

Rosemount® 8782 Slurry Magnetic Flow Meter Transmitter with HART Protocol



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1

Hazard messages

This document uses the following criteria for hazard messages based on ANSI standards Z535.6-2011 (R2017).



DANGER

Serious injury or death will occur if a hazardous situation is not avoided.



WARNING

Serious injury or death could occur if a hazardous situation is not avoided.



CAUTION

Minor or moderate injury will or could occur if a hazardous situation is not avoided.

NOTICE

Data loss, property damage, hardware damage, or software damage can occur if a situation is not avoided. There is no credible risk of physical injury.

Physical access

NOTICE

Unauthorized personnel can potentially cause significant damage and/or misconfiguration of end users' equipment. Protect against all intentional or unintentional unauthorized use.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access to protect users' assets. This is true for all systems used within the facility.

1.1

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 Safety Data Sheet (SDS) 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.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- 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.
- Flow meters 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 flow meter 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.
- Flow meters 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 flow meter 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 flow tube 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 is remotely mounted away from the sensor.

Figure 2-1: 8782 transmitter

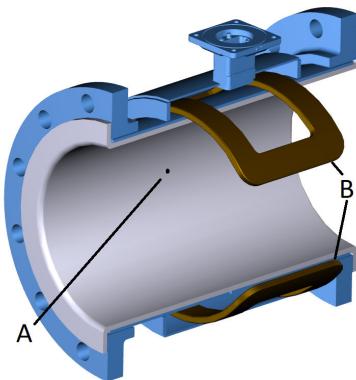


Figure 2-2: MS sensor



The flow sensor contains two magnetic coils located on opposite sides of the sensor. Two electrodes, located perpendicular to the coils and opposite each other, make contact with the liquid. The transmitter energizes the coils and creates a magnetic field. A conductive liquid moving through the magnetic field generates an induced voltage at the electrodes. This voltage is proportional to the flow velocity. The transmitter converts the voltage detected by the electrodes into a flow reading. A cross-sectional view is show in [Figure 2-3](#).

Figure 2-3: 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

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

Related information

[Remote Transmitter Installation](#)

3.1

Handling and Lifting Safety



CAUTION

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

- Handle all parts carefully to prevent damage. Whenever possible, transport the system to the installation site in the original shipping container.
- PTFE-lined sensors are shipped with end covers that protect flange sealing surfaces 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 safety 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.

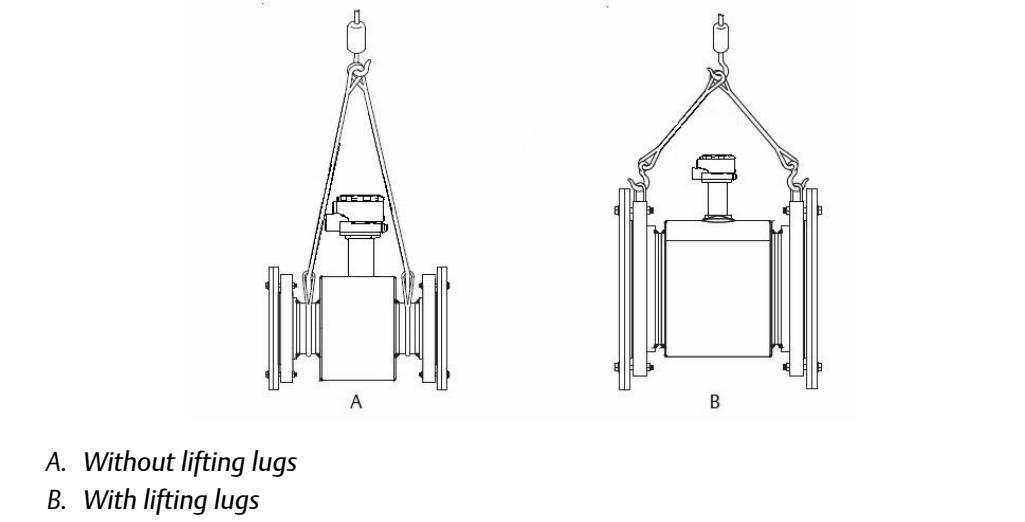
3.1.1 Lifting lugs

⚠ CAUTION

If provided, use the lifting lugs on each flange to handle the flow meter when it is transported and lowered into place at the installation site. If lifting lugs are not provided, the flow meter must be supported with a lifting sling on each side of the housing.

- Standard pressure 3 inch through 36 inch flanged magnetic flowmeters come with lifting lugs.
- High pressure (above 600#) 3 inch through 24 inch flanged magnetic flow meters come with lifting lugs.

Figure 3-1: Example lifting without and with lifting lugs



3.2 Location and Position

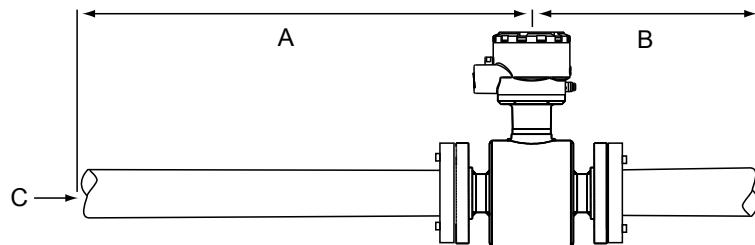
3.2.1 Environmental considerations

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

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

3.2.2 Upstream and downstream piping

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

Figure 3-2: 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

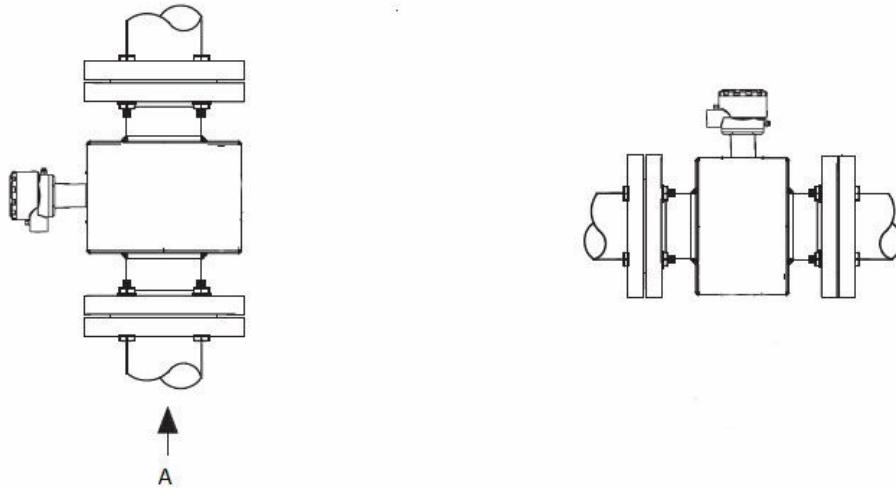
The sensor should be mounted so that the arrow points in the direction of flow.

Figure 3-3: 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.

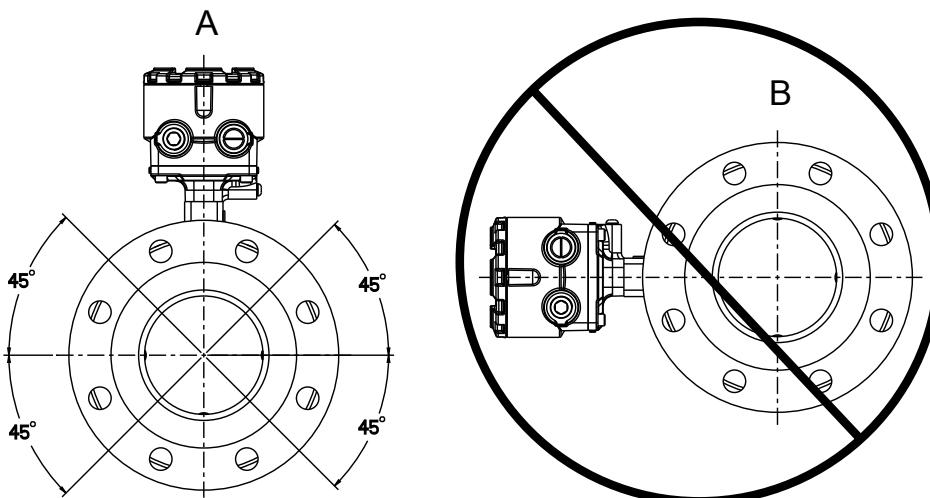
- Vertical installation with upward process fluid flow keeps the cross-sectional area full, regardless of flow rate.
- Horizontal installation should be restricted to low piping sections that are normally full.

Figure 3-4: 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 3-5](#). 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 3-5](#).

Figure 3-5: Electrode orientation

A. Correct orientation

B. Incorrect orientation

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

3.3 Sensor Installation

3.3.1 Flanged sensors

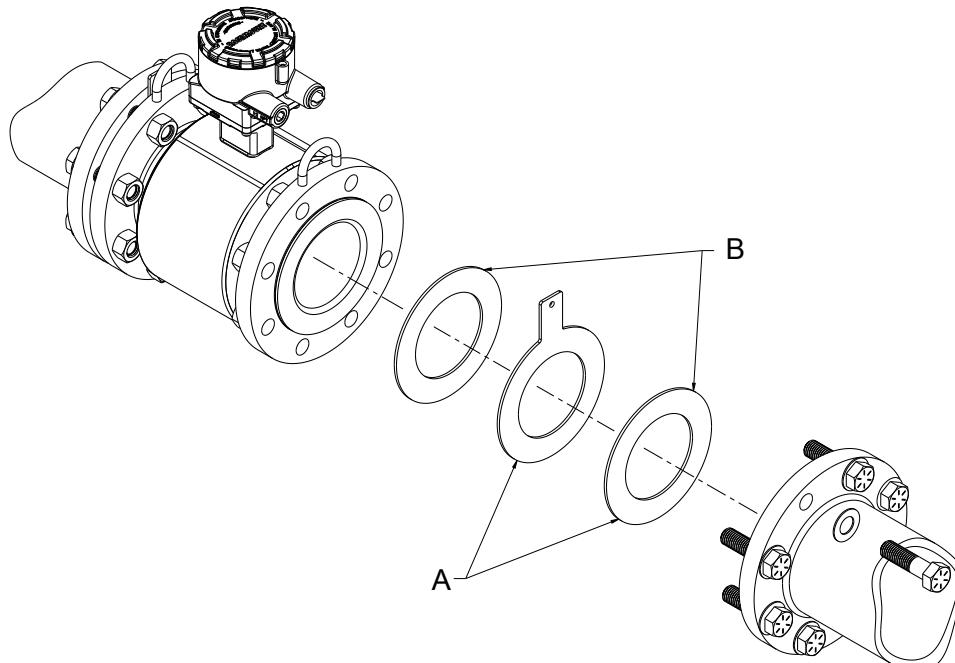
Gaskets

The sensor requires a gasket at each process connection. The gasket material must be compatible with the process fluid and operating conditions. Gaskets are required on each side of a grounding ring (see [Figure 3-6](#)). 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 3-6: 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

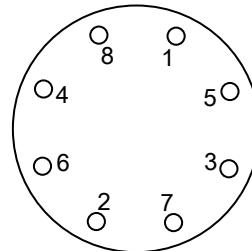
Do not snug and tighten the upstream side and then snug and tighten the downstream side. Failure to alternate between the upstream and downstream flanges when tightening bolts may result in liner damage.

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 3-7](#) 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 3-7: Flange bolt torquing sequence



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

Table 3-1: Lining material

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

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

Size code	Line size	Fluoropolymer liners		Other liners	
		Class 150 (lb-ft)	Class 300 (lb-ft)	Class 150 (lb-ft)	Class 300 (pound feet)
030	3 inch (80 mm)	34	35	23	23
040	4 inch (100 mm)	26	50	17	32
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 MS sensors with fluoropolymer liners (EN 1092-1)

Size code	Line size	Fluoropolymer liners (in Newton-meters)			
		PN 10	PN 16	PN 25	PN 40
030	3 inch (80 mm)	N/A	N/A	N/A	50
040	4 inch (100 mm)	N/A	50	N/A	70
060	6 inch (150mm)	N/A	90	N/A	130

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

Size code	Line size	Fluoropolymer liners (in Newton-meters)			
		PN 10	PN 16	PN 25	PN 40
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 MS 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
030	3 inch (80 mm)	N/A	N/A	N/A	30
040	4 inch (100 mm)	N/A	40	N/A	50
060	6 inch (150mm)	N/A	60	N/A	90
080	8 inch (200 mm)	90	60	90	110
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

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 3-5](#) to determine which process reference option to follow for proper installation.

Table 3-5: Process reference options

Type of pipe	Grounding straps	Grounding rings	Reference electrode	Lining protectors
Conductive unlined pipe	See Figure 3-8	See Figure 3-9	See Figure 3-11	See Figure 3-9
Conductive lined pipe	Insufficient grounding	See Figure 3-9	See Figure 3-8	See Figure 3-9
Non-conductive pipe	Insufficient grounding	See Figure 3-10	Not recommended	See Figure 3-10

Note

For line sizes 10-inch and larger the ground strap may come attached to the sensor body near the flange. See [Figure 3-12](#).

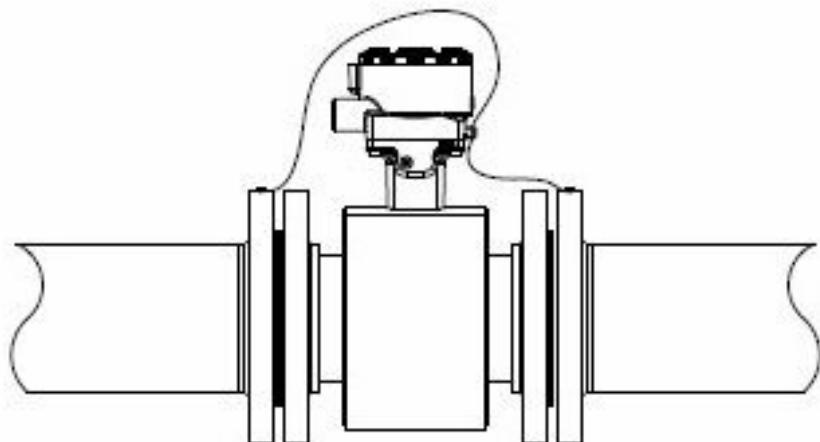
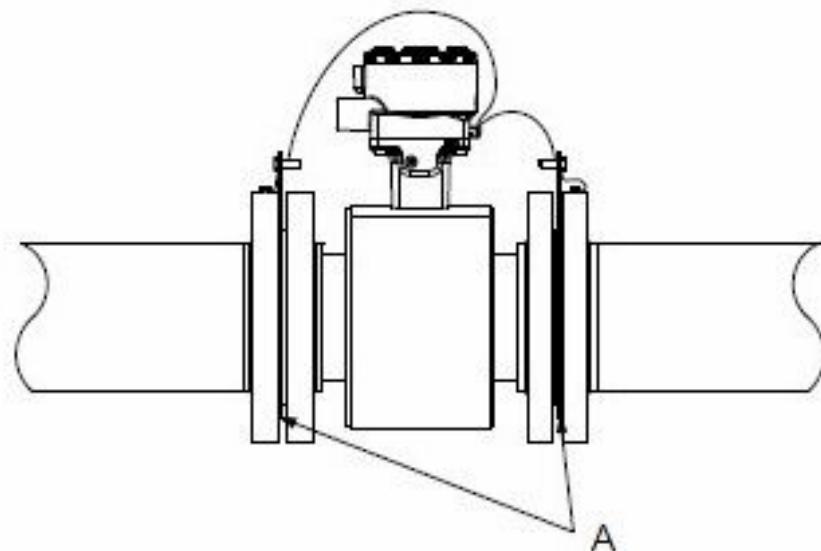
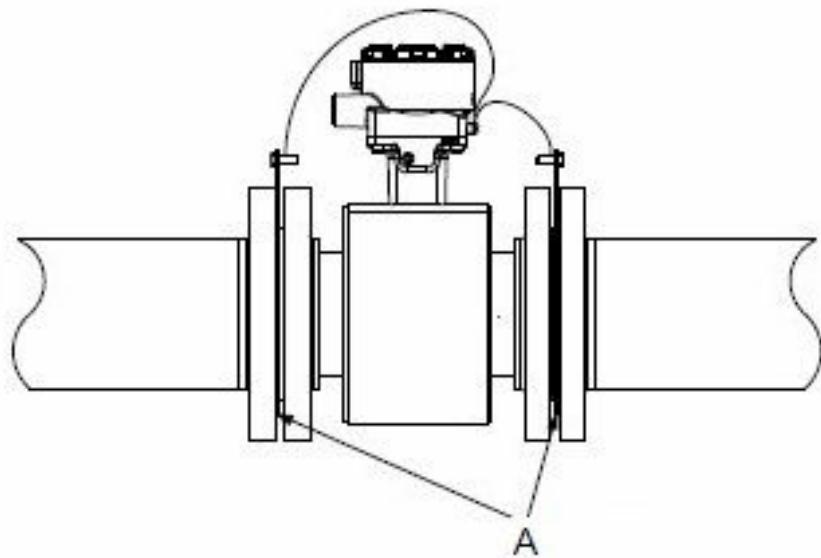
Figure 3-8: Grounding straps in conductive unlined pipe or reference electrode in lined pipe

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



A. *Grounding rings or lining protectors*

Figure 3-10: Grounding with grounding rings or lining protectors in non-conductive pipe



A. *Grounding rings or lining protectors*

Figure 3-11: Grounding with reference electrode in conductive unlined pipe

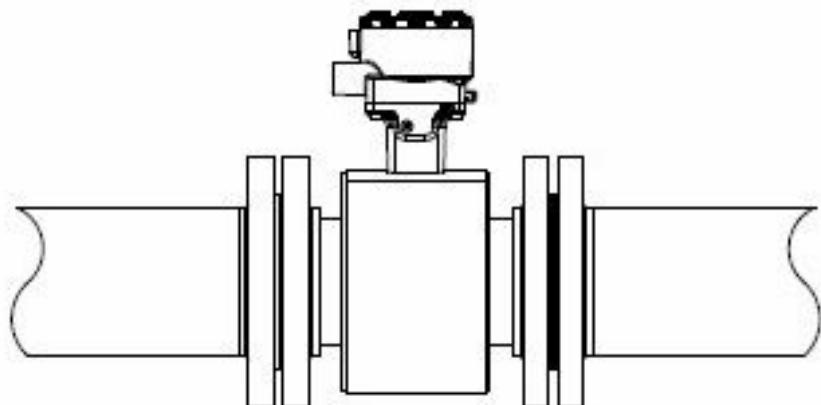
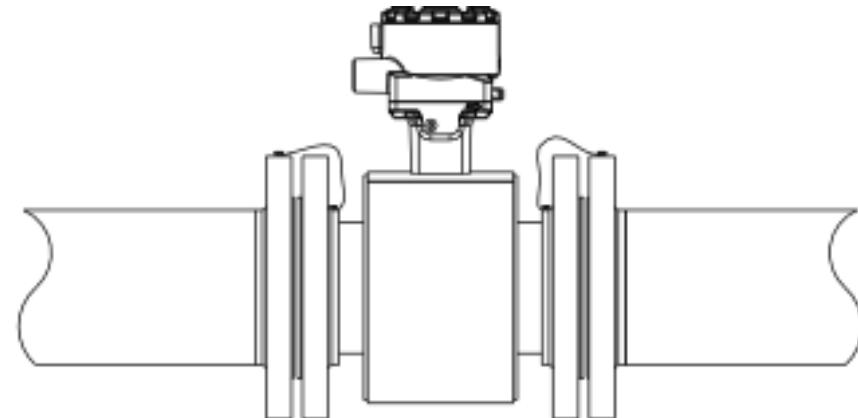


Figure 3-12: Grounding for line sizes 10-in. and larger



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:

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

Note

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

Identify options and configurations

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

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

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

Table 4-1: Hardware switch default settings

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

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

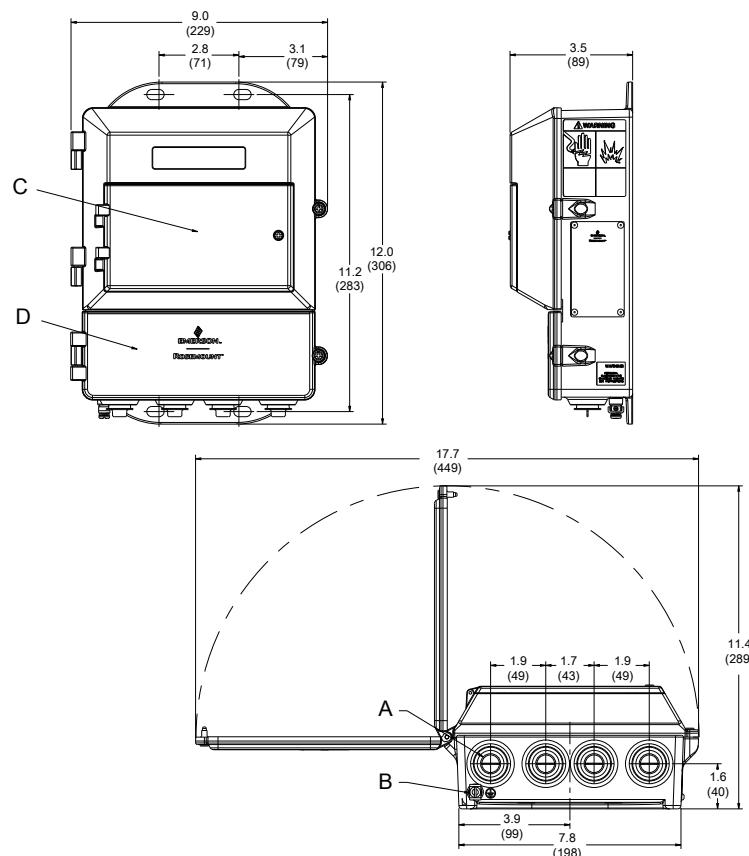
In most cases, it is not necessary to change the setting of the hardware switches. If the switch settings need to be changed, refer to [Hardware switches](#).

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: Rosemount 8782 Dimensional Drawing



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

Note

Dimensions are in inches (Millimeters)

Electrical considerations

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

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

Table 4-2: Electrical Data

Electrical data	
Power input	AC power: 90–250 VAC (\sim), 1.5A, 120 VA
	Standard DC power: 12–42 VDC (—), 8.6 A, 120 W
Pulsed circuit	Internally powered (Active): Outputs up to 12 VDC, 12.1 mA, 73 mW Externally powered (Passive): Input up to 28 VDC, 100 mA, 1 W
4-20mA output circuit	Internally Powered (Active): Outputs up to 25 mA, 24 VDC, 600 mW Externally Powered (Passive): Input up to 25 mA, 30 VDC, 750 mW
Um	250 V
Coil excitation output	2.0 A, 85 V max, 80 W max

Environmental considerations

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.

