

Rosemount® 8712EM Transmitter with HART Protocol Reference Manual



Contents

Chapter 1	Safety messages	1
Chapter 2	Introduction	5
	2.1 System description	5
	2.2 Product recycling/disposal	7
Chapter 3	Sensor Installation	9
	3.1 Handling and Lifting Safety	9
	3.2 Location and Position	10
	3.3 Sensor Installation	12
	3.4 Process reference connection	20
Chapter 4	Remote Transmitter Installation	25
	4.1 Pre-installation	25
	4.2 Transmitter symbols	28
	4.3 Mounting	29
	4.4 Wiring	30
Chapter 5	Basic Configuration	47
	5.1 Basic Setup	47
	5.2 Local operator interface (LOI)	48
	5.3 Field Communicator interface	48
	5.4 Measurement units	49
Chapter 6	Advanced installation details	51
	6.1 Hardware switches	51
	6.2 Additional loops	53
	6.3 Coil housing configuration	64
Chapter 7	Operation	71
	7.1 Introduction	71
	7.2 Local operator interface (LOI)	71
	7.3 Field Communicator interface	80
Chapter 8	Advanced Configuration Functionality	85
	8.1 Introduction	85
	8.2 Configure outputs	85
	8.3 Configure HART	100
	8.4 Configure LOI	104
	8.5 Additional parameters	105
	8.6 Configure special units	106
Chapter 9	Advanced Diagnostics Configuration	109
	9.1 Introduction	109
	9.2 Licensing and enabling	110
	9.3 Tunable empty pipe detection	111
	9.4 Electronics temperature	113
	9.5 Ground/wiring fault detection	113
	9.6 High process noise detection	114
	9.7 Coated electrode detection	115
	9.8 4-20 mA loop verification	117

9.9	SMART™ Meter Verification	118
9.10	Run manual SMART Meter Verification	121
9.11	Continuous SMART Meter Verification	122
9.12	SMART Meter Verification test results	123
9.13	SMART Meter Verification measurements	125
9.14	Optimizing the SMART Meter Verification	127
Chapter 10	Digital Signal Processing	131
10.1	Introduction	131
10.2	Safety messages	131
10.3	Process noise profiles	132
10.4	High process noise diagnostic	133
10.5	Optimizing flow reading in noisy applications	133
10.6	Explanation of signal processing algorithm	136
Chapter 11	Maintenance	139
11.1	Introduction	139
11.2	Safety information	139
11.3	Installing a local operator interface (LOI)	140
11.4	Replacing electronics stack	141
11.5	Replacing a terminal block socket module	142
11.6	Replacing a terminal block with amp clips	143
11.7	Trims	144
Chapter 12	Troubleshooting	149
12.1	Introduction	149
12.2	Safety information	150
12.3	Installation check and guide	150
12.4	Diagnostic messages	152
12.5	Basic troubleshooting	162
12.6	Sensor troubleshooting	166
12.7	Installed sensor tests	170
12.8	Uninstalled sensor tests	172
12.9	Technical support	174
12.10	Service	175

Appendices and reference

Appendix A	Product Specifications	177
A.1	Rosemount 8700M Flowmeter Platform specifications	177
A.2	Transmitter specifications	182
A.3	8705-M Flanged Sensor Specifications	191
A.4	8711-M/L Wafer Sensor Specifications	196
A.5	8721 Hygienic (Sanitary) Sensor Specifications	199
Appendix B	Product Certifications	205
Appendix C	Wiring Diagrams	207
C.1	Wiring diagrams	208
C.2	775 Smart Wireless THUM™ Adapter wiring diagrams	210
C.3	Field Communicator wiring diagrams	212
Appendix D	Implementing a Universal Transmitter	215
D.1	Safety messages	215

D.2	Universal capability	216
D.3	Three step process	216
D.4	Wiring the universal transmitter	217
D.5	Rosemount sensors	217
D.6	Brooks sensors	221
D.7	Endress and Hauser sensors	223
D.8	Fischer and Porter sensors	224
D.9	Foxboro sensors	231
D.10	Kent Veriflux VTC sensor	235
D.11	Kent sensors	237
D.12	Krohne sensors	238
D.13	Taylor sensors	239
D.14	Yamatake Honeywell sensors	241
D.15	Yokogawa sensors	242
D.16	Generic manufacturer sensor to 8712 Transmitter	244

1 Safety messages

WARNING!

General hazards. Failure to follow these instructions could result in death or serious injury.

- Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.
- Installation and servicing instructions are for use by qualified personnel only. Do not perform any servicing other than that contained in the operating instructions, unless qualified.
- Verify the installation is completed safely and is consistent with the operating environment.
- Do not substitute factory components with non-factory components. Substitution of components may impair Intrinsic Safety.
- Do not perform any services other than those contained in this manual.
- Process leaks may result in death or serious injury.
- Mishandling products exposed to a hazardous substance may result in death or serious injury.
- The electrode compartment may contain line pressure; it must be depressurized before the cover is removed.
- If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned goods.
- The products described in this document are NOT designed for nuclear-qualified applications. Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings. For information on Rosemount nuclear-qualified products, contact your local Emerson Process Management Sales Representative.

⚠ WARNING!

Explosion hazards. Failure to follow these instructions could cause an explosion, resulting in death or serious injury.

- If installed in explosive atmospheres [hazardous areas, classified areas, or an “Ex” environment], it must be assured that the device certification and installation techniques are suitable for that particular environment.
- Do not remove transmitter covers in explosive atmospheres when the circuit is live. Both transmitter covers must be fully engaged to meet explosion-proof requirements.
- Do not disconnect equipment when a flammable or combustible atmosphere is present.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Do not connect a Rosemount transmitter to a non-Rosemount sensor that is located in an explosive atmosphere. The transmitter has not been evaluated for use with other manufacturers' magnetic flowmeter sensors in hazardous (Ex or Classified) areas. Special care should be taken by the end-user and installer to ensure the transmitter meets the safety and performance requirements of the other manufacturer's equipment.
- Follow national, local, and plant standards to properly earth ground the transmitter and sensor. The earth ground must be separate from the process reference ground.
- Rosemount Magnetic Flowmeters ordered with non-standard paint options or non-metallic labels may be subject to electrostatic discharge. To avoid electrostatic charge build-up, do not rub the flowmeter with a dry cloth or clean with solvents.

⚠ WARNING!

Electrical hazards. Failure to follow these instructions could cause damaging and unsafe discharge of electricity, resulting in death or serious injury.

- Follow national, local, and plant standards to properly earth ground the transmitter and sensor. The earth ground must be separate from the process reference ground.
- Disconnect power before servicing circuits.
- Allow ten minutes for charge to dissipate prior to removing electronics compartment cover. The electronics may store energy in this period immediately after power is removed.
- Avoid contact with leads and terminals. High voltage that may be present on leads could cause electrical shock.
- Rosemount Magnetic Flowmeters ordered with non-standard paint options or non-metallic labels may be subject to electrostatic discharge. To avoid electrostatic charge build-up, do not rub the flowmeter with a dry cloth or clean with solvents.

NOTICE

Damage hazards. Failure to follow these instructions could result in damage or destruction of equipment.

- **The sensor liner is vulnerable to handling damage. Never place anything through the sensor for the purpose of lifting or gaining leverage. Liner damage may render the sensor inoperable.**
- **Metallic or spiral-wound gaskets should not be used as they will damage the liner face of the sensor. If spiral wound or metallic gaskets are required for the application, lining protectors must be used. If frequent removal is anticipated, take precautions to protect the liner ends. Short spool pieces attached to the sensor ends are often used for protection.**
- **Correct flange bolt tightening is crucial for proper sensor operation and life. All bolts must be tightened in the proper sequence to the specified torque specifications. Failure to observe these instructions could result in severe damage to the sensor lining and possible sensor replacement.**
- **In cases where high voltage/high current are present near the meter installation, ensure proper protection methods are followed to prevent stray electricity from passing through the meter. Failure to adequately protect the meter could result in damage to the transmitter and lead to meter failure.**
- **Completely remove all electrical connections from both sensor and transmitter prior to welding on the pipe. For maximum protection of the sensor, consider removing it from the pipeline.**
- **Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.**

2 Introduction

Topics covered in this chapter:

- *System description*
- *Product recycling/disposal*

2.1 System description

The 8700M Magnetic Flowmeter Platform consists of a sensor and a transmitter. The sensor is installed in-line with the process piping; the transmitter is remotely mounted to the sensor.

Figure 2-1: Wall mount transmitter



There are three Rosemount[®] flow sensors available.⁽¹⁾

Figure 2-2: 8705 flanged sensor



(1) Also available for use with 8707 High Signal sensor with dual calibration (option code D2).

Figure 2-3: 8711 wafer sensor

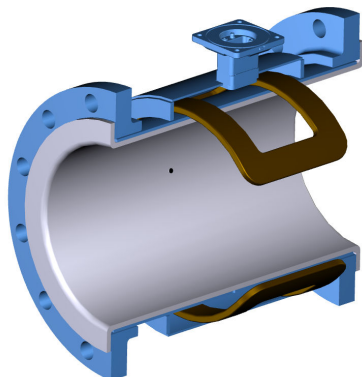


Figure 2-4: 8721 hygienic sensor



The flow sensor contains two magnetic coils located on opposite sides of the sensor. Two electrodes, located perpendicular to the coils and opposite each other, make contact with the liquid. The transmitter energizes the coils and creates a magnetic field. A conductive liquid moving through the magnetic field generates an induced voltage at the electrodes. This voltage is proportional to the flow velocity. The transmitter converts the voltage detected by the electrodes into a flow reading. A cross-sectional view is shown in [Figure 2-5](#).

Figure 2-5: 8705 Cross Section



2.2 **Product recycling/disposal**

Recycling of equipment and packaging should be taken into consideration and disposed of in accordance with local and national legislation/regulations.

3 Sensor Installation

Topics covered in this chapter:

- [Handling and Lifting Safety](#)
- [Location and Position](#)
- [Sensor Installation](#)
- [Process reference connection](#)

This chapter provides instructions for handling and installing the flow sensor with a remotely mounted transmitter.

Related information

[Remote Transmitter Installation](#)

3.1 Handling and Lifting Safety

CAUTION!

To reduce the risk of personal injury or damage to equipment, follow all lifting and handling instructions.

- Handle all parts carefully to prevent damage. Whenever possible, transport the system to the installation site in the original shipping container.
- PTFE-lined sensors are shipped with end covers that protect it from both mechanical damage and normal unrestrained distortion. Remove the end covers just before installation.
- Keep the shipping plugs in the conduit ports until you are ready to connect and seal them. Appropriate care should be taken to prevent water ingress.
- The sensor should be supported by the pipeline. Pipe supports are recommended on both the inlet and outlet sides of the sensor pipeline. There should be no additional support attached to the sensor.
- Use proper PPE (Personal Protection Equipment) including safety glasses and steel toed shoes.
- Do not lift the meter by holding the electronics housing or junction box.
- The sensor liner is vulnerable to handling damage. Never place anything through the sensor for the purpose of lifting or gaining leverage. Liner damage can render the sensor useless.
- Do not drop the device from any height.

3.2 Location and Position

3.2.1 Environmental considerations

To ensure maximum transmitter life, avoid extreme temperatures and excessive vibration. Typical problem areas include the following:

- Tropical/desert installations in direct sunlight
- Outdoor installations in arctic climates

Remote mounted transmitters may be installed in the control room to protect the electronics from the harsh environment and to provide easy access for configuration or service.

3.2.2 Upstream and downstream piping

To ensure specified accuracy over widely varying process conditions, install the sensor with a minimum of five straight pipe diameters upstream and two pipe diameters downstream from the electrode plane.

Figure 3-1: Upstream and downstream straight pipe diameters



- A. Five pipe diameters (upstream)
B. Two pipe diameters (downstream)
C. Flow direction

Installations with reduced upstream and downstream straight runs are possible. In reduced straight run installations, the meter may not meet absolute accuracy specifications. Reported flow rates will still be highly repeatable.

3.2.3 Flow direction

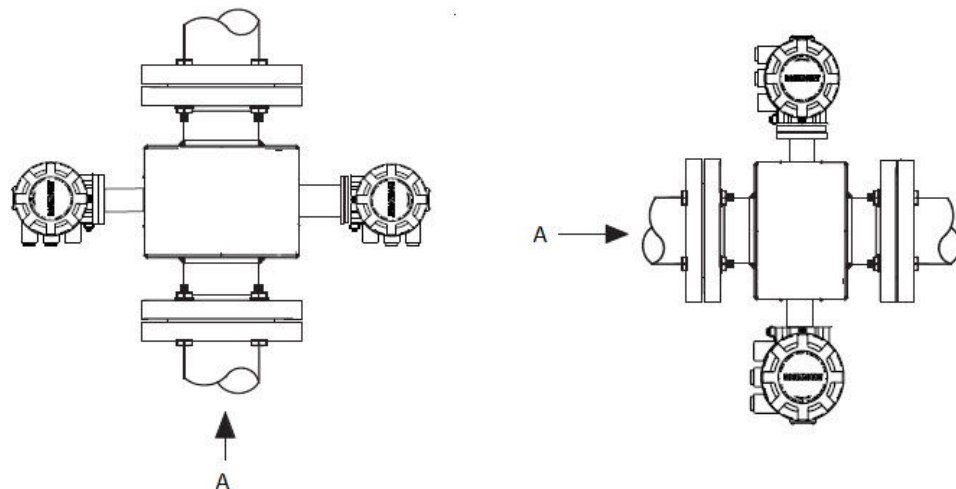
The sensor should be mounted so that the arrow points in the direction of flow.

Figure 3-2: Flow direction arrow


3.2.4 Sensor piping location and orientation

The sensor should be installed in a location that ensures it remains full during operation. Depending on where it is installed, orientation must also be considered.

- Vertical installation with upward process fluid flow keeps the cross-sectional area full, regardless of flow rate.
- Horizontal installation should be restricted to low piping sections that are normally full.

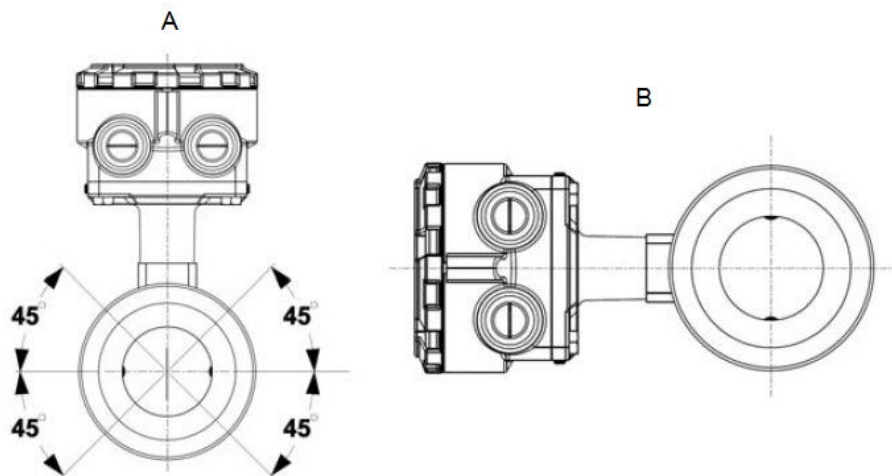
Figure 3-3: Sensor orientation


A. *Flow direction*

3.2.5 Electrode orientation

The electrodes in the sensor are properly oriented when the two measurement electrodes are in the 3 and 9 o'clock positions or within 45 degrees from the horizontal, as shown on the left side of [Figure 3-4](#). Avoid any mounting orientation that positions the top of the sensor at 90 degrees from the vertical position as shown on the right of the Electrode Orientation figure.

Figure 3-4: Electrode orientation



- A. *Correct orientation*
- B. *Incorrect orientation*

The sensor may require a specific orientation to comply with Hazardous Area T-code rating. Refer to the appropriate reference manual for any potential restrictions.

3.3 Sensor Installation

3.3.1 Flanged sensors

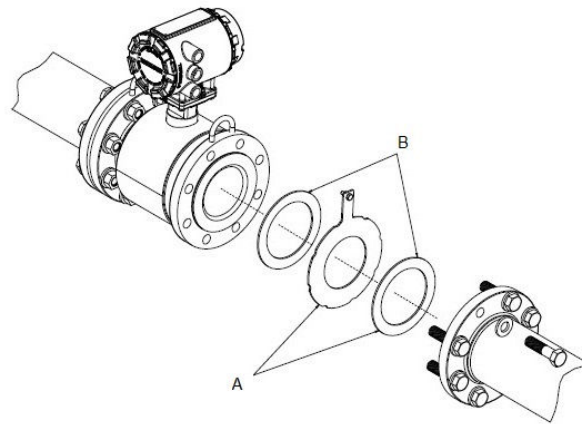
Gaskets

The sensor requires a gasket at each process connection. The gasket material must be compatible with the process fluid and operating conditions. Gaskets are required on each side of a grounding ring (see [Figure 3-5](#)). All other applications (including sensors with lining protectors or a grounding electrode) require only one gasket on each process connection.

Note

Metallic or spiral-wound gaskets should not be used as they will damage the liner face of the sensor. If spiral wound or metallic gaskets are required for the application, lining protectors must be used.

Figure 3-5: Gasket placement for flanged sensors



- A. Grounding ring and gasket (optional)
- B. Customer-supplied gasket

Bolts**Note**

Do not bolt one side at a time. Tighten both sides simultaneously. Example:

1. Snug upstream
2. Snug downstream
3. Tighten upstream
4. Tighten downstream

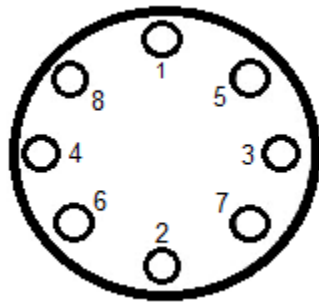
Do not snug and tighten the upstream side and then snug and tighten the downstream side. Failure to alternate between the upstream and downstream flanges when tightening bolts may result in liner damage.

Suggested torque values by sensor line size and liner type are listed in [Table 3-2](#) for ASME B16.5 flanges and [Table 3-3](#) or [Table 3-4](#) for EN flanges. Consult the factory if the flange rating of the sensor is not listed. Tighten flange bolts on the upstream side of the sensor in the incremental sequence shown in [Figure 3-6](#) to 20% of the suggested torque values. Repeat the process on the downstream side of the sensor. For sensors with greater or fewer flange bolts, tighten the bolts in a similar crosswise sequence. Repeat this entire tightening sequence at 40%, 60%, 80%, and 100% of the suggested torque values.

If leakage occurs at the suggested torque values, the bolts can be tightened in additional 10% increments until the joint stops leaking, or until the measured torque value reaches the maximum torque value of the bolts. Practical consideration for the integrity of the liner often leads to distinct torque values to stop leakage due to the unique combinations of flanges, bolts, gaskets, and sensor liner material.

Check for leaks at the flanges after tightening the bolts. Failure to use the correct tightening methods can result in severe damage. While under pressure, sensor materials may deform over time and require a second tightening 24 hours after the initial installation.

Figure 3-6: Flange bolt torquing sequence



Prior to installation, identify the lining material of the flow sensor to ensure the suggested torque values are applied.

Table 3-1: Lining material

Fluoropolymer liners	Other liners
T - PTFE	P - Polyurethane
F - ETFE	N - Neoprene
A - PFA	L - Linatex (Natural Rubber)
K - PFA+	D - Adiprene

Table 3-2: Suggested flange bolt torque values for Rosemount 8705 (ASME)

Size Code	Line Size	Fluoropolymer liners		Other liners	
		Class 150 (pound-feet)	Class 300 (pound-feet)	Class 150 (pound-feet)	Class 300 (pound feet)
005	0.5-in. (15 mm)	8	8	N/A	N /A
010	1-in. (25 mm)	8	12	6	10
015	1.5-in. (40 mm)	13	25	7	18
020	2-in. (50 mm)	19	17	14	11

**Table 3-2: Suggested flange bolt torque values for Rosemount 8705 (ASME)
(continued)**

Size Code	Line Size	Fluoropolymer liners		Other liners	
		Class 150 (pound-feet)	Class 300 (pound-feet)	Class 150 (pound-feet)	Class 300 (pound feet)
025	2.5-in. (65 mm)	22	24	17	16
030	3-in. (80 mm)	34	35	23	23
040	4-in. (100 mm)	26	50	17	32
050	5-in. (125 mm)	36	60	25	35
060	6-in. (150 mm)	45	50	30	37
080	8-in. (200 mm)	60	82	42	55
100	10-in. (250 mm)	55	80	40	70
120	12-in. (300 mm)	65	125	55	105
140	14-in. (350 mm)	85	110	70	95
160	16-in. (400 mm)	85	160	65	140
180	18-in. (450 mm)	120	170	95	150
200	20-in. (500 mm)	110	175	90	150
240	24-in. (600 mm)	165	280	140	250
300	30-in. (750 mm)	195	415	165	375
360	36-in. (900 mm)	280	575	245	525

Table 3-3: Suggested flange bolt torque values for Rosemount 8705 sensors with fluoropolymer liners (EN 1092-1)

Size code	Line size	Fluoropolymer liners (in Newton-meters)			
		PN 10	PN 16	PN 25	PN 40
005	0.5-in. (15 mm)	N/A	N/A	N/A	10
010	1-in. (25 mm)	N/A	N/A	N/A	20
015	1.5-in. (40 mm)	N/A	N/A	N/A	50
020	2-in. (50 mm)	N/A	N/A	N/A	60
025	2.5-in. (65 mm)	N/A	N/A	N/A	50
030	3-in. (80 mm)	N/A	N/A	N/A	50
040	4-in. (100 mm)	N/A	50	N/A	70
050	5.0-in. (125 mm)	N/A	70	N/A	100
060	6-in. (150mm)	N/A	90	N/A	130
080	8-in. (200 mm)	130	90	130	170
100	10-in. (250 mm)	100	130	190	250
120	12-in. (300 mm)	120	170	190	270

Table 3-3: Suggested flange bolt torque values for Rosemount 8705 sensors with fluoropolymer liners (EN 1092-1) (continued)

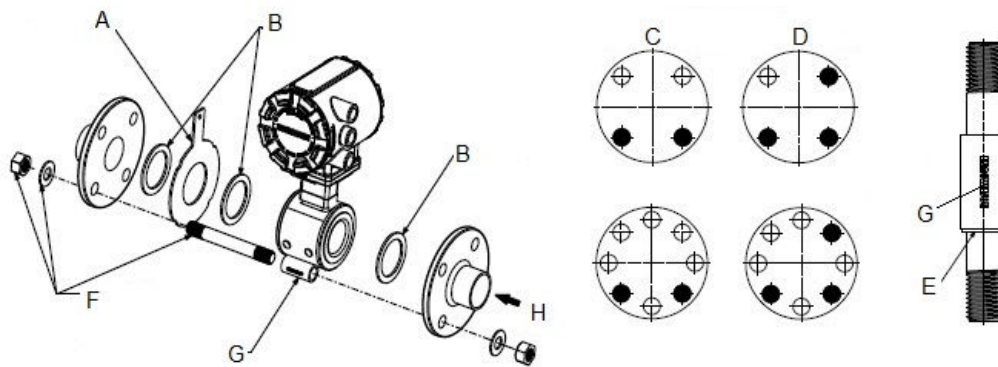
Size code	Line size	Fluoropolymer liners (in Newton-meters)			
		PN 10	PN 16	PN 25	PN 40
140	14-in. (350 mm)	160	220	320	410
160	16-in. (400 mm)	220	280	410	610
180	18-in. (450 mm)	190	340	330	420
200	20-in. (500 mm)	230	380	440	520
240	24-in. (600 mm)	290	570	590	850

Table 3-4: Suggested flange bolt torque values for Rosemount 8705 sensors with non-fluoropolymer liners (EN 1092-1)

Size Code	Line Size	Non-fluoropolymer liners (in Newton-meters)			
		PN 10	PN 16	PN 25	PN 40
005	0.5-in. (15 mm)	N/A	N/A	N/A	20
010	1-in. (25 mm)	N/A	N/A	N/A	30
015	1.5-in. (40 mm)	N/A	N/A	N/A	40
020	2-in. (50 mm)	N/A	N/A	N/A	30
025	2.5-in. (65 mm)	N/A	N/A	N/A	35
030	3-in. (80 mm)	N/A	N/A	N/A	30
040	4-in. (100 mm)	N/A	40	N/A	50
050	5.0-in. (125 mm)	N/A	50	N/A	70
060	6-in. (150mm)	N/A	60	N/A	90
080	8-in. (200 mm)	90	60	90	110
100	10-in. (250 mm)	70	80	130	170
120	12-in. (300 mm)	80	110	130	180
140	14-in. (350 mm)	110	150	210	288
160	16-in. (400 mm)	150	190	280	410
180	18-in. (450 mm)	130	230	220	280
200	20-in. (500 mm)	150	260	300	350
240	24-in. (600 mm)	200	380	390	560

3.3.2 Wafer sensors

When installing wafer sensors, there are several components that must be included and requirements that must be met.

Figure 3-7: Wafer sensors installation components and assembly requirements

- A. Ground ring (optional)
- B. Customer supplied gaskets
- C. Spacer installation (horizontal meters)
- D. Spacer installation (vertical meters)
- E. O-ring
- F. Installation studs, nuts, and washers (optional)
- G. Wafer alignment spacer
- H. Flow

Gaskets

The sensor requires a gasket at each process connection. The gasket material selected must be compatible with the process fluid and operating conditions. Gaskets are required on each side of a grounding ring. See [Figure 3-7](#).

Note

Metallic or spiral-wound gaskets should not be used as they will damage the liner face of the sensor.

Alignment spacers

On 1.5 inch through 8 inch (40 through 200 mm) line sizes, Rosemount requires installing the alignment spacers to ensure proper centering of the wafer sensor between the process flanges. To order an Alignment Spacer Kit (quantity 3 spacers) use p/n 08711-3211-xxxx where xxxx equals the dash number shown in [Table 3-5](#).

Table 3-5: Rosemount alignment spacers

Dash-no. (-xxxx)	Line size		Flange rating
	(in)	(mm)	
0A15	1.5	40	JIS 10K-20K
0A20	2	50	JIS 10K-20K
0A30	3	80	JIS 10K

Table 3-5: Rosemount alignment spacers (continued)

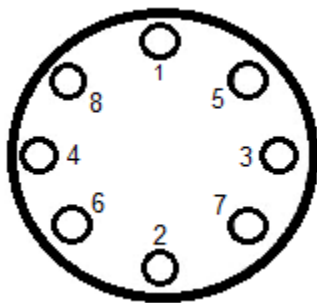
Dash-no. (-xxxx)	Line size		Flange rating
	(in)	(mm)	
0B15	1.5	40	JIS 40K
AA15	1.5	40	ASME- 150#
AA20	2	50	ASME - 150#
AA30	3	80	ASME - 150#
AA40	4	100	ASME - 150#
AA60	6	150	ASME - 150#
AA80	8	200	ASME - 150#
AB15	1.5	40	ASME - 300#
AB20	2	50	ASME - 300#
AB30	3	80	ASME - 300#
AB40	4	100	ASME - 300#
AB60	6	150	ASME - 300#
AB80	8	200	ASME - 300#
DB40	4	100	EN 1092-1 - PN10/16
DB60	6	150	EN 1092-1 - PN10/16
DB80	8	200	EN 1092-1 - PN10/16
DC80	8	200	EN 1092-1 - PN25
DD15	1.5	40	EN 1092-1 - PN10/16/25/40
DD20	2	50	EN 1092-1 - PN10/16/25/40
DD30	3	80	EN 1092-1 - PN10/16/25/40
DD40	4	100	EN 1092-1 - PN25/40
DD60	6	150	EN 1092-1 - PN25/40
DD80	8	200	EN 1092-1 - PN40
RA80	8	200	AS40871-PN16
RC20	2	50	AS40871-PN21/35
RC30	3	80	AS40871-PN21/35
RC40	4	100	AS40871-PN21/35
RC60	6	150	AS40871-PN21/35
RC80	8	200	AS40871-PN21/35

Studs

Wafer sensors require threaded studs. See [Figure 3-8](#) for torque sequence. Always check for leaks at the flanges after tightening the flange bolts. All sensors require a second tightening 24 hours after initial flange bolt tightening.

Table 3-6: Stud specifications

Nominal sensor size	Stud specifications
0.15–1-in. (4–25 mm)	316 SST ASTM A193, Grade B8M, Class 1 threaded mounted studs
1½–8-in. (40–200 mm)	CS, ASTM A193, Grade B7, threaded mounting studs

Figure 3-8: Flange bolt torquing sequence

Installation

1. Insert studs for the the bottom side of the sensor between the pipe flanges and center the alignment spacer in the middle of the stud. See [Figure 3-7](#) for the bolt hole locations recommended for the spacers provided. Stud specifications are listed in [Table 3-6](#).
2. Place the sensor between the flanges. Make sure the alignment spacers are properly centered on the studs. For vertical flow installations slide the o-ring over the stud to keep the spacer in place. See [Figure 3-7](#). Ensure the spacers match the flange size and class rating for the process flanges. See [Table 3-5](#).
3. Insert the remaining studs, washers, and nuts.
4. Tighten to the torque specifications shown in [Table 3-7](#). Do not over-tighten the bolts or the liner may be damaged.

Table 3-7: Rosemount 8711 torque specifications

Size code	Line size	Pound-feet	Newton-meter
015	1.5-in. (40 mm)	15	20
020	2-in. (50 mm)	25	34
030	3-in. (80 mm)	40	54
040	4-in. (100 mm)	30	41
060	6-in. (150 mm)	50	68

Table 3-7: Rosemount 8711 torque specifications (continued)

Size code	Line size	Pound-feet	Newton-meter
080	8-in. (200 mm)	70	95

3.3.3 Sanitary sensors

Gaskets

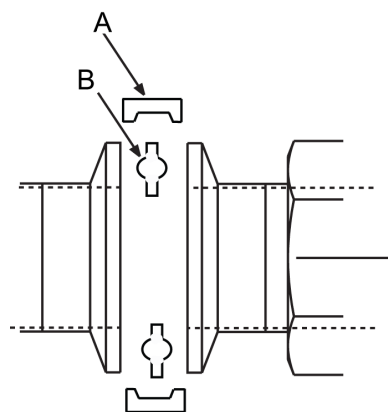
The sensor requires a gasket at each of its connections to adjacent devices or piping. The gasket material selected must be compatible with the process fluid and operating conditions.

Note

Gaskets are supplied between the IDF fitting and the process connection fitting, such as a Tri-Clamp fitting, on all Rosemount 8721 Sanitary sensors except when the process connection fittings are not supplied and the only connection type is an IDF fitting.

Alignment and bolting

Standard plant practices should be followed when installing a magmeter with sanitary fittings. Unique torque values and bolting techniques are not required.

Figure 3-9: Sanitary sensor gasket and clamp alignment

- A. User supplied clamp
B. User supplied gasket

3.4 Process reference connection

The figures shown in this chapter illustrate process reference connections only. Earth safety ground is also required as part of this installation, but is not shown in the figures. Follow national, local, and plant electrical codes for safety ground.

Use the Process reference options table to determine which process reference option to follow for proper installation.

Table 3-8: Process reference options

Type of pipe	Grounding straps	Grounding rings	Reference electrode	Lining protectors
Conductive unlined pipe	See Figure 3-10	See Figure 3-11	See Figure 3-13	See Figure 3-11
Conductive lined pipe	Insufficient grounding	See Figure 3-11	See Figure 3-10	See Figure 3-11
Non-conductive pipe	Insufficient grounding	See Figure 3-12	Not recommended	See Figure 3-12

Note

For line sizes 10-inch and larger the ground strap may come attached to the sensor body near the flange. See [Figure 3-14](#).

Figure 3-10: Grounding straps in conductive unlined pipe or reference electrode in lined pipe

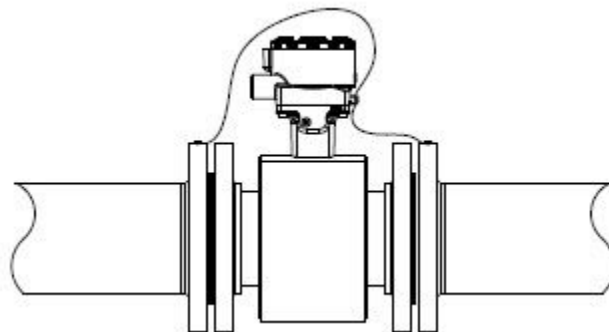
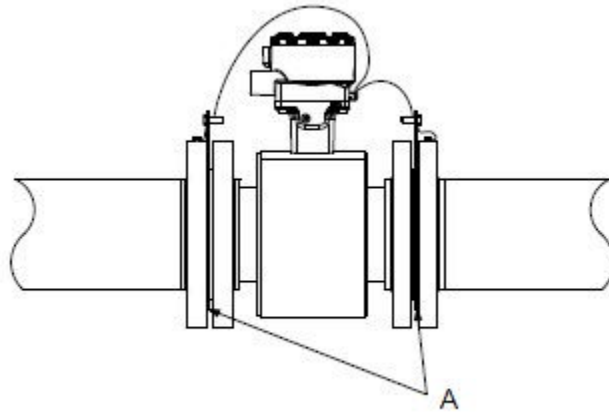
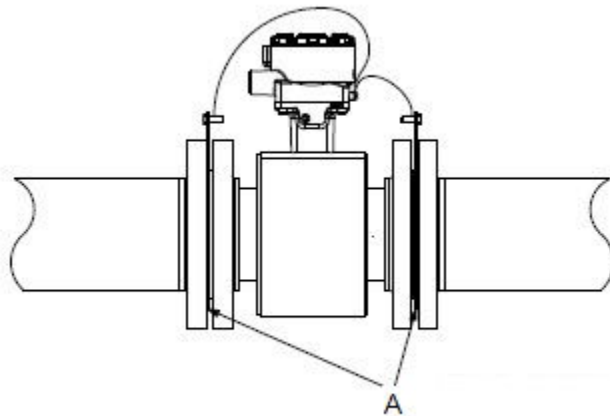


Figure 3-11: Grounding with grounding rings or lining protectors in conductive pipe



A. *Grounding rings or lining protectors*

Figure 3-12: Grounding with grounding rings or lining protectors in non-conductive pipe



A. *Grounding rings or lining protectors*

Figure 3-13: Grounding with reference electrode in conductive unlined pipe

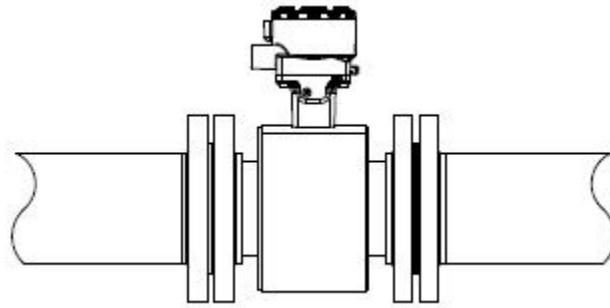
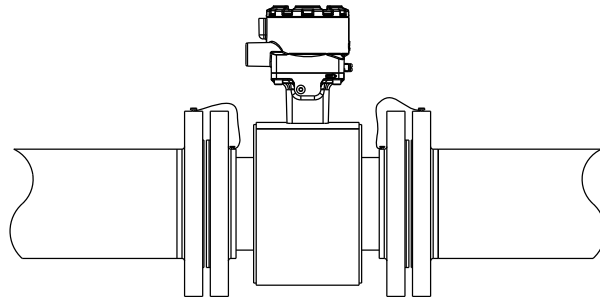


Figure 3-14: Grounding for line sizes 10-in. and larger



4 Remote Transmitter Installation

Topics covered in this chapter:

- [Pre-installation](#)
- [Transmitter symbols](#)
- [Mounting](#)
- [Wiring](#)

This chapter provides instructions for installing and wiring a remotely mounted transmitter.

Related information

[Sensor Installation](#)

4.1 Pre-installation

Before installing the transmitter, there are several pre-installation steps that should be completed to make the installation process easier:

- Identify options and configurations that apply to your application
- Set the hardware switches if necessary
- Consider mechanical, electrical, and environmental requirements

Note

Refer to [Appendix A](#) for more detailed requirements.

Identify options and configurations

The typical transmitter installation includes a device power connection, a 4-20mA output connection, and sensor coil and electrode connections. Other applications may require one or more of the following configurations or options:

- Pulse output
- Discrete input/discrete output
- HART multidrop configuration

Hardware switches

The transmitter may have up to four user-selectable hardware switches. These switches set the alarm mode, internal/external analog power, internal/external pulse power, and transmitter security. The standard configuration for these switches when shipped from the factory is as follows:

Table 4-1: Hardware switch default settings

Setting	Factory configuration
Alarm mode	High
Internal/external analog power	Internal
Internal/external pulse power	External
Transmitter security	Off

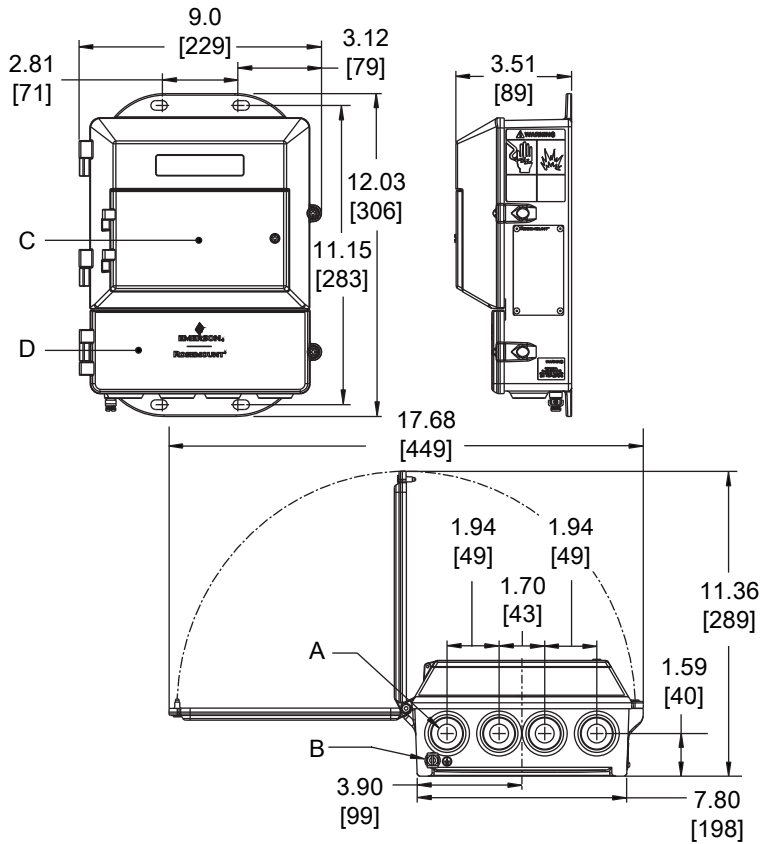
The analog power switch and pulse power switches are not available when ordered with intrinsically safe output, ordering code B.

In most cases, it is not necessary to change the setting of the hardware switches. If the switch settings need to be changed, refer to [Section 6.1](#).

Be sure to identify any additional options and configurations that apply to the installation. Keep a list of these options for consideration during the installation and configuration procedures.

Mechanical considerations

The mounting site for the transmitter should provide enough room for secure mounting, easy access to conduit entries, full opening of the transmitter covers, and easy readability of the Local Operator Interface (LOI) screen (if equipped).

Figure 4-1: Rosemount 8712EM Dimensional Drawing

- A. Conduit entry, 1/2-14 NPT (4 places)
- B. Ground lug
- C. LOI keypad cover
- D. Lower cover opens for electrical connections

Note

Dimensions are in inches [Millimeters]

Electrical considerations

Before making any electrical connections to the transmitter, consider national, local, and plant electrical installation requirements. Be sure to have the proper power supply, conduit, and other accessories necessary to comply with these standards.

The transmitter requires external power. Ensure access to a suitable power source.

Table 4-2: Electrical Data

Rosemount 8712EM Flow Transmitter	
Power input	AC power: 90–250VAC, 0.45A, 40VA
	Standard DC power: 12–42VDC, 1.2A, 15W
	Low power DC: 12–30VDC, 0.25A, 3W
Pulsed circuit	Internally powered (Active): Outputs up to 12VDC, 12.1mA, 73mW Externally powered (Passive): Input up to 28VDC, 100mA, 1W
4-20mA output circuit	Internally Powered (Active): Outputs up to 25mA, 24VDC, 600mW Externally Powered (Passive): Input up to 25mA, 30VDC, 750mW
Um	250V
Coil excitation output	500mA, 40V max, 9W max



Environmental considerations

To ensure maximum transmitter life, avoid extreme temperatures and excessive vibration. Typical problem areas include the following:

- Tropical or desert installations in direct sunlight
- Outdoor installations in arctic climates

Remote mounted transmitters may be installed in the control room to protect the electronics from the harsh environment and to provide easy access for configuration or service.

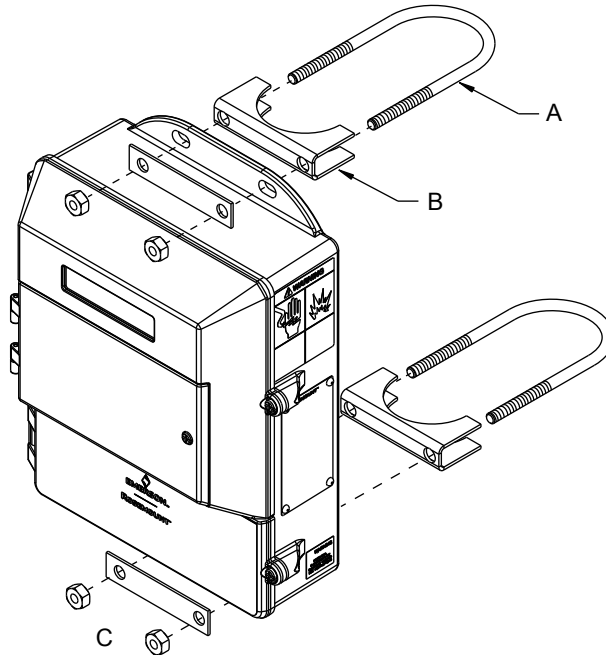
4.2 Transmitter symbols

Caution symbol – check product documentation for details	
Protective conductor (grounding) terminal	

4.3 Mounting

Wall mount transmitters are shipped with mounting hardware for use on a 2-in. pipe or flat surface.

Figure 4-2: Mounting bracket



- A. U-bolt
- B. Saddle clamp
- C. Fasteners

4.3.1 Pipe mounting

1. Attach the saddle clamp to the pipe using the U-bolt mounting hardware.
2. Attach the transmitter to the saddle clamp assembly with appropriate fasteners.

4.3.2 Surface mounting

Attach the transmitter to the mounting location using customer supplied mounting screws. The installation of the transmitter shall be rated for four (4) times the weight of the transmitter or 44lbs (20kgs).

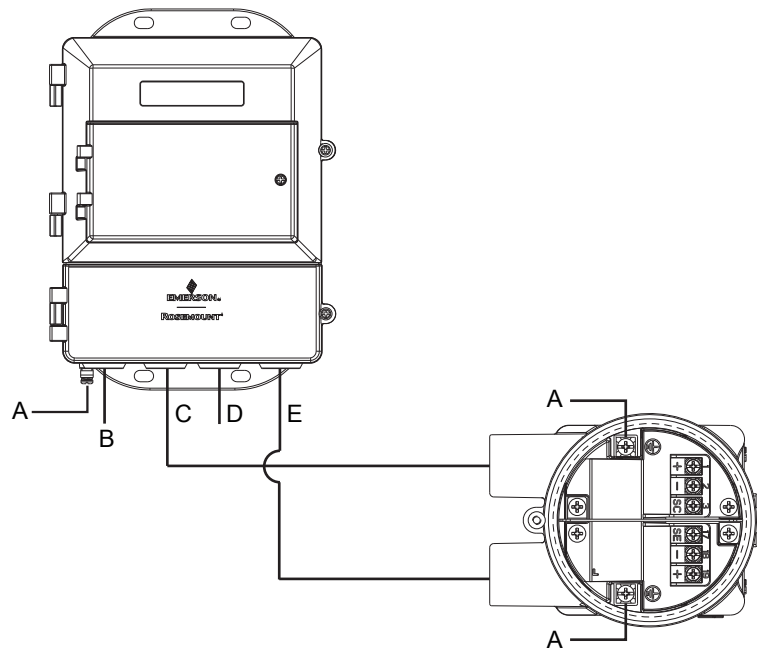
4.4 Wiring

4.4.1 Conduit entries and connections

Transmitter conduit entries ports are ½"-14NPT as standard, M20 conduit connections will use an adapter. Conduit connections should be made in accordance with national, local, and plant electrical codes. Unused conduit entries should be sealed with the appropriate certified plugs. The plastic shipping plugs do not provide ingress protection.

4.4.2 Conduit requirements

- For installations with an intrinsically safe electrode circuit, a separate conduit for the coil cable and the electrode cable may be required. Refer to [Appendix B](#).
- For installations with non-intrinsically safe electrode circuit, or when using the combination cable, a single dedicated conduit run for the coil drive and electrode cable between the sensor and the remote transmitter may be acceptable. Removal of the barriers for intrinsic safety isolation is permitted for non-intrinsically safe electrode installations.
- Bundled cables from other equipment in a single conduit are likely to create interference and noise in the system. See [Figure 4-3](#).
- Electrode cables should not be run together in the same cable tray with power cables.
- Output cables should not be run together with power cables.
- Select conduit size appropriate to feed cables through to the flowmeter.

Figure 4-3: Best practice conduit preparation

- A. Safety ground
- B. Power
- C. Coil
- D. Output
- E. Electrode

4.4.3 Sensor to transmitter wiring

Wiring details

Cables kits are available as individual component cables or as a combination coil/electrode cable. Remote cables can be ordered directly using the kit numbers shown in [Table 4-3](#), [Table 4-4](#), and [Table 4-5](#). Equivalent Alpha cable part numbers are also provided as an alternative. To order cable, specify length as quantity desired. Equal length of component cables is required.

