

Rosemount™ 8750W Transmitter with FOUNDATION™ Fieldbus Protocol



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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 Emerson nuclear-qualified products, contact your local 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.
- 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.
- 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.
- 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 stated 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

2.1 System description

The flowmeter consists of a sensor and a transmitter. The sensor is installed in-line with the process piping; the transmitter can be integrally mounted to the sensor or remotely mounted away from the sensor.

Figure 2-1: Intergral field mount transmitter



Figure 2-2: Remote field mount transmitter

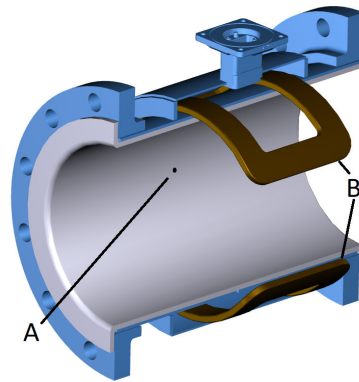


Figure 2-3: Wall mount transmitter



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 show in [Figure 2-4](#).

Figure 2-4: Sensor cross section



- A. *Electrode*
 - B. *Coils*
-

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

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:

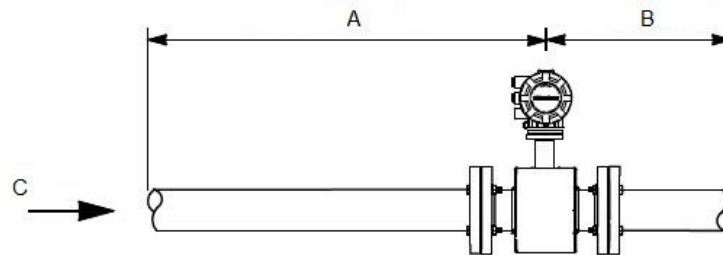
- High-vibration lines with integrally mounted transmitters
- Tropical/desert installations in direct sunlight
- Outdoor installations in arctic climates

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 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

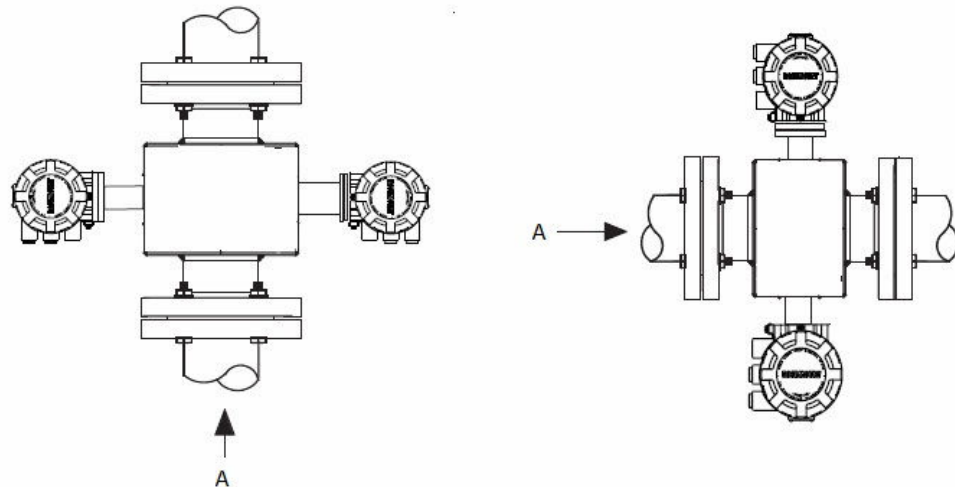


3.2.4 Sensor piping location and orientation

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

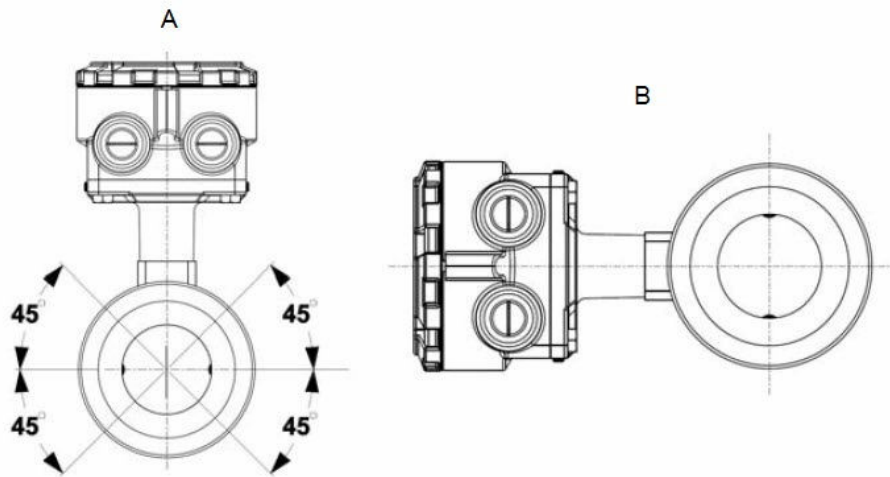


A. Flow direction

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 [Figure 3-4](#).

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

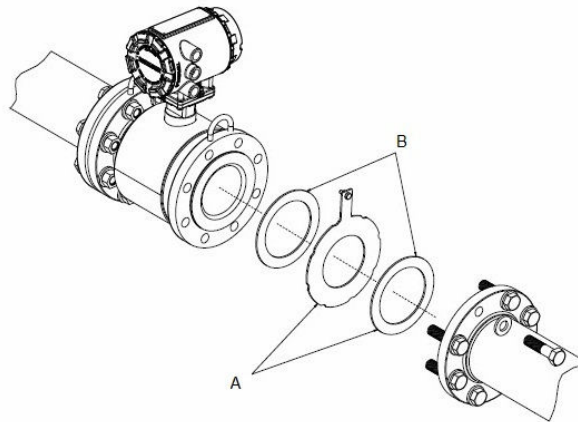
Gaskets

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

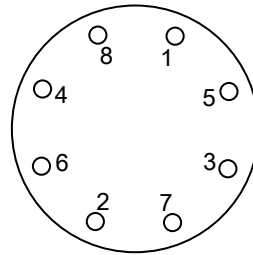
Do not snug and tighten the upstream side and then snug and tighten the downstream side. Failure to alternate between the upstream and downstream flanges when tightening bolts may result in liner damage.

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	Non-fluoropolymer liners
T - PTFE	P - Polyurethane

Table 3-2: Suggested flange bolt torque values for Rosemount 8750W (ASME)

Size code	Line size	Fluoropolymer liners		Other liners	
		Class 150 (lb-ft)	Class 300 (lb-ft)	Class 150 (lb-ft)	Class 300 (lb-ft)
005	0.5 inch (15 mm)	8	8	N/A	N/A
010	1 inch (25 mm)	8	12	6	10
015	1.5 inch (40 mm)	13	25	7	18
020	2 inch (50 mm)	19	17	14	11
025	2.5 inch (65 mm)	22	24	17	16
030	3 inch (80 mm)	34	35	23	23
040	4 inch (100 mm)	26	50	17	32
050	5 inch (125 mm)	36	60	25	35
060	6 inch (150 mm)	45	50	30	37
080	8 inch (200 mm)	60	82	42	55
100	10 inch (250 mm)	55	80	40	70
120	12 inch (300 mm)	65	125	55	105
140	14 inch (350 mm)	85	110	70	95
160	16 inch (400 mm)	85	160	65	140
180	18 inch (450 mm)	120	170	95	150
200	20 inch (500 mm)	110	175	90	150
240	24 inch (600 mm)	165	280	140	250
300	30 inch (750 mm)	195	415	165	375
360	36 inch (900 mm)	280	575	245	525

Table 3-3: Suggested flange bolt torque values for Rosemount 8750W 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 inch (15 mm)	N/A	N/A	N/A	10
010	1 inch (25 mm)	N/A	N/A	N/A	20
015	1.5 inch (40 mm)	N/A	N/A	N/A	50
020	2 inch (50 mm)	N/A	60	N/A	60
025	2.5 inch (65 mm)	N/A	50	N/A	50
030	3 inch (80 mm)	N/A	50	N/A	50
040	4 inch (100 mm)	N/A	50	N/A	70
050	5.0 inch (125 mm)	N/A	70	N/A	100
060	6 inch (150mm)	N/A	90	N/A	130
080	8 inch (200 mm)	130	90	130	170
100	10 inch (250 mm)	100	130	190	250
120	12 inch (300 mm)	120	170	190	270
140	14 inch (350 mm)	160	220	320	410
160	16 inch (400 mm)	220	280	410	610
180	18 inch (450 mm)	190	340	330	420
200	20 inch (500 mm)	230	380	440	520
240	24 inch (600 mm)	290	570	590	850

Table 3-4: Suggested flange bolt torque values for Rosemount 8750W 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 inch (15 mm)	N/A	N/A	N/A	20
010	1 inch (25 mm)	N/A	N/A	N/A	30
015	1.5 inch (40 mm)	N/A	N/A	N/A	40
020	2 inch (50 mm)	N/A	30	N/A	30
025	2.5 inch (65 mm)	N/A	35	N/A	35
030	3 inch (80 mm)	N/A	30	N/A	30
040	4 inch (100 mm)	N/A	40	N/A	50
050	5.0 inch (125 mm)	N/A	50	N/A	70
060	6 inch (150mm)	N/A	60	N/A	90
080	8 inch (200 mm)	90	60	90	110

Table 3-4: Suggested flange bolt torque values for Rosemount 8750W sensors with non-fluoropolymer liners (EN 1092-1) (continued)

Size code	Line size	Non-fluoropolymer liners (in Newton-meters)			
		PN 10	PN 16	PN 25	PN 40
100	10 inch (250 mm)	70	80	130	170
120	12 inch (300 mm)	80	110	130	180
140	14 inch (350 mm)	110	150	210	288
160	16 inch (400 mm)	150	190	280	410
180	18 inch (450 mm)	130	230	220	280
200	20 inch (500 mm)	150	260	300	350
240	24 inch (600 mm)	200	380	390	560

Table 3-5: Suggested flange bolt torque values for Rosemount 8750W with fluoropolymer liners (AWWA C207)

Size code	Line size	Class D (lb-ft)	Class E (lb-ft)	Class F (lb-ft)
300	30 inch (750 mm)	195	195	195
360	36 inch (900 mm)	280	280	280

Table 3-6: Suggested flange bolt torque values for Rosemount 8750W with non-fluoropolymer liners (AWWA C207)

Size code	Line size	Class D (lb-ft)	Class E (lb-ft)	Class F (lb-ft)
300	30 inch (750 mm)	165	165	165
360	36 inch (900 mm)	245	245	245
400	40 inch (1000 mm)	757	757	N/A
420	42 inch (1050 mm)	839	839	N/A
480	48 inch (1200 mm)	872	872	N/A

3.4 Process reference connection

The figures shown in this section illustrate best practice installations for process reference connections only. For installations in conductive, unlined pipe it may be acceptable to use one ground ring or one lining protector to establish a process reference connection. 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 [Table 3-7](#) to determine which process reference option to follow for proper installation.

Table 3-7: Process reference options

Type of pipe	Grounding straps	Grounding rings	Reference electrode	Lining protectors
Conductive unlined pipe	See Figure 3-7	See Figure 3-8	See Figure 3-10	See Figure 3-8
Conductive lined pipe	Insufficient grounding	See Figure 3-8	See Figure 3-7	See Figure 3-8
Non-conductive pipe	Insufficient grounding	See Figure 3-9	Not recommended	See Figure 3-9

Note

For line sizes 10-inch and larger the ground strap may come attached to the sensor body near the flange. See [Figure 3-11](#).

Figure 3-7: Grounding straps in conductive unlined pipe or reference electrode in lined pipe

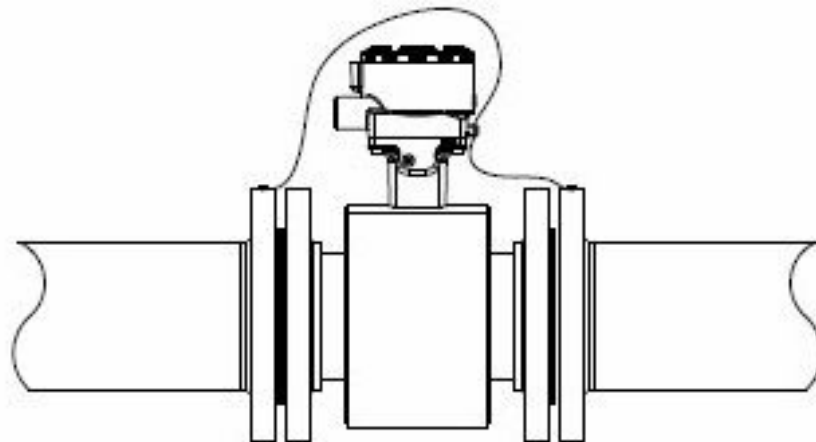
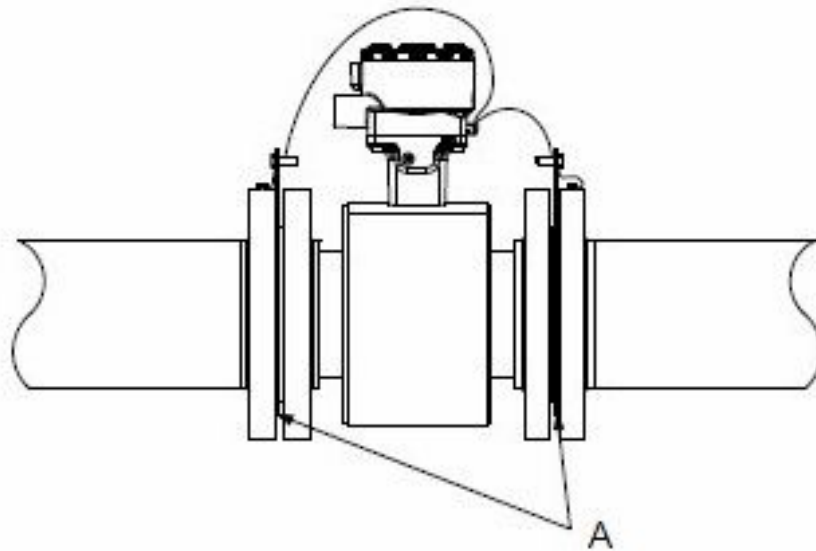
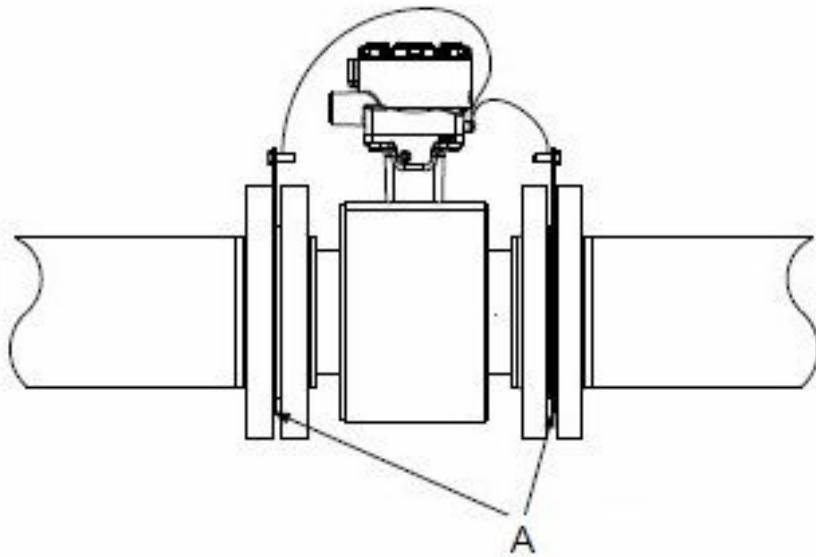


Figure 3-8: Grounding with grounding rings or lining protectors in conductive pipe



A. Grounding rings or lining protectors

Figure 3-9: Grounding with grounding rings or lining protectors in non-conductive pipe



A. Grounding rings or lining protectors

Figure 3-10: Grounding with reference electrode in conductive unlined pipe

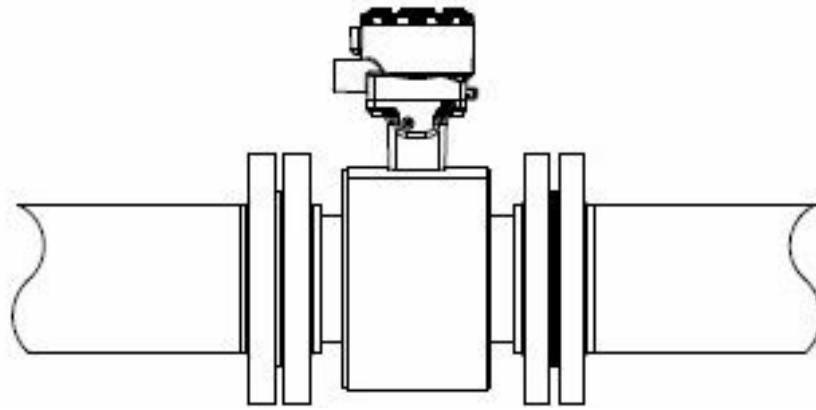
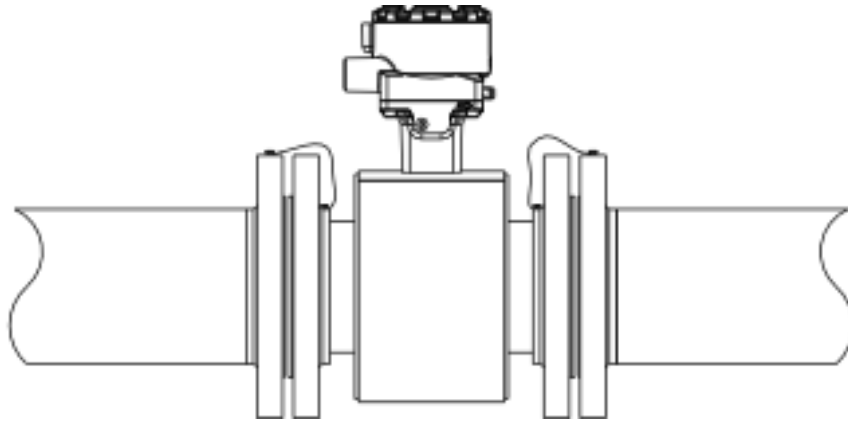


Figure 3-11: Grounding for line sizes 10-in. and larger



4 Remote Transmitter Installation

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:

- Set the hardware switches if necessary
- Consider mechanical, electrical, and environmental requirements

Note

Refer to [Product Specifications](#) for more detailed requirements.

Hardware switches

The electronics board is equipped with two user-selectable hardware switches. These switches set the Simulate Enable and Transmitter Security. The standard configuration for these switches when shipped from the factory are as follows:

Table 4-1: Hardware switch default settings

Setting	Factory configuration
Simulate enable	Off
Transmitter security	Off

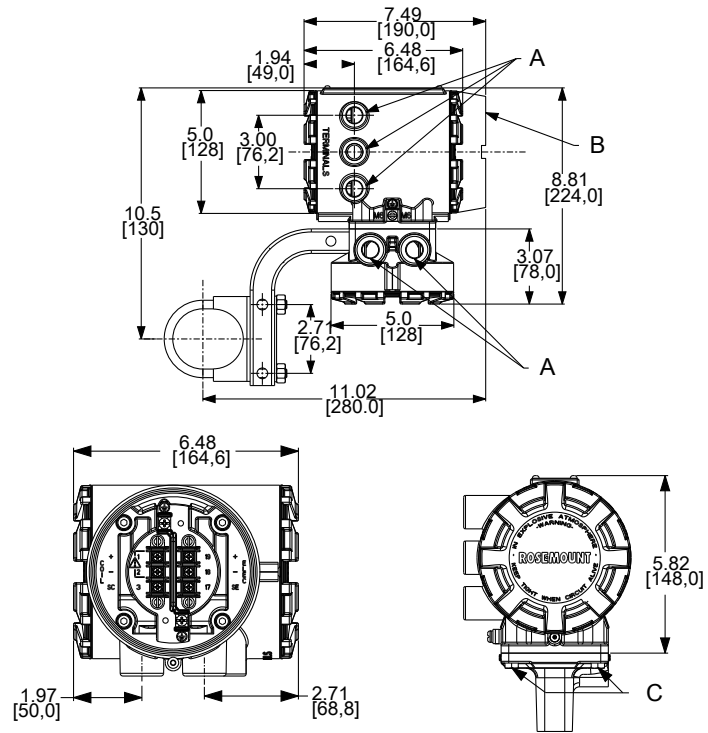
In most cases, it is not necessary to change the setting of the hardware switches. If the switch settings need to be changed, refer to [Hardware switches](#).

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

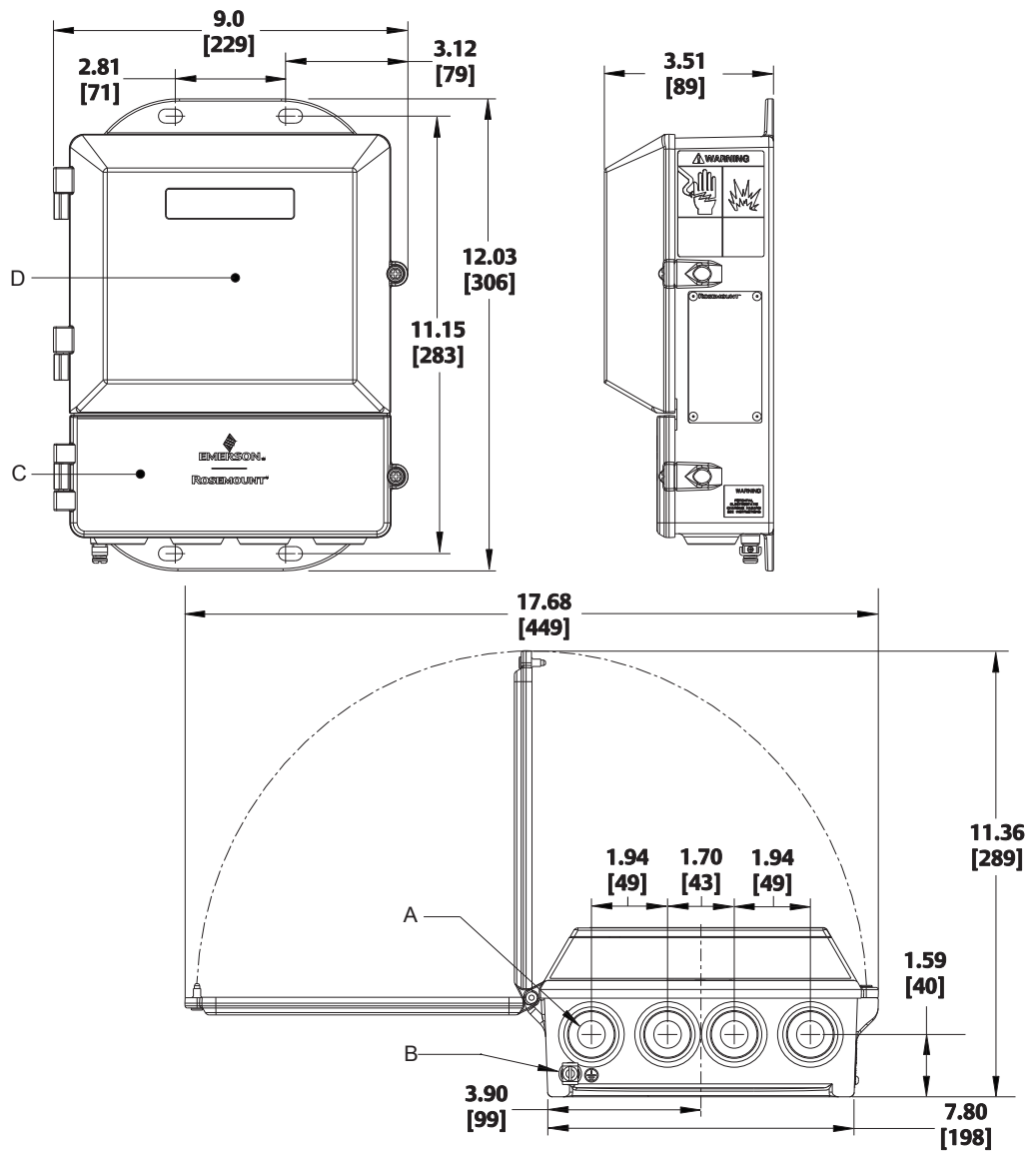
The mounting site for the transmitter should provide enough room for secure mounting, easy access to conduit entries, full opening of the transmitter covers, and easy readability of the Local Operator Interface (LOI) screen (if equipped).

Figure 4-1: Field mount transmitter dimensional drawing



- A. Conduit entry ½-14 NPT or M20
- B. LOI cover
- C. Mounting screws

Figure 4-2: Wall mount transmitter dimensional drawing



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

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

Wall mount and field mount transmitter	
Power input	AC power: 90–250VAC, 0.45A, 40VA
	Standard DC power: 12–42VDC, 1.2A, 15W
Fieldbus	Fieldbus segment requires a separate 9VDC to 32VDC power supply with a power conditioner to decouple the power supply output from the fieldbus wiring segment.



Environmental considerations

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

- High-vibration lines with integrally mounted transmitters
- 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.

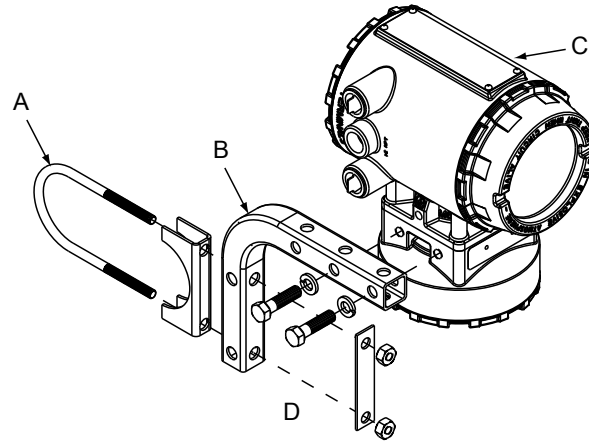
4.2 Transmitter symbols

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

4.3 Mounting

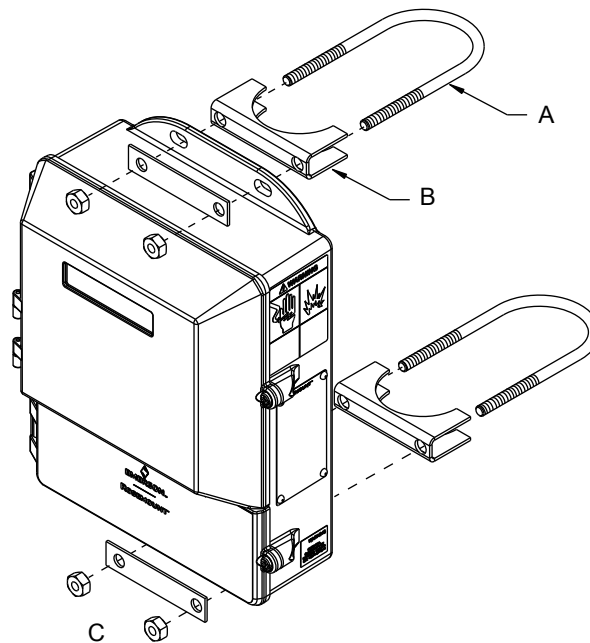
Remote-mount transmitters are shipped with a mounting bracket for use on a 2-in. pipe or a flat surface.

Figure 4-3: Rosemount 8750W field mount transmitter mounting hardware



- A. U-bolt
- B. Mounting bracket
- C. Transmitter
- D. Fasteners (example configuration)

Figure 4-4: Rosemount 8750W wall mount transmitter mounting hardware



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

1. Assemble the hardware as needed to accommodate the mounting configuration.
2. Secure the transmitter to the mounting hardware.

For field mount style transmitters, the LOI/Display can be rotated in 90 degree increments up to 180 degrees if desired. Do not rotate more than 180 degrees in any one direction.

