

# Rosemount Guided Wave Radar Transmitters in Upstream Applications

## Best Practices User Guide





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## Best Practices Users Guide

### **⚠ CAUTION**

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

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

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

This product is designed to meet FCC and R&TTE requirements for a non-intentional radiator. It does not require any licensing whatsoever and has no tank restrictions associated with telecommunications issues.

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

*Rosemount 3300 Series Guided Wave Radar Level and Interface Transmitters may be protected by one or more of the following U.S. Patent Nos. 5,955,684; 6,148,681; 6,198,424; 6,373,261 and other patents issued or pending in the U.S. and other countries. May depend on model.*

*Rosemount 5300 Series High Performance Guided Wave Radar Transmitters may be protected by one or more of the following U.S. Patent Nos. 6,148,681; 5,955,684; 6,295,018; 6,198,424; 6,972,712; 6,842,139; 6,700,530 and other patents issued or pending in the U.S. and other countries. May depend on model.*

*Cover Photo: cover\_combined 2.jpg*





# Table of Contents

<b>SECTION 1</b>	Introduction . . . . .	1-1
<b>Introduction</b>	System Integration . . . . .	1-2
<b>SECTION 2</b>	Safety messages . . . . .	2-1
<b>Installation</b>	Introduction . . . . .	2-2
<b>Considerations</b>	Mechanical Installation . . . . .	2-2
	Recommended Mounting Position . . . . .	2-2
	Transition Zones . . . . .	2-5
	Process Connections . . . . .	2-7
	Electrical Installation . . . . .	2-12
	Rosemount 3300 Series: HART Version . . . . .	2-12
	Rosemount 3300 Series: Modbus Version . . . . .	2-13
	PC Communication with MA(+) MB(-) . . . . .	2-14
	Cathodic Protection . . . . .	2-15
	Rosemount 5300 Series: HART Version . . . . .	2-16
	Rosemount 5300 Series: Foundation™ fieldbus Version . . . . .	2-18
<b>SECTION 3</b>	Specific Applications . . . . .	3-1
<b>Upstream Applications</b>	Separators . . . . .	3-2
	Horizontal separator (bullet tank) . . . . .	3-2
	Vertical separator (vertical cylinder tank) . . . . .	3-3
	Output measurement at different interface levels . . . . .	3-4
	Production/Slop Tanks . . . . .	3-7
	Vertical cylinder . . . . .	3-7
	Slop tanks . . . . .	3-9
	Underground or open pit . . . . .	3-9
<b>SECTION 4</b>	Safety messages . . . . .	4-1
<b>Commissioning</b>	Introduction . . . . .	4-2
	Commissioning . . . . .	4-2
	Trim Near Zone . . . . .	4-2
	Store Backup and Verification Files . . . . .	4-4
	Plotting the Measurement Signal . . . . .	4-5
	Plotting the Measurement Signal for the Rosemount 3300 Series . . . . .	4-5
	Plotting the Measurement Signal for the Rosemount 5300 Series . . . . .	4-6
	Differences Between Plots in RRM and RCT . . . . .	4-9
<b>SECTION 5</b>	Safety messages . . . . .	5-2
<b>Troubleshooting</b>	Rosemount 3300 Threshold Settings . . . . .	5-3
	Case 1 - Level measurements . . . . .	5-3
	Case 2 - Level & Interface measurements . . . . .	5-4
	Disturbances From Nozzle . . . . .	5-5
	Upper Null Zone adjustment . . . . .	5-5

# Rosemount Radar Level Transmitters

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	Nozzle influence . . . . .	5-6
	Near Zone Threshold . . . . .	5-7
	Rosemount 5300 Threshold Settings . . . . .	5-10
	Device status . . . . .	5-12
	Device Status: Rosemount 3300 Series . . . . .	5-12
	Device Status: Rosemount 5300 Series . . . . .	5-13
<b>SECTION 6</b>		
<b>Verification Procedure</b>	Introduction . . . . .	6-1
	Verification Procedure . . . . .	6-2
	Self Test . . . . .	6-2
	Rosemount 3300 Plot Verification . . . . .	6-3
	Rosemount 5300 Plot Verification . . . . .	6-4
	Diagnostics . . . . .	6-5
<b>APPENDIX A</b>		
<b>Model Code Information</b>	Model Code 3302 and 5302, Level and Interface in Liquids . . . . .	A-2
	Model Code Example - Rosemount 3300 Series . . . . .	A-5
	Model Code Example - Rosemount 5300 Series . . . . .	A-5

# Section 1 Introduction

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Introduction .....	page 1-1
System Integration .....	page 1-2

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## INTRODUCTION

This document describes some of the best practices learned during the installation of thousands of Rosemount Guided Wave Radar level transmitters in upstream oil and gas applications. However, it is not a complete set of instructions; for more detailed information, refer to the respective product manual:

- Rosemount 5300 Series Reference Manual (Document No. 00809-0100-4530)
- Rosemount 3300 Series Reference Manual (Document No. 00809-0100-4811)

The Rosemount 3300 Series and 5300 Series Guided Wave Radar transmitters are Time Domain Reflectometry Pulsed Radar level instruments. They are utilized in the Oil and Gas industry for the measurement of hydrocarbons and water in production and separator tanks. Both the Rosemount 3300 and 5300 Series have the ability to measure overall level as well as interface level in the vessels. They can be installed in several different configurations including flanges, threaded, and side-mounted connections.

The Rosemount 3300 can transmit measurement values and diagnostics with the 4-20 mA HART® and RS-485 Modicon RTU Modbus communication protocols. The Rosemount 5300 is a high performance transmitter and can transmit measurement values and diagnostics with the 4-20 mA HART and FOUNDATION™ fieldbus communication protocols.

This document describes which series, models, and probes to use on the various applications within upstream Oil and Gas fields, and therefore serves as a selection guideline specific to these applications and needs. Local restrictions, regulations, or best practices may also apply and should be taken into consideration.

# Rosemount Radar Level Transmitters

## SYSTEM INTEGRATION

Figure 1-1. Rosemount 3300 Series: HART system.

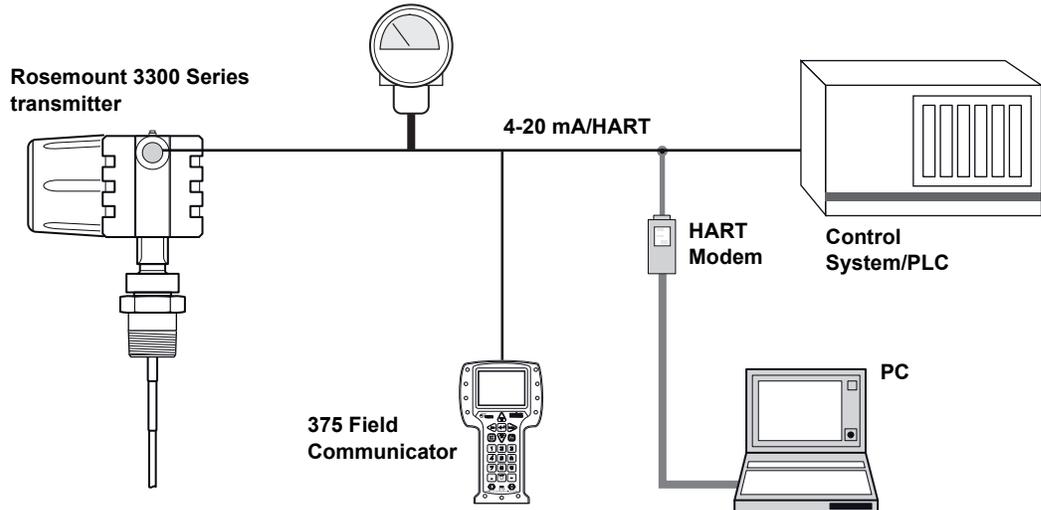
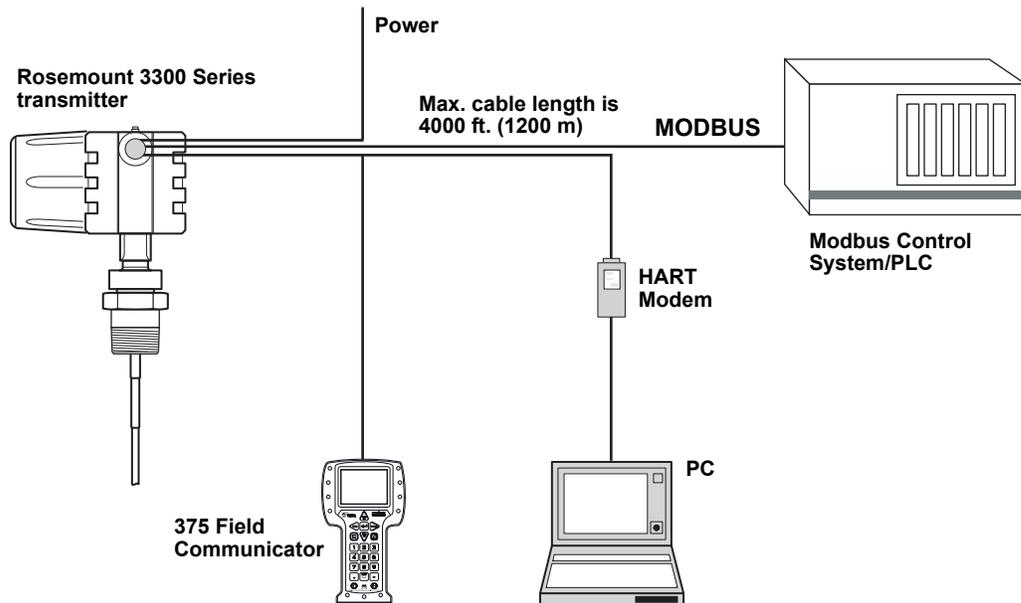


Figure 1-2. Rosemount 3300 Series: MODBUS system.



# Rosemount Radar Level Transmitters

Figure 1-3. Rosemount 5300 Series: HART system.

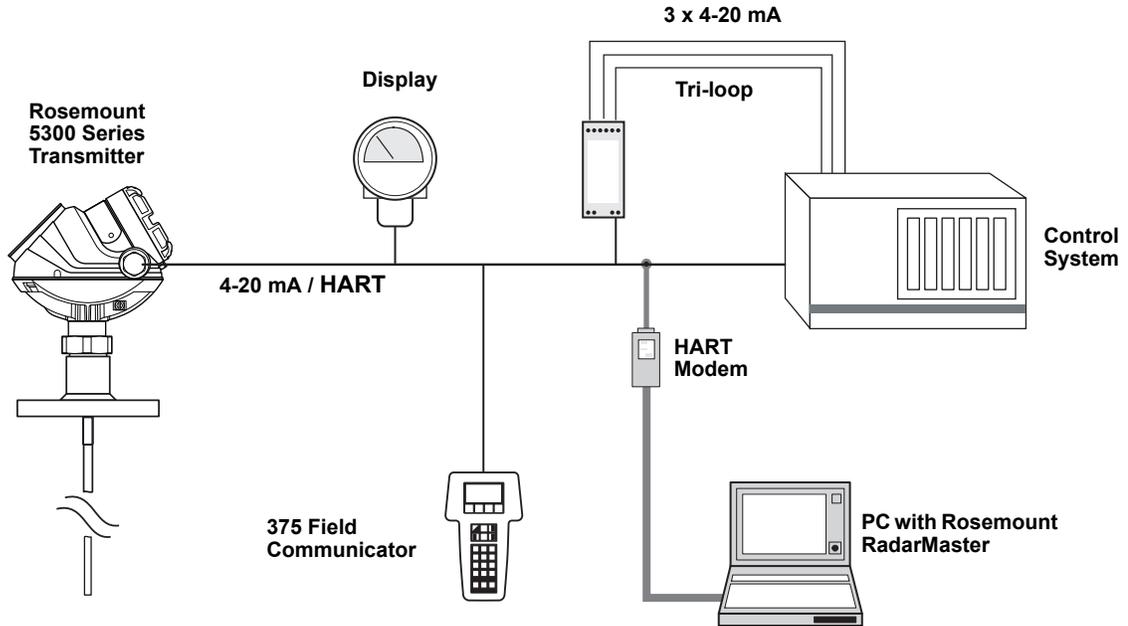
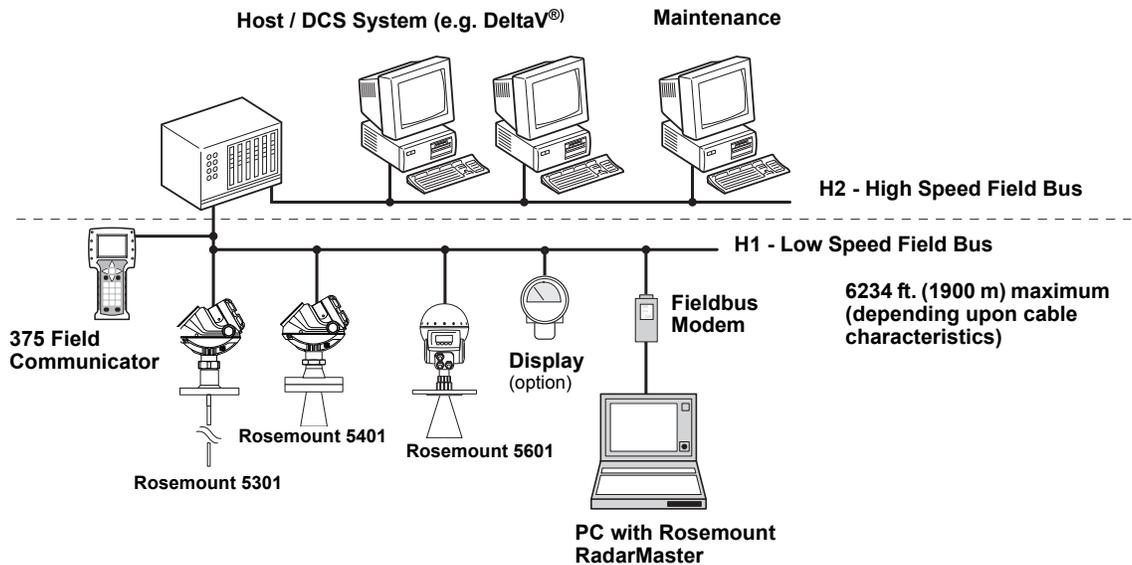


Figure 1-4. Rosemount 5300 Series - FOUNDATION™ fieldbus system.

**Note:**  
 Intrinsically safe installations may allow fewer devices per I.S. barrier due to current limitations.



# Rosemount Radar Level Transmitters

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# Section 2 Installation Considerations

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Safety messages . . . . .	page 2-1
Introduction . . . . .	page 2-2
Mechanical Installation . . . . .	page 2-2
Electrical Installation . . . . .	page 2-12

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## SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please 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 gauge is consistent with the appropriate hazardous locations certifications.  
Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.  
Do not remove the gauge cover in explosive atmospheres when the circuit is alive.  
**Failure to follow safe installation and servicing guidelines could result in death or serious injury.**  
Make sure only qualified personnel perform the installation.  
Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.  
Do not perform any service other than those contained in this manual unless you are qualified.  
**High voltage that may be present on leads could cause electrical shock.**  
Avoid contact with leads and terminals.  
Make sure the main power to the Rosemount 3300 / 5300 Transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.  
Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.  
**Process leaks could result in death or serious injury.**  
Make sure that the transmitter is handled carefully. If the Process Seal is damaged, gas might escape from the tank if the transmitter head is removed from the probe.

# Rosemount Radar Level Transmitters

## INTRODUCTION

In addition to selecting the appropriate radar level transmitter, mechanical installation is one of the most critical steps of the commissioning procedure. When done correctly, the subsequent transmitter configuration will be considerably simplified.

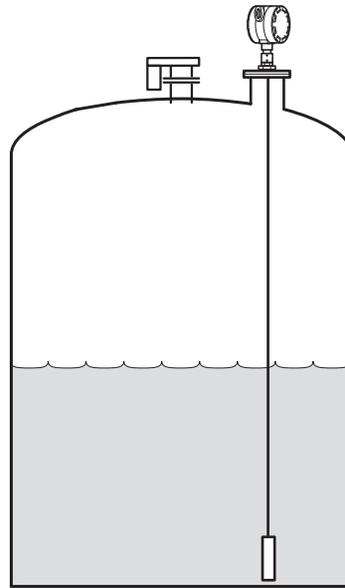
The main focus of this section is to provide a framework for installations in a variety of tanks and process connections typically found in the upstream oil and gas industry.

## MECHANICAL INSTALLATION

### Recommended Mounting Position

To find an appropriate mounting position for the transmitter, consider the conditions of the tank. The transmitter should be mounted so that turbulence from disturbing objects is reduced. If turbulence is present, the probe may need to be anchored to the bottom.

Figure 2-1. Mounting Position.



Guidelines to be considered when mounting the transmitter:

- Do not mount close to inlet pipes
- If the probe sways because of turbulent conditions in the tank, the probe should be anchored to the tank bottom. In these applications, the best option is anchoring with a Magnet fastened to the weight
- Avoid mounting close to internal objects that are within 6 in. (150 mm) from probe at any time
- The probe should not come into contact with the nozzle or other objects in the tank

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### NOTE!

Violent fluid movements can cause forces that could break rigid probes.

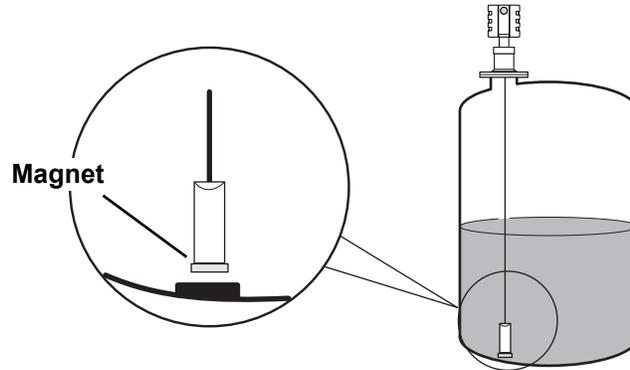
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### Anchoring a Flexible Single Lead probe

A magnet can be fastened to a threaded (M8x14) hole at the end of the weight. Placing a metal plate beneath the magnet, as illustrated in Figure 2-2, will help to guide the probe.

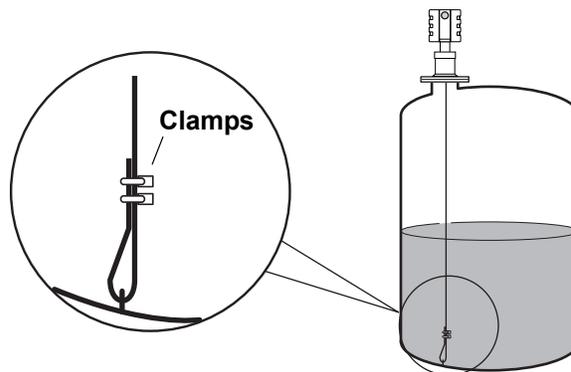
Magnets should not be used on long nozzle applications because the magnet could attach to the side of the nozzle during installation.

Figure 2-2. Anchoring the probe with a magnet.



The probe rope can also be used for anchoring. The probe rope can be pulled through a suitable anchoring point, e.g. a welded eye and fastened with two clamps. The length from the underside of the flange to the top clamp should be used to configure the probe length.

Figure 2-3. Anchoring the probe through a welded eye.

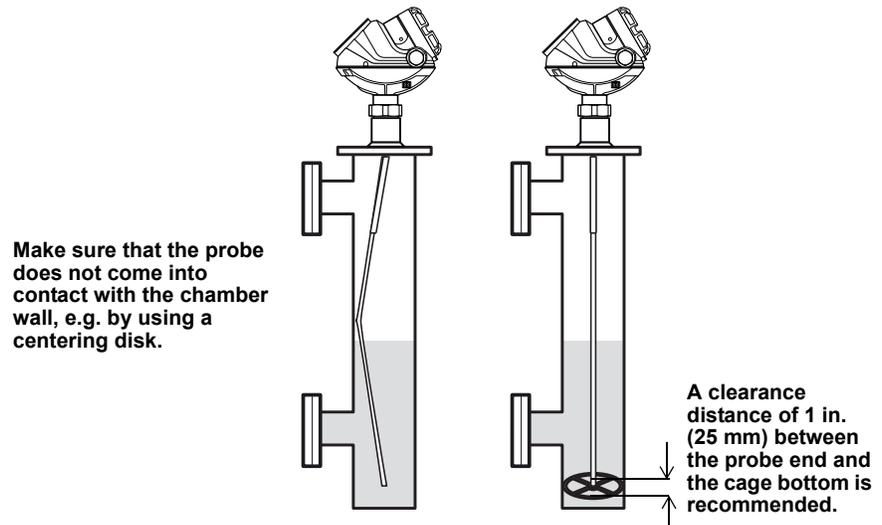


# Rosemount Radar Level Transmitters

## Installation in pipes

A centering disk is recommended when installing in pipes to prevent the probe from contacting the chamber wall. The disk is attached to the end of the probe to keep the probe centered in the chamber. The discs are available in stainless steel (SST) and PTFE. The PTFE option is recommended for most applications and the SST centering disk is used for high temperature operations.

