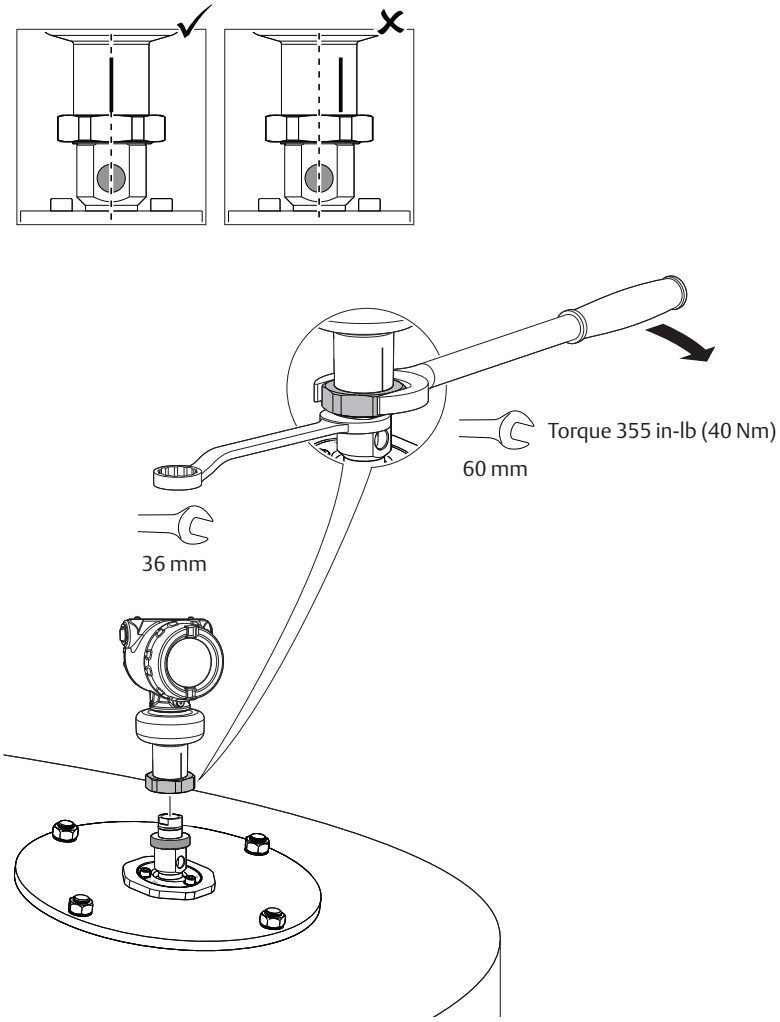
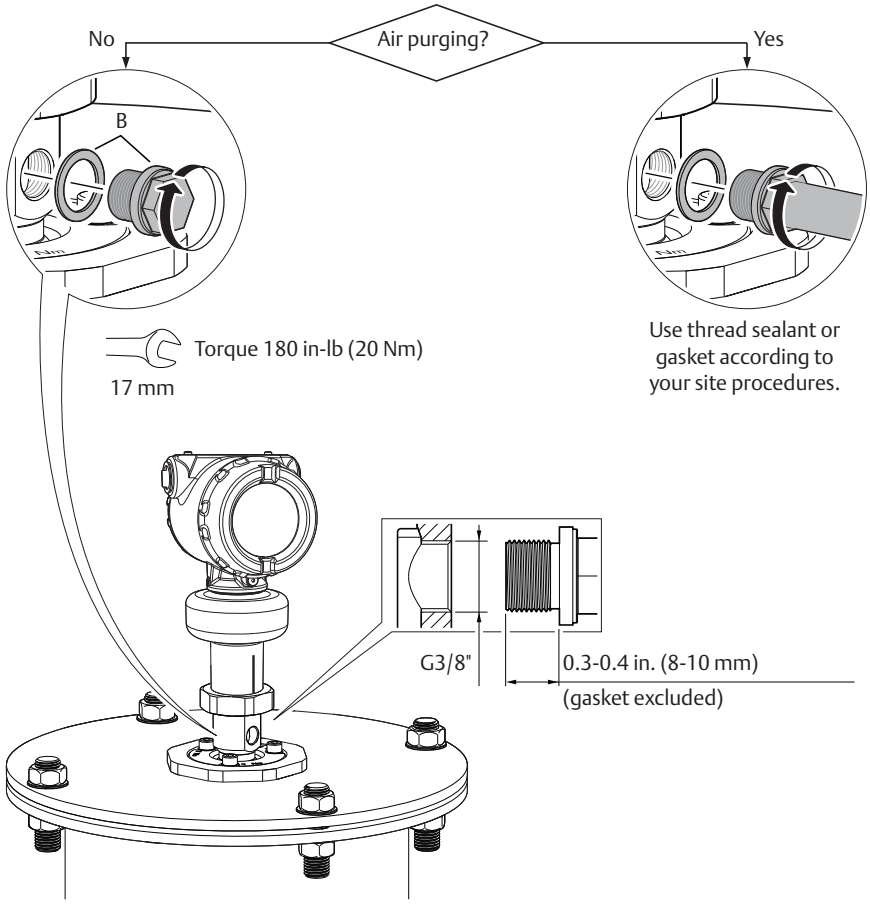
7. Mount the transmitter head.

   Align the marking on sensor module with the air purge connection.



3.5.5 Connect the air purging

If air purging is not used, plug and seal the entry with the air plug kit (optional with order) or a suitable blanking plug.

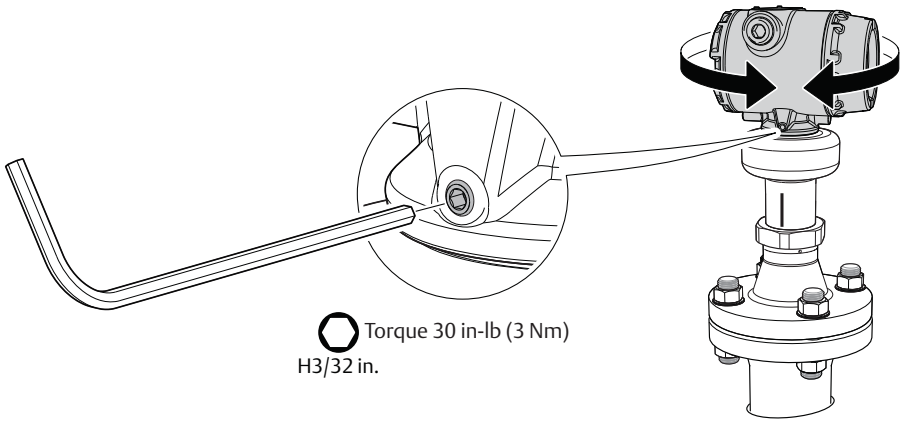


3.6 Adjust display orientation (optional)

To improve field access to wiring or to better view the optional LCD display:

1. Loosen the set screw until the transmitter housing can rotate smoothly.
2. First, rotate the housing clockwise to the desired location. If the desired location cannot be achieved due to thread limit, rotate the housing counterclockwise to the desired location (up to 360° from thread limit).
3. Re-tighten the set screw.

Figure 3-13. Rotate the Transmitter Housing



Section 4 Electrical Installation

4.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operation. Information that raises potential 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 service guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a Field Communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Do not remove the transmitter covers in explosive atmospheres when the circuit is alive.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.
- Make sure the main power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

4.2 Cable selection

Use 24-14 AWG wire. Twisted pairs and shielded wiring are recommended for environments with high EMI (electromagnetic interference).

The cables must be suitable for the supply voltage and approved for use in hazardous areas, where applicable. Two wires can be safely connected to each terminal screw.

4.3 Cable gland/conduit

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

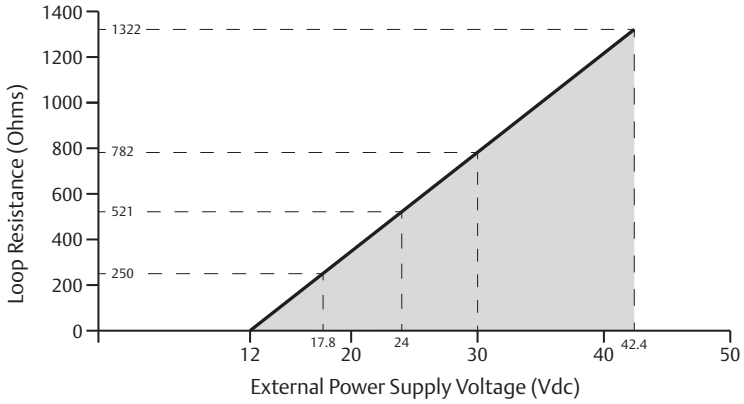
4.4 Power supply

The transmitter operates on 12-42.4 Vdc (12-30 Vdc in Intrinsically Safe installations) at the transmitter terminals.

For HART communication, a minimum loop resistance of 250 Ω is required. Maximum loop resistance is determined by the voltage level of the external power supply, as described by Figure 4-1.

Figure 4-1. Load Limits

Maximum Loop Resistance = 43.5 * (External Power Supply Voltage - 12)

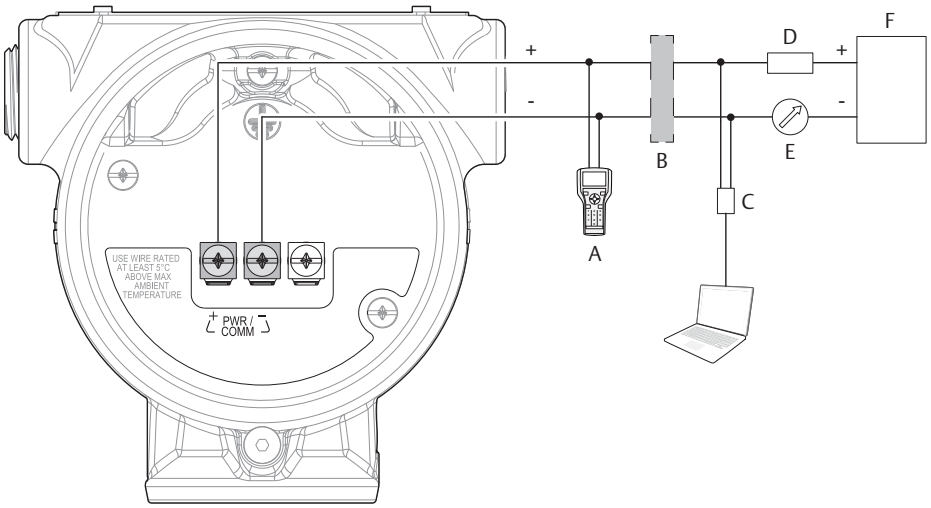


4.5 Hazardous areas

When the transmitter is installed in hazardous areas, local regulations and specifications in applicable certificates must be observed. See Appendix B: Product Certifications for more information.

4.6 Wiring diagram

Figure 4-2. 4-20 mA/HART Communication



A. Field Communicator
B. Approved IS barrier (for Intrinsically Safe installations only)
C. HART modem
D. Load resistance (≥250 Ω)
E. Current meter

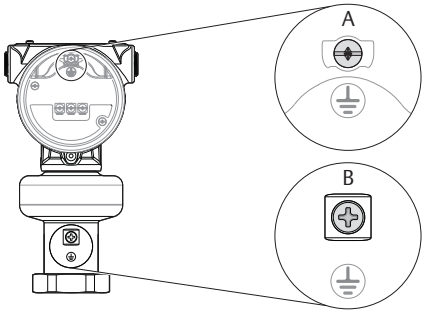
4.7 Grounding

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

4.7.1 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 4-3).

Figure 4-3. Ground Screws



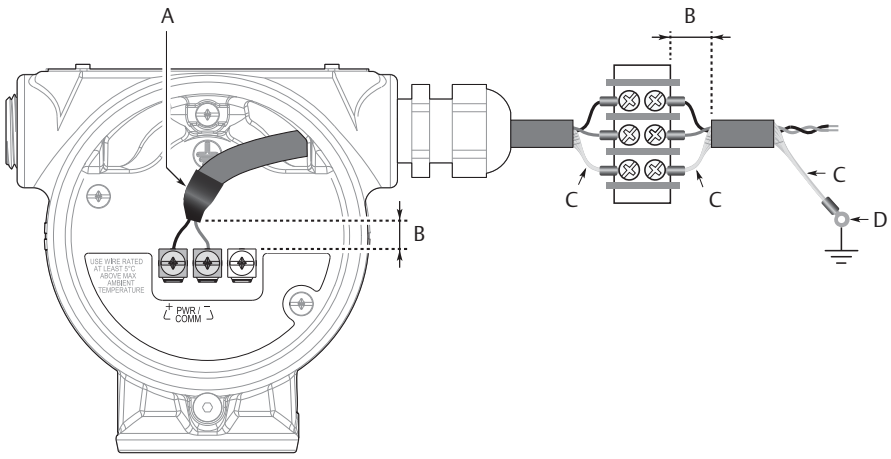
A. Internal ground screw
B. External ground screw

4.7.2 Signal 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 4-4. Cable Shield

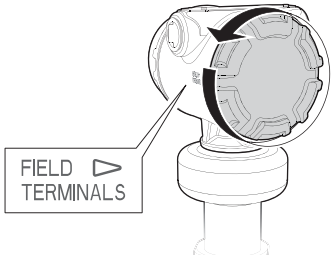


A. Insulate shield
B. Minimize distance
C. Trim shield and insulate
D. Connect shield back to the power supply ground

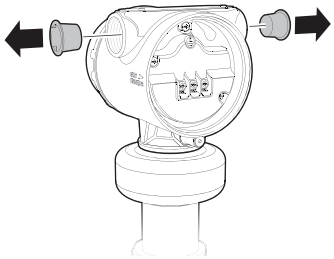
4.8 Wiring and power up

⚠ 1. Verify the power supply is disconnected.

2. Remove the cover.

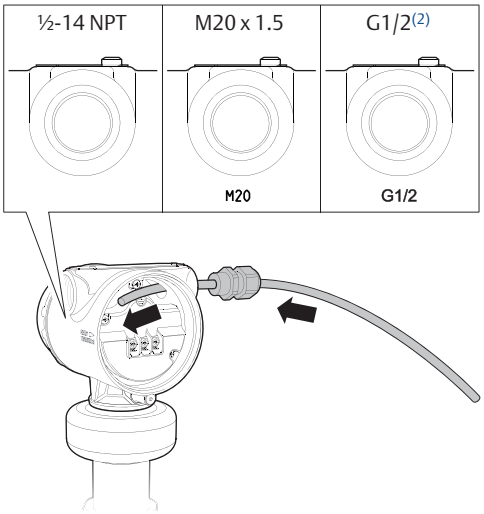


3. Remove the plastic plugs.



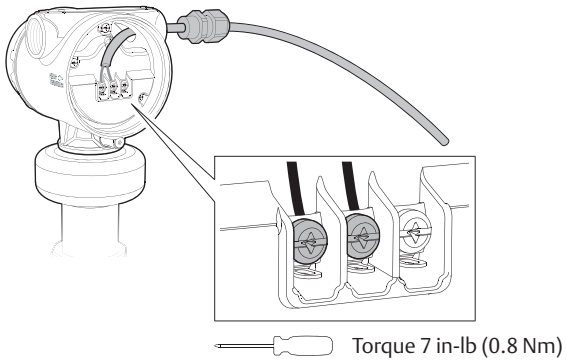
4. Pull the cable through the cable gland/conduit.[1]

Identification of thread size and type



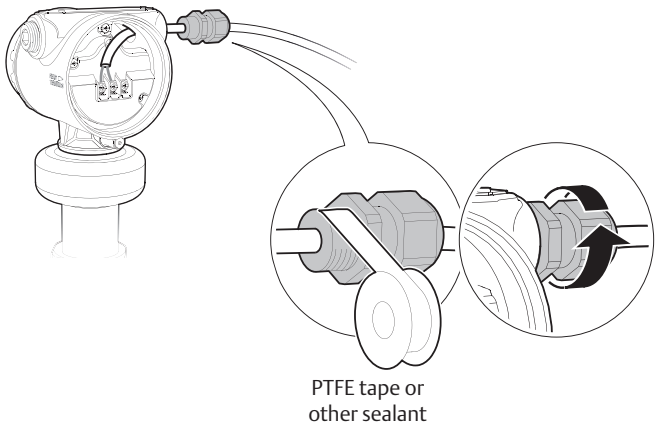
1. *Unless marked, the conduit/cable entries in the transmitter housing use a 1/2–14 NPT thread form.*
2. *G1/2 thread form is not allowed for explosion-proof/flameproof installations.*

5. Connect the cable wires (see "Wiring diagram" on page 55).

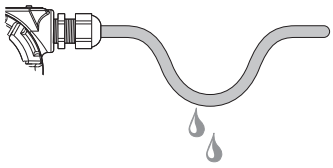


6. Ensure proper grounding (see"Grounding" on page 55).

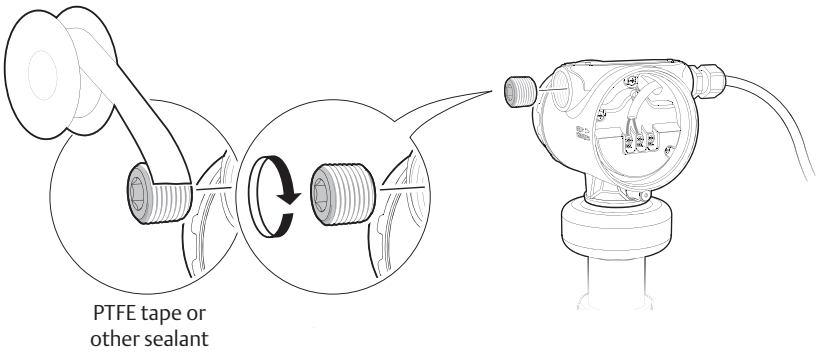
7. Tighten the cable gland.



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

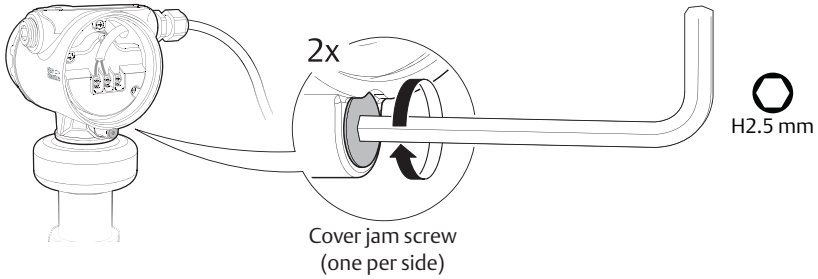


8. Seal any unused ports with the enclosed metal plug.

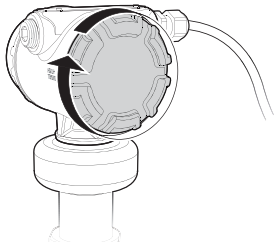


9. Attach and tighten the covers. Make sure the covers are fully engaged.

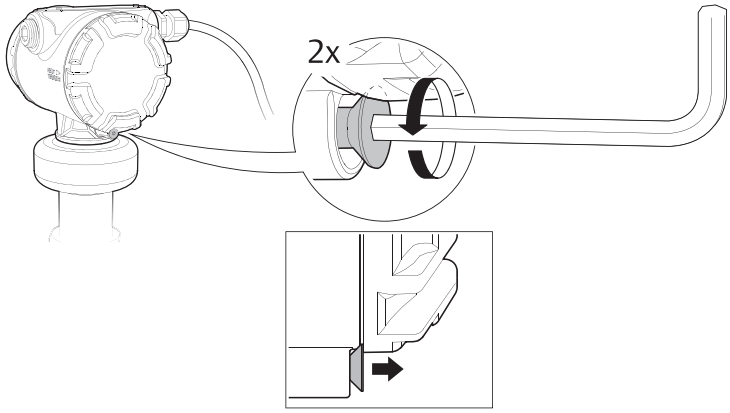
   a. Verify the cover jam screws are completely threaded into the housing.



   b. Attach and tighten the covers.



   c. Turn the jam screw counterclockwise until it contacts the cover.
   ⚠ Required for explosion-proof/flameproof installations only.



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

10. Connect the power supply.

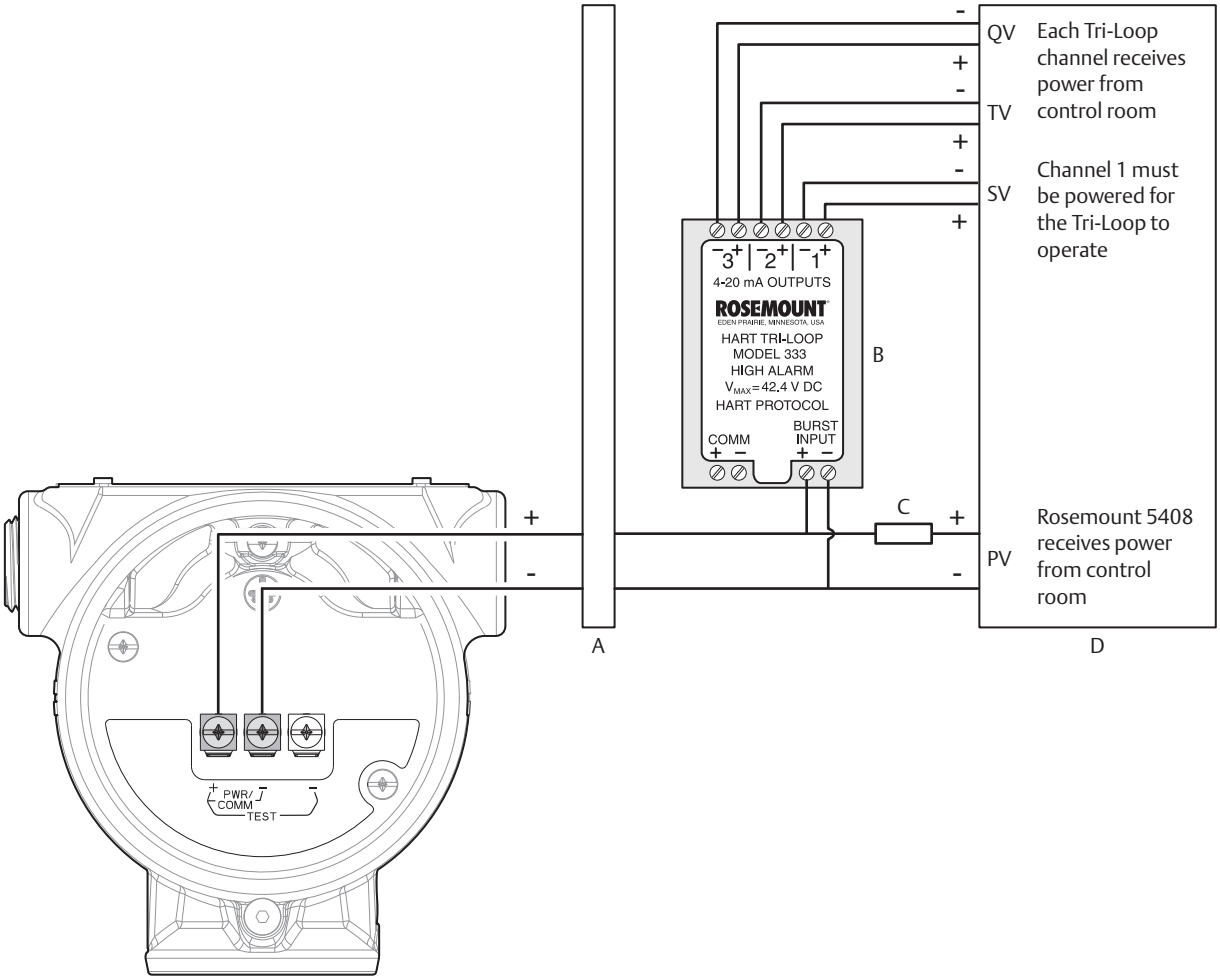
Note
It may take up to 15 seconds before the LCD display lights up.

4.9 Optional devices

4.9.1 Rosemount 333 HART Tri-Loop™

The Rosemount 5408 and 5408:SIS Level Transmitters output a HART signal with four process variables. By using the Rosemount 333 HART Tri-Loop HART-to-Analog Signal Converter, up to three additional analog 4-20 mA outputs are provided.

Figure 4-5. Example Installation of Rosemount 333 Tri-Loop with Rosemount 5408



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

Refer to the Rosemount 333 HART Tri-Loop Reference Manual for further information on how to install and configure the Rosemount 333.

Section 5 Configuration

5.1 Safety messages

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

⚠WARNING

Explosions could result in death or serious injury.

- Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a Field Communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Do not remove the transmitter covers in explosive atmospheres when the circuit is alive.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

5.2 Overview

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

5.3 Get started with your preferred configuration tool

The Rosemount 5408 and 5408:SIS Level Transmitters can easily be configured by using:

- Rosemount Radar Master (running in Instrument Inspector™)
- Device Descriptor (DD) based systems, e.g. AMS™ Device Manager, 475 Field Communicator, and DeltaV™
- Field Device Integration (FDI) based systems

Rosemount Radar Master is the recommended tool for configuration.

5.3.1 Rosemount Radar Master

The Rosemount Radar Master is a user-friendly software package that includes basic configuration options as well as advanced configuration and service functions. The Instrument Inspector application or any FDI compliant host is needed to run Rosemount Radar Master.

Instrument Inspector is shipped with every transmitter. See the CD installation guide for a list of supported HART modems and system requirements.

Instrument Inspector is also available at:
http://www2.emersonprocess.com/en-US/brands/amssuite/FDI-Configuration-Tool/Pages/FDI-Configuration-Tool.aspx

Get the latest FDI Package

The FDI Package is typically installed together with Instrument Inspector.

To download the latest FDI Package, visit the Emerson Process Management Device Install Kit site at EmersonProcess.com/devicefiles.

After downloading, add the FDI Package to Instrument Inspector:

1. Start **Instrument Inspector**.
2. From the menu bar, select  , and then select **Add Device Package**.
3. Browse to the downloaded FDI Package and select **Open**.
4. Select **Add**.

5.3.2 AMS Device Manager

Get the latest Device Descriptor (DD)

The Device Descriptor (DD) is a configuration tool that is developed to assist the user through the configuration. The DD is typically installed together with AMS Device Manager.

To download the latest HART DD, visit the Emerson Process Management Device Install Kit site at EmersonProcess.com/devicefiles

After downloading, add the DD to AMS Device Manager:

1. Close AMS Device Manager.
2. Click the **Start** button, and then select **All Programs** > **AMS Device Manager** > **Add Device Type**.
3. Browse to the downloaded DD files and select **OK**.

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

Configure the HART® modem interface

Before connecting to the device using a HART modem, the HART modem interface must be configured in AMS Device Manager:

1. Close AMS Device Manager.
2. Click the **Start** button, and then select **All Programs** > **AMS Device Manager** > **Network Configuration**.
3. Select **Add**.
4. In the drop down list, select **HART modem** and select **Install**.
5. Follow the on-screen instructions.

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

5.3.3 Field Communicator

An overview of the Field Communicator is shown in Figure 5-1. See Figure C-2 on page 161 for a menu tree diagram.

Figure 5-1. 475 Field Communicator

A. Power key
B. Navigation keys
C. Tab key
D. Backlight key
E. Enter key
F. Function key
G. Alphanumeric keypad

Get the latest Device Descriptor (DD)

If the DD is not included in your 475, then use the Easy Upgrade Utility to update the Field Communicator with the latest DD.

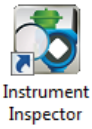
For more information on how to update the device descriptors and all the capabilities, see the 475 Field Communicator User's Manual, available at www.fieldcommunicator.com.

5.4 Configure device using Guided Setup

The options available in the Guided Setup wizard include all items required for basic operation. All basic configuration parameters are described in Appendix C: Configuration Parameters.

Rosemount Radar Master

1. Click the **Start** button, and then select **All Programs** > **Emerson Process Management** > **Instrument Inspector** > **Instrument Inspector** or double-click the **Instrument Inspector** icon on the Windows™ desktop.



2. Under *HART*, double-click the device icon.
3. From the *Overview* screen, select **Rosemount Radar Master**.
4. Under *Configure*, select **Guided Setup** and follow the on-screen instructions.

AMS Device Manager

1. Click the **Start** button, and then select **All Programs** > **AMS Device Manager** > **AMS Device Manager**.
2. Select **View** > **Device Connection View**.
3. In the *Device Connection View*, double-click the HART modem icon.
4. Double-click the device icon.
5. From the *Home* screen, select **Configure** > **Guided Setup**.
6. Select **Basic Setup** and follow the on-screen instructions.

Field Communicator

1. Turn on the Field Communicator.
2. From the *Main Menu*, tap the HART symbol. The Field Communicator now connects to the device.
3. From the *Home* screen, select **Configure** > **Guided Setup**.
4. Select **Basic Setup** and follow the on-screen instructions.

5.5 Verify Level

Run the Verify Level tool to match the product level reported by the device to a reference measurement (measured by using for example handgauging).

If any difference, the Calibration Offset parameter will be adjusted as shown in Figure 5-2. A minor adjustment using Calibration Offset is normal. There may, for example be a deviation between the actual tank height and the configured value.

Note
Before running Verify Level, make sure that; the product surface is calm, the tank is not being filled or emptied, and the actual level is well above the tank bottom.

Verify Level is included as part of the Guided Setup wizard. The tool is also available as follows:

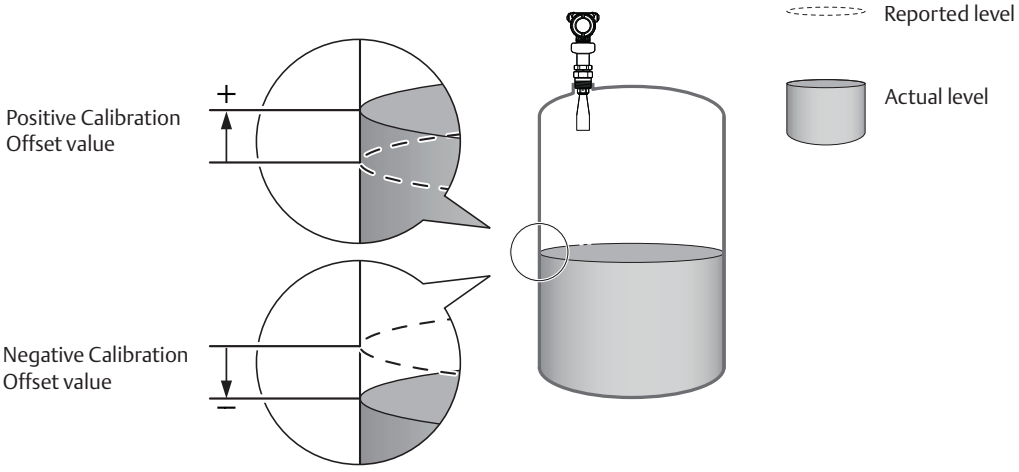
Rosemount Radar Master

1. Under *Configure*, select **Verify Level** to check your level measurement, and follow the on-screen instructions.

AMS Device Manager and Field Communicator

1. From the *Home* screen, select **Configure** > **Guided Setup**.
2. Select **Verify Level** to check your level measurement, and follow the on-screen instructions.

Figure 5-2. Calibration Offset



5.6 Establish 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.

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

5.7 Use with the 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.

AMS Device Manager and Field Communicator

1. Make sure the transmitter is properly configured.
2. If desired, change the measurement units.
   - From the *Home* screen, select **Configure** > **Manual Setup** > **Device Setup** > **Units**.
3. Set the desired transmitter variable to use for Primary Variable (PV), Secondary Variable (SV), Third Variable (TV), and Fourth Variable (QV).
   a. From the *Home* screen, select **Configure** > **Manual Setup** > **Device Setup** > **HART**.
   b. Under *Variable Mapping*, select variables for PV, SV, TV, and QV.
4. Set the Rosemount 5408 to Burst Mode.

   HART Revision 6:

   a. Under *Burst Mode*, select **On**.
   b. Under *Burst Command*, select **PV, SV, TV, QV**.

   HART Revision 7:

   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 *Trigger Mode*, select **Continuous**, and then select **Next**.
   f. Set the Update Rate.
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.

