is activated or the discrete event occurs. You may specify as many screens as desired.

If the print request occurs:

- When flow is not present (the batch is stopped or ended), the batch ticket is printed.
- When flow is present, the request is queued until flow stops, and the batch ticket is printed at that time.

Note: You can assign one or more actions to a single discrete input or discrete event. Other discrete input and discrete event actions and assignments are listed and defined in Table 7-14. Note that if you assign ticket printing to a discrete input or a discrete event, all standard, batch, batch (NTEP), and batch (OIML) tickets will be printed, but if a transfer (OIML) ticket is assigned with other ticket types, only the transfer (OIML) ticket will be printed. If required, assign the transfer (OIML) ticket to one discrete input and assign all other tickets to the second discrete input.

Multiple tickets

If multiple tickets are printed:

- With one print request, all tickets are identical.
- With multiple print requests, each ticket contains the timestamp and batch data that was current when the ticket was printed.

15.5 Batch (NTEP) tickets

This section describes the formatting and printing of transfer tickets when the custody transfer application is configured for World Area = NTEP.

15.5.1 Formatting

The batch (NTEP) ticket is basically a batch ticket, with a few additional options. To format batch (NTEP) tickets:

1. Format a batch ticket as described in Section 15.4.1.
2. In the Digital Communication menu, select **Configure RS-485**, then select **Format W&M Ticket**. The menu shown in Figure 15-3 is displayed.
3. Set parameters as desired. See Table 15-5.

Note: Other parameters in this menu are defined in Table 13-3.

Note: The Pre Header, Post Footer, Header Line 1, Header Line 2, and Footer parameters are shared with all ticket types. Any formatting defined for batch (NTEP) tickets is applied to all tickets.

Figure 15-3 Ticket configuration menu – Batch (NTEP) tickets

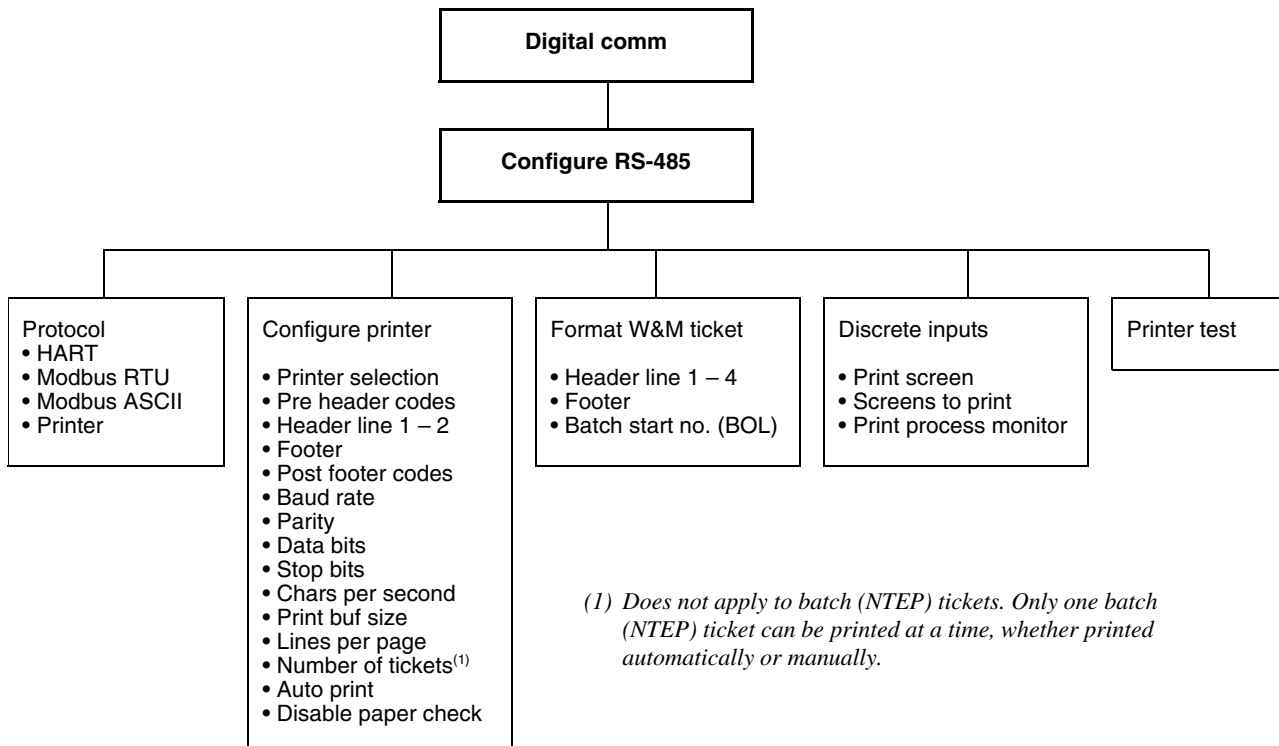


Table 15-5 Ticket parameters – Batch (NTEP) tickets

Variable		Default	Description
Header line 1	Text	Blank (no text)	Enter the text for this line of the header or for the footer.
Header line 2			You may enter up to 22 characters. A maximum of 21 characters are displayed. Scroll as required to view all characters.
Header line 3			
Header line 4	Line feeds	1 line	Enter 1, 2, or 3. This parameter controls the space between the current line and the following line.
Footer	Font size	Normal height	Select normal height or double height. ⁽¹⁾
Batch start no. (BOL)		0	Starting ticket number for batch bills of lading (BOL).

(1) Not all printers are capable of double height. If double height is configured but the printer cannot print double height, normal height will be used.

15.5.2 Printing

Batch (NTEP) tickets can be printed in several ways:

- Automatically, when the batch ends or when a discrete event occurs
- Manually, using the display or a discrete input

Only one batch (NTEP) ticket can be printed at a time; the Number of Tickets parameter is not applied.

The custody transfer transaction ends when the first batch (NTEP) ticket is printed for the current batch. This is true even when the batch is ended, the target is increased, and the batch is then resumed. In this case, all tickets will contain identical custody transfer data, even though the batch data may have changed.

Auto print

To print a batch (NTEP) ticket automatically when the batch target is reached, set the Auto Print parameter for batch tickets to Yes (see Table 15-4).

Display

To print a batch (NTEP) ticket from the display, use the **PRINT** button on the batch process screen. The **PRINT** button appears only when the batch is ended; it does not appear when the batch is stopped.

Discrete input or discrete event

You can configure the Series 3000 device to print a batch (NTEP) ticket when a discrete input is activated or a discrete event occurs. This ticket can include one or several screens in addition to the batch (NTEP) ticket; all assigned screens will be printed. To do this:

1. From the Digital Communication menu (see Figure 15-1), select **Configure RS-485**, then select **Discrete Inputs**.
2. Using the **Print Screen** option, select the discrete input or discrete event to which you will assign screens.
3. Using the **Screens to Print** option, specify the screens that will be printed when the specified discrete input is activated or the discrete event occurs. You may specify as many screens as desired.

If the print request occurs:

- When flow is not present (the batch is stopped or ended), the batch (NTEP) ticket is printed.
- When flow is present, the request is queued until flow stops, and the batch (NTEP) ticket is printed at that time.

Note: You can assign one or more actions to a single discrete input or discrete event. Other discrete input and discrete event actions and assignments are listed and defined in Table 7-14.

Additional tickets

Before the batch reset is performed, additional batch (NTEP) tickets for the current transaction can be printed manually, by using the **PRINT** button or by activating a discrete input that has been configured to print a batch (NTEP) ticket. The batch (NTEP) tickets will contain identical custody transfer data, and all tickets except the first, will include the “Duplicate receipt” banner.

15.6 Transfer (OIML) tickets

This section describes the formatting and printing of transfer tickets when the custody transfer application is configured for World Area = OIML and the discrete batch application is not used to manage the custody transfer transaction.

15.6.1 Formatting

To format transfer (OIML) tickets:

1. In the Digital Communication menu, select **Configure RS-485** and set **Protocol** to **Printer**. The menu shown in Figure 15-4 is displayed.
2. Select **Format W&M Ticket**.
3. Set parameters as desired. See Table 15-6.

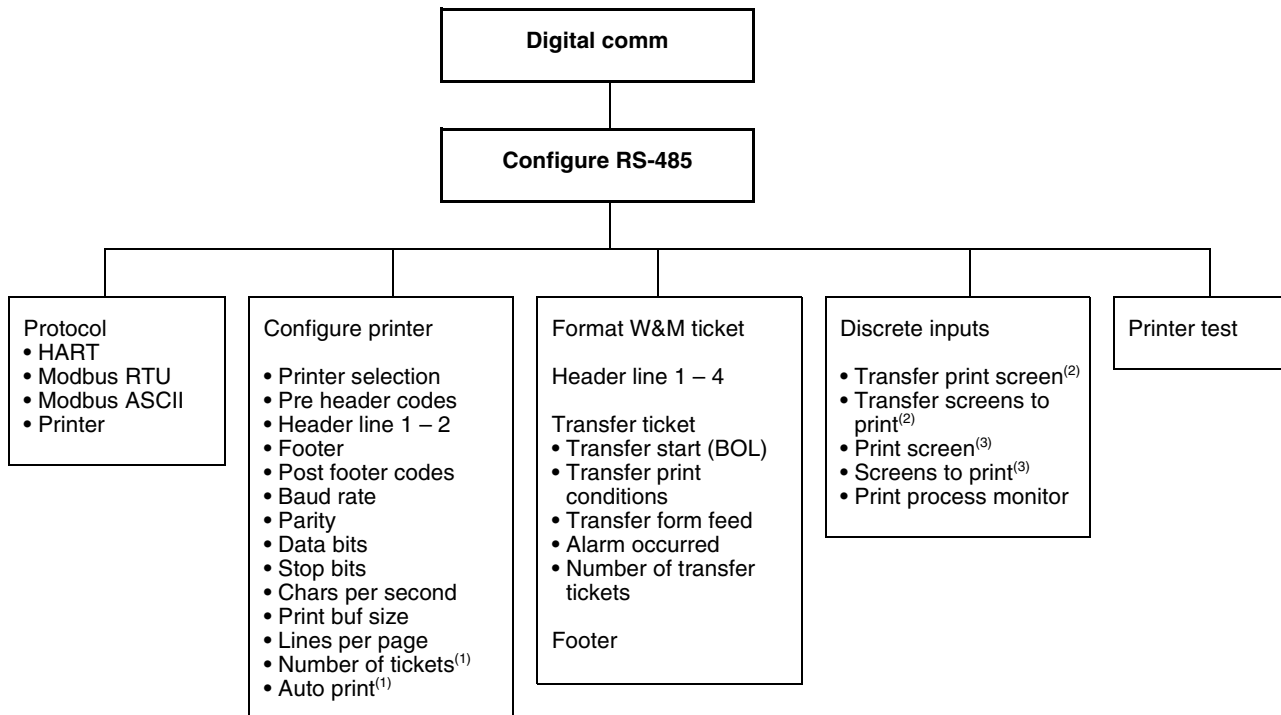
Ticket Formatting and Printing

Note: The Pre Header, Post Footer, Header Line 1, Header Line 2, and Footer parameters are shared with all ticket types. Any formatting defined for transfer (OIML) tickets is applied to all tickets.

Note: Other parameters in this menu are defined in Table 13-3.

Note: In previous versions of the custody transfer application, a Transfer Total Format parameter was displayed. This has been replaced by the W&M Approval option (see Section 14.5, Step 4).

Figure 15-4 Ticket configuration menu – Transfer (OIML) tickets



(1) Not applicable to transfer (OIML) tickets.

(2) Used to print transfer (OIML) tickets.

(3) Used to print other ticket types.

Table 15-6 Ticket parameters – Transfer (OIML) tickets

Variable	Default	Description	
Pre header codes	None	Printer control codes. Enter any control codes required by your printer, e.g., form feed.	
Post footer codes			
Header line 1	Blank (no text)	Enter the text for this line of the header or for the footer. You may enter up to 22 characters. Scroll as required to view all characters.	
Header line 2			
Header line 3			
Header line 4			
Footer	Line feeds	1 line	Enter 1, 2, or 3. This parameter controls the space between the current line and the following line.
	Font size	Normal height	Select normal height or double height. ⁽¹⁾

Table 15-6 Ticket parameters – Transfer (OIML) tickets *continued*

Variable	Default	Description
Transfer ticket	Transfer start (BOL) 0	Starting ticket number for transfer bills of lading (BOL). Changing the start number resets the transfer log. If the start number is changed after transfers have been completed, all data in the transfer log is lost.
	Transfer print conditions With flow	<ul style="list-style-type: none"> • No Flow – Tickets cannot be printed if there is any flow through the sensor. If a ticket is printed under conditions of no flow, and the ticket includes a transfer total, the transfer is completed, and the flow rate and the banner “Complete” are printed on the ticket. • With Flow – Tickets may be printed while flow is occurring. <ul style="list-style-type: none"> - If a ticket is printed while flow is occurring, the flow rate and the banner “Not complete” are printed on the ticket, and the transfer continues. - If a ticket is printed under conditions of no flow and the ticket includes a transfer total, the transfer is completed, and the flow rate and the banner “Complete” are printed on the ticket. - If a ticket is printed under conditions of no flow and the ticket does not include a transfer total, the flow rate is printed on the ticket and the transfer is not completed.
	Transfer form feed No	<ul style="list-style-type: none"> • No – A form feed will not be issued automatically after a ticket has been printed. • Yes – A form feed will be issued automatically after a ticket has been printed.
	Alarm occurred No	<ul style="list-style-type: none"> • No – Tickets will not include the banner “Alarm occurred during the transfer” if an alarm occurs during transfer processing. • Yes – Tickets will include the banner “Alarm occurred during the transfer” if an alarm occurs during transfer processing.
	Number of transfer tickets 1	The number of transfer (OIML) tickets to be printed when a print request is received. The range is 1 to 3. ⁽²⁾

(1) Not all printers are capable of double height. If double height is configured but the printer cannot print double height, normal height will be used.

(2) Each print request (depending on flow and ticket contents) completes a transaction. If duplicate tickets are required for each transaction, you must specify the required number here; there is no other way to print duplicate tickets. All tickets for the same transfer are identical; they do not contain the “Duplicate receipt” banner.

15.6.2 Printing

Transfer (OIML) tickets must be printed manually, using either the **PRINT** button on the display or a discrete input configured to print a transfer (OIML) ticket.

The results of the print request depend on the flow at the time of the print request and the Transfer Print Conditions parameter, and the contents of the ticket, as shown in Table 15-7.

Table 15-7 Results of print request for transfer (OIML) tickets

Flow at time of print request?	Ticket contains transfer total?	Transfer Print Conditions	Result
Flow present	N/A	With Flow	<ul style="list-style-type: none"> • “Not Complete” banner and flow rate printed on ticket • Current transfer totals are printed on ticket, but not marked with asterisks even if the process variables are approved • Transfer continues
	N/A	No Flow	<ul style="list-style-type: none"> • Ticket not printed • Transfer continues
No flow	Yes	N/A	<ul style="list-style-type: none"> • “Complete” banner printed on ticket • Transfer total printed on ticket • Approved process variables marked with asterisks • Custody transfer transaction completed automatically • Transfer data written to transfer log • Transfer BOL number incremented • Next custody transfer transaction started
	No	N/A	<ul style="list-style-type: none"> • “Not Complete” banner and flow rate printed on ticket • Transfer continues

Display

Note: This function is not available if flow is present and Transfer Print Conditions is set to No Flow.

To print a transfer (OIML) ticket from the display:

1. From the View menu, select **Transfer Totalizer**.
2. Select the type of ticket you want to print.
3. Press the **PRINT** button.

Discrete input

You can configure a discrete input to print a transfer (OIML) ticket.

Note: You can assign one or more actions to a single discrete input. Other discrete input actions and assignments are listed and defined in Table 7-14. Note that if you assign ticket printing to a discrete input, all standard, batch, and batch (OIML) tickets can be printed from one discrete input, but if a transfer (OIML) ticket is assigned with other ticket types, only the transfer (OIML) ticket will be printed. If required, assign the transfer (OIML) ticket to one discrete input and assign all other tickets to the second discrete input.

To do this:

1. From the Digital Communication menu (see Figure 15-4), select **Configure RS-485**, then select **Discrete Inputs**.
2. Use the **Transfer Print Screen** option to select the discrete input to which you will assign the transfer (OIML) ticket.
3. Use the **Transfer Screen to Print** option to specify the set of data that will be printed when the specified discrete input is activated.
 - If **Transfer Totals, Transfer & Inventory, API Transfer & Inventory** or **ED Transfer & Inventory** is selected, printing this ticket under conditions of no flow will cause the transfer to be completed and transfer data to be recorded in the transfer log.
 - If **Inventory** is selected, printing this ticket will not cause the transfer to be completed and no data will be recorded in the transfer log.

Note: The Transfer Print Screen and Transfer Screens to Print options are similar to the Transfer Reset Screen and Transfer Scr To Reset menu options described in Section 14.5, Step 6, except that this menu includes the Inventory option, and if the discrete input is configured here, a ticket will be printed when the discrete input is activated. The discrete input and transfer screens specified here are reflected in the corresponding reset menu options, and vice versa.

Multiple tickets

If multiple tickets are required, set Number of Transfer Tickets to the required number. Because a transfer (OIML) print request may complete the current transfer and begin a new one, you cannot use multiple print requests to print duplicate tickets. All tickets for the same OIML transfer are identical; they do not contain the “Duplicate receipt” banner.

15.7 Batch (OIML) tickets

This section describes the formatting and printing of transfer tickets when the custody transfer application is configured for World Area = OIML and the discrete batch application is used to manage the custody transfer transaction.

15.7.1 Formatting

To format batch (OIML) tickets:

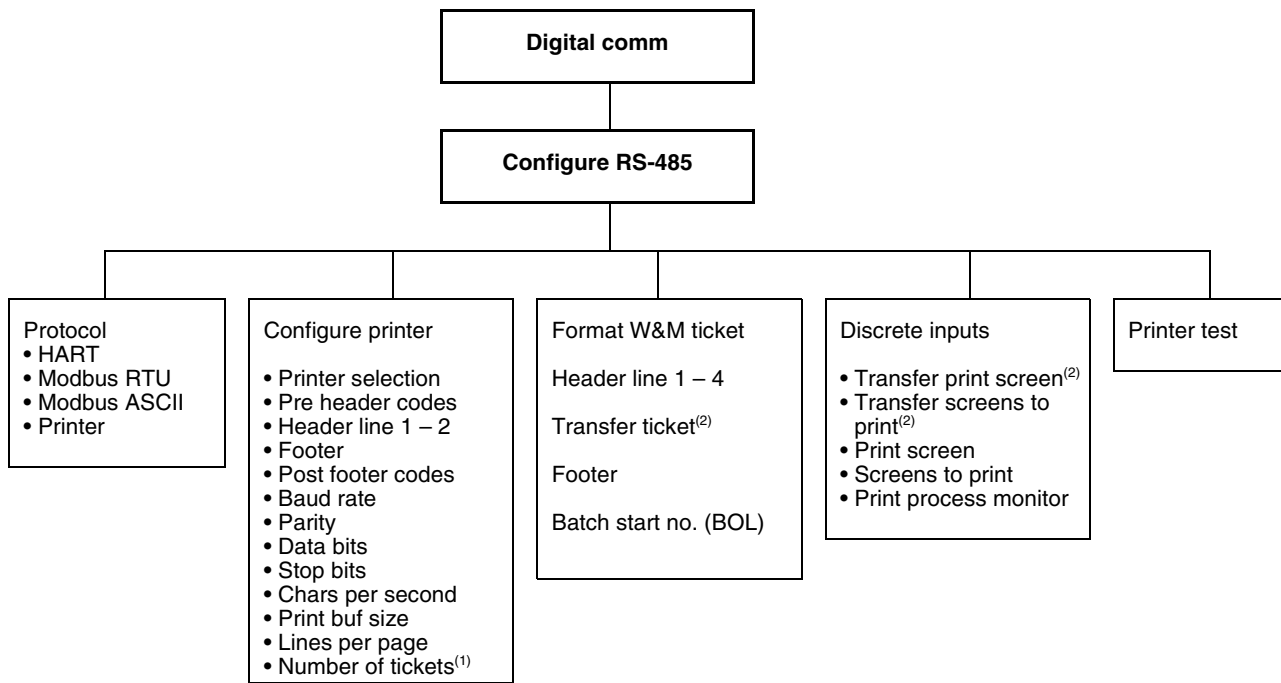
1. In the Digital Communication menu, select **Configure RS-485** and set **Protocol** to **Printer**. The menu shown in Figure 15-4 is displayed.
2. Select **Format W&M Ticket**.
3. Set parameters as desired. See Table 15-6.

Note: The Pre Header, Post Footer, Header Line 1, Header Line 2, and Footer parameters are shared with all ticket types. Any formatting defined for transfer (OIML) or batch (OIML) tickets is applied to all tickets.

Note: Other parameters in this menu are defined in Table 13-3.

Note: In previous versions of the custody transfer application, a Transfer Total Format parameter was displayed. This has been replaced by the W&M Approval option in the Configuration > Monitoring menu (see Section 14.5, Step 4).

Figure 15-5 Ticket configuration menu – Batch (OIML) tickets



(1) Applies only to batch tickets. Not applicable to batch (OIML) tickets.
 (2) Not applicable to batch (OIML) tickets.

Table 15-8 Ticket parameters – Batch (OIML) tickets

Variable	Default	Description
Pre header codes Post footer codes	None	Printer control codes. Enter any control codes required by your printer, e.g., form feed.
Header line 1 Text Header line 2 Header line 3 Header line 4 Footer	Blank (no text)	Enter the text for this line of the header or for the footer. You may enter up to 22 characters. Scroll as required to view all characters.
Line feeds	1 line	Enter 1, 2, or 3. This parameter controls the space between the current line and the following line.
Font size	Normal height	Select normal height or double height. ⁽¹⁾
Transfer ticket		Not applicable to batch (OIML) tickets.
Batch start number (BOL)		Starting ticket number for batch bills of lading (BOL).

(1) Not all printers are capable of double height. If double height is configured but the printer cannot print double height, normal height will be used.

15.7.2 Printing

Batch (OIML) tickets can be printed in several ways:

- Automatically, when the batch ends
- Manually, using the display or a discrete input

Only one batch (OIML) ticket can be printed at a time; the Number of Tickets parameter is not applied.

The custody transfer transaction ends when the first batch (OIML) ticket is printed for the current batch. This is true even when the batch is ended, the target is increased, and the batch is then resumed. In this case, all tickets will contain identical custody transfer data, even though the batch data may have changed.

Auto print

To print a batch (OIML) ticket automatically when the batch target is reached, set the Auto Print parameter for batch tickets to Yes (see Table 15-8).

Display

To print a batch (OIML) ticket from the display, use the **PRINT** button on the batch process screen. The **PRINT** button appears only when the batch is ended; it does not appear when the batch is stopped.

Discrete input or discrete event

You can configure the Series 3000 device to print a batch (OIML) ticket when a discrete input is activated or a discrete event occurs. This ticket can include one or several screens in addition to the batch (OIML) ticket; all assigned screens will be printed.

Note: You can assign one or more actions to a single discrete input or discrete event. Other discrete input and discrete event actions and assignments are listed and defined in Table 7-14. Note that if you assign ticket printing to a discrete input or a discrete event, all standard and batch (OIML) tickets can be printed from one discrete input or discrete event, but if a transfer (OIML) ticket is assigned with other ticket types, only the transfer (OIML) ticket will be printed. If required, assign the transfer (OIML) ticket to one discrete input and assign all other tickets to the second discrete input.

To do this:

1. From the Digital Communication menu (see Figure 15-4), select **Configure RS-485**, then select **Discrete Inputs**.
2. Use the **Print Screen** option to select the discrete input to which you will assign the batch (OIML) ticket.
3. Use the **Screens to Print** option to specify that a batch ticket will be printed. Printing this ticket will always complete the transfer.

Multiple tickets

If multiple tickets are required, use the **PRINT** button or the discrete input to print additional tickets before the batch is reset. One ticket will be printed for each print request. The additional tickets will contain the “Duplicate receipt” banner.

Chapter 16

Startup Procedures

16.1 About this chapter

This chapter explains the procedures that are required for initial startup of the Series 3000 device. After initial startup, these procedures may be performed as required for troubleshooting or maintenance.

The following procedures are discussed:

- Applying power to the flowmeter
- Sensor zero
- Testing the inputs and outputs
- Milliamp output trim

Note: If you are using a Model 3300 or Model 3350 controller, the sensor zero procedure is not applicable to your device. Perform the other procedures as applicable.

16.2 Applying power

Before you apply power to the Series 3000 device, close and tighten all housing covers.

WARNING

Operating the Series 3000 device without covers in place creates electrical hazards that can cause death, injury, or property damage.

Make sure safety barrier partition and covers for the field-wiring, circuit board compartments, electronics module, and housing are all in place before applying power to the Series 3000 device.

Turn on the electrical power at the power supply. The flowmeter automatically tests its display. During display testing, the screen darkens for approximately five seconds. After the display test is completed:

1. The Micro Motion logo is displayed for two to three seconds.
2. An application list is displayed for two to three seconds.
3. The device enters operation mode:
 - If the discrete batch application is not installed, the process monitor screen is displayed, as shown in Figure 17-1.
 - If the discrete batch application is installed, the batch process screen is displayed (see Figure 18-1).

4. If there are any active alarms, the alarm category will be displayed in the alarm bar. To view, acknowledge, or respond to the alarms, see Chapter 22.

Note: Series 3000 transmitters are ready to begin measurement approximately one minute after power-up (time varies with models). However, approximately ten minutes are required for the electronics to warm up to equilibrium. During this ten-minute period, the transmitter may exhibit minor instability or inaccuracy.

16.2.1 Communication methods after power-up

After power-up:

- Communication via the display is available as soon as the display is visible.
- If you are using the Communicator, or ProLink II with HART/Bell 202, you can establish communication with the Series 3000 device immediately after power-up, using the primary mA output terminals. See Appendix G for more information on using ProLink II and Appendix H for more information on using the Communicator.
- If you are using ProLink II via the RS-485 physical layer, the RS-485 terminals are available to establish a connection in service port mode for 10 seconds immediately after power-up. If no service port connection is made during this period, the terminals are automatically reset to the configured RS-485/Modbus communication parameters. Be sure to set the ProLink II connection parameters appropriately.

16.3 Sensor zero

Note: This section is not applicable to Model 3300 or Model 3350 controllers.

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

When you zero the flowmeter, you may need to adjust the zero time parameter. *Zero time* is the amount of time the transmitter takes to determine its zero-flow reference point. The default zero time is 20 seconds.

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

For most applications, the default zero time is appropriate.

Note: Do not zero the flowmeter if a fault alarm is active. Correct the problem, then zero the flowmeter. You may zero the flowmeter if a low-severity alarm is active. See Section 22.6 for information on viewing transmitter status and alarms.

16.3.1 Zero failure and restoring zero values

If the zero procedure fails, see Section 16.3.4 for troubleshooting information.

Additionally, if you have the enhanced core processor:

- You can restore the factory zero. This procedure returns the zero value to the value obtained at the factory, if the factory configuration has been saved on the transmitter.
- If 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.

16.3.2 Preparing for sensor zero calibration

To prepare the flowmeter for sensor zero:

1. Install the sensor according to the appropriate sensor instruction manual.
2. Apply power to the Series 3000 system, then allow it to warm up for at least 30 minutes.
3. Run the process fluid to be measured through the sensor until the sensor temperature approximates the normal process operating temperature.
4. Close the shutoff valve downstream from the sensor.
5. Fill the sensor completely with process fluid under normal process conditions of temperature, density, pressure, etc., and ensure zero flow through the sensor.
6. Make sure flow through the sensor is 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.

16.3.3 Performing the sensor zero calibration

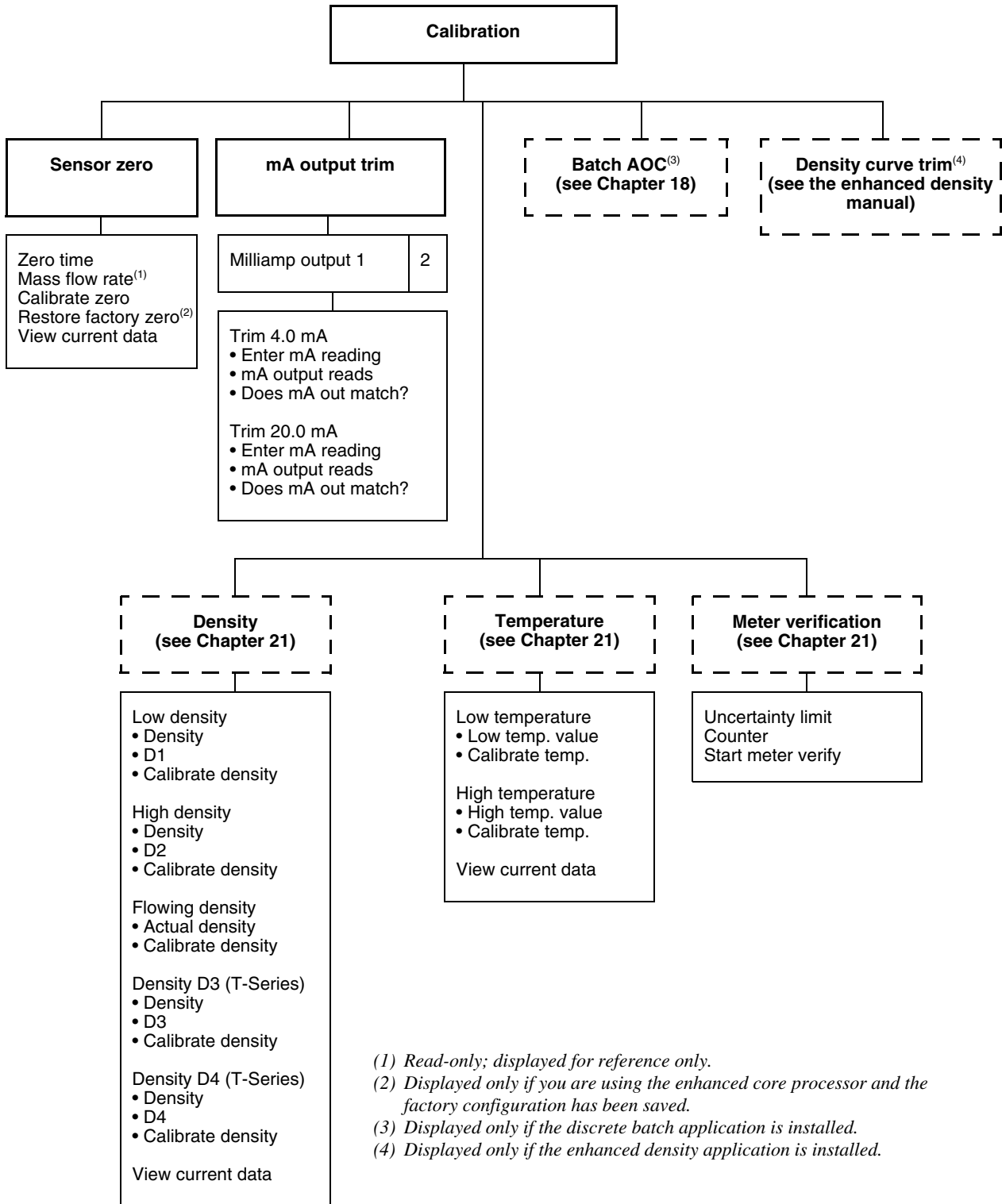
To perform the sensor zero:

1. From the Calibration menu (see Figure 16-1), select **Sensor Zero**. The Calibration menu is accessed through the Maintenance option of the Management menu.
2. Check the setting for **Zero Time**, and change it if desired.
3. Note the value displayed for **Mass Flow Rate**. If it is non-zero, recheck sensor preparation (see Section 16.3.2).
4. Select **Calibrate Zero**, then press **SEL**. During sensor zero:
 - A **Calibration In Progress** alarm is generated.
 - The time remaining counts down to zero seconds.
 - The **Calibrate Zero** screen displays an “In Progress” status, and the zero offset in microseconds.

Startup Procedures

5. When the calibration is complete:
 - In the active alarm log, the alarm changes from “active” to “inactive but unacknowledged.”
 - If the calibration succeeded, a “Success” status is displayed.
 - If the calibration failed, a “Failed” status is displayed.
6. Press **EXIT** to return to the Sensor Zero screen.
7. (Optional) To clear the alarm from the active alarm log and the alarm bar at the top of the display, acknowledge the alarm using the procedures described in Chapter 22.

Figure 16-1 Calibration menu



(1) Read-only; displayed for reference only.
 (2) Displayed only if you are using the enhanced core processor and the factory configuration has been saved.
 (3) Displayed only if the discrete batch application is installed.
 (4) Displayed only if the enhanced density application is installed.

16.3.4 Diagnosing sensor zero failure

If the Calibrate Zero screen reads “Calibration Failure,” the sensor zero calibration was not successfully completed. “Calibration Failure” could indicate:

- Flow of fluid during the sensor zero calibration
- Partially empty flow tubes
- An improperly mounted sensor

To clear a sensor zero failure:

- Press **EXIT** to exit the Calibrate Zero screen, then re-zero after correcting the problem, or
- Abort the sensor zero procedure by cycling power to the platform
- If appropriate, restore the factory zero or prior zero (see Section 16.3.1)

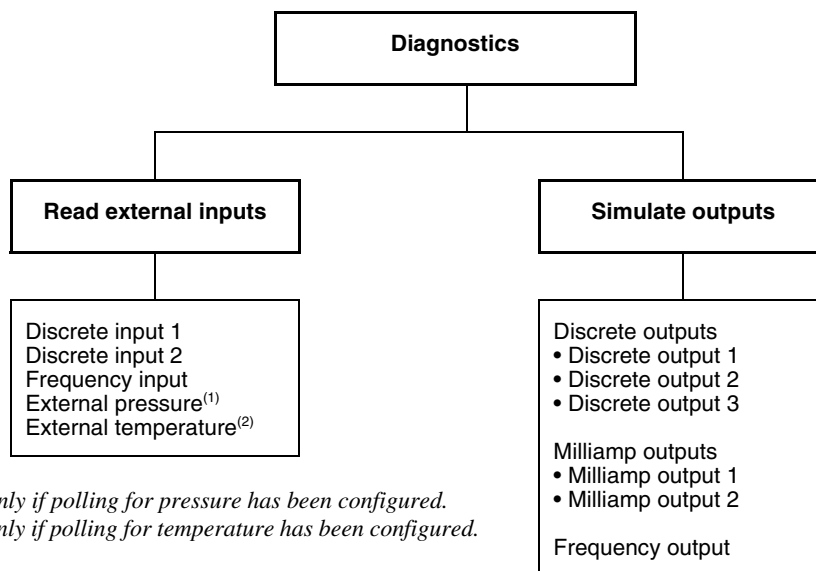
16.4 Testing the inputs and outputs

The Diagnostics menu is used to test the inputs and outputs. Figure 16-2 shows the Diagnostics menu. The Diagnostics menu is accessed through the Maintenance option of the Management menu.

Using the Diagnostics menu, you can:

- Read the states of discrete inputs
- Read the pressure and temperature values as received from external devices
- Read the value of the frequency input
- Set a specific value for discrete outputs, mA outputs, and the frequency output

Figure 16-2 Diagnostics menu



(1) Displayed only if polling for pressure has been configured.

(2) Displayed only if polling for temperature has been configured.

Note: The Diagnostics menu is not the same as the diagnostic monitor. The diagnostic monitor, accessed through the View menu, allows you to read the values for tube frequency, left pickoff, right pickoff, drive gain, and live zero. The diagnostic monitor and its use are described in Chapter 17 and Chapter 22.

16.4.1 Reading and testing the discrete inputs

Refer to Figure 16-2 to access and read the current states of Discrete Input 1 and 2. States are shown as:

- Yes (ON)
- No (OFF)

To test the discrete inputs, toggle the remote input device and verify that the appropriate value is received by the Series 3000 device.

16.4.2 Reading and testing the frequency input

If the Series 3000 device has been wired for a frequency input, refer to Figure 16-2 to access and read the output level of the frequency input. The frequency is displayed in Hz.

To test the frequency input, check the frequency at the remote input device and verify that the appropriate value is received by the Series 3000 device.

16.4.3 Reading and testing the pressure and external temperature

If polling for pressure or external temperature has been configured, refer to Figure 16-2 to access and read the pressure and temperature values being received by the Series 3000.

To test the pressure and temperature input, use a reference device and verify that the appropriate value is received by the Series 3000 device.

16.4.4 Setting and testing outputs

The software enables you to set the states of discrete outputs or the values of milliamp outputs or the frequency output.

CAUTION

Performing output tests while control devices are set for automatic control will result in measurement error.

To avoid measurement error, set control devices for manual operation before performing output tests.

Discrete outputs

Refer to Figure 16-2 to access and set the current states of discrete outputs.

1. Select the discrete output to be set.
2. The default setting is Unfixed. Reset the output to ON or OFF. The outputs associated with ON and OFF depends on the output's polarity, as shown in Table 8-1. (For information on setting the discrete output polarity, see Section 8.3.1.)
3. Press **SAVE** to set the state of the selected discrete output.
4. Check the receiving device to ensure that the correct level is being received.
5. Reset the discrete output to Unfixed, or exit to the Simulate Outputs screen. The discrete output is released and is again controlled by the application.

Milliamp outputs

Refer to Figure 16-2 to access and set the output levels of milliamp outputs.

1. Select the milliamp output to be set.
2. Use the cursor control buttons to change the output value.
3. Press **SAVE** to set the output level.
4. Check the receiving device to ensure that the correct output level is being received.

When you exit to the Simulate Outputs screen, the milliamp output is released and is again controlled by the application.

If the difference between the output level sent by the Series 3000 device and the output level received by the receiving device is not acceptable for your application, perform a milliamp output trim. See Section 16.5.

Frequency output

Refer to Figure 16-2 to access and set the output levels of the frequency output.

1. Select the frequency output.
2. Use the cursor control buttons to change the output value.
3. Press **SAVE** to set the value.
4. Check the receiving device to ensure that the correct output level is being received.

When you exit to the Simulate Outputs screen, the frequency output is released and is again controlled by the application.

16.5 Milliamp output trim

A *milliamp output trim* creates a common measurement range between the Series 3000 device and the device that receives the mA output. For instance, a Series 3000 device might send a 4 mA signal that the receiving device reports incorrectly as 3.8 mA. If the Series 3000 device 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 outputs at both the 4 mA and 20 mA points to ensure appropriate compensation across the entire range of outputs.

To perform a milliamp output trim:

1. Connect a digital multimeter (DMM) or other reference device to the primary or secondary milliamp wiring terminals. Ensure that the reference device is connected in series. Table 16-1 lists the terminals to which the reference device should be connected.
2. Ensure that the reference device is set to read milliamps.

Table 16-1 Milliamp output wiring terminals

Terminal designation	Polarity	Terminal number		
		Model 3300 or Model 3500 with screw-type or solder-tail terminals	Model 3300 or Model 3500 with I/O cables	Model 3350 or Model 3700
4–20 mA primary	+	c 2	1	2
	–	a 2	2	1
4–20 mA secondary	+	c 4	14	4
	–	a 4	15	3
Terminal block location		Farthest right block on back panel	Attached to DIN rail	Gray terminal block

3. From the Maintenance menu, select **Calibration** (see Figure 16-1).
4. Select **mA Output Trim**.
5. Select **Milliamp Output 1** or **Milliamp Output 2**.
6. Select the output level to be trimmed:
 - To trim at 4 mA, select **Trim 4.0 mA**
 - To trim at 20 mA, select **Trim 20.0 mA**
7. Press **CHG**, enter the amount of current indicated by the reference device, then press **SAVE**.
8. Compare the output level that is indicated by the reference device to the output level that appears in the display.
 - If the output level that appears in the display matches the output level that is indicated by the reference device, press **YES**.
 - If the output level that appears in the display does **not** match the output level that is indicated by the reference device, press **NO**, then repeat Steps 7 and 8.

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

Note: If you are trimming the primary mA output, and you are performing a trim using a HART connection to the Series 3000 device, the HART signal will affect the reading. Disconnect the HART connection before reading the output, then reconnect and resume the trim after taking the reading.

Chapter 17

Operation Mode

17.1 About this chapter

This chapter explains how to use the Series 3000 device in operation mode.

There are two different operation modes:

- The process monitor is the default operation mode unless the discrete batch application is present. Process monitor mode is described in Section 17.4.
- Batch mode, which is the default operation mode if the discrete batch application is installed. Batch mode is described in Chapter 18.

Both modes will operate differently if the custody transfer application is installed and security is enabled. See Chapter 19.

To determine what applications or special options have been installed, use the applications list in the View menu (see Section 17.5.9).

17.2 Startup and display test

At startup, the Series 3000 device automatically tests its display. During display testing, the screen darkens for approximately five seconds. After the display test is completed:

1. The Micro Motion logo is displayed for two to three seconds.
2. An application list is displayed for two to three seconds.
3. The device enters operation mode:
 - If the discrete batch application is not installed, the process monitor screen is displayed, as shown in Figure 17-1.
 - If the discrete batch application is installed, the batch process screen is displayed (see Figure 18-1).
4. If there are any active alarms, the alarm category will be displayed in the alarm bar. To view, acknowledge, or respond to the alarms, see Section 22.6.

17.3 Initial startup

For Series 3000 transmitters, a sensor zero may be performed at initial startup. Sensor zero establishes flowmeter response to zero flow and sets a baseline for flow measurement.

Once the sensor zero is set, it remains part of the transmitter nonvolatile memory, and will not be affected by a power failure, brownout, or power cycle.

See Section 16.3 for instructions on performing a sensor zero.

⚠ CAUTION

Failure to perform a sensor zero calibration at initial startup could cause the flowmeter to produce inaccurate signals.

To avoid inaccurate measurements, perform a sensor zero before putting the flowmeter into operation.

17.4 Process monitor operation mode

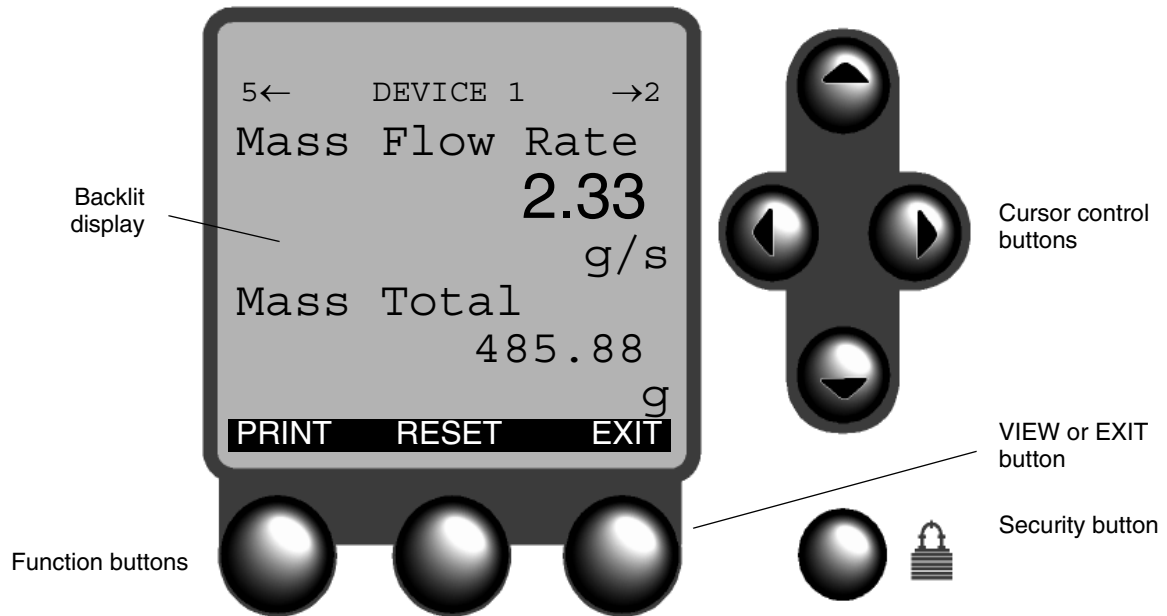
The process monitor, shown in Figure 17-1, is the default operation mode unless the discrete batch application is present.

- To scroll through the process monitor, press the left or right cursor control button. The number beside each arrow on the top line indicates the screen that will be displayed if the left or right cursor control button is pressed. If no display variables are configured for a particular screen, that screen is skipped.
- If a total appears on the screen, you can press **RESET** to reset it to 0. Pressing **RESET** will reset only the totals on the screen that is displayed.
- Press **PRINT** to print a ticket that includes values of process variables on the screen that is displayed.

You can configure the process variables that will be displayed on each of the five screens of the process monitor. To configure the process monitor, see Chapter 12.

If the discrete batch application is installed, you can monitor process variables by using the Process Monitor option from the View menu (see Section 17.5).

Figure 17-1 Series 3000 display in process monitor mode



17.5 Using the View menu

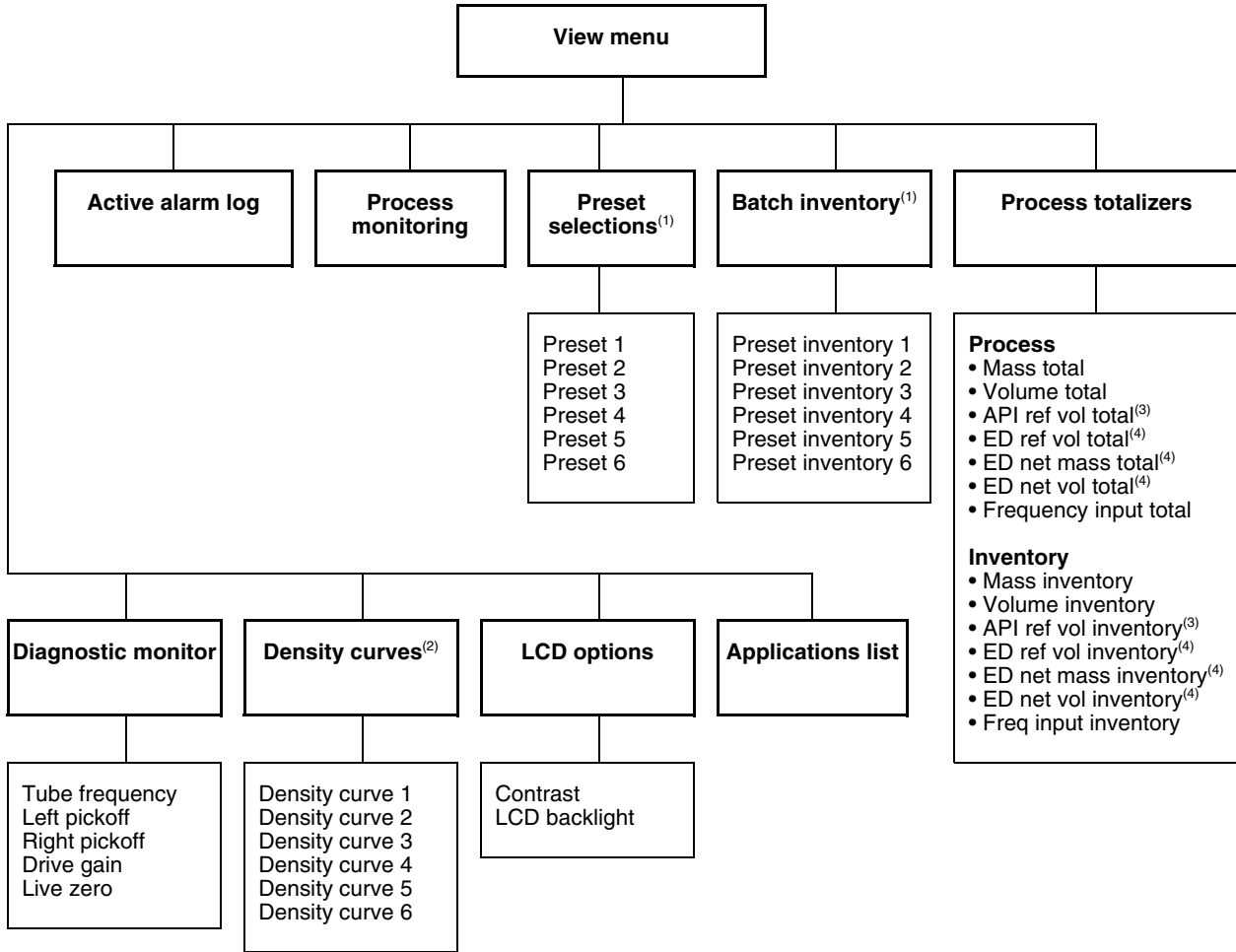
When you press **VIEW** at the operation screen, the View menu is displayed (see Figure 17-2).

This menu varies according to the installed applications. Your menu may be different.

Note: See Chapter 19 for a discussion of the View menu if the custody transfer application is installed and World Area is set to OIML.

Figure 17-3 shows the functions performed by the function buttons and cursor control buttons in the View menu.

Figure 17-2 View menu



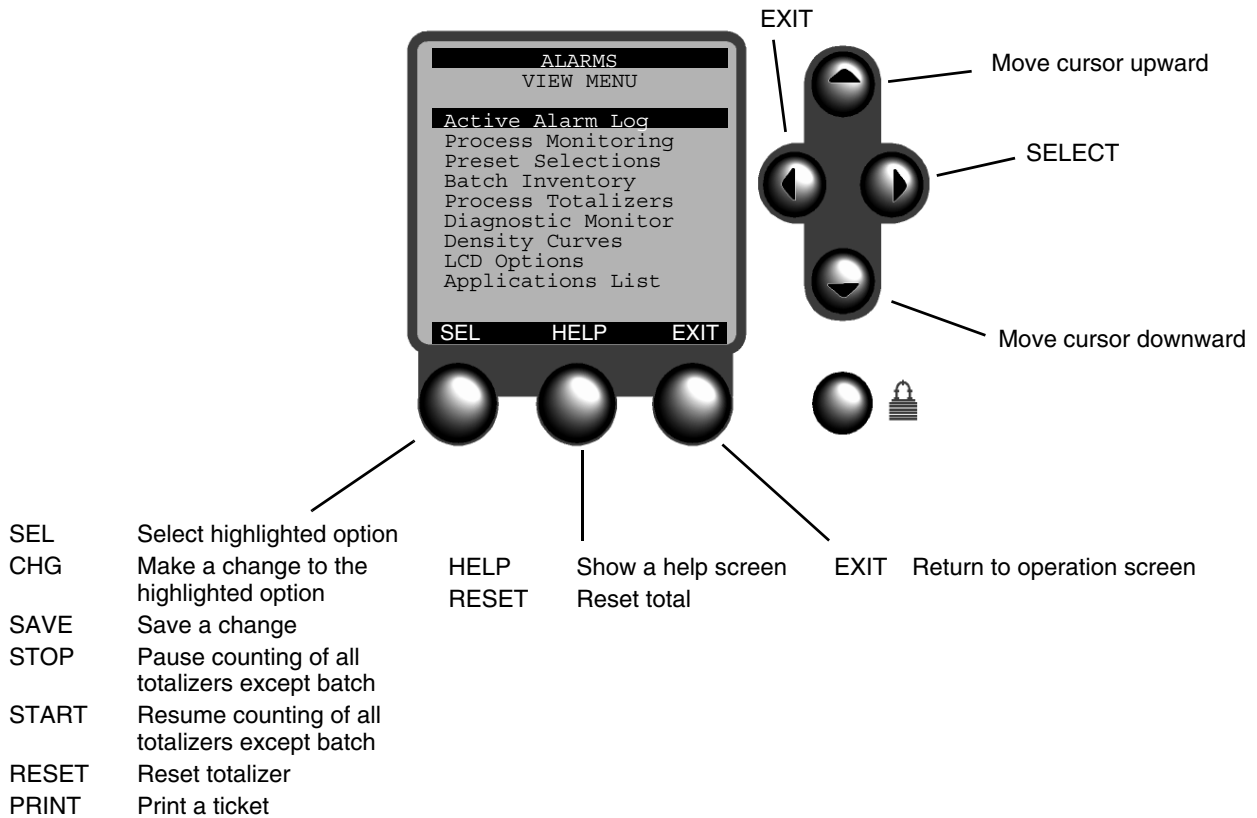
(1) If batch application is installed and configured.

(2) If enhanced density application software is installed and configured, and density curves have not been assigned to batch presets.

(3) If petroleum measurement application is installed and configured.

(4) If enhanced density application software is installed and configured.

Figure 17-3 Working with the View menu



17.5.1 Active alarm log

The platform performs self-diagnostics during operation. If the platform detects certain events or conditions, an alarm message appears in the highlight bar at the top of the screen and an item is added to the active alarm log.

The active alarm log lists:

- All alarms that are active (the condition that caused the alarm is active)
- All alarms that have not been acknowledged (even if the condition causing the alarm is no longer active)

The alarm will be listed in the active alarm log and displayed in the highlight bar until the alarm has been acknowledged.

The active alarm log is organized in either of two ways:

- If accessed via the View menu, as shown in Figure 17-2, only alarm categories containing active or unacknowledged alarms are listed. Alarm categories are listed in order of priority (Electronics, Sensor, Process, Configuration). To view individual alarms, place the cursor on an alarm category and press **HELP**.
- If accessed via the Maintenance menu, individual alarms are listed in numerical order by alarm number (alarm numbers are documented in Section 22.7).

For information about acknowledging alarms or responding to alarm messages, see Section 22.6.

17.5.2 Process monitoring

This selection displays the process monitor, as described in Section 17.4. The display is identical to the display shown in Figure 17-1.

If you enter the process monitor from the View menu, then press **EXIT**, you are returned to the View menu.

17.5.3 Preset selections

The Preset Selections option allows you to specify which of the existing presets will be used to control batching. Only presets that have been enabled are listed here.

The discrete batch application can be set up with as many as six different batch presets. Each preset has its own target. A preset may also have a descriptive name, which will appear on the selection menu.

For more information on batch presets and how to configure them, see Section 11.6.

Note: If a density curve has been assigned to the selected preset, batch totals will be based on the derived variable that was selected during configuration of the density application. See the enhanced density manual.

17.5.4 Batch inventory

This option displays the current inventory totals for all enabled presets.

For more information on batch presets and how to configure them, see Section 11.6. For more information on batch inventories and how to reset them, see Section 18.3.

17.5.5 Process totalizers and inventories

The View menu allows you to view, start, stop, and reset process totalizers, and view process inventories.

To view or manage process totalizers:

1. From the View menu, select **Process Totalizers**.
2. Select **Process**. Current values for the first four totalizers are displayed. Scroll down as required to view additional totalizers.
3. To start or stop all totalizers, press the left function button (labeled **START** or **STOP**).
4. To reset a specific totalizer:
 - a. Highlight the totalizer to be reset.
 - b. Press the **RESET** button.

