Reference Manual
00809-0100-4418, Rev AF
April 2025

Rosemount™ 3408 Level Transmitter

Non-Contacting Radar with HART® Protocol



ROSEMOUNT™

EMERSON™

Safety messages

⚠ WARNING

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

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

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

For installations in hazardous locations, the transmitter must be installed according to the Rosemount 3408 Product Certifications document and System Control Drawing.

⚠ WARNING

Explosions could result in death or serious injury.

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

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

In Explosion-proof/Flameproof and Non-Incendive/Type Ex ec installations, do not remove the transmitter cover when power is applied to the transmitter.

The transmitter cover must be fully engaged to meet Explosion-proof/Flameproof requirements.

⚠ WARNING

Electrical shock could cause death or serious injury.

Ensure the mains power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure the transmitter is handled carefully. If the process seal is damaged, gas might escape from the tank.

⚠ WARNING

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

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 Equipment ratings and certifications are no longer valid on any products that have been damaged or modified without the prior written permission of Emerson.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 in 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

Hot surfaces

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



NOTICE

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.

Contents

Chapter 1 Introduction 7
1.1 Before you begin 7
1.2 Using this manual 7
1.3 NAMUR NE 53 revision history 7
1.4 Product certifications 8
1.5 Open source licenses 8
1.6 Product recycling/disposal 8

Chapter 2 Transmitter overview 9
2.1 Measurement principle 9
2.2 Process characteristics 9
2.3 Vessel characteristics 10
2.4 Non-contacting radar technology 11
2.5 Components of the transmitter 13
2.6 System integration 14

Chapter 3 Mechanical installation 15
3.1 Safety messages 15
3.2 Confirm approval type 16
3.3 Installation considerations 16
3.4 Mount the process seal antenna 21
3.5 Mount the lens antenna 22
3.6 Mount the ATAP lens antenna 24
3.7 Rotate the transmitter housing 27

Chapter 4 Electrical installation 29
4.1 Safety messages 29
4.2 Hazardous areas 30
4.3 Prepare the electrical connections 30
4.4 Connect wiring and power up 33
4.5 Optional devices 37

Chapter 5 Configuration 39
5.1 Safety messages 39
5.2 Overview 40
5.3 Configuration tools 40
5.4 Confirm correct device driver 40
5.5 Rosemount Radar Master Plus 40
5.6 AMS Device Configurator 41
5.7 Configure transmitter using guided setup 41
5.8 Wireless configuration via Bluetooth® technology 42
5.9 Run verify level 43
5.10 Multidrop communication 43
5.11 Use with the Rosemount 333 HART® Tri-Loop™ 43

5.12 Write protection 44
5.13 Advanced setup 45

Chapter 6 Operation and maintenance 47
6.1 Variable screens 47
6.2 Set up the LCD display 48
6.3 View measurement data 49
6.4 Check device status 49
6.5 Smart echo level test 51
6.6 Smart meter verification 52

Chapter 7 Service and troubleshooting 55
7.1 Safety messages 55
7.2 Diagnostic messages per NAMUR NE 107 56
7.3 Troubleshooting guides 68
7.4 Service and troubleshooting tools 83
7.5 Application challenges 92
7.6 Service support 102

Appendix A Specifications and reference data 103
A.1 Performance specifications 103
A.2 Functional specifications 105
A.3 Physical specifications 110
A.4 Dimensional drawings 112

Appendix B Configuration parameters 117
B.1 Menu tree 117
B.2 Device setup 119
B.3 Level setup 123
B.4 Alert setup 136

1 Introduction

1.1 Before you begin

NOTICE

Read this manual before working with the product. For personal and system safety and for optimum product performance, ensure that 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.

1.2 Using this manual

The sections in this manual provide information on installing, operating, and maintaining the Rosemount™ 3408 Level Transmitter – Non-Contacting Radar.

The sections are organized as follows:

Transmitter overview provides an introduction to theory of operation, a description of the transmitter, information on typical applications, and process characteristics.

Mechanical installation contains mechanical installation instructions.

Electrical installation contains electrical installation instructions.

Configuration provides instructions on configuration of the transmitter.

Operation and maintenance 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.

1.3 NAMUR NE 53 revision history

The Rosemount 3408 meets the NAMUR recommendation NE 53. See the Device Revision History document for more information.

1.4 Product certifications

See the Rosemount 3408 Product Certifications document for detailed information on the existing approvals and certifications.

1.5 Open source licenses

This device uses open source software. Further information can be found in the License Information document available at Emerson.com/Rosemount.

1.6 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.

2 Transmitter overview

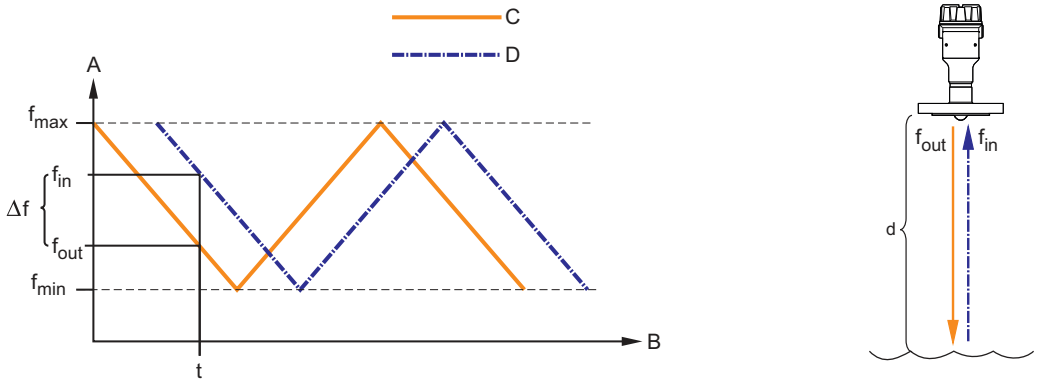
2.1 Measurement principle

The Rosemount 3408 is a device for continuous level measurements using fast-sweep Frequency Modulated Continuous Wave (FMCW) technology.

The device continuously emits signal sweeps with a constantly varying frequency towards the product surface. Since the device continuously changes the frequency of the transmitted signal, there will be a difference in frequency between the transmitted and the reflected signals (see Figure 2-1).

The frequency of the reflected signal is subtracted from the frequency of the signal transmitted at that moment, resulting in a low frequency signal which is proportional to the distance to the product surface. This signal is further processed to obtain fast, reliable, and highly accurate level measurements.

Figure 2-1: FMCW-method



Δf∼d=distance

A. Frequency (GHz)
B. Time (s)
C. Transmitted signal
D. Reflected signal

2.2 Process characteristics

2.2.1 Dielectric constant

A key parameter for measurement performance is reflectivity. A high dielectric constant of the medium provides better reflection and enables a longer measuring range.

2.2.2 Foam and turbulence

Foaming liquids or turbulence may cause weak and varying surface echo amplitudes. Surface turbulence is not normally a problem unless it is excessive.

Measurement in foamy applications depends largely on the foam properties. When the foam is light and airy, the actual product level is measured. For heavy and dense foam, the device may measure the level of the foam's upper surface.

The Double Surface Handling function allows the user to select if the foam layer or product surface should be used as output.

Related information

Process conditions
Double surface handling

2.2.3 Dust

Dust is often present in solids applications, and even if the non-contacting radar is not affected by the dust in the vapor space, dust can be sticky and create a layer on the antenna. If this layer becomes too thick, it may affect the measurement. This is best managed by using air purging.

2.2.4 Solid surface

Solids have some common characteristics which may cause weak and varying surface reflections. The surface is rarely flat or horizontal, the angle of the sloping surface differs during filling and emptying, and the dielectric constant of many solids is fairly low. Table 2-1 presents common characteristics of some solids applications.

Table 2-1: Common Characteristics of Solids Applications

Applications	Common characteristics				
	Particle size			Vapor space	
	Dust or powder	Small (<1 in.)	Larger (>1 in.)	Dust	Steam or condensation
Wood chip bins	Yes	Yes	Yes	Yes	Possible
Grain silo - small kernel grains	Yes	Yes	No	Yes	No
Grain silo - large kernel grains	No	Yes	No	No	No
Lime stone silo	No	Yes	Yes	Possible	No
Cement - raw mill silo	Yes	Yes	No	Yes	No
Cement - finished product silo	Yes	Yes	No	Yes	No
Coal bin	Yes	Yes	Yes	Yes	Yes
Saw dust	Yes	Yes	No	Yes	No
High consistency - pulp stock	No	No	No	No	Yes
Alumina	Yes	Yes	No	Yes	No
Salt	No	Yes	Yes	No	No

2.3 Vessel characteristics

2.3.1 In-tank obstructions

The device should be mounted so that objects such as heating coils, ladders, and agitators are not within the radar beam. These objects may cause false echoes resulting in reduced

measurement performance. However, the device has built-in functions designed to reduce the influence from disturbing objects where such objects cannot be totally avoided.

Vertical and inclined structures cause minimal effect since the radar signal is scattered rather than directed back to the antenna.

2.3.2 Tank shape

The shape of the tank bottom affects the measurement signal when the product surface is close to the tank bottom. The transmitter has built-in functions which optimize measurement performance for various bottom shapes.

2.4 Non-contacting radar technology

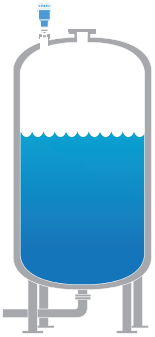
Non-contacting radar technology is ideal for a wide range of applications as it is maintenance-free, has a top-down installation that reduces the risk of leakages, and is unaffected by process conditions such as density, viscosity, temperature, pressure, and pH.

The Rosemount 3408 uses Frequency Modulated Continuous Wave (FMCW) technology and smart algorithms to maximize measurement accuracy and reliability, even in small tanks and challenging fast-filling vessels.

2.4.1 Application examples

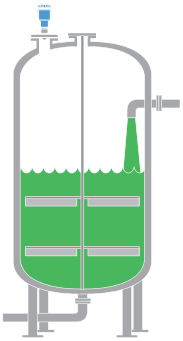
Storage tanks

Ensure correct filling and storage levels in your tanks.



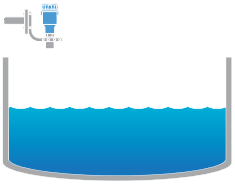
Mixing tanks

Gain insights into your process and ensure production runs smoothly without interruption.



Open air applications

Get reliable level measurements of sumps or ponds, regardless of challenging surface and weather conditions.



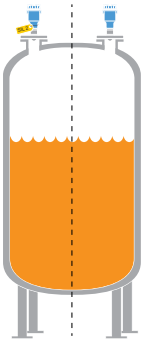
Bulk solids

The Rosemount 3408 can be used for a wide range of solid applications. It provides a reliable measurement that is unaffected by dust or low product reflectivity.



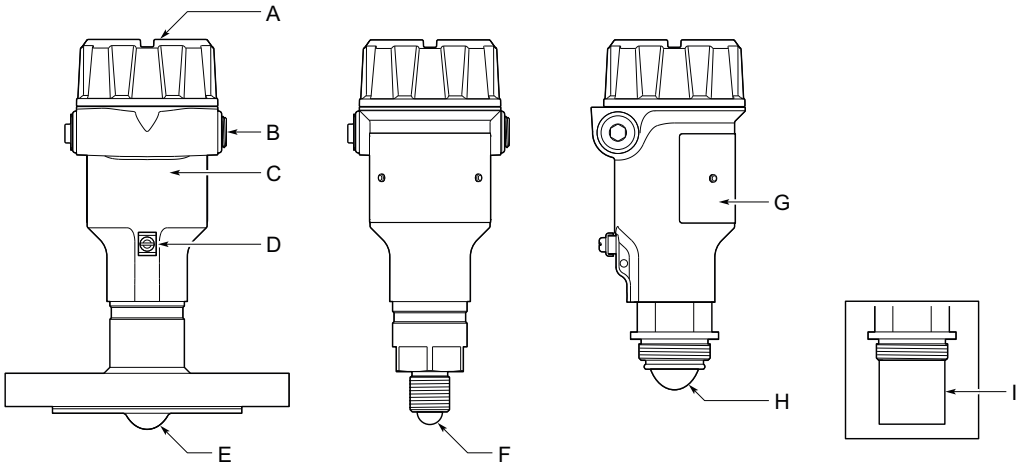
Safety applications

The Rosemount 3408 is suitable for safety applications such as overfill prevention, dry-run prevention, or level range monitoring.



2.5 Components of the transmitter

Figure 2-2: Components



A. LCD display (optional)
B. Two cable/conduit entries (½-14 NPT or M20 x 1.5)
C. Transmitter housing
D. External ground screw
E. Process seal antenna
F. Lens antenna
G. Main label
H. ATAP (Atmospheric Temperature and Atmospheric Pressure) lens antenna
I. Antenna extension for open air installations

Related information

Dimensional drawings

2.6 System integration

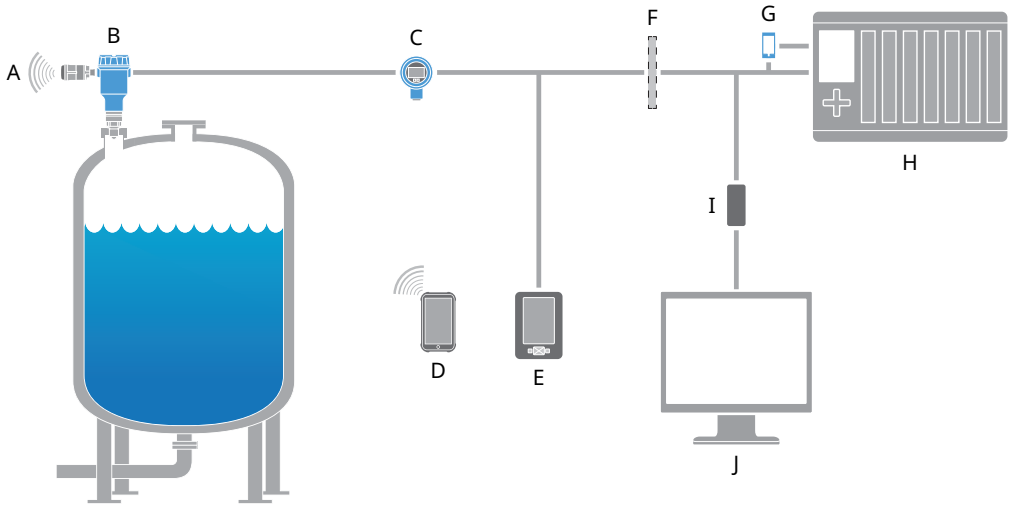
The transmitter is loop-powered, and uses the same two wires for power supply and output signal. The output is a 4-20 mA analog signal superimposed with a digital HART® signal.

By using the optional Rosemount 333 HART Tri-Loop™, the digital HART signal can be converted into three additional 4-20 mA analog signals.

With the HART protocol, multidrop configuration is possible. In this case, communication is restricted to digital, since current is fixed to the 4 mA minimum value.

The transmitter can be combined with the Emerson Wireless 775 THUM™ Adapter to wirelessly communicate HART data with IEC 62591 (*Wireless*HART®) technology. In addition, the transmitter can be connected to a Rosemount 751 Field Signal Indicator, or it can be equipped with an integral display (available with optional Bluetooth® wireless technology).

Figure 2-3: System Architecture



A. Emerson Wireless 775 THUM Adapter
B. Rosemount 3408
C. Rosemount 751
D. Wireless communication using Bluetooth® technology
E. Handheld communicator
F. Approved IS barrier (for Intrinsically Safe installations only)
G. Rosemount 333
H. Host/DCS system
I. HART modem
J. PC with Rosemount Radar Master Plus

The Rosemount 3408 is compliant with NAMUR NE 107 Field Diagnostics for standardized device diagnostic information.

3 Mechanical 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.

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For installations in hazardous locations, the transmitter must be installed according to the Rosemount 3408 Product Certifications document and System Control Drawing.

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 transmitter is consistent with the appropriate hazardous locations certifications.

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

In Explosion-proof/Flameproof and Non-Incendive/Type Ex ec installations, do not remove the transmitter cover when power is applied to the transmitter.

The transmitter cover must be fully engaged to meet Explosion-proof/Flameproof requirements.

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Electrical shock could cause death or serious injury.

Ensure the mains power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure the transmitter is handled carefully. If the process seal is damaged, gas might escape from the tank.

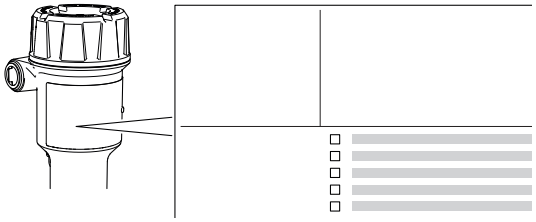
3.2 Confirm approval type

For hazardous locations transmitters labeled with multiple approval types:

Procedure

Permanently mark the checkbox of the selected approval type.

Figure 3-1: Label with Multiple Approval Types



3.3 Installation considerations

Before installing the device, follow recommendations for mounting position, sufficient free space, nozzle requirements, etc.

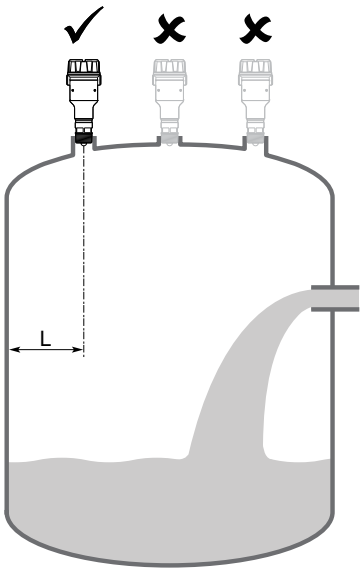
3.3.1 Mounting position

When finding an appropriate location on the tank for the device, the conditions of the tank must be carefully considered.

Consider the following guidelines when mounting the device:

- For optimal performance, the device should be installed in locations with a clear and unobstructed view of the product surface.
- The device should be mounted with as few internal structures as possible within the radar beam.
- Do not install the device in the center of the tank.
- Do not mount close to or above the inlet stream.
- Do not mount the device on a manway cover.
- Do not position the device directly over a side manway door.
- Multiple Rosemount 3408 devices can be used in the same tank without interfering with each other.

Figure 3-2: Recommended Mounting Position



3.3.2 Free space requirements

If the device is mounted close to a wall or other tank obstruction such as heating coils and ladders, noise might appear in the measurement signal. See Table 3-1 for recommended clearance.

Figure 3-3: Free Space Requirements

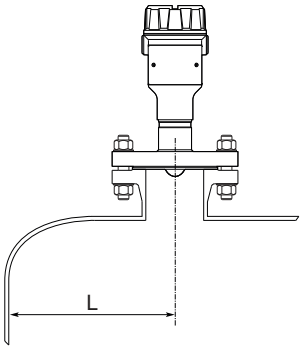


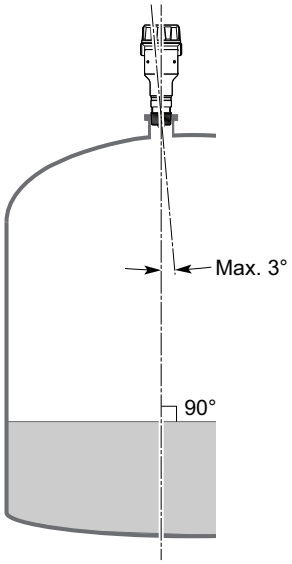
Table 3-1: Distance to Tank Wall (L)

Application	Minimum	Recommended
Liquids	8 in. (200 mm)	½ of tank radius
Solids	8 in. (200 mm)	⅔ of tank radius

3.3.3 Inclination

The device should be mounted vertically to ensure a good echo from the product surface. See Figure 3-4 for recommended maximum inclination.

Figure 3-4: Inclination



3.3.4 Non-metallic tanks

Nearby objects outside the tank may cause disturbing radar echoes. Wherever possible, the device should be positioned so that objects close to the tank are kept outside the radar beam.

3.3.5 Beam angle and beam width

The device should be mounted with as few internal structures as possible within the radar beam.

Figure 3-5: Beam Angle and Beam Width

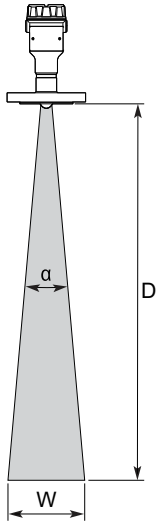


Table 3-2: Beam Angle

Antenna type	Beam angle (α)
Process seal antenna	8°
Lens antenna (¾-in. thread)	12°
Lens antenna (1- and 1½-in. threads)	9°
ATAP lens antenna	8°

Beam width

See Table 3-3 for beam width at different distances.

Table 3-3: Beam Width, ft. (m)

Distance (D)	Beam width (W)		
	α = 8°	α = 9°	α = 12°
16 (5)	2.2 (0.7)	2.5 (0.8)	3.4 (1.1)
33 (10)	4.6 (1.4)	5.2 (1.6)	6.9 (2.1)
49 (15)	6.9 (2.1)	7.7 (2.4)	10.3 (3.2)
66 (20)	9.2 (2.8)	10.4 (3.1)	13.9 (4.2)
82 (25)	11.5 (3.5)	12.9 (3.9)	17.2 (5.3)
98 (30)	13.7 (4.2)	15.4 (4.7)	20.6 (6.3)

3.3.6 Nozzle requirements

See Table 3-4 for recommended nozzle dimensions. The inside of the nozzle must be smooth (i.e. avoid bad welding, rust, or deposit).

Figure 3-6: Mounting in Nozzles

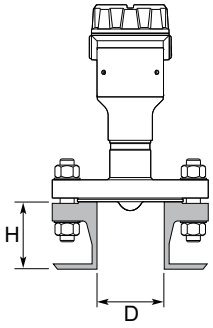


Table 3-4: Nozzle Requirements

Nozzle diameter (D)	Recommended maximum nozzle height (H)	
	Lens antenna and ATAP lens antenna	Process seal antenna
1 in. (25 mm)	3.9 in. (100 mm)	N/A
1.5 in. (40 mm)	5.9 in. (150 mm)	5.9 in. (150 mm)
2 in. (50 mm)	7.9 in. (200 mm)	19.7 in. (500 mm)
3 in. (80 mm)	11.8 in. (300 mm)	39.4 in. (1000 mm)
4 in. (100 mm)	15.8 in. (400 mm)	39.4 in. (1000 mm)
6 in. (150 mm)	23.6 in. (600 mm)	51.2 in. (1300 mm)

In some applications, especially in solids, it may be necessary to increase the Upper Null Zone to block out disturbance echoes from the tank nozzle. Amplitude threshold adjustments may also be needed.

3.3.7 Shipboard installations

Devices with aluminum housing are not approved for open deck installations; for use only in engine room, pump room, etc.

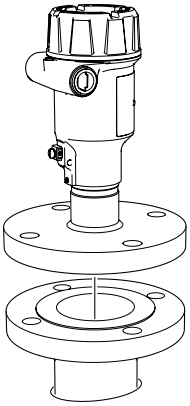
For application conditions and limitations refer to the applicable shipboard approval.

3.4 Mount the process seal antenna

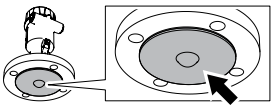
3.4.1 Mount the flanged version

Procedure

1. Lower the transmitter into the nozzle.



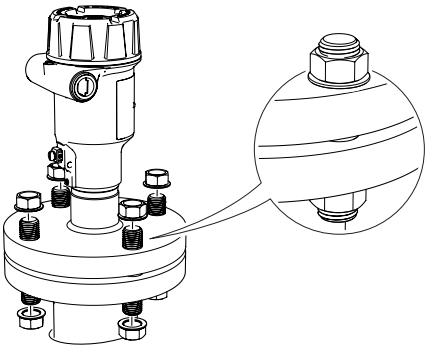
Note
Be careful not to scratch or otherwise damage the PTFE sealing.



2. Tighten the bolts and nuts (see Table 3-5).

Note

- Re-tighten after 24 hours and again after the first temperature cycle.
- Check at regular intervals and re-tighten if necessary.



3.4.2 Torque specifications

The conditions used for the calculation are:

- Standard mating metal flange
- A193 B8M Cl.2 / A4-70 bolt material
- Friction coefficient of μ=0.16

Low strength bolt and non-metallic mating flange may require lower tightening torque.

Table 3-5: Torque Values for Process Seal Antenna, lb-ft (N-m)

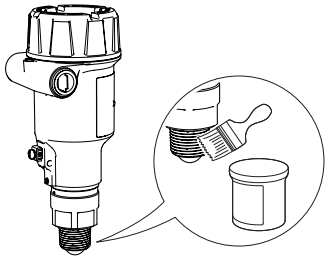
Process connection size	Process connection rating					
	ASME B16.5		EN1092-1		JIS B2220	
	Class 150	Class 300	PN16	PN40	10K	20K
2-in./DN50/50A	29 (40)	52 (70)	26 (35)	29 (40)	18 (25)	37 (50)
3-in./DN80/80A	33 (45)	48 (65)	37 (50)	41 (55)	22 (30)	70 (95)
4-in./DN100/100A	59 (80)	52 (70)	37 (50)	74 (100)	26 (35)	74 (100)
6-in./DN150/150A	66 (90)	66 (90)	74 (100)	136 (185)	74 (100)	N/A

3.5 Mount the lens antenna

3.5.1 Mount on NPT threaded connections

Procedure

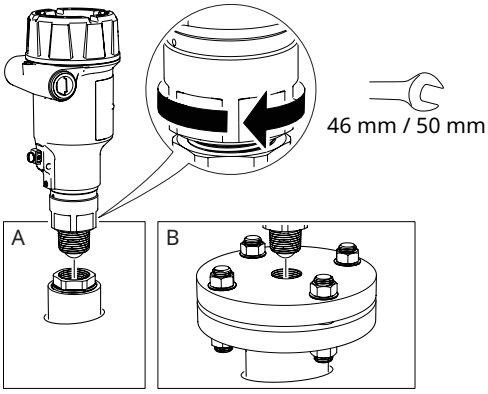
1. Apply anti-seize paste or PTFE tape on threads according to your site procedures.



