Reference Manual
00809-0100-4530, Rev AA
June 2007

Rosemount 5300 Series

High Performance Guided Wave Radar



HART® FIELD COMMUNICATIONS PROTOCOL

FOUNDATION®

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EMERSON™
Process Management

Reference Manual
00809-0100-4530, Rev AA
June 2007

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, Rosemount Inc. 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 Rosemount 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 Rosemount Sales Representative.

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

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

Cover Photo: 5300_coverphoto.tif

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

MANUAL OVERVIEW

This manual provides installation, configuration and maintenance information for the Rosemount 3300 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
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Appendix D: Level Transducer Block
Describes the operation and parameters of the Level transducer block.

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

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

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

Appendix H: 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 Rosemount representative.

Within the United States, call the Rosemount National 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.

Rosemount National 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.

Section 2 Transmitter Overview

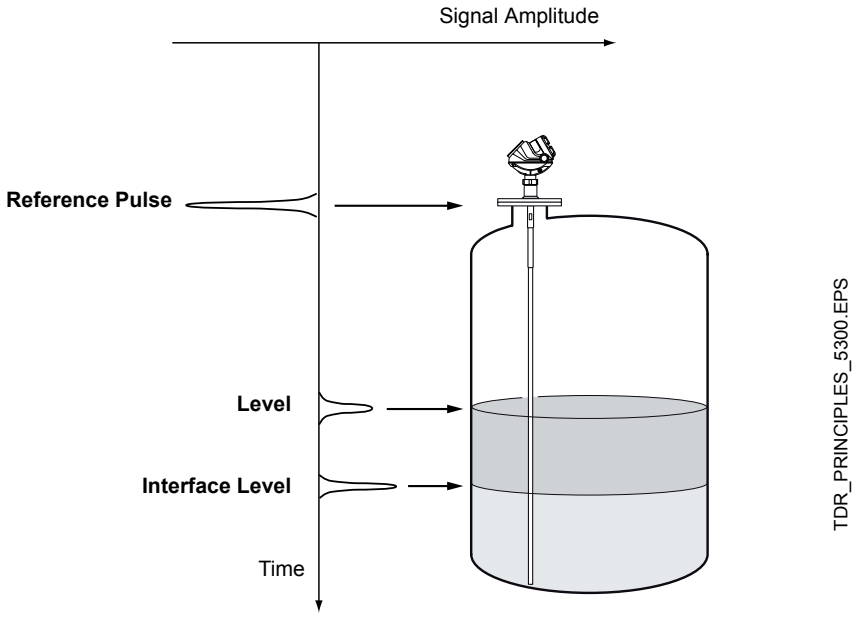
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THEORY OF OPERATION

The Rosemount 5300 Series Radar Transmitter is a smart, two-wire continuous level transmitter that is based on Time Domain Reflectometry (TDR) principles. Low power nano-second-pulses are guided along a probe immersed in the process media. When a pulse reaches the surface of the material it is measuring, 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 from which the total level or interface level is calculated (see below).

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

Figure 2-1. Measurement Principle.



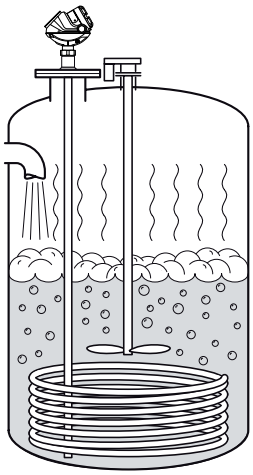
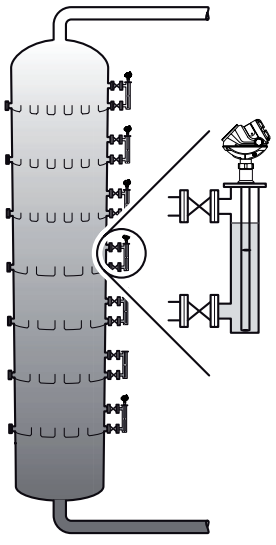
APPLICATIONS

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

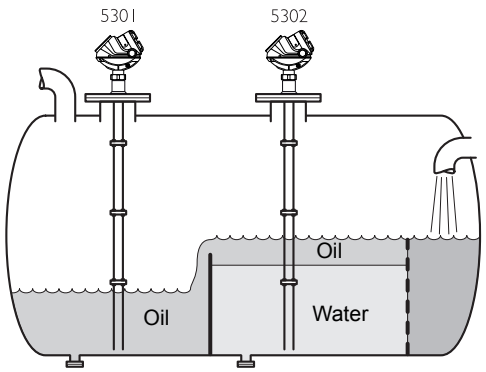
Guided microwave technology offers highest reliability and precision which ensure measurements are virtually unaffected by temperature, pressure, vapor gas mixtures, density, turbulence, bubbling/boiling, low level, varying dielectric media, pH, and viscosity.

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

Figure 2-2. Application examples

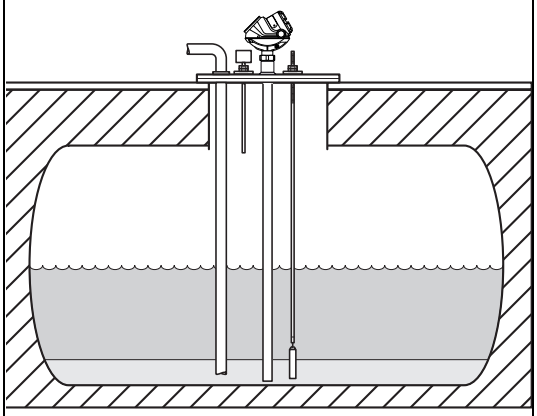
APPLICATION_TURBULENCE.EPS 	The 5300 transmitter works well in boiling conditions with vapor and turbulence. If there are disturbing objects in the vicinity of the transmitter the coaxial probe is particularly suitable.
APPLICATION_BRIDLE.EPS 	The Rosemount 5300 Series of transmitters is well suited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

APPLICATIONS_SEPARATOR.EPS



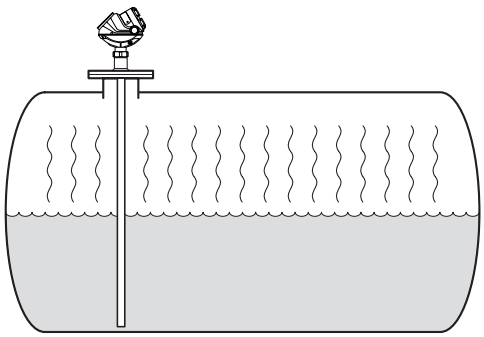
Separator tank. The Rosemount 5302 measures both level and interface level.

APPLICATIONS_UNDERGROUND.EPS



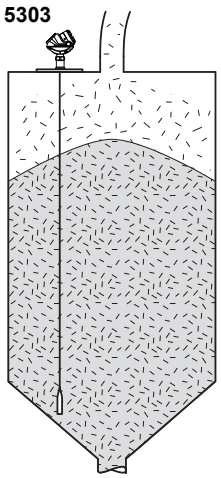
The Rosemount 5300 series is a good choice for underground tanks since it is installed on the tank top with the radar pulse concentrated near the probe. It can be equipped with probes that are unaffected by high and narrow openings or nearby objects.

APPLICATIONS_AMMONIA.EPS



Guided wave radar technology is a good choice for reliable measurements in ammonia, NGL and LPG tanks.

APPLICATIONS_SOLIDS.EPS



Model 5303 with a flexible single lead probe is the solution for solids, powders and granules.
It measures independently of dust, angled surfaces etc.

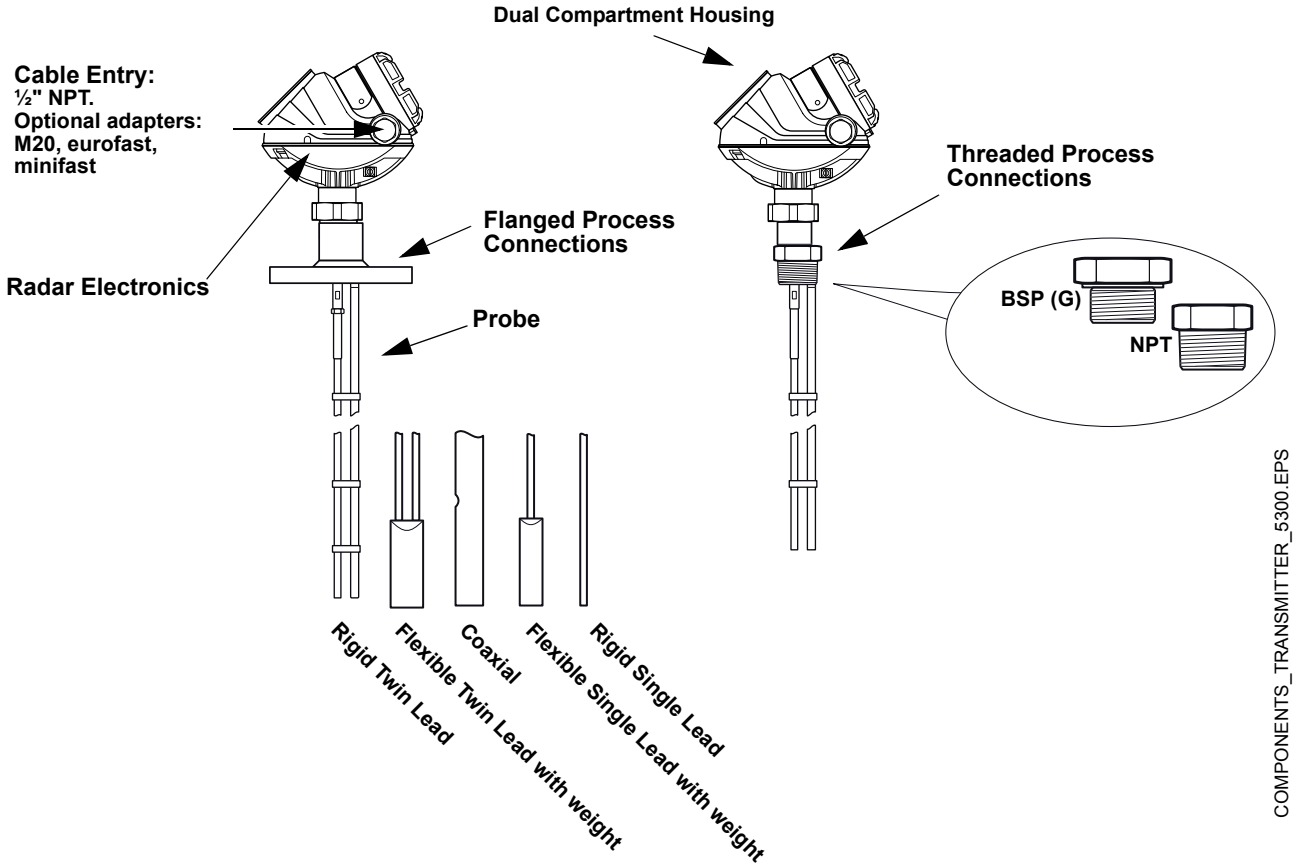
COMPONENTS OF THE TRANSMITTER

The Rosemount 5300 Series Radar Transmitter has an aluminum *transmitter housing* which contains advanced electronics and software for signal processing.

The *radar electronics* produces an electromagnetic pulse which is guided by the *probe*.

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.



SYSTEM ARCHITECTURE

The Rosemount 5300 Series Radar Transmitter is loop-powered which means 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 signal or FOUNDATION Fieldbus.

By using the optional HART Tri-loop, it is possible to convert the HART signal to up to three additional 4-20 mA analog signals.

With the HART protocol it is possible to use multidrop configuration. 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 by using a 375 Field Communicator or a PC with the Rosemount Radar Master software. Rosemount 5300 Series transmitters are also compatible with the AMS Suite and DeltaV software, and other tools supporting Electronic Device Description Language (EDDL) functionality. These tools can be used for configuration.