4.4 Wiring

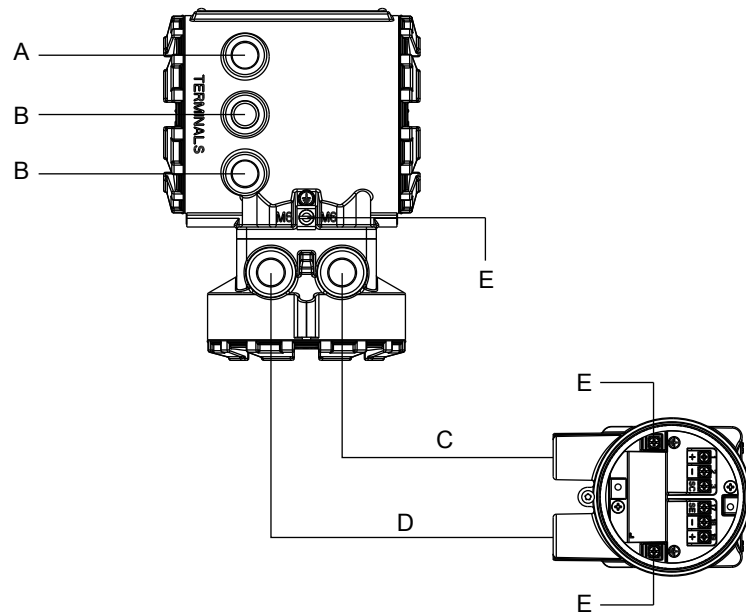
4.4.1 Conduit entries and connections

Transmitter conduit entry ports can be ordered with ½"-14NPT or M20 female threaded connections. 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

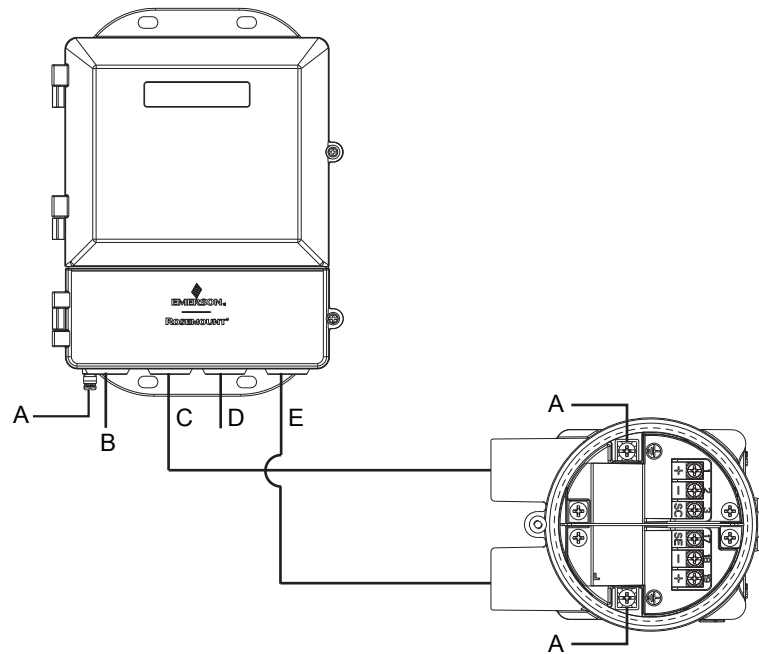
- For installations with an intrinsically safe electrode circuit, a separate conduit for the coil cable and the electrode cable may be required.
- For installations with non-intrinsically safe electrode circuit, or when using the combination cable, a single dedicated conduit run for the coil drive and 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 4-5](#) and [Figure 4-6](#).
- 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 4-5: Best practice conduit preparation (field mount)



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

Figure 4-6: Best practice conduit preparation (wall mount)



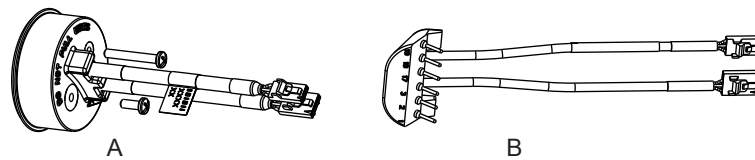
- A. Safety ground
- B. Power
- C. Coil
- D. Output
- E. Electrode

4.4.3 Sensor to transmitter wiring

Integral mount transmitters

Integral mount transmitters ordered with a sensor will be shipped assembled and wired at the factory using an interconnecting cable. Use only the factory supplied cable provided with the instrument. For replacement transmitters use the existing interconnecting cable from the original assembly. Replacement cables, if applicable, are available (see [Figure 4-7](#)).

Figure 4-7: Replacement interconnecting cables



- A. Socket module 08732-CSKT-0001
- B. IMS cable 08732-CSKT-0004

Remote mount transmitters

Cable 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
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 Cables, Ext Temp. (includes Coil and Electrode)	Coil Electrode	Not available Not available
08732-0065-1002 (meters)	Kit, Component Cables, Ext Temp. (includes Coil and Electrode)	Coil Electrode	Not available Not available
08732-0065-1003 (feet)	Kit, Component Cables, Ext Temp. (includes Coil and I.S. Electrode)	Coil Intrinsically Safe Blue Electrode	Not available Not available
08732-0065-1004 (meters)	Kit, Component Cables, Ext Temp. (includes Coil and I.S. Electrode)	Coil Intrinsically Safe Blue Electrode	Not available Not available

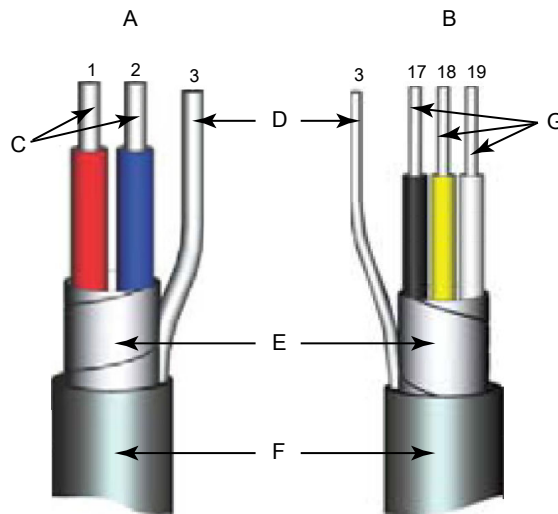
Table 4-5: Combination cable kits - coil and electrode cable (-20°C to 80°C)

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 4-8](#). 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 4-9](#). Combination cable lengths should be limited to less than 330 feet (100 m).

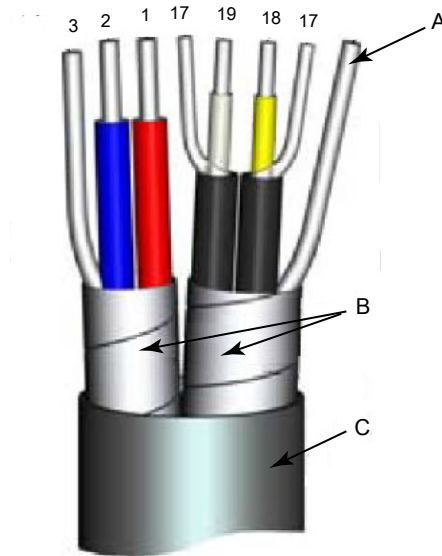
Figure 4-8: Individual component cables



- 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 4-9: Combination coil and electrode cable



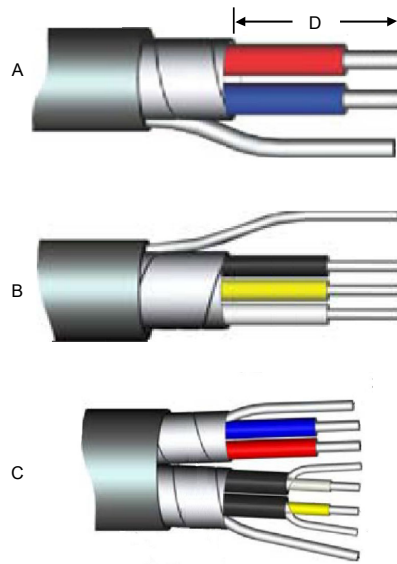
- A. *Electrode shield drain*
- B. *Overlapping foil shield*
- C. *Outer jacket*

- 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 4-10](#). 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 4-10: Cable ends



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

! WARNING

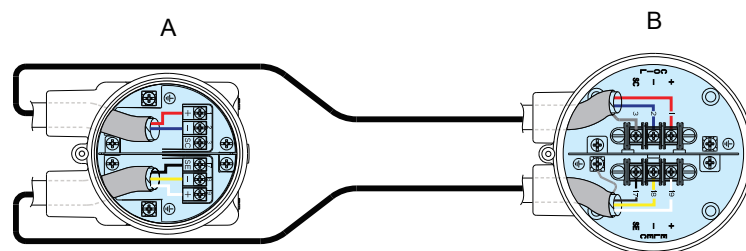
Shock hazard! Potential shock hazard across remote junction box terminals 1 and 2 (40V).

! 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).

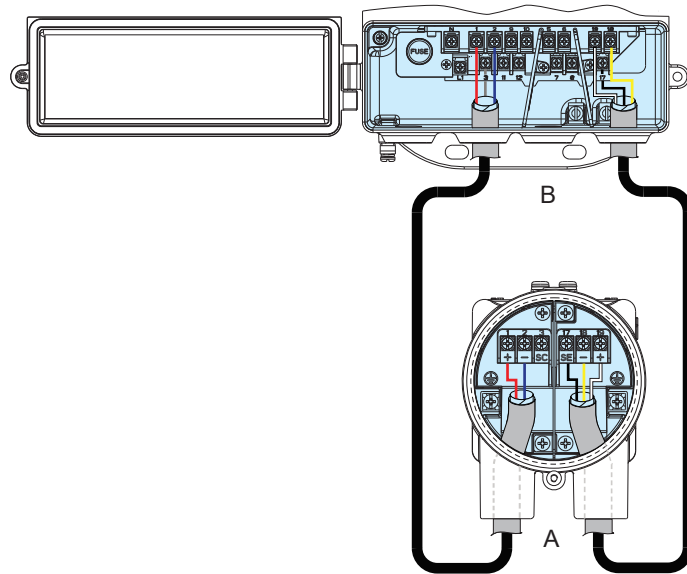
Remote junction box terminal blocks

Figure 4-11: Remote junction box views (field mount)



- A. Sensor
- B. Transmitter

Figure 4-12: Remote junction box views (wall mount)



- A. Sensor
- B. Transmitter

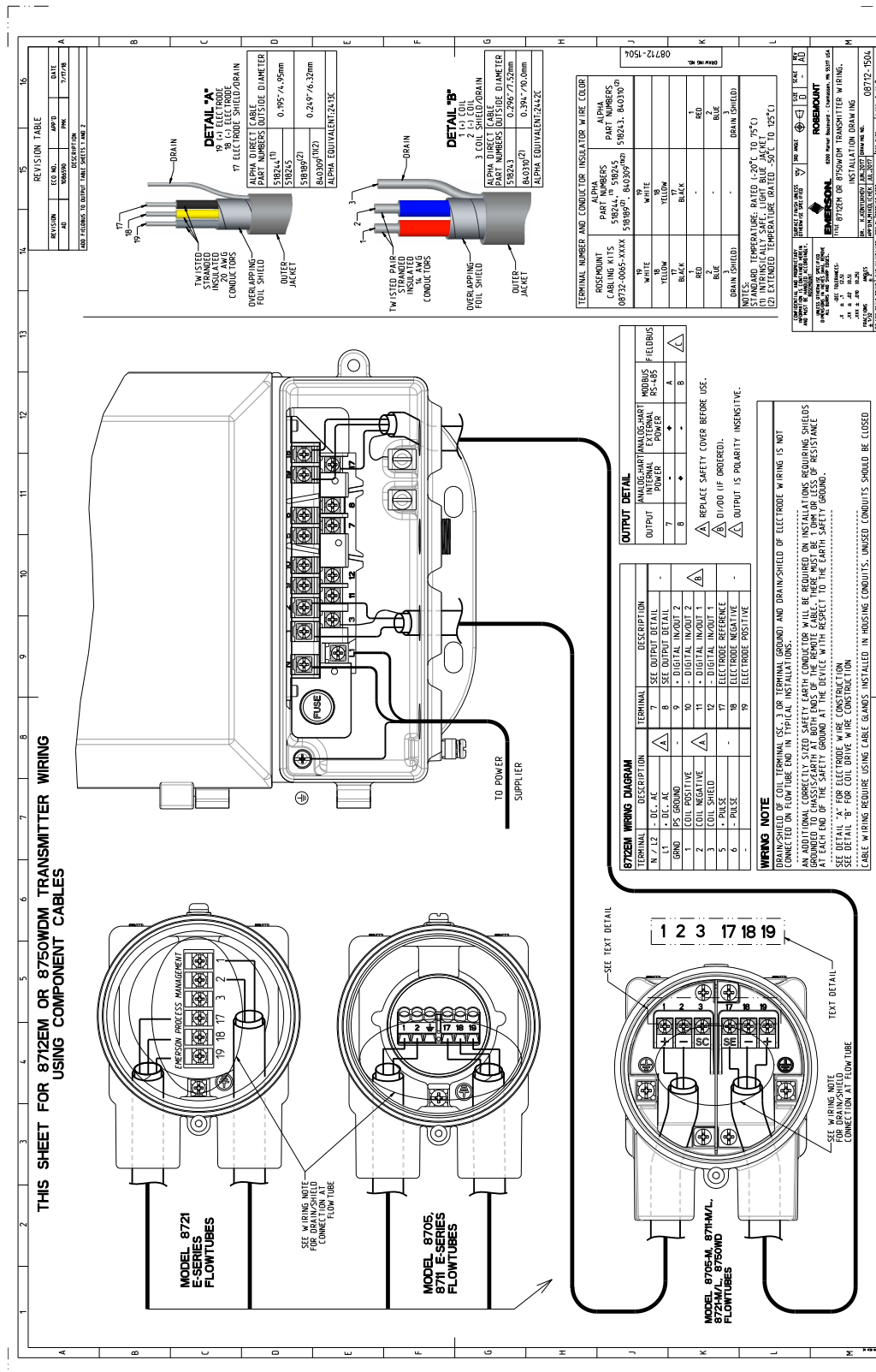
Table 4-6: Sensor/transmitter wiring

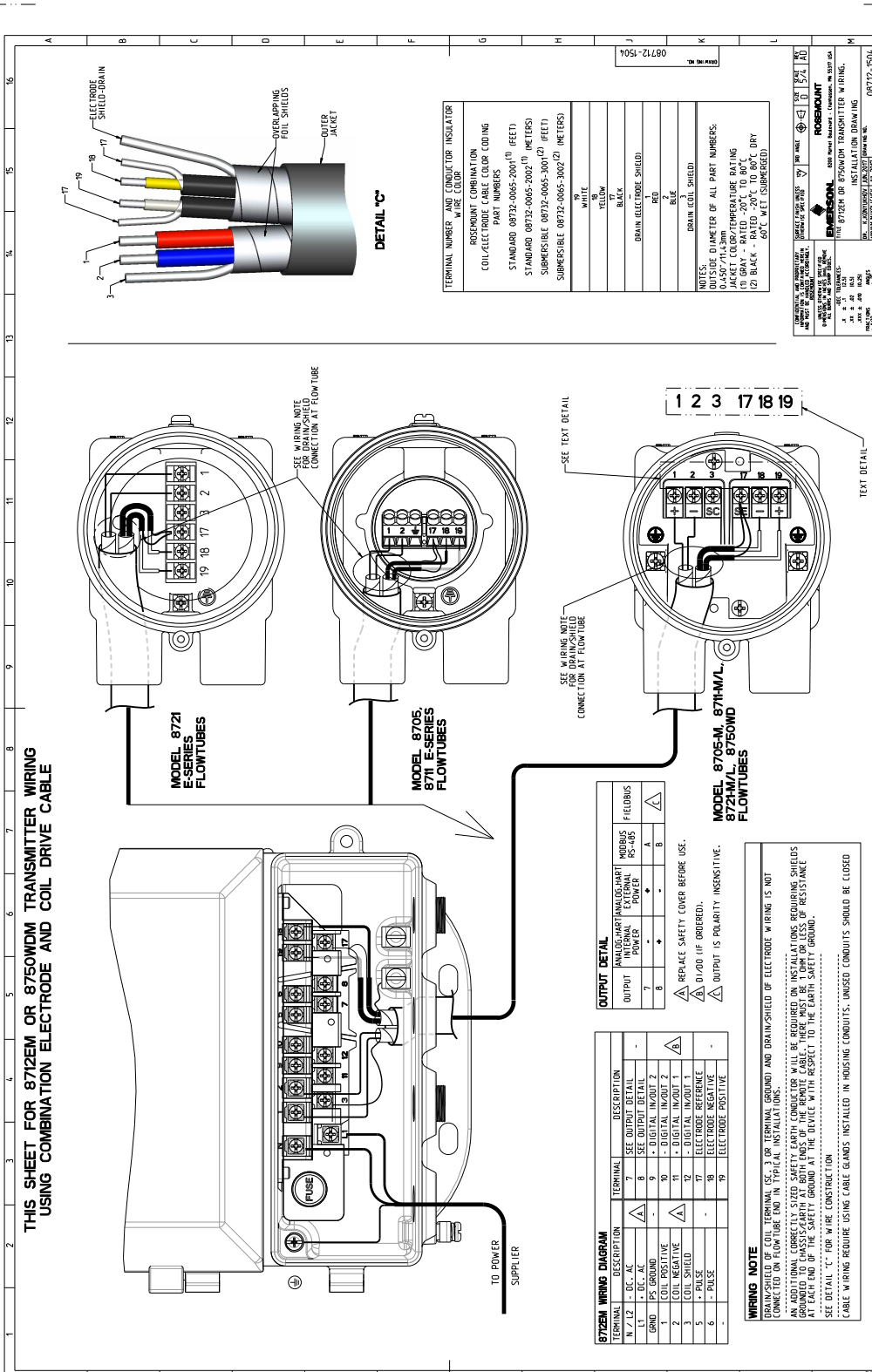
Wire color	Sensor terminal	Transmitter terminal
Red	1	1
Blue	2	2
Coil drain	3 or float	3
Black	17	17
Yellow	18	18
White	19	19
Electrode drain	⊕ or float	⊕

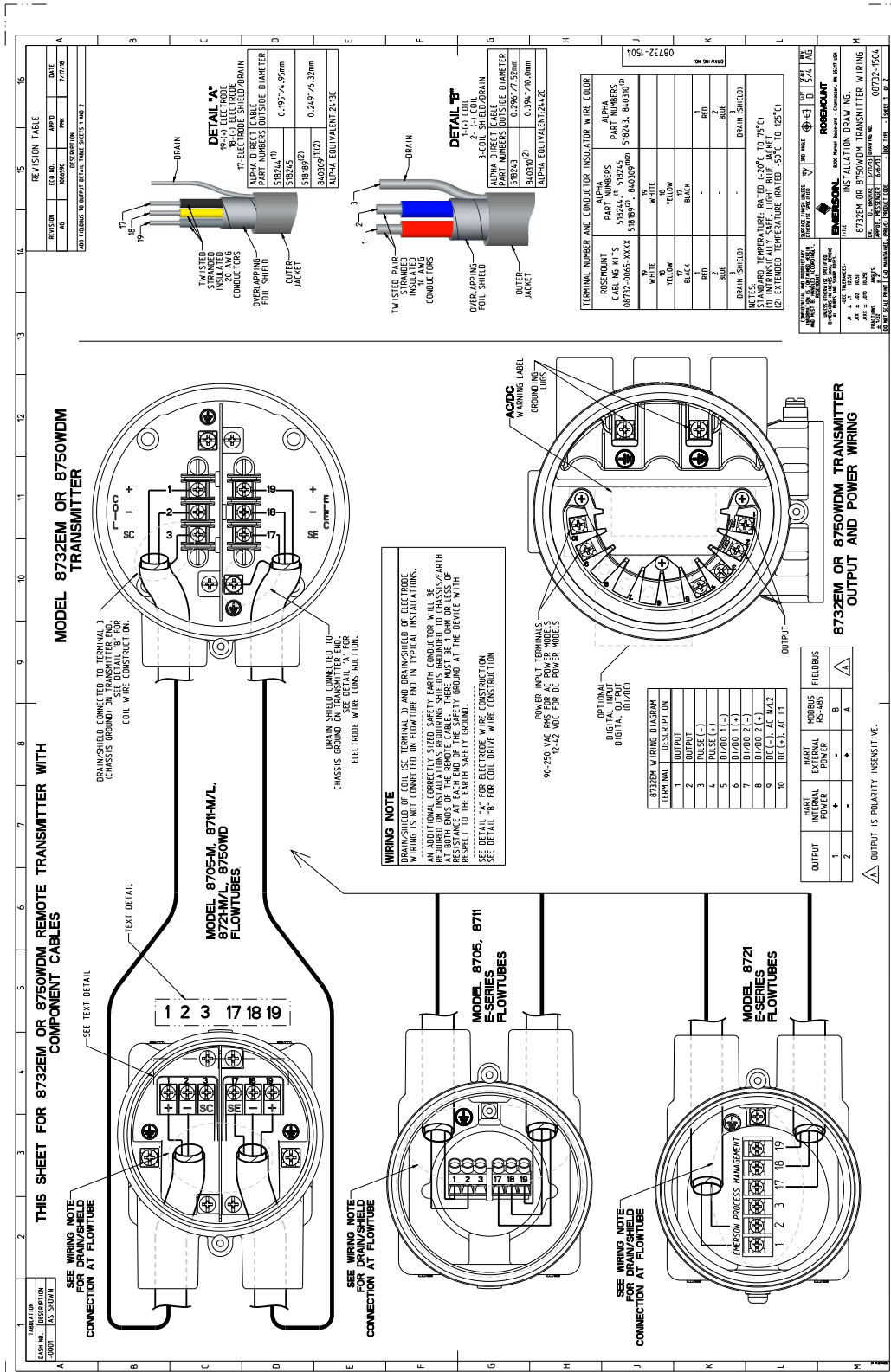
Note

For hazardous locations, refer to [Product Certifications](#).

4.4.4 Installation and wiring drawings



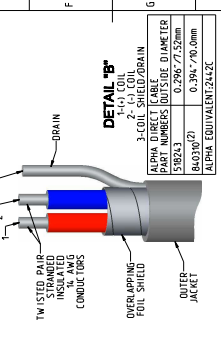
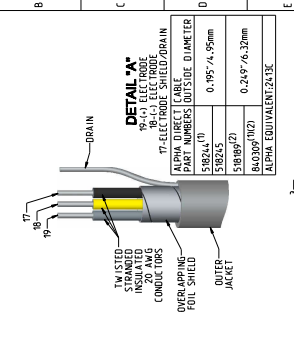




REVISION TABLE

REV. NO.	DESCRIPTION	DATE
1	ISSUED	1/27/18

END FLOWTUBE TO REMOTE TRANSMITTER SHEETS 1 AND 2



TERMINAL NUMBER AND CONDUCTOR INSULATOR WIRE COLOR

ROSEBOUNT CABBING KITS	ALPHA PART NUMBERS	ALPHA PART NUMBERS
08732-005-XXXX	51824(1)	51824.1, 840310 (1)
	51825	840369(2)
	840369(1)	840369(2)
	840367(1)	840367(2)
	840367(2)	840367(1)
	840369(2)	840369(1)
	840369(1)	840369(2)
	840367(1)	840367(2)
	840367(2)	840367(1)

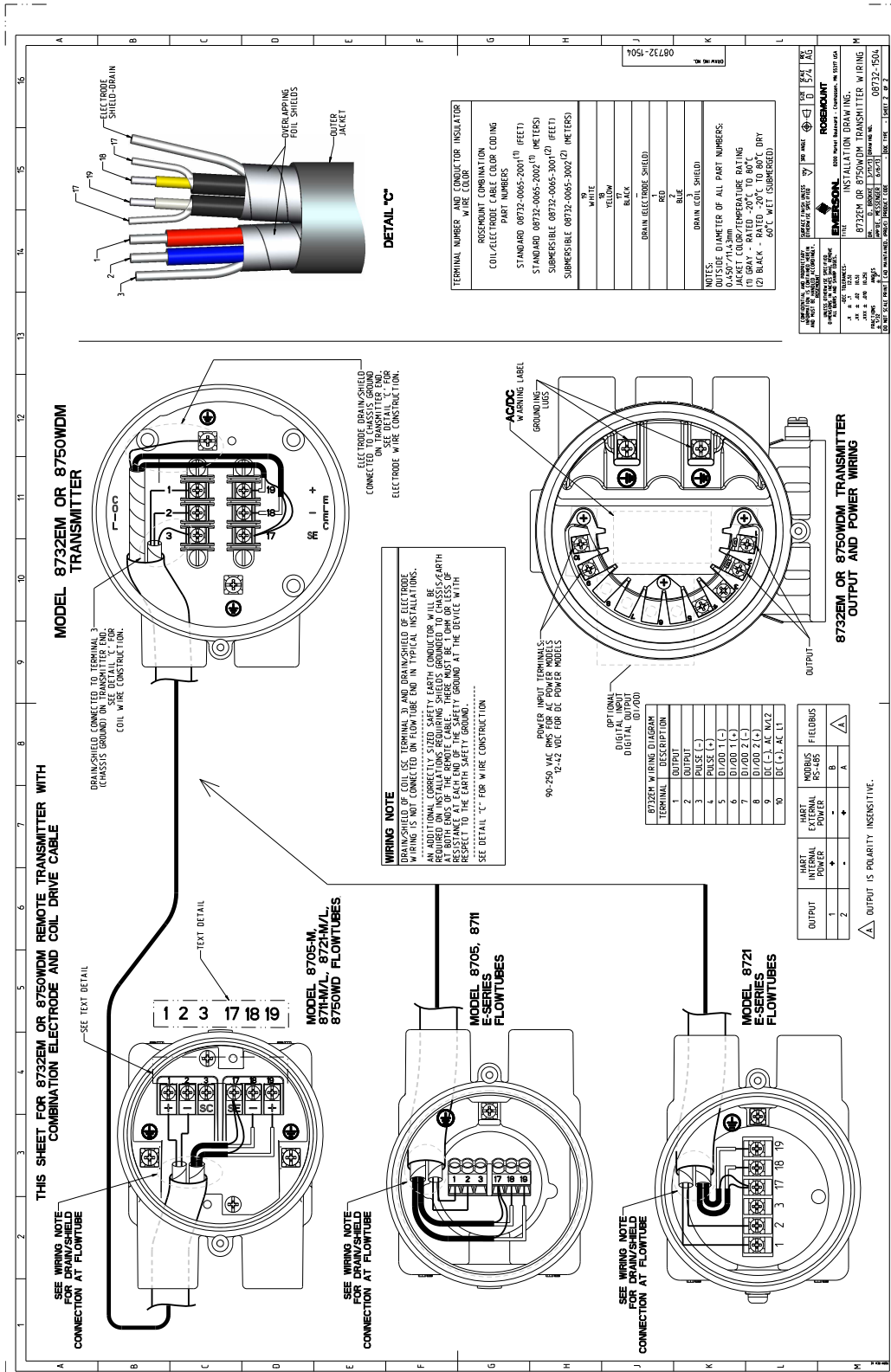
TO: WHITE, RED, YELLOW, BLACK, BLUE, DRAIN SHIELD

FROM: RED, YELLOW, BLACK, BLUE, DRAIN SHIELD

NOTES:
 (1) MINIMUM AMBIENT TEMPERATURE: 40°F TO 75°F
 (2) MAXIMUM AMBIENT TEMPERATURE: 100°F TO 125°F
 (3) EXTENDED TEMPERATURE RATED: -50°F TO 125°F

ROSEBOUNT

EMERSON
 8000 South Boulevard • Columbus, GA 31906 USA
 8732EM OR 8750WDM REMOTE TRANSMITTER WIRING
 PART NO. 00809-0500-4750
 DATE: 1/27/18



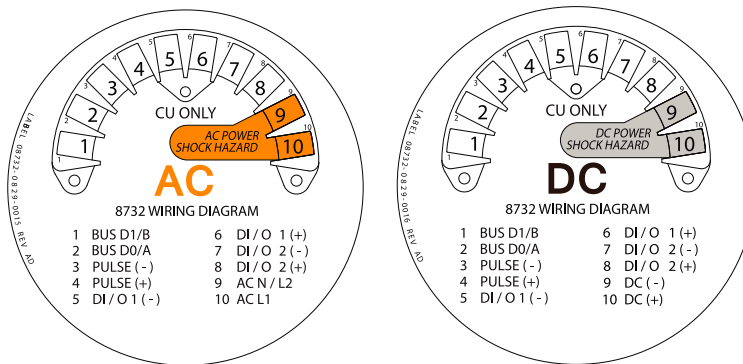
4.4.5 Power and fieldbus terminal blocks (field mount)

Remove the back cover of the transmitter to access the terminal block.

Note

To connect pulse output, see [Connect pulse output](#).

Figure 4-13: Terminal blocks (field mount)



- A. AC version
- B. DC version

Table 4-7: Power and I/O terminals (field mount transmitter)

Terminal number	AC version	DC version
1	D1 / B	D1 / B
2	D0 / A	D0 / A
3	Pulse (-)	Pulse (-)
4	Pulse (+)	Pulse (+)
5	Not used	Not used
6	Not used	Not used
7	Not used	Not used
8	Not used	Not used
9	AC (Neutral)/L2	DC (-)
10	AC L1	DC (+)

4.4.6 Power and fieldbus terminal blocks (wall mount)

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

Note

To connect pulse output, see [Connect pulse output](#).