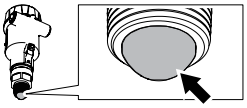
2. Mount the transmitter on the tank.

   Example

   - (A) Threaded fitting
   - (B) Threaded flange



Note
Be careful not to scratch or otherwise damage the PTFE sealing.



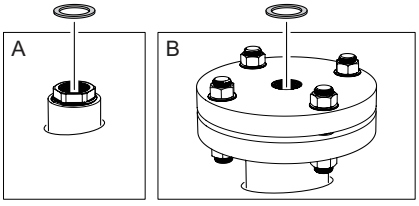
3.5.2 Mount on BSPP (G) threaded connections

Procedure

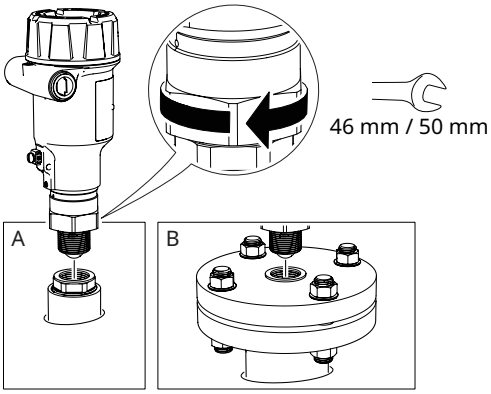
1. Place a suitable gasket on the tank nozzle.

   Example

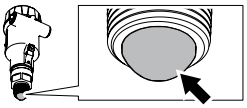
   - (A) Threaded fitting
   - (B) Threaded flange



2. Mount the transmitter on the tank.



Note
Be careful not to scratch or otherwise damage the PTFE sealing.

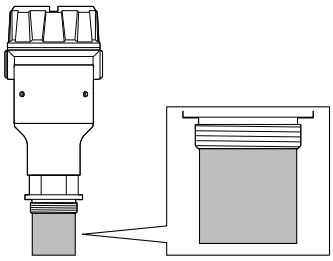


3.6 Mount the ATAP lens antenna

3.6.1 Open air installations

The antenna extension must be fitted to the transmitter to comply with open air requirements.

Figure 3-7: Antenna Extension



3.6.2 Mount the bracket

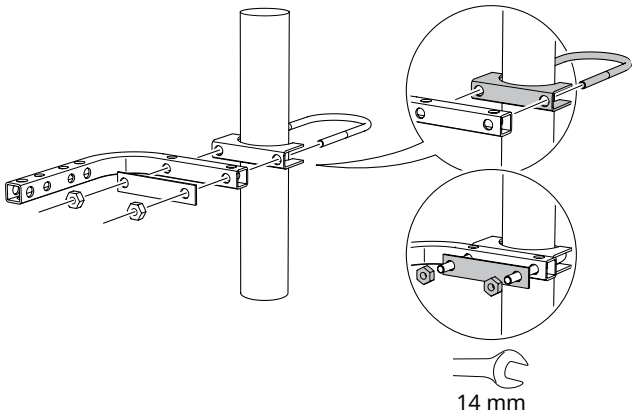
Prerequisites

Mount the bracket so that it is not susceptible to vibration.

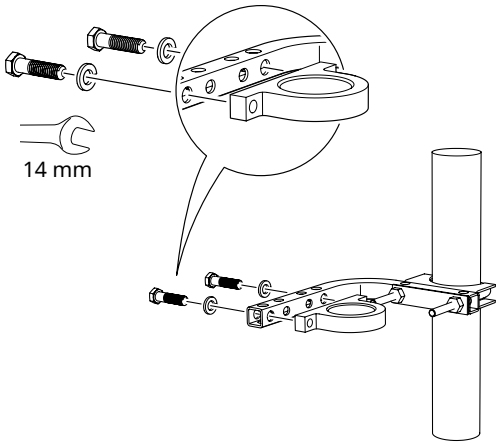
Procedure

1. Mount the bracket to the pipe/wall.

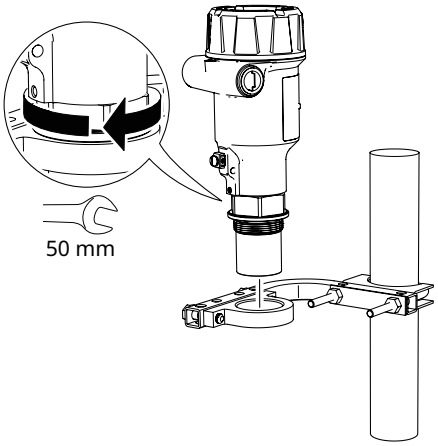
   Example



2. Mount the adapter.



3. Secure the transmitter to the adapter.



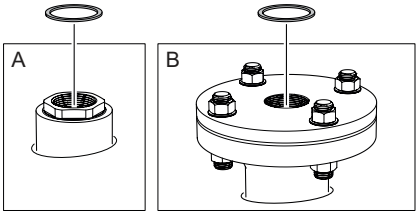
3.6.3 Mount on 1½-in. BSPP (G) threaded connections

Procedure

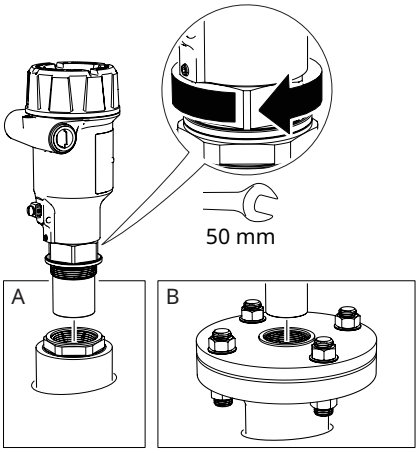
1. Place a suitable gasket on the tank nozzle.

   Example

   - (A) Threaded fitting
   - (B) Threaded flange

2. Mount the transmitter on the tank.

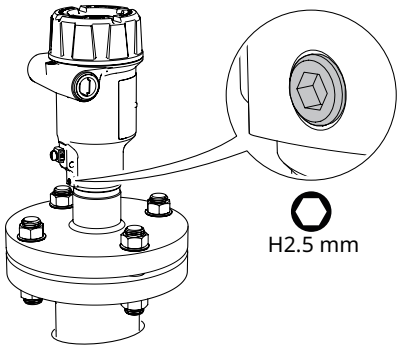
   

3.7 Rotate the transmitter housing

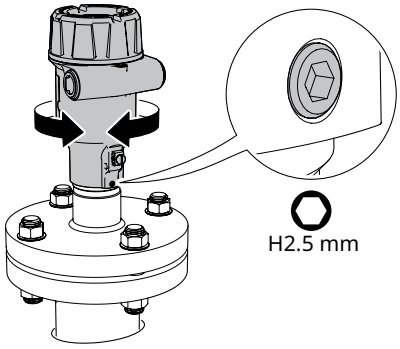
The housing can be rotated to improve field access or to better view the optional LCD display.

Procedure

1. Loosen the set screw.



2. Rotate the transmitter housing to the desired location, and then retighten the set screw.



4 Electrical installation

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 transmitter is installed by qualified personnel and in accordance with applicable code of practice.

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

For installations in hazardous locations, the transmitter must be installed according to the Rosemount 3408 Product Certifications document and System Control Drawing.

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 transmitter is consistent with the appropriate hazardous locations certifications.

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

In Explosion-proof/Flameproof and Non-Incendive/Type Ex ec installations, do not remove the transmitter cover when power is applied to the transmitter.

The transmitter cover must be fully engaged to meet Explosion-proof/Flameproof requirements.

⚠ WARNING

Electrical shock could cause death or serious injury.

Ensure the mains power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure the transmitter is handled carefully. If the process seal is damaged, gas might escape from the tank.

4.2 Hazardous areas

When the transmitter is installed in hazardous areas, local regulations, and specifications in applicable certificates must be observed.

Related information

Product certifications

4.3 Prepare the electrical connections

4.3.1 Cable selection

Use 24-16 AWG wire (0.20-1.5 mm^2). Twisted pairs and shielded wiring are recommended for environments with high EMI (electromagnetic interference).

Fine stranded conductors shall be equipped with a ferrule.

4.3.2 Cable gland/conduit

For explosion-proof/flameproof installations, only use cable glands or conduit entry devices certified explosion-proof or flameproof.

4.3.3 Internal power consumption

< 0.8 W in normal operation

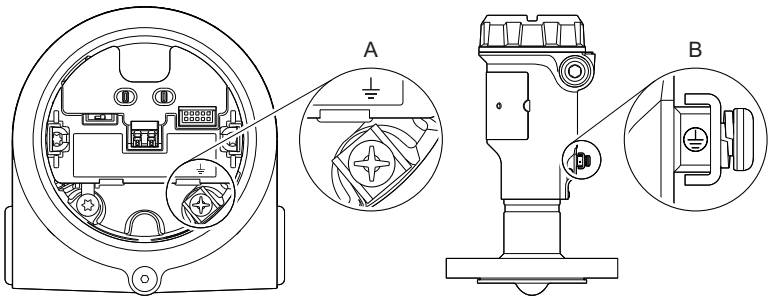
4.3.4 Grounding

Make sure grounding is done according to national and local electrical codes. Failure to do so may impair the protection provided by the equipment.

Transmitter housing

The most effective grounding method is direct connection to earth ground with minimal impedance. There are two grounding screw connections provided (see Figure 4-1).

Figure 4-1: Ground Screws



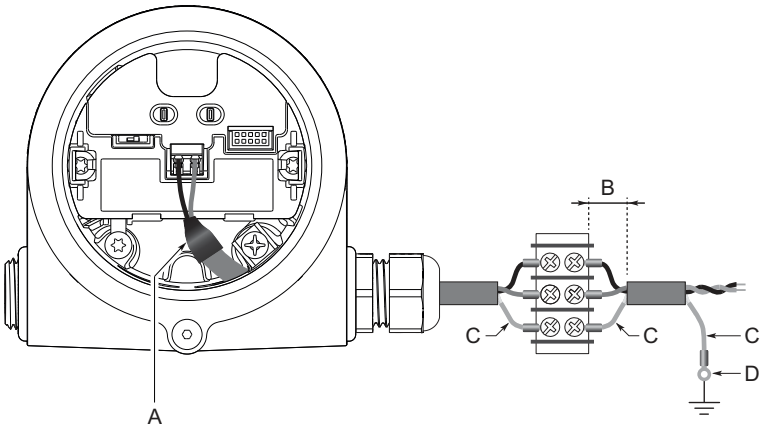
A. Internal ground screw
B. External ground screw

Cable shield grounding

Make sure the instrument cable shield is:

- Trimmed close and insulated from touching the transmitter housing.
- Continuously connected throughout the segment.
- Connected to a good earth ground at the power supply end.

Figure 4-2: Cable Shield



A. Insulate shield and drain wire
B. Minimize distance
C. Trim shield and insulate exposed drain wire
D. Connect drain wire to the power supply ground

Note
Do not ground the shield and its drain wire at the transmitter. If the cable shield touches the transmitter housing, it can create ground loops and interfere with communications.

4.3.5 Power supply

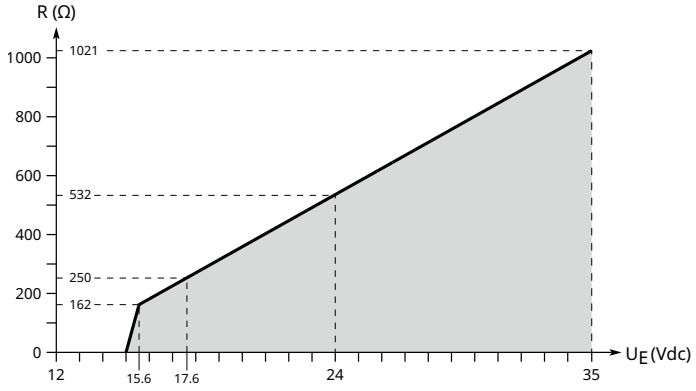
The transmitter operates on max. 35 Vdc transmitter terminal voltage and max. 22.5 mA (max. 30 Vdc in Intrinsically Safe installations).

4.3.6 Load limitations

For HART® communication, a minimum loop resistance of 250 Ω is required. Maximum loop resistance (R) is determined by the voltage level of the external power supply (U_E):

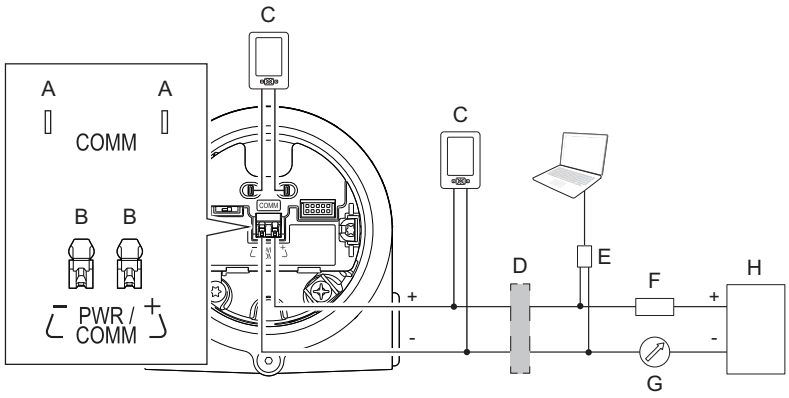
U_E (Vdc)	**R (Ω)**
≥ 15.6	$R = 44.4 \times (U_E - 12)$
< 15.6	$R = 250 \times (U_E - 15)$

Figure 4-3: Load Limits



4.3.7 Wiring diagram

Figure 4-4: 4-20 mA/HART® Communication

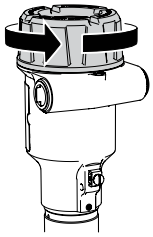


A. Communication terminals for temporary connection to HART device
B. Power/communication terminals
C. Handheld communicator
D. Approved IS barrier (for Intrinsically Safe installations only)
E. HART modem
F. Load resistance (≥250 Ω)
G. Current meter
H. Power supply

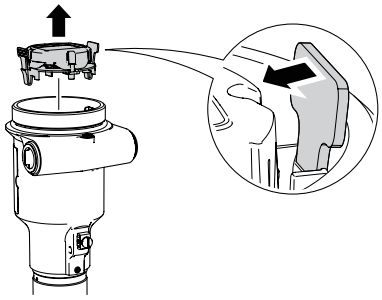
4.4 Connect wiring and power up

Procedure

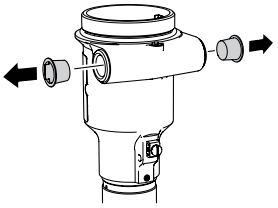
1. ⚠ Verify the power supply is disconnected.
2. Remove the cover.



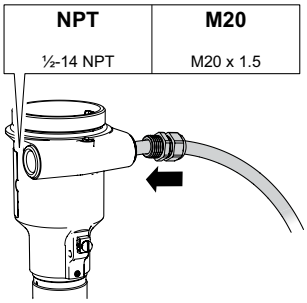
3. Remove the LCD display (if fitted).



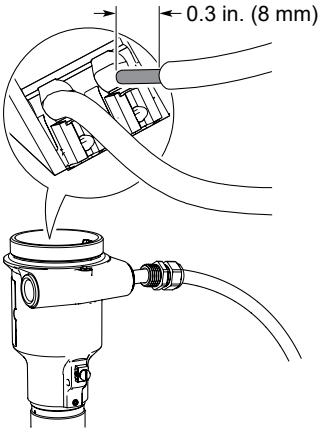
4. Remove the plastic plugs.



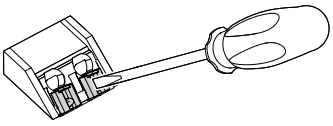
5. Pull the cable through the cable gland/conduit.
   Identification of thread size and type:



6. Connect the cable wires.

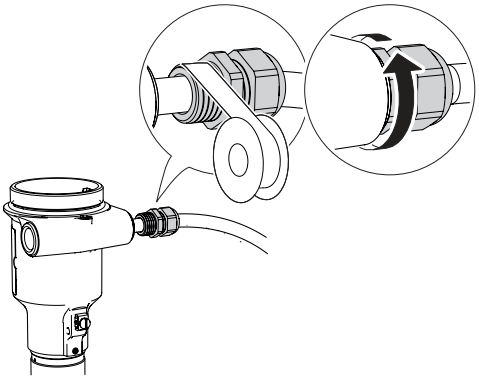


Note
When connecting a flexible (stranded) conductor, use a small screwdriver to press down and hold the terminal connection open.

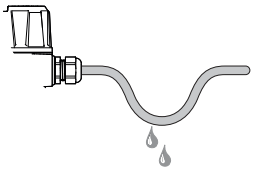


7. Ensure proper grounding.

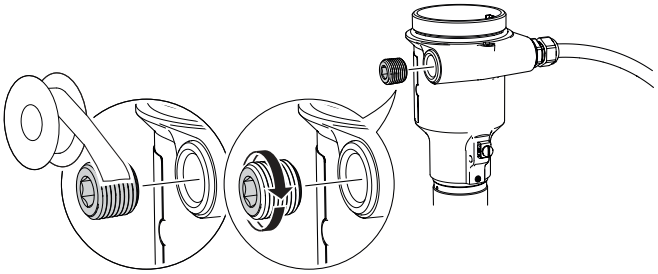
8. Tighten the cable gland.
   Apply PTFE tape or other sealant to the threads.



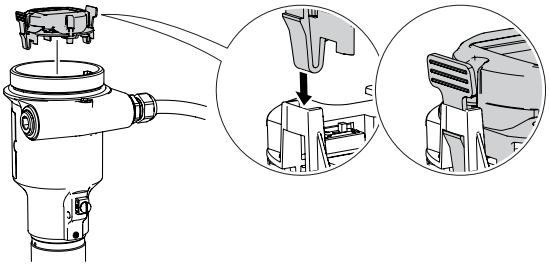
Note
Make sure to arrange the wiring with a drip loop.



9. Seal any unused port with the enclosed metal plug.
   Apply PTFE tape or other sealant to the threads.

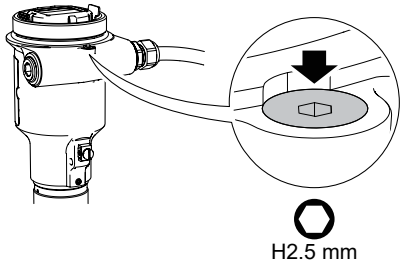


10. Insert the LCD display into the compartment until you hear a "click" sound.

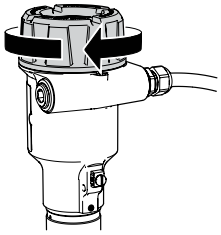


11. Attach and tighten the cover.

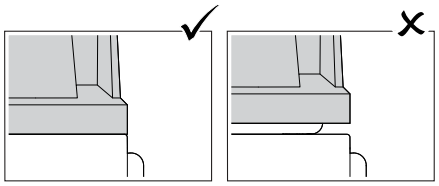
a) Verify the cover jam screw is completely threaded into the housing.



b) Attach and tighten the cover.

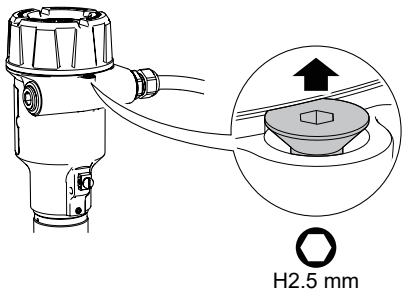


Note
Make sure the cover is fully engaged. There should be no gap between the cover and the housing.



c) Turn the jam screw counterclockwise until it contacts the cover.

Note
Required for explosion-proof/flameproof installations only.



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

12. Connect the power supply.

4.5 Optional devices

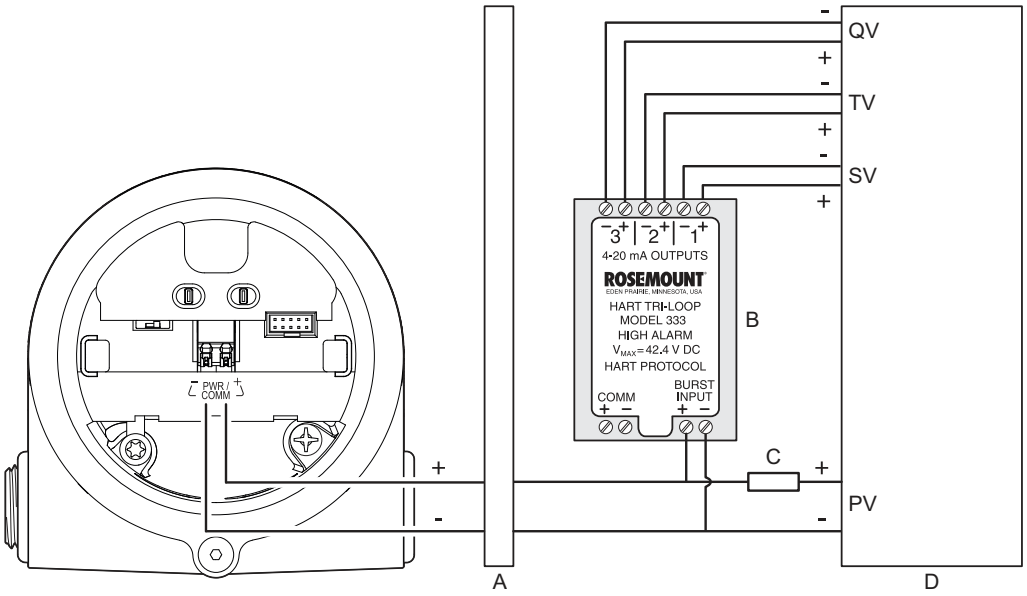
4.5.1 Rosemount 333 HART® Tri-Loop™

The Rosemount 3408 outputs a HART signal with four process variables. By using the Rosemount 333 HART Tri-Loop, up to three additional analog 4-20 mA outputs are provided.

Each Tri-Loop channel receives power from control room. Channel 1 must be powered for the Tri-Loop to operate.

The transmitter receives power from control room.

Figure 4-5: Example Installation of Rosemount 333 with Rosemount 3408



A. Approved IS barrier
B. DIN rail mounted Rosemount 333
C. Load resistance (≥250 Ω)
D. Control room

Related information

Rosemount 333 Reference Manual

5 Configuration

5.1 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 transmitter is installed by qualified personnel and in accordance with applicable code of practice.

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

For installations in hazardous locations, the transmitter must be installed according to the Rosemount 3408 Product Certifications document and System Control Drawing.

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 transmitter is consistent with the appropriate hazardous locations certifications.

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

In Explosion-proof/Flameproof and Non-Incendive/Type Ex ec installations, do not remove the transmitter cover when power is applied to the transmitter.

The transmitter cover must be fully engaged to meet Explosion-proof/Flameproof requirements.

⚠ WARNING

Electrical shock could cause death or serious injury.

Ensure the mains power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure the transmitter is handled carefully. If the process seal is damaged, gas might escape from the tank.

5.2 Overview

This chapter provides information about configuration and configuration tools. Appendix Configuration parameters provides extended information about the configuration parameters.

5.3 Configuration tools

- Field Device Integration (FDI) compliant systems
- Device Descriptor (DD) compliant systems
- Device Type Manager (DTM™) compliant systems
- Emerson's configuration tools with Bluetooth® wireless technology capabilities

5.4 Confirm correct device driver

Prerequisites

This only applies to the desktop version.

Procedure

1. Verify that the correct FDI/DD/DTM Package is loaded on your systems to ensure proper communication.
2. Download the latest FDI/DD/DTM Package from the **Device Driver Hub** page at Emerson.com/MySoftware.

5.5 Rosemount Radar Master Plus

Rosemount Radar Master Plus is the recommended tool for configuration. It is a User Interface Plug-in (UIP) that includes basic configuration options, as well as advanced configuration and service functions. An FDI compliant host, such as AMS Device Configurator, or a DTM compliant host is needed to run Rosemount Radar Master Plus.

You can also connect to Rosemount Radar Master Plus via Bluetooth® on the desktop version of AMS Device Configurator.

Related information

Emerson.com/RosemountRadarMasterPlus

5.6 AMS Device Configurator

5.6.1 Download AMS Device Configurator

Procedure

Download and install the mobile or desktop version.



Note
The mobile version requires Bluetooth® connection.

Related information

Emerson.com/AMSDeviceConfigurator

5.6.2 Add the FDI Package to AMS Device Configurator

Procedure

1. Start AMS Device Configurator.
2. At the top left, click the menu icon and select **Add Device Package**.

3. Browse to the downloaded FDI Package and select **Open**.
4. Select **Add**.
5. Select **Back**.

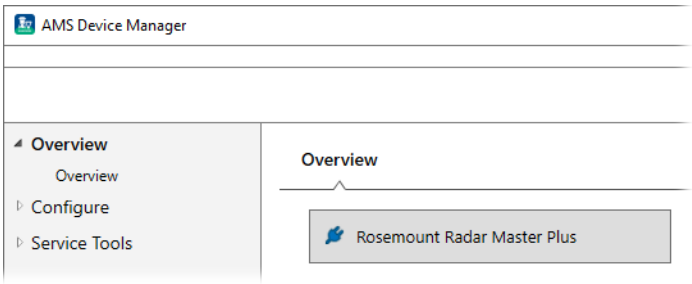
   

5.7 Configure transmitter using guided setup

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

Procedure

1. If using an FDI or DTM compliant software, then select **Overview** → **Rosemount Radar Master Plus**.

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

Related information

Save a backup file of the device configuration

5.8 Wireless configuration via Bluetooth® technology

5.8.1 Configure via Bluetooth® wireless technology

Prerequisites

Bluetooth connectivity is available for devices with option code BLE.