Examples:

- 25 feet = Qty (25) 08732-0065-0001
- 25 meters = Qty (25) 08732-0065-0002

Table 4-3: Component cable kits - standard temperature (-20°C to 75°C)

Cable kit #	Description	Individual cable	Alpha p/n
08732-0065-0001 (feet)	Kit, component cables, Std temp (includes Coil and Electrode)	Coil Electrode	2442C 2413C

Table 4-3: Component cable kits - standard temperature (-20°C to 75°C) (continued)

Cable kit #	Description	Individual cable	Alpha p/n
08732-0065-0002 (meters)	Kit, component cables, Std temp (includes Coil and Electrode)	Coil Electrode	2442C 2413C
08732-0065-0003 (feet)	Kit, component cables, Std temp (includes Coil and I.S. Electrode)	Coil Intrinsically Safe Blue Electrode	2442C Not available
08732-0065-0004 (meters)	Kit, component cables, Std temp (includes Coil and I.S. Electrode)	Coil Intrinsically Safe Blue Electrode	2442C Not available

Table 4-4: Component cable kits - extended temperature (-50°C to 125°C)

Cable kit #	Description	Individual cable	Alpha p/n
08732-0065-1001 (feet)	Kit, Component Ca- bles, Ext Temp. (in- cludes Coil and Elec- trode)	Coil Electrode	Not available Not available
08732-0065-1002 (meters)	Kit, Component Ca- bles, Ext Temp. (in- cludes Coil and Elec- trode)	Coil Electrode	Not available Not available
08732-0065-1003 (feet)	Kit, Component Ca- bles, Ext Temp. (in- cludes Coil and I.S. Electrode)	Coil Intrinsically Safe Blue Electrode	Not available Not available
08732-0065-1004 (meters)	Kit, Component Ca- bles, Ext Temp. (in- cludes Coil and I.S. Electrode)	Coil Intrinsically Safe Blue Electrode	Not available Not available

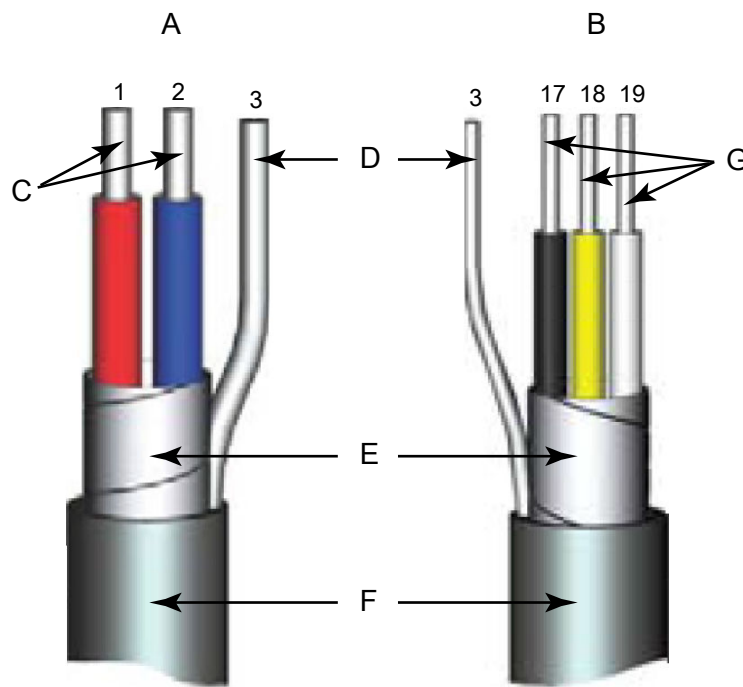
Table 4-5: Combination cable kits - coil and electrode cable (-20°C to 80°C)

Cable kit #	Description
08732-0065-2001 (feet)	Kit, Combination Cable, Standard
08732-0065-2002 (meters)	
08732-0065-3001 (feet)	Kit, Combination Cable, Submersible (80°C dry/60°C Wet) (33ft Continuous)
08732-0065-3002 (meters)	

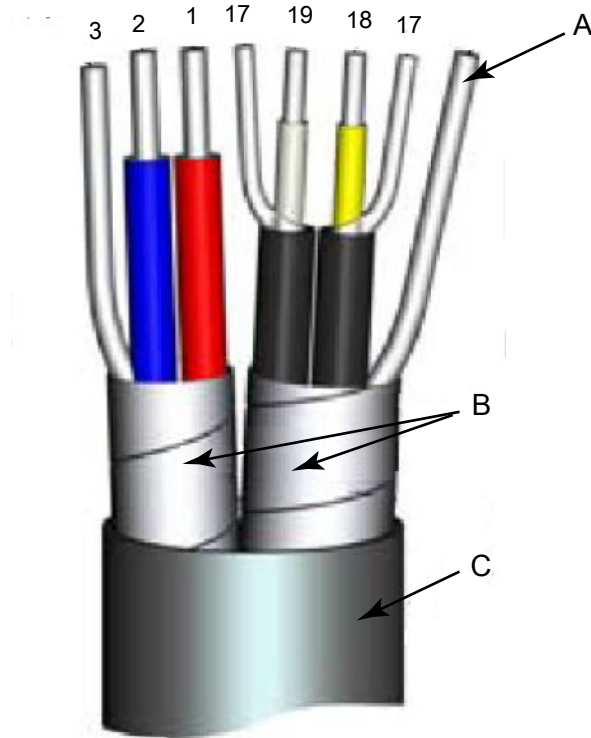
Cable requirements

Shielded twisted pairs or triads must be used. For installations using the individual coil drive and electrode cable, see [Figure 4-4](#). Cable lengths should be limited to less than 500 feet (152 m). Consult factory for length between 500–1000 feet (152–304 m). Equal length cable is required for each. For installations using the combination coil drive/ electrode cable, see [Figure 4-5](#). Combination cable lengths should be limited to less than 330 feet (100 m).

Figure 4-4: Individual component cables



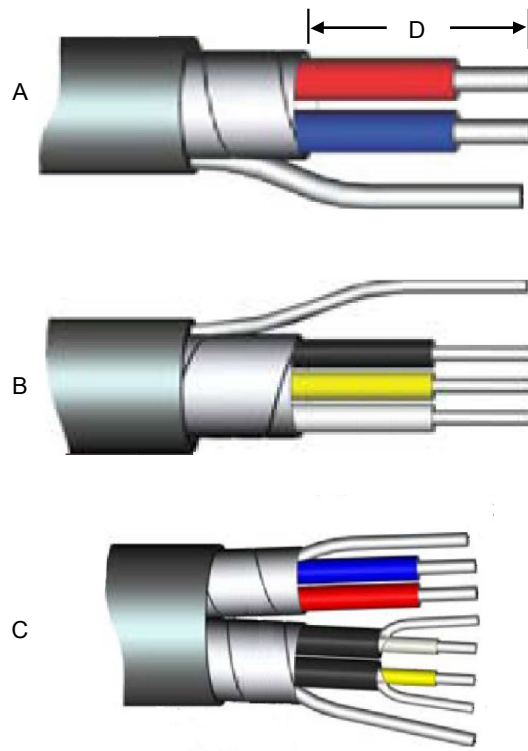
- A. Coil drive
- B. Electrode
- C. Twisted, stranded, insulated 14 AWG conductors
- D. Drain
- E. Overlapping foil shield
- F. Outer jacket
- G. Twisted, stranded, insulated 20 AWG conductors
 - 1 = Red
 - 2 = Blue
 - 3 = Drain
 - 17 = Black
 - 18 = Yellow
 - 19 = White

Figure 4-5: Combination coil and electrode cable

- A. *Electrode shield drain*
- B. *Overlapping foil shield*
- C. *Outer jacket*
- 1 = Red
- 2 = Blue
- 3 = Drain
- 17 = Reference
- 18 = Yellow
- 19 = White

Cable preparation

Prepare the ends of the coil drive and electrode cables as shown in [Figure 4-6](#). Remove only enough insulation so that the exposed conductor fits completely under the terminal connection. Best practice is to limit the unshielded length (D) of each conductor to less than one inch. Excessive removal of insulation may result in an unwanted electrical short to the transmitter housing or other terminal connections. Excessive unshielded length, or failure to connect cable shields properly, may also expose the unit to electrical noise, resulting in an unstable meter reading.

Figure 4-6: Cable ends

- A. Coil
- B. Electrode
- C. Combination
- D. Unshielded length

⚠ WARNING!

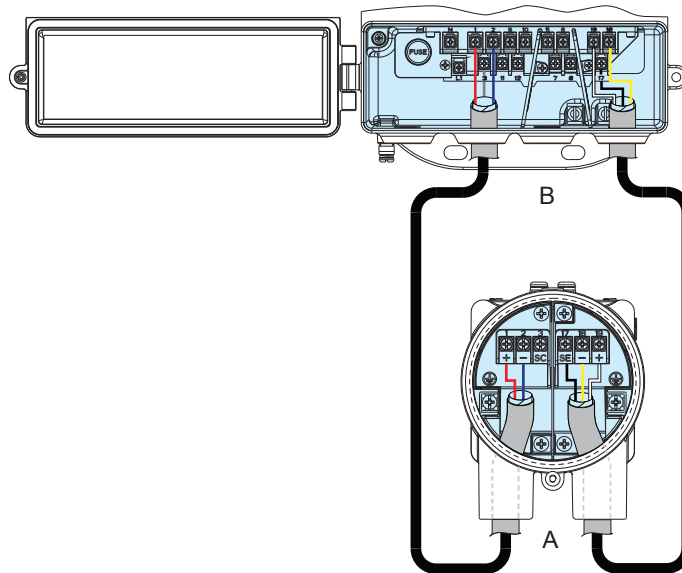
Shock hazard! Potential shock hazard across remote junction box terminals 1 and 2 (40V).

⚠ WARNING!

Explosion hazard! Electrodes exposed to process. Use only compatible transmitter and approved installation practices. For process temperatures greater than 284°F (140°C), use a wire rated for 257°F (125°C).

Remote junction box terminal blocks

Figure 4-7: Remote junction box views



- A. Sensor
- B. Transmitter

Table 4-6: Sensor/transmitter wiring

Wire color	Sensor terminal	Transmitter terminal
Red	1	1
Blue	2	2
Shield	3 or Float	3
Black	17	17
Yellow	18	18
White	19	19

Note

For hazardous locations, refer to [Appendix B](#).

4.4.4 Wiring diagrams

Figure 4-8: Wiring 8712EM using component cable

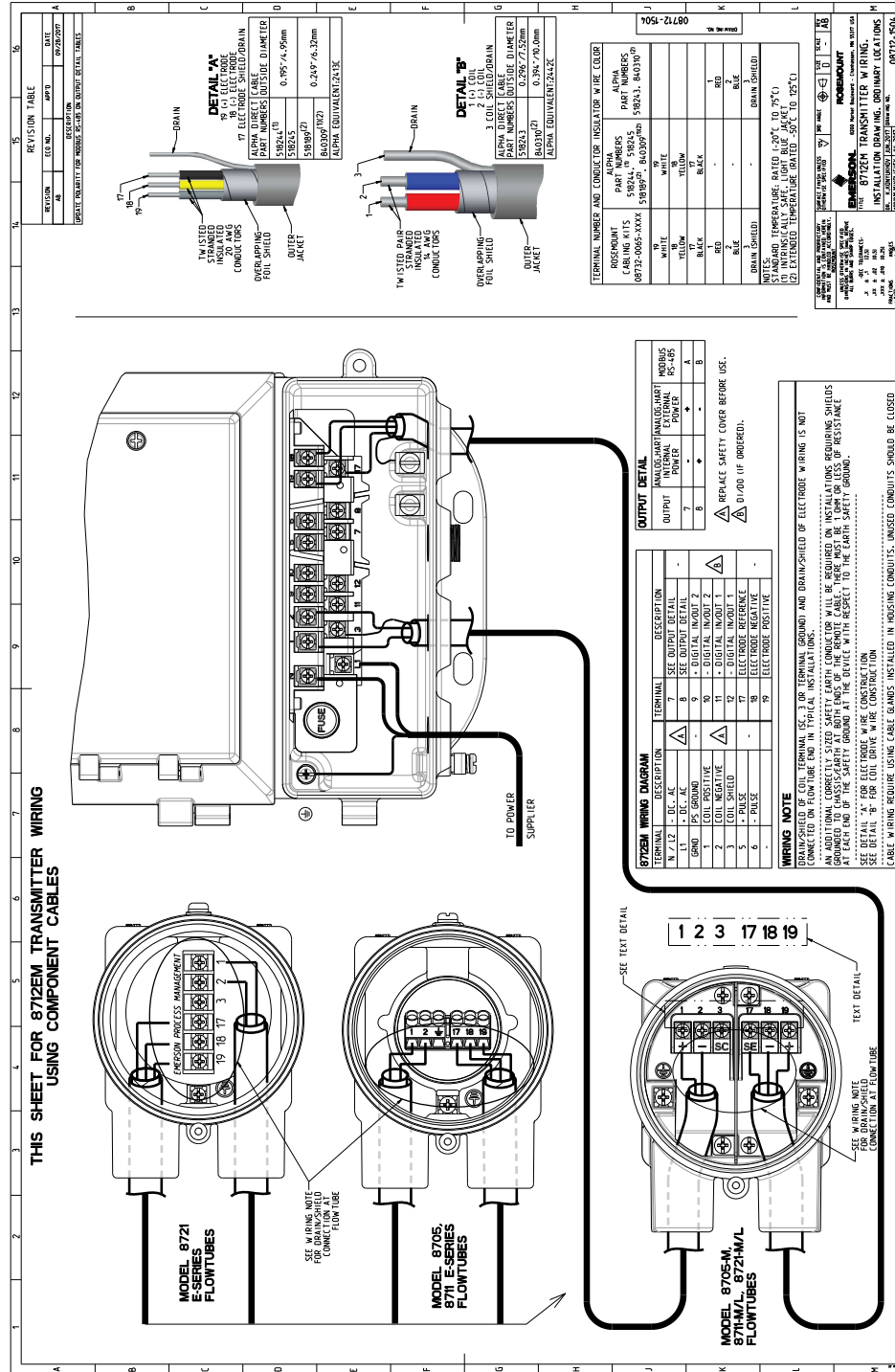
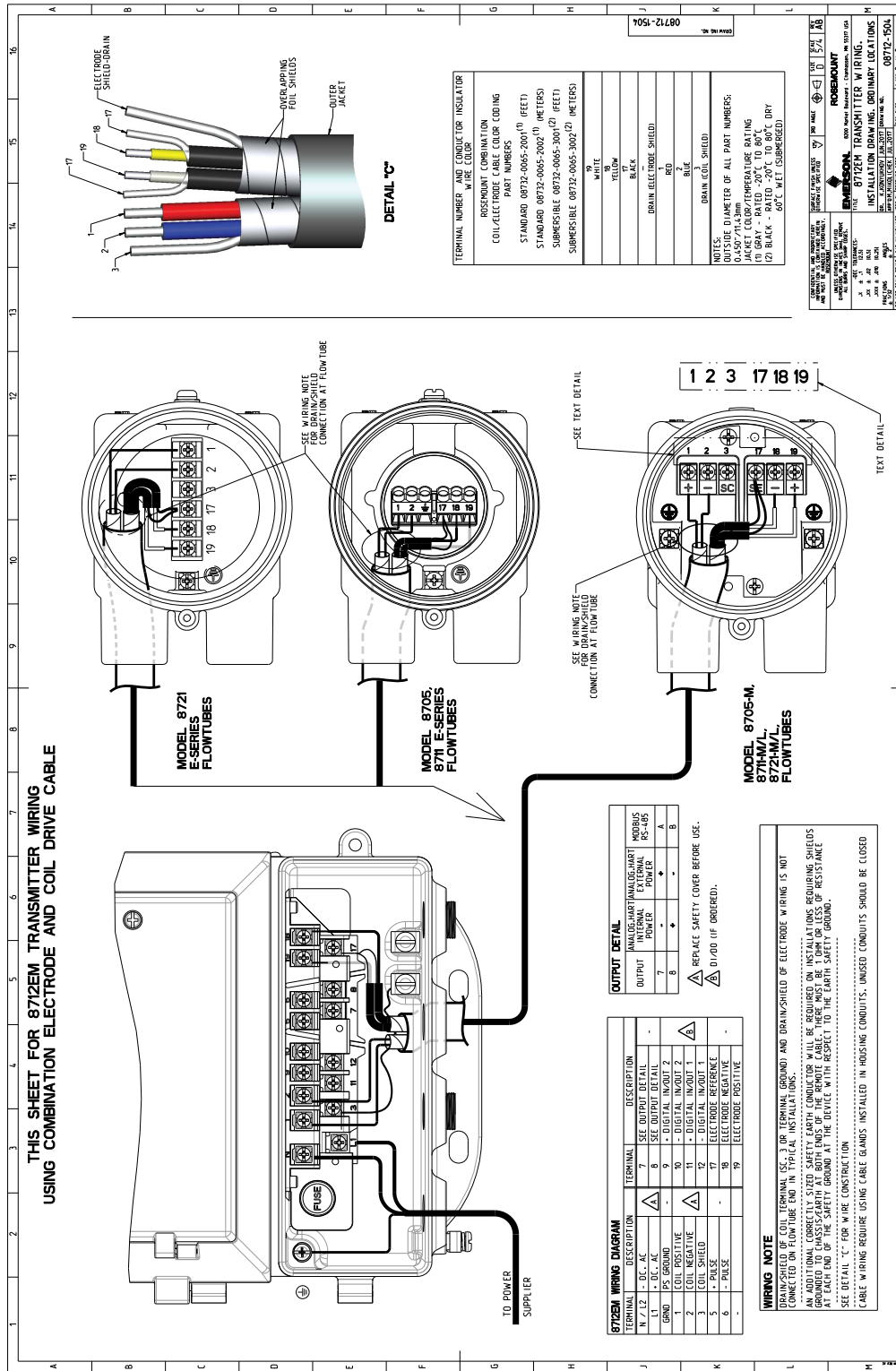


Figure 4-9: Wiring 8712EM using combination cable



4.4.5 Power and I/O terminal blocks

Open the bottom cover of the transmitter to access the terminal block.

Note

To connect pulse output and/or discrete input/output, refer to [Chapter 6](#), and for installations with intrinsically safe outputs, refer to [Appendix B](#).

Figure 4-10: 8712EM Terminal blocks

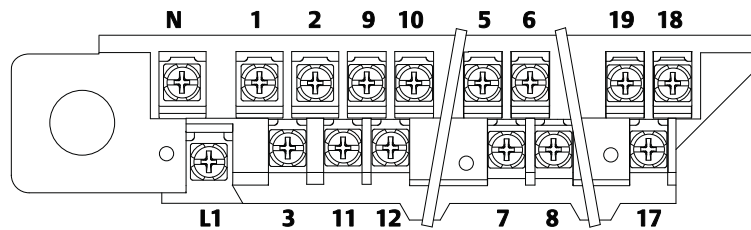


Table 4-7: 8712EM Power and I/O terminals

Terminal number	AC version	DC version
1	Coil Positive	Coil Positive
2	Coil Negative	Coil Negative
3	Coil Shield	Coil Shield
5	+ Pulse	+ Pulse
6	- Pulse	- Pulse
7 ⁽¹⁾	Analog HART	Analog HART
8 ⁽¹⁾	Analog HART	Analog HART
9 ⁽²⁾	+ Discrete In/Out 2	+ Discrete In/Out 2
10 ⁽²⁾	- Discrete In/Out 2	- Discrete In/Out 2
11 ⁽²⁾	+ Discrete In/Out 1	+ Discrete In/Out 1
12 ⁽²⁾	- Discrete In/Out 1	- Discrete In/Out 1
17	Electrode Reference	Electrode Reference
18	Electrode Negative	Electrode Negative
19	Electrode Positive	Electrode Positive
N	AC (Neutral)/L2	DC (-)
L1	AC L1	DC (+)

(1) Note Polarity: Internally Powered, Terminal 7 (-) Analog HART, Terminal 8 (+) Analog HART. Externally Powered, Terminal 7 (+) Analog HART, Terminal 8 (-) Analog HART

(2) Only available with ordering code AX.

4.4.6 Powering the transmitter

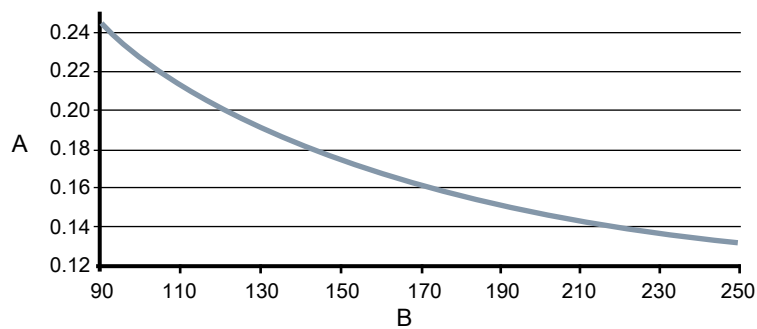
The transmitter is available in three models. The AC powered transmitter is designed to be powered by 90–250VAC (50/60Hz). The DC powered transmitter is designed to be powered by 12–42VDC. The low power transmitter is designed to be powered by 12–30VDC. Before connecting power to the transmitter, be sure to have the proper power supply, conduit, and other accessories. Wire the transmitter according to national, local, and plant electrical requirements for the supply voltage.

If installing in a hazardous location, verify that the meter has the appropriate hazardous area approval. Each meter has a hazardous area approval tag attached to the side of the transmitter housing.

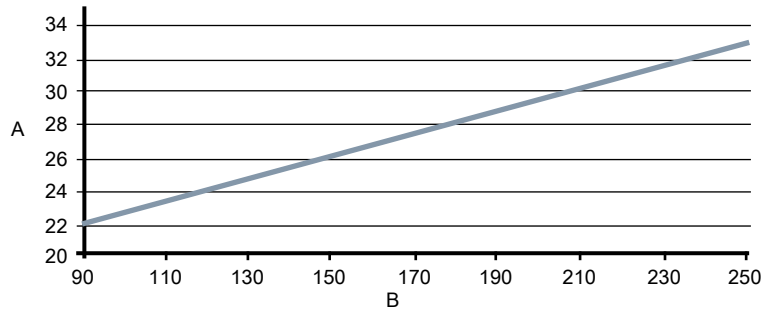
AC power supply requirements

Units powered by 90 - 250VAC have the following power requirements. Peak inrush is 35.7A at 250VAC supply, lasting approximately 1ms. Inrush for other supply voltages can be estimated with: $\text{Inrush (Amps)} = \text{Supply (Volts)} / 7.0$

Figure 4-11: AC current requirements



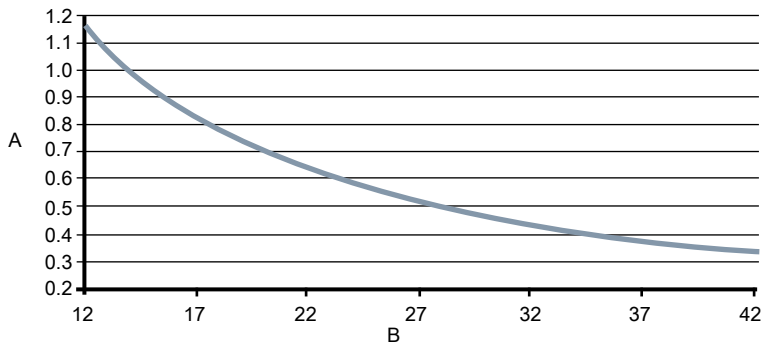
- A. Supply current (amps)
B. Power supply (VAC)

Figure 4-12: Apparent power

- A. Apparent power (VA)
 B. Power supply (VAC)

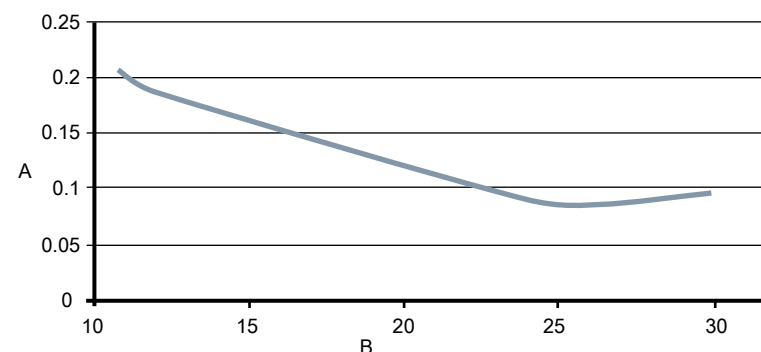
DC power supply requirements

Standard DC units powered by 12VDC power supply may draw up to 1.2A of current steady state. Low power DC units may draw up to 0.25A of current steady state. Peak inrush is 42A at 42VDC supply, lasting approximately 1ms. Inrush for other supply voltages can be estimated with: $\text{Inrush (Amps)} = \text{Supply (Volts)} / 1.0$

Figure 4-13: DC current requirements

- A. Supply current (amps)
 B. Power supply (VDC)

Figure 4-14: Low power DC current requirements



- A. Supply current (amps)
- B. Power supply (VDC)

Supply wire requirements

Use 10–18 AWG wire rated for the proper temperature of the application. For wire 10–14 AWG use lugs or other appropriate connectors. For connections in ambient temperatures above 122 °F (50 °C), use a wire rated for 194 °F (90 °C). For DC powered transmitters with extended cable lengths, verify that there is a minimum of 12VDC at the terminals of the transmitter with the device under load.

Electrical disconnect requirements

Connect the device through an external disconnect or circuit breaker per national and local electrical code.

Installation category

The installation category for the transmitter is OVERVOLTAGE CAT II.

Overcurrent protection

The transmitter requires overcurrent protection of the supply lines. Fuse rating and compatible fuses are shown in [Table 4-8](#).

Table 4-8: Fuse requirements

Power system	Power supply	Fuse rating	Manufacturer
AC power	90–250VAC	2 Amp quick acting	Bussman AGC2 or equivalent
DC power	12–42VDC	3 Amp quick acting	Bussman AGC3 or equivalent
DC low power	12–30VDC	3 Amp quick acting	Bussman AGC3 or equivalent

Power terminals

For AC powered transmitter (90–250VAC, 50/60 Hz):

- Connect AC Neutral to Terminal N and AC Line to Terminal L1.

For DC powered transmitter:

- Connect negative to Terminal N and positive to Terminal L1.
- DC powered units may draw up to 1.2A.

Covers

Use the transmitter lower door screw to secure the terminal compartment after the instrument has been wired and powered up. Follow these steps to ensure the housing is properly sealed to meet ingress protection requirements:

1. Ensure all wiring is complete and close the lower door.
2. Tighten the lower door screw until the lower door is tight against the housing. Metal to metal contact of the screw bosses is required to ensure a proper seal.

Note

Application of excessive torque may strip the threads or break the screw.

3. Verify the lower door is secure.

4.4.7 Analog output

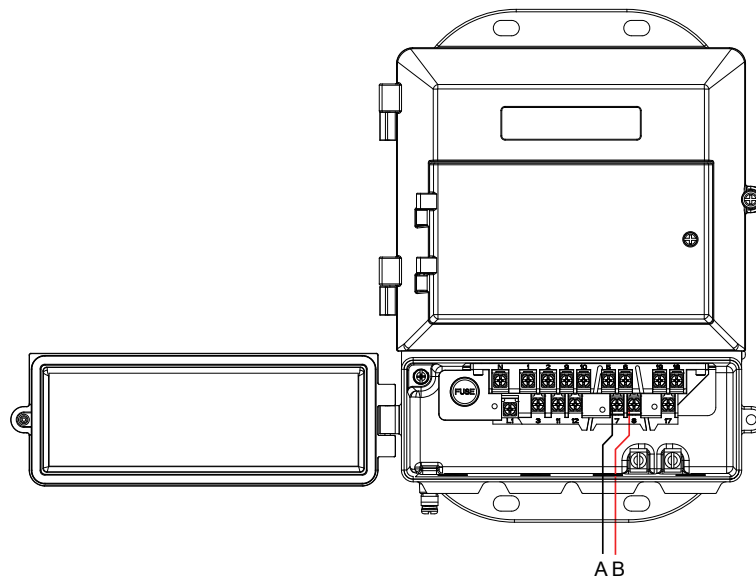
The analog output signal is a 4-20mA current loop. Depending on the IS output option, the loop can be powered internally or externally via a hardware switch located on the front of the electronics stack. The switch is set to internal power when shipped from the factory. Intrinsically safe analog output requires a shielded twisted pair cable. For HART communication, a minimum resistance of 250 ohms is required. It is recommended to use individually shielded twisted pair cable. The minimum conductor size is 24 AWG (0.51mm) diameter for cable runs less than 5,000 feet (1,500m) and 20 AWG (0.81mm) diameter for longer distances.

Note

For more information about the analog output characteristics, see [Section A.2.3](#).

Internal Power

Figure 4-15: Analog output wiring, internal power



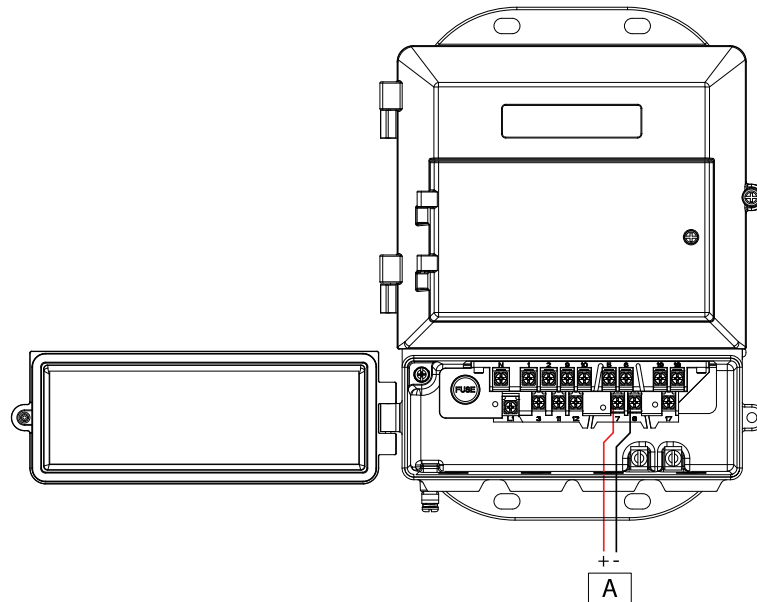
- A. 4–20 mA (–) to Terminal #7
- B. 4–20 mA (+) to Terminal #8

Note

Terminal polarity for the analog output is reversed between internally and externally powered.

External power

Figure 4-16: Analog output wiring, external power

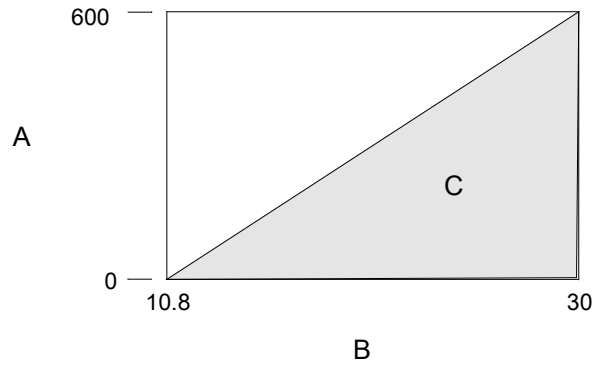


- A. Power supply
- (+) to Terminal #7
 - (-) to Terminal #8

Note

Terminal polarity for the analog output is reversed between internally and externally powered.

Figure 4-17: Analog loop load limitations



- A. Load (ohms)
 - B. Power supply (volts)
 - C. Operating region
 - $R_{max} = 31.25 (V_{ps} - 10.8)$
 - V_{ps} = power supply voltage (volts)
 - R_{max} = maximum loop resistance (ohms)
-

5 Basic Configuration

Topics covered in this chapter:

- [Basic Setup](#)
- [Local operator interface \(LOI\)](#)
- [Field Communicator interface](#)
- [Measurement units](#)

Once the magnetic flowmeter is installed and power has been supplied, the transmitter must be configured through the basic setup. These parameters can be configured through either an LOI or a HART communication device. Configuration settings are saved in nonvolatile memory within the transmitter. Descriptions of more advanced functions are included in [Chapter 8](#).

5.1 Basic Setup

Tag

Tag is the quickest and shortest way of identifying and distinguishing between transmitters. Transmitters can be tagged according to the requirements of your application. The tag may be up to eight characters long as standard, or 32 characters long when ordered with HART 7.

Flow units (PV)

The flow units variable specifies the format in which the flow rate will be displayed. Units should be selected to meet your particular metering needs. .

Line size

The line size (sensor size) must be set to match the actual sensor connected to the transmitter. The size must be specified in inches.

Upper range value (URV)

The URV sets the 20 mA point for the analog output. This value is typically set to full-scale flow. The units that appear will be the same as those selected under the flow units parameter. The URV may be set between -39.3 ft/s to 39.3 ft/s (-12 m/s to 12 m/s). There must be at least 1 ft/s (0.3 m/s) span between the URV and LRV.

Lower range value (LRV)

The LRV sets the 4 mA point for the analog output. This value is typically set to zero flow. The units that appear will be the same as those selected under the flow units parameter. The LRV may be set between -39.3 ft/s to 39.3 ft/s (-12 m/s to 12 m/s). There must be at least 1 ft/s (0.3 m/s) span between the URV and LRV.

Calibration number

The sensor calibration number is a 16-digit number generated at the factory during flow calibration, is unique to each sensor, and is located on the sensor tag.

5.2 Local operator interface (LOI)

To access the transmitter menu, press the XMTR MENU key. Use the UP, DOWN, LEFT(E), and RIGHT arrows to navigate the menu structure.

The display can be locked to prevent unintentional configuration changes. The display lock can be activated through a HART communication device, or by holding the UP arrow for three seconds and then following the on-screen instructions.

When the display lock is activated, a lock symbol will appear in the lower right hand corner of the display. To deactivate the display lock, hold the UP arrow for three seconds and follow the on-screen instructions. Once deactivated, the lock symbol will no longer appear in the lower right hand corner of the display.

5.3 Field Communicator interface

Use the menu paths to configure basic setup of the transmitter using a field communicator.

Table 5-1: Basic setup menu paths

Function	Menu path
Basic Setup	Configure > Manual Setup > Basic Setup
Flow Units	Configure > Manual Setup > Basic Setup > Flow Units
PV Upper Range Value (URV)	Configure > Manual Setup > Basic Setup > AO > URV
PV Lower Range Value (LRV)	Configure > Manual Setup > Basic Setup > AO > LRV
Calibration Number	Configure > Manual Setup > Basic Setup > Setup > Calibration number
Line Size	Configure > Manual Setup > Basic Setup > Setup > Line Size
Tag	Configure > Manual Setup > Device Info > Identification > Tag
Long Tag	Configure > Manual Setup > Device Info > Identification > Long Tag
Overview	Overview

5.4 Measurement units

Table 5-2: Volumetric flow units

gal/sec	gal/min	gal/hr	gal/day
L/sec	L/min	L/hr	L/day
ft3/sec	ft3/min	ft3/hr	ft3/day
	cm3/min		
m3/sec	m3/min	m3/hr	m3/day
Impgal/sec	Impgal/min	Impgal/hr	Impgal/day
B31/sec (1 barrel = 31 gallons)	B31/min (1 barrel = 31 gallons)	B31/hr (1 barrel = 31 gallons)	B31/day (1 barrel = 31 gallons)
B42/sec (1 barrel = 42 gallons)	B42/min (1 barrel = 42 gallons)	B42/hr (1 barrel = 42 gallons)	B42/day (1 barrel = 42 gallons)

Table 5-3: Mass flow units

lbs/sec	lbs/min	lbs/hr	lbs/day
kg/sec	kg/min	kg/hr	kg/day
	(s) tons/min	(s) tons/hr	(s) tons/day
	(m) tons/min	(m) tons/hr	(m) tons/day

Table 5-4: Velocity units

ft/sec	m/sec
--------	-------

6 Advanced installation details

Topics covered in this chapter:

- [Hardware switches](#)
- [Additional loops](#)
- [Coil housing configuration](#)

6.1 Hardware switches

The electronics are equipped with four user-selectable hardware switches. These switches set the Alarm Mode, Internal/External Analog Power, Transmitter Security, and Internal/External Pulse Power.

Definitions of these switches and their functions are provided below. To change the settings, see below.

6.1.1 Alarm mode

If an event occurs that would trigger an alarm in the electronics, the analog output will be driven high or low, depending on the switch position. The switch is set in the HIGH position when shipped from the factory. Refer to [Table 8-1](#) and [Table 8-2](#) for analog output values of the alarm.

6.1.2 Transmitter security

The **SECURITY** switch allows the user to lock out any configuration changes attempted on the transmitter.

- When the security switch is in the **ON** position, the configuration can be viewed but no changes can be made.
- When the security switch is in the **OFF** position, the configuration can be viewed and changes can be made.

The switch is in the **OFF** position when the transmitter is shipped from the factory.

Note

The flow rate indication and totalizer functions remain active when the **SECURITY** switch is in either position.

6.1.3 Internal/external analog power

The 4–20 mA loop can be powered internally by the transmitter or externally by an external power supply. The **ANALOG** switch determines the source of the 4–20 mA loop power.

- When the switch is in the **INTERNAL** position, the 4–20 mA loop is powered internally by the transmitter.
- When the switch is in the **EXTERNAL** position, a 10–30 VDC external power supply is required. For more information about 4–20 mA external power, see [Section 4.4.7](#).

The switch is in the **INTERNAL** position when the transmitter is shipped from the factory.

Note

External power is required for multidrop configurations.

6.1.4 Internal/external pulse power

The pulse loop can be powered internally by the transmitter or externally or by an external power supply. The **PULSE** switch determines the source of the pulse loop power.

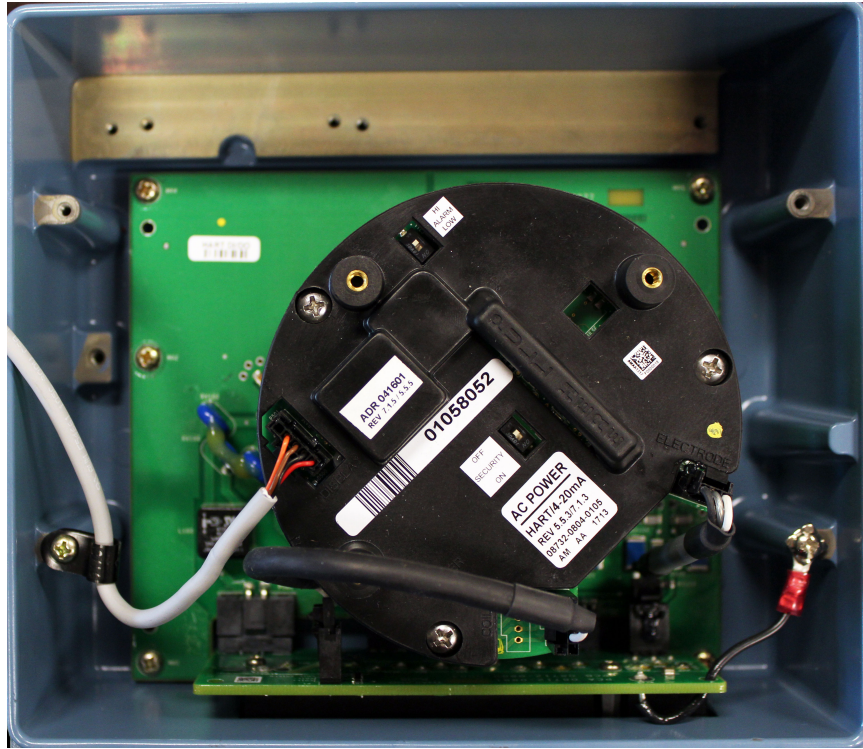
- When the switch is in the **INTERNAL** position, the pulse loop is powered internally by the transmitter.
- When the switch is in the **EXTERNAL** position, a 5–28 VDC external supply is required. For more information about pulse external power, see [Section 6.2.1](#).

The switch is in the **EXTERNAL** position when the transmitter is shipped from the factory.

6.1.5 Changing hardware switch settings

Note

The hardware switches are located on the top side of the electronics board and changing their settings requires opening the electronics housing. If possible, carry out these procedures away from the plant environment in order to protect the electronics.

Figure 6-1: Rosemount 8712EM Electronics Stack and Hardware Switches**Procedure**

1. Place the control loop into manual control.
2. Disconnect power to the transmitter
3. Open the electronics compartment cover.
4. Identify the location of each switch (see [Figure 6-1](#)).
5. Change the setting of the desired switches with a small, non-metallic tool.
6. Close the electronics compartment cover. See [Section 4.4.6](#) for details on the covers.
7. Return power to the transmitter and verify the flow measurement is correct.
8. Return the control loop to automatic control.

6.2 Additional loops

There are three additional loop connections available on the Transmitter:

- Pulse output - used for external or remote totalization.
- Channel 1 can be configured as discrete input or discrete output.
- Channel 2 can be configured as discrete output only.

6.2.1 Connect pulse output

The pulse output function provides a galvanically isolated frequency signal that is proportional to the flow through the sensor. The signal is typically used in conjunction with an external totalizer or control system. The default position of the internal/external pulse power switch is in the **EXTERNAL** position. The user-selectable power switch is located on the electronics board.

External

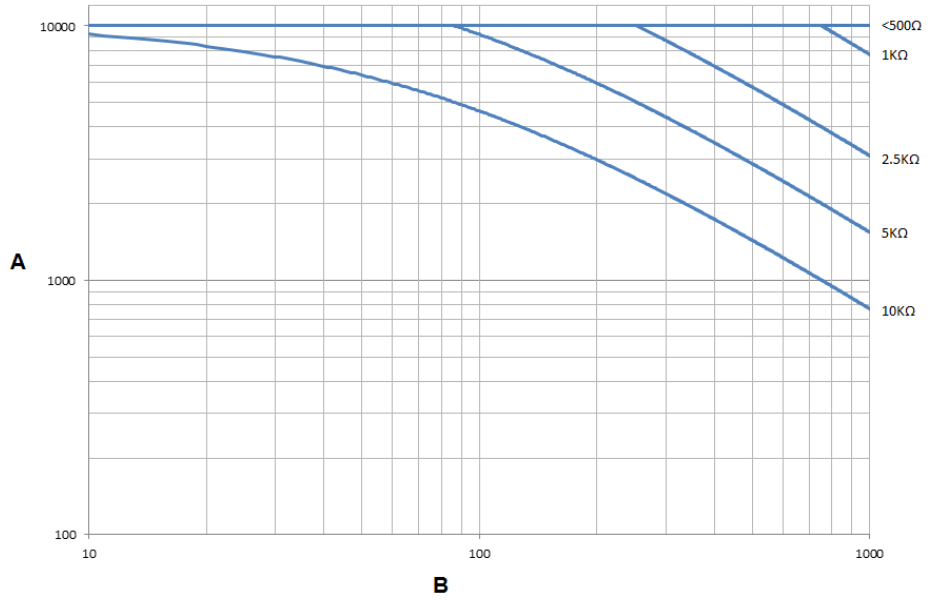
For transmitters with the internal/external pulse power switch (output option code A) set in the **EXTERNAL** position or transmitters with intrinsically safe outputs (output option code B) the following requirements apply:

- Supply voltage: 5 to 28 VDC
- Maximum current: 100 mA
- Maximum power: 1.0 W
- Load resistance: 200 to 10k Ohms (typical value 1k Ohms). Refer to the figure indicated:

Output option code	Supply voltage	Resistance vs cable length
A	5-28 VDC	See Figure 6-2
B	5 VDC	See Figure 6-3
B	12 VDC	See Figure 6-4
B	24 VDC	See Figure 6-5

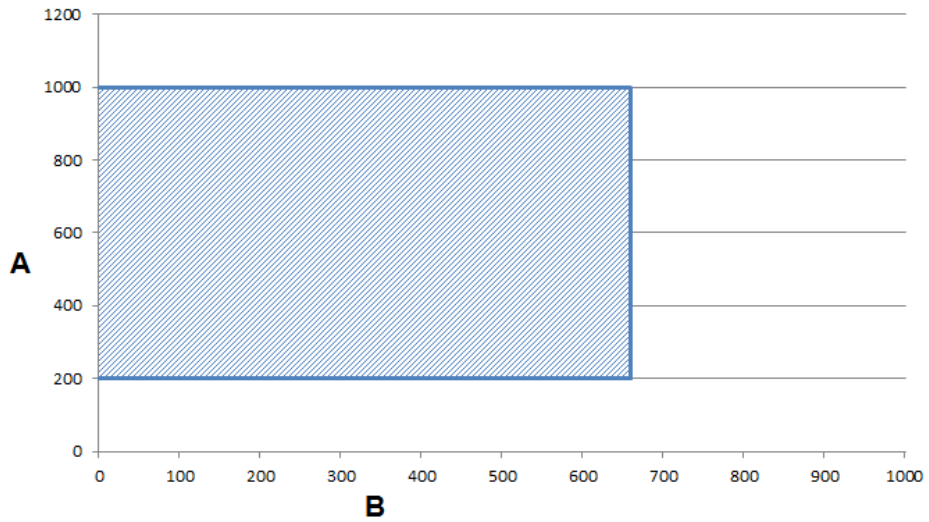
- Pulse mode: Fixed pulse width or 50% duty cycle
- Pulse duration: 0.1 to 650 ms (adjustable)
- Maximum pulse frequency:
 - Output option code A is 10,000 Hz
 - Output option code B is 5000 Hz
- FET switch closure: solid state switch

Figure 6-2: Output Option Code A—Maximum Frequency vs. Cable Length



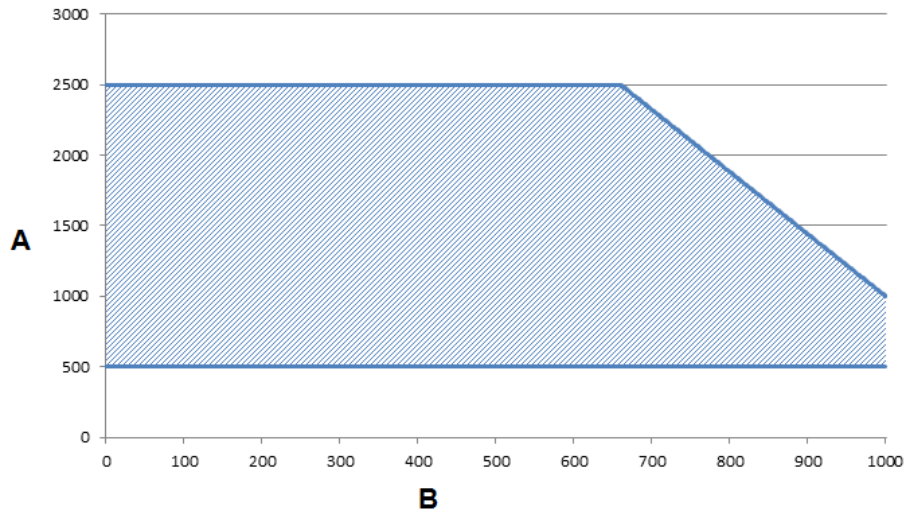
- A. Frequency (Hz)
- B. Cable length (feet)

Figure 6-3: Output Option Code B—VDC Supply



- A. Resistance (Ω)
- B. Cable length (feet)

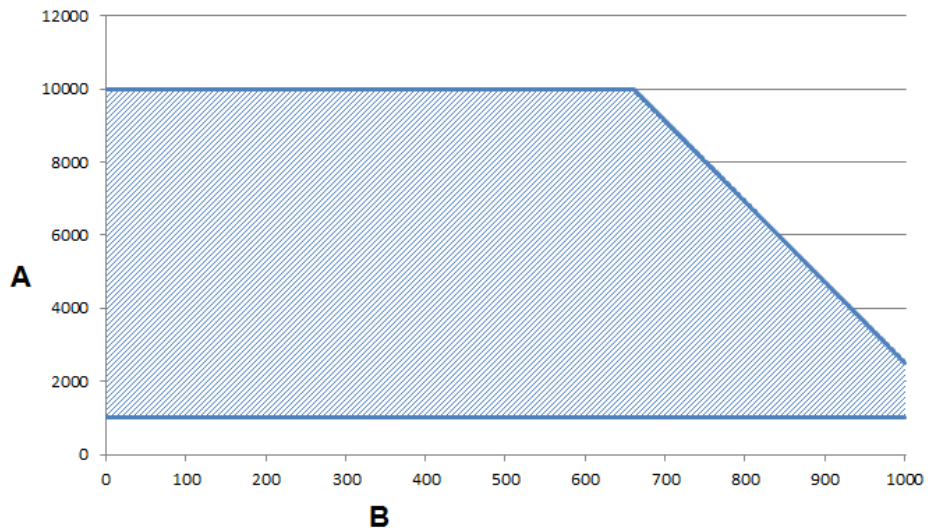
At 5000 Hz operation with a 5 VDC supply, pull-up resistances of 200 to 1000 Ohms allow cable lengths up to 660 ft (200 m).

