Reference Manual
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Rosemount™ 8750W Transmitter with EtherNet/IP™ Protocol

ROSEMOUNT™

EMERSON™

Contents

1 Before you begin

1.1 About this manual

This manual helps you configure, commission, use, and maintain Rosemount 8750W Field Mount Magnetic Flow Meter transmitter with Ethernet.

Important
This Manual assumes that:

- The transmitter has been installed correctly and completely according to the instructions in the Quick Start Guide.
- Users understand basic transmitter and sensor installation, configuration, and maintenance concepts and procedures.

1.2 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.

1.2.1 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 nonincendive field wiring practices.

Do not connect a Rosemount transmitter to a non-Rosemount sensor that is located in an explosive atmosphere. The transmitter has not been evaluated for use with other manufacturers' magnetic flowmeter sensors in hazardous (Ex or Classified) areas. Special care should be taken by the end-user and installer to ensure the transmitter meets the safety and performance requirements of the other manufacturer's equipment.

Follow national, local, and plant standards to properly earth ground the transmitter and sensor. The earth ground must be separate from the process reference ground.

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.

⚠ WARNING

Physical access

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.

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.

1.3 Related documents

You can find all product documentation on the product documentation page at Emerson.com/global.

See any of the following documents for more information:

- *Rosemount™ 8700M Magnetic Flowmeter Platform Product Data Sheet*
- *Rosemount™ 8700 Magnetic Flow Meter Sensor Quick Installation Guide*
-

1.4 Communication methods

You can use several different communications methods to interface with the transmitter. You may use different methods in different locations or for different tasks.

Interface	Tool
Ethernet port	Field Device Technology (FDT) frame application
	Web server (http)
Display	Four optical buttons

1.5 Cybersecurity

1.5.1 Defense-in-depth strategy

Security capabilities

The Rosemount 8750W Transmitter with EtherNet/IP Protocol has several features that can help to protect it against either intentional or unintentional access and configuration changes. For each input and output, the secure set up is described:

- Write-protect physical lock switch (refer to Transmitter security in the *Rosemount 8750W Transmitter with EtherNet/IP Protocol Reference Manual* for the display).
- The system includes the Engineer role-based permission for the Ethernet connection configuration and the non-authenticated operator access for general parameter viewing.

Mitigation strategies

Any device in the field is prone to a physical attack, which must be mitigated by physical security controls.

If a device can access the worldwide internet, then it can be discoverable by malicious actors. As a result, field devices must be in a dedicated and actively-managed network. If an input or an output is described as insecure, it means that it is unencrypted (available in clear text) and does not have access control capabilities (for example, there is no way to tell who is communicating with the transmitter).

EtherNet/IP is unencrypted and unauthenticated. As a result, Emerson recommends using these protocols while the transmitter is within an isolated and secured internal network, according to a company's security policy. The security switch controls non-Ethernet configuration. The physical write protect (dip) switch is located behind the display. More information can be found in Transmitter security in the *Rosemount 8750W Transmitter with EtherNet/IP Protocol Reference Manual*.

Security measures

The device is not intended to be directly connected to an enterprise or to an internet-facing network without a compensating control in place. Do not connect the device without mitigation measures in place.

This transmitter device has been updated using secure design principals and procedures, including threat modeling and security specific testing.

1.5.2 Security hardening guidelines

Product integration

The device has optional applications for configuration and data viewing. When such applications are used, they must run on devices that are configured according to the security policy of the company using the device.

Configuring the device

There are cybersecurity considerations for configuring the device with EtherNet/IP including:

Consideration	Resolution
Local display allows the user to configure the non-Ethernet parts of the device. Anyone in physical proximity to the device could use it. **Note** The local display has only one access role, unlike the roles for web server configuration (Engineer and non-authenticated operator access).	Protect physical access to the device.
Any web browser with network access to the device can access web server. See list of Recommended web browsers. This can allow the device IP configuration to be changed with the proper password.	Keep the provided passwords for the Engineer account controlled. Protect network access to the device.
The Device Type Manager (DTM) allows access to all configuration on the device (Ethernet and non-Ethernet). There is no password access through this interface. Only one DTM connection should be used at a time.	Protect network access to the device. If using DTM access, it is suggested to move process offline and directly connect the PC running the DTM to the device.

Defaults

If the customer orders the EtherNet/IP communication option, Rosemount 8750W Transmitter will be shipped with Ethernet and EtherNet/IP enabled. Configure Ethernet communication according to your company's security policy.

This transmitter is designed to be implemented in an industrial automation control system (Level 1 of the Purdue Reference Architecture Model), with defense-in-depth security controls. Additionally, the transmitter is not intended to be directly connected to an enterprise or to an internet-facing network without a compensating control in place.

1.5.3 Secure operation guidelines

Operation of product

Best practices for product operation:

- Operate the device within a controlled and secured physical environment.
- Operate the device within a controlled and secured network environment.
- Manage all the accounts on the device according to the security policy of your company.

Reporting security vulnerabilities

Use Report a Vulnerability on Emerson.com/Global for reporting vulnerabilities back to Emerson.

Best security practices

Best practices for secure product operation:

- Do not connect the device to the worldwide net.
- Do not share passwords, passcodes, or other protected information.

1.5.4 Secure product disposal guidelines

Instructions for product removal

When the device needs to be disposed of, consider the following aspects of device removal:

- Identify whether the device can be reused in another part of the process for either testing or training purposes.
- If the device is ready for disposal, then it can be discarded or physically destroyed using your organization’s security policy.

2 Introduction

2.1 System description

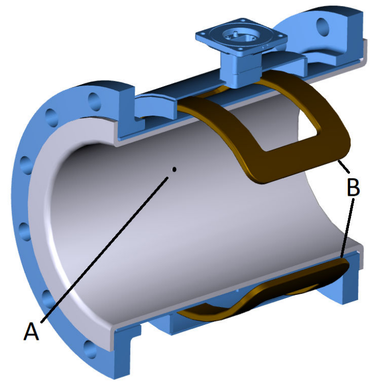
The flowmeter consists of a sensor and a transmitter. The sensor is installed in-line with the process piping; the transmitter can be integrally mounted to the sensor or remotely mounted away from the sensor.

Figure 2-1: Integral field mount transmitter

Figure 2-2: Remote field mount transmitter

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

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

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.

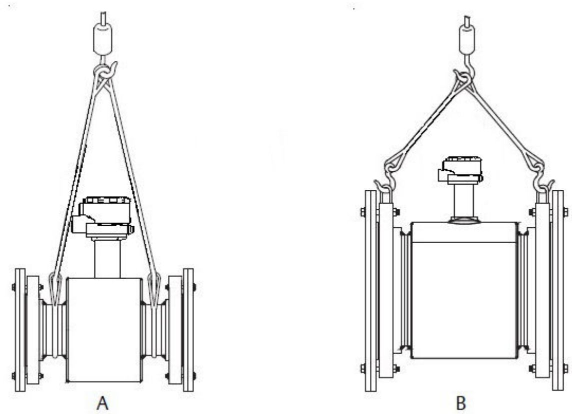
3.1.1 Lifting lugs

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

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



A. Without lifting lugs
B. With lifting lugs

3.2 Location and Position

3.2.1 Environmental considerations

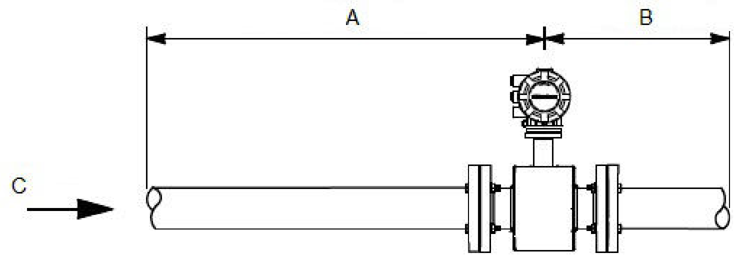
To ensure maximum transmitter life, avoid extreme temperatures and excessive vibration. Typical problem areas include the following:

- High-vibration lines with integrally mounted transmitters
- 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, Emerson recommends installing 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.

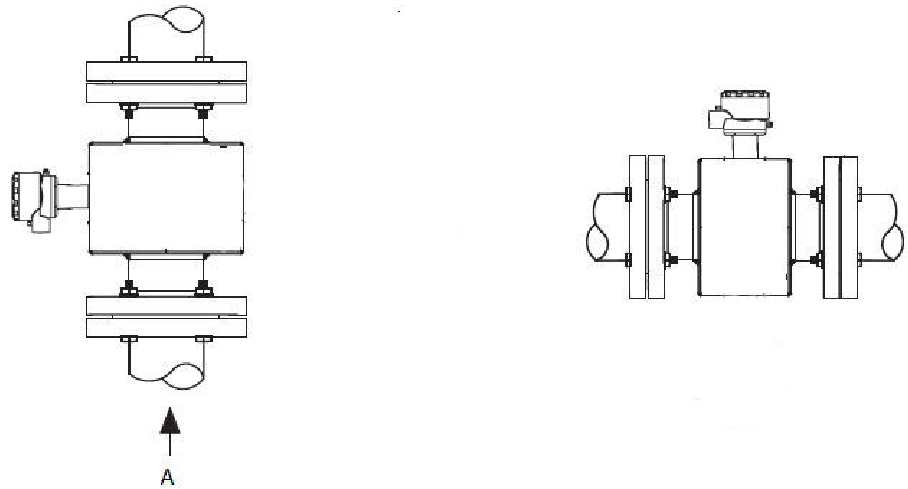
Figure 3-3: Flow direction arrow

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

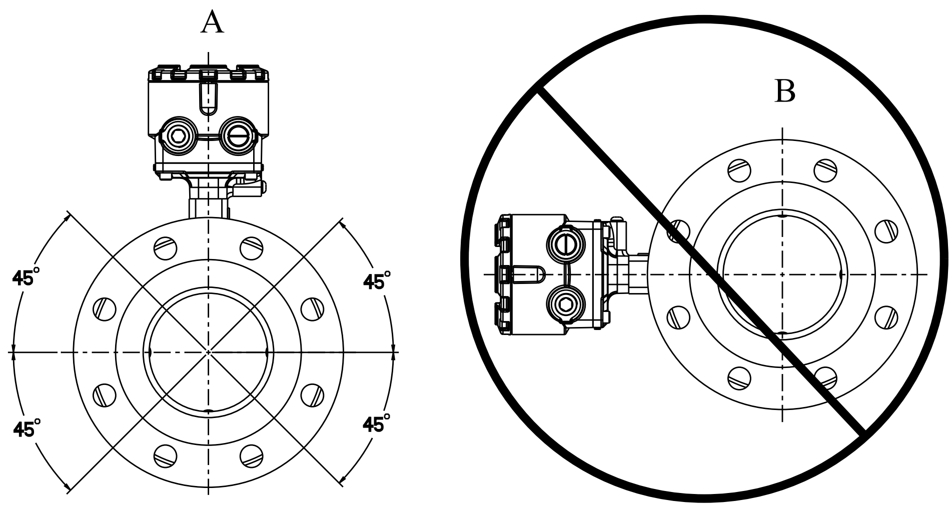
3.2.5 Transmitter or remote junction box rotation

To rotate housing, disconnect the interconnecting cables from the electronics board inside the transmitter housing prior to rotation.

3.2.6 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

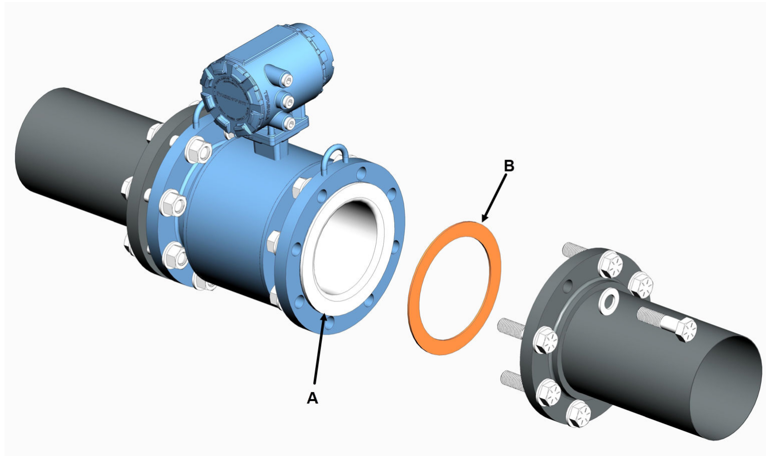
Gaskets

- It is the responsibility of the customer to provide an appropriate gasket for their installation.
- The gasket material must be compatible with the process fluid and process conditions. See note below for more information regarding suitable gasket materials.
- If no ground rings or lining protectors are being used, a gasket is required at each process connection. See Figure 3-6.
- If using grounding ring(s), a gasket is required on each side of each grounding ring. See Figure 3-7.

Note

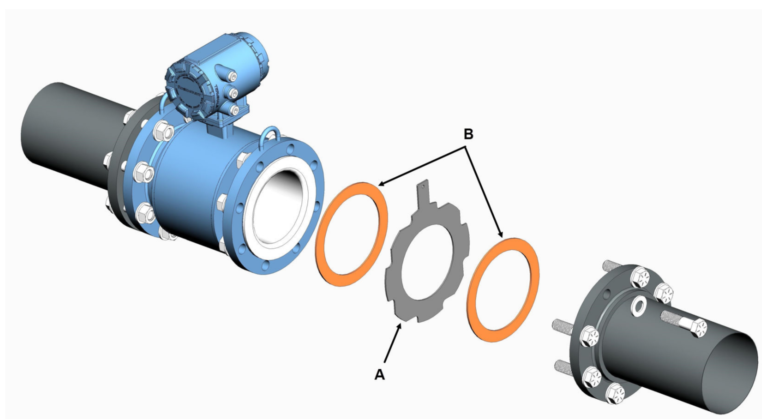
- Metallic or spiral wound gaskets should not be used in contact with the liner face. **They will damage the liner face**. If metallic or spiral wound gaskets are required for the application, then lining protectors must be used.
- Examples of non-metallic gasket materials that will not damage the liner face are rubber, fiber, or PTFE.
- Flat ring gasket types are suitable for raised-face (RF) flanges. Full-face gasket types are suitable for flat-face (FF) flanges. Full-face gaskets may be used with raised-face flanges.

Figure 3-6: Flanged Gasket Placement with no Grounding Ring(s) or Lining Protector(s)



A. *Liner face*
B. *Customer supplied gasket (x2)*

Figure 3-7: Flanged Gasket Placement with Grounding Ring(s)



A. *Ground ring*
B. *Customer supplied gaskets (x2 per ground ring)*

Bolts

Note

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

1. Snug upstream
2. Snug downstream
3. Tighten upstream (20%)
4. Tighten downstream (20%)

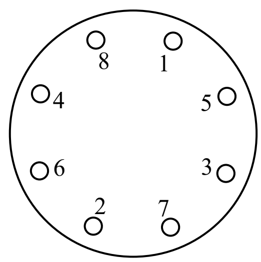
Do not snug and tighten the upstream side and then snug and tighten the downstream side. Failure to alternate between the upstream and downstream flanges when tightening bolts may result in liner damage.

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 3-8 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 3-8: 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

Group A	Group B
T - PTFE	P - Polyurethane
H - PEX	N - Neoprene

Table 3-2: Suggested flange bolt torque values for Group A and Group B (ASME)

Size code	Line size	Group A		Group B	
		Class 150 (pound-feet)	Class 300 (pound-feet)	Class 150 (pound-feet)	Class 300 (pound-feet)
005	0.5 inch (15 mm)	4	8	N/A	N /A
010	1 inch (25 mm)	8	19	6	20
015	1.5 inch (40 mm)	17	36	13	38
020	2 inch (50 mm)	34	20	26	21
025	2.5 inch (65 mm)	40	30	30	31
030	3 inch (80 mm)	58	37	44	39
040	4 inch (100 mm)	41	50	31	52
050	5 inch (125 mm)	61	61	46	62

Table 3-2: Suggested flange bolt torque values for Group A and Group B (ASME) *(continued)*

Size code	Line size	Group A		Group B	
		Class 150 (pound-feet)	Class 300 (pound-feet)	Class 150 (pound-feet)	Class 300 (pound-feet)
060	6 inch (150 mm)	77	51	59	50
080	8 inch (200 mm)	105	81	79	77
100	10 inch (250 mm)	98	84	74	81
120	12 inch (300 mm)	131	126	99	110
140	14 inch (350 mm)	162	110	123	98
160	16 inch (400 mm)	154	154	117	123
180	18 inch (450 mm)	236	175	179	133
200	20 inch (500 mm)	207	191	157	145
240	24 inch (600 mm)	293	293	222	222
300	30 inch (750 mm)	309	432	234	328
360	36 inch (900 mm)	442	589	335	447

Table 3-3: Suggested flange bolt torque values for Group A (EN 1092-1)

Size code	Line size	Group A (in Newton-meters)			
		PN 10	PN 16	PN 25	PN 40
005	0.5 inch (15 mm)	N/A	N/A	N/A	10
010	1 inch (25 mm)	N/A	N/A	N/A	23
015	1.5 inch (40 mm)	N/A	N/A	N/A	49
020	2 inch (50 mm)	N/A	62	N/A	62
025	2.5 inch (65 mm)	N/A	43	N/A	43
030	3 inch (80 mm)	N/A	51	N/A	51
040	4 inch (100 mm)	N/A	53	76	76
050	5.0 inch (125 mm)	N/A	70	N/A	106
060	6 inch (150mm)	N/A	95	132	132
080	8 inch (200 mm)	135	90	134	180
100	10 inch (250 mm)	103	123	200	265
120	12 inch (300 mm)	118	170	205	285
140	14 inch (350 mm)	166	223	344	450
160	16 inch (400 mm)	227	298	445	662
180	18 inch (450 mm)	198	299	391	452
200	20 inch (500 mm)	225	408	474	558
240	24 inch (600 mm)	300	601	625	903

Table 3-4: Suggested flange bolt torque values for Group B (EN 1092-1)

Size code	Line size	Group B (in Newton-meters)			
		PN 10	PN 16	PN 25	PN 40
005	0.5 inch (15 mm)	N/A	N/A	N/A	8
010	1 inch (25 mm)	N/A	N/A	N/A	18
015	1.5 inch (40 mm)	N/A	N/A	N/A	37
020	2 inch (50 mm)	N/A	47	N/A	47
025	2.5 inch (65 mm)	N/A	33	N/A	33
030	3 inch (80 mm)	N/A	38	N/A	38
040	4 inch (100 mm)	N/A	41	57	57
050	5.0 inch (125 mm)	N/A	53	N/A	81
060	6 inch (150mm)	N/A	72	100	100
080	8 inch (200 mm)	103	68	102	137
100	10 inch (250 mm)	78	94	152	201
120	12 inch (300 mm)	89	129	156	216
140	14 inch (350 mm)	126	169	261	341
160	16 inch (400 mm)	172	226	337	502
180	18 inch (450 mm)	150	227	296	343
200	20 inch (500 mm)	170	309	359	423
240	24 inch (600 mm)	228	456	474	685

Table 3-5: Suggested flange bolt torque values for Group A (AWWA C207)

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

Table 3-6: Suggested flange bolt torque values for Group B (AWWA C207)

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

3.4 Process reference connection

The figures shown in this section illustrate best practice installations for process reference connections only. For installations in conductive, unlined pipe it may be acceptable to use one ground ring or one lining protector to establish a process reference connection. Earth safety ground is also required as part of this installation, but is not shown in the figures. Follow national, local, and plant electrical codes for safety ground.

Use Table 3-7 to determine which process reference option to follow for proper installation.

Table 3-7: Process reference options

Type of pipe	Grounding straps	Grounding rings	Reference electrode	Lining protectors
Conductive unlined pipe	See Figure 3-9	See Figure 3-10	See Figure 3-12	See Figure 3-10
Conductive lined pipe	Insufficient grounding	See Figure 3-10	See Figure 3-9	See Figure 3-10
Non-conductive pipe	Insufficient grounding	See Figure 3-11	Not recommended	See Figure 3-11

Note
For line sizes 10 inch and larger, the ground strap may come attached to the sensor body near the flange. See Figure 3-13.