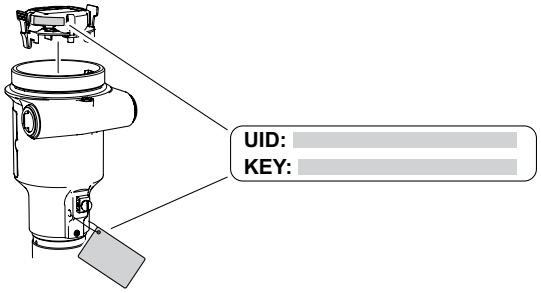
Procedure

1. Start AMS Device Configurator.
   The ***Communication Type*** dialog opens on the desktop version.
2. If using the desktop version, select **Bluetooth** as the communication type.
   This can also be changed from the **Settings** menu.
3. Click on the device you want to connect to.
4. On first connection, enter the key for this device.
5. If using the mobile version, select the menu icon at the top left to navigate the desired device menu.

Bluetooth® UID and key

You can find the UID and key on the paper tag attached to the device, and on the display unit.

Figure 5-1: Bluetooth Security Information



5.8.2 Turn off Bluetooth® wireless technology

The Bluetooth functionality is enabled by default. If you are not using this wireless capability, it is recommended to disable it using a standard device configuration tool.

Procedure

1. Select **Service Tools** → **Communication**.
2. In the **Bluetooth Radio** list, select **Disable**.

5.9 Run verify level

The Verify Level tool matches the product level reported by the device to a reference measurement (for example hand-dipping with a measurement tape).

If any difference, the Calibration Offset parameter will be adjusted. A minor adjustment using Calibration Offset is normal. There may, for example be a deviation between the actual tank height and the configured value.

Verify Level may also be run in an empty tank. Besides the offset calibration, it includes some setup of the signal processing such as registration of disturbance echoes.

Note
Verify Level will not register any disturbance echoes in the solids measurement mode.

Prerequisites

If there is product in the tank, then ensure that:

- The product surface is calm.
- The tank is not being filled or emptied.
- The actual level is well above the tank bottom.

Procedure

1. Select **Configure** → **(Guided Setup)** → **Verify Level**.
2. Follow the on-screen instructions.

Related information

Calibration offset

5.10 Multidrop communication

Multidropping transmitters refers to the connection of several transmitters to a single communications transmission line. Communication between the host and the transmitters takes place digitally with the analog output of the transmitters deactivated.

5.10.1 Establish multidrop communication

In multidrop communication, each transmitter in the loop must have a unique HART address.

Procedure

1. Select **Configure** → **(Manual Setup)** → **Device Setup** → **HART**.
2. Select **Change Address** (not applicable to Rosemount Radar Master Plus).
3. Enter the desired HART address.
4. Ensure that **HART Multidrop** is selected.

5.11 Use with the Rosemount 333 HART® Tri-Loop™

To prepare the transmitter for use with a Rosemount 333 HART Tri-Loop, the transmitter must be configured to Burst Mode and the process variable output order must be set.

Prerequisites

The operational mode on the Rosemount 3408 must be set to Control/Monitoring when used with the Rosemount 333 HART Tri-Loop.

Burst Mode configuration is possible via host systems supporting Device Descriptors (DD).

Procedure

1. Make sure the transmitter is properly configured.
2. If desired, change the measurement units.
    a) Select **Configure** → **Manual Setup** → **Device Setup** → **Units**.
3. Set the desired device variable to use for Primary Variable (PV), Secondary Variable (SV), Third Variable (TV), and Fourth Variable (QV).
    a) Select **Configure** → **Manual Setup** → **Device Setup** → **HART**.
    b) Under ***Variable Mapping***, select variables for PV, SV, TV, and QV.
4. Set the Rosemount 3408 to Burst Mode.
    a) Select **Configure Burst Mode**.
    b) Select **View/Configure Message 1**.
    c) Under ***Message 1 Broadcast***, select **Wired HART Enabled**.
    d) Under ***Burst Command***, select **PV, SV, TV, QV**, and then select **Next**.
    e) Under ***Burst Msg Trigger Mode***, select **Continuous**, and then select **Next**.
    f) Set the Update Period, and then select **Finish**.
5. Prior to exiting the configuration, note the selected variables for SV, TV, and QV, and the units set for each of the variables. The same configuration must be used for the Rosemount 333.

Related information

Rosemount 333 Reference Manual

5.12 Write protection

The Rosemount 3408 supports both software and hardware write protection.

5.12.1 Write protect a transmitter

The transmitter can be write protected (with or without a password) to prevent unauthorized changes.

Prerequisites

If the transmitter is configured for use in Safety (SIS) operational mode, then the Safety Mode must be enabled for the transmitter to become operational. When Safety Mode is enabled, the transmitter is write protected to prevent unauthorized changes.

Procedure

1. Select **Overview** → **Device Information** → **Alarm and Security**.
2. Under ***Security***, select **Change Write Protection** and follow the on-screen instructions.

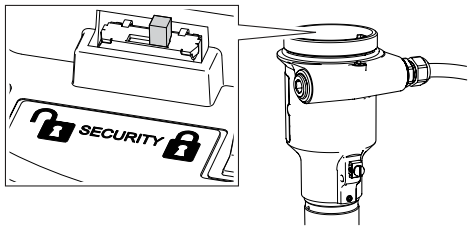
5.12.2 Set the position of the security switch

The security switch is located inside the transmitter housing (accessible after removing the housing cover and display unit).

Procedure

Slide the security switch to the preferred position.

In the locked (🔒) position, all writes to the transmitter are rejected.



5.13 Advanced setup

5.13.1 Sweep mode

The device has two sweep modes:

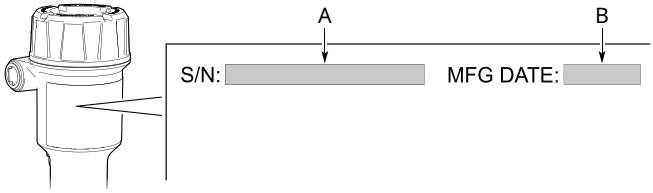
- Mode 1 (77-81 GHz)
- Mode 2 (76-77 GHz)

Sweep mode impacts metrological properties. Use mode 2 only if required by local radio spectrum regulations in your country. The default setting is mode 1.

5.13.2 Change the sweep mode

Contact your local Emerson representative for further instructions. You need to provide the manufacturing date and serial number.

Figure 5-2: Main Label



A. Serial number
B. Manufacturing date

6 Operation and maintenance

6.1 Variable screens

The transmitter can display the following variables:

Table 6-1: LCD Display Variables

Parameter	Presentation on display	Description
Level	LEVEL	The current level measurement value.
Distance	DISTANCE	Distance from the upper reference point to the product surface.
Level rate	LEVEL RATE	The current velocity at which the level is moving. A positive value indicates the surface is moving up.
Signal strength	SIG STRENGTH	The signal amplitude of the surface echo.
Volume	VOLUME	Volume of the product at the current level.
Electronics temperature	ELECTRONICS	The current temperature at the electronics.
Signal quality(1)	SIGNAL QUALITY	The quality of product surface echo signal compared to surface threshold and noise.
Scaled variable(1)	SCALED VARIABLE(2)	A variable calculated from a scaling table (as defined by pairs of input/ scaled values).
Percent of range primary variable	% OF RANGE PV	A variable value expressed in percent within a range defined by a Lower Range Value (LRV) and an Upper Range Value (URV).
Auxiliary percent of range	% OF RANGE AUX	A variable value expressed in percent within a range defined by the lower and upper range values (0% Auxiliary and 100% Auxiliary).
User defined variable(1)	USER DEFINED(2)	A variable associated with a selected register in the device.
Loop current	ANALOG OUT	Loop current as perceived by the device.

(1) Only for transmitters ordered with Smart Diagnostics Suite or Smart Meter Verification (professional).
(2) Default, user selectable display text (up to 14 characters).

Related information

User defined variable setup

6.2 Set up the LCD display

6.2.1 Select the display variables

It is possible to specify the variables to be presented on the optional LCD display.

Procedure

1. Select **Configure** → **(Manual Setup)** → **Device Setup** → **Display**.
2. Select the desired variables to be displayed on the LCD display.

6.2.2 Change the display language

Procedure

1. Select **Configure** → **(Manual Setup)** → **Device Setup** → **Display**.
2. In the **Display Language** list, select the desired language.

6.2.3 Rotate the display

The LCD display can be rotated 180 degrees.

Procedure

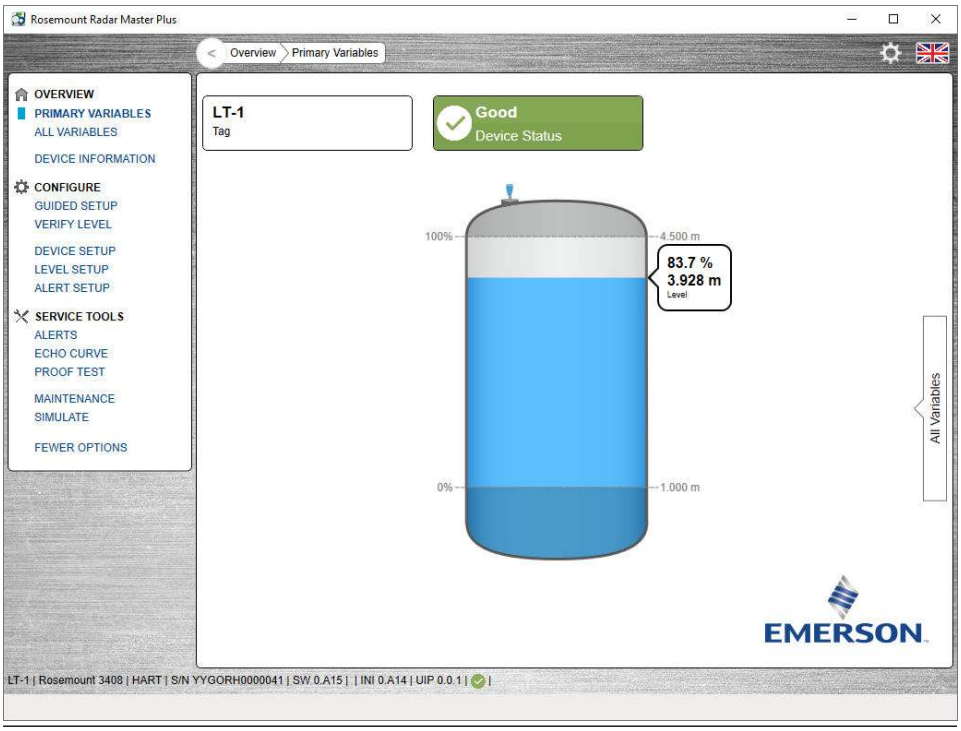
1. Select **Configure** → **(Manual Setup)** → **Device Setup** → **Display**.
2. In the **Display Orientation** list, select **0 deg** or **180 deg**.

6.3 View measurement data

Procedure

1. Select **Overview** → **Primary Variables**.

Figure 6-1: Overview Screen in Rosemount Radar Master Plus



2. Optional: Select **Overview** → **All Variables** (**Service Tools** → **Variables** in DD).

6.3.1 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.

6.4 Check device status

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**.

Related information

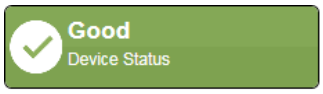
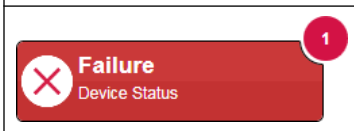
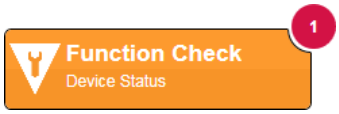
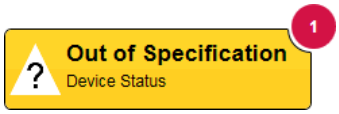
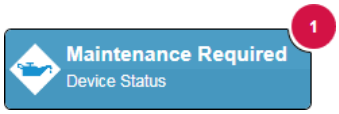
Diagnostic messages per NAMUR NE 107

6.4.1 Device status images

Table 6-2: Device Status Images in DD

Device status image	Category	Description	Action
	Good	No active alert.	N/A
	Failure	At least one Failure alert is active.	Click the **Troubleshoot** button to open a window with active alerts together with recommended actions.
	Function Check	At least one Function Check alert is active (and no Failure alerts).	Click the **Investigate** button to open a window with active alerts together with recommended actions.
	Out of Specification	At least one Out of Specification alert is active (and no Failure or Function Check alerts).	
	Maintenance Required	At least one Maintenance Required alert is active (and no Failure, Function Check, or Out of Specification alerts).	

Table 6-3: Device Status Images in UIP (Rosemount Radar Master Plus)

Device status image	Category	Description	Action
	Good	No active alert.	N/A
	Failure	At least one Failure alert is active.	Click the device status image to open a window with active alerts together with recommended actions.
	Function Check	At least one Function Check alert is active (and no Failure alerts).	
	Out of Specification	At least one Out of Specification alert is active (and no Failure or Function Check alerts).	
	Maintenance Required	At least one Maintenance Required alert is active (and no Failure, Function Check, or Out of Specification alerts).	

6.5 Smart echo level test

The function allows you to test the behavior of the transmitter in a real tank environment without raising the level. During the test, a virtual surface echo is superimposed onto the radar signal, and the transmitter will output a level corresponding to the echo position.

The test verifies the integrity of the signal processing, and can be used to test the alarm limits in the host system, output of the transmitter, and transmitter configuration (for example the upper/lower range values).

6.5.1 Configure the smart echo level

Prerequisites

This test is available for transmitters with:

- Option code ET, MV, or QT
- Rosemount Radar Master Plus

Procedure

1. Select **Service Tools** → **Proof Test**.
2. Select **Configure Smart Echo**.
3. In the **Smart Echo Level** box, enter the desired value.
4. Select **Save**.

6.5.2 Perform a smart echo level test

During the test, a virtual surface echo is superimposed onto the radar signal, and the transmitter will output a level corresponding to the echo position.

Prerequisites

Prior to and during the test, ensure that:

- The product surface is calm.
- The smart echo level is not closer than 1 ft. (0.3 m) to the liquid surface (1.6 ft. [0.5 m] when measuring solids).
- The tank is not being filled or emptied.
- There are no disturbance echoes nearby.

⚠ WARNING

During the proof test, the transmitter will not output measurement values corresponding to the product surface level. Ensure systems and people relying on measurement values from the transmitter are made aware of the changed conditions. Failure to do so could result in death, serious injury and/or property damage.

Procedure

1. Select **Service Tools** → **Proof Test**.
2. Select **Smart Echo Level Test**.
3. Select **Start** and follow the on-screen instructions.

Postrequisites

When you have finished testing, select **Stop** to return to normal operation.

Related information

Simulation/test active

6.6 Smart meter verification

Smart Meter Verification is an automatic diagnostic tool that monitors the entire transmitter's performance and integrity without interrupting the process. The results of this diagnostic provide a pass/fail summary report helping you to quickly identify and resolve potential issues. Configuration changes since previous verification are tracked to verify consistency of the device setup.

The Smart Meter Verification functionality can be scheduled to run at defined intervals, or it can be initiated on demand. Enabling the Signal Quality Alert offers an additional layer of assurance through continuous measurement health monitoring.

6.6.1 Supported features

Table 6-4: Basic vs Professional

Feature	Basic	Professional (option code MV)
Manually initiated verification	✓	✓
Schedule verification	–	✓
Previous verifications stored	1	20
Printable report	–	✓
Continuous measurement health monitoring	(✓)(1)	✓

(1) Only for transmitters ordered with Smart Diagnostics Suite (includes Signal Quality Alert).

6.6.2 Perform smart meter verification

Procedure

1. Select **Service Tools** → **Verification**.
2. Under ***Manual Verification***, select **Perform Verification** and follow the on-screen instructions.

Need help?

1. If the verification fails, check device status.
2. Resolve any active alerts, and then re-run verification.

Related information

Check device status

6.6.3 Verification result

The verification result is categorized into seven diagnostics categories. Each category will have a pass/fail result. All must pass for the verification to pass. There may be other active alerts in the device that do not affect the result.

Table 6-5: Verification Details

Diagnostics category	Standard diagnostics
Transmitter/electronics	Startup failure
Transmitter/electronics	Electronics failure, transmitter
Transmitter/electronics	Electronics temperature out of limits
Radar signal	Radar signal failure
Sensor	Electronics failure, sensor module
Memory	Device memory failure
Firmware	Software error
Configuration	Configuration error
Configuration	Simulation/test active
Configuration	Safety mode not activated
Configuration	Linearized variable out of range
Configuration	Dielectric constant estimation degraded
Auxiliary	Low signal quality (if enabled and configured)

Related information

Diagnostic messages per NAMUR NE 107

Level detected

The Level Detected parameter indicates whether the device detected a level while performing the verification. This parameter does not affect the verification result.

6.6.4 Summary report

After completing the verification, you can save or print a time-stamped summary report for future reference or troubleshooting purposes. The report includes the pass/fail results, configuration changes since previous verification together with a check sum.

6.6.5 Schedule automatic verification

Procedure

1. Select **Service Tools** → **Verification**.
2. Under ***Automatic Verification***, select **Schedule Verification** and follow the on-screen instructions.

7 Service and troubleshooting

7.1 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 transmitter is installed by qualified personnel and in accordance with applicable code of practice.

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

For installations in hazardous locations, the transmitter must be installed according to the Rosemount 3408 Product Certifications document and System Control Drawing.

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 transmitter is consistent with the appropriate hazardous locations certifications.

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

In Explosion-proof/Flameproof and Non-Incendive/Type Ex ec installations, do not remove the transmitter cover when power is applied to the transmitter.

The transmitter cover must be fully engaged to meet Explosion-proof/Flameproof requirements.

⚠ WARNING

Electrical shock could cause death or serious injury.

Ensure the mains power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure the transmitter is handled carefully. If the process seal is damaged, gas might escape from the tank.

7.2 Diagnostic messages per NAMUR NE 107

7.2.1 Electronics failure, transmitter

Category Failure

Cause

An electronics error has occurred.

The device measurement reading is invalid.

Recommended actions

1. Restart the device.
2. If the condition persists, replace the transmitter electronics.

Related information

Restart the device

7.2.2 Electronics failure, sensor module

Category Failure

Cause

An electronics error has occurred.

The device measurement reading is invalid.

Recommended actions

1. Restart the device.
2. If the condition persists, replace the transmitter electronics (or the device).

Related information

Restart the device

7.2.3 Device memory failure

Category Failure

Cause

A device memory error has occurred.

The device measurement reading is invalid.

Recommended actions

1. Restore default settings, restart device, and reconfigure the device.
2. If the condition persists, replace the device.

Related information

Restore to default settings
Restart the device
Configure transmitter using guided setup

7.2.4 Radar signal failure

Category Failure

Cause

The received radar signal is invalid resulting in an invalid device measurement reading.

Recommended actions

1. Clean the antenna.
2. If the condition persists, replace the device.

7.2.5 Startup failure

Category Failure

Cause

Device repeatedly failed to start up with user configuration settings.

The device measurement reading is invalid.

Recommended actions

1. Check supply voltage is within range and restart device.
2. Restore default settings, restart device, and reconfigure the device.
3. If the condition persists, replace the device.

Related information

Power supply
Restore to default settings
Restart the device
Configure transmitter using guided setup

7.2.6 Software error

Category Failure

Cause

The software in the device encountered a problem and stopped running which may cause an invalid measurement reading.

In some cases, problems may be caused by temporary environmental conditions (e.g. electromagnetic interferences) and not observed again.

Recommended actions

1. Restart the device.
2. Restore default settings and reconfigure the device.
3. If the condition persists, replace the device.

Related information

Restart the device
Restore to default settings
Configure transmitter using guided setup

7.2.7 Level measurement lost

Category Failure

Cause

No valid level reading. Reasons may be multiple:

- No valid surface echo peak in the measuring range.
- Incorrect device configuration.

Recommended actions

1. Analyze the Echo Curve at time of loss for reason and check device configuration, especially thresholds.
2. Check device physical installation (for instance antenna contamination).
3. Consider increasing Measurement Recovery Time parameter for intermittent conditions.
4. Restart the device.
5. Restore default settings and reconfigure the device.
6. If the condition persists, replace the device.

Related information

Read the echo curve
Amplitude threshold
Measurement recovery time
Restart the device
Restore to default settings
Configure transmitter using guided setup

7.2.8 Configuration error

Category Failure

Cause

The device has detected a configuration error. Reasons may be multiple.

Recommended actions

1. Click the **Details** button for more information.
2. Correct the parameter causing the error.

Volume configuration error

Cause

The volume cannot be calculated correctly with the current configuration.

Recommended actions

1. If strapping table is used, check that level-volume values are entered in increasing order.
2. If strapping table is used, check that number of strapping points to use is correct.
3. If tank dimensions are used for volume, check that geometry shape and size measures are correct.
4. If condition persists, restore default settings and reconfigure the device.

Related information

Volume
Geometry
Restore to default settings
Configure transmitter using guided setup

Scaled variable configuration error

Cause

The Scaled Variable configuration is incorrect.

Recommended actions

1. Check that the value pairs in the scaled variable table are entered in increasing order.
2. Check the number of table points to use is correct.
3. If condition persists, restore default settings, and reconfigure the device.

Related information

Scaled variable
Restore to default settings
Configure transmitter using guided setup

Geometry configuration error

Cause

The configured tank geometry results in a too large level measuring range for this device.

Recommended actions

1. Check tank geometry configuration and reduce Reference Height.
2. If condition persists, restore default settings and reconfigure the device.

Related information

Reference height
Restore to default settings
Configure transmitter using guided setup

Primary variable configuration error

Cause

The Primary Variable selection is not supported.

Note
The IEC 61508 certified version only supports level or distance as Primary Variable.

Recommended actions

1. Change Primary Variable to variable supported by device.
2. Consider purchasing an upgrade of the device to access additional variables.

Related information

Primary variable

Measurement correction configuration error

Cause

The factory measurement correction data is invalid.

Recommended actions

1. Restore default settings and reconfigure the device.
2. If the condition persists, replace the device.

Related information

Restore to default settings
Configure transmitter using guided setup

Threshold configuration error

Cause

The surface threshold configuration is incorrect.

Recommended actions in UIP (Rosemount Radar Master Plus)

1. Adjust the threshold as necessary.
2. If condition persists, restore default settings and reconfigure device.

Recommended actions in DD

1. In the threshold table, check that distance-threshold values are entered in increasing order.
2. Check that the number of threshold points to use is correct.
3. If condition persists, restore default settings and reconfigure the device.

Related information

Amplitude threshold
Restore to default settings
Configure transmitter using guided setup

Factory approval error

Cause

- The Sensor Module factory approval is missing.
- The Transmitter factory approval is missing.

Note
This error may also be set as a result of the startup failure. If both errors are present, then see the startup failure message.

Recommended actions

1. Restart the device.
2. Restore default settings and reconfigure device.
3. If the condition persists, replace the device.

Related information

Restart the device
Restore to default settings
Configure transmitter using guided setup

SIS configuration error

Cause

It is currently not possible to enable Safety Mode due to other active alerts.

Recommended actions

1. Clear other active alerts by priority order until this alert is cleared.
2. Change Operational Mode to Control/Monitoring if device is not intended to be used as safety device.
3. If the condition persists, restore default settings and reconfigure device.

Related information

Rosemount 3408 Safety Manual
Operational mode
Restore to default settings
Configure transmitter using guided setup

Function not supported

Cause

Functionality in the device is enabled, but not supported by this device.

Additional features may be enabled by purchasing an upgrade of the device.

Recommended actions

1. Check that selections for variables (e.g. Primary Variable) are supported by this device.
2. Turn off functionality not supported by this device.
3. Consider purchasing an upgrade of the device to access additional variables and functionality.
4. If condition persists, restore default settings and reconfigure device.

Related information

Primary variable
Restore to default settings
Configure transmitter using guided setup

Antenna type configuration error

Cause

The configured Antenna Type is not supported by the device.

Recommended actions

1. Check configuration of Antenna Type.
2. Make sure the configured antenna type matches the physical antenna for the device.

Related information

Antenna type

Antenna type not configured

Cause

The Antenna Type has not been configured.

Recommended actions

1. Check configuration of Antenna Type.
2. Make sure the configured antenna type matches the physical antenna for the device.

Related information

Antenna type

Factory calibration error

Cause

The factory calibration in the device is missing.

Note
This error may also be set as a result of the startup failure. If both errors are present, then see the startup failure message.

Recommended actions

Replace the device.

Analog out span configuration error

Cause

The span for the configured analog out range is too small.

Recommended actions

Increase analog out span by adjusting Upper or Lower Range Value.

Related information

Upper/lower range value

Analog out calibration error

Cause

Analog output calibration failed.

Recommended actions

1. Try calibrating the analog output again.
2. If the condition persists, replace the device.

Related information

Calibrate analog out

SIS multidrop error

Cause

HART multidrop mode is not supported for safety (SIS) devices. Only 4-20 mA output is supported for safety devices.

Recommended actions

1. Disable multidrop mode.
2. Change Operational Mode to Control/Monitoring if device is not intended to be used as safety device.
3. If the condition persists, restore default settings and reconfigure device.

Related information

Rosemount 3408 Safety Manual
Operational mode
Restore to default settings
Configure transmitter using guided setup

Engineering unit configuration error

Cause

One of the configured engineering units is not supported by the device.