Figure 4-14: Terminal blocks (wall mount)

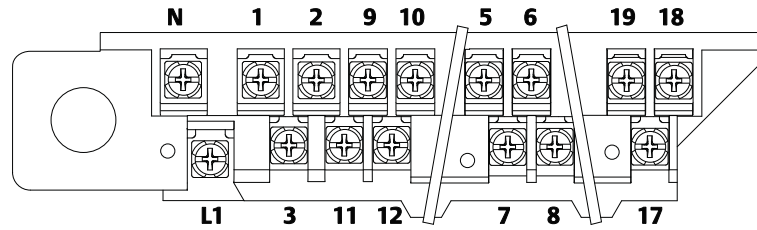


Table 4-8: Power and fieldbus terminals (wall mount transmitter)

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	D0 / A	D0 / A
8	D1 / B	D1 / B
9	Not used	Not used
10	Not used	Not used
11	Not used	Not used
12	Not used	Not used
17	Not used	Not used
18	Not used	Not used
19	Not used	Not used
N	AC (Neutral)/L2	DC (-)
L1	AC L1	DC (+)

4.4.7 Powering the transmitter

Before connecting power to the transmitter, be sure to have the necessary electrical supplies and required power source:

- The AC powered transmitter requires 90–250V AC (50/60Hz).
- The DC powered transmitter requires 12–42V DC.

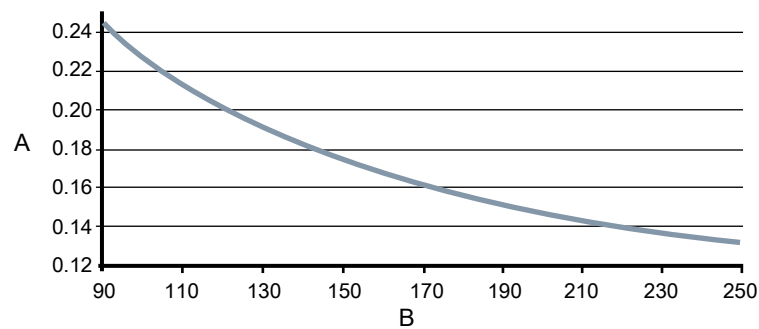
Wire the transmitter according to national, local, and plant electrical requirements.

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 top of the transmitter housing.

AC power supply requirements

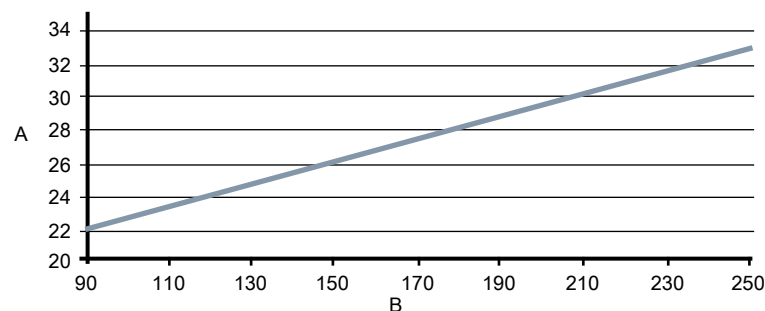
Units powered by 90 - 250VAC have the following power requirements. Peak inrush is 35.7A at 250VAC supply, lasting approximately 1ms. Inrush for other supply voltages can be estimated with: $\text{Inrush (Amps)} = \text{Supply (Volts)} / 7.0$

Figure 4-15: AC current requirements



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

Figure 4-16: Apparent power

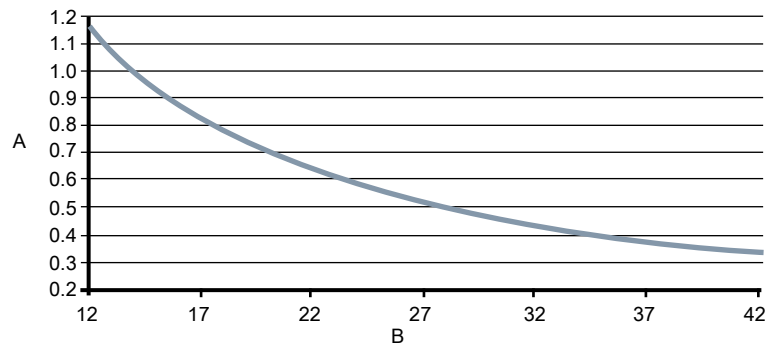


- A. Apparent power (VA)
B. Power supply (VAC)

DC power supply requirements

Standard DC units powered by 12VDC power supply may draw up to 1.2A of current steady state. 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 4-17: 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 4-9](#).

Table 4-9: 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

Power terminals (field mount transmitter)

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

- Connect AC Neutral to terminal 9 (AC N/L2) and AC Line to terminal 10 (AC/L1).

For DC powered transmitter:

- Connect negative to terminal 9 (DC -) and positive to terminal 10 (DC +).
- DC powered units may draw up to 1.2A.

Power terminals (wall mount transmitter)

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.

Cover jam screw (field mount transmitter)

For flow meters shipped with a cover jam screw, the screw should be installed after the instrument has been wired and powered up. Follow these steps to install the cover jam screw:

1. Verify the cover jam screw is completely threaded into the housing.
2. Install the housing cover and verify the cover is tight against the housing.
3. Using a 2.5 mm hex wrench, loosen the jam screw until it contacts the transmitter cover.
4. Turn the jam screw an additional ½ turn counterclockwise to secure the cover.

Note

Application of excessive torque may strip the threads.

5. Verify the cover cannot be removed.

Covers (wall mount transmitter)

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.

4.4.8 Fieldbus wiring

Transmitter communication input

The FOUNDATION fieldbus communication requires a minimum of 9VDC and a maximum of 32VDC at the transmitter communication terminals. Do not exceed 32VDC at the transmitter communication terminals. Do not apply AC line voltage to the transmitter communication terminals. Improper supply voltage can damage the transmitter.

Field wiring

Power independent of the transmitter power supply must be supplied for FOUNDATION fieldbus communications. Use shielded, twisted pair for best results. In order to get maximum performance in new applications, twisted pair cable specifically designed for fieldbus communications should be used. The number of devices on a fieldbus segment is limited by the power supply voltage, the resistance of the cable, and the amount of current drawn by each device. See [Table 4-10](#) for cable specifications.

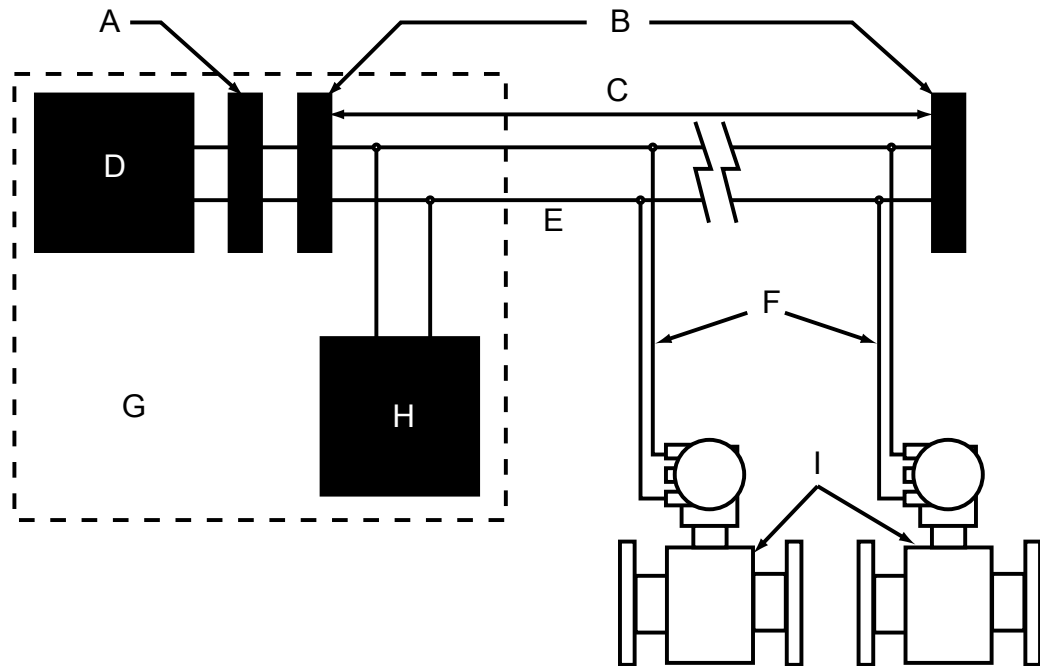
Table 4-10: Ideal cable specifications for fieldbus wiring

Characteristic	Ideal specification
Impedance	100 Ohms \pm 20% at 31.25 kHz
Wire size	18 AWG (0.8 mm ²)
Shield coverage	90%
Attenuation	3 db/km
Capacitive unbalance	2 nF/km

Power conditioning

Each fieldbus power supply requires a power conditioner to decouple the power supply output from the fieldbus wiring segment.

Figure 4-18: Power connections

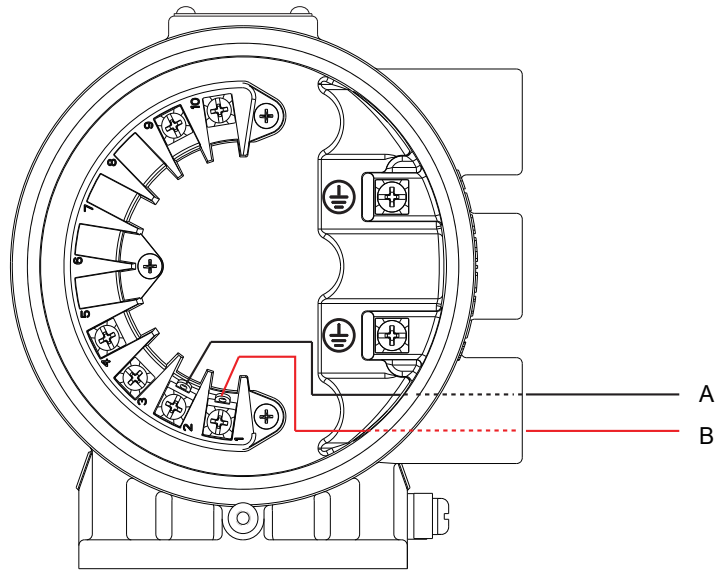


- A. Power conditioner
- B. Terminators
- C. Fieldbus segment
- D. Power supply
- E. Trunk
- F. Spurs
- G. Control room
- H. FOUNDATION fieldbus host
- I. Devices 1 through 11

Transmitter wiring connection

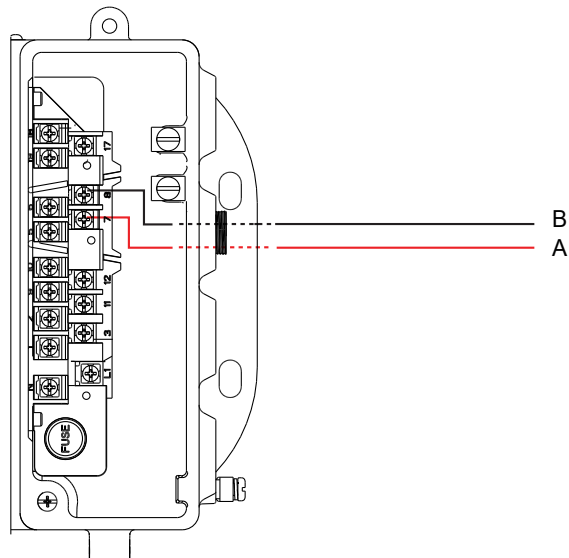
- Use wire terminals 1 and 2 for field mount transmitters.
- Use wire terminals 7 and 8 for wall mount transmitters.
- The transmitter fieldbus connection is polarity insensitive.

Figure 4-19: Fieldbus wiring (field mount)



- A. Fieldbus terminal (2)
- B. Fieldbus terminal (1)

Figure 4-20: Fieldbus wiring (wall mount)



- A. Fieldbus terminal (7) D0 / A
- B. Fieldbus terminal (8) D1 / B

4.5 Cover jam screw

For flow meters shipped with a cover jam screw, the screw should be installed after the instrument has been wired and powered up. Follow these steps to install the cover jam screw:

1. Verify the cover jam screw is completely threaded into the housing.
2. Install the housing cover and verify the cover is tight against the housing.
3. Using a 2.5 mm hex wrench, loosen the jam screw until it contacts the transmitter cover.
4. Turn the jam screw an additional $\frac{1}{2}$ turn counterclockwise to secure the cover.

Note

Application of excessive torque may strip the threads.

5. Verify the cover cannot be removed.

5 Basic Configuration

Once the magnetic flowmeter is installed and power has been supplied, the transmitter basic setup parameters must be configured with a FOUNDATION fieldbus host (See [Communication methods](#)). Configuration settings are saved in nonvolatile memory within the transmitter.

The standard transmitter configuration, without Option Code C1, Custom Configuration, is shipped with the following parameters:

- Engineering Units: ft/s
- Sensor Size: 3-in.
- Sensor Calibration Number: 100000501000000

Descriptions of more advanced functions are included in [Advanced Configuration Functionality](#).

5.1 Communication methods

You will see references to the transmitter "LOI" (Local Operator Interface) in the fieldbus parameter names and on configuration screens and tools. However this type of display provides only one-way communication from the transmitter to the user for process variables, status, and diagnostics.

All configuration and other communication from the user to the transmitter requires one of two types of FOUNDATION fieldbus host:

- On an *enhanced FF host*, the transmitter parameters are displayed either in the form of a menu tree (for example, a Field Communicator) or in the form of tabbed display screens (for example, the AMS Intelligent Device Manager with DeltaV™ System). Both the menu tree and tabbed display screens are provided as part of the unique Device Description files specific to this transmitter.
- A *basic FF host* displays the transmitter parameters in the form of a list under the Resource block and transducer blocks.

This document contains information for both types of host.

Note

Fieldbus configuration tools and hosts from some vendors may interpret device information differently than others. As a result, you may notice slight differences in the paths, locations, or parameter names on your host or configuration tool.

5.2 FOUNDATION fieldbus configuration

Assigning physical device tag and node address

The transmitter is shipped with a blank physical device tag and a temporary address to allow a host to automatically assign an address and a physical device tag. If the physical device tag or address need to be changed, use the features of the configuration tool. The tools do the following:

- Change the physical device tag to a new value.
- Change the address to a new address.

When the transmitter is at a temporary address, only the physical device tag and address can be changed or written to. The resource, transducer, and function blocks are all disabled.

Flow-specific AI block configuration

The factory configuration of the four Analog Input function blocks ("AI blocks") is the following:

- One of them is configured for flow:
 - CHANNEL parameter is set to 1
 - XD_SCALE parameters are set to:
 - EU_100: -39.37
 - EU_0: -39.37
 - UNITS_INDEX: ft/sec
 - DECIMAL: 2
 - L_TYPE parameter is set to Direct
- The other three are configured as Totalizer A, Totalizer B, and Totalizer C

For more information:

- For totalizer configuration, see [Totalizer](#).
- For more information about AI block parameters, see [Analog Input \(AI\) Function Block](#).
- For additional AI block configuration and troubleshooting, refer to *FOUNDATION™ Fieldbus Function Blocks*, document 00809-0100-4783.

If you need to reconfigure the flow measurement AI block:

1. Set the CHANNEL parameter to 1 for flow.
2. Set the XD_SCALE parameters (EU_100, EU_0, UNITS_INDEX, and DECIMAL) to the desired measurement scale from the flow measurement transducer.
3. Set the L_TYPE parameter to the desired linearization method, and then if necessary, set the OUT_SCALE parameters:
 - For direct measurement (the AI block output is the same as the XD_SCALE), set L_TYPE to Direct. This completes the channel configuration.
 - For indirect measurement (the AI block output is scaled from the XD_SCALE), set L_TYPE to Indirect, and then set the OUT_SCALE parameters (EU_100, EU_0, UNITS_INDEX, and DECIMAL) to the scale required by the control/monitoring system.

General, flow-specific block configuration

In general, only the transducer block and AI blocks have configurations for flow-specific parameters. All other function blocks are configured by linking the AI blocks to other blocks to be used for control and/or monitoring applications.

5.3 Basic Setup

Descriptive tag

Enhanced FF host	Configure > Device Information > Description
Basic FF host	TB > TAG_DESC (OD Index 2)

The descriptive tag fieldbus parameter permits you to assign a 32 character identifier to a transmitter to distinguish it from others in your system. It is **not** the same as the physical device tag (see [Assigning physical device tag and node address](#)), which is used by the control scheme.

Flow units

Flow units must be configured from the AI block configured for flow measurement. See [FOUNDATION fieldbus configuration](#).

Line size

Enhanced FF host	Configure > Basic Setup
Basic FF host	TB > TUBE_SIZE (OD Index 36)

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

Calibration number

Enhanced FF host	Configure > Basic Setup
Basic FF host	TB > FLOW_TUBE_CAL_NUM (OD Index 35)

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

6 Advanced installation details

6.1 Hardware switches

The electronics are equipped with two user-selectable hardware switches. These switches set the Transmitter Security and Simulate Enable.

6.1.1 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.

6.1.2 Simulate mode

The Simulate Mode switch is used in conjunction with the Analog Input (AI) function block. The switch is used to enable flow measurement and diagnostic alert simulation. To enable the simulate enable feature, the switch must transition from OFF to ON after power is applied to the transmitter, preventing the transmitter from being accidentally left in simulate mode. Simulate Mode is set in the OFF position when shipped from the factory.

6.1.3 Changing hardware switch settings (field mount)

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: Electronics Stack and Hardware Switches



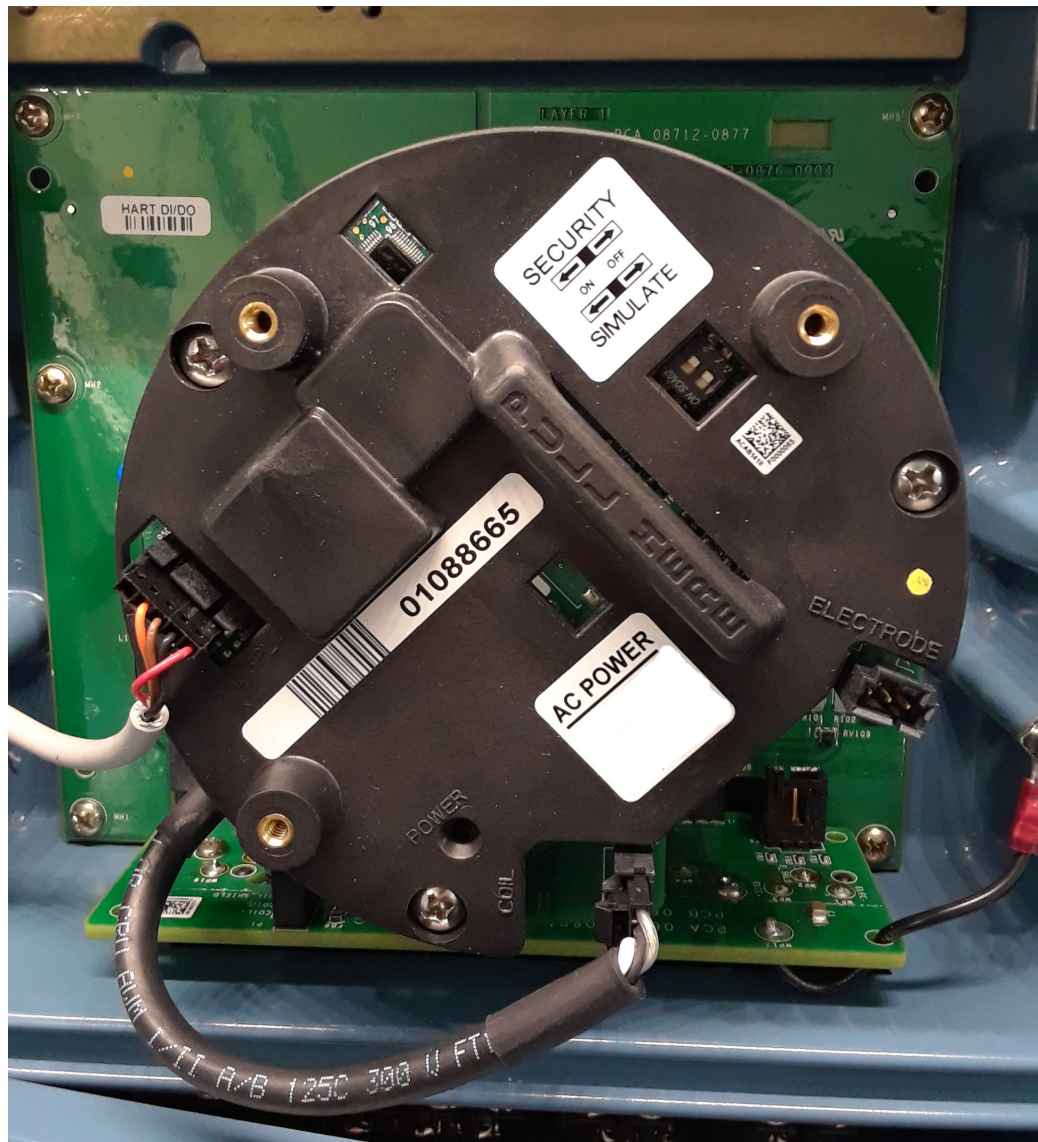
1. Place the control loop into manual control.
2. Disconnect power to the transmitter
3. Remove the electronics compartment cover.
If the cover has a cover jam screw, this must be loosened prior to removal of the cover.
4. Remove the LOI/Display, if applicable.
5. Identify the location of each switch (see [Figure 6-1](#)).
6. Change the setting of the desired switches with a small, non-metallic tool.
7. Replace the LOI/Display, if applicable.
8. Replace the electronics compartment cover.
If the cover has a cover jam screw, this must be tightened to comply with installation requirements. See [Cover jam screw](#) for details on the cover jam screw.
9. Return power to the transmitter and verify the flow measurement is correct.
10. Return the control loop to automatic control.

6.1.4 Changing hardware switch settings (wall mount)

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 6-2: Electronics stack and hardware switches



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 6-2](#)).
5. Change the setting of the desired switches with a small, non-metallic tool.
6. Close the electronics compartment cover. See [Powering the transmitter](#) 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 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.

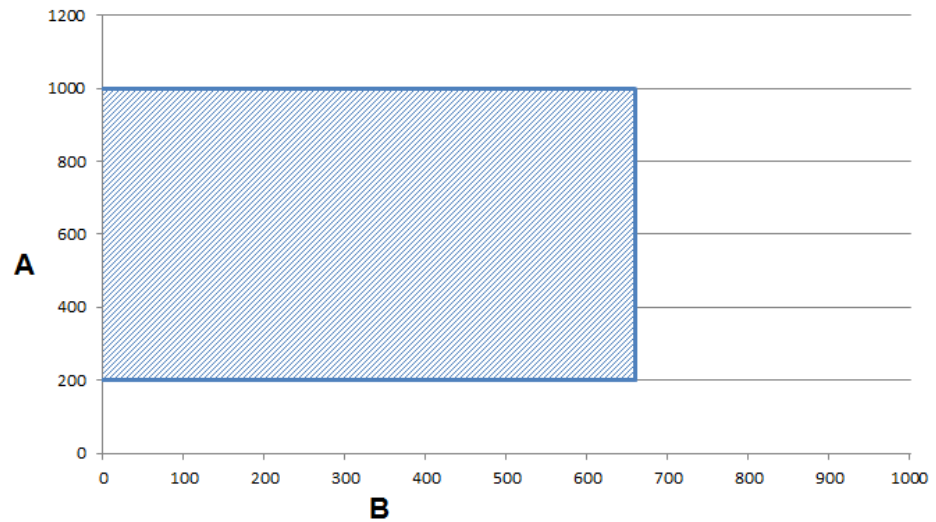
The transmitter supports a pulse output with an external power supply that meets the following requirements:

- Supply voltage: 5 to 24 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:

Supply voltage	Resistance vs cable length
5 VDC	See Figure 6-3
12 VDC	See Figure 6-4
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: 5,000 Hz
- FET switch closure: solid state switch

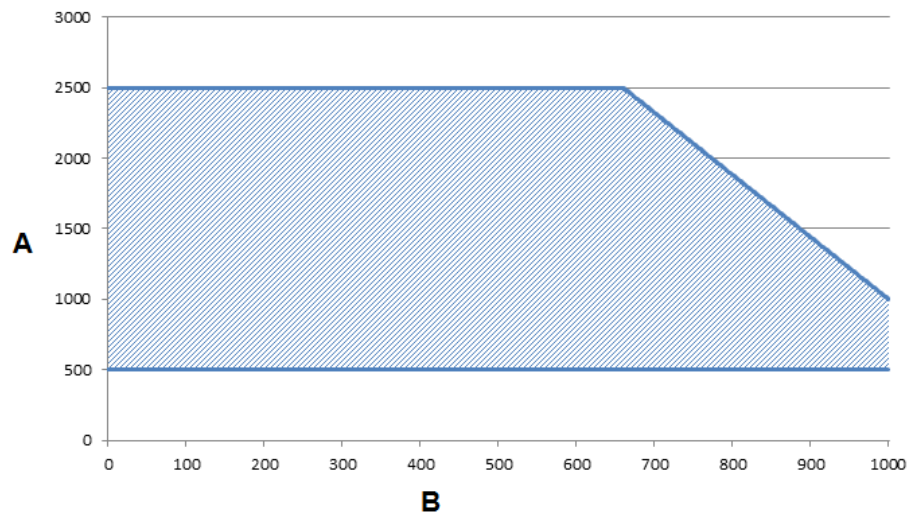
Figure 6-3: 5 VDC Supply



- 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).

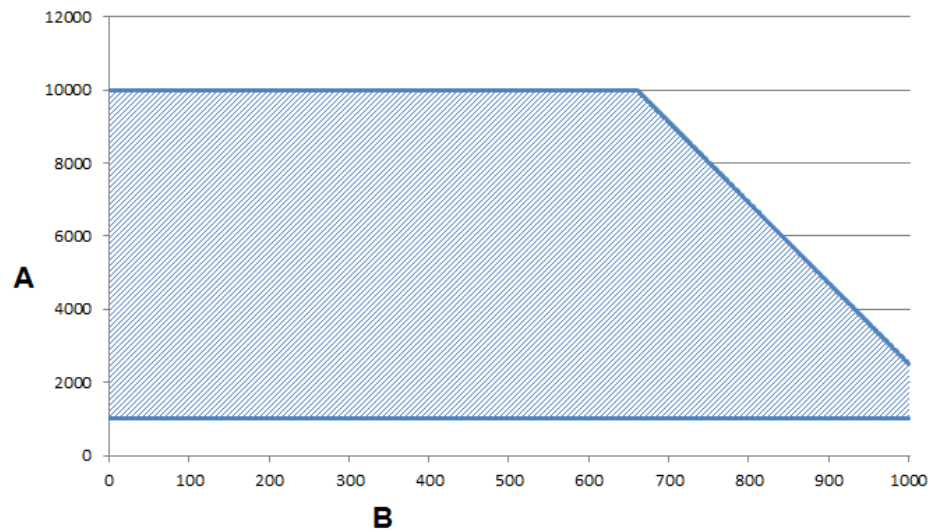
Figure 6-4: 12 VDC Supply



- 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: 24 VDC Supply



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

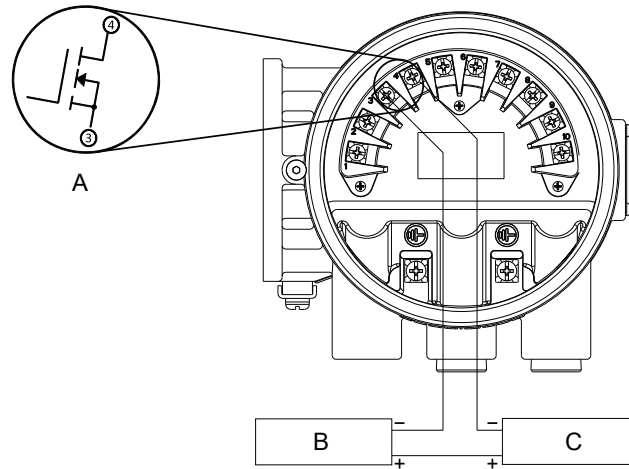
At 5000 Hz operation with a 24 VDC supply, pull-up resistances of 1000 to 10,000 Ohms allow cable lengths up to 660 ft (200 m). Resistances from 1000 to 2500 Ohms allow a cable length of 1000 ft (330 m).

6.2.1 Connecting an external power supply

Note

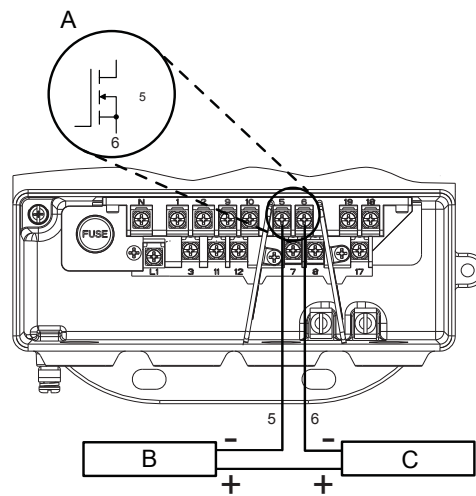
Total loop impedance must be sufficient to keep loop current below maximum rating. A resistor can be added in the loop to raise impedance.