To view a process inventory:

1. From the View menu, select **Process Totalizers**.
2. Select **Inventory**.
3. Scroll down the list as required to view the desired value.

Note: Inventories cannot be reset from the View menu. To reset an inventory, you must use the Maintenance menu. See Section 20.5.

17.5.6 Diagnostic monitor

The Diagnostic Monitor shows real-time values for sensor flow tube frequency, left and right pickoffs, drive gain, and live zero.

Drive gain, pickoff levels, and sensor flow tube frequency values are useful for troubleshooting fault alarms. For information about troubleshooting fault alarms, see Chapter 22.

Live zero is useful for monitoring the flow rate when it drops below the mass low flow cutoff. To configure the mass low flow cutoff, see Section 7.3.2.

Note: The diagnostic monitor is not the same as the Diagnostics menu. The Diagnostics menu, accessed through the Maintenance option of the Management menu, allows you to read the values of external inputs and simulate output levels for outputs. The Diagnostics menu and its use are described in Chapter 16.

17.5.7 LCD options

The LCD Options allow you to adjust the contrast, or to enable screen backlighting.

1. Select **LCD Options** from the View menu.
2. Select **Contrast** to adjust the screen contrast.
3. Select **LCD Backlight** to turn screen backlighting on or off.

17.5.8 Density curves

The Density Curves menu item is available only if the enhanced density application is installed and one or more density curves has been configured. This screen lists all density curves that have been configured. The active density curve is highlighted.

- If no density curve has been assigned to a batch preset, you can use this menu to change the active density curve. To do this, highlight the desired curve in the list and press **SEL**.
- If a density curve has been assigned to a batch preset, that curve is active and you cannot change the active density curve from this menu.

17.5.9 Applications list

The Applications List shows the software version of the Series 3000 device and the core processor (if applicable) and all applications that are installed. Refer to this screen for the software revision number to report problems.

Chapter 18

Operation Mode – Batch

18.1 About this chapter

This chapter explains how to use the discrete batch control application and how to perform batch AOC (automatic overshoot compensation).

Note: Before you can use the discrete batch application, it must be configured. For information on configuring the discrete batch application, see Chapter 11.

Note: For information on formatting and printing batch tickets, see Chapter 15.

18.2 About discrete batching

Discrete batching is used to start flow, then stop flow automatically when the target amount of process fluid has flowed through the sensor. During a batch, flow may be stopped and resumed. A batch may also be ended before the target is reached.

The normal batching sequence is as follows:

1. Select a batch preset (see Section 17.5.3). The batch preset determines the target, how end warnings and overruns will be handled, and, for 2-stage batching only, the point at which the primary and secondary valves will be opened and the point at which the primary valve will be closed.
2. Start the batch. The operator can start the batch manually, using the **START** button on the batch process screen, or a discrete input or discrete event can be configured to start the batch (see Section 11.7). Before a batch can be started, the previous batch must be ended and the totals must be reset.

*Note: Reset may be automatic (Reset on Start is enabled; see Section 11.5) or manual via the **RESET** button or an assigned discrete input (see Section 11.7).*

3. In normal operation, the flowmeter will stop the batch automatically when the configured target is reached.

The operator can halt the batch manually, using the **STOP** or **END** buttons on the batch process screen. The **STOP** and **END** functions can also be assigned to a discrete input or discrete event (see Section 11.7).

- If the batch is stopped, the current batch totals are retained, and pressing the **RESUME** button will restart the batch from the current totals. The **RESUME** function can also be assigned to a discrete input or discrete event (see Section 11.7).
- If the batch is ended, it cannot be restarted (with one exception: by increasing the batch target to a value that is greater than the current batch total).

Table 18-1 describes batch events and how the batch function buttons operate under different batch conditions.

For examples of batch processing, including the effects of **STOP** and **RESUME**, see Section 18.4.

For a discussion of batch control functions, see Section 11.7.

Table 18-1 Batch events

Event	Description
Batch in progress	<ul style="list-style-type: none"> • Batch is in progress. • Batch in progress remains active until the batch completes or is ended. If the batch is stopped, batch in progress remains active.
Primary valve open/close, 1-stage batch	<ul style="list-style-type: none"> • If control options are configured for Reset on Start, pressing START resets the batch total to zero, starts the pump or opens the valve, and starts the batch. • If control options are not configured for Reset on Start, pressing START starts the pump or opens the valve to start the batch. • The pump stops or the valve closes automatically when the target is reached.
Primary valve open/close, 2-stage batch	<ul style="list-style-type: none"> • If control options are configured for Reset on Start and the preset is configured so Open Primary is 0% of target, or Quantity is set to 0, pressing START resets the batch total to zero, opens the primary valve, and starts the batch. • If control options are not configured for Reset on Start and the preset is configured so Open Primary is 0% of target, or Quantity is set to 0, pressing START opens the primary valve and starts the batch. • If the preset is configured so Open Primary is a value other than 0% of target, or a quantity other than 0, the valve opens when the batch total achieves the Open Primary value. • The primary valve closes when the batch total achieves the Close Primary value.
Secondary valve open/close, 2-stage batch	<ul style="list-style-type: none"> • If control options are configured for Reset on Start and the preset is configured so Open Secondary is 0% of target, or Quantity is set to 0, pressing START resets the batch total, opens the secondary valve, and starts the batch. • If control options are not configured for Reset on Start and the preset is configured so Open Secondary is 0% of target, or Quantity is set to 0, pressing START opens the secondary valve and starts the batch. • If the preset is configured so Open Secondary is a value other than 0% of target, or a quantity other than 0, the secondary valve opens when the batch total achieves the Open Secondary value. • The secondary valve closes when the target is achieved.
End warning	<ul style="list-style-type: none"> • If End Warning was enabled during configuration, the batch controller produces an alarm when the batch total achieves the programmed end warning value. • The end warning remains active until batch completion.
Overrun	<ul style="list-style-type: none"> • If Overrun was enabled during configuration, the batch controller produces an alarm when the batch total exceeds the target by the programmed amount or percent of target. • Overrun remains active until flow stops.
Batch pump	<ul style="list-style-type: none"> • The system pump is operating. • The pump remains on while the primary or secondary valve is open.

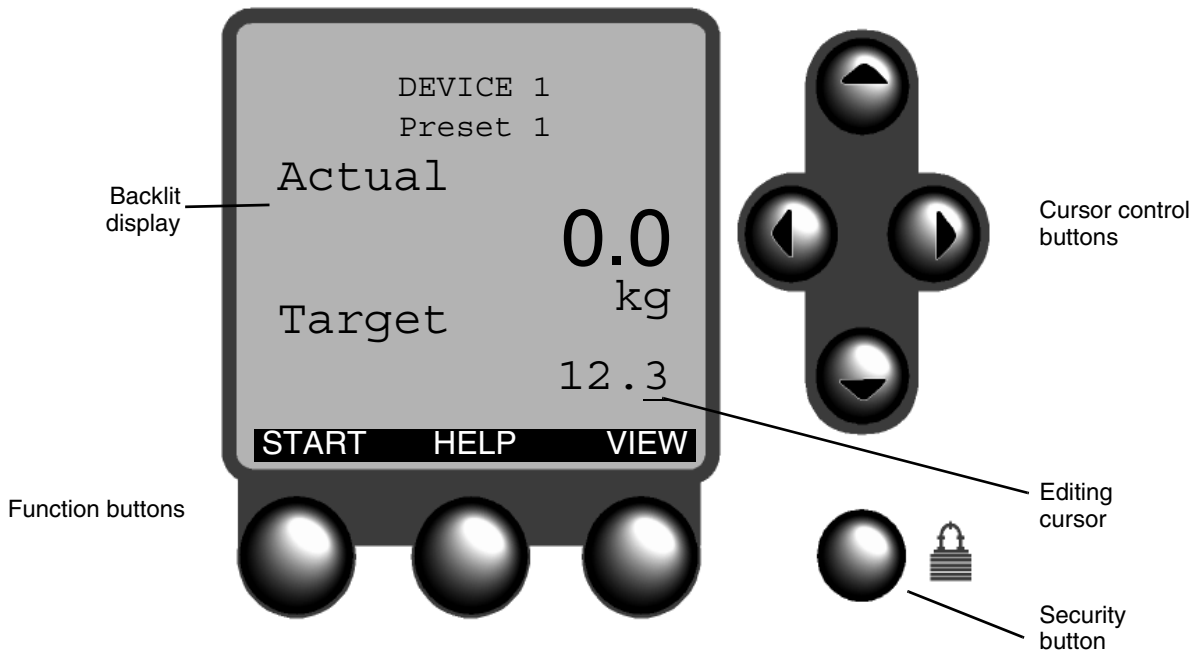
18.3 Batch process screen

Figure 18-1 shows the Series 3000 display in batch operation mode, ready to start a batch.

The display shows that there have been zero kilograms of actual delivery in this batch. When flow starts, the display is continuously updated to show the actual amount that has been delivered.

The display can be set up to show either the amount that has been delivered (Count Up) or the amount remaining to be delivered (Count Down). To configure Count Up or Count Down, see Section 11.5.

Figure 18-1 Series 3000 display in batch mode



Note: If the petroleum measurement application or the enhanced density application is installed and the batch controller is measuring standard volume, net volume, or net mass, actual and target values indicate net totals rather than gross totals.

18.3.1 Function buttons

In Figure 18-2, the display shows that the batch target is 12.3 kg.

- When you press **START**, the discrete outputs assigned to the pump and valve are activated, and flow starts.
- When the target amount has passed through the flowmeter, the discrete outputs assigned to the pump and valve are deactivated, and flow stops.

The labels on the three function buttons are changed during the batch run to show the actions you can perform at each point.

To start the batch, press the button on the left, labeled **START**. Figure 18-2 shows what happens.

Figure 18-2 Using batch function buttons

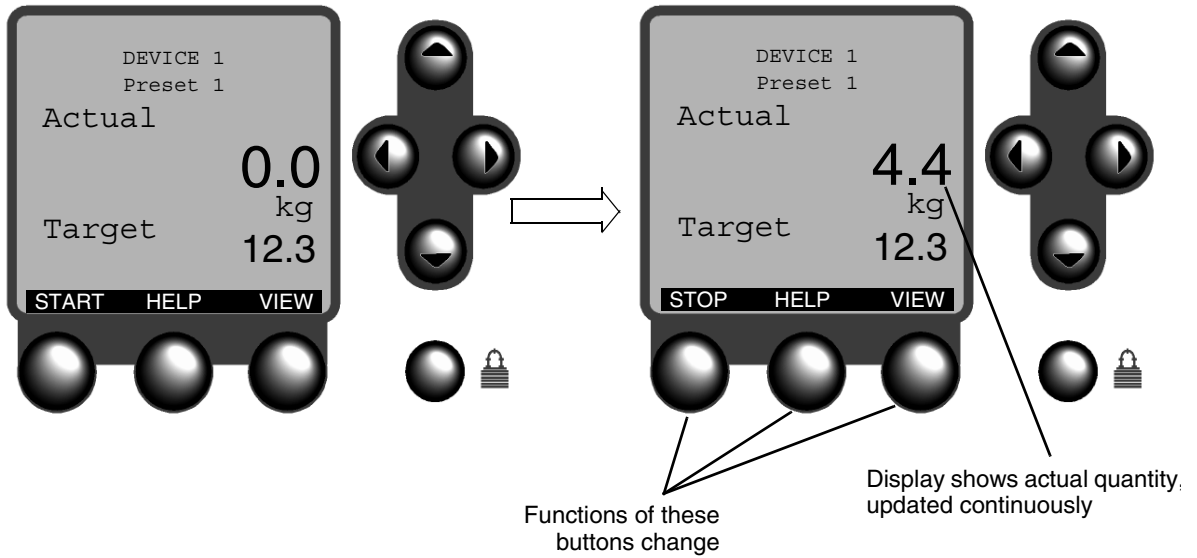
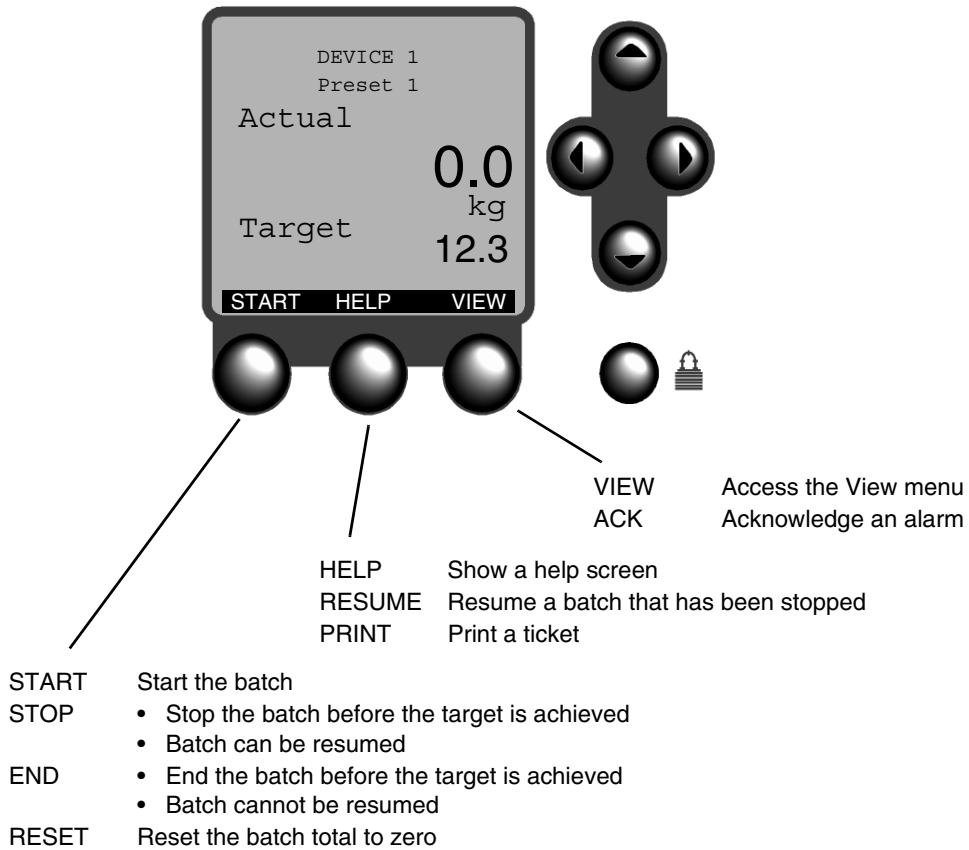


Figure 18-3 indicates the actions that are performed by the function buttons during batch operation.

Figure 18-3 Function buttons in batch mode



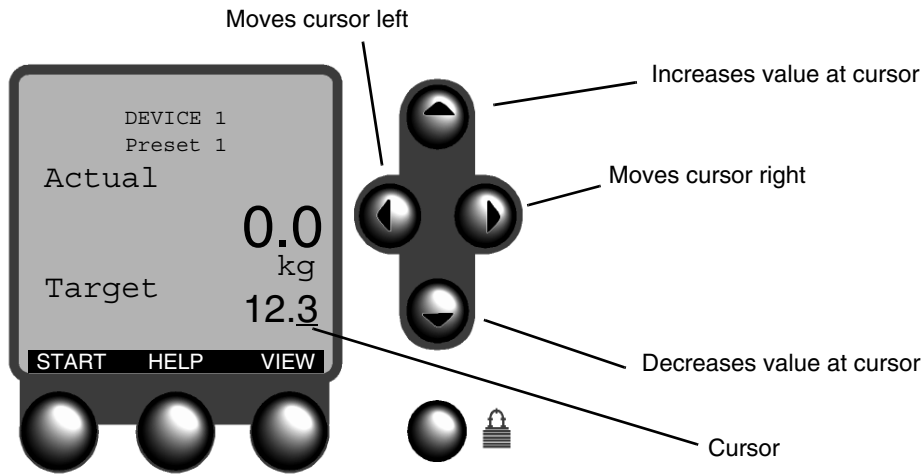
18.3.2 Cursor control buttons

The Lockout Target parameter can be set to allow the operator to change the target directly from the batch operation screen when the batch is not running (Lockout Target set to No). To enable target adjustment, see Section 11.5.

In Figure 18-4, the line beneath the farthest right digit of the target is the editing cursor. If Lockout Target is set to No, the cursor appears on the screen whenever the batch is not running. Whenever the cursor appears on the screen, you can use the cursor control buttons to change the target.

Figure 18-4 shows how the cursor control buttons work when the editing cursor is displayed.

Figure 18-4 Adjusting the batch target



Note: If the petroleum measurement application or the enhanced density application is installed and the batch controller is measuring standard volume, net volume, or net mass, the actual and target values indicate net totals rather than gross totals.

18.4 Batch processing sequences

The following sequences (Figures 18-5 and 18-6) show the opening and closing of the primary and secondary valves, under normal processing and when **STOP / RESUME** is performed at different points during the batch.

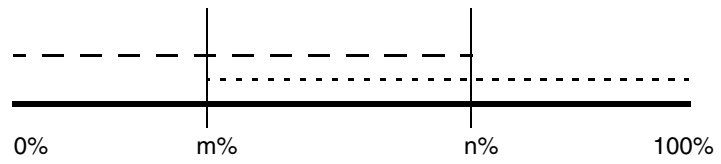
Note: Because the pump is on whenever a valve is open, it is not shown in these sequences.

For a description of two specific sequences, see the examples following the figures.

Operation Mode – Batch

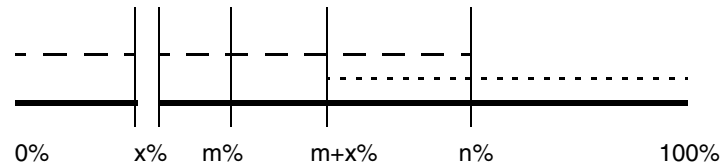
Figure 18-5 Batch processing sequences: 2-stage batching, Open Primary at 0%

Normal operation

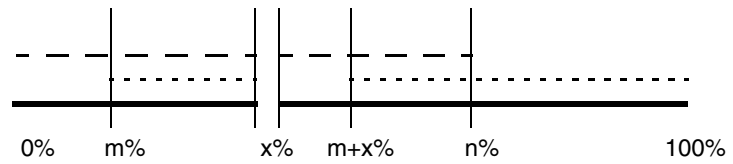


Valve behavior with STOP/RESUME at x%

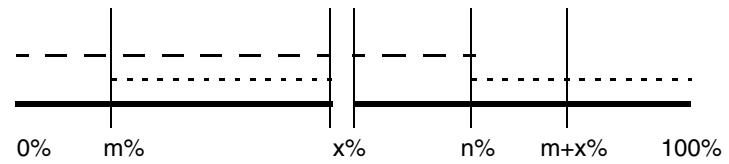
x% before secondary open



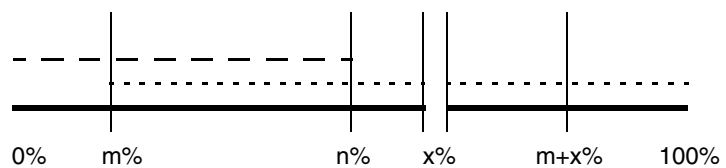
x% after secondary open, when $m+x% < n%$



x% after secondary open, when $m+x% > n%$



x% after primary close



Configured values

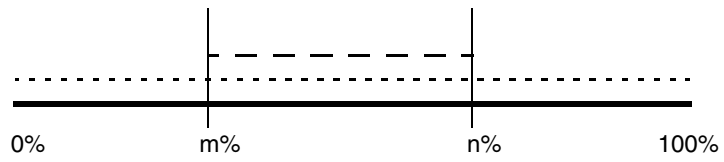
- Open Primary: 0%
- Open Secondary: m%
- Close Primary: n%

Legend

- Primary valve - - - - -
- Secondary valve
- Flow —————

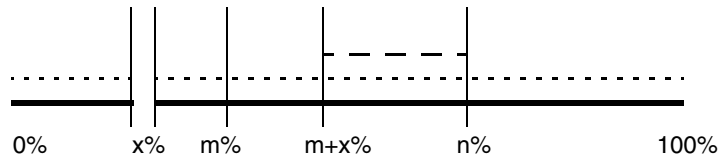
Figure 18-6 Batch processing sequences: 2-stage batching, Open Secondary at 0%

Normal operation

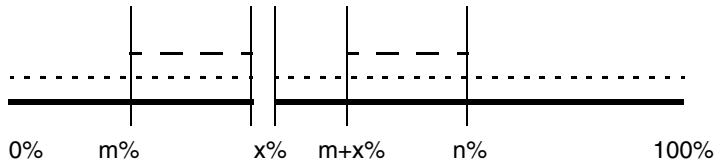


Valve behavior with STOP/RESUME at x%

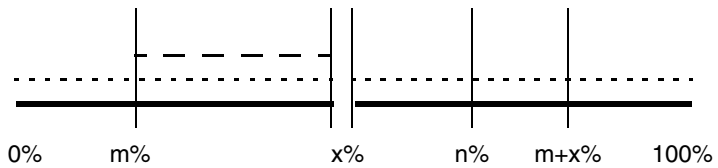
x% before primary open



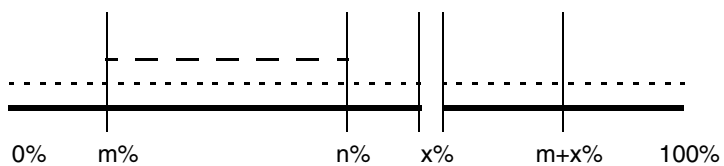
x% after primary open, when $m+x% < n%$



x% after primary open, when $m+x% > n%$



x% after primary close



Configured values

- Open Primary: m%
- Open Secondary: 0%
- Close Primary: n%

Legend

- Primary valve - - - - -
- Secondary valve
- Flow —————

Example 1

Batch control configuration:

- No. of Stages = 2
- Configure Presets By = % of Target

Preset configuration:

- Target = 100 liters
- Open Primary = 0%
- m (Open Secondary) = 30%
- n (Close Primary) = 70%

Operator actions:

- None (see the first sequence in Figure 18-5)

As a result:

- At the beginning of the batch run, the primary valve opens and flow starts.
- When the flowmeter has measured 30 liters, the secondary valve opens.
- When the flowmeter has measured 70 liters, the primary valve closes.
- When the flowmeter has measured 100 liters, the secondary valve closes.

Example 2

Batch control configuration:

- No. of Stages = 2
- Configure Presets By = % of Target

Preset configuration:

- Target = 100 liters
- Open Primary = 0%
- m (Open Secondary) = 30%
- n (Close Primary) = 70%

Operator actions:

- STOP/RESUME occurred after 20 liters had been measured (20% of target; $x = 20\%$) (see the second sequence in Figure 18-5)

As a result:

- At the beginning of the batch run, the primary valve opens and flow starts.
- When the flowmeter has measured 50 liters ($30 + 20$, or $m + x$), the secondary valve opens.
- When the flowmeter has measured 70 liters, the primary valve closes.
- When the flowmeter has measured 100 liters, the secondary valve closes.

18.5 Special cases in batch processing

This section describes two common situations in batch processing that may require special attention from the operator.

18.5.1 Cleaning/purging the tubes

In normal processing, the batch totalizer increments whenever flow is detected. To run fluid through the tubes without incrementing the batch totalizer:

1. Ensure that the Inhibit Totalizer batch control function has been assigned to a discrete input, as described in Section 11.7.
2. Activate the discrete input or discrete event.
3. Run fluid through the tubes as desired.
4. When you are ready to resume totalizing, deactivate the discrete input.

18.5.2 Ending a batch while flow is present

In general, to end a batch:

- Automatically, the target must be reached and flow must be stopped.
- Manually, the batch must be stopped (paused) and flow must be stopped.

To end a batch while flow is present:

1. Ensure that the Inhibit Flow batch control function has been assigned to a discrete input, as described in Section 11.7.
2. When the batch total reaches the target, activate the discrete input so that the batch can end normally.

18.6 Batch AOC calibration

Batch AOC (Automatic Overshoot Compensation) keeps the actual quantity delivered as close as possible to the batch target, by minimizing the amount of overshoot.

If batch AOC is enabled (see Section 11.5), batch AOC calibration is required to provide data for the compensation process. Thereafter, batch AOC calibration is recommended:

- Whenever consistent overshooting or undershooting of the target occurs
- If equipment (valve or pump) is changed

Note: If batch AOC is not enabled, you cannot perform batch AOC calibration.

To perform batch AOC calibration:

1. From the Maintenance menu, select **Calibration** (see Figure 4-2).
2. Select **Batch AOC**.
3. Select **Start Calibration**.
4. Press **EXIT** repeatedly to return to the operation screen.
5. Run 2 to 10 batches.

Operation Mode – Batch

6. When overshoot has been adequately minimized:
 - a. From the Maintenance menu, select **Calibration**.
 - b. Select **Batch AOC**.
7. Select **Save Calibration**.
8. Press **SEL**.

Chapter 19

Operation Mode – Custody Transfer

19.1 About this chapter

This chapter explains how to use and manage the custody transfer application. The following topics are discussed:

- Identifying a security breach – see Section 19.2
- General differences between secured versus unsecured states – see Section 19.3
- Using custody batch (NTEP) – see Section 19.4
- Using custody transfer (OIML) and custody transfer (OIML/batch) – see Section 19.5
- Clearing a security breach – see Section 19.6
- Reconfiguring the Series 3000 device – see Section 19.7
- Audit trail – see Section 19.8

The custody transfer application must be configured for the system that will be used. See Chapter 14 for information on configuring the custody transfer application.

19.2 Identifying a security breach

It is useful to distinguish between data security and legal security. Data security is present if the custody transfer switch is in the ON position and there is no “Security Breach” banner on the Series 3000 display. However, legal security requires data security plus an intact weights and measures seal.

For custody transfer use, legal security is required. Therefore, a security breach is present if either of the following is true:

- Visual inspection shows that the weights and measures seal is broken or missing.
- The Series 3000 device has detected a security breach and posted the “Security Breach” banner on the display.

Note: The “Security breach” and “Not a legal receipt” banners will also be printed on batch (NTEP) tickets or batch (OIML) tickets, but not on transfer (OIML) tickets.

If a security breach is present, security cannot be guaranteed, and Series 3000 data cannot be used to meet weights and measures requirements. To clear a security breach, see Section 19.6.

19.3 Secured versus unsecured

In general, when the Series 3000 device is secured, the operator can run a batch and view process data, but cannot change device configuration. When the device is unsecured, configuration changes are permitted but other device behavior changes to indicate the unsecured status.

Table 19-1 provides a detailed list of changes to specific features or functions when the custody transfer application is installed and the Series 3000 device is either secured or unsecured.

Operation Mode – Custody Transfer

Table 19-1 Series 3000 behavior and available functions

Function	Custody transfer (NTEP)		Custody transfer (OIML) and custody transfer (OIML/batch)	
	Secured	Unsecured	Secured	Unsecured
Batch processing				
Batch reset	Y	Y	Y	Y
Batch start, stop, resume	Y	Y	Y	Y
Batch BOL number changed manually	N	Y	N	Y
Different batch preset selected	Y	Y	Y	Y
Transfer BOL number changed manually	N/A	N/A	N	Y
Time of day	Can be changed by one hour in either direction. Cannot be changed in the same direction twice consecutively.	Y	Can be changed by one hour in either direction. Cannot be changed in the same direction twice consecutively.	Y
External pressure and temperature data				
Updated via polling	Y	Y	Y	Y
Updated by Modbus or HART host	N	Y	N	Y
Calibration				
Zero	N	Y	N	Y
Density	N	Y	N	Y
Temperature	N	Y	N	Y
Meter verification				
Original version	N	Y	N	Y
Smart Meter Verification				
• Outputs set to Continue Measuring	Y	Y	Y	Y
• Outputs set to Fault	Y	Y	Y	Y
• Outputs set to Hold Last Value	N	Y	N	Y

Table 19-1 Series 3000 behavior and available functions *continued*

Function	Custody transfer (NTEP)		Custody transfer (OIML) and custody transfer (OIML/batch)	
	Secured	Unsecured	Secured	Unsecured
Outputs				
mA output behavior	Normal	If reporting flow rate, show zero flow Otherwise, normal	Normal	Perform configured fault action
mA output trim	N	Y	N	Y
mA output loop test	N	Y	N	Y
Frequency output behavior	Normal	Inactive (produces no pulses) even under fault conditions	Normal	Perform configured fault action
Frequency output loop test	N	N	N	Y
Discrete output behavior	Normal	Normal	Normal	Perform configured fault action
Discrete output loop test	N	Y	N	Y
Service port connections	N	Y If device is secured while service port connection is active, terminals are reset to RS-485 mode and connection is broken.	N	Y If device is secured while service port connection is active, terminals are reset to RS-485 mode and connection is broken.

Operation Mode – Custody Transfer

Table 19-1 Series 3000 behavior and available functions *continued*

Function	Custody transfer (NTEP)		Custody transfer (OIML) and custody transfer (OIML/batch)	
	Secured	Unsecured	Secured	Unsecured
Process variables				
All flow rates	Reported normally	Reported as zero	Reported normally	Reported normally
Density and temperature	Reported normally	Reported normally	Reported normally	Reported normally
Process totalizers	Increment normally Cannot be stopped Cannot be reset unless flowrate is zero. If any one is reset: • All others are reset automatically • A test of the display is performed automatically	Stopped If any one is reset: • All others are reset automatically • A test of the display is performed automatically	Replaced by transfer totalizers Transfer totalizers Increment normally	Replaced by transfer totalizers Transfer totalizers stopped
Process inventories	Increment normally Cannot be stopped Cannot be reset	Stopped Cannot be reset	Increment normally Cannot be stopped Cannot be reset	Stopped Cannot be reset
Transfer totalizers	N/A	N/A	Rollover indicator: • Cannot be cleared manually • Cleared automatically upon starting new transfer	Rollover indicator can be cleared
Transfer inventories	N/A	N/A	Rollover indicator cannot be cleared	Rollover indicator can be cleared
Simulation mode	N	Y	N	Y
Alarm menu	Normal	Normal	Alarm log password required (if enabled)	Alarm log password required (if enabled)

19.4 Custody transfer (NTEP)

This section provides information on the BOL number, the custody transfer transaction, tickets and ticket printing, and general use of the Series 3000 device when World Area is set to NTEP.

19.4.1 BOL number

In custody transfer (NTEP) applications, there is one bill of lading (BOL) number. The BOL number is used to identify both the custody transfer transaction and the batch. The default BOL start number is 0, and the BOL number is incremented automatically when the discrete batch is reset. To change or reset the BOL start number manually, see Section 15.5.1.

Note: The BOL number rolls over to 0 after 99,999,999 batches.

You cannot change the BOL start number while the device is secured. In most cases, the BOL start number is set during initial configuration and is not changed thereafter. To determine the current BOL number, check the most recent batch (NTEP) ticket.

19.4.2 Executing a custody transfer (NTEP) transaction

Custody transfer (NTEP) is used with the discrete batch application. To execute a custody transfer (NTEP) transaction:

1. Reset the batch. Because Reset on Start is disabled, you must reset the batch manually. At this point, the batch BOL number is incremented, the batch total is reset, and the custody transfer transaction begins.
 2. Run the batch. The discrete batch application will automatically stop flow when the target is reached, but you may increase the target and resume flow if desired.
 3. When the desired quantity has been delivered, as measured by the discrete batch application, stop flow and end the batch.
 4. End the transaction by printing a batch (NTEP) ticket. The custody transfer transaction ends when the first batch (NTEP) ticket is printed. You can print the ticket manually or automatically, at the end of a batch. You cannot print the ticket while the batch is stopped.
- See the following section for information on ticket printing.

19.4.3 Batch (NTEP) tickets and ticket printing

The batch (NTEP) ticket is very similar to the batch ticket but contains some additional data. The batch (NTEP) ticket serves as the legal receipt. To print a batch (NTEP) ticket, see Section 15.5.2 for instructions for both automatic and manual printing, and for printing additional tickets.

Note the following:

- A batch (NTEP) ticket cannot be printed until flow stops.
- If a batch (NTEP) ticket is printed, and the batch target is then increased and the batch is resumed, the custody transfer data will not change even though the batch data changes. All additional batch (NTEP) tickets printed during this batch will contain the original custody transfer data and the “Duplicate receipt” banner.
- For printer type Epson TMU295, an out-of-paper alarm can be generated, depending on the setting of the Disable Paper Check parameter (see Table 13-3). No other forms of print failure are detected.

19.4.4 General use of Series 3000 device

This section describes the effect of custody transfer (NTEP) on specific Series 3000 device functions. Information in this section supplements the information in Table 19-1.

19.4.5 Inventories

Process inventory values may become too large to display on screen. If this happens, the decimal point is shifted to the right, and eventually the screen display may be converted to scientific notation.

Note: Precision may be lost only in the displayed value. No precision is lost in the value stored in the device.

Note: For definitions of process totalizers, process inventories, transfer totalizers, and transfer inventories, see Section 20.2.

Audit trail

The audit trail function (see Section 19.8) is active, whether the device is currently secured or unsecured.

19.5 Custody transfer (OIML) and custody transfer (OIML/batch)

This section provides information on BOL numbers, the custody transfer transaction, tickets and ticket printing, the transfer log, and general use of the Series 3000 device when World Area is set to OIML.

19.5.1 BOL numbers

For custody transfer (OIML), the transfer BOL number is used to identify the custody transfer transaction. The default transfer BOL start number is 0, and the transfer BOL number is incremented automatically when the custody transfer is completed. The BOL start number is never reset automatically. To change or reset the transfer BOL start number manually, see Section 15.6.1.

Note: If the transfer BOL start number is changed or reset, the transfer log is reset and all transfer data is lost. See Section 19.5.5.

For custody transfer (OIML/batch), the batch BOL number is used to identify the custody transfer transaction. The default batch BOL start number is 0, and the batch BOL number is incremented automatically when the batch is reset. The batch BOL start number is never reset automatically. To change or reset the batch BOL start number manually, see Section 15.6.1.

You cannot change either BOL start number while the device is secured. In most cases, the BOL start numbers are set during initial configuration and are not changed thereafter. To determine the current BOL number, check the most recent transfer (OIML) or batch (OIML) ticket. For transfer (OIML), you can also check the transfer log (see Section 19.5.5).

19.5.2 Executing a custody transfer (OIML) transaction

To execute a custody transfer (OIML) transaction:

1. Start flow.
2. Stop flow when the desired quantity has been delivered.

3. End the transaction, either by printing a transfer (OIML) ticket or by using the transfer reset function.
 - To end a transaction via ticket printing, print a transfer (OIML) ticket that contains the transfer total (see Section 19.5.4).
 - To end a transaction via the transfer reset function, perform one of the following:
 - Press the **RESET-T** button.
 - Activate a discrete input that is configured for transfer completion (see Section 14.5, Step 6).

Note: During the transfer reset function, the Series 3000 display is temporarily blank.

When the transfer is completed, transfer data is written to the transfer log, the transfer BOL number is incremented by 1, all totalizers except the batch totalizer are reset automatically, and the next custody transfer transaction begins immediately.

Note: Inventories are not reset automatically when a transfer is completed.

Note the following:

- Tickets are optional. If you do not print a ticket, the transfer log is used for legal compliance, and the transfer reset function is used to end the transaction and begin a new one.
- If flow is present:
 - You cannot end the transaction.
 - The transfer reset function is disabled.
 - You may or may not be able to print a ticket. If you can, ticket contents will include the flow rate and a “Not Complete” banner. See Section 19.5.4.
- A custody transfer (OIML) transaction can be executed and completed whether the device is secured or unsecured.

19.5.3 Executing a custody transfer (OIML/batch) transaction

To execute a custody transfer (OIML/batch) transaction:

1. Reset the batch. Because Reset on Start is disabled, you must reset the batch manually. At this point, the batch BOL number is incremented, the batch total is reset, and the custody transfer transaction begins.
2. Run the batch. The discrete batch application will automatically stop flow when the target is reached, but you may increase the target and resume flow if desired.
3. When the desired quantity has been delivered and flow is stopped, end the batch.
4. End the transaction by printing a batch (OIML) ticket (see Section 19.5.4).

Note the following:

- Ending a batch does not automatically end the transaction. The transaction ends when the first batch (OIML) ticket is printed or when the batch is reset.
- If flow is present, you cannot end the transaction.

19.5.4 Transfer (OIML) and batch (OIML) tickets and ticket printing

Printing methods, conditions, and ticket contents for transfer (OIML) and batch (OIML) tickets are described in Table 19-2.

Table 19-2 Transfer (OIML) and batch (OIML) ticket printing methods, conditions, and contents

	Transfer (OIML) tickets	Batch (OIML) tickets
Printing method	<ul style="list-style-type: none"> • Manual, from PRINT button or discrete input • See Section 15.6.2 	<ul style="list-style-type: none"> • Manual, from PRINT button or discrete input • Automatic, via Auto Print parameter or discrete event • See Section 15.7.2
Approved process variables	Marked with asterisks	Not marked with asterisks
Printing when flow is present	May or may not be permitted, depending on Transfer Print Conditions parameter (see Table 15-7)	Not permitted
Security breach	No security breach banner Alarm banner may or may not be included, depending on Alarms Occurred parameter (see Table 15-6)	Security breach banner printed on ticket
Print failure	See the section entitled <i>Print failure</i>	See the section entitled <i>Print failure</i>
Print job status	See the section entitled <i>Print job status</i>	See the section entitled <i>Print job status</i>

Print failure

If a print failure occurs:

- For printer type FDW and transfer (OIML) tickets, the following warning message is displayed for five seconds after the first failure:

**Ticket Print Failure
Printer off-line and/or out of paper**

If ticket printing fails a second time, the transfer is automatically completed and the following warning message is displayed:

**Ticket Print Failure
Manually record the transfer data from the Transfer Log**

The display then shows the transfer log entry for the just completed transfer.

- For printer type FDW and batch (OIML) tickets, the following warning message is displayed for five seconds after the first failure:

**Ticket Print Failure
Printer off-line and/or out of paper**

If the second print attempt succeeds, the ticket will include the “Duplicate receipt” banner, with other data (e.g., batch totals and timestamp) based on the first print attempt.

If ticket printing fails a second time, the failure message is repeated, the batch total is reset, and the batch BOL is incremented.

- For printer type Epson TMU295, when the printer is connected through an RS-485 converter, the out-of-paper condition is handled via the warning message described above. Other types of print failure cannot be detected.
- For other printer types, two-way communication is not supported. No forms of print failure are detected.

Print job status

For some printer types, a discrete output can be configured to indicate that the ticket could not be printed (see Section 8.3.2), for one of these two reasons:

- The last ticket print request failed.
- The flow rate is not zero.

If either of these situations occurs, the discrete output is activated.

19.5.5 Transfer log

Note: The transfer log is used only for transfer (OIML) transactions. The transfer log does not contain entries for batch (NTEP) or batch (OIML) transactions.

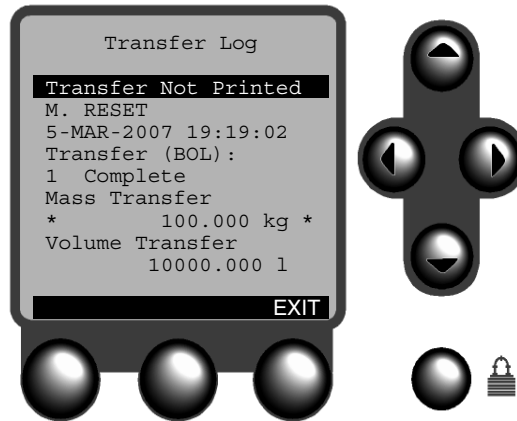
Whenever a transfer is completed, transfer data is added to the transfer log. The entry may contain the transfer totals, or the transfer totals and inventories, and the transfer variable may be marked with asterisks, depending on configuration (see Section 14.5). An example transfer log entry is shown in Figure 19-1.

If a ticket is printed but the transfer is not completed, no data is added to the transfer log.

You may view data from the transfer log for the 20 most recent transfers. To do this:

1. Select **Transfer Log** from the View menu.
2. Use the **Select BOL to View** option to specify the transfer you want to view. Log data for the selected transfer is displayed automatically.

Figure 19-1 Example transfer log entry



Note: If the Transfer Start (BOL) parameter is changed, the transfer log is reset and all transfer data is lost.

Note: It is not possible to print the transfer log or retrieve it via digital communications.

19.5.6 General use of Series 3000 device

This section describes the effect of custody transfer (OIML) and custody transfer (OIML/batch) on specific Series 3000 device functions. Information in this section supplements the information in Table 19-1.

Process monitor

Depending on configuration, the transfer variable may be marked with asterisks on the process monitor (see Section 14.5, Step 5).

Alarm log password

If the alarm log password has been enabled (see Section 14.5, Step 7), operators will be prompted for the alarm log password when they attempt to access the active alarm log, the alarm history, or the event log.

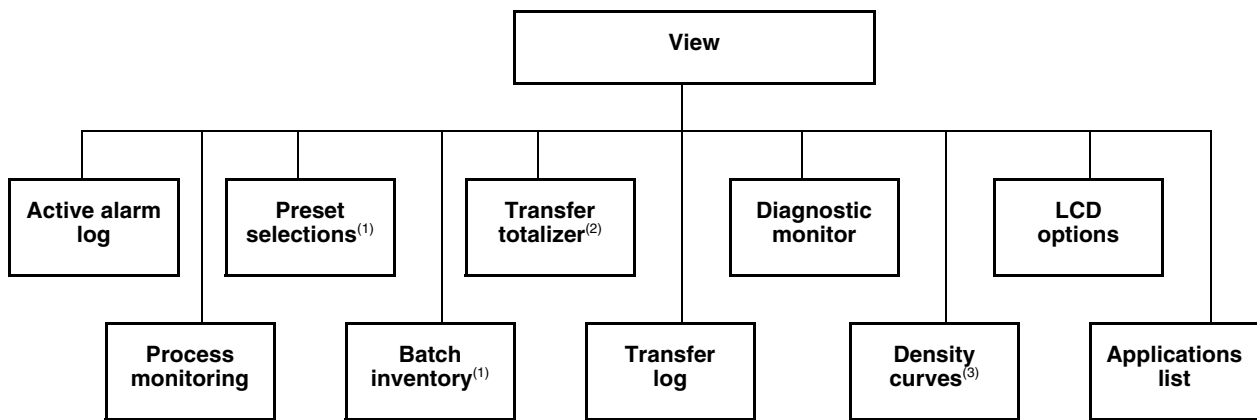
View menu

The View menu changes as follows:

- Transfer Totalizer replaces Process Totalizers.
- Transfer Log is added.

See Figure 19-2.

Figure 19-2 View menu – Custody transfer (OIML) and custody transfer (OIML/batch)



(1) Displayed only if discrete batch application is installed.

(2) Buttons on Transfer Totalizer screen depend on configured Protocol.

(3) Displayed only if enhanced density application is installed.

If you select Transfer Totalizer:

- You can view current transfer, inventory, or transfer and inventory values for the current transfer.
- If Protocol is set to Printer, a **PRINT** button is displayed when the print function is available (i.e., if Transfer Print Conditions is set to With Flow, or if Transfer Print Conditions is set to No Flow and there is no flow through the sensor). You can print current transfer, inventory, or transfer and inventory values for the current transfer. If you print a ticket that contains a transfer value, under conditions of zero flow, the current custody transfer transaction is completed and a new one is started (see Section 19.5.3).
- If Protocol is not set to Printer, the **RESET-T** button is displayed. This button can be used to complete the current custody transfer transaction and start a new one (see Section 19.5.3).

To view data for a different transfer:

1. Select **Transfer Log** from the **View** menu.
2. Use the **Select BOL to View** option to specify the transfer you want to view. You can view data for the 20 most recent transfers. Log data for the selected transfer is displayed automatically.

Totalizers and inventories

Note: For definitions of process totalizers, process inventories, transfer totalizers, and transfer inventories, see Section 20.2.

Whether the Series 3000 device is secured or unsecured:

- The process totalizers are not available. They are replaced by the transfer totalizers.
- Process inventories cannot be reset.

The maximum value for transfer totalizers and inventories is **999999999**. They are not displayed in scientific notation. If the maximum value is reached, they roll over to **0** and the character **R** (rollover indicator) is added to the data line on transfer screens. The **R** may or may not be displayed on the process monitor or printed on process monitor tickets, depending on approval of the process monitor:

- If the process monitor is approved (see Section 14.5), the **R** is displayed on the process monitor and printed on process monitor tickets.
- If the process monitor is not approved, the **R** is not displayed on the process monitor and not printed on process monitor tickets.

The **R** is cleared automatically from transfer totalizer values when a new custody transfer transaction is started. The **R** is not cleared automatically from transfer inventory values. To clear the **R** from transfer inventory values:

1. Select **Transfer Totalizer** from the **View** menu.
2. Select **Inventory**.
3. Select the inventory whose display indicator you want to clear.
4. Press the **CLEAR** button (see Figure 4-6).

Note: This action clears only the rollover indicator, and does not affect the transfer inventory value. To clear the R, the Series 3000 device must be unsecured.

Audit trail

The audit trail function (see Section 19.8) is active, whether the Series 3000 device is currently secured or unsecured.

19.6 Clearing a security breach

The method used to clear a security breach depends on the cause of the breach. See Table 19-3.

Table 19-3 Security breach causes and clearing methods

Cause	Clearing method
Security switch set to OFF	Set security switch to ON.
Core processor replaced, or disconnected and reconnected	<ul style="list-style-type: none">• Set security switch to OFF and back to ON.• If A009 and A026 alarms are present on Model 3300 or Model 3500 panel-mount devices, see Section 22.9.

Note: Clearing the security breach on the Series 3000 device does not establish legal security (see Section 19.2). To establish legal security, an authorized installation of the weights and measures seal must be performed (see Section 14.7).

19.7 Reconfiguring the Series 3000 device

If you need to reconfigure the Series 3000 device:

1. Break the weights and measures seal.
2. Set the security switch to OFF (see Section 14.6).
3. Perform required configuration changes.
4. Set the security switch to ON (see Section 14.6).
5. If desired, acknowledge the security breach alarm (see Section 22.6). This step is not required; the Series 3000 device will operate normally with an unacknowledged alarm.
6. Perform an authorized installation of the weights and measures seal (see Section 14.7).

19.8 Audit trail

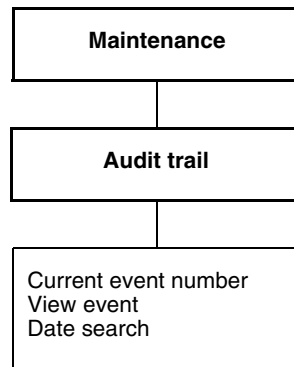
The audit trail feature is used to track any changes made to Series 3000 parameters while the device is unsecured.

The audit trail is organized into events. The Series 3000 device assigns a number to each event, and stores the events in numerical order. An event includes all parameter changes made between the time secure mode is exited and the time secure mode is reentered. For example:

- Secure mode is exited, no parameter changes are made, and secure mode is entered – no event is logged in the audit trail.
- Secure mode is exited, one parameter change is made, and secure mode is entered – one event is logged in the audit trail.
- Secure mode is exited, several parameter changes are made on one day, and several more are made on the following day, then secure mode is entered – one event is logged in the audit trail.

The audit trail is accessed from the Maintenance menu. See Figure 19-3.

Figure 19-3 Audit trail menu



19.8.1 Using the audit trail

The Current Event Number item on the Audit Trail menu displays the event number of the most recent event.

The View Event item is used to locate the event to be viewed.

To locate an event for viewing, use one of the following methods:

- Manual
 - a. Highlight **View Event**.
 - b. Press **CHG**.
 - c. Use the cursor buttons to move to the event number.
 - d. Press **SAVE**.
 - e. Press **EXIT**.
- Date search
 - a. Highlight **Date Search**.
 - b. Press **SEL**.
 - c. Set **Day**, **Month**, and **Year** to the date on which you want to start your search.
 - d. Press **SAVE**.
 - e. Press **EXIT**.

To view an event:

1. Use **View Event** as required to locate the event.
2. Press **VIEW**.
3. If more than one event is listed, scroll through the list and highlight the event you want to view.
4. Press **SEL**.
5. Scroll through the list of parameter changes, using the cursor buttons or the **PGDN** and **PGUP** buttons.

Chapter 20

Using Totalizers and Inventories

20.1 About this chapter

This chapter explains how to monitor, start, stop, and reset totalizers and inventories.

Note: Totalizers and inventories operate differently if the custody transfer application is installed. See Chapter 19 for more information.

20.2 Overview

There are several totalizer types:

- *Process totalizers* track the total quantity of a process variable, and can be viewed, stopped, started, and reset during normal use (i.e., from the process monitor or the View menu). Process totalizers include:
 - Mass total
 - Volume total
 - API reference volume total
 - ED (enhanced density) reference volume total
 - ED net mass total
 - ED net volume total
 - Frequency input total
- *Process inventories* track the total quantity of a process variable. They can be viewed from the process monitor or from the View or the Maintenance menu, but can be reset only from the Maintenance menu. They are typically used to track the total quantity of a process variable across multiple resets of the process totalizer. Process inventories include:
 - Mass inventory
 - Volume inventory
 - API reference volume inventory
 - ED reference volume inventory
 - ED net mass inventory
 - ED net volume inventory
 - Frequency input inventory
- *Batch inventories* track the total quantity of a process variable across batches. There is one batch inventory for each batch preset. Batch inventories are available only if the discrete batch application is installed and configured. The View menu allows you to view batch inventory values for only the batch presets that are enabled. The Maintenance menu allows you to view and reset batch inventory values for all six batch presets, whether or not they are defined or enabled.

Using Totalizers and Inventories

In addition, if the custody transfer application is installed and World Area is set to OIML, the process totalizers and inventories are replaced by the following:

- *Transfer totalizers* – track the total quantity of the transfer variable measured by a single custody transfer transaction. They are automatically reset when the custody transfer transaction ends.
- *Transfer inventories* – track the total quantity of the transfer variable measured across custody transfer transactions. They cannot be reset.

For more information on transfer totalizers and transfer inventories, see Section 19.5.6.

Note: The transmitter can store totalizer and inventory values up to 2⁶⁴. Values larger than this cause the internal totalizer to go into overflow.

20.3 Totalizer management

The method used to manage totalizers depends on the totalizer type and the function to be performed. See Table 20-1.

Totalizers appear on the process monitor only if the process monitor has been configured to display them (see Section 12.3). The user-specified label will be used (see Section 12.4). For information on using the process monitor to reset totalizers, see Section 17.4.

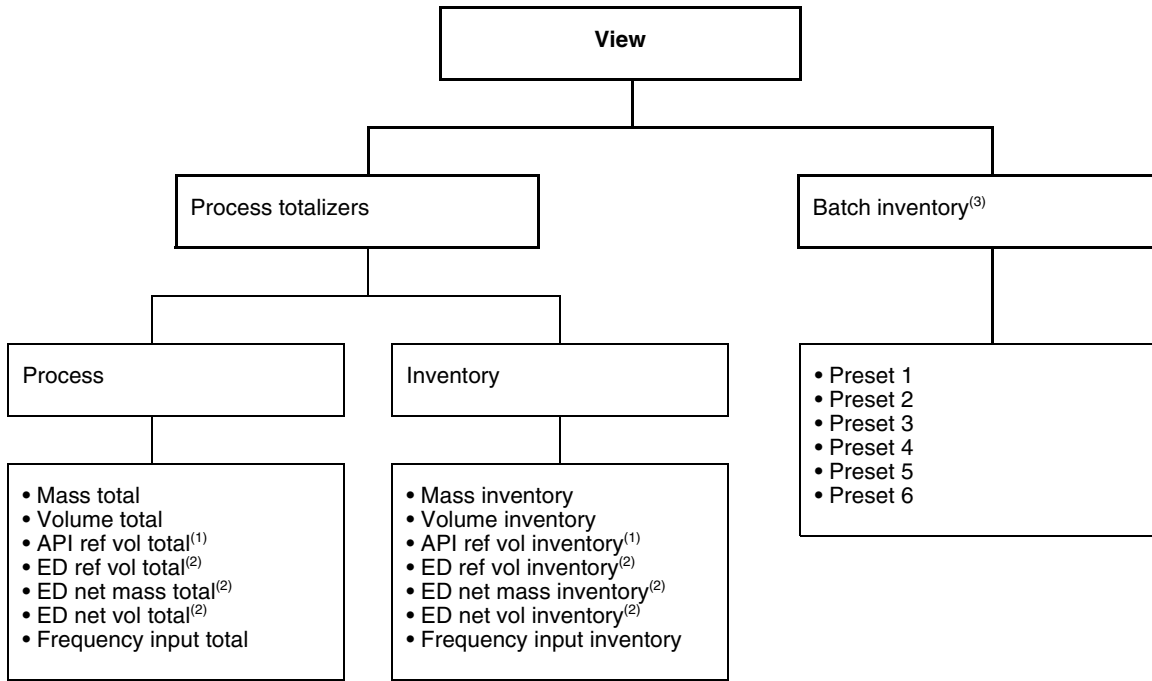
Refer to Chapter 4 for information on accessing the View menu and the Maintenance menu.

Table 20-1 Totalizer management

Totalizer type	Process monitor	View menu	Maintenance menu
Process totalizer	View current value, reset ⁽¹⁾	View current value, start, stop, reset ⁽¹⁾	Not accessible
Process inventory	View current value	View current value	View current value, reset ⁽¹⁾
Batch inventory	N/A	View current value for enabled batch presets	View current value, reset for all six batch presets

(1) Reset is available only if enabled via the display. See Section 5.3.3.

Figure 20-1 View menu – Totalizer management

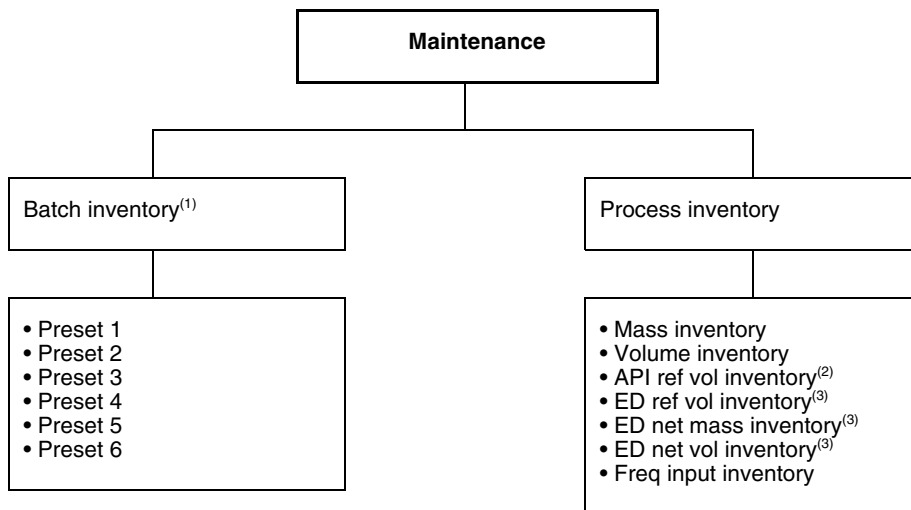


(1) Displayed only if the petroleum measurement application is installed.