Figure 2-4. Improper and proper probe positions.



To avoid bending the probe (rigid probes) or twisting and coming in contact with the chamber wall (flexible probes), a small clearance distance of 1 in. (25 mm) between the centering disk and chamber bottom is recommended. It should be selected with a dome shaped chamber bottom in mind, which may prevent the centering disk from reaching the bottom.

Side-pipe locations and the effective measurement range are determined by the mating tank connections. There are no constraints on the diameter of the side-pipes, but build-up and clogging should be considered. Also the inlet pipes should not protrude into the chamber since they may interfere with the radar measurement. Always use the same construction material for the chamber and the tank, otherwise, mechanical tensions can arise in the side-connections.

The recommended chamber diameter is 3 in. (75 mm) or 4 in. (100 mm). Chambers with a diameter less than 3 in. (75 mm) may have build-up problems and it may also be difficult to center the probe. Chambers larger than 6 in. (150 mm) can be used, but provide no advantages for the radar measurement.

With the Rosemount 3300 / 5300 Series, single probes are recommended for use in 3 in. (75 mm) and 4 in. (100 mm) chambers. Other probe types are susceptible to build-up and should not be used in this application.

The probe must not touch the chamber wall and should extend the full height of the chamber, but it does not need to touch the bottom of the chamber. Probe type selection depends on the probe length:

**Less than 3 ft. (1 m):** Use Single Rigid Probe and no centering disk is needed. The transition zones and the height of the weight will limit the use of single flexible probes shorter than 3 ft. (1 m).

**Between 3 ft. (1 m) and 10 ft. (3 m):** Use either Rigid Single or Flexible Single Probe with the weight and centering disk. Rigid Single has smaller transition zones, while the Flexible Single requires less head-space during installation and is less likely to be damaged.

**More than 10 ft. (3 m):** Use Flexible Single Probe with a weight and centering disk.

**Light hydrocarbon applications not in chambers:** Use the Rosemount 5300 Series with either a Rigid Single or Flexible Single Probe. In very light hydrocarbons, the Rosemount 3300 signal loses too much energy on a single probe. The Rosemount 5300 has more efficient and sensitive microwave modules that increase signal strength. The 3300 will, however, work in light hydrocarbon chamber applications, because chambers have similar physics of propagation as the traditional coaxial style probe.

## Transition Zones

Transition zones, located at the very top and bottom of the probes, are regions where measurement performance is reduced. Different factors affect the size of the transition zones - probe type, centering disk or no centering disk, and the material and media measured, as shown in Table 2-1.

Table 2-1. Transition Zones for Rosemount 3300 and 5300 Series.

	Dielectric Constant	Rigid Single Lead <sup>(1)</sup>		Rigid Single Lead, with metallic centering disk		Flexible Single Lead	
		3300	5300	3300	5300	3300	5300
Upper <sup>(2)</sup> Transition Zone	80 (water)	4 in. (10 cm)	4.3 in. (11 cm)	4 in. (10 cm)	4.3 in. (11 cm)	5.9 in. (15 cm)	4.3 in. (11 cm)
	2 (oil)	4 in. (10 cm)	6.3 in. (16 cm)	4 in. (10 cm)	6.3 in. (16 cm)	20 in. (50 cm)	7.1 in. (18 cm)
Lower <sup>(3)</sup> Transition Zone	80 (water)	2 in. (5 cm)	2 in. (5 cm)	2 in. (5 cm)	2 in. (5 cm)	2 in. (5 cm) <sup>(4) (5)</sup>	0 in. (0 cm) <sup>(5) (6)</sup>
	2 (oil)	4 in. (10 cm)	2.8 in. (7 cm)	8 in. (20 cm)	8 in. (20 cm)	4.7 in. (12 cm) <sup>(4)</sup>	2 in. (5 cm) <sup>(6)</sup>

(1) Rigid Single Lead probe without SST centering disk or with PTFE centering disk.

(2) The distance from the upper reference point where measurements have reduced accuracy.

(3) The distance from the lower reference point where measurements have reduced accuracy.

(4) Note that the weight length adds to non-measurable area. For more information, see Dimensional Drawings in the Guided Wave Radar Level and Interface Transmitter, Rosemount 3300 Series Product Data Sheet (Document No. 00813-0100-4811).

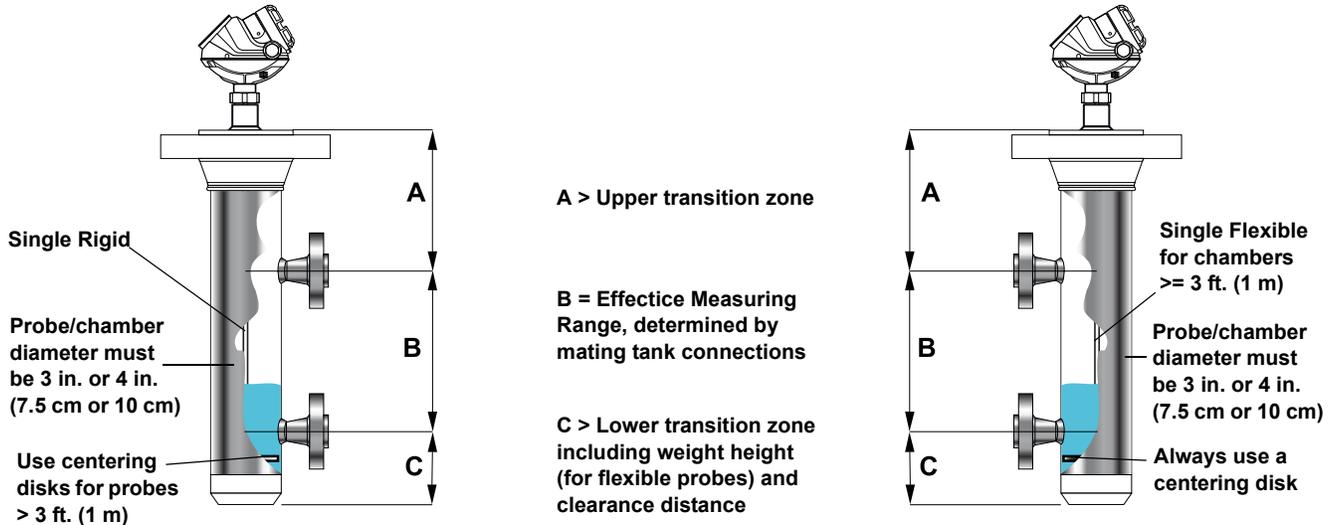
(5) The measuring range for the PTFE covered Flexible Single Lead probe includes the weight when measuring on a high dielectric media.

(6) Note that the weight length adds to non-measurable area. For more information, see Dimensional Drawings in the High Performance Guided Wave Radar, Rosemount 5300 Product Data Sheet (Document No. 00813-0100-4530).

# Rosemount Radar Level Transmitters

The weight on the flexible probes reduces the measurement range. Therefore, it is recommended to dimension the cage (A, C) so it does not interfere with the effective measurement range (B). The transition zones also limit the minimum probe length. See Figure 2-5 on page 2-6.

Figure 2-5. Measuring zones in chambers.



## Process Connections

There are a few different types of Process Connections used in these applications. Below are some directions and guidelines on how to install and what to consider for the various connections.

### Flanged connections

Below are recommendations for the nozzle configuration and dimensions for flanged installations on top of the tank/vessel.

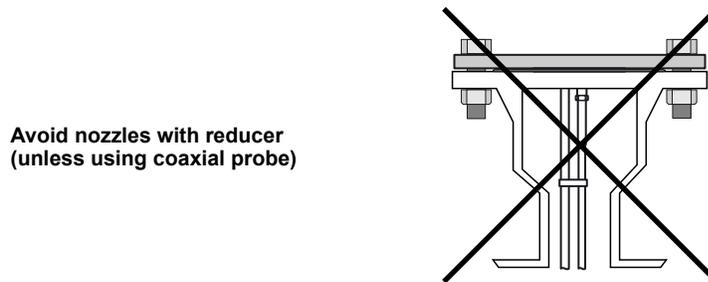
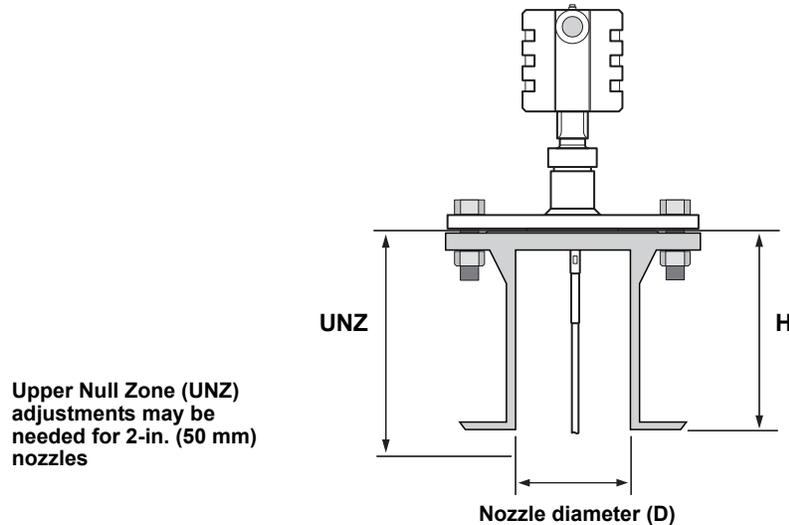


Table 2-2. Nozzle considerations.

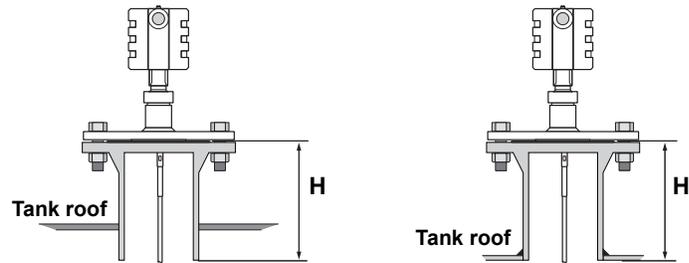
Single (Rigid / Flexible)	
Recommended Nozzle Diameter (D)	4-6 in. (100-150 mm)
Minimum Nozzle Diameter (D) <sup>(1)</sup>	2 in. (50 mm)
Maximum Nozzle Height (H)	4 in. (100 mm) + Nozzle Diameter

(1) An Upper Null Zone setup may be required to mask the nozzle, which may reduce the measuring range.

Nozzle height **H** is measured from the flange to the bottom of the nozzle, regardless of how the nozzle is attached to the tank roof as illustrated in Figure 2-6.

# Rosemount Radar Level Transmitters

Figure 2-6. Definition of nozzle height H.



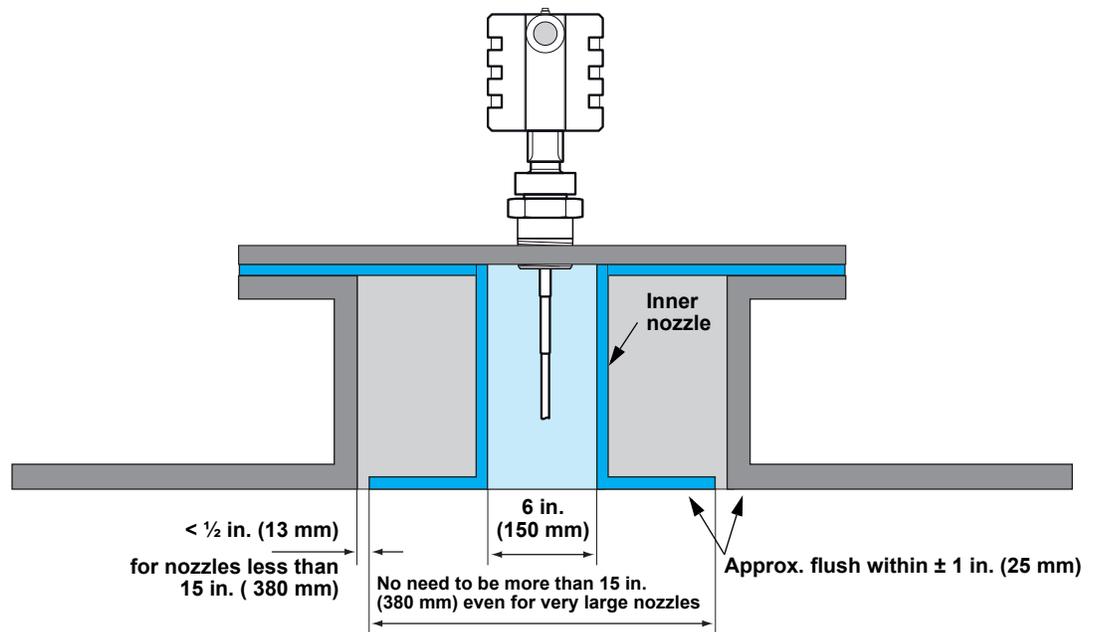
## 10-in. (250 mm) or larger flange/manway connection

If a Rosemount 3300/5300 Series Guided Wave Radar with single lead probe is installed in a 10-in. (250 mm) (DN250) high nozzle or larger, there may be resonance and double bounce problems. This can lead to measurement errors for products with low dielectric constants, so 10-in. (250 mm) nozzles or larger should be avoided.

In cases where 10-in. (250 mm) nozzles or larger are used, install an inner steel nozzle with a smaller diameter, as illustrated in *Figure 2-7*.

Flat tank roof installation is not affected by this phenomenon.

Figure 2-7. Special installation considerations for 10 inch nozzles.



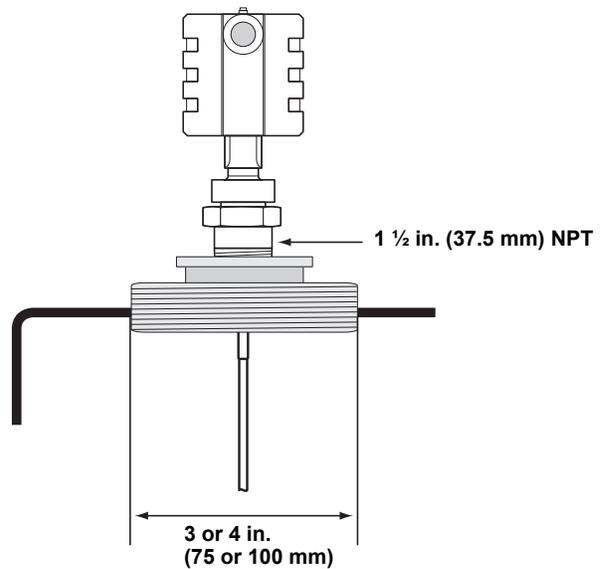
### Threaded tank connection

Many Oil and Gas applications have 3-in. (75 mm) or 4-in. (100 mm) threaded connections on top of the tank roof.

For this connection, install the Rosemount 3300 / 5300 transmitters with a 1 ½-in. ( 37.5 mm) NPT threaded connection (model code option **RA**). The probe can be attached to a bushing or adapter piece, reducing the tank opening from a 3-in. (75 mm) or 4 in. (100 mm) threaded connection to the desired 1 ½-in. (37.5 mm) standard Rosemount 3300 / 5300 process connection.

Figure 2-8. The Rosemount 3300 / 5300 can be installed in a 3 or 4 in. (75 or 100 mm) tank opening by using an adapter.

**Do not use Teflon tape or similar non-conductive materials in the threaded connections. These connections must be able to provide a ground connection between the probe and the tank.**



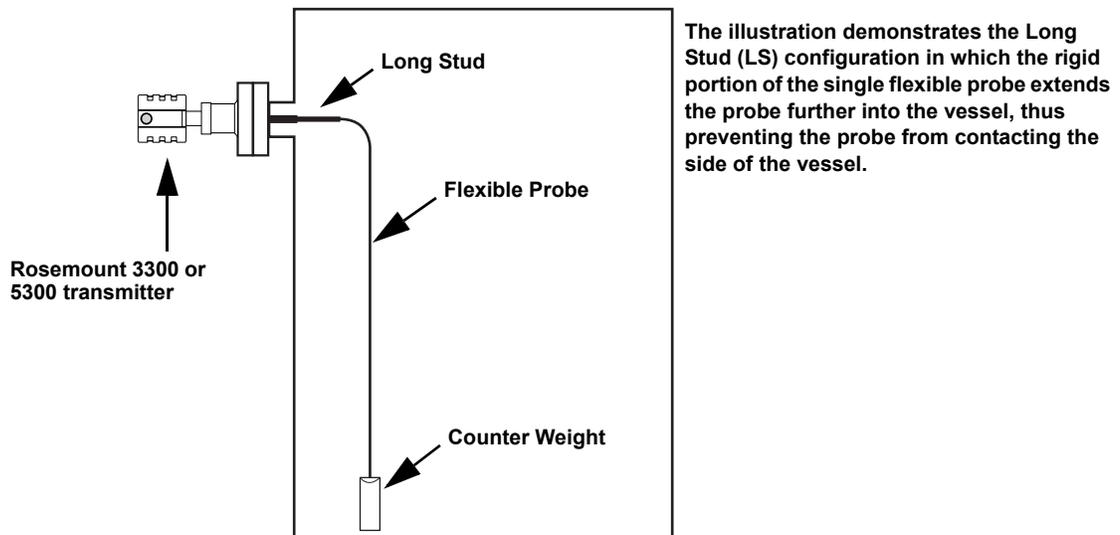
# Rosemount Radar Level Transmitters

## Side mounted process connection

In some cases, tanks might not have top process connections suitable for installation of Guided Wave Radar units, so side mounted process connections are a viable and reliable installation practice. Certain precautions must be taken to ensure successful level measurements in these vessels. Both flexible and rigid single lead probes can be utilized for these installations.

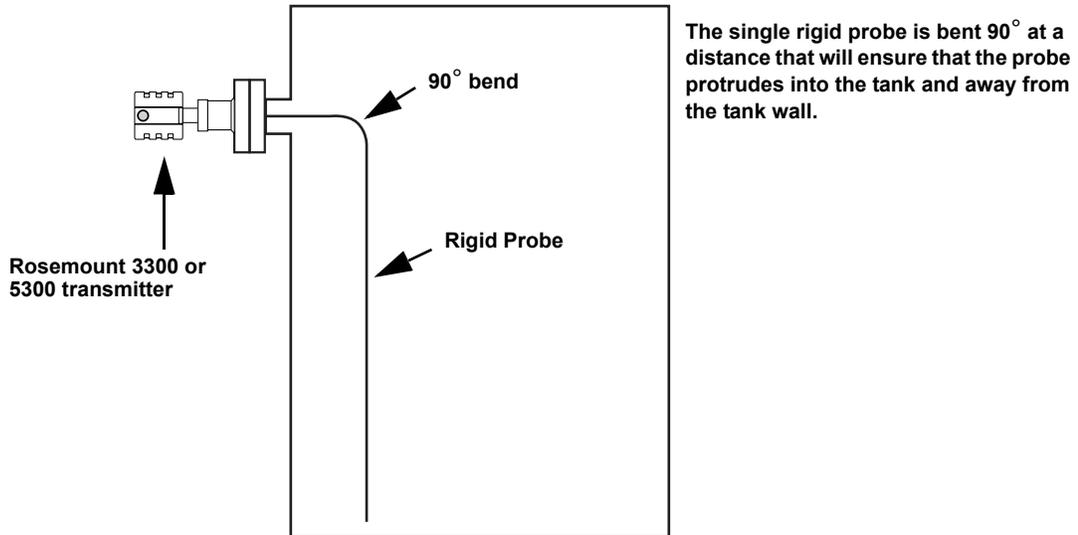
A special mechanical configuration, Long Stud (model code option **LS**), can be used for the Flexible Single Lead probe to prevent contact with walls or nozzles. The Long Stud incorporates a longer rigid rod extension piece which connects to the flexible portion of the probe. This is useful for side mounted probes since it allows for the probe to extend further into the vessel before it is bent vertically down towards the tank bottom. Figure 2-9 illustrates this type of installation:

Figure 2-9. Side mounting with Flexible Single Lead probe.



For side mounting with a Rigid Single Lead probe, the probe is bent at a 90° angle to ensure that the probe extends into the tank and away from the tank wall. Figure 2-10 illustrates this type of installation:

Figure 2-10. Side mounting with Rigid Single Lead probe.



### Non-metallic Process Connections

See "Non-metallic process connections" on page 3-10.