Table 4-3: Transmitter housing environmental ratings

Type	Rating
Ingress protection	IP66, IP69
NEMA	4X
Pollution Degree	2
Maximum altitude rating	<ul style="list-style-type: none"> • 13,123 ft (4000 m) at rated input power voltage (90–250 VAC) • 16,404 ft (5000 m) at maximum input power voltage of 150 VAC

Note

For complete environmental and other specifications, see [Product Specifications](#).

4.2

Transmitter symbols

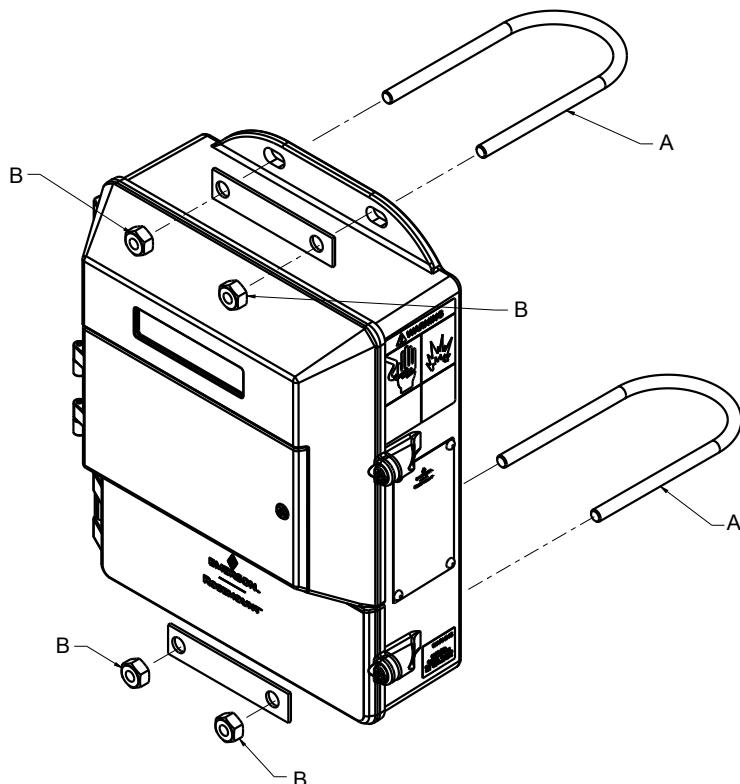
Caution symbol — check product documentation for details	
Protective conductor (grounding) terminal	

4.3

Mounting

Wall mount transmitters are shipped with mounting hardware for use on a 2 inch (50 mm) pipe or flat surface.

Figure 4-2: Mounting bracket



A. U-bolt

B. Fasteners

4.3.1

Pipe mounting

1. Assemble the hardware and transmitter housing on the pole as shown in [Figure 4-2](#).
2. Tighten the nuts to ensure a snug fit.

4.3.2 Surface mounting

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

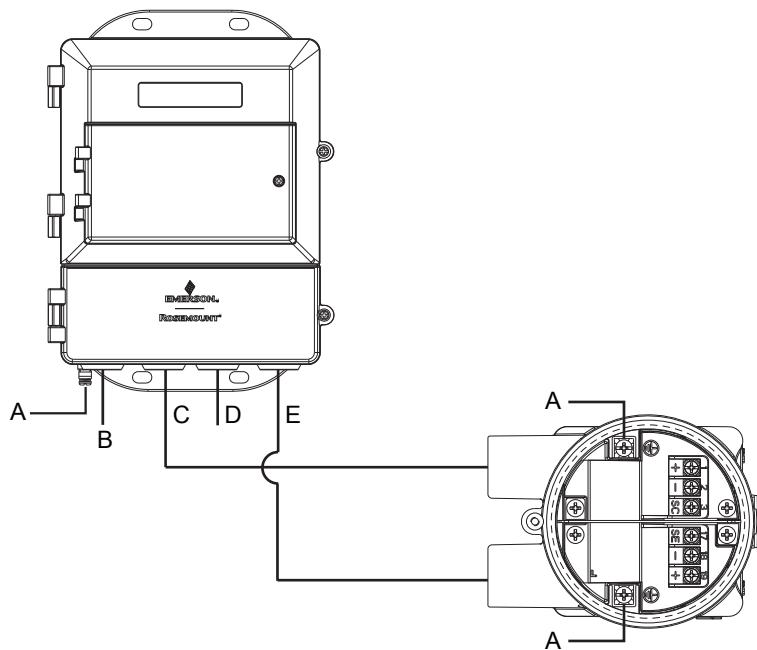
4.4 Wiring

4.4.1 Conduit entries and connections

Transmitter conduit entries ports are $\frac{1}{2}$ "-14NPT as standard, M20 conduit connections will use an adapter. Conduit connections should be made in accordance with national, local, and plant electrical codes. Unused conduit entries should be sealed with the appropriate certified plugs. The plastic shipping plugs do not provide ingress protection.

4.4.2 Conduit requirements

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

Figure 4-3: Best practice conduit preparation

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

4.4.3 Sensor to transmitter wiring

Remote cable kits can be ordered directly using the kit numbers shown in [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 4-4: 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

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

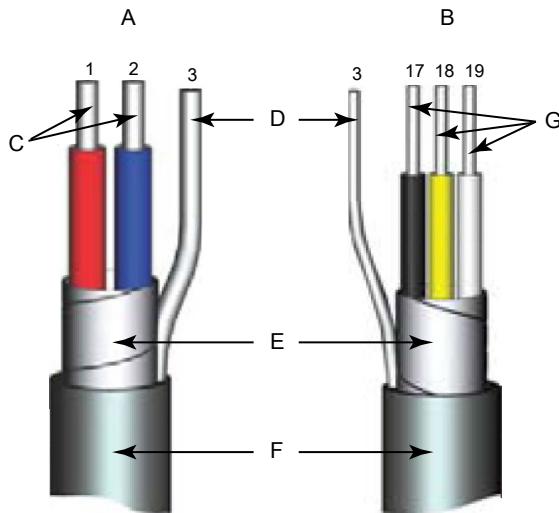
Cable kit #	Description	Individual cable	Alpha p/n
08732-0065-0003 (feet)	Kit, component cables, Std temp (includes Coil and I.S. Electrode)	Coil Intrinsically Safe Blue Electrode	2442C Not available
08732-0065-0004 (meters)	Kit, component cables, Std temp (includes Coil and I.S. Electrode)	Coil Intrinsically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

Table 4-5: 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

Cable requirements

Shielded twisted pairs or triads must be used. See [Figure 4-4](#). Cable lengths should be limited to less than 300 feet (100 m).

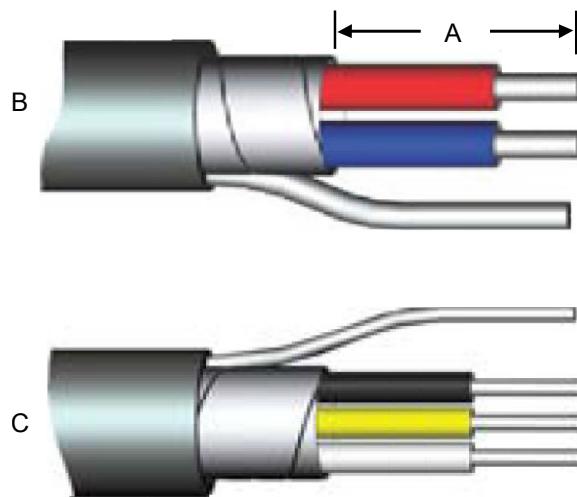
Figure 4-4: Individual component cables

- A. Coil drive
- B. Electrode
- C. Twisted, stranded, insulated 14 AWG conductors
- D. Drain
- E. Overlapping foil shield
- F. Outer jacket
- G. Twisted, stranded, insulated 20 AWG conductors

- 1 = Red
- 2 = Blue
- 3 = Drain
- 17 = Black
- 18 = Yellow
- 19 = White

Cable preparation

Prepare the ends of the coil drive and electrode cables as shown in [Figure 4-5](#). 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 4-5: Cable ends

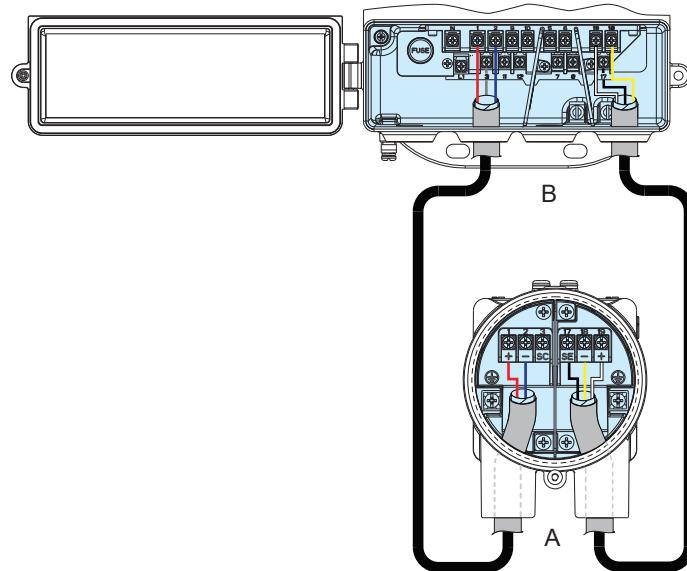
- A. Unshielded length
- B. Coil
- C. Electrode

⚠️ WARNING

Shock hazard! Potential shock hazard across remote junction box terminals 1 and 2 (85V).

⚠️ 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 4-6: Remote junction box views***A. Sensor**B. Transmitter***Note**

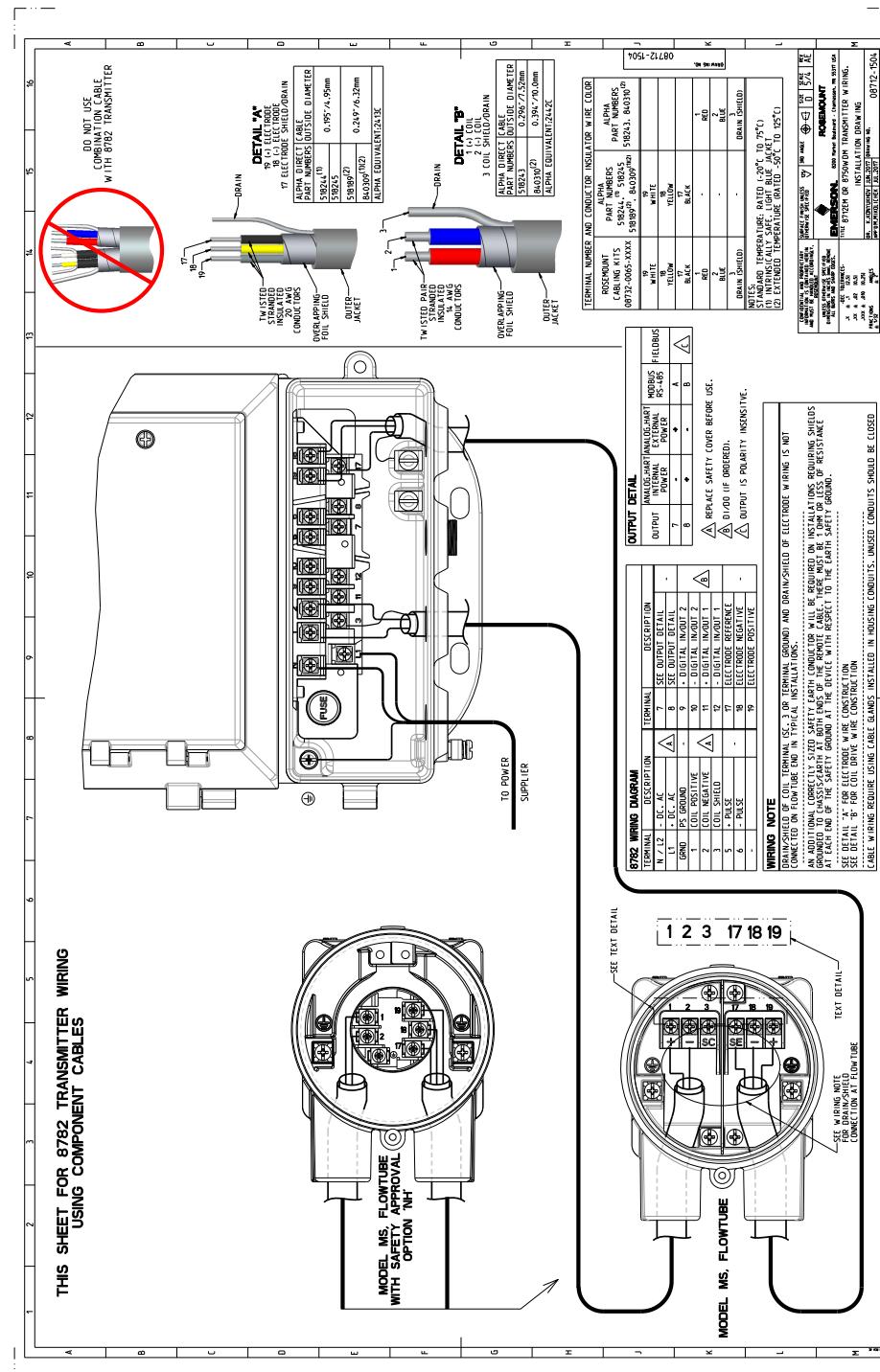
Junction box appearance and configuration may vary, but terminal numbering is consistent for all junction box types.

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	\ominus or float	\ominus

4.4.4 Wiring sensor to transmitter

Figure 4-7: Wiring using component cable



4.4.5 Power and I/O terminal blocks

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

Note

To connect pulse output and/or discrete input/output, refer to [Advanced installation details](#), and for installations with intrinsically safe outputs, refer to [Product Certifications](#).

Figure 4-8: Terminal blocks

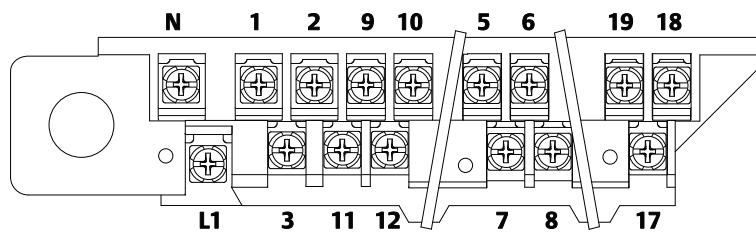


Table 4-7: Power and I/O terminals

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

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

(2) Only available with ordering code AX.

4.4.6 Powering the transmitter

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

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. The hazardous area ratings are located on the main nameplate tag attached to the side of the transmitter.

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.

Overcurrent protection

The transmitter requires overcurrent protection of the supply lines. Fuse rating and compatible fuses are shown in [Line power fuses](#).

Installation category

The installation category for the transmitter is OVERVOLTAGE CAT II.

AC power system installation requirements

Neutral-earth power requirements

- The power system must have a neutral that is locally bonded to earth, or provide both line to earth and neutral to earth voltage limitation of no more than 250 VAC.

Power line impedance

- Sources of inductance on the AC power system, such as isolation transformers, must be limited to less than 1 mH at 120 VAC, and 2 mH at 240 VAC.

Power terminals

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

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

For DC powered transmitter:

- Connect negative to Terminal N and positive to Terminal L1.
- DC powered units may draw up to 8.6 A.

Power supply

- 90 VAC to 250 VAC @ 50/60Hz.
 - Overvoltage Category II
 - Single Phase Earthed Neutral System
- 12 VDC to 42 VDC.

Note

For applications with sensors greater than 14 inch (350 mm) and process temperature greater than 212 °F (100 °C), consult an Emerson Flow representative (see back page) when applying less than 18 VDC to power terminals.

Line power fuses

Power supply type	Rating	Manufacturer part number
90–250 VAC	2.5 A, 250 VAC	Bel Fuse 3AG 2.5-R, Littlefuse 312025, or equivalent
12–42 VDC	12 A, 250 VAC	Bel Fuse 3AB 12-R, Littlefuse 314012, or equivalent

Power consumption

- 90 VAC to 250 VAC: 120 VA maximum
- 12 VDC to 42 VDC: 120 W maximum

Inrush/Start-up current

The power system must be capable of supporting inrush/start-up currents of:

- AC supply: Maximum 7 A (<5 ms)
- DC supply: Maximum 13 A (<5 ms)

Covers

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

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

Note

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

3. Verify the lower door is secure.

4.4.7

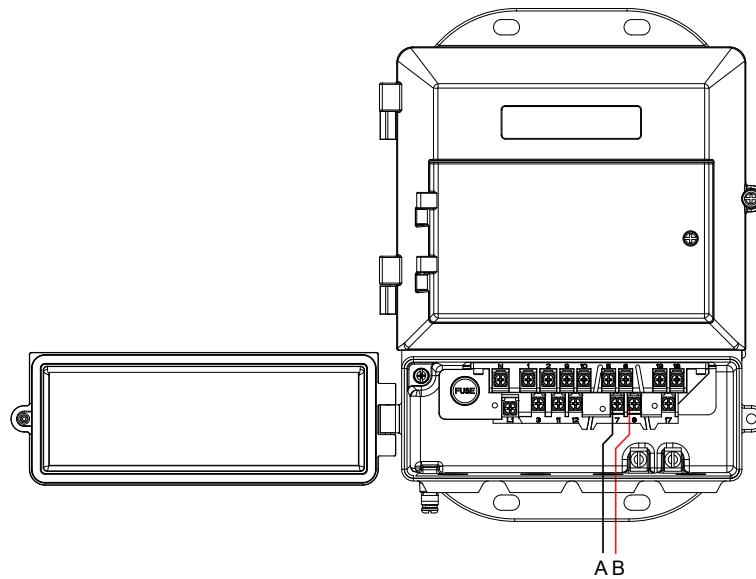
Analog output

The analog output signal is a 4-20 mA current loop. Depending on the IS output option, the loop can be powered internally or externally via a hardware switch located on the front of the electronics stack. The switch is set to internal power when shipped from the factory.

Intrinsically safe analog output requires a shielded twisted pair cable. For HART communication, a minimum resistance of 250 ohms is required. It is recommended to use individually shielded twisted pair cable. The minimum conductor size is 24 AWG (0.51 mm) diameter for cable runs less than 5,000 feet (1,500 m) and 20 AWG (0.81 mm) diameter for longer distances.

Note

For more information about the analog output characteristics, see [Output signals](#).

Figure 4-9: Analog output wiring

A. Terminal #7

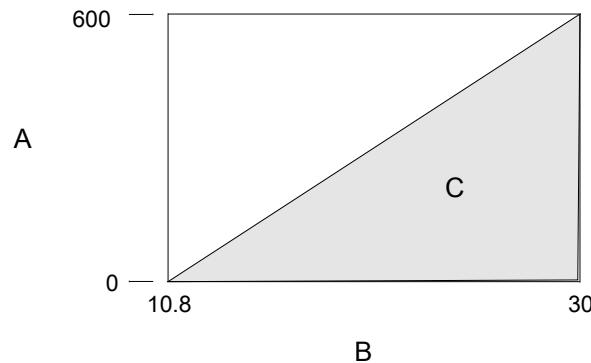
B. Terminal #8

Note

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

Table 4-8: Terminal assignment by power source type

Power source	Terminal #7	Terminal #8
Internal	4–20 mA negative (-)	4–20 mA positive (+)
External	4–20 mA positive (+)	4–20 mA negative (-)

Figure 4-10: Analog loop load limitations

- A. Load (ohms)
- B. Power supply (volts)
- C. Operating region

- $R_{max} = 31.25 (V_{ps} - 10.8)$
 - V_{ps} = power supply voltage (volts)
 - R_{max} = maximum loop resistance (ohms)
-

5 Basic Configuration

Once the flow meter is installed and power has been supplied, the transmitter must be configured using the LOI, if equipped, or a configuration tool, such as ProLink III Software. Descriptions of more advanced functions are included in [Advanced Configuration Functionality](#).

5.1 Basic Setup

Tag

Tag is the quickest and shortest way of identifying and distinguishing between transmitters. Transmitters can be tagged according to the requirements of your application. The transmitter supports the 8 character Tag and the 32 character Long Tag. Both parameters are available for configuration.

Calibration number

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

Flow units (PV)

The flow units variable specifies the format in which the flow rate will be displayed. Units should be selected to meet your particular metering needs. See [Measurement units](#).

Line size

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

Upper range value (URV)

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

Note

If entering a negative number, the minus sign must be entered in the furthest left position on the LOI.

Lower range value (LRV)

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

Note

If entering a negative number, the minus sign must be entered in the furthest left position on the LOI.

Auto zero

The Auto zero is recommended for optimum performance when a flow meter is initially installed, and it typically does not need to be performed again. However, if process conditions drastically change, a new Auto zero is recommended. The sensor must be filled completely with process fluid at zero flow. For more information, see [Auto zero](#).

5.2 Local operator interface (LOI)

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

A complete map of the LOI menu structure is shown in [LOI Menu trees](#).

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

5.3 Other configuration tools

[Table 5-1](#) shows the approximate category or location of basic setup parameters for typical configuration tools.

Table 5-1: Approximate setup category/locations for typical configuration tools

Function	Category/Location
Flow Units	Basic Setup
PV Upper Range Value (URV)	Basic Setup → AO
PV Lower Range Value (LRV)	Basic Setup → AO
Auto zero	Diagnostics
Calibration Number	Basic Setup → Setup
Line Size	Basic Setup → Setup
Tag	Device Info → Identification
Long Tag	Device Info → Identification

5.4 Measurement units

Table 5-2: Volumetric flow units

gal/sec	gal/min	gal/hr	gal/day
L/sec	L/min	L/hr	L/day
ft ³ /sec	ft ³ /min	ft ³ /hr	ft ³ /day
	cm ³ /min		
m ³ /sec	m ³ /min	m ³ /hr	m ³ /day

Table 5-2: Volumetric flow units (continued)

Impgal/sec	Impgal/min	Impgal/hr	Impgal/day
B31/sec (1 barrel = 31 gallons)	B31/min (1 barrel = 31 gallons)	B31/hr (1 barrel = 31 gallons)	B31/day (1 barrel = 31 gallons)
B42/sec (1 barrel = 42 gallons)	B42/min (1 barrel = 42 gallons)	B42/hr (1 barrel = 42 gallons)	B42/day (1 barrel = 42 gallons)

Table 5-3: Mass flow units

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

Table 5-4: Velocity units

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

6

Advanced installation details

6.1

Hardware switches

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

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

6.1.1

Alarm mode

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

6.1.2

Transmitter security

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

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

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

Note

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

6.1.3

Internal/external analog power

Note

With output option code B, the analog output can only be externally powered and there is no **ANALOG** switch.

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

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

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

Note

External power is required for multidrop configurations.

6.1.4 Internal/external pulse power

Note

With output option code B, the pulse output can only be externally powered and there is no **PULSE** switch.

