Reference Manual
00809-0100-4530, Rev BA
July 2009

Rosemount 5300 Series

Superior Performance Guided Wave Radar

HART® FIELD COMMUNICATIONS PROTOCOL

FOUNDATION

ROSEMOUNT®

www.rosemount.com

EMERSON™ Process Management

Rosemount 5300 Series

Guided Wave Radar Level and Interface Transmitters

NOTICE

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

Within the United States, Emerson Process Management has two toll-free assistance numbers.

Customer Central: 1-800-999-9307(*7:00 a.m. to 7:00 p.m. CST)*
Technical support, quoting, and order-related questions.

North American Response Center:

Equipment service needs.

1-800-654-7768 (*24 hours a day – Includes Canada*)

For equipment service or support needs outside the United States, contact your local Emerson Process Management representative.

⚠CAUTION

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

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

For information on Rosemount nuclear-qualified products, contact your local Emerson Process Management 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.

Cover Photo: 5300_coverphoto.tif

Table of Contents

SECTION 4
Electrical Installation

SECTION 5
Configuration

SECTION 6
Operation

SECTION 7
Service and Troubleshooting

APPENDIX B Product Certifications

APPENDIX C Advanced Configuration

APPENDIX D Remote Mounting

APPENDIX E Performing Proof Test

APPENDIX F Level Transducer Block

APPENDIX G
Register Transducer Block

APPENDIX H
Advanced Configuration Transducer Block

APPENDIX I
Resource Transducer Block

APPENDIX J
Analog-Input Block

Section 1 Introduction

SAFETY MESSAGES

Procedures and instructions in this manual 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 (⚠). Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

⚠WARNING

Failure to follow these installation 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.

Explosions could result in death or serious injury.

- Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a 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.

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

⚠WARNING

Any substitution of non-authorized parts or repair, other than exchanging the complete transmitter head or probe assembly, may jeopardize safety and is prohibited.

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

MANUAL OVERVIEW

This manual provides installation, configuration and maintenance information for the Rosemount 5300 Series Radar Transmitter.

Section 2: Transmitter Overview

- Theory of operation
- Description of the transmitter
- Process and vessel characteristics

Section 3: Mechanical Installation

- Mounting considerations
- Mounting

Section 4: Electrical Installation

- Grounding
- Cable selection
- Power requirements
- Wiring
- Optional devices

Section 5: Configuration

- Basic configuration
- Configuration using the 375 Field Communicator
- Configuration using the RRM software
- Configuration using AMS Suite
- Configuration using DeltaV
- Foundation™ Fieldbus

Section 6: Operation

- Viewing measurement data
- Display functionality

Section 7: Service and Troubleshooting

- Service functions
- Diagnostic messages
- Error messages

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

- Functional specifications
- Installation
- Configuration
- Operation and maintenance
- Spare parts

Appendix A: Reference Data

- Specifications
- Dimensional drawings
- Ordering information

Appendix B: Product Certifications

- Labels
- European ATEX Directive information
- NEPSI approvals
- FM approvals
- CSA approvals
- IECEx approvals
- Combination approvals
- Approval drawings

Appendix C: Advanced Configuration

- Advanced Tank Geometry
- Advanced Transmitter Configuration
- Dynamic Vapor Compensation
- Signal Quality Metrics

Appendix D: Remote Housing

- Remote Housing, New Units
- Remote Housing, Field Retrofit
- Remote Housing Configuration

Appendix E: Performing Proof Test

- Describes the process of performing proof test.

Appendix F: Level Transducer Block
Describes the operation and parameters of the Level transducer block.

Appendix G: Register Transducer Block
Describes the operation and parameters of the Register transducer block.

Appendix H: Advanced Configuration Transducer Block
Describes the operation and parameters of the Advanced Configuration transducer block.

Appendix I: Resource Transducer Block
Describes the operation and parameters of the Resource transducer block.

Appendix J: Analog-Input Transducer Block
Describes the operation and parameters of the Analog Input transducer block.

SERVICE SUPPORT

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

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

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

Emerson Process Management Instrument and Valves Response Center representatives will explain the additional information and procedures necessary to return goods exposed to hazardous substance can avoid injury if they are informed of and understand the hazard. If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned goods.

PRODUCT RECYCLING/DISPOSAL

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

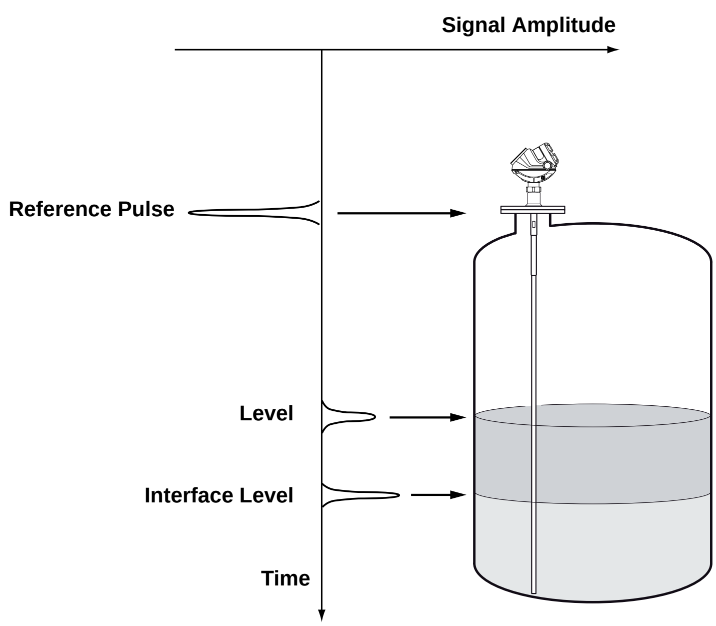
Section 2 Transmitter Overview

THEORY OF OPERATION

The Rosemount 5300 Series Radar Transmitter is a smart, two-wire continuous level transmitter based on Time Domain Reflectometry (TDR) principles. Low power nano-second-pulses are guided along an immersed probe. When a pulse reaches the surface, part of the energy is reflected back to the transmitter, and the time difference between the generated and reflected pulse is converted into a distance, which calculates the total level or interface level (see below).

The reflectivity of the product is a key parameter for measurement performance. Media with a high dielectric constant gives better reflection and a longer measuring range.

Figure 2-1. Measurement Principle.



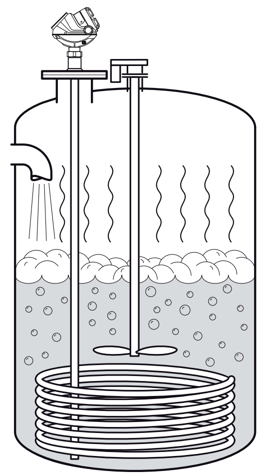
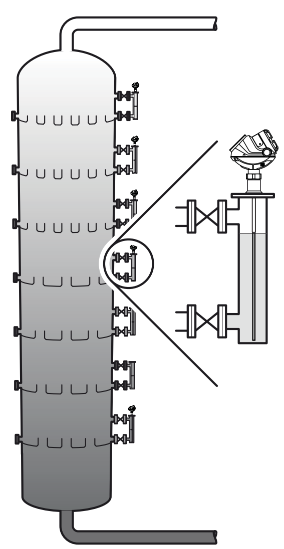
APPLICATIONS

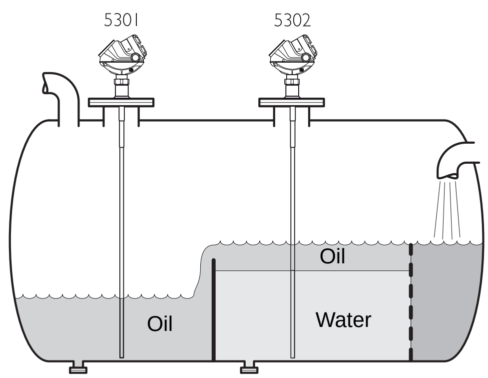
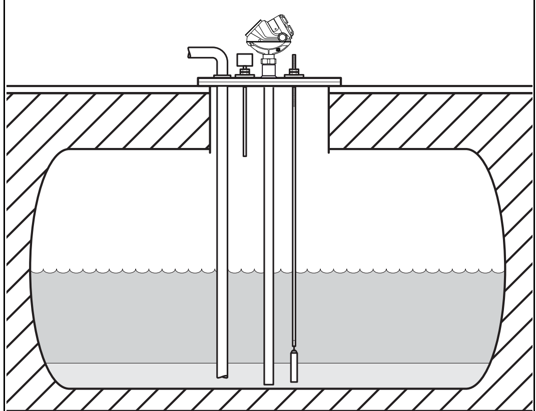
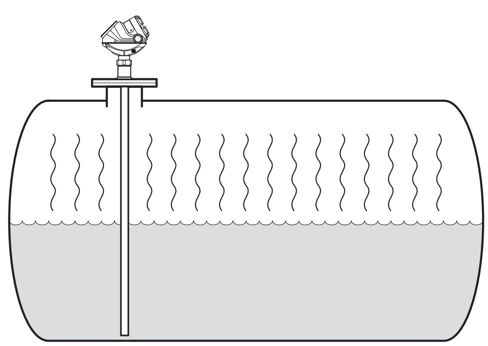
The Rosemount 5300 Series Radar Transmitter series is suited for aggregate (total) level measurements on most liquids, semi-liquids, solids, and liquid/liquid interfaces.

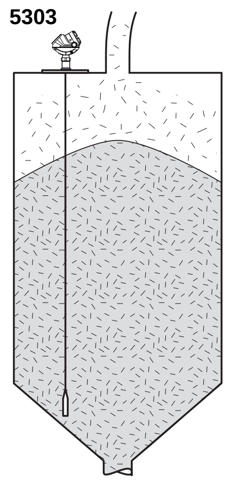
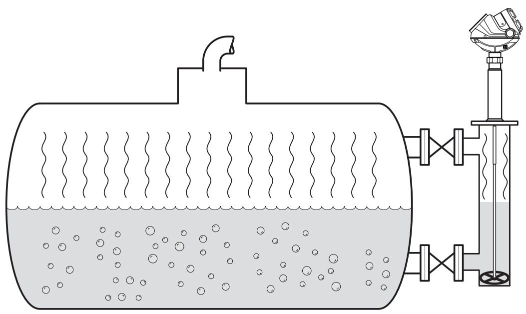
Guided microwave technology offers the highest reliability and precision to ensure measurements are virtually unaffected by temperature, pressure, vapor gas mixtures, density, turbulence, bubbling/boiling, low level, varying dielectric media, pH, and viscosity.

Guided wave radar technology in combination with advanced signal processing makes the Rosemount 5300 transmitters suitable for a wide range of applications:

Figure 2-2. Application examples

	The Rosemount 5300 transmitter works well in boiling conditions with vapor and turbulence. If there are disturbing objects in the vicinity of the transmitter, the coaxial probe is particularly suitable.
	The Rosemount 5300 Series is well suited for chamber applications, such as distillation columns.

	The Rosemount 5302 measures both level and interface level in a separator tank.
	The Rosemount 5300 Series is a good choice for underground tanks. It is installed on the top of the tank with the radar pulse concentrated near the probe. It can be equipped with probes that are unaffected by high and narrow openings or nearby objects.
	Guided wave radar technology provides reliable measurements in ammonia, LNG and LPG tanks.

	Model 5303, with a flexible single lead probe, is the solution for solids, powders and granules. It measures independently of dust, angled surfaces etc.
	The Rosemount 5300 with Dynamic Vapor Compensation will automatically compensate for dielectric changes in high pressure steam applications and maintain the level accuracy.

COMPONENTS OF THE TRANSMITTER

The Rosemount 5300 Series Radar Transmitter has an aluminum or stainless steel (SST) *transmitter housing* containing advanced electronics and software for signal processing. SST housing is preferred for harsh environment applications, such as off-shore platforms or other locations where the housing can be exposed to corrodents, such as salt solutions and caustics.

The *radar electronics* produces an electromagnetic pulse that is guided by the *probe*. It comes with flange, threaded or Tri-Clamp process connection.

There are different probe types available for various applications: Rigid Twin Lead, Flexible Twin Lead, Rigid Single Lead, Flexible Single Lead, and Coaxial.

Figure 2-3. Transmitter components.

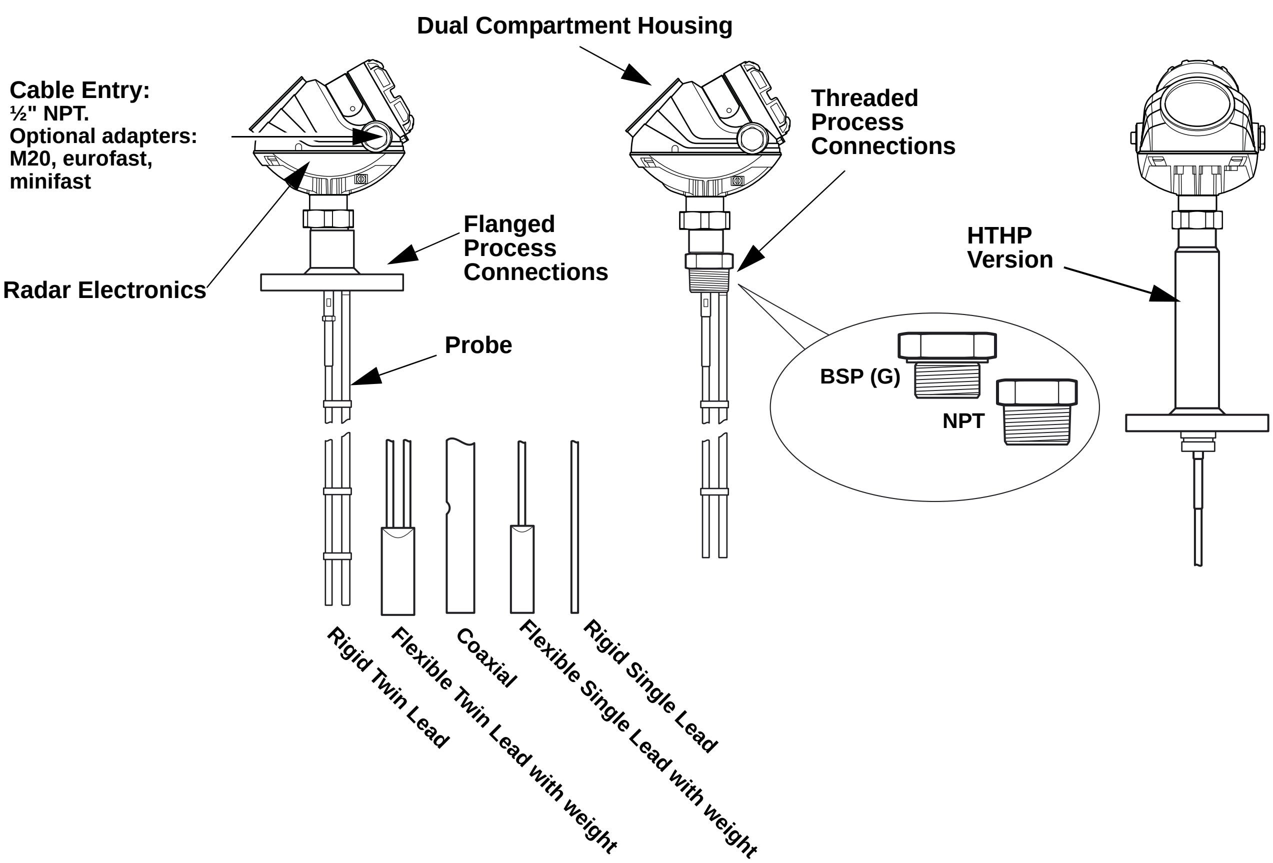
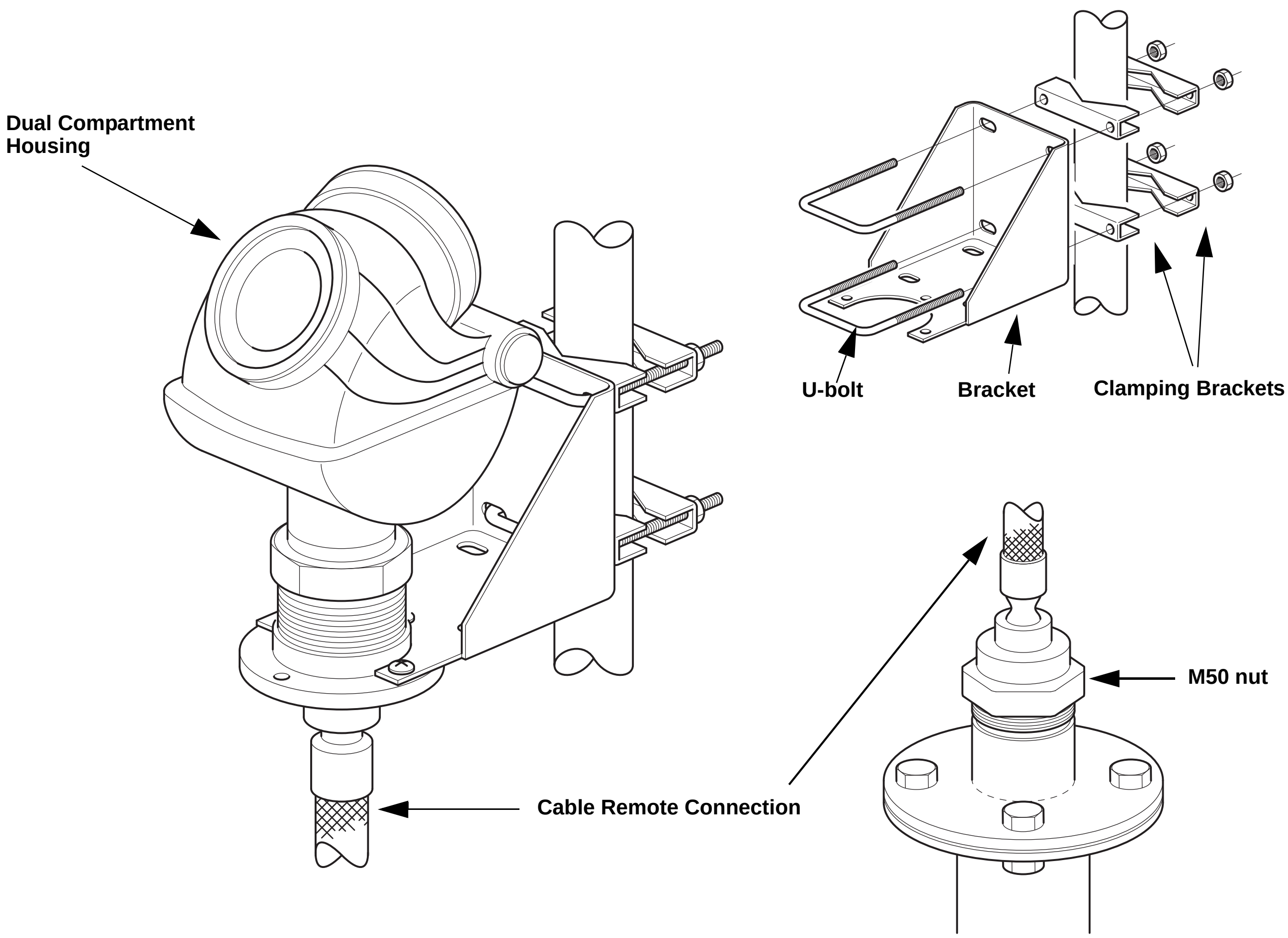


Figure 2-4. Remote Housing components.

Remote Housing allows for the transmitter head to be mounted separately from the probe.



SYSTEM ARCHITECTURE

The Rosemount 5300 Series Radar Transmitter is loop-powered, and it uses the same two wires for both power supply and output signal. The output is a 4-20 mA analog signal superimposed with a digital HART® or FOUNDATION™ Fieldbus signal.

By using the optional Rosemount 333 HART Tri-loop, the HART signal can convert up to three additional 4-20 mA analog signals.

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

The transmitter can be connected to a Rosemount 751 Field Signal Indicator, or it can be equipped with an integral display.

The transmitter can easily be configured using a Rosemount 375 Field Communicator or a PC with the Rosemount Radar Master software. Rosemount 5300 Series transmitters can also be configured with the AMS® Suite and DeltaV™ software, and other tools supporting Electronic Device Description Language (EDDL) functionality.

For HART communication a minimum load resistance of 250 Ω within the loop is required.

Figure 2-5. HART system architecture

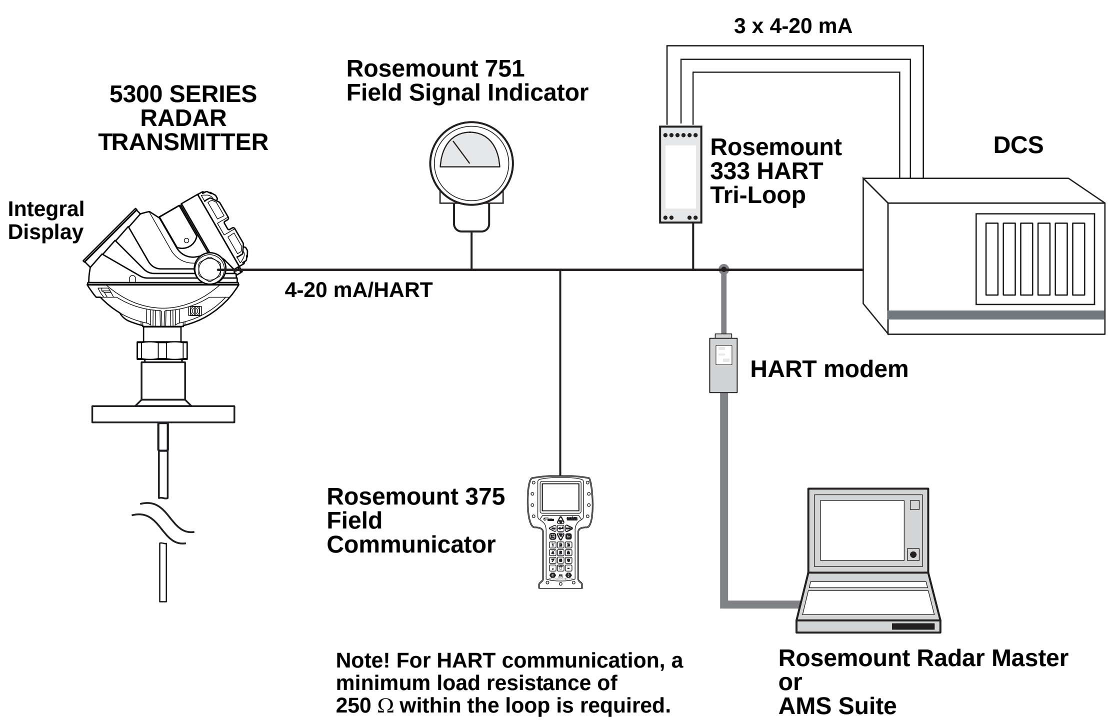
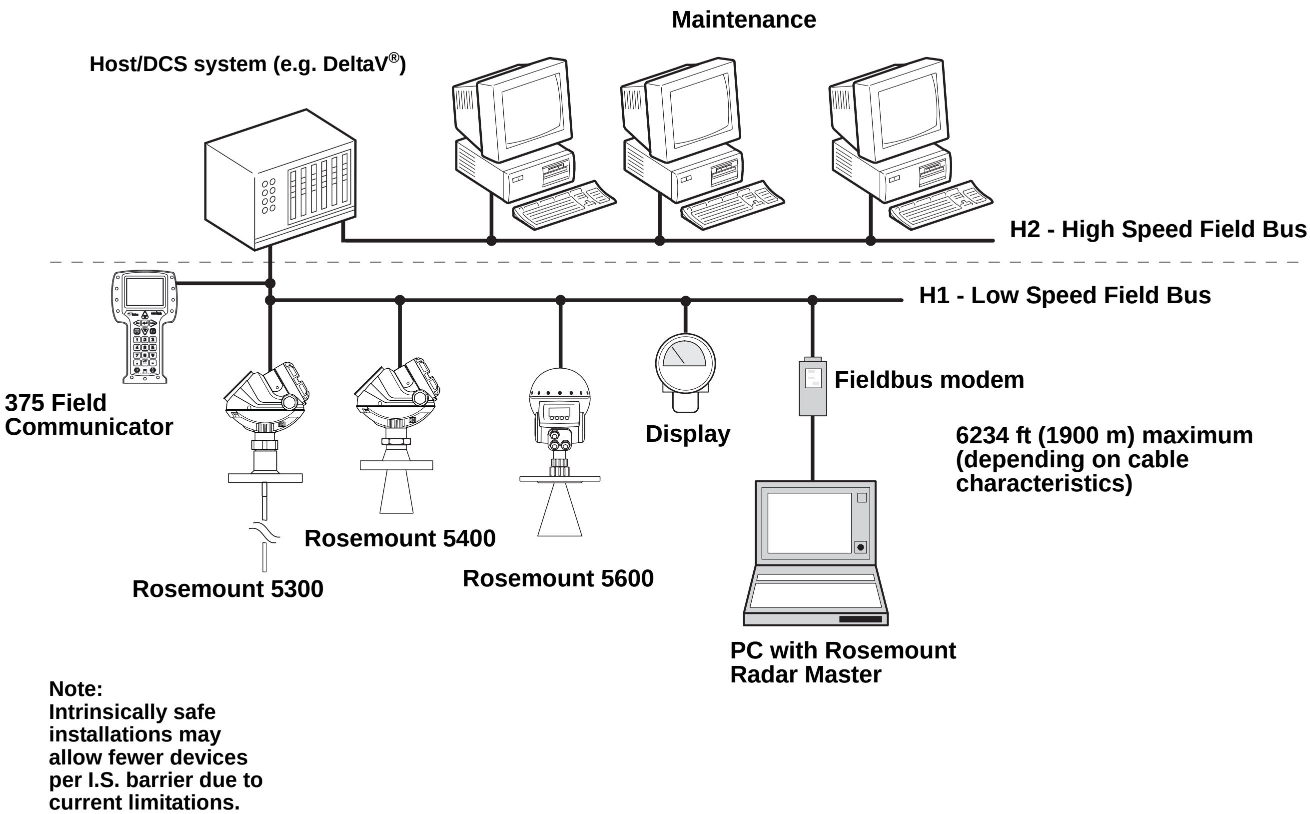


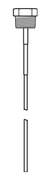
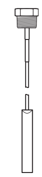
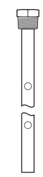
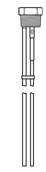
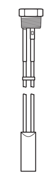
Figure 2-6. FOUNDATION Fieldbus system architecture



PROBE SELECTION GUIDE

The following guidelines should be used to choose the appropriate probe for the Rosemount 5300 transmitter:

Table 2-1. Probe selection guide.

	Rigid Single Lead	**Flexible Single Lead**	**Coaxial**	**Rigid Twin Lead**	**Flexible Twin Lead**
G=Good NR=Not Recommended AD=Application Dependent (consult your local Emerson Process Management representative)					
Measurements					
Level	G	G	G	G	G
Interface (liquid/liquid)	G	G	G	G	G
Process Medium Characteristics					
Changing density	G	G	G	G	G
Changing dielectric(1)	G	G	G	G	G
Wide pH variations	G	G	G	G	G
Pressure changes	G	G	G	G	G
Temperature changes	G	G	G	G	G
Condensing vapors	G	G	G	G	G
Bubbling/boiling surfaces	G	AD	G	G	G
Foam (mechanical avoidance)	NR	NR	AD	NR	NR
Foam (top of foam measurement)	AD	AD	NR	AD	AD
Foam (foam and liquid measurement)	AD	AD	NR	AD	AD
Clean liquids	G	G	G	G	G
Liquid with very low dielectric constants, see also Table 2-4.	G	G(2)	G	G	G(2)
Coating/sticky liquids	AD	AD	NR	NR	NR
Viscous liquids	AD	G	NR	AD	AD
Crystallizing liquids	AD	AD	NR	NR	NR
Solids, granules, powders	AD	G	NR	NR	NR
Fibrous liquids	G	G	NR	NR	NR
Tank Environment Considerations					
Probe is close (<12 in./30 cm) to tank wall / disturbing objects	AD	AD	G	G	G
Probe might touch tank wall, nozzle or disturbing objects	NR	NR	G	NR	NR
Turbulence	G	AD	G	G	AD
Turbulent conditions causing breaking forces	NR	AD	NR	NR	AD
Tall, narrow nozzles	AD	AD	G	AD	AD
Angled or slanted surface (viscous or solids materials)	G	G	NR	AD	AD
Liquid or vapor spray might touch probe above surface	NR	NR	G	NR	NR
Disturbing Electromagnetic interference in tank	AD	AD	G	AD	AD
Cleanability of probe	G	G	NR	AD	AD

(1) For overall level applications, a changing dielectric has no effect on the measurement. For interface measurements, a changing dielectric for the top fluid will degrade the accuracy of the interface measurement.
(2) Limited measuring range.

Transition Zones

The measuring range depends on probe type and product properties, and is limited by the Upper and Lower Transition Zones. In these zones, measurement accuracy may be reduced. The **Upper Transition Zone** is the minimum measurement distance between the upper reference point and the product surface. At the end of the probe, the measuring accuracy is reduced in the **Lower Transition Zone**. The Transition Zones vary depending on probe type and product.

Figure 2-7 illustrates how the measuring range is related to the Transition Zones:

Figure 2-7. Transition Zones

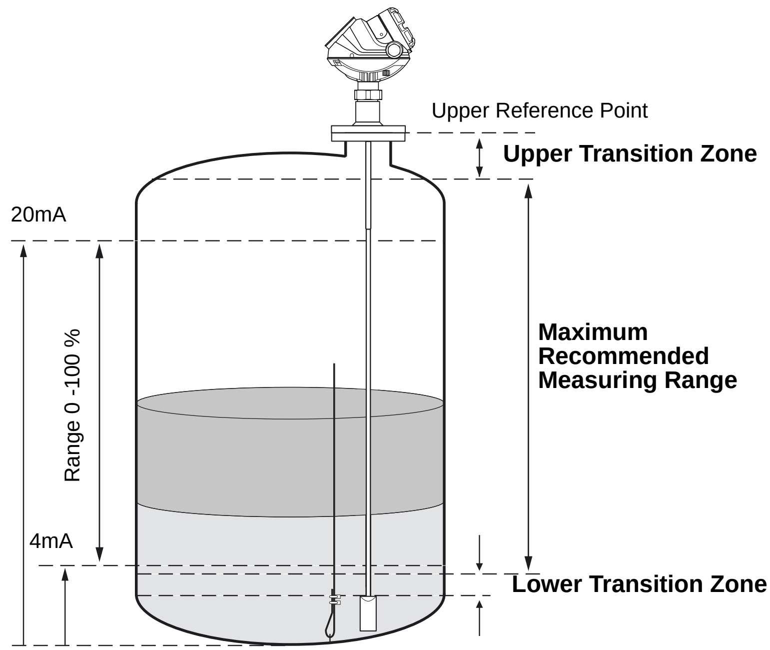


Table 2-2. Transition Zones for different probe types and dielectric constants

	Dielectric Constant	Rigid Single Lead	Flexible Single Lead	Coaxial	Rigid Twin Lead	Flexible Twin Lead
Upper(1) Transition Zone	80	4.3 in. (11 cm)	4.3 in. (11 cm)	4.3 in. (11 cm)	4.3 in. (11 cm)	4.7 in. (12 cm)
	2	6.3 in. (16 cm)	7.1 in. (18 cm)	4.3 in. (11 cm)	5.5 in. (14 cm)	5.5 in. (14 cm)
Lower(2) Transition Zone	80	2 in. (5 cm)	0 in. (0 cm)(4)(3)	0.4 in. (1 cm)	1.2 in. (3 cm)	2 in. (5 cm)(4)
	2	2.8 in. (7 cm)(5)	2 in. (5 cm) - long weight(4) 3.2 in. (8 cm) - short weight(4)	2 in. (5 cm)	4 in. (10 cm)	5.5 in. (14 cm)(4)

(1) The distance from the upper reference point where measurements have reduced accuracy, see picture above.
(2) The distance from the lower reference point where measurements have reduced accuracy, see picture above.
(3) The measuring range for the PTFE covered Flexible Single Lead probe includes the weight. For low dielectric media, special configuration may be required.
(4) Note that the weight length adds to non-measurable area and is not included in the table. See “Dimensional Drawings” on page A-9.
(5) If using a metal centering disc, the lower transition zone is up to 8 in. (20 cm). If using a PTFE centering disc, the lower transition zone is not affected.

NOTE!
Measurements in the Transition Zones may be non-linear, or have reduced accuracy. It is recommended the 4-20 mA points be set between the Transition Zones.

PROCESS CHARACTERISTICS

The Rosemount 5300 Series has high sensitivity because of its advanced signal processing and high signal to noise ratio. This makes it able to handle various disturbances, however, the following circumstances should be considered before mounting the transmitter.

Coating

Heavy coating of the probe should be avoided since it may decrease the sensitivity of the transmitter and lead to measurement errors. In viscous or sticky applications, periodic cleaning may be required.

For viscous or sticky applications, it is important to choose a suitable probe:

Table 2-3. Probe type guide for different product viscosity

Coaxial	Twin Lead	Single Lead
Maximum viscosity		
500 cP	1500 cP	8000 cP(1)(2)
Coating/Build-up		
Coating not recommended	Thin coating allowed, but no bridging	Coating allowed

(1) Consult your local Emerson Process Management representatvie for agitation/turbulence and high viscous products.
(2) Be precautious in HTHP viscous or crystallizing media applications where temperature at instrument connection is significantly lower than process temperature with risk of coating in the upper part of probe that may reduce the measurement signal. Consider using HP or STD probes in such applications.

Maximum measurement error due to coating is 1-10% depending on probe type, dielectric constant, coating thickness and coating height above product surface.

Signal Quality Metrics (SQM) diagnostic option can give an indication of how good the surface signal is compared to the noise, and when to clean the probe.

Bridging

Heavy product coating results in bridging between the two probes in a twin lead version, or between the pipe and inner rod for coaxial probes, and may cause erroneous level readings, so it must be prevented. A single lead probe is recommended in these situations.

Foam

The Rosemount 5300 Series Radar Transmitter measurement in foamy applications depends on the foam properties; light and airy or dense and heavy, high or low dielectrics, etc. If the foam is conductive and creamy, the transmitter may measure the surface of the foam. If the foam is less conductive the microwaves may penetrate the foam and measure the liquid surface.

Vapor

In some applications, such as high pressure boiling water, there is a heavy vapor above the product surface that could influence the level measurement. The Rosemount 5300 Series Radar Transmitter can be configured to compensate for the influence of vapor.

Boiling Hydrocarbons

For products with very low dielectric constants, such as boiling hydrocarbons and solids, the threshold may need to be lowered, and/or the Probe End Projection (PEP) function activated.

Measuring Range

The measuring range differs depending on probe type and characteristics of the application. *Table 2-4* can be used as a guideline for clean liquids.

See Appendix A: Reference Data for the measuring range when using Remote Housing.

Table 2-4. Measuring Range

Rigid Single Lead	Flexible Single Lead(1)	Coaxial	Rigid Twin Lead	Flexible Twin Lead
Maximum Measuring Range				
9 ft 10 in. (3 m) - for 8 mm probes 14 ft 9 in. (4.5 m) - for 13 mm probes	164 ft (50 m)	19 ft 8 in. (6 m)	9 ft 10 in. (3 m)	164 ft (50 m)
Minimum Dielectric Constant at Maximum Measuring Range				
1.4 (1.25 if installed in a metallic bypass or stilling well)(1)(2)	1.4, up to 49 ft (15 m)(1) 1.8, up to 82 ft (25 m)(1) 2.0, up to 115 ft (35 m)(1) 3, up to 138 ft (42 m) 4, up to 151 ft (46 m) 6, up to 164 ft (50 m)	1.2 (Standard) 1.4 (HP/C) 2.0 (HTHP)	1.4	1.4, up to 82 ft (25 m)(1) 2.0, up to 115 ft (35 m)(1) 2.5, up to 131 ft (40 m)(1) 3.5, up to 148 ft (45 m) 6, up to 164 ft (50 m)

(1) The probe end projection software function will improve the minimum dielectric constant. Consult you local Emerson Process Management representative for details.
(2) Measuring range may be lower depending on installation.

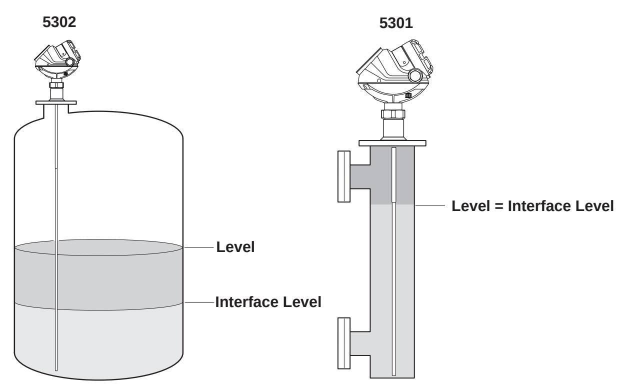
The maximum measuring range differs based on application according to:

- Disturbing objects close to the probe
- Media with higher dielectric constant (ε_r) has better reflection and a longer measuring range
- Surface foam and particles in the tank atmosphere might affect measuring performance
- Heavy coating / contamination on the probe may reduce the measuring range and cause erroneous level readings
- Disturbing EMC environment in tank
- Tank material (e.g. concrete or plastic) for measurements with single lead probes

Interface

Rosemount 5302 is the ideal choice for measuring the level of oil, and the interface of oil and water, or other liquids with significant dielectric differences. Rosemount 5301 can also be used for interface measurement in applications where the probe is fully submerged in the liquid.

Figure 2-8. Interface measurement with a Rosemount 5302 and a Rosemount 5301 (fully submerged probe).



For measuring interface level, the transmitter uses the residual wave of the first reflection. Part of the wave, not reflected at the upper product surface, continues until it is reflected at the lower product surface. The speed of this wave depends fully on the dielectric constant of the upper product.

To measure interface, the following criteria have to be fulfilled:

- The dielectric constant of the upper product must be known and should be constant. The Rosemount Radar Master software has a built-in dielectric constant calculator to assist in determining the dielectric constant of the upper product. (see “Dielectric Constant/Dielectric Range” on page 5-23)
- The upper product must have a lower dielectric constant than the lower product to have a distinct reflection
- The difference between the dielectric constants for the two products must be greater than 6
- The maximum dielectric constant for the upper product: 10 for the coaxial probe, 7 for the twin lead, and 8 for the single lead probes
- The upper product thickness must be greater than 5.1 in. (0.13 m) for all probes, except the HTHP coaxial probe, which requires 8 in. (0.2 m), to distinguish the echoes of the two liquids

The maximum allowable upper product thickness/measuring range is primarily determined by the dielectric constants of the two liquids.

Target applications include interfaces between oil / oil-like and water / water-like liquids with a low (<3) dielectric constant for the upper product and a high (>20) dielectric constant for the lower product.

For such applications, the maximum measuring range is limited by the length of the coaxial, rigid twin, and rigid single lead probes.

For flexible probes, the maximum measuring range is reduced by the maximum upper product thickness, according to the diagram below. However, characteristics may vary between the different applications.

Figure 2-9. Maximum Upper Product thickness for the Flexible Single Lead probe.

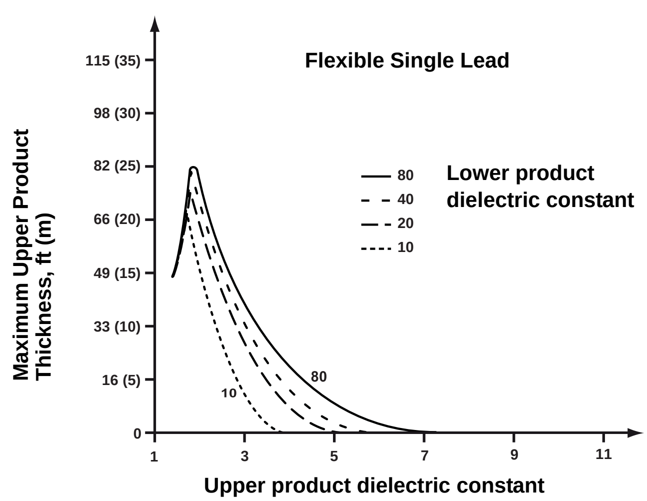
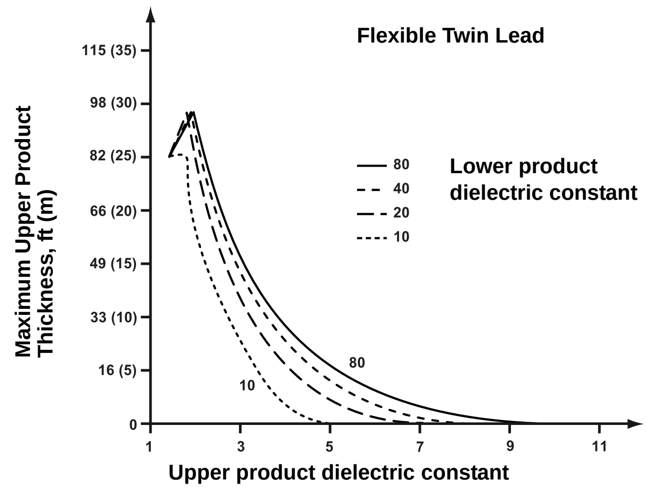


Figure 2-10. Maximum Upper Product thickness for the Flexible Twin Lead probe.



NOTE!
Maximum distance to the interface = 164 ft.(50 m) - Maximum Upper Product Thickness.

Emulsion Layers

Sometimes an emulsion layer (mix of the products) forms between the two products and can affect interface measurements. For assistance with emulsion applications, consult your local Emerson Process Management representative.

VESSEL CHARACTERISTICS

Heating Coils, Agitators

Because the radar signal is transmitted along a probe, the Rosemount 5300 Radar transmitter is generally not affected by objects in the tank. Avoid physical contact with metallic objects when Twin Lead or Single Lead probes are used.

Avoid physical contact between probes and agitators, as well as applications with strong fluid movement, unless the probe is anchored. If the probe is able to move 1 ft. (30 cm) from any object, such as an agitator, during operation, the probe tie-down is recommended.

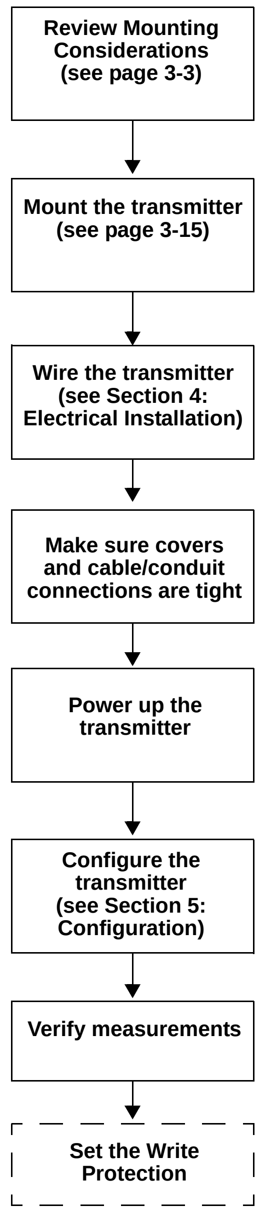
To stabilize the probe for side forces, a weight may be hung at the probe end (flexible probes only) or fix/guide the probe to the tank bottom.

Tank Shape

The guided wave radar transmitter is insensitive to tank shape. Since the radar signal travels along a probe, the shape of the tank bottom has virtually no effect on the measurement performance. The transmitter can handle flat or dish-bottom tanks.

INSTALLATION PROCEDURE

Follow these steps for proper installation:



Section 3 Mechanical Installation

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

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 services other than those contained in this manual unless you are qualified.

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.

⚠WARNING

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

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.

⚠WARNING

Any substitution of non-authorized parts or repair, other than exchanging the complete transmitter head or probe assembly, may jeopardize safety and is prohibited.

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

MOUNTING CONSIDERATIONS

Before installing the Rosemount 5300 Series Radar Transmitter, consider specific mounting requirements, vessel and process characteristics.

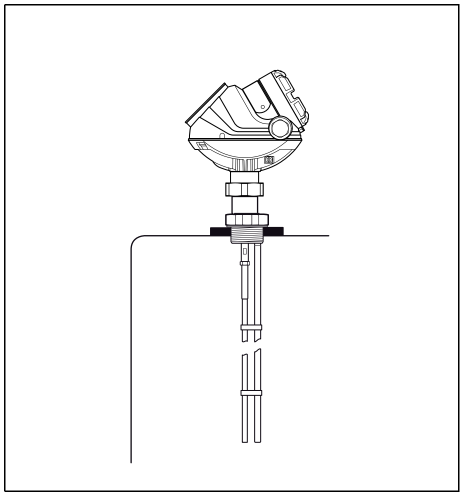
For **Remote Housing** installation see Appendix D: Remote Mounting.

Process Connection

The Rosemount 5300 Series has a threaded connection for easy mounting on a tank roof. It can also be mounted on a nozzle by using different flanges.

Threaded Connection

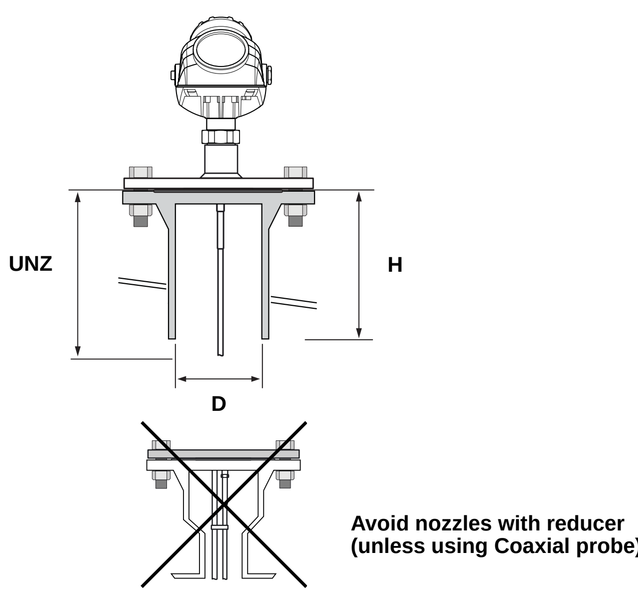
Figure 3-1. Mounting on tank roof using threaded connection.



Mounting on tank roof.

Flange Connection on Nozzles

Figure 3-2. Mounting in nozzles



The transmitter can be mounted in nozzles by using an appropriate flange. The nozzle sizes given in *Table 3-1* show the recommended dimensions. For small nozzles, it may be necessary to increase the Upper Null Zone (UNZ) to reduce the measuring range in the upper part of the tank. Amplitude Threshold adjustments may also be needed in this case. A Trim Near Zone is recommended in most nozzle installations, for example, when there are disturbing obstacles in the near zone. See Appendix C: Handling of Disturbances from Nozzle on page C-4.

NOTE!
The probe should not contact the nozzle, with the exception of the Coaxial Probe. If the nozzle diameter is less than recommended, the measuring range may be reduced.

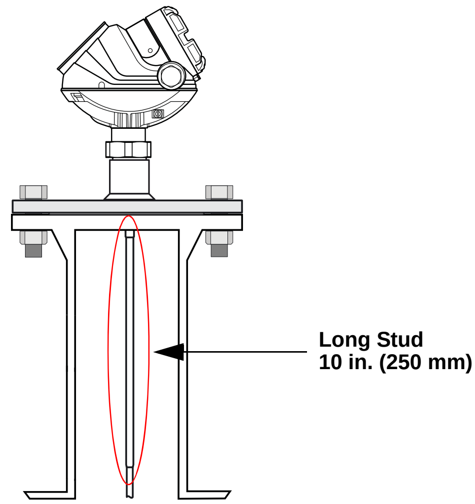
Table 3-1. Nozzle considerations

	Single (Rigid/Flexible)	Coaxial	Twin (Rigid/Flexible)
Recommended Nozzle Diameter (D)	6 in. (150 mm)	> Probe Diameter	4 in. (100 mm)
Minimum Nozzle Diameter (D)(1)	2 in. (50 mm)	> Probe Diameter	2 in. (50 mm)
Recommended Nozzle Height (H)(2)	4 in. + Nozzle Diameter(3)	N/A	4 in. + Nozzle Diameter

(1) The Trim Near Zone function may be necessary or an Upper Null Zone setup may be required to mask the nozzle.
(2) Longer nozzles may be used in certain applications. Consult your local Emerson Process Management representative for details.
(3) When using single flexible probes in tall nozzles, it is recommended to use the Long Stud (LS).

A long stud - 10 in. (250 mm) - is recommended for single flexible probes in a tall nozzle.

Figure 3-3. A single flexible probe with a long stud.

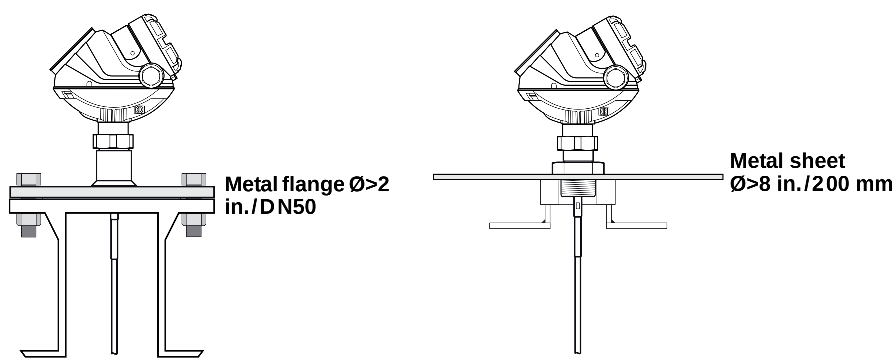


NOTE!
For single lead probes, avoid 10-in. (250 mm)/DN250 or larger diameter nozzles, especially in applications with low dielectric constant. An alternative is to install a smaller nozzle inside the nozzle.

Installation of Single Lead Probes in Non-metallic Vessels

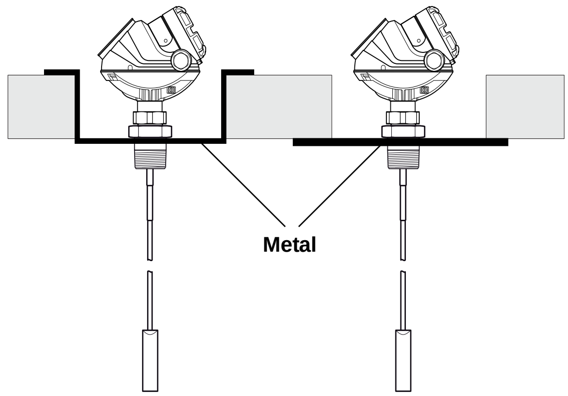
For optimal single lead probe performance in non-metallic (plastic) vessels, the probe must be mounted with a metal flange, or screwed in to a metal sheet (d>8 in./200 mm), if the threaded version is used.

Figure 3-4. Mounting in non-metallic vessels.



Electromagnetic disturbances should be kept to a minimum since they may affect measurement performance.

Installation in Concrete Silos



Considerations for Solid Applications

The flexible single lead probe is recommended for solids and is available in two versions to handle different loads and lengths:

- 0.16 in. (4 mm) diameter
  Tensile strength is minimum 2698 lb (12 kN)
  Collapse load is maximum 3597 lb (16 kN)
- 0.24 in. (6 mm) diameter
  Tensile strength is minimum 6519 lb (29 kN)
  Collapse load is maximum 7868 lb (35 kN)

Keep the following in mind when planning installation of the Rosemount 5300 in solid applications:

- There might be considerable down-pull forces on silo roofs caused by the media, so the silo roof must withstand the maximum probe tensile load
- The tensile load depends on silo size, material density, and the friction coefficient. Forces increase with the buried length, the silo, and probe diameter
- In critical cases, such as for products with a risk for build-up, use a 0.24 in. (6 mm) probe
- Depending on position, forces on probes are two to ten times greater on probes with tie-down, than on probes with ballast weights(1)

Guidelines for the tensile load from free-flowing solids acting on a suspended probe without any tie-down or weight in a smooth metallic wall silo as shown in Table 3-2. A safety factor of 2 is included for the figures. Consult your local Emerson Process Management representative for more information.

(1) The weight should not be fixed for probe 100 ft (30 m) or longer.

Table 3-2. Pulling force on probe installed in tanks with different products

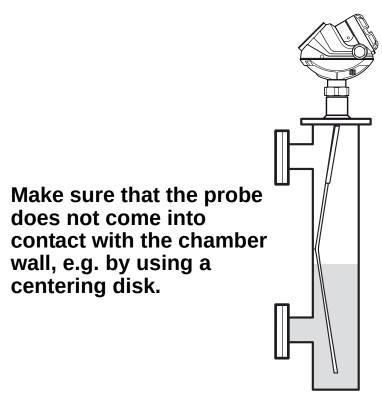
Material	Tensile load for 0.16 in. (4 mm) flexible single lead probe, lb (kN)				Tensile load for 0.24 in. (6 mm) flexible single lead probe, lb (kN)			
	Probe length 49 ft (15 m)		Probe length 115 ft (35 m)		Probe length 49 ft (15 m)		Probe length 115 ft (35 m)	
	Tank Ø= 10 ft (3 m)	Tank Ø= 39 ft (12 m)	Tank Ø= 10 ft (3 m)	Tank Ø= 39 ft (12 m)	Tank Ø= 10 ft (3 m)	Tank Ø= 39 ft (12 m)	Tank Ø= 10 ft (3 m)	Tank Ø= 39 ft (12 m)
Wheat	670 (3)	1120 (5)	1800 (8)	4500 (20) Exceeds tensile strength limit	900 (4)	1690 (7.5)	2810 (12.5)	6740 (30) Exceeds tensile strength limit
Polypropylene Pellets	340 (1.5)	670 (3)	810 (3.6)	2360 (10.5)	450 (2)	920(4.1)	1190 (5.3)	3510 (15.6)
Cement	900 (4)	2020 (9)	2470 (11)	7310 (32.5) Exceeds tensile strength limit	1350 (6)	2920 (13)	3600 (16)	10790 (48) Exceeds tensile strength limit

NOTE!
For environments where electrostatic discharges (plastics) are likely to occur, it is recommended that the probe end is grounded.

Mounting in Chamber/ Still Pipe

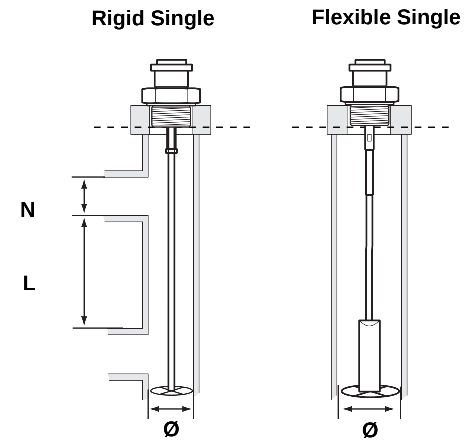
The chamber is also known as bridle, side pipe, bypass pipe, and cage. Dimensioning the chamber correctly and selecting the appropriate probe is key to the success in these applications.

To prevent the probe from contacting the wall, centering discs are available for the Rigid Single, Flexible Single, and Flexible Twin Lead Probes. The disc is attached to the end of the probe, and thus keeps the probe centered in the chamber. See also “Mounting a Centering Disc for Pipe Installations“ on page 3-25.



NOTE!
To avoid disturbances from object near the pipe, metal-pipes are preferred, especially in applications with low dielectric constant.

Figure 3-5. Mounting Single Probe in Chamber/Still Pipe



Inlet pipe diameter N<Ø. Effective measuring range L≥12 in. (300 mm).

Table 3-3. Recommended and minimum chamber/still pipe diameters for different probes.

Probe Type	Recommended Diameter	Minimum Diameter
Rigid Single	3 or 4 in. (75 or 100 mm)	2 in. (50 mm)
Flexible Single	4 in. (100 mm)	Consult your local Emerson Process Management representative
Rigid Twin(1)	3 or 4 in. (75 or 100 mm)	2 in. (50 mm)
Flexible Twin(1)	4 in. (100 mm)	Consult your local Emerson Process Management representative
Coaxial	3 or 4 in. (75 or 100 mm)	1.5 in. (37.5 mm)

(1) The center rod must be placed more than 0.6 in. (15 mm) away from the pipe wall.

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 cause problems with build-up and it may also be difficult to avoid contact between chamber wall and probe. Chambers larger than 6 in. (150 mm) can be used but provide no advantages for radar measurement.

It is recommended that single probes are used with the Rosemount 5300 Series. Other probe types are more susceptible to build-up and are not recommended.(1) An exception is with liquefied gas > 40 bar when the coaxial probe should be used.

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

Less than 14.7 ft (4.5 m): Rigid Single Probe is recommended. Use a centering disc for a probe > 3.3 ft. (1 m). If installation requires less head-space, use a Flexible Single Probe with a weight and centering disc.(2)

More than 14.7 ft (4.5 m): Use Flexible Single Probe with a weight and centering disc.

(1) The single probe creates a virtual coaxial probe with the chamber as the outer tube. The extra gain provided by the twin and coaxial probes is not necessary; the electronics in the Rosemount 5300 Series is very sensitive and is not a limiting factor.

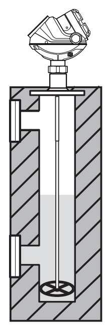
(2) The transition zones and the height of the weight limit the use of single flexible probes shorter than 3 ft. (1 m). If using the flexible probe, the short weight is recommended.

A short weight for the single flexible 0.16 in. (4 mm) SST probe can be used for measuring close to the probe end. The height is 2 in. (50 mm) and the diameter is 1.5 in.
(37.5 mm). Option code W2.

For hot applications, the chamber should always be insulated to prevent personal injuries and to reduce the amount of energy needed for heating. See Figure 3-6. It is often an advantage, and sometimes even required, for the radar measurement:

- In hot applications, insulation reduces the amount of condensation, since it prevents the upper part of the chamber from becoming a cold spot
- Insulation prevents product solidification inside the chamber, and clogging of the inlet-pipes

Figure 3-6. Insulated Chamber.

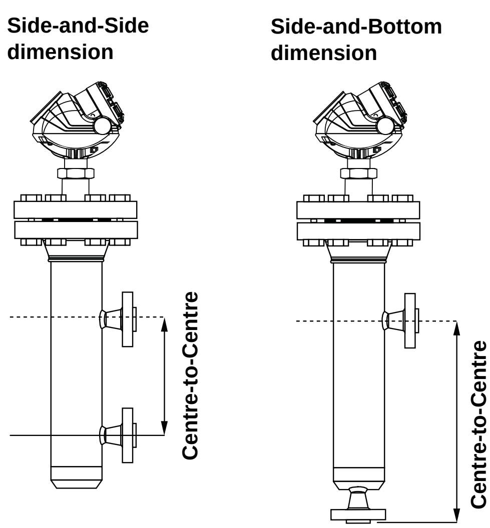


See page 3-14 for more information.

When mounting in a Rosemount 9901 chamber, the probe length to use can be calculated with these formulas:

Side-and-Side dimension: Probe length = Centre-to-Centre dimension + 19 in. (48 cm)

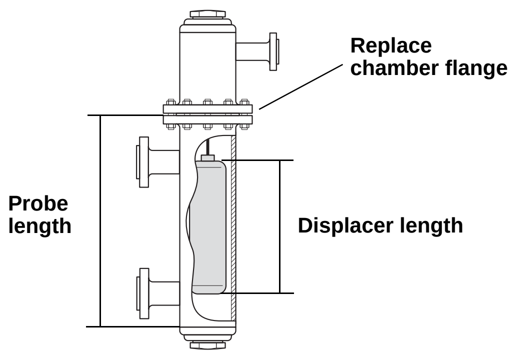
Side-and-Bottom dimension: Probe length = Centre-to-Centre dimension + 4 in. (10 cm)



NOTE!
The formulas are not valid when using Dynamic Vapor Compensation probes.

Replacing a Displacer in an Existing Displacer Chamber

A Rosemount 5300 Series transmitter is the perfect replacement for an existing displacer chamber. To simplify installation, proprietary flanges are offered to allow for using the same chambers.



Rosemount 5300 benefits

- No moving parts: Less maintenance - dramatically reduced costs, and as a result, improved measurement availability
- Reliable measurement, that is independent of density, turbulence, and vibrations

Considerations when changing to Rosemount 5300

When changing from a displacer to a Rosemount 5300 Series transmitter, make sure to correctly match the 5300 Series flange choice and probe length to the chamber. Both standard ANSI and EN (DIN), as well as proprietary chamber flanges are available.

Table 3-4 shows probe length guidelines.

Table 3-4. Required Probe Length Depending on Chamber Manufacturers

Chamber Manufacturer	Probe Length(1)
Major torque-tube manufacture (249B, 249C, 2449K, 249N, 259B)	Displacer + 9 in. (229 mm)
Masoneilan (Torque tube operated), proprietary flange	Displacer + 8 in. (203 mm)
Others - torque tube(2)	Displacer + 8 in. (203 mm)
Magnetrol (spring operated)(3)	Displacer + between 7.8 in. (195 mm) to 15 in. (383 mm)
Others - spring operated	Displacer + 19.7 in. (500 mm)

(1) If flushing ring is used, add 1 in. (25 mm).
(2) For other manufacturers, there are small variations. This is an approximate value, actual length should be verified.
(3) Lengths vary depending on model, SG and rating, and should be verified.

Free Space

For easy access to the transmitter, make sure it is mounted with sufficient service space. For maximum measurement performance, the transmitter should not be mounted close to the tank wall or near other objects in the tank.

If the probe is mounted close to a wall, nozzle or other tank obstruction, noise may appear in the level signal. The minimum clearance shown in Table 3-5 and Table 3-6 is recommended:

Figure 3-7. Free Space Requirement

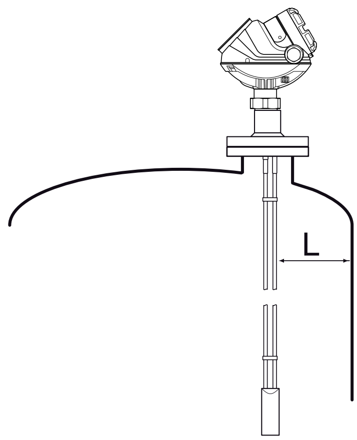


Table 3-5. Recommended minimum free space **L** to tank wall or other objects in the tank

Coaxial	Rigid Twin	Flexible Twin
0 in. (0 mm)	4 in. (100 mm)	4 in. (100 mm)

Table 3-6. Recommended minimum free space **L** to tank wall or other objects in the tank for Single Lead probes

Rigid Single/Flexible Single	
4 in. (100 mm)	Smooth metal wall.
20 in. (500 mm)(1)	Disturbing objects such as pipes and beams, concrete or plastic tank walls, rugged metal tank walls.

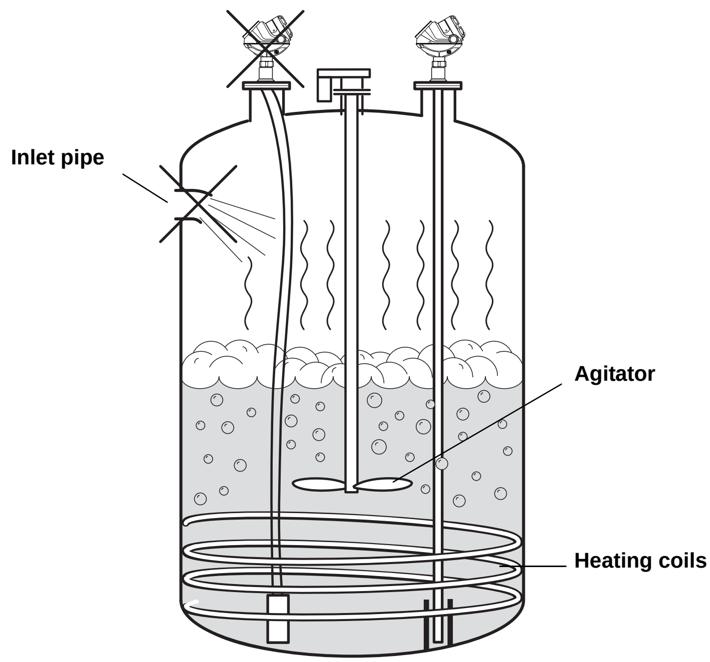
(1) When measuring in low DC (around 1.4). For higher DC, the recommended free space is lower.

Recommended Mounting Position for Liquids

Tank conditions are recommended to be carefully considered when finding the appropriate mounting position for the transmitter. The transmitter should be mounted so the influence of disturbing objects is reduced to a minimum.

In case of turbulence, the probe may need to be anchored to the bottom. See *“Anchoring“ on page 3-22* for more information.

Figure 3-8. Mounting Position

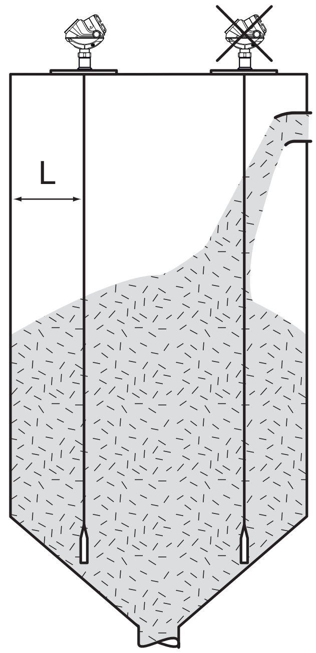


When mounting the transmitter the following guidelines should be considered:

- Do not mount close to inlet pipes
- Do not mount close to agitators. If the probe can move to within 30 cm away from an agitator, a probe tie-down is recommended
- If the probe tends to sway from the turbulent conditions in the tank, the probe should be anchored to the tank bottom
- Avoid mounting near heating coils
- The nozzle should not extend into the tank
- The probe should not come into contact with the nozzle or other objects in the tank
- Position the probe so it is subject to a minimum of lateral force

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

Recommended Mounting for Solids



Consider the following guidelines when mounting the transmitter:

- Do not mount near inlet pipes in order to avoid product filling on the probe
- Regularly check the probe for defects
- It is recommended that the vessel be empty during installation
- For concrete vessels, the distance (L) between the probe and the wall should be at least 20 in. (500 mm)
- Stabilize the probe for side forces, by attaching the probe to the tank bottom.
  For solids, use the 0.24 in. (6 mm) probe, because of the higher tensile strength. The probe should have a sag of ≥ 1 in./100 in. (1 cm/m) to prevent probe damage. See “Anchoring“ on page 3-22 for more information
- Avoid anchoring in solids tanks over 98 ft (30 m) in height since tensile loads are much stronger for anchored probes, see “Considerations for Solid Applications“ on page 3-6
- Product build-up on the silo walls near the probe may interfere with measurements. Choose a mounting position where the probe is not in contact with, or close to, the product build-up

Insulated Tanks

When the Rosemount 5300 is installed in high temperature applications, consider the maximum ambient temperature. Tank insulation should not exceed 4 in. (10 cm).

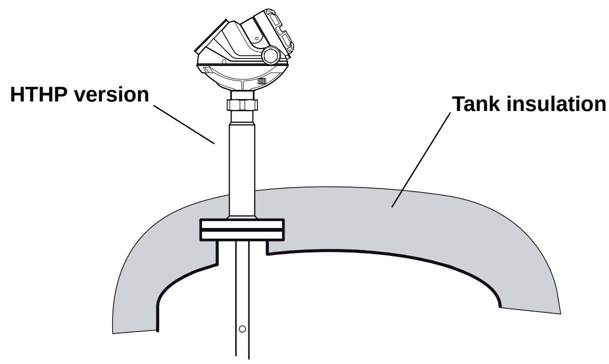
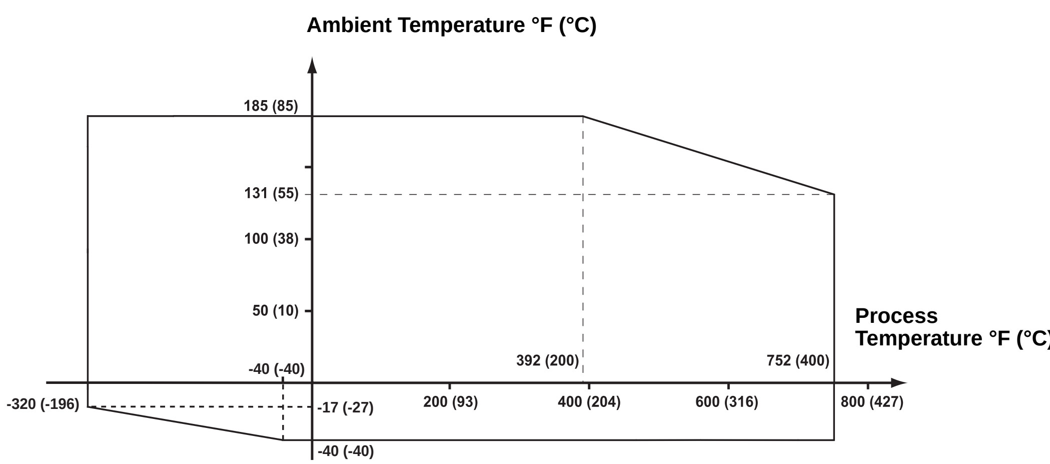


Figure 3-9. Ambient temperature vs. process temperature.



MOUNTING

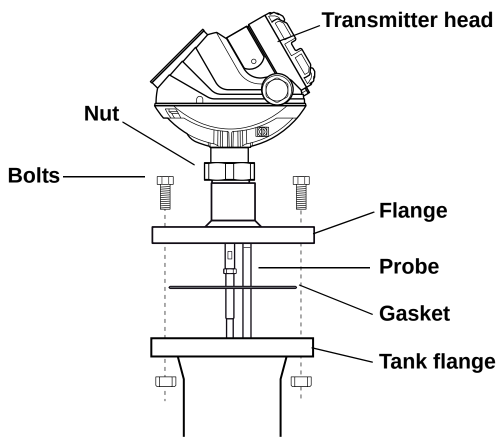
Mount the transmitter with flange on a nozzle on top of the tank. The transmitter can also be mounted on a threaded connection. Make sure only qualified personnel perform the installation.

NOTE!
If you need to remove the transmitter head from the probe, make sure that the Process Seal is carefully protected from dust and water. See *“Removing the Transmitter Head“ on page 7-28* for further information.

NOTE!
PTFE covered probes must be handled carefully to prevent damage to the coating.

Flange Connection

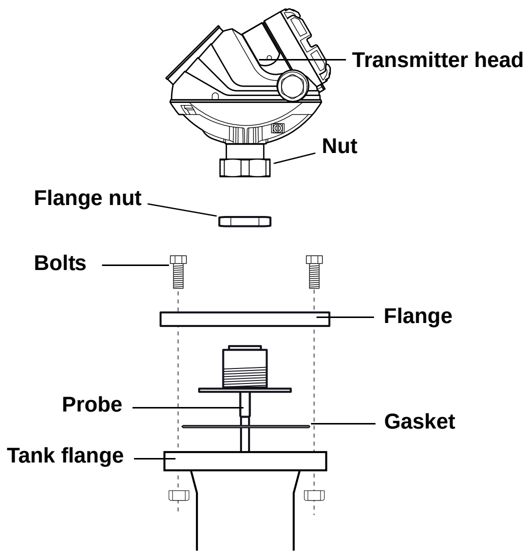
Figure 3-10. Tank connection with flange.



The transmitter is delivered with head, flange, and probe assembled into one unit.

1. Place a gasket on top of the tank flange.
2. Lower the transmitter and probe with flange into the tank.
3. Tighten the bolts.
4. Loosen the nut that connects the transmitter housing to the probe slightly.
5. Rotate the transmitter housing so the cable entries/display face the desired direction.
6. Tighten the nut.

Figure 3-11. Tank connection with loose flange ("plate design").



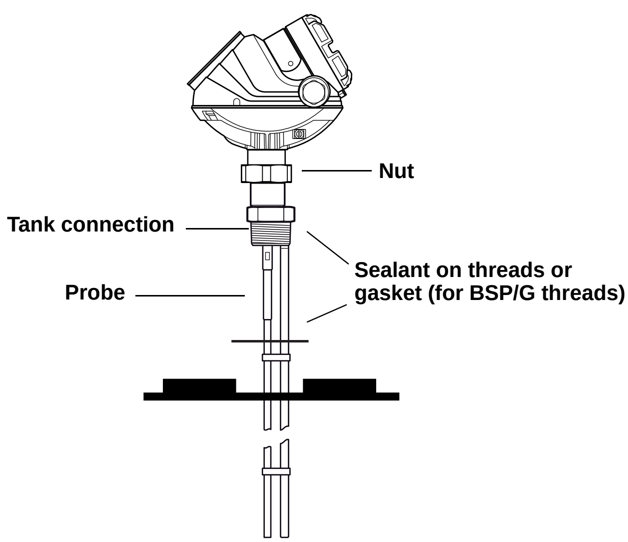
Transmitters delivered with Alloy probes featuring plate design are mounted as described below:

1. Place a gasket on top of the tank flange.
2. Mount(1) the flange on the probe and tighten the flange nut.
3. Mount(1) the transmitter head.
4. Lower the transmitter and probe with flange into the tank.
5. Tighten the bolts.
6. Loosen the nut that connects the transmitter housing to the probe slightly.
7. Rotate the transmitter housing so the cable entries/display face the desired direction.
8. Tighten the nut.

(1) Flange and transmitter head are normally mounted at the factory.

Threaded Connection

Figure 3-12. Threaded tank connection.

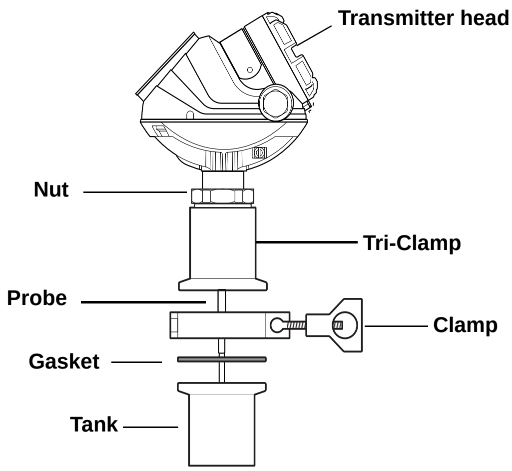


1. For tank connections with BSP/G threads, place a gasket on top of the tank flange, or use a sealant on the threads of the tank connection.
2. Lower the transmitter and probe into the tank.
3. Screw the adapter into the process connection.
4. Loosen the nut that connects the transmitter housing to the probe slightly.
5. Rotate the transmitter housing so the cable entries/display face the desired direction.
6. Tighten the nut.

NOTE!
For adapters with NPT threads, pressure-tight joints require a sealant.

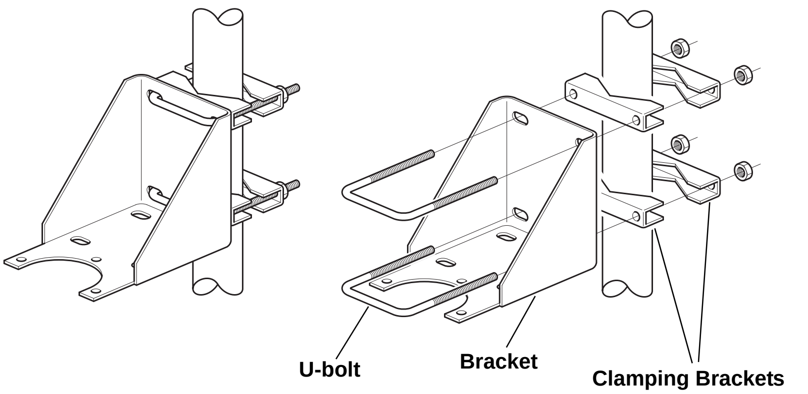
Tri-Clamp Connection

Figure 3-13. Tri-Clamp tank connection.



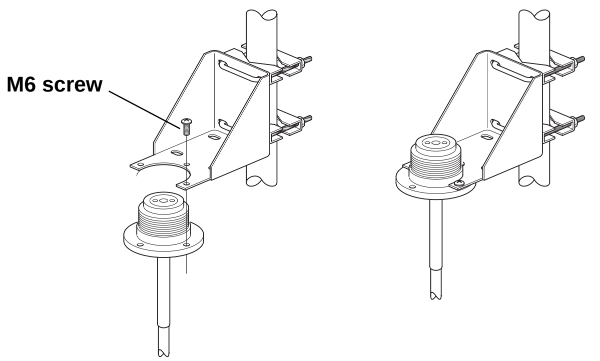
1. Place a gasket on top of the tank flange.
2. Lower the transmitter and probe into the tank.
3. Fasten the Tri-Clamp to the tank with a clamp.
4. Loosen the nut that connects the transmitter housing to the probe slightly.
5. Rotate the transmitter housing so the cable entries/display face the desired direction.
6. Tighten the nut.

Bracket Mounting



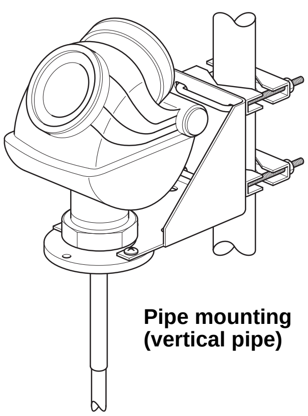
Mount the bracket to the pole

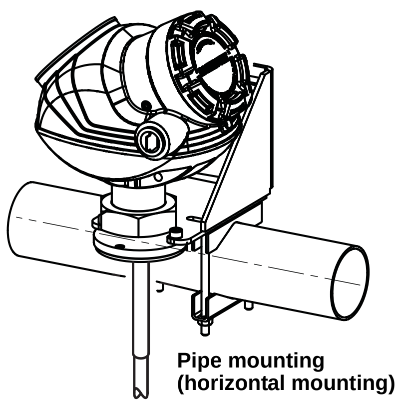
1. Put the two U-bolts through the holes of the bracket. Several holes are available for vertical/horizontal pipe mounting.
2. Put the clamping brackets on the U-bolts and around the pipe.
3. Use the supplied nuts to fasten the bracket to the pipe.



Fasten the housing support to the bracket

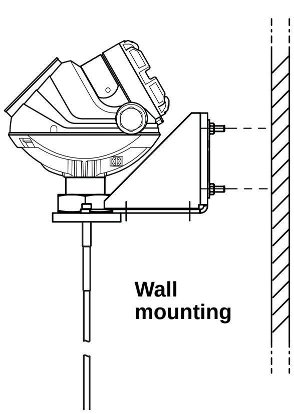
Fasten the housing support to the bracket using the M6 screws. The screws are threaded through the top of the mounting bracket and into the housing support.





Connect the transmitter head on the probe

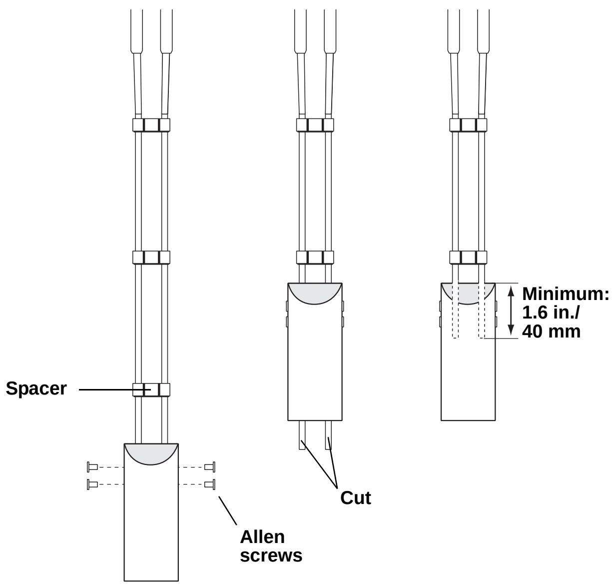
Connect the transmitter head on the probe, making sure that the M50 nut is properly tightened.



Shortening the Probe

NOTE!
HTHP Coaxial and PTFE probes must not be shortened.

Flexible Twin/Single Lead



1. Mark off the required probe length. Add at least 1.6 in. (40 mm) to the required probe length to be inserted into the weight.
2. Loosen the Allen screws.
3. Slide the weight upwards as much as needed in order to cut the probe.
4. Cut the probe. If necessary, remove a spacer to make room for the weight.
5. Slide the weight down to the required cable length.
6. Tighten the screws. Required torque:

   M6: 7 Nm

   M8: 15 Nm

   M10: 25 Nm
7. Update the transmitter configuration to the new probe length, see “Tank and Probe Geometry“ on page 5-4 and “Probe“ on page 5-21.

If the weight was removed from the cables when cutting, make sure that at least 1.6 in. (40 mm) of the cable is inserted when the weight is replaced.

NOTE!
If the screws are not tightened according to the required torque, the weight may fall off. This is especially important for solid applications with high tensile loads on the probe.

