

Rosemount™ 2160 Wireless Level Detector

Vibrating Fork



Safety messages

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, ensure you thoroughly understand the contents before installing, using, or maintaining this product.

For technical assistance, contacts are listed below:

Customer Central

Technical support, quoting, and order-related questions.

- United States - 1-800-999-9307 (7:00 am to 7:00 pm CST)
- Asia Pacific- 65 777 8211

North American Response Center

Equipment service needs.

- 1-800-654-7768 (24 hours a day — includes Canada)
- Outside of these areas, contact your local Emerson representative.

⚠ WARNING

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

Ensure the level detector is installed by qualified personnel and in accordance with applicable code of practice.

Use the level detector only as specified in this manual. Failure to do so may impair the protection provided by the level detector.

The weight of a level detector with a heavy flange and extended fork length may exceed 37 lb. (18 kg). A risk assessment is required before carrying, lifting, and installing the level detector.

⚠ WARNING

Explosions could result in death or serious injury.

Installation of device in an explosive environment must be in accordance with appropriate local, national, and international standards, codes, and practices.

Verify that the operating atmosphere of the level detector is consistent with the appropriate hazardous locations certifications.

Before connecting a handheld communicator in an explosive atmosphere, ensure that the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure the level detector is handled carefully. If the process seal is damaged, gas might escape from the vessel (tank) or pipe.

⚠ WARNING

Any substitution of non-recognized parts may jeopardize safety. Repair (e.g. substitution of components) may also jeopardize safety and is not allowed under any circumstances.

Unauthorized changes to the product are strictly prohibited as they may unintentionally and unpredictably alter performance and jeopardize safety. Unauthorized changes that interfere with the integrity of the welds or flanges, such as making additional perforations, compromise product integrity and safety. Equipment ratings and certifications are no longer valid on any products that have been damaged or modified without the prior written permission of Emerson. Any continued use of product that has been damaged or modified without the written authorization is at the customer's sole risk and expense.

⚠ WARNING

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

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

⚠ CAUTION

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact your local Emerson Sales Representative.

⚠ CAUTION

Hot surfaces

The flange and process seal may be hot at high process temperatures. Allow to cool before servicing.



NOTICE

Power module considerations.

Each power module contains primary lithium/thionyl chloride batteries. Under normal conditions, the battery materials are self-contained and are not reactive as long as the batteries and the pack integrity are maintained. Care should be taken to prevent thermal, electrical or mechanical damage. Contacts should be protected to prevent premature discharge.

Battery hazards remain when cells are discharged.

Use caution when handling the power module. The Power Module may be damaged if dropped from heights in excess of 20 ft. (6 m).

Power modules should be stored in a clean and dry area. For maximum battery life, storage temperature should not exceed 86 °F (30 °C).

The power module may be replaced in a hazardous area. The power module has surface resistivity greater than one gigaohm and must be properly installed in the wireless device enclosure. Care must be taken during transportation to and from the point of installation to prevent electrostatic charge build-up.

NOTICE

Shipping considerations for wireless products.

The unit was shipped to you without the power module installed. Remove the power module prior to any re-shipping.

Each Black Power Module (model number 701PBKKF) contains two "C" size primary lithium batteries. Primary lithium batteries (charged or discharged) are regulated in transportation by the U. S. Department of Transportation, and are also covered by IATA (International Air Transport Association), ICAO (International Civil Aviation Organization), and ARD (European Ground Transportation of Dangerous Goods). It is the responsibility of the shipper to ensure compliance with these or any other local requirements. Consult current regulations and requirements before shipping.

Each Blue Power Module (A0701PBU) contains two "D" size primary lithium batteries. Primary lithium batteries (charged or discharged) are regulated in transportation by the U.S. Department of Transportation, and are also covered by IATA (International Air Transport Association), ICAO (International Civil Aviation Organization), and ARD (European Ground Transportation of Dangerous Goods). It is the responsibility of the shipper to ensure compliance with these or any other local requirements. Please consult current regulations and requirements before shipping.

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1 Introduction

1.1 Using this manual

The sections in this manual provide detailed information on installing, operating, and maintaining the Rosemount 2160 Wireless Level Detector - Vibrating Fork.

The sections are organized as follows:

[Level detector overview](#) provides a description of the Rosemount 2160 and its basic principles.

[Installation](#) contains mechanical installation instructions.

[Configuration](#) provides instructions on how to configure the level detector.

[Operation](#) contains operation and maintenance techniques.

[Service and troubleshooting](#) provides troubleshooting techniques for the most common operating problems.

[Specifications and reference data](#) supplies reference and specification data.

[Configuration parameters](#) provides extended information about the configuration parameters.

1.2 Product certifications

See the Rosemount 2160 [Product Certifications](#) document for detailed information on the existing approvals and certifications.

1.3 Product recycling/disposal

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

Related information

[Service support](#)

2 Level detector overview

2.1 Measurement principle

The Rosemount 2160 is the world's first *WirelessHART*[®] level detector using Emerson's vibrating fork technology.

Using the principle of a tuning fork, a piezo-electric crystal oscillates the forks at their natural frequency. Changes to the oscillation frequency are continuously monitored by electronics as it varies depending on the liquid medium in which the forks are immersed. The denser the liquid, the lower the oscillation frequency.

Whenever a liquid medium in a vessel (tank) or pipe drains down past the forks, it causes a distinct frequency change. This change is detected by the electronics and a dry condition is indicated.

Whenever a liquid medium in a vessel (tank) or pipe rises and contacts the forks, again a distinct frequency change is detected. This time, the electronics will indicate a wet condition.

The wet and dry conditions, along with other parameters, are regularly transmitted over a secure wireless connection to a wireless gateway.

2.2 Process characteristics

Emerson's vibrating fork technology is virtually unaffected by turbulence, foam, solids content, coating products, and liquid properties. The natural frequency (1400 Hz) of the fork avoids interference from plant vibration that may cause false detection. This allows for minimum intrusion into the tank or pipe using a short fork.

2.3 Vessel characteristics

The level detector should be mounted using its process connection, and in a horizontal or vertical orientation so that the liquid medium can flow freely in the gap between the forks.

A vessel (tank) or pipe can be almost any shape or type, but check that the process conditions are within the operating limits of the level detector.

Avoid installing near agitators and inlet pipes where the forks are likely to be splashed and cause a false detection of a wet condition. False detection events can be minimized by a programmable delay that allows time for the fork to dry.

Never force the level detector into a vessel (tank) or pipe space. Any contact with the opposite wall, or in-tank objects, could damage the forks and other wetted-process parts.

Extended length versions require supports at regular spaced intervals.

Related information

[Required supports for extended fork](#)

2.4 Application examples

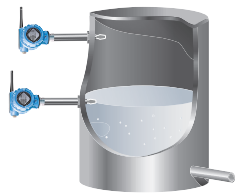
Overfill prevention

Spillage caused by overfilling can be hazardous to people and the environment, resulting in lost product and potentially high clean-up costs. The Rosemount 2160 is an overfill prevention product from Emerson that can be used as one of multiple layers of protection.



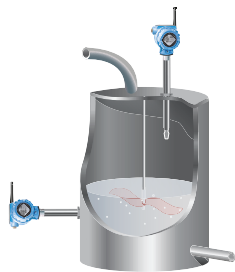
High and low level point alarms

Maximum and minimum level detection in tanks containing different types of liquids are ideal applications. It is common practice to have an independent high level alarm switch or detector as a backup to an installed level device in case of primary failure.



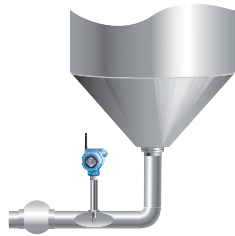
Pump control or limit detection

Batch processing tanks often contain stirrers and agitators to ensure mixing and product 'fluidity'. The Rosemount 2160 has a software-configurable time delay, from 0 to 3600 seconds, that virtually eliminates the risk of false detection from splashing.



Pump protection or empty pipe detection

With the fork projecting only 2 in. (50 mm) (dependent on connection type), the Rosemount 2160 can be installed in small diameter pipes. Short forks mean minimum intrusion on the wet side and allow for simple, low cost installation at any angle into pipes or tanks. The Rosemount 2160 is ideal for reliable pump control and can be used to protect against pumps running dry.



High temperature applications

The high temperature version of the Rosemount 2160 is designed for continuous operation within the temperature range of -94 to 500 °F (-70 to 260 °C).



Hygienic applications

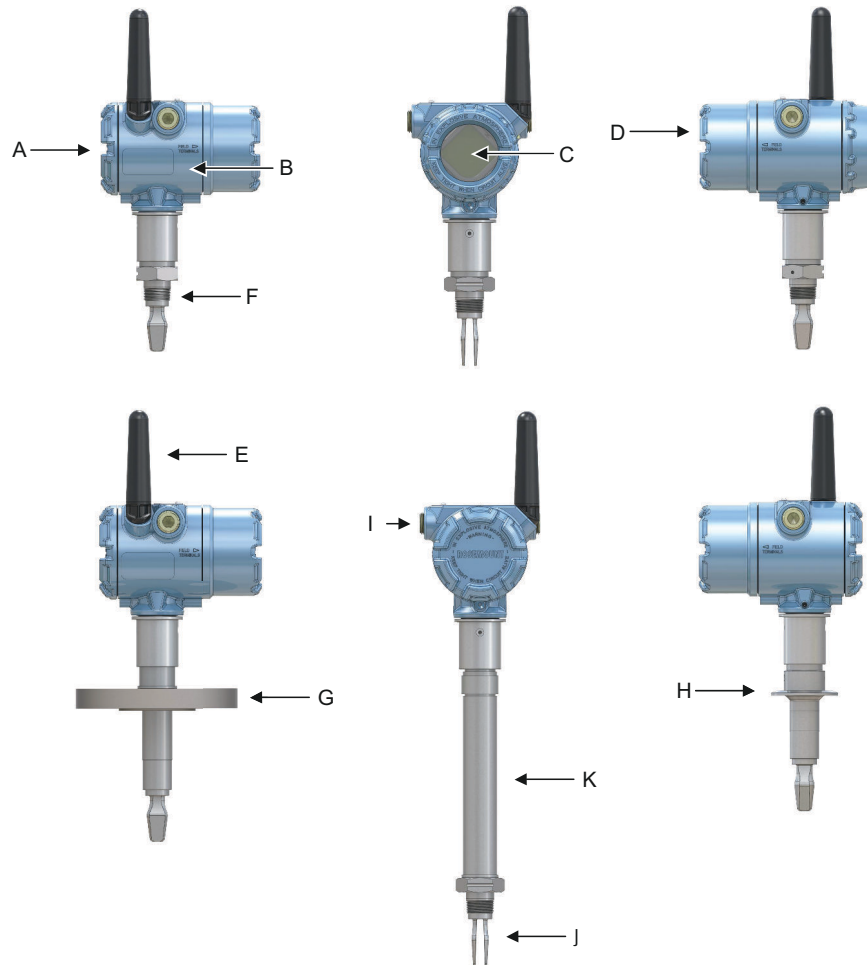
With the highly polished forks option providing a surface finish (Ra) better than 0.4 μm , the Rosemount 2160 meets the most stringent hygienic requirements used in food and beverage, and pharmaceutical applications.



2.5 Components of the level detector

Figure 2-1 shows the components of a Rosemount 2160.

Figure 2-1: Rosemount 2160 Features



- A. Removable cover (no LCD fitted)
- B. Electronics housing
- C. LCD display (optional)
- D. Removable cover (battery compartment)
- E. Antenna
- F. Threaded process connection (BSPT (R) or BSPP (G))
- G. Flanged process connection
- H. Tri Clamp process connection
- I. Unused cable/conduit entry
- J. 'Fast drip' forks
- K. Thermal tube (on high temperature version only)

2.5.1 Short fork technology

Using short-fork technology, the device can be used in almost all liquid applications. Extensive research has maximized the operational effectiveness of the fork design, making it suitable for most liquid mediums including coating liquids, aerated liquids, and slurries.

2.5.2 Fork design

The “fast drip” design allows the liquid to be quickly drawn away from the fork tip, making the Rosemount 2160 quicker and more responsive in high density or viscous liquid applications.

Figure 2-2: “Fast drip” forks



2.5.3 Battery powered

The device is powered by an integral battery. The fork sensor requires very little power and the battery life remains long even with fast update rates.

2.5.4 Instrument health monitor and continuous self-check

The Rosemount 2160 continuously performs instrument health diagnostics to self-check the condition of the fork and sensor. These diagnostics can detect damage to the forks including corrosion, internal or external damage to the forks, and breakages to the internal wiring.

2.5.5 Adjustable time delay and update rate

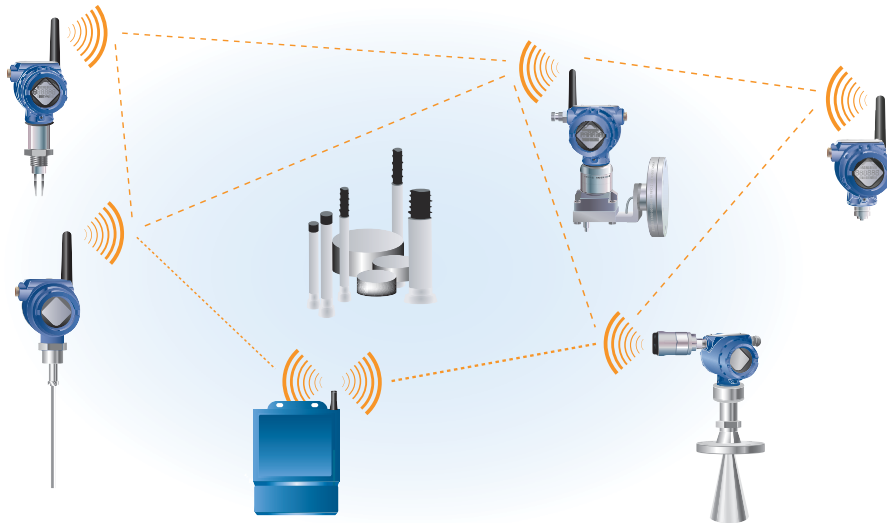
There is a software-configurable output delay to virtually eliminate the risk of false detections in turbulent or splashing applications. The ‘fast drip’ fork design also helps with these types of application.

A software-configurable update rate allows a selection from one second up to 60 minutes. A higher update rate will get more frequent updates to process variables at the expense of draining the battery more quickly. A lower update rate can be used together with the adjustable output delay, and prolong battery life.

2.6 Emerson Wireless

Emerson Wireless is a self-organizing network solution. Wireless field instruments send data to a Gateway, directly or routed through any of the wireless devices in the network, as illustrated in Figure 2-3. Multiple communication paths are managed and analyzed in parallel to assure optimal communication and sustained network reliability even if obstructions are introduced.

Figure 2-3: Emerson Wireless Network




Gateways interface with existing host systems using industry standard protocols, and native integration into DeltaV™ and Ovation™ is transparent and seamless.

Interference from other radios, Wi-Fi®, and EMC sources is avoided through Time Synchronized Channel Hopping and Direct Sequence Spread Spectrum (DSSS). Also, a layered security implementing industry standard Encryption, Authentication, Verification, Anti-Jamming, and Key Management ensures that data transmissions are secure and received only by the Gateway.

The Rosemount 2160 is a member of the Emerson Wireless portfolio, whose wireless network experience totals billions of operating hours, hundreds of thousands of field devices, and tens of thousands of networks around the world.

3 Installation

3.1 Safety messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol () . Refer to the following safety messages before performing an operation preceded by this symbol.

WARNING

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

Ensure the level detector is installed by qualified personnel and in accordance with applicable code of practice.

Use the level detector only as specified in this manual. Failure to do so may impair the protection provided by the level detector.

The weight of a level detector with a heavy flange and extended fork length may exceed 37 lb. (18 kg). A risk assessment is required before carrying, lifting, and installing the level detector.

Repair, e.g. substitution of components, etc. may jeopardize safety and is under no circumstances allowed.

WARNING

Explosions could result in death or serious injury.

Verify that the operating atmosphere of the level detector is consistent with the appropriate hazardous locations certifications.

Before connecting a handheld communicator in an explosive atmosphere, ensure that the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

WARNING

Process leaks could result in death or serious injury.