# Rosemount Radar Level Transmitters

## ELECTRICAL INSTALLATION

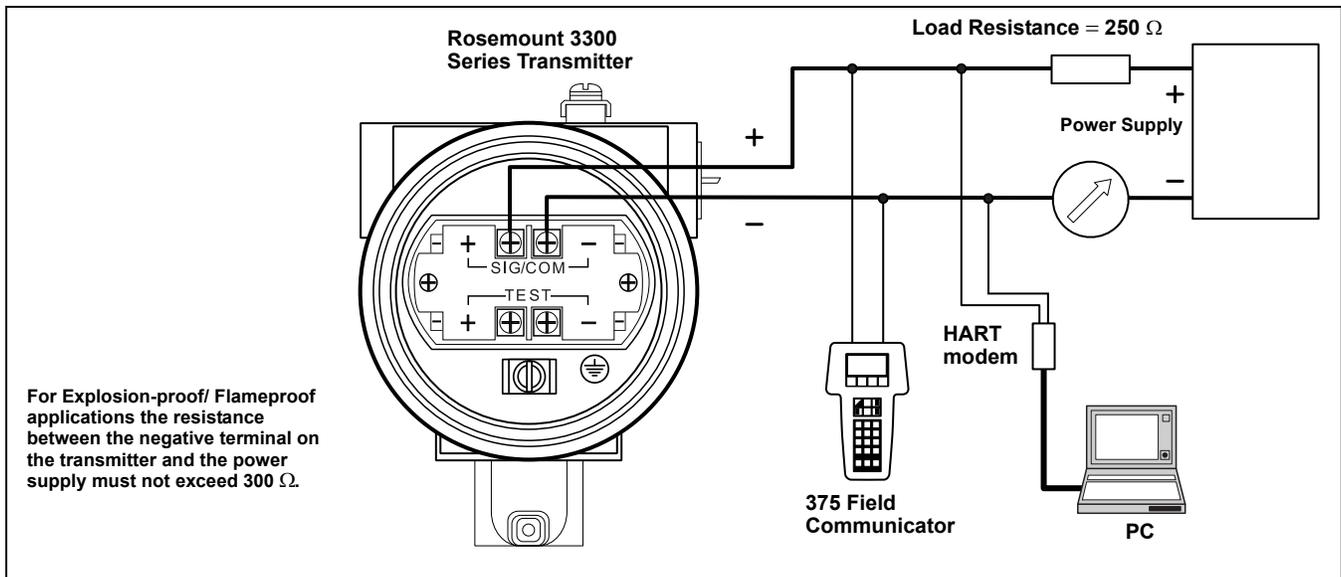
This is a brief description of the Rosemount 3300 and 5300 wiring procedure. For more information, see the respective reference manual: Rosemount 3300 Series (Document No. 00809-0100-4811) and Rosemount 5300 Series (Document No. 00809-0100-4530).

### Rosemount 3300 Series: HART Version

The 3300 Series is a two-wire loop powered transmitter accepting power supplies ranging from 11 Vdc to 42 Vdc. It uses 4-20 mA power superimposed with a HART signal. To connect the transmitter:

1. Make sure the power supply is disconnected.
2. Remove the cover on the transmitter housing terminal side (see label). Do not remove the cover in explosive atmospheres when the circuit is live. All power to the transmitter is supplied over the signal wiring.
3. Pull the cable through the cable gland/conduit.
4. Connect wires according to Figure 2-11 for non-intrinsically safe output. Make sure that the transmitter housing is grounded in accordance with national and local electrical codes. There are two grounding screw connections provided. One is inside the Field Terminal side of the housing identified by a ground symbol:  $\oplus$ , and the other is located on top of the housing.
5. Attach and tighten the housing cover. Tighten the cable gland, plug and seal any unused connections and connect the power supply.

Figure 2-11. Wiring diagram for non-intrinsically safe installations of the 3300.



For HART communication, a minimum load resistance of 250  $\Omega$  within the loop is required.

The power supply voltage ranges from  $V_{min}$  Vdc to 42 Vdc where  $V_{min}$  is the minimum voltage given by:

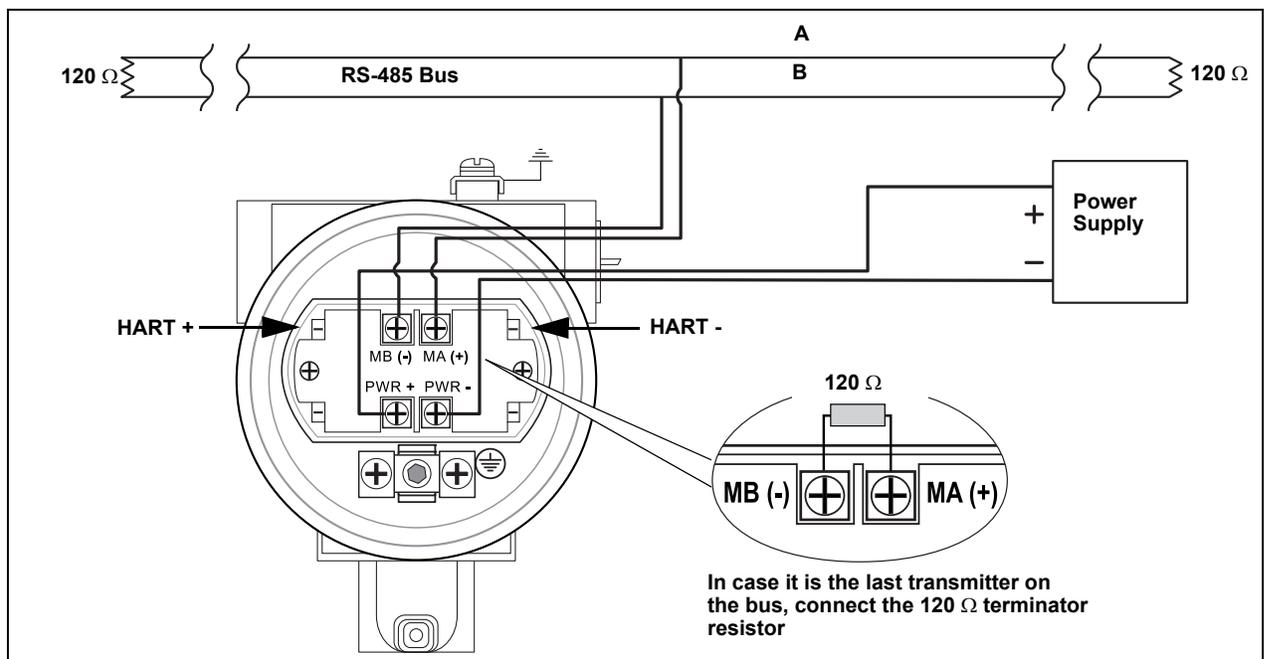
11 V	Non-hazardous locations certification
16 V	Explosion-proof/flameproof certification

## Rosemount 3300 Series: Modbus Version

To connect the Rosemount 3300:

1. Make sure the power supply is disconnected.
2. Remove the cover on the transmitter housing terminal side (see label). Do not remove the cover in explosive atmospheres when the circuit is live. All power to the transmitter is supplied over the signal wiring.
3. Pull the cable through the cable gland/conduit. For the RS-485 bus use shielded twisted pair wiring, preferably with an impedance of  $120\ \Omega$  (typically 24 AWG) to comply with the EIA-485 standard and EMC regulations. Maximum cable length is 4000 ft. (1200 m).
4. Connect wires according to Figure 2-12 and Table 2-3. Connect the lead that originates from the "A" line from the RS-485 bus to the terminal marked MA (+), and the lead that originates from the "B" line to the terminal marked MB (-). Make sure that the transmitter housing is grounded in accordance with national and local electrical codes. There are three grounding screw connections provided. Two are inside the Field Terminal side of the housing identified by a ground symbol:  $\oplus$ , and the other is located on top of the housing.
5. If it is the last transmitter on the bus, connect the  $120\ \Omega$  termination resistor.
6. Connect the leads from the positive side of the power supply to the terminal marked PWR +, and the leads from the negative side of the power supply to the terminal marked PWR -. The power supply cables must be suitable for the supply voltage and approved for use in hazardous areas, where applicable.
7. Attach and tighten the housing cover. Tighten the cable gland, plug and seal any unused connections and connect the power supply.

Figure 2-12. Field Wiring Connection for the 3300 with Modbus.



# Rosemount Radar Level Transmitters

## Connection Terminals

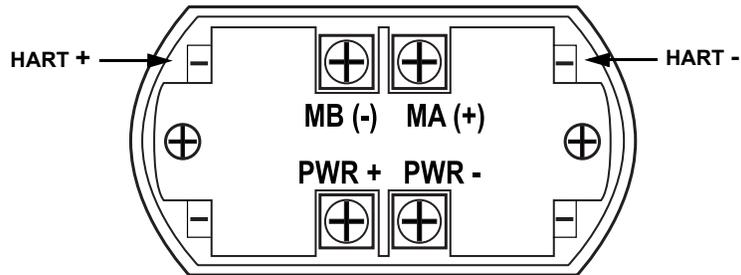
The connection terminals are described in Table 2-3 below:

Table 2-3. Connection Terminals

Connector label	Description	Comment
HART +	Positive HART connector	Connect to PC with RCT software, 375 Field Communicator, or other HART configurators
HART -	Negative HART connector	
MA (+)	Modbus RS-485 <b>A</b> connection (RX/TX+) <sup>(1)</sup>	Connect to Modbus Master
MB (-)	Modbus RS-485 <b>B</b> connection (RX/TX-) <sup>(1)</sup>	
PWR +	Positive Power input terminal	Apply +8 Vdc to +30 Vdc
PWR -	Negative Power input terminal	

*(1) The designation of the connectors do not follow the EIA-485 convention, which states that RX/TX- should be referred to as 'A' and RX/TX+ as 'B'.*

Figure 2-13. Connection Terminals for Rosemount 3300 with Modbus



## PC Communication with MA(+) MB(-)

The Rosemount 3300 level transmitter can be configured with the Rosemount Configuration Tools (RCT) software by using the MA (+), MB (-) connectors. The PC communicates with the 3300 by transferring the HART protocol over the RS-485. This requires using a RS-232/RS-485 Converter.

To communicate with the 3300 transmitter, the COM port used for serial communication (RS-232) must be selected in RCT. Check the Device Manager in Windows if unsure which COM port to use.

See Help, Contents in RCT for information on how to use a specific COM port.

### NOTE

Make sure the 3300 transmitter is alone on the bus and disconnect or turn off power from other devices.

## Cathodic Protection

The ground plane voltage is elevated in applications where the tank is protected by a Cathodic Protection System. For HART units, an isolator should be used to protect the circuits from ground currents. A Modbus unit is more robust against ground currents, and can handle a difference of ground voltages of up to 20 V without using an Isolator.

Using an Isolator avoids undesired ground current in the 4-20 mA loop that may interfere with the correct 4-20 mA output. Installing an isolator ensures galvanic isolation between the control system and the transmitter and will break the undesired loop, preventing interference with the wanted output.

Figure 2-14. 4-20 mA loop with isolator to ensure galvanic isolation.

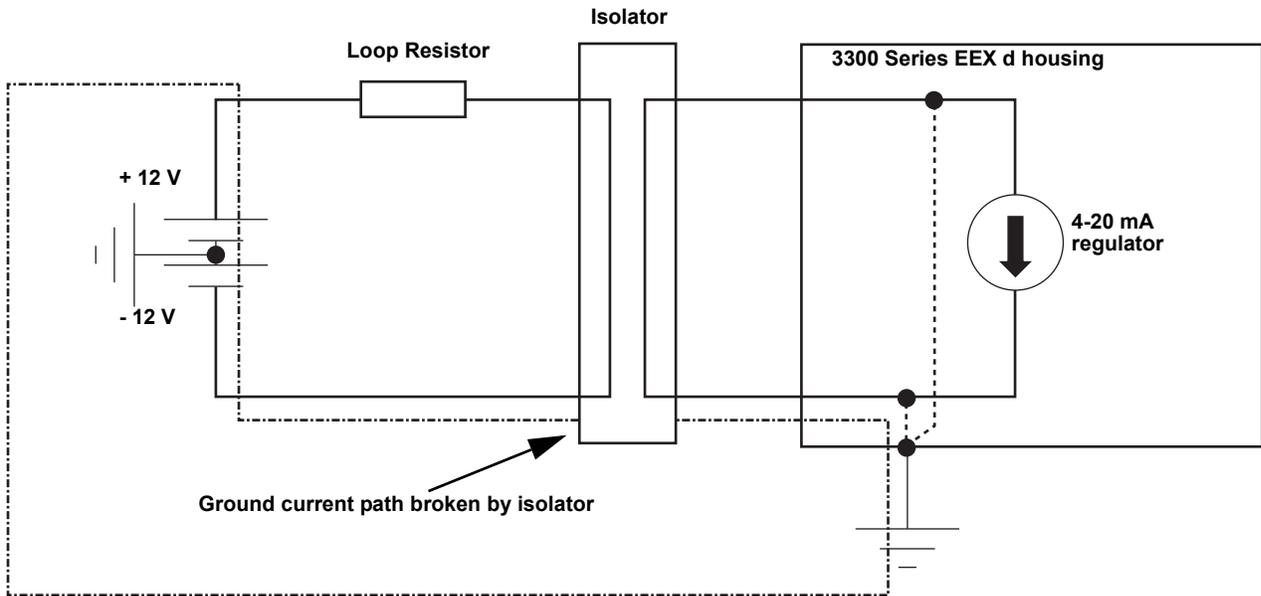


Figure 2-14 above shows a 4-20 mA loop with isolator installed.

We recommend a loop powered isolator made by Dataforth;  
<http://www.dataforth.com/catalog/pdf/DSCL22.pdf>. Rosemount part number: DSCL22-01.

# Rosemount Radar Level Transmitters

## Rosemount 5300 Series: HART Version

The Rosemount 5300 Series transmitter operates with a power supply ranging from 16-42.4 V (16-30 V in IS applications, 20-42.4 V in explosion-proof / flameproof applications). All configuration tools for HART communication, such as the Rosemount 375 Field Communicator and Rosemount Radar Master, require a minimum load resistance (RL) of 250  $\Omega$  within the loop to function properly. See the diagrams below.

To connect the transmitter:

1. Make sure the housing is grounded (including IS ground inside Terminal compartment) according to Hazardous Locations Certifications, national, and local electrical codes.
2. Verify the power supply is disconnected.
3. Remove the terminal block cover (see Figure 2-15).
4. Pull the cable through the cable gland / conduit. For explosion-proof / flameproof installations, only use cable glands or conduit entry devices certified explosion-proof or flameproof.
5. Install wiring with a drip loop where the bottom of the loop must be lower than the cable / conduit entry.
6. To connect the wires, see Figure 2-16.
7. Use the enclosed metal plug to seal any unused port.
8. Mount the cover and tighten the cable gland making sure the cover is fully engaged to meet explosion-proof requirements (adapters are required if M20 glands are used). For ATEX and IECEx installations, lock the cover with the locking screw.
9. Connect the power supply.

### NOTE!

Use PTFE tape or other sealant at the NPT threads in the Cable Entries.

Figure 2-15. Rosemount 5300 Series Terminal Block.

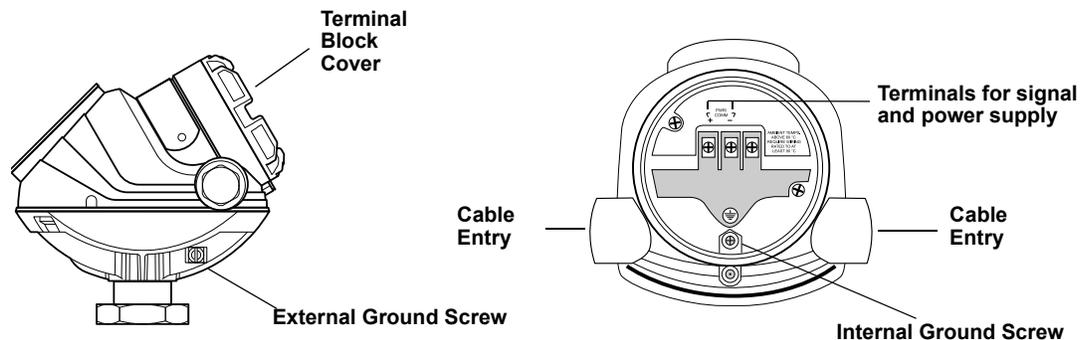
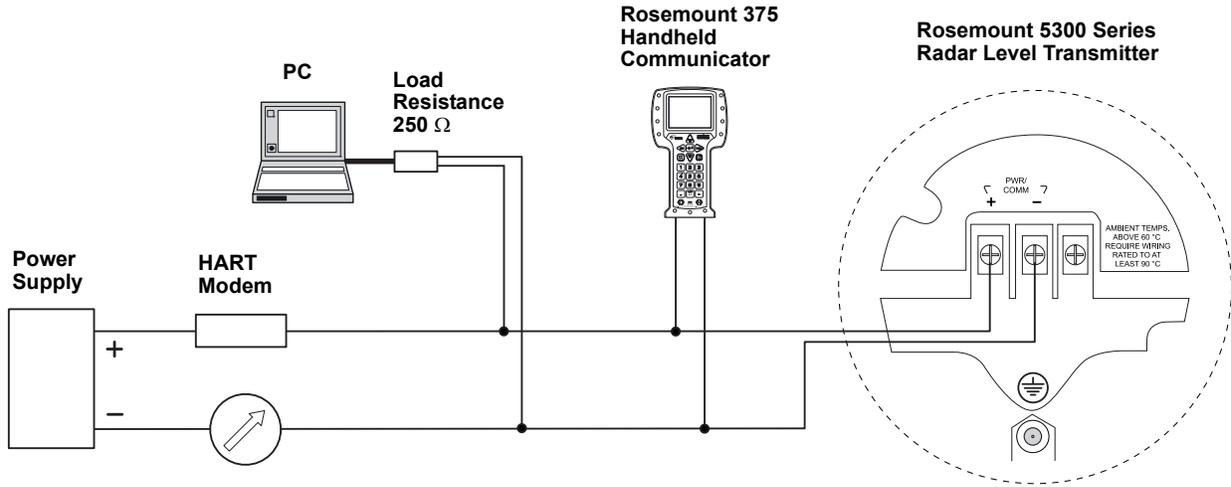


Figure 2-16. Wiring diagram for non-intrinsically safe installations of the Rosemount 5300 with HART.



# Rosemount Radar Level Transmitters

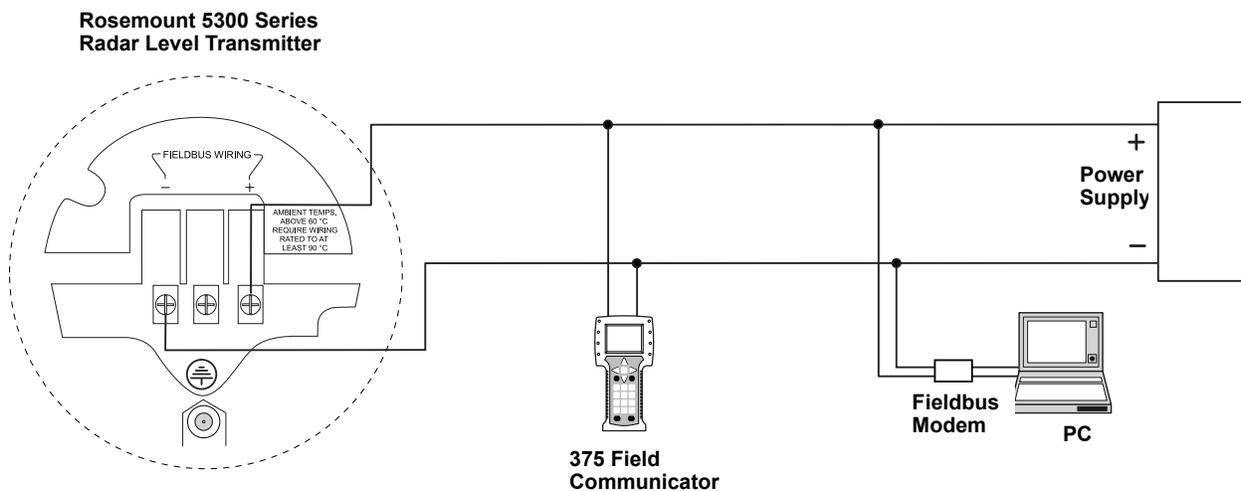
## Rosemount 5300 Series: FOUNDATION™ fieldbus Version

The 5300 Series transmitter, FOUNDATION™ fieldbus version, operates with a power supply ranging from 9-32 V (9-30 V in IS applications and 16-32 V in explosion-proof / flameproof applications) FISCO, IS applications: 9-17.5 V.

To connect the transmitter:

1. Make sure the housing is grounded (including IS ground inside terminal compartment) according to Hazardous Locations Certifications, national, and local electrical codes.
2. Verify the power supply is disconnected.
3. Remove the terminal block cover (see Figure 2-15).
4. Pull the cable through the cable gland / conduit. For explosion-proof / flameproof installations, only use cable glands or conduit entry devices certified explosion-proof or flameproof. Install wiring with a drip loop where the bottom of the loop must be lower than the cable / conduit entry.
5. To connect the wires, see Figure 2-17.
6. Use the enclosed metal plug to seal any unused port.
7. Mount the cover and tighten the cable gland making sure the cover is fully engaged to meet explosion-proof requirements (adapters are required if M20 glands are used). For ATEX and IECEx installations, lock the cover with the locking screw.
8. Connect the power supply.