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

Figure 2-4. HART system architecture

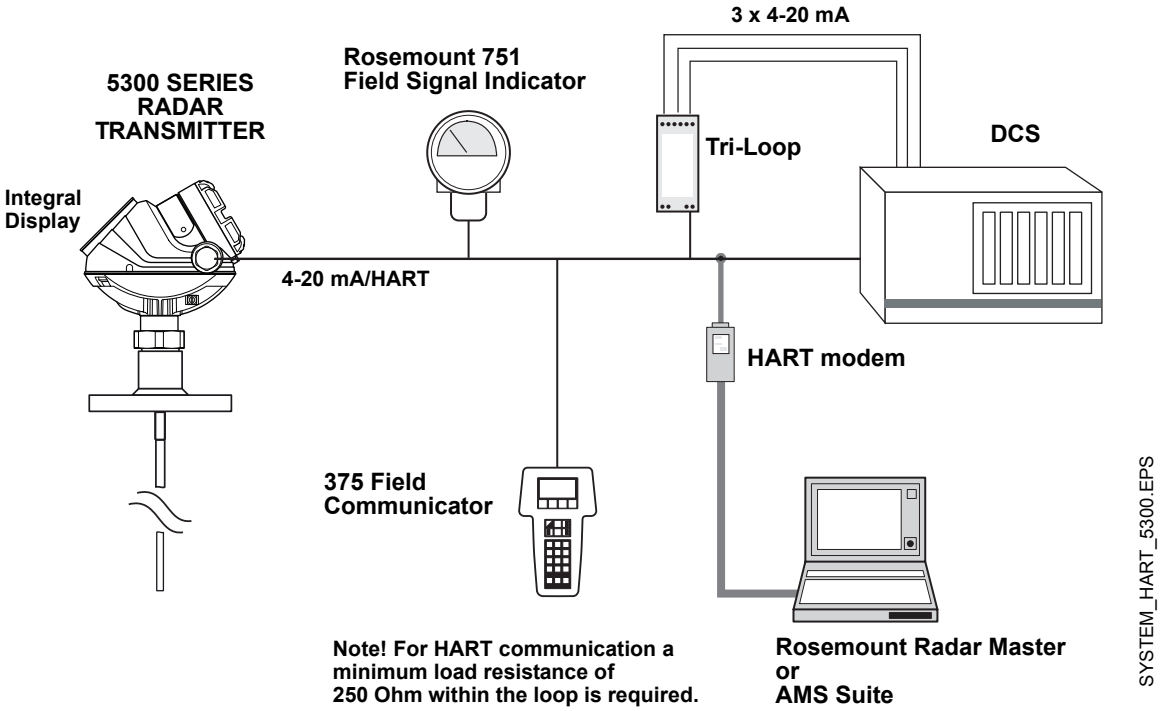
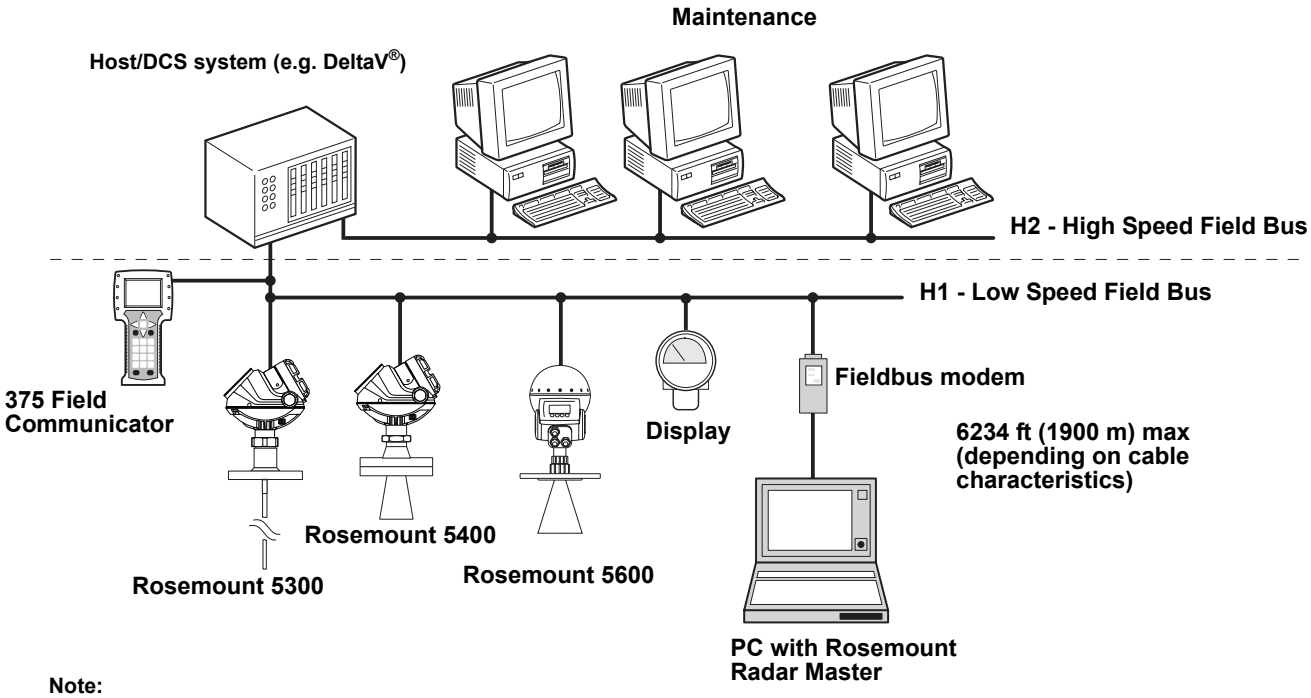


Figure 2-5. FOUNDATION®
Fieldbus system architecture



PROBE SELECTION GUIDE

Use the following guidelines to choose appropriate probe for your 5300 transmitter:

Table 2-1. Probe selection guide. G=Good, NR=Not Recommended, AD=Application Dependent (consult factory)

	Coaxial	Rigid Twin Lead	Flexible Twin Lead	Rigid Single Lead	Flexible Single Lead
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	G	G	G	AD
Foam (mechanical avoidance)	AD	NR	NR	NR	NR
Foam (top of foam measurement)	NR	AD	AD	AD	AD
Foam (foam and liquid measurement)	NR	AD	AD	AD	AD
Clean liquids	G	G	G	G	G
Liquid with very low dielectric constants, see also Table 2-4.	G	G	G(2)	G	G(2)
Coating/sticky liquids	NR	NR	NR	AD	AD
Viscous liquids	NR	AD	AD	AD	G
Crystallizing liquids	NR	NR	NR	AD	AD
Solids, granules, powders	NR	NR	NR	AD	G
Fibrous liquids	NR	NR	NR	G	G
Tank Environment Considerations					
Probe is close (<12 in./30 cm) to tank wall / disturbing objects	G	G	G	AD	AD
Probe might touch tank wall, nozzle or disturbing objects	G	NR	NR	NR	NR
Turbulence	G	G	AD	G	AD
Turbulent conditions causing breaking forces	NR	NR	AD	NR	AD
Tall, narrow nozzles	G	AD	AD	NR	NR
Angled or slanted surface (viscous or solids materials)	NR	AD	AD	G	G
Liquid or vapor spray might touch probe above surface	G	NR	NR	NR	NR
Disturbing Electromagnetic interference in tank	G	AD	AD	AD	AD
Cleanability of probe	NR	AD	AD	G	G

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

Transition Zones

The measuring range depends on probe type and properties of the product, and is limited by the Upper and Lower Transition Zones. In these zones measurements may have reduced accuracy. 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 range is reduced by the **Lower Transition Zone**. The Transition Zones vary depending on probe type and product.

Figure 2-6 illustrates how the measuring range is related to the Transition Zones:

Figure 2-6. Transition Zones

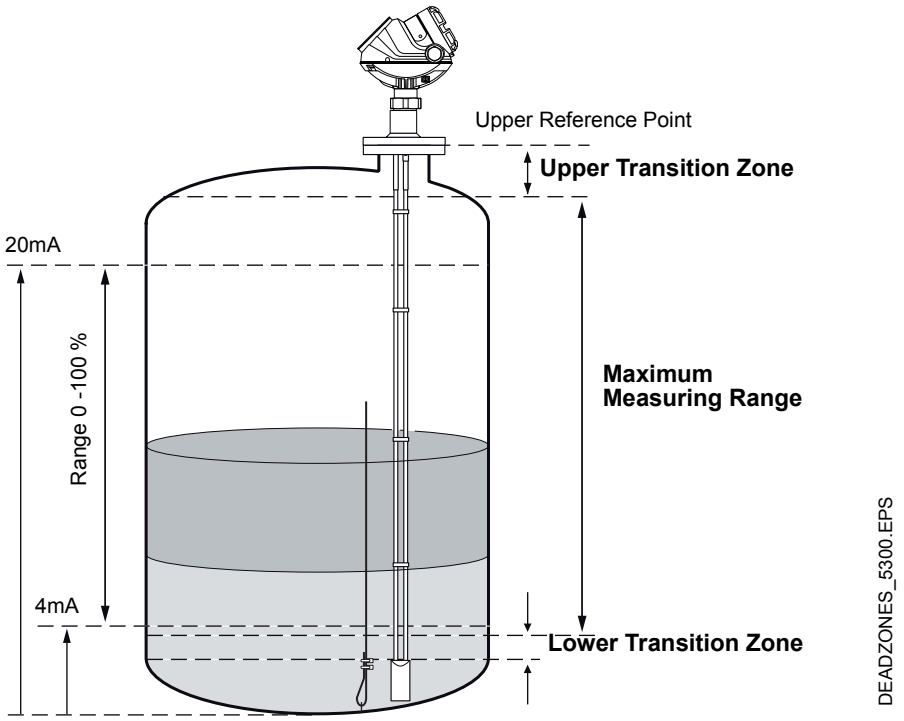


Table 2-2. Transition Zones for different probe types and dielectric constants

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

(1) Note that the weight length adds to non-measurable area and is not included in the diagram.
(2) The measuring range for the PTFE covered Flexible Single Lead probe includes the weight when measuring on a high dielectric media.
(3) Transition Zone=8 inch (20 cm) including weight, if applicable, when SST centering disc is mounted. The PTFE centering disc does not affect the Transition Zone.

NOTE
Measurements in the Transition Zones may be non-linear, or with reduced accuracy. Therefore it is recommended to set the 4-20 mA points between the Transition Zones.

PROCESS CHARACTERISTICS

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

Coating

Coating on the probe should be avoided since the sensitivity of the transmitter may be decreased leading 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 factory if agitation/turbulence and high viscous products.
(2) HTHP and HP single probes should be used with precaution in viscous or crystallizing media. Cooling of high temperature vapor in the upper part of the probe may lead to condensation and deposition that blocks the measurement signal.

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

Bridging

Heavy coating that results in product bridging across the two probes for twin lead versions, or between the pipe and the inner rod for coaxial probes, will cause erroneous level readings and must be prevented. Single lead probes are preferred in this case. If a Twin Lead probe is required, regular cleaning may be necessary.

Foam

How well the Rosemount 5300 Series Radar Transmitter measures in foamy applications depends upon the properties of the foam; light and airy or dense and heavy, high or low dielectrics, etc. If the foam is conductive and creamy the transmitter will probably measure the surface of the foam. If the foam is less conductive the microwaves will probably penetrate the foam and measure the liquid surface.

Vapor

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

Measuring Range

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

Table 2-4. Measuring Range

Coaxial	Rigid Twin Lead	Flexible Twin Lead	Rigid Single Lead	Flexible Single Lead[1]
Maximum Measuring Range				
19 ft 8 in. (6 m)	9 ft 10 in. (3 m)	164 ft (50 m)	9 ft 10 in. (3 m)	164 ft (50 m)
Minimum Dielectric Constant at Maximum Measuring Range				
1.2 (Standard) 1.4 (HP) 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)	1.4 (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) Probe end projection software function will improve the minimum dielectric constant. Consult factory for details.
(2) May be lower depending on installation.

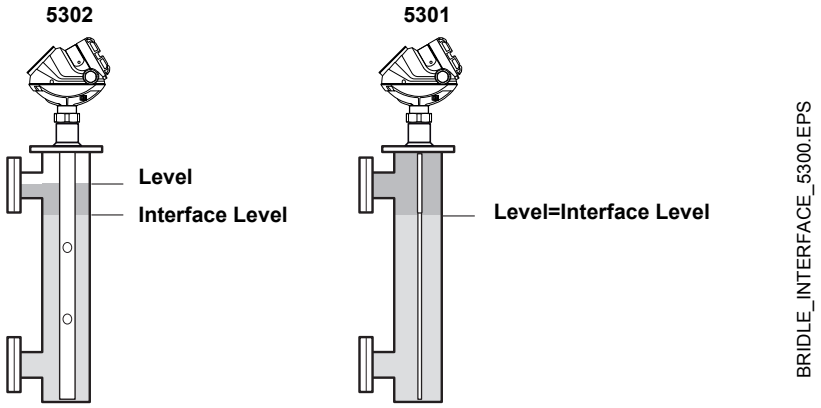
The maximum measuring range differs depending on application according to:

- Disturbing objects close to the probe.
- Media with higher dielectric constant (ε_r) gives better reflection and allows a longer measuring range.
- Surface foam and particles in the tank atmosphere are also circumstances that might affect measuring performance.
- Coating/contamination can reduce the measuring range.
- 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 in applications where the probe is fully submerged in the liquid.

Figure 2-7. Interface measurement with a Rosemount 5302 and a Rosemount 5301 (fully submerged probe).



For measuring the interface level, the transmitter uses the residual wave of the first reflection. Part of the wave, which was 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.

If interface is to be measured, the following criteria have to be fulfilled:

- The dielectric constant of the upper product must be known and should not vary. The Rosemount Radar Master software has a built-in dielectric constant calculator to assist the user in determining the dielectric constant of the upper product. (see “Dielectric Constant/Dielectric Range” on page 5-22).
- The dielectric constant of the upper product must have a lower dielectric constant than the lower product in order to have a distinct reflection.
- The difference between the dielectric constants for the two products must be larger than 6.
- Maximum dielectric constant for the upper product is 10 for the coaxial probe, 7 for the twin lead and 8 for the single lead probes.
- The upper product thickness must be larger than 5.1 in. (0.13 m) for all probes except the HTHP coaxial probe, which requires 8 in. (0.2 m), in order 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 low (<3) upper product dielectric constant and high (>20) lower product dielectric constant.

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

For the flexible probes, the maximum measuring range will be reduced depending on maximum upper product thickness according to the diagram below. However, characteristics vary widely between different applications.

Figure 2-8. Maximum Upper Product thickness for the Flexible Single Lead probe.

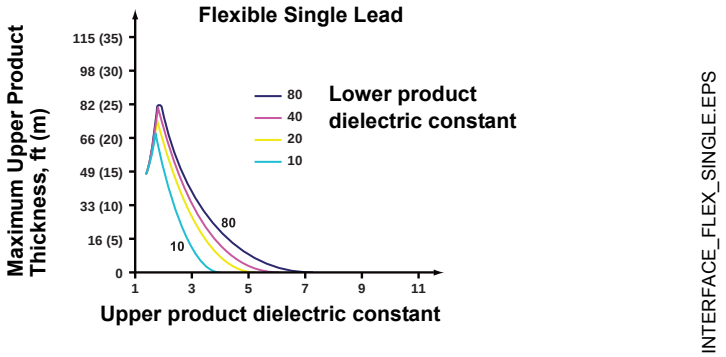
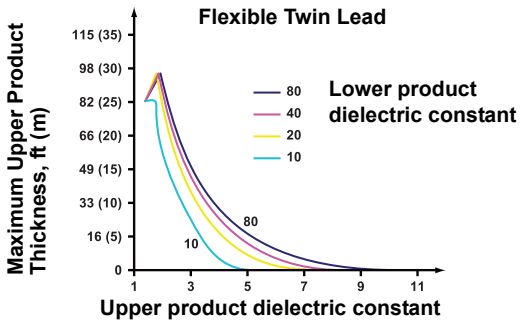


Figure 2-9. Maximum Upper Prodcut thickness for the Flexible Twin Lead probe.



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

Emulsion Layers

Sometimes there is an emulsion layer (mix of the products) between the two products which can affect interface measurements. For assistance with emulsion applications, consult factory.

VESSEL CHARACTERISTICS

Heating Coils, Agitators

The Rosemount 5300 Series Radar Transmitter is relatively insensitive to objects in the tank since the radar signal is transmitted along a probe. Avoid physical contact with metallic objects if 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 can move within 1 ft (30 cm) away from any object, such as an agitator, during operation then probe tie-down is recommended.