Recommended actions

1. Check unit configuration.
2. If condition persists, restore default settings and reconfigure device.

Related information

Units
Restore to default settings
Configure transmitter using guided setup

Burst mode configuration error

Cause

The burst mode configuration is incorrect.

Recommended actions

1. Check configuration of burst mode.
2. If condition persists, restore default settings and reconfigure device.

Related information

Burst mode
Restore to default settings
Configure transmitter using guided setup

Start code configuration error

Cause

The start code to enable options in the device is invalid.

Note
Start codes are unique for individual devices and cannot be copied from one device to another.

Recommended actions

1. Enter a valid start code for this device using the Upgrade function.
2. If condition persists, contact your local Emerson representative to get a valid start code.

7.2.9 Safety mode not activated

Category Function Check

Cause

Safety Mode is disabled and device is in alarm mode.

This device is configured for use in Safety Instrumented Systems (SIS) which requires Safety Mode to be enabled.

Recommended actions

1. Change Safety Mode to Enabled for use in SIS application.
2. Change Operational Mode to Control/Monitoring if device is not intended to be used as safety device.

Related information

Rosemount 3408 Safety Manual

7.2.10 Simulation/test active

Category Function Check

Cause

The device is in simulation or test mode and is not reporting actual information.

Recommended actions

1. If this behavior is not desired, stop simulation or test mode.
2. If the condition persists, restart the device.

Related information

Use the simulation mode
Restart the device

7.2.11 Electronics temperature out of limits

Category Out of Specification

Cause

The temperature of the electronics board has exceeded the transmitter's operating range.

Recommended actions

1. Verify ambient temperature is within the operating range.
2. Remote mount the transmitter away from the process and environmental conditions.

Related information

Ambient temperature

7.2.12 Low signal quality

Category Maintenance Required

Cause

The Signal Quality is below the defined alert limit.

Recommended actions

1. Take action based on your intended use of this alert.
2. Clean the antenna.
3. If no actions were necessary, consider to change the limit.

Related information

Signal quality alert

7.2.13 High user defined alert

Category Maintenance Required

Cause

The user defined variable is above the defined limit.

Recommended actions

1. Bring the system to a safe state.
2. Verify that the process variable is within specified limits.
3. Reconfirm the user defined alarm limit.
4. If not needed, disable this alert.

Related information

High/low user defined alert

7.2.14 Low user defined alert

Category Maintenance Required

Cause

The user defined variable is below the defined limit.

Recommended actions

1. Bring the system to a safe state.
2. Verify that the process variable is within specified limits.
3. Reconfirm the user defined alarm limit.
4. If not needed, disable this alert.

Related information

High/low user defined alert

7.2.15 Linearized variable out of range

Category Maintenance Required

Cause

The level measurement is outside the configured range for volume or scaled variable, or both.

Accuracy of volume/scaled variable measurement may be degraded.

Recommended actions

1. If volume strapping table is used, make sure level values within operating range are included.
2. If scaled variable table is used, make sure input variable values within operating range are included.

Related information

Volume
Scaled variable

7.2.16 Dielectric constant estimation degraded

Category Maintenance Required

Cause

The dielectric constant estimation is degraded.

Accuracy of level measurement may be degraded.

Recommended actions

1. Check configuration of Bottom Product Dielectric Constant.
2. Check configuration of Reference Height and Bottom Offset.
3. If not needed, disable Tank Bottom Projection.

Related information

Tank bottom projection
Reference height
Bottom offset

7.2.17 Bluetooth® alert

Category Maintenance Required

Cause

A Bluetooth communication error has been detected.

The field device will continue to function independent of this Bluetooth communication alert.

Recommended actions

1. Click the **Details** button for more information.
2. Follow the instructions to correct the Bluetooth communication error.

Bluetooth® functionality limited

Cause

Device is unable to send device data over Bluetooth communication due to an internal error.

The field device will continue to function independent of this Bluetooth communication alert.

Recommended actions

1. Restart the device.
2. Check the electrical connection (remove and re-mount the Bluetooth communication display).
3. Replace Bluetooth communication display.
4. If the condition persists, replace the transmitter electronics.

Related information

Restart the device

Bluetooth® electronics error

Cause

Device internal diagnostics detected a Bluetooth electronics error.

This error will likely result in reduced or no Bluetooth communication capability; the field device will continue to function independent of this Bluetooth communication alert.

Recommended actions

1. Restart the device.
2. Replace Bluetooth communication display.

Related information

Restart the device

Bluetooth® firmware out of date

Cause

This incompatibility will result in no Bluetooth communications; the field device will continue to function independent of this Bluetooth communication alert.

Recommended actions

Update the Bluetooth firmware.

7.3 Troubleshooting guides

If there is a malfunction despite the absence of alerts, follow the procedures described in the appropriate troubleshooting guide. Under each of the symptoms, specific suggestions for solving problems are offered.

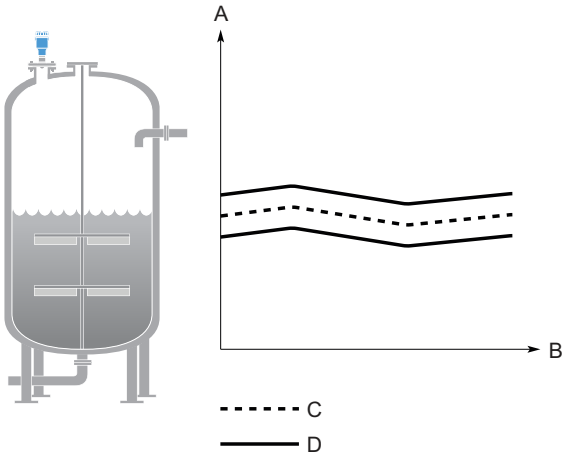
Related information

Troubleshooting incorrect level readings
Troubleshooting the 4-20 mA/HART output

7.3.1 Troubleshooting incorrect level readings

Reported level is too high or low

Figure 7-1: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Incorrect tank geometry configuration.

Recommended actions

- Verify the tank geometry parameters are configured correctly (especially the Reference Height).

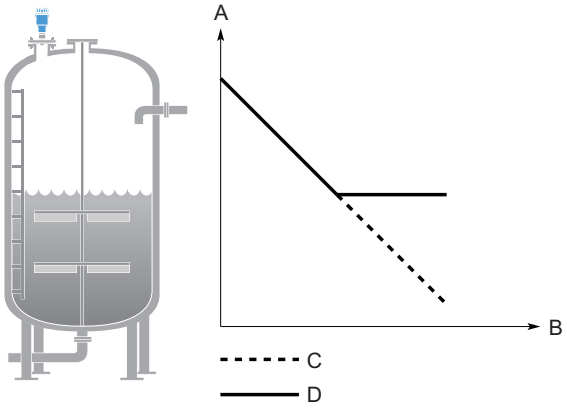
- Run Verify Level to adjust level measurement.
- Analyze the echo curve and check amplitude thresholds.
- Restore default settings and reconfigure the device.

Related information

Reference height
Run verify level
Read the echo curve
Amplitude threshold
Restore to default settings

Level is stuck in measuring range

Figure 7-2: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Disturbing object in the tank.

Recommended actions

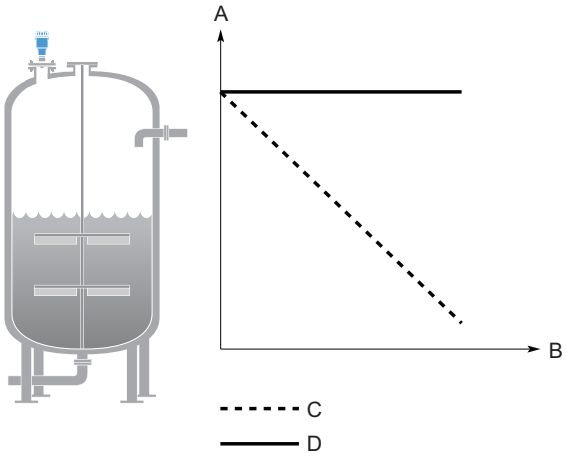
- Use the suppress false echoes function to manage strong disturbance echoes.
- Analyze the echo curve and check amplitude thresholds.
- Remove the disturbing object.
- Put an inclined metal plate on top of the disturbing object.
- Move the device to another position.

Related information

Suppressing false echoes
Read the echo curve
Amplitude threshold
Mounting position

Level is stuck in full tank

Figure 7-3: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Disturbing object near the antenna.

Recommended actions

- Use the suppress false echoes function to manage strong disturbance echoes.
- Analyze the echo curve and check amplitude thresholds.
- Increase the Upper Null Zone.
- Remove the disturbing object.
- Move the device to another position.

Possible cause

Product build-up on the antenna.

Recommended actions

- Clean the antenna.

Related information

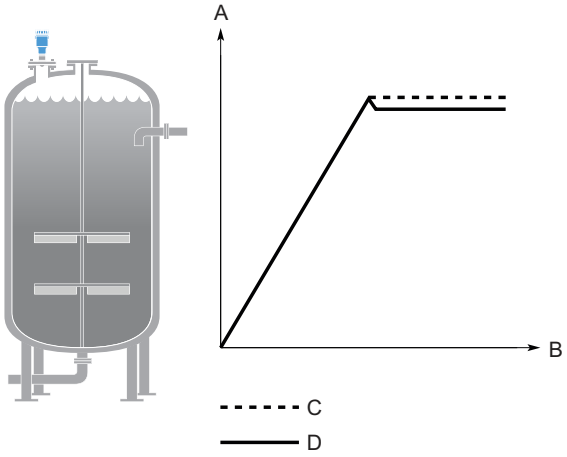
Suppressing false echoes
Read the echo curve
Amplitude threshold
Change the upper null zone
Mounting position

Level value drops when close to antenna

Symptom

Level value drops to a lower value when product surface is close to antenna.

Figure 7-4: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Product surface is within the Upper Null Zone and a disturbance echo is interpreted as the product surface.

Recommended actions

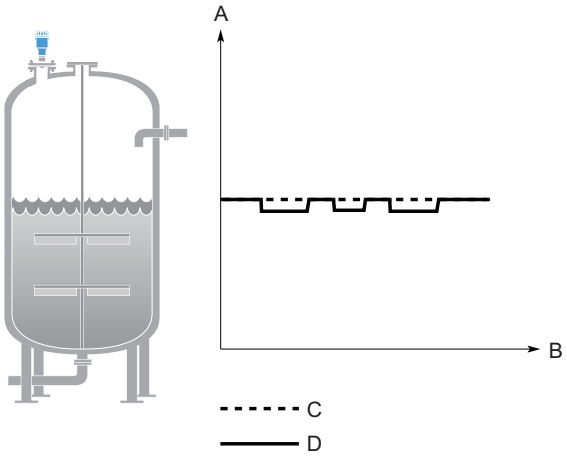
- Check the setting of the Upper Null Zone.

Related information

Upper null zone

Measured value jumps to a lower value

Figure 7-5: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Multiple products in the tank, e.g. thin oil layer on top of water that is sometimes detected, sometimes not.

Recommended actions

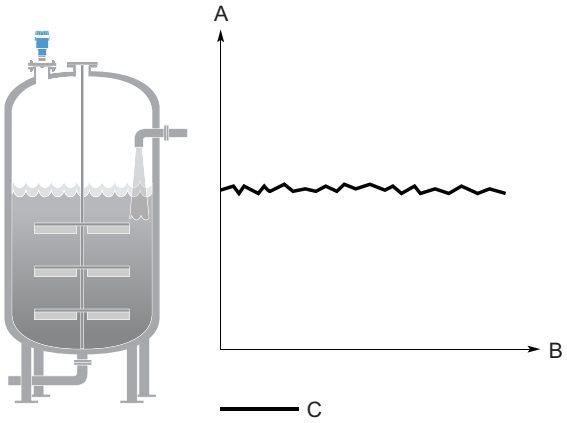
- Set Double Surface Handling to Track Upper Surface or Track Lower Surface.

Related information

Double surface handling

Measured level fluctuates

Figure 7-6: Symptom



A. Level
B. Time
C. Reported level

Possible cause

Excessive foaming or turbulence.

Recommended actions

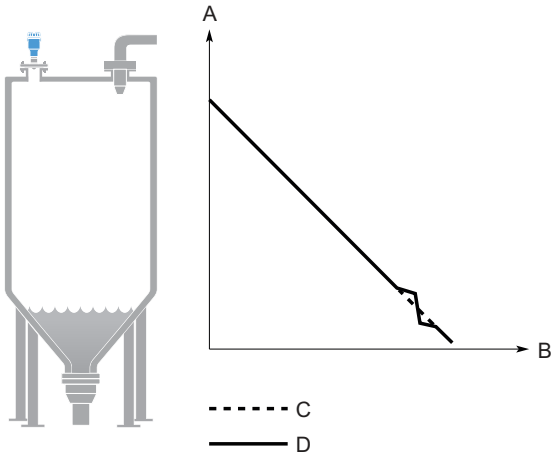
- Under turbulent conditions with low level rates, consider increasing the Damping value.
- Enable the Foam parameter or Turbulent Surface parameter, or both.

Related information

Damping value
Process conditions

Measured level is occasionally unstable

Figure 7-7: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

The product surface is close to a suppressed false echo.

Recommended actions

- If possible, remove the disturbing object.

Related information

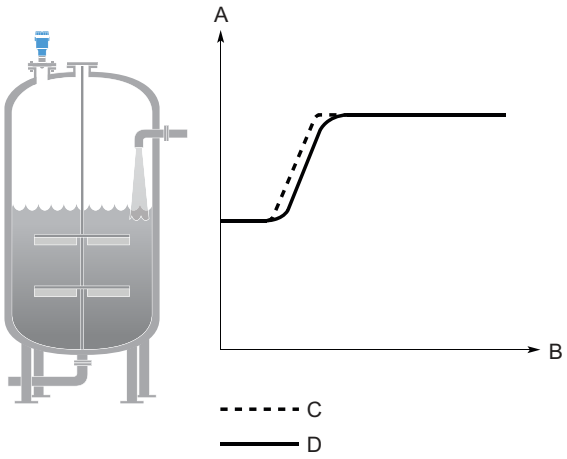
Read the echo curve

Lagging of measured level

Symptom

Measured level lags during rapid level changes.

Figure 7-8: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Damping value is set too high.

Recommended actions

- If there is a problem with lag during rapid level changes, consider decreasing the Damping value.

Possible cause

Maximum Level Rate value too low.

Recommended actions

- Verify Maximum Level Rate configuration.

Related information

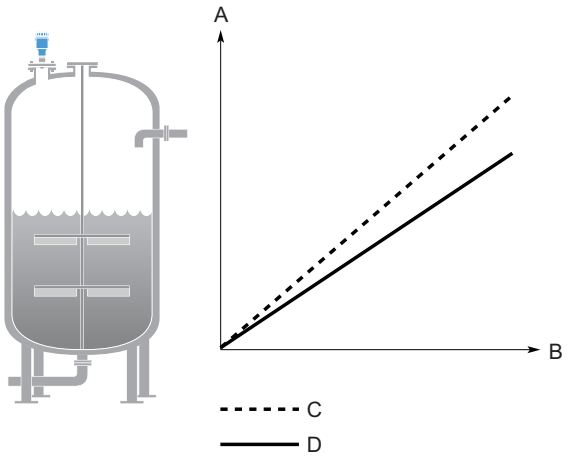
Damping value
Maximum level rate

Incorrect level at 100% (20 mA)

Symptom

Measured level is correct at 0% (4 mA) but incorrect at 100% (20 mA).

Figure 7-9: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Upper Range Value is not set correctly.

Recommended actions

- Check that the Upper Range Value matches the 100% (20 mA) level in the tank.

Related information

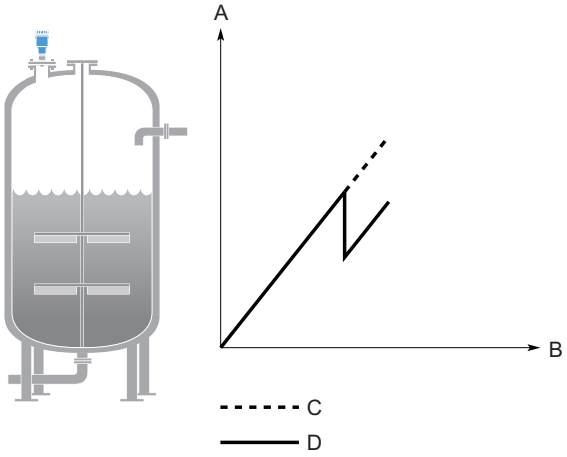
Upper/lower range value

Incorrect level when product surface is above 50%

Symptom

The reported level is incorrect when the product surface is above the 50% level.

Figure 7-10: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

A strong double bounce echo is interpreted as the product surface.

Recommended actions

- Enable the Double Bounce Handling function.

Related information

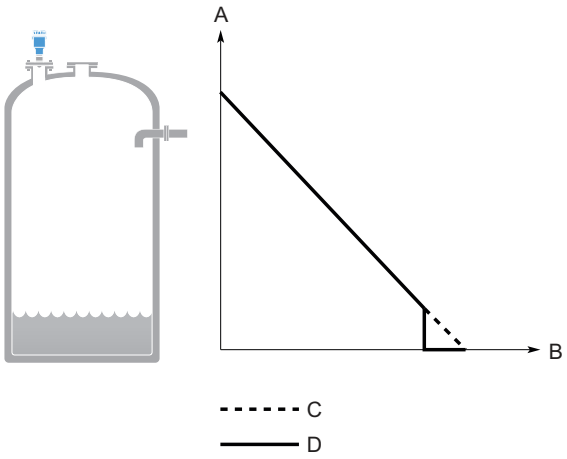
Handling strong double bounce echoes

Dropping of level close to tank bottom

Symptom

Measured value drops to zero level in the tank bottom region.

Figure 7-11: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Device has locked on a strong tank bottom echo.

Recommended actions

- Verify the Reference Height is configured correctly.
- Enable the Tank Bottom Projection function
- Enable the Bottom echo visible when tank is empty parameter.

Related information

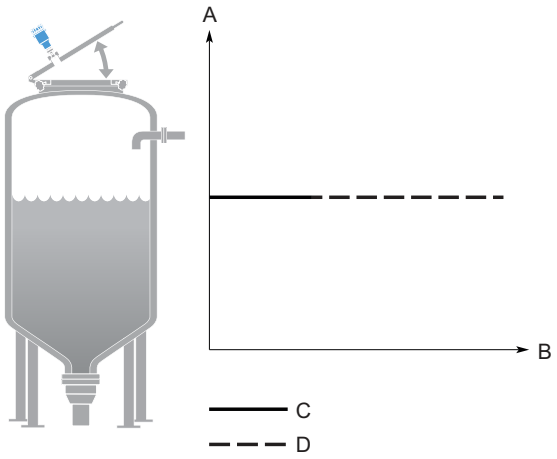
Reference height
Use tank bottom projection
Enable bottom echo visible when tank is empty

Level measurement lost in a manway cover installation

Symptom

The device reports "Level measurement lost" when opening/closing the manway cover.

Figure 7-12: Symptom



A. Level
B. Time
C. Actual level
D. Level measurement lost

Possible cause

If mounted on a manway cover, the device may lock on a disturbance echo and report this as surface level when the cover is opened. After closing the cover, the echo is lost and the device reports "Level measurement lost".

Recommended actions

- Before opening the manway cover, disconnect power to the device.
- After closing, restart the device.
- Move the device to another position.

Related information

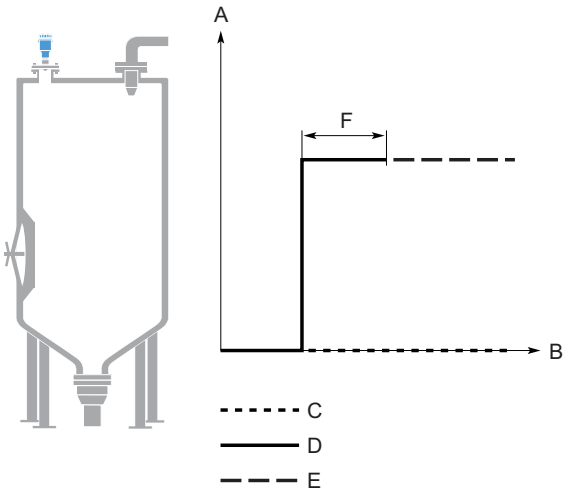
Restart the device
Mounting position

Level measurement is lost in an empty tank

Symptom

The device reports "Level measurement lost" in an empty tank after closing the side manway door.

Figure 7-13: Symptom



A. Level
B. Time
C. Actual level
D. Reported level
E. Level measurement lost
F. Manway door open

Possible cause

When the manway door is opened inward, it generates a disturbance echo which is interpreted as the product surface echo. After closing the door, the echo is lost and the device reports "Level measurement lost". The message is cleared when start filling the tank.

Recommended actions

- Before opening the manway door, disconnect power to the device.
- After closing, restart the device.
- Move the device to another position.

Related information

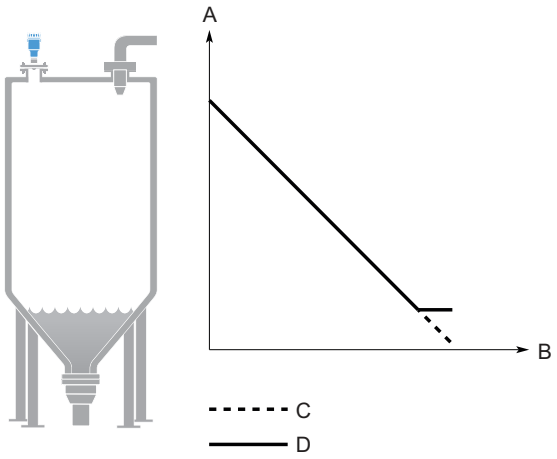
Restart the device
Mounting position

Alarm mode close to tank bottom

Symptom

When the product surface is near the sloped tank bottom, the device enters alarm mode.

Figure 7-14: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Reduction of projected surface area close to sloping tank bottom.

Recommended actions

- Verify the tank geometry parameters are configured correctly (especially the Reference Height and Bottom Offset).
- If measurement in this region is not crucial, increase the Empty Tank Detection Area.
- Verify the Bottom echo visible when tank is empty parameter is disabled.

Related information

Reference height
Bottom offset
Empty tank handling
Enable bottom echo visible when tank is empty

7.3.2 Troubleshooting the 4-20 mA/HART output

Device milliamp reading is zero

Recommended actions

1. Verify power is applied to signal terminals.
2. Verify power supply voltage is adequate at signal terminals.

3. Verify device and power supply are properly grounded.

Related information

Power supply
Grounding

Device milliamp reading is too low or high

Recommended actions

1. Verify level.
2. Check the settings of the 4-20 mA range values.
3. Verify output is not in alarm condition.
4. Check that power wires are connected to the correct signal terminals.
5. Perform Calibrate Analog Out.

Related information

Upper/lower range value
Alarm mode
Calibrate analog out

Milliamp reading is erratic

Recommended actions

1. Verify power supply voltage is adequate at signal terminals.
2. Check for external electrical interference.
3. Verify device is properly grounded.
4. Verify shield for twisted pair is only grounded at the power supply end.
5. Under turbulent conditions with low level rates, consider increasing the Damping value.

Related information

Power supply
Grounding
Damping value

Device will not respond to changes in level

Recommended actions

- Verify level is between the 4 and 20 mA set points.
- Verify output is not in alarm condition.
- Verify device is not in loop test or simulation mode.

Related information

Upper/lower range value
Alarm mode
Check device status

There is no HART communication (lost device communication)

Recommended actions

1. Verify power supply voltage is adequate at signal terminals.
2. Check load resistance (250 ohms minimum).
3. Check if device is at an alternate HART address.
4. Check current analog output value to verify that device hardware works.

Related information

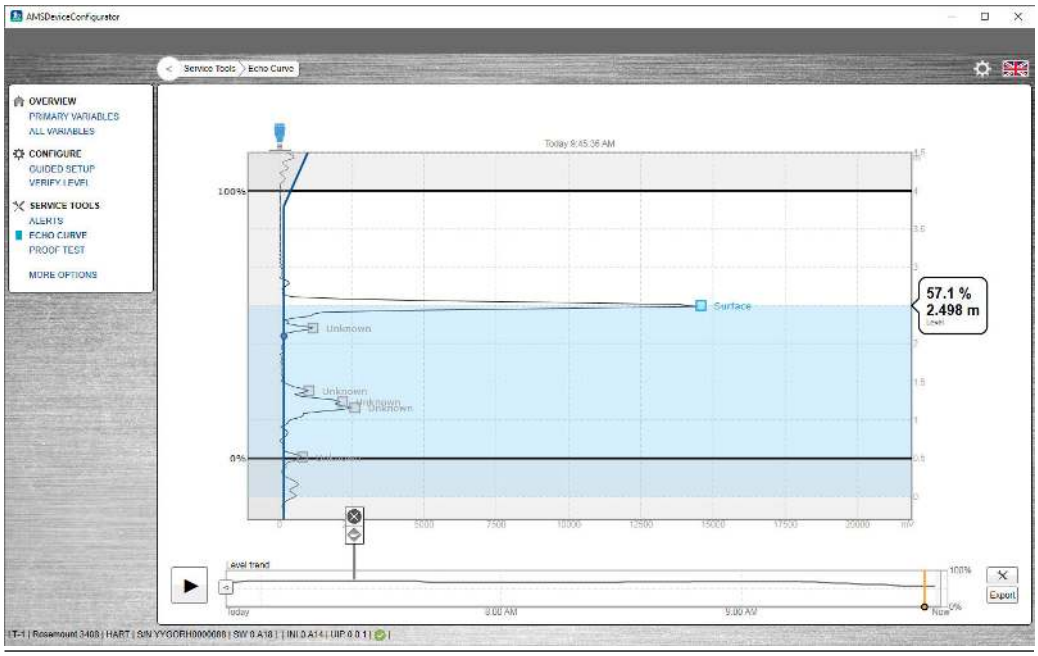
Power supply
HART/polling address

7.4 Service and troubleshooting tools

7.4.1 Using the echo curve

The Rosemount Radar Master Plus software includes functions for viewing and recording single instances or movies of the echo curve. The echo curve represents the tank, as seen by the radar transmitter. Each peak corresponds to a strong reflection of the radar signal.