Ensure the level detector is handled carefully. If the process seal is damaged, gas might escape from the vessel (tank) or pipe.

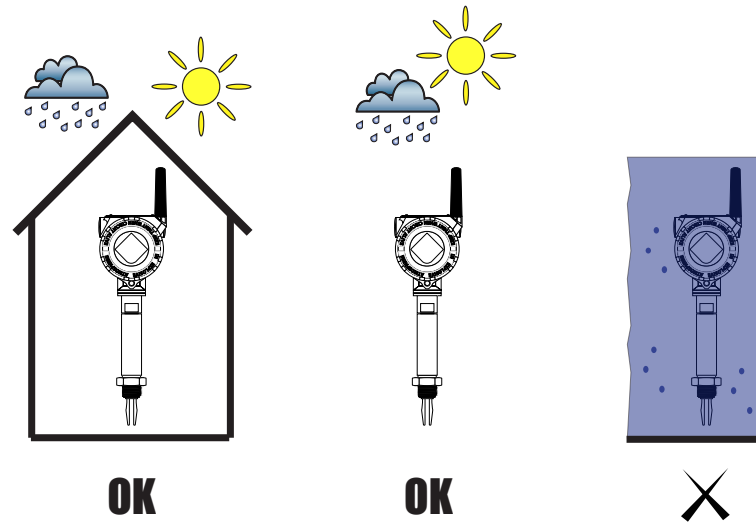
3.2 Installation considerations

Before installing the level detector, review the safety, environmental, application, and pre-installation sections.

3.2.1 Environmental considerations

The Rosemount 2160 is weatherproof and protected against the ingress of dust, but must be protected from flooding. Avoid installing the level detector near heat sources.

Figure 3-1: Environmental Considerations



3.2.2 Application considerations

The Rosemount 2160 is a wireless HART point level devices for use on open or closed vessels (tanks) and in pipework containing liquid mediums.

For most liquids, including coating, aerated liquids and slurries, the function is virtually unaffected by flow, turbulence, bubbles, foam, vibration, solid particles, build-up, or properties of the liquid medium.

Avoid process medium build-up on the forks

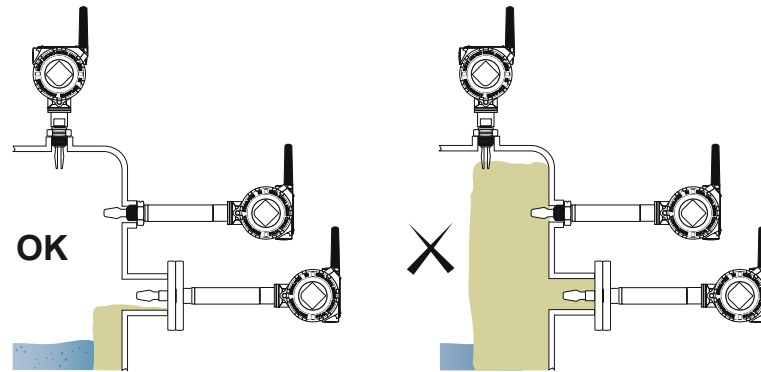
Avoid situations where a drying and coating process medium may create an excessive build-up or implement preventative maintenance programs to ensure the build-up is not enough to impair performance (see [Figure 3-2](#)).

Always ensure:

- There is sufficient distance between build-up on the tank wall and the fork.
- There is no risk of 'bridging' the level switch forks.

Examples of products that can create 'bridging' of forks and impair performance are dense paper slurries and bitumen.

Figure 3-2: Avoid Product Build-up



Operating temperature and pressure ranges

Ensure the process is operating within the instrument operating temperature and pressure ranges.

Liquid density requirements

Minimum liquid density is 31.2 lb/ft³ (500 kg/m³).

Liquid viscosity range

0.2 to 10000 cP (centiPoise)

Solids content in the liquid medium

As a guideline, the maximum solid particle diameter in the liquid process medium is 0.2 in. (5 mm). Extra consideration is needed when solid particles are bigger than 0.2 in. (5 mm) and advice should be sought from Emerson.

Foams

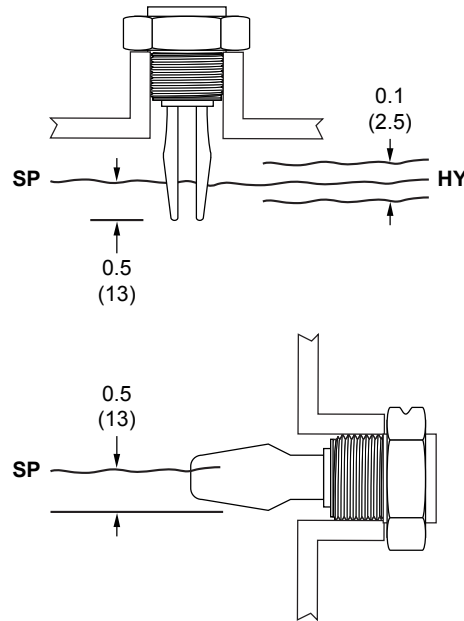
In almost all cases, the Rosemount 2160 is insensitive to foams (i.e. does not see the foam).

However in rare occasions, some very dense foams may be seen as liquid; known examples of this are found in ice-cream and orange juice manufacturing.

Switching point

The switching point varies with different liquid densities. The switching point (SP) and hysteresis (HY) for water are shown in [Figure 3-3](#).

Figure 3-3: Switching Point in Inches (Millimeters)



Note

When mounted vertically, a low density medium has a switching point closer to the process connection. A high density medium has a switching point closer to fork tip.

3.2.3 Pre-installation considerations

Measurement accuracy is dependent upon the proper installation of the device. Keep in mind the need for easy access, personnel safety, practical field calibration, and a suitable environment for the device.

Device identification

To identify a version of the level detector, see the label on the housing.

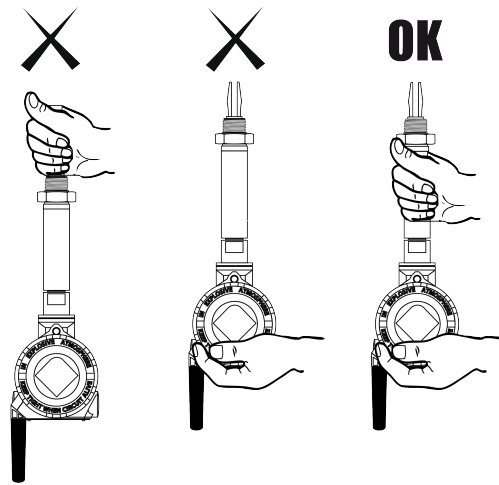
How to handle a level detector

Handle the level detector with great care.

The weight of the level detector with a heavy flange and extended fork length may exceed 37 lb. (18 kg). A risk assessment is required to be done before carrying, lifting, and installing the level detector.

Use both hands to carry the extended length and high temperature versions, and do not hold a level detector by the forks (see [Figure 3-4](#)).

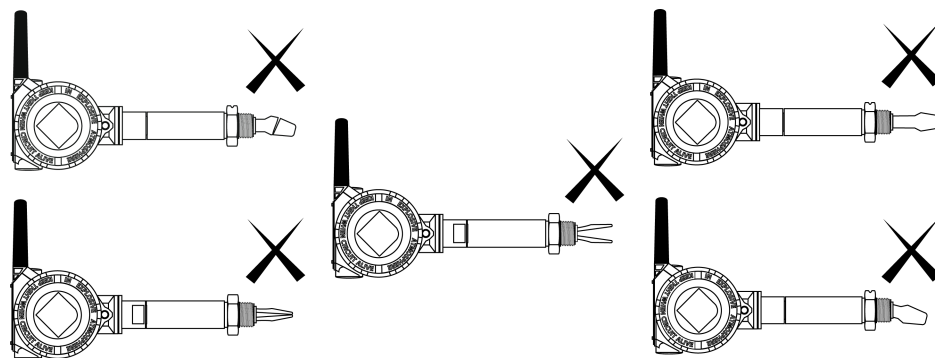
Figure 3-4: Handling



Make no alterations to the level detector

Never make any alterations to the mechanical or electrical features of the level detector (see [Figure 3-5](#)).

Figure 3-5: Make No Alterations



Allow adequate space outside tank or pipe

Mount the Rosemount 2160 so that it is removable and allow easy access to the replaceable battery. Ensure there is also enough room for replacing the battery.

Clearances:

- A clearance of $2\frac{3}{8}$ in. (60 mm) for the standard battery-side cover to be removed.
- A clearance of 0.75 in. (19 mm) is required for a standard terminals-side cover to be removed. If an LCD display is installed, 3 in. (76.2 mm) of clearance is required for removal.

Note

The electronics housing and antenna can be rotated for optimal viewing position and strongest wireless signal.

Covers installation

Ensure a proper seal by installing the electronics housing covers so that metal contacts metal. Always use Emerson's O-rings.

Mounting orientation

Mount the Rosemount 2160 at any angle that allows the level of the process medium to rise, fall, or flow through the fork gap.

Related information

[Correct fork alignment](#)

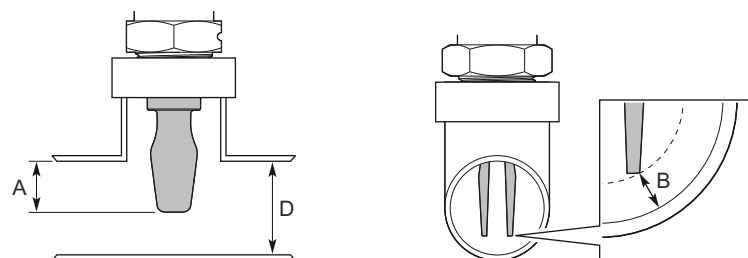
Grounding the housing

Always ground the housing in accordance with national and local electrical codes. The most effective grounding method for the housing is a direct connection to earth ground with minimal impedance.

Pipe installation requirements

- The inside pipe diameter (D) must be 1.4 in. (35 mm) or larger.
- Ensure the fork tines intrude at least 0.9 in. (22 mm) into the pipe.
- Keep at least 0.3 in. (7 mm) of clearance between the fork tines and the pipe wall.

Figure 3-6: Pipe Installation



A. Minimum intrusion 0.9 in. (22 mm)

B. Minimum clearance 0.3 in. (7 mm)

Other recommendations

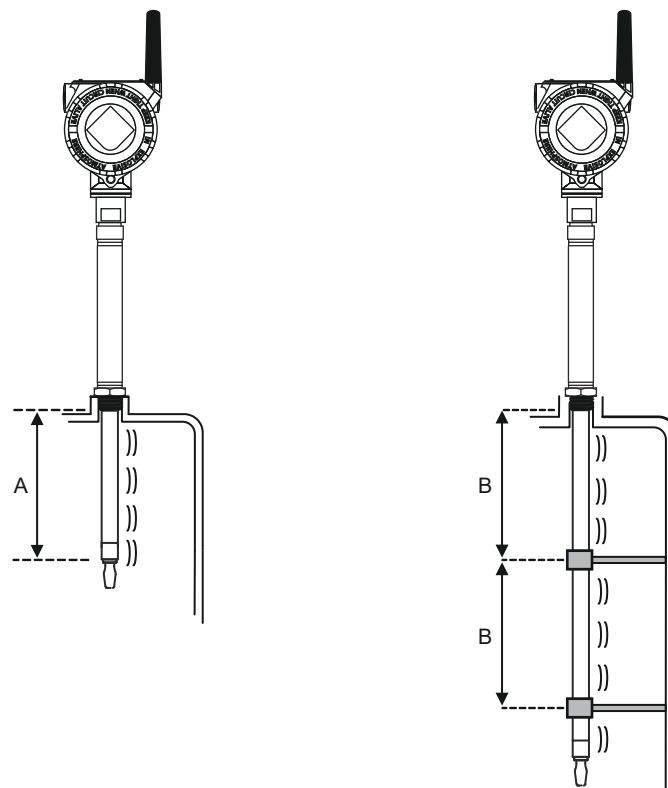
- Avoid:
 - Installing near to liquid entering the tank at the filling-point.
 - Heavy splashing on the forks.Increasing the sensor output delay reduces accidental detection caused by splashing.
- Always ensure:
 - The overall system is tested during commissioning.

- The installation does not create tank crevices around the forks where a liquid medium may collect. This event can happen with high-viscosity and high-density liquids.
- The forks do not come into contact with the vessel (tank) or pipe wall, internal fittings, or any other obstructions.
- Extra consideration is needed if the plant vibration is close to the 1400 Hz operating frequency of the fork.

Required supports for extended fork

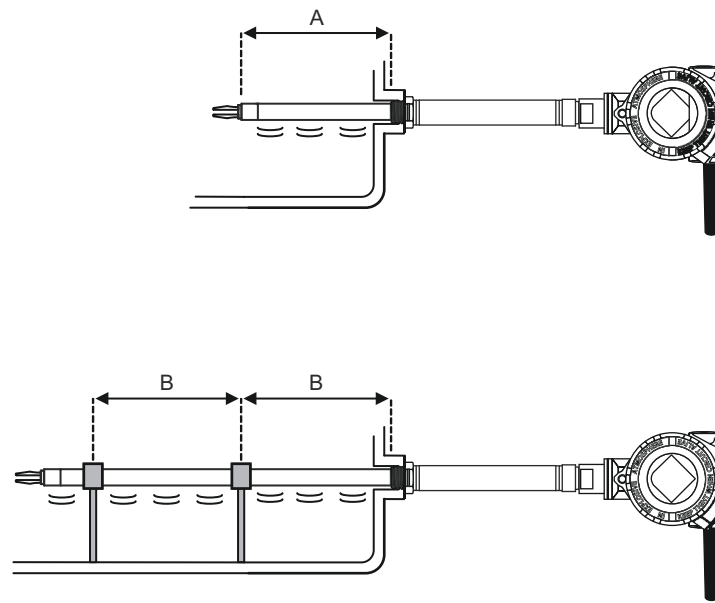
Supporting the extended fork avoids long fork length vibration.

Figure 3-7: Vertical Installation



- A. Maximum 3.28 ft. (1.0 m)
- B. 3.28 ft. (1.0 m)

Figure 3-8: Horizontal Installation

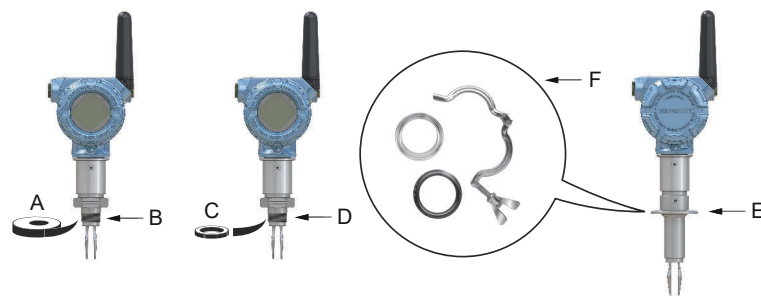


- A. Maximum 3.28 ft. (1.0 m)
- B. 3.28 ft. (1.0 m)

3.3 Installation procedures

3.3.1 Process connection seals

Figure 3-9: Process Connection Seals



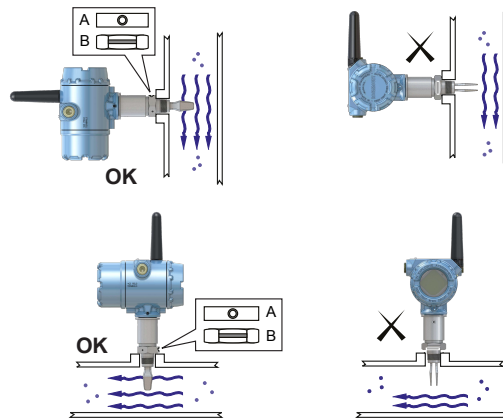
- A. PTFE tape
- B. NPT or BSPT (R) thread
- C. Gasket
- D. BSPP (G) thread
- E. Tri Clamp
- F. The Tri Clamp seal is supplied in an accessory kit

3.3.2 Correct fork alignment

Fork alignment in a pipe installation

The fork is correctly aligned by positioning the groove or notch as indicated (Figure 3-10).