Figure 6-4: Output Option Code B—2 VDC Supply

- A. Resistance (Ω)
B. Cable length (feet)

At 5000 Hz operation with a 12 VDC supply, pull-up resistances of 500 to 2500 Ohms allow cable lengths up to 660 ft (200 m). Resistances from 500 to 1000 Ohms allow a cable length of 1000 ft (330 m).

Figure 6-5: Output Option Code B—24 VDC Supply

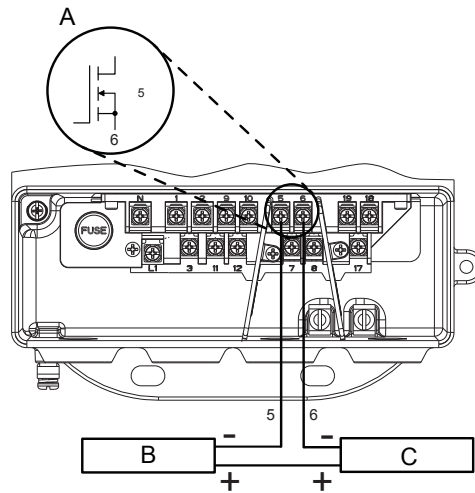


- A. Resistance (Ω)
- B. Cable length (feet)

At 5000 Hz operation with a 24 VDC supply, pull-up resistances of 1000 to 10,000 Ohms allow cable lengths up to 660 ft (200 m). Resistances from 1000 to 2500 Ohms allow a cable length of 1000 ft (330 m).

Connecting an external power supply

Figure 6-6: Connecting an Electromechanical Totalizer/Counter with External Power Supply

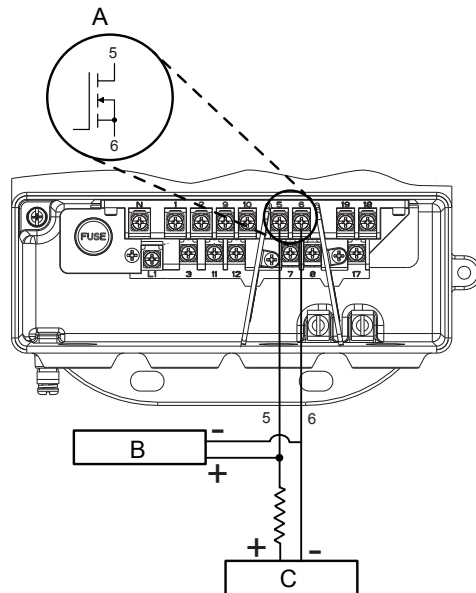


- A. Schematic showing FET between terminal 5 and 6
- B. Electro-mechanical counter
- C. 5–24 VDC power supply

Note

Total loop impedance must be sufficient to keep loop current below maximum rating. A resistor can be added in the loop to raise impedance.

Figure 6-7: Connecting to an Electronic Totalizer/Counter with External Power Supply



- A. Schematic showing FET between terminal 5 and 6
- B. Electronic counter
- C. 5–24 VDC power supply

Note

Total loop impedance must be sufficient to keep loop current below maximum rating.

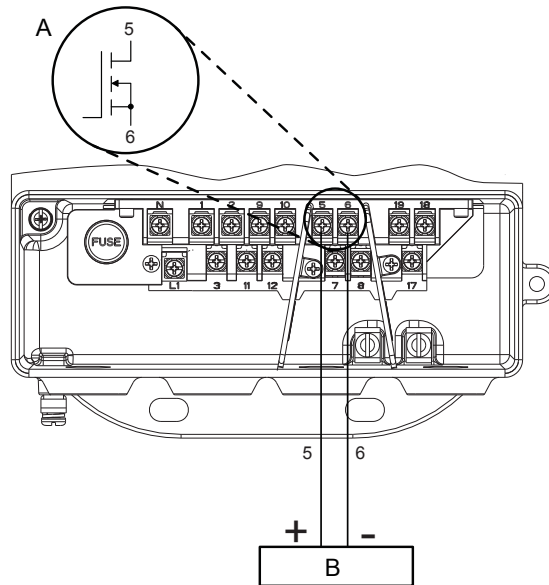
Procedure

1. Ensure the power source and connecting cable meet the requirements outlined previously.
2. Turn off the transmitter and pulse output power sources.
3. Run the power cable to the transmitter.
4. Connect - DC to terminal 6.
5. Connect + DC to terminal 5.

Internal

When the pulse switch is set to internal, the pulse loop will be powered from the transmitter. Supply voltage from the transmitter can be up to 12 VDC. Refer to [Figure 6-8](#) and connect the transmitter directly to the counter. Internal pulse power can only be used with an electronic totalizer or counter and cannot be used with an electromechanical counter.

Figure 6-8: Connecting to an Electronic Totalizer/Counter with Internal Power Supply



- A. Schematic showing FET between terminal 5 and 6
 B. Electronic counter

Procedure

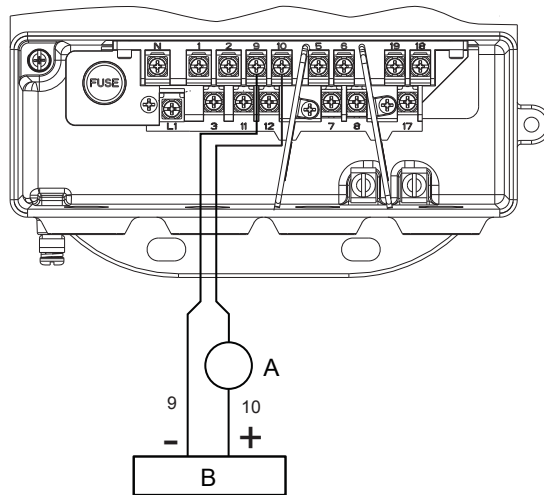
1. Turn off the transmitter.
2. Connect - DC to terminal 6.
3. Connect + DC to terminal 5.

6.2.2 Connect discrete output

The discrete output control function can be configured to drive an external signal to indicate zero flow, reverse flow, empty pipe, diagnostic status, flow limit, or transmitter status. The following requirements apply:

- Supply Voltage: 5 to 28 VDC
- Maximum Voltage: 28 VDC at 240 mA
- Switch Closure: solid state relay

See [Figure 6-9](#).

Figure 6-9: Connect Discrete Output to Relay or Control System Input

- A. Control relay or input
 B. 5–28 VDC power supply

Note

Total loop impedance must be sufficient to keep loop current below maximum rating. A resistor can be added in the loop to raise impedance.

For discrete output control, connect the power source and control relay to the transmitter. To connect external power for discrete output control, complete the following steps:

Procedure

1. Ensure the power source and connecting cable meet the requirements outlined previously.
2. Turn off the transmitter and discrete power sources.
3. Run the power cable to the transmitter.
4. Channel 1: Connect -DC to terminal 11, connect +DC to terminal 12.
5. Channel 2: Connect -DC to terminal 9, connect +DC to terminal 10.

6.2.3 Connect discrete input

- For HART version 5.4 firmware, the discrete input can provide positive zero return (PZR) or net totalizer reset.
- For HART version 5.5 or 7.1 firmware, the discrete input can provide positive zero return (PZR) or reset totalizer (A, B, C, or all totals).

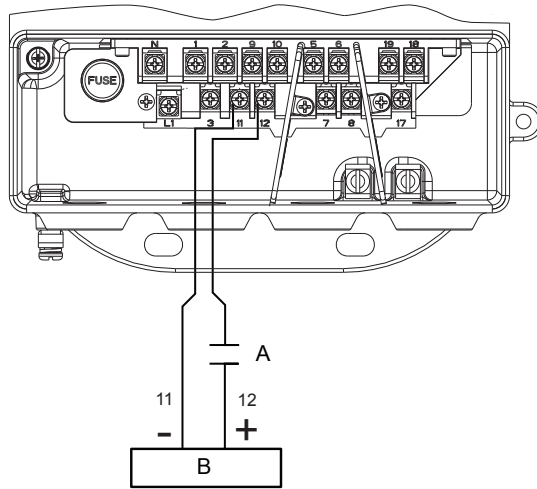
Note

If a particular totalizer is configured to be not resettable, the totalizer will not be reset with this function.

The following requirements apply:

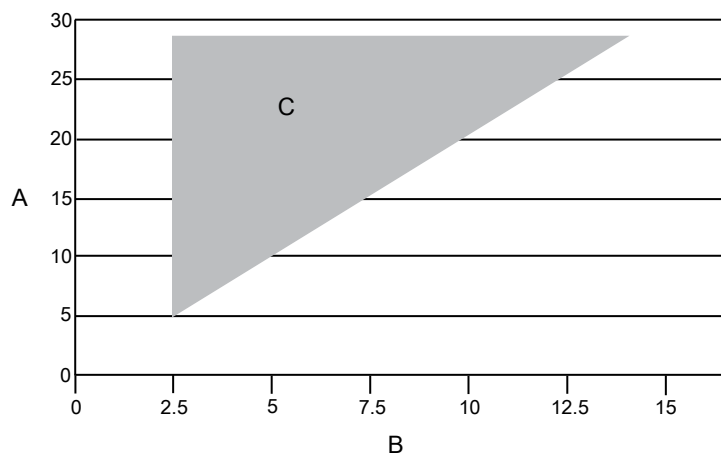
Supply Voltage	5 to 28 VDC Control
Current	1.5 - 20mA
Input Impedance	2.5 k plus 1.2V Diode drop. See Figure 6-11 .

Figure 6-10: Connecting Discrete Input



- A. Relay contactor control system output
- B. 5–28 VDC power supply

Figure 6-11: Discrete Input Operating Range



- A. Supply voltage
- B. series resistance $\Omega_{in} + \Omega_{ext}$ (K Ω)

To connect the discrete input, complete the following steps.

Procedure

1. Ensure the power source and connecting cable meet the requirements outlined previously.
2. Turn off the transmitter and discrete power sources.
3. Run the power cable to the transmitter.
4. Connect -DC to terminal 11.
5. Connect +DC to terminal 12.

6.3 Coil housing configuration

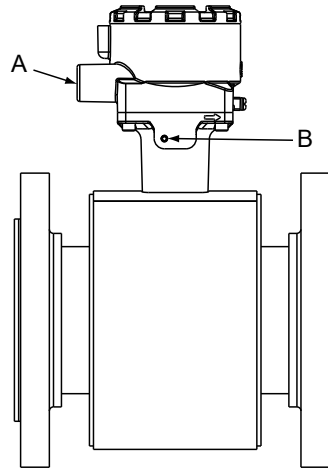
The coil housing provides physical protection of the coils and other internal components from contamination and physical damage that might occur in an industrial environment. The coil housing is an all-welded and gasket-free design.

The 8705 model is available in four coil housing configurations. Configurations are identified by the M0, M1, M2, or M4 options codes found in the model number. The 8711 and 8721 models are only available in one coil housing coil configuration; a separate option code is not available.

6.3.1 Standard coil housing configuration

The standard coil housing configuration is a factory sealed all-welded enclosure and is available for the following models (see [Figure 6-12](#)):

- 8705 with option code M0 - 8705xxxxxxxM0
- 8711 with option code M/L - 8711xxxxxM/L
- 8721 with option code R/U - 8721xxxxxR/U

Figure 6-12: Standard Housing Configuration (8705 Shown)

- A. Conduit connection
 B. No relief port (welded shut)

6.3.2 Process leak protection (option M1)

The 8705 is available with process leak detection through the use of a threaded connection and pressure relief valve (PRV). This coil housing configuration is a factory sealed all-welded enclosure. The M1 configuration is available for the 8705 only.

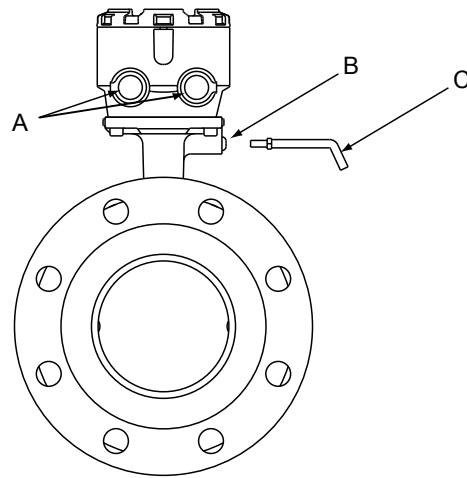
- 8705 with option code M1 - 8705xxxxxxxxM1

A PRV can be installed in the threaded connection to prevent possible over-pressuring of the coil housing caused by a primary seal failure. The PRV is capable of venting fugitive emissions when pressure inside the coil housing exceeds five psi. Additional piping may be connected to the PRV to drain any process leakage to a safe location (see [Figure 6-13](#)).

In the event of a primary seal failure, this configuration will not protect the coils or other internal components of the sensor from exposure to the process fluid.

Note

The PRV is supplied with the meter to be installed by the customer. Installation of the PRV and any associated piping must be performed in accordance with environmental and hazardous area requirements.

Figure 6-13: 8705 with M1 Coil Housing Configuration and PRV

- A. Conduit connection
 B. M6 threaded pressure relief port with removable cap screw
 C. Optional: Use relief port to plumb to safe area (supplied by user).

6.3.3 Process leak containment (Option M2 or M4)

The 8705 is available with process leak containment. The coil housing configuration is a factory sealed all-welded enclosure with the addition of sealed electrode compartments. The M2/M4 configuration is available for the 8705 only.

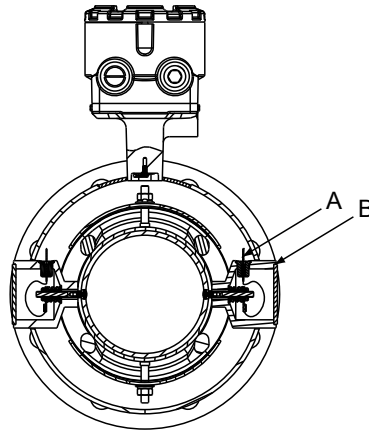
- 8705 with option code M2/M4 - 8705xxxxxxxxM2/M4

This configuration divides the coil housing into separate compartments, one for each electrode and one for the coils. In the event of a primary seal failure, the fluid is contained in the electrode compartment. The sealed electrode compartment prevents the process fluid from entering the coil compartment where it may damage the coils and other internal components. The electrode compartments are designed to contain the process fluid up to a maximum pressure of 740 psig.

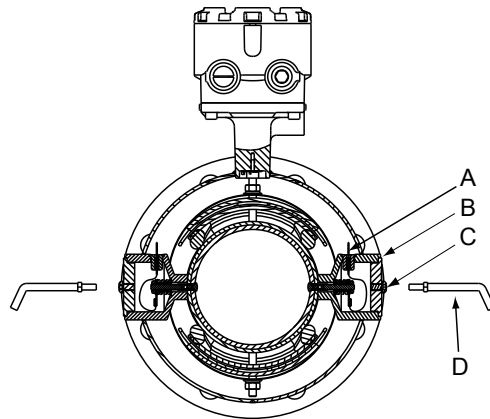
- Code M2 - sealed, welded coil housing with separate sealed and welded electrode compartments (see [Figure 6-14](#)).
- Code M4 - sealed, welded coil housing with separate sealed and welded electrode compartments with a threaded port on the electrode tunnel cap, capable of venting fugitive emissions (see [Figure 6-15](#)).

Note

To properly vent process fluid from the electrode compartment to a safe location, additional piping is required and must be installed by the user. Installation of any associated piping must be performed in accordance with environmental and hazardous area requirements. In the event of primary seal failure, the electrode compartment may be pressurized. Use caution when removing the cap screw.

Figure 6-14: 8705 with M2 Coil Housing Configuration


- A. 2x fused glass seal
 B. 2x sealed electrode compartment
-

Figure 6-15: 8705 with M4 Coil Housing Configuration


- A. 2x fused glass seal
 B. 2x sealed electrode compartment
 C. M6 threaded pressure relief port with removable cap screw
 D. Optional: Use relief port to plumb to safe area (supplied by user).
-

6.3.4 Process leak containment with electrode access (option M3)

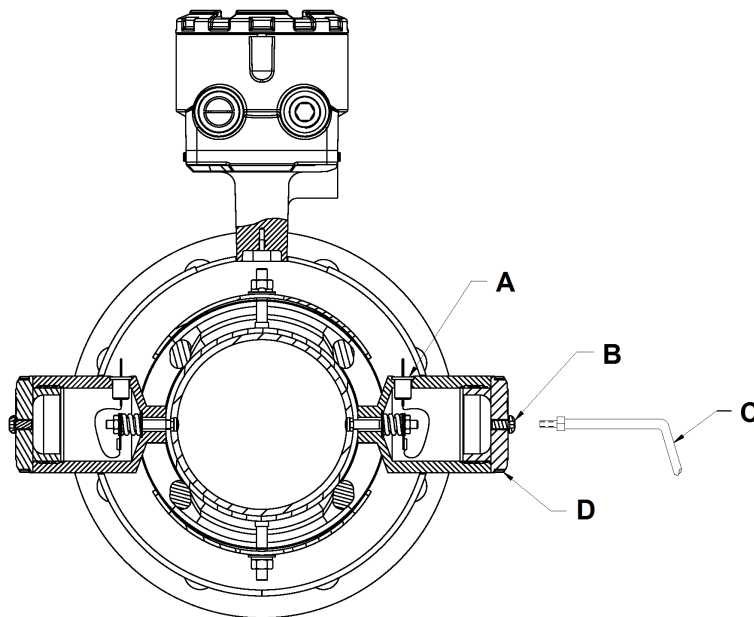
The 8705 is available with Process Leak Containment and Electrode Access. The coil housing configuration is a factory sealed, all-welded enclosure with the addition of sealed electrode compartments that include access covers. The M3 configuration is available on the 8705 only.

- 8705 with option code M3 - 8705xxxxxxxxM3

This configuration divides the coil housing into separate compartments, one for each electrode and one for the coils. In the event of a primary seal failure, the fluid is contained in the electrode compartment. The sealed electrode compartment prevents the process fluid from entering the coil compartment where it may damage the coils and other internal components. The electrode compartments are designed to contain the process fluid up to a maximum pressure of 740 psig.

⚠ CAUTION!

To properly vent process fluid from the electrode compartment to a safe location, additional piping is required and must be installed by the user. Installation of any associated piping must be performed in accordance with environmental and hazardous area requirements. In the event of primary seal failure, the electrode compartment may be pressurized. Use caution when removing the cap screw.



- A. 2X fused glass seal
- B. 2X M6 threaded pressure relief port
- C. Optional: use relief port to plumb to safe area (supplied by user)
- D. Threaded electrode access cover

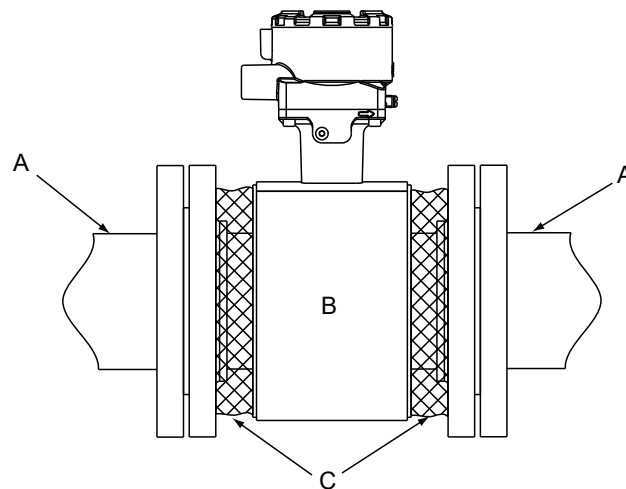
6.3.5 Higher temperature applications and sensor insulation best practices

Insulation of the magnetic flowmeter sensor is not typically recommended. However, in applications with higher temperature process fluids (above 150°F / 65°C), plant safety, sensor reliability, and sensor longevity can be improved with careful attention to proper insulation.

Procedure

1. In applications where process fluid permeation of the liner has been observed or may be expected, the rate of permeation can be reduced by decreasing the temperature gradient between the process fluid and the outside of the meter body. In these applications only the space between the process flanges and the coil housing should be insulated (see [Figure 6-16](#)).

Figure 6-16: Insulating a Rosemount Magnetic Flowmeter for Permeation

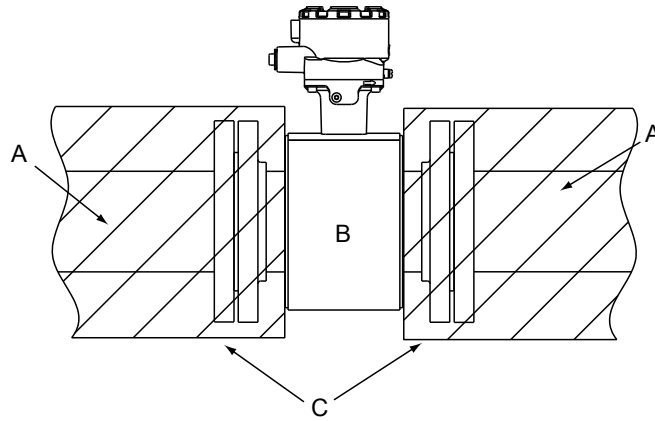


- A. Process piping
 B. Coil housing
 C. Insulation

2. When insulation of the magnetic flowmeter sensor is required due to plant safety standards designed to protect personnel from contact burns, extend the insulation up to the coil housing, covering both ends of the sensor and flanges ([Figure 6-17](#)).

The insulation should NOT cover the coil housing or the terminal junction box. Insulating the coil housing and the terminal junction box can result in overheating of the coil compartment and terminals, resulting in erratic/erroneous flow readings and potential damage or failure of the meter.

Figure 6-17: Insulating a Rosemount Magnetic Flowmeter for Safety/Plant Standards



- A. *Process piping*
 - B. *Coil housing*
 - C. *Insulation*
-

7 Operation

Topics covered in this chapter:

- [Introduction](#)
- [Local operator interface \(LOI\)](#)
- [Field Communicator interface](#)

7.1 Introduction

The transmitter features a full range of software functions, transmitter configurations, and diagnostic settings. These features can be accessed through the Local Operator Interface (LOI), a handheld Field Communicator, AMS[®] Device Manager, ProLink III software, or a host control system. Configuration variables may be changed at any time; specific instructions are provided through on-screen instructions.

This section covers the basic features of the LOI (optional) and provides general instructions on how to navigate the configuration menus using the buttons. The section also covers the use of a Field Communicator and provides menu trees to access each function. For detailed LOI configuration refer to [Chapter 8](#).

7.2 Local operator interface (LOI)

The optional LOI provides a communications center for the transmitter.

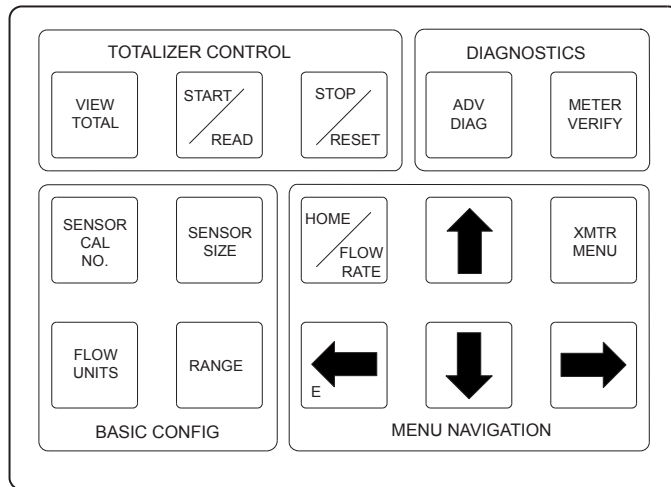
The LOI allows an operator to:

- Change transmitter configuration
- View flow and totalizer values
- Start/stop and reset totalizer values
- Run diagnostics and view the results
- Monitor transmitter status

7.2.1 Basic features

The basic features of the LOI include totalizer control, diagnostics, basic config, and menu navigation. These features provide control of all transmitter functions.

Figure 7-1: Local Operator Interface and Character Display



Totalizer Control

The totalizer control buttons enable you to view, start, stop, read, and reset the totalizer.



—**VIEW TOTAL**. Scroll through the totalizer values in alphabetical order (Totalizer A, Totalizer B, Totalizer C).



—**START/READ**. This functionality applies to the currently displayed totalizer value.

- If the totalizers are not running, pressing this button starts ALL totalizers counting.
- If the totalizers are running, pressing this button pauses the display, enabling the user to read the total value. It does NOT stop the totalizer value from accumulating in the background. Pressing the button while the display is paused returns the display to the accumulating totalizer value



—**STOP/RESET**. This functionality applies to the currently displayed totalizer value.

- If the totalizers are running, pressing this button stops ALL totalizers from accumulating.
- If the totalizer is stopped, pressing this button resets the total value to a value of zero.

Note

If you attempt to reset the totalizer from the LOI when it is configured as non-resettable from the LOI, a notification appears.

Diagnostics The diagnostics buttons provide direct access to the advanced diagnostic functions of the transmitter and meter verification.



—**ADV DIAG**. Access the advanced diagnostic menu.



—**METER VERIFY**. Run Meter Verification.

Basic Config The basic config buttons provide direct access to the most common transmitter parameters.



—**SENSOR CAL NO.** Access the sensor calibration number parameter. Press , , and to modify the sensor calibration number. Press to store the new value as the sensor calibration number.



—**SENSOR SIZE**. Access the Line Size parameter. Press or to select the sensor line size. Press to increment the line size. Press to store the new value as the sensor line size.



—**FLOW UNITS**. Access the Flow Units parameter. Press or to select the flow units. Press to increment the flow units. Press will store the selection.



—**RANGE**. Access the PV URV parameter. Press , , and to modify the upper range value. Press to store the new value as the PV Upper Range Value.

Menu Navigation

The menu navigation buttons enable you to move the display cursor, incrementally increase the value, enter the selected value, display the home screen, or access the transmitter menu.



—**HOME/FLOW RATE**. Access the flow rate display screen.



—**XMTR MENU**. Access the transmitter menu structure.



—(Up). Increment a numerical or list value.







—(Left) or **E**. Back out or enter/store parameters to the transmitter memory.



—(Down). Decrement a numerical or list value.














—(Right). Highlight a numerical or text character, or increment a list value.


Press **XMTR MENU** to access the menu. Use , , , and  to navigate the menu structure. A map of the LOI menu structure is shown in [Section 7.2.11](#).



7.2.2 Data entry

The LOI keypad does not have alphanumeric keys. Alphanumeric and symbolic data is entered by the following procedure. Use the steps below to access the appropriate functions.

Procedure

1. Use , , , and  to navigate the menu ([Section 7.2.11](#)) and access the appropriate alphanumeric parameter.
2. Use , , or  to begin editing the parameter.
 - Press  to go back without changing the value.
 - For numerical data, scroll through the digits 0-9, decimal point, and dash.
 - For alphabetical data, scroll through the letters of the alphabet A-Z, digits 0-9, and the symbols ?, &, +, -, *, /, \$, @, %, and the blank space.
3. Use  to highlight each character you want to change and then use  and  to select the value.

If you go past a character that you wish to change, keep using  to wrap around and arrive at the character you want to change.

4. Press  when all changes are complete to save the entered values.
5. Press  again to navigate back to the menu tree.

7.2.3 Data entry examples









Parameter values are classified as *table values* or *select values*.

- Table values are available from a predefined list for parameters such as line size or flow units.
- Select values are integers, floating point numbers, or character strings and are entered one character at a time using the arrow keys for parameters such as PV URV and calibration number.

Table value example

Setting the sensor size:

Procedure










1. Press **XMTR MENU** to access the menu. See [Section 7.2.11](#).
2. Use , , , and  to select line size from the basic setup menu.
3. Use  or  to increase/decrease the sensor size.
4. When you reach the desired sensor size, press .
5. Set the loop to manual if necessary, and press  again.

After a moment, the LOI will display `VALUE STORED SUCCESSFULLY` and then display the selected value.

Select value example

Changing the upper range limit:




Procedure

1. Press **XMTR MENU** to access the menu. See [Section 7.2.11](#).
2. Use , , , and  to select **PV URV** from the basic setup menu.
3. Press  to position the cursor.
4. Press  or  to set the number.
5. Repeat steps 3 and 4 until desired number is displayed, press .
6. Set the loop to manual if necessary, and press  again.

After a moment, the LOI will display `VALUE STORED SUCCESSFULLY` and then display the selected value.

7.2.4 Dynamic variable display pause

To make dynamically changing variables easier to read and record, a pause feature has been built into the LOI.


When viewing a dynamic variable (such as a totalizer value) from the view variable screen, press  to pause the display value. To return the screen to the dynamic display mode, press , or exit the screen by pressing .

Note

It is important to note this feature pauses only the display. While the display is paused, the transmitter continues to measure all variables dynamically, and continues to increment the totalizer.

7.2.5 Totalizer functionality

Totalizer selection

- To view the totalizer values, press  to access the LOI menu structure.
- To view the totalizer values, press **VIEW TOTAL** to access the LOI menu structure.

The first option is the totalizers. Under this section, you can view and configure the totalizers. See [Section 8.2.3](#) for more information on the totalizer functionality.

Start all / Stop all

Totalizers can be started or stopped simultaneously. See [Section 8.2.3](#).

Reset totalizer

The totalizers can be configured to be reset through the LOI. They can be reset individually, or simultaneously through a global command. For details on configuring the reset functionality and on resetting the totalizers, refer to [Section 8.2.3](#).

7.2.6 Display lock

The transmitter has display lock functionality to prevent unintentional configuration changes. The display can be locked manually or configured to automatically lock after a set period of time. When locked, the LOI will display the flow screen.







Manual display lock

To activate, hold the UP arrow for 3 seconds and follow the on-screen instructions. When the display lock is activated, a lock symbol will appear in the lower right hand corner of the display. To deactivate, hold the UP arrow for 3 seconds and follow the on-screen instructions. When the display lock is deactivated, the lock symbol will no longer appear in the lower right hand corner of the display.

Auto display lock

The transmitter can be configured to automatically lock the LOI. Follow the instructions below to access configuration.

Procedure

1. Press **XMTR MENU** to access the menu. See [Section 7.2.11](#).
2. Scroll to and select **LOI Config** from the Detailed Setup menu.
3. Press  to highlight **Disp Auto Lock** and press  to enter the menu.
4. Press  or  to select the auto lock time.
5. When you reach the desired time, press .
6. Set the loop to manual if necessary, and press .

After a moment, the LOI will display `VALUE STORED SUCCESSFULLY` and then display the selected value.

7.2.7 Security

The transmitter uses two types of protection to prevent users from making changes to the transmitter configuration. Only one security setting is needed to be ON to prevent changes, both security settings need to be OFF to allow changes.

Write protect

Read-only informational variable that reflects the setting of the hardware security switch. If Write Protect is ON, configuration data are protected and cannot be changed from the LOI, a HART-based communicator or control system. If Write Protect is OFF, configuration data may be changed.

HART Lock (HART 7 only)

Read-only informational variable that reflects the setting of the software security. If HART Lock is ON, configuration data are protected and cannot be changed from the LOI or a HART-based communicator or control system. If HART Lock is OFF, configuration data may be changed.

7.2.8 Locate device

For HART 7 devices with LCD displays, enabling Locate Device displays the characters "0-0-0-0-0-0-0-0-" on the LCD display. This allows for easy field identification of the device during commissioning or service.

7.2.9 Diagnostic messages

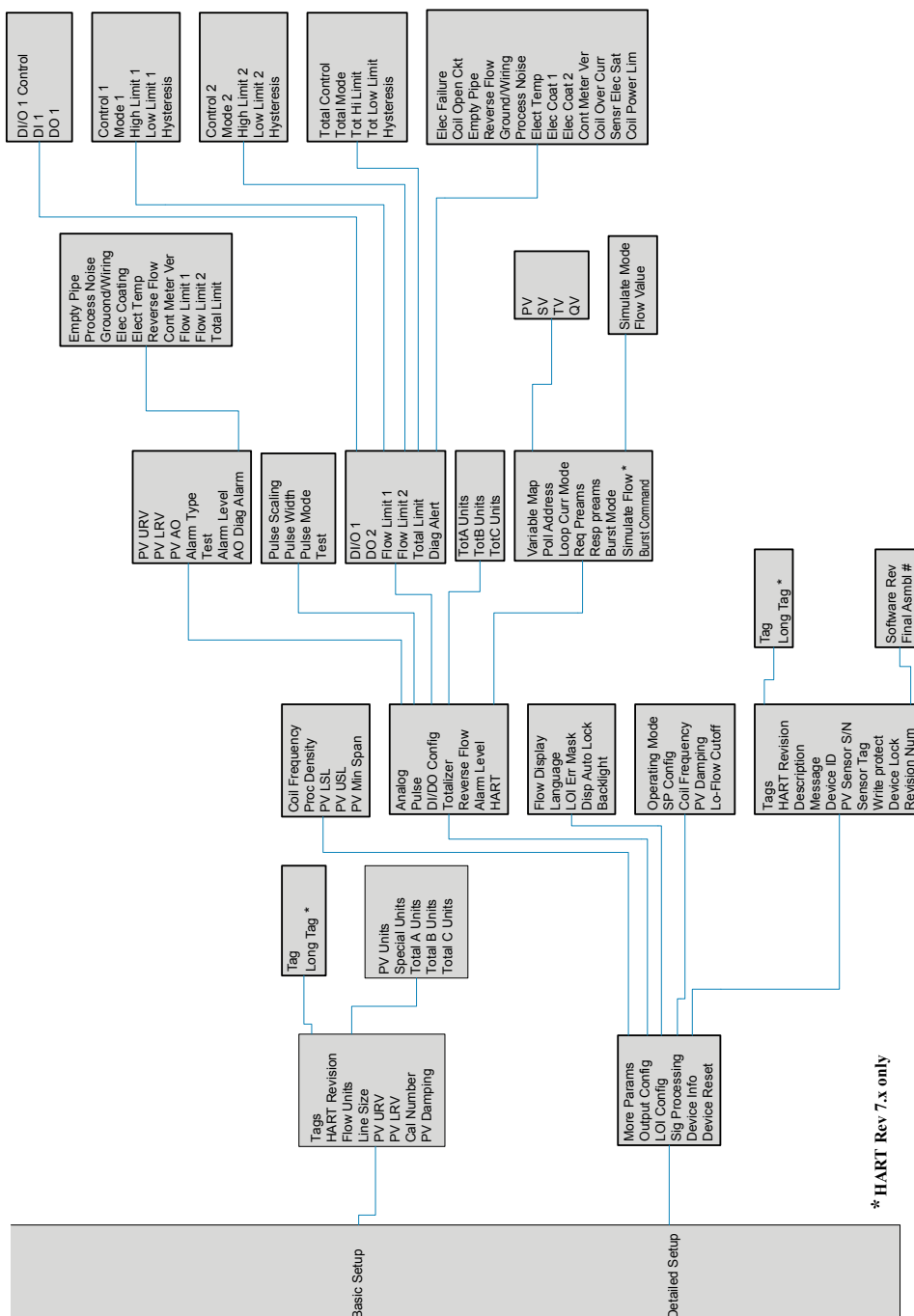
Diagnostic messages may appear on the LOI. See [Chapter 9](#) for a complete list of messages, potential causes, and corrective actions for these messages.

7.2.10 Display symbols

When certain transmitter functions are active, a symbol will appear in the lower-right corner of the display. The possible symbols include the following:

Display Lock	
Totalizer	
Reverse flow	
Continuous meter verification	

Figure 7-3: LOI menu tree for HART rev 5.5 and HART rev 7.1, part 2



* HART Rev 7.x only

7.3 Field Communicator interface

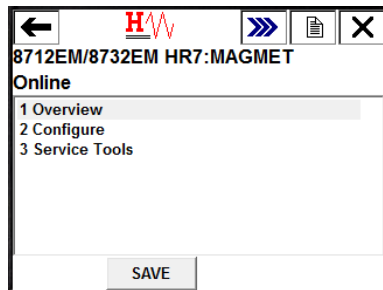
The transmitter can be configured with a Field Communicator using HART® Protocol gaining access to the software functions, transmitter configurations, and diagnostic settings. Refer to the Field Communicator Manual for detailed instructions on how to connect to the device.

7.3.1 Field Communicator user interface

The device driver uses conditional formatting menus. If the diagnostic is not active, the diagnostic will not be displayed as a menu item in the Field Communicator, and menu trees will be resequenced accordingly.

The device dashboard interface is shown in [Figure 7-4](#). The corresponding menu trees are shown in [Section 7.3.2](#).

Figure 7-4: Device Dashboard Interface



7.3.2 Field Communicator menu trees

Figure 7-5: Field Communicator Dashboard Menu Tree (HART v5.5, part 1)

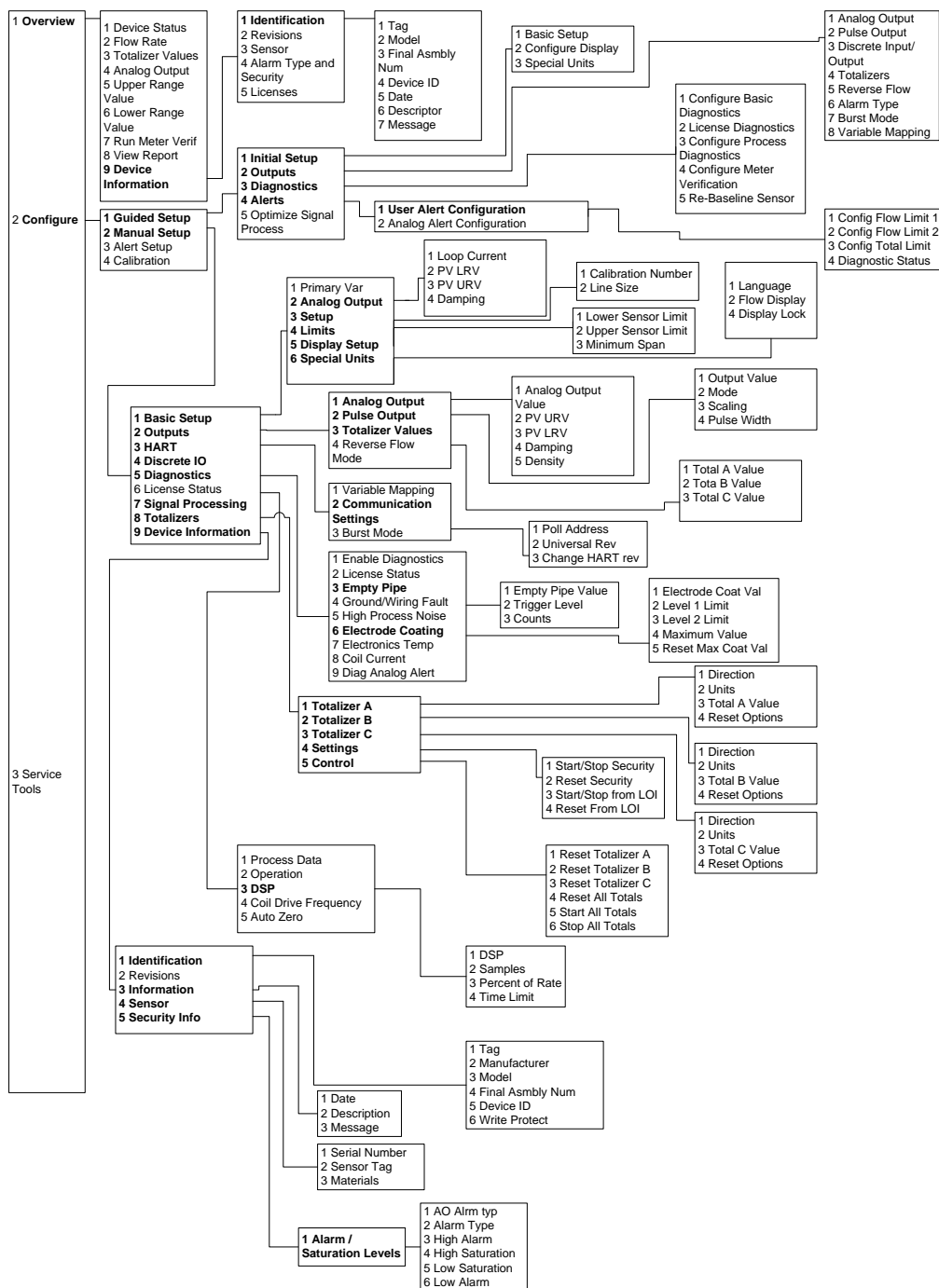


Figure 7-7: Field Communicator Dashboard Menu Tree (HART v7.1, part 1)

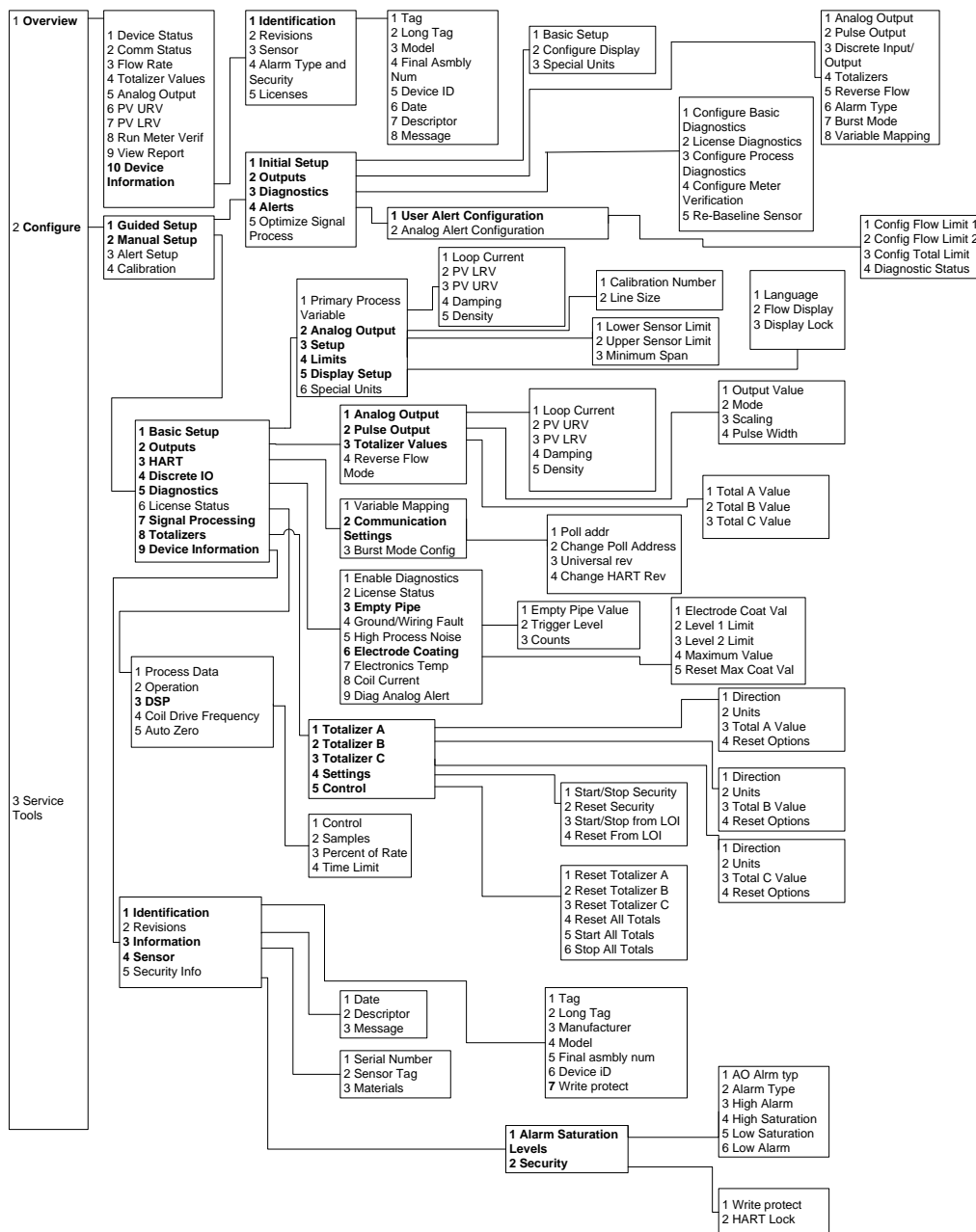
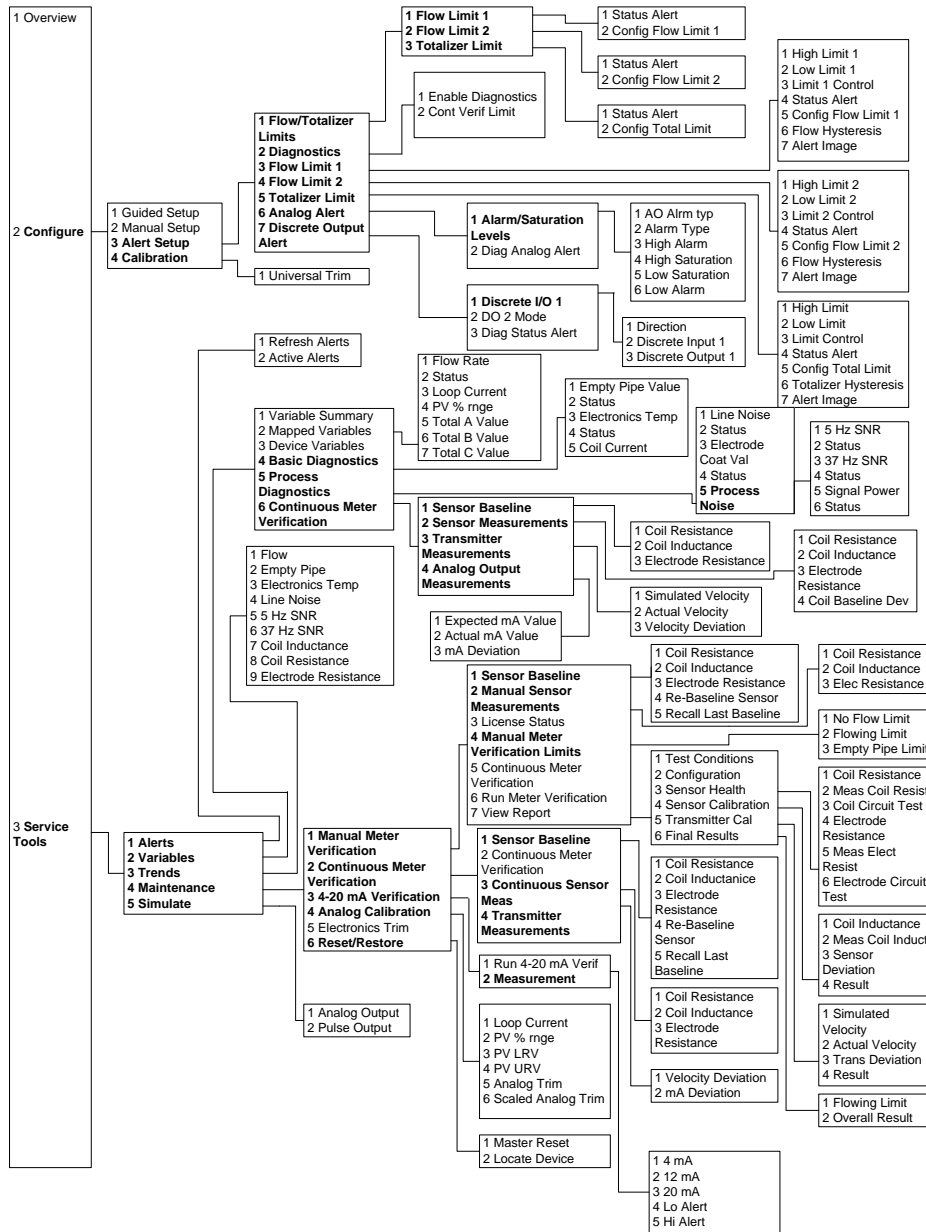


Figure 7-8: Field Communicator Dashboard Menu Tree (HART v7.1, part 2)



8 Advanced Configuration Functionality

Topics covered in this chapter:

- [Introduction](#)
- [Configure outputs](#)
- [Configure HART](#)
- [Configure LOI](#)
- [Additional parameters](#)
- [Configure special units](#)

8.1 Introduction

This section contains information for advanced configuration parameters.