Rigid Single Lead

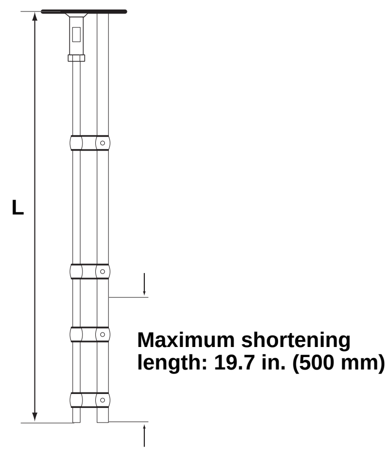
1. Cut the Single Lead probe to the desired length. The minimum probe length is 15.7 in. (400 mm).
2. If a centering disc is used, follow the instructions on page 3-26.
3. Update the transmitter configuration to the new probe length, see “Tank and Probe Geometry“ on page 5-4 and “Probe“ on page 5-21.

Rigid Twin Lead

The spacers are put closer together at the probe end. The maximum amount that can be cut is related to the ordering length **L**.

To cut a Rigid Twin Lead probe:

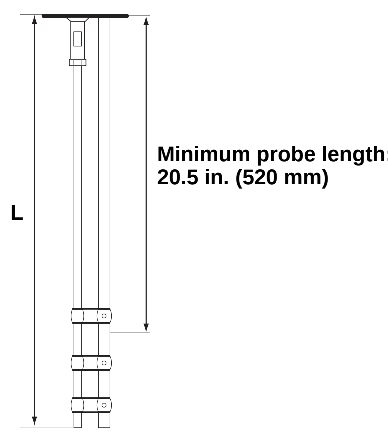
L>46.5 in. (1180 mm)



1. Cut the rods to the desired length:
   - You may cut up to 19.7 in. (500 mm) from the probe end for probe length **L** above 46.5 in. (1180 mm)
   - For probe length 20.5 to 46.5 in. (520 to 1180 mm) the minimium length is 20.5 in. (520 mm)
   - For probe length 15.7 to 20.5 in. (400 to 520 mm) the minimium length is 15.7 in. (400 mm)

20.5 < L<46.5 in.

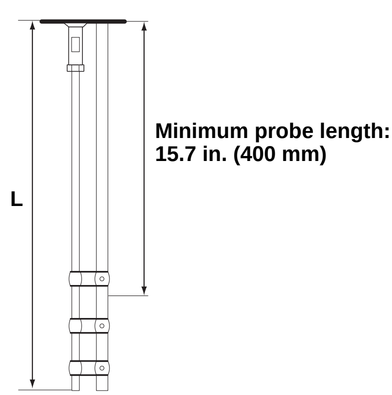
(520 mm< L <1180 mm)



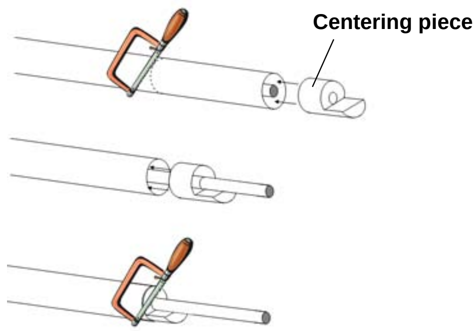
2. Update the transmitter configuration to the new probe length, see “Tank and Probe Geometry“ on page 5-4 and “Probe“ on page 5-21.

15.7< L<20.5 in.

(400< L<520 mm)



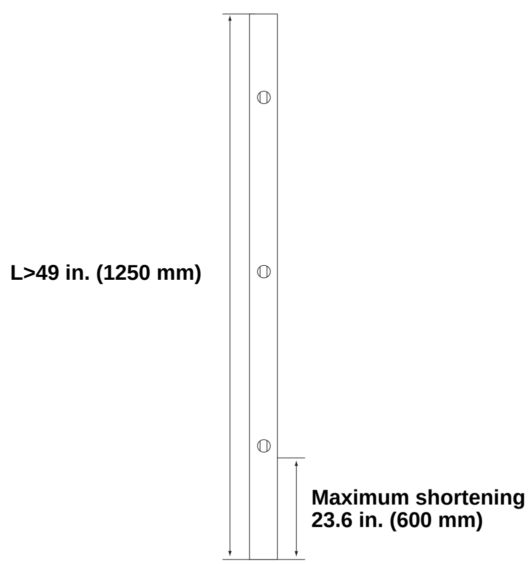
Coaxial



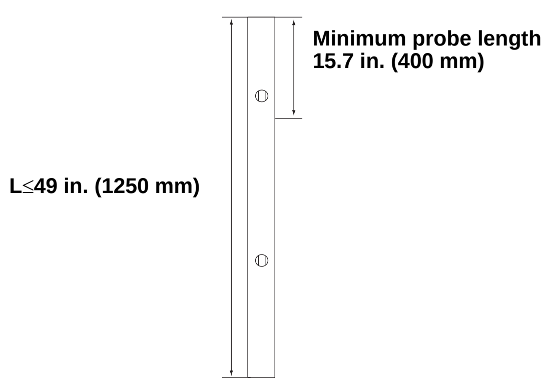
To cut a coaxial probe:

NOTE!
The HTHP coaxial probe must not be cut in field.

1. Insert the centering piece. (**The centering piece is delivered from factory and should be used to prevent the spacers centering the rod from coming loose**).
2. Cut the tube to the desired length.
3. Move the centering piece.
4. Cut the rod inside the tube. Make sure that the rod is fixed with the centering piece while cutting.
   - Pipes longer than 49 in. (1250 mm) can be shortened by as much as 23.6 in. (600 mm)
   - Pipes shorter than 49 in. (1250 mm) can be cut as long as the remaining length is not less than 15.7 in. (400 mm)

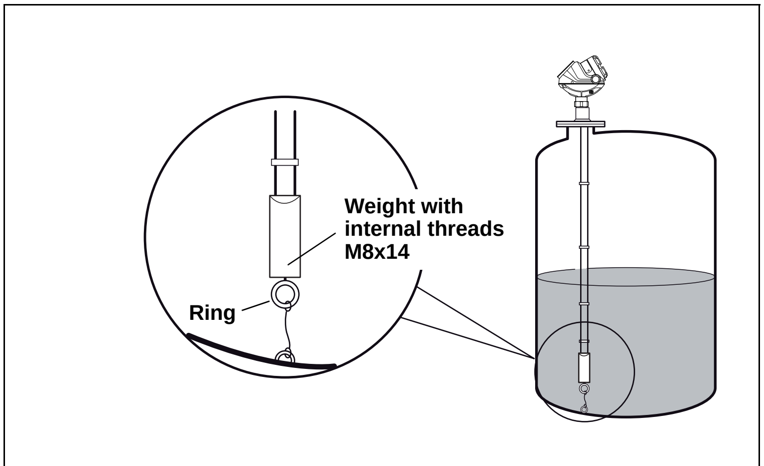


5. Update the transmitter configuration to the new probe length, see “Tank and Probe Geometry“ on page 5-4 and “Probe“ on page 5-21.



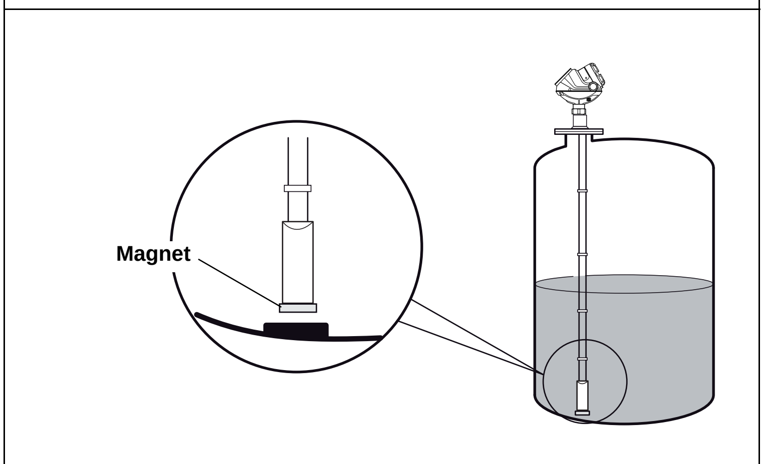
Anchoring

In turbulent tanks, it may be necessary to fix the probe. Depending on the probe type, different methods can be used to guide the probe to the tank bottom. This may be needed to prevent the probe from hitting the tank wall or other objects in the tank, as well as preventing a probe from breaking.



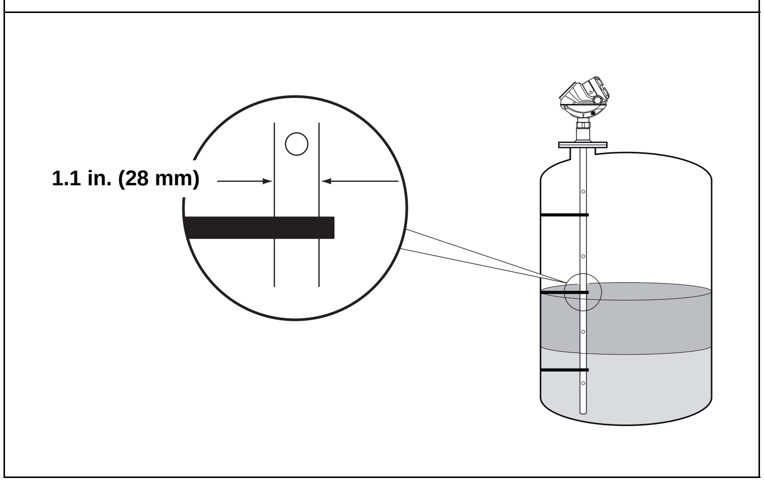
Flexible Twin/Single Lead probe with weight and ring.

A ring (customer supplied) can be attached to the weight in a threaded (M8x14) hole at the end of the weight. Attach the ring to a suitable anchoring point.



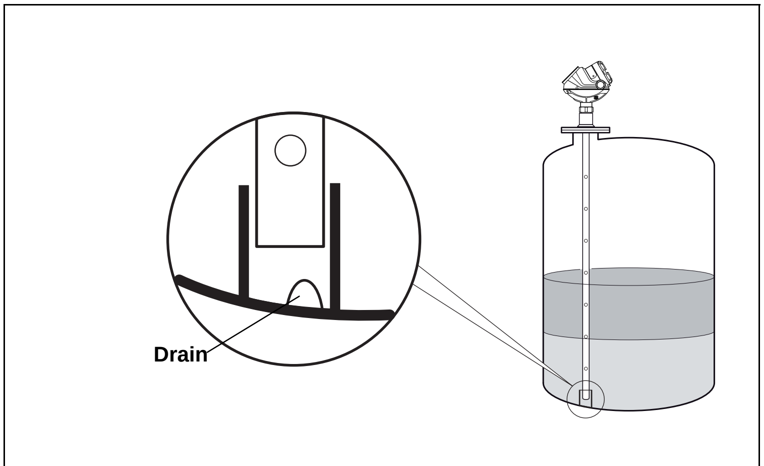
Flexible Twin/Single Lead probe with weight and magnet.

A magnet (customer supplied) can be fastened in a threaded (M8x14) hole at the end of the weight. The probe can then be guided by placing a suitable metal plate beneath the magnet.



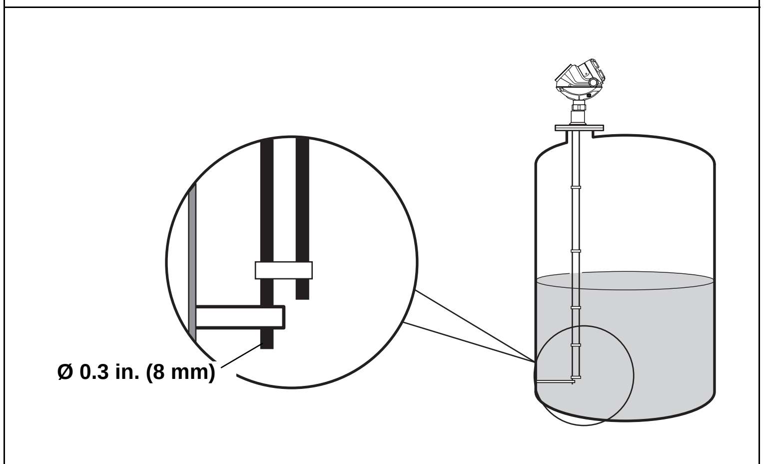
Coaxial probe fixed to the tank wall.

The coaxial probe can be guided to the tank wall by fixtures fastened to the tank wall. Fixtures are customer supplied. Make sure the probe can move freely due to thermal expansion without getting stuck in the fixture.



Coaxial probe.

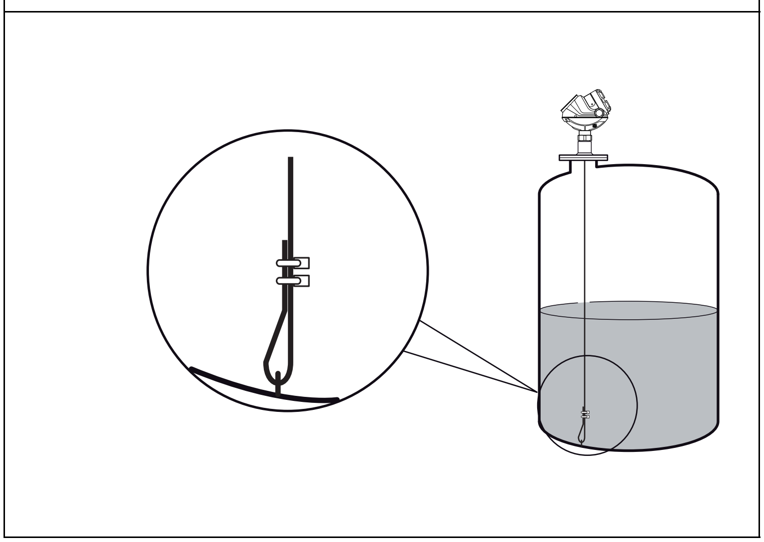
The Coaxial probe can be guided by a tube welded on the tank bottom. Tubes are customer supplied. Make sure that the probe can move freely in order to handle thermal expansion.



Rigid Twin Lead probe.

The Rigid Twin Lead probe can be secured to the tank wall by cutting the center rod and putting a fixture at the end of the outer rod.

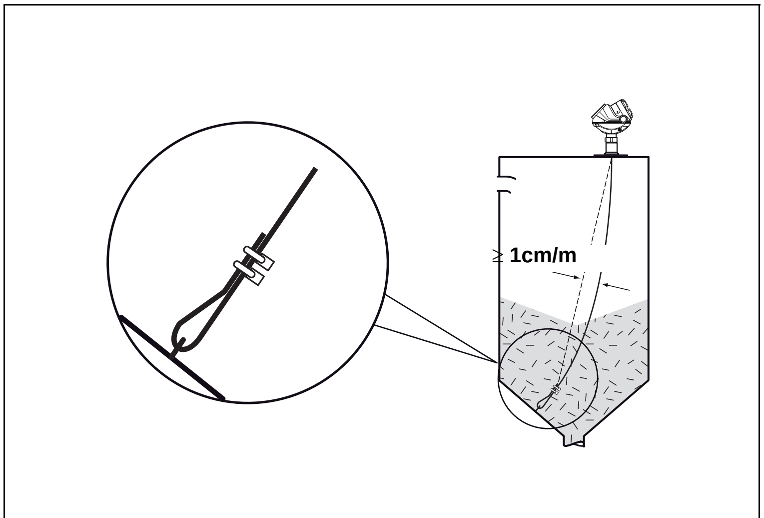
The fixture is customer supplied. Make sure the probe is only guided and not fastened in the fixture to be able to move freely for thermal expansion.



Flexible Single Lead probe.

The probe rope itself can be used for anchoring. Pull the probe rope through a suitable anchoring point, e.g. a welded eye and fasten it with two clamps.

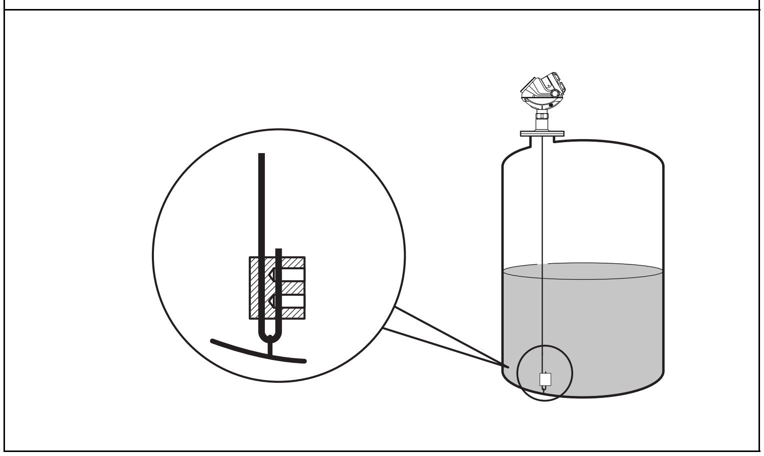
The length of the loop will add to the transition zone.The location of the clamps will determine the beginning of the transition zone. The probe length should be configured as the length from the underside of the flange to the top clamp. See section “Transition Zones“ on page 2-10 for further information on Transition Zones.



Solid Applications

Pull the probe rope through a suitable anchoring point, e.g. a welded eye and fasten it with two clamps. It is recommended that the probe is slack in order to prevent high tensile loads.

The sag should be at least 1.5 in./10 ft (1 cm/m) of the probe length.



Alternative chuck for Flexible Single Lead probes

Loosen the screws. Pull the probe rope through a suitable anchoring point, e.g. a welded eye.

Tighten the screws. The required torque and hex key dimensions:
4 mm wire: 15 Nm, 4 mm
6 mm wire: 25 Nm, 5 mm

Mounting a Centering Disc for Pipe Installations

To prevent the probe from contacting the bridle wall when replacing displacers or installing in pipes, centering discs are available for rigid single, flexible single, and flexible twin lead probes. The disc is attached to the end of the probe and thus keeps the probe centered in the bridle. The discs are made of stainless steel, Alloy C-276, or PTFE.

When mounting a centering disc, it is important that it fits correctly in the pipe. See Table 3-7 for the appropriate disc diameters.

Table 3-7. Choose the right centering disc diameter for a particular Pipe Schedule.

	Pipe Schedule					
Pipe Size	**5s,5**	**10s,10**	**40s,40**	**80s,80**	**120**	**160**
2 in.	2 in.	2 in.	2 in.	2 in.	NA(1)	NA(2)
3 in.	3 in.	3 in.	3 in.	3 in.	NA(1)	2 in.
4 in.	4 in.	4 in.	4 in.	4 in.	4 in.	3 in.
5 in.	4 in.	4 in.	4 in.	4 in.	4 in.	4 in.
6 in.	6 in.	6 in.	6 in.	6 in.	4 in.	4 in.
7 in.	NA(1)	NA(1)	6 in.	6 in.	NA(1)	NA(1)
8 in.	8 in.	8 in.	8 in.	8 in.	6 in.	6 in.

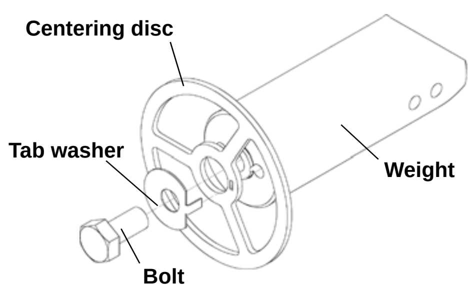
(1) Schedule is not available for pipe size.
(2) No centering disc is available.

This table shows the actual outer diameter for discs.

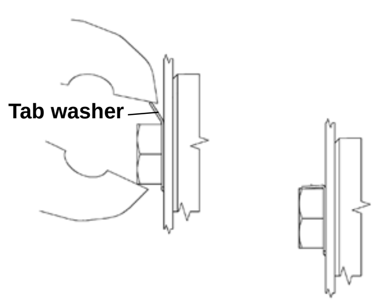
Table 3-8. Outer diameter for discs according to disc size.

Disc Size	Actual Disc Diameter
2 in.	**1.8 in. (45 mm)**
3 in.	**2.7 in. (68 mm)**
4 in.	**3.6 in. (92 mm)**
6 in.	**5.55 in. (141 mm)**
8 in.	**7.4 in. (188 mm)**

Mounting a Centering Disc on Flexible Single Probes



1. Mount the centering disc at the end of the weight.
2. Make sure that the tab washer is properly inserted in the centering disc.
3. Fasten the centering disc with the bolt.



4. Secure the bolt by folding the tab washer.

NOTE!
When using centering discs made of PTFE, note that the maximum temperature is 392 °F (200 °C).

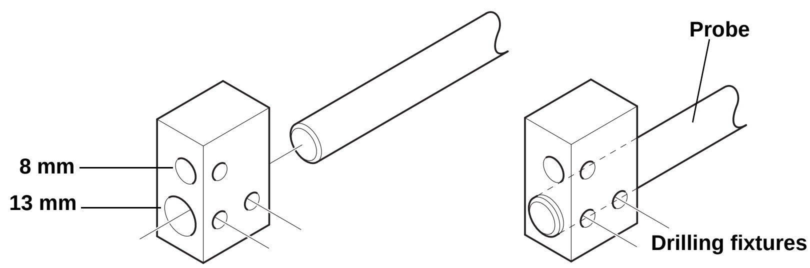
Mounting a Centering Disc on Rigid Single Probes

The mounting of a centering disc on a rigid single lead probe requires one hole (8 mm probe) or two holes (13 mm probe) at certain distances from the end of the lead. The drilling fixture included in your shipment should be used to make the hole(s) according to Figure 3-14.

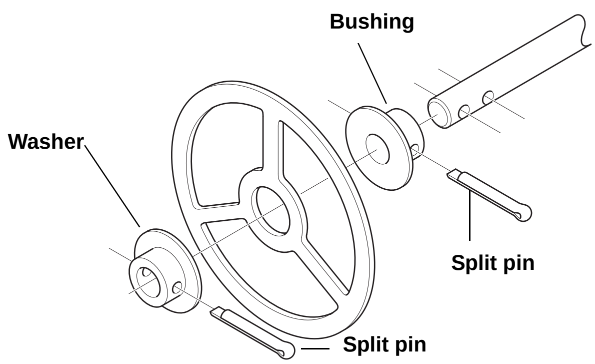
Table 3-9. Hole requirements on probes for mounting a centering disc.

Probe	Minimum distance to hole from probe end	Number of holes	Hole diameter
8 mm	5 mm	1	3.5 mm
13 mm	7 mm (first hole)	2	3.5 mm

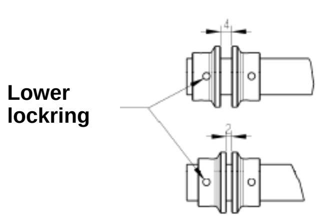
Figure 3-14. Use drill template for proper holes.



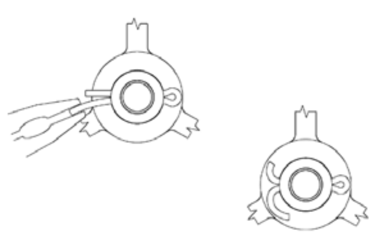
Rigid Single Lead probe (13 mm)



1. Mount the centering disc at the end of the probe.
2. Fasten the disc by inserting the split pins through the bushings and the probe.

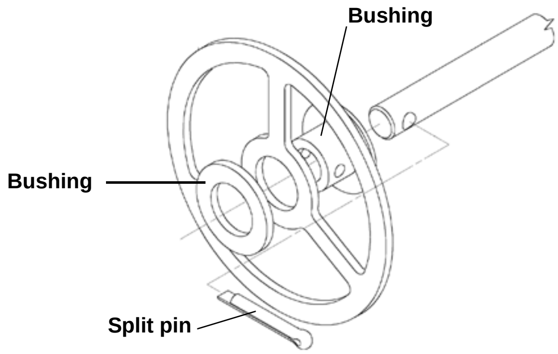


3. Adjust distance by shifting hole for split pin in lower lockring.

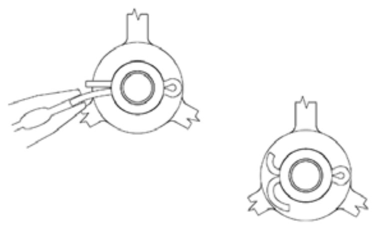


4. Secure the split pin.

Rigid Single Lead probe (8 mm)



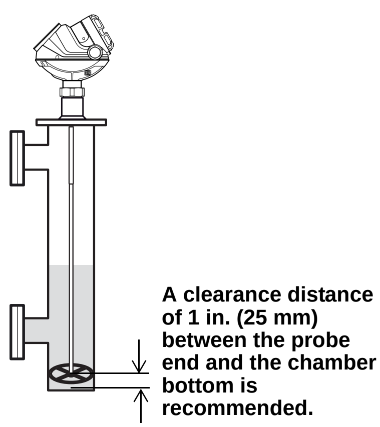
1. Mount the centering disc at the end of the probe.
2. Fasten the disc by inserting the split pin through the bushing and the probe.



3. Secure the split pin.

NOTE!
The washer should not be used if the disc material is C-276.

NOTE!
Centering discs may not be used with PTFE covered probes.



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

Section 4 Electrical Installation

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 transmitter 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.

⚠WARNING

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.

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.

⚠WARNING

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 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.

CABLE/CONDUIT ENTRIES

The electronics housing has two entries for ½ - 14 NPT. Optional M20×1.5, minifast and eurofast adapters are also available. The connections are made in accordance with local or plant electrical codes.

Make sure that unused ports are properly sealed to prevent moisture or other contamination from entering the terminal block compartment of the electronics housing.

NOTE!
Use the enclosed metal plug to seal the unused port. The orange plastic plugs mounted at delivery are not sufficient as seal!

GROUNDING

The housing should always be grounded in accordance with national and local electrical codes. Failure to do so may impair the protection provided by the equipment. The most effective grounding method is direct connection to earth ground with minimal impedance. There are two grounding screw connections provided. One is inside the Field Terminal side of the housing and the other is located on the housing. The internal ground screw is identified by a ground symbol: ⏚.

NOTE!
Grounding the transmitter via threaded conduit connection may not provide sufficient ground.

NOTE!
In the Explosion-proof/Flameproof version, the electronics is grounded via the transmitter housing. After installation and commissioning make sure that no ground currents exist due to high ground potential differences in the installation.

CABLE SELECTION

Use shielded twisted pair wiring for the Rosemount 5300 Series to comply with EMC regulations. The cables must be suitable for the supply voltage and approved for use in hazardous areas, where applicable. For instance, in the U.S., explosion-proof conduits must be used in the vicinity of the vessel. For the ATEX flameproof and the IECEx approval versions of the Rosemount 5300 Series, suitable conduits with sealing device or flameproof (EEx d) cable glands must be used depending on local requirements.

Use 18 AWG to 12 AWG to minimize the voltage drop to the transmitter.

HAZARDOUS AREAS

When the Rosemount 5300 transmitter is installed in a hazardous area, local regulations and specifications in applicable certificates must be observed.

HART

Power Requirements

Terminals in the transmitter housing provide connections for signal cables. The Rosemount 5300 transmitter is loop-powered and operates with the following power supplies:

Hazardous approval	Current: 3.75 mA	Current: 21.75 mA
	Minimum input voltage (U_I)	
Non-Hazardous Installations and Intrinsically Safe Installations	16 Vdc	11 Vdc
Explosion-proof / Flameproof Installations	20 Vdc	15.5 Vdc

The input voltage for HART is 16-42.4 Vdc (16-30 Vdc in IS applications, and 20-42.4 Vdc in Explosion-proof / Flameproof applications).

Maximum Loop Resistance

The maximum current loop resistance (see Figure 4-5 and Figure 4-6) is given by the following diagrams:

Figure 4-1. Explosion-proof /Flameproof installations.

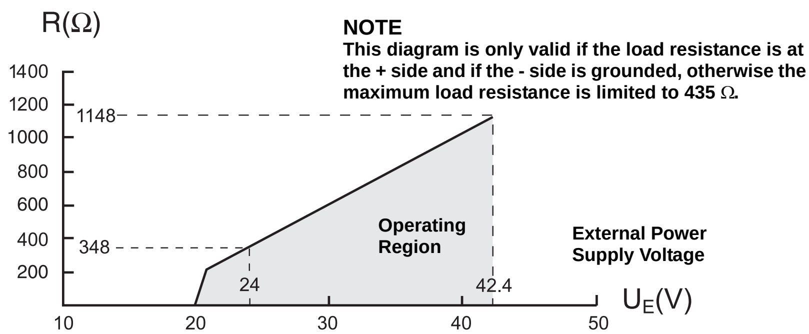


Figure 4-2. Non-hazardous installations.

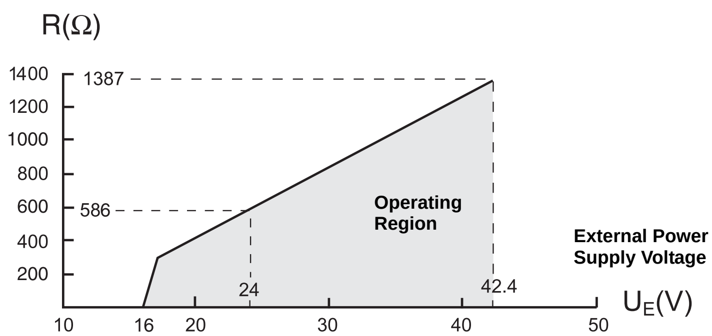
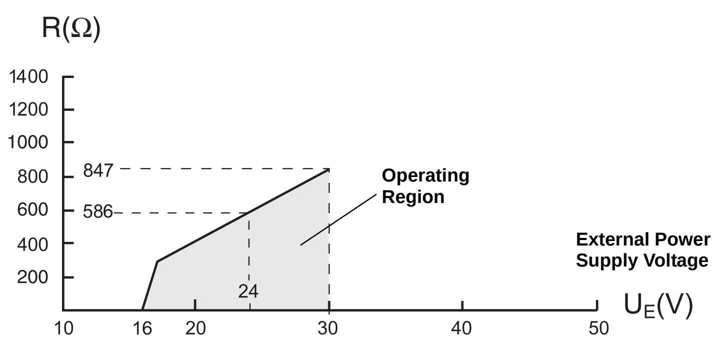


Figure 4-3. Intrinsically Safe installations.



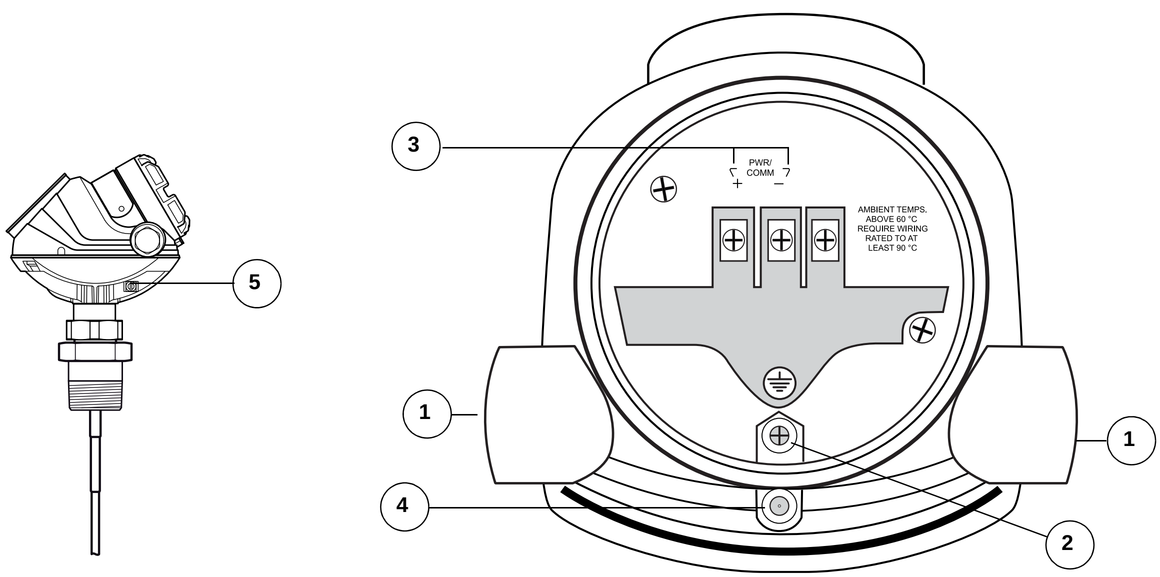
Connecting the Transmitter

To connect the Rosemount 5300 Series transmitter:

1. Make sure the power supply is switched off.
2. Remove the terminal block cover.
3. Pull the cable through the cable gland/conduit. Install wiring with a drip loop. The bottom of the loop must be lower than the cable/conduit entry.
4. Connect wires according to Figure 4-5 for non-intrinsically safe power supplies and according to Figure 4-6 for intrinsically safe power supplies.
5. Use the enclosed metal plug to seal any unused port.
6. Mount the cover and tighten the cable gland making sure the cover is secure to meet explosion-proof requirements.
7. For ATEX, IECEx and NEPSI installations, lock the cover with the Locking Screw 4 .
8. Connect the power supply.

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

Figure 4-4. Terminal compartment and external ground screw.



1 Cable entries.

2 Internal Ground screw.

3 Terminals for signal and power supply.

4 Locking screw.

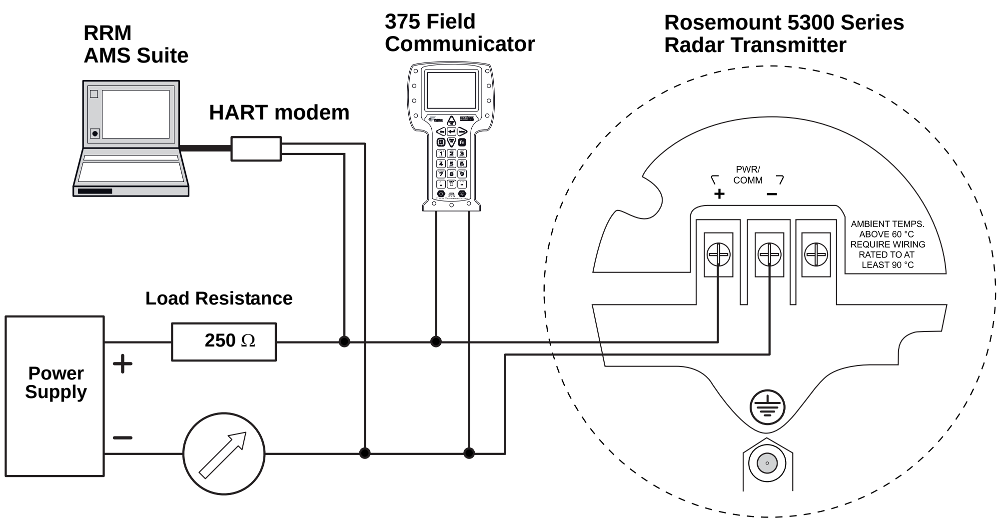
5 External Ground screw

Non-Intrinsically Safe Output

With non-intrinsically safe power supply in non-hazardous installations or Explosion-proof/Flameproof installations, wire the transmitter as shown in Figure 4-5.

NOTE!
Make sure that the power supply is off when connecting the transmitter.

Figure 4-5. Wiring diagram for non-intrinsically safe installations (HART).



For HART communication a minimum load resistance of 250 Ω within the loop is required. For maximum load resistance. See Figure 4-1 (Explosion/Flameproof) and Figure 4-2 (Non-hazardous installations).

For Explosion-proof/Flameproof applications the resistance between the negative terminal on the transmitter and the power supply must not exceed 435 Ohm.

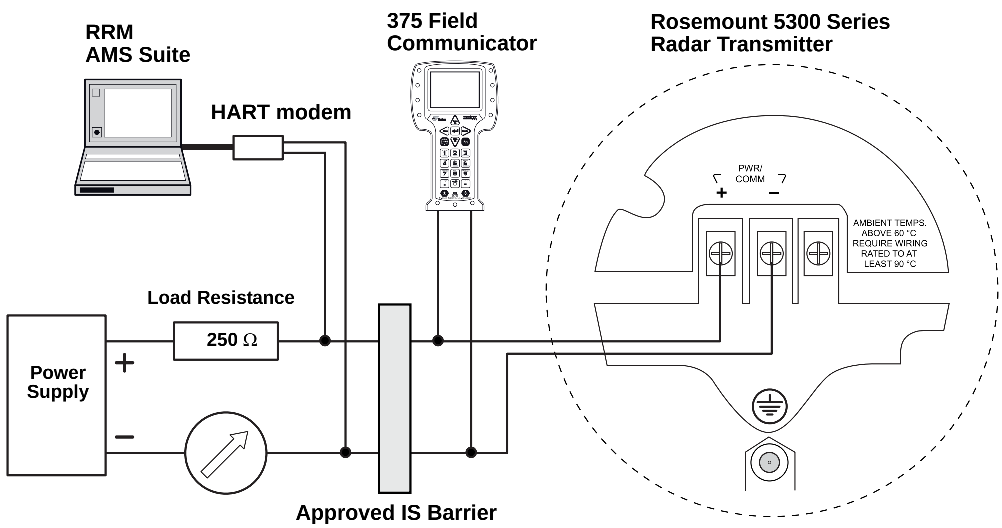
NOTE!
For Explosion-proof/Flameproof installations, make sure the transmitter is grounded to the internal ground terminal inside the terminal compartment in accordance with national and local electrical codes.

Intrinsically Safe Output

For intrinsically safe installations wire the transmitter as shown in Figure 4-6.

NOTE!
Make sure the instruments in the loop are installed in accordance with intrinsically safe field wiring practices and System Control Drawings when applicable.

Figure 4-6. Wiring diagram for intrinsically safe installations (HART).



For HART communication, a minimum load resistance of 250 Ω within the loop is required. For maximum load resistance see Figure 4-3.

The power supply voltage ranges from 16 Vdc to 30 Vdc.

IS parameters(1)

Ui=30 V.

Ii=130 mA.

Pi=1 W.

Ci=7.26 nF.

Li=0.

(1) See Section B: Product Certifications for more information.

FOUNDATION FIELDBUS

Power Requirements

Terminals in the transmitter housing provide connections for signal cables. The Rosemount 5300 transmitter is powered over FOUNDATION Fieldbus with standard fielbus power supplies. The transmitter operates with the following power supplies:

Approval Type	Power Supply (Vdc)
IS	9 - 30
Explosion-Proof/Flameproof	16 - 32
None	9 - 32
FISCO; IS	9 - 17.5

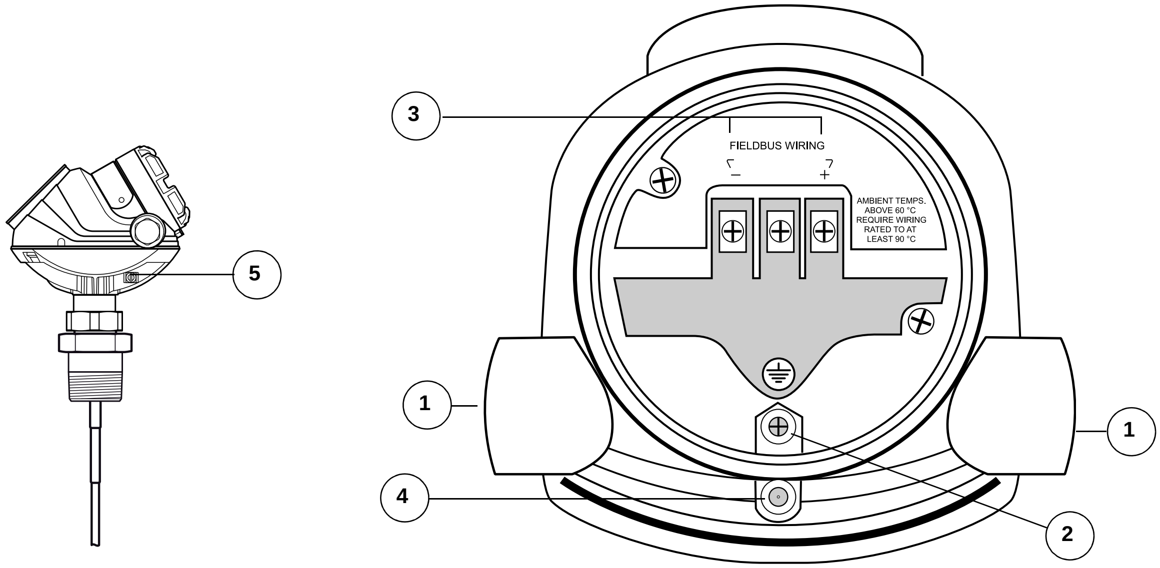
Connecting the Transmitter

To connect the transmitter:

1. Make sure the power supply is switched off.
2. ⚠ Remove the terminal block cover.
3. Pull the cable through the cable gland/conduit. Install wiring with a drip loop. The bottom of the loop must be lower than the cable/conduit entry.
4. Connect wires according to Figure 4-9 for non-intrinsically safe power supplies, and according to Figure 4-10 for intrinsically safe power supplies.
5. Use the enclosed metal plug to seal any unused port.
6. ⚠ Mount the cover and tighten the cable gland making sure the cover is secure to meet explosion-proof requirements.
7. For ATEX, IECEx and NEPSI installations, lock the cover with the Locking Screw ④.
8. Connect the power supply.

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

Figure 4-7. Terminal compartment and external ground screw.



① Cable entries.

② Internal Ground screw.

③ Terminals for signal and power supply.

④ Locking screw.

⑤ External Ground screw

Grounding - Foundation Fieldbus

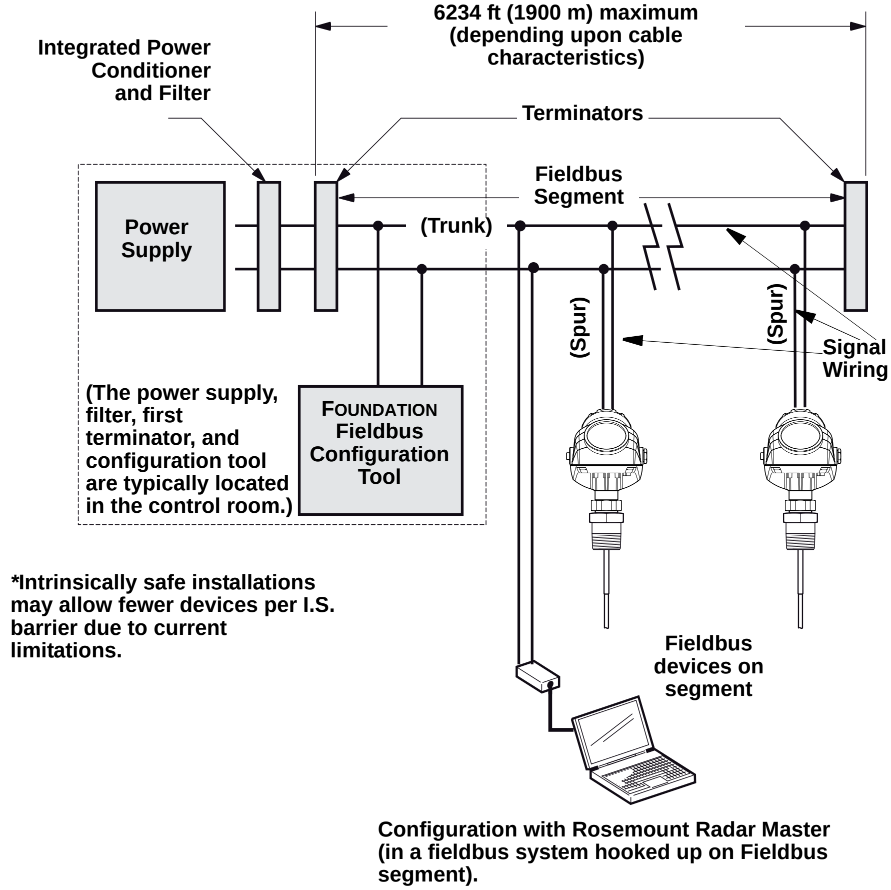
Signal wiring of the fieldbus segment cannot be grounded. Grounding out one of the signal wires will shut down the entire fieldbus segment.

Shield Wire Ground

To protect the fieldbus segment from noise, grounding techniques for shield wire usually require a single grounding point for shield wire to avoid creating a ground loop. The ground point is typically at the power supply.

Connecting Fieldbus Devices

Figure 4-8. Rosemount 5300 Radar Transmitter field wiring.

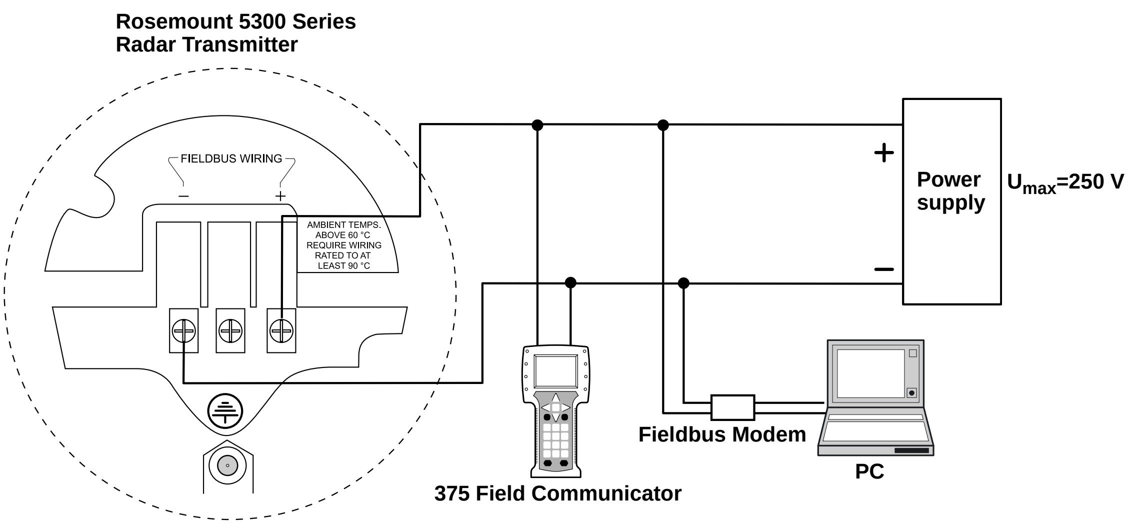


Non-Intrinsically Safe Output

With non-intrinsically safe power supply in Non-hazardous installations or Explosion-proof/Flameproof installations, wire the transmitter as shown in Figure 4-9.

NOTE!
Make sure that the power supply is off when connecting the transmitter.

Figure 4-9. Wiring for non-intrinsically safe power supply (Foundation Fieldbus).



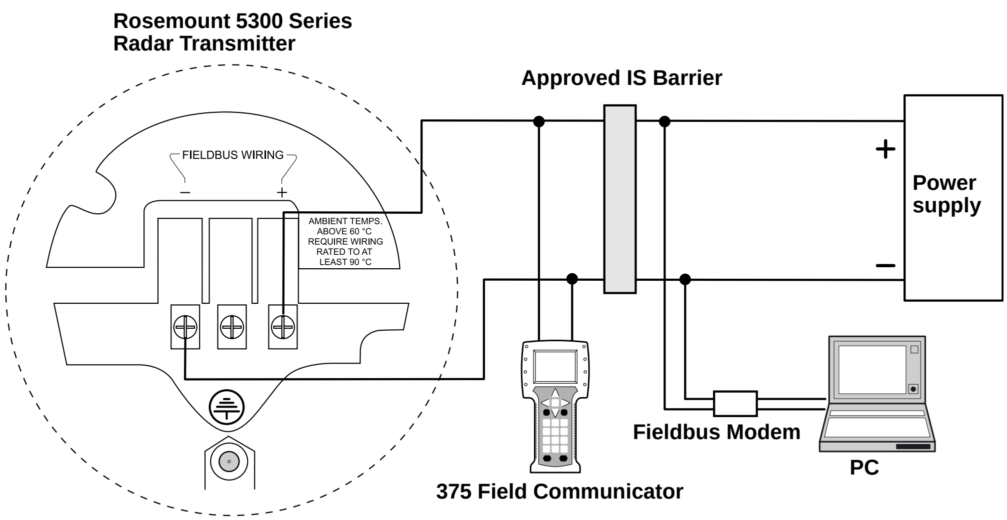
NOTE!
For Explosion Proof/Flameproof installations, make sure the transmitter is grounded to the internal ground terminal inside the terminal compartment in accordance with national and local electrical codes.

Intrinsically Safe Output

When your power supply is intrinsically safe, wire the transmitter as shown in Figure 4-10.

NOTE!
Make sure the instruments in the loop are installed in accordance with intrinsically safe field wiring practices.

Figure 4-10. Wiring diagram for intrinsically safe power supply (Foundation Fieldbus).



IS parameters(1)

Ui=30 V.

Ii=300 mA.

Pi=1.5 W (ATEX), 1.3 W (FM)

Ci=7.26 nF.

Li=0.

FISCO IS parameters

Ui=17.5 V.

Ii=380 mA.

Pi=5.32 W.

Ci=0.

Li=0.

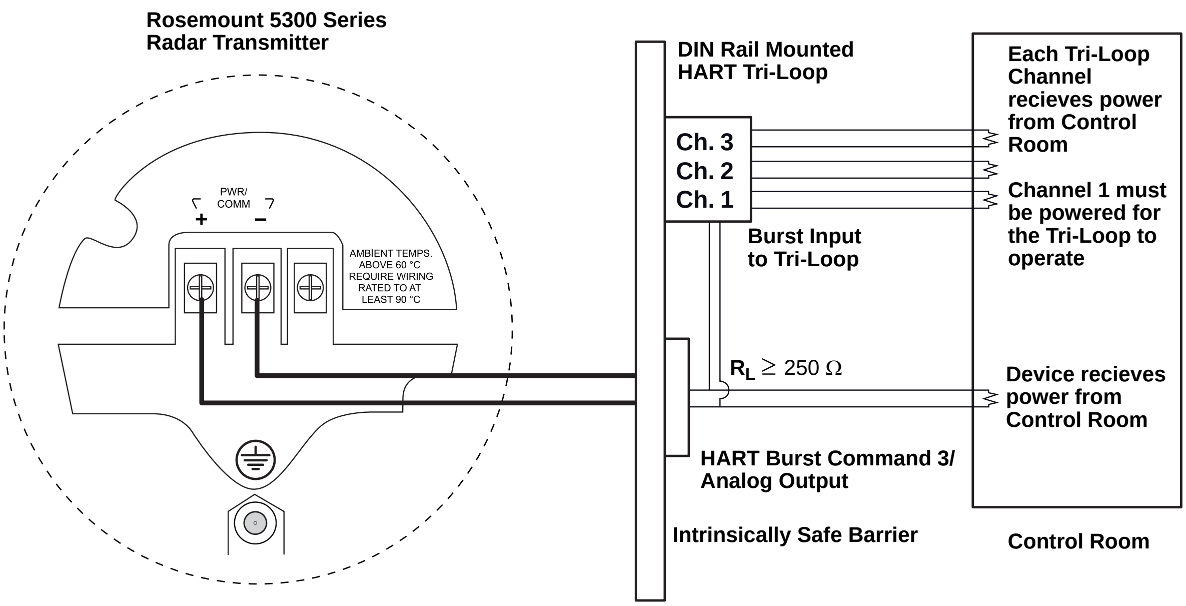
(1) See Section B: Product Certifications for more information.

OPTIONAL DEVICES

Tri-Loop HART to analog converter

The Rosemount 5300 transmitter outputs a HART signal with four process variables. By using the Model 333 HART Tri-Loop, up to three additional analog 4-20 mA outputs are provided.

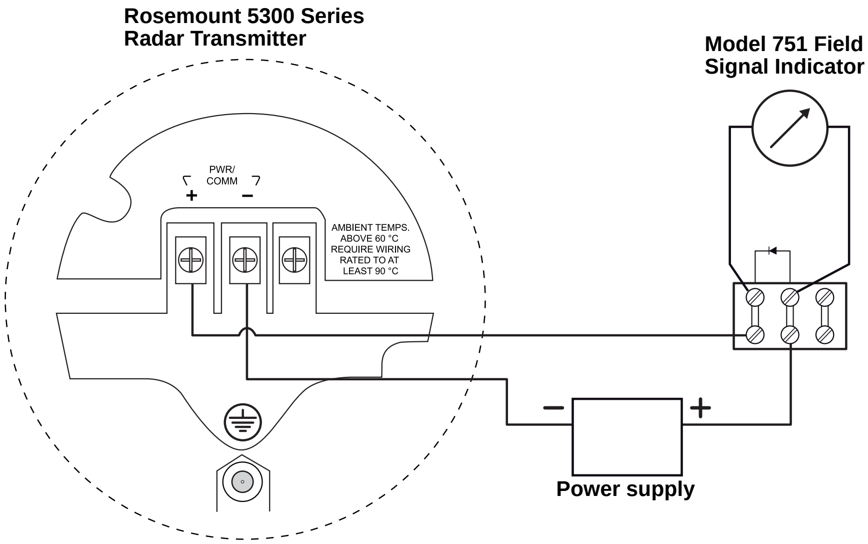
Figure 4-11. Wiring diagram for HART Tri-Loop.



Configure Channels 1, 2, and 3 to reflect the units as well as Upper Range Values and Lower Range Values for your secondary, tertiary and fourth variables (variable assignment is configured in the Rosemount 5300). It is also possible to enable or disable a channel from this menu. See “Tri-Loop HART to Analog Converter“ on page 5-45 for further information on how to install a Tri-Loop.

751 Field Signal Indicator

Figure 4-12. Wiring diagram for a Rosemount 5300 transmitter with 751 Field Signal Indicator.



Section 5 Configuration

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 (⚠). Refer to the safety messages listed at the beginning of each section 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.

⚠WARNING

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.

OVERVIEW

The configuration of a Rosemount 5300 transmitter is normally a simple and straight-forward task. The complete configuration of a Rosemount 5300 transmitter includes Basic Configuration, Echo Tuning and Advanced Configuration. This section describes Basic Configuration.

If the transmitter is pre-configured at the factory according to the ordering specifications in the Configuration Data Sheet, no further Basic Configuration is required unless tank conditions have changed. The Rosemount 5300 Series supports a set of advanced configuration options as well, which can be used to handle special tank conditions and applications.

Basic Configuration

The Basic Configuration includes parameters for a standard configuration which is sufficient in most cases. The Basic Configuration comprises the following items:

- Measurement Units
- Tank Configuration
  - Tank Geometry
  - Environment
  - Volume
- Analog Output

Echo Tuning

Amplitude thresholds can be adjusted in order to handle special situations when, for example, objects in the tank cause disturbing echoes that are stronger than the surface echo. A useful function is the so called *Amplitude Threshold Curve* (ATC) which lets you filter out single disturbing echoes. See *Section 7: Service and Troubleshooting,* and *Appendix C: Advanced Configuration* for more information.

LCD Configuration

It is possible to specify the variables to be presented on the Display Panel. See also Section 6: Operation.

Advanced Configuration

For some applications, further device specific configuration is needed in addition to the Basic Configuration. This may be due to product properties or tank shape. See *Appendix C: Advanced Configuration* for more information.

Configuration Tools

There are several tools available for the configuration of a Rosemount 5300 transmitter:

- Rosemount Radar Master (RRM). Note that RRM is recommended for advanced configuration features.
  See “Basic Configuration Using Rosemount Radar Master” on page 5-13 for information on how to use RRM for configuration of the 5300 Series
- Rosemount 375 Field Communicator.
  See “Basic Configuration Using a 375 Field Communicator” on page 5-11 for the Field Communicator Menu Tree
- AMS Suite software (for HART). See “Basic Configuration Using AMS Suite (HART)” on page 5-30
- DeltaV (only for Foundation Fieldbus). See “Basic Configuration Using DeltaV” on page 5-31
- Other tools that support Electronic Device Description Language (EDDL) functionality

RRM is a user-friendly, Windows® based software package including waveform plots, off-line/on-line configuration Wizard, logging, and extensive on-line help.

To communicate with the transmitter using RRM, a HART modem (part number 03300-7004-0001 or 03300-7004-0002) or a FOUNDATION Fieldbus modem (part number 03095-5108-0001 for PCMCIA) is required. For FOUNDATION Fieldbus communication you will also need the *National Instruments Communication Manager* software (see “Installing the RRM Software for FOUNDATION Fieldbus” on page 5-16).

BASIC CONFIGURATION PARAMETERS

This section describes basic configuration parameters for a Rosemount 5300 transmitter. Basic configuration is only needed for the 5300 Series transmitters which are not pre-configured at the factory. Factory configuration is normally specified in the Configuration Data Sheet.

Measurement Units

Measurement units can be specified for presentation of Level/Interface Level, Level Rate, Volume, and Temperature values.

Tank and Probe Geometry

The basic transmitter configuration includes setting the tank geometry parameters.

Figure 5-1. Tank Geometry

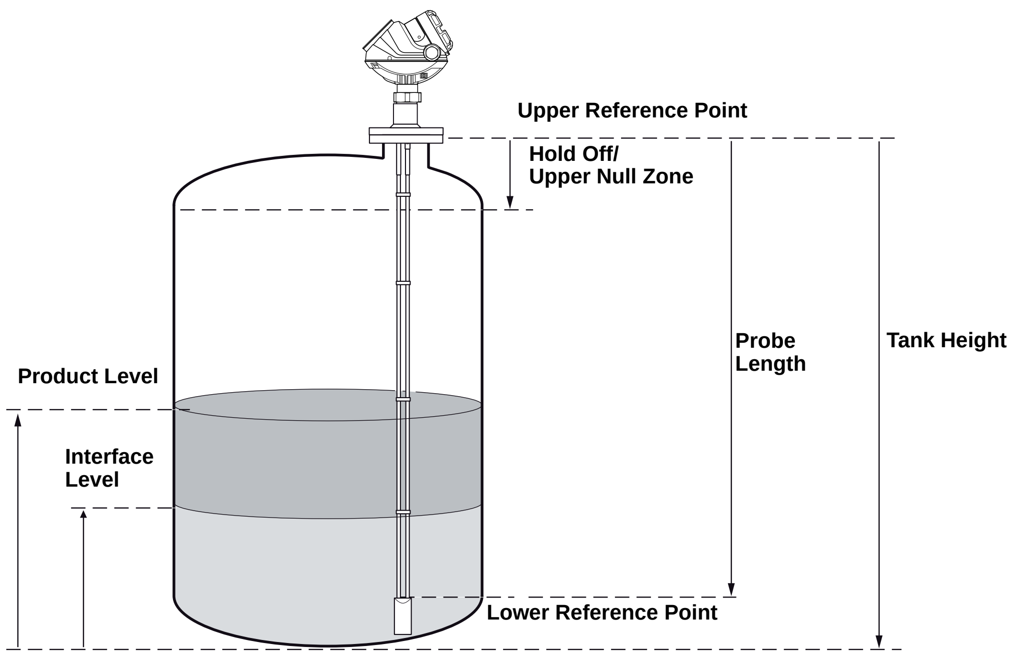
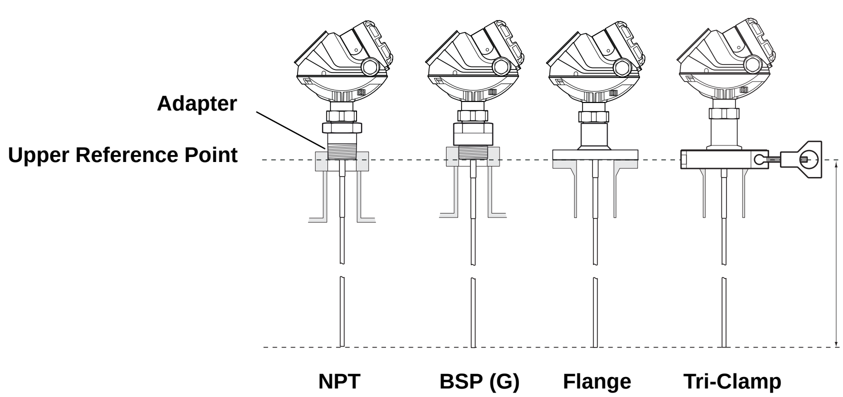


Figure 5-2. Upper Reference Point

For the different tank connections the Upper Reference Point is located at the underside of the threaded adapter or at the underside of the welded flange, as illustrated in Figure 5-2:



Tank Height

The Tank Height is defined as the distance from the Upper Reference Point to the Lower Reference Point. The transmitter measures the distance to the product surface and subtracts this value from the Tank Height to determine the product level. The Lower Reference Point can be set to any position in the tank simply by adjusting the Tank Height.

Mounting Type

Enter the type of mounting for the device. This configuration optimizes the device for the respective mounting type.

- Unknown – default factory setting for mounting type, and can also be used if the mounting type is unknown
- Pipe/Chamber – select this option if the device is mounted on a chamber/bridle or in a pipe. When selecting this alternative enter the corresponding Inner Diameter as well
- Nozzle – select this if the device is installed on a nozzle. When selecting this alternative, configure the Inner Diameter and the Nozzle Height as well
- Direct/Bracket – when the device is mounted directly on the tank roof with no traditional nozzle, this is the alternative to use. With this selection no inner diameter or height is required, thus those selections are disabled

Inner Diameter

Using with pipe, chamber - and nozzle installations.

Nozzle Height

For nozzle installations.

Probe Length

The probe length is the distance between the Upper Reference Point and the end of the probe. If a weight is used at the end of the probe, it should not be included.

For Flexible Single Lead probes anchored with clamps, the probe length should be configured as the distance between the underside of the flange and the upper clamp (see “Anchoring” on page 3-22).

This parameter is pre-configured at the factory. It must be changed if the probe is shortened.

Probe Type

The transmitter is designed to optimize measurement performance for each probe type.

This parameter is pre-configured at the factory. This value needs to be changed if the probe type is changed.

Hold Off/Upper Null Zone

This parameter should only be changed if there are measurement problems in the upper part of the tank. Such problems may occur if there are disturbing objects, such as a narrow nozzle with rough walls, close to the probe. By adjusting the Hold Off/Upper Null Zone, the measuring range is reduced. See *"Handling of Disturbances from Nozzle" on page C-4* for further information.

Tank Environment

Measurement Mode

Normally, the Measurement Mode does not need to be changed. The transmitter is pre-configured according to the specified model:

Table 5-1. List of Measurement Modes which can be used for different 5300 models

Model	Measurement Mode
5301	• *Liquid Product Level*(1) • *Interface Level with Submerged probe*
5302	• *Liquid Product Level* • *Product Level and Interface Level*(1) • *Interface Level with Submerged probe* • *Solid Product Level*
5303	• *Solid Product Level*(1)

(1) Default setting

Submerged is used for applications where the probe is fully submerged in liquid. In this mode, the transmitter ignores the upper product level. See *"Interface Measurements with Fully Submerged Probes" on page 7-15*" for more information.

NOTE!
Only use *Submerged* for applications where the interface is measured with a fully submerged probe.

Rapid Level Changes

Optimize the transmitter for measurement conditions where the level changes quickly due to filling and emptying of the tank. As a default standard, a Rosemount 5300 transmitter is able to track level changes of up to 1.5 in./s (40 mm/s). When the Rapid Level Changes check box is marked, the transmitter can track level changes of up to 8 in./s (200 mm/s).

The Rapid Level Changes check-box should not be used in normal conditions when the product surface moves slowly.

Dielectric Constant

For interface measurements, the dielectric constant of the upper product is essential to obtain good accuracy. See "Interface" on page 2-12 for further information on dielectric constants. If the dielectric constant of the lower product is significantly smaller than the dielectric constant of water, you may need to make special adjustments, see Appendix C: Advanced Configuration for further information.

For level measurements, the **Upper Product Dielectric** parameter corresponds to the actual dielectric constant of the product in the tank.

Normally, this parameter does not need to be changed even if the actual dielectric constant of the product deviates from the Upper Product Dielectric parameter value. However, for some products, measurement performance can be optimized by setting the proper product dielectric constant.

Volume Configuration

For volume calculations, you can choose one of the standard tank shapes or the strapping option. Choose None if volume calculation is not used. For the standard tanks, a Volume Offset parameter can be specified which can be used for a non-zero volume that corresponds to the zero level. This may be useful, for example, if the user wants to include the product volume below the zero level.

Tank Type

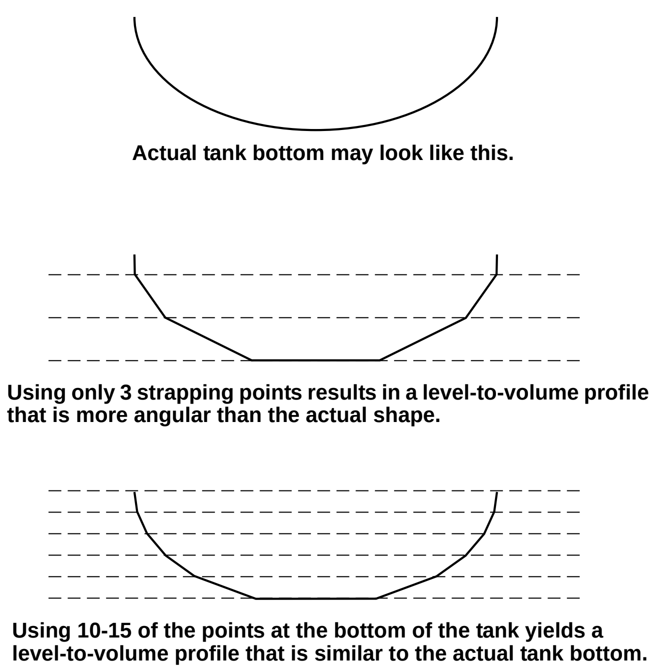
You can choose one of the following options:

- Strap table
- Vertical Cylinder
- Horizontal Cylinder
- Vertical Bullet
- Horizontal Bullet
- Sphere
- None

Strapping Table

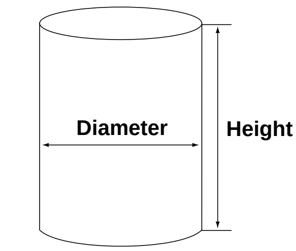
Use a strapping table if a standard tank type does not provide sufficient accuracy. Use most of the strapping points in regions where the tank shape is non-linear. A maximum of 20 points can be added to the strapping table.

Figure 5-3. Strapping points



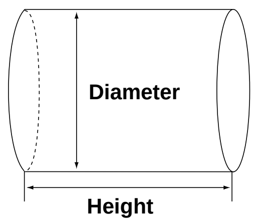
Standard Tank Shapes

Figure 5-4. Standard tank shapes



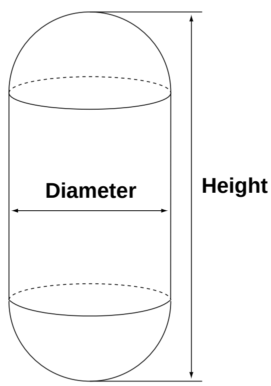
Vertical Cylinder

Vertical Cylinder tanks are specified by Diameter, Height, and Volume Offset.



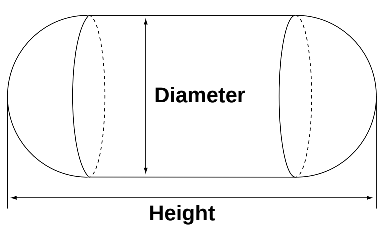
Horizontal Cylinder

Horizontal Cylinders are specified by Diameter, Height, and Volume Offset.



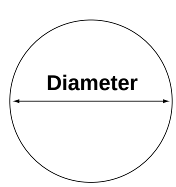
Vertical Bullet

Vertical Bullet tanks are specified by Diameter, Height and Volume Offset. The volume calculation model for this tank type assumes that the radius of the bullet end is equal to the Diameter/2.



Horizontal Bullet

Horizontal Bullets are specified by Diameter, Height, and Volume Offset. The volume calculation model for this tank type assumes that the radius of the bullet end is equal to the Diameter/2.



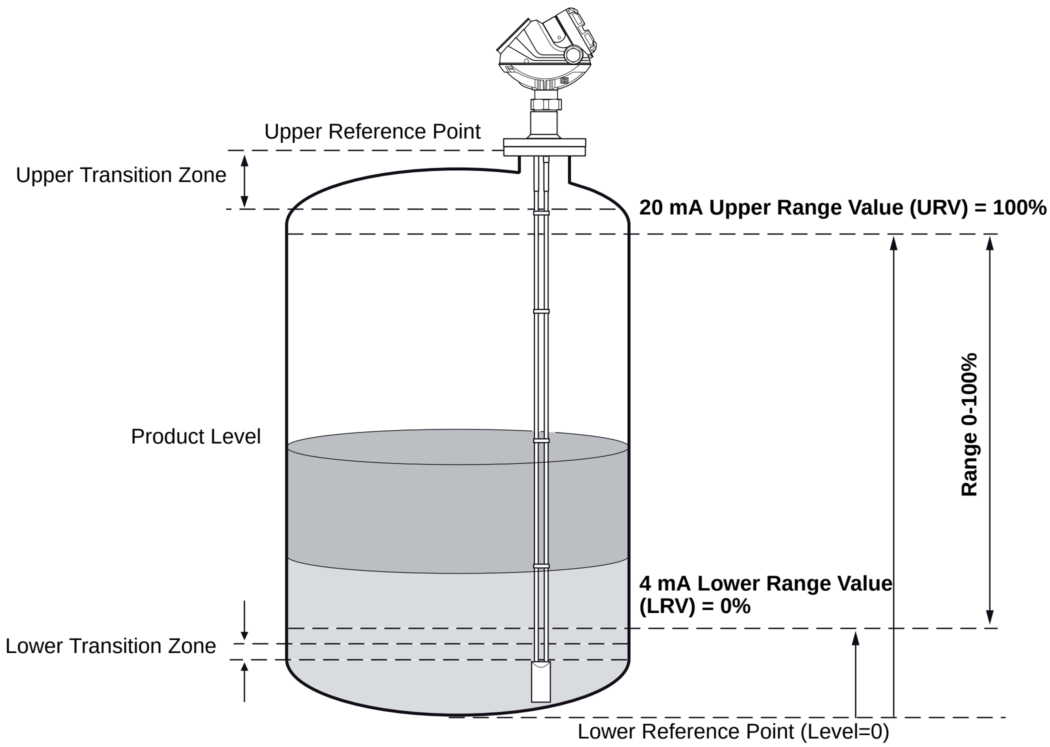
Sphere

Spherical tanks are specified by Diameter and Volume Offset.

Analog Output (HART)

The Output Source (Primary Value), Range Values and Alarm Mode are specified for the analog output.

Figure 5-5. Example of Range Value settings



Output Source/Primary Variable

Specify the source to control the analog output. Typically, the Primary Value is configured to be the Product Level.

Upper/Lower Range Value

Enter the range values that correspond to the analog output values 4 and 20 mA. It is recommended that the 4 mA and 20 mA values are set outside the Transition Zones. See *"Transition Zones" on page 2-10* for more information.

If a measured value goes beyond the measurement range, the transmitter enters saturation mode (limit alarm is disabled) or alarm mode depending on the current configuration.

Also make sure that the 20 mA value is below the Upper Null Zone (UNZ). (This parameter may be used if there are measurement problems in the upper part of the tank, see *"Handling of Disturbances from Nozzle" on page C-4*). The UNZ is equal to zero in the default configuration.

Alarm Mode

The Alarm mode specifies the analog output state when there is a failure or a measurement error:

High: the output current is set to the High Alarm Limit.

Low: the output current is set to the Low Alarm Limit.

Freeze Current: the output current is set to the last valid value at the time when the error occurs.

Default settings for alarm mode:

- Measurement errors: Output current=High.
- Measured value out of range: transmitter enters saturation mode (if Limit Alarm is disabled).

Table 5-2. Analog Output: Standard Alarm Values vs. Saturation Values

Level	4–20 mA Saturation Values	4–20 mA Alarm Value
Low	3.9 mA	3.75 mA
High	20.8 mA	21.75 mA

Table 5-3. Analog Output: NAMUR-Compliant Alarm Values vs. Saturation Values

Level	4–20 mA Saturation Values	4–20 mA Alarm Value
Low	3.8 mA	3.6 mA
High	20.5 mA	22.5 mA

BASIC CONFIGURATION USING A 375 FIELD COMMUNICATOR

This section describes how to configure the 5300 transmitter by using a 375 Field Communicator.

The menu tree with the various configuration parameters is shown in *Figure 5-7 on page 5-12*. Section *"Basic Configuration Parameters" on page 5-4* presents a description of the basic configuration parameters.

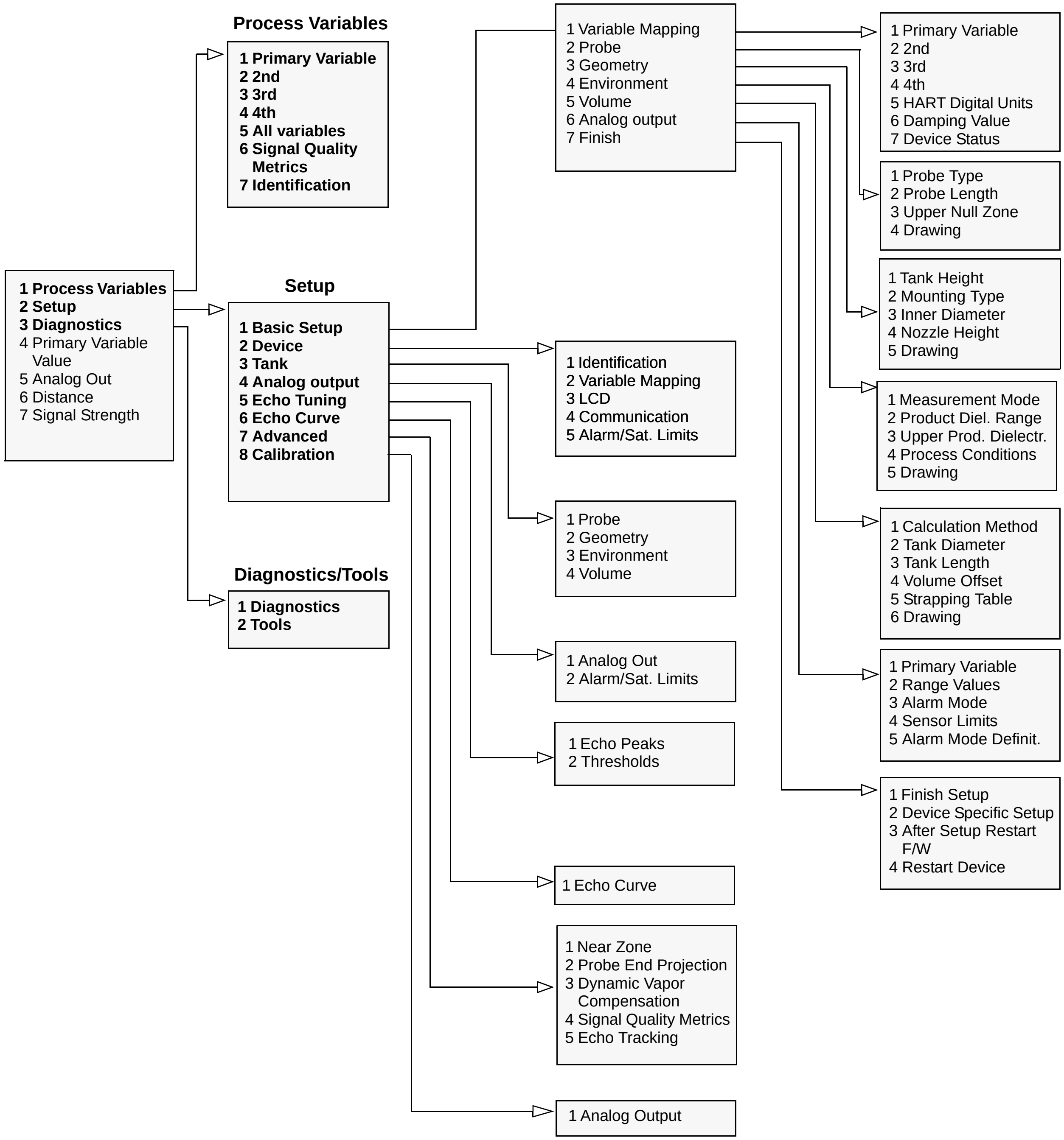
For information on all the capabilities, refer to the 375 Field Communicator Product Manual (Document No. 00809-0100-4276).

Figure 5-6. The 375 Field Communicator.

1. Check that the desired Measurement Units are selected.
2. Open the Process Variable menu and select Primary Variable. HART command: [1,1]. Select the desired parameter.
3. Open the Basic Setup menu. HART command: [2, 1]. This menu includes Probe, Tank Geometry, Environment, Volume, and Analog Output settings.
4. Select Finish, Device Specific Setup to see if there is any additional configuration that needs to be done.
5. Restart the transmitter. HART command: [3, 2, 1, 1].

See also "Guided Setup" on page 5-19 for further information on configuration of the Rosemount 5300 transmitter.

Figure 5-7. HART Communicator Menu Tree corresponding to Device Revision 3.



BASIC CONFIGURATION USING ROSEMOUNT RADAR MASTER

The *Rosemount Radar Master* (RRM) is a user-friendly software tool that allows the user to configure the Rosemount 5300 Series transmitter. Choose either of the following methods to configure a Rosemount 5300 Series transmitter with RRM:

- Guided Setup if you are unfamiliar with the 5300 transmitter (see page 5-19).
- Setup functions if you are already familiar with the configuration process or for changes to the current settings (page 5-18).

System Requirements

Hardware

Processor (minimum/recommended): Pentium 200 MHz/1 GHz

Memory (minimum/recommended): 64/128 MB RAM

COM Port: 1 serial COM port or 1 USB port

Graphical Card (minimum/recommended):
screen resolution 800 x 600/1024 x 768

Hard drive space: 100 MB

Software

Operating Systems supported:

Windows 2000 - Service Pack 3

Windows XP - Service Pack 2

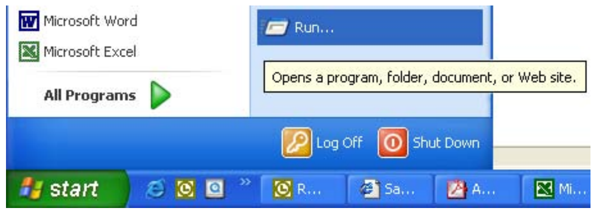
Help In RRM

Help is accessed by selecting the Contents option from the Help menu. Help is also available from a Help button in most windows.

Installing the RRM software for HART communication

To install the Rosemount Radar Master:

1. Insert the installation CD into your CD-ROM drive.
2. If the installation program is not automatically started, choose Run from the Windows Start bar.



3. Type D:\RRM**Setup.exe**, where D is the CD-ROM drive.
4. Follow the instructions on the screen.
5. Make sure that HART is chosen as default protocol.
6. For Windows 2000/XP set COM Port Buffers to 1, see page 5-15.

Getting Started

1. From the Start menu click *Programs>Rosemount>Rosemount Radar Master* or click the RRM icon in the Windows workspace.
2. If the *Search Device* window did not appear automatically, choose menu option Device>Search.
3. In the *Search Device* window, choose communication protocol HART, and click the Start Scan button (click the Advanced button if you want to specify start and stop address).
Now RRM searches for the transmitter.
4. After a while the *Search Device* window presents a list of found transmitters.
5. Select the desired transmitter and press OK to connect. If communication does not work, check that the correct COM port is connected to the computer and that the COM port is properly configured, see "Specifying the COM Port" on page 5-15. You may also check in the *Communication Preferences* window that HART communication is enabled.
6. In the RRM Status Bar verify that RRM communicates with the transmitter:

RRM communicates with the transmitter

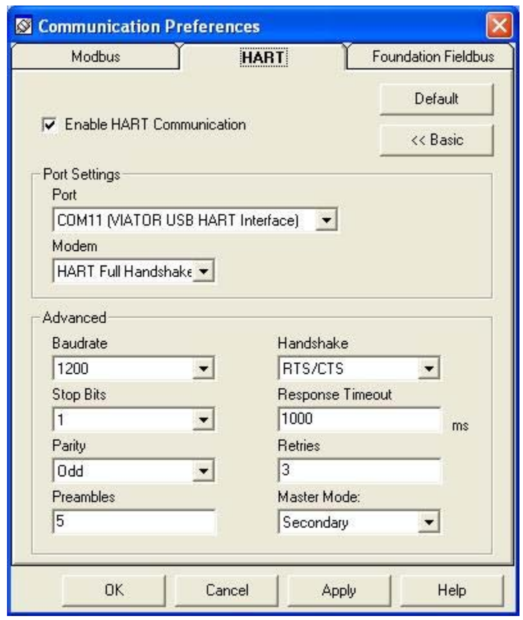
No communication with the transmitter

Specifying the COM Port

If communication is not established, open the *Communication Preferences* window and check that the correct COM Port is selected:

1. From the **View** menu select Communication Preferences in RRM.

Figure 5-8. Communication Preferences.



2. Select the HART tab.
3. Make sure that HART communication is enabled.
4. Check which COM port the modem is connected to.
5. Choose the COM Port option that matches the actual COM Port on the PC that the transmitter is connected to.

To set the COM port buffers

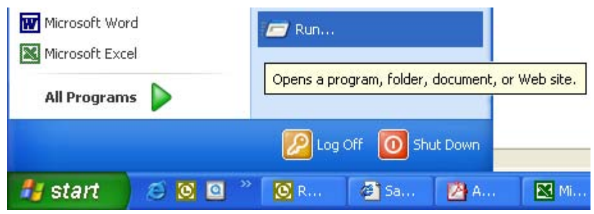
For Windows 2000/XP the COM port **Receive Buffer** and **Transmit Buffer** need to be set to 1. To set the COM port buffers:

1. In the MS Windows Control Panel open the **System** option.
2. Choose the **Hardware** tab and click the **Device Manager** button.
3. Expand the **Ports** node in the tree view.
4. Click the right mouse button on the selected COM port and choose **Properties**.
5. Select the **Port Settings** tab and click the **Advanced** button.
6. Drag the *Receive Buffer* and *Transmit Buffer* slides to 1.
7. Click the **OK** button.
8. **Restart the computer**.