Figure 3-9: Grounding straps in conductive unlined pipe or reference electrode in lined pipe

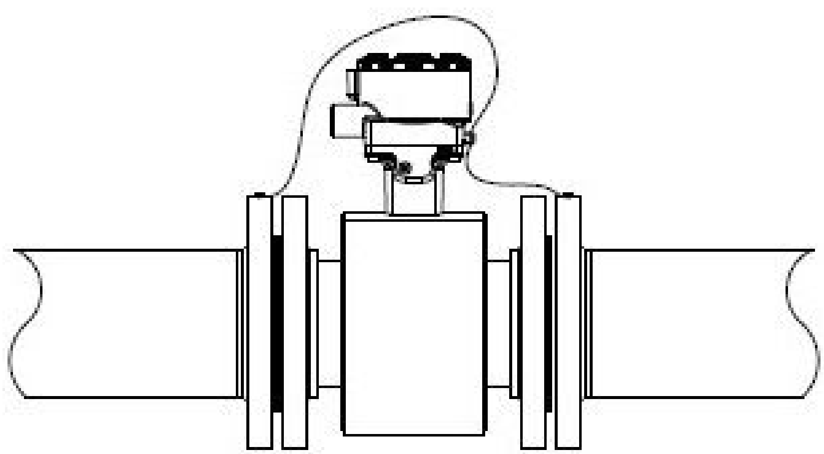
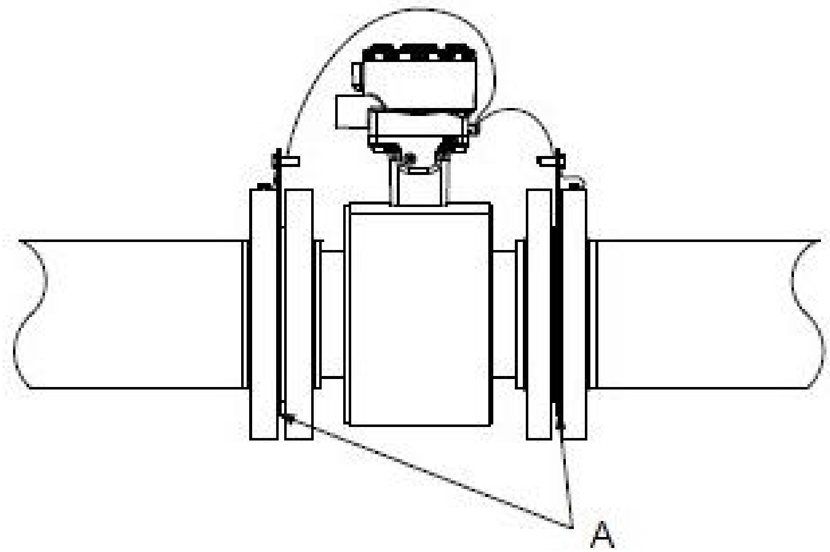
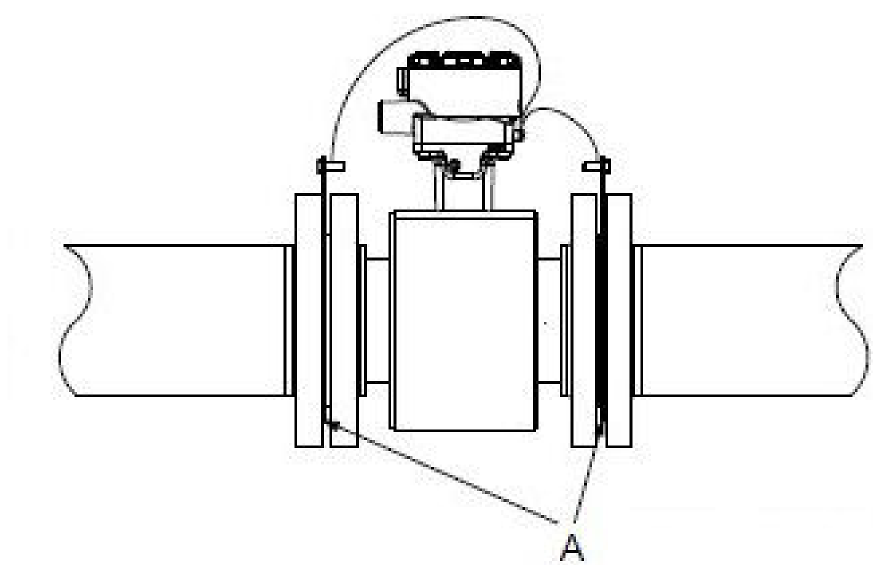


Figure 3-10: Grounding with grounding rings or lining protectors in conductive pipe



A. Grounding rings or lining protectors

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



A. Grounding rings or lining protectors

Figure 3-12: Grounding with reference electrode in conductive unlined pipe

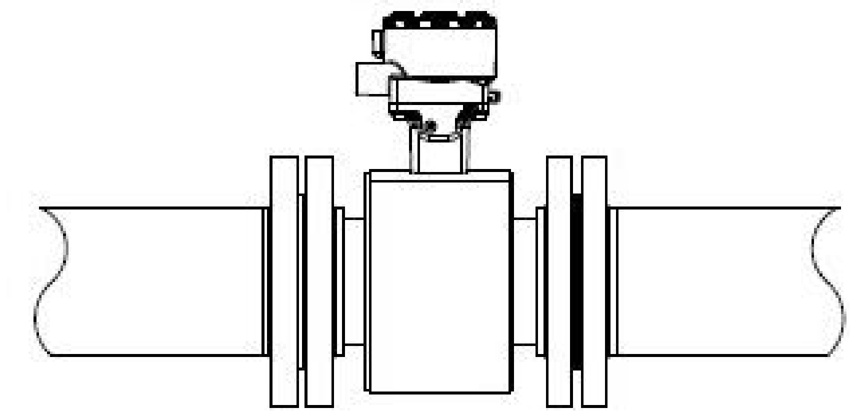
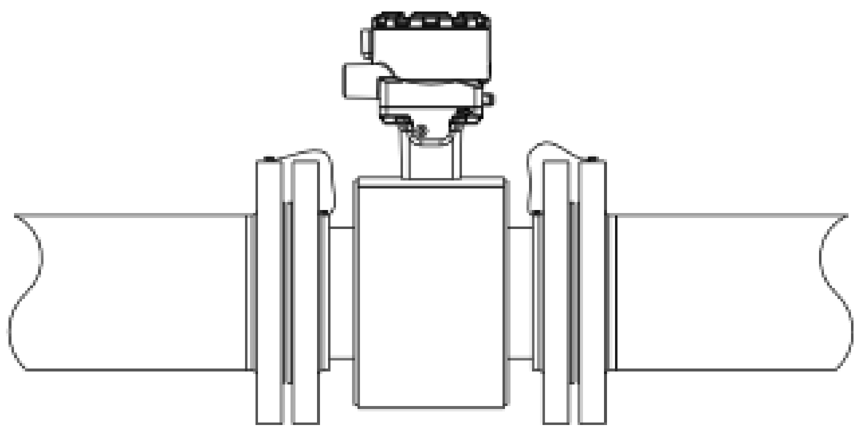


Figure 3-13: Grounding for line sizes 10 inch and larger



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 pulse output connection, a RJ45 jack for Ethernet output connection, and sensor coil and electrode connections.

Hardware switches

The transmitter has two user-selectable hardware switches. These switches set the 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
Internal/external pulse power	External
Transmitter security	Off

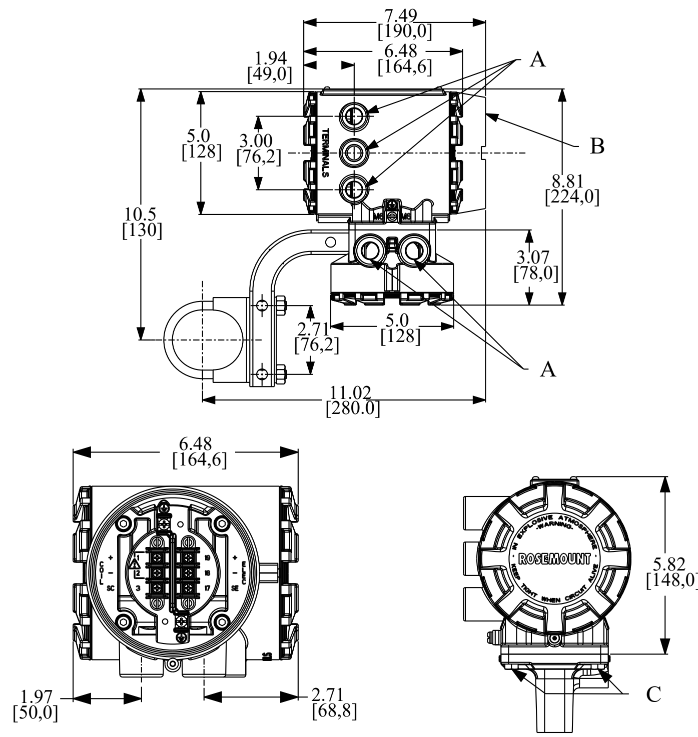
In most cases, it is not necessary to change the setting of the hardware switches. If the switch settings need to be changed, refer to Hardware switches.

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

Mechanical considerations

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

Figure 4-1: Rosemount 8750W dimensional drawing



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

Note
Dimensions are in inches [mm].

Electrical considerations

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

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

Table 4-2: Electrical data

Rosemount 8750W Flow Transmitter	
Power input	AC power: 90–250 VAC, 0.5 A, 40 VA
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

Table 4-2: Electrical data *(continued)*

Rosemount 8750W Flow Transmitter	
EtherNet/IP output circuit	Transmission rate: • 100 MBit/s • 10 MBit/s Interface type: • 100 BASE-TX, isolated • 10 Base-T Half duplex / Full duplex: Supported (at 100 MBit/s) Auto-negotiation: Supported Auto-crossover: Supported
Um	250 V
Coil excitation output	500 mA, 40 V max, 9 W max

Environmental considerations

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

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

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

Table 4-3: Transmitter housing environmental ratings

Type	**Rating**
Ingress protection	IP66, IP69
NEMA	4X
Pollution Degree	2
Maximum altitude rating	• AC Input Voltage: Maximum 250 VAC - Up to 2,000 meters (6,500 feet) • AC Input Voltage: Maximum 150 VAC - Up to 4,000 meters (13,000 feet)

Note
For complete environmental and other specifications, see Product specifications.

4.2 Transmitter symbols

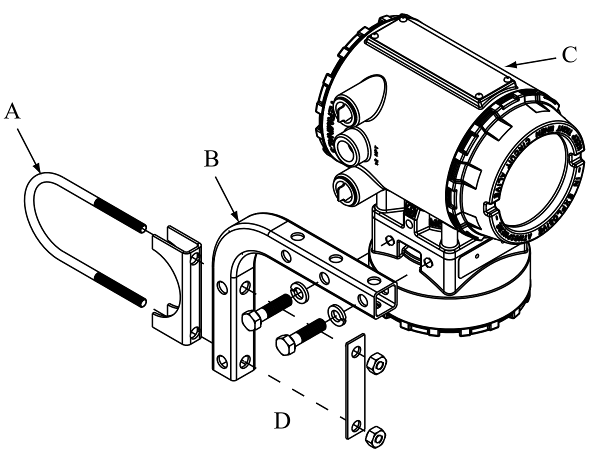
Caution symbol — check product documentation for details	

Protective conductor (grounding) terminal	⏚

4.3 Mounting

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

Figure 4-2: Rosemount 8750W field mount transmitter mounting hardware



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

Procedure

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

Postrequisites

The LOI/Display can be rotated in 90 degree increments up to 180 degrees if desired. Do not rotate more than 180 degrees in any one direction.

4.4 Wiring

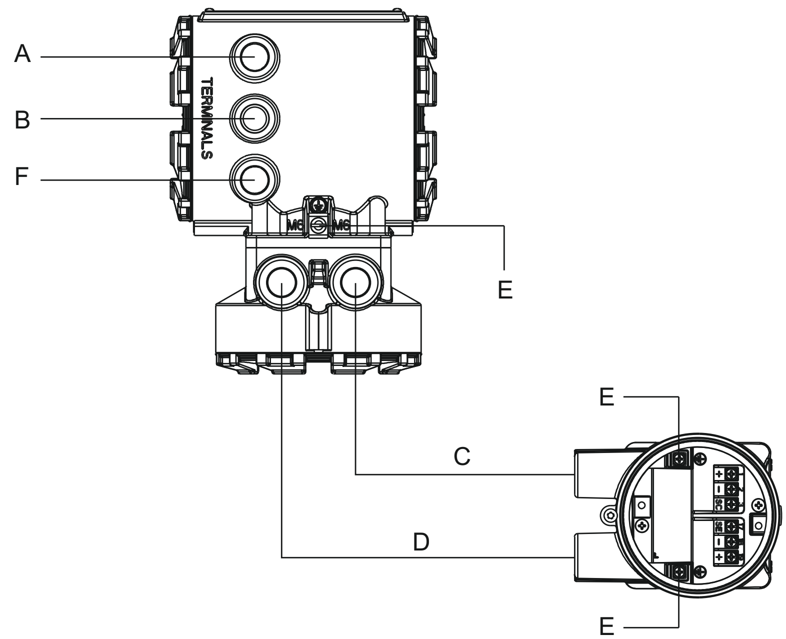
4.4.1 Conduit entries and connections

Transmitter conduit entry ports can be ordered with ½-14 NPT or M20 female threaded connections. Conduit connections should be made in accordance with national, local, and plant electrical codes. Unused conduit entries should be sealed with the appropriate certified plugs. The plastic shipping plugs do not provide ingress protection.

4.4.2 Conduit requirements

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

Figure 4-3: Best practice conduit preparation



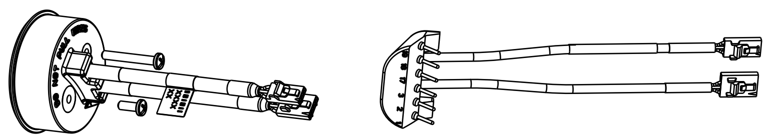
A. Power
B. EtherNet/IP Output
C. Coil
D. Electrode
E. Safety ground
F. Pulse output

4.4.3 Sensor to transmitter wiring

Integral mount transmitters

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

Figure 4-4: Replacement interconnecting cables



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

Remote mount transmitters

Remote cable kits are available as individual component cables or as a combination coil/electrode cable. They can be ordered directly using the kit numbers shown in Table 4-4, Table 4-5, and Table 4-6. 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
08732-0065-0003 (feet)	Kit, component cables, Std temp (includes Coil and I.S. Electrode)	Coil Instrinsically Safe Blue Electrode	2442C Not available
08732-0065-0004 (meters)	Kit, component cables, Std temp (includes Coil and I.S. Electrode)	Coil Instrinsically 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

Table 4-5: Component cable kits - extended temperature (-50 °C to 125 °C) *(continued)*

Cable kit #	Description	Individual cable	Alpha p/n
08732-0065-1004 (meters)	Kit, Component Cables, Ext Temp. (includes Coil and I.S. Electrode)	Coil Intrinsically Safe Blue Electrode	Not available Not available

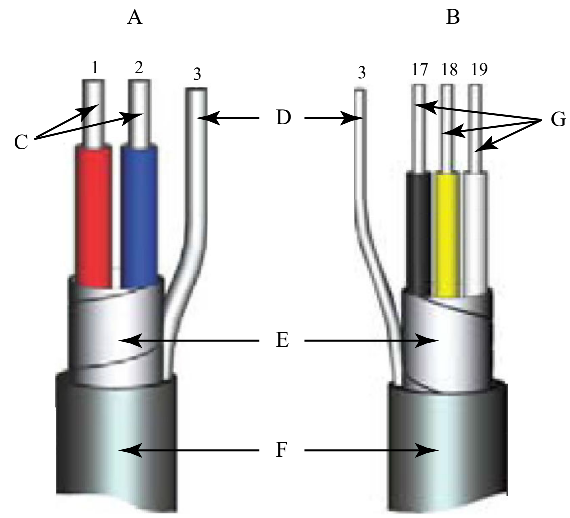
Table 4-6: Combination cable kits - coil and electrode cable (-20 °C to 80 °C)

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

Cable requirements

Shielded twisted pairs or triads must be used. For installations using the individual coil drive and electrode cable, see Figure 4-5. Cable lengths should be limited to less than 500 ft. (152 m). Consult factory for length between 500–1000 ft. (152–304 m). Equal length cable is required for each. For installations using the combination coil drive/electrode cable, see Figure 4-6. Combination cable lengths should be limited to less than 330 ft. (100 m).

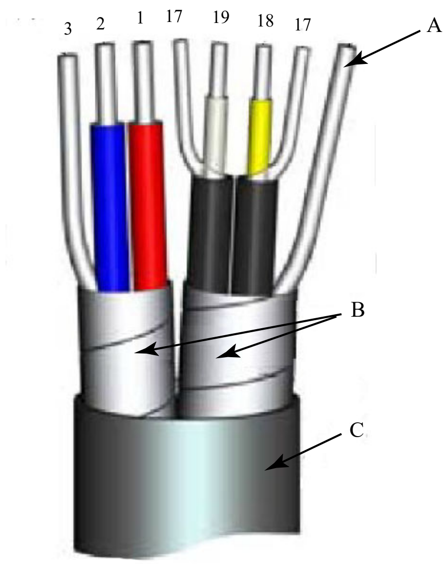
Figure 4-5: Individual component cables



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

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

Figure 4-6: Combination coil and electrode cable



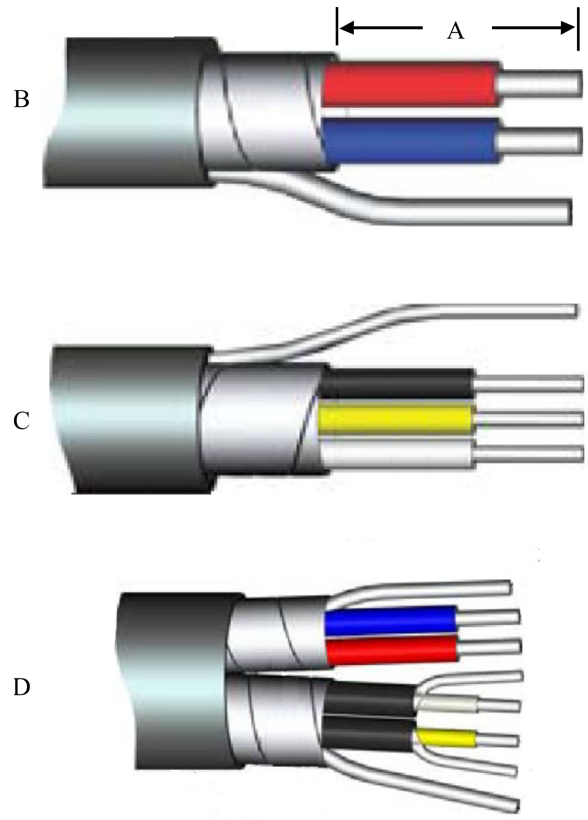
A. *Electrode shield drain*
B. *Overlapping foil shield*
C. *Outer jacket*

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

Cable preparation

Prepare the ends of the coil drive and electrode cables as shown in Figure 4-7. 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 4-7: Cable ends



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

⚠ WARNING

Shock hazard

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

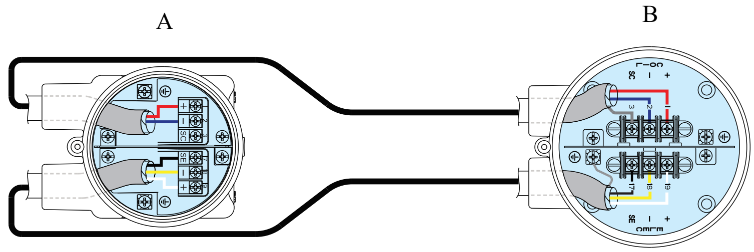
⚠ WARNING

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 4-8: Remote junction box views (field mount)



A. Sensor
B. Transmitter

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

Table 4-7: Sensor/transmitter wiring

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

Note
For hazardous locations, refer to Product certifications.

4.4.4 Power and I/O terminal blocks (field mount)

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

Figure 4-9: Terminal blocks (field mount)

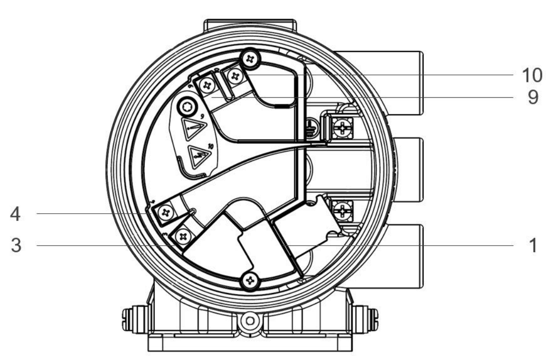


Table 4-8: Power and I/O terminals (field mount transmitter)

Terminal number	AC version
1	EtherNet/IP
3	Pulse (–)
4	Pulse (+)
9	AC (Neutral)/L2
10	AC L1

4.4.5 Powering the transmitter

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

The AC powered transmitter requires 90–250 VAC (50/60 Hz).

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

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

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).

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.

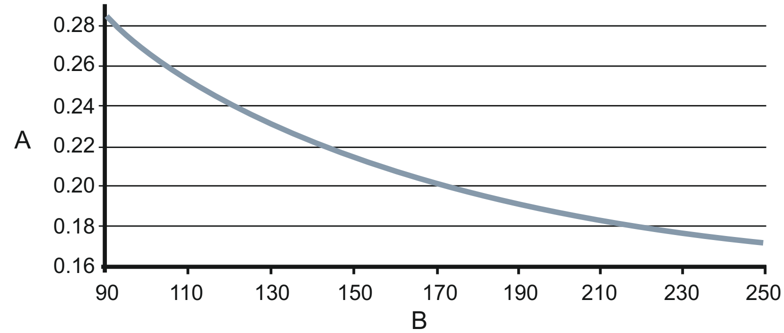
Power line impedance

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.