Figure 3-10: Correct Fork Alignment for Pipe Installation

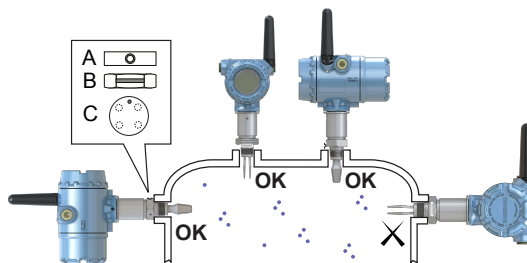


- A. Tri Clamp process connections have a circular notch
- B. Threaded process connections have a groove

Fork alignment in a vessel (tank) installation

The fork is correctly aligned by positioning the groove or notch as indicated (Figure 3-11).

Figure 3-11: Correct Fork Alignment for Vessel (Tank) Installation



- A. Tri Clamp process connections have a circular notch
- B. Threaded process connections have a groove
- C. Flanged process connections have a circular notch

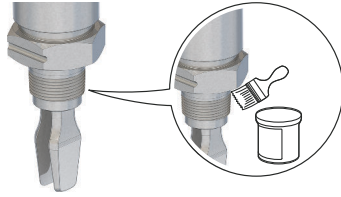
3.3.3 Mounting the threaded version

Threaded vessel (tank) or pipework connection

Procedure

1. Seal and protect the threads. Use anti-seize paste or PTFE tape according to site procedures.

A gasket may be used as a sealant for BSPP (G) threaded connections.

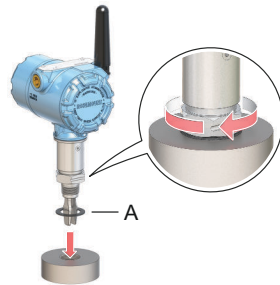


2. Screw the level detector into the process connection.

Note

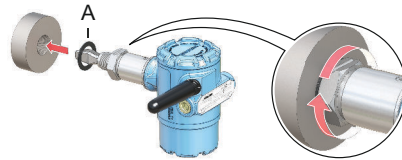
Tighten using the hexagon nut only.

Figure 3-12: Vertical Installation



A. Gasket for BSPP (G) threaded connection

Figure 3-13: Horizontal Installation

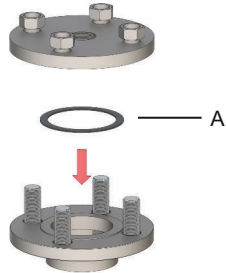


A. Gasket for BSPP (G) threaded connection

Threaded flange connection

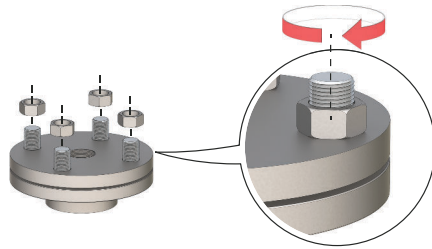
Procedure

1. Place the customer-supplied flange and gasket on the vessel (tank) nozzle.



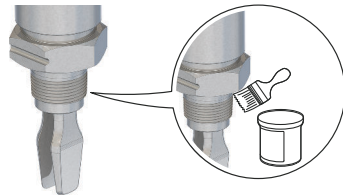
A. Gasket (customer supplied)

2. Tighten the bolts and nuts with sufficient torque for the flange and gasket.



3. Seal and protect the threads. Use anti-seize paste or PTFE tape according to site procedures.

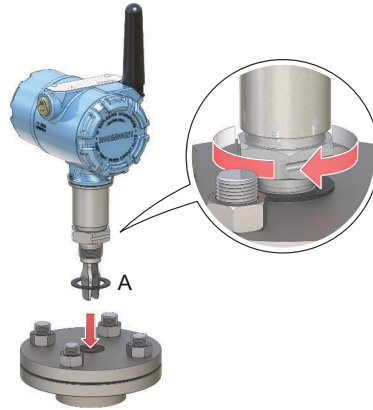
A gasket may be used as a sealant for BSPP (G) threaded connections.



4. Screw the level detector into the flange thread.

Note

Tighten using the hexagon nut only.

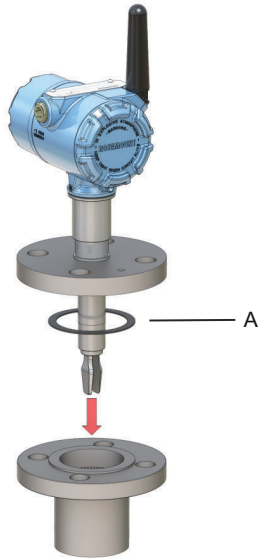


A. Gasket for BSPP (G) threaded connection

3.3.4 Mounting the flanged version

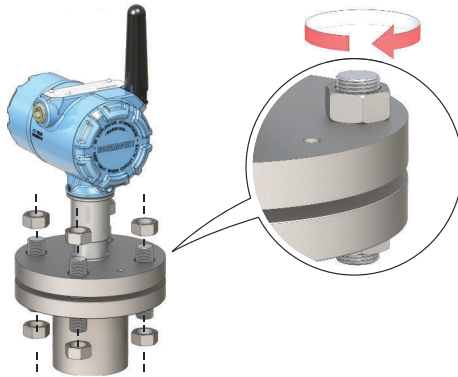
Procedure

1. Lower the level detector into the nozzle.



A. Gasket (customer supplied)

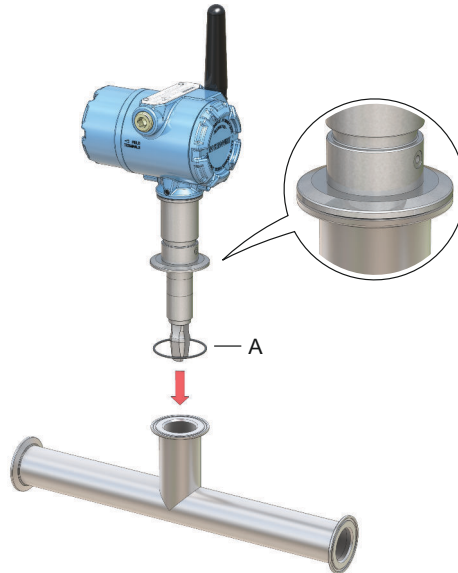
2. Tighten the bolts and nuts with sufficient torque for the flange and gasket.



3.3.5 Mounting the Tri Clamp version

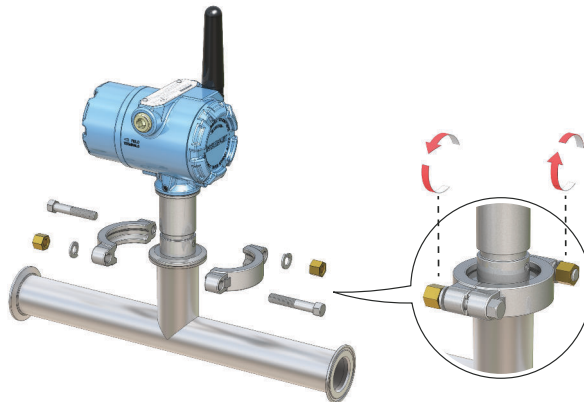
Procedure

1. Lower the level detector into the flange face.



A. Seal (supplied with Tri Clamp)

2. Fit the Tri Clamp.



3.3.6 Install the power module

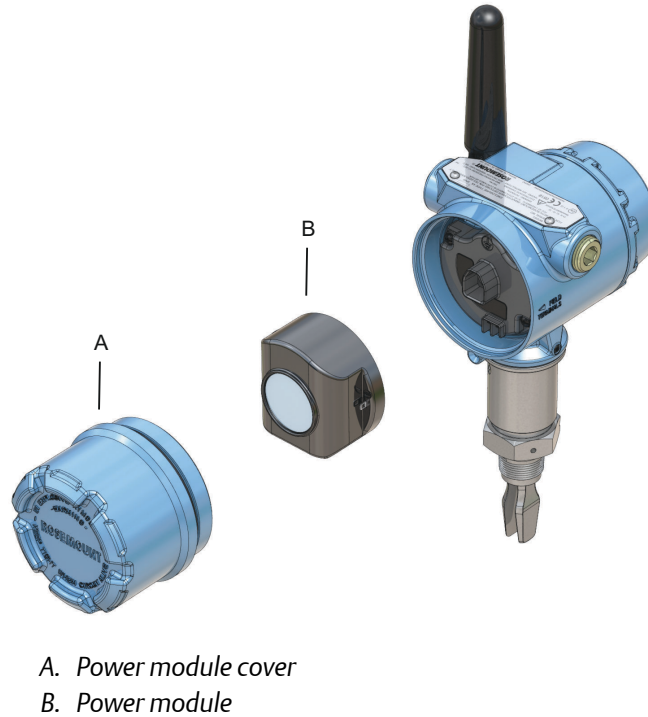
To install the battery that supplies all power to the Rosemount 2160:

Procedure

1. Remove the power module cover.
2. Connect the power module.

3. Replace the power module cover and tighten to safety specification (metal-to-metal).

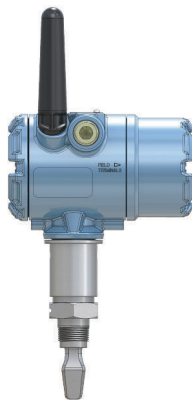
Figure 3-14: Wireless Power Module Installation



3.3.7 Position the antenna

The antenna should be positioned vertically, either straight up or straight down, and it should be approximately 3 ft. (1 m) from any large structure, building, or conductive surface to allow for clear communication to other devices.

Figure 3-15: Antenna Positioned Vertically



3.3.8 Adjust LCD meter orientation

If a device display is ordered, it will be shipped attached to the level detector. The display is ordered in the level detector model number, option code M5.

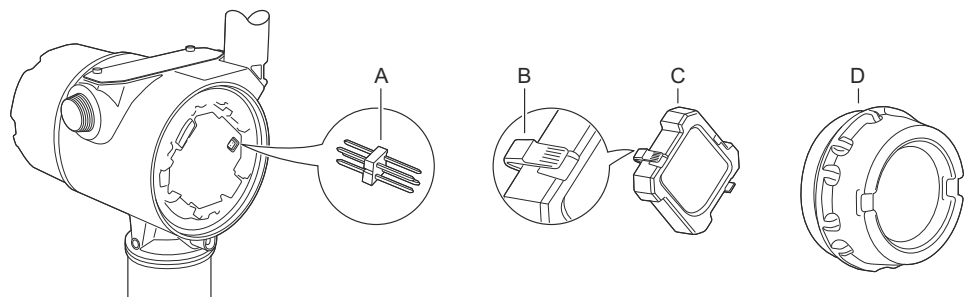
Rotate the device display

The device display can be rotated in 90-degree increments.

Procedure

1. Squeeze the two black tabs on opposite sides of the display. Refer to [Figure 3-16](#).
2. Gently pull out the display.
3. Rotate the display to the desired orientation, and snap the display into place.

Figure 3-16: Device Display



- A. Display pins
- B. Black tabs
- C. Display
- D. Cover

Note

If the device display four-pin connector is inadvertently removed from the interface board, carefully reinsert the connector before snapping the device display back into place.

3.3.9 Adjust housing orientation

The housing can be rotated for optimal viewing of the optional LCD display and to get the best antenna position.

Procedure

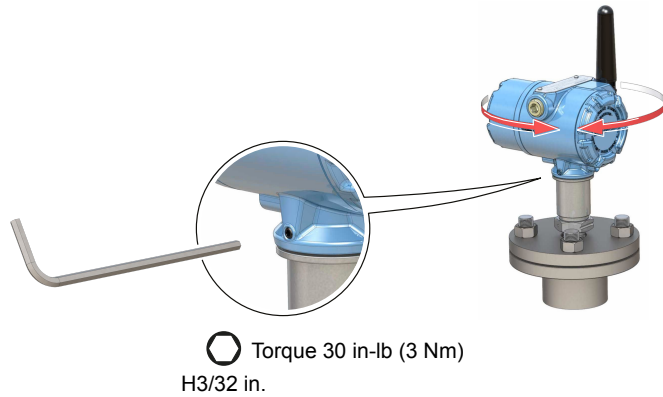
1. Loosen the set screw until the level detector housing can rotate smoothly.
Do not unscrew all the way. Rotating the housing, without this screw in place, can damage the internal wiring.
2. First, rotate the housing clockwise to the desired location.
If the desired location cannot be achieved due to thread limit, rotate the housing counterclockwise.

3. Re-tighten the set screw.

Note

Do not attempt to rotate the housing beyond the thread limit.

Figure 3-17: Housing Rotation



4 Configuration

4.1 Safety messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

⚠ WARNING

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

Ensure the level detector is installed by qualified personnel and in accordance with applicable code of practice.

Use the level detector only as specified in this manual. Failure to do so may impair the protection provided by the level detector.

The weight of a level detector with a heavy flange and extended fork length may exceed 37 lb. (18 kg). A risk assessment is required before carrying, lifting, and installing the level detector.

Repair, e.g. substitution of components, etc. may jeopardize safety and is under no circumstances allowed.

⚠ WARNING

Explosions could result in death or serious injury.

Verify that the operating atmosphere of the level detector is consistent with the appropriate hazardous locations certifications.

Before connecting a handheld communicator in an explosive atmosphere, ensure that the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure the level detector is handled carefully. If the process seal is damaged, gas might escape from the vessel (tank) or pipe.

4.2 Configuration procedure

Follow these steps for proper configuration:

Procedure

1. Get started with your preferred configuration tool.
 - AMS Wireless Configurator
 - Handheld communicator
2. Join device to wireless network.
 - a) Insert the power module.
 - b) Connect to device.
 - c) Configure update rate.
 - d) Obtain network ID and join key.
 - e) Enter network ID and join key.
 - f) Verify device joins Network.
3. Configure device.
 - a) Connect to device.
 - b) Configure using basic setup.
 - c) Consider optional guided setups.
4. Verify the fork status (dry or wet) is as expected.

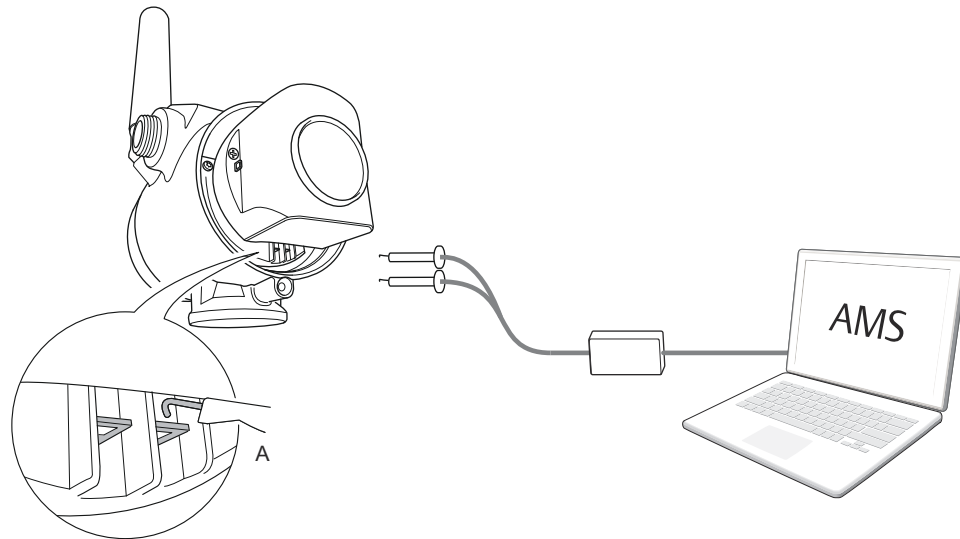
4.3 Get started with your preferred configuration tool

4.3.1 AMS Wireless Configurator

The AMS Wireless Configurator is the recommended software tool for the wireless network devices, and is supplied with the Emerson Wireless Gateway.