Figure 2-17. Wiring diagram for non-intrinsically safe installations of Rosemount 5300 with FOUNDATION™ fieldbus.



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## Section 3 Upstream Applications

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Specific Applications .....	page 3-1
Separators .....	page 3-2
Production/Slop Tanks .....	page 3-7
Slop tanks .....	page 3-9

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### SPECIFIC APPLICATIONS

This document primarily describes two areas where our Guided Wave Radar product is an excellent choice for level or level & interface measurements. The areas are Gas Well and Oil Well applications. There are primarily three types of applications at these production sites:

- Separator tanks (horizontal or vertical)
- Production tanks
- Slop tanks

The main difference between the tanks referenced above is the process or product they contain. In gas wells, condensate (NGL) and water are the primary products, whereas crude oil and water are the primary products in oil wells.

The following description recommends which Rosemount Guided Wave Radar transmitter to use for the different applications, along with details on the proper model code for ordering. A complete list of recommended model code information is found in Appendix A.

# Rosemount Radar Level Transmitters

## SEPARATORS

### Horizontal separator (bullet tank)

#### Transmitter and probe selection

Horizontal separators are typically smaller in diameter and are used in both Gas and Oil fields. The recommended installation is a Rosemount 3300 with a Single lead probe.

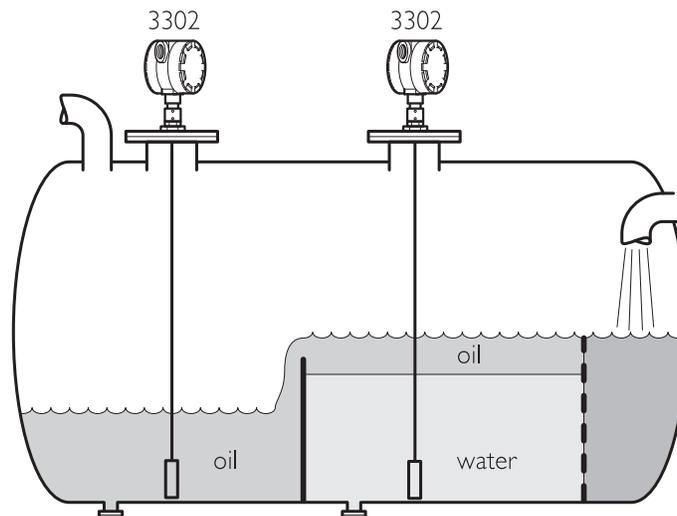
Single Rigid Probes (model code option **4A**) may be used if the tank height is less than 9 ft. 10 in. (3 m 250 mm), and for anything taller, a Single Flexible Probe (model code option **5A**) must be used. If there is a high risk for a rigid probe bending during installation, a flexible probe can be used on anything taller than 3 ft. 4 in. (1 m 100 mm).

There are different materials of construction that can be used for the probes. However, Stainless Steel (316/316L) is sufficient for the majority of these applications, but material compatibility should be verified for each application.

#### Tank seal selection

The operating temperature is normally ambient temperature, however, the pressure will vary in different applications/separators. The product alternatives are either the *Standard pressure and temperature* tank seal (model code option **S**) or the *High Pressure* tank seal (model code option **P**).

- The standard seal is rated to 580 psig (40 bar) at maximum 302 °F (150 °C).
- The High Pressure tank seal is rated to 3500 psig (243 bar) at maximum 392 °F (200 °C) or higher pressure for a lower temperature, up to 5000 psig (345 bar) at a maximum of 100 °F (38 °C).



#### Model selection

The Rosemount 3302 is used for *Level & Interface* applications. If there is no interface and only level is required, the transmitter can be configured for *Level* measurement only. The separators have mounting connections either on the top or on the side of the bullet tank in a chamber. See "*Process Connections*" on page 2-7.

## Vertical separator (vertical cylinder tank)

### Transmitter and probe selection

Vertical separators vary in tank height and are used in both gas and oil fields. The recommended product selection is a Rosemount 3300 with a Single lead probe. It can be installed on top of the tank. On tall vertical cylinders, the 3300 may be installed on a chamber on the lower side of the separator with the probe fully immersed.

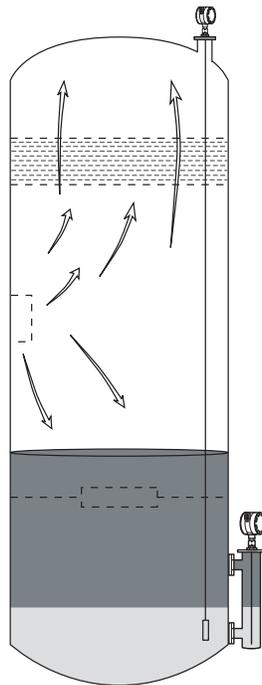
Single Rigid Probes (model code option **4A**) may be used if the tank height is less than 9 ft. 10 in. (3 m 250 mm), and for anything taller, a Single Flexible Probe (model code option **5A**) must be used. If there is high risk for a rigid probe bending during installation, a flexible probe can be used on anything taller than 3 ft. 4 in. (1 m 100 mm). If the flexible probe version is used, select the probe type that has a weight attached to the end (model code option **5A**).

### Tank seal selection

The operating temperature is normally ambient temperature, but the pressure will vary in different applications/separators. One of the following product alternatives should be selected:

- Standard pressure and temperature tank seal (model code option **S**)
- High Pressure tank seal (model code option **P**)

Figure 3-1. The Rosemount 3300 transmitter can be installed on vertical separator tanks.



- The standard seal is rated to maximum 580 psig (40 bar) at maximum 302 °F (150 °C)
- The High Pressure tank seal is rated to maximum 3524 psig (243 bar) at maximum 392 °F (200 °C) or higher pressure for a lower temperature, up to 5000 psig (345 bar) at a maximum of 100 °F (38 °C)
- One advantage of using Guided Wave Radar technology is that it can cut through foam because of its lower frequency

### Model selection

Rosemount 3302 is used for *Level & Interface* applications in situations where the probe is not fully immersed. The 3302 can be reconfigured for fully immersed applications in chambers. The separators have mounting connections either on top of the vertical tank or in a chamber on the lower side of the tank. These process connections are used for interface measurement. See “*Process Connections*” on page 2-7 for recommendations on different process connections.

# Rosemount Radar Level Transmitters

## Output measurement at different interface levels

Interface measurement depends on several factors. If the tank contains two products, level, interface, and thickness can be measured. However, if the upper or the lower product is pumped out, the peaks of the waveform plot must be interpreted properly to get precise measurement data.

Figure 3-2 gives an overview of the various echoes presented on a waveform plot when two products are found.

Figure 3-2. Measurement levels.

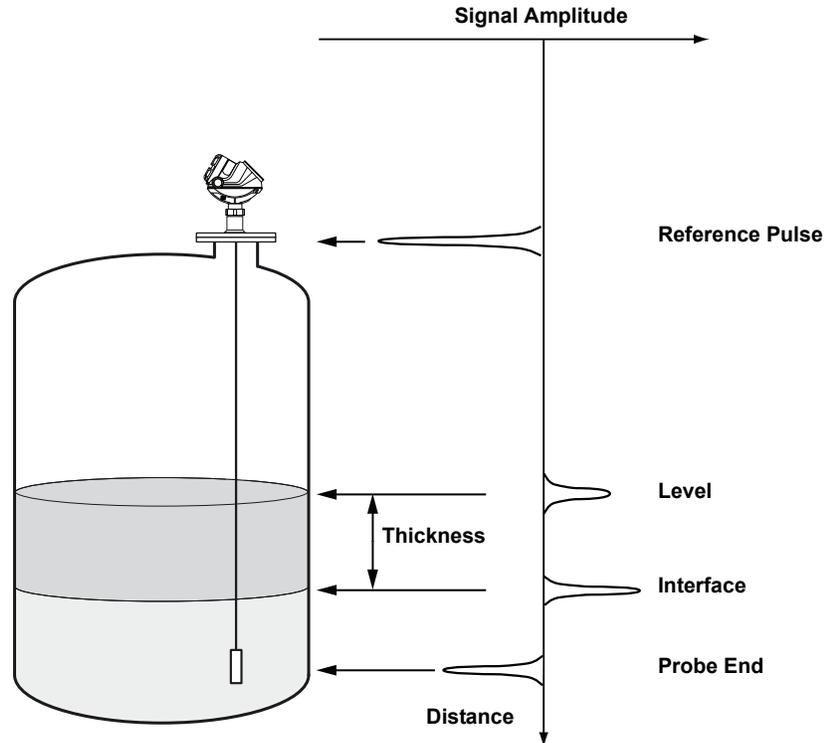
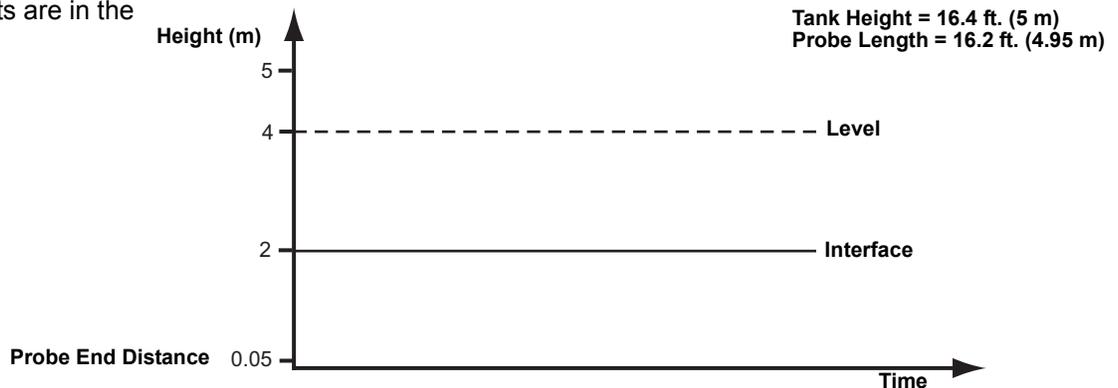


Figure 3-3 shows how this state is presented on a waveform plot.

In the example below, tank height is 16.4 ft. (5 m), and probe length is 16.2 ft. (4.95 m).

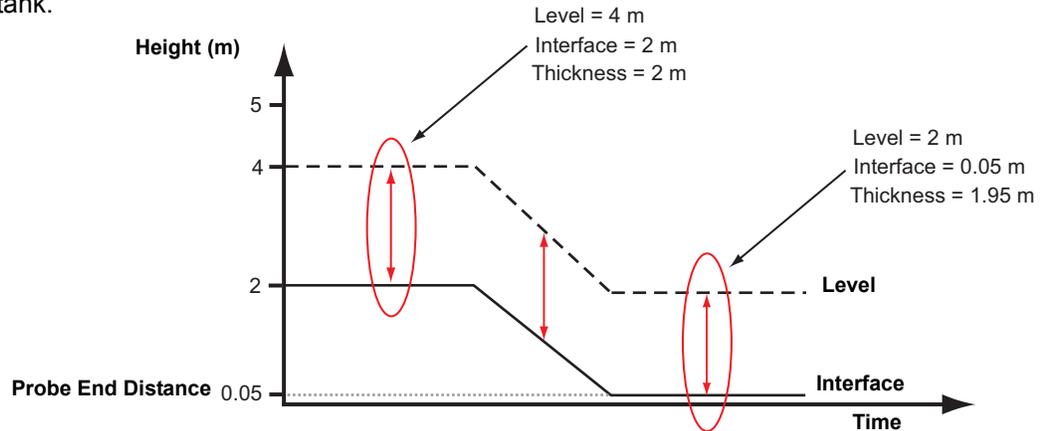
Figure 3-3. Level measurement when both products are in the tank.



# Rosemount Radar Level Transmitters

Figure 3-4 illustrates the output signals presented as the lower product is pumped out.

Figure 3-4. The lower product is pumped out of the tank.



**NOTE!**

The measured thickness is different before and after emptying the lower product. The level measurement is done until it reaches the end of the probe.

When the lower product reaches the probe end, the signal generated turns into a constant, horizontal line, but no longer shows the actual interface. It also effects the thickness measurement.

The plot shows that there is a large layer of the upper product left after the lower product has been pumped out. In this case, both the upper product surface echo and the probe end echo are easily detected. The level and interface will not have the same value. The level will be set to the level of the upper product, and the interface (level) will be set to the probe end level.

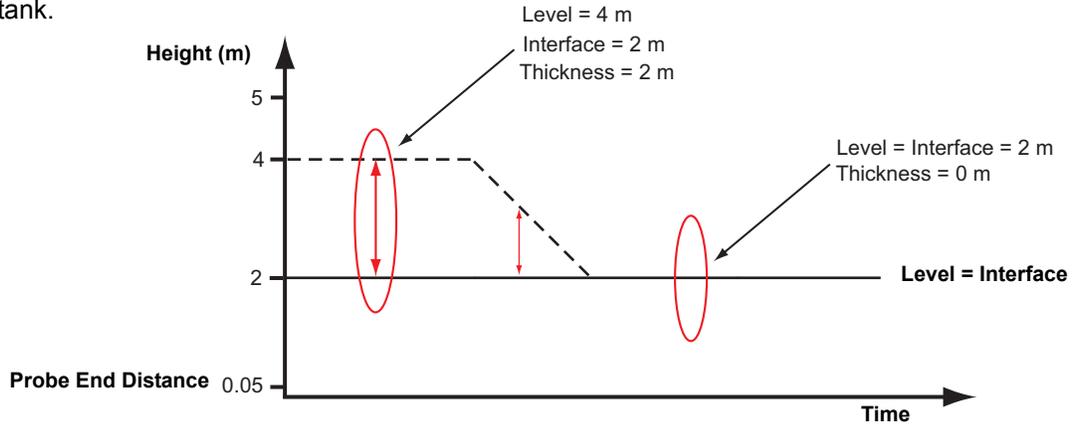
If both the upper and lower products are pumped out, the level and interface (level) will have the same value until both the upper product surface echo and the probe end echo can be detected.

Thickness is measured from the product surface (level) to the interface. However, if the lower product is pumped out, the thickness will be measured from the product surface to the probe end only, since further signs cannot be detected.

When the tank refills, the level and interface output will be the same. Interface is not detectable until the minimum thickness requirement is reached.

If the upper product is pumped out of the tank, interface measurement is presented as illustrated in Figure 3-5:

Figure 3-5. The upper product is pumped out of the tank.



## PRODUCTION/SLOP TANKS

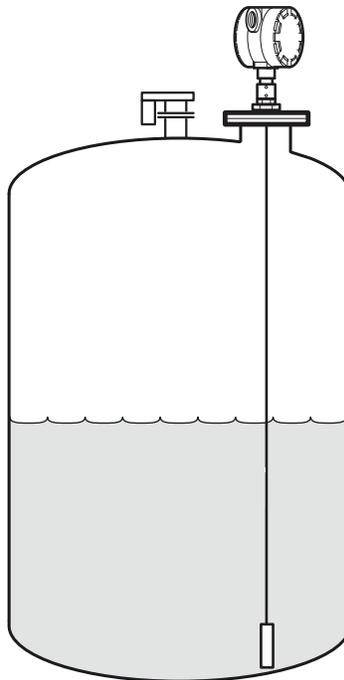
### Vertical cylinder

#### Transmitter and probe selection

Vertical cylinder tanks are holding or storage tanks where the separated product (oil or condensate) is stored before it is moved to the next step in the exploration process. These vertical cylinders vary in tank height.

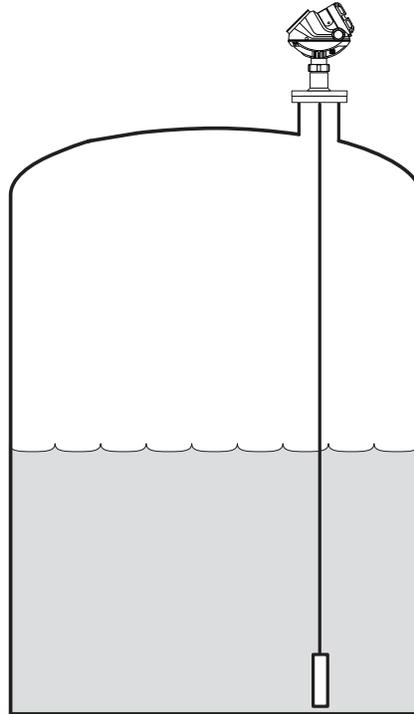
If the tank is metallic, a Rosemount 3300 transmitter is sufficient. However, for a non-metallic tank, a Rosemount 5300 transmitter is required for additional EMI protection. Non-metallic tanks expose the probe to signal interference from nearby motors or cables. The 5300 provides a more stable microwave signal and improves EMI performance resulting in a more robust measurement. The recommended product selection is a Rosemount 3300 with single flexible probe with a weight attached to the bottom (model code option **5A**).

Figure 3-6. The Rosemount 3300 with Single Flexible probe is suitable for metallic Vertical cylinder storage tanks.



# Rosemount Radar Level Transmitters

Figure 3-7. The Rosemount 5300 with Single Flexible probe is suitable for non-metallic (i.e. Fiberglass) storage tanks.



### Tank seal selection

Vertical cylinder tanks are usually vented to the atmosphere, but some have a vapor recovery system so the Rosemount 3300 standard tank seal is suitable.

For this application the *Standard pressure and temperature* tank seal version (model code option **S**) should be used. The standard seal is rated from full vacuum to maximum 580 psig (40 bar) at maximum 302 °F (150 °C).

### Model selection

Most of these installations require both level and interface measurement, while some only require level measurement.

For metallic tanks, a Rosemount **3302** allows for configuring the 3300 for either *Level & Interface* mode or just *Level*.

For non-metallic tanks, a Rosemount **5302** allows for configuring the 5300 for either *Level & Interface* mode or just *Level*.

## SLOP TANKS

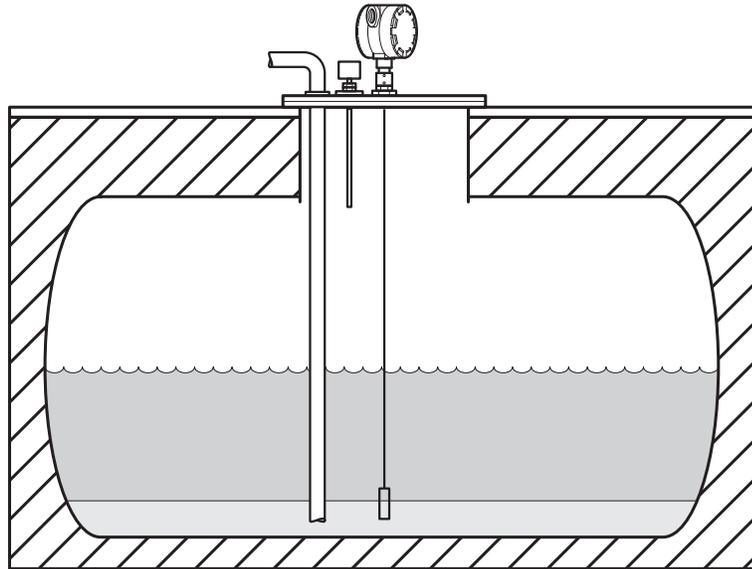
### Underground or open pit

#### Transmitter and probe selection

Oily and dirty water, as well as residue, are pumped into slop tanks for temporary storage until further processing. Slop tanks are sometimes underground tanks, or open pits often covered with a metal cover/plate.

A Rosemount 3300 with single lead probe is recommended. Single Rigid Probes (model code option **4A**) may be used if the tank height is less than 9 ft. 10 in. (3 m 250 mm). For anything taller, a Single Flexible Probe (model code option **5A**) must be used. If there is a high risk for a rigid probe bending during installation, a flexible probe can be used on anything taller than 3 ft. 4 in. (1 m 100 mm).

If the flexible probe version is used, select the probe type that has a weight attached to the end (model code option **5A**).



#### Tank seal selection

These tanks are usually vented to the atmosphere, but some have a vapor recovery system so the Rosemount 3300 standard tank seal is suitable.

For this application the *Standard pressure and temperature* tank seal version (model code option **S**) should be used. The standard seal is rated from full vacuum to maximum 580 psig (40 bar) at maximum 302 °F (150 °C).

#### Model selection

Most of these installations require both level and interface measurement, while some only require level measurement.

Using a **3302** allows for configuring the 3300 for either *Level & Interface* mode or just *Level*.