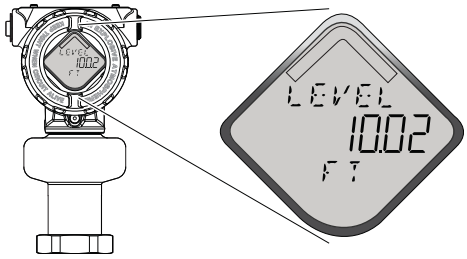
Refer to the Rosemount 333 HART Tri-Loop Reference Manual for full information about installing and configuring the Rosemount 333.

Section 6 Operation

6.1 LCD display screen messages

The optional LCD display shows output variables and abbreviated diagnostic messages.

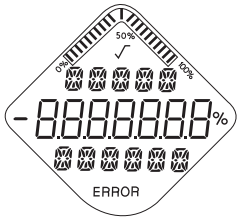
Figure 6-1. LCD Display (Option Code M5)



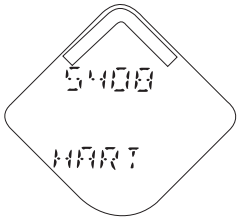
6.1.1 Startup screen sequence

The following screens are shown on the LCD display when the transmitter is switched on:

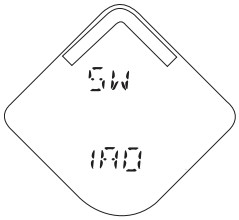
Figure 6-2. Startup Screen Sequence



1. All segments on

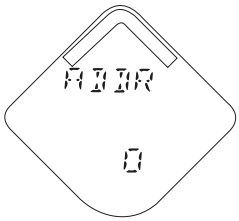


2. Device type and communication protocol



3. Software revision

4. Serial number



5. Device HART® address

6.1.2 Variable screens

The Rosemount 5408 and 5408:SIS Level Transmitters can display the following variables:

Table 6-1. LCD Display Variables

Parameter	Presentation on display	Description
Level	LEVEL	The current level measurement value.
Distance	DIST	Distance from the upper reference point to the product surface.
Level Rate	LR	The current velocity at which the level is moving. A positive value indicates the surface is moving up.
Signal Strength	AMP	The signal amplitude of the surface echo.
Volume	VOLUM	Volume of the product at the current level.
Electronics Temperature	ITEMP	The current temperature at the electronics.
Signal Quality(1)	SIG QUALITY	The quality of product surface echo signal compared to surface threshold and noise.
Scaled Variable(1)	SCALE(2)	A variable calculated from a scaling table (as defined by pairs of input/scaled values).
Percent of Range Primary Variable	PV %RANGE	A variable value expressed in percent within a range defined by a Lower Range Value (LVR) and an Upper Range Value (URV).
Auxiliary Percent of Range	AUX %RANGE	A variable value expressed in percent within a range defined by a Lower Range Value (LVR) and an Upper Range Value (URV).
User Defined Variable(1)	USER(2)	A variable associated with a selected register in the device. Refer Table C-4 on page 175 for a list of suitable register variables.

1. Only for transmitters ordered with Smart Diagnostics Suite (option code DA1).
2. Default, user selectable display text.

6.2 Set up the LCD display

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

Rosemount Radar Master

1. Under *Configure*, select **Device Setup**, and then select the **Display** tab.
2. Select the desired variables to be displayed on the LCD display.
3. Select **Save**.

AMS Device Manager and Field Communicator

1. From the *Home* screen, select **Configure** > **Manual Setup** > **Device Setup** > **Display**.
2. Select the desired variables to be displayed on the LCD display.
3. Select **Send**.

6.3 View measurement data

Measurement values can be viewed using Rosemount Radar Master, AMS™ Device Manager, Field Communicator, or other communicator.

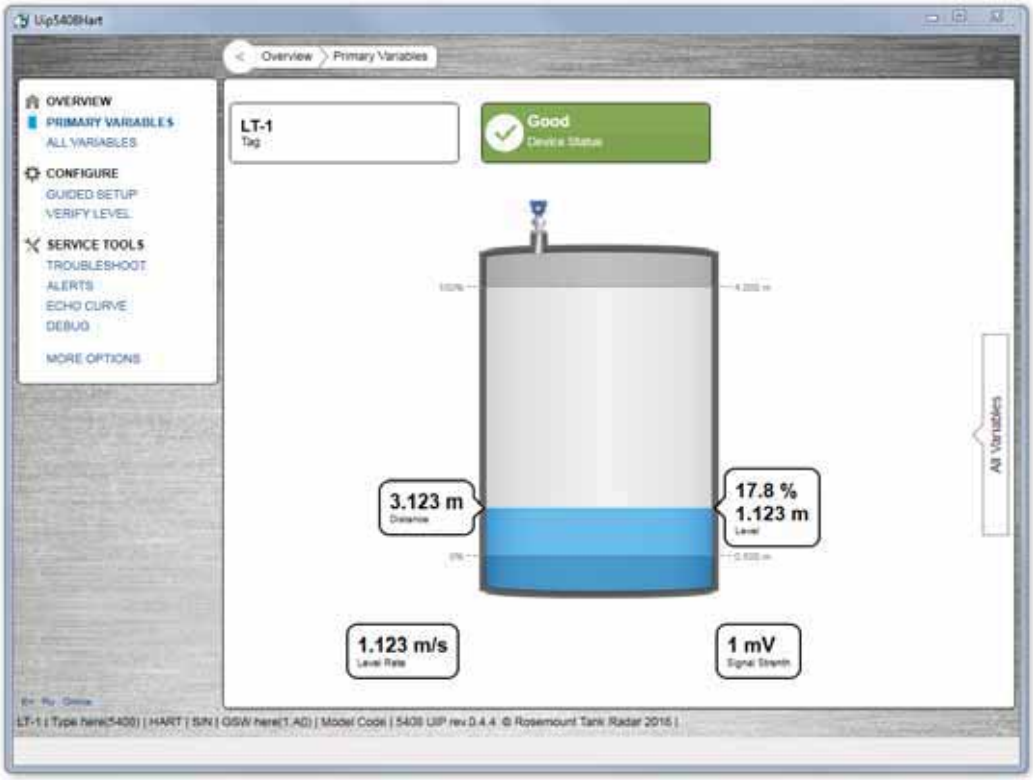
6.3.1 View current measurement values

Rosemount Radar Master

Current measurement data of the primary variables are presented on the *Overview* screen together with a graphical representation of the tank (see Figure 6-3).

- Select **All Variables** to view a complete list of all variables within the transmitter.

Figure 6-3. Overview Screen



AMS Device Manager and Field Communicator

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

1. From the *Home* Screen, select **Service Tools** > **Variables**.
2. Select **Mapped Variable**, **Process**, **Device** or **Signal Quality**.

6.3.2 Interpret measurement status bars

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.

Figure 6-4. Measurement Status Bars

6.4 Check device status

The overall device status is presented under the *Overview* screen in Rosemount Radar Master, AMS Device Manager, and Field Communicator. The transmitter reports diagnostic alerts when there is a device malfunction. For information on these alerts, see “Diagnostic messages” on page 76.

The device can also be configured to report user defined alerts based on the measured variables, see “Alert Setup” on page 173 for more information.

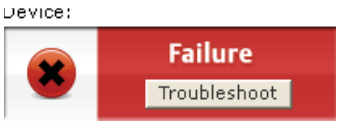
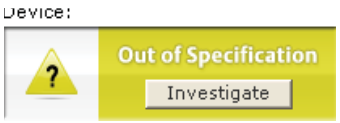
To check device status and see whether there are any active alerts reported, do one of the following:

- Go to the **Overview** screen to view the overall device status. If status is anything than *Good*, click the button in the device status image to open a window with active alerts. The different device status images are shown in Table 6-2.

  OR

- Select **Service Tools** > **Alerts** to view both active and historical alerts.

Table 6-2. Presentation of Device Status Images as per NAMUR NE 107

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.	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 alerts).	
	Maintenance Required	At least one maintenance required alert is active (and no failure or out of specification alerts).	

Section 7 Troubleshooting

7.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operation. Information that raises potential 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 service guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a Field Communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Do not remove the transmitter covers in explosive atmospheres when the circuit is alive.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.
- Make sure the main power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

7.2 Diagnostic messages

Diagnostic messages per NAMUR NE 107 are listed in Table 7-1 to Table 7-5.

Table 7-1. Status - Failed

LCD display message	Host diagnostic message	Description	Recommended actions
ELEC FAILUR	Electronics Failure, Transmitter	An electronics error has occurred. The device measurement reading is invalid.	1. Restart the device. 2. Consider increasing Alarm Delay parameter for intermittent conditions. 3. If the condition persists, replace the transmitter housing.
ELEC FAILUR	Electronics Failure, Sensor Module	An electronics error has occurred. The device measurement reading is invalid.	1. Restart the device. 2. Consider increasing Alarm Delay parameter for intermittent conditions. 3. If the condition persists, replace the sensor module.
MEMRY FAILUR	Device Memory Failure	A device memory error has occurred. The device measurement reading is invalid.	1. Restore default settings, restart device, and reconfigure device. 2. If the condition persists, replace the device.
ANTEN FAILUR	Radar Antenna Disconnected	The device cannot detect the radar antenna. The device measurement reading is invalid.	1. Check that the nut between transmitter and process seal is properly tightened. 2. Check that the antenna connection is dry and clean. 3. Restart the device. 4. If the condition persists, replace the device or the process seal with antenna, or both.
SIGNL FAILUR	Radar Signal Failure	The received radar signal is invalid resulting in an invalid device measurement reading.	1. Clean the antenna. 2. Consider increasing Alarm Delay parameter for intermittent conditions. 3. If the condition persists, replace device.
START FAILUR	Startup Failure	Device repeatedly failed to start up with user configuration settings. The device measurement reading is invalid.	1. Check supply voltage is within range and restart device. 2. Restore default settings, restart device, and reconfigure device. 3. If the condition persists, replace the device.

LCD display message	Host diagnostic message	Description	Recommended actions
SW ERROR	Software Error	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.	1. Restart the device. 2. Restore default settings and reconfigure the device. 3. If the condition persists, replace the device.
MEAS FAILUR	Level Measurement Lost	No valid level reading. Reasons may be multiple: ■ No valid surface echo peak in the measuring range. ■ Incorrect device configuration.	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 Alarm Delay parameter for intermittent conditions. 4. Restart the device. 5. Restore default settings and reconfigure the device. 6. If the condition persists, replace the device.
CONFG ERROR	Configuration Error	The device has detected a configuration error. Reasons may be multiple (see Table 7-2 for details).	1. Click the Details button for more information. 2. Correct the parameter causing the error.

Table 7-2. Configuration Error Details

Host diagnostic message	Description	Recommended actions
Volume Configuration Error	The volume cannot be calculated correctly with the current configuration.	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 size measures are correct. 4. If condition persists, restore default settings and reconfigure device.

Host diagnostic message	Description	Recommended actions
Scaled Variable Configuration Error	The Scaled Variable configuration is incorrect.	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, then restore default settings, and reconfigure device.
Geometry Configuration Error	The configured tank geometry results in a too large level measuring range for this device.	1. Check tank geometry configuration and reduce Reference Height. 2. If condition persists, then restore default settings and reconfigure device.
Primary Variable Configuration Error	The Primary Variable selection is not supported. **Note** Rosemount 5408:SIS only supports level or distance as Primary Variable.	1. Change Primary Variable to variable supported by device. 2. Consider purchasing an upgrade of the device to access additional variables.
Measurement Correction Configuration Error	The factory measurement correction data is invalid.	1. Restore default settings and reconfigure device. 2. If the condition persists, replace the device.
Threshold Configuration Error	The surface threshold configuration is incorrect.	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 device.
Factory Approval Error	The Sensor Module factory approval is missing.	1. Restart the device. 2. Restore default settings and reconfigure device. 3. If the condition persists, replace the device.
SIS Configuration Error	It is currently not possible to enable Safety Mode due to other active alerts.	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.

Host diagnostic message	Description	Recommended actions
Function Not Supported	Functionality in the device is enabled, but not supported by this device. Additional features may be enabled by purchasing an upgrade of the device.	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.
Antenna Type Configuration Error	The configured Antenna Type is not supported by the device.	1. Check configuration of Antenna Type. 2. Make sure the configured antenna type matches the physical antenna for the device.
Factory Calibration Error	The factory calibration in the device is missing.	1. Replace the device.
Analog Out Span Configuration Error	The span for the configured analog out range is too small.	1. Increase analog out span by adjusting Upper or Lower Range Value.
Analog Out Calibration Error	Analog output calibration failed.	1. Try calibrating the analog output again. 2. If the condition persists, replace the device.
SIS Multidrop Error	HART® multidrop mode is not supported for safety (SIS) devices. Only 4-20 mA output is supported for safety devices.	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.
Factory Approval Error	The Transmitter factory approval is missing.	1. Restart the device. 2. Restore default settings and reconfigure device. 3. If the condition persists, replace the device.
Engineering Unit Configuration Error	One of the configured engineering units is not supported by the device.	1. Check unit configuration. 2. If condition persists, restore default settings and reconfigure device.
Burst Mode Configuration Error	The burst mode configuration is incorrect.	1. Check configuration of burst mode. 2. If condition persists, restore default settings and reconfigure device.
Start Code Configuration Error	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.	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.

Table 7-3. Status - Function Check

LCD display message	Host diagnostic message	Description	Recommended actions
SAFE DISBLD	Safety Mode Not Activated	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.	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.
SIMUL ACTIVE	Simulation/Test Active	The device is in simulation or test mode and is not reporting actual information.	1. If this behavior is not desired, stop simulation or test mode. 2. If the condition persists, restart device.

Table 7-4. Status - Out of Specification

LCD display message	Host diagnostic message	Description	Recommended actions
TEMP LIMITS	Electronics Temperature Out of Limits	The temperature of the electronics board has exceeded the transmitter's operating range.	1. Verify ambient temperature is within the operating range. 2. Remote mount the transmitter away from the process and environmental conditions.

Table 7-5. Status - Maintenance Required

LCD display message	Host diagnostic message	Description	Recommended actions
SUPLY LOW	Supply Voltage Low	The supply voltage is low and may affect device operation.	1. Check supply voltage is within range.
LOW SIG Q	Low Signal Quality	The Signal Quality is below the defined alert limit.	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.
HIGH ALERT	High User Defined Alert	The user defined variable is above the defined limit.	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.

LCD display message	Host diagnostic message	Description	Recommended actions
LOW ALERT	Low User Defined Alert	The user defined variable is below the defined limit.	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.
VAR OUTRNG	Linearized Variable Out of Range	The level measurement is outside the configured range for volume or scaled variable, or both. Accuracy of volume/scaled variable measurement may be degraded.	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.
DC DEGRAD	Dielectric Constant Estimation Degraded	The dielectric constant estimation is degraded. Accuracy of level measurement may be degraded.	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.

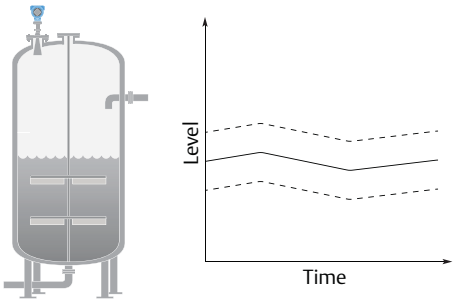
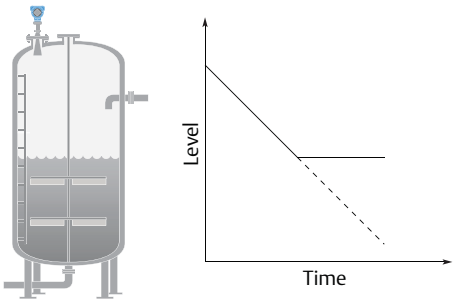
7.3 Troubleshooting guide

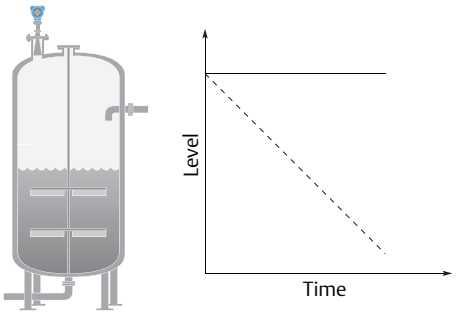
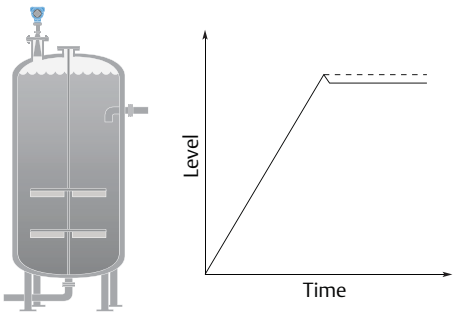
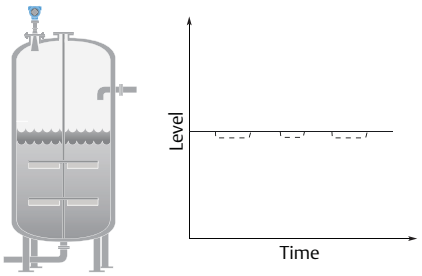
If there is a malfunction despite the absence of alerts, see Table 7-6 and Table 7-7 for information on possible causes and recommended actions.

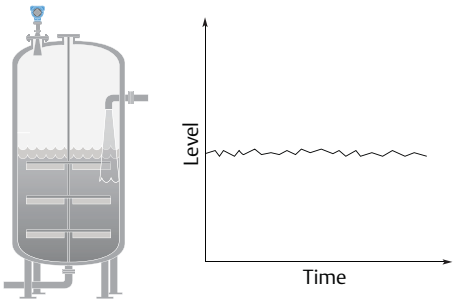
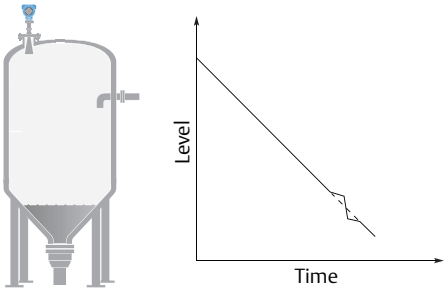
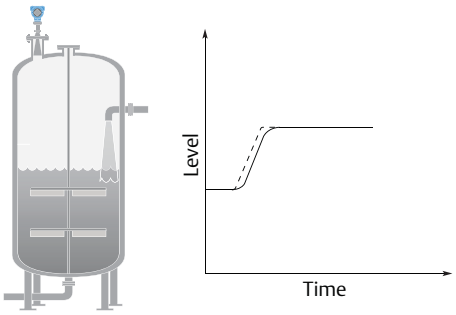
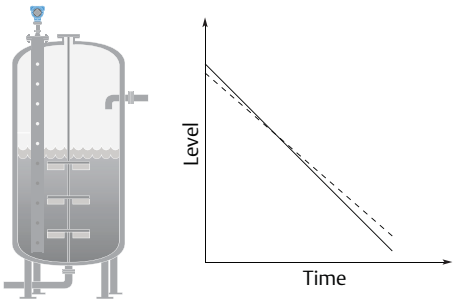
The troubleshooting guide contains the following symptoms:

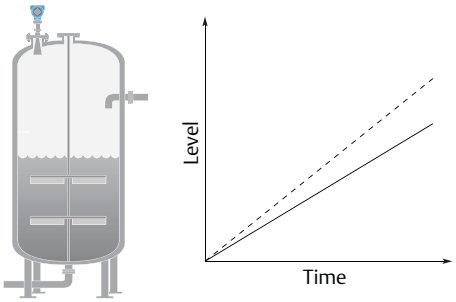
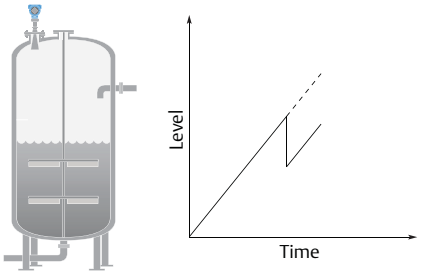
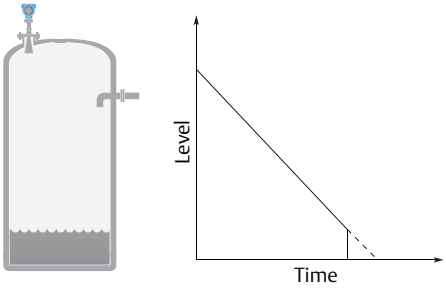
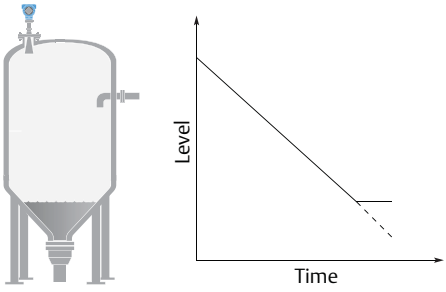
- Incorrect level readings (see Table 7-6)
- Troubleshooting the 4-20 mA/HART output (see Table 7-7)

Table 7-6. Incorrect Level Readings

Symptom[1]	Possible causes	Recommended actions
■ Reported level is too high or low. 	■ Incorrect tank geometry configuration.	■ Verify the tank geometry parameters are configured correctly (especially the Reference Height). ■ Run Verify Level to adjust level measurement, see "Verify Level" on page 66. ■ Analyze the echo curve and check amplitude thresholds, see "Set amplitude thresholds" on page 90. ■ Restore default settings and reconfigure the device.
■ Level is stuck in measuring range. 	■ Incorrect alignment of the transmitter.	■ Verify the transmitter head is correctly aligned, see "Align transmitter head" on page 34.
	■ Disturbing objects in the tank.	■ Use the suppress false echoes function to manage strong disturbance echoes, see "Suppress false echoes" on page 92. ■ Analyze the echo curve and check amplitude thresholds, see "Set amplitude thresholds" on page 90. ■ Remove the disturbing object. ■ Change alignment of transmitter head in steps of about 15 degrees, see "Align transmitter head" on page 34. After each step, check if impact of disturbing echoes is decreased using the echo curve. ■ Put an inclined metal plate on top of the disturbing object. ■ Move the transmitter to another position. Refer to Section 3: Mechanical Installation for installation considerations.

Symptom[1]	Possible causes	Recommended actions
■ Level is stuck in full. 	■ Disturbing objects near the antenna.	■ Use the suppress false echoes function to manage strong disturbance echoes, see "Suppress false echoes" on page 92. ■ Analyze the echo curve and check amplitude thresholds, see "Set amplitude thresholds" on page 90. ■ Increase the Upper Null Zone, see "Handling disturbances at top of tank" on page 99. ■ Remove the disturbing object. ■ Move the transmitter to another position. Refer to Section 3: Mechanical Installation for installation considerations.
	■ Product build-up on the antenna.	■ Clean the antenna. ■ Use transmitter with air purging connection.
	■ Cone antenna does not extend below the nozzle.	■ Use the extended cone antenna.
■ Level value drops to a lower value when product surface is close to antenna. 	■ Product surface is within the Upper Null Zone and a disturbance echo is interpreted as the product surface.	■ Check the setting of the Upper Null Zone, see "Upper null zone" on page 174.
■ Measured value jumps to a lower value. 	■ Multiple products in the tank, e.g. thin oil layer on top of water that is sometimes detected, sometimes not.	■ Set Double Surface Handling to Track Upper Surface or Track Lower Surface, see "Double surface handling" on page 177.

Symptom[1]	Possible causes	Recommended actions
■ Measured level fluctuates. 	■ Excessive foaming or turbulence.	■ Under turbulent conditions with low level rates, consider increasing the Damping value, see "Damping value" on page 162. ■ Enable the Foam parameter or Turbulent Surface parameter, or both. See "Process conditions" on page 171. ■ If two surfaces are seen in foamy applications, set Double Surface Handling to Track Lower Surface. See "Double surface handling" on page 177.
■ Measured level is occasionally unstable. 	■ May be caused by an empty tank with the amplitude threshold set too low.	■ Analyze the echo curve and check amplitude thresholds, see "Set amplitude thresholds" on page 90.
	■ The product surface is close to a suppressed false echo.	■ If possible, remove the disturbing object.
■ Measured level lags during rapid level changes. 	■ Damping value too high.	■ If there is a problem with lag during rapid level changes, consider decreasing the Damping value, see "Damping value" on page 162.
	■ Maximum Level Rate value too low.	■ Verify Maximum Level Rate configuration.
■ Incorrect level when using still pipe. 	■ Device is not configured for still pipe measurement.	■ Enable pipe measurement, see "Mounting type" on page 167.
	■ Incorrect Pipe Inner Diameter configuration.	■ Verify the configured Pipe Inner Diameter matches the physical inner diameter.
	■ Ghost echo problems below the product surface.	■ Enable the Track First Echo function, see "Handling ghost echoes in still pipes" on page 102.

Symptom[1]	Possible causes	Recommended actions
■ Measured level is correct at 0% (4 mA) but incorrect at 100% (20 mA). 	■ Upper Range Value is not set correctly.	■ Check that the Upper Range Value matches the 100% (20 mA) level in the tank.
■ Incorrect level when the product surface is above the 50% level. 	■ Strong double bounce echo that is interpreted as the product surface.	■ Enable the Double Bounce Handling function, see "Handling strong double bounce echoes" on page 103.
■ Measured value drops to zero level. 	■ Transmitter has locked on a strong tank bottom echo.	■ Verify the Reference Height is configured correctly. ■ Enable the Tank Bottom Projection function, see "Use tank bottom projection" on page 100. ■ Enable the Bottom echo visible when tank is empty parameter, see "Enable bottom echo visible when tank is empty" on page 100.
■ When the product surface is near the sloped tank bottom, the transmitter enters alarm mode. 	■ Reduction of projected surface area close to sloping tank bottom.	■ 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, see "Empty tank detection area" on page 176. ■ Verify the *Bottom echo visible when tank is empty* parameter is disabled, see "Bottom echo visible when tank is empty" on page 176.

1. - - - - - - - - = actual level
   ———— = reported level

Table 7-7. Troubleshooting the 4-20 mA/HART Output

Symptom	Recommended actions
■ Transmitter milliamp reading is zero.	■ Verify power is applied to signal terminals. ■ Verify power supply voltage is adequate at signal terminals, see "Power supply" on page 54. ■ Verify transmitter and power supply are properly grounded.
■ Transmitter milliamp reading is too low or high.	■ Verify level. ■ Check the settings of the 4-20 mA range values, see"Upper/lower range value" on page 163. ■ Verify output is not in alarm condition. ■ Check that power wires are connected to the correct signal terminals. ■ Perform Calibrate Analog Out, see "Calibrate analog out" on page 95.
■ Milliamp reading is erratic.	■ Verify power supply voltage is adequate at signal terminals, see "Power supply" on page 54. ■ Check for external electrical interference. ■ Verify transmitter is properly grounded. ■ Verify shield for twisted pair is only grounded at the power supply end. ■ Under turbulent conditions with low level rates, consider increasing the Damping value.
■ Transmitter will not respond to changes in level.	■ Verify level is between the 4 and 20 mA set points. ■ Verify output is not in alarm condition. ■ Verify transmitter is not in loop test or simulation mode.
■ No HART communication.	■ Verify power supply voltage is adequate at signal terminals, see "Power supply" on page 54. ■ Check load resistance (250 ohms minimum). ■ Check if transmitter is at an alternate HART address. ■ Check current analog output value to verify that transmitter hardware works.

7.4 Service and troubleshooting tools

This section briefly describes tools and functions in the Rosemount Radar Master, AMS Device Manager, and Field Communicator, which may be useful for service and troubleshooting of the Rosemount 5408 and 5408:SIS Level Transmitters.

7.4.1 Use the echo curve function

The Rosemount Radar Master 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.

When connected to Rosemount Radar Master, past measurement records and echo curves including the 10 highest peaks, as well as the 50 last event alerts 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 (see Figure 7-1).

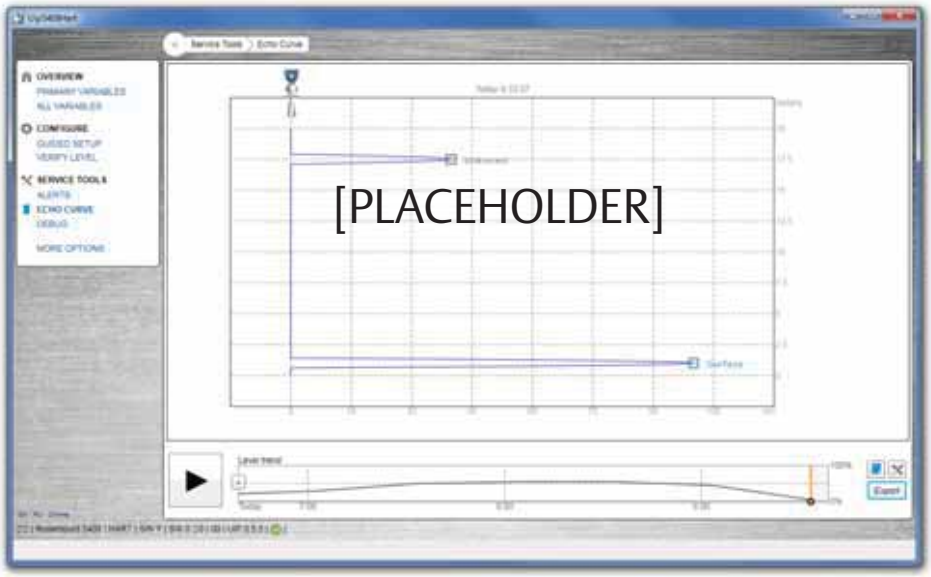
Measurement problems can be understood by studying the position and amplitude of the different peaks. Additionally, the recorded echo curves give insight into unexpected and intermittent measurement behaviors, for instance, at the time of the triggered alert.

Read the echo curve

To read the echo curve in Rosemount Radar Master:

1. Under *Service Tools*, select **Echo Curve**.
2. Select **Play**.

Figure 7-1. Echo Curve



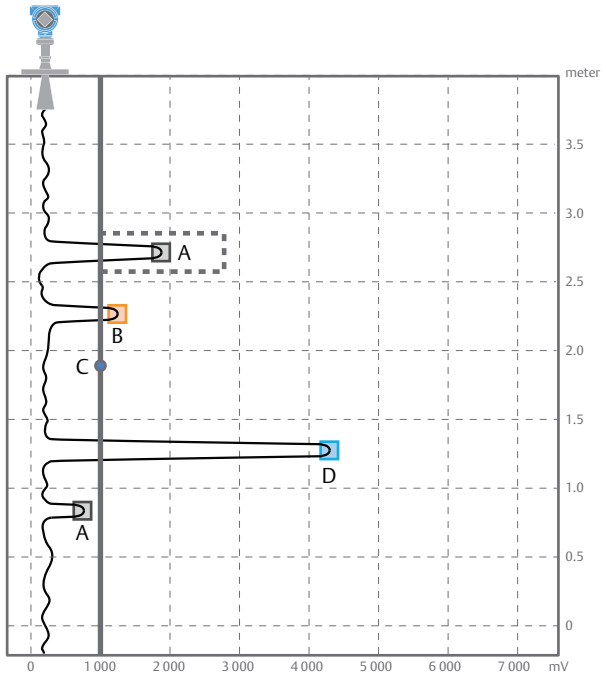
Analyze the echo curve

The following echo peaks may appear in the echo curve:

Table 7-8. 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 7-2. Echo Curve with Typical Echo Peaks



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

View level trends and historical echo curves

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:

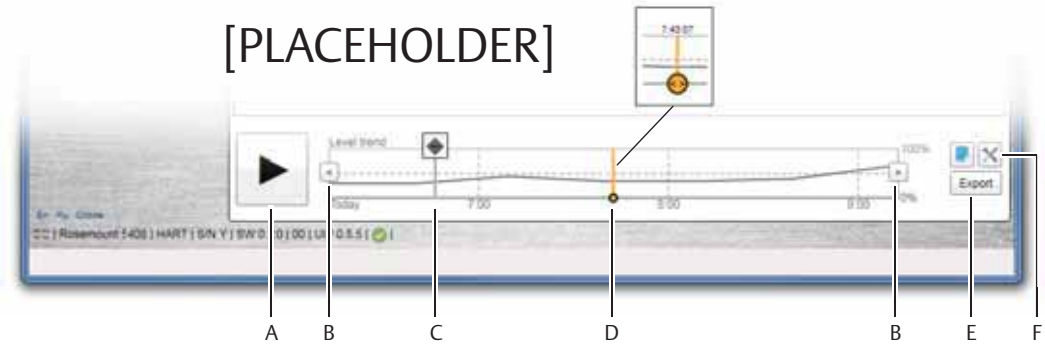
- Click the left or right arrow, or click and drag anywhere in the timeline.