(2) Displayed only if the enhanced density application is installed.

(3) Displayed only if the discrete batch application is installed. Only enabled presets are listed.

Figure 20-2 Maintenance menu – Totalizer management



(1) Displayed only if the discrete batch application is installed.

(2) Displayed only if the petroleum measurement application is installed.

(3) Displayed only if the enhanced density application is installed.

20.4 Process totalizers

Use the View menu to:

- View the current value of a process totalizer
- Start or stop all process totalizers and inventories simultaneously
- Reset a process totalizer

From the View menu:

1. Select **Process Totalizers**.
2. Select **Process**. All process totalizers are displayed. Scroll down the list as required.
3. To start all totalizers and inventories, press **START**.
4. To stop all totalizers and inventories, press **STOP**.
5. To reset a totalizer, highlight the desired totalizer and press **RESET**.

Note: The RESET button is available only if resetting totalizers via the display has been enabled. See Section 5.3.3.

Note: If write-protection has been enabled (see Section 5.3.2), process totalizers cannot be reset unless the flow rate is zero.

20.5 Process inventories

Use the Maintenance menu to:

- View the current value of a process inventory
- Reset a process inventory

From the Maintenance menu:

1. Select **Process Inventory**. All process inventories are displayed. Scroll down the list as required.
2. To reset a process inventory, highlight the desired process inventory and press **RESET**.

Note: The RESET button is available only if resetting totalizers via the display has been enabled. See Section 5.3.3.

You can also use the View menu to view the current value of a process inventory. From the View menu:

1. Select **Process Totalizers**.
2. Select **Inventory**.
3. Select the desired process inventory. Its current value is displayed on screen.

20.6 Batch inventories

Use the Maintenance menu to:

- View the current value of a batch inventory
- Reset a batch inventory

From the Maintenance menu:

1. Select **Batch Inventory**. Values for all batch presets are displayed. Scroll down the list as required.
2. To reset a batch inventory, highlight the desired batch preset and press **RESET**.

Using Totalizers and Inventories

You can also use the View menu to view the current value of a batch inventory. From the View menu:

1. Select **Batch Inventory**. Values are listed only for presets that have been enabled.
2. Scroll down the list as required.

Chapter 21

Measurement Performance

21.1 Overview

This chapter describes the following procedures:

- Meter verification – see Section 21.3
- Meter validation and adjusting meter factors – see Section 21.4
- Density calibration – see Section 21.5
- Temperature calibration – see Section 21.6

This chapter provides basic information and procedural flowcharts for each step. For more details about how to perform each procedure, see the flowcharts for your Series 3000 device and communication tool, provided in the appendices to this manual.

Notes: All ProLink II or Communicator procedures provided in this section assume that your computer is already connected to the Series 3000 device and you have established communication, and that you are complying with all applicable safety requirements.

21.2 Meter verification, meter validation, and calibration

There are three procedures:

- *Meter verification* – establishing confidence in the sensor's performance by analyzing secondary variables that are highly correlated with flow and density calibration factors
- *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

These three procedures are discussed and compared in Sections 21.2.1 through 21.2.4. Before performing any of these procedures, review these sections to ensure that you will be performing the appropriate procedure for your purposes.

21.2.1 Meter verification

Meter verification applies only to the Model 3500 and Model 3700 transmitters. To use meter verification, the transmitter must be connected to an enhanced core processor and the meter verification option must have been ordered.

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

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

There are two versions of the meter verification application: the original version and Micro Motion Smart Meter Verification. Table 21-1 lists requirements for the original version and Smart Meter Verification. Table 21-2 provides a comparison of the two versions.

Note: If you are running an older version of ProLink II or the Communicator device description, you will not be able to access the additional features in Smart Meter Verification. If you are running an updated version of ProLink II or the Communicator with the original version of meter verification, the meter verification procedures will be slightly different from the procedures shown here.

Table 21-1 Version requirements for meter verification application

Requirement type	Meter verification application	
	Original version	Smart Meter Verification
Transmitter	v7.0	v8.0 and later
Enhanced core processor ⁽¹⁾	v3.0	v3.6 and later
ProLink II requirements	v2.5	v2.9
HART DD requirements	375 Field Communicator device rev 7, DD rev 1	375 Field Communicator device rev 8, DD rev 1

(1) The standard core processor does not support meter verification.

Table 21-2 Comparison of meter verification features and functions: original version vs. Smart Meter Verification

Feature or function	Meter verification application	
	Original version	Smart Meter Verification
Process interruption	No need to halt flow	No need to halt flow
Measurement interruption	Three minutes. Outputs go to: <ul style="list-style-type: none"> • Last Measured Value • Configured Fault Value 	User option: <ul style="list-style-type: none"> • Continue Measurement. Measurement is not interrupted. Test requires approximately 90 seconds. • Last Measured Value. Outputs fixed and measurement interrupted for approximately 140 seconds. • Configured Fault Value. Outputs fixed and measurement interrupted for approximately 140 seconds.
Result storage	Test results stored only for tests run with ProLink II, and stored on the PC	Twenty most recent results stored on the transmitter, independent of tool used to perform the procedure. For tests run with ProLink II, additional result data stored on PC.

Table 21-2 Comparison of meter verification features and functions: original version vs. Smart Meter Verification *continued*

Feature or function	Meter verification application	
	Original version	Smart Meter Verification
Result data on display	Pass/Fail/Abort for current test	For all results stored on transmitter: <ul style="list-style-type: none"> • Pass/Fail/Abort • Abort code (if relevant) • Stiffness of the right and left pickoffs
Result data with Communicator	Pass/Caution/Abort for current test	For all results stored on transmitter: <ul style="list-style-type: none"> • Pass/Caution/Abort • Abort code (if relevant) • Stiffness of the right and left pickoffs • Comparison table for stored results • Comparison plot for stored results
Result data with ProLink II	For all results stored on PC: <ul style="list-style-type: none"> • Pass/Fail/Abort • Abort code (if relevant) • Stiffness of the right and left pickoffs • Test execution metadata • Comparison graphs • Test reports • Data export and manipulation capabilities 	For all results stored on transmitter: <ul style="list-style-type: none"> • Pass/Fail/Abort • Abort code (if relevant) • Stiffness of the right and left pickoffs • Test execution metadata • Comparison graphs • Test reports • Data export and manipulation capabilities
Startup methods	Manual	Manual Scheduler Event Discrete input

21.2.2 Meter validation and meter factors

Meter validation can be used with all Series 3000 systems (both transmitters and controllers). There are no special requirements.

Meter validation compares a measurement value reported by the Series 3000 device 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 Series 3000 device’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 Series 3000 device 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.

21.2.3 Calibration

Calibration applies only to the Model 3500 and Model 3700 transmitters. There are no special requirements.

Measurement Performance

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 16.3)
- 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.

Transmitters 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.

21.2.4 Comparison and recommendations

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

- Process and measurement interruption
 - Smart Meter Verification provides an option that allows process measurement to continue during the test.
 - The original version of meter verification requires approximately three minutes to perform. During these three minutes, flow can continue (provided sufficient stability is maintained); however, measurement is halted.
 - Meter validation for density does not interrupt the process or process measurement. 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 with low-temperature and high-temperature fluids.
- External measurement requirements
 - Neither version of meter verification requires 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 option and performing meter verification on a regular basis.

21.3 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.

21.3.1 Preparing for the meter verification test

Process fluid and process conditions

The meter verification test can be performed on any process fluid. It is not necessary to match factory conditions.

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 the stability of the process and retry the test.

Transmitter configuration

Meter verification is not affected by any parameters configured for flow, density, or temperature. It is not necessary to change the transmitter configuration.

Control loops and process measurement

If the transmitter outputs will be set to Last Measured Value or Fault during the test, the outputs will be fixed for two minutes (Smart Meter Verification) or three minutes (original version). Disable all control loops for the duration of the test, and ensure that any data reported during this period is handled appropriately.

Specification uncertainty limit

The specification uncertainty limit defines the acceptable degree of variation from factory results, expressed as a percentage. Variation inside the limit is reported as Pass. Variation outside the limit is reported as Fail or Caution.

- In Smart Meter Verification, the specification uncertainty limit is set at the factory and cannot be configured.
- In the original version of meter verification, the specification uncertainty limit is configurable. However, Micro Motion suggests using the default value. Contact Micro Motion Customer Service before changing the specification uncertainty limit.

21.3.2 Running the meter verification test, original version

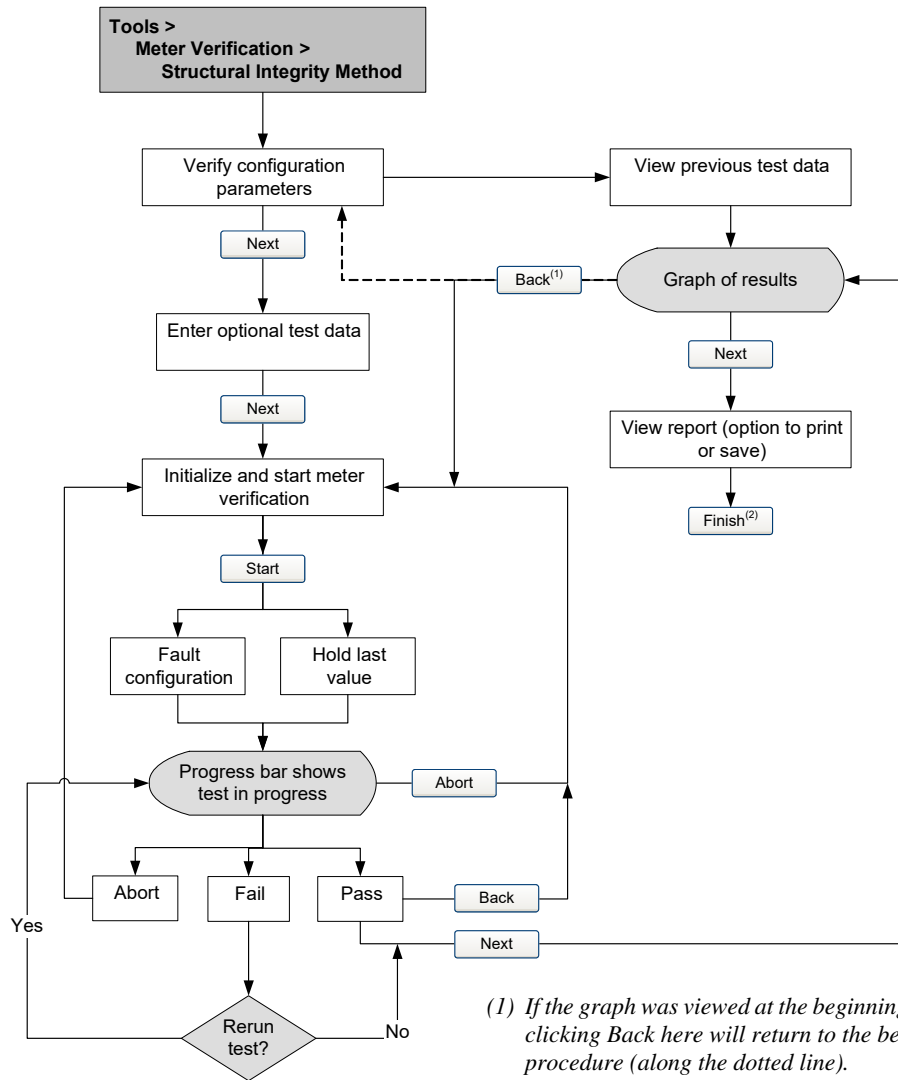
To run a meter verification test:

- With ProLink II, see Figure 21-1
- With the display, see Figure 21-2

Note: If you start a meter verification test from ProLink II, the transmitter display shows the following message:

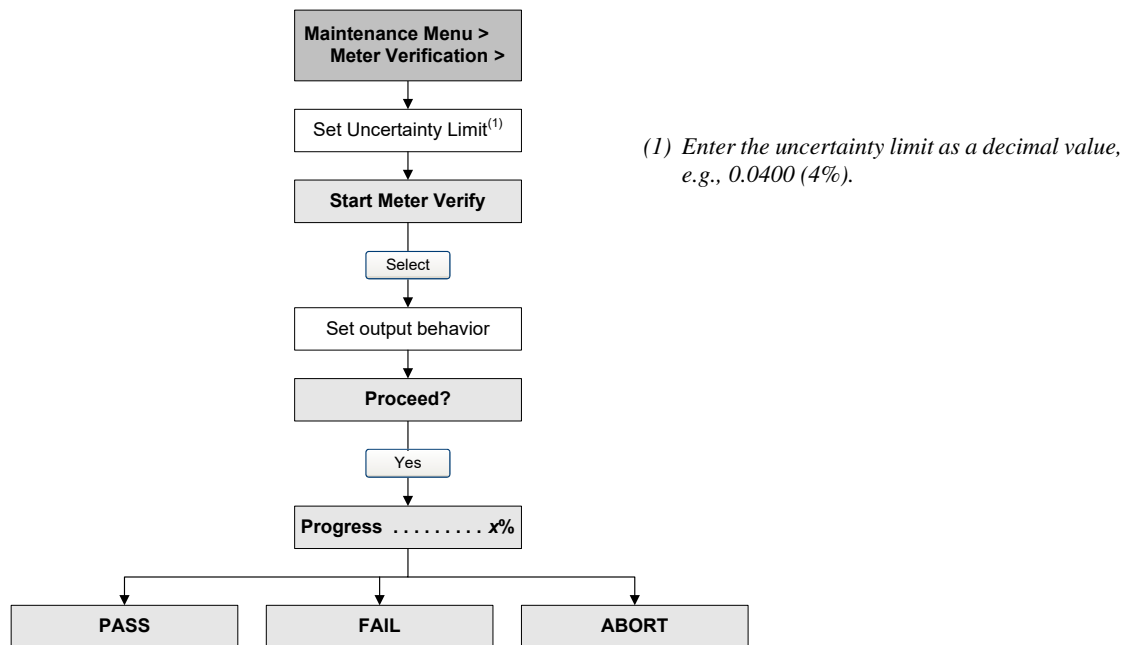
**SENSOR
VERFY/x%**

Figure 21-1 Meter verification test, original version – ProLink II



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

Figure 21-2 Meter verification test, original version – Display



21.3.3 Running Smart Meter Verification

To run a Smart Meter Verification test:

- With ProLink II, see Figure 21-3.
- With the display, see Figure 21-4.
- With the Communicator, see Figure 21-5.

Note: If the custody transfer application is installed and the transmitter is secured, you can run a Smart Meter Verification test with outputs set to Continue Measuring or Fault. Last Measured Value is not available. See Section 19.3 for detailed information.

Note: If you start a Smart Meter Verification test from ProLink II or the Communicator, and the outputs are set to Last Measured Value or Fault, the transmitter display shows the following message:

**SENSOR
VERFY/x%**

Figure 21-3 Smart Meter Verification test – ProLink II

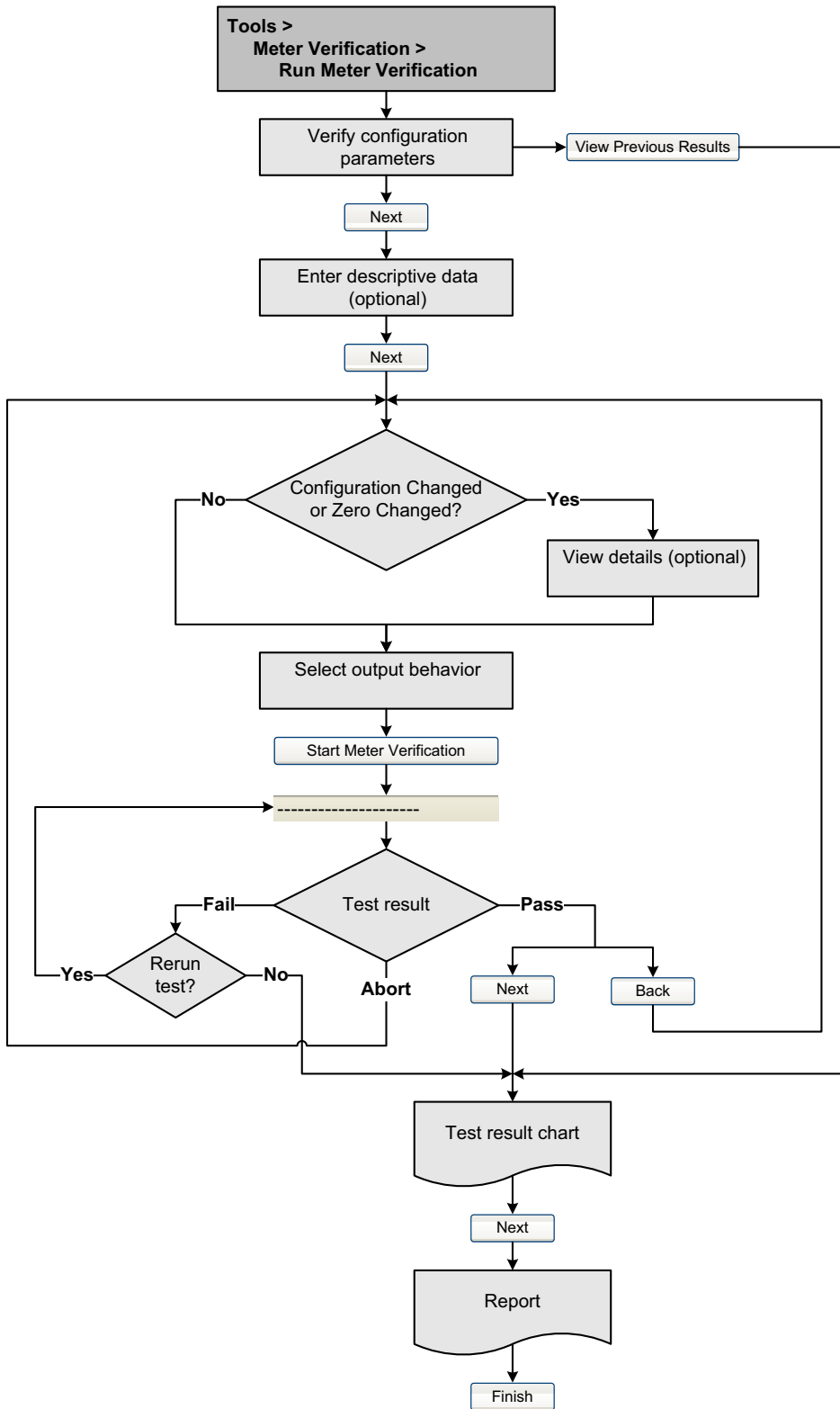


Figure 21-4 Smart Meter Verification test – Display

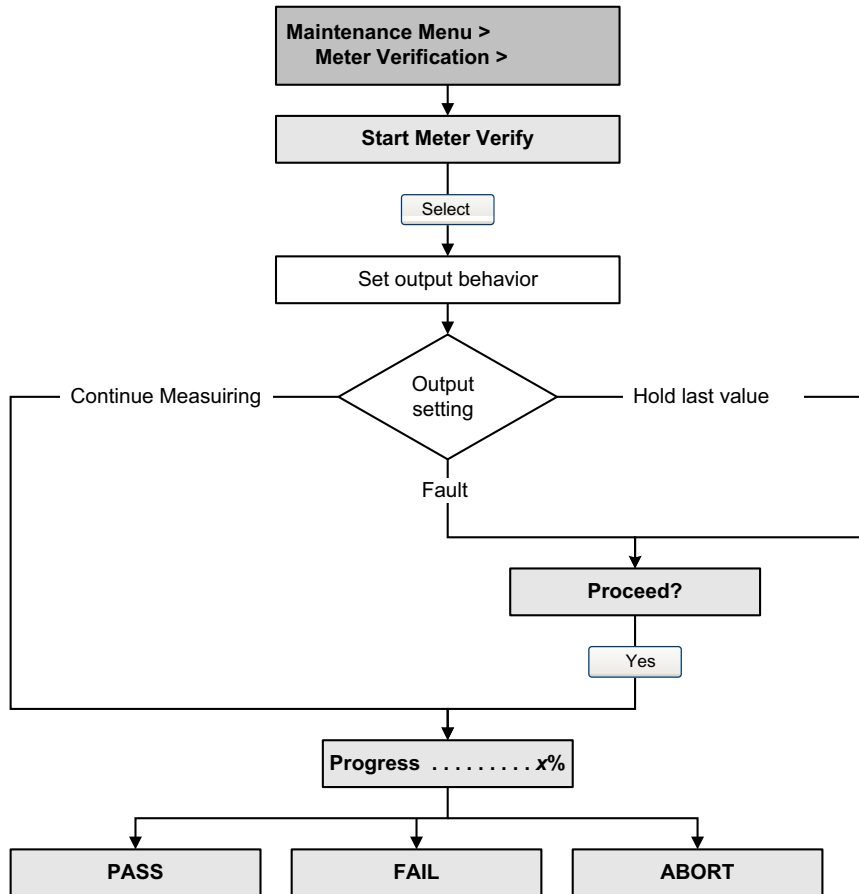
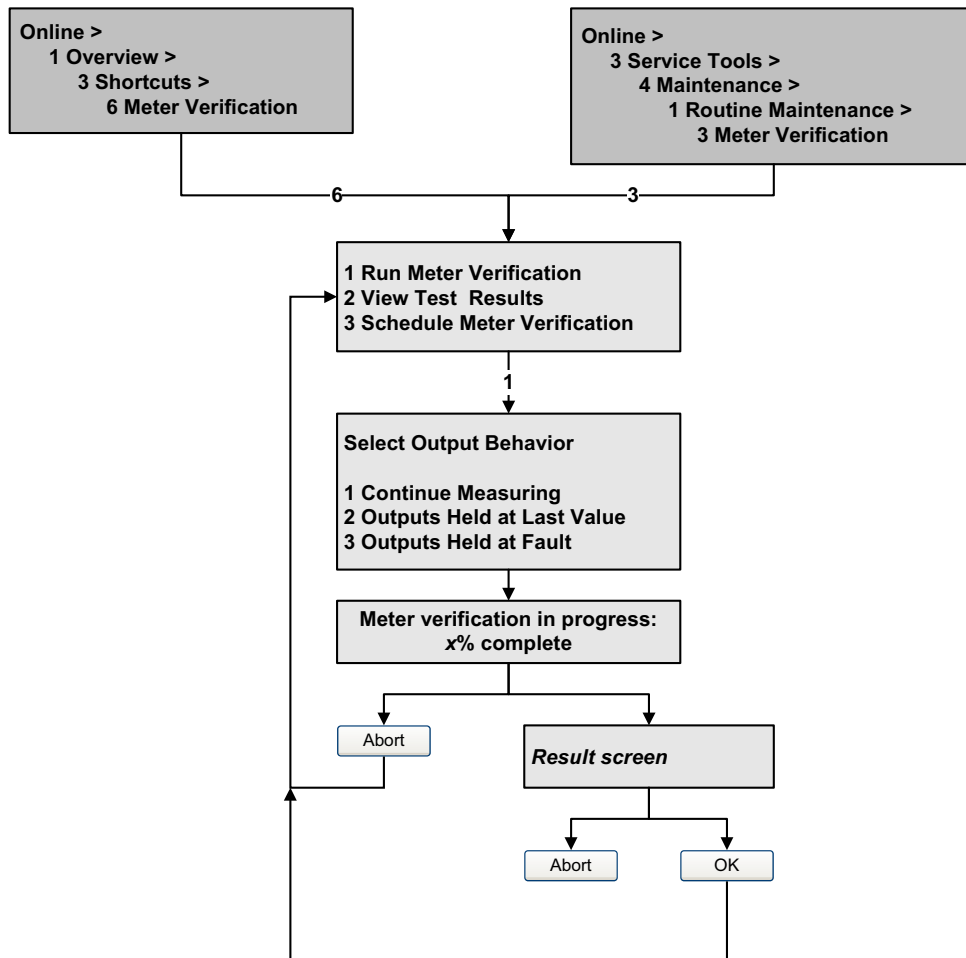


Figure 21-5 Smart Meter Verification test – Communicator



21.3.4 Reading and interpreting meter verification test results

Pass/Fail/Abort

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. In other words, the stiffness of the left and right pickoffs match the factory values plus or minus 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 repeat the meter verification test. If you were using Smart Meter Verification, with outputs set to Continue Measurement, change the setting to Last Measured Value or Fault.
 - 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 your process knowledge to determine the possibilities for damage and the appropriate actions for each. These actions might include removing the meter from service and physically inspecting the tubes. At minimum, you should perform a flow validation and a density calibration.
- *Abort* – A problem occurred with the meter verification test (e.g., process instability). Abort codes are listed and defined in Table 21-3, and suggested actions are provided for each code.

Table 21-3 Meter verification abort codes

Abort code	Description	Suggested action
1	User-initiated abort	None required. Wait for 15 seconds before starting another test.
3	Frequency drift	Ensure that temperature, flow, and density are stable, and rerun the test.
5	High drive gain	Ensure that flow is stable, minimize entrained gas, and rerun the test.
8	Unstable flow	Review the suggestions for stable flow in Section 21.3.1 and rerun the test.
13	No factory reference data for meter verification test performed on air	Contact Micro Motion customer service and provide the abort code.
14	No factory reference data for meter verification test performed on water	Contact Micro Motion customer service and provide the abort code.
15	No configuration data for meter verification	Contact Micro Motion customer service and provide the abort code.
Other	General abort.	Repeat the test. If the test aborts again, contact Micro Motion customer service and provide the abort code.

Detailed test data with ProLink II

For each test, the following data is stored on the transmitter:

- Powered-on hours at the time of the test (Smart Meter Verification)
- Test result
- Stiffness of the left and right pickoffs, shown as percentage variation from the factory value. If the test aborted, 0 is stored for these values.
- Abort code, if applicable

ProLink II stores additional descriptive information for each test in a database on the local PC, including:

- Timestamp from the PC clock
- Current flowmeter identification data
- Current flow and density configuration parameters
- Current zero values
- Current process values for mass flow rate, volume flow rate, density, temperature, and external pressure
- (Optional) User-entered customer and test descriptions

If you are using Smart Meter Verification and you run a meter verification test from ProLink II, ProLink II first checks for new test results on the transmitter and synchronizes the local database if required. During this step, ProLink II displays the following message:

Synchronizing x out of y
Please wait

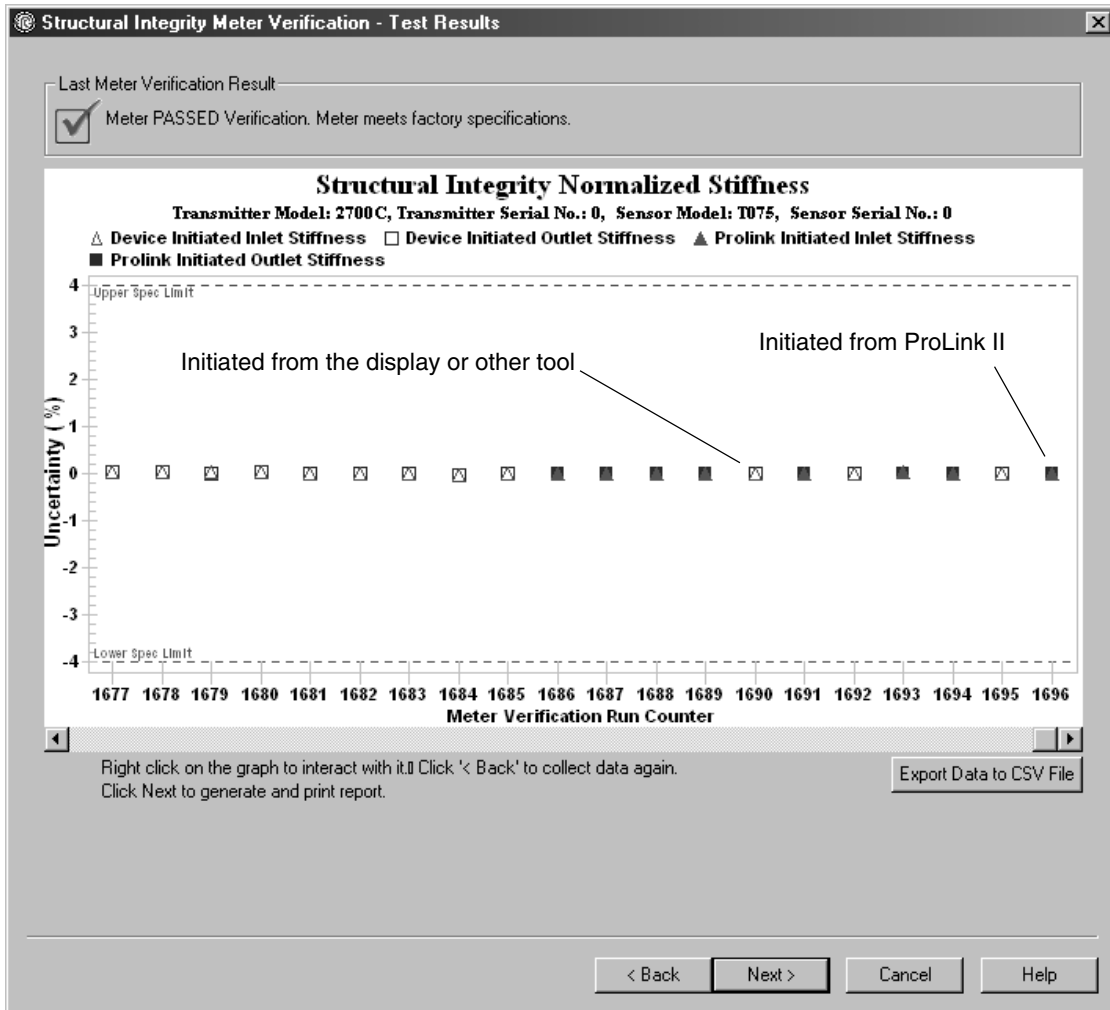
Note: If you request an action while synchronization is in process, ProLink II displays a message asking whether or not you want to complete synchronization. If you choose No, the ProLink II database may not include the latest test results from the transmitter.

Test results are available at the end of each test, in the following forms:

- A test result chart (see Figure 21-6).
- A test report that includes the descriptive information for the current test, the test result chart, and background information about meter verification. You can export this report to an HTML file or print it to the default printer.

Note: To view the chart and the report for previous tests without running a test, click View Previous Test Results and Print Report from the first meter verification panel. See Figure 21-3. Test reports are available only for tests initiated from ProLink II.

Figure 21-6 Test result chart



The test result chart shows the results for all tests in the ProLink II database, plotted against the specification uncertainty limit. The inlet stiffness and the outlet stiffness are plotted separately. This helps to distinguish between local and uniform changes to the sensor tubes.

This chart supports trend analysis, which can be helpful in detecting meter problems before they become severe.

Note the following:

- The test result chart may not show all test results, and test counters may not be continuous. ProLink II stores information about all tests initiated from ProLink II and all tests available on the transmitter when the test database is synchronized. However, the transmitter stores only the twenty most recent test results. To ensure a complete result set, always use ProLink II to initiate the tests, or synchronize the ProLink II database before overwriting occurs.
- The chart uses different symbols to differentiate between tests initiated from ProLink II and tests initiated using a different tool. A test report is available only for tests that were initiated from ProLink II.
- You can double-click the chart to manipulate the presentation in a variety of ways (change titles, change fonts, colors, borders and gridlines, etc.), and to export the data to additional formats (including “to printer”).
- You can export this chart to a CSV file for use in external applications.

Detailed test data with the display

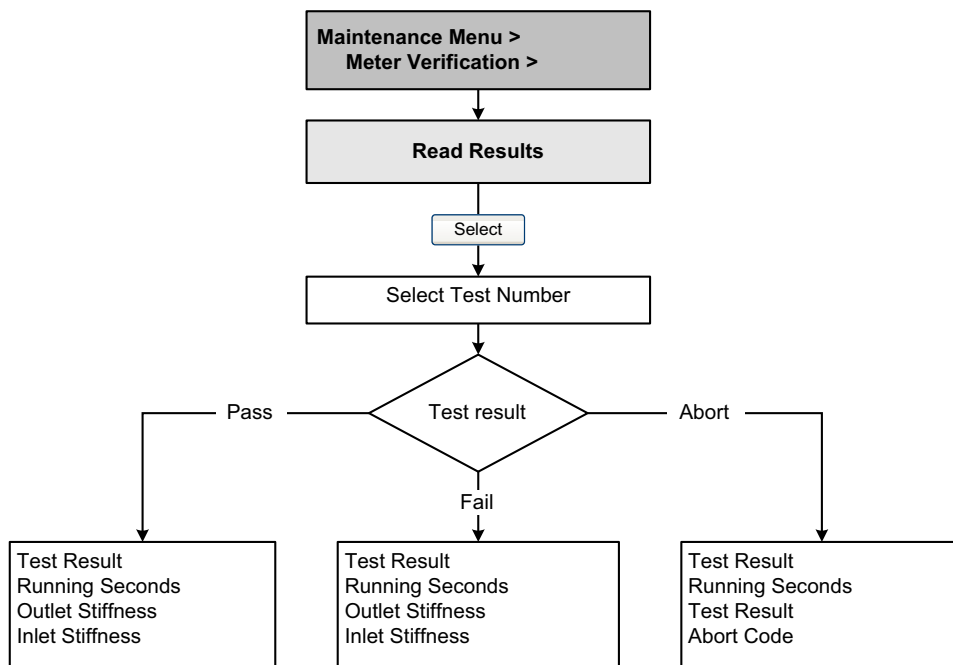
Note: Requires Smart Meter Verification. No detailed test data is available with the original version of the meter verification application.

For each Smart Meter Verification test, the following data is stored on the transmitter:

- Powered-on hours at the time of the test
- Test result
- Stiffness of the left and right pickoffs, shown as percentage variation from the factory value. If the test aborted, 0 is stored for these values.
- Abort code, if applicable

To view this data, see Figure 21-7.

Figure 21-7 Meter verification test data – Display



Detailed test data with the Communicator

Note: Requires Smart Meter Verification. No detailed test data is available with the original version of the meter verification application.

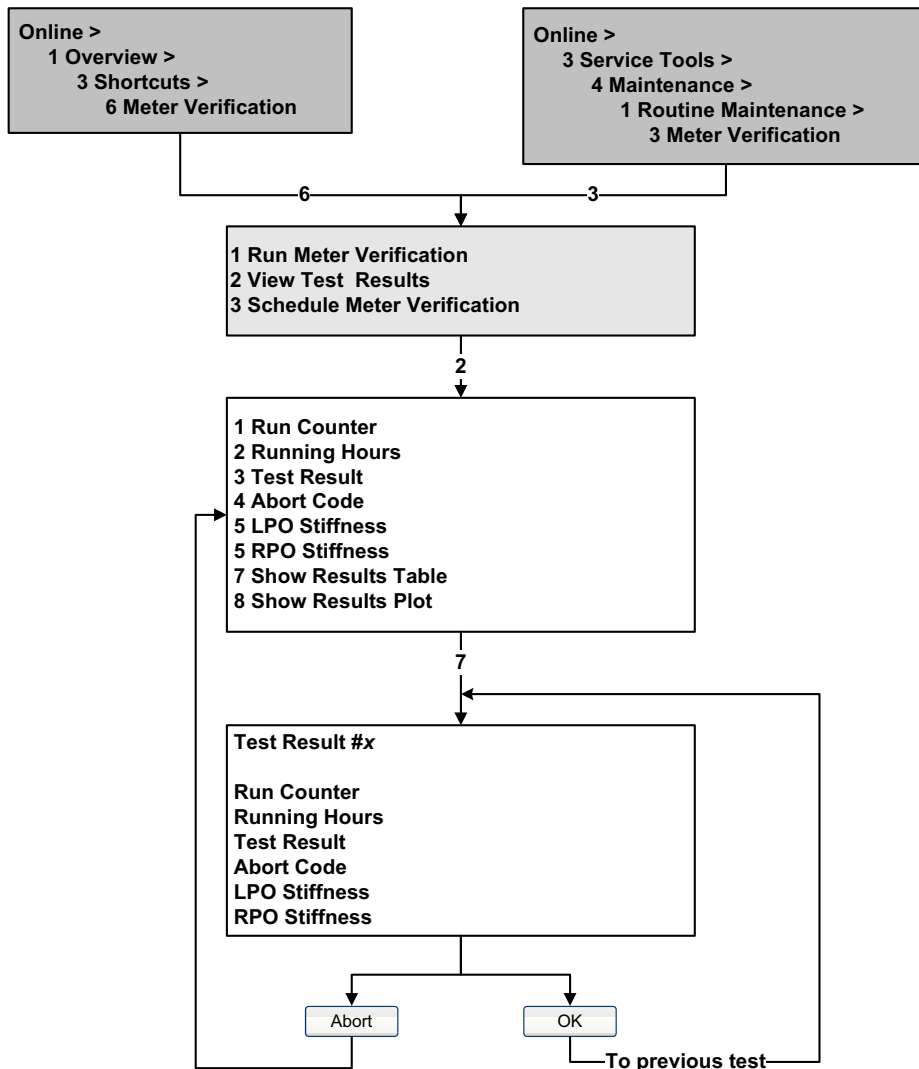
For each Smart Meter Verification test, the following data is stored on the transmitter:

- Powered-on hours at the time of the test
- Test result
- Stiffness of the left and right pickoffs, shown as percentage variation from the factory value. If the test aborted, 0 is stored for these values.
- Abort code, if applicable

The Communicator also provides a trend function that allows you to compare the results of the 20 tests, viewed as either a table or a graph.

To view this data, see Figure 21-8.

Figure 21-8 Meter verification test data – Communicator



21.3.5 Setting up automatic or remote execution of the meter verification test

Note: Requires Smart Meter Verification. Scheduling is not available with the original version of the meter verification application.

There are three ways to execute a Smart Meter Verification test automatically:

- Define it as an event action
- Set up a one-time automatic execution
- Set up a recurring execution

In addition, if your transmitter has a discrete input, you can configure the discrete input to initiate a Smart Meter Verification test remotely.

In all cases, the test will be performed with outputs set to **Continue Measuring**.

You can use these methods in any combination. For example, you can specify that a Smart Meter Verification test will be executed three hours from now, every 24 hours starting now, every time a specific discrete event occurs, and every time the discrete input is activated.

- To define meter verification as an event action, see Figure 10.4.
- To define meter verification as a discrete input action, see Section 7.3.5.
- To set up a one-time automatic execution, set up a recurring execution, view the number of hours until the next scheduled test, or delete a schedule:
 - With ProLink II, click **Tools > Meter Verification > Schedule Meter Verification**.
 - With the display, see Figure 21-9.
 - With the Communicator, see Figure 21-10

Note the following:

- If you are setting up a one-time automatic execution, specify the start time as a number of hours from the present time. For example, if the present time is 2:00 and you specify 3.5 hours, the test will be initiated at 5:30.
- If you are setting up a recurring execution, specify the number of hours to elapse between executions. The first test will be initiated when the specified number of hours has elapsed, and testing will be repeated at the same interval until the schedule is deleted. For example, if the present time is 2:00 and you specify 2 hours, the first test will be initiated at 4:00, the next at 6:00, and so on.
- To turn off automatic execution from the display, set the appropriate value (**Next Run** or **Recurring Time**) to 0 hours.

Figure 21-9 Smart Meter Verification scheduler – Display

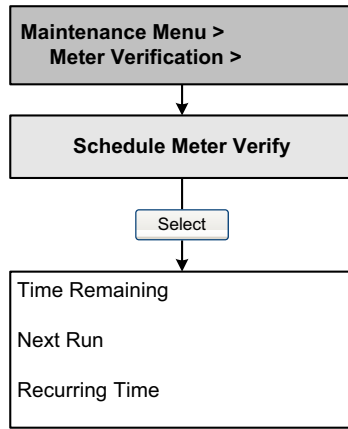
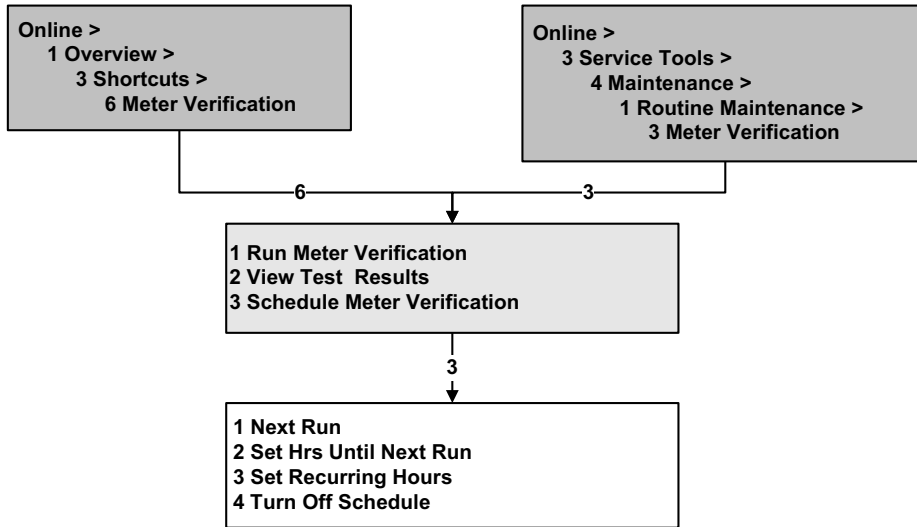


Figure 21-10 Smart Meter Verification scheduler – Communicator



21.4 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.

To enter the new meter factor, use the Inputs menu (see Figure 7-1).

Example

The flowmeter is installed and proved for the first time. The flowmeter mass measurement is 250.27 lb; the reference device measurement is 250 lb. A mass flow meter factor is determined as follows:

$$\text{MassFlowMeterFactor} = 1 \times \frac{250}{250.27} = 0.9989$$

The first 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:

$$\text{MassFlowMeterFactor} = 0.9989 \times \frac{250.25}{250.07} = 0.9996$$

The new mass flow meter factor is 0.9996.

21.5 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.

21.5.1 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/cm³
- Minimum difference of 0.1 g/cm³ 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/cm³
- Minimum difference of 0.1 g/cm³ 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/cm³ 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

During the calibration, you must enter the density of the calibration fluid. For convenience, Tables 21-4 and 21-5 provide the density of air and water at different environmental conditions.

Table 21-4 Density of air

Pressure in millibar (inches of mercury)	Temperature in °C and °F								
	10 °C 50 °F	15 °C 59 °F	20 °C 68 °F	25 °C 77 °F	30 °C 86 °F	35 °C 95 °F	40 °C 104 °F	45 °C 113 °F	50 °C 122 °F
850 (25.14)	.0010	.0010	.0010	.0010	.0010	.0010	.0009	.0009	.0009
900 (26.62)	.0011	.0011	.0011	.0010	.0010	.0010	.0010	.0010	.0009
950 (28.10)	.0012	.0011	.0011	.0011	.0011	.0011	.0010	.0010	.0010
1000 (29.57)	.0012	.0012	.0012	.0012	.0011	.0011	.0011	.0011	.0011
1050 (31.06)	.0013	.0013	.0012	.0012	.0012	.0012	.0012	.0011	.0011

Table 21-5 Density of water

Temperature			Temperature		
°C	°F	Density in g/cm ³	°C	°F	Density in g/cm ³
0	32	0.99987	21	69.8	0.99802
1	33.8	0.99993	22	71.6	0.99780
2	35.6	0.99997	23	73.4	0.99756
3	37.4	0.99999	24	75.2	0.99732
4	39.2	1.00000	25	77	0.99707
5	41	0.99999	26	78.8	0.99681
6	42.8	0.99997	27	80.6	0.99654
7	44.6	0.99993	28	82.4	0.99626
8	46.4	0.99988	29	84.2	0.99597
9	48.2	0.99981	30	86	0.99567
10	50	0.99973			
11	51.8	0.99963	31	87.8	0.99537
12	53.6	0.99952	32	89.6	0.99505
13	55.4	0.99940	33	91.4	0.99473
14	57.2	0.99927	34	93.2	0.99440
15	59	0.99913	35	95	0.99406
16	60.8	0.99897	36	96.8	0.99371
17	62.6	0.99880	37	98.6	0.99336
18	64.4	0.99862	38	100.4	0.99229
19	66.2	0.99843			
20	68	0.99823			

21.5.2 Density calibration procedures

To perform the low-density calibration:

1. Fill the sensor with a low-density fluid, such as air.
2. If possible, shut off the flow. Otherwise, pump the fluid through the sensor at the lowest flow rate allowed by the process.
3. Use any established method to derive an accurate density, in g/cm³, for the fluid at line conditions. If air is the low-density calibration fluid, a value from Table 21-4 can be used for the density.
4. Press the Security button on the display.
5. From the Maintenance menu, select **Calibration**.
6. Select **Density**.
7. Select **Low Density**.
 - a. Set the **D1** value to the line-condition density *in grams per cubic centimeter*.
 - b. Select **Calibrate Density**, then press **SEL**. A “Calibration In Progress” alarm is generated.
8. When the calibration is complete:
 - In the active alarm log, the alarm changes from “active” to “inactive but unacknowledged.”
 - If the calibration succeeded, a “Success” status is displayed.
 - If the calibration failed, a “Failed” status is displayed.
9. Press **EXIT** to return to the Density menu.
10. (Optional) To clear the alarm from the active alarm log and the alarm bar at the top of the display, acknowledge the alarm using the procedures described in Chapter 22.

To perform the high-density calibration:

1. Fill the sensor with a high-density fluid, such as water.

Measurement Performance

2. If possible, shut off the flow. Otherwise, pump the fluid through the sensor at the lowest flow rate allowed by the process.
3. To ensure stable density, make sure the fluid in the flow tubes remains *completely* free of gas bubbles during the calibration.
4. Use any established method to derive an accurate density, in g/cm^3 , for the fluid at line conditions. If water is the high-density calibration fluid, a value from Table 21-5 can be used for the density.
5. From the Density menu, select **High Density**.
 - a. Set the **D2** value to the line-condition density *in grams per cubic centimeter*.
 - b. Select **Calibrate Density**, then press **SEL**. A “Calibration In Progress” alarm is generated.
6. When the calibration is complete:
 - In the active alarm log, the alarm changes from “active” to “inactive but unacknowledged.”
 - If the calibration succeeded, a “Success” status is displayed.
 - If the calibration failed, a “Failed” status is displayed.
7. Press **EXIT** to return to the Density menu.
8. (Optional) To clear the alarm from the active alarm log and the alarm bar at the top of the display, acknowledge the alarm using the procedures described in Chapter 22.

To perform the D3 calibration (T-Series sensors only):

1. Fill the sensor completely with a fluid of known density.
2. If possible, shut off the flow. Otherwise, pump the fluid through the sensor at the lowest flow rate allowed by the process.
3. To ensure stable density, make sure the fluid in the flow tubes remains *completely* free of gas bubbles during the calibration.
4. Use any established method to derive an accurate density, in g/cm^3 , for the fluid at line conditions.
5. From the Density menu, select **Density D3**.
 - a. Set the **D3** value to the line-condition density *in grams per cubic centimeter*.
 - b. Select **Calibrate Density**, then press **SEL**. A “Calibration In Progress” alarm is generated.
6. When the calibration is complete:
 - In the active alarm log, the alarm changes from “active” to “inactive but unacknowledged.”
 - If the calibration succeeded, a “Success” status is displayed.
 - If the calibration failed, a “Failed” status is displayed.
7. Press **EXIT** to return to the Density menu.
8. (Optional) To clear the alarm from the active alarm log and the alarm bar at the top of the display, acknowledge the alarm using the procedures described in Chapter 22.

To perform the D4 calibration (T-Series sensors only):

1. Fill the sensor completely with a fluid of known density.
2. If possible, shut off the flow. Otherwise, pump the fluid through the sensor at the lowest flow rate allowed by the process.
3. To ensure stable density, make sure the fluid in the flow tubes remains *completely* free of gas bubbles during the calibration.

4. Use any established method to derive an accurate density, in g/cm^3 , for the fluid at line conditions.
5. From the Density menu, select **Density D4**.
 - a. Set the **D4** value to the line-condition density *in grams per cubic centimeter*.
 - b. Select **Calibrate Density**, then press **SEL**. A “Calibration In Progress” alarm is generated.
6. When the calibration is complete:
 - In the active alarm log, the alarm changes from “active” to “inactive but unacknowledged.”
 - If the calibration succeeded, a “Success” status is displayed.
 - If the calibration failed, a “Failed” status is displayed.
7. Press **EXIT** to return to the Density menu.
8. (Optional) To clear the alarm from the active alarm log and the alarm bar at the top of the display, acknowledge the alarm using the procedures described in Chapter 22.

21.6 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.

Temperature calibration requires reading and entering temperature values in degrees Celsius. Although it is not required, it may be useful to configure the temperature unit for degrees Celsius. See Section 7.3.2 for information on configuring the temperature unit.

To perform the temperature offset calibration:

1. Fill the sensor with process fluid at the lowest temperature measured during the application.
2. Wait approximately 30 minutes for the flow tube temperature to stabilize.
3. Use a highly accurate thermometer, temperature sensor, RTD, or other device to measure the temperature of the process fluid.
4. From the Maintenance menu, select **Calibration**.
5. Select **Temperature**.
6. Select **Low Temperature**.
7. At the Low Temperature menu:
 - a. Set the **Low Temperature Value** to the temperature that was measured in Step 3, *in degrees Celsius*, then press **SAVE**.
 - b. Select **Calibrate Temp**, then press **SEL**.
8. During calibration, an alarm message is generated.
9. When the calibration is complete:
 - In the active alarm log, the alarm changes from “active” to “inactive but unacknowledged.”
 - If the calibration succeeded, a “Success” status is displayed.
 - If the calibration failed, a “Failed” status is displayed.
10. Press **EXIT** to return to the Temperature menu.
11. (Optional) To clear the alarm from the active alarm log and the alarm bar at the top of the display, acknowledge the alarm using the procedures described in Chapter 22.

To perform the temperature slope calibration:

1. Fill the sensor with process fluid at the highest temperature measured during the application.

Measurement Performance

2. Wait approximately 30 minutes for the flow tube temperature to stabilize.
3. Use the same reference device as the one that was used during the temperature offset calibration to measure the temperature of the process fluid.
4. From the Temperature menu, select **High Temperature**.
5. At the High Temperature menu:
 - a. Set the **High Temperature Value** to the temperature that was measured in Step 3, *in degrees Celsius*, then press **SAVE**.
 - b. Select **Calibrate Temp**, then press **SEL**.
6. During calibration, an alarm message is generated.
7. When the calibration is complete:
 - In the active alarm log, the alarm changes from “active” to “inactive but unacknowledged.”
 - If the calibration succeeded, a “Success” status is displayed.
 - If the calibration failed, a “Failed” status is displayed.
8. Press **EXIT** to return to the Temperature menu.
9. (Optional) To clear the alarm from the active alarm log and the alarm bar at the top of the display, acknowledge the alarm using the procedures described in Chapter 22.

Chapter 22

Diagnostics and Troubleshooting

22.1 About this chapter

This chapter explains how to use the diagnostic software to troubleshoot alarm conditions. Diagnostic software includes:

- Meter fingerprinting
- Sensor simulation mode
- The active alarm log
- Alarm messages
- The diagnostic monitor

This chapter also provides additional information on troubleshooting.

22.2 Checking process variables

Micro Motion suggests that you make a record of basic process variables under normal operating conditions. This will help you recognize when the process variables are unusually high or low. The meter fingerprinting feature (see Section 22.3) may be used to record the current levels of twelve process variables, and to view the recorded levels of these process variables at three other points of transmitter operation.

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

Unusual values for process variables may indicate a variety of different problems. Table 22-1 lists several possible problems and remedies.

Table 22-1 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 16.3.
	Inappropriate measurement unit	Check configuration. See Section 22.13.
	Cutoff set too low	Check configuration. See Section 7.3.2.
	Bad flow calibration factor	Verify characterization. See Section 22.16.

Table 22-1 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 22.11.5.
	Wiring problem	Verify all sensor-to-transmitter wiring and ensure the wires are making good contact.
	Incorrectly grounded 9-wire cable (remote core processor with remote transmitter installations)	Verify 9-wire cable installation.
	Vibration in pipeline at rate close to sensor tube frequency	Check environment and remove source of vibration.
	Improper sensor grounding (T-Series sensors only)	Verify that the sensor is grounded to earth ground.
	Leaking valve or seal	Check pipeline.
	Inappropriate measurement unit	Check configuration. See Section 22.13.
	Inappropriate damping value	Check configuration. See Section 7.3.2.
	Slug flow	See <i>Slug flow alarms</i> in Section 22.7.3.
	Plugged flow tube	Check drive gain and tube frequency. Purge the flow tubes or replace the sensor.
	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: <ul style="list-style-type: none"> • 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 Series 3000 device and receiving device. See the transmitter installation instructions.
	Problem with receiving device	Test with another receiving device.
	Inappropriate measurement unit	Check configuration. See Section 22.13.
	Inappropriate damping value	Check configuration. See Section 7.3.2.
	Excessive or erratic drive gain	See Section 22.18.3 and Section 22.18.4.
	Slug flow	See <i>Slug flow alarms</i> in Section 22.7.3.
	Plugged flow tube	Check drive gain and tube frequency. Purge the flow tubes or replace the sensor.
	Wiring problem	Verify all sensor-to-transmitter wiring and ensure the wires are making good contact.

Table 22-1 Process variables problems and possible remedies *continued*

Symptom	Cause	Possible remedy
Inaccurate flow rate or batch total	Bad flow calibration factor	Verify characterization. See Section 7.3.3.
	Inappropriate measurement unit	Check configuration. See Section 22.13.
	Bad sensor zero	Rezero the meter. See Section 16.3.
	Bad density calibration factors	Verify characterization. See Section 7.3.3.
	Bad flowmeter grounding	See Section 22.11.3.
	Slug flow	See <i>Slug flow alarms</i> in Section 22.7.3.
	Problem with receiving device	See Section 22.11.6.
	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 7.3.3.
	Wiring problem	Verify all sensor-to-transmitter wiring and ensure the wires are making good contact.
	Bad flowmeter grounding	See Section 22.11.3.
	Slug flow	See <i>Slug flow alarms</i> in Section 22.7.3.
	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 or replace the sensor.
Temperature reading significantly different from process temperature	RTD failure	Check for alarm conditions and follow troubleshooting procedure for indicated alarm. Verify polling configuration and disable polling for temperature if appropriate. See Section 7.6.
	Problem with sensor wiring	Check wiring to sensor. See Section 22.11.2.
	Incorrect calibration factor	Verify that the temperature calibration factor is set correctly. See Section 22.17.
Temperature reading slightly different from process temperature	Temperature calibration required	Perform temperature calibration. See Section 21.6.
	Loose connections in sensor wiring	Check wiring to sensor. See Section 22.11.2.
	Corrosion in flow tube	Purge the flow tubes.
Unusually high density reading	Plugged, partially filled, or coated flow tube	Check drive gain and tube frequency. See Section 22.18. Purge the flow tubes.
	Incorrect K2 value	Verify characterization. See Section 22.16.