AC power supply requirements

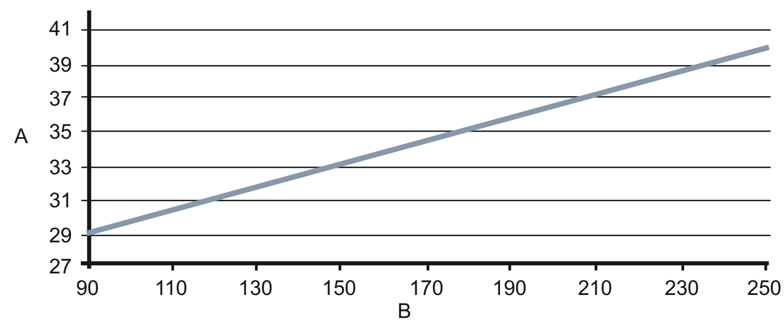
Units powered by 90 - 250 VAC have the following power requirements. Peak inrush is 37.6 A at 250 VAC supply, lasting approximately 1 ms. Inrush for other supply voltages can be estimated with: Inrush (Amps) = Supply (Volts) / 7.0

Figure 4-10: AC current requirements



1. *Supply current (amps)*
2. *Power supply (VAC)*

Figure 4-11: Apparent power



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

Table 4-9: Fuse requirements

Power system	Power supply	Fuse rating	Manufacturer
AC power	90–250 VAC	2 Amp quick acting	Schurter 34.1749, Littelfuse 0312002 or equivalent

Power terminals

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

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

Cover jam screw

For flow meters shipped with a cover jam screw, the screw should be installed after the instrument has been wired and powered up.

To install the cover jam screw:

1. Verify the cover jam screw is completely threaded into the housing.
2. Install the housing cover and verify the cover is tight against the housing.
3. Using a 2.5 mm hex wrench, loosen the jam screw until it contacts the transmitter cover.

4. Turn the jam screw an additional ½ turn counterclockwise to secure the cover.

Note
Application of excessive torque may strip the threads.

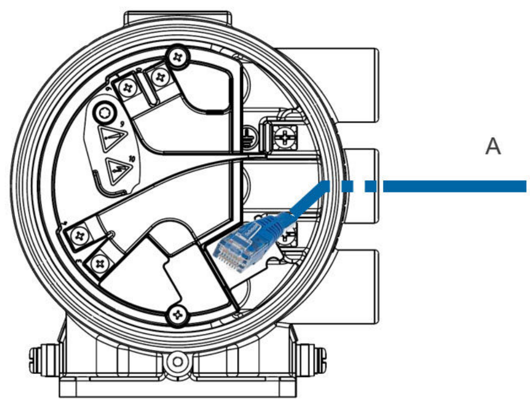
5. Verify the cover cannot be removed.

4.4.6 EtherNet/IP output wiring

Cable characteristics

Type	Any shielded or unshielded Cat5 or higher-rated instrumentation cable

Figure 4-12: EtherNet/IP output wiring



A. *Any shielded or unshielded Cat5 or higher-rated instrumentation cable*

Wire an Ethernet network using the RJ45 ports

Prerequisites

Large industrial ethernet jacks are not supported. All standard Cat5, 5e, 6, bulk, and/or overmolded are supported.

Direct connection and star topology

Procedure

1. Feed the RJ45 cable through the middle conduit entry of the transmitter. See Figure 4-12.
2. Connect the RJ45 cable into Terminal 1.
3. Anchor the cable to the module backplate using a cable tie or equivalent.

Status LED and device status

The status LED on the RJ45 port provides a quick indication of device status by changing color and flashing.

Table 4-10: Status LED and device status

Network status LED condition	Network status
Solid green	Connection made with primary protocol host.

Table 4-10: Status LED and device status *(continued)*

Network status LED condition	Network status
Green Off	No connections made with primary protocol host.
Flashing yellow	The device sends/receives Ethernet frames.

5 Basic configuration

Once the flow meter is installed and power has been supplied, the transmitter must be configured using the Local operator interface (LOI), if equipped, or a configuration tool. See Table 5-1.

Table 5-1: Basic Configuration

Configuration tool	Transmitter settings	Ethernet network settings
Field Device Technology (FDT) Frame application	✔	✔
Web server(1)		✔
LOI	✔	

(1) Transmitters settings can only be viewed with the web server and are not configurable.

NOTICE

Do not change any Modbus® settings through the LOI.

Configuration settings are saved in nonvolatile memory within the transmitter.

5.1 Basic Setup

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

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

Line size

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

Table 5-2 shows the approximate category or location of basic setup parameters for typical configuration tools.

Table 5-2: Approximate setup category/locations for typical configuration tools

Function	Category/Location
Flow units	**Basic Setup**
Calibration number	**Basic Setup → Setup**
Line size	**Basic Setup → Setup**

5.2 Local operator interface (LOI)

To activate the optional LOI, press the **DOWN** arrow.

Use the **UP**, **DOWN**, **LEFT(E)**, and **RIGHT** arrows to navigate the menu structure.

The display can be locked to prevent unintentional configuration changes. When the display lock is activated, a lock symbol will appear in the lower right hand corner of the display. To deactivate the display lock, hold the **UP** arrow for three seconds and follow the on-screen instructions. Once deactivated, the lock symbol will no longer appear in the lower right hand corner of the display.

5.3 Using a FDT frame application to configure the transmitter

5.3.1 Basic information about a FDT frame application

A FDT frame application is a software application that enables a graphical interface or view used to configure, maintain and diagnose intelligent measurement devices.

Software requirements

- A FDT frame application
  - (i.e. FDT Framework PACTware™ 5.0)
- An EtherNet/IP DTM
  - (i.e. Schnieder Electric EtherNet/IP Communication DTM Library, V1.5.1)
- Rosemount 8732EM Ethernet DTM version 1.0.11 or later

5.3.2 Connect with a FDT frame application

A connection from a FDT frame application, along with an EtherNet/IP DTM and the transmitter DTM, to your transmitter allows you to read process data, configure transmitter and Ethernet network settings, and perform maintenance and troubleshooting tasks.

FDT frame application connection types

To connect the FDT frame application to the transmitter, direct connection to the Ethernet port or connection to a local area Ethernet network is required.

Configuring transmitter and PC Ethernet settings

FDT	**Configuration → Communication (EtherNet/IP) → Network Settings**
Web server	**Information → EIP Configuration → Network Information**

Prerequisites

One of the following:

- An Ethernet cable directly connected between Terminal 1 and an Ethernet port on a PC.
- The transmitter and a PC connected to the same Ethernet network.

Refer to the EtherNet/IP output wiring for information about making cable connections to the transmitter.

Note
The Ethernet settings are the same for a FDT frame application connection over Ethernet as they are for connecting to a web server.

Procedure

Configure Ethernet settings as required.

- Use the FDT frame application or a web server to configure the transmitter.
- Use the PC control panel to configure the PC network adapter.

Table 5-3: Transmitter and PC network settings

Connection type	Transmitter network settings	PC network adapter IPv4 settings
Direct connection: Ethernet cable connected directly between Terminal 1 and the PC Ethernet adapter.	• **Auto Obtain IP (DHCP)**: Disabled • **IP address**: any IP address in the same subnet as the PC network adapter. Default IP address is 192.168.0.1 • **Subnet mask**: Default is 255.255.255.0 • **Default Gateway**: 0.0.0.0 (this indicates that no gateway will be used)	• **Auto Obtain IP (DHCP)**: Disabled • **IPv4 address**: any IPv4 address in the same subnet as the PC network adapter. Recommended 192.168.0.2 if transmitter is at the default address of 192.168.0.1. • **Subnet mask**: 255.255.255.0 • **Default Gateway**: none (leave blank)
Local network connection: The transmitter and PC are connected to a common network with a DHCP.	All settings to be assigned by network administrator. Typical network settings shown. • **Auto Obtain IP (DHCP)**: Enabled • **IP address**: automatically assigned by a DHCP server • **Subnet mask**: 255.255.255.0 • **Default Gateway**: 0.0.0.0 (this indicates that no gateway will be used)	All settings to be assigned by network administrator.

Note
If there are multiple devices on the same local area network, a different IP address for each device is necessary.

Note
If your PC has more than one wired network adapter, be sure to select the adapter that is connected to the transmitter.

Connect FDT Frame Application to the transmitter

This section will utilize FDT Framework PACTware™ 5.0, a free of charge software configuration tool, as the FDT frame application and the Schneider Electric EtherNet/IP Communication DTM Library, V1.5.1 as the EtherNet/IP DTM.

⚠ WARNING

If the transmitter is in a hazardous area, do not remove the housing cover while the transmitter is powered up. Failure to follow these instructions can cause an explosion, resulting in serious injury or death.

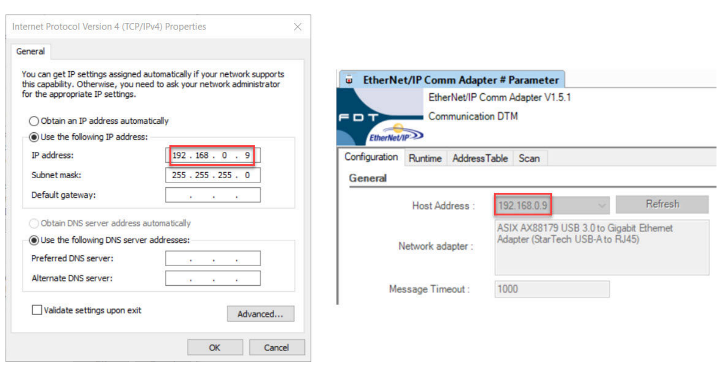
Prerequisites

The transmitter and PC must be properly configured and physically connected to each other by an Ethernet or USB cable, or they must both be connected to a local area Ethernet network.

Procedure

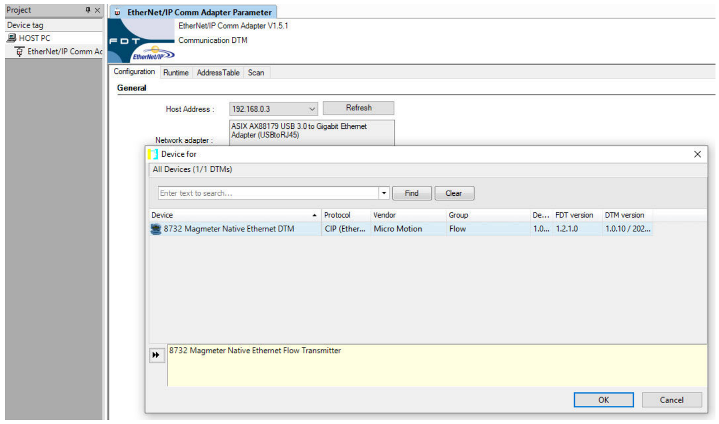
1. Download and install **FDT Framework PACTware 5.0**.
2. Download and install **EtherNet/IP Communication DTM Library**.
3. Download and install **Rosemount 8732EM Ethernet DTM** from the Rosemount 8732EM product website.
4. Restart the PC to complete the installation of the drivers.
5. Start PACTware 5.0.
6. In PACTware 5.0, select **View** → **Device Catalog**.
7. Click on **Update Device Catalog** button and click the **Yes** button.
8. On the left side of the app, right-click on **HOST PC** and select **Add Device**.
9. Double-click on **EtherNet/IP Comm Adapter** device.
10. On the left side of the app, right-click on **EtherNet/IP Comm Adapter** and select **Parameter**. Ensure that the PC port address is the same as the EtherNet/IP DTM host address.

Figure 5-1: PC port address and EtherNet/IP DTM host address verification



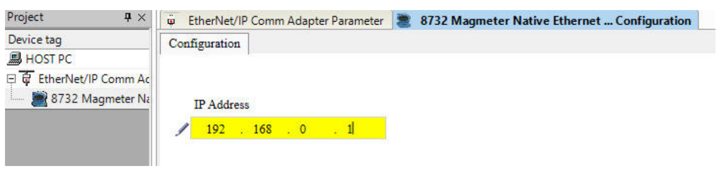
11. On the left side of the app, right-click on **EtherNet/IP Comm Adapter** and select **Add Device**.

12. Double-click on **8732 Magmeter Native Ethernet DTM** device.



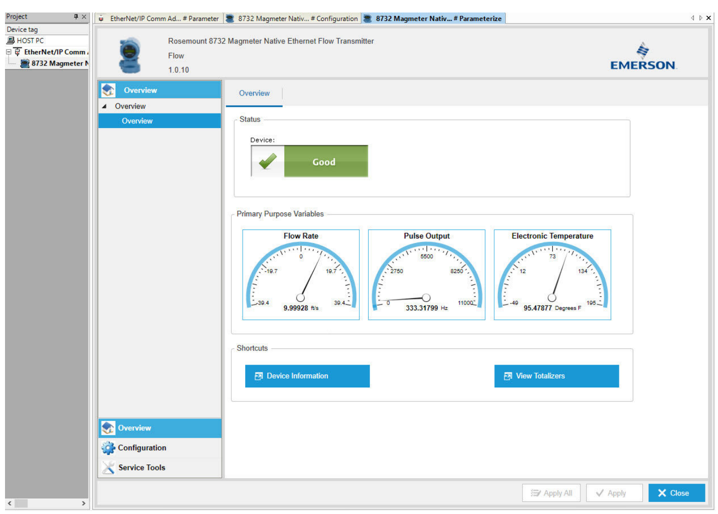
13. On the left side of the app, right-click on **8732 Magmeter Native Ethernet DTM** and select **Parameter → Configuration**.
14. In the ***Configuration*** tab, enter the **IP Address** of the transmitter and select **Apply**.

Note
Default IP address is 192.168.0.1.



15. Right-click on **8732 Magmeter Native Ethernet DTM** and select **Connect.**
16. Right-click on **8732 Magmeter Native Ethernet DTM** and select **Parameter → Online Configuration → Parameterize**.

    Upon successful connection, the overview section of the transmitter DTM displays.



5.4 Using a web server to configure the transmitter

A connection from the web server allows you to:

- Configure Ethernet network settings.
- Read the transmitter configuration settings and process data.

5.4.1 Recommended web browsers

Browser	Version
Mozilla Firefox	132 or newer
Microsoft Edge	127.0.2651.105 or newer
Google Chrome	130.0.6723.92 or newer

5.4.2 Configuring transmitter and PC Ethernet settings

FDT	**Configuration → Communication (EtherNet/IP) → Network Settings**
Web server	**Information → EIP Configuration → Network Information**

Prerequisites

One of the following:

- An Ethernet cable directly connected between Terminal 1 and an Ethernet port on a PC.
- The transmitter and a PC connected to the same Ethernet network.

Refer to the EtherNet/IP output wiring for information about making cable connections to the transmitter.

Note
The Ethernet settings are the same for a FDT frame application connection over Ethernet as they are for connecting to a web server.

Procedure

Configure Ethernet settings as required.

- Use the FDT frame application or a web server to configure the transmitter.
- Use the PC control panel to configure the PC network adapter.

Table 5-4: Transmitter and PC network settings

Connection type	Transmitter network settings	PC network adapter IPv4 settings
Direct connection: Ethernet cable connected directly between Terminal 1 and the PC Ethernet adapter.	• **Auto Obtain IP (DHCP)**: Disabled • **IP address**: any IP address in the same subnet as the PC network adapter. Default IP address is 192.168.0.1 • **Subnet mask**: Default is 255.255.255.0 • **Default Gateway**: 0.0.0.0 (this indicates that no gateway will be used)	• **Auto Obtain IP (DHCP)**: Disabled • **IPv4 address**: any IPv4 address in the same subnet as the PC network adapter. Recommended 192.168.0.2 if transmitter is at the default address of 192.168.0.1. • **Subnet mask**: 255.255.255.0 • **Default Gateway**: none (leave blank)
Local network connection: The transmitter and PC are connected to a common network with a DHCP.	All settings to be assigned by network administrator. Typical network settings shown. • **Auto Obtain IP (DHCP)**: Enabled • **IP address**: automatically assigned by a DHCP server • **Subnet mask**: 255.255.255.0 • **Default Gateway**: 0.0.0.0 (this indicates that no gateway will be used)	All settings to be assigned by network administrator.

Note
If there are multiple devices on the same local area network, a different IP address for each device is necessary.

Note
If your PC has more than one wired network adapter, be sure to select the adapter that is connected to the transmitter.

5.4.3 Connecting to the web server using an unsecure connection

Prerequisites

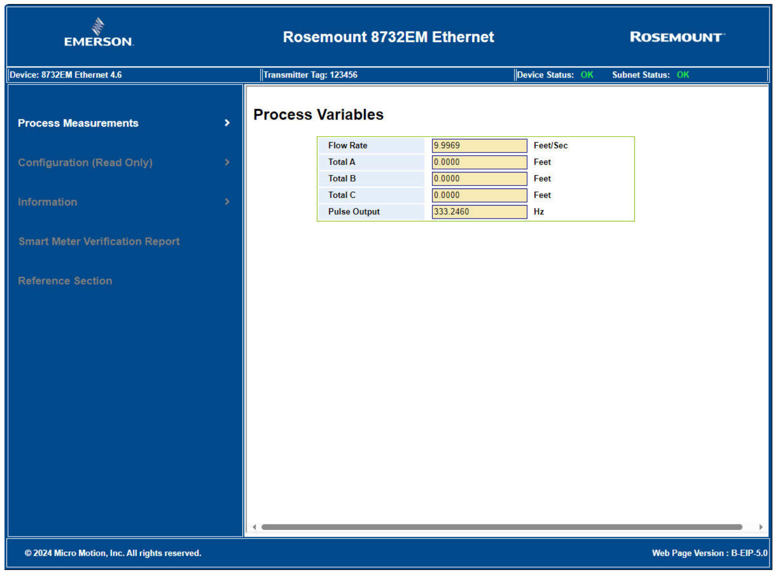
To connect to the transmitter with a web server:

- The PC and transmitter must have been properly configured for their connection type.
- You must know the IP address of the transmitter. Default IP address is 192.168.0.1.

Procedure

Enter the IP address of the transmitter in the web browser address bar.
Upon successful connection, the home page of the transmitter displays:

Figure 5-2: Transmitter home page



5.4.4 Log in to view or change Ethernet network settings

Ethernet login is required to prevent unauthorized access to configuring the Ethernet network settings on the transmitter through the web server.

To view or change the Ethernet network settings:

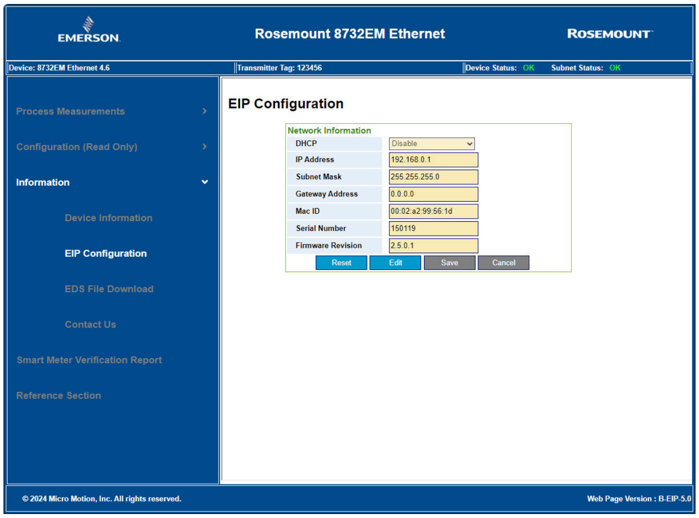
Procedure

1. On the left side of the web browser page, select **Information**.
2. In the **Information** drop-down menu, select **EIP Configuration**.
3. Enter **engineer** for the username and **Ro$3m0unt_8732** for the password in the pop up window and select **Sign In**.

Figure 5-3: Ethernet username and password

Upon successful log in, the ***EIP Configuration*** page of the transmitter displays:

Figure 5-4: EIP Configuration



6 Advanced installation details

6.1 Hardware switches

The electronics are equipped with two user-selectable hardware switches. These switches set the Transmitter Security and Internal/External Pulse Power.

6.1.1 Transmitter security

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

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

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

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

6.1.2 Internal/external pulse power

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

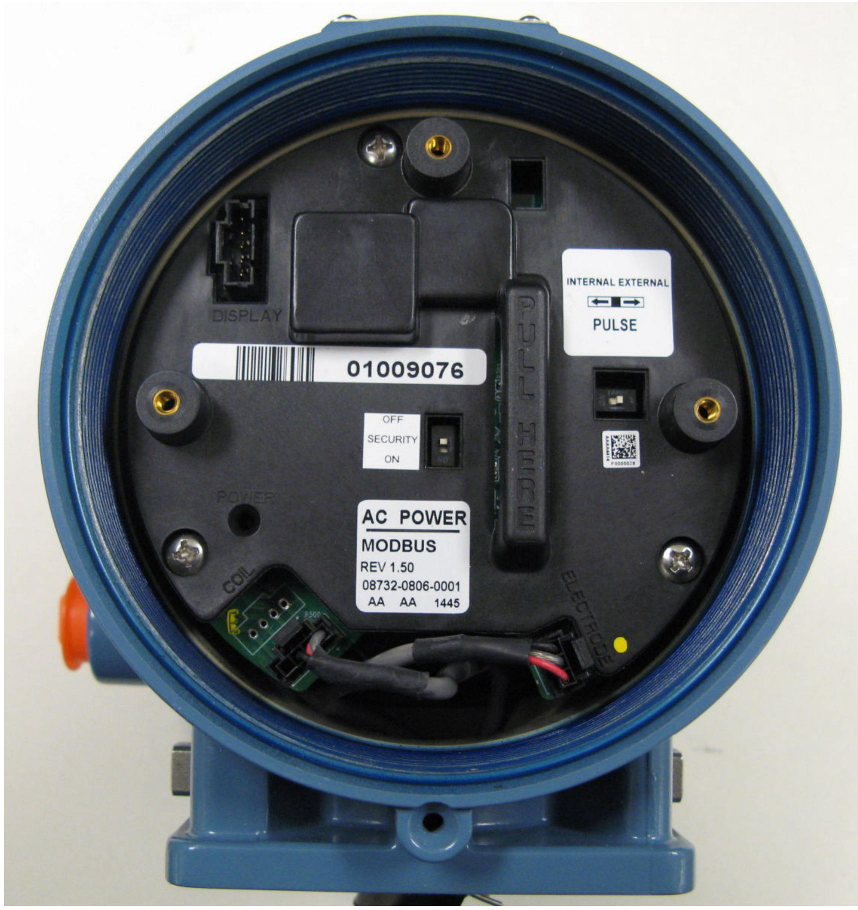
- When the switch is in the **INTERNAL** position, the pulse loop is powered internally by the transmitter.
- When the switch is in the **EXTERNAL** position, a 5–28 VDC external supply is required. For more information about pulse external power, see Connect pulse output.