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

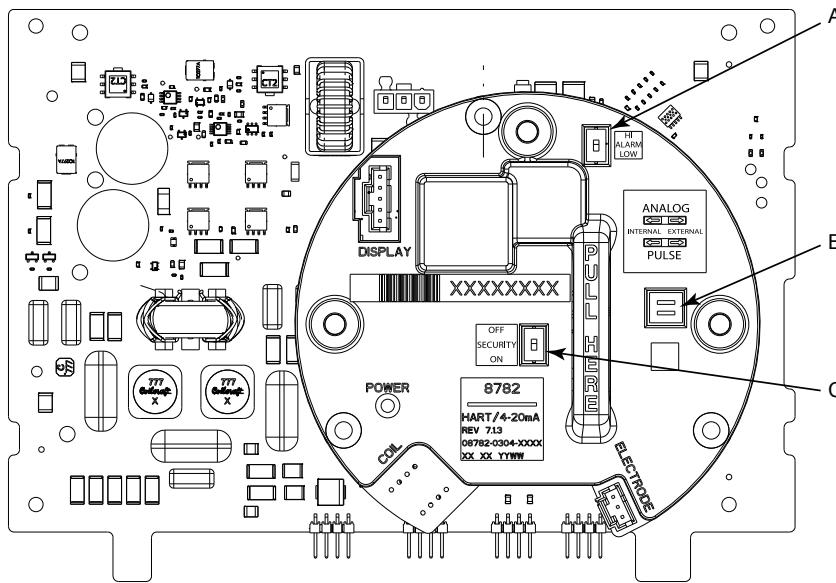
- When the switch is in the **INTERNAL** position, the pulse loop is powered internally by the transmitter.
- When the switch is in the **EXTERNAL** position, a 5–28 VDC external supply is required. For more information about pulse external power, see [Connect pulse output](#).

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

6.1.5 Changing hardware switch settings

Note

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

Figure 6-1: Electronics stack and hardware switches

- A. Alarm level
- B. Analog and pulse internal and external power
- C. Security

Note

Review safety information in [Hazard messages](#) before accessing the transmitter electronics.

1. Place the control loop into manual control.
2. Disconnect power to the transmitter
3. Open the electronics compartment cover.
4. Identify the location of each switch (see [Figure 6-1](#)).
5. Change the setting of the desired switches with a small, non-metallic tool.
6. Close the electronics compartment cover. See [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

Pulse output and discrete input/outputs

There are three additional loop connections available on the Transmitter:

- Pulse output - used for external or remote totalization (see [Pulse output](#)).
- Discrete I/O Channel 1 can be configured as discrete input or discrete output (see [Discrete input/output](#)).

- Discrete I/O Channel 2 can be configured as discrete output only (see [Discrete input/output](#)).

6.2.1 Connect pulse output

The pulse output function provides a galvanically isolated frequency signal that is proportional to the flow through the sensor. The signal is typically used in conjunction with an external totalizer or control system.

Note

- With output option code A, the pulse output can be internally or externally powered, and the **PULSE** switch must be set accordingly (the default setting is **EXTERNAL**).
- With output option code B, the pulse output can only be externally powered and there is no **PULSE** switch. See [Internal/external pulse power](#).

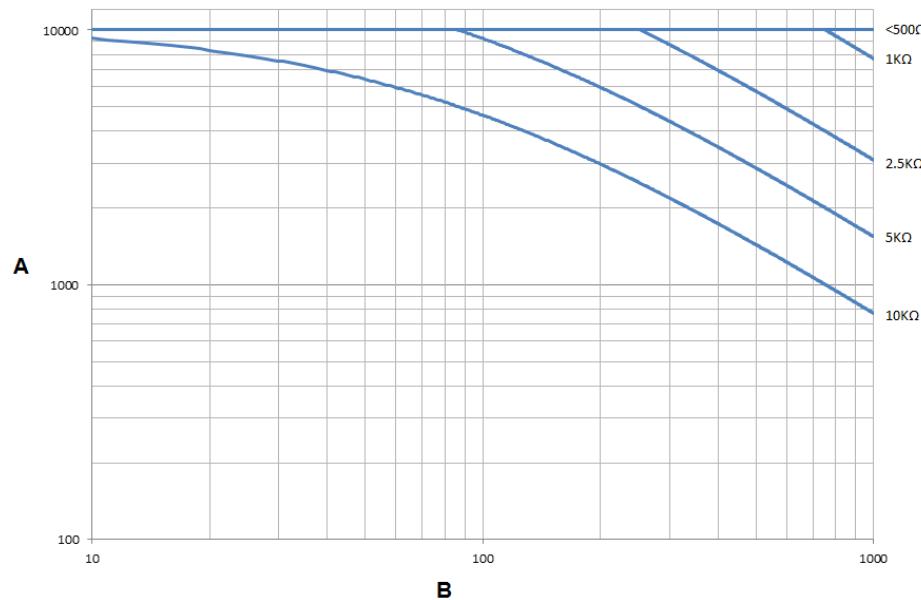
External power supply

For an externally powered pulse output, the following requirements apply:

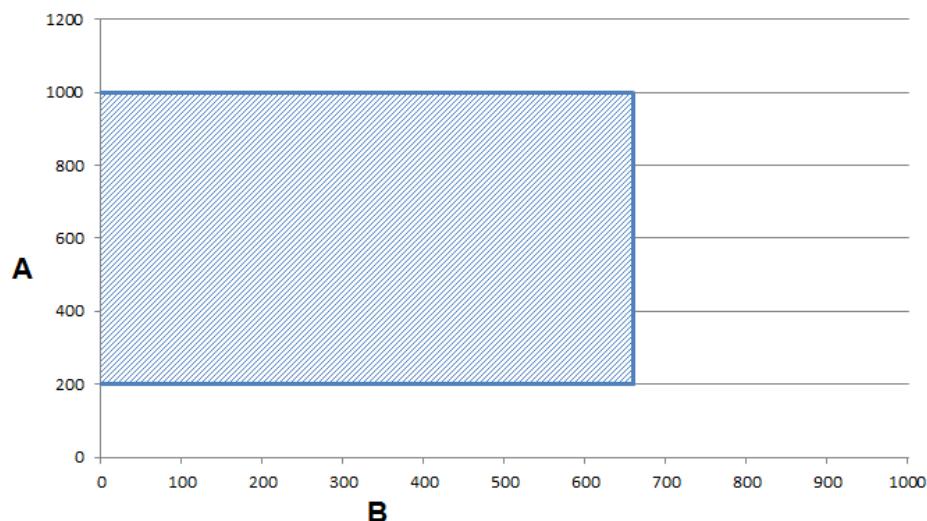
- Supply voltage: 5 to 28 VDC
- Maximum current: 100 mA
- Maximum power: 1.0 W
- Load resistance: 200 to 10k Ohms (typical value 1k Ohms). Refer to the figure indicated:

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

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

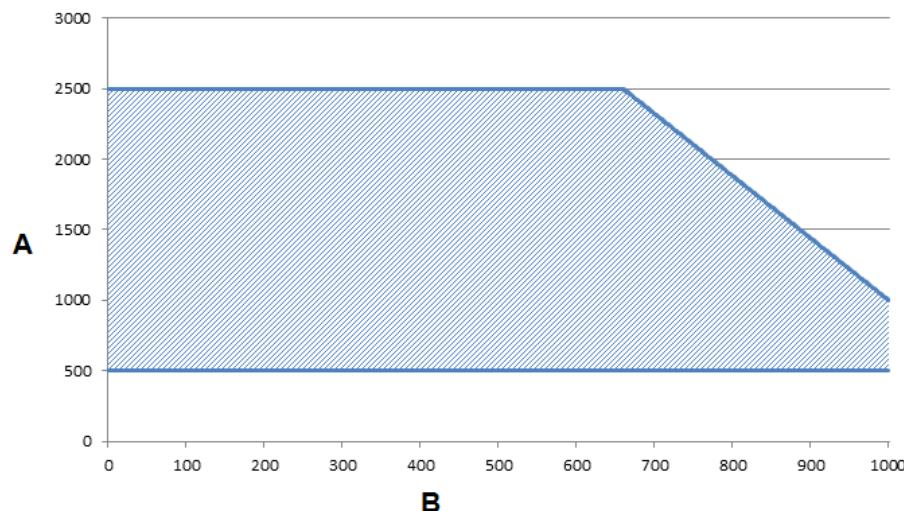
Figure 6-2: Output Option Code A—Maximum Frequency vs. Cable Length

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

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

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

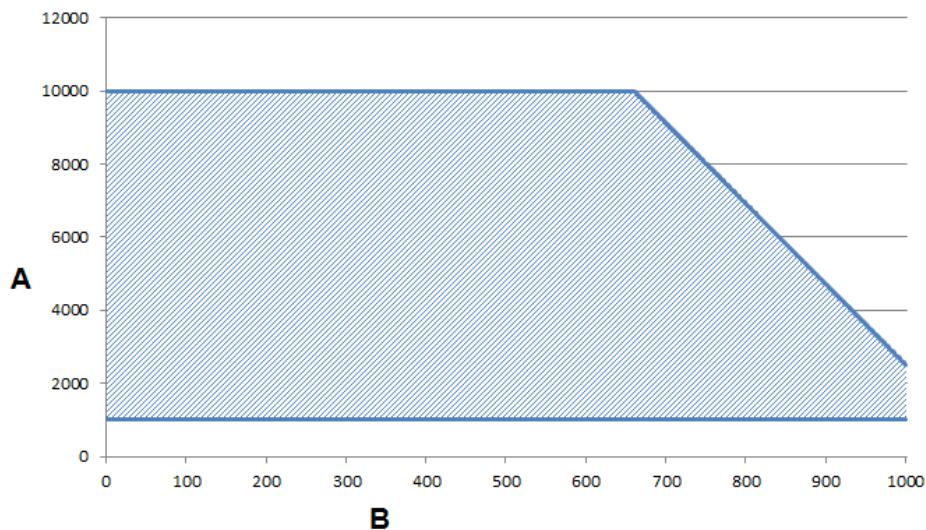
At 5000 Hz operation with a 5 VDC supply, pull-up resistances of 200 to 1000 Ohms allow cable lengths up to 660 ft (200 m).

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

A. Resistance (Ω)

B. Cable length (feet)

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

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

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

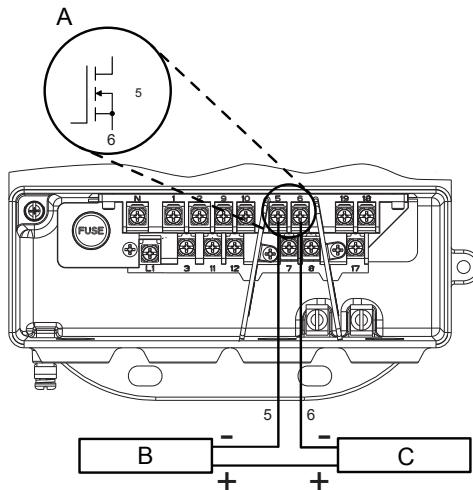
At 5000 Hz operation with a 24 VDC supply, pull-up resistances of 1000 to 10,000 Ohms allow cable lengths up to 660 ft (200 m). Resistances from 1000 to 2500 Ohms allow a cable length of 1000 ft (330 m).

Connecting an external power supply

Note

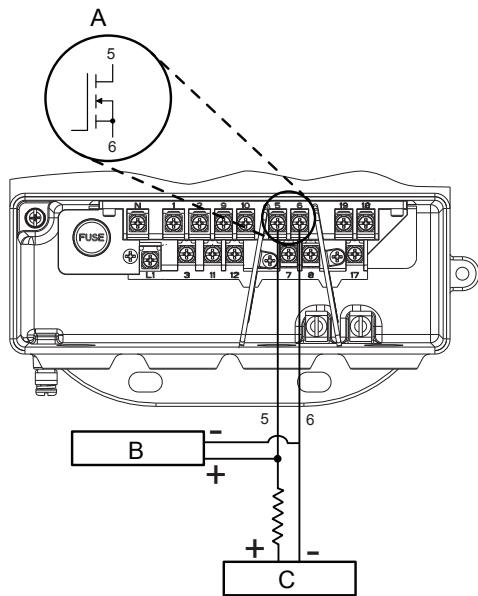
Total loop impedance must be sufficient to keep loop current below maximum rating. A resistor can be added in the loop to raise impedance.

Figure 6-6: Connecting an electromechanical totalizer/counter with external power supply



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

Figure 6-7: Connecting to an electronic totalizer/counter with external power supply



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

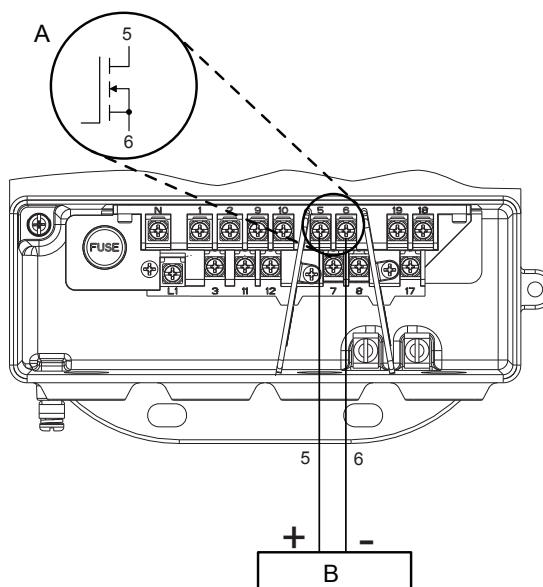
1. Ensure the power source and connecting cable meet the requirements outlined previously.

2. Turn off the transmitter and pulse output power sources.
3. Run the power cable to the transmitter.
4. Connect - DC to terminal 6.
5. Connect + DC to terminal 5.

Internal power supply

For an internally powered pulse output, the supply voltage from the transmitter can be up to 12 VDC. Connect the transmitter directly to the counter as shown. Internal pulse power can only be used with an electronic totalizer or counter and cannot be used with an electromechanical counter.

Figure 6-8: Connecting to an electronic totalizer/counter with internal power supply



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

1. Turn off the transmitter.
2. Connect wires from the counter to the transmitter as shown.

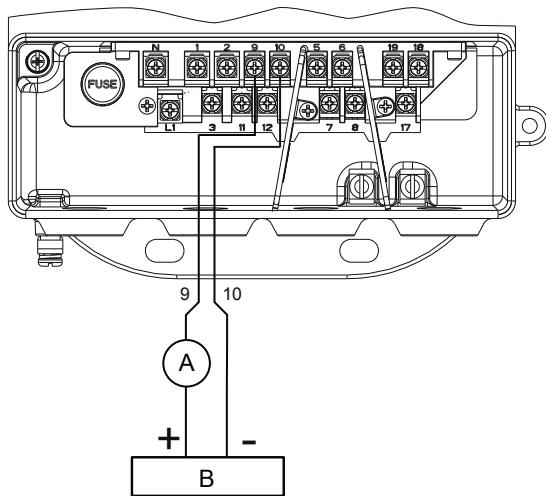
6.2.2

Connect discrete output

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

- Supply Voltage: 5 to 28 VDC
- Maximum current: 50 mA
- Switch Closure: solid state relay

Figure 6-9: Connect discrete output to relay or control system input



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

Note

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

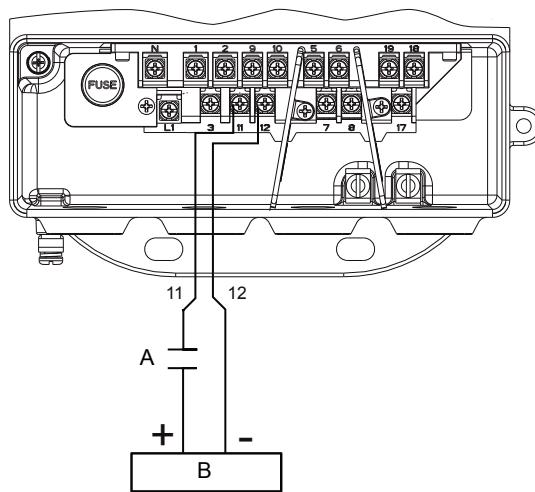
For discrete output control, connect the power source and control relay to the transmitter. To connect external power for discrete output control, complete the following steps:

1. Ensure the power source and connecting cable meet the requirements outlined previously.
2. Turn off the transmitter and discrete power sources.
3. Run the power cable to the transmitter.
4. Connect the DC power supply to the transmitter as shown.

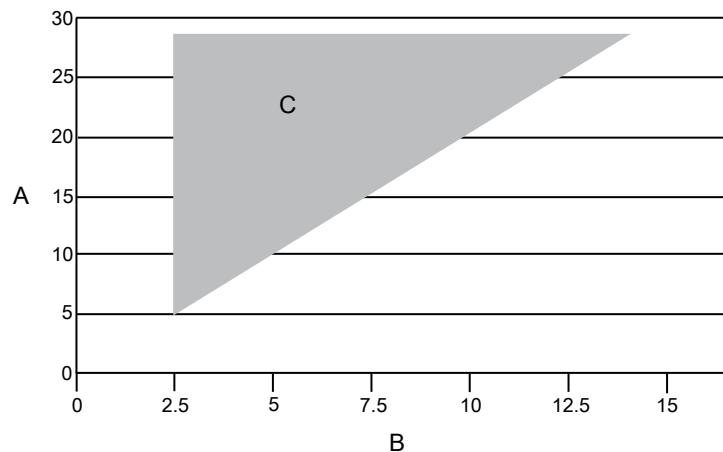
6.2.3 Connect discrete input

The following requirements apply:

- Supply voltage: 5 VDC to 28 VDC
- Current: 1.5 mA to 20 mA
- Input Impedance: 2.5 k plus 1.2 V diode drop. See [Figure 6-11](#).

Figure 6-10: Connecting Discrete Input

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

Figure 6-11: Discrete Input Operating Range

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

To connect the discrete input, complete the following steps.

1. Ensure the power source and connecting cable meet the requirements outlined previously.
2. Turn off the transmitter and discrete power sources.
3. Run the power cable to the transmitter.
4. Connect the wires to the transmitter as shown.

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 MS sensor model is available in four coil housing configurations. Configurations are identified by the M0, M1, M2, or M4 options codes found in the model number.

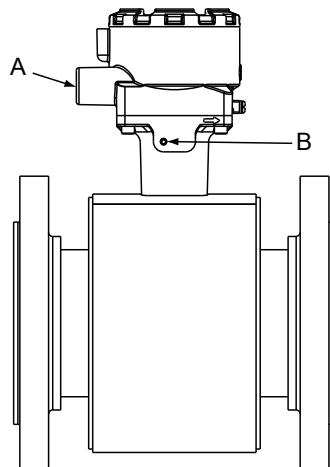
6.3.1

Standard coil housing configuration

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

- MS with option code M0 - MSxxxxxxxxxxxxM0

Figure 6-12: Standard Housing Configuration



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

6.3.2

Process leak protection (option M1)

The sensor 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.

- MS with option code M1 - MSxxxxxxxxxxxxM1

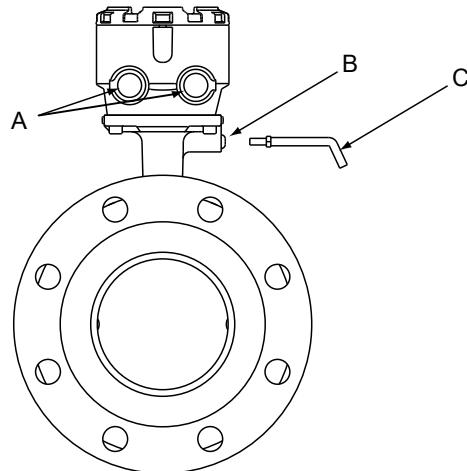
A PRV can be installed in the threaded connection to prevent possible over-pressuring of the coil housing caused by a primary seal failure. The PRV is capable of venting fugitive emissions when pressure inside the coil housing exceeds five psi. Additional piping may be connected to the PRV to drain any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

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

Note

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

Figure 6-13: Sensor 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 sensor is available with process leak containment. The coil housing configuration is a factory sealed all-welded enclosure with the addition of sealed electrode compartments.

- MS with option code M2/M4 - MSxxxxxxxxxxM2/M4

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

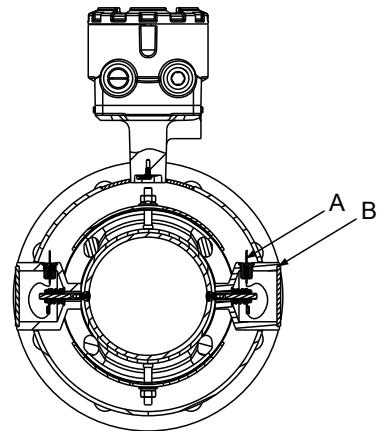
- Code M2 - sealed, welded coil housing with separate sealed and welded electrode compartments (see [Figure 6-14](#)).
- Code M4 - sealed, welded coil housing with separate sealed and welded electrode compartments with a threaded port on the electrode tunnel cap, capable of venting fugitive emissions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

Note

To properly vent process fluid from the electrode compartment to a safe location, additional piping is required and must be installed by the user. Installation of any associated piping must be performed in accordance with environmental and hazardous

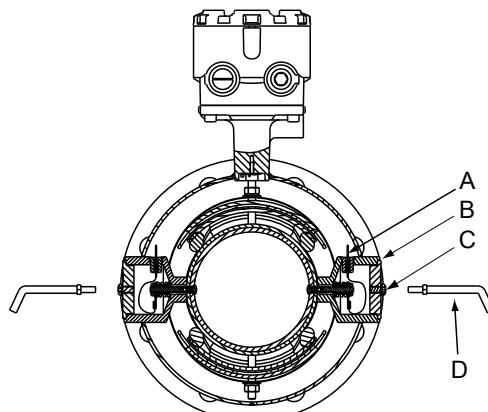
area requirements. In the event of primary seal failure, the electrode compartment may be pressurized. Use caution when removing the cap screw.

Figure 6-14: Sensor with M2 Coil Housing Configuration



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

Figure 6-15: Sensor 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).

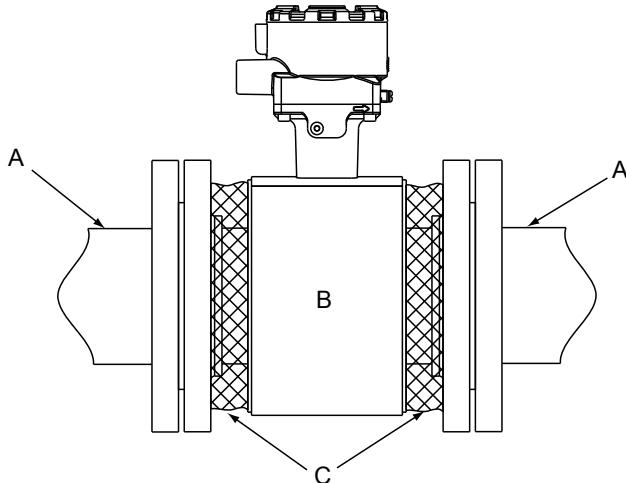
6.3.4

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 6-16](#)).