Installing the RRM Software for FOUNDATION Fieldbus

To install the Rosemount Radar Master for FOUNDATION Fieldbus communication:

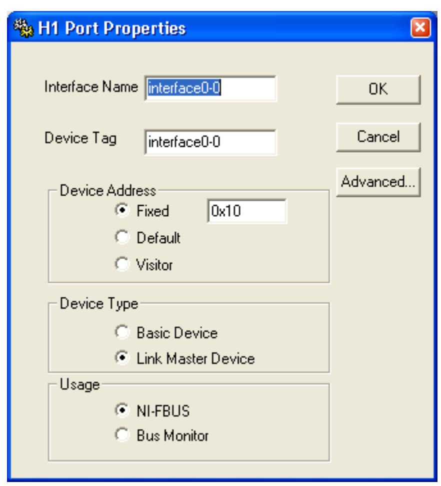
1. Start by installing the *National Instruments Communication Manager* software. See National Instruments manual (*Getting started with your PCMCIA-FBUS and the NI-FBUS™ software*) for more information.
2. Insert the RRM installation CD into your CD-ROM drive.
3. If the installation program is not automatically started, choose Run from the Windows Start bar.



4. Type D:\RRM**Setup.exe** where D is the CD-ROM drive.
5. Follow the instructions on the screen.
6. Make sure that FOUNDATION Fieldbus is chosen as default protocol.

Getting Started

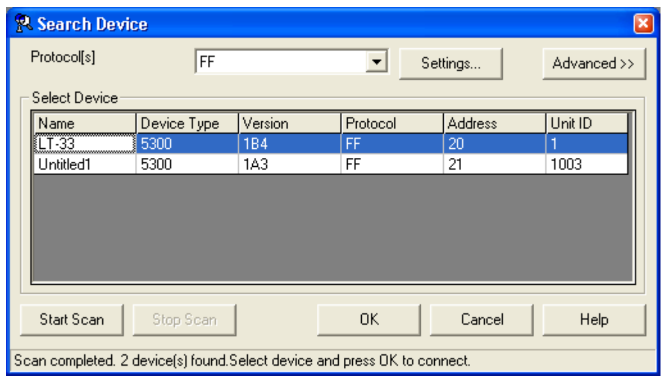
1. Before starting RRM make sure that appropriate settings are made with the *National Instruments Interface Configuration Utility*:



If only Rosemount Radar Master is connected to the bus:
Device address=Fixed
Device Type=Link Master Device
Usage=NI-FBUS

If other host systems are connected to the bus:
Device address=Visitor
Device Type=Basic Device
Usage=NI-FBUS

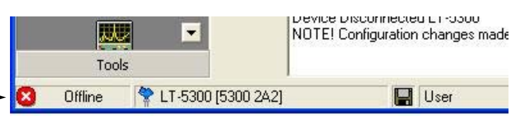
2. Start Rosemount Radar Master (RRM): from the Start menu click *Programs>Rosemount>Rosemount Radar Master* or click the RRM icon in the MS Windows workspace.
3. If the *National Instruments Communication Manager* server is not running, click Yes when RRM displays a request for starting the server.
4. If the *Search Device* window did not appear automatically choose menu option Device>Search.
5. In the *Search Device* window choose communication protocol FOUNDATION Fieldbus (if not already selected) and click the Start Scan button (click the Advanced button if you want to specify start and stop dress).
   Now RRM searches for the transmitter. After a while RRM shows the transmitters found on the bus:



6. Select the desired transmitter and click OK to connect.
   In the RRM Status Bar verify that RRM communicates with the transmitter:

RRM communicates with the transmitter

No communication with the transmitter



Specifying Measurement Units

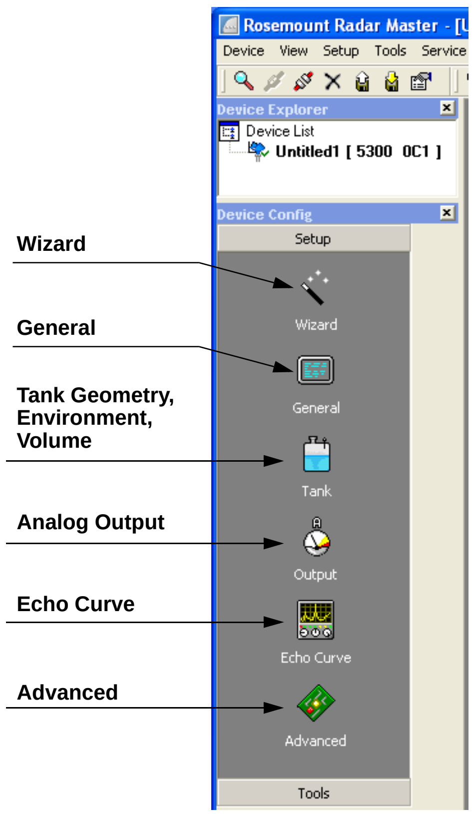
Measurement units for data presentation in RRM can be specified when the RRM program is installed. Units can also be changed as follows:

1. From the View menu, choose the Application Preferences option.
2. Select the **Measurement Units** tab.
3. Choose the desired units for Length, Level Rate, Volume, and Temperature.

Using the Setup Functions

Use the **Setup** function if you are already familiar with the configuration process for the Rosemount 5300 Series transmitter or for changes to the current settings:

Figure 5-9. Setup functions in RRM.



1. Start the RRM software.
2. In the RRM workspace choose the appropriate icon for the configuration of transmitter parameters:
    - **Wizard**: the Wizard is a tool that guides you through the basic configuration procedure of a Rosemount 5300 Series transmitter
    - **General**: configuration of general settings such as measurement units and communication parameters. This window also lets you configure which LCD variables to be displayed, see *Section 6: Operation*
    - **Tank**: configuration of Tank Geometry, Tank Environment, and Volume
    - **Output**: configuration of Analog Output
    - **Echo Curve**: disturbance echo handling
    - **Advanced**: advanced configuration

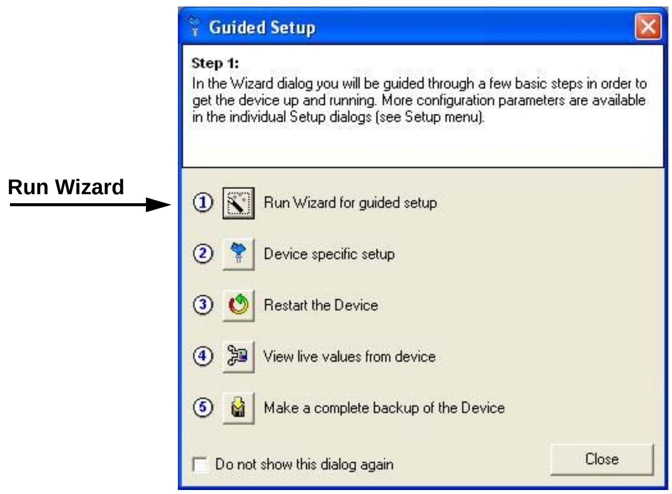
Guided Setup

The following description shows how to use the RRM Guided Setup. The corresponding HART commands (375 Field Communicator Fast Key Sequence) and FOUNDATION Fieldbus parameters are also shown.

The Guided Setup is useful if you are unfamiliar with the Rosemount 5300 Series transmitter.

1. Start the Guided Setup

   Start RRM. It automatically presents a list of available transmitters. Select the desired transmitter. Now the transmitter is connected and the *Guided Setup* window appears automatically:



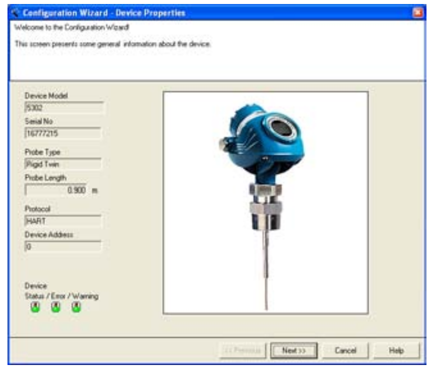
2. Start the Configuration Wizard

   In the *Guided Setup* window, click the **Run Wizard...** button and follow the instructions.

   Now you will be guided through a short transmitter installation procedure.

NOTE!
The *Guided Setup* is an extended installation guide that includes more than just the configuration Wizard. It can be disabled by deselecting the *Show Introduction Dialog after Connect* check box in the *Application Settings* window (see menu option View>Application Preferences).

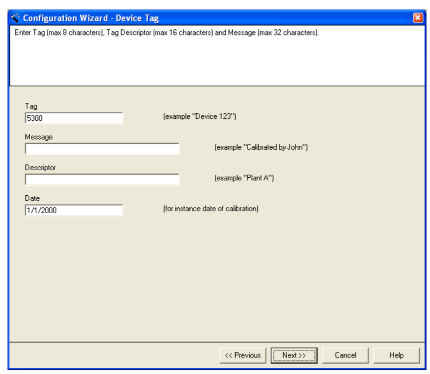
Device Properties



3. Check the device properties

   The first window in the configuration wizard presents general information stored in the transmitter database such as device model, serial number, probe type, probe length, communication protocol and device address. Check that the information complies with the ordering information.

General Information

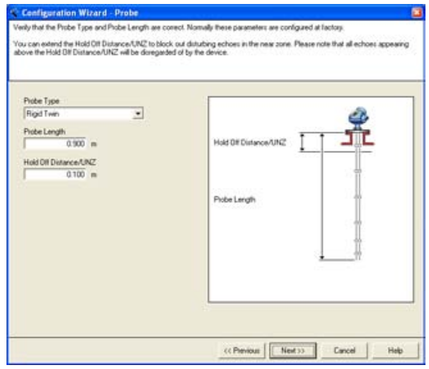


4. Enter Device Information

   HART command: [2, 2, 1].

   This window lets the user enter Tag, Message, Descriptor, and Date. The information is not required for the operation of the transmitter and can be left out if desired.

Probe



5. Probe settings

HART command: [2, 1, 2].

FOUNDATION Fieldbus parameters:

TRANSDUCER 1100>PROBE_TYPE
TRANSDUCER 1100>PROBE_LENGTH
TRANSDUCER 1100>GEOM_HOLD_OFF_DIST

Check that the correct Probe Type is chosen. Normally, the Probe Type is pre-configured at the factory, but if the current configuration does not match the actual probe, choose the correct **Probe Type** from the list.

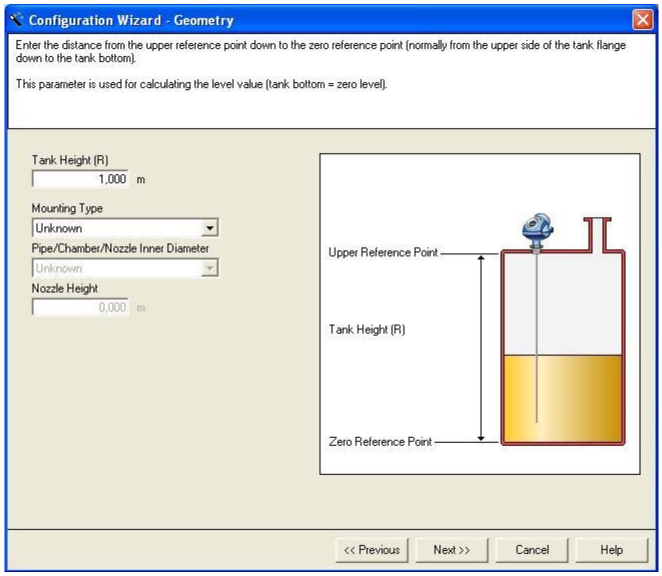
The Rosemount 5300 Series transmitter automatically makes some initial calibrations based on the chosen **Probe Type**. The following Probe Types are available:

- Rigid Twin
- Flexible Twin
- Coaxial, Coaxial HP, Coaxial HTHP
- Rigid Single, Rigid Single HTHP/HP/C, Rigid Single PTFE
- Flexible Single, Flexible Single HTHP/HP/C, Flexible Single PTFE

The **Probe Length** is the distance from the Upper Reference Point to the end of the probe, see Figure 5-1. If the probe is anchored to a weight, do not include the height of the weight. The Probe Length needs to be changed if, for example, the probe is shortened.

The **Hold Off Distance/Upper Null Zone** (UNZ) should not be changed unless there are disturbances at the top of the tank. By increasing the Upper Null Zone, measurements in this region are avoided. See *“Handling of Disturbances from Nozzle” on page C-4* for more information on how to use the UNZ. The UNZ is set to zero in the factory configuration.

Geometry



6. Geometry

HART command: [2, 1, 3].

FOUNDATION Fieldbus parameter:

TRANSDUCER 1100>GEOM_TANK_HEIGHT
TRANSDUCER 1100>MOUNTING_TYPE
TRANSDUCER 1100>PIPE_DIAMETER
TRANSDUCER 1100>NOZZLE_HEIGHT

Tank Height is the distance from the Upper Reference Point to the Lower Reference Point (see Figure 5-1 on page 5-4 and Figure 5-2 on page 5-4). The Upper Reference Point is located at the bottom part of the threaded adapter, or at the underside of the welded flange.

Make sure the Tank Height is as accurate as possible, since a Tank Height error results in a corresponding Level value offset error.

When specifying the Tank Height, keep in mind that this value is used for all level and volume measurements performed by the Rosemount 5300 Series transmitter.

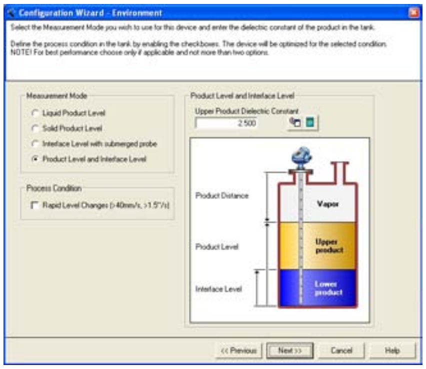
The Tank Height must be set in linear (level) units, such as feet or meters, regardless of primary variable assignment.

Select the **Mounting Type** used.

Select **Inner Diameter** if using pipe, chamber or nozzle.

Type **Nozzle Height** if using nozzle.

Tank Environment



7. Specify Tank Environment

HART command: [2, 1, 4].

FOUNDATION Fieldbus parameter:

TRANSDUCER 1100>MEAS_MODE
TRANSDUCER 1100>PRODUCT_DIELEC_RANGE
TRANSDUCER 1100>UPPER_PRODUCT_DC
TRANSDUCER 1100>ENV_ENVIRONMENT

Measurement Mode

Normally, the Measurement Mode does not need to be changed. The transmitter is pre-configured according to the specified model. See “Basic Configuration Parameters” on page 5-4 for more information.

Process Conditions

Select the *Rapid Level Changes* check-box only if the surface is moving quickly up or down at rates over 1.5 in./s (40 mm/s).

Dielectric Constant/Dielectric Range

The dielectric constant of the product is used for setting the appropriate signal amplitude thresholds, see *Section 7: Service and Troubleshooting* for more information on amplitude threshold settings. Normally, this parameter does not need to be changed for level measurements. However, for some products, measurement performance can be optimized by setting the proper product dielectric constant.

For **Interface Level** measurements, the dielectric constant of the upper product is essential for calculating interface level and the upper product thickness. By default, the **Upper Product Dielectric** parameter is about 2.

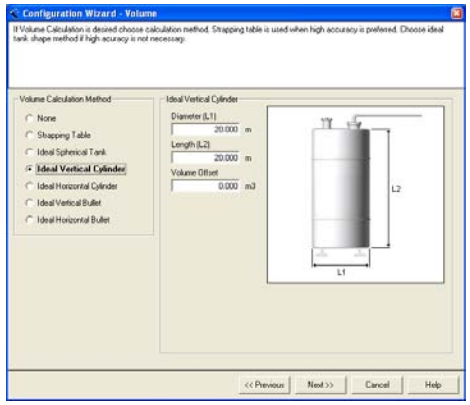
Set the **Upper Product Dielectric Constant** to a value that corresponds to the current product.

Rosemount Radar Master (RRM) includes tools to estimate the dielectric constant of the current product:

- The **Dielectric Chart** lists the dielectric constant of a large number of products. The Dielectric Chart can be opened with one of the following methods:
  - Choose the View>Dielectric Constant Chart menu option
  - Click the Dielectric Chart button in the *Configuration Wizard - Environment* window
  - Choose the *Setup>Tank* menu option and click the Dielectric Chart button in the *Tank/Environment* window
- The **Dielectric Calculator** lets you calculate the dielectric constant of the Upper Product based on the following input:
  - actual upper product thickness,
  - the dielectric constant value stored in the transmitter, and
  - the upper product thickness presented by the transmitter.

  The **Dielectric Calculator** is available via the Dielectric Calculator button in the *Configuration Wizard - Environment* window or the *Tank/Environment* window.

Volume



8. Choose Volume Calculation Method

HART command: [2, 1, 5].

FOUNDATION Fieldbus parameters:

Calculation method:
TRANSDUCER 1300>VOL_VOLUME_CALC_METHOD

Tank Diameter:
TRANSDUCER 1300>VOL_IDEAL_DIAMETER

Tank Length:
TRANSDUCER 1300>VOL_IDEAL_LENGTH

Volume Offset:
TRANSDUCER 1300>VOL_VOLUME_OFFSET

To use volume calculation, choose a pre-defined calculation method based on the tank shape that best corresponds to the actual tank. See “Volume Configuration” on page 5-7.

Use the Strapping Table option if the actual tank does not match any of the available options for pre-defined tanks, or if higher calculation accuracy is desired.

Choose None if volume calculation is not desired at all.

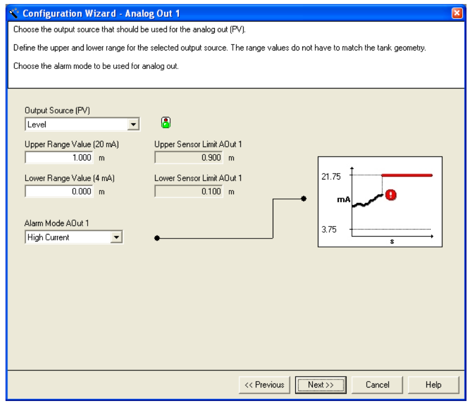
The following standard tank shapes are available:

- Vertical Cylinder
- Horizontal Cylinder
- Vertical Bullet
- Horizontal Bullet
- Sphere
- None

The following parameters must be entered for a standard tank shape:

- Tank diameter
- Tank height/length (not for spherical tanks)
- Volume Offset: use this parameter if you do not want zero volume and zero level to match (for example if you want to include a volume below the zero level)

Analog Output (HART)



9. Configure the Analog Output

HART command: [2,1, 6].

Analog Output is not available for FOUNDATION Fieldbus.

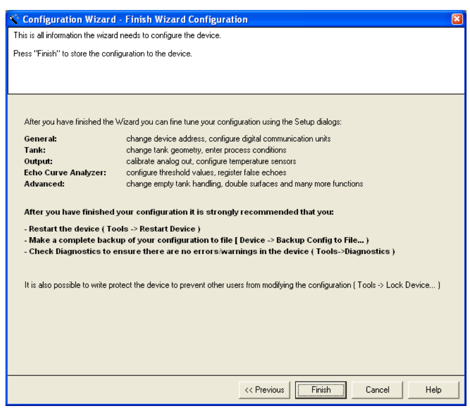
Typically, the **Primary Variable** (PV) is configured to be Product Level, Interface Level, or Volume. Other variables like Product Distance, Interface Distance, Upper Product Thickness, etc. are available as well.

Specify the analog output range by setting the **Lower Range Value** (4 mA) and the **Upper Range Value** (20 mA) to the desired values.

The Alarm Mode specifies the output state when a measurement error occurs.

See also *"Analog Output (HART)" on page 5-9* for information on Analog Output configuration.

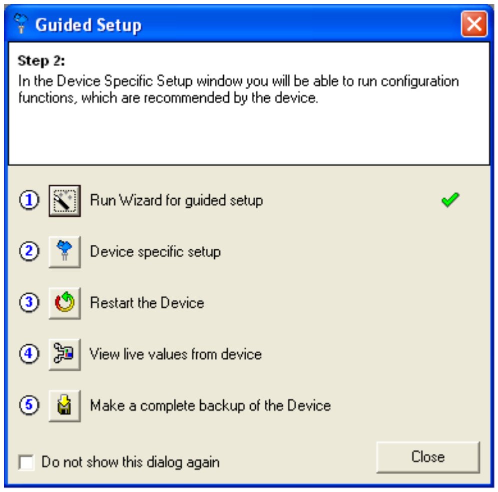
Finish Configuration Wizard



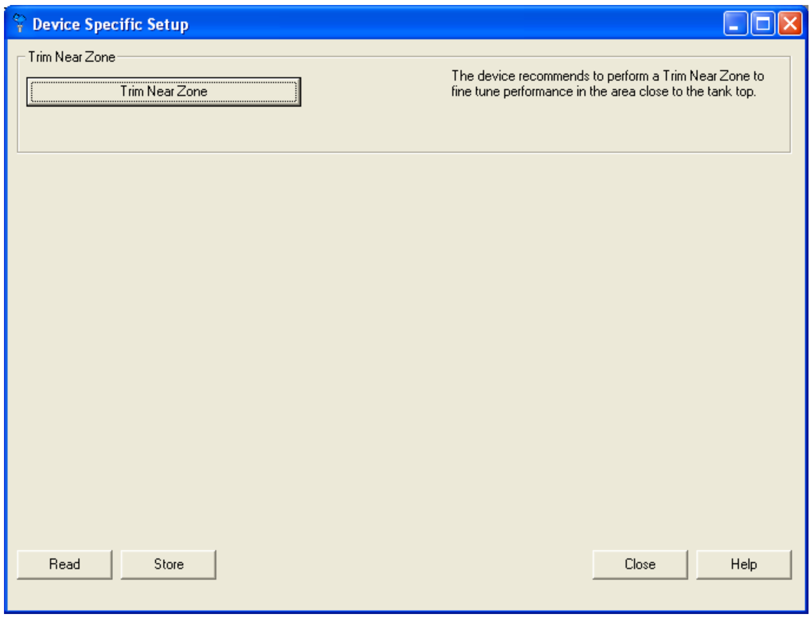
10. Finish the Configuration Wizard

This is the last window in the Configuration Wizard concluding the basic configuration. The current configuration can be changed at any time by using the Setup windows (General, Tank, Output etc., see "Using the Setup Functions" on page 5-18).
The Setup windows contain further options not available in the configuration wizard.
Click the Finish button and continue with the next step in the Guided Setup.

Device Specific Configuration



11. Click the Device specific setup button



12. This window will show if any additional configuration is needed. Proceed to step 13 if no configuration is needed.

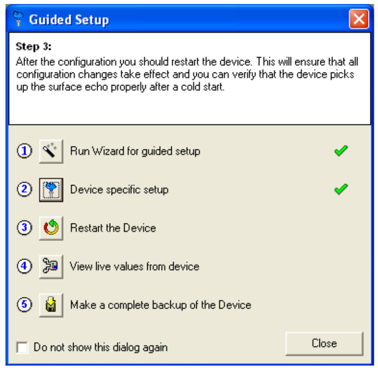
Trim Near Zone is described further in “Handling of Disturbances from Nozzle” on page C-4.

Probe End Projection is described further in “Probe End Projection” on page C-10.

Vapor Compensation is described further in “Dielectric Constant Settings” on page C-14.

Choose the **Tank Material** if recommended.

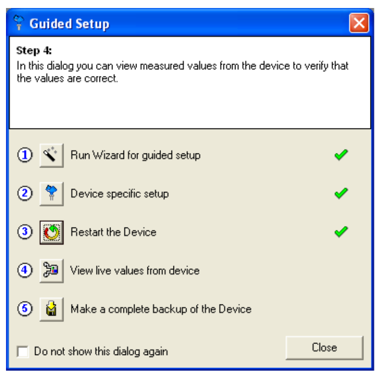
Restart the Transmitter



13. Restart the transmitter

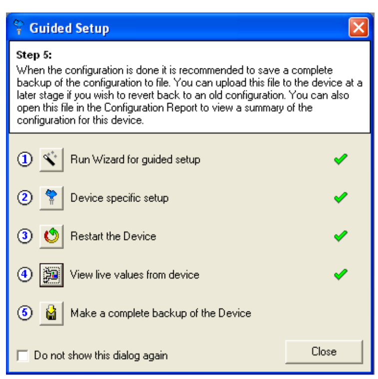
When the transmitter is configured, it should be restarted to make sure that all configuration changes are properly activated and the transmitter performs as expected. It may take up to 60 seconds after the restart button is pressed until measurement values are updated.

View Measured Values



14. Step three in the Guided Setup lets you view measurement values in order to verify that the transmitter works correctly. If the measured values seem incorrect, configuration settings may need to be adjusted.

Backup



15. When configuration is finished, it is recommended that the configuration is saved to a backup file.

This information may be useful for:

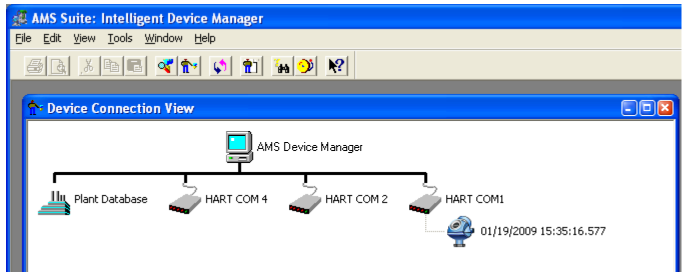
- installing another 5300 in a similar tank since the file can be directly uploaded to a new device
- restoring the configuration, if for any reason, configuration data is lost or accidentally modified making the device inoperable

The *Configuration Report* window appears automatically when the backup is completed.

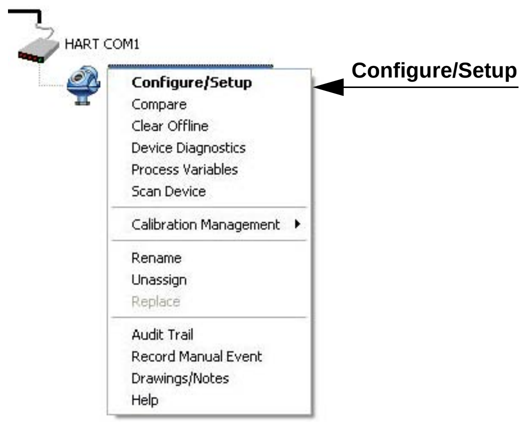
BASIC CONFIGURATION USING AMS SUITE (HART)

The Rosemount 5300 transmitter can be configured by using the AMS Suite software.

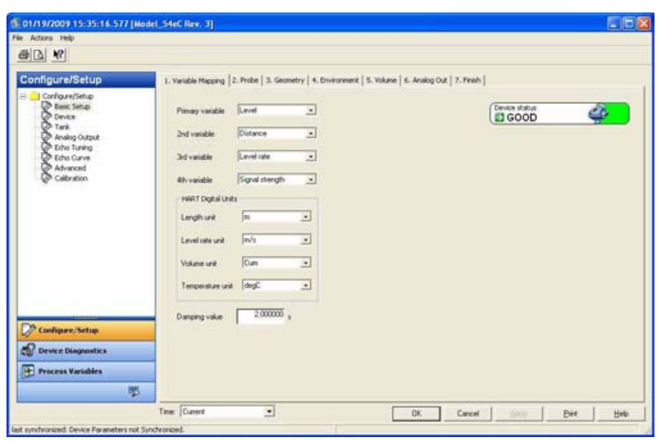
1. Start the *AMS Device Manager* and make sure that the transmitter connects.



2. In the *Device Connection View,* click the right mouse button on the transmitter icon.



3. Choose the **Configure/Setup** option.



4. Choose the **Basic Setup** option.

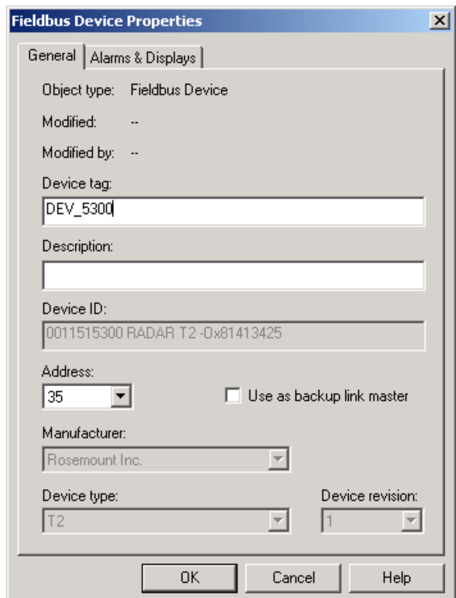
5. Configure the transmitter by selecting the appropriate tab. See “Basic Configuration Parameters” on page 5-4 for information on the various configuration parameters.

BASIC CONFIGURATION USING DELTAV

The Rosemount 5300 Series supports DD Methods for DeltaV to facilitate transmitter configuration. The following description shows how to use DeltaV with the AMS application to configure the Rosemount 5300 Series. The corresponding FOUNDATION Fieldbus commands are also shown.

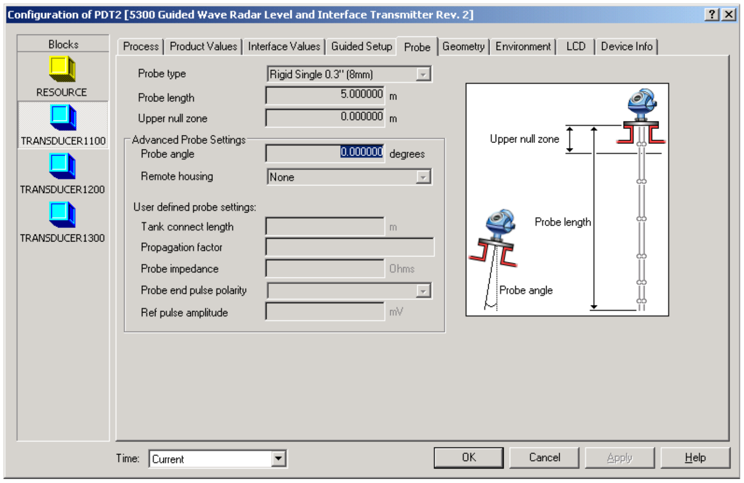
To configure the Rosemount 5300 with DeltaV:

1. Select DeltaV>Engineering>DeltaV Explorer from the Start menu.
2. Navigate through the file structure to find the 5300 transmitter
3. Click the right mouse button on the 5300 transmitter icon and choose Properties.



4. The Fieldbus Device Properties window lets you enter Device Tag and Description. This information is not required for the operation of the transmitter and can be left out if desired.
General information such as device type (5300), manufacturer, device ID are presented. The Rosemount 5300 Series device ID consists of the following components:
Manufacturer ID-Model-Serial Number.
Example: 0011515300 Radar T2-0x81413425.
Check that the information complies with the ordering information.
5. Select the desired transmitter in the **DeltaV Explorer** and choose the **Configure** option.

6. Select the TRANSDUCER1100 block and choose the **Probe** tab.



FOUNDATION Fieldbus parameters:

TRANSDUCER 1100>PROBE_TYPE
TRANSDUCER 1100>PROBE_LENGTH
TRANSDUCER 1100>GEOM_HOLD_OFF_DIST

Check that the correct **Probe Type** is chosen. Normally, the Probe Type is pre-configured at the factory, but if the current configuration does not match the actual probe, choose the correct Probe Type from the list.

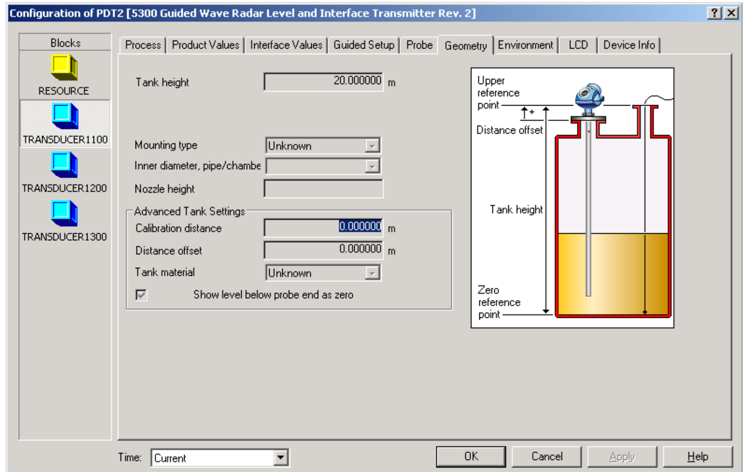
The Rosemount 5300 Series transmitter automatically makes some initial calibrations based on the chosen Probe Type. The following probes are available:

- Rigid Twin
- Flexible Twin
- Coaxial, Coaxial HP, Coaxial HTHP
- Rigid Single, Rigid Single HTHP/HP/C, Rigid Single PTFE
- Flexible Single, Flexible Single HTHP/HP/C, Flexible Single PTFE

The **Probe Length** is the distance from the Upper Reference Point to the end of the probe, see Figure 5-1. If the probe is anchored to a weight do not include the height of the weight. The Probe Length needs to be changed if, for example, the probe is shortened.

The **Hold Off Distance/Upper Null Zone** (UNZ) should not be changed unless there are disturbances at the top of the tank. By increasing the Upper Null Zone, measurements in this region are avoided. See *“Handling of Disturbances from Nozzle” on page C-4* for more information on how to use the UNZ. The UNZ is equal to zero in the factory configuration.

7. Select the TRANSDUCER1100 block and choose the **Geometry** tab.

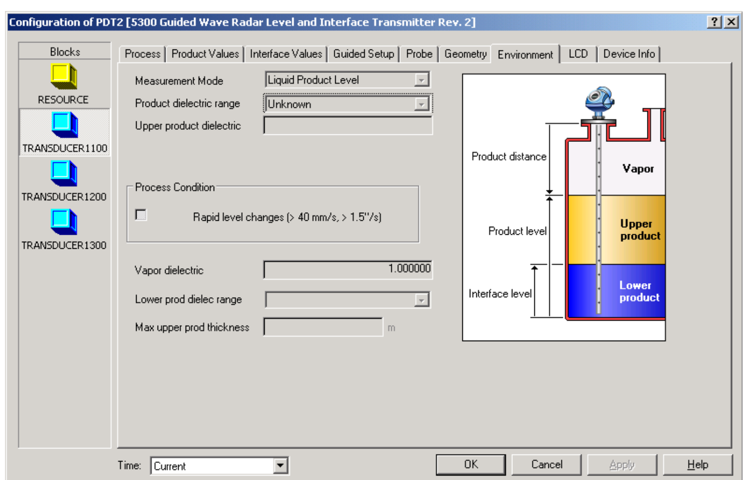


8. **Tank Height** is the distance from the Upper Reference Point to the tank bottom (see “Tank and Probe Geometry” on page 5-4). Make sure that this number is as accurate as possible.
9. Select the **Mounting Type** used.
10. Select **Inner Diameter** if using pipe, chamber, or nozzle.
11. Type **Nozzle Height** if using nozzle.

FOUNDATION Fieldbus parameter:

TRANSDUCER 1100>GEOM_TANK_HEIGHT
TRANSDUCER 1100>MOUNTING_TYPE
TRANSDUCER 1100>PIPE_DIAMETER
TRANSDUCER 1100>NOZZLE_HEIGHT

12. Select the **Environment** tab.



13. Normally, the **Measurement Mode** does not need to be changed. The transmitter is pre-configured according to the specified model.

Submerged is used for applications where the probe is fully submerged in liquid. In this mode, the transmitter ignores the upper product level. See "Section 7: Interface Measurements with Fully Submerged Probes" for more information.

NOTE!
Only use *Submerged* for applications where the interface is measured with a fully submerged probe.

FOUNDATION Fieldbus parameter:
TRANSDUCER 1100>MEAS_MODE

Dielectric Constant/Dielectric Range

The dielectric constant of the product is used for setting the appropriate signal amplitude thresholds, see *Section 7: Service and Troubleshooting* for more information on amplitude threshold settings. Normally, this parameter does not need to be changed for level measurements. However, for some products, measurement performance can be optimized by setting the proper product dielectric constant.

For **Interface Level** measurements, the dielectric constant of the upper product is essential for calculating interface level and the upper product thickness. By default, the **Upper Product Dielectric** parameter is about 2.

Set the **Upper Product Dielectric Constant** to a value that corresponds to the current product.

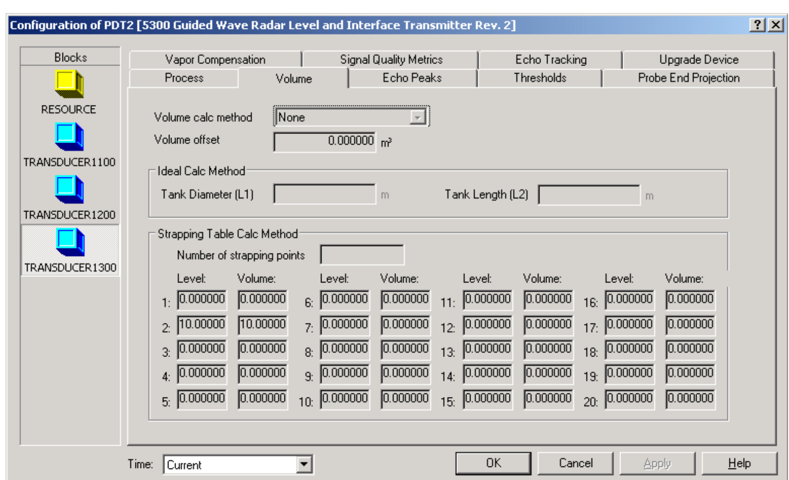
FOUNDATION Fieldbus parameters:
TRANSDUCER 1100>PRODUCT_DIELEC_RANGE
TRANSDUCER 1100>UPPER_PRODUCT_DC

Process Conditions

Select the *Rapid Level Changes* check-box only if the surface is moving quickly up or down at rates over 1.5 in./s (40 mm/s).

FOUNDATION Fieldbus parameter:
TRANSDUCER 1100>ENV_ENVIRONMENT

14. To configure volume calculation, select the TRANSDUCER1300 block and choose the Volume tab.



15. Choose a pre-defined calculation method based on a tank shape that corresponds to the actual tank. Choose None if volume calculation is not desired.
    Use Volume Offset if you do not want zero volume and zero level to match (for example if you want to include the product volume below the zero level).
    The Strapping Table option is used if the actual tank does not match any of the available options for pre-defined tanks or if a higher calculation accuracy is desired.

    Calculation Method:
    FOUNDATION Fieldbus parameter:
    TRANSDUCER 1300>VOL_VOLUME_CALC_METHOD

    Diameter:
    FOUNDATION Fieldbus parameter:
    TRANSDUCER 1300>VOL_IDEAL_DIAMETER

    Tank Length:
    FOUNDATION Fieldbus parameter:
    TRANSDUCER 1300>VOL_IDEAL_LENGTH

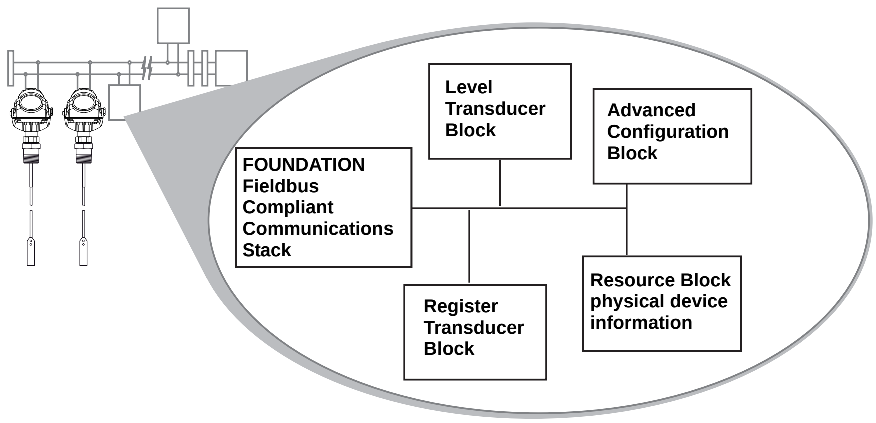
    Volume Offset:
    FOUNDATION Fieldbus parameter:
    TRANSDUCER 1300>VOL_VOLUME_OFFSET

    See “Volume Configuration” on page 5-7 for more information.

FOUNDATION FIELDBUS OVERVIEW

Figure 5-10 illustrates how the signals are channeled through the transmitter.

Figure 5-10. Function Block Diagram for the Rosemount 5300 Series Radar Level Transmitters with FOUNDATION Fieldbus.



NOTE!
It is highly recommended that you limit the number of periodic writes to all static or non-volatile parameters such as HI_HI_LIM, LOW_CUT, SP, TRACK_IN_D, OUT, IO_OPTS, BIAS, STATUS_OPTS, SP_HI_LIM, and so on. Static parameter writes increment the static revision counter, ST_REV, and are written to the device's non-volatile memory. Fieldbus devices have a non-volatile memory write limit. If a static or non-volatile parameter is configured to be written periodically, the device can stop its normal operation after it reaches its limit or fail to accept new values.

This section provides a brief overview of FOUNDATION Fieldbus block operation with the Rosemount 5300 Series Level Transmitter.

For detailed information about FOUNDATION Fieldbus technology and function blocks used in the Rosemount 5300 Series, refer to the FOUNDATION Fieldbus Block Manual (Document No. 00809-0100-4783).

Assigning Device Tag and Node Address

A Rosemount 5300 Series transmitter is shipped with a blank tag and a temporary address (unless specifically ordered with both) to allow a host to automatically assign an address and a tag. If the tag or address need to be changed, use the features of the configuration tool. The tool basically does the following:

1. Changes the address to a temporary address (248-251).
2. Changes the tag to a new value.
3. Changes the address to a new address.

When the transmitter is at a temporary address, only the tag and address can be changed or written to. The resource, transducer, and function blocks are all disabled.

FOUNDATION Fieldbus Block Operation

Function blocks within the fieldbus device perform the various functions required for process control. Function blocks perform process control functions, such as analog input (AI) functions, as well as proportional-integral derivative (PID) functions. The standard function blocks provide a common structure for defining function block inputs, outputs, control parameters, events, alarms, and modes, and combining them into a process that can be implemented within a single device or over the fieldbus network. This simplifies the identification of characteristics that are common to function blocks.

In addition to function blocks, fieldbus devices contain two other block types to support the function blocks. These are the **Resource block** and the **Transducer block**.

Resource blocks contain the hardware specific characteristics associated with a device; they have no input or output parameters. The algorithm within a resource block monitors and controls the general operation of the physical device hardware. There is only one resource block defined for a device.

Transducer blocks connect function blocks to local input/output functions. They read sensor hardware and write to effector (actuator) hardware.

Level Transducer Block

The Level Transducer block contains transmitter information including diagnostics and the ability to configure, set to factory defaults and restarting the transmitter.

Register Transducer Block

The Register Transducer Block allows a service engineer to access all database registers in the device.

Advanced Configuration Transducer Block

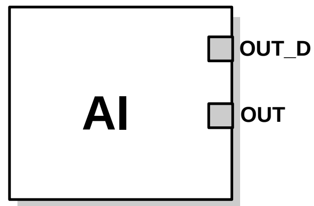
The Advanced Configuration Transducer Block contains functions such as amplitude threshold settings for filtering of disturbing echoes and noise, simulation of measurement values, and strapping table for volume measurements.

Resource Block

The Resource block contains diagnostic, hardware, electronics, and mode handling information. There are no linkable inputs or outputs to the Resource Block.

Analog Input Block

Figure 5-11. Analog-Input Block



OUT=The block output value and status
OUT_D=Discrete output that signals a selected alarm condition

The Analog Input (AI) function block processes field device measurements and makes them available to other function blocks. The output value from the AI block is in engineering units and contains a status indicating the quality of the measurement. The measuring device may have several measurements or derived values available in different channels. Use the channel number to define the variable that the AI block processes and passes on to linked blocks. For further information refer to Appendix J: Analog-Input Block.

For more information on the different function blocks refer to *Appendix F: Level Transducer Block*, *Appendix G: Register Transducer Block*, *Appendix H: Advanced Configuration Transducer Block*, *Appendix I: Resource Transducer Block* and *Appendix J: Analog-Input Block*.

Function Block Summary

The following function blocks are available for the Rosemount 5300 Series:

- Analog Input (AI)
- Proportional/Integral/Derivative (PID)
- Input Selector (ISEL)
- Signal Characterizer (SGCR)
- Arithmetic (ARTH)
- Output Splitter (OS)

For detailed information about FOUNDATION Fieldbus technology and function blocks used in the Rosemount 5300 Series, refer to the FOUNDATION Fieldbus Block Manual (Document No. 00809-0100-4783).

CONFIGURE THE AI BLOCK

⚠ A minimum of four parameters are required to configure the AI Block. The parameters are described below with example configurations shown at the end of this section.

CHANNEL

Select the channel that corresponds to the desired sensor measurement. The Rosemount 5300 measures Level (channel 1), Distance (channel 2), Level Rate (channel 3), Signal Strength (channel 4), Volume (channel 5), Internal Temperature (channel 6), Upper Product Volume (channel 7), Lower Product Volume (channel 8), Interface Distance (channel 9), Upper Product Thickness (channel 10), Interface Level (channel 11), Interface Level Rate (channel 12), Interface Signal Strength (channel 13), Signal Quality (channel 14), Surface/Noise Margin (channel 15), and Vapor DC (channel 16).

AI Block	TB Channel Value	Process Variable
Level	1	CHANNEL_RADAR_LEVEL
Ullage	2	CHANNEL_RADAR_ULLAGE
Level Rate	3	CHANNEL_RADAR_LEVELRATE
Signal Strength	4	CHANNEL_RADAR_SIGNAL_STRENGTH
Volume	5	CHANNEL_RADAR_VOLUME
Internal Temperature	6	CHANNEL_RADAR_INTERNAL_TEMPERATURE
Upper Product Volume	7	CHANNEL_UPPER_PRODUCT_VOLUME
Lower Product Volume	8	CHANNEL_LOWER_ PRODUCT_VOLUME
Interface Distance	9	CHANNEL_INTERFACE_ DISTANCE
Upper Product Thickness	10	CHANNEL_UPPER_ PRODUCT_THICKNESS
Interface Level	11	CHANNEL_INTERFACE_LEVEL
Interface Level Rate	12	CHANNEL_INTERFACE_ LEVELRATE
Interface Signal Strength	13	CHANNEL_INTERFACE_ SIGNALSTRENGTH
Signal Quality	14	CHANNEL_SIGNAL_QUALITY
Surface/Noise Margin	15	CHANNEL_ SURFACE_NOISE_MARGIN
Vapor DC	16	CHANNEL_VAPOR_DC

L_TYPE

The L_TYPE parameter defines the relationship of the transmitter measurement (Level, Distance, Level Rate, Signal Strength, Volume, and Average Temperature) to the desired output of the AI Block. The relationship can be direct or indirect root.

Direct
Select direct when the desired output will be the same as the transmitter measurement (Level, Distance, Level Rate, Signal Strength, Volume, and Internal Temperature).

Indirect
Select indirect when the desired output is a calculated measurement based on the transmitter measurement (Level, Distance, Level Rate, Signal Strength, Volume, and Internal Temperature). The relationship between the transmitter measurement and the calculated measurement will be linear.

Indirect Square Root
Select indirect square root when the desired output is an inferred measurement based on the transmitter measurement and the relationship between the sensor measurement and the inferred measurement is square root (e.g. level).

XD_SCALE and OUT_SCALE

The XD_SCALE and OUT_SCALE each include three parameters: 0%, 100%, and engineering units. Set these based on the L_TYPE:

L_TYPE is Direct
When the desired output is the measured variable, set the XD_SCALE to represent the operating range of the process. Set OUT_SCALE to match XD_SCALE.

L_TYPE is Indirect
When an inferred measurement is made based on the sensor measurement, set the XD_SCALE to represent the operating range that the sensor will see in the process. Determine the inferred measurement values that correspond to the XD_SCALE 0 and 100% points and set these for the OUT_SCALE.

L_TYPE is Indirect Square Root
When an inferred measurement is made based on the transmitter measurement and the relationship between the inferred measurement and sensor measurement is square root, set the XD_SCALE to represent the operating range that the sensor will see in the process. Determine the inferred measurement values that correspond to the XD_SCALE 0 and 100% points and set these for the OUT_SCALE.

Engineering Units

NOTE!
To avoid configuration errors, only select Engineering Units for XD_SCALE and OUT_SCALE that are supported by the device.

The supported units are:

Table 5-4. Length

Display	Description
m	meter
cm	centimeter
mm	millimeter
ft	feet
in	inch

Table 5-5. Level Rate

Display	Description
m/s	meter per second
m/h	meter per hour
ft/s	feet per second
in/m	inch per minute

Table 5-6. Temperature

Display	Description
°C	Degree Celsius
°F	Degree Fahrenheit

Table 5-7. Signal Strength

Display	Description
mV	millivolt

Table 5-8. Volume

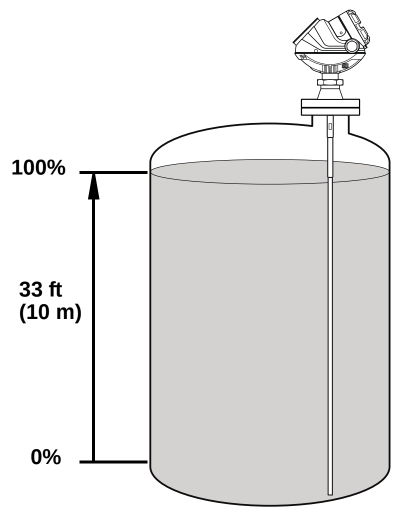
Display	Description
m^3	Cubic meter
L	Liter
in^3	Cubic inch
ft^3	Cubic feet
Yd^3	Cubic yard
Gallon	US gallon
ImpGall	Imperial gallon
Bbl	Barrel (oil, 42 US gallons)

Application Example 1

Radar Level Transmitter, Level Value

A level transmitter is measuring the level in a 33 ft. (10 m) high tank.

Figure 5-12. Situation Diagram



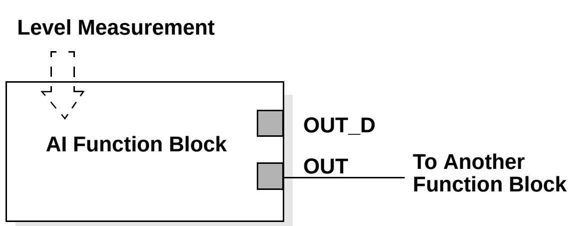
Solution

Table 5-9 lists the appropriate configuration settings, and Figure 5-13 illustrates the correct function block configuration.

Table 5-9. Analog Input Function Block Configuration for a typical Level Transmitter

Parameter	Configured Values
L_TYPE	Direct
XD_SCALE	Not Used
OUT_SCALE	Not Used
CHANNEL	CH1: Level

Figure 5-13. Analog Input Function Block Diagram for a typical Level Transmitter



Application Example 2

Radar Level Gauge, Level value in percent (%)

The maximum level in the tank is 46 ft. (14 m). The level value is displayed in percentage of the full span (see Figure 5-14).

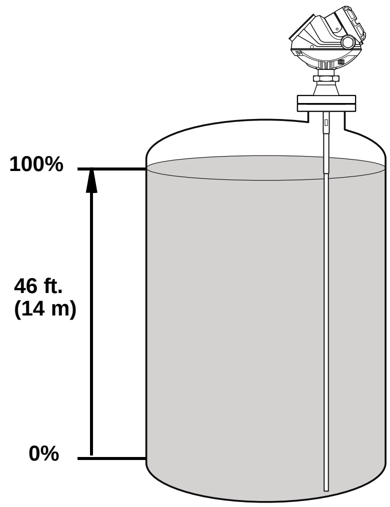


Figure 5-14. Situation Diagram

Solution

Table 5-10 lists the appropriate configuration settings, and Figure 5-15 illustrates the correct function block configuration.

Table 5-10. Analog Input Function Block Configuration for a Level Transmitter where level output is scaled between 0-100%

Parameter	Configured Values
L_TYPE	Indirect
XD_SCALE	0 to 14 m
OUT_SCALE	0 to 100%
CHANNEL	CH1: Level

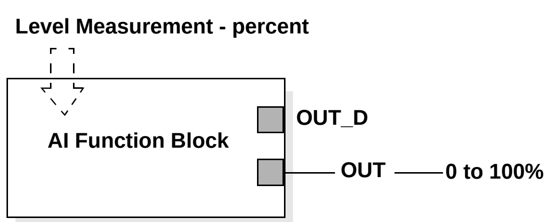


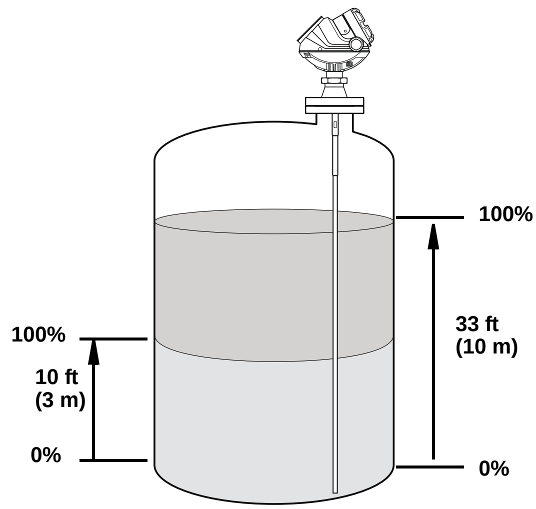
Figure 5-15. Function Block Diagram for a Level Transmitter where level output is scaled between 0-100%

Application Example 3

Radar Level Transmitter, Product Level and Interface Level Value

A level transmitter is measuring the product level and the interface level in a 33 ft. (10 m) high tank. The maximum interface level is 10 ft. (3 m).

Figure 5-16. Situation Diagram



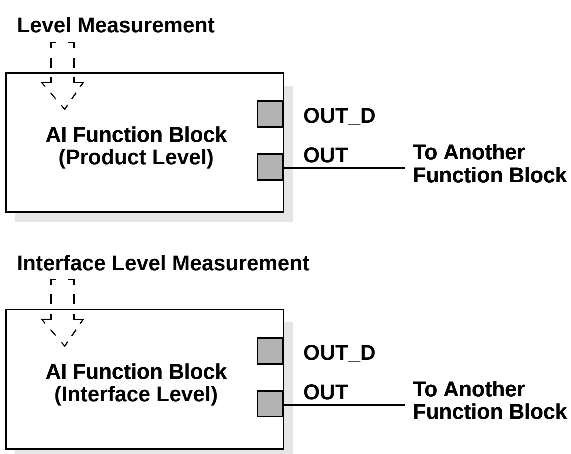
Solution

Table 5-11 lists the appropriate configuration settings, and Figure 5-17 illustrates the correct function block configuration.

Table 5-11. Analog Input Function Block Configuration for a Level and Interface Transmitter

AI Function Block Product Level		AI Function Block Interface Level	
Parameter	**Configured Values**	**Parameter**	**Configured Values**
L_TYPE	Direct	L_TYPE	Direct
XD_SCALE	Not Used	XD_SCALE	Not Used
OUT_SCALE	Not Used	OUT_SCALE	Not Used
CHANNEL	CH1: Level	CHANNEL	CH11: Interface Level

Figure 5-17. Analog Input Function Block Diagram for a Level and Interface Transmitter

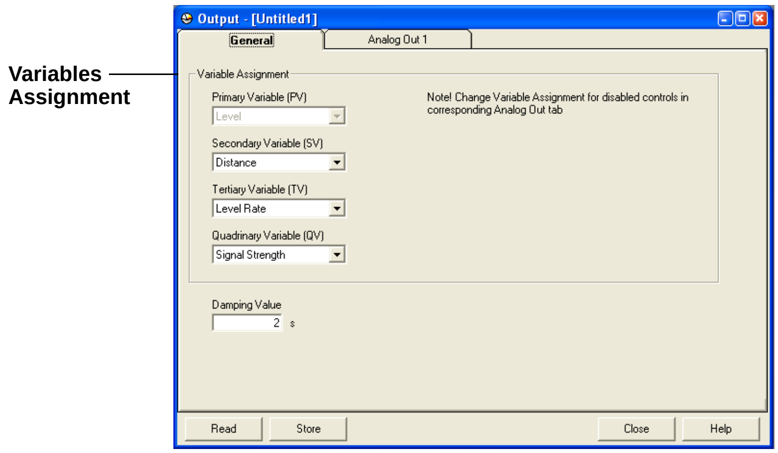


TRI-LOOP HART TO ANALOG CONVERTER

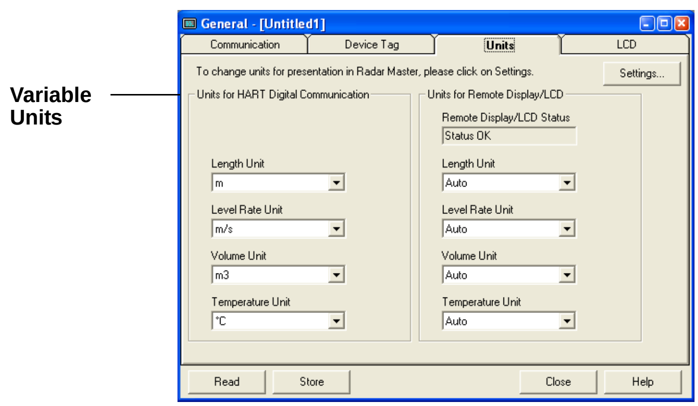
The Rosemount 333 HART Tri-Loop HART-to-Analog Signal Converter is capable of converting a digital HART burst signal into three additional 4-20 mA analog signals.

To set the Rosemount 5300 transmitter up for the HART Tri-Loop:

1. Make sure the Rosemount 5300 transmitter is properly configured.
2. Assign transmitter variables Primary Variable, Secondary Variable etc.
HART command [2,1,1].
RRM: Setup>Output/General.



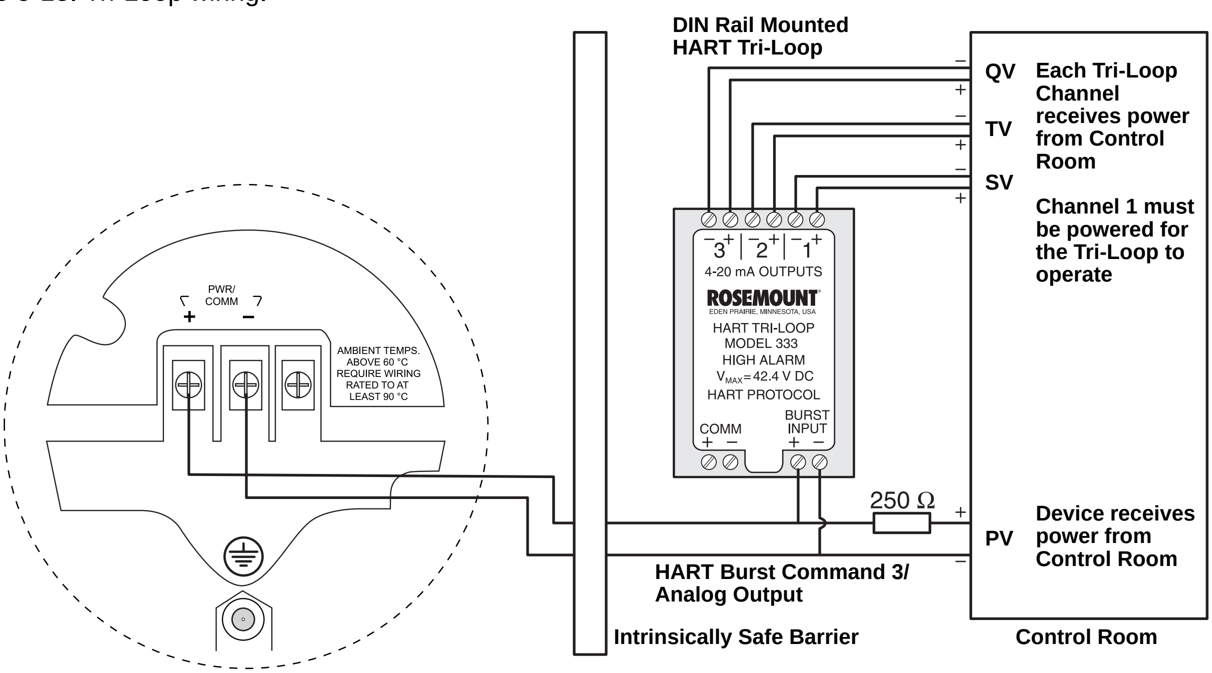
3. Configure variable units: Length, Level Rate, Volume and Temperature.
HART command [2,2,2,5].
RRM: Setup>General/Units.



4. Set the 5300 in Burst mode.
HART command [2,2,4,2].
RRM: Setup>General/Communication.
5. Select Burst option 3=Process variables and current (Process vars/crnt).
HART command [2,2,4,2,2].
6. Install the Tri-Loop. Connect Channel 1 wires, and optionally wires for Channel 2 and Channel 3.

7. Configure Tri-Loop Channel 1:
    a. Assign variable: Tri-Loop HART command [1,2,2,1,1]. Make sure that the SV, TV, and QV match the configuration of the 5300 transmitter.
    b. Assign units: Tri-Loop HART command [1,2,2,1,2]. Make sure that the same units are used as for the 5300 transmitter.
    c. Set the Upper Range Value and the Lower Range Value: Tri-Loop HART command [1,2,2,1,3-4].
    d. Enable the channel. Tri-Loop HART command [1,2,2,1,5].
8. (Optional) Repeat steps a-d for Channels 2 and 3.
9. Connect wires to Tri-Loop Burst Input.
10. Enter the desired tag, descriptor, and message information:
Tri-Loop HART command [1,2,3].
11. (Optional) If necessary, perform an analog output trim for Channel 1 (and Channel 2 and 3 if they are used).
Tri-Loop HART command [1,1,4].

Figure 5-18. Tri-Loop wiring.



See the reference manual for the *Model 333 HART Tri-Loop HART-to-Analog Signal Converter* for further information on how to install and configure the Tri-Loop.

To turn off the Burst Mode

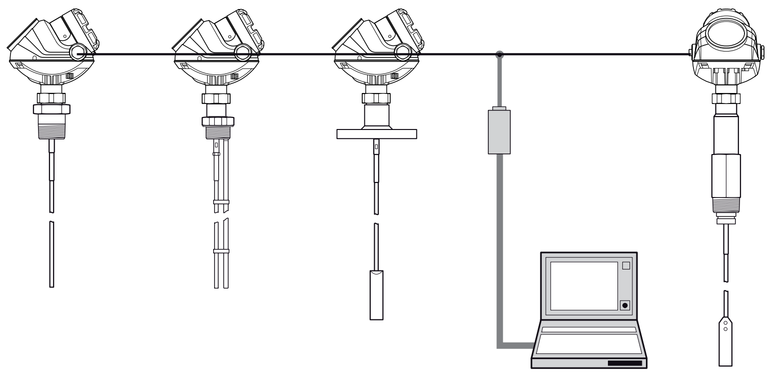
To turn off the Burst Mode, use one of the following options:

- The RRM program
- The Rosemount Burst Mode Switch software
- A 375 Field Communicator
- The AMS software

HART MULTI-DROP CONFIGURATION

The 5300 transmitter can be run in multidrop mode. In the multidrop mode each transmitter has a unique HART address.

Figure 5-19. Multidrop connection

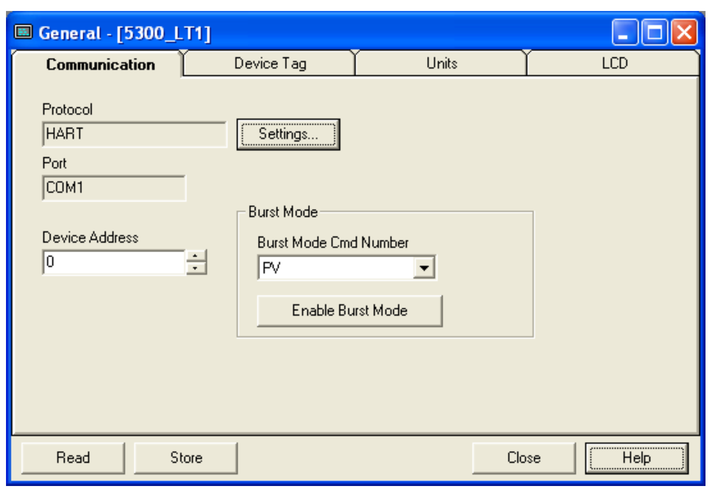


The poll address can be changed by using a 375 Field Communicator or by using the Rosemount Radar Master software.

To change the poll address using a 375 Field Communicator, choose HART command [2, 2, 4, 1].

To change the poll address using the Rosemount Radar Master (RRM) software:

1. Choose the Setup>General option.



2. Select the *Communication* tab.
3. Set the desired address (between 1 and 15 for multidrop operation).
4. Click the Store button to save the new address.

Section 6 Operation

SAFETY MESSAGES

Procedures and instructions in this manual 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 (⚠). Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

⚠WARNING

Failure to follow these installation 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.

Explosions could result in death or serious injury.

- Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a 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.

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

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

- 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.

⚠WARNING

Any substitution of non-authorized parts or repair, other than exchanging the complete transmitter head or probe assembly, may jeopardize safety and is prohibited.

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

VIEWING MEASUREMENT DATA

Using the Display Panel

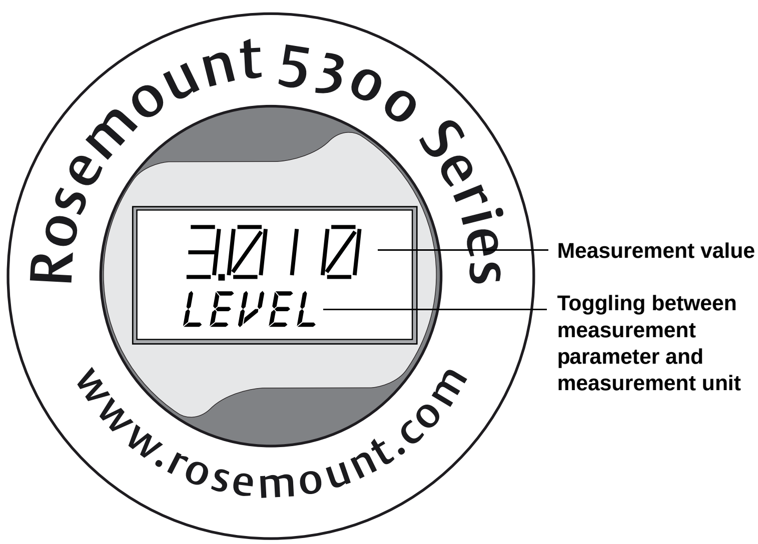
The Rosemount 5300 transmitter uses an optional Display Panel for presentation of measurement data. When the transmitter is switched on, the Display Panel presents information such as transmitter model, measurement frequency, software version, communication type (HART, FF), serial number, HART identification tag, setting of write protection switch, and Analog Output settings.

When the transmitter is up and running, the Display Panel presents Level, Signal Amplitude, Volume, and other measurement data depending on the Display Panel configuration (see "Specifying Display Panel Variables" on page 6-3). The available LCD parameters are listed in Table 6-1 on page 6-6.

The display has two rows, the upper row shows the measurement value and the lower row shows the parameter name and measurement unit. It toggles between the different measurement values every 2 seconds. The lower row toggles between parameter name and measurement unit each second.

Variables to be presented are configurable by using a 375 Handheld Communicator, AMS, DeltaV or the Rosemount Radar Master software.

Figure 6-1. The 5300 Display Panel.



Error messages are listed in section "LCD Error Messages" on page 7-42.

Specifying Display Panel Variables

It is possible to specify the variables to be presented on the Display Panel (LCD).

Using a Handheld Communicator

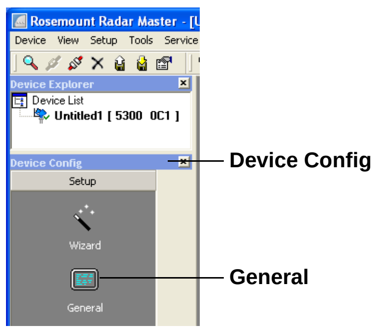
For a 375 Handheld Communicator, the LCD settings are available with:
HART command [2, 2, 3].

FOUNDATION Fieldbus parameters:
TRANSDUCER 1100>LCD_PARAMETERS.

Using Rosemount Radar Master (RRM)

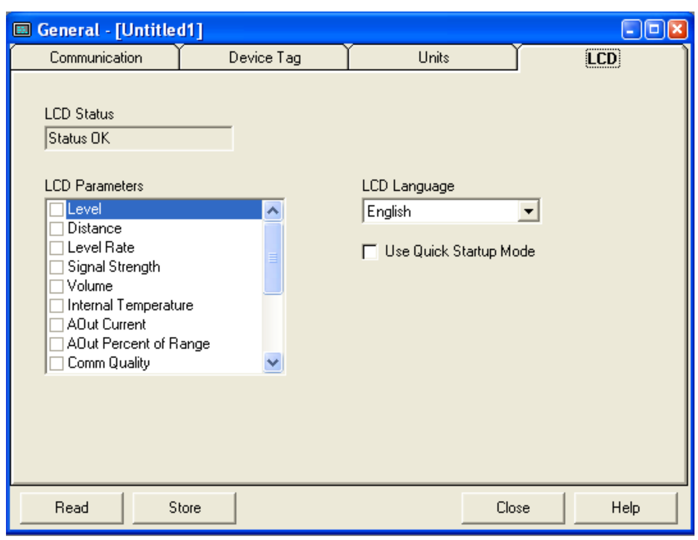
The LCD tab in the *General* window lets you specify which variables to view on the Display Panel screen:

1. Choose the **General** option from the **Setup** menu, or
   click the General icon in the Device Configuration window.



2. Select the **LCD** tab.

Figure 6-2. RRM lets you specify variables for the 5300 Display Panel.



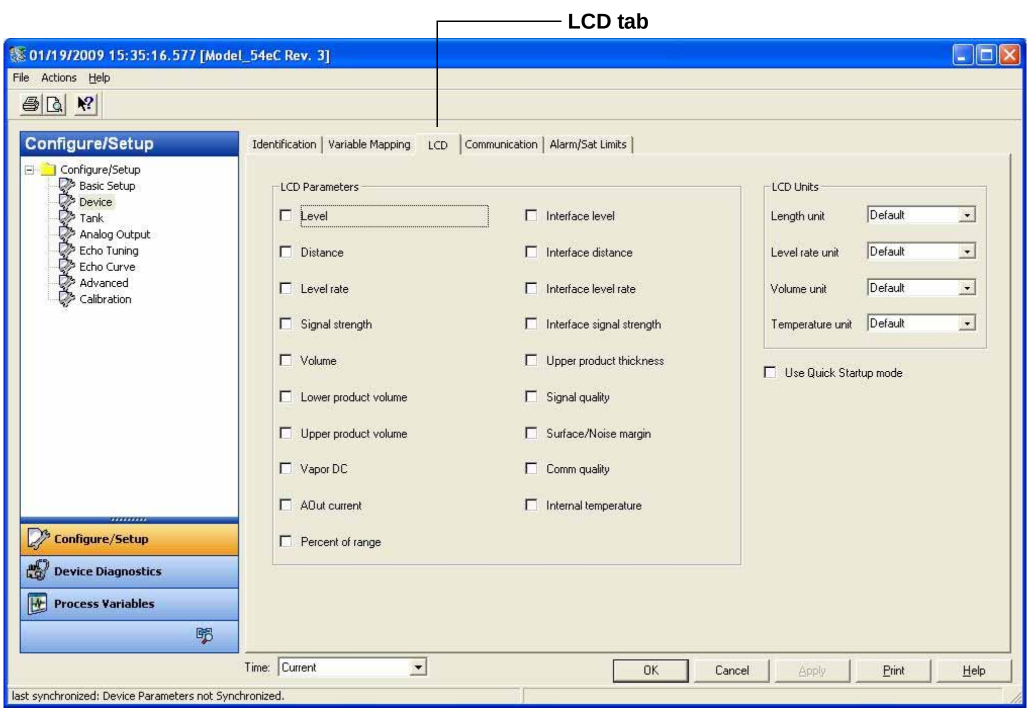
3. Select the variables to be shown on the display panel. The LCD will alternate between the selected items.
   The available LCD parameters are listed in Table 6-1 on page 6-6.
4. Click the **Store** button to save the LCD settings in the transmitter database.

Using AMS

The LCD tab in the *Configure/Setup* window lets you specify which variables to view on the Display Panel screen:

1. Select the transmitter icon in the AMS Suite *Device Connection View* window.
2. Click the right mouse button and choose the **Configure/Setup/Device** option.
3. Select the LCD tab and choose the desired LCD parameters and LCD measurement units. The available LCD parameters are listed in Table 6-1 on page 6-6.
4. Click the OK button to save the configuration and close the window.

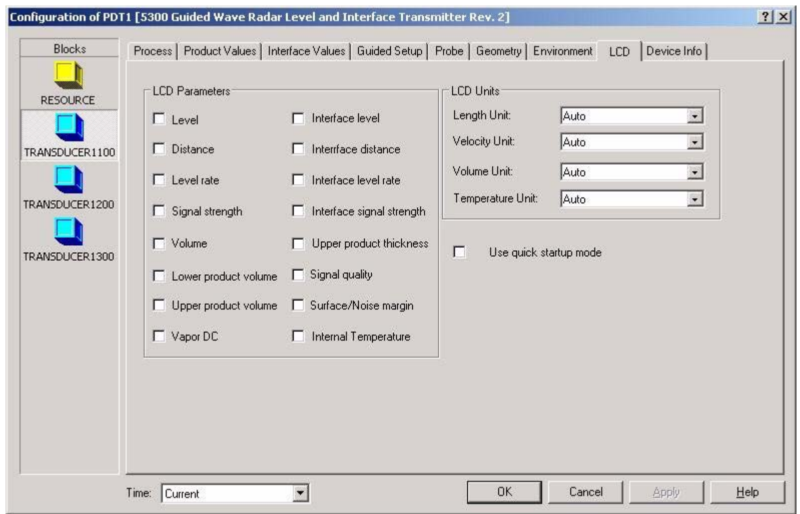
Figure 6-3. The LCD tab in the AMS Suite configuration window lets you configure parameters to be presented on the Display Panel.



Using DeltaV

1. Click the right mouse button on the transmitter icon and choose the **Properties** option.
2. Select the **Transducer1100** block.
3. Select the **LCD** tab.

Figure 6-4. The Transducer 1100 block lets you specify variables for the 5300 Display Panel.



4. Choose the variables you want to appear on the Display Panel and the corresponding measurement units.
   You can specify the same measurement units as selected in the *Product Values* tab and in the *Interface Values* tab by choosing the **Auto** option for the LCD Unit.
   The LCD will alternate between the selected display parameters.
   The available LCD parameters are listed in Table 6-1 on page 6-6.
5. Click the OK button to save the LCD settings in the transmitter database.

LCD Parameters

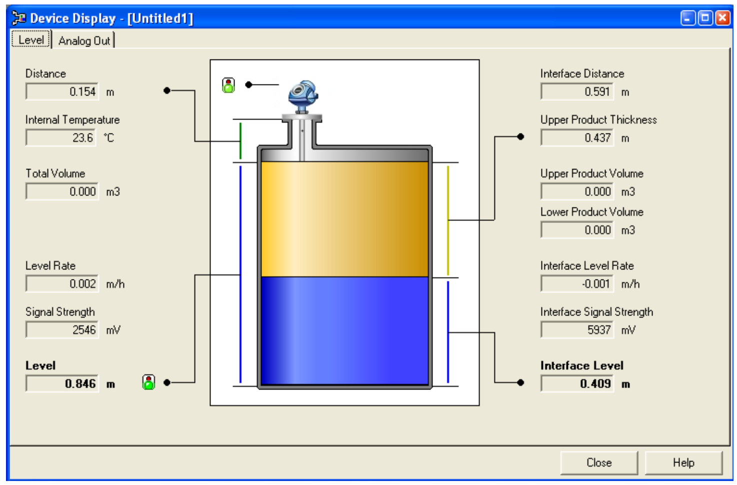
Table 6-1. LCD parameters and presentation on display

Parameter	Presentation on display	Description
Level	LEVEL	Product level.
Distance	DIST	Distance from the upper reference point to the product surface.
Level Rate	LRATE	The speed of level movement up or down.
Signal Strength	AMPL	The signal amplitude of the surface echo.
Volume	VOUME	Total product volume.
Internal Temperature	INTEMP	Temperature inside the transmitter housing.
Analog Output Current	ANOUT	4 -20 mA current.
Percent Range	%RANGE	Level value in percent of total measurement range.
Interface Level	IFLVL	Level of the lower product.
Interface Distance	IFDIST	Distance between the upper reference point and the interface between the upper and lower product.
Interface Level Rate	IFRATE	The speed of interface level movement up or down.
Interface Signal Strength	IFAMPL	The signal amplitude of the interface echo.
Volume Lower	VOL LO	Product volume of lower product.
Volume Upper	VOL UP	Product volume of upper product.
Upper Product Thickness	UPTKNS	Thickness of the upper product.
Signal Quality	SIG Q	The signal quality.
Surface/Noise Margin	SNM	The relationship between the surface peak amplitude and the strongest noise peak amplitude.
Vapor DC	VAP DC	The vapor dielectric constant.

Viewing Measurement Data in RRM

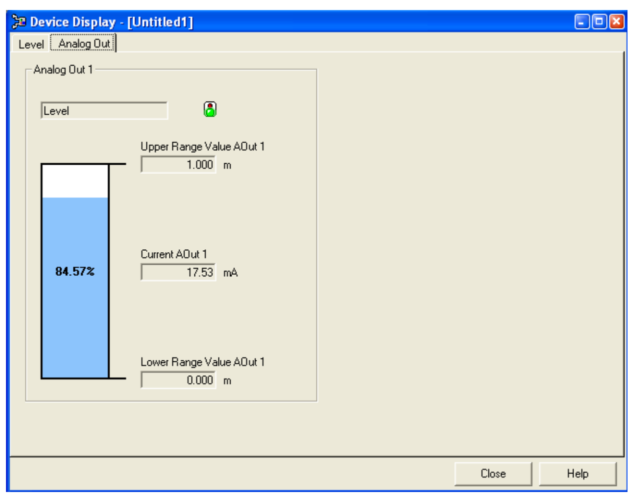
To view measurement data such as Level, Signal Strength, etc. in Rosemount Radar Master, choose the **Tools>Device Display** option and select the Level tab:

Figure 6-5. Presentation of measurement data in RRM.



To view the Analog Output signal, choose the **Tools>Device Display** option and select the Analog Out tab:

Figure 6-6. Presentation of Analog Output value in RRM.

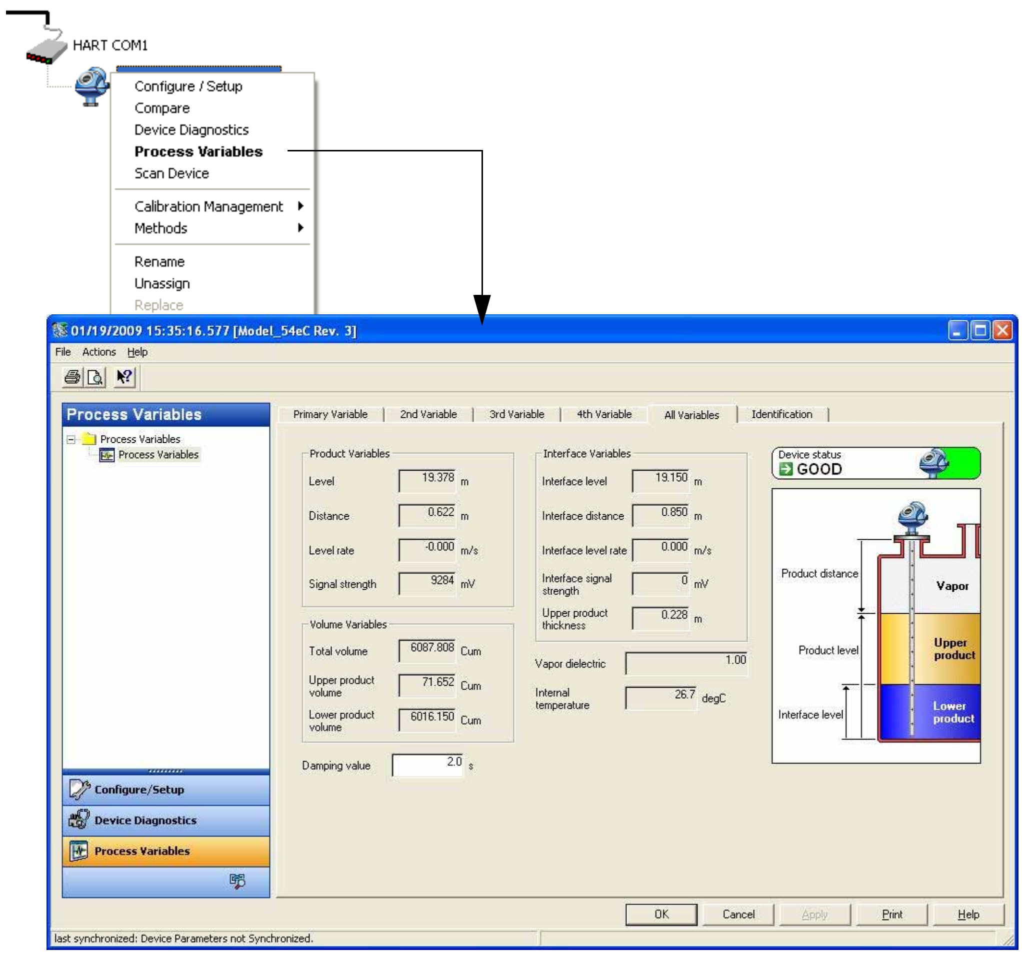


Viewing Measurement Data in AMS Suite

To view measurement data such as Level, Signal Strength, etc. in the AMS Suite:

1. Select the transmitter icon in the AMS Suite *Device Connection View* window.
2. Click the right mouse button and choose the **Process Variables** option.