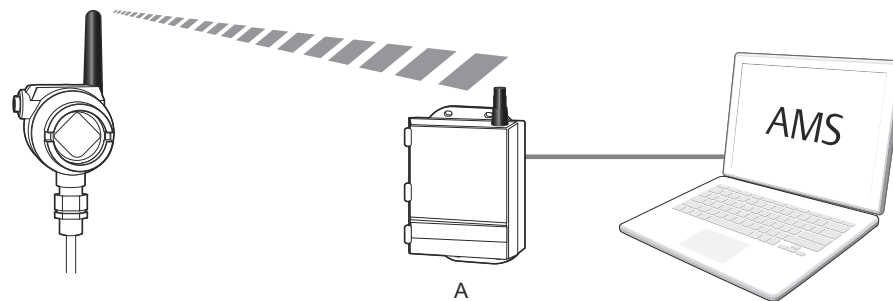
Configuration can be done by connecting to the wireless network devices either point-to-point using a HART modem as shown in [Figure 4-1](#), or wirelessly through the Gateway as shown in [Figure 4-2](#). Initial configuration to join a device to the wireless network must be done point-to-point.

Figure 4-1: Connect Point-to-Point using HART Modem



A. Communication terminals

Figure 4-2: Connect Wirelessly through the Wireless Gateway



A. Wireless Gateway

Download the latest Device Descriptor (DD)

The Device Descriptor (DD) is a configuration tool that is developed to assist the user through the configuration.

Procedure

Download the latest DD at [Emerson.com/DeviceInstallKits](https://www.emerson.com/DeviceInstallKits).

Add the DD to AMS Wireless Configurator

Prerequisites

The Rosemount 2160 DD is typically installed together with AMS Wireless Configurator.

Procedure

1. Close AMS Wireless Configurator.

2. Go to **Start** → **Programs** → **AMS Device Manager** and select **Add Device Type**.
3. Browse to the downloaded DD files and select **Ok**.

Need help?

In the **Add Device Type** application, select the **Help** button for more information on how to complete this operation.

Configure the HART® modem interface

Before connecting to the device using a HART modem, the HART modem interface must be configured in AMS Wireless Configurator.

Procedure

1. Close AMS Wireless Configurator.
2. Go to **Start** → **Programs** → **AMS Device Manager** and select **Network Configuration**.
3. Select **Add**.
4. In the drop down list, select **HART modem** and then select **Install**.
5. Follow the on-screen instructions.

Need help?

In the **Network Configuration** application, select the **Help** button for more information on how to complete this operation.

Configure the wireless network interface

Before connecting to the device wirelessly using a Wireless Gateway, the wireless network must be configured in AMS Wireless Configurator.

Procedure

1. Close AMS Wireless Configurator.
2. Go to **Start** → **Programs** → **AMS Device Manager** and select **Network Configuration**.
3. Select **Add**.
4. In the drop-down list select **Wireless Network** and then select **Install**.
5. Follow the on-screen instructions.

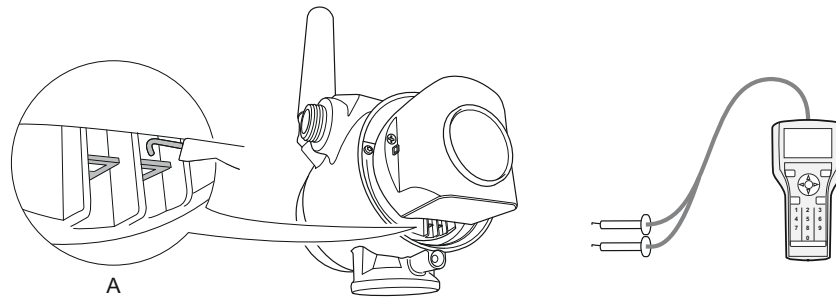
Need help?

In the **Network Configuration** application, select the **Help** button for more information on how to complete this operation.

4.3.2 Handheld communicator

This section describes how to prepare the handheld communicator to communicate with a Rosemount 2160. The handheld communicator can be used to configure the device with a point-to-point connection. Connect the leads on the handheld communicator to the communication terminals of the device.

Figure 4-3: Connect Point-to-Point using a Handheld Communicator



A. Communication terminals

Get the latest Device Descriptor (DD)

If the DD is not installed in your handheld communicator, see the appropriate handheld communicator User's Manual available at [Emerson.com/FieldCommunicator](https://www.emerson.com/FieldCommunicator) for instructions on how to update the handheld communicator with the latest DD.

4.4 Join device to wireless network

4.4.1 Power up the wireless device

Prerequisites

Make sure that the Wireless Gateway is installed and functioning properly before any wireless field devices are powered.

Wireless devices should be powered up in order of proximity from the Gateway, beginning with the closest. This will result in a simpler and faster network installation.

Procedure

1. Install the power module.
2. Enable **Active Advertising** on the Gateway to ensure that new devices join the network faster.

Related information

[Install the power module](#)

Startup screen sequence

The following screens will be displayed in sequence when the power module is first connected to the Rosemount 2160.

Table 4-1: Startup Screen Sequence

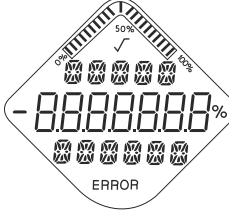
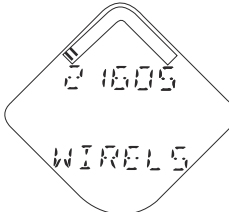
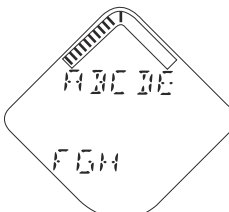
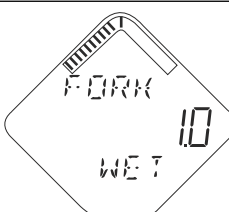
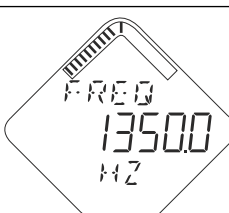
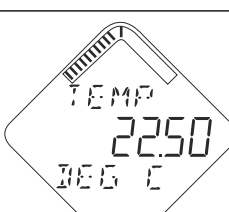

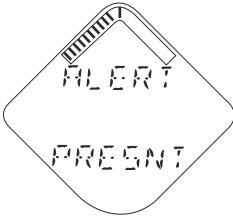
Screen	Sequence	Description
	1. All segments ON	Used to visually determine if there are any bad segments on the device display.
	2. Device identification	Identification string used to determine the device type.
	3. Device information: Tag	User entered tag, 8 characters long. This screen will not display if all characters are blank.
	4. Primary Variable (PV) - Fork state	Fork (switch) state.
	5. Secondary Variable (PV) - Fork frequency	Fork (switch) frequency.
	6. Tertiary Variable (TV) - Electronic temperature	Temperature value of device electronics.

Table 4-1: Startup Screen Sequence (continued)

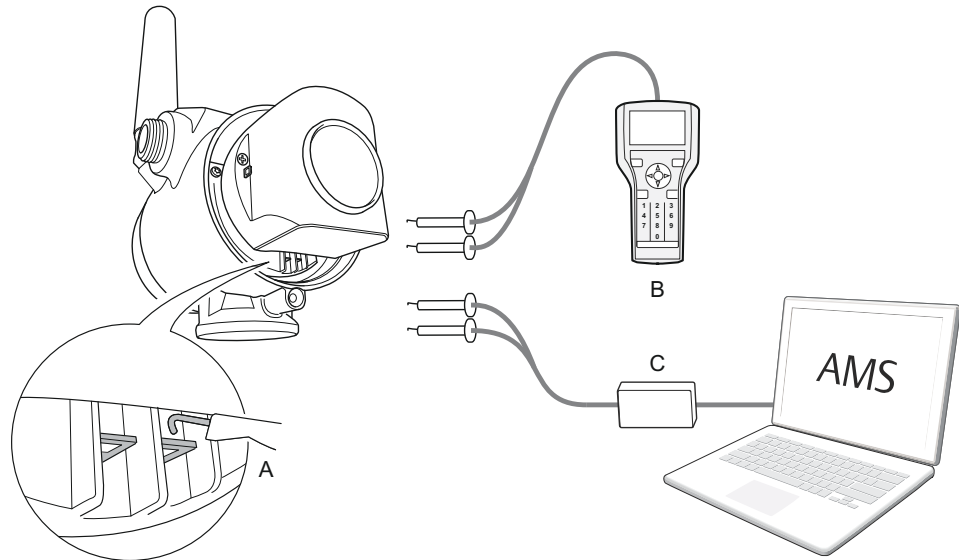
Screen	Sequence	Description
	<p>7. Quaternary Variable (QV) - Supply voltage</p>	<p>Voltage reading of the power module.</p>
	<p>8. Active alert present</p>	<p>This screen will only appear if there is at least one active alert present. For detailed information of the failure source and recommended actions, go to the Active Alerts screen in AMS Wireless Configurator or the handheld communicator. Some active alerts will be displayed on the LCD display as part of the diagnostic button screen sequence.</p>

4.4.2 Connect to device

Procedure

1. Connect a handheld communicator or a HART[®] modem to the communication terminals as shown in [Figure 4-4](#).

Figure 4-4: Connect to Device



- A. Communication terminals
- B. Handheld communicator
- C. HART modem

2. Do one of the following:
 - AMS Wireless Configurator:
 - a. Start AMS Wireless Configurator.
 - b. Select **View** → **Device Connection View**.
 - c. Double click the device under the HART modem.
 - Handheld communicator:
 - Turn on the handheld communicator and connect to the device.

4.4.3 Configure update rate

The update rate is the frequency at which a new measurement is transmitted over the wireless network. The default update rate is 1 minute.

Prerequisites

Note

If the time between each update is too long, the high/low alerts may be triggered too late.

Procedure

1. Select **Configure** → **Guided Setup**.
2. Select **Configure Update Rate** and follow the on-screen instructions.

Note

If the update rate is reconfigured, the unit will continuously update for five minutes and then update with the reconfigured update rate.

Related information

[Wireless update rate](#)

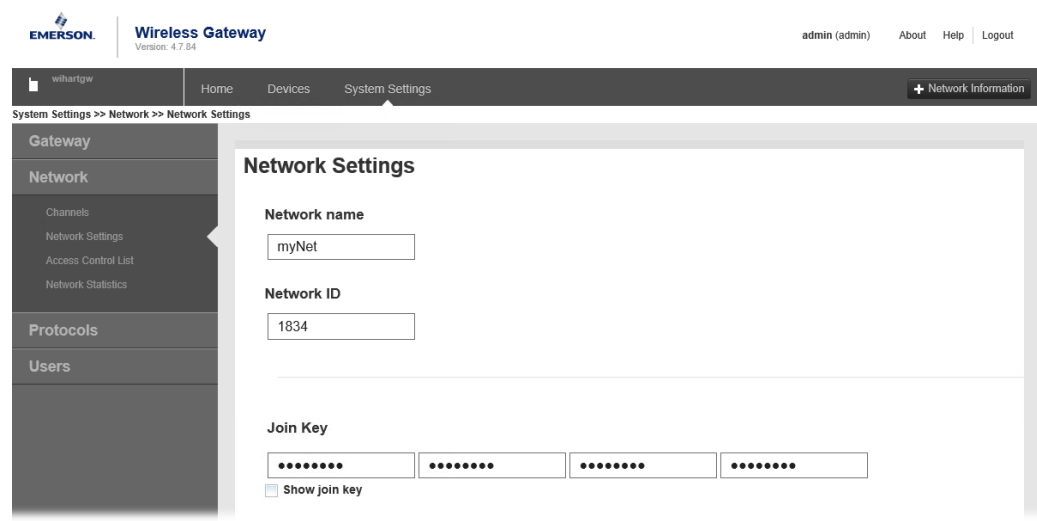
4.4.4 Obtain network ID and join key

In order to communicate with the Wireless Gateway, and ultimately the host system, the Rosemount 2160 must be configured to communicate on the wireless network. This step is the wireless equivalent of connecting wires from a device to the host system.

Procedure

From the Wireless Gateway's integrated web interface, select **System Settings** → **Network** → **Network Settings**.

Figure 4-5: Gateway Network Settings



4.4.5 Enter network ID and join key

The device must be configured with the same Network ID and Join Key as the Gateway in order to join the network.

Procedure

1. Select **Configure** → **Guided Setup**.
2. Select **Join Device to Network** and follow on-screen the instructions.

Postrequisites

If the device is not to be commissioned yet, remove the power module and fasten the housing cover. This is to conserve power module life and to ensure safe transportation. The power module should be inserted only when the device is ready to be commissioned.

4.4.6 Verify device joins network

Network connection can be verified in four ways, further described in this section:

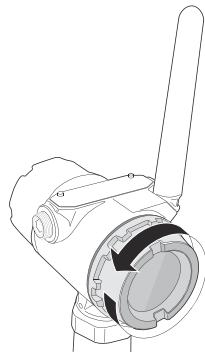
- At the device display
- Using the AMS Wireless Configurator
- In the Wireless Gateway's integrated web interface
- Using the handheld communicator

If the Rosemount 2160 was configured with the Network ID and Join Key, and sufficient time has passed, the device should be connected to the network. It usually takes a few minutes for the device to join the network.

Verify by device display

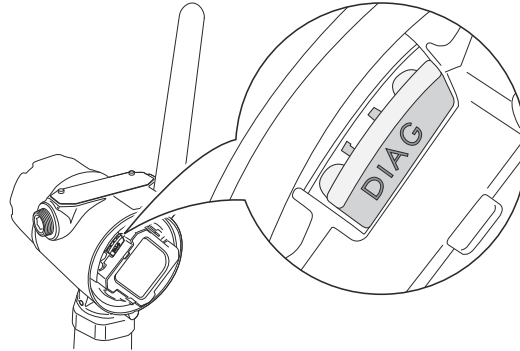
Procedure

1. Unscrew the device display cover.



2. Press the **DIAG** button.

The display will show: Tag, Device Serial Number, Network ID, Network Connection Status, and Supply Voltage screens.



When the network diagnostic status is displayed as “NETWK OK”, the device has successfully joined the network.

Network connection status screens

When joining the wireless network, there is a sequence of status changes until the network is finally joined. [Table 4-2](#) presents the different network connection status screens.

Table 4-2: Network Connection Status Screens

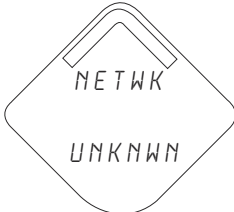
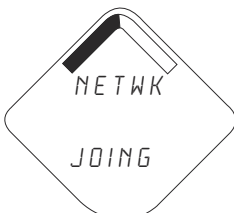
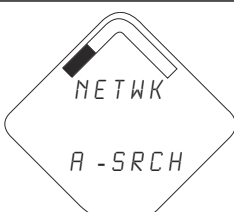
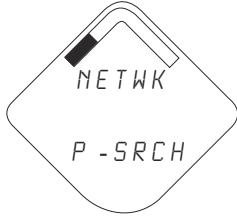

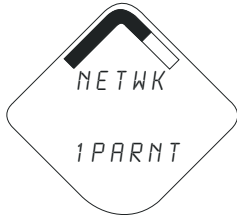
Screen	Status	Description
	Network Unknown	The device is still in the process of being activated.
	Network Joining	The device has started the process of joining a network.
	Network Active Search	The device is actively searching for a network.

Table 4-2: Network Connection Status Screens (continued)

Screen	Status	Description
	Network Passive Search	The device is passively searching for a network.
	Network Sleep	The device couldn't find the network and is in deep sleep mode to preserve battery power.
	Network 1 Parent	The device has joined a network and has been fully configured but has only 1 parent device.

Verify with AMS Wireless Configurator

Procedure

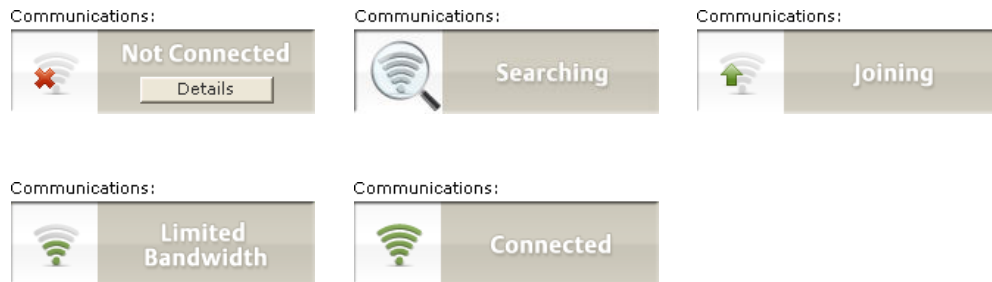
1. Start the AMS Wireless Configurator.
2. Navigate to the Smart Wireless Gateway icon.