Tip
To speed up the upload time of historical data, select **Pause** to halt the new echo curve reading. Reading new echo curves have priority over uploading previously recorded data to the timeline.

View active/historical alerts

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

Figure 7-3. Level Trend Timeline



A. Play or pause
B. Click left or right arrow, or click and drag anywhere in the timeline, to move the timeline forward or backward.
C. Click the alert icon for details.
D. Drag the slider, or click anywhere in the timeline, to go to a desired point in the displayed part of the timeline.
E. Export echo curves
F. Options

Play echo curve movies

1. Drag the slider to desired start point, or click the start point in the timeline.
2. Select **Play**.

Export echo curve movies

1. Under *Service Tools*, select **Echo Curve**.
2. Select the **Export** icon.

   Export
3. Browse to the desired directory.

4. Type your desired file name and select **Save**.
5. TBD.

Set echo curve range

1. Under *Service Tools*, select **Echo Curve**.
2. Select the **Options** icon.

3. Under *Echo Curve Range*, enter the desired values.
4. Select **Save**.
5. Select **Back**.


Set timeline resolution

To set the resolution of the level trend timeline:

1. Under *Service Tools*, select **Echo Curve**.
2. Select the **Options** icon.

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


7.4.2 Manage disturbance echoes

There are two general methods for managing disturbance echoes:

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

Set amplitude thresholds

The amplitude thresholds are 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.

General recommendations

Use the following best practices to apply custom threshold adjustments:

- Generally, set amplitude threshold to about 10% of surface echo amplitude.
- Do not set the amplitude threshold to less than 150 mV.

Procedure

It is recommended to adjust thresholds using Rosemount Radar Master.

To adjust the threshold value:

1. In Rosemount Radar Master, under *Service Tools*, select **Echo Curve**.
2. In the echo curve, click and drag the amplitude threshold point left or right, or in the *Threshold* box, type the desired value.
3. Select **Save**.

To add or delete an amplitude threshold point:

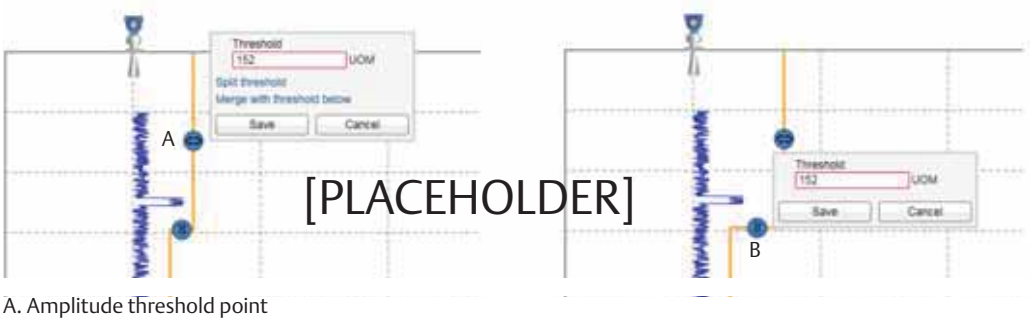
1. In the echo curve, click the desired amplitude threshold point, and select **Split threshold** or **Merge with threshold below**.
2. Select **Save**.

To set the endpoint of a threshold segment:

1. In the echo curve, click and drag the endpoint up or down, or in the *Split level* box, type the desired value.

2. Select **Save**.

Figure 7-4. Adjust Amplitude Thresholds



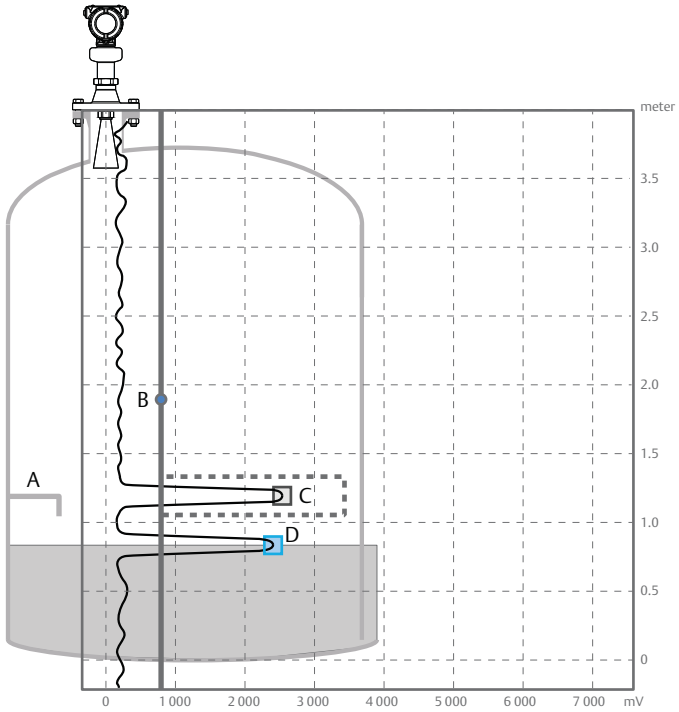
A. Amplitude threshold point
B. Endpoint

Suppress 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 7-5.

Figure 7-5. Suppression of False Echoes



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

Prerequisites

Follow these recommendations before suppressing new false echoes:

- Make sure a correct amplitude threshold is set (see "Set amplitude thresholds" on page 90).
- 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 may be necessary to suppress new false echoes at a later stage when objects have become visible due to surface movement.

Procedure

Rosemount Radar Master

1. Under *Service Tools*, select **Echo Curve**.
2. In the echo curve, click the square at the unknown echo peak, and then select **Suppress**.

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

1. Under *Service Tools*, select **Echo Curve**.
2. Select the **Options** icon.

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**.

AMS Device Manager and Field Communicator

1. From the *Home* screen, select **Service Tools** > **Echo Tuning** > **Suppress**. Suppressed echoes are shown in the table.
2. Select **Suppress** or **Remove Suppression**.
3. Type the distance to the echo that should be added to or removed from the list.

7.4.3 Save and load configuration files

When configuration is finished, it is recommended to store the device configuration in a backup file for future reference using Rosemount Radar Master. A backup of the device configuration and a configuration report will be saved to file.

The backup file may be useful to:

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

Procedure

To save a backup file of the device configuration:

1. In Rosemount Radar Master, under *Service Tools*, select **Maintenance**.
2. Select **Save Configuration**.
3. Browse to the desired directory.
4. Type your desired file name and select **Save**.

To download configuration from file to device:

1. In Rosemount Radar Master, under *Service Tools*, select **Maintenance**.
2. Select **Restore Configuration**.
3. Browse to the backup file and select **Open**.

7.4.4 Restore to default settings

This function restores the transmitter to default settings (user configuration is overwritten). Before restoring the transmitter to default settings, it is recommended to backup the transmitter configuration, see "Save and load configuration files" on page 94. The backup file can be used to restore configuration at a later stage.

Procedure

Rosemount Radar Master

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

AMS Device Manager and Field Communicator

1. From the *Home* screen, select **Service Tools** > **Maintenance** > **Reset/Restore**.
2. Select **Restore Default Settings** and follow the on-screen instructions.

7.4.5 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

Rosemount Radar Master

1. Under *Service Tools*, select **Maintenance** > **Routine Maintenance**.
2. Select **Calibrate Analog Out** and follow the on-screen instructions.

AMS Device Manager and Field Communicator

1. From the *Home* screen, select **Service Tools** > **Maintenance** > **Routine Maintenance**.
2. Select **D/A trim** and follow the on-screen instructions.

7.4.6 Use the simulation mode

This function can be used to simulate measurements.

Procedure

Rosemount Radar Master

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

AMS Device Manager and Field Communicator

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

7.4.7 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

Rosemount Radar Master

1. Under *Configure*, select **Level Setup** > **Advanced**.
2. Under *More Advanced Options*, select **Expert Options**.
3. Select the **Input Registers** tab.
4. Under *Show registers by*, do one of the following:
   - Select **Block**, and then in the list, select the desired register group.
   - Select **Number**, and then type the desired register number.
5. Select **Refresh**.

AMS Device Manager and Field Communicator

1. From the *Home* screen, select **Configure** > **Manual Setup** > **Level Setup** > **Advanced** > **Expert Options** > **Input Registers**.
2. Type the desired register number to start reading from.
3. Select **Read Input Registers**. 10 registers will be read, starting from the selected number.

7.4.8 View/edit holding registers

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

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

Rosemount Radar Master

1. Under *Configure*, select **Level Setup** > **Advanced**.
2. Under *More Advanced Options*, select **Expert Options**.
3. Select the **Holding Registers** tab.
4. Under *Show registers by*, do one of the following:
   - Select **Block**, and then in the list, select the desired register group.
   - Select **Number**, and then type the desired register number.
5. Select **Refresh**.
6. To change a holding register value, type a new value in the corresponding value field, or select a new value from the corresponding list.

   Some holding registers are edited in a separate window. In this case, individual data bits can be changed.
7. Select **Save** to store the new value.

AMS Device Manager and Field Communicator

To view a holding register value:

1. From the *Home* screen, select **Configure** > **Manual Setup** > **Level Setup** > **Advanced** > **Expert Options** > **Holding Registers**.
2. Type the desired register number to start reading from.
3. Select **Read Holding Registers**. 10 registers will be read, starting from the selected number.

To edit a holding register value:

1. From the *Home* screen, select **Configure** > **Manual Setup** > **Level Setup** > **Advanced** > **Expert Options** > **Holding Registers**.
2. Select **Write Holding Registers** and follow the on-screen instructions.

7.5 Write protect a transmitter

The transmitter can be write protected (with or without a password) to prevent unauthorized changes.[1]

Procedure

Rosemount Radar Master

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

AMS Device Manager and Field Communicator

1. From the *Home* screen, select **Configure** > **Manual Setup** > **Device Setup** > **Security**.
2. Under *Security*, select **Change Write Protection** and follow the on-screen instructions.

1. *If the Rosemount 5408:SIS 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. Refer to "Configuration" on page 110 for more information.*

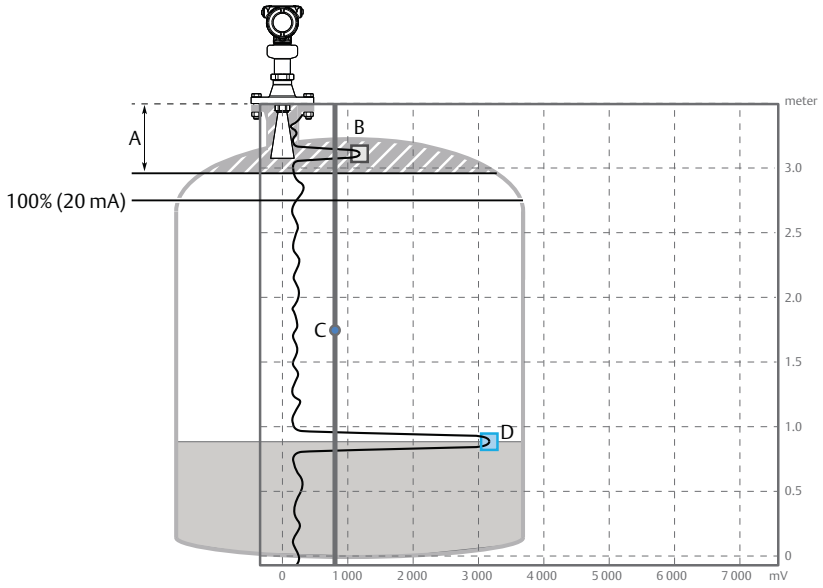
7.6 Application challenges

7.6.1 Handling disturbances at top of tank

The Upper Null Zone defines a zone close to the transmitter where echoes are to be ignored. As an alternative to a customized amplitude threshold section, the Upper Null Zone can be extended to block out disturbing echoes at the top of the tank, for example from the tank nozzle or bypass well inlet (see Figure 7-6).

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.

Figure 7-6. Upper Null Zone



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

Procedure

1. Identify desired Upper Null Zone using the echo curve plot.
   a. In Rosemount Radar Master, start the echo curve reading, see "Use the echo curve function" on page 87.
   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. Under *Configure*, select **Level Setup** > **Antenna**.
   b. Under *Advanced*, type desired Upper Null Zone, and then select **Save**.

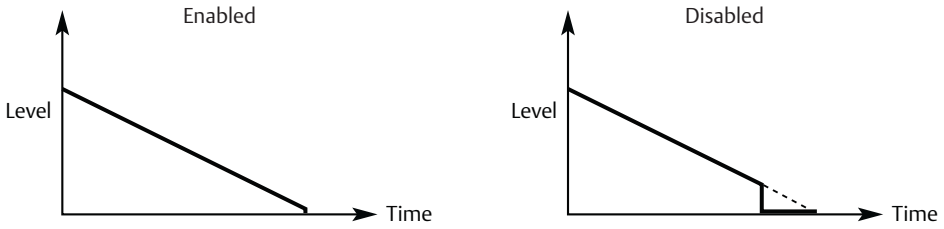
7.6.2 Tracking of weak surface echoes close to tank bottom

Use tank bottom projection

The Tank Bottom Projection function can be used to enhance measurement performance 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 7-7 illustrates an example of the Tank Bottom Projection when the tank is being emptied.

Figure 7-7. Tank Bottom Projection



Procedure

1. In Rosemount Radar Master, under *Configure*, select **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.

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.

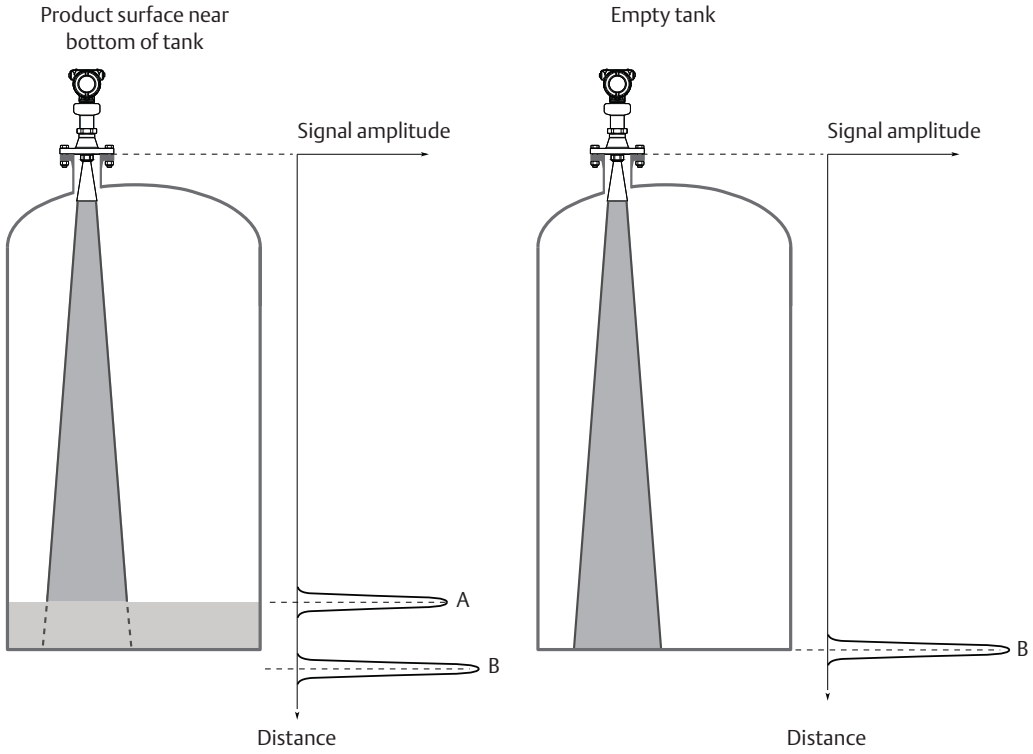
Enable bottom echo visible when tank is empty

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.

Note
Only enable this parameter if a bottom echo is visible when tank is empty. To verify this, use the echo curve function.

Figure 7-8. Bottom Echo Visible



A. Surface echo
B. Echo peak from tank bottom (at the electrical distance when product in the tank)

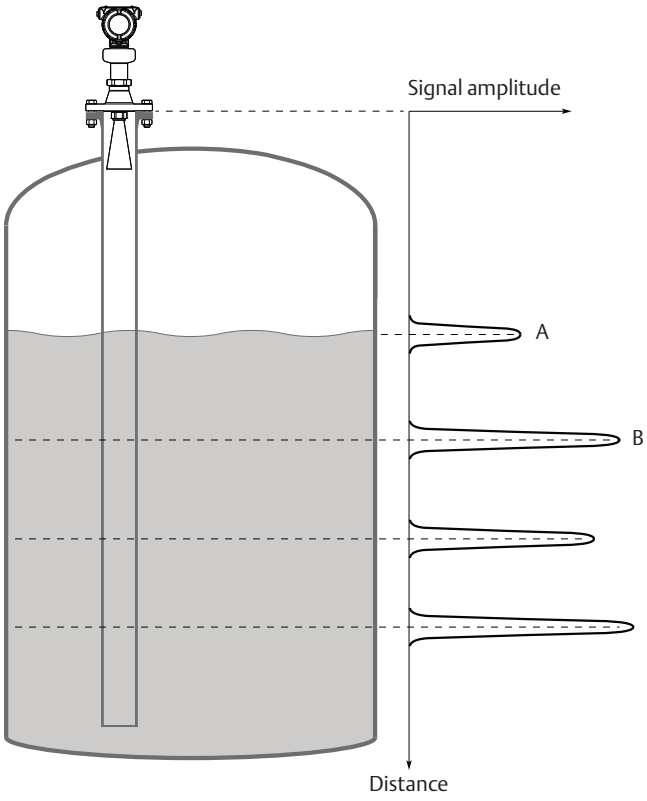
Procedure

1. In Rosemount Radar Master, under *Configure*, select **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.

7.6.3 Handling ghost echoes in still pipes

Ghost echoes may occur in still pipes because of multiple reflections between the pipe wall, flange, and antenna. In the echo curve, these echoes appear as amplitude peaks at various distances below the product surface, see Figure 7-9. The Track First Echo function can eliminate ghost echo problems below the product surface. When enabled, the first echo above threshold will always be considered as the surface echo.

Figure 7-9. Ghost Echoes in Still Pipes



A. Actual level
B. Virtual level

Procedure

1. In Rosemount Radar Master, read the echo curve. Make sure there are no disturbing echoes above the product surface. See "Use the echo curve function" on page 87.
2. Under *Configure*, select **Level Setup** > **Advanced**.
3. Under *More Advanced Options*, select **Echo Tracking**.
4. In the *Surface Echo Tracking* list, select **User defined**, and then select the **Track First Echo** check box.

7.6.4 Handling strong double bounce echoes

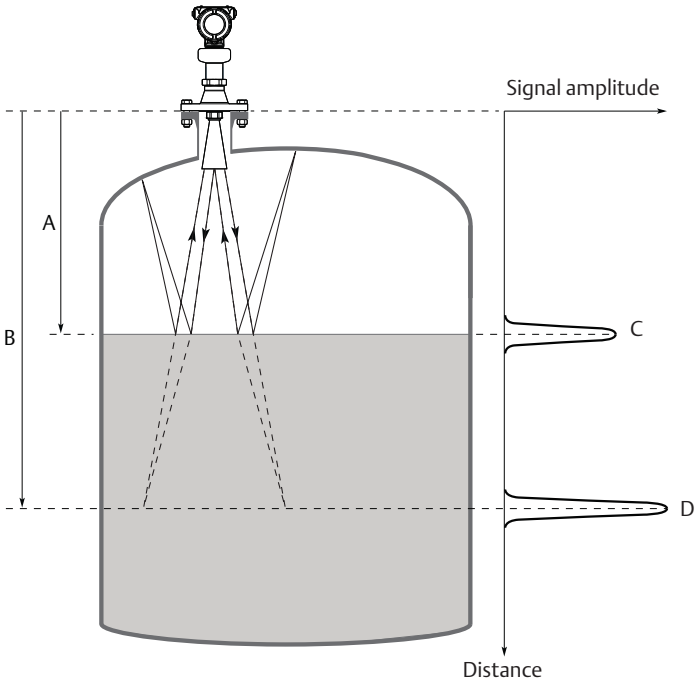
A double bounce echo occurs when a radar signal bounces back and forth between the product surface and tank roof (or other object within the tank) before it is detected by the transmitter. Normally, these signals have a low amplitude and are ignored by the transmitter.

Double bounces are most commonly present in spherical or horizontal cylinder tanks, and usually appear when the tank is about 60-70% 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.

Note
The Double Bounce Handling function should only be used if the problem of double bounces can not 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 (see page 174), there is no product surface reference and the double bounce might be interpreted as the surface echo.

Figure 7-10. Double Bounce Echoes



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

Procedure

1. In Rosemount Radar Master, read the echo curve plot to determine if double bounce echoes are present, see “Use the echo curve function” on page 87.
2. Under *Configure*, select **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.

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 7-10):

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.

7.7 Service support

To expedite the return process outside of the United States, contact the nearest Emerson™ Process Management representative.

Within the United States, call the Emerson Process Management Instrument and Valve Response Center using the 1-800-654-RSMT (7768) toll-free number. This center, available 24 hours a day, will assist you with any needed information or materials.

The center will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. The center will also ask for the process material to which the product was last exposed.

⚠ CAUTION

Individuals who handle products exposed to a hazardous substance can avoid injury if they are informed of and understand the hazard. The product being returned will require a copy of the required Material Safety Data Sheet (MSDS) for each substance must be included with the returned goods.

Emerson Process Management Instrument and Valve Response Center representatives will explain the additional information and procedures necessary to return goods exposed to hazardous substances.

Section 8 Safety Instrumented Systems (4-20 mA only)

8.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operation. Information that raises potential 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 service guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a Field Communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Do not remove the transmitter covers in explosive atmospheres when the circuit is alive.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.
- Make sure the main power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

8.2 Terms and definitions

Table 8-1. Terms and Definitions

Term	Definition
BPCS	Basic Process Control System
λ_{DU}	Dangerous Undetected
λ_{DD}	Dangerous Detected
λ_{SU}	Safe Undetected
λ_{SD}	Safe Detected
Diagnostic coverage	Fraction of dangerous failures detected by automatic on-line diagnostic tests.
Diagnostic test interval	The time from when a dangerous failure/condition occurs until the device has set the safety related output in a safe state (total time required for fault detection and fault reaction).
FIT	Failure In Time per billion hours
FMEDA	Failure Modes, Effects and Diagnostic Analysis
HART®	Highway Addressable Remote Transducer
HFT	Hardware Fault Tolerance
High demand mode	The safety function is only performed on demand, in order to transfer the EUC (Equipment Under Control) into a specified safe state, and where the frequency of demands is greater than one per year (IEC 61508-4).
Low demand mode	The safety function is only performed on demand, in order to transfer the EUC into a specified safe state, and where the frequency of demands is no greater than one per year (IEC 61508-4).
Mission time	The time from an instrumented system's start-up until its replacement or refurbishment to as-new condition.
PFD_{AVG}	Average Probability of Failure on Demand
Proof-test coverage factor	The effectiveness of a proof-test is described using the coverage factor which specifies the share of detected dangerous undetected failures (λ_{DU}). The coverage factor is an indication of a proof-test's effectiveness to detect dangerous undetected faults.

Term	Definition
Safety deviation	The maximum allowed deflection of the safety output due to a failure within the device (expressed as a percentage of span). Any failure causing the device output to change less than the Safety Deviation is considered as a "No Effect" failure. All failures causing the device output to change more than the Safety Deviation and with the device output still within the active range (non-alarm state) are considered dangerous failures. Note that the Safety Deviation is independent of the normal performance specification or any additional application specific measurement error.
SFF	Safe Failure Fraction
SIF	Safety Instrumented Function
SIL	Safety Integrity Level – a discrete level (one out of four) for specifying the safety integrity requirements of the safety instrumented functions to be allocated to the safety instrumented systems. SIL 4 has the highest level of safety integrity, and SIL 1 has the lowest level.
SIS	Safety Instrumented System – an instrumented system used to implement one or more safety instrumented functions. An SIS is composed of any combination of sensors, logic solvers, and final elements.
Systematic Capability	Systematic Capability is a measure (expressed on a scale of SC 1 to SC 4) of the confidence that the systematic safety integrity of an element meets the requirements of the specified SIL, in respect of the specified element safety function, when the element is applied in accordance with the instructions specified in the compliant item safety manual for the element.
Transmitter response time	The time from a step change in the process until transmitter output reaches 90% of its final steady state value (step response time as per IEC 61298-2).
Type B device	Complex device using controllers or programmable logic, as defined by the standard IEC 61508.
Useful lifetime	Useful lifetime is a reliability engineering term that describes the operational time interval where the failure rate of a device is relatively constant. It is not a term which covers product obsolescence, warranty, or other commercial issues.

8.3 Safety Instrumented System (SIS) certification

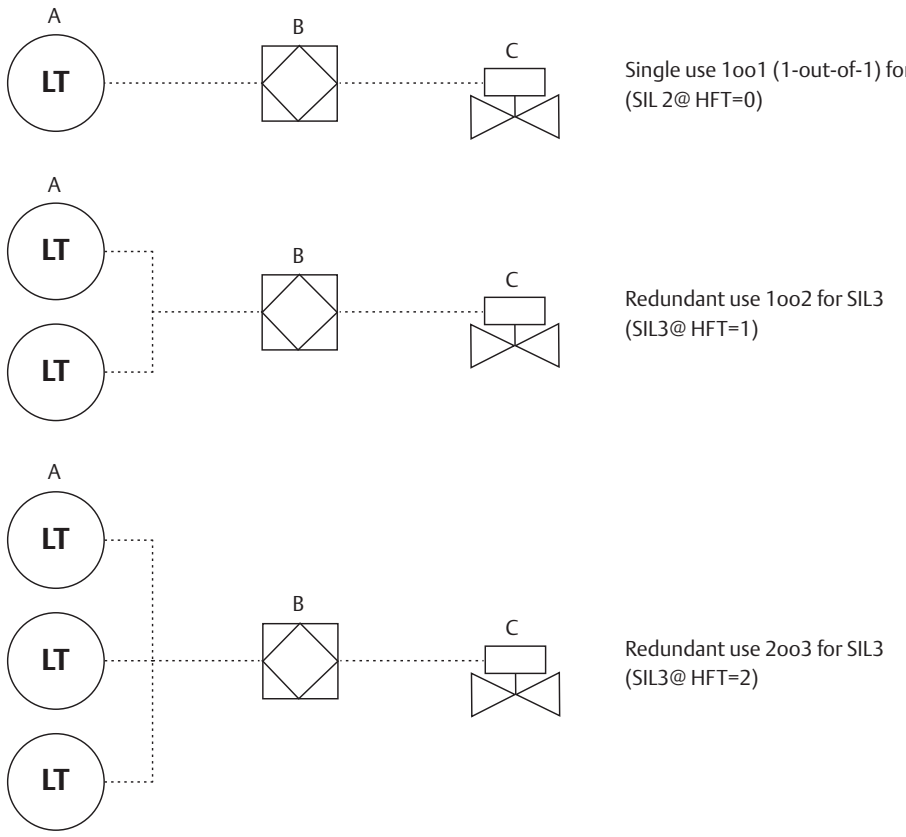
For safety instrumented systems usage, the 4-20 mA analog output is used as the primary safety variable. It is configured to activate the alarm function if an error occurs. If a measured value goes beyond the measurement range, the transmitter enters saturation mode.

The measurement signal used by the logic solver must be the analog 4-20 mA signal proportional to the level or distance (ullage) generated. The HART protocol can only be used for setup, calibration, and diagnostic purposes, not for safety critical operation.

The Rosemount™ 5408:SIS Level Transmitter is IEC 61508 certified accordingly:

- 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

Figure 8-1. SIF Configuration Examples



A. Rosemount 5408:SIS Level Transmitter (sensor)
B. Logic-solver
C. Actuator

Application examples

- Level range monitoring
- Dry-run prevention
- Overfill prevention

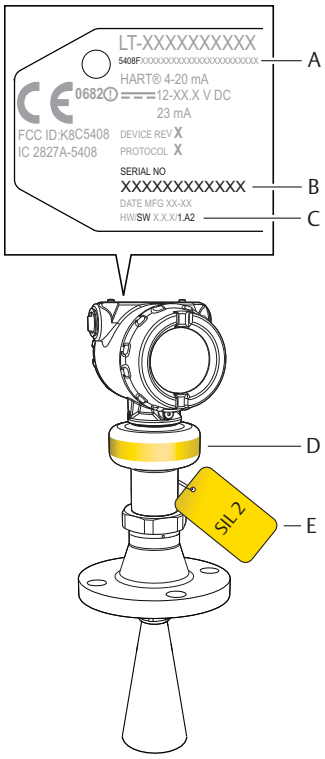
8.4 Safety certified identification

All Rosemount 5408:SIS Level Transmitters must be identified as safety certified before installing into SIS systems.

Verify that:

1. The transmitter model code starts with **5408F**.
2. The software (SW) is 1.A2 or later.

Figure 8-2. Identification



A. Model code
B. Serial number
C. SW version
D. Yellow stripe for locating device from distance
E. Yellow tag for locating device from distance

8.5 Installation

The Rosemount 5408:SIS must be installed and configured as described in Section 3: Mechanical Installation and Section 4: Electrical Installation. No special installation is required in addition to the standard installation practices outlined in this manual.

The loop should be designed so the terminal voltage is within the limits specified in section "Power supply" on page 124.

Check that environmental conditions do not exceed the ratings in Appendix A: Specifications and Reference Data.

Note
The Rosemount 5408:SIS Level Transmitter is not safety-rated during maintenance work, configuration changes, multidrop, loop test, proof-test, or other activity that affects the safety function. Alternative means should be used to ensure process safety during such activities.

8.5.1 Measuring range

The recommended measuring range is up to 82 ft. (25 m) for the Rosemount 5408:SIS Level Transmitter. Refer to Appendix A: Specifications and Reference Data for performance specification data.

8.6 Configuration

Use a HART-compliant master, such as Rosemount Radar Master, AMS™ Device Manager or a Field Communicator, to communicate with and verify configuration of the Rosemount 5408:SIS.

8.6.1 Prerequisites

Before doing any configuration, write down the serial number from the transmitter label (see Figure 8-2 on page 109), and make sure you are connected to the correct transmitter by verifying the same serial number in your configuration tool.

Rosemount Radar Master

- Under *Overview*, select **Device Information** > **Identification**.

AMS Device Manager and Field Communicator

- From the *Home* screen, select **Overview** > **Device Information** > **Identification**.

8.6.2 Configure device using Guided Setup

Follow the Guided Setup wizard for transmitter configuration, refer to Section 5: Configuration. When configuring parameters not included in the Guided Setup, it may be necessary to do additional verification.

8.6.3 Set operational mode

The Rosemount 5408:SIS can be used as the level sensor in a BPCS or as a safety device in a safety instrumented system.

If the Rosemount 5408:SIS is used as safety device in a Safety Instrumented System, then the operational mode must be set to Safety (SIS). The Safety (SIS) operational mode can be activated via the Guided Setup wizard, or as follows:

Rosemount Radar Master

1. Under *Configure*, select **Device Setup** > **Security**.
2. Under *Operational Mode*, select **Change** and follow the on-screen instructions.

AMS Device Manager and Field Communicator

1. From the *Home* screen, select **Configure** > **Manual Setup** > **Device Setup** > **Security**.
2. Under *Safety Instrumented Systems*, select **Change Operation Mode** and follow the on-screen instructions.

Note
When entering the Safety (SIS) operational mode, the analog output will be put into alarm mode until the Safety Mode is enabled.

8.6.4 Enable safety mode

If the transmitter is configured for use in 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.

Rosemount Radar Master

1. Under *Configure*, select **Device Setup** > **Security**.
2. Under *Safety Mode*, select **Change** and follow the on-screen instructions.