Figure 6-6: Connecting an electromechanical totalizer/counter with external power supply (field mount)



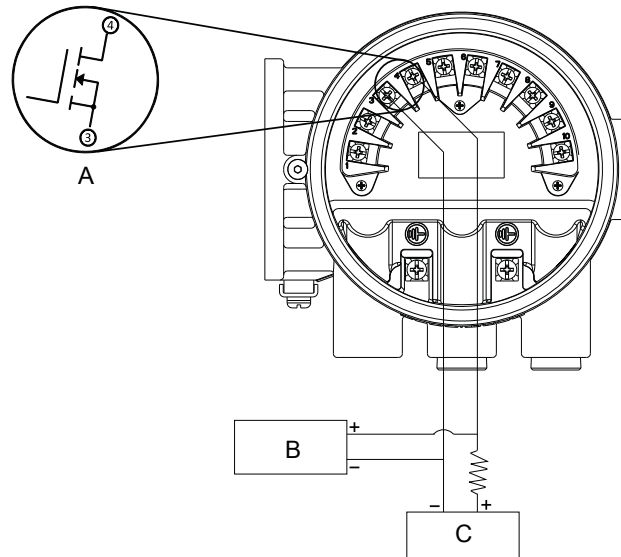
- A. Schematic showing FET between terminal 3 and 4
- B. 5–24 VDC power supply
- C. Electro-mechanical counter

Figure 6-7: Connecting an electromechanical totalizer/counter with external power supply (wall mount)



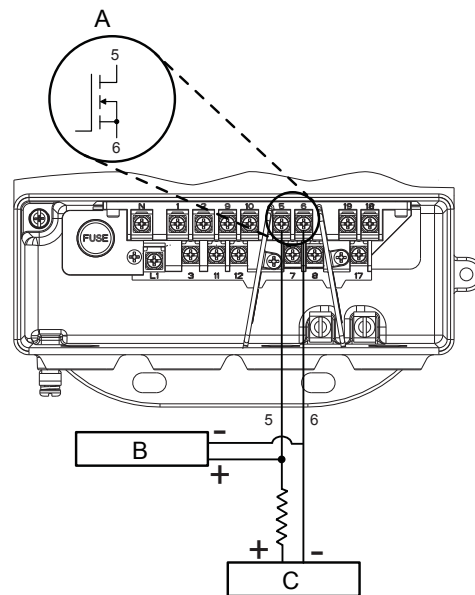
- A. Schematic showing FET between terminal 5 and 6
- B. Electro-mechanical counter
- C. 5–24 VDC power supply

Figure 6-8: Connecting to an electronic totalizer/counter with external power supply (field mount)



- A. Schematic showing FET between terminal 3 and 4
- B. Electronic counter
- C. 5–24 VDC power supply

Figure 6-9: Connecting to an electronic totalizer/counter with external power supply (wall mount)



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

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 3.
5. Connect - DC to terminal 6.
6. Connect + DC to terminal 4.
7. Connect + DC to terminal 5.

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.

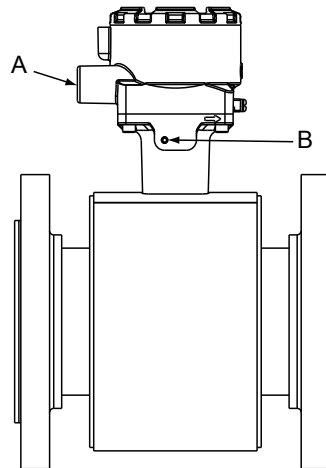
The 8705 model is available in four coil housing configurations. Configurations are identified by the M0, M1, M2, M3, or M4 options codes found in the model number. The 8711 and 8721 models are only available in one coil housing coil configuration; a separate option code is not available.

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 6-10](#)):

- 8705 with option code M0 - 8705xxxxxxxM0
- 8711 with option code M/L - 8711xxxxxxM/L
- 8721 with option code R/U - 8721xxxxxxR/U

Figure 6-10: 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 - 8705xxxxxxxM1

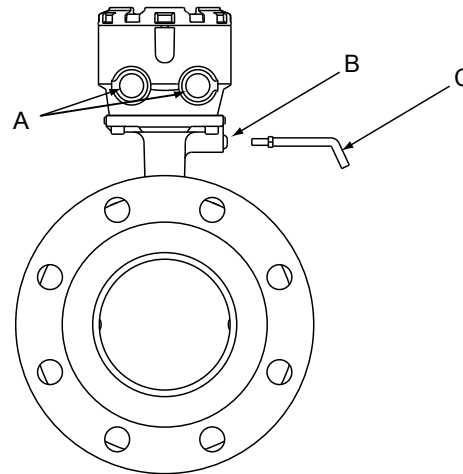
A PRV can be installed in the threaded connection to prevent possible over-pressuring of the coil housing caused by a primary seal failure. The PRV is capable of venting fugitive emissions when pressure inside the coil housing exceeds five psi. Additional piping may be connected to the PRV to drain any process leakage to a safe location (see [Figure 6-11](#)).

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 6-11: 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

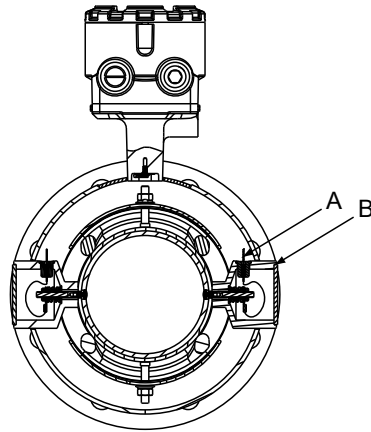
This configuration divides the coil housing into separate compartments, one for each electrode and one for the coils. In the event of a primary seal failure, the fluid is contained in the electrode compartment. The sealed electrode compartment prevents the process fluid from entering the coil compartment 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 6-12](#)).
- 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 6-13](#)).

Note

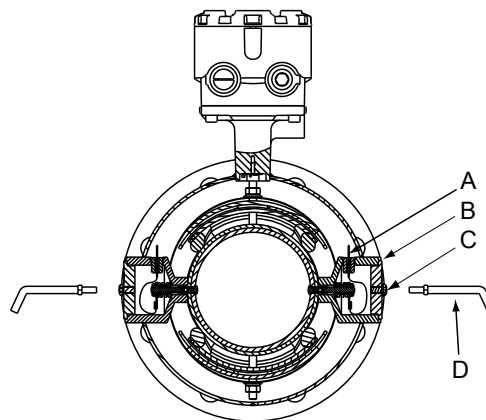
To properly vent process fluid from the electrode compartment to a safe location, additional piping is required and must be installed by the user. Installation of any associated piping must be performed in accordance with environmental and hazardous area requirements. In the event of primary seal failure,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

Figure 6-12: 8705 with M2 Coil Housing Configuration



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

Figure 6-13: 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

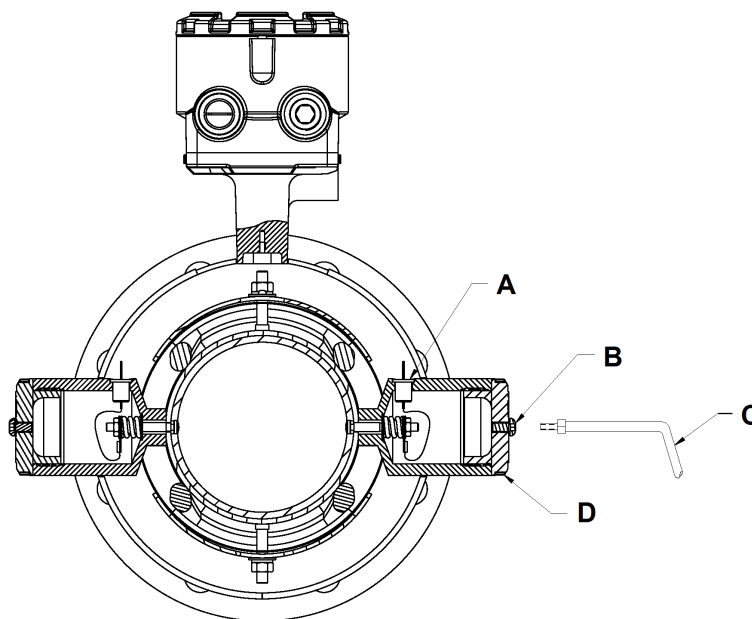
electrode compartments that include access covers. The M3 configuration is available on the 8705 only.

- 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

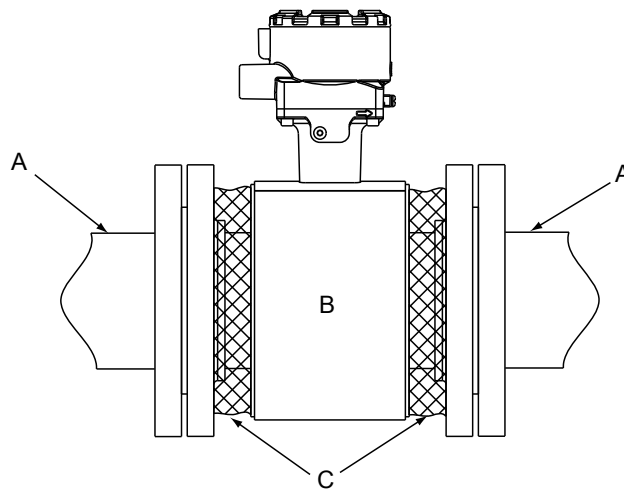
6.3.5 Higher temperature applications and sensor insulation best practices

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.

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 6-14](#)).

Figure 6-14: Insulating a Rosemount Magnetic Flowmeter for Permeation

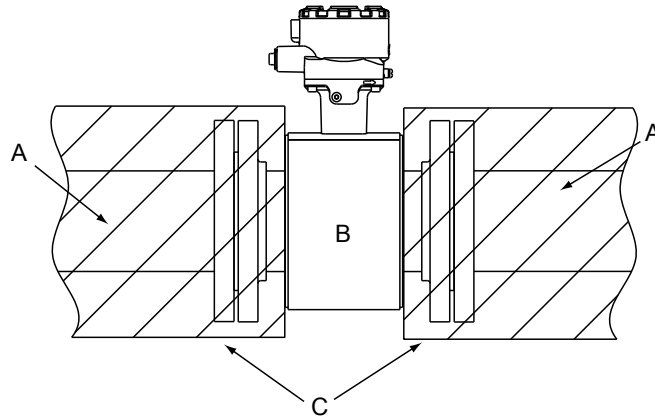


- A. Process piping
- B. Coil housing
- C. Insulation

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 6-15](#)).

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 6-15: Insulating a Rosemount Magnetic Flowmeter for Safety/Plant Standards



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

7 Advanced Configuration Functionality

7.1 Introduction

The transmitter features a full range of software functions, transmitter configurations, and diagnostic settings. These features can be accessed and configured using a basic or enhanced FF host.

7.2 Configure outputs

7.2.1 Pulse output

Enhanced FF host	Pulse Output
Basic FF host	TB > PULSE CONFIGURATION (OD Index #38)

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

Pulse scaling

Enhanced FF host	Pulse Output > Factor
Basic FF host	TB > PULSE CONFIGURATION (OD Index #38) FACTOR

Transmitter may be commanded to supply a specified frequency between 1 pulse/ day at 39.37 ft/sec (12 m/s) to 5000 Hz at 1 ft/sec (0.3 m/s).

Note

The maximum pulse scaling frequency for transmitters with an intrinsically safe output is 5000 Hz.

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 5000 Hz. The minimum conversion factor value is found by dividing the minimum span (in units of volume per second) by 5000 Hz.

When selecting pulse output scaling, the maximum pulse rate is 5000 Hz. With the 10 percent over range capability, the absolute limit is 5500 Hz. For example, if you want the transmitter to pulse every time 0.01 gallons pass through the sensor, and the flow rate is 5000 gal/min, you will exceed the 5000 Hz full-scale limit:

$$\frac{5000 \text{ gal}}{1 \text{ min}} \times \frac{1 \text{ min}}{(60 \text{ sec})} \times \frac{1 \text{ pulse}}{0.01 \text{ gal}} = 8,333.3 \text{ Hz}$$

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

Enhanced FF host	Pulse Output > Factor Units
Basic FF host	TB > PULSE CONFIGURATION (OD Index #38) 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.

Table 7-1: Pulse factor volume units

Fieldbus unit code	Units
1048	US Gallons
1038	Liters
1049	Imperial gallons
1034	Cubic meters
1051	Barrels (42 gallons)
1042	Cubic feet
1036	Cubic centimeters
1052	Barrels (31 gallons)

Table 7-2: Pulse factor mass units

Fieldbus unit code	Units
1088	Kilograms
1092	Metric tons
1094	Pounds
1095	Short tons

Table 7-3: Pulse factor other units

Fieldbus unit code	Units
1018	Feet (default)

Table 7-3: Pulse factor other units (continued)

Fieldbus unit code	Units
1010	Meters

Pulse width

Enhanced FF host	Pulse Output > Pulse Width
Basic FF host	TB > PULSE CONFIGURATION (OD Index #38) PULSE_WIDTH

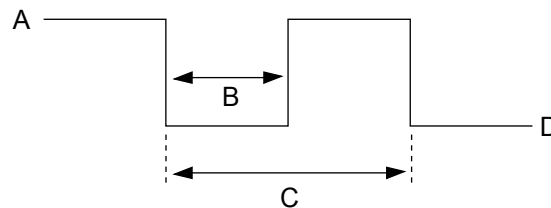
The factory default pulse width is 0.5 ms.

The width, or duration, of the pulse can be adjusted to match the requirements of different counters or controllers (see [Figure 7-1](#)). 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 7-1: 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 5000 Hz at 10,000 gpm.

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

$$\text{Pulse Scaling} = \frac{10,000 \text{ gpm}}{(60 \frac{\text{sec}}{\text{min}}) \times (5000 \text{ Hz})}$$

$$\text{Pulse Scaling} = 0.0333 \frac{\text{gal}}{\text{pulse}}$$

$$1 \text{ pulse} = 0.0333 \text{ gal}$$

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, 5000 Hz is scaled to the full scale analog reading.

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

$$\text{Pulse Scaling} = \frac{3,000 \text{ gpm}}{(60 \frac{\text{sec}}{\text{min}}) \times 5000 \text{ Hz}}$$

$$\text{Pulse Scaling} = 0.01 \frac{\text{gal}}{\text{pulse}}$$

$$1 \text{ pulse} = 0.01 \text{ gal}$$

Fixed frequency test mode

Enhanced FF host	Pulse Output > Fixed Frequency Mode
Basic FF host	TB > PULSE CONFIGURATION (OD Index #38) FIXED_FREQUENCY

Fixed frequency test mode generates a constant, fixed-frequency pulse output. This can be useful for testing frequency input devices or control loop configurations.

Table 7-4: Fixed frequency test mode

Fixed frequency parameter value	Mode
0	Fixed frequency test mode disabled
1 to 5500 (Hz)	Fixed frequency test mode enabled, pulse output set to parameter value.

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

7.2.2 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

Enhanced FF host	Overview > View Totalizers
Basic FF host	TB > TOTAL_A_VALUE (OD Index #29) TB > TOTAL_B_VALUE (OD Index #30) TB > TOTAL_C_VALUE (OD Index #31)

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

Configure totalizers

Enhanced FF host	Totalizers Control
Basic FF host	TB > TOTAL_A_CONFIG (OD Index #43) TB > TOTAL_B_CONFIG (OD Index #44) TB > TOTAL_C_CONFIG (OD Index #45)

Start, stop, reset all totalizers

Enhanced FF host	Totalizers Control > Start/Stop Totalizers Totalizers Control > Reset All Totals
Basic FF host	See below.

Totalizer funtion	Fieldbus parameter (Index #)	Parameter value
Start all totalizers	TOTALIZER CONTROL: ENABLE_ALL (Index #42)	2
Stop all totalizers	TOTALIZER CONTROL: ENABLE_ALL(Index #42)	1
Reset all totalizers	TOTALIZER CONTROL: RESET_ALL (Index #42)	1

Note

If an individual totalizer is configured as non-resettable, reset all totalizers will **not** affect that totalizer.

Totalizer direction

Enhanced FF host	Totalizers Control > Totalizer (A, B, C) > Flow Direction
Basic FF host	TB > TOTAL_A_CONFIG (OD Index #43) TB > TOTAL_B_CONFIG (OD Index #44) TB > TOTAL_C_CONFIG (OD Index #45) FLOW_DIRECTION

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

FLOW_DIRECTION parameter value	Totalizer direction
1	Net
2	Forward only
3	Reverse only

Totalizer units

Enhanced FF host	Totalizers Control > Totalizer (A, B, C) > Units
Basic FF host	TB > TOTAL_A_CONFIG (OD Index #43) TB > TOTAL_B_CONFIG (OD Index #44) TB > TOTAL_C_CONFIG (OD Index #45) UNITS

Configure the units for totalizers.

Table 7-5: Volume units

Fieldbus unit code	Units
1048	US Gallons
1038	Liters
1049	Imperial gallons
1034	Cubic meters
1051	Barrels (42 gallons)
1042	Cubic feet
1036	Cubic centimeters
1052	Barrels (31 gallons)

Table 7-6: Mass units

Fieldbus unit code	Units
1088	Kilograms
1092	Metric tons
1094	Pounds
1095	Short tons

Table 7-7: Other units

Fieldbus unit code	Units
1018	Feet (default)
1010	Meters

Reset configuration

Enhanced FF host	Totalizers Control > Totalizer (A, B, C) > Reset Options
Basic FF host	TB > TOTAL_A_CONFIG (OD Index #43) TB > TOTAL_B_CONFIG (OD Index #44) TB > TOTAL_C_CONFIG (OD Index #45) ALLOW_RESET

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

ALLOW_RESET parameter value	Reset options
1	Reset not allowed
2	Reset allowed

Reset individual totalizer

Enhanced FF host	Totalizers Control > Reset Totalizer (A, B, C)
------------------	--

Basic FF host	TB > TOTAL_A_CONFIG (OD Index #43) TB > TOTAL_B_CONFIG (OD Index #44) TB > TOTAL_C_CONFIG (OD Index #45) RESET
---------------	---

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

RESET parameter value	Reset options
1	Reset totalizer

7.3 Configure LOI/Display

7.3.1 Flow and totalizer display

Enhanced FF host	LOI Flow Display Timing > Flow Rate Time LOI Flow Display Timing > Totalizer (A, B, C) Time
Basic FF host	TB > LOI_CONFIGURATION (OD Index #53) PV_LOI_TIME (Process variable) TA_LOI_TIME (Totalizer A) TB_LOI_TIME (Totalizer B) TC_LOI_TIME (Totalizer C)

The Process Variable and each of the three totalizer values can be shown in a scrolling cycle for zero to 10 seconds based on the settings selected in the LOI Configuration parameter. For basic FF hosts, the integer value of the parameter indicates the number of seconds the PV or totalizer value will be shown. To prevent the PV or a totalizer from appearing, set its value to zero.

- The default setting for the PV is 3 seconds
- The default setting for all totalizers is 0 seconds

Note

If all timing values are set to zero, the LOI/Display will default to showing only the PV.

7.3.2 Language

Enhanced FF host	Display Setup > Local Display Language
Basic FF host	TB > LOI_CONFIGURATION (OD Index #53) LANGUAGE

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

Table 7-8: Basic FF host languages

Parameter value	Language
1	English
2	Spanish
3	German
4	French
5	Portuguese

7.3.3 Backlight control

Enhanced FF host	Display Setup > Backlight
Basic FF host	TB > LOI_CONFIGURATION (OD Index #53) BACKLIGHT

The LOI/Display backlight parameter determines whether or not the backlight is always on or always off.

Table 7-9: BACKLIGHT parameter

Parameter value	Backlight control
0	OFF
5	ON

7.4 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 [Digital Signal Processing](#) for the detailed description of how the signal processing works.

7.4.1 PV (flow) damping

Enhanced FF host	Signal Processing > Process Data > PV Damping
Basic FF host	TB > DAMPING_CONSTANT (OD Index #32)

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.

7.4.2 Process density

Enhanced FF host	Signal Processing > Process Data > Density
Basic FF host	TB > DENSITY_CONSTANT (OD Index #34) TB > DENSITY_CONSTANT_UNITS (OD Index #33)

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

Table 7-10: DENSITY_CONSTANT_UNITS parameter

Parameter value	Description
1107	Pounds per cubic foot (lb/ft ³)
1097	Kilograms per cubic meter (kg/m ³)

7.4.3 Low flow cutoff

Enhanced FF host	Signal Processing > Operation > Low Flow Cutoff
Basic FF host	TB > LOW_FLOW_CUTOFF (OD Index #49)

Low flow cutoff allows the user to set a low flow limit to be specified. The flow reading is driven to zero 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.

7.4.4 Reverse flow

Enhanced FF host	Signal Processing > Operation > Reverse Flow
Basic FF host	TB > REVERSE_FLOW (OD Index #75)

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

Table 7-11: REVERSE_FLOW parameter

Parameter value	Operating mode
1	Reverse flow disabled (default)
2	Reverse flow enabled

7.4.5 Coil drive frequency

Enhanced FF host	Signal Processing > Coil drive > Coil Drive Frequency
Basic FF host	TB > COIL_DRIVE_FREQ > (OD Index #37)

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.

Note

37 Hz coil drive frequency should not be used for sensor sizes larger than 20-inch.

See [Auto zero](#).

8 Advanced Diagnostics Configuration

8.1 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 8-1: 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 8-2: 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)

Options for accessing Rosemount Magmeter Diagnostics

Rosemount Magmeter Diagnostics can be viewed on the LOI/Display, and they can be viewed and accessed using a basic or enhanced FOUNDATION fieldbus host, such as AMS® Device Manager.

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.

8.2 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.

8.2.1 Licensing the diagnostics

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

Enhanced FF host	License > License Upgrade > Software
Basic FF host	TB > DSP_SOFTWARE_REV_NUM (OD Index #59)

3. Determine the Device ID.

Enhanced FF host	License > License Upgrade > Output Board Serial Number
Basic FF host	TB > SERIAL_NUMBER (OD Index #115)

4. Obtain a license key from a local Rosemount representative.
5. Enter license key.

Enhanced FF host	License > License Upgrade > License Key
Basic FF host	TB > LICENSE_KEY (OD Index #82)

8.2.2 Enabling the diagnostics

Enhanced FF host	Diagnostics > Enabled Diagnostics
Basic FF host	TB > DIAGNOSTIC_HANDLING (OD Index #73). See below.

After diagnostics are licensed, they can be enabled or disabled individually.

For Basic FOUNDATION fieldbus hosts, [Table 8-3](#) identifies which bits are associated with each diagnostic function. When the bit is set, the diagnostic is enabled.

Table 8-3: DIAGNOSTIC_HANDLING parameter

Bit	Diagnostic function
3	Empty pipe detection

Table 8-3: DIAGNOSTIC_HANDLING parameter (continued)

Bit	Diagnostic function
13	High process noise
15	Grounding/wiring fault
10	Electronics temperature out of range
18	Electrode coating

8.3 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

Enhanced FF host	Diagnostics > Enabled Diagnostics > Empty Pipe Detection
Basic FF host	See Enabling the diagnostics .

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.

8.3.1 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

Enhanced FF host	Diagnostics > Empty Pipe > Value
Basic FF host	TB > EP_VALUE (OD Index #56)

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

Enhanced FF host	Diagnostics > Empty Pipe > Trigger Level
Basic FF host	TB > EP_TRIG_LEVEL (OD Index #55)

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

Enhanced FF host	Diagnostics > Empty Pipe > Counts
Basic FF host	TB > EP_TRIG_COUNTS (OD Index #54)

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.

8.3.2 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.

1. Record the empty pipe value with a full pipe condition.
Full reading = 0.2
2. Record the empty pipe value with an empty pipe condition.
Empty reading = 80.0
3. 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.
Set the trigger level to 25.0
4. 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.
Set the counts to 10

8.4 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.

8.4.1 Turning electronics temperature on/off

Enhanced FF host	Diagnostics > Enabled Diagnostics > Electronics Temperature Out of Range
Basic FF host	See Enabling the diagnostics .

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.

8.4.2 Electronics temperature parameters

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

Enhanced FF host	Diagnostics > Electronics Temperature
Basic FF host	TB > ELECT_TEMP (OD Index #57)

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

8.5 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.

8.5.1 Turning ground/wiring fault on/off

Enhanced FF host	Diagnostics > Enabled Diagnostics > Grounding/Wiring Fault Detection
Basic FF host	See Enabling the diagnostics .

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.

8.5.2 Ground/wiring fault parameters

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

Line noise

Enhanced FF host	Diagnostics > Ground/Wiring Fault Detection > Line Noise
Basic FF host	TB > LINE_NOISE (OD Index #72)

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.

8.6 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.

8.6.1 Turning high process noise on/off

Enhanced FF host	Diagnostics > Enabled Diagnostics > High Process Noise Detection
Basic FF host	See Enabling the diagnostics .

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.

8.6.2 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)

Enhanced FF host	Diagnostics > High Process Noise Detection > 5 Hz Signal-to-Noise Ratio
Basic FF host	DIAG_SNR_5HZ (OD Index #69)

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)

Enhanced FF host	Diagnostics > High Process Noise Detection > 37 Hz Signal-to-Noise Ratio
Basic FF host	DIAG_SNR_37HZ (OD Index #70)

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.

8.7 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.

8.7.1 Turning coated electrode detection on/off

Enhanced FF host	Diagnostics > Enabled Diagnostics > Electrode Coating Detection
Basic FF host	See Enabling the diagnostics .

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.

8.7.2 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

Enhanced FF host	Diagnosics > Electrode Coating > Electrode Coating Value
Basic FF host	TB > ELECTRODE_COATING > CURRENT_VALUE (OD Index #47)

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

Electrode coating (EC) level 1 limit

Enhanced FF host	Diagnosics > Electrode Coating > Level 1 Limit
Basic FF host	TB > ELECTRODE_COATING_CFG > LEVEL_1 (OD Index #46)

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

Enhanced FF host	Diagnosics > Electrode Coating > Level 2 Limit
Basic FF host	TB > ELECTRODE_COATING_CFG > LEVEL_2 (OD Index #46)

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)

Enhanced FF host	Diagnosics > Electrode Coating > Electrode Coating Max Value
Basic FF host	TB > ELECTRODE_COATING_CFG > MAX_VALUE (OD Index #47)

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

Enhanced FF host	Diagnosics > Electrode Coating > Clear Max Electrode Coating
Basic FF host	TB > ELECTRODE_COATING_CFG > CLEAR_MAX (OD Index #46)

Use this method to reset the maximum electrode coating value.

8.8 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.

8.8.1 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

Enhanced FF host	Meter Verification > Sensor Baseline > Coil Resistance
Basic FF host	TB > COIL_RESIST_VALUE (OD Index #99)

The coil 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)

Enhanced FF host	Meter Verification > Sensor Baseline > Coil Inductance
Basic FF host	TB > COIL_INDUCT_VALUE (OD Index #96)

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

Enhanced FF host	Meter Verification > Sensor Baseline > Electrode Resistance
Basic FF host	TB > ELECT_RESIST_VALUE (OD Index #101)

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.

8.8.2 Establishing the sensor baseline (signature)

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

Reset baseline (re-signature meter)

Enhanced FF host	Meter Verification > Sensor Baseline > Re-Baseline Sensor
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Basic FF host	TB > PERFORM_REFINGERPRINT_FLOWTUBE (OD Index #110)
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Having the transmitter take an initial sensor baseline when first installed will provide the comparison point for the verification tests that are done in the future. The sensor baseline 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 baseline 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 baseline should only be run for the coils.

Once the sensor baseline 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)

Enhanced FF host	Meter Verification > Sensor Baseline > Recall Last Baseline
Basic FF host	TB > RECALL_FINGERPRINT_VALUES (OD Index #109)

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

8.8.3 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

Enhanced FF host	Meter Verification > Manual Meter Verification Limits > No Flow
Basic FF host	TB > METER_VERIF_NO_FLOW_LIM (OD Index #108)

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

Enhanced FF host	Meter Verification > Manual Meter Verification Limits > Flowing
Basic FF host	TB > METER_VERIF_FLOWING_LIM (OD Index #107)

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

Enhanced FF host	Meter Verification > Manual Meter Verification Limits > Empty Pipe
Basic FF host	TB > METER_VERIF_EP_LIM (OD Index #106)

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

Enhanced FF host	Meter Verification > Continuous Meter Verification > Continuous Verification Limit
Basic FF host	TB > CONT_METER_VERIFY_LIMIT (OD Index #84)

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.

8.9 Run manual SMART Meter Verification

Enhanced FF host	Overview > Run Meter Verification
Basic FF host	TB > PERFORM_METER_VERIFY (OD Index #111)

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.

8.9.1 Test conditions

Enhanced FF host	Meter Verification > Meter Verification Parameters > Test Conditions
Basic FF host	TB > METER_VERIF_TEST_COND_IN (OD Index #87)

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.

8.9.2 Test scope

Enhanced FF host	Meter Verification > Meter Verification Parameters > Coils, Electrodes, Transmitter
Basic FF host	TB > METER_VERIF_TEST_SCOPE (OD Index #86)

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.

Use the parameter values below to set the test scope. The parameter value must be set before initiating SMART Meter Verification.