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

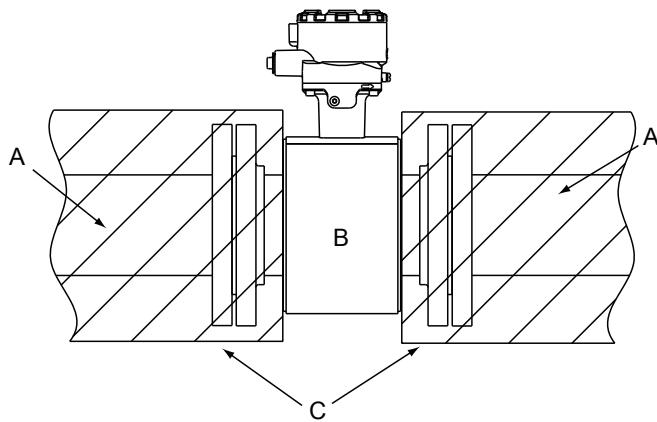


- A. Process piping
- B. Coil housing
- C. Insulation

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

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

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



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

7 Operation

7.1 Introduction

The transmitter features a full range of software functions, transmitter configurations, and diagnostic settings. These features can be accessed through the Local Operator Interface (LOI) or ProLink III software. Configuration variables may be changed at any time; specific instructions are provided through on-screen instructions.

This section covers the basic features of the LOI (optional) and provides general instructions on how to navigate the configuration menus using the buttons. For detailed LOI configuration refer to [Configure LOI/Display](#).

7.2 Local operator interface (LOI)

The optional LOI provides a communications center for the transmitter.

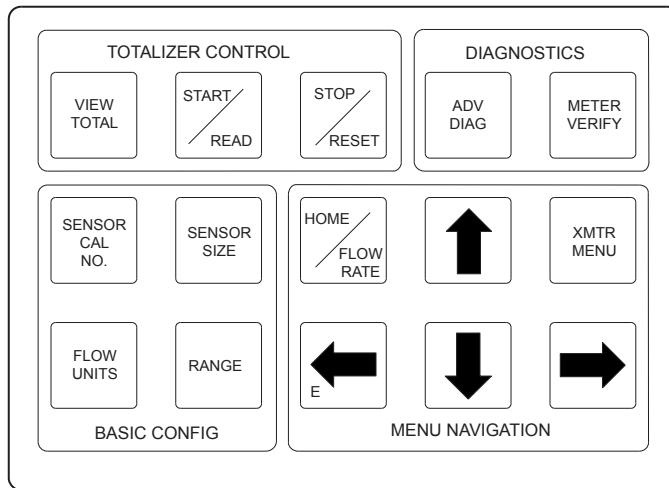
The LOI allows an operator to:

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

7.2.1 Basic features

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

Figure 7-1: Local Operator Interface and Character Display



Totalizer Control

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



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



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

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



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

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

Note

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

Diagnostics

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



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



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

Basic Config

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



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



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



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



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

Menu Navigation

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



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



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



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



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



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



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

Press **XMTR MENU** to access the menu. Use **▲**, **▼**, **◀**, and **▶** to navigate the menu structure. A map of the LOI menu structure is shown in .

7.2.2 Data entry

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

1. Use **▲**, **▼**, **◀**, and **▶** to navigate the menu () and access the appropriate alphanumeric parameter.
2. Use **■**, **█** or **█** to begin editing the parameter.
 - Press **█** to go back without changing the value.
 - For numerical data, scroll through the digits 0-9, decimal point, and dash.
 - For alphabetical data, scroll through the letters of the alphabet A-Z, digits 0-9, and the symbols ?, &, +, -, *, /, \$, @, %, and the blank space.

3. Use **█** to highlight each character you want to change and then use **↑** and **↓** to select the value.
If you go past a character that you wish to change, keep using **█** to wrap around and arrive at the character you want to change.
4. Press **█** when all changes are complete to save the entered values.
5. Press **█** again to navigate back to the menu tree.

7.2.3 Data entry examples

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

Table values They are available from a predefined list for parameters such as line size or flow units.

Select values Integers, floating point numbers, or character strings that are entered one character at a time using the arrow keys for parameters such as PV URV and calibration number.

Table value example

Setting the sensor size:

1. Use **█**, **█**, **█**, and **█** to select line size from the basic setup menu.
2. Use **█** or **█** to increase/decrease the sensor size.
3. When you reach the desired sensor size, press **█**.
4. Set the loop to manual if necessary, and press **█** again.

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

Select value example

Changing the upper range limit:

1. Use **█**, **█**, **█**, and **█** to select PV URV from the basic setup menu.
2. Press **█** to position the cursor.
3. Press **█** or **█** to set the number.
4. Repeat Step 2 and Step 3 until desired number is displayed, press **█**.
5. Set the loop to manual if necessary, and press **█** again.

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

7.2.4 Totalizer functionality

Totalizer selection

- To view the totalizer values, press **VIEW TOTAL**.

See [Totalizer](#) for more information on the totalizer functionality.

Start all / Stop all

Totalizers can be started or stopped simultaneously. See [Totalizer](#). They cannot be started and stopped individually.

Reset totalizer

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

7.2.5 Display lock

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

Manual display lock

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

Auto display lock

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

1. Scroll to and select **LOI Config** from the Detailed Setup menu.
2. Press **▲** to highlight **Disp Auto Lock** and press **■** to enter the menu.
3. Press **▲** or **▼** to select the auto lock time.
4. When you reach the desired time, press **■**.
5. Set the loop to manual if necessary, and press **■**.

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

7.2.6 Security

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

Write protect

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

HART Lock

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

7.2.7 Locate device

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

7.2.8 Diagnostic messages

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

7.2.9 Display symbols

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

Display Lock	
Totalizer	
Reverse flow	
Continuous meter verification	

7.2.10 LOI menu tree

Figure 7-2: LOI menu tree, part 1

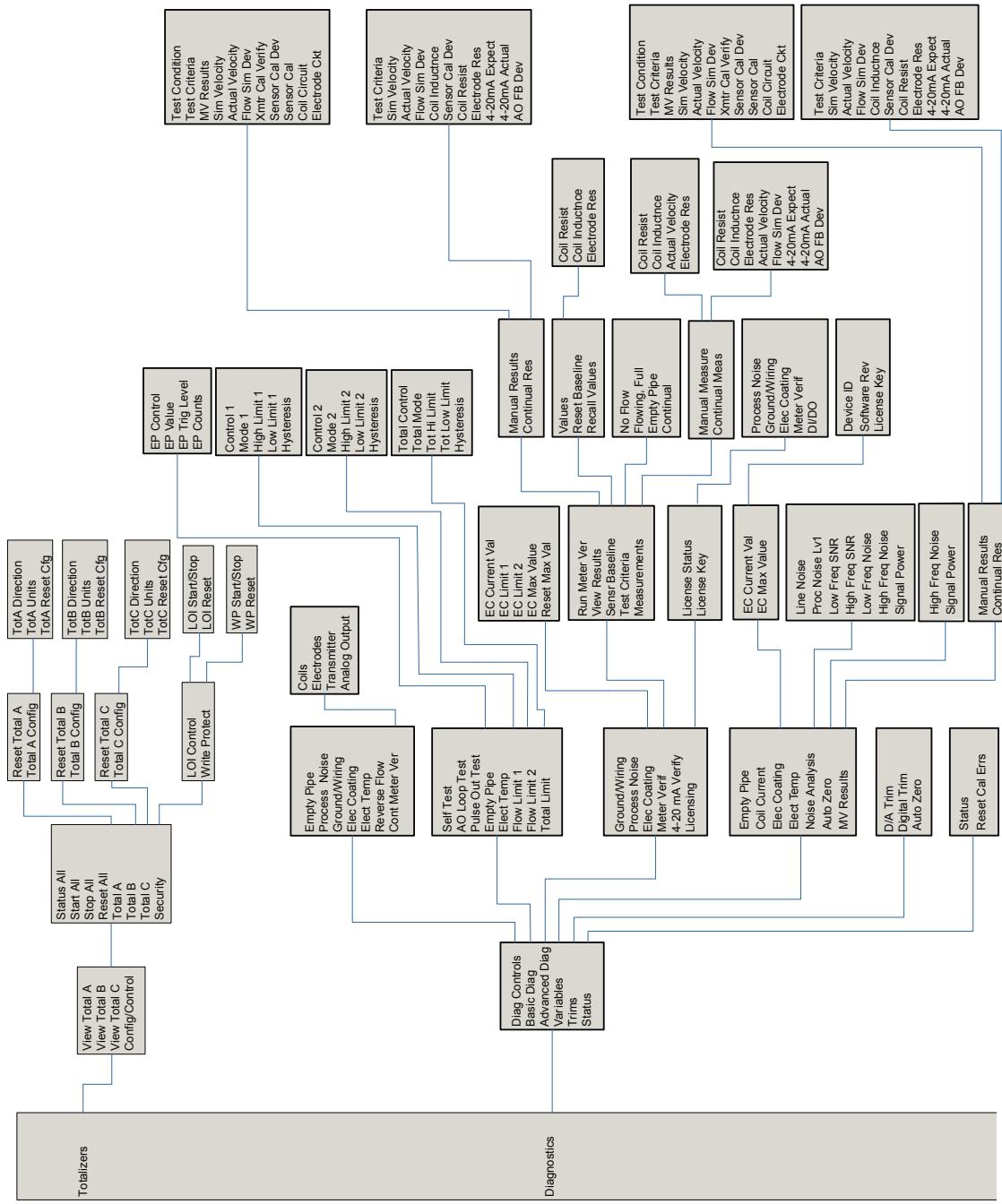
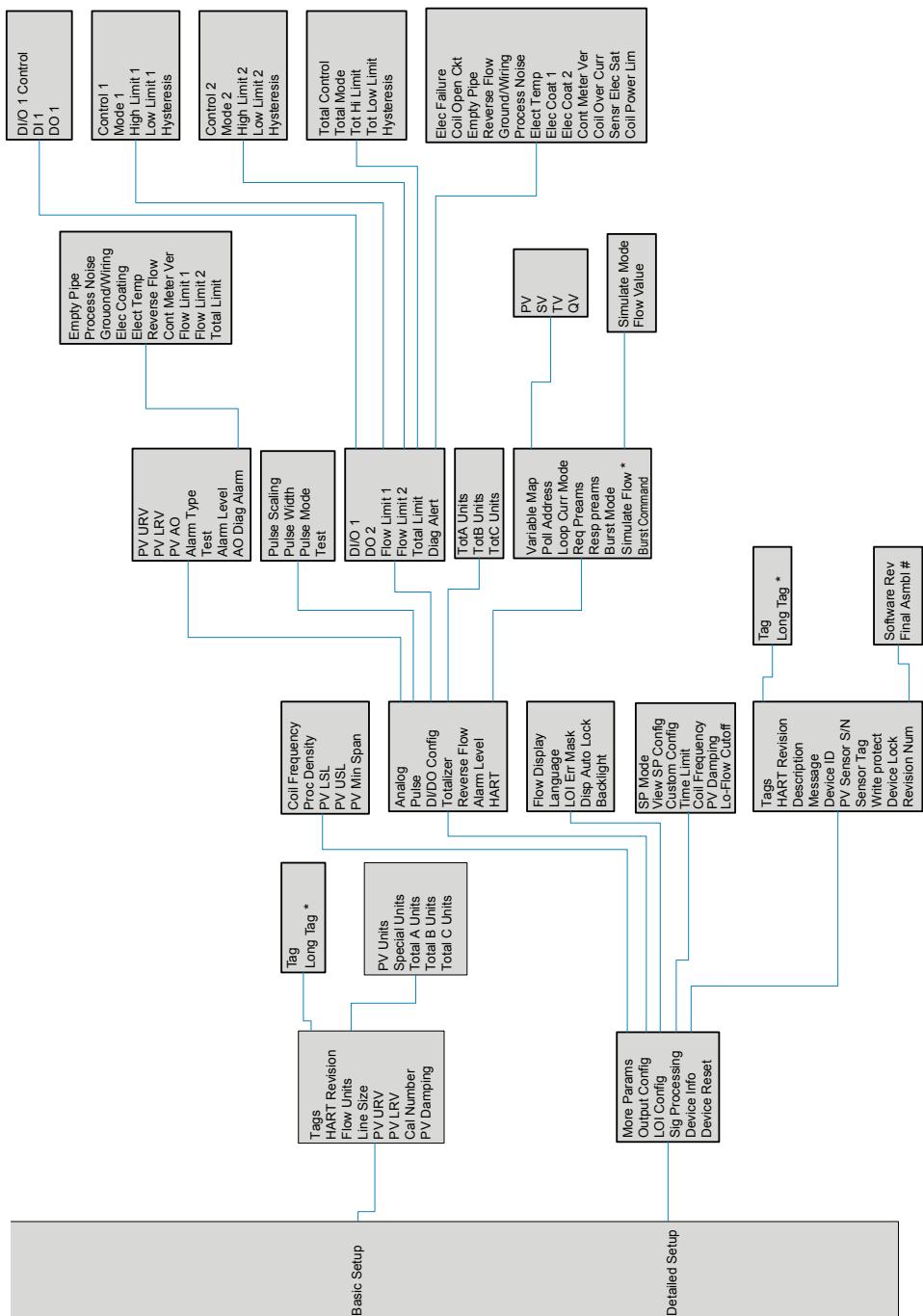


Figure 7-3: LOI menu tree, part 2

8 Advanced Configuration Functionality

8.1 Introduction

This section contains information for advanced configuration parameters.

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

8.2 Configure outputs

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

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

8.2.1 Analog output

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

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

Upper range value

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

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

Note

If entering a negative number, the minus sign must be entered in the furthest left position on the LOI.

Lower range value

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

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

Note

If entering a negative number, the minus sign must be entered in the furthest left position on the LOI.

Alarm type

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

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

- High
- Low

Alarm level

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

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

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

Table 8-1: Rosemount Values

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

Table 8-2: NAMUR Values

Level	4-20 mA saturation	4-20 mA alarm
Low	3.8 mA	3.5 mA
High	20.5 mA	22.6 mA

AO diagnostic alarm

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

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

Table 8-3: Analog Alarm Diagnostic Options

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

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

8.2.2 Pulse output

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

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

Pulse scaling

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

Transmitter may be commanded to supply a specified frequency between 1 pulse/ day at 39.37 ft/sec (12 m/s) to 10,000 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 10,000 Hz. The minimum conversion factor value is found by dividing the minimum span (in units of volume per second) by 10,000 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

LOI menu path	Detailed Setup → Output Config → Pulse → Units
---------------	--

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

Pulse width

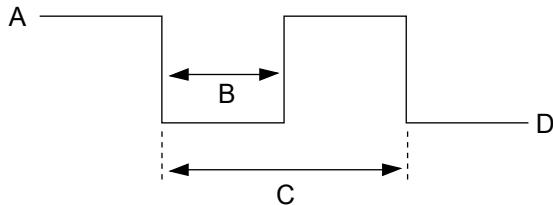
LOI menu path	Detailed Setup → Output Config → Pulse → Pulse Width
---------------	--

The factory default pulse width is 0.5 ms.

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

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

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

Figure 8-1: Pulse Output

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

Example

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

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

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

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

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

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.

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

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

Frequency = 5.833 Hz

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

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

8.2.3 Totalizer

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

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

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

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

View Totals

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

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

Configure totalizers

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

Totalizer direction

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

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

Totalizer units

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

Configure the units for totalizers.

Table 8-4: Totalizer units

Volume units		Mass units		Other units			
LOI	Units	LOI	Units	LOI	Units		
gal	Gallons	KG	Kilograms	ft	Feet		
l	Liters	Mton	Metric tons	m	Meters		
lgal	Imperial gallons	lb	Pounds	Special	Special Units ⁽¹⁾		
m3	Cubic meters	Ston	Short tons				
B42	Barrels (42 gallons)						
ft3	Cubic feet						
cm3	Cubic centimeters						
B31	Barrels (31 gallons)						
Mgal	Million gallons						

(1) See [Configure special units](#).

Reset configuration

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

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

Reset individual totalizer

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

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

8.2.4 Discrete input/output

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

- The discrete input can provide positive zero return (PZR) or reset totalizer (A, B, C, or all totals).

Note

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

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

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

Discrete input options (Channel 1 only)

PZR (Positive Zero Return) When conditions are met to activate the input, the transmitter will force the output to zero flow.

Net Total Reset When conditions are met to activate the input, the transmitter will reset the net total value to zero.

Discrete output options

Reverse Flow	The output will activate when the transmitter detects a reverse flow condition.
Zero Flow	The output will activate when a no flow condition is detected.
Transmitter Fault	The output will activate when a transmitter fault condition is detected.
Empty Pipe	The output will activate when the transmitter detects an empty pipe condition.
Flow Limit 1	The output will activate when the transmitter measures a flow rate that meets the conditions established for the flow limit 1 alert.
Flow Limit 2	The output will activate when the transmitter measures a flow rate that meets the conditions established for the flow limit 2 alert.
Diagnostic Status Alert	The output will activate when the transmitter detects a condition that meets the configured criteria of the diagnostic status alert.
Total Limit	The output will activate when the transmitter Totalizer A value meets the conditions established for the total limit alert.

Channel 1

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

DI/O 1 control

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

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

Note

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

Discrete input 1

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

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

Discrete output 1

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

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

Channel 2

Channel 2 is available as discrete output only.

Discrete output 2

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

This parameter displays the configuration for channel 2.

Flow limit (1 and 2)

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

Control

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

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

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

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

Mode

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

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

- > High limit** The HART alert will activate when the measured flow rate exceeds the high limit set point.
- < Low limit** The HART alert will activate when the measured flow rate falls below the low limit set point.
- In range** The HART alert will activate when the measured flow rate is between the high limit and low limit set points.
- Out of range** The HART alert will activate when the measured flow rate exceeds the high limit set point or falls below the low limit set point.

High limit

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

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

Low limit

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

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

Flow limit hysteresis

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

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

Total limit

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

Total control

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

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

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

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

Total mode

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

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

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

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

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

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

Total high limit

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

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

Total low limit

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

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

Total limit hysteresis

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

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

Diagnostic status alert

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

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

ON The diagnostic status alert will activate when a transmitter detects a diagnostic designated as ON.

OFF The diagnostic status alert will not activate when diagnostics designated as OFF are detected.

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

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

8.3

Configure HART

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

8.3.1

Variable mapping

LOI menu path	Detailed Setup → Output Config → HART → Variable Map
---------------	--

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

Primary variable (PV)

LOI menu path	Detailed Setup → Output Config → HART → Variable Map → PV
---------------	---

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

Secondary variable (SV)

LOI menu path	Detailed Setup → Output Config → HART → Variable Map → SV
---------------	---

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

Tertiary variable (TV)

LOI menu path	Detailed Setup → Output Config → HART → Variable Map → TV
---------------	---

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

Quaternary variable (QV)

LOI menu path	Detailed Setup → Output Config → HART → Variable Map → QV
---------------	---

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

Available Variables

- Flow Rate
- Pulse Output
- Totalizer A
- Totalizer B
- Totalizer C
- Electronics Temperature
- Line Noise
- Low Freq SNR (DS1 Option)
- High Freq SNR (DS1 Option)
- Signal Power
- Empty Pipe Value
- Transmitter Velocity Deviation
- Electrode Coating Value (DS1 Option)
- Electrode Resistance
- Coil Resistance Value (MV Option)
- Coil Inductance Value (MV Option)
- Coil Baseline Deviation (MV Option)
- Analog Output Feedback Deviation
- Coil Current

8.3.2 Poll address

LOI menu path	Detailed Setup → Output Config → HART → Poll Address
---------------	--

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

The transmitter poll address is set to zero at the factory, allowing standard operation in a point-to-point manner with a 4–20 mA output signal. To activate multi-drop communication:

- The transmitter poll address must be changed to a non-zero integer (1–63).
- The Loop Current Mode may need to be set to ON to fix the output current to 4 mA, or it can be set to OFF if a 4–20 mA output is desired. See [Loop current mode](#).

8.3.3 Loop current mode

LOI menu path	Detailed Setup → Output Config → HART → Loop Curr Mode
---------------	--

Available through the LOI only.

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

8.3.4 Burst mode

LOI menu path	Detailed Setup → Output Config → HART → Burst Mode
---------------	--

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

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

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

Request preambles

LOI menu path	Detailed Setup → Output Config → HART → Req Preams
---------------	--

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

Response preambles

LOI menu path	Detailed Setup → Output Config → HART → Resp Preams
---------------	---

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

8.4 Configure LOI/Display

8.4.1 Flow and totalizer display

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

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

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

8.4.2 Language

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

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

8.4.3 Display lock

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

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

- OFF (default)
- 1 Minute
- 10 Minutes

The display is always locked on the flow screen.

8.4.4 Error mask

LOI menu path	Detailed Setup → LOI Config → LOI Err Mask
---------------	--

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

8.4.5 Backlight control

LOI menu path	Detailed Setup → LOI Config → Backlight
---------------	---

To conserve power, the LOI backlight can be configured to automatically turn off after a set amount of time without keypad activity.

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

8.5 Additional parameters

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

8.5.1 Coil drive frequency

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

This parameter changes the drive frequency of the magnetic coils.

Low

The standard coil drive frequency is Low. This is the recommended coil drive frequency setting for most applications.

High

If the process fluid causes a noisy or unstable flow reading, increase the coil drive frequency to High. If the coil drive frequency is set to High, the auto zero trim is highly recommended for optimal performance. Not performing the auto zero trim can lead to degraded accuracy, especially at low flow rates.

8.5.2 Process density

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

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

$$Q_m = Q_v \times \rho$$

Where:

Q_m is the mass flow rate

Q_v is the volumetric flow rate, and

ρ is the fluid density

8.5.3 Reverse flow

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

Use reverse flow to enable or disable the transmitter's ability to read flow in the opposite direction of the flow direction arrow (see [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.

8.5.4 Low flow cutoff

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

Low flow cutoff allows the user to set a low flow limit to be specified. The low flow cutoff units are the same as the PV units and cannot be changed. The low flow cutoff value applies to both forward and reverse flows.

8.5.5 PV (flow) damping

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

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

8.6 Configure special units

Special units are used when the application requires units that are not included in the flow units available from the device. Refer to for a complete list of the available units.

8.6.1 Base volume unit

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

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

8.6.2 Conversion factor

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

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

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

8.6.3 Base time unit

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

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

8.6.4 Special volume unit

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

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

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

8.6.5 Special flow rate unit

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

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

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

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

9 Advanced Diagnostics Configuration

9.1 Introduction

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

Table 9-1: Magnetic flow meter diagnostics

Diagnostic name	Diagnostic category	Product capability
Basic diagnostics		
Empty Pipe	Process	Standard
Reverse Flow	Process	Standard
Electrode saturation	Installation/process	Standard
Transmitter Fault	Meter Health	Standard
Electronics Temperature	Meter Health	Standard
Coil Circuit Fault	Meter Health	Standard
Advanced diagnostics		
High Process Noise	Process	Suite 1 (DS1)
Coated Electrode Detection	Process	Suite 1 (DS1)
Commanded Smart Meter Verification	Meter Health	Suite 2 (MV)
Continuous Smart Meter Verification	Meter Health	Suite 2 (MV)
4-20 mA Loop Verification	Installation	Suite 2 (MV)

9.2

Meter factors

Meter Factor is a gain adjustment that may be needed to adjust for installation effects caused by less than ideal straight run piping or if pairing the 8782 with an 8707 instead of with a MS sensor.