The software configuration settings for the transmitter can be accessed through a HART[®]-based communicator, Local Operator Interface (LOI), AMS, or through a control system. Before operating the transmitter in an actual installation, you should review all of the factory set configuration data to ensure that they reflect the current application.

8.2 Configure outputs

LOI menu path	Detailed Setup > Output Config
---------------	--

The configure outputs functionality is used to configure advanced features that control the analog, pulse, auxiliary, and totalizer outputs of the transmitter.

8.2.1 Analog output

LOI menu path	Detailed Setup > Output Config > Analog
---------------	--

The analog output function is used to configure all of the features of the 4-20 mA output.

Upper range value

LOI menu path	Detailed Setup > Output Config > Analog > PV URV
---------------	--

The *upper range value* (URV) sets the 20 mA point for the analog output. This value is typically set to full-scale flow. The units that appear will be the same as those selected under the units parameter. The URV may be set between -39.3 ft/s to 39.3 ft/s (-12 m/s to 12 m/s) or the equivalent range based on the selected flow units. There must be at least 1 ft/s (0.3 m/s) span or equivalent between the URV and LRV.

Lower range value

LOI menu path	Detailed Setup > Output Config, > Analog > PV LRV
---------------	---

The *lower range value* (LRV) sets the 4 mA point for the analog output. This value is typically set to zero flow. The units that appear will be the same as those selected under the units parameter. The LRV may be set between -39.3 ft/s to 39.3 ft/s (-12 m/s to 12 m/s) or the equivalent range based on the selected flow units. There must be at least 1 ft/s (0.3 m/s) span or equivalent between the URV and LRV.

Alarm type

LOI menu path	Detailed Setup > Output Config > Analog > Alarm Type
---------------	--

The analog output alarm type displays the position of the alarm switch on the electronics board. There are two available positions for this switch:

- High
- Low

Alarm level

LOI menu path	Detailed Setup > Output Config > Analog > Alarm Level
---------------	---

The alarm level configuration will drive the transmitter to preset values if an alarm occurs. There are two options:

- Rosemount Alarm and Saturation Values (see table [Table 8-1](#) for specific values)
- NAMUR-Compliant Alarm and Saturation Values (see [Table 8-2](#) for specific values)

Table 8-1: Rosemount Values

Level	4-20 mA saturation	4-20 mA alarm
Low	3.9 mA	3.75 mA
High	20.8 mA	22.5 mA

Table 8-2: NAMUR Values

Level	4-20 mA saturation	4-20 mA alarm

Table 8-2: NAMUR Values (continued)

Low	3.8 mA	3.5 mA
High	20.5 mA	22.6 mA

AO diagnostic alarm

LOI menu path	Detailed Setup > Output Config > Analog > AO Diag Alarm
---------------	---

There are diagnostics that, when under active conditions, do not drive the analog output to alarm level. The AO diagnostic alarm menu enables selection of these diagnostics to be associated with an analog alarm. If any of the selected diagnostics are active, it will cause the analog output to go to the configured alarm level. For a list of diagnostic alarms that can be configured to drive an analog alarm, see [Table 8-3](#).

Table 8-3: Analog Alarm Diagnostic Options

Diagnostic	Description
Empty Pipe ⁽¹⁾	Drive to an alarm state when empty pipe is detected.
Reverse Flow	Drive to an alarm state when reverse flow is detected.
Grounding / Wiring Fault	Drive to an alarm state when grounding or wiring fault is detected.
High Process Noise	Drive to an alarm state when the transmitter detects high levels of process noise.
Electronics Temperature Out of Range	Drive to an alarm state when the temperature of the electronics exceeds allowable limits
Electrode Coating Limit 2	Drive to an alarm state when electrode coating reaches a point where it impacts the flow measurement
Totalizer Limit 1	Drive to an alarm state when the totalizer value exceeds the parameters set in the totalizer limit configuration (see page 5-x for more details on this functionality)
Flow Limit 1	Drive to an alarm state when the flow rate exceeds the parameters set in the flow limit 1 configuration (see page 5-x for more details on this functionality)
Flow Limit 2	Drive to an alarm state when the flow rate exceeds the parameters set in the flow limit 2 configuration (see page 5-x for more details on this functionality)

Table 8-3: Analog Alarm Diagnostic Options (continued)

Diagnostic	Description
Continuous Meter Verification	Drive to an alarm state when the continuous meter verification diagnostic detects a failure of one of the tests

(1) See [Chapter 12](#) for more details on each of the diagnostics

8.2.2 Pulse output

LOI menu path	Detailed Setup > Output Config > Pulse
---------------	--

Under this function the pulse output of the transmitter can be configured.

Pulse scaling

LOI menu path	Detailed Setup > Output Config > Pulse > Pulse Scaling
---------------	--

Transmitter may be commanded to supply a specified frequency between 1 pulse/ day at 39.37 ft/sec (12 m/s) to 10,000Hz at 1 ft/sec (0.3 m/s).

Note

Line size, special units, and density must be selected prior to configuration of the pulse scaling factor.

The pulse output scaling equates one transistor switch closure pulse to a selectable number of volume units. The volume unit used for scaling pulse output is taken from the numerator of the configured flow units. For example, if gal/min had been chosen when selecting the flow unit, the volume unit displayed would be gallons.

Note

The pulse output scaling is designed to operate between 0 and 10,000Hz. The minimum conversion factor value is found by dividing the minimum span (in units of volume per second) by 10,000Hz.

Note

The maximum pulse scaling frequency for transmitters with an intrinsically safe output (output option code B) is 5000Hz.

When selecting pulse output scaling, the maximum pulse rate is 10,000Hz. With the 110 percent over range capability, the absolute limit is 11,000Hz. For example, if you want the transmitter to pulse every time 0.01 gallons pass through the sensor, and the flow rate is 10,000 gal/min, you will exceed the 10,000Hz full-scale limit:

$$\frac{10,000 \text{ gal}}{1 \text{ min}} \times \frac{1 \text{ min}}{(60 \text{ sec})} \times \frac{1 \text{ pulse}}{0.01 \text{ gal}} = 16,666.7 \text{ Hz}$$

The best choice for this parameter depends upon the required resolution, the number of digits in the totalizer, the extent of range required, and the maximum frequency limit of the external counter.

Pulse factor units

The pulse factor unit assigns the unit of measure to the pulse scaling factor. The default read-only value is the unit of measure from the configured flow units. For example, if gal/min is selected when configuring the flow units, the pulse factor unit will be gallons.

Pulse width

LOI menu path	Detailed Setup > Output Config > Pulse > Pulse Width
---------------	--

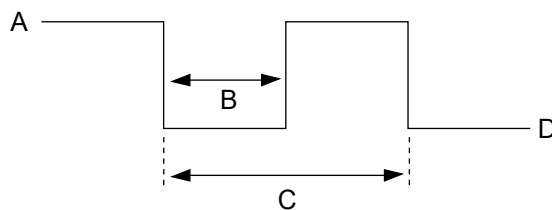
The factory default pulse width is 0.5 ms.

The width, or duration, of the pulse can be adjusted to match the requirements of different counters or controllers (see [Figure 8-1](#)). These are typically lower frequency applications (< 1000Hz). The transmitter will accept values from 0.1 ms to 650 ms.

For frequencies higher than 1000Hz, it is recommended to set the pulse mode to 50% duty cycle by setting the pulse mode to frequency output.

The pulse width will limit the maximum frequency output, If the pulse width is set too wide (more than 1/2 the period of the pulse) the transmitter will limit the pulse output. See example below.

Figure 8-1: Pulse Output



- A. Open
- B. Pulse width
- C. Period
- D. Closed

Example

If pulse width is set to 100 ms, the maximum output is 5Hz; for a pulse width of 0.5 ms, the maximum output would be 1000Hz (at the maximum frequency output there is a 50% duty cycle).

Pulse width	Minimum period (50% duty cycle)	Maximum frequency
100 ms	200 ms	$\frac{1 \text{ cycle}}{200 \text{ ms}} = 5 \text{ Hz}$
0.5 ms	1.0 ms	$\frac{1 \text{ cycle}}{1.0 \text{ ms}} = 1000 \text{ Hz}$

To achieve the greatest maximum frequency output, set the pulse width to the lowest value that is consistent with the requirements of the pulse output power source, pulse driven external totalizer, or other peripheral equipment.

The maximum flow rate is 10,000 gpm. Set the pulse output scaling such that the transmitter outputs 10,000Hz at 10,000 gpm.

$$\text{Pulse Scaling} = \frac{\text{Flow Rate (gpm)}}{(60 \frac{\text{sec}}{\text{min}}) \times (\text{frequency})}$$

$$\text{Pulse Scaling} = \frac{10,000 \text{ gpm}}{(60 \frac{\text{sec}}{\text{min}}) \times (10,000 \text{ Hz})}$$

$$\text{Pulse Scaling} = 0.0167 \frac{\text{gal}}{\text{pulse}}$$

$$1 \text{ pulse} = 0.0167 \text{ gal}$$

Note

Changes to pulse width are only required when there is a minimum pulse width required for external counters, relays, etc.

The external counter is ranged for 350 gpm and pulse is set for one gallon. Assuming the pulse width is 0.5 ms, the maximum frequency output is 5.833Hz.

$$\text{Frequency} = \frac{\text{Flow Rate (gpm)}}{(60 \frac{\text{sec}}{\text{min}}) \times (\text{pulse scaling} \frac{\text{gal}}{\text{pulse}})}$$

$$\text{Pulse Scaling} = \frac{350 \text{ gpm}}{(60 \frac{\text{sec}}{\text{min}}) \times 1 \frac{\text{gal}}{\text{pulse}}}$$

$$\text{Frequency} = 5.833 \text{ Hz}$$

The upper range value (20mA) is 3000 gpm. To obtain the highest resolution of the pulse output, 10,000Hz is scaled to the full scale analog reading.

$$\text{Frequency} = \frac{\text{Flow Rate (gpm)}}{(60 \frac{\text{sec}}{\text{min}}) \times (\text{pulse scaling} \frac{\text{gal}}{\text{pulse}})}$$

$$\text{Pulse Scaling} = \frac{3,000 \text{ gpm}}{(60 \frac{\text{sec}}{\text{min}}) \times 10,000 \text{ Hz}}$$

$$\text{Pulse Scaling} = 0.005 \frac{\text{gal}}{\text{pulse}}$$

$$1 \text{ pulse} = 0.005 \text{ gal}$$

Pulse mode

LOI menu path	Detailed Setup > Output Config > Pulse > Pulse Mode
---------------	---

The pulse mode configures the frequency output of the pulse. It can be set to either 50% duty cycle, or fixed. There are two options that pulse mode can be configured to:

- Pulse Output (user defines a fixed pulse width)
- Frequency Output (pulse width automatically set to 50% duty cycle)

To use pulse width settings, pulse mode must be set to pulse output.

8.2.3 Totalizer

The totalizer provides the total amount of fluid that has passed through the meter. There are three available totalizers: Total A, Total B, and Total C. They can be independently configured for one of the following options:

- Net - increments with forward flow and decrements with reverse flow (reverse flow must be enabled).
- Reverse total - will only increment with reverse flow if reverse flow is enabled
- Forward total - will only increment with forward flow

All totalizer values will be reset if **line size** is changed. This will happen even if the totalizer reset control is set to **non-resettable**.

The totalizers have the capability to increment the total to a maximum value of 50 feet per second of flow (or the volumetric equivalent) for a period of 20 years before roll-over occurs.

View Totals

LOI menu path	Totalizer A: Totalizers > View Total A Totalizer B: Totalizers > View Total B Totalizer C: Totalizers > View Total C
---------------	--

Displays the current value for each totalizer and shows the totalizer incrementing/decrementing based on totalizer configuration and flow direction.

Configure totalizers

LOI menu path	Totalizers > Config/Control
---------------	---------------------------------------

Start, stop, and reset all totalizers, configure the independent totalizers, and security controls for write protecting and resetting the individual totalizers.

Note

If an individual totalizer is configured as non-resettable, the global totalizer reset command will *not* affect that totalizer.

Note

If an individual totalizer is configured as write protected, the global totalizer start/stop/reset commands will *not* affect that totalizer.

Totalizer direction

LOI menu path	Totalizer A: Totalizers > Config/Control > Total A > Total A Config > Direction Totalizer B: Totalizers > Config/Control > Total B > Total B Config > Direction Totalizer C: Totalizers > Config/Control > Total C > Total C Config > Direction
---------------	--

Configure the direction for the totalizers as either Net, Forward, or Reverse.

Totalizer units

LOI menu path	Totalizer A: Totalizers > Config/Control > Total A > Total A Config > TotA Units Totalizer B: Totalizers > Config/Control > Total B > Total B Config > TotB Units Totalizer C: Totalizers > Config/Control > Total C > Total C Config > TotC Units
---------------	---

Configure the units for totalizers.

Table 8-4: Totalizer units

Volume units		Mass units		Other units	
LOI abbreviation	Units	LOI abbreviation	Units	LOI abbreviation	Units
gal	Gallons	KG	Kilograms	ft	Feet
l	Liters	Mton	Metric tons	m	Meters

Table 8-4: Totalizer units (continued)

Volume units		Mass units		Other units	
LOI abbreviation	Units	LOI abbreviation	Units	LOI abbreviation	Units
lgal	Imperial gallons	lb	Pounds	Special	Special Units ⁽¹⁾
m3	Cubic meters	Ston	Short tons		
B42	Barrels (42 gallons)				
ft3	Cubic feet				
cm3	Cubic centimeters				
B31	Barrels (31 gallons)				
Mgal	Million gallons				

(1) See [Section 8.6](#).

Reset configuration

LOI menu path	Totalizer A: Totalizers > Config/Control > Total A > Total A Config > TotA Reset Config Totalizer B: Totalizers > Config/Control > Total B > Total B Config > TotB Reset Config Totalizer C: Totalizers > Config/Control > Total C > Total C Config > TotC Reset Config
---------------	--

Configure if the totalizer is non-resettable, or if it can be reset through the reset commands.

Reset individual totalizer

LOI menu path	Totalizer A: Totalizers > Config/Control > Total A > Reset Total A Totalizer B: Totalizers > Config/Control > Total B > Reset Total B Totalizer C: Totalizers > Config/Control > Total C > Reset Total C
---------------	--

Independently reset the totalizers. This requires the reset option to be configured as resettable.

Reset all totalizers

LOI menu path	Totalizers > Config/Control > Reset All
---------------	--

This global command will reset totalizer values to zero for all totalizers that have been configured as resettable.

Totalizer security

LOI menu path	Totalizers > Config/Control > Security
---------------	---

Configure totalizer security capabilities for the Local Operator Interface and write protection.

LOI control

LOI menu path	Totalizers > Config/Control > Security > LOI Control
---------------	--

Configure the ability to start, stop, and reset the totalizers through the LOI.

LOI totalizer start/stop

LOI menu path	Totalizers > Config/Control > Security > LOI Control > LOI Start/Stop
---------------	--

Enable/disable the ability to start or stop totalizers through the LOI.

LOI totalizer reset

LOI menu path	Totalizers > Config/Control > Security > LOI Control > LOI Reset
---------------	---

Enable/disable the ability to reset the totalizers through the LOI.

Totalizer write protection

LOI menu path	Totalizers > Config/Control > Security > Write Protect
---------------	--

In addition to controlling the LOI capability to start/stop and reset the totalizers, specific write protect functionality can also be configured adding an additional level of security to the totalizers.

Start/stop write protect

LOI menu path	Totalizers > Config/Control > Security > Write Protect > WP Start/Stop
---------------	---

Configure write protection on the ability to start or stop the totalizers. This is a global command and applies to all totalizers.

Reset write protect

LOI menu path	Totalizers > Config/Control > Security > Write Protect > WP Reset
---------------	--

Configure write protection on the ability to reset the totalizers. This is a global command and applies to all totalizers.

8.2.4 Discrete input/output

This configuration option is only available if the auxiliary output suite (option code AX) was ordered. The auxiliary output suite provides two channels for control.

- For HART version 5.5 or 7.1 firmware, the discrete input can provide positive zero return (PZR) or reset totalizer (A, B, C, or all totals).

Note

If a particular totalizer is configured to be not resettable, the totalizer will not be reset with this function.

- The discrete output control function can be configured to drive an external signal to indicate zero flow, reverse flow, empty pipe, diagnostic status, flow limit, or transmitter status.

A complete list and description of the available auxiliary functions is provided below.

Discrete input options (Channel 1 only)

PZR (Positive Zero Return)	When conditions are met to activate the input, the transmitter will force the output to zero flow.
Net Total Reset	When conditions are met to activate the input, the transmitter will reset the net total value to zero.

Discrete output options

Reverse Flow	The output will activate when the transmitter detects a reverse flow condition.
Zero Flow	The output will activate when a no flow condition is detected.
Transmitter Fault	The output will activate when a transmitter fault condition is detected.
Empty Pipe	The output will activate when the transmitter detects an empty pipe condition.
Flow Limit 1	The output will activate when the transmitter measures a flow rate that meets the conditions established for the flow limit 1 alert.
Flow Limit 2	The output will activate when the transmitter measures a flow rate that meets the conditions established for the flow limit 2 alert.

Diagnostic Status Alert	The output will activate when the transmitter detects a condition that meets the configured criteria of the diagnostic status alert.
Total Limit	The output will activate when the transmitter Totalizer A value meets the conditions established for the total limit alert.

Channel 1

Channel 1 can be configured as either a discrete input (DI) or as a discrete output (DO).

DI/O 1 control

LOI menu path	Detailed Setup > Output Config > DI/DO Config > DI/O 1 > DI/O 1 Control
---------------	--

This parameter configures the auxiliary output channel 1. It controls whether channel 1 will be a discrete input or discrete output on terminals 11(-) and 12(+).

Note

The transmitter must have been ordered with the auxiliary output suite (option code AX) to have access to this functionality.

Discrete input 1

LOI menu path	Detailed Setup > Output Config > DI/DO Config > DI/O 1 > DI 1
---------------	--

This parameter displays the configuration for channel 1 when used as a discrete input.

Discrete output 1

LOI menu path	Detailed Setup > Output Config > DI/DO Config > DI/O 1 > DO 1
---------------	--

This parameter displays the configuration for channel 1 when used as a discrete output.

Channel 2

Channel 2 is available as discrete output only.

Discrete output 2

LOI menu path	Detailed Setup > Output Config > DI/DO Config > DO 2
---------------	--

This parameter displays the configuration for channel 2.

Flow limit (1 and 2)

There are two configurable flow limits. Configure the parameters that will determine the criteria for activation of a HART alert if the measured flow rate falls within a set of configured criteria. This functionality can be used for operating simple batching operations or generating alerts when certain flow conditions are met. This parameter can be configured as a discrete output if the transmitter was ordered with the auxiliary output suite (option code AX) and the outputs are enabled. If a discrete output is configured for flow limit, the discrete output will activate when the conditions defined under mode configuration are met. See [Mode](#) below.

Control

LOI menu path	Flow 1: Detailed Setup > Output Config > DI/DO Config > Flow Limit 1 > Control 1 Flow 2: Detailed Setup > Output Config > DI/DO Config > Flow Limit 2 > Control 2
---------------	--

This parameter turns the flow limit HART alert ON or OFF.

ON The transmitter will generate a HART alert when the defined conditions are met. If a discrete output is configured for flow limit, the discrete output will activate when the conditions for mode are met.

OFF The transmitter will not generate an alert for the flow limit.

Mode

LOI menu path	Flow 1: Detailed Setup > Output Config > DI/DO Config > Flow Limit 1 > Mode 1 Flow 2: Detailed Setup > Output Config > DI/DO Config > Flow Limit 2 > Mode 2
---------------	--

The mode parameter sets the conditions under which the flow limit HART alert will activate. High and low limits exist for each channel and can be configured independently.

> High limit The HART alert will activate when the measured flow rate exceeds the high limit set point.

< Low limit The HART alert will activate when the measured flow rate falls below the low limit set point.

In range The HART alert will activate when the measured flow rate is between the high limit and low limit set points.

Out of range The HART alert will activate when the measured flow rate exceeds the high limit set point or falls below the low limit set point.

High limit

LOI menu path	Flow 1: Detailed Setup > Output Config > DI/DO Config > Flow Limit 1 > High Limit 1 Flow 2: Detailed Setup > Output Config > DI/DO Config > Flow Limit 2 > High Limit 2
---------------	--

Set the flow rate value that corresponds to the high limit set point for the flow limit alert.

Low limit

LOI menu path	Flow 1: Detailed Setup > Output Config > DI/DO Config > Flow Limit 1 > Low Limit 1 Flow 2: Detailed Setup > Output Config > DI/DO Config > Flow Limit 2 > Low Limit 2
---------------	--

Set the flow rate value that corresponds to the low limit set point for the flow limit alert.

Flow limit hysteresis

LOI menu path	Flow 1: Detailed Setup > Output Config > DI/DO Config > Flow Limit 1 > Hysteresis Flow 2: Detailed Setup > Output Config > DI/DO Config > Flow Limit 2 > Hysteresis
---------------	--

Set the hysteresis band for the flow limit to determine how quickly the transmitter comes out of alert status. The hysteresis value is used for both flow limit 1 and flow limit 2. Changing this parameter under the configuration parameters for one channel will cause it to also change in the other channel.

Total limit

Configure the parameters that will determine the criteria for activating a HART alert if Totalizer A falls within a set of configured criteria. This functionality can be used for operating simple batching operations or generating alerts when certain localized values are met. This parameter can be configured as a discrete output if the transmitter was ordered with auxiliary outputs enabled (option code AX). If a digital output is configured for total limit, the digital output will activate when the conditions for total mode are met.

Total control

LOI menu path	Detailed Setup > Output Config > DI/DO Config > Total Limit > Total Control
---------------	--

This parameter turns the total limit HART alert ON or OFF.

ON The transmitter will generate a HART alert when the defined conditions are met.

OFF The transmitter will not generate a HART alert for the total limit.

Total mode

LOI menu path	Detailed Setup > Output Config > DI/DO Config > Total Limit > Total Mode
---------------	---

The total mode parameter sets the conditions under which the total limit HART alert will activate. High and low limits exist for each channel and can be configured independently.

> High limit The HART alert will activate when the totalizer value exceeds the high limit set point.

< Low limit The HART alert will activate when the totalizer value falls below the low limit set point.

In range The HART alert will activate when the totalizer value is between the high limit and low limit set points.

Out of range The HART alert will activate when the totalizer value exceeds the high limit set point or falls below the low limit set point.

Total high limit

LOI menu path	Detailed Setup > Output Config > DI/DO Config > Total Limit > Tot Hi Limit
---------------	---

Set Totalizer A to a value that corresponds to the high limit set point for the total high limit alert.

Total low limit

LOI menu path	Detailed Setup > Output Config > DI/DO Config > Total Limit > Tot Low Limit
---------------	--

Set the net total value that corresponds to the low limit set point for the total low limit alert.

Total limit hysteresis

LOI menu path	Detailed Setup > Output Config > DI/DO Config > Total Limit > Hysteresis
---------------	---

Set the hysteresis band for the total limit to determine how quickly the transmitter comes out of alert status.

Diagnostic status alert

LOI menu path	Detailed Setup > Output Config > DI/DO Config > Diag Alert
---------------	--

The diagnostic status alert is used to turn on or off the diagnostics that will cause this alert to activate.

- ON** The diagnostic status alert will activate when a transmitter detects a diagnostic designated as ON.
- OFF** The diagnostic status alert will not activate when diagnostics designated as OFF are detected.

Alerts for the following diagnostics can be turned ON or OFF:

- Electronics Failure
- Coil Open Circuit
- Empty Pipe
- Reverse Flow
- Ground/Wiring Fault
- High Process Noise
- Electronics Temperature Out of Range
- Electrode Coat Limit 1
- Electrode Coat Limit 2
- Continuous Meter Verification

8.3 Configure HART

The transmitter has four HART variables available as outputs. The variables can be configured for dynamic readings including flow, total, and diagnostic values. The HART output can also be configured for burst mode or multi-drop communication if required.

8.3.1 Variable mapping

Variable mapping allows configuration of the variables that are mapped to the secondary, tertiary and quaternary variables. The primary variable is fixed to output flow and cannot be configured.

Primary variable (PV)

The primary variable is configured for flow. This variable is fixed and cannot be configured. The primary variable is tied to the analog output.

Secondary variable (SV)

The secondary variable maps the second variable of the transmitter. This variable is a HART only variable and can be read from the HART signal with a HART enabled input card, or can be burst for use with a HART Tri-Loop to convert the HART signal to an analog output. Options available for mapping to this variable can be found in [Table 8-5](#).

Tertiary variable (TV)

The tertiary variable maps the third variable of the transmitter. This variable is a HART only variable and can be read from the HART signal with a HART enabled input card, or can be burst for use with a HART Tri-Loop to convert the HART signal to an analog output. Options available for mapping to this variable can be found in [Table 8-5](#).

Quaternary variable (QV)

The quaternary variable maps the fourth variable of the transmitter. This variable is a HART only variable and can be read from the HART signal with a HART enabled input card, or can be burst for use with a HART Tri-Loop™ to convert the HART signal to an analog output. Options available for mapping to this variable can be found in [Table 8-5](#).

Table 8-5: Available Variables

Flow Rate	Empty Pipe Value
Pulse Output	Transmitter Velocity Deviation
Totalizer A	Electrode Coating Value
Totalizer B	Electrode Resistance
Totalizer C	Coil Resistance Value
Electronics Temperature	Coil Inductance Value
Line Noise	Coil Baseline Deviation
5 Hz SNR	Analog Output Feedback Deviation
37 Hz SNR	Coil Current
Signal Power	

8.3.2 Poll address

Poll address enables the transmitter to be used in point-to-point mode or multi-drop mode. When in multi-drop mode, the poll address is used to identify each meter on the multi-drop line.

The transmitter poll address is set to zero at the factory, allowing standard operation in a point-to-point manner with a 4-20 mA output signal. To activate multi-drop communication, the transmitter poll address must be changed to a non-zero integer; for HART 5 between 1-15, for HART 7 between 1-63. This change fixes the analog output current to 4 mA and disables the failure mode alarm signal.

8.3.3 Loop current mode

Available on HART 7 through the LOI only.

When loop current mode is set to **ON**, the analog output current tracks with changes in PV. When loop current mode is **OFF**, the analog output current is fixed at 4mA.

8.3.4 HART revision

Transmitter electronics supporting software revision v5.4 have a fixed HART 5 menu configuration. Transmitter electronics supporting software revision v5.5 or v7.1 can be configured for either HART 5 or HART 7 menu configurations.

Universal revision

Read-only informational variable that reflects the setting of the HART revision in the transmitter.

Change HART revision

On enabled devices, this function allows the user to change between HART 5 or HART 7.

8.3.5 Burst mode

The transmitter includes a burst mode function that can be enabled to broadcast the primary variable or all dynamic variables approximately three to four times per second. Burst mode is a specialized function used in very specific applications. The burst mode function enables you to select the variables that are broadcast while in the burst mode.

Burst mode enables you to set the burst mode as OFF or ON:

- OFF - Turns burst mode off; no data are broadcast over the loop
- ON - Turns burst mode on; data selected under burst option are broadcast over the loop

Additional burst mode capabilities, not visible from the LOI, are available through a HART host.

Burst option (burst command)—HART 5 only

Burst option enables you to select the variable(s) that is broadcast during the transmitter burst. Choose one of the following options:

- 1; PV; Primary Variable - Selects the primary variable
- 2; % range/current; Percent of Range and Loop Current - Selects the variable as percent of range and analog output
- 3; Process vars/crnt; All Variables and Loop Current - Selects all variables and analog output
- 110; Dynamic vars; Dynamic Variables - Burst all dynamic variables in the transmitter

Request preambles

Request preambles is the number of preambles required by the transmitter for HART communications.

Response preambles

Response preambles is the number of preambles sent by the transmitter in response to any host request.

8.3.6 Configure LOI

The LOI configuration contains functionality to configure the display of the transmitter.

Flow display

Use flow display to configure the parameters that will appear on the LOI flowrate screen. The flowrate screen displays two lines of information. Choose one of the following options:

- Flowrate, % of Span
- Flow, Total A
- % Span, Total A
- Flow, Total B
- % Span, Total B
- Flow, Total C
- % Span, Total C

Language

Use language to configure the display language shown on the LOI. Choose one of the following options:

- English
- Spanish
- Portuguese
- German
- French

LOI error mask

Use LOI error mask to turn off the analog output power error message (AO No Power). This may be desired if the analog output is not being used.

Display auto lock

Use display auto lock to configure the LOI to automatically lock the LOI after a set period of time. Choose one of the following options:

- OFF
- 1 Minute

- 10 Minutes (default)

LOI backlight control

To conserve power, the LOI backlight can be configured to automatically turn off after a set amount of time without keypad activity. Configure the timeout control for the LOI backlight using the following options:

- Always OFF (default for low power)
- 10 Seconds
- 20 Seconds
- 30 Seconds
- Always ON (default)

8.4 Configure LOI

The LOI configuration contains functionality to configure the display of the transmitter.

8.4.1 Flow display

LOI menu path	Detailed Setup > LOI Config > Flow Display
---------------	---

Use flow display to configure the parameters that will appear on the LOI flowrate screen. The flowrate screen displays two lines of information.

8.4.2 Language

LOI menu path	Detailed Setup > LOI Config > Language
---------------	---

Use language to configure the display language shown on the LOI.

8.4.3 LOI display lock

LOI menu path	Detailed Setup > LOI Config > Disp Auto Lock
---------------	---

The transmitter has display lock functionality to prevent unintentional configuration changes. The display can be locked manually or configured to automatically lock after a set period of time. The display is always locked on the flow screen

8.5 Additional parameters

The following parameters may be required for detailed configuration settings based on your application.

8.5.1 Coil drive frequency

LOI menu path	Detailed Setup > More Params > Coil Frequency
---------------	---

Use coil drive frequency to change the pulse rate of the coils.

- 5 Hz - The standard coil drive frequency is 5 Hz, which is sufficient for nearly all applications.
- 37 Hz - If the process fluid causes a noisy or unstable output, increase the coil drive frequency to 37.5 Hz. If the 37 Hz mode is selected, perform the auto zero function for optimum performance.

See [Section 10.5.2](#).

8.5.2 Process density

LOI menu path	Detailed Setup > More Params > Proc Density
---------------	---

Use the process density value to convert from a volumetric flow rate to a mass flow rate using the following equation:

$$Q_m = Q_v \times \rho$$

Where:

Q_m is the mass flow rate

Q_v is the volumetric flow rate, and

ρ is the fluid density

8.5.3 Reverse flow

LOI menu path	Detailed Setup > Output Config > Reverse Flow
---------------	---

Use reverse flow to enable or disable the transmitter's ability to read flow in the opposite direction of the flow direction arrow (see [Section 3.2.3](#)). This may occur when the process has bi-directional flow, or when either the electrode wires or the coil wires are reversed (see Troubleshooting [Section 12.3.3](#)). This also enables the totalizer to count in the reverse direction.

8.5.4 Low flow cutoff

LOI menu path	Detailed Setup > Sig Processing > Lo-Flow Cutoff
---------------	---

Low flow cutoff allows the user to set a low flow limit to be specified. The analog output signal is driven to 4mA for flow rates below the set point. The low flow cutoff units are the same as the PV units and cannot be changed. The low flow cutoff value applies to both forward and reverse flows.

8.5.5 PV (flow) damping

LOI menu path	Detailed Setup > Sig Processing > Damping
---------------	--

Primary variable damping allows selection of a response time, in seconds, to a step change in flow rate. It is most often used to smooth fluctuations in output.

8.5.6 Signal processing

The transmitter contains several advanced functions that can be used to stabilize erratic outputs caused by process noise. The signal processing menu contains this functionality.

If the 37 Hz coil drive mode has been set, and the output is still unstable, the damping and signal processing function should be used. It is important to set the coil drive mode to 37 Hz first, so the loop response time is not increased.

The transmitter provides for a very easy and straightforward start-up, and also incorporates the capability to deal with difficult applications that have previously manifested themselves in a noisy output signal. In addition to selecting a higher coil drive frequency (37 Hz vs. 5 Hz) to isolate the flow signal from the process noise, the microprocessor can actually scrutinize each input based on three user-defined parameters to reject the noise specific to the application.

See [Chapter 10](#) for the detailed description of how the signal processing works.

8.6 Configure special units

Special units are used when the application requires units that are not included in the flow units available from the device. Refer to [Section 5.4](#) for a complete list of the available units.

8.6.1 Base volume unit

LOI menu path	Basic Setup > Flow Units > Special Units > Base Vol Units
---------------	---

Base volume unit is the unit from which the conversion is being made. Set this variable to the appropriate option.

8.6.2 Conversion factor

LOI menu path	Basic Setup > Flow Units > Special Units > Conv Factor
---------------	--

The special units conversion factor is used to convert base units to special units. For a straight conversion of units from one unit of measure to a different unit of measure, the conversion factor is the number of base units in the new unit.

If you are converting from gallons to barrels and there are 31 gallons in a barrel, the conversion factor is 31.

8.6.3 Base time unit

LOI menu path	Basic Setup > Flow Units > Special Units > Base Time Unit
---------------	---

Base time unit provides the time unit from which to calculate the special units. For example, if your special units is a volume per minute, select minutes.

8.6.4 Special volume unit

LOI menu path	Basic Setup > Flow Units > Special Units > Volume Unit
---------------	--

Special volume unit enables you to display the volume unit format to which you have converted the base volume units.

If the special units are abc/min, the special volume variable is abc. The volume units variable is also used in totalizing the special units flow.

8.6.5 Special flow rate unit

LOI menu path	Basic Setup > Flow Units > Special Units > Rate Unit
---------------	--

Flow rate unit is a format variable that provides a record of the units to which you are converting. The Handheld Communicator will display a special units designator as the units format for your primary variable. The actual special units setting you define will not appear. Four characters are available to store the new units designation. The LOI will display the four character designation as configured.

To display flow in acre-feet per day, and acre-foot is equal to 43560 cubic feet, the procedure would be:

1. Set the volume unit to ACFT.
2. Set the base volume unit to ft3.
3. Set the conversion factor to 43560.
4. Set the time base unit to Day.
5. Set the flow rate unit to AF/D.

9 Advanced Diagnostics Configuration

Topics covered in this chapter:

- *Introduction*
- *Licensing and enabling*
- *Tunable empty pipe detection*
- *Electronics temperature*
- *Ground/wiring fault detection*
- *High process noise detection*
- *Coated electrode detection*
- *4-20 mA loop verification*
- *SMART™ Meter Verification*
- *Run manual SMART Meter Verification*
- *Continuous SMART Meter Verification*
- *SMART Meter Verification test results*
- *SMART Meter Verification measurements*
- *Optimizing the SMART Meter Verification*

9.1 Introduction

Rosemount magnetic flowmeters provide device diagnostics that detect and warn of abnormal situations throughout the life of the meter - from installation to maintenance and meter verification. With Rosemount magnetic flowmeter diagnostics enabled, plant availability and throughput can be improved, and costs through simplified installation, maintenance and troubleshooting can be reduced.

Table 9-1: Basic diagnostics availability

Diagnostic name	Diagnostic category	Product capability
Tunable Empty Pipe	Process	Standard
Electronics Temperature	Maintenance	Standard
Coil Fault	Maintenance	Standard
Transmitter Fault	Maintenance	Standard
Reverse Flow	Process	Standard
Electrode Saturation	Process	Standard
Coil Current	Maintenance	Standard
Coil Power	Maintenance	Standard

Table 9-2: Advanced diagnostics availability

Diagnostic name	Diagnostic category	Product capability
High Process Noise	Process	Suite 1 (DA1)
Grounding and Wiring Fault	Installation	Suite 1 (DA1)
Coated Electrode Detection	Process	Suite 1 (DA1)
Commanded Meter Verification	Meter Health	Suite 2 (DA2)
Continuous Meter Verification	Meter Health	Suite 2 (DA2)
4-20 mA Loop Verification	Installation	Suite 2 (DA2)

Options for accessing Rosemount Magmeter Diagnostics

Rosemount Magmeter Diagnostics can be accessed through the Local Operator Interface (LOI), a Field Communicator, and AMS[®] Device Manager.

Access diagnostics through the LOI for quicker installation, maintenance, and meter verification

Rosemount Magmeter Diagnostics are available through the LOI to make maintenance of every magmeter easier.

Access diagnostics through AMS Device Manager

The value of the diagnostics increases significantly when AMS is used. The user will see simplified screen flow and procedures on how to respond to the diagnostics messages.

9.2 Licensing and enabling

All advanced diagnostics are licensed by ordering option code DA1, DA2, or both. In the event that a diagnostic option is not ordered, advanced diagnostics can be licensed in the field through the use of a license key. Each transmitter has a unique license key specific to the diagnostic option code. A trial license is also available to enable the advanced diagnostics. This temporary functionality will be automatically disabled after 30-days or when power to the transmitter is cycled, whichever occurs first. This trial code can be used a maximum of three times per transmitter. See the detailed procedures below for entering the license key and enabling the advanced diagnostics. To obtain a permanent or trial license key, contact your local Rosemount representative.

9.2.1 Licensing the diagnostics

1. Power up the transmitter.
2. Verify the software version is 4.4 software or later.

LOI menu path	Detailed Setup > Device Info > Software Rev
---------------	---

- Determine the Device ID.

LOI menu path	Detailed Setup > Device Info > Device ID
---------------	--

- Obtain a license key from a local Rosemount representative.
- Enter license key.

LOI menu path	Diagnostics > Advanced Diag > Licensing > License Key > License Key
---------------	---

- Enable Diagnostics.

LOI menu path	Diagnostics > Diag Controls
---------------	-----------------------------

9.3 Tunable empty pipe detection

The tunable empty pipe detection provides a means of minimizing issues and false readings when the pipe is empty. This is most important in batching applications where the pipe may run empty with some regularity. If the pipe is empty, this diagnostic will activate, set the flow rate to 0, and deliver an alert.

Turning empty pipe on/off

LOI menu path	Diagnostics > Diag Controls > Empty Pipe
---------------	--

The tunable empty pipe detection diagnostic can be turned on or off as required by the application. The empty pipe diagnostic is shipped turned “On” by default.

9.3.1 Tunable empty pipe parameters

The tunable empty pipe diagnostic has one read-only parameter, and two parameters that can be custom configured to optimize the diagnostic performance.

Empty pipe (EP) value

LOI menu path	Diagnostics > Variables > Empty Pipe
---------------	--------------------------------------

This parameter shows the current empty pipe value. This is a read-only value. This number is a unit-less number and is calculated based on multiple installation and process variables such as sensor type, line size, process fluid properties, and wiring. If the empty pipe value exceeds the empty pipe trigger level for a specified number of updates, then the empty pipe diagnostic alert will activate.

Empty pipe (EP) trigger level

LOI menu path	Diagnostics > Basic Diag > Empty Pipe > EP Trig Level
---------------	---

Limits: 3 to 2000

Empty pipe trigger level is the threshold limit that the empty pipe value must exceed before the empty pipe diagnostic alert activates. The default setting from the factory is 100.

Empty pipe (EP) counts

LOI menu path	Diagnostics > Basic Diag > Empty Pipe > EP Counts
---------------	---

Limits: 2 to 50

Empty pipe counts is the number of consecutive updates that the transmitter must receive where the empty pipe value exceeds the empty pipe trigger level before the empty pipe diagnostic alert activates. The default setting from the factory is 5.

9.3.2 Optimizing tunable empty pipe

The tunable empty pipe diagnostic is set at the factory to properly diagnose most applications. If this diagnostic activates, the following procedure can be followed to optimize the empty pipe diagnostic for the application.

Procedure

- Record the empty pipe value with a full pipe condition.
Example:
Full reading = 0.2
- Record the empty pipe value with an empty pipe condition.
Example:
Empty reading = 80.0
- Set the empty pipe trigger level to a value between the full and empty readings.
For increased sensitivity to empty pipe conditions, set the trigger level to a value closer to the full pipe value.
Example:
Set the trigger level to 25.0
- Set the empty pipe counts to a value corresponding to the desired sensitivity level for the diagnostic.

For applications with entrained air or potential air slugs, less sensitivity may be desired.

Example:

Set the counts to 10

9.4 Electronics temperature

The transmitter continuously monitors the temperature of the internal electronics. If the measured electronics temperature exceeds the operating limits of -40 to 140 °F (-40 to 60 °C) the transmitter will go into alarm and generate an alert.

9.4.1 Turning electronics temperature on/off

LOI menu path	Diagnostics > Diag Controls > Elect Temp
---------------	---

The electronics temperature diagnostic can be turned on or off as required by the application. The electronics temperature diagnostic will be turned on by default.

9.4.2 Electronics temperature parameters

The electronics temperature diagnostic has one read-only parameter. It does not have any configurable parameters.

LOI menu path	Diagnostics > Variables > Elect Temp
---------------	---

This parameter shows the current temperature of the electronics. This is a read-only value.

9.5 Ground/wiring fault detection

The transmitter continuously monitors signal amplitudes over a wide range of frequencies. For the ground/wiring fault detection diagnostic, the transmitter specifically looks at the signal amplitude at frequencies of 50 Hz and 60 Hz which are the common AC cycle frequencies found throughout the world. If the amplitude of the signal at either of these frequencies exceeds 5 mV, that is an indication that there is a ground or wiring issue and that stray electrical signals are getting into the transmitter. The diagnostic alert will activate indicating that the ground and wiring of the installation should be carefully reviewed.

The ground/wiring fault detection diagnostic provides a means of verifying installations are done correctly. If the installation is not wired or grounded properly, this diagnostic will activate and deliver an alert. This diagnostic can also detect if the grounding is lost over-time due to corrosion or another root cause.

9.5.1 Turning ground/wiring fault on/off

LOI menu path	Diagnostics > Diag Controls > Ground/Wiring
---------------	--

The ground/wiring fault detection diagnostic can be turned on or off as required by the application. If the advanced diagnostics suite 1 (DA1 Option) was ordered, then the ground/wiring fault detection diagnostic will be turned on. If DA1 was not ordered or licensed, this diagnostic is not available.

9.5.2 Ground/wiring fault parameters

The ground/wiring fault detection diagnostic has one read-only parameter. It does not have any configurable parameters.

Line noise

LOI menu path	Diagnostics > Variables > Line Noise
---------------	---

The line noise parameter shows the amplitude of the line noise. This is a read-only value. This number is a measure of the signal strength at 50/60 Hz. If the line noise value exceeds 5 mV, then the ground/wiring fault diagnostic alert will activate.

9.6 High process noise detection

The high process noise diagnostic detects if there is a process condition causing an unstable or noisy reading that is not an actual flow variation. A common cause of high process noise is slurry flow, like pulp stock or mining slurries. Other conditions that cause this diagnostic to activate are high levels of chemical reaction or entrained gas in the liquid. If unusual noise or flow variation is seen, this diagnostic will activate and deliver an alert. If this situation exists and is left without remedy, it will add additional uncertainty and noise to the flow reading.

9.6.1 Turning high process noise on/off

LOI menu path	Diagnostics > Diag Controls > Process Noise
---------------	--

The high process noise diagnostic can be turned on or off as required by the application. If the advanced diagnostics suite 1 (DA1 Option) was ordered, then the high process noise diagnostic will be turned on. If DA1 was not ordered or licensed, this diagnostic is not available.

9.6.2 High process noise parameters

The high process noise diagnostic has two read-only parameters. It does not have any configurable parameters. This diagnostic requires that flow be present in the pipe and the velocity be greater than 1 ft/s (0.3 m/s).

5 Hz signal to noise ratio (SNR)

LOI menu path	Diagnostics > Variables > 5Hz SNR
---------------	--

This parameter shows the value of the signal to noise ratio at the coil drive frequency of 5 Hz. This is a read-only value. This number is a measure of the signal strength at 5 Hz relative to the amount of process noise. If the transmitter is operating in 5 Hz mode, and the signal to noise ratio remains below 25 for one minute, then the high process noise diagnostic alert will activate.

37 Hz signal to noise ratio (SNR)

LOI menu path	Diagnostics > Variables > 37Hz SNR
---------------	---

This parameter shows the current value of the signal to noise ratio at the coil drive frequency of 37 Hz. This is a read-only value. This number is a measure of the signal strength at 37 Hz relative to the amount of process noise. If the transmitter is operating in 37 Hz mode, and the signal to noise ratio remains below 25 for one minute, then the high process noise diagnostic alert will activate.

9.7 Coated electrode detection

The coated electrode detection diagnostic provides a means of monitoring insulating coating buildup on the measurement electrodes. If coating is not detected, buildup over time can lead to a compromised flow measurement. This diagnostic can detect if the electrode is coated and if the amount of coating is affecting the flow measurement. There are two levels of electrode coating.