When the device has joined the network, it will appear in the AMS Wireless Configurator window.

Network connection status

Figure 4-6 presents the different network connection status images that are shown in the AMS Wireless Configurator **Overview** screen.

Figure 4-6: Network Connection Status Images



Verify by Gateway

Procedure

1. From the Emerson Wireless Gateway home page, navigate to the **Devices** page. This page shows whether the device has joined the network and if it is communicating properly.
2. Locate the device in question and verify all status indicators are good (green). It may take several minutes for the device to join the network and be seen on the Gateway's integrated web interface.

Figure 4-7: Wireless Gateway Devices Page

The screenshot shows the 'Devices' page of the Emerson Wireless Gateway. At the top, there are navigation tabs for 'Home', 'Devices', and 'System Settings'. A summary bar indicates 'All Devices 17', 'Live 17', 'Unreachable 0', and 'Power Module Low 0'. Below this is a table with columns for Name, PV, SV, TV, QV, and Last Update. Each row represents a device with various sensor readings and a green checkmark indicating a good status.

Name	PV	SV	TV	QV	Last Update
12TT902	15.429 DegC	15.65 DegC	16.25 DegC	7.127 V	12/20/21 15:07:11
11PT0902	32.819 mbar	18.456 DegC	19 DegC	7.21 V	12/20/21 15:07:16
13TT903	14.941 DegC	15.088 DegC	15 DegC	7.136 V	12/20/21 15:06:59
11PT0901	282.285 mbar	18.88 DegC	19 DegC	7.183 V	12/20/21 15:06:59
14TT904	14.766 DegC	15.041 DegC	15.25 DegC	7.195 V	12/20/21 15:06:46
11PT0922	0.364 bar	15.035 DegC	0.364 bar	3.598 V	12/20/21 15:07:12
12PT0924	0.699 bar	14.6 DegC	0.699 bar	3.602 V	12/20/21 15:07:16
11TT901	15.339 DegC	15.629 DegC	15.75 DegC	7.124 V	12/20/21 15:06:42
12XT910	0 counts	16.277 DegC	16.75 DegC	3.651 V	12/20/21 15:07:14

Verify with handheld communicator

Prerequisites

Do not remove the power module. Removing the power module may cause the device to drop off the network.

Note

In order to communicate with a handheld communicator, the device must be powered by the power module.

Procedure

1. Connect the handheld communicator.
2. Select **Service Tools** → **Communications**.
3. Select **Join Status**.

4.5 Configure device using guided setup

The options available in the Basic Setup wizard include all items required for basic operation.

Procedure

1. Select **Configure** → **Guided Setup**.
2. Select **Basic Setup** and follow the on-screen instructions.
3. Consider optional guided setups such as **Configure Device Display** and **Configure Alerts**.

5 Operation

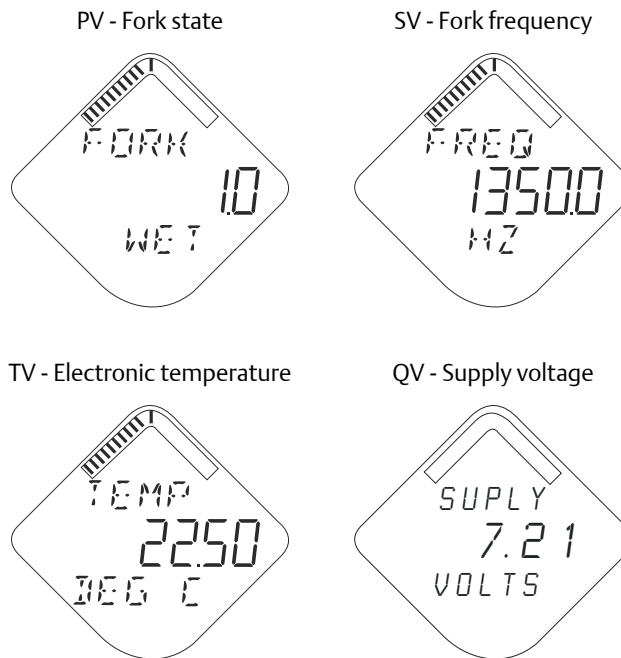
5.1 Device display screen messages

The device display can be used to present different variables and a diagnostic screen sequence.

5.1.1 Variable screens

The Rosemount 2160 can display the following variables:

Figure 5-1: LCD Display Variables

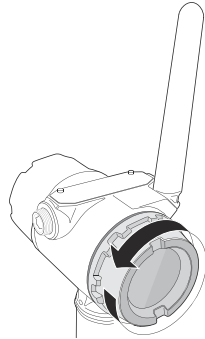


5.2 View diagnostic screens

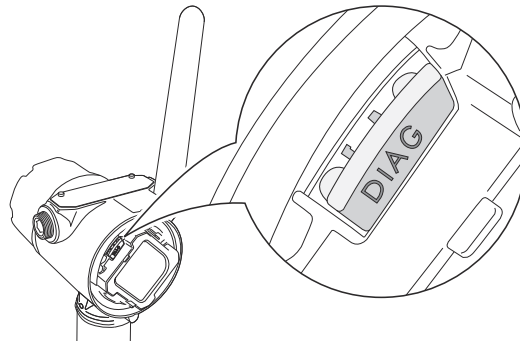
The diagnostic button screen sequence on the device display can be used to obtain detailed diagnostic information.

Procedure

1. Unscrew the device display cover.



2. Press and hold the DIAG button until the first diagnostic button screen appears on the device display. Release the DIAG button.

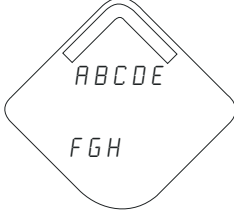
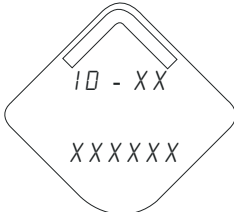
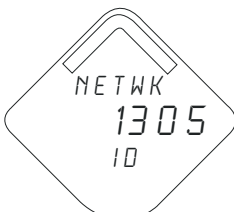

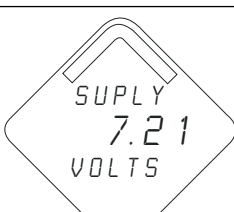


The device display will now automatically show the diagnostic screens.

5.2.1 Diagnostic button screen sequence

The following five screens will display when the device is operating properly and the DIAG button has been pressed.

Table 5-1: Diagnostic Button Screen Sequence

Screen	Sequence	Description
	1. Device Information: Tag	User entered tag which is 8 characters long. This screen will not display if all characters are blank.
	2. Device Serial Number	Used to determine Device Serial Number.
	3. Network ID	Used to determine the entered Network ID in the device.
	4. Network Connection Status	The screen displayed is dependent on the progress of the device in joining the wireless network.
	5. Supply voltage	Used to indicate the voltage of the battery.

Related information

[Device display alerts](#)

5.3 View measurement data

Current measurement data of the primary variables are presented on the **Overview** screen. To view all current measurement values:

Procedure

Select **Service Tools** → **Variables**.

5.3.1 Interpret measurement status

A “Good” or “Bad” status next to a value is an indication of the reliability or integrity of the data being received, not an indication of whether or not the value is within the configured upper or lower ranges. A value that triggers an alert, such as a high or low temperature indication, will change the overall status of the device, but the measurement might still be indicated as “Good” if the reliability of the data is good.

5.4 Check device status




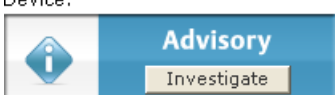
The overall device status is presented under the **Overview** screen. The device reports diagnostic alerts when there is a device malfunction.

Procedure

1. Go to the **Overview** screen to view the overall device status.
2. If status is anything other than Good, select the button in the device status image to open a window with Active Alerts.
Active Alerts can also be obtained via **Service Tools** → **Alerts**.

5.4.1 Device status images

Table 5-2: Presentation of Device Status Images

Device status image	Category	Condition	Action
Device: 	Good	No active alert.	N/A
Device: 	Failed	At least one Failure Alert is active.	Click the Troubleshoot button to open a window with Active Alerts together with recommended actions.
Device: 	Maintenance	At least one Maintenance Alert is active (and no Failed alerts).	Click the Investigate button to open a window with Active Alerts together with recommended actions.
Device: 	Advisory	At least one Advisory Alert is active (and no Failed or Maintenance Alerts).	

6 Service and troubleshooting

6.1 Safety messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

⚠ WARNING

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

Ensure the level detector is installed by qualified personnel and in accordance with applicable code of practice.

Use the level detector only as specified in this manual. Failure to do so may impair the protection provided by the level detector.

The weight of a level detector with a heavy flange and extended fork length may exceed 37 lb. (18 kg). A risk assessment is required before carrying, lifting, and installing the level detector.

Repair, e.g. substitution of components, etc. may jeopardize safety and is under no circumstances allowed.

⚠ WARNING

Explosions could result in death or serious injury.

Verify that the operating atmosphere of the level detector is consistent with the appropriate hazardous locations certifications.

Before connecting a handheld communicator in an explosive atmosphere, ensure that the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure the level detector is handled carefully. If the process seal is damaged, gas might escape from the vessel (tank) or pipe.

6.2 Device display alerts

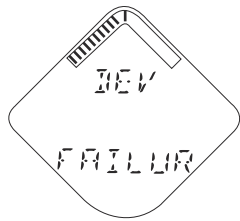
The following active alert screens will show the device diagnostics depending on the state of the device.

If the device display shows **ALERT PRESNT** but none of the following screens appear, then go to the **Active Alerts** screen in AMS Wireless Configurator or the handheld communicator for further information.

For detailed information of the failure source and recommended actions, go to the **Active Alerts** screen in AMS Wireless Configurator or the handheld communicator.

6.2.1 Device failure

Screen



Cause

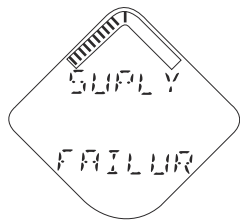
There is a critical error which may prevent the device from operating correctly.

Recommended actions

Check additional status screens for more information.

6.2.2 Supply voltage failure

Screen



Cause

The terminal voltage has dropped below level of operating limit.

Recommended actions

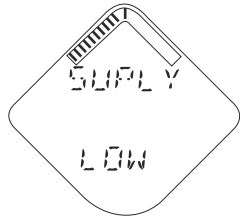
Replace the power module.

Related information

[Replace power module](#)

6.2.3 Supply voltage low

Screen



Cause

The supply voltage is low and may soon affect broadcast updates.

Recommended actions

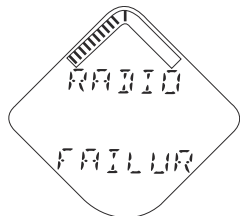
Replace the power module.

Related information

[Replace power module](#)

6.2.4 Radio failure

Screen



Cause

The wireless radio has detected a failure or stopped communicating.

Recommended actions

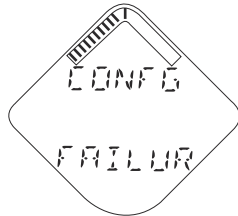
1. Reset the device.
2. If the condition persists, contact your local Emerson representative.

Related information

[Perform a device reset](#)

6.2.5 Configuration failure

Screen



Cause

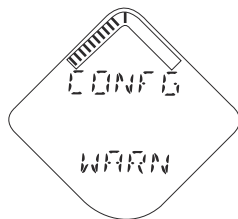
Configuration of the device is invalid such that critical operation of the device may be affected.

Recommended actions

Check the extended configuration status to identify which configuration item(s) need to be corrected.

6.2.6 Configuration warning

Screen



Cause

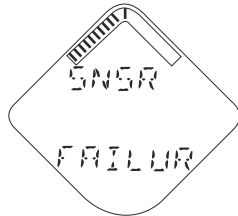
Configuration of the device is invalid such that non-critical operation of the device may be affected.

Recommended actions

Check the extended configuration status to identify which configuration item(s) need to be corrected.

6.2.7 Sensor failure

Screen



Cause

A sensor attached to the device has failed, and valid readings from that sensor are no longer possible.

Recommended actions

1. Check the sensor and sensor wiring connections.
2. Check additional status for more detailed information of the failure source.

6.3 Troubleshooting

6.3.1 LCD is not functioning

Recommended actions

1. Re-seat the LCD.
2. Verify that the LCD is a wireless LCD. An LCD from a wired device will not function in a wireless device.
3. Verify that the LCD display mode is not disabled.

Related information

[Rotate the device display](#)

[Display mode](#)

6.3.2 Does not switch output state

Possible cause

There is no power.

Recommended actions

Check the power module is installed correctly. Try another power module.

Possible cause

Fork is damaged.

Recommended actions

Replace the device.

Possible cause

Thick encrustation on the forks.

Recommended actions

Clean the fork with care.

6.3.3 Incorrect switching of output state

Recommended actions

Check the configuration of frequency bands.

Related information

[Calibration frequencies and switch points](#)

6.3.4 Faulty switching

Symptom or indication

Turbulence.

Recommended actions

Set a longer switching time delay.

Symptom or indication

Excessive electrical noise.

Recommended actions

Suppress the cause of the interference.

Related information

[Sensor output delay](#)

6.3.5 Wireless network troubleshooting

The device is not joining the wireless network

Recommended actions

1. Verify Network ID and Join Key. The Network ID and Join Key in the device must match the Network ID and Join Key of the Gateway.
2. Enable High Speed Operation on the Wireless Gateway.
3. Check Power Module.
4. Verify that Active Advertising has been enabled on the Wireless Gateway.

5. Verify device is within range of at least one other wireless device or the Wireless Gateway.
6. Verify device is configured to join. Send the “Join Now” command to the device.

Limited bandwidth error

Recommended actions

1. Reduce the Update Rate on device.
2. Increase communication paths by adding more wireless points.
3. Check that device has been online for at least an hour.
4. Check that device is not routing through a “limited” routing node.
5. Create a new network with an additional Wireless Gateway.

6.4 Service and troubleshooting tools

This section briefly describes tools and functions in the AMS Wireless Configurator and handheld communicator, which may be useful for servicing and troubleshooting of the Rosemount 2160.

6.4.1 Reviewing network join status and details

View network join status

Wireless devices join the network through a four step process:

- Step 1. Network Found
- Step 2. Network Security Clearance Granted
- Step 3. Network Bandwidth Allocated
- Step 4. Network Join Complete

To view the Network Join Status of the device:

Procedure

Select **Service Tools** → **Communications** → **Join Status**.

Obtain network join details

Obtain detailed information about the network join, and configure how the device attempts to join the network.

Procedure

Select **Service Tools** → **Communications**.

Network join details

Table 6-1: Network Join Details Functions

Term	Description
Join Mode	This mode configures how the device attempts to join the network. Settable options are: <ul style="list-style-type: none">• Don't Attempt to Join• Join Now• Join on Powerup or Reset
Number of Available Neighbors	Defines how many wireless devices are within the communication range of this device. In a self-organizing network, the more neighbors a device has, the more robust the network will be.
Number of Advertisements Heard	Number of advertised packets received by the device from all networks within range.
Number of Join Attempts	Number of times the device has tried to join the network prior to being accepted. Too many join attempts result in the device considering the join attempt as failed. If this happens, re-check the Join Key and Network ID.

6.4.2 View diagnostic information

Procedure

Select **Service Tools** → **Maintenance** → **Diagnostics**.

Sensor frequency

The vibrating fork frequency is indicated in the read-only Sensor Frequency device variable.

Temperature compensation

The temperature coefficient of the vibrating fork sensor in units of %/°C.

Uncompensated frequency

Uncompensated Frequency indicates the vibrating fork frequency before compensating for a varying process temperature.

Sensor state

This is a read-only variable and indicates the present state of the vibrating fork sensor.

As the vibrating fork sensor becomes immersed in a process liquid, the vibration frequency decreases and the sensor state changes to a 'wet state' at the detection point.

When a process liquid falls away from the fork, the vibration frequency increases and the sensor state changes to a 'dry state' at a detection point.