AMS Device Manager and Field Communicator

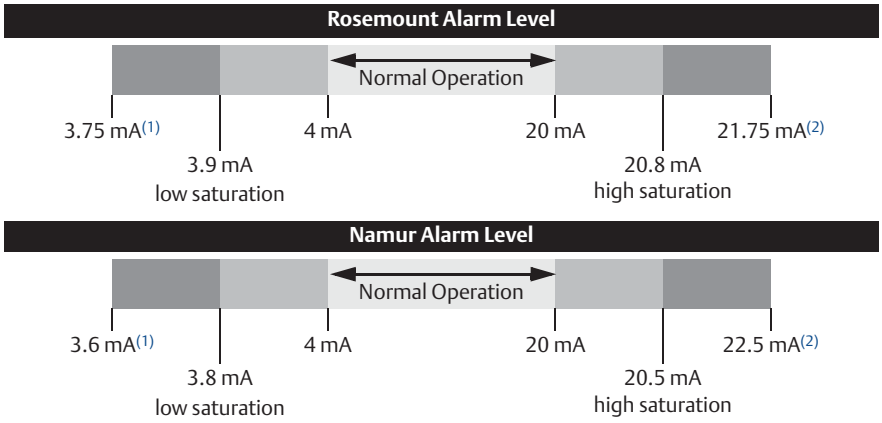
1. From the Home screen, select **Configure** > **Manual Setup** > **Device Setup** > **Security**.
2. Under *Safety Instrumented Systems*, select **Change Safety Mode** and follow the on-screen instructions.

8.6.5 Alarm and saturation levels

DCS or safety logic solver should be configured to handle both High alarm and Low alarm. In addition, the transmitter must be configured for High or Low alarm (see "Alarm mode" on page 163).

Figure 8-3 identifies the alarm levels available and their operation values[1].

Figure 8-3. Alarm Levels and Operation Values



1. Transmitter Failure, hardware or software alarm in Low position.
2. Transmitter Failure, hardware or software alarm in High position.

8.7 Site acceptance

After installation and/or configuration, proper operation of the transmitter (including verification of all configuration changes) must be verified. A site acceptance test is therefore recommended. The proof-tests outlined in section "Proof-testing" on page 112 can be used for this.

8.8 Proof-testing

8.8.1 Overview

The Rosemount 5408:SIS Level Transmitter must be tested at regular intervals to reveal faults which are undetected by automatic diagnostics. It is the user's responsibility to choose the type of testing and the frequency of these tests.

Results from periodic proof-tests shall be recorded and periodically reviewed. If an error is found in the safety functionality, the transmitter shall be put out of operation and the process shall be kept in a safe state by other measures.

1. *Note that during startup, the Rosemount 5408:SIS always outputs Low alarm current even if the transmitter is configured for High alarm mode.*

Note
For a valid result, always perform the proof-test on the product that will be stored in the tank while the device is in operation.

The following proof-tests are suggested:

- (A) 1-point level and analog output verification (see page 114)
- (B) 2-point level and analog output verification (see page 116)
- (C) Analog output verification (see page 118)
- (D) Level deviation monitoring (see page 118)

Table 8-2 can be used as a guidance for selecting the appropriate proof-test.

Table 8-2. Suggested Proof-tests

Proof-test #	Type	Proof-test coverage (%) of DU	Remaining dangerous, undetected failures	Test coverage			Can be performed remotely
				Output circuitry	Measurement electronics	Antenna	
A	Comprehensive	XX	xx FIT	Y	Y	Y	Y(1)
B		XX	xx FIT	Y	Y	Y	Y(1)
C	Partial	XX	xx FIT	Y	N	N	Y
D		XX	xx FIT	N	Y	N	Y

1. With the assumption that the BPCS level sensor is used as independent measurement.

Proof-test interval

The time intervals for proof-testing are defined by the SIL verification calculation (subject to the PFD_{AVG}). The SIL verification calculation is an analytical method to calculate an appropriate proof-test interval for the specific safety function based on equipment's reliability and required risk reduction for the specific SIF.

The proof-tests must be performed more frequently than or as frequently as specified in the SIL verification calculation, in order to maintain the required safety integrity of the overall SIF.

Tools required

- HART host/communicator or Rosemount Radar Master
- Current meter
- Safety logic solver
- Independent measuring device (e.g. BPCS level sensor, measuring tape)

8.8.2 1-point level and analog output verification

⚠ WARNING

During the proof-test, the transmitter will not output measurement values corresponding to the product surface level. Make sure 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.

1. Prior to the test, ensure there are no alarms or warnings present in the transmitter.

   Rosemount Radar Master:

   - Under *Service Tools*, select **Alerts**.

   AMS Device Manager and Field Communicator:

   - From the *Home* screen, select **Service Tools** > **Alerts**.

2. Bypass the safety function and take appropriate action to avoid a false trip.

3. Output fixed 4.00 mA current and measure the loop current (e.g. using the safety logic solver or current meter).

   Rosemount Radar Master:

   a. Under *Service Tools*, select **Simulate**.
   b. Select **Loop Test**.
   c. Select **4 mA** and then select **Start**.
   d. Measure loop current.
   e. Verify the current deviation is within the safety deviation of 2% (±0.32 mA).

      Note: The inaccuracy of safety logic solver or current meter needs to be considered.
   f. Select **Stop** to end loop test.

   AMS Device Manager and Field Communicator:

   a. From the *Home* screen, select **Service Tools** > **Simulate**.
   b. Select **Loop Test**.
   c. Select **4 mA** and then select **Next**.
   d. Measure loop current.
   e. Verify the current deviation is within the safety deviation of 2% (±0.32 mA).

      Note: The inaccuracy of safety logic solver or current meter needs to be considered.
   f. Select **End** and then select **Next** to end loop test.

4. Output fixed 20.00 mA current and measure the loop current (e.g. using the safety logic solver or current meter).

   Rosemount Radar Master:

   a. Under *Service Tools*, select **Simulate**.
   b. Select **Loop Test**.
   c. Select **20 mA** and then select **Start**.
   d. Measure loop current.
   e. Verify the current deviation is within the safety deviation of 2% (±0.32 mA).

      Note: The inaccuracy of safety logic solver or current meter needs to be considered.
   f. Select **Stop** to end loop test.

   AMS Device Manager and Field Communicator:

   a. From the *Home* screen, select **Service Tools** > **Simulate**.
   b. Select **Loop Test**.
   c. Select **20 mA** and then select **Next**.
   d. Measure loop current.
   e. Verify the current deviation is within the safety deviation of 2% (±0.32 mA).

      Note: The inaccuracy of safety logic solver or current meter needs to be considered.
   f. Select **End** and then select **Next** to end loop test.

5. Perform a one-point level measurement verification of the transmitter in the measuring range. Compare with independent measurement (e.g. the BPCS level sensor).

   Rosemount Radar Master:

   a. Under *Overview*, select **All Variables**.
   b. Verify the current level or distance reading with an independent measurement is within the safety deviation of 2%.

      Note: The inaccuracy of the independent measurement needs to be considered.

   AMS Device Manager and Field Communicator:

   a. From the Home screen, select **Service Tools** > **Variables** > **Process**.
   b. Verify the current level or distance reading with an independent measurement is within the safety deviation of 2%.

      Note: The inaccuracy of the independent measurement needs to be considered.

6. Remove the bypass and otherwise restore normal operation.

8.8.3 2-point level and analog output verification

⚠ WARNING

During the proof-test, the transmitter will not output measurement values corresponding to the product surface level. Make sure 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.

1. Prior to the test, ensure there are no alarms or warnings present in the transmitter.

   Rosemount Radar Master:

   - Under *Service Tools*, select **Alerts**.

   AMS Device Manager and Field Communicator:

   - From the *Home* screen, select **Service Tools** > **Alerts**.

2. Bypass the safety function and take appropriate action to avoid a false trip.

3. Output fixed 4.00 mA current and measure the loop current (e.g. using the safety logic solver or current meter).

   Rosemount Radar Master:

   a. Under *Service Tools*, select **Simulate**.
   b. Select **Loop Test**.
   c. Select **4 mA** and then select **Start**.
   d. Measure loop current.
   e. Verify the current deviation is within the safety deviation of 2% (±0.32 mA).

      Note: The inaccuracy of safety logic solver or current meter needs to be considered.
   f. Select **Stop** to end loop test.

   AMS Device Manager and Field Communicator:

   a. From the *Home* screen, select **Service Tools** > **Simulate**.
   b. Select **Loop Test**.
   c. Select **4 mA** and then select **Next**.
   d. Measure loop current.
   e. Verify the current deviation is within the safety deviation of 2% (±0.32 mA).

      Note: The inaccuracy of safety logic solver or current meter needs to be considered.
   f. Select **End** and then select **Next** to end loop test.

4. Output fixed 20.00 mA current and measure the loop current (e.g. using the safety logic solver or current meter).

Rosemount Radar Master:

a. Under *Service Tools*, select **Simulate**.
b. Select **Loop Test**.
c. Select **20 mA** and then select **Start**.
d. Measure loop current.
e. Verify the current deviation is within the safety deviation of 2% (±0.32 mA).

   Note: The inaccuracy of safety logic solver or current meter needs to be considered.
f. Select **Stop** to end loop test.

AMS Device Manager and Field Communicator:

a. From the *Home* screen, select **Service Tools** > **Simulate**.
b. Select **Loop Test**.
c. Select **20 mA** and then select **Next**.
d. Measure loop current.
e. Verify the current deviation is within the safety deviation of 2% (±0.32 mA).

   Note: The inaccuracy of safety logic solver or current meter needs to be considered.
f. Select **End** and then select **Next** to end loop test.

5. Perform a two-point level measurement verification of the transmitter in the measuring range. Compare with independent measurement (e.g. the BPCS level sensor).

Rosemount Radar Master:

a. Under *Overview*, select **All Variables**.
b. Verify the current level or distance reading with an independent measurement is within the safety deviation of 2%.

   Note: The inaccuracy of the independent measurement needs to be considered.
c. Move the surface in the tank at least 10% of the full measuring span (level 0-100%).
d. Repeat steps (a) to (b) for the second point.

AMS Device Manager and Field Communicator:

a. From the Home screen, select **Service Tools** > **Variables** > **Process**.
b. Verify the current level or distance reading with an independent measurement is within the safety deviation of 2%.

   Note: The inaccuracy of the independent measurement needs to be considered.
c. Move the surface in the tank at least 10% of the full measuring span (level 0-100%).
d. Repeat steps (a) to (b) for the second point.

6. Remove the bypass and otherwise restore normal operation.

8.8.4 Analog output verification

Compare HART Primary Variable digital value with analog output reading. Verify that the deviation is within the pass limit.

1. Obtain the loop current as a digital value.
   - In Rosemount Radar Master, under *Overview*, select All Variables and read the current analog output value.

     OR
   - Read HART command 2 or 3 via the host system.[1]
2. Obtain the loop current as an analog value (e.g. by using the safety logic solver).
3. Compare the current values.
4. Verify the current deviation is within the safety deviation of 2% (±0.32 mA).
   Note: The inaccuracy of safety logic solver needs to be considered.

8.8.5 Level deviation monitoring

Use the analog output to obtain level (or distance) reading and compare with an independent level measurement. Verify that the deviation is within the pass limit.

1. Obtain the level (or distance) measurement value derived from the analog output (e.g. by checking measurement value in safety logic solver).
2. Obtain the level (or distance) measurement value from an independent level measurement (e.g. the BPCS level sensor).
3. Compare the measurements and verify that the deviation is within the pass limit.

8.8.6 Product repair

The Rosemount 5408:SIS is repairable by major component replacement. All failures detected by the transmitter diagnostics or by the proof-test must be reported. Feedback can be submitted electronically at EmersonProcess.com/Rosemount-safety (Contact Us).

1. *Command 2: Analog output current and Percent of range*
   Command 3: Device variables (PV, SV, TV and QV) and Analog output current

8.9 Specifications

The Rosemount 5408:SIS must be operated according to the functional and performance specifications provided in Appendix A: Specifications and Reference Data.

Failure rate data

The FMEDA report includes failure rate data, assessment details, and assumptions regarding failure rate analysis. The full report is accessible at:
EmersonProcess.com/Rosemount-Safety

Safety deviation

+/-2.0% of analog output span under reference conditions

Transmitter response time(1)(2)

< 6 s at damping value 2 s (default)

< 2 s at damping value 0 s (minimum)

Diagnostic test interval(3)

< 90 min (< 30 s (default) for xx% of self-diagnostic tests)

Turn-on time(4)

< 40 s

Useful lifetime(5)

XX years

8.10 SIS loop example

This section will include PFD_{avg} vs time graphs for the proof-tests at different proof-test intervals.

1. *Step response time as per IEC 60298-2.*
2. *The transmitter response time will be a function of the configured Damping value. Rosemount Radar Master has a built-in function to calculate the transmitter's measurement response time (select Configure > Device Setup > HART > Calculate Response Time).*
3. *The fault reaction time depends on the configured Alarm Delay (default value is 30 seconds). The Alarm Delay parameter controls the maximum time from when a fault condition is detected until it is annunciated, see "Alarm delay" on page 178.*
4. *Time from when power is applied to the transmitter until performance is within specifications.*
5. *Estimated useful lifetime; see the FMEDA report for more information.*

Appendix A Specifications and Reference Data

A.1 Performance specifications

A.1.1 General

Reference conditions

- Measurement target: Metal plate, no disturbing objects
- Temperature: 68 to 86 °F (20 to 30 °C)
- Ambient pressure: 14 to 15 psi (960 to1060 mbar)
- Relative humidity: 25-75%

Instrument accuracy (under reference conditions)[1]

± 0.08 in. (2 mm)

Repeatability

±0.04 in. (±1 mm)

Resolution

TBD

Ambient temperature effect

TBD

Ambient temperature hysteresis

TBD

Vibration effect

TBD

Process temperature effect

TBD

Electromagnetic interference effect[2]

TBD

Sensor update rate

TBD

Maximum level rate

TBD

A.1.2 Measuring range

Maximum measuring range[3]

- Rosemount 5408: 130 ft (40 m)
- Rosemount 5408:SIS: 82 ft (25 m)

Blind zones

The measuring range is limited by the Blind Zones at the very top and bottom of the tank. In the Blind Zones, the accuracy exceeds ±TBD in. (TBD mm), and measurements may not be possible. Measurements close to the Blind Zones will have reduced accuracy.

Figure A-1. Accuracy Over Measuring Range

[PLACEHOLDER]

1. *Refer to the IEC 60770-1 (IEC 1292-2) standard for a definition of radar specific performance parameters and if applicable corresponding test procedure.*
2. *Deviation through electromagnetic interference according to EN 61326.*
3. *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.*

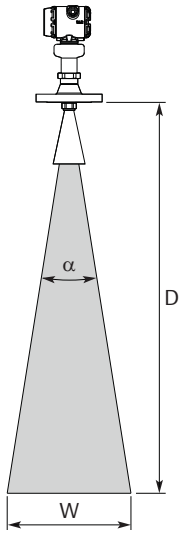
Beam angle

- 2-in. cone antenna: 18°
- 3-in. cone antenna: 14°
- 4-in. cone antenna: 10°
- Parabolic antenna: 4.5°

Beam width

Distance (D), ft (m)	Beam width (W), ft (m)			
	2-in. cone	3-in. cone	4-in. cone	Parabolic
16 (5)	5.2 (1.6)	4.0 (1.2)	2.9 (0.9)	1.3 (0.4)
33 (10)	10.4 (3.2)	8.1 (2.5)	5.7 (1.8)	2.6 (0.8)
49 (15)	15.6 (4.8)	12.1 (3.7)	8.6 (2.6)	3.9 (1.2)
66 (20)	20.8 (6.3)	16.1 (4.9)	11.5 (3.5)	5.2 (1.6)
82 (25)	26.0 (7.9)	20.1 (6.1)	14.3 (4.4)	6.4 (2.0)
98 (30)	31.2 (9.5)	24.2 (7.4)	17.2 (5.3)	7.7 (2.4)
131 (40)	41.6 (12.7)	32.2 (9.8)	23.0 (7.0)	10.3 (3.1)

Figure A-2. Beam Width and Beam Angle



A.1.3 Environment

Vibration resistance

No effect when tested per the requirements of:

- IEC61298-3, level “field with general application”
- IACS UR E10 test 7

Electromagnetic compatibility (EMC)

- EMC Directive (2014/30/EU): EN 61326-1:2013
- EN 61326-2-3:2013

Pressure Equipment Directive (PED)

Complies with 2014/68/EU article 3.3

Built-in lightning protection

EN 61326, IEC 61000-4-5, level 6kV

Radio approvals

Complies with:

- Radio Equipment Directive (2014/53/EU): ETSI EN 302 372, ETSI EN 302 729 and EN 62479
- Part 15 of the FCC Rules
- Industry Canada RSS 211

A.2 Functional specifications

A.2.1 General

Field of application

Continuous level measurements for tank monitoring, process control, and overfill prevention on a broad range of liquids and slurries.

Ideal for applications with varying and harsh process conditions, such as heavy turbulence, foaming, product build-up, condensing vapors, sticky, viscous, corrosive, and crystallizing products.

Measurement principle

Frequency Modulated Continuous Wave (FMCW), 26 GHz

Frequency range

24.05 to 27.0 (26.5[1]) GHz

Maximum output power

-5 dBm (0.32 mW)

Internal power consumption

< 1 W in normal operation

Humidity

0 - 100% relative humidity, non-condensing

Turn-on time[2]

< 40 s

1. *For LPR (Level Probing Radar), option code OA.*
2. *Time from when power is applied to the transmitter until performance is within specifications.*

A.2.2 Display and configuration

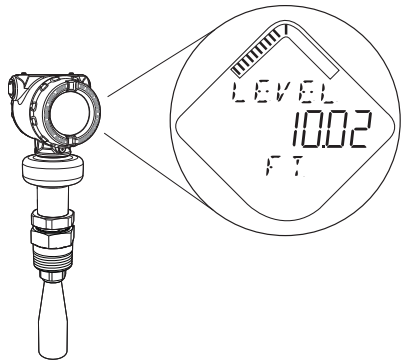
Configuration tools

- Rosemount Radar Master (running in Instrument Inspector™)[1]
- Device Descriptor (DD) based systems, e.g. AMS™ Device Manager, 475 Field Communicator, and DeltaV™
- Field Device Integration (FDI) based systems

Device display (option code M5)

- Toggles between selected output variables
- Shows diagnostic information (alerts)

Figure A-3. Device Display



Remote display

Data can be read remotely by using the Rosemount 751 Field Signal Indicator, see the Product Data Sheet for more information.

1. *Included in delivery of the transmitter.*

Output variables

Variable	4-20 mA	Digital output	Device display
Level	+	+	+
Distance (Ullage)	+	+	+
Volume	+	+	+
Scaled Variable[1]	+	+	+
Electronics Temperature	-	+	+
Signal Quality[1]	-	+	+
Level Rate	-	+	+
Signal strength	-	+	+
Percent of Range	-	+	+
Percent of Range Auxiliary	-	+	+
User Defined[1]	+	+	+

+ Available
- Not available

1. Only for transmitters ordered with Smart Diagnostics Suite (option code DA1)

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

Damping[2]

0 to 60 seconds (user selectable, default 2 seconds)

A.2.3 4-20 mA HART (output code H)

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 HART signal can be used in multidrop mode.

HART Revision

- Revision 6 (default)
- Revision 7 (option code HR7)

The HART revision can be switched in field.

2. *The Damping parameter defines how fast the device responds to level changes (step response). A high value makes the level steady but the device reacts slowly to level changes in the tank.*

Power supply

Transmitter operates on 12-42.4 Vdc transmitter terminal voltage (12-30 Vdc in Intrinsically Safe installations).

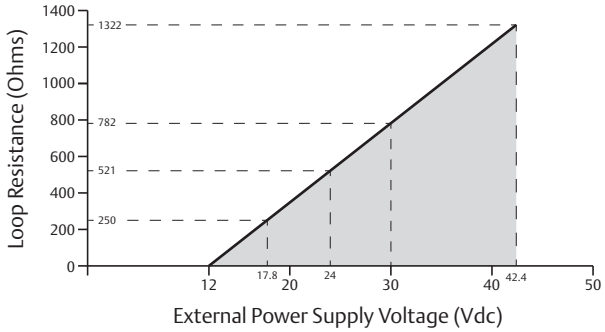
Power consumption

- Max. 1 W, current max. 23 mA

Load limitations

Maximum loop resistance is determined by the voltage level of the external power supply, as described by:

Maximum Loop Resistance = 43.5 * (External Power Supply Voltage - 12)



For HART communication, a minimum loop resistance of 250 Ω is required.

Signal wiring

24-14 AWG[1]

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.

	High	Low
Rosemount standard	≥ 21.75 mA (default)	≤ 3.75 mA (option code C8)
NAMUR NE43	≥ 22.50 mA (option code C4)	≤ 3.6 mA (option code C5)

Analog saturation levels

The transmitter will drive the output to high or low saturation values if measurement goes outside the 4-20 mA range values.

	High	Low
Rosemount standard (default and option code C8)	20.8 mA	3.9 mA
NAMUR NE43 (option code C4 and C5)	20.5 mA	3.8 mA

1. *Twisted pairs and shielded wiring are recommended for environments with high EMI (electromagnetic interference).*

A.2.4 Diagnostics

Alerts

The Rosemount 5408 and 5408:SIS are compliant to the NAMUR NE 107 Field Diagnostics for standardized device diagnostic information.

Tools and logging in Rosemount Radar Master

- Echo curve
- Alert and measurement log

The Rosemount Radar Master software enables easy and powerful troubleshooting with the echo curve tool.

When connected to Rosemount Radar Master, past measurement records (level and echo curves) as well as the 50 last event alerts are transferred from the transmitter's internal memory to your local computer. Historical data is then presented in a graphical time line, enabling you to thoroughly understand unexpected and intermittent measurement behaviors or triggered alerts.

Smart Diagnostics Suite (option code DA1)

Signal Quality Metrics - Diagnostics package that monitors the relations between surface, noise and threshold. The function can be used to detect abnormal conditions in the process such as antenna contamination or sudden loss of signal strength. Signal Quality is available as output variable and it comes with user configurable alerts.

Power Advisory - The transmitter automatically measures and monitors the input voltage. If the voltage is too low, operators will be provided with an early alert.

Scaled Variable - The scaled variable configuration allows the user to convert a transmitter variable into an alternative measurement, such as flow, mass or calibrated level (e.g. 5 point verification).

User Defined Variable - Allows designating any input register in the device as output variable.

A.2.5 Process temperature and pressure rating

The following figures give the maximum process temperature (measured at the lower part of the flange or threaded connection) and pressure rating for different antenna types.

Final rating may be lower depending on flange selection.

Figure A-4. Cone Antenna (PTFE Seal)

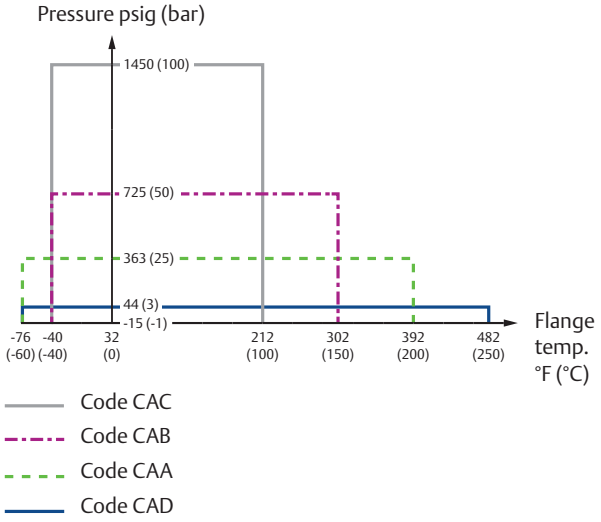


Figure A-5. Cone Antenna (PEEK Seal)

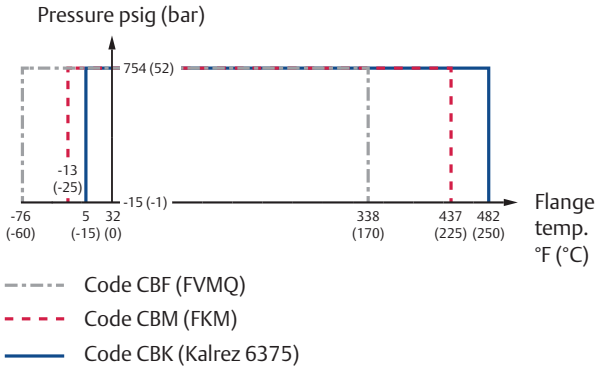


Figure A-6. Parabolic Antenna

A.2.6 Temperature limits

	Operating limit	Storage limit[1]
Without LCD display	TBD	TBD
With LCD display[2]	TBD	TBD

1. The minimum storage temperature is -22 °F (-30 °C) for the cone antenna with Kalrez 6375 O-ring (antenna type code CBK).
2. LCD display may not be readable and LCD display updates will be slower at temperatures below -4 °F (-20 °C).

Temperature limits may be further restricted by hazardous area approvals, see "Product Certifications" on page 145.

A.2.7 Process sealing for flammable fluids

The bottom of the transmitter head is approved as a SINGLE SEAL device, according to ANSI/ISA 12.27.01, up to a process pressure of 160 bar.

Materials of the seal

Stainless Steel 316L and Glass

A.2.8 Flange rating

ASME

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

EN

1.4404 according to EN 1092-1 material group 13E0

JIS

TBD

Conditions used for flange strength calculations

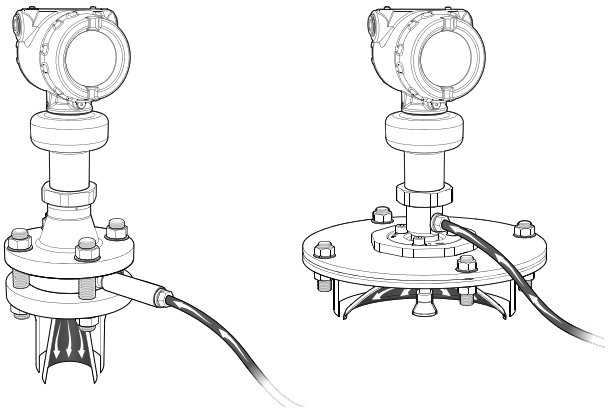
	ASME	EN, JIS
Bolting material	TBD	TBD
Gasket	TBD	TBD
Flange material	TBD	TBD

A.2.9 Air purging

An air purge connection can prevent clogging of the antenna in extremely dusty applications. The easiest way to determine if air purging is needed, is to open the manhole hatch and see if there is a thick layer of dust/condensation on it. If so, air purging is most likely needed. Typical media to use is air.

All parabolic antennas come with an integrated air purge connection. A separate air purge ring is available for cone antennas with flanged connection (select option code PC1).

Figure A-7. Air Purging



Incoming air supply specification

- Maximum pressure: 190 psi (13 bar)
- Recommended pressure: 100 to 115 psi (7 to 8 bar)
- Inlet/outlet connection: G 3/8-in.
- Air consumption: 252 gal/min at 65 psi (955 l/min at 4.5 bar)

A.2.10 System integration

HART Tri-Loop™

By sending the digital HART signal to the optional HART Tri-Loop, it is possible to have up to three additional 4–20 mA analog signals. See the Rosemount 333 HART Tri-Loop Product Data Sheet for additional information.

Emerson Wireless 775 THUM™ Adapter

The optional Emerson Wireless 775 THUM Adapter can be mounted directly on the transmitter or by using a remote mounting kit.

IEC 62591 (*Wireless*HART®) enables access to multivariable data and diagnostics, and adds wireless to almost any measurement point.

See the Emerson Wireless 775 THUM Adapter Product Data Sheet and Technical Note for additional information.

A.3 Physical specifications

A.3.1 Material selection

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

A.3.2 Engineered solutions

When standard model codes are not sufficient to fulfill requirements, please consult the factory to explore possible Engineered Solutions. This is typically, but not exclusively, related to the choice of wetted materials or the design of a process connection. These Engineered Solutions are part of the expanded offerings and may be subject to additional delivery lead time. For ordering, factory will supply a special P-labeled numeric option code that should be added at the end of the standard model string.

See example model string below.

Example Model String:
5408 A 1 S H A 1 E5 1 F 3 AB CAA 3 M5 DA1 **P1234**

A.3.3 Housing and enclosure

Electrical connections

Two cable/conduit entries (½-14 NPT, M20 x 1.5 or G1/2)

Optional adapters: M12 4-pin male eurofast® connector or A size Mini 4-pin male minifast® connector

Materials

- Electronics housing: Polyurethane-covered Aluminum or Stainless Steel Grade CF-8M (ASTM A743)
- Sensor module: 316L Stainless Steel

Ingress protection

IP 66/67/68[(1)] and NEMA® 4X

A.3.4 Tank connection

The tank connection consists of a tank seal, a flange, NPT thread or BSPP (G) threads, or a specific welded connection with swivel feature for parabolic antenna.

A.3.5 Flange dimensions

Follows ASME B16.5, JIS B2220, and EN 1092-1 standards. For more information, see "Standard flanges" on page 143.

A.3.6 Antenna versions

Cone antenna

- Best choice for a broad range of applications, including free-propagation and still pipe/chamber installations
- Cone extensions are available (option code S1 and S2)

Parabolic antenna

- Ideal for long measuring ranges

A.3.7 Material exposed to tank atmosphere

Cone antenna, PTFE seal

- 316 / 316L SST (EN 1.4404)
- PTFE fluoropolymer

Cone antenna, PEEK seal

- 316 / 316L SST (EN 1.4404)
- PEEK polyetheretherketone with PTFE fluoropolymer filler
- FVMQ flourosilicone, Kalrez® 6375 perfluoroelastomer or FKM fluoroelastomer (O-ring)

Parabolic antenna

- 316 / 316 L SST (EN 1.4404)
- PTFE fluoropolymer
- FVMQ flourosilicone (O-ring)

1. *The transmitter meets IP 68 at 9.8 ft (3 m) for 30 minutes.*

A.3.8 Weights

Transmitter heads[1]

- Aluminum housing: TBD
- Stainless steel housing: TBD

Antennas

- 2-in. cone antenna: TBD
- 3-in. cone antenna: TBD
- 4-in. cone antenna: TBD
- 2-in. cone antenna with extension (code S1): TBD
- 3-in. cone antenna with extension (code S1): TBD
- 4-in. cone antenna with extension (code S1): TBD
- Parabolic antenna: 3.2 lb (1.5 kg)

Process connections

Item	Weight in lb. (kg)

1. *Fully functional transmitter with sensor module, housing, terminal block, and covers.*

A.4 Ordering information

Table A-1. Rosemount 5408 Level Transmitter Ordering Information

The starred options (★) represent the most common options and should be selected for best delivery.
The non-starred offerings are subject to additional delivery lead time.

Model	Product description		
5408	Radar Level Transmitter		★
Profile			
A	Standard Monitoring & Control Applications		★
Measurement type			
1	Liquid Level Measurement		★
Performance class		**Range**	
S	Standard	Up to 130 ft (40 m)	★
Signal output			
H	4–20 mA with digital signal based on HART® Revision 6 protocol (HART Revision 7 available as option)		★
Housing material			
A	Aluminum		★
S	Stainless Steel (SST)		★
Conduit/cable threads			
1	1/2-14 NPT		★
2	M20 x 1.5		★
3(1)	G1/2		
Hazardous locations certifications			
NA	None		★
E1	ATEX Flameproof		★
I1	ATEX Intrinsic Safety		★
N1	ATEX Type n		★
E5	FM Explosion-proof, Dust Ignition-proof		★
I5	FM Intrinsically Safe; Nonincendive		★
E6	Canadian Explosion-proof, Dust Ignition-proof, Division 2		★
I6	Canadian Intrinsically Safe		★
E7	IECEx Flameproof, Dust Ignition-proof		★
I7	IECEx Intrinsic Safety		★
N7	IECEx Type n		★

Table A-1. Rosemount 5408 Level Transmitter Ordering Information

The starred options (★) represent the most common options and should be selected for best delivery.
The non-starred offerings are subject to additional delivery lead time.