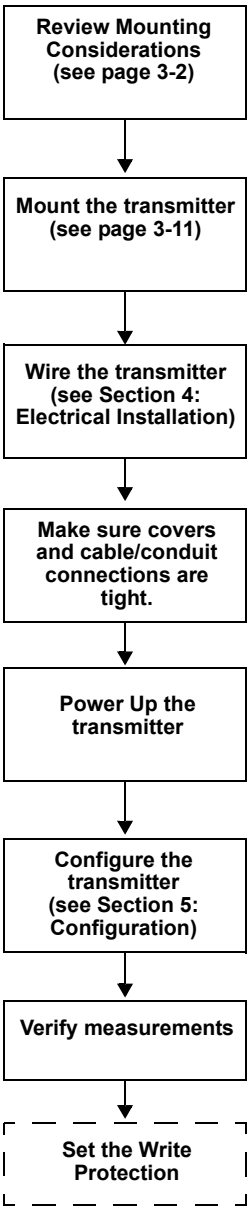
In order to stabilize the probe for side forces, it is possible to hang a weight at the probe end (flexible probes only) or fix/guide the probe to the tank bottom.

Tank Shape

The guided wave radar transmitter is insensitive to the 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 handles flat or dish-bottom tanks equally well.

INSTALLATION PROCEDURE

Follow these steps for proper installation:



Section 3 Mechanical Installation

Safety messages . . . . . page 3-1
Mounting Considerations . . . . . page 3-2
Mounting . . . . . page 3-11

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 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:

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.

MOUNTING CONSIDERATIONS

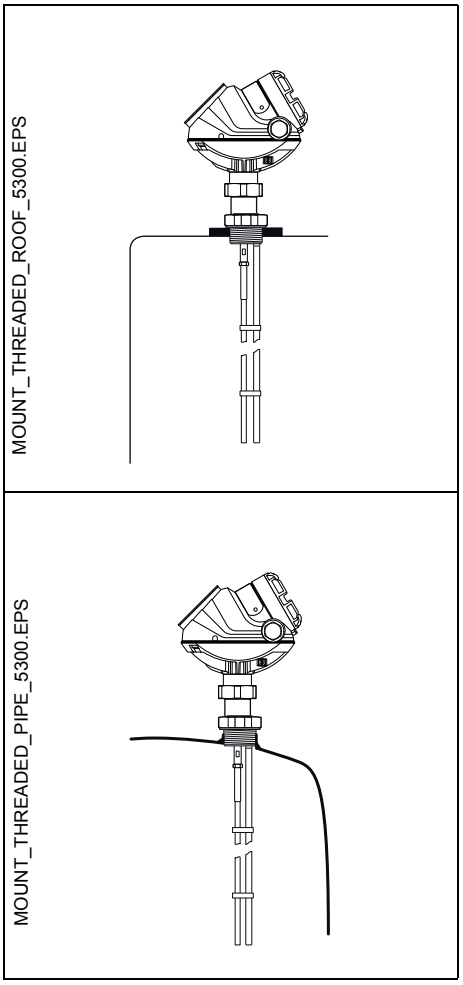
Before you install the Rosemount 5300 Series Radar Transmitter, be sure to consider specific mounting requirements, vessel characteristics and process characteristics.

Process Connection

The 5300 Series has a threaded connection for easy mounting on the 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

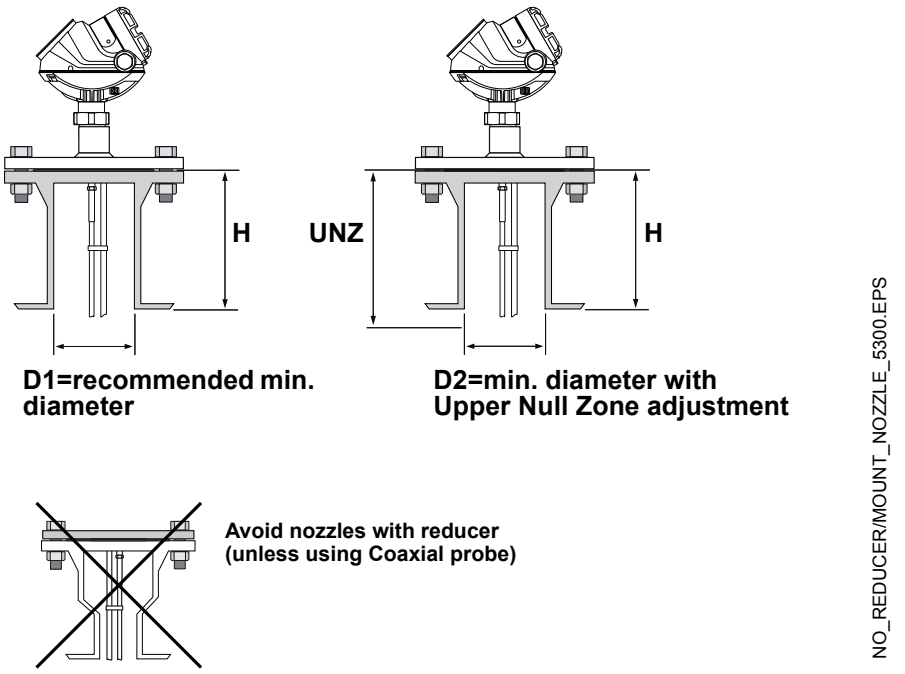


Mounting on tank roof.

Mounting in threaded pipe.

Flange Connection on Nozzles

Figure 3-2. Mounting in nozzles



The transmitter can be mounted in nozzles by using an appropriate flange. It is recommended that the nozzle size is within the dimensions given in *Table 3-1*. For small nozzles it may be necessary to increase the Upper Null Zone (UNZ) in order to reduce the measuring range in the upper part of the tank. See also section *"Disturbance Echo Handling" on page 7-8*. Amplitude Threshold adjustments may also be needed in this case.

NOTE
Except for the Coaxial Probe the probe must not be in contact with the nozzle. If nozzle diameter is less than the recommended, the measuring range may be reduced.

Table 3-1. Minimum nozzle diameter D1/D2 and maximum nozzle height H (inch/mm).

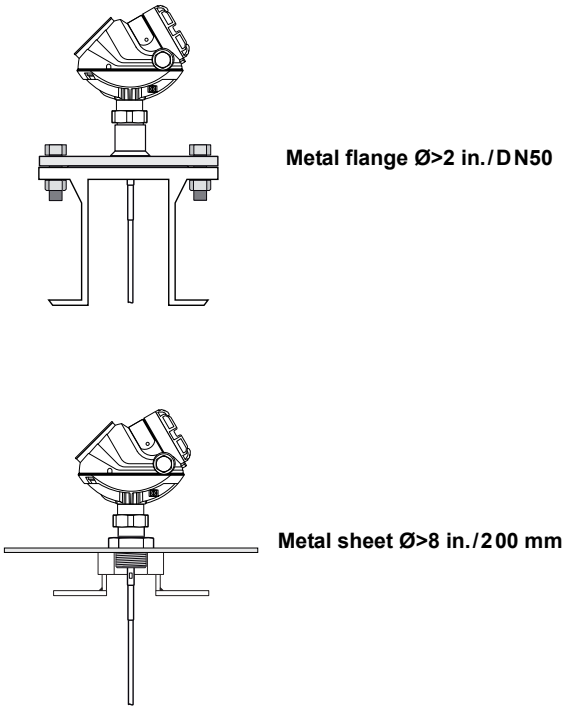
	Rigid Twin Lead	Flexible Twin Lead	Coaxial	Single Lead	Flexible Single
D1(1)	4/100	4/100	> Probe diameter	6/150	6/150
D2(2)	2/50	2/50	> Probe diameter	2/50(3) 1.5/38(4)	2/50
H(5)	4/100 + D(6)	4/100 + D(6)	-	4/100 + D(6)	4/100 + D(6) (7)

(1) Upper Null Zone=0.
(2) Upper Null Zone>0.
(3) Process connection 1.5 inch.
(4) Process connection 1 inch.
(5) Recommended maximum nozzle height. For coaxial probes there is no limitation on nozzle height.
(6) Nozzle diameter.
(7) For tall nozzles the Long Stud version is recommended (option code LS).

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.

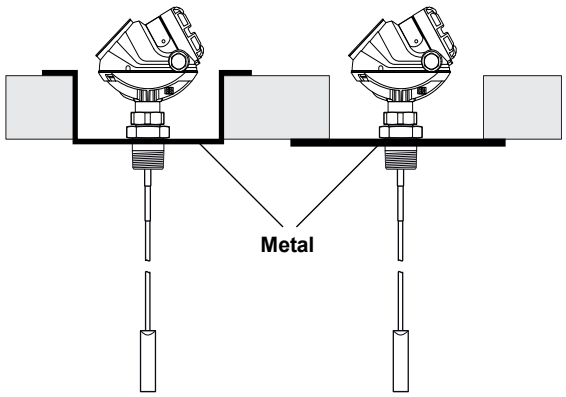
Figure 3-3. Mounting in non-metallic vessels.



5300_NON-METAL_METALSHEET.EPS/5300_NON-METAL_FLANGE.EPS

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

Installation in Concrete Silos



Considerations for Solid Applications

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

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

It is important to keep the following in mind when planning for installation of the Rosemount 5300 in solid applications:

- There might be considerable down-pull forces on silo roofs, caused by the media. The silo roof must withstand the maximum probe pulling force.
- The pulling force depends on the silo size, material density and the friction coefficient. Forces increase with the buried length and the silo diameter.
- Depending on their position, forces on probes are generally two to ten times greater on probes with tie-down than on probes with ballast weights(1).

The table below shows guidelines for the tensile load from free-flowing solids acting on a suspended probe without any tie-down or weight in a silo with smooth metallic walls. A safety factor of 2 is included for the figures. Consult factory for more information.

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

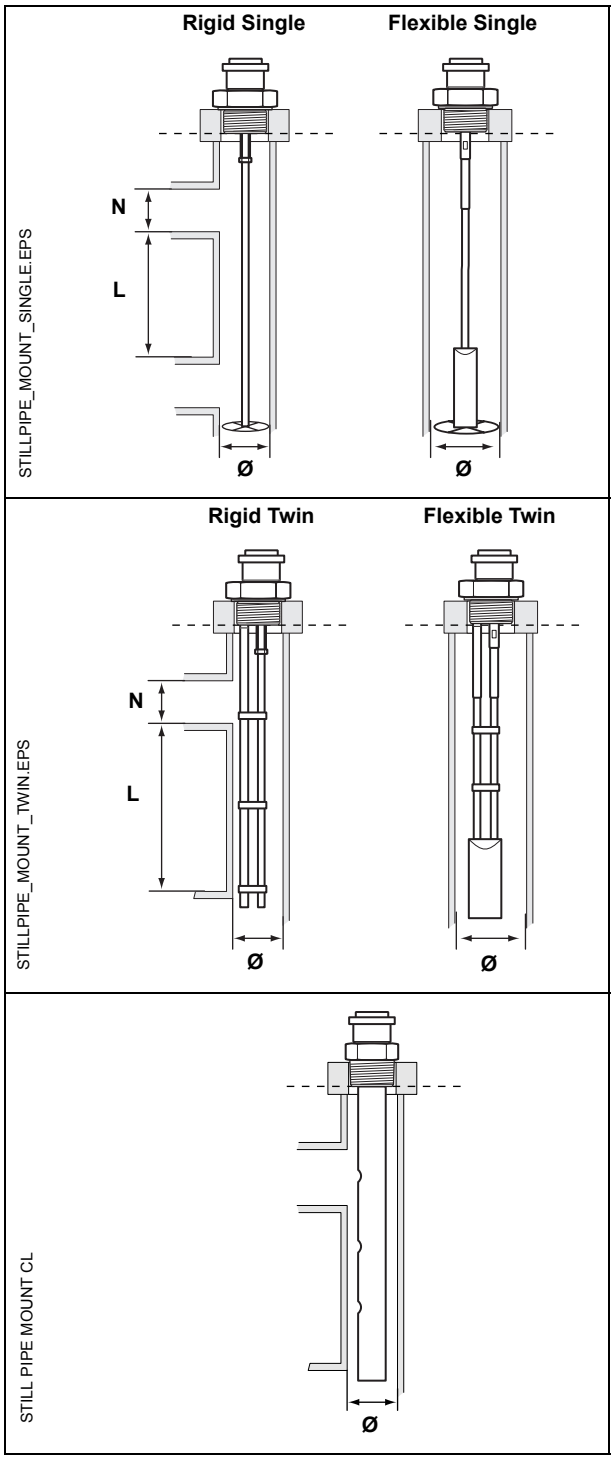
Material	**Tensile load for 0.16 in. (4 mm) flexible single lead probe, lb (kN)**				**Tensile load for 0.24 in. (6 mm) flexible single lead probe, lb (kN)**			
	Probe length 49 ft (15 m)		**Probe length 115 ft (35 m)**		**Probe length 49 ft (15 m)**		**Probe length 115 ft (35 m)**	
	Tank Ø= 10 ft (3 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

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

Mounting in Still pipes/by-pass pipes

In order to prevent the probe from contacting the bridle wall when replacing displacers or installing in pipes, **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 bridle. The discs are available in stainless steel and teflon (PTFE). See also *"Mounting a Centering Disc for Pipe Installations" on page 3-19*.

Figure 3-4. Mounting in Still Pipes.



Note! It is not recommended that flexible probes be installed in by-pass pipes with less than 4 inch diameter.

Rigid Single Lead.
Pipe diameter Ø≥2 inch (50 mm).
Inlet pipe diameter N<Ø.
L≥12 inch (300 mm).

Flexible Single Lead.
Pipe diameter Ø≥4 inch (100 mm).
Note! For smaller pipes please consult factory.

Make sure that the probe is at the center of the Still pipe by, for example, using a centering disc.

Note! It is not recommended that flexible probes be installed in by-pass pipes.

Rigid Twin Lead.
Pipe diameter Ø≥2 inch (50 mm).
Inlet pipe diameter N<Ø.
L≥12 inch (300 mm).
The center rod must be placed more than 0.6 inch/15 mm away from the pipe wall.

Flexible Twin Lead.
Pipe diameter Ø≥4 inch (100 mm).
Note! For smaller pipes please consult factory.

The center rod must be placed more than 0.6 inch/15 mm away from the pipe wall. The probe may under no circumstance contact the pipe wall. It is recommended that a centering disc is used.

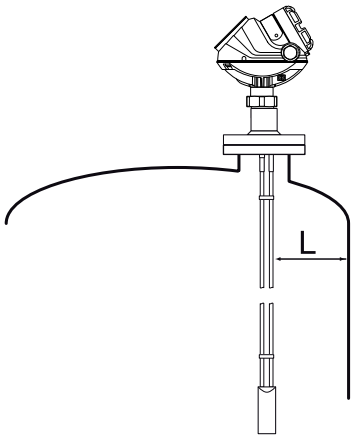
Coaxial Lead.
Pipe diameter Ø≥1.5 inch (38 mm).