Figure 7-15: Echo Curve



When connected to Rosemount Radar Master Plus, past measurement records and echo curves including the 10 highest peaks, as well as the 50 last alert events are automatically transferred from the transmitter's internal memory to the hard drive on your local computer. Past measurement records are then available the next time you connect to the transmitter using the level trend timeline.

Measurement problems can be understood by studying the position and amplitude of the different peaks. Additionally, the recorded echo curves give insight into unexpected and intermittent measurement behaviors, for instance, at the time of the triggered alert.

Read the echo curve

To read the echo curve in Rosemount Radar Master Plus:

Procedure

1. Select **Service Tools** → **Echo Curve**.
   Rosemount Radar Master Plus reads one echo curve and then stops.
2. To continuously update the echo curve, select the **Play** icon.

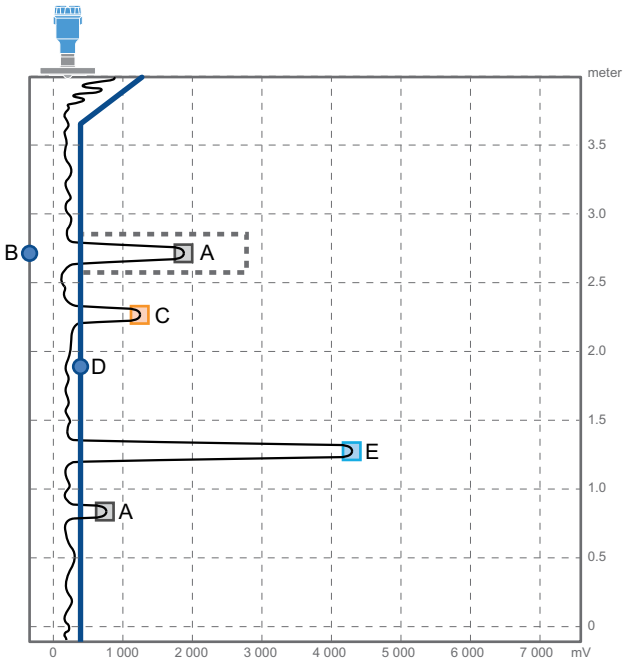
Echo peaks

The following echo peaks may appear in the echo curve:

Table 7-1: Echo Peak Types

Type	Description
Surface	Echo tracked as the current surface echo
Unknown	Echo not recognized by the device, which might interfere with measurement
Suppressed	Echoes that are identified but suppressed by the device
Suppressed (double bounce)	Echo managed as a double bounce echo by the Double Bounce function
Secondary surface	Echo tracked as the current secondary surface (if Double Surface Handling function is enabled)
Tank bottom echo	Echo considered as an echo from the tank bottom

Figure 7-16: Echo Curve with Typical Echo Peaks



A. Suppressed (dashed line indicates use of false echo suppression)
B. False echo suppression
C. Unknown
D. Amplitude threshold
E. Surface

Zoom in and out the echo curve

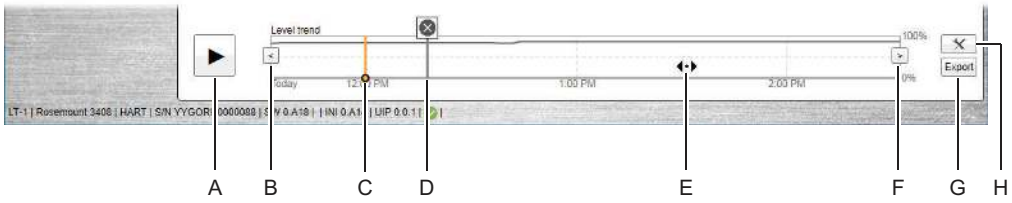
You can zoom in to a specific area of the echo curve.

Procedure

- To zoom in, drag a rectangle around the area you want to magnify.
- To zoom out, in the upper right corner of the echo curve, select **Reset Zoom**.

Level trend timeline

Figure 7-17: Timeline



A. Play or pause
B. Left arrow
C. Timeline slider
D. History alert icon
E. Drag anywhere in the timeline to move the timeline forward or backward.
F. Right arrow
G. Export echo curves
H. Options

View level trends and historical echo curves

Procedure

- To go to a desired point in the displayed part of the timeline, drag the slider, or click anywhere in the timeline.
- To move the timeline forward or backward, click the left or right arrow, or drag anywhere in the timeline.

Tip
To speed up the upload time of historical data in a specific area, click or drag the slider to the desired start point on the timeline. Rosemount Radar Master Plus continues to load data from that point forward.

View active/historical alerts

Procedure

In the timeline, click the left or right arrow to scroll to the alert, and then select the alert icon for details.

Play echo curve movies

Procedure

1. Set the start point.
   a) Click the left or right arrow, or drag anywhere in the timeline.
   b) Click the start point in the timeline.
2. Select **Play**, or drag the timeline slider to move one frame at a time.

Export echo curve movies

Procedure

1. Select **Service Tools** → **Echo Curve**.

2. Select **Export**.



3. Type your desired file name.
4. Browse to the desired directory, and then select **Save**.
5. Under ***Time range***, select **Last 1 hour**, **Last 3 hours**, **Last 24 hours**, or **User defined range**.
6. If **User defined range** is selected, specify the start and end times.
7. Select **Export**.
8. Select **Back**.



Set echo curve range

Procedure

1. Select **Service Tools** → **Echo Curve**.
2. Select **Options**.



3. Under ***Echo Curve Range***, select **User Defined**.
4. Enter the desired values.
5. Select **Save**.
6. Select **Back**.



Set timeline resolution

To set the resolution of the level trend timeline:

Procedure

1. Select **Service Tools** → **Echo Curve**.
2. Select **Options**.



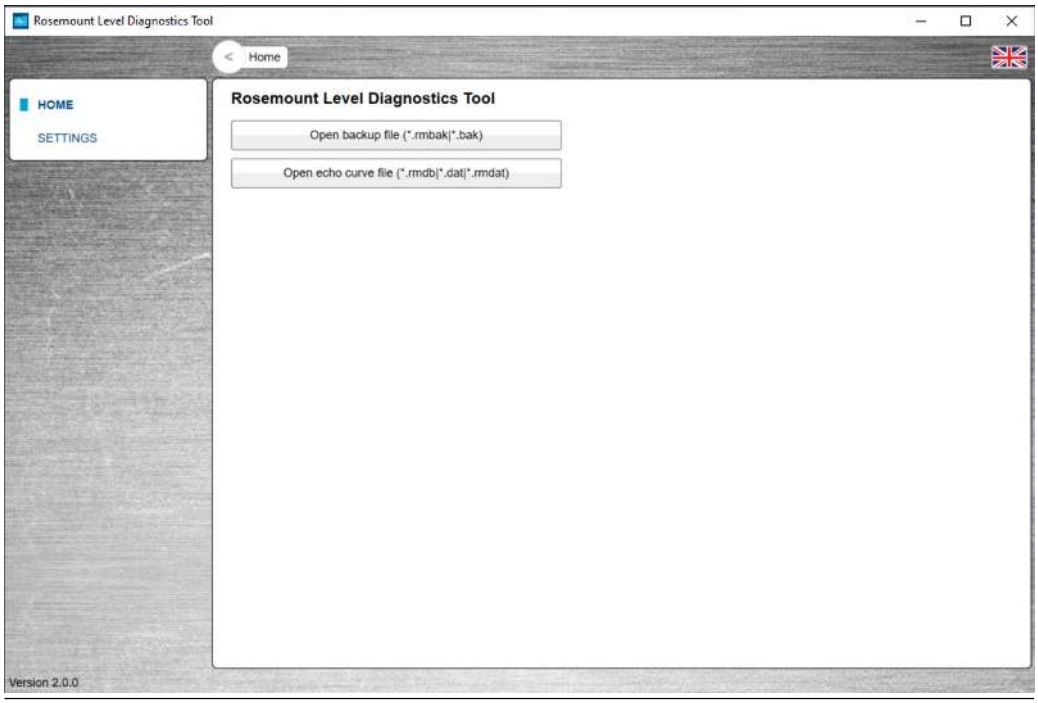
3. In the **Timeline Resolution** list, select the desired length (in hours) of the timeline.
4. Select **Save**.
5. Select **Back**.



7.4.2 Using the Rosemount Level Diagnostics Tool

You can view backup and echo curve files with the Rosemount Level Diagnostics Tool.

Figure 7-18: Rosemount Level Diagnostics Tool



Download Rosemount Level Diagnostics Tool

Procedure

Download the software at Emerson.com/RosemountLevelDiagnosticsTool.

View a backup file of the device configuration

You can view backup files with the Rosemount Level Diagnostics Tool.

Procedure

1. Start **Rosemount Level Diagnostics Tool**.
2. Select **Open backup file**.
3. Browse to the saved backup file (.rmbak or .bak), and then select **Open**.

View a saved echo curve file

You can view echo curve files with the Rosemount Level Diagnostics Tool.

Procedure

1. Start **Rosemount Level Diagnostics Tool**.
2. Select **Open echo curve file**.
3. Browse to the saved echo curve file (.rmdb, .dat, or .rmdat), and then select **Open**.

Change measurement units

Procedure

1. Select **Settings**.
2. In the **Length presentation unit** list, select the desired unit.
3. In the **Volume presentation unit** list, select the desired unit.
4. In the **Temperature presentation unit** list, select the desired unit.
5. In the **Velocity presentation unit** list, select the desired unit.

7.4.3 Perform an analog loop test

During a loop test, the transmitter outputs a fixed value (4 mA, 20 mA, or user-selected value).

The loop test command verifies the output of the transmitter, the integrity of the loop, and the operations of any recorders or similar devices installed in the loop. A loop test can also be used to determine the need for an analog output calibration.

Procedure

1. Select **Service Tools** → **Simulate**.
2. Under ***Analog Out***, select **Loop test**, and then follow the on-screen instructions.
3. Measure the loop current.

Postrequisites

Select **End** or **Cancel** to exit loop test (**Stop** in Rosemount Radar Master Plus).

Related information

Calibrate analog out
Simulation/test active

7.4.4 Calibrate analog out

Use this function to calibrate the analog output by comparing the actual output current with the nominal 4 mA and 20 mA currents. Calibration is done at factory and the analog output does not normally need to be recalibrated.

Procedure

1. Select **Service Tools** → **Maintenance** → **Routine Maintenance**.
2. Select **D/A trim** (**Calibrate Analog Out** in Rosemount Radar Master Plus) and follow the on-screen instructions.

7.4.5 Save a backup file of the device configuration

When configuration is finished, it is recommended to store the device configuration in a backup file for future reference. A backup of the device configuration will be saved to file as well as a configuration report (optional).

The backup file may be useful to:

- Restore the configuration of the transmitter.
- Install another transmitter in a similar tank.
- Troubleshoot the transmitter.

Prerequisites

This function is only available in Rosemount Radar Master Plus.

Procedure

1. Select **Service Tools** → **Maintenance** → **Backup**.
2. Select **Save Configuration**.
3. Type your desired file name.
4. Browse to the desired directory, and then select **Save**.
5. Optional: Select the **Create and save report (.pdf)** check box.
6. Select **Save**.

7.4.6 Download configuration from file to device

Prerequisites

This function is only available in Rosemount Radar Master Plus.

Procedure

1. Select **Service Tools** → **Maintenance** → **Backup**.
2. Select **Restore Configuration**.
3. Browse to the backup file and select **Open**.

7.4.7 Restart the device

To restart the device electronics:

Procedure

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

7.4.8 Restore to default settings

This function restores the transmitter to default settings (user configuration is overwritten).

Prerequisites

Before restoring the transmitter to default settings, it is recommended to backup the device configuration. The backup file can be used to restore configuration at a later stage.

Procedure

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

Related information

Save a backup file of the device configuration

7.4.9 Reset Bluetooth® security

Procedure

1. Select **Configure** → **(Manual Setup)** → **Device Setup** → **Security**.

2. Under ***Bluetooth***, select **Reset Bluetooth Security** and follow the on-screen instructions.
3. To confirm the reset, reconnect the device to the mobile app using the default key.

7.4.10 Use the simulation mode

This function can be used to simulate measurements.

Procedure

1. Select **Service Tools** → **Simulate**.
2. Under ***Simulate Measurement Values***, select desired transmitter variable and follow the on-screen instructions.

Related information

Simulation/test active

7.4.11 View input registers

Measured data is continuously stored in the input registers. By viewing the contents of the input registers, expert users can check that the transmitter works properly.

Procedure

1. Select **Configure** → **(Manual Setup)** → **Level Setup** → **Advanced** → **Expert Options** → **Input Registers**.
2. Type the desired register number to start reading from.

   In Rosemount Radar Master Plus, registers can also be viewed by selecting a group from the **Block** list.
3. Select **Read Input Registers** (**Refresh** in Rosemount Radar Master Plus).
4. (Handheld communicator) Select **Input Registers**.

7.4.12 View holding registers

The holding registers store various transmitter parameters, such as configuration data, used to control the measurement performance.

Procedure

1. Select **Configure** → **(Manual Setup)** → **Level Setup** → **Advanced** → **Expert Options** → **Holding Registers**.
2. Type the desired register number to start reading from.

   In Rosemount Radar Master Plus, registers can also be viewed by selecting a group from the **Block** list.
3. Select **Read Holding Registers** (**Refresh** in Rosemount Radar Master Plus).
4. (Handheld communicator) Select **Holding Registers**.

7.4.13 Edit holding registers

Edit holding registers using Rosemount Radar Master Plus

Prerequisites

Note
Do not use holding registers to configure the transmitter unless you are qualified. This dialog is mainly used for service purposes and for advanced configuration.

Procedure

1. To change a holding register value, type a new value in the corresponding value field, or select a new value from the corresponding list.
2. Select **Save** to store the new value.

Edit holding registers in DD compliant host

Prerequisites

Note
Do not use holding registers to configure the transmitter unless you are qualified. This dialog is mainly used for service purposes and for advanced configuration.

Procedure

In the **Holding Registers** tab, select **Write Holding Register** and follow the on-screen instructions.

7.5 Application challenges

7.5.1 Managing disturbance echoes

There are two general methods for managing disturbance echoes:

- Set amplitude threshold to filter out weak disturbance echoes and noise.
- Use the suppress false echoes function to manage strong disturbance echoes.

Amplitude threshold

The amplitude threshold is used to filter out noise and disturbing echoes from the product surface echo. The transmitter uses certain criteria to decide which type of echo peak that is detected. Only echoes above the amplitude threshold might be considered the product surface. The amplitude threshold can either be set to a constant value, or split into sections as defined by up to 10 anchor points.

If necessary, a customized amplitude threshold section can for instance be used to remove the influence from the tank nozzle, or disturbances close to the tank bottom. Additionally, it might be needed in areas where there are occasionally strong echoes present, for instance due to wide mixer blades. Suppressing false echoes may not be sufficient in those areas.

Note
Do not create a customized amplitude threshold section around echoes which are already registered as false echoes.

Adjust the amplitude threshold

If necessary, the amplitude threshold can be increased if a disturbance echo is interpreted as the product surface. Alternatively, a lower threshold may be required to handle weak surface echoes (e.g. due to excessive foaming or turbulence).

Prerequisites

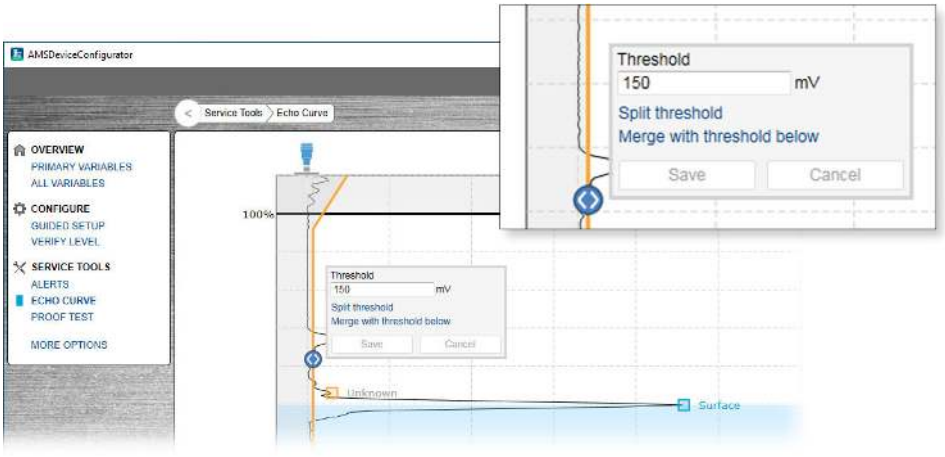
The amplitude threshold is set at factory for optimum performance and should not normally need an adjustment. Before changing the factory default, study the position and amplitude of the different echo peaks.

It is recommended to adjust thresholds using Rosemount Radar Master Plus.

Procedure

1. Select **Service Tools** → **Echo Curve**.
2. In the echo curve, drag the amplitude threshold point left or right, or type the desired value.

Figure 7-19: Amplitude Threshold Point



3. Select **Save**.

Set the endpoint of a threshold segment

Procedure

1. In the echo curve, drag the endpoint up or down, or type the desired value.

Figure 7-20: Endpoint



2. Select **Save**.

Add or delete an amplitude threshold point

Procedure

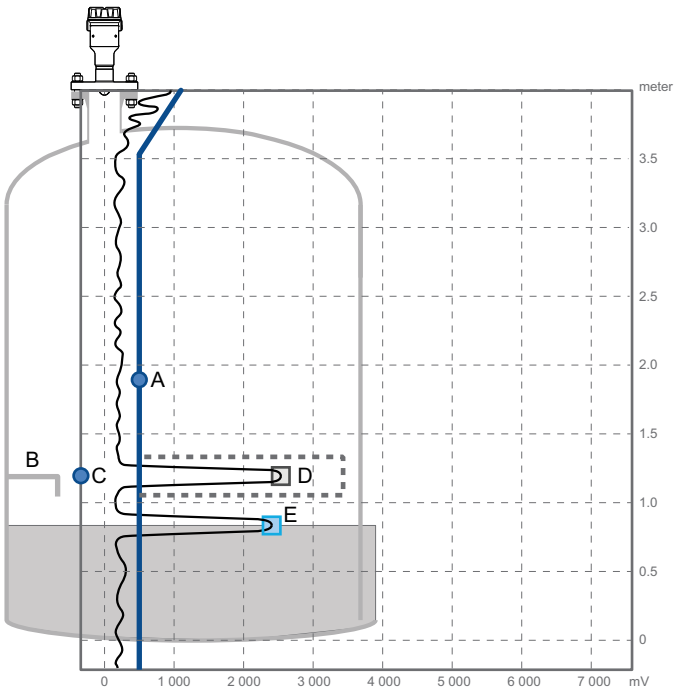
1. In the echo curve, select the desired amplitude threshold point, and select **Split threshold** or **Merge with threshold below**.
2. Click again on one of the amplitude threshold points and select **Save**.

Suppressing false echoes

Stationary objects with horizontal surfaces may generate strong false echoes. When the surface is close to an obstruction in the tank (e.g. beams and agitators), the surface and false echoes might interfere and cause a decrease in performance.

However, false echoes can be suppressed to reduce the influence of such objects, in case they cannot be totally avoided. When the surface is passing by a disturbing object, the transmitter will then measure with higher reliability, even if the surface echo is weaker than the false echo, see Figure 7-21.

Figure 7-21: Suppression of False Echoes



A. Amplitude threshold
B. Disturbing object
C. False echo suppression
D. Suppressed echo
E. Surface

Add a new false echo suppression

Prerequisites

Follow these recommendations before suppressing new false echoes:

- Make sure a correct amplitude threshold is set.
- Make sure the level is stable. A fluctuating level may indicate a temporary disturbance which is not due to an interfering object.
- Only suppress echoes which can be clearly identified as objects in the tank. Compare the list of interfering echoes with the tank drawing or visual inspection of the tank.
- Do not suppress false echoes located below the product surface.
- Keep the number of suppressed false echoes to a minimum.

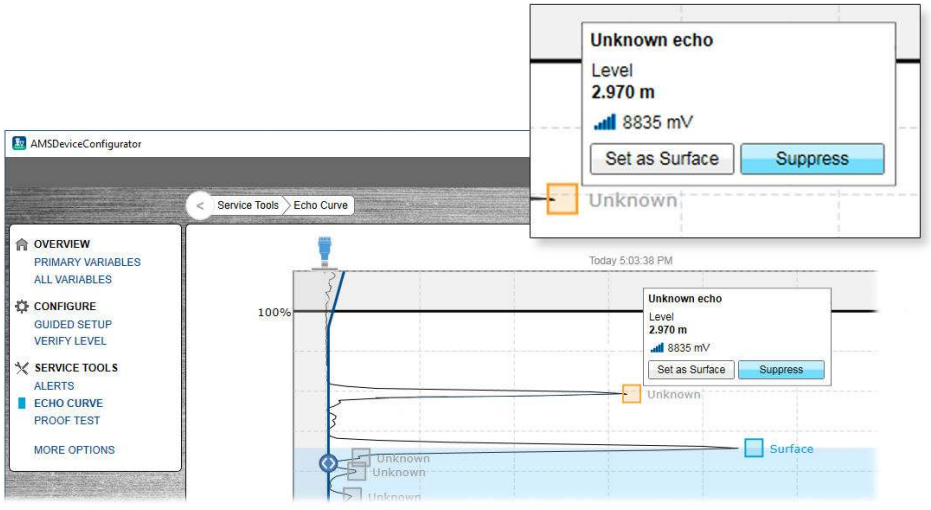
It is recommended to suppress false echoes using Rosemount Radar Master Plus.

Procedure

1. Select **Service Tools** → **Echo Curve**.

2. In the echo curve, click at the unknown echo peak, and then select **Suppress**.

Figure 7-22: Add False Echo Suppression



Postrequisites

It may be necessary to suppress new false echoes at a later stage when objects have become visible due to surface movement.

Related information

Amplitude threshold

Delete a false echo suppression

Prerequisites

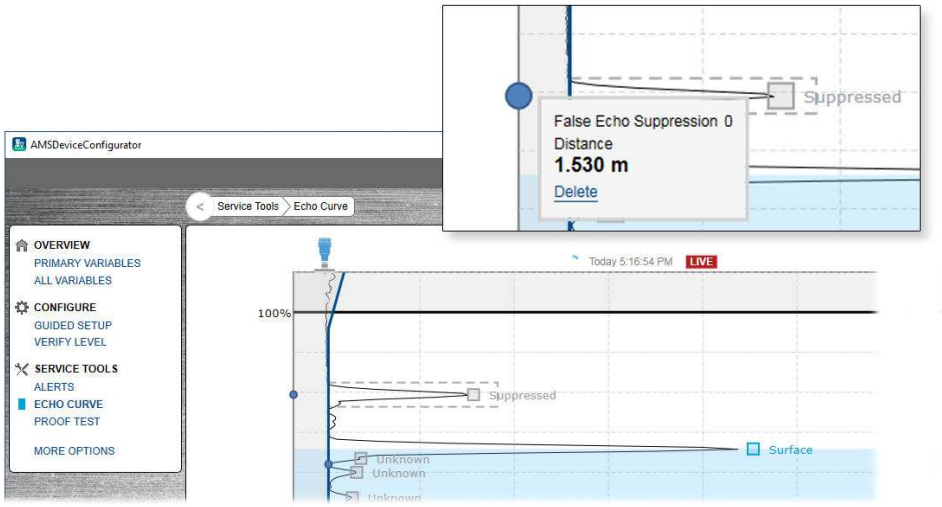
It is recommended to suppress false echoes using Rosemount Radar Master Plus.

Procedure

1. Select **Service Tools** → **Echo Curve**.

2. In the echo curve, click at the left end of the false echo suppression, and then select **Delete**.

Figure 7-23: Delete False Echo Suppression



Suppress a false echo manually

The false echo may also be suppressed manually if the position of the false echo is known.

Prerequisites

It is recommended to suppress false echoes using Rosemount Radar Master Plus.

Procedure

1. Select **Service Tools** → **Echo Curve**.
2. Select **Options**.

3. Select **Suppress False Echo Manually**. Suppressed echoes are shown in the table.
   - To add a new suppression, select **Add**, and then type the distance to the false echo and the width of the false echo area.
   - To change a suppression, select the cell you want change and type the new value.
   - To delete a suppression, select the row you want to delete, and then select **Delete**.
4. Select **Save**.
5. Select **Back**.

7.5.2 Handling disturbances at top of tank

Change the upper null zone

The Upper Null Zone defines a zone close to the transmitter where echoes are ignored. This zone can be extended to block out disturbing echoes at the top of the tank.

Prerequisites

Note
Make sure the Upper Range Value (100%/20 mA) value is below the Upper Null Zone. Measurements are not performed within the Upper Null Zone.

Procedure

1. Identify desired Upper Null Zone using the echo curve plot.
   a) In Rosemount Radar Master Plus, start the echo curve reading.
   b) View the echo curve plot to find out if there are disturbing echoes close to the transmitter.
2. Set the desired Upper Null Zone value.
   a) Select **Configure** → **Level Setup** → **Antenna**.
   b) Under ***Advanced***, type desired Upper Null Zone, and then select **Save**.