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

6.1.3 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 to protect the electronics.

Figure 6-1: Electronics Stack and Hardware Switches



Procedure

1. Place the control loop into **manual** control.
2. Disconnect power to the transmitter
3. Remove the electronics compartment cover.

   If the cover has a cover jam screw, this must be loosened prior to removal of the cover.
4. Remove the LOI/Display, if applicable.
5. Identify the location of each switch (see Figure 6-1).
6. Change the setting of the desired switches with a small, non-metallic tool.
7. Replace the LOI/Display, if applicable.
8. Replace the electronics compartment cover.

   If the cover has a cover jam screw, this must be tightened to comply with installation requirements. See Cover jam screw for more details.
9. Return power to the transmitter and verify the flow measurement is correct.
10. Return the control loop to **automatic** control.

6.2 Pulse output

There is one additional loop connection available on the Transmitter:

Pulse output - used for external or remote totalization (see Configure Pulse 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
The pulse output can be internally or externally powered, and the **PULSE** switch must be set accordingly (the default setting is **EXTERNAL**).

External

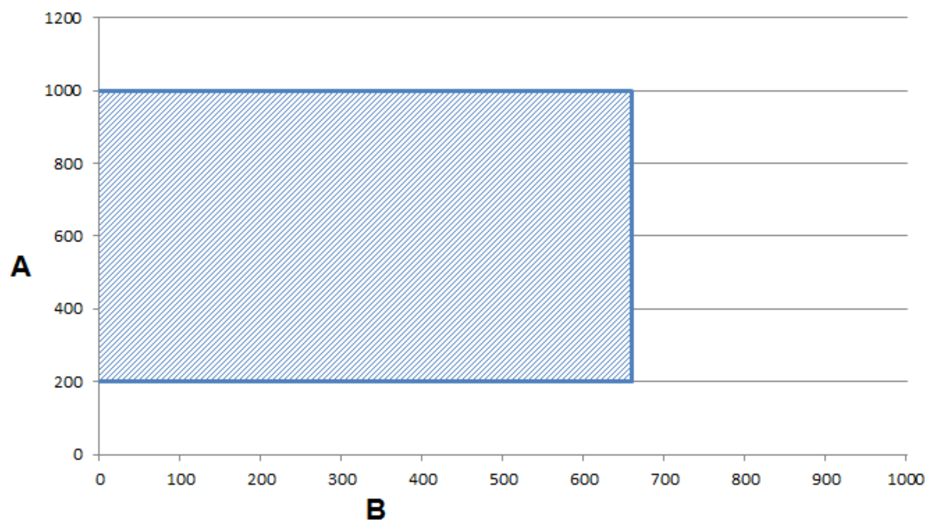
The transmitter supports a pulse output with an external power supply that meets the following requirements:

- Supply voltage: 5 to 24 VDC
- Maximum current: 100 mA
- Maximum power: 1.0 W
- Load resistance: 200 to 10k Ohms (typical value 1k Ohms). Refer to the figure indicated:

Supply voltage	Resistance vs cable length
5 VDC	See Figure 6-2
12 VDC	See Figure 6-3
24 VDC	See Figure 6-4

- Pulse mode: Fixed pulse width or 50% duty cycle
- Pulse duration: 0.1 to 650 ms (adjustable)
- Maximum pulse frequency: 5,000 Hz
- FET switch closure: solid state switch

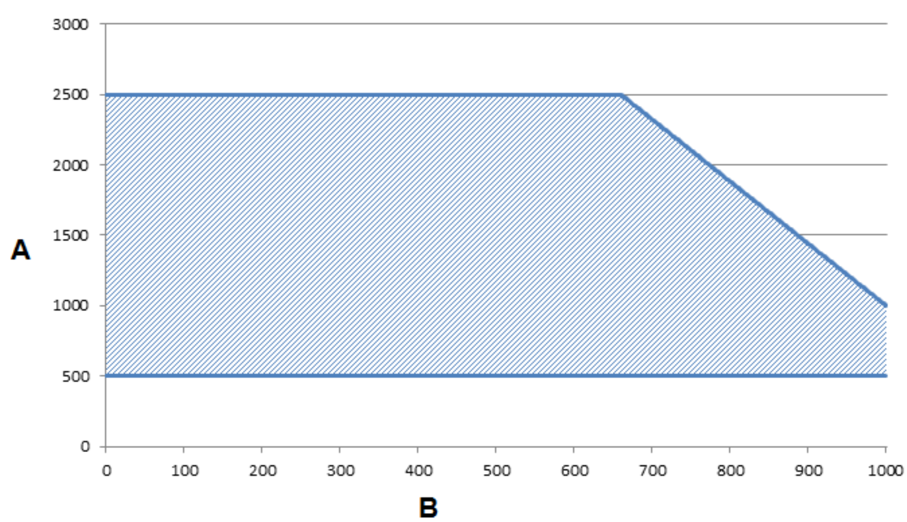
Figure 6-2: 5 VDC Supply



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

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

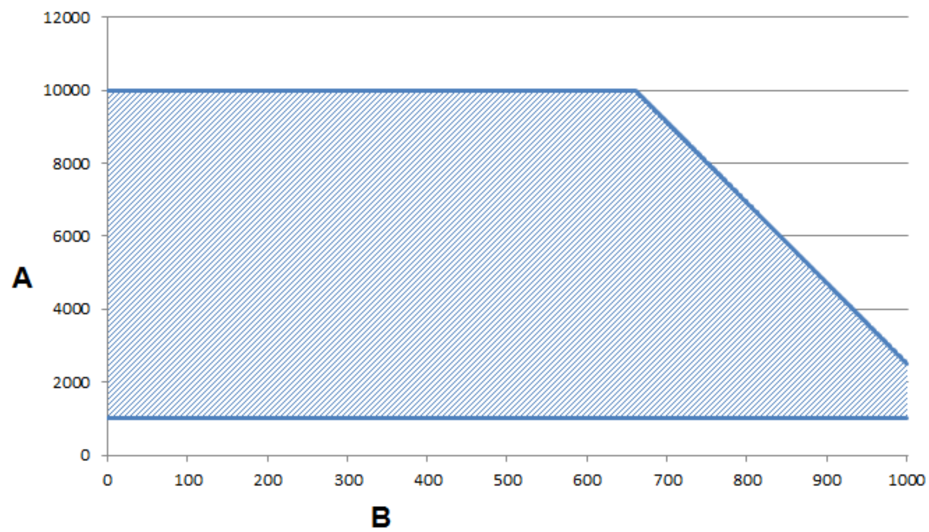
Figure 6-3: 12 VDC Supply



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

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

Figure 6-4: 24 VDC Supply



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

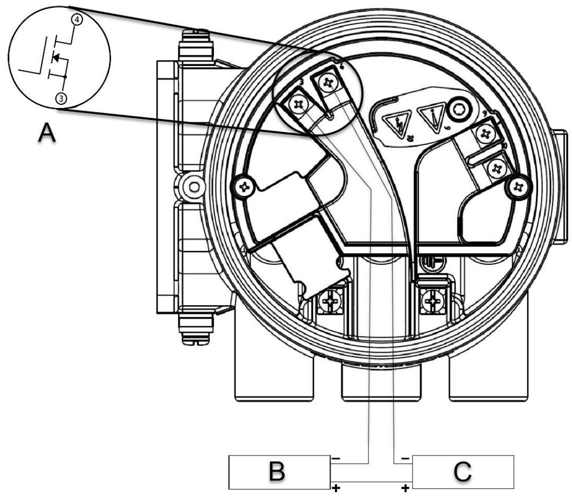
At 5000 Hz operation with a 24 VDC supply, pull-up resistances of 1000 to 10,000 Ohms allow cable lengths up to 660 ft (200 m). Resistances from 1000 to 2500 Ohms allow a cable length of 1000 ft (330 m).

Connecting an external power supply

Note

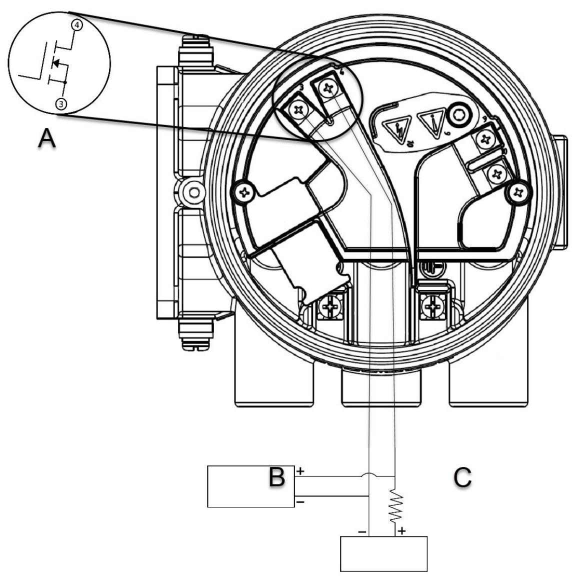
Total loop impedance must be sufficient to keep loop current below maximum rating. A resistor can be added in the loop to raise impedance.

Figure 6-5: Connecting an electromechanical totalizer/counter with external power supply



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

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



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

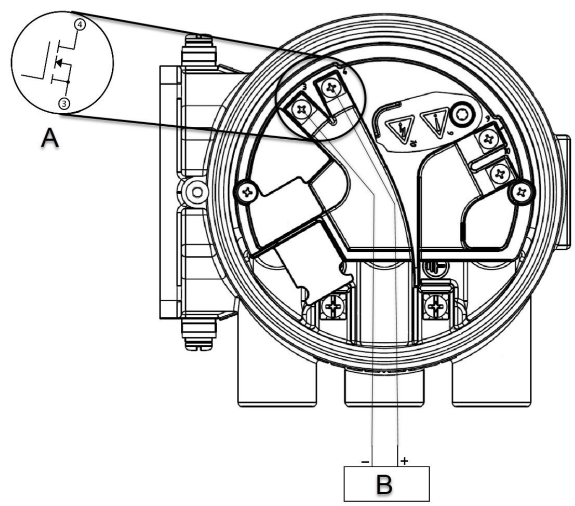
Procedure

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

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



A. Schematic showing FET between terminal 3 and 4
B. Electronic counter

Procedure

1. Turn off the transmitter.
2. Connect wires from the counter to the transmitter as shown in Figure 6-7.

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 LOI or configuration tools.

Table 7-1: Basic Configuration

Configuration tool	Transmitter settings	Ethernet network settings
Field Device Technology (FDT) Frame application	✔	✔
Web server(1)		✔
LOI	✔	

(1) Transmitters settings can only be viewed with the web server and are not configurable.

NOTICE

Do not change any Modbus® settings through the LOI.

The Local Operator Interface (LOI) is a configurable, passive display that can show process variables, status information, and diagnostic messages. Refer to Advanced Configuration Functionality for information about configuring the LOI.

7.1.1 Make a start up connection to the transmitter

For all configuration tools except the display, you must have an active connection to the transmitter to configure the transmitter.

Procedure

Identify the connection type to use, and follow the instructions for that connection type in the appropriate appendix.

Communications tool	Connection type to use	Instructions
FDM Frame Application	Ethernet	Refer to Using a FDT frame application to configure the transmitter for more information.
Web server	Ethernet	Refer to Using a web server to configure the transmitter for more information.

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

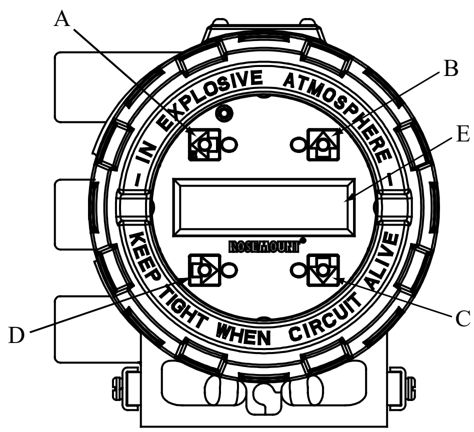
- Start/stop and reset totalizer values
- Run diagnostics and view the results
- Monitor transmitter status

Ethernet network settings cannot be viewed or configured through the LOI.

7.2.1 Basic features

The basic features of the LOI include a display window and four navigational arrow keys.

Figure 7-1: Local Operator Interface Keypad and Character Display



*A. **LEFT** (E) key*
*B. **UP** key*
*C. **DOWN** key*
*D. **RIGHT** key*
E. Display window

To access the LOI, press the **DOWN** arrow one time. Use the **UP**, **DOWN**, **LEFT**, and **RIGHT** arrows to navigate the menu structure. A map of the LOI menu structure is shown in LOI menu tree.

7.2.2 Data entry

The LOI keypad does not have alphanumeric keys. Alphanumeric and symbolic data is entered by the following procedure. To access the appropriate functions:

Procedure

1. Use ⬆, ⬇, ⬅, and ➡ to navigate the menu (LOI menu tree) 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:

Procedure

1. Press ⬇ key to access the menu. See LOI menu tree.
2. Use ⬆, ⬇, ⬅, and ➡ to select line size from the basic setup menu.
3. Use ⬆ or ⬇ to increase/decrease the sensor size.
4. When you reach the desired sensor size, press ⬅.
5. Set the loop to manual if necessary, and press ⬅ again.

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

Select value example

Changing the upper range limit:

Procedure

1. Press ⬇ key to access the menu. See LOI menu tree.
2. Use ⬆, ⬇, ⬅, and ➡ to select **PV URV** from the basic setup menu.
3. Press ➡ to position the cursor.
4. Press ⬆ or ⬇ to set the number.
5. Repeat Step 3 and Step 4 until desired number is displayed, press ⬅.
6. Set the loop to manual if necessary, and press ⬅ again.

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

7.2.4 Dynamic variable display pause

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

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

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

7.2.5 Totalizer functionality

Totalizer selection

Procedure

- To view the totalizer values, first press ⬇ to access the LOI menu structure. The first option is the totalizers. Under this section, you can view and configure the totalizers.

See Configure Totalizers for more information on the totalizer functionality.

Start all / Stop all

Totalizers can be started or stopped simultaneously. See Configure Totalizers. 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 Configure Totalizers.

7.2.6 Display lock

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

Manual display lock

To activate, hold the **UP** arrow for 3 seconds and follow the on-screen instructions. When the display lock is activated, a lock symbol will appear in the lower right hand corner of the display.

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

Auto display lock

The transmitter can be configured to automatically lock the LOI. To access configuration:

Procedure

1. Press ⬇ to access the menu. See LOI menu tree.

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

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

7.2.7 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.

7.2.8 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	R
Continuous meter verification	✓