Figure 6-7. Presentation of measurement data in AMS Suite.

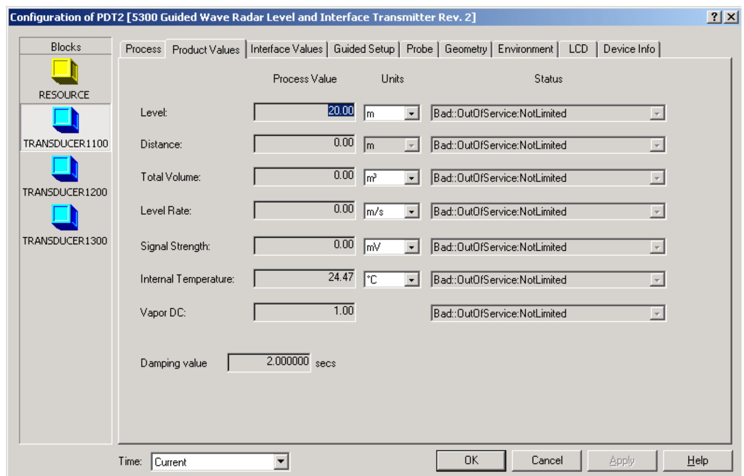


Viewing Measurement Data in DeltaV

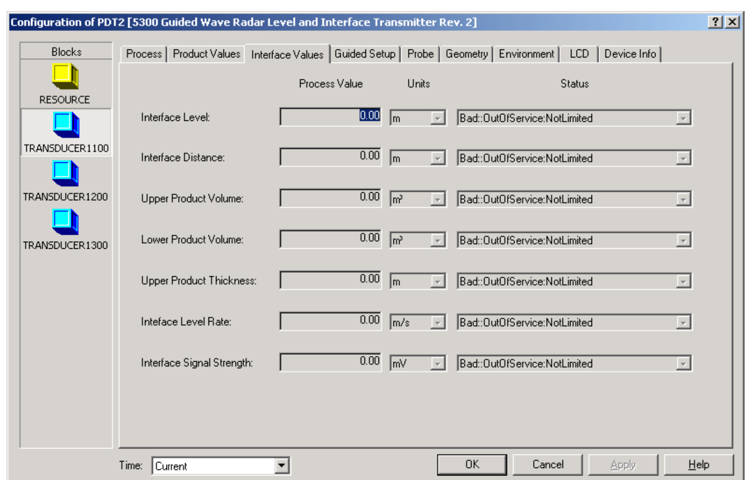
1. Click the right mouse button on the transmitter icon and choose the **Properties** option.
2. Select the **Transducer1100** block.
3. Select the **Product Values** tab.
   For interface measurement, select the **Interface Values** tab.

Figure 6-8. Presentation of measurement data in DeltaV for the Rosemount 5300.

Level values



Interface Level values



Section 7 Service and Troubleshooting

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 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.

⚠WARNING

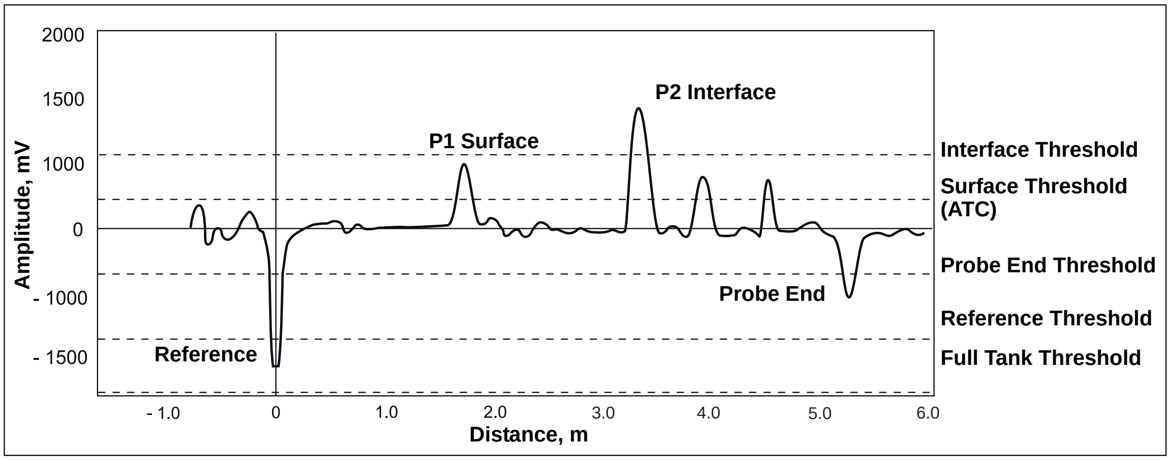
Any substitution of non-authorized parts or repair, other than exchanging the complete transmitter head or probe assembly, may jeopardize safety and is prohibited.

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

ANALYZING THE MEASUREMENT SIGNAL

Rosemount Radar Master (RRM) and other tools using enhanced EDDL has powerful functions for advanced troubleshooting. Using the Echo Curve plot function, an instant view of the tank signal is shown. Measurement problems can be solved by studying the position and amplitude of the different pulses.

Figure 7-1. The Echo Curve presents all visible echoes



In a typical measurement situation, the following pulses appear in the diagram:

Reference. This pulse is caused by the transition between transmitter head and probe. It is used by the transmitter as a reference at level measurements. The pulse amplitude depends on the probe type and installation geometry.

Product surface. This pulse is caused by a reflection on the product surface.

Interface. This pulse is caused by reflection on the interface between an upper product and a bottom product with a relatively high dielectric constant. This pulse is shown when the transmitter is in Measurement Mode=Level & Interface.

Probe End. It is caused by reflection on the probe end. If the probe is grounded, the pulse will be positive.

Different amplitude thresholds are used to filter out unwanted signals and to pick up the different pulses. The transmitter uses certain criteria to decide which type of pulse that is detected.

For example, counting from the top of the tank, the first echo found above the Surface Threshold is considered as the product surface. Other pulses further away from the top, although above the Surface Threshold, are ignored.

When the surface echo is found, the next pulse below the product surface and with a signal strength above the Interface Threshold, is considered as the Interface.

The following amplitude thresholds are used for the Rosemount 5300 Series transmitter:

Reference Threshold - amplitude threshold for detection of the Reference pulse.

Surface Threshold - amplitude threshold for detection of the Product level peak. The surface threshold is designed as a number of individually adjustable amplitude threshold points, the *Amplitude Threshold Curve* (ATC), see “Amplitude Threshold Curve” on page 7-7.

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

Full Tank Threshold - amplitude threshold that can be used to detect whether the probe is fully submerged in the upper product or not.

Probe End Threshold - amplitude threshold for detection of the Probe End peak.

Thresholds are recommended to be set to approximately 50% of the signal peak amplitude. To adjust the **Amplitude Thresholds** see “Using the Echo Curve Analyzer” on page 7-10.

SURFACE PULSE NOT FOUND

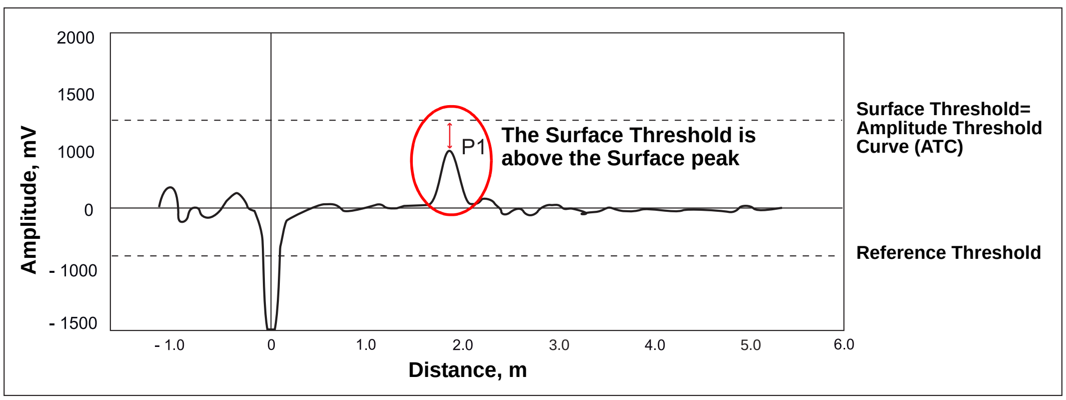
The amplitude thresholds are automatically adjusted to appropriate values to filter out noise and other non-valid measurements from the measurement signal.

The amplitude of the measurement signal, i.e. the amplitude of the signal that is reflected by the product surface, is related to the actual dielectric constant of the product. The amplitude threshold that is used by the transmitter is based on the parameter configuration of the current product dielectric constant (see *“Basic Configuration Parameters” on page 5-4*). Normally no other threshold adjustment is needed, but if the transmitter still does not track the product surface correctly, it may be necessary to adjust the threshold values.

Rosemount Radar Master (RRM) has a plot function showing the reflections along the probe (see “Using the Echo Curve Analyzer” on page 7-10).

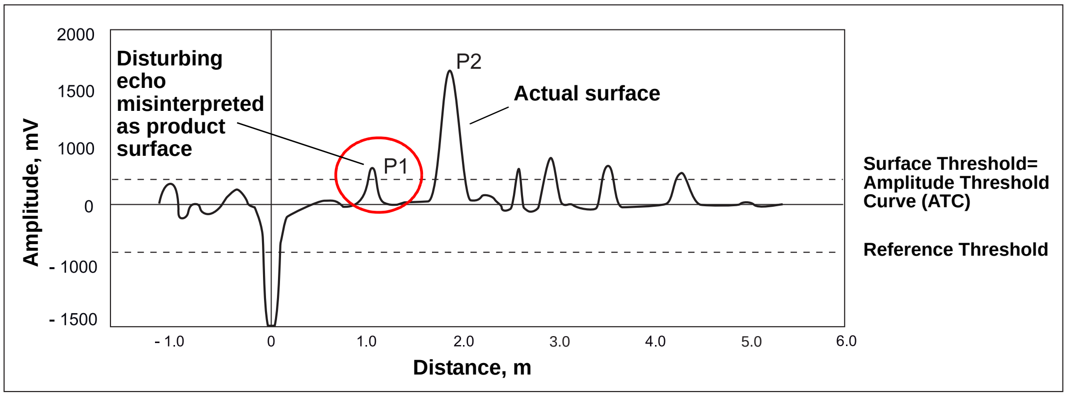
If the amplitude threshold is too high, the product level will not be detected as illustrated in Figure 7-2. In a situation like this, the amplitude threshold has to be lowered so that the Surface peak is not filtered out.

Figure 7-2. Example 1: surface threshold is too high.



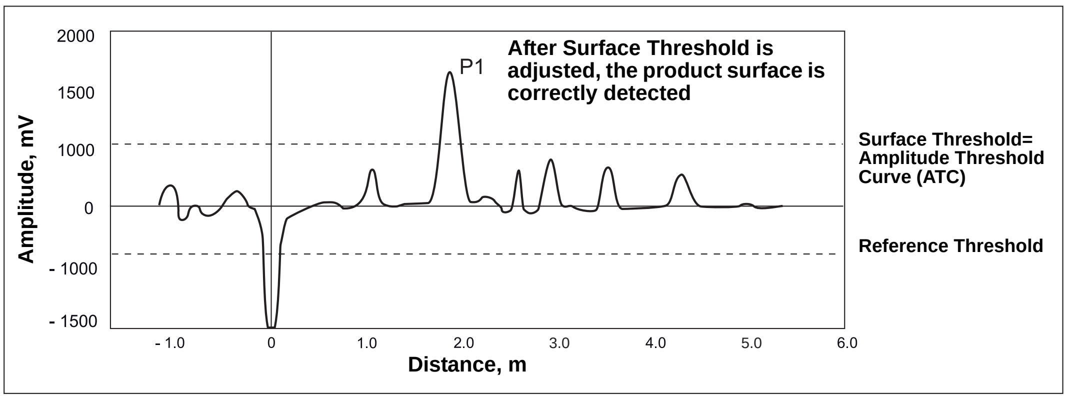
If there are disturbing objects in the tank, the threshold must be carefully set to avoid locking on the wrong amplitude peak. In Figure 7-3, the transmitter has locked on a peak above the actual product surface, i.e. a disturbance was interpreted as the product surface, whereas the actual product surface was interpreted as the interface or the probe end.

Figure 7-3. Example 2: surface threshold is too low.



By adjusting the surface threshold the product surface is properly detected as illustrated in Figure 7-4:

Figure 7-4. Echo Curve after surface threshold was adjusted



To adjust the amplitude thresholds, see “Using the Echo Curve Analyzer” on page 7-10.

In the *Echo Curve Analyzer* in RRM, the amplitude thresholds can be easily dragged to the desired values.

The surface and interface thresholds should be set to about 50% of the measured signal amplitude of the product surface and the interface peaks, respectively.

NOTE!
For interface measurements, check that the Upper Dielectric Constant parameter setting is set to the actual dielectric constant value of the upper product before changing the amplitude thresholds.

Probe End Projection

Probe End Projection allows you to measure product level when the surface pulse is too weak to be detected. For example, long measuring range and products with very poor reflectivity (low dielectric constant).

See *Appendix C: Advanced Configuration* for information on how to use the Probe End Projection function in *Rosemount Radar Master*.

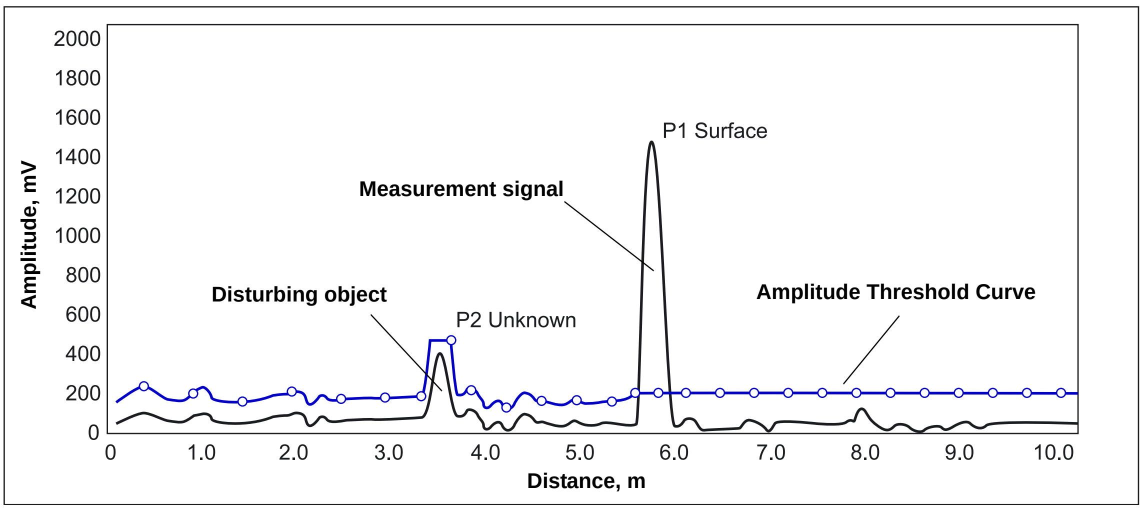
DISTURBANCE ECHO HANDLING

When the Basic Configuration is done, the transmitter may need a fine-tuning to handle disturbing objects in the tank. The Amplitude Threshold Curve (ATC) function can be used for disturbance echo handling with the Rosemount 5300 Series transmitter.

Amplitude Threshold Curve

As shown in Figure 7-5, the ATC can be designed to filter out single disturbing echoes by adapting the curve around the corresponding amplitude peak. It is important in this case that the disturbance is fixed at a certain tank level. Disturbing echoes which may appear different from time to time can be filtered out by raising the whole ATC.

Figure 7-5. Disturbing echoes can be filtered out by creating an amplitude threshold.



Disturbances at the Top of the Tank

In addition to using the ATC, the Rosemount 5300 transmitter supports alternative methods to filter out disturbances at the top of the tank, such as the *Trim Near Zone* and the *Upper Null Zone* functions, which can be used to handle disturbances from narrow nozzles or nozzles with rough edges. See “Handling of Disturbances from Nozzle” on page C-4 for more information.

INTERFACE PULSE NOT FOUND

In interface applications where the bottom product has a relatively low dielectric constant (<40), or if the signal is attenuated in the upper product, the amplitude of the reflected signal is relatively low and difficult for the transmitter to detect. In such cases, it may be possible to detect the reflected signal if the corresponding amplitude threshold is adjusted.

The Rosemount Radar Master (RRM) lets you view a waveform plot to analyze the measurement signal. The plot shows the signal and the thresholds used for the different amplitude peaks. By adjusting the Interface Threshold, it is possible to detect even weak interface signals.

Guidelines for amplitude threshold settings:

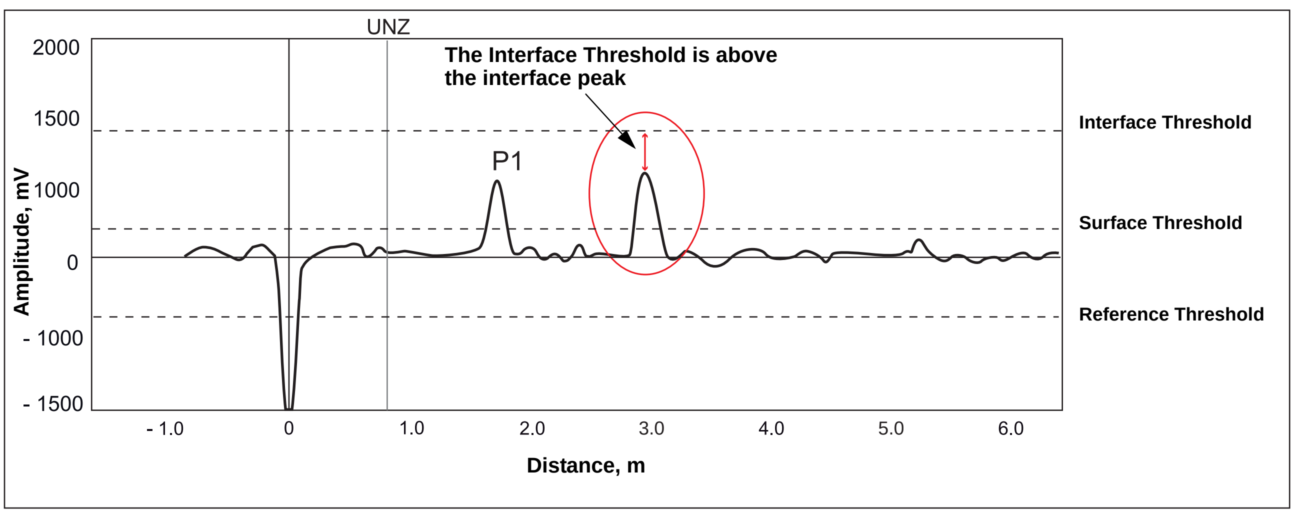
- The Interface Threshold should be approximately 50% of the interface signal amplitude.
- If possible, the Interface Threshold should be higher than the Surface Threshold.

You can use the RRM software or a 375 Field Communicator to change the amplitude thresholds. See “Using the Echo Curve Analyzer” on page 7-10 for more information.

If the Lower Product Dielectric Constant is known, the corresponding configuration parameter can be changed as an alternative to adjusting the amplitude thresholds. See also “Dielectric Constant Settings” on page C-14.

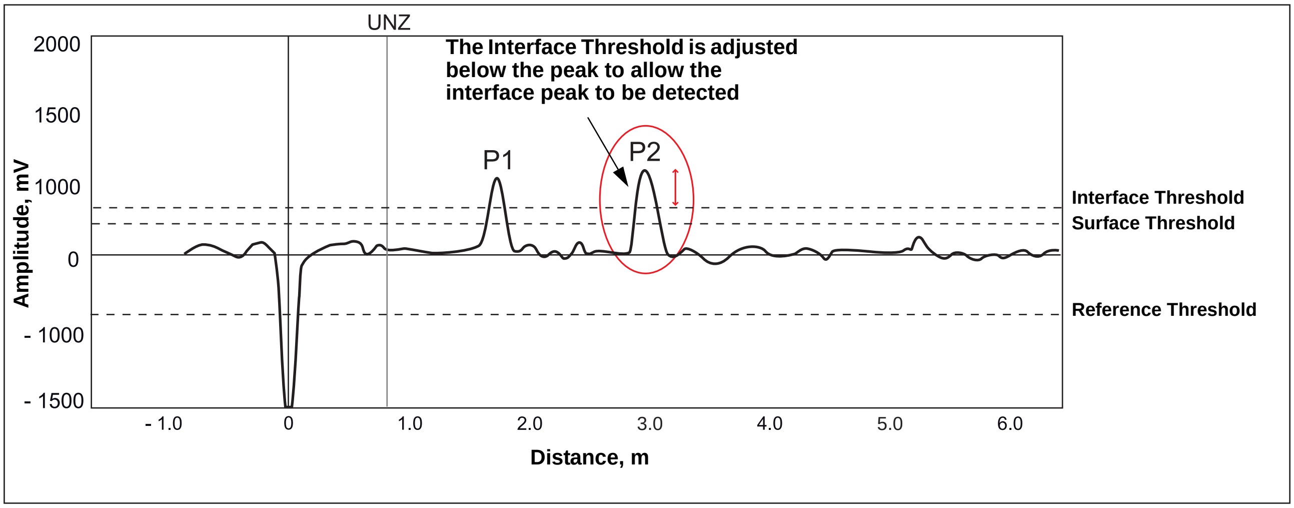
Figure 7-6 illustrates a situation where the Interface Threshold is too high. The signal amplitude peak at the interface between the upper and lower products is not detected in this case.

Figure 7-6. Echo Curve plot indicating that the amplitude threshold for the interface peak is too high.



By adjusting the Interface Threshold, the peak at the interface between the upper and lower products is detected as illustrated in Figure 7-7:

Figure 7-7. After changing the amplitude threshold the transmitter detects the interface



Signal Quality Metrics

Build up on the probe and different surface conditions are factors that can affect signal and noise levels. Signal Quality Metrics can give an indication of how good the surface signal is compared to the noise. See Signal Quality Metrics page C-18 in Appendix C: Advanced Configuration.

USING THE ECHO CURVE ANALYZER

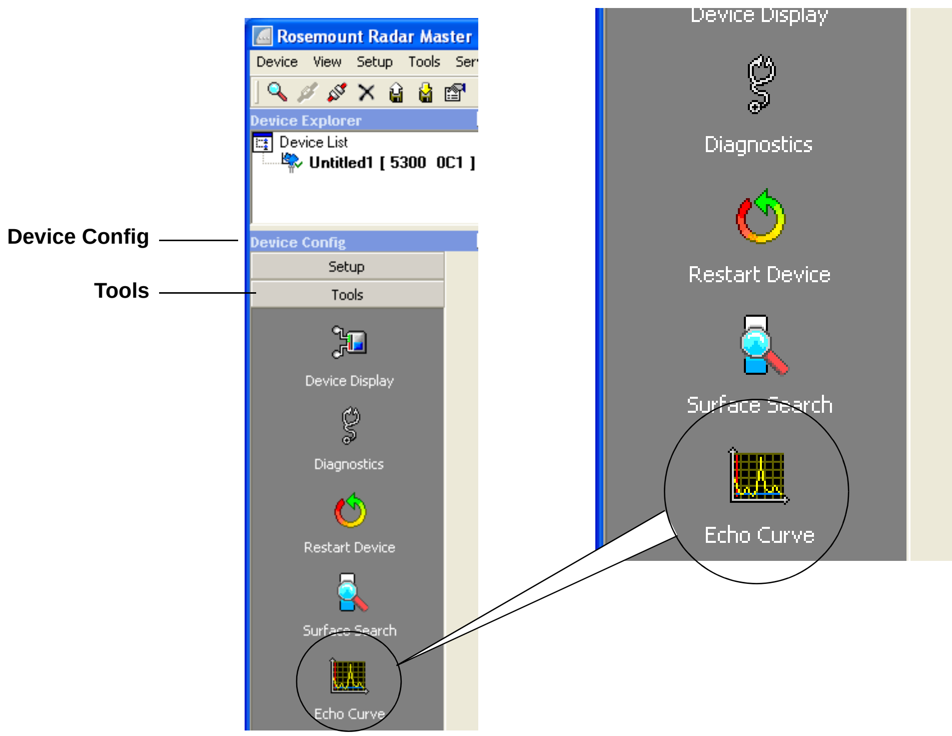
The *Echo Curve Analyzer* in *Rosemount Radar Master* (RRM) shows the measurement signal amplitude from the top to the bottom of the tank. It includes functions for viewing and recording the Echo Curve, and advanced functions for configuration of amplitude thresholds

Using the Rosemount Radar Master

To plot the measurement signal:

1. Start RRM.
2. Open Device Config/Tools (or Device Config/Setup).
3. Click the Echo Curve icon (see Figure 7-8).

Figure 7-8. The Echo Curve function is a useful tool for signal analysis.

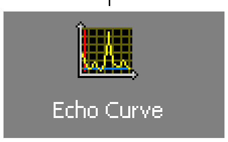


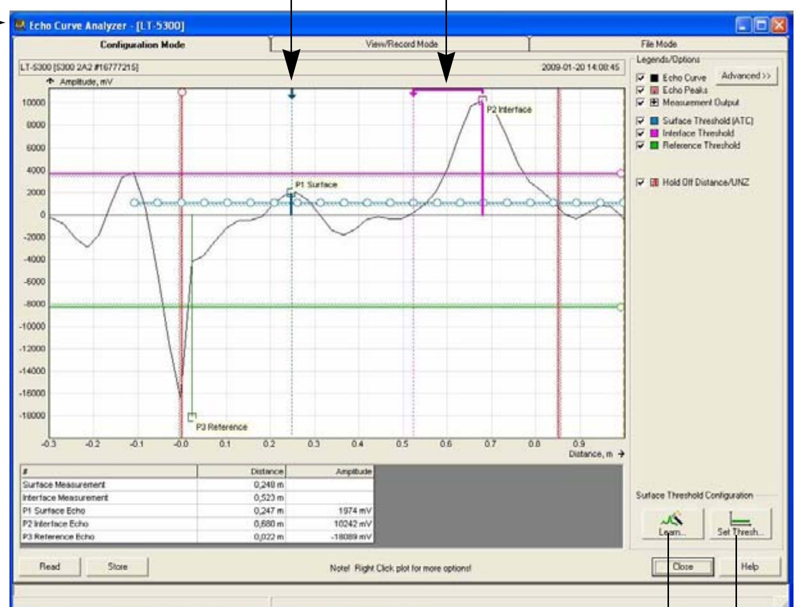
4. The *Echo Curve Analyzer* window appears with the **View/Record Mode** tab (or the **Configuration Mode** tab) selected.

The Configuration Mode Tab

The Configuration Mode tab lets you adjust the different amplitude thresholds. When clicking the **Echo Curve** icon under Device Config/Setup, the *Echo Curve Analyzer* window appears with the **Configuration Mode** tab selected:

Figure 7-9. Echo Curve Analyzer plot in Configuration mode.





See the RRM online-help for descriptions of the various display options in the Echo Curve Analyzer window.

The **Measure and Learn** function in *RRM* automatically creates an Amplitude Threshold Curve (ATC) which is used by the Rosemount 5300 transmitter to find the surface pulse. The ATC is adapted to the shape of the measurement signal as described in *“Disturbance Echo Handling” on page 7-7*.

To create an Amplitude Threshold Curve (ATC), click the **Learn** button in the *Echo Curve Analyzer/Configuration Mode* window. By clicking the **Learn** button, the Measure and Learn function is activated, which creates an ATC that filters out all disturbing echoes. The ATC can also be manually edited if further fine tuning is needed.

The *Configuration Mode* window also allows you to manually change the amplitude thresholds simply by dragging the corresponding anchoring points in the plot to the desired positions. This option can be used to change the Interface Threshold.

Note that by manually changing the amplitude thresholds in the Echo Curve plot, the Automatic mode is disabled for the corresponding threshold (see “Threshold Settings” on page C-8 for more information).

See “Surface Pulse Not Found” on page 7-5 for more information on threshold settings.

The **Set Thresholds** button allows you to set the ATC to a fixed value based on the configured Dielectric Constant of the product.

See also “Threshold Settings” on page C-8 for more information on how to adjust amplitude thresholds.

The current level **Measurement Output** from the device is presented with an arrow at the top of the plot.

Normally, the measurement output points directly at the surface echo peak, but if, for instance, the tank is empty, and there is no surface echo peak detected, the Measurement Output is still presented indicating the distance to the tank bottom.

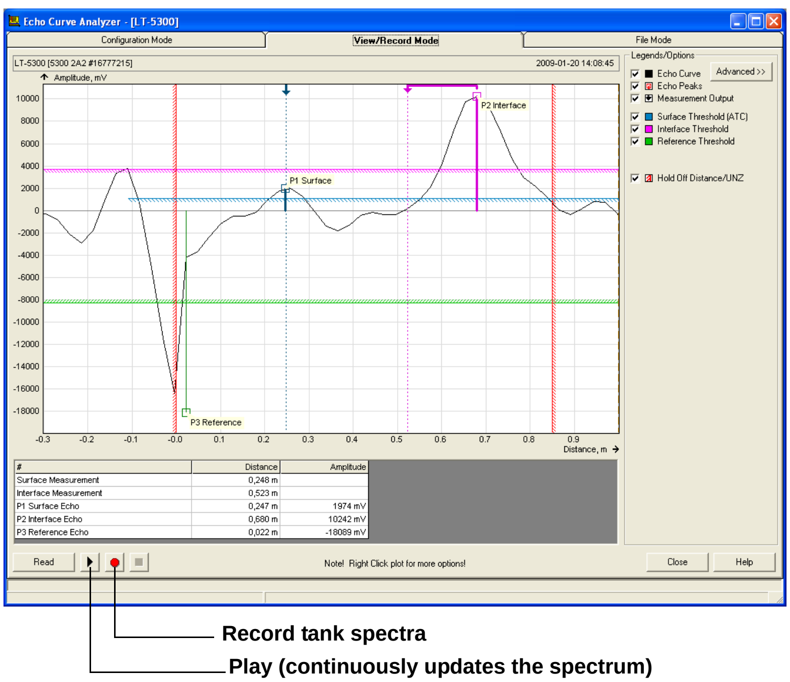
In Figure 7-10, the interface output peak is pointing to the linear distance based on corrections for the dielectric of the material. The actual interface peak is at the electrical distance.

The View/Record ModeTab

The View/Record Mode tab presents a plot of the current tank conditions. Each radar echo is displayed as a peak in the signal plot.

When clicking the **Echo Curve** icon under Device Config/Tools, the *Echo Curve Analyzer* window appears with the **View/Record Mode** tab selected:

Figure 7-10. An Echo Curve plot in View/Record mode.



Advanced

The Advanced button opens a list below the Echo Curve plot with information about all echoes in the tank such as signal amplitude and position in the tank.

Play

When the Play button is clicked, the tank spectrum is continuously updated without being stored.

Record Tank Spectra

This function allows you to record tank spectra over time. This can be a useful function if, for example, you want to study the tank signal when filling or emptying the tank.

The File ModeTab

The **File Mode** tab lets you open files with saved snapshots/movies to be presented in the spectrum plot. A movie file can be played to view the amplitude plot at the desired update rate.

Using the Echo Curve Analyzer with a 375 Field Communicator

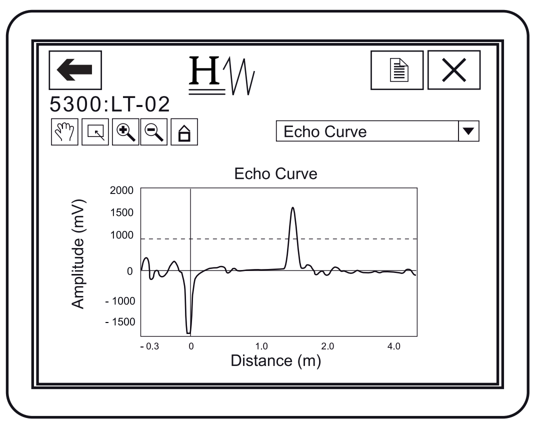
The 375 Field Communicator supports the Electronic Device Description Language (EDDL) with enhancements that allows you to view the Echo Curve, create an Amplitude Threshold Curve (ATC) and specify amplitude thresholds such as the Surface Threshold, Interface Threshold, and Reference Threshold.

Viewing the Echo Curve

To view the Echo Curve:

1. Select HART command [2, 6, 1].
   FOUNDATION Fieldbus parameter:
   TRANSDUCER 1300>AMPLITUDE_THRESHOLD_CURVE

   The Echo Curve appears on the display:



2. Use the Hand and Zoom tools to view specific parts of the Echo Curve. The drop down list allows you choose items, such as the different amplitude thresholds, to be displayed in the plot.

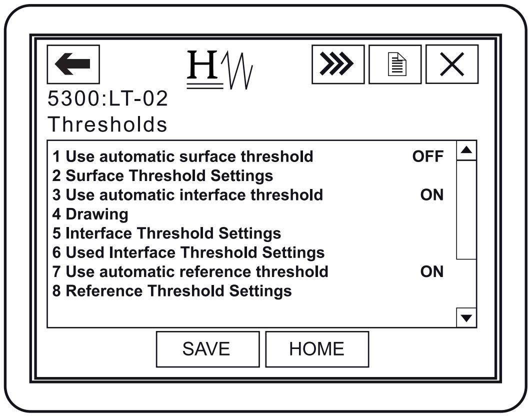
   The Echo Curve plot also shows an ATC if available. See *“Threshold Settings” on page 7-13* for information on how to create an ATC with the *Measure and Learn* function.

Threshold Settings

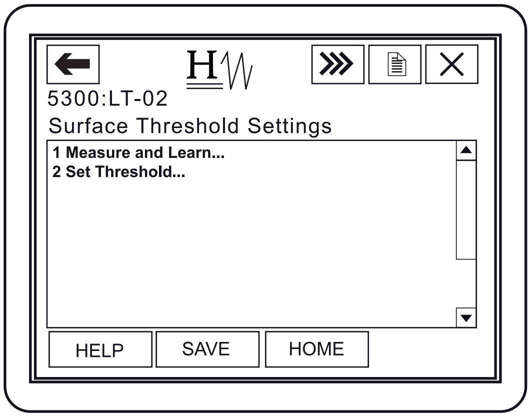
To adjust the amplitude thresholds:

1. Select HART command [2, 5, 2].
   FOUNDATION Fieldbus parameter:
   TRANSDUCER 1300>PROBE_END_THRESH
   TRANSDUCER 1300>REFERENCE_THRESH
   TRANSDUCER 1300>INTERFACE_THRESH
   TRANSDUCER 1300>FULL_TANK_THRESH_OFFSET

   The different threshold options appear on the display:



2. Open the desired option. For example, choosing option *2 Surface Threshold Settings* displays the following screen:



3. Option *1 Measure and Learn* lets you create an Amplitude Threshold Curve (ATC), see *"Amplitude Threshold Curve" on page 7-7* for more information.
   Option *2 Set Threshold* lets you specify a constant Surface Threshold.

   See also "Analyzing the Measurement Signal" on page 7-3 and "Surface Pulse Not Found" on page 7-5 for more information on how to use the amplitude thresholds.

4. Click the SAVE button to store the new settings in the transmitter database.

INTERFACE MEASUREMENTS WITH FULLY SUBMERGED PROBES

The Rosemount 5300 series has a measurement option which makes it possible to handle interface measurements when the probe is fully submerged into the upper product, see Figure 7-11, and only the interface level is detected by the transmitter. Even if the upper product level drops, it is ignored by the transmitter which continues to measure only the interface level, but the measurement accuracy is reduced since the transmitter does not take into account the influence of the air gap above the product surface. To achieve high accuracy in this measurement mode, the probe must be fully submerged, or a 5302 for Level and Interface measurements should be used.

The Measurement Mode parameter is available via the HART command [2, 3, 3].

FOUNDATION Fieldbus parameter: TRANSDUCER 1100>MEAS_MODE

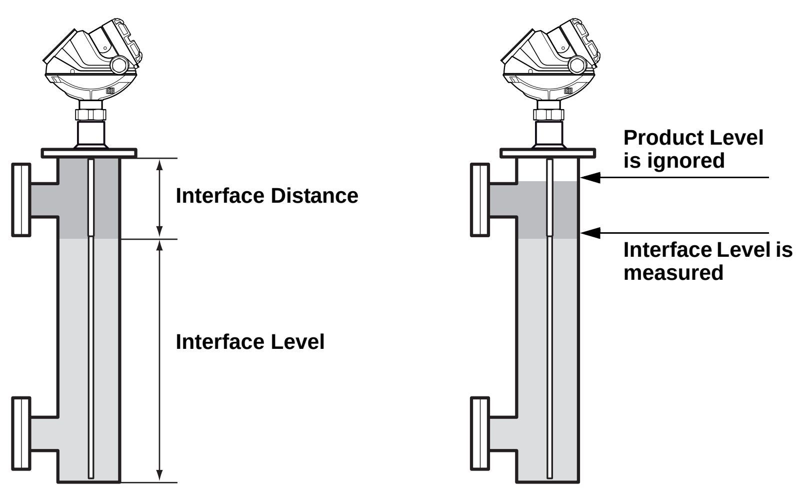
Choose the *Interface Level with Submerged Probe* option.

Measurement mode *Interface Level with Submerged Probe* can also be activated in the RRM software:

1. In the RRM workspace, click the Tank icon.
2. Select the Environment tab.
3. Select the Measurement Mode *Interface Level with Submerged Probe* option.
4. Click the OK button.

NOTE!
Do not use Measurement Mode *Interface Level with Submerged Probe* in applications when both Interface Level and Product Level are available.

Figure 7-11. Interface Level measurements in a full chamber.



NOTE!
Adjust Surface Threshold if the interface level pulse is not detected. Note that in Submerged Mode the interface is picked up by the Surface Threshold. See also “Using the Echo Curve Analyzer” on page 7-10.

ANALOG OUTPUT CALIBRATION

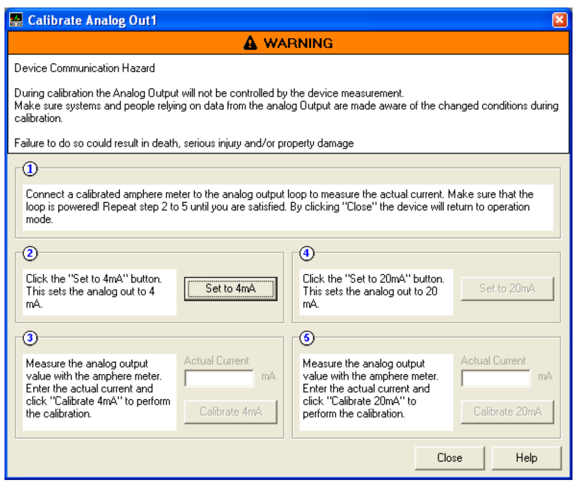
This function lets you calibrate the Analog Output by comparing the actual output current with the nominal 4 mA and 20 mA currents. Calibration is done at the factory and normally the transmitter does not need to be recalibrated.

The Analog Output Calibration function is available via the HART command [2, 8, 1].

In RRM, this function is available via Setup>Output.

To calibrate the Analog Output current:

1. Start RRM and make sure that the transmitter communicates with the PC (see Section 5: Basic Configuration Using Rosemount Radar Master).
2. Click the **Output** icon in the Device Config/Setup toolbar.
3. Select the **Analog Out** tab in the *Output* window.
4. Click the Calibrate DAC button.



5. Follow the instructions to calibrate the 4 mA and the 20 mA outputs.

LEVEL AND DISTANCE CALIBRATION

Level and distance calibration may be necessary when using a nozzle or pipe or if there are disturbances in the near zone caused by a physical object.

Non-metallic (e.g. plastic) vessels and installation geometry may introduce an offset for the zero reference point. This offset may be up to ± 25 mm. The offset can be compensated for using Distance Calibration.

When calibrating the transmitter, it is important that the product surface is calm and that the tank is not being filled or emptied.

A complete calibration is performed in two steps:

1. Calibrate the Distance measurement by adjusting the Calibration Offset parameter.
2. Calibrate the Level measurement by adjusting the Tank Height.

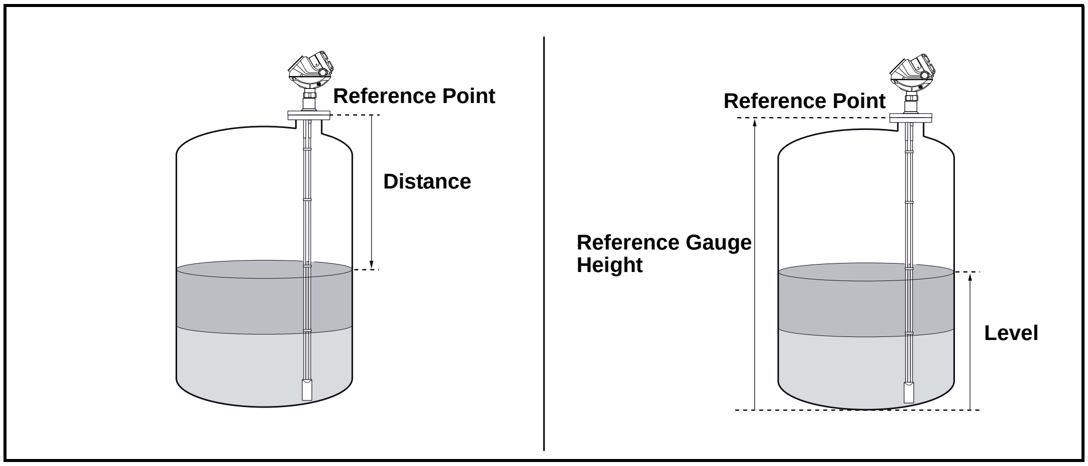
Distance calibration

1. Measure the actual distance between the Upper Reference Point and the product surface.
2. Adjust the **Calibration Distance** so that the Distance measured by the transmitter corresponds to the actual distance.
   The Calibration Distance parameter is available via
   HART command [2, 3, 2, 4, 1],
   or
   RRM:
   a. Click the **Tank** icon under Device Config/Setup in the RRM workspace.
   b. In the *Tank* window, select the *Geometry* tab.
   c. Click the **Advanced** button.
   d. Enter the desired value in the **Calibration Distance** field and click the Store button.

Level calibration

1. Measure the actual Product Level.
2. Adjust the **Tank Height** so the product level measured by the transmitter corresponds to the actual product level.

Figure 7-12. Distance and Level calibration

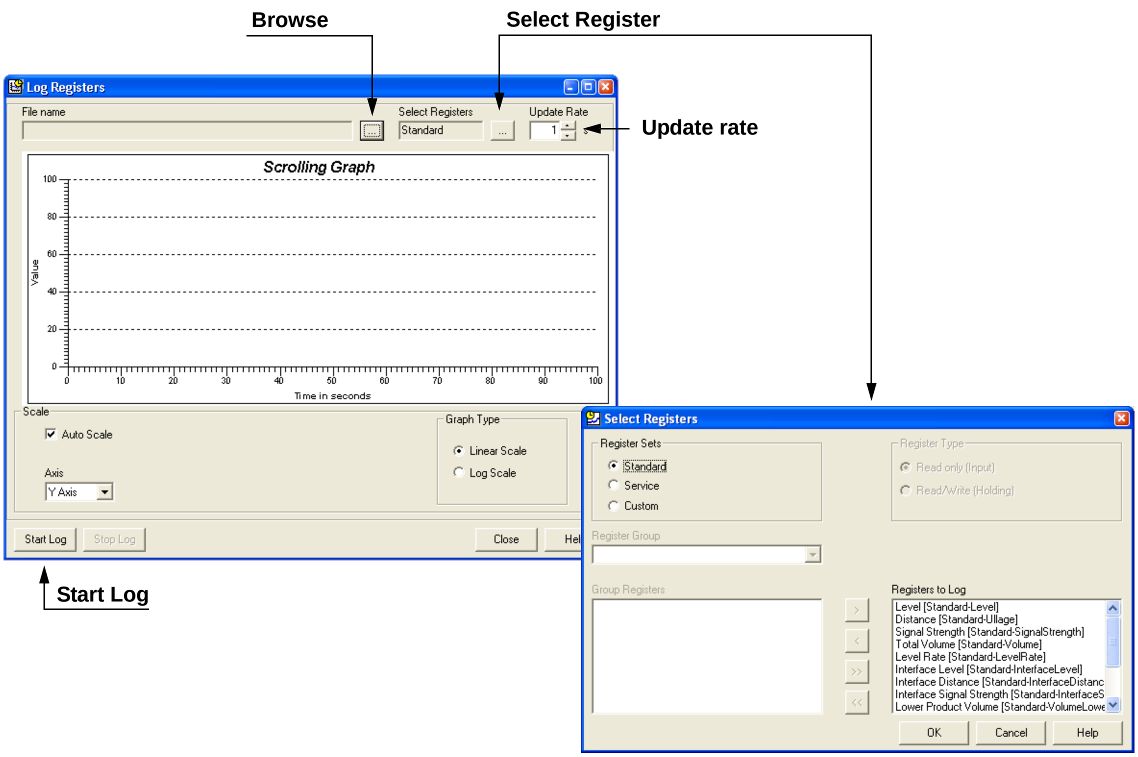


LOGGING MEASUREMENT DATA

By using the Log Device Registers function in the RRM software, you can log Input and Holding registers over time. It is possible to choose from different pre-defined sets of registers. This function is useful for verifying that the transmitter works properly.

To log device registers, choose the **Tools>Log Device Registers** option to open the *Log Registers* window:

Figure 7-13. The Log Registers function can be used to verify that the transmitter works properly.



To start logging:

1. Click the Browse button, select a directory to store the log file, and type a log file title.
2. Click the Select Register button and choose register type to be logged.
3. Select the desired registers to be logged. There are three options available: Standard, Service, and Custom. Standard and Service refer to pre-defined sets of registers. The Custom option lets you choose the desired range of registers.
4. Enter the update rate. An update rate of for example 10 seconds means that the plot will be updated every 10 seconds.
5. Click the Start Log button. The logging will proceed until stopped by clicking the Stop Log button.

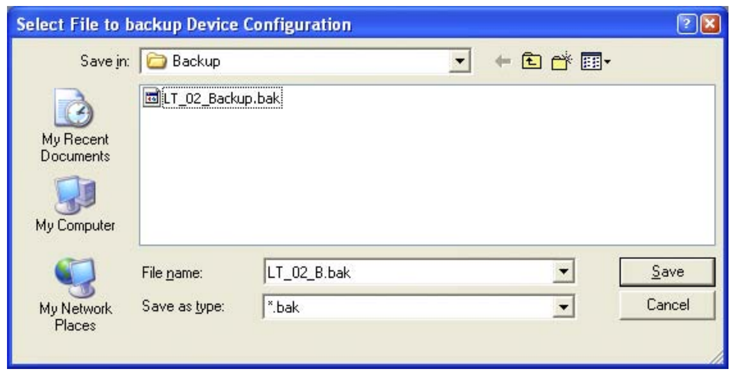
BACKING UP THE TRANSMITTER CONFIGURATION

Use this RRM option to make a backup copy of the configuration parameters in the transmitter database. The backup file can be used to restore the transmitter configuration. It can also be used for configuration of a transmitter in a similar application. Parameters in the saved file can be uploaded directly to the new device.

The backup function is available from the *Device* menu in RRM:

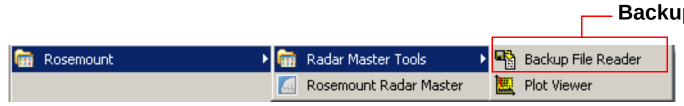
1. From the **Device** menu, choose the **Backup Config to File** option.
2. Browse to the desired directory:

Figure 7-14. It is recommended that the transmitter configuration is stored in a backup file.



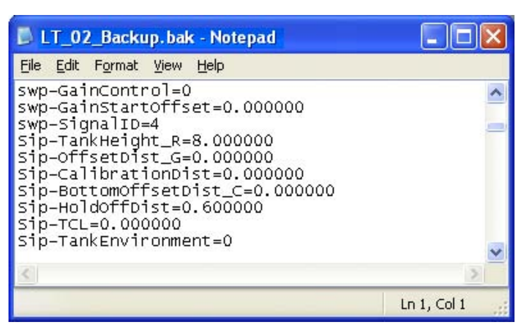
3. Type a name of the backup file and click the **Save** button.
   Now the transmitter configuration is stored. The backup file can be used at a later stage to restore a configuration which has been accidentally changed. The backup file can also be used to quickly configure transmitters which are installed on similar tanks.To upload a backup configuration, choose the **Upload Config to Device** option from the **Device** menu.
   The backup file can be viewed by using the **Backup File Reader** which is installed with the RRM software:

Backup File Reader



4. The backup file can also be viewed as a text file in a word processing program such as the Notepad:

Figure 7-15. The configuration backup file can be viewed in a word processor program.



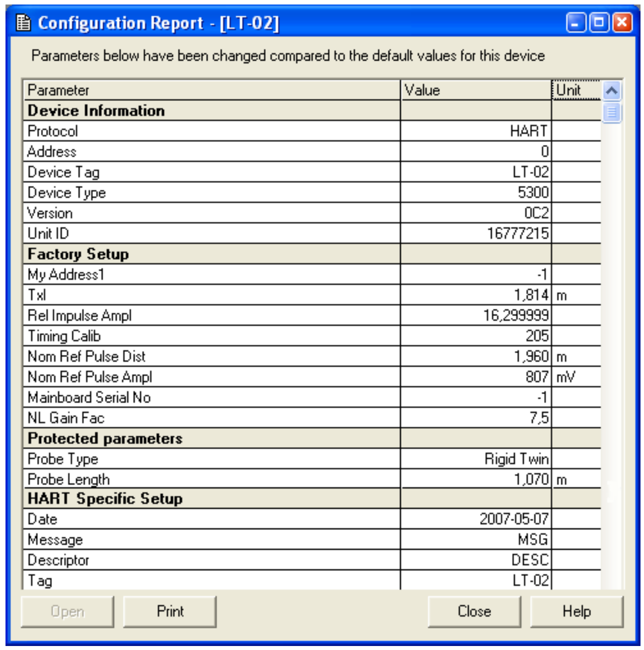
See also *"Configuration Report" on page 7-21* for further information on viewing backup files.

CONFIGURATION REPORT

This function in RRM shows what configuration changes have been done to the transmitter compared to the factory configuration. The report compares a specified backup file with the default transmitter configuration.

To open the Configuration Report, choose the **Tools>Configuration Report** menu option:

Figure 7-16. The Configuration Report window in RRM.



Information on probe type, software versions, software and hardware configuration, and unit code is presented.

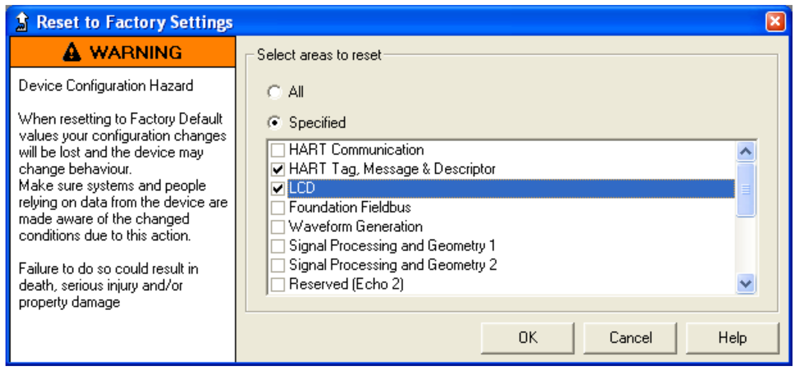
RESET TO FACTORY SETTINGS

This function resets all or a specific part of the holding registers to factory settings.

NOTE!
It is recommended that a backup of the configuration is done before the factory reset. Then the old transmitter configuration can be loaded if necessary.

RRM: choose menu option **Tools>Factory Settings**:

Figure 7-17. The Reset to Factory Settings window in RRM.

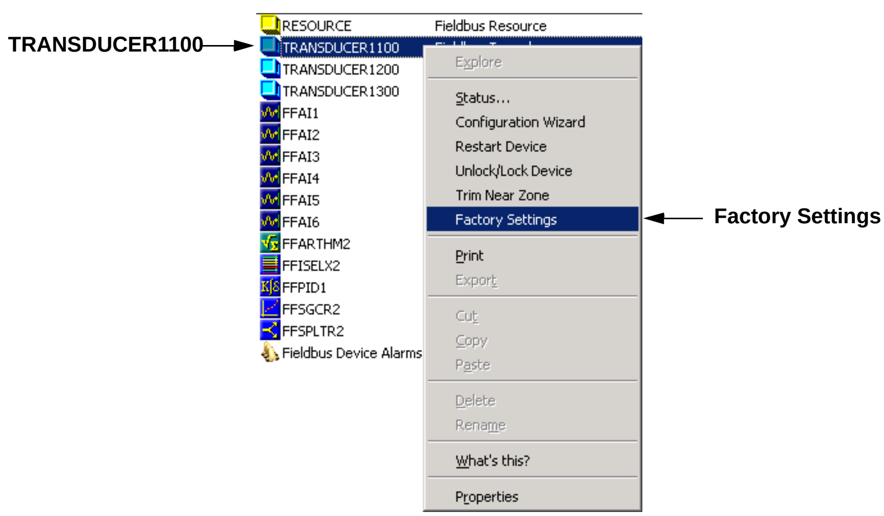


AMS Suite: Tools/Service>Factory Settings.

HART Command: [3, 2, 1, 2].

DeltaV:

1. In the DeltaV Explorer, select the desired transmitter icon, and click the right mouse button on the **Transducer 1100** block icon:



2. Choose the **Factory Settings** option.

DIAGNOSTICS

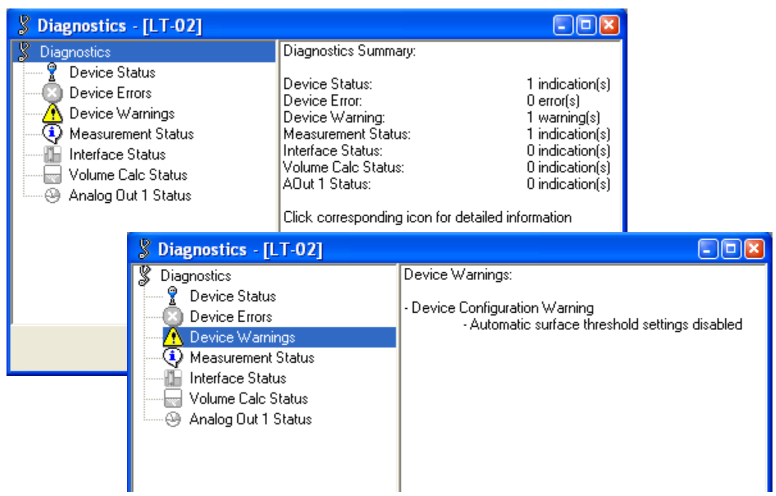
The following information about the device can be retrieved:

- device status, see “Device Status” on page 7-35.
- device errors, see “Errors” on page 7-36.
- device warnings, see “Warnings” on page 7-37.
- measurement status, see “Measurement Status” on page 7-38.
- volume status, see “Volume Calculation Status” on page 7-40.
- analog output status, see “Analog Output Status” on page 7-41.

Rosemount Radar Master

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

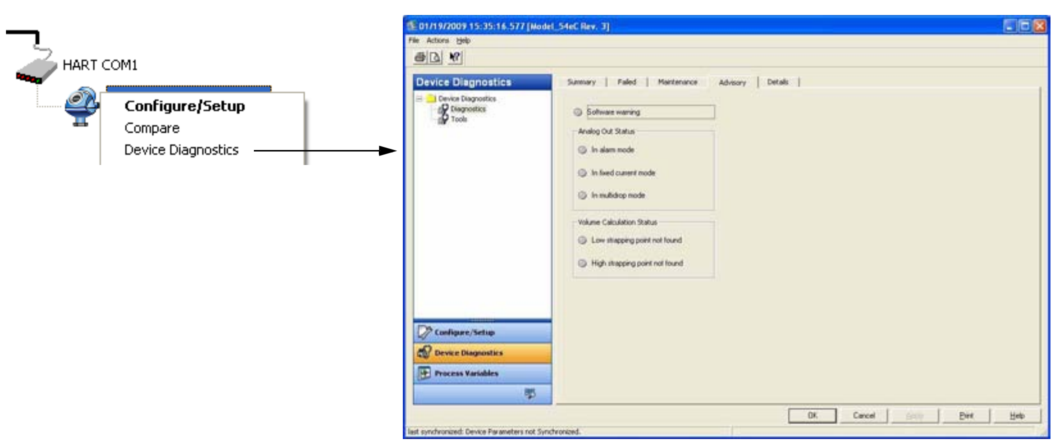
Figure 7-18. The Diagnostics window in RRM.



AMS

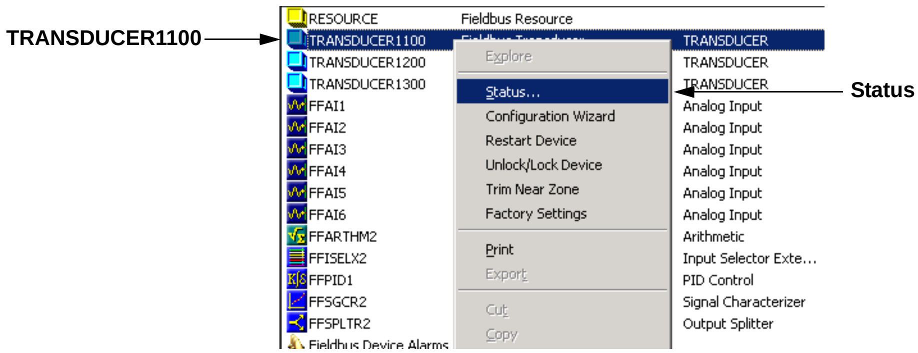
To view the Diagnostics window in AMS Suite, click the right mouse button on the desired transmitter, and choose the **Device Diagnostics** option:

Figure 7-19. Device Diagnostics window in AMS Suite.



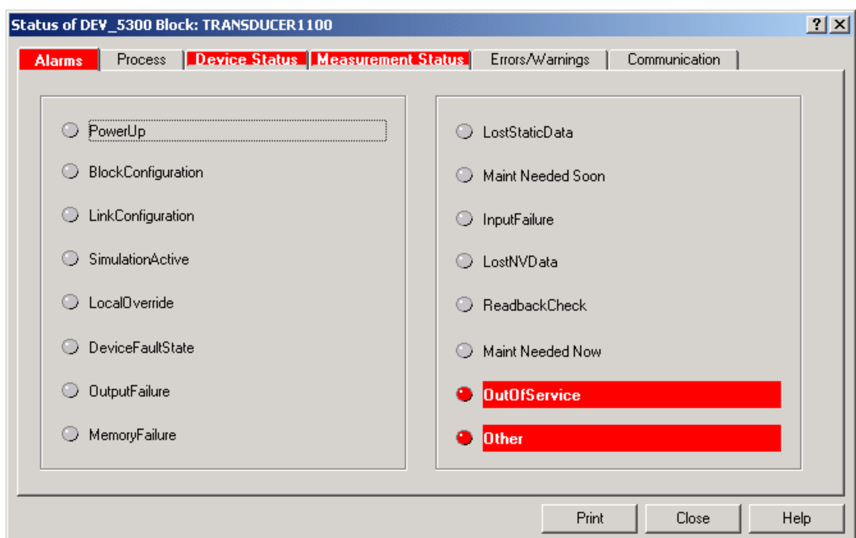
DeltaV

1. In the DeltaV Explorer, select the desired transmitter icon, and click the right mouse button on the **Transducer 1100** block icon:



2. Choose the **Status** option.
3. Select the Device Status tab for information on measurement status. Select the Errors/Warnings tab for information on errors and warnings.

Figure 7-20. The Status window in DeltaV shows various status information.



HART command

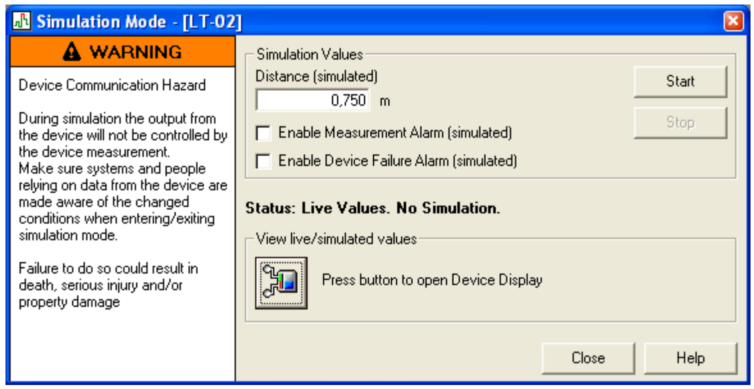
For a 375 Field Communicator, the corresponding HART command for the Diagnostics option is [3, 1].

USING THE SIMULATION MODE

This function can be used to simulate measurements and alarms.

RRM: choose menu option **Tools>Simulation Mode**:

Figure 7-21. The Simulation Mode window in RRM.

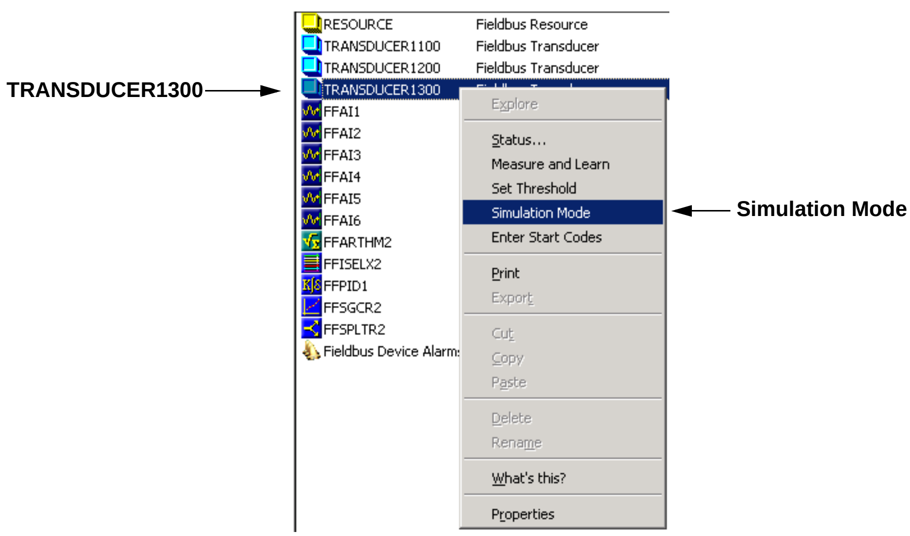


AMS Suite: Tools>Service>Simulation Mode.

HART Command: [3, 2, 1, 3].

DeltaV:

1. In the DeltaV Explorer, select the desired transmitter icon, and click the right mouse button on the **Transducer 1300** block icon:



2. Choose the **Simulation Mode** option.

WRITE PROTECTING A TRANSMITTER

A Rosemount 5300 Series transmitter can be protected from unintentional configuration changes by a password protected function. The default password is **12345**. It is recommended that this password is not changed to facilitate service and maintenance of the transmitter.

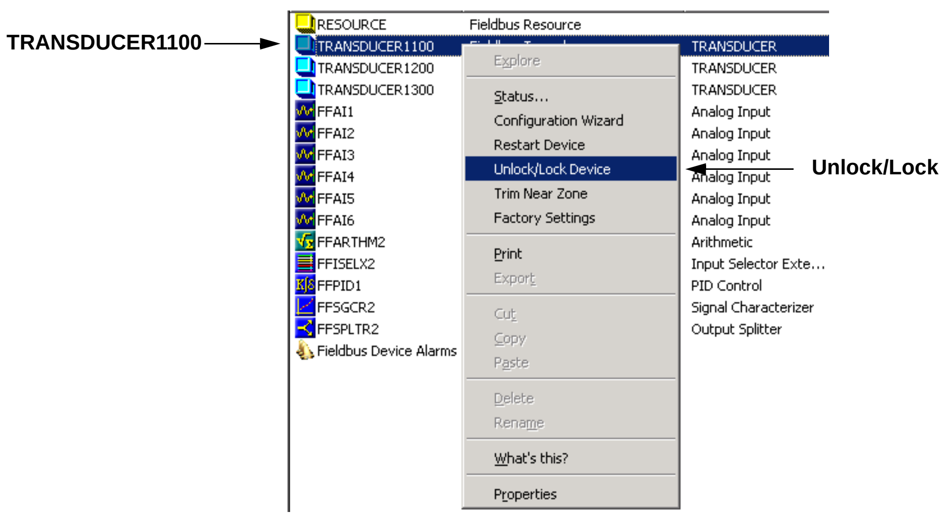
RRM: Tools>Lock/Unlock Configuration Area.

AMS Suite: Tools>Service>Lock/Unlock Device.

HART Command: [3, 2, 1, 2].

DeltaV:

1. In the DeltaV Explorer, select the transmitter icon, and click the right mouse button on the **Transducer 1100** block icon.



2. Choose the **Unlock/Lock Device** option.

ENTER SERVICE MODE IN RRM

In RRM, service functions for advanced users are available for the Rosemount 5300 Series transmitter. Setting RRM into Service Mode, all the Service menu options in RRM are enabled. The default password for enabling the Service Mode is “admin”. The password can be changed by selecting the *Change Password* option from the Service menu.

VIEWING INPUT AND HOLDING REGISTERS

Measured data is continuously stored in the **Input Registers**. Viewing the contents of the Input Registers, advanced users can check that the transmitter works properly.

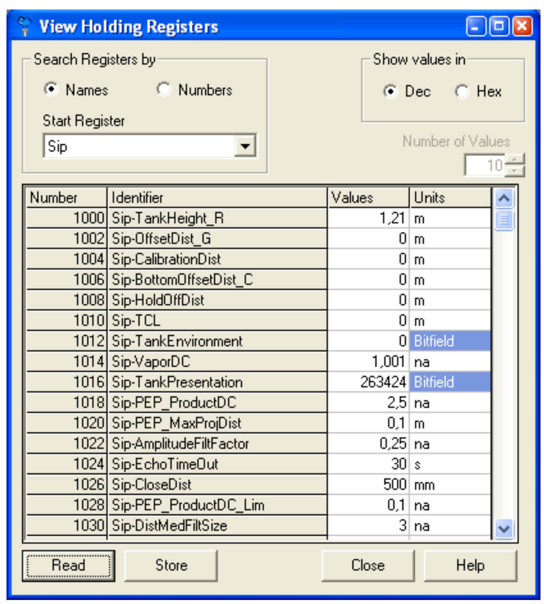
The **Holding Registers** store various transmitter parameters, such as configuration data, used to control the measurement performance.

Using RRM, most Holding Registers can be edited by simply typing a new value in the appropriate Value input field. Some Holding Registers can be edited in a separate window. In this case, you can change individual data bits.

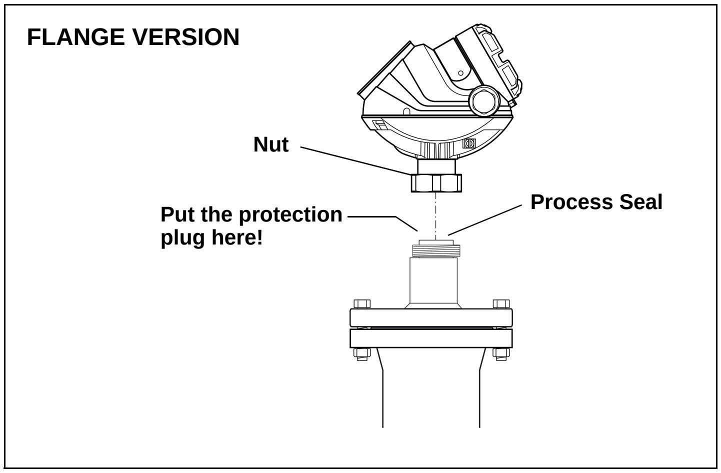
To be able to view the Input/Holding registers in RRM, the Service Mode must be activated:

1. Choose the **Enter Service Mode** option from the **Service** menu.
2. Type the password (default password is “admin”). Now the View Input and View Holding Registers options are available.
3. Choose the **View Input/Holding Registers** option from the **Service** menu.
4. Click the Read button. To change a Holding register value, just type a new value in the corresponding Value field. The new value is not stored until the Store button is clicked.

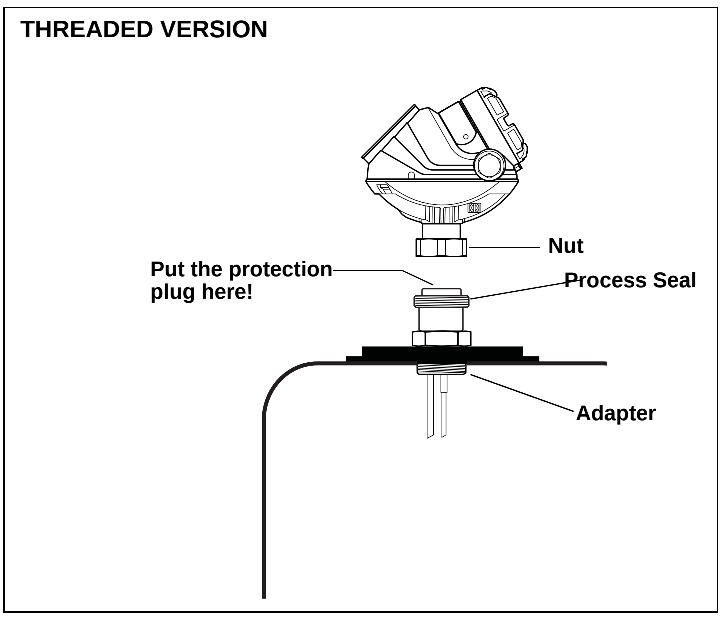
Figure 7-22. Holding and Input Registers can be viewed in RRM.



REMOVING THE TRANSMITTER HEAD



1. Loosen the nut that connects the transmitter housing to the Process Seal.
2. ⚠ Carefully lift the transmitter head.
3. Make sure the upper surface of the Process Seal is clean and the spring-loaded pin at the center of the Process Seal is properly inserted (the pin should move back when pushed into the hole).
4. Attach the protection plug to the Process Seal.



NOTE!
Do not remove the Process Seal from the adapter!

CHANGING A PROBE

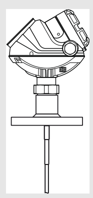
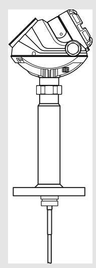
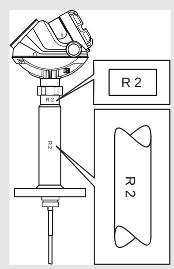
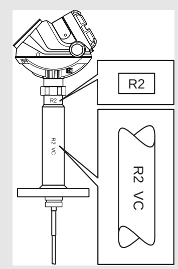
Probe and Firmware Compatibility

Transmitter heads with a firmware version earlier than 1.A4 (manufacturing date before 2008-06-18) are not compatible with HP/HTHP/C probes marked with R2.

Transmitter heads with a firmware version 1.A4 or later are compatible with HP/HTHP probes without the R2 marking when the Trim Near Zone function is performed, as illustrated below.

Only probes with the VC marking are compatible with the Dynamic Vapor Compensation function. See Appendix C: Advanced Configuration to determine if the Dynamic Vapor Compensation function is supported by the transmitter head.

Table 7-1. Compatibility between probe type and firmware version

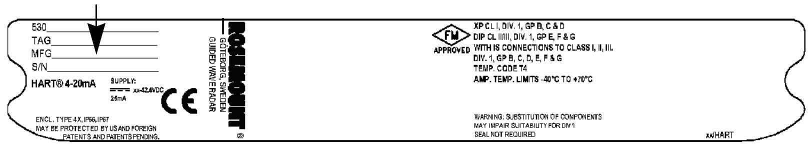
Compatibility Between Probe Types and Firmware Versions				
Firmware Version	**Probe Type**			
	Standard 	HP / HTHP without R2 marking 	HP / HTHP / C with R2 marking only(1) 	HTHP with both R2 and VC marking(1) 
Firmware version earlier than 1.A4	Yes	Yes	No	No
Firmware version 1.A4	Yes	Yes(2)	Yes	No
Firmware version 2.A2 or later	Yes	Yes(2)	Yes(3)	Yes(4)

(1) The R2 marking is on the housing seal or the adapter as seen in the figure.
(2) Trim Near Zone function is required.
(3) When Dynamic Vapor Compensation is not used.
(4) The probe requires that Dynamic Vapor Compensation is activated in the device for full functionality.

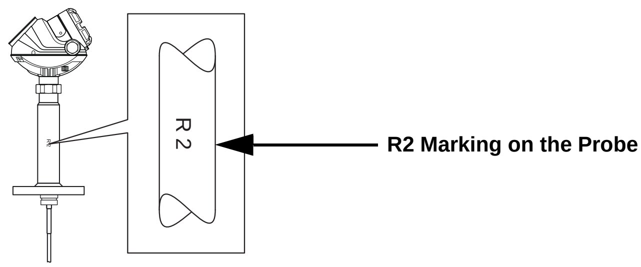
Check Firmware and Probe Version

1. Check the manufacturing date on the transmitter head label.

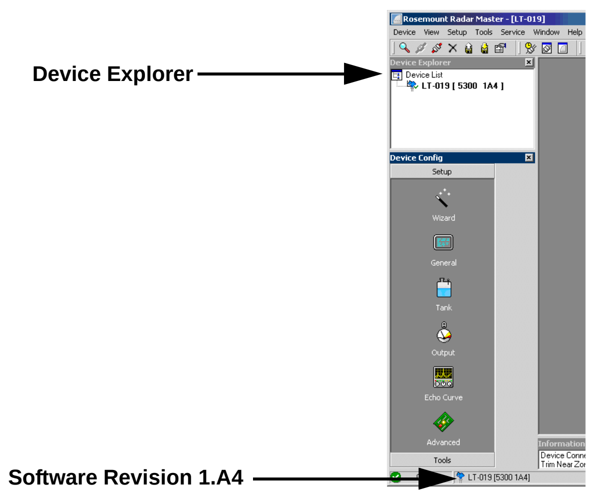
Manufacturing Date Before 080618 (YYMMDD)



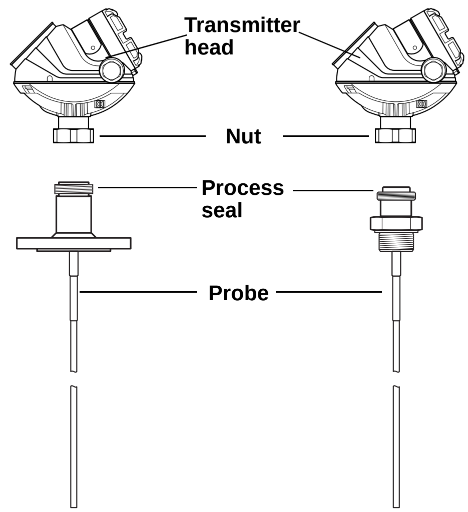
2. Check the R2, VC marking on the probe.



NOTE!
In RRM, the software revision number can be checked either in Device Explorer, or at the bottom of the RRM window, as shown in the screenshot below.



Changing the Probe



1. Loosen the nut.
2. Remove the transmitter head from the old probe.
3. On the new probe, make sure that the protection plug is removed and the upper surface of the Process Seal is clean. Also make sure that the spring-loaded pin at the center of the Process Seal is properly inserted.
4. Mount the transmitter head on the new probe.
5. Fasten the nut again.
6. If the new probe is not of the same type as the old one, update the transmitter configuration by setting the **Probe Type** parameter to the appropriate value:
   HART Fast Key sequence [2, 1, 2]
   or
   in RRM, click the **Tank** icon in the Device Config/Setup toolbar.
7. Measure the **Probe length** and enter the measured value:
   HART Fast Key sequence [2, 1, 2],
   or
   in RRM, click the **Tank** icon in the Device Config/Setup toolbar, and select the **Probe** tab in the *Tank* window.
8. In certain cases, a fine tune by using the Trim Near Zone function is necessary.
   In RRM **Guided Setup > Device specific setup** can be seen if it is needed.
   For 375, use HART Fast Key Sequence [2, 1, 7, 2].
   When using the Trim Near Zone function, product level in the vessel must be lowered beneath the Near Zone to get precise measurement data (see Figure 7-23).

Figure 7-23. Product level lowered beneath the Near Zone.

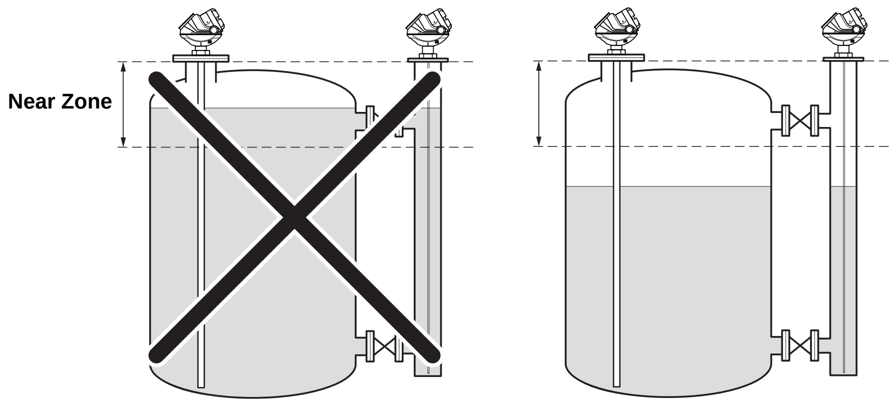


Table 7-2. Near Zone definitions depending on software releases and probe type

5300 GWR Series Near Zone		
Firmware Version	**Rigid Probes**	**Flexible Probes**
Firmware version earlier than 1.A4	15 in. (0.37 m)	
Firmware version 1.A4 or 2.A2	40 in. (1 m)	

9. Verify that the transmitter measures correct product level, otherwise see "Level and Distance Calibration" on page 7-17.

DIAGNOSTIC MESSAGES

Troubleshooting

If there is a malfunction despite the absence of diagnostic messages, see Table 7-3 for information on possible causes.