Related information

Read the echo curve
Upper null zone

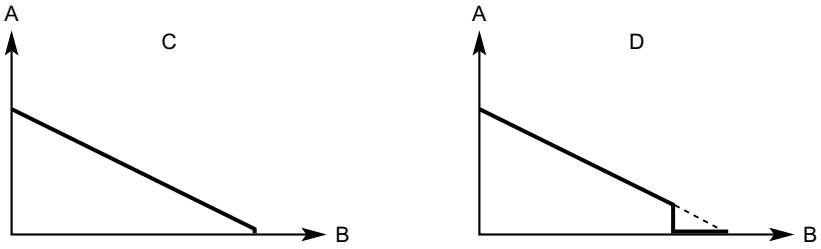
7.5.3 Tracking of weak surface echoes close to tank bottom

Use tank bottom projection

The Tank Bottom Projection function can be used to enhance measurements on liquids in the tank bottom region.

If the product surface echo is weak in the tank bottom region and the bottom echo is strong (typical for flat tank bottoms), the transmitter may lock on the bottom echo and report a false level measurement (empty tank). If the application requires, the Tank Bottom Projection settings can be user-defined. Figure 7-24 illustrates an example of the Tank Bottom Projection when the tank is being emptied.

Figure 7-24: Tank Bottom Projection



A. Level
B. Time
C. Enabled
D. Disabled

Prerequisites

The Tank Bottom Projection function is only available in Rosemount Radar Master Plus.

This function is not suitable for solids applications.

Procedure

1. Select **Configure** → **Level Setup** → **Advanced**.
2. Under ***More Advanced Options***, select **Empty Tank Handling**.
3. In the **Tank Bottom Projection** list, select **Enabled** or **Disabled**.
4. If you enabled Tank Bottom Projection, then:
    a) Set the Bottom Product Dielectric Constant.
    b) Enter Maximum Projection Distance.
    c) Enter Minimum Tank Bottom Echo Amplitude.
5. Select **Save**.

Related information

Read the echo curve

Bottom product dielectric constant

Enter the product dielectric constant for the product in the bottom of the tank.

Maximum projection distance

This defines the range in which the function operates. Enter the maximum distance from the zero level (tank bottom). It is recommended to use the default setting.

Minimum tank bottom echo amplitude

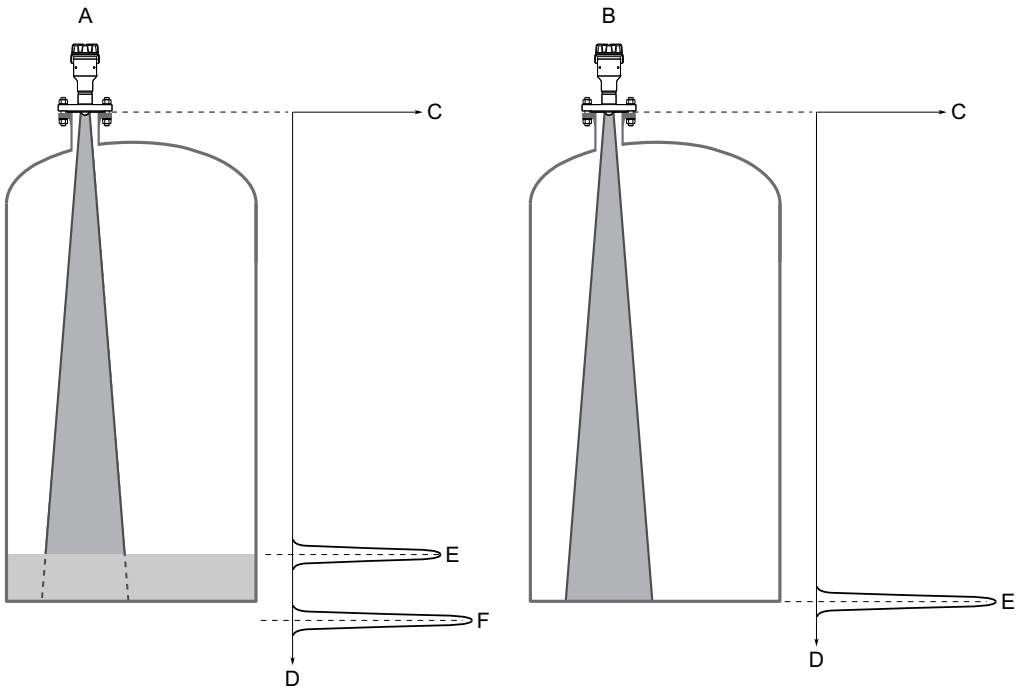
Enter the minimum allowed amplitude for the echo from the tank bottom before this function is activated. It is recommended to use the default setting.

Enable bottom echo visible when tank is empty

Enable the Bottom echo visible when tank is empty parameter if a bottom echo is visible when tank is empty (i.e. for flat tank bottoms). The bottom echo will then be treated as a disturbance echo to facilitate tracking of weak surface echoes close to the tank bottom.

This function may be useful for products which are relatively transparent for microwaves, such as oil.

Figure 7-25: Bottom Echo Visible



A. Product surface near bottom of tank
B. Empty tank
C. Signal amplitude
D. Distance
E. Surface echo
F. Echo peak from tank bottom (at the electrical distance when product in the tank)

Prerequisites

Before enabling the Bottom echo visible when tank is empty parameter:

- Analyze the echo curve and check that a bottom echo is visible when tank is empty.
- Verify that the Bottom Offset value is correct.

The Bottom echo visible when tank is empty parameter is only available in Rosemount Radar Master Plus.

Procedure

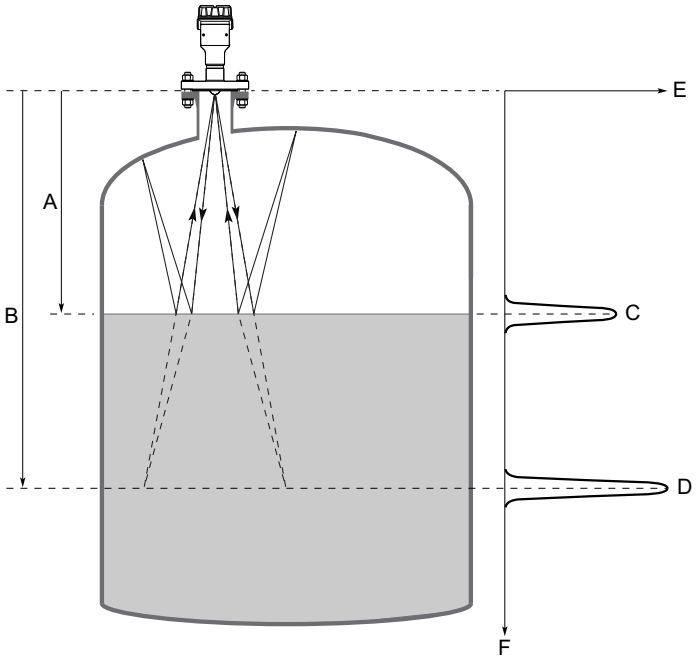
1. Select **Configure** → **Level Setup** → **Advanced**.
2. Under ***More Advanced Options***, select **Empty Tank Handling**.
3. In the **Empty Tank Handling list**, select **User Defined**.
4. Select the **Bottom echo visible when tank is empty** check box.
5. Select **Save**.

7.5.4 Handling strong double bounce echoes

Double bounces are most commonly present in spherical or horizontal cylinder tanks, and usually appear when the tank is about 60-70 percent filled. In these cases, the amplitude may be strong enough for the transmitter to interpret the double bounce as the surface echo. The Double Bounce Handling function is used for managing such problems.

A double bounce echo occurs when a radar signal bounces back and forth between the product surface and tank roof (or other object within the tank) before it is detected by the transmitter. Normally, these signals have a low amplitude and are ignored by the transmitter.

Figure 7-26: Double Bounce Echoes



A. Distance to surface
B. Distance to first double bounce
C. Actual level
D. Virtual level (first double bounce)
E. Signal amplitude
F. Distance

Prerequisites

Note
The Double Bounce Handling function should only be used if the problem of double bounces cannot be solved by changing the mounting position.

Note
The surface echo is required to suppress the double bounce. If the surface echo enters the Upper Null Zone, there is no product surface reference and the double bounce might be interpreted as the surface echo.

The Double Bounce Handling function is only available in Rosemount Radar Master Plus.

Procedure

1. Read the echo curve plot to determine if double bounce echoes are present.
2. Select **Configure** → **Level Setup** → **Advanced**.
3. Under ***More Advanced Options***, select **Echo Tracking**.
4. In the **Double Bounce Handling** list, select **Enabled** or **Disabled**.
5. If you enabled Double Bounce Handling, then enter desired Double Bounce Offset.
6. Select **Save**.

Related information

Read the echo curve

Double bounce offset

The distance between each double bounce echo is constant. The Double Bounce Offset is used to define the distance between detected double bounces, as given by the following formula (see Figure 7-26):

Double Bounce Offset = B - 2A

The Double Bounce Offset is negative if the reflection point (normally the tank roof) is below the Tank Reference Point.

7.6 Service support

To expedite the return process, refer to 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 Performance specifications

A.1.1 General

Reference conditions

- Measurement target: Stationary metal plate, no disturbing objects
- Antenna: Process seal
- Temperature: 59 to 77 °F (15 to 25 °C)
- Ambient pressure: 14 to 15 psi (960 to 1060 mbar)
- Relative humidity: 25-75%
- Damping: Default value, 2 s
- Frequency range: 77 to 81 GHz(1)

Instrument accuracy (under reference conditions)

- Ultra accuracy: ±0.04 in. (±1 mm)(2)
- Standard: ±0.08 in. (±2 mm)(2)

Repeatability

±0.02 in. (±0.5 mm)

Ambient temperature effect

±0.04 in. (±1 mm)/10 K

Sensor update rate

- Minimum 1 Hz (with 15 Vdc at 4 mA; 12 Vdc at 22.5 mA)
- Minimum 0.5 Hz (with 13 Vdc at 4 mA)

Maximum level rate

40 mm/s as default, adjustable up to 200 mm/s

A.1.2 Measuring range

Maximum measuring range

98 ft. (30 m)(3)

(1) Radar performance may be affected if it is configured for certain local radio spectrum regulations.
(2) Refers to inaccuracy according to IEC 60770-1 when excluding installation dependent offset. See the IEC 60770-1 standard for a definition of radar specific performance parameters and if applicable corresponding test procedures.

Measuring range for solids

The figures given in Table A-1 should be considered as guidelines; the total measuring range may differ depending on other contributing application conditions such as product filling, how the product piles up, silo diameter vs. angle of repose, internal obstacles within the silo, dust, condensation, antenna build up, etc.

Table A-1: Recommended Measuring Range for Solids, ft. (m)

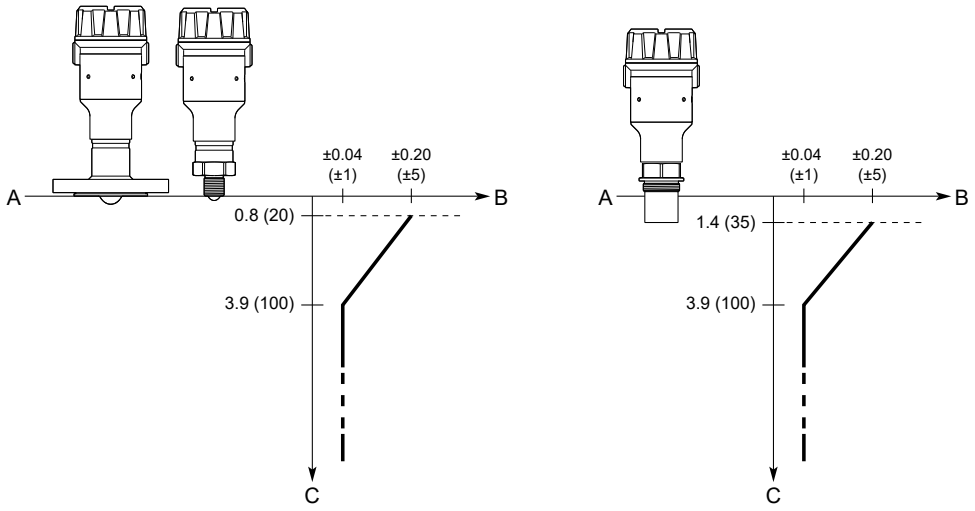
Antenna	Light powder(1)	Light granulates and pellets(2)	Heavy powder(3)	Grains(4)	Larger particles(5)
Lens antenna (¾-in. thread)	33 (10)	49 (15)	49 (15)	49 (15)	49 (15)
Lens antenna (1- and 1½-in. threads)	49 (15)	66 (20)	98 (30)	98 (30)	98 (30)
Process seal and ATAP lens antennas	66 (20)	98 (30)	98 (30)	98 (30)	98 (30)

(1) Light powder, etc. (Dielectric constant: 1.2)
(2) Plastic pellets, etc. (Dielectric constant: 1.35)
(3) Lime powder, cement, sand, etc. (Dielectric constant: 1.5)
(4) Kernels, brans, etc. (Dielectric constant: 1.5)
(5) Wood chips/pellets, etc. (Dielectric constant: 1.7)

Accuracy over measuring range

Figure A-1 illustrates the accuracy over measuring range at reference conditions. Actual measurement performance in the near zone and close to a strong bottom echo will depend on the product's characteristics and application conditions.

Figure A-1: Accuracy Over Measuring Range



A. Device Reference Point
B. Accuracy in inches (millimeters)
C. Distance in inches (millimeters)

(3) The measuring range is limited to 49 ft. (15 m) for the lens antenna with a ¾-in. threaded process connection. Also note that a combination of adverse process conditions, such as heavy turbulence, foam, and condensation, together with products with poor reflection may affect the measuring range.

A.1.3 Environment

Vibration resistance

2 g at 10-1000 Hz according to IEC 61298-3, level “field with general application”

Note
The bracket option does not meet the vibration requirements.

Electromagnetic compatibility (EMC)

- EMC Directive (2014/30/EU): EN 61326-1
- EN 61326-2-3
- NAMUR recommendations NE21

Pressure Equipment Directive (PED)

Complies with 2014/68/EU article 4.3

Built-in lightning protection

EN 61326, IEC 61000-4-5, level 2kV

Radio approvals

- Radio Equipment Directive (2014/53/EU):
  - ETSI EN 302 372 (TLPR)
  - ETSI EN 302 729 (LPR)
  - EN 301 489-1
  - EN 301 489-17
  - EN 301 489-33
  - EN 300 328 (Bluetooth®)
  - EN 62479
- Part 15 of the FCC Rules
- Industry Canada RSS 211
- Other country approvals

Related information

Product certifications

A.2 Functional specifications

A.2.1 General

Field of application

Continuous level measurements on a broad range of liquids, slurries, and solids.

Measurement principle

Frequency Modulated Continuous Wave (FMCW)

Frequency range

77 to 81 GHz (76 to 77 GHz in applicable countries)

Note
Operating the device without selecting the relevant radio spectrum may constitute a violation of the regulations of the radio approvals of the respective country.

Maximum output power

+5 dBm (3.2 mW)

Internal power consumption

< 0.8 W in normal operation

Humidity

0 - 100% relative humidity, non-condensing

Turn-on time

< 60 s(4)

A.2.2 Functional safety

The Rosemount 3408 Level Transmitter is IEC 61508 certified to:

- Low and high demand: Type B element
- SIL 2 for random integrity @ HFT=0
- SIL 3 for random integrity @ HFT=1
- SIL 3 for systematic capability

Related information

Functional Safety Certificate
Rosemount 3408 Safety Manual

A.2.3 4-20 mA HART®

Output

Two-wire, 4-20 mA. Digital process variable is superimposed on 4-20 mA signal, and available to any host that conforms to the HART® protocol. The digital HART signal can be used in multidrop mode.

HART universal revision

7

(4) Time from when power is applied to the transmitter until performance is within specifications.

Analog signal on alarm

The transmitter automatically and continuously performs self-diagnostic routines. If a failure or a measurement error is detected, the analog signal will be driven offscale to alert the user. High or low failure mode is user-configurable.

Table A-2: Signal on Alarm

Standard	High	Low
Rosemount standard	≥ 21.75 mA	≤ 3.75 mA
NAMUR NE43	≥ 21.0 mA	≤ 3.6 mA

Analog saturation levels

The transmitter will continue to set a current that corresponds to the measurement until reaching the associated saturation limit (and then freeze).

Table A-3: Saturation Levels

Standard	High	Low
Rosemount standard	20.8 mA	3.9 mA
NAMUR NE43	20.5 mA	3.8 mA

A.2.4 Bluetooth® connectivity

Typical range

At least 50 ft. (15 m) line of sight.

Maximum communication range will vary depending on orientation, obstacles (person, metal, wall, etc.) or electromagnetic environment.

A.2.5 Display and configuration

Damping

User selectable (default is 2 s, minimum is 0 s)

Output units

- Level and distance: ft., in., m, cm, mm
- Level rate: ft/s, in./min, in./s, m/h, m/s
- Volume: ft^3, $in.^3$, yd^3, US gal, imperial gal, barrel (bbl), m^3, l
- Temperature: °F, °C
- Signal strength: mV

Output variables

Variable	4-20 mA	Digital output	LCD display
Level	✓	✓	✓
Distance (ullage)	✓	✓	✓
Volume	✓	✓	✓
Scaled variable(1)	✓	✓	✓
Electronics temperature	N/A	✓	✓
Signal quality(1)	N/A	✓	✓
Level rate	N/A	✓	✓
Signal strength	N/A	✓	✓
Percent of range	N/A	✓	✓
Percent of range auxiliary	N/A	✓	✓
User-defined(1)	✓	✓	✓
Loop current	N/A	N/A	✓

(1) Only for transmitters ordered with Smart Diagnostics Suite or Smart Meter Verification (professional).

A.2.6 Process pressure

Final rating may be lower depending on flange selection.

Process seal antenna

-15 to 363 psig (-1 to 25 bar)

Lens antenna

-15 to 363 psig (-1 to 25 bar)

ATAP lens antenna

-15 to 7 psig (-1 to 0.5 bar)

A.2.7 Temperature limits

Process temperature

Process seal antenna

-76 to 392 °F (-60 to 200 °C)

Lens antenna

-76 to 392 °F (-60 to 200 °C)

ATAP lens antenna

-4 to 176 °F (-20 to 80 °C)

Note
The temperature range is -40 to 176 °F (-40 to 80 °C) for open air applications.

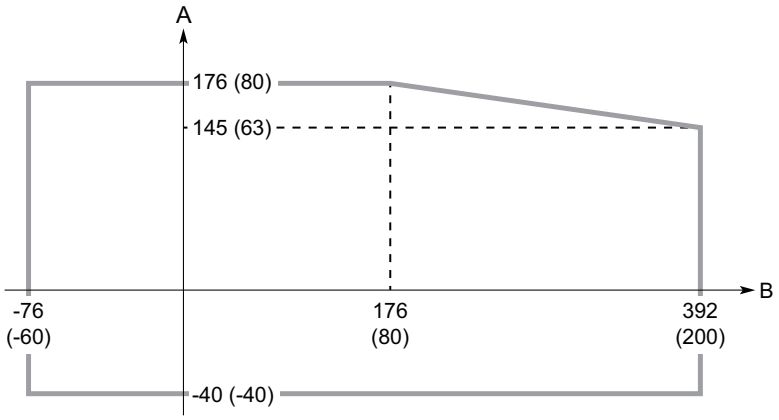
Ambient temperature

-40 to 176 °F (-40 to 80 °C)

Note
LCD display may not be readable and LCD display updates will be slower at temperatures below -4 °F (-20 °C).

The ambient temperature limits may be further restricted by the process temperature as described by Figure A-2.

Figure A-2: Ambient Temperature vs. Process Temperature



A. Ambient temperature °F (°C)
B. Process temperature °F (°C)

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

Related information

Product certifications

Storage temperature

-40 to 176 °F (-40 to 80 °C)

A.2.8 Flange rating

ASME

316 SST according to ASME B16.5 Table 2-2.2

EN

1.4404 according to EN 1092-1 material group 13E0

JIS

316 SST according to JIS B2220 material group No. 2.2

A.2.9 Conditions used for flange strength calculations

Table A-4: Stainless Steel Flanges

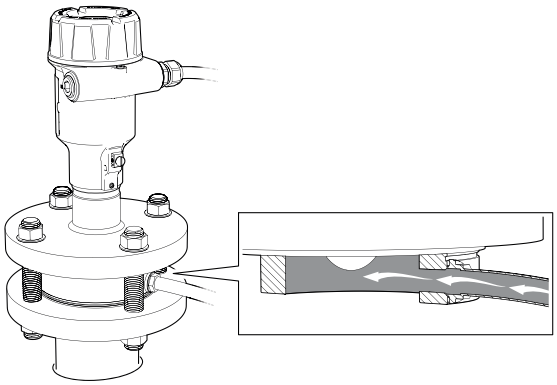
Item	ASME	EN, JIS
Bolting material	SA193 B8M CL.2	ISO 3506 A4-70
Flange material	Stainless steel A182 Gr. F316 and EN 10222-5-1.4404	
Hub material	Stainless steel SA479 316 and EN 10272-1.4404	

A.2.10 Air purging

An air purge connection can prevent clogging of the antenna in extreme applications with dirt or heavy coating. To determine if air purging is needed, inspect the tank internal conditions at the location intended for the transmitter. If there is normally a thick layer of product build-up there, air purging is most likely needed. Typical purging media to use is air.

Flushing connection rings are available as accessory for use with process seal antennas.

Figure A-3: Air Purging for Process Seal Antenna



Incoming air supply specification

- Maximum pressure: 190 psi (13 bar)
- Recommended pressure: 100 to 115 psi (7 to 8 bar)
- Inlet/outlet connection: BSPP (G) ⅜-in.
- Air consumption: 252 gal/min at 65 psi (955 l/min at 4.5 bar)

A.3 Physical specifications

A.3.1 Housing and enclosure

Electrical connections

Two cable/conduit entries (½-14 NPT or M20 x 1.5)

Housing material

Polyurethane-covered aluminum

Ingress protection

Process seal and lens antennas

- IP 66/67/68[5]
- NEMA® 4X

ATAP lens antenna

- IP 65
- NEMA® 4X

A.3.2 Antenna versions

Process seal antenna

All PTFE wetted parts ideal for use in applications with corrosive media, dust, and heavy condensation

Lens antenna

Suitable for use on vessels with small process fittings

ATAP lens antenna

Designed for open air installations and non-pressurized tanks

A.3.3 Material exposed to tank atmosphere

Process seal antenna

- PTFE sealing: PTFE fluoropolymer

Lens antenna

- PTFE sealing: PTFE fluoropolymer
- Threaded process connection: Stainless steel 316/316L (EN 1.4404)

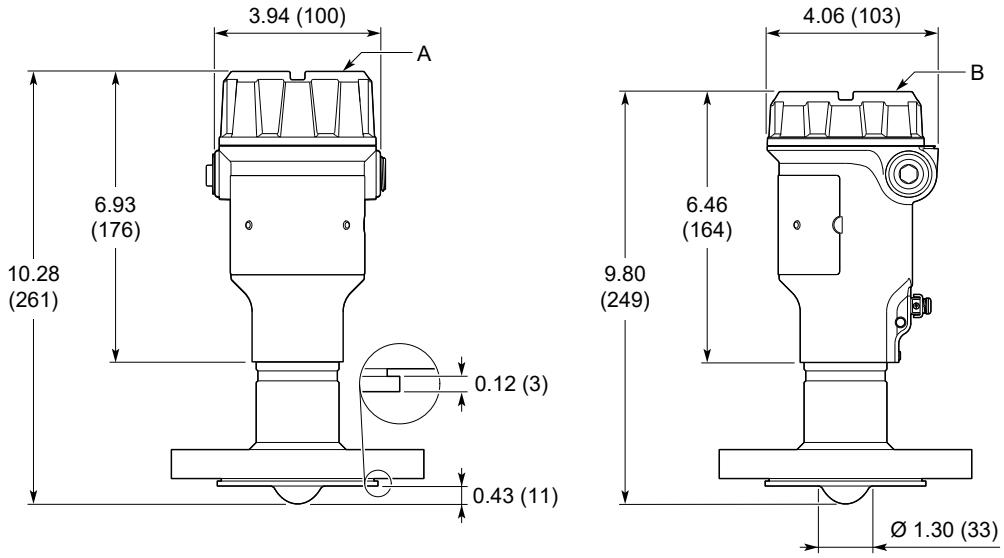
ATAP lens antenna

- PTFE sealing: PTFE fluoropolymer
- Threaded process connection: Anodized aluminum 6082-T6 or 6061-T6
- O-ring: FKM
- Antenna extension for open air: PTFE fluoropolymer with carbon filler

(5) *The transmitter meets IP 68 at 9.8 ft. (3 m) for 45 minutes.*

A.4 Dimensional drawings

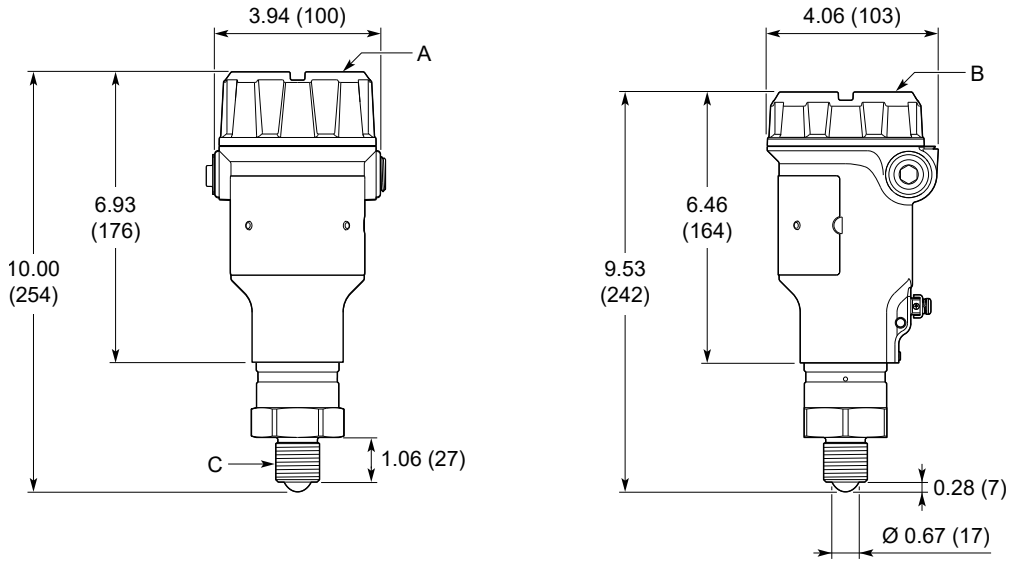
Figure A-4: Process Seal Antenna



A. LCD display option
B. No LCD display

Dimensions are in inches (millimeters).