Table 22-1 Process variables problems and possible remedies *continued*

Symptom	Cause	Possible remedy
Unusually low density reading	Slug flow	See Section 22.7.3.
	Incorrect K2 value	Verify characterization. See Section 22.16.
	Sensor erosion	Contact Micro Motion.
Unusually high tube frequency	Sensor erosion	Contact Micro Motion.
	Reversed drive coil leads (remote core processor with remote transmitter installations)	Verify drive coil leads
Unusually low tube frequency	Plugged, partially filled, or coated flow tube	Check drive gain and tube frequency. See Section 22.18. Purge the flow tubes.
Unusually low pickoff voltages	Several possible causes	See Section 22.18.5.
Unusually high drive gain	Several possible causes	See Section 22.18.3.

22.3 Meter fingerprinting

Note: Meter fingerprinting is available only on systems with the standard core processor.

The meter fingerprinting feature provides snapshots, or “fingerprints,” of twelve process variables, at four different points of transmitter operation. See Table 22-2.

Table 22-2 Meter fingerprinting data

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

For each process variable, the following values are recorded:

- For Mech Zero:
 - 5-minute running average
 - 5-minute running standard deviation
- For all other process variables:
 - Instantaneous value
 - 5-minute running average
 - 5-minute running standard deviation
 - Recorded minimum
 - Recorded maximum

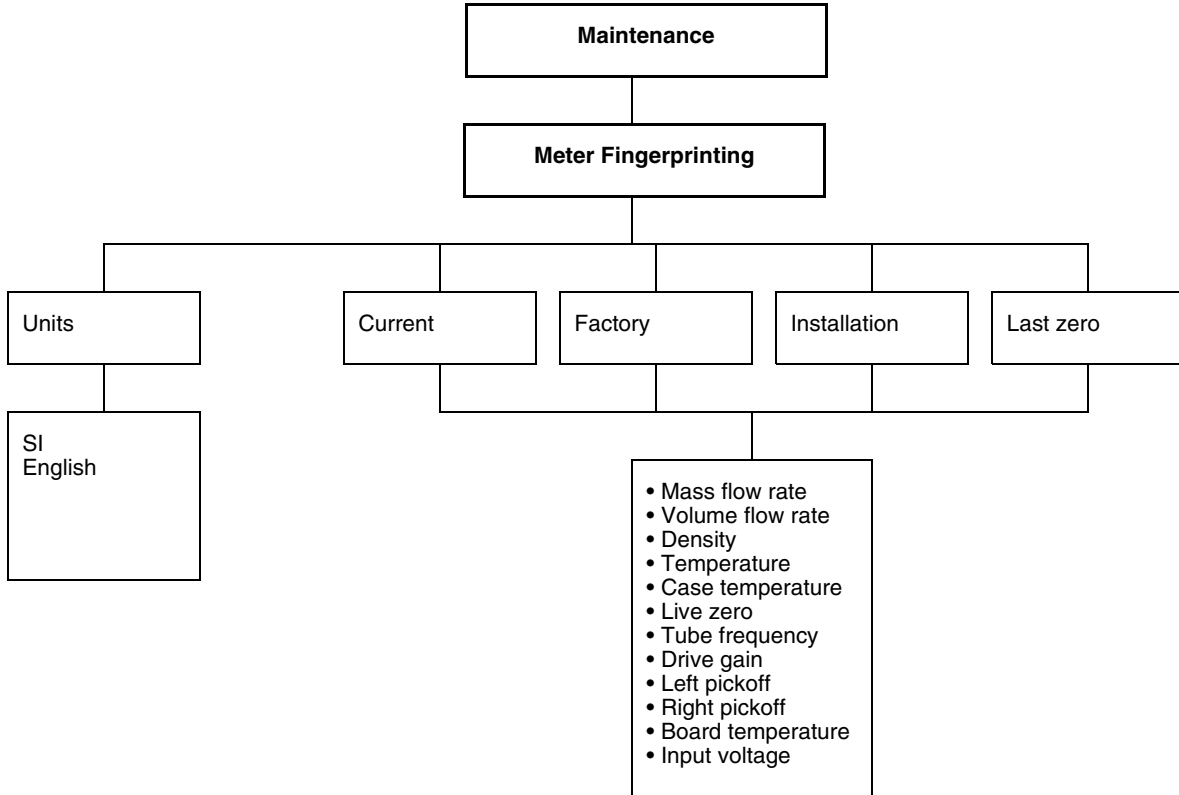
To access meter fingerprint data, use the Maintenance menu as shown in Figure 22-1. The transmitter will report the data in either SI units or English units, as configured from the Units menu item. The display is updated continuously.

When the cursor is positioned on Current, you can use the **RESET** button to set a new start time for the recorded minimum and maximum values.

When the cursor is positioned on Factory, you can use the **SAVE** button to overwrite the data in the factory fingerprint with the current fingerprint data.

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.

Figure 22-1 Meter fingerprinting menu



22.4 Sensor simulation mode

Note: Sensor simulation mode is available only on systems with the enhanced core processor.

Sensor simulation allows you to simulate process data for mass flow, temperature, and density. Sensor simulation mode has several uses:

- It can help determine if a problem is located in the transmitter or elsewhere in the system. For example, signal oscillation or noise is a common occurrence. The source could be the PLC, the meter, improper grounding, or a number of other factors. By using sensor simulation to output a flat signal, you can determine the point at which the noise is introduced.
- It can be used to analyze system response or to tune the loop.

Diagnostics and Troubleshooting

If sensor simulation mode is active, the specified simulated values are substituted for process data from the sensor. Therefore, sensor simulation will affect, for example:

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

Accordingly, do not enable simulation when your process cannot tolerate these effects, and be sure to disable simulation when you have finished testing.

Note: Unlike actual mass flow and density values, the simulated values are not temperature-compensated.

Note: Simulation does not change any diagnostic values.

Sensor simulation mode is available via ProLink II (see Figure G-3) or the Communicator (see Figure H-7). To set up sensor simulation, follow the steps below:

1. Enable simulation mode.
2. For mass flow:
 - a. Specify the type of simulation you want: fixed value, triangular wave, or sine wave.
 - b. Enter the required values.
 - If you specified fixed value simulation, enter a fixed value.
 - If you specified triangular wave or sine wave simulation, enter a minimum amplitude, maximum amplitude, and period.
3. Repeat Step 2 for temperature and density.

To use sensor simulation mode for problem location, enable simulation mode and check the signal at various points between the transmitter and the receiving device.

22.5 Updates, upgrades, and master resets

Micro Motion recommends that you document or save device configuration information before updating or upgrading the software in your Series 3000 device or before performing a master reset.

You can document the configuration manually. Alternatively, if you have ProLink II, you can save the configuration data to a file on the PC.

22.6 Alarm types and handling

The Series 3000 device performs self-diagnostics during operation. If the device detects certain events or conditions, an alarm message appears in the highlight bar at the top of the screen, and an alarm is written to the active alarm log.

22.6.1 Alarm severity

Alarms are classified into three levels of severity. The *severity level* controls device behavior when the alarm condition occurs. See Table 22-3.

Table 22-3 Alarm severity levels and fault reporting

Severity level	Series 3000 device action if condition occurs			
	“Alarm active” status bit set?	Alarm shown on display?	“Alarm active” record written to history?	Fault indication activated? ⁽¹⁾
Fault	Yes	Yes	Yes	Yes
Informational	Yes	Yes	Yes	No
Ignore	Yes	No	No	No

(1) For some alarms, fault indication (setting outputs to configured fault levels) will not occur until the fault timeout expired. For other alarms, fault indication begins as soon as the fault condition is recognized. Tables 22-4 through 22-6 include information on which alarms are affected by the fault timeout. To configure fault timeout, see Chapter 8.

Some alarms can be reclassified. For example:

- The default severity level for Alarm A020 (calibration factors unentered) is Fault, but you can reconfigure it to either Informational or Ignore.
- The default severity level for Alarm A102 (drive over-range) is Informational, but you can reconfigure it to either Ignore or Fault.

For information on which alarms can be reclassified, see Section 22.7. For information on how to reclassify alarms, see Section 6.3.1.

22.6.2 Fault timeout

By default, the Series 3000 device immediately sets outputs to their configured fault levels when a fault is encountered. For specific faults, you can delay this action by changing the fault timeout to a non-zero value (see Chapter 8). If fault timeout is configured:

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

The fault timeout is not applicable to all faults. See Section 22.7 for information about which faults are affected.

22.6.3 Alarm categories

Alarms are organized into four *alarm categories*, in the following order of priority:

- Electronics
- Sensor (Model 3500 and Model 3700 transmitters only)
- Process
- Configuration

22.6.4 Alarm occurrences and logs

Information about alarm occurrences is maintained and displayed in three different ways:

- *Active alarm log* (see Figure 22-2) – Lists:
 - All alarms that are active (the condition that caused the alarm is active)
 - All alarms that have not been acknowledged (even if the condition causing the alarm is no longer active)

The active alarm log provides help for each alarm listed (see Section 22.6.5), and also allows you to acknowledge alarms. It is cleared and regenerated with every Series 3000 power cycle. When the active alarm log is viewed through the View menu, only categories containing active alarms are listed; individual alarms are not listed. When the active alarm log is viewed through the Maintenance menu, individual alarms are listed.

- *Alarm history* (see Figure 22-3) – Lists all alarms that have occurred, with a count of the number of times a particular alarm has occurred, and the timestamp of the last time the alarm was posted and cleared. It is not cleared when a Series 3000 power cycle occurs. You cannot acknowledge alarms or access the help system from alarm history. Alarm history is accessible from the Maintenance menu.
- *Alarm event log* (see Figure 22-4) – Lists the 50 most recent alarm post or alarm clear events. It is not cleared when a Series 3000 power cycle occurs. You cannot acknowledge alarms or access the help system from the alarm event log. The alarm event log is accessible from the Maintenance menu.

Figure 22-2 Example alarm log

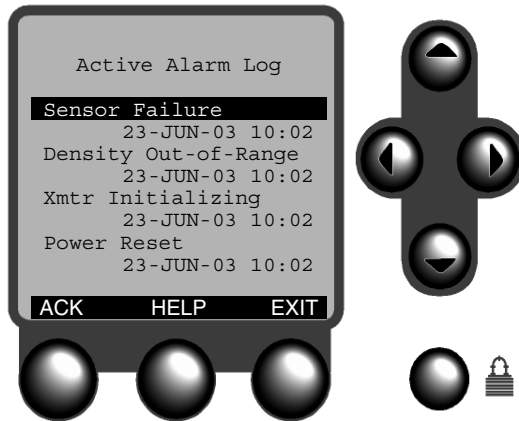


Figure 22-3 Example alarm history

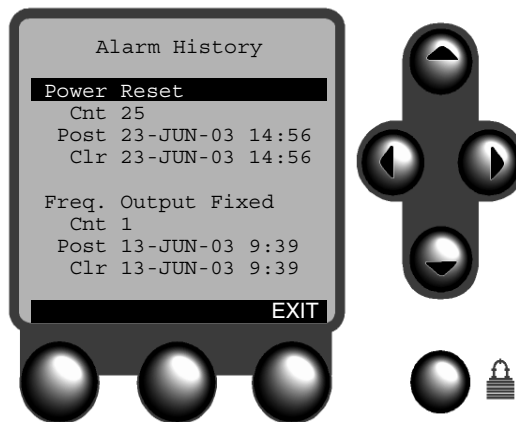
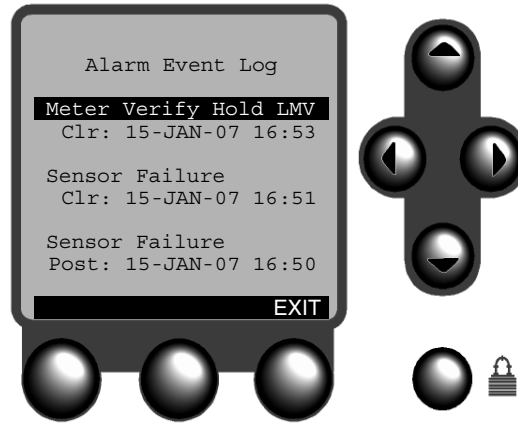


Figure 22-4 Example alarm event log



Active alarm log

To access the active alarm log from the View menu:

1. At the operation screen, press **EXIT** or **VIEW**.
2. Highlight **Active Alarm Log**.
3. To acknowledge all alarms, press the **ACKALL** button.
4. To acknowledge all alarms in an alarm category:
 - a. Select **Active Alarm Log**.
 - b. Use the cursor keys to highlight the alarm category.
 - c. Press the **ACK** button.

Note: You cannot view and acknowledge individual alarms from the View menu.

To access the active alarm log from the Maintenance menu:

1. At the operation screen, press the **Security** button.
2. Select **Maintenance**.
3. Highlight **Active Alarm Log**.
4. To acknowledge all alarms, press the **ACKALL** button.
5. To acknowledge a single alarm:
 - a. Select **Active Alarm Log**.
 - b. Use the cursor keys to highlight the alarm.
 - c. Press the **ACK** button.

22.6.5 Help system

Help is provided for each alarm. The help system can be accessed from several locations:

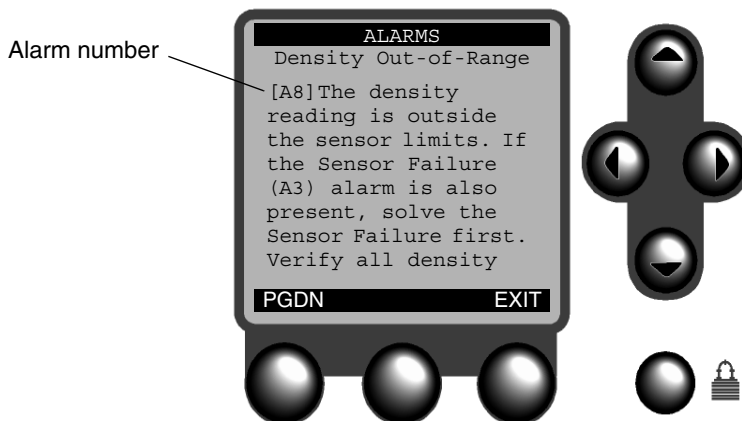
- From the list of alarm categories in the active alarm log. If multiple alarms are posted in the active alarm log, press **PGDN** to view help for all alarms in the selected category.
- From the list of individual alarms in the active alarm log
- Wherever the **HELP** button appears

To view help from a list, highlight a list entry and press the **HELP** button.

The help system will display up to five screens of information. On these screens:

- The alarm number is displayed.
- An explanation of the alarm is provided.
- Instructions for correcting the alarm condition may be provided.
- If the help occupies more than one screen, use the **PGDN** (page down) or **PGUP** (page up) buttons to view all the help text.

Figure 22-5 Example alarm help



22.7 Alarm listings by category

This section lists all alarms in the four alarm categories (Electronics, Sensor, Process, and Configuration), and provides information on alarm severity level, user configuration, fault timeout behavior, and suggested user actions.

22.7.1 Electronics alarms

Table 22-4 lists all alarms in the Electronics category, with descriptions, suggested user actions, and related information.

Table 22-4 Electronics alarms

Alarm number	Maintenance menu listing	Description	Alarm severity		Affected by fault timeout	User actions
			Default	User config?		
A001	CP EEPROM Failure	Uncorrectable checksum mismatch.	Fault	No	No	Cycle power to the flowmeter. The flowmeter might need service. Contact Micro Motion customer service.
A002	CP RAM Failure	A RAM location in the core processor cannot be written to.	Fault	No	No	Cycle power to the flowmeter. The flowmeter might need service. Contact Micro Motion customer service.

Table 22-4 Electronics alarms *continued*

Alarm number	Maintenance menu listing	Description	Alarm severity		Affected by fault timeout	User actions
			Default	User config?		
A009	Xmtr Initializing	Device is performing self-calibration after power-up.	Fault	Yes	No	No action required unless alarm does not clear. If alarm does not clear: <ul style="list-style-type: none"> • Check wiring to sensor. • Check power supply wiring. • Make sure that the sensor is completely full or completely empty. • Verify sensor configuration. See Section 7.3.3. • If A026 alarm is present, check core processor address. See Section 19.6.
A014	Transmitter Error	Transmitter failure for any of several reasons.	Fault	No	No	Cycle power to the flowmeter. <hr/> Perform sensor coil and resistance tests. See Section 22.20. <hr/> The flowmeter might need service. Contact Micro Motion customer service.
A018	EEPROM (3000)	Uncorrectable checksum mismatch.	Fault	No	No	Cycle power to the flowmeter. <hr/> The flowmeter might need service. Contact Micro Motion customer service.
A019	RAM Failure	A RAM location in the transmitter cannot be written to.	Fault	No	No	Cycle power to the flowmeter. <hr/> The flowmeter might need service. Contact Micro Motion customer service.
A022 ⁽¹⁾	CP Config Failure	Uncorrectable checksum mismatch.	Fault	No	No	Cycle power to the flowmeter. <hr/> The flowmeter might need service. Contact Micro Motion customer service.
A023 ⁽¹⁾	CP Totals Failure	Uncorrectable checksum mismatch.	Fault	No	No	Cycle power to the flowmeter. <hr/> The flowmeter might need service. Contact Micro Motion customer service.
A024 ⁽¹⁾	CP Program Failure	Uncorrectable checksum mismatch.	Fault	No	No	Cycle power to the flowmeter. <hr/> The flowmeter might need service. Contact Micro Motion customer service.
A025 ⁽¹⁾	CP Boot Program Fault	Uncorrectable checksum mismatch.	Fault	No	No	Cycle power to the flowmeter. <hr/> The flowmeter might need service. Contact Micro Motion customer service.

Table 22-4 Electronics alarms *continued*

Alarm number	Maintenance menu listing	Description	Alarm severity		Affected by fault timeout	User actions
			Default	User config?		
A026	Xmtr Comm Problem	Communication errors between transmitter and core processor.	Fault	No	No	<p>If the custody transfer application is installed, the core processor may have been disconnected or replaced. See Section 22.9.</p> <hr/> <p>Check wiring between transmitter and core processor (remote core processor with remote transmitter installations).</p> <hr/> <p>Check for noise in wiring or transmitter environment.</p> <hr/> <p>Check the core processor LED. See Section 22.19.1.</p> <hr/> <p>Check that the core processor is receiving power. See Section 22.11.1.</p> <hr/> <p>Perform the core processor resistance test. See Section 22.19.2.</p>
A028	Xmtr Write Error	Attempt to write to the core processor has failed.	Fault	No	No	<p>Cycle power to the flowmeter.</p> <hr/> <p>The flowmeter might need service. Contact Micro Motion customer service.</p>
A031 ⁽²⁾	Low Power	The core processor is not receiving enough power.	Fault	No	No	<p>Check the power supply and all power wiring.</p>
A103 ⁽¹⁾	Data Loss Possible	Core processor unable to store totalizer values on last power down.	Info	Yes	No	<p>Cycle power to the flowmeter.</p> <hr/> <p>View the entire current configuration to determine what data were lost. Configure any settings with missing or incorrect data.</p> <hr/> <p>The flowmeter might need service. Contact Micro Motion customer service.</p>
A107	Power Reset	Transmitter has been restarted.	Info	Yes	No	<p>No action required.</p>
A112 ⁽³⁾	Upgrade Software	Transmitter software is downlevel from core processor software.	Info	Yes	No	<p>Upgrade software. Contact Micro Motion customer service. Note that the device is still functional.</p>
A129	PPI Display Error	(Custody transfer only) Readback function from transmitter display indicates error or failure.	Info	Yes	No	<p>Cycle power to the flowmeter. If the problem persists, contact Micro Motion customer service.</p>

Table 22-4 Electronics alarms *continued*

Alarm number	Maintenance menu listing	Description	Alarm severity		Affected by fault timeout	User actions
			Default	User config?		
A130	Printer Out of Paper	(Custody transfer only) The ticket printer is out of paper.	Ignore	Yes	No	Add paper to the printer.
A134	PPI Memory Error	Memory or checksum error in transmitter display.	Info	Yes	No	Cycle power to the flowmeter. If the problem persists, contact Micro Motion customer service.
A135	PPI Comm Error	Internal communication error with transmitter display.	Info	Yes	No	Cycle power to the flowmeter. If the problem persists, contact Micro Motion customer service.

- (1) Applies only to systems with the standard core processor.
- (2) Applies only to systems with the enhanced core processor.
- (3) Applies only to systems with transmitter software earlier than rev7.0.

22.7.2 Sensor alarms

Table 22-5 lists all alarms in the Sensor category, with descriptions, suggested user actions, and related information.

Table 22-5 Sensor alarms

Alarm number	Maintenance menu listing	Description	Alarm severity		Affected by fault timeout	User actions
			Default	User config?		
A003	Sensor Failure	No tube vibration detected at the sensor.	Fault	Yes	Yes	Check the test points. See Section 22.18. Check the sensor coils. See Section 22.20. Check wiring to sensor. See Section 22.11.2. Check for slug flow. See Section 22.7.3. Check sensor tubes.

Table 22-5 Sensor alarms *continued*

Alarm number	Maintenance menu listing	Description	Alarm severity		Affected by fault timeout	User actions
			Default	User config?		
A004	Temp. Out-of-Range	The measured temperature is outside the sensor limits.	Fault	No	Yes	<p>Check wiring to sensor. See Section 22.11.2.</p> <hr/> <p>Verify sensor configuration. See Section 7.3.3.</p> <hr/> <p>Check the test points. See Section 22.18.</p> <hr/> <p>Check the sensor coils and RTD. See Section 22.20.</p> <hr/> <p>Verify that process temperature is within range of sensor and transmitter.</p> <hr/> <p>Contact Micro Motion customer service.</p>
A016	Sensor RTD Error	Sensor RTD has failed.	Fault	Yes	Yes	<p>Check wiring to sensor. See Section 22.11.2.</p> <hr/> <p>Make sure the appropriate sensor type is configured. See Section 7.3.3.</p> <hr/> <p>Check the test points. See Section 22.18.</p> <hr/> <p>Check the sensor coils. See Section 22.20.</p> <hr/> <p>Contact Micro Motion customer service.</p>
A017	Meter RTD Error	Meter RTD has failed.	Fault	Yes	Yes	<p>Check wiring to sensor. See Section 22.11.2.</p> <hr/> <p>Make sure the appropriate sensor type is configured. See Section 7.3.3.</p> <hr/> <p>Contact Micro Motion customer service.</p>

22.7.3 Process alarms

Table 22-6 lists all alarms in the Process category, with descriptions, suggested user actions, and related information. More information on specific process alarms is provided later in this section.

Table 22-6 Process alarms

Alarm number	Maintenance menu listing	Description	Alarm severity		Affected by fault timeout	User actions
			Default	User config?		
A005	Mass Flow Overrange	Mass flow value is outside sensor limits.	Fault	Yes	Yes	<p>Check the test points. See Section 22.18.</p> <p>Check the sensor coils. See Section 22.20.</p> <p>Verify process.</p> <p>Make sure that the appropriate measurement unit is configured. See Section 22.13.</p> <p>Verify 4 mA and 20 mA values. See Section 22.14.</p> <p>Verify calibration factors in transmitter configuration. See Section 22.17.</p> <p>Re-zero the transmitter.</p>
A008	Density Out-of-Range	Density value is outside sensor limits.	Fault	Yes	Yes	<p>Check the test points. See Section 22.18.</p> <p>If accompanied by an A003 alarm, check the sensor coils. See Section 22.20.</p> <p>Verify process. Check for air in the flow tubes, tubes not filled, foreign material in tubes, or coating in tubes.</p> <p>Verify calibration factors in transmitter configuration. See Section 22.17.</p> <p>Perform density calibration. See Section 21.5.</p>
A010	Calibration Failure	Calibration procedure failed for any of a variety of reasons.	Fault	No	No	<p>Ensure that there is no flow through the sensor. Check for pipe stress at sensor. Then retry. See <i>Calibration alarms</i>.</p> <p>Cycle power to the flowmeter, then retry. See <i>Calibration alarms</i>.</p>
A011	Cal Fail - Too Low	Calibration procedure failed due to reverse flow through the sensor.	Fault	Yes	No	<p>Ensure that there is no flow through the sensor. Check for pipe stress at sensor. Then retry. See <i>Calibration alarms</i>.</p> <p>Cycle power to the flowmeter, then retry. See <i>Calibration alarms</i>.</p>

Table 22-6 Process alarms *continued*

Alarm number	Maintenance menu listing	Description	Alarm severity		Affected by fault timeout	User actions
			Default	User config?		
A012	Cal Fail - Too High	Calibration procedure failed due to flow through the sensor.	Fault	Yes	No	<p>Ensure that there is no flow through the sensor. Check for pipe stress at sensor. Then retry. See <i>Calibration alarms</i>.</p> <hr/> <p>Cycle power to the flowmeter, then retry. See <i>Calibration alarms</i>.</p>
A013	Cal Fail - Too Noisy	Calibration procedure failed due to flow through the sensor.	Fault	Yes	No	<p>Ensure that there is no flow through the sensor. Check for electromechanical noise. Sources of noise include:</p> <ul style="list-style-type: none"> • Mechanical pumps • Pipe stress at sensor • Electrical interference • Vibration effects from nearby machinery <p>Then retry. See <i>Calibration alarms</i>.</p> <hr/> <p>Cycle power to the flowmeter, then retry. See <i>Calibration alarms</i>.</p>
A033 ⁽¹⁾	Tube Not Full	No signal from LPO or RPO, suggesting that sensor tubes are not vibrating.	Fault	Yes	Yes	Verify process. Check for air in the flow tubes, tubes not filled, foreign material in tubes, or coating in tubes.
A100	mA 1 Saturated	Process variable assigned to primary mA output is outside configured limits.	Info	Yes ⁽²⁾	No	See <i>Output saturation alarms</i> .
A102	Drive Overrange	No tube vibration or erratic tube vibration.	Info	Yes	No	<p>Ensure that sensor tubes are unobstructed. Purge tubes if necessary.</p> <hr/> <p>Ensure sensor is full of process fluid.</p> <hr/> <p>Ensure sensor is free to vibrate.</p> <hr/> <p>Verify sensor configuration. See Section 7.3.3.</p> <hr/> <p>Ensure that flow rate is within sensor limits.</p>
A105	Slug Flow	Slug flow detected in process.	Info	Yes	No	See <i>Slug flow alarms</i> .
A110	Freq. Out Saturated	Process variable assigned to frequency output is outside configured scale limits.	Info	Yes ⁽²⁾	No	See <i>Output saturation alarms</i> .

Table 22-6 Process alarms *continued*

Alarm number	Maintenance menu listing	Description	Alarm severity		Affected by fault timeout	User actions
			Default	User config?		
A113	mA 2 Saturated	Process variable assigned to secondary mA output is outside configured limits.	Info	Yes ⁽²⁾	No	See <i>Output saturation alarms</i> .
A115	External Input Error	HART polling connection to external device has failed.	Info	Yes	No	Ensure that external device is available: <ul style="list-style-type: none"> • Verify device operation. • Verify wiring. Verify polling configuration. See Section 7.6.
A116	API: Temp Overrange	Process temperature outside API-defined extrapolation limits.	Info	Yes	No	Verify process. Verify API reference table and temperature configuration. See Section 9.4.
A117	API: Dens Overrange	Process density outside API-defined extrapolation limits.	Info	Yes	No	Verify process. Verify API reference table and density configuration. See Section 9.4.
A121	ED: Extrap. Fail	Enhanced density calculations are outside the configured data range.	Info	Yes	No	Verify process temperature. Verify process density. Verify enhanced density configuration. See the enhanced density manual.
A124	Freq. Input Saturated	Frequency input from external device is too high.	Info	Yes	No	Reconfigure frequency scaling on input device. Reconfigure frequency scaling on Series 3000 platform. See Section 7.4.
A125	Batcher Timeout	No flow detected during configured timeout period.	Info	Yes	No	See <i>Batch alarms</i> .
A126	Batcher Overrun	The batcher has overrun the configured target.	Info	Yes	No	See <i>Output saturation alarms</i> .

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

(2) Can be set to either Info or Ignore, but cannot be set to Fault.

Slug flow alarms

Slugs – for example, 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/cm³. Raising the low slug-flow limit or lowering the high slug-flow limit will increase the possibility of slug flow conditions.

Diagnostics and Troubleshooting

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” 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 7.3.2).
- If desired, increase slug duration (see Section 7.3.2).

Output saturation alarms

If an output variable exceeds the upper range limit or goes below the lower range limit, the Series 3000 device 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 20 mA and 4 mA values (see Section 8.4.4).
- For the frequency output, change frequency and flow values, pulses/unit, or units/pulse (see Section 8.5).

Batch alarms

If the batch controller is operating, the Series 3000 device produces batch alarms. Table 22-7 summarizes batch alarms and lists corrective actions.

Table 22-7 Using batch alarms

Alarm message	Cause	Action
Time Out	No flow was detected for the number of seconds configured for time out	<ul style="list-style-type: none"> • Check valves, piping, and pumps for proper operation • Check flow source configuration. • Increase number of seconds for time out. See Section 11.5. • After cause has been diagnosed, press END to end batch or RESUME to resume batch. • If you are using a Model 3300 or Model 3350, verify that the controller is receiving frequency input from the remote transmitter.
Overrun	<ul style="list-style-type: none"> • Batch total has exceeded target • Batch has not ended • Flow is still being measured 	<ul style="list-style-type: none"> • End batch if required. • Check wiring for discrete output indicating overrun. • Check device connected to discrete output indicating overrun. • Enable batch AOC. See Section 11.5. • Increase quantity configured for overrun. • Verify that low-flow cutoff is correctly configured for process conditions. • Re-zero flowmeter. • After cause has been diagnosed, press RESET or START to start new batch.
Start Without Reset	Operator attempted to start batch without pressing RESET	<ul style="list-style-type: none"> • Press RESET, then press START or • Set Reset on start option to Yes. See Section 11.5.
Start Not OK	Enable batch control option is set to No	Set Enable batch control option to Yes. See Section 11.5.
	Batch flow source is not configured	Configure batch flow source. See Section 11.4.
	Control functions have not been assigned to discrete outputs	Assign control functions such as primary valve, secondary valve, or pump to discrete outputs. See Section 8.3.2).
	An alarm is active	Clear all alarm messages. See Section 22.6.
	Discrete input is configured to inhibit batch	Shut off discrete input.
	Target value is zero	Change target value. See Section 11.6.
	If enhanced density is enabled and an enhanced density variable has been configured as the batch flow source, a valid enhanced density curve has not been assigned to the current preset	Configure batch preset for a valid enhanced density curve. See Section 11.6.
Output is fixed, calibration is in progress, or slug flow has occurred	Correct the condition and retry.	

Calibration alarms

If a calibration procedure fails:

1. Ensure that there is no flow through the sensor.
2. Eliminate mechanical noise, if possible.
3. Ensure the interior of the sensor junction box (if present in your installation) is dry.
4. Retry the calibration procedure.

22.7.4 Configuration alarms

Table 22-8 lists all alarms in the Configuration category, with descriptions, suggested user actions, and related information.

Table 22-8 Using configuration alarms

Alarm number	Maintenance menu listing	Description	Alarm severity		Affected by fault timeout	User actions
			Default	User config?		
A006	Characterize Meter	Master reset has been performed. Required calibration values are missing.	Fault	Yes	No	Enter required values. See Section 7.3.3.
A020	Cal. Factors Missing	Master reset has been performed. Required calibration values are missing.	Fault	Yes	No	Enter required values. See Section 7.3.3.
A021	Sensor Type Incorrect	K1 value missing or incorrect, or RTD data from sensor is incorrect.	Fault	No	No	Verify characterization parameters. See Section 7.3.3.
A027	Security Breach	(Custody transfer only) Device has been tampered with.	Fault	No	No	Weights and Measures security seal has been broken. Alarm can be cleared by user, but authorized procedure is required to reestablish security. Ensure that the security switch is set to the ON position. Contact Micro Motion.
A032 ⁽¹⁾⁽²⁾	Meter Verify Fault	Meter verification in progress, with outputs set to fault.	Fault	No	No	Allow the procedure to complete. If desired, abort the procedure and restart with outputs set to last measured value.
A032 ⁽³⁾	Outputs Fixed	Meter verification in progress, with outputs set to Fault or Last Measured Value.	Varies ⁽⁴⁾			Allow the procedure to complete. If desired, abort the procedure and restart with outputs set to Continue Measurement.
A034 ⁽³⁾	Meter Verify Failed	The test ran to completion but the results were not within limits.	Info	Yes	No	Rerun the test. If the test fails again, see Section 21.3.4.
A035 ⁽³⁾	Meter Verify Aborted	The test did not run to completion.	Info	Yes	No	If desired, read the abort code, see Section 21.3.4, and perform the appropriate action.

Table 22-8 Using configuration alarms *continued*

Alarm number	Maintenance menu listing	Description	Alarm severity		Affected by fault timeout	User actions
			Default	User config?		
A101	mA 1 Fixed	Primary mA output is transmitting fixed output level.	Info	Yes ⁽⁵⁾	No	Change Loop Current Mode parameter. See Section 22.11.7. Exit from mA output trim. See Section 16.5. Exit from mA output simulation. See Section 16.4.4. Check to see if the output has been fixed via digital communication.
A104	Cal in Progress	Transmitter currently performing flow or density calibration.	Info	Yes ⁽⁵⁾	No	No action required.
A106	Burst Enabled	Transmitter configured for burst mode.	Info	Yes ⁽⁵⁾	No	No action required.
A111	Freq. Output Fixed	Frequency output is transmitting fixed output level.	Info	Yes ⁽⁵⁾	No	Exit from frequency output simulation. See Section 16.4.2.
A114	mA 2 Fixed	Secondary mA output is transmitting fixed output level.	Info	Yes ⁽⁵⁾	No	Exit from mA output trim. See Section 16.5. Exit from mA output simulation. See Section 16.4.4. Check to see if the output has been fixed via digital communication.
A118	DO 1 Fixed	Discrete output 1 transmitting fixed output.	Info	Yes ⁽⁵⁾	No	Unfix discrete output 1. See Section 16.4.1.
A119	DO 2 Fixed	Discrete output 2 transmitting fixed output.	Info	Yes ⁽⁵⁾	No	Unfix discrete output 2. See Section 16.4.1.
A120	ED: Curve Fit Fail	Configured values for density curves do not meet accuracy requirements.	Info	No	No	Verify enhanced density configuration. See the enhanced density manual.
A122	DO 3 Fixed	Discrete output 3 transmitting fixed output.	Info	Yes ⁽⁵⁾	No	Unfix discrete output 3. See Section 16.4.1.
A127	Batcher Needs Reset	Tried to start a batch without resetting previous batch.	Info	Yes	No	See Section 22.7.3.
A128	Batcher Cannot Start	Transmitter cannot start a batch.	Info	Yes	No	See Section 22.7.3.

Table 22-8 Using configuration alarms *continued*

Alarm number	Maintenance menu listing	Description	Alarm severity		Affected by fault timeout	User actions
			Default	User config?		
A131 ⁽¹⁾⁽²⁾	Meter Verify Hold LMV	Meter verification in progress, with outputs set to last measured value.	Info	Yes	No	Allow the procedure to complete. If desired, abort the procedure and restart with outputs set to fault.
A131 ⁽³⁾	Meter Verify Progress	Meter verification in progress, with outputs set to continue reporting process data.	Info	Yes	No	Allow the procedure to complete.
A132 ⁽¹⁾	Simulation Mode	Simulation mode is active.	Info	Yes ⁽⁵⁾	No	Disable simulation mode. See Section 22.4.

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

(2) Applies only to systems with the original version of the meter verification application.

(3) Applies only to systems with Smart Meter Verification.

(4) If outputs are set to Last Measured Value, severity is Info. If outputs are set to Fault, severity is Fault.

(5) Can be set to either Info or Ignore, but cannot be set to Fault.

22.8 Restoring a working configuration

At times it may be easier to start from a known working configuration than to troubleshoot the existing configuration. To do this, you can:

- Restore a configuration file saved via ProLink II, if one is available. See Figure G-1.
- Restore the factory configuration, as stored in the Series 3000 device (no external configuration file is required). To do this:
 - Using ProLink II, see Figure G-2. ProLink II v2.6 or higher is required.
 - Using the Communicator, see Figure H-3.

Both of these actions will overwrite the existing configuration. Ensure that the existing configuration is appropriately documented or saved.

22.9 A009/A026 alarms on Model 3300 or Model 3500 panel-mount

On Model 3300 or Model 3500 panel-mount devices rev6.1 or lower, when the custody transfer application is installed, A009 and A026 alarms may be generated if the position of the security switch is changed while the device is powered.

Note: These alarms occur because to change the position of the security switch, you must remove the connector wiring bracket, which means that power to the core processor will be interrupted.

To clear these alarms, you must change the core processor address manually to the default value of 1 while the transmitter is unsecured. Then, when the transmitter is secured, the core processor address will automatically be changed to the unique address used for secure processing.

To change the core processor address manually:

1. Disconnect the RS-485 wires from the RS-485 terminals on the Series 3000 device (see Figure 2-3).
2. Connect ProLink II to the RS-485 wires, or to the RS-485 terminals on the core processor, using Modbus RTU (8-bit) protocol and any values for baud rate, parity, and stop bit.

3. Poll to make a connection to the core processor.
4. When the core processor is found, click **ProLink > Configuration > Device** and set the Modbus address to **1**.
5. Click **Apply**.
6. Disconnect ProLink II.
7. Reconnect the RS-485 wiring between the Series 3000 device and the core processor.

To avoid this problem, always power down the transmitter before removing the connector wiring bracket.

Note: Do not confuse the Modbus address of the core processor with the Modbus address of the transmitter. The Modbus address of the core processor is accessible only when you connect directly to the core processor.

22.10 I/O problems

If you are experiencing problems with I/O, use Table 22-9 to identify an appropriate remedy.

Table 22-9 I/O problems and remedies

Symptom	Possible cause	Possible remedy
No mA output <i>and</i> no frequency output <i>or</i> loop test failed	Power supply problem	Check power supply and power-supply wiring. See Section 22.11.
	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 8.4.2 to check the mA fault indicator or Section 8.5 to check the frequency fault indicator. If a fault condition is present, see Section 22.7.
mA output < 4 mA	Process condition below value configured for 4 mA	Verify process. Verify or change the 4 mA value. See Section 8.4.4.
	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 8.4.2. If a fault condition is present, check the active alarm log. See Section 22.6.
	Open in wiring	Verify all connections.
	Bad mA receiving device	Check the mA receiving device or try another mA receiving device. See Section 22.11.6.
	Bad output circuit	Measure DC voltage across output to verify that output is active. Test output. See Section 16.4.4.

Table 22-9 I/O problems and remedies *continued*

Symptom	Possible cause	Possible remedy
No frequency output	Process condition below cutoff	Verify or change the cutoff. See Section 8.4.4.
	Fault condition if fault indicator is 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 8.5. If a fault condition is present, check the active alarm log. See Section 22.6.
	Slug flow	See <i>Slug flow alarms</i> in Section 22.7.3.
	Flow in reverse direction from configured flow direction parameter	Verify process. Check flow direction parameter. See Section 7.3.2. Verify sensor orientation. Ensure that flow direction arrow on sensor case matches process flow.
	Bad frequency receiving device	Check the frequency receiving device or try another frequency receiving device. See Section 22.11.6.
	Output level not compatible with receiving device	Verify that the output level and the required receiving input level are compatible.
	Bad output circuit	Test output. See Section 16.4.4.
	Incorrect pulse width configuration	Verify pulse width setting. See Section 8.5.2.
	Internal totalizer stopped and not restarted	Restart internal totalizer.
Constant mA output	Output is configured for passive power	Ensure output power is set to active. See Section 8.5.
	Non-zero HART address (multi-drop communications) (primary mA output only)	Set HART address to zero. See Section 22.11.7.
	Output is fixed in a test mode	Exit output from test mode. See Section 16.4.4.
	Burst mode enabled (primary mA output only)	Disable burst mode. See Section 13.4.
mA output consistently out of range	Zero calibration failure	See Section 22.17.
	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 8.4.2. If a fault condition is present, check the active alarm log. See Section 22.6.
Consistently incorrect mA measurement	20 mA and 4 mA values not set correctly	Check the 20 mA and 4 mA values. See Section 22.14.
	Output not trimmed correctly	Trim the output. See Section 16.5.
	Incorrect flow measurement unit configured	Verify flow measurement unit configuration. See Section 22.13.
	Incorrect process variable configured	Verify process variable assigned to mA output. See Section 8.4.3.
mA reading correct at low currents but wrong at higher currents	20 mA and 4 mA values not set correctly	Check the 20 mA and 4 mA values. See Section 22.14.
	mA loop resistance may be too high	Verify mA output load resistance is below maximum supported load.

Table 22-9 I/O problems and remedies *continued*

Symptom	Possible cause	Possible remedy
Consistently incorrect frequency measurement	Output not scaled correctly	Check frequency output scale and method. See Section 22.15. Verify that voltage and resistance match the frequency output load resistance value chart.
	Incorrect flow measurement unit configured	Verify flow measurement unit configuration. See Section 22.13.
Erratic frequency measurement when flow is stable	RF (radio frequency) interference from environment	See Section 22.11.5.
Cannot connect to RS-485 terminals 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 Series 3000 devices on network default to address=111 during 10-second service port interval. Disconnect or power down other devices, or use RS-485 communications.
	Device is secured (custody transfer only)	Change Series 3000 device to unsecured, or use RS-485 communications.
Cannot connect to RS-485 terminals in RS-485 mode	Terminals not in RS-485 mode	For the first 10 seconds after power-up, the terminals are in service port mode. If a service port connection is made during this period, they remain in service port mode. Wait until 10-second interval has expired, cycle power to the device to reset the terminals if required, or connect in service port mode.
	Incorrect RS-485 configuration	After 10-second interval on power-up, the transmitter switches to RS-485 mode. Default settings are: <ul style="list-style-type: none"> • Address=1 • Baud rate=9600 • Parity=odd Use the display to check or change the RS-485 settings (see Section 13.3), then set parameters appropriately in the remote device.
	Leads reversed	Switch leads and try again.

22.11 Diagnosing wiring problems

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

22.11.1 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. If the transmitter is in a hazardous area, wait five minutes.
3. Ensure that the power supply wires are connected to the correct terminals. See the installation instructions.
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 (see Appendix A or Appendix B).

22.11.2 Checking the sensor-to-transmitter wiring

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

- The transmitter is connected to the sensor according to the wiring information provided in the installation instructions.
- The wires are making good contact with the terminals.

If the wires are incorrectly connected:

1. Power down the transmitter.
2. If the transmitter is in a hazardous area, wait five minutes.
3. Correct the wiring.
4. Restore power to the transmitter.

22.11.3 Checking grounding

The Series 3000 device must be grounded. If you are using a T-Series sensor, it must be grounded. If the core processor is installed separately, it must be grounded separately. See the installation instructions.

22.11.4 Checking the HART communication loop

To check the HART communication loop (primary mA output only):

1. Verify that the loop wires are connected correctly for HART/analog wiring.
2. Remove analog loop wiring.
3. Install a 250 Ω resistor across the primary mA output terminals.
4. Check for voltage drop across the resistor (4–20 mA = 1–5 VDC). If voltage drop < 1 VDC, add resistance to achieve voltage drop > 1 VDC.
5. Connect the Communicator directly across the resistor and attempt to communicate (poll).

22.11.5 Checking for RF interference

If you are experiencing RF (radio frequency) interference on your frequency output or 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 frequency 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.

22.11.6 Checking the output wiring and receiving device

If you receive an inaccurate frequency or 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.

22.11.7 Checking the Loop Current Mode parameter

Depending on the setting of the Loop Current Mode parameter, the primary mA output may be fixed at 4 mA. In this situation:

- The primary mA output will not report process variable data.
- The primary mA output will not indicate fault conditions.

See Section 13.4.1.

22.12 Checking the sensor tubes

Corrosion, erosion, or damage to the sensor tubes can affect process measurement. To check for these conditions, perform the meter verification procedure, if available (see Chapter 21). If the meter verification procedure is not available, perform a visual inspection, or perform a density calibration and check for a shift in the K1 and K2 values. Contact Micro Motion customer service.

22.13 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 7.3.2.

22.14 Checking the calibration span

A saturated mA output or incorrect mA measurement could indicate that an incorrect 4 mA or 20 mA value has been configured for the mA output. Verify that these values are correct and change them if necessary. See Section 8.4.4.

22.15 Checking the frequency output scale and method

A saturated frequency output or an incorrect frequency measurement could indicate a faulty frequency output scale and/or method. Verify that the frequency output scale and method are correct and change them if necessary. See Section 8.5.

22.16 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. See Section 7.3.3.

22.17 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. To calibrate for true accuracy, always use a measurement source that is more accurate than the flowmeter.

If there is significant discrepancy (>20%) between process data and the transmitter's reported values, do not attempt to recalibrate. 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 verification, see Chapter 21.

22.18 Checking the test points

Some status alarms that indicate a sensor failure or overrange condition can be caused by problems other than a failed sensor. You can diagnose sensor failure or overrange status alarms by checking the flowmeter test points. These values describe the current operation of the sensor.

22.18.1 Obtaining the test points

To obtain current values for test points, use the Diagnostic Monitor, which is accessed from the View menu. The Diagnostic Monitor displays:

- Tube frequency
- Left pickoff
- Right pickoff
- Drive gain
- Live zero

Note: The Diagnostic Monitor is not the same as the Diagnostics menu. The Diagnostics menu, accessed through the Maintenance option of the Management menu, allows you to read the values of external inputs and set output levels for outputs. The Diagnostics menu and its use are described in Chapter 16.

22.18.2 Evaluating the test points

Use the following guidelines to evaluate the test points:

- If the drive gain is unstable, refer to Section 22.18.3.
- If the value for the left or right pickoff does not equal the appropriate value from Table 22-10, based on the sensor flow tube frequency, refer to Section 22.18.5.
- If the values for the left and right pickoffs equal the appropriate values from Table 22-10, based on the sensor flow tube frequency, record your troubleshooting data and contact Micro Motion customer service for assistance.

Table 22-10 Sensor pickoff values

Sensor model ⁽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.

22.18.3 Excessive drive gain

Excessive drive gain can be caused by several problems. See Table 22-11.

Table 22-11 Excessive drive gain causes and remedies

Cause	Possible remedy
Excessive slug flow	Eliminate slugs.
	Change the sensor orientation.
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.
Overpressurized tubes	Contact Micro Motion.
Drive board or module failure, cracked flow tube, or sensor imbalance	Contact Micro Motion.
Mechanical binding at sensor	Ensure sensor is free to vibrate.
Open drive or left pickoff sensor coil	Contact Micro Motion.
Incorrect sensor characterization	Verify sensor configuration. See Section 22.16.

22.18.4 Erratic drive gain

Erratic drive gain can be caused by several problems. See Table 22-12.

Table 22-12 Erratic drive gain causes and remedies

Cause	Possible remedy
Wrong K1 characterization constant for sensor	Re-enter the K1 characterization constant. See Section 7.3.3.
Polarity of pick-off reversed or polarity of drive reversed	Contact Micro Motion.
Slug flow	Verify flow tubes are completely full of process fluid.
Foreign material caught in flow tubes	Purge flow tubes.

22.18.5 Low pickoff voltage

Low pickoff voltage can be caused by several problems. See Table 22-13.

Table 22-13 Low pickoff voltage causes and remedies

Cause	Possible remedy
Faulty wiring runs between the sensor and core processor	Verify wiring. See Section 22.11.2.
Process flow rate beyond the limits of the sensor	Verify that the process flow rate is not out of range of the sensor.
Slug flow	Verify flow tubes are completely full of process fluid.
No tube vibration in sensor	Check for plugging. Verify power to transmitter. Ensure sensor is free to vibrate (no mechanical binding). Verify wiring. See Section 22.11.2. Test coils at sensor. See Section 22.20.
Moisture in the sensor electronics	Eliminate the moisture in the sensor electronics.
The sensor is damaged	Contact Micro Motion.

22.19 Checking the core processor

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 22-14.
- If an A026 alarm is present, you can perform the core processor resistance test to check for a damaged core processor.

22.19.1 Checking the core processor LED

To check the core processor LED:

- Maintain power to the transmitter.
- Remove the core processor lid. The core processor is intrinsically safe and can be opened in all environments. Do not disconnect the 4-wire cable between the core processor and the transmitter.
- Check the core processor LED against the conditions described in Table 22-14 (standard core processor) or Table 22-15 (enhanced core processor).
- To return to normal operation, replace the lid.

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

Table 22-14 Standard core processor LED behavior, flowmeter 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 22.7.3.
Solid ON	Zero or calibration in progress	If calibration is in progress, no action required. If no calibration is in progress, contact Micro Motion.
	Core processor receiving between 11.5 and 5 volts	Check power supply to transmitter.
3 rapid flashes, followed by pause	Sensor not recognized	Check wiring between transmitter and sensor. See Section 22.11.2.
	Improper configuration	Check sensor characterization parameters. See Section 22.16.
	Broken pin between sensor and core processor	Contact Micro Motion.
4 flashes per second	Fault condition	Check alarm status. See Section 22.6.
OFF	Core processor receiving less than 5 volts	<ul style="list-style-type: none"> • Verify power supply wiring to core processor. See Section 22.11.2. • If transmitter display 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. If reading is 0, internal transmitter failure is possible. Remove the wires from core processor terminals 1 and 2, and check the voltage across the wires. If the voltage reading is now ~14 VDC, the transmitter is normal. If the voltage reading is not ~14 VDC, contact Micro Motion. If reading is less than 1 VDC, verify power supply wiring to core processor. Wires may be switched. See Section 22.11.2. • If transmitter display is not lit, transmitter is not receiving power. Check power supply. If power supply is operational, internal transmitter or display failure is possible. Contact Micro Motion.
	Core processor internal failure	Contact Micro Motion.

Table 22-15 Enhanced core processor LED behavior, flowmeter 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.
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 <i>Slug flow alarms</i> in Section 22.7.3.
		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.

Table 22-15 Enhanced core processor LED behavior, flowmeter conditions, and remedies *continued*

LED behavior	Condition	Possible remedy
Flashing red (50% on, 50% off, skips every 4th)	Sensor failed	Contact Micro Motion.
OFF	Core processor receiving less than 5 volts	<ul style="list-style-type: none"> • Verify power supply wiring to core processor. • If transmitter display 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 22.11. Otherwise, contact Micro Motion. • If transmitter display is not lit, transmitter is not receiving power. Check power supply. See Section 22.11. If power supply is operational, internal transmitter, display, or LED failure is possible. Contact Micro Motion.
	Core processor internal failure	Contact Micro Motion.

22.19.2 Core processor resistance test (standard core processor only)

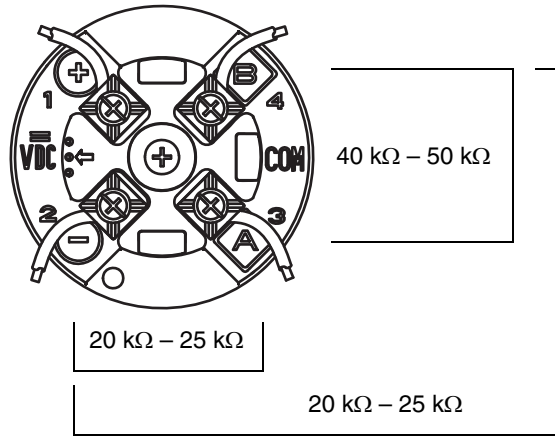
Note: Perform this test only if an A026 alarm is present.

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.
4. Measure the resistance between core processor terminals 3 and 4 (RS-485/A and RS-485/B). See Figure 22-6. 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 customer service.
8. To return to normal operation:
 - a. Reconnect the 4-wire cable between the core processor and the transmitter.
 - b. Replace the core processor lid.

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

Figure 22-6 Core processor resistance test



22.20 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.

22.20.1 Remote core processor with remote transmitter installation

If you have a remote core processor with remote transmitter installation:

1. Power down the transmitter.
2. If the transmitter is in a hazardous area, wait five minutes.
3. At the core processor:
 - a. Remove the end-cap.
 - b. Unplug the terminal blocks from the terminal board.
 - c. Using a digital multimeter (DMM), check the pickoff coils listed in Table 22-16 by placing the DMM leads on the unplugged terminal blocks for each terminal pair. Record the values.

Table 22-16 Coils and test terminal pairs

Coil	Test terminal pair
Drive coil	Brown to red
Left pickoff coil (LPO)	Green to white
Right pickoff coil (RPO)	Blue to gray
Resistance temperature detector (RTD)	Yellow to violet
Lead length compensator (LLC) (all sensors except CMF400 I.S. and T-Series)	Yellow to orange
Composite RTD (T-Series sensors only)	
Fixed resistor (CMF400 I.S. sensors only)	

4. There should be no open circuits, i.e., no infinite resistance readings. The LPO and RPO readings should be the same or very close ($\pm 5 \Omega$). 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.

Diagnostics and Troubleshooting

5. 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.
6. 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 customer service for assistance.

There should be infinite resistance for each pair. If there is any resistance at all, there is a short between terminals. See Table 22-17 for possible causes and solutions.

7. If the problem is not resolved, contact Micro Motion customer service for assistance.
8. 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 22-17 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.
Internally shorted feedthrough (sealed passage for wiring from sensor to sensor junction box)	Contact Micro Motion.
Faulty cable	Replace cable.
Improper wire termination	Verify wire terminations inside sensor junction box. See Micro Motion's <i>9-Wire Flowmeter Cable Preparation and Installation Guide</i> or the sensor manual.

22.20.2 4-wire remote installation

If you have a 4-wire remote installation:

1. Power down the transmitter.
2. If the transmitter is in a hazardous area, wait five minutes.
3. Remove the core processor lid.

4. Disconnect the wires from the core processor terminals.
5. 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.**
6. 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 by removing the snap clip and pulling the plug straight out.

⚠ CAUTION

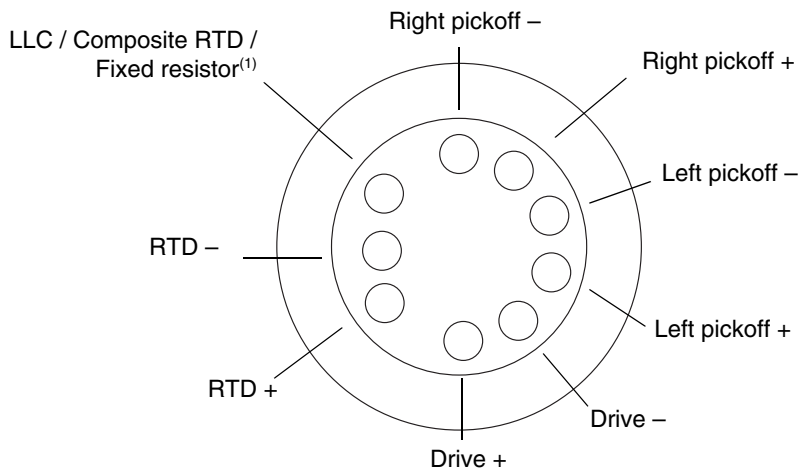
If the core processor (feedthrough) pins are bent, broken, or damaged in any way, the core processor will not operate.