- Limit 1 indicates when coating is starting to occur, but has not compromised the flow measurement.
- Limit 2 indicates when coating is affecting the flow measurement and the meter should be serviced immediately.

9.7.1 Turning coated electrode detection on/off

LOI menu path	Diagnostics > Diag Controls > Elec Coating
---------------	---

The coated electrode detection diagnostic can be turned on or off as required by the application. If the advanced diagnostics suite 1 (DA1 option) was ordered, then the coated electrode detection diagnostic will be turned on. If DA1 was not ordered or licensed, this diagnostic is not available.

9.7.2 Coated electrode parameters

The coated electrode detection diagnostic has four parameters. Two are read-only and two are configurable parameters. The electrode coating parameters need to be initially monitored to accurately set the electrode coating limit levels for each application.

Electrode coating (EC) value

LOI menu path	Diagnostics > Advanced Diag > Elec Coating > EC Current Val
---------------	---

The electrode coating value reads the value of the coated electrode detection diagnostic.

Electrode coating (EC) level 1 limit

LOI menu path	Diagnostics > Advanced Diag > Elec Coat > EC Limit 1
---------------	--

Set the criteria for the electrode coating limit 1 which indicates when coating is starting to occur, but has not compromised the flow measurement. The default value for this parameter is 1000 k Ohm.

Electrode coating (EC) level 2 limit

LOI menu path	Diagnostics > Advanced Diag > Elec Coat > EC Limit 2
---------------	--

Set the criteria for the electrode coating limit 2 which indicates when coating is affecting the flow measurement and the meter should be serviced immediately. The default value for this parameter is 2000 k Ohm.

Maximum electrode coating (EC)

LOI menu path	Diagnostics > Advanced Diag > Elec Coat > EC Max Value
---------------	--

The maximum electrode coating value reads the maximum value of the coated electrode detection diagnostic since the last maximum value reset.

Clear maximum electrode value

LOI menu path	Diagnostics > Advanced Diag > Elec Coat > Reset Max Val
---------------	---

Use this method to reset the maximum electrode coating value.

9.8 4-20 mA loop verification

The 4-20 mA loop verification diagnostic provides a means of verifying the analog output loop is functioning properly. This is a manually initiated diagnostic test. This diagnostic checks the integrity of the analog loop and provides a health status of the circuit. If the verification does not pass, this will be highlighted in the results given at the end of the check.

The 4-20 mA loop verification diagnostic is useful for testing the analog output when errors are suspected. The diagnostic tests the analog loop at five different mA output levels:

- 4 mA
- 12 mA
- 20 mA
- Low alarm level
- High alarm level

9.8.1 Initiating 4-20 mA loop verification

LOI menu path	Diagnostics > Advanced Diag > 4-20mA Verify > 4-20mA Verify
---------------	---

The 4-20 mA loop verification diagnostic can be initiated as required by the application. If the advanced diagnostics suite 2 (DA2 Option) was ordered, then the 4-20 mA loop verification diagnostic will be available. If DA2 was not ordered or licensed, this diagnostic is not available.

9.8.2 4-20 mA loop verification parameters

The 4-20 mA loop verification diagnostic has five read-only parameters plus an overall test result. It does not have any configurable parameters.

4-20 mA loop verification test result

LOI menu path	Diagnostics > Advanced Diag > 4-20mA Verify > View Results
---------------	--

Shows the results of the 4-20 mA loop verification test as either passed or failed.

4 mA measurement

LOI menu path	N/A
---------------	-----

Shows the measured value of the 4 mA loop verification test.

12 mA measurement

LOI menu path	N/A
---------------	-----

Shows the measured value of the 12 mA loop verification test.

20 mA measurement

LOI menu path	N/A
---------------	-----

Shows the measured value of the 20 mA loop verification test.

Low alarm measurement

LOI menu path	N/A
---------------	-----

Shows the measured value of the low alarm verification test.

High alarm measurement

LOI menu path	N/A
---------------	-----

Shows the measured value of the high alarm verification test.

9.9 SMART™ Meter Verification

The SMART Meter Verification diagnostic provides a means of verifying the flowmeter is within calibration without removing the sensor from the process. This diagnostic test provides a review of the transmitter and sensor's critical parameters as a means to document verification of calibration. The results of this diagnostic provide the deviation amount from expected values and a pass/fail summary against user-defined criteria for the application and conditions. The SMART Meter Verification diagnostic can be configured to run continuously in the background during normal operation, or it can be manually initiated as required by the application.

9.9.1 Sensor baseline (signature) parameters

The SMART Meter Verification diagnostic functions by taking a baseline sensor signature and then comparing measurements taken during the verification test to these baseline results.

The sensor signature describes the magnetic behavior of the sensor. Based on Faraday's law, the induced voltage measured on the electrodes is proportional to the magnetic field strength. Thus, any changes in the magnetic field will result in a calibration shift of the sensor. Having the transmitter take an initial sensor signature when first installed will provide the baseline for the verification tests that are done in the future. There are three specific measurements that are stored in the transmitter's non-volatile memory that are used when performing the calibration verification.

Coil circuit resistance

LOI menu path	Diagnostics > Advanced Diag > Meter Verif > Sensr Baseline > Values > Coil Resist
---------------	---

The coil circuit resistance is a measurement of the coil circuit health. This value is used as a baseline to determine if the coil circuit is still operating correctly.

Coil inductance (signature)

LOI menu path	Diagnostics > Advanced Diag > Meter Verif > Sensr Baseline > Values > Coil Inductnce
---------------	--

The coil inductance is a measurement of the magnetic field strength. This value is used as a baseline to determine if a sensor calibration shift has occurred.

Electrode circuit resistance

LOI menu path	Diagnostics > Advanced Diag > Meter Verif > Sensr Baseline > Values > Electrode Res
---------------	---

The electrode circuit resistance is a measurement of the electrode circuit health. This value is used as a baseline to determine if the electrode circuit is still operating correctly.

9.9.2 Establishing the sensor baseline (signature)

The first step in running the SMART Meter Verification test is establishing the reference signature that the test will use as the baseline for comparison. This is accomplished by having the transmitter take a signature of the sensor.

Reset baseline (re-signature meter)

LOI menu path	Diagnostics > Advanced Diag > Meter Verif > Sensr Baseline > Re-set Baseline
---------------	---

Having the transmitter take an initial sensor signature when first installed will provide the baseline for the verification tests that are done in the future. The sensor signature should be taken during the start-up process when the transmitter is first connected to the sensor,

with a full line, and ideally with no flow in the line. Running the sensor signature procedure when there is flow in the line is permissible, but this may introduce some noise into the electrode circuit resistance measurement. If an empty pipe condition exists, then the sensor signature should only be run for the coils.

Once the sensor signature process is complete, the measurements taken during this procedure are stored in non-volatile memory to prevent loss in the event of a power interruption to the meter. This initial sensor signature is required for both manual and continuous SMART Meter Verification.

Recall values (recall last saved)

LOI menu path	Diagnostics > Advanced Diag > Meter Verif > Sensr Baseline > Recall Values
---------------	---

In the event that the sensor baseline was reset accidentally or incorrectly, this function will restore the previously saved sensor baseline values.

9.9.3 SMART Meter Verification test criteria

The Smart Meter Verification diagnostic provides the ability to customize the test criteria to which the verification must be tested. The test criteria can be set for each of the flow conditions discussed above.

No flow limit

LOI menu path	Diagnostics > Advanced Diag > Meter Verif > Test Criteria > No Flow
---------------	--

Set the test criteria for the no flow condition. The factory default for this value is set to five percent with limits configurable between one and ten percent. This parameter applies to manually initiated test only.

Flowing full limit

LOI menu path	Diagnostics > Advanced Diag > Meter Verif > Test Criteria > Flowing, Full
---------------	--

Set the test criteria for the flowing, full condition. The factory default for this value is set to five percent with limits configurable between one and ten percent. This parameter applies to manually initiated tests only.

Empty pipe limit

LOI menu path	Diagnostics > Advanced Diag > Meter Verif > Test Criteria > Empty Pipe
---------------	---

Set the test criteria for the empty pipe condition. The factory default for this value is set to five percent with limits configurable between one and ten percent. This parameter applies to manually initiated test only.

Continuous limit

LOI menu path	Diagnostics > Advanced Diag > Meter Verif > Test Criteria > Con- tinual
---------------	--

Set the test criteria for the continuous SMART Meter Verification diagnostic. The factory default for this value is set to five percent with limits configurable between two and ten percent. If the tolerance band is set too tightly, under empty pipe conditions or noisy flowing conditions, a false failure of the transmitter test may occur.

9.10 Run manual SMART Meter Verification

LOI menu path	Diagnostics > Advanced Diag > Meter Verif > Run Meter Ver
---------------	---

The SMART Meter Verification diagnostic will be available if the advanced diagnostic suite (DA2) was ordered. If DA2 was not ordered or licensed, this diagnostic will not be available. This method will initiate the manual meter verification test.

9.10.1 Test conditions

LOI menu path	Diagnostics > Advanced Diag > Meter Verif > Run Meter Ver > Test Condition
---------------	---

SMART Meter Verification can be initiated under three possible test conditions. This parameter is set at the time that the sensor baseline or SMART Meter Verification test is manually initiated.

No flow

Run the SMART Meter Verification test with a full pipe and no flow in the line. Running the SMART Meter Verification test under this condition provides the most accurate results and the best indication of magnetic flowmeter health.

Flowing full

Run the SMART Meter Verification test with a full pipe and flow in the line. Running the SMART Meter Verification test under this condition provides the ability to verify the magnetic flowmeter health without shutting down the process flow in applications when a shutdown is not possible. Running the diagnostic under flowing conditions can cause a false test failure if there is significant process noise present.

Empty pipe

Run the SMART Meter Verification test with an empty pipe. Running the SMART Meter Verification test under this condition provides the ability to verify the magnetic flowmeter health with an empty pipe. Running the verification diagnostic under empty pipe conditions will not check the electrode circuit health.

9.10.2 Test scope

The manually initiated SMART Meter Verification test can be used to verify the entire flowmeter installation or individual parts such as the transmitter or sensor. This parameter is set at the time that the SMART Meter Verification test is manually initiated. There are three test scopes from which to choose.

LOI menu path	Diagnostics > Advanced Diag > Meter Verif > Run Meter Ver > Test Scope
---------------	---

All

Run the SMART Meter Verification test and verify the entire flowmeter installation. This parameter results in the diagnostic performing the transmitter calibration verification, sensor calibration verification, coil health check, and electrode health check. Transmitter calibration and sensor calibration are verified to the percentage associated with the test condition selected when the test was initiated. This setting applies to manually initiated tests only.

Transmitter

Run the SMART Meter Verification test on the transmitter only. This results in the verification test only checking the transmitter calibration to the limits of the test criteria selected when the verification test was initiated. This setting applies to manually initiated tests only.

Sensor

Run the SMART Meter Verification test on the sensor only. This results in the verification test checking the sensor calibration to the limits of the test criteria selected when the SMART Meter Verification test was initiated, verifying the coil circuit health, and the electrode circuit health. This setting applies to manually initiated tests only.

9.11 Continuous SMART Meter Verification

Continuous SMART Meter Verification can be used to monitor and verify the health of the flowmeter system. The continuous SMART Meter Verification will not report results until 30 minutes after powering up to ensure the system is stable and to avoid false failures.

9.11.1 Test scope

Continuous SMART Meter Verification can be configured to monitor the sensor coils, electrodes, analog output, and transmitter calibration. All of these parameters can be individually enabled or disabled. These parameters apply to continuous SMART Meter Verification only.

Coils

LOI menu path	Diagnostics > Diag Controls > Cont Meter Ver > Coils
---------------	--

Continuously monitor the sensor coil circuit by enabling this continuous SMART Meter Verification parameter.

Electrodes

LOI menu path	Diagnostics > Diag Controls > Cont Meter Ver > Electrodes
---------------	---

Continuously monitor the electrode resistance by enabling this continuous SMART Meter Verification parameter.

Transmitter

LOI menu path	Diagnostics > Diag Controls > Cont Meter Ver > Transmitter
---------------	--

Continuously monitor the transmitter calibration by enabling this continuous SMART Meter Verification parameter.

Analog output

LOI menu path	Diagnostics > Diag Controls > Cont Meter Ver > Analog Output
---------------	--

Continuously monitor the analog output signal by enabling this continuous SMART Meter Verification parameter.

9.12 SMART Meter Verification test results

If the SMART Meter Verification test is manually initiated, the transmitter will make several measurements to verify the transmitter calibration, sensor calibration, coil circuit health, and electrode circuits health. The results of these tests can be reviewed and recorded on the [Table 9-3](#) form. Print the "Manual Calibration Verification Results" form and enter the test results as you view them. The completed form can be used to validate that the meter is within the required calibration limits to comply with governmental regulatory agencies.

Depending on the method used to view the results, they will be displayed in either a menu structure, as a method, or in the report format. When using the HART[®] Field Communicator, each individual parameter can be viewed as a menu item. When using the LOI, the parameters are viewed as a method using the left arrow key to cycle through the results. In AMS, the calibration verification report is populated with the necessary data eliminating the need to manually complete the form.

When using AMS there are two possible methods that can be used to print the report:

- Method one involves using the print functionality within the EDDL screen. This print functionality essentially prints a screen shot of the report.
- Method two involves using the print feature within AMS while on the Maintenance Service Tools screen. This will result in a printout of all of the maintenance information. Page one of the report contains the meter verification result data.

The results are displayed in the order found in the table below. Each parameter displays a value used by the diagnostic to evaluate meter health.

Table 9-3: Manual Smart Meter Verification Test Parameters

	Parameter	LOI menu path (Diagnostics > Variables > MV Results > Manual Results)
1	Test Condition	Test Condition
2	Test Criteria	Test Criteria
3	8714i Test Result	MV Results
4	Simulated Velocity	Sim Velocity
5	Actual Velocity	ActualVelocity
6	Velocity Deviation	Flow Sim Dev
7	Xmtr Cal Test Result	Xmtr Cal Verify
8	Sensor Cal Deviation	Sensor Cal Dev
9	Sensor Cal Test Result	Sensor Cal
10	Coil Circuit Test Result	Coil Circuit
11	Electrode Circuit Test Result	Electrode Ckt

Table 9-4: Continuous SMART Meter Verification Test Parameters

	Parameter	LOI menu path (Diagnostics > Variables > MV Results > Continual Res)
1	Continuous Limit	Test Criteria
2	Simulated Velocity	Sim Velocity
3	Actual Velocity	ActualVelocity
4	Velocity Deviation	Flow Sim Dev
5	Coil Signature	Coil Inductnce
6	Sensor Cal Deviation	Sensor Cal Dev
7	Coil Resistance	Coil Resist

Table 9-4: Continuous SMART Meter Verification Test Parameters (continued)

	Parameter	LOI menu path (Diagnostics > Variables > MV Results > Continual Res)
8	Electrode Resistance	Electrode Res
9	mA Expected	4–20 mA Expect
10	mA Actual	4–20 mA Actual
11	mA Deviation	AO FB Dev

9.13 SMART Meter Verification measurements

The SMART Meter Verification test will make measurements of the coil resistance, coil signature, and electrode resistance and compare these values to the values taken during the sensor signature process to determine the sensor calibration deviation, the coil circuit health, and the electrode circuit health. In addition, the measurements taken by this test can provide additional information when troubleshooting the meter.

Coil circuit resistance

LOI menu path	Manual: Diagnostics > Advanced Diag > Meter Verif > Measurements > Manual Measure > Coil Resist Continuous: Diagnostics > Advanced Diag > Meter Verif > Measurements > Continual Meas > Coil Resist
---------------	--

The coil circuit resistance is a measurement of the coil circuit health. This value is compared to the coil circuit resistance baseline measurement taken during the sensor signature process to determine coil circuit health. This value can be continuously monitored using continuous SMART Meter Verification.

Coil signature

LOI menu path	Manual: Diagnostics > Advanced Diag > Meter Verif > Measurements > Manual Measure > Coil Inductnce Continuous: Diagnostics > Advanced Diag > Meter Verif > Measurements > Continual Meas > Coil Inductnce
---------------	--

The coil signature is a measurement of the magnetic field strength. This value is compared to the coil signature baseline measurement taken during the sensor signature process to determine sensor calibration deviation. This value can be continuously monitored using continuous SMART Meter Verification.

Electrode circuit resistance

LOI menu path	Manual: Diagnostics > Advanced Diag > Meter Verif > Measurements > Manual Measure > Electrode Res Continuous: Diagnostics > Advanced Diag > Meter Verif > Measurements > Continual Meas > Electrode Res
---------------	--

The electrode circuit resistance is a measurement of the electrode circuit health. This value is compared to the electrode circuit resistance baseline measurement taken during the sensor signature process to determine electrode circuit health. This value can be continuously monitored using continuous SMART Meter Verification.

Actual velocity

LOI menu path	Manual: Diagnostics > Advanced Diag > Meter Verif > Measurements > Manual Measure > ActualVelocity Continuous: Diagnostics > Advanced Diag > Meter Verif > Measurements > Continual Meas > ActualVelocity
---------------	--

The actual velocity is a measurement of the simulated velocity signal. This value is compared to the simulated velocity to determine transmitter calibration deviation. This value can be continuously monitored using continuous SMART Meter Verification.

Flow simulation deviation

LOI menu path	Manual: > Diagnostics > Variables > MV Results > Manual Results > Flow Sim Dev Continuous: > Diagnostics > Variables > MV Results > Continual Res > Flow Sim Dev
---------------	---

The flow simulation deviation is a measurement of the percent difference between the simulated velocity and the actual measured velocity from the transmitter calibration verification test. This value can be continuously monitored using continuous SMART Meter Verification.

4-20 mA expected value

LOI menu path	Manual: Diagnostics > Advanced Diag > 4-20 mA Verify > View Results Continuous: Diagnostics > Advanced Diag > Meter Verif > Measurements > Continual Meas > 4-20 mA Expect
---------------	---

The 4-20 mA expected value is the simulated analog signal used for the 4-20 mA meter verification test. This value is compared to the actual analog signal to determine analog output deviation. This value can be continuously monitored using continuous SMART Meter Verification.

4-20 mA actual value

LOI menu path	Manual: Diagnostics > Advanced Diag > 4-20 mA Verify > View Results Continuous: Diagnostics > Advanced Diag > Meter Verif > Measurements > Continual Meas > 4-20 mA Actual
---------------	---

The 4-20 mA actual value is the measured analog signal used for the 4-20 mA meter verification test. This value is compared to the simulated analog signal to determine analog output deviation. This value can be continuously monitored using continuous SMART Meter Verification.

4-20 mA deviation

LOI menu path	Manual: Diagnostics > Advanced Diag, > 4-20 mA Verify > View Results Continuous: Diagnostics > Advanced Diag > Meter Verif > Measurements > Continual Meas > AO FB Dev
---------------	---

The 4-20 mA deviation is a measurement of the percent difference between the simulated analog signal and the actual measured analog signal from the analog output verification test. This value can be continuously monitored using continuous SMART Meter Verification.

9.14 Optimizing the SMART Meter Verification

The SMART Meter Verification diagnostic can be optimized by setting the test criteria to the desired levels necessary to meet the compliance requirements of the application. The following examples below will provide some guidance on how to set these levels.

An effluent meter must be certified annually to comply with environmental regulations. This example regulation requires that the meter be certified to five percent. Since this is an effluent meter, shutting down the process may not be viable. In this instance the SMART Meter Verification test will be performed under flowing conditions. Set the test criteria for flowing, full to five percent to meet the requirements of the governmental agencies.

A pharmaceutical company requires bi-annual verification of meter calibration on a critical feed line for one of their products. This is an internal standard, and the plant requires a calibration record be kept on-hand. Meter calibration on this process must meet two percent. The process is a batch process so it is possible to perform the calibration

verification with the line full and with no flow. Since the SMART Meter Verification test can be run under no flow conditions, set the test criteria for no flow to two percent to comply with the necessary plant standards.

A food and beverage company requires an annual calibration of a meter on a product line. The plant standard calls for the accuracy to be three percent or better. They manufacture this product in batches, and the measurement cannot be interrupted when a batch is in process. When the batch is complete, the line goes empty. Since there is no means of performing the SMART Meter Verification test while there is product in the line, the test must be performed under empty pipe conditions. The test criteria for empty pipe should be set to three percent, and it should be noted that the electrode circuit health cannot be verified.

For continuous SMART Meter Verification, there is only one test criteria value to configure, and it will be used for all flow conditions. The factory default is set to five percent to minimize the potential for false failures under empty pipe conditions. For best results, set the criteria to match the maximum value of the three test criteria set during manual meter verification (no flow, flowing full, and empty pipe). For example, a plant might set the following manual meter verification test criteria: two percent for no flow, three percent for flowing full, and four percent for empty pipe. In this case, the maximum test criterion is four percent, so the test criteria for continuous SMART Meter Verification should be set to four percent. If the tolerance band is set too tightly, under empty pipe conditions or noisy flowing conditions, a false failure of the transmitter test may occur.

9.14.1 Optimizing continuous SMART Meter Verification

For continuous SMART Meter Verification, there is only one test criteria value to configure, and it will be used for all flow conditions. The factory default is set to five percent to minimize the potential for false failures under empty pipe conditions. For best results, set the criteria to match the maximum value of the three test criteria set during manual meter verification (no flow, flowing full, and empty pipe).

For example, a plant might set the following manual meter verification test criteria: two percent for no flow, three percent for flowing full, and four percent for empty pipe. In this case, the maximum test criterion is four percent, so the test criteria for continuous SMART Meter Verification should be set to four percent. If the tolerance band is set too tightly, under empty pipe conditions or noisy flowing conditions, a false failure of the transmitter test may occur.

Manual Calibration Verification Results

Report parameters	
User Name: _____ _____	Calibration Conditions: <input type="checkbox"/> Internal <input type="checkbox"/> External
Tag #: _____ _____	Test Conditions: <input type="checkbox"/> Flowing <input type="checkbox"/> No Flow, Full Pipe <input type="checkbox"/> Empty Pipe
Flowmeter information and configuration	
Software Tag:	PV URV (20 mA scale): _____ _____
Calibration Number:	PV LRV (4 mA scale): _____ _____
Line Size:	PV Damping: _____ _____
Transmitter calibration verification results	
Simulated Velocity:	Sensor calibration verification results
Actual Velocity:	Sensor Deviation %: _____ _____
Deviation %:	Sensor Test: <input type="checkbox"/> PASS / <input type="checkbox"/> FAIL / <input type="checkbox"/> NOT TESTED
Transmitter: <input type="checkbox"/> PASS / <input type="checkbox"/> FAIL / <input type="checkbox"/> NOT TESTED	Coil Circuit Test: <input type="checkbox"/> PASS / <input type="checkbox"/> FAIL / <input type="checkbox"/> NOT TESTED
	Electrode Circuit Test: <input type="checkbox"/> PASS / <input type="checkbox"/> FAIL / <input type="checkbox"/> NOT TESTED
Summary of Calibration Verification results	
Verification Results: The result of the flowmeter verification test is: <input type="checkbox"/> PASSED / <input type="checkbox"/> FAILED	
Verification Criteria: This meter was verified to be functioning within _____ % of deviation from the original test parameters.	
Signature: _____ _____	Date: _____ _____

10 Digital Signal Processing

Topics covered in this chapter:

- *Introduction*
- *Safety messages*
- *Process noise profiles*
- *High process noise diagnostic*
- *Optimizing flow reading in noisy applications*
- *Explanation of signal processing algorithm*

10.1 Introduction

Magneters are used in applications that can create noisy flow readings. The transmitter has the capability to deal with difficult applications that have previously manifested themselves in a noisy output signal. In addition to selecting a higher coil drive frequency (37 Hz vs. 5 Hz) to isolate the flow signal from the process noise, the microprocessor has digital signal processing that is capable of rejecting the noise specific to the application. This section explains the different types of process noise, provides instructions for optimizing the flow reading in noisy applications, and provides a detailed description of the digital signal processing functionality.

10.2 Safety messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Read the following safety messages before performing any operation described in this section.

⚠ WARNING!

Explosions could result in death or serious injury.

- Verify the operating atmosphere of the sensor and transmitter is consistent with the appropriate hazardous locations certifications.
- Do not remove the transmitter cover in explosive atmospheres when the circuit is live.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

Failure to follow safe installation and servicing guidelines could result in death or serious injury.

- Installation should be performed by qualified personnel only.
- Do not perform any service other than those contained in this manual.
- Process leaks may result in death or serious injury.
- The electrode compartment may contain line pressure; it must be depressurized before the cover is removed.

High voltage that may be present on leads could cause electrical shock.

- Avoid contact with leads and terminals.

10.3 Process noise profiles

1/f noise

This type of noise has higher amplitudes at lower frequencies, but generally degrades over increasing frequencies. Potential sources of 1/f noise include chemical mixing and slurry flow particles rubbing against the electrodes.

Spike noise

This type of noise generally results in a high amplitude signal at specific frequencies which can vary depending on the source of the noise. Common sources of spike noise include chemical injections directly upstream of the flowmeter, hydraulic pumps, and slurry flows with low concentrations of particles in the stream. The particles bounce off of the electrode generating a “spike” in the electrode signal. An example of this type of flow stream would be a recycle flow in a paper mill.

White noise

This type of noise results in a high amplitude signal that is relatively constant over the frequency range. Common sources of white noise include chemical reactions or mixing that occurs as the fluid passes through the flowmeter and high concentration slurry flows where the particulates are constantly passing over the electrode head. An example of this type of flow stream would be a basis weight stream in a paper mill.

10.4 High process noise diagnostic

The transmitter continuously monitors signal amplitudes over a wide range of frequencies. For the high process noise diagnostic, the transmitter specifically looks at the signal amplitude at frequencies of 2.5 Hz, 7.5 Hz, 32.5 Hz, and 42.5 Hz. The transmitter uses the values from 2.5 and 7.5 Hz and calculates an average noise level. This average is compared to the amplitude of the signal at 5 Hz. If the signal amplitude is not 25 times greater than the noise level, and the coil drive frequency is set at 5 Hz, the high process noise diagnostic will trip indicating that the flow signal may be compromised. The transmitter performs the same analysis around the 37.5 Hz coil drive frequency using the 32.5 Hz and 42.5 Hz values to establish a noise level.

10.5 Optimizing flow reading in noisy applications

If the flow reading is unstable, first check the wiring, grounding, and process reference associated with the magnetic flowmeter system. Ensure that the following conditions are met:

- Ground straps are attached to the adjacent flange or ground ring
- Grounding rings, lining protectors, or a process reference electrode are being used in lined or non-conductive piping

The causes of unstable transmitter output can usually be traced to extraneous voltages on the measuring electrodes. This “process noise” can arise from several causes including electrochemical reactions between the fluid and the electrode, chemical reactions in the process itself, free ion activity in the fluid, or some other disturbance of the fluid/electrode capacitive layer. In such noisy applications, an analysis of the frequency spectrum reveals process noise that typically becomes significant below 15 Hz.

In some cases, the effects of process noise may be sharply reduced by elevating the coil drive frequency above the 15 Hz region. Coil drive mode is selectable between the standard 5 Hz and the noise-reducing 37 Hz.

10.5.1 Coil drive frequency

LOI menu path	Detailed Setup > Additional Params > Coil Drive Freq
---------------	--

This parameter changes the pulse rate of the magnetic coils.

5 Hz

The standard coil drive frequency is 5 Hz, which is sufficient for nearly all applications.

37 Hz

If the process fluid causes a noisy or unstable flow reading, increase the coil drive frequency to 37 Hz. If the 37 Hz mode is selected, perform the auto zero function for optimum performance.

10.5.2 Auto zero

LOI menu path	Diagnostics > Trims > Auto Zero
---------------	--

To ensure optimum accuracy when using 37 Hz coil drive mode, there is an auto zero function that should be initiated. When using 37 Hz coil drive mode it is important to zero the system for the specific application and installation.

The auto zero procedure should be performed only under the following conditions:

- With the transmitter and sensor installed in their final positions. This procedure is not applicable on the bench.
- With the transmitter in 37 Hz coil drive mode. Never attempt this procedure with the transmitter in 5 Hz coil drive mode.
- With the sensor full of process fluid at zero flow.

These conditions should cause an output equivalent to zero flow.

Set the loop to manual if necessary and begin the auto zero procedure. The transmitter completes the procedure automatically in about 90 seconds. A clock symbol will appear in the lower right-hand corner of the display to indicate that the procedure is running.

Note

Failure to complete an auto zero may result in a flow velocity error of 5 to 10% at 1 ft/s (0.3 m/s). While the output level will be offset by the error, the repeatability will not be affected.

10.5.3 Digital signal processing (DSP)

LOI menu path	Detailed Setup > Signal Processing
---------------	--

The transmitter contains several advanced functions that can be used to stabilize erratic outputs caused by process noise. The signal processing menu contains this functionality. If the 37 Hz coil drive frequency has been set, and the output is still unstable, the damping and signal processing function should be used. It is important to set the coil drive frequency to 37 Hz to increase the flow sampling rate. The transmitter provides an easy and straightforward start-up, and also incorporates the capability to deal with difficult applications that have previously manifested themselves in a noisy output signal. In addition to selecting a higher coil drive frequency (37 Hz vs. 5 Hz) to isolate the flow signal from the process noise, the microprocessor can scrutinize each input based on three user-defined parameters to reject the noise specific to the application.

Operating mode

LOI menu path	Detailed Setup > Signal Processing > Operating Mode
---------------	--

The operating mode should be used only when the signal is noisy and gives an unstable output. Filter mode automatically uses 37 Hz coil drive mode and activates signal processing at the factory set default values. When using filter mode, perform an auto zero with no flow and a full sensor. Either of the parameters, coil drive mode or signal processing, may still be changed individually. Turning signal processing off or changing the coil drive frequency to 5 Hz will automatically change the operating mode from filter mode to normal mode. This software technique, known as signal processing, “qualifies” individual flow signals based on historic flow information and three user-definable parameters, plus an on/off control. These parameters are described below.

Status

LOI menu path	Detailed Setup > Signal Processing > Main Config DSP > Status
---------------	---

Enable or disable the DSP capabilities. When ON is selected, the output is derived using a running average of the individual flow inputs. Signal processing is a software algorithm that examines the quality of the electrode signal against user-specified tolerances. The three parameters that make up signal processing (number of samples, maximum percent limit, and time limit) are described below.

Number of samples

LOI menu path	Detailed Setup > Signal Processing > Main Config DSP > Samples
---------------	--

The number of samples sets the amount of time that inputs are collected and used to calculate the average value. Each second is divided into tenths with the number of samples equaling the number of increments used to calculate the average. This parameter can be configured for an integer value between 1 and 125. The default value is 90 samples.

For example:

- A value of 1 averages the inputs over the past $1/10$ second
- A value of 10 averages the inputs over the past 1 second
- A value of 100 averages the inputs over the past 10 seconds
- A value of 125 averages the inputs over the past 12.5 seconds

Percent limit

LOI menu path	Detailed Setup > Signal Processing > Main Config DSP > % Limit
---------------	--

This parameter will set the tolerance band on either side of the running average, referring to percent deviation from the average. Values within the limit are accepted while value outside the limit are scrutinized to determine if they are a noise spike or an actual flow change. This parameter can be configured for an integer value between 0 and 100 percent. The default value is 2 percent.

Time limit

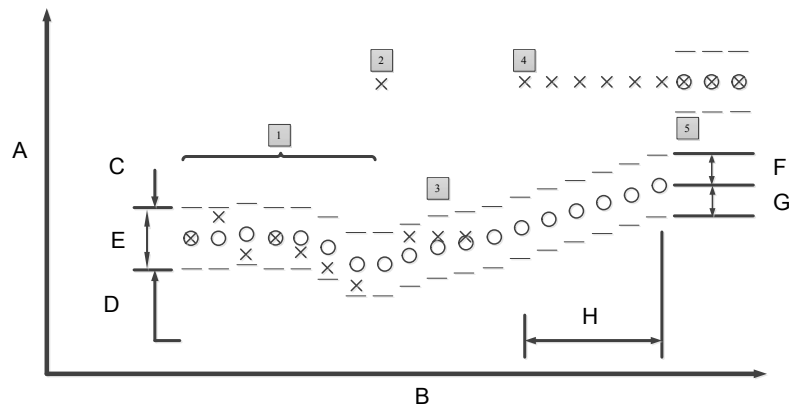
LOI menu path	Detailed Setup > Signal Processing > Main Config DSP > Time Limit
---------------	---

The time limit parameter forces the output and running average values to the new value of an actual flow rate change that is outside the percent limit boundaries. It thereby limits response time to flow changes to the time limit value rather than the length of the running average. If the number of samples selected is 100, then the response time of the system is 10 seconds. In some cases this may be unacceptable. Setting the time limit forces the transmitter to clear the value of the running average and re-establish the output and average at the new flow rate once the time limit has elapsed. This parameter limits the response time added to the loop. A suggested time limit value of two seconds is a good starting point for most applicable process fluids. This parameter can be configured for a value between 0.6 and 256 seconds. The default value is 2 seconds.

10.6 Explanation of signal processing algorithm

An example plotting flow rate versus time is given below to help visualize the signal processing algorithm.

Figure 10-1: Signal Processing Functionality



- A. Flow rate
 B. Time (10 samples = 1 second)
 C. Upper value
 D. Lower value
 E. Tolerance band
 F. Maximum percent limit
 G. Minimum percent limit
 H. Time limit
- X = Input flow signal from sensor
 - O = Average flow signals and transmitter output, determined by the number of samples parameter
 - Tolerance band, determined by the percent limit parameter
 - Upper value = average flow + [(percent limit/100) average flow]
 - Lower value = average flow - [(percent limit/100) average flow]

1. This scenario is that of a typical non-noisy flow. The input flow signal is within the percent limit tolerance band, therefore qualifying itself as a good input. In this case the new input is added directly into the running average and is passed on as a part of the average value to the output.
2. This signal is outside the tolerance band and therefore is held in memory until the next input can be evaluated. The running average is provided as the output.
3. The previous signal currently held in memory is simply rejected as a noise spike since the next flow input signal is back within the tolerance band. This results in complete rejection of noise spikes rather than allowing them to be “averaged” with the good signals as occurs in the typical damping circuits.
4. As in number 2 above, the input is outside the tolerance band. This first signal is held in memory and compared to the next signal. The next signal is also outside the tolerance band (in the same direction), so the stored value is added to the running average as the next input and the running average begins to slowly approach the new input level.

5. To avoid waiting for the slowly incrementing average value to catch up to the new level input, an algorithm is provided. This is the “time limit” parameter. The user can set this parameter to eliminate the slow ramping of the output toward the new input level.

11 Maintenance

Topics covered in this chapter:

- *Introduction*
- *Safety information*
- *Installing a local operator interface (LOI)*
- *Replacing electronics stack*
- *Replacing a terminal block socket module*
- *Replacing a terminal block with amp clips*
- *Trims*

11.1 Introduction

This section covers basic transmitter maintenance. Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Read the following safety messages before performing any operation described in this section. Refer to these warnings when appropriate throughout this section.

11.2 Safety information

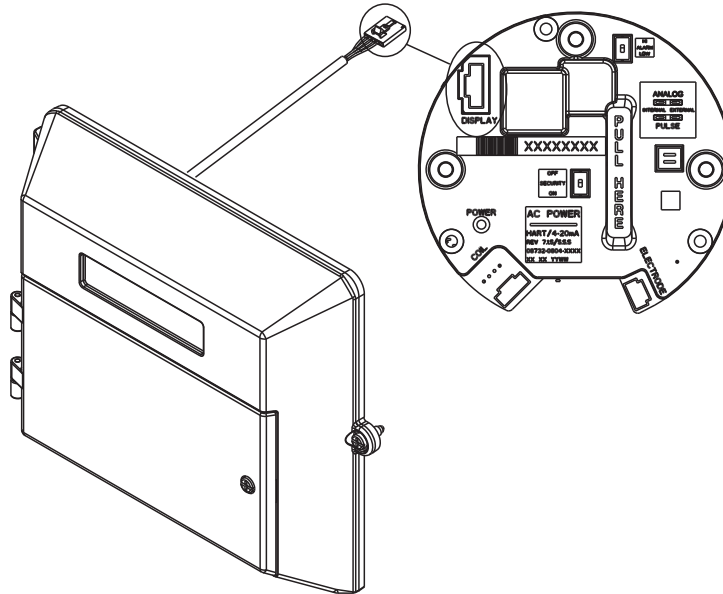
WARNING!

Failure to follow these maintenance guidelines could result in death or serious injury.

- **Installation and servicing instructions should be performed by qualified personnel only.**
- **Do not perform any servicing other than that contained in the operating instructions.**
- **Verify the operating environment of the sensor and transmitter is consistent with the appropriate hazardous area approval.**
- **Do not connect the transmitter to a non-Rosemount sensor that is located in an explosive atmosphere.**
- **Mishandling products exposed to a hazardous substance may result in death or serious injury.**
- **If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned goods.**

11.3 Installing a local operator interface (LOI)

Figure 11-1: Rosemount 8712 cover assembly with LOI



Procedure

1. If the transmitter is installed in a control loop, secure the loop.
2. Remove power from the transmitter.
3. Loosen the upper door screw and open the top electronics compartment of the transmitter housing.

Note

See [Section 4.4.6](#) for details on the covers.

4. Remove the existing blind door by lifting it up and away from the transmitter housing.
5. Align the new LOI door pins with the transmitter hinges and install the new door by pushing it down towards the transmitter housing.
6. Plug the serial connector from the back of the LOI into the receptacle on the electronics stack.
7. Once the serial connector is installed on the electronics stack, install the wire clamp around the cable, securely tighten the screw, washers, and wire clamp into the top left housing post of the transmitter housing.

8. Close the upper compartment door and tighten the upper door screw to ensure the housing is properly sealed to meet ingress protection requirements. Return power to the transmitter and verify that it is functioning correctly and reporting the expected flow rate.
9. If installed in a control loop, return the loop to automatic control.

11.4 Replacing electronics stack

Prerequisites

Verify the model number is correct. If the transmitter model is not correct, the replacement electronics are not compatible.

Procedure

1. If the transmitter is installed in a control loop, secure the loop.
2. Remove power from the transmitter.
3. Loosen the upper door screw and open the top electronics compartment of the transmitter housing. Note

Note

See [Section 4.4.6](#) for details on the covers.

4. If applicable, unplug the display connector from the top receptacle on the electronics stack.
5. Unplug the coil connector from the top receptacle on the electronics stack.
6. Unplug the electrode connector from the top receptacle on the electronics stack.
7. Remove the three screws that secure the electronics stack into the housing.
8. Remove the old electronics by pulling the electronics board stack handle directly away from the transmitter housing.
9. Remove the screws from the old electronics stack and insert them into the new electronics stack.
10. While holding onto the new electronics handle, align the electronics stack with the housing, and push the electronics stack into the housing.
11. Securely tighten the three electronic stack screws into the housing.
12. If applicable, plug the display connector into the display receptacle on the top of the electronics stack.
13. Plug the coil connector into the coil receptacle on the top of the electronics stack.
14. Plug the electrode connector into the electrode receptacle on the top of the electronics stack.
15. Close the upper compartment door and tighten the upper door screw to ensure the housing is properly sealed to meet ingress protection requirements. Return power to the transmitter and verify that it is functioning correctly and reporting the expected flow rate.

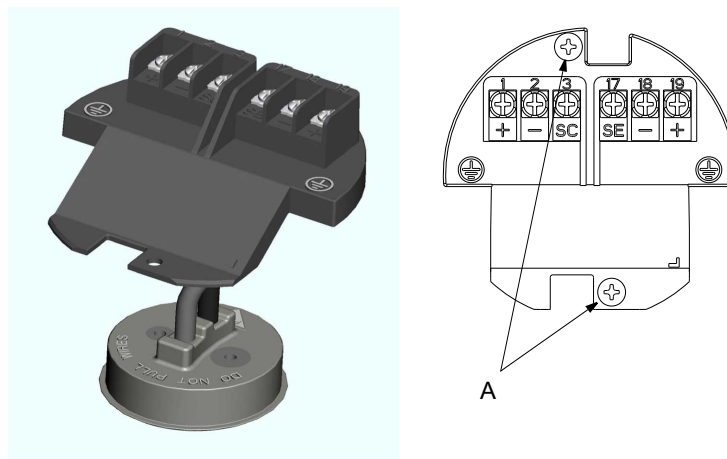
16. If installed in a control loop, return the loop to automatic control.

11.5 Replacing a terminal block socket module

Prerequisites

The terminal block socket module is shown in [Figure 11-2](#). To gain access to the socket module, remove the junction box from the sensor adapter.

Figure 11-2: Socket Module—Terminal Block



- A. *Mounting screws:*
- 2X—standard
 - 4X—with I.S. divider

11.5.1 Removing a terminal block socket module

1. Disconnect power to the transmitter and the remote cabling connected to the terminal block.
2. Remove the junction box cover to gain access to the remote cabling.
3. To disconnect the terminal block from the junction box housing, remove the two mounting screws and the two divider mounting screws (if applicable).
4. Pull up on the terminal block to expose the socket module base.
5. To remove the socket module, loosen the two mounting screws and pull up on the socket module from the base.
6. When removing the socket module, do not pull on the wires.

11.5.2 Installing a terminal block socket module

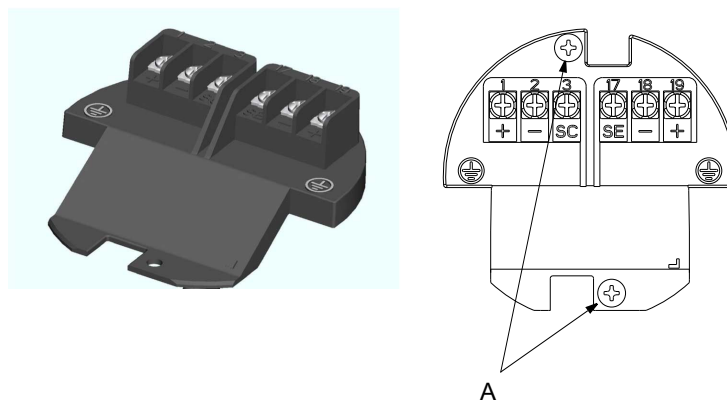
1. Insert the new terminal block socket module, press the base into its keyed position, and tighten the two mounting screws.
2. Connect the terminal block to the junction box housing by tightening the two mounting screws.

Install the divider with the two mounting screws if applicable.

3. Reconnect remote cabling and power and replace junction box cover.

11.6 Replacing a terminal block with amp clips

Figure 11-3: Terminal block with amp clips



- A. *Mounting screws:*
- 2X—standard
 - 4X—with I.S. divider

11.6.1 Removing a terminal block

1. Disconnect power to the transmitter.
2. Remove the junction box cover on the sensor to gain access to the remote cabling and disconnect the remote cabling connected to the terminal block.
3. To disconnect the terminal block from the junction box housing, remove the two mounting screws and the two divider mounting screws (if applicable).
4. Pull up on the terminal block to expose the connecting wires.
5. To remove the terminal block, unclip both wire connectors.

11.6.2 Installing a terminal block

1. Clip the connecting wires to the back of the terminal block, the clips are different sizes and must be connected to their matching receptacle.
2. Connect the terminal block to the junction box housing by tightening the two mounting screws. Install the divider with the two mounting screws if applicable.
3. Reconnect remote cabling, replace the junction box cover on the sensor, and connect power.

11.7 Trims

Trims are used to calibrate the analog loop, calibrate the transmitter, re-zero the transmitter, and calibrate the transmitter with another manufacturer's sensor. Proceed with caution whenever performing a trim function.

11.7.1 D/A trim

LOI menu path	Diagnostics > Trims > D/A Trim
---------------	---

The D/A trim is used to calibrate the 4-20mA analog loop output from the transmitter. For maximum accuracy, the analog output should be trimmed for your system loop. Use the following steps to complete the output trim function.

Procedure

1. Set the loop to manual, if necessary.
2. Connect a precision ammeter in the 4-20mA loop.
3. Initiate the D/A trim function with the LOI or Handheld Communicator.
4. Enter the 4mA meter value when prompted.
5. Enter the 20mA meter value when prompted.
6. Return the loop to automatic control, if necessary.

The 4-20mA trim is now complete. The D/A trim can be repeated to check the results. Alternatively, the analog output test can also be used to verify loop performance.

11.7.2 Scaled D/A trim

A scaled D/A trim enables calibration of the flowmeter analog output using a different scale than the standard 4-20mA output scale. Non-scaled D/A trimming (described above), is typically performed using an ammeter where calibration values are entered in units of milliamperes. Scaled D/A trimming enables trimming of the flowmeter using a scale that may be more convenient based upon the method of measurement.

For example, it may be more convenient to make current measurements by direct voltage readings across the loop resistor. If the loop resistor is 500 ohms, and calibration of the meter will be done using voltage measurements across this resistor, the trim points can be rescaled from 4-20mA to 4-20mA x 500 ohm or 2-10VDC. Once the scaled trim points have been entered as 2 and 10, calibration of the flowmeter can be done by entering voltage measurements directly from the voltmeter.

11.7.3 Digital trim

LOI menu path	Diagnostics > Trims > Digital Trim
---------------	---

Digital trim is the function by which the factory calibrates the transmitter. This procedure is rarely needed by users. It is only necessary if the transmitter is suspected to be no longer accurate. A Rosemount 8714D Calibration Standard is required to complete a digital trim. Attempting a digital trim without a Rosemount 8714D Calibration Standard may result in an inaccurate transmitter or an error message. The digital trim must be performed with the coil drive mode set to 5Hz and with a nominal sensor calibration number stored in the memory.

Note

Attempting a digital trim without a Rosemount 8714D Calibration Standard may result in an inaccurate transmitter, or a “DIGITAL TRIM FAILURE” message may appear. If this message occurs, no values were changed in the transmitter. Simply cycle power on the transmitter to clear the message.

To simulate a nominal sensor with the Rosemount 8714D Calibration Standard, change/verify the following five parameters in the transmitter:

- Calibration Number-1000015010000000
- Units-ft/s
- PV URV-20mA = 30.00 ft/s
- PV LRV-4mA = 0 ft/s
- Coil Drive Frequency-5Hz

Before changing any of the configuration parameters, be sure to record the original values so that the transmitter can be returned to the original configuration prior to being placed back into operation. Failure to return the settings to the original configuration will result in incorrect flow and totalizer readings.

The instructions for changing the calibration number, units, PV URV, and PV LRV are located in [Section 5.1](#). Instructions for changing the coil drive frequency can be found on [Section 8.5.1](#).

Set the loop to manual (if necessary) and then complete the following steps:

Procedure

1. Power down the transmitter.

2. Connect the transmitter to a Rosemount 8714D Calibration Standard.
3. Power up the transmitter with the Rosemount 8714D connected and read the flow rate.

The electronics need about a 5-minute warm-up time to stabilize.

4. Set the 8714D Calibration Standard to the 30 ft/s (9.1 m/s) setting.
5. The flow rate reading after warm-up should be between 29.97 (9.1 m/s) and 30.03 ft/s (9.2 m/s).
6. If the reading is within the range, return the transmitter to the original configuration parameters.
7. If the reading is not within this range, initiate a digital trim with the LOI or Handheld Communicator.