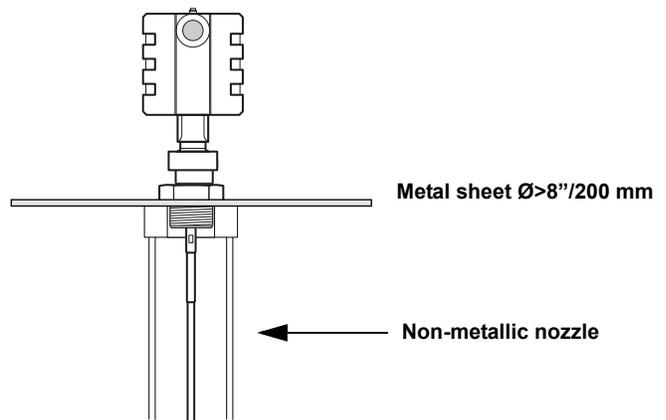
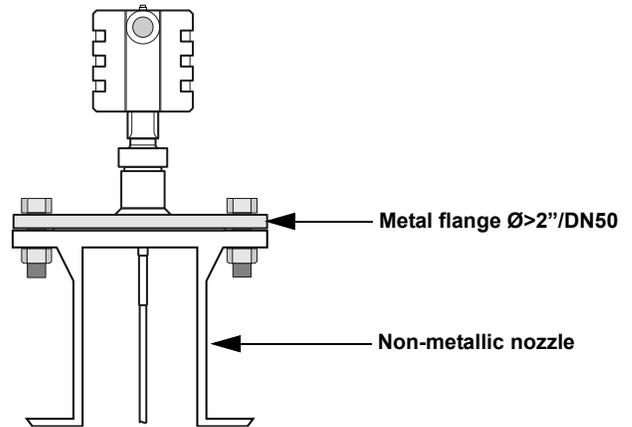
# Rosemount Radar Level Transmitters

## Non-metallic process connections

For optimum measurement performance in non-metallic tanks, the Rosemount 5300 Series is required. For tanks with non-metallic process connections, the probe must be mounted with a metal flange, or screwed in to a metal sheet ( $d > 8$  in./200 mm) if the threaded version is used.

Figure 3-8. Mounting in non-metallic process connections.

Do not use Teflon tape or similar non-conductive materials in the threaded connections. These connections must be able to provide a ground connection between the probe and the tank.



# Section 4 Commissioning

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Safety messages . . . . .	page 4-1
Introduction . . . . .	page 4-2
Commissioning . . . . .	page 4-2
Plotting the Measurement Signal . . . . .	page 4-5

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## SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please 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 gauge is consistent with the appropriate hazardous locations certifications.  
Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.  
Do not remove the gauge cover in explosive atmospheres when the circuit is alive.  
**Failure to follow safe installation and servicing guidelines could result in death or serious injury.**  
Make sure only qualified personnel perform the installation.  
Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.  
Do not perform any service other than those contained in this manual unless you are qualified.  
**High voltage that may be present on leads could cause electrical shock.**  
Avoid contact with leads and terminals.  
Make sure the main power to the Rosemount 3300 / 5300 transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.  
Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

# Rosemount Radar Level Transmitters

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## **INTRODUCTION**

This section is a brief outline of commissioning, and does not provide comprehensive information on the whole procedure.

To execute the commissioning process, the product-related Quick Installation Guides steps are to be followed.

## **COMMISSIONING**

The transmitter installation should be carried out as described in the Quick Installation Guide, enclosed with every transmitter. Even though the transmitter may be installed on the bench, it must be configured according to the actual process conditions.

Do not bend the probe during any part of the installation. If it is necessary, shorten the probe, mount a centering disk, or anchor the probe during the mechanical installation. For more information see the respective Reference Manuals:

- Rosemount 5300 Series Reference Manual (Document No. 00809-0100-4530)
- Rosemount 3300 Series Reference Manual (Document No. 00809-0100-4811)

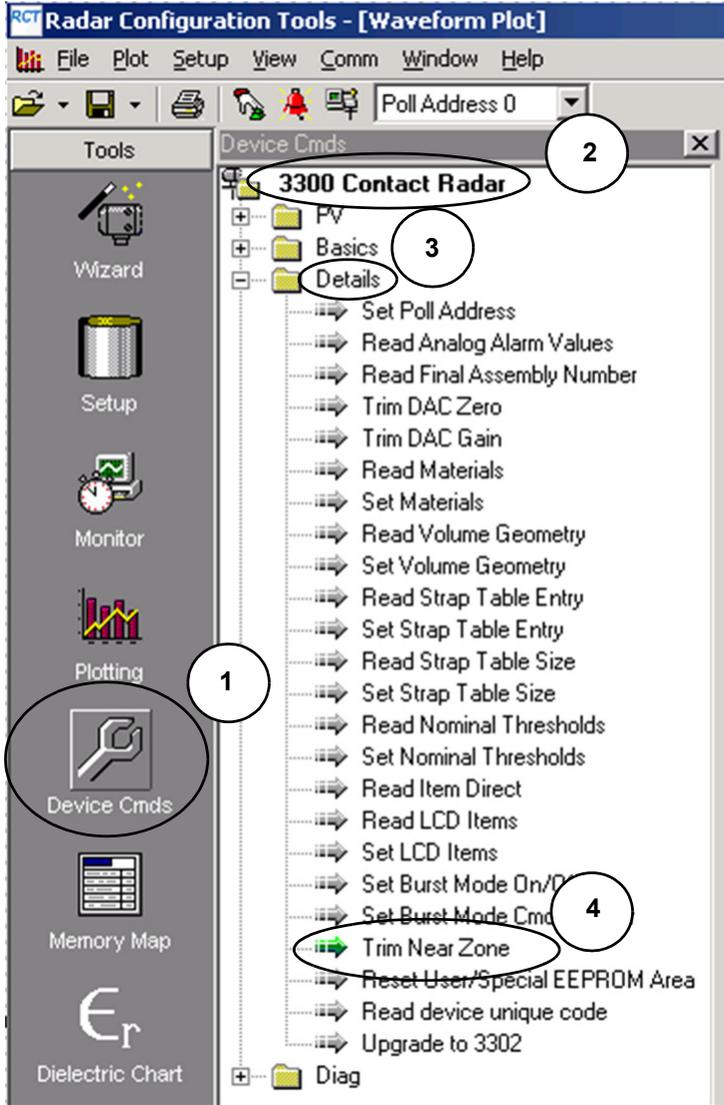
Beside these required steps, it is recommended as best practice to perform a Trim Near Zone, save a backup of the transmitter settings, and save the initial echo curve plot.

## **Trim Near Zone**

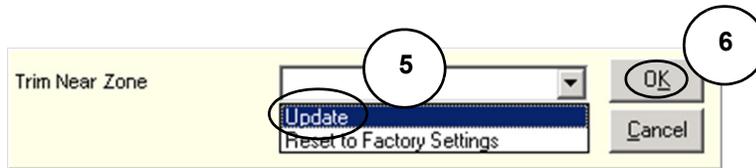
The Rosemount 3300 / 5300 Series transmitters are equipped with a firmware functionality that minimizes the Upper Transition Zone based on the actual mounting conditions.

To activate this functionality, ensure that the tank or chamber is empty, alternatively, that the (upper) product is no closer than 40 in. (1 m), and then execute the Trim Near Zone command.

For the Rosemount 3300 Series, the Trim Near Zone command can be completed in the Radar Configuration Tools (RCT) software. Follow these steps to conduct a Trim Near Zone:



1. Click the *Device Cmds* tool.
2. Double-click *3300x*.
3. Click *Details*.
4. Double-click *Trim Near Zone*.



5. Select *Update*.
6. Click *OK*.
7. Wait 1 minute.



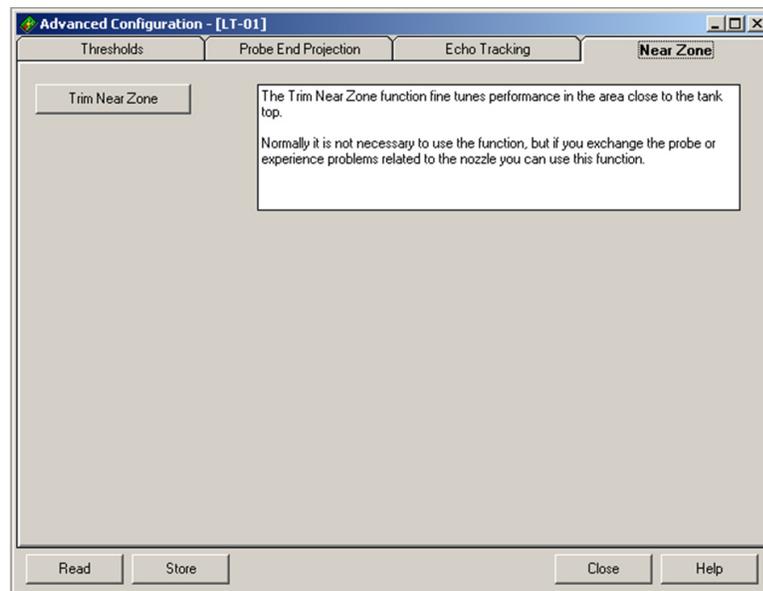
8. Restart the device clicking this icon.

# Rosemount Radar Level Transmitters

For the Rosemount 5300 Series, the Trim Near Zone command can be completed with the Rosemount Radar Master (RRM) software. The function is found in the *Advanced Configuration* screen.

*Rosemount Radar Master > Advanced > Near Zone > Trim Near Zone*

Figure 4-1. The Trim Near Zone command is on the Advanced Configuration screen.



For detailed information on the Trim Near Zone functionality, refer to Rosemount 3300 (Document No. 00809-0100-4811) or 5300 Series Reference Manuals (Document No. 00809-0100-4530).

## Store Backup and Verification Files

As the last step of the commissioning procedure, it is recommended that both the transmitter settings and the echo curve be stored. These can be used for subsequent transmitter verification or troubleshooting.

For the 3300 Series in RCT, use the following procedure:

*Radar Configuration Tools > View > Setup > Basics > (right click) Receive All > (right click) Save Setup*

*Radar Configuration Tools > View > Plotting > Start the plot reading and disk logging*

For the 5300 Series in RRM, use the following procedure:

*Rosemount Radar Master > Device > Backup Config to file*

*Rosemount Radar Master > Tools > Echo Curve > Record*

## PLOTTING THE MEASUREMENT SIGNAL

The 3300 Series and 5300 Series are compatible with different softwares for plotting the measurement signal. The 3300 Series transmitter utilizes the Radar Configuration Tools (RCT) software, while the 5300 Series transmitter utilizes the Rosemount Radar Master (RRM) software.

The two software configuration programs have similar functions. Both programs have the ability to plot the measurement signal. This section explains how to view plots in RCT and RMM, and highlights the differences between the two plot views.

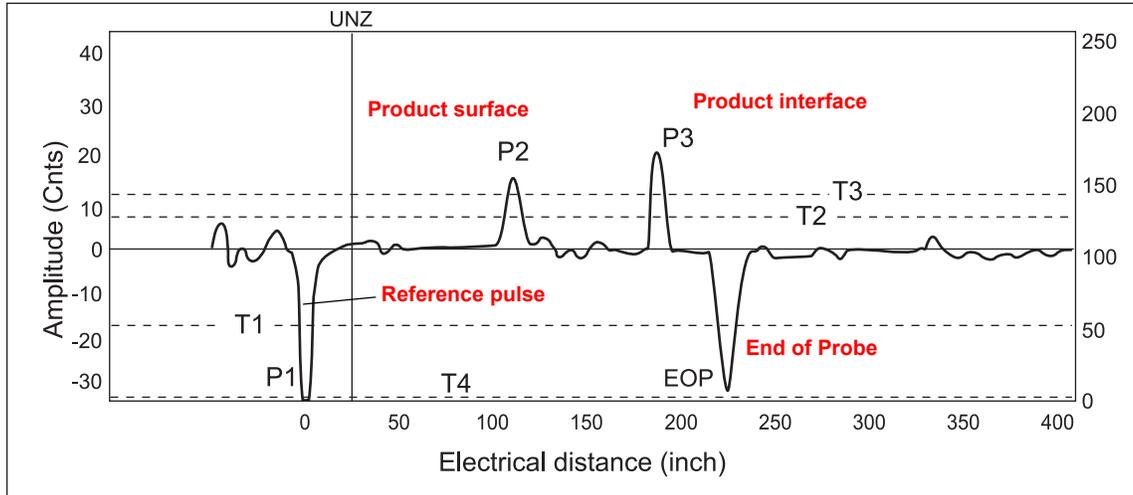
### Plotting the Measurement Signal for the Rosemount 3300 Series

For the 3300 Series, the Radar Configuration Tools (RCT) program has powerful tools for advanced troubleshooting. Using the Waveform Plot function gives an instant view of the tank signal.

To plot the measurement signal:

1. Start the Radar Configuration Tools program by clicking the RCT desktop icon:  .
2. Choose *View > Plotting* menu option, or choose the Plotting  icon in the RCT workspace (Tools pane at the left-hand side of the workspace) and click the Read  button.

Figure 4-2. Example of a 3300 Series Waveform plot.



The plot shows peaks for the product surface (P2), reference pulse (P1) and end of probe (EOP). The probe end may not always be visible depending on the amount of product above.

**T1** - amplitude threshold for detection of the Reference pulse **P1**.

**T2** - amplitude threshold for detection of the product level peak **P2**.

**T3** - amplitude threshold for detection of the interface level peak **P3**.

**T4** - amplitude threshold that is used to detect whether the probe is fully immersed in the upper product or not.

# Rosemount Radar Level Transmitters

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## Plotting the Measurement Signal for the Rosemount 5300 Series

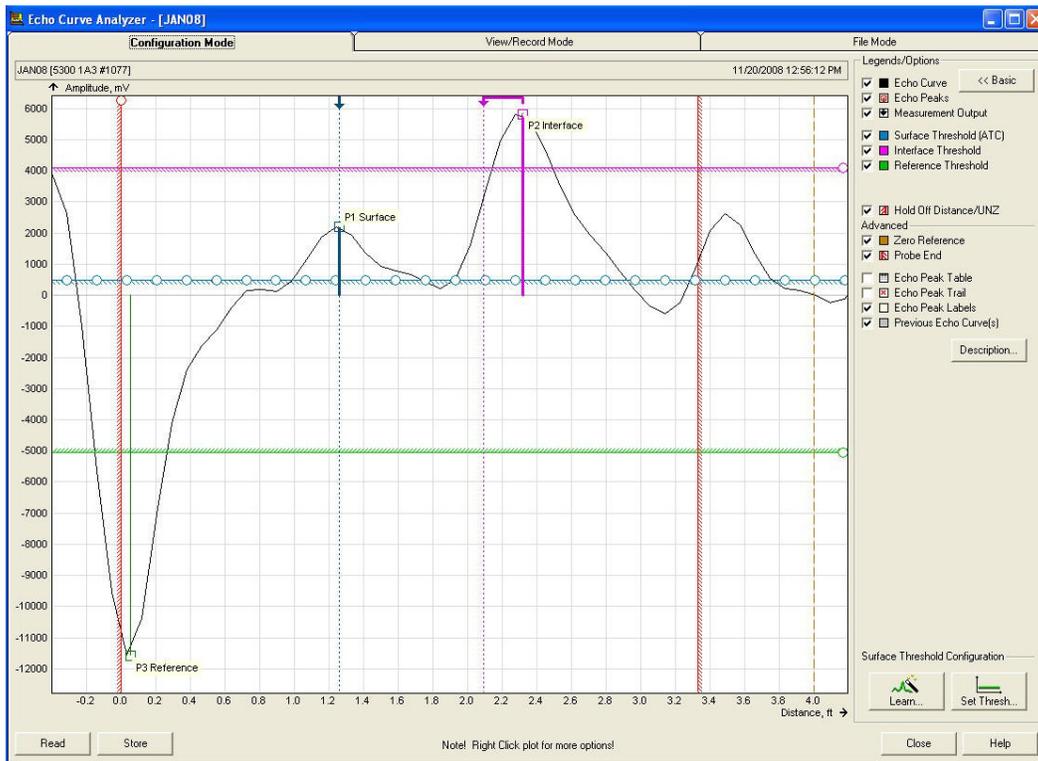
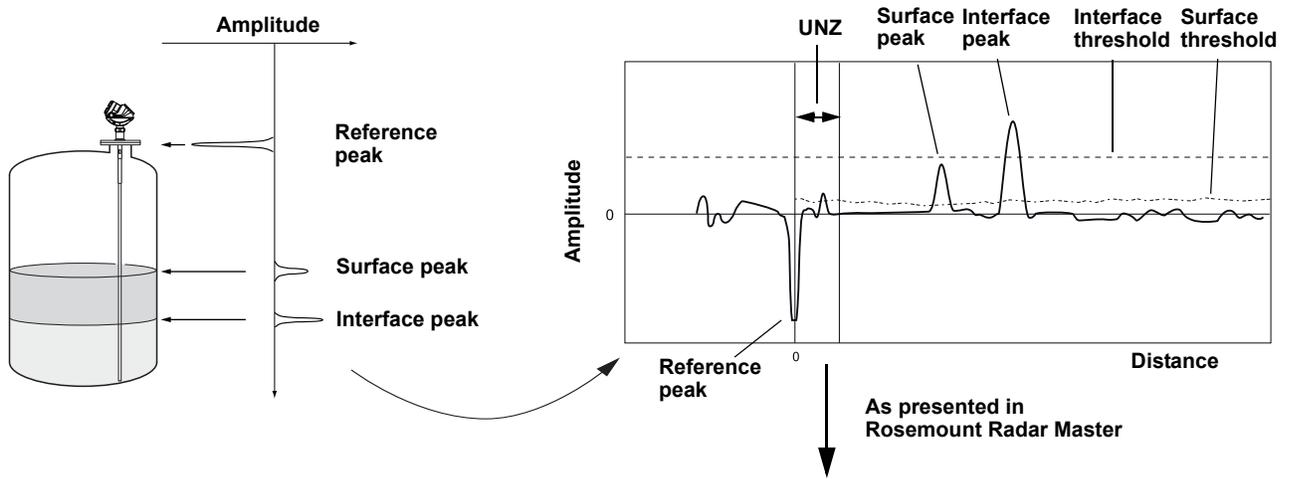
For the 5300 Series, Rosemount Radar Master (RRM) and other tools using enhanced EDDL have the functionality for advanced troubleshooting and plot viewing. In RRM, the waveform plot is often referred to as the Echo Curve.

To open the Echo Curve:

1. Start Rosemount Radar Master program by clicking on the RRM desktop icon: 
2. Choose the *Tools > Echo Curve* menu option, or choose the Echo Curve  icon in the RRM workspace (*Tools* or *Setup* pane at the left-hand side of the workspace) and click the *Read* button.

The echo curve represents the tank, as seen by the radar transmitter. Each peak corresponds to a reflection of the radar signal (e.g. the surface of the level or interface, an obstacle, or something else). By viewing single instances or movies of the echo curve, the transmitter configuration can be adjusted to achieve a reliable level measurement. Additionally, the echo curve gives insight into transmitter functionality. Usually, an echo curve analysis is not needed, because the transmitter automatically sets the appropriate parameters based on the startup information, such as tank height and tank media. However, the echo curve functionality is valuable for troubleshooting difficult applications.

## Echo Curve Constituents



In a typical measurement situation, the following peaks appear in the echo curve:

**Reference peak.** This reference pulse is caused by the transition between transmitter head and probe.

**Surface peak.** This pulse is caused by a reflection from the product surface.

The measurement output from the device is presented with an arrow at the top of the plot. Normally, the output arrow points directly at the surface or interface echo peak, but sometimes the output and echo peak distance do not coincide. When this happens, a line is drawn from the echo peak to the position of the measurement output arrow.

# Rosemount Radar Level Transmitters

The output arrow can be displaced when there are rapidly changing surface echo peaks because the transmitters filter the echo peaks to stabilize the measurement output. The displacement also occurs during interface measurement.

In the plot shown on page 4-7, the interface peak does not align with the interface output because the transmitter compensates for the decreased speed of microwaves through the upper product by using the dielectric constant of the upper product. The transmitters put the arrow at the actual physical distance to the interface, which is less than the distance to the interface peak.

**Interface peak (5302 only).** This pulse is from the reflection from the interface between the upper and lower product. This peak will only be identified by the transmitter when it is configured for Measurement Mode *Level & Interface*.

Table 4-1. Typical peak amplitudes for Rosemount 5300 Series with single lead probe in 4 in. (100 mm) chambers

Peak	Approximate signal strength, ideal conditions for single lead probe in 4 in. (100 mm) chambers
Reference peak	~10,000 mV <sup>(1)</sup>
Surface peak, 5301 with oil (DC=2)	~2,000 mV
Surface peak, 5301 with water (DC=80) at 3 ft (1 m) distance	~10,000 mV
Interface peak, 5302 with oil and water	~8,000 mV

*(1) This value does not apply and may be considerably lower when the probe is completely submerged in product.*

Various amplitude thresholds filter out unwanted signals and pick up the different peaks. The transmitter uses certain criteria to select which peaks correspond to the actual level and interface surfaces.

Counting from the top of the tank, the first echo above the Surface Threshold is considered the product surface. Pulses further from the top, although above the Surface Threshold, are ignored. When the surface echo is identified, the next pulse that is below the product surface with a signal strength above the Interface Threshold is considered the Interface.

**Surface Threshold** - amplitude threshold for detection of the Product level peak. The surface threshold is a number of individually adjustable amplitude threshold points, called the Amplitude Threshold Curve (ATC).