7.2.9 LOI menu tree

Figure 7-2: Totalizers menu map

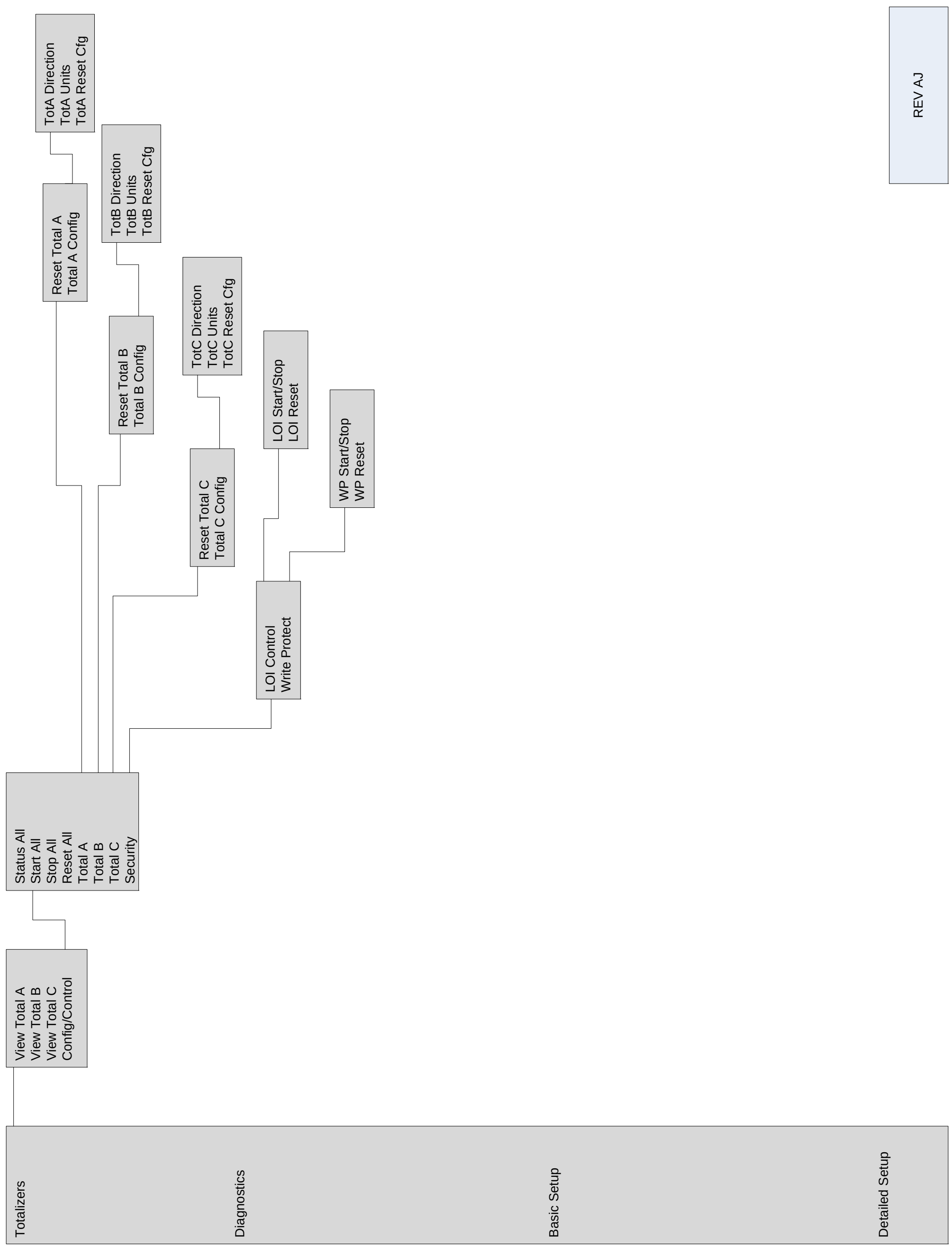


Figure 7-3: Diagnostics menu map

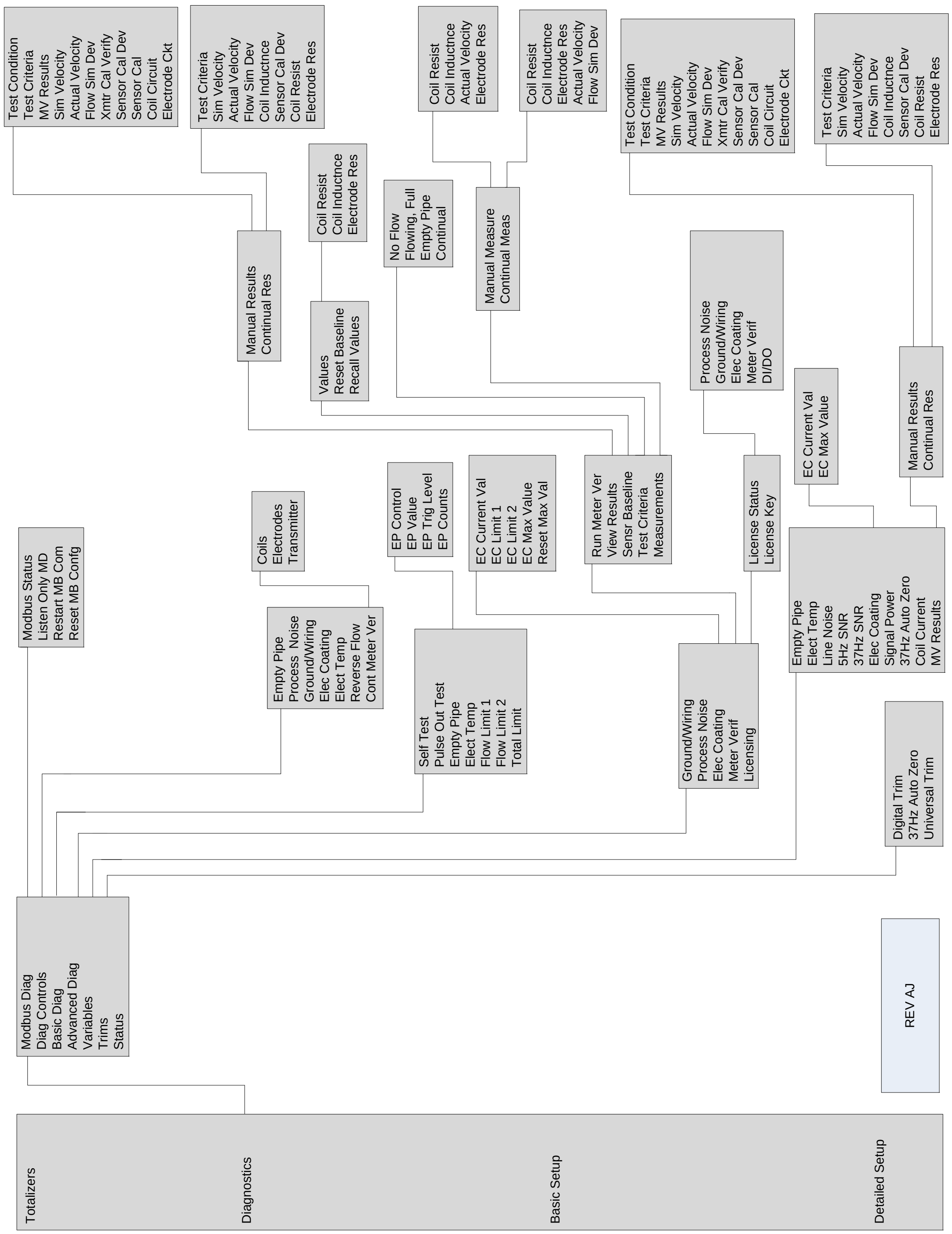


Figure 7-4: Basic setup menu map

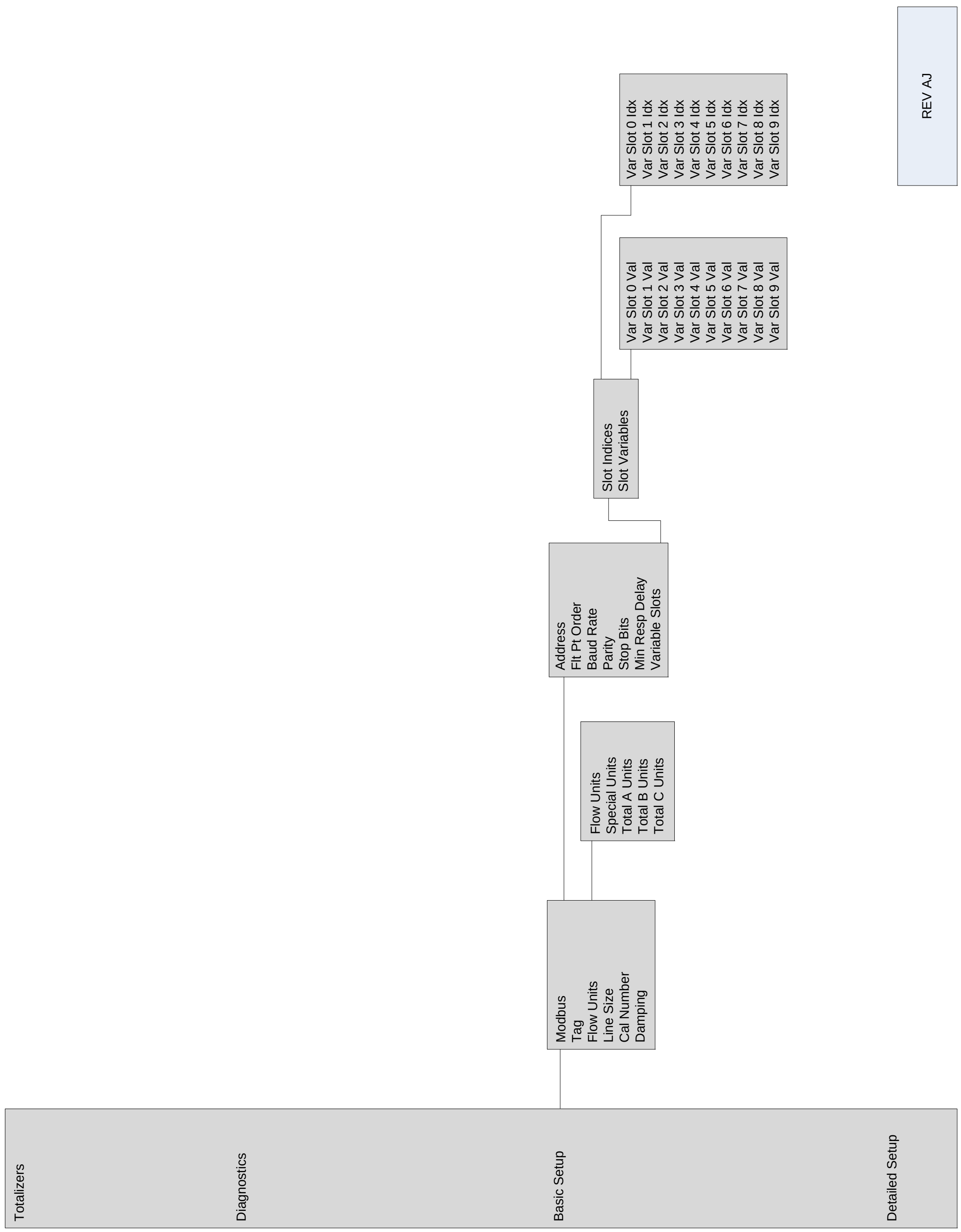
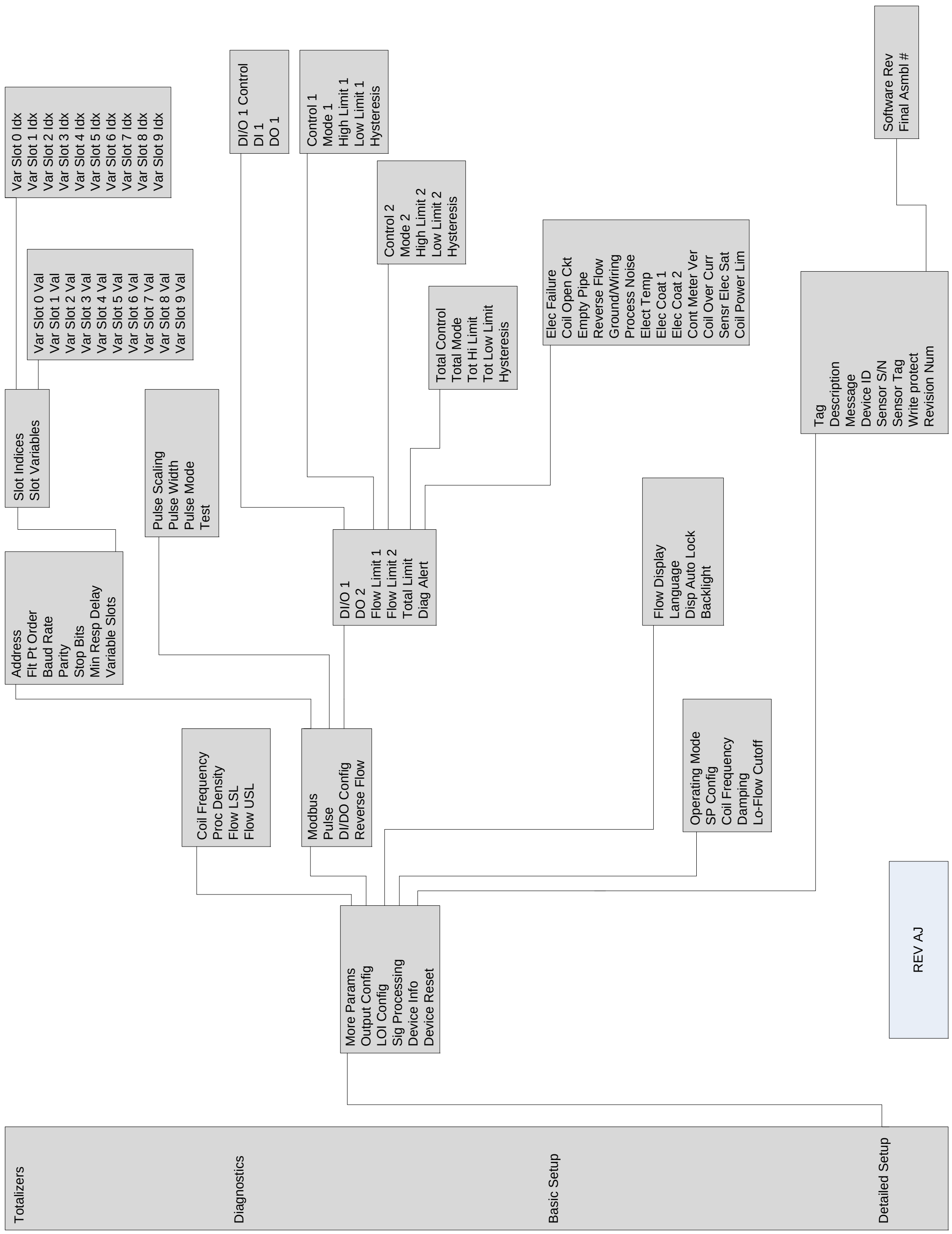


Figure 7-5: Detailed setup menu map



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 the Local Operator Interface (LOI) or a FDT frame application. 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 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**
FDT frame application	**Configuration → Manual Setup → Input/Output → Pulse Output → Pulse Scaling**

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

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

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

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

Note
The pulse output scaling is designed to operate between 0 and 5000 Hz. The minimum conversion factor value is found by dividing the minimum span (in units of volume per second) by 5000 Hz.

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

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

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 scaling units

FDT frame application	**Configuration → Manual Setup → Input/Output → Pulse Output**

This 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 scaling unit will be gallons.

Pulse width

LOI menu path	**Detailed Setup → Output Config → Pulse → Pulse Width**
FDT frame application	**Configuration → Manual Setup → Input/Output → Pulse Output → Pulse Width**

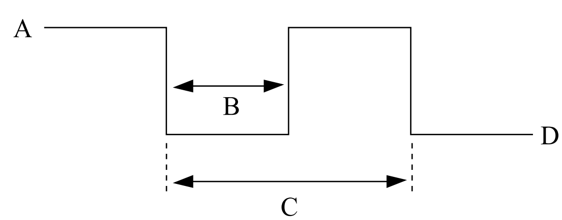
The factory default pulse width is 0.5 ms.

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 (< 1000 Hz). The transmitter will accept values from 0.1 ms to 650 ms.

For frequencies higher than 1000 Hz, 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 ½ the period of the pulse) the transmitter will limit the pulse output. See example.

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

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

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

The maximum flow rate is 10,000 gpm. Set the pulse output scaling such that the transmitter outputs 5000 Hz at 10,000 gpm.

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

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

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

$$1\ pulse = 0.0333\ gal$$

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

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

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

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

$$Frequency = 5.833\ Hz$$

The upper range value (20 mA) is 3000 gpm. To obtain the highest resolution of the pulse output, 5000 Hz is scaled to the full scale analog reading.

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

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

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

$$1\ pulse = 0.01\ gal$$

Pulse mode

LOI menu path	**Detailed Setup → Output Config → Pulse → Pulse Mode**
FDT frame application	**Configuration → Manual Setup → Input/Output → Pulse Output → Pulse Mode**

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

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

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

8.3 Configure Totalizers

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**
FDT frame application	Totalizer A: **Overview → View Totalizers → Totalizer A** Totalizer B: **Overview → View Totalizers → Totalizer B** Totalizer C: **Overview → View Totalizers → Totalizer C**

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

Start, stop, reset all totalizers

LOI menu path	Start all totalizers: **Totalizers → Config/Control → Start All** Stop all totalizers: **Totalizers → Config/Control → Stop All** Reset all totalizers: **Totalizers → Config/Control → Reset All**
FDT frame application	Start all totalizers: **Overview → View Totalizers → Start All Totals** Stop all totalizers: **Overview → View Totalizers → Stop All Totals** Reset all totalizers: **Overview → View Totalizers → Reset All Totals**

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

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

Totalizer direction

LOI menu path	Totalizer A: **Totalizers → Config/Control → Total A → Total A Config → Direction** Totalizer B: **Totalizers → Config/Control → Total B → Total B Config → Direction** Totalizer C: **Totalizers → Config/Control → Total C → Total C Config → Direction**
FDT frame application	Totalizer A: **Overview → View Totalizers → Totalizer A → Direction** Totalizer B: **Overview → View Totalizers → Totalizer B → Direction** Totalizer C: **Overview → View Totalizers → Totalizer C → 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**
FDT frame application	Totalizer A: **Overview → View Totalizers → Totalizer A → Totalizer A Units** Totalizer B: **Overview → View Totalizers → Totalizer B → Totalizer B Units** Totalizer C: **Overview → View Totalizers → Totalizer C → Totalizer C Units**

Configure the units for totalizers.

Table 8-1: 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
Igal	Imperial gallons	lb	Pounds	Special	Special Units[(1)]
m3	Cubic meters	Ston	Short tons		
B42	Barrels (42 gallonsJ)				
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**
FDT frame application	Totalizer A: **Overview → View Totalizers → Totalizer A → Reset Options** Totalizer B: **Overview → View Totalizers → Totalizer B → Reset Options** Totalizer C: **Overview → View Totalizers → Totalizer C → Reset Options**

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

Reset individual totalizer

LOI menu path	Totalizer A: **Totalizers → Config/Control → Total A → Reset Total A** Totalizer B: **Totalizers → Config/Control → Total B → Reset Total B** Totalizer C: **Totalizers → Config/Control → Total C → Reset Total C**
FDT frame application	Totalizer A: **Overview → View Totalizers → Reset Totalizer A** Totalizer B: **Overview → View Totalizers → Reset Totalizer B** Totalizer C: **Overview → View Totalizers → Reset Totalizer C**

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

Totalizer security

LOI menu path	**Totalizers → Config/Control → Security**
FDT frame application	**Overview → View Totalizers → Totalizer Settings**

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

LOI totalizer start/stop

LOI menu path	**Totalizers → Config/Control → Security → LOI Control → LOI Start/ Stop**
FDT frame application	**Overview → View Totalizers → Totalizer Settings → Start/Stop from LOI**

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

LOI totalizer reset

LOI menu path	**Totalizers → Config/Control → Security → LOI Control → LOI Reset**
FDT frame application	**Overview → View Totalizers → Totalizer Settings → Reset from LOI**

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

Start/stop write protect

LOI menu path	**Totalizers → Config/Control → Security → Write Protect → WP Start/Stop**
FDT frame application	**Overview → View Totalizers → Totalizer Settings → Write Protect Start/Stop Security**

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

Reset write protect

LOI menu path	**Totalizers → Config/Control → Security → Write Protect → WP Reset**
FDT frame application	**Overview → View Totalizers → Totalizer Settings → Write Protect Reset Security**

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

8.4 Configure LOI/Display

8.4.1 Flow and totalizer display

LOI menu path	**Detailed Setup → LOI Config → Flow Display**
FDT frame application	**Configuration → Manual Setup → Transmitter Display → 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:

- Flow, Total A
- Flow, Total B
- Flow, Total C

8.4.2 Language

LOI menu path	**Detailed Setup → LOI Config → Language**
FDT frame application	**Configuration → Manual Setup → Transmitter Display → Language**

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

- English
- Spanish
- Portuguese
- German
- French

8.4.3 Display lock

LOI menu path	**Detailed Setup → LOI Config → Disp Auto Lock**
FDT frame application	**Configuration → Manual Setup → Transmitter Display → 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 Backlight control

LOI menu path	**Detailed Setup → LOI Config → Backlight**
FDT frame application	**Configuration → Manual Setup → Transmitter Display → Back Light**

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

- OFF
- 10 seconds
- 20 seconds
- 30 seconds
- 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 → More Params → Coil Frequency**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Signal Processing → Coil Drive Frequency**

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

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

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

Related information

Auto zero

8.5.2 Process density

LOI menu path	**Detailed Setup → More Params → Proc Density**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Density → Process Data**

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

Qm = Qv x p

Where:

Qm is the mass flow rate

Qv is the volumetric flow rate, and

p is the fluid density

8.5.3 Reverse flow

LOI menu path	**Detailed Setup → Output Config → Reverse Flow**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Signal Processing → Operation → Reverse Flow Mode**

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**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Signal Processing → Operation → Low 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**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Signal Processing → Process Data → Damping**

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

8.5.6 Signal processing

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

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

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

See Digital Signal Processing for the detailed description of how the signal processing works.

8.6 Configure special units

Special units are used when the application requires units that are not included in the flow units available from the device. Refer to Basic Setup 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**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Flow → Flow Units → Special Units**

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

Base volume units

- Gallons (default)
- Liters
- Imperial gallons
- Cubic meters
- Barrels (42 gallons)
- Cubic feet
- Cubic centimeters
- Barrels (31 gallons)

Base mass units

- Kilograms
- Metric tons
- Pounds
- Short tons

Base velocity units

- Feet
- Meters

8.6.2 Conversion factor

LOI menu path	**Basic Setup → Flow Units → Special Units → Conv Factor**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Flow → Flow Units → Special Units → Conversion Number**

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, then the conversion factor is 31.

8.6.3 Base time unit

LOI menu path	**Basic Setup → Flow Units → Special Units → Base Time Unit**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Flow → 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.**

- Minute (default)
- Second
- Hour
- Day

8.6.4 Special volume unit

LOI menu path	**Basic Setup → Flow Units → Special Units → Volume Unit**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Flow → Flow Units → Special Units → Special 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, then 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**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Flow → Flow Units → Special Units → Special Flow Rate Unit**

Flow rate unit is a format variable that provides a record of the units to which you are converting. 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: Basic diagnostics availability

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

Table 9-2: Advanced diagnostics availability

Diagnostic name	Diagnostic category	Product capability
High Process Noise	Process	Suite 1 (DA1)
Coated Electrode Detection	Process	Suite 1 (DA1)
Commanded Meter Verification	Meter Health	Suite 2 (DA2)
Continuous Meter Verification	Meter Health	Suite 2 (DA2)

9.2 Licensing and enabling

All advanced diagnostics are licensed by ordering option code DA1, DA2, or both. In the event that a diagnostic option is not ordered, advanced diagnostics can be licensed in the field through the use of a license key.

Each transmitter has a unique license key specific to the diagnostic option code. A trial license is also available to enable the advanced diagnostics. This temporary functionality will be automatically disabled after 30-days or when power to the transmitter is cycled, whichever occurs first. This trial code can be used a maximum of three times per transmitter. See the detailed procedures below for entering the license key and enabling the advanced diagnostics. To obtain a permanent or trial license key, contact an Emerson representative.

9.2.1 Licensing the diagnostics

Procedure

1. Power up the transmitter.
2. Verify the software version is 4.6 software or later.

LOI menu path	**Detailed Setup → Device Info → Revision Num → Software Num**
FDT frame application	**Overview → Device Information → Revision Number**

3. Determine the Device ID.

LOI menu path	**Detailed Setup → Device Info → Device ID**
FDT frame application	**Overview → Device Information → 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**
FDT frame application	**Configuration → Manual Setup → License Status → Upgrade License → License Key**

9.3 Tunable empty pipe detection

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

Turning empty pipe on/off

LOI menu path	**Diagnostics → Diag Controls → Empty Pipe**
FDT frame application	**Configuration → Manual Setup → Basic Diagnostics → Empty Pipe → Empty Pipe Detection**

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

9.3.1 Tunable empty pipe parameters

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

Empty pipe (EP) value

LOI menu path	**Diagnostics → Variables → Empty Pipe**
FDT frame application	**Configuration → Manual Setup → Basic Diagnostics → 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**
FDT frame application	**Configuration → Manual Setup → Basic Diagnostics → Empty Pipe → Trigger Value**

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**
FDT frame application	**Configuration → Manual Setup → Basic Diagnostics → Empty Pipe → Counts**

Limits: 2 to 50

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

9.3.2 Optimizing tunable empty pipe

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

Procedure

1. Record the empty pipe value with a full pipe condition.

   Example

   Full reading = 0.2

2. Record the empty pipe value with an empty pipe condition.

   Example

   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.

   Example

   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.

Example

Set the counts to 10

9.4 Electronics temperature

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

9.4.1 Turning electronics temperature on/off

LOI menu path	**Diagnostics → Diag Controls → Elect Temp**
FDT frame application	**Configuration → Manual Setup → Basic Diagnostics → Electronics Temperature → Electronics Temperature Range Detection**

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

9.4.2 Electronics temperature parameters

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

LOI menu path	**Diagnostics → Variables → Elect Temp**
FDT frame application	**Configuration → Manual Setup → Basic Diagnostics → Electronics Temperature → Electronics Temperature**

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

9.5 Ground/wiring fault detection

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

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

9.5.1 Turning ground/wiring fault on/off

LOI menu path	**Diagnostics → Diag Controls → Ground/Wiring**
FDT frame application	**Configuration → Manual Setup → Process Diagnostics → Grounding/Wiring Fault Detection → Grounding/Wiring Fault Detection**

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

9.5.2 Ground/wiring fault parameters

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

Line noise

LOI menu path	**Diagnostics → Variables → Line Noise**
FDT frame application	**Configuration → Manual Setup → Process Diagnostics → Grounding/Wiring Fault Detection → Line Noise**

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

9.6 High process noise detection

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

9.6.1 Turning high process noise on/off

LOI menu path	**Diagnostics → Diag Controls → Process Noise**
FDT frame application	**Configuration → Manual Setup → Process Diagnostics → Process Noise → High Process Noise Detection**

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

9.6.2 High process noise parameters

The high process noise diagnostic has two read-only parameters. It does not have any configurable parameters. This diagnostic requires that flow be present in the pipe and the velocity be greater than1 ft/s (0.3 m/s).