The procedure is very similar to Vortex and Coriolis and is entered as a flow multiplication factor of the range 0.2 to 1.8. Not all installations will require a Meter Factor and the 8782 will have a stable flow rate without a Meter Factor. If replacing an existing legacy transmitter, a Meter Factor will enable the 8782 to match the legacy transmitter flow reading if there is a discrepancy.

Performing an auto zero trim is recommended for best performance on the 8782. If an auto zero trim is performed at any time after entering a meter factor adjustment, the meter factor will need to be re-calculated and re-entered post auto zero trim or else accuracy could be impacted.

Meter Factor = Actual Flow Rate (from 8712H) / Current Flow Rate (From 8782)

Example:

- The known actual flow rate is 100 GPM.
- A newly installed transmitter reads a flow rate of 1150 GPM after auto zero.

Remedy:

1. Perform a Meter Factor calculation of $100/115 = 0.8696$.
2. Enter a Meter Factor of 0.8696 into the transmitter.

Note

Four decimal places are available to avoid rounding errors.

Result:

- The transmitter now reads 100 GPM

9.3

Licensing and enabling

All advanced diagnostics are licensed by ordering option code MV or DS1. 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 an Emerson representative.

9.3.1

Licensing the diagnostics

1. Power up the transmitter.
2. Verify the software version is 7.1.1 software or later.

LOI menu path	Detailed Setup → Device Info → Revision Num → Software Num
---------------	--

3. Determine the Device ID.

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

4. Obtain a license key from an Emerson representative.

5. Enter license key.

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

9.4

Tunable empty pipe detection

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

Turning empty pipe on/off

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

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

9.4.1

Tunable empty pipe parameters

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

Empty pipe (EP) value

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

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

Empty pipe (EP) trigger level

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

Limits: 3 to 2000

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

Empty pipe (EP) counts

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

Limits: 2 to 50

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

9.4.2 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

9.5 Electronics temperature

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

9.5.1

Turning electronics temperature on/off

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

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

9.5.2

Electronics temperature parameters

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

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

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

9.6

Ground/wiring fault detection

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

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

9.6.1

Turning ground/wiring fault on/off

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

The ground/wiring fault detection diagnostic can be turned on or off as required by the application.

9.6.2

Ground/wiring fault parameters

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

Line noise

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

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

9.7

High process noise detection

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

9.7.1

Turning high process noise on/off

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

The high process noise diagnostic can be turned on or off as required by the application. If the advanced diagnostics suite 1 (DS1 Option) was ordered, then the high process noise diagnostic will be turned on. If DS1 was not ordered or licensed, this diagnostic is not available.

9.7.2

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). The low and high frequency signal values depend on the line size.

Low frequency signal to noise ratio (SNR)

LOI menu path	Diagnostics → Variables → Noise Analysis → Low Freq Noise
---------------	---

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

High frequency signal to noise ratio (SNR)

LOI menu path	Diagnostics → Variables → Noise Analysis → High Freq Noise
---------------	--

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

9.8

Coated electrode detection

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

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

9.8.1

Turning coated electrode detection on/off

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

The coated electrode detection diagnostic can be turned on or off as required by the application. If the advanced diagnostics suite 1 (DS1 option) was ordered, then the coated electrode detection diagnostic will be turned on. If DS1 was not ordered or licensed, this diagnostic is not available.

9.8.2

Coated electrode parameters

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

Electrode coating (EC) value

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

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

Electrode coating (EC) level 1 limit

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

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

Electrode coating (EC) level 2 limit

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

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

Maximum electrode coating (EC)

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

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

Clear maximum electrode value

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

Use this method to reset the maximum electrode coating value.

9.9

4-20 mA loop verification

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

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

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

9.9.1 Initiating 4-20 mA loop verification

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

The 4–20 mA loop verification diagnostic can be initiated as required by the application. If Smart Meter Verification Professional (MV Option) was ordered, then the 4–20 mA loop verification diagnostic will be available. If MV was not ordered or licensed, this diagnostic is not available.

9.9.2 4-20 mA loop verification parameters

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

4-20 mA loop verification test result

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

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

4 mA measurement

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

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

12 mA measurement

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

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

20 mA measurement

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

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

Low alarm measurement

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

Shows the measured value of the low alarm verification test.

High alarm measurement

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

Shows the measured value of the high alarm verification test.

9.10

Smart Meter Verification

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

9.10.1

Sensor baseline parameters

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

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

Coil circuit resistance

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

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

Coil inductance (signature)

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

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

Electrode circuit resistance

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

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

9.10.2 Establishing the sensor baseline

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)

LOI menu path	Diagnostics → Advanced Diag → Meter Verif → Sensr Baseline → Reset Baseline
---------------	--

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.

Note

For high temperature applications, it is a best practice to take the sensor baseline when the process fluid and sensor have reached their normal operating temperature if that will be operating condition during test measurements.

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)

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

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

9.10.3 Smart Meter Verification test criteria

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

No flow limit

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

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

Flowing full limit

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

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

Empty pipe limit

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

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

Continuous limit

LOI menu path	Diagnostics → Advanced Diag → Meter Verif → Test Criteria → Continual
---------------	---

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

9.11

Run commanded Smart Meter Verification

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

The Smart Meter Verification diagnostic will be available if the Smart Meter Verification Professional (MV) was ordered. If MV was not ordered or licensed, this diagnostic will not be available. This method will initiate the commanded meter verification test.

9.11.1

Test conditions

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

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

- No flow** Run the Smart Meter Verification test with a full pipe and no flow in the line. Running the Smart Meter Verification test under this condition provides the

most accurate results and the best indication of magnetic flowmeter health.

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

9.11.2 Test scope

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

The commanded 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.

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.

9.12

Continuous Smart Meter Verification

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

9.12.1 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

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

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

Electrodes

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

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

Transmitter

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

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

Analog output

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

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

9.13

Smart Meter Verification test results

If the Smart Meter Verification test is initiated by command, the transmitter will make several measurements to verify the transmitter calibration, sensor calibration, coil circuit health, and electrode circuits health. The results of these tests can be reviewed and recorded on the [Table 9-2](#) form. Print the "Commanded Calibration Verification Results" form and enter the test results as you view them. The completed form can be used to validate that the meter is within the required calibration limits to comply with governmental regulatory agencies.

Depending on the method used to view the results, they will be displayed in either a menu structure, as a method, or in the report format. When using the LOI, the parameters are viewed as a method using the left arrow key to cycle through the results.

Table 9-2: Manual Smart Meter Verification Test Parameters

	Parameter	LOI menu path (Diagnostics → Variables → MV Results → Manual Results)
1	Test Condition	Test Condition
2	Test Criteria	Test Criteria
3	8785 Test Result	MV Results
4	Simulated Velocity	Sim Velocity
5	Actual Velocity	ActualVelocity
6	Velocity Deviation	Flow Sim Dev
7	Xmtr Cal Test Result	Xmtr Cal Verify
8	Sensor Cal Deviation	Sensor Cal Dev
9	Sensor Cal Test Result	Sensor Cal
10	Coil Circuit Test Result	Coil Circuit
11	Electrode Circuit Test Result	Electrode Ckt

Table 9-3: Continuous Smart Meter Verification Test Parameters

	Parameter	LOI menu path (Diagnostics → Variables → MV Results → Continual Res)
1	Continuous Limit	Test Criteria
2	Simulated Velocity	Sim Velocity
3	Actual Velocity	ActualVelocity
4	Velocity Deviation	Flow Sim Dev
5	Coil Signature	Coil Inductnce
6	Sensor Cal Deviation	Sensor Cal Dev
7	Coil Resistance	Coil Resist
8	Electrode Resistance	Electrode Res
9	mA Expected	4–20 mA Expect
10	mA Actual	4–20 mA Actual
11	mA Deviation	AO FB Dev

9.14

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

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

The coil circuit resistance is a measurement of the coil circuit health. This value is compared to the coil circuit resistance 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)

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

The coil 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

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

The electrode circuit resistance is a measurement of the electrode circuit health. This value is compared to the electrode circuit resistance 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

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

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

Flow simulation deviation

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

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

9.15

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.

9.15.1

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 commanded meter verification (no flow, flowing full, and empty pipe).

For example, a plant might set the following commanded 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: _____

10 Digital Signal Processing

10.1 Introduction

Magnetic flow meters 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 (High Frequency vs. Low Frequency) to isolate the flow signal from the process noise, the microprocessor has *Digital Signal Processing* (DSP) that is capable of rejecting the noise specific to the application. This section explains the different types of process noise, provides instructions for optimizing the flow reading in noisy applications, and provides a detailed description of the digital signal processing functionality.

10.2 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 on 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 flow meter and high concentration slurry flows where the particulates are constantly passing over the electrode head. An example of this type of flow stream would be a basis weight stream in a paper mill.

10.3 High process noise diagnostic

Note

See also [High process noise detection](#).

The transmitter continuously monitors signal amplitudes over a wide range of frequencies. For the high process noise diagnostic, the transmitter specifically looks at the noise amplitude adjacent to the Low and High coil drive frequencies. The noise values are used to calculate a signal-to-noise ratio for both drive frequencies. If the signal-to-noise ratio is less than 25 at the currently selected coil drive frequency, the high process noise diagnostic will trip, indicating that the flow signal may be compromised.

10.4

Optimizing flow reading in noisy applications

If the flow reading is unstable, first check the wiring, grounding, and process reference associated with the flow meter. 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 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 increasing the coil drive frequency above the 15 Hz region. The coil drive frequency is optimized by sensor size at the factory to run at the highest frequency with a minimal zero offset. Coil drive mode is selectable between standard Low frequency and noise-reducing High frequency.

10.4.1

Coil drive frequency

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

This parameter changes the drive frequency of the magnetic coils.

Low

The standard coil drive frequency is Low. This is the recommended coil drive frequency setting for most applications.

High

If the process fluid causes a noisy or unstable flow reading, increase the coil drive frequency to High. If the coil drive frequency is set to High, the auto zero trim is highly recommended for optimal performance. Not performing the auto zero trim can lead to degraded accuracy, especially at low flow rates.

10.4.2 Auto zero

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

To ensure optimum accuracy at either low or high frequency, there is an auto zero trim that should be initiated. This is more important at High frequency or if running at low flow rates (<0.3 m/s).

The auto zero trim 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.
- The coil drive frequency can be either Low or High. The auto zero trim will calculate both Low and High frequency auto zero offsets.
- 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 trim. The transmitter completes the auto zero trim automatically in about 90 seconds. A clock symbol will appear in the lower right-hand corner of the display to indicate that it is running.

Note

Failure to complete an auto zero trim may result in a flow velocity offset error of 0 to 2% at 1 ft/s (0.3 m/s) at Low frequency and 5% to 10% at 1 ft/s (0.3 m/s) at High frequencies. While the output level will be offset by the error, the repeatability will not be affected.

10.4.3 Other signal processing tools

The transmitter contains several advanced functions that can be used to stabilize erratic flow readings caused by process noise. If the High coil drive frequency has been set, and the flow reading is still unstable, the damping and signal processing functions should be adjusted. It is best to set the coil drive frequency to High to increase the flow sampling rate. In addition to selecting a higher coil drive frequency (High vs. Low) to isolate the flow signal from the process noise, the transmitter can measure the noise level and automatically adjust and analyze each input based on user defined parameters to reject the noise specific to the application.

Signal processing mode

LOI menu path	Detailed Setup → Signal Processing → SP Mode
---------------	--

The signal processing mode is the primary way the user should adjust the signal processing. The signal processing modes in [Table 10-1](#) automatically configure the signal processing settings.

Table 10-1: Signal processing modes

Signal processing mode	Description
Off	Signal processing is disabled.
Minimal	Provides a minimal amount of signal processing to remove spike noise with the fastest response.

Table 10-1: Signal processing modes (continued)

Signal processing mode	Description
Default	Appropriate for most applications as a starting place.
Increased	Minimizes the noise but does not respond as quickly to process flow step changes.
Maximum	Sets the maximum amount of filtering.
Custom	Allows the maximum amount of filtering. This is the only Signal processing mode setting that allows the user to adjust the individual signal processing settings.

Averaging time

LOI menu path	Detailed Setup → Signal Processing → Custom Config → Averaging time
---------------	---

The Averaging Time sets the amount of time that inputs are collected and used to calculate the running average value. This parameter can be configured for a value between 0.1 seconds and 10 seconds. The default value is 1 second.

Process noise level

LOI menu path	Detailed Setup → Signal Processing → Process Noise Level
---------------	--

This is a read-only parameter that indicates the amount of noise affecting process flow measurement. Cleaner fluids are closer to a noise level of zero; as the solid content or other chemical factors increase the noise, the Process Noise Level reading increases.

Process noise factor

LOI menu path	Detailed Setup → Signal Processing → Custom Config → Process Noise Factor
---------------	---

This parameter will set the tolerance band around the running average. The tolerance band dynamically changes based on the process noise level and the process noise factor. Flow values within the limit are accepted while values 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 0.5 and 20. The default value is 2.0.

- As the process noise factor is decreased, the flow measurement will be more steady but will react slower to changing process flow rates.
- As the process noise factor is increased, the flow measurement could become less stable but will react faster to changing process flow rates.

Scan time

LOI menu path	Detailed Setup → Signal Processing → Custom Config → Scan Time
---------------	--

This setting allows signal processing to scan the flow and provide a more stable output. The default setting is 0.5 seconds; the range is 0 to 1.0 seconds. Setting Scan Time to zero disables this feature.

- A shorter Scan Time can increase response time but may introduce more noise into the flow reading.
- A longer Scan Time can decrease response time but may provide a more stable flow reading.

Time limit

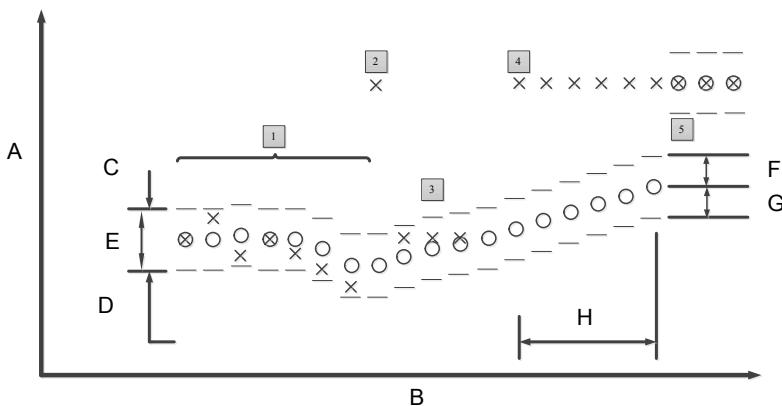
LOI menu path	Detailed Setup → Signal Processing → Time Limit
---------------	---

The time limit parameter forces the output and running average values to the new value of an actual flow rate change that is outside the percent limit boundaries. It thereby limits response time to flow changes to the time limit value rather than the length of the running average. If the average time is 10 seconds, 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 2 seconds is a good starting point for most applicable process fluids. This parameter can be configured for a value between 0.6 and 256 seconds. The default value is 2 seconds.

10.5

Explanation of signal processing algorithm

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

Figure 10-1: Signal Processing Functionality

A. Flow rate

B. Time

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.

11 Maintenance

11.1 Introduction

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

11.2 Safety information

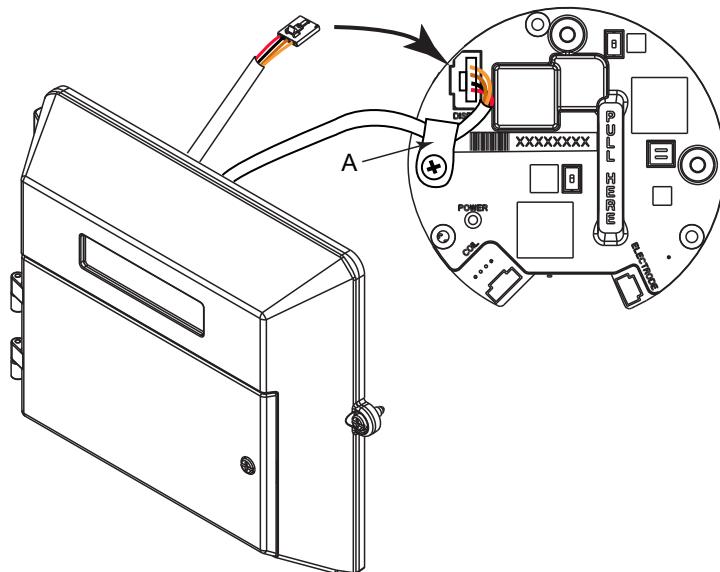
WARNING

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

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

11.3 Installing a LOI/Display

Figure 11-1: Cover assembly with LOI/Display



A. Wire clamp

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 into the electronics stack, install the wire clamp around the cable, and securely tighten the screw, washers, and wire clamp into the left post (9 o'clock position) of the plastic board stack shroud. The wire should be routed on the connector side of this post.
8. Close the upper compartment door and tighten the upper door screw to ensure the housing is properly sealed to meet ingress protection requirements. Return power to the transmitter and verify that it is functioning correctly and reporting the expected flow rate.
9. If installed in a control loop, return the loop to automatic control.

11.4

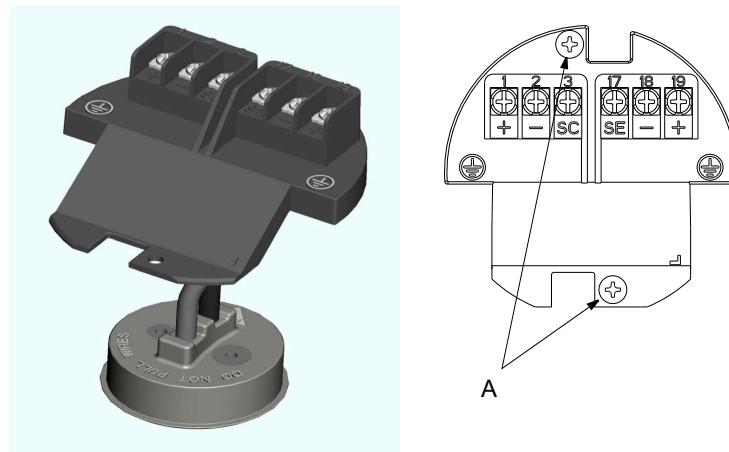
Replacing a terminal block socket module

Note

This section only applies to sensors with Kx approval codes.

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

Figure 11-2: Socket Module—Terminal Block



A. *Mounting screws:*

- 2X—standard
- 4X—with I.S. divider

11.4.1

Removing a terminal block socket module

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

11.4.2

Installing a terminal block socket module

1. Insert the new terminal block socket module, press the base into its keyed position, and tighten the two mounting screws.

2. Connect the terminal block to the junction box housing by tightening the two mounting screws.
Install the divider with the two mounting screws if applicable.
3. Reconnect remote cabling and power and replace junction box cover.

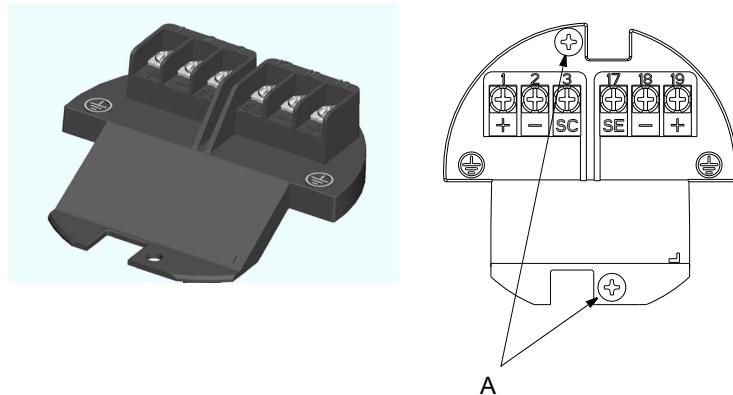
11.5

Replacing a terminal block with amp clips

Note

This section applies only to sensors with Nx approval codes.

Figure 11-3: Terminal block with amp clips



A. Mounting screws:

- 2X—standard
- 4X—with I.S. divider

11.5.1

Removing a terminal block

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

11.5.2 Installing a terminal block

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

11.6 Trims

LOI menu path	Diagnostics → 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.

11.6.1 D/A trim

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

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

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

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

11.6.2 Scaled D/A trim

LOI menu path	Diagnostics → Trims → Scaled D/A Trim
---------------	---------------------------------------

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

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

11.6.3 Digital trim

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

Digital trim is calibration of the transmitter. It is first performed at the factory with transmitters before they are shipped. It is only necessary for a customer to perform the digital trim when inaccurate measurement is observed or suspected.

Complete these steps to identify if a digital trim is needed, and then perform and verify it, when necessary.

NOTICE

To avoid electrical damage to equipment, use the 8785 Calibration Standard only with the Rosemount 8782 transmitter.

1. Set the loop to manual (if necessary).
2. Record the current transmitter configuration settings for Calibration Number, Units, PV URV, PV LRV, and Coil Drive Frequency.
3. Change the following transmitter configuration settings:
 - Calibration Number: 1000075010000000
 - Units-ft/s
 - PV URV-20mA = 30.00 ft/s
 - PV LRV-4mA = 0 ft/s
 - Coil Drive Frequency- Low Frequency setting

Note

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

4. Power down the transmitter.

5. Connect the transmitter to the Calibration Standard.
See [Calibration Standard connections to transmitter](#).
6. Power up the transmitter with the Calibration Standard connected.
7. Set the Calibration Standard to the 30 ft/s (9.1 m/s) setting.
8. Wait 30 minutes for accurate flow rate measurement.
The electronics need 30 minutes to warm up and stabilize after the Calibration Standard is connected, oriented, and situated.
9. Read the flow rate.
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).
10. If the reading is within the range, digital trim is not necessary.
 - a) Power down the transmitter.
 - b) Disconnect the Calibration Standard.
 - c) Power up the transmitter.
 - d) Return the transmitter to the original configuration parameters recorded in [Step 2](#).
 - e) Return the flow meter into service.
11. If the reading is not within this range, use the LOI or other configuration tool to perform a digital trim.
Performing the digital trim means simply executing the Digital Trim function and waiting for it to complete.
 - It takes about 90 seconds to complete. No transmitter adjustments are required.
 - You must use a Rosemount 8785 Calibration Standard to complete this procedure. Attempting a digital trim without a Rosemount 8785 Calibration Standard may result in an inaccurate transmitter or a “DIGITAL TRIM FAILURE” message.
12. After completing the digital trim, verify the calibration at each flow rate setting on the Calibration Standard:
 - Use the selector switch on the Calibration Standard to change the flow rate.
 - Use the transmitter LOI or other configuration tool to read the flow measurement.
 - The flow rate reading should be within $\pm 0.1\%$ of the simulated flow rate. For example, at 30 ft/s (9.14 m/s), the reading should be between 29.97 ft/s and 30.03 ft/s (between 9.13 m/s and 9.15 m/s).
 - If any of the verified values are not within $\pm 0.1\%$ of the simulated flow rate, replace the transmitter and/or contact an Emerson Flow representative for service (see back page).