**Interface Threshold** - known as amplitude threshold for detection of the Interface level peak.

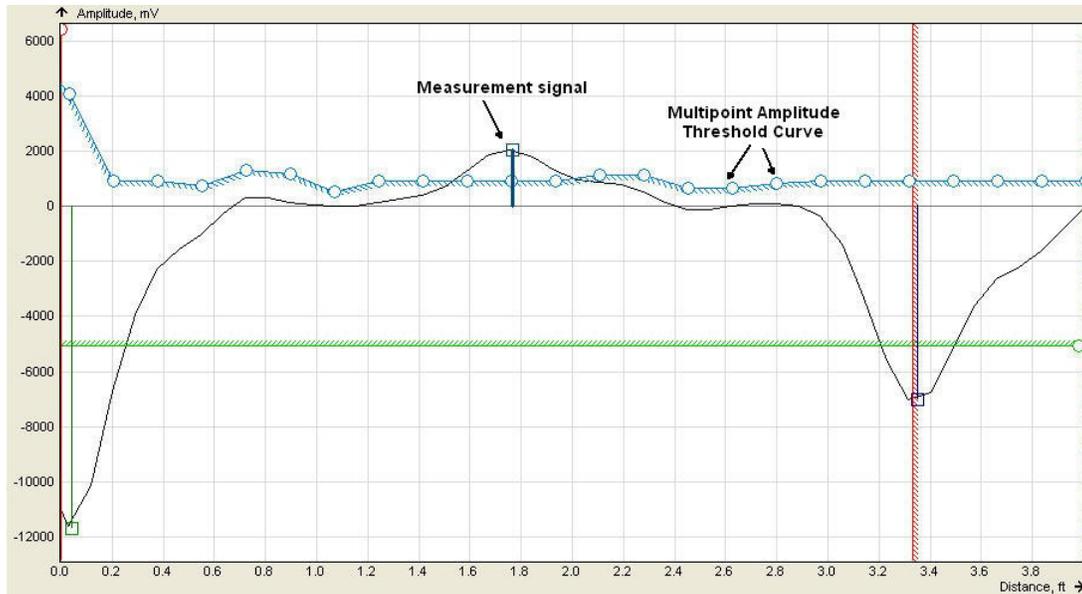
**Upper Null Zone / Hold Off Distance** - measurements are not performed within the Upper Null Zone (UNZ) / Hold Off Distance, and can be used to avoid measurements above a certain level, e.g. disturbances in the nozzle.

## Differences Between Plots in RRM and RCT

There are a few differences between functionality of the Waveform Plot in RCT and the Echo Curve in RRM. In RRM, the x-axis plots the physical distance to the product or disturbance. The x-axis in RCT represents the electrical distance.

Additionally, there are a few differences in the threshold settings. RRM has automated recognition of a fully submersed probe, so there is no need for a T4 threshold. In RCT, the T2, surface threshold, setting is linear. But in RRM, the surface threshold setting is a curve that can be manipulated by moving points along the threshold curve. The T3, interface threshold, is linear for both RCT and RRM. Figure 4-3 demonstrates a multi-point threshold curve.

Figure 4-3. Surface Threshold Curve.



# Rosemount Radar Level Transmitters

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## Section 5 Troubleshooting

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<b>Safety messages</b> .....	<b>page 5-2</b>
<b>Rosemount 3300 Threshold Settings</b> .....	<b>page 5-3</b>
<b>Disturbances From Nozzle</b> .....	<b>page 5-5</b>
<b>Device status</b> .....	<b>page 5-12</b>

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This section describes examples of measurement problems that might occur. The examples show how these problems are identified using the Waveform Plot function, and the result after adjustments.

The Waveform Plot function can be found in the Radar Configuration Tools (RCT) program for the Rosemount 3300 Series.

The Rosemount 5300 Series transmitter utilizes the Rosemount Radar Master software for plotting and configuring functionality. The two software systems are not interchangeable between the different transmitter series.

Warning, Error, and Device Status messages are listed in the Reference Manuals:

- Rosemount 5300 Series Reference Manual (Document No. 00809-0100-4530)
- Rosemount 3300 Series Reference Manual (Document No. 00809-0100-4811)

# Rosemount Radar Level Transmitters

## SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please 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 gauge is consistent with the appropriate hazardous locations certifications.

Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

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

Make sure only qualified personnel perform the installation.

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

Do not perform any service other than those contained in this manual unless you are qualified.

**High voltage that may be present on leads could cause electrical shock.**

Avoid contact with leads and terminals.

Make sure the main power to the Rosemount 3300 / 5300 Transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

**Process leaks could result in death or serious injury.**

Make sure that the transmitter is handled carefully. If the Process Seal is damaged, gas might escape from the tank if the transmitter head is removed from the probe.

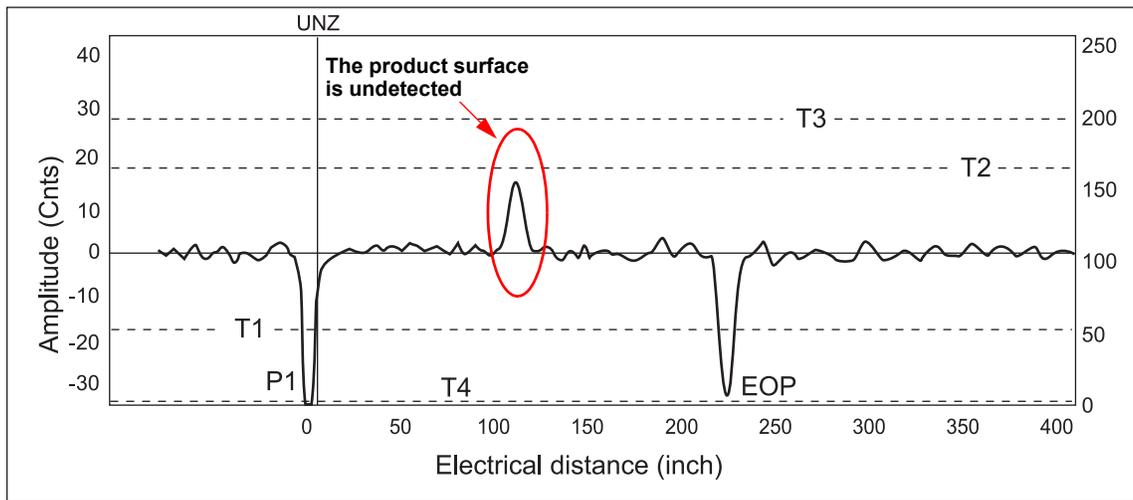
## ROSEMOUNT 3300 THRESHOLD SETTINGS

The following Threshold Setting scenarios are shown using the Waveform Plot tool in RCT (connected to a Rosemount 3300 Series transmitter). Threshold settings for RRM (connected to a Rosemount 5300 Series transmitter) can be similarly configured. General guidelines for 5300 threshold settings can be found on page 5-10.

### Case 1 - Level measurements

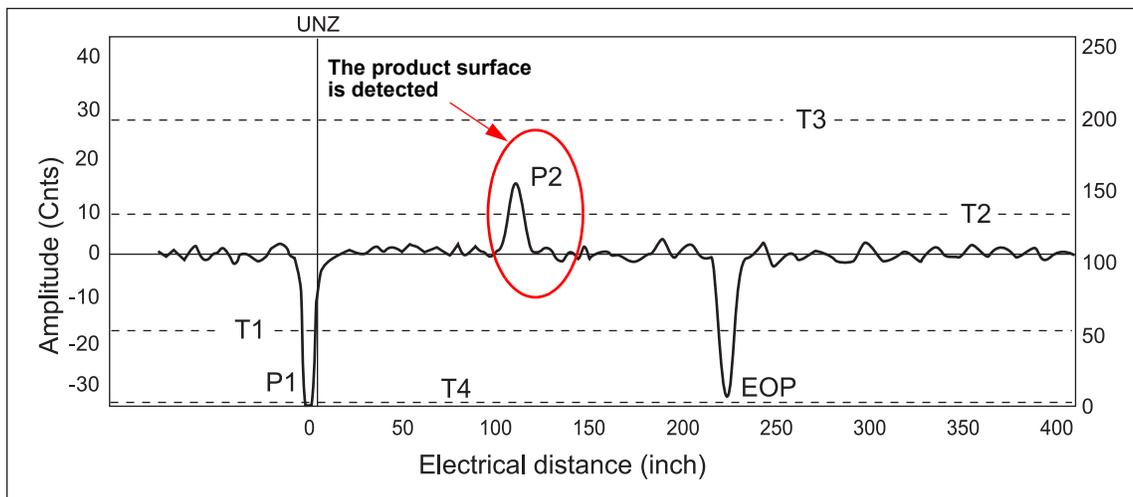
The Product Dielectric Constant is wrong, resulting in an amplitude threshold T2 above the actual product surface peak.

Figure 5-1. Threshold T2 too high. Level peak not detected.



The Product Dielectric Constant is corrected, resulting in an amplitude threshold T2 properly set to pick up the product surface level.

Figure 5-2. Threshold T2 lowered. Product surface P2 detected.

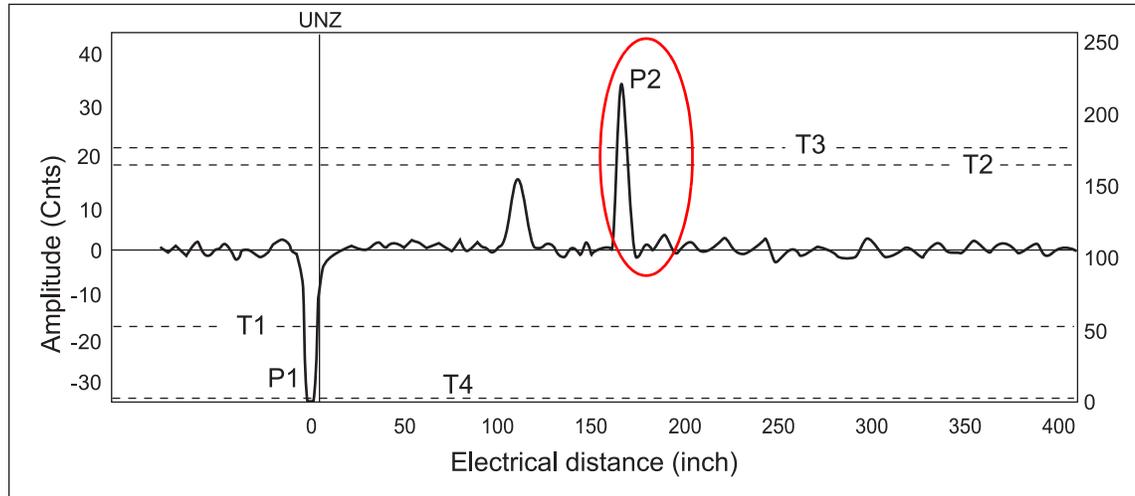


# Rosemount Radar Level Transmitters

## Case 2 - Level & Interface measurements

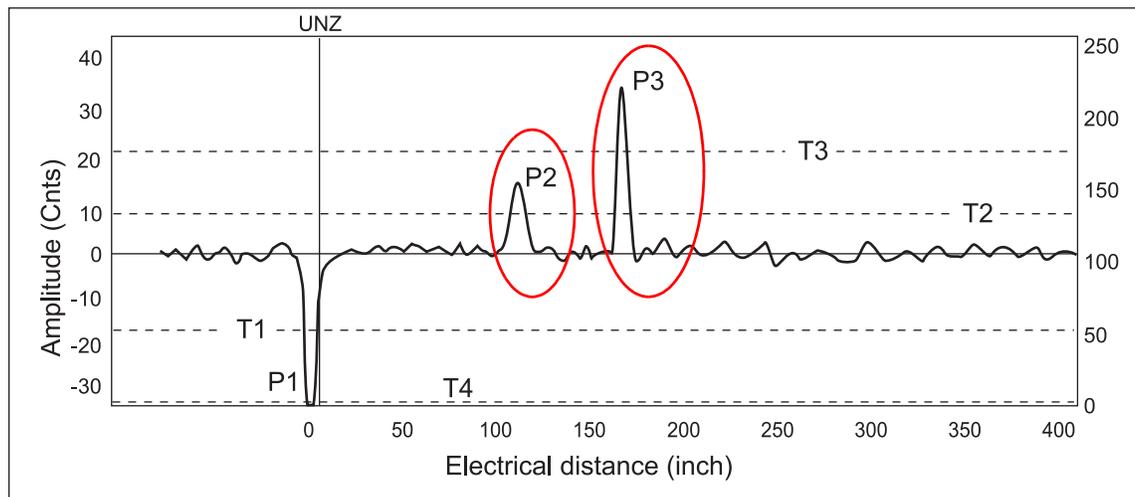
The wrong Upper Product Dielectric Constant is set, resulting in an amplitude threshold T2 above the actual product surface peak. The interface peak is incorrectly interpreted as the product surface.

Figure 5-3. Using the wrong Upper Product DC may result in a threshold T2 above the surface peak.



When the correct Upper Product Dielectric Constant is set, the amplitude threshold T2 is located below the product surface level peak. Both the product surface level and the interface level are detected.

Figure 5-4. Correct Upper Product DC allows the transmitter to detect both the product level and the interface.

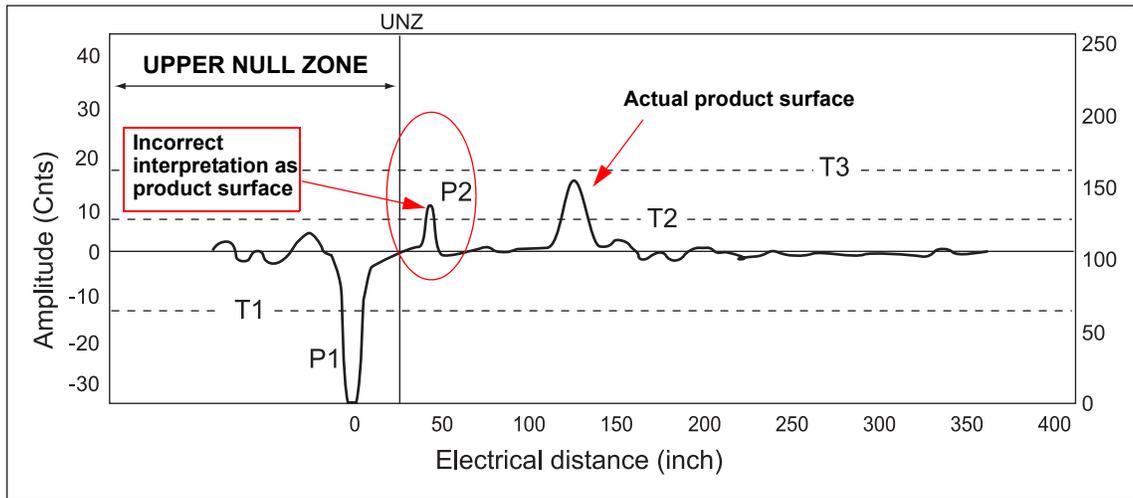


## DISTURBANCES FROM NOZZLE

### Upper Null Zone adjustment

The transmitter identifies a disturbance from the nozzle as the product surface (P2), as shown in Figure 5-5.

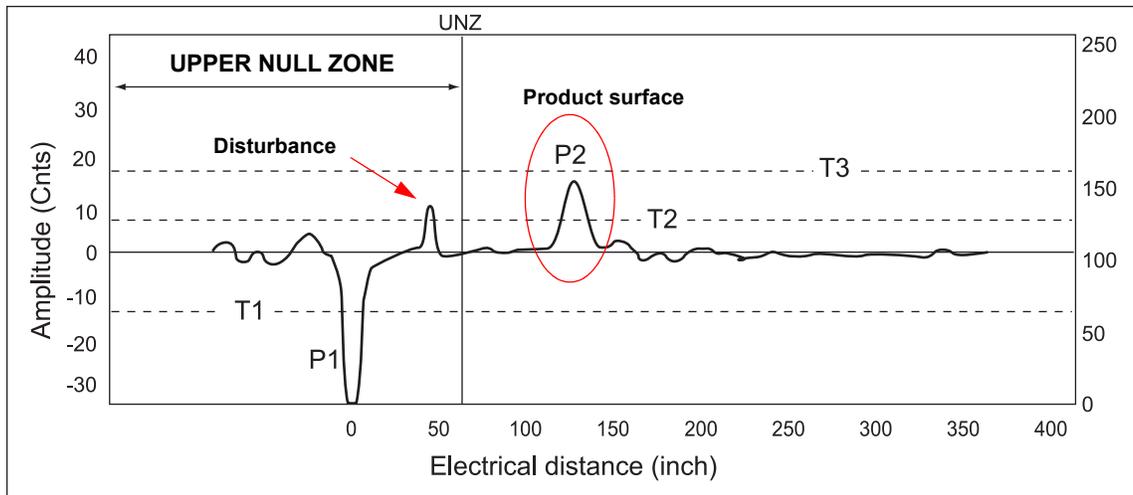
Figure 5-5. Waveform plot indicates that the transmitter misinterprets a disturbing echo as the product surface.



To change the Upper Null Zone in RCT:  
**View>Device Commands>Basics>Set Null Zones.**

After the Upper Null Zone (UNZ) is adjusted, the transmitter ignores the disturbing echo and correctly shows the product surface.

Figure 5-6. Waveform plot after UNZ was adjusted.

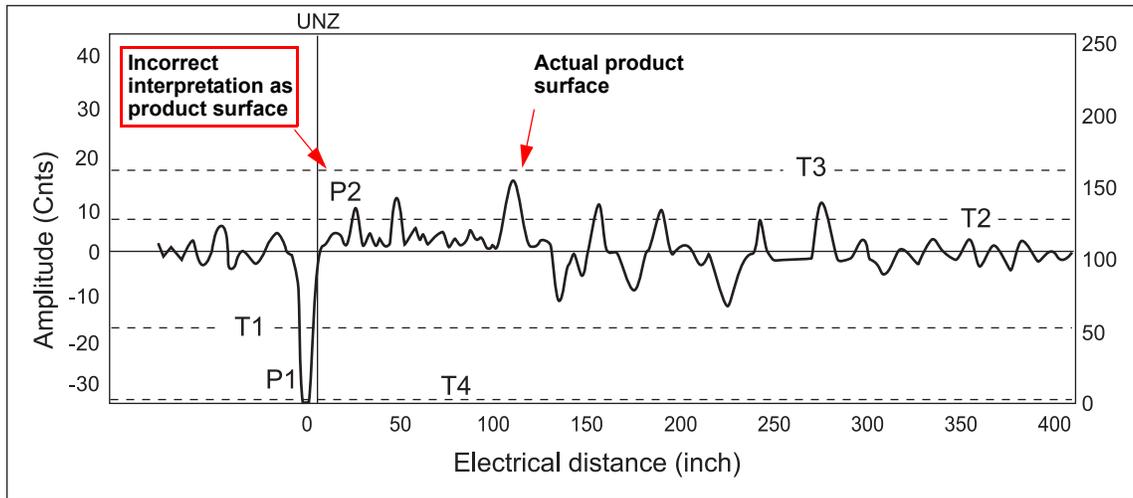


# Rosemount Radar Level Transmitters

## Nozzle influence

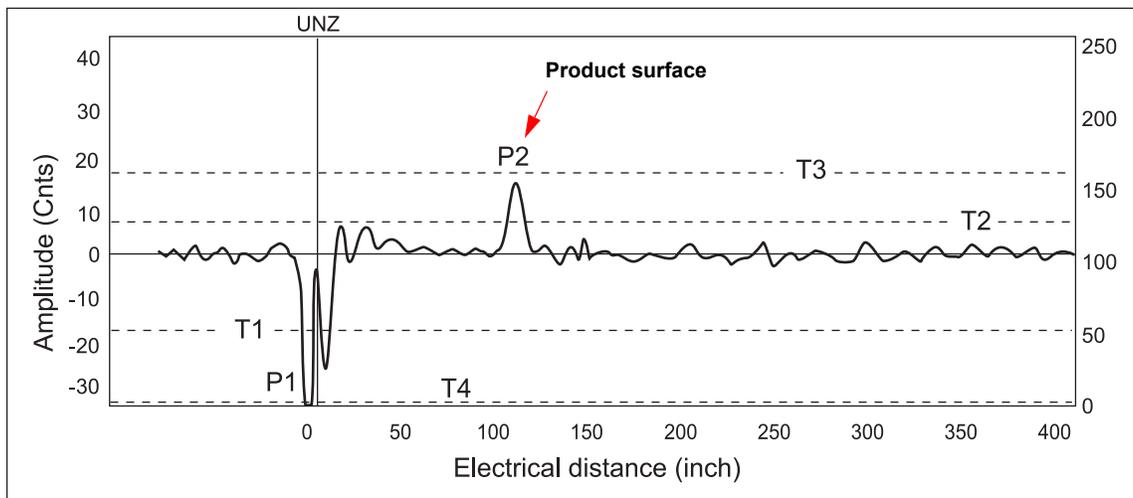
Installation in a rough nozzle may result in several disturbing echoes, as illustrated in Figure 5-7.