5 Hz signal to noise ratio (SNR)

LOI menu path	**Diagnostics → Variables → 5Hz SNR**
FDT frame application	**Configuration → Manual Setup → Process Diagnostics → Process Noise → 5 Hz SNR**

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

37 Hz signal to noise ratio (SNR)

LOI menu path	**Diagnostics → Variables → 37Hz SNR**
FDT frame application	**Configuration → Manual Setup → Process Diagnostics → Process Noise → 37 Hz SNR**

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

9.7 Coated electrode detection

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

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

9.7.1 Turning coated electrode detection on/off

LOI menu path	**Diagnostics → Diag Controls → Elec Coating**
FDT frame application	**Configuration → Manual Setup → Process Diagnostics → Electrode Coating → Electrode Coating**

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

9.7.2 Coated electrode parameters

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

Electrode coating (EC) value

LOI menu path	**Diagnostics → Advanced Diag → Elec Coating → EC Current Val**
FDT frame application	**Configuration → Manual Setup → Process Diagnostics → Electrode Coating → Electrode Coating Value**

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**
FDT frame application	**Configuration → Manual Setup → Process Diagnostics → Electrode Coating → Level 1 Limit**

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**
FDT frame application	**Configuration → Manual Setup → Process Diagnostics → Electrode Coating → Level 2 Limit**

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**
FDT frame application	**Configuration → Manual Setup → Process Diagnostics → Electrode Coating → Maximum 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**
FDT frame application	**Configuration → Manual Setup → Process Diagnostics → Electrode Coating → Reset Maximum Coating Value**

Use this method to reset the maximum electrode coating value.

9.8 Smart Meter Verification

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

9.8.1 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**
FDT frame application	**Service Tools → Maintenance → Meter Verification → Sensor Baseline → Coil Resistance**

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**
FDT frame application	**Service Tools → Maintenance → Meter Verification → Sensor Baseline → Coil Inductance**

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**
FDT frame application	**Service Tools → Maintenance → Meter Verification → Sensor Baseline → Electrode Resistance**

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.

9.8.2 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**
FDT frame application	**Service Tools → Maintenance → Meter Verification → Sensor Baseline → Re-Baseline Sensor**

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**
FDT frame application	**Service Tools → Maintenance → Meter Verification → Sensor Baseline → Recall Last Baseline**

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

9.8.3 Smart Meter Verification test criteria

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

No flow limit

LOI menu path	**Diagnostics → Advanced Diag → Meter Verif → Test Criteria → No Flow**
FDT frame application	**Configuration → Manual Setup → Meter Verification → Manual Meter Verification → No Flow Limit**

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**
FDT frame application	**Configuration → Manual Setup → Meter Verification → Manual Meter Verification → Flowing Limit**

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**
FDT frame application	**Configuration → Manual Setup → Meter Verification → Manual Meter Verification → Empty Pipe Limit**

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**
FDT frame application	**Configuration → Manual Setup → Meter Verification → Continuous Meter Verification → Continuous Verification Limit**

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.

9.9 Run commanded Smart Meter Verification

LOI menu path	**Diagnostics → Advanced Diag → Meter Verif → Run Meter Ver**
FDT frame application	**Service Tools → Maintenance → Meter Verification → Sensor Measurements → Run Meter Verification**

The Smart Meter Verification diagnostic will be available if the Smart Meter Verification Professional (DA2) was ordered. If DA2 was not ordered or licensed, this diagnostic will not be available. This method will initiate the commanded meter verification test.

9.9.1 Test conditions

LOI menu path	**Diagnostics → Advanced Diag → Meter Verif → Run Meter Ver → Test Condition**
FDT frame application	**Service Tools → Maintenance → Meter Verification → Sensor Measurements → Run Meter Verification**

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.

9.9.2 Test scope

LOI menu path	**Diagnostics → Advanced Diag → Meter Verif → Run Meter Ver → Test Scope**
FDT frame application	**Service Tools → Maintenance → Meter Verification → Sensor Measurements → Run Meter Verification**

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.

9.10 Continuous Smart Meter Verification

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

9.10.1 Test scope

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

Coils

LOI menu path	**Diagnostics → Diag Controls → Cont Meter Ver → Coils**
FDT frame application	**Configuration → Manual Setup → Meter Verification → Continuous Meter Verification → 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**
FDT frame application	**Configuration → Manual Setup → Meter Verification → Continuous Meter Verification → 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**
FDT frame application	**Configuration → Manual Setup → Meter Verification → Continuous Meter Verification → Transmitter**

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

9.11 SMART Meter Verification test results

If the SMART Meter Verification test is manually initiated, the transmitter will make several measurements to verify the transmitter calibration, sensor calibration, coil circuit health, and electrode circuits health. The results of these tests can be reviewed and recorded on the calibration verification report (see Optimizing continuous Smart Meter Verification) . This report can be used to validate that the meter is within the required calibration limits to comply with governmental regulatory agencies.

Depending on the method used to view the results, they will be displayed in either a menu structure, as a method, or in the report format. When using the LOI, the parameters are viewed as a method using the left arrow key to cycle through the results. In a FDT frame application or web server, the calibration report is populated with the necessary data eliminating the need to manually complete the report.

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

Table 9-3: Manual Smart Meter Verification Test Parameters

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

Table 9-4: Continuous Smart Meter Verification Test Parameters

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

9.12 Smart Meter Verification measurements

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

Coil circuit resistance

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**
FDT frame application	Manual: **Service Tools → Maintenance → Meter Verification → Sensor Measurements → Measured Coil Resistance (Manual)** Continuous: **Service Tools → Maintenance → Meter Verification → Sensor Measurements → Measured Coil Resistance (Continuous)**

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 Inductance** Continuous: **Diagnostics → Advanced Diag → Meter Verif → Measurements → Continual Meas → Coil Inductance**
FDT frame application	Manual: **Service Tools → Maintenance → Meter Verification → Sensor Measurements → Measured Coil Inductance (Manual)** Continuous: **Service Tools → Maintenance → Meter Verification → Sensor Measurements → Measured Coil Inductance (Continuous)**

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**
FDT frame application	Manual: **Service Tools → Maintenance → Meter Verification → Sensor Measurements → Measured Electrode Resistance (Manual)** Continuous: **Service Tools → Maintenance → Meter Verification → Sensor Measurements → Measured Electrode Resistance (Continuous)**

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**
FDT frame application	Manual: **Service Tools → Maintenance → Meter Verification → Transmitter Measurement → Actual Velocity (Manual)** Continuous: **Service Tools → Maintenance → Meter Verification → Transmitter Measurement → Actual Velocity (Continuous)**

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.

9.13 Optimizing the Smart Meter Verification

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

Example 1 An effluent meter must be certified annually to comply with environmental regulations. This example regulation requires that the meter be certified to five percent. Since this is an effluent meter, shutting down the process may not be viable. In this instance, the Smart Meter Verification test will be performed under flowing conditions. Set the test criteria for flowing, full to five percent to meet the requirements of the governmental agencies.

Example 2 A pharmaceutical company requires bi-annual verification of meter calibration on a critical feed line for one of their products. This is an internal standard, and the plant requires a calibration record be kept on-hand. Meter calibration on this process must meet two percent. The process is a batch process so it is possible to perform the calibration verification with the line full and with no flow. Since the Smart Meter Verification test can be run under no flow conditions, set the test criteria for no flow to two percent to comply with the necessary plant standards.

Example 3 A food and beverage company requires an annual calibration of a meter on a product line. The plant standard calls for the accuracy to be three percent or better. They manufacture this product in batches, and the measurement cannot be interrupted when a batch is in process. When the batch is complete, the line goes empty. Since there is no means of performing the Smart Meter Verification test while there is product in the line, the test must be performed under empty pipe conditions. The test criteria for empty pipe should be set to three percent, and it should be noted that the electrode circuit health cannot be verified.

9.13.1 Optimizing continuous Smart Meter Verification

For continuous Smart Meter Verification, there is only one test criteria value to configure, and it will be used for all flow conditions. The factory default is set to five percent to minimize the potential for false failures under empty pipe conditions. For best results, set the criteria to match the maximum value of the three test criteria set during 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: ❑ Internal ❑ External
Tag #:____	Test Conditions: ❑ Flowing ❑ No Flow, Full Pipe ❑ 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: ❑ PASS / ❑ FAIL / ❑ NOT TESTED
Deviation %:	Coil Circuit Test: ❑ PASS / ❑ FAIL / ❑ NOT TESTED
Transmitter: ❑ PASS / ❑ FAIL / ❑ NOT TESTED	Electrode Circuit Test: ❑ PASS / ❑ FAIL / ❑ NOT TESTED
Summary of Calibration Verification results	
Verification Results: The result of the flowmeter verification test is: ❑ PASSED / ❑ 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

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

10.2 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

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.

Related information

High process noise detection

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 magnetic flowmeter system. Ensure that the following conditions are met:

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

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

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

10.4.1 Coil drive frequency

LOI menu path	**Detailed Setup → Additional Params → Coil Drive Freq**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Signal Processing → Coil Drive Frequency**

This parameter changes the pulse rate of the magnetic coils.

5 Hz

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

37 Hz

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

Note
37 Hz coil drive frequency mode should not be used for sensors larger than 20-inch.

10.4.2 Auto zero

LOI menu path	**Diagnostics → Trims → Auto Zero**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Signal Processing → Coil Drive Frequency → Auto Zero**

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

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

- With the transmitter and sensor installed in their final positions. This procedure is not applicable on the bench.

- With the transmitter in 37 Hz coil drive mode. Never attempt this procedure with the transmitter in 5 Hz coil drive mode.
- With the sensor full of process fluid at zero flow.

These conditions should cause an output equivalent to zero flow.

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

Note
Failure to complete an auto zero may result in a flow velocity error of 5 to10% at1 ft/s (0.3 m/s). 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 outputs caused by process noise. The signal processing menu contains this functionality. If the 37 Hz coil drive frequency has been set, and the output is still unstable, the damping and signal processing function should be used. It is important to set the coil drive frequency to 37 Hz to increase the flow sampling rate. The transmitter provides an easy and straightforward start-up, and also incorporates the capability to deal with difficult applications that have previously manifested themselves in a noisy output signal. In addition to selecting a higher coil drive frequency (37 Hz vs. 5 Hz) to isolate the flow signal from the process noise, the microprocessor can scrutinize each input based on three user-defined parameters to reject the noise specific to the application.

Operating mode

LOI menu path	**Detailed Setup → Signal Processing → Operating Mode**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Signal Processing → Digital Signal Processing → Operating Mode**

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

- Normal mode (default)
- Filter mode

Status

LOI menu path	**Detailed Setup → Signal Processing → Main Config DSP → Status**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Signal Processing → Digital Signal Processing → DSP Control**

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

Number of samples

LOI menu path	**Detailed Setup → Signal Processing → Main Config DSP → Samples**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Signal Processing → Digital Signal Processing → Samples**

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

For example:

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

Percent limit

LOI menu path	**Detailed Setup → Signal Processing → Main Config DSP → % Limit**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Signal Processing → Digital Signal Processing → Percent of Rate**

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

Time limit

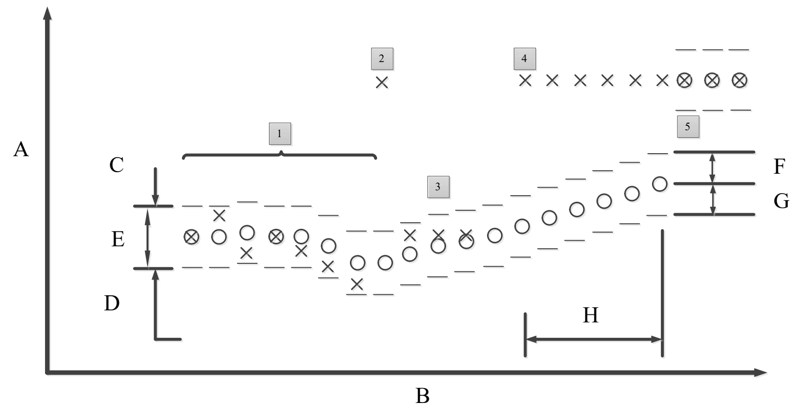
LOI menu path	**Detailed Setup → Signal Processing → Main Config DSP → Time Limit**
FDT frame application	**Configuration → Manual Setup → Process Measurement → Signal Processing → Digital Signal Processing → Time Limit**

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

10.5 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 (10 samples = 1 second)*
C. *Upper value*
D. *Lower value*
E. *Tolerance band*
F. *Maximum percent limit*
G. *Minimum percent limit*
H. *Time limit*

- X = Input flow signal from sensor
- O = Average flow signals and transmitter output, determined by the number of samples parameter
- Tolerance band, determined by the percent limit parameter
- Upper value = average flow + [(percent limit/100) average flow]
- Lower value = average flow - [(percent limit/100) average flow]

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

can set this parameter to eliminate the slow ramping of the output toward the new input level.

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

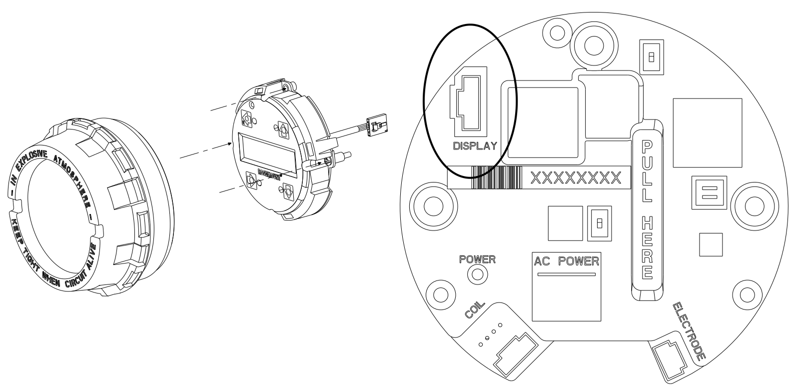
⚠ WARNING

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: Installing a LOI/Display



Procedure

1. If the transmitter is installed in a control loop, then secure the loop.
2. Remove power from the transmitter.
3. Remove the cover on the electronics compartment of the transmitter housing. If the cover has a cover jam screw, loosen it before removing the cover.

   See Cover jam screw for details.

4. On the electronics stack, locate the serial connection labeled **DISPLAY**.

   See Figure 11-1.

5. Plug the serial connector from the back of the LOI/Display into the receptacle on the electronics stack.

   The LOI/Display can be rotated in 90 degree increments to provide the best viewing position. Rotate the LOI/Display to the desired orientation, taking care to not exceed 360 degrees of rotation.

   NOTICE

   Exceeding 360 degrees of rotation could damage the LOI/Display cable and/or connector.

6. Once the serial connector is installed on the electronics stack, and the LOI/Display is oriented in the desired position, tighten the three mounting screws.
7. Install the extended cover with the glass viewing pane and tighten to metal-to-metal contact.

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

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

11.4 Replacing electronics stack

Procedure

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

   Note
   See Powering the transmitter for details on the covers.

4. Remove the three screws that hold the LOI/Display to the electronics stack.
5. Carefully unplug the LOI/Display connector and remove and set aside the LOI/Display.
6. Carefully unplug the coil and electrode connectors.
7. Remove the three screws that secure the electronics stack into the housing.
8. Carefully pull out the electronics stack by the handle marked **PULL HERE**.
9. Remove the screws from the old electronics stack and insert them into the new electronics stack.

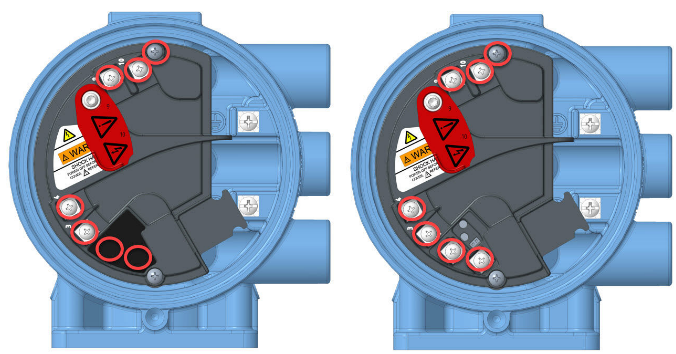
10. Hold the new electronics stack by the handle and carefully insert it into the housing, making certain that the screw holes and electrical connectors are in proper alignment to seat the stack.
11. Securely tighten the three electronics stack screws into the housing.
12. Plug in the coil and electrode connectors.
13. Replace the LOI/Display and refasten the three screws to secure it to the electronics stack.
14. Reinstall the LOI/Display-side cover of the transmitter and tighten it to ensure the housing is properly sealed to meet ingress protection requirements.
15. Return power to the transmitter and verify that it is functioning correctly and reporting the expected flow rate.
16. If installed in a control loop, then return the loop to automatic control.

11.5 Replace transmitter terminal block

Procedure

1. If the transmitter is installed in a control loop, then secure the loop.
2. Remove power from the transmitter.
3. Remove the terminal block side cover of the transmitter.
4. Remove the eight screws that are securing the terminal block to the transmitter. Note that there are two screws hidden under the label. See Figure 11-2 for location of the screws.

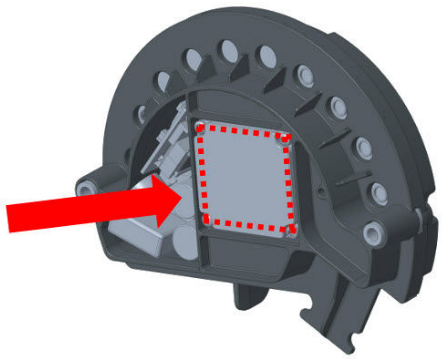
Figure 11-2: Location of the screws



5. Lift the terminal block to remove the terminal block. Ensure that any thermal heat sink pad remnants are removed from the housing.

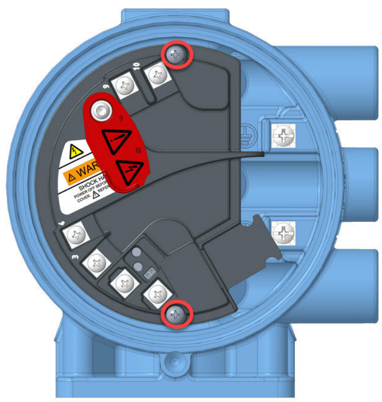
6. Remove plastic film from one side of thermal heat sink pad and install over the heat sink on the bottom of the new terminal block.

Figure 11-3: Location of terminal heat sink



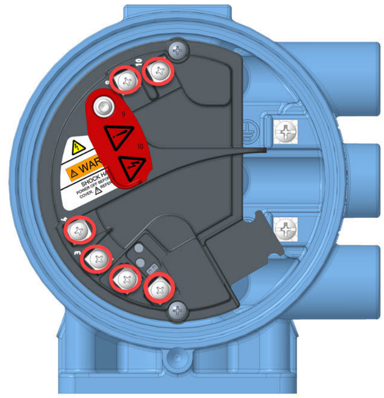
7. Remove the other plastic film and place the terminal block into the housing.
8. Install two 6-32x1" screws and torque screws to 10 in-lbs.

Figure 11-4: Location of outside screws



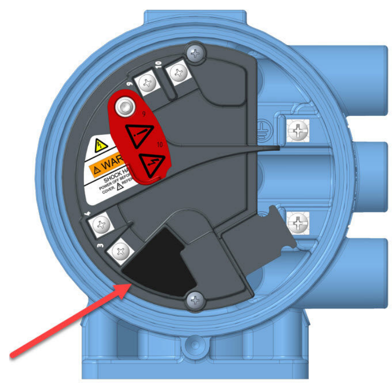
9. Install six terminal connection screws and torque to 10 in-lbs.

Figure 11-5: Location of inside screws



10. Use label to cover first two terminal connection screws.

Figure 11-6: Terminal label



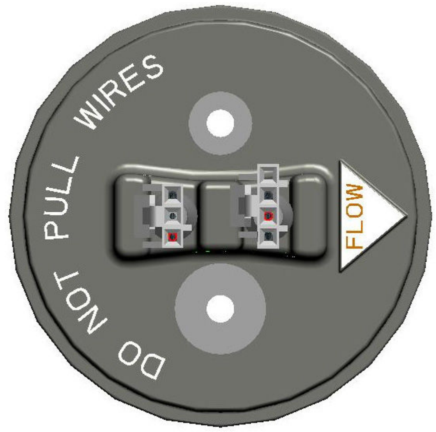
11. Replace the terminal block side cover of the transmitter. Tighten it to ensure the housing is properly sealed to meet ingress protection requirements.
12. Return power to the transmitter and verify that it is functioning correctly and reporting the expected flow rate.
13. If installed in a control loop, then return the loop to automatic control.

11.6 Replacing a socket module/terminal block

The socket module connects the sensor adapter to the transmitter. There are two versions of the socket module — one for integral mount transmitters and one for remote mount transmitters. The socket module is a replaceable component.

To remove the socket module, loosen the two mounting screws and pull up on the socket module from the base. When removing the socket module, do not pull on the wires. See Figure 11-7.

Figure 11-7: Socket Module Warning



11.6.1 Replacing an integral mount socket module

Prerequisites

The integral mount socket module is shown in Figure 11-8. To gain access to the socket module, the transmitter must be removed from the sensor adapter.

Figure 11-8: Socket Module—Integral Mount

Removing an integral mount socket module

Procedure

1. Disconnect power.
2. Remove electronics cover to gain access to the coil and electrode cables.
3. If the transmitter has a LOI/Display, it will need to be removed to gain access to the coil and electrode cables.
4. Disconnect the coil and electrode cables.
5. Remove the four transmitter mounting bolts.
6. Lift the transmitter off of the sensor adapter.