The digital trim takes about 90 seconds to complete. No transmitter adjustments are required.

11.7.4 37 Hz auto zero trim

To ensure optimum accuracy when using 37 Hz coil drive mode, there is an auto zero function that should be initiated. When using 37 Hz coil drive mode it is important to zero the system for the specific application and installation.

The auto zero procedure should be performed only under the following conditions:

- With the transmitter and sensor installed in their final positions. This procedure is not applicable on the bench.
- With the transmitter in 37 Hz coil drive mode. Never attempt this procedure with the transmitter in 5 Hz coil drive mode.
- With the sensor full of process fluid at zero flow.

These conditions should cause an output equivalent to zero flow.

Set the loop to manual if necessary and begin the auto zero procedure. The transmitter completes the procedure automatically in about 90 seconds. A clock symbol will appear in the lower right-hand corner of the display to indicate that the procedure is running.

Note

Failure to complete an auto zero may result in a flow velocity error of 5 to 10% at 1 ft/s (0.3 m/s). While the output level will be offset by the error, the repeatability will not be affected.

11.7.5 Universal trim

LOI menu path	Diagnostics > Trims > Universal Trim
---------------	---

The universal auto trim function enables the transmitter to calibrate sensors that were not calibrated at the factory. The function is activated as one step in a procedure known as in-process calibration. If a sensor has a 16-digit calibration number, in-process calibration is not required. If it does not, or if the sensor is made by another manufacturer, complete the following steps for in-process calibration. Refer to [Appendix D](#).

Procedure

1. Determine the flow rate of the process fluid in the sensor.

Note

The flow rate in the line can be determined by using another sensor in the line, by counting the revolutions of a centrifugal pump, or by performing a bucket test to determine how fast a given volume is filled by the process fluid.

2. Complete the universal auto trim function.

When the routine is completed, the sensor is ready for use.

12 Troubleshooting

Topics covered in this chapter:

- [Introduction](#)
- [Safety information](#)
- [Installation check and guide](#)
- [Diagnostic messages](#)
- [Basic troubleshooting](#)
- [Sensor troubleshooting](#)
- [Installed sensor tests](#)
- [Uninstalled sensor tests](#)
- [Technical support](#)
- [Service](#)

12.1 Introduction

This section covers basic transmitter and sensor troubleshooting. Problems in the magnetic flowmeter system are usually indicated by incorrect output readings from the system, error messages, or failed tests. Consider all sources when identifying a problem in the system. If the problem persists, consult the local Rosemount representative to determine if the material should be returned to the factory. Emerson offers several diagnostics that aid in the troubleshooting process. Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Read the following safety messages before performing any operation described in this section. Refer to these warnings when appropriate throughout this section.

The transmitter performs self-diagnostics on the entire magnetic flowmeter system: the transmitter, the sensor, and the interconnecting wiring. By sequentially troubleshooting each individual piece of the magmeter system, it becomes easier to identify the problem and make the appropriate adjustments.

If there are problems with a new magmeter installation, see [Section 12.3](#) below for a quick guide to solve the most common installation problems. For existing magmeter installations, [Table 12-7](#) lists the most common magmeter problems and corrective actions.

12.2 Safety information

WARNING!

Failure to follow these troubleshooting guidelines could result in death or serious injury.

- Installation and servicing instructions should be performed by qualified personnel only.
- Do not perform any servicing other than that contained in the operating instructions.
- Verify that the operating environment of the sensor and transmitter is consistent with the appropriate hazardous area approval.
- Do not connect the transmitter to a non-Rosemount sensor that is located in an explosive atmosphere.
- Mishandling products exposed to a hazardous substance may result in death or serious injury.
- If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned goods.

12.3 Installation check and guide

Use this guide to check new installations of Rosemount magnetic flowmeter systems that appear to malfunction.

12.3.1 Transmitter

Checking the transmitter before applying power

Prerequisites

Before applying power to the magnetic flowmeter system, make the following transmitter checks:

Procedure

1. Record the transmitter model number and serial number.
2. Visually inspect the transmitter for any damage including the terminal block.
3. Verify the proper wiring connections have been made for the power and outputs.

Checking the transmitter after applying power

Prerequisites

Apply power to the magnetic flowmeter system before making the following transmitter checks:

Procedure

1. Check for an active error message or status alert. Refer to [Section 12.4](#).
2. Verify the correct sensor calibration number is entered in the transmitter.
The calibration number is listed on the sensor nameplate.
3. Verify the correct sensor line size is entered in the transmitter.
The line size value is listed on the sensor nameplate.
4. Verify the analog range of the transmitter matches the analog range in the control system.
5. Verify the forced analog output and forced pulse output of the transmitter produces the correct output at the control system.
6. If desired, use a Rosemount 8714D to verify the transmitter calibration.

12.3.2 Sensor

Prerequisites

Be sure that power to magnetic flowmeter system is removed before beginning the following sensor checks:

Procedure

1. Record the sensor model number and serial number.
2. Visually inspect the sensor for any damage including inside the remote junction box, if applicable.
3. For horizontal flow installations, ensure that the electrodes remain covered by process fluid.

For vertical or inclined installations, ensure that the process fluid is flowing up into the sensor to keep the electrodes covered by process fluid.
4. Verify the flow arrow is pointing in the same direction as forward flow.
5. Ensure the grounding straps on the sensor are connected to grounding rings, lining protectors, or the adjacent pipe flanges. Improper grounding will cause erratic operation of the system.

Sensors with a ground electrode will not require the grounding straps to be connected.

12.3.3 Remote wiring

1. The electrode signal and coil drive wires must be separate cables, unless Rosemount specified combo cable is used.

See [Section 4.4.3](#).
2. The electrode signal wire and coil drive wire must be twisted shielded cable. Rosemount recommends 20 AWG twisted shielded cable for the electrode signal and 14 AWG twisted shielded cable for the coil drive.

- See [Section 4.4.3](#).
3. See [Appendix B](#) regarding wiring installation requirements.
 4. See [Appendix C](#) for component and/or combination cable wiring.
 5. Verify there is minimal exposed wiring and shielding.
Less than 1 inch (25 mm) is recommended.
 6. Verify that the single conduit that houses both the electrode signal and coil drive cables do not contain any other wires, including wires from other magmeters.

Note

For installations requiring intrinsically safe electrodes, the signal and coil drive cables must be run in Individual conduits.

12.3.4 Process fluid

1. The process fluid should have a minimum conductivity of 5 microSiemens/cm (5 micro mhos/cm).
2. The process fluid must be free of air and gas.
3. The sensor must be full of process fluid.
4. The process fluid must be compatible with the wetted materials - liner, electrodes, ground rings, and lining protectors.

Refer to the *Rosemount® Magnetic Flowmeter Material Selection Guide (00816-0100-3033)* Technical Note for details.

5. If the process is electrolytic or has cathodic protection, refer to the *Installation and Grounding of Magmeters in Typical and Special Applications (00840-2400-4727)* Technical Note for special installation requirements.

12.4 Diagnostic messages

Problems in the magnetic flowmeter system are usually indicated by incorrect output readings from the system, error messages, or failed tests. Consider all sources in identifying a problem in the system.

Table 12-1: Basic Diagnostic Messages

Error message	Potential cause	Corrective action
Empty Pipe	Empty pipe	None - message will clear when pipe is full
	Wiring error	Check that wiring matches appropriate wiring diagrams
	Electrode error	Perform sensor tests - see Section 12.7
	Conductivity less than 5 microSiemens per cm	Increase conductivity to greater than or equal to 5 microSiemens per cm

Table 12-1: Basic Diagnostic Messages (continued)

Error message	Potential cause	Corrective action
	Intermittent diagnostic	Adjust tuning of empty pipe parameters - see Section 12.4.1
Coil Open Circuit	Improper wiring	Check coil drive wiring and sensor coils. Perform sensor tests - see Section 12.7
	Other manufacturer's sensor	Change coil current to 75 mA - set calibration numbers to 10000550100000030 Perform a universal auto-trim to select the proper coil current
	Electronics board failure	Replace electronics stack
	Coil circuit open fuse	Return the unit to the factory for fuse replacement
Auto Zero Failure	Flow is not set to zero	Force flow to zero, perform auto zero trim
	Unshielded cable in use	Change wire to shielded cable
	Moisture problems	See Section 12.7
Auto-Trim Failure	No flow in pipe while performing Universal Auto Trim	Establish a known flow rate, and perform universal auto-trim calibration
	Wiring error	Check that wiring matches appropriate wiring diagrams - see Appendix D
	Flow rate is changing in pipe while performing Universal Auto-Trim routine	Establish a constant flow rate, and perform universal auto-trim calibration
	Flow rate through sensor is significantly different than value entered during Universal Auto-Trim routine	Verify flow in sensor and perform universal auto-trim calibration
	Incorrect calibration number entered into transmitter for Universal Auto-Trim routine	Replace sensor calibration number with 1000005010000000
	Wrong sensor size selected	Correct sensor size setting - see Section 5.1
	Sensor failure	Perform sensor tests - see Section 12.7
Electronics Failure	Electronics self check failure	Cycle power to see if diagnostic message clears
		Replace Electronics stack
Electronics Temp Fail	Ambient temperature exceeded the electronics temperature limits	Move transmitter to a location with an ambient temperature range of -40 to 140 °F (-40 to 60 °C)
Reverse Flow	Electrode or coil wires reverse	Verify wiring between sensor and transmitter
	Flow is reverse	Turn ON Reverse Flow Enable to read flow
	Sensor installed backwards	Install sensor correctly, or switch either the electrode wires (18 and 19) or the coil wires (1 and 2)
PZR Activated (Positive Zero Return)	External voltage applied to terminals 11 and 12	Remove voltage to turn PZR off
Pulse Out of Range	The transmitter is trying to generate a frequency greater than allowed	Standard pulse - increase pulse scaling to prevent pulse output from exceeding 11,000 Hz

Table 12-1: Basic Diagnostic Messages (continued)

Error message	Potential cause	Corrective action
		Intrinsically safe pulse - Increase pulse scaling to prevent pulse output from exceeding 5,500 Hz
		Pulse output is in fixed pulse mode and is trying to generate a frequency greater than the pulse width can support - see Section 8.2.2
		Verify the sensor calibration number and line size are correctly entered in the electronics
Analog Out of Range	Flow rate is greater than analog output range	Reduce flow, adjust URV and LRV values
		Verify the sensor calibration number and line sizes are correctly entered in the electronics
Flowrate > 43 ft/sec	Flow rate is greater than 43 ft/sec	Lower flow velocity, increase pipe diameter
	Improper wiring	Check coil drive wiring and sensor coils
		Perform sensor tests - see Section 12.7
Digital Trim Failure (Cycle power to clear messages, no changes were made)	The calibrator (8714B/C/D) is not connected properly	Review calibrator connections
	Incorrect calibration number entered into transmitter	Replace sensor calibration number with 1000015010000000
	Calibrator is not set to 30 FPS	Change calibrator setting to 30 FPS
	Bad calibrator or calibrator cable	Replace calibrator and/or calibrator cable
Coil Over Current	Improper wiring	Check coil drive wiring and sensor coils Perform sensor tests - see Section 12.7
	Transmitter failure	Replace the electronics stack
Coil Power Limit	Improper wiring	Check coil drive wiring and sensor coils. Perform sensor tests - see Section 12.7
	Incorrect calibration number	Verify configured calibration number matches sensor tag
	Transmitter connected to other manufacturer's sensor	Change coil current to 75 mA - set calibration number to 10000550100000030 Perform a universal auto-trim to select the proper coil current
	Coil drive frequency set to 37 Hz	Sensor may not be compatible with 37 Hz. Switch coil drive frequency to 5 Hz.
	Sensor failure	Perform sensor tests - see Section 12.7
	Improper wiring	Check the analog loop wiring - see Section 4.4.7
No AO Power	No external loop power	Verify the analog power switch position (internal/external) For externally powered loop, verify power supply requirements - see Section 4.4.6
	No loop resistance (open loop)	Install resistance across the analog output terminals

Table 12-1: Basic Diagnostic Messages (continued)

Error message	Potential cause	Corrective action
		Disable message using LOI Error Mask parameter
	Transmitter failure	Replace the electronics stack
Electrode Saturation	Improper wiring	See Section 4.4
	Improper process reference	See Section 3.4
	Improper earth grounding	Verify earth ground connections - see Section 4.4
	Application requires special transmitter	Replace transmitter with transmitter that includes special option F0100

Table 12-2: Advanced Process Diagnostic Messages

Error message	Potential cause	Corrective action
Grounding/Wiring Fault	Improper installation of wiring	See Section 4.4
	Coil/electrode shield not connected	See Section 4.4
	Improper process grounding	See Section 3.4
	Faulty ground connection	Check wiring for corrosion, moisture in the terminal block -see Section 3.4
	Sensor not full	Verify sensor is full Enable empty pipe detection
High Process Noise	Slurry flows - mining/pulp stock	Decrease the flow rate below 10 ft/s (3 m/s)
		Complete the possible solutions listed under Section 12.4.3
	Chemical additives upstream of the sensor	Move injection point downstream of the sensor or move the sensor to a new location
		Complete the possible solutions listed under Section 12.4.3
	Electrode not compatible with the process fluid	Refer to the <i>Rosemount® Magnetic Flowmeter Material Selection Guide (00816-0100-3033)</i>
	Gas/air in line	Move the sensor to another location in the process line to ensure that it is full under all conditions
	Electrode coating	Enable coated electrode detection diagnostic
		Use bullet-nose electrodes
		Downsize sensor to increase flowrate above 3 ft/s (1 m/s)
		Periodically clean sensor
Styrofoam or other insulating particles	Complete the possible solutions listed under Section 12.4.3	
	Consult factory	
Low conductivity fluids (below 10 microsiemens/cm)	Trim electrode and coil wires - see Chapter 3	

Table 12-2: Advanced Process Diagnostic Messages (continued)

Error message	Potential cause	Corrective action
		Use integral mount transmitter
		Set coil drive frequency to 37Hz
Electrode Coating Level 1	Coating is starting to buildup on electrode and interfering with measurement signal	Schedule maintenance to clean electrode
		Use bullet nose electrodes
		Downsize sensor to increase flow rate above 3ft/s (1ms)
	Process fluid conductivity has changed	Verify process fluid conductivity
Electrode Coating Level 2	Coating has built-up on electrode and is interfering with measurement signal	Schedule maintenance to clean electrode
		Use bullet nose electrodes
		Downsize sensor to increase flow rate above 3ft/s (1ms)
		Process fluid conductivity has changed

Table 12-3: Advanced Meter Verification Messages

Error message	Potential cause	Corrective action
8714i Failed	Transmitter calibration verification test failed	Verify pass/fail criteria
		Rerun SMART™ Meter Verification (8714i) under no flow conditions
		Verify calibration using 8714 Calibration Standard
		Perform digital trim
		Replace electronics board
	Sensor calibration test failed	Verify pass/fail criteria
		Rerun SMART Meter Verification (8714i)
		Perform sensor tests - see Section 12.7
	Sensor coil circuit test failed	Verify pass/fail criteria
		Rerun SMART Meter Verification (8714i)
		Perform sensor tests - see Section 12.7
	Sensor electrode circuit test failed	Verify electrode resistance has a baseline (signature) value from a full pipe baseline
		Verify test condition was selected properly
		Verify pass/fail criteria
		Rerun SMART Meter Verification (8714i)
		Perform sensor tests - see Section 12.7
4-20 mA loop verification failed	Analog loop not powered	Check 4-20 mA internal/external loop power switch - see Section 6.1.3
		Check external supply voltage to the transmitter

Table 12-3: Advanced Meter Verification Messages (continued)

Error message	Potential cause	Corrective action
	Transmitter failure	Check for parallel paths in the current loop
		Perform transmitter self test
		Perform manual analog loop test and D/A trim if necessary
Continuous Meter Verification Error	Transmitter calibration verification test failed	Replace the electronics board
		Verify pass/fail criteria
		Run manual SMART Meter Verification (8714i) under no flow conditions
		Verify calibration using 8714D Calibration Standard
	Sensor calibration test failed	Perform digital trim
		Replace electronics stack
	Sensor coil circuit test failed	Run manual SMART Meter Verification (8714i)
		Perform sensor tests - see Section 12.7
	Sensor electrode circuit test failed	Run manual SMART Meter Verification (8714i)
		Perform sensor tests - see Section 12.7
Verify electrode resistance has a signature value from a full pipe baseline		
Simulated Velocity Out of Spec	Unstable flow rate during the verification test or noisy process	Run manual transmitter verification test with no flow and a full pipe
		Transmitter drift or faulty electronics
	Verify transmitter electronics with 8714D Calibration Standard. The dial on the 8714D should be set to 30 ft/s (9.14 m/s). The transmitter should be set up with the nominal calibration number (1000015010000000) and 5 Hz coil drive frequency.	
		Perform an electronics trim using the 8714
Coil Resistance Out of Spec	Moisture in the terminal block of the sensor or shorted coil	If the electronics trim doesn't correct the issue, replace the electronics
		Perform sensor tests - see Section 12.7
Coil Signature Out of Spec	Moisture in the terminal block of the sensor or shorted coil	If the problem persists, replace the sensor
		Perform sensor tests - see Section 12.7
	Calibration shift caused by heat cycling or vibration	If the problem persists, replace the sensor
		Perform sensor tests - see Section 12.7
Electrode Resistance Out of Spec	Moisture in the terminal block of the sensor	Perform sensor tests - see Section 12.7
		If the problem persists, replace the sensor

Table 12-3: Advanced Meter Verification Messages (continued)

Error message	Potential cause	Corrective action
	Electrode coating	Enable coated electrode detection diagnostic
		Use bullet-nose electrodes
		Downsize sensor to increases flowrate above 3 ft/s (1 m/s)
		Periodically clean sensor
	Shorted electrodes	Perform sensor tests - see Section 12.7
		If the problem persists, replace the sensor
Analog Output Out of Spec	Unstable flow rate during the verification test or noisy process	Run manual transmitter verification test with no flow and a full pipe
	Analog output is no longer within accuracy specifications	Check the analog loop wiring. Excessive loop resistance can cause an invalid test

12.4.1 Troubleshooting empty pipe

The following actions can be taken if empty pipe detection is unexpected:

Procedure

1. Verify the sensor is full.
2. Verify the sensor has not been installed with a measurement electrode at the top of the pipe.
3. Decrease the sensitivity by setting the empty pipe trigger level to a value of at least 20 counts above the empty pipe value read with a full pipe.
4. Decrease the sensitivity by increasing the empty pipe counts to compensate for process noise. The empty pipe counts is the number of consecutive empty pipe value readings above the empty pipe trigger level required to set the empty pipe diagnostic. The count range is 2-50, factory default set at 5.
5. Increase process fluid conductivity above 50 microsiemens/cm.
6. Properly connect the wiring between the sensor and the transmitter. Corresponding terminal block numbers in the sensor and transmitter must be connected.
7. Perform the sensor electrical resistance tests. For more detailed information, consult [Section 12.7](#).

12.4.2 Troubleshooting ground/wiring fault

If transmitter detects high levels (greater than 5mV) 50/60 Hz noise caused by improper wiring or poor process grounding:

Procedure

1. Verify the transmitter is earth grounded.

2. Connect ground rings, grounding electrode, lining protector, or grounding straps. Grounding diagrams can be found in [Section 3.4](#).
3. Verify the sensor is full.
4. Verify wiring between sensor and transmitter is prepared properly. Shielding should be stripped back less than 1 inch (25 mm).
5. Use separate shielded twisted pairs for wiring between sensor and transmitter.
6. Properly connect the wiring between the sensor and the transmitter. Corresponding terminal block numbers in the sensor and transmitter must be connected.

12.4.3 Troubleshooting high process noise

Note

In applications where very high levels of noise are a concern, it is recommended that a dual-calibrated Rosemount High-Signal 8707 sensor be used. These sensors can be calibrated to run at lower coil drive current supplied by the standard Rosemount transmitters, but can also be upgraded by changing to the 8712H High-Signal transmitter.

1/f noise

This type of noise has higher amplitudes at lower frequencies, but generally degrades over increasing frequencies. Potential sources of 1/f noise include chemical mixing and slurry flow particles rubbing against the electrodes. This type of noise can be mitigated by switching to the 37Hz coil drive frequency.

Spike noise

This type of noise generally results in a high amplitude signal at specific frequencies which can vary depending on the source of the noise. Common sources of spike noise include chemical injections directly upstream of the flowmeter, hydraulic pumps, and slurry flows with low concentrations of particles in the stream. The particles bounce off of the electrode generating a “spike” in the electrode signal. An example of this type of flow stream would be a recycle flow in a paper mill. The type of noise can be mitigated by switching to the 37Hz coil drive frequency and enabling the digital signal processing.

White noise

This type of noise results in a high amplitude signal that is relatively constant over the frequency range. Common sources of white noise include chemical reactions or mixing that occurs as the fluid passes through the flowmeter and high concentration slurry flows where the particulates are constantly passing over the electrode head. An example of this type of flow stream would be a basis weight stream in a paper mill. This type of noise can be mitigated by switching to the 37Hz coil drive frequency and enabling the digital signal processing.

Noise ratio less than 25 in 5 Hz mode

The transmitter detected high levels of process noise. If the signal to noise ratio is less than 25 while operating in 5 Hz mode, proceed with the following steps:

Procedure

1. Increase transmitter coil drive frequency to 37 Hz (refer to [Section 10.5.1](#) and, if possible, perform auto zero function [Section 10.5.2](#)).
2. Verify sensor is electrically connected to the process with process reference electrode, grounding rings with grounding straps, or lining protector with grounding straps.
3. If possible, redirect chemical additions downstream of the magmeter.
4. Verify process fluid conductivity is above 10 microSiemens/cm.

Noise ratio less than 25 in 37 Hz mode

If the signal to noise ratio is less than 25 while operating in 37 Hz mode, proceed with the following steps:

Procedure

1. Turn on the Digital Signal Processing (DSP) technology and follow the setup procedure (see [Chapter 10](#)).

This will minimize the level of damping in the flow measurement and control loop while also stabilizing the reading to minimize valve actuation.

2. Increase damping to stabilize the signal (refer to [Section 8.5.5](#)).

This will add response time to the control loop.

3. Move to a Rosemount High-Signal flowmeter system.

This flowmeter will deliver a stable signal by increasing the amplitude of the flow signal by ten times to increase the signal to noise ratio. For example if the signal to noise ratio (SNR) of a standard magmeter is 5, the High-Signal would have a SNR of 50 in the same application. The Rosemount High-Signal system is comprised of the 8707 sensor which has modified coils and magnetics and the 8712H High-Signal transmitter.

12.4.4 Troubleshooting coated electrode detection

In the event that electrode coating is detected, use the following table to determine the appropriate course of action.

Table 12-4: Troubleshooting the Electrode Coating Diagnostic

Error message	Potential causes of error	Steps to correct
Electrode Coating Level 1	<ul style="list-style-type: none"> Insulating coating is starting to build up on the electrode and may interfere with the flow measurement signal Process fluid conductivity has decreased to a level close to operational limits of the meter 	<ul style="list-style-type: none"> Verify process fluid conductivity Schedule maintenance to clean the electrodes Use bullet nose electrodes Replace the meter with a smaller diameter meter to increase the flow velocity to above 3 ft/s (1 m/s)
Electrode Coating Level 2	<ul style="list-style-type: none"> Insulating coating has built up on the electrodes and is interfering with the flow measurement signal Process fluid conductivity has decreased to a level below the operational limits of the meter 	<ul style="list-style-type: none"> Verify process fluid conductivity Schedule maintenance to clean the electrodes Use bullet nose electrodes Replace the meter with a smaller diameter meter to increase the flow velocity to above 3 ft/s (1 m/s)

12.4.5 Troubleshooting 4-20 mA loop verification

In the event that the 4-20 mA Loop Verification fails, use the following table to determine the appropriate course of action.

Table 12-5: Troubleshooting the Analog Loop Verification Diagnostic

Test	Potential cause	Corrective action
4-20 mA Loop Verification Failure	Analog loop not powered	Check analog loop wiring
		Check loop resistance
		Check analog loop power switch – see Section 6.1.3
		Check external supply voltage to the transmitter
		Check for parallel paths in the current loop
	Analog drift	Perform D/A trim
Transmitter failure	Perform transmitter self-test	
	Perform manual analog loop test	

Table 12-5: Troubleshooting the Analog Loop Verification Diagnostic (continued)

Test	Potential cause	Corrective action
		Replace the electronics stack

12.4.6 Troubleshooting the SMART Meter Verification test

If the SMART Meter Verification test fails, use the following table to determine the appropriate course of action. Begin by reviewing the SMART Meter Verification results to determine the specific test that failed.

Table 12-6: Troubleshooting the SMART Meter Verification Diagnostic

Test	Potential cause	Corrective action
Transmitter Verification Test	<ul style="list-style-type: none"> • Unstable flow reading during the test • Noise in the process • Transmitter drift • Faulty electronics 	<ul style="list-style-type: none"> • Rerun SMART Meter Verification (8714i) under No Flow conditions • Check the transmitter calibration with the 8714D Calibration Standard • Perform a digital trim • Replace the electronics stack
Sensor Calibration Verification	<ul style="list-style-type: none"> • Moisture in the sensor terminal block • Calibration shift caused by heat cycling or vibration 	<ul style="list-style-type: none"> • Rerun SMART Meter Verification (8714i) • Perform the sensor checks detailed in Section 12.6.
Coil Circuit Health	<ul style="list-style-type: none"> • Moisture in the sensor terminal block • Shorted Coil 	<ul style="list-style-type: none"> • Remove the sensor and send back for evaluation and / or recalibration
Electrode Circuit Health	<ul style="list-style-type: none"> • Electrode resistance baseline was not taken after installation • Test condition was not selected properly • Moisture in the sensor terminal block • Coated electrodes • Shorted electrodes 	

12.5 Basic troubleshooting

When troubleshooting a magmeter, it is important to identify the issue. [Table 12-7](#) provides common symptoms displayed by a magmeter that is not functioning properly. This table provides potential causes and suggested corrective actions for each symptom.

Table 12-7: Common Magmeter Issue

Symptom	Potential cause	Corrective action
Output at 0 mA	No power to transmitter	Check power source and connections to the transmitter
	Analog output improperly configured	Check the analog power switch position Verify wiring and analog power
	Electronics failure	Verify transmitter operation with an 8714D Calibration Standard or replace the electronic stack
	Blown fuse	Check the fuse and replace with an appropriately rated fuse, if necessary
Output at 4 mA	Transmitter in multidrop mode	Configure Poll Address to 0 to take transmitter out of multidrop mode
	Low Flow Cutoff set too high	Configure Low Flow Cutoff to a lower setting or increase flow to a value above the low flow cutoff
	PZR Activated	Open PZR switch at terminals 11 and 12 to deactivate the PZR
	Flow is in reverse direction	Enable Reverse Flow function
	Shorted coil	Coil check – perform sensor test
	Empty pipe	Fill pipe
	Electronics failure	Verify transmitter operation with an 8714D Calibration Standard or replace the electronics stack
Output will not reach 20 mA	Loop resistance is greater than 600 ohms	Reduce loop resistance to less than 600 ohms Perform analog loop test
	Insufficient supply voltage to analog output	Verify analog output supply voltage Perform analog loop test
Output at 20.8 mA	Transmitter not ranged properly	Reset the transmitter range values – see Section 5.1
		Check tube size setting in transmitter and make sure it matches the actual tube size – see Section 5.1
Output at alarm level	Electronics failure	Cycle power. If alarm is still present, verify transmitter operation with an 8714 D Calibration Standard or replace the electronics stack
	Open coil circuit	Check coil drive circuit connections at the sensor and at the transmitter
	Analog output diagnostic alarm is active	See AO diagnostic alarm
	Coil power or coil current is over limit	Check coil drive circuit connections at the sensor and at the transmitter Cycle power. If alarm is still present, verify transmitter operation with an 8714 D Calibration Standard or replace the electronics stack
	Connected to incompatible sensor	See Appendix D

Table 12-7: Common Magmeter Issue (continued)

Symptom	Potential cause	Corrective action	
Pulse output at zero, regardless of flow	Wiring error	Check pulse output wiring at terminals 5 and 6. Refer to wiring diagram for pulse counter and pulse output. See Section 6.2.1 .	
	PZR activated	Remove signal at terminals 11 and 12 to deactivate the PZR.	
	No power to transmitter		Check pulse output wiring at terminals 5 and 6. Refer to wiring diagram for pulse counter and pulse output.
			Power the transmitter
	Reverse flow	Enable Reverse Flow function	
	Electronics failure	Verify transmitter operation with an 8714D Calibration Standard or replace the electronics stack	
	Pulse output incorrectly configured	Review configuration and correct as necessary	
Communication problems with the Handheld Communicator	4–20 mA output configuration	Check analog power switch (internal/external). The Handheld Communicator requires a 4–20 mA output to function.	
	Communication interface wiring problems	Incorrect load resistance (250 Ohm minimum, 600 Ohm maximum)Check appropriate wiring diagram	
	Low batteries in the Handheld Communicator	Replace the batteries in the Handheld Communicator – see the communicator manual for instructions	
	Old revision of software in the Handheld Communicator	Consult your local sales office about updating to the latest revision of software	
Error Messages on LOI or Handheld Communicator	Many possible causes depending upon the message	See Table 12-1 , Table 12-2 , and Table 12-3 for the LOI or Handheld Communicator messages	
Discrete input does not register	Input signal does not provide enough counts	Verify that the discrete input provided meets the requirements in Section 6.2.3	
		Perform a loop test to validate the analog control loop	
		Perform a D/A trim. This allows the calibration of the analog output with an external reference at operating endpoints of the analog output.	
Reading does not appear to be within rated accuracy	Transmitter, control system, or other receiving device not configured properly	Check all configuration variables for the transmitter, sensor, communicator, and/or control system	
		Check these other transmitter settings:	
		Sensor calibration number	
		Units	
		Line size	
	Perform a loop test to check the integrity of the circuit		
Electrode Coating	Enable Coated Electrode Detection diagnostic		

Table 12-7: Common Magmeter Issue (continued)

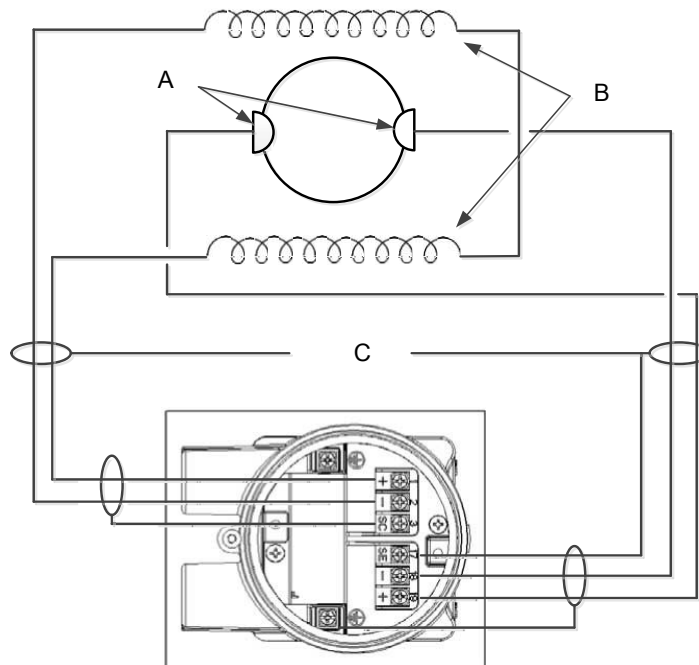
Symptom	Potential cause	Corrective action
		Use bullet-nose electrodes
		Downsize sensor to increase flow rate above 3 ft/s
		Periodically clean sensor
	Gas/air in line	Move the sensor to another location in the process line to ensure it is full under all conditions
	Moisture problem	Perform the sensor tests - see Section 12.7
	Insufficient upstream/downstream pipe diameter	Move sensor to a new location with 5 pipe diameters upstream and 2 pipe diameters downstream if possible
	Cables for multiple magmeters run through same conduit	Use dedicated conduit run for each sensor and transmitter
	Improper wiring	If electrode shield and electrode signal wires are switched, flow indication will be about half of what is expected. Check wiring diagrams.
	Flow rate is below 1 ft/s (specification issue)	See accuracy specification for specific transmitter and sensor
	Auto zero was not performed when the coil drive frequency was changed from 5 Hz to 37 Hz	Set the coil drive frequency to 37 Hz, verify the sensor is full, verify there is no flow, and perform the auto zero function
	Sensor failure—shorted electrode	Perform the sensor tests - see Section 12.7
	Sensor failure—shorted or open coil	Perform the sensor tests - see Section 12.7
Transmitter failure	Verify transmitter operation with an 8714 Calibration Standard or replace the electronics board	
Noisy Process	Chemical additives upstream of magnetic flowmeter	See Section 12.4.3
		Move injection point downstream of magnetic flowmeter, or move magnetic flowmeter
	Sludge flows—mining/coal/sand/slurries (other slurries with hard particles)	Decrease flow rate below 10 ft/s
	Styrofoam or other insulating particles in process	See Section 12.4.3
		Consult factory
	Electrode coating	Enable Coated Electrode Detection diagnostic
		Use a smaller sensor to increase flow rate above 3 ft/s
		Periodically clean sensor
	Gas/air in line	Move the sensor to another location in the process line to ensure it is full under all conditions
	Low conductivity fluids (below 10 microsiemens/cm)	Trim electrode and coil wires – see Section 4.4.3
Keep flow rate below 3 FPS		
Integral mount transmitter		

Table 12-7: Common Magmeter Issue (continued)

Symptom	Potential cause	Corrective action
		Use component cable - see Section 4.4.3
Meter output is unstable	Medium to low conductivity fluids (10–25 microsiemens/cm) combined with cable vibration or 60 Hz interference	Eliminate cable vibration
		Move cable to lower vibration run
		Tie down cable mechanically
		Use an integral mount
		Trim electrode and coil wires - see Section 4.4.3
		Route cable line away from other equipment powered by 60 Hz
		Use component cable - see Section 4.4.3
	Electrode incompatibility	Check the Technical Data Sheet, Magnetic Flowmeter Material Selection Guide (document number 00816-0100-3033), for chemical compatibility with electrode material
	Improper grounding	Check ground wiring – see Section 3.4 for wiring and grounding procedures
	High local magnetic or electric fields	Move magnetic flowmeter (20–25 ft away is usually acceptable)
Control loop improperly tuned	Check control loop tuning	
Sticky valve (look for periodic oscillation of meter output)	Service valve	
Sensor failure	Perform the sensor tests (See Section 12.7)	
Analog output loop problem	Check that the 4 to 20 mA loop matches the digital value Perform analog output test	

12.6 Sensor troubleshooting

This section describes manual tests that can be performed on the sensor to verify the health of individual components. The tests will require the use of a digital multimeter capable of measuring conductance in nanoSiemens and an LCR meter. A sensor circuit diagram is shown in [Figure 12-1](#). The tests described below will check for continuity or isolation of the internal components of the sensor.

Figure 12-1: Sensor Circuit Diagram (Simplified)

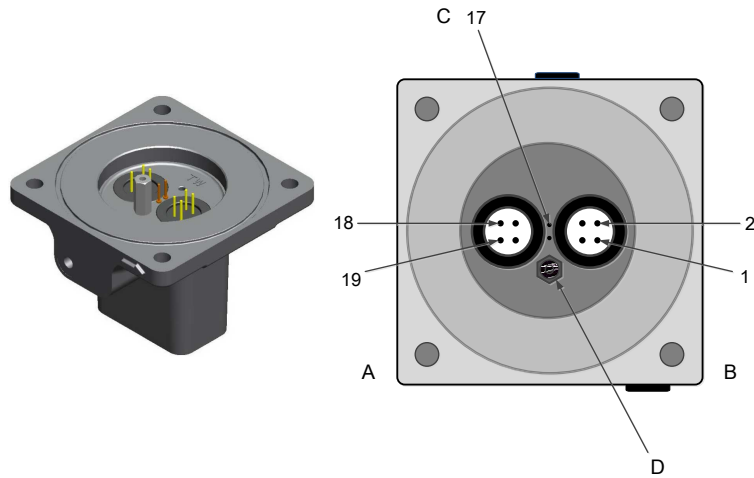
- A. *Electrodes*
- B. *Coils*
- C. *Sensor housing*

12.6.1 Sensor adapter feed through pins

The sensor adapter is the part of the sensor that provides the internal connection feed-through wiring from the internal sensor components to the socket module connections. The top of the adapter has 10 pins - four pins for the coils, four pins for the electrodes, and two pins for the process reference. Each connection point has two pins associated for redundant continuity. See [Figure 12-2](#).

The best location for testing the sensor components is taking measurements directly on the feed-through pins. Direct measurement on the pins eliminates the possibility of an erroneous measurement caused by a bad socket module or remote wiring. The figure below shows the feed-through pin connections as they relate to the terminal connections described in the tests.

Figure 12-2: Sensor Adapter Feed-through Pins

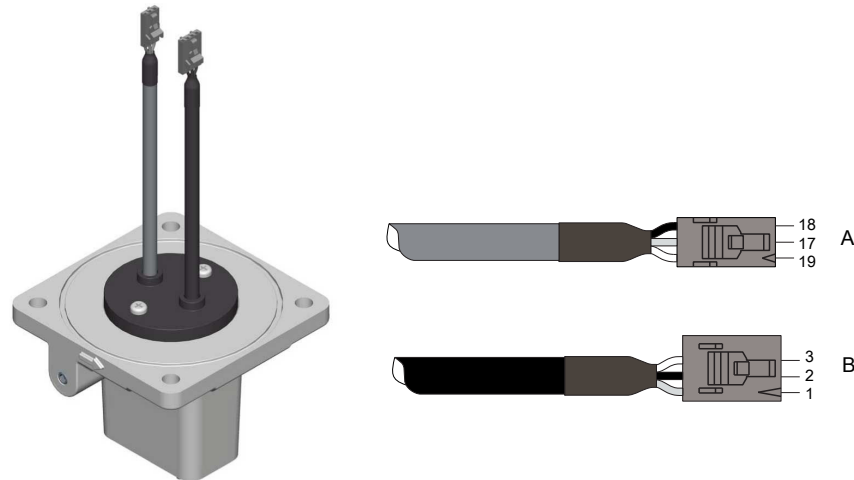


- A. *Electrode side*
- B. *Coil side*
- C. *Process reference*
- D. *Orientation key*

12.6.2 Sensor adapter direct lead pins

The sensor adapter direct leads are the part of the sensor that provides the direct connection from the internal sensor components to the terminal block connections. The top of the adapter has 6 pins - three pins for the coils, and three pins for the electrodes. See [Figure 12-3](#). The best location for testing the sensor components is taking measurements directly on the slot pins. Direct measurement on the pins eliminates the possibility of an erroneous measurement caused by a bad terminal block or remote wiring. [Figure 12-3](#) shows the slot pin connections as they relate to the terminal connections described in the tests.

Figure 12-3: Sensor adapter direct lead pins



- A. *Electrode side*
- B. *Coil side*

12.6.3 Socket module

The socket module connects the sensor adapter to the transmitter. See [Figure 12-4](#). The socket module is a replaceable component. If test measurements taken through the socket module show a failure, remove the socket module and confirm measurements directly on the feed-through pins of the sensor adapter. To remove the socket module, refer to [Chapter 11](#).

Figure 12-4: Remote Mount Socket Module



12.7 Installed sensor tests

If a problem with an installed sensor is identified, refer to [Table 12-8](#) through [Table 12-12](#) to assist in troubleshooting the sensor. Disconnect or turn off power to the transmitter before performing any of the sensor tests. Always check the operation of test equipment before each test.

If possible, take all readings from feed-through pins in the sensor adapter. If the pins in the sensor adapter are inaccessible, take measurements at the sensor terminal block or through remote cabling as close to the sensor as possible. Readings taken through remote cabling that is more than 100 feet (30 meters) in length may provide incorrect or inconclusive information and should be avoided.

The expected values in the test below assume the measurements have been taken directly at the pins.

Table 12-8: Test A: Sensor coil

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: installed or uninstalled Required equipment: multi-meter Measuring at connections: 1 and 2 = R 	$2\Omega \leq R \leq 18\Omega$	<ul style="list-style-type: none"> Open or shorted coil 	<ul style="list-style-type: none"> Remove and replace sensor

Table 12-9: Test B: Shields to case

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: installed or uninstalled Required equipment: multi-meter Measuring at connections: <ul style="list-style-type: none"> - 17 and 3 - 3 and case ground - 17 and case ground 	$<0.3\Omega$	<ul style="list-style-type: none"> Moisture in terminal block Leaky electrode Process behind liner 	<ul style="list-style-type: none"> Clean terminal block Remove sensor

Table 12-10: Test C. Coil to coil shield

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: installed or unin-stalled Required equipment: multi-meter Measuring at connections: <ul style="list-style-type: none"> - 1 and 3 - 2 and 3 	$\infty\Omega$ (< 1nS)	<ul style="list-style-type: none"> Process behind liner Leaky electrode Moisture in terminal block 	<ul style="list-style-type: none"> Remove sensor and dry Clean terminal block Confirm with sensor coil test

Table 12-11: Test D. Electrode to electrode shield

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: installed Required equipment: LCR (Set to Resistance and 120 Hz) Measuring at connections: <ul style="list-style-type: none"> - 18 and 17 = R_1 - 19 and 17 = R_2 	<ul style="list-style-type: none"> R_1 and R_2 should be stable $R_1 - R_2 \leq 300\Omega$ 	<ul style="list-style-type: none"> Unstable R_1 or R_2 values confirm coated electrode Shorted electrode Electrode not in contact with process Empty pipe Low conductivity Leaky electrode Process reference ground not connected properly 	<ul style="list-style-type: none"> Remove coating from sensor wall Use bullet-nose electrodes Repeat measurement Remove sensor and complete tests in Section 12.8 Connect process reference ground per Section 3.4

Table 12-12: Test E. Electrode to Electrode

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: installed Required equipment: LCR (Set to Resistance and 120 Hz) Measuring at connections: 18 and 19 <ul style="list-style-type: none"> - 18 and 17 = R_1 - 19 and 17 = R_2 	Should be stable and same relative magnitude of R_1 and R_2 from Test D	<ul style="list-style-type: none"> Unstable R_1 or R_2 values confirm coated electrode Shorted electrode Electrode not in contact with process Empty pipe Low conductivity Leaky electrode Process reference ground not connected properly 	<ul style="list-style-type: none"> Remove coating from sensor wall Use bullet-nose electrodes Repeat measurement Remove sensor and complete tests in Section 12.8 Connect process reference ground per Section 3.4

To test the sensor, a multimeter capable of measuring conductance in nanoSiemens is preferred. Conductance is the reciprocal of resistance.

Or:

$$1 \text{ nanosiemens} = \frac{1}{1 \text{ gigaohm}} \quad 1 \text{ nanosiemens} = \frac{1}{1 \times 10^9 \text{ ohm}}$$

12.8 Uninstalled sensor tests

Sensor troubleshooting can also be performed on an uninstalled sensor. If test results from installed sensor tests are inconclusive, the next step is remove the sensor and perform the tests outlined in this section. Take measurements from the feed-through pins and directly on the electrode head inside the sensor. The measurement electrodes, 18 and 19, are on opposite sides in the inside diameter of the sensor. If applicable, the third process reference electrode is between the two measurement electrodes.

The expected values in the test below assume the measurements have been taken directly at the pins.

Table 12-13: Test A. Terminal to front electrode

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: uninstalled Required equipment: Multi-meter 18 and electrode 18⁽¹⁾ 	≤ 1 Ω	<ul style="list-style-type: none"> Shorted electrode Open electrode Coated electrode 	<ul style="list-style-type: none"> Replace sensor Remove coating from sensor wall

(1) When the connection head is in the vertical upright position and the flow arrow (see Section 3.2.3) on the connection head flange points to the right, the front of the meter will be facing towards you. Electrode 18 is on the front of the meter. If you cannot determine the front of the meter, measure both electrodes. One electrode should result in an open reading, while the other electrode should be less than 0.3 ohm.

Table 12-14: Test B. Terminal to back electrode

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: uninstalled Required equipment: Multi-meter 19 and electrode 19⁽¹⁾ 	≤ 1 Ω	<ul style="list-style-type: none"> Shorted electrode Open electrode Coated electrode 	<ul style="list-style-type: none"> Replace sensor Remove coating from sensor wall

(1) When the connection head is in the vertical upright position and the flow arrow (see Section 3.2.3) on the connection head flange points to the right, the front of the meter will be facing towards you. Electrode 18 is on the front of the meter. If you cannot determine the front of the meter, measure both electrodes. One electrode should result in an open reading, while the other electrode should be less than 0.3 ohm.

Table 12-15: Test C. Terminal to reference electrode

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: uninstalled Required equipment: Multi-meter 17 and process reference electrode⁽¹⁾ 	≤ 0.3 Ω	<ul style="list-style-type: none"> Shorted electrode Open electrode Coated electrode 	<ul style="list-style-type: none"> Replace sensor Remove coating from sensor wall

(1) Only valid if the sensor has a process reference electrode.

Table 12-16: Test D. Terminal to case ground

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: uninstalled Required equipment: Multi-meter 17 and safety ground 	≤ 0.3 Ω	<ul style="list-style-type: none"> Moisture in terminal block Leaky electrode Process behind liner 	<ul style="list-style-type: none"> Clean terminal block Replace terminal block Replace sensor

Table 12-17: Test E. Electrode to electrode shield

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: uninstalled Required equipment: Multi-meter 18 and 17 19 and 17 	$\infty\Omega$ (<1 nS)	<ul style="list-style-type: none"> Shorted electrode Leaky electrode Moisture in terminal block 	<ul style="list-style-type: none"> Replace sensor Clean terminal block Replace terminal block

Table 12-18: Test F. Electrode shield to coil

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: uninstalled Required equipment: Multi-meter 17 and 1 	$\infty\Omega$ (<1 nS)	<ul style="list-style-type: none"> Process in coil housing Moisture in terminal block 	<ul style="list-style-type: none"> Replace sensor Clean terminal block Replace terminal block

12.9 Technical support

Email addresses:

Worldwide: flow.support@emerson.com

Asia-Pacific: APflow.support@emerson.com

Middle East and Africa: FlowTechnicalSupport@emerson.com

North and South America		Europe and Middle East		Asia Pacific	
United States	800-522-6277	U.K.	0870 240 1978	Australia	800 158 727
Canada	+1 303-527-5200	The Netherlands	+31 (0) 318 495 555	New Zealand	099 128 804
Mexico	+41 (0) 41 7686 111	France	0800 917 901	India	800 440 1468
Argentina	+54 11 4837 7000	Germany	0800 182 5347	Pakistan	888 550 2682
Brazil	+55 15 3238 3677	Italy	8008 77334	China	+86 21 2892 9000
Venezuela	+58 26 1731 3446	Central & Eastern	+41 (0) 41 7686 111	Japan	+81 3 5769 6803
		Russia/CIS	+7 495 981 9811	South Korea	+82 2 3438 4600
		Egypt	0800 000 0015	Singapore	+65 6 777 8211
		Oman	800 70101	Thailand	001 800 441 6426
		Qatar	431 0044	Malaysia	800 814 008

North and South America		Europe and Middle East		Asia Pacific	
		Kuwait	663 299 01		
		South Africa	800 991 390		
		Saudi Arabia	800 844 9564		
		UAE	800 0444 0684		

12.10 Service

To expedite the return process outside the United States, contact the nearest Rosemount representative.