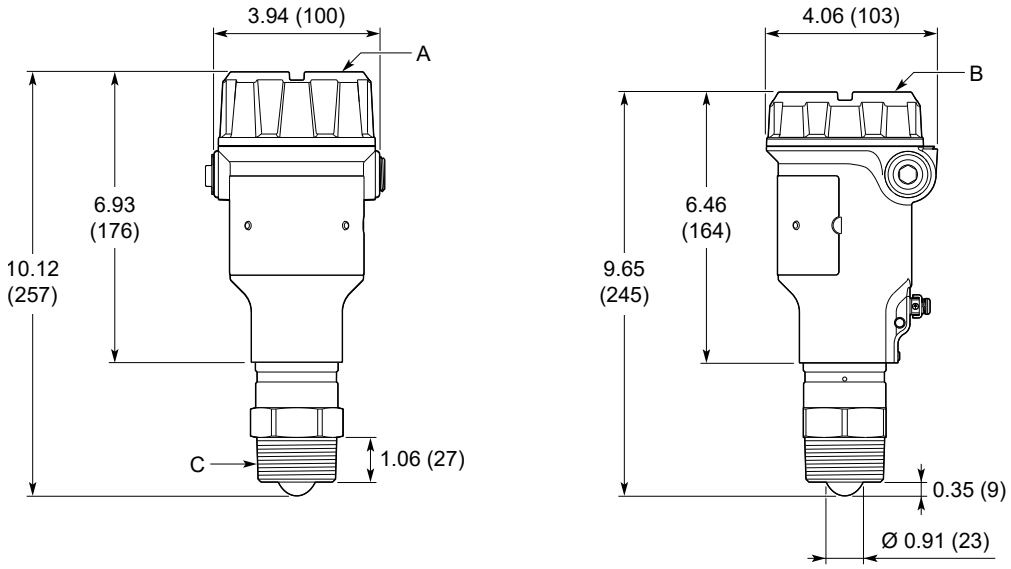
Figure A-5: Lens Antenna with ¾-in. Threaded Process Connection



A. LCD display option
B. No LCD display
C. NPT or BSPP (G)

Dimensions are in inches (millimeters).

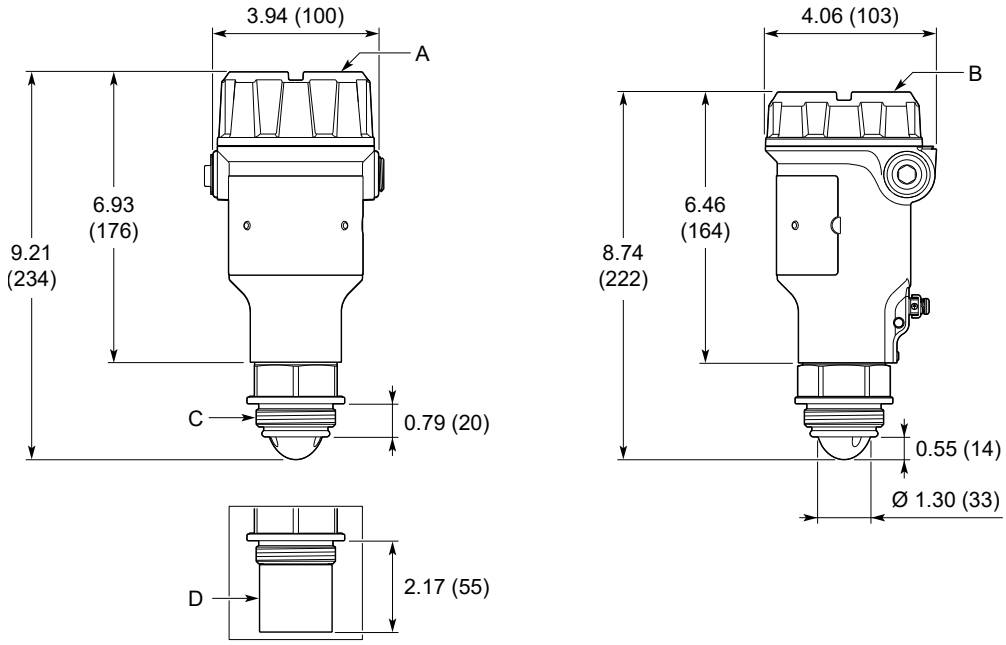
Figure A-6: Lens Antenna with 1- or 1½-in. Threaded Process Connection



A. LCD display option
B. No LCD display
C. NPT or BSPP (G)

Dimensions are in inches (millimeters).

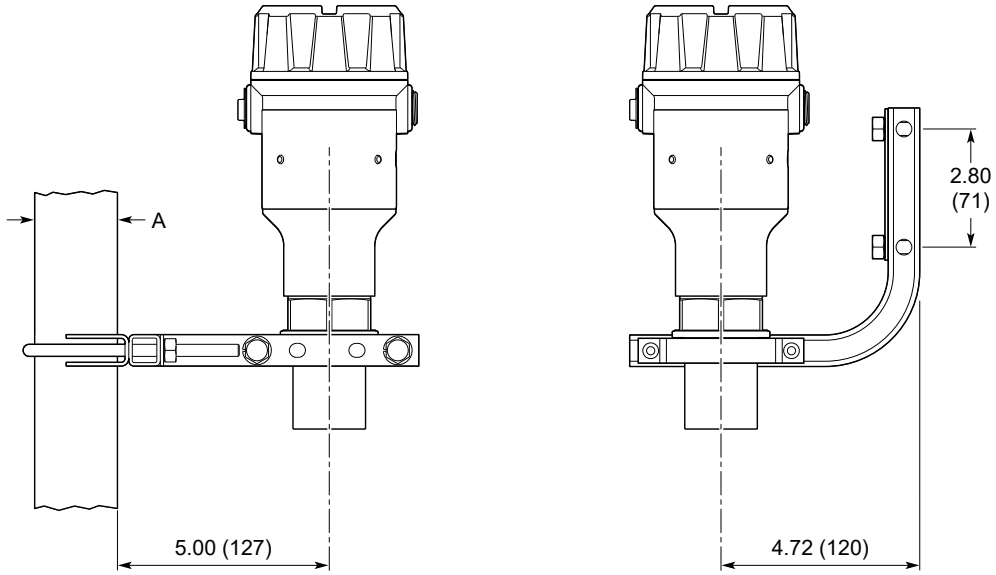
Figure A-7: ATAP Lens Antenna



A. LCD display option
B. No LCD display
C. BSPP (G) 1½-in.
D. Antenna extension for open air installations

Dimensions are in inches (millimeters).

Figure A-8: ATAP Lens Antenna with Mounting Bracket

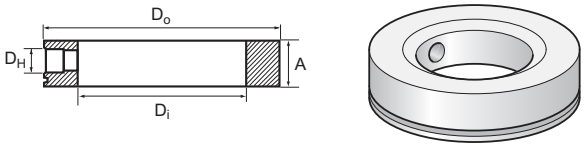


A. Pipe diameter, max 2.5 (63.5)

Dimensions are in inches (millimeters).

A.4.1 Flushing connection rings

Figure A-9: Flushing Connection Rings



A. Height: 0.97 in. (24.6 mm)

Table A-5: Dimensions of Flushing Connection Rings

Flushing connection rings	D_i	D_o	D_H
2-in. ANSI	2.12 (53.8)	3.62 (91.9)	¼-in. NPT
3-in. ANSI	3.60 (91.4)	5.00 (127.0)	¼-in. NPT
4-in. ANSI/DN100	3.60 (91.4)	6.20 (157.5)	¼-in. NPT
6-in. ANSI	3.60 (91.4)	8.50 (215.9)	¼-in. NPT
DN50	2.40 (61.0)	4.00 (102.0)	¼-in. NPT
DN80	3.60 (91.4)	5.43 (138.0)	¼-in. NPT

B Configuration parameters

B.1 Menu tree

Figure B-1 shows the UIP menu tree for Rosemount Radar Master Plus. See Figure B-2 for the DD menu tree.

Figure B-1: UIP Menu Tree

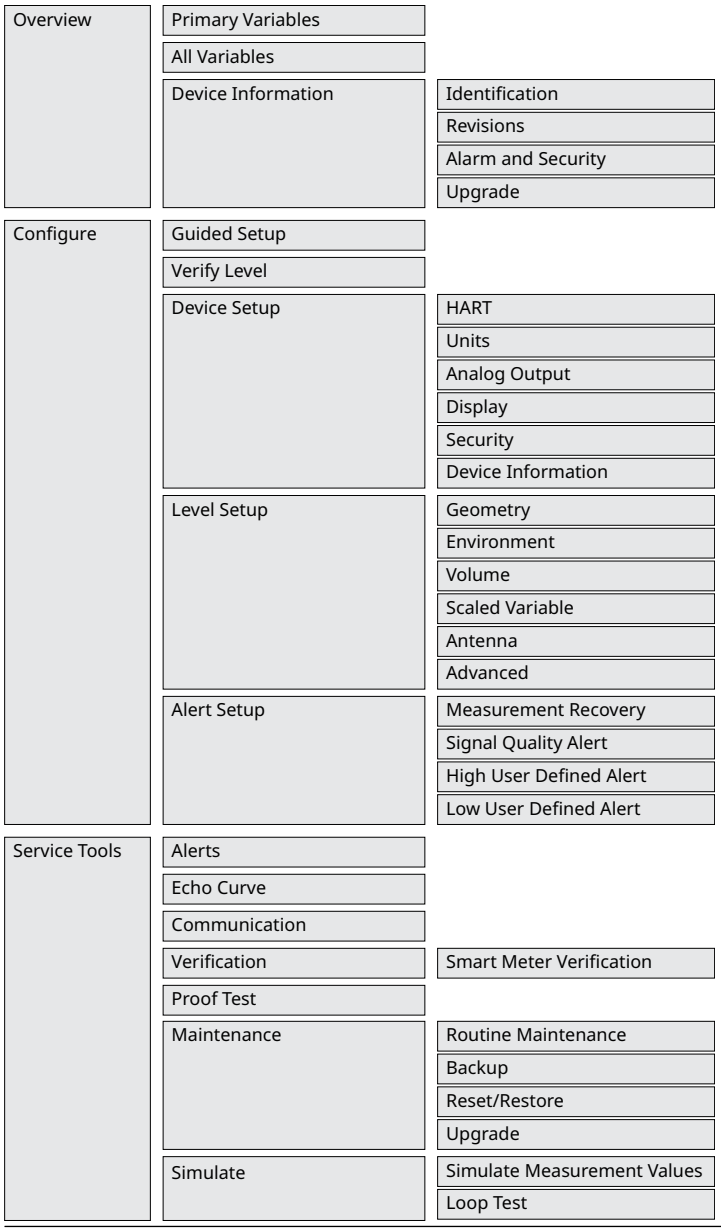
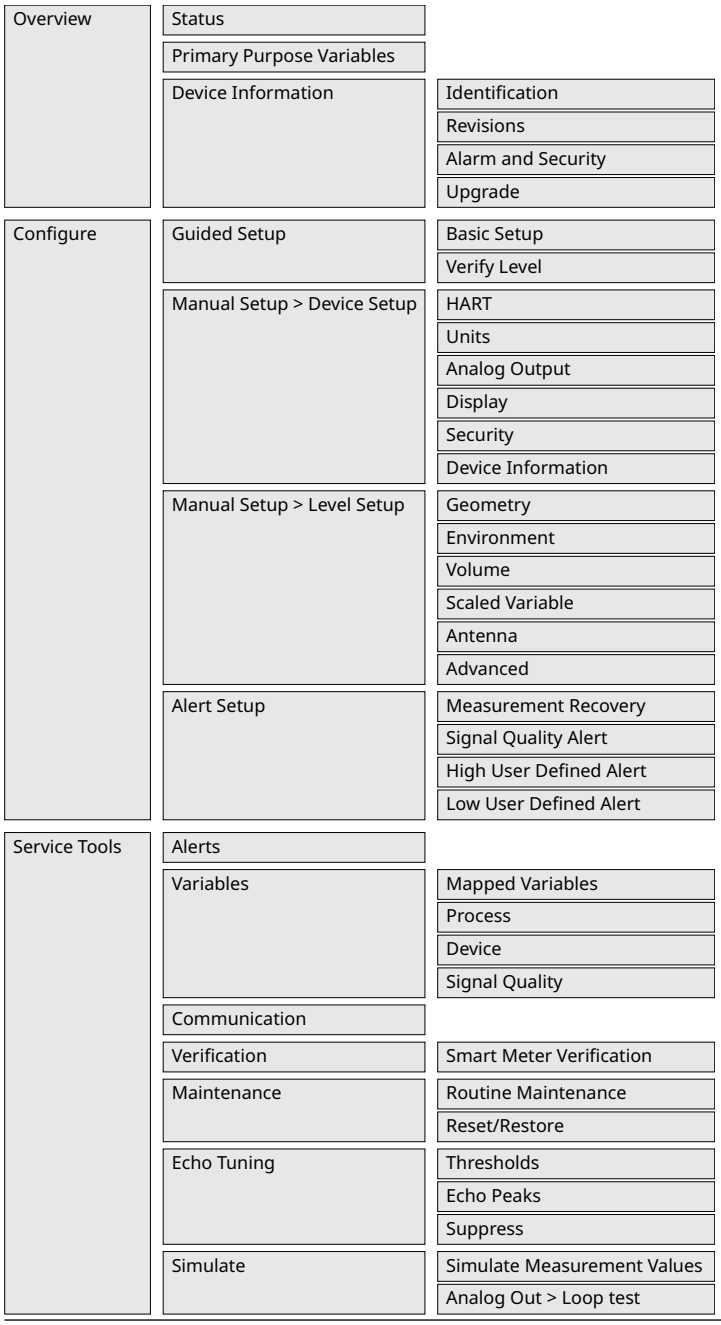


Figure B-2: DD Menu Tree



B.2 Device setup

B.2.1 HART protocol

HART/polling address

The address range is 0 to 63. The transmitter operates in either standard mode with a 4–20 mA output signal or in multidrop. When the transmitter is in multi-drop mode, the current output is fixed to 4 mA.

Burst mode

When set to burst mode, the transmitter regularly sends out messages instead of waiting for the host to request it.

Both the transmitter and host must be configured to operate in burst mode. Almost all HART host systems today are designed to communicate in poll/response mode, not burst mode. However, the Rosemount 333 HART Tri-Loop™ requires burst mode communication.

Related information

Use with the Rosemount 333 HART Tri-Loop

Variable mapping

Up to four device variables can be assigned for the HART protocol. The transmitter outputs a 4-20 mA signal proportional to the primary variable. Additional variables are available through the HART digital signal.

Related information

Output variables

Damping value

This parameter defines how fast the transmitter reacts to a change of the level value (step response). The default value is 2 seconds.

A high value makes the level reading steady, while a low value allows the transmitter to respond to rapid level changes (but the presented level value may be less steady).

Percent of range auxiliary

Set this parameter to output the percent of range for another device variable (in addition to the primary variable).

Table B-1: Percent of range auxiliary

Parameter	Description
Percent of range auxiliary	The variable selected for percent of range auxiliary.
100% auxiliary	Value corresponding to 100 percent range of variable selected for percent of range auxiliary.
0% auxiliary	Value corresponding to 0 percent range of variable selected for percent of range auxiliary.

B.2.2 Units

The units for length, volume, temperature, and level rates are selectable. All configuration parameters and device variables will be expressed in these units.

Related information

Output units

B.2.3 Analog output

The output source (primary variable), range values, and alarm mode are specified for the analog output.

Primary variable

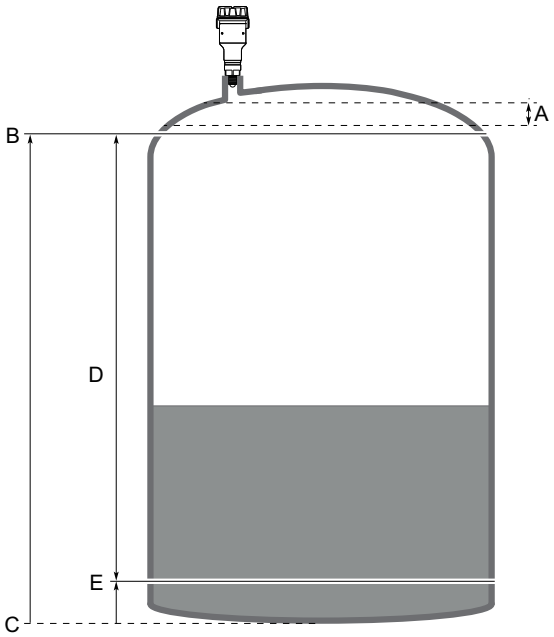
Select the desired device variable to use for the analog output.

Upper/lower range value

Enter the range values that correspond to the analog output values 4 and 20 mA. The transmitter will drive the output to saturation mode if a measured value goes outside the 4-20 mA range values.

Note
The 20 mA point should be set below the reduced accuracy zone at the top of the tank.

Figure B-3: Example of Range Value Settings



A. Reduced accuracy zone
B. 100% (20 mA)
C. Zero Level
D. Level measurement range 0-100%
E. 0% (4 mA)

Related information

Accuracy over measuring range

Alarm mode

The transmitter automatically and continuously performs self-diagnostic routines. If a failure or a measurement error is detected, the transmitter drives the output to selected alarm limit (high or low).

High/low alarm value

The high/low alarm current for the analog output when the device enters the alarm mode.

Related information

Analog signal on alarm

High/low saturation value

The device will continue to set a current that corresponds with the measurement until reaching the upper/lower limit (and then freeze).

Related information

Analog saturation levels

B.2.4 Display

Select variables to show on the optional LCD display. If more than one variable is selected, then the LCD display toggles between the output variables.

Display language

The display can be configured to be in different languages.

Display orientation

The display text can be rotated 180 degrees.

Related information

Set up the LCD display

B.2.5 Security

Write protection

The Rosemount 3408 supports both software and hardware write protection.

SW write protection

The transmitter can be write protected (with or without a password) to prevent unintentional changes.

HW write protection

The security switch is used to prevent changes to the configuration data. In the locked (🔒) position, all writes to the transmitter are rejected.

B.2.6 Safety Instrumented System

Operational mode

The IEC 61508 certified version has two operational modes: Control/Monitoring and Safety (SIS).

If the transmitter is used as safety device in a Safety Instrumented System, the operational mode must be set to Safety (SIS).

Safety mode

When the operational mode is set to Safety (SIS), then the Safety Mode must be enabled for the transmitter to become operational. When Safety Mode is enabled, the transmitter is write protected (with or without a password) to prevent unauthorized changes.

Change counter

A counter that increments each time the device enters active Safety Mode.

B.2.7 Bluetooth®

Bluetooth radio ID

The unique identifier for this device's Bluetooth radio.

Number of Bluetooth security resets

A counter of the number of times a Bluetooth security reset has been performed on this device.

B.2.8 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).

Date

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

Descriptor

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

Message

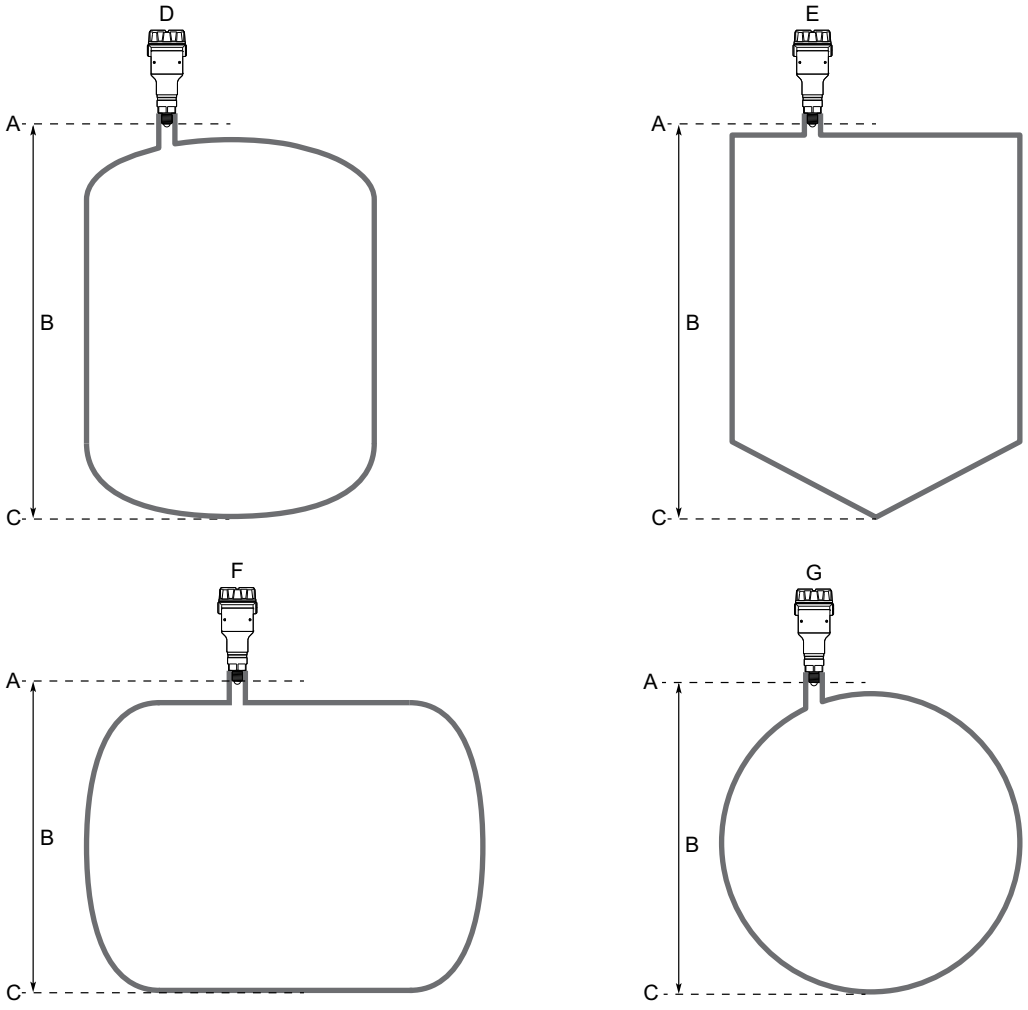
The 32-character message field can be used for any purpose, such as providing details of the last configuration change.

B.3 Level setup

B.3.1 Geometry

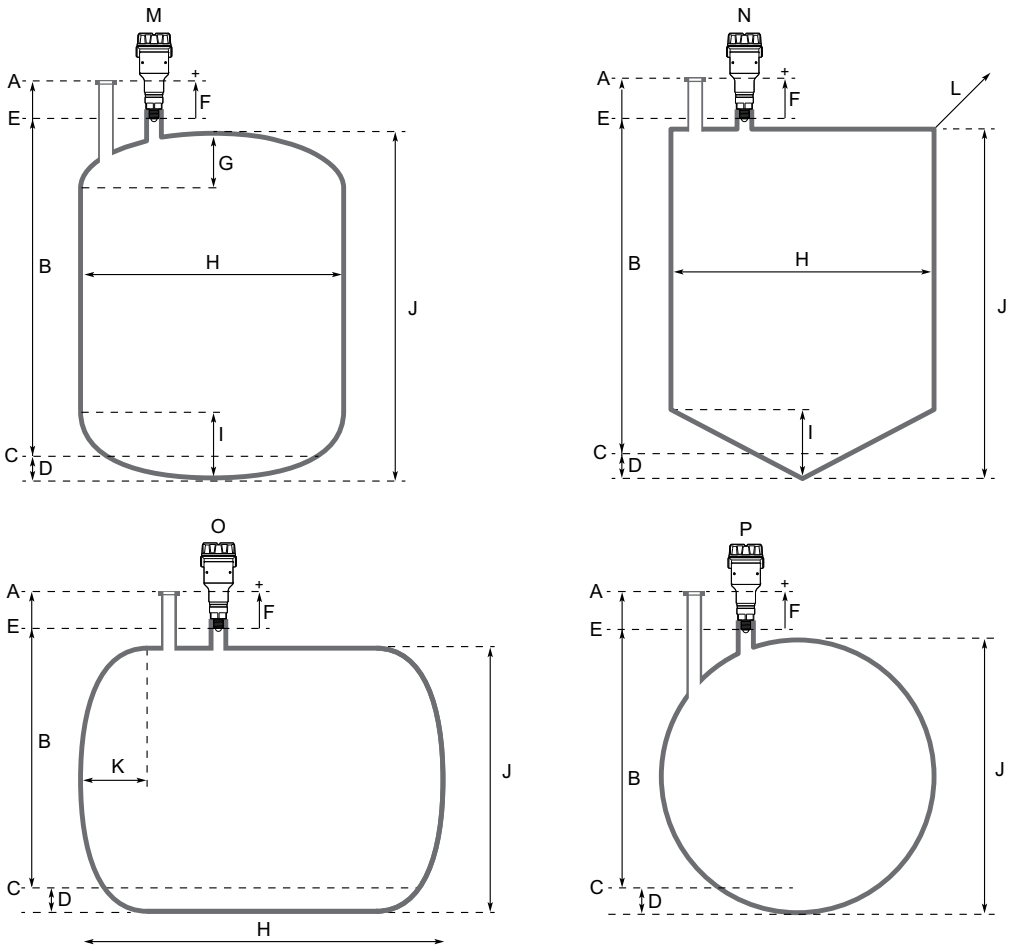
The transmitter configuration includes setting the tank geometry parameters, see Figure B-4 and Figure B-5.