To avoid damage to the core processor pins:

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

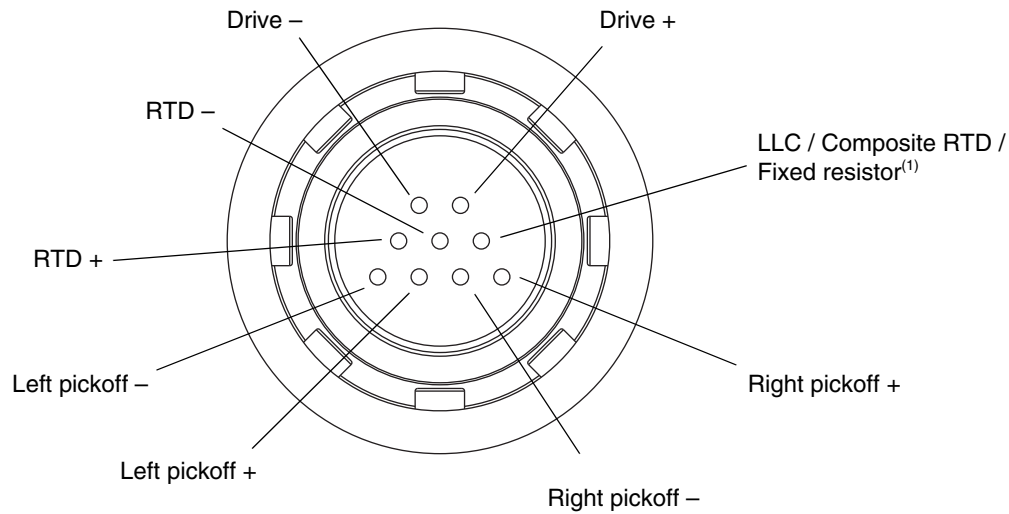
7. Using a digital multimeter (DMM), check the pickoff coil resistances by placing the DMM leads on the pin pairs. Refer to Figure 22-7 (standard core processor) or Figure 22-8 (enhanced core processor) to identify the pins and pin pairs. Record the values.

Figure 22-7 Sensor pins – Standard core processor



(1) Functions as fixed resistor for the following sensors: F300, H300, F025A, F050A, F100A, CMF400 I.S., CMFS. Functions as composite RTD for T-Series sensors. For all other sensors, functions as lead length compensator (LLC).

Figure 22-8 Sensor pins – Enhanced core processor



(1) Functions as fixed resistor for the following sensors: F300, H300, F025A, F050A, F100A, CMF400 I.S., CMFS. Functions as composite RTD for T-Series sensors. For all other sensors, functions as lead length compensator (LLC).

8. There should be no open circuits, i.e., no infinite resistance readings. The LPO and RPO readings should be the same or very close ($\pm 5 \Omega$).
9. 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 22-17 for possible causes and solutions.
10. 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 customer service for assistance.

There should be infinite resistance for each pair. If there is any resistance at all, there is a short between terminals. See Table 22-17 for possible causes and solutions.

11. If the problem is not resolved, contact Micro Motion customer service for assistance.

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.
 - b. Reinsert the snap clip to secure the sensor cable to the feedthrough.
 - c. 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. Reconnect the wires to the core processor terminals.
5. Replace the core processor lid.

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

Appendix A

Specifications – Model 3300 and Model 3500

A.1 Housing and mounting

There are two housing and mounting options available for the Model 3300 or Model 3500.

A.1.1 Panel-mount

- With bezel mounting kit
- Front panel with bezel is rated IP65 (NEMA 4X)

A.1.2 Rack-mount

- 19-inch (486,2 mm) rack-mount meets DIN standard 41494 and IEC 297-3
- Front panel is rated IP40

A.2 Interface/display

Screen

- Backlit LCD, 128 x 128 pixel, bit map
- Adjustable contrast
- Non-glare chemical-resistant acrylic lens

Keypad membrane switch

- Large pushbuttons with tactile feedback
- Software-defined function keys
- Chemical-resistant polyester

A.3 Weight

Maximum 3.5 lb (1,6 kg), excluding prepared cables

A.4 Dimensions

Panel-mount: See Figures A-1 and A-2.

Rack-mount: See Figure A-3.

Core processor: See Figure A-4.

Specifications – Model 3300 and Model 3500

Figure A-1 Panel-mount dimensions for Model 3300 or Model 3500 with screw-type connectors

Dimensions in inches
(mm)

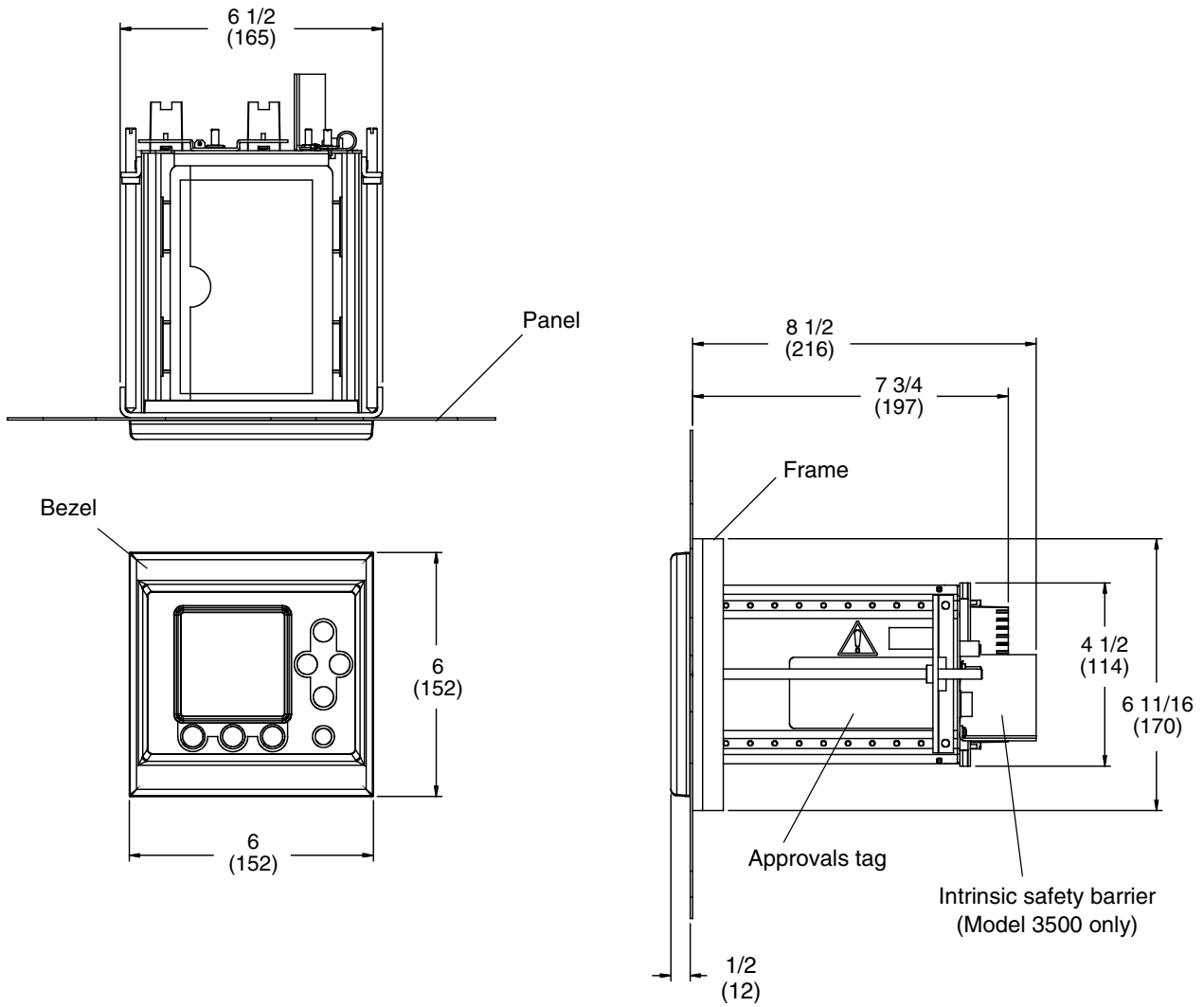


Figure A-2 Panel-mount dimensions for Model 3300 or Model 3500 with I/O cables

Dimensions in inches
(mm)

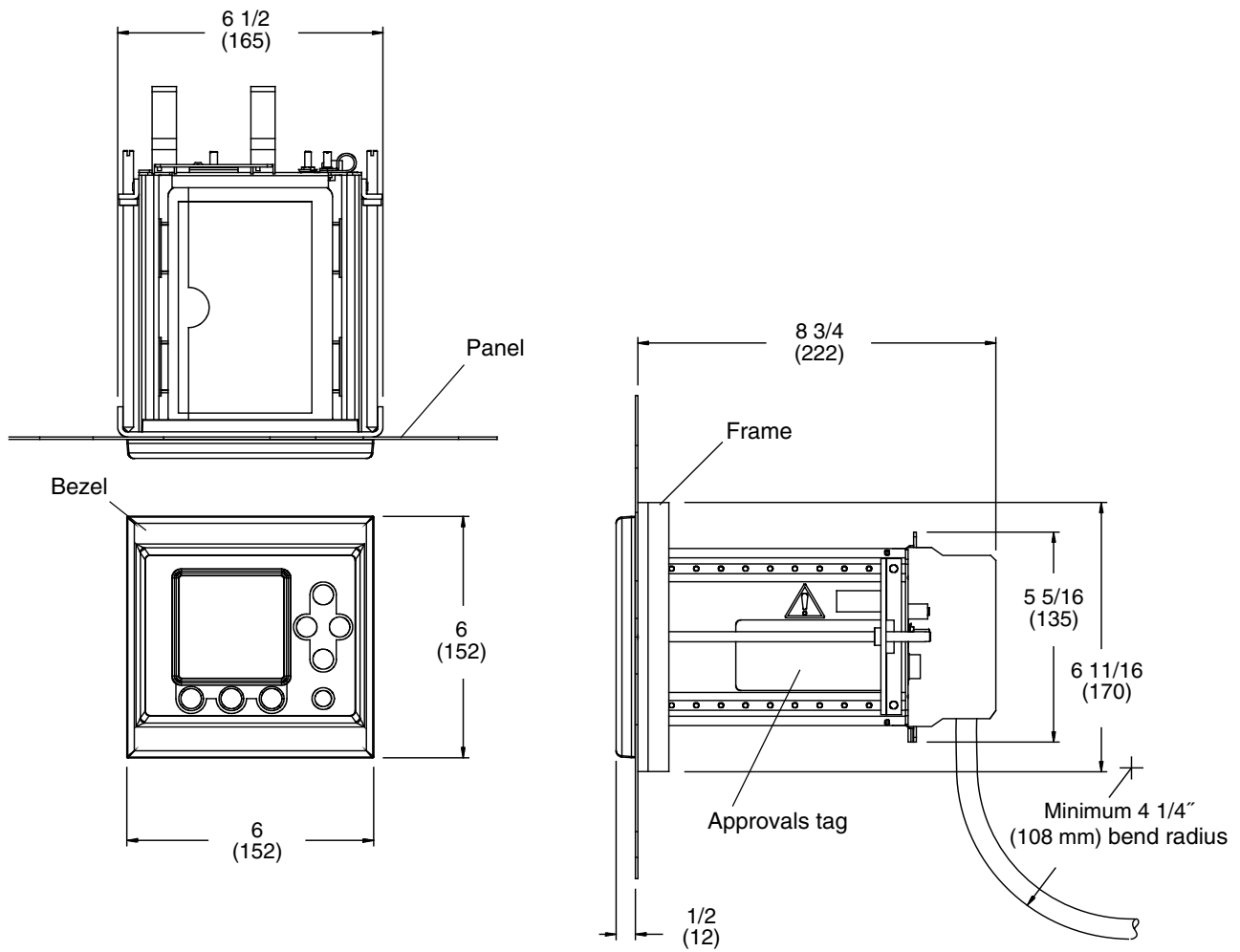


Figure A-3 Rack-mount dimensions for Model 3300 or Model 3500

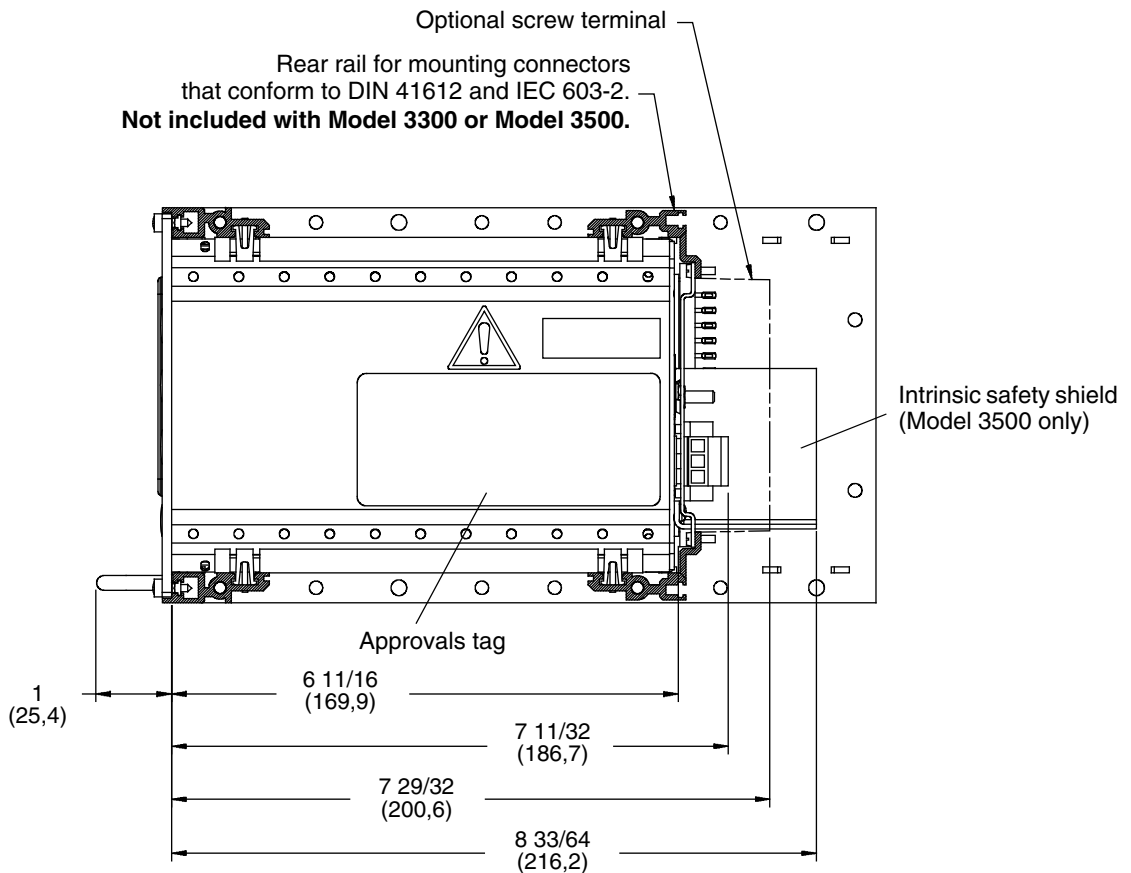
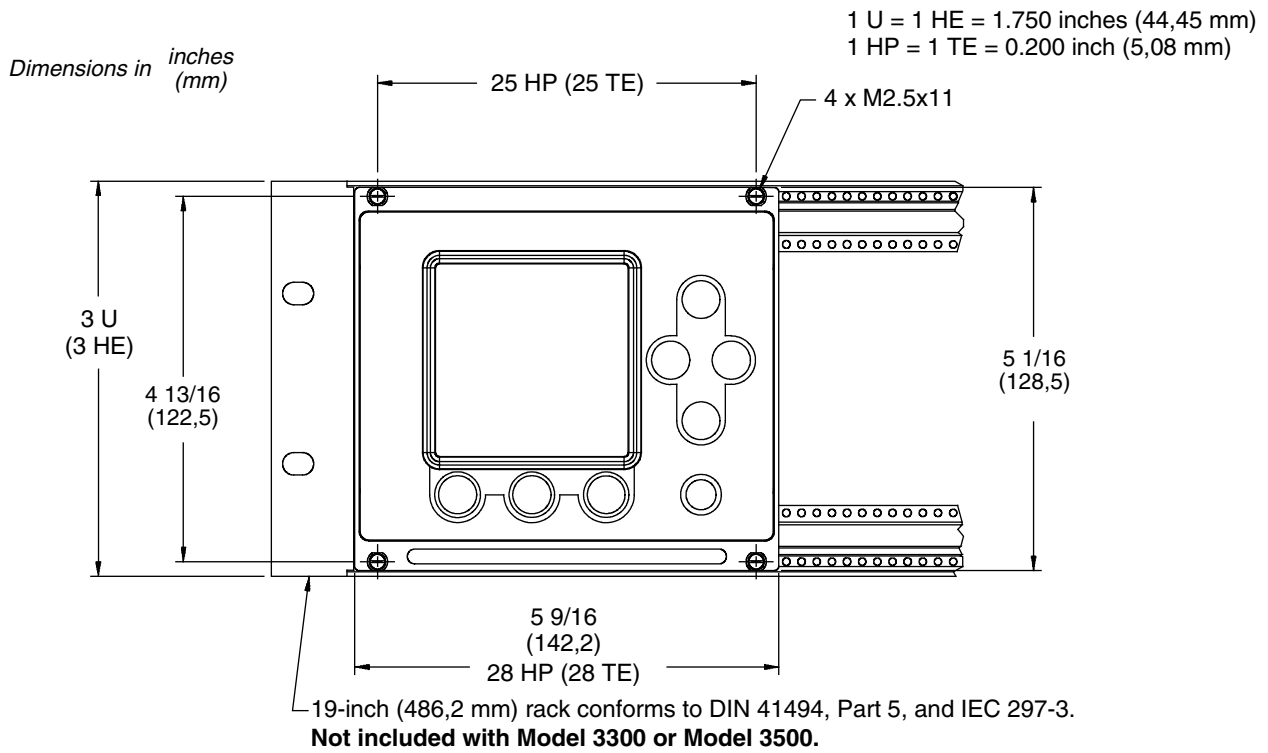
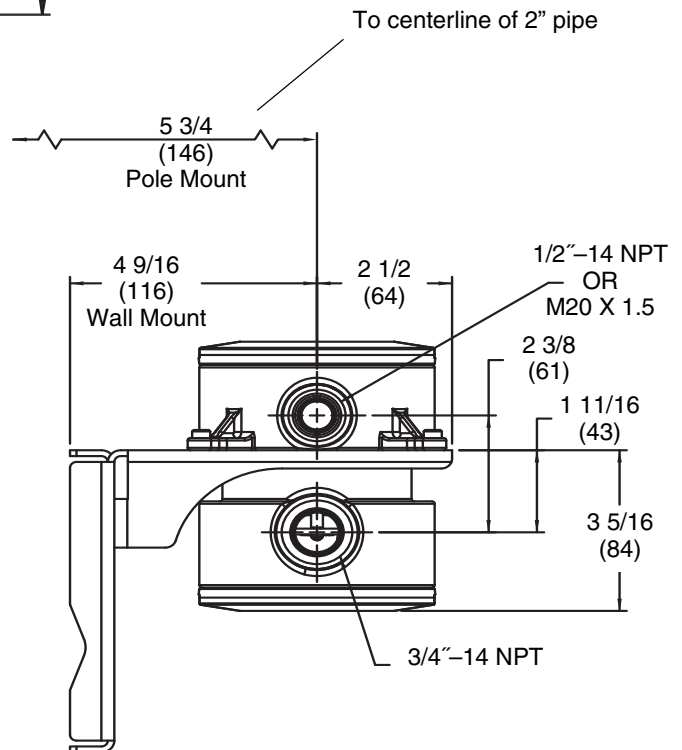
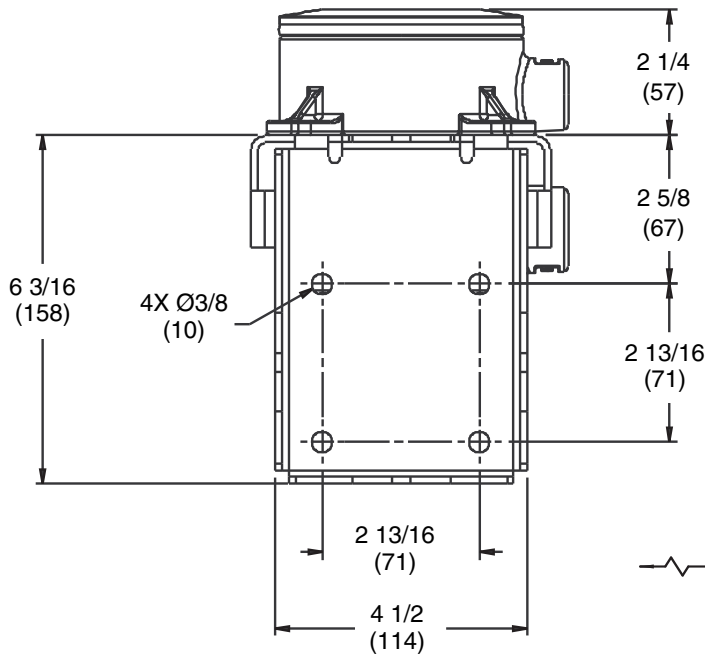
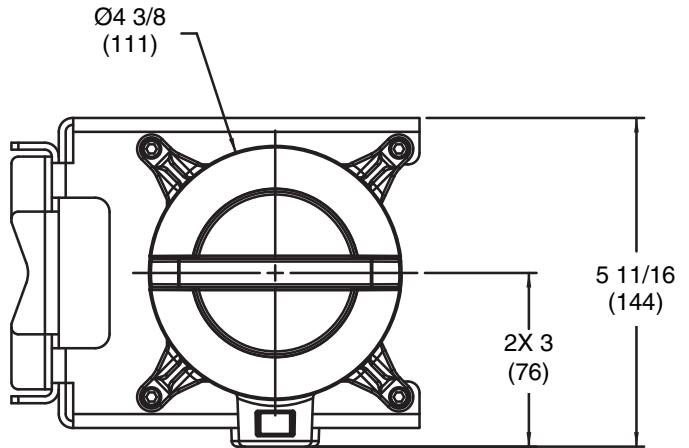
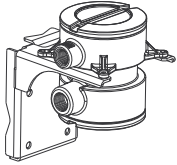


Figure A-4 Core processor dimensions

Dimensions in inches (mm)



Note: These dimensions apply only to the core processor component in remote core processor with remote transmitter installations.

A.5 Electrical connections

Electrical connections depend on the mounting option.

A.5.1 Panel-mount

Input and output connections

- Available as screw terminals (standard) or remote DIN-rail-mount screw terminals (optional) with I/O cable
- Remote terminals attach to any of four rail types. I/O cable is available in lengths of 2, 5, and 10 feet (0,6, 1,5, and 3 meters)
- Terminals accept 24 to 16 AWG (0,25 to 1,5 mm²) wires

Power connection

Screw terminals accept 18 to 14 AWG (0,75 to 2,5 mm²) wires

A.5.2 Rack-mount

Input and output connections

- Type D connectors per DIN standard 41612 (IEC 603-2)
- Available as solder tails (standard) or screw terminals (optional)
- Screw terminals accept 24 to 16 AWG (0,25 to 1,5 mm²) wires

Power connection

- Screw terminals are fixed to rack chassis
- Ground makes first and breaks last
- Terminals accept 18 to 14 AWG (0,75 to 2,5 mm²) wires

A.6 Inputs and outputs

A.6.1 Intrinsically safe input signals

One 4-wire Coriolis sensor signal input with ground (standard)

A.6.2 Non-intrinsically safe input signals

Frequency/pulse input

One 2-wire frequency/pulse input

- Frequency range: 0–20,000 Hz
- Minimum pulse width: 25 µsec
- Power: Sourcing or sinking
- Voltage: 0–0.8 VDC low state, 3–30 VDC high state
- Current: Nominal 5 mA pull-up

Discrete inputs

Two discrete, momentary inputs

- Pulse width: 0.15 sec minimum
- Voltage: 0–0.8 VDC low state, 3–30 VDC high state, dry contacts

A.6.3 Non-intrinsically safe output signals

Milliamp outputs

Two active 4–20 mA outputs

- Isolated to ± 50 VDC from all other outputs and earth ground
- Maximum load limit: 1000 Ω
- Output is linear with process from 3.8 to 20.5 mA, per NAMUR NE43 (June 1994)

Discrete outputs

Three discrete outputs

- Configurable for the application
- Polarity: Active high or active low, software selectable
- Power: Internal pull-up to 24 V
- Voltage: 24 VDC nominal
- Current: Sourcing at 5.6 mA when $V_{out} = 3$ VCD, sinking up to 500 mA at 30 VDC maximum

Frequency/pulse output

One 2-wire frequency/pulse output

- Output is linear with flow rate to 12,500 Hz
- Configurable unit of measure
- Scalable to 10000 Hz
- Pulse width: 50% duty cycle above 500 Hz, configurable for frequencies below 500 Hz
- Power: Active or passive, software selectable
- Polarity: Active high or active low, software selectable
- Voltage: 24 VDC nominal, active; 30 VDC applied maximum, passive
- Current: Sourcing, 10 mA at 3 VDC, active; sinking, 500 mA, active or passive

Fault output

When a fault is detected, outputs go to configured states. User can select high, low, last measured value, or internal zero. Milliamp outputs conform to NAMUR NE43 (June 1994).

- High output limits can be configured from 21 to 24 mA for milliamp; 15,000 Hz for frequency
- Low output limits can be configured from 1 to 3.6 mA for milliamp; 0 Hz for frequency
- Last measured value is the last output for the process variable
- Internal zero drives the milliamp and frequency outputs for process variables to zero values

Specifications – Model 3300 and Model 3500

A.6.4 Digital communications

- One RS-485 port (standard)
 - Supports Modbus RTU, Modbus ASCII, HART/RS-485, or printer
 - User-configurable
- HART superimposed on primary mA output
 - Standard HART/Bell 202 communication parameters, not configurable
- External adapters (not included) required for conversion to RS-232

A.7 Power supply options

A.7.1 Model 3300 controller

85 to 265 VAC

- 50/60 Hz, 15 VA
- 0.25 A max at 85 VAC; 0.12 A max at 265 VAC
- IEC 127-3/4 fuse, 0.63 A time-delay
- Complies with “low-voltage directive” 2006/95/EC per IEC 61010-1
- Installation (Overvoltage) Category II, Pollution Degree 2

18 to 30 VDC

- 7 watts typical, 14 watts maximum
- IEC 127-3/4 fuse, 1.6 A time-delay

A.7.2 Model 3500 transmitter

85 to 265 VAC

- 50/60 Hz, 30 VA
- 0.33 A max at 85 VAC; 0.15 A max at 265 VAC
- IEC 127-3/4 fuse, 0.63 A time-delay
- Complies with “low-voltage directive” 2006/95/EC per IEC 61010-1
- Installation (Overvoltage) Category II, Pollution Degree 2

18 to 30 VDC

- 18 watts typical, 25 watts maximum
- IEC 127-3/4 fuse; 1.6 A time-delay

A.8 Environmental limits

- Ambient temperature:
 - Operating: -4 to $+140$ °F (-20 to $+60$ °C)
 - Storage: -40 to $+158$ °F (-40 to $+70$ °C)Some darkening of display may occur above 131 °F (55 °C). Display responsiveness decreases below -4 °F (-20 °C).
- Humidity: 5 to 95% relative humidity, non-condensing at 140 °F (60 °C)
- Vibration: Meets IEC 68.2.6, endurance sweep, 5 to 2000 Hz, 50 sweep cycles at 1.0 g

A.9 Environmental effects

EMI effects

- Meets EMC directive 89/336/EEC per EN 61326 Industrial
- Conforms to NAMUR NE21 (June 1997)

Ambient temperature effect

- On analog outputs: $\pm 0.005\%$ of span per °C

A.10 Hazardous area classifications

A.10.1 ATEX

Model 3500 transmitter

Safe area only [Ex ib] IIB/IIC. The sensor outputs are intrinsically safe and can be connected to a sensor in the Zone 1 area.

A.10.2 UL and CSA

Model 3300 controller

Class I, Div. 2, Groups A, B, C, D when installed in a suitable enclosure.

Model 3500 transmitter

Class I, Div. 2, Groups A, B, C, D when installed in a suitable enclosure. Provides nonincendive sensor outputs for use in Class I, Div. 2, Groups A, B, C, D, or intrinsically safe sensor outputs for use in Class I, Div. 1, Groups C and D; Class II, Div. 1, Groups E, F, and G.

A.11 Performance specifications

For performance specifications, refer to the sensor specifications.

A.12 Cleaning instructions

To clean the Model 3300 or Model 3500, use a clean dry cloth or dry air.

Appendix B

Specifications – Model 3350 and Model 3700

B.1 Compartmentalized housing

- Compartment with threaded cover contains electronics
- Terminal compartment contains:
 - Non-intrinsically safe compartment with input and output terminals
 - Intrinsically safe compartment with interface/display, sensor wiring terminals (Model 3700 only), and optional input and output terminals
- Mounting bracket and interface/display rotate to allow mounting in four different orientations
- Rated NEMA 4X (IP67)

B.2 Interface/display

Screen

- Backlit LCD, 128 × 128 pixel, bit map
- Adjustable contrast
- Non-glare tempered glass lens
- Suitable for hazardous area installation

Keypad membrane switch

- Large pushbuttons with tactile feedback
- Software-defined function keys
- Chemical-resistant polyester

B.3 Weight

19 lb (8,6 kg)

B.4 Dimensions

See Figures B-1 through B-4.

Specifications – Model 3350 and Model 3700

Figure B-1 Model 3350 or Model 3700 dimensions – Face view

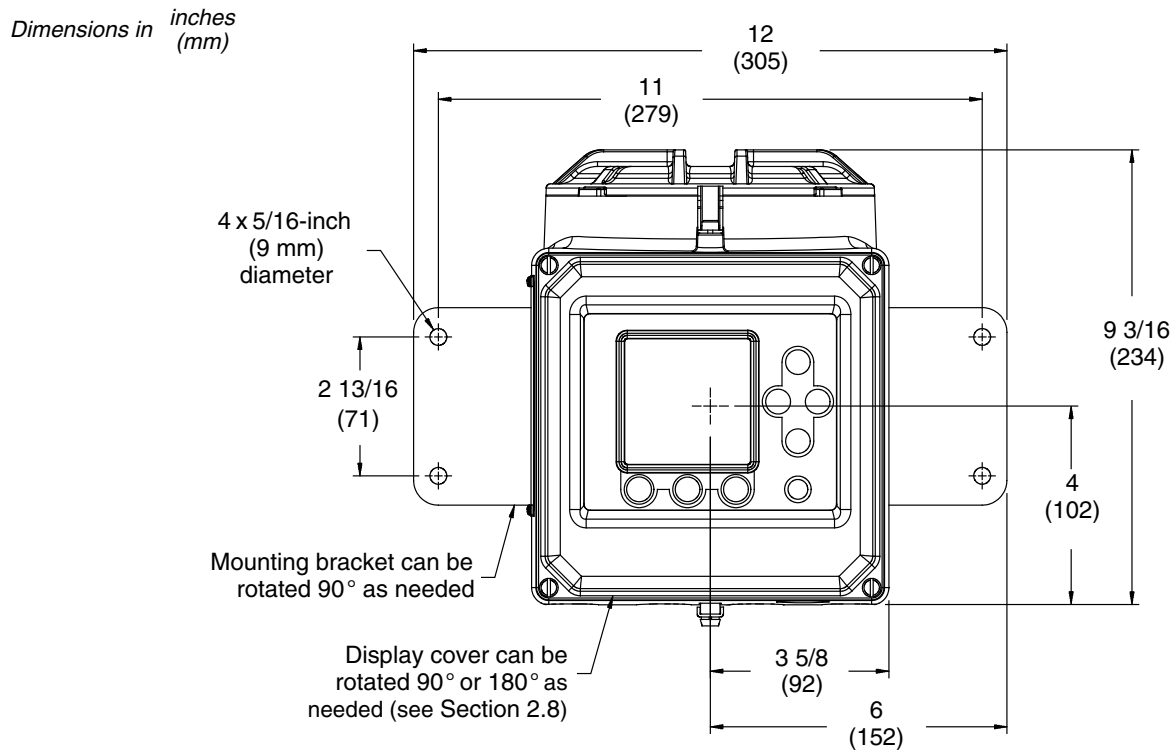


Figure B-2 Model 3350 or Model 3700 dimensions – Top view

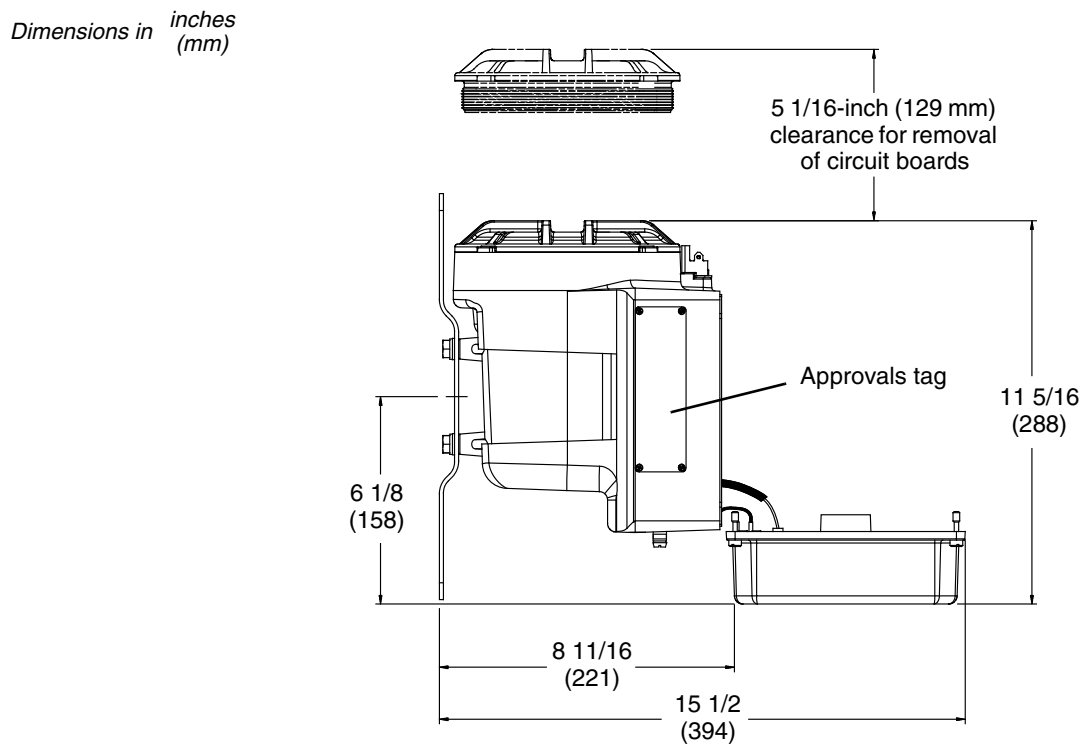


Figure B-3 Model 3350 or Model 3700 dimensions – Conduit openings view

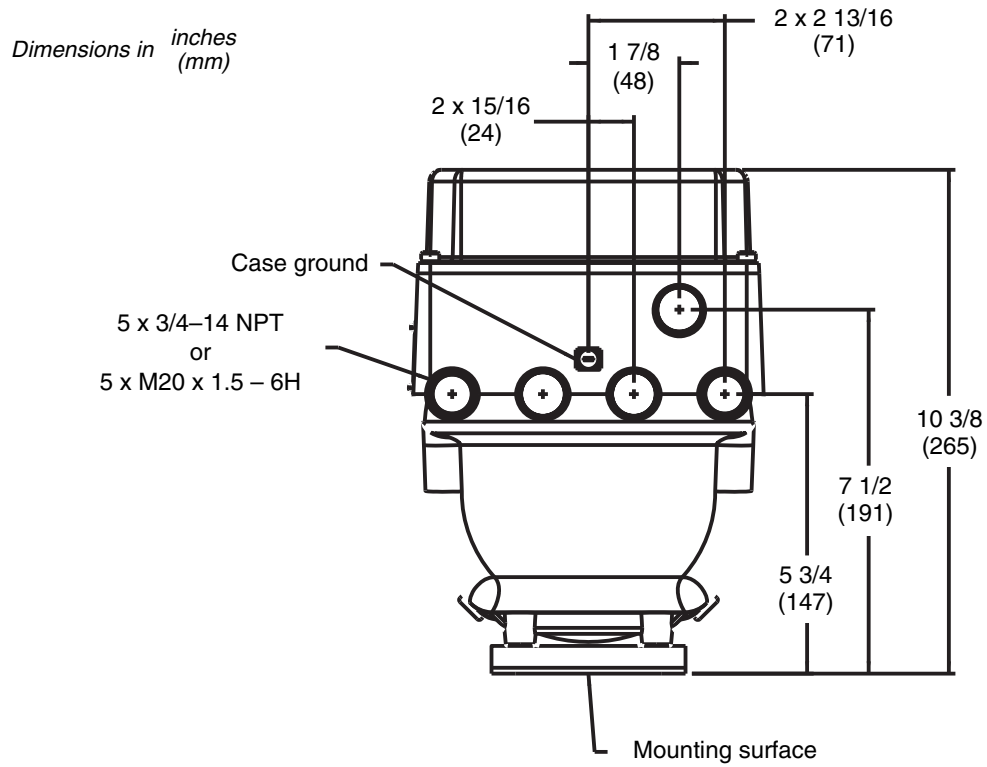
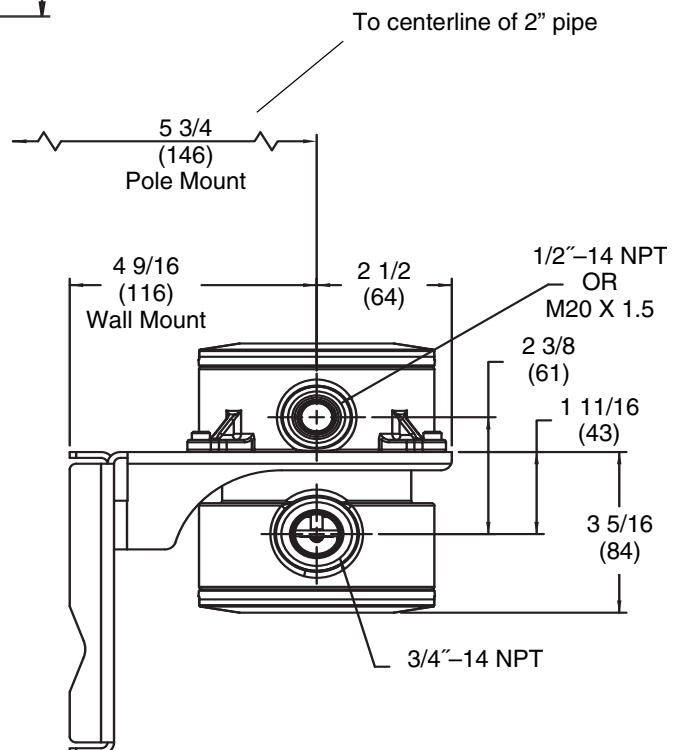
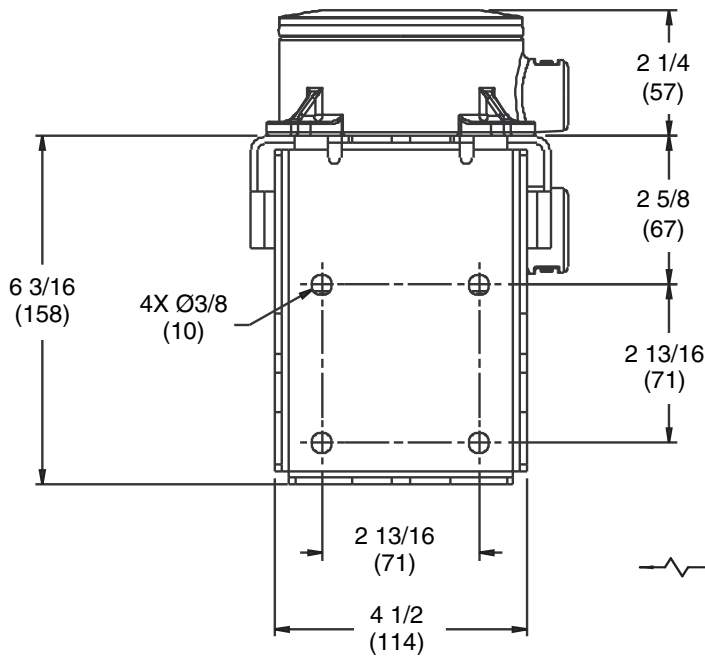
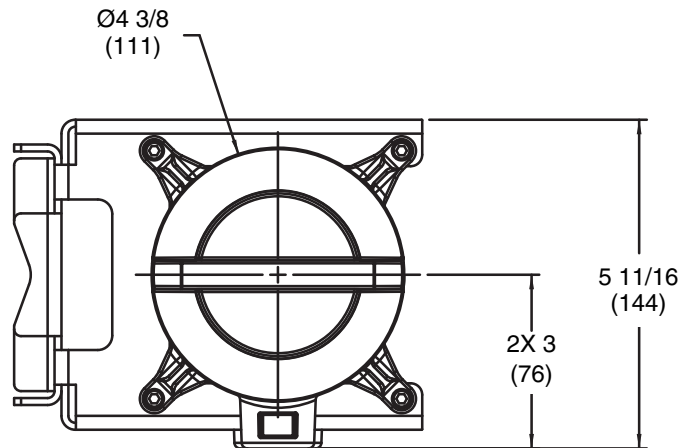
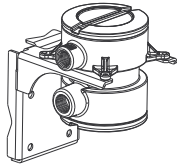


Figure B-4 Core processor dimensions

Dimensions in inches (mm)



Note: These dimensions apply only to the core processor component in remote core processor with remote transmitter installations.

B.5 Electrical connections

Two color-coded wiring compartments:

- Compartment with intrinsically safe terminal block has two 3/4-inch NPT or M20 × 1.5 conduit openings
- Compartment with non-intrinsically safe terminal block has three 3/4-inch NPT or M20 × 1.5 conduit openings

Input and output screw terminals accept 22 to 16 AWG (0,35 to 1,5 mm²) wires

Power screw terminals accept 18 to 12 AWG (0,75 to 4.0 mm²) wires

B.6 Inputs and outputs

B.6.1 Intrinsically safe input signals

One 4-wire Coriolis sensor signal input with ground (standard)

B.6.2 Non-intrinsically safe input signals

Frequency/pulse input

One 2-wire frequency/pulse input

- Frequency range: 0–20,000 Hz
- Minimum pulse width: 25 μsec
- Power: Sourcing or sinking
- Voltage: 0–0.8 VDC low state, 3–30 VDC high state
- Current: Nominal 5 mA pull-up

Discrete inputs

Two discrete, momentary inputs

- Pulse width: 0.15 sec minimum
- Voltage: 0–0.8 VDC low state, 3–30 VDC high state, dry contacts

B.6.3 Non-intrinsically safe output signals

Milliamp outputs

Two active 4–20 mA outputs

- Isolated to ±50 VDC from all other outputs and earth ground
- Maximum load limit: 1000 Ω
- Output is linear with process from 3.8 to 20.5 mA, per NAMUR NE43 (June 1994)

Discrete outputs

Three discrete outputs

- Configurable for the application
- Polarity: Active high or active low, software selectable
- Power: Internal pull-up to 24 V
- Voltage: 24 VDC nominal
- Current: Sourcing at 5.6 mA when $V_{out} = 3$ VCD; sinking up to 500 mA at 30 VDC maximum

Frequency/pulse output

One 2-wire frequency/pulse output

- Output is linear with flow rate to 12,500 Hz
- Configurable unit of measure
- Scalable to 10000 Hz
- Pulse width: 50% duty cycle above 500 Hz, configurable for frequencies below 500 Hz
- Power: Active or passive, software selectable
- Polarity: Active high or active low, software selectable
- Voltage: 24 VDC nominal, active; 30 VDC applied maximum, passive
- Current: Sourcing, 10 mA at 3 VDC, active; sinking, 500 mA, active or passive

Fault output

When a fault is detected, outputs go to configured states. User can select high, low, last measured value, or internal zero. Milliamp outputs conform to NAMUR NE43 (June 1994).

- High output limits can be configured from 21 to 24 mA for milliamp; 15,000 Hz for frequency
- Low output limits can be configured from 1 to 3.6 mA for milliamp; 0 Hz for frequency
- Last measured value is the last output for the process variable
- Internal zero drives the milliamp and frequency outputs for process variables to zero values

B.6.4 Digital communications

- One RS-485 port (standard)
 - Supports Modbus RTU, Modbus ASCII, HART/RS-485, or printer
 - User-configurable
- HART superimposed on primary mA output
 - Standard HART/Bell 202 communication parameters, not configurable
- External adapters (not included) required for conversion to RS-232

B.7 Power supply options

85 to 265 VAC

- 50/60 Hz, 30 VA
- 0.33 A max at 85 VAC; 0.15 A max at 265 VAC
- IEC 127-3/4 fuse, 0.63 A time-delay
- Complies with “low-voltage directive” 2006/95/EC per IEC 61010-1
- Installation (Overvoltage) Category II, Pollution Degree 2

18 to 30 VDC

- 18 watts typical, 25 watts maximum
- IEC 127-3/4 fuse; 1.6 A time-delay

B.8 Environmental limits

- Ambient temperature:
 - Operating: –4 to +140 °F (–20 to +60 °C)
 - Storage: –40 to +158 °F (–40 to +70 °C)

Some darkening of display may occur above 131 °F (55 °C). Display responsiveness decreases below –4 °F (–20 °C).

- Humidity: 5 to 95% relative humidity, non-condensing at 140 °F (60 °C)
- Vibration: Meets IEC 68.2.6, endurance sweep, 5 to 2000 Hz, 50 sweep cycles at 1.0 g

B.9 Environmental effects

EMI effects

- Meets EMC directive 89/336/EEC per EN 61326 Industrial
- Conforms to NAMUR NE21 (June 1997)

Ambient temperature effect

- On analog outputs $\pm 0.005\%$ of span per °C

B.10 Hazardous area classifications

B.10.1 ATEX

Zone 1, complying with ATEX Directive (94/9/EC) for group II category 2G and marked as EEx de [ib] IIB/IIC T4.

B.10.2 UL and CSA

Class I, Div. 2, Groups A, B, C, and D. Provides nonincendive sensor outputs for use in Class I, Div. 2, Groups A, B, C, D, or intrinsically safe sensor outputs for use in Class I, Div. 1, Groups C and D; Class II, Div. 1, Groups E, F, and G.

Specifications – Model 3350 and Model 3700

B.11 Performance specifications

For performance specifications, refer to the sensor specifications.

B.12 Cleaning instructions

To clean the Model 3350 or Model 3700, use a clean damp cloth.

WARNING

Using a dry cloth to clean the display cover of the Model 3350 or Model 3700 can cause static discharge, which could result in an explosion in an explosive atmosphere.

To prevent an explosion, use a clean damp cloth to clean the display cover of the Model 3350 or Model 3700 in an explosive atmosphere.

Appendix C

Specifications – Model 3100

C.1 Overview

The Model 3100 accessory features relay packs for interfacing with high-energy solenoids, pump starters, or other devices.

C.2 Relay packs

The Model 3100 contains three relays with the following characteristics:

- Solid state, SPST
- Rated at 24–250 VAC, 40 mA–5 A; or 0–70 VDC, 5 A
- Energized by discrete outputs

C.3 Hazardous area classifications

C.3.1 ATEX

Zone 2, complying with ATEX Directive (94/9/EC) for Group II, Category 3G, according to CENELEC standard prEN 50021:1998 and marked as:

- EEx n V II T4
- KEMA 97 ATEX 4940 X
- Ambient temperature –20 to +60 °C (–4 to +140 °F)

C.3.2 UL and CSA

Class I, Division 2, Groups A, B, C, and D

Appendix D

Installing Relays

D.1 About this appendix

This appendix explains how to install relay modules for the Series 3000 device. Relays are used to connect the device's discrete outputs to control devices.

D.2 Relay types

Two types of relay can be used with the Series 3000:

- The Model 3100 relay module supplied by Micro Motion. The Model 3100 contains three solid-state relays.
- User-supplied relay or relay module compatible with the Series 3000 discrete outputs (see Section D.5.1).

D.2.1 Power

The Model 3100 relay module is powered by the Series 3000 discrete outputs.

User-supplied relays can be powered by the Series 3000 discrete outputs if both of the following are true:

- They are solid-state relays, *and*
- The relay input requirements are met by the discrete output characteristics (see Section D.5.1).

If either of these conditions is not true, user-supplied relays must be powered externally.

D.3 Hazardous area installations

If you are installing the relay or relay module in a hazardous area, review the information in this section.

D.3.1 Model 3100 relays

ATEX

Model 3100 relay modules are suitable for installation in Zone 2, complying with ATEX Directive (94/9/EC) for Group II, Category 3G, according to CENELEC standard prEN 50021:1998 and marked as:

- EEx nV II T4
- KEMA 97 ATEX 4940 X
- Ambient temperature -20 to $+60$ °C (-4 to $+140$ °F)

Installing Relays

To comply with hazardous area requirements:

- Model 3100 relay modules must be mounted into a suitable and classified enclosure that provides ingress protection of at least IP4X according to EN 60529, taking into account the environmental conditions into which the equipment will be installed.
- The external metal parts of the relay module (heat sinks) must be connected to the potential-equalizing system within the hazardous area.

UL and CSA

Model 3100 relay modules are suitable for installation in Class I, Division 2, Groups A, B, C, and D.

Note: For CSA compliance, the relay module must be installed in a suitable enclosure where the final combination is subject to acceptance by the Canadian Standards Association (CSA).

D.3.2 User-supplied relays

User-supplied relays to be used for Zone 2 applications must be certified as Category 3 equipment.

D.4 Replacing relays

You may not replace a defective relay separately. If an individual relay is defective, you must replace the entire relay module.

This requirement applies to both the Model 3100 and to user-supplied relays, and to both hazardous and non-hazardous areas.

D.5 Using relays with the Series 3000 device

A relay is used to connect the Series 3000 device's discrete outputs to control devices.

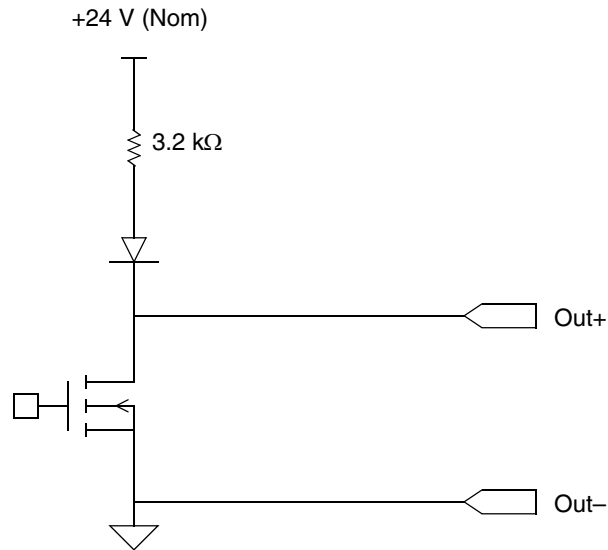
D.5.1 Series 3000 discrete outputs

The Series 3000 has three discrete outputs, which can be configured for specific application requirements. The outputs have the following characteristics:

- Polarity:
 - Active high or active low
 - Software selectable
- Current:
 - Sourcing at 5.6 mA, $V_{out} = 3$ VDC minimum
 - Sinking up to 500 mA at 30 VDC supply maximum

Figure D-1 shows a diagram of a typical discrete output circuit.

Figure D-1 Discrete output circuit



D.6 Installing the Model 3100 relay module

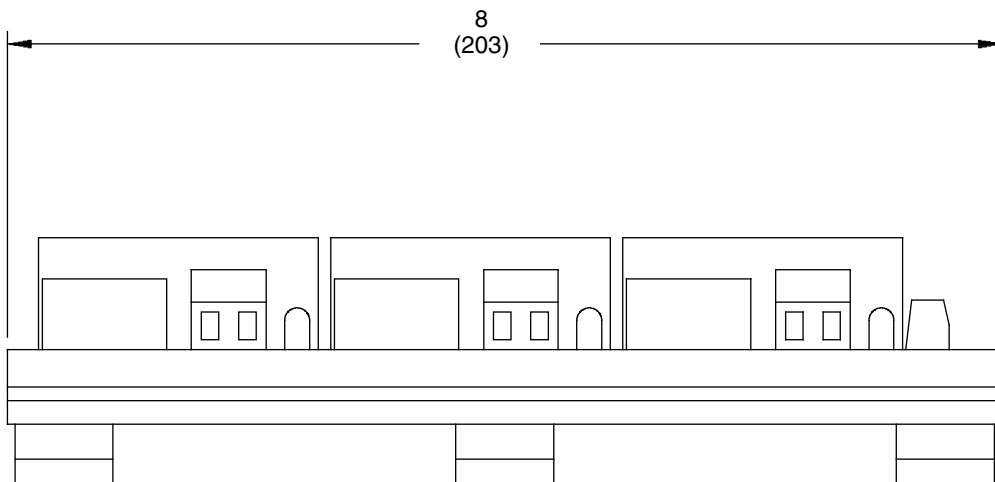
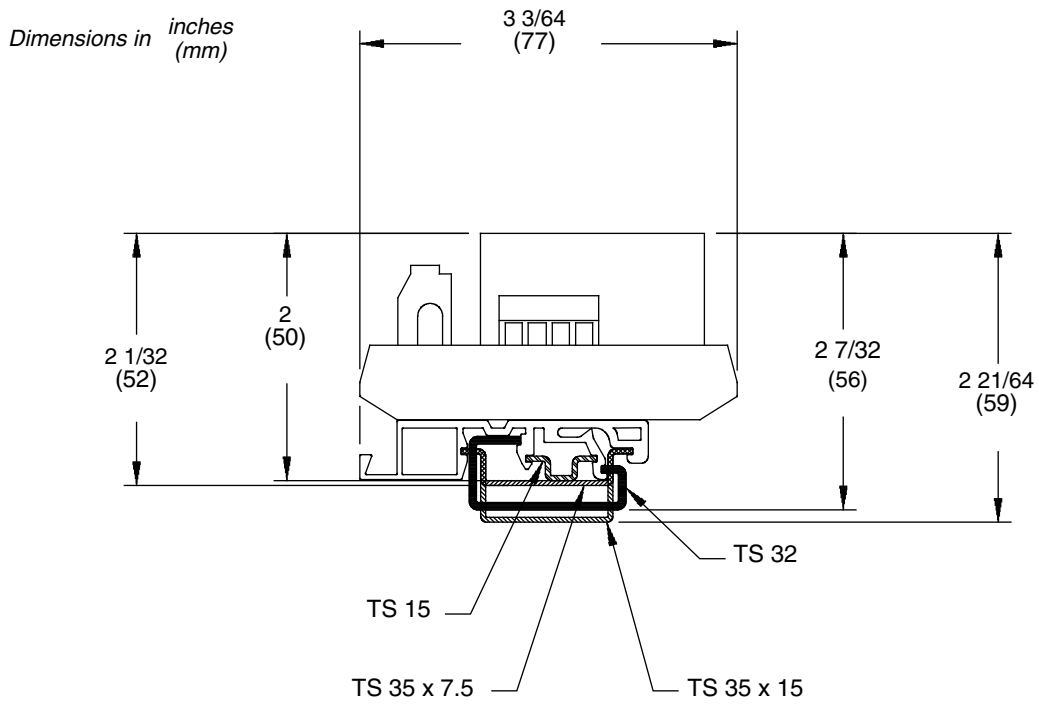
Follow these steps to install a Model 3100 relay module.