Materials of construction			
1	316 / 316L / EN 1.4404		★
Process connection type		**Available antenna types**	
F[2]	Flat Face Flange	All	★
R[3]	Raised Face Flange	All	★
N	NPT thread	Cone Antenna	★
G	BSPP (G) thread	All	★
B	Bracket Mounting	Cone Antenna	★
W	Welded Connection	Parabolic Antenna	★
Process connection size		**Available process connection types**	
A	1½-in.	Thread	★
2	2-in. / DN50 / 50A	Flange, Thread	★
3	3-in. / DN80 / 80A	Flange, Thread	★
B	3½-in.	Thread	★
4	4-in. / DN100 / 100A	Flange, Thread	★
6	6-in. / DN150 / 150A	Flange	★
8	8-in. / DN200 / 200A	Flange	★
T	10-in. / DN250 / 250A	Flange	★
Z	None (use when ordering bracket mounting)	Bracket Mounting	★
Process connection rating			
ZZ	For use with non-flange process connection type		★
ASME flanges (refer to Table A-3 and Table A-4 on page 139 for availability)			
AA	ASME B16.5 Class 150		★
AB	ASME B16.5 Class 300		★
AC	ASME B16.5 Class 600		★
EN flanges (refer to Table A-3 and Table A-4 on page 139 for availability)			
DK	EN1092-1 PN6		★
DA	EN1092-1 PN16		★
DB	EN1092-1 PN40		★
DC	EN1092-1 PN63		★
DD	EN1092-1 PN100		★

Table A-1. Rosemount 5408 Level Transmitter Ordering Information

The starred options (★) represent the most common options and should be selected for best delivery.
The non-starred offerings are subject to additional delivery lead time.

JIS flanges (refer to Table A-3 and Table A-4 on page 139 for availability)				
JK	JIS 5K			★
JA	JIS 10K			★
JB	JIS 20K			★
Antenna type		**Operating pressure**	**Operating temperature**	
CAA	Cone Antenna (PTFE seal)	-15 to 363 psig (-1 to 25 bar)	-76 to 392 °F (-60 to 200 °C)	★
CAB	Cone Antenna (PTFE seal)	-15 to 725 psig (-1 to 50 bar)	-40 to 302 °F (-40 to 150 °C)	★
CAC	Cone Antenna (PTFE seal)	-15 to 1450 psig (-1 to 100 bar)	-40 to 212 °F (-40 to 100 °C)	★
CAD	Cone Antenna (PTFE seal)	-15 to 44 psig (-1 to 3 bar)	-76 to 482 °F (-60 to 250 °C)	★
CBF	Cone Antenna (PEEK seal, FVMQ)	-15 to 754 psig (-1 to 52 bar)	-76 to 338 °F (-60 to 170 °C)	★
CBK	Cone Antenna (PEEK seal, Kalrez® 6375)	-15 to 754 psig (-1 to 52 bar)	5 to 482 °F (-15 to 250 °C)	★
CBM	Cone Antenna (PEEK seal, FKM)	-15 to 754 psig (-1 to 52 bar)	-13 to 437 °F (-25 to 225 °C)	★
PAS	Parabolic Antenna, Swivel Mount	-7 to 43 psig (-0.5 to 3 bar)	-67 to 392 °F (-55 to 200 °C)	★
Antenna size		**Available antenna types**		
2	2-in. (DN50)	Cone Antenna		★
3	3-in. (DN80)	Cone Antenna		★
4	4-in. (DN100)	Cone Antenna		★
8	8-in. (DN200)	Parabolic Antenna		★

Options (include with selected model number)

Antenna extensions		**Total length**	
S1	SST Cone Antenna Extension	24-in. (600 mm)	★
S2	SST Cone Antenna Extension segmented	48-in. (1200 mm)	★
Purging connection			
PC1	Purging Connector (see page 126)		★
Display			
M5	LCD Display		★
Functional safety options			
EF1	Ready for upgrade to Rosemount 5408:SIS		★
Diagnostic functionality			
DA1	Smart Diagnostics Suite (see page 124)		★

Table A-1. Rosemount 5408 Level Transmitter Ordering Information

The starred options (★) represent the most common options and should be selected for best delivery.
The non-starred offerings are subject to additional delivery lead time.

HART revision configuration		
HR7	4-20 mA with digital signal based on HART Revision 7 protocol	★
Open air applications configuration		
OA[4]	Open Air Applications Configuration; LPR (Level Probing Radar)	★
Alarm limits		
C4	NAMUR Alarm and Saturation Levels, High Alarm	★
C5	NAMUR Alarm and Saturation Levels, Low Alarm	★
C8[5]	Standard Rosemount Alarm and Saturation Levels, Low Alarm	★
Welding standard for flanges		
AW[6]	According to ASME standard	★
EW[6]	According to EN standard	★
Special quality assurance		
Q4	Calibration Data Certificate	★
Hydrostatic testing		
Q5[7]	Hydrostatic Testing, including certificate	★
Quality traceability certification		
Q8[8]	Material Traceability Certification per EN 10204 (2.1/3.1 non metallic)	★
Materials certification		
Q15	NACE® Material Recommendation per NACE MR0175/ISO 15156	★
Q25	NACE Material Recommendation per ANSI/NACE MR0103/ISO 17495-1	★
Q35	NACE Material Recommendation per NACE MR0175/ISO 15156 and/or ANSI/NACE MR0103/ISO 17495-1	★
Canadian Registration Number (CRN)		
Q17	CRN Approval Certificate	★
Welding procedure qualification record documentation		
Q66[6]	Welding Procedure Qualification Record Documentation (WPQR)	★
Q67[6]	Welder Performance Qualification Record (WPQ)	★
Q68[6]	Welding Procedure Specification (WPS)	★
Q79[6]	WPQR/WPQ/WPS	★
Dye penetration test certificate		
Q73[6]	Certificate of Liquid Penetrant Inspection	★

Table A-1. Rosemount 5408 Level Transmitter Ordering Information

The starred options (★) represent the most common options and should be selected for best delivery.
The non-starred offerings are subject to additional delivery lead time.

Positive material identification certificate		
Q76	Positive Material Identification Certificate of Conformance	★
Extended product warranty		
WR3	3-year Limited Warranty	★
WR5	5-year Limited Warranty	★
Paint option for aluminum housing		
PY1	Housing and Covers in Yellow	★
PY2	Covers in Yellow	★
PR1	Housing and Covers in Red	★
PR2	Covers in Red	★
PO1	Housing and Covers in Orange	★
PO2	Covers in Orange	★
Conduit electrical connector		
EC[9]	M 12, 4-pin, Male connector (eurofast®)	★
MC[9]	A size Mini, 4-pin, Male connector (minifast®)	★
Adapter wetted parts		
A1	Adapter for Rosemount 5402 Antennas	★
Specials (see page 127)		
PXXXX	Custom Engineered Solutions beyond standard model codes. Consult factory for details.	
Typical model number: 5408 A 1 S H A 1 E5 1 R 3 AB CAB 3 M5 DA1		

1. G1/2 thread form is not available with explosion-proof/flameproof approvals.
2. Type A flat face for EN 1092-1 flanges.
3. Type B1 raised face for EN 1092-1 flanges.
4. Not available with 2-in. or 3-in. cone antenna.
5. The standard alarm setting is high.
6. Only applies to flanged process connections with welded construction; only applicable to cone antennas (see Table A-3 on page 138).
7. Hydrostatic testing is only available for cone antennas with flanged process connections.
8. Certificate includes all pressure retaining wetted parts.
9. Requires 1/2-14 NPT conduit/cable threads (code 1). Available with Intrinsically Safe approvals only.

Table A-2. Rosemount 5408:SIS Level Transmitter Ordering Information

The starred options (★) represent the most common options and should be selected for best delivery.
The non-starred offerings are subject to additional delivery lead time.

Model	Product description		
5408	Radar Level Transmitter		★
Profile			
F	Functional Safety / SIS Applications		★
Measurement type			
1	Liquid Level Measurement		★
Performance class		**Range**	
S	Standard	Up to 82 ft (25 m)	★
Signal output			
H	4–20 mA with digital signal based on HART Revision 6 protocol (HART Revision 7 available as option)		★
Housing material			
A	Aluminum		★
S	Stainless Steel (SST)		★
Conduit/cable threads			
1	1/2-14 NPT		★
2	M20 x 1.5		★
3[(1)]	G1/2		
Hazardous locations certifications			
NA	None		★
E1	ATEX Flameproof		★
I1	ATEX Intrinsic Safety		★
N1	ATEX Type n		★
E5	FM Explosion-proof, Dust Ignition-proof		★
I5	FM Intrinsically Safe; Nonincendive		★
E6	Canadian Explosion-proof, Dust Ignition-proof, Division 2		★
I6	Canadian Intrinsically Safe		★
E7	IECEx Flameproof, Dust Ignition-proof		★
I7	IECEx Intrinsic Safety		★
N7	IECEx Type n		★
Materials of construction			
1	316 / 316L / EN 1.4404		★

Table A-2. Rosemount 5408:SIS Level Transmitter Ordering Information

The starred options (★) represent the most common options and should be selected for best delivery.
The non-starred offerings are subject to additional delivery lead time.

Process connection type		**Available antenna types**	
F[2]	Flat Face Flange	All	★
R[3]	Raised Face Flange	All	★
N	NPT thread	Cone Antenna	★
G	BSPP (G) thread	All	★
B	Bracket Mounting	Cone Antenna	★
W	Welded Connection	Parabolic Antenna	★
Process connection size		**Available process connection types**	
A	1½-in.	Thread	★
2	2-in. / DN50 / 50A	Flange, Thread	★
3	3-in. / DN80 / 80A	Flange, Thread	★
B	3½-in.	Thread	★
4	4-in. / DN100 / 100A	Flange, Thread	★
6	6-in. / DN150 / 150A	Flange	★
8	8-in. / DN200 / 200A	Flange	★
T	10-in. / DN250 / 250A	Flange	★
Z	None (use when ordering bracket mounting)	Bracket Mounting	★
Process connection rating			
ZZ	For use with non-flange process connection type		★
ASME flanges (refer to Table A-3 and Table A-4 on page 139 for availability)			
AA	ASME B16.5 Class 150		★
AB	ASME B16.5 Class 300		★
AC	ASME B16.5 Class 600		★
EN flanges (refer to Table A-3 and Table A-4 on page 139 for availability)			
DK	EN1092-1 PN6		★
DA	EN1092-1 PN16		★
DB	EN1092-1 PN40		★
DC	EN1092-1 PN63		★
DD	EN1092-1 PN100		★
JIS flanges (refer to Table A-3 and Table A-4 on page 139 for availability)			
JK	JIS 5K		★
JA	JIS 10K		★
JB	JIS 20K		★

Table A-2. Rosemount 5408:SIS Level Transmitter Ordering Information

The starred options (★) represent the most common options and should be selected for best delivery.
The non-starred offerings are subject to additional delivery lead time.

Antenna type		Operating pressure	Operating temperature	
CAA	Cone Antenna (PTFE seal)	-15 to 363 psig (-1 to 25 bar)	-76 to 392 °F (-60 to 200 °C)	★
CAB	Cone Antenna (PTFE seal)	-15 to 725 psig (-1 to 50 bar)	-40 to 302 °F (-40 to 150 °C)	★
CAC	Cone Antenna (PTFE seal)	-15 to 1450 psig (-1 to 100 bar)	-40 to 212 °F (-40 to 100 °C)	★
CAD	Cone Antenna (PTFE seal)	-15 to 44 psig (-1 to 3 bar)	-76 to 482 °F (-60 to 250 °C)	★
CBF	Cone Antenna (PEEK seal, FVMQ)	-15 to 754 psig (-1 to 52 bar)	-76 to 338 °F (-60 to 170 °C)	★
CBK	Cone Antenna (PEEK seal, Kalrez 6375)	-15 to 754 psig (-1 to 52 bar)	5 to 482 °F (-15 to 250 °C)	★
CBM	Cone Antenna (PEEK seal, FKM)	-15 to 754 psig (-1 to 52 bar)	-13 to 437 °F (-25 to 225 °C)	★
PAS	Parabolic Antenna, Swivel Mount	-7 to 43 psig (-0.5 to 3 bar)	-67 to 392 °F (-55 to 200 °C)	★
Antenna size		**Available antenna types**		
2	2-in. (DN50)	Cone Antenna		★
3	3-in. (DN80)	Cone Antenna		★
4	4-in. (DN100)	Cone Antenna		★
8	8-in. (DN200)	Parabolic Antenna		★

Options (include with selected model number)

Antenna extensions		Total length	
S1	SST Cone Antenna Extension	24-in. (600 mm)	★
S2	SST Cone Antenna Extension segmented	48-in. (1200 mm)	★
Purging connection			
PC1	Purging Connector (see page 126)		★
Display			
M5	LCD Display		★
Functional safety options			
EF2	Extended SIS Package		★
Diagnostic functionality			
DA1	Smart Diagnostics Suite (see page 124)		★
HART revision configuration			
HR7	4-20 mA with digital signal based on HART Revision 7 protocol		★
Open air applications configuration			
OA[4]	Open Air Applications Configuration; LPR (Level Probing Radar)		★

Table A-2. Rosemount 5408:SIS Level Transmitter Ordering Information

The starred options (★) represent the most common options and should be selected for best delivery.
The non-starred offerings are subject to additional delivery lead time.

Alarm limits		
C4	NAMUR Alarm and Saturation Levels, High Alarm	★
C5	NAMUR Alarm and Saturation Levels, Low Alarm	★
C8[5]	Standard Rosemount Alarm and Saturation Levels, Low Alarm	★
Welding standard for flanges		
AW[6]	According to ASME standard	★
EW[6]	According to EN standard	★
Special quality assurance		
Q4	Calibration Data Certificate	★
Hydrostatic testing		
Q5[7]	Hydrostatic Testing, including certificate	★
Quality traceability certification		
Q8[8]	Material Traceability Certification per EN 10204 (2.1/3.1 non metallic)	★
Quality certification for safety		
QS	Prior-use certificate of FMEDA Data	★
QT	Safety-certified to IEC 61508 with certificate of FMEDA data	★
Materials certification		
Q15	NACE Material Recommendation per NACE MR0175/ISO 15156	★
Q25	NACE Material Recommendation per ANSI/NACE MR0103/ISO 17495-1	★
Q35	NACE Material Recommendation per NACE MR0175/ISO 15156 and/or ANSI/NACE MR0103/ISO 17495-1	★
Canadian Registration Number (CRN)		
Q17	CRN Approval Certificate	★
Welding procedure qualification record documentation		
Q66[6]	Welding Procedure Qualification Record Documentation (WPQR)	★
Q67[6]	Welder Performance Qualification Record (WPQ)	★
Q68[6]	Welding Procedure Specification (WPS)	★
Q79[6]	WPQR/WPQ/WPS	★
Dye penetration test certificate		
Q73[6]	Certificate of Liquid Penetrant Inspection	★
Positive material identification certificate		
Q76	Positive Material Identification Certificate of Conformance	★

Table A-2. Rosemount 5408:SIS Level Transmitter Ordering Information

The starred options (★) represent the most common options and should be selected for best delivery.
The non-starred offerings are subject to additional delivery lead time.

Extended product warranty		
WR3	3-year Limited Warranty	★
WR5	5-year Limited Warranty	★
Paint option for aluminum housing		
PY1	Housing and Covers in Yellow	★
PY2	Covers in Yellow	★
PR1	Housing and Covers in Red	★
PR2	Covers in Red	★
PO1	Housing and Covers in Orange	★
PO2	Covers in Orange	★
Conduit electrical connector		
EC[9]	M 12, 4-pin, Male connector (eurofast®)	★
MC[9]	A size Mini, 4-pin, Male connector (minifast®)	★
Adapter wetted parts		
A1	Adapter for Rosemount 5402 Antennas	★
Specials (see page 127)		
PXXXX	Custom Engineered Solutions beyond standard model codes. Consult factory for details.	
Typical model number: 5408 F 1 S H A 1 E5 1 R 3 AB CAB 3 M5 DA1 EF2 QT		

1. G1/2 thread form is not available with explosion-proof/flameproof approvals.
2. Type A flat face for EN 1092-1 flanges.
3. Type B1 raised face for EN 1092-1 flanges.
4. Not available with 2-in. or 3-in. cone antenna.
5. The standard alarm setting is high.
6. Only applies to flanged process connections with welded construction; only applicable to cone antennas (see Table A-3 on page 138).
7. Hydrostatic testing is only available for cone antennas with flanged process connections.
8. Certificate includes all pressure retaining wetted parts.
9. Requires 1/2-14 NPT conduit/cable threads (code 1). Available with Intrinsically Safe approvals only.

Table A-3. Cone Antenna - Availability of Flanged Process Connections (Type[1] vs. Size and Rating)

Process connection size	Process connection rating								
	ASME B16.5 flanges			EN1092-1 flanges				JIS B2220 flanges	
	Class 150[2]	Class 300[2]	Class 600[3]	PN16[4]	PN40[4]	PN63[3]	PN100[3]	10K[2]	20K[3]
2-in. / DN50 / 50A	R	R	R	F	F, R	F, R	F	R	R
3-in. / DN80 / 80A	R	R	R	F, R	F, R	F, R	F, R	R	R

Table A-3. Cone Antenna - Availability of Flanged Process Connections (Type(1) vs. Size and Rating)

4-in. / DN100 / 100A	R	R	N/A	F, R	F, R	F	F	R	R
6-in. / DN150 / 150A	R	R	N/A	F, R	F, R	N/A	N/A	R	R
8-in. / DN200 / 200A	R	R	N/A	F, R	F, R	N/A	N/A	R	N/A

1. F = Flat Face (process connection type code F)
   G = BSPP (G) thread (process connection type code G)
   N = NPT thread (process connection type code N)
   R = Raised Face (process connection type code R)
2. Forged one-piece flange (see page 143)
3. Welded construction (see page 143)
4. Welded construction for type A flat face; forged one-piece flange for type B1 raised face.

Table A-4. Parabolic Antenna - Availability of Process Connections (Type(1) vs. Size and Rating)

Process connection size	Process connection rating			
	Threaded/welded connection	ASME B16.5 Class 150 flange	EN1092-1 PN6 flange	JIS B2220 5K flange
3½-in.	G, W	N/A	N/A	N/A
8-in. / DN200 / 200A	N/A	R	F	R
10-in. / DN250 / 250A	N/A	R	F	R

1. F = Flat Face face (process connection type code F)
   G = BSPP (G) thread (process connection type code G)
   R = Raised Face face (process connection type code R)
   W = Welded connection (process connection type code W)

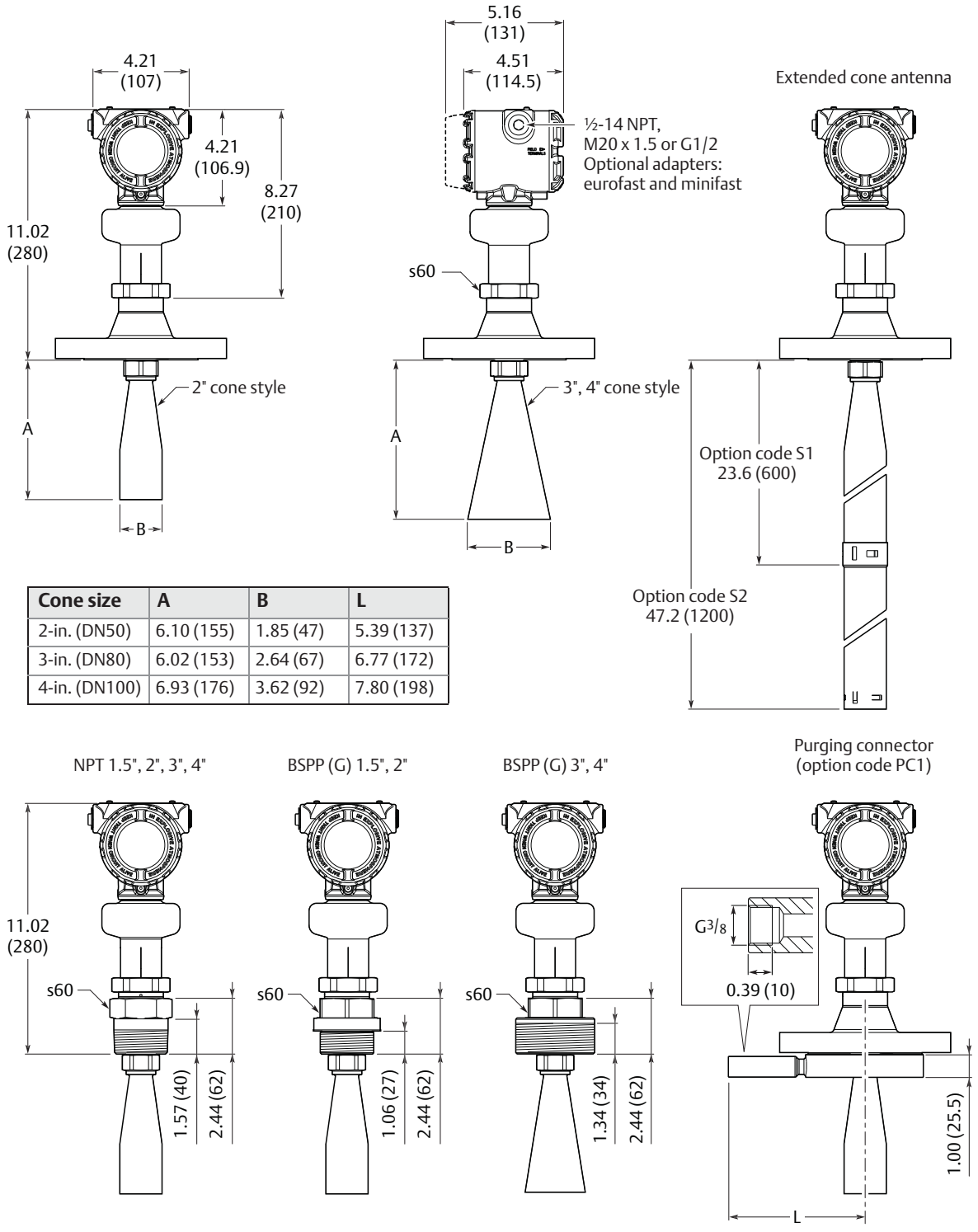
Table A-5. Accessories

The starred options (★) represent the most common options and should be selected for best delivery.
The non-starred offerings are subject to additional delivery lead time.

HART modem and cable		
03300-7004-0001	MACTek® VIATOR® HART modem and cables (RS-232 connection)	★
03300-7004-0002	MACTek VIATOR HART modem and cables (USB connection)	★
Parabolic antenna accessories (see page 141)		
05400-1200-0001	Purge plug kit (blind plug and bonded seal)	TBD
05400-1200-0002	Lock nut G 3½-in. (for parabolic antenna with threaded connection)	TBD

A.5 Dimensional drawings

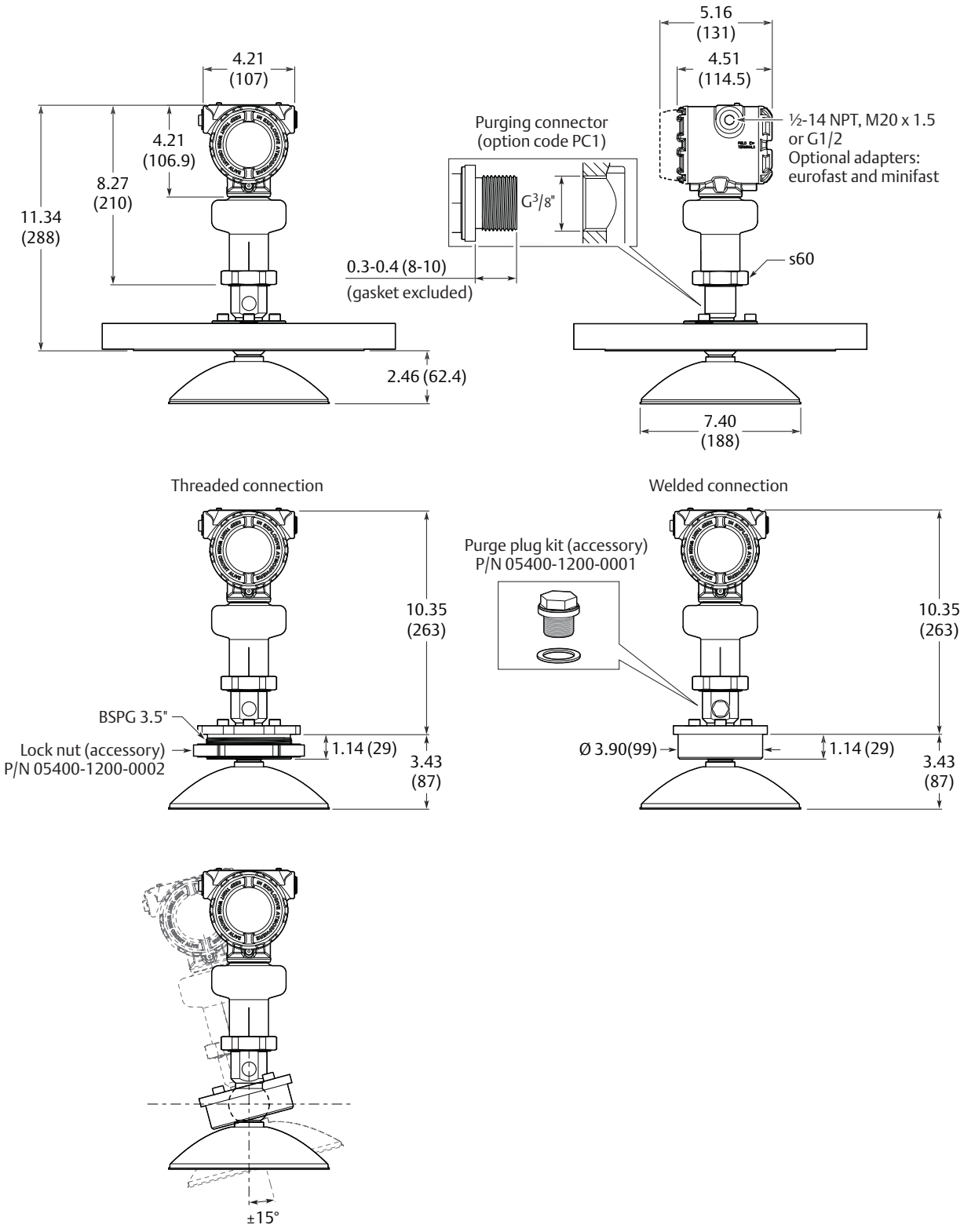
Figure A-8. Cone Antenna



Cone size	A	B	L
2-in. (DN50)	6.10 (155)	1.85 (47)	5.39 (137)
3-in. (DN80)	6.02 (153)	2.64 (67)	6.77 (172)
4-in. (DN100)	6.93 (176)	3.62 (92)	7.80 (198)

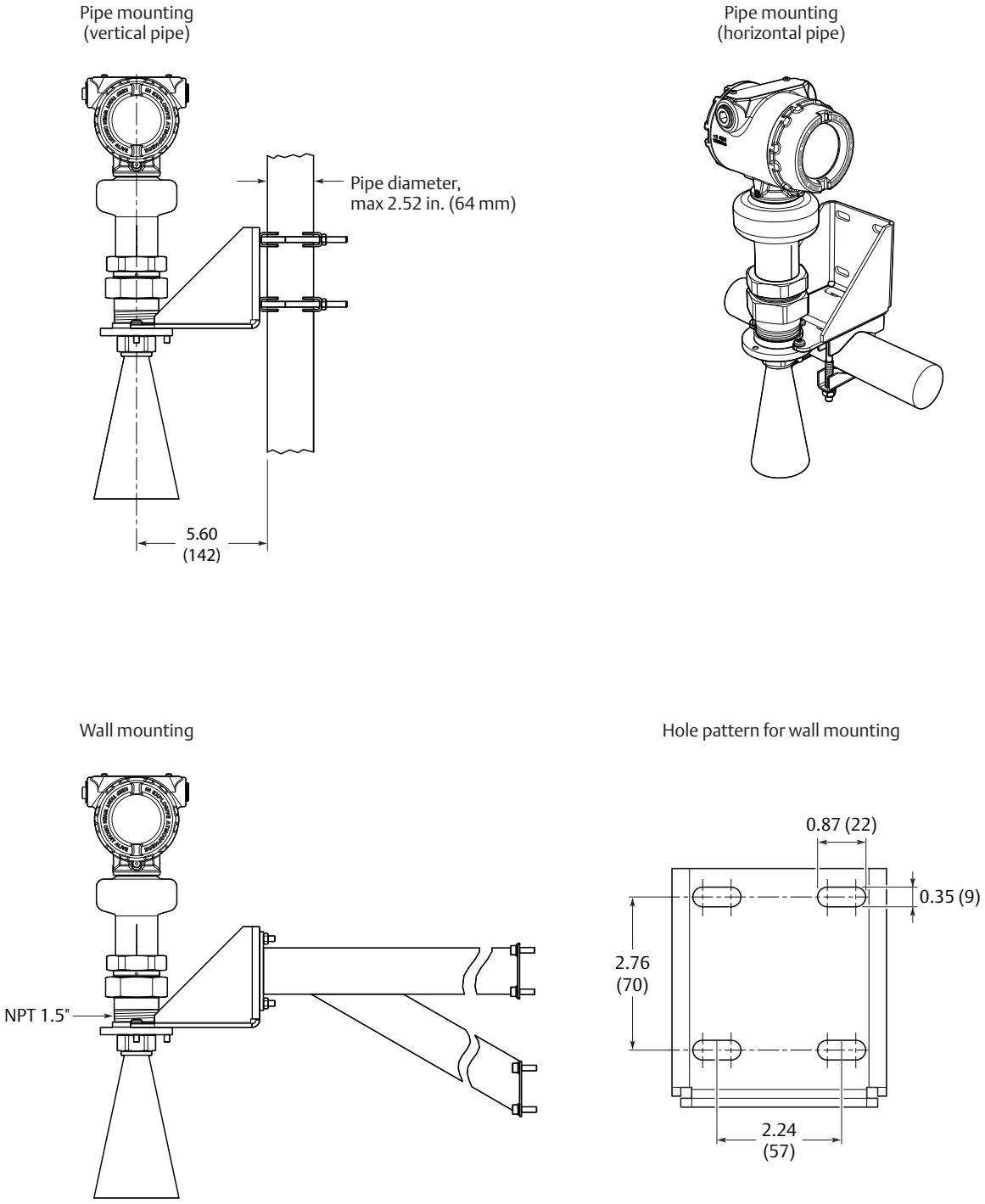
Dimensions are in inches (millimeters).

Figure A-9. Parabolic Antenna



Dimensions are in inches (millimeters).

Figure A-10. Bracket Mounting (Process Connection Type Code B)



Dimensions are in inches (millimeters).

A.6 Standard flanges

Figure A-11. Cone Antenna

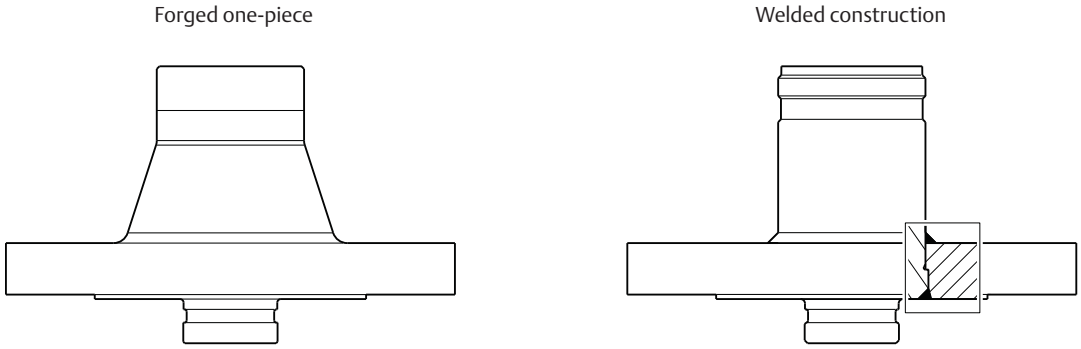


Table A-6. Standard Flanges for Cone Antenna

Standard	Face type(1)	Face surface finish, R_a	Material
ASME B16.5	Raised face	125-250 µin	316 / 316L
EN 1092-1	Type B1 raised face	3.2-12.5 µm	EN 1.4404
	Type A flat face	3.2-12.5 µm	EN 1.4404
JIS B2220	Raised face	3.2-6.3 µm	EN 1.4404

1. Face gasket surface is serrated per mating standard.

Figure A-12. Parabolic antenna

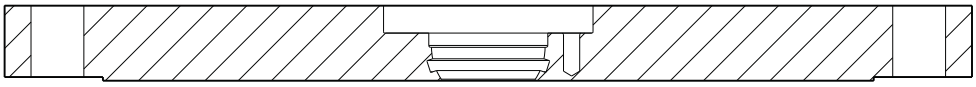


Table A-7. Standard Flanges for Parabolic Antenna

Standard	Face type(1)	Face surface finish	Material
ASME B16.5	Raised face, TBD in.	125-250 µin	316 / 316L
EN 1092-1	Type A flat face	3.2-12.5 µm	EN 1.4404
JIS B2220	Raised face, TBD mm	3.2-12.5 µm	EN 1.4404

1. Face gasket surface is serrated per mating standard.

Appendix B Product Certifications

Rev 0.88

B.1 European Directive Information

A copy of the EU Declaration of Conformity can be found at the end of the Product Certifications document. The most recent revision of the EU Declaration of Conformity can be found at EmersonProcess.com/Rosemount.