Table 7-3. Troubleshooting chart

Symptom	Possible cause	Action
No level reading	• Power disconnected • Data communication cables disconnected • Probe is not connected	• Check the power supply • Check the cables for serial data communication • View the Diagnostic window, see “Diagnostics” on page 7-23 in order to check active status messages • Check if “Probe Missing” is active. If it is, check the probe connection
No HART communication.	• COM Port configuration does not match the connected COM Port • Cables may be disconnected • Wrong HART address is used • Hardware failure • HART resistor	• Check that correct COM Port is selected in the HART server (see “Specifying the COM Port” on page 5-15 • Check wiring diagram • Verify that the 250 Ω resistor is in the loop. • Check cables • Make sure that correct HART short address is used. Try address=0 • Check Analog Output current value to verify that transmitter hardware works • Check that the correct settings are used in RRM. Select Device, Search from the menu. Click Settings and HART tab. Make sure the values are properly chosen. The standard values are shown on page 5-10
Analog Out is set in Alarm.	Measurement or transmitter failure.	View the Diagnostic window, see “Diagnostics” on page 7-23 to check active error and status messages.
Both Surface pulse and Interface Pulse are detected, but Interface Level is reported as unknown in the Echo Curve plot.	Measurement Mode is set to “Level Only”.	Set Measurement Mode to “Level and Interface” (see “Basic Configuration Parameters” on page 5-4).
Both Surface pulse and Interface pulse are detected, but Interface Level is reported as unknown in the Echo Curve plot.	• Interface pulse is identified as a double bounce • Surface pulse and Interface pulse are very close	No action required. Use the Echo Curve plot to verify that the surface and interface are close, see “Analyzing the Measurement Signal” on page 7-3.
Surface pulse is detected, but Level is incorrectly reported as Full or Empty.	• Wrong Probe Type set • Bad Reference Threshold value	View the Diagnostics window, see “Diagnostics” on page 7-23, to check active messages and check if the warning “Full Tank/Empty Tank” is active. If this is the case, check that: • the transmitter is configured with correct probe type • the reference pulse is below the reference amplitude threshold. If not, adjust reference threshold to an appropriate value

Symptom	Possible cause	Action
The reference pulse is not detected.	• The tank is full • The transmitter is configured with wrong probe type • Reference Amplitude Threshold is incorrect	• Check the product level • Check that correct probe type is configured • Check Reference Amplitude Threshold
Incorrect Interface Level reading.	• Interface threshold incorrect • Upper Product Dielectric constant incorrect	• Adjust Interface threshold, see "Interface Pulse not Found" on page 7-8 • Check the Upper Product Dielectric constant, see "Basic Configuration Parameters" on page 5-4
Incorrect level reading.	• Configuration error • Disturbing objects in the tank	• Check the Tank Height parameter • Check status information and diagnostic information • Check that the transmitter has not locked on an interfering object, see "Disturbance Echo Handling" on page 7-7 • Adjust the Surface amplitude threshold, see "Surface Pulse Not Found" on page 7-5
Integral display does not work.		• Check the display configuration • Check loop power • Check Display connection • Contact Emerson Process Management Service Department(1)
FOUNDATION Fieldbus Card to Transmitter Communication Fault		• Verify Device Mode setting, should be FOUNDATION Fieldbus (Parameter: ENV_DEVICE_MODE) • Restart method from Resource Block • Reboot gauge (Cycle Power)
Level Measurement Failure		• Check Power Supply • Check the gauge configuration (Transducer Block) • Check that the mechanical installation is correct
Temperature Measurement Failure		• Check ambient temperature(2) • Restart gauge • Contact Emerson Process Management Service Department
Volume Measurement Failure		• Restart gauge • Check gauge configuration using PC Based configuration tool
No surface echo		• Check signal strength • Restart transmitter • See "Surface Pulse Not Found" on page 7-5
DB Error/ Microwave Unit Error/ Configuration Error/ Other Error		• Restart transmitter • Set database to default; load default Database • Download Application Software • Call Service Center
SW Error/ Display Error/ Analog Out Error		• Restart transmitter • Call Service Center

(1) A malfunctioning display panel may only be replaced by service personnel at the Emerson Process Management Service Department. A display must not be replaced when the transmitter is in operation.
(2) If the 5300 transmitter has been exposed to temperatures outside the specified limits, the device may stop its normal operation.

Device Status

Device Status messages that may appear on the Integral Display, on the 375 Field Communicator, or in RMM are shown in Table 7-4:

Table 7-4. 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.
Sim Mode 0 Active	The simulation mode is active.	Turn off the simulation mode in RRM, select Tools, Simulation Mode, and click the Stop button.
Advanced Simulation Mode Active	The advanced simulation mode is active.	To turn off the Advanced Simulation mode, set Holding Register 3600=0 (see "Viewing Input and Holding Registers" on page 7-27).
Interface Invalid	The interface measurement is invalid.	Check the Error Messages, Warning Messages, and the Interface Status for details.
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 (see "Write Protecting a Transmitter" on page 7-26).
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.

Errors

Error messages that may be displayed on the Integral Display, on a 375 Handheld Communicator, in AMS, or in RRM are shown in Table 7-5. Errors normally result in Analog Output alarm.

Errors are indicated in RRM in the *Diagnostics* window.

Table 7-5. Error messages.

Message	Description	Action
RAM error	An error in the gauge data memory (RAM) has been detected during the startup tests. Note: this automatically resets the gauge.	Contact Emerson Process Management Service Department.
FPROM error	An error in the gauge program memory (FPROM) has been detected during the startup tests. Note: this automatically resets the gauge.	Contact Emerson Process Management Service Department.
Database (Hreg) error	An error in the transmitter configuration memory (EEPROM) has been detected. The error is either a checksum error that can be solved by loading the default database or a hardware error. NOTE: the default values are used until the problem is solved.	Load default database and restart the transmitter. Contact Emerson Process Management Service Department if the problem persists.
Microwave Module error	An error in the microwave module.	Contact Emerson Process Management Service Department.
LCD error	An error in the LCD is detected.	Contact Emerson Process Management Service Department.
Modem error	An error in the modem used for digital communication has been detected.	Contact Emerson Process Management Service Department.
Analog out error	An error in the Analog Out Module.	Contact Emerson Process Management Service Department.
Internal temperature error	An error in the internal temperature measurement. -40 ºC<Internal Temperature<85 ºC.	Contact Emerson Process Management Service Department.
Other hardware error	An unspecified hardware error has been detected.	Contact Emerson Process Management Service Department.
Measurement error	A serious measurement error has been detected.	Contact Emerson Process Management Service Department.
Configuration error	At least one configuration parameter is outside allowed range. NOTE: the default values are used until the problem is solved.	• Load the default database and restart the transmitter (see “Reset to Factory Settings” on page 7-22) • Configure the transmitter or upload a backup configuration file (see “Backing up the Transmitter Configuration” on page 7-20) • Contact Emerson Process Management Service Department if the problem persists
Software error	An error has been detected in the transmitter software.	Contact Emerson Process Management Service Department.

Warnings

Table 7-6 shows a list of diagnostic messages that may be displayed on the Integral Display, on the 375 Handheld Communicator, or in RRM. Warnings are less serious than errors and in most cases do not result in Analog Output alarms.

In RRM, warnings are indicated in the *Diagnostics* window.

Table 7-6. Warning messages.

<table>
<tr><th>Message</th><th>Description</th><th>Action</th></tr>
<tr><td>RAM warning</td><td colspan="2" rowspan="12">See Diagnostics (RRM: Tools>Diagnostics) for further information on a warning message.
See also “Diagnostics” on page 7-23.</td></tr>
<tr><td>FPROM warning</td></tr>
<tr><td>Hreg warning</td></tr>
<tr><td>MWM warning</td></tr>
<tr><td>LCD warning</td></tr>
<tr><td>Modem warning</td></tr>
<tr><td>Analog out warning</td></tr>
<tr><td>Internal temperature warning</td></tr>
<tr><td>Other hardware warning</td></tr>
<tr><td>Measurement warning</td></tr>
<tr><td>Config warning</td></tr>
<tr><td>SW warning</td></tr>
</table>

Measurement Status

Measurement Status messages that may appear on the Integral Display, on the 375 Handheld Communicator, in DeltaV, or in RRM are shown in Table 7-7:

Table 7-7. Measurement status.

Message	Description	Action
Full tank	The level measurement is in Full Tank state. The transmitter waits for the surface echo to be detected at the top of the tank.	No action needed.
Empty tank	The level measurement is in Empty Tank state. The transmitter waits for the surface echo to be detected at the bottom of the tank.	No action needed.
Probe missing	Probe is not detected.	Check that the probe is correctly mounted. Check the connection between probe and transmitter head.
Seal contaminated	Suspected contamination of the seal has been detected.	Check if the seal connection with the probe is contaminated.
Reference pulse calculated	The position of the reference pulse is calculated from the internal reference pulse.	No action needed.
Reference pulse invalid	An error in the reference pulse in the last sampled tank signal.	Check Warning messages. If MicroWave Module (MWM) Warning is active, this might indicate a transmitter error. Contact Emerson Process Management Service Department.
DeltaF not at setpoint	The DeltaF is not correctly regulated.	Check Warning Messages. If MicroWave Module (MWM) Warning is active, this might indicate a transmitter error. Contact Emerson Process Management Service Department.
Tank signal clip warning	The last Tank Signal was clipped.	Check Warning Messages. If MWM Warning is active, this might indicate a transmitter error. Contact Emerson Process Management Service Department.
No surface echo found	The Surface Echo Pulse cannot be detected. Possible cause: • Wrong surface threshold • Liquid level in Transition Zone or below probe end	Check if the configuration can be changed so that the surface echo can be tracked in this current region. View the Echo Curve plot and check surface threshold.
Predicted level	The presented level is predicted. The surface echo could not be detected.	Check if the configuration can be changed so that the surface echo can be tracked in this current region. View the Echo Curve plot and check surface threshold.
No reference echo	The Surface Echo Pulse cannot be detected.	Check if the configuration can be changed so that the surface echo can be tracked in this current region.
Reduced reference echo	The reference echo has been found with reduced amplitude.	No action needed.
In full tank state	The level measurement is in the full tank state, waiting for a surface echo detection at the top of the tank.	No action needed.
Sampling failed	The sampling of the last tank signal failed.	Check Warning Messages.
Invalid volume value	The given volume value is invalid. The given measurements are simulated.	Check Volume Status for details.

Message	Description	Action
Sim mode 0 active	The simulation mode is active. The given measurements are simulated.	Turn off the simulation mode.
Advanced Simulation Mode active	The advanced simulation mode is active.	To turn off the Advanced Simulation mode, set Holding Register 3600=0 (see “Viewing Input and Holding Registers” on page 7-27).
Invalid Lower Volume Value	The given lower volume value is invalid.	Check Lower Volume Status for details.
Invalid Upper Volume Value	The given upper volume value is invalid.	Check Upper Volume Status for details.
Using probe end projection measurement	The probe end projection is active in the transmitter software.	No action needed.
Reference echo present	An echo has been detected in the reference zone.	No action needed.
Sudden level jump detected	This may result from various measurement problems, such as: 1. Rapid level changes 2. Surface level within transition zone 3. Disturbing echo	Check the tank to find out what causes problem to track the surface. 1. Set the Rapid Level Changes parameter, see “Tank Environment” on page 5-6. 2. In the Transition Zones, the level may jump to Full Tank/End of Probe, see “Transition Zones” on page 2-10. 3. See “Disturbance Echo Handling” on page 7-7.
Nearzone echo present	An echo has been detected in the nearzone.	No action needed.
Nonlinear gain used	The nonlinear gain is enabled.	No action needed.
Nearzone measurement	The current sweep can be used as a measurement of the nearzone.	No action needed.

Interface Status

Interface Status messages that may appear on the Integral Display, on the 375 Handheld Communicator, in DeltaV, or in RRM are shown in Table 7-8:

Table 7-8. Interface status.

Message	Description	Action
Interface not OK	The interface measurement is not OK.	Check other interface status messages for reason.
Interface not found	No interface available Interface threshold to high	No action needed. Adjust Interface threshold, see "Interface Pulse not Found" on page 7-8.
Can't measure interface on horizontal probe	Interface cannot be measured when the probe is horizontally mounted.	Change the probe mounting or turn off interface measurement by changing the measurement mode.
Can't handle max possible interface thickness	With the current configuration, the maximum measurement range is too short to guarantee that the interface echo can always be found.	Accept the limitation or change the tank environment and device configuration.
Interface thickness close to max range	The interface is close to the limit where it will be lost due to the limited maximum measurement range.	No action needed but the interface echo may be lost if the upper product thickness increases.
Interface set to max thickness	No interface echo found. The upper product thickness is set the maximum value of the current level measurement.	No action needed.
Interface thickness greater than probe length	The interface was found below the probe end.	The Upper Product Dielectric Constant is probably incorrect.

Volume Calculation Status

Volume Calculation Status messages that may appear on the Integral Display, on the 375 Handheld Communicator, or in RRM are shown in Table 7-9:

Table 7-9. Volume status.

Message	Description	Action
Level is below lowest strapping point.	The measured level is below the lowest point in the given strapping table.	For a correct volume calculation in this region, change the strapping table.
Level is above highest strapping point.	The measured level is above the highest point in the given strapping table.	For a correct volume calculation in this region, change the strapping table.
Level out of range.	The measured level is outside the given tank shape.	Check if the correct tank type is chosen and check the configured Tank Height.
Strap table length not valid.	The configured strap table length is too small or too large.	Change the strapping table size to a valid number of strapping points. A maximum number of 20 strapping points can be entered.
Strap table not valid.	The strapping table is not correctly configured.	Check that both level and volume values in the strapping table are increasing with strapping table index.
Level not valid.	The measured level is not valid. No volume value can be calculated.	Check Measurement Status, Warning and Error Messages.
Volume configuration missing.	No volume calculation method is chosen.	Do a volume configuration.
Volume not valid.	The calculated volume is not valid.	Check the other volume status messages for the reason.

Analog Output Status

Analog Output Status messages that may appear on the Integral Display, on the 375 Handheld Communicator, or in RRM are shown in Table 7-10:

Table 7-10. Analog Output status.

Message	Description	Action
Not connected	Analog output hardware is not connected.	
Alarm Mode	The analog output is in Alarm Mode.	Check Error and Warning Messages to find the reason for the Alarm.
Saturated	The analog output signal value is saturated, i.e. equal to the saturation value.	No action needed.
Multidrop	The transmitter is in Multidrop Mode. The analog output is fixed at 4 mA.	This is the normal setting when a device is used in Multidrop configuration.
Fixed Current mode	The analog output is in fixed current mode.	This mode is used when calibrating the Analog Output channel.
PV out of Limits	The Primary variable is out of range.	Check the Upper and Lower Range Value
Span Too Small	The configured span is too small.	Check the Upper and Lower Range Value.
Invalid Limits	The given Upper and Lower Sensor Limits are invalid.	Check that the difference between the Upper and Lower Sensor Limits is greater than the Minimum Span.

LCD ERROR MESSAGES

Figure 7-24. The 5300 Display Panel displaying an error message.

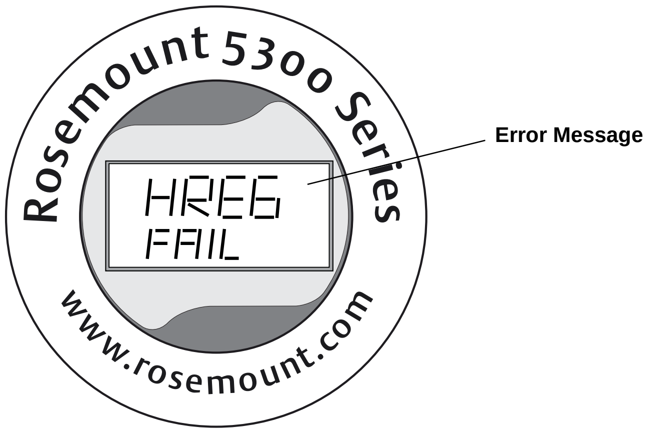


Table 7-11. Error messages displayed on the 5300 Display Panel.

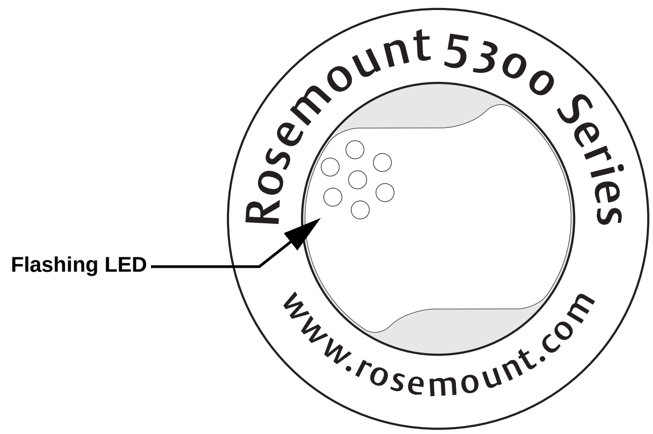
Error Message	Description
RAM FAIL	An error in the gauge data memory (RAM) has been detected during the startup tests. Note: this resets the gauge automatically.
FPROM FAIL	An error in the gauge program memory (FPROM) has been detected during the startup tests. Note: this resets the gauge automatically.
HREG FAIL	An error in the transmitter configuration memory (EEPROM) has been detected. The error is either a checksum error that can be solved by loading the default database, or a hardware error. NOTE: the default values are used until the problem is solved.
OMEM FAIL	
MWM FAIL	An error in the microwave module.
DPLY FAIL	An error in the LCD.
MODEM FAIL	Modem hardware failure.
AOUT FAIL	An error in the Analog Out Module.
OHW FAIL	An unspecified hardware error has been detected.
ITEMP FAIL	An error in the internal temperature measurement.
MEAS FAIL	A serious measurement error has been detected.
CONFIG FAIL	At least one configuration parameter is outside the allowed range. NOTE: the default values are used until the problem is solved.
SW FAIL	An error has been detected in the transmitter software.

For more information on errors, see “Errors” on page 7-36.

LED ERROR MESSAGES

For Rosemount 5300 transmitters without display, a flashing Light Emitting Diode (LED) is used for presentation of error messages.

Figure 7-25. Rosemount 5300 transmitters without display use a LED for presentation of error messages.



In normal operation, the LED flashes once every other second. When an error occurs, the LED flashes a sequence that corresponds to the Code number followed by a five second pause. This sequence is continuously repeated.

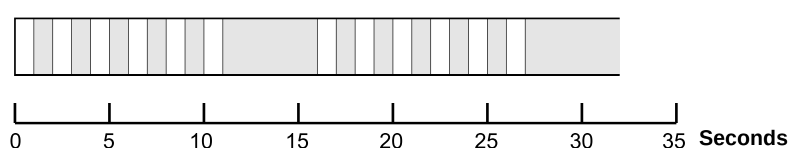
The following errors can be displayed:

Table 7-12. LED error codes.

Code	Error
0	Ram Failure
1	FPROM
2	HREG
4	Microwave Module
5	Display
6	Modem
7	Analog Out
8	Internal Temperature
11	Hardware
12	Measurement
14	Configuration
15	Software

Example

Modem error (code 6) is displayed as the following flash sequence:



FOUNDATION FIELDBUS ERROR MESSAGES

Resource Block

This section describes error conditions found in the Resource block. Read Table 7-13 through Table 7-15 to determine the appropriate corrective action.

Block Errors

Table 7-13 lists conditions reported in the BLOCK_ERR parameter.

Table 7-13. Resource Block BLOCK_ERR messages

Condition Name and Description
Other
Simulate Active: This indicates that the simulation switch is in place. This is not an indication that the I/O blocks are using simulated data
Device Fault State Set
Device Needs Maintenance Soon
Memory Failure: A memory failure has occurred in FLASH, RAM, or EEPROM memory
Lost Static Data: Static data that is stored in non-volatile memory has been lost
Lost NV Data: Non-volatile data that is stored in non-volatile memory has been lost
Device Needs Maintenance Now
Out of Service: The actual mode is out of service

Table 7-14. Resource Block SUMMARY_STATUS messages

Condition Name
Uninitialized
No repair needed
Repairable
Call Service Center

Table 7-15. Resource Block DETAILED_STATUS with recommended action messages

Condition Name	Recommended Action
LOI Transducer block error	1. Restart processor 2. Check display connection 3. Call service center
Sensor Transducer block error	1. Restart processor 2. Check Rosemount 5300 cable 3. Call service center
Mfg. Block integrity error	1. Restart processor 2. Call service center
Non-Volatile memory integrity error	1. Restart processor 2.Call service center
ROM integrity error	1. Restart processor 2. Call service center

Transducer Block

This section describes error conditions found in the Sensor Transducer Block.

Table 7-16. Transducer Block BLOCK_ERR messages

Condition Name and Description
Other
Out of Service: The actual mode is out of service

Table 7-17. Transducer Block XD_ERR messages

Condition Name and Description
Electronics Failure: An electrical component failed
I/O Failure: An I/O failure occurred
Data Integrity Error: Data stored in the device is no longer valid due to a non-volatile memory checksum failure, a data verify after write failure, etc.
Algorithm Error: The algorithm used in the transducer block produced an error due to overflow, data reasonableness failure, etc.

Analog Input (AI) Function Block

This section describes error conditions that are supported by the AI Block. Read Table 7-19 to determine the appropriate corrective action.

Table 7-18. AI BLOCK_ERR Conditions

.

Condition Number	Condition Name and Description
0	Other
1	**Block Configuration Error:** the selected channel carries a measurement that is incompatible with the engineering units selected in XD_SCALE, the L_TYPE parameter is not configured, or CHANNEL = zero
3	**Simulate Active:** Simulation is enabled and the block is using a simulated value in its execution
7	**Input Failure/Process Variable has Bad Status:** The hardware is bad, or a bad status is being simulated
14	**Power Up**
15	**Out of Service:** The actual mode is out of service

Table 7-19. Troubleshooting the AI block

Symptom	Possible Causes	Recommended Actions
Bad or no level readings (Read the AI "BLOCK_ERR" parameter)	BLOCK_ERR reads OUT OF SERVICE (OOS)	1. AI Block target mode set to OOS. 2. Resource Block OUT OF SERVICE.
	BLOCK_ERR reads CONFIGURATION ERROR	1. Check CHANNEL parameter (see "CHANNEL" on page 5-39). 2. Check L_TYPE parameter (see "L_TYPE" on page 5-39). 3. Check XD_SCALE engineering units. (see "XD_SCALE and OUT_SCALE" on page 5-40.
	BLOCK_ERR reads POWERUP	Download Schedule into block. Refer to host for downloading procedure.
	BLOCK_ERR reads BAD INPUT	1. Sensor Transducer Block Out Of Service (OOS). 2. Resource Block Out of Service (OOS).
	No BLOCK_ERR but readings are not correct. If using Indirect mode, scaling could be wrong	1. Check XD_SCALE parameter. 2. Check OUT_SCALE parameter. (see "XD_SCALE and OUT_SCALE" on page 5-40).
OUT parameter status reads UNCERTAIN and substatus reads EngUnitRangViolation	Out_ScaleEU_0 and EU_100 settings are incorrect.	See "XD_SCALE and OUT_SCALE" on page 5-40.
Mode will not leave OOS	Target mode not set	Set target mode to something other than OOS.
	Configuration error	BLOCK_ERR will show the configuration error bit set. The following are parameters that must be set before the block is allowed out of OOS: CHANNEL must be set to a valid value and cannot be left at the initial value of 0. XD_SCALE.UNITS_INDX must match the units in the transducer block channel value. L_TYPE must be set to Direct, Indirect, or Indirect Square Root and cannot be left at the initial value of 0.
	Resource block	The actual mode of the Resource block is OOS. See Resource Block Diagnostics for corrective action.
	Schedule	Block is not scheduled and therefore cannot execute to go to Target Mode. Schedule the block to execute.
Process and/or block alarms will not work	Features	FEATURES_SEL does not have Alerts enabled. Enable the Alerts bit.
	Notification	LIM_NOTIFY is not high enough. Set equal to MAX_NOTIFY.
	Status Options	STATUS_OPTS has Propagate Fault Forward bit set. This should be cleared to cause an alarm to occur.
Value of output does not make sense	Linearization Type	L_TYPE must be set to Direct, Indirect, or Indirect Square Root and cannot be left at the initial value of 0.
	Scaling	Scaling parameters are set incorrectly: XD_SCALE.EU0 and EU100 should match that of the transducer block channel value. OUT_SCALE.EU0 and EU100 are not set properly.
Cannot set HI_LIMIT, HI_HI_LIMIT, LO_LIMIT, or LO_LO_LIMIT Values	Scaling	Limit values are outside the OUT_SCALE.EU0 and OUT_SCALE.EU100 values. Change OUT_SCALE or set values within range.

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

SAFETY MESSAGES

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

⚠WARNING

Failure to follow these installation 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.

Explosions could result in death or serious injury.

- Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a 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.

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

⚠WARNING

Any substitution of non-authorized parts or repair, other than exchanging the complete transmitter head or probe assembly, may jeopardize safety and is prohibited.

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

OVERVIEW

The following section applies to the 4-20 mA Rosemount 5300 Prior-Use option (Special certification: QS) transmitter used in Safety Instrumented Systems (SIS) applications. The 5300 Prior-Use option with analog output provides overfill and empty tank protection to improve the system safety. The transmitter is classified as a Type B device. It contains self-diagnostics and is programmed to send its output to either a high or low failure state upon internal detection of a failure.

An independent FMEDA (hardware assessment) was conducted by *Exida* according to IEC 61508. The FMEDA is performed to determine failure rates, calculate the Safe Failure Fraction (SFF), and the average Probability of Failure on Demand (PFD_{AVG}). The hardware assessment is one of the steps taken to achieve functional safety per IEC 61508.

NOTE:
Refer to the 5300 FMEDA[1] report for failure rate data, assessment details, and assumptions regarding failure rate analysis.

Applicable Models

Table 8-1 lists the versions of the Rosemount 5300 Series transmitter that have been considered for the hardware assessment, to which this section applies.

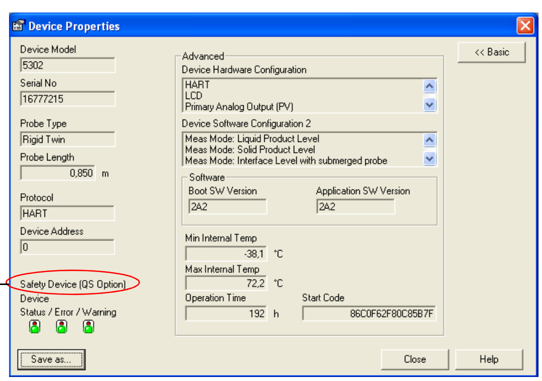
Table 8-1. Rosemount 5300 Series Prior-Use Option Model Codes

Prior-Use Option Model Codes	
1	Model 5301HxxxxxxxxxxxxxxQS
2	Model 5302HxxxxxxxxxxxxxxQS
3	Model 5303HxxxxxxxxxxxxxxQS

To identify a 5300 Prior-Use option transmitter:

- Verify the option code QS in the model code, on the label affixed to the outside of the transmitter head or
- 375 Field Communicator: HART Sequence [1, 7, 8]. Verify that Prior-Use safety device is ON
- Open Rosemount Radar Master, right click on the device, and select properties. Verify that the Safety Device (QS Option) is present

Safety Device (QS Option)



Skill Level of Personnel

It is assumed that the personnel installing, configuring, and operating the system have the knowledge equal or greater than that of a qualified Instrument Technician familiar with safety-related systems, process control applications and general instrument use.

(1) The 5300 FMEDA report is accessible at www.emersonprocess.com/rosemount/safety/PriorUse.htm.

NOTE!
The Rosemount 5300 transmitter is not safety-rated during maintenance work, configuration changes, multidrop, loop test, or other activity that affects the Safety Function. Alternative means should be used to ensure process safety during such activities.

FUNCTIONAL SPECIFICATIONS

The Safety Function is based on the analog output 4-20 mA, used as the safety variable. It is configured to activate the alarm function if an error occurs or if the measured value goes beyond the measurement range set by the user.

Only the 4-20 mA output can be used in the Safety Function. The HART protocol can only be used for setup, calibration, and diagnostic purposes, not for safety critical operation. The measurement signal used by the logic solver must be the analog 4-20 mA signal proportional to the level generated.

INSTALLATION

The device should be installed and configured as a level sensing device per manufacturer's instructions. The materials must be compatible with process conditions and process fluids. No special installation is required in addition to the standard installation practices outlined in this document.

Environmental limits are available in *Appendix A: Reference Data*.

The loop must be designed so the terminal voltage does not drop below the minimum input voltage, see values in Table 8-2, when the transmitter output is 22.5 mA.

Table 8-2. Minimum input voltage (U_i) at different currents

Hazardous approval	Current			
	3.60 mA	3.75 mA	21.75 mA	22.50 mA
	Minimum input voltage (U_i)			
Non-Hazardous Installations and Intrinsically Safe Installations	16 Vdc	16 Vdc	11 Vdc	11 Vdc
Explosion-proof / Flameproof Installations	20 Vdc	20 Vdc	15.5 Vdc	15.5 Vdc

CONFIGURATION

Use a HART-compliant master, such as Rosemount Radar Master or 375 Field Communicator, to communicate with and verify configuration of the Rosemount 5300. A full review of configuration methods is available in *Section 5: Configuration*. These instructions are applicable to the 5300 Prior-Use option with any differences noted.

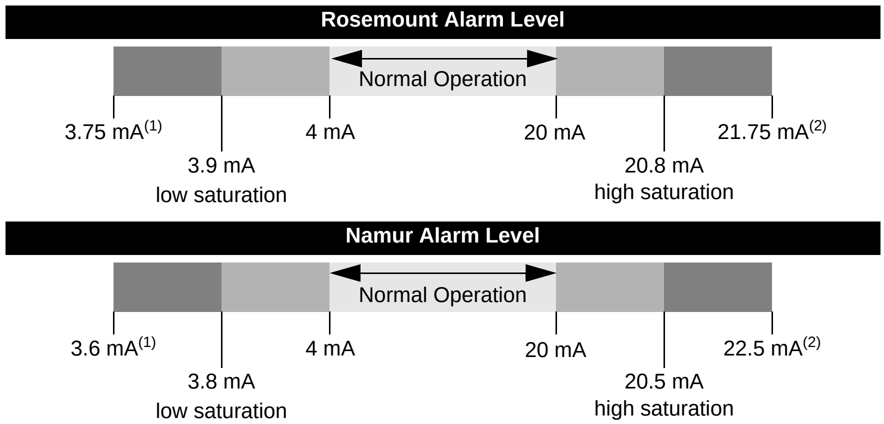
Damping

User adjusted damping will affect the transmitter's ability to respond to process changes. Therefore, the *damping values + response time* should not exceed the loop requirements. For further information on damping, see *"Echo Tracking" on page C-12*.

Alarm and Saturation Levels

DCS or safety logic solver should be configured to match transmitter configuration. Table 8-3 identifies the alarm levels available and their operation values.(1)

Table 8-3. Alarm levels and operation values



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

It is assumed that the current output signal is fed to a SIL2-compliant analog input board of a safety logic solver. For instructions on alarm level settings see “Analog Output (HART)” on page 5-9.

NOTE!
Only the High or Low Alarm Mode can be used for the Safety Function. Do not choose Freeze Current as an error will not be announced in the current loop.

Write Protection

A Rosemount 5300 transmitter can be protected from unintentional configuration changes by a password protected function. It is recommended to use write protection described in *“Write Protecting a Transmitter” on page 7-26*.

Site Acceptance

After the installation and configuration, proper operation of the transmitter should be verified. A site acceptance test is therefore recommended. The proof test outlined in this section can be used for this.

OPERATION AND MAINTENANCE

General

The Rosemount 5300 Series Prior-Use option must be tested at regular intervals to confirm that the overfill and empty tank protection function result in the desired system response. The required proof test intervals are dependant on the configuration of the transmitter and the process environment. The Rosemount 5300 is designed to have a 5-year proof test interval assuming it represents the typical 35% of the SIF PFD_{AVG}. However, it is the responsibility of the operator/owner of the system to determine the sufficient time interval and verify it is followed. See the FMEDA report for additional details or references.

(1) In certain cases, the transmitter does not go into the user defined alarm state. For example, in case of a short circuit, the transmitter goes into High Alarm state even if Low Alarm has been configured.

If the overfill and empty tank protection function cannot be tested by a controlled filling to the response height, suitable simulation of the level or of the physical measuring effect, e.g. by shorting the probe, must be used to make the level sensor respond.

The following proof test is recommended. If an error is found in the safety functionality, the measuring system must be switched out of service and the process held in a safe state by means of other measures. Proof test results and corrective actions taken must be documented at www.emersonprocess.com/rosemount/safety.

Proof test

This test detects approximately 95% of the possible Dangerous Undetected (DU) failures of the transmitter including the sensor element, not detected by the transmitter's automatic diagnostics. Instructions for performing the proof test with the 375 Field Communicator, Rosemount Radar Master, or AMS, are available in *Appendix E: Performing Proof Test.* Note that prior to this test, the echo curve should be inspected to ensure that no disturbing echoes affecting the measurement performance are present in the tank.

Required Tools: HART host/communicator and mA meter.

1. Bypass the logic solver or take other appropriate actions to avoid false trip.
2. Disable write protection if the function is enabled.
3. Using Loop Test, enter the mA value representing a high alarm current output and verify that the analog current reaches that value using the reference meter.

   This step tests for compliance voltage problems, such as low loop power supply voltage or increased wiring resistance.
4. Using Loop Test, enter the mA value representing a low alarm current output and verify that the analog current reaches that value using the reference meter.

   This step tests for possible quiescent current related failures.
5. Perform a two-point calibration check of the transmitter by applying the level to two points on the probe within the measuring range(1). Verify that the current output corresponds to the level input values using a known reference measurement.

   This step verifies that the analog output is correct in the operating range and that the Primary Variable is properly configured.
6. Enable write protection.
7. Restore the loop to full operation.
8. Remove the bypass from the safety logic solver or otherwise restore normal operation.
9. Document the test result for future reference.

For troubleshooting the transmitter, see *"Service and Troubleshooting" on page 7-1*.

(1) For best performance, use the 4 - 20 mA range points as calibration points.

Inspection

Visual Inspection

It is recommended to inspect the probe for possible build up or clogging.

Special Tools

Not required.

Product Repair

The Rosemount 5300 is repairable by major component replacement. All failures detected by the transmitter diagnostics or by the proof test must be reported. Feedback can be submitted electronically at www.emersonprocess.com/rosemount/safety (**Contact Us**).

REFERENCES

Specifications

The Rosemount 5300 must be operated in accordance with the functional and performance specifications provided in *Appendix A: Reference Data*.

Failure Rate Data

The FMEDA report includes failure rates. The full report is accessible at www.emersonprocess.com/rosemount/safety/PriorUse.htm.

Useful Lifetime

The established failure rates of electrical components apply within the useful lifetime, which should be based on experience. According to IEC 61508-2, 7.4.7.4, note 3, the useful lifetime often lies within a range of 8 to 12 years.

SPARE PARTS

Additional spare parts are available in *Appendix A: Reference Data*.

TERMS AND DEFINITIONS

FMEDA: Failure Modes, Effects and Diagnostic Analysis

HART: Highway Addressable Remote Transducer

PFD_{AVG}: Average Probability of Failure on Demand

SIF: Safety Instrumented Function

SIL: Safety Integrity Level, discrete level (one out of a possible four) for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/PE safety-related systems, where Safety Integrity Level 4 has the highest level of safety integrity, and Safety Integrity Level 1 has the lowest.

SIS: Safety Instrumented System – Implementation of one or more Safety Instrumented Functions. A SIS is composed of any combination of sensor(s), logic solver(s), and final element(s)

SFF: Safe Failure Fraction

Type B device: Complex device (using microcontrollers or programmable logic)

Appendix A Reference Data

SPECIFICATIONS

General	
Product	Rosemount 5300 Series Guided Wave Radar Level and Interface Transmitter; Model 5301, Liquid Level or Interface Transmitter (interface available for fully submerged probe). Model 5302 Liquid Level and Interface Transmitter. Model 5303 Solids Level Transmitter.
Measurement Principle	Time Domain Reflectometry (TDR).
Reference Conditions	Single Standard probe, 77°F (25°C) in water and ambient pressure.
Microwave Output Power	Nominal 300 µW, Max. 45 mW.
CE-mark	Complies with applicable directives (EMC, ATEX).
Safety Integrity Level	5300 FMEDA suitable for SIL2: The 5300 Series has been evaluated by Exida per hardware assessment IEC61508. With a SFF > 90% it is Prior-use SIL2 suitable. For more information, go to: http://www.emersonprocess.com/rosemount/safety/. Option code is QS.
Start-up Time	< 40 s
Measuring Performance	
Reference Accuracy	± 0.12 in. (3 mm) or 0.03% of measured distance, whichever is greatest.(1) (2) (3)
Repeatability	± 0.04 in. (1 mm).
Ambient Temperature Effect	± 0.008 in. (0.2 mm) /°K or ± 30 ppm/°K of measured value, whichever is greatest.
Update Interval	< 1 per second.
Measuring Range	16 in. (0.4 m) to 164 ft (50 m).
Display / Configuration	
Integral Display	The integral digital display can toggle between: level, distance, volume, internal temperature, interface distance, interface level, peak amplitudes, interface thickness, percentage of range, analog current out. Note! The display cannot be used for configuration purposes.
Output Variables	All models: Level, Distance to Level, Volume, Level Rate, Signal Strength, Internal Temperature, Signal Quality, Surface/Noise Margin, Vapor DC, Analog Output Current(4) and % of Range(4). Model 5301 (in addition to the above for the case with fully submerged probe): Interface Level and Interface Distance. Model 5302 (in addition to the above): Interface Level, Interface Level Rate, Interface Distance, Upper Volume, Lower Volume and Upper Product Thickness.
Output Units	Level, Interface and Distance: ft, inches, m, cm or mm. Level Rate: ft/s, m/s, in./min, m/h. Volume: ft^3, $inch^3$, US gals, Imp gals, barrels, yd^3, m^3 or liters. Temperature: °F and °C.
Configuration Tools	HART: Rosemount Radar Master, Rosemount 375 Field Communicator, AMS Suite or any other DD (Device Description) compatible host system. FOUNDATION Fieldbus: Rosemount Radar Master, 375 Handheld Communicator, DeltaV® or any other DD (Device Description) compatible host system.
FOUNDATION Fieldbus Blocks	Resource block, 3 Transducer blocks, 6 AI blocks, PID block, ISEL block, SGCR block, ARTH block, and OS block.

Display / Configuration (continued)	
FOUNDATION Fieldbus Class (Basic or Link Master)	Link Master (LAS).
FOUNDATION Fieldbus Block Execution Time	AI-block: 30 ms. PID-block: 40 ms. ARTH-, ISEL-, OSPL-block: 65 ms. CHAR-block: 75 ms.
FOUNDATION Fieldbus Instantiation	No.
Conforming FOUNDATION Fieldbus	ITK 5.0.
FOUNDATION Fieldbus PlantWeb® Alert Support	Yes.
Damping	0-60 s (2 s, default value).
Electric	
Power Supply	HART: 16-42.4 Vdc (16-30 Vdc in IS applications, 20-42.4 Vdc in Explosion-proof / Flameproof applications). FOUNDATION Fieldbus: 9-32 Vdc (9-30 Vdc in IS applications, and 16-32 Vdc in Explosionproof / Flameproof applications). FISCO, IS applications: 9-17.5 Vdc.
Internal Power Consumption	< 50 mW in normal operation.
Output	HART 4-20 mA current loop or FOUNDATION Fieldbus.
Quiescent Current Draw (FOUNDATION Fieldbus)	21 mA
Signal on Alarm	Standard : Low = 3.75 mA, High = 21.75 mA. Namur NE 43: Low = 3.60 mA, High = 22.50 mA.
Saturation Levels	Standard: Low = 3.9 mA, High = 20.8 mA. Namur NE 43: Low = 3.8 mA, High = 20.5 mA.
IS Parameters	See Appendix B: Product Certifications.
Cable Entry	½ - 14 NPT for cable glands or conduit entries. Optional: M20 x 1.5 conduit / cable adapter, M12 4-pin male eurofast® connector or A size Mini 4-pin male minifast® connector.
Output Cabling	Twisted shielded pairs, 18-12 AWG.
Mechanical	
Probes	Coaxial: 1.3 ft (0.4 m) to 19.7 ft (6 m). Rigid Twin Lead: 1.3 ft (0.4 m) to 9.8 ft (3 m). Flexible Twin Lead: 3.3 ft (1 m) to 164 ft (50 m). Rigid Single Lead (0.3 in./8 mm): 1.3 ft (0.4 m) to 9.8 ft (3 m) Rigid Single Lead (0.5 in./13 mm): 1.3 ft (0.4 m) to 14.8 ft (4.5 m) Flexible Single Lead: 3.3 ft (1 m) to 164 ft (50 m).
Tensile Strength	4 mm Flexible Single Lead probe (model code 5A, 5B): 2698 lb (12 kN) 6 mm Flexible Single Lead probe (model code 6A, 6B): 6519 lb (29 kN) Flexible Twin Lead probe: 2023 lb (9 kN).
Collapse Load	4 mm Flexible Single Lead probe (model code 5A, 5B): 3597 lb (16 kN) 6 mm Flexible Single Lead probe (model code 6A, 6B): 7868 lb (35 kN)
Sideway Capacity	Coaxial: 73.7 ft lbf or 3.7 lb at 19.7 ft (100 Nm or 1.67 kg at 6 m). Rigid Twin Lead: 2.2 ft lbf or 0.22 lb at 9.8 ft (3 Nm or 0.1 kg at 3 m). Rigid Single Lead: 4.4 ft lbf or 0.44 lb at 9.8 ft (6 Nm or 0.2 kg at 3 m).
Material Exposed to Tank Atmosphere	• 316L SST (EN 1.4404), PTFE, PFA(5) and O-ring materials (Standard Probe, Material model code 1) or • Alloy C-276 (UNS N10276), PTFE, PFA(5) and O-ring materials (Standard Probe, Material model code 2) or • Alloy 400 (UNS N04400), PTFE, PFA(5) and O-ring materials (Standard Probe, Material model code 3) • PTFE(6) (Standard Probe, Material model code 7) or • PTFE(6), 316 L SST (EN 1.4404) and O-ring materials (Standard Probe, Material model code 8) • 316L SST (EN 1.4404), Ceramic (Al_2O_3), Graphite, Inconel (HTHP Probe, Material model code 1) • Alloy C-276 (UNS N10276), Ceramic (Al_2O_3), Graphite, Inconel (HTHP Probe, Material model code 2 and H) • 316L SST (EN 1.4404), Ceramic (Al_2O_3), Graphite, PFA, PTFE, Inconel (HP Probe, Material model code 1) • Alloy C-276 (UNS N10276), Ceramic (Al_2O_3), Graphite, PFA, PTFE, Inconel (HP Probe, Material model code 2 and H) • 316L SST (EN 1.4404), Ceramic (Al_2O_3), Graphite, PFA, PTFE, Inconel (C Probe, Material model code 1) See “Ordering Information” on page A-21.

Mechanical (continued)	
Dimensions	See "Dimensional Drawings" on page A-9.
Probe Angle	0 to 90 degrees.
Housing / Enclosure	Polyurethane-covered Aluminum or SST Grade CF8M (ASTM A743).
Flanges, Threads	See "Ordering Information" on page A-21.
Height Above Flange	See "Ordering Information" on page A-21.
Weight	Transmitter Head (TH): 4.4 lbs (2 kg). SST 10.8 lbs (4.9 kg). Flange: depends on flange size. Coaxial probe: 0.67 lbs/ft (1 kg/m). Rigid Single Lead probe (0.3 in./8 mm): 0.27 lbs/ft (0.4 kg/m). Rigid Single Lead probe (0.5 in./13 mm): 0.71 lbs/ft (1.06 kg/m). Rigid Twin Lead probe: 0.40 lbs/ft (0.6 kg/m). Flexible Single Lead probe: 0.05 lbs/ft (0.08 kg/m). Flexible Twin Lead probe: 0.09 lbs/ft (0.14 kg/m). End weight: 0.88 lbs (0.40 kg) for the 4 mm single lead probe, 1.2 lbs (0.55 kg) for the 6 mm single lead probe and 1.3 lbs (0.60 kg) for twin lead probes.
Environment	
Ambient Temperature	Non-Hazardous, HART communication: -40°F to 176°F (-40°C to 80°C). IS/EEx ia and XP/EEx d, HART communication: -58°F to 158°F (-50°C to 70°C). IS/EEx ia and XP/EEx d, FOUNDATION Fieldbus: -58°F to 140°F (-50°C to 60°C). LCD readable in: -4°F to 158°F (-20°C to 70°C).
Storage Temperature	-58°F to 194°F (-50°C to 90°C). LCD: -40°F to 185°F (-40°C to 85°C).
Process Temperature(7)	Standard: -40°F to +302°F (-40°C to +150°C) HTHP: -76°F to +752°F (-60°C to +400°C) HP: -76°F to +392°F (-60°C to +200°C) C: -320°F to +392°F (-196°C to +200 °C) See temperature and pressure diagrams on page A-4.
Process Pressure(7)	Standard: Full vacuum to 580 psig (-1 to 40 Bar). HTHP: Full vacuum to 5000 psig (-1 to 345 Bar). HP: Full vacuum to 5000 psig (-1 to 345 Bar). C: Full vacuum to 5000 psig (-1 to 345 Bar). See temperature and pressure diagrams on page A-4.
Humidity	0 - 100% Relative Humidity.
Ingress Protection	NEMA 4X, IP 66 and IP67.
Telecommunication (FCC and R&TTE)	FCC part 15 (1998) subpart B and R&TTE (EU directive 99/5/EC). Considered to be an unintentional radiator under the Part 15 rules.
Factory Sealed	Yes.
Vibration Resistance	Aluminum housing: IEC 60770-1 Level 1. Stainless Steel housing: IACS E10.
Electromagnetic Compatibility	Emission and Immunity: EMC directive 204/108/EC. EN61326-1: 2006. NAMUR recommendations NE21.
Built-in Lightning Protection	EN61326, IEC 801-5, level 1 kV. T1 option: the transmitter complies with IEEE 587 Category B transient protection and IEEE 472 surge protection
Pressure Equipment Directive (PED)	Complies with 97/23/EC article 3.3.

(1) For probes with spacers, the accuracy may deviate close to the spacers.
(2) If the reference conditions are not met, an offset adjustment for the zero reference point may be necessary. The offset may be up to ± 25 mm.
(3) When using remote housing, the accuracy may be reduced.
(4) Not applicable for FOUNDATION Fieldbus.
(5) PFA is a fluoropolymer with properties similar to PTFE.
(6) 1 mm PTFE cover.
(7) Final rating may be lower depending on flange and O-ring selection.

Process Temperature and Pressure Rating

The tank connection consists of a tank seal, a flange[1], Tri-Clamp[2] or NPT or BSP/G threads[3]. See “Ordering Information” on page A-21).

Flange mating face dimensions follow ANSI B 16.5, JIS B2220, and EN 1092-1 standards for blind flanges. Fisher and Masoneilan flanges are also available.

Certain models of flanged Alloy and PTFE covered probes have a tank connection design with a protective plate of the same material as the probe, to prevent the 316L / EN 1.4404 SST flange from being exposed to the tank atmosphere.

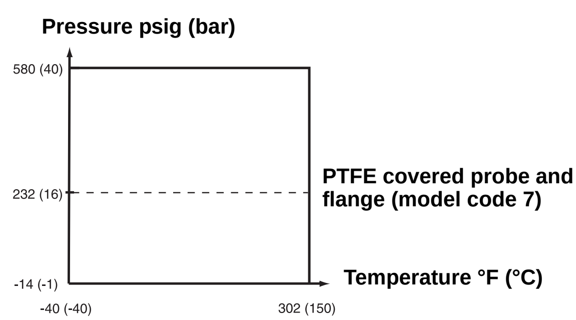
The following diagrams give process temperature (maximum product temperature at the lower part of the flange) and pressure ratings for tank connections:

- Standard (Std)
- High Temperature and High Pressure (HTHP)
- High Pressure (HP)
- Cryogenic (C)

NOTE!
For standard tank connection, the final rating depends on flange and O-ring selection.

The C version can manage lower temperatures (-321 °F/-196 °C) than the Standard, HP, and HTHP versions.

Figure A-1. Maximum process temperature and pressure diagram for standard tank connections.



(1) *EN (DIN), ANSI, Fisher or Masoneilan.*
(2) *1.5, 2, 3 or 4 in. for Single Lead probes.*
(3) *1, 1.5, or 2 in. depending on probe type*

Figure A-2. Maximum process temperature and pressure diagram for HTHP tank connection.

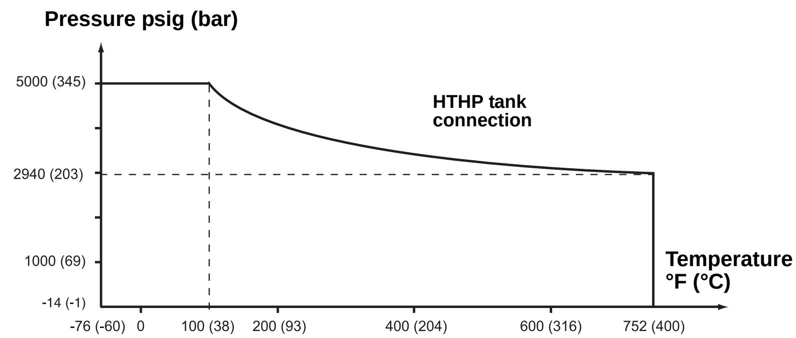


Figure A-3. Maximum process temperature and pressure diagram for HP tank connection.

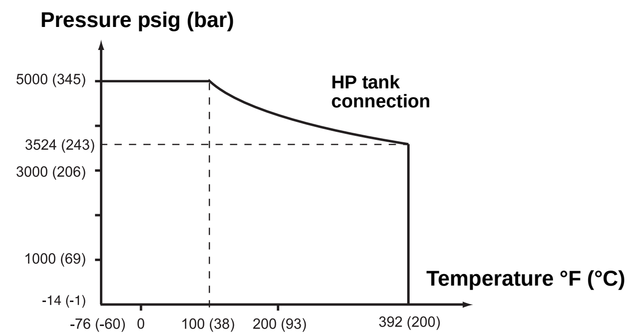
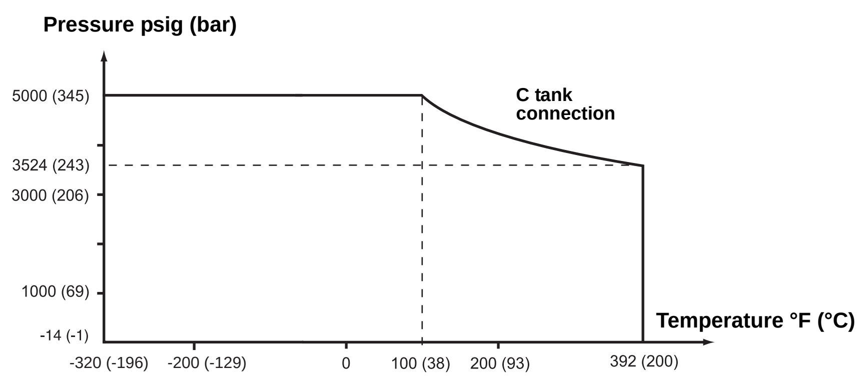


Figure A-4. Process temperature and pressure diagram for C tank connection



The HTHP, HP, and C versions have a ceramic tank seal, and graphite gaskets - no O-rings are used. The final rating depends on flange selection.

A difference between the HP/C and HTHP coaxial versions is material for some parts; PFA/PTFE for HP/C, and ceramics for HTHP. Ceramic spacers allow for usage in applications with higher temperature.

The following table gives the temperature ranges for tank seal with different O-ring material (applicable for the Standard Tank Connection):

Table A-1. Temperature range for different tank seal material.

Tank Seal with different O-ring material	Min. Temperature °F (°C) in air	Max. Temperature °F (°C) in air
Viton	5 (-15)	302 (150)
Ethylene Propylene (EPDM)	-40 (-40)	266 (130)
Kalrez 6375	14 (-10)	302 (150)
Buna-N	-31 (-35)	230 (110)

For Tri-Clamps, the maximum pressure is 16 bar for 1.5 in. (37.5 mm) and 2 in. (50 mm) housing; and 10 bar for 3 in. (75 mm) and 4 in. (100 mm) housing. The final rating depends on the clamp and gasket you are using. Tri-Clamp is available for the Standard Temperature and Pressure seal.

Flange Connection Rating

Flange strength calculations are made with the following conditions:

- For 316L SST:

	Bolting material	Gasket		Flange material	Hub material
		Standard/HTHP	**HP/HTHP/C**		
ANSI	Stainless steel SA193 B8M C1.2	Soft (1a) with min. thickness 1.6 mm.	Spiral wound gasket with nonmetallic filler (1b)	Stainless steel A182 Gr. F316L and EN 10222-5-1.4404.	Stainless steel A479M 316L or EN 10272-1.4404.
EN	EN 1515-1/-2 group 13E0, A4-70.	Soft (EN 1514-1) with min. thickness 1.6 mm.	Spiral wound gasket with nonmetallic filler (EN 1514-2)		

- For Alloy C-276:

	Bolting material	Gasket		Flange material	Hub material
		HTHP	**HP/HTHP/C**		
ANSI	UNS N10276	Soft (1a) with min. Thickness 1.6 mm	Spiral wound gasket with nonmetallic filler (1b)	SB462 Gr. N10276 (solution annealed condition) or SB575 Gr. N10276 (solution annealed condition)	SB574 Gr. N10276
EN		Soft (EN 1514-1) with min. Thickness 1.6 mm	Spiral wound gasket with nonmetallic filler (EN 1514-2)		

Calculations show that the following applies.

Flange Rating Standards

- **ANSI:**
  316L SST Flanges according to ANSI B16.5 Table 2-2.3.
  Standard: Max. 302 °F/580 psig
  (150 °C/40 Bar).
  HP/HTHP/C: Up to Class 2500.

  Alloy C-276 (UNS N10276) flanges
  according to ANSI B16.5 Table 2-3.8.
  HP: Class 1500 up to max 200 °C or
  max 100 °F/5000 psig (38°C/345 bar) and
  392 °F/3500 psig (200 °C/243 bar)
  HTHP: Class 1500 up to max 400 °C or max
  100 °F/5000 psig (38 °C/345 bar) and
  752 °F/2940 psig (400 °C/203 bar).

- **EN:**
  316L SST according to EN 1092-1 Table 18, material group 13E0.
  Standard: Max. 302 °F/580 psig
  (150 °C/40 Bar).
  HP/HTHP/C: Up to PN 320.

  Alloy C-276 according to EN 1092-1 table 18 material group 12E0.
  HP/HTHP: Up to PN320.

- **Fisher & Masoneilan:**
  According to ANSI B16.5 Table 2-2.3.
  Standard: Max. 302 °F/580 psig
  (150 °C/40 Bar).
  HP/HTHP/C: 32 °F/1199 psig (20 °C/82.7 Bar).
  Up to Class 600, Table 2.3.
- **JIS:**
  According to JIS B2220 Table 2.3
  Standard: 10K/20K/150C.
  HP/C: 10K/20K/200C.
  HTHP: 10K/20K/400C

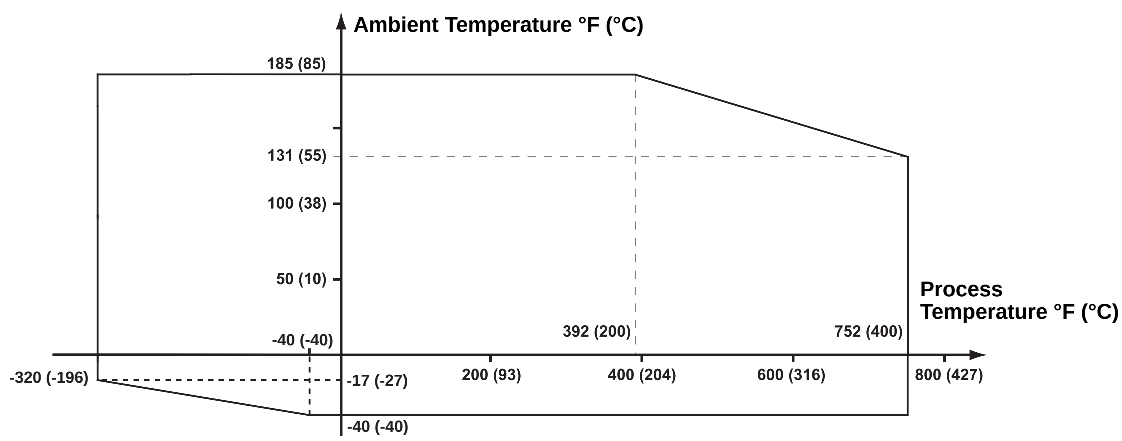
For Alloy C-276 HTHP/HP probes with flange plate design is available up to Class 600/PN 63.

Ambient Temperature

When the Rosemount 5300 is installed in high or low temperature applications, it is important that the maximum/minimum ambient temperature is considered. Nozzle insulation for the HTHP version should not exceed 4 in. (10 cm).

The diagram below shows the ambient temperature vs. process temperature:

Figure A-5. Ambient temperature vs. process temperature.



NOTE!
The maximum ambient temperature also depends on hazardous locations certfications.

Remote Housing Measuring Range

This table shows the maximum recommended measuring range with Remote Housing for different RH lengths, installation types, Dielectric Constants, and probe types.

Table A-2. Remote Housing measuring range

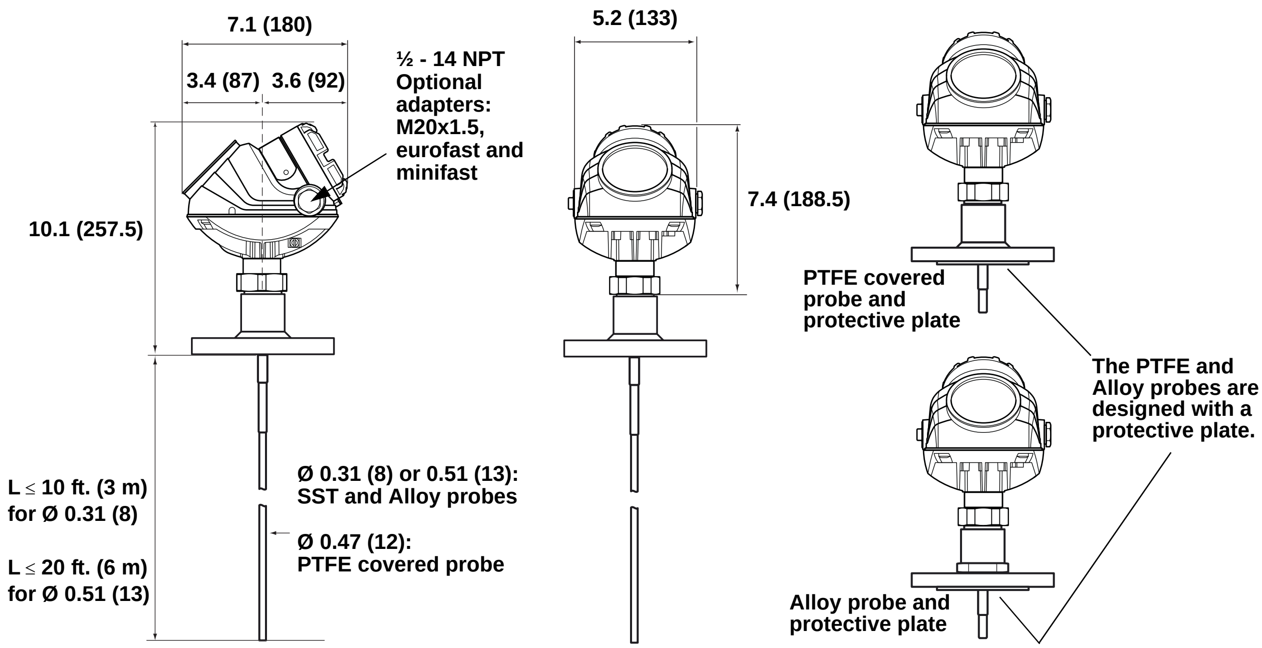
		Dielectric Constant	Rigid Single 8 mm	Rigid Single 13 mm	Flexible Single	Coaxial	Rigid Twin	Flexible Twin
1 m Remote Housing	Chamber / pipe installations ≤ 4 in. (100 mm)	1.4	4 ft (1.25 m)	15 ft (4.5 m)[1]	33 ft (10 m)[1] [2]	19 ft (6 m)	10 ft (3 m)[1]	33 ft (10 m)[1] [2]
		2	10 ft (3 m)[1]	15 ft (4.5 m)[1]	33 ft (10 m)[1] [2]		10 ft (3 m)[1]	33 ft (10 m)[1] [2]
		80	10 ft (3 m)	15 ft (4.5 m)[1]	33 ft (10 m)[1] [2]		10 ft (3 m)[1]	33 ft (10 m)[1] [2]
	Tank installations	1.4	4 ft (1.25 m)	4 ft (1.25 m)	4 ft (1.25 m)		4 ft (1.25 m)	4 ft (1.25 m)
		2	4 ft (1.25 m)	4 ft (1.25 m)	4 ft (1.25 m)		4 ft (1.25 m)	98 ft (30 m)[1]
		80	10 ft (3 m)[1]	10 ft (3 m)[1]	159 ft (48.5 m)[1]		10 ft (3 m)[1]	159 ft (48.5 m)[1]
2 m Remote Housing	Chamber / pipe installations ≤ 4 in. (100 mm)	1.4	9 ft (2.75 m)	15 ft (4.5 m)[1]	33 ft (10 m)[1] [2]	19 ft (6 m)	10 ft (3 m)[1]	33 ft (10 m)[1] [2]
		2	10 ft (3 m)[1]	15 ft (4.5 m)[1]	33 ft (10 m)[1] [2]		10 ft (3 m)[1]	33 ft (10 m)[1] [2]
		80	10 ft (3 m)	15 ft (4.5 m)	33 ft (10 m)[1] [2]		10 ft (3 m)[1]	33 ft (10 m)[1] [2]
	Tank installations	1.4	9 ft (2.75 m)	9 ft (2.75 m)	9 ft (2.75 m)		9 ft (2.75 m)	9 ft (2.75 m)
		2	9 ft (2.75 m)	9 ft (2.75 m)	9 ft (2.75 m)		9 ft (2.75 m)	98 ft (30 m)[1]
		80	10 ft (3 m)[1]	10 ft (3 m)[1]	154 ft (47 m)[1]		10 ft (3 m)[1]	154 ft (47 m)[1]
3 m Remote Housing	Chamber / pipe installations ≤ 4 in. (100 mm)	1.4	10 ft (3 m)	15 ft (4.5 m)	33 ft (10 m)[1] [2]	19 ft (6 m)	10 ft (3 m)[1]	33 ft (10 m)[1] [2]
		2		15 ft (4.5 m)	33 ft (10 m)[1] [2]			33 ft (10 m)[1] [2]
		80		15 ft (4.5 m)	33 ft (10 m)[1] [2]			33 ft (10 m)[1] [2]
	Tank installations	1.4		14 ft (4.25 m)	14 ft (4.25 m)			14 ft (4.25 m)
		2		14 ft (4.25 m)	14 ft (4.25 m)			98 ft (30 m)[1]
		80		15 ft (4.5 m)[1]	149 ft (45.5 m)[1]			149 ft (45.5 m)[1]

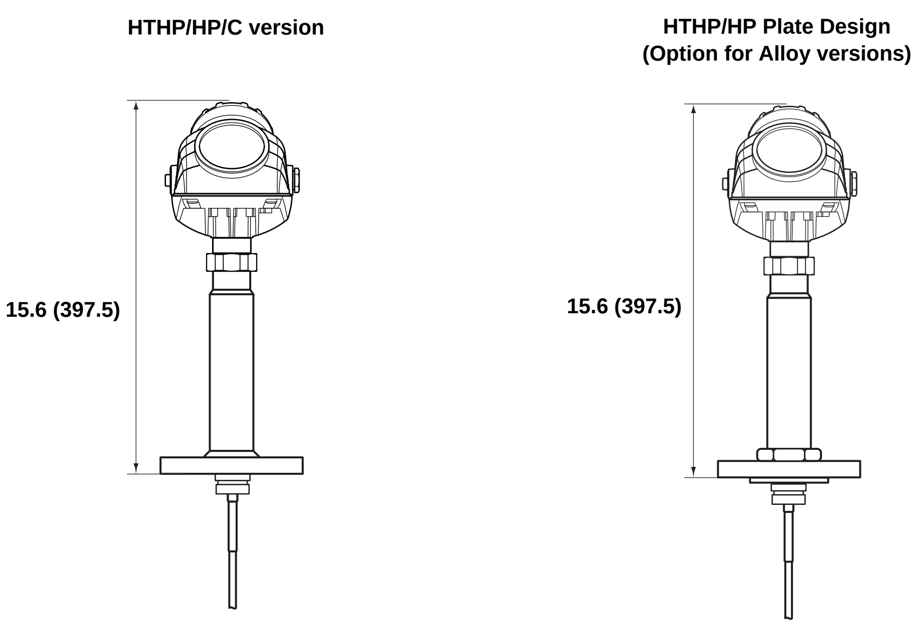
(1) Accuracy may be affected up to ± 1.2 in. (30 mm).
(2) Required chamber/pipe size is 3 or 4 in. (75 -100 mm).

DIMENSIONAL DRAWINGS

Probe Type 4A, 4B

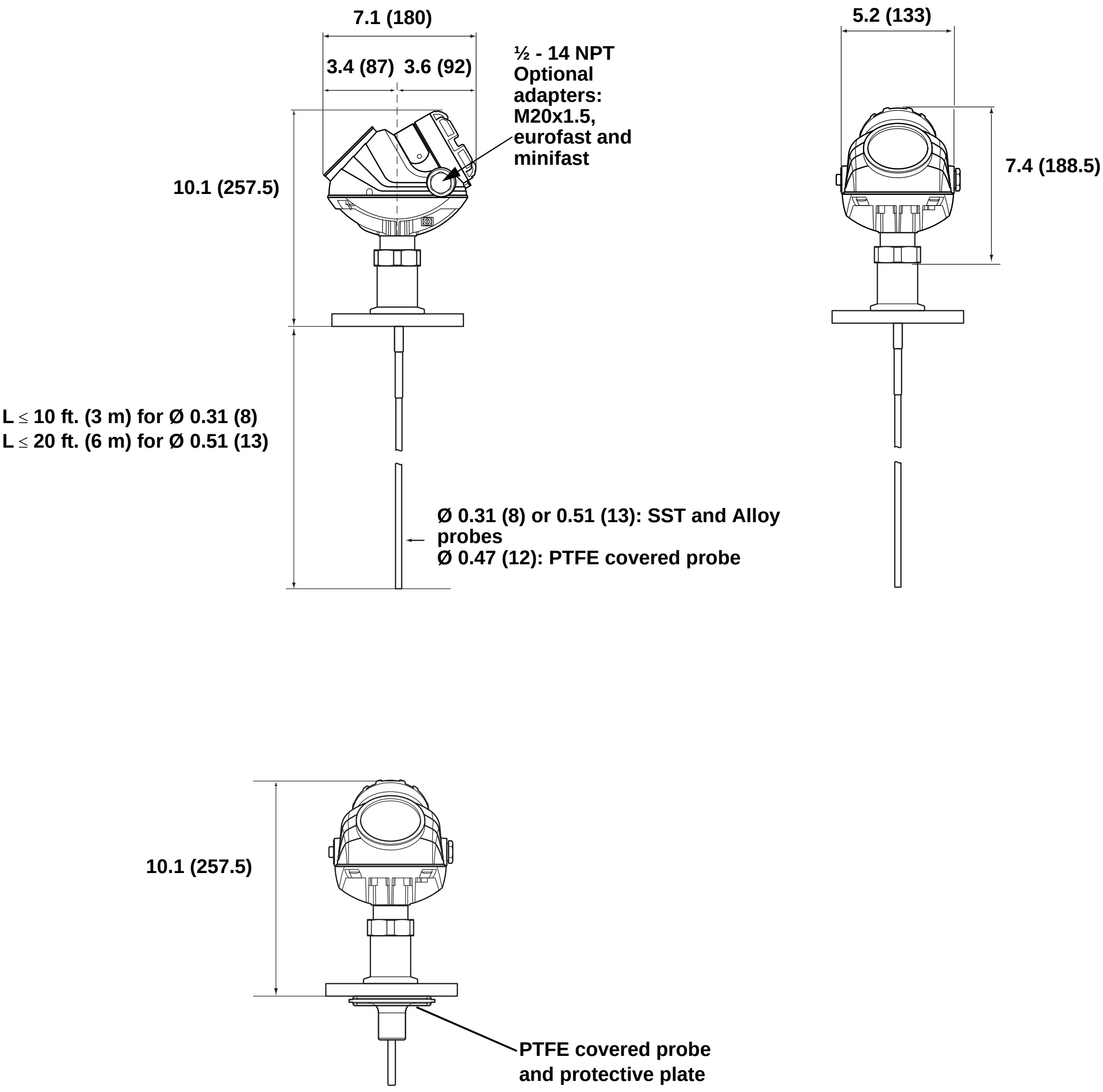
Figure A-6. Rigid Single Lead Probe with Flange Connection





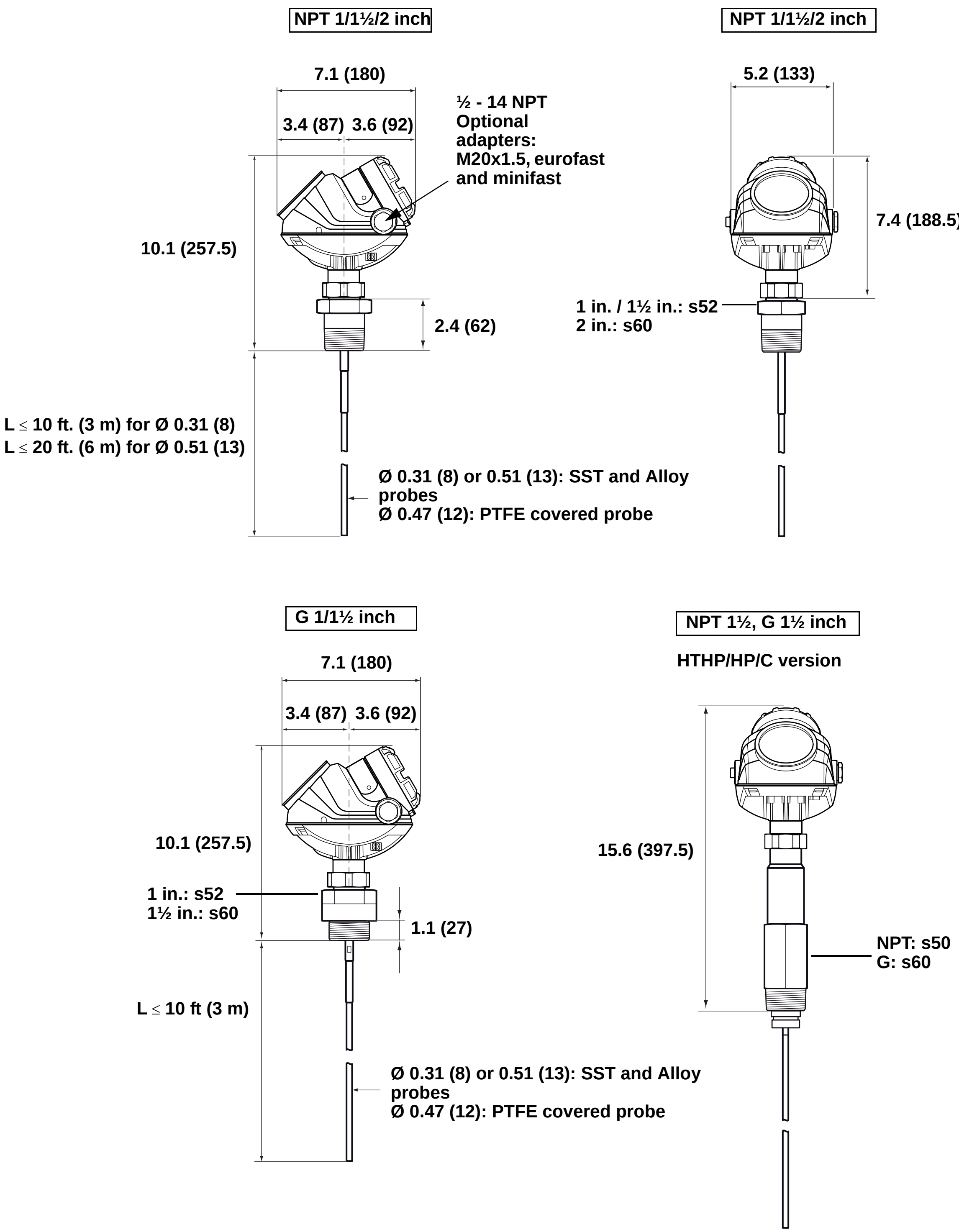
Dimensions are in inches (millimeters).

Figure A-7. Rigid Single Lead Probe with Tri-Clamp Connection



Dimensions are in inches (millimeters).

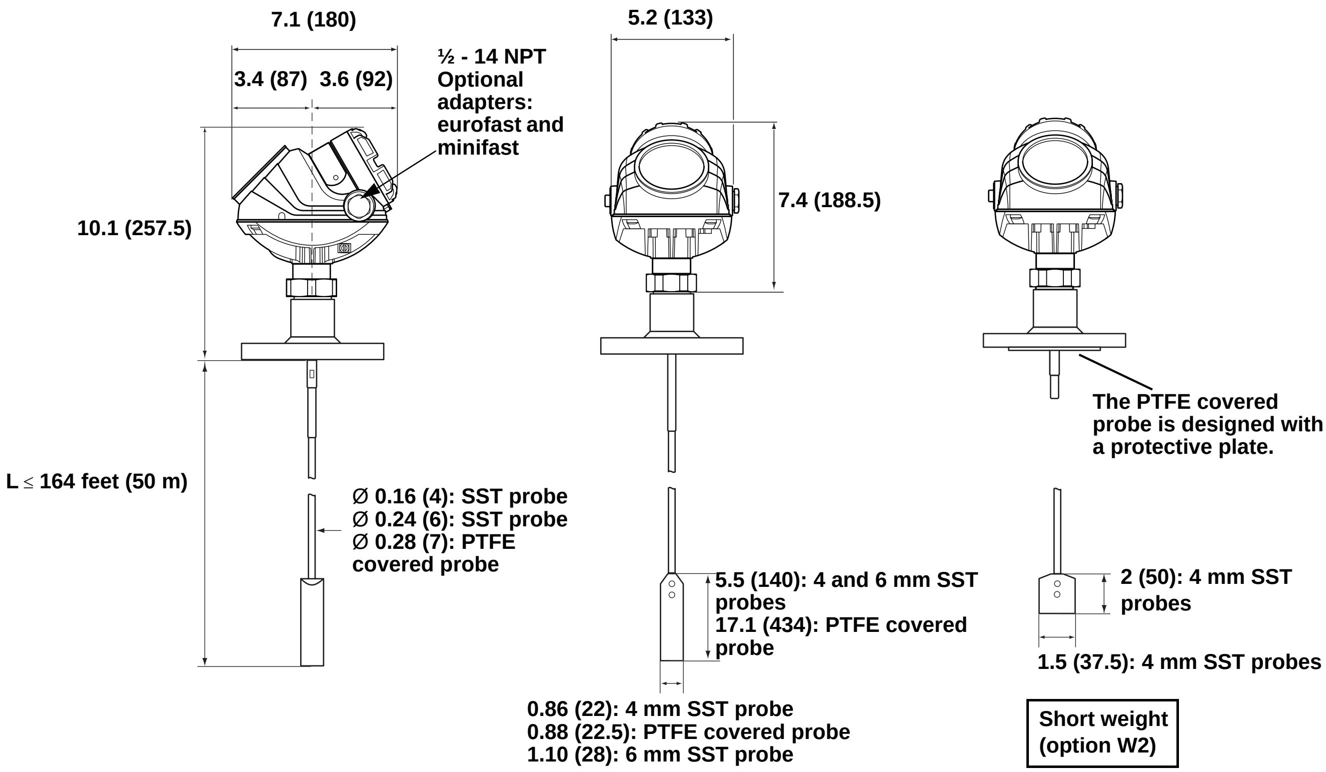
Figure A-8. Rigid Single Lead
with threaded connection

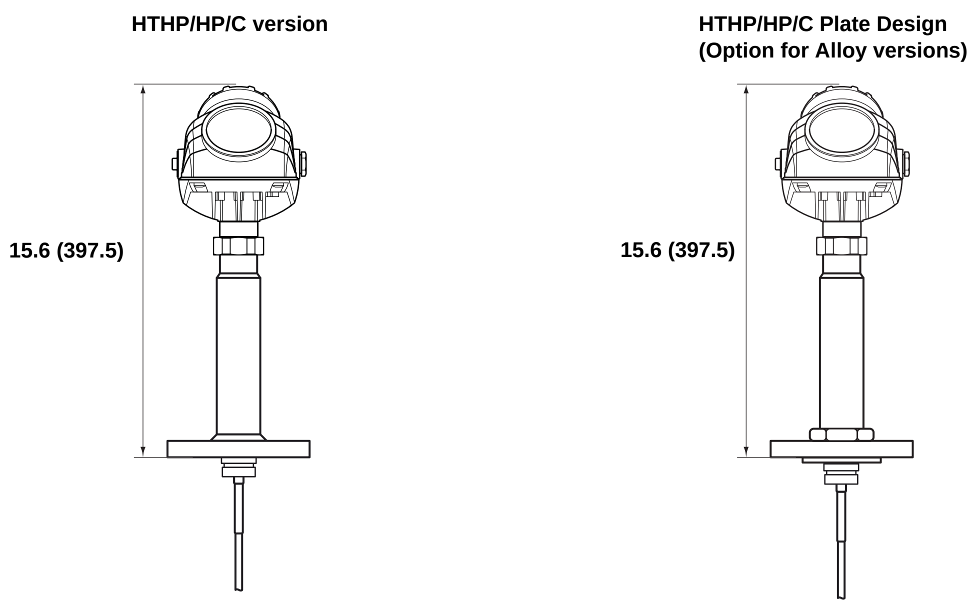


Dimensions are in inches (millimeters).

Figure A-9. Flexible Single Lead Probe with Flange Connection

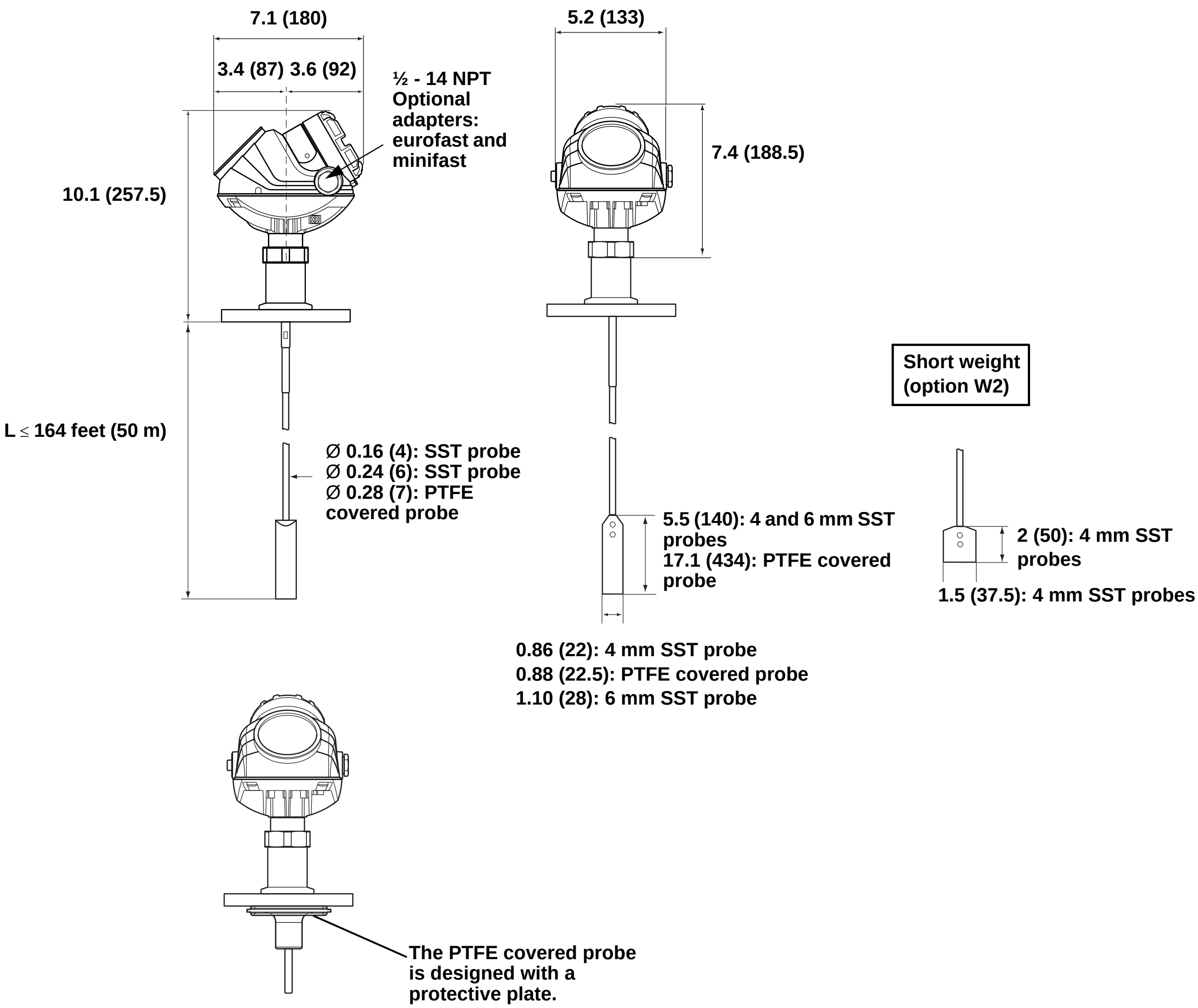
Probe Type 5A, 5B





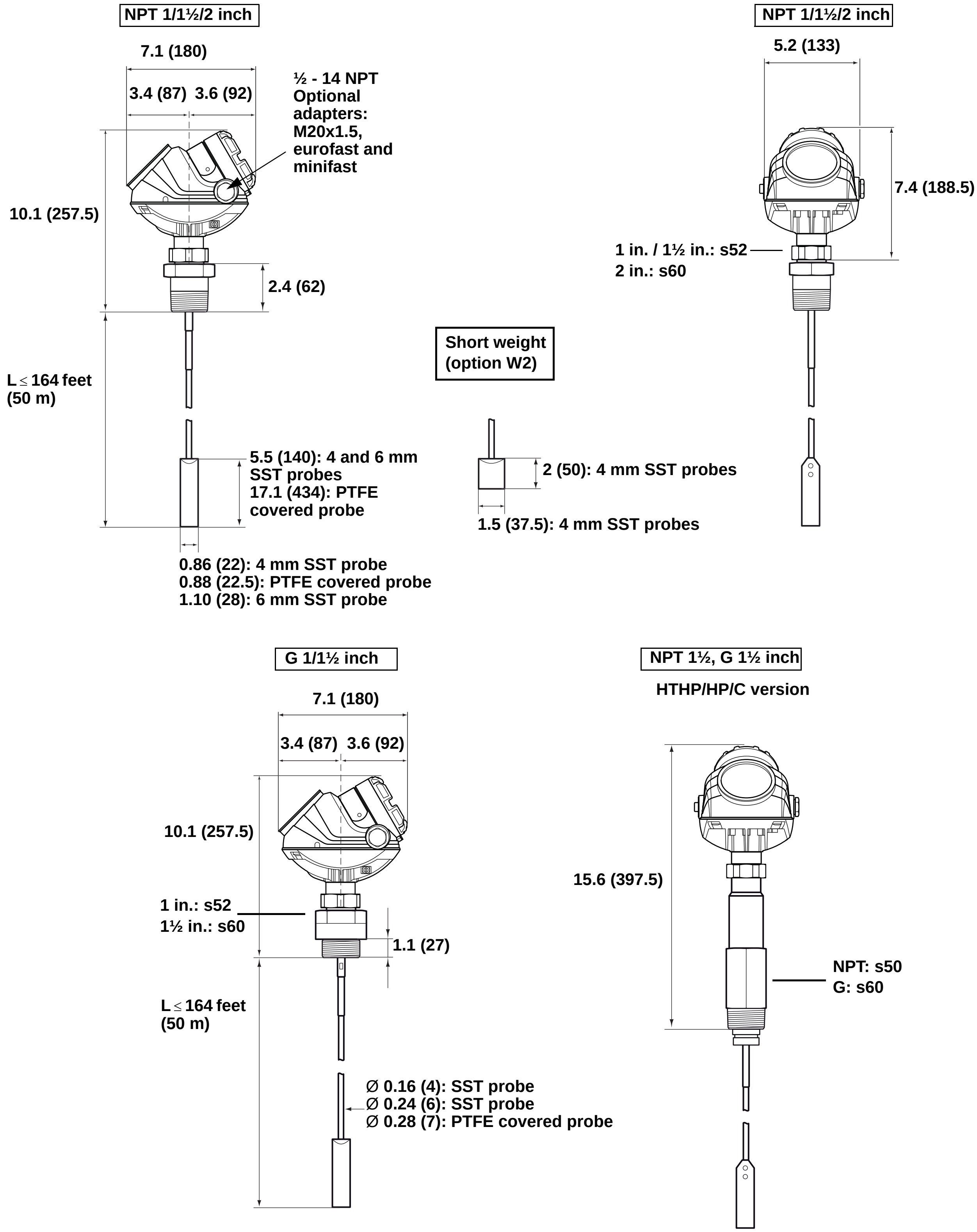
Dimensions are in inches (millimeters).