Step 1 Mount relay module

Mount the supplied relay module to a DIN rail. The relay module accommodates various standard rail types. See Figure D-2.

Installing Relays

Figure D-2 Relay module dimensions



Step 2 Connect discrete output terminals to relays

Follow the steps below to connect the transmitter/controller’s discrete output wiring terminals to one, two, or three relays.

⚠ WARNING

Shock Hazard.

Improper installation of wiring, or installation with power supply on, can cause electric shock or property damage.

For personal and system safety:

- Shut off power before installing wiring.
- Make sure the installation meets or exceeds local code requirements.
- Install relays and wiring in accordance with the illustrations in these instructions.
- Install relays and wiring where ambient temperature remains between –4 and +140°F (–20 and +60°C).

1. Use the following wire sizes:
 - Model 3300 or Model 3500: 24 to 16 AWG (0,25 to 1,5 mm²)
 - Model 3350 or Model 3700: 22 to 16 AWG (0,35 to 1,5 mm²)
2. Connect the wires between the transmitter/controller terminals and the relay terminals as shown in Table D-1 and in the following diagrams:
 - Model 3300 or Model 3500 with screw-type or solder-tail connectors: see Figure D-3
 - Model 3300 or Model 3500 with I/O cables: see Figure D-4
 - Model 3350 or Model 3700: see Figure D-5

Table D-1 Transmitter/controller terminals and Model 3100 terminals

Transmitter/controller terminals				
Model 3300 or Model 3500		Model 3350 or Model 3700		
I/O cables or I/O terminal block	Screw-type or solder-tail terminals	Gray terminal block	Terminal function	Model 3100 terminals
19	a 14	20	Return	a 14
18	c 14	18	DO1	c 14
20	c 16	17	DO2	c 16
22	c 18	16	DO3	c 18

Installing Relays

Figure D-3 Model 3300 or Model 3500 to Model 3100 – Screw-type or solder-tail connector

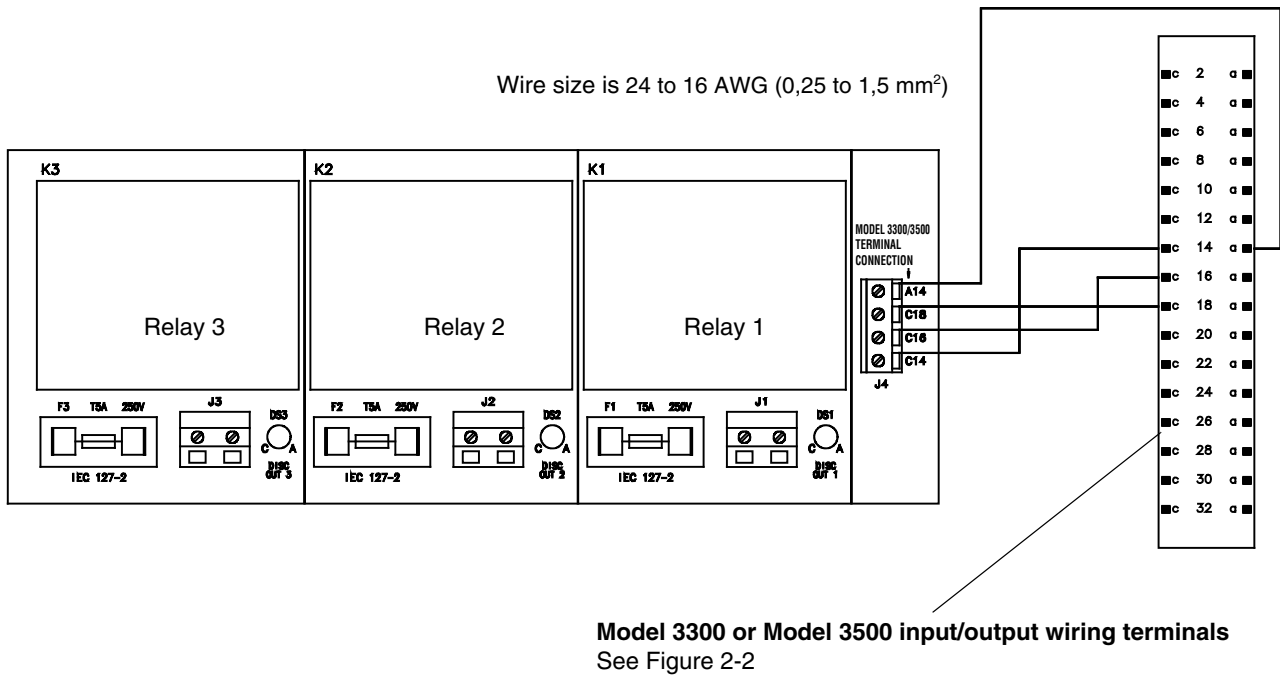


Figure D-4 Model 3300 or Model 3500 to Model 3100 – I/O cables

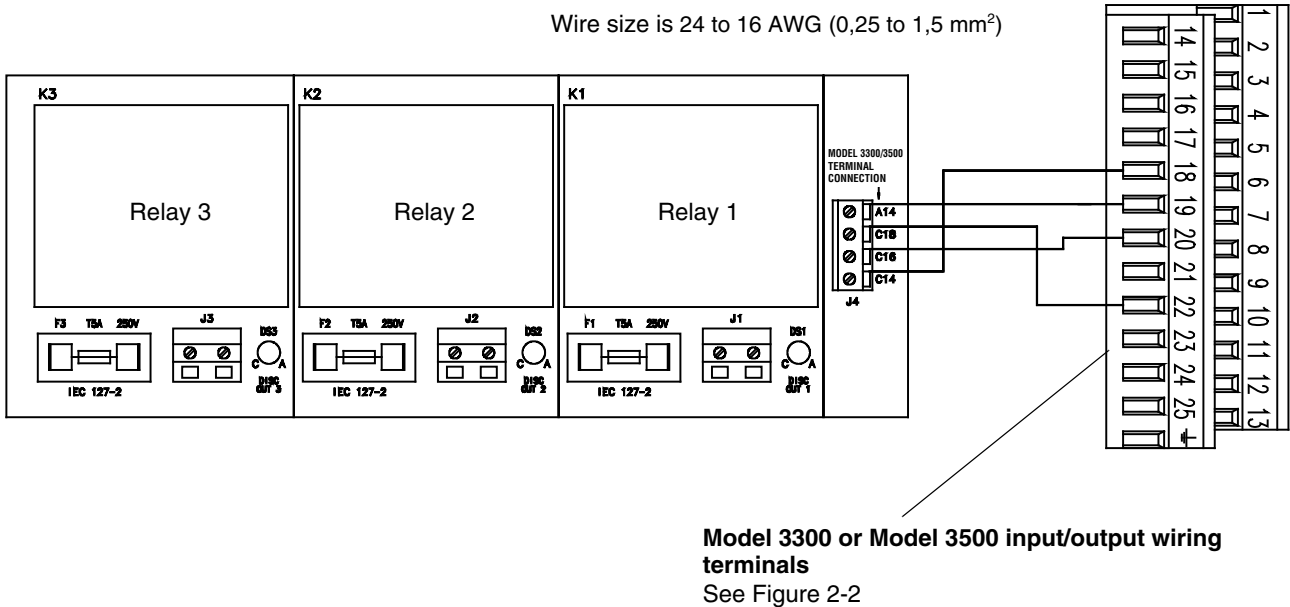
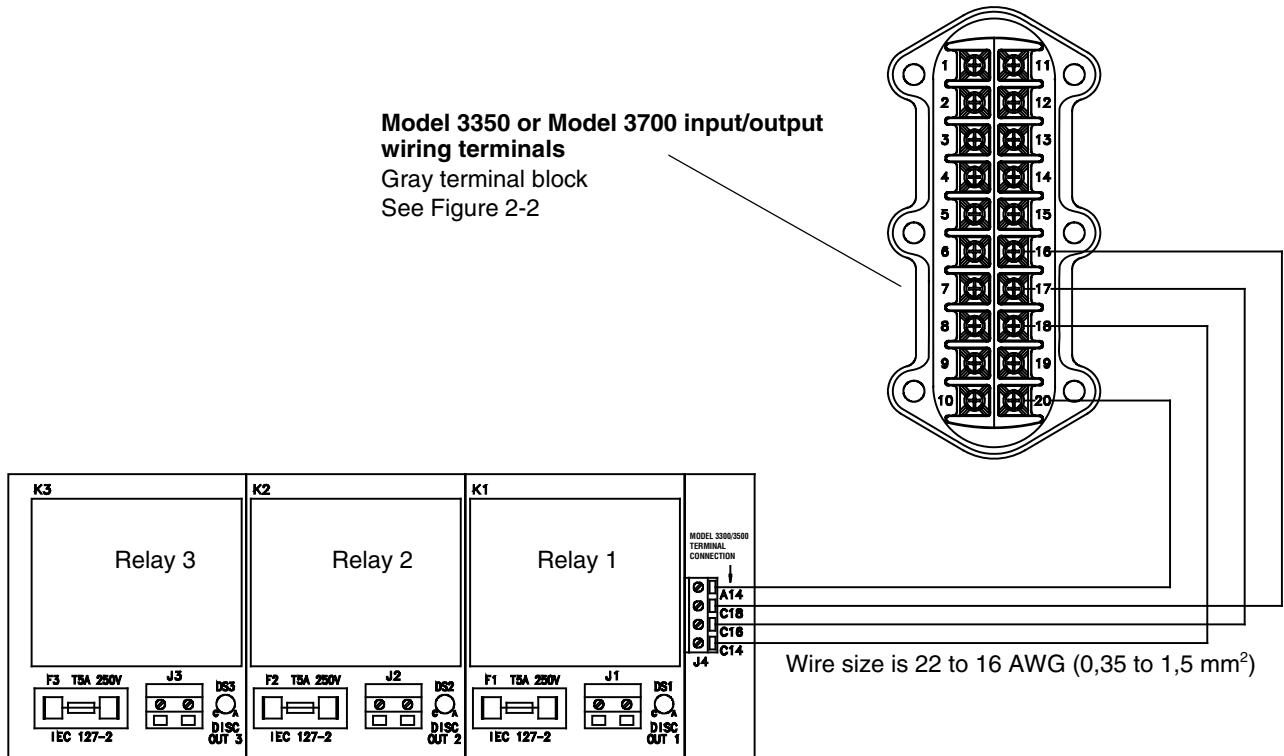


Figure D-5 Model 3350 or Model 3700 to Model 3100



Step 3 Connect relay wiring to control devices

Follow the steps below to connect one, two, or three relays to a control device.

1. Wire size must be between 22 and 16 AWG (0,35 to 1,5 mm²).
2. Connect the wires between the relay module and the control device as shown in the diagrams:
 - If the relay loads have an AC power supply, see Figure D-6. AC output terminals do not have polarity.
 - If the relay loads have a DC power supply, see Figure D-7. DC output terminals have polarity.

Installing Relays

Figure D-6 Model 3100 relay module to control devices – AC power

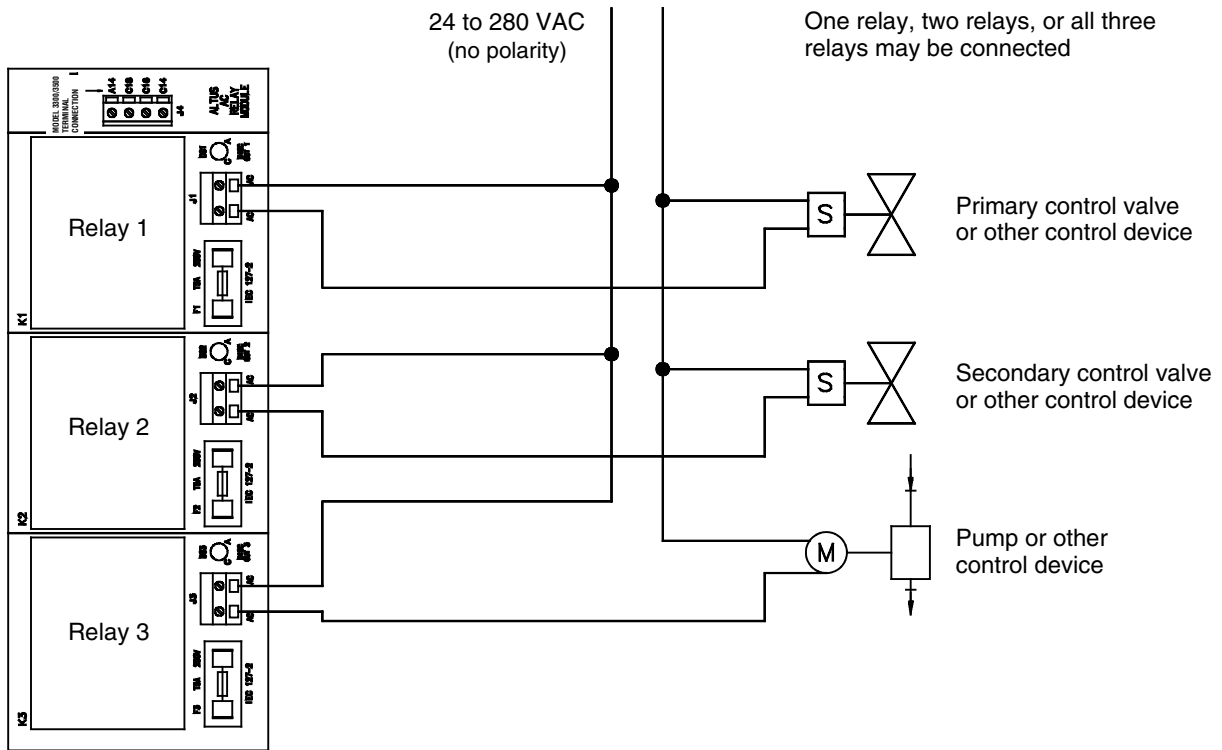
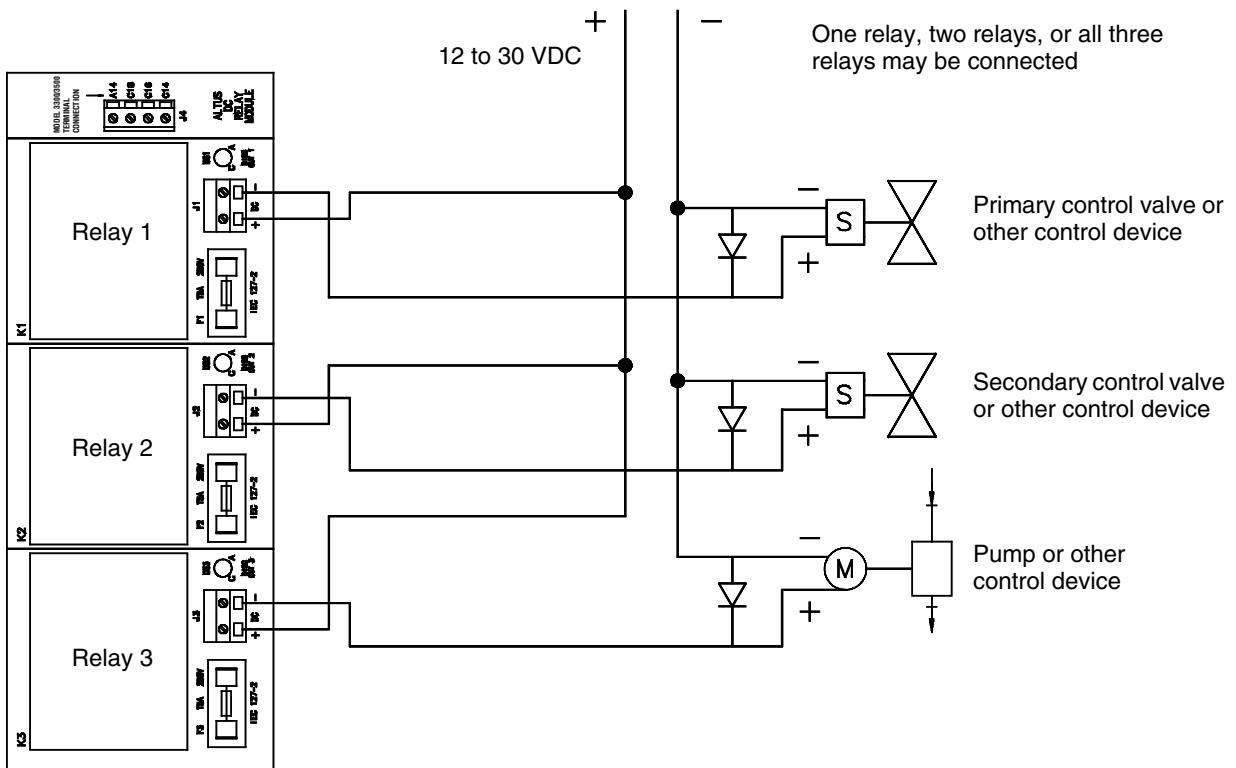


Figure D-7 Model 3100 relay module to control devices – DC power



Installing Relays

D.7 Installing user-supplied relays

Follow these steps to install user-supplied relays.

Step 1 Connect discrete output terminals to relays

Follow the steps below to connect the transmitter/controller's discrete output wiring terminals to one, two, or three relays.

⚠ WARNING

Shock Hazard.

Improper installation of wiring, or installation with power supply on, can cause electric shock or property damage.

For personal and system safety:

- Shut off power before installing wiring.
- Make sure the installation meets or exceeds local code requirements.
- Install relays and wiring in accordance with the illustrations in these instructions.
- Install relays and wiring where ambient temperature remains between -4 and $+140$ °F (-20 and $+60$ °C).

1. Use the following wire sizes:
 - Model 3300 or Model 3500: 24 to 16 AWG (0,25 to 1,5 mm²)
 - Model 3350 or Model 3700: 22 to 16 AWG (0,35 to 1,5 mm²)
2. Connect the wires between the transmitter/controller and the relay as shown in Table D-2 and in the following diagrams:
 - Model 3300 or Model 3500 with screw-type or solder-tail connectors: see Figure D-8
 - Model 3300 or Model 3500 with I/O cables: see Figure D-9
 - Model 3350 or Model 3700: see Figure D-10

Table D-2 Transmitter/controller terminals for user-supplied relays

Transmitter/controller terminals			
Model 3300 or Model 3500		Model 3350 or Model 3700	
I/O cables or I/O terminal block	Screw-type or solder-tail terminals	Gray terminal block	Terminal function
19	a 14	20	Return
18	c 14	18	DO1
20	c 16	17	DO2
22	c 18	16	DO3

Installing Relays

Figure D-8 Model 3300 or Model 3500 to user-supplied relay – Screw-type or solder-tail connector

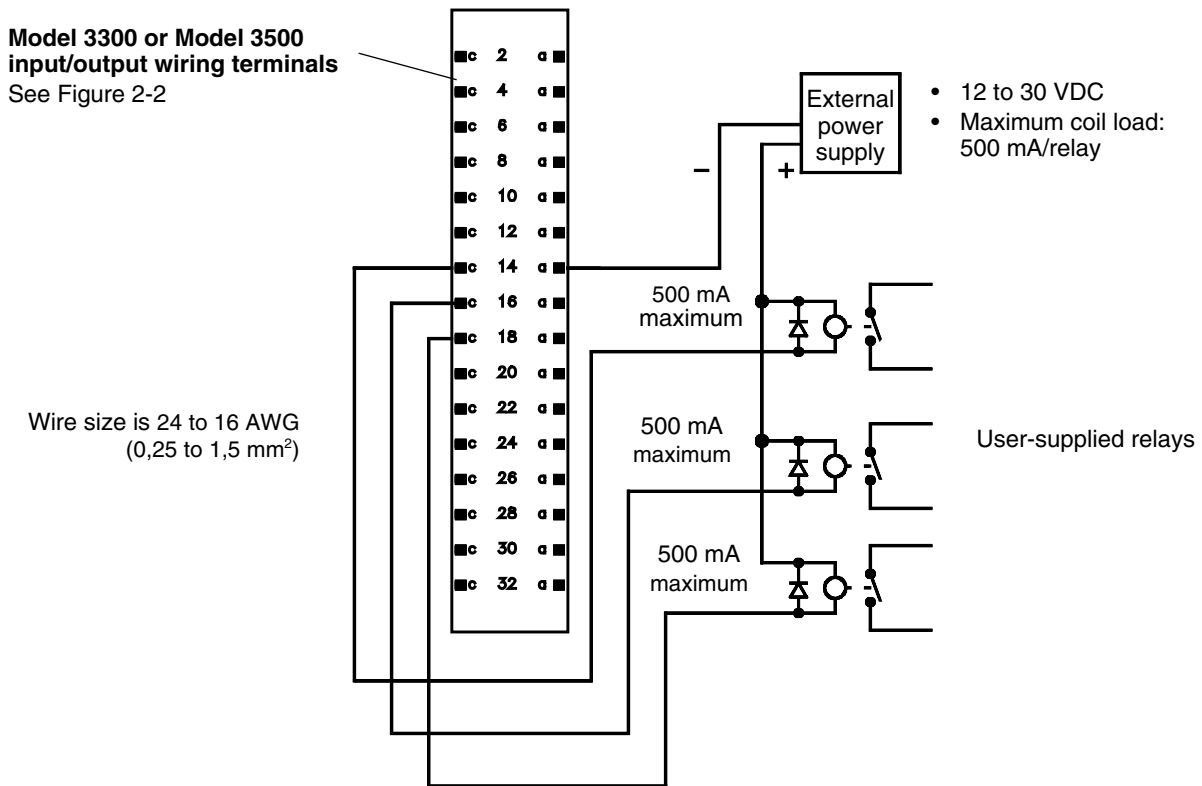


Figure D-9 Model 3300 or Model 3500 to user-supplied relay – I/O cable

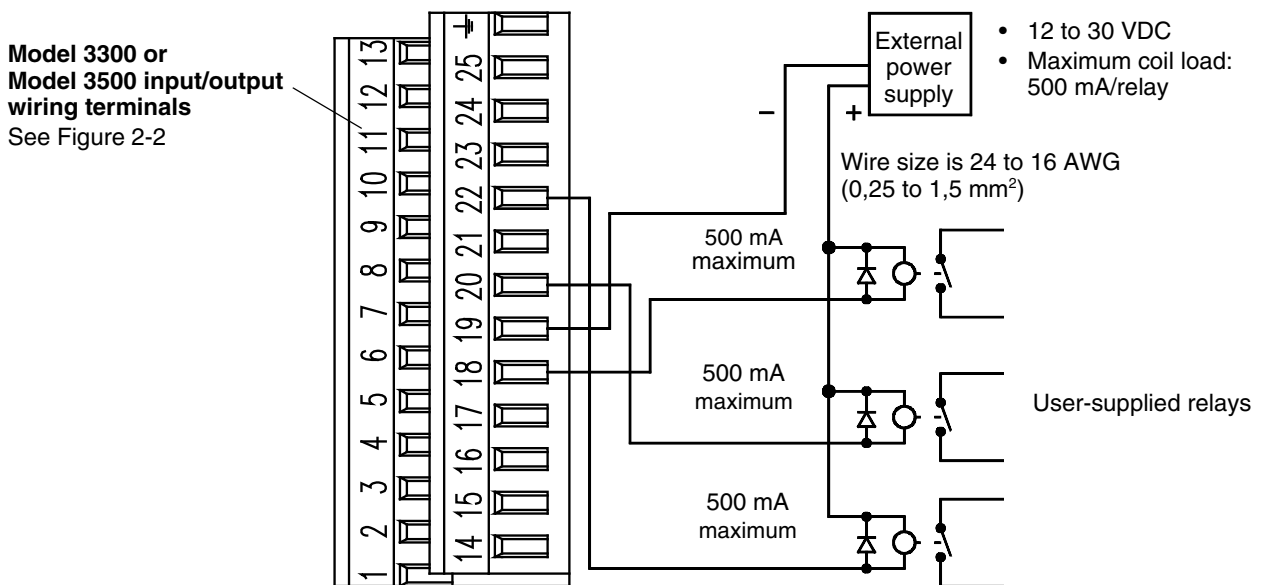
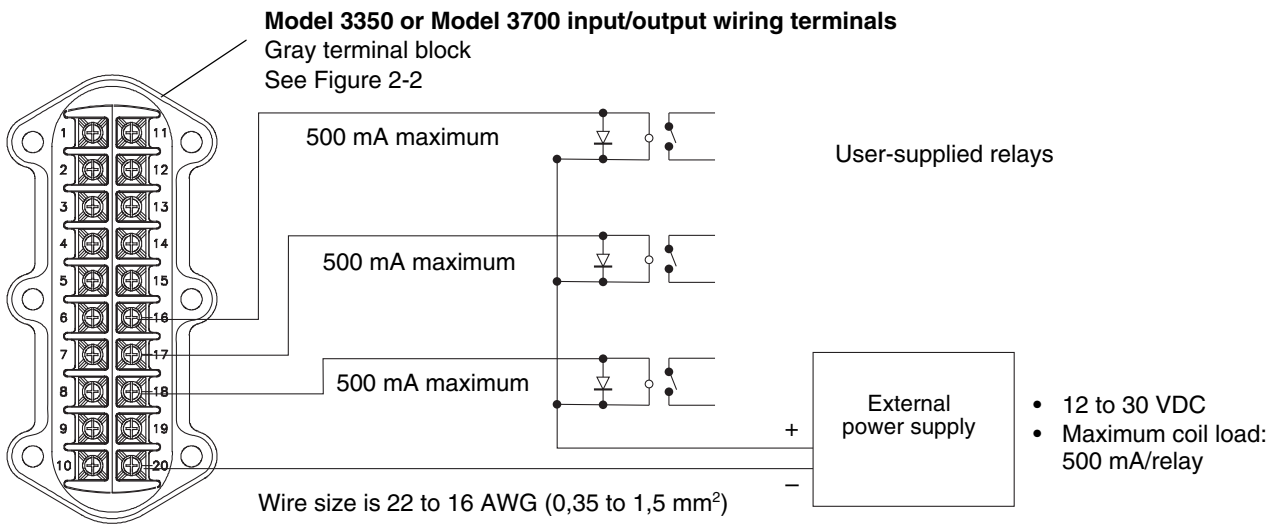


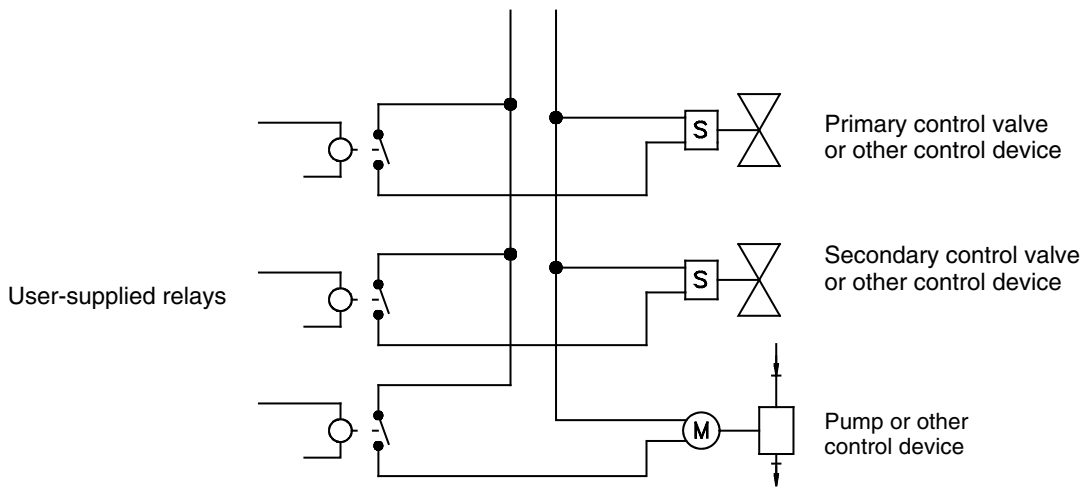
Figure D-10 Model 3350 or Model 3700 to user-supplied relay



Step 2 Connect relay wiring to control devices

The method used to connect the relay to the control device depends on the function the relay will perform. For an illustration of typical wiring for a 2-stage batch application, see Figure D-11.

Figure D-11 User-supplied relay to control device: 2-stage batch application



Appendix E

Default Values and Ranges

E.1 Overview

This appendix provides information on the default values for most Series 3000 parameters. Where appropriate, valid ranges are also defined.

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

E.2 Most frequently used defaults and ranges

The table below contains the default values and ranges for the most frequently used Series 3000 settings.

Table E-1 Series 3000 default values and ranges

Type	Setting	Default	Range	Comments
Flow	Flow direction	Forward only		
	Flow damping	0.8 sec	0.0 – 51.2 sec	User-entered value is corrected to nearest lower value in list of preset values. For gas applications, Micro Motion recommends a value of 2.56 seconds or higher.
	Flow calibration factor	1.00005.13		For T-Series sensors, this value represents the FCF and FT factors concatenated. See Section 7.3.3.
	Mass flow units	g/s		
	Mass flow cutoff	0.0000 g/s		Recommended setting: <ul style="list-style-type: none"> • Standard use – 0.2% of the sensor's rated maximum flowrate • Empty-full-empty batching – 2.5% of the sensor's maximum flowrate
	Volume flow type	Liquid		
	Volume flow units	L/s		
	Volume flow cutoff	0.0000 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		

Default Values and Ranges

Table E-1 Series 3000 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 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 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
Temperature units		degC		
Temperature calibration factor		1.00000T0.0000		
Frequency input	Flow rate units	kg/min		
	Scaling method	Frequency = Flow		
	Frequency	1000.0000		
	Flow	999.9999 kg/min		
	K factor	1.0000		
Discrete inputs	Polarity	Active low		
Discrete events	Type	HI		
	Process variable	Mass flow rate		
	HI PV value	0.0000		
Discrete outputs	Polarity	Active low		
	Assignment	None		
	Fault indication	None		
Milliamp output 1	Fault indication: Condition	Downscale		
	Fault indication: Setting	2.0000 mA	1.0 – 3.6 mA	
	Fault indication: Last measured value timeout	0 sec	0.0 – 60.0 sec	
	Variable assignment	Mass flow		
	Calibration span: 20.0 mA	200.0000 g/s		
	Calibration span: 4.0 mA	-200.0000 g/s		
	Calibration span: Low flow cutoff	0.0000 g/s		
	Damping seconds	0.0000		

Default Values and Ranges

Table E-1 Series 3000 default values and ranges *continued*

Type	Setting	Default	Range	Comments
Milliamp output 2	Fault indication: Condition	Downscale		
	Fault indication: Setting	2.0000 mA	1.0 – 3.6 mA	
	Fault indication: Last measured value timeout	0 sec	0.0 – 60.0 sec	
	Variable assignment	Density		
	Calibration span: 20.0 mA	10.0000 g/cm ³		
	Calibration span: 4.0 mA	0.0000 g/cm ³		
	Damping seconds	0.0000		
LRV	Mass flow	–200.000 g/s		
	Volume flow	–0.200 l/s		
	Density	0.000 g/cm ³		
	Temperature	–240.000 °C		
	Drive gain	0.000%		
	Gas standard volume flow	–423.78 SCFM		
	External temperature	–240.000 °C		
	External pressure	0.000 psi		
URV	Mass flow	200.000 g/s		
	Volume flow	0.200 l/s		
	Density	10.000 g/cm ³		
	Temperature	450.000 °C		
	Drive gain	100.000%		
	Gas standard volume flow	423.78 SCFM		
	External temperature	450.000 °C		
	External pressure	100.000 psi		
Frequency output	Flow source	Mass flow		
	Scaling method	Frequency = flow		
	Frequency	1,000.00 Hz	0.00091 – 10,000.00 Hz	
	Flow	16,666.66999 g/s		
	Max pulse width	277.2352 ms	0 – 277.2352 ms	
	Power	Active		
	Polarity	Active high		
	Fault indication	Downscale		
	Last measured value timeout	0.0 sec	0.0 – 60.0 sec	
RS-485 parameters – HART protocol	Baud rate	9600		
	Parity	Odd		
	Data bits	8		
	Stop bits	1		
	Polling address	0		

Default Values and Ranges

Table E-1 Series 3000 default values and ranges *continued*

Type	Setting	Default	Range	Comments
RS-485 parameters – Modbus RTU protocol	Baud rate	9600		Modbus RTU is the default RS-485 protocol
	Parity	Odd		
	Data bits	8		
	Stop bits	1		
	Polling address	1		
	Byte order	3–4–1–2		
RS-485 parameters – Modbus ASCII protocol	Baud rate	9600		
	Parity	Odd		
	Data bits	7		
	Stop bits	1		
	Polling address	1		
	Byte order	3–4–1–2		
RS-485 parameters – printer protocol	Baud rate	9600		
	Parity	Odd		
	Data bits	7		
	Stop bits	1		
Bell 202 parameters	HART polling address	0		
	Burst mode	Disabled		
	Burst command	PV & Pct Range		
Device parameters	Fault setting	None		
	HART QV	Volume flow		

Appendix F

Series 3000 Menu Flowcharts

F.1 Overview

This appendix provides flowcharts for the Series 3000 display menus.

F.2 Process monitor

Access to the process monitor depends on whether or not the discrete batch application is installed:

- As shown in Figure F-1, when the discrete batch is not installed, the process monitor is the default display. The five process monitor screens are accessed via the **Left** and **Right** cursor control buttons. If no display variables are configured for a particular screen, that screen is skipped.
- As shown in Figure F-2, when the discrete batch application is installed, the default display is the batch operation screen, and the process monitor is accessed through the View menu.

Figure F-1 Process monitor: Discrete batch application not installed

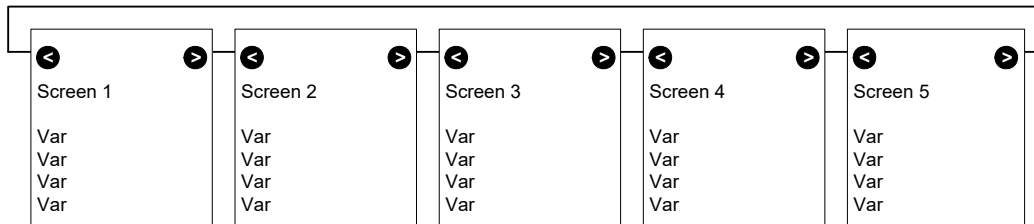
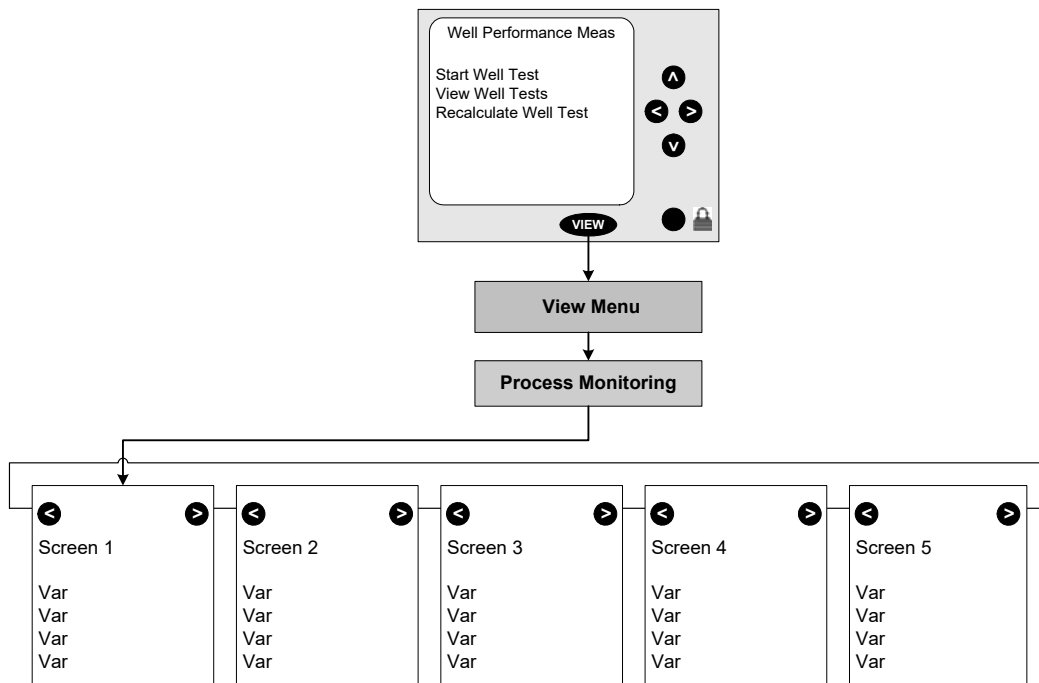


Figure F-2 Process monitor: Discrete batch application installed

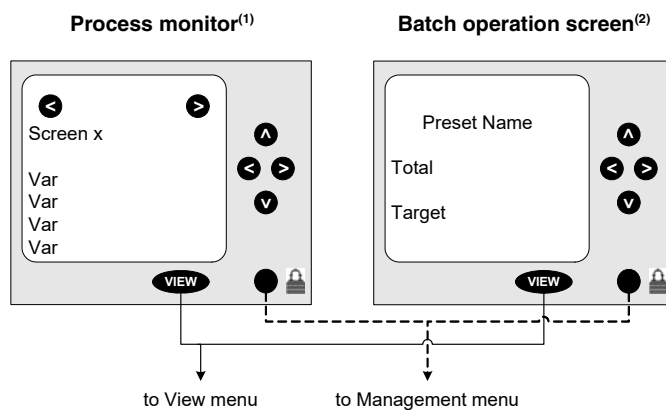


F.3 Menu access

As shown in Figure F-3:

- To access the View menu system, press the **VIEW** function button.
- To access the Management menu system, press the Security button.

Figure F-3 Menu access



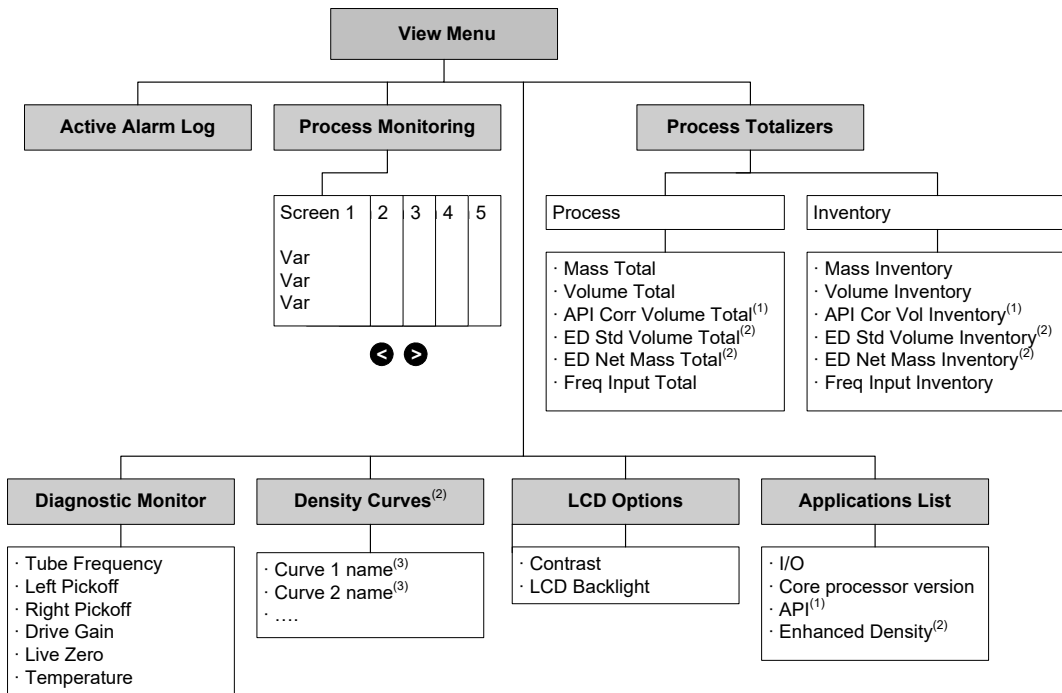
- (1) Displayed if the discrete batch application is not installed. See Figure F-1 for details.
 (2) Displayed if the discrete batch application is installed. See Figure F-2 for details.

F.4 View menu

The appearance of the View menu depends on the special applications that are installed:

- Figure F-4 shows the View menu when neither the custody transfer application or the discrete batch application is installed. The petroleum measurement and enhanced density applications are optional.
- Figure F-5 shows the View menu when the custody transfer application is installed and configured for OIML compliance. The discrete batch, petroleum measurement, and enhanced density applications are optional.
- Figure F-6 shows the View menu when the discrete batch application is installed, or the discrete batch and custody transfer applications are installed and custody transfer is configured for NTEP compliance. The petroleum measurement and enhanced density applications are optional.

Figure F-4 View menu: Special applications – None, API only, or ED only

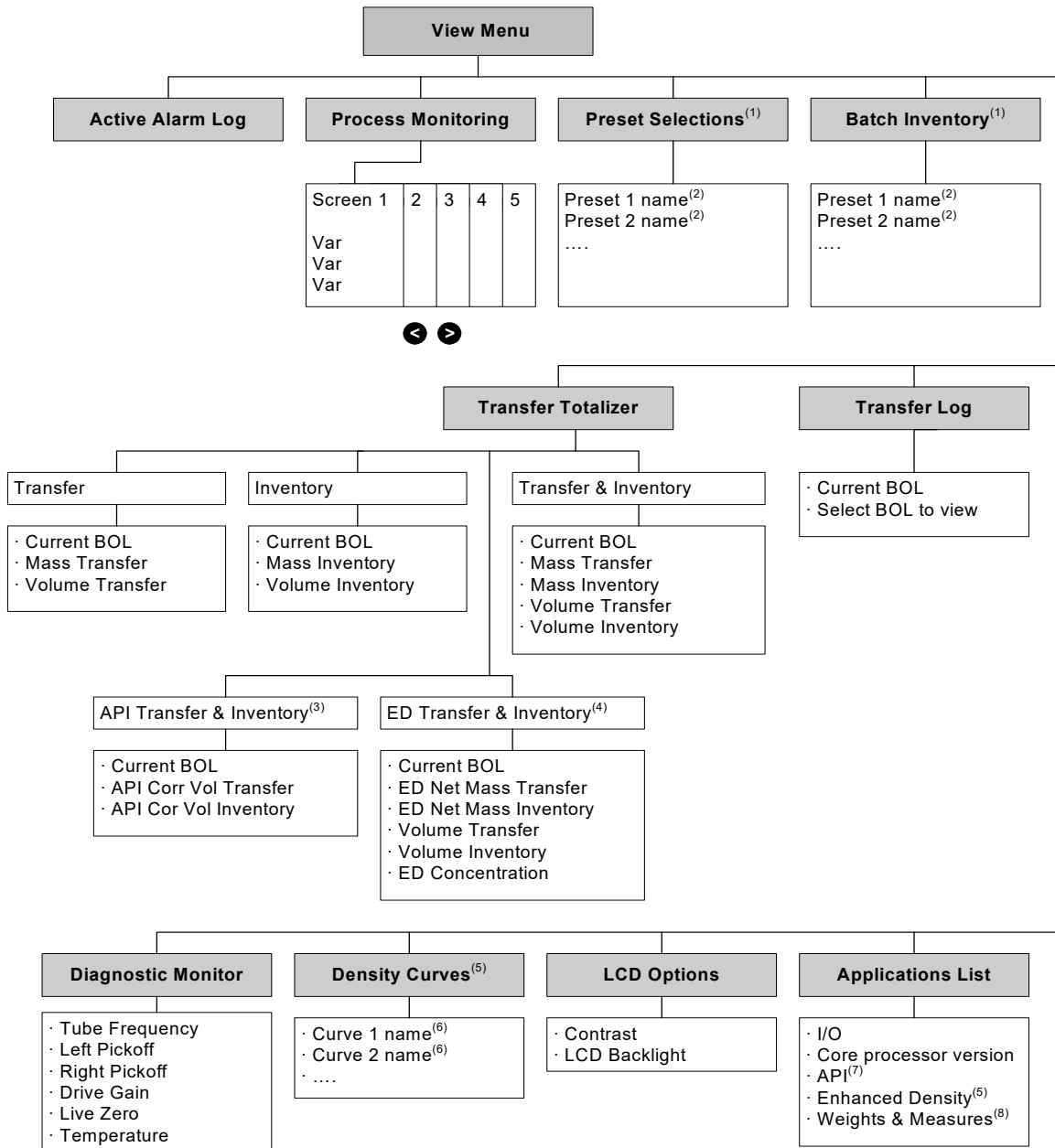


(1) Displayed only if the petroleum measurement application is installed.

(2) Displayed only if the enhanced density application is installed.

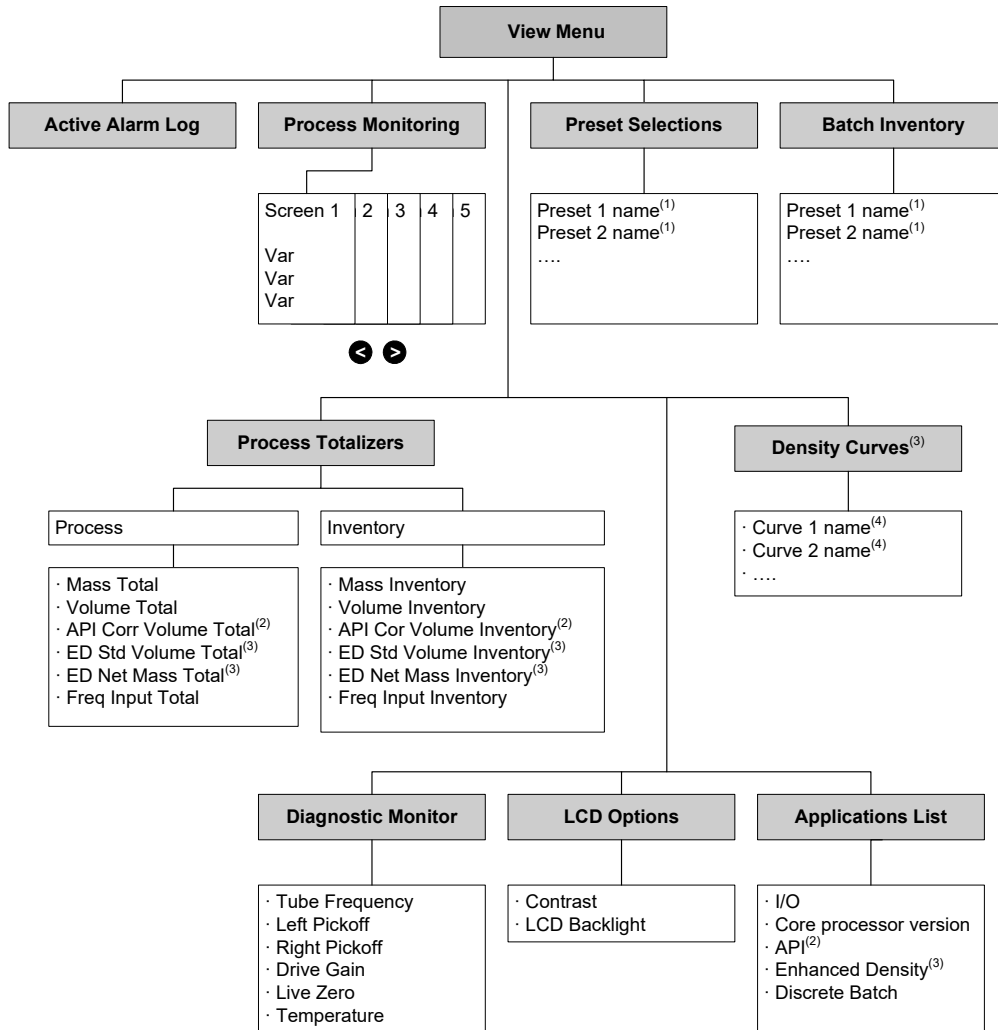
(3) Only configured curves are listed.

Figure F-5 View menu: Special applications – Custody transfer (OIML)
(Discrete batching, API, and ED optional)



- (1) Displayed only if the discrete batch application is installed.
- (2) Only configured presets are listed.
- (3) Displayed only if the petroleum measurement application is installed and approved for custody transfer.
- (4) Displayed only if the enhanced density application is installed and approved for custody transfer.
- (5) Displayed only if the enhanced density application is installed.
- (6) Only configured curves are listed.
- (7) Displayed only if the petroleum measurement application is installed.
- (8) If World Area is set to OIML, the custody transfer application version is displayed.

Figure F-6 View menu: Special applications – Discrete batch (no custody transfer) or discrete batch with custody transfer (NTEP) (API and ED optional)



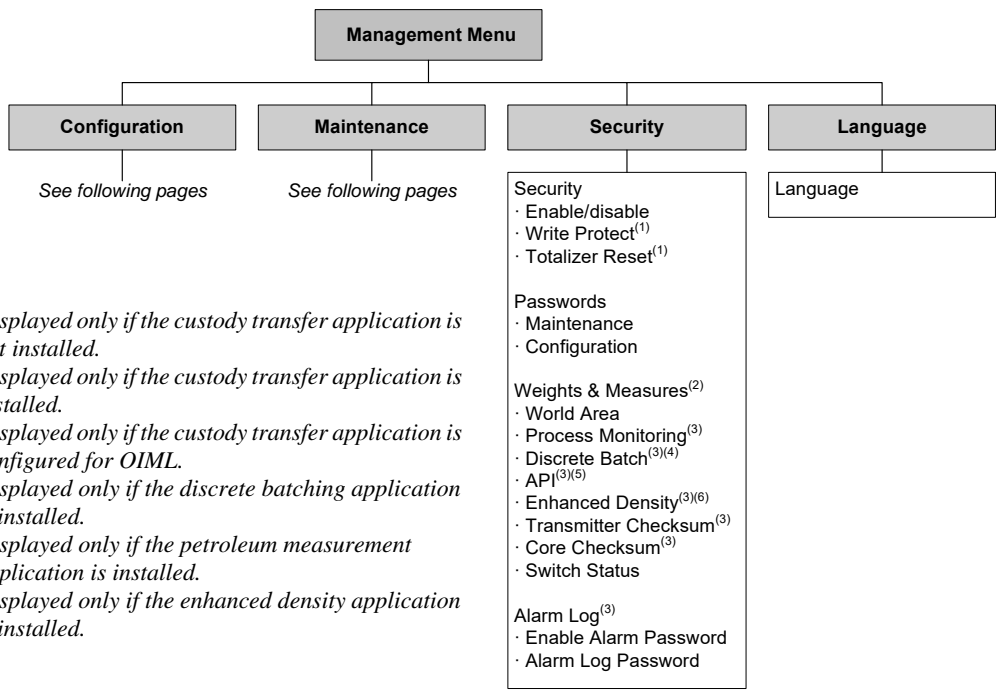
- (1) Only configured presets are listed.
- (2) Displayed only if the petroleum measurement application is installed.
- (3) Displayed only if the enhanced density application is installed.
- (4) Only configured curves are listed.

F.5 Management menus

The Management menu system is illustrated in Figures F-7 through F-13:

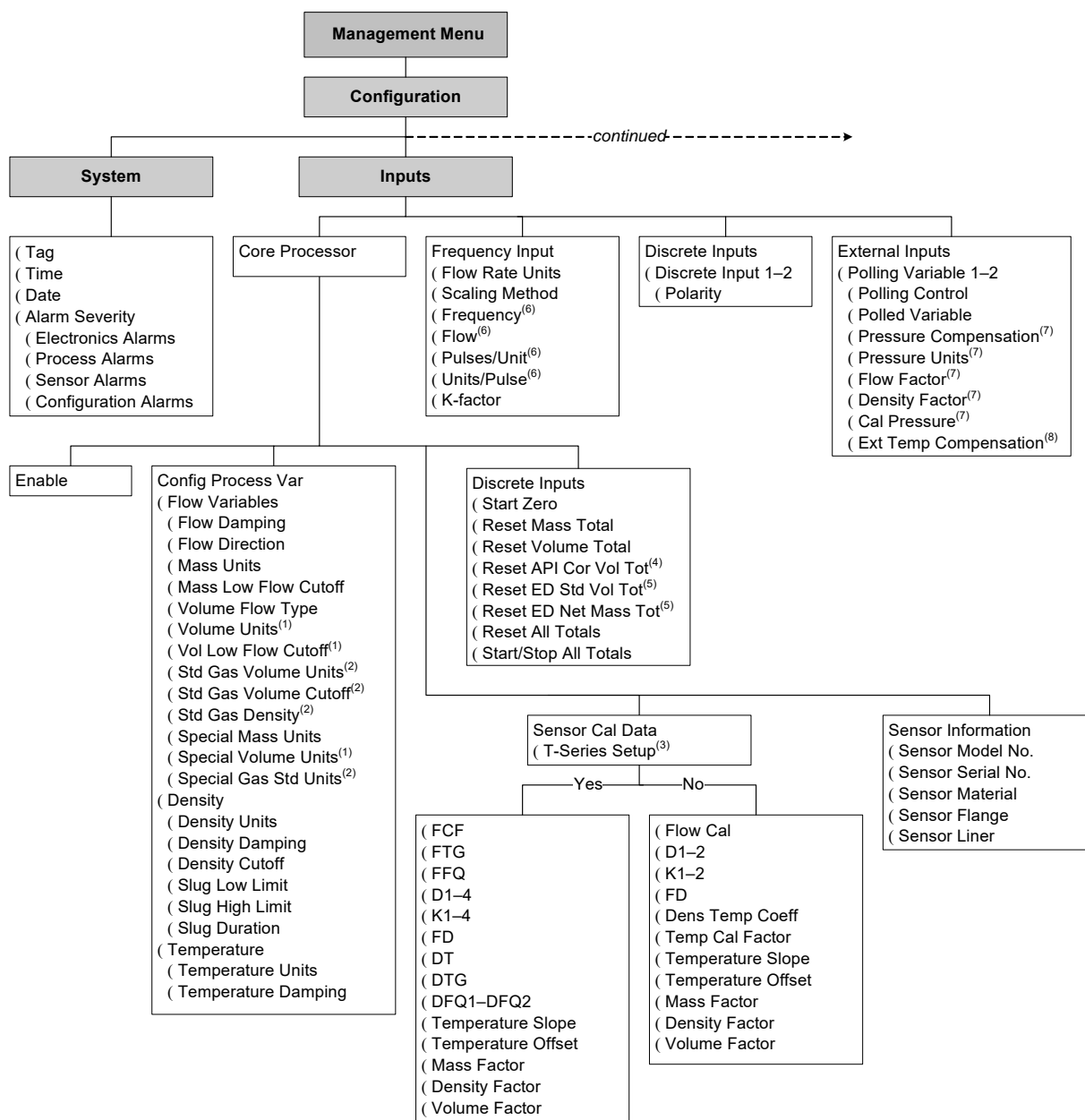
- Figure F-7 shows the top level of the Management menu, plus the Security and Language menus.
- Figures F-8 through F-12 show the Configuration menu. Note that the Digital Communication menu structure changes according to the setting of the Protocol parameter.
- Figure F-13 shows the Maintenance menu.