Sensor status

This is a read-only variable. It indicates if the level detector is operating in a valid or fault state.

The Sensor Status is dependent on the configuration of Sensor State and Operation Mode.

Sensor status logic

Table 6-2: Normal Mode

Sensor status	Sensor state ⁽¹⁾	PV (output status)
Valid	Dry	0.0 (Dry)
Valid	Wet	1.0 (Wet)

(1) Sensor Fault Delay does not delay the update of Sensor State when the operation mode is Normal.

Note

If the operation mode is Normal, Sensor State cannot indicate Too Dry, Too Wet, or Zero, and the Sensor Status always indicates a Valid state.

Table 6-3: Enhanced Mode, Fault = Wet

Sensor status	Sensor state ⁽¹⁾	PV (output status)
Valid	Dry	0.0 (Dry) ⁽²⁾
Fault	Too Dry (Fault)	1.0 (Wet) ⁽³⁾
Valid	Wet	1.0 (Wet) ⁽²⁾
Fault	Too Wet (Fault)	1.0 (Wet) ⁽³⁾
Fault	Zero	1.0 (Wet) ⁽³⁾

(1) Sensor Fault Delay delays the update of Sensor State when the operation mode is Enhanced.

(2) PV is not changed.

(3) PV is automatically changed to 1.0 (Wet process condition).

Table 6-4: Enhanced Mode, Fault = Dry

Sensor status	Sensor state ⁽¹⁾	PV (output status)
Valid	Dry	0.0 (Dry) ⁽²⁾
Fault	Too Dry (Fault)	0.0 (Dry) ⁽³⁾
Valid	Wet	1.0 (Wet) ⁽²⁾
Fault	Too Wet (Fault)	0.0 (Dry) ⁽³⁾
Fault	Zero	0.0 (Dry) ⁽³⁾

(1) Sensor Fault Delay delays the update of Sensor State when the operation mode is Enhanced.

(2) PV is not changed.

(3) PV is automatically changed to 0.0 (Dry process condition).

Calibration frequencies and switch points

The switching points for Sensor State transitions are determined from these read-only frequencies:

Table 6-5: Calibration Frequencies and Switch Points

Term	Description
Dry fork frequency	This is the frequency recorded when the Rosemount 2160 was calibrated in dry conditions. Typically it is in the range 1.2 to 1.5 KHz.
Dry to too dry	Above this upper limit, a measured frequency is considered to be a fault by being outside of the normal dry fork range. The level detector must be operating in Enhanced Mode if this fault is to be indicated in the Sensor Status variable.
Dry to indeterminate	Above this upper limit, a measured frequency is not yet considered to be a fault but is close to being outside of the normal dry fork range.
Wet to indeterminate	Below this lower limit, a measured frequency is not yet considered to be a fault but is close to being outside of the normal wet fork range.
Wet to too wet	Below this lower limit, a measured frequency is considered to be a fault by being outside of the normal wet fork range. The level detector must be operating in Enhanced Mode if this fault is to be indicated in the Sensor Status variable.
Zero	Below this low limit, a measured frequency is considered to be 0 Hz and a fault. The level detector must be operating in Enhanced Mode if this fault is to be indicated in the Sensor Status variable. Note When the level detector is operating in Normal Mode, a 0 Hz sensor frequency represents a Wet condition (and not a fault). When operating in Enhanced Mode, a 0 Hz sensor frequency represents a fault condition.

6.4.3 View counters/timers

Procedure

Select **Service Tools** → **Maintenance** → **Counters/Timers**.

Counters

The Counters menu displays the following live counters:

Table 6-6: Counters Menu

Term	Description
Sensor Wet Count	This counter increments each time the PV (Output State) changes "dry" and "wet" state. Optionally, reset or preset it by setting a new value using the Reset/Preset Wet Count command.
Calibration Count	The Rosemount 2160 is calibrated under reference conditions at the factory. In special circumstances, it may be re-calibrated in the field and this will increment the calibration count.
Fault Count	This counter increments each time there is a fault condition. Optionally, reset the counter to zero using the Reset Fault Count command.

Timers

The Timers menu displays the following live timers:

Table 6-7: Timers Menu

Term	Description
Time Since Output Change	This is the time elapsed since the PV (Output State) variable last changed to a "dry" or "wet" state. Optionally, this timer can be reset to zero by editing the counter.
Total Time Dry	The total time that the PV (Output State) variable has been in a 'dry' state. Optionally, this timer can be reset to zero by editing the counter.
Total Time Wet	The total time that the PV (Output State) variable has been in a 'wet' state. Optionally, this timer can be reset to zero by editing the counter.
Number of Join Attempts	Number of times the device has tried to join the network prior to being accepted. Too many join attempts result in the device considering the join attempt as failed. If this happens, re-check the Join Key and Network ID.

Note

Units for the timers are days, hours, minutes, and seconds. Seconds are not shown for long times.

6.4.4 Dry fork calibration

This command starts the on-site calibration of the fork sensor in dry process conditions. It should only be performed by authorized persons.

A comparison is made between the live fork sensor frequency measured in dry process conditions and original factory-set Dry Fork Frequency value.

If the difference is greater than Allowable Change In Dry Fork Frequency, the re-calibration is rejected. Check the fork for damage, corrosion, or coating, and clean it if necessary before re-trying.

When the calibration is successful, Dry Fork Frequency is set to the new dry frequency.

Related information

[Allowable change in fork frequency](#)

Start the dry fork calibration

Procedure

1. Select **Service Tools** → **Maintenance** → **Calibrate**.
2. Select **Calibrate Dry Fork** and follow the on-screen instructions to perform the dry fork calibration.

Sensor calibration status

Sensor Calibration Status indicates:

Status	Description
Factory calibrated	No further calibration is normally required.
Site calibrated	Calibration successfully performed on-site.
Un-calibrated	Calibration is required. Contact the factory.

Restoring factory calibration of dry fork sensor

This command restores the factory calibration of the fork sensor in dry process conditions. It is accessible after a site calibration has been performed, but should only be performed by authorized persons.

Restoring site calibration of dry fork sensor

This command restores the site calibration of the fork sensor in dry process conditions. It is accessible after the restoration of a factory calibration has been performed, but should only be performed by authorized persons.

6.4.5 Adjust sensor compensation

The frequency of the vibrating fork sensor may be affected by a process temperature being different to the calibrated temperature. Entering a known process temperature can compensate accordingly and provide an improved frequency switching point.

Procedure

1. Select **Service Tools** → **Maintenance** → **Calibrate**.
2. Under **Sensor Compensation**, enter the known **Process Temperature**.

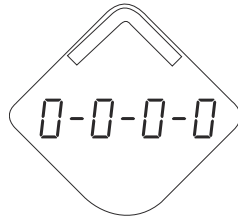
6.4.6 Locate the device

Use the Locate Device function to identify this device by showing a pattern on the device display, as illustrated in [Figure 6-1](#).

Procedure

1. Select **Service Tools** → **Maintenance** → **Routine Maintenance**.
2. Select **Locate Device** and follow the on-screen instructions.

Figure 6-1: Locate Device Pattern



6.4.7 Run the install new power module setup

Run this setup when a new power module is installed.

Procedure

1. Select **Service Tools** → **Maintenance** → **Routine Maintenance**.
2. Select **Install New Power Module** and follow the on-screen instructions.

6.4.8 Perform a device reset

The Device Reset function re-starts electronics of the Rosemount 2160 without having to cycle the power. It preserves the user-configuration.

Procedure

1. Select **Service Tools** → **Maintenance**, → **Reset/Restore**
2. Select **Device Reset** and follow the on-screen instructions.

6.4.9 Load user defaults

The Load User Defaults function resets the user-configuration to the ex-factory settings.

Procedure

1. Select **Service Tools** → **Maintenance** → **Reset/Restore**.
2. Select **Load User Defaults** and follow the on-screen instructions.

6.4.10 Device variable simulation

Simulation mode is available for the following device variables:

Variable	Description
Output State	This device variable can be temporarily overridden to be 'wet' (1.0) or 'dry'(0.0).
Sensor Frequency	This device variable can be temporarily overridden with an entered frequency in the range 0 to 3000 Hz.
Electronics Temperature	This device variable can be temporarily overridden with an entered temperature value.
Voltage Supply	This device variable can be temporarily overridden with an entered voltage value.

Simulate a device variable

Procedure

1. Select **Service Tools** → **Simulate**.
2. Select a device variable to be used for the simulation.
3. Follow on-screen instructions to perform the simulation.

Postrequisites

A simulation is canceled by exiting the screen. It can also be cleared by the power cycling or using the **Device Reset** command.

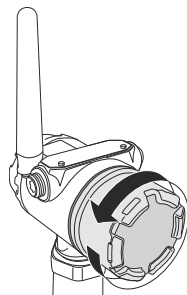
6.5 Replace power module

Prerequisites

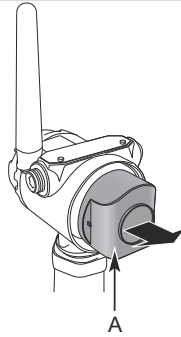
Only use an Emerson approved power module designed for use with the Rosemount 2160. The power modules are only compatible with their respective covers.

Procedure

1. Remove the cover.

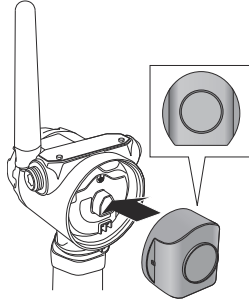


2. Remove the old power module.

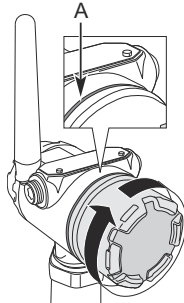


A. *Dispose of in accordance with Government regulations*

3. Connect the new power module.



4. Attach and tighten the cover.



A. *Keep cover tight*

Postrequisites

Run the install new power module setup.

Related information

[Emerson Wireless Black SmartPower Solutions Product Data Sheet](#)

[Emerson Wireless Blue SmartPower Solutions Product Data Sheet](#)

[Run the install new power module setup](#)

6.5.1 Handling considerations

The power modules with the wireless unit contains primary lithium/thionyl chloride batteries. Under normal conditions, the battery materials are self-contained and are not reactive as long as the batteries and the battery pack integrity are maintained. Care should be taken to prevent thermal, electrical or mechanical damage. Contacts should be protected to prevent premature discharge.

Use caution when handling the power module. It may be damaged if dropped from heights in excess of 20 ft. (6 m).

⚠ Battery hazards remain when cells are discharged.

6.5.2 Environmental considerations

As with any battery, local environmental rules and regulations should be consulted for proper management of spent batteries. If no specific requirements exist, recycling through a qualified recycler is encouraged. Consult the Safety Data Sheet (SDS) for battery specific information.

6.5.3 Shipping considerations

The unit was shipped to you without the power module installed. Please remove the power module prior to shipping.

Each Black Power Module (model number 701PBKKF) contains two "C" size primary lithium batteries. Primary lithium batteries (charged or discharged) are regulated in transportation by the U. S. Department of Transportation, and are also covered by IATA (International Air Transport Association), ICAO (International Civil Aviation Organization), and ARD (European Ground Transportation of Dangerous Goods). It is the responsibility of the shipper to ensure compliance with these or any other local requirements. Consult current regulations and requirements before shipping.

Each Blue Power Module (A0701PBU) contains two "D" size primary lithium batteries. Primary lithium batteries (charged or discharged) are regulated in transportation by the U.S. Department of Transportation, and are also covered by IATA (International Air Transport Association), ICAO (International Civil Aviation Organization), and ARD (European Ground Transportation of Dangerous Goods). It is the responsibility of the shipper to ensure compliance with these or any other local requirements. Please consult current regulations and requirements before shipping.

6.6 Opening the lid (cover)

Before opening the lid for maintenance reasons observe following items:

- Do not remove the lid while circuits are live.
- No dust deposits or whirlings are present.
- No rain can enter into the housing.

6.7 Service support

To expedite the return process, refer to [Emerson.com](https://www.emerson.com) and contact the nearest Emerson representative.

⚠ CAUTION

Individuals who handle products exposed to a hazardous substance can avoid injury if they are informed of and understand the hazard. Returned products must include a copy of the required Safety Data Sheet (SDS) for each substance.

Emerson representatives will explain the additional information and procedures necessary to return goods exposed to hazardous substances.

A Specifications and reference data

A.1 General

A.1.1 Measuring technology

Vibrating fork

A.1.2 Applications

Point level detection in liquid process mediums, including coating liquids, aerated liquids, and slurries. Suitable for horizontal and vertical installation.

A.2 Physical specifications

A.2.1 Material selection

Emerson provides a variety of Rosemount products with various product options and configurations, including materials of construction that can be expected to perform well in a wide range of applications. The Rosemount product information presented is intended as a guide for the purchaser to make an appropriate selection for the application. It is the purchaser's sole responsibility to make a careful analysis of all process parameters (such as all chemical components, temperature, pressure, flow rate, abrasives, contaminants, etc.), when specifying product, materials, options, and components for the particular application. Emerson is not in a position to evaluate or guarantee the compatibility of the process fluid or other process parameters with the product, options, configuration, or materials of construction selected.

A.2.2 Electronics housing

Enclosure

- Housing: Stainless steel or low-copper aluminum
- Paint: Polyurethane (aluminum housing only)
- Cover O-ring: Nitrile butadiene

Terminal block and power module pack

PBT

Antenna

PBT/PC integrated omni-directional antenna

Rotation

Rotatable housing allows correct alignment of both the forks and the omni-directional antenna for optimal signal and best viewing position of the LCD integral display.

Ingress protection

Housing is NEMA 4X and IP66 compliant.

A.2.3 Process wetted connections

Connections

Threaded, Tri Clamp, and flanged process connection options.

Materials

- 316/316L stainless steel (1.4401/1.4404 dual-certified)
Hand-polished to better than 0.4 μm option for Tri Clamp connections.
- Alloy C (UNS N10002) and Alloy C-276 (UNS N10276)
Available for flanged, and selected threaded process connections ($\frac{3}{4}$ -in. and 1-in. BSPT (R), and $\frac{3}{4}$ -in. and 1-in. NPT).
- Gasket material for $\frac{3}{4}$ -in. and 1-in. BSPP (G) is non-asbestos BS7531 Grade X carbon fiber with rubber binder.
Gaskets are not supplied with flanged process connections.

A.2.4 Customer specified fork length

Table A-1: Extended Fork Lengths

Process connection	Minimum	Maximum ⁽¹⁾
$\frac{3}{4}$ -in. threaded	3.8 in. (95 mm)	118.1 in. (3000 mm)
1-in. threaded	3.7 in. (94 mm)	118.1 in. (3000 mm)
Flanged	3.5 in. (89 mm)	118.1 in. (3000 mm)
Tri Clamp	4.1 in. (105 mm)	118.1 in. (3000 mm)

(1) Maximum extended length of fork with hand-polished option is 39.4 in. (1000 mm).

A.3 Performance specifications

A.3.1 Electromagnetic Compatibility (EMC)

All versions of the Rosemount 2160 meet all relevant requirements of EN 61326.

A.3.2 Hysteresis (water)

0.1 in. (2.5 mm)

A.3.3 Switching point (water)

0.5 in. (13 mm) from fork tip if mounted vertically.

0.5 in. (13 mm) from the fork edge if mounted horizontally.

The switching point varies with different liquid densities.

A.3.4 Liquid density requirements

Minimum liquid density is 31.2 lb/ft³ (500 kg/m³).

A.3.5 Liquid viscosity range

0.2 to 10000 cP (centiPoise)

A.3.6 Humidity limits

0 to 100% relative humidity.

A.3.7 Solids content and coating

The maximum recommended diameter of solid particles in the liquid is 0.2 in. (5 mm).

Avoid bridging of forks (fork-to-fork).

A.3.8 Detection output delay

Optional output delay, programmable from 0 to 3600 seconds, to prevent false detection caused by splashing on the forks. Default delay is 1 second.

A.4 Electrical specifications

A.4.1 Wireless power module

Replaceable, intrinsically safe Lithium-Thionyl Chloride power module with PBT enclosure.

A.4.2 Power module battery life

Ten year life at one minute update rate.