7. To remove the socket module, loosen the two mounting screws and pull up on the socket module from the base.
8. When removing the socket module, do not pull on the wires.

   See Figure 11-7.

Installing an integral mount socket module

Procedure

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

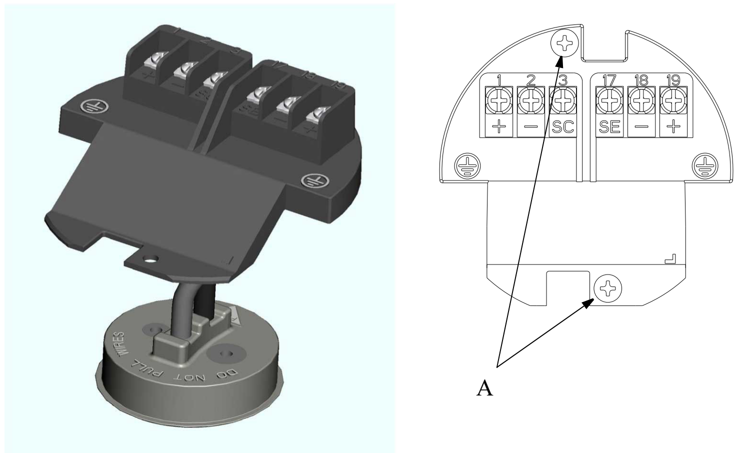
11.6.2 Replacing a terminal block socket module

Prerequisites

Note
This section only applies to sensors with Kx approval codes.

The terminal block socket module is shown in Figure 11-9. To gain access to the socket module, remove the junction box from the sensor adapter.

Figure 11-9: Socket Module—Terminal Block



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

Removing a terminal block socket module

Procedure

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.

   See Figure 11-7.

Installing a terminal block socket module

Procedure

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.

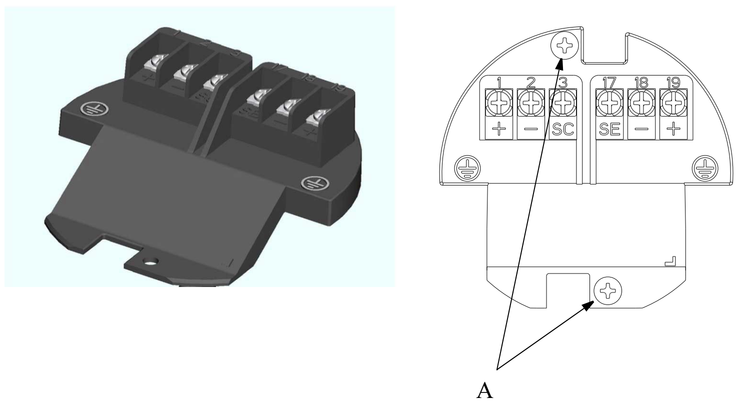
   If applicable, install the divider with the two mounting screws.

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

11.6.3 Replacing a terminal block with amp clips

Note
This section applies only to sensors with Nx approval codes or no hazardous area approval code for use in ordinary locations.

Figure 11-10: Terminal block with amp clips



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

Removing a terminal block

Procedure

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

Installing a terminal block

Procedure

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. If applicable, install the divider with the two mounting screws.
3. Reconnect remote cabling, replace the junction box cover on the sensor, and connect power.

11.7 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.

11.7.1 Digital trim

LOI menu path	**Diagnostics → Trims → Digital Trim**
FDT frame application	**Configuration → Manual Setup → Calibration → Digital Trim**

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

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

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

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

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

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

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

Procedure

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

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

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

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

11.7.2 Universal trim

LOI menu path	**Diagnostics → Trims → Universal Trim**
FDT frame application	**Configuration → Manual Setup → Calibration → Universal Trim**

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

Procedure

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

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

2. Complete the universal auto trim function.

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

11.8 Review

LOI menu path	**Device Setup → Review**

The transmitter includes a capability to review the configuration variable settings.

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

Note
If the LOI is used to review variables, each variable must be accessed as if changing its setting. The value displayed on the LOI screen is the configured value of the variable.

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 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.

Though Modbus output is a selectable option for configuration, there is no Modbus output. Modbus settings must not be changed. Configuration must not be changed from these required settings:

Parameter	Required value
Address	1
Floating point byte order	0-1-2-3
Baud rate	115,200
Parity	Even
Stop bits	1
Minimum response delay	10 ms

NOTICE

Change in Modbus settings will result in Ethernet miscommunication.

12.2 Safety information

⚠ WARNING

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

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

12.3 Installation check and guide

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

12.3.1 Transmitter

Checking the transmitter before applying power

Prerequisites

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

Procedure

1. Record the transmitter model number and serial number.
2. Visually inspect the transmitter for any damage including the terminal block.
3. Verify the proper wiring connections have been made for the power and outputs.

Checking the transmitter after applying power

Prerequisites

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

Procedure

1. Check for an active error message or status alert. Refer to Diagnostic messages.
2. Verify the correct sensor calibration number is entered in the transmitter.

   The calibration number is listed on the sensor nameplate.

3. Verify the correct sensor line size is entered in the transmitter.

The line size value is listed on the sensor nameplate.

4. If desired, use a Rosemount 8714D Calibration Standard to verify the transmitter calibration.

12.3.2 Sensor

Prerequisites

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

Procedure

1. Record the sensor model number and serial number.
2. Visually inspect the sensor for any damage, including inside the remote junction box, if applicable.
3. For horizontal flow installations, ensure that the electrodes remain covered by process fluid.

   For vertical or inclined installations, ensure that the process fluid is flowing up into the sensor to keep the electrodes covered by process fluid.
4. Verify the flow arrow is pointing in the same direction as forward flow.
5. Ensure the grounding straps on the sensor are connected to grounding rings, lining protectors, or the adjacent pipe flanges. Improper grounding will cause erratic operation of the system.

   Sensors with a ground electrode will not require the grounding straps to be connected.

12.3.3 Remote wiring

Procedure

1. The electrode signal and coil drive wires must be separate cables unless Rosemount specified combo cable is used.

   See Sensor to transmitter wiring.
2. The electrode signal wire and coil drive wire must be twisted shielded cable. Rosemount recommends 20 AWG twisted shielded cable for the electrode signal and 14 AWG twisted shielded cable for the coil drive.

   See Sensor to transmitter wiring.
3. See Product certifications regarding wiring installation requirements.
4. See Wiring Diagrams for component 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

Procedure

1. The process fluid should have a minimum conductivity of 5 microSiemens/cm (5 micro mhos/cm).
2. The process fluid must be free of air and gas.
3. The sensor must be full of process fluid.
4. The process fluid must be compatible with the wetted materials - liner, electrodes, ground rings, and lining protectors.

   Refer to the Rosemount Magnetic Flow Meter Material Selection Guide Technical Data Sheet (00816-0100-3033) 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 Technical Note (00840-2400-4727) 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.

This section details troubleshooting internal Modbus communication between transmitter electronics board and Ethernet terminal block.

Table 12-1: Basic Diagnostic Messages

Status 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 5 microSiemens per cm	Increase conductivity to greater than or equal to 5 microSiemens per cm.
	Intermittent diagnostic	Adjust tuning of empty pipe parameters - see Troubleshooting empty pipe.
Coil Open Circuit	Improper wiring	Check coil drive wiring and sensor coils. Perform sensor tests - see Installed sensor tests.
	Other manufacturer's sensor	Change coil current to 75 mA - set calibration numbers to 10000550100000030.
		Perform a universal auto-trim to select the proper coil current.
	Electronics board failure	Replace electronics stack.
	Coil circuit open fuse	Replace the sensor.
Auto Zero Failure	Flow is not set to zero	Force flow to zero, perform auto zero trim.
	Unshielded cable in use	Change wire to shielded cable.
	Moisture problems	See Installed sensor tests.

Table 12-1: Basic Diagnostic Messages *(continued)*

Status message	Potential cause	Corrective action
Auto-Trim Failure	No flow in pipe while performing Universal Auto Trim	Establish a known flow rate, and perform universal auto-trim calibration.
	Wiring error	Check that wiring matches appropriate wiring diagrams - see Implementing a Universal Transmitter.
	Flow rate is changing in pipe while performing Universal Auto-Trim routine.	Establish a constant flow rate, and perform universal auto-trim calibration.
	Flow rate through sensor is significantly different than value entered during Universal Auto-Trim routine.	Verify flow in sensor and perform universal auto-trim calibration.
	Incorrect calibration number entered into transmitter for Universal Auto-Trim routine	Replace sensor calibration number with 1000005010000000.
	Wrong sensor size selected	Correct sensor size setting - see Basic Setup.
	Sensor failure	Perform sensor tests - see Installed sensor tests.
Electronics Failure	Electronics self check failure	Cycle power to see if diagnostic message clears.
		Replace Electronics stack.
Electronics Temp Fail	Ambient temperature exceeded the electronics temperature limits	Move transmitter to a location with an ambient temperature range of -40 to 140 °F (-40 to 60 °C).
Reverse Flow	Electrode or coil wires reverse	Verify wiring between sensor and transmitter.
	Flow is reverse	Turn ON Reverse Flow Enable to read flow.
	Sensor installed backwards	Install sensor correctly, or switch either the electrode wires (18 and 19) or the coil wires (1 and 2).
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 Configure Pulse output.
		Verify the sensor calibration number and line size are correctly entered in the electronics.
Flow rate > 43 ft/sec	Flow rate is greater than 43 ft/sec.	Lower flow velocity, increase pipe diameter.
	Improper wiring	Check coil drive wiring and sensor coils.
		Perform sensor tests - see Installed sensor tests.
Digital Trim Failure (Cycle power to clear messages, no changes were made)	The calibrator (8714B/C/D) is not connected properly.	Review calibrator connections.
	Incorrect calibration number entered into transmitter	Replace sensor calibration number with 1000015010000000.
	Calibrator is not set to 30 FPS.	Change calibrator setting to 30 FPS.
	Bad calibrator or calibrator cable	Replace calibrator and/or calibrator cable.
Coil Over Current	Improper wiring	Check coil drive wiring and sensor coils. Perform sensor tests - see Installed sensor tests.

Table 12-1: Basic Diagnostic Messages *(continued)*

Status message	Potential cause	Corrective action
	Transmitter failure	Replace the electronics stack.
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.
	Transmitter connected to other manufacturer's sensor	Change coil current to 75 mA - set calibration number to 10000550100000030.
		Perform a universal auto-trim to select the proper coil current.
	Coil drive frequency set to 37 Hz	Sensor may not be compatible with 37 Hz. Switch coil drive frequency to 5 Hz.
	Sensor failure	Perform sensor tests - see Installed sensor tests.
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.
LOI Comm Error/LOI Lost Sync	Electrical noise	Verify earth ground connections - see Wiring.
	Extreme vibration	Relocate transmitter.
	Transmitter failure	Cycle power. If error returns, replace board stack.
LOI Key Stuck	Debris on the LOI glass	Clean LOI glass of any debris.
	Holding LOI key for more than 60 seconds	Lock LOI to prevent unintentional configuration changes - see Display lock.
	High levels of electrical noise	Move transmitter away from other electrical equipment or cables.
	Faulty LOI	Replace LOI.

Table 12-2: Advanced Process Diagnostic Messages

Status 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.
High Process Noise	Slurry flows - mining/pulp stock	Decrease the flow rate below 10 ft/s (3 m/s).
		Complete the possible solutions listed under Troubleshooting high process noise.

Table 12-2: Advanced Process Diagnostic Messages *(continued)*

Status message	Potential cause	Corrective action
	Chemical additives upstream of the sensor	Move injection point downstream of the sensor or move the sensor to a new location.
		Complete the possible solutions listed under Troubleshooting high process noise.
	Electrode not compatible with the process fluid	Refer to the Rosemount Magnetic Flowmeter Material Selection Guide Technical Data Sheet (00816-0100-3033).
	Gas/air in line	Move the sensor to another location in the process line to ensure that it is full under all conditions.
	Electrode coating	Enable coated electrode detection diagnostic.
		Use bullet-nose electrodes.
		Downsize sensor to increase flow rate above 3 ft/s (1 m/s).
		Periodically clean sensor.
	Styrofoam or other insulating particles	Complete the possible solutions listed under Troubleshooting high process noise.
		Consult factory.
	Low conductivity fluids (below 10 microsiemens/cm)	Trim electrode and coil wires - see Sensor Installation.
		Use integral mount transmitter.
		Set coil drive frequency to 37 Hz.
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 3 ft/s (1 ms).
	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 3 ft/s (1 ms).
	Process fluid conductivity has changed.	Verify process fluid conductivity.

Table 12-3: Advanced Meter Verification Messages

Status message	Potential cause	Corrective action
Meter Ver Failed	Transmitter calibration verification test failed	Verify pass/fail criteria.
		Rerun Smart™ Meter Verification under no flow conditions.
		Verify calibration using 8714D Calibration Standard.
		Perform digital trim.
		Replace electronics board.
	Sensor calibration test failed	Verify pass/fail criteria.

Table 12-3: Advanced Meter Verification Messages *(continued)*

Status message	Potential cause	Corrective action
		Rerun Smart Meter Verification.
		Perform sensor tests - see Installed sensor tests.
	Sensor coil circuit test failed	Verify pass/fail criteria.
		Rerun Smart Meter Verification.
		Perform sensor tests - see Installed sensor tests.
	Sensor electrode circuit test failed	Verify electrode resistance has a baseline (signature) value from a full pipe baseline.
		Verify test condition was selected properly.
		Verify pass/fail criteria.
		Rerun Smart Meter Verification.
		Perform sensor tests - see Installed sensor tests.
Continuous Meter Verification Error	Transmitter calibration verification test failed	Verify pass/fail criteria.
		Run manual Smart Meter Verification under no flow conditions.
		Verify calibration using 8714D Calibration Standard.
		Perform digital trim.
		Replace electronics stack.
	Sensor calibration test failed	Run manual Smart Meter Verification.
		Perform sensor tests - see Installed sensor tests.
	Sensor coil circuit test failed	Run manual Smart Meter Verification.
		Perform sensor tests - see Installed sensor tests.
	Sensor electrode circuit test failed	Run manual Smart Meter Verification.
		Perform sensor tests - see Installed sensor tests.
		Verify electrode resistance has a signature value from a full pipe baseline.
Simulated Velocity Out of Spec	Unstable flow rate during the verification test or noisy process	Run manual transmitter verification test with no flow and a full pipe.
	Transmitter drift or faulty electronics	Verify transmitter electronics with 8714D Calibration Standard. The dial on the 8714D should be set to 30 ft/s (9.14 m/s). The transmitter should be set up with the nominal calibration number (1000015010000000) and 5 Hz coil drive frequency.
		Perform an electronics trim using the 8714D.
		If the electronics trim doesn't correct the issue, replace the electronics.
Coil Resistance Out of Spec	Moisture in the terminal block of the sensor or shorted coil	Perform sensor tests - see Installed sensor tests.
		If the problem persists, replace the sensor.
Coil Signature Out of Spec	Moisture in the terminal block of the sensor or shorted coil	Perform sensor tests - see Installed sensor tests.
		If the problem persists, replace the sensor.

Table 12-3: Advanced Meter Verification Messages *(continued)*

Status message	Potential cause	Corrective action
	Calibration shift caused by heat cycling or vibration	Perform sensor tests - see Installed sensor tests.
		If the problem persists, replace the sensor.
Electrode Resistance Out of Spec	Moisture in the terminal block of the sensor	Perform sensor tests - see Installed sensor tests.
		If the problem persists, replace the sensor.
	Electrode coating	Enable coated electrode detection diagnostic.
		Use bullet-nose electrodes.
		Downsize sensor to increases flowrate above 3 ft/s (1 m/s).
		Periodically clean sensor.
	Shorted electrodes	Perform sensor tests - see Installed sensor tests.
		If the problem persists, replace the sensor.

12.4.1 Troubleshooting empty pipe

If empty pipe detection is unexpected:

Procedure

1. Verify the sensor is full.
2. Verify the sensor has not been installed with a measurement electrode at the top of the pipe.
3. Decrease the sensitivity by setting the empty pipe trigger level to a value of at least 20 counts above the empty pipe value read with a full pipe.
4. Decrease the sensitivity by increasing the empty pipe counts to compensate for process noise. The empty pipe counts is the number of consecutive empty pipe value readings above the empty pipe trigger level required to set the empty pipe diagnostic. The count range is 2-50, factory default set at 5.
5. Increase process fluid conductivity above 5 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 5 mV) 50/60 Hz noise caused by improper wiring or poor process grounding:

Procedure

1. Verify the transmitter is earth grounded.
2. Connect ground rings, process reference 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
In applications where very high levels of noise are a concern, it is recommended that a dual-calibrated Rosemount High-Signal 8707 sensor be used. These sensors can be calibrated to run at lower coil drive current supplied by the standard Rosemount transmitters, but can also be upgraded by changing to the 8712H High-Signal transmitter.

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 37 Hz coil drive setting.

Spike noise

The type of noise can be mitigated by switching to the 37 Hz coil drive setting.

White noise

This type of noise can be mitigated by switching to the 37 Hz coil drive setting.

Noise ratio less than 25 in 5 Hz coil drive frequency mode

The transmitter detected high levels of process noise. If the signal to noise ratio is less than 25 in 5 Hz coil drive frequency mode, proceed with the following steps:

Procedure

1. Increase transmitter coil drive frequency mode to 37 Hz (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 5 microSiemens/cm.

Noise ratio less than less than 25 in 37 Hz coil drive frequency mode

If the signal to noise ratio is less than 25 in 37 Hz coil drive frequency mode, see Digital Signal Processing.

12.4.4 Troubleshooting coated electrode detection

If an electrode coating is detected, use Table 12-4 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	• 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.	• 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	• 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.	• 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 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 12-5: Troubleshooting the Smart Meter Verification diagnostic

Test	Potential cause	Corrective action
Transmitter Verification Test	• Unstable flow reading during the test • Noise in the process • Transmitter drift • Faulty electronics	• Rerun Smart Meter Verification under No Flow conditions. • Check the transmitter calibration with the 8714D Calibration Standard. • Perform a digital trim. • Contact an Emerson Flow representative.

Table 12-5: Troubleshooting the Smart Meter Verification diagnostic *(continued)*

<table>
<tr><th>Test</th><th>Potential cause</th><th>Corrective action</th></tr>
<tr><td>Sensor Calibration Verification</td><td>• Moisture in the sensor terminal block
• Calibration shift caused by heat cycling or vibration</td><td rowspan="3">• 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.</td></tr>
<tr><td>Coil Circuit Health</td><td>• Moisture in the sensor terminal block
• Shorted Coil
• High temperature application
• Long remote cable length</td></tr>
<tr><td>Electrode Circuit Health</td><td>• Electrode resistance baseline was not taken after installation
• Test condition was not selected properly
• Moisture in the sensor terminal block
• Coated electrodes
• Shorted electrodes</td></tr>
</table>

12.4.6 Modbus communication diagnostics messages

EtherNet/IP output is provided through a Modbus to EtherNet/IP output conversion. This section details troubleshooting messages relating to the Modbus communication between transmitter electronics board and Ethernet terminal block.

Modbus status

LOI menu path	**Diagnostics → Modbus Diag → Modbus Status**

Displays the status of the Modbus communication. There are three possible status modes:

Active The transmitter is communicating with the host with no errors.

Inactive The transmitter is not communicating with the host.

Communication Mismatch The transmitter is communicating with the host, but the configuration parameters between the transmitter and the host do not match, resulting in incorrect parsing of the Modbus data.

Listen only mode

LOI menu path	**Diagnostics → Modbus Diag → Listen Only MD**

The transmitter has been placed into listen only mode through either the host system or LOI. The transmitter is not actively sending Modbus data, but is receiving commands from the host system.

Restart Modbus communication

LOI menu path	**Diagnostics → Modbus Diag → Restart MB Com**

This function is only available through the LOI. This function can be used to perform a soft reset of the Modbus communication.

Reset Modbus configuration

LOI menu path	**Diagnostics → Modbus Diag → Reset MB Confg**

This function is only available through the LOI. This will initiate a method to reset all Modbus communication parameters back to the factory default. Activating this method will result in a series of screens that describe what the default parameters are, and then allow the user to proceed with the reset or cancel the method. Default configuration parameters are shown in Table 12-6.

Table 12-6: Default configuration parameters

Parameter	Required value
Address	1
Floating point byte order	0-1-2-3
Baud rate	115,200
Parity	Even
Stop bits	1
Minimum response delay	10 ms

Table 12-7: Modbus communication diagnostic messages

Status message	Potential cause	Corrective action
I/O Processor Failure	ROM failure	• Use LOI to re-set Modbus communication. • Cycle power to transmitter. • Replace electronics.
	Checksum failure	
	RAM failure	
	Stack failure	
	Register failure	
Modbus Non-volatile Memory Error	The non-volatile memory on the Modbus processor is corrupted.	• Cycle power to transmitter. • Replace electronics.
Modbus in Listen-Only Mode	The listen-only mode was activated through the LOI.	• Use LOI to turn off listen-only mode.
I/O Processor Comm Failure	No communication with the Modbus processor for 10 seconds	• Use LOI to re-set Modbus communication.
	Modbus network error	• Verify all wiring is correct and terminations are sound. • Cycle power to transmitter. • Replace electronics.
Invalid parameter error (not found on LOI)	Trying to complete a trim or test with an uninitialized value for a test parameter	• Consult section of the manual for applicable trim or test. • Verify all parameters are configured.