Figure F-7 Management menu – top level, Security menu, and Language menu



- (1) Displayed only if the custody transfer application is not installed.
- (2) Displayed only if the custody transfer application is installed.
- (3) Displayed only if the custody transfer application is configured for OIML.
- (4) Displayed only if the discrete batching application is installed.
- (5) Displayed only if the petroleum measurement application is installed.
- (6) Displayed only if the enhanced density application is installed.

Figure F-8 Configuration menu



(1) Liquid volume; displayed only if Volume Flow Type = Liquid.

(2) Gas standard volume; displayed only if Volume Flow Type = Gas Standard.

(3) T-Series option displayed only if transmitter is not connected to sensor. The parameter list displayed depends on the sensor type.

(4) Displayed only if the petroleum measurement application is installed.

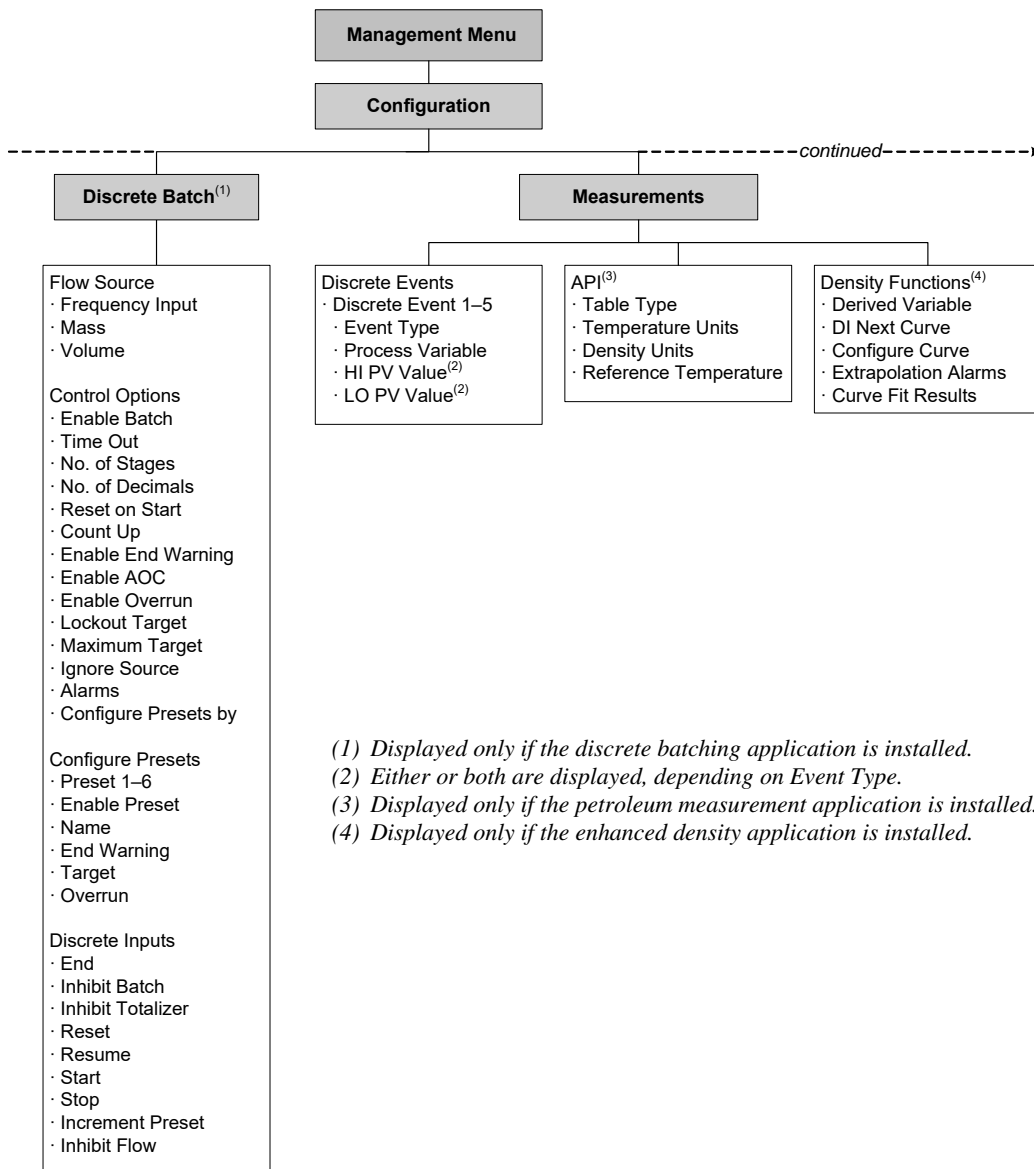
(5) Displayed only if the enhanced density application is installed.

(6) Options displayed depend on Scaling Method.

(7) Displayed only if Polled Variable = Pressure.

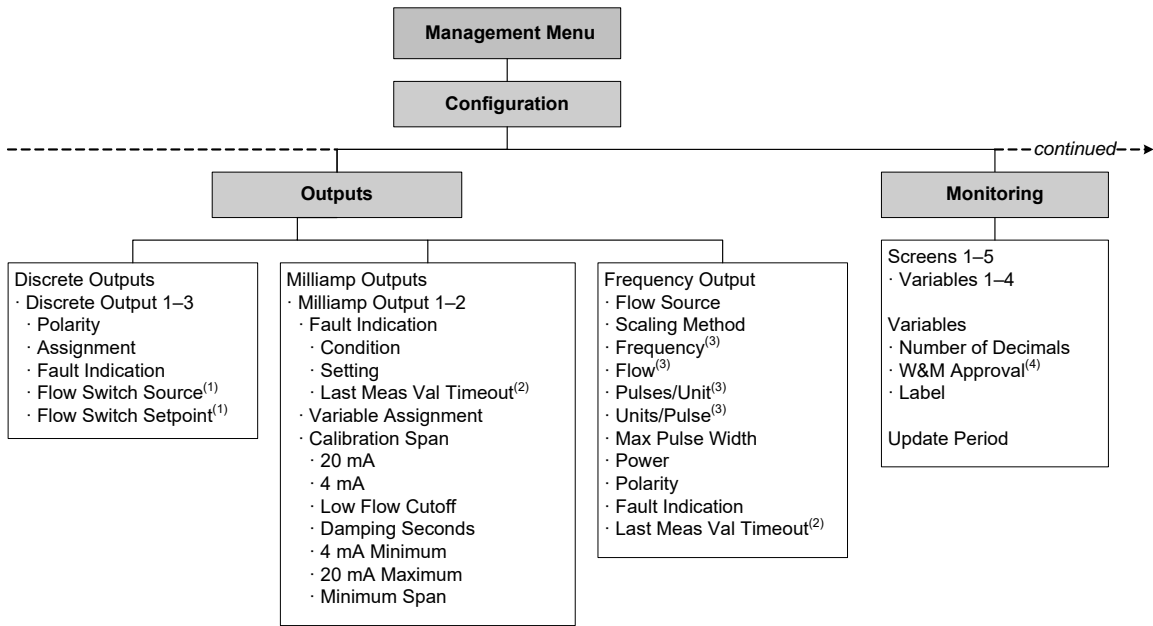
(8) Displayed only if Polled Variable = Temperature.

Figure F-9 Configuration menu *continued*



(1) Displayed only if the discrete batching application is installed.
 (2) Either or both are displayed, depending on Event Type.
 (3) Displayed only if the petroleum measurement application is installed.
 (4) Displayed only if the enhanced density application is installed.

Figure F-10 Configuration menu *continued*



- (1) Displayed only if Assignment = Flow Switch.
- (2) One setting applies to both milliamp and frequency outputs.
- (3) Options displayed depend on Scaling Method.
- (4) Displayed only if the custody transfer application is installed and configured for OIML.

Figure F-11 Configuration menu *continued*

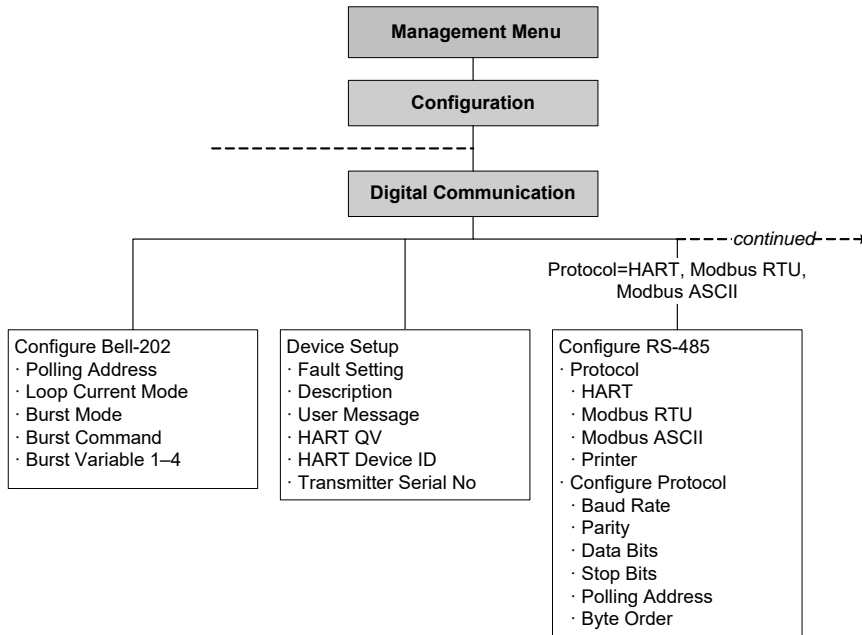


Figure F-12 Configuration menu *continued*

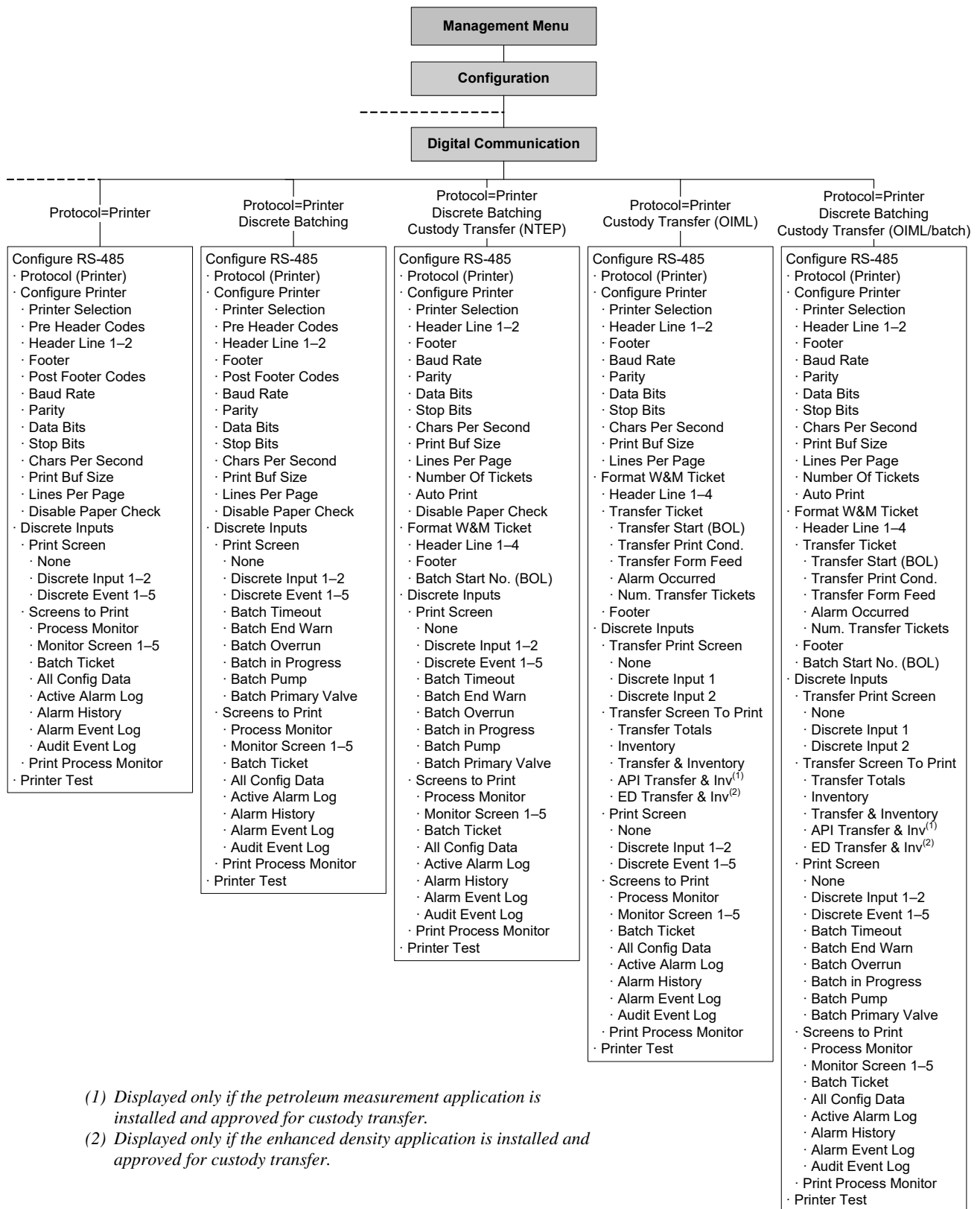
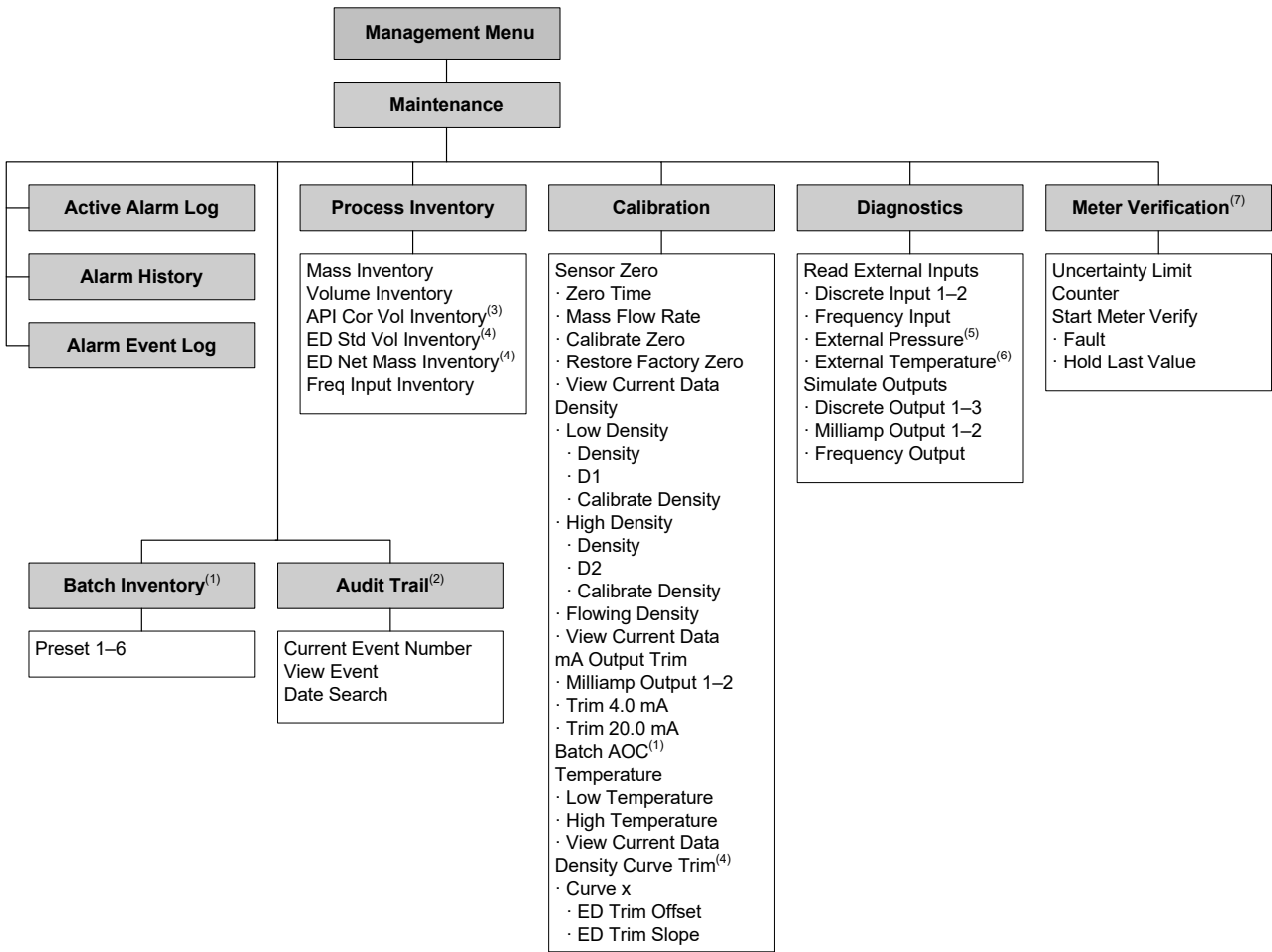


Figure F-13 Maintenance menu



- (1) Displayed only if the discrete batching application is installed.
- (2) Displayed only if the custody transfer application is installed.
- (3) Displayed only if the petroleum measurement application is installed.
- (4) Displayed only if the enhanced density application is installed.
- (5) Displayed only if polling for pressure is configured.
- (6) Displayed only if polling for temperature is configured.
- (7) Displayed only if the meter verification option is available.

Appendix G

ProLink II and Pocket ProLink

G.1 Overview

ProLink II is a Windows-based configuration and management tool for Micro Motion transmitters. It provides access to most Series 3000 functions and data. Pocket ProLink is a version of ProLink II that runs on a Pocket PC.

Note: Not all Series 3000 features and functions are available via ProLink II. For complete access, use the Series 3000 display menus.

This appendix provides basic information for connecting and using ProLink II with your Series 3000 device. The following topics and procedures are discussed:

- Requirements – see Section G.2
- Configuration upload/download – see Section G.3
- Connecting to a Series 3000 device – see Section G.4
- ProLink II menus for Series 3000 devices – see Section G.4

For more information on installing or using ProLink II, see the ProLink II manual. For more information on installing or using Pocket ProLink, see the Pocket ProLink manual. Instructions in this appendix will refer only to ProLink II.

G.2 Requirements

To use ProLink II with a Series 3000 device, the following are required:

- ProLink II v2.5 or later for most basic functions
- ProLink II v2.9 or later for the most recent Series 3000 enhancements
- One of the following ProLink II installation kits:
 - RS-232 to Bell 202 (HART) converter with tester and cables
 - RS-232 to RS-485 (Modbus or HART) converter with tester and cables
 - USB to Bell 202 (HART) converter with tester and cables
 - USB to RS-485 (Modbus or HART) converter with tester and cables

Note: Windows drivers are required for correct operation of the USB converters. The drivers are provided with the USB installation kits. Install the driver before connecting the converter or adapter. If you do not, Windows will not recognize the device when it is plugged in.

Note: If you are using the enhanced core processor and you connect directly to the core processor's RS-485 terminals, instead of to the transmitter, ProLink II v2.4 or later is required. This connection type is sometimes used for troubleshooting.

G.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 device configuration
- Easy replication of configuration sets

Micro Motion recommends that all Series 3000 configurations be downloaded to a PC as soon as the configuration is complete.

To access the configuration upload/download function:

1. Connect ProLink II to your Series 3000 device 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 Series 3000 device, use the **Send to Xmtr from File** option.

G.4 Connecting from a PC to a Series 3000 device

For a Series 3000 device, ProLink II supports the following connection types:

- HART/Bell 202
- HART/RS-485
- Modbus/RS-485
- Service port (specialized Modbus/RS-485)

Notes: Due to the design of HART protocol, connections made using HART protocol are slower than connections that use Modbus protocol. If you use HART protocol, you cannot open more than one ProLink II window at a time.

The RS-485 terminals are available in service port mode only for the first 10 seconds after power-up. If a service port connection is made during that period, the terminals remain in service port mode until power is cycled. If no connection is made during that period, they revert to standard Modbus/RS-485 mode using the RS-485 parameters configured in the Series 3000 device.

To connect to the Series 3000 device:

1. Determine the connection type you will use.
2. Identify the terminals for that connection type:
 - All Bell 202 connections use the primary mA output terminals.
 - All RS-485 connections use the RS-485 terminals.

See Figure 2-2 for the location of the terminal blocks on the different Series 3000 devices. See Figure 2-3 to identify the terminals.

3. Connect the appropriate signal converter to your PC's serial or USB port, using adapters as required.
4. Connect the two leads of the signal converter leads to the appropriate terminals, or to any point on the network.

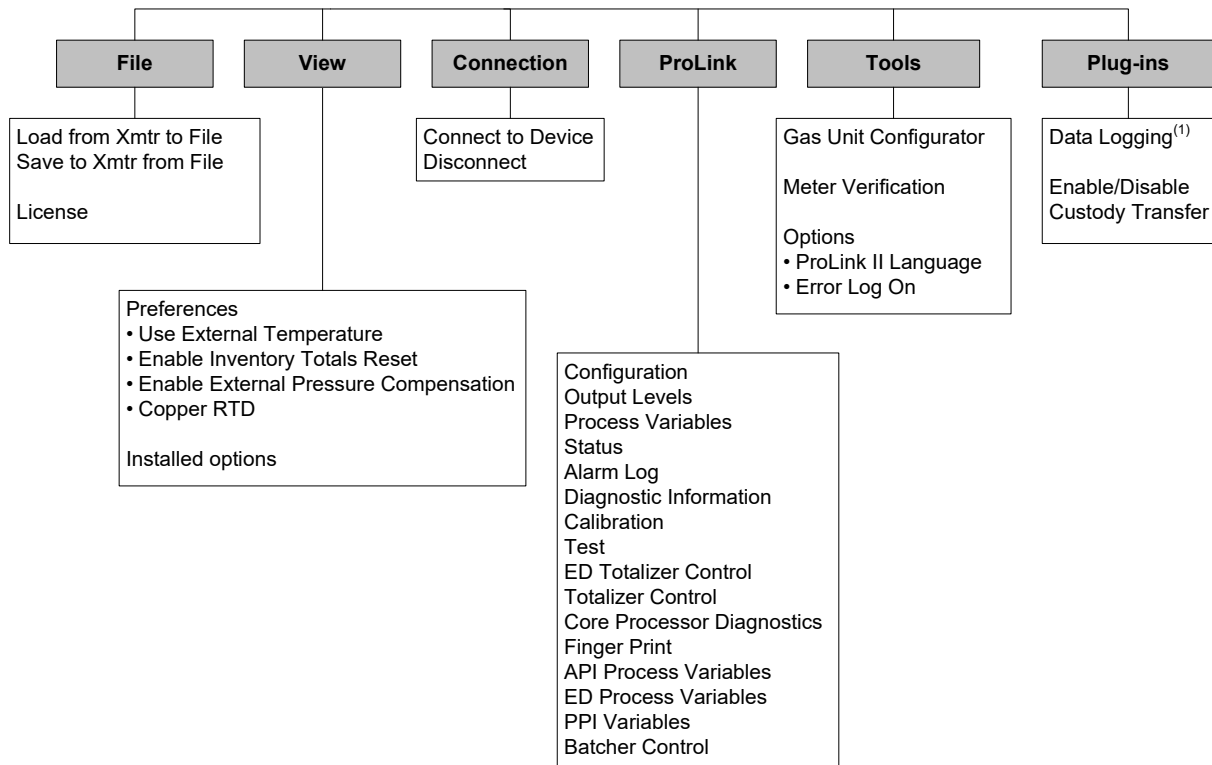
5. Add resistance as required.
 - For HART/Bell 202 connections, the signal converter must be connected across a resistance of 250–600 Ω . See the ProLink II manual for more information.
 - For RS-485 connections, additional resistance may or may not be required. See the ProLink II manual for more information.
6. Start ProLink II and click **Connection > Connect to Device**. In the Connect dialog box:
 - a. Select the protocol for your connection type. The ProLink II dialog box is updated to reflect your choice.
 - b. Set other required parameters.
 - c. Click **Connect**.
7. If you are using an RS-485 connection, the RS-485 terminals may not be in the desired mode. To change mode:
 - a. Power-cycle the device.
 - b. To connect in service port mode, click **Connect** within the 10-second interval after power-up.
 - c. To connect in RS-485 mode, wait more than 10 seconds, then click **Connect**.

G.5 ProLink II menu flowcharts

This section contains flowcharts for the ProLink II main menu and the configuration menu. These flowcharts are based on:

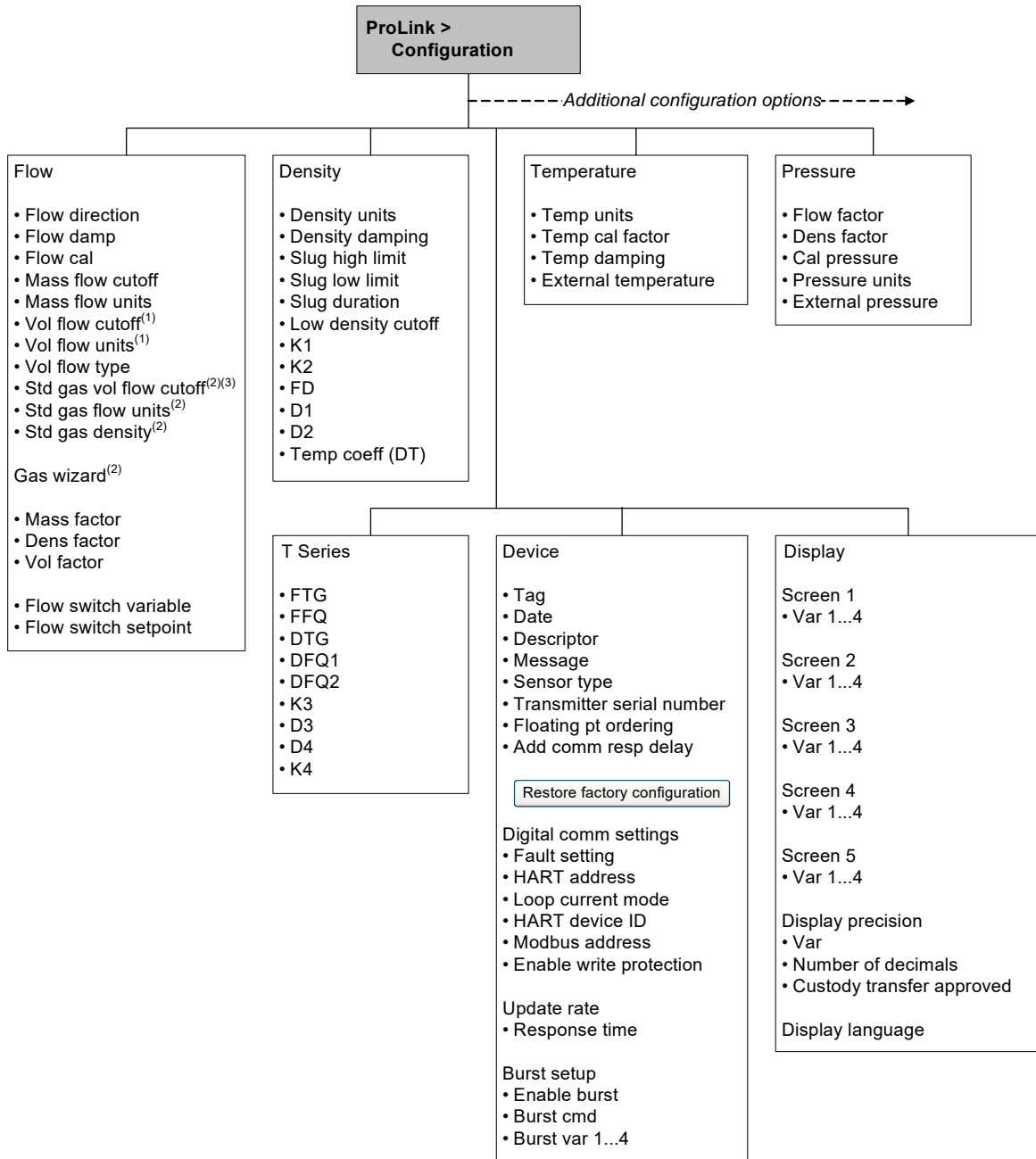
- ProLink II v2.6
- Series 3000 device software rev7.0

Figure G-1 ProLink II main menu



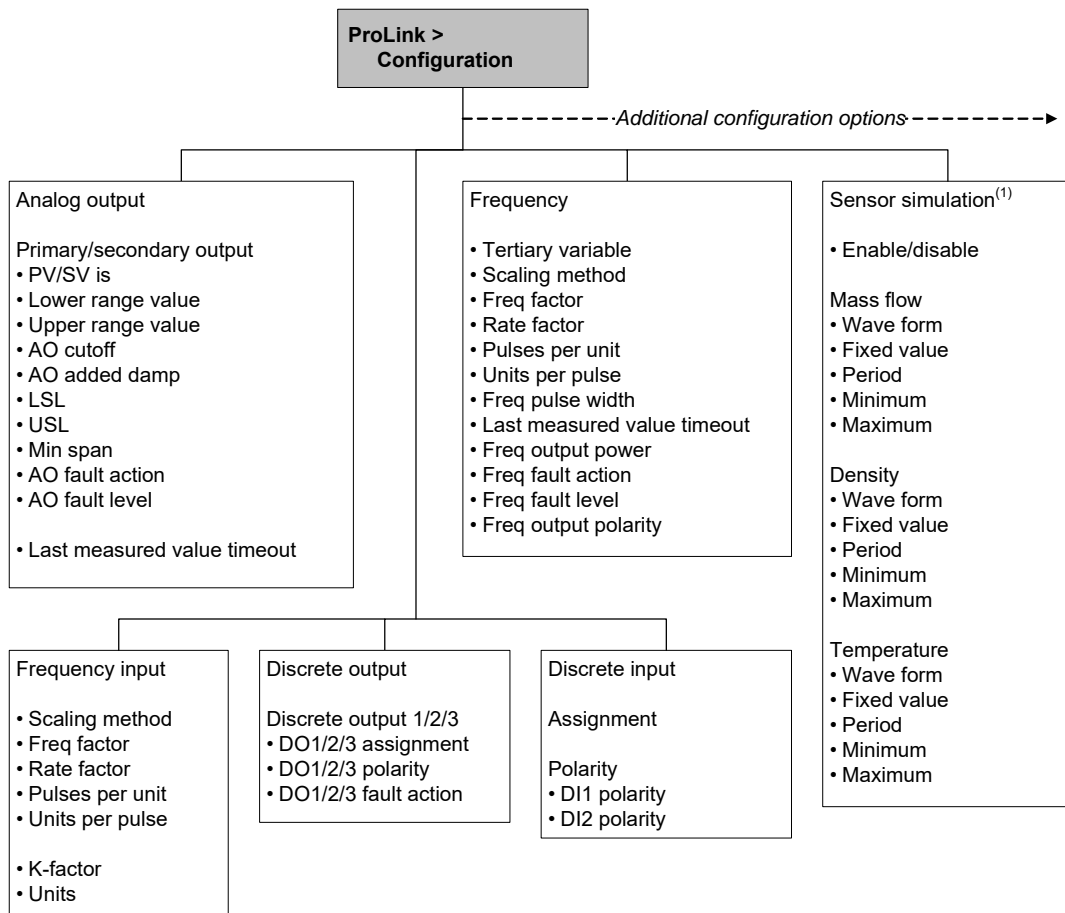
(1) For information about using Data Logger, refer to the ProLink II manual.

Figure G-2 ProLink II configuration menu



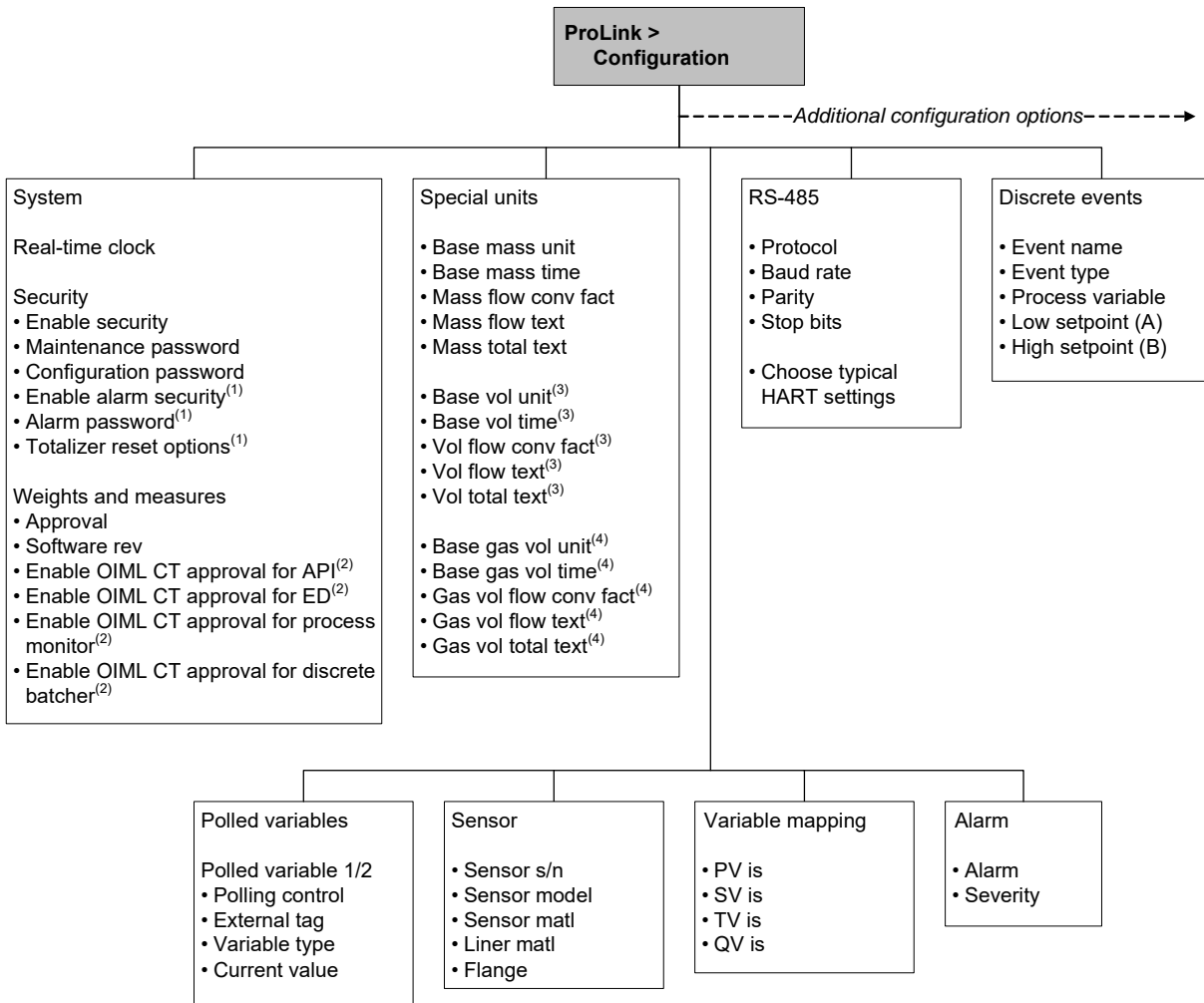
(1) Displayed only if Volume Flow Type = Liquid Volume.
 (2) Displayed only if Volume Flow Type = Gas Standard Volume.
 (3) Displayed only on systems with the enhanced core processor.

Figure G-3 ProLink II configuration menu *continued*



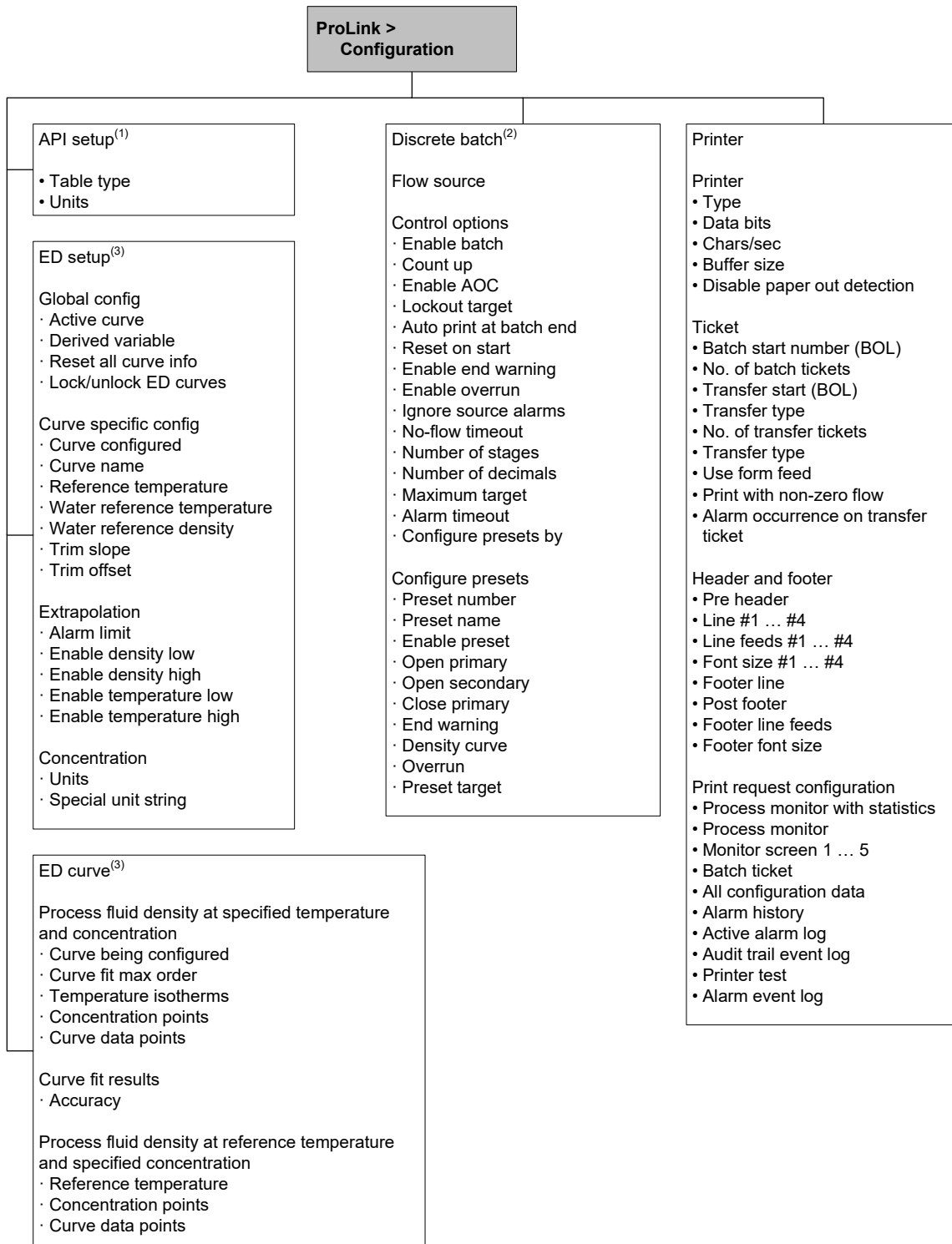
(1) Displayed only on systems with the enhanced core processor.

Figure G-4 ProLink II configuration menu *continued*



(1) Available only if the custody transfer application is installed.
 (2) Available only if Approval is set to OIML.
 (3) Displayed only if Vol Flow Type is set to Liquid.
 (4) Displayed only if Vol Flow Type is set to Gas Standard.

Figure G-5 ProLink II configuration menu *continued*



(1) Displayed only if the petroleum measurement application is installed.

(2) Displayed only if the discrete batch application is installed.

(3) Displayed only if the enhanced density application is installed.

Appendix H

375 Field Communicator

H.1 Overview

This appendix provides basic information for connecting and using the 375 Field Communicator with your Series 3000 device. The following topics and procedures are discussed:

- Requirements – see Section H.2
- Connecting to a Series 3000 device – see Section H.3
- Communicator menus – see Section H.4

H.2 DD requirements

To use the 375 Field Communicator with a Series 3000 device, the following device description (DD) must be loaded to your Communicator: **Micro Motion 3000 Mass flo v7 DD v2**

This DD does not provide complete access to the Series 3000 features, functions, and data. For complete access, use the Series 3000 display menus.

H.3 Connecting from the 375 Field Communicator to a Series 3000 device

To connect to the Series 3000 device:

1. Identify the primary mA output terminals on your Series 3000 platform.
See Figure 2-2 for the location of the terminal blocks on the different Series 3000 devices. See Figure 2-3 to identify the terminals.
2. Attach the leads from the Communicator to the primary mA output terminals.
3. Add resistance as required.
4. Follow standard Communicator procedures to connect to the Series 3000 device.

H.4 Communicator menu flowcharts

This section contains flowcharts for most Communicator menus. These flowcharts are based on:

- Micro Motion 3000 Mass flo v7 DD v2
- Series 3000 device software rev7.0

The flowcharts start from the Communicator Online menu.

Figure H-1 Communicator Process Vars menu

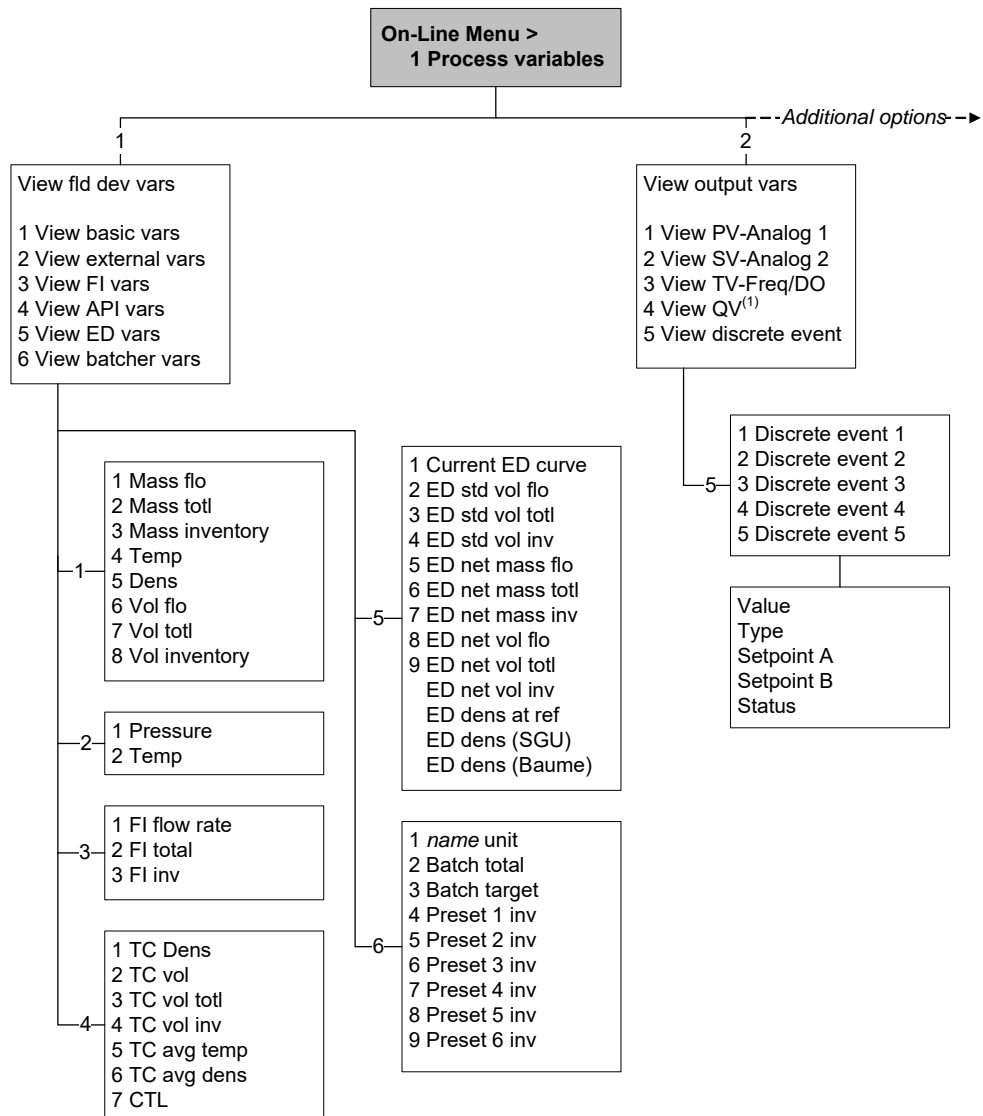


Figure H-2 Communicator Process Vars menu *continued*

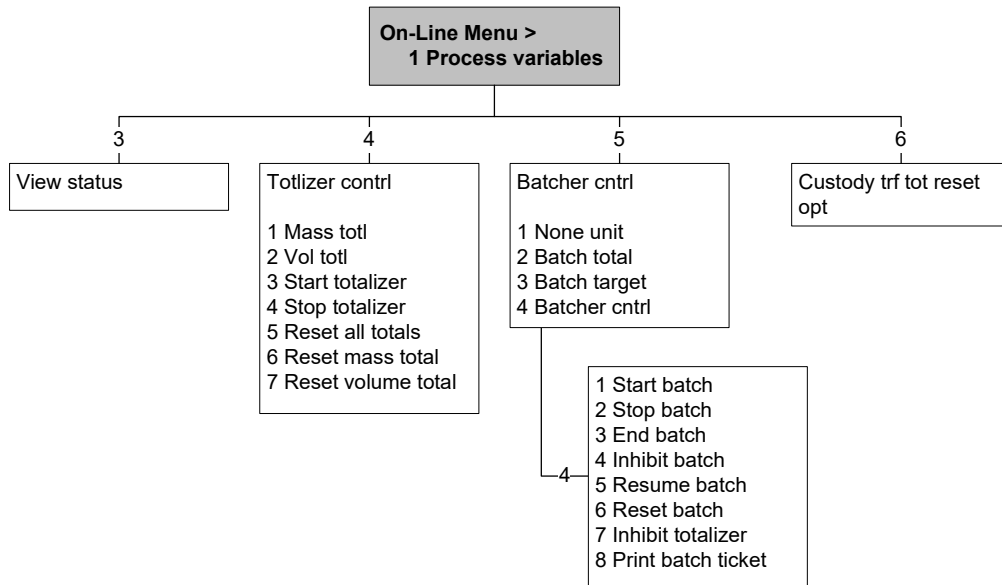


Figure H-3 Communicator Diag/Service menu

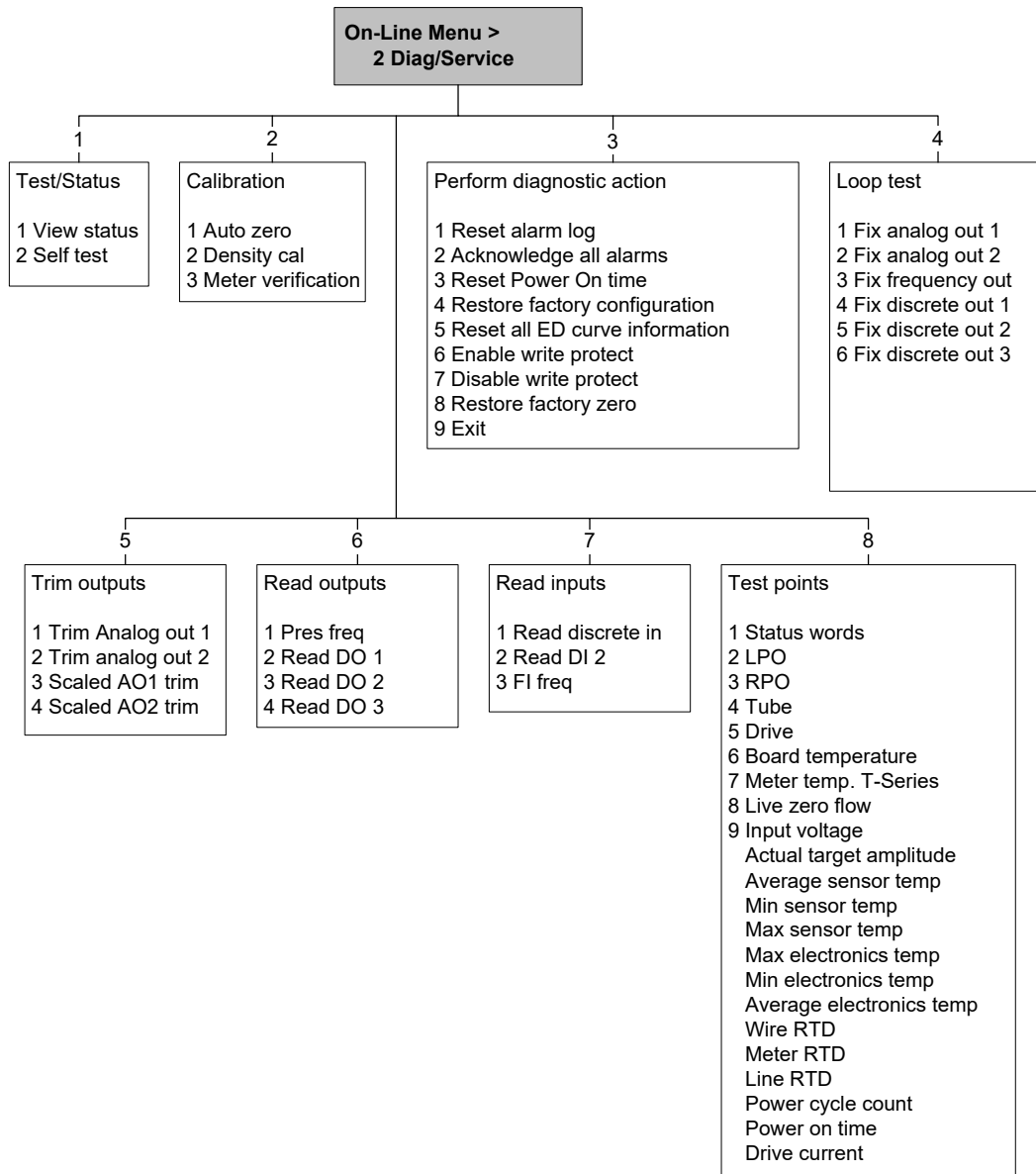
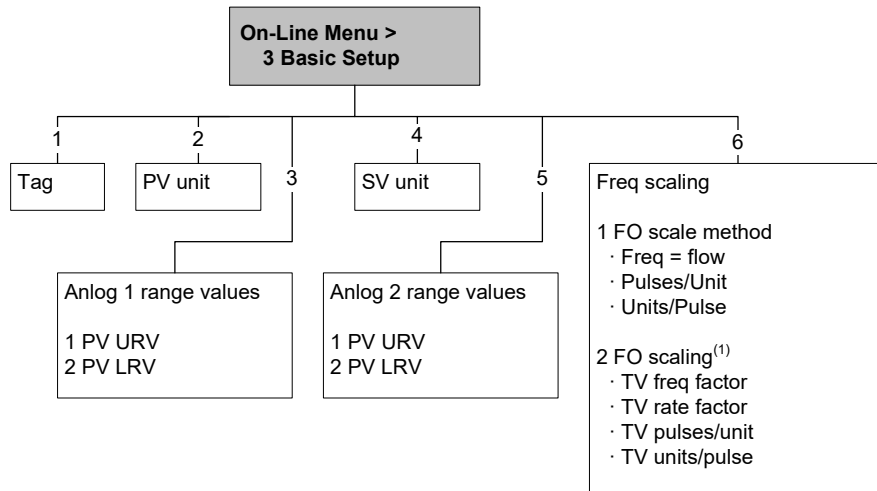
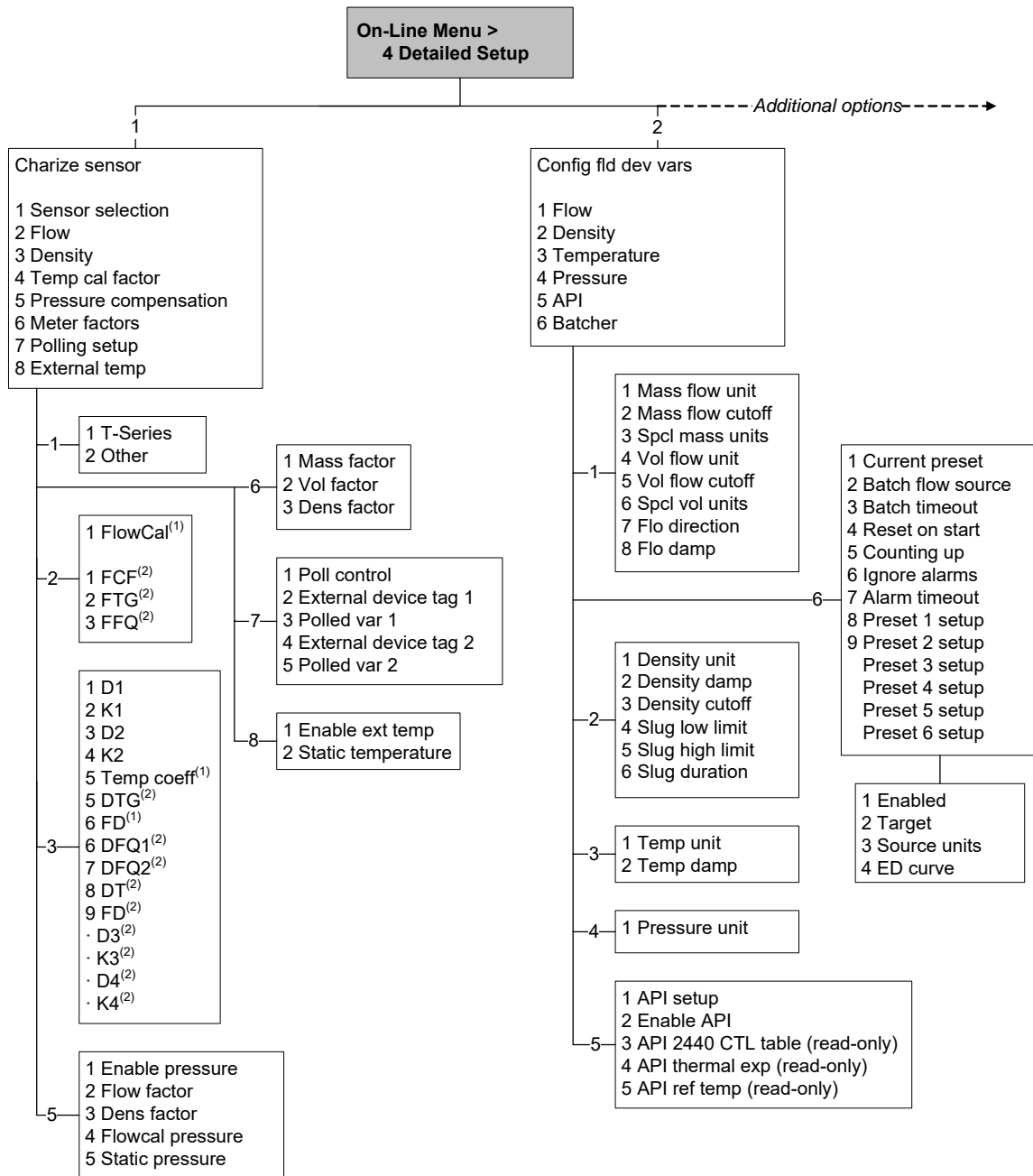


Figure H-4 Communicator Basic Setup menu



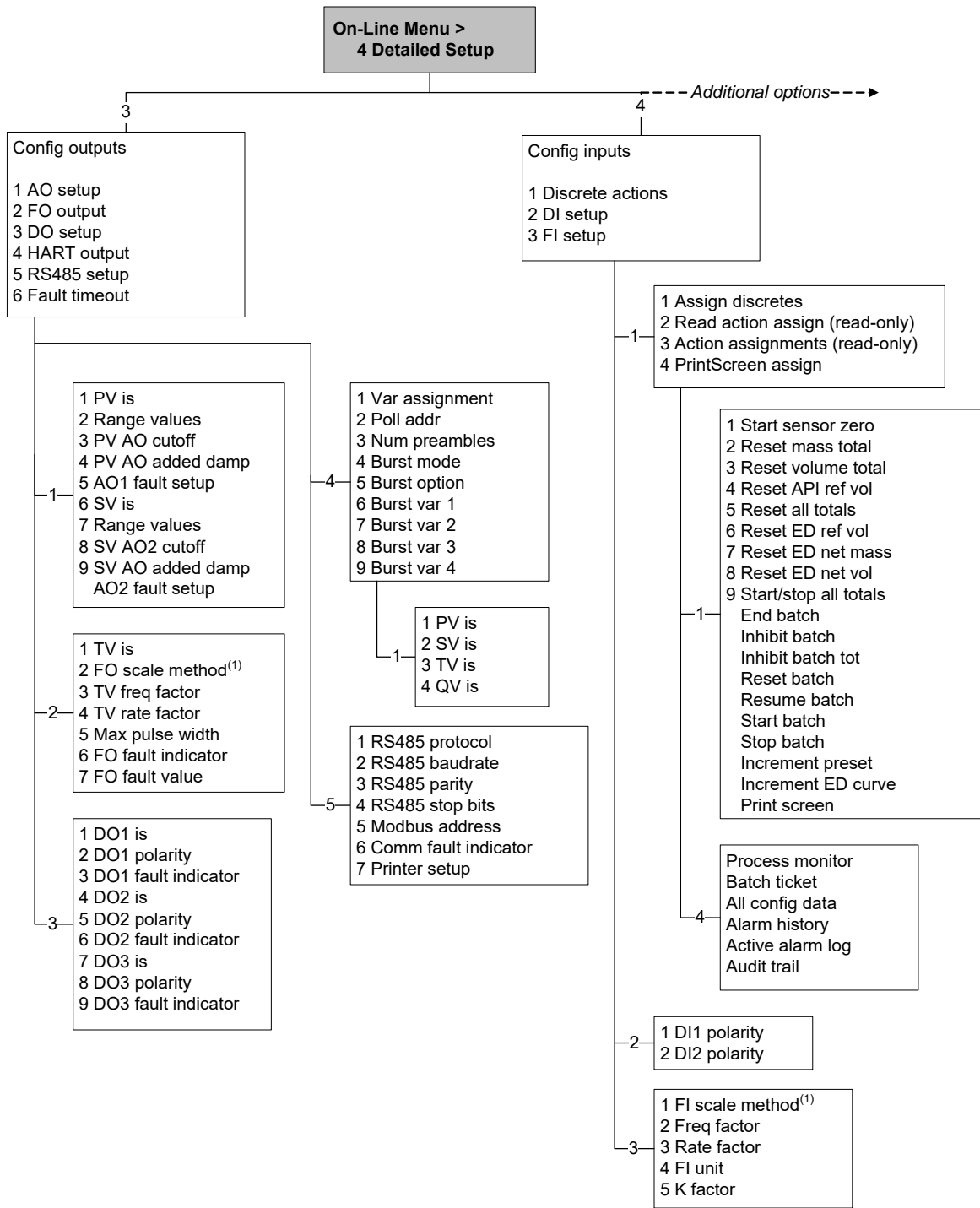
(1) Options displayed depend on FO Scale Method.