Figure 5-7. Example of a waveform plot for an installation in a rough nozzle.



With a 4-in. (100 mm) smooth nozzle that is clean on the inside, the Level and Interface peaks are easily distinguished from noise and other disturbing peaks.

Figure 5-8. Typical plot for an installation in a 4 in. (100 mm) nozzle with a smooth interior.



## Near Zone Threshold

Disturbing echoes may result from rough edges in the nozzle. Figure 5-9 illustrates that this may cause the transmitter to identify the wrong peak as the product surface.

If the product surface is not located as close to the nozzle as indicated in the waveform plot, set the Near Zone Threshold. The amplitude threshold T2 can be adjusted to filter out disturbances close to the nozzle. The adjusted threshold T2 correctly detects the surface peak, as illustrated in Figure 5-10.

Figure 5-9. A disturbing echo from the nozzle is erroneously marked as the product surface.

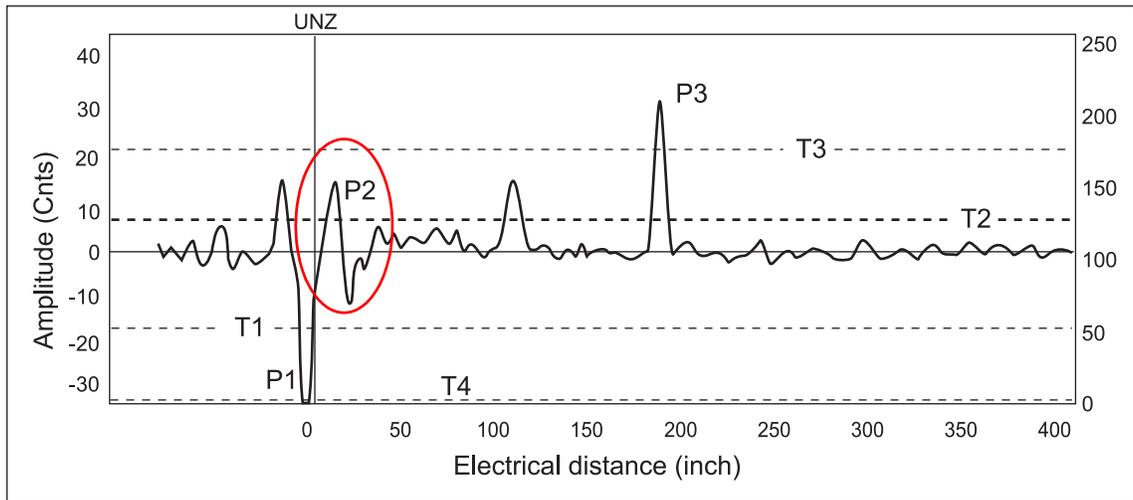
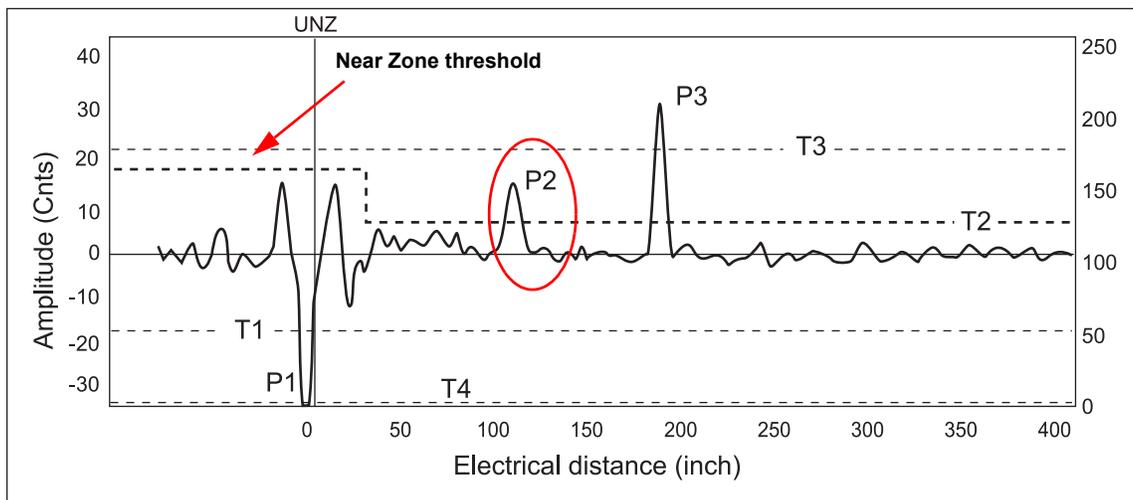


Figure 5-10. The Near Zone Threshold hides the disturbing echoes.

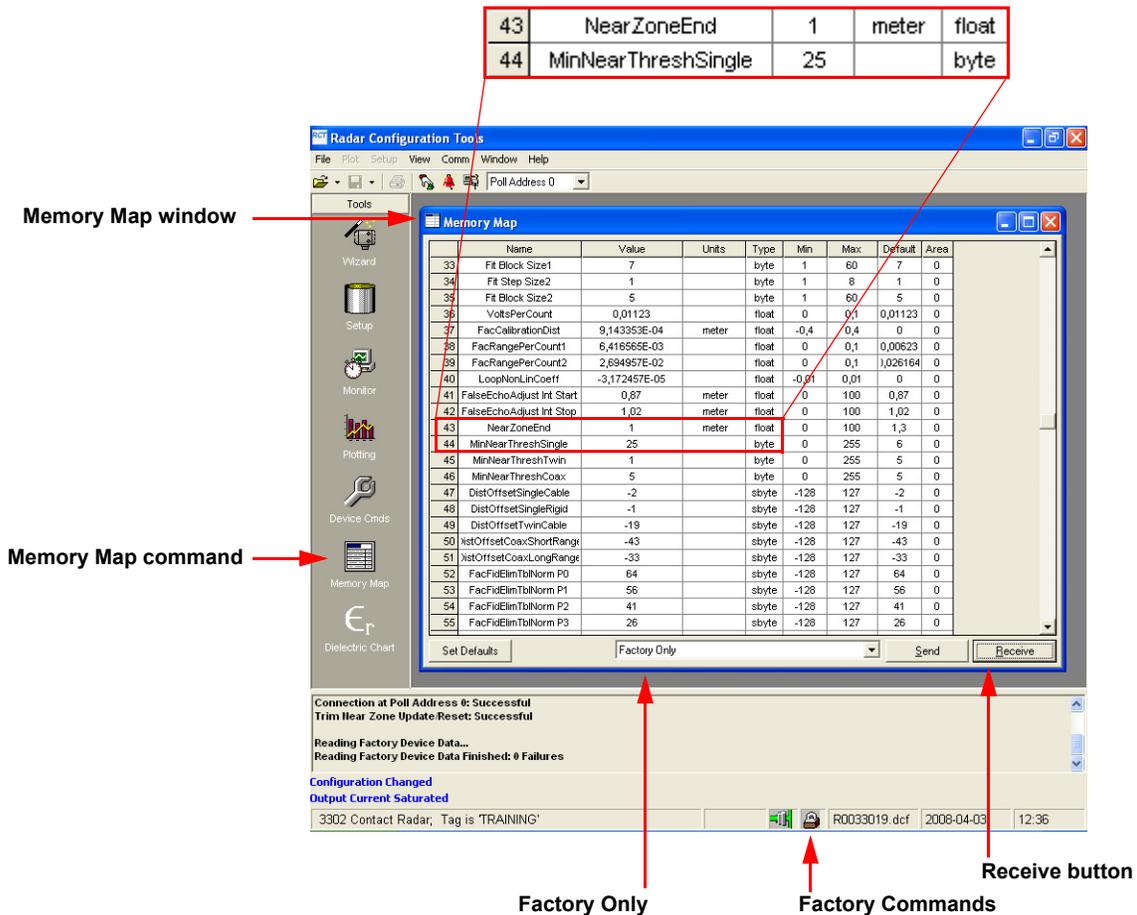


# Rosemount Radar Level Transmitters

To set the Near Zone Threshold:

1. In the RCT program Status bar, click the Factory Commands icon to open the password input field.
2. Enter the password. The default password is "RMT".
3. Click the Memory Map icon in the RCT project bar. Response: the *Memory Map* window appears.

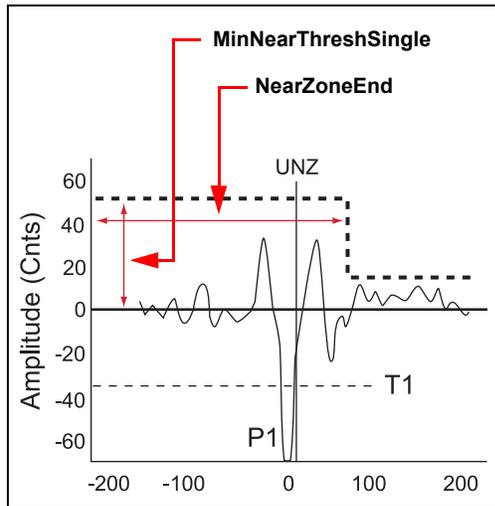
Figure 5-11. Near Zone threshold is defined by distance from reference pulse and amplitude.



4. Choose Factory Only from the memory area drop-down list. Please note that if another drop-down item is chosen, the row number may not line up with the Memory Map name.
5. Click the Receive button to update the Memory Map window with the current transmitter database settings.
6. In the **NearZoneEnd** field enter the desired distance measured from the Reference pulse (in the Waveform plot the x-axis zero is located on the Reference pulse).

# Rosemount Radar Level Transmitters

7. In the **MinNearThreshSingle** field enter the desired threshold value. Note that the MinNearThreshSingle parameter is used for Rigid Single Lead and Flexible Single Lead probes only.
8. Click the Send button to forward the threshold values to the transmitter database.
- ⚠ If other memory map values are changed, the transmitter may stop working as intended. Only make changes to values as suggested in these instructions.
9. Open the Waveform Plot to verify the threshold settings.



10. In the *Waveform Plot* window, click the Read<sup>(1)</sup>  button to view the measurement signal and the Near Zone threshold (see also “Rosemount 3300 Threshold Settings” on page 5-3).

(1) You may have to read the Waveform Plot twice in order to view the updated Near Zone Threshold.

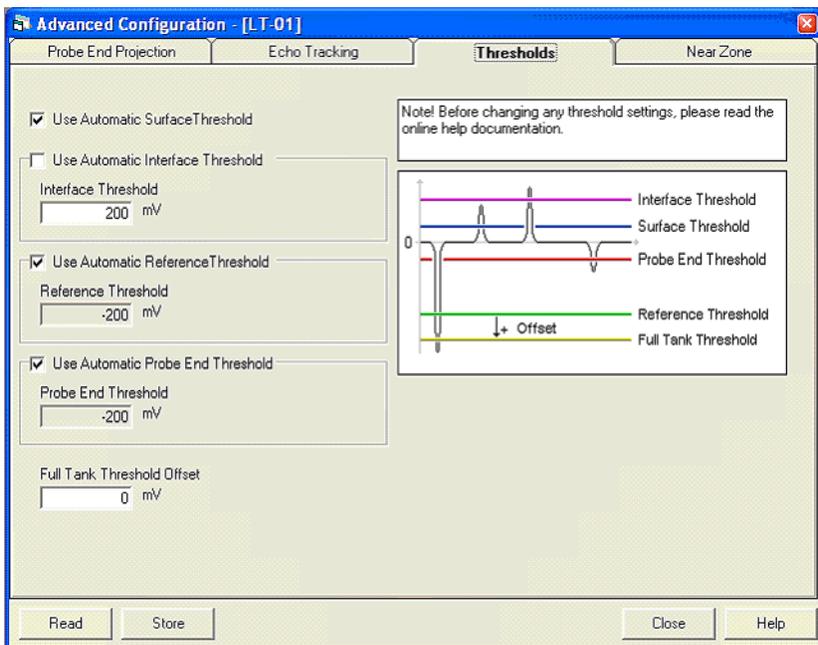
# Rosemount Radar Level Transmitters

## ROSEMOUNT 5300 THRESHOLD SETTINGS

The Rosemount 5300 measurement is based on the radar signal pulses reflected by the product surface and the interface between two liquids. Various signal amplitude thresholds are used to separate the measurement signal from disturbing echoes and noise. The amplitude thresholds are automatically set by the 5300 transmitter, and no manual settings are needed. However, due to the properties of the product, it may be necessary to adjust the amplitude thresholds for optimum measurement performance. The *Rosemount Radar Master* (RRM) supports threshold settings in the *Advanced Configuration* window:

1. Click the **Advanced** icon in the Device Config/Setup toolbar.
2. Select the **Thresholds** tab in the *Advanced Configuration* window.

Figure 5-12. Threshold settings in *Rosemount Radar Master* (RRM).



Automatic threshold settings are enabled by default. In the *Advanced Configuration* window the *Interface*, *Reference*, *Probe End* and *Full Tank* thresholds can be set manually.

### Automatic Surface Threshold

When this check-box is selected, the transmitter automatically sets the Surface threshold to a constant value based on the configured Dielectric Constant of the product.

Note that by enabling the Automatic Surface threshold setting, the *Amplitude Threshold Curve* (ATC) is replaced by a constant threshold value.

The Surface threshold can also be set manually using the **Set Threshold** function in the *Echo Curve Analyzer / Configuration Mode* window.

### Interface Threshold

Amplitude threshold for detection of the Interface level peak.

### Reference Threshold

Amplitude threshold for detection of the Reference pulse.

### Probe End Threshold

If the Probe End Projection function is used, this threshold may need to be adjusted so the probe end pulse is properly detected.

### Full Tank Threshold Offset

The Full Tank threshold is related to the Reference Threshold, and can detect that the tank is full. The given offset value determines the gap between the Reference threshold and the Full Tank threshold. The transmitter considers the tank full when the amplitude of the Reference Peak has dropped to a value between the two threshold values.

If the amplitude of the Reference peak is below the Full Tank Threshold (negative amplitude of the Reference peak) the tank is not considered full.

The Full Tank Threshold Offset should be set so the Full Tank Threshold coincides with an amplitude value equal to 90% of the Reference Echo peak amplitude when the tank is not full.

### Example

In the example below the following assumptions are made (note the negative sign):

Reference Echo peak amplitude = -2000 mV.

Reference Threshold = -1000 mV.

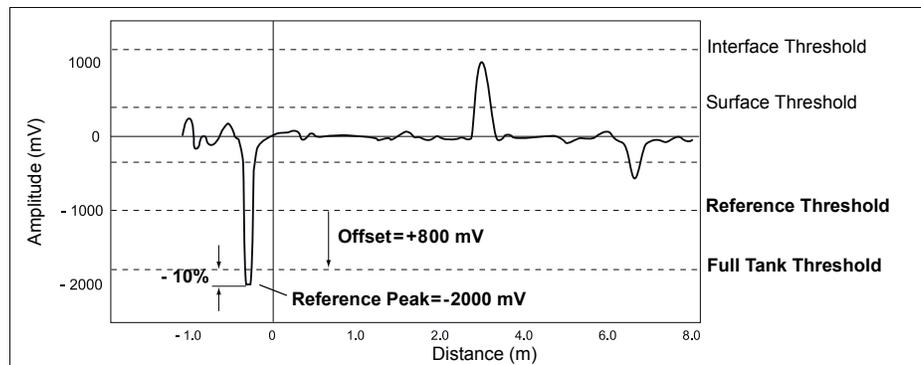
The target position for the Full Tank Threshold is 10% below the Reference Echo peak amplitude. In this example the Full Tank Threshold should be located at 10% below the Reference peak at -2000 mV:

$$-2000 \text{ mV} - (-200 \text{ mV}) = -1800 \text{ mV}.$$

Since the Full Tank Threshold refers to the Reference Threshold, the resulting offset value has to be expressed in terms of the distance to the Reference Threshold:

$$\text{Full Tank Threshold Offset} = -1000 \text{ mV} - (-1800 \text{ mV}) = +800 \text{ mV}.$$

Figure 5-13. Example of how to specify the Full Tank Threshold.



# Rosemount Radar Level Transmitters

## DEVICE STATUS

Warnings, Errors and Device Status messages are indicated in the Radar Configuration Tools (RCT) workspace Message area as illustrated in Figure 4-2.

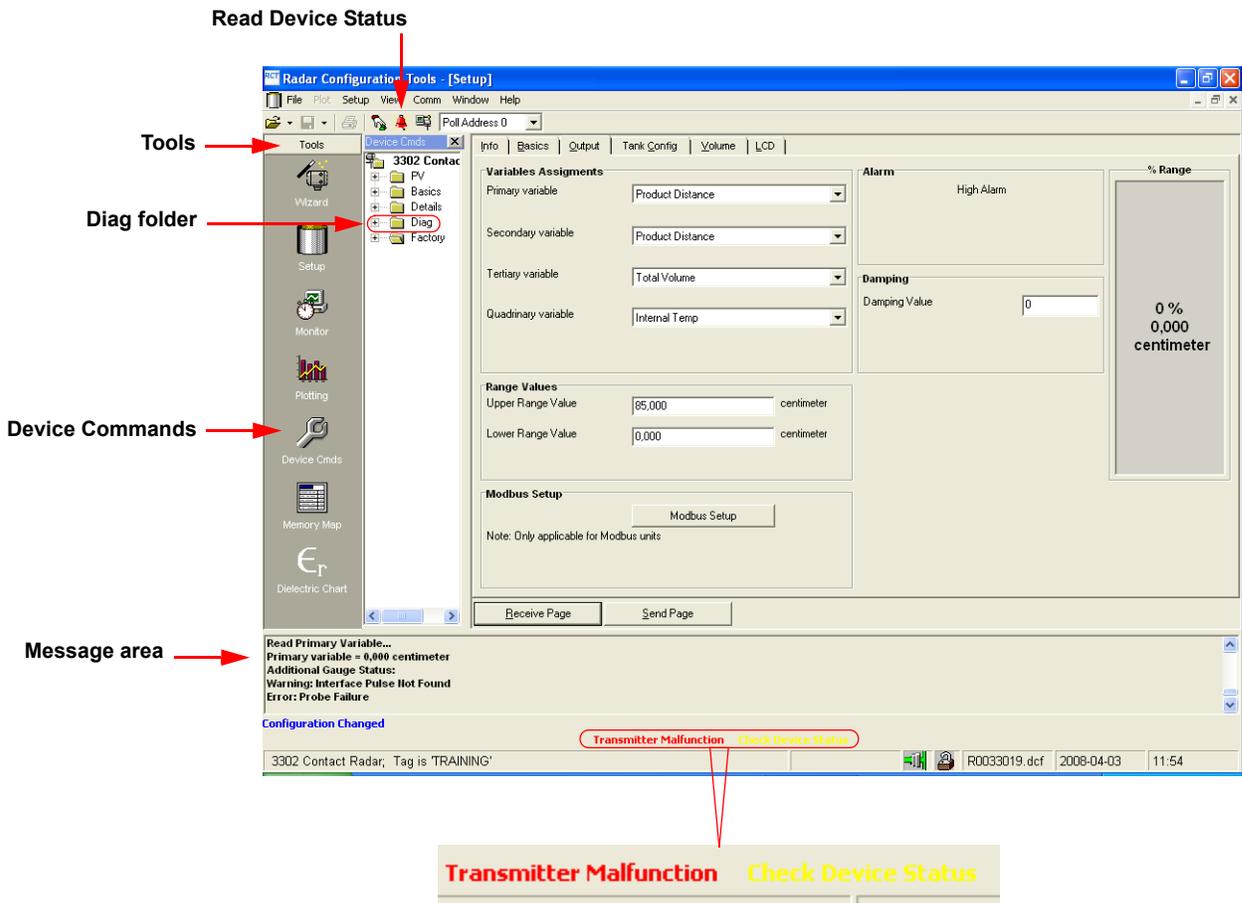
### Device Status: Rosemount 3300 Series

To view error messages in the Message area do one of the following:

- Click the **Read Device Status** icon  in the toolbar at the top of the RCT workspace
- 1. Open the Tools section in the RCT workspace Project Bar and click the **Device Commands** icon, or choose the Device Commands option from the View menu.  
2. Open the folder named Diag and double-click the Read Gauge Status option.

The different device status, error, and warning messages are listed in the Rosemount 3300 Series Reference manual (00809-0100-4811).

Figure 5-14. RCT offers several options to view device status and error messages.



**Device Status:  
 Rosemount 5300 Series**

Device Status messages that may appear on the Integral Display, on the 375 Field Communicator, or in the Rosemount Radar Master (RRM) program are shown in Table 5-1:

Table 5-1. Device status.