Figure A-10. Flexible Single Lead Probe with Tri-Clamp Connection



Dimensions are in inches (millimeters).

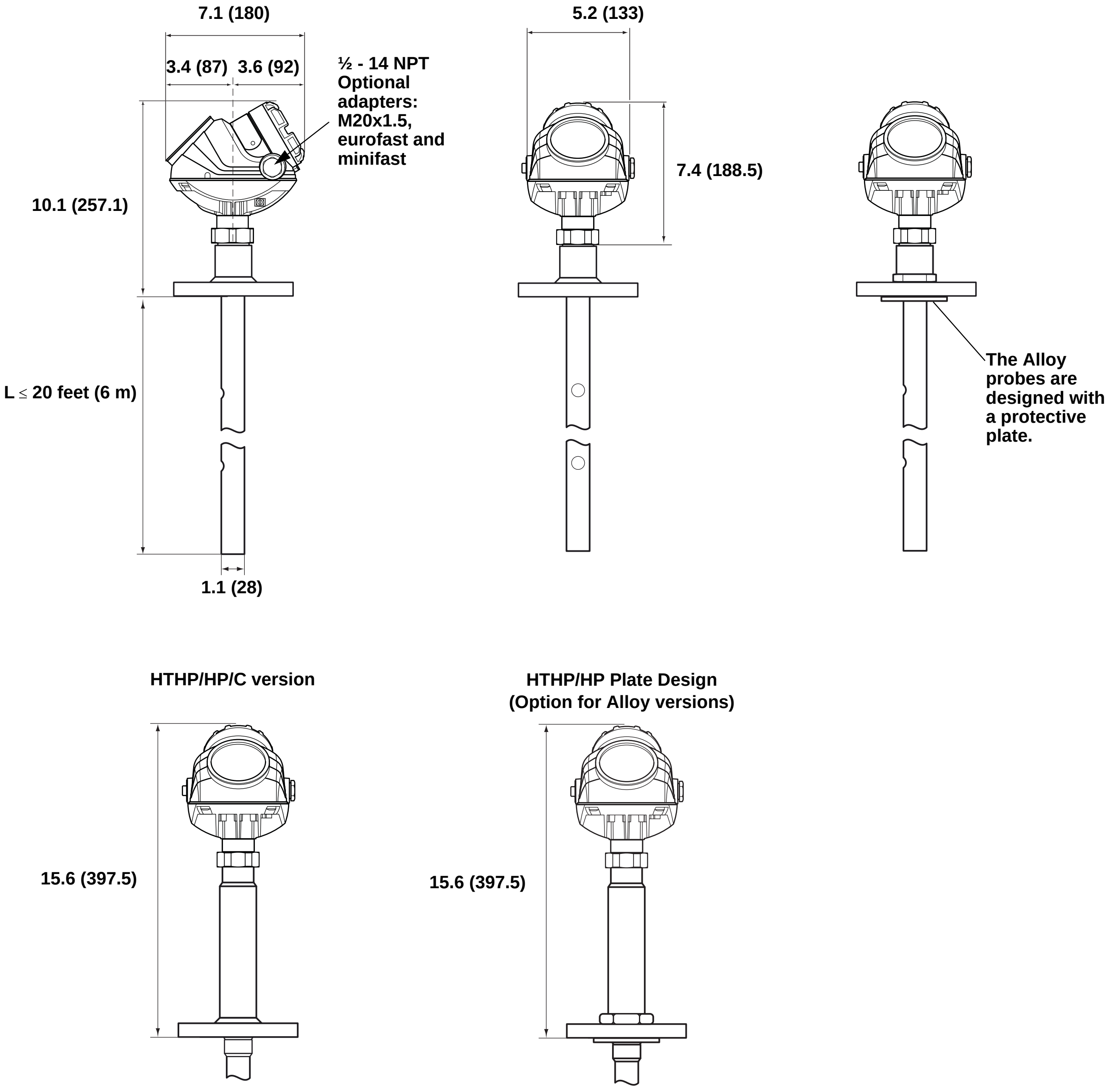
Figure A-11. Flexible Single Lead with threaded connection



Dimensions are in inches (millimeters).

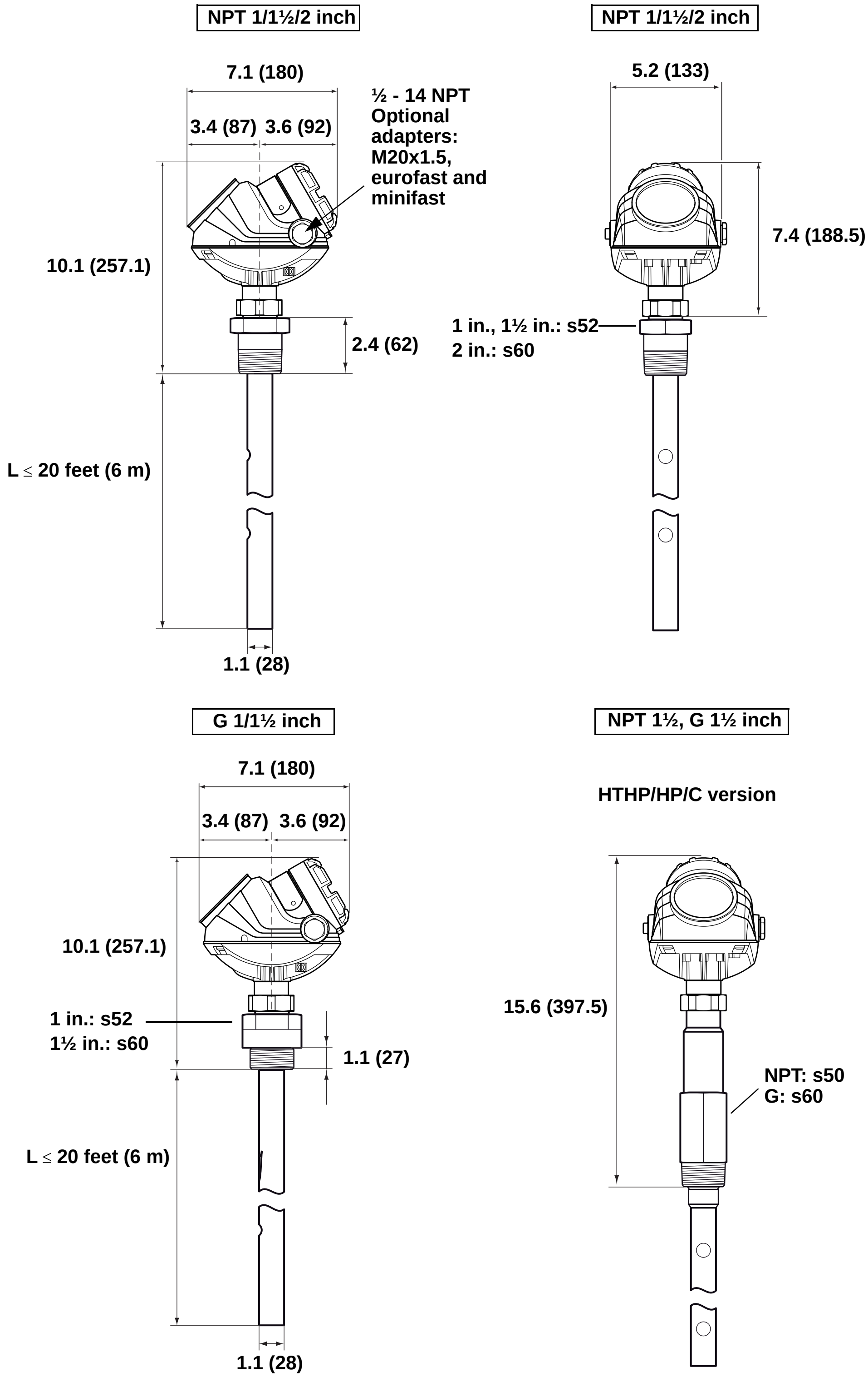
Figure A-12. Coaxial probe with flange connection

Probe Type 3A, 3B



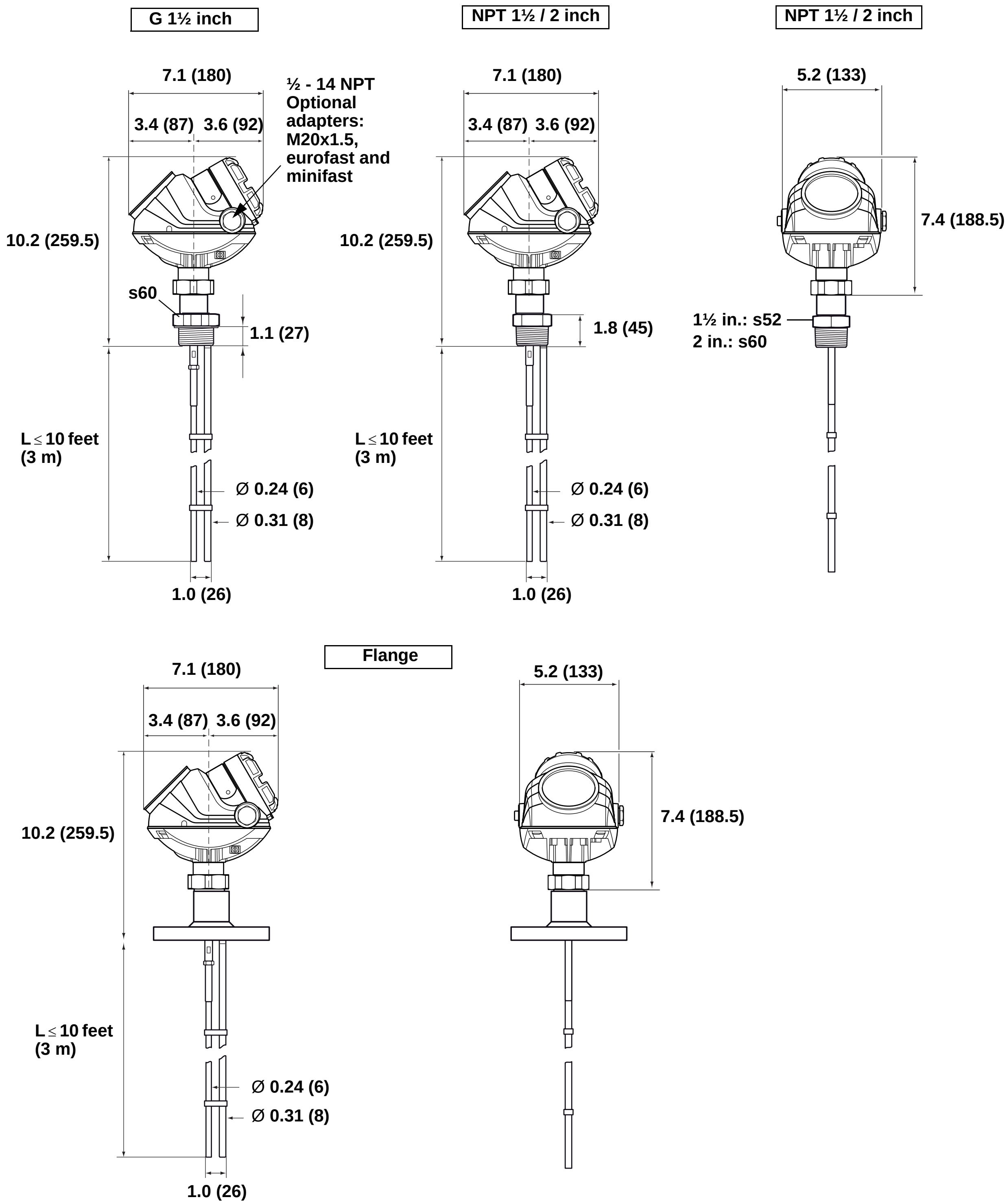
Dimensions are in inches (millimeters).

Figure A-13. Coaxial probe with threaded connection



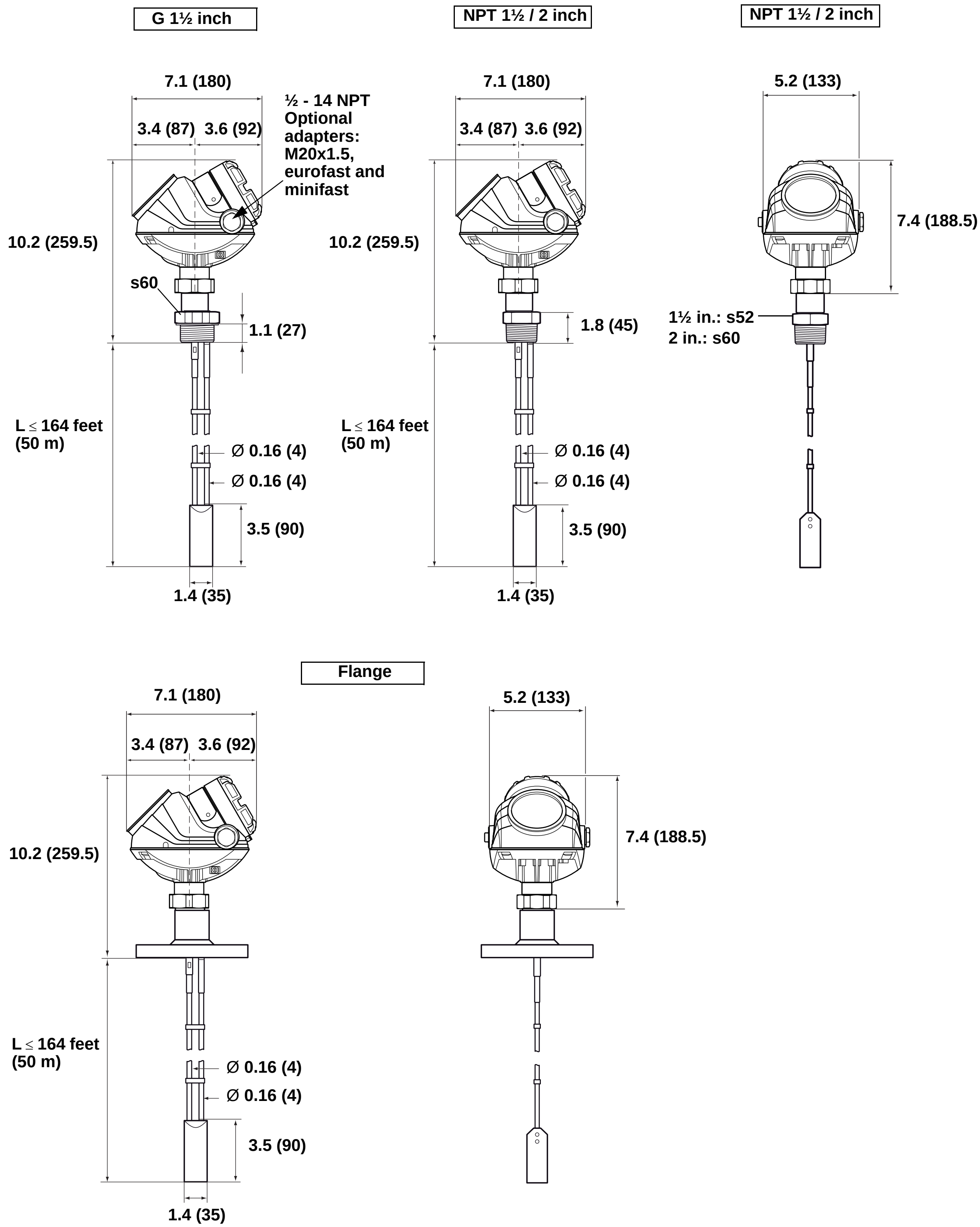
Dimensions are in inches (millimeters).

Figure A-14. Rigid Twin Lead **Probe Type 1A**



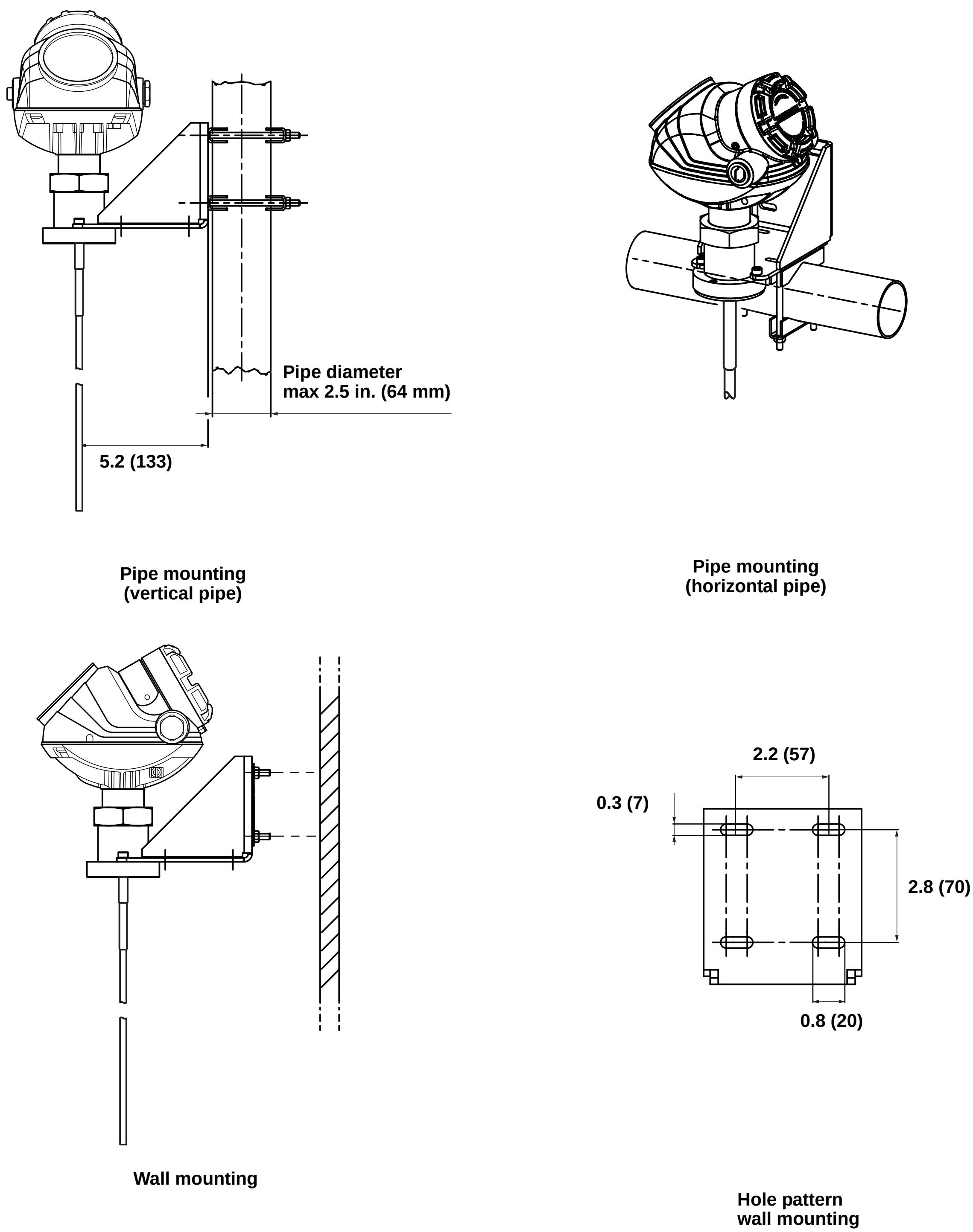
Dimensions are in inches (millimeters).

Figure A-15. Flexible Twin Lead **Probe Type 2A**



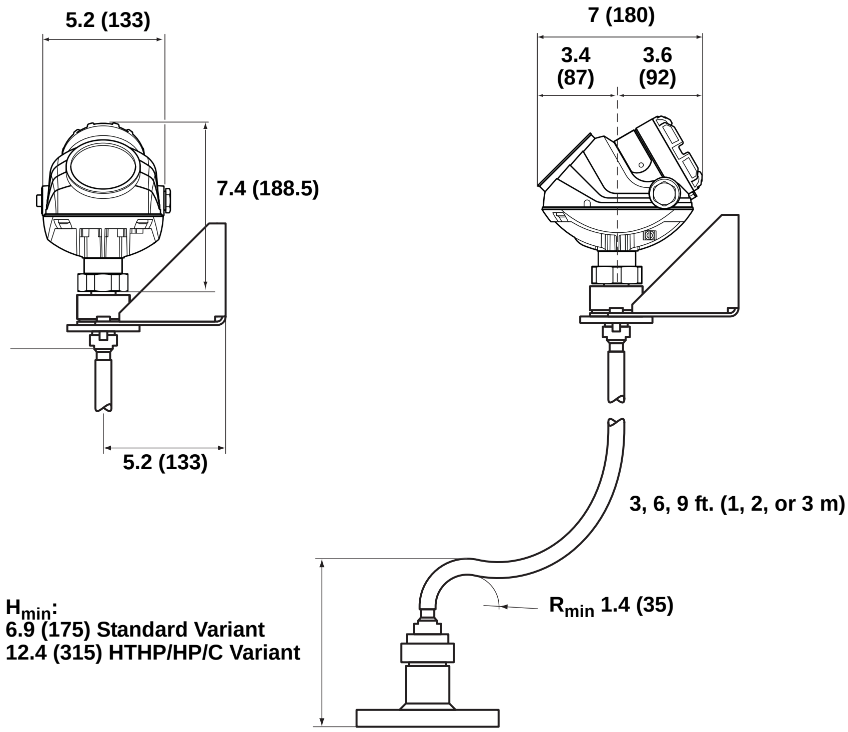
Dimensions are in inches (millimeters).

Figure A-16. Bracket mounting.



Dimensions are in inches (millimeters).

Figure A-17. Remote housing.



Dimensions are in inches (millimeters).

ORDERING INFORMATION

Model Code 5301 and 5302 Level and/or Interface in Liquids

Model	**Product Description**		
5301	Guided Wave Radar Liquid Level or Interface Transmitter (interface available for fully submerged probe)		
5302	Guided Wave Radar Liquid Level and Interface Transmitter		
Code	**Signal Output**		
H	4-20 mA with HART communication		
F	FOUNDATION fieldbus		
Code	**Housing Material**		
A	Polyurethane-covered Aluminum		
S	Stainless Steel, Grade CF8M (ASTM A743)		
Code	**Conduit / Cable Threads**		
1	½ - 14 NPT		
2	M20 x 1.5 adapter		
E	M12, 4-pin, Male connector (eurofast®)[1]		
M	A size Mini, 4-pin, Male connector (minifast®)[1]		
Code	**Operating Temperature and Pressure[2]**		**Probe Type**
S	- 15 psig (-1bar) to 580 psig (40 bar) @ 302 °F (150 °C)		All
H	High Temperature / High Pressure[3]: 2940 psi @ 752 °F and 5000 psi @ 100 °F (203 bar @ 400 °C and 345 bar @ 38 °C) according to ANSI Class 2500		3A, 3B, 4A, 4U, 4V, 5A and 5B
P	High Pressure[3]: 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
C	Cryogenic Temperature[3] [4] -321 °F (-196 °C) 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, 5B (only SST)
Code	**Material of Construction[5]: Process Connection / Probe**	**Probe Type**	**Valid Operation Temperature and Pressure**
1	316 L SST (EN 1.4404)	All	S, H, P, C
2	Alloy C-276 (UNS N10276). With plate design if flanged version. Up to class 600, PN 63 for HTHP/HP probes.	3A, 3B, 4A	S, H, P
3	Alloy 400 (UNS N04400). With plate design if flanged version.	3A, 3B, 4A, 5A, 5B	S
7	PTFE covered probe and flange. With plate design.	4A and 5A	S
8	PTFE covered probe	4A and 5A	S
H	Alloy C-276 (UNS N10276) process connection, flange and probe[6]	3A, 3B, 4A	H, P
Code	**Sealing, O-ring Material (Consult the factory for other o-ring materials)**		
N	None[7]		
V	Viton® fluoroelastomer		
E	Ethylene Propylene		
K	Kalrez® 6375 perfluoroelastomer		
B	Buna-N		

Code	Probe Type	Process Connection	Probe Lengths
1A	Rigid Twin Lead(9)	Flange / 1.5 in., 2 in.(9) Thread	Min: 1 ft 4 in. (0.4 m). Max: 9 ft 10 in. (3 m)
2A	Flexible Twin Lead with weight (9)	Flange / 1.5 in., 2 in.(9) Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
3A	Coaxial (for level measurement)(8)	Flange / 1 in.(9), 1.5 in., 2 in.(9) Thread	Min: 1 ft 4 in. (0.4 m). Max: 19 ft 8 in. (6 m)
3B	Coaxial, perforated. For level and interface measurement, or easier cleaning.	Flange / 1 in,(9) 1.5 in., 2 in.(9) Thread	Min: 1 ft 4 in. (0.4 m). Max: 19 ft 8 in. (6 m)
4A	Rigid Single Lead (8 mm)	Flange / 1 in.(9), 1.5 in., 2 in.(9) Thread / Tri-Clamp	Min: 1 ft 4 in. (0.4 m). Max: 9 ft 10 in. (3 m)
4B	Rigid Single Lead (13 mm)(10)	Flange / 1 in., 1.5 in., 2 in. Thread / Tri-Clamp	Min: 1 ft 4 in. (0.4 m). Max: 14 ft 9 in. (4.5 m)
4U	Vapor Single Rigid Probe for 2 in. pipes(11)	Flange / 1.5 in. Thread	Min: 2 ft 5 in. (0.76 m). Max: 13 ft (4 m)
4V	Vapor Single Rigid Probe for 3-4 in. pipes(11)	Flange / 1.5 in. Thread	Min: 2 ft 5 in. (0.76 m). Max: 13 ft (4 m)
5A	Flexible Single Lead with weight	Flange / 1 in.(9), 1.5 in., 2 in.(9) Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
5B	Flexible Single Lead with chuck(12)	Flange / 1 in.(9), 1.5 in., 2 in.(9) Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
Code	**Probe Length Units**		
E	English (feet, in.)		
M	Metric (meters, centimeters)		
Code	**Total Probe Length (13) (feet/m)**		
xxx	0-164 ft or 0-50 m		
Code	**Total Probe Length (13) (in./cm)**		
xx	0-11 in. or 0-99 cm		
Code	**Process Connection - Size / Type (consult factory for other process connections)**		
ANSI Flanges(14)			
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		

EN (DIN) Flanges(15)		
HB	DN50, PN40	
HC	DN50, PN63. HTHP / HP units	
HD	DN50, PN100. HTHP / HP units	
HE	DN50, PN160. HTHP / HP units	
HF	DN50, PN250. HTHP / HP units	
IA	DN80, PN16	
IB	DN80, PN40	
IC	DN80, PN63. HTHP / HP units	
ID	DN80, PN100. HTHP / HP units	
IE	DN80, PN160. HTHP / HP units	
IF	DN80, PN250. HTHP / HP units	
JA	DN100, PN16	
JB	DN100, PN40	
JC	DN100, PN63. HTHP / HP units	
JD	DN100, PN100. HTHP / HP units	
JE	DN100, PN160. HTHP / HP units	
JF	DN100, PN250. HTHP / HP units	
KA	DN150, PN16	
JIS Flanges(15)		
UA	50A, 10K	
UB	50A, 20K	
VA	80A, 10K	
VB	80A, 20K	
XA	100A, 10K	
XB	100A, 20K	
YA	150A, 10K	
YB	150A, 20K	
ZA	200A, 10K	
ZB	200A, 20K	
Threaded Connections(14)		**Probe Type**
RA	1 ½ in. NPT thread	All
RB	1 in. NPT thread	3A, 3B, 4A, 4B, 5A, 5B, standard temperature and pressure
RC	2 in. NPT thread	3A, 3B, 4A, 4B, 5A, 5B, standard temperature and pressure
SA	1 ½ in. BSP (G 1 ½ in.) thread	All
SB	1 in. BSP (G 1 in.) thread	3A, 3B, 4A, 4B, 5A, 5B, standard temperature and pressure
Tri-Clamp Fittings(14)		**Probe Type**
FT	1 ½ in. Tri-Clamp	4A, 5A, 5B standard temperature and pressure
AT	2 in. Tri-Clamp	4A, 4B, 5A, 5B standard temperature and pressure
BT	3 in. Tri-Clamp	4A, 4B, 5A, 5B standard temperature and pressure
CT	4 in. Tri-Clamp	4A, 4B, 5A, 5B standard temperature and pressure
Proprietary Flanges		
TF	Fisher - proprietary 316L SST (for 249B cages) Torque Tube Flange	
TT	Fisher - proprietary 316L SST (for 249C cages) Torque Tube Flange	
TM	Masoneilan - proprietary 316L SST Torque Tube Flange	

Code	Hazardous Locations Certifications
NA	No Hazardous Locations Certifications
E1	ATEX Flameproof(16)
E3	NEPSI Flameproof(16)
E5	FM Explosion-proof(16)
E6	CSA Explosion-proof(16)
E7	IECEx Flameproof(16)
I1	ATEX Intrinsic Safety
IA	ATEX FISCO Intrinsic Safety(17)
I3	NEPSI Intrinsic Safety
IC	NEPSI FISCO Intrinsic Safety(17)
I5	FM Intrinsic Safety and Non-Incendive
IE	FM FISCO Intrinsic Safety(17)
I6	CSA Intrinsic Safety
IF	CSA FISCO Intrinsic Safety(17)
I7	IECEx Intrinsic Safety
IG	IECEx FISCO Intrinsic Safety(17)
KA	ATEX, FM, CSA Flameproof/Explosion-proof(16)
KB	ATEX, FM, IECEx Flameproof/Explosion-proof(16)
KC	ATEX, CSA, IECEx Flameproof/Explosion-proof(16)
KD	FM, CSA, IECEx Flameproof/Explosion-proof(16)
KE	ATEX, FM, CSA Intrinsic Safety
KF	ATEX, FM, IECEx Intrinsic Safety
KG	ATEX, CSA, IECEx Intrinsic Safety
KH	FM, CSA, IECEx Intrinsic Safety
KI	FISCO - ATEX, FM, CSA Intrinsic Safety(17)
KJ	FISCO - ATEX, FM, IECEx Intrinsic Safety(17)
KK	FISCO - ATEX, CSA, IECEx Intrinsic Safety(17)
KL	FISCO - FM, CSA, IECEx Intrinsic Safety(17)
Code	**Options**
M1	Integral digital display
P1	Hydrostatic testing(18)
N2	NACE material recommendation per MR-0175 and MR-0103(19)
LS	Long stud(20) 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
W2	Short weight for flexible single lead probe(21)
BR	Mounting Bracket for 1.5 in. NPT Process Connection (RA)
T1	Transient Protection Terminal Block (standard with FISCO options)
U1	WHG Overfill Approval (pending, consult factory)
Special Configuration (Software)	
C1	Factory configuration (CDS required with order)
C4	Namur alarm and saturation levels, high alarm
C5	Namur alarm and saturation levels, low alarm
C8	Low alarm (22) (standard Rosemount alarm and saturation levels)
Qx - Special Certifications	
Q4	Calibration Data Certification
Q8	Material Traceability Certification per EN 10204 3.1(23)
QG	GOST Primary Verification Certificate
QS	Prior-use certificate of FMEDA Data. Only available with HART 4-20 mA output (output code H).

PlantWeb Diagnostic Functionality		
D01	FOUNDATION fieldbus Diagnostics Suite	
DA1	HART Diagnostics Suite	
Centering Discs		**Outer Diameter**
S2	2 in. Centering disc(24)	1.8 in. (45 mm)
S3	3 in. Centering disc(24)	2.7 in. (68 mm)
S4	4 in. Centering disc(24)	3.6 in. (92 mm)
S6	6 in. Centering disc(24)	5.55 in. (141 mm)
S8	8 in. Centering disc(24)	7.40 in. (188 mm)
P2	2 in. Centering disc PTFE(25)	1.8 in. (45 mm)
P3	3 in. Centering disc PTFE(25)	2.7 in. (68 mm)
P4	4 in. Centering disc PTFE(25)	3.6 in. (92 mm)
P6	6 in. Centering disc PTFE(25)	5.55 in. (141 mm)
P8	8 in. Centering disc PTFE(25)	7.40 in. (188 mm)
Remote Housing Mounting		
B1	1 m / 3.2 ft. Remote Housing Mounting Cable and Bracket	
B2	2 m / 6.5 ft. Remote Housing Mounting Cable and Bracket	
B3	3 m / 9.8 ft. Remote Housing Mounting Cable and Bracket	
Consolidate to Chamber		
XC	Consolidate to Chamber(26)	

(1) Not available with Flame/Explosion-proof approvals (E1, E3, E5, E6, E7, KA, KB, KC, and KD)
(2) Process seal rating. Final rating depends on flange and O-ring selection.
(3) Requires option None for sealing (no O-ring).
(4) Welding Procedure Qualification Record Documentation will be supplied.
(5) For other materials, consult the factory.
(6) Consult the factory for this option.
(7) Requires High Temperature High Pressure (code H), High Pressure (code P), or Cryogenic (code C) probe.
(8) Requires model 5301.
(9) Only available with standard temperature and pressure (code S).
(10) Available in SST. Consult the factory for other materials.
(11) This is an HTHP probe.
(12) Extra length for fastening is added in factory.
(13) 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, please round up to an even length when ordering. Probes can be cut to exact length in field. Maximum allowable length is determined by process conditions.
(14) Available in 316L SST. For other materials consult the factory.
(15) Available in 316L SST (EN 1.4404). For other materials, consult the factory.
(16) Probes are intrinsically safe.
(17) Requires Foundation fieldbus signal output (U_i parameter listed in Appendix B: Product Certifications).
(18) For standard tank connection, only available with flange .
(19) For Material SST, Alloy C-276 and Alloy 400; Probe Type 3A, 3B, 4A, 4B, 4U, and 4V.
(20) Not available with PTFE covered probes.
(21) Only for Material of Construction code 1 and 3. For other materials, consult the factory.
(22) The standard alarm setting is high.
(23) Certificate includes all pressure retaining wetted parts.
(24) Available for SST and Alloy C-276 probe, type 2A, 4A, 4B, and 5A. Same disc material as probe material.
(25) Available for probe types 2A, 4A, 4B, and 5A, except for HTHP.
(26) Not available for Cryogenic probe.

Example Model String: 5301-H-A-1-S-1-V-1A-M-002-05-AA-I1-M1C1. E-002-05, means 2 ft and 5 in. probe length. M-002-05, means 2.05 m

Model Code 5303, Level for Solids

Model	Product Description		
5303	Guided Wave Solids Level Transmitter		
Code	**Signal Output**		
H	4-20 mA with HART communication		
F	FOUNDATION fieldbus		
Code	**Housing Material**		
A	Polyurethane-covered Aluminum		
S	Stainless Steel, Grade CF8M (ASTM A743)		
Code	**Conduit / Cable Threads**		
1	½ - 14 NPT		
2	M20 x 1.5 adapter		
E	M12, 4-pin, Male connector (eurofast®)(1)		
M	A size Mini, 4-pin, Male connector (minifast®)(1)		
Code	**Operating Temperature and Pressure**		**Probe Type**
S	- 15 psig (-1bar) to 580 psig (40 bar) @ 302 °F (150 °C)(2)		All
Code	**Material of Construction(3): Process Connection / Probe**		**Probe Type**
1	316 L SST (EN 1.4404)		All
Code	**Sealing, O-ring Material (Consult factory for other o-ring materials)**		
V	Viton® fluoroelastomer		
E	Ethylene Propylene		
K	Kalrez® 6375 perfluoroelastomer		
B	Buna-N		
Code	**Probe Type**	**Process Connection**	**Probe Lengths**
5A	Flexible Single Lead with weight, 4 mm	Flange / 1 in., 1.5 in., 2 in. Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 115 ft (35 m)
5B	Flexible Single Lead with chuck, 4 mm(4)	Flange / 1 in., 1.5 in., 2 in. Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 115 ft (35 m)
6A	Flexible Single Lead with weight, 6 mm	Flange / 1 in., 1.5 in., 2 in. Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
6B	Flexible Single Lead with chuck, 6 mm(4)	Flange / 1 in., 1.5 in., 2 in. Thread /Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
Code	**Probe Length Units**		
E	English (feet, in.)		
M	Metric (meters, centimeters)		
Code	**Total Probe Length (5) (feet/m)**		
xxx	0-164 ft or 0-50 m		
Code	**Total Probe Length (5) (in./cm)**		
xx	0-11 in. or 0-99 cm		

Code	Process Connection - Size / Type (consult the factory for other process connections)	
ANSI Flanges(6)		
AA	2 in. ANSI, 150 lb	
AB	2 in. ANSI, 300 lb	
BA	3 in. ANSI, 150 lb	
BB	3 in. ANSI, 300 lb	
CA	4 in. ANSI, 150 lb	
CB	4 in. ANSI, 300 lb	
DA	6 in. ANSI, 150 lb	
EN (DIN) Flanges(7)		
HB	DN50, PN40	
IA	DN80, PN16	
IB	DN80, PN40	
JA	DN100, PN16	
JB	DN100, PN40	
KA	DN150, PN16	
JIS Flanges(7)		
UA	50A, 10K	
UB	50A, 20K	
VA	80A, 10K	
VB	80A, 20K	
XA	100A, 10K	
XB	100A, 20K	
YA	150A, 10K	
YB	150A, 20K	
ZA	200A, 10K	
ZB	200A, 20K	
Threaded Connections(6)		**Probe Type**
RA	1 ½ in. NPT thread	All
RB	1 in. NPT thread	5A, 5B, 6A, 6B, standard temperature and pressure
RC	2 in. NPT thread	All for standard temperature and pressure
SA	1 ½ in. BSP (G 1 ½ in.) thread	All
SB	1 in. BSP (G 1 in.) thread	5A, 5B, 6A, 6B standard temperature and pressure

Code	Hazardous Locations Certifications
NA	No Hazardous Locations Certifications
E1	ATEX Flameproof
E3	NEPSI Flameproof
E5	FM Explosion-proof
E6	CSA Explosion-proof
E7	IECEx Flameproof
I1	ATEX Intrinsic Safety
IA	ATEX FISCO Intrinsic Safety(8)
I3	NEPSI Intrinsic Safety
IC	NEPSI FISCO Intrinsic Safety(8)
I5	FM Intrinsic Safety and Non-Incendive
IE	FM FISCO Intrinsic Safety(8)
I6	CSA Intrinsic Safety
IF	CSA FISCO Intrinsic Safety(8)
I7	IECEx Intrinsic Safety
IG	IECEx FISCO Intrinsic Safety(8)
KA	ATEX, FM, CSA Flameproof/Explosion-proof
KB	ATEX, FM, IECEx Flameproof/Explosion-proof
KC	ATEX, CSA, IECEx Flameproof/Explosion-proof
KD	FM, CSA, IECEx Flameproof/Explosion-proof
KE	ATEX, FM, CSA Intrinsic Safety
KF	ATEX, FM, IECEx Intrinsic Safety
KG	ATEX, CSA, IECEx Intrinsic Safety
KH	FM, CSA, IECEx Intrinsic Safety
KI	FISCO - ATEX, FM, CSA Intrinsic Safety(8)
KJ	FISCO - ATEX, FM, IECEX Intrinsic Safety (8)
KK	FISCO - ATEX, CSA, IECEX Intrinsic Safety(8)
KL	FISCO - FM, CSA, IECEX Intrinsic Safety(8)
Code	**Options**
M1	Integral digital display
P1	Hydrostatic testing(9)
LS	Long stud 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; 5.9 in. (150 mm) for probes 6A and 6B.
T1	Transient Protection Terminal Block (standard with FISCO options)
BR	Mounting Bracket for 1.5 in. NPT Process Connection (RA)(10)
U1	WHG Overfill Approval (pending, consult the factory)
Special Configuration (Software)	
C1	Factory configuration (CDS required with order)
C4	Namur alarm and saturation levels, high alarm
C5	Namur alarm and saturation levels, low alarm
C8	Low alarm(11) (standard Rosemount alarm and saturation levels)
Special Certifications	
Q4	Calibration Data Certification
Q8	Material Traceability Certification per EN 10204 3.1(12)
QG	GOST Primary Verification Certificate
QS	Prior-use certificate of FMEDA Data. Only available with HART 4-20 mA output (output code H).

PlantWeb Diagnostic Functionality	
D01	FOUNDATION fieldbus Diagnostics Suite
DA1	HART Diagnostics Suite
Remote Housing Mounting	
B1	1 m / 3.2 ft. Remote Housing Mounting Cable and Bracket
B2	2 m / 6.5 ft. Remote Housing Mounting Cable and Bracket
B3	3 m / 9.8 ft. Remote Housing Mounting Cable and Bracket

(1) Not available with Flame/Explosion-proof approvals (E1, E3, E5, E6, E7, KA, KB, KC, and KD)
(2) Process seal rating. Final rating depends on flange and O-ring selection..
(3) For other materials, consult factory.
(4) Extra length for fastening is added in the factory.
(5) 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, please round up to an even length when ordering. Probes can be cut to exact length in field. Maximum allowable length is determined by process conditions. See "Mounting Considerations" on page 3-3 for more probe length guidance.
(6) Available in 316L SST. For other materials, consult the factory.
(7) Available in 316L SST (EN 1.4404). For other materials, consult the factory.
(8) Requires Foundation fieldbus signal output (U_i parameter listed in Appendix B: Product Certifications).
(9) Available for flanged connection.
(10) Only for Standard Temperature and Pressure.
(11) The standard alarm setting is high.
(12) Certificate includes all pressure retaining wetted parts.

Example Model String: 5303-H-A-1-S-1-V-6A-M-025-50-AA-I1-M1C1. E-025-05, means 25 ft and 5 in. probe length. M-025-50, means 25.5 m.

SPARE PARTS

Spare parts list Transmitter head Model 5301/5302/5303

Model	Product Description
5301	Guided Wave Radar Liquid Level or Interface Transmitter (interface available for fully submerged probe)
5302	Guided Wave Radar Liquid Level and Interface Transmitter
5303	Guided Wave Radar Solid Level Transmitter
Code	**Signal Output**
H	4-20 mA with HART communication
F	FOUNDATION Fieldbus
Code	**Housing Material**
A	Polyurethane-covered Aluminum
S	Stainless Steel, Grade CF8M (ASTM A743)
Code	**Conduit / Cable Threads**
1	½ - 14 NPT
2	M20 x 1.5 adapter
E	M12, 4-pin, Male connector (eurofast®)(1)
M	A size Mini, 4-pin, Male connector (minifast®)(1)
Code	**Operating Temperature and Pressure**
N	Not Applicable
Code	**Material of Construction: Process Connection / Probe**
0	Not Applicable
Code	**Sealing, O-ring Material (Consult factory for other o-ring materials)**
N	Not Applicable
Code	**Probe Type**
0N	None
Code	**Probe Length Units**
N	Not Applicable
Code	**Total Probe Length (feet/m)**
00	Not Applicable
Code	**Total Probe Length (in./cm)**
00	Not Applicable
Code	**Process Connection - Size / Type (consult the factory for other process connections)**
NA	Not Applicable
Code	**Hazardous Locations Certifications**
NA	No Hazardous Locations Certifications
E1	ATEX Flameproof(3)
E3	NEPSI Flameproof(3)
E5	FM Explosion-proof(3)
E6	CSA Explosion-proof(3)
E7	IECEx Flameproof(3)
I1	ATEX Intrinsic Safety
IA	ATEX FISCO Intrinsic Safety(2)
I3	NEPSI Intrinsic Safety
IC	NEPSI FISCO Intrinsic Safety(2)
I5	FM Intrinsic Safety and Non-Incendive
IE	FM FISCO Intrinsic Safety(2)
I6	CSA Intrinsic Safety

Code	Hazardous Locations Certifications (continued)
IF	CSA FISCO Intrinsic Safety(2)
I7	IECEx Intrinsic Safety
IG	IECEx FISCO Intrinsic Safety(2)
KA	ATEX, FM, CSA Flameproof/Explosion-proof(3)
KB	ATEX, FM, IECEx Flameproof/Explosion-proof(3)
KC	ATEX, CSA, IECEx Flameproof/Explosion-proof(3)
KD	FM, CSA, IECEx Flameproof/Explosion-proof(3)
KE	ATEX, FM, CSA Intrinsic Safety
KF	ATEX, FM, IECEx Intrinsic Safety
KG	ATEX, CSA, IECEx Intrinsic Safety
KH	FM, CSA, IECEx Intrinsic Safety
KI	FISCO - ATEX, FM, CSA Intrinsic Safety(2)
KJ	FISCO - ATEX, FM, IECEX Intrinsic Safety(2)
KK	FISCO - ATEX, CSA, IECEX Intrinsic Safety(2)
KL	FISCO - FM, CSA, IECEX Intrinsic Safety(2)
Code	**Options**
M1	Integral digital display
T1	Transient Protection Terminal Block (standard with FISCO options)
Remote Housing Mounting	
B1	1 m / 3.2 ft. Remote Housing Mounting Cable and Bracket
B2	2 m / 6.5 ft. Remote Housing Mounting Cable and Bracket
B3	3 m / 9.8 ft. Remote Housing Mounting Cable and Bracket
Special Configuration (Software)	
C1	Factory configuration (CDS required with order)
C4	Namur alarm and saturation levels, high alarm
C5	Namur alarm and saturation levels, low alarm
C8	Low alarm (4) (standard Rosemount alarm and saturation levels)
Special Certifications	
Q4	Calibration Data Certification
QG	GOST Primary Verification Certificate
QS	Prior-use certificate of FMEDA Data. Only available with HART 4-20 mA output (output code H).
PlantWeb Diagnostic Functionality	
D01	FOUNDATION fieldbus Diagnostics Suite
DA1	HART Diagnostics Suite

(1) Not available with Flame/Explosionproof approvals (E1, E3, E5, E6, E7, KA, KB, KC, and KD)
(2) Requires Foundation Fieldbus signal output.
(3) Probes are intrinsically safe.
(4) The standard alarm setting is high.

Spare parts list Probe Model 5301/5302/5303

Model	**Product Description**		
5309	Spare probe		
Code	**Signal Output**		
N	Not Applicable		
Code	**Housing Material**		
N	Not Applicable		
Code	**Conduit / Cable Threads**		
N	Not Applicable		
Code	**Operating Temperature and Pressure(1)**		**Probe Type**
S	- 15 psig (-1bar) to 580 psig (40 bar) @ 302 °F (150 °C)		All
H	High Temp / High Pressure(2): 2940 psi @ 752 °F and 5000 psi @ 100 °F (203 bar @ 400 °C and 345 bar @ 38 °C) according to ANSI Class 2500		3A, 3B, 4A, 4U, 4V, 5A and 5B
P	High Pressure(2): 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
C	Cryogenic Temperature(2) (3) -321 °F (-196 °C) 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, 5B (only SST)
Code	**Material of Construction(4): Process Connection / Probe**	**Probe Type**	**Valid Operation Temperature and Pressure**
1	316 L SST (EN 1.4404)	All	S, H, P, C
2	Alloy C-276 (UNS N10276). With plate design if flanged version. Up to class 600, PN 63 for HTHP/HP probes.	3A, 3B, 4A	S, H, P
3	Alloy 400 (UNS N04400). With plate design if flanged version.	3A, 3B, 4A, 5A, 5B	S
7	PTFE covered probe and flange. With plate design.	4A and 5A	S
8	PTFE covered probe.	4A and 5A	S
H	Alloy C-276 (UNS N10276) process connection, flange and probe(5)	3A, 3B, 4A	H, P
Code	**Sealing, O-ring Material (Consult factory for other o-ring materials)**		
N	None(6)		
V	Viton® fluoroelastomer		
E	Ethylene Propylene		
K	Kalrez® 6375 perfluoroelastomer		
B	Buna-N		
Code	**Probe Type**	**Process Connection**	**Probe Lengths**
1A	Rigid Twin Lead(7)	Flange / 1.5 in., 2 in.(7) Thread	Min: 1 ft 4 in. (0.4 m). Max: 9 ft 10 in. (3 m)
2A	Flexible Twin Lead with weight(7)	Flange / 1.5 in., 2 in.(7) Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
3A	Coaxial (for level measurement)(8)	Flange / 1 in.(7), 1.5 in., 2 in.(7) Thread	Min: 1 ft 4 in. (0.4 m). Max: 19 ft 8 in. (6 m)
3B	Coaxial, perforated. For level and interface measurement, or easier cleaning.	Flange / 1 in.(7), 1.5 in., 2 in.(7) Thread	Min: 1 ft 4 in. (0.4 m). Max: 19 ft 8 in. (6 m)
4A	Rigid Single Lead (8 mm)	Flange / 1 in.(7), 1.5 in., 2 in.(7) Thread / Tri-Clamp	Min: 1 ft 4 in. (0.4 m). Max: 9 ft 10 in. (3 m)
4B	Rigid Single Lead (13 mm)(9)	Flange / 1 in., 1.5 in., 2 in. Thread / Tri-Clamp	Min: 1 ft 4 in. (0.4 m). Max: 14 ft 9 in. (4.5 m)
4U	Vapor Single Rigid Probe for 2 in. pipes(10)	Flange / 1.5 in. Thread	Min: 2 ft 5 in. (0.76 m). Max: 13 ft (4 m)

Code	Probe Type	Process Connection	Probe Lengths
4V	Vapor Single Rigid Probe for 3-4 in. pipes(10)	Flange / 1.5 in. Thread	Min: 2 ft 5 in. (0.76 m). Max: 13 ft (4 m)
5A	Flexible Single Lead with weight	Flange / 1 in.(7), 1.5 in., 2 in.(7) Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
5B	Flexible Single Lead with chuck(11)	Flange / 1 in.(7), 1.5 in., 2 in.(7) Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
Code	**Probe Length Units**		
E	English (feet, in.)		
M	Metric (meters, centimeters)		
Code	**Total Probe Length (12) (feet/m)**		
xxx	0-164 ft or 0-50 m		
Code	**Total Probe Length (12) (in./cm)**		
xx	0-11 in. or 0-99 cm		
Code	**Process Connection - Size / Type (consult factory for other process connections)**		
ANSI Flanges(15)			
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		
EN (DIN) Flanges(13)			
HB	DN50, PN40		
HC	DN50, PN63. HTHP / HP units		
HD	DN50, PN100. HTHP / HP units		
HE	DN50, PN160. HTHP / HP units		
HF	DN50, PN250. HTHP / HP units		
IA	DN80, PN16		
IB	DN80, PN40		
IC	DN80, PN64 . HTHP / HP units		

EN (DIN) Flanges(14) (continued)		
ID	DN80, PN100. HTHP / HP units	
IE	DN80, PN160. HTHP / HP units	
IF	DN80, PN250. HTHP / HP units	
JA	DN100, PN16	
JB	DN100, PN40	
JC	DN100, PN64. HTHP / HP units	
JD	DN100, PN100. HTHP / HP units	
JE	DN100, PN160. HTHP / HP units	
JF	DN100, PN250. HTHP / HP units	
KA	DN150, PN16	
JIS Flanges(13)		
UA	50A, 10K	
UB	50A, 20K	
VA	80A, 10K	
VB	80A, 20K	
XA	100A, 10K	
XB	100A, 20K	
YA	150A, 10K	
YB	150A, 20K	
ZA	200A, 10K	
ZB	200A, 20K	
Threaded Connections(15)		**Probe Type**
RA	1 ½ in. NPT thread	All
RB	1 in. NPT thread	3A, 3B, 4A, 4B, 5A, 5B, standard temperature and pressure
RC	2 in. NPT thread	All for standard temperature and pressure
SA	1 ½ in. BSP (G 1 ½ in.) thread	All
SB	1 in. BSP (G 1 in.) thread	3A, 3B, 4A, 4B, 5A, 5B, standard temperature and pressure
Tri-Clamp Fittings(15)		**Probe Type**
FT	1 ½ in. Tri-Clamp	4A, 5A, 5B standard temperature and pressure
AT	2 in. Tri-Clamp	4A, 4B, 5A, 5B standard temperature and pressure
BT	3 in. Tri-Clamp	4A, 4B, 5A, 5B standard temperature and pressure
CT	4 in. Tri-Clamp	4A, 4B, 5A, 5B standard temperature and pressure
Proprietary Flanges		
TF	Fisher - proprietary 316L SST (for 249B cages) Torque Tube Flange	
TT	Fisher - proprietary 316L SST (for 249C cages) Torque Tube Flange	
TM	Masoneilan - proprietary 316L SST Torque Tube Flange	
Special Process Connection		
XX	Special Process Connection	
Code	**Hazardous Locations Certifications**	
NA	Not Applicable	
Code	**Options**	
P1	Hydrostatic testing(16)	
N2	NACE material recommendation per MR 0175 (17)	
LS	Long stud(18) 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; 5.9 in. (150 mm) for probes 6A and 6B.	

Code	Options (continued)	
W2	Short weight for flexible single lead probe(19)	
BR	Mounting Bracket for 1.5 in. NPT Process Connection (RA)(20)	
Centering Discs		**Outer Diameter**
S2	2 in. Centering disc(21)	1.8 in. (45 mm)
S3	3 in. Centering disc(21)	2.7 in. (68 mm)
S4	4 in. Centering disc(21)	3.6 in. (92 mm)
S6	6 in. Centering disc(21)	5.55 in. (141 mm)
S8	8 in. Centering disc(21)	7.40 in. (188 mm)
P2	2 in. Centering disc PTFE(22)	1.8 in. (45 mm)
P3	3 in. Centering disc PTFE(22)	2.7 in. (68 mm)
P4	4 in. Centering disc PTFE(22)	3.6 in. (92 mm)
P6	6 in. Centering disc PTFE(22)	5.55 in. (141 mm)
P8	8 in. Centering disc PTFE(22)	7.40 in. (188 mm)
Special Certifications		
Q8	Material Traceability Certification per EN 10204 3.1(23)	

(1) Process seal rating. Final rating depends on flange and O-ring selection.
(2) Requires option None for sealing (no O-ring).
(3) Welding Procedure Qualification Record Documentation will be supplied.
(4) For other materials, consult the factory.
(5) Consult the factory for this option.
(6) Requires High Temperature High Pressure (code H) or High Pressure (code P) probe.
(7) Only available with standard temperature and pressure (code S).
(8) Requires model 5301.
(9) Available in SST. Consult the factory for other materials.
(10) This is an HTHP probe.
(11) Extra length for fastening is added in factory.
(12) 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, please round up to an even length when ordering. Probes can be cut to exact length in field. Maximum allowable length is determined by process conditions. See "Mounting Considerations" on page 3-3 for more probe length guidance.
(13) Available in 316L SST (EN 1.4404). For other materials consult the factory.
(14) Available in 316L SST (EN 1.4404). For other materials consult the factory.
(15) Available in 316L SST. For other materials consult the factory.
(16) For standard tank connection only available with flange .
(17) For Material SST, Alloy C-276 and Alloy 400; Probe Type 3A, 3B, 4A, 4B, 4U, and 4V.
(18) Not available with PTFE covered probes.
(19) Only for Material of Construction code 1. For other materials, consult the factory.
(20) Only for Standard Temperature and Pressure.
(21) Available for SST and Alloy C-276 probes, type 2A, 4A, 4B, and 5A. Same disc material as probe material.
(22) Available for SST probes, type 2A, 4A, 4B, 5A and 6A except for HTHP.
(23) Certificate includes all pressure retaining wetted metal parts.

Spare parts list Other Spares and Accessories Rosemount 5300 Series

Code	Process Connection - Size/Type (consult factory for other process connections)
Other spares	
03300-7001-0002	Weight kit Flexible Twin lead
03300-7001-0003	Weight kit Flexible 4 mm Single lead
03300-7001-0004	Weight kit Flexible 6 mm Single lead
Other accessories	
03300-7004-0001	Viatec HART Modem and cables (RS 232 connection)
03300-7004-0002	Viatec HART Modem and cables (USB connection)
03300-2001-0001	Mounting Bracket for 1.5 in. NPT Process Connection (RA)
Centering discs(1) (2)	
03300-1655-0001	Kit, 2 in. Centering Disk, SST, Rigid Single
03300-1655-0002	Kit, 3 in. Centering Disk, SST, Rigid Single
03300-1655-0003	Kit, 4 in. Centering Disk, SST, Rigid Single
03300-1655-0004	Kit, 6 in. Centering Disk, SST, Rigid Single
03300-1655-0005	Kit, 8 in. Centering Disk, SST, Rigid Single
03300-1655-0006	Kit, 2 in. Centering Disk, PTFE, Rigid Single
03300-1655-0007	Kit, 3 in. Centering Disk, PTFE, Rigid Single
03300-1655-0008	Kit, 4 in. Centering Disk, PTFE, Rigid Single
03300-1655-0009	Kit, 6 in. Centering Disk, PTFE, Rigid Single
03300-1655-0010	Kit, 8 in. Centering Disk, PTFE, Rigid Single
03300-1655-1001	Kit, 2 in. Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1002	Kit, 3 in. Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1003	Kit, 4 in. Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1004	Kit, 6 in. Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1005	Kit, 8 in. Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1006	Kit, 2 in. Centering Disk, PTFE, Single / Twin Flex Lead
03300-1655-1007	Kit, 3 in. Centering Disk, PTFE, Single / Twin Flex Lead
03300-1655-1008	Kit, 4 in. Centering Disk, PTFE, Single / Twin Flex Lead
03300-1655-1009	Kit, 6 in. Centering Disk, PTFE, Single / Twin Flex Lead
03300-1655-1010	Kit, 8 in. Centering Disk, PTFE, Single / Twin Flex Lead
Remote Housing / Bracket Mounting	
03300-3001-0001	1m / 3.2 ft Remote Housing Mounting Cable and Bracket
03300-3001-0002	2m / 6.5 ft Remote Housing Mounting Cable and Bracket
03300-3001-0003	3m / 9.8 ft Remote Housing Mounting Cable and Bracket
03300-3001-0004	1m / 3.2 ft Remote Housing Mounting Cable
03300-3001-0005	2m / 6.5 ft Remote Housing Mounting Cable
03300-3001-0006	3m / 9.8 ft Remote Housing Mounting Cable
Vented Flanges (3)	
03300-1811-9001	Fisher 249B
03300-1811-9002	Fisher 249C
03300-1811-9003	Masoneilan
Flushing Connection Rings	
DP0002-2111-S6	2 in. ANSI, ¼ in. NPT connection
DP0002-3111-S6	3 in. ANSI, ¼ in. NPT connection
DP0002-4111-S6	4 in. ANSI, ¼ in. NPT connection
DP0002-5111-S6	DN50, ¼ in. NPT connection
DP0002-8111-S6	DN80, ¼ in. NPT connection
Cable Glands	
03300-7000-0001	Cable Gland 8-15mm, 1/2NPT Mo Brass Nickel Plated, KV1
03300-7000-0002	Cable Gland 4-8mm, 1/2NPT Brass, KVE7, EExd
03300-7000-0003	Cable Gland 8-11mm, 1/2NPT Brass, KVE8, EExd
03300-7000-0004	Cable Gland 6-12mm, 1/2 NPT Polyamide Grey

(1) If a centering disc is required for a flanged probe the centering disc can be ordered with options CS or CP in the model code. If a centering disc is required for a threaded connection or as a spare part it should be ordered using the item numbers listed below.
(2) To order a centering disc in a different material, consult the factory.
(3) 1½ in. NPT threaded connection (RA) is required.

Appendix B Product Certifications

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 transmitter 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 transmitter cover in explosive atmospheres when the circuit is alive.

⚠WARNING

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

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

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

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

Any substitution of non-recognized spare parts may jeopardize safety. Repair, for e.g. substitution of components etc. may also jeopardize safety and is under no circumstances allowed.

To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

⚠WARNING

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

Avoid contact with leads and terminals.

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

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.

EU CONFORMITY

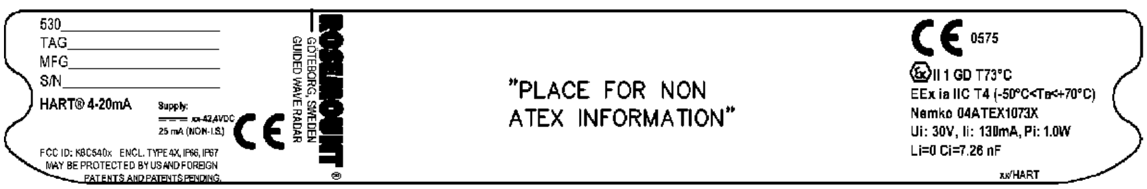
The EC declaration of conformity for all applicable European directives for this product can be found on the Rosemount website at www.rosemount.com. A hard copy may be obtained by contacting our local sales representative.

EUROPEAN ATEX DIRECTIVE INFORMATION

Intrinsic Safety

The Rosemount 5300 Series Guided Wave Radar Level Transmitter that has the following label attached has been certified to comply with Directive 94/9/EC of the European Parliament and the Council as published in the Official Journal of the European Communities No. L 100/1 on 19-April-1994.

Figure B-1. Approval Label ATEX HART model



I1 The following information is provided as part of the label of the transmitter:

- Name and address of the manufacturer (Rosemount).
- CE Conformity Marking

  CE 0575
- Complete model number
- The serial number of the device
- Year of construction
- Marking for explosion protection:

  Ex II 1 GD T73°C
- EEx ia IIC T4 (-50 °C $\leq T_a \leq$ +70 °C)(1)
- 4-20 mA/HART model: U_i=30 V, I_i=130 mA, P_i=1.0 W, C_i=7.26 nF, L_i=0.
- Nemko ATEX certificate number: Nemko 04ATEX1073X
- Installation Drawing: 9240 030-938

Special Conditions for Safe Use (X):

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible areas for Group IIC and Category II 1G according to EN 50284 clause 4.4.3 (4 cm^2). Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to EN 50284 clause 4.3.1 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in category II 1 G.

(1) Other temperature restrictions may apply, please refer to "Specifications" on page A-1.

Figure B-2. Approval Label ATEX Foundation Fieldbus model

I1 The following information is provided as part of the label of the transmitter:

- Name and address of the manufacturer (Rosemount).
- CE Conformity Marking

  0575
- Complete model number
- The serial number of the device
- Year of construction
- Marking for explosion protection:

  II 1 GD T63°C
- EEx ia IIC T4 (-50 °C ≤ T_a ≤ +60 °C)
- FOUNDATION Fieldbus model: U_i=30 Vdc, I_i=300 mA, P_i=1.5 W, C_i=0 nF, L_i=0 H.
- Nemko ATEX certificate number: Nemko 04ATEX1073X
- Installation Drawing: 9240 030-938

Special Conditions for Safe Use (X):

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible areas for Group IIC and Category II 1G according to EN 50284 clause 4.4.3 (4 cm^2). Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to EN 50284 clause 4.3.1 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in category II 1 G.

Figure B-3. Approval Label
ATEX FISCO model

IA The following information is provided as part of the label of the transmitter:

- Name and address of the manufacturer (Rosemount).
- CE Conformity Marking

  0575
- Complete model number
- The serial number of the device
- Year of construction
- Marking for explosion protection:

  II 1 GD T63˚C
- EEx ia IIC T4 (-50 °C $\leq T_a \leq$ +60 °C)
- FISCO model: U_i=17.5 Vdc, I_i=380 mA, P_i=5.32 W, L_i=C_i=0.
- Nemko ATEX certificate number: Nemko 04ATEX1073X
- Installation Drawing: 9240 030-938

Special Conditions for Safe Use (X):

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible areas for Group IIC and Category II 1G according to EN 50284 clause 4.4.3 (4 cm^2). Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to EN 50284 clause 4.3.1 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in category II 1 G.

Flameproof

The Rosemount 5300 Series Guided Wave Radar Level Transmitter that has the following label attached has been certified to comply with Directive 94/9/EC of the European Parliament and the Council as published in the Official Journal of the European Communities No. L 100/1 on 19-April-1994.

Figure B-4. Approval Label ATEX HART model

E1 The following information is provided as part of the label of the transmitter:

- Name and address of the manufacturer (Rosemount).
- CE Conformity Marking

  CE 0575

- Complete model number
- The serial number of the device
- Year of construction
- Marking for explosion protection:

  II 1/2 GD T73°C

- EEx iad IIC T4 (-40 °C<T_a< +70 °C)
- Nemko ATEX certificate number: Nemko 04ATEX1073X
- U_m=250 VAC

Special Conditions for Safe Use (X):

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible areas for Group IIC and Category II 1G according to EN 50284 clause 4.4.3 (4 cm^2). Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to EN 50284 clause 4.3.1 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in category II 1 G.

Figure B-5. Approval Label
ATEX Foundation Fieldbus

E1 The following information is provided as part of the label of the transmitter:

- Name and address of the manufacturer (Rosemount).
- CE Conformity Marking

  CE 0575

- Complete model number
- The serial number of the device
- Year of construction
- Marking for explosion protection:

  II 1/2 GD T63°C

- EEx iad IIC T4 (-40 °C<T_a< +60 °C)
- Nemko ATEX certificate number: Nemko 04ATEX1073X
- U_m=250 VAC

Special Conditions for Safe Use (X):

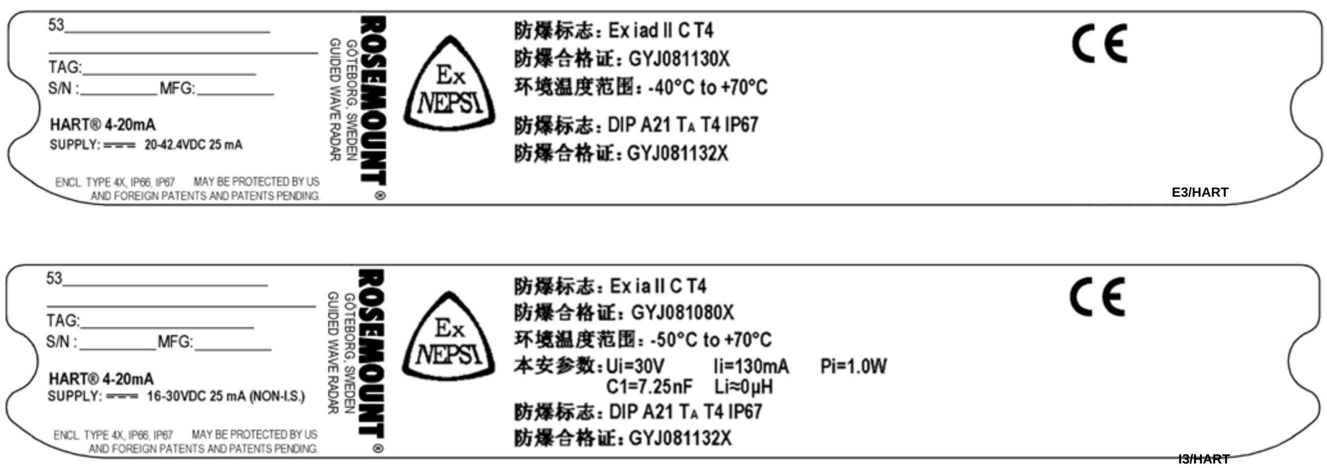
The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible areas for Group IIC and Category II 1G according to EN 50284 clause 4.4.3 (4 cm^2). Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to EN 50284 clause 4.3.1 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in category II 1 G.

NATIONAL SUPERVISION AND INSPECTION CENTER FOR EXPLOSION PROTECTION AND SAFETY OF INSTRUMENTATION (NEPSI) APPROVALS

Figure B-6. Approval Label National Supervision and Inspection Center for Explosion Protection and Safety of Instrumentation (NEPSI) HART Model



E3 Flameproof:

Ex iad IIC T4 (- 40 °C < T_a < + 70 °C)

I3 Intrinsically Safe:

- Ex ia IIC T4 (- 50 °C < T_a < + 70 °C)
- 4-20 mA / HART model: U_i = 30 V, I_i = 130 mA, P_i = 1.0 W, C_i = 7.25 nF, Li ~ 0 μH

Special Conditions for Safe Use (X):

Refer to Certificates: GYJ081080X for Ex ia IIC T4 and GYJ081130X for Ex iad IIC T4.

Figure B-7. Approval Label National Supervision and Inspection Center for Explosion Protection and Safety of Instrumentation (NEPSI) Foundation Fieldbus Model

E3 Flameproof:

- Ex iad IIC T4 (- 40 °C < T_a < + 60 °C)

I3 Intrinsically Safe:

- Ex ia IIC T4 (- 50 °C < T_a < + 60 °C)
- U_i = 30 V, I_i = 300 mA, P_i = 1.5 W, C_i ~ 0 nF, Li ~ 0 μH

Special Conditions for Safe Use (X):

Refer to Certificates: GYJ081080X for Ex ia IIC T4 and GYJ081130X for Ex iad IIC T4.

Figure B-8. Approval Label National Supervision and Inspection Center for Explosion Protection and Safety of Instrumentation (NEPSI) FISCO Model

IC The following information is provided as part of the label of the transmitter:

- Ex ia IIC T4 (- 50 °C < T_a < + 60 °C)
- U_i = 17.5 V, I_i = 380 mA, P_i = 5.32 W, C_i ~ 0 nF, L_i ~ 0 μH

Special Conditions for Safe Use (X):

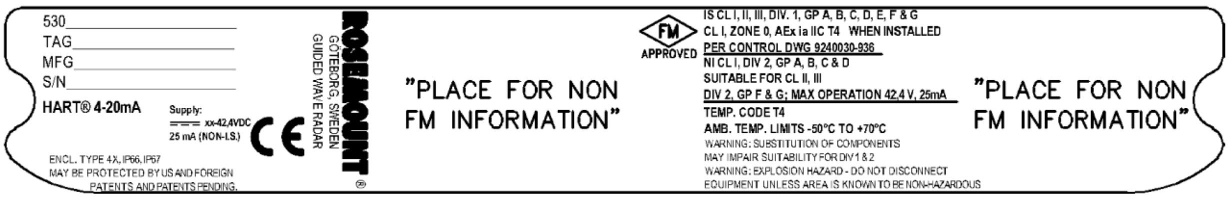
Refer to Certificates: GYJ081080X for Ex ia IIC T4 and GYJ081130X for Ex iad IIC T4.

FACTORY MUTUAL (FM) APPROVALS

The Rosemount 5300 Series Guided Wave Radar Level Transmitter that have the following labels attached have been certified to comply with the requirements of the approval agencies noted.

Intrinsic Safety

Figure B-9. Approval Labels Factory Mutual (FM) HART model



I5 Intrinsically Safe for Class I, II, III, Division 1, Groups A, B, C, D, E, F and G.
Class I, Zone 0, AEX ia IIC T4 when installed per Control Drawing: 9240030-936.

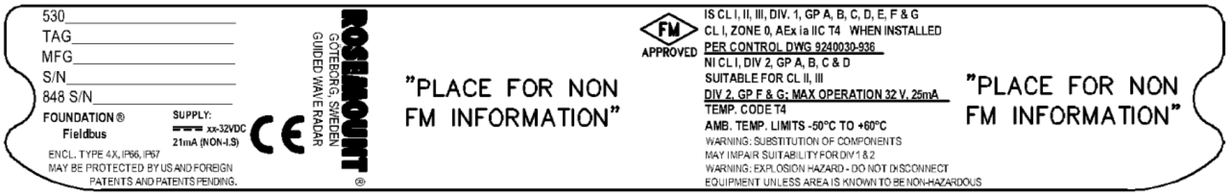
Non-incendive for Class I, Division 2, Groups A, B, C and D.

Suitable for Class II, III, Division 2, Groups F and G.

4-20 mA/HART model: U_i=30 V, I_i=130 mA, P_i=1.0 W, C_i=7.26 nF, L_i=0.
Max operation 42.4 V, 25 mA.

Temperature code T4.
Ambient Temperature Limits: -50 °C to + 70 °C.

Figure B-10. Approval Labels Factory Mutual (FM) Foundation Fieldbus model



I5 Intrinsically Safe for Class I, II, III, Division 1, Groups A, B, C, D, E, F and G.
Class I, Zone 0, AEX ia IIC T4 when installed per Control Drawing: 9240030-936.

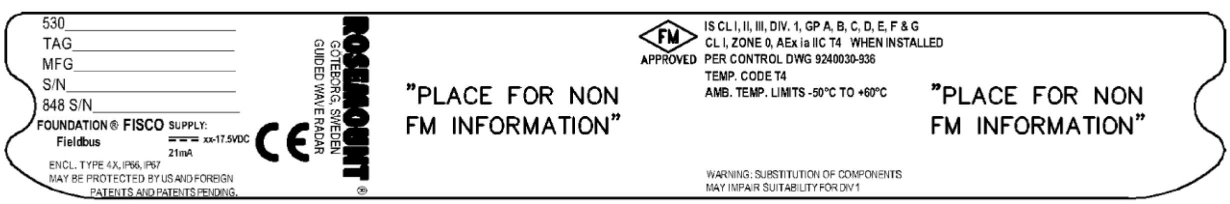
Non-incendive for Class I, Division 2, Groups A, B, C and D.

Suitable for Class II, III, Division 2, Groups F and G;

FOUNDATION Fieldbus model: U_i=30 Vdc, I_i=300 mA, P_i=1.3 W, C_i=0 nF, L_i=0 H. Max operation 32 V, 25 mA.

Temperature code T4.
Ambient Temperature Limits: -50 °C to + 60 °C

Figure B-11. Approval Labels Factory Mutual (FM) FISCO model



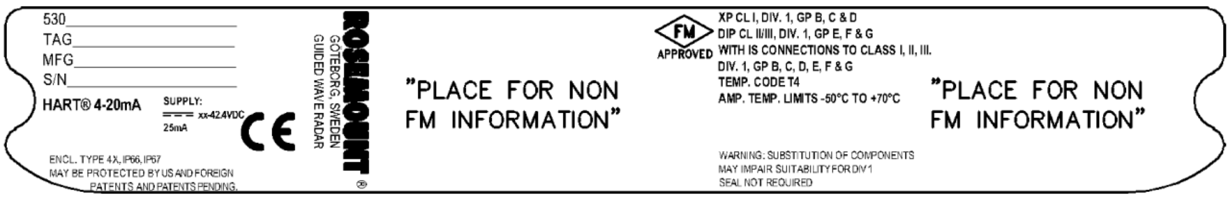
IE Intrinsically Safe for Class I, II, III, Division 1, Groups A, B, C, D, E, F and G.
Class I, Zone 0, AEX ia IIC T4 when installed per Control Drawing: 9240030-936.

FISCO model: U_i=17.5 Vdc, I_i=380 mA, P_i=5.32 W, L_i=C_i=0.

Temperature code T4.
Ambient Temperature Limits: -50 °C to + 60 °C

Explosion Proof

Figure B-12. Approval Labels Factory Mutual (FM) HART model



E5 Explosion-Proof for Class I, Division 1, Groups B, C and D.

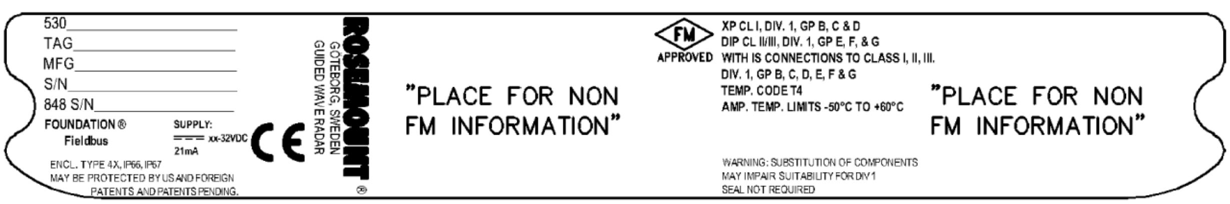
Dust-Ignition proof for Class II/III, Division 1, Groups E, F and G with intrinsically safe connections to Class I, II, III, Div 1, Groups B, C, D, E, F and G.

Temperature code T4.

Ambient temperature limits: -50 °C to + 70 °C.

Seal not required.

Figure B-13. Approval Label Factory Mutual (FM) Foundation Fieldbus model



E5 Explosion-Proof for Class I, Division 1, Groups B, C and D.

Dust-Ignition proof for Class II/III, Division 1, Groups E, F and G with intrinsically safe connections to Class I, II, III, Div 1, Groups B, C, D, E, F and G.

Temperature code T4.

Ambient temperature limits: -50°C to + 60°C.

Seal not required.

CANADIAN STANDARDS ASSOCIATION (CSA) APPROVAL

This product meets the Dual Seal Requirements of ANSI/ISA 12.27.01-2003.

Dual seal annunciation

The breach of the secondary seal is annunciated via product leakage from the antenna's vents. The leakage will be visible and/or audible from the transmitter head's threads.

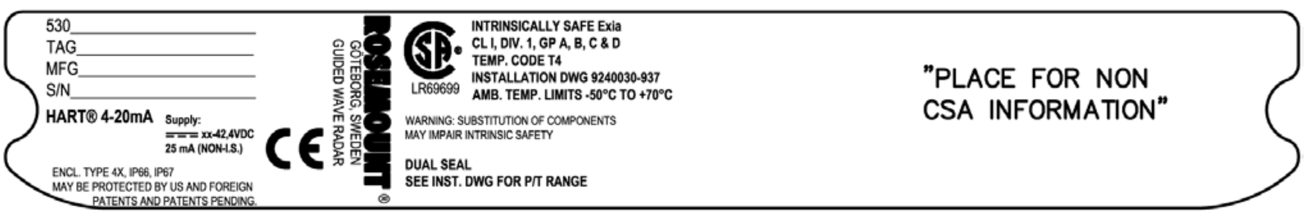
Dual seal maintenance

No maintenance required. Verify proper operation by keeping leak path free from ice or contamination.

Cert. no. 1514653.

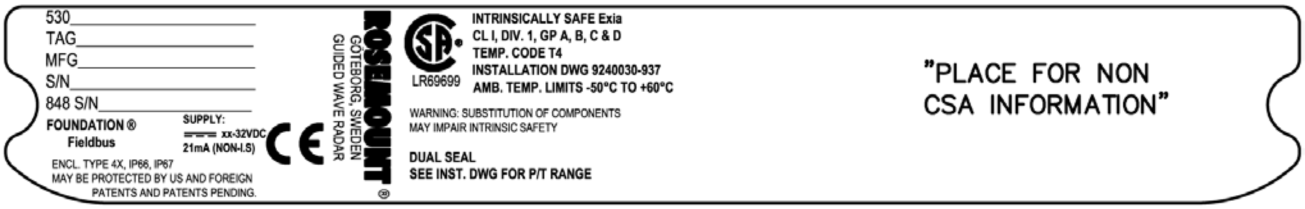
Intrinsic Safety

Figure B-14. Approval Label Canadian Standards Association (CSA) HART model



I6 Intrinsically Safe Ex ia.
Class I, Division 1, Groups A, B, C and D.
Temperature code T4.
4-20 mA/HART model: U_i=30 V, I_i=130 mA, P_i=1.0 W, C_i=7.26 nF, L_i=0 H.
Installation Drawing: 9240 030-937.
Ambient temperature limits: -50 °C to + 70 °C.