Note

Only labeled and marked dial positions are used. The dial may turn to other positions but will not provide meaningful outputs.

13. After successful verification:
 - a) Power down the transmitter.
 - b) Disconnect the Calibration Standard.
 - c) Power up the transmitter.
 - d) Return the transmitter to the original configuration parameters recorded in [Step 2](#).
 - e) Return the flow meter into service.

11.6.4 Auto zero trim

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 sensor full of process fluid at zero flow.

These conditions should cause an output equivalent to zero flow.

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

Note

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

11.6.5 Reset calibration status

LOI menu path	Diagnostics → Status → Reset Cal Errs
---------------	---------------------------------------

Reset Calibration Status allows the user to clear the following calibration status bits without restarting transmitter:

- Digital Trim Error
- Auto Zero Failure
- High Frequency Autozero Saturated

12 Troubleshooting

12.1 Introduction

This section covers basic transmitter and sensor troubleshooting. Problems in the magnetic flow meter 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 an Emerson Flow Representative (see back page) 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 flow meter system: the transmitter, the sensor, and the interconnecting wiring. By sequentially troubleshooting each individual piece of the system, it becomes easier to identify the problem and make the appropriate adjustments.

If there are problems with a new installation, see [Installation check and guide](#) below for a quick guide to solve the most common problems. For existing installations, lists the most common problems and corrective actions.

12.2 Safety information

WARNING

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

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

12.3 Installation check and guide

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

12.3.1 Transmitter

Checking the transmitter before applying power

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 8785 Calibration Standard to verify the transmitter calibration.

12.3.2 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.

12.3.3 Remote wiring

1. The electrode signal and coil drive wires must be separate cables.
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 wiring.
5. Verify there is minimal exposed wiring and shielding.
Less than 1 inch (25 mm) is recommended.
6. Verify that the single conduit that houses both the electrode signal and coil drive cables do not contain any other wires, including wires from other magmeters.

Note

For installations requiring intrinsically safe electrodes, the signal and coil drive cables must be run in individual conduits.

12.3.4 Process fluid

1. The process fluid should have a minimum conductivity of 50 microSiemens/cm (50 micro mhos/cm).
2. The process fluid must be free of air and gas.
3. The sensor must be full of process fluid.
4. The process fluid must be compatible with the wetted materials - liner, electrodes, ground rings, and lining protectors.

Refer to the *Rosemount™ Magnetic Flowmeter Material Selection Guide* (00816-0100-3033) Technical Note for details.

5. If the process is electrolytic or has cathodic protection, refer to the *Installation and Grounding of Magmeters in Typical and Special Applications* (00840-2400-4727) Technical Note for special installation requirements.

12.4 Diagnostic messages

Problems in the magnetic flowmeter system are usually indicated by incorrect output readings from the system, error messages, or failed tests. Consider all sources in identifying a problem in the system.

Table 12-1: Basic diagnostic messages

Error message	Potential cause	Corrective action
Empty Pipe	Empty pipe	None - message will clear when pipe is full
	Wiring error	Check that wiring matches appropriate wiring diagrams
	Electrode error	Perform sensor tests - see Installed sensor tests
	Conductivity less than 50 microSiemens per cm	Increase conductivity to greater than or equal to 50 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
	Electronics board failure	Contact an Emerson Flow representative (see back page)
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
Electronics Failure	Electronics self check failure	Cycle power to see if diagnostic message clears
		Contact an Emerson Flow representative (see back page)
Electronics Temp Fail	Ambient temperature exceeded the electronics temperature limits	Move transmitter to a location with an ambient temperature range of -40 to 140 °F (-40 to 60 °C)
Reverse Flow	Electrode or coil wires reverse	Verify wiring between sensor and transmitter
	Flow is reverse	Turn ON Reverse Flow Enable to read flow
	Sensor installed backwards	Install sensor correctly, or switch either the electrode wires (18 and 19) or the coil wires (1 and 2)
PZR Activated (Positive Zero Return)	External voltage applied to terminals 11 and 12	Remove voltage to turn PZR off
Pulse Out of Range	The transmitter is trying to generate a frequency greater than allowed	Standard pulse - increase pulse scaling to prevent pulse output from exceeding 11,000 Hz
		Intrinsically safe pulse - Increase pulse scaling to prevent pulse output from exceeding 5,500 Hz
		Pulse output is in fixed pulse mode and is trying to generate a frequency greater than the pulse width can support - see Pulse output
		Verify the sensor calibration number and line size are correctly entered in the electronics
Analog Out of Range	Flow rate is greater than analog output range	Reduce flow, adjust URV and LRV values
		Verify the sensor calibration number and line sizes are correctly entered in the electronics

Table 12-1: Basic diagnostic messages (continued)

Error message	Potential cause	Corrective action
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 8785 calibrator is not connected properly	Review calibrator connections
	Incorrect calibration number entered into transmitter	Replace sensor calibration number with 1000075010000000
	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	Contact an Emerson Flow representative (see back page)
Coil Wiring Fault	Wiring error between the transmitter and the sensor	Check the wiring in the transmitter and sensor terminal blocks for loose and/or intermittent connections
		Check the length and condition of the cables
		Check that the proper cable type is being used
		See Installed sensor tests
Coil Power Limit	Improper wiring	Check coil drive wiring and sensor coils Perform sensor tests - see Installed sensor tests
	Incorrect calibration number	Verify configured calibration number matches sensor tag
	Coil drive frequency set to High	Sensor may not be compatible with High setting; Switch coil drive frequency to Low setting
	Sensor failure	Perform sensor tests - see Installed sensor tests
	Improper wiring	Check the analog loop wiring - see Analog output
No AO Power	No external loop power	Verify the analog power switch position (internal/external) For externally powered loop, verify power supply requirements - see Powering the transmitter
		Install resistance across the analog output terminals Disable message using LOI Error Mask parameter
	No loop resistance (open loop)	Contact an Emerson Flow representative (see back page)
	Transmitter failure	

Table 12-1: Basic diagnostic messages (continued)

Error message	Potential cause	Corrective action
High Frequency Auto Zero Saturated	The high frequency auto zero value has saturated—This may be from running auto zero when flow is not zero, using the improper cabling, or having moisture present in the terminal block	If operating at the low coil drive frequency, this will not affect flow measurements: Cycle power to clear the error message and continue normal operation If operating at the high coil drive frequency, follow the corrective actions below; Operating with a High Frequency AZ Saturated error will result in degraded accuracy <ul style="list-style-type: none"> • Set the flow rate to zero flow and perform the Auto Zero trim • Check that the proper cable type is being used • Check shielding connections of cables • Remove any moisture from the terminal block, or replace a damaged terminal block • Consult factory
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 12-2: 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
	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

Table 12-2: Advanced process diagnostic messages (continued)

Error message	Potential cause	Corrective action
High Process Noise	Slurry flows - mining/pulp stock	Set coil drive frequency to High
		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	Set coil drive frequency to High
		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 ejection 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	Set coil drive frequency to High
		Complete the possible solutions listed under Troubleshooting high process noise
		Consult factory
	Low conductivity fluids (below 50 microsiemens/cm)	Trim electrode and coil wires - see Sensor Installation
		Set coil drive frequency to High
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 12-3: 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 8785 Calibration Standard
		Perform digital trim
		Contact an Emerson Flow representative (see back page)
	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
		For high temperature applications, retake the coil baseline once the sensor has reached operating temperature
		For installations with long lengths of remote cable, retake the coil baseline
		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
4-20 mA loop verification failed	Analog loop not powered	Check 4-20 mA internal/external loop power switch - see Internal/external analog power
		Check external supply voltage to the transmitter
		Check for parallel paths in the current loop
	Transmitter failure	Perform transmitter self test
		Perform manual analog loop test and D/A trim if necessary
		Contact an Emerson Flow representative (see back page)

Table 12-3: Advanced meter verification messages (continued)

Error message	Potential cause	Corrective action
Continuous Meter Verification Error	Transmitter calibration verification test failed	Verify pass/fail criteria
		Run commanded Smart Meter Verification under no flow conditions
		Verify calibration using 8785 Calibration Standard
		Perform digital trim
		Contact an Emerson Flow representative (see back page)
	Sensor calibration test failed	Run commanded Smart Meter Verification
		Perform sensor tests - see Installed sensor tests
	Sensor coil circuit test failed	Run commanded Smart Meter Verification
		For high temperature applications, retake the coil baseline once the sensor has reached operating temperature
		For installations with long lengths of remote cable, retake the coil baseline
	Sensor electrode circuit test failed	Perform sensor tests - see Installed sensor tests
		Run commanded Smart Meter Verification
		Verify electrode resistance has a signature value from a full pipe baseline
Simulated Velocity Out of Spec	Unstable flow rate during the verification test or noisy process	Run commanded meter verification test with no flow and a full pipe
	Transmitter drift or faulty electronics	Perform the procedure in Digital trim ; If the problem persists, contact an Emerson Flow representative (see back page)
		For high temperature applications, retake the coil baseline once the sensor has reached operating temperature
		For installations with long lengths of remote cable, retake the coil baseline
	Moisture in the terminal block of the sensor, shorted coil, high temperature application, or long length of remote cable	Perform sensor tests - see Installed sensor tests
		If the problem persists, replace the sensor
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
	Calibration shift caused by heat cycling or vibration	Perform sensor tests - see Installed sensor tests
		If the problem persists, replace the sensor
Coil Signature Out of Spec	Calibration shift caused by heat cycling or vibration	Perform sensor tests - see Installed sensor tests
		If the problem persists, replace the sensor

Table 12-3: Advanced meter verification messages (continued)

Error message	Potential cause	Corrective action
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)
	Shorted electrodes	Periodically clean sensor
Analog Output Out of Spec	Unstable flow rate during the verification test or noisy process	Perform sensor tests - see Installed sensor tests
	Analog output is no longer within accuracy specifications	If the problem persists, replace the sensor
Analog Output Out of Spec	Unstable flow rate during the verification test or noisy process	Run manual transmitter verification test with no flow and a full pipe
	Analog output is no longer within accuracy specifications	Check the analog loop wiring; excessive loop resistance can cause an invalid test

12.4.1 Troubleshooting empty pipe

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

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.
7. Perform the sensor electrical resistance tests. For more detailed information, consult [Installed sensor tests](#).

12.4.2 Troubleshooting ground/wiring fault

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

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.

12.4.3 Troubleshooting high process noise

Note

For more information about process noise, see [Process noise profiles](#).

1/f noise

This type of noise can be mitigated by switching to the High frequency coil drive setting.

Spike noise

The type of noise can be mitigated by switching to the High frequency coil drive setting, and enabling the Increased, Maximum, or Custom signal processing modes.

White noise

This type of noise can be mitigated by switching to the High frequency coil drive setting, and enabling the Increased or Custom signal processing modes.

Noise ratio less than 25 in Low coil drive frequency mode

The transmitter detected high levels of process noise. If the signal to noise ratio is less than 25 in Low coil drive frequency mode, proceed with the following steps:

1. Increase transmitter coil drive frequency mode to High (refer to [Coil drive frequency](#) and, if possible, perform auto zero function. See [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 50 microSiemens/cm.

Noise ratio less than less than 25 in High coil drive frequency mode

If the signal to noise ratio is less than 25 in High coil drive frequency mode, see [Digital Signal Processing](#).

12.4.4 Troubleshooting coated electrode detection

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

Table 12-4: Troubleshooting the Electrode Coating Diagnostic

Error message	Potential causes of error	Steps to correct
Electrode Coating Level 1	<ul style="list-style-type: none"> Insulating coating is starting to build up on the electrode and may interfere with the flow measurement signal Process fluid conductivity has decreased to a level close to operational limits of the meter 	<ul style="list-style-type: none"> Verify process fluid conductivity Schedule maintenance to clean the electrodes Use bullet nose electrodes Replace the meter with a smaller diameter meter to increase the flow velocity to above 3 ft/s (1 m/s)
Electrode Coating Level 2	<ul style="list-style-type: none"> Insulating coating has built up on the electrodes and is interfering with the flow measurement signal Process fluid conductivity has decreased to a level below the operational limits of the meter 	<ul style="list-style-type: none"> Verify process fluid conductivity Schedule maintenance to clean the electrodes Use bullet nose electrodes Replace the meter with a smaller diameter meter to increase the flow velocity to above 3 ft/s (1 m/s)

12.4.5 Troubleshooting 4-20 mA loop verification

In the event that the 4-20 mA Loop Verification fails, use the following table to determine the appropriate course of action.

Table 12-5: Troubleshooting the Analog Loop Verification Diagnostic

Test	Potential cause	Corrective action
4-20 mA Loop Verification Failure	Analog loop not powered	Check analog loop wiring
		Check loop resistance
		Check analog loop power switch – see Internal/external analog power
		Check external supply voltage to the transmitter
		Check for parallel paths in the current loop
	Analog drift	Perform D/A trim
	Transmitter failure	Perform transmitter self-test
		Perform manual analog loop test
		Contact an Emerson Flow representative (see back page)

12.4.6 Troubleshooting the Smart Meter Verification test

If the Smart Meter Verification test fails, use the following table to determine the appropriate course of action. Begin by reviewing the Smart Meter Verification results to determine the specific test that failed.

Table 12-6: Troubleshooting the Smart Meter Verification diagnostic

Test	Potential cause	Corrective action
Transmitter Verification Test	<ul style="list-style-type: none"> Unstable flow reading during the test Noise in the process Transmitter drift Faulty electronics 	<ul style="list-style-type: none"> Rerun Smart Meter Verification under No Flow conditions Check the transmitter calibration with the 8785 Calibration Standard Perform a digital trim Contact an Emerson Flow representative (see back page)
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 Perform the sensor checks detailed in Sensor troubleshooting Remove the sensor and send back for evaluation and / or recalibration Retake sensor baseline at operating temperature
Coil Circuit Health	<ul style="list-style-type: none"> Moisture in the sensor terminal block Shorted Coil High temperature application Long remote cable length 	
Electrode Circuit Health	<ul style="list-style-type: none"> Electrode resistance baseline was not taken after installation Test condition was not selected properly Moisture in the sensor terminal block Coated electrodes Shorted electrodes 	

12.5 Basic troubleshooting

When troubleshooting a magnetic flow meter, it is important to identify the issue. [Table 12-7](#) provides common symptoms displayed by a magnetic flow meter that is not functioning properly. This table provides potential causes and suggested corrective actions for each symptom.

Table 12-7: Common magnetic flow meter Issues

Symptom	Potential cause	Corrective action
Output at 0 mA	No power to transmitter	Check power source and connections to the transmitter
	Analog output improperly configured	Check the analog power switch position Verify wiring and analog power
	Electronics failure	Verify transmitter operation with an 8785 Calibration Standard; If it fails, contact an Emerson Flow representative (see back page)
	Blown fuse	Check the fuse and replace with an appropriately rated fuse, if necessary
Output at 4 mA	Transmitter in multidrop mode	Configure Poll Address to 0 to take transmitter out of multidrop mode
	Low Flow Cutoff set too high	Configure Low Flow Cutoff to a lower setting or increase flow to a value above the low flow cutoff
	PZR Activated	Open PZR switch at terminals 11 and 12 to deactivate the PZR
	Flow is in reverse direction	Enable Reverse Flow function
	Shorted coil	Coil check – perform sensor test
	Empty pipe	Fill pipe
	Electronics failure	Verify transmitter operation with an 8785 Calibration Standard; If it fails, contact an Emerson Flow representative (see back page)
Fixed Current Mode is turned ON		Turn Fixed Current Mode OFF
Output will not reach 20 mA	Loop resistance is greater than 600 ohms	Reduce loop resistance to less than 600 ohms Perform analog loop test
	Insufficient supply voltage to analog output	Verify analog output supply voltage Perform analog loop test
Output at 20.8 mA	Transmitter not ranged properly	Reset the transmitter range values – see Basic Setup
		Check tube size setting in transmitter and make sure it matches the actual tube size – see Basic Setup

Table 12-7: Common magnetic flow meter Issues (continued)

Symptom	Potential cause	Corrective action
Output at alarm level	Electronics failure	Cycle power; If alarm is still present, verify transmitter operation with an 8785 Calibration Standard; If it fails, contact an Emerson Flow representative (see back page)
	Open coil circuit	Check coil drive circuit connections at the sensor and at the transmitter
	Analog output diagnostic alarm is active	See AO diagnostic alarm
	Coil power or coil current is over limit	Check coil drive circuit connections at the sensor and at the transmitter Cycle power; If alarm is still present, verify transmitter operation with an 8785 Calibration Standard; If it fails, contact an Emerson Flow representative (see back page)
Pulse output at zero, regardless of flow	Wiring error	Check pulse output wiring at terminals 5 and 6; Refer to wiring diagram for pulse counter and pulse output; See Connect pulse output
	PZR activated	Remove signal at terminals 11 and 12 to deactivate the PZR
	No power to transmitter	Check pulse output wiring at terminals 5 and 6; Refer to wiring diagram for pulse counter and pulse output Power the transmitter
	Reverse flow	Enable Reverse Flow function
	Electronics failure	Verify transmitter operation with an 8785 Calibration Standard; If it fails, contact an Emerson Flow representative (see back page)
	Pulse output incorrectly configured	Review configuration and correct as necessary
Error Messages on LOI	Many possible causes depending upon the message	See Diagnostic messages
Discrete input does not register	Input signal does not provide enough counts	Verify that the discrete input provided meets the requirements in Connect discrete input
		Perform a loop test to validate the analog control loop
		Perform a D/A trim; This allows the calibration of the analog output with an external reference at operating endpoints of the analog output

Table 12-7: Common magnetic flow meter Issues (continued)

Symptom	Potential cause	Corrective action
Reading does not appear to be within rated accuracy	Transmitter, control system, or other receiving device not configured properly	<p>Check all configuration variables for the transmitter, sensor, communicator, and/or control system</p> <p>Check these other transmitter settings:</p> <ul style="list-style-type: none"> • Sensor calibration number • Units • Line size <p>Perform a loop test to check the integrity of the circuit</p>
	Electrode Coating	<p>Enable Coated Electrode Detection diagnostic</p> <p>Use bullet-nose electrodes</p> <p>Downsize sensor to increase flow rate above 3 ft/s</p> <p>Periodically clean sensor</p>
	Gas/air in line	Move the sensor to another location in the process line to ensure it is full under all conditions
	Moisture problem	Perform the sensor tests - see Installed sensor tests
	Insufficient upstream/downstream pipe diameter	Move sensor to a new location with 5 pipe diameters upstream and 2 pipe diameters downstream if possible
	Cables for multiple magmeters run through same conduit	Use dedicated conduit run for each sensor and transmitter
	Improper wiring	If electrode shield and electrode signal wires are switched, flow indication will be about half of what is expected; Check wiring diagrams
	Flow rate is below 1 ft/s (specification issue)	See accuracy specification for specific transmitter and sensor
	Auto zero was not performed	Verify the sensor is full, verify there is no flow, and perform the auto zero function
	Sensor failure–shorted electrode	Perform the sensor tests - see Installed sensor tests
	Sensor failure–shorted or open coil	Perform the sensor tests - see Installed sensor tests
	Transmitter failure	Verify transmitter operation with an 8785 Calibration Standard; If it fails, contact an Emerson Flow representative (see back page)

Table 12-7: Common magnetic flow meter Issues (continued)

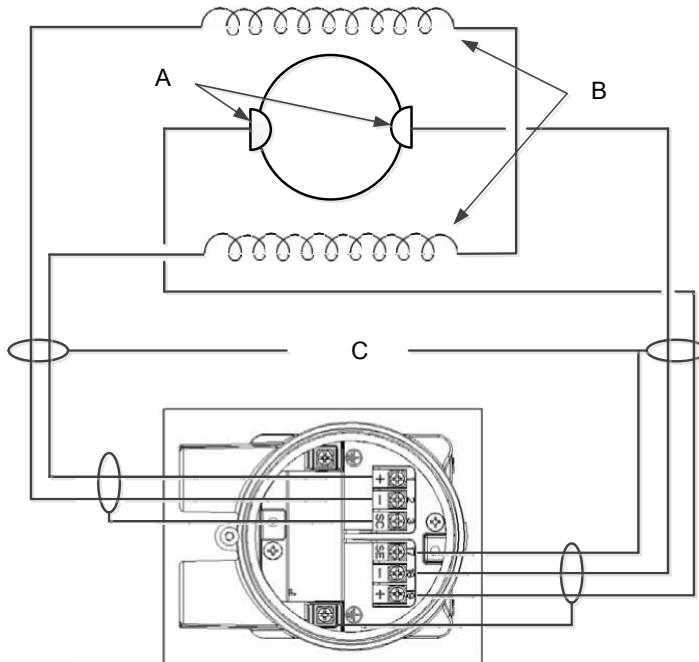
Symptom	Potential cause	Corrective action
Noisy Process	Chemical additives upstream of magnetic flowmeter	See Troubleshooting high process noise
		Move injection point downstream of magnetic flowmeter, or move magnetic flowmeter
		Set Coil Drive Frequency to High
	Sludge flows—mining/coal/sand/slurries (other slurries with hard particles)	Decrease flow rate below 10 ft/s
		Set Coil Drive Frequency to High
	Styrofoam or other insulating particles in process	See Troubleshooting high process noise
		Consult factory
		Set Coil Drive Frequency to High
	Electrode coating	Enable Coated Electrode Detection diagnostic
		Use a smaller sensor to increase flow rate above 3 ft/s
		Periodically clean sensor
Meter output is unstable	Gas/air in line	Move the sensor to another location in the process line to ensure it is full under all conditions
		Trim electrode and coil wires – see Sensor to transmitter wiring
		Keep flow rate below 3 FPS
		Use component cable - see Sensor to transmitter wiring
	Low conductivity fluids (below 10 microsiemens/cm)	Eliminate cable vibration
		Move cable to lower vibration run
		Tie down cable mechanically
		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
Electrode incompatibility	Electrode incompatibility	Check the Technical Data Sheet, Magnetic Flowmeter Material Selection Guide (document number 00816-0100-3033), for chemical compatibility with electrode material
	Improper grounding	Check ground wiring – see Process reference connection for wiring and grounding procedures
	High local magnetic or electric fields	Move magnetic flowmeter (20–25 ft away is usually acceptable)
	Control loop improperly tuned	Check control loop tuning

Table 12-7: Common magnetic flow meter Issues (continued)

Symptom	Potential cause	Corrective action
	Sticky valve (look for periodic oscillation of meter output)	Service valve
	Sensor failure	Perform the sensor tests (See Installed sensor tests)
	Analog output loop problem	Check that the 4–20 mA loop matches the digital value Perform analog output test

12.6 Sensor troubleshooting

This section describes manual tests that can be performed on the sensor to verify the health of individual components. The tests will require the use of a digital multimeter capable of measuring conductance in nanoSiemens and an LCR meter. A sensor circuit diagram is shown in [Figure 12-1](#). The tests described below will check for continuity or isolation of the internal components of the sensor.