Figure B-4: Tank Geometry, Basic Dimensions



A. Device Reference Point
B. Reference Height
C. Zero Level
D. Vertical cylinder
E. Cubical tank
F. Horizontal cylinder
G. Spherical tank

Figure B-5: Tank Geometry, All Dimensions



A.	Tank Reference Point	I.	Bottom Shape Height*/Bottom Height**
B.	Reference Height	J.	Height of Tank*/Height (of tank)**
C.	Zero Level	K.	End Shape Length*/End Length**
D.	Bottom Offset	L.	Length of Tank*/Length**
E.	Device Reference Point	M.	Vertical cylinder
F.	Reference Offset	N.	Cubical tank
G.	Top Shape Height*/Top Height**	O.	Horizontal cylinder
H.	Width of Tank*/Width**	P.	Spherical tank

* DD

** UIP (Rosemount Radar Master Plus)

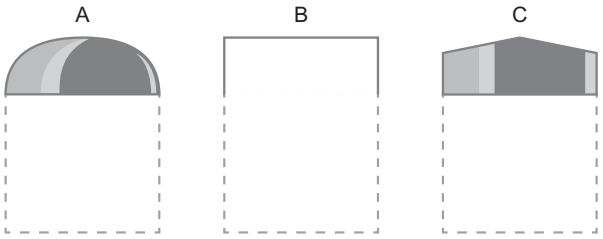
Tank shape

Select a tank shape that corresponds to the actual tank. If the actual tank does not match one of the pre-defined tank shapes, then select Other (e.g. level measurements of sumps, basins, or ponds).

Tank top shape

Form of the upper tank closure.

Figure B-6: Tank Top Shape

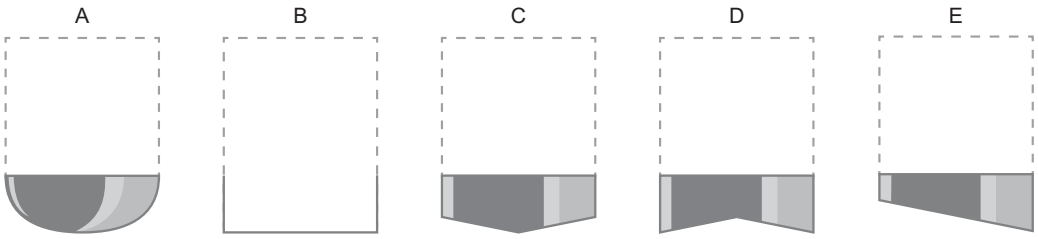


A. Dome
B. Flat
C. Conical

Tank bottom shape

Form of the lower tank closure.

Figure B-7: Tank Bottom Shape



A. Dome
B. Flat
C. Conical/pyramid
D. Flat, inclined (for vertical cylinder)
E. Flat, inclined (for cubical tank)

Tank end shape

For a horizontal tank, form of the tank ends. Same shape is assumed at both ends.

Figure B-8: Tank End Shape



A. Dome
B. Flat

Reference height

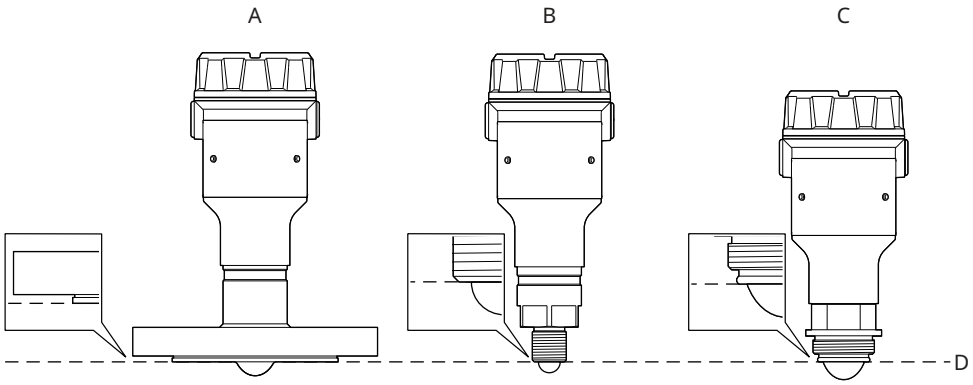
Distance between the Tank Reference Point (typically same as Device Reference Point) and Zero Level.

Ensure the Reference Height is set as accurate as possible. The transmitter measures the distance to the product surface and subtracts this value from the Reference Height to determine the level.

Device reference point

Figure B-9 shows the Device Reference Point for various antennas.

Figure B-9: Device Reference Point



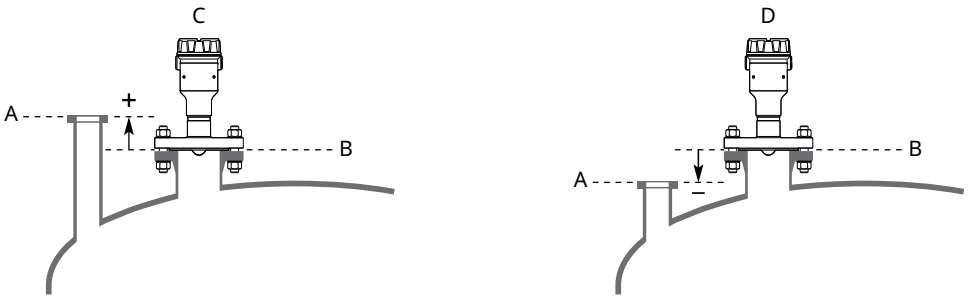
A. Process seal antenna
B. Lens antenna
C. ATAP lens antenna
D. Device Reference Point

Reference offset

Distance between the Device Reference Point and the Tank Reference Point (typically the upper side of a customer plug where levels can be manually measured).

The Reference Offset parameter can be used to specify your own reference point, for example when the measured level by the transmitter should correspond with the level value obtained by hand-dipping.

Figure B-10: Reference Offset



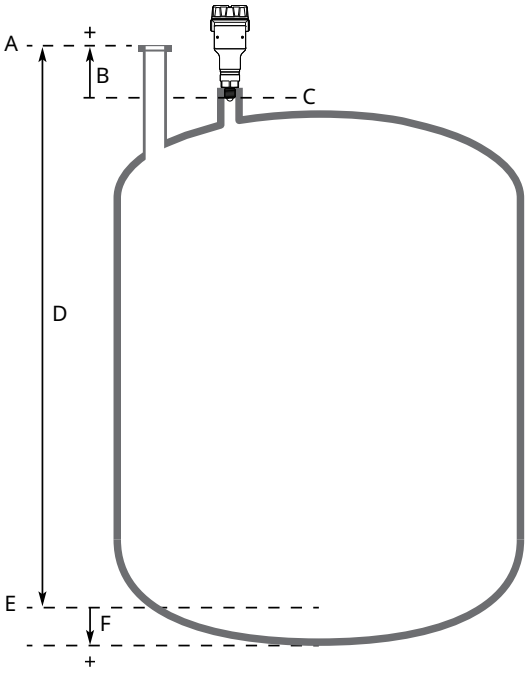
A. Tank Reference Point
B. Device Reference Point
C. Reference Offset > 0
D. Reference Offset < 0

Bottom offset

The Bottom Offset is defined as the distance between Zero Level and the tank bottom. The default value is zero.

If the Zero Level is not located at the tank bottom, then enter a Bottom Offset. It is needed for the transmitter to know the position of the tank bottom echo and for correct volume calculations.

Figure B-11: Bottom Offset



A. Tank Reference Point
B. Reference Offset
C. Device Reference Point
D. Reference Height
E. Zero Level
F. Bottom Offset

Height of tank

The vertical distance between tank bottom and tank roof. For a horizontal cylinder or spherical tank, this is the diameter of the tank.

Width of tank

The horizontal distance between tank ends. For a vertical cylinder, this is the diameter of the tank. The width of tank is also the shortest horizontal side of a box-shaped (cubical) tank.

Length of tank

The longest horizontal side of a cubical tank.

Top shape height

The height of the shape on tank top (typically from shape floor to cap top, measured at cylinder center line).

Bottom shape height

The height of the shape at tank bottom (typically from shape floor to shape bottom, measured at cylinder center line).

End shape length

The width of the spherical cap at tank end (measured at cylinder center line).

Show negative level as zero

When this setting is selected and the product surface is at or below Zero Level, the level measurement output will be zero.

B.3.2 Environment

Product type

The media (liquid/solid) used in the monitored process.

- Liquid (requires measurement type code 1 or 4)
- Solid (requires measurement type code 3 or 4)

The solids measurement mode should never be used for measuring liquid products due to the solids specific signal processing method, and vice versa.

Process conditions

Foam

This parameter should be used if there is, or may be, surface foam. When setting this parameter, the transmitter is optimized for conditions with weak and varying surface echo amplitudes, which is typical for presence of surface foam.

Turbulent surface

Set this parameter to improve the performance of the transmitter when there are small and local rapid level changes caused by surface turbulence. The reason for the turbulence might be splash loading, agitators, mixers, or boiling product.

Cleaning in place

Optimize measurement performance for applications with tank cleaning processes.

Maximum level rate

Fastest rate that may occur in the monitored process to (partially) fill or empty this tank. Note that product level rate may be higher during upset conditions.

Product dielectric range

Select the range of the dielectric constant for the product in the tank. If the range is not known, or if the product in the tank is changed on a regular basis, then select Default.

B.3.3 Volume

Volume calculation method

Select if the volume measurement should be calculated from the configured tank dimensions or a strapping table.

Strapping table

Strapping tables can be used for irregularly shaped tanks, to eliminate errors due to bulging when product is added to a tank, or if a pre-defined tank type does not provide sufficient accuracy.

Strapping table requires entering level-volume pairs in a table (maximum 50 points). Use most of the strapping points in regions where the tank shape is non-linear. Starting at the bottom of the tank, for each new point, enter the total volume up to the specified level value.

Volume offset

Use this parameter to add a volume to each calculated volume value, for example a sump volume below the Zero Level in the tank.

B.3.4 Scaled variable

The scaled variable can be used to convert a device variable into an alternative measurement, such as open channel flow, mass, or calibrated level (e.g. 5 point verification). This variable is available only for transmitters ordered with Smart Diagnostics Suite or Smart Meter Verification (professional).

The scaled variable is defined by creating a table of device variables and corresponding output variables. A maximum of 50 points can be specified. Between the points linearly interpolated values are calculated.

Table B-2: Scaled Variable Examples

Input variable	Output variable
Level	Flow
Volume	Mass
Level	Calibrated Level

As an example, consider a product with a density of 900 kg/m^3. In this case, the volume to mass conversion is given by Table B-3.

Table B-3: Example of Scaled Variable Table

Number	Input value (volume)	Output value (mass)
1	0 m^3	0 kg
2	100 m^3	90 000 kg

Scaled variable name

Name of the scaled variable. It is recommended to enter a short name to fit into the LCD display area.

Scaled variable unit

Units of measurement of the scaled variable.

Number of scaled values

Number of values in the scaled variable table.

Input variable

Select the input variable to use for scaled variable calculation.

B.3.5 Antenna

Antenna type

The transmitter is designed to optimize measurement performance for each available antenna type. This parameter is pre-configured at factory; it only needs to be set if the antenna is changed to another type, or if you have installed a spare transmitter.

User defined antenna options

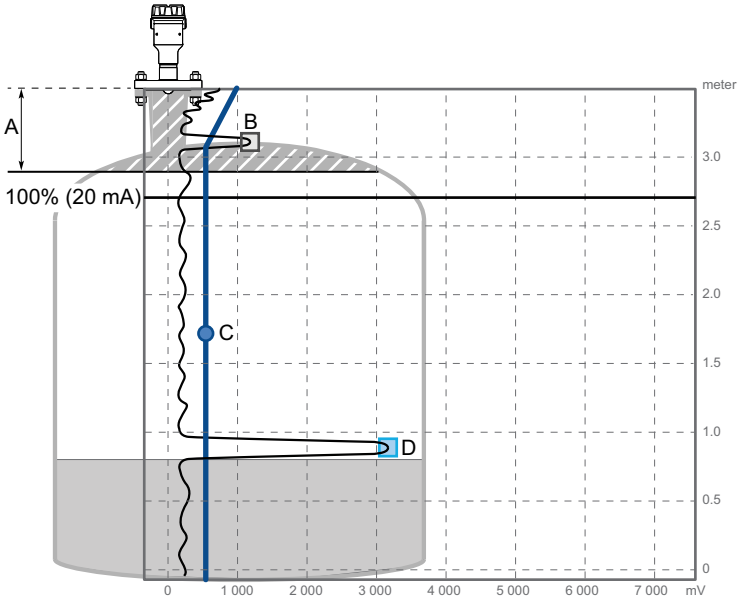
These antenna parameters are applicable to customized antennas only. The settings are typically provided by factory.

Upper null zone

The Upper Null Zone defines how close to the device's reference point a level value is accepted. You can extend this value to block out disturbing echoes close to the antenna, for example from the tank nozzle.

Note
Make sure the 20 mA value is below the Upper Null Zone. Measurements are not performed within the Upper Null Zone (UNZ).

Figure B-12: Upper Null Zone



A. Upper Null Zone
B. Disturbance echo
C. Amplitude threshold
D. Product surface echo

Related information

Change the upper null zone

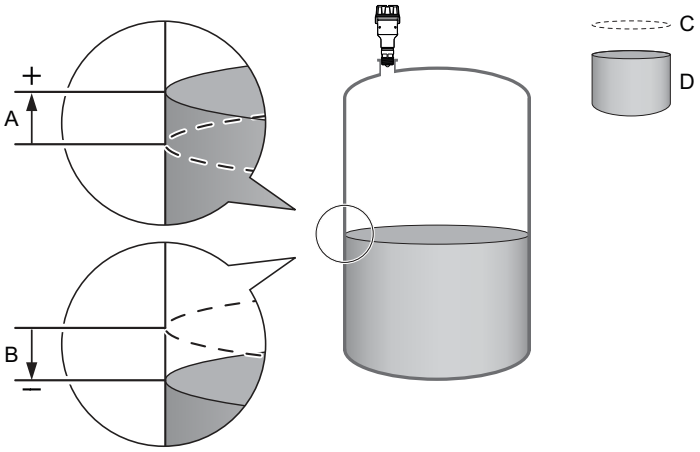
B.3.6 Advanced

Calibration offset

Difference between surface distance measured by transmitter and the same distance measured by, for example, hand-dipping with a measurement tape. A positive Calibration Offset value will increase the presented level value.

It is recommended to run the Verify Level tool to match the product level reported by the transmitter to a reference measurement.

Figure B-13: Calibration Offset



A. Positive Calibration Offset value
B. Negative Calibration Offset value
C. Reported level
D. Actual level

Related information

Run verify level

User defined variable setup

This section applies only to transmitters ordered with Smart Diagnostics Suite or Smart Meter Verification (professional).

Name

Name of the user defined variable. It is recommended to enter a short name to fit into the LCD display area.

Input register

Enter the number of the input register that contains value of the user defined variable. See Table B-4 for a list of suitable input registers.

The default value is 20210 (Distance).

Table B-4: List of Input Registers to the User Defined Variable

Variable	Register	Description
Min Electronics Temperature	20146	Minimum electronics temperature measured by the device (°C)
Max Electronics Temperature	20148	Maximum electronics temperature measured by the device (°C)
Min Signal Quality	21034	Minimum signal quality measured by the device since last signal quality reset. Signal quality calculation must be enabled to use this variable.
Max Signal Quality	21036	Maximum signal quality measured by the device since last signal quality reset. Signal quality calculation must be enabled to use this variable.
Distance to Upper Surface	21042	Distance to the upper product surface (m) when measuring on multiple products in the tanks. Double Surface function must be enabled to use this variable.
Distance to Lower Surface	21044	Distance to the lower product surface (m) when measuring on multiple products in the tanks. Double Surface function must be enabled to use this variable.
Surface Signal/Noise Ratio	21054	Ratio between surface echo signal strength and signal noise (dB). A high value (>20 dB) indicates very good margin to noise.
Product Dielectric Constant	22800	Square root of the product dielectric constant estimated by the transmitter when the Bottom Projection function is enabled. The product dielectric constant is calculated when both the bottom and surface echoes are found by device, and when surface echo is within the Max Projection Distance. Product dielectric constant estimation is frozen if any of these conditions are not fulfilled.

Unit

Units of measurement of the user defined variable.

More advanced options

More advanced options are only available in Rosemount Radar Master Plus.

By default, these parameters are automatically set based on current configuration. It is recommended that these parameters should remain at the default settings, unless there is a good understanding of the function and capability of the parameters.

Empty tank handling

The Empty Tank Handling functions handle situations when the surface echo is close to the tank bottom.

Table B-5: Empty Tank Handling

Parameter	Description
Empty tank detection area	The Empty Tank Detection Area defines a range where it is accepted to lose the echo from the product. If the echo is lost in this range, the tank is considered empty and the level is presented as 0. When the tank is empty, the transmitter looks in this range for the product surface. When a new echo is found in this range, it is considered to be the product surface. Therefore, if there are disturbance echoes in this area, they may need to be filtered out. This function requires the Bottom echo visible when tank is empty parameter to be disabled.
Bottom echo visible when tank is empty	Only enable this parameter if the bottom echo is visible when tank is empty. By setting this parameter, the bottom echo will be treated as a disturbance echo to facilitate tracking of weak surface echoes close to the tank bottom.

Related information

Enable bottom echo visible when tank is empty

Tank bottom projection

Note
This function is not suitable for solids applications.

The Tank Bottom Projection is used to enhance measurements on liquids near the bottom of the tank. When the tank bottom echo is strong (typical for flat tank bottoms) and the dielectric constant of the product is low (e.g. oil), the transmitter may lock on the bottom echo and report a false level measurement (empty tank). This problem can be solved by using the Tank Bottom Projection function.

Table B-6: Tank Bottom Projection

Parameter	Description
Bottom product dielectric constant	Enter the product dielectric constant for the product in the bottom of the tank.
Maximum projection distance	This defines the range where the function is active. Enter the maximum distance from the zero level (tank bottom).
Minimum tank bottom amplitude	Enter the minimum allowed amplitude for the echo from the tank bottom before this function is activated.

Related information

Use tank bottom projection

Echo tracking

Surface echo tracking

Use these settings to configure how the transmitter should keep track of the surface. These are advanced settings. Normally, they should not be changed.

Table B-7: Surface Echo Tracking

Parameter	Description
Search window size	This parameter defines a window centered at the current surface position where new surface echo candidates can be selected. The size of the window is ±Search Window Size. Echoes outside this window will not be considered as surface echoes. If there are rapid level changes in the tank, the value of the Search Window Size can be increased to prevent the transmitter from missing level changes. On the other hand, a large value may cause the transmitter to select an invalid echo as the surface echo.
Track first echo	Select the Track First Echo check box if the first echo above the amplitude threshold always should be considered as the surface echo. **Note** Before enabling Track First Echo, analyze the echo curve and check amplitude thresholds.

Double surface handling

If there are multiple products in the tank, the Double Surface Handling function can be manually set to allow user to select if the upper or lower product should be used as output.

The upper and lower surface echoes must be stronger than any disturbance echoes in the search region for Double Surface Handling to function properly.

Table B-8: Double Surface Handling

Parameter	Description
Track upper surface	Track upper surface when there are multiple products in the tank (for example thin oil layer on top of water).
Track lower surface	Track the lower product surface, such as the interface when there are multiple products in the tank, or the product surface instead of a foam layer.
Upper product dielectric constant	Enter the dielectric constant for the upper product. A more precise value results in better accuracy for the lower surface level.

Double bounce handling

Use this function to prevent transmitter from locking on strong double bounce echoes (may occur in spherical and horizontal cylinder tanks).

Related information

Handling strong double bounce echoes

Overfill prevention

The Overfill Prevention function adds an extra layer of protection to prevent tank overfills. The function uses an independent echo logic algorithm to identify the surface echo close to the top of the tank.

In the unlikely event there is a conflict between the normal and the overfill prevention echo logic, the Overfill Prevention function will have a precedence in determining the position of the surface. The transmitter will then output this new value, or generate an alarm if the normal echo logic is not able to find the surface echo at the new position.

The Overfill Prevention Range defines the lower end of the range in which the function operates. The range is configurable.

Expert options

Use the expert options to view input registers, and to view and edit holding registers.

Note
Instructions for how to use Expert options are typically provided by factory and should only be modified if required.

Related information

View input registers
View holding registers

B.4 Alert setup

B.4.1 Measurement recovery

Measurement recovery time

The Measurement Recovery Time (Echo Timeout) parameter controls the maximum time from when measurement is lost (e.g. due to process conditions such as foam or turbulence) until it is annunciated. If measurement is recovered within the time specified by this parameter, then it will not be annunciated.

Measurement recovery handling

By default, the Measurement Recovery Time is set up automatically by the device based on the transmitter configuration.

It is recommended to leave the Measurement Recovery Handling at default unless required by your application. A higher value may be entered to increase robustness and avoid nuisance alarms. Only enter a lower value if lost measurement is required to be annunciated within a certain time for your application.

Used measurement recovery time

This is the value used by the transmitter.

B.4.2 Signal quality alert

This section applies only to transmitters ordered with Smart Diagnostics Suite or Smart Meter Verification (professional).

Signal Quality is a measure of the product surface echo amplitude compared to the surface threshold and noise.

The Signal Quality spans from 0 to 10. A low value means that there is a risk for the noise peak to be mistaken for the product surface peak.

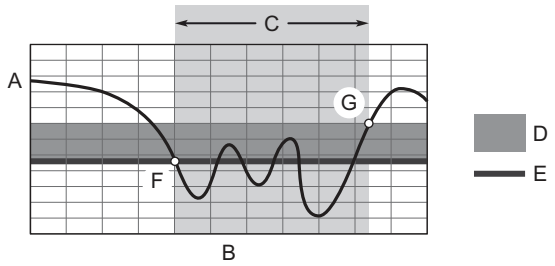
Note
The Signal Quality may not be 10 even if the antenna is clean. The value depends on antenna type, application conditions, configured surface threshold, as well as the condition of the antenna.

Build up on the antenna and different surface conditions are factors that can result in a low Signal Quality value. By setting an alert, the Signal Quality value can be used to schedule maintenance to clean the antenna, fine-tune the surface threshold, or detect and monitor adverse surface conditions such as turbulence or foam.

Note
Signal strength fluctuations are common when measuring solids, so Signal Quality alerts may not be appropriate in this case.

Suitable alert limits vary from application to application. Appropriate value can be determined by logging Signal Quality over time and viewing maximum/minimum values. The Signal Quality Alert limit should be at least 1, but a better guideline is 2-3.

Figure B-14: Signal Quality Alert



A. Signal quality
B. Time
C. Alert ON
D. Deadband
E. Limit
F. The Signal Quality drops below the alert limit and an alert message is triggered.
G. The alert message is reset once the Signal Quality value rises above the Deadband range.

Limit

The Signal Quality value that will trigger the alert.

Deadband

The Deadband is a buffer zone so the alerts do not toggle on and off when the Signal Quality fluctuates around the alert limit. The alert is set when value falls below the alert limit. The alert is then cleared when value rises above the Deadband range.

B.4.3 High/low user defined alert

A high and low alert may be established to output an alert message when the measurement readings exceed the specified limits.

Variable

Select the device variable to use for the alert.

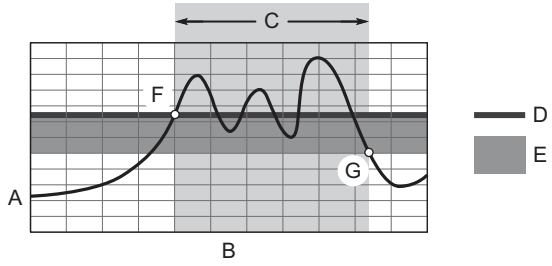
Limit

The value that will trigger the alert.

Deadband

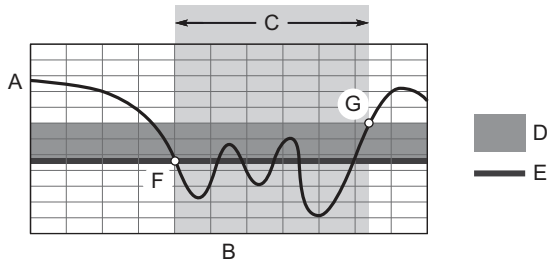
The Deadband is a buffer zone so the alerts do not toggle on and off when the measurement value fluctuates around the alert limit. The alert is set when the value exceeds the alert limit. The alert is then cleared when the value falls outside the Deadband range.

Figure B-15: High User Defined Alert



A. User Defined Alert
B. Time
C. High Alert ON
D. Limit
E. Deadband
F. The alert is active when the level value rises above the alert limit.
G. The alert turns off when the value falls below the deadband.

Figure B-16: Low User Defined Alert



A. User Defined Alert
B. Time
C. Low Alert ON
D. Deadband
E. Limit
F. The alert is active when the level value falls below the alert limit.
G. The alert turns off when the value rises above the deadband.

00809-0100-4418
Rev. AF
2025

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