Free Space

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

If the probe is mounted close to a wall, nozzle or other tank obstruction noise might appear in the level signal. Therefore the following minimum clearance, according to the table below, must be maintained:

Figure 3-5. Free Space Requirement



5300_FREE_SPACE.EPS

Table 3-3. 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 3-4. Recommended minimum free space **L** to tank wall or other objects in the tank for Single Lead probes.

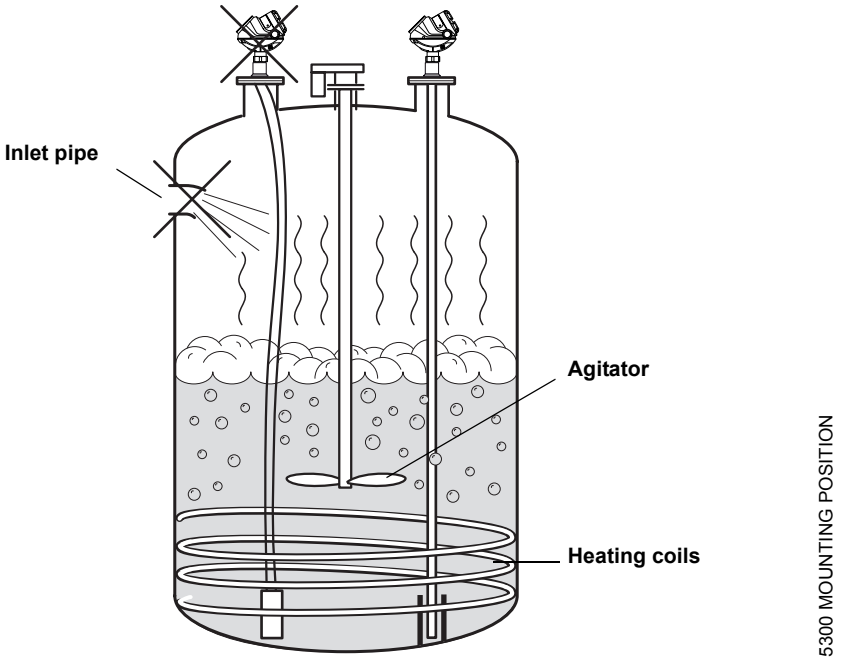
Rigid Single/Flexible Single	
4 in. (100 mm)	Smooth metal wall.
20 in. (500 mm)	Disturbing objects such as pipes and beams, concrete or plastic tank walls, rugged metal tank walls.

Recommended Mounting Position for Liquids

When finding an appropriate mounting position for the transmitter the conditions in the tank must be carefully considered. The transmitter should be mounted so that 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 3-16* for more information.

Figure 3-6. Mounting Position

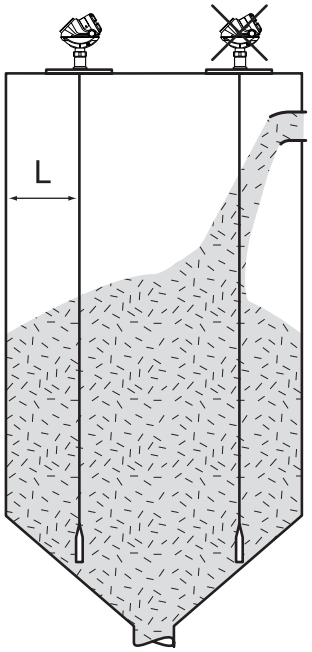


The following guidelines should be considered when mounting the transmitter:

- 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 due to turbulent conditions in the tank, the probe should be anchored to the tank bottom.
- Avoid mounting close to heating coils.
- Make sure that the nozzle does not extend into the tank.
- Make sure that the probe does not come into contact with the nozzle or other objects in the tank.
- Position the probe such that it is subject to a minimum of lateral force.

NOTE!
Violent fluid movements causing high sideways force may break rigid probes.

Recommended Mounting for Solids



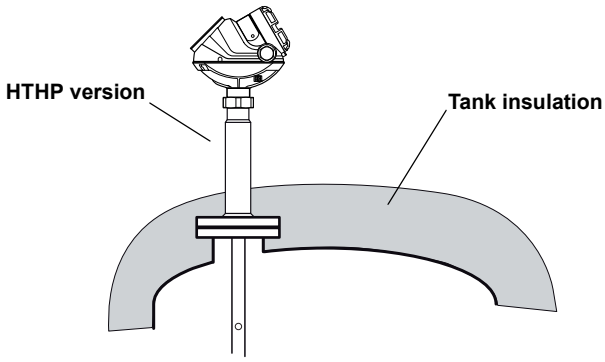
MOUNTING_SOLIDS.EPS

The following guidelines should be considered when mounting the transmitter:

- Do not mount close to inlet pipes in order to avoid product filling on the probe.
- Regularly check that the probe has no defects.
- It is recommended that installation is carried out when the vessel is empty.
- In concrete vessels the distance L between the probe and the wall should be at least 500 mm (20 in.).
- In order to stabilize the probe for side forces, it is possible to fix the probe to the tank bottom.
  For solids, consider using the 0.24 in. (6 mm) probe since it has 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 3-16 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 3-5.
- Product build-up on the silo walls close to the probe may interfere with measurements. Choose a mounting position which makes sure that the probe is not in contact with, or very close to, the product build-up.

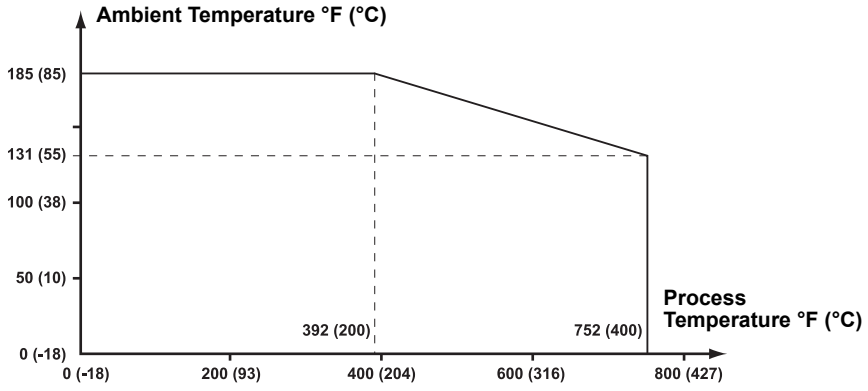
Insulated Tanks

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



INSULATEDTANK_5300

Figure 3-7. Maximum ambient temperature vs. process temperature.



AMBIENT_PROC_TEMP.EPS

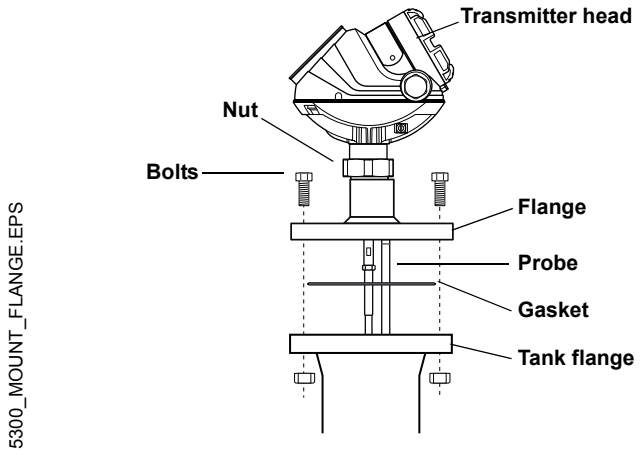
MOUNTING

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.

Flange Connection

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.

Figure 3-8. Tank connection with flange.

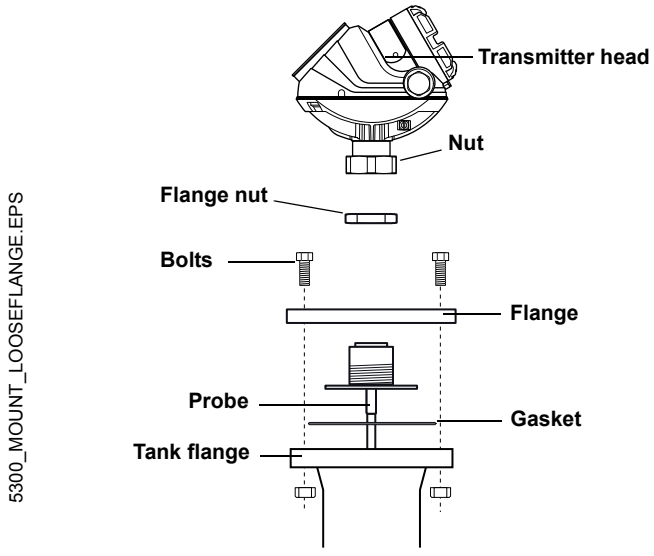


The transmitter is delivered with head, flange and probe assembled into one unit.

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.

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

Figure 3-9. Tank connection with loose flange ("plate design").



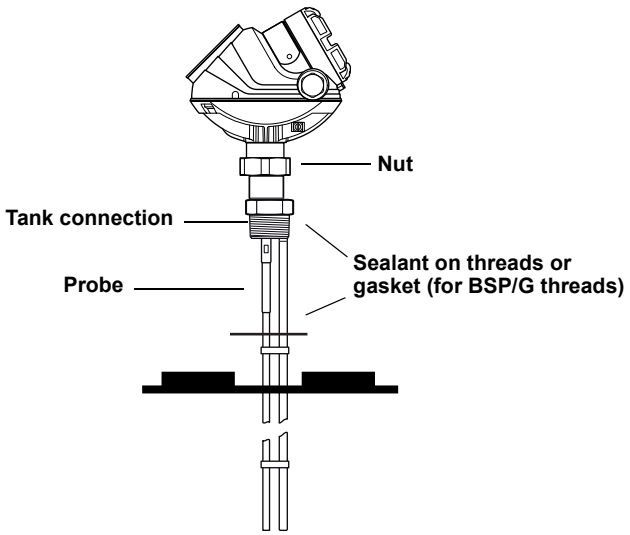
Transmitters delivered with Hastelloy or Monel probes are mounted as described below:

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 factory.

Threaded Connection

Figure 3-10. Threaded tank connection.

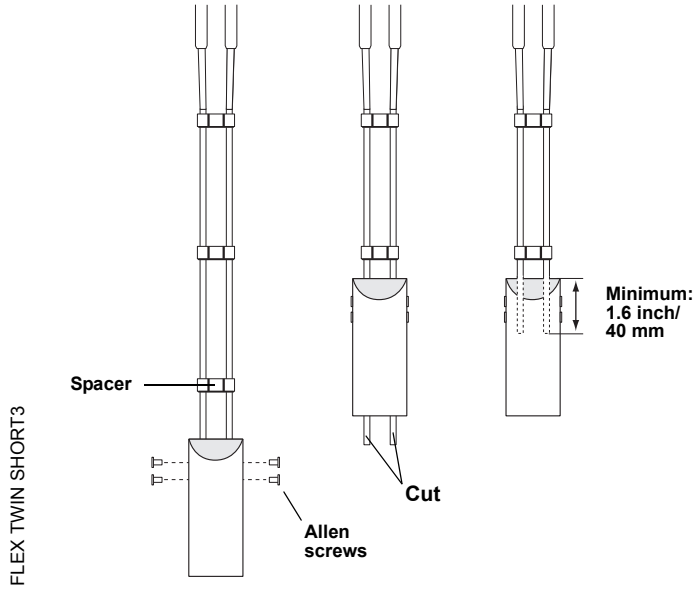


1. For tank connections with BSP/G threads, place a gasket on top of the tank flange, or use a sealant on the threads of the tank connection.
2. Lower the transmitter and probe into the tank.
3. Screw the adapter into the process connection.
4. Loosen the nut that connects the transmitter housing to 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.

Shortening the Probe

Flexible Twin/Single Lead



1. Mark off the required probe length. Add at least 1.6 inch/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 5-3 and “Probe“ on page 5-20.

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

Rigid Single Lead

1. Cut the Single Lead probe to the desired length.
2. Update the transmitter configuration to the new probe length, see “Tank and Probe Geometry“ on page 5-3 and “Probe“ on page 5-20.

NOTE!
The PTFE covered probes must not be cut in field.

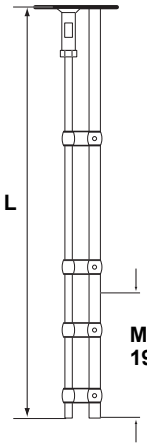
NOTE!
If the screws are not tightened according to required torque the weight may fall off. This is especially important for solid applications with high tensile loads on the probe.

Rigid Twin Lead

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

To cut a Rigid Twin Lead probe do the following:

L>46.5 in. (1180 mm)



RIGIDTWIN_SHORT_BA.EPS

1. Cut the rods to the desired length:
   - You may cut up to 19.7 inch (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).

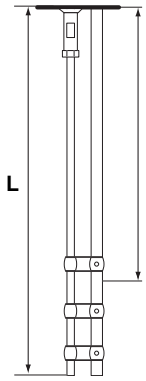
20.5 < L<46.5 inch
(520 mm< L <1180 mm)



RIGIDTWIN_SHORT_BA_2.EPS

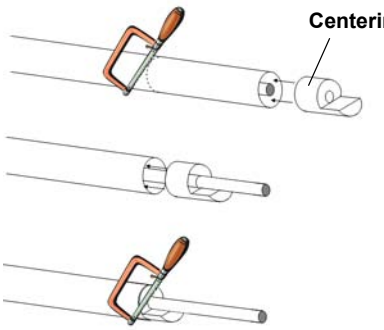
2. Update the transmitter configuration to the new probe length, see see “Tank and Probe Geometry“ on page 5-3 and “Probe“ on page 5-20.