Register value	Test scope
0	Uninitialized
1	All (sensor and transmitter)
2	Sensor
3	Transmitter

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 (coils and electrodes) 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.

8.10 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.

8.10.1 Test scope

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

Coils

Enhanced FF host	View Meter Verification Report
Basic FF host	TB > CONT_METER_VERIFY_ENABLE > bit 0 (OD Index #85)

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

Electrodes

Enhanced FF host	View Meter Verification Report
Basic FF host	TB > CONT_METER_VERIFY_ENABLE > bit 1 (OD Index #85)

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

Transmitter

Enhanced FF host	View Meter Verification Report
Basic FF host	TB > CONT_METER_VERIFY_ENABLE > bit 2 (OD Index #85)

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

8.11 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 calibration verification report (see [Optimizing continuous SMART Meter Verification](#)). This report 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.

The results are displayed in the order found in the following table. Each parameter displays a value used in the SMART Meter Verification diagnostic evaluation of the meter health.

Table 8-4: Manual Smart Meter Verification Test Parameters

Transducer block parameter name	Index number(s)
METER_VERIF_TEST_SCOPE	86
METER_VERIF_TEST_COND_IN	87
METER_VERIF_TEST_COND_OUT	88
METER_VERIF_CRITERIA	89
METER_VERIF_RESULT	90
COIL_RESIST_RESULT	91
COIL_INDUCT_RESULT	92
ELECT_RESIST_RESULT	93
INT_SIM_RESULT	94
INT_SIM_DEVIATION	103

Table 8-5: Continuous SMART Meter Verification Test Parameters

Parameter	Index number(s)
CONT_METER_VERIFY_LIMIT	84
CONT_METER_VERIFY_ENABLE	85
CONTINUOUS_MV_RESULTS: INTERNAL_SIM_VALUE	52
CONTINUOUS_MV_RESULTS: INTERNAL_SIM_DEVIATION	52
CONTINUOUS_MV_RESULTS: COIL_INDUCT_VALUE	52
CONTINUOUS_MV_RESULTS: COIL_INDUCT_DEVIATION	52
CONTINUOUS_MV_RESULTS: COIL_RESIST_VALUE	52
CONTINUOUS_MV_RESULTS: ELECTRODE_RESIST_VALUE	52

8.12 SMART Meter Verification measurements

The SMART Meter Verification test will make measurements of the coil resistance, coil inductance, and electrode resistance and compare these values to the values taken during the sensor baseline 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

Enhanced FF host	View Meter Verification Report
Basic FF host	Manual: TB > COIL_RESIST_RESULT (OD Index #91) Continuous: TB > CONTINUOUS_MV_RESULTS > COIL_RESIST_VALUE (OD Index #52)

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

Coil inductance (signature)

Enhanced FF host	View Meter Verification Report
Basic FF host	Manual: TB > COIL_INDUCT_RESULT (OD Index #92) Continuous: TB > CONTINUOUS_MV_RESULTS > COIL_INDUCT_VALUE (OD Index #52)

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

Electrode circuit resistance

Enhanced FF host	View Meter Verification Report
Basic FF host	Manual: TB > ELECT_RESIST_RESULT (OD Index #93) Continuous: TB > CONTINUOUS_MV_RESULTS > ELECTRODE_RESIST_VALUE (OD Index #52)

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

Actual velocity

Enhanced FF host	View Meter Verification Report
Basic FF host	Manual: TB > INT_SIM_RESULT (OD Index #94) Continuous: TB > CONTINUOUS_MV_RESULTS > INTERNAL_SIM_VELOCITY (OD Index #52)

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

Enhanced FF host	View Meter Verification Report
Basic FF host	Manual: TB > INT_SIM_DEVIATION (OD Index #103) Continuous: TB > CONTINUOUS_MV_RESULTS > INTERNAL_SIM_DEVIATION (OD Index #52)

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.

8.13 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.

Example 1 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.

Example 2 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.

Example 3 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.

8.13.1 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:	
Calibration Number:	
Line Size:	PV Damping: _____
Transmitter calibration verification results	Sensor calibration verification results
Simulated Velocity:	Sensor Deviation %: _____
Actual Velocity:	Sensor Test: <input type="checkbox"/> PASS / <input type="checkbox"/> FAIL / <input type="checkbox"/> NOT TESTED
Deviation %:	Coil Circuit 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	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: _____

9 Digital Signal Processing

9.1 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.

9.2 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.

9.3 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.

9.4 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.

9.4.1 Coil drive frequency

Enhanced FF host	Signal Processing > Coil drive > Coil Drive Frequency
Basic FF host	TB > COIL_DRIVE_FREQ > (OD Index #37)

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.

Note

37 Hz coil drive frequency should not be used for sensor sizes larger than 20-inch.

See [Auto zero](#).

9.4.2 Auto zero

Enhanced FF host	Signal Processing > Auto Zero
Basic FF host	TB > PERFORM_AUTO_ZERO (OD Index #60)

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.

9.4.3 Other signal processing tools

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

Enhanced FF host	Signal Processing > Operation > Operating Mode
Basic FF host	TB > SP_NOISE_MODE (OD Index #78)

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.

Table 9-1: SP_NOISE_MODE parameter

Parameter value	Operation mode
1	Normal mode (default)
2	Filter mode

Status

Enhanced FF host	Signal Processing > Digital Signal Processing > Control
Basic FF host	TB > SP_CONTROL (OD Index #77)

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.

Table 9-2: SP_CONTROL parameter

Parameter value	Operation mode
1	DSP is turned OFF
2	DSP is turned ON

Number of samples

Enhanced FF host	Signal Processing > Digital Signal Processing > Samples
Basic FF host	TB > SP_NUM_SAMPS (OD Index #79)

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

Enhanced FF host	Signal Processing > Digital Signal Processing > % Limit
Basic FF host	TB > SP_PERCENT_LIMIT (OD Index #80)

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

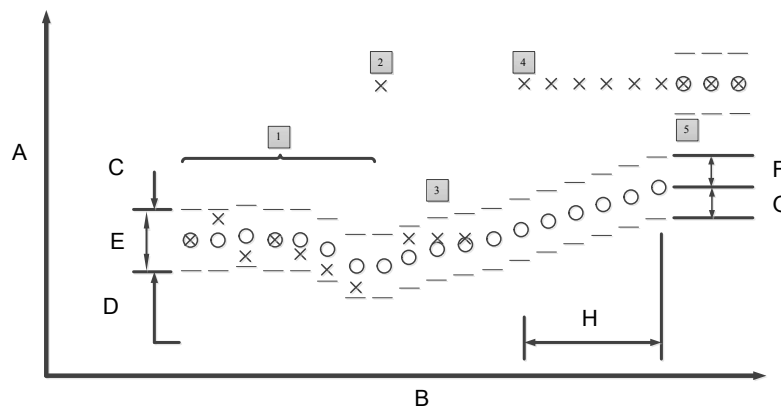
Enhanced FF host	Signal Processing > Digital Signal Processing > Time Limit
Basic FF host	TB > SP_TIME_LIMIT (OD Index #81)

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.

9.5 Explanation of signal processing algorithm

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

Figure 9-1: 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 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.

10 Maintenance

10.1 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.

10.2 Safety information

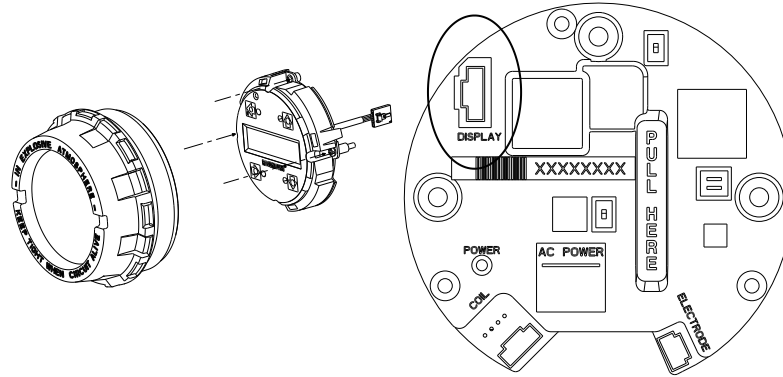
WARNING

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.

10.3 Installing a LOI/Display (field mount)

Figure 10-1: Installing a LOI/Display



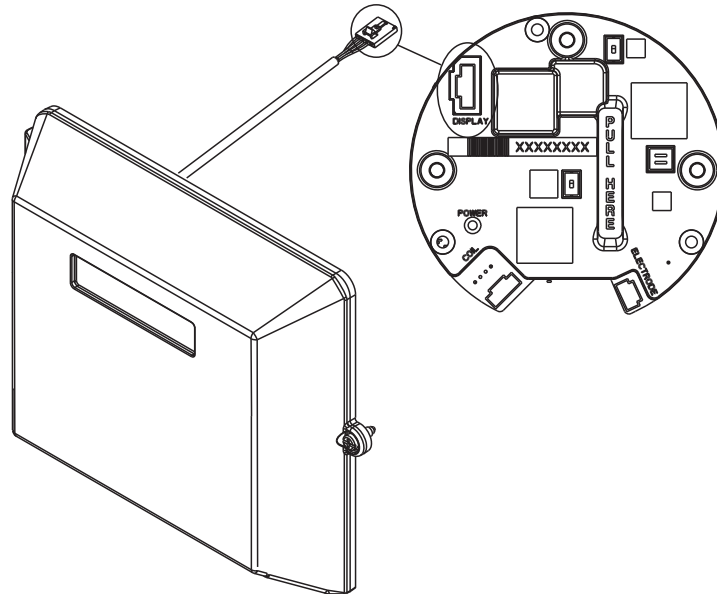
1. If the transmitter is installed in a control loop, secure the loop.
2. Remove power from the transmitter.
3. Remove the cover on the electronics compartment of the transmitter housing. If the cover has a cover jam screw, loosen it before removing the cover.
See [Cover jam screw](#) for details on the cover jam screw.
4. On the electronics stack, locate the serial connection labeled “DISPLAY”.
See [Figure 10-1](#).
5. Plug the serial connector from the back of the LOI/Display into the receptacle on the electronics stack.

The LOI/Display can be rotated in 90 degree increments to provide the best viewing position. Rotate the LOI/Display to the desired orientation, taking care to not exceed 360 degrees of rotation. Exceeding 360 degrees of rotation could damage the LOI/Display cable and/or connector.
6. Once the serial connector is installed on the electronics stack, and the LOI/Display is oriented in the desired position, tighten the three mounting screws.
7. Install the extended cover with the glass viewing pane and tighten to metal-to-metal contact.

If the cover has a cover jam screw, this must be tightened to comply with installation requirements. Return power to the transmitter and verify that it is functioning correctly and reporting the expected flow rate.
8. If installed in a control loop, return the loop to automatic control.

10.4 Installing a LOI/Display (wall mount)

Figure 10-2: Cover assembly with LOI/Display



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 [Powering the transmitter](#) 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/Display 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/Display 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.

10.5 Replacing electronics stack (field mount)

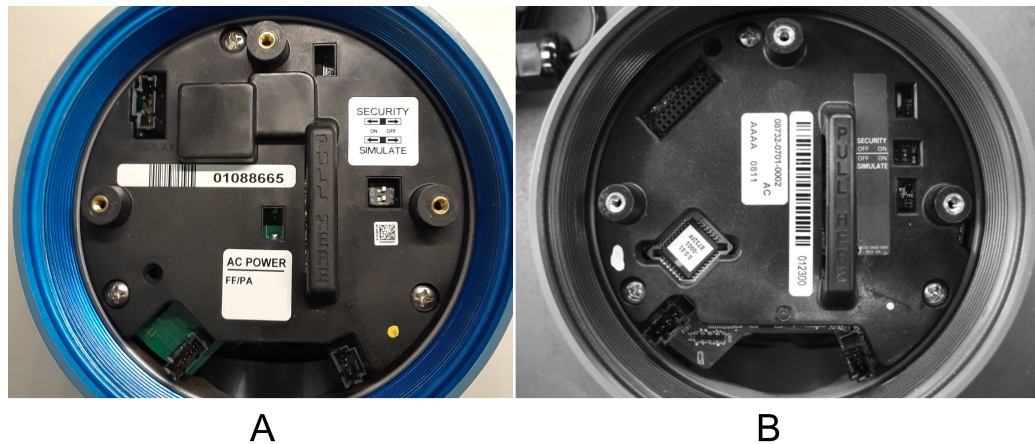
Make sure that the existing electronics stack is the same as the replacement (Revision 4) electronics stack. There are two ways to make sure:

- Look at the complete transmitter model number. Current (Revision 4) electronics are only compatible with Models 8750WM. If your transmitter model number as shown on the model number tag is not 8750WM, you cannot use a Revision 4 board stack.
- Visually inspect the existing and new electronics stacks to ensure that they are physically alike. The current (Revision 4) version of the stack has its electrical connections in different locations from the older versions. Both are shown in [Figure 10-3](#).

Note

You must open the housing and expose the electronics stack to inspect it (steps [Step 1](#) through [Step 5](#) below). Follow all applicable safety procedures and see [Powering the transmitter](#) for details on the covers.

Figure 10-3: Electronics Stack Identification



- A. Current (Revision 4) electronics stack.
B. Old electronics stack.

1. If the transmitter is installed in a control loop, secure the loop.
2. Remove power from the transmitter.
3. Remove the LOI/Display-side cover of the transmitter.

Note

See [Powering the transmitter](#) for details on the covers.

4. Remove the three screws that hold the LOI/Display to the electronics stack.
5. Carefully unplug the LOI/Display connector and remove and set aside the LOI/Display.
6. Carefully unplug the coil and electrode connectors.
7. Remove the three screws that secure the electronics stack into the housing.

8. Carefully pull out the electronics stack by the handle marked **PULL HERE**.
9. Remove the screws from the old electronics stack and insert them into the new electronics stack.
10. Hold the new electronics stack by the handle and carefully insert it into the housing, making certain that the screw holes and electrical connectors are in proper alignment to seat the stack.
11. Securely tighten the three electronics stack screws into the housing.
12. Plug in the coil and electrode connectors.
13. Replace the LOI/Display and refasten the three screws to secure it to the electronics stack.
14. Reinstall the LOI/Display-side cover of the transmitter and tighten it to ensure the housing is properly sealed to meet ingress protection requirements.
15. 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.

10.6 Replacing electronics stack (wall mount)

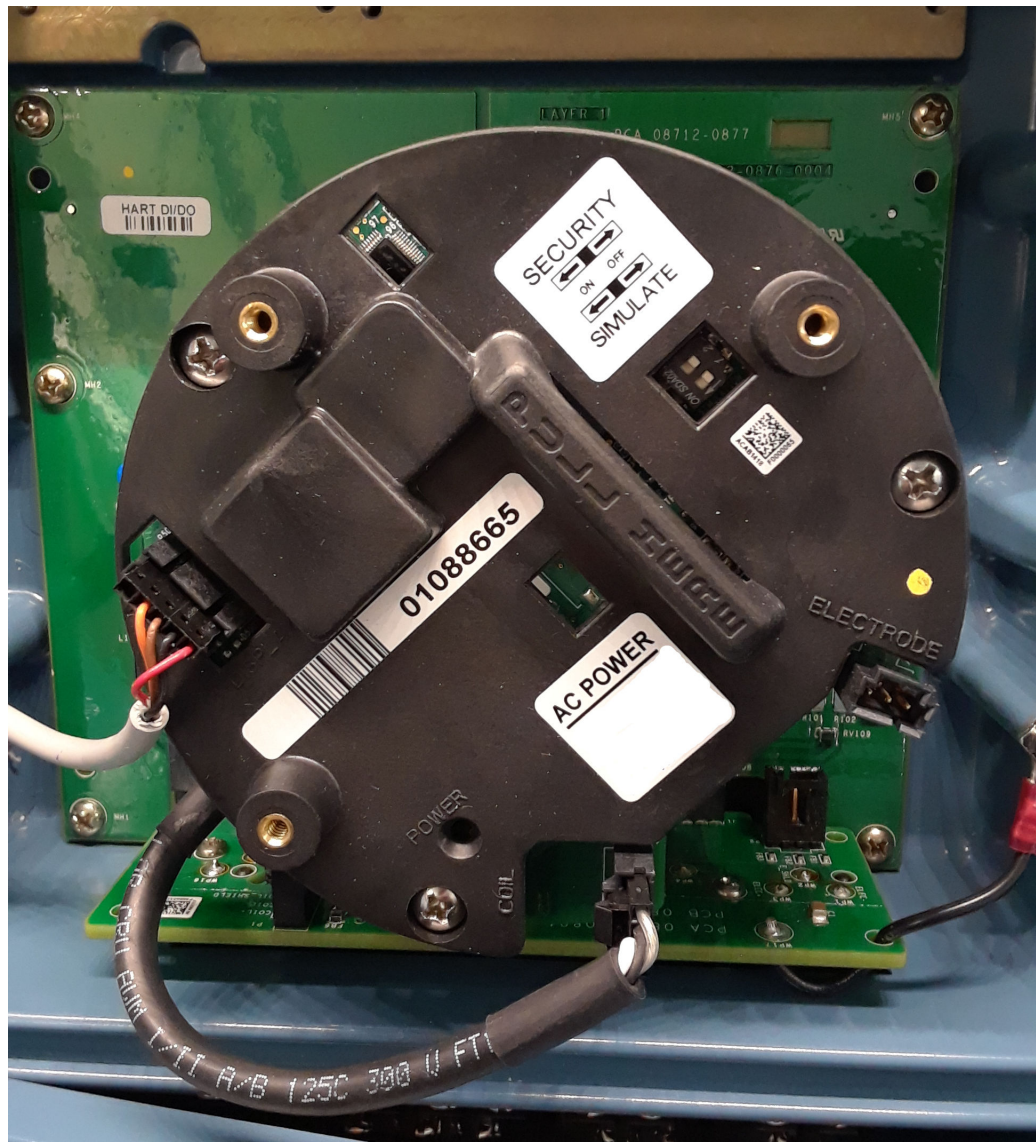
Make sure that the replacement board stack matches the existing stack. There are two ways to make sure:

- Look at the complete transmitter model number. Current (Revision 4) electronics are only compatible with Models 8750WM. If your transmitter model number as shown on the model number tag is not 8750WM, you cannot use a Revision 4 board stack.
- Visually inspect the existing and new electronics stacks to ensure that they are physically alike. The older version of the electronics stack was rectangular; the current (Revision 4) electronics stack is circular, as shown in [Figure 10-4](#).

Note

You must open the transmitter housing to inspect the electronics stack (steps [Step 1](#) through [Step 3](#) below). Follow all applicable safety procedures and see [Powering the transmitter](#) for details on the covers.

Figure 10-4: Revision 4 electronics stack



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 [Powering the transmitter](#) for details on the covers.

4. Carefully unplug each of the connectors from the top of the electronics stack: LOI/Display (if equipped), coil, and electrode.
5. Remove the three screws that secure the electronics stack into the housing.
6. Carefully pull out the electronics stack by the handle marked **PULL HERE**.

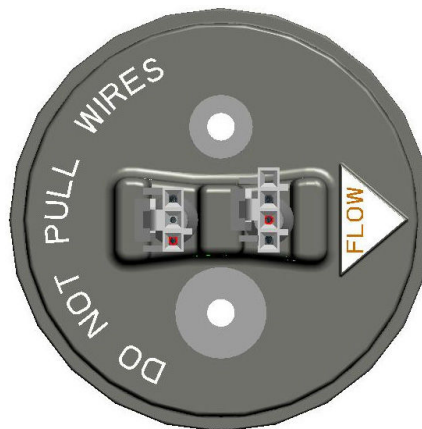
7. Remove the screws from the old electronics stack and insert them into the new electronics stack.
8. Hold the new electronics stack by the handle and carefully insert it into the housing, making certain that the screw holes and electrical connectors are in proper alignment to seat the stack.
9. Securely tighten the three electronics stack screws into the housing.
10. Plug in each of the connectors from the top of the electronics stack: LOI/Display (if equipped), coil, and electrode.
11. Close the upper compartment door and tighten the upper door screw to ensure the housing is properly sealed to meet ingress protection requirements.
12. Return power to the transmitter and verify that it is functioning correctly and reporting the expected flow rate.
13. If installed in a control loop, return the loop to automatic control.

10.7 Replacing a socket module/terminal block

The socket module connects the sensor adapter to the transmitter. The socket module is a replaceable component.

To remove the socket module, loosen the two mounting screws and pull up on the socket module from the base. When removing the socket module, do not pull on the wires. See [Figure 10-5](#).

Figure 10-5: Socket Module Warning



10.7.1 Replacing an integral mount socket module

The integral mount socket module is shown in [Figure 10-6](#). To gain access to the socket module, the transmitter must be removed from the sensor adapter.

Figure 10-6: Socket Module—Integral Mount



Removing an integral mount socket module

1. Disconnect power.
2. Remove electronics cover to gain access to the coil and electrode cables.
3. If the transmitter has a LOI/Display, it will need to be removed to gain access to the coil and electrode cables.
4. Disconnect the coil and electrode cables.
5. Remove the four transmitter mounting bolts.
6. Lift the transmitter off of the sensor adapter.
7. To remove the socket module, loosen the two mounting screws and pull up on the socket module from the base.
8. When removing the socket module, do not pull on the wires.

See [Figure 10-5](#).

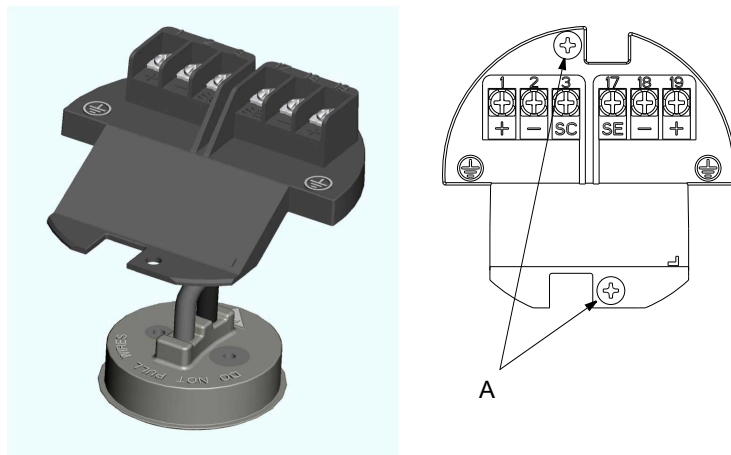
Installing an integral mount socket module

1. To insert a new integral mount socket module, press the base into its keyed position and tighten the two mounting screws.
2. The coil and electrode cables are fed through the bottom opening of the transmitter and plugged into the face of the electronics.
3. The coil and electrode cables are keyed so they will only fit into their dedicated location.
4. If the transmitter has a LOI/Display, it will need to be removed to access the coil and electrode ports.
5. Once the connections are made, the transmitter can be secured to the sensor adapter using the four mounting bolts.

10.7.2 Replacing a terminal block socket module

The terminal block socket module is shown in [Figure 10-7](#). To gain access to the socket module, remove the junction box from the sensor adapter.

Figure 10-7: Socket Module—Terminal Block



A. Mounting screws:

- 2X—standard
- 4X—with I.S. divider

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.

Installing a terminal block socket module

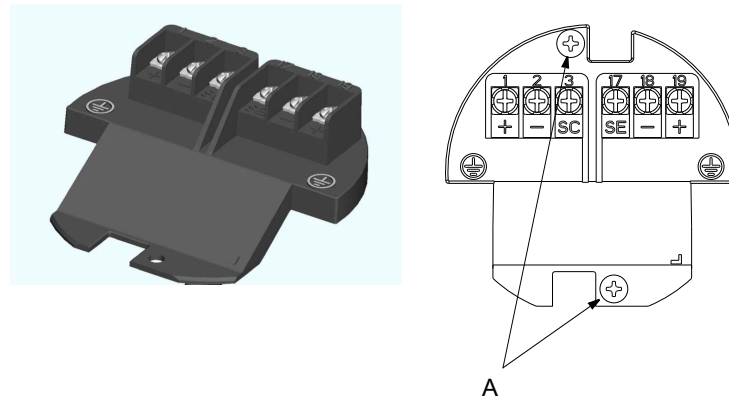
1. Insert the new terminal block socket module, press the base into its keyed position, and tighten the two mounting screws.
2. Connect the terminal block to the junction box housing by tightening the two mounting screws.

Install the divider with the two mounting screws if applicable.

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

10.7.3 Replacing a terminal block with amp clips

Figure 10-8: Terminal block with amp clips



A. Mounting screws:

- 2X—standard
- 4X—with I.S. divider

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.

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.

10.8 Trims

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

10.8.1 Digital trim

Enhanced FF host	Service Tools > Digital Trim
Basic FF host	TB > PERFORM_ELECTRONICS_TRIM (OD Index #61)

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 parameters in the transmitter:

- Calibration Number-1000015010000000
- Units-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, and units are located in [Basic Setup](#). Instructions for changing the coil drive frequency can be found on [Coil drive frequency](#).

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

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.

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

10.8.2 Universal trim

Enhanced FF host	Service Tools > Digital Trim
Basic FF host	TB > U_FLOW_RATE (OD Index #74) TB > PERFORM_UNIVERSAL_TRIM (OD Index #76)

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, complete the following steps for in-process calibration.

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. Enter the flow rate into the Universal Flow Rate parameter.
3. Start the universal auto trim.

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

10.9 Review

Enhanced FF host	Classic View
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The transmitter includes a capability to review the configuration variable settings.

The flowmeter configuration parameters set at the factory should be reviewed to ensure accuracy and compatibility with the particular application of the flowmeter.

11 Troubleshooting

11.1 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 [Installation check and guide](#) below for a quick guide to solve the most common installation problems. For existing magmeter installations, lists the most common magmeter problems and corrective actions.

11.2 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.

11.3 Installation check and guide

Use this guide to check new installations of Rosemount magnetic flowmeter systems that appear to malfunction.

11.3.1 Transmitter

Checking the transmitter before applying power

Before applying power to the magnetic flowmeter system, make the following transmitter checks:

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

Apply power to the magnetic flowmeter system before making the following transmitter checks:

1. Check for an active error message or status alert. Refer to [Diagnostic messages](#).
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. If desired, use a Rosemount 8714D to verify the transmitter calibration.

11.3.2 Sensor

Be sure that power to magnetic flowmeter system is removed before beginning the following sensor checks:

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.

11.3.3 Remote wiring

1. The electrode signal and coil drive wires must be separate cables, unless Rosemount specified combo cable is used.
See [Sensor to transmitter wiring](#).
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 [Sensor to transmitter wiring](#).
3. See [Product Certifications](#) regarding wiring installation requirements.
4. See [Wiring Diagrams](#) 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.

11.3.4 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.

11.4 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 11-1: Fieldbus communication diagnostic messages

Error message	Potential cause	Corrective action
Fieldbus Not Communicating	Fieldbus segment is disconnected	Connect the fieldbus segment
	Fieldbus segment power missing	Verify the segment fieldbus voltage
	Electronics failure	Replace electronics

Table 11-2: Basic Diagnostic Messages

Error message	Potential cause	Corrective action
Sensor Processor Not Communicating	Transmitter input power (AC/DC) is not connected	Connect the input power. If the LCD displays a message, the input power is applied.
	Electronics failure	Replace electronics
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 Installed sensor tests
	Conductivity less than 5 microSiemens per cm	Increase conductivity to greater than or equal to 5 microSiemens per cm
	Intermittent diagnostic	Adjust tuning of empty pipe parameters - see Troubleshooting empty pipe
Coil Open Circuit	Improper wiring	Check coil drive wiring and sensor coils. Perform sensor tests - see Installed sensor tests
	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	Replace the sensor	
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 Installed sensor tests
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
	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

Table 11-2: Basic Diagnostic Messages (continued)

Error message	Potential cause	Corrective action
	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
	Sensor failure	Perform sensor tests - see Installed sensor tests
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)
Flow rate > 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 Installed sensor tests
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 Installed sensor tests
	Transmitter failure	Replace the electronics stack
Electrode Saturation	Improper wiring	See Wiring
	Improper process reference	See Process reference connection
	Improper earth grounding	Verify earth ground connections - see Wiring
	Application requires special transmitter	Replace transmitter with transmitter that includes special option F0100

Table 11-3: Advanced Process Diagnostic Messages

Error message	Potential cause	Corrective action
Grounding/Wiring Fault	Improper installation of wiring	See Wiring
	Coil/electrode shield not connected	See Wiring
	Improper process grounding	See Process reference connection

Table 11-3: Advanced Process Diagnostic Messages (continued)

Error message	Potential cause	Corrective action
	Faulty ground connection	Check wiring for corrosion, moisture in the terminal block -see Process reference connection
	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 Troubleshooting high process noise
	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 Troubleshooting high process noise
	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 Troubleshooting high process noise	
	Consult factory	
Low conductivity fluids (below 10 microsiemens/cm)	Trim electrode and coil wires - see Sensor Installation	
	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	Verify process fluid conductivity

Table 11-4: Advanced Meter Verification Messages

Error message	Potential cause	Corrective action
Meter Ver Failed	Transmitter calibration verification test failed	Verify pass/fail criteria
		Rerun SMART™ Meter Verification under no flow conditions
		Verify calibration using 8714D Calibration Standard
		Perform digital trim
		Replace electronics board
	Sensor calibration test failed	Verify pass/fail criteria
		Rerun SMART Meter Verification
		Perform sensor tests - see Installed sensor tests
	Sensor coil circuit test failed	Verify pass/fail criteria
		Rerun SMART Meter Verification
		Perform sensor tests - see Installed sensor tests
	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
		Perform sensor tests - see Installed sensor tests
Continuous Meter Verification Error	Transmitter calibration verification test failed	Verify pass/fail criteria
		Run manual SMART Meter Verification under no flow conditions
		Verify calibration using 8714D Calibration Standard
		Perform digital trim
		Replace electronics stack
	Sensor calibration test failed	Run manual SMART Meter Verification
		Perform sensor tests - see Installed sensor tests
	Sensor coil circuit test failed	Run manual SMART Meter Verification
		Perform sensor tests - see Installed sensor tests
	Sensor electrode circuit test failed	Run manual SMART Meter Verification
		Perform sensor tests - see Installed sensor tests
		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

Table 11-4: Advanced Meter Verification Messages (continued)

Error message	Potential cause	Corrective action
	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 8714D If the electronics trim doesn't correct the issue, replace the electronics
Coil Resistance Out of Spec	Moisture in the terminal block of the sensor or shorted coil	Perform sensor tests - see Installed sensor tests If the problem persists, replace the sensor
Coil Signature Out of Spec	Moisture in the terminal block of the sensor or shorted coil	Perform sensor tests - see Installed sensor tests If the problem persists, replace the sensor
	Calibration shift caused by heat cycling or vibration	Perform sensor tests - see Installed sensor tests If the problem persists, replace the sensor
Electrode Resistance Out of Spec	Moisture in the terminal block of the sensor	Perform sensor tests - see Installed sensor tests If the problem persists, replace the sensor
	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 Installed sensor tests If the problem persists, replace the sensor

11.4.1 Troubleshooting empty pipe

The following actions can be taken if empty pipe detection is unexpected:

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 [Installed sensor tests](#).