Figure B-15. Approval Label Canadian Standards Association (CSA) Foundation Fieldbus model



I6 Intrinsically Safe Ex ia.

Class I, Division 1, Groups A, B, C and D.

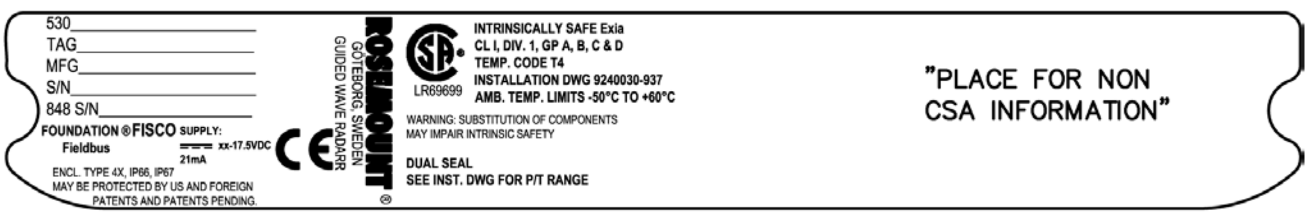
Temperature code T4.

FOUNDATION Fieldbus model: U_i=30 Vdc, I_i=300 mA, P_i=1.3 W, C_i=0 nF, L_i=0 H.

Control Drawing: 9240 030-937.

Ambient temperature limits: -50 °C to + 60 °C

Figure B-16. Approval Label Canadian Standards Association (CSA) FISCO model



IF Intrinsically Safe Ex ia.

Class I, Division 1, Groups A, B, C and D.

Temperature code T4.

FISCO model: U_i=17.5 Vdc, I_i=380 mA, P_i=5.32 W, C_i=0 nF, L_i=0 H.

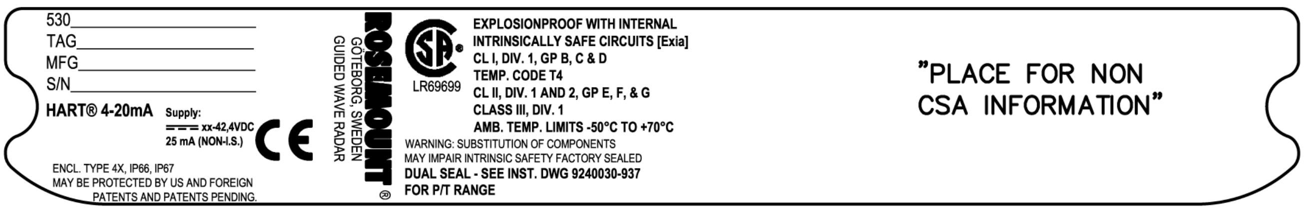
Control Drawing: 9240 030-937.

Ambient temperature limits: -50 °C to + 60 °C

Explosion Proof

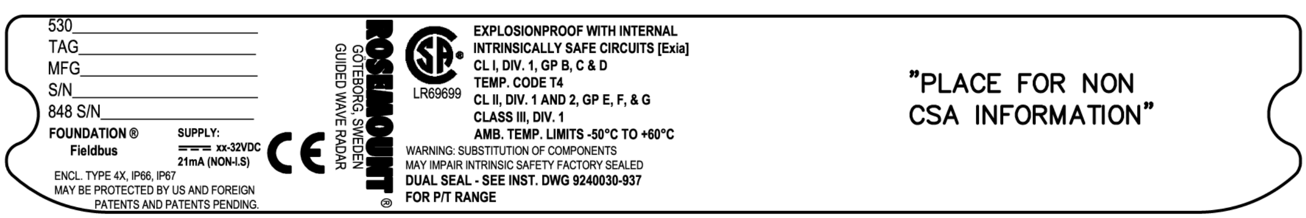
Cert. no. 1514653.

Figure B-17. Approval Label Canadian Standards Association (CSA) HART model



E6 Explosion-proof with internal Intrinsically Safe Circuits [Exia].
Class I, Div. 1, Groups B, C and D.
Temperature Code T4.
Class II, Div. 1 and 2, Groups E, F and G;
Class III, Div. 1
Ambient temperature limits -50 °C to +70 °C.
Factory sealed.

Figure B-18. Approval Label Canadian Standards Association (CSA) Foundation Fieldbus model

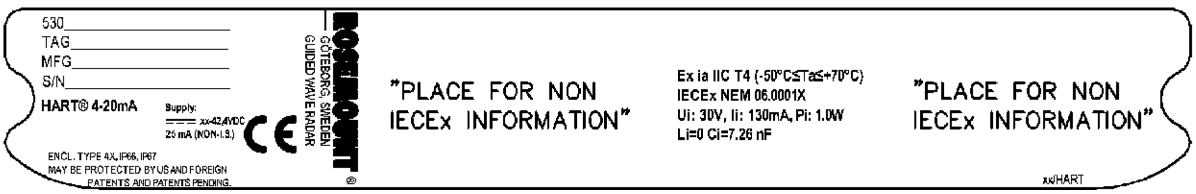


E6 Explosion-proof with internal Intrinsically Safe Circuits [Exia].
Class I, Div. 1, Groups B, C and D.
Temperature Code T4.
Class II, Div. 1 and 2, Groups E, F and G;
Class III, Div. 1
Ambient temperature limits -50 °C to +60 °C.
Factory sealed.

IECEX APPROVAL

Intrinsic Safety

Figure B-19. Approval Label
IECEx HART model



I7 Intrinsically Safe

Ex ia IIC T4 (T_{amb} = -50 °C to +70 °C)(1).

IECEx NEM 06.0001X.

4-20 mA/HART: U_i=30 V, I_i=130 mA, P_i=1 W, C_i=7.26 nF, L_i=0 mH.

Installation Drawing: 9240 030-938.

Conditions of Certification

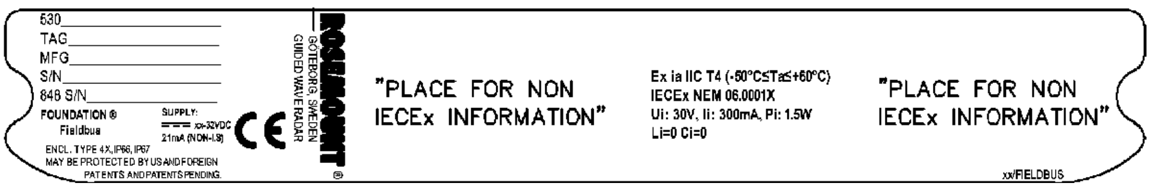
The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible area for Group IIC accoring to IEC 60079-01 clause 7.3: 20 cm^2 for Zone 1 and 4 cm^2 for Zone 0. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to IEC 60079-0 clause 8.1.2 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in Zone 0.

(1) Other temperature restrictions may apply, please refer to "Specifications" on page A-1.

Figure B-20. Approval Label IECEx Foundation Fieldbus model



I7 Intrinsically Safe

Ex ia IIC T4 (T_{amb} = -50 °C to +60 °C).

IECEx NEM 06.0001X.

FOUNDATION Fieldbus: U_i=30 V, I_i=300 mA, P_i=1.5 W, C_i=0 nF, L_i=0 mH.

Installation Drawing: 9240 030-938.

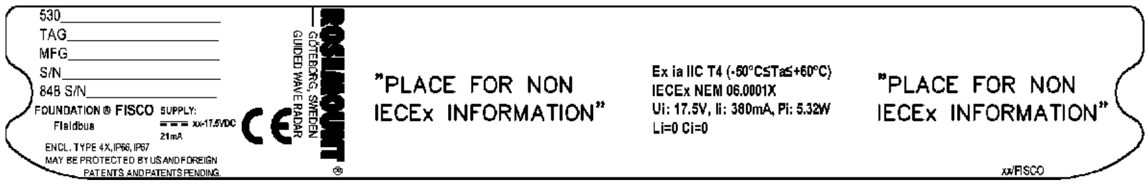
Conditions of Certification

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible area for Group IIC accoring to IEC 60079-01 clause 7.3: 20 cm^2 for Zone 1 and 4 cm^2 for Zone 0. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to IEC 60079-0 clause 8.1.2 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in Zone 0.

Figure B-21. Approval Label
IECEx FISCO model



IG Intrinsically Safe

Ex ia IIC T4 (T_{amb} = -50 °C to +60 °C).

IECEx NEM 06.0001X.

FISCO: U_i=17.5 V, I_i=380 mA, P_i=5.32 W, C_i=0 nF, L_i=0 mH.

Installation Drawing: 9240 030-938.

Conditions of Certification

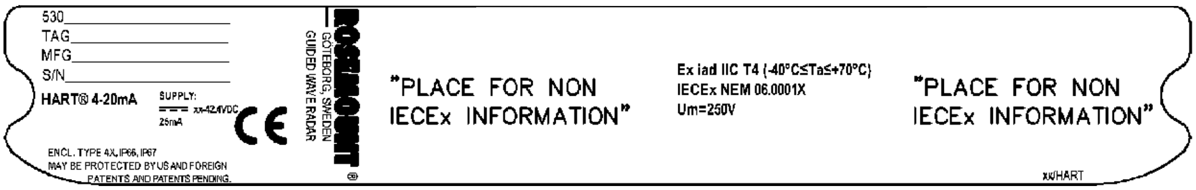
The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible area for Group IIC accoring to IEC 60079-01 clause 7.3: 20 cm^2 for Zone 1 and 4 cm^2 for Zone 0. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to IEC 60079-0 clause 8.1.2 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in Zone 0.

Flameproof

Figure B-22. Approval Labels
IECEx HART



E7 Flameproof

Ex iad IIC T4 (T_{amb} :-40° C to +70 °C).

IECEx NEM 06.0001X.

U_m=250 VAC

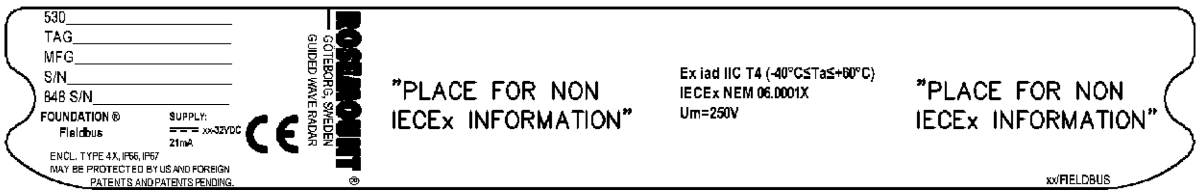
Conditions of Certification

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible area for Group IIC accoring to IEC 60079-01 clause 7.3: 20 cm^2 for Zone 1 and 4 cm^2 for Zone 0. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to IEC 60079-0 clause 8.1.2 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in Zone 0.

Figure B-23. Approval Labels
IECEx Foundation Fieldbus



E7 Flameproof

Ex iad IIC T4 (T_{amb} :-40° C to +60 °C).

IECEx NEM 06.0001X.

U_m=250 VAC

Conditions of Certification

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible area for Group IIC accoring to IEC 60079-01 clause 7.3: 20 cm^2 for Zone 1 and 4 cm^2 for Zone 0. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to IEC 60079-0 clause 8.1.2 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in Zone 0.

COMBINATION APPROVALS

KA ATEX, FM, CSA Flameproof/Explosion-proof

KB ATEX, FM, IECEx Flameproof/Explosion-proof

KC ATEX, CSA, IECEx Flameproof/Explosion-proof

KD FM, CSA, IECEx Flameproof/Explosion-proof

KE ATEX, FM, CSA Intrinsic Safety

KF ATEX, FM, IECEx Intrinsic Safety

KG ATEX, CSA, IECEx Intrinsic Safety

KH FM, CSA, IECEx Intrinsic Safety

KI FISCO - ATEX, FM, CSA Intrinsic Safety

KJ FISCO - ATEX, FM, IECEX Intrinsic Safety

KK FISCO - ATEX, CSA, IECEX Intrinsic Safety

KL FISCO - FM, CSA, IECEX Intrinsic Safety

APPROVAL DRAWINGS

This section contains FM Approvals System Control Drawing and Canadian Standards Association and IECEx/ATEX Installation Drawings. You must follow the installation guidelines presented in order to maintain certified ratings for installed transmitters.

This section contains the following drawings:

Rosemount drawing 9240030-936:

System Control Drawing for hazardous location installation of intrinsically safe FM approved apparatus.

Rosemount drawing 9240030-937:

Installation Drawing for hazardous location installation of CSA approved apparatus.

Rosemount drawing 9240030-938:

Installation Drawing for hazardous location installation of ATEX and IECEx approved apparatus.

Figure B-24. System Control Drawing for hazardous location installation of intrinsically safe FM approved apparatus.

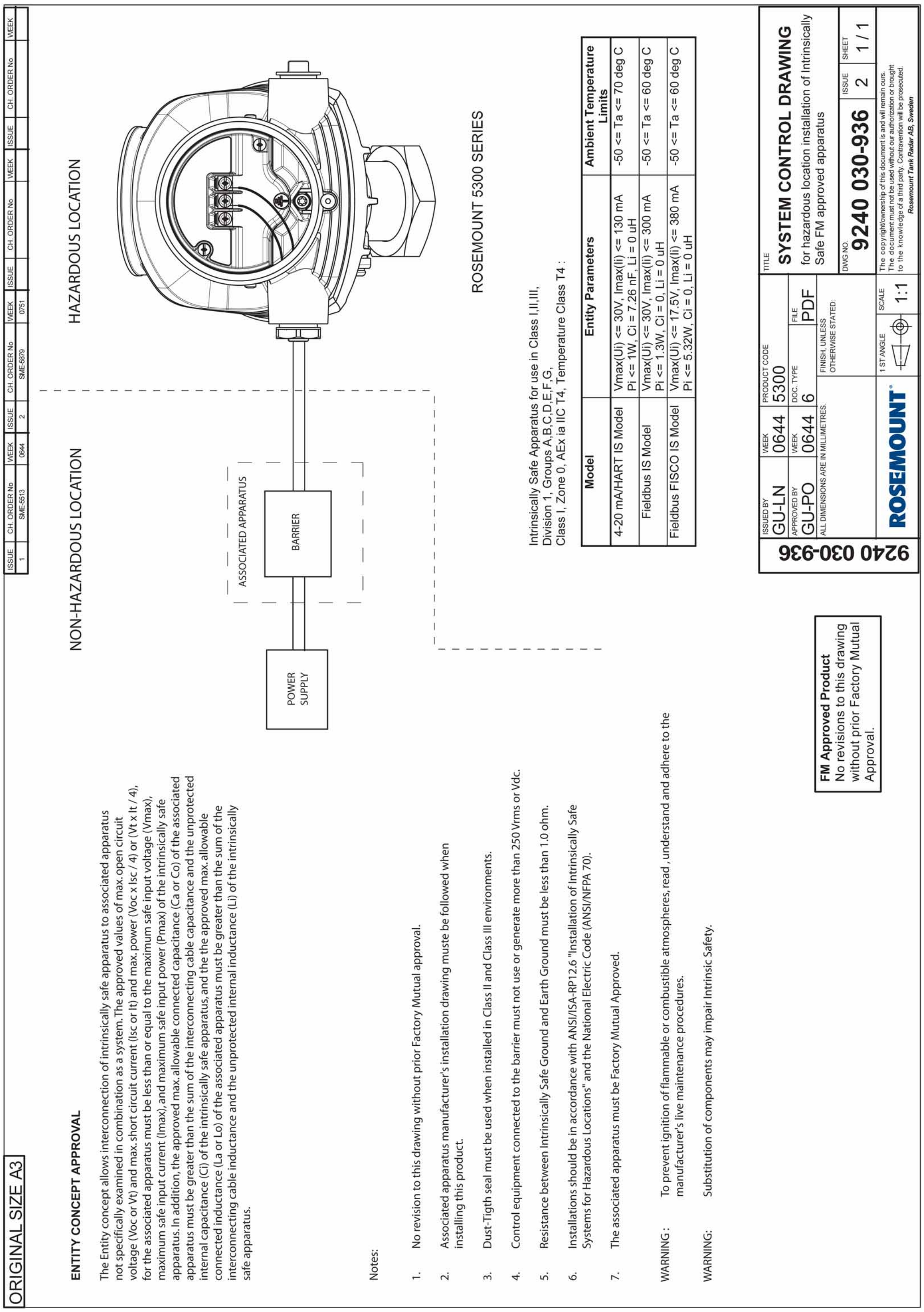
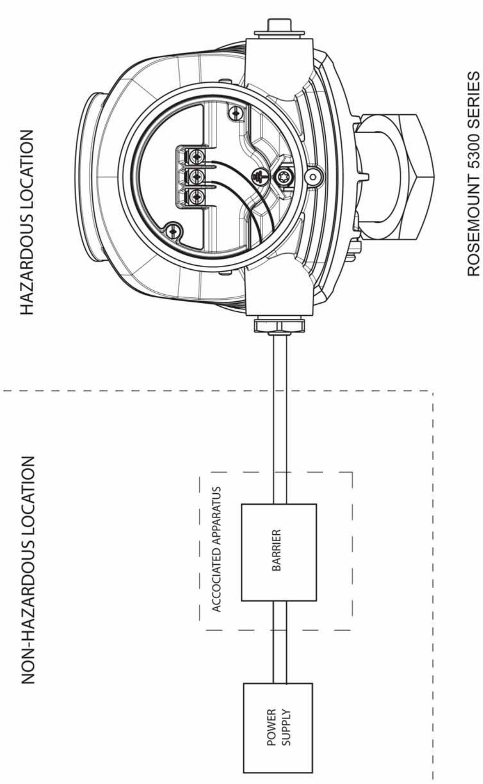


Figure B-25. Installation Drawing for hazardous location installation of intrinsically safe CSA approved apparatus.

ORIGINAL SIZE A3

ISSUE	CH. ORDER No	WEEK	ISSUE	CH. ORDER No	WEEK	ISSUE	CH. ORDER No	WEEK	ISSUE	CH. ORDER No	WEEK
1	SME-5514	0644	2	SME-5983	0840						

EX-CERTIFIED PRODUCT.
No modifications permitted
without reference to the
Ex-certifying Authorities.



ROSEMOUNT 5300 SERIES

ENTITY CONCEPT APPROVAL

The Entity concept allows interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in combination as a system. The approved values of maximum open circuit voltage (Voc) and maximum short circuit current (Isc) and maximum output power (or Voc x Isc / 4), for the associated apparatus must be less than or equal to the maximum safe input voltage (Ui), maximum safe input current (Ii), and maximum safe input power (Pi) of the intrinsically safe apparatus. In addition, the approved maximum allowable connected capacitance (Ca) of the associated apparatus must be greater than the sum of the interconnecting cable capacitance and the unprotected internal capacitance (Ci) of the intrinsically safe apparatus, and the approved maximum allowable connected inductance (La) of the associated apparatus must be greater than the sum of the interconnecting cable inductance and the unprotected internal inductance (Li) of the intrinsically safe apparatus.

Intrinsically Safe Ex ia
Class I, Division 1, Groups A,B,C and D, Temperature Code T4 :

Model	Entity Parameters	Ambient Temperature Limits
4-20 mA/HART IS Model	Vmax <= 30V, Imax <= 130 mA Pi <= 1W, Ci = 7.3 nF , Li = 0 uH	-50 <= Ta <= 70 deg C
Fieldbus IS Model	Vmax <= 30V, Imax <= 300 mA Pi <= 1.3W, Ci = 0, Li = 0 uH	-50 <= Ta <= 60 deg C
Fieldbus FISCO IS Model	Vmax <= 17.5V, Imax <= 380 mA Pi <= 5.32W, Ci = 0, Li = 0 uH	-50 <= Ta <= 60 deg C

Notes :

1. Entity parameters listed (for HART/Fieldbus Model) apply only to associated apparatus with linear output.
2. Control equipment connected to the barrier must not use or generate more than 250 Vrms or Vdc.
3. Installations should be in accordance with ANSI/ISA-RP12.6 "Installations of Intrinsically Safe Systems for Hazardous Locations" and the Canadian Electric Code.
4. This product meets the Dual Seal Requirements of ANSI/ISA 12.27.01. No additional process sealing is required. For the in-service limits applicable to a specific model, see Process Pressure/Temperature range in Appendix A of the Reference manual.

9240 030-937

ISSUED BY	WEEK	PRODUCT CODE	
GU-LN	0644	5300	
APPROVED BY	WEEK	DOC. TYPE	FILE
GU-PO	0644	6	PDF

ALL DIMENSIONS ARE IN MILLIMETRES.
FINISH, UNLESS OTHERWISE STATED:
1 ST ANGLE
SCALE 1:1
ROSEMOUNT

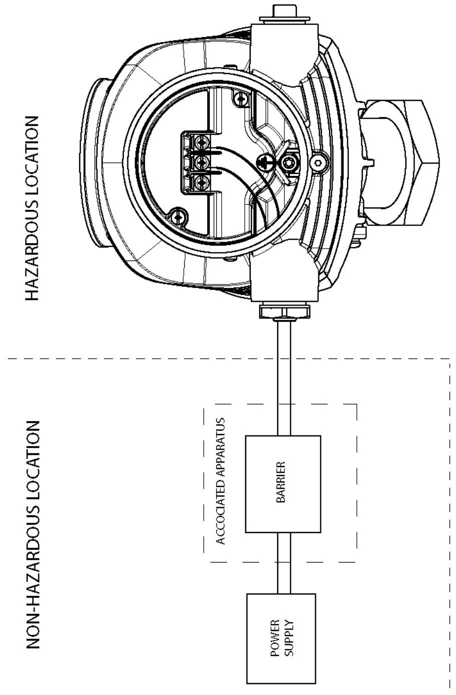
TITLE
INSTALLATION DRAWING
for hazardous location installation
of CSA approved apparatus

DWG NO. **9240 030-937** ISSUE 2 SHEET 1 / 1

Figure B-26. Installation Drawing for hazardous location installation of intrinsically safe ATEX and IECEx approved apparatus.

ORIGINAL SIZE A3

ISSUE	CH. ORDER No	WEEK	ISSUE	CH. ORDER No	WEEK	ISSUE	CH. ORDER No	WEEK	ISSUE	CH. ORDER No	WEEK
1	SME-5515	0644									



ROSEMOUNT 5300 SERIES

SPECIAL CONDITIONS FOR SAFE USE (X) :

A) The apparatus is not capable of withstanding the 500V test as defined in clause 6.4.12 of EN 50020. This must be considered during installation!

B) The transmitter enclosure is made of aluminium. Impact and friction hazards need to be considered when the transmitter is used in category II 1 G according to EN 50284 clause 4.3.1.

C) 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.

INTRINSICALLY SAFE INSTALLATIONS

The approved values of maximum open circuit voltage (Uo) and maximum short circuit current (Io) and maximum output power (or Uo x Io / 4), for the associated apparatus must be less than or equal to the maximum safe input voltage (Ui), maximum safe input current (Ii), and maximum safe input power (Pi) of the intrinsically safe apparatus. In addition, the approved maximum allowable connected capacitance (Co) of the associated apparatus must be greater than the sum of the interconnecting cable capacitance and the unprotected internal capacitance (Ci) of the intrinsically safe apparatus, and the approved maximum allowable connected inductance (Lo) of the associated apparatus must be greater than the sum of the interconnecting cable inductance and the unprotected internal inductance (Li) of the intrinsically safe apparatus.

Intrinsic Safety Parameters (EEx ia IIC T4) :

Model	Parameters	Ambient Temperature Limits
4-20 mA/HART IS Model	Ui <= 30V, Ii <= 130 mA Pi <= 1W, Ci = 7.26 nF, Li = 0	-50 <= Ta <= 70 deg C
Fieldbus IS Model	Ui <= 30V, Ii <= 300 mA Pi <= 1.5W, Ci = 0, Li = 0	-50 <= Ta <= 60 deg C
Fieldbus FISCO IS Model	Ui <= 17.5V, Ii <= 380 mA Pi <= 5.32W, Ci = 0, Li = 0	-50 <= Ta <= 60 deg C

Notes :

1. Safety parameters listed (for HART/Fieldbus Model) apply only to associated apparatus with linear output.
2. Control equipment connected to the barrier must not use or generate more than 250 Vrms or Vdc.

EX-CERTIFIED PRODUCT.
No modifications permitted without reference to the Ex-certifying Authorities.

9240 030-938

ISSUED BY	WEEK	PRODUCT CODE		TITLE
GU-LN	0644	5300		**INSTALLATION DRAWING** for hazardous location installation of ATEX and IECEx approved apparatus
APPROVED BY GU-PO	WEEK 0644	DOC. TYPE 6	FILE PDF	
ALL DIMENSIONS ARE IN MILLIMETRES.		FINISH, UNLESS OTHERWISE STATED:		DWG NO. **9240 030-938** ISSUE 1 SHEET 1 / 1
ROSEMOUNT		1 ST ANGLE	SCALE 1:1	The copyright/ownership of this document is and will remain ours. The document must not be used without our authorization or brought to the knowledge of a third party. Contravention will be prosecuted. *Rosemount Tank Radar AB, Sweden*

Appendix C Advanced Configuration

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 transmitter 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 transmitter cover in explosive atmospheres when the circuit is alive.

⚠WARNING

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

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

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

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

Any substitution of non-recognized spare parts may jeopardize safety. Repair, for e.g. substitution of components etc. may also jeopardize safety and is under no circumstances allowed.

To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

⚠WARNING

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

Avoid contact with leads and terminals.

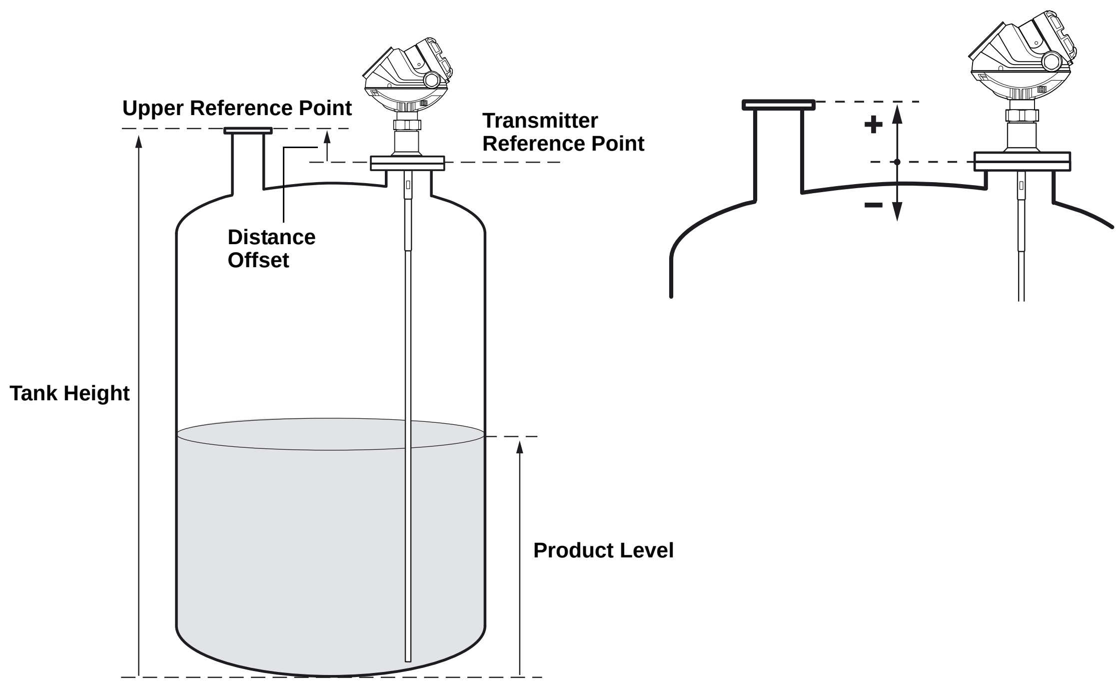
Make sure the mains power to the Radar Transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

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.

USER DEFINED UPPER REFERENCE POINT

An Upper Reference Point other than the standard Transmitter Reference Point can be specified by setting the *Calibration Offset* parameter as illustrated in Figure C-1:

Figure C-1. The Upper Reference Point can be specified by using the Distance Offset parameter.



To set the desired upper reference point:

1. Adjust the **Tank Height** to the distance from the tank bottom to the desired **Upper Reference Point**.
2. Add the distance between the **Upper Reference Point** and the **Transmitter Reference Point** to the **Distance Offset** value that is stored in the transmitter database.

   With a 375 Handheld Communicator the Distance Offset is available as HART Fast Key sequence [2, 3, 2, 4, 2].

   FOUNDATION Fieldbus parameter:
   TRANSDUCER 1100>GEOM_OFFSET_DIST

   The Distance Offset is also available in RRM:

   a. Click the **Tank** icon under Device Config/Setup in the RRM workspace.
   b. In the *Tank* window, select the *Geometry* tab.
   c. Click the **Advanced** button.

HANDLING OF DISTURBANCES FROM NOZZLE

Trim Near Zone

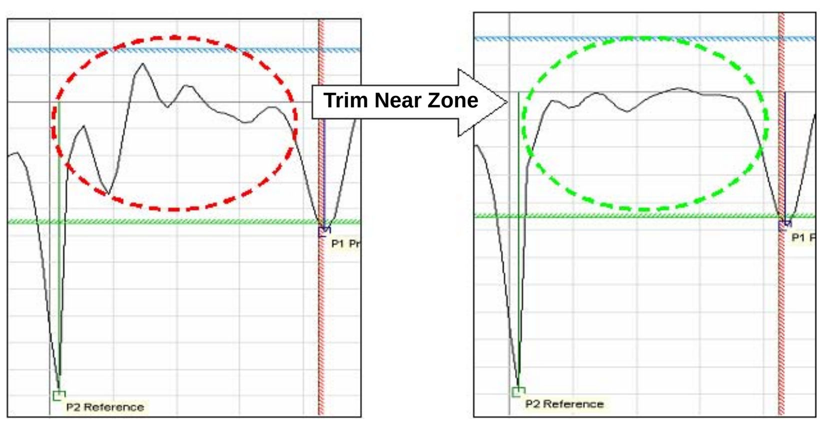
Using the Trim Near Zone Function

For transmitters using the Guided Wave Radar technology the performance In the Near Zone (referred to as the region between 0-3.3 ft. (0-1 m) below the Upper Reference Point) is normally somewhat limited. However, the Rosemount 5300 transmitter is equipped with a software functionality that minimizes the Upper Transition Zone. The factory setting is normally sufficient and doesn't need to be repeated after installation.

However, since the setting is optimized depending on actual installation, further trimming may be necessary in the case of unfavorable conditions. An example is if there are disturbing obstacles in the Near Zone. Trimming means that the measurement performance in the Near Zone is maintained even under these conditions and prevents false echo indication.

NOTE!
Make sure that the product level is below the Near Zone region (0-3.3 ft. (0-1 m) below the Upper Reference Point) before performing the Trim Near Zone.

Figure C-2. Echo Curve before and after Trim Near Zone.

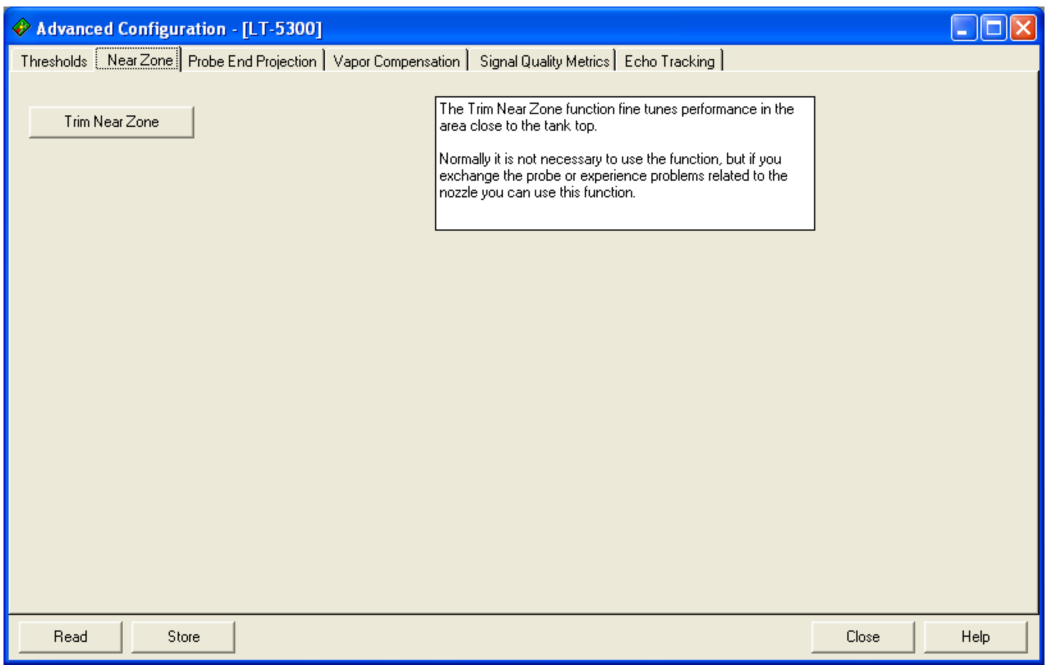


NOTE!
The Trim Near Zone function should only be used for reducing impact from stationary disturbances. It is not suitable for occasional disturbances.

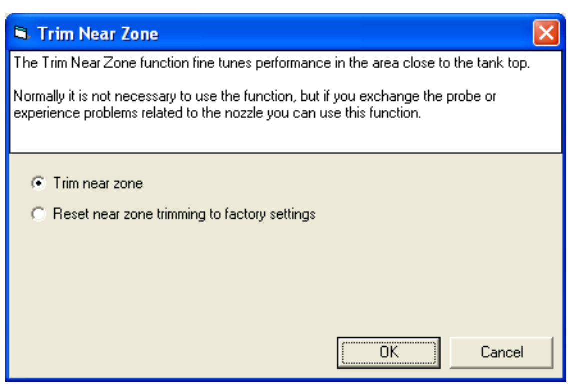
Trim Near Zone can be done in RRM. The function can be reached from **Device Specific Configuration** in the **Guided Setup** (if the command is recommended) or from the **Advanced Configuration** window, *Trim Near Zone* tab.

NOTE!
Note that for firmware version 2.A2 the Trim Near Zone is not possible in combination with Narrow Nozzles, as defined below:
50 mm< Nozzle height ≤ 300 mm
Nozzle diameter ≤ 2 in. for all single probes except 13 mm single rigid
Nozzle diameter ≤ 3 in. for 13 mm single rigid

Figure C-3. Trim Near Zone using RRM.



1. Click **Trim Near Zone**.



2. Select Trim near zone and click **OK**.
3. Click OK in the appearing dialog.
4. Wait 1 minute.
5. Restart the transmitter.

NOTE!
The Trim Near Zone function can be reset by selecting *Reset near zone trimming to factory settings* in the previous dialog.

In 375 Field Communicator, the Trim Near Zone is reached with the [2, 1, 7, 2] HART sequence (if the command is recommended) or from the [2, 7, 1] HART sequence.

Wait 1 minute and restart the transmitter.

Changing the Upper Null Zone

Measurements are not performed within the Upper Null Zone (UNZ). By setting the UNZ parameter to zero, measurements can be performed in the region close to the flange (Near Zone).

If there are measurement problems in the upper part of the tank, you may use the Trim Near Zone function as described above.

If the desired measurement range is below the Near Zone, or if disturbing objects are located below the Near Zone, the Upper Null Zone parameter can be used to avoid measurements above a certain level.

To set the Upper Null Zone with a 375 Field Communicator:

1. Select the HART command [2, 1, 2, 3].
2. Select the Upper Null Zone option.
3. Enter the desired value.

To set the Upper Null Zone with RRM:

1. Start RRM.
2. Click the **Tank** icon in the Device Config/Setup toolbar.
3. Select the **Probe** tab in the *Tank* window.
4. Type the desired value in the Upper Null Zone field.
5. Click the OK button. Now the Upper Null Zone is stored in the transmitter memory.

Figure C-4. Upper Null Zone.

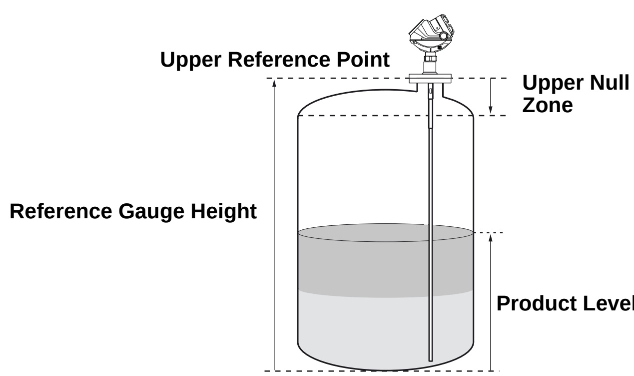
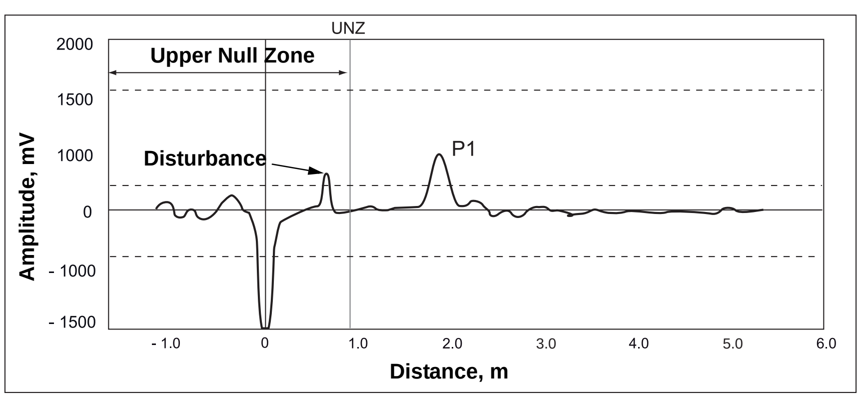


Figure C-5. Identifying the Upper Null Zone in the Echo Curve plot

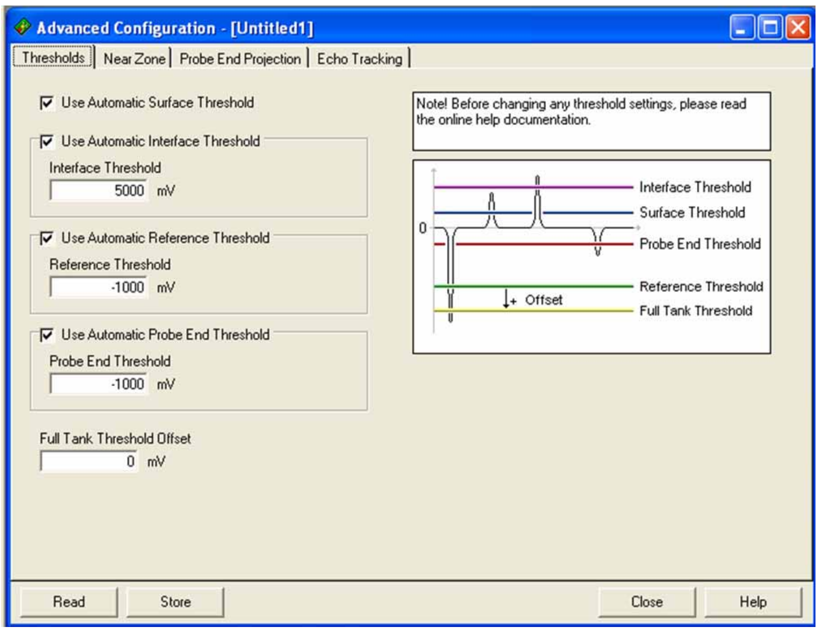


THRESHOLD SETTINGS

Measurement with the Rosemount 5300 is based on the fact that the radar signal pulses are 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. Normally, 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 in rare cases be necessary to adjust the amplitude thresholds for optimum measurement performance. 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 C-6. Threshold settings in RRM.



Automatic threshold settings are enabled by default. In the *Advanced Configuration* window the *Interface*, *Reference*, *Probe End* and *Full Tank* thresholds can also 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. See “Using the Echo Curve Analyzer” on page 7-10 for more information on how to use the ATC.

The Surface threshold can also be manually set by using the **Set Threshold** function in the *Echo Curve Analyzer/Configuration* Mode window (see *“The Configuration Mode Tab” on page 7-11*).

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 (see "Dielectric Constant Settings" on page C-14), this threshold may need to be adjusted to make sure that the probe end pulse is properly detected.

Full Tank Threshold Offset

The Full Tank threshold is related to the Reference Threshold, and can be used for detecting 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 normally be set so that 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

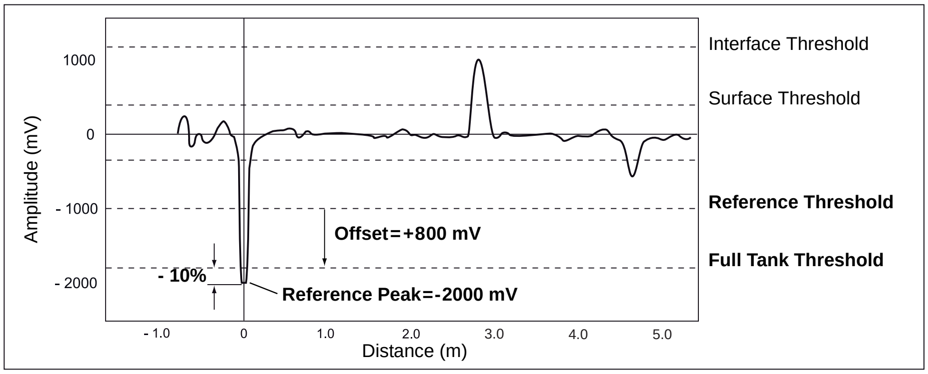
In the example below, the following assumptions are made (note the negative sign):

Reference Echo peak amplitude = -2000 mV
Reference Threshold = -1000 mV

The target position for the Full Tank Threshold is at 10% below the Reference Echo peak amplitude. In this example, it means that the Full Tank Threshold should be located at 10% below the Reference peak at -2000 mV:
-2000 mV - (-200 mV)= -1800 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:
Full Tank Threshold Offset = -1000 mV - (-1800 mV) = +800 mV.

Figure C-7. Example of how to specify the Full Tank Threshold



By default, this value is 0 (function is not used). This is because highly contaminated or condensed tank-seals, and turbulent or boiling surfaces, which can cause splashing, may cause function to be triggered.

PROBE END PROJECTION

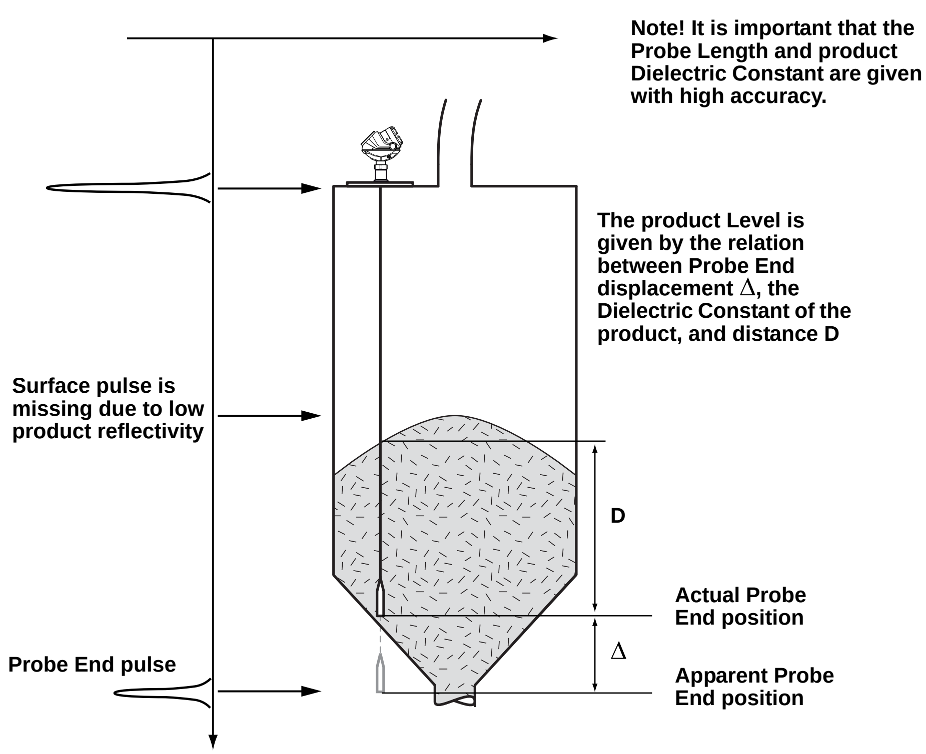
Probe End Projection allows you to measure product level when the surface pulse is too weak to be detected. For example, long measuring range and products with very poor reflectivity (low dielectric constant).

A product with very low reflectivity is characterized by its low dielectric constant. Such a product reflects relatively small amounts of the microwave energy emitted from the Rosemount 5300 transmitter, and most of it is transmitted through the product. Consequently, situations may occur where the surface pulse is invisible to the transmitter at long measuring ranges. The Probe End Projection function in the Rosemount 5300 transmitter makes it possible to carry out accurate measurements even under such circumstances.

When the microwaves emitted by the Rosemount 5300 transmitter propagate through the product in the tank, the Probe End pulse appears to be located below the actual probe end. The apparent displacement of the Probe End pulse is a consequence of the reduced propagation speed of the measurement signal through the product compared to the speed through air. The displacement of the Probe End pulse can be observed by using the Echo Curve Analyzer in the Rosemount Radar Master (see *"Using the Echo Curve Analyzer" on page 7-10*).

For products with very low dielectric constants the product surface level can be determined by comparing the actual probe end position as given by the Probe Length value, with the apparent position of the Probe End pulse. The difference is related to the properties of the product, i.e. the **Dielectric Constant**, and the distance **D** travelled by the measurement signal through the product, see Figure C-8.

Figure C-8. The properties of the product makes the probe end pulse appear to be below the actual probe end.



Probe End Projection is used to :

- Use the probe end echo as reference, in case the surface echo is lost, to calculate the surface echo position
- Use the probe end echo as reference when the surface echo is close to the probe end to enhance accuracy of the surface echo position

NOTE!
This function is only available for Liquid/solid product **level** measurement modes (i.e. not available for interface or fully submersed interface measurement modes) and a well defined probe end echo (i.e. ensure that the probe end/centering disc/weight is either always in contact with the tank wall or never in contact with the tank wall).

NOTE!
Assure that the Tank settings; Mounting Type, Probe Type, and Probe Length have been assigned correct values before continuing.

Probe End Projection can be configured using a guide. When the tank is empty, the guided setup will be able to accurately calibrate probe end offset and probe end pulse polarity. You will be asked to insert an initial value for the Product DC. This is the value for the product dielectric constant that the device uses as a start point for estimation. This value must be as accurate to the actual value of the dielectric constant as possible.

When the tank is filled, the guided setup will be able to estimate the Product DC. This value is used as an initial value for future estimation of the Product DC.

For best performance, complete the guided setup with an empty tank and then a second time with a filled tank, but do not overwrite the empty tank calibration.

Probe End Projection can be configured in RRM. This function can be reached from the **Device Specific Configuration** in the Guided Setup (if the configuration is recommended) or from the **Advanced Configuration** window, *Probe End Projection* tab. Click **Guided Probe End Projection Setup** to start the configuration.

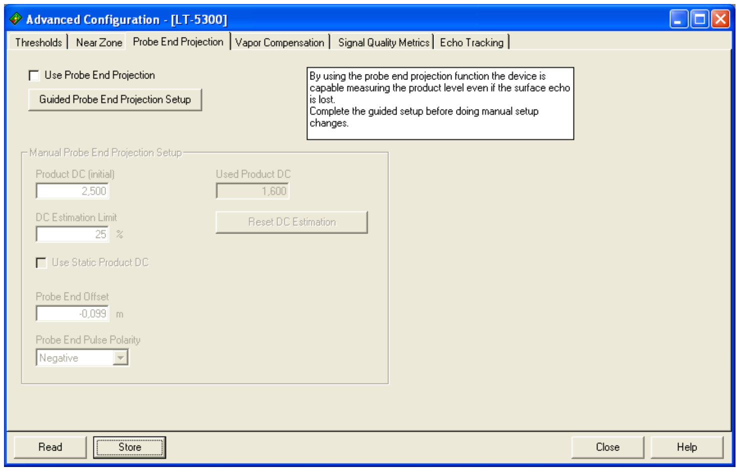
Figure C-9. Probe End Projection setup.

In 375 Field Communicator, the Device Specific Configuration is reached with sequence [2, 1, 7, 2] (if the configuration is recommended) or from the sequence: [2, 7, 2].

Optional configurations:

DC Estimation Limit: This is a limit for the product dielectric constant estimation. The limit is a percentage, saying how much the estimated product DC is allowed to differ from the initial product DC value. If the estimation goes outside this limit, a warning will be generated.

Used Product DC: This is the estimated product dielectric constant that the device will use for Probe End Projection.



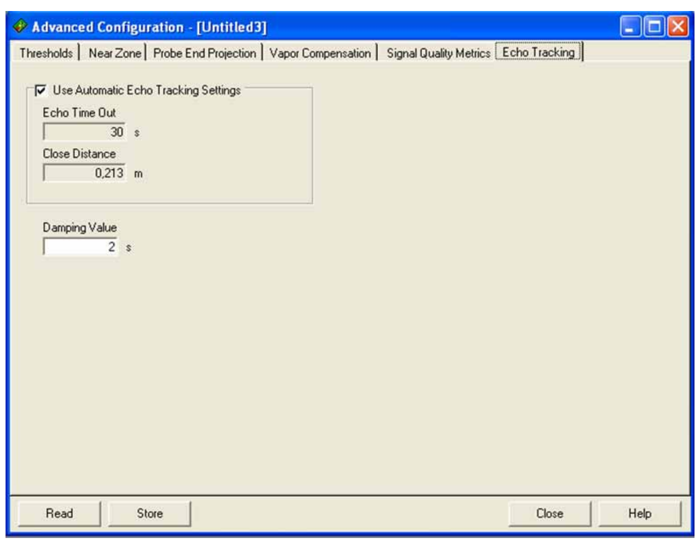
Reset DC Estimation: Resets DC estimation to the configured initial value, forcing the device to start over estimating the product DC.

Use Static Product DC: Check this setting if you do not want the device to estimate the product DC. This will force the device to use the configured initial product DC.

ECHO TRACKING

Measurement with the Rosemount 5300 is based on the fact that the radar signal pulses are reflected by the product surface. Different parameters are used to track the measurement signal to achieve a reliable and stable measurement. Normally, the echo tracking parameters are automatically set by the 5300 transmitter, and no manual settings are needed. However, due to the properties of the product, in rare cases it may be necessary to adjust the echo tracking settings for optimum measurement performance. RRM supports echo tracking settings in the **Advanced Configuration** window, *Echo Tracking* tab.

Figure C-10. Echo Tracking in RRM.



Automatic echo tracking settings are enabled by default. In the Advanced Configuration window the Echo Tracking settings Echo Timeout and Close Distance can be also be set manually.

Use Automatic Echo Tracking Settings

When this check-box is selected, the transmitter automatically sets the echo tracking parameters to a constant value based on the configured tank environment and measurement mode.

Echo Timeout: defines the time in seconds before the device should start to search for a surface echo outside the Close Distance window after it was lost. After an echo was lost, the device does not start searching (or set Invalid Level) until the specified time has elapsed. In some applications, especially with solid products or applications with foam, the surface echo may disappear for periods of time. This value can be increased to prevent the device from entering alarm mode too early after the surface is lost.

Close Distance: defines a window centred at the current surface position where new surface echo candidates can be selected. The size of the window is ±Close Distance. Echoes outside this window will not be considered as surface echoes. The device will without delay jump to the strongest echo within this window. This value can be increased if there are rapid level changes in the tank. If the value is too large the device might select an invalid echo as the surface echo.

Damping

The Damping parameter defines how fast the device reacts to a change of the level value (step response). A high value makes the level steady but the device reacts slowly to level changes in the tank. A low value makes the device react quickly to level changes but the presented level value can be somewhat jumpy. The default value is 2 seconds. Note that increasing the damping value will also prolong the system response time. The damping value can also be changed from the **Output**, *General* tab.

DIELECTRIC CONSTANT SETTINGS

Static Vapor Compensation

In some applications, there is heavy vapor above the product surface having a significant influence on the level measurement, for example, in the case of saturated water steam under high pressure. In such cases, the vapor dielectric can be entered to compensate for this effect.

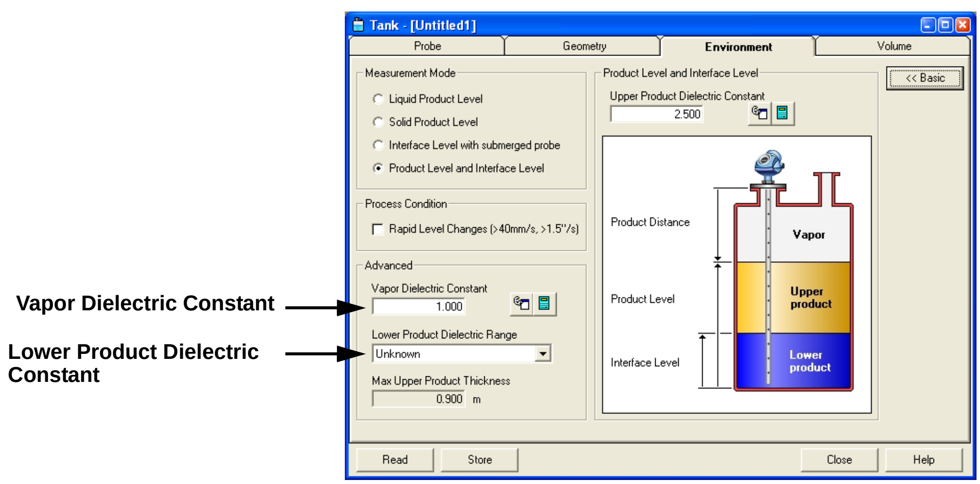
For applications with a varying pressure and/or temperature, certain models of the Rosemount 5300 Series have a built-in function that automatically compensates for varying vapor dielectric constants. See "Dynamic Vapor Compensation" on page C-15.

The default value is equal to 1 which corresponds to the dielectricity of vacuum. Normally this value does not need to be changed since the effect on measurement performance is very small for most vapors.

To change the Vapor Dielectric Constant:

1. Start RRM.
2. Click the Tank icon in the RRM workspace, or choose Tank from the Setup menu.
3. Select the Environment tab and click the Advanced button.

Figure C-11. Dielectric constants can be adjusted in the Tank Environment window.



4. Type the desired value in the Vapor Dielectric Constant field. You may also use the Vapor Dielectric Calculator or the Vapor Dielectric Chart to find the correct value.

Lower Product

If the dielectric constant of the lower product is significantly smaller than the dielectric constant of water, you may need to adjust the Lower Product Dielectric Range, see Figure C-11.

Special adjustments can also be made by trimming the appropriate amplitude thresholds. See section "Interface Pulse not Found" on page 7-8 for further information.

DYNAMIC VAPOR COMPENSATION

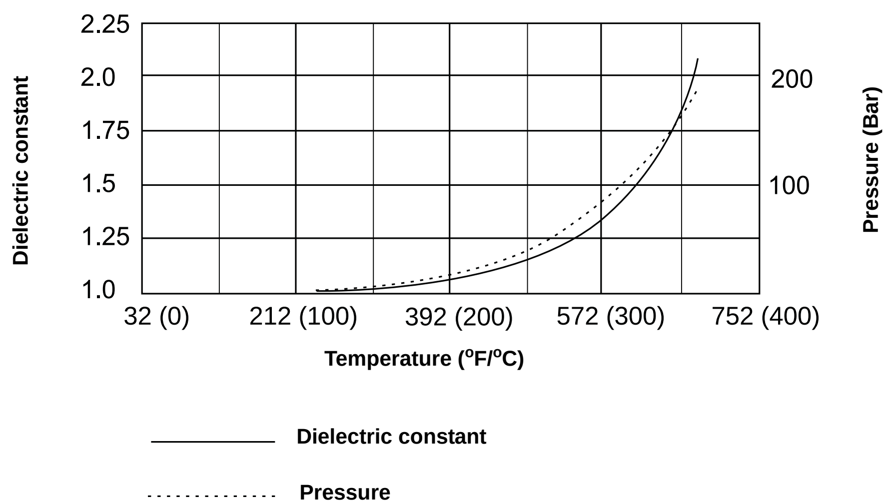
Rosemount 5300 Series is based on the Time Domain Reflectometry (TDR) technology where low power nanosecond microwave pulses are guided down a probe submerged in the process media. When a radar pulse reaches a media with a different dielectric constant, part of the energy is reflected to the transmitter. The time difference between the transmitted pulse and the reflected pulse is converted into a distance from which the total level or interface level is calculated.

For radar level gauging, the actual measured quantity is the propagation time through the empty space between the radar level transmitter and the liquid surface. For typical radar level transmitter accuracy, the propagation speed of the radar signal should be close to the velocity of light in vacuum. However, in some important cases, the deviation is not negligible and must be taken into account for accuracy. High tank pressure in combination with certain gases is an example.

High pressure water steam can influence radar level transmitter measurements. This is due to the high pressure as well as the polar structure of water molecules. In such cases, the Rosemount 5300 Series Level transmitter can be configured for compensation for this effect.

Water has high critical temperature and pressure (705 ºF / 374 ºC and 140 bar, respectively). Level measurement may not be possible above these limits. However, some applications, such as power plants, may use water near the limits. In a closed vessel containing water liquid and water vapor, existing databases (referred to as a Mollier diagram) have been used to calculate pressure and vapor density, and deduce the dielectric constant of the vapor from this. The dielectric constant changes as given in Figure C-12.

Figure C-12. Dielectric constant versus temperature for saturated water vapor.



The standard version of a Rosemount 5300 Series level transmitter can be configured for static compensation of vapor by manually entering the dielectric constant of vapor, see “Dielectric Constant Settings” on page C-14. For applications with a varying pressure and/or temperature, certain models of the Rosemount 5300 Series have a built-in function (Dynamic Vapor Compensation) that automatically compensates for varying vapor dielectric constants.

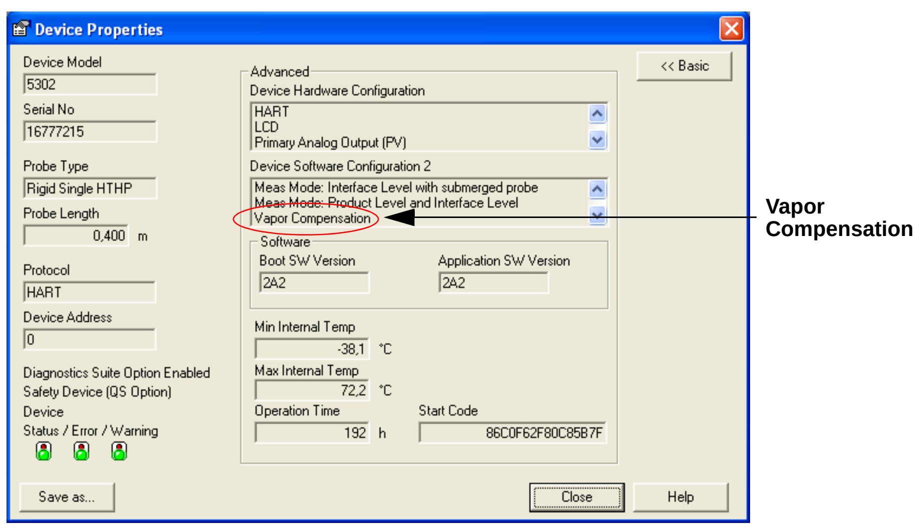
The Rosemount 5300 uses a reference reflector mounted on the probe at a certain distance to estimate the dielectric constant of the vapor. The transmitter knows where the reference reflector pulse should have been if there were no vapor present. However, since there is vapor in the tank, the reference reflector pulse will appear beyond the actual reflector point. The distance between the actual reflector point and the apparent reflector point will be used to calculate the vapor dielectric constant. The calculated dielectric constant is then dynamically used to compensate for changes in vapor dielectric constant and eliminates the need to do any compensation in the control system.

To check if the Dynamic Vapor Compensation function is supported, do one of the following:

- If probe type 4U or 4V is mentioned in the model code on the label, the device supports Vapor Compensation.
  Model Code: 530xxxxxxx**4U**xxxxxxxxx or 530xxxxxxx**4V**xxxxxxxxx

- In RRM:
  1. Connect to the device.
  2. Right click on the device and select **Properties**.

Figure C-13. Check if Dynamic Vapor Compensation is supported.



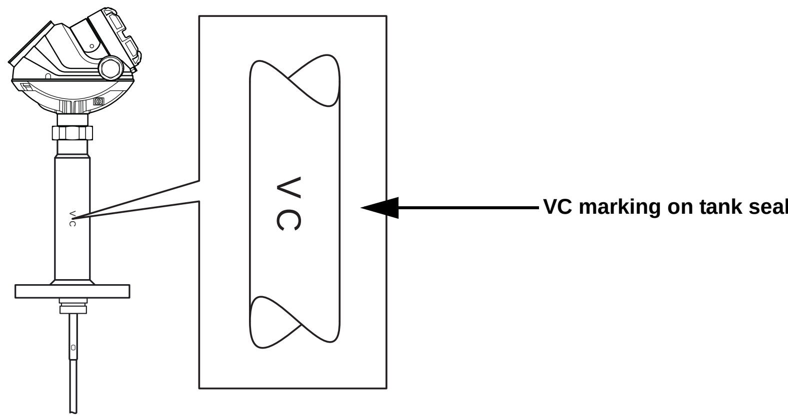
  3. If "Vapor Compensation" is mentioned in the *Device Software Configuration 2* list, the device supports Vapor Compensation.

- In 375 Field Communicator, if Vapor Compensation is supported, it can be found with the [3, 2, 2, 1] HART sequence

NOTE!
Vapor compensation is supported for Product Level measurement mode only.

NOTE!
Single Rigid HTHP equipped with reference reflector is the only probe that supports vapor compensation. The probe is marked “VC” as shown in Figure C-14.

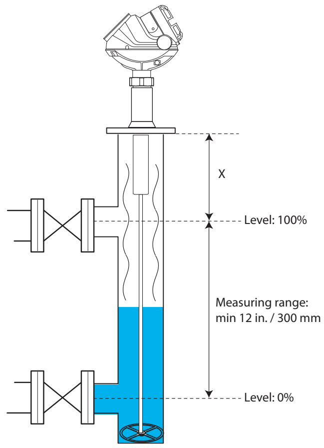
Figure C-14. Single Rigid HTHP with VC marking on the probe.



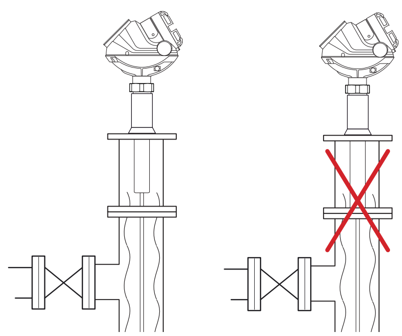
- Probes up to 13.1 ft (4 m) length are supported
- Pipe / Chamber is the only supported mounting type. Supported pipe inner diameters are 2, 3, and 4 in. (5, 7.5, and 10 cm)
- Probe End Projection is disabled when vapor compensation is enabled
- Trim near zone shall not be used when dynamic vapor compensation is used.

Dynamic Vapor Compensation requires a minimum distance from the flange to the surface level to measure the change in the vapor dielectric constant. If the level rises within this area, the unit switches over to static compensation, using the last known vapor dielectric constant. This minimum distance is 17.3 in. (440 mm) for probe length < 6.6 ft (2 m), and 28 in. (710 mm) for probe length > 6.6 ft (2 m) (see X in figure below), to dynamically compensate up to level 100%. The minimum measuring range for this functionality is 12 in. (300 mm).

Figure C-15. Minimum requirements.



If a 5300 Series transmitter is ordered from Rosemount together with a 9901 Chamber, these space requirements are met. If an existing chamber is used, which does not meet these space requirements, a spool piece can be added. For an installation with a spool piece, it is important to make sure that the reference reflector and the spool piece do not have the same length. The spool piece needs to be at least 2 in. (50 mm) longer or shorter.



If a spool piece is used, it is important that the reference reflector and the spool piece do not have the same length.

Installation Setup

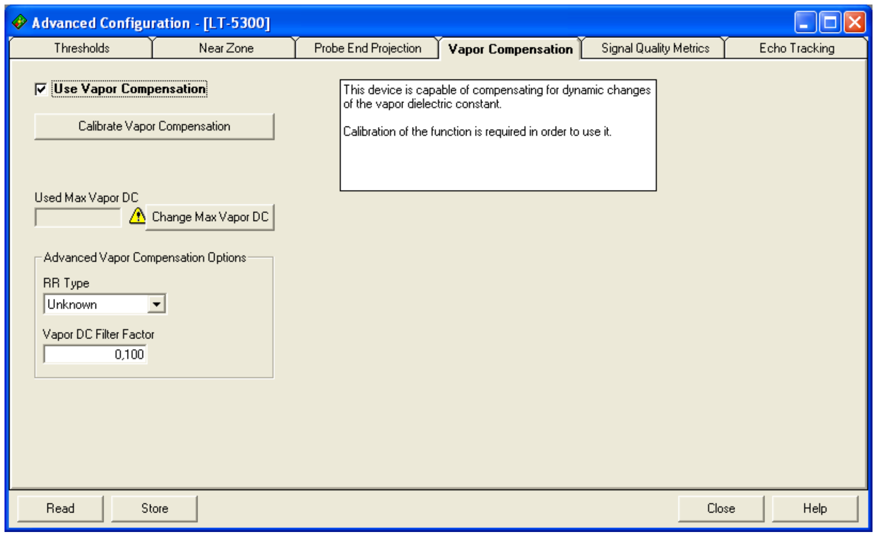
It is important that the vapor compensation function is calibrated after installation. Before calibration:

- The surface level must be at least 19.7 in. (0.5 m) below the end of the reflector (It is recommended to empty the pipe/chamber.)
- Perform the calibration at ambient pressure and temperature conditions, i.e. when the vapor dielectric constant is close to 1.0

To calibrate Dynamic Vapor Compensation:

1. Either choose **Device Specific Configuration** in the Guided Setup (if the configuration is recommended) or **Setup, Advanced.**
2. Select the *Vapor Compensation* tab.

Figure C-16. Calibrate Dynamic Vapor Compensation.



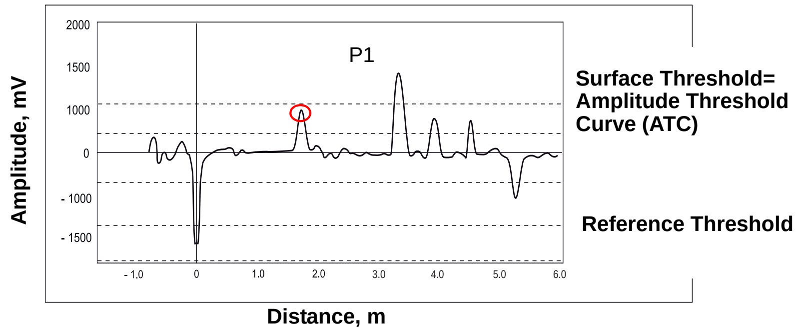
3. Click the **Calibrate Vapor Compensation** button.
4. Make sure *Use Vapor Compensation* is selected.
5. The echo from the reference reflector end can be viewed in the Echo Curve in RRM. Probes shorter than 6.6 ft. (2 m) will have the reflector end at 0.75 ft. (0.23 m) distance and probes longer than 6.6 ft. (2 m) will have the reflector end at 1.6 ft. (0.5 m).
6. Cycle power to finish.

In 375 Field Communicator, the calibration can be done by HART command [2, 7, 3].

SIGNAL QUALITY METRICS

Signal Quality Metrics indicates the surface signal integrity compared to the noise. It can be used to schedule maintenance to clean the probe or detect and monitor turbulence, boiling, foam and emulsions.

Figure C-17. Echo curve showing surface peak amplitude, noise peak amplitude, and surface threshold.



The following diagnostics measurements are available:

Signal Quality is a measurement of the surface peak amplitude (P1) compared to the surface threshold (ATC) and the smallest marginal between the noise and the ATC above the surface (indicated with a circle) compared to the ATC.

The Signal Quality spans from 0 to 10, where 0 indicates a low margin, and 10 indicates a high margin. It indicates how much margin there is until the noise peak is indicated as the surface level.

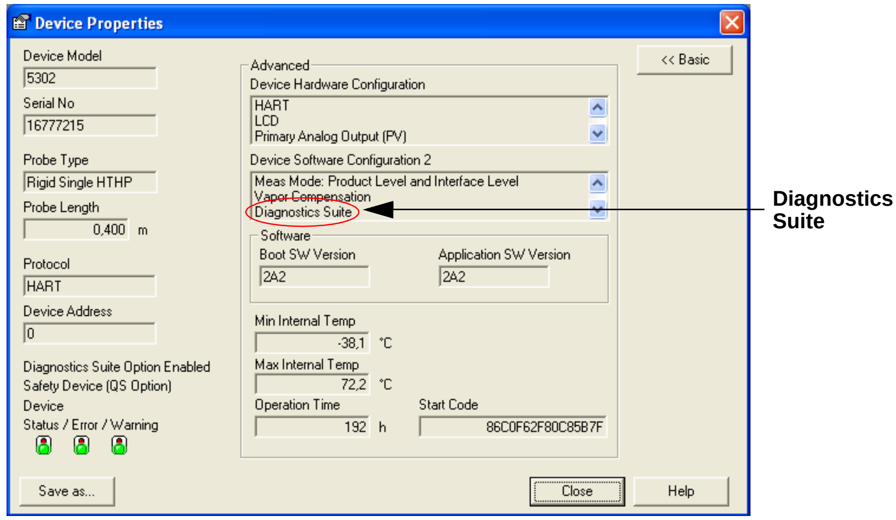
Surface / Noise Margin is the relationship between surface peak amplitude and the amplitude of the strongest noise peak above the surface. The Surface / Noise Margin spans from 0 to 10, where 0 indicates a low margin, and 10 indicates a high margin. It indicates how much disturbance the device can handle in the tank.

NOTE!
The signal amplitude and the noise margin depend on probe type and application conditions, as well as the condition of the probe. Even if the probe is clean, Signal Quality and Surface / Noise Margin may not be a 10.

To check if Signal Quality Metrics is supported, do one of the following:

- If “DA1” or “D01” is mentioned in the model code on the label, the device supports Signal Quality Metrics.
  Model Code: 530xxxxxxxxxxxxxxxxDA1 or
  530xxxxxxxxxxxxxxxxD01xx
- In RRM:
  1. Connect to the device.
  2. Right click on the device and select **Properties**.

Figure C-18. Check if Signal Quality Metrics is supported.



3. If “Diagnostics Suite” is mentioned in the *Device Software Configuration 2* list, the device supports Signal Quality Metrics.

- In 375 Field Communicator, if Signal Quality Metrics is supported, it can be found with the [3, 2, 2, 1] sequence. Check if “Diagnostics Suite” is present

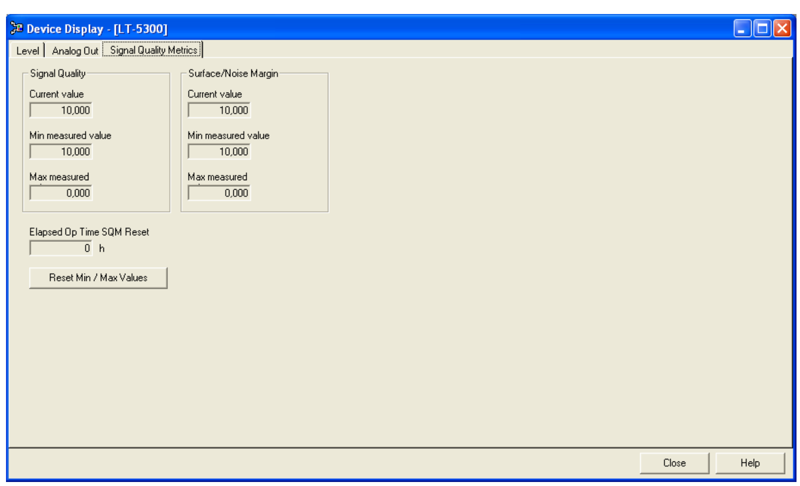
Signal Quality Metrics can be enabled/disabled in RRM. Choose **Tools, Advanced,** *Signal Quality Metrics* tab.

NOTE!
If Signal Quality Metrics is not supported or disabled, the Signal Quality and Surface / Noise Margin will always be set to 0.

Viewing Signal Quality Metrics in RRM

To view Signal Quality Metrics in RRM, choose the **Tools > Device Display** option and select the *Signal Quality Metrics* tab.

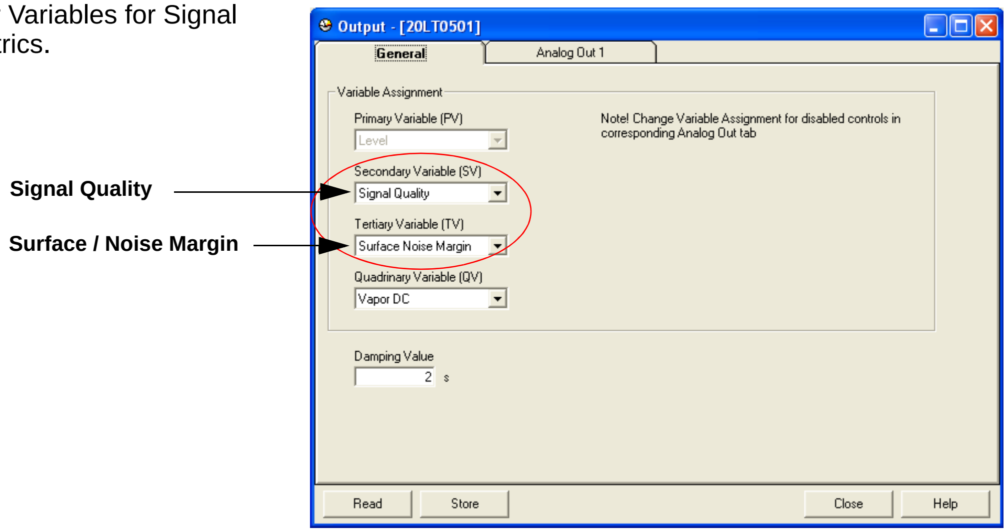
Figure C-19. View Signal Quality Metrics Values.



Signal Quality Metrics can be shown on the LCD panel. See “Operation” on page 6-1.

Signal Quality Metrics can be assigned to Transmitter Variables (SV, TV, or QV). In RRM, this can be done by selecting **Setup, Output** from the menu.

Figure C-20. Configure Transmitter Variables for Signal Quality Metrics.



Variables can be sent to Distributed Control System (DCS) to trigger an alarm. Suitable trigger levels vary from application to application. Guidelines for appropriate values can be determined by logging Signal Quality Metrics over time and viewing minimum/maximum values. The Signal Quality alarm trigger value should be at least 1, but a better guideline is 2-3.

Appendix D Remote Mounting

REMOTE HOUSING, NEW UNITS

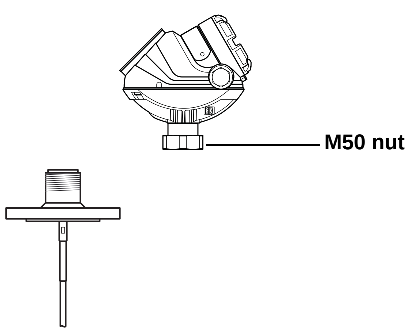
Remote Housing can be used to place the head apart from the probe if it is in a hot or vibrating place. With Remote Housing, you can place the transmitter head in a better position to be able to read the display, for example.

The remote housing assembly is shipped with the transmitter head mounted on the probe and the remote connection in a separate box.

The transmitter head must have the remote connection installed before functioning.

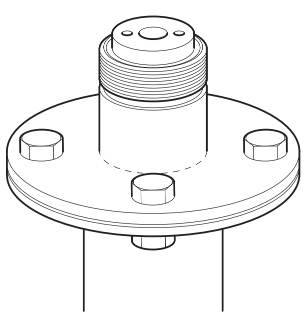
The parts in the shipping unit consist of:

- Transmitter head mounted on probe
- Remote connection
- Bracket kit
  - Bracket (1 pcs)
  - Clamping bracket (4 pcs)
  - U-bolt (2 pcs)
  - M6 screw (3 pcs)
  - M6 nut (4 pcs)

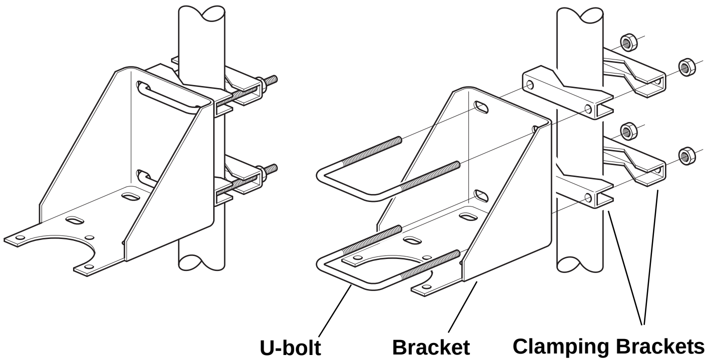


Remove the transmitter head from the probe

Remove the transmitter head from the probe by unscrewing the M50 nut.



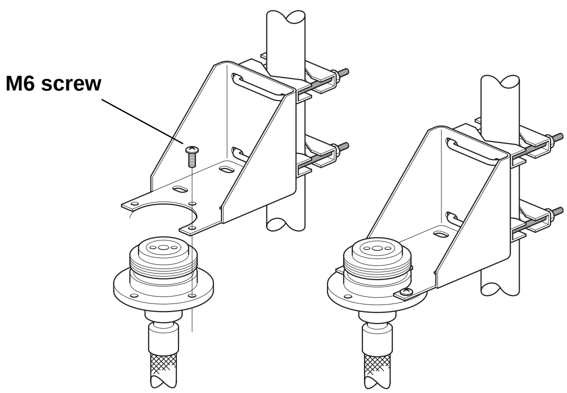
Mount the probe in the tank



Mount the bracket to the pole

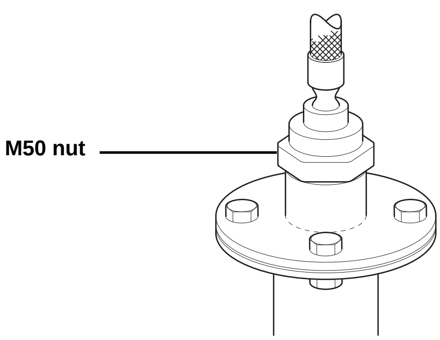
Mount the bracket to the pole, making sure the distance between the probe and bracket does not exceed the length of the remote connection.

1. Put the two U-bolts through the holes of the bracket. Several holes are available for vertical/horizontal pipe mounting.
2. Put the clamping brackets on the U-bolts and around the pipe.
3. Use the supplied nuts to fasten the bracket to the pipe.



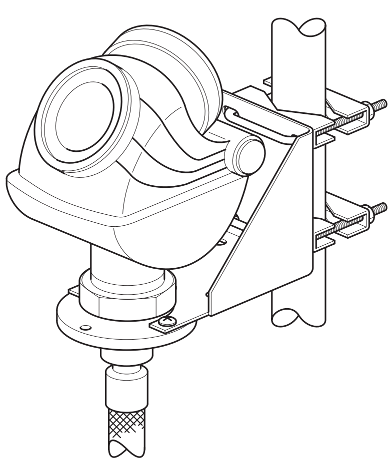
Fasten the housing support to the bracket

Fasten the housing support to the bracket using the M6 screws. The screws are threaded through the top of the mounting bracket and into the housing support.



Mount the probe housing on the probe

Mount the probe housing on the probe, making sure that the M50 nut is properly tightened.



Connect the transmitter head on the housing support

Connect the transmitter head on the housing support, making sure that the M50 nut is properly tightened.

See “Remote Housing Configuration” on page D-4 to check if the transmitter is configured with remote housing.

REMOTE CONNECTION, FIELD RETROFIT

To upgrade a currently installed Rosemount 5300 transmitter with a remote housing, the embedded software needs revision 2.A2 or later, and the Spare Part Kit (03300-3001-000X) must be ordered.

The Rosemount 5300 transmitter head must be configured for remote housing to work.

The Spare Part Kit consists of:

- Remote connection
- Bracket kit
  - Bracket (1 pcs)
  - Clamping bracket (4 pcs)
  - U-bolt (2 pcs)
  - M6 screw (3 pcs)
  - M6 nut (4 pcs)

Mount the bracket to the pole

Mount the bracket to the pole, making sure the distance between the probe and bracket does not exceed the length of the remote connection.