15.7< L<20.5 inch
(400< L<520 mm)



RIGIDTWIN_SHORT_BA_3.EPS

Coaxial

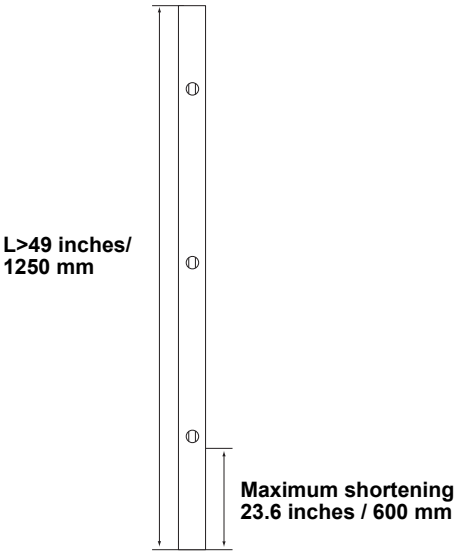


COAXIAL_CUT.TIF

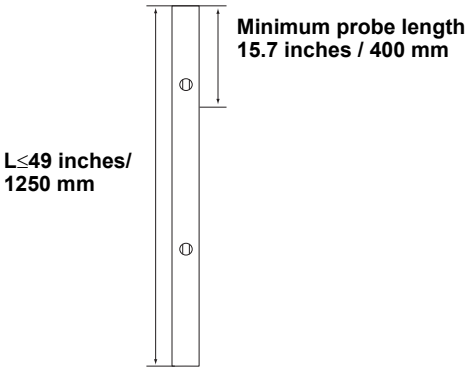
To cut a coaxial probe do the following:

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 inches/1250 mm can be shortened by as much as 23.6 inches/600 mm.
   - Pipes shorter than 49 inches/1250 mm can be cut as long as the remaining length is not less than 15.7 inches/400 mm.



COAXIAL SHORT1



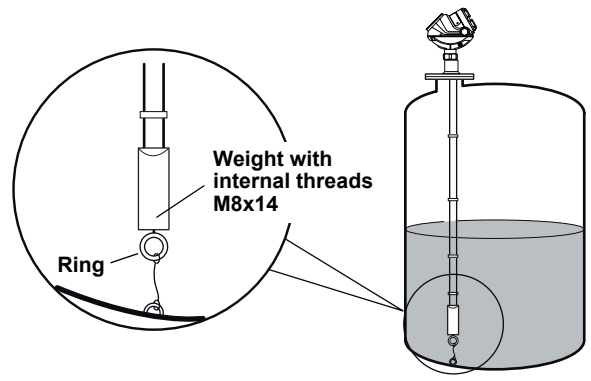
COAXIAL SHORT2

5. Update the transmitter configuration to the new probe length, see “Tank and Probe Geometry“ on page 5-3 and “Probe“ on page 5-20.

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 in order to prevent the probe from hitting the tank wall or other objects in the tank, as well as preventing a probe from breaking.

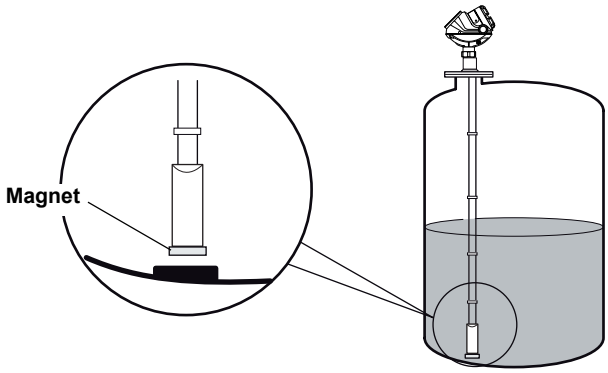
PROBEANCHOR RING FLEXIBLE TWIN



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.

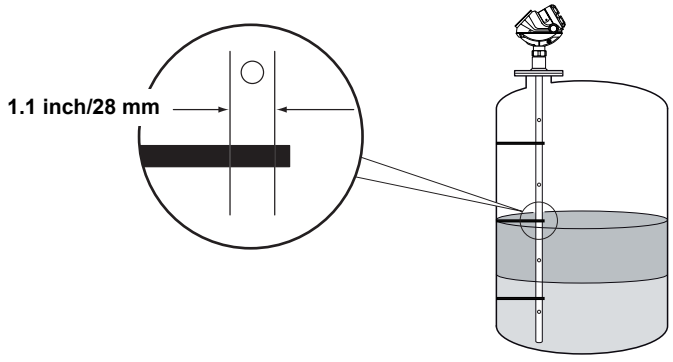
PROBEANCHOR MAGNET FLEXIBLE TWIN



Flexible Twin/Single Lead probe with weight and magnet.

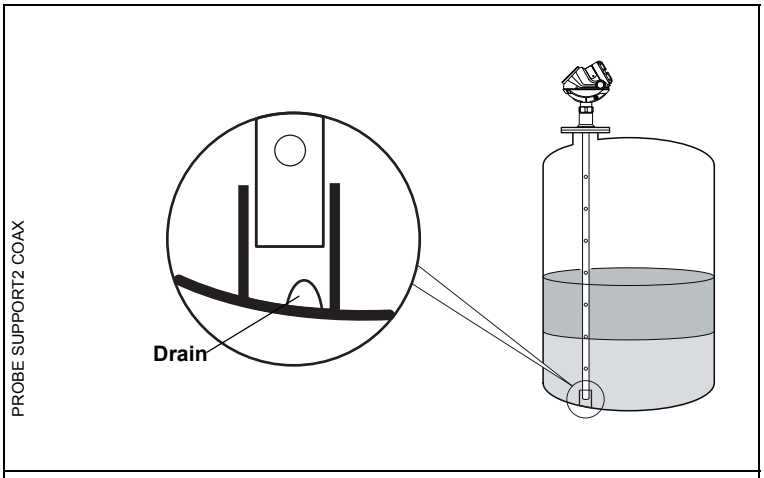
A magnet (customer supplied) can be fastened in a threaded (M8x14) hole at the end of the weight. The probe can then be guided by placing a suitable metal plate beneath the magnet.

PROBE SUPPORT COAX



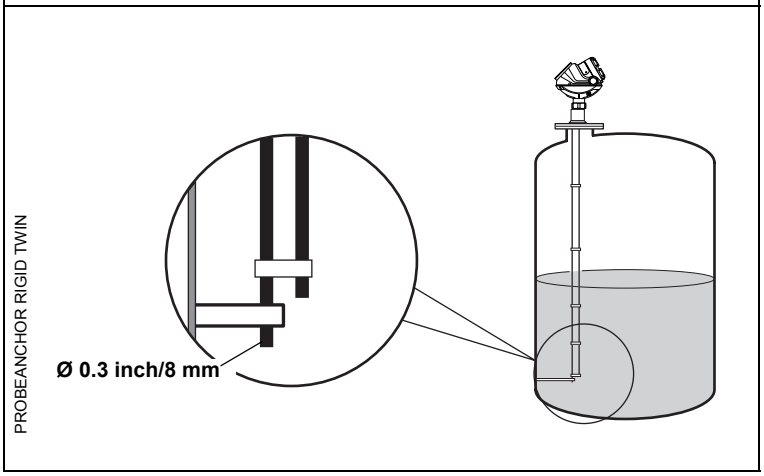
Coaxial probe fixed to the tank wall.

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.

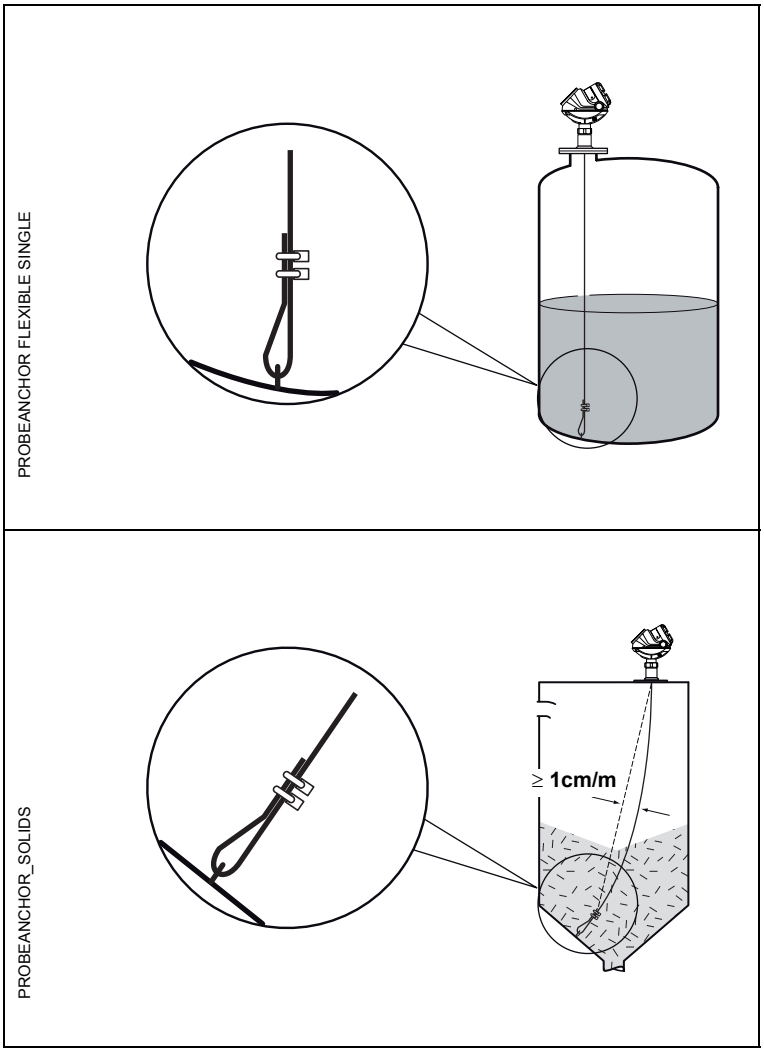
The Coaxial probe can be guided by a tube welded on the tank bottom. Tubes are customer supplied. Make sure that the probe can move freely in order to handle thermal expansion.



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 2-9 for further information on Transition Zones.

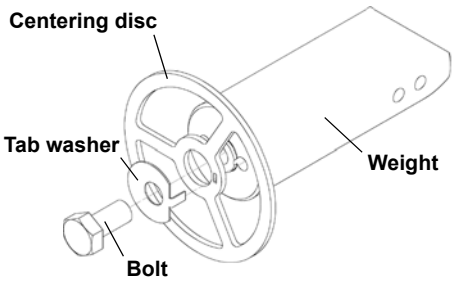
Solid Applications

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.

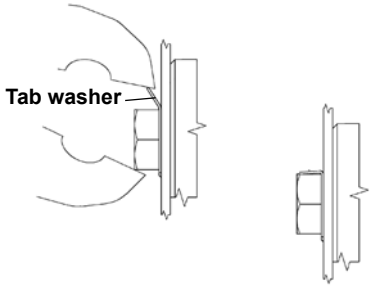
The sag should be at least 1.5 in./10 ft (1 cm/m) of the probe length.

Mounting a Centering Disc for Pipe Installations

Flexible Single/Twin Lead probe



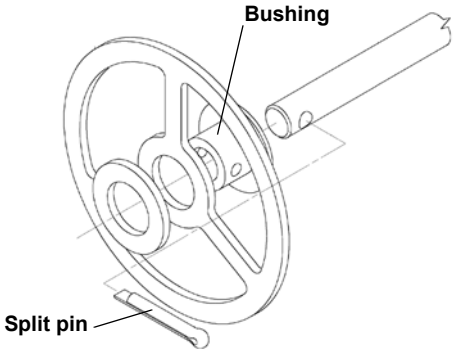
1. Mount the centering disc at the end of the weight.
2. Make sure that the tab washer is properly inserted in the centering disc.
3. Fasten the centering disc with the bolt.



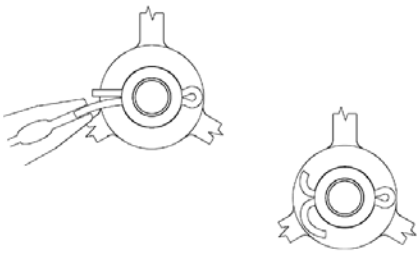
4. Secure the bolt by folding the tab washer.

NOTE!
Centering discs made of PTFE must not be used with the Rosemount 5300 HTHP version.

Rigid Single Lead probe



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

Section 4 Electrical Installation

Safety messages . . . . . page 4-1
Cable/conduit entries . . . . . page 4-3
Grounding . . . . . page 4-3
Cable Selection . . . . . page 4-3
Hazardous Areas . . . . . page 4-3
HART . . . . . page 4-4
FOUNDATION™ Fieldbus . . . . . page 4-8
Optional Devices . . . . . page 4-13

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 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/Flame-proof 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 in order 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 flame proof and the IECEx approval versions of the 5300 Series, suitable conduits with sealing device or flame proof (EEx d) cable glands must be used depending on local requirements.