B.2 Telecommunication compliance

Measurement principle

Frequency Modulated Continuous Wave (FMCW), 26 GHz

Maximum output power

-5 dBm (0.32 mW)

Frequency range

24.05 to 27.0 GHz (TLPR)

24.05 to 26.5 GHz (LPR)

LPR (Level Probing Radar) equipment are devices for measurement of level in the open air or in a closed space. Model option “OA”.

TLPR (Tank Level Probing Radar) equipment are devices for measurement of level in a closed space only (i.e metallic or concrete tanks).

B.3 FCC

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC ID: K8C5408L (for LPR)
K8C5408T (for TLPR)

B.4 IC

This device complies with Industry Canada’s licence-exempt RSS standard. Operation is subject to the following conditions:

1) This device may not cause interference.

2) This device must accept any interference received, including interference that may cause undesired operation.

3) The installation of the LPR/TLPR device shall be done by trained installers in strict compliance with the manufacturer's instructions.

4) The use of this device is on a "no-interference, no-protection" basis. That is, the user shall accept operations of high-powered radar in the same frequency band which may interfere with or damage this device. However, devices found to interfere with primary licensing operations will be required to be removed at the user's expense.

5) Devices operating under TLPR conditions (i.e. not operating in "Open Air" Mode) shall be installed and operated in a completely enclosed container to prevent RF emissions, which can otherwise interfere with aeronautical navigation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux conditions suivantes:

1) l'appareil ne doit pas produire de brouillage.

2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

3) L'installation d'un dispositif LPR ou TLPR doit être effectuée par des installateurs qualifiés, en pleine conformité avec les instructions du fabricant.

4) Ce dispositif ne peut être exploité qu'en régime de non-brouillage et de non-protection, c'est-à-dire que l'utilisateur doit accepter que des radars de haute puissance de la même bande de fréquences puissent brouiller ce dispositif ou même l'endommager. D'autre part, les capteurs de niveau qui perturbent une exploitation autorisée par licence de fonctionnement principal doivent être enlevés aux frais de leur utilisateur.

5) Un dispositif visé comme TLPR ("Open Air") doit être installé et exploité dans un réservoir entièrement fermé afin de prévenir les rayonnements RF qui pourraient autrement perturber la navigation aéronautique.

Certificate: 2827A-5408L (for LPR)
2827A-5408T (for TLPR)

B.5 Radio Equipment Directive (RED) 2014/53/EU

This device complies with ETSI EN 302 372 (TLPR), ETSI EN 302 729 (LPR) and EN 62479.

For the receiver test that covers the influence of an interferer signal to the device, the performance criterion has at least the following level of performance according to ETSI TS 103 361 [6].

- Performance criterion: measurement value variation Δd over time during a distance measurement
- Level of performance: Δd ≤ +/- 2 mm

LPR (Level Probing Radar), model code "OA"

Install at a separation distance of >4 km from Radio Astronomy sites, unless a special authorization has been provided by the responsible National regulatory authority (a list of Radio Astronomy sites may be found at www.craf.eu).

Between 4 km to 40 km around any Radio Astronomy site the LPR antenna height shall not exceed 15 m height above ground.

TLPR (Tank Level Probing Radar)

The device must be installed in closed tanks. Install according to requirements in ETSI EN 302 372 (Annex E).

B.6 Installing Equipment in North America

The US National Electrical Code (NEC) and the Canadian Electrical Code (CEC) permit the use of Division marked equipment in Zones and Zone marked equipment in Divisions. The markings must be suitable for the area classification, gas, and temperature class. This information is clearly defined in the respective codes.

B.7 USA

E5 FM Explosionproof (XP), Dust-Ignitionproof (DIP)

Certificate: FM16US0010X

Standards: FM Class 3600 – 2011; FM Class 3615 – 2006; FM Class 3810 – 2005; ANSI/ISA 60079-0 – 2013; ANSI/ISA 60079-1 – 2009 (R2013); ANSI/ISA 60079-26 – 2011; ANSI/ISA 60079-31 – 2013; ANSI/NEMA 250 – 2008; ANSI/IEC 60529 – 2004

Markings: XP CL I, DIV 1, GRPS A, B, C, D T6...T2; DIP CLII/III, DIV 1, GRPS E, F, G; T6...T3; CL I Zone 0/1 AEx db IIC T6...T2; Zone 21 AEx tb IIIC T85 °C...T250 °C *) (-40°C≤Ta≤70°C); Type 4X/IP65

Specific Conditions of Use (X):

1. Flamepath joints are not for repair. Contact the manufacturer.
2. Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.

4. The Transmitter can be installed in the boundary wall between a Zone 0 and Zone 1 area. In this configuration, the process connection is installed in Zone 0, while the transmitter housing is installed in Zone 1. Refer to Control Drawing D7000002-885.
5. For Equipment Marked Zone 21 AEx tb IIIC T85°C...T250°C Db:
   - Cable entries must be used which maintain the ingress protection of the enclosure to at least IP65.
   - To maintain the ingress protection ratings (IP65), Covers and Sensor Module to be fully tightened and PTFE tape or pipe dope is required for cable entries and blanking plugs. See Instruction Manual on application requirements.
6. Install per Control drawing D7000002-885.
7. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
8. *) LCD Display option (M5) is limited to minimum -34 °C Ambient and Process Temperature.
9. *)The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows;

For Divisions:

Temperature Class / Maximum Surface Temperature	Ambient Temperature Range	Process Temperature Range
Division Gas Groups:		
T2	-40°C≤Ta≤70°C	-40°C to 250°C
T3	-40°C≤Ta≤70°C	-40°C to 195°C
T4	-40°C≤Ta≤70°C	-40°C to 130°C
T5	-40°C≤Ta≤70°C	-40°C to 95°C
T6	-40°C≤Ta≤70°C	-40°C to 80°C
Division Dust Groups:		
T165°C	-50°C≤Ta≤70°C	-50°C to 160°C
T135°C	-50°C≤Ta≤70°C	-50°C to 130°C
T100°C	-50°C≤Ta≤70°C	-50°C to 95°C
T85°C	-50°C≤Ta≤70°C	-50°C to 80°C

For Zones:

Temperature Class / Maximum Surface Temperature	Ambient Temperature Range	Process Temperature Range
Zone Gas Groups:		
T2	-50°C≤Ta≤70°C	-50°C to 250°C
T3	-50°C≤Ta≤70°C	-50°C to 195°C
T4	-50°C≤Ta≤70°C	-50°C to 130°C
T5	-50°C≤Ta≤70°C	-50°C to 95°C
T6	-50°C≤Ta≤70°C	-50°C to 80°C
Zone Dust Groups:		
T250°C	-55°C≤Ta≤70°C	-55°C to 250°C
T200°C	-55°C≤Ta≤70°C	-55°C to 195°C
T135°C	-55°C≤Ta≤70°C	-55°C to 130°C
T100°C	-55°C≤Ta≤70°C	-55°C to 95°C
T85°C	-55°C≤Ta≤70°C	-55°C to 80°C

I5 FM Intrinsic Safety (IS), Non-Incendive (NI)

Certificate: FM16US0010X

Standards: FM Class 3600 – 2011; FM Class 3610 – 2015; FM Class 3611 – 2004; FM Class 3810 – 2005; ANSI/ISA 60079-0 – 2013; ANSI/ISA 60079-11 – 2013; ANSI/ISA 60079-26 – 2011; ANSI/NEMA 250 – 2008; ANSI/IEC 60529 – 2004

Markings: IS CL I, II, III DIV 1, GRPS A-G T4...T2
NI CL I, DIV 2, GRPS A-D T4...T2
S CL II, III DIV 2, GRPS E-G T4...T3
CL I Zone 0 AEx ia IIC T4...T2
CL I Zone 0/1 AEx ib IIC T4...T2
Zone 20 AEx ia IIIC T85°C...T250°C
*) (-55°C≤Ta≤+70°C)
When installed per Control Drawing D7000002-885

Safety Parameter	HART®
Voltage U_i	30 V
Current I_i	133 mA
Power P_i	1.0 W
Capacitance C_i	7.3 nF
Inductance L_i	0

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between a Zone 0 and Zone 1 area. In this configuration, the process connection is installed in Zone 0, while the transmitter housing is installed in Zone 1. Refer to Control Drawing D7000002-885.
5. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
6. *) LCD Display option (M5) is limited to minimum -34 °C Ambient and Process Temperature.
7. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows;

For Divisions:

Temperature Class / Maximum Surface Temperature	Ambient Temperature Range	Process Temperature Range
Division Gas Groups:		
T2	-55°C≤Ta≤70°C	-55°C to 250°C
T3	-55°C≤Ta≤70°C	-55°C to 195°C
T4	-55°C≤Ta≤70°C	-55°C to 130°C
Division Dust Groups:		
T165°C	-55°C≤Ta≤70°C	-55°C to 160°C
T135°C	-55°C≤Ta≤70°C	-55°C to 130°C
T100°C	-55°C≤Ta≤70°C	-55°C to 95°C
T85°C	-55°C≤Ta≤70°C	-55°C to 80°C

For Zones:

Temperature Class / Maximum Surface Temperature	Ambient Temperature Range	Process Temperature Range
Zone Gas Groups:		
T2	-55°C≤Ta≤70°C	-55°C to 250°C
T3	-55°C≤Ta≤70°C	-55°C to 195°C
T4	-55°C≤Ta≤70°C	-55°C to 130°C
Zone Dust Groups:		
T250°C	-55°C≤Ta≤70°C	-55°C to 250°C
T200°C	-55°C≤Ta≤70°C	-55°C to 195°C
T135°C	-55°C≤Ta≤70°C	-55°C to 130°C
T100°C	-55°C≤Ta≤70°C	-55°C to 95°C
T85°C	-55°C≤Ta≤70°C	-55°C to 80°C

B.8 Canada

E6 CSA Explosionproof, Dust-Ignitionproof

Certificate: FM16CA0011X

Standards: C22.2 NO. 0.4-04:2004 (R2013), C22.2 NO. 0.5-16:2016, C22.2 No. 25-1966:1966 (R:2014), C22.2 No.30-M1986:1986 (R:2012), C22.2 No.94-M91:1991 (R:2011), C22.2 No. 1010.1:2004, CAN/CSA C22.2 No. 60079-0:2015 Ed. 3, C22.2 No. 60079-1:2011 Ed. 2, CAN/CSA-C22.2 No. 60079-31:2015, C22.2. 60529:2005 (R:2015)

Markings: XP CL I, DIV 1, GRPS A-D T6...T2;
DIP CLII/III, DIV 1, GRPS E-G; T6...T2;
Ex db IIC T6...T3;
Ex tb IIIC T85 °C...T250°C
*) (-40°C≤Ta≤+70°C); Type 4X/IP65

Specific Conditions of Use (X):

1. Flamepath joints are not for repair. Contact the manufacturer.
2. Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.
4. Metric Field Wiring Entries are not allowed for Divisions.

5. The Transmitter can be installed in the boundary wall between a Zone 0 and Zone 1 area. In this configuration, the process connection is installed in Zone 0, while the transmitter housing is installed in Zone 1. Refer to Control Drawing D7000002-885.
6. For Equipment Marked Ex tb IIIC T85°C...T250°C Db:
   - Cable entries must be used which maintain the ingress protection of the enclosure to at least IP65.
   - To maintain the ingress protection ratings (IP65), Covers and Sensor Module to be fully tightened and PTFE tape or pipe dope is required for cable entries and blanking plugs. See Instruction Manual on application requirements.
7. Install per Control Drawing D7000002-885.
8. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
9. *) LCD Display option (M5) is limited to minimum -34 °C Ambient and Process Temperature.
10. *) The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows;

For Divisions:

Temperature Class / Maximum Surface Temperature	Ambient Temperature Range	Process Temperature Range
Division Gas Groups:		
T2	-40°C≤Ta≤70°C	-40°C to 250°C
T3	-40°C≤Ta≤70°C	-40°C to 195°C
T4	-40°C≤Ta≤70°C	-40°C to 130°C
T5	-40°C≤Ta≤70°C	-40°C to 95°C
T6	-40°C≤Ta≤70°C	-40°C to 80°C
Division Dust Groups:		
T165°C	-50°C≤Ta≤70°C	-50°C to 160°C
T135°C	-50°C≤Ta≤70°C	-50°C to 130°C
T100°C	-50°C≤Ta≤70°C	-50°C to 95°C
T85°C	-50°C≤Ta≤70°C	-50°C to 80°C

For Zones:

Temperature Class / Maximum Surface Temperature	Ambient Temperature Range	Process Temperature Range
Zone Gas Groups:		
T2	-50°C≤Ta≤70°C	-50°C to 250°C
T3	-50°C≤Ta≤70°C	-50°C to 195°C
T4	-50°C≤Ta≤70°C	-50°C to 130°C
T5	-50°C≤Ta≤70°C	-50°C to 95°C
T6	-50°C≤Ta≤70°C	-50°C to 80°C
Zone Dust Groups:		
T250°C	-55°C≤Ta≤70°C	-55°C to 250°C
T200°C	-55°C≤Ta≤70°C	-55°C to 195°C
T135°C	-55°C≤Ta≤70°C	-55°C to 130°C
T100°C	-55°C≤Ta≤70°C	-55°C to 95°C
T85°C	-55°C≤Ta≤70°C	-55°C to 80°C

I6 CSA Intrinsically Safe and Non-Incendive Systems

Certificate: FM16CA0011X

Standards: C22.2 NO. 0.4-04:2004 (R2013), C22.2 NO. 0.5-16:2016, C22.2 No. 25-1966:1966 (R:2014), C22.2 No.94-M91:1991 (R:2011), C22.2 No. 213-M1987:1987 (R:2013), C22.2 No. 1010.1:2004, CAN/CSA C22.2 No. 60079-0:2015 Ed. 3, CAN/CSAC22.2 No. 60079-11:2014 Ed. 2, CAN/CSAC22.2 No. 60079-15:2012 Ed.1, CAN/CSA-C22.2 No. 60079-31:2015, C22.2. 60529:2005 (R:2015)

Markings: IS CL I, II, III DIV 1, GRPS A-G T4...T2
NI CL I, DIV 2, GRPS A-D T4...T2
S CL II, III DIV 2, GRPS E-G T4...T3
Ex ia IIC T4...T2
Ex ib IIC T4...T2
Ex ia IIIC T85°C...T250°C
*) (-55°C≤Ta≤+70°C)
When installed per Control Drawing D7000002-885

Safety Parameter	HART
Voltage U_i	30 V
Current I_i	133 mA
Power P_i	1.0 W
Capacitance C_i	7.3 nF
Inductance L_i	0

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between a Zone 0 and Zone 1 area. In this configuration, the process connection is installed in Zone 0, while the transmitter housing is installed in Zone 1. Refer to Control Drawing D7000002-885.
5. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
6. *) LCD Display option (M5) is limited to minimum -34 °C Ambient and Process Temperature.
7. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows;

For Divisions:

Temperature Class / Maximum Surface Temperature	Ambient Temperature Range	Process Temperature Range
Division Gas Groups:		
T2	-55°C≤Ta≤70°C	-55°C to 250°C
T3	-55°C≤Ta≤70°C	-55°C to 195°C
T4	-55°C≤Ta≤70°C	-55°C to 130°C
Division Dust Groups:		
T165°C	-55°C≤Ta≤70°C	-55°C to 160°C
T135°C	-55°C≤Ta≤70°C	-55°C to 130°C
T100°C	-55°C≤Ta≤70°C	-55°C to 95°C
T85°C	-55°C≤Ta≤70°C	-55°C to 80°C

For Zones:

Temperature Class / Maximum Surface Temperature	Ambient Temperature Range	Process Temperature Range
Zone Gas Groups:		
T2	-55°C≤Ta≤70°C	-55°C to 250°C
T3	-55°C≤Ta≤70°C	-55°C to 195°C
T4	-55°C≤Ta≤70°C	-55°C to 130°C
Zone Dust Groups:		
T250°C	-55°C≤Ta≤70°C	-55°C to 250°C
T200°C	-55°C≤Ta≤70°C	-55°C to 195°C
T135°C	-55°C≤Ta≤70°C	-55°C to 130°C
T100°C	-55°C≤Ta≤70°C	-55°C to 95°C
T85°C	-55°C≤Ta≤70°C	-55°C to 80°C

B.9 Europe

E1 ATEX Flameproof

Certificate: FM15ATEX0055X

Standards: EN 60079-0:2012, EN 60079-1:2014, EN 60079-26:2015, EN 60079-31:2014, EN 60529+A1+A2:2013

Markings: ⟨Ex⟩ II 1/2G Ex db IIC T6...T2 Ga/Gb
II 2D Ex tb IIIC T85°C... T250°C Db, IP65
*) (-55°C≤Ta≤+70 °C)

Specific Conditions of Use (X):

1. Flamepath joints are not for repair. Contact the manufacturer.
2. Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between a Category 1 and Category 2 location. In this configuration, the process connection is installed in Category 1, while the transmitter housing is installed in Category 2. Refer to Control Drawing D7000002-885.
5. For Equipment Marked Ex tb IIIC T85°C...T250°C Db:
   - Cable entries must be used which maintain the ingress protection of the enclosure to at least IP65.

- To maintain the ingress protection ratings (IP65), Covers and Sensor Module to be fully tightened and PTFE tape or pipe dope is required for cable entries and blanking plugs. See Instruction Manual on application requirements.

6. Install per Control Drawing D7000002-885.
7. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
8. *) LCD Display option (M5) is limited to minimum -34 °C Ambient and Process Temperature.
9. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows;

Temperature Class / Maximum Surface Temperature	Ambient Temperature Range	Process Temperature Range
Gas & Dust Groups:		
T2 / T250°C	-55°C≤Ta≤70°C	-55°C to 250°C
T3 / T200°C	-55°C≤Ta≤70°C	-55°C to 195°C
T4 / T135°C	-55°C≤Ta≤70°C	-55°C to 130°C
T5 / T100°C	-55°C≤Ta≤70°C	-55°C to 95°C
T6 / T85°C	-55°C≤Ta≤70°C	-55°C to 80°C

I1 ATEX Intrinsic Safety

Certificate: FM15ATEX0055X

Standards: EN 60079-0:2012, EN 60079-11:2012, EN 60079-26:2015

Markings: II 1G Ex ia IIC T4...T2 Ga
II 1/2G Ex ib IIC T4...T2 Ga/Gb
II 1D Ex ia IIIC T135°C...T250°C Da
II 2D Ex ib IIIC T135°C...T250°C Db
(-55°C≤Ta≤+70°C)

Safety Parameter	HART
Voltage U_i	30 V
Current I_i	133 mA
Power P_i	1.0 W
Capacitance C_i	7.3 nF
Inductance L_i	0

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between a Category 1 and Category 2 location. In this configuration, the process connection is installed in Category 1, while the transmitter housing is installed in Category 2. Refer to Control Drawing D7000002-885.
5. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
6. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows;

Temperature Class / Maximum Surface Temperature	Ambient Temperature Range	Process Temperature Range
Gas Groups:		
T2	-55°C≤Ta≤70°C	-55°C to 250°C
T3	-55°C≤Ta≤70°C	-55°C to 195°C
T4	-55°C≤Ta≤70°C	-55°C to 130°C
Dust Groups:		
T250°C	-55°C≤Ta≤70°C	-55°C to 250°C
T200°C	-55°C≤Ta≤70°C	-55°C to 195°C
T135°C	-55°C≤Ta≤70°C	-55°C to 130°C
T100°C	-55°C≤Ta≤70°C	-55°C to 95°C
T85°C	-55°C≤Ta≤70°C	-55°C to 80°C

N1 ATEX Type N: Non-Sparking

Certificate: FM15ATEX0056X

Standards: EN 60079-0:2012, EN 60079-15:2010

Markings: II 3G Ex nA IIC T4...T2 Gc, IP65
*) (-55°C≤Ta≤+70°C)
V≤42.4V, I≤23 mA

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.
4. *) LCD Display option (M5) is limited to minimum -34 °C Ambient and Process Temperature.
5. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows;

Temperature Class	Ambient Temperature Range	Process Temperature Range
T2	-55°C≤Ta≤70°C	-55°C to 250°C
T3	-55°C≤Ta≤70°C	-55°C to 195°C
T4	-55°C≤Ta≤70°C	-55°C to 130°C

B.10 International

E7 IECEx Flameproof

Certificate: IECEx FMG15.0033X

Standards: IEC 60079-0:2011, IEC 60079-1:2014-06, IEC 60079-11:2011; IEC 60079-26:2014, IEC 60079-31:2013

Markings: Ex db IIC T6...T2 Ga/Gb
Ex tb IIIC T85 °C...T250°C Db IP65
*) (-55°C≤Ta≤+70 °C)

Specific Conditions of Use (X):

1. Flamepath joints are not for repair. Contact the manufacturer.
2. Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between EPL Ga and EPL Gb. In this configuration, the process connection is EPL Ga, while the transmitter housing is EPL Gb. Refer to Control Drawing D7000002-885.
5. For Equipment Marked Ex tb IIIC T85°C...T250°C Db:
   - Cable entries must be used which maintain the ingress protection of the enclosure to at least IP65.
   - To maintain the ingress protection ratings (IP65), Covers and Sensor Module to be fully tightened and PTFE tape or pipe dope is required for cable entries and blanking plugs. See Instruction Manual on application requirements.
6. Install per Control Drawing D7000002-885.
7. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
8. *) LCD Display option (M5) is limited to minimum -34 °C Ambient and Process Temperature.
9. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows;

Temperature Class / Maximum Surface Temperature	Ambient Temperature Range	Process Temperature Range
Gas & Dust Groups		
T2 / T250°C	-55°C≤Ta≤70°C	-55°C to 250°C
T3 / T200°C	-55°C≤Ta≤70°C	-55°C to 195°C
T4 / T135°C	-55°C≤Ta≤70°C	-55°C to 130°C
T5 / T100°C	-55°C≤Ta≤70°C	-55°C to 95°C
T6 / T85°C	-55°C≤Ta≤70°C	-55°C to 80°C

I7 IECEx Intrinsic Safety

Certificate: IECEx FMG15.0033X

Standards: IEC 60079-0:2011, IEC 60079-11:2011, IEC 60079-26:2014

Markings: Ex ia IIC T4...T2 Ga
Ex ib IIC T4...T2 Ga/Gb
Ex ia IIIC T135°C...T250°C Da
Ex ib IIIC T135°C...T250°C Da/Db
(-55°C≤Ta≤+70°C)

Safety Parameter	HART
Voltage U_i	30 V
Current I_i	133 mA
Power P_i	1.0 W
Capacitance C_i	7.3 nF
Inductance L_i	0

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between EPL Ga and EPL Gb. In this configuration, the process connection is EPL Ga, while the transmitter housing is EPL Gb. Refer to Control Drawing D7000002-885.
5. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
6. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows;

Temperature Class / Maximum Surface Temperature	Ambient Temperature Range	Process Temperature Range
Gas Groups:		
T2	-55°C≤Ta≤70°C	-55°C to 250°C
T3	-55°C≤Ta≤70°C	-55°C to 195°C
T4	-55°C≤Ta≤70°C	-55°C to 130°C
Dust Groups:		
T250°C	-55°C≤Ta≤70°C	-55°C to 250°C
T200°C	-55°C≤Ta≤70°C	-55°C to 195°C
T135°C	-55°C≤Ta≤70°C	-55°C to 130°C
T100°C	-55°C≤Ta≤70°C	-55°C to 95°C
T85°C	-55°C≤Ta≤70°C	-55°C to 80°C

N7 IECEx Type N: Non-Sparking

Certificate: IECEx FMG15.0033X

Standards: IEC 60079-0:2011, IEC 60079-15:2010

Markings: Ex nA IIC T4...T2 Gc
*) (-55°C≤Ta≤+70°C), IP65
V≤42.4V, I≤23 mA

Specific Conditions of Use (X):

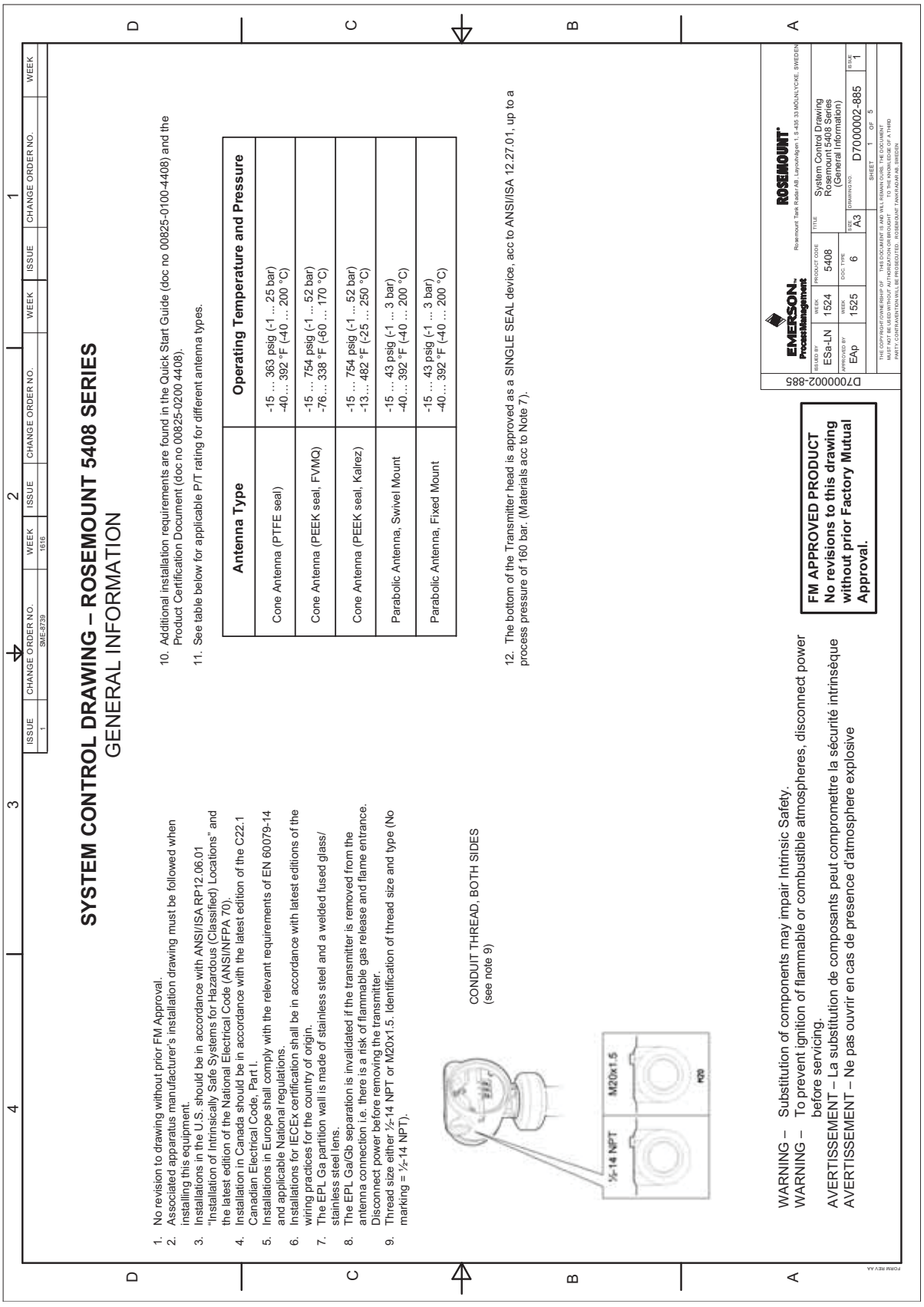
1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.
4. *) LCD Display option (M5) is limited to minimum -34 °C Ambient and Process Temperature.
5. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows;

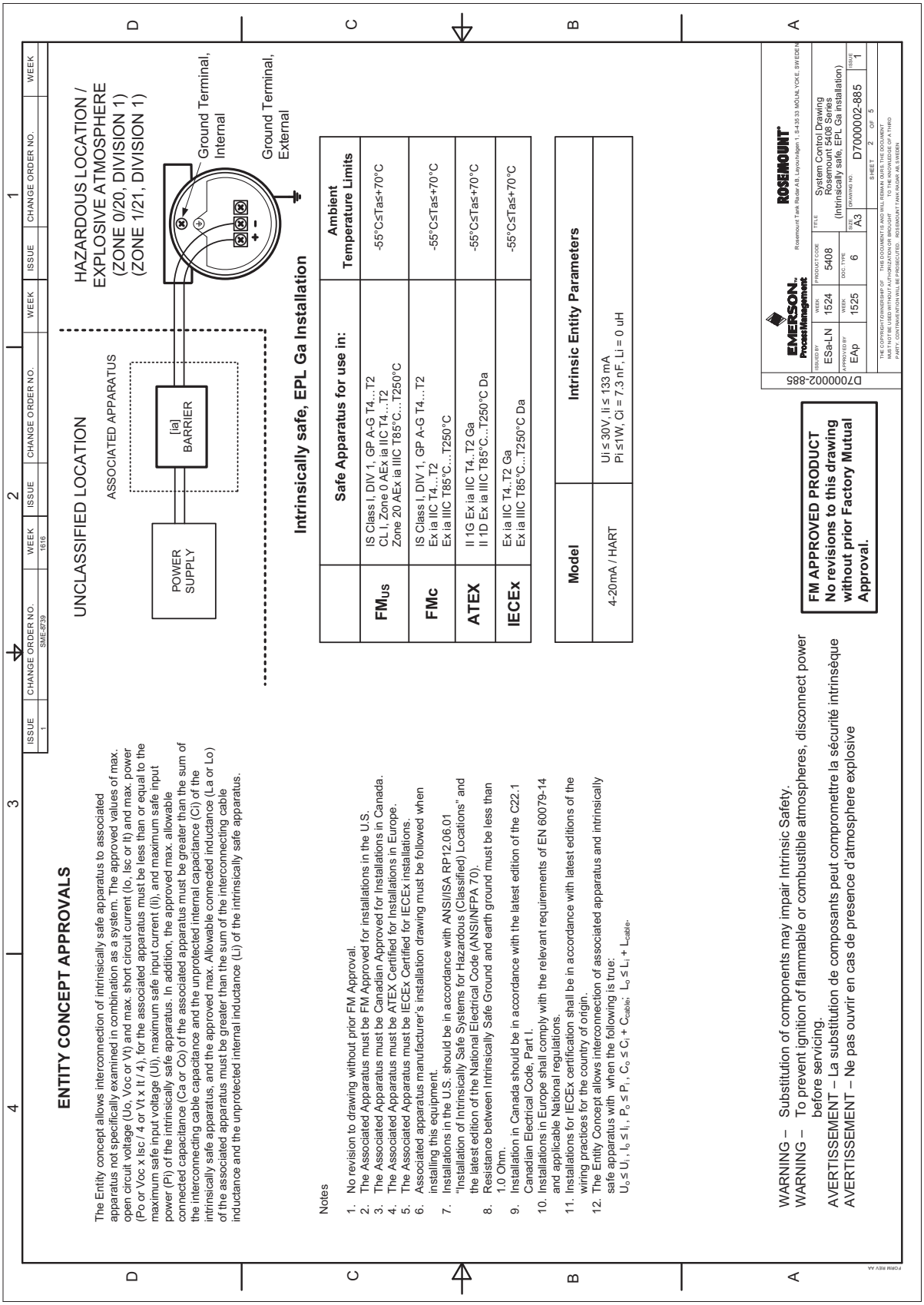
Temperature Class / Maximum Surface Temperature	Ambient Temperature Range	Process Temperature Range
T2	-55°C≤Ta≤70°C	-55°C to 250°C
T3	-55°C≤Ta≤70°C	-55°C to 195°C
T4	-55°C≤Ta≤70°C	-55°C to 130°C

B.11 Approval drawings

The installation guidelines presented by the System Control Drawing must be followed in order to maintain certified ratings for installed transmitters.