Within the United States and Canada, call the North American Response Center using the 800-654-RSMT (7768) toll-free number. The Response Center, available 24 hours a day, will assist you with any needed information or materials.

The center will ask for product, model, and serial numbers and will provide a Return Material Authorization (RMA) number. The center will also ask for the name of the process material to which the product was last exposed.

Mishandling products exposed to a hazardous substance may result in death or serious injury. If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned goods.

The North American Response Center will detail the additional information and procedures necessary to return goods exposed to hazardous substances.

Appendix A

Product Specifications

Topics covered in this appendix:

- [Rosemount 8700M Flowmeter Platform specifications](#)
- [Transmitter specifications](#)
- [8705-M Flanged Sensor Specifications](#)
- [8711-M/L Wafer Sensor Specifications](#)
- [8721 Hygienic \(Sanitary\) Sensor Specifications](#)

A.1 Rosemount 8700M Flowmeter Platform specifications

The tables below outline some of the basic performance, physical, and functional specifications of the Rosemount 8700M Magnetic Flowmeter Platform.

- [Table A-1](#) provides an overview of the Rosemount 8712EM Transmitter.
- [Table A-2](#) provides an overview of the Rosemount 8700M Sensor products.

Table A-1: Rosemount 8712EM Transmitter Specifications


	Model	8712EM
	Base accuracy ⁽¹⁾	0.25% Standard 0.15% High Accuracy Option
	Mounting	Remote
	Power supply	Global AC or DC
	User interface	15 button tactile keypad
	Communication protocol	HART
	Diagnostics	Basic, DA1, DA2
	Sensor compatibility	All Rosemount plus other manufacturers
	Detailed specifications	Section A.2

Table A-1: Rosemount 8712EM Transmitter Specifications (continued)

	Ordering information	Product Data Sheet
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(1) For complete accuracy specifications, please refer to [Section A.2.1](#).

Table A-2: Rosemount Sensor Specifications

	Model	8705
	Style	Flanged
	Base accuracy ⁽¹⁾	0.25% Standard 0.15% High Accuracy Option
	Line sizes	½-in. to 36-in. (15 mm to 900 mm)
	Design features	Standard Process Design
	Detailed specifications	Section A.3
	Ordering information	Product Data Sheet
	Model	8711
	Style	Wafer
	Base accuracy ⁽¹⁾	0.25% Standard 0.15% High Accuracy Option
	Line sizes	1½ -in. to 8-in. (40 mm to 200 mm)
	Design features	Compact, Light Weight
	Detailed specifications	Section A.4
	Ordering information	Product Data Sheet
	Model	8721
	Style	Hygienic (sanitary)
	Base accuracy ⁽¹⁾	0.5% Standard 0.25% High Accuracy Option
	Line sizes	½-in. to 4-in. (15 mm to 100 mm)
	Design features	3-A and EHEDG CIP/SIP
	Detailed specifications	Section A.5
	Ordering information	Product Data Sheet

(1) For complete accuracy specifications, refer to the sensor detailed specifications.

Table A-3: Lining Material Selection


Liner material	General characteristics
PFA, PFA+ 	Best chemical resistance
	Better abrasion resistance than PTFE
	Best high temperature capabilities
	Process temperature: -58 to 350 °F (-50 to 177 °C)

Table A-3: Lining Material Selection (continued)


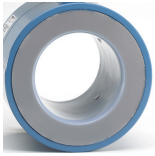
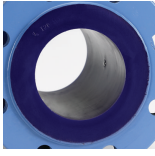
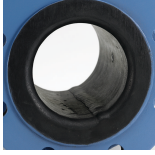

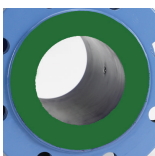
Liner material	General characteristics
	Highly chemical resistant
	Excellent high temperature capabilities
	Process temperature: -58 to 350 °F (-50 to 177 °C)
	Excellent chemical resistance
	Better abrasion resistance than PTFE
	Process temperature: -58 to 300 °F (-50 to 149 °C)
	Limited chemical resistance
	Excellent abrasion resistance for slurries with small and medium particles
	Process temperature: 0 to 140 °F (-18 to 60 °C)
	Typically applied in clean water
	Very good abrasion resistance for small and medium particles
	Better chemical resistance than polyurethane
	Typically applied in water with chemicals, and sea water
	Preferred liner for high pressure > ASME B16.5 Class 900
	Process temperature: 0 to 176 °F (-18 to 80 °C)
	Limited chemical resistance especially in acids
	Very good abrasion resistance for large particles
	Softer material than polyurethane and neoprene
	Typically applied in mining slurries
	Process temperature: 0 to 158 °F (-18 to 70 °C)
	Ideal for applications with high salinity and/or hydrocarbon carryover
	Excellent abrasion resistance
	Typically used for Water Injection, Recovered Water, and Coal Gasification Slurries
	Preferred liner for high pressure > ASME B16.5 Class 900
Process temperature: 0 to 200 °F (-18 to 93 °C)	

Table A-4: Electrode Material

Electrode material	General characteristics
316L Stainless Steel	Good corrosion resistance
	Good abrasion resistance
	Not recommended for sulfuric or hydrochloric acids
Nickel Alloy 276 (UNS N10276)	Better corrosion resistance
	High strength
	Good in slurry applications
	Effective in oxidizing fluids
Tantalum	Excellent corrosion resistance
	Not recommended for hydrofluoric acid, fluorosilic acid, or sodium hydroxide
80% Platinum 20% Iridium	Best chemical resistance
	Expensive material
	Not recommended for aquaregia
Titanium	Better chemical resistance
	Better abrasion resistance
	Good for sea water applications
	Not recommended for hydrofluoric or sulfuric acid
Tungsten Carbide coated	Limited chemical resistance
	Best abrasion resistance
	High concentration slurries
	Preferred electrode for oil and gas fracturing applications

Table A-5: Electrode Type

Electrode type	General characteristics
Standard Measurement	Lowest cost
	Good for most applications
Measurement + Reference Electrode (Also see Table A-6 and Table A-7 for grounding options and installation)	Low cost grounding option especially for large line sizes
	Minimum conductivity of 100 microSiemens/cm
	Not recommended for electrolytic or galvanic corrosion applications
Bulletnose	Extended head protrudes into the flow stream for self-cleaning
	Best option for coating processes

Table A-5: Electrode Type (continued)

Electrode type	General characteristics
Flat Head	Low profile head
	Best option for abrasive slurries

Table A-6: Process Reference Options

Grounding options	General characteristics
No Grounding Options (grounding straps)	Acceptable for conductive unlined pipe
	Grounding straps provided at no cost
Reference Electrode	Same material as measurement electrodes
	Sufficient grounding option when process fluid conductivity is greater than 100 microSiemens/cm
	Not recommended in electrolysis applications, galvanic corrosion applications, applications where the electrodes may coat, or non-conductive pipe.
Grounding Rings	Low conductivity process fluids
	Cathodic or electrolysis applications that may have stray currents in or around the process
	Variety of materials for process fluid compatibility
Lining Protectors	Protect upstream edge of sensor from abrasive fluids
	Permanently installed on sensor
	Protect liner material from over torquing of flange bolts
	Provide ground path and eliminate need for grounding rings or reference electrode
	Required for applications where Flexitallic gaskets are used

Table A-7: Process Reference Installation

Type of pipe	Grounding straps	Grounding rings	Reference electrode	Lining protectors
Conductive unlined pipe	Acceptable	Not required	Not required	Not required
Conductive lined pipe	Not acceptable	Acceptable	Acceptable	Acceptable
Non-conductive pipe	Not acceptable	Acceptable	Not recommended	Acceptable

A.2 Transmitter specifications

A.2.1 Transmitter functional specifications

Sensor compatibility

Compatible with Rosemount 8705, 8711, and 8721 sensors. Compatible with AC and DC powered sensors of other manufacturers.

Transmitter coil drive current

500mA

Flow rate range

Capable of processing signals from fluids with velocities between 0.04 and 39 ft/s (0.01 to 12 m/s) for both forward and reverse flow in all sensor sizes. Full scale continuously adjustable between -39 and 39 ft/s (-12 to 12 m/s).

Conductivity limits

Process liquid must have a conductivity of 5 microSiemens/cm (5 micromhos/cm) or greater.

Power supply

90 - 250VAC @ 50/60Hz, 12 - 42VDC, or 12 - 30VDC

Line power fuses

- 90 - 250VAC systems:
 - 2 amp quick acting
 - Bussman AGC2 or equivalent
- 12 - 42VDC systems
 - 3 amp quick acting
 - Bussman AGC3 or equivalent
- 12 - 30VDC systems
 - 3 amp quick acting
 - Bussman AGC3 or equivalent

Power consumption

- 90 - 250VAC: 40VA maximum
- 12 - 42VDC: 15W maximum
- 12 - 30VDC: 3W maximum

Switch-on current

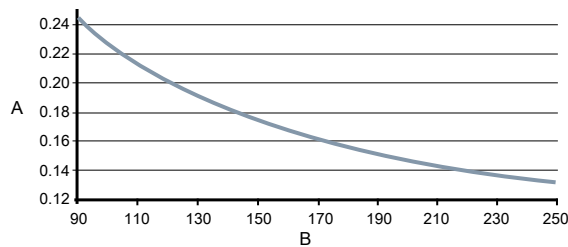
- At 250VAC: Maximum 35.7A (< 5ms)
- At 42VDC: Maximum 42A (< 5ms)

- At 30VDC: Maximum 42A (< 5ms)

AC power supply requirements

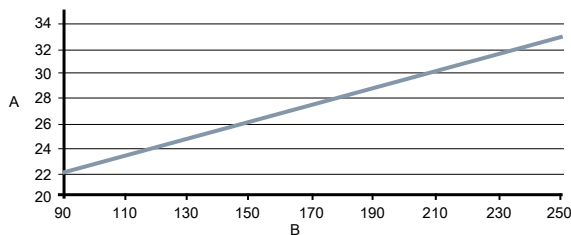
Units powered by 90 - 250VAC have the following power requirements. Peak inrush is 35.7A at 250VAC supply, lasting approximately 1ms. Inrush for other supply voltages can be estimated with: $\text{Inrush (Amps)} = \text{Supply (Volts)} / 7.0$

Figure A-1: AC current requirements



- A. Supply current (amps)
B. Power supply (VAC)

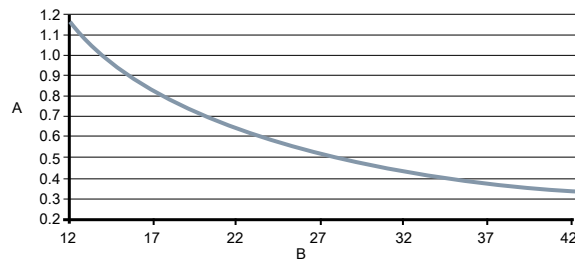
Figure A-2: Apparent power



- A. Apparent power (VA)
B. Power supply (VAC)

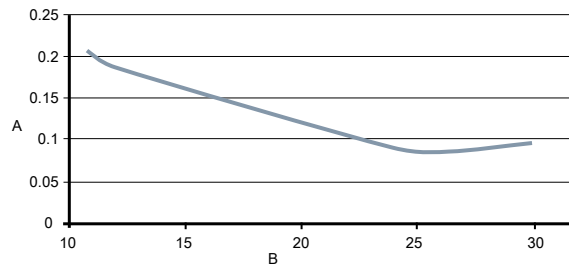
DC power supply requirements

Standard DC units powered by 12VDC power supply may draw up to 1.2A of current steady state. Low power DC units may draw up to 0.25A of current steady state. Peak inrush is 42A at 42VDC supply, lasting approximately 1ms. Inrush for other supply voltages can be estimated with: $\text{Inrush (Amps)} = \text{Supply (Volts)} / 1.0$

Figure A-3: DC current requirements

- A. Supply current (amps)
 B. Power supply (VDC)

DC low power supply requirements

Figure A-4: Low power DC current requirements

- A. Supply current (amps)
 B. Power supply (VDC)

Low power software option

This software option lowers the coil current from 500 mA to 75 mA in order to conserve power for applications in remote locations where power is scarce. The coils are still driven in a continuous manner optimizing measurement performance and providing access to all diagnostic capabilities. Because of the reduced coil current, flow measurement accuracy is reduced to 1% of rate for low power systems. [Table A-8](#) shows the power consumption that can be expected for various configurations. Due to the reduced coil current, sensor size is limited to a maximum line size of 10-in. (250 mm).

The low power option is available with DC power only (option code 3) and output code . To ensure the sensor will support the low power functionality, option code D3 for a low power calibration must appear in both the transmitter and sensor model number. Sample model numbers for a low power system are:

8712EMR3M1N6M4DA1DA2D3

8705DHA020D7M0N6B3D3

Table A-8: F0875 Low power consumption

Output code	Power consumption	Flow accuracy	Measurement range
Output Code B Utilize Pulse Output Only	2 Watts Maximum	1% of Rate	0.04 fps to 39 fps 0.01 m/s to 12 m/s
Output Code B Utilize Pulse and Analog Output	3 Watts Maximum	1% of Rate	0.04 fps to 39 fps 0.01 m/s to 12 m/s
Output code M Utilizing Modbus RS-485 and Pulse Output	4 Watts Maximum	1% of Rate	0.04 fps to 39 fps 0.01 m/s to 12 m/s

Ambient temperature limits

- Operating:
 - -58 to 140 °F (-50 to 60 °C) without local operator interface
 - -4 to 140 °F (-20 to 60 °C) with local operator interface
 - The Local Operator Interface (LOI) will not display at temperatures below -20°C
- Storage:
 - -58 to 185 °F (-50 to 85 °C) without local operator interface
 - -22 to 176 °F (-30 to 80 °C) with local operator interface

Humidity limits

0–95% RH to 140 °F (60 °C)

Altitude

2000 meters maximum

Enclosure rating

Type 4X, IEC 60529, IP66 (transmitter)

Transient protection rating

Built in transient protection that conforms to:

- IEC 61000-4-4 for burst currents
- IEC 61000-4-5 for surge currents
- IEC 611185-2.2000, Class 3 up to 2kV and up to 2kA protection

Turn-on time

- 5 minutes to rated accuracy from power up
- 5 seconds from power interruption

Start-up time

50ms from zero flow

Low flow cut-off

Adjustable between 0.01 and 38.37 ft/s (0.003 and 11.7 m/s). Below selected value, output is driven to the zero flow rate signal level.

Overrange capability

Signal output will remain linear until 110% of upper range value or 44 ft/s (13 m/s). The signal output will remain constant above these values. Out of range message displayed on LOI and the Field Communicator.

Damping

Adjustable between 0 and 256 seconds

A.2.2 Advanced diagnostics capabilities

Basic

- Self test
- Transmitter faults
- Pulse output test
- Tunable empty pipe
- Reverse flow
- Coil circuit fault
- Electronics temperature

Process diagnostics (DA1)

- Ground/wiring fault
- High process noise
- Electrode coating diagnostic

Smart Meter Verification (DA2)

- Smart Meter Verification (continuous or on-demand)

A.2.3 Output signals

Analog alarm mode

High or low alarm signal is user-selectable via the Alarm switch on the front of the electronics. NAMUR-compliant alarm limits are software configurable and can be preset via CDS (C1). Individual diagnostic alarms are also software configurable. Alarms will drive the analog signal to the following mA values. High or low alarm signal is user-selectable via

the Alarm switch on the front of the electronics. NAMUR-compliant alarm limits are software configurable and can be preset via CDS (C1). Individual diagnostic alarms are also software configurable. Alarms will drive the analog signal to the following mA values.

Low	3.75 mA	Requires CDS (C1)
High	22.50 mA	Factory default
NAMUR Low	3.5 mA	Requires CDS (C1)
NAMUR High	22.6 mA	Requires CDS (C1)

Scalable pulse frequency adjustment⁽¹⁾⁽²⁾

- 0-10,000Hz, switch-selectable as internally or externally powered
- Pulse value can be set to equal desired volume in selected engineering units
- Pulse width adjustable from 0.1 to 650 ms
- Internally powered: Outputs up to 12VDC
- Externally powered: Input 5 - 28VDC

Output testing

Pulse output test⁽²⁾ Transmitter may be commanded to supply a specified frequency between 1 and 10,000Hz.

Optional discrete output function (AX option)

Externally powered at 5 - 28VDC, 240mA max, solid state switch closure to indicate either:

Reverse flow	Activates switch closure output when reverse flow is detected.
Zero flow	Activates switch closure output when flow goes to 0 ft/s or below low flow cutoff.
Empty pipe	Activates switch closure output when an empty pipe condition is detected.
Transmitter faults	Activates switch closure output when a transmitter fault is detected.
Flow limit 1, flow limit 2	Activates switch closure output when the transmitter measures a flow rate that meets the conditions established for this alert. There are two independent flow limit alerts that can be configured as discrete outputs.
Totalizer limit	Activates switch closure output when the transmitter measures a total flow that meets the conditions established for this alert.
Diagnostic status	Activates switch closure output when the transmitter detects a condition that meets the configured criteria of this output.

(1) For transmitters with intrinsically safe outputs (option code B), power must be supplied externally.

(2) For transmitters with intrinsically safe outputs (option code B), frequency range is limited to 0-5000Hz.

Optional discrete input function (AX option)

Externally powered at 5 - 28VDC, 1.4 - 20mA to activate switch closure to indicate either:

Reset Totalizer A (or B or C)	Resets Totalizer A (or B or C) value to zero.
Reset All Totals	Resets all totalizer values to zero.
Positive Zero Return (PZR)	Forces outputs of the transmitter to zero flow.

Sensor compensation

Rosemount sensors are calibrated in a flow lab at the factory and are assigned a calibration number. The calibration number must be entered into the transmitter, enabling interchangeability of sensors without calculations or a compromise in standard accuracy.

Transmitters and other manufacturers' sensors can be calibrated at known process conditions or at the Rosemount NIST-Traceable Flow Facility. Transmitters calibrated on site require a two-step procedure to match a known flow rate. This procedure can be found in the operations manual.

A.2.4 Performance specifications

System specifications are given using the frequency output and with the unit at reference conditions.

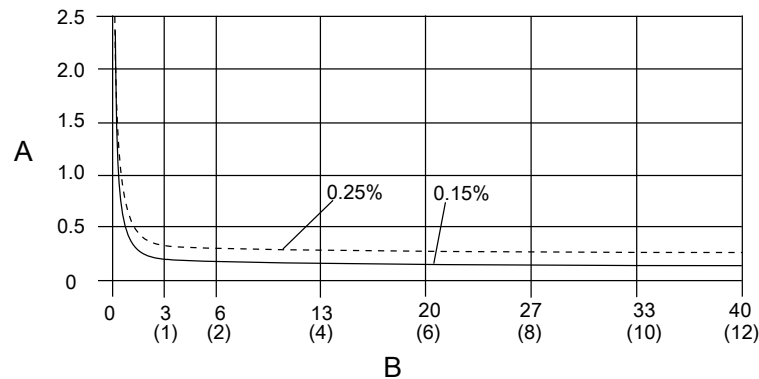
Accuracy

Includes the combined effects of linearity, hysteresis, and repeatability.

Rosemount 8705-M Sensor

- Standard system accuracy:
 - $\pm 0.25\%$ of rate ± 1.0 mm/sec from 0.04 to 6 ft/s (0.01 to 2 m/s)
 - $\pm 0.25\%$ of rate ± 1.5 mm/sec above 6 ft/s (2 m/s)
- Optional high accuracy:⁽³⁾
 - $\pm 0.15\%$ of rate ± 1.0 mm/sec from 0.04 to 13 ft/s (0.01 to 4 m/s)
 - $\pm 0.18\%$ of rate above 13 ft/s (4 m/s)

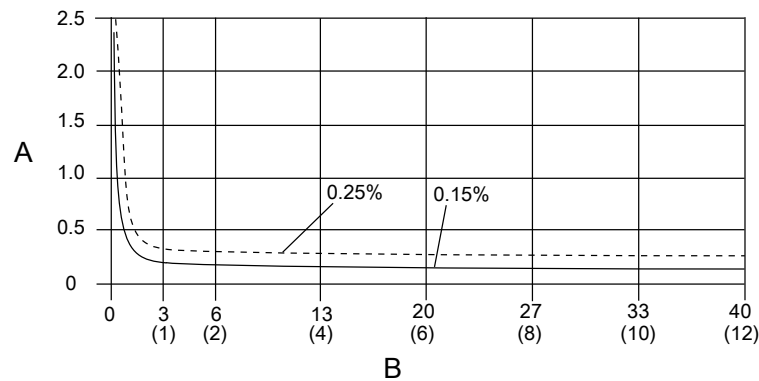
(3) For sensor sizes greater than 12 in. (300 mm) the high accuracy is $\pm 0.25\%$ of rate from 3 to 39 ft/sec (1 to 12 m/sec).



A. Percentage of rate
B. Velocity in ft/s (m/s)

Rosemount 8711-M/L Sensor

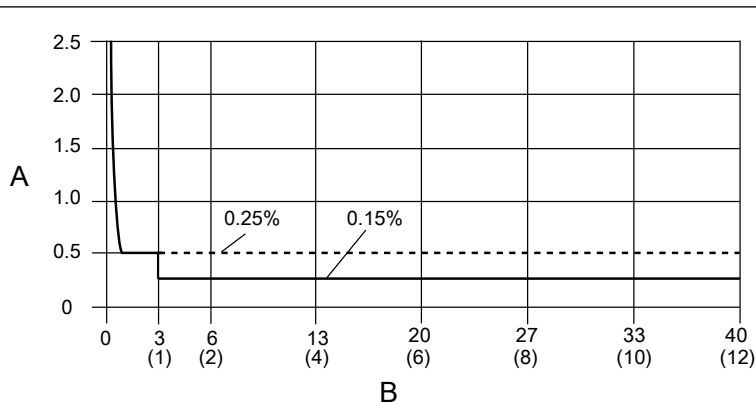
- Standard system accuracy: $\pm 0.25\%$ of rate ± 2.0 mm/sec from 0.04 to 39 ft/s (0.01 to 12 m/s)
- Optional high accuracy:
 - $\pm 0.15\%$ of rate ± 1.0 mm/sec from 0.04 to 13 ft/s (0.01 to 4 m/s)
 - $\pm 0.18\%$ of rate above 13 ft/s (4 m/s)



A. Percentage of rate
B. Velocity in ft/s (m/s)

Rosemount 8721 Sensor

- Standard system accuracy:
 - $\pm 0.5\%$ of rate from 1 to 39 ft/s (0.3 to 12 m/s)
 - ± 0.005 ft/s (0.0015 m/s) between 0.04 and 1.0 ft/s (0.01 and 0.3 m/s)
- Optional high accuracy: $\pm 0.25\%$ of rate from 3 to 39 ft/s (1 to 12 m/s):



A. Percentage of rate
 B. Velocity in ft/s (m/s)

Other manufacturers' sensors

- When calibrated in the Rosemount Flow Facility, system accuracies as good as 0.5% of rate can be attained.
- There is no accuracy specification for other manufacturers' sensors calibrated in the process line.

Analog output effects

Analog output has the same accuracy as frequency output plus an additional $\pm 4 \mu A$ at room temperature.

Repeatability	$\pm 0.1\%$ of reading
Response time (analog output)	20 ms max response time to step change in input
Stability	$\pm 0.1\%$ of rate over six months
Ambient temperature effect	$\pm 0.25\%$ change over operating temperature range

A.2.5 8712 Wall mount transmitter physical specifications

Materials of construction

Standard housing	Low copper aluminum Type 4X and IEC 60529 IP66
Paint	Polyurethane coat (1.8 to 2.2 mils thick)
Optional housing	Not available
Cover gaskets	Silicone

Electrical connections

Conduit entries	½ inch NPT or M20
Terminal block screws	6-32 (No. 6) suitable for up to 14 AWG wire
Safety grounding screws	External stainless assembly, M5; internal 8-32 (No. 8)

Vibration rating

2G per IEC 61298

Dimensions

See Product Data Sheet.

Weight

Rosemount 8712EM	Aluminum	Approximately 9 lbs. (4 kg)
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Add 1 pound (0.5 kg) for local operator interface.

A.3 8705-M Flanged Sensor Specifications



A.3.1 Functional specifications

Service

Conductive liquids and slurries

Line sizes

½ -in. to 36-in. (15 mm to 900 mm)

Sensor coil resistance

7 - 16 Ω

Interchangeability

Rosemount 8705-M sensors are interchangeable with 8712EM and 8732EM transmitters. Rosemount 8750W sensors are interchangeable with 8750W transmitters. System accuracy is maintained regardless of line size or optional features. Each sensor nameplate has a sixteen-digit calibration number that can be entered into a transmitter through the Local Operator Interface (LOI) or the Field Communicator.

Upper range limit

39.37 ft/s (12 m/s)

Ambient temperature limits

- -20 to 140 °F (-29 to 60 °C) standard design
- -58 to 140 °F (-50 to 60 °C) with "SH" all stainless design⁽⁴⁾

Pressure limits

See [Process temperature limits](#).

Vacuum limits

PTFE lining	Full vacuum to 350 °F (177 °C) through 4-in. (100 mm) line sizes. Consult Technical Support for vacuum applications with line sizes of 6 inches (150 mm) or larger
All other standard sensor lining materials	Full vacuum to maximum material temperature limits for all available line sizes.

Submergence protection IP68

The remote mount sensor is rated IP68 for submergence to a depth of 33 ft (10 m) for a period of 48 hours. IP68 rating requires that the transmitter must be remote mount. Installer must use IP68 approved cable glands, conduit connections, and/or conduit plugs.

For more details on proper installation techniques for IP68, reference Rosemount Technical Note 00840-0100-4750 available on www.rosemount.com.

Conductivity limits

Process liquid must have a minimum conductivity of 5 microSiemens/cm (5 micromhos/cm) or greater.

Process temperature limits

PTFE lining	-58 to 350 °F (-50 to 177 °C)
ETFE lining	-58 to 300 °F (-50 to 149 °C)
PFA and PFA+ lining	-58 to 350 °F (-50 to 177 °C)
Polyurethane lining	0 to 140 °F (-18 to 60 °C)

(4) Not available for Class/Div approval codes N5, N6, K5, KU.

Neoprene lining	0 to 176 °F (-18 to 80 °C)
Linatex lining	0 to 158 °F (-18 to 70 °C)
Adiprene lining	0 to 200 °F (-18 to 93 °C)

Table A-9: Temperature vs. Pressure Limits for ASME B16.5 class flanges ⁽¹⁾

Sensor temperature vs. pressure limits for ASME B16.5 class flanges (½ -in. to 36-in. Line Sizes) ⁽²⁾					
Flange material	Flange rating	Pressure			
		@ -20 to 100 °F (-29 to 38 °C)	@ 200 °F (93 °C)	@ 300 °F (149 °C)	@ 350 °F (177 °C)
Carbon Steel	Class 150	285 psi	260 psi	230 psi	215 psi
	Class 300	740 psi	675 psi	655 psi	645 psi
	Class 600 ⁽³⁾	1000 psi	800 psi	700 psi	650 psi
	Class 600 ⁽⁴⁾	1480 psi	1350 psi	1315 psi	1292 psi
	Class 900	2220 psi	2025 psi	1970 psi	1935 psi
	Class 1500	3705 psi	3375 psi	3280 psi	3225 psi
	Class 2500	6170 psi	5625 psi	5470 psi	5375 psi
304 Stainless Steel	Class 150	275 psi	235 psi	205 psi	190 psi
	Class 300	720 psi	600 psi	530 psi	500 psi
	Class 600 ⁽⁵⁾	1000 psi	800 psi	700 psi	650 psi
	Class 600 ⁽⁶⁾	1440 psi	1200 psi	1055 psi	997 psi
	Class 900	2160 psi	1800 psi	1585 psi	1497 psi
	Class 1500	3600 psi	3000 psi	2640 psi	2495 psi
	Class 2500	6000 psi	5000 psi	4400 psi	4160 psi

(1) Liner temperature limits must also be considered.

(2) 30-in. and 36-in. AWWA C207 Class D rated to 150 psi at atmospheric temperature.

(3) Option Code C6.

(4) Option Code C7.

(5) Option Code S6.

(6) Option Code S7.

Table A-10: Temperature vs. Pressure Limits for AS2129 Table D and E flanges ⁽¹⁾

Sensor temperature vs. pressure limits for AS2129 Table D and E flanges (4-in. to 24-in. line sizes)					
Flange Material	Flange Rating	Pressure			
		@ -29 to 50 °C (-20 to 122 °F)	@ 100 °C (212 °F)	@ 150 °C (302 °F)	@ 200 °C (392 °F)
Carbon Steel	D	101.6 psi	101.6 psi	101.6 psi	94.3 psi

Table A-10: Temperature vs. Pressure Limits for AS2129 Table D and E flanges ⁽¹⁾ (continued)

Sensor temperature vs. pressure limits for AS2129 Table D and E flanges (4-in. to 24-in. line sizes)					
Flange Material	Flange Rating	Pressure			
		@ -29 to 50 °C (-20 to 122 °F)	@ 100 °C (212 °F)	@ 150 °C (302 °F)	@ 200 °C (392 °F)
	E	203.1 psi	203.1 psi	203.1 psi	188.6 psi

(1) Liner temperature limits must also be considered.

Table A-11: Temperature vs. Pressure Limits for EN 1092-1 flanges ⁽¹⁾

Sensor temperature vs. pressure limits for EN 1092-1 flanges (15 mm to 600 mm Line Sizes)					
Flange material	Flange rating	Pressure			
		@ -29 to 50 °C (-20 to 122 °F)	@ 100 °C (212 °F)	@ 150 °C (302 °F)	@ 175 °C (347 °F)
Carbon Steel	PN 10	10 bar	10 bar	9.7 bar	9.5 bar
	PN 16	16 bar	16 bar	15.6 bar	15.3 bar
	PN 25	25 bar	25 bar	24.4 bar	24.0 bar
	PN 40	40 bar	40 bar	39.1 bar	38.5 bar
304 Stainless Steel	PN 10	9.1 bar	7.5 bar	6.8 bar	6.5 bar
	PN 16	14.7 bar	12.1 bar	11.0 bar	10.6 bar
	PN 25	23 bar	18.9 bar	17.2 bar	16.6 bar
	PN 40	36.8 bar	30.3 bar	27.5 bar	26.5 bar

(1) Liner temperature limits must also be considered.

A.3.2 Physical specifications

Non-wetted materials

Sensor Pipe	Type 304/304L SST or Type 316/316L SST
Flanges	Carbon steel, Type 304/304L SST, or Type 316/316L SST
Coil housing	Rolled carbon steel
Paint	Polyurethane coat (2.6 mils or greater)
Optional coil housing	316/316L unpainted, option code SH

Process-wetted materials

Lining	PTFE, ETFE, PFA, Polyurethane, Neoprene, Linatex, Adiprene, PFA+
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Electrodes	316L SST, Nickel Alloy 276 (UNS N10276), Tantalum, 80% Platinum-20% Iridium, Titanium
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Flat-faced flanges

Sensors ordered with flat-faced flanges and Neoprene or Linatex liners are manufactured with the liner extending to the outer dimension of the flange. All other liner selections extend to the diameter of raised face dimension and create a raised surface on the flange face.

Process connections

ASME B16.5	<ul style="list-style-type: none"> Class 150: ½-in. to 24-in. (15 mm to 600 mm) Class 300: ½-in. to 24-in. (15 mm to 600 mm) Class 600: ½-in. to 24-in. (15 mm to 600 mm)⁽¹⁾ Class 900: 1-in. to 12-in. (25 mm to 300 mm)⁽²⁾ Class 1500: 1½-in. to 12-in. (40 mm to 300 mm)⁽²⁾ 1½-in. to 6-in. (40 mm to 150 mm)⁽²⁾
ASME B16.47	<ul style="list-style-type: none"> Class 150: 30-in. to 36-in. (750 mm to 900 mm) Class 300: 30-in. to 36-in. (750 mm to 900 mm)
AWWA C207	<ul style="list-style-type: none"> Class D: 30-in. and 36-in. (750 mm and 900 mm)
MSS SP44	<ul style="list-style-type: none"> Class 150: 30-in. to 36-in. (750 mm to 900 mm)
EN 1092-1	<ul style="list-style-type: none"> PN10: 200 mm to 900mm (8-in. to 36-in.) PN16: 100 mm to 900mm (4-in. to 36-in.) PN25: 200 mm to 900mm (8-in. to 36-in.) PN40: 15 mm to 900mm (½-in. to 36-in.)
AS2129	<ul style="list-style-type: none"> Table D and Table E: 15 mm to 900 mm (½-in. to 36-in.)
AS4087	<ul style="list-style-type: none"> PN16, PN21, PN35: 50 mm to 600 mm (2-in. to 24-in.)
JIS B2220	<ul style="list-style-type: none"> 10K, 20K, 40K: 15 mm to 200 mm (½-in. to 8-in.)

(1) For PTFE, PFA, PFA+, and ETFE, maximum working pressure is derated to 1000 psig.

(2) For Class 900 and higher flange ratings, liner selection is limited to resilient liners.

Electrical connections

Conduit entries	Available with 1/2 inch NPT and M20
Terminal block screws	6-32 (No. 6) suitable for up to 14 AWG wire
Safety grounding screws	External stainless assembly, M5; internal 8-32 (No. 8)

Process reference electrode (optional)

A process reference electrode can be installed similarly to the measurement electrodes through the sensor lining on 8705 sensors. It will be made of the same material as the measurement electrodes.

Grounding rings (optional)

Grounding rings can be installed between the flange and the sensor face on both ends of the sensor. Single ground rings can be installed on either end of the sensor. They have an I.D. slightly larger than the sensor I.D. and an external tab to attach ground wiring. Grounding rings are available in 316L SST, Nickel Alloy 276 (UNS N10276), titanium, and tantalum. .

Lining protectors (optional)

Lining protectors can be installed between the flange and the sensor face on both ends of the sensor. The leading edge of lining material is protected by the lining protector; lining protectors cannot be removed once they are installed. Lining protectors are available in 316L SST, Nickel Alloy 276 (UNS N10276), and titanium. .

Dimensions

See Product Data Sheet.

Weight

See Product Data Sheet.

A.4 8711-M/L Wafer Sensor Specifications



A.4.1 Functional specifications

Service

Conductive liquids and slurries

Line sizes

1.5-in. to 8-in. (4 mm to 200 mm)

Sensor coil resistance

10 - 18 Ω

Interchangeability

Rosemount 8711-M/L Sensors are interchangeable with 8712EM and 8732EM Transmitters. System accuracy is maintained regardless of line size or optional features. Each sensor nameplate has a sixteen-digit calibration number that can be entered into a transmitter through the Local Operator Interface (LOI) or the Field Communicator.

Upper range limit

39.37 ft/s (12 m/s)

Process temperature limits

ETFE lining	-20 to 300 °F (-29 to 149 °C)
PTFE lining	-20 to 350 °F (-29 to 177 °C)

Ambient temperature limits

-20 to 140 °F (-29 to 60 °C)

Maximum safe working pressure at 100 °F (38 °C)

ETFE lining	Full vacuum to 740 psi (5.1 MPa)
PTFE lining	<ul style="list-style-type: none"> Line sizes 1.5-in. (40 mm) through 4-in. (100 mm); Full vacuum to 740 psi (5.1 MPa) Consult Technical Support for vacuum applications with line sizes of 6-in. (150 mm) or larger

Submergence protection IP68

The remote mount 8711-M/L sensor is rated IP68 for submergence to a depth of 33 ft (10 m) for a period of 48 hours. IP68 rating requires that the transmitter must be remote mount. Installer must use IP68 approved cable glands, conduit connections, and/or conduit plugs. For more details on proper installation techniques for IP68, reference Rosemount Technical Document 00840-0100-4750 available on www.rosemount.com.

Conductivity limits

Process liquid must have a minimum conductivity of 5 microSiemens/cm (5 micromhos/cm) or greater for 8711.

A.4.2 Physical specifications

Non-wetted materials

Sensor body	<ul style="list-style-type: none"> 303 SST CF3M or CF8M Type 304/304L
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Coil housing	Rolled carbon steel
Paint	Polyurethane coat (2.6 mils or greater)

Process-wetted materials

Lining	PTFE, ETFE
Electrodes	316L SST, Nickel Alloy 276 (UNS N10276), Tantalum, 80% Platinum—20% Iridium, Titanium

Electrical connections

Conduit entries	Available with 1/2 inch NPT and M20. See ordering table footnotes for details
Terminal block screws	6-32 (No. 6) suitable for up to 14 AWG wire
Safety grounding screws	External stainless assembly, M5; internal 8-32 (No. 8)

Process reference electrode (optional)

A process reference electrode can be installed similarly to the measurement electrodes through the sensor lining. It will be made of the same material as the measurement electrodes.

Grounding rings (optional)

Grounding rings can be installed between the flange and the sensor face on both ends of the sensor. They have an I.D. slightly smaller than the sensor I.D. and an external tab to attach ground wiring. Grounding rings are available in 316L SST, Nickel Alloy 276 (UNS N10276), titanium, and tantalum.

Dimensions

See Product Data Sheet.

Weight

See Product Data Sheet.

Process connections—Mounts between these flange configurations

ASME B16.5	Class 150, 300
EN 1092-1	PN10, PN16, PN25, PN40
JIS B2220	10K, 20K
AS4087	PN16, PN21, PN35

Studs, nuts, and washers—MK2-carbon steel

Component	ASME B16.5	EN1092-1
Studs, full thread	CS, ASTM A193, Grade B7	CS, ASTM A193, Grade B7
Hex nuts	ASTM A194 Grade 2H	ASTM A194 Grade 2H; DIN 934 H = D
Flat washers	CS, Type A, Series N, SAE per ANSI B18.2.1	CS, DIN 125
All items	Clear, chromate zinc-plated	Yellow zinc-plated

Studs, nuts, and washers—MK3-316 SST

Component	ASME B16.5	EN1092-1
Studs, full thread	ASTM A193, Grade B8M Class 1	ASTM A193, Grade B8M Class 1
Hex nuts	ASTM A194 Grade 8M	ASTM A194 Grade 8M; DIN 934 H = D
Flat washers	316 SST, Type A, Series N, SAE per ANSI B18.2.1	316 SST, DIN 125

A.5 8721 Hygienic (Sanitary) Sensor Specifications



A.5.1 Functional specifications

Service

Conductive liquids and slurries

Line sizes

1/2 -in. to 4-in. (15 mm to 100 mm)

Sensor coil resistance5 -10 Ω

Interchangeability

The Rosemount 8721 sensors are interchangeable with Rosemount 8712EM and 8732EM transmitters. System accuracy is maintained regardless of line size or optional features.

Each sensor label has a 16 digit calibration number that can be entered into the transmitter through the Local Operator Interface (LOI) or the Field Communicator.

Conductivity limits

Process liquid must have a minimum conductivity of 5 microSiemens/cm (5 micromhos/cm) or greater. Excludes the effect of interconnecting cable length in remote mount transmitter installations.

Flow rate range

Capable of processing signals from fluids that are traveling between 0.04 and 39 ft/s (0.01 to 12 m/s) for both forward and reverse flow in all sensor sizes. Full scale continuously adjustable between -39 and 39 ft/s (-12 to 12 m/s).

Sensor ambient temperature limits

14 to 140 °F (-15 to 60 °C)

Process temperature limits

PFA lining -20 to 350 °F (-29 to 177 °C)

Table A-12: Pressure limits

Line size	Max working pressure	CE mark max. working pressure
1/2 -in. (15 mm)	300 psi (20.7 bar)	300 psi (20.7 bar)
1-in. (25 mm)	300 psi (20.7 bar)	300 psi (20.7 bar)
1 1/2 -in. (40 mm)	300 psi (20.7 bar)	300 psi (20.7 bar)
2-in. (50 mm)	300 psi (20.7 bar)	300 psi (20.7 bar)
2 1/2 -in. (65 mm)	300 psi (20.7 bar)	240 psi (16.5 bar)
3 -in. (80 mm)	300 psi (20.7 bar)	198 psi (13.7 bar)
4-in. (100 mm)	210 psi (14.5 bar)	148 psi (10.2 bar)

Vacuum limits

Full vacuum at maximum lining material temperature; consult Technical Support.

Submergence protection IP68

The remote mount 8721 sensor is rated IP68 for submergence to a depth of 33 ft (10 m) for a period of 48 hours. IP68 rating requires that the transmitter must be remote mount. Installer must use IP68 approved cable glands, conduit connections, and/or conduit plugs. For more details on proper installation techniques for IP68, reference Rosemount Technical Note 00840-0100-4750 available on www.rosemount.com.

Sanitary fitting torque

Hand tighten IDF nut to approximately 50 in-lbs [5 1/2 Newton-meters (N-m)] of torque. Re-tighten after a few minutes until there are no leaks (up to 130 in-lbs [14 1/2 Newton-meters (N-m)] of torque).

Fittings that continue to leak at a higher torque may be distorted or damaged.

Compression-limiting gaskets are used to meet EHEDG Document 8. These gaskets limit over-torque.

A.5.2 Physical specifications

Mounting

Integrally mounted transmitters are factory-wired and do not require interconnecting cables. The transmitter can rotate in 90° increments. Remote mounted transmitters require only a single conduit connection to the sensor.

Non-wetted materials

Sensor	304 Stainless Steel (wrapper), 304 Stainless Steel (pipe)
Terminal junction box	Low copper aluminum Optional: 304 Stainless Steel

Process wetted materials (sensor)

Liner	PFA with Ra < 32µ in. (0.81 µm)
Electrodes	<ul style="list-style-type: none"> • 316L SST with Ra < 15µ in. (0.38 µm) • Nickel Alloy 276 (UNS N10276) with Ra < 15µ in. (0.38 µm) • 80% Platinum-20% Iridium with Ra < 15µ in. (0.38 µm)

Process connections

The Rosemount 8721 Sanitary Sensor is designed using a standard IDF fitting as the basis for providing a flexible, hygienic interface for a variety of process connections. The Rosemount 8721 Sensor has the threaded or “male” end of the IDF fitting on the ends of the base sensor. The sensor can be directly connected with user supplied IDF fittings and gaskets. If other process connections are needed, the IDF fittings and gaskets can be provided and welded directly into the sanitary process tubing, or can be supplied with adapters to standard Tri Clamp process connections. All connections are PED compliant for group 2 fluids.

Tri Clamp sanitary coupling	<ul style="list-style-type: none"> • IDF Sanitary Coupling (screw type) • IDF specification per BS4825 part 4 • ANSI Weld Nipple • DIN 11850 Weld Nipple • DIN 11851 (Imperial and Metric) • DIN 11864-1 form A • DIN 11864-2 form A • SMS 1145 • Cherry-Burrell I-Line
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Process connection material

- 316L Stainless Steel with Ra < 32µ in. (0.81µm)
- Optional Electropolished Surface Finish with Ra < 15µ in. (0.38µ m)

Process connection gasket material

- Silicone
- EPDM
- Viton

Electrical connections

Conduit entries	1/2 -in. NPT standard, M20 adapters
Terminal block screws	M3
Safety grounding screws	External stainless assembly, M5; internal 6-32 (No. 6)

Dimensions

See Product Data Sheet.