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

HAZARDOUS AREAS

When the 5300 transmitter is installed in 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 5300 transmitter is loop-powered and operates with the following power supplies:

Approval Type	Power Supply (VDC)
IS	16 - 30
Explosion-Proof/Flameproof	20 - 42.4
None	16 - 42.4

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 /Flame-proof installations

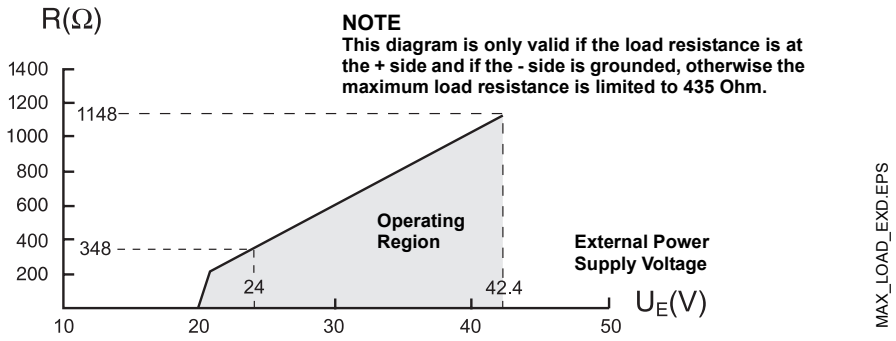


Figure 4-2. Non-hazardous installations

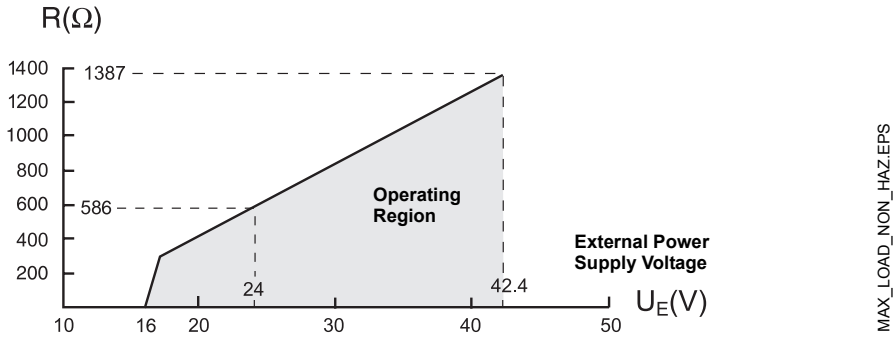
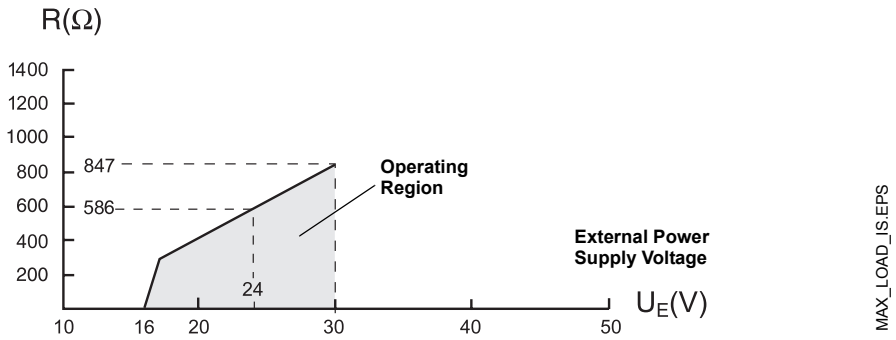


Figure 4-3. Intrinsically Safe installations



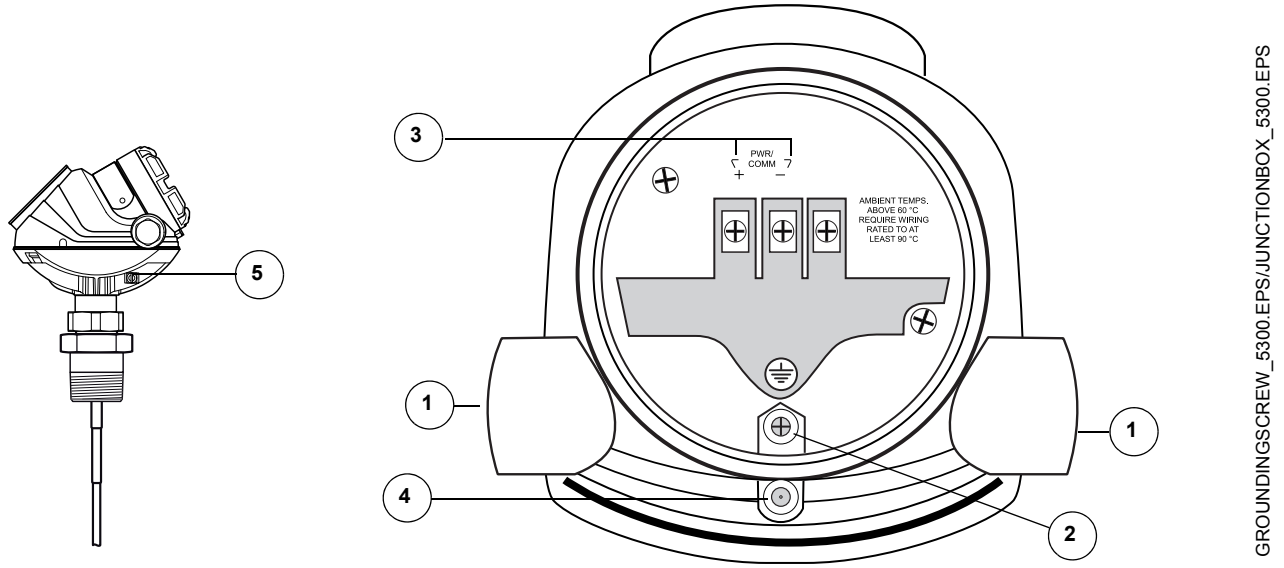
Connecting the Transmitter

To connect the Rosemount 5300 Series transmitter:

1. Make sure that 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 conduit/cable gland. Make sure that the cover is fully engaged to meet explosion-proof requirements.
   Note that adapters are required if M20 glands are used.
7. Tighten the Locking Screw ④ (ATEX Flameproof and IECEx versions).
8. Switch on 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.

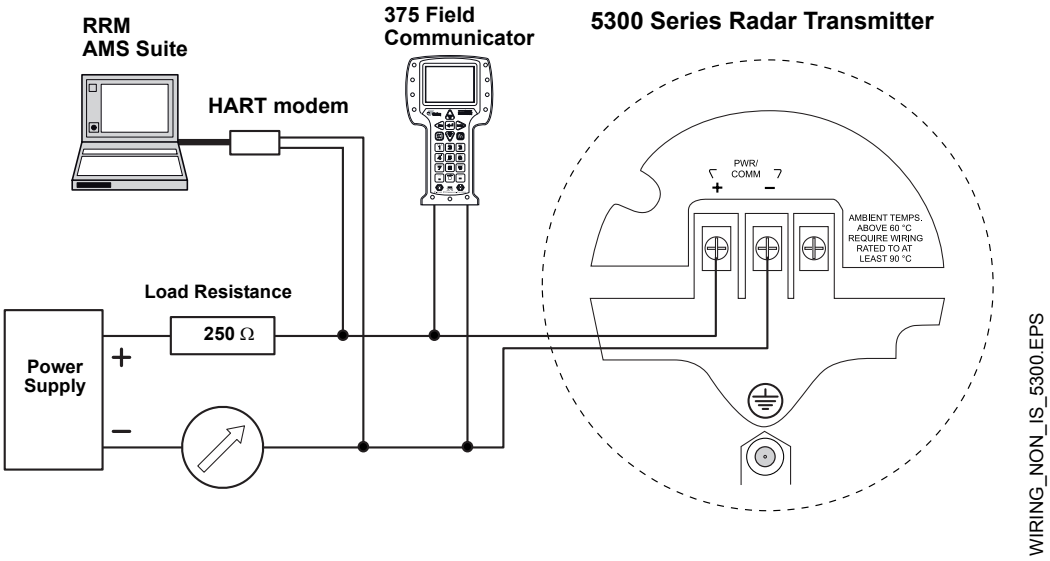
⑤ External Ground screw

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 Ohm within the loop is required. For maximum load resistance see Figure 4-1 (Explosion/Flame Proof) and Figure 4-2 (Non-hazardous installations).

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

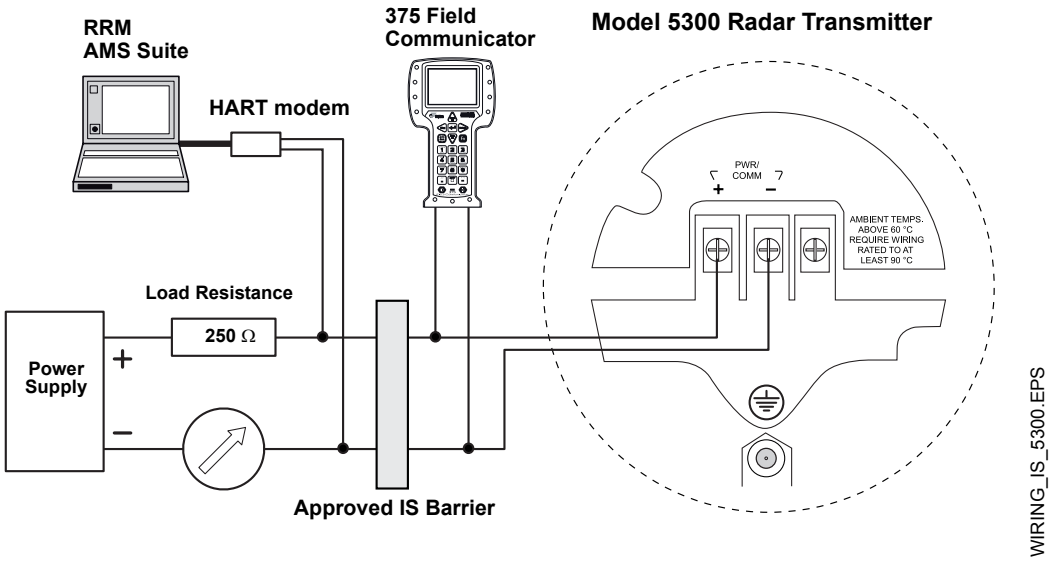
NOTE!
For Explosion-proof/Flameproof installations make sure that the transmitter is grounded to the internal ground terminal inside the terminal compartment in accordance with national and local electrical codes.

Intrinsically Safe Output

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

NOTE!
Make sure that 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 Ohm within the loop is required. For maximum load resistance see Figure 4-3.

The power supply voltage ranges from 16 V dc to 30 V dc.

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 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

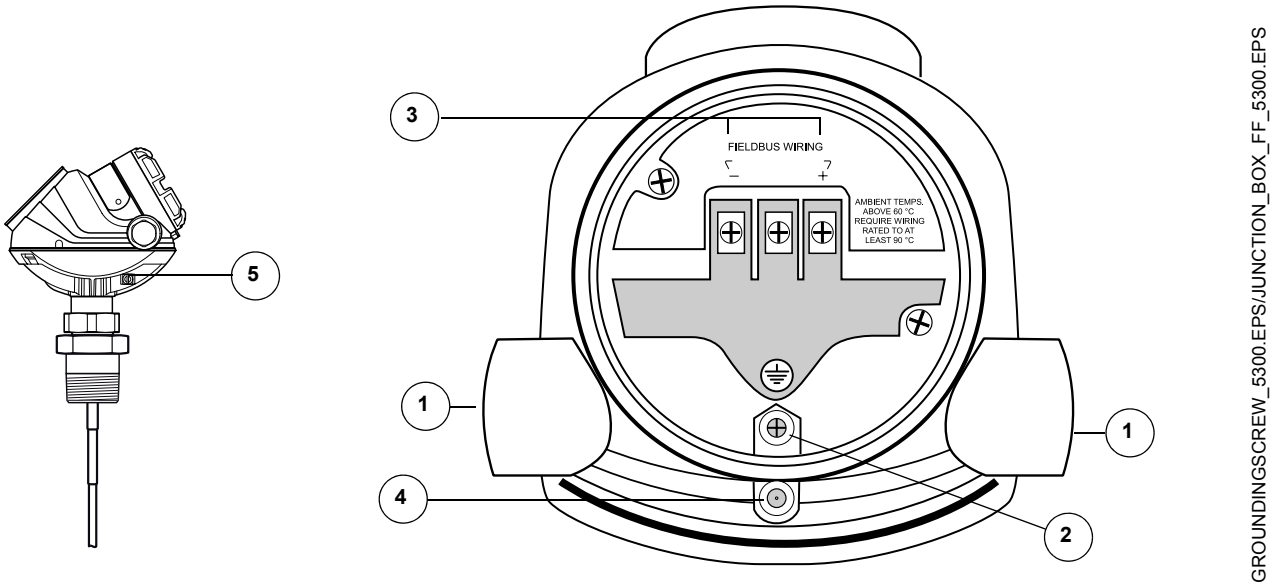
Connecting the Transmitter

To connect the transmitter:

1. Make sure that 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 conduit/cable gland. Make sure that the cover is fully engaged to meet explosion-proof requirements.
   Note that adapters are required if M20 glands are used.
7. Tighten the Locking Screw ④ (ATEX Flameproof and IECEx versions).
8. Switch on 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.



GROUNDINGSCREW_5300.EPS/JUNCTION_BOX_FF_5300.EPS

① Cable entries.

② Internal Ground screw.

③ Terminals for signal and power supply.

④ Locking screw.

⑤ External Ground screw

Grounding - Foundation Fieldbus

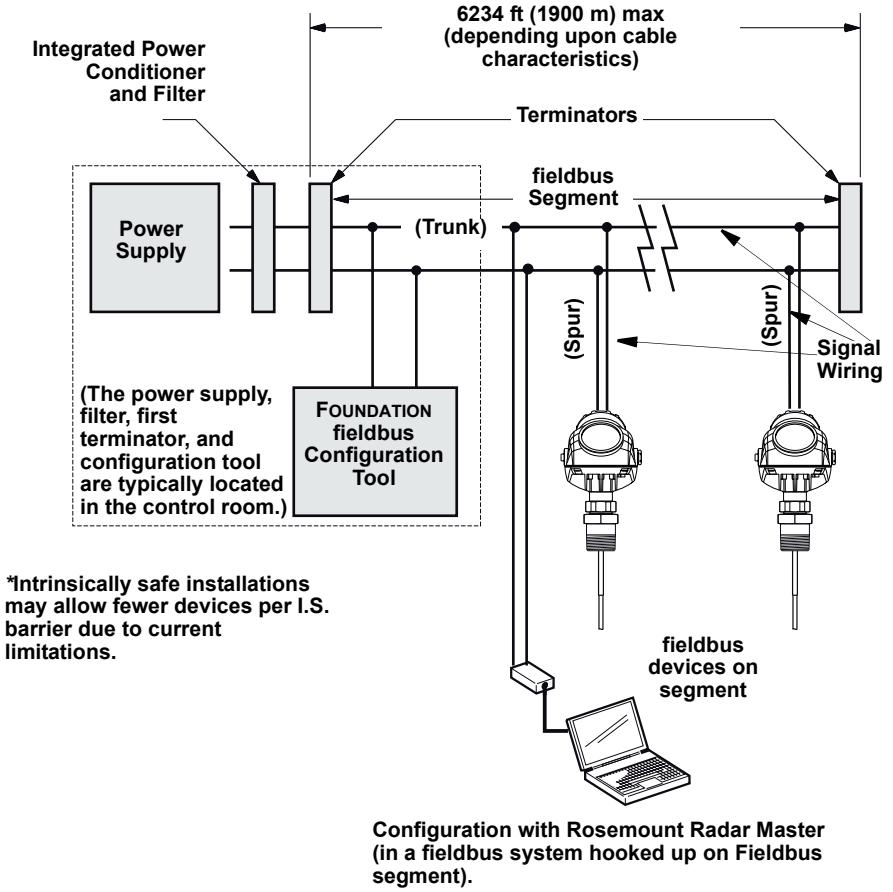
Signal wiring of the fieldbus segment can not be grounded. Grounding out one of the signal wires will shut down the entire fieldbus segment.