Message	Description	Action
Running Boot Software	The application software could not be started.	Contact Emerson Process Management Service Department.
Device Warning	A device warning is active.	See Warning Messages for details.
Device Error	A device error is active.	See Error Messages for details.
Simulation Mode 0	The simulation mode is active.	Turn off the simulation mode.
Simulation Mode 1	The advanced simulation mode is active.	To turn off the Advanced Simulation mode, set Holding Register 3600=0.
Invalid Measurement	The level measurement is invalid.	Check Error Messages, Warning Messages and Measurement Status for details.
User Register Area Write Protected	The configuration registers are write protected.	Use the Lock / Unlock function to turn off the write protection.
Write Protected Jumper Set	Write protection jumper on the display is enabled.	Remove the write protection jumper.
Factory Settings Used	The factory default configuration is used.	The transmitter has lost its calibration. Contact Emerson Process Management Service Department.
Probe missing	Probe is not detected.	Check that the probe is correctly mounted. Check the connection between probe and transmitter head.

# Rosemount Radar Level Transmitters

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## Section 6 Verification Procedure

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Introduction .....	page 6-1
Verification Procedure .....	page 6-2
Diagnostics .....	page 6-5

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### INTRODUCTION

Once a Rosemount 3300 / 5300 transmitter is installed and configured, it will continuously deliver measurement data with a minimum of maintenance. Transmitter performance should be verified on a regular basis to ensure proper function.

- Configure and commission the transmitter as described in this document and the Rosemount 3300 / 5300 Series Reference Manuals (Document No. 00809-0100-4811 and 00809-0100-4530)
- If needed, adjust threshold settings, Upper Null Zone settings, Trim Near Zone, or mechanical nozzle adjustments
- When using the 3300 Series, run the **Self Test** function to verify there are no transmitter hardware or software errors. The 5300 Series automatically performs a self test
- View and save a **waveform plot** for the configured transmitter. A plot function is available in the Radar Configuration Tools (RCT) for the 3300 Series, and in the Rosemount Radar Master (RRM) software for the 5300 Series. The plot is used as a baseline for future reference when verifying the transmitter
- For the 5300 Series, additional diagnostics capabilities eliminate the need for verification self-tests. The following information can be retrieved about the device:
  - device status
  - device errors
  - device warnings
  - measurement status
  - volume status
  - analog output status

For more information, see section *Service and Troubleshooting* in the High Performance Guided Wave Radar, Rosemount 5300 Series Reference Manual (Document No. 00809-0100-4530).

# Rosemount Radar Level Transmitters

## VERIFICATION PROCEDURE

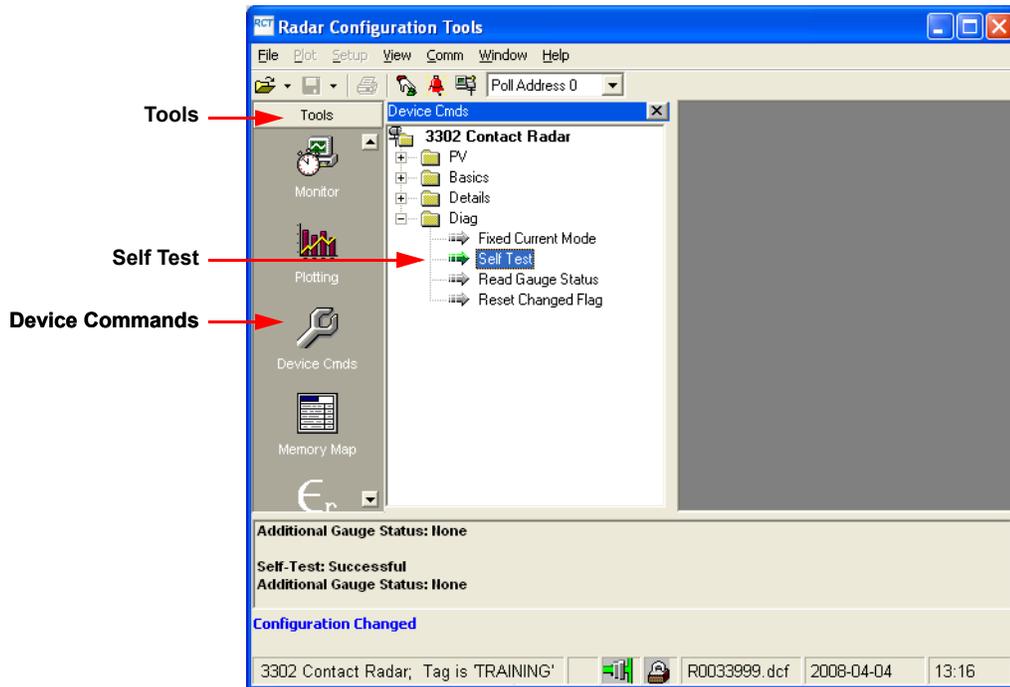
The Rosemount 3300 transmitter is equipped with diagnostic tools which facilitate verification of measurement performance. The verification procedure should include a transmitter self test and an inspection of the waveform plot described below.

### Self Test

The built-in self test function is available in the RCT program. To run the self test:

1. Open the **Tools** section in the RCT workspace Project Bar.
2. Click the **Device Commands** icon, or choose the Device Commands option from the View menu.
3. Open the **Diag** folder and double-click the Self Test option.
4. Verify that the Self Test result is successful.

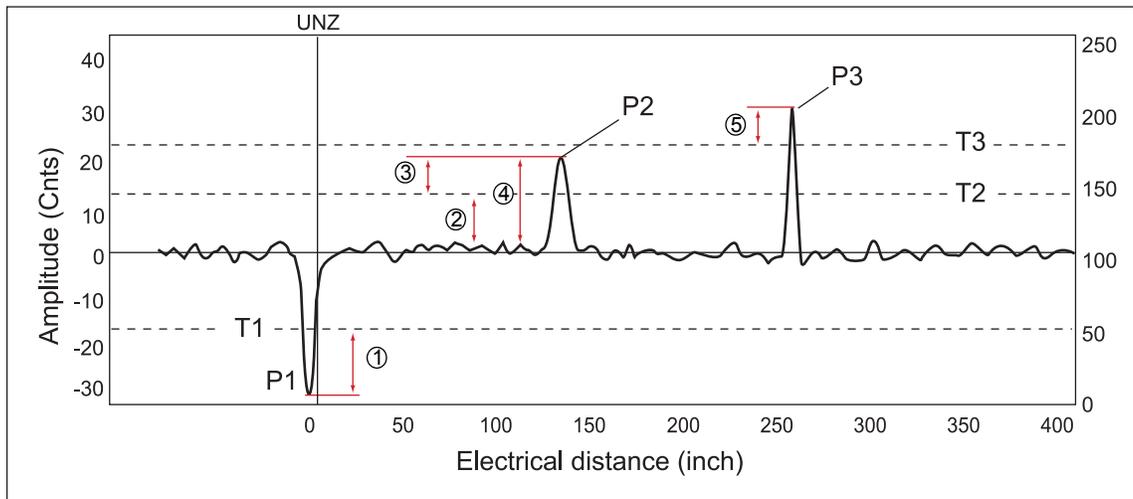
Figure 6-1. Use the Self Test function to verify that no hardware errors occur.



## Rosemount 3300 Plot Verification

To verify the Rosemount 3300 level measurement, read a waveform plot and save it on a disk. Open the original plot from the original transmitter commissioning and compare it to the new plot. Use the check list below to verify sufficient signal/noise ratio and proper amplitude threshold values.

Figure 6-2. Rosemount 3300: Measurement conditions can be analyzed by using the Waveform Plot.



1. Check the Reference pulse amplitude and position.  
Ensure that the margin to T1 is sufficient. If the Reference pulse amplitude peak is above the threshold T1, the transmitter will report "Full Tank".
2. Check the noise amplitude versus threshold T2.  
The noise level may increase when the probe is coated, reducing the margin to surface threshold T2. An insufficient margin may lead to the wrong peak being interpreted as the product surface.
3. Check the margin between signal peak P2 and surface threshold T2.  
Robust measurement is achieved from having a margin that allows minor amplitude fluctuations because of a turbulent product surface or coated probe. Failure to detect the product surface, or the wrong peak being interpreted as the product surface may be from a margin that does not allow minor amplitude fluctuations.
4. Check the signal/noise ratio, i.e. the maximum noise amplitude/peak amplitude P2.  
An incorrect ratio may cause failure to detect the product surface, or the wrong peak being interpreted as the product surface.
5. Check the margin between interface peak P3 and amplitude threshold T3.  
If the margin is incorrect, it may lead to failure.

# Rosemount Radar Level Transmitters

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## Rosemount 5300 Plot Verification

Recommendations for the Rosemount 5300 Series:

1. Use of the automatic threshold settings ensures that the dielectric constants of the upper and lower products have been entered correctly.
2. If needed, apply the *Measure and Learn* function.
3. Use the following best practices to apply custom threshold adjustments, if necessary:
  - Generally, the threshold should be at 40-50% of the surface peak. Example: If the surface is 2000 mV, the threshold should be set at 800-1000 mV
  - The threshold should never be closer than 300 mV to a disturbing object. Example: If there is a 1100 mV peak from an inlet pipe, the threshold around it should be 1400 mV

The threshold should never be below 800 mV in the range 0-1 ft. (0.3 m) and never below 500 mV from ranges above 1 ft. (0.3 m).

For products with very low dielectric constants, such as solids, it may be necessary to lower the threshold.

## DIAGNOSTICS

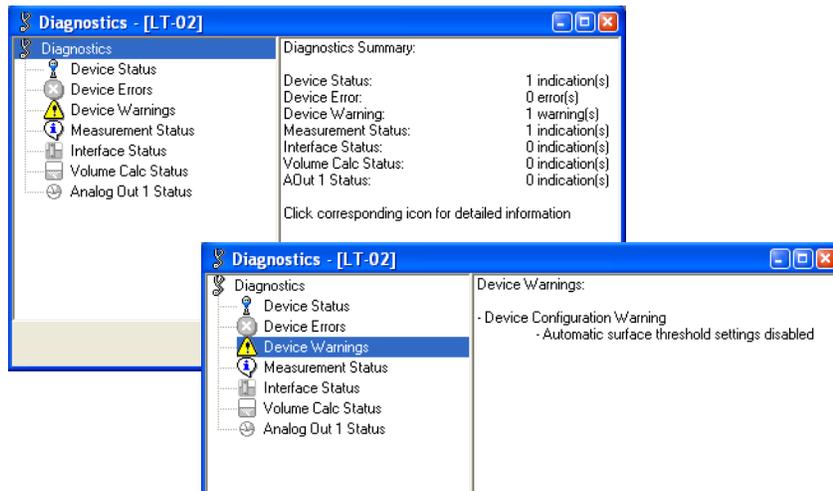
The following information is available in the referred subsections of *Service and Troubleshooting* in the Rosemount 5300 Series Reference Manual (Document No. 00809-0100-4530):

- device status, see “Device Status”
- device errors, see “Errors”
- device warnings, see “Warnings”
- measurement status, see “Measurement Status”
- volume status, see “Volume Calculation Status”
- analog output status, see “Analog Output Status”

### Rosemount Radar Master

To open the *Diagnostics* window in RRM, choose the **Diagnostics** option from the **Tools** menu:

Figure 6-3. The Diagnostics window in Rosemount Radar Master.



### HART command

For a 375 Field Communicator the corresponding HART command for the Diagnostics option is [3, 1].

# Rosemount Radar Level Transmitters

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# Appendix A      Model Code Information

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**Model Code 3302 and 5302, Level and Interface in Liquids . . . page A-2**

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This is a summary of the Rosemount 3300 / 5300 model codes, adapted to the applications described in the previous sections of this document. The complete model code for the Rosemount 3300 / 5300 Series is available in the following documents:

- Rosemount 3300 Series Reference Manual  
(Document No. 00809-0100-4811)
- Rosemount 3300 Series Product Data Sheet  
(Document No. 00813-0100-4811)
- Rosemount 5300 Series Reference Manual  
(Document No. 00809-0100-4530)
- Rosemount 5300 Series Product Data Sheet  
(Document No. 00813-0100-4530)

# Rosemount Radar Level Transmitters

## MODEL CODE 3302 AND 5302, LEVEL AND INTERFACE IN LIQUIDS

Model	Product Description		
3302	Guided Wave Radar Level and Interface Transmitter		
5302	Guided Wave Radar Liquid Level and Interface Transmitter		
Code	Signal Output		
H	4-20 mA with HART® communication		
M	RS-485 with Modbus communication <sup>(1)</sup>		
F	FOUNDATION™ fieldbus (Rosemount 5300 Series only)		
Code	Housing Material		
A	Polyurethane-covered Aluminum		
Code	Conduit / Cable Threads		
1	½ - 14 NPT		
Code	Operating Temperature and Pressure <sup>(2)</sup>	Probe Type	
S	- 15 psig (-1bar) to 580 psig (40 bar) @ 302 °F (150 °C)	All	
P	High Pressure <sup>(3)</sup> : Max 392 °F (200 °C): 3500 psi @ 392 °F and 5000 psi @ 100 °F (243 bar @ 200 °C and 345 bar @ 38 °C) according to ANSI Class 2500	3A, 3B, 4A, 5A and 5B (only SST)	
Code	Material of Construction <sup>(4)</sup> ; Process Connection / Probe	Probe Type	
1	316 / 316 L SST (EN 1.4404)	All	
Code	Sealing, O-ring Material (Consult factory for other o-ring materials)		
N	None <sup>(5)</sup>		
V	Viton® fluoroelastomer		
E	Ethylene Propylene		
Code	Probe Type	Process Connection	Probe Lengths
4A	Rigid Single Lead	Flange, 1 <sup>(6)</sup> or 1.5 in. Thread	Min: 1 ft 4 in. (0.4 m). Max: 9 ft 10 in. (3 m)
5A	Flexible Single Lead with weight	Flange, 1 <sup>(6)</sup> or 1.5 in. Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
5B	Flexible Single Lead with chuck <sup>(7)</sup>	Flange, 1 <sup>(6)</sup> or 1.5 in. Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
Code	Probe Length Units		
E	English (feet, in.)		
M	Metric (meters, centimeters)		

<b>Code</b>		<b>Total Probe Length <sup>(8)</sup> (feet/m)</b>
xxx	0-164 ft. or 0-50 m (Code xxx for the 5300 Series only. Code xx for the 3300 Series with ranges 0-77 ft. or 0-23 m.)	
<b>Code</b>		<b>Total Probe Length <sup>(8)</sup> (in./cm)</b>
xx	0-11 in. or 0-99 cm	
<b>Code</b> <b>Process Connection - Size / Type (consult factory for other process connections)</b>		
<b>ANSI Flanges in 316L SST (EN 1.4404)</b>		
AA	2 in. ANSI, 150 lb	
AB	2 in. ANSI, 300 lb	
AC	2 in. ANSI, 600 lb. HTHP / HP units	
AD	2 in. ANSI, 900 lb. HTHP / HP units	
AE	2 in. ANSI, 1500 lb. HTHP / HP units	
AI	2 in. ANSI, 600 lb, RTJ (Ring Type Joint). HTHP / HP units	
AJ	2 in. ANSI, 900 lb, RTJ (Ring Type Joint). HTHP / HP units	
AK	2 in. ANSI, 1500 lb, RTJ (Ring Type Joint). HTHP / HP units	
BA	3 in. ANSI, 150 lb	
BB	3 in. ANSI, 300 lb	
BC	3 in. ANSI, 600 lb. HTHP / HP units	
BD	3 in. ANSI, 900 lb. HTHP / HP units	
BE	3 in. ANSI, 1500 lb. HTHP / HP units	
BI	3 in. ANSI, 600 lb, RTJ (Ring Type Joint). HTHP / HP units	
BJ	3 in. ANSI, 900 lb, RTJ (Ring Type Joint). HTHP / HP units	
BK	3 in. ANSI, 1500 lb, RTJ (Ring Type Joint). HTHP / HP units	
CA	4 in. ANSI, 150 lb	
CB	4 in. ANSI, 300 lb	
CC	4 in. ANSI, 600 lb. HTHP / HP units	
CD	4 in. ANSI, 900 lb. HTHP / HP units	
CE	4 in. ANSI, 1500 lb. HTHP / HP units	
CI	4 in. ANSI, 600 lb, RTJ (Ring Type Joint). HTHP / HP units	
CJ	4 in. ANSI, 900 lb, RTJ (Ring Type Joint). HTHP / HP units	
CK	4 in. ANSI, 1500 lb, RTJ (Ring Type Joint). HTHP / HP units	
DA	6 in. ANSI, 150 lb	

# Rosemount Radar Level Transmitters

<b>Code      Process Connection - Size / Type (consult factory for other process connections)</b>		
<b>Threaded Connections</b>		<b>Probe Type</b>
RA	1 ½ in. NPT thread	All
RB	1 in. NPT thread	3A, 3B, 4A, 5A, 5B, standard temperature and pressure
<b>Code      Hazardous Locations Certifications</b>		
E5	FM Explosion-proof	
<b>Code      Options</b>		
M1	Integral digital display	
LS	Long stud <sup>(9)</sup> 9.8 in. (250 mm) for flexible single lead probe to prevent contact with wall/nozzle. Standard height is 3.9 in. (100 mm) for probes 5A and 5B.	
T1	Transient Protection Terminal Block (5300 Series only. Defaulted for the 3300 Series, so no T1 option needed.)	
<b>Sx and Px - Centering Discs</b>		<b>Outer Diameter</b>
S2	2 in. Centering disc SST <sup>(10)</sup>	1.8 in. (45 mm)
S3	3 in. Centering disc SST <sup>(10)</sup>	2.7 in. (68 mm)
S4	4 in. Centering disc SST <sup>(10)</sup>	3.6 in. (92 mm)
P2	2 in. Centering disc PTFE <sup>(11)</sup>	1.8 in. (45 mm)
P3	3 in. Centering disc PTFE <sup>(11)</sup>	2.7 in. (68 mm)
P4	4 in. Centering disc PTFE <sup>(11)</sup>	3.6 in. (92 mm)
<b>Cx - Special Configuration (Software)</b>		
C1	Factory configuration (CDS required with order)	
C8	Low alarm <sup>(12)</sup> (standard Rosemount alarm and saturation levels)	
<b>Qx - Special Certifications</b>		
Q4	Calibration Data Certification	
Q8	Material Traceability Certification per EN 10204 3.1 <sup>(13)</sup>	

- (1) Requires external 8-30 Vdc power supply.
- (2) Process seal rating. Final rating depends on flange and O-ring selection.
- (3) Requires option None for sealing (no O-ring). Only for SST ("Material of Construction, Code 1).
- (4) For other materials, consult factory.
- (5) Requires High Temperature High Pressure (code H) or High Pressure (Code P) probe.
- (6) Only available with standard temperature and pressure (Code S).
- (7) Extra length for fastening is added in factory.
- (8) Probe weight included, if applicable. Give the total probe length in feet and inches or meters and centimeters, depending on selected probe length unit. If tank height is unknown, round up to an even length when ordering, because probes can be cut to exact length in the field. The maximum allowable length is determined by process conditions.
- (9) Not available with PTFE covered probes.
- (10) Available for SST probes, type 2A, 4A and 5A.
- (11) Available for SST probes, type 2A, 4A and 5A, except for HTHP.
- (12) The standard alarm setting is high.
- (13) Certificate includes all pressure retaining wetted parts.

## Model Code Example - Rosemount 3300 Series

<b>3302 H A 1 P 1 N 4A E 05 11 CA E5 M1 S4</b>	
<i>Application: 6 ft chamber on high pressure vertical separator tank; requires interface only</i>	
H	4-20 mA with HART communication
A	Aluminum housing
1	½ - 14 NPT conduit
P	High Pressure: Max. 392 °F (200 °C): 3500 psi @ 392 °F and 5000 psi @ 100 °F (243 bar @ 200 °C and 345 bar @ 38 °C) according to ANSI Class 2500
1	Material of construction: 316 / 316 L SST (EN 1.4404)
N	None
4A	Rigid Single Lead probe
E	English (feet, in.)
05 11	5 ft and 11 in. probe
CA	4 in. ANSI, 150 lb flange
E5	FM Explosion-proof
M1	Integral digital display
S4	4 in. Centering disc SST; Outer Diameter: 3.6 in. (92 mm)

## Model Code Example - Rosemount 5300 Series

<b>5302 H A 1 S 1 V 5A E 011 06 CA E5 M1 T1</b>	
<i>Application: Fiberglass storage tank approx. 11 1/2 ft; Both level and level / interface</i>	
H	4-20 mA with HART communication
A	Aluminum housing
1	½ - 14 NPT conduit
S	Operating Temperature: -15 psig (-1 bar) to 580 psig (40 bar) @ 302 °F (150 °C)
1	Material of construction: 316 / 316 L SST (EN 1.4404)
V	Viton® fluoroelastomer seal
5A	Flexible Single Lead probe
E	English (feet, in.)
011 06	11 ft and 6 in. probe
CA	4 in. ANSI, 150 lb flange
E5	FM Explosion-proof
M1	Integral digital display
T1	Transient Protection Terminal Block

# Rosemount Radar Level Transmitters

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## Reference Manual

00809-0600-4811, Rev AA

February 2009

# Rosemount Radar Level Transmitters

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