11.4.2 Troubleshooting ground/wiring fault

If transmitter detects high levels (greater than 5mV) 50/60 Hz noise caused by improper wiring or poor process grounding:

1. Verify the transmitter is earth grounded.
2. Connect ground rings, grounding electrode, lining protector, or grounding straps. Grounding diagrams can be found in [Process reference connection](#).
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.

11.4.3 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:

1. Increase transmitter coil drive frequency to 37 Hz (refer to [Coil drive frequency](#) and, if possible, perform auto zero function [Auto zero](#)).
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:

1. Turn on the Digital Signal Processing (DSP) technology and follow the setup procedure (see [Digital Signal Processing](#)).

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 [PV \(flow\) damping](#)).

This will add response time to the control loop.

3. Move to a Rosemount High-Signal flowmeter system.

Note

The High-Signal flowmeter system described below is currently **not** available with a FOUNDATION fieldbus output.

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 magnetic flowmeter 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.

11.4.4 Troubleshooting coated electrode detection

In the event that electrode coating is detected, use the following table to determine the appropriate course of action.

Table 11-5: 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)

11.4.5 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 11-6: 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 Sensor troubleshooting.
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

Table 11-6: Troubleshooting the SMART Meter Verification Diagnostic (continued)

Test	Potential cause	Corrective action
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 	

11.5 Basic troubleshooting

When troubleshooting a magmeter, it is important to identify the issue. below 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 11-7: Common magmeter issue

Symptom	Electronics failure	Corrective action
Status Is bad	<ul style="list-style-type: none"> • Electronics failure 	<ul style="list-style-type: none"> • Cycle power • If status is still bad, verify transmitter operation with an 8714 D Calibration Standard • Replace the electronics stack
	<ul style="list-style-type: none"> • Open coil circuit 	<ul style="list-style-type: none"> • Check coil drive circuit connections at the sensor and at the transmitter
	<ul style="list-style-type: none"> • Coil power or coil current is over limit 	<ul style="list-style-type: none"> • Check coil drive circuit connections at the sensor and at the transmitter • Cycle power • If status is still bad, verify transmitter operation with an 8714D Calibration Standard • Replace the electronics stack
Error Messages on LOI/Display	<ul style="list-style-type: none"> • Many possible causes depending upon the message 	<ul style="list-style-type: none"> • See Table 11-2, Table 11-3, and Table 11-4 for the LOI/Display messages

Table 11-7: Common magmeter issue (continued)

Symptom	Electronics failure	Corrective action
Reading does not appear to be within rated accuracy	<ul style="list-style-type: none"> Transmitter, control system, or other receiving device not configured properly 	<ul style="list-style-type: none"> Check all configuration variables for the transmitter, sensor, communicator, and/or control system Check these other transmitter settings: <ul style="list-style-type: none"> Sensor calibration number Units Line size
	<ul style="list-style-type: none"> Electrode Coating 	<ul style="list-style-type: none"> Enable Coated Electrode Detection diagnostic Use bullet-nose electrodes Downsize sensor to increase flow rate above 3 ft/s Periodically clean sensor
	<ul style="list-style-type: none"> Gas/air in line 	<ul style="list-style-type: none"> Move the sensor to another location in the process line to ensure that it is full under all conditions
	<ul style="list-style-type: none"> Moisture problem 	<ul style="list-style-type: none"> Perform the sensor tests - see Sensor troubleshooting
	<ul style="list-style-type: none"> Insufficient upstream/downstream pipe diameter 	<ul style="list-style-type: none"> Move sensor to a new location with 5 pipe diameters upstream and 2 pipe diameters downstream if possible
	<ul style="list-style-type: none"> Cables for multiple magmeters run through same conduit 	<ul style="list-style-type: none"> Use dedicated conduit run for each sensor and transmitter
	<ul style="list-style-type: none"> Improper wiring 	<ul style="list-style-type: none"> If electrode shield and electrode signal wires are switched, flow indication will be about half of what is expected. Check wiring diagrams.
	<ul style="list-style-type: none"> Flow rate is below 1 ft/s (specification issue) 	<ul style="list-style-type: none"> See accuracy specification for specific transmitter and sensor
	<ul style="list-style-type: none"> Auto zero was not performed when the coil drive frequency was changed from 5 Hz to 37 Hz 	<ul style="list-style-type: none"> Set the coil drive frequency to 37 Hz, verify the sensor is full, verify there is no flow, and perform the auto zero function
	<ul style="list-style-type: none"> Sensor failure—shorted electrode 	<ul style="list-style-type: none"> Perform the sensor tests - see Sensor troubleshooting
<ul style="list-style-type: none"> Sensor failure—shorted or open coil 	<ul style="list-style-type: none"> Perform the sensor tests - see Sensor troubleshooting 	

Table 11-7: Common magmeter issue (continued)

Symptom	Electronics failure	Corrective action
	<ul style="list-style-type: none"> Transmitter failure 	<ul style="list-style-type: none"> Verify transmitter operation with an 8714 Calibration Standard or replace the electronics board
Noisy Process	<ul style="list-style-type: none"> Chemical additives upstream of magnetic flowmeter 	<ul style="list-style-type: none"> See Troubleshooting high process noise Move injection point downstream of magnetic flowmeter, or move magnetic flowmeter
	<ul style="list-style-type: none"> Sludge flows—mining/coal/sand/slurries (other slurries with hard particles) 	<ul style="list-style-type: none"> Decrease flow rate below 10 ft/s
	<ul style="list-style-type: none"> Styrofoam or other insulating particles in process 	<ul style="list-style-type: none"> See Troubleshooting high process noise Consult factory
	<ul style="list-style-type: none"> Electrode coating 	<ul style="list-style-type: none"> Enable Coated Electrode Detection diagnostic Use a smaller sensor to increase flow rate above 3 ft/s Periodically clean sensor
	<ul style="list-style-type: none"> Gas/air in line 	<ul style="list-style-type: none"> Move the sensor to another location in the process line to ensure that it is full under all conditions
	<ul style="list-style-type: none"> Low conductivity fluids (below 10 microsiemens/cm) 	<ul style="list-style-type: none"> Trim electrode and coil wires – see Conduit requirements Keep flow rate below 3 ft/s Integral mount transmitter Use component cable - see Sensor to transmitter wiring
Meter output is unstable	<ul style="list-style-type: none"> Medium to low conductivity fluids (10–25 microsiemens/cm) combined with cable vibration or 60 Hz interference 	<ul style="list-style-type: none"> Eliminate cable vibration Move cable to lower vibration run Tie down cable mechanically Use an integral mount Trim electrode and coil wires - see Sensor to transmitter wiring Route cable line away from other equipment powered by 60 Hz Use component cable - see Sensor to transmitter wiring

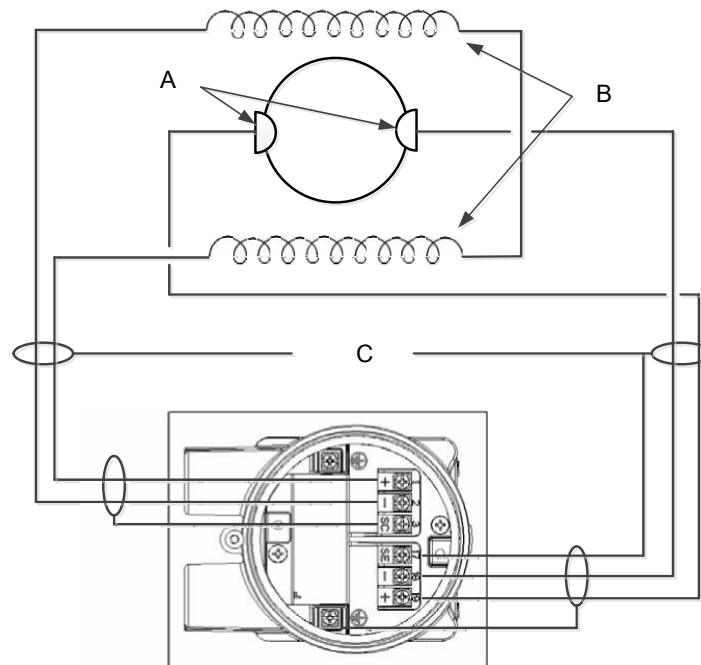
Table 11-7: Common magmeter issue (continued)

Symptom	Electronics failure	Corrective action
	<ul style="list-style-type: none"> Electrode incompatibility 	<ul style="list-style-type: none"> Check the <i>Technical Data Sheet, Magnetic Flowmeter Material Selection Guide</i> (document number 00816-0100-3033), for chemical compatibility with electrode material
	<ul style="list-style-type: none"> Improper grounding 	<ul style="list-style-type: none"> Check ground wiring – see Process reference connection for wiring and grounding procedures
	<ul style="list-style-type: none"> High local magnetic or electric fields 	<ul style="list-style-type: none"> Move magnetic flowmeter (20–25 ft away is usually acceptable)
	<ul style="list-style-type: none"> Control loop improperly tuned 	<ul style="list-style-type: none"> Check control loop tuning
	<ul style="list-style-type: none"> Sticky valve (look for periodic oscillation of meter output) 	<ul style="list-style-type: none"> Service valve
	<ul style="list-style-type: none"> Sensor failure 	<ul style="list-style-type: none"> Perform the sensor tests (See Sensor troubleshooting)

11.6 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 11-1](#). The tests described below will check for continuity or isolation of the internal components of the sensor.

Figure 11-1: Sensor Circuit Diagram (Simplified)



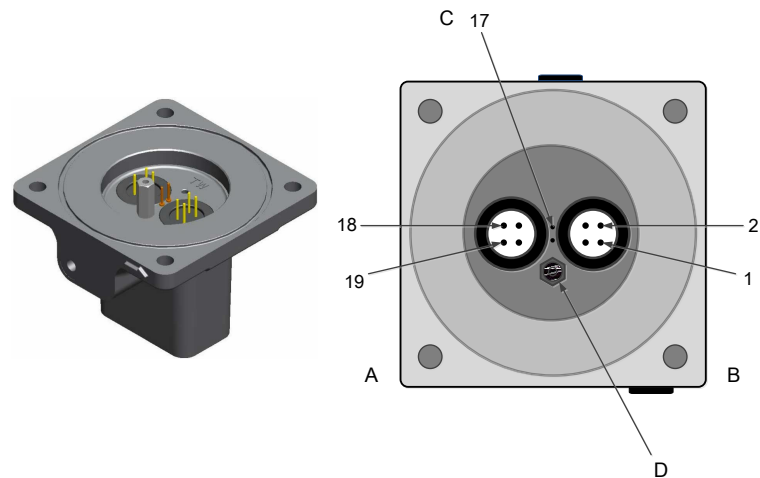
- A. Electrodes
- B. Coils
- C. Sensor housing

11.6.1 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 11-2](#).

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 11-2: Sensor Adapter Feed-through Pins

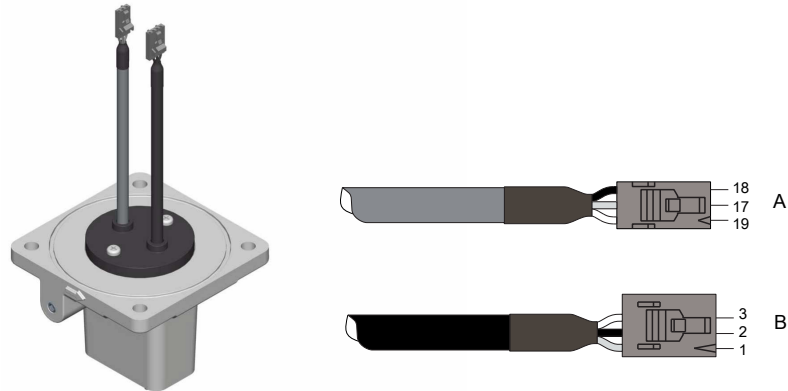


- A. Electrode side
- B. Coil side
- C. Process reference
- D. Orientation key

11.6.2 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 11-3](#). 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 11-3](#) shows the slot pin connections as they relate to the terminal connections described in the tests.

Figure 11-3: Sensor adapter direct lead pins



- A. Electrode side
- B. Coil side

11.6.3 Socket module

Figure 11-4: Remote Mount Socket Module



11.7 Installed sensor tests

If a problem with an installed sensor is identified, refer to [Table 11-8](#) through [Table 11-12](#) 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 11-8: Test A. Sensor coil

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: installed or uninstalled Required equipment: multimeter 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 11-9: 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: multimeter 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 11-10: Test C. Coil to coil shield

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: installed or uninstalled Required equipment: multimeter 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 11-11: 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 = R₁ 19 and 17 = R₂ 	<ul style="list-style-type: none"> R₁ and R₂ should be stable R₁-R₂ ≤ 300Ω 	<ul style="list-style-type: none"> Unstable R₁ or R₂ 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 Uninstalled sensor tests Connect process reference ground per Process reference connection

Table 11-12: 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 = R₁ 19 and 17 = R₂ 	Should be stable and same relative magnitude of R ₁ and R ₂ from Test D	<ul style="list-style-type: none"> Unstable R₁ or R₂ 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 Uninstalled sensor tests Connect process reference ground per Process reference connection

To test the sensor, a multimeter capable of measuring conductance in nanoSiemens is preferred. Conductance is the reciprocal of resistance.

Or:

$$1 \text{ nanosiemens} = \frac{1}{1 \text{ gigaohm}} \quad 1 \text{ nanosiemens} = \frac{1}{1 \times 10^9 \text{ ohm}}$$

11.8 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 11-13: Test A. Terminal to front electrode

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: uninstalled Required equipment: Multimeter 18 and electrode 18⁽¹⁾ 	$\leq 1 \Omega$	<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 [Flow direction](#)) 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 11-14: Test B. Terminal to back electrode

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: uninstalled Required equipment: Multimeter 19 and electrode 19⁽¹⁾ 	$\leq 1 \Omega$	<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 [Flow direction](#)) 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 11-15: Test C. Terminal to reference electrode

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: uninstalled Required equipment: Multimeter 17 and process reference electrode⁽¹⁾ 	$\leq 0.3 \Omega$	<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 11-16: Test D. Terminal to case ground

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: uninstalled Required equipment: Multimeter 17 and safety ground 	$\leq 0.3 \Omega$	<ul style="list-style-type: none"> Moisture in terminal block Leaky electrode Process behind liner 	<ul style="list-style-type: none"> Clean terminal block Replace terminal block Replace sensor

Table 11-17: Test E. Electrode to electrode shield

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: uninstalled Required equipment: Multimeter 18 and 17 19 and 17 	$\infty \Omega (<1 \text{ nS})$	<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 11-18: Test F. Electrode shield to coil

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: uninstalled Required equipment: Multimeter 17 and 1 	$\infty \Omega (<1 \text{ nS})$	<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

11.9 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

North and South America		Europe and Middle East		Asia Pacific	
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
		Kuwait	663 299 01		
		South Africa	800 991 390		
		Saudi Arabia	800 844 9564		
		UAE	800 0444 0684		

11.10 Service

To expedite the return process outside the United States, contact the nearest Rosemount representative.

Within the United States and Canada:

- For returns, contact the Flow RMA Team at 800-522-6277.
- For other assistance or information, contact the North American Response Center at 800-654-RSMT (7768), which is available 24 hours a day.

Be prepared to provide product, model, and serial numbers, as well as information about the process material to which the product was last exposed.



WARNING

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.


When a return is authorized, a Return Material Authorization (RMA) number will be issued.

A Product Specifications

A.1 Basic specifications


The tables below outline some of the basic performance, physical, and functional specifications.

Table A-1: Wall mount transmitter Specifications

	Style	Wall mount
	Base accuracy ⁽¹⁾	0.5% Standard 0.25% High Accuracy Option
	Mounting	Remote
	Power supply	Global AC or DC
	User interface	LCD display only (optional) No display (standard)
	Communication protocol	FOUNDATION™ fieldbus
	Diagnostics	Basic, DA1, DA2
	Sensor compatibility	All Rosemount plus other manufacturers
	Detailed specifications	Transmitter specifications
	Ordering information	Product Data Sheet


(1) For complete accuracy specifications, please refer to [Transmitter functional specifications](#).

Table A-2: Field mount transmitter specifications

	Style	Field mount
	Base accuracy ⁽¹⁾	0.5% Standard 0.25% High Accuracy Option
	Mounting	Integral or Remote
	Power supply	Global AC or DC
	User interface	LCD display only (optional) No display (standard)
	Communication protocol	FOUNDATION™ fieldbus
	Diagnostics	Basic, DA1, DA2
	Sensor compatibility	All Rosemount plus other manufacturers
	Detailed specifications	Transmitter specifications
	Ordering information	Product Data Sheet

(1) For complete accuracy specifications, please refer to [Transmitter functional specifications](#).

Table A-3: Sensor specifications

	Style	Flanged
	Base accuracy ⁽¹⁾	0.5% Standard 0.25% High Accuracy Option
	Line sizes	½-in. to 48-in. (15 mm to 1200 mm)
	Design features	Standard Process Design
	Detailed specifications	Sensor specifications
	Ordering information	Product Data Sheet

(1) For complete accuracy specifications, refer to the sensor detailed specifications.

Table A-4: Lining Material Selection


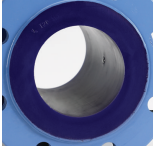
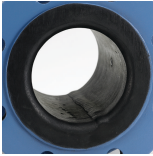
Liner material	General characteristics
PTFE 	Process temperature: 0 to +248 °F (-18 to +120 °C)
Polyurethane 	Process temperature: 0 to +140 °F (-18 to +60 °C) Typically applied in clean water
Neoprene 	Typically applied in water with chemicals, and sea water Process temperature: 0 to 176 °F (-18 to 80 °C)

Table A-5: Electrode Material

Electrode material	General characteristics
316L Stainless Steel	Good corrosion resistance
	Good abrasion resistance
Nickel Alloy 276 (UNS N10276)	Better corrosion resistance
	High strength

Table A-6: Electrode Type

Electrode type	General characteristics
Standard Measurement	Lowest cost
	Good for most applications
Measurement + Reference Electrode (Also see Table A-7 and Table A-8 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
Bulletonose	Extended head protrudes into the flow stream for self-cleaning
	Best option for coating processes

Table A-7: 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

Table A-8: 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

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

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

Power consumption

- 90 - 250VAC: 40VA maximum
- 12 - 42VDC: 15W maximum

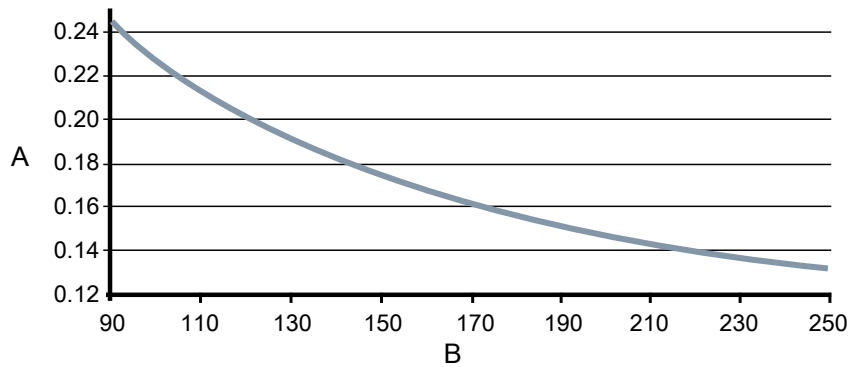
Switch-on current

- At 250VAC: Maximum 35.7A (< 5ms)
- At 42VDC: Maximum 42A (< 5ms)

AC power supply requirements

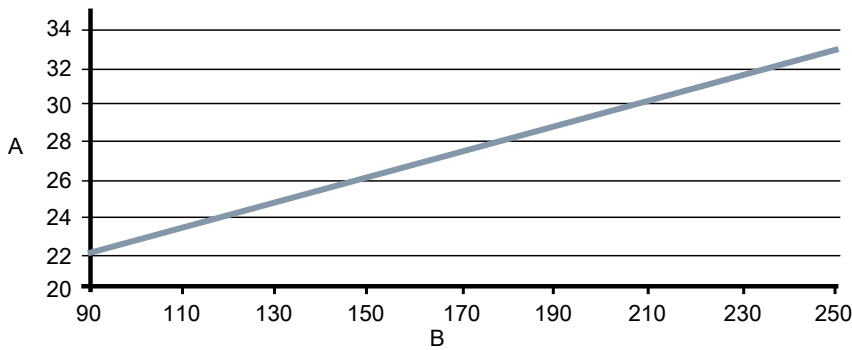
Units powered by 90 - 250VAC have the following power requirements. Peak inrush is 35.7A at 250VAC supply, lasting approximately 1ms. Inrush for other supply voltages can be estimated with: Inrush (Amps) = Supply (Volts) / 7.0

Figure A-1: AC current requirements



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

Figure A-2: Apparent power

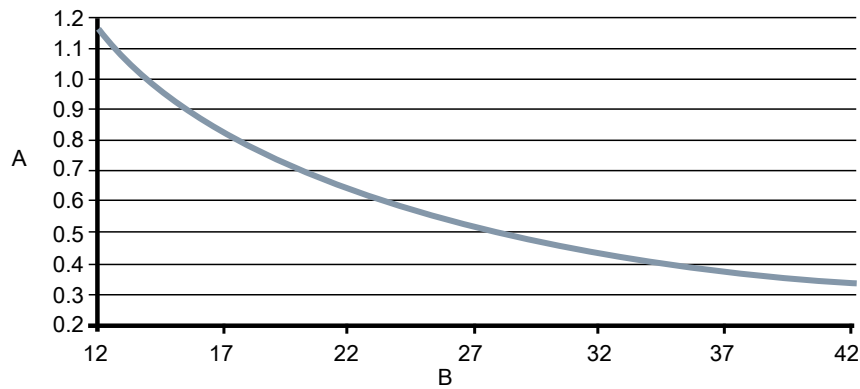


- A. Apparent power (VA)
- B. Power supply (VAC)

DC power supply requirements

Units powered by 12VDC power supply may draw up to 1.2A 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)

Ambient temperature limits

- Operating:
 - -58 to 140 °F (-50 to 60 °C) without LOI/Display
 - -4 to 140 °F (-20 to 60 °C) with LOI/Display
 - The LOI/Display will not be visible at temperatures below -20°C
- Storage:
 - -58 to 185 °F (-50 to 85 °C) without LOI/Display
 - -22 to 176 °F (-30 to 80 °C) with LOI/Display

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/Display 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

FOUNDATION™ Fieldbus output

Output signal	Manchester-encoded digital signal that conforms to IEC 1158-2 and ISA 50.02
Scheduled Entries	Seven (7)
Links	Twenty (20)

Virtual Communications Relationships (VCRs) One (1) predefined (F6, F7) Nineteen (19) configurable

FOUNDATION™ fieldbus function blocks

Table A-9: Function block execution times

Block	Execution time (milliseconds)
Resource (RB)	—
Transducer (TB)	—
Analog Input (AI)	15
Proportional/Integral/Derivative (PID)	20
Integrator (INT)	25
Arithmetic (AR)	25
Discrete Output (DO)	15

Transducer Block The transducer block calculates flow from the measured induced voltage. The calculation includes information related to the calibration number, line size, and diagnostics.

Resource Block The resource block contains physical transmitter information, including available memory, manufacturer identification, device type, software tag, and unique identification.

Backup Link Active Scheduler (LAS) The transmitter is classified as a device link master. A device link master can function as a Link Active Scheduler (LAS) if the current link master device fails or is removed from the segment. The host or other configuration tool is used to download the schedule for the application to the link master device. In the absence of a primary link master, the transmitter will claim the LAS and provide permanent control for the H1 segment.

Diagnostics The transmitter automatically performs continuous self-diagnostics. The user can perform on-line testing of the transmitter digital signal. Advanced simulation diagnostics are available. This enables remote verification of the electronics via a flow signal generator built into the electronics. The sensor strength value can be used to view the process flow signal and provide information regarding filter settings.

Analog Input The AI function block processes the measurement and makes it available to other function blocks. The AI function block also allows filtering, alarming, and engineering unit changes.

Arithmetic Block Provides pre-defined application-based equations including flow with partial density compensation, electronic remote seals, hydrostatic tank gauging, ratio control and others.

Proportional/Integral/Derivative The PID function block provides a sophisticated implementation of the universal PID algorithm. The PID function block features input for feed forward control, alarms on the process variable, and control

deviation. The PID type (series or Instrument Society of America [ISA]) is user-selectable on the derivative filter.

Integrator	The standard integrator block is available for totalization of flow.
Reverse Flow	Detects and reports reverse flow
Software Lockout	A write-lock switch and software lockout are provided in the resource function block.
Totalizer	Non-volatile totalizer for net, gross, forward and reverse totals.
Discrete Output	The DO function block processes a discrete setpoint and saves it to a specified channel to produce an output signal. The block supports mode control, output tracking, and simulation.

Scalable pulse frequency adjustment

- 0-5000Hz, externally powered: Input 5 - 28VDC
- Pulse value can be set to equal desired volume in selected engineering units
- Pulse width adjustable from 0.1 to 650 ms

Output testing

Pulse output test Transmitter may be commanded to supply a specified frequency between 1 and 5000Hz.

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.

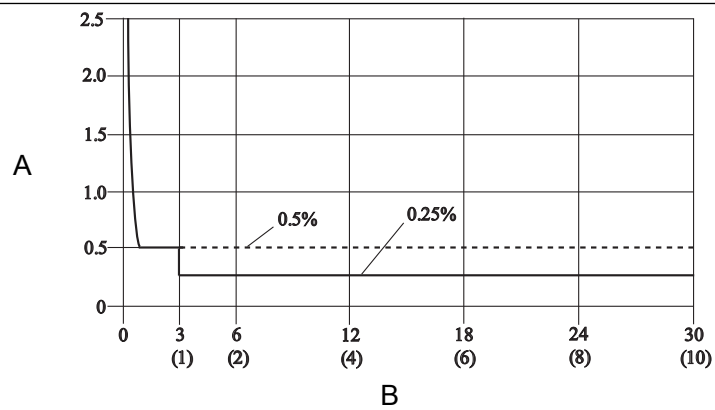
Accuracy

Includes the combined effects of linearity, hysteresis, and repeatability.

- 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) from the low flow cutoff to 1 ft/s (0.3 m/s)
- Optional high accuracy:⁽¹⁾

⁽¹⁾ 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).

— $\pm 0.25\%$ of rate ± 1.0 mm/sec from 3 to 39 ft/s (1 to 12 m/s)



A. Percentage of rate
B. Velocity in ft/s (m/s)

Analog output effects

Analog output has the same accuracy as frequency output plus an additional $\pm 4 \mu\text{A}$ 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 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	$\frac{1}{2}$ 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

Weight

Wall mount transmitter	Aluminum	Approximately 9 lbs. (4 kg)
------------------------	----------	-----------------------------

Add 1 pound (0.5 kg) for LOI/Display.

A.2.6 Field 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	316/316L unpainted, option code SH Type 4X and IEC 60529 IP66
Cover gasket	Aluminum housing: Buna-N

Ingress protection

Consult Emerson for installations requiring IP67/IP68/IP69K.