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

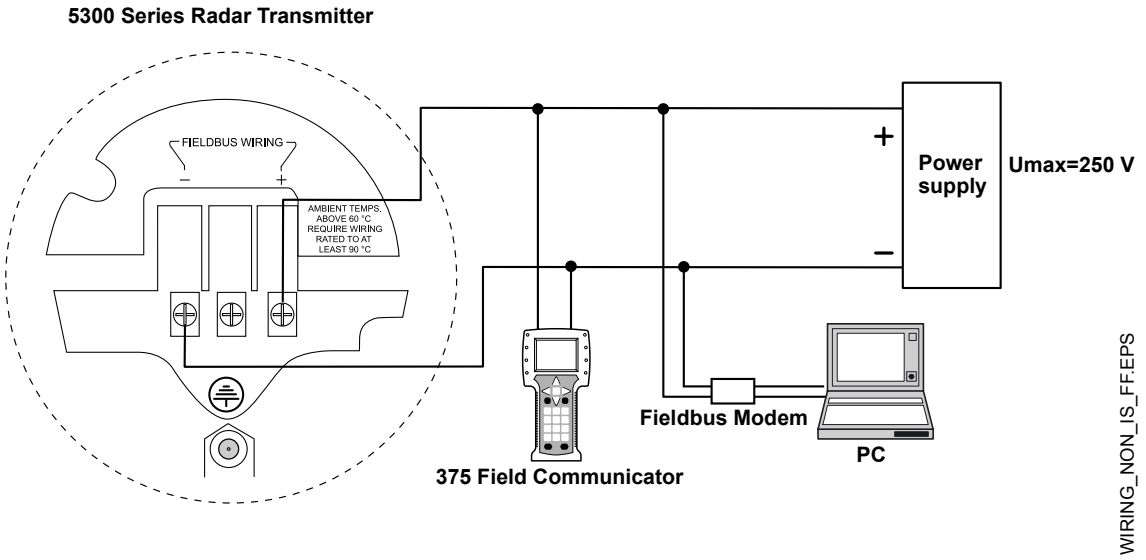


Non-Intrinsically Safe Output

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)



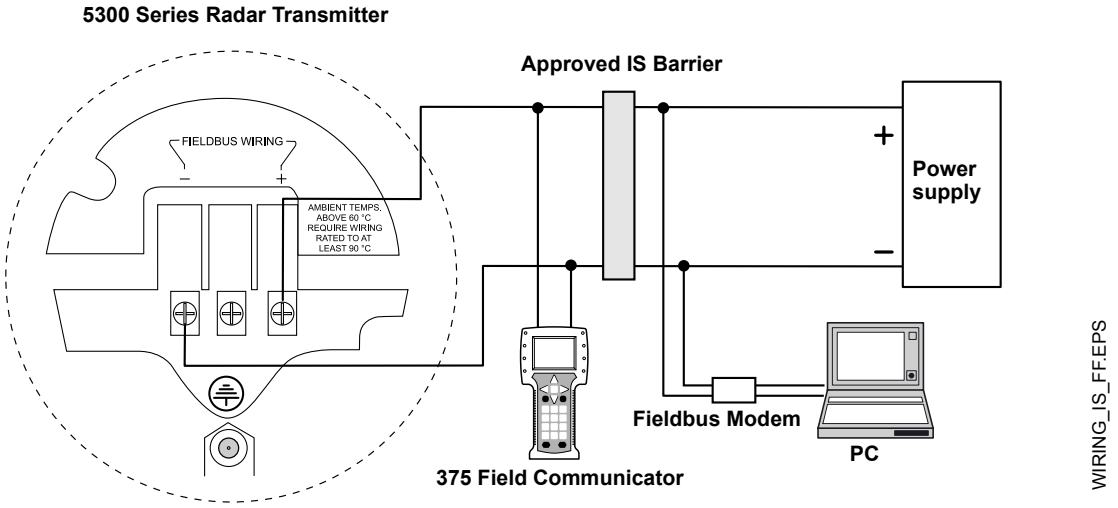
NOTE!
For Explosion Proof/Flame Proof installations make sure that the transmitter is grounded to the internal ground terminal inside the terminal compartment in accordance with national and local electrical codes.

Intrinsically Safe Output

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

NOTE!
Make sure that 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.

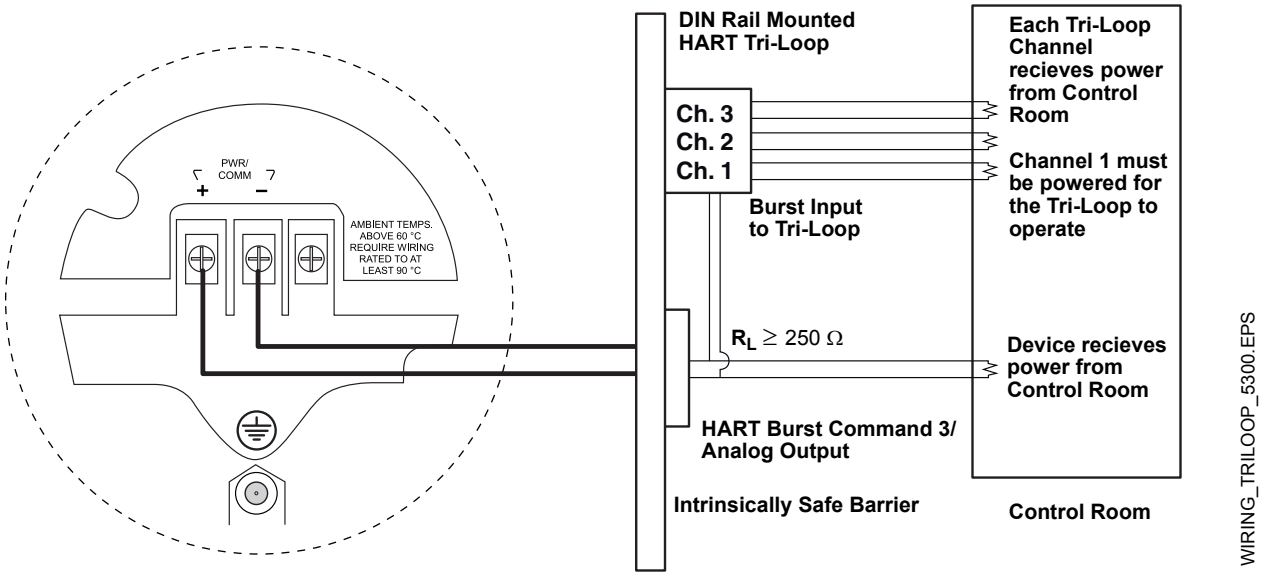
(1) See Section B: Product Certifications for more information.

OPTIONAL DEVICES

Tri-Loop HART to analog converter

The Model 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.

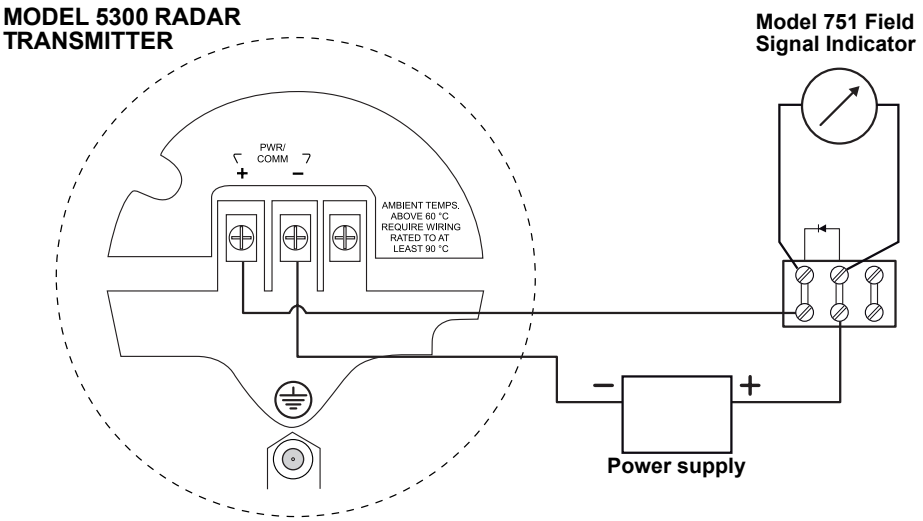
Figure 4-11. Wiring diagram for HART Tri-Loop



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 Model 5300). It is also possible to enable or disable a channel from this menu. See “TriLoop HART to Analog Converter“ on page 5-44 for further information on how to install a Tri-Loop.

751 Field Signal Indicator

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



Section 5 Configuration

Safety messages . . . . . page 5-1
Overview . . . . . page 5-2
Basic Configuration Parameters . . . . . page 5-3
Basic Configuration using a 375 Field Communicator . . page 5-10
Basic Configuration Using Rosemount Radar Master . . page 5-12
Basic Configuration Using AMS Suite (HART) . . . . . page 5-29
Basic Configuration Using DeltaV . . . . . page 5-30
FOUNDATION Fieldbus Overview . . . . . page 5-35
Configure the AI Block . . . . . page 5-38
TriLoop HART to Analog Converter . . . . . page 5-44
HART Multi-drop Configuration . . . . . page 5-46

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

Configuration of a Rosemount 5300 transmitter is normally a simple and straight-forward task. A 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 factory according to the ordering specifications in the Configuration Data Sheet, no further Basic Configuration is required unless tank conditions have changed. The 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 *Section 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 configuration is needed in addition to the Basic Configuration. This may be due to the properties of the product or the shape of the tank. See *Appendix C: Advanced Configuration* for more information.

Configuration Tools

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

- Rosemount Radar Master (RRM). Note that RRM is recommended for advanced configuration features.
  See “Basic Configuration Using Rosemount Radar Master” on page 5-12 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 5-10 for the Field Communicator Menu Tree.
- AMS Suite software (for HART). See “Basic Configuration Using AMS Suite (HART)” on page 5-29.
- DeltaV (only for Foundation Fieldbus). See “Basic Configuration Using DeltaV” on page 5-30.
- 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 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 5-15).

BASIC CONFIGURATION PARAMETERS

This section describes basic configuration parameters for a Rosemount 5300 transmitter. Basic configuration is only needed for 5300 transmitters which are not pre-configured at 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

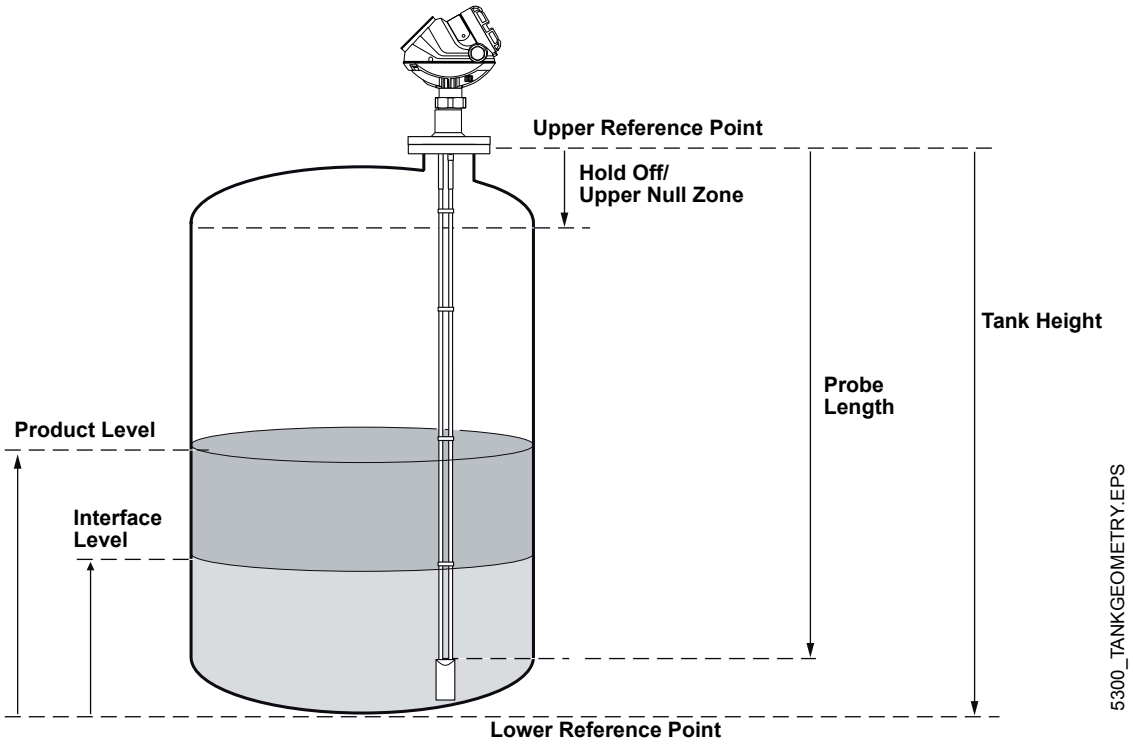
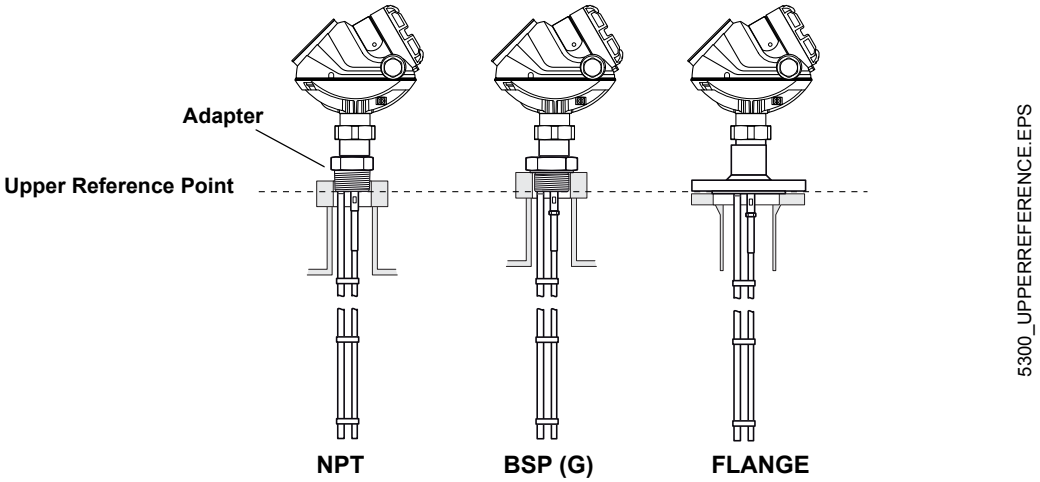


Figure 5-2. Upper Reference Point

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.

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 shall 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 3-16).