12.5 Basic troubleshooting

When troubleshooting a magmeter, it is important to identify the issue. Table 12-8 below provides common symptoms displayed by a magmeter that is not functioning properly. It provides potential causes and suggested corrective actions for each symptom.

Table 12-8: Common magmeter issue

Symptom	Electronics failure	Corrective action
Status Is bad	• Electronics failure	• Cycle power. • If status is still bad, verify transmitter operation with an 8714 D Calibration Standard. • Replace the electronics stack.
	• Open coil circuit	• Check coil drive circuit connections at the sensor and at the transmitter.
	• Coil power or coil current is over limit.	• Check coil drive circuit connections at the sensor and at the transmitter. • Cycle power. • If status is still bad, verify transmitter operation with an 8714D Calibration Standard. • Replace the electronics stack.
	• Connected to incompatible sensor	• See Implementing a Universal Transmitter.
	• Communication parameter mismatch	• Verify Modbus communication parameters in the transmitter match the communication parameters in the host system.
Pulse output at zero, regardless of flow	• Wiring error	• Check pulse output wiring at terminals 3 and 4. Refer to wiring diagram for pulse counter and pulse output. See Power and I/O terminal blocks.
	• PZR activated	• Remove signal at terminals 5 and 6 to deactivate the PZR.
	• No power to transmitter	• Check pulse output wiring at terminals 3 and 4. Refer to wiring diagram for pulse counter and pulse output. • Power the transmitter.
	• Reverse flow	• Enable Reverse Flow function.
	• Electronics failure	• Verify transmitter operation with an 8714D Calibration Standard. • Replace the electronics stack.
	• Pulse output incorrectly configured	• Review configuration and correct as necessary.

Table 12-8: Common magmeter issue *(continued)*

Symptom	Electronics failure	Corrective action
Error Messages on LOI	• Many possible causes depending upon the message	• See Table 12-1, Table 12-2, and Table 12-3 for the LOI messages.
Reading does not appear to be within rated accuracy	• Transmitter, control system, or other receiving device not configured properly	• Check all configuration variables for the transmitter, sensor, communicator, and/or control system. • Check these other transmitter settings: — Sensor calibration number — Units — Line size
	• Electrode Coating	• Enable Coated Electrode Detection diagnostic. • Use bullet-nose electrodes. • Downsize sensor to increase flow rate above 3 ft/s. • Periodically clean sensor.
	• Gas/air in line	• Move the sensor to another location in the process line to ensure that it is full under all conditions.
	• Moisture problem	• Perform the sensor tests - see Sensor troubleshooting.
	• Insufficient upstream/ downstream pipe diameter	• Move sensor to a new location with 5 pipe diameters upstream and 2 pipe diameters downstream if possible.
	• Cables for multiple magmeters run through same conduit	• Use dedicated conduit run for each sensor and transmitter.
	• Improper wiring	• If electrode shield and electrode signal wires are switched, flow indication will be about half of what is expected. Check wiring diagrams.
	• Flow rate is below 1 ft/s (specification issue)	• See accuracy specification for specific transmitter and sensor.
	• Auto zero was not performed when the coil drive frequency was changed from 5 Hz to 37 Hz	• Set the coil drive frequency to 37 Hz, verify the sensor is full, verify there is no flow, and perform the auto zero function.
	• Sensor failure–shorted electrode	• Perform the sensor tests - see Sensor troubleshooting.
	• Sensor failure–shorted or open coil	• Perform the sensor tests - see Sensor troubleshooting.
	• Transmitter failure	• Verify transmitter operation with an 8714 Calibration Standard or replace the electronics board.

Table 12-8: Common magmeter issue *(continued)*

Symptom	Electronics failure	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.
	• Sludge flows–mining/coal/ sand/slurries (other slurries with hard particles)	• Decrease flow rate below 10 ft/s.
	• Styrofoam or other insulating particles in process	• See Troubleshooting high process noise. • Consult factory.
	• Electrode coating	• Enable Coated Electrode Detection diagnostic. • Use a smaller sensor to increase flow rate above 3 ft/s. • Periodically clean sensor.
	• Gas/air in line	• Move the sensor to another location in the process line to ensure that it is full under all conditions.
	• Low conductivity fluids (below 10 microsiemens/cm)	• Trim electrode and coil wires – see Conduit requirements. • Keep flow rate below 3 ft/s. • Integral mount transmitter. • Use component cable - see Sensor to transmitter wiring.
Meter output is unstable	• Medium to low conductivity fluids (10–25 microsiemens/cm) combined with cable vibration or 60 Hz interference	• Eliminate cable vibration. • Move cable to lower vibration run. • Tie down cable mechanically. • Use an integral mount. • Trim electrode and coil wires - see 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	• Check the Rosemount Magnetic Flow Meter Material Selection Guide Technical Data Sheet (00816-0100-3033) for chemical compatibility with electrode material.
	• Improper grounding	• Check ground wiring – see Process reference connection for wiring and grounding procedures.

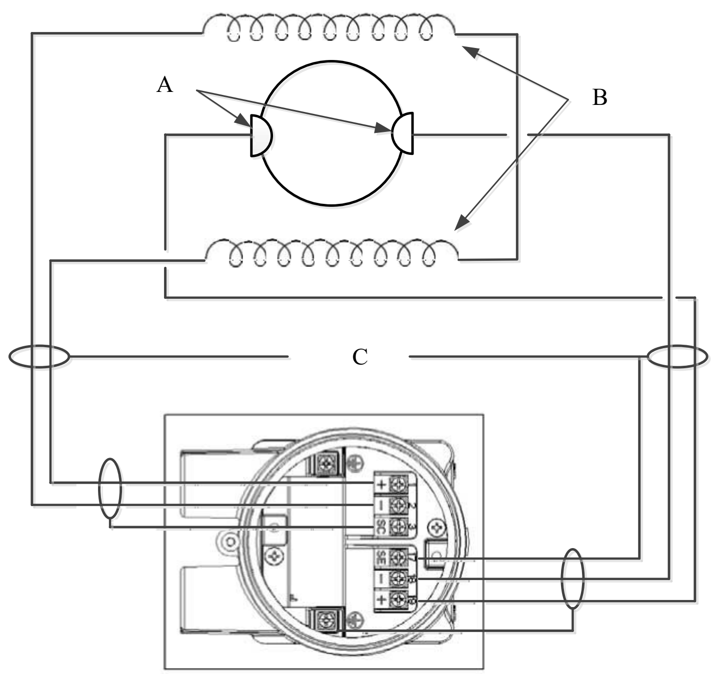
Table 12-8: Common magmeter issue *(continued)*

Symptom	Electronics failure	Corrective action
	• High local magnetic or electric fields	• Move magnetic flowmeter (20–25 ft away is usually acceptable).
	• Control loop improperly tuned	• Check control loop tuning.
	• Sticky valve (look for periodic oscillation of meter output)	• Service valve.
	• Sensor failure	• Perform the sensor tests (See Sensor troubleshooting).

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)



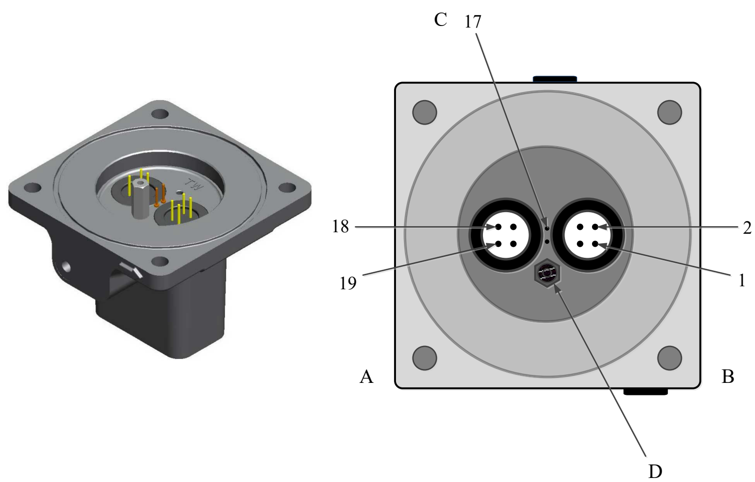
A. Electrodes
B. Coils
C. Sensor housing

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. Figure 12-2 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 Socket module

The socket module connects the sensor adapter to the transmitter. There are two versions of the socket module—one for integral mount transmitters and one for remote mount transmitters. See Figure 12-3 and Figure 12-4. The socket module is a replaceable component. If test measurements taken through the socket module show a failure, remove the socket module and confirm measurements directly on the feed-through pins of the sensor adapter. To remove the socket module, refer to Maintenance.

Figure 12-3: Socket Module—Integral Mount

Figure 12-4: Remote Mount Socket Module

12.7 Installed sensor tests

If a problem with an installed sensor is identified, refer to Table 12-9 through Table 12-13 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 12-9: Test A. Sensor coil

Test conditions	Expected value	Potential cause	Corrective action
• Location: installed or uninstalled • Required equipment: multimeter • Measuring at connections: 1 and 2 = R	2Ω≤R≤18Ω	• Open or shorted coil	• Remove and replace sensor.

Table 12-10: Test B: Shields to case

Test conditions	Expected value	Potential cause	Corrective action
• Location: installed or uninstalled • Required equipment: multimeter • Measuring at connections: — 17 and 3 — 3 and case ground — 17 and case ground	< 0.3Ω	• Moisture in terminal block • Leaky electrode • Process behind liner	• Clean terminal block. • Remove sensor.

Table 12-11: Test C. Coil to coil shield

Test conditions	Expected value	Potential cause	Corrective action
• Location: installed or uninstalled • Required equipment: multimeter • Measuring at connections: — 1 and 3 — 2 and 3	∞Ω (< 1nS)	• Process behind liner • Leaky electrode • Moisture in terminal block	• Remove sensor and dry. • Clean terminal block. • Confirm with sensor coil test.

Table 12-12: Test D. Electrode to electrode shield

Test conditions	Expected value	Potential cause	Corrective action
• Location: installed • Required equipment: LCR (Set to Resistance and 120 Hz) • Measuring at connections: — 18 and 17 = R_1 — 19 and 17 = R_2	• R_1 and R_2 should be stable • $\lvert R_1 – R_2 \rvert$ ≤300Ω	• 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	• 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 12-13: Test E. Electrode to Electrode

Test conditions	Expected value	Potential cause	Corrective action
• Location: installed • Required equipment: LCR (Set to Resistance and 120 Hz) • Measuring at connections: 18 and 19 — 18 and 17 = R_1 — 19 and 17 = R_2	Should be stable and same relative magnitude of R_1 and R_2 from Test D	• 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	• 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.

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

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

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 12-14: Test A. Terminal to front electrode

Test conditions	Expected value	Potential cause	Corrective action
• Location: uninstalled • Required equipment: Multimeter • 18 and electrode 18[(1)]	≤ 1 Ω	• Shorted electrode • Open electrode • Coated electrode	• 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 B. Terminal to back electrode

Test conditions	Expected value	Potential cause	Corrective action
• Location: uninstalled • Required equipment: Multimeter • 19 and electrode 19(1)	≤ 1 Ω	• Shorted electrode • Open electrode • Coated electrode	• 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 12-16: Test C. Terminal to reference electrode

Test conditions	Expected value	Potential cause	Corrective action
• Location: uninstalled • Required equipment: Multimeter • 17 and process reference electrode(1)	≤ 0.3 Ω	• Shorted electrode • Open electrode • Coated electrode	• Replace sensor • Remove coating from sensor wall

(1) *Only valid if the sensor has a process reference electrode.*

Table 12-17: Test D. Terminal to case ground

Test conditions	Expected value	Potential cause	Corrective action
• Location: uninstalled • Required equipment: Multimeter • 17 and safety ground	≤ 0.3 Ω	• Moisture in terminal block • Leaky electrode • Process behind liner	• Clean terminal block • Replace terminal block • Replace sensor

Table 12-18: Test E. Electrode to electrode shield

Test conditions	Expected value	Potential cause	Corrective action
• Location: uninstalled • Required equipment: Multimeter • 18 and 17 • 19 and 17	∞Ω (< 1 nS)	• Shorted electrode • Leaky electrode • Moisture in terminal block	• Replace sensor • Clean terminal block • Replace terminal block

Table 12-19: Test F. Electrode shield to coil

Test conditions	Expected value	Potential cause	Corrective action
• Location: uninstalled • Required equipment: Multimeter • 17 and 1	∞Ω (< 1 nS)	• Process in coil housing • Moisture in terminal block	• Replace sensor • Clean terminal block • Replace terminal block

12.9 Technical support and service

Worldwide: flow.support@emerson.com

Asia-Pacific: APflow.support@emerson.com

Middle East and Africa: FlowTechnicalSupport@emerson.com

12.10 Service

To expedite the return process outside the United States, contact an Emerson representative.

A Product specifications

For detailed product specifications information, see the appropriate document listed below:

- Document number 00813-0100-4444: Rosemount 8700M Magnetic Flowmeter Platform Product Data Sheet
- Document number 00813-0300-4750: Rosemount 8750W Magnetic Flowmeter System Product Data Sheet

B Product certifications

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

- Document number 00825-MA00-0001: *Rosemount 8700M Approval Document - IECEx and ATEX*
- Document number 00825-MA00-0002: *Rosemount 8700M Approval Document – Class Division*
- Document number 00825-MA00-0003: *Rosemount 8700M Approval Document - North America Zone*
- Document number 00825-MA00-0007: *Rosemount 8700M Approval Document - NEPSI EN Zone 1 China*
- Document number 00825-MA00-0004: *Rosemount 8750W Approval Document - IECEx and ATEX*
- Document number 00825-MA00-0005: *Rosemount 8750W Approval Document – Class Division*
- Document number 00825-MA00-0006: *Rosemount 8750W Approval Document – North America Zone*

C Wiring Diagrams

C.1 Wiring sensor to transmitter

Figure C-1: Wiring 8750W using component cable

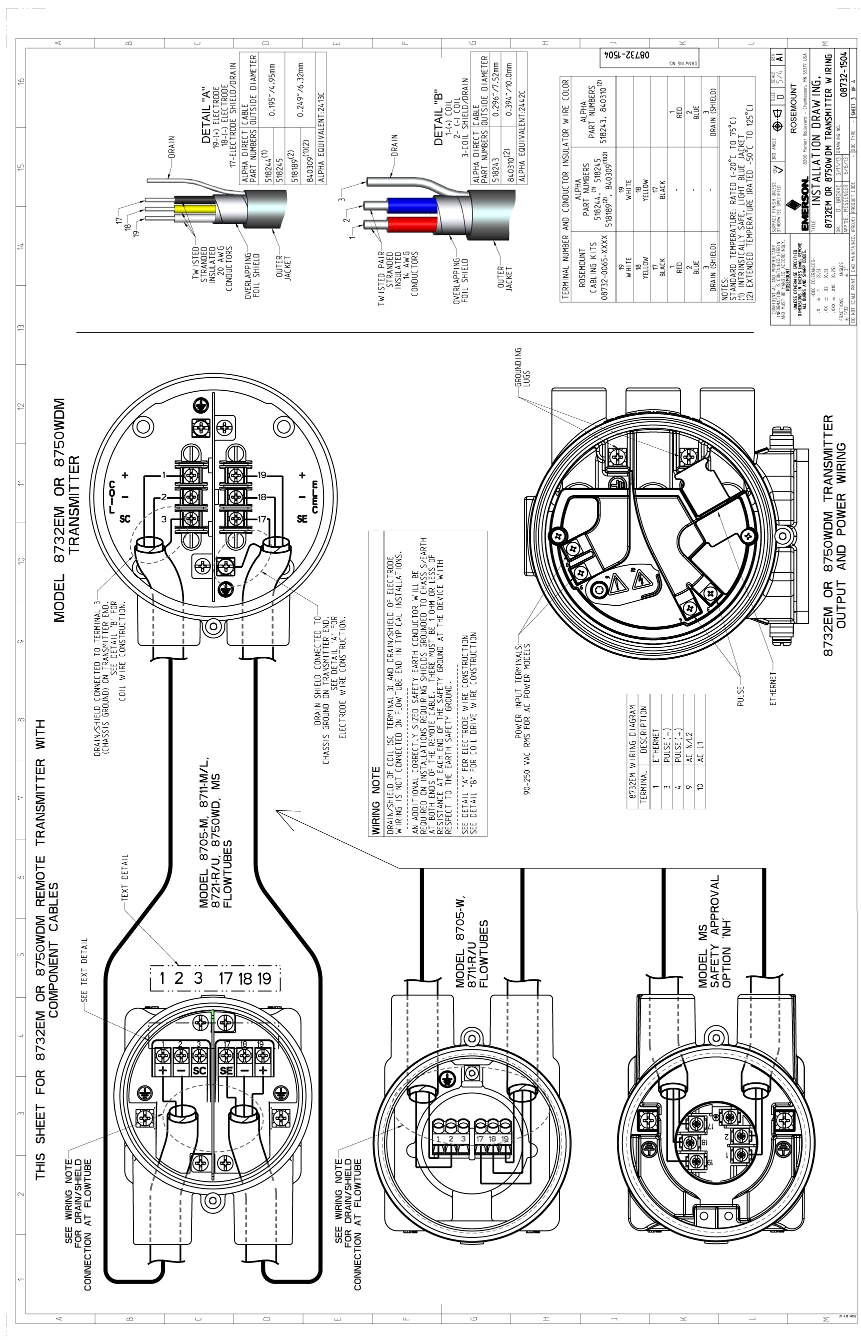
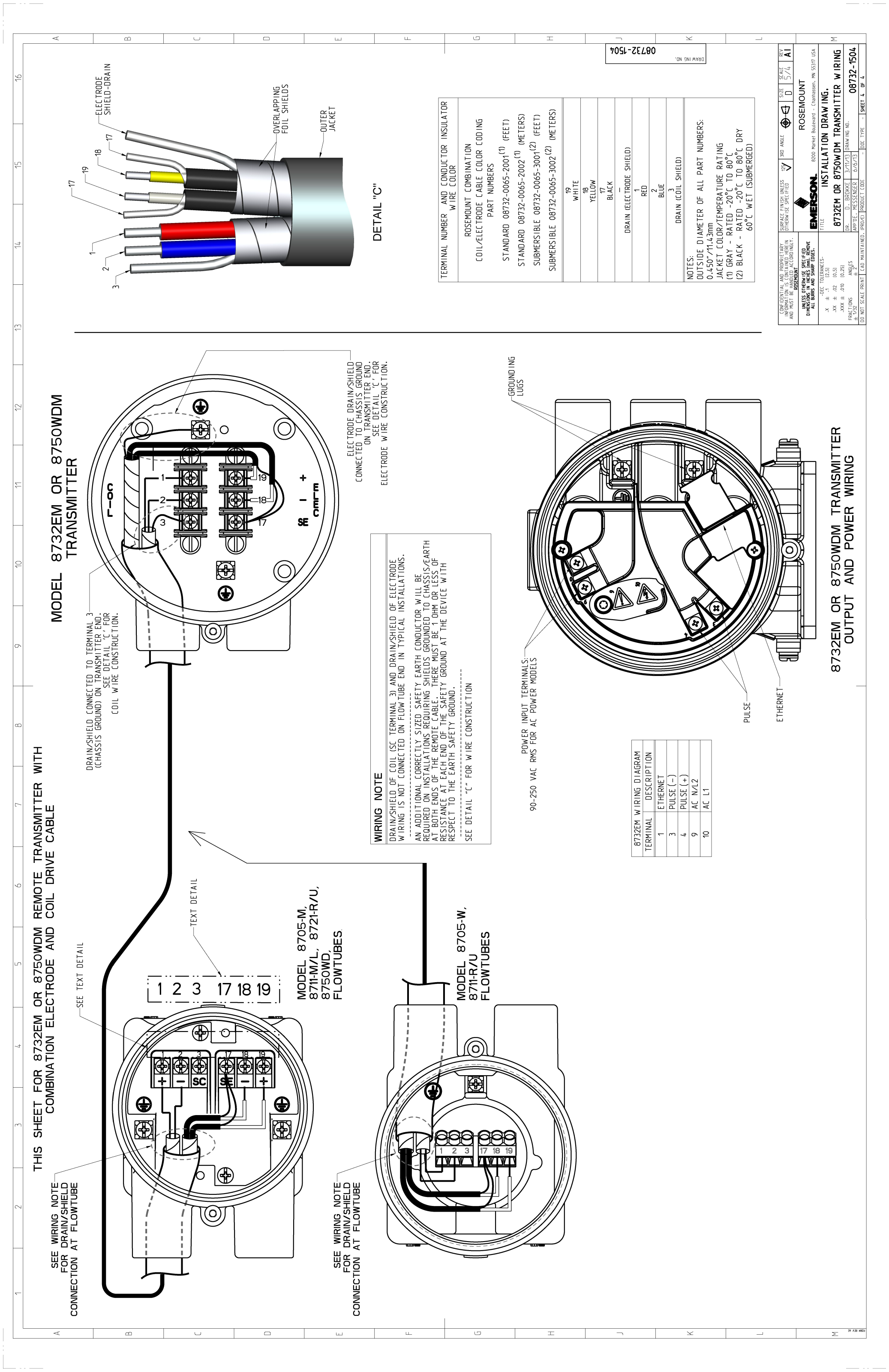


Figure C-2: Wiring 8750W using combination cable



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