Electrical connections

Conduit entries	Available in 1/2 inch NPT or 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)

Vibration rating

Integral mount	2G per IEC 61298
Remote mount	5G per IEC 61298

Dimensions

Weight

Field mount transmitter only	Aluminum	Approximately 7 lbs. (3.2 kg)
	316 stainless steel	Approximately 23 lbs. (10.5 kg)

Add 1 pound (0.5 kg) for LOI/Display.

A.3 Sensor specifications



A.3.1 Functional specifications

Service

Conductive liquids and slurries

Line sizes

½ -in. to 48-in. (15 mm to 1200 mm)

Sensor coil resistance

7 - 16 Ω

Interchangeability

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 during configuration.

Upper range limit

39.37 ft/s (12 m/s)

Ambient temperature limits

- -20 to 140 °F (-29 to 60 °C) standard design

Pressure limits

See [Process temperature limits](#).

Vacuum limits

PTFE lining	Full vacuum to +248 °F (+120 °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.emerson.com.

Conductivity limits

Process liquid must have a minimum conductivity of 5 microSiemens/cm (5 micromhos/cm) or greater.

Process temperature limits

PTFE lining	0 to +248 °F (–18 to +120 °C)
Polyurethane lining	0 to +140 °F (–18 to +60 °C)
Neoprene lining	0 to +176 °F (–18 to +80 °C)

Table A-10: 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 24-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
304 Stainless Steel	Class 150	275 psi	235 psi	205 psi	190 psi
	Class 300	720 psi	600 psi	530 psi	500 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.

Table A-11: 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
	E	203.1 psi	203.1 psi	203.1 psi	188.6 psi

(1) Liner temperature limits must also be considered.

Table A-12: 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 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 40	36.8 bar	30.3 bar	27.5 bar	26.5 bar

(1) Liner temperature limits must also be considered.

Table A-13: Temperature vs. Pressure Limits for GB/T 9119 Flanges ⁽¹⁾

Temperature vs. Pressure Limits for GB/T 9119 Flanges				
Flange material	Flange rating	Pressure (Mpa)		
		≤ 20 °C	@ 100 °C (212 °F)	@ 150 °C (302 °F)
Carbon steel Group 3E0	PN 10	1.00	0.92	0.88
	PN 16	1.60	1.48	1.40
	PN 40	4.00	3.71	3.52
304 SST Group 11E0	PN 10	1.00	0.90	0.81
	PN 16	1.60	1.45	1.31
	PN 40	4.00	3.63	3.27

(1) Liner temperature limits must also be considered.

Table A-14: Temperature vs. Pressure Limits for JIS B2220 Flanges ⁽¹⁾

Temperature vs. Pressure Limits for JIS B2220 Flanges			
Flange material	Flange rating	Pressure (Mpa)	
		≤ 50 °C (122 °F)	@ 120 °C (248 °F)
Carbon steel	10K	1.4	1.4
304 stainless steel (15 mm to 65 mm)	10K	1.4	1.4
304 stainless steel (≤ 80 mm)	10K	1.4	1.4

(1) Liner temperature limits must also be considered.

A.3.2 Physical specifications

Non-wetted materials

Sensor Pipe	Type 304/304L SST
Flanges	Carbon steel, Type 304/304L SST
Coil housing	Rolled carbon steel
Paint	Polyurethane coat (2.6 mils or greater)

Process-wetted materials

Lining	PTFE, Polyurethane, Neoprene
Electrodes	316L SST, Nickel Alloy 276 (UNS N10276)

Flat-faced flanges

Flat-faced flanges are manufactured with full-face liners. Available in Neoprene only.

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)
AWWA C207	<ul style="list-style-type: none"> Class D: 30-in. to 48-in. (750 mm to 1200 mm) Class E: 30-in. to 48-in. (750 mm to 1200 mm)
EN 1092-1	<ul style="list-style-type: none"> PN10: 200 mm to 900 mm (8-in. to 36-in.) PN16: 50 mm to 900 mm (2-in. to 36-in.) PN40: 15 mm to 900 mm (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: 2-in. to 40-in., 48-in. (8-in. excluded) (50 mm to 1000 mm, 1200 mm) PN35: 2-in. to 36-in. (8-in. excluded) (50 mm to 900 mm)
GB/T9119	<ul style="list-style-type: none"> PN10: 8- and 24-, 36-, 40-, 48-in. (200 mm to 600 mm, 900 mm, 1000 mm, 1200 mm) PN16: 4- and 24-, 36-, 40-in. (100 mm to 600 mm, 900 mm, 1000 mm) PN40: ½- to 24-in. (15 mm to 600 mm)
JIS B2220	<ul style="list-style-type: none"> 10K, 20K: ½- to 24-in. (15 mm to 600 mm)

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)
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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. 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, and Nickel Alloy 276 (UNS N10276). See Product Data Sheet.

Dimensions

See Product Data Sheet.

Weight

See Product Data Sheet.

B Product Certifications

For detailed approval certification information and installation drawings, please see the appropriate document listed below:

- Document number 00825-MA00-0004: *Rosemount 8750W Approval Document - IECEx and ATEX*
- Document number 00825-MA00-0005: *Rosemount 8750W Approval Document – Class Division*
- Document number 00825-MA00-0006: *Rosemount 8750W Approval Document – North America Zone*

C Transducer block

This section contains information on the flowmeter transducer block. Descriptions of all transducer block parameters, errors, and diagnostics are listed. Also, the modes, alarm detection, status handling, application information, and troubleshooting are discussed.

Quick transducer block configuration guide

Proper configuration of the flowmeter is essential for accurate performance. The following is a quick configuration guide for those already familiar with magnetic flowmeters.

For most parameters configured in the flowmeter, the transmitter must perform extensive calculations to derive internal parameters used to accurately measure flow. It is recommended that each parameter in the Transducer Block be configured and sent to the transmitter individually. If too many parameter changes are sent to the transmitter at one time, the transmitter will return an error. The parameters not accepted will have to be re-sent.

Parameters and descriptions

Table C-1: Fieldbus standard parameters

TB Index	Parameter Name	Description
1	ST_REV	Static Revision. Incremented when parameter changed.
2	TAG_DESC	Static Tag. ASCII character string.
3	STRATEGY	Can be used to help group the blocks. Not checked or processed by the block.
4	ALERT_KEY	ID number of the transmitter. May be used on the host for sorting alarms.
5	MODE_BLK	Mode of the record of the block. Contains the actual, target, permitted and normal modes.
6	BLOCK_ERR	Reflects the error status associated with hardware or software components associated with a block.
7	UPDATE_EVT	Update event
8	BLOCK_ALM	Block Alarm
9	TRANSDUCER_DIRECTORY	Directory that specifies the number and starting indices of the transducers in the transducer block
10	TRANSDUCER_TYPE	Identifies the transducer
11	TRANSDUCER_TYPE_VER	The version of the transducer identified by TRANSDUCER_TYPE in the form 0xAABB where AA is the major revision of the transducer specification on which the transducer is based, and BB is a revision number assigned and controlled by the manufacturer of the device.
12	XD_ERROR	Transducer Error
13	COLLECTION_DIRECTORY	A directory that specifies the number, starting indices, and DD Item ID's of the data collections in each transducer within a transducer block.

Table C-2: Device specific parameters

TB Index	Parameter Name	Description
14	PRIMARY_VALUE_TYPE	The type of measurement represented by the primary value. Parameter is RW but only value accepted is 101
15	PRIMARY_VALUE	The measured value and status available to the Function Blocks
16	PRIMARY_VALUE_RANGE	The High and Low Range limit values, the engineering units code and the number of digits to the right of the decimal point to be used to display the primary value. See Engineering Units , for supported unit codes. Note The units are changed from the AI block. The unit code must be sent to SENSOR_RANGE simultaneously.
17	SECONDARY_VALUE_TYPE	Selects the type of measurement represented in SECONDARY_VALUE. This will be the Pulse Output only. Parameter is RW but only value accepted is 101
18	SECONDARY_VALUE	The secondary value, related to the sensor.
19	SECONDARY_VALUE_RANGE	The engineering units to be used with SECONDARY_VALUE.
20	XD_OPTS	Options which the user may select to alter transducer behavior.
21	SENSOR_TYPE	Sensor type. Parameter is read/write, but only 102: electromagnetic is accepted
22	SENSOR_RANGE	The high and low range limit values, the engineering units code, and the number of digits to the right of the decimal point for the sensor. See Table C-6 for supported unit codes. Note The units are changed from the AI block. The unit code must be sent to PRIMARY_VALUE_RANGE simultaneously.
23	SENSOR_SN	The sensor serial number. Note This parameter should not be used. The parameter FLOW_TUBE_SERIAL NUMBER is used to store the flow tube (sensor) serial number.
24	SENSOR_CAL_METHOD	The method of the last sensor calibration. ISO defines several standard methods of calibration. This parameter is intended to record that method or if some other method was used.
25	SENSOR_CAL_LOC	The location of the last sensor calibration. This describes the physical location at which the calibration was performed.
26	SENSOR_CAL_DATE	The date of the last sensor calibration. This is intended to reflect the calibration of the sensor.
27	SENSOR_CAL_WHO	The name of the person responsible for the last sensor calibration.
28	BLOCK_ERR_DESC_1	These parameters are used by a device to report more specific details regarding persistent errors that are reported through BLOCK_ERR.

Table C-2: Device specific parameters (continued)

TB Index	Parameter Name	Description
29	TOTAL_A_VALUE	Totalizer A Value: This is the accumulated volumetric flow stored in totalizer A.
30	TOTAL_B_VALUE	Totalizer B Value: This is the accumulated volumetric flow stored in totalizer B.
31	TOTAL_C_VALUE	Totalizer C Value: This is the accumulated volumetric flow stored in totalizer C.
32	DAMPING_CONSTANT	Damping filter value in seconds
33	DENSITY_CONSTANT_UNITS	The units will be in kg/m ³ or lbs/ft ³ , depending on whether the flow value is in Metric or English units. The user can not write directly to this parameter.
34	DENSITY_CONSTANT	User entered density value to be used when calculating flow in mass flow units
35	FLOW_TUBE_CAL_NUM	Flow tube (sensor) gain and zero offset number used in flow calculation. Number entered is located on physical tag of the sensor body.
36	TUBE_SIZE	Sensor Size. See for actual line sizes.
37	COIL_DRIVE_FREQ	Coil Drive Frequency Note This parameter may change or be changed by other parameters.
38	PULSE_CONFIGURATION	Pulse Configuration: Parameters needed to configure the pulse output feature of the device.
	FACTOR	Factor: Factor value for the Pulse Output
	FACTOR_UNITS	Pulse Factor Units are derived from PV Range units.
	PULSE_WIDTH	Pulse Width: Pulse Width rounded to the nearest 0.1 ms
	FIXED_FREQUENCY	Fixed Frequency: Pulse Output Fixed Frequency
39	RESET_TOTAL_A_IN	Reset Total A Input: Resets totalizer A value through a channel output from a function block.
40	RESET_TOTAL_B_IN	Reset Total B Input: Resets totalizer A value through a channel output from a function block.
41	RESET_TOTAL_C_IN	Reset Total C Input: Resets totalizer A value through a channel output from a function block.
42	TOTALIZER_CONTROL	Totalizer Control: This will allow all totalizers to be enabled/disabled or reset.
	ENABLE_ALL	Enable: This will enable or disable all 3 totalizers in the device.
	RESET_ALL	Reset All: If this is selected, all resettable totalizers will be returned to zero.
43	TOTALIZER_A_CONFIG	Totalizer A Config: Parameters needed to configure or reset the value for totalizer A.

Table C-2: Device specific parameters (continued)

TB Index	Parameter Name	Description
	UNITS	Units: The units used by totalizer. These units are independent of the flow units and the other 2 totalizers. The totalizer units are R/W until you use the AI block XD_SCALE to change the units. After the AI has configured the units of a particular totalizer, the units in the TB totalizer parameter become Read Only.
	FLOW_DIRECTION	Flow Direction: Determines if the totalizer value will be accumulated based on the net flow, forward only flow or the reverse only flow.
	RESET	Reset: Individual totalizer will be reset. Parameter value will return to completed after totalizer is reset.
	ALLOW_RESET	Allow Reset: Allows or disallows the resetting of the totalizer.
44	TOTALIZER_B_CONFIG:	Totalizer B Config: Parameters needed to configure or reset the value for totalizer B.
	UNITS	Units: The units used by totalizer. These units are independent of the flow units and the other 2 totalizers. The totalizer units are R/W until you use the AI block XD_SCALE to change the units. After the AI has configured the units of a particular totalizer, the units in the TB totalizer parameter become Read Only.
	FLOW_DIRECTION	Flow Direction B: Determines if the totalizer value will be accumulated based on the net flow, forward only flow or the reverse only flow.
	RESET	Reset: Individual totalizer will be reset. Parameter value will return to completed after totalizer is reset.
	ALLOW_RESET	Allow Reset B: Allows or disallows the resetting of the totalizer.
45	TOTALIZER_C_CONFIG:	Totalizer C Config: Parameters needed to configure or reset the value for totalizer C.
	UNITS	Units: The units used by totalizer. These units are independent of the flow units and the other 2 totalizers. The totalizer units are R/W until you use the AI block XD_SCALE to change the units. After the AI has configured the units of a particular totalizer, the units in the TB totalizer parameter become Read Only.
	FLOW_DIRECTION	Flow Direction C: Determines if the totalizer value will be accumulated based on the net flow, forward only flow or the reverse only flow.
	RESET	Reset: Individual totalizer will be reset. Parameter value will return to completed after totalizer is reset.
	ALLOW_RESET	Allow Reset C: Allows or disallows the resetting of the totalizer.
46	ELECTRODE_COATING_CFG	Electrode Coating Cfg: Parameters needed to configure or reset the monitoring values for electrode coating.
	LEVEL_1	Level 1: Electrode Coating Threshold Level 1 (kOhms) Note: Electrode Coating Level 2 must be greater or equal to Electrode Coating Level 1.

Table C-2: Device specific parameters (continued)

TB Index	Parameter Name	Description
	LEVEL_2	Level 2: Electrode Coating Threshold Level 2 (kOhms) Note: Electrode Coating Level 2 must be greater or equal to Electrode Coating Level 1.
	CLEAR_MAX	Clear Max: Reset the Electrode Coating Max Value.
47	ELECTRODE_COATING	Electrode Coating: The current and maximum values for the electrode coating resistance values.
	CURRENT_VALUE	Current Value: The current electrode coating resistance value in kOhms.
	MAX_VALUE	Max Value: The maximum Electrode Coating Resistance value.
48	DIAG_SIG_POWER	Signal power at current coil drive frequency.
49	LOW_FLOW_CUTOFF	When flow rate is less than this entered value, flow rate output will be set to 0.0 flow.
50	DETAILED_STATUS	Detailed Status: Provides information on error/status conditions in the transducer block. For information about how DETAILED_STATUS affects Field Diagnostic Alerts see Table C-8
51	CALIBRATION_STATUS	Calibration Status: Provides information on calibration (digital, auto and universal) error/status conditions in the transducer block.
52	CONTINUOUS_MV_RESULTS	Continuous MV Results: Result values from the continuous meter verification.
	INTERNAL_SIM_VALUE	Internal Sim Value: Continuous Internal Flow Simulator Measurement.
	INTERNAL_SIM_DEVIATION	Internal Sim Deviation: Continuous meter verification Internal Flow Simulator Deviation from reference.
	COIL_INDUCT_VALUE	Coil Induct Value: Continuous meter verification coil inductance measurement. (MB: COIL_INDUCT_CONT_VALUE).
	COIL_INDUCT_DEVIATION	Coil Induct Deviation: Continuous meter verification coil Inductance deviation from reference.
	COIL_RESIST_VALUE	Coil Resist Value: Continuous meter verification coil resistance measurement.
	ELECTRODE_RESIST_VALUE	Electrode Resist Val: Continuous meter verification electrode resistance measurement.
53	LOI_CONFIGURATION	LOI/Display Configuration: Parameters needed to configure the LOI/Display display.
	LANGUAGE	Language: Selects the language to be used on the LOI/Display for status and diagnostics messages.
	PV_LOI_TIME	PV LOI/Display Time: Time in seconds for which the LOI/Display should show the value of volume flow. 0 indicates that the volume flow shall not be displayed on the LOI/Display. If all the LOI/Display display timings in this LOI/Display configuration record are also 0, then the LOI/Display shall show only volume flow value.

Table C-2: Device specific parameters (continued)

TB Index	Parameter Name	Description
	TA_LOI_TIME	TA LOI/Display Time: Time in seconds for which the LOI/Display should show the value of totalizer A. 0 indicates that the totalizer A shall not be displayed on the LOI/Display.
	TB_LOI_TIME	TB LOI/Display Time: Time in seconds for which the LOI/Display should show the value of totalizer B. 0 indicates that the totalizer B shall not be displayed on the LOI/Display.
	TC_LOI_TIME	TC LOI/Display Time: Time in seconds for which the LOI/Display should show the value of totalizer C. 0 indicates that the totalizer C shall not be displayed on the LOI/Display.
	BACKLIGHT	Backlight: The keys on the FF version of the transmitter are disabled so the backlight will only have the option of being on or off.
54	EP_TRIG_COUNTS	Number of EP measurements that must be above the trigger level to set empty pipe.
55	EP_TRIG_LEVEL	Empty Pipe Trigger Level.
56	EP_VALUE	Value of the Empty Pipe measurement (Same scale as EP_TRIG_LEVEL).
57	ELECT_TEMP	Compensated electronics temperature. The ELECT_TEMP value will be in units (°C or °F) depending on whether the flow value is in Metric or English units.
58	TEMPERATURE_UNITS	The units will be in °C or °F, depending on whether the flow value is in Metric or English units. The user can not write directly to this parameter.
59	DSP_SOFTWARE_REV_NUM	DSP software Rev Number – The unsigned bit number consist of 2 parts; The Transmitter specific revision and the software revision code. Essentially a “major” and a “minor” revision number.
60	PERFORM_AUTO_ZERO	Perform auto zero calibration routine. Note Writing anything but a 2 has no effect and any greater than 2 will return an error for out of range value. Reads will always return a 1 or a 2.
61	PERFORM_ELECTRONICS_TRIM	Perform input trim calibration routine.
62	FLOW_TUBE_TAG	Text string identifier of sensor.
63	FLOW_TUBE_SERIAL_NUMBER	Sensor serial number from physical tag on sensor body.
64	LINER_MATERIAL	Enumerated string indicating liner material of installed sensor.
65	ELECTRODE_MATERIAL	Enumerated string indicating electrode material of installed sensor.
66	ELECTRODE_TYPE	Enumerated string indicating electrode type of installed sensor.
67	FLANGE_TYPE	Enumerated string indicating flange type of installed sensor.
68	FLANGE_MATERIAL	Enumerated string indicating flange material of installed sensor.
69	DIAG_SNR_5HZ	Signal to Noise ratio at 5 Hz.
70	DIAG_SNR_37HZ	Signal to Noise ratio at 37.5 Hz.

Table C-2: Device specific parameters (continued)

TB Index	Parameter Name	Description
71	UPDATE_IN_PROGRESS	This parameter is used to tell when a long command, such as electronics trim, is running. This is very similar to the "Update in Progress" HART response code returned with command 48 when a long command is running.
72	LINE_NOISE	50/60 Hz line noise
73	DIAGNOSTIC_HANDLING	On/off handling for diagnostics. Note The DD uses the defines found in the Diagnostic Conditions table and then translate those to the 16 bits that are sent to the PIC32 through the IPC write. This also happens when the bits are read from the PIC32.
74	U_FLOW_RATE	Flow rate used in Universal Trim.
75	REVERSE_FLOW	Enable/disable the reading of reverse flow.
76	PERFORM_UNIVERSAL_TRIM	Perform universal trim calibration routine. Note See Perform a Long Duration Activity for an example.
77	SP_CONTROL	Signal Processing Control Code. Note This parameter may change or be changed by other parameters.
78	SP_NOISE_MODE	Noise Mode. Note This parameter may change or be changed by other parameters.
79	SP_NUM_SAMPS	Signal Processing Number of Samples. Note This parameter may be changed by other parameters.
80	SP_PERCENT_LIMIT	Signal Processing Percent Limit. Note Stored in tenths of percent as a U16 on the DSP. This parameter may be changed by other parameters.
81	SP_TIME_LIMIT	Signal Processing Time Limit. Note Stored in tenths of a second as a U16 on the DSP. This parameter may be changed by other parameters.
82	LICENSE_KEY	Key/password to enable diagnostic features. Any changes to the licensing will be shown in the LICENSE_STATUS parameter.

Table C-2: Device specific parameters (continued)

TB Index	Parameter Name	Description
83	LICENSE_STATUS	Bit mask that shows which diagnostics are licensed. Parameter is writable in the factory. Note The license status can be written directly via the factory info parameters.
84	CONT_METER_VERIFY_LIMIT	Test Limit Percentage for Continuous Flowmeter Verification Tests. This parameter's Valid Values depend on the value of XMTR_MODE.
85	CONT_METER_VERIFY_ENABLE	Cont Meter Verify Enable: Enable Continuous Flowmeter Verification. Individual meter verification can be enabled.
86	METER_VERIF_TEST_SCOPE	Scope of the Flowmeter Verification Test. Note This parameter needs to be configured before the Meter Verification is started via the PERFORM_METER_VERIFY parameter.
87	METER_VERIF_TEST_COND_IN	Incoming Test Condition of the Flowmeter Verification Test. Note This parameter needs to be configured before the Meter Verification is started via the PERFORM_METER_VERIFY parameter.
88	METER_VERIF_TEST_COND_OUT	Actual Test Condition of the Flowmeter Verification Test
89	METER_VERIF_CRITERIA	Test limits that the Flowmeter Verification Test was ran against.
90	METER_VERIF_RESULT	Flowmeter Verification Test summary result.
91	COIL_RESIST_RESULT	Coil Resistance Test Result, part of the Flowmeter Verification Test.
92	COIL_INDUCT_RESULT	Coil Inductance Test Result, part of the Flowmeter Verification Test.
93	ELECT_RESIST_RESULT	Electrode Resistance Test Result, part of the Flowmeter Verification Test.
94	INT_SIM_RESULT	Internal Simulator Test Result, part of the Flowmeter Verification Test.
95	CLEAR_FINGERPRINT_VALUES	Perform the Clear Fingerprint Values command. Do not use.
96	COIL_INDUCT_VALUE	Coil Inductance value.
97	COIL_INDUCT_DEVIATION	Coil Inductance Deviation.
98	COIL_INDUCT_FINGERPRINT	Coil Inductance Fingerprint. Read only.
99	COIL_RESIST_VALUE	Coil Resistance value.
100	COIL_RESIST_FINGERPRINT	Coil Resistance Fingerprint. Read only.
101	ELECT_RESIST_VALUE	Electrode Resistance value.
102	ELECT_RESIST_FINGERPRINT	Electrode Resistance Fingerprint. Read only.
103	INT_SIM_DEVIATION	The internal flow simulator reading as a percent deviation from the reference value.

Table C-2: Device specific parameters (continued)

TB Index	Parameter Name	Description
104	INT_SIM_REF_VALUE	Internal Flow Simulator Reference Value.
105	INT_SIM_VALUE	The internal flow simulator reading.
106	METER_VERIF_EP_LIM	Flowmeter Verification Limit – Empty Pipe condition.
107	METER_VERIF_FLOWING_LIM	Flowmeter Verification Limit – Flowing condition.
108	METER_VERIF_NO_FLOW_LIM	Flowmeter Verification Limit – No Flow condition.
109	RECALL_FINGERPRINT_VALUES	Perform a recall of the previous fingerprint values.
110	PERFORM_REFINGERPRINT_FLOWTUBE	Perform the re-fingerprint command. Note The parameter FINGERPRINT_SELECT needs to be configured before the Refingerprint operation is started.
111	PERFORM_METER_VERIFY	Perform the meter verification command. Note The parameter METER_VERIF_TEST_SCOPE and METER_VERIF_TEST_COND_IN needs to be configured before the Refingerprint operation is started.
112	FINGERPRINT_SELECT	Components to re-fingerprint. Note This parameter needs to be configured before the Refingerprint operation is started via the PERFORM_REFINGERPRINT_FLOWTUBE parameter.
113	COIL_CURRENT_VALUE	Coil Current Value: Coil current measurement.
114	37HZ_AUTOZERO_OFFSET	37Hz Auto Zero Offset: Auto Zero Offset at 37.5 Hz
115	SERIAL_NUMBER	This parameter reads directly from Resource Block parameter OUTPUT_BOARD_SN.

Block/transducer errors

The BLOCK_ERR conditions are listed in the table below. The XD_ERROR conditions are listed in [Table C-3](#).

Table C-3: BLOCK_ERR conditions

Condition number	Condition name and description
3	Simulate active
6	Device needs maintenance soon
7	Input failure/process variable has bad status
13	Device needs maintenance now
14	Power up: the device was just powered up

Table C-4: XD_ERR conditions

Condition number	Condition name and description
15	Out of Service: The actual mode is out of service.
16	Unspecified error: An unidentified error occurred.
17	General Error: A general error that cannot be specified below occurred.
18	Calibration Error: An error occurred during calibration of the device, or a calibration error was detected during normal operations.
19	Configuration Error: An error occurred during configuration of the device, or a configuration error was detected during normal operations.
20	Electronics Failure: An electrical component failed.
21	Mechanical Failure: A mechanical component failed.
22	I/O Failure: An I/O failure occurred.
23	Data Integrity Error: Data stored in the device are no longer valid due to a nonvolatile memory checksum failure, a data verify after write failure, etc.
24	Software Error: The software has detected an error due to an improper interrupt service routine, an arithmetic overflow, a watchdog time-out, etc.
25	Algorithm Error: The algorithm used in the transducer block produced an error due to overflow, data reasonableness failure, etc.

Flow-specific block configuration values

Once the transmitter is installed and communication is established, configuration must be completed. Three parameters must be entered for proper configuration:

- Sensor calibration number
- Engineering units (configured via AI block)
- Sensor size

The sensor calibration number can be found on the sensor nameplate. A list of all possible sensor sizes and engineering units are listed in [Table C-5](#) and [Table C-6](#), respectively. Mass units (lb, kg, ton, and ston) require configuration of the DENSITY_VALUE.

Table C-5: Supported line sizes

Fieldbus code	Line size	Fieldbus code	Line size
1	0.1 inch (3 mm)	20	18 inch (450 mm)
2	0.15 inch (4 mm)	21	20 inch (500 mm)
3	0.25 inch (6 mm)	22	24 inch (600 mm)
4	0.3 in (8 mm)	23	28 inch (700 mm)
5	0.5 inch (15 mm)	24	30 inch (750 mm)
6	0.75 inch (20 mm)	25	32 inch (800 mm)
7	1 inch (25 mm)	26	36 inch (900 mm)
8	1.5 inch (40 mm)	27	40 inch (1000 mm)

Table C-5: Supported line sizes (continued)

Fieldbus code	Line size	Fieldbus code	Line size
9	2 inch (50 mm)	28	42 inch (1050 mm)
10	2.5 inch (65 mm)	29	44 inch (1100 mm)
11	3 inch (80 mm)	30	48 inch (1200 mm)
12	4 inch (100 mm)	31	54 inch (1350 mm)
13	5 inch (125 mm)	32	56 inch (1400 mm)
14	6 inch (150 mm)	33	60 inch (1500 mm)
15	8 inch (200 mm)	34	64 inch (1600 mm)
16	10 inch (250 mm)	35	66 inch (1660 mm)
17	12 inch (300 mm)	36	72 inch (1800 mm)
18	14 inch (350 mm)	37	78 inch (1950 mm)
19	16 inch (400 mm)	38	80 inch (2000 mm)

Table C-6: Engineering units for PRIMARY_VALUE, PRIMARY_VALUE_RANGE, SENSOR_RANGE, LOW_FLOW_CUTOFF

Fieldbus code	Unit	Fieldbus code	Unit
1362	US gallons/sec	1369	imperial gallons/hr
1363	US gallons/min	1370	imperial gallons/d
1364	US gallons/hr	1511	cubic centimeters/sec
1365	US gallons/d	1512	cubic centimeters/min
1366	Mega US gallons/d	1513	cubic centimeters/hr
1351	liters/sec	1514	cubic centimeters/d
1352	liters/min	1067	ft/sec
1353	liters/hr	1070	ft/min
1354	liters/day	1073	ft/hr
1347	cubic meters/sec	1061	meters/sec
1348	cubic meters/min	1063	meters/hour
1349	cubic meters/hr	1330	Pounds/second
1350	cubic meters/d	1331	Pounds/minute
1356	cubic ft/sec	1332	Pounds/hour
1357	cubic ft/min	1333	Pounds/day
1358	cubic ft/hr	1334	Short tons/second
1359	cubic ft/d	1335	Short tons/minute
1371	barrels/sec	1336	Short tons/hour
1372	barrels/min	1337	Short tons/day

Table C-6: Engineering units for PRIMARY_VALUE, PRIMARY_VALUE_RANGE, SENSOR_RANGE, LOW_FLOW_CUTOFF (continued)

Fieldbus code	Unit	Fieldbus code	Unit
1373	barrels/hr	1322	Kilograms/second
1374	barrels/day	1323	Kilograms/minute
1634	barrels (US Beer)/sec	1324	Kilograms/hour
1633	barrels (US Beer)/min	1325	Kilograms/day
1632	barrels (US Beer)/hr	1326	Metric tons/second
1631	barrels (US Beer)/d	1327	Metric tons/minute
1367	imperial gallons/sec	1328	Metric tons/hour
1368	imperial gallons/min	1329	Metric tons/day

Table C-7: Engineering units for TOTAL_A_VALUE, TOTAL_B_VALUE, TOTAL_C_VALUE, PULSE_CONFIGURATION: FACTOR_UNITS

Fieldbus code	Unit	Fieldbus code	Unit
1048	US gallons	1052	barrels (US Beer)
1667	Megagallons	1049	imperial gallons
1038	liters	1036	cubic centimeters
1034	cubic meters	1094	Pounds
1043	cubic ft	1095	Short tons
1018	feet	1088	Kilograms
1010	meters	1092	Metric tons
1051	barrels		

Diagnostics

In addition to the BLOCK_ERR and XD_ERROR parameters, more detailed information on the measurement status can be obtained through the TB_ELECTRONICS_STATUS. lists the potential errors and the possible corrective actions for the given values.