Figure B-1. D7000002-885 - System Control Drawing




ISSUE | CHANGE ORDER NO. | WEEK | ISSUE | CHANGE ORDER NO. | WEEK | ISSUE | CHANGE ORDER NO. | WEEK
1 | SME-8739 | 1616
UNCLASSIFIED LOCATION
ASSOCIATED APPARATUS
POWER SUPPLY
[ia] BARRIER
HAZARDOUS LOCATION / EXPLOSIVE ATMOSPHERE (ZONE 0/20, DIVISION 1) (ZONE 1/21, DIVISION 1)
Ground Terminal, Internal
Ground Terminal, External
ENTITY CONCEPT APPROVALS
The Entity concept allows interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in combination as a system. The approved values of max. open circuit voltage (Uo, Voc or Vt) and max. short circuit current (Io, Isc or It) and max. power (Po or Voc x Isc / 4 or Vt x It / 4), for the associated apparatus must be less than or equal to the maximum safe input voltage (Ui), maximum safe input current (Ii), and maximum safe input power (Pi) of the intrinsically safe apparatus. In addition, the approved max. allowable connected capacitance (Ca or Co) of the associated apparatus must be greater than the sum of the interconnecting cable capacitance and the unprotected internal capacitance (Ci) of the intrinsically safe apparatus, and the approved max. Allowable connected inductance (La or Lo) of the associated apparatus must be greater than the sum of the interconnecting cable inductance and the unprotected internal inductance (Li) of the intrinsically safe apparatus.
Intrinsically safe, EPL Ga Installation
Safe Apparatus for use in:
Ambient Temperature Limits
FMus
IS Class I, DIV 1, GP A-G T4...T2
CL I, Zone 0 AEx ia IIC T4...T2
Zone 20 AEx ia IIIC T85°C...T250°C
-55°C≤Ta≤+70°C
FMc
IS Class I, DIV 1, GP A-G T4...T2
Ex ia IIC T4...T2
Ex ia IIIC T85°C...T250°C
-55°C≤Ta≤+70°C
ATEX
II 1G Ex ia IIC T4..T2 Ga
II 1D Ex ia IIIC T85°C...T250°C Da
-55°C≤Ta≤+70°C
IECEx
Ex ia IIC T4..T2 Ga
Ex ia IIIC T85°C...T250°C Da
-55°C≤Ta≤+70°C
Model
Intrinsic Entity Parameters
4-20mA / HART
Ui ≤ 30V, Ii ≤ 133 mA
Pi ≤1W, Ci = 7.3 nF, Li = 0 uH
Notes
1. No revision to drawing without prior FM Approval.
2. The Associated Apparatus must be FM Approved for installations in the U.S.
3. The Associated Apparatus must be Canadian Approved for Installations in Canada.
4. The Associated Apparatus must be ATEX Certified for Installations in Europe.
5. The Associated Apparatus must be IECEx Certified for IECEx installations.
6. Associated apparatus manufacturer's installation drawing must be followed when installing this equipment.
7. Installations in the U.S. should be in accordance with ANSI/ISA RP12.06.01 "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations" and the latest edition of the National Electrical Code (ANSI/NFPA 70).
8. Resistance between Intrinsically Safe Ground and earth ground must be less than 1.0 Ohm.
9. Installation in Canada should be in accordance with the latest edition of the C22.1 Canadian Electrical Code, Part I.
10. Installations in Europe shall comply with the relevant requirements of EN 60079-14 and applicable National regulations.
11. Installations for IECEx certification shall be in accordance with latest editions of the wiring practices for the country of origin.
12. The Entity Concept allows interconnection of associated apparatus and intrinsically safe apparatus with when the following is true:
$U_o \leq U_i$, $I_o \leq I_i$, $P_o \leq P_i$, $C_o \leq C_i + C_{cable}$; $L_o \leq L_i + L_{cable}$.
FM APPROVED PRODUCT
No revisions to this drawing without prior Factory Mutual Approval.
WARNING – Substitution of components may impair Intrinsic Safety.
WARNING – To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.
AVERTISSEMENT – La substitution de composants peut compromettre la sécurité intrinsèque
AVERTISSEMENT – Ne pas ouvrir en cas de presence d'atmosphere explosive
D7000002-885
EMERSON. Process Management
ROSEMOUNT
Rosemount Tank Radar AB, Lagvägen 1, S-435 33 MÖLNLYCKE, SWEDEN
ISSUED BY ESa-LN WEEK 1524
PRODUCT CODE 5408
TITLE System Control Drawing Rosemount 5408 Series (Intrinsically safe, EPL Ga installation)
APPROVED BY EAp WEEK 1525
DOC. TYPE 6
SIZE A3
DRAWING NO D7000002-885
ISSUE 1
SHEET 2 OF 5
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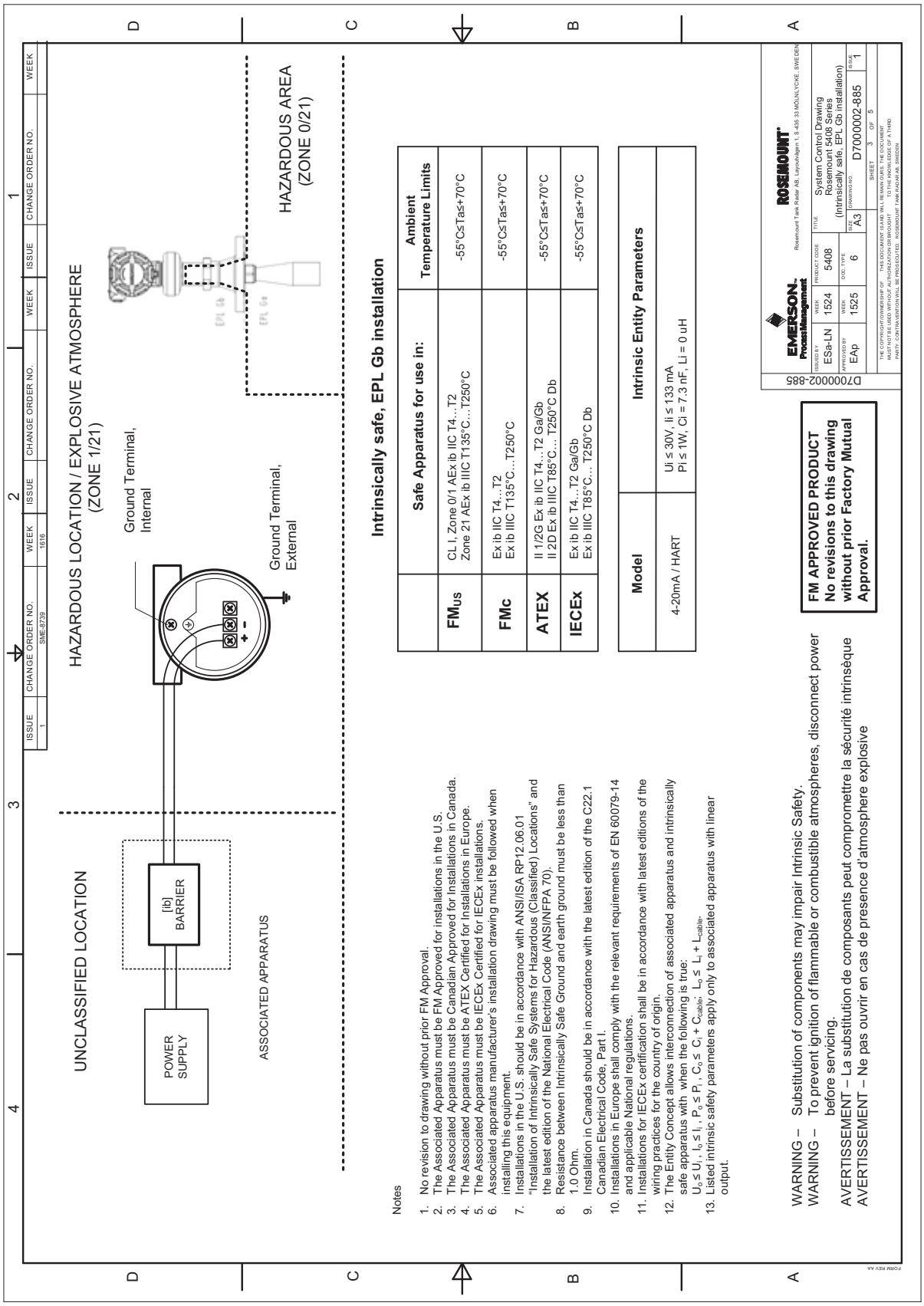
FORM REV AA



Intrinsically safe, EPL Gb installation

	Safe Apparatus for use in:	Ambient Temperature Limits
FM_{US}	CL I, Zone 0/1 AEx ib IIC T4...T2 Zone 21 AEx ib IIIC T135°C...T250°C	-55°C≤Ta≤+70°C
FMc	Ex ib IIC T4...T2 Ex ib IIIC T135°C...T250°C	-55°C≤Ta≤+70°C
ATEX	II 1/2G Ex ib IIC T4...T2 Ga/Gb II 2D Ex ib IIIC T85°C... T250°C Db	-55°C≤Ta≤+70°C
IECEx	Ex ib IIC T4...T2 Ga/Gb Ex ib IIIC T85°C... T250°C Db	-55°C≤Ta≤+70°C

Model	Intrinsic Entity Parameters
4-20mA / HART	Ui ≤ 30V, Ii ≤ 133 mA Pi ≤ 1W, Ci = 7.3 nF, Li = 0 uH

FM APPROVED PRODUCT
No revisions to this drawing without prior Factory Mutual Approval.

Notes

1. No revision to drawing without prior FM Approval.
2. The Associated Apparatus must be FM Approved for installations in the U.S.
3. The Associated Apparatus must be Canadian Approved for Installations in Canada.
4. The Associated Apparatus must be ATEX Certified for Installations in Europe.
5. The Associated Apparatus must be IECEx Certified for IECEx installations.
6. Associated apparatus manufacturer's installation drawing must be followed when installing this equipment.
7. Installations in the U.S. should be in accordance with ANSI/ISA RP12.06.01 "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations" and the latest edition of the National Electrical Code (ANSI/NFPA 70).
8. Resistance between Intrinsically Safe Ground and earth ground must be less than 1.0 Ohm.
9. Installation in Canada should be in accordance with the latest edition of the C22.1 Canadian Electrical Code, Part I.
10. Installations in Europe shall comply with the relevant requirements of EN 60079-14 and applicable National regulations.
11. Installations for IECEx certification shall be in accordance with latest editions of the wiring practices for the country of origin.
12. The Entity Concept allows interconnection of associated apparatus and intrinsically safe apparatus with when the following is true:
    $U_o \leq U_i$, $I_o \leq I_i$, $P_o \leq P_i$, $C_o \leq C_i + C_{cable}$; $L_o \leq L_i + L_{cable}$.
13. Listed intrinsic safety parameters apply only to associated apparatus with linear output.

WARNING – Substitution of components may impair Intrinsic Safety.
WARNING – To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.
AVERTISSEMENT – La substitution de composants peut compromettre la sécurité intrinsèque
AVERTISSEMENT – Ne pas ouvrir en cas de presence d'atmosphere explosive

D7000002-885
EMERSON. Process Management
ROSEMOUNT
Rosemount Tank Radar AB, Layovägen 1, S-435 33 MÖLNLYCKE, SWEDEN
ISSUED BY: ESa-LN | WEEK: 1524 | PRODUCT CODE: 5408
APPROVED BY: EAp | WEEK: 1525 | DOC. TYPE: 6
TITLE: System Control Drawing Rosemount 5408 Series (Intrinsically safe, EPL Gb installation)
SIZE: A3 | DRAWING NO: D7000002-885 | REV: 1
SHEET 3 OF 5
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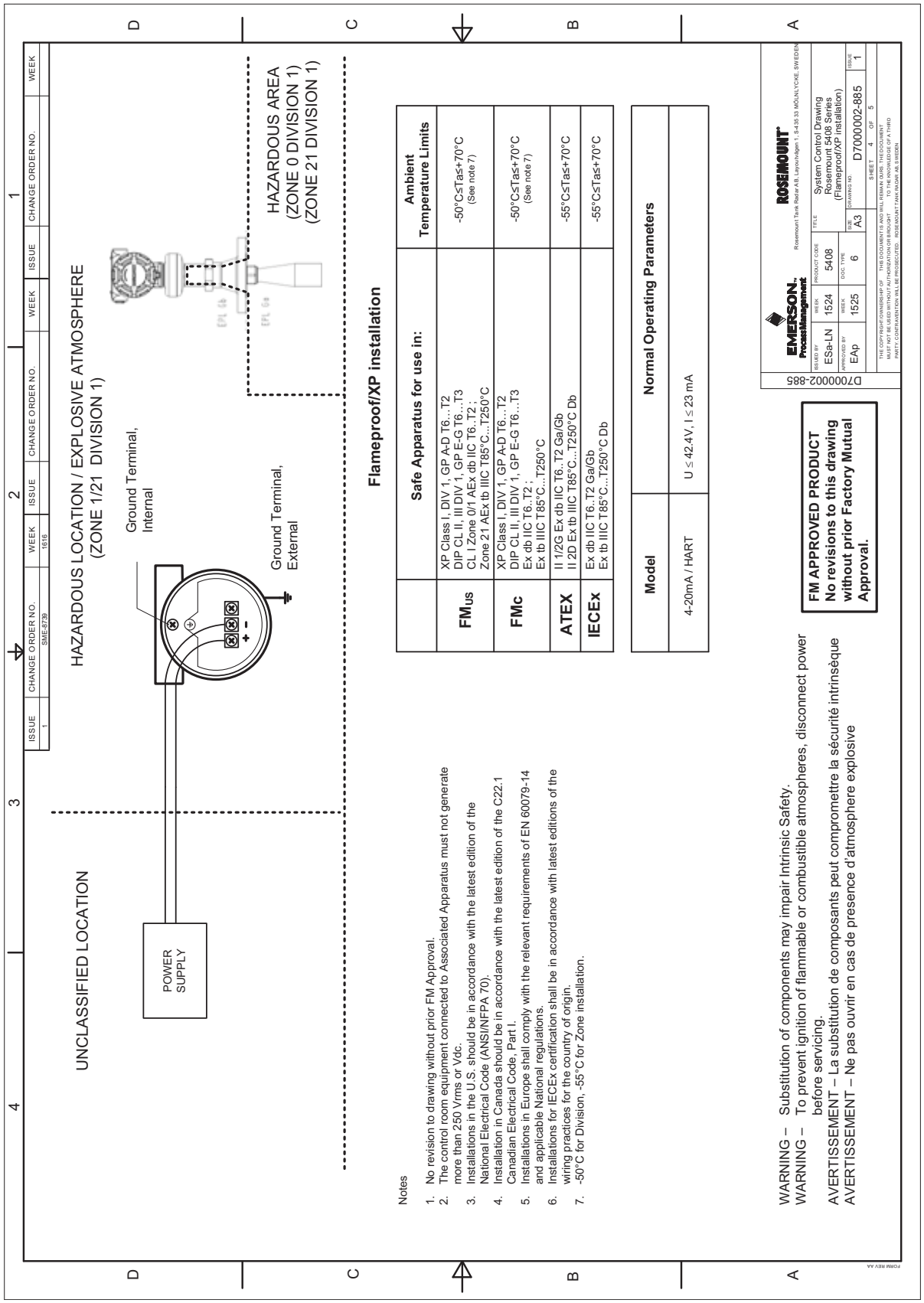
FORM REV AA


HAZARDOUS LOCATION / EXPLOSIVE ATMOSPHERE
(ZONE 1/21 DIVISION 1)
HAZARDOUS AREA
(ZONE 0 DIVISION 1)
(ZONE 21 DIVISION 1)
UNCLASSIFIED LOCATION
Ground Terminal, Internal
Ground Terminal, External
POWER SUPPLY
Flameproof/XP installation
Safe Apparatus for use in:
Ambient Temperature Limits
FMus
XP Class I, DIV 1, GP A-D T6...T2
DIP CL II, III DIV 1, GP E-G T6...T3
CL I Zone 0/1 AEx db IIC T6..T2 ;
Zone 21 AEx tb IIIC T85°C...T250°C
-50°C≤Ta≤+70°C
(See note 7)
FMc
XP Class I, DIV 1, GP A-D T6...T2
DIP CL II, III DIV 1, GP E-G T6...T3
Ex db IIC T6..T2 ;
Ex tb IIIC T85°C...T250°C
-50°C≤Ta≤+70°C
(See note 7)
ATEX
II 1/2G Ex db IIC T6..T2 Ga/Gb
II 2D Ex tb IIIC T85°C...T250°C Db
-55°C≤Ta≤+70°C
IECEx
Ex db IIC T6..T2 Ga/Gb
Ex tb IIIC T85°C...T250°C Db
-55°C≤Ta≤+70°C
Model
Normal Operating Parameters
4-20mA / HART
U ≤ 42.4V, I ≤ 23 mA
FM APPROVED PRODUCT
No revisions to this drawing without prior Factory Mutual Approval.
Notes
1. No revision to drawing without prior FM Approval.
2. The control room equipment connected to Associated Apparatus must not generate more than 250 Vrms or Vdc.
3. Installations in the U.S. should be in accordance with the latest edition of the National Electrical Code (ANSI/NFPA 70).
4. Installation in Canada should be in accordance with the latest edition of the C22.1 Canadian Electrical Code, Part I.
5. Installations in Europe shall comply with the relevant requirements of EN 60079-14 and applicable National regulations.
6. Installations for IECEx certification shall be in accordance with latest editions of the wiring practices for the country of origin.
7. -50°C for Division, -55°C for Zone installation.
WARNING – Substitution of components may impair Intrinsic Safety.
WARNING – To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.
AVERTISSEMENT – La substitution de composants peut compromettre la sécurité intrinsèque
AVERTISSEMENT – Ne pas ouvrir en cas de presence d'atmosphere explosive
ISSUE 1
CHANGE ORDER NO. SME-8729
WEEK 1616
CHANGE ORDER NO.
WEEK
ISSUE
CHANGE ORDER NO.
WEEK
ISSUE
CHANGE ORDER NO.
WEEK
EMERSON. Process Management
ROSEMOUNT
Rosemount Tank Radar AB, Layoutvägen 1, S-435 33 MÖLNLYCKE, SWEDEN
ISSUED BY ESa-LN
WEEK 1524
PRODUCT CODE 5408
APPROVED BY EAp
WEEK 1525
DOC. TYPE 6
TITLE System Control Drawing Rosemount 5408 Series (Flameproof/XP installation)
SIZE A3
DRAWING NO. D7000002-885
ISSUE 1
SHEET 4 OF 5
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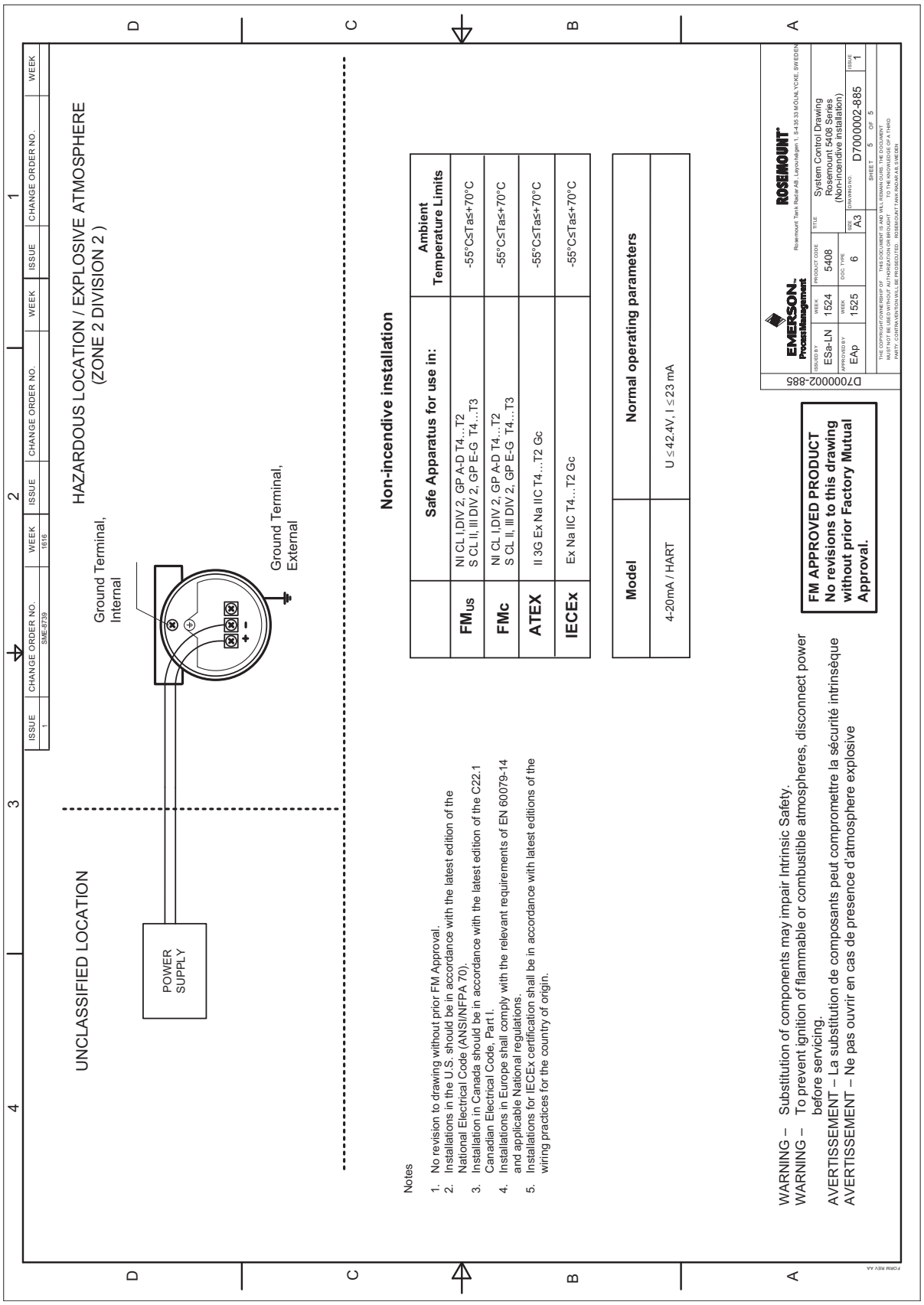
D7000002-885
FORM REV AA


UNCLASSIFIED LOCATION
HAZARDOUS LOCATION / EXPLOSIVE ATMOSPHERE
(ZONE 2 DIVISION 2)
POWER SUPPLY
Ground Terminal, Internal
Ground Terminal, External
Non-incendive installation
Safe Apparatus for use in:
Ambient Temperature Limits
FMUS
NI CL I,DIV 2, GP A-D T4...T2
S CL II, III DIV 2, GP E-G T4...T3
-55°C≤Ta≤+70°C
FMc
NI CL I,DIV 2, GP A-D T4...T2
S CL II, III DIV 2, GP E-G T4...T3
-55°C≤Ta≤+70°C
ATEX
II 3G Ex Na IIC T4...T2 Gc
-55°C≤Ta≤+70°C
IECEx
Ex Na IIC T4...T2 Gc
-55°C≤Ta≤+70°C
Model
Normal operating parameters
4-20mA / HART
U ≤ 42.4V, I ≤ 23 mA
Notes
1. No revision to drawing without prior FM Approval.
2. Installations in the U.S. should be in accordance with the latest edition of the National Electrical Code (ANSI/NFPA 70).
3. Installation in Canada should be in accordance with the latest edition of the C22.1 Canadian Electrical Code, Part I.
4. Installations in Europe shall comply with the relevant requirements of EN 60079-14 and applicable National regulations.
5. Installations for IECEx certification shall be in accordance with latest editions of the wiring practices for the country of origin.
FM APPROVED PRODUCT
No revisions to this drawing without prior Factory Mutual Approval.
WARNING – Substitution of components may impair Intrinsic Safety.
WARNING – To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.
AVERTISSEMENT – La substitution de composants peut compromettre la sécurité intrinsèque
AVERTISSEMENT – Ne pas ouvrir en cas de presence d'atmosphere explosive
ISSUE
CHANGE ORDER NO.
WEEK
SME-8739
1616
EMERSON Process Management
ROSEMOUNT
Rosemount Tank Radar AB Layovägen 1, S-435 33 MÖLNLYCKE, SWEDEN
D7000002-885
ISSUED BY ESa-LN
WEEK 1524
APPROVED BY EAp
WEEK 1525
PRODUCT CODE 5408
DOC. TYPE 6
SIZE A3
TITLE System Control Drawing Rosemount 5408 Series (Non-incendive installation)
DRAWING NO. D7000002-885
ISSUE 1
SHEET 5 OF 5
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Appendix C Configuration Parameters

C.1 Menu tree

The menu tree structure in Figure C-1 is applicable for Rosemount Radar Master. For AMS Device Manager and the Field Communicator, see Figure C-2.

Figure C-1. Menu Tree for Rosemount Radar Master

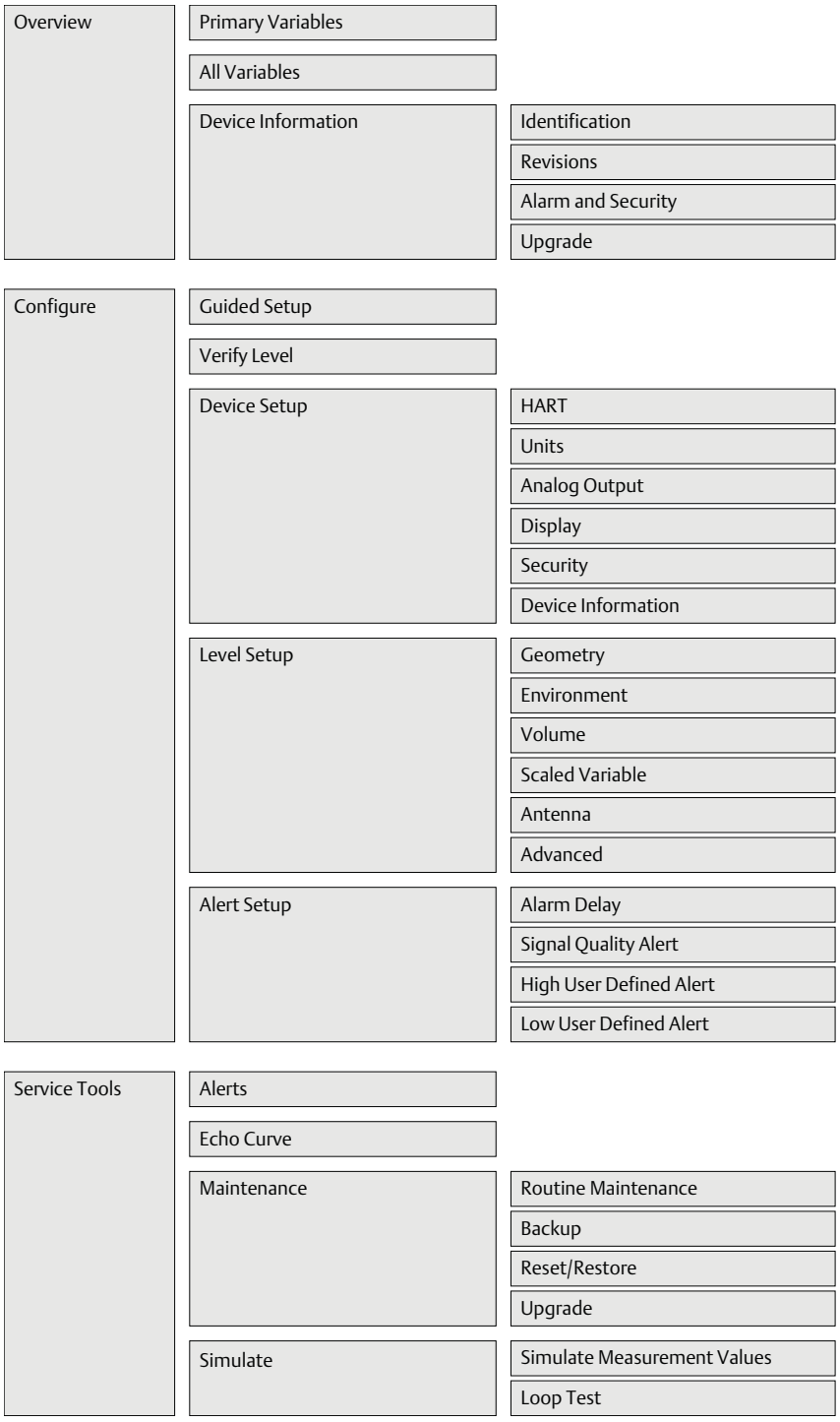
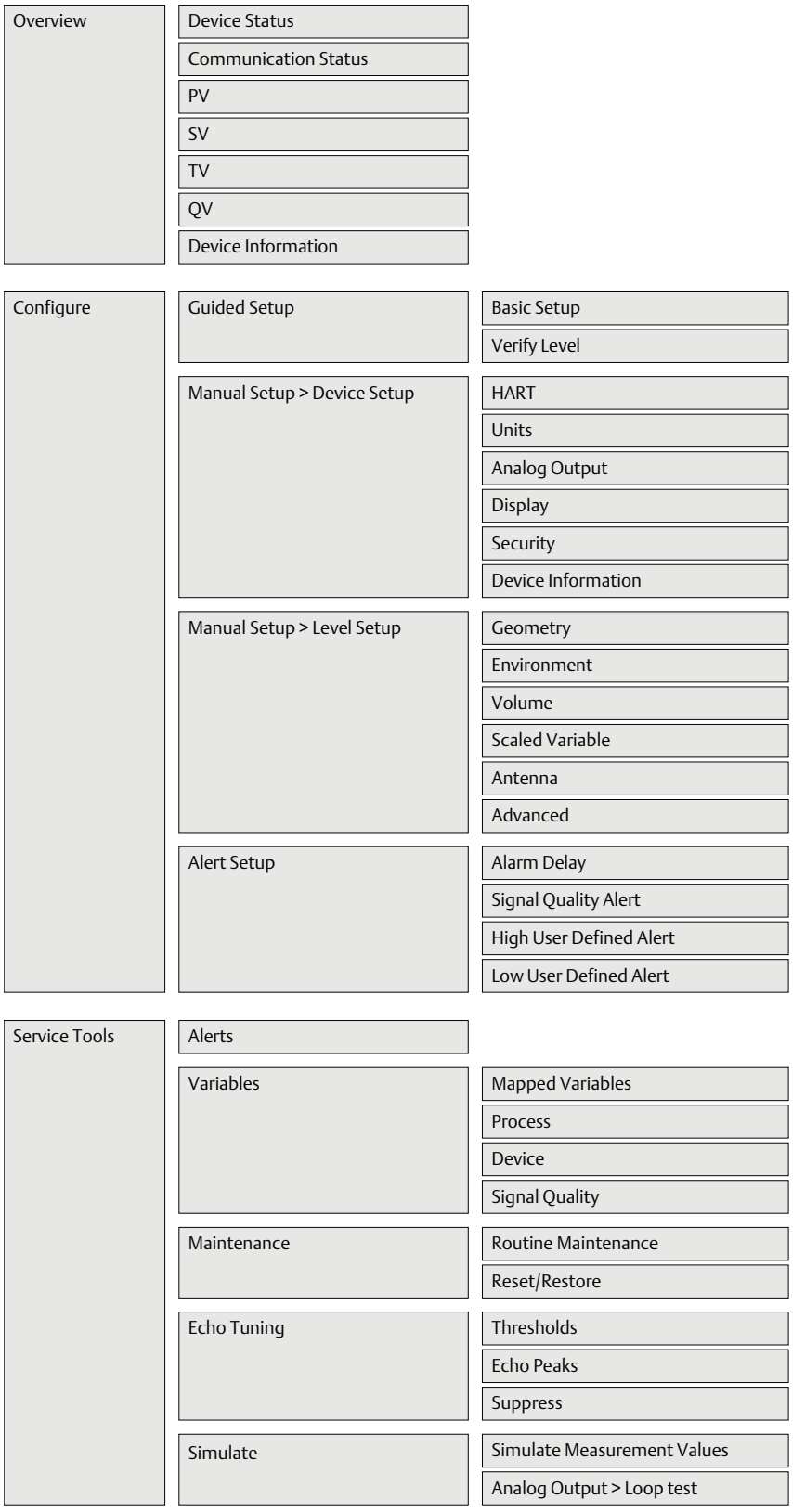


Figure C-2. Menu Tree for AMS Device Manager and Field Communicator



C.2 Device setup

C.2.1 HART

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 multi-drop. 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 (see section "Use with the HART Tri-Loop" on page 67).