Note

Reference conditions are 70 °F (21 °C), and routing data for three additional network devices. Continuous exposure to ambient temperature limits -40 °F or 185 °F (-40 °C or 85 °C) may reduce specified power module life by 20 percent.

A.4.3 Handheld communicator connections

Clips are permanently fixed to the terminal block.

A.5 Functional specifications

A.5.1 Outputs

IEC 62591 (*WirelessHART*[®]) 2.4 GHz DSSS

A.5.2 Radio frequency power output from antenna

Maximum of 10 mW (10 dBm) EIRP

A.5.3 Wireless update rate

User-selectable: from one second up to sixty minutes.

The optional integral LCD display updates at each wireless update.

A.5.4 Local display

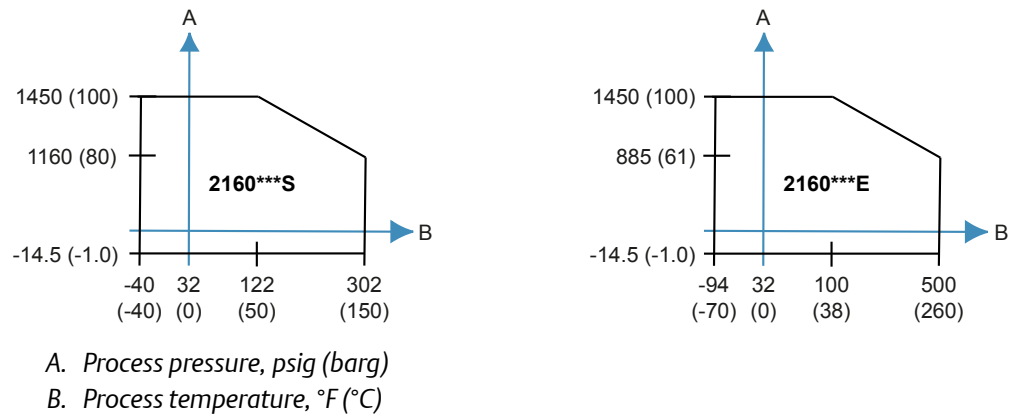
A 'locate device' function allows easy identification of instrument during commissioning inspection.

The optional five-digit integral LCD can indicate a sequence of up to four process variables (dry/wet, electronics temperature, frequency, and supply voltage) and diagnostic information.

A.6 Environmental specifications

A.6.1 Maximum operating pressures

Figure A-1: Operating Pressures



The final rating depends on the process-wetted connection.

Threaded process connection

See [Figure A-1](#).

Hygienic process connection

435 psig (30 barg)

Flanged process connection

The maximum operating pressure is the lower of the process pressure ([Figure A-1](#)) and flange pressure rating (see [Table A-2](#)).

Table A-2: Maximum Flange Pressure Rating

Flange standard	Stainless steel flanges ⁽¹⁾
ASME B16.5 Class 150	275 psig ⁽²⁾
ASME B16.5 Class 300	720 psig ⁽²⁾
ASME B16.5 Class 600	1440 psig ⁽²⁾
EN1092-1 PN 10/16	16 barg ⁽³⁾
EN1092-1 PN 25/40	40 barg ⁽³⁾
EN1092-1 PN 63	63 barg ⁽³⁾
EN1092-1 PN 100	100 barg ⁽³⁾

(1) ASTM stainless steel.

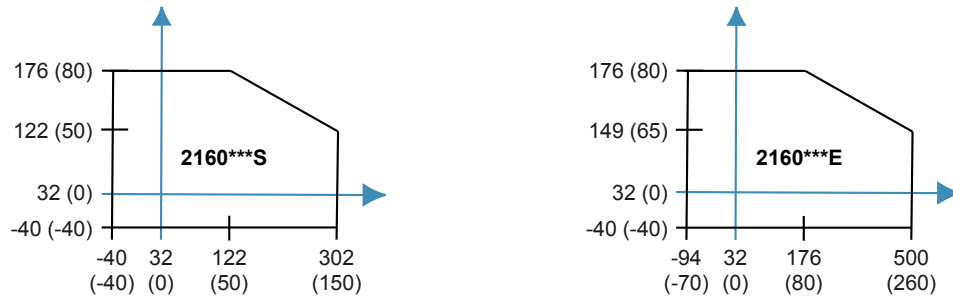
(2) At 100 °F (38 °C), the pressure rating decreases with an increasing process temperature.

(3) At 122 °F (50 °C), the pressure rating decreases with an increasing process temperature.

A.6.2 Maximum and minimum operating temperatures

See [Figure A-2](#) for the maximum and minimum operating temperatures.

Figure A-2: Operating Temperatures



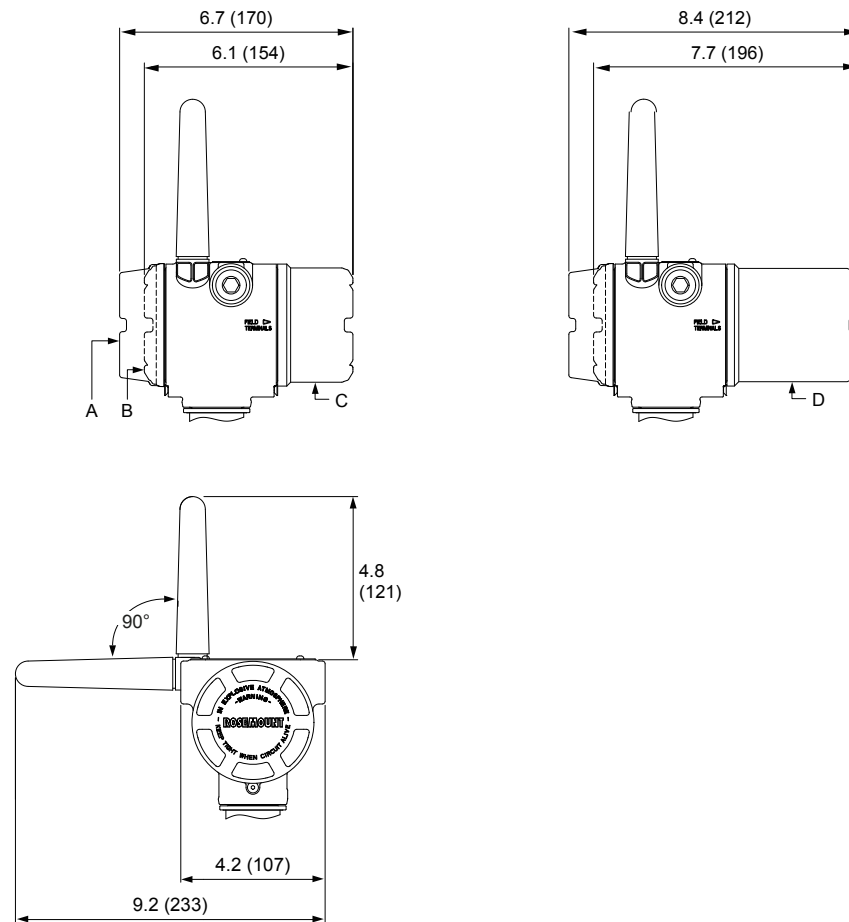
A. Ambient Temperature, °F (°C)

B. Process Temperature, °F (°C)

A.7 Dimensional drawings

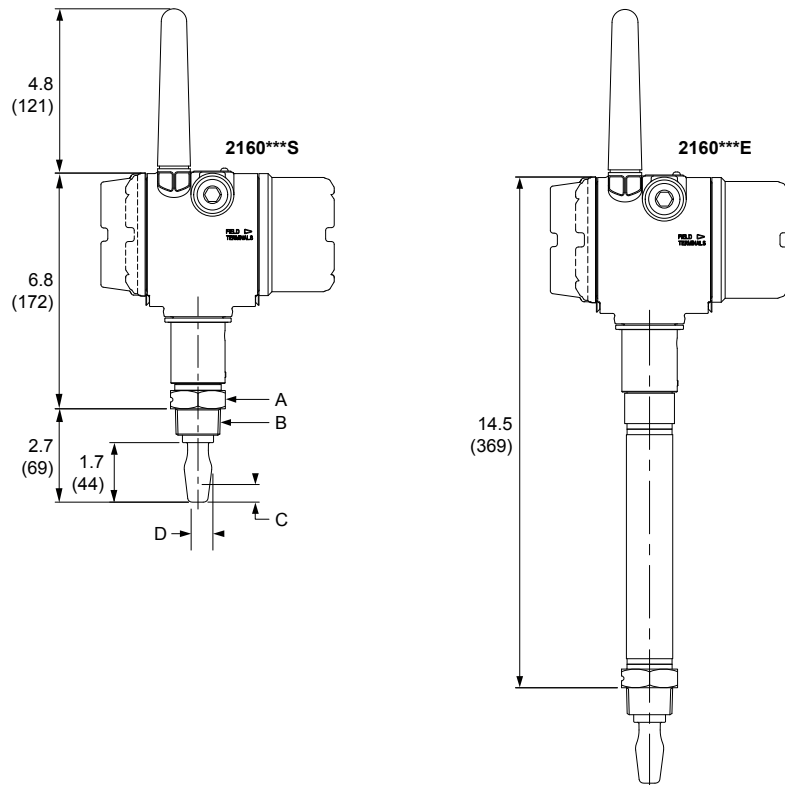
Refer to the [Type 1 Drawing](#) on the Rosemount 2160 [web page](#) for dimensions of the O-ring seal (BSPP) versions.

Figure A-3: Housing and Antenna



- A. LCD display (option M5)
- B. No LCD display
- C. Black Power Module cover (option WK1)
- D. Blue Power Module cover (option WK2)

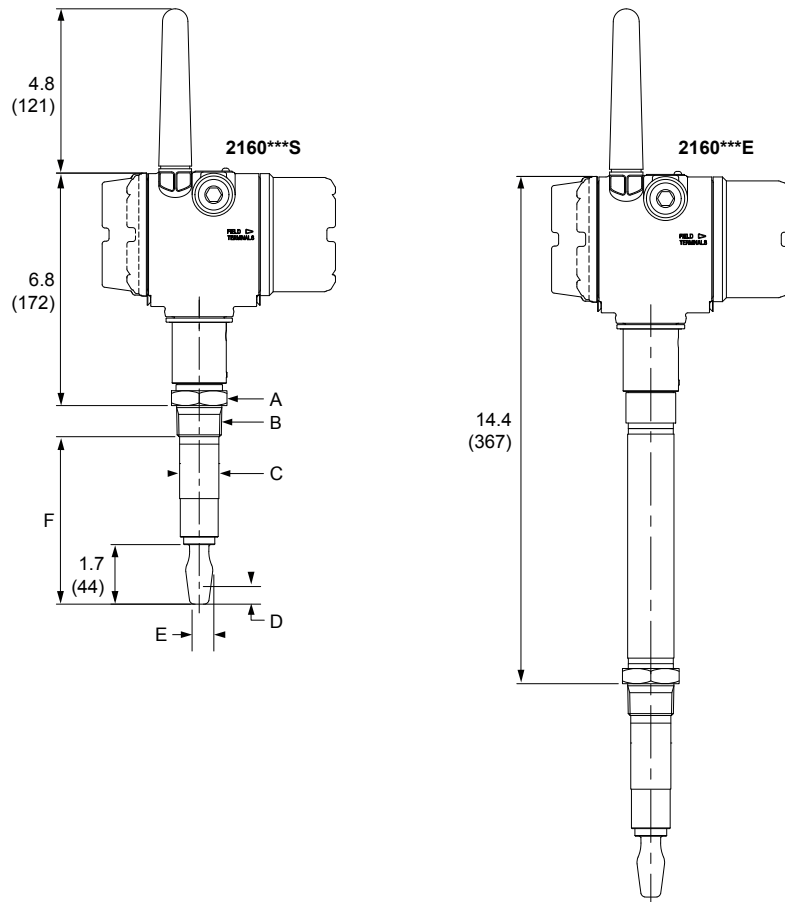
Figure A-4: Threaded Process Connections (Standard Fork Length)



- A. 1.6 (40) A/F hexagon
- B. $\frac{3}{4}$ - or 1-in. thread
- C. 0.5 (13) switchpoint (when mounted vertically)
- D. 0.5 (13) switchpoint (when mounted horizontally)

Dimensions are in inches (millimeters).

Figure A-5: Threaded Process Connections (Extended Fork Length)



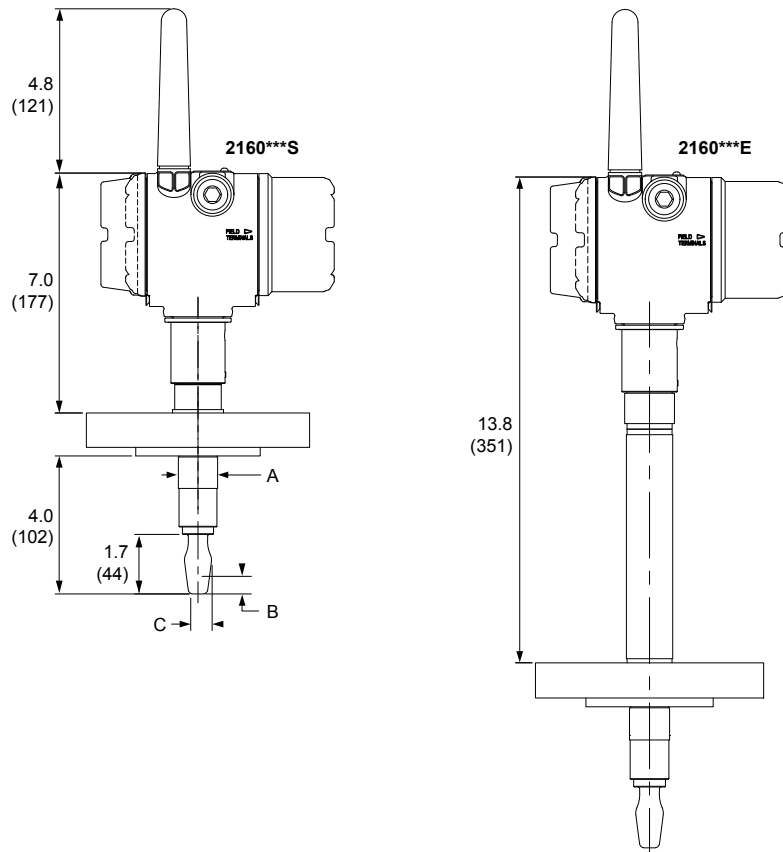
- A. 1.6 (40) A/F hexagon
- B. ¾- or 1-in. thread
- C. See [Table A-3](#) for dimensions
- D. 0.5 (13) switchpoint (when mounted vertically)
- E. 0.5 (13) switchpoint (when mounted horizontally)
- F. Customer specified fork length (see [Table A-1](#))

Dimensions are in inches (millimeters).

Table A-3: Tube Diameters

Tube material	Size	Tube diameter in inches (mm)
316/316L	¾-in.	0.9 (22.9)
	1-in.	1.125 (28.6)
Alloy C/C-276	¾-in.	0.84 (21.4)
	1-in.	1.050 (26.7)

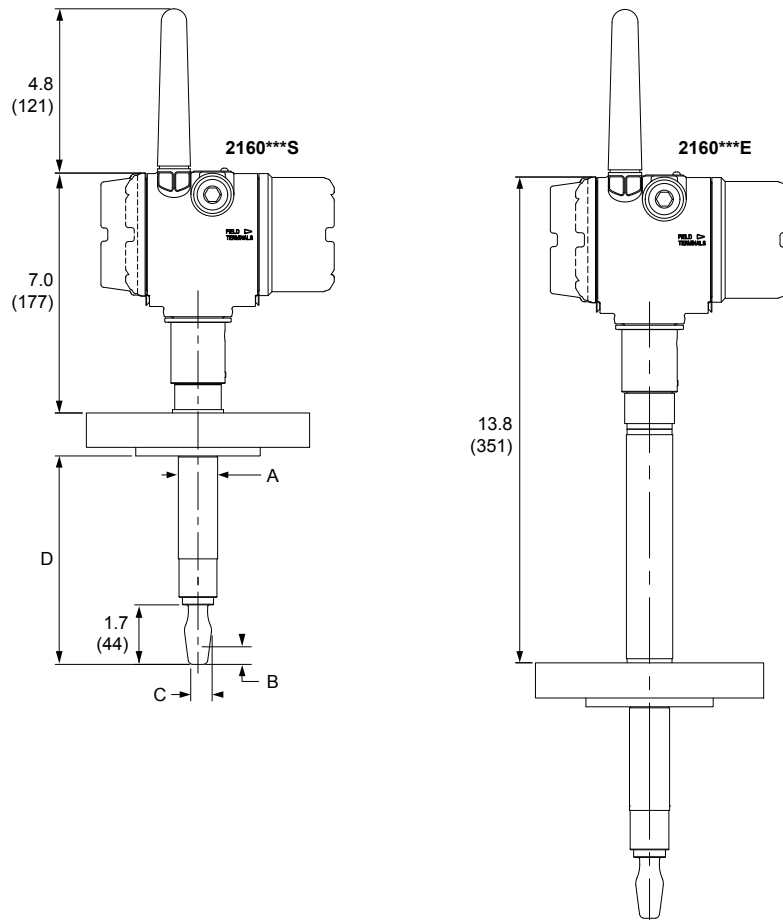
Figure A-6: Flanged Process Connections (Standard Fork Length)



- A. $\text{\O}0.9$ (23) for 1-in. flange; $\text{\O}1.14$ (29) for 1½-in. or larger flange
- B. 0.5 (13) switchpoint (when mounted vertically)
- C. 0.5 (13) switchpoint (when mounted horizontally)

Dimensions are in inches (millimeters).