Weight

Table A-13: 8721 Sensor Weight

Line size	Sensor only	008721-0350 Tri Clamp fitting (Each)
1/2 -in. (15 mm)	4.84 lbs (2.20 kg)	0.58 lbs (0.263 kg)
1-in. (25 mm)	4.52 lbs (2.05 kg)	0.68 lbs (0.309 kg)
1 1/2 -in. (40 mm)	5.52 lbs (2.51 kg)	0.88 lbs (0.400 kg)
2-in. (50 mm)	6.78 lbs (3.08 kg)	1.30 lbs (0.591 kg)
2 1/2 -in. (65 mm)	8.79 lbs (4.00 kg)	1.66 lbs (0.727 kg)
3 -in. (80 mm)	13.26 lbs (6.03 kg)	2.22 lbs (1.01 kg)
4-in. (100 mm)	21.04 lbs (9.56 kg)	3.28 lbs (1.49 kg)

Aluminum remote junction box	<ul style="list-style-type: none">• Approximately 1 lb. (0.45 kg)• Paint - Polyurethane (1.3 to 5 mils)
SST remote junction box	<ul style="list-style-type: none">• Approximately 2.5 lbs. (1.13 kg)• Unpainted

Appendix B

Product Certifications

For detailed approval certification information, please see the appropriate document listed below:

- Document number 00825-MA00-0001: *Rosemount 8700M Approval Document - IECEx and ATEX*
- Document number 00825-MA00-0002: *Rosemount 8700M Approval Document – Class Division*
- Document number 00825-MA00-0003: *Rosemount 8700M Approval Document - North America Zone*

Appendix C

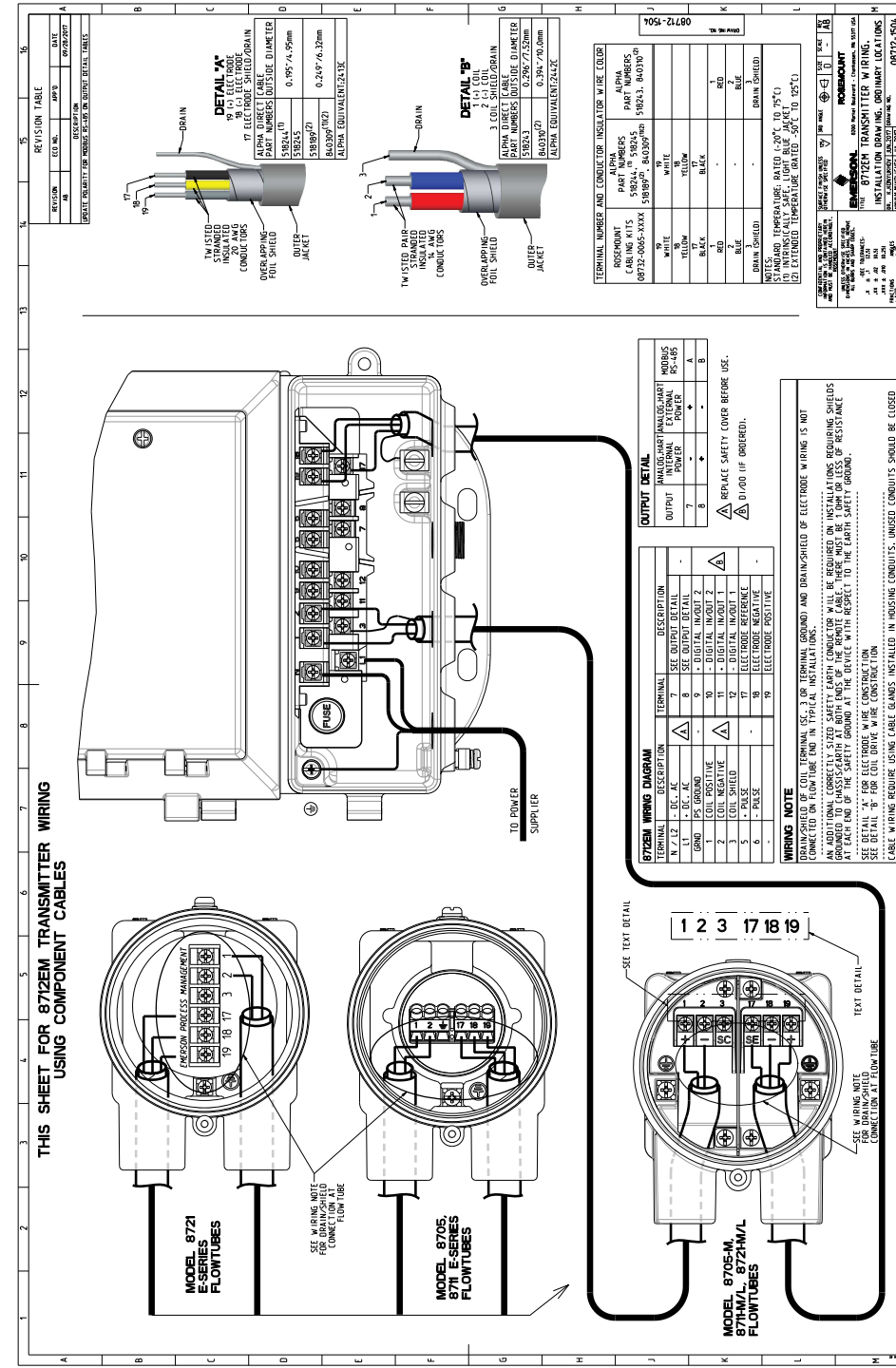
Wiring Diagrams

Topics covered in this appendix:

- *Wiring diagrams*
- *775 Smart Wireless THUM™ Adapter wiring diagrams*
- *Field Communicator wiring diagrams*

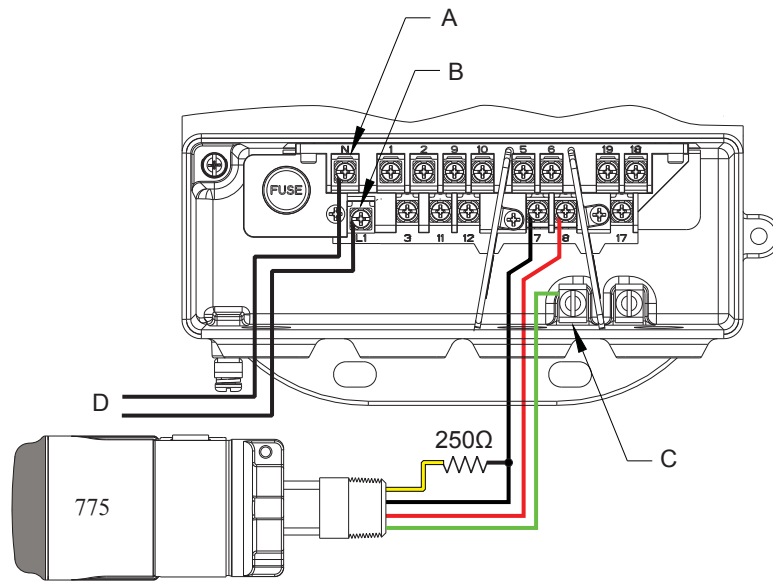
C.1 Wiring diagrams

Figure C-1: Wiring 8712EM using component cable



C.2 775 Smart Wireless THUM™ Adapter wiring diagrams

Figure C-3: Wiring Diagram—775 Smart Wireless THUM Adapter with 8712EM Internal Analog Power

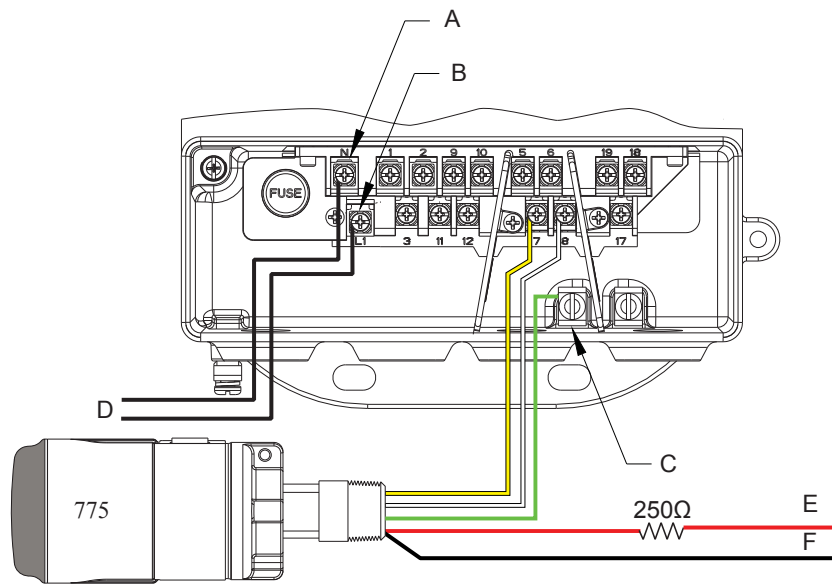


- A. AC neutral or DC -
- B. AC Line or DC +
- C. AC or DC Ground
- D. Transmitter Power

Table C-1: 775 wiring guide

Wire color	Connect to...
Red	Transmitter (+) pin 8
Black	Transmitter (-) pin 7 and 250Ω
Yellow	250Ω
Green	Transmitter housing
White	No connection

Figure C-4: Wiring Diagram—775 Smart Wireless THUM Adapter with 8712EM External Analog Power

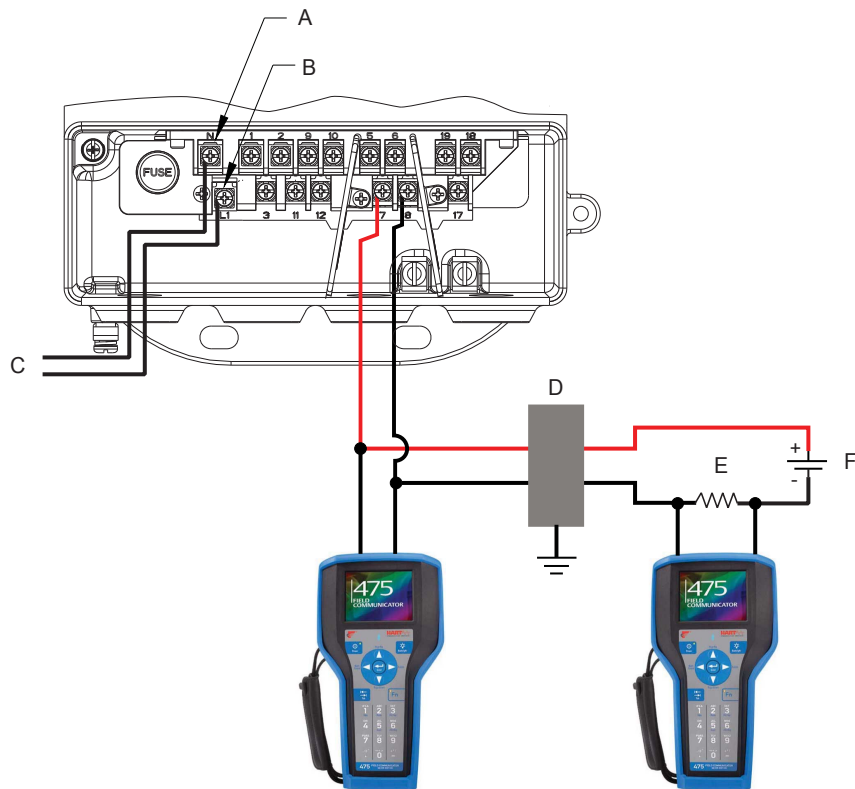


- A. AC neutral or DC -
- B. AC Line or DC +
- C. AC or DC Ground
- D. Transmitter Power
- E. 4–20mA +
- F. 4–20mA -

Table C-2: 775 wiring guide

Wire color	Connect to...
Red	Transmitter (+) pin 8
Black	Transmitter (-) pin 7 and 250Ω
Yellow	250Ω
Green	Transmitter housing
White	No connection

Figure C-6: Wiring diagram—Field Communicator with 8712EM external analog power



- A. AC neutral or DC-
- B. AC line or DC +
- C. Transmitter power
- D. Intrinsic safety barrier, if required.
- E. RL
- F. 24 VDC

Appendix D

Implementing a Universal Transmitter

Topics covered in this appendix:

- *Safety messages*
- *Universal capability*
- *Three step process*
- *Wiring the universal transmitter*
- *Rosemount sensors*
- *Brooks sensors*
- *Endress and Hauser sensors*
- *Fischer and Porter sensors*
- *Foxboro sensors*
- *Kent Veriflux VTC sensor*
- *Kent sensors*
- *Krohne sensors*
- *Taylor sensors*
- *Yamatake Honeywell sensors*
- *Yokogawa sensors*
- *Generic manufacturer sensor to 8712 Transmitter*

D.1 Safety messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please read the following safety messages before performing any operation described in this section.

 **WARNING!**

The transmitter has not been evaluated for use with other manufacturers' magnetic flowmeter sensors in hazardous (Ex or Classified) areas. Special care should be taken by the end-user and installer that the transmitter meets the safety and performance requirements of the other manufacturer's equipment.

D.2 Universal capability

The transmitter has the ability to drive other manufacturers' sensors. In addition to providing a flow measurement, all diagnostic functionality is available. This capability can provide additional information about the installation, the process, and the health of the sensor. Universal capabilities enable a common maintenance practice for all magnetic flowmeter installations and help reduce spares inventory of magnetic flowmeter transmitters.

This section provides wiring diagrams for connecting the transmitter to other manufacturers' sensors, and describes how to configure the universal capabilities.

D.3 Three step process

There are three steps to implementing a universal transmitter:

Procedure

1. Review the existing application. Verify that the existing sensor is in good working order, and that it is compatible with a universal transmitter.

Locate the wiring diagram (in this Appendix) that applies to your sensor. While the Universal transmitter may be able to drive the existing sensor, if the sensor is not in good working order, the universal transmitter may not function correctly.

2. Connect the universal transmitter to the existing sensor using the appropriate wiring diagram from this appendix.

If the sensor you are using is not listed in this appendix, contact Rosemount technical support for more details on the application of the universal capabilities.

3. Configure the transmitter following the guidelines in [Chapter 7](#) and [Chapter 8](#), setting up parameters as needed.

One of the key configuration parameters is the sensor calibration number. There are several methods to determine the calibration number, but the most common method will be to use the universal trim capability. This functionality is detailed in this appendix. Accuracy of the meter when the universal trim is used to determine the calibration number will be dependent on the accuracy of the known flow rate used in the trim process.

In addition to the universal trim, there are two other methodologies for determining a calibration number for the sensor:

Method 1: Have the sensor sent to a Rosemount service center for determination of a calibration number compatible with the universal transmitter. This is the most accurate method for determining the calibration number and will provide a $\pm 0.5\%$ of rate measurement accuracy from 3 to 40 fps (1-10 m/s).

Method 2: Involves the conversion of the existing sensor calibration number / meter factors to an equivalent Rosemount 16-digit calibration number. Accuracy of the meter using this methodology is estimated to be in the range of 2-3%. Contact the Rosemount technical support for more information on this method or to determine a calibration number for the existing sensor.

Once these steps are completed, the meter will begin measuring flow. Verify the measured flow rate is within the expected range and that the output correctly corresponds to the measured flow rate. Also verify the reading in the control system matches the reading at the transmitter. Once these items have been verified, the loop can be placed into automatic control as needed.

D.3.1 Universal trim

The universal auto trim function enables the transmitter to determine a calibration number for sensors that were not calibrated at the factory. See [Section 11.7.5](#).

D.4 Wiring the universal transmitter

The wiring diagrams in this section illustrate the proper connections between the transmitter and most sensors currently on the market. Specific diagrams are included for most models, and where information for a particular model of a manufacturer is not available, a generic drawing pertaining to that manufacturer's sensors is provided. If the manufacturer for the existing sensor is not included, see the drawing for generic connections.

Any trademarks used herein regarding sensors not manufactured by Rosemount are owned by the particular manufacturer of the sensor.

D.5 Rosemount sensors

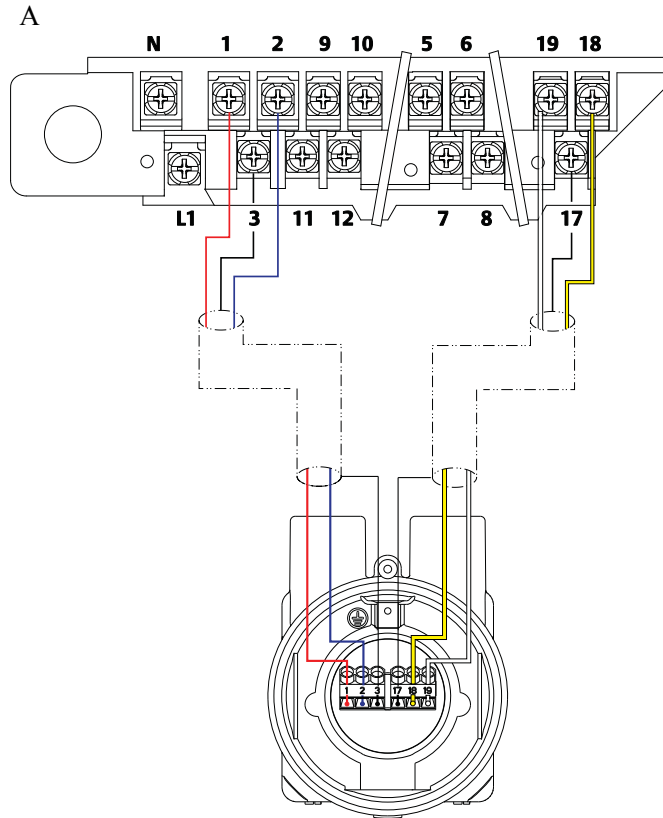
D.5.1 8705/8707/8711/8721 Sensors to 8712 Transmitter

To connect a Rosemount 8705/8707/8711/8721 Sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-1](#).

 **CAUTION!**

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-1: Wiring Diagram for a Rosemount 8712 Transmitter



A. Rosemount 8712 transmitter

Table D-1: Rosemount 8705/8707/8711/8721 Sensor Wiring Connections

Rosemount 8712 Transmitters	Rosemount 8705/8707/8711/8721 Sensors
1	1
2	2
3	3
17	17
18	18
19	19

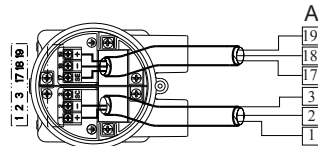
D.5.2 8705 M and 8711 M/L Sensors to 8712EM Transmitter

To connect a Rosemount 8705 M or 8711 M/L Sensor to a Rosemount 8712EM Transmitter, connect coil drive and electrode cables as shown in [Figure D-2](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-2: Wiring Diagram for a Rosemount 8712EM Transmitter



A. Rosemount 8712 transmitter

Table D-2: Rosemount 8705/8711 Sensor Wiring Connections

Rosemount 8712 Transmitters	Rosemount 8705/8711 Sensors
1	1 / +
2	2 / -
3	3 / SC
17	17 / SE
18	18 / -
19	19 / +

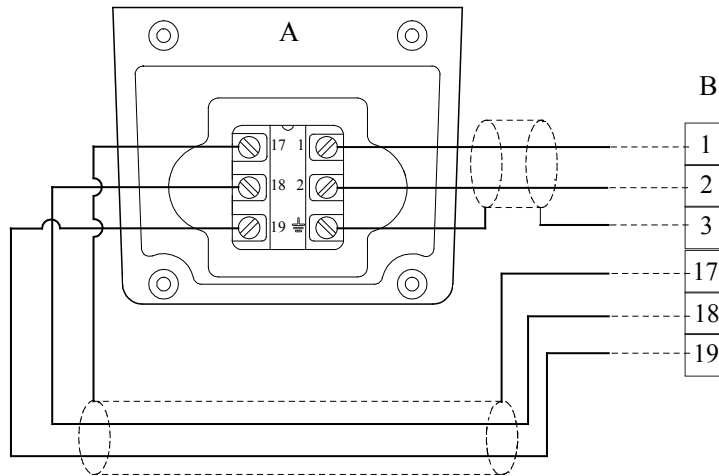
D.5.3 8701 sensor to 8712 transmitter

To connect a Rosemount 8701 sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-3](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-3: Wiring Diagram for Rosemount 8701 Sensor and Rosemount 8712 Transmitter



- A. Rosemount 8701 sensor
- B. Rosemount 8712 transmitter

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-3: Rosemount 8701 Sensor Wiring Connections

Rosemount 8712	Rosemount 8701 sensors
1	1
2	2
3	3
17	17
18	18
19	19

D.5.4 Connecting sensors of other manufacturers

Prerequisites

Before connecting another manufacturer’s sensor to the transmitter, it is necessary to perform the following functions.

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Procedure

1. Turn off the AC power to the sensor and transmitter.

⚠ CAUTION!

Failure to do so could result in electrical shock or damage to the transmitter.

2. Verify the coil drive cables between the sensor and the transmitter are not connected to any other equipment.
3. Label the coil drive cables and electrode cables for connection to the transmitter.
4. Disconnect the wires from the existing transmitter.
5. Remove the existing transmitter and then mount the new transmitter.

See [Chapter 4](#).

6. Verify the sensor coil is configured for series connection.

Other manufacturers sensors may be wired in either a series or parallel circuit. All Rosemount magnetic sensors are wired in a series circuit. (Other manufacturers AC sensors (AC coils) wired for 220 V operation are typically wired in parallel and must be rewired in series.)

7. Use the manufacturer's recommended test procedure for verification of sensor condition to verify the sensor is in good working condition. Perform the basic checks:
 - a. Check the coils for shorts or open circuits.
 - b. Check the sensor liner for wear or damage.
 - c. Check the electrodes for shorts, leaks, or damage.
8. Connect the sensor to the transmitter in accordance with reference wiring diagrams.

See [Appendix C](#) for specific drawings.
9. Connect and verify all connections between the sensor and the transmitter, then apply power to the transmitter.
10. Perform the Universal Auto Trim function.

D.6 Brooks sensors

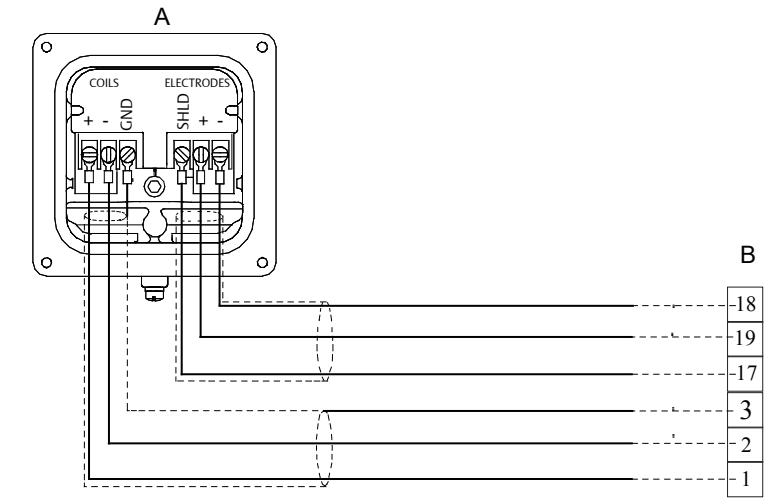
D.6.1 Model 5000 sensor to 8712 Transmitter

To connect a Model 5000 sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-4](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-4: Wiring Diagram for Brooks Sensor Model 5000 and Rosemount 8712



- A. Brooks Model 5000
- B. Rosemount 8712 transmitter

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-4: Brooks Model 5000 Sensor Wiring Connections

Rosemount 8712	Brooks sensors Model 5000
1	COILS (+)
2	COILS (-)
3	COILS (GND)
17	ELECTRODES (SHLD)
18	ELECTRODES (-)
19	ELECTRODES (+)

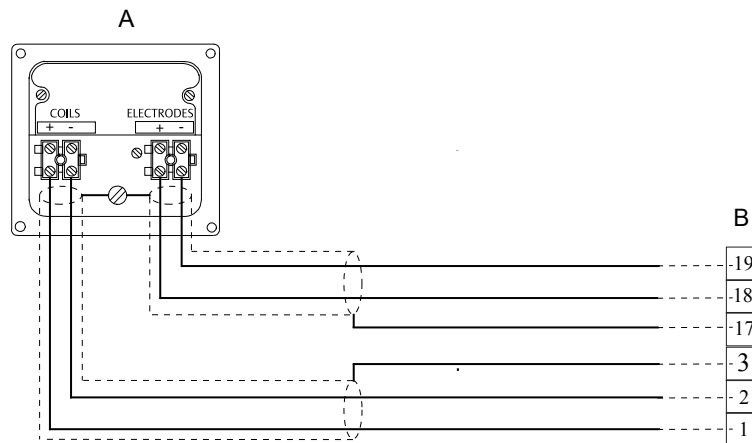
D.6.2 Model 7400 sensor to 8712 Transmitter

To connect a Model 7400 sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-5](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-5: Wiring Diagram for Brooks Sensor Model 7400 and Rosemount 8712



- A. Brooks Model 7400
B. Rosemount 8712 transmitter

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-5: Brooks Model 7400 sensor Wiring Connections

Rosemount 8712	Brooks Sensors Model 7400
1	Coils +
2	Coils -
3	3
17	Shield
18	Electrode +
19	Electrode -

D.7 Endress and Hauser sensors

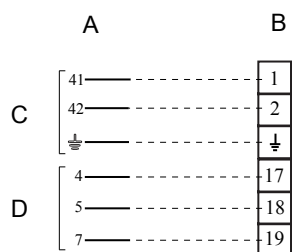
D.7.1 Endress and Hauser sensor to 8712 Transmitter

To connect an Endress and Hauser sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-6](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-6: Wiring Diagram for Endress and Hauser Sensors and Rosemount 8712



- A. Endress and Hauser sensors
- B. Rosemount 8712 transmitter
- C. Coils
- D. Electrodes

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-6: Endress and Hauser Sensor Wiring Connections

Rosemount 8712	Endress and Hauser sensors
1	41
2	42
3	14
17	4
18	5
19	7

D.8 Fischer and Porter sensors

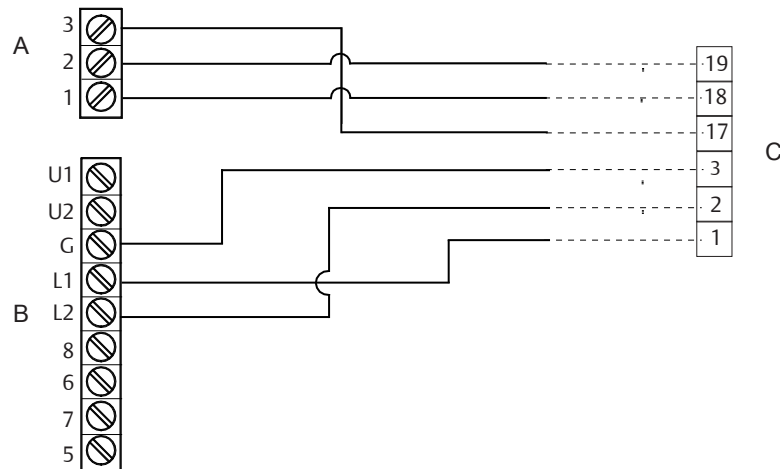
D.8.1 Model 10D1418 sensor to 8712 Transmitter

To connect a Model 10D1418 sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-7](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-7: Wiring Diagram for Fischer and Porter Sensor Model 10D1418 and Rosemount 8712



- A. Electrode connections
- B. Coil connections
- C. Rosemount 8712 transmitter

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-7: Fischer and Porter Model 10D1418 Sensor Wiring Connections

Rosemount 8712	Fischer and Porter Model 10D1418 sensors
1	L1
2	L2
3	Chassis ground
17	3
18	1
19	2

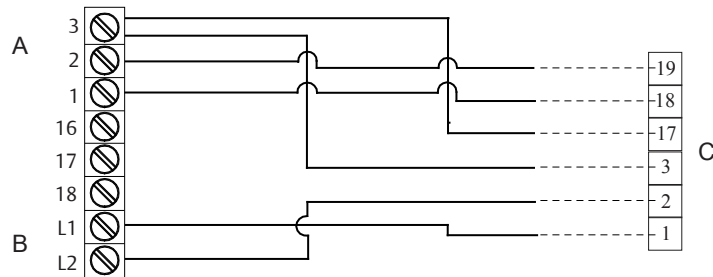
D.8.2 Model 10D1419 sensor to 8712 Transmitter

To connect a Model 10D1419 sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-8](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-8: Wiring Diagram for Fischer and Porter Sensor Model 10D1419 and Rosemount 8712



- A. Electrode connections
- B. Coil connections
- C. Rosemount 8712 transmitter

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-8: Fischer and Porter Model 10D1419 Sensor Wiring Connections

Rosemount 8712	Fischer and Porter Model 10D1419 sensors
1	L1
2	L2
3	3
17	3
18	1
19	2

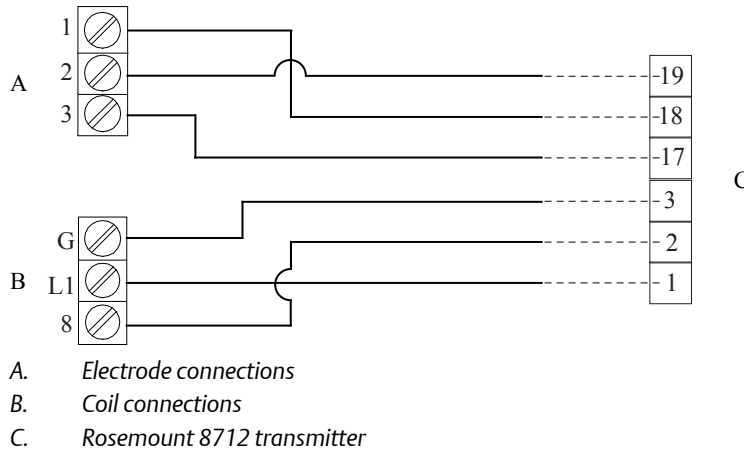
D.8.3 Model 10D1430 sensor (remote) to 8712 Transmitter

To connect a Model 10D1430 sensor (remote) to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-9](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-9: Wiring Diagram for Fischer and Porter Sensor Model 10D1430 (Remote) and Rosemount 8712



Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-9: Fischer and Porter Model 10D1430 (Remote) Sensor Wiring Connections

Rosemount 8712	Fischer and Porter Model 10D1430 (Remote) sensors
1	L1
2	8
3	G
17	3
18	1
19	2

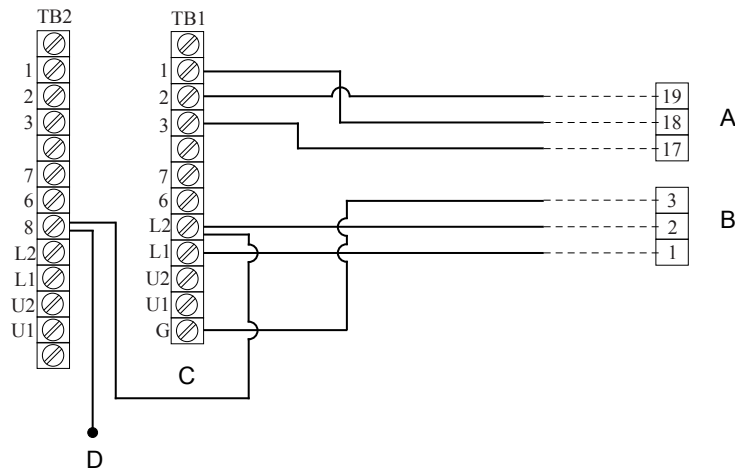
D.8.4 Model 10D1430 sensor (integral) to 8712 Transmitter

To connect a Model 10D1430 sensor (integral) to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-10](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-10: Wiring Diagram for Fischer and Porter Sensor Model 10D1430 (Integral) and Rosemount 8712



- A. Electrode connections
- B. Coil connections
- C. Blue
- D. To calibration device

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-10: Fischer and Porter Model 10D1430 (integral) Sensor Wiring Connections

Rosemount 8712	Fischer and Porter Model 10D1430 (Integral) sensors
1	L1
2	L2
3	G
17	3
18	1
19	2

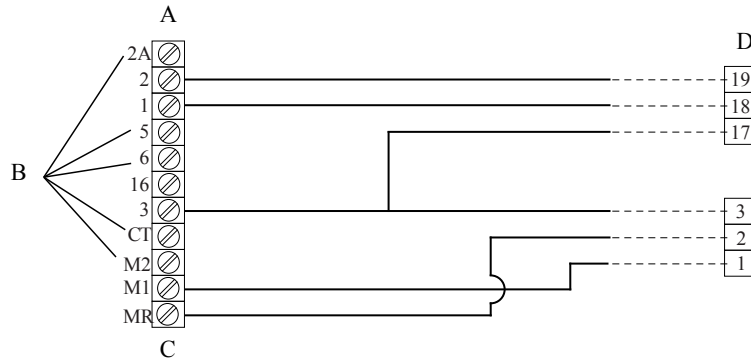
D.8.5 Model 10D1465/10D1475 sensors to 8712 Transmitter

To connect a Model 10D1465 or 10D1475 sensor (integral) to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-11](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-11: Wiring Diagram for Fischer and Porter Sensor Model 10D1465 and Model 10D1475 (integral) and Rosemount 8712



- A. Electrode connections
- B. Disconnect
- C. Coil connections
- D. Rosemount 8712 transmitter

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-11: Fischer and Porter Model 10D1465 and 10D1475 Sensor Wiring Connections

Rosemount 8712	Fischer and Porter Model 10D1465 and 10D1475 sensors
1	M1
2	MR
3	3
17	3
18	1
19	2

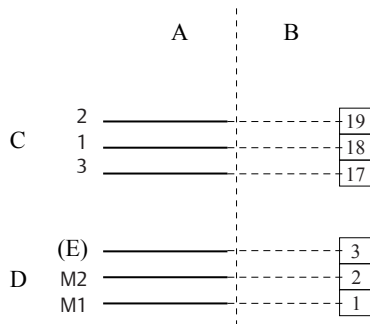
D.8.6 Fischer and Porter sensor to 8712 Transmitter

To connect a Fischer and Porter sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-12](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-12: Generic Wiring Diagram for Fischer and Porter Sensors and Rosemount 8712



- A. Fischer and Porter sensors
- B. Rosemount 8712 transmitter
- C. Electrode connections
- D. Coil connections
- E. Chassis

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-12: Fischer and Porter Generic Sensor Wiring Connections

Rosemount 8712	Fischer and Porter sensors
1	M1
2	M2
3	Chassis ground
17	3
18	1
19	2

D.9 Foxboro sensors

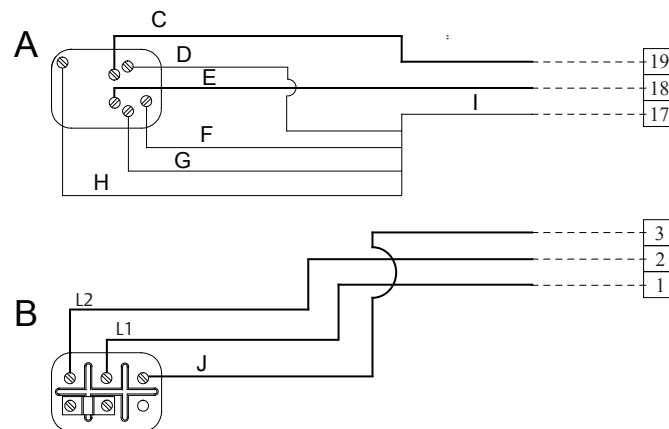
D.9.1 Series 1800 sensor to 8712 Transmitter

To connect a Series 1800 sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-13](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-13: Wiring Diagram for Foxboro Series 1800 and Rosemount 8712



- A. Electrode connections
- B. Coil connections
- C. White lead
- D. White shield
- E. Black lead
- F. Inner shield
- G. Black shield
- H. Outer shield
- I. Any shield
- J. Chassis ground

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-13: Foxboro Series 1800 Sensor Wiring Connections

Rosemount 8712	Foxboro Series 1800 sensors
1	L1

Table D-13: Foxboro Series 1800 Sensor Wiring Connections (continued)

Rosemount 8712	Foxboro Series 1800 sensors
2	L2
3	Chassis ground
17	Any shield
18	Black
19	White

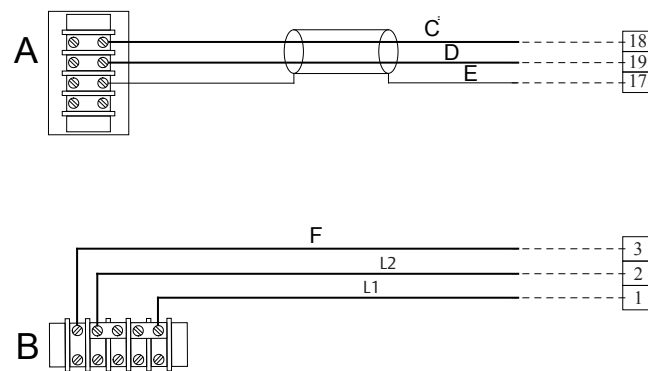
D.9.2 Series 1800 (version 2) sensor to 8712 Transmitter

To connect a Series 1800 (version 2) sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-14](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-14: Wiring Diagram for Foxboro Series 1800 (Version 2) and Rosemount 8712



- A. Electrode connections
- B. Coil connections
- C. Black lead
- D. White lead
- E. Shield
- F. Chassis ground

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-14: Foxboro Series 1800 (Version 2) Sensor Wiring Connections

Rosemount 8712	Foxboro Series 1800 sensors
1	L1
2	L2
3	Chassis Ground
17	Any Shield
18	Black
19	White

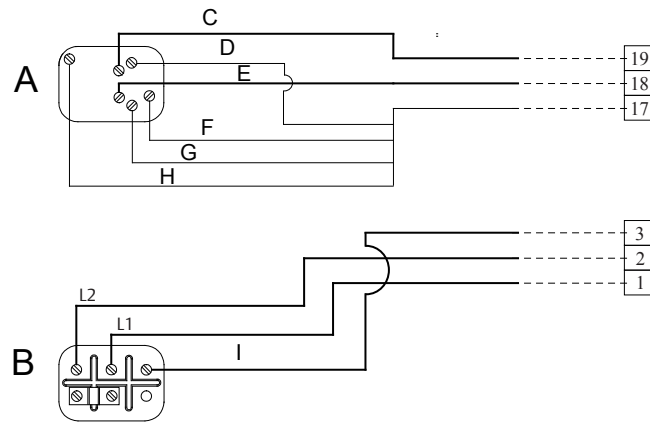
D.9.3 Series 2800 Sensor to 8712 Transmitter

To connect a Series 2800 Sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-15](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-15: Wiring Diagram for Foxboro Series 2800 and Rosemount 8712



- A. Electrode connections
- B. Coil connections
- C. White lead
- D. Black lead
- E. Inner shield
- F. Black shield
- G. Outer shield
- H. Chassis ground

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-15: Foxboro Series 2800 Sensor Wiring Connections

Rosemount 8712	Foxboro Series 2800 Sensors
1	L1
2	L2
3	Chassis Ground
17	Any Shield
18	Black
19	White

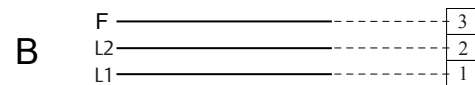
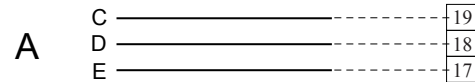
D.9.4 Foxboro Sensor to 8712 Transmitter

To connect a Foxboro Sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-16](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-16: Generic Wiring Diagram for Foxboro Sensors and Rosemount 8712



- A. Electrode connections
- B. Coil connections
- C. White
- D. Black
- E. Any shield
- F. Chassis ground

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-16: Foxboro Generic Sensor Wiring Connections

Rosemount 8712	Foxboro sensors
1	L1
2	L2
3	Chassis Ground
17	Any Shield
18	Black
19	White

D.10 Kent Veriflux VTC sensor

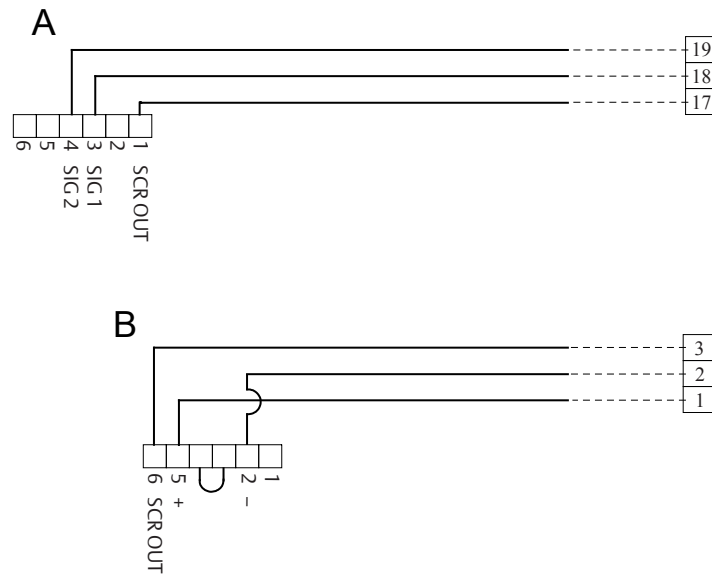
D.10.1 Veriflux VTC sensor to 8712 Transmitter

To connect a Veriflux VTC sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-17](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-17: Wiring Diagram for Kent Veriflux VTC Sensor and Rosemount 8712



- A. Electrode connections
- B. Coil connections

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-17: Kent Veriflux VTC Sensor Wiring Connections

Rosemount 8712	Kent Veriflux VTC sensors
1	2
2	1
3	SCR OUT
17	SCR OUT
18	SIG1
19	SIG2

D.11 Kent sensors

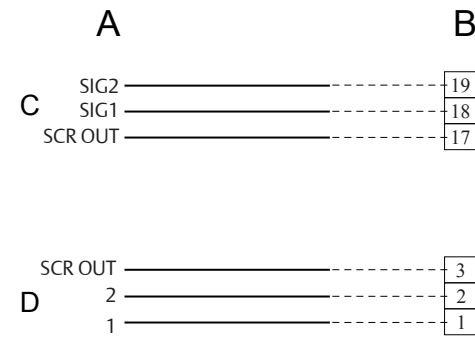
D.11.1 Kent sensor to 8712 Transmitter

To connect a Kent sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-18](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-18: Generic Wiring Diagram for Kent Sensors and Rosemount 8712



- A. Kent sensors
- B. Rosemount 8712 transmitter
- C. Electrode connections
- D. Coil connections

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-18: Kent Sensor Wiring Connections

Rosemount 8712	Kent sensors
1	1
2	2
3	SCR OUT
17	SCR OUT
18	SIG1
19	SIG2

D.12 Krohne sensors

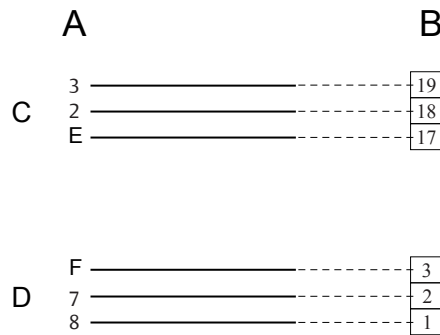
D.12.1 Krohne sensor to 8712 Transmitter

To connect a Krohne sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-19](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-19: Generic Wiring Diagram for Krohne Sensors and Rosemount 8712



- A. Kent sensors
- B. Rosemount 8712 transmitter
- C. Electrode connections
- D. Coil connections
- E. Electrode shield
- F. Coil shield

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-19: Krohne Sensor Wiring Connections

Rosemount 8712	Krohne sensors
1	8
2	7
3	Coil Shield
17	Electrode Shield
18	2
19	3

D.13 Taylor sensors

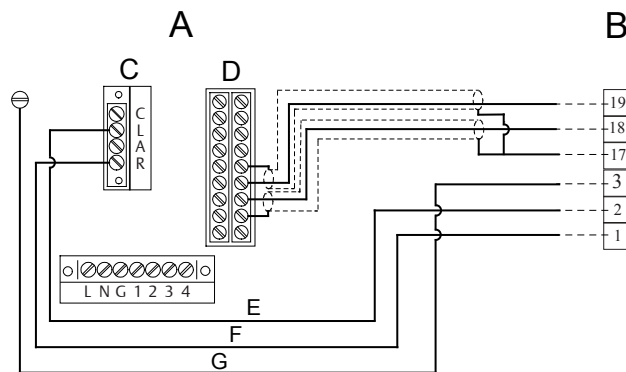
D.13.1 Series 1100 sensor to 8712 Transmitter

To connect a Series 1100 sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in *Figure D-20*.

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-20: Wiring Diagram for Taylor Series 1100 Sensors and Rosemount 8712



- A. Taylor Series 1100 sensor
- B. Rosemount 8712 transmitter
- C. Coil connections
- D. Electrode connections
- E. White
- F. Black
- G. Green

Note

Refer to *Figure D-1* for actual terminal block configuration drawing.

Table D-20: Taylor Series 1100 Sensor Wiring Connections

Rosemount 8712	Taylor Series 1100 sensors
1	Black
2	White
3	Green
17	S1 and S2
18	E1

Table D-20: Taylor Series 1100 Sensor Wiring Connections (continued)

Rosemount 8712	Taylor Series 1100 sensors
19	E2

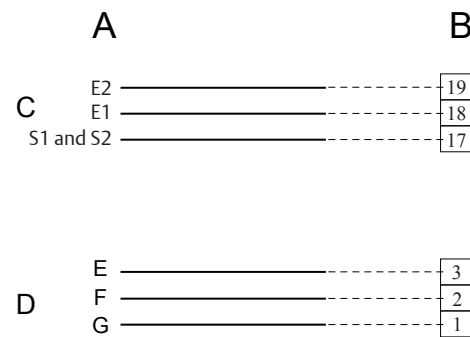
D.13.2 Taylor sensor to 8712 Transmitter

To connect a Taylor sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-21](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-21: Generic Wiring Diagram for Taylor Sensors and Rosemount 8712



- A. Taylor sensor
- B. Rosemount 8712 transmitter
- C. Electrode connections
- D. Coil connections
- E. Green
- F. White
- G. Black

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-21: Taylor Sensor Wiring Connections

Rosemount 8712	Taylor sensors
1	Black
2	White
3	Green

Table D-21: Taylor Sensor Wiring Connections (continued)

Rosemount 8712	Taylor sensors
17	S1 and S2
18	E1
19	E2

D.14 Yamatake Honeywell sensors

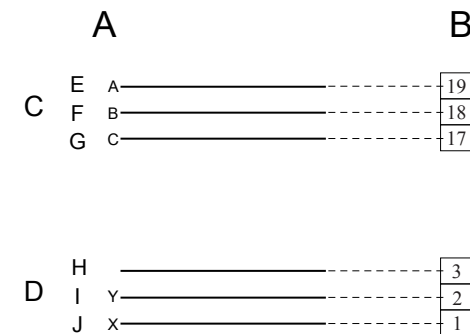
D.14.1 Yamatake Honeywell sensor to 8712 Transmitter

To connect a Yamatake Honeywell sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-22](#).

 **CAUTION!**

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-22: Generic Wiring Diagram for Yamatake Honeywell Sensors and Rosemount 8712



- A. Yamatake Honeywell sensors
- B. Rosemount 8712 transmitter
- C. Electrode connections
- D. Coil connections
- E. Terminal A
- F. Terminal B
- G. Terminal C
- H. Chassis ground
- I. Terminal Y
- J. Terminal X

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-22: Yamatake Honeywell Sensor Wiring Connections

Rosemount 8712	Yamatake Honeywell sensors
1	X
2	Y
3	Chassis Ground
17	C
18	B
19	A

D.15 Yokogawa sensors

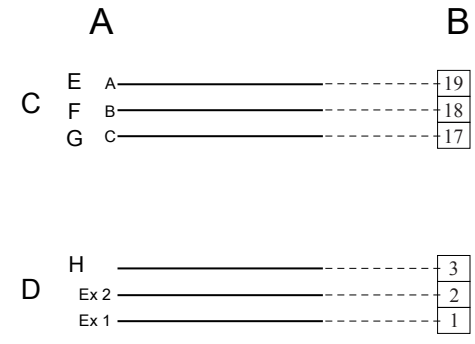
D.15.1 Yokogawa sensor to 8712 Transmitter

To connect a Yokogawa sensor to a Rosemount 8712 Transmitter, connect coil drive and electrode cables as shown in [Figure D-23](#).

⚠ CAUTION!

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

Figure D-23: Generic Wiring Diagram for Yokogawa Sensors and Rosemount 8712



- A. Yokogawa sensors
- B. Rosemount 8712 transmitter
- C. Electrode connections
- D. Terminal A
- E. Terminal B
- F. Terminal C
- G. Chassis ground

Note

Refer to [Figure D-1](#) for actual terminal block configuration drawing.

Table D-23: Yokogawa Sensor Wiring Connections

Rosemount 8712	Yokogawa sensors
1	EX1
2	EX2
3	Chassis Ground
17	C
18	B
19	A

D.16 Generic manufacturer sensor to 8712 Transmitter

D.16.1 Identify the terminals

Prerequisites

First check the sensor manufacturer's manual to identify the appropriate terminals. Otherwise, perform the following procedure.

Identify coil and electrode terminals

1. Select a terminal and touch an ohmmeter probe to it.
2. Touch the second probe to each of the other terminals and record the results for each terminal.
3. Repeat the process and record the results for every terminal.

Coil terminals will have a resistance of approximately 3-300 ohms.

Electrode terminals will have an open circuit.

Identify a chassis ground

1. Touch one probe of an ohmmeter to the sensor chassis.
2. Touch the other probe to the each sensor terminal and the record the results for each terminal.

The chassis ground will have a resistance value of one ohm or less.

D.16.2 Wiring connections

1.  **CAUTION!**

Do not connect mains or line power to the magnetic flowtube sensor or to the transmitter coil excitation circuit.

1. Connect the electrode terminals to Rosemount 8712 terminals 18 and 19. The electrode shield should be connected to terminal 17.
2. Connect the coil terminals to Rosemount 8712 terminals 1, 2, and 3.
3. If the Rosemount 8712 Transmitter indicates a reverse flow condition, switch the coil wires connected to terminals 1 and 2.



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