Variable mapping

Up to four transmitter 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. See "Output variables" on page 123 for a list of available transmitter 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 transmitter variable (in addition to the primary variable).

100% auxiliary

Value corresponding to 100% range of variable selected for percent of range auxiliary.

0% auxiliary

Value corresponding to 0% range of variable selected for percent of range auxiliary.

C.2.2 Units

The units for length, volume, temperature, and level rates are selectable. All configuration parameters and transmitter variables will be expressed in these units. For information on available units of measure, see "Output units" on page 123.

C.2.3 Analog output

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

Primary variable

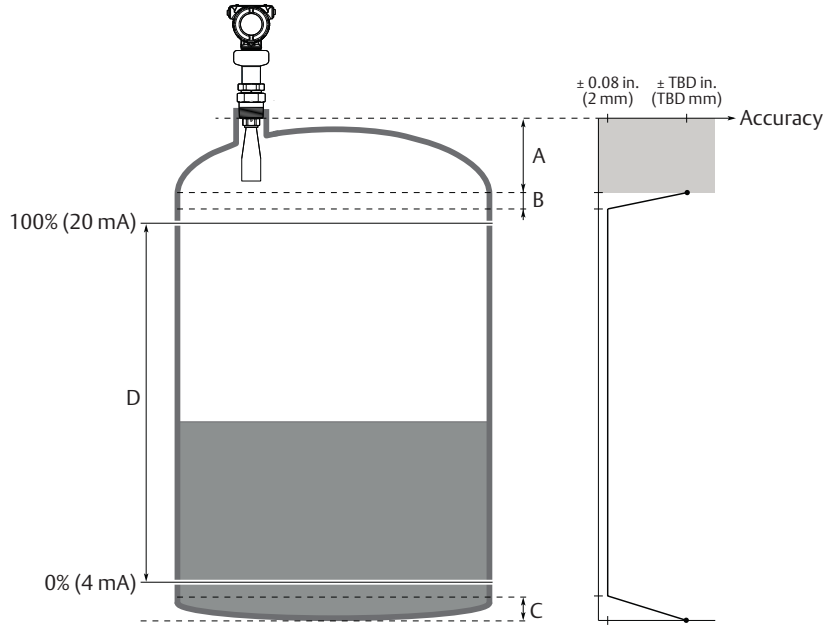
Select the desired transmitter variable to use for the analog output.

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
Measurements may not be possible in the Blind Zones, and measurements close to the Blind Zones will have reduced accuracy. Therefore, the 4-20 mA points should be set outside these zones (see Figure C-10).

Figure C-3. Example of Range Value Settings



A. Upper blind zone
B. Upper reduced accuracy zone
C. Lower reduced accuracy zone
D. Level measurement range 0-100%

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).

C.2.4 Display

Select variables to show on the optional LCD display (option code M5). If more than one variable is selected, then the LCD display toggles between the output variables.

C.2.5 Security

Write protection

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

Operational mode(1)

There are two Operational Modes to choose from for the Rosemount 5408:SIS: 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(1)

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(1)

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

C.2.6 Device Information

Tag

Identifier of up to 8 characters for the transmitter 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 transmitter used by host system. It is recommended to enter both a short and a long tag (they may be the same).

Descriptor

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

Message

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

Date

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

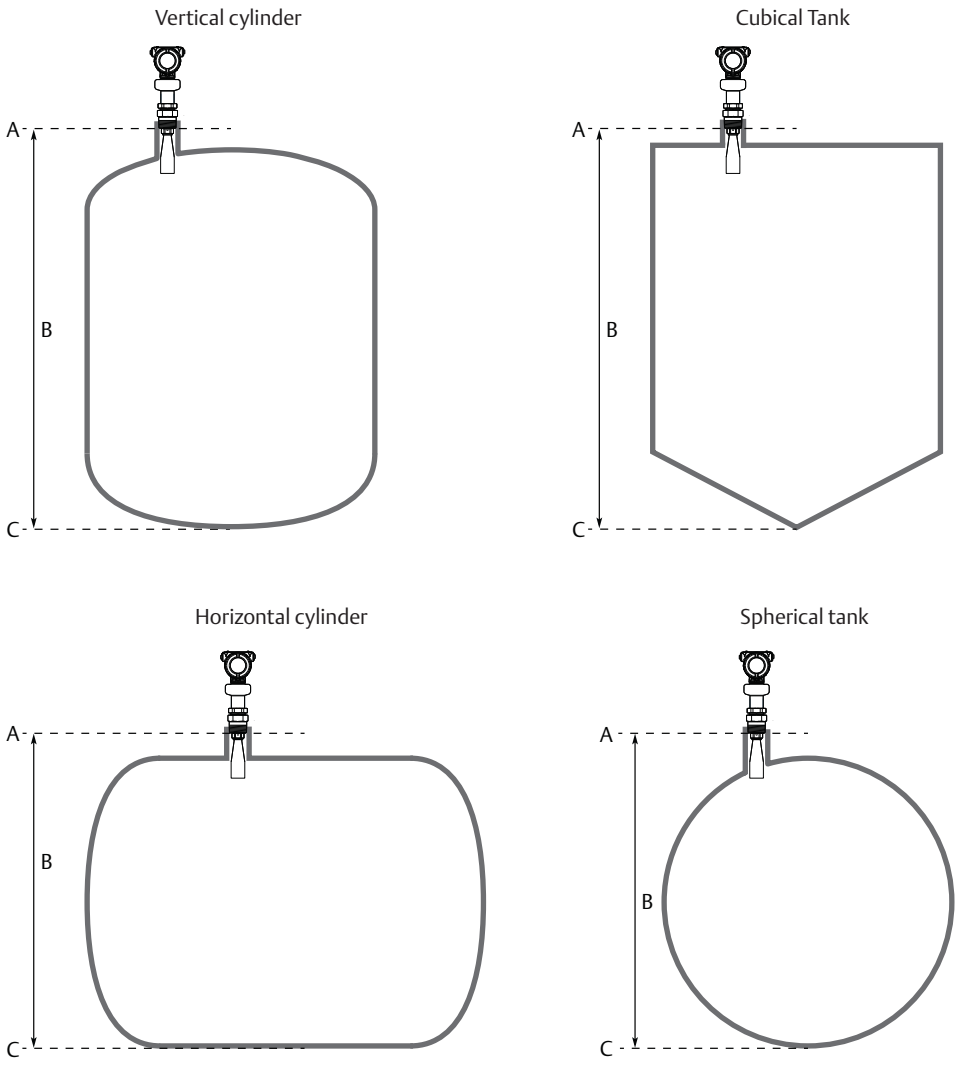
1. *Applies only to Rosemount 5408:SIS (profile code F).*

C.3 Level setup

C.3.1 Geometry

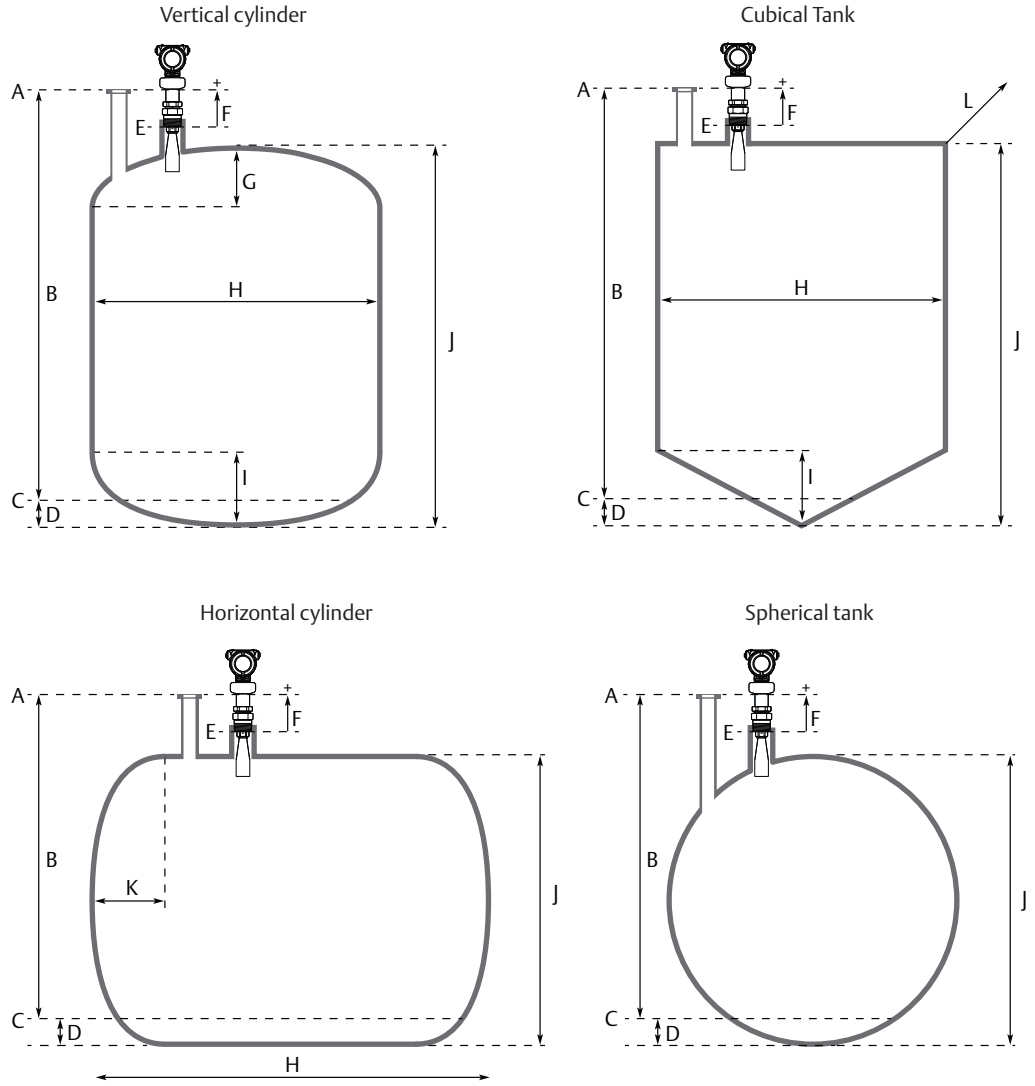
The transmitter configuration includes setting the tank geometry parameters, see Figure C-4 and Figure C-5.

Figure C-4. Tank Geometry, Basic Dimensions



A. Device Reference Point
B. Reference Height
C. Zero Level

Figure C-5. Tank Geometry, All Dimensions



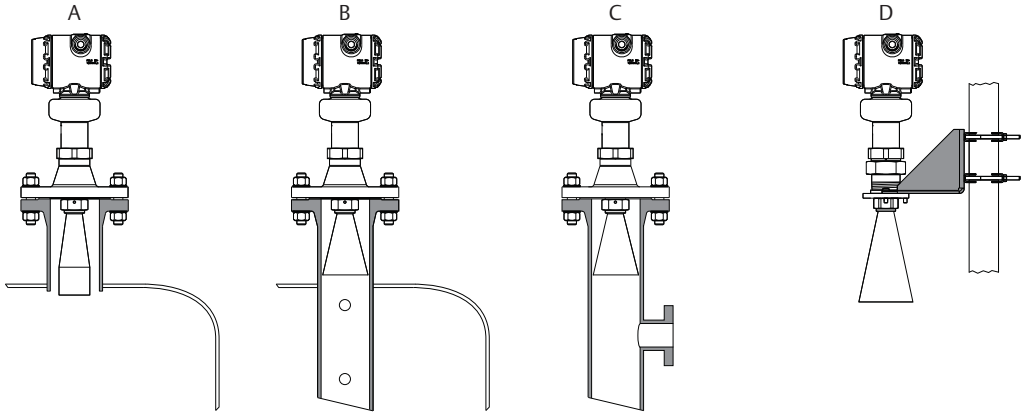
A. Tank Reference Point
B. Reference Height
C. Zero Level
D. Bottom Offset
E. Device Reference Point
F. Reference Offset
G. Top Shape Height*/Top Height**
H. Width of Tank*/Width**
I. Bottom Shape Height*/Bottom Height**
J. Height of Tank*/Height**
K. End Shape Length*/End Length**
L. Length of Tank*/Length**

* AMS Device Manager and Field Communicator
** Rosemount Radar Master

Mounting type

Select option best describing how transmitter is mounted on the tank. There are four options to choose from: Nozzle, Still pipe, Chamber, and Bracket.

Figure C-6. Mounting Type



A. Nozzle
B. Still pipe
C. Chamber
D. Bracket (open air)

Inner diameter, pipe/chamber

Enter the inner diameter for the pipe or chamber in which the antenna is mounted. The inner diameter value is used to compensate for the lower microwave propagation speed inside the pipe/chamber. An incorrect value will give a scale factor error.

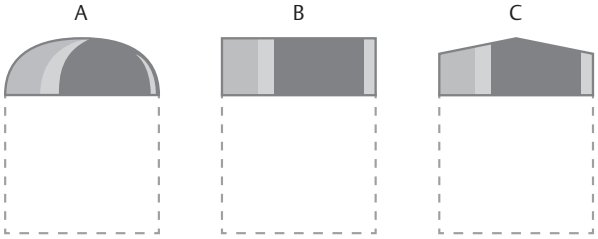
Tank shape

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 C-7. Tank Top Shape

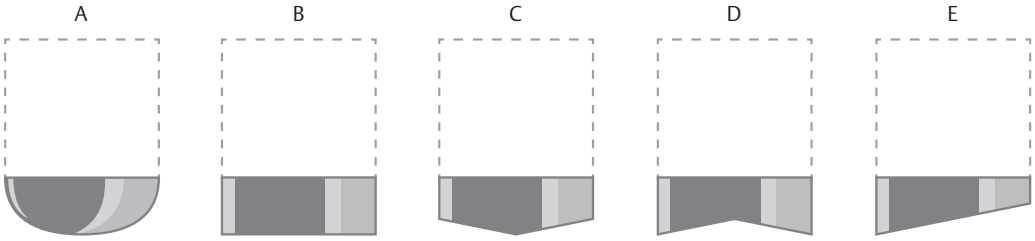


A. Dome
B. Flat
C. Conical

Tank bottom shape

Form of the lower tank closure.

Figure C-8. Tank Top 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 C-9. Tank End Shape

A. Dome
B. Flat

Reference height

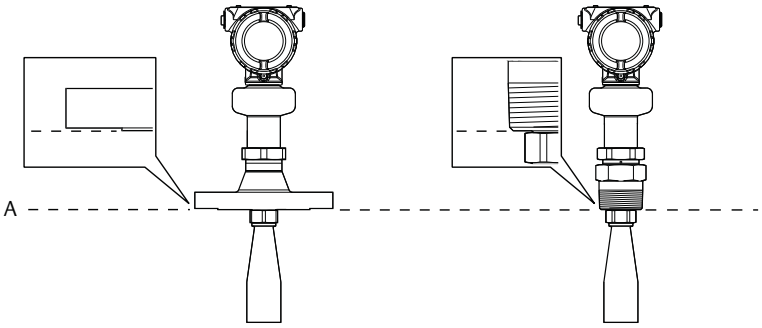
Distance between the Tank Reference Point (typically same as Device Reference Point) and zero level.

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

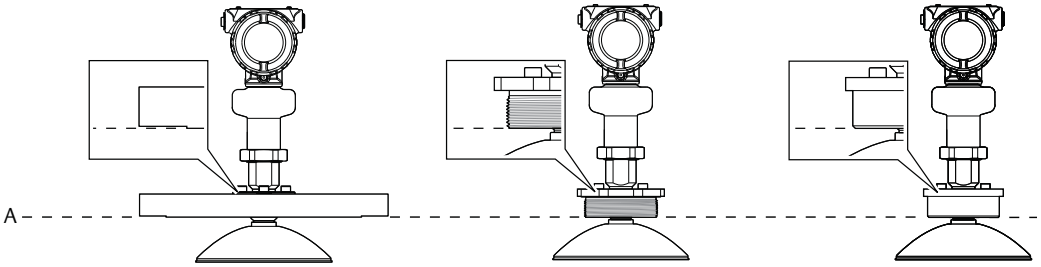
Figure C-10 and Figure C-11 show the Device Reference Point for various antennas and tank connections.

Figure C-10. Device Reference Point for Cone Antennas



A. Device Reference Point

Figure C-11. Device Reference Point for Parabolic Antennas with Swivel Mount



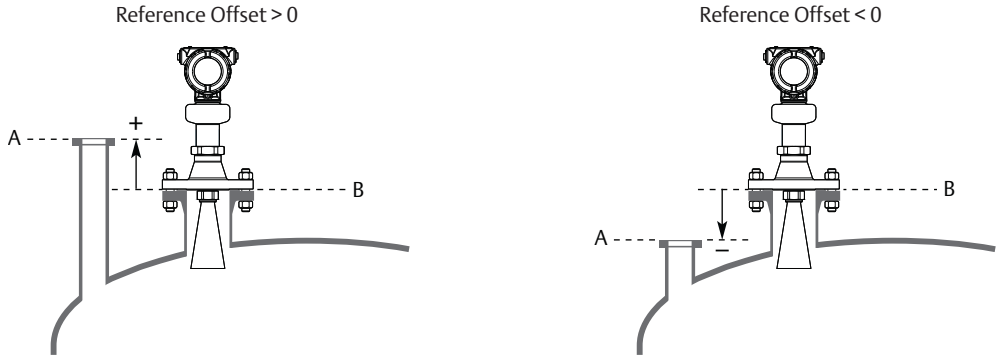
A. Device Reference Point

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 C-12. Reference Offset



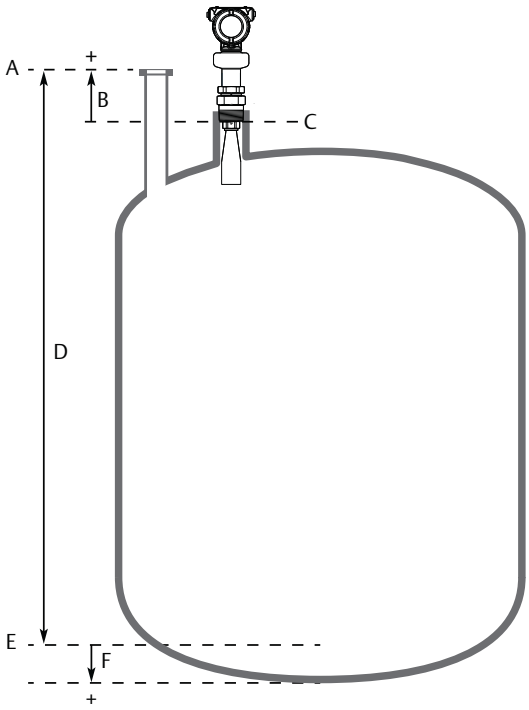
A. Tank Reference Point
B. Device Reference Point

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 C-13. 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.

C.3.2 Environment

Product type

The media used in the monitored process.

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.

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

Enter 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.

C.3.3 Volume

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

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

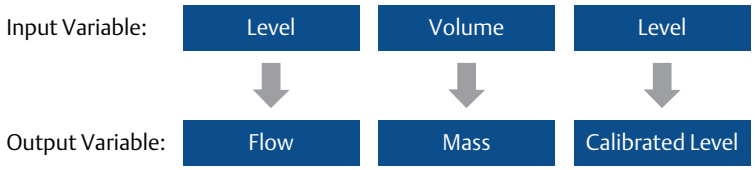
Use this parameter to add a volume to each calculated volume value, for example a sump volume below the Zero Level in the tank.

C.3.4 Scaled variable(1)

The scaled variable can be used to convert a transmitter variable into an alternative measurement, such as flow, mass, or calibrated level (e.g. 5 point verification).

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

Figure C-14. Scaled Variable Examples



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 the following table:

Table C-1. Example of Scaled Variable Table

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

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.

1. *Only for transmitters ordered with Smart Diagnostics Suite (option code DA1).*

Number of scaled values

Number of values in the scaled variable table.

Input variable

Select the input variable to use for scaled variable calculation.

C.3.5 Antenna

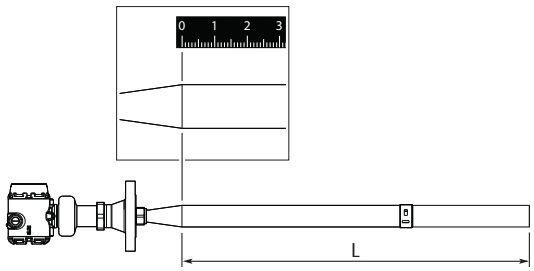
Antenna type

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.

Antenna extension length

This parameter is pre-configured at factory. The Antenna Extension Length (see Figure C-15) must be changed if the extension is shortened, or if you have ordered a spare transmitter head. Enter zero (0) for antennas without extensions.

Figure C-15. Antenna Extension Length (L)



User defined antenna options

Parameters for user defined antenna. These settings are typically provided by factory and should only be modified for customized antennas.

When a Rosemount 5408 transmitter head is mounted on a Rosemount 5402 antenna, refer to Table C-2 and Table C-3 for antenna parameters.

Table C-2. Rosemount 5402 Antenna Parameters, Open Tanks (Free Propagation)

Antenna type	Tank connection length		Antenna gain	Nearzone threshold (mV)	Nearzone range		Upper Null Zone[1]	
	ft	m			ft	m	ft	m
2-in. cone	0.502	0.153	2.3	2260	4.23	1.29	0.541	0.165
3-in. cone	0.495	0.151	1.35	1410	3.31	1.01	0.492	0.15
4-in. cone	0.499	0.152	0.9	990	3.87	1.18	0.738	0.225
2-in. process seal	0.906	0.276	2.9	2780	4.86	1.48	0.492	0.15
3-in. process seal	1.168	0.356	1.5	2330	3.51	1.07	0.492	0.15
4-in. process seal	1.296	0.395	0.8	810	3.64	1.11	0.492	0.15

1. Default setting. The Upper Null Zone may need to be increased if there are disturbance echoes in the region close to the antenna.

Table C-3. Rosemount 5402 Antenna Parameters, Still Pipes/Chambers

Antenna type	Tank connection length		Antenna gain	Nearzone threshold (mV)	Nearzone range		Upper Null Zone[1]	
	ft	m			ft	m	ft	m
2-in. cone	0.502	0.153	0.125	400	2.6	0.8	0.541	0.165
3-in. cone	0.495	0.151	0.125	400	2.6	0.8	0.492	0.15
4-in. cone	0.499	0.152	0.125	400	2.6	0.8	0.738	0.225
2-in. process seal	0.906	0.276	0.125	400	3.3	1.0	0.492	0.15
3-in. process seal	1.168	0.356	0.125	400	3.3	1.0	0.492	0.15
4-in. process seal	1.296	0.395	0.125	400	3.3	1.0	0.492	0.15

1. Default setting. The Upper Null Zone may need to be increased if there are disturbance echoes in the region close to the antenna.

Upper null zone

The Upper Null Zone defines how close to the transmitter'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 or bypass well inlet. See "Handling disturbances at top of tank" on page 99 for more information.

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

C.3.6 Advanced

Calibration offset

Difference between surface distance measured by transmitter and the same distance measured by e.g. 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, see "Verify Level" on page 66.

User defined variable setup[1]

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 C-4 for a list of suitable input registers.

Table C-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)
Surface Update Relation	21028	Determines how robust the surface echo measurement is (0 to 1). A decreasing value may be used to identify turbulence or foam in the process.
Min Signal Quality	21034	Minimum signal quality measured by the transmitter 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.

1. *Only for transmitters ordered with Smart Diagnostics Suite (option code DA1).*

Unit

Units of measurement of the user defined variable.

More advanced options[1]

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.

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 (see "Enable bottom echo visible when tank is empty" on page 100).

Tank bottom projection

The Tank Bottom Projection is used to enhance measurement performance 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. See "Tracking of weak surface echoes close to tank bottom" on page 100 for further instructions.

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

1. *Only available in Rosemount Radar Master.*

Enter the minimum allowed amplitude for the echo from the tank bottom before this function is activated.

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.

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 threshold always should be considered as the surface echo (see “Handling ghost echoes in still pipes” on page 102).

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.

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). See “Handling strong double bounce echoes” on page 103 for more information.

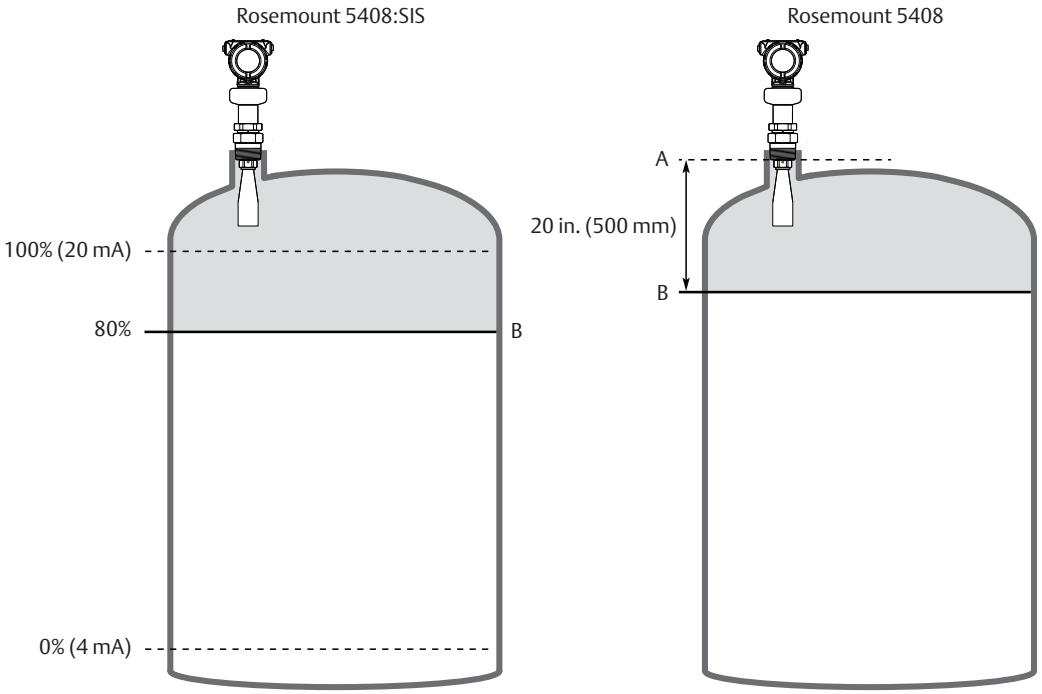
Overfill prevention

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. See Figure C-16 for default factory settings.

Figure C-16. Overfill Prevention Range



A. Device Reference Point
B. Overfill Prevention Range

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.

C.4 Alert setup

C.4.1 Alarm delay

The Alarm Delay parameter controls the maximum time from when a fault condition is detected until it is annunciated. Conditions that are cleared within the time specified by Alarm Delay time will not be annunciated.

It is recommended to keep Alarm Delay at default value (30 seconds) and only decrease it if a shorter detection time is required. Alarm Delay can be increased to increase robustness and avoid nuisance alarms.

Alarm Delay is applicable for diagnostic tests that run frequently (typically every measurement cycle). Alarm Delay is not applicable for critical hardware failures that will be annunciated as soon as they are detected by the device.

C.4.2 Signal quality alert(1)

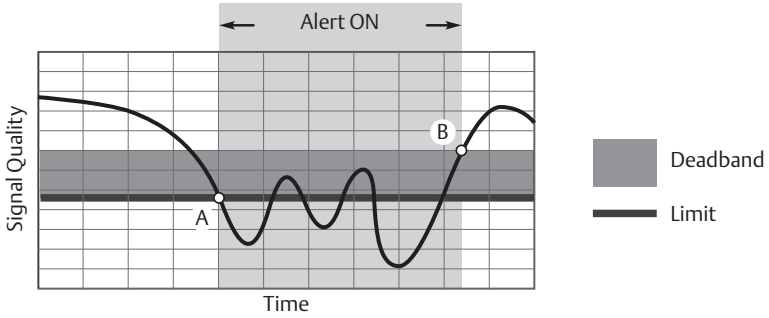
Signal Quality is a measure of the product surface echo amplitude compared to the surface threshold and noise.

The Signal Quality spans from 0 to 10. A low value means there is a risk for losing the level measurement. The Signal Quality may not be10 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.

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 C-17. Signal Quality Alert



A. The Signal Quality drops below the alert limit and an alert message is triggered.
B. 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.

1. *Only for transmitters ordered with Smart Diagnostics Suite (option code DA1).*

C.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 transmitter variable to use for the alert.

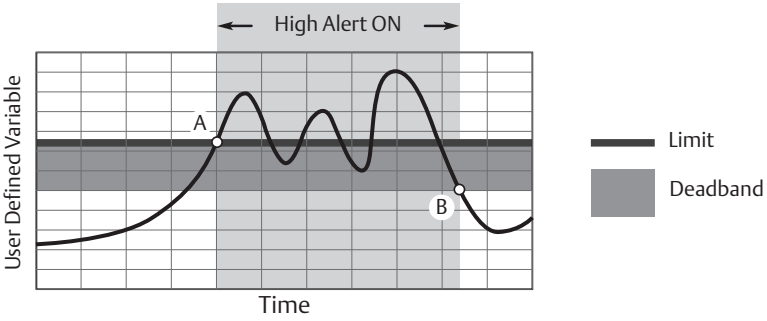
Limit

The value that will trigger the alert.

Deadband

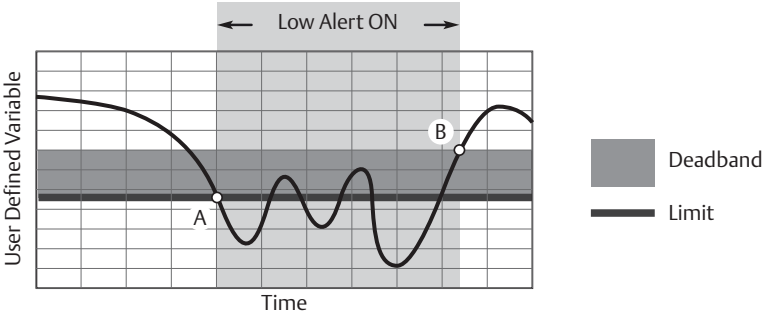
The Deadband is a buffer zone so the alerts do not toggle on and off when the measurement value fluctuates around the alert limit. The alert is set when the value exceeds the alert limit. The alert is then cleared when the value falls outside the Deadband range, see Figure C-18 and Figure C-19.

Figure C-18. High User Defined Alert



A. The alert is active when the values rises above the alert limit.
B. The alert turns off when the value falls below the deadband.

Figure C-19. Low User Defined Alert



A. The alert is active when the values falls below the alert limit.
B. The alert turns off when the value rises above the deadband.

PRELIMINARY

Reference Manual
00809-0100-4408, Rev AA
November 2016

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