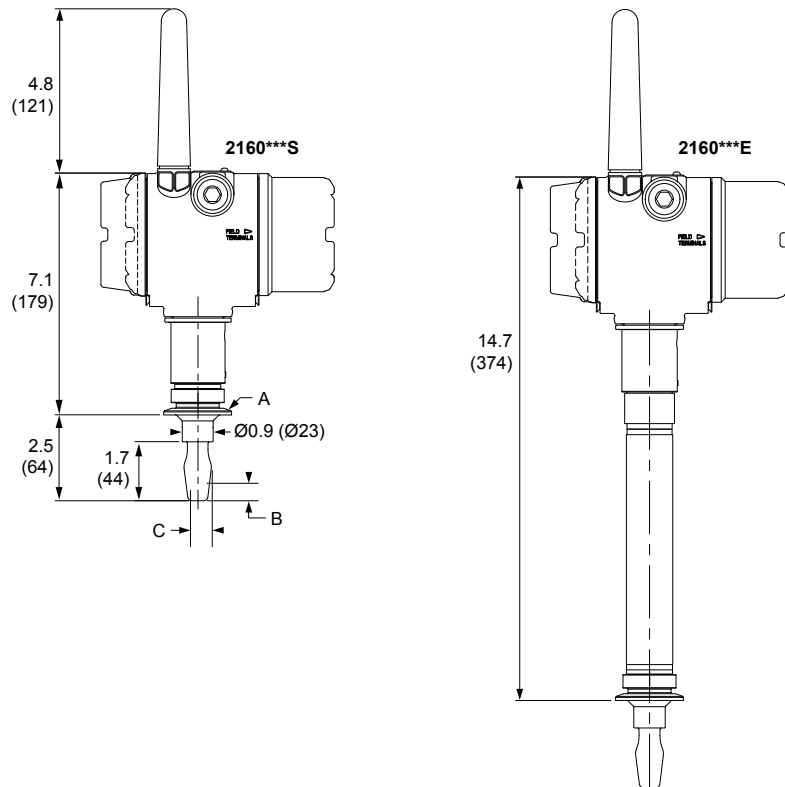
Figure A-7: Flanged Process Connections (Extended Fork Length)



- A. $\varnothing 0.9$ (23) for 1-in. flange; $\varnothing 1.14$ (29) for 1½-in. or larger flange
- B. 0.5 (13) switchpoint (when mounted vertically)
- C. 0.5 (13) switchpoint (when mounted horizontally)
- D. Customer specified fork length (see [Table A-1](#))

Dimensions are in inches (millimeters).

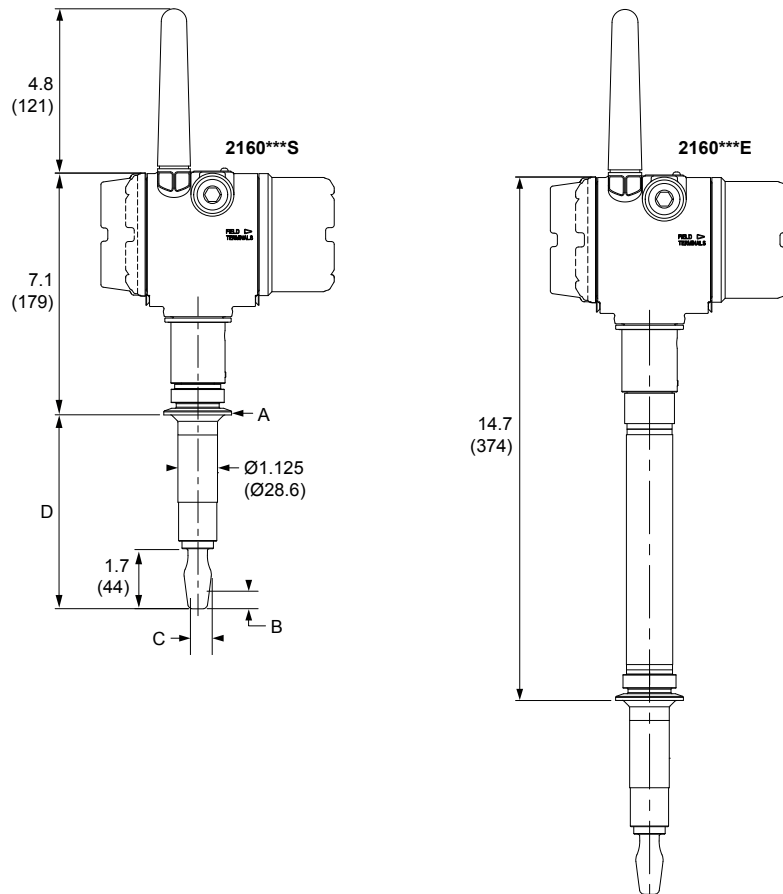
Figure A-8: Tri Clamp Process Connections (Standard Fork Length)



- A. ½-in. (38) or 2-in. (52) Tri Clamp
- B. 0.5 (13) switchpoint (when mounted vertically)
- C. 0.5 (13) switchpoint (when mounted horizontally)

Dimensions are in inches (millimeters).

Figure A-9: Tri Clamp Process Connections (Extended Fork Length)



- A. ½-in. (38) or 2-in. (52) Tri Clamp
- B. 0.5 (13) switchpoint (when mounted vertically)
- C. 0.5 (13) switchpoint (when mounted horizontally)
- D. Customer specified fork length (see [Table A-1](#))

Dimensions are in inches (millimeters).

B Configuration parameters

B.1 Manual setup

B.1.1 Wireless

Network ID

Identification number that tells the device which network it belongs to. Obtained from the network administrator.

Join key

A kind of password that the device uses to join the network. Obtained from the network administrator. All sections must contain the same number of characters.

Broadcast information

Message content

Which content (HART command) to broadcast for a message.

Message variables

Which variables that are included in the content.

Trigger mode

How message will be triggered.

Trigger level

At which level message will be triggered.

First and trigger variable

The 1st variable contained within message which also will be used to trigger a broadcast.

Triggered update rate

This defines how often the broadcast message is sent to the gateway after a user defined trigger level threshold has been crossed. Faster update rates have an impact on the total communications traffic on the network, and power module life.

Default update rate

This defines how often the broadcast message is sent to the gateway. Faster update rates have an impact on the total communications traffic on the network, and power module life.

B.1.2 Operation

Application Operation mode

The Rosemount 2160 has three operation modes:

Table B-1: Operation Modes

Option	Description
Standard	Default operation mode for no sensor fault detection.
Enhanced (Fault=WET)	Output is forced to Wet when fault detected.
Enhanced (Fault=DRY)	Output is forced to Dry when fault detected.

Sensor output delay

When the Rosemount 2160 detects a change in process conditions from wet-to-dry or dry-to-wet, the Sensor Output Delay parameter causes a delay of up to 3600 seconds before a new process condition is indicated in the process variables.

If, for example, there are waves in a tank, then the Rosemount 2160 may intermittently detect a change in process conditions. The sensor output delay ensures that the fork of the level detector is dry or wet for a period before switching.

Depending on the application, a suitable delay can prevent constant switching of the output state.

Media density

The vibration frequency of the fork sensor varies depending on the density of the process liquid. For higher accuracy of switching points, to select one of the following options:

Table B-2: Media Density Options

Option	Description
Normal	Select when the specific gravity of the process liquid is between 0.7 and 2.0.
Low	Select when the specific gravity of the process liquid is less than 0.7.
High	Select when the specific gravity of the process liquid is greater than 2.0.

Sensor Sensor stabilization time

The time needed for the fork sensor to reach a stable vibration may vary depending on the process conditions. Sensor Stabilization Time sets a delay before taking a frequency measurement.

The default setting is 60 ms. It can be set to a time in the range 20 to 1000 ms and is adjustable in 20 ms steps. Alternatively, the setting AUTO is for the Rosemount 2160 to automatically calculate a delay.

Measurement time

The time needed for the fork sensor to take an accurate measurement, after reaching a stable vibration, may vary depending on the process conditions. Measurement Time sets a delay before taking a frequency measurement.

The default setting is "60 ms". It can be set to a time in the range 20 to 1000 ms and is adjustable in 20 ms steps. Alternatively, the setting "AUTO" is for the Rosemount 2160 to automatically calculate a delay.

Allowable change in fork frequency

When the level detector is re-calibrated in the field, a comparison is made between the new dry fork frequency and original factory-set Dry Fork Frequency value. If the difference is greater than the allowable change value, the re-calibration is rejected. Check the fork for damage, corrosion, or coating, and clean the fork if necessary before re-trying.

The default setting is 100 Hz. It can be set to a value in the range 1 to 254 Hz.

Sensor fault delay

When the level detector is operating in Enhanced Mode and detects a fork sensor fault, Sensor State indicates a fault state after a delay set by Sensor Fault Delay.

The default setting is 600 seconds. It can be set to value in the range 0 to 3600 seconds.

Note

When the level detector is operating in Normal mode, a fork sensor fault is not detected and Sensor State continues to indicate a valid state.

B.1.3

Display

Display mode

The display can be configured to different display modes: Disabled, On Demand, or Periodic.

Table B-3: Display Modes

Option	Description
Disabled	The display is always turned off.
On Demand	The display is by default turned off. Selected variable screens will only appear in the end of the diagnostic button screen sequence.
Periodic	The display shows selected variable screens in a periodic sequence. A new screen will appear on each wireless update.

Display items

The optional LCD display can be configured to show up to four variables:

- Output State variable (default selection)
- Sensor Frequency variable (default selection)
- Electronics Temperature variable

- Supply Voltage variable

If more than one variable is selected, the display will toggle between the values of those variables.

B.1.4 Data logging

The level detector can store a series of 12 data collection (sample) points for a chosen device variable.

Measurement and status log

There are two alternatives for data collection:

- Log data on change - where the sampling is triggered by a changing value.
- Continuous logging - where the sampling is triggered at a regular interval (sample interval).

Configure data history

Enable data history trending by selecting **Enable Single Data Point Trending** (recommended) or **Enable Filtered Trending**.

After data history trending is enabled, select a device variable to be logged, and then the sample interval (4 to 7200 seconds).

B.1.5 Security

Write protection

The level detector can prevent changes to the configuration by activating this security function.

B.1.6 Device temperature

Temperature units

The Device Temperature menu displays the following menu items:

Electronics temp

This is the live measurement of the temperature inside the electronics housing.

Electronics temperature status

This indicates a valid or fault status for the electronics temperature measurement.

Unit

The units for temperature can be changed to Fahrenheit (°F) or Celsius (°C) using the Unit parameter.

Maximum and minimum

These show the highest and lowest temperature that has been measured by the device.

B.1.7 Device information

Tag

Identifier of up to 8 characters for the device used by host system. The tag is typically a reference number, location, or duty description.

Long tag

Identifier of up to 32 characters for the device used by host system. It is recommended to enter both a short and a long tag (they may be the same).

Descriptor

The 16-character descriptor field can be used for any purpose.

Message

The 32-character message field can be used for any purpose, such as providing details of the last configuration change.

Date

The date field can be used for any purpose, for example to save the date of the last configuration change.

Country

This can be used for any purpose and does not affect the operation of the device.

SI unit control

Allows non-SI Units to be displayed.

B.1.8 Power

Power mode

Configures the device to take periodic measurements to conserve battery life, or to take continuous measurements.

Note

Always On mode is only recommended for devices connected to line power.

Power source

Optimizes the device to make use of the power source to which it is attached.

B.2 Alert setup

B.2.1 Process alerts

Process alerts allow the Rosemount 2160 to indicate when a pre-set data point is exceeded.

Alerts can be set for the following device variables:

- Output State
- Sensor Frequency
- Electronics Temperature
- Supply Voltage

An active alert is displayed on the status screen of a host or on the optional LCD display. When the value returns within range, an alert is reset.

Mode

Select “on” to enable the alert, or “off” to switch the alert off.

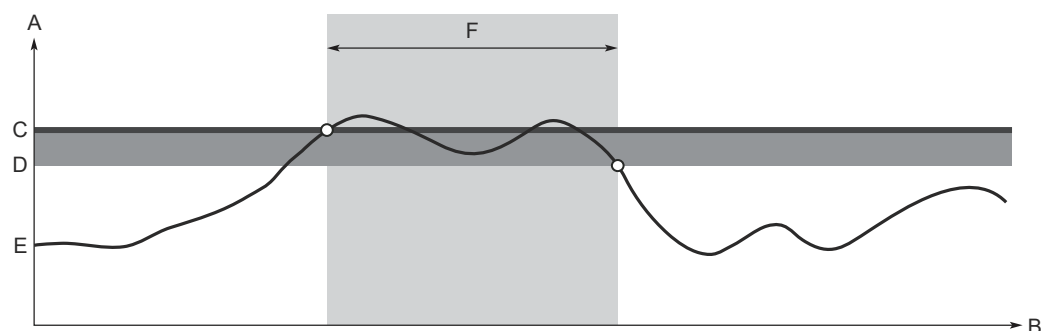
Variable

Select Output State, Sensor Frequency, Electronics Temperature, or Supply Voltage.

Direction

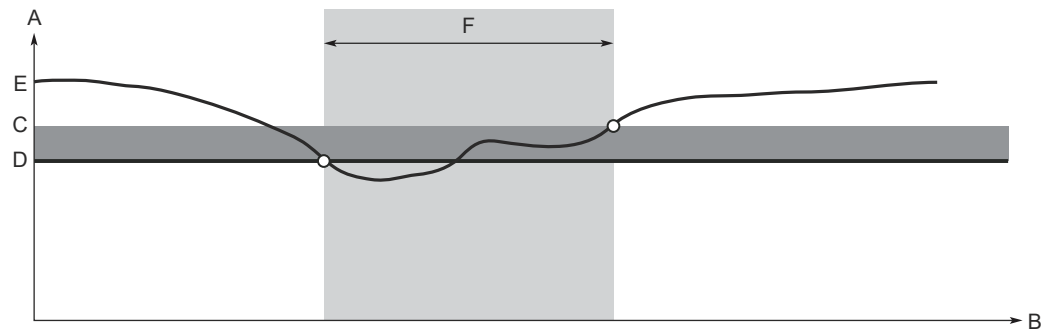
Rising alert (see [Figure B-1](#)) or falling alert (see [Figure B-2](#)).

Figure B-1: Example 1: Rising Alert



- A. Units of measurement
- B. Time
- C. Alert set point
- D. Deadband
- E. Assigned value
- F. Alert "ON"

Figure B-2: Example 2: Falling Alert



- A. Units of measurement
- B. Time
- C. Deadband
- D. Alert set point
- E. Assigned value
- F. Alert "ON"

Limit

Alert set point (in same units as the variable).

Deadband

Hysteresis data point (in same units as the variable) for transition from deadband zone to new alert state.

For more information: [Emerson.com](https://www.emerson.com)

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