Figure H-5 Communicator Detailed Setup menu



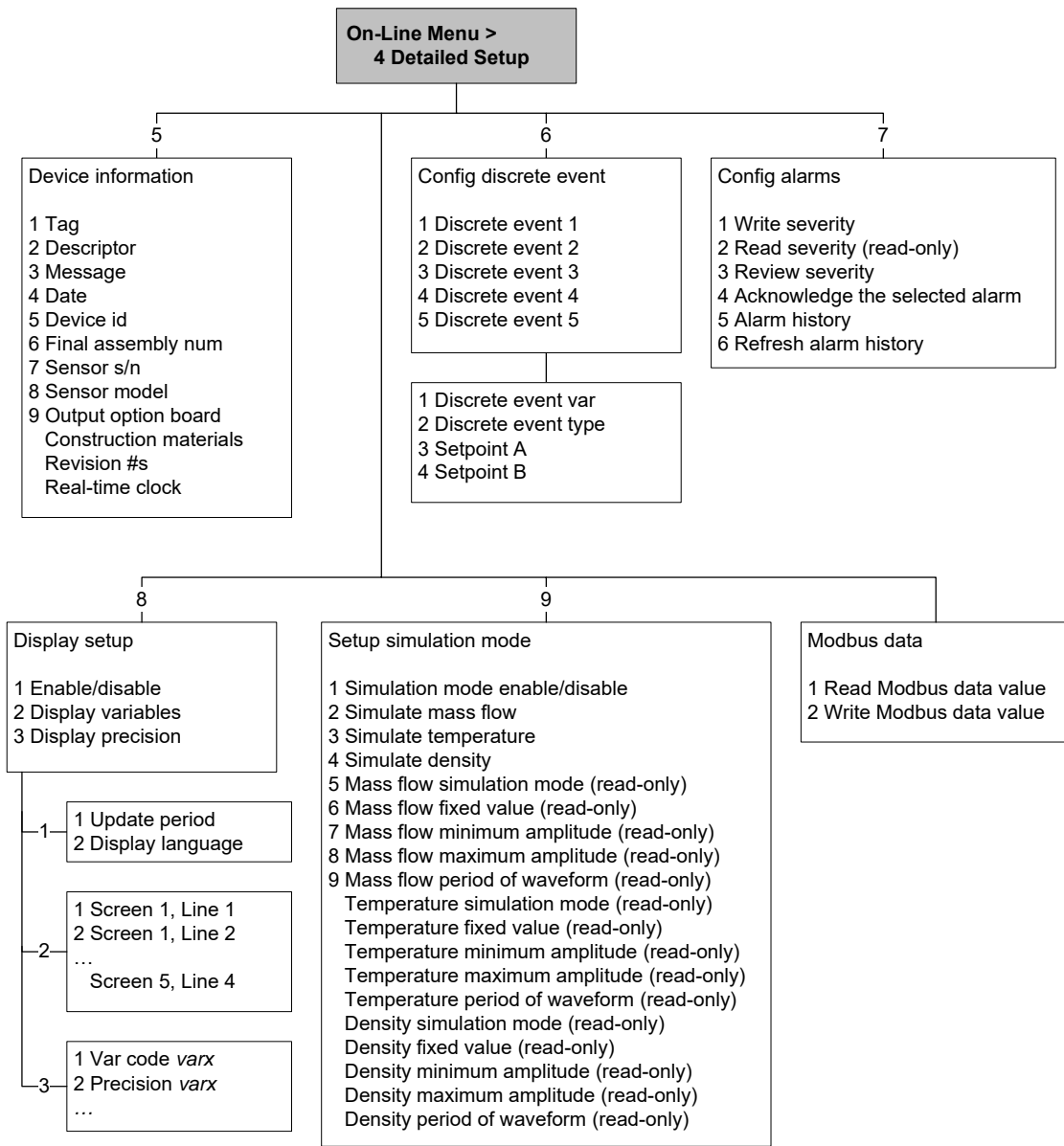
(1) All sensors except T-Series.
 (2) T-Series sensors only.

Figure H-6 Communicator Detailed Setup menu *continued*



(1) Options displayed depend on FO or FI Scale Method.

Figure H-7 Communicator Detailed Setup menu *continued*



Appendix I

Sample Tickets

I.1 Overview

This appendix provides sample tickets for the following ticket types:

- Standard tickets
 - Process monitor tickets – see Figure I-1
 - Alarm tickets – see Figure I-2
 - Configuration ticket and audit event log ticket – see Figure I-3
- Batch tickets – see Figure I-4
- Batch (NTEP) tickets
 - Original tickets – see Figure I-5
 - Duplicate tickets – see Figure I-6
- Transfer (OIML) tickets
 - No alarm banner – see Figure I-7
 - Alarm banner – see Figure I-8
 - Process variable approved – see Figure I-9
- Batch (OIML) tickets
 - Original tickets – see Figure I-10
 - Duplicate tickets – see Figure I-11

Sample Tickets

I.2 Standard tickets

Figure I-1 Typical process monitor tickets

No custody transfer With Stats	Custody transfer installed Without Stats
<pre>HEADER 1 HEADER 2 M. RESET 29-SEP-2003 10:58:27 Mass Flow Rate g/s Current_Value:0.000000 Average:-0.043297 Maximum:56:830570 Minimum:-0.145275 Mass Total g Current_Value:628050.562500 Volume Flow Rate l/s Current_Value:0.000000 Average:-0.000035 Maximum:0.046584 Minimum:-0.000107 Volume Total l Current_Value:744.410522 Density g/cm3 Current_Value:1.219813 Average:1.219888839 Maximum:1.262375 Minimum:1.216220 FOOTER</pre>	<pre>Not A Legal Receipt HEADER 1 HEADER 2 M. RESET 29-SEP-2003 10:58:27 Mass Flow Rate g/s Current_Value:0.000000 Mass Total g Current_Value:628050.562500 Volume Flow Rate l/s Current_Value:0.000000 Volume Total l Current_Value:744.410522 Density g/cm3 Current_Value:1.219813 FOOTER Not A Legal Receipt</pre>

Figure I-2 Typical alarm tickets

Active alarm log

```

HEADER          1
HEADER          2

M. RESET
29-SEP-2003      13:27:33
Active Alarm Log
Temp. Out-of-Range
INFO 17-JAN-07 14:14:53
Sensor RTD Error
INFO 17-JAN-07 14:14:53
Meter RTD Error
INFO 17-JAN-07 14:14:53
API: Temp Overrange
FAULT 17-JAN-07 14:14:53
FOOTER
    
```

Alarm history

```

HEADER          1
HEADER          2

M. RESET
29-SEP-2003      13:27:33
Historical Alarm Log
Drive Overrange
    Cnt  13
    Post 29-SEP-3 13:27
    Clr  29-SEP-3 13:27
Security Breach
    Cnt  11
    Post 29-SEP-3 11:02
    Clr  29-SEP-3 11:03
Xmtr Initializing
    Cnt  10
    Post 29-SEP-3 13:27
    Clr  29-SEP-3 13:27
FOOTER
    
```

Alarm event log

```

HEADER          1
HEADER          2

M. RESET
28-MAR-2007      16:36:45
Alarm Event Log
Drive Overrang
Post: 28-MAR-07 16:36
Power Reset
Clr: 28-MAR-07 16:36
Power Reset
Post: 28-MAR-07 16:36
Security Breach
Post: 28-MAR-07 16:36
FOOTER
    
```

Sample Tickets

Figure I-3 Configuration ticket and audit event log ticket

HEADER	1
HEADER	2
M.RESET	
29-SEP-2003	1:05:03
::Frequency Output::	
0	
FO Active	
1	
FO Polarity	
1	
FO Flow Source	
0	
FO Fault Frequency	
15000.000000	
FO Frequency Factor	
1000.000000	
. . .	
FOOTER	

HEADER	1
HEADER	2
HEADER	3
HEADER	4
M. RESET	
29-SEP-2003	1:05:03
Audit Trail	
001 4-JAN-2003 15:58:58	
MA01 Source	
0	
001 4-JAN-2003 15:58:58	
MA02 Source	
0	
001 4-JAN-2003 15:59:01	
FO Flow Source	
5	
001 4-JAN-2003 15:59:01:	
Flow Direction	
2	
FOOTER	

For the tickets shown in Figure I-3, codes are used for all items which are selected from a selection list. For example, FO Flow Source code 0 represents mass flow rate, and FO Flow Source code 5 represents volume flow rate.

Selection lists and codes are documented 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)

In the audit event log ticket:

- The first date and time represent the time at which the ticket print job was initiated.
- All other dates and times represent the time at which the configuration parameter was changed.

Sample Tickets

I.3 Batch tickets

Figure I-4 Typical batch tickets

Custody transfer application not installed

HEADER	1
HEADER	2
M. RESET	
29-SEP-2003	11:05:01
Preset	1
Units:	g
Actual:	1324.5 g
Target:	1300.9 g
FOOTER	

Custody transfer application installed,
discrete batch application not approved

Not A Legal Receipt	
HEADER	1
HEADER	2
M. RESET	
15-MAR-2005	11:05:01
Preset	1
Units:	g
Actual:	1324.5 g
Target:	1300.9 g
FOOTER	
Not A Legal Receipt	

I.4 Batch (NTEP) tickets

Figure I-5 Original tickets

Data secured

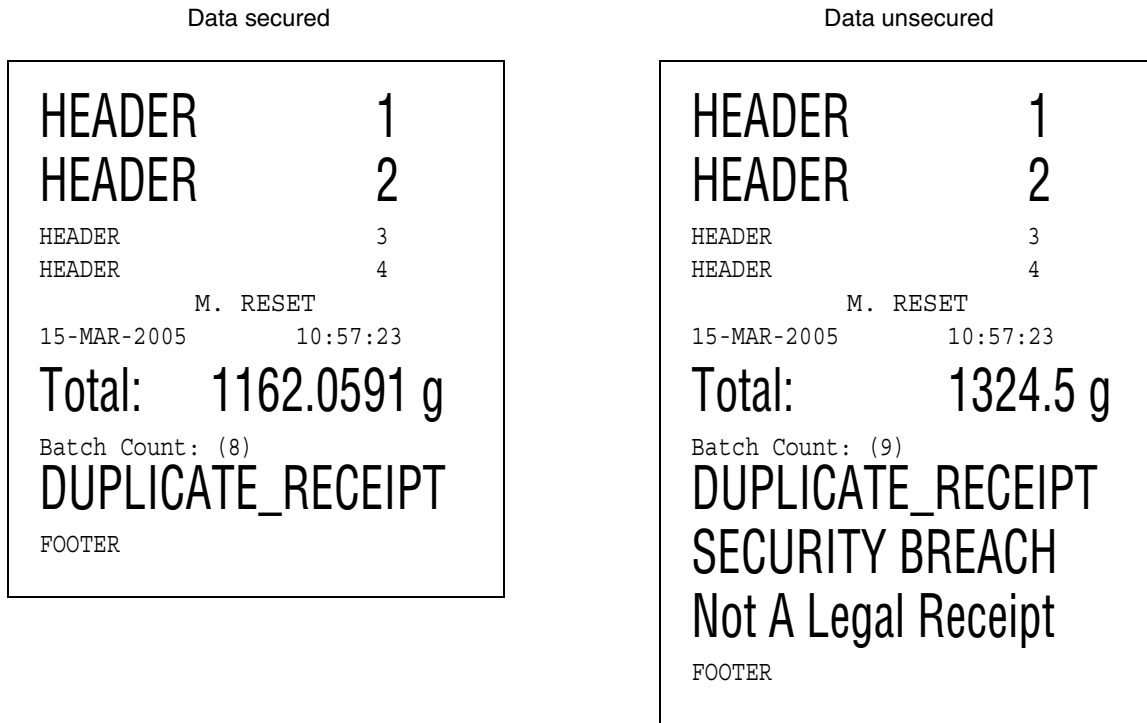
HEADER	1
HEADER	2
HEADER	3
HEADER	4
M. RESET	
15-MAR-2005	10:57:23
Total:	1162.0591 g
Batch Count: (8)	
FOOTER	

Data unsecured

HEADER	1
HEADER	2
HEADER	3
HEADER	4
M. RESET	
15-MAR-2005	10:57:23
Total:	1324.5 g
Batch Count: (9)	
SECURITY BREACH	
Not A Legal Receipt	
FOOTER	

Sample Tickets

Figure I-6 Duplicate tickets



I.5 Transfer (OIML) tickets

For the tickets shown in Figure I-7, there is no way to distinguish between the following:

- No alarm occurred.
- An alarm occurred (possibly a security breach), but the **Alarm Occurred** parameter was disabled.

For the tickets shown in Figure I-8, the alarm may or may not be a security breach. The security breach banner will appear on the Series 3000 display, if appropriate.

Figure I-7 No alarm banner

Transfer complete	Transfer incomplete
<pre> HEADER 1 HEADER 2 HEADER 3 HEADER 4 M. RESET 15-MAR-2005 10:57:23 Transfer (BOL): 31 Complete Mass Transfer * 0.906 kg* Volume Transfer * 0.3 US gal* FOOTER </pre>	<pre> HEADER 1 HEADER 2 HEADER 3 HEADER 4 M. RESET 15-MAR-2005 10:57:23 Transfer (BOL): 500 Not Complete Mass Flow Rate 0.0513 g/s Volume Flow Rate 0.0001 l/s Mass Transfer 53434.1016 g Volume Transfer 60.3386 l FOOTER </pre>

Sample Tickets

Figure I-8 Alarm banner

Transfer complete

HEADER	1
HEADER	2
HEADER	3
HEADER	4
M. RESET	
15-MAR-2005	10:57:23
Transfer (BOL):	
36 Complete	
Mass Transfer	
*	0.000 kg*
Mass Inventory	
	297.18 kg
Volume Transfer	
*	0.0 US gal*
Volume Inventory	
	137.3086 US gal
Alarm occurred during the	
Transfer.	
FOOTER	

Transfer incomplete

HEADER	1
HEADER	2
HEADER	3
HEADER	4
M. RESET	
15-MAR-2005	10:57:23
Transfer (BOL):	
501 Not Complete	
Mass Flow Rate	
	0.0513 g/s
Volume Flow Rate	
	0.0001 l/s
Mass Transfer	
	53434.1016 g
Volume Transfer	
	70.3386 l
Alarm occurred during the	
Transfer.	
FOOTER	

Figure I-9 Process variable approved

Approved variable: Mass total
Transfer complete

HEADER	1
HEADER	2
HEADER	3
HEADER	4
M. RESET	
28-MAR-2007	16:42:01
Transfer (BOL):	
2 Complete	
Mass Flow Rate	
	0.0000 kg/s
Volume Flow Rate	
	0.0000 l/s
Mass Transfer	
*	5.1050 kg*
Volume Transfer	
	5.1718 l
FOOTER	

Approved variable: Volume total
Transfer incomplete

HEADER	1
HEADER	2
HEADER	3
HEADER	4
M. RESET	
28-MAR-2007	16:41:43
Transfer (BOL):	
2 Not Complete	
Mass Flow Rate	
	0.1007 kg/s
Volume Flow Rate	
	0.1020 l/s
Mass Transfer	
	5.1050 kg
Volume Transfer	
	5.1718 l
FOOTER	

I.6 Batch (OIML) tickets

Figure I-10 Original tickets

Data secured

HEADER	1
HEADER	2
HEADER	3
HEADER	4
M. RESET	
15-MAR-2005	10:57:23
Total:	1162.0591 g
Batch Count: (8)	
FOOTER	

Data unsecured

HEADER	1
HEADER	2
HEADER	3
HEADER	4
M. RESET	
15-MAR-2005	10:57:23
Total:	1324.5 g
Batch Count: (9)	
SECURITY BREACH	
Not A Legal Receipt	
FOOTER	

Sample Tickets

Figure I-11 Duplicate tickets

Data secured

```
HEADER          1
HEADER          2
HEADER          3
HEADER          4
                M. RESET
15-MAR-2005     10:57:23
Total: 1162.0591 g
Batch Count: (8)
DUPLICATE_RECEIPT
FOOTER
```

Data unsecured

```
HEADER          1
HEADER          2
HEADER          3
HEADER          4
                M. RESET
15-MAR-2005     10:57:23
Total: 1324.5 g
Batch Count: (9)
DUPLICATE_RECEIPT
SECURITY BREACH
Not A Legal Receipt
FOOTER
```

Appendix J

Label Maintenance and Replacement

J.1 Maintaining and replacing labels

Micro Motion product safety labels have been designed in accordance with the voluntary standard ANSI Z535.4. If the labels illustrated below are illegible, damaged, or missing, promptly have new ones installed.

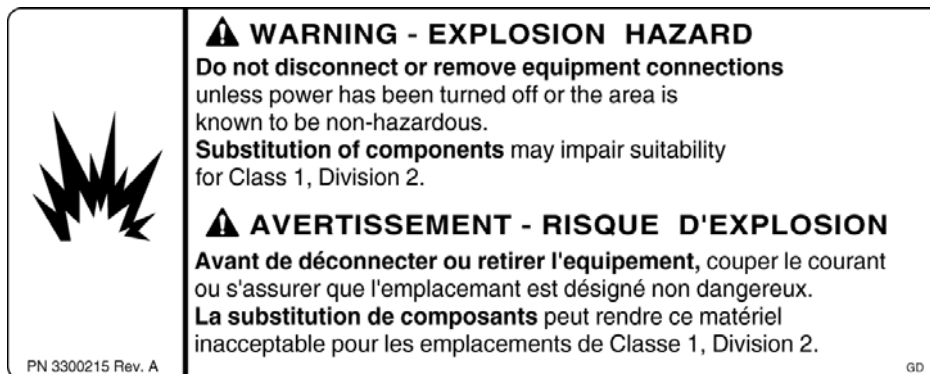
Contact Micro Motion for replacement labels. Contact information is provided on the title page of this manual.

J.2 Labels on the device

The Series 3000 platform may include the safety labels illustrated below.

Figure J-1 Safety labels

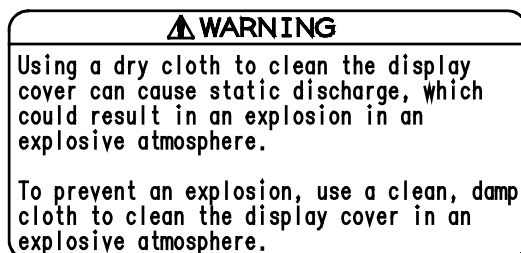
Label number 3300215



Label number 3100436



Label number 3300709



Appendix K

Return Policy

K.1 General guidelines

Micro Motion procedures must be followed when returning equipment. These procedures ensure legal compliance with government transportation agencies and help provide a safe working environment for Micro Motion employees. Failure to follow Micro Motion procedures will result in your equipment being refused delivery.

Information on return procedures and forms is available on our web support system at www.micromotion.com, or by phoning Micro Motion customer service.

K.2 New and unused equipment

Only equipment that has not been removed from the original shipping package will be considered new and unused. New and unused equipment requires a completed Return Materials Authorization form.

K.3 Used equipment

All equipment that is not classified as new and unused is considered used. This equipment must be completely decontaminated and cleaned before being returned.

Used equipment must be accompanied by a completed Return Materials Authorization form and a Decontamination Statement for all process fluids that have been in contact with the equipment. If a Decontamination Statement cannot be completed (e.g., for food-grade process fluids), you must include a statement certifying decontamination and documenting all foreign substances that have come in contact with the equipment.

Appendix L

NE 53 History

L.1 Overview

This appendix documents the change history of the Series 3000 MVD device software.

L.2 Software change history

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

Table L-1 Series 3000 device software change history

Date	Software version	Changes to software	Operating instructions
10/2003	6.00	Initial release	20001266A
7/2005	6.10	<i>Software expansion</i>	20001266B
		Independent reset of inventory totals	
		Added display of enhanced density curve fit result	
		Added support for Katakana language on the display	
		Added configurable pre-header and post-footer control codes for printing	
		<i>Software adjustment</i>	
		Improved accuracy when batching on frequency input	
		Allow batch to be ended when flow is present	
		Clarified the behavior of certain Modbus calibration coils	
		HART Tri-Loop and other communication improvements	
		HART support of concentration units	
		Clarified state of discrete outputs during device startup following a power on condition.	
		<i>Feature addition</i>	
		Added support for FDW printer protocol	
Added compliance with OIML custody transfer requirements			

Table L-1 Series 3000 device software change history *continued*

Date	Software version	Changes to software	Operating instructions
3/2007	7.00	<i>Software expansion</i>	20001266C
		Added flow switch to selection list for discrete output assignment	
		Added ability to configure discrete output fault indication	
		Added several HART and Modbus commands	
		Added ability to restore the factory configuration	
		Added ability to restore the factory zero value	
		Added alarm event log	
		Added ability to write protect configuration data	
		Added new items to selection list for mA output source assignment	
		Range values for mA output stored separately for each process variable	
		Expanded custody transfer application for independent implementation of NTEP and OIML compliance	
		Expanded custody transfer (OIML) features to include configurable approval of discrete batcher, enhanced density, API, and process monitor applications; added ability to mark OIML-approved process variables with asterisks, added display of firmware checksum of core processor and transmitter, added display of W&M version number, expanded discrete output source selection to include PPI Display Error, added configurable password protection of alarms menu	
		Added ability to configure the display update rate	
		Printer output expanded to include alarm event history	
		Expanded HART command 33 to include frequency input raw frequency	
		Added ability to use discrete input to inhibit flow measurement by discrete batcher	
		Added active enhanced density curve to selection list for process monitor display variables	
		Added discrete events for Model 3300 controller	
		Added core processor ETO number to applications list on display	
		Added ability to configure Loop Current Mode	
Added ability to configure text strings used to identify totals and inventories			
Added 304 Stainless Steel to selection of sensor material			

Table L-1 Series 3000 device software change history *continued*

Date	Software version	Changes to software	Operating instructions
		<p><i>Software adjustment</i></p> <ul style="list-style-type: none"> Clarified range checking when writing D1 and D2 values for T-Series sensors Clarified posting of Start Not Okay alarm Allow discrete batch to be started when milliamp output is fixed Allow batch target to be changed from batcher process screen when no decimal point is displayed (precision set to zero) Removed printing of character when power is cycled Allow batch preset selection to be changed when device is secured for custody transfer. Clarified use of HART command 180 for Model 3300 controller for writing output fault parameters Clarified default derived variable when standard curves feature is enabled Expanded range of frequency input total and frequency input inventory <p><i>Feature addition</i></p> <ul style="list-style-type: none"> Added configurable alarm severity Added gas standard volume functionality Added support for meter verification option 	
11/2009	8.00	<p><i>Software expansion</i></p> <ul style="list-style-type: none"> Added Field Verification Zero process variable Updated meter verification to add support for “continue measurement” option, scheduling, and execution from a discrete input or discrete event Added user-configurable hysteresis to flow switch Added ability to configure pre header and post footer printer codes when the custody transfer application is enabled but the transmitter is not secured <p><i>Software adjustment</i></p> <ul style="list-style-type: none"> Support for HART command 139 modified to include unit checking Response to a Modbus write command to coil 34 modified so that an A028 alarm is no longer generated <p><i>Feature addition</i></p> <ul style="list-style-type: none"> Added support for Marine Bunker Transfer Package (refer to the manual entitled <i>Series 3000 Transmitters: Marine Bunker Transfer Package Supplement</i>, available on the Micro Motion web site at www.micromotion.com) 	20001266CA

Index

Numerics

- 20 mA value
 - configuration 67
 - troubleshooting 229
- 375 Field Communicator 297
 - connecting to Series 3000 device 297
 - menu flowcharts 297
 - requirements 297
- 4 mA value
 - configuration 67
 - troubleshooting 229
- 4-wire cable 10
- 9-wire cable 10

A

- Active alarm log 209
 - from View menu 146
- Active high 66
- Active low 66
- Alarm event log 210
- Alarm history 210
- Alarm log password 110, 168
- Alarm severity 38, 208
- Alarms
 - active alarm log 146, 209
 - alarm categories 209
 - alarm event log 210
 - alarm handling 208
 - alarm history 210
 - alarm severity 208
 - alarm types 208
 - batch alarms 220
 - calibration alarms 221
 - configuration alarms 222
 - electronics alarms 212
 - help 211
 - listed by category 212
 - output saturation alarms 220
 - process alarms 216
 - sensor alarms 215
 - slug flow alarms 219
- Ambient temperature effect
 - Model 3300 or Model 3500 249
 - Model 3350 or Model 3700 257
- API
 - See Petroleum measurement application

- Application 2
- Applications list 148
- ATEX 259, 261
 - Model 3350 or Model 3700 257
 - Model 3500 249
- Audit trail 170
- Auto print
 - batch (NTEP) tickets 125
 - batch (OIML) tickets 131
 - batch tickets 122

B

- Batch
 - See Discrete batch application
- Batch (NTEP) tickets
 - See Tickets, batch (NTEP)
- Batch (OIML) tickets
 - See Tickets, batch (OIML)
- Batch alarms 220
- Batch AOC 85, 157
- Batch inventories
 - See Inventories
- Batch tickets
 - See Tickets, batch
- Bell 202
 - communications 19
 - parameters 102
 - signal converter 16
 - wiring diagrams 20
 - wiring terminals 19
- BOL number
 - batch 163, 164
 - transfer 164
- Burst mode 103
- Buttons
 - cursor control buttons 30
 - in discrete batch operation mode 153
 - function buttons 28
 - in discrete batch operation mode 151
 - Security button 27
- C**
- Cable glands 11
- Cable types 10
- Calibration 179, 181
 - alarms 221

Index

- batch AOC 85, 157
- density 197
- sensor zero 134
- temperature 201
- troubleshooting 230
- Calibration factors 53
- Calibration span 67
- Characterization 53
 - density calibration factors 54
 - flow calibration parameters 55
 - troubleshooting 229
- Checksum, core processor 110
- Checksum, transmitter 110
- Cleaning instructions
 - Model 3300 or Model 3500 249
 - Model 3350 or Model 3700 258
- Coil, testing resistance 235
- Communication loop, troubleshooting 228
- Communication parameters
 - HART over Bell 202 104
 - RS-485 mode 100
 - service port mode 100
- Communication tools
 - 375 Field Communicator 3
 - local display 3
 - Pocket ProLink 3
 - ProLink II 3
- Configuration
 - alarm severity 38
 - Bell 202 parameters 102
 - burst mode 103
 - core processor parameters 41
 - custody transfer application 105
 - cutoff
 - density 51
 - mass flow 42
 - milliamp output 68
 - volume flow (gas standard) 43
 - volume flow (liquid) 43
 - damping
 - density 51
 - flow 42
 - temperature 52
 - date 38
 - default values and ranges 273
 - density damping 51
 - density process variable 51
 - density units 51
 - device parameters 104
 - digital communications 97
 - discrete batch application 83
 - batch control methods 90
 - control options 86
 - flow source 85
 - presets 88
 - discrete events 79
 - action 81
 - event type 80
 - high and low values 81
 - process variable 80
 - setpoints 81
 - discrete inputs
 - assignment 56
 - polarity 58
 - discrete outputs 63
 - assignment 64
 - fault indication 65
 - polarity 63
 - external inputs 59
 - flow damping 42
 - flow direction 42
 - frequency input 57
 - flow rate units 57
 - K-factor 57
 - scaling method 57
 - frequency output 70
 - flow source 70
 - maximum pulse width 71
 - polarity 71
 - power 71
 - scaling method 70
 - HART over RS-485 99
 - input parameters 39
 - language 35
 - low flow cutoff
 - mass flow 42
 - volume flow (gas standard) 43
 - volume flow (liquid) 43
 - mass flow process variable 42
 - mass flow units 42
 - measurement units
 - density 51
 - mass flow 42
 - temperature 52
 - volume flow (gas standard) 43
 - volume flow (liquid) 43
 - milliamp outputs 66
 - Modbus 99
 - outputs 61
 - passwords 34
 - petroleum measurement application 75
 - polling 59
 - printer 101
 - process inventory reset methods 35

- process monitor
 - display variables 94
 - precision of displayed variables 94
- process totalizer and process inventory labels 94
- process totalizer reset methods 35
- process variables 42
- quaternary variable 104
- restoring a working configuration 224
- RS-485 parameters 99
- RS-485 protocol 99
- security 34
- sensor calibration data 53
- sensor information 56
- slug duration 51
- slug high limit 51
- slug low limit 51
- standard gas density 43
- system parameters 37
- tag 38
- temperature damping 52
- temperature process variable 52
- temperature units 52
- ticket formatting and printing 117
 - batch (NTEP) tickets 123
 - batch (OIML) tickets 129
 - batch tickets 121
 - standard tickets 119
 - transfer (OIML) tickets 125
- time 38
- volume flow process variable 42
- volume flow type 43
- volume flow units (gas standard) 43
- volume flow units (liquid) 43
- when custody transfer application is enabled 170
- write-protecting 34
- Configuration files (ProLink II) 290
- Connecting with ProLink II or Pocket ProLink software 277
- Control device, connecting to relay 267, 271
- Control options 86
- Controller 2
- Core processor 2
 - dimensions 245, 254
 - enhanced 2
 - remote 10
 - standard 2
 - troubleshooting 232
- Core processor checksum 110
- Core processor inputs
 - enabling and disabling 42
- Core processor parameters
 - configuration 41
 - discrete inputs 56
 - process variables 42
 - sensor calibration data 53
 - sensor information 56
- Core processor resistance test 234
- Crossover frequency 72
- CSA 259, 262
 - Model 3300 or Model 3500 249
 - Model 3350 or Model 3700 257
- CTL 76
- Cursor control buttons 30
 - in discrete batch operation mode 153
- Custody transfer application 105
 - audit trail 170
 - configuration 105
 - device behavior 159
 - NTEP 106
 - BOL number 163
 - configuration 107
 - executing a transaction 163
 - process inventory values 164
 - ticket printing 163
 - transfer variable 107
 - OIML 106
 - alarm log password 110
 - application approval 108
 - BOL number 164
 - configuration 108
 - executing a transaction 164
 - process monitor approval 109
 - process variable approval 94, 109
 - ticket printing 166
 - transfer log 167
 - transfer variable 108
 - transfer variable approval 109
 - View menu 168
 - OIML/batch 106
 - alarm log password 110
 - application approval 108
 - BOL number 164
 - configuration 108
 - executing a transaction 165
 - process monitor approval 109
 - process variable approval 94, 109
 - ticket printing 166
 - transfer variable 108
 - transfer variable approval 109
 - View menu 168
 - operation mode 159
 - reconfiguring Series 3000 device 170

Index

- security switch 111
 - Model 3300 or Model 3500 panel-mount 111
 - Model 3300 or Model 3500 rack-mount 112
 - Model 3350 or Model 3700 field-mount 113
- weights and measures seal 115
- Customer service, contacting 5
- Cutoff
 - definition 53
 - density 51
 - interaction between milliamp output cutoff and low flow cutoff 69
 - mass flow 42
 - milliamp outputs 67
 - volume flow (gas standard) 43
 - volume flow (liquid) 43
- D**
- Damping
 - damping values 52
 - definition 52
 - density 51
 - flow 42
 - interaction between milliamp output damping and other damping parameters 69
 - milliamp outputs 67
 - temperature 52
- Data security 159
- Default values 273
- Density
 - calibration 197
 - calibration factors 54
 - cutoff 51
 - damping 51
 - process variable configuration 51
 - slug flow alarms 219
 - slug flow configuration parameters 51
 - units 51
- Density curves
 - from View menu 148
 - See also* Enhanced density application
- Device parameters 104
- Diagnostic monitor 148
- Digital communications 15
 - configuration 97
 - fault indication 104
 - installation 15
 - protocols 15
 - wiring 13
- Dimensions
 - core processor 245, 254
 - Model 3300 or Model 3500 241
 - Model 3350 or Model 3700 251
 - relay module 264
- Discrete batch application 83
 - batch AOC 85, 157
 - batch control functions 91
 - batch events 150
 - cleaning or purging the tubes 157
 - configuration 83
 - control options 86
 - ending with flow 157
 - flow source 85
 - function buttons 151
 - operation mode 149
 - preset selections 147
 - presets 88
 - printing batch tickets 122
 - processing sequences 153
 - stages 88
 - tickets 85
- Discrete events
 - configuration 79
 - action 81
 - event type 80
 - high and low values 81
 - setpoints 81
 - in batch control 90
 - printing
 - batch (NTEP) tickets 125
 - batch (OIML) tickets 131
 - batch tickets 122
 - standard tickets 120
 - process variable 80
- Discrete inputs
 - configuration
 - assignment 56
 - polarity 58
 - in batch control 90
 - printing
 - batch (NTEP) tickets 125
 - batch (OIML) tickets 131
 - batch tickets 122
 - standard tickets 120
 - transfer (OIML) tickets 128
 - testing 139
- Discrete outputs 262, 265
 - configuration 63
 - assignment 64
 - fault indication 65
 - polarity 63
 - discrete batch requirements 65
 - testing 139
 - troubleshooting 228

- voltage levels 63
- Display
 - process monitor configuration 94
 - scientific notation 30
 - startup 25
 - update period 95
 - using 25
- Documentation resources 4
- Drive gain
 - erratic 231
 - excessive 231
- Duty cycle 72
- E**
- Electrical connections
 - Model 3300 or Model 3500 246
 - Model 3350 or Model 3700 255
- EMI effects
 - Model 3300 or Model 3500 249
 - Model 3350 or Model 3700 257
- End batch 91
- Enhanced core processor 2
- Enhanced density application 1
- Environmental effects
 - Model 3300 or Model 3500 249
 - Model 3350 or Model 3700 257
- Environmental limits
 - Model 3300 or Model 3500 249
 - Model 3350 or Model 3700 257
- Erratic drive gain 231
- Events
 - See* Discrete events
- Excessive drive gain 231
- External inputs
 - configuration 59
 - testing 139
- External temperature compensation 59
 - configuration 59
 - petroleum measurement application 78
 - wiring diagram 22
 - with HART Tri-Loop, wiring diagram 23
- F**
- Factory zero 135
- Fault indication
 - digital communications 104
 - discrete outputs 65
 - frequency output 71
 - milliamp outputs 66
- Fault timeout 209
- Field Verification Zero 110
- Field-mount
 - See* Model 3350 or Model 3700
- Flow calibration parameters 55
- Flow direction 42
- Flow source
 - discrete batch 85
 - frequency output 70
- Flow switch 65
 - setpoint 65
- Flow switch, hysteresis 65
- Frequency input
 - cable length 8
 - configuration 57
 - flow rate units 57
 - K-factor 57
 - scaling method 57
 - testing 139
- Frequency output
 - configuration 70
 - fault indication 71
 - flow source 70
 - maximum pulse width 71
 - polarity 71
 - power 71
 - scaling method 70
 - testing 140
 - troubleshooting 225, 228, 229
- Function buttons 28
 - in discrete batch operation mode 151
- FVZ
 - See* Field Verification Zero
- G**
- Gas standard volume flow 43, 48
- Grounding
 - I/O wiring 13
 - troubleshooting 228
- GSV
 - See* Gas standard volume flow
- H**
- HART
 - loop current mode 103
 - polling address 100
 - RS-485 configuration 99
 - See also* Bell 202
- HART burst mode
 - See* Burst mode 103
- HART Communicator
 - See* 375 Field Communicator
- HART interface 289

Index

- HART Tri-Loop wiring diagram 23
 - with pressure compensation or external temperature compensation 23
- Hazardous area classifications
 - Model 3100 259
 - Model 3300 or Model 3500 249
 - Model 3350 or Model 3700 257
 - user-supplied relays 262
- Help system 211
- Housing
 - Model 3300 or Model 3500 241
 - Model 3350 or Model 3700 251
- Hysteresis, flow switch 65
- I**
- I/O wiring 11
 - grounding 13
 - relays 13
 - terminal blocks and terminal locations 11
- Increment preset 91
- Ingress protection on Model 3300 8
- Inhibit batch 91
- Inhibit flow 91
- Inhibit totalizer 91
- Input parameters 39
- Inputs
 - Model 3300 or Model 3500 246
 - Model 3350 or Model 3700 255
- Installation
 - digital communications 15
 - digital communications wiring 13
 - display cover orientation (Model 3350 or Model 3700) 9
 - environmental requirements 8
 - frequency input cable length 8
 - grounding I/O wiring 13
 - I/O wiring 11
 - Model 3100 263
 - relay 13, 263
 - remote core processor 10
 - sensor wiring 10
 - supplemental information 7
 - user-supplied relay 269
- Interface/display
 - Model 3300 or Model 3500 241
 - Model 3350 or Model 3700 251
- Inventories 173
 - batch inventories 147, 174
 - managing 174
 - process inventories
 - configuring labels 94
 - configuring reset methods 35
 - displaying large values 164
 - with custody transfer (OIML) or custody transfer (OIML/batch) 169
 - See also* Totalizers
 - transfer inventories 169, 174
 - viewing 174
- K**
- K-factor 57
- L**
- Labels
 - maintaining and replacing safety labels 315
 - safety labels on Series 3000 device 315
 - terminal labels on Series 3000 device 11
 - used for process totalizers and process inventories 95
- Language used in Series 3000 device 35
- LCD options 148
- Legal security 159
- Liquid volume flow 43
- Loop current mode 103, 229
- Low flow cutoff
 - mass flow 42
 - volume flow (gas standard) 43
 - volume flow (liquid) 43
- Low pickoff voltage 232
- M**
- mA outputs
 - See* Milliamp outputs
- Maintenance
 - cleaning instructions
 - Model 3300 or Model 3500 249
 - Model 3350 or Model 3700 258
 - density calibration 179
 - meter factors 179
 - meter validation 179
 - meter verification 179
 - safety labels 315
 - temperature calibration 179
 - zero calibration 179
- Management menu 26
 - Security button 27
- Marine Bunker Transfer Package 1
- Mass flow
 - damping 42
 - low flow cutoff 42
 - process variable configuration 42
 - special units 49
 - units 42
- Maximum pulse width 71, 72

- Measurement units
 - density 51
 - mass flow 42
 - special units 49
 - temperature 52
 - verifying correct configuration 229
 - volume flow (gas standard) 43
 - volume flow (liquid) 43
 - Measuring Instruments Directive 110
 - Menu system
 - flowcharts 277
 - Management menu 26
 - Management menu flowcharts 281
 - process monitor flowcharts 277
 - shortcuts 28
 - using 25
 - View menu 26
 - View menu flowcharts 279
 - Meter factors 55, 181, 196
 - Meter fingerprinting 206
 - Meter validation 179, 181, 196
 - Meter verification 179, 180, 183
 - execution 184
 - preparing for test 183
 - results 190
 - See also* Smart Meter Verification
 - Meter verification, specification uncertainty
 - limit 184
 - Micro Motion customer service 5
 - MID
 - See* Measuring Instruments Directive
 - Milliamp outputs
 - configuration 66
 - calibration span 67
 - cutoff 67
 - damping 67
 - fault indication 66
 - process variable 67
 - range 67
 - scale 67
 - testing 140
 - trimming 140
 - troubleshooting 225
 - calibration span 229
 - Modbus
 - configuration 99
 - polling address 100
 - Model 3300
 - frequency input cable length 8
 - ingress protection 8
 - installation 7
 - K-factor 57
 - Quick Reference Guide 7
 - rack-mount
 - replacement for RFT9739 rack-mount 7
 - Model 3350
 - display cover orientation 9
 - frequency input cable length 8
 - installation 7
 - K-factor 57
 - Quick Reference Guide 7
 - Model 3500
 - installation 7
 - Quick Reference Guide 7
 - rack-mount
 - replacement for RFT9739 rack-mount 7
 - sensor wiring 10
 - Model 3700
 - display cover orientation 9
 - installation 7
 - Quick Reference Guide 7
 - sensor wiring 10
 - Mounting relays 263
 - MVD 2
- N**
- Net Oil Computer 1
 - New equipment returns 317
 - NTEP
 - See* Custody transfer application
- O**
- OIML
 - See* Custody transfer application
 - OIML/batch
 - See* Custody transfer application
 - Operation mode
 - custody transfer application 159
 - discrete batch application 149
 - process monitor mode 144
 - View menu 145
 - Optional applications 1
 - applications list 148
 - Output, troubleshooting
 - frequency output 225
 - milliamp outputs 225
 - Outputs
 - configuration 61
 - Model 3300 or Model 3500 246
 - Model 3350 or Model 3700 255
 - output saturation alarms 220

Index

P

Panel-mount
 See Model 3300 or Model 3500 panel-mount

Passwords
 configuration 34
 alarm log password 110
 configuration password 34
 maintenance password 34
 types 34

Petroleum measurement application 75
 definitions 76
 external temperature compensation 78
 parameters 76
 reference tables 77

Pickoff voltage 232

Platform 2

Pocket ProLink 277, 289

Polarity
 discrete inputs 58
 discrete outputs 63
 frequency output 71

Polling 59

Polling address
 HART over Bell 202 102
 HART over RS-485 100
 Modbus 100

Power supply
 for relay 261
 specifications
 Model 3300 or Model 3500 248
 Model 3350 or Model 3700 257

Power supply, troubleshooting 227

Power-up 133

Preset selections 147

Presets 88

Pressure compensation 59
 configuration 59
 wiring diagram 22
 with HART Tri-Loop, wiring diagram 23

Printer
 configuration 101
 test 102

Printing
 auto print
 batch (NTEP) tickets 125
 batch (OIML) tickets 131
 batch tickets 122
 batch (NTEP) tickets 124
 batch (OIML) tickets 131
 batch tickets 85, 122
 standard tickets 120
 transfer (OIML) tickets 127

Prior zero 135

Process inventories
 See Inventories

Process monitor
 approval for custody transfer 109
 configuration
 displayed variables 94
 precision of displayed variables 94
 process totalizer and process inventory
 labels 94
 from View menu 147
 process variable approval 94, 168

Process monitor mode 144

Process totalizers
 See Totalizers

Process variable
 approval for custody transfer 109
 assigned to frequency output 70
 assigned to milliamp outputs 67
 configuration 42
 in discrete events 80
 troubleshooting 203

ProLink II 277, 289
 configuration upload and download 290
 connecting to Series 3000 device 290
 menu flowcharts 291
 requirements 289
 saving configuration files 290

Protocol
 on RS-485 terminals 99
 printer 101
 supported 15

Pulse width
 definition 72
 See also Maximum pulse width

Q

QRG
 See Quick Reference Guide

Quaternary variable 104

Quick Reference Guide 7

QV
 See Quaternary variable 104

R

Rack-mount
 See Model 3300 or Model 3500

Range
 milliamp outputs 67

Receiving device, troubleshooting 229

Relay 13, 261
 connecting to control device 267, 271

- installation 263
 - mounting 263
 - power 261
 - replacing 262
 - types 261
 - user-supplied 262, 269
 - Relay packs 259
 - Remote core processor 10
 - Replacing relays 262
 - Reset batch 91
 - Resistance
 - testing coil 235
 - testing core processor 234
 - Restore factory configuration 224
 - Resume batch 91
 - Return policy 317
 - RF (radio frequency) interference 228
 - RFT9739 rack-mount transmitter, replacing 7
 - RS-485 16
 - parameters 99
 - signal converter 15
 - wiring diagrams 17
 - wiring terminals 16
- S**
- Safety labels 315
 - Safety messages 1
 - Saving ProLink II configuration files 290
 - Scale, milliamp outputs 67
 - Scaling method
 - frequency input 57
 - frequency output 70
 - Scientific notation 30
 - Security
 - configuration 34
 - with custody transfer application 159
 - Security breach
 - clearing 170
 - identifying 159
 - Security button 27, 159
 - Security switch 111
 - Model 3300 or Model 3500 panel-mount 111
 - Model 3300 or Model 3500 rack-mount 112
 - Model 3350 or Model 3700 field-mount 113
 - Sensor 2
 - characterization 53
 - pickoff values 231
 - testing coil resistance 235
 - Sensor simulation mode 207
 - Sensor tubes 229
 - Sensor wiring 10
 - cable glands 11
 - cable types 10
 - Sensor zero 134
 - Series 3000 2
 - software change history 319
 - Service port mode 100
 - Setpoint
 - discrete events 81
 - flow switch 65
 - Short to case test 235
 - Signal converter
 - Bell 202 16
 - RS-485 15, 289
 - Simulation mode
 - See* Sensor simulation mode
 - Slug flow
 - alarms 219
 - configuration parameters 51
 - Smart Meter Verification
 - execution 186
 - preparing for test 183
 - results 190
 - scheduling 195
 - Special units 49
 - Specification uncertainty limit 184
 - Specifications
 - Model 3100 259
 - Model 3300 241
 - Model 3350 251
 - Model 3500 241
 - Model 3700 251
 - Standard core processor 2
 - Standard density 48
 - Standard gas density 43
 - Standard tickets
 - See* Tickets, standard
 - Start batch 91
 - Startup
 - device behavior 143
 - initial 133, 143
 - Startup procedures
 - milliamp output trim 140
 - sensor zero 134
 - testing inputs and outputs 138
 - Stop batch 91
 - System parameters
 - configuration 37
- T**
- TEC 76
 - Temperature
 - calibration 201
 - damping 52

Index

- process variable configuration 52
- units 52
- Temperature compensation
 - See* External temperature compensation
- Terminal blocks 11
- Terminal labels 11
- Terminology 2
 - controller 2
 - core processor 2
 - enhanced core processor 2
 - MVD 2
 - platform 2
 - sensor 2
 - Series 3000 2
 - standard core processor 2
 - transmitter 2
- Test points 230
- Testing
 - core processor resistance 234
 - discrete inputs 139
 - discrete outputs 139
 - external temperature value 139
 - frequency input 139
 - frequency output 140
 - inputs 138
 - meter verification 184
 - milliamp outputs 140
 - outputs 138
 - pressure value 139
 - printer 102
 - sensor coil resistance 235
 - short to case 235
 - Smart Meter Verification 186
- Tickets
 - batch (NTEP) tickets
 - formatting 123
 - printing 124
 - batch (OIML) tickets
 - formatting 129
 - printing 131, 166
 - batch tickets 85
 - formatting 121
 - printing 122
 - sample tickets 305
 - standard tickets
 - formatting 119
 - printing 120
 - transfer (OIML) tickets 127
 - formatting 125
 - printing 127, 166
 - types 117
- Totalizers
 - managing
 - from Maintenance menu 174
 - from View menu 147, 174
 - process totalizers 176
 - configuring labels 94
 - configuring reset methods 35
 - from View menu 147
 - with custody transfer (OIML) or custody transfer (OIML/batch) 169
 - See also* Inventories
 - transfer totalizers 169, 174
 - types 173
 - viewing 174
- Transfer (OIML) tickets
 - See* Tickets, transfer (OIML)
- Transfer log
 - See* Custody transfer application, OIML, transfer log
- Transfer variable
 - See* Custody transfer application
- Transmitter 2
 - default values 273
 - ranges 273
- Transmitter checksum 110
- Trimming the milliamp outputs 140
- Troubleshooting 203
 - alarms 208
 - calibration 230
 - calibration span 229
 - characterization 229
 - communication loop 228
 - core processor 232
 - core processor resistance test 234
 - customer service telephone number 5
 - discrete outputs 228
 - erratic drive gain 231
 - excessive drive gain 231
 - frequency output 225, 228, 229
 - grounding 228
 - loop current mode 229
 - low pickoff voltage 232
 - mA output fixed 229
 - measurement range 229
 - measurement unit configuration 229
 - meter fingerprinting 206
 - milliamp outputs 225
 - power supply wiring 227
 - process variables 203
 - receiving device 229
 - RF (radio frequency) interference 228
 - sensor coil resistance 235

Index

- sensor pickoff values 231
- sensor simulation mode 207
- sensor tubes 229
- sensor-to-transmitter wiring 228
- short to case 235
- test points 230
- wiring problems 227

U

- UL 259, 262
 - Model 3300 or Model 3500 249
 - Model 3350 or Model 3700 257
- Update period 95
- Used equipment returns 317
- User-supplied relays 262, 269

V

- VCF 76
- View menu 26
 - active alarm log 146
 - applications list 148
 - batch inventories 147
 - density curves 148
 - diagnostic monitor 148
 - in process monitor mode 145
 - LCD options 148
 - managing totalizers 147
 - managing totalizers and inventories 174
 - preset selections 147
 - process monitoring 147
 - process totalizers 147
 - with custody transfer (OIML) or custody transfer (OIML) batch 168

Volume flow

- damping 42
- gas standard 43, 48
 - low flow cutoff 43
 - special units 49
 - standard gas density 43
 - units 43
- liquid 43
 - low flow cutoff 43
 - special units 49
 - units 43
- process variable configuration 42
- type 43

W

- Weight
 - Model 3300 or Model 3500 241
 - Model 3350 or Model 3700 251

- Weights and measures
 - seal 115
 - See* Custody transfer application

Wiring

- digital communications 13
- I/O 11
- sensor 10

Wiring diagrams

- Bell 202 20
- external temperature compensation 22
- external temperature compensation with HART Tri-Loop 23
- HART multidrop 22
- HART Tri-Loop 23
- HART/analog single-loop 21
- pressure compensation 22
- pressure compensation with HART Tri-Loop 23
- RS-485 17

Wiring problems 227

Write-protection

- device configuration 34
- with custody transfer application 159

Z

- Zero 134
 - factory zero 135
 - prior zero 135



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