1. Put the two U-bolts through the holes of the bracket. Several holes are available for vertical/horizontal pipe mounting.
2. Put the clamping brackets on the U-bolts and around the pipe.

Use the supplied nuts to fasten the bracket to the pipe.

Fasten the housing support to the bracket

Fasten the housing support to the bracket using the M6 screws. The screws are threaded through the top of the mounting bracket and into the housing support.

Remove the transmitter head from the probe

Remove the transmitter head from the probe by unscrewing the M50 nut.

Mount the probe housing on the probe

Mount the probe housing on the probe, making sure that the M50 nut is properly tightened.

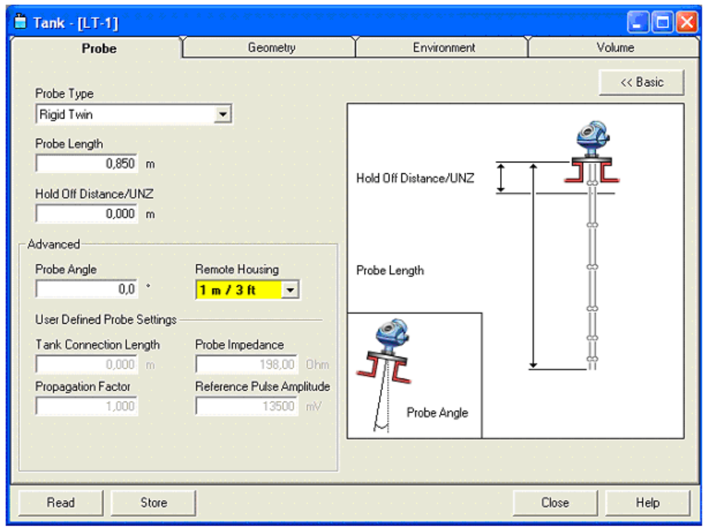
Connect the transmitter head on the housing support

Connect the transmitter head on the housing support, making sure that the M50 nut is properly tightened.

REMOTE HOUSING CONFIGURATION

When using remote housing, the remote connection length should be configured. If the Remote Housing is ordered with a transmitter, it is configured in the factory.

In Rosemount Radar Master, select Setup > Tank.



Under the *Probe* tab, Remote Housing length can be selected. Click the Store button to save changes.

In the 375 Field Communicator, Remote Housing can be set with HART command [2, 3, 1, 4, 2].

NOTE!
When disconnecting a remote housing cable from a probe in low temperatures, -22 °F (-30 °C), Radar Master may not show that the probe is missing.

Appendix E Performing Proof Test

PERFORMING PROOF TEST

This test detects approximately 95% of the possible DU failures of the transmitter including the sensor element. Here is a description of how to perform the test using a 375 Field Communicator, Rosemount Radar Master (RRM), or AMS Suite. Note that the transmitter is not safety-rated during proof tests. Alternative means should be used to ensure process safety during such activities.

Required tools: HART host/communicator and a mA meter.

375 FIELD COMMUNICATOR

Prior to this test, inspect the echo curve to ensure that no disturbing echoes affecting the measurement performance are present.

375 HART Sequence: [2, 6, 1]

1. Bypass the safety PLC or take other appropriate actions to avoid false trip.
2. Disable write protection if the function is enabled.

   375 HART Sequence: [3, 2, 1, 2, 1]. Type the password.

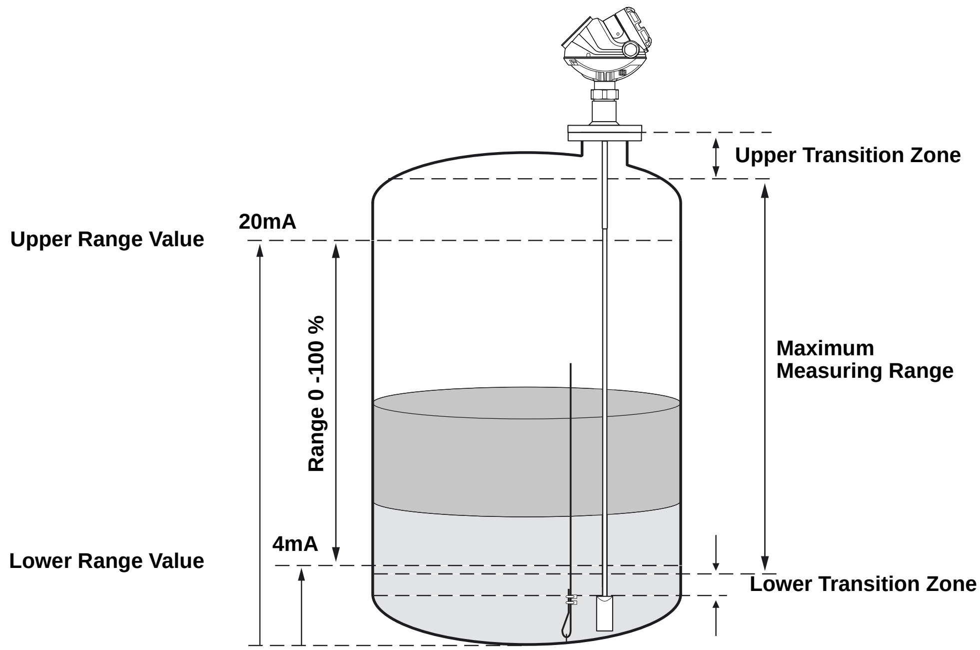
3. Using loop test, enter the mA value representing the high alarm current. Verify that the analog output current is correct using the reference meter. *This step tests for compliance voltage problems, such as low power supply voltage or increased wiring resistance.*

   375 HART Sequence: [2, 4, 1, 7]. Select **3 Other**. Enter the analog output level representing the high alarm current. Press **Enter** and click **OK**.
   Verify that the analog output current is correct. Click **Abort** to end loop test.

4. Using loop test, enter the mA value representing the low alarm current. Verify that the analog output current is correct using the reference meter. *This step tests for possible quiescent current related failures.*

   375 HART Sequence: [2, 4, 1, 7]. Select **3 Other**. Enter the analog output level representing the low alarm current. Press **Enter** and click **OK**.
   Verify that the analog output current is correct. Click **Abort** to end loop test. Verify that the Current output is restored to the original mode.

Figure E-1. Range Values.



5. Perform a two-point calibration check of the transmitter by applying level to two points on the probe within the measuring range. Verify that the current output corresponds to the level input values using a known reference measurement.
This step verifies that the analog output is correct in the operating range and that the Primary Variable is properly configured.

   Note that the applied level has to be between the Upper and Lower Range values, otherwise the transmitter enters alarm mode. If the applied level is outside the Maximum Measuring Range, the level reading accuracy may be reduced. For best performance, use the 4-20 mA range points as calibration points. See Figure E-1.

6. Enable write protection.

   375 HART Sequence: [3, 2, 1, 2, 1].

7. Restore the loop to full operation.
8. Remove the bypass from the safety PLC or otherwise restore normal operation.
9. Document the test results for future reference.

ROSEMOUNT RADAR MASTER (RRM)

Prior to this test, inspect the echo curve to ensure that no disturbing echoes affecting the measurement performance are present.

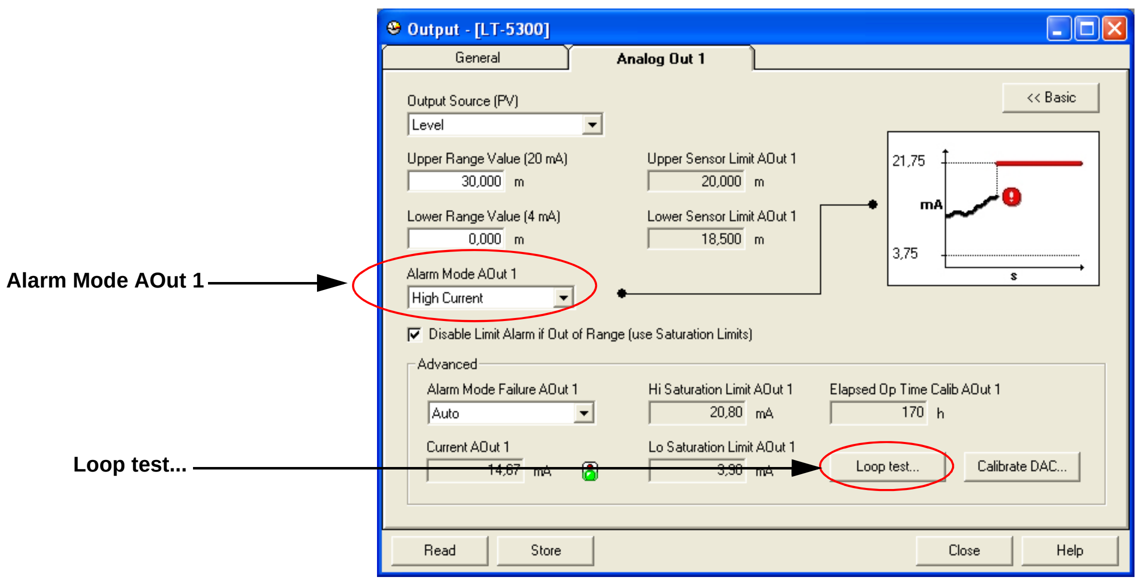
RRM: Tools / Echo Curve

1. Bypass the safety PLC or take other appropriate actions to avoid false trip.
2. Disable write protection if the function is enabled.

   RRM: Select **Tools, Lock / Unlock Configuration Area** from the menu. Type the password being used for this device and click **OK**.

3. Set Alarm mode to High Current. Using loop test, enter the mA value representing the high alarm current. Verify that the analog output current is correct using the reference meter.
   This step tests for compliance voltage problems, such as low power supply voltage or increased wiring resistance.

   RRM: Select **Setup**, **Output** from the menu.



   Make sure **Alarm Mode AOut 1** is set to High Current. Click Store to save changes. Click **Loop test...** and enter the **Current AOut 1** value representing the high alarm current.
   Click **Start** and verify that the output current is correct.
   Click **Stop** to end loop test.

4. Set Alarm mode to Low Current. Using loop test, enter the mA value representing the low alarm current. Verify that the analog output current is correct using the reference meter.
   This step tests for possible quiescent current related failures.

   RRM: Set **Alarm Mode AOut 1** to Low Current. Click **Store** to save changes. Click **Loop test...** and enter the **Current AOut 1** value representing the low alarm current.
   Click **Start** and verify that the output current is correct.
   Click **Stop** to end loop test.

5. Restore the Alarm mode to the original mode used in the loop. Verify that the analog output current is correct.

   RRM: Set **Alarm Mode AOut 1** to original mode. Click Store to save changes.
   Verify that the output current is correct.

6. Perform a two-point calibration check of the transmitter by applying level to two points on the probe within the measuring range. Verify that the current output corresponds to the level input values using a known reference measurement.
   This step verifies that the analog output is correct in the operating range and that the Primary Variable is properly configured.

   Note that the applied level has to be between the Upper and Lower Range values, otherwise the transmitter enters alarm mode. If the applied level is outside the Maximum Measuring Range, the level reading accuracy may be reduced. For best performance, use the 4-20 mA range points as calibration points. See Figure E-1 on page E-2.

7. Enable write protection.

   RRM: Select **Tools**, **Lock / Unlock Configuration Area** from the menu.

8. Restore the loop to full operation.
9. Remove the bypass from the safety PLC or otherwise restore normal operation.
10. Document the test results for future reference.

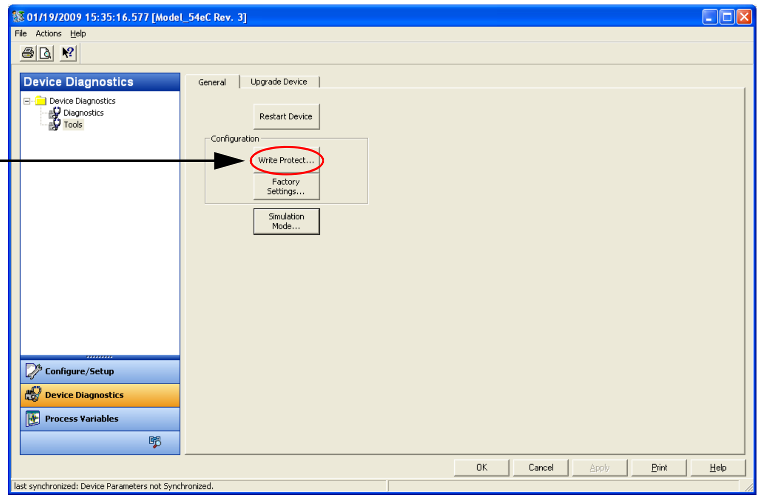
AMS SUITE

Prior to this test, inspect the echo curve to ensure that no disturbing echoes affecting the measurement performance are present.

AMS: Click **Configure / Setup / Echo Curve**

1. Bypass the safety PLC or take other appropriate actions to avoid false trip.
2. Disable write protection if the function is enabled.

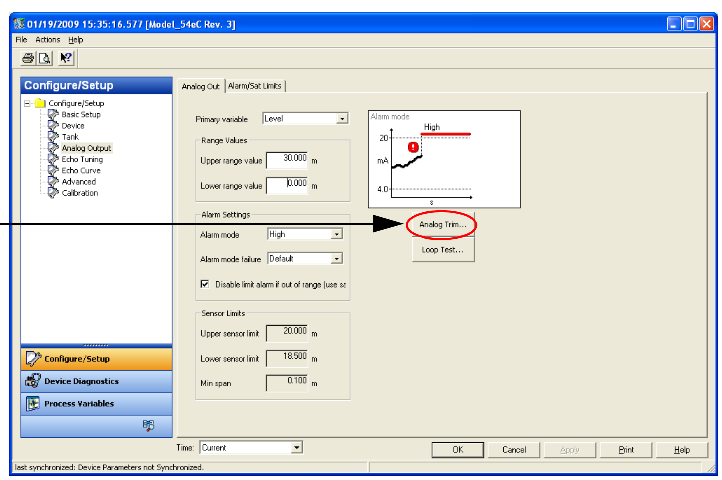
   AMS: Select **Device Diagnostics** / **Tools** from the left menu.



   Click **Write Protect...** and follow the instructions. (Note that the password cannot be written with letters.)

3. Using loop test, enter the mA value representing the high alarm current. Verify that the analog output current is correct using the reference meter. *This step tests for compliance voltage problems, such as low power supply voltage or increased wiring resistance.*

   AMS: Select **Configure** / **Setup**, **Analog Output** from the menu.



   Click **Loop Test...** Select **Other** and enter the mA value representing the high **Analog Output Level** and follow the instructions. Verify that the output current is correct.

4. Using loop test, enter the mA value representing the low alarm mode. Verify that the analog output current is correct using the reference meter. *This step tests for possible quiescent current related failures.*

   AMS: Select **Configure** / **Setup**, **Analog Output** from the menu. Click **Loop Test...** Select **Other** and enter the mA value representing the low **Analog Output Level** and follow the instructions. Click **OK** to save changes. Verify that the output current is correct.
   Select **End** to stop loop test. Verify that the Current output is restored to the original mode.

5. Perform a two-point calibration check of the transmitter by applying level to two points on the probe within the measuring range. Verify that the current output corresponds to the level input values using a known reference measurement.
   This step verifies that the analog output is correct in the operating range and that the Primary Variable is properly configured.

   Note that the applied level has to be between the Upper and Lower Range values, otherwise the transmitter enters alarm mode. If the applied level is outside the Maximum Measuring Range, the level reading accuracy may be reduced. For best performance, use the 4-20 mA range points as calibration points. See Figure E-1 on page E-2.

6. Enable write protection.

   AMS: Select **Device Diagnostics** / **Tools** from the menu, click **Write Protect...** and follow the instructions. (Note that the password cannot be written with letters.)

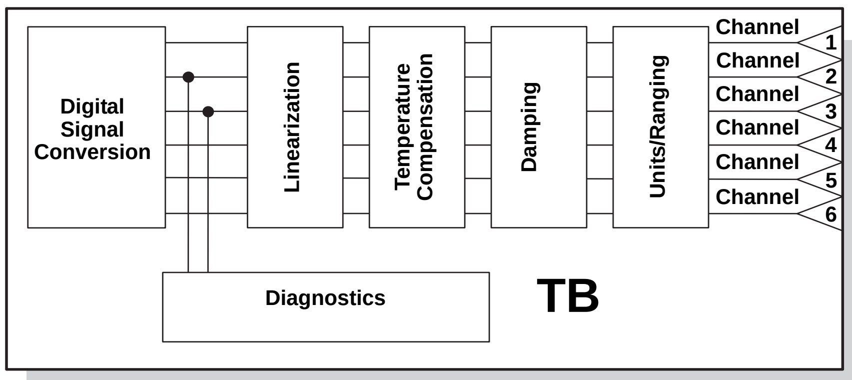
7. Restore the loop to full operation.
8. Remove the bypass from the safety PLC or otherwise restore normal operation.
9. Document the test results for future reference.

Appendix F Level Transducer Block

OVERVIEW

This section contains information on the 5300 Level Transducer Block (TB). Descriptions of all Transducer Block parameters, errors, and diagnostics are listed.

Figure F-1. Transducer Block Diagram



Definition

The transducer block contains the actual measurement data, including a level and distance reading. Channels 1–16 are assigned to these measurements (see Figure F-1). The transducer block includes information about sensor type, engineering units, and all parameters needed to configure the transmitter.

Channel Definitions

Each input has an assigned channel which can be linked to the AI block. The channels for the Rosemount 5300 Series are the following:

Table F-1. Channel Assignments

Channel Name	Channel Number	Process variable
Level	1	CHANNEL_RADAR_LEVEL
Ullage	2	CHANNEL_RADAR_ULLAGE
Level Rate	3	CHANNEL_RADAR_LEVELRATE
Signal Strength	4	CHANNEL_RADAR_SIGNAL_STRENGTH
Volume	5	CHANNEL_RADAR_VOLUME
Internal Temperature	6	CHANNEL_RADAR_INTERNAL_TEMPERATURE
Upper Product Volume	7	CHANNEL_UPPER_PRODUCT_VOLUME
Lower Product Volume	8	CHANNEL_LOWER_ PRODUCT_VOLUME
Interface Distance	9	CHANNEL_INTERFACE_ DISTANCE
Upper Product Thickness	10	CHANNEL_UPPER_ PRODUCT_THICKNESS
Interface Level	11	CHANNEL_INTERFACE_LEVEL
Interface Level Rate	12	CHANNEL_INTERFACE_ LEVELRATE
Interface Signal Strength	13	CHANNEL_INTERFACE_ SIGNALSTRENGTH
Signal Quality	14	CHANNEL_SIGNAL_QUALITY
Surface/Noise Margin	15	CHANNEL_ SURFACE_NOISE_MARGIN
Vapor DC	16	CHANNEL_VAPOR_DC

PARAMETERS AND DESCRIPTIONS

Table F-2. Level Transducer Block Parameters and Descriptions.

Parameter	Index Number	Description
ST_REV	1	The revision level of the static data associated with the function block. The revision value increments each time a static parameter value in the block is changed.
TAG_DESC	2	The user description of the intended application of the block.
STRATEGY	3	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ALERT_KEY	4	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
MODE_BLK	5	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
BLOCK_ERR	6	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
UPDATE_EVT	7	This alert is generated by any change to the static data.

Parameter	Index Number	Description
BLOCK_ALM	8	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
TRANSDUCER_DIRECTORY	9	Directory that specifies the number and starting indices of the transducers in the transducer block.
TRANSDUCER_TYPE	10	Identifies the transducer.
XD_ERROR	11	A transducer block alarm subcode.
COLLECTION_DIRECTORY	12	A directory that specifies the number, starting indices, and DD Item ID's of the data collections in each transducer within a transducer block.
RADAR_LEVEL_TYPE	13	Not used
RADAR_LEVEL	14	Level
RADAR_LEVEL_RANGE	15	See Table J-4
RADAR_ULLAGE	16	Distance (Ullage)
RADAR_LEVELRATE	17	Level Rate
RADAR_LEVELRATE_RANGE	18	See Table J-5
RADAR_LEVEL_SIGNAL_STRENGTH	19	Signal strength
RADAR_LEVEL_SIGNAL_STRENGTH_RANGE	20	See Table J-7
RADAR_VOLUME	21	Volume
RADAR_VOLUME_RANGE	22	See Table J-8
RADAR_INTERNAL_TEMPERATURE	23	Internal Temperature
RADAR_INTERNAL_TEMPERATURE_ RANGE	24	Range, unit and number of decimals
VOLUME_UPPER	25	The calculated volume value of the upper product at the current level and interface
VOLUME_LOWER	26	The calculated volume value of the lower product at the current interface
INTERFACE_DISTANCE	27	The distance to the interface (from the upper reference point).
UPPER_PRODUCT_THICKNESS	28	The thickness of the upper product (from the surface value to the interface value).
INTERFACE_LEVEL	29	The current interface level value (from the zero level reference point and up to the interface).
INTERFACE_LEVELRATE	30	The current velocity at which the interface is moving. A positive value indicates the interface is moving up.
INTERFACE_SIGNAL_STRENGTH	31	The current signal strength of the interface echo.
PROBE_TYPE	32	Select the type of probe that is mounted to this device. Use User Defined probe if your probe can not be found in the list or if you have done modifications to a standard probe.
PROBE_LENGTH	33	Enter the length of the probe measured from the device's upper reference point (normally the upper side of the tank flange) down to the probe end. If a weight is used it shall not be included in the length.
PROBE_ANGLE	34	Defines the angle compared to the plumb line at which the device with probe is mounted (0°means that probe is mounted vertically).
PROBE_END_PULSE_POLARITY	35	This parameter is used for User Defined probes only. Please contact Emerson Process Management Service Department for more information
PROBE_IMPEDANCE	36	This parameter is used for User Defined probes only. Please contact Emerson Process Management Service Department for more information

Parameter	Index Number	Description
TCL	37	This parameter is used for User Defined probes only. Please contact Emerson Process Management Service Department for more information
PROPAGATION_FACTOR	38	This parameter is used for User Defined probes only. Please contact Emerson Process Management Service Department for more information
REF_PULSE_AMPL	39	This parameter is used for User Defined probes only. Please contact Emerson Process Management Service Department for more information
GEOM_TANK_HEIGHT	40	Tank Height (R)
GEOM_HOLD_OFF_DIST	41	Hold off distance
VAPOR_DC	42	Enter the dielectric constant for the vapor gas in the tank. For air at 20 degC and atmospherical pressure the vapor DC is close to 1, but for high pressure/high temperature applications the DC may increase and affect the accuracy of the measurement
UPPER_PRODUCT_DC	43	Enter the Upper Product Dielectric Constant (DC) as dielectric accurate as possible. This value affects the accuracy of the interface level measurement
LOWER_PRODUCT_DC_RANGE	44	Enter the range of the dielectric constant (DC) for the lower product in the tank. If you are uncertain about the value for this parameter or are changing product in the tank on a regular basis choose Unknown
PRODUCT_DIELEC_RANGE	45	Enter the range of the Product DC for the product in the tank. If you are uncertain about the value for this parameter or are changing product in the tank on a regular basis choose Unknown
MEAS_MODE	46	Select the Measurement Mode to use in the device. Some modes require software options to be enabled in the device. You can upgrade the device to enable more software options
DAMP_VALUE	47	Damping value
GEOM_OFFSET_DIST	48	Distance Offset
GEOM_CALIBRATION_DIST	49	Calibration Distance
LCD_SETTINGS	50	
LCD_PARAMETERS	51	Parameters to show
LCD_LANGUAGE	52	Language on display
LCD_LENGTH_UNIT	53	Length unit on display
LCD_VOLUME_UNIT	54	Volume unit on display
LCD_TEMPERATURE_UNIT	55	Temperature unit on display
LCD_VELOCITY_UNIT	56	Velocity unit on display
MAX_INTERNAL_TEMPERATURE	57	The maximum temperature that has been measured inside the device during operation
MIN_INTERNAL_TEMPERATURE	58	The minimum temperature that has been measured inside the device during operation
OPERATION TIME	59	The total number of hours the device has been in operation
ENV_ENVIRONMENT	60	Process Condition
ENV_PRESENTATION	61	Tank Presentation
ENV_DEVICE_MODE	62	Service mode
ENV_WRITE_PROTECT	63	Write protect
DIAGN_DEVICE_ALERT	64	Errors, Warnings, Status, Plant web alerts
DIAGN_VERSION	65	Gauge SW version
DIAGN_REVISION	66	P1451 revision
DIAGN_DEVICE_ID	67	Device ID for the gauge.
DIAGN_DEVICE_MODEL	68	Type of 5300. LF or HF
STATS_ATTEMPTS	69	The total number of messages sent to the transducer A/D board
STATS_FAILURES	70	The total number of failed A/D board message attempts

Parameter	Index Number	Description
STATS_TIMEOUTS	71	The total number of timed out A/D board message attempts
MAX_UPPER_PRODUCT_THICKNESS	72	This is the maximum thickness of the upper product that the device is able to measure through. If the thickness of the upper product is larger than this value, the device will not be able to locate the interface echo
MEAS_STATUS	73	
INTERFACE_STATUS	74	
REMOTE_HOUSING	75	
MEAS_VAPOR_DC	76	Measured Vapor Dielectric Constant
SPEC_CONFIG_TNZ	77	Configure Trim Near Zone
SPEC_CONFIG_PEP	78	Configure Probe End Projection
SPEC_CONFIG_TANK_MATERIAL	79	Configure Tank Material
SPEC_CONFIG_VC	80	Configure Vapor Compensation
VC_WARNING	81	Vapor Compensation Warning
PEP_STATUS	82	Probe End Projection Status
TANK_MATERIAL	83	
SW_SUPPORT2	84	Defines what options are enabled in the device.
MOUNTING_TYPE	85	
PIPE_DIAMETER	86	
NOZZLE_HEIGHT	87	
DEVICE_HW_CONFIG	88	
DEVICE_STATUS	89	
VOLUME_STATUS	90	
MWM_WARNING	91	
MEAS_WARNING	92	
CONFIG_WARNING	93	
VAPOR_COMP_STATUS	94	Vapor Compensation Status

Table F-3. Probe Type

VALUE	PROBE_TYPE
0	User defined
1	Rigid Twin
2	Flexible Twin
3	Coaxial
4	Rigid Single 0.3 in. (8 mm)
5	Flexible Single
10	Coaxial HTHP
11	Coaxial HP/C
12	Rigid Single HTHP/HP 0.3 in. (8 mm)
13	Flexible Single HTHP
20	Rigid Single PTFE
21	Flexible Single PTFE
30	Rigid Single HP/C 0.3 in. (8 mm)
31	Flexible Single HP
32	Flexible Single PA
33	Rigid Single 0.5 in. (13 mm)
40	Rigid Single HTHP 0.5 in. (13 mm)
41	Rigid Single HP/C 0.5 in. (13 mm)

Table F-4. Device Mode

VALUE	ENV_DEVICE_MODE
0	Normal operation
1	Spare
2	Restart device
3	Set to factory default database
4	Trim Near Zone

Table F-5. Environment

Bit Number	Value of ENV_ENVIRONMENT	Description
2	0x00000004	Turbulent
3	0x00000008	Foam
28	0x10000000	Rapid Changes

Table F-6. Presentation

Bit Number	Value of ENV_PRESENTATION	Description
28	0x10000000	Do Not Use Full Tank State
2	0x00000002	Use 3300 Full and Empty Detect Areas
3	0x00000004	Disable PEP PE Sign Change Logic
8	0x00000100	Show Negative Level as Zero
10	0x00000400	Probe End Projection
11	0x00000800	Do Not Use Automatic PEP DC Estimation
12	0x00001000	Do Not Reject Possible Double Bounces
18	0x00040000	Use Jump Filter
22	0x00400000	Show Level below Probe End as Zero
23	0x00800000	Use Vapor Compensation
24	0x01000000	Calculate Signal Quality Metrics

Table F-7. LCD Parameters

Bit Number	Value of LCD_PARAMETERS	Description
28	0x10000000	Level
1	0x00000002	Distance
2	0x00000004	Level Rate
3	0x00000008	Signal Strength
4	0x00000010	Volume
5	0x00000020	Internal Temperature
6	0x00000040	Analog Out Current
7	0x00000080	Percent Of Range
8	0x00000100	Com Quality
9	0x00000200	Interface Level
10	0x00000400	Interface Distance
11	0x00000800	Interface Level Rate
12	0x00001000	Interface Signal Strength
13	0x00002000	Upper Product Thickness
14	0x00004000	Lower Volume
15	0x00008000	Upper Volume

Bit Number	Value of LCD_PARAMETERS	Description
16	0x00010000	Signal Quality
17	0x00020000	Surface Noise Margin
18	0x00040000	Vapor DC

Table F-8. Product Dielectrical Range

VALUE	ENV_DIELECTR_CONST
0	1.4 - 1.9 (e.g. liquified gas, plastics)
1	1.9-2.5 (e.g. Oil Based)
2	2.5-4 (e.g. Oil Based)
3	4-10 (e.g. Alcohol, Acids)
4	>10 (e.g. Waterbased)
5	Unknown

Table F-9. Measurement Mode

VALUE	MEAS_MODE
0	Liquid Product Level
1	Product Level and Interface Level
2	Solid Product Level
3	Interface Level with Submerged Probe

SUPPORTED UNITS

Unit Codes

Table F-10. Length

Value	Display	Description
1010	m	meter
1012	cm	centimeter
1013	mm	millimeter
1018	ft	feet
1019	in	inch

Table F-11. Level Rate

Value	Display	Description
1061	m/s	meter per second
1063	m/h	meter per hour
1067	ft/s	feet per second
1069	in/m	inch per minute

Table F-12. Temperature

Value	Display	Description
1001	°C	Degree Celsius
1002	°F	Degree Fahrenheit

Table F-13. Signal Strength

Value	Display	Description
1243	mV	millivolt

Table F-14. Volume

Value	Display	Description
1034	m^3	Cubic meter
1038	L	Liter
1042	in^3	Cubic inch
1043	ft^3	Cubic feet
1044	Yd^3	Cubic yard
1048	Gallon	US gallon
1049	ImpGall	Imperial gallon
1051	Bbl	Barrel

Table F-15. Time

Value	Display	Description
1054	s	Second

Table F-16. Percent

Value	Display	Description
1342	%	Percent

DIAGNOSTICS DEVICE ERRORS

In addition to the BLOCK_ERR and XD_ERROR parameters, more detailed information on the measurement status can be obtained via DIAGN_DEV_ALERT. Table F-17 lists the potential errors and the possible corrective actions for the given values. The corrective actions are in order of increasing system level compromises. The first step should always be to reset the gauge and then if the error persists, try the steps in Table F-17. Start with the first corrective action and then try the second.

Table F-17. Device Errors Diagnostics

Bit Number	Value of DIAGN_DEV_ALERT	Description	Corrective action
	0	No alarm active	
0	0x00000001	Reserved	
1	0x00000002	FF card to gauge comm fault	Replace gauge
2	0x00000004	Level Measurement Failure	Verify device installation and configuration
3	0x00000008	Temperature Measurement Failure	Check ambient temperature. If ambient temperature ok replace the device.
4	0x00000010	Volume measurement failure	Check volume configuration
5	0x00000020	Database Error	Load default database to the device and reconfigure the device
6	0x00000040	HW Error	Replace device
7	0x00000080	Microwave Unit Error	Replace device
8	0x00000100	Configuration Error	Load default database to the device and reconfigure the device
9	0x00000200	SW Error	Replace device
10	0x00000400	Invalid Strap Table	Check the Strapping Table configuration
11	0x00000800	Internal Temp Warning	Check ambient temperature at installation site
12	0x00001000	Database Warning	Check the device configuration
13	0x00002000	HW Warning	Check device installation and configuration
14	0x00004000	Microwave Unit Warning	Check device installation and configuration
15	0x00008000	Configuration Warning	Check the device configuration
16	0x00010000	SW Warning	Check device installation and configuration
17	0x00020000	Simulation Mode	Use Simulation Method under advanced configuration tool to get the device out of Simulation Mode
18	0x00040000	Volume Range Warning	Verify Strapping Table
19	0x00080000	Software Write Protected	
20	0x00100000	Vapor Compensation Not Calibrated	
21	0x00200000	Vapor DC Estimation Limited	
22	0x00400000	Reference Reflector Not Found	
23	0x00800000	BaseLine too low	
24	0x01000000	BaseLine too high	
25	0x02000000	Gain control	
26	0x04000000	Unsupported Combination of Functions	
27	0x08000000		
28	0x10000000		
29	0x20000000	Probe Missing	Check probe connection
30	0x40000000	Interface Measurement Failure	Check interface measurement configuration
31	0x80000000	Hardware Write Protected	

Appendix G Register Transducer Block

OVERVIEW

The Register Transducer Block allows access to Database registers and Input registers of the Rosemount 5300 transmitter. This makes it possible to read a selected set of register directly by accessing the memory location.

The Register Transducer Block is only available with advanced service.

⚠CAUTION

Since this Register Transducer Block allows access to most registers in the transmitter, which includes the registers set by the Methods and Configuration screens, in the Level Transducer Block (see *Appendix F: Level Transducer Block*) it should be handled with care and ONLY to be changed by trained and certified service personnel, or as guided by Emerson Process Management, Rosemount Division support personnel.

Register Access Transducer Block Parameters

Table G-1. Register Access Transducer Block Parameters

Parameter	Index Number	Description
ST_REV	1	The revision level of the static data associated with the function block. The revision value increments each time a static parameter value in the block is changed.
TAG_DESC	2	The user description of the intended application of the block.
STRATEGY	3	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ALERT_KEY	4	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
MODE_BLK	5	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
BLOCK_ERR	6	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
UPDATE_EVT	7	This alert is generated by any change to the static data.
BLOCK_ALM	8	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
TRANSDUCER_DIRECTORY	9	Directory that specifies the number and starting indices of the transducers in the transducer block.
TRANSDUCER_TYPE	10	Identifies the transducer.

Parameter	Index Number	Description
XD_ERROR	11	A transducer block alarm subcode.
COLLECTION_DIRECTORY	12	
INP_SEARCH_START_NBR	13	Search start number for input registers
DB_SEARCH_START_NBR	14	Search start number for holding registers
INP_REG_1_TYPE	15	Register type
INP_REG_1_FLOAT	16	If the register contains a float value, it should be displayed here
INP_REG_1_INT_DEC	17	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
INP_REG_2_TYPE	18	Register type
INP_REG_2_FLOAT	19	If the register contains a float value, it should be displayed here
INP_REG_2_INT_DEC	20	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
INP_REG_3_TYPE	21	Register type
INP_REG_3_FLOAT	22	If the register contains a float value, it should be displayed here
INP_REG_3_INT_DEC	23	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
INP_REG_4_TYPE	24	Register type
INP_REG_4_FLOAT	25	If the register contains a float value, it should be displayed here
INP_REG_4_INT_DEC	26	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
INP_REG_5_TYPE	27	Register type
INP_REG_5_FLOAT	28	If the register contains a float value, it should be displayed here
INP_REG_5_INT_DEC	29	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
INP_REG_6_TYPE	30	Register type
INP_REG_6_FLOAT	31	If the register contains a float value, it should be displayed here
INP_REG_6_INT_DEC	32	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
INP_REG_7_TYPE	33	Register type
INP_REG_7_FLOAT	34	If the register contains a float value, it should be displayed here
INP_REG_7_INT_DEC	35	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
INP_REG_8_TYPE	36	Register type
INP_REG_8_FLOAT	37	If the register contains a float value, it should be displayed here
INP_REG_8_INT_DEC	38	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
INP_REG_9_TYPE	39	Register type
INP_REG_9_FLOAT	40	If the register contains a float value, it should be displayed here
INP_REG_9_INT_DEC	41	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
INP_REG_10_TYPE	42	Register type
INP_REG_10_FLOAT	43	If the register contains a float value, it should be displayed here
INP_REG_10_INT_DEC	44	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
DB_REG_1_TYPE	45	Register type
DB_REG_1_FLOAT	46	If the register contains a float value, it should be displayed here
DB_REG_1_INT_DEC	47	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
DB_REG_2_TYPE	48	Register type

Parameter	Index Number	Description
DB_REG_2_FLOAT	49	If the register contains a float value, it should be displayed here
DB_REG_2_INT_DEC	50	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
DB_REG_3_TYPE	51	Register type
DB_REG_3_FLOAT	52	If the register contains a float value, it should be displayed here
DB_REG_3_INT_DEC	53	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
DB_REG_4_TYPE	54	Register type
DB_REG_4_FLOAT	55	If the register contains a float value, it should be displayed here
DB_REG_4_INT_DEC	56	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
DB_REG_5_TYPE	57	Register type
DB_REG_5_FLOAT	58	If the register contains a float value, it should be displayed here
DB_REG_5_INT_DEC	59	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
DB_REG_6_TYPE	60	Register type
DB_REG_6_FLOAT	61	If the register contains a float value, it should be displayed here
DB_REG_6_INT_DEC	62	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
DB_REG_7_TYPE	63	Register type
DB_REG_7_FLOAT	64	If the register contains a float value, it should be displayed here
DB_REG_7_INT_DEC	65	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
DB_REG_8_TYPE	66	Register type
DB_REG_8_FLOAT	67	If the register contains a float value, it should be displayed here
DB_REG_8_INT_DEC	68	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
DB_REG_9_TYPE	69	Register type
DB_REG_9_FLOAT	70	If the register contains a float value, it should be displayed here
DB_REG_9_INT_DEC	71	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
DB_REG_10_TYPE	72	Register type
DB_REG_10_FLOAT	73	If the register contains a float value, it should be displayed here
DB_REG_10_INT_DEC	74	If the register contains a DWORD value, and *dec* is chosen, it should be displayed here
RM_COMMAND	75	Used to set what will be read or write from a secondary master.
RM_DATA	76	Data read/write from secondary master.
RM_STATUS	77	Status read by a secondary master.

Appendix H Advanced Configuration Transducer Block

OVERVIEW

The Advanced Configuration Transducer Block contains functions for the advanced configuration of the Rosemount 5300 transmitter. It includes functions, such as amplitude threshold settings for filtering of disturbing echoes and noise, simulation of measurement values, Empty Tank Handling for optimizing measurements close to the tank bottom, and strapping table for volume measurements.

Advanced Configuration Transducer Block Parameters

Table H-1. Advanced Configuration Transducer Block Parameters

Parameter	Index Number	Description
ST_REV	1	The revision level of the static data associated with the function block. The revision value increments each time a static parameter value in the block is changed.
TAG_DESC	2	The user description of the intended application of the block.
STRATEGY	3	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ALERT_KEY	4	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
MODE_BLK	5	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
BLOCK_ERR	6	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
UPDATE_EVT	7	This alert is generated by any change to the static data.
BLOCK_ALM	8	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
TRANSDUCER_DIRECTORY	9	Directory that specifies the number and starting indices of the transducers in the transducer block.
TRANSDUCER_TYPE	10	Identifies the transducer. 100 = Standard pressure with calibration
XD_ERROR	11	A transducer block alarm subcode.
COLLECTION_DIRECTORY	12	

Parameter	Index Number	Description
AMPLITUDE_THRESHOLD_CURVE	13	ATC: filters out weak disturbance echoes and noise.
SIMULATION_MODE	14	Simulation of measurement values.
SET_CONSTANT_THRESHOLD	15	A constant amplitude threshold can be used to filter out noise.
RADAR_LEVEL_RANGE	16	
RADAR_LEVEL_SIGNAL_STRENGTH_RANGE	17	
RADAR_VOLUME_RANGE	18	
ENV_PRESENTATION	19	
PROBE_END_THRESH	20	This threshold is used to locate the probe end echo. The probe end echo is used by the device to know when the tank is empty, but is sometimes also useful when no surface echo can be found.
REFERENCE_THRESH	21	This threshold is used to locate the reference echo.
INTERFACE_THRESH	22	This threshold is used to block out disturbing echoes and noise when locating the interface echo.
FULL_TANK_THRESH_OFFSET	23	By adding an offset to the Reference Threshold it is possible for the device to determine when the tank is full. If the reference echo amplitude is between the Reference Threshold and the Full Tank Threshold then the tank is considered full.
PEP_PRODUCT_DC	24	Enter the product dielectric constant for the product in the tank.
AUTO_CONF_MEAS_FUNC	25	
ECHO_TIME_OUT	26	Change this parameter to define the time in seconds before the device should start to search for a surface echo after it has been lost.
CLOSE_DIST	27	This parameter defines a window centered at the current surface position where new surface echo candidates can be selected. The size of the window is +/-Close Distance. Echoes outside this window will not be considered as surface echoes.
USED_PROBE_END_THRESH	28	Probe End Threshold currently used in the device.
USED_REFERENCE_THRESH	29	Reference Threshold currently used in the device.
USED_INTERFACE_THRESH	30	Interface Threshold currently used in the device.
USED_TANK_PRESENTATION	31	
USED_ECHO_TIME_OUT	32	Echo Timeout currently used in the device.
USED_CLOSE_DIST	33	Close Distance currently used in the device.
SW_SUPPORT2	34	Defines what options are enabled in the device.
USED_HOLD_OFF_DIST	35	The upper null zone distance currently used in the device.
USED_PEP_PRODUCT_DC	36	Product Dielectric currently used in the device.
START_CODE	37	This code determines what options are available in your device. Do not change your Start Code unless you have received a valid one. Use Enter Start Codes method to change it.
UNIT_CODE	38	Unit code 1 -4 can be sent to your local Emerson representative in order to receive new Start Codes for upgrading your device.
ENV_SET_START_CODE	39	Set Start Code
PROBE_END_ANCHORING	40	
PEP_PROBE_END_OFFSET	41	
USED_PEP_ PROBE_END_OFFSET	42	
VOL_VOLUME_CALC_METHOD	43	Choose what kind of volume calculation method to use.
VOL_IDEAL_DIAMETER	44	Diameter of the tank (only for ideal tank shapes).
VOL_IDEAL_LENGTH	45	Length/height of the tank (only for ideal tank shapes).

Parameter	Index Number	Description
VOL_VOLUME_OFFSET	46	Use this parameter to add a volume to each calculated volume value. The volume can for instance correspond to a sump volume that you wish to add to your calculation.
VOL_STRAP_TABLE_LENGTH	47	Number of points to use in the strapping table.
VOL_STRAP_LEVEL	48	Strap value level 1-20 points
VOL_STRAP_VOLUME	49	Strap value volume 1-20 points
ECHO_REG	50	Read Echo distance, amplitude and class from gauge. The Echo Distance is the distance from the reference echo to the target echo calculated by the radar from the plot and gauge configuration.
ECHO_WRITE	51	Echo Found/False Record
PEP_STATUS	52	Probe End Projection Status
PEP_PRODUCT_DC_LIMIT	53	Probe End Projection Dielectric Constant Limit
PROBE_END_PULSE_POLARITY	54	
USED_MAX_VAPOR_DC	55	
REF_REFLECTOR_TYPE	56	Reference Reflector Type
VAPOR_DC_FILTER_FACTOR	57	Vapor Dielectric Constant Filter Factor
SIGNAL_QUALITY	58	
MIN_SIGNAL_QUALITY	59	
MAX_SIGNAL_QUALITY	60	
TIME_SINCE_LAST_RESET	61	
SURFACE_NOISE_MARGIN	62	Surface/Noise Margin
MIN_SURFACE_NOISE_MARGIN	63	Minimum Surface/Noise Margin
MAX_SURFACE_NOISE_MARGIN	64	Maximum Surface/Noise Margin
VAPOR_COMP_STATUS	65	Vapor Compensation Status
DEVICE_COMMAND	66	
DEVICE_COMMAND_STATUS	67	
RADAR_INTERNAL_TEMPERATURE_RANGE	68	
MAX_PRESSURE	69	
MAX_TEMPERATURE	70	
MAX_VAPOR_DC	71	Maximum Vapor Dielectric Constant
MEAS_STATUS	72	Measurement Status
CENTERING_DISC	73	
PEP_TRIM_EMPTY_FAILURE	74	Probe End Projection - Trim Empty Failure
PEP_TRIM_FILL_FAILURE	75	Probe End Projection - Fill Failure
PEP_RAW_PRODUCT_DC_EST	76	Probe End Projection - Raw Product Dielectric Constant Estimation
PEP_RAW_DC_EST_USED_DISTANCE	77	
USE_PROBE_END_PROJECTION	78	
USE_STATIC_PRODUCT_DC	79	Use Static Product Dielectric Constant
CALCULATE_SIGNAL_QUALITY_METRICS	80	
USE_VAPOR_COMPENSATION	81	
SPEC_CONFIG_PEP	82	Configure Probe End Projection
SPEC_CONFIG_VC	83	Configure Vapor Compensation

Appendix I Resource Transducer Block

OVERVIEW

This section contains information on the Rosemount 5300 Series Radar Level Transmitter Resource Block. Descriptions of all Resource Block Parameters, errors, and diagnostics are included. Also the modes, alarm detection, status handling, and troubleshooting are discussed.

Definition

The resource block defines the physical resources of the device. The resource block also handles functionality that is common across multiple blocks. The block has no linkable inputs or outputs.

PARAMETERS AND DESCRIPTIONS

The table below lists all the configurable parameters of the Resource Block, including the descriptions and index numbers for each.

Parameter	Index Number	Description
ACK_OPTION	38	Selection of whether alarms associated with the function block will be automatically acknowledged.
ADVISE_ACTIVE	82	Enumerated list of advisory conditions within a device.
ADVISE_ALM	83	Alarm indicating advisory alarms. These conditions do not have a direct impact on the process or device integrity.
ADVISE_ENABLE	80	Enabled ADVISE_ALM alarm conditions. Corresponds bit for bit to the ADVISE_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected.
ADVISE_MASK	81	Mask of ADVISE_ALM. Corresponds bit of bit to ADVISE_ACTIVE. A bit on means that the condition is masked out from alarming.
ADVISE_PRI	79	Designates the alarming priority of the ADVISE_ALM
ALARM_SUM	37	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
ALERT_KEY	04	The identification number of the plant unit.
BLOCK_ALM	36	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
BLOCK_ERR	06	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
CLR_FSTATE	30	Writing a Clear to this parameter will clear the device FAIL_SAFE if the field condition has cleared.
CONFIRM_TIME	33	The time the resource will wait for confirmation of receipt of a report before trying again. Retry will not happen when CONFIRM_TIME=0.
CYCLE_SEL	20	Used to select the block execution method for this resource. The Rosemount 5300 supports the following: Scheduled: Blocks are only executed based on the function block schedule. Block Execution: A block may be executed by linking to another blocks completion.

Parameter	Index Number	Description
CYCLE_TYPE	19	Identifies the block execution methods available for this resource.
DD_RESOURCE	09	String identifying the tag of the resource which contains the Device Description for this resource.
DD_REV	13	Revision of the DD associated with the resource - used by an interface device to locate the DD file for the resource.
DEFINE_WRITE_LOCK	60	Allows the operator to select how WRITE_LOCK behaves. The initial value is “lock everything”. If the value is set to “lock only physical device” then the resource and transducer blocks of the device will be locked but changes to function blocks will be allowed.
DETAILED_STATUS	55	Indicates the state of the transmitter. See Resource Block detailed status codes.
DEV_REV	12	Manufacturer revision number associated with the resource - used by an interface device to locate the DD file for the resource.
DEV_STRING	43	This is used to load new licensing into the device. The value can be written but will always read back with a value of 0.
DEV_TYPE	11	Manufacturer’s model number associated with the resource - used by interface devices to locate the DD file for the resource.
DIAG_OPTION	46	Indicates which diagnostics licensing options are enabled.
DISTRIBUTOR	42	Reserved for use as distributor ID. No Foundation enumerations defined at this time.
DOWNLOAD_MODE	67	Gives access to the boot block code for over-the-wire downloads. 0 = Uninitialized 1 = Run mode 2 = Download mode
FAULT_STATE	28	Condition set by loss of communication to an output block, fault promoted to an output block or physical contact. When FAIL_SAFE condition is set, then output function blocks will perform their FAIL_SAFE actions.
FAILED_ACTIVE	72	Enumerated list of failure conditions within a device.
FAILED_ALM	73	Alarm indicating a failure within a device which makes the device non-operational.
FAILED_ENABLE	70	Enabled FAILED_ALM alarm conditions. Corresponds bit for bit to the FAILED_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected.
FAILED_MASK	71	Mask of FAILED_ALM. Corresponds bit of bit to FAILED_ACTIVE. A bit on means that the condition is masked out from alarming.
FAILED_PRI	69	Designates the alarming priority of the FAILED_ALM.
FB_OPTION	45	Indicates which function block licensing options are enabled.
FEATURES	17	Used to show supported resource block options. The supported features are: SOFT_WRITE_LOCK_SUPPORT, HARD_WRITE_LOCK_SUPPORT, REPORTS, and UNICODE
FEATURES_SEL	18	Used to select resource block options.
FINAL_ASSY_NUM	54	The same final assembly number placed on the neck label.
FREE_SPACE	24	Percent of memory available for further configuration. Zero in a preconfigured device.
FREE_TIME	25	Percent of the block processing time that is free to process additional blocks.
GRANT_DENY	14	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device.
HARD_TYPES	15	The types of hardware available as channel numbers.
HARDWARE_REV	52	Hardware revision of the hardware that has the resource block in it.
HEALTH_INDEX	84	Parameter representing the overall health of the device, 100 being perfect and 1 being non-functioning. The value is based on the active PWA alarms.
ITK_VER	41	Major revision number of the inter operability test case used in certifying this device as interoperable. The format and range are controlled by the Fieldbus Foundation.
LIM_NOTIFY	32	Maximum number of unconfirmed alert notify messages allowed.
MAINT_ACTIVE	77	Enumerated list of maintenance conditions within a device.

Parameter	Index Number	Description
MAINT_ALM	78	Alarm indicating the device needs maintenance soon. If the condition is ignored, the device will eventually fail.
MAINT_ENABLE	75	Enabled MAINT_ALM alarm conditions. Corresponds bit for bit to the MAINT_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected.
MAINT_MASK	76	Mask of MAINT_ALM. Corresponds bit of bit to MAINT_ACTIVE. A bit on means that the condition is masked out from alarming.
MAINT_PRI	74	Designates the alarming priority of the MAINT_ALM
MANUFAC_ID	10	Manufacturer identification number – used by an interface device to locate the DD file for the resource.
MAX_NOTIFY	31	Maximum number of unconfirmed notify messages possible.
MEMORY_SIZE	22	Available configuration memory in the empty resource. To be checked before attempting a download.
MESSAGE_DATE	57	Date associated with the MESSAGE_TEXT parameter.
MESSAGE_TEXT	58	Used to indicate changes made by the user to the device's installation, configuration, or calibration.
MIN_CYCLE_T	21	Time duration of the shortest cycle interval of which the resource is capable.
MISC_OPTION	47	Indicates which miscellaneous licensing options are enabled.
MODE_BLK	05	The actual, target, permitted, and normal modes of the block: Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for actual
NV_CYCLE_T	23	Minimum time interval specified by the manufacturer for writing copies of NV parameters to non-volatile memory. Zero means it will never be automatically copied. At the end of NV_CYCLE_T, only those parameters which have changed need to be updated in NVRAM.
OUTPUT_BOARD_SN	53	Output board serial number.
PWA_SIMULATE	85	Parameter allowing simulation of PWA alarms.
RB_SFTWR_REV_ALL	51	The string will contains the following fields: Major rev: 1-3 characters, decimal number 0-255 Minor rev: 1-3 characters, decimal number 0-255 Build rev: 1-5 characters, decimal number 0-255 Time of build: 8 characters, xx:xx:xx, military time Day of week of build: 3 characters, Sun, Mon,... Month of build: 3 characters, Jan, Feb. Day of month of build: 1-2 characters, decimal number 1-31 Year of build: 4 characters, decimal Builder: 7 characters, login name of builder
RB_SFTWR_REV_BUILD	50	Build of software that the resource block was created with.
RB_SFTWR_REV_MAJOR	48	Major revision of software that the resource block was created with.
RB_SFTWR_REV_MINOR	49	Minor revision of software that the resource block was created with.
RECOMMENDED_ACTION	68	Enumerated list of recommended actions displayed with a device alert.
RESTART	16	Allows a manual restart to be initiated. Several degrees of restart are possible. They are the following: 1 Run – nominal state when not restarting 2 Restart resource – not used 3 Restart with defaults – set parameters to default values. See START_WITH_DEFAULTS below for which parameters are set. 4 Restart processor – does a warm start of CPU.
RS_STATE	07	State of the function block application state machine.
SAVE_CONFIG_BLOCKS	62	Number of EEPROM blocks that have been modified since last burn. This value will count down to zero when the configuration is saved.

Parameter	Index Number	Description
SAVE_CONFIG_NOW	61	Allows the user to optionally save all non-volatile information immediately.
SECURITY_IO	65	Status of security switch.
SELF_TEST	59	Instructs resource block to perform self-test. Tests are device specific.
SET_FSTATE	29	Allows the FAIL_SAFE condition to be manually initiated by selecting Set.
SHED_RCAS	26	Time duration at which to give up on computer writes to function block RCas locations. Shed from RCas shall never happen when SHED_ROUT = 0
SHED_ROUT	27	Time duration at which to give up on computer writes to function block ROut locations. Shed from ROut shall never happen when SHED_ROUT = 0
SIMULATE_IO	64	Status of simulate switch.
SIMULATE_STATE	66	The state of the simulate switch: 0 = Uninitialized 1 = Switch off, simulation not allowed 2 = Switch on, simulation not allowed (need to cycle jumper/switch) 3 = Switch on, simulation allowed
ST_REV	01	The revision level of the static data associated with the function block.
START_WITH_DEFAULTS	63	0 = Uninitialized 1 = do not power-up with NV defaults 2 = power-up with default node address 3 = power-up with default pd_tag and node address 4 = power-up with default data for the entire communications stack (no application data)
STRATEGY	03	The strategy field can be used to identify grouping of blocks.
SUMMARY_STATUS	56	An enumerated value of repair analysis.
TAG_DESC	02	The user description of the intended application of the block.
TEST_RW	08	Read/write test parameter - used only for conformance testing.
UPDATE_EVT	35	This alert is generated by any change to the static data.
WRITE_ALM	40	This alert is generated if the write lock parameter is cleared.
WRITE_LOCK	34	When hardware write protection is selected, WRITE_LOCK becomes an indicator of the jumper setting and is unavailable for software write protection. When software write lock is selected, and WRITE_LOCK is set, no writings from anywhere else are allowed, except to clear WRITE_LOCK. Block input will continue to be updated.
WRITE_PRI	39	Priority of the alarm generated by clearing the write lock.
XD_OPTION	44	Indicates which transducer block licensing options are enabled.

PlantWeb™ Alerts

The Resource Block will act as a coordinator for PlantWeb alerts. There will be three alarm parameters (FAILED_ALARM, MAINT_ALARM, and ADVISE_ALARM) which will contain information regarding some of the device errors which are detected by the transmitter software. There will be a RECOMMENDED_ACTION parameter which will be used to display the recommended action text for the highest priority alarm, and a HEALTH_INDEX parameter (0 - 100) indicating the overall health of the transmitter. FAILED_ALARM will have the highest priority followed by MAINT_ALARM, and ADVISE_ALARM will be the lowest priority.

FAILED_ALARMS

A failure alarm indicates a failure within a device that will make the device or some part of the device non-operational. This implies that the device is in need of repair and must be fixed immediately. There are five parameters associated with FAILED_ALARMS specifically, they are described below.

FAILED_ENABLED

This parameter contains a list of failures in the device which makes the device non-operational that will cause an alert to be sent. Below is a list of the failures:

1. Level / Interface Measurement Failure
2. Volume / Temperature Measurement Failure
3. Electronics Failure / Transducer Block
4. Probe Missing
5. Input / Output Failure
6. Non-Volatile Memory Failure
7. Electronics Failure / Output Board

Software Incompatibility Error*FAILED_MASK*

This parameter will mask any of the failed conditions listed in FAILED_ENABLED. A bit on means that the condition is masked out from alarming and will not be reported.

FAILED_PRI

Designates the alerting priority of the FAILED_ALM, see “Alarm Priority” on page I-7. The default is 0 and the recommended values are between 8 and 15.

FAILED_ACTIVE

This parameter displays which of the alarms is active. Only the alarm with the highest priority will be displayed. This priority is not the same as the FAILED_PRI parameter described above. This priority is hard coded within the device and is not user configurable.

FAILED_ALM

Alarm indicating a failure within a device which makes the device non-operational.

MAINT_ALARMS

A maintenance alarm indicates that the device or some part of the device needs maintenance soon. If the condition is ignored, the device will eventually fail. There are five parameters associated with MAINT_ALARMS, they are described below.

MAINT_ENABLED
The MAINT_ENABLED parameter contains a list of conditions indicating that the device or some part of the device needs maintenance soon.

Below is a list of the conditions:

1. Configuration Error
2. Configuration Warning
3. Simulation Mode
4. Volume / Temperature Measurement Warning
5. Vapor Compensation Warning

Probe Contamination*MAINT_MASK*
The MAINT_MASK parameter will mask any of the failed conditions listed in MAINT_ENABLED. A bit on means that the condition is masked out from alarming and will not be reported.

MAINT_PRI
MAINT_PRI designates the alarming priority of the MAINT_ALM, see “Process Alarms” on page I-7. The default is 0 and the recommended values are 3 to 7.

MAINT_ACTIVE
The MAINT_ACTIVE parameter displays which of the alarms is active. Only the condition with the highest priority will be displayed. This priority is not the same as the MAINT_PRI parameter described above. This priority is hard coded within the device and is not user configurable.

MAINT_ALM
An alarm indicating that the device needs maintenance soon. If the condition is ignored, the device will eventually fail.

Advisory Alarms
An advisory alarm indicates informative conditions that do not have a direct impact on the primary functions of the device. There are five parameters associated with ADVISE_ALARMS, they are described below.

ADVISE_ENABLED
The ADVISE_ENABLED parameter contains a list of informative conditions that do not have a direct impact on the primary functions of the device. Below is a list of the advisories:

1. Non-Volatile Writes Deferred
2. Electronics Warning - Transducer Block
3. PlantWeb Alerts Simulation

ADVISE_MASK
The ADVISE_MASK parameter will mask any of the failed conditions listed in ADVISE_ENABLED. A bit on means the condition is masked out from alarming and will not be reported.

ADVISE_PRI
ADVISE_PRI designates the alarming priority of the ADVISE_ALM, see “Process Alarms” on page I-7. The default is 0 and the recommended values are 1 or 2.

ADVISE_ACTIVE
The ADVISE_ACTIVE parameter displays which of the advisories is active. Only the advisory with the highest priority will be displayed. This priority is not the same as the ADVISE_PRI parameter described above. This priority is hard coded within the device and is not user configurable.

ADVISE_ALM
ADVISE_ALM is an alarm indicating advisory alarms. These conditions do not have a direct impact on the process or device integrity.

Alarm Priority

Alarms are grouped into five levels of priority:

Priority Number	Priority Description
0	The alarm condition is not used.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator.
3-7	Alarm conditions of priority 3 to 7 are advisory alarms of increasing priority.
8-15	Alarm conditions of priority 8 to 15 are critical alarms of increasing priority.

Process Alarms

Process Alarm detection is based on the OUT value. Configure the alarm limits of the following standard alarms:

- High (HI_LIM)
- High high (HI_HI_LIM)
- Low (LO_LIM)
- Low low (LO_LO_LIM)

To avoid alarm chattering when the variable is oscillating around the alarm limit, an alarm hysteresis in percent of the PV span can be set using the ALARM_HYS parameter. The priority of each alarm is set in the following parameters:

- HI_PRI
- HI_HI_PRI
- LO_PRI
- LO_LO_PRI

Recommended Actions for PlantWeb Alerts

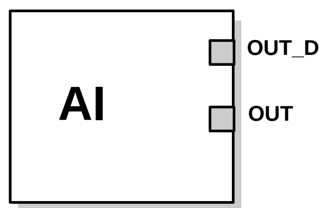
RECOMMENDED_ACTION
The RECOMMENDED_ACTION parameter displays a text string that will give a recommended course of action to take based on which type and which specific event of the PlantWeb alerts are active.

Table I-1. RB.RECOMMENDED_ACTION

	Alarm Type	Failed/Maint/Advise Active Event	Recommended Action Text String
PlantWeb Alerts	None	None	No action required
	Advisory	Non-Volatile Writes Deferred	Non-volatile writes have been deferred, leave the device powered until the advisory goes away.
		Electronics Warning - Transducer Block	Check device installation and configuration
		PlantWeb Alerts Simulation	Use the switch on the Fieldbus electronics board to turn simulation on or off.
	Maintenance	Probe Contamination	Clean the probe.
		Configuration Error	Load default database to the device and reconfigure it.
		Configuration Warning	Check device configuration
		Simulation Mode	Use **Start** / **Stop Device Simulation** to enable or disable simulation.
		Vapor Compensation Warning	1. Recalibrate vapor compensation. 2. Check Vapor DC configuration. 3. Check that the correct probe is attached.
		Volume/Temperature Measurement Warning	1. Check volume configuration. 2. Check ambient temperature at installation site. 3. If the surrounding temperature is OK, it might indicate a hardware error producing heat. Replace the transmitter head.
	Failed	Level / Interface Measurement Failure	1. Analyze echo curve for reason and check device configuration. 2. Check device physical installation (for instance probe contamination). 3. Load default database to the device and reconfigure it. 4. If error persists, it might indicate a hardware error. Replace the transmitter head.
		Volume / Temperature Measurement Failure	1. If Level Measurement Failure is active, clear that alert first. 2. Check volume configuration. 3. Load default database to the device and reconfigure it. 4. Check ambient temperature at installation site. 5. If error persists, it might indicate a hardware error. Replace the transmitter head.
		Electronics Failure - Transducer Block	Replace transmitter head.
		Probe Missing	Check that the probe is properly connected.
		Input / Output Failure	Replace the transmitter.
		Non-Volatile Memory Failure	1. Load default database to the device to clear the error. 2. Download a device configuration. 3. If error persists, it may indicate a faulty memory chip. Replace the transmitter head.
		Electronics Failure - Output Board	Replace the transmitter.
		Software Incompatible Error	Replace the device.

Appendix J Analog-Input Block

Figure J-1. Analog-Input Block



OUT=The block output value and status
OUT_D=Discrete output that signals a selected alarm condition

The Analog Input (AI) function block processes field device measurements and makes them available to other function blocks. The output value from the AI block is in engineering units and contains a status indicating the quality of the measurement. The measuring device may have several measurements or derived values available in different channels. Use the channel number to define the variable that the AI block processes.

The AI block supports alarming, signal scaling, signal filtering, signal status calculation, mode control, and simulation. In Automatic mode, the block's output parameter (OUT) reflects the process variable (PV) value and status. In Manual mode, OUT may be set manually. The Manual mode is reflected on the output status. A discrete output (OUT_D) is provided to indicate whether a selected alarm condition is active. Alarm detection is based on the OUT value and user specified alarm limits. Figure J-2 on page J-4 illustrates the internal components of the AI function block, and Table J-1 lists the AI block parameters and their units of measure, descriptions, and index numbers.

Table J-1. Definitions of Analog Input Function Block System Parameters

Parameter	Index Number	Units	Description
ACK_OPTION	23	None	Used to set auto acknowledgment of alarms.
ALARM_HYS	24	Percent	The amount the alarm value must return within the alarm limit before the associated active alarm condition clears.
ALARM_SEL	38	None	Used to select the process alarm conditions that will cause the OUT_D parameter to be set.
ALARM_SUM	22	None	The summary alarm is used for all process alarms in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
ALERT_KEY	04	None	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
BLOCK_ALM	21	None	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
BLOCK_ERR	06	None	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
CHANNEL	15	None	The CHANNEL value is used to select the measurement value. Refer to the appropriate device manual for information about the specific channels available in each device. You must configure the CHANNEL parameter before you can configure the XD_SCALE parameter.
FIELD_VAL	19	Percent	The value and status from the transducer block or from the simulated input when simulation is enabled.
GRANT_DENY	12	None	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device.
HI_ALM	34	None	The HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
HI_HI_ALM	33	None	The HI HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
HI_HI_LIM	26	EU of PV_SCALE	The setting for the alarm limit used to detect the HI HI alarm condition.
HI_HI_PRI	25	None	The priority of the HI HI alarm.
HI_LIM	28	EU of PV_SCALE	The setting for the alarm limit used to detect the HI alarm condition.
HI_PRI	27	None	The priority of the HI alarm.
IO_OPTS	13	None	Allows the selection of input/output options used to alter the PV. Low cutoff enabled is the only selectable option.
L_TYPE	16	None	Linearization type. Determines whether the field value is used directly (Direct) or is converted linearly (Indirect).
LO_ALM	35	None	The LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
LO_LIM	30	EU of PV_SCALE	The setting for the alarm limit used to detect the LO alarm condition.
LO_LO_ALM	36	None	The LO LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
LO_LO_LIM	32	EU of PV_SCALE	The setting for the alarm limit used to detect the LO LO alarm condition.
LO_LO_PRI	31	None	The priority of the LO LO alarm.

Parameter	Index Number	Units	Description
LO_PRI	29	None	The priority of the LO alarm.
LOW_CUT	17	%	If percentage value of transducer input fails below this, PV = 0.
MODE_BLK	05	None	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
OUT	08	EU of OUT_SCALE	The block output value and status.
OUT_D	37	None	Discrete output to indicate a selected alarm condition.
OUT_SCALE	11	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with OUT.
PV	07	EU of XD_SCALE	The process variable used in block execution.
PV_FTIME	18	Seconds	The time constant of the first-order PV filter. It is the time required for a 63% change in the IN value.
SIMULATE	09	None	A group of data that contains the current transducer value and status, the simulated transducer value and status, and the enable/disable bit.
STRATEGY	03	None	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ST_REV	01	None	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
TAG_DESC	02	None	The user description of the intended application of the block.
UPDATE_EVT	20	None	This alert is generated by any change to the static data.
VAR_INDEX	39	% of OUT Range	The average absolute error between the PV and its previous mean value over that evaluation time defined by VAR_SCAN.
VAR_SCAN	40	Seconds	The time over which the VAR_INDEX is evaluated.
XD_SCALE	10	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with the channel input value.

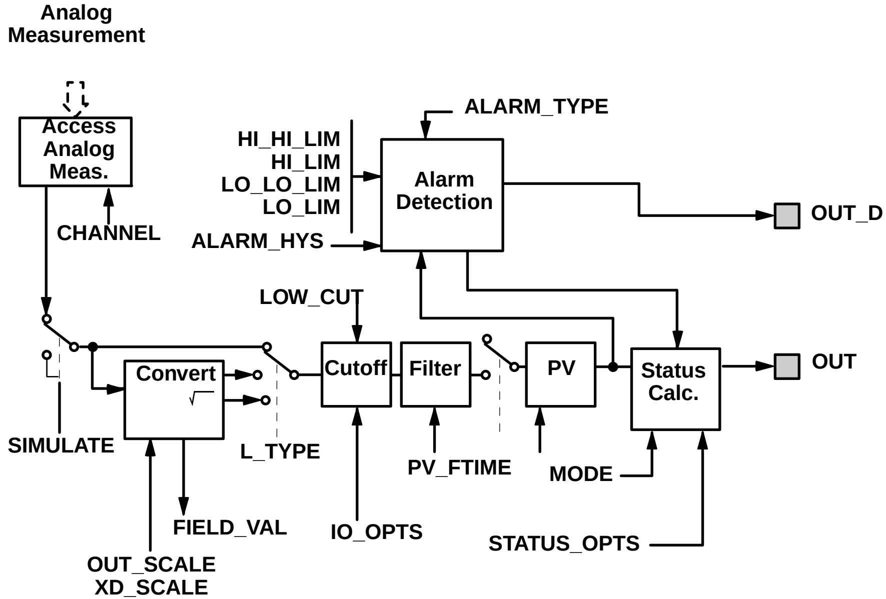
SIMULATION

To support testing, you can either change the mode of the block to manual and adjust the output value, or you can enable simulation through the configuration tool and manually enter a value for the measurement value and its status. In both cases, you must first set the ENABLE jumper on the field device.

NOTE!
All fieldbus instruments have a simulation jumper. As a safety measure, the jumper has to be reset every time there is a power interruption. This measure is to prevent devices that went through simulation in the staging process from being installed with simulation enabled.

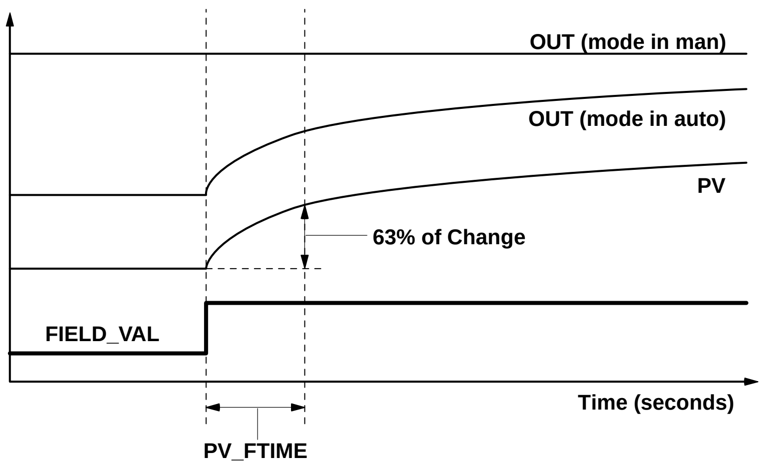
With simulation enabled, the actual measurement value has no impact on the OUT value or the status.

Figure J-2. Analog Input Function Block Schematic



NOTES:
OUT = block output value and status.
OUT_D = discrete output that signals a selected alarm condition.

Figure J-3. Analog Input Function Block Timing Diagram



DAMPING

The filtering feature changes the response time of the device to smooth variations in output readings caused by rapid changes in input. You can adjust the filter time constant (in seconds) using the PV_FTIME parameter. Set the filter time constant to zero to disable the filter feature.

SIGNAL CONVERSION

You can set the signal conversion type with the Linearization Type (L_TYPE) parameter. You can view the converted signal (in percent of XD_SCALE) through the FIELD_VAL parameter.

$$\text{FIELD\_VAL} = \frac{100 \times (\text{Channel Value} - \text{EU*@0\%})}{(\text{EU*@100\%} - \text{EU*@0\%})}$$

*** XD_SCALE values**

You can choose from direct or indirect signal conversion with the L_TYPE parameter.

Direct

Direct signal conversion allows the signal to pass through the accessed channel input value (or the simulated value when simulation is enabled).

$$\text{PV} = \text{Channel Value}$$

Indirect

Indirect signal conversion converts the signal linearly to the accessed channel input value (or the simulated value when simulation is enabled) from its specified range (XD_SCALE) to the range and units of the PV and OUT parameters (OUT_SCALE).

$$\text{PV} = \left(\frac{\text{FIELD\_VAL}}{100}\right) \times (\text{EU**@100\%} - \text{EU**@0\%}) + \text{EU**@0\%}$$

**** OUT_SCALE values**

Indirect Square Root

Indirect Square Root signal conversion takes the square root of the value computed with the indirect signal conversion and scales it to the range and units of the PV and OUT parameters..

$$\text{PV} \quad \sqrt{\left(\frac{\text{FIELD\_VAL}}{100}\right)} \times (\text{EU**@100\%} \quad \text{EU**@0\%}) \quad \text{EU**@0\%}$$

**** OUT_SCALE values**

When the converted input value is below the limit specified by the LOW_CUT parameter, and the Low Cutoff I/O option (IO_OPTS) is enabled (True), a value of zero is used for the converted value (PV). This option is useful to eliminate false readings when the differential pressure measurement is close to zero, and it may also be useful with zero-based measurement devices such as flowmeters.

NOTE!
Low Cutoff is the only I/O option supported by the AI block. You can set the I/O option in **Manual** or **Out of Service** mode only.

BLOCK ERRORS

Table J-2 lists conditions reported in the BLOCK_ERR parameter.

Table J-2. BLOCK_ERR Conditions

Condition Number	Condition Name and Description
0	Other
1	**Block Configuration Error:** the selected channel carries a measurement that is incompatible with the engineering units selected in XD_SCALE, the L_TYPE parameter is not configured, or CHANNEL = zero.
2	Link Configuration Error
3	**Simulate Active:** Simulation is enabled and the block is using a simulated value in its execution.
4	Local Override
5	Device Fault State Set
6	Device Needs Maintenance Soon
7	**Input Failure/Process Variable has Bad Status:** The hardware is bad, or a bad status is being simulated.
8	**Output Failure:** The output is bad based primarily upon a bad input.
9	Memory Failure
10	Lost Static Data
11	Lost NV Data
12	Readback Check Failed
13	Device Needs Maintenance Now
14	Power Up
15	**Out of Service:** The actual mode is out of service.

MODES

The AI Function Block supports three modes of operation as defined by the MODE_BLK parameter:

- **Manual (Man)** The block output (OUT) may be set manually
- **Automatic (Auto)** OUT reflects the analog input measurement or the simulated value when simulation is enabled
- **Out of Service (O/S)** The block is not processed. FIELD_VAL and PV are not updated and the OUT status is set to Bad: Out of Service. The BLOCK_ERR parameter shows Out of Service. In this mode, you can make changes to all configurable parameters. The target mode of a block may be restricted to one or more of the supported modes.

ALARM DETECTION

A block alarm will be generated whenever the BLOCK_ERR has an error bit set. The types of block error for the AI block are defined above.

Process Alarm detection is based on the OUT value. You can configure the alarm limits of the following standard alarms:

- High (HI_LIM)
- High high (HI_HI_LIM)
- Low (LO_LIM)
- Low low (LO_LO_LIM)

In order to avoid alarm chattering when the variable is oscillating around the alarm limit, an alarm hysteresis in percent of the PV span can be set using the ALARM_HYS parameter. The priority of each alarm is set in the following parameters:

- HI_PRI
- HI_HI_PRI
- LO_PRI
- LO_LO_PRI

Alarms are grouped into five levels of priority:

Table J-3. Alarm level priority

Priority Number	Priority Description
0	The priority of an alarm condition changes to 0 after the condition that caused the alarm is corrected.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator, but does not require operator attention (such as diagnostics and system alerts).
3-7	Alarm conditions of priority 3 to 7 are advisory alarms of increasing priority.
8-15	Alarm conditions of priority 8 to 15 are critical alarms of increasing priority.

Status Handling

Normally, the status of the PV reflects the status of the measurement value, the operating condition of the I/O card, and any active alarm condition. In Auto mode, OUT reflects the value and status quality of the PV. In Man mode, the OUT status constant limit is set to indicate that the value is a constant and the OUT status is *Good*.

The **Uncertain** - EU range violation status is always set, and the PV status is set high- or low-limited if the sensor limits for conversion are exceeded.

In the STATUS_OPTS parameter, you can select from the following options to control the status handling:

BAD if Limited – sets the OUT status quality to *Bad* when the value is higher or lower than the sensor limits.

Uncertain if Limited – sets the OUT status quality to *Uncertain* when the value is higher or lower than the sensor limits.

Uncertain if in Manual mode – The status of the Output is set to *Uncertain* when the mode is set to Manual.

NOTE!
The instrument must be in **Manual** or **Out of Service** mode to set the status option.
The AI block only supports the **BAD if Limited** option. Unsupported options are not grayed out; they appear on the screen in the same manner as supported options.

ADVANCED FEATURES

The AI function block provided with Fisher-Rosemount fieldbus devices provides added capability through the addition of the following parameters:

ALARM_TYPE – Allows one or more of the process alarm conditions detected by the AI function block to be used in setting its OUT_D parameter.

OUT_D – Discrete output of the AI function block based on the detection of process alarm condition(s). This parameter may be linked to other function blocks that require a discrete input based on the detected alarm condition.

VAR_SCAN – Time period in seconds over which the variability index (VAR_INDEX) is computed.

VAR_INDEX – Process variability index measured as the integral of average absolute error between PV and its mean value over the previous evaluation period. This index is calculated as a percent of OUT span and is updated at the end of the time period defined by VAR_SCAN.

CONFIGURE THE AI BLOCK

⚠ A minimum of four parameters are required to configure the AI Block. The parameters are described below with example configurations shown at the end of this section.

CHANNEL

Select the channel that corresponds to the desired sensor measurement. The Rosemount 5300 measures Level (channel 1), Distance (channel 2), Level Rate (channel 3), Signal Strength (channel 4), Volume (channel 5), Internal Temperature (channel 6), Upper Product Volume (channel 7), Lower Product Volume (channel 8), Interface Distance (channel 9), Upper Product Thickness (channel 10), Interface Level (channel 11), Interface Level Rate (channel 12), and Interface Signal Strength (channel 13).

AI Block	TB Channel Value	Process Variable
Level	1	CHANNEL_RADAR_LEVEL
Ullage	2	CHANNEL_RADAR_ULLAGE
Level Rate	3	CHANNEL_RADAR_LEVELRATE
Signal Strength	4	CHANNEL_RADAR_SIGNAL_STRENGTH
Volume	5	CHANNEL_RADAR_VOLUME
Internal Temperature	6	CHANNEL_RADAR_INTERNAL_TEMPERATURE
Upper Product Volume	7	CHANNEL_UPPER_PRODUCT_VOLUME
Lower Product Volume	8	CHANNEL_LOWER_ PRODUCT_VOLUME
Interface Distance	9	CHANNEL_INTERFACE_ DISTANCE
Upper Product Thickness	10	CHANNEL_UPPER_ PRODUCT_THICKNESS
Interface Level	11	CHANNEL_INTERFACE_LEVEL
Interface Level Rate	12	CHANNEL_INTERFACE_ LEVELRATE
Interface Signal Strength	13	CHANNEL_INTERFACE_ SIGNALSTRENGTH
Signal Quality	14	CHANNEL_SIGNAL_QUALITY
Surface/Noise Margin	15	CHANNEL_ SURFACE_NOISE_MARGIN
Vapor DC	16	CHANNEL_VAPOR_DC

L_TYPE

The L_TYPE parameter defines the relationship of the transmitter measurement (Level, Distance, Level Rate, Signal Strength, Volume, and Average Temperature) to the desired output of the AI Block. The relationship can be direct or indirect root.

Direct
Select direct when the desired output will be the same as the transmitter measurement (Level, Distance, Level Rate, Signal Strength, Volume, and Average Temperature).

Indirect
Select indirect when the desired output is a calculated measurement based on the transmitter measurement (Level, Distance, Level Rate, Signal Strength, Volume, and Average Temperature). The relationship between the transmitter measurement and the calculated measurement will be linear.

Indirect Square Root
Select indirect square root when the desired output is an inferred measurement based on the transmitter measurement and the relationship between the sensor measurement and the inferred measurement is square root (e.g. level).

XD_SCALE and OUT_SCALE

The XD_SCALE and OUT_SCALE each include three parameters: 0%, 100%, and, engineering units. Set these based on the L_TYPE:

L_TYPE is Direct
When the desired output is the measured variable, set the XD_SCALE to represent the operating range of the process. Set OUT_SCALE to match XD_SCALE.

L_TYPE is Indirect
When an inferred measurement is made based on the sensor measurement, set the XD_SCALE to represent the operating range that the sensor will see in the process. Determine the inferred measurement values that correspond to the XD_SCALE 0 and 100% points and set these for the OUT_SCALE.

L_TYPE is Indirect Square Root
When an inferred measurement is made based on the transmitter measurement and the relationship between the inferred measurement and sensor measurement is square root, set the XD_SCALE to represent the operating range that the sensor will see in the process. Determine the inferred measurement values that correspond to the XD_SCALE 0 and 100% points and set these for the OUT_SCALE.

NOTE!
To avoid configuration errors, only select Engineering Units for XD_SCALE and OUT_SCALE that are supported by the device. The supported units are:

Table J-4. Length

Display	Description
m	meter
cm	centimeter
mm	millimeter
ft	feet
in	inch

Table J-5. Level Rate

Display	Description
m/s	meter per second
m/h	meter per hour
ft/s	feet per second
in/m	inch/minute

Table J-6. Temperature

Display	Description
°C	Degree Celsius
°F	Degree Fahrenheit

Table J-7. Signal Strength

Display	Description
mV	millivolt

Table J-8. Volume

Display	Description
m^3	Cubic meter
L	Liter
in^3	Cubic inch
ft^3	Cubic feet
Yd^3	Cubic yard
Gallon	US gallon
ImpGall	Imperial gallon
bbl	barrel

Index

Standard Terms and Conditions of Sale can be found at www.rosemount.com\terms_of_sale.

Emerson Process Management
Rosemount Measurement
8200 Market Boulevard
Chanhassen MN 55317 USA
Tel (USA) 1 800 999 9307
Tel (International) +1 952 906 8888
Fax +1 952 949 7001

Emerson Process Management
Blegistrasse 23
P.O. Box 1046
CH 6341 Baar
Switzerland
Tel +41 (0) 41 768 6111
Fax + 41 (0) 41 768 6300

Emerson FZE
P.O. Box 17033
Jebel Ali Free Zone
Dubai UAE
Tel +971 4 811 8100
Fax + 971 4 886 5465

Emerson Process Management Asia Pacific Pte Ltd
1 Pandan Crescent
Singapore 128461
Tel +65 6777 8211
Fax +65 6777 0947
Service Support Hotline: +65 6770 8711
Email: Enquiries@AP.EmersonProcess.com