Table C-8: Diagnostics

XMTR STATUS REG	Description	Local display error message
NA	Fieldbus Processor Not Communicating	NA
	Transducer Block Out of Service	Out of Service
IPC_IDX_U16_DSP_SW_REV_NUM	PIC32 Hardware not compatible with software	Incompatible SW
[2] bit 8	Electronics Failure	Elect Failure
[0] bit 14	Coil Drive Current is Zero	Coil Open Ckt
[0] bit 1	Empty Pipe Detected	Empty Pipe

Table C-8: Diagnostics (continued)

XMTR STATUS REG	Description	Local display error message
[2] bit 13	Electrode Resistance Error	Elect Resist Err
[2] bit 10	Coil Inductance Error	Coil Induct Err
[0] bit 0	Sensor Out of Range	Flow > Sens limit
Hornet detects	Sensor Processor Not Communicating	Sensor Comm Err
[2] bit 9	Coil Resistance Error	Coil Resist Err
[0] bit 15	Reverse Flow Rate Detected	Flashing "R" on LOI/Display if Reverse Flow is disabled
[1] bit 15	Electronics Temperature Out of Range	Temp out of range
[0] bit 12	Continuous Meter Verification Error	Meter Verify Err
[0] bit 3	Pulse Output, Out of Range	Pulse out of range
[1] bit 14	High Process Noise	Hi Process Noise
[2] bit 12	Reverse Flow Detected	Flashing "R" on LOI/Display if reverse flow is enabled
[1] bit 13	Grounding/Wiring Fault	Grnd/Wire Fault
[0] bit 7	Pulse Output Fixed	Pulse Out Fixed
[1] bit 0	Internal Flow Simulation Test Error	Int Flow Sim Err
[1] bit 8	Electrode Coated Limit 1	Elec Coat 1
[1] bit 9	Electrode Coated Limit 2	Elec Coat 2
[2] bit 5	Coil Over Current Detected	Coil Over Curr
[2] bit 6	Sensor Electrode Saturated	Sensr Elec Sat
[2] bit 7	Coil Power Limit	Coil Power Lim

Table C-9: Calibration conditions

XMTR STATUS REG	Description	Local Display Error Message
[2] bit 11	Digital Trim Failure	Dig Trim Failure
[2] bit 14	Auto Zero Failure	Auto Zero Fail
[1] bit 5	Universal Trim Failure	Auto Trim Fail
[1] bit 1	Excess Auto Zero Correction, ZR too Low	
[1] bit 2	Excess Auto Zero Correction, ZR too High	
[1] bit 3	Auto Zero attempt with nonzero flow.	
[1] bit 10	Excess Calibration Correction, GN too Low	
[1] bit 11	Excess Calibration Correction, GN too High	

Table C-9: Calibration conditions (continued)

XMTR STATUS REG	Description	Local Display Error Message
[1] bit 12	Calibration Attempt Without Calibrator	

Modes

The resource block supports two modes of operation as defined by the MODE_BLK parameter:

- Automatic (Auto)** The block is processing its normal background memory checks.
- Out of Service (O/S)** The block is not processed. Channel outputs are not updated and the status is set to BAD: OUT OF SERVICE for each channel. The BLOCK_ERR parameter shows OUT OF SERVICE. In this mode, you can make changes to all configurable parameters. The target mode of a block may be restricted to one or more of the supported modes.

Alarm detection

Alarms are not generated by the transducer block. By correctly handling the status of the channel values, the down stream block (AI) will generate the necessary alarms for the measurement. The error that generated this alarm can be determined by looking at BLOCK_ERR and XD_ERROR.

Status handling

Normally, the status of the output channels reflects the status of the measurement value, the operating condition of the measurement electronics card, and any active alarm condition. In Auto mode, OUT reflects the value and status quality of the output channels.

Troubleshooting

Table C-10: Troubleshooting

Symptom	Possible causes	Corrective action
Mode will not leave OOS	Target mode not set	Set target mode to something other than OOS.
	Resource block	The actual mode of the resource block is OOS. See Resource block .
PV or SV is BAD	Measurement	See Table C-8 .
		Flow is above SENSOR_RANGE.EU1.
PV or SV is UNCERTAIN	Measurement	Flow is above PRIMARY_VALUE_RANGE.EU100.

D Resource block

This section contains information on the resource block. Descriptions of all resource block parameters, errors, and diagnostics are included. Also, the modes, alarm detection, status handling, virtual communication relationships (VCRs), and troubleshooting are discussed.

Definition

The resource block defines the physical resources of the device, such as measurement and memory. The resource block also handles functionality, such as shed times, that is common across multiple blocks. The block has no linkable inputs or outputs, and it performs memory-level diagnostics.

Parameters and descriptions

The following table lists all of the configurable parameters of the resource block, including the descriptions and index numbers for each parameter. Newer software revisions have added functionality and some index numbers have changed. To determine the software revision of a transmitter, check the parameter SOFTWARE_REVISION_MAJOR. The most recent transmitters have a label on the electronic board stack. Seven views are defined for the resource block. The table also shows the applicable views for each parameter, and the size of the parameter in that view, in bytes. Many of the parameters are common to all fieldbus devices. Definitions for these parameters are available in the referenced fieldbus specification.

Table D-1: Resource block parameters and views

Index	Parameter	View							Description
		1	2	3	3_1	4	4_1	4_2	
1	ST_REV	2	2	2	2	2	2	2	The revision level of the static data associated with the function block.
2	TAG_DESC								The user description of the intended application of the block.
3	STRATEGY					2			The strategy field can be used to identify grouping of blocks.
4	ALERT_KEY					1			The identification number of the plant unit.
5	MODE_BLK	4		4					The actual, target, permitted, and normal modes of the block. Note When Acutal is O/S the Acutal mode of all other blocks will be changed to O/S.
6	BLOCK_ERR	2		2					This parameter reflects the error status associated with the hardware or software components associated with a block. it is a bit string, so that multiple errors may be shown.
7	RS_STATE	1		1					State of the function block application state machine.

Table D-1: Resource block parameters and views (continued)

Index	Parameter	View							Description
		1	2	3	3_1	4	4_1	4_2	
8	TEST_RW								Read/write test parameter - used only for conformance testing.
9	DD_RESOURCE								String identifying the tag of the resource which contains the Device Description for the resource.
10	MANUFAC_ID					4			Manufacturer identification number - used by an interface device to locate the DD file for the resource.
11	DEV_TYPE					2			Manufacturer's model number associated with the resource - used by interface devices to locate the DD file for the resource.
12	DEV_REV					1			Manufacturer revision number associated with the resource - used by an interface device to locate the DD file for the resource.
13	DD_REV[1]					1			Revision of the DD associated with the resource - used by the interface device to locate the DD file for the resource.
14	GRANT_DENY		2						Options for controlling access of host computer and local control panels to operating, tuning and alarm parameters of the block.
15	HARD_TYPES					2			The types of hardware available as channel numbers. The supported hardware types are: SCALAR_INPUT
16	RESTART								Allows a manual restart to be initiated. Note: Setting Restart to 4 will also restart the DSP.
17	FEATURES					2			Used to show supported resource block options.
18	FEATURE_SEL		2						Used to select resource block options.
19	CYCLE_TYPE					2			Identifies the block execution methods available for this resource. The supported cycle types are: SCHEDULED, and COMPLETION_OF_BLOCK_EXECUTION
20	CYCLE_SEL		2						Used to select the block execution method for this resource.
21	MIN_CYCLE_T					4			Time duration of the shortest cycle interval of which the resource is capable.
22	MEMORY_SIZE					2			Available configuration memory in the empty resource. To be checked before attempting a download.

Table D-1: Resource block parameters and views (continued)

Index	Parameter	View							Description
		1	2	3	3_1	4	4_1	4_2	
23	NV_CYCLE_T		4						Minimum time interval specified by the manufacturer for writing copies of NV parameters to non-volatile memory. Zero means it will never be automatically copied. At the end of NV_CYCLE_T, only those parameters which have changed need to be updated in NVRAM.
24	FREE_SPACE		4						Percent of memory available for further configuration. Zero in preconfigured resource.
25	FREE_TIME	4		4					Percent of the block processing time that is free to process additional blocks.
26	SHED_RCAS		4						Time duration at which to give up on computer writes to function block RCAs locations. Shed from RCAs will never happen when SHED_RCAS = 0.
27	SHED_ROUT		4						Time duration at which to give up on computer writes to function block ROut locations. Shed from ROut will never happen when SHED_ROUT = 0.
28	FAULT_STATE	1		1					Condition set by loss of communication to an output block, fault promoted to an output block or a physical contact. When Fault State condition is set, then output function blocks will perform their FSTATE actions.
29	SET_FSTATE								Allows the Fault State condition to be manually initiated by selecting Set.
30	CLR_FSTATE								Writing a Clear to this parameter will clear the device fault state if the field condition, if any, has cleared.
31	MAX_NOTIFY					1			Maximum number of unconfirmed notify messages possible.
32	LIM_NOTIFY		1						Maximum number of unconfirmed alert notify messages allowed.
33	CONFIRM_TIME		4						The time the resource will wait for confirmation of receipt of a report before trying again. Retry will not happen when CONFIRM_TIME=0.
34	WRITE_LOCK		1						If set, no writes from anywhere are allowed, except to clear WRITE_LOCK. Block inputs will continue to be updated.
35	UPDATE_EVT								This alert is generated by any change to the static data.

Table D-1: Resource block parameters and views (continued)

Index	Parameter	View							Description
		1	2	3	3_1	4	4_1	4_2	
36	BLOCK_ALM								The BLOCK_ALM is used for all configuration, hardware, connection failure, or system problems in the block. The cause of the alert is entered in the sub code field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the sub code has changed.
37	ALARM_SUM	8		8					The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
38	ACK_OPTION					2			Selection of whether alarms associated with the block will be automatically acknowledged.
39	WRITE_PRI					1			Priority of the alarm generated by clearing the write lock.
40	WRITE_ALM								This alert is generated if the write lock parameter is cleared.
41	ITK_VER					2			Major revision number of the interoperability test case used in certifying this device as interoperable. The format and range are controlled by the Fieldbus Foundation.
42	FD_VER					2			Major version of the Field Diagnostics specification for this device revision
43	FD_FAIL_ACTIVE	4		4					This parameter reflects the error conditions that are being detected as active for FD_FAIL category. It is a bit string, so that multiple conditions may be shown.
44	FD_OFFSPEC_ACTIVE	4		4					This parameter reflects the error conditions that are being detected as active for FD_OFFSPEC category. It is a bit string, so that multiple conditions may be shown.
45	FD_MAINT_ACTIVE	4		4					This parameter reflects the error conditions that are being detected as active for FD_MAINT category. It is a bit string, so that multiple conditions may be shown
46	FD_CHECK_ACTIVE	4		4					This parameter reflects the error conditions that are being detected as active for FD_CHECK category. It is a bit string, so that multiple conditions may be shown
47	FD_FAIL_MAP					4			This parameter maps conditions to be detected as active for FD_FAIL alarm category.

Table D-1: Resource block parameters and views (continued)

Index	Parameter	View							Description
		1	2	3	3_1	4	4_1	4_2	
48	FD_OFFSPEC_MAP					4			This parameter maps conditions to be detected as active for FD_OFFSPEC alarm category.
49	FD_MAINT_MAP					4			This parameter maps conditions to be detected as active for FD_MAINT alarm category.
50	FD_CHECK_MAP					4			This parameter maps conditions to be detected as active for FD_CHECK alarm category.
51	FD_FAIL_MASK					4			This parameter allows the user to suppress any single or multiple conditions that are active in FD_FAIL category, from being broadcast to the host through the alarm parameter. A bit equal to '1' will mask, i.e., inhibit the broadcast of a condition, and a bit equal to '0' will unmask, i.e., allow broadcast of a condition.
52	FD_OFFSPEC_MASK					4			This parameter allows the user to suppress any single or multiple conditions that are active in FD_OFFSPEC category, from being broadcast to the host through the alarm parameter. A bit equal to '1' will mask, i.e., inhibit the broadcast of a condition, and a bit equal to '0' will unmask, i.e., allow broadcast of a condition.
53	FD_MAINT_MASK					4			This parameter allows the user to suppress any single or multiple conditions that are active in FD_MAINT category, from being broadcast to the host through the alarm parameter. A bit equal to '1' will mask, i.e., inhibit the broadcast of a condition, and a bit equal to '0' will unmask, i.e., allow broadcast of a condition.
54	FD_CHECK_MASK					4			This parameter allows the user to suppress any single or multiple conditions that are active in FD_CHECK category, from being broadcast to the host through the alarm parameter. A bit equal to '1' will mask, i.e., inhibit the broadcast of a condition, and a bit equal to '0' will unmask, i.e., allow broadcast of a condition.
55	FD_FAIL_ALM								This parameter is used primarily to broadcast a change in the associated active conditions, which are not masked, for this alarm category to a Host System.
56	FD_OFFSPEC_ALM								This parameter is used primarily to broadcast a change in the associated active conditions, which are not masked, for this alarm category to a Host System.
57	FD_MAINT_ALM								This parameter is used primarily to broadcast a change in the associated active conditions, which are not masked, for this alarm category to a Host System.

Table D-1: Resource block parameters and views (continued)

Index	Parameter	View							Description
		1	2	3	3_1	4	4_1	4_2	
58	FD_CHECK_ALM								This parameter is used primarily to broadcast a change in the associated active conditions, which are not masked, for this alarm category to a Host System.
59	FD_FAIL_PRI					1			This parameter allows the user to specify the priority of FD_FAIL alarm
60	FD_OFFSPEC_PRI					1			This parameter allows the user to specify the priority of FD_OFFSPEC alarm
61	FD_MAINT_PRI					1			This parameter allows the user to specify the priority of FD_MAINT alarm
62	FD_CHECK_PRI					1			This parameter allows the user to specify the priority of FD_CHECK alarm.
63	FD_SIMULATE			9					This parameter allows the conditions to be manually supplied when simulation is enabled. When simulation is disabled both the diagnostic simulate value and the diagnostic value track the actual conditions. The simulate jumper is required for simulation to be enabled and while simulation is enabled the recommended action will show that simulation is active.
64	FD_RECOMMEN_ACT	2		2					This parameter is a device enumerated summarization of the most severe condition or conditions detected.
65	FD_EXTENDED_ACTIVE	4		4					An optional parameter to allow the user finer detail on conditions causing an active condition in the FD_*_ACTIVE parameters.
66	FD_EXTENDED_MAP					4			An optional parameter to allow the user finer control on enabling conditions contributing to the conditions in FD_*_ACTIVE parameters.
67	COMPATIBILITY_REV								This parameter is used when replacing field devices. The correct value of this parameter is the DEV_REV value of the replaced device.
68	HARDWARE_REVISION								Hardware revision of the device
69	SOFTWARE_REV								Software revision of the firmware
70	PD_TAG						32		PD tag description of device.
71	DEV_STRING						32		This is used to load new licensing into the device. The value can be written but will always read back with a value of 0.
72	DEV_OPTIONS						4		Indicates which miscellaneous device licensing options are enabled.
73	OUTPUT_BOARD_SN						4		Output board serial number.

Table D-1: Resource block parameters and views (continued)

Index	Parameter	View							Description
		1	2	3	3_1	4	4_1	4_2	
74	FINAL_ASSY_NUM						4		The same final assembly number placed on the neck label.
75	DOWNLOAD_MODE								Gives access to the boot block code for downloading new firmware image to device
76	HEALTH_INDEX			1					Parameter representing the overall health of the device, 100 being perfect.
77	CAPABILITY_LEV							1	This parameter may be included in a device to indicate the capability level supported by a device.
78	FAILED_PRI							1	Designates the alarming priority of the PWA FAILED_ALM and also used as switch b/w FD and legacy PWA. If value is greater than or equal to 1 then PWA alerts will be active in device else device will have FD alerts.
79	RECOMMENDED_ACTION				2				Enumerated list of recommended actions displayed with a device alert.
80	FAILED_ALM								Alarm indicating a failure within a device which makes the device non-operational.
81	MAINT_ALM								Alarm indicating the device needs maintenance soon. If the condition is ignored, the device will eventually fail.
82	ADVISE_ALM								Alarm indicating advisory alarms. These conditions do not have a direct impact on the process or device integrity.
83	FAILED_ENABLE							4	Alarm enable parameter for PWA FAILED_ALM. This parameter is the Read Only copy of FD_FAIL_MAP.
84	FAILED_MASK							4	Mask parameter for PWA FAILED_ALM. This parameter is the Read Only copy of FD_FAIL_MASK.
85	FAILED_ACTIVE				4				Enumerated list of failed conditions within a device. This parameter is the Read Only copy of FD_FAIL_ACTIVE.
86	MAINT_PRI							1	Designates the alarm priority of the PWA MAINT_ALM.
87	MAINT_ENABLE							4	Alarm enable parameter for PWA MAINT_ALM.. This parameter is the Read Only copy of FD_OFFSPEC_MAP
88	MAINT_MASK							4	Mask parameter for PWA MAINT_ALM. This parameter is the Read Only copy of FD_OFFSPEC_MASK

Table D-1: Resource block parameters and views (continued)

Index	Parameter	View							Description
		1	2	3	3_1	4	4_1	4_2	
89	MAINT_ACTIVE				4				Enumerated list of maintenance needed conditions within a device. This parameter is the Read Only copy of FD_OFFSPEC_ACTIVE
90	ADVISE_PRI							1	Designates the alarm priority of the PWA ADVISE_ALM.
91	ADVISE_ENABLE							4	Alarm enable parameter for PWA ADVISE_ALM. This parameter is the Read Only copy of FD_MAINT_MAP & FD_CHECK_MAP
92	ADVISE_MASK							4	Mask parameter for PWA ADVISE_ALM. This parameter is the Read Only copy of FD_MAINT_MASK & FD_CHECK_MASK
93	ADVISE_ACTIVE				4				Enumerated list of advisory conditions within a device. This parameter is the Read Only copy of FD_MAINT_ACTIVE & FD_CHECK_ACTIVE

Resource block errors

The following table lists conditions that can be reported in the BLOCK_ERR parameter.

Table D-2: Resource BLOCK_ERR conditions

Number	Name	Description
1	Block Configuration Error	A feature in FEATURES_SEL is set that is not supported by FEATURES or an execution cycle in CYCLE_SEL is set that is not supported by CYCLE_TYPE.
2	Link Configuration Error	A link used in one of the function blocks is improperly configured.
3	Simulate Active	The simulation jumper is in place. Simulate active is not an indication that the I/O blocks are using simulated data.
9	Memory Failure	A memory failure has occurred in FLASH, RAM, or EEPROM memory.
10	Lost Static Data	Static data that are stored in nonvolatile memory have been lost.
11	Lost NV Data	Nonvolatile data that are stored in nonvolatile memory have been lost.
13		Device Needs Maintenance Now
14	Power Up	The device was just powered-up.
15	Out of Service	The actual mode is out of service.

Modes

The resource block supports two modes of operation as defined by the MODE_BLK parameter:

Automatic (Auto)

The block is processing its normal background memory checks.

Out of Service (O/S) The block is not processing its tasks. When the resource block is in O/S, all blocks within the resource (device) are forced into O/S. The BLOCK_ERR parameter shows OUT OF SERVICE. In this mode, you can make changes to all configurable parameters. The target mode of a block may be restricted to one or more of the supported modes.

Alarm detection

A block alarm will be generated whenever the BLOCK_ERR has an error bit set. The types of block error for the resource block are defined in Table D-2. A write alarm is generated whenever the WRITE_LOCK parameter is cleared. The priority of the write alarm is set in the WRITE_PRI parameter. Alarms are grouped into five levels of priority, as shown in Table D-3.

Table D-3: Alarm priorities

Priority number	Priority description
0	The priority of an alarm condition changes to 0 after the condition that caused the alarm is corrected.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator, but does not require operator attention (such as diagnostics and system alerts).
3-7	Alarm conditions of priority 3-7 are advisory alarms of increasing priority.
8-15	Alarm conditions of priority 8-15 are critical alarms of increasing priority.

Status handling

There are no status parameters associated with the resource block.

VCR

The number of configurable virtual communication relationships or VCRs is 18. The parameter is not contained or viewable within the resource block, but it does apply to all blocks.

Troubleshooting

Refer to Table D-4 to troubleshoot resource block problems.

Table D-4: Troubleshooting

Symptom	Possible causes	Corrective action
Mode will not leave OOS	Target mode not set	Set target mode to something other than OOS.
	Memory failure	BLOCK_ERR will show the lost NV Data or Lost Static Data bit set. Restart the device by setting RESTART to Processor. If the block error does not clear, call the factory.

Table D-4: Troubleshooting *(continued)*

Symptom	Possible causes	Corrective action
Block alarms will not work	Features	FEATURES_SEL does not have Alerts enabled. Enable the Alerts bit.
	Notification	LIM_NOTIFY is not high enough. Set equal to MAX_NOTIFY.
	Status options	STATUS_OPTS has Propagate Fault Forward bit set. This should be cleared to cause an alarm to occur.

E Analog Input (AI) Function Block

This section defines the parameters of the transmitter's four Analog Input function blocks.

Table E-1: AI block parameters

Index	Parameter	Available values	Units	Default	Read/write	Description
01	ST_REV	Not applicable	None	0	Read only	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
02	TAG_DESC	32 text characters	None	none	Read and Write	The user description of the intended application of the block.
03	STRATEGY	0 – 65535	None	0	Read and Write	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
04	ALERT_KEY	1– 255	None	0	Read and Write	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
05	MODE_BLK	Auto Manual Out of Service	None	Not applicable	Read and Write	The actual, target, permitted, and normal modes of the block. Target: The mode to “ go to ” Actual: The mode the “ block is currently in ” Permitted: Allowed modes that target may take on Normal: Most common mode for target
06	BLOCK_ERR	Not applicable	None	Not applicable	Read only	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
07	PV	Not applicable	Out_Scale ⁽¹⁾	Not applicable	Read only	The process variable used in block execution.
08	OUT	Out_Scale ⁽¹⁾ ± 10%	Out_Scale ⁽¹⁾	Not applicable	Read and Write	The block output value and status.

Table E-1: AI block parameters (continued)

Index	Parameter	Available values	Units	Default	Read/write	Description
09	SIMULATE	Not applicable	None	Disable	Read and Write	A group of data that contains the current transducer value and status, the simulated transducer value and status, and the enable/disable bit.
10	XD_SCALE	See Table C-6.		-39.37, -39.37, ft/ sec, 2	Read and Write	Transducer scaling (XD_SCALE) is applied to the value from the transducer block channel to produce the FIELD_VAL. The AI Block XD_SCALE units code is used to set the units code in the Transducer Block as these unit codes must be compatible.
11	OUT_SCALE			EU_100: 100 EU_0: 0 UNITS_INDE X: 0x053E DECIMAL: 0	Read and Write	OUT_SCALE provides scaling for the AI OUT. The AI Block OUT_SCALE parameter determines the conversion of the AI Block FIELD_VAL to OUT if the L_TYPE parameter is set to Indirect.
12	GRANT_DENY	Program Tune Alarm Local	None	Not applicable	Read and Write	Normally the operator has permission to write to parameter values, but Program or Local remove that permission and give it to the host controller or a local control panel.
13	IO_OPTS	Low Cutoff Enable/Disable	None	Disable	Read and Write	Allows the selection of input/output options used to alter the PV. Low cutoff enabled is the only selectable option.
14	STATUS_OPTS	Propagate fault forward Uncertain if Limited Bad if Limited Uncertain if Man Mode		0	Read and Write	
15	CHANNEL for AI1	1: Flow		1: Flow	Read and Write	The number of the logical hardware channel that is connected to this I/O block. This information defines the transducer to
	CHANNEL for AI2	2: Totalizer A		2: Totalizer A	Read and Write	

Table E-1: AI block parameters (continued)

Index	Parameter	Available values	Units	Default	Read/write	Description
	CHANNEL for AI3	3: Totalizer B		3: Totalizer B	Read and Write	be used going to or from the physical world.
	CHANNEL for AI4	4: Totalizer C		4: Totalizer C	Read and Write	
16	L_TYPE	1: Direct 2: Indirect 3: Ind Sqr Root		1: Direct	Read and Write	Determines if the values passed by the transducer block to the AI block may be used directly (Direct) or if the value is in different units and must be converted linearly (Indirect), or with square root (Ind Sqr Root), using the input range defined by the transducer and the associated output range.
17	LOW_CUT	>= 0	Out_Scale ⁽¹⁾	0	Read and Write	If percentage value of transducer input fails below this, PV = 0.
18	PV_FTIME	≥ 0	Seconds	0	Read and Write	The time constant of the first-order PV filter. It is the time required for a 63% change in the IN value.
19	FIELD_VAL	0 – 100	Percent	Not applicable	Read only	The value and status from the transducer block or from the simulated input when simulation is enabled.
20	UPDATE_EVT	Not applicable	None	Not applicable	Read only	This alert is generated by any change to the static data.
21	BLOCK_ALM	Not applicable	None	Not applicable	Read only	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.

Table E-1: AI block parameters (continued)

Index	Parameter	Available values	Units	Default	Read/write	Description
22	ALARM_SUM	Enable/Disable	None	Enable	Read and Write	The summary alarm is used for all process alarms in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
23	ACK_OPTION	0= Auto Ack Disabled 1= Auto Ack Enabled	None	0 all Disabled	Read and Write	Used to set auto acknowledgment of alarms.
24	ALARM_HYS	0– 50	Percent	0.5	Read and Write	The amount the alarm value must return within the alarm limit before the associated active alarm condition clears.
25	HI_HI_PRI	0 – 15	None	0	Read and Write	The priority of the HI HI alarm.
26	HI_HI_LIM	Out_Scale ⁽¹⁾	Out_Scale ⁽¹⁾	+ infinity	Read and Write	The setting for the alarm limit used to detect the HI HI alarm condition.
27	HI_PRI	0 – 15	None	0	Read and Write	The priority of the HI alarm.
28	HI_LIM	Out_Scale ⁽¹⁾	Out_Scale ⁽¹⁾	+ infinity	Read and Write	The setting for the alarm limit used to detect the HI alarm condition.
29	LO_PRI	0 – 15	None	0	Read and Write	The priority of the LO alarm.
30	LO_LIM	Out_Scale ⁽¹⁾	Out_Scale ⁽¹⁾	- infinity	Read and Write	The setting for the alarm limit used to detect the LO alarm condition.
31	LO_LO_PRI	0 – 15	None	0	Read and Write	The priority of the LO LO alarm.
32	LO_LO_LIM	Out_Scale ⁽¹⁾	Out_Scale ⁽¹⁾	- infinity	Read and Write	The setting for the alarm limit used to detect the LO LO alarm condition.

Table E-1: AI block parameters (continued)

Index	Parameter	Available values	Units	Default	Read/write	Description
33	HI_HI_ALM	Not applicable	None	Uninitialized	Read only	The HI HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
34	HI_ALM	Not applicable	None	Uninitialized	Read only	The HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
35	LO_ALM	Not applicable	None	Uninitialized	Read only	The LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
36	LO_LO_ALM	Not applicable	None	Uninitialized	Read only	The LO LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
37	OUT_D	Discrete_State 1 – 16	None	Disabled	Read and Write	Discrete output to indicate a selected alarm condition.
38	ALARM_SEL	HI_HI, HI, LO, LO_LO	None	Nonselected	Read and Write	Used to select the process alarm conditions that will cause the OUT_D parameter to be set.
39	STDDEV	0 – 100	Percent	0	Read and Write	The average absolute error between the PV and its previous mean value over that evaluation time defined by VAR_SCAN.
40	CAP_STDDEV	≥ 0	Seconds	0	Read and Write	The time over which the VAR_INDEX is evaluated.

(1) Assume that when L_Type = Direct, the user configures Out_Scale which is equal to XD_Scale.



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