Figure 12-1: Sensor Circuit Diagram (Simplified)

A. Electrodes

B. Coils

C. Sensor housing

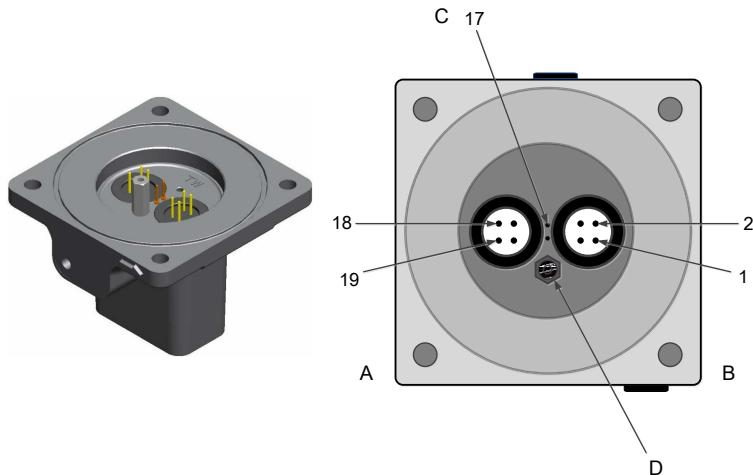
12.6.1 Sensor adapter feed through pins

The sensor adapter is the part of the sensor that provides the internal connection feed-through wiring from the internal sensor components to the socket module connections.

The top of the adapter has 10 pins - four pins for the coils, four pins for the electrodes, and two pins for the process reference. Each connection point has two pins associated for redundant continuity. See [Figure 12-2](#).

The best location for testing the sensor components is taking measurements directly on the feed-through pins. Direct measurement on the pins eliminates the possibility of an erroneous measurement caused by a bad socket module or remote wiring. The figure below shows the feed-through pin connections as they relate to the terminal connections described in the tests.

Figure 12-2: Sensor Adapter Feed-through Pins



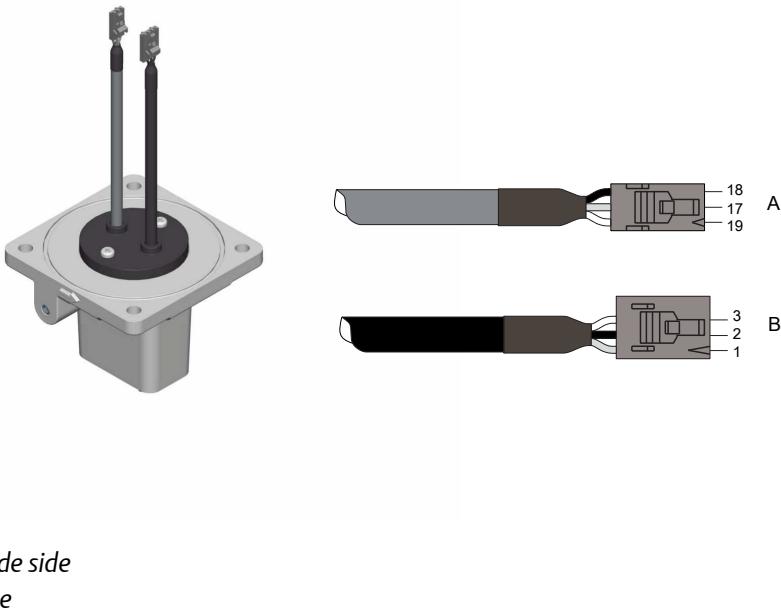
- A. Electrode side
- B. Coil side
- C. Process reference
- D. Orientation key

12.6.2

Sensor adapter direct lead pins

The sensor adapter direct leads are the part of the sensor that provides the direct connection from the internal sensor components to the terminal block connections. The top of the adapter has 6 pins - three pins for the coils, and three pins for the electrodes. See [Figure 12-3](#). The best location for testing the sensor components is taking measurements directly on the slot pins. Direct measurement on the pins eliminates the possibility of an erroneous measurement caused by a bad terminal block or remote wiring. [Figure 12-3](#) shows the slot pin connections as they relate to the terminal connections described in the tests.

Figure 12-3: Sensor adapter direct lead pins



12.6.3 Socket module

Figure 12-4: Remote Mount Socket Module



12.7 Installed sensor tests

If a problem with an installed sensor is identified, refer to [Table 12-8](#) through [Table 12-12](#) to assist in troubleshooting the sensor. Disconnect or turn off power to the transmitter before performing any of the sensor tests. Always check the operation of test equipment before each test.

If possible, take all readings from the preferred locations identified in [Sensor adapter feed through pins](#), [Sensor adapter direct lead pins](#), and [Socket module](#). If the recommended

locations in the sensor adapter are inaccessible, take measurements at the sensor terminal block or through remote cabling as close to the sensor as possible. Readings taken through remote cabling that is more than 100 feet (30 meters) in length may provide incorrect or inconclusive information and should be avoided.

The expected values in the test below assume the measurements have been taken directly at the pins.

Table 12-8: Test A. Sensor coil

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: installed or uninstalled Required equipment: 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 12-9: Test B: Shields to case

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: installed or uninstalled Required equipment: multimeter Measuring at connections: <ul style="list-style-type: none"> 17 and 3 3 and case ground 17 and case ground 	<0.3Ω	<ul style="list-style-type: none"> Moisture in terminal block Leaky electrode Process behind liner 	<ul style="list-style-type: none"> Clean terminal block Remove sensor

Table 12-10: Test C. Coil to coil shield

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> Location: installed or 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 12-11: Test D. Electrode to electrode shield

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> • Location: installed • Required equipment: LCR (Set to Resistance and 120 Hz) • Measuring at connections: <ul style="list-style-type: none"> — $18 \text{ and } 17 = R_1$ — $19 \text{ and } 17 = R_2$ 	<ul style="list-style-type: none"> • R_1 and R_2 should be stable • $R_1 - R_2 \leq 300\Omega$ 	<ul style="list-style-type: none"> • Unstable R_1 or R_2 values confirm coated electrode • Shorted electrode • Electrode not in contact with process • Empty pipe • Low conductivity • Leaky electrode • Process reference ground not connected properly 	<ul style="list-style-type: none"> • Remove coating from sensor wall • Use bullet-nose electrodes • Repeat measurement • Remove sensor and complete tests in Uninstalled sensor tests • Connect process reference ground per Process reference connection

Table 12-12: Test E. Electrode to Electrode

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> • Location: installed • Required equipment: LCR (Set to Resistance and 120 Hz) • Measuring at connections: 18 and 19 <ul style="list-style-type: none"> — $18 \text{ and } 17 = R_1$ — $19 \text{ and } 17 = R_2$ 	Should be stable and same relative magnitude of R_1 and R_2 from Test D	<ul style="list-style-type: none"> • Unstable R_1 or R_2 values confirm coated electrode • Shorted electrode • Electrode not in contact with process • Empty pipe • Low conductivity • Leaky electrode • Process reference ground not connected properly 	<ul style="list-style-type: none"> • Remove coating from sensor wall • Use bullet-nose electrodes • Repeat measurement • Remove sensor and complete tests in 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:

$$1 \text{ nanosiemens} = \frac{1}{1 \text{ gigaohm}}$$

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

12.8 Uninstalled sensor tests

Sensor troubleshooting can also be performed on an uninstalled sensor. If test results from installed sensor tests are inconclusive, the next step is remove the sensor and perform the tests outlined in this section. Take measurements from the recommended terminal location, and directly on the electrode head inside the sensor. The measurement

electrodes, 18 and 19, are on opposite sides in the inside diameter of the sensor. If applicable, the third process reference electrode is between the two measurement electrodes.

The expected values in the test below assume the measurements have been taken directly at the pins.

Table 12-13: Test A. Terminal to front electrode

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> • Location: uninstalled • Required equipment: 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 12-14: Test B. Terminal to back electrode

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> • Location: uninstalled • Required equipment: 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 12-15: Test C. Terminal to reference electrode

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> • Location: uninstalled • Required equipment: 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 12-16: Test D. Terminal to case ground

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> • Location: uninstalled • Required equipment: 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 12-17: Test E. Electrode to electrode shield

Test conditions	Expected value	Potential cause	Corrective action
<ul style="list-style-type: none"> • Location: uninstalled • Required equipment: Multimeter • 18 and 17 • 19 and 17 	$\approx \Omega (< 1 \text{ nS})$	<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 12-18: Test F. Electrode shield to coil

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

12.9 Technical support and service

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	+7 495 995 9559	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		

A

Product Specifications

A.1

Rosemount 8782 Slurry Magnetic Flow Meter Platform Specifications

The tables below outline some of the basic performance, physical, and functional specifications of the Rosemount 8782 Slurry Magnetic Flow Meter platform.

- [Table A-1](#) provides an overview of the Rosemount 8782 Transmitter.
- [Table A-2](#) provides an overview of the Rosemount MS Sensor.

Table A-1: Rosemount 8782 Slurry transmitter specifications

	Model	8782
	Base accuracy ⁽¹⁾	0.25% Standard 0.15% High Accuracy Option
	Mounting	Remote
	Power supply	Global AC or DC
	User interface	LCD display with 15 button tactile keypad LCD display only No display
	Communication protocol	HART 7
	Diagnostics	Basic, MV, DS1
	Sensor compatibility	Rosemount MS and 8707 sensors only
	Detailed specifications	Transmitter specifications
	Ordering information	Product Data Sheet

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

Table A-2: Rosemount MS Sensor Specifications

	Model	MS
	Style	Flanged
	Base accuracy ⁽¹⁾	0.25% Standard 0.15% High Accuracy Option
	Line sizes	3 inch to 36 inch (80 mm to 900 mm)
	Design features	Standard process design
	Transmitter compatibility	Rosemount 8782, 8732EM, and 8712EM
	Detailed specifications	MS Sensor Specifications
	Ordering information	Product Data Sheet

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

Table A-3: Lining Material Selection

Liner material	General characteristics
PFA+	Best permeation resistance
	Best chemical resistance
	Better abrasion resistance than PTFE
	Best high temperature capabilities
	Excellent for pulp and paper, or liquor applications
	Process temperature: -58 to 350 °F (-50 to 177 °C)
PTFE	Highly chemical resistant
	Excellent high temperature capabilities
	Process temperature: -58 to 350 °F (-50 to 177 °C)
Polyurethane	Limited chemical resistance
	Excellent abrasion resistance for slurries with small and medium particles
	Process temperature: 0 to 140 °F (-18 to 60 °C)
	Typically applied in clean water
Neoprene	Very good abrasion resistance for small and medium particles
	Better chemical resistance than polyurethane
	Typically applied in water with chemicals, and sea water
	Preferred liner for high pressure > ASME B16.5 Class 900
	Process temperature: 0 to 176 °F (-18 to 80 °C)
Linatex rubber	Limited chemical resistance especially in acids
	Very good abrasion resistance for large particles
	Softer material than polyurethane and neoprene
	Typically applied in mining slurries
	Process temperature: 0 to 158 °F (-18 to 70 °C)
Adiprene	Ideal for applications with high salinity and/or hydrocarbon carryover
	Excellent abrasion resistance
	Typically used for Water Injection, Recovered Water, and Coal Gasification Slurries
	Preferred liner for high pressure > ASME B16.5 Class 900
	Process temperature: 0 to 200 °F (-18 to 93 °C)

Table A-4: Electrode material

Electrode material	General characteristics
316L Stainless steel	Good corrosion resistance
	Good abrasion resistance
	Not recommended for sulfuric or hydrochloric acids
Nickel alloy 276 (UNS N10276)	Better corrosion resistance
	High strength
	Good in slurry applications
	Effective in oxidizing fluids
Tantalum	Excellent corrosion resistance
	Not recommended for hydrofluoric acid, fluorosilic acid, or sodium hydroxide
80% platinum 20% iridium	Best chemical resistance
	Expensive material
	Not recommended for aqua regia
Titanium	Improved chemical resistance
	Improved abrasion resistance
	Good for sea water applications
	Not recommended for hydrofluoric or sulfuric acid
Tungsten carbide coated	Limited chemical resistance
	Best abrasion resistance
	High concentration slurries
	Preferred electrode for oil and gas fracturing applications

Table A-5: Electrode type

Electrode type	General characteristics
Standard measurement	Lowest cost
	Good for most applications
(Also see and Table A-6 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; not recommended for plastic or non-metallic piping
Bulletnose	Extended head protrudes into the flow stream for self-cleaning
	Best option for coating processes

Table A-5: Electrode type (continued)

Electrode type	General characteristics
Flat head	Low profile head
	Best option for abrasive slurries

Table A-6: Process reference options

Grounding options	General characteristics
Grounding straps (no grounding options selected).	Acceptable for conductive unlined pipe Grounding straps provided at no cost
Reference electrode	Same material as measurement electrodes Sufficient grounding option when process fluid conductivity is greater than 100 microSiemens/cm Not recommended in electrolysis applications, galvanic corrosion applications, applications where the electrodes may coat, or non-conductive pipe.
Grounding rings	Low conductivity process fluids Cathodic or electrolysis applications that may have stray currents in or around the process Variety of materials for process fluid compatibility
Lining protectors	Protect upstream edge of sensor from abrasive fluids Permanently installed on sensor Protect liner material from over torquing of flange bolts in many cases Provide process reference ground path and eliminate need for grounding rings or reference electrode Required for applications where Flexitallic gaskets are used

Table A-7: Process reference installation

Type of pipe	Grounding straps	Grounding rings	Reference electrode	Lining protectors
Conductive unlined pipe	Acceptable	Not required	Not required	Not required
Conductive lined pipe	Not acceptable	Acceptable	Acceptable	Acceptable
Non-conductive pipe	Not acceptable	Acceptable	Not recommended	Acceptable

A.2

Transmitter specifications

A.2.1

Transmitter functional specifications

Transmitter coil drive current

For use with Rosemount MS and 8707 sensors only.

Flow rate range

Capable of processing signals from fluids with velocities between 0.04 ft/s and 39 ft/s (0.01 m/s and 12 m/s) for both forward and reverse flow in all sensor sizes. Full scale continuously adjustable between –39 ft/s and 39 ft/s (–12 m/s and 12 m/s).

Conductivity limits

Process liquid must have a conductivity of 50 microSiemens/cm or greater. Consult an Emerson Flow representative (see back page), for conductivity less than 50 microSiemens/cm.

Power supply

- 90 VAC to 250 VAC @ 50/60Hz.
 - Overvoltage Category II
 - Single Phase Earthed Neutral System
- 12 VDC to 42 VDC.

Note

For applications with sensors greater than 14 inch (350 mm) and process temperature greater than 212 °F (100 °C), consult an Emerson Flow representative (see back page) when applying less than 18 VDC to power terminals.

Line power fuses

Power supply type	Rating	Manufacturer part number
90–250 VAC	2.5 A, 250 VAC	Bel Fuse 3AG 2.5-R, Littlefuse 312025, or equivalent
12–42 VDC	12 A, 250 VAC	Bel Fuse 3AB 12-R, Littlefuse 314012, or equivalent

Power consumption

- 90 VAC to 250 VAC: 120 VA maximum
- 12 VDC to 42 VDC: 120 W maximum

Inrush/Start-up current

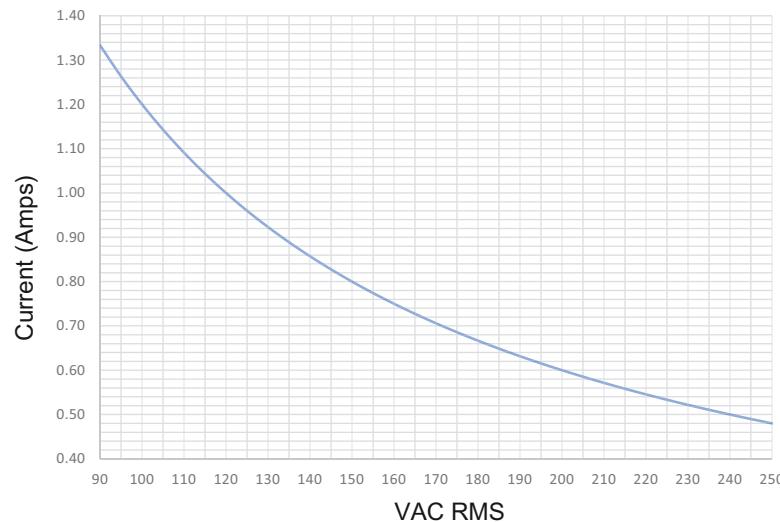
The power system must be capable of supporting inrush/start-up currents of:

- AC supply: Maximum 7 A (<5 ms)
- DC supply: Maximum 13 A (<5 ms)

AC power supply requirements

Units powered by 90 VAC to 250 VAC have the following power requirements. Peak inrush is 7 A at 250 VAC supply, lasting approximately 1 ms.

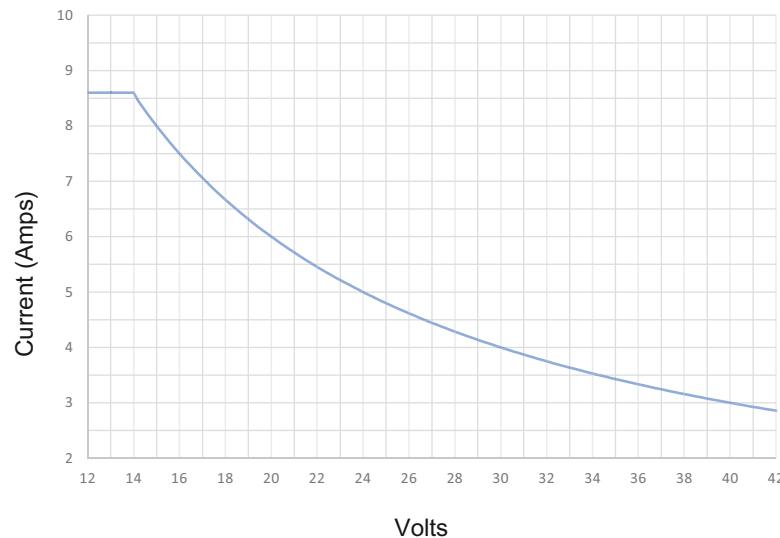
Figure A-1: AC current requirements



DC power supply requirements

Units powered by 12 VDC power supply may draw up to 8.6 A of current steady state. Peak inrush is 13 A at 12 VDC supply, lasting approximately 1 ms.

Figure A-2: DC current requirements



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

Ambient temperature limits

- Operating:
 - -40 to 140°F (-40 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 -4°F (-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 to 95% RH to 140°F (60°C)

Altitude

- 13,123 ft (4000 m) at rated input power voltage (90–250 VAC)
- 16,404 ft (5000 m) at maximum input power voltage of 150 VAC

Enclosure rating

Type 4X, IEC 60529, IP66, IP69 (transmitter)

Note

In order to achieve the rated Ingress Protection levels, the appropriately rated cable glands, conduit connections, and/or conduit plugs shall be used.

Transient protection rating

Built in transient protection that conforms to:

- IEC 61000-4-4 for burst voltages
- IEC 61000-4-5 for surge voltages and currents

Turn-on time

- 5 minutes to rated accuracy from power up
- 10 seconds from power interruption

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

- Grounding and Wiring fault
- Empty Pipe
- Reverse Flow
- Electrode Saturation
- Transmitter Fault
- Electronics Temperature
- Coil Circuit Fault

Process diagnostics (DS1)

- High process noise
- Electrode coating diagnostic

Smart Meter Verification (MV)

- Smart Meter Verification Professional (continuous or on-demand)
- 4-20mA loop verification

A.2.3 Output signals

Analog output adjustment⁽¹⁾

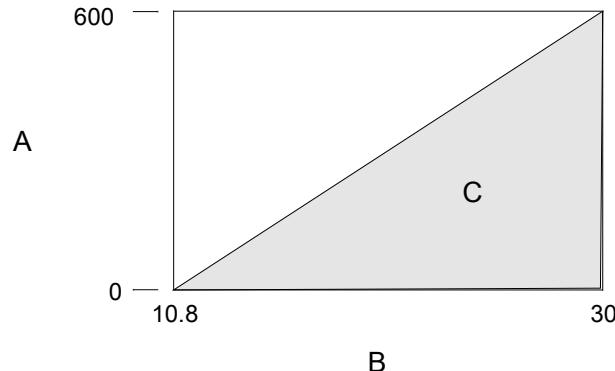
4–20mA, switch-selectable as internally or externally powered.

(1) For transmitters with intrinsically safe outputs (option code B), power must be supplied externally.

Analog loop load limitations

- Internally powered 24VDC max, 500 ohms max loop resistance
- Externally powered 10.8 - 30VDC max.
- Loop resistance is determined by the voltage level of the external power supply at the transmitter terminals:

Figure A-3: Analog loop load limitations



- A. Load (ohms)
- B. Power supply (volts)
- C. Operating region

- $R_{max} = 31.25 (V_{ps} - 10.8)$
- V_{ps} = power supply voltage (volts)
- R_{max} = maximum loop resistance (ohms)

The analog output is automatically scaled to provide 4mA at lower range value and 20mA at upper range value. Full scale continuously adjustable between -39 and 39 ft/s (-12 to 12 m/sec), 1 ft/s (0.3 m/s) minimum span.

HART Communications is a digital flow signal. The digital signal is superimposed on the 4–20mA signal and is available for the control system interface. A minimum of 250 ohms loop resistance is required for HART communications.

Analog alarm mode

High or low alarm signal is user-selectable via the Alarm switch on the front of the electronics. NAMUR-compliant alarm limits are software configurable and can be preset via CDS (C1). Individual diagnostic alarms are also software configurable. Alarms will drive the analog signal to the following mA values.

Low	3.75 mA	Requires CDS (C1)
High	22.50 mA	Factory default
NAMUR Low	3.5 mA	Requires CDS (C1)
NAMUR High	22.6 mA	Requires CDS (C1)

Scalable pulse frequency adjustment

- 0-10,000Hz, switch-selectable as internally or externally powered⁽²⁾
- Pulse value can be set to equal desired volume in selected engineering units
- Pulse width adjustable from 0.1 to 650 ms
- Internally powered: Outputs up to 12VDC⁽³⁾
- Externally powered: Input 5 - 28VDC

Output testing

Analog output test⁽³⁾ Transmitter may be commanded to supply a specified current between 3.5 and 23mA.

Pulse output test Transmitter may be commanded to supply a specified frequency between 1 and 10,000Hz.⁽²⁾

Security lockout

Security lockout switch on the electronics board can be set to deactivate all LOI and HART-based communicator functions to protect configuration variables from unwanted or accidental change.

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.

A.2.4

Performance specifications

System specifications are given using the frequency output and with the unit at reference conditions.

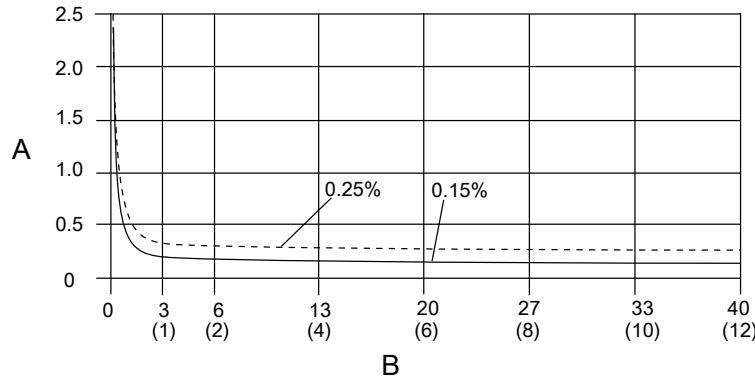
Accuracy

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

(2) For transmitters with intrinsically safe outputs (option code B), frequency range is limited to 0-5000Hz and must be powered externally.

(3) For transmitters with intrinsically safe outputs (option code B), power must be supplied externally.

- Standard system accuracy:
 - $\pm 0.25\%$ of rate $\pm 1.0 \text{ mm/sec}$ from 0.04 to 6 ft/s (0.01 to 2 m/s)
 - $\pm 0.25\%$ of rate $\pm 1.5 \text{ mm/sec}$ above 6 ft/s (2 m/s)
- Optional high accuracy:⁽⁴⁾
 - $\pm 0.15\%$ of rate $\pm 1.0 \text{ mm/sec}$ from 0.04 to 13 ft/s (0.01 to 4 m/s)
 - $\pm 0.18\%$ of rate above 13 ft/s (4 m/s)



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

Additional transmitter performance effects

Repeatability	$\pm 0.1\%$ of rate
Stability	$\pm 0.1\%$ of rate over six months
Ambient temperature effect	$\pm 0.25\%$ of rate change over operating temperature range
Analog output effect	$\pm 0.025\%$ of span

Analog output response

20 ms max response time to step change input.

A.2.5 8782 transmitter physical specifications

Materials of construction

Housing	Low copper aluminum Type 4X and IEC 60529 IP66, IP69
Paint	Polyurethane coat (1.8 to 2.2 mils thick)
Cover gaskets	Silicone

(4) 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).

Electrical connections

Conduit entries	½–14 NPT or M20–1.5 ⁽¹⁾
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)

(1) M20–1.5 connections provided with an adapter.

Vibration rating

2G per IEC 61298

Dimensions

See Product Data Sheet.

Weight

Wall mount transmitter	Approximately 11 lbs. (5 kg)
------------------------	------------------------------

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

A.3

MS Sensor Specifications



A.3.1

Functional specifications

Service

Conductive liquids and slurries

Line sizes

3 inch to 36 inch (80 mm to 900 mm)

Sensor coil resistance

2 - 20 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
- 58 to 140 °F (–50 to 60 °C) with "SH" all stainless design⁽⁵⁾

Pressure limits

See Process temperature limits.

Vacuum limits

PTFE lining	Full vacuum to +350 °F (+177 °C) through 4-in. (100 mm) line sizes. Consult an Emerson Flow representative (see back page) 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.

Conductivity limits

Process liquid must have a conductivity of 50 microSiemens/cm or greater. Consult an Emerson Flow representative (see back page), for conductivity less than 50 microSiemens/cm.

⁽⁵⁾ Not available for Class/Div approval code N5.

Process temperature limits

PTFE lining	-58 to +350 °F (-50 to +177 °C)
PFA and PFA+ lining	-58 to +350 °F (-50 to +177 °C)
Polyurethane lining	0 to +140 °F (-18 to +60 °C)
Neoprene lining	0 to +176 °F (-18 to +80 °C)
Linatex lining	0 to +158 °F (-18 to +70 °C)
Adiprene lining	0 to +200 °F (-18 to +93 °C)

Note

Sensors ordered with hazardous location ratings may have different maximum process temperature limits. The sensors must be installed and used as directed by the installation drawing number noted on the serial nameplate.

Table A-8: Temperature vs. Pressure Limits for ASME B16.5 class flanges⁽¹⁾

Sensor temperature vs. pressure limits for ASME B16.5 class flanges					
Flange material	Flange rating	Pressure			
		@ -20 to 100 °F (-29 to 38 °C)	@ 200 °F (93 °C)	@ 300 °F (149 °C)	@ 350 °F (177 °C)
Carbon Steel	Class 150	285 psi	260 psi	230 psi	215 psi
	Class 300	740 psi	675 psi	655 psi	645 psi
	Class 600 ⁽²⁾	1000 psi	800 psi	700 psi	650 psi
	Class 600 ⁽³⁾	1480 psi	1350 psi	1315 psi	1292 psi
	Class 900	2220 psi	2025 psi	1970 psi	1935 psi
	Class 1500	3705 psi	3375 psi	3280 psi	3225 psi
	Class 2500	6170 psi	5625 psi	5470 psi	5375 psi
304 Stainless Steel	Class 150	275 psi	235 psi	205 psi	190 psi
	Class 300	720 psi	600 psi	530 psi	500 psi
	Class 600 ⁽²⁾	1000 psi	800 psi	700 psi	650 psi
	Class 600 ⁽³⁾	1440 psi	1200 psi	1055 psi	997 psi
	Class 900	2160 psi	1800 psi	1585 psi	1497 psi
	Class 1500	3600 psi	3000 psi	2640 psi	2495 psi
	Class 2500	6000 psi	5000 psi	4400 psi	4160 psi

(1) Liner temperature limits must also be considered.

(2) Flange rating Code 6.

(3) Flange rating Code 7.

Table A-9: 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 inch to 24 inch 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-10: Temperature vs. Pressure Limits for EN 1092-1 flanges⁽¹⁾

Sensor temperature vs. pressure limits for EN 1092-1 flanges (15 mm to 600 mm Line Sizes)					
Flange material	Flange rating	Pressure			
		@ -29 to 50 °C (-20 to 122 °F)	@ 100 °C (212 °F)	@ 150°C (302 °F)	@ 175°C (347 °F)
Carbon Steel	PN 10	10 bar	10 bar	9.7 bar	9.5 bar
	PN 16	16 bar	16 bar	15.6 bar	15.3 bar
	PN 25	25 bar	25 bar	24.4 bar	24.0 bar
	PN 40	40 bar	40 bar	39.1 bar	38.5 bar
304 Stainless Steel	PN 10	9.1 bar	7.5 bar	6.8 bar	6.5 bar
	PN 16	14.7 bar	12.1 bar	11.0 bar	10.6 bar
	PN 25	23 bar	18.9 bar	17.2 bar	16.6 bar
	PN 40	36.8 bar	30.3 bar	27.5 bar	26.5 bar

(1) Liner temperature limits must also be considered.

Table A-11: Sensor Temperature vs. Pressure Limits for Grooved Coupling⁽¹⁾

Sensor temperature vs. pressure limits for grooved coupling (3 inch to 10 inch line sizes)		
Flange Material	Line Size	Maximum Pressure @ -20 to 100 °F (-29 to 38 °C)
304 Stainless Steel	3 inch (80 mm)	500 psi (34 bar)
	4 inch (100 mm)	400 psi (27 bar)
	6 inch (150 mm)	400 psi (27 bar)
	8 inch (200 mm)	350 psi (24 bar)
	10 inch (250 mm)	800 psi (55 bar)

(1) Customer must supply clamp and gasket that meets line pressure requirement, not to exceed pressures listed above.

A.3.2 Physical specifications

Non-wetted materials

Sensor Pipe	Type 304/304L SST or Type 316/316L SST
Flanges	A105 Carbon steel, Type 304/304L SST, or Type 316/316L SST ⁽¹⁾
Coil housing	Rolled carbon steel or 300 series stainless steel
Paint	Polyurethane coat (2.6 mils or greater)

⁽¹⁾ Ambient temperature low limit for A105 carbon steel is -20 °F (-29 °C) per ANSI B16.5. For colder ambient environments, stainless steel flanges must be used.

Process-wetted materials

Lining	PTFE, Polyurethane, Neoprene, Linatex, Adiprene, PFA+
Electrodes	316L SST, Nickel Alloy 276 (UNS N10276), Tantalum, 80% Platinum-20% Iridium, Titanium

Flat-faced flanges

Sensors ordered with flat-faced flanges and Neoprene or Linatex liners are manufactured with the liner extending to the outer dimension of the flange. All other liner selections extend to the diameter of raised face dimension and create a raised surface on the flange face.

Process connections

ASME B16.5	<ul style="list-style-type: none"> Class 150 and Class 300: 3 inch to 24 inch (80 mm to 600 mm)
ASME B16.47	<ul style="list-style-type: none"> Class 150: 30 inch to 36 inch (750 mm to 900 mm)
EN 1092-1	<ul style="list-style-type: none"> PN10: 200 mm to 900 mm (8 inch to 36 inch) PN16: 100 mm to 900 mm (4 inch to 36 inch) PN40: 80 mm to 900 mm (3 inch to 36 inch)
AS2129	<ul style="list-style-type: none"> Table D and Table E: 80 mm to 900 mm (3 inch to 36 inch)
AS4087	<ul style="list-style-type: none"> PN16, PN21, PN35: 80 mm to 600 mm (3 inch to 24 inch)
JIS B2220	<ul style="list-style-type: none"> 10K, 20K, 40K: 80 mm to 200 mm (3 inch to 8 inch)

Electrical connections

Conduit entries	Available with ½ inch NPT and M20
Terminal block screws	6-32 (No. 6) suitable for up to 14 AWG wire
Safety grounding screws	External stainless assembly, M5; internal 8-32 (No. 8)

Process reference electrode (optional)

A process reference electrode can be installed similarly to the measurement electrodes through the sensor lining. 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 straps. Grounding rings are available in 316L SST, Nickel Alloy 276 (UNS N10276), titanium, and tantalum. See Product Data Sheet.

Lining protectors (optional)

Lining protectors can be installed between the flange and the sensor face on both ends of the sensor. The leading edge of lining material is protected by the lining protector; lining protectors cannot be removed once they are installed. Lining protectors are available in 316L SST, Nickel Alloy 276 (UNS N10276), and titanium. See Product Data Sheet.

Dimensions

See Product Data Sheet.

Weight

See Product Data Sheet.

A.4

8785 Reference Calibration Standard

A.4.1

Functional specifications

Ambient temperature limits

- Operating: +40 °F to 104 °F (+5 °C to 40 °C)
- Storage: -40 °F to 140 °F (-40 °C to 60°C)

Humidity Limits

0 to 95% relative humidity up to 13,000 ft (4000 m)

A.4.2

Performance specifications

Accuracy

- ±0.05% of rate at 30 ft/s
- ±0.10% of rate at 10 ft/s and 3 ft/s

Warm-up Time

5 minutes minimum; 30 minutes for best accuracy

Ambient Temperature Effect

< 0.015% of rate per 10 °F (< 0.027% per 10 °C)

Humidity Effect

- No effect from 0 to 60% relative humidity
- < 0.10% of rate from 60 to 95% relative humidity

A.4.3 Physical specifications

Electrical connections

Electrical connections are compatible with Model 8782 terminal blocks. Electrical connections are not compatible with other terminal blocks.

Orientation

Must be steady with all four feet firmly resting on a flat surface. Warm up time begins after the Calibration Standard is settled.

Materials of construction

Enclosure	Extruded aluminum and 316 stainless steel
Paint	Epoxy polyester

Weight

Approximately 10 lb (4.5 kg).

B Product Certifications

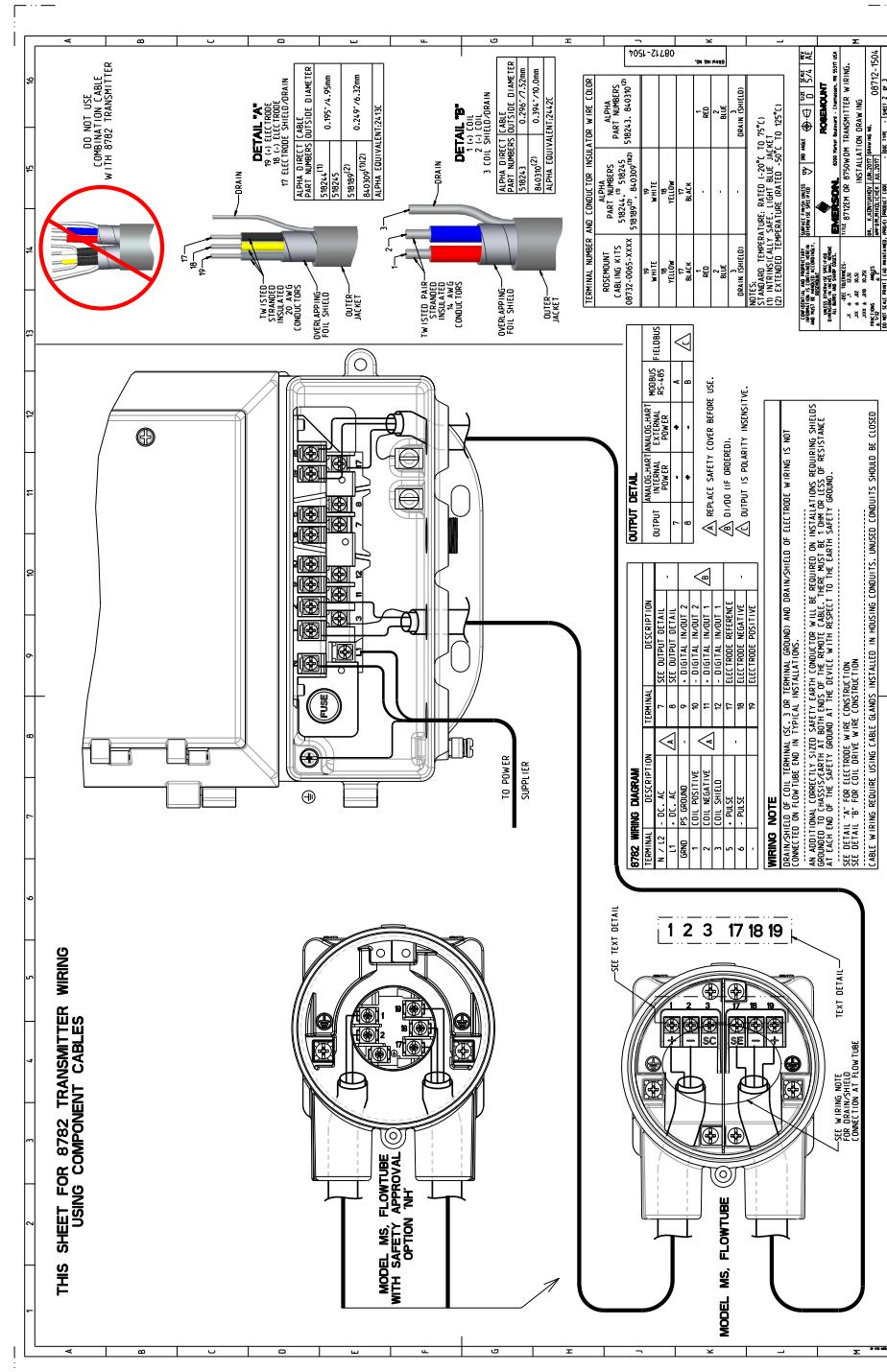
For detailed approval certification information and installation drawings, please see the appropriate document listed below:

- Document number 00825-MA00-0009: *Rosemount 8782 and MS Approval Document - Class Division*
- Document number 00825-MA00-0010: *Rosemount 8782 and MS Approval Document - IECEx and ATEX*
- Document number 00825-MA00-0011: *Rosemount 8782 and MS Approval Document - North America Zone*
- Document number 00825-MA00-0012: *Rosemount 8785 Approval Document*
- Document number 00825-MA00-0013: *Rosemount 8782 and MS Approval Document - EAC EX*

C Wiring Diagrams

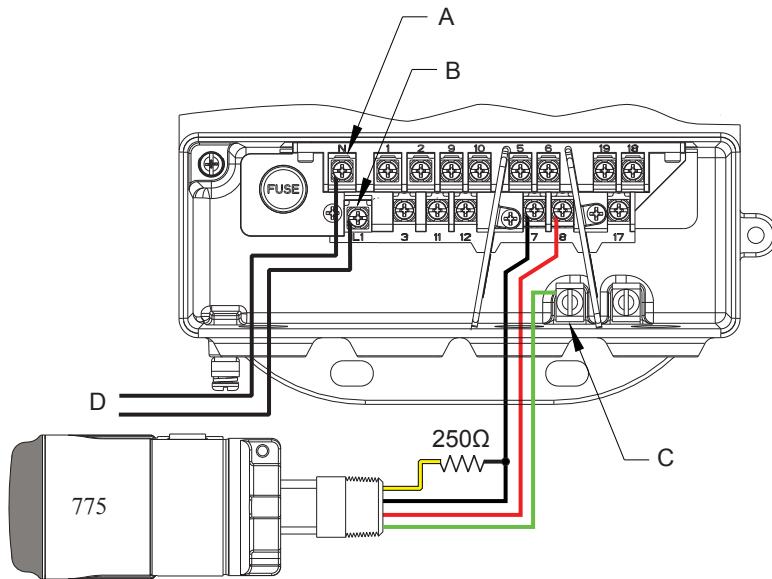
C.1 Wiring sensor to transmitter

Figure C-1: Wiring using component cables



C.2**775 Smart Wireless THUM™ Adapter wiring diagrams**

Figure C-2: Wiring diagram—775 Smart Wireless THUM Adapter with transmitter internal analog power

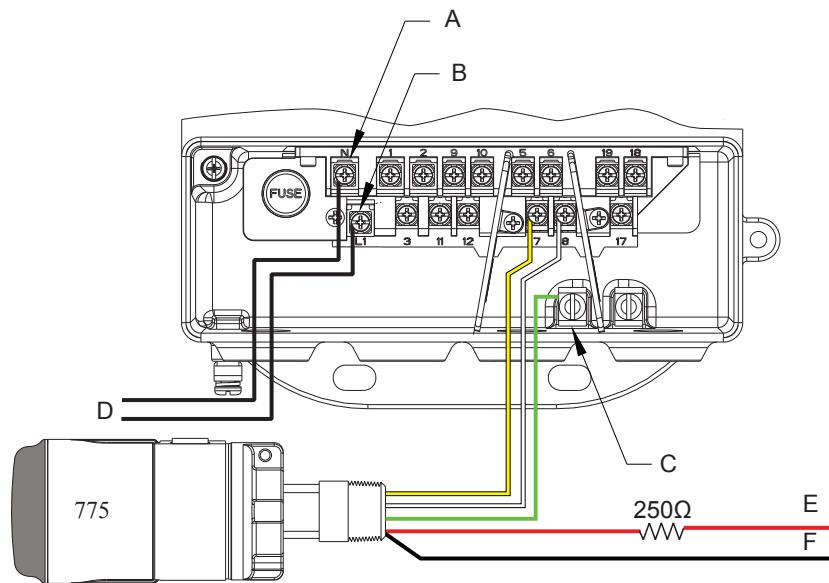


- A. AC neutral or DC-
- B. AC Line or DC +
- C. AC or DC Ground
- D. Transmitter Power

Table C-1: 775 wiring guide

Wire color	Connect to...
Red	Transmitter (+) pin 8
Black	Transmitter (-) pin 7 and 250Ω
Yellow	250Ω
Green	Transmitter housing
White	No connection

Figure C-3: Wiring diagram—775 Smart Wireless THUM Adapter with transmitter external analog power



- A. AC neutral or DC -
- B. AC Line or DC +
- C. AC or DC Ground
- D. Transmitter Power
- E. 4-20mA +
- F. 4-20mA -

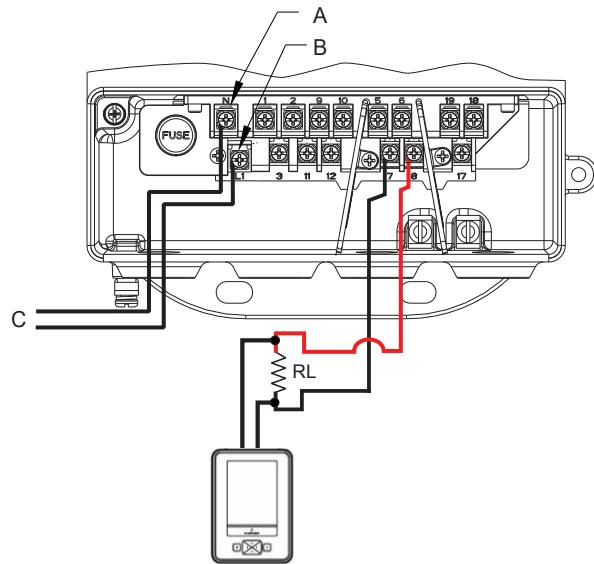
Table C-2: 775 wiring guide

Wire color	Connect to...
Red	Transmitter (+) pin 8
Black	Transmitter (-) pin 7 and 250Ω
Yellow	250Ω
Green	Transmitter housing
White	No connection

C.3

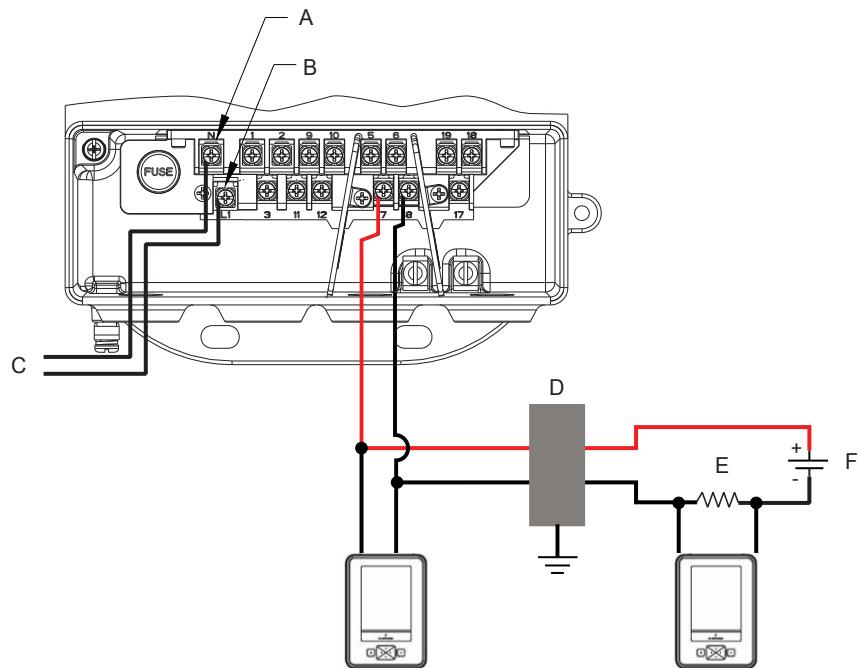
Field Communicator wiring diagrams

Figure C-4: Wiring diagram—Field Communicator with transmitter internal analog power



- A. AC neutral or DC-
- B. AC line or DC +
- C. Transmitter power

Figure C-5: Wiring diagram—Field Communicator with transmitter external analog power



- A. AC neutral or DC-
 - B. AC line or DC +
 - C. Transmitter power
 - D. Intrinsic safety barrier, if required.
 - E. RL
 - F. 24 VDC
-



00809-0100-8782
Rev. AA
2019

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