This parameter is pre-configured at 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 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 7-16*" 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 5300 transmitter is able to track level changes of up to 1.5 inch/s (40 mm/s). When the Rapid Level Changes check box is marked, the transmitter can track level changes of up to 8 inch/s (200 mm/s).

The Rapid Level Changes check box shall 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 in order to obtain good accuracy. See section "Interface" on page 2-11 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 if you don't want zero volume to correspond to the zero level. This may be useful if you for example like to include the product volume below the zero level.

Tank Type

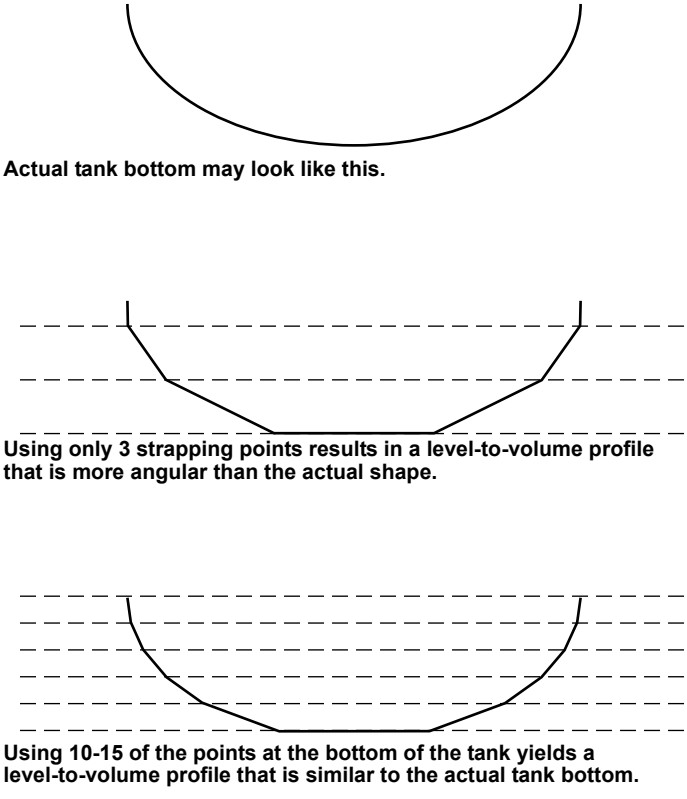
You can choose one of the following options:

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

Strapping Table

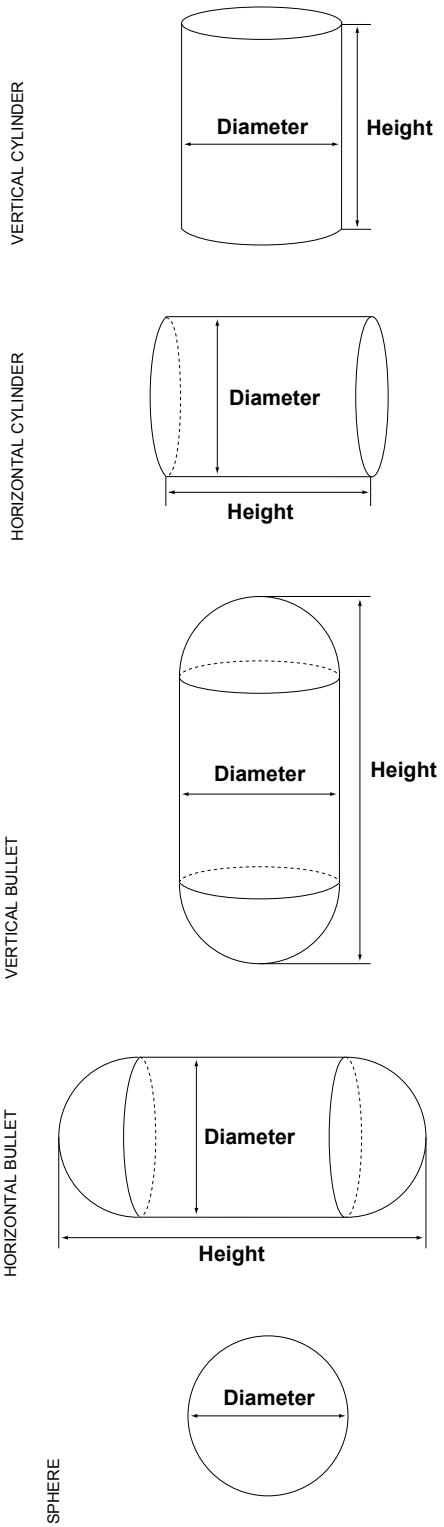
Use a strapping table if a standard tank type does not provide sufficient accuracy. Use most of the strapping points in regions where the tank shape is non-linear. A maximum of 20 points can be added to the strapping table.

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.

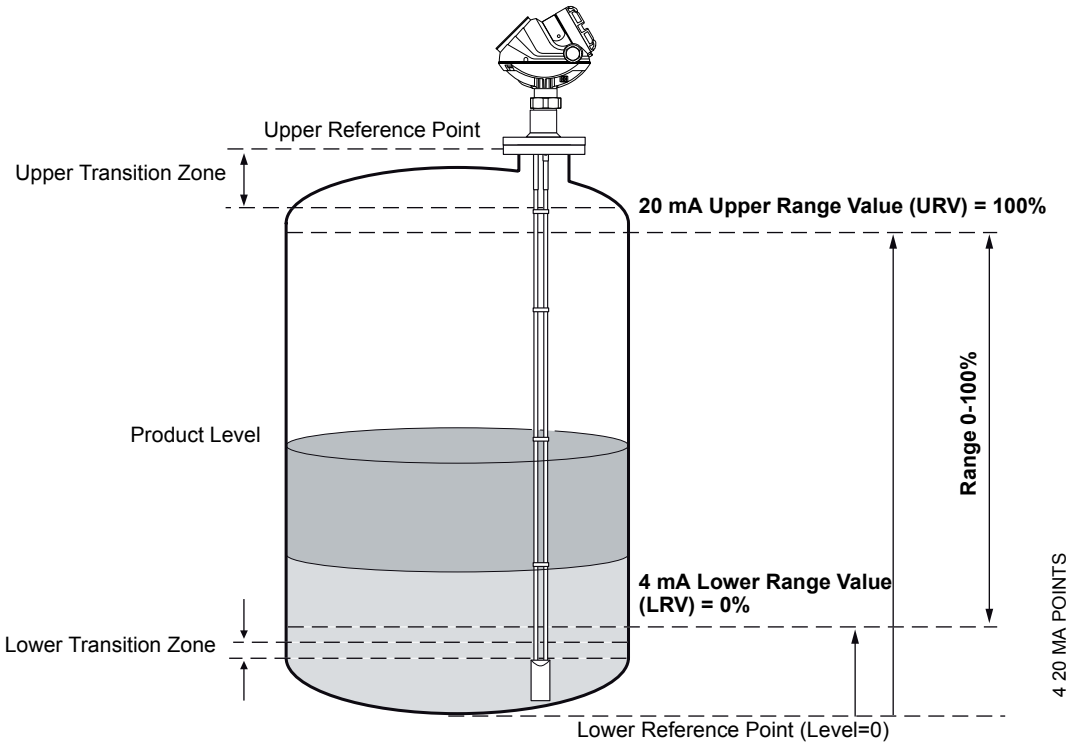
Sphere

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 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 2-9* 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.

The 4 mA point should be above the Lower Transition Zone. If the 4 mA point is set to a point within the Transition Zone or below the probe end (tank bottom for example), the full range of the analog output is not used.

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 5-11*. Section *"Basic Configuration Parameters" on page 5-3* presents a description of the basic configuration parameters.

For information on all the capabilities, refer to the 375 Field Communicator Product Manual (document 00809-0100-4276).

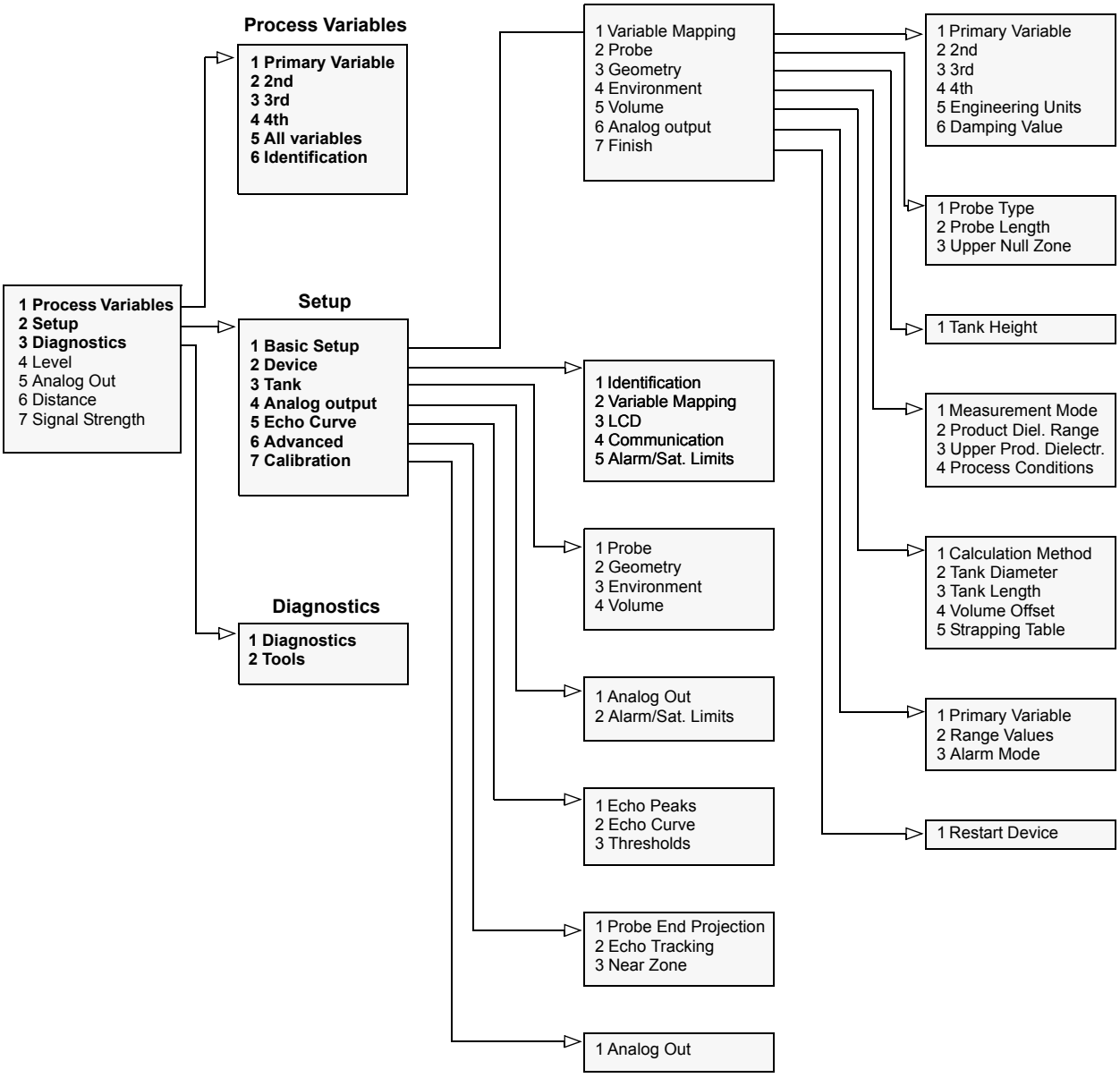
Figure 5-6. The 375 Field Communicator.



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. Restart the transmitter. HART command: [3, 2, 1, 1].

See also "Guided Setup" on page 5-18 for further information on configuration of the Rosemount 5300 transmitter.

Figure 5-7. HART Communicator Menu Tree corresponding to Device Revision 2.



BASIC CONFIGURATION USING ROSEMOUNT RADAR MASTER

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

- Guided Setup if you are unfamiliar with the 5300 transmitter (see page 5-18).
- Setup functions if you are already familiar with the configuration process or if you just want to change the current settings (page 5-17).

System Requirements

Hardware

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

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

COM Port: 1 serial COM port

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

Hard drive space: 100 MB

Software

Operating Systems supported:

Windows 98 - service pack 3 and above

Windows 2000

Windows XP

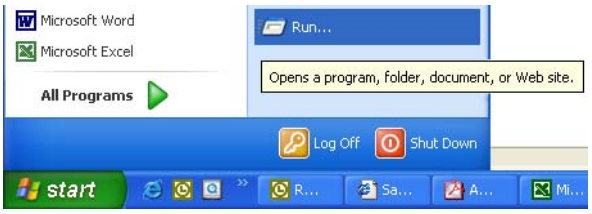
Help In RRM

Help is accessed by selecting the Contents option from the Help menu. Help is also available via 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.



RRM/START_BAR_RUN.TIF

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 5-14.

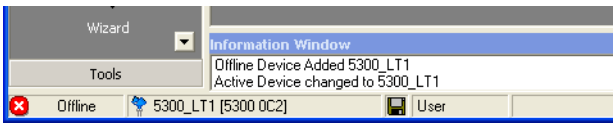
Getting Started

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 on the computer and that the COM port is properly configured, see “Specifying the COM Port” on page 5-14. 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



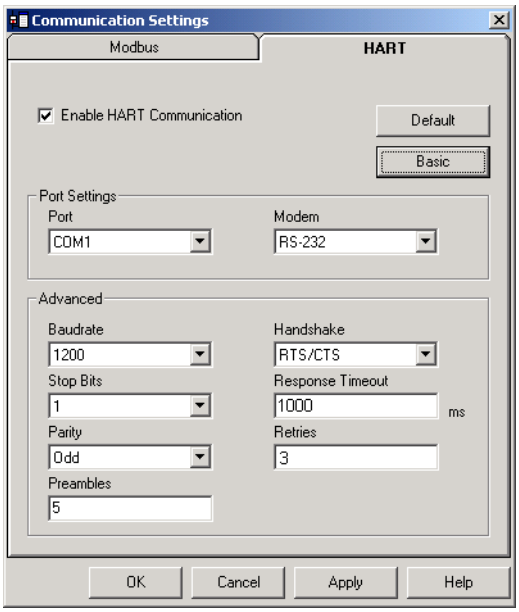
STATUSBAR_OFFLINE_53.TIF / STATUSBAR_ONLINE_53.TIF

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 Settings.



RRM/COMMUNICATIONSETTINGS.TIF

2. Make sure that HART communication is enabled.
3. Check which COM port that the modem is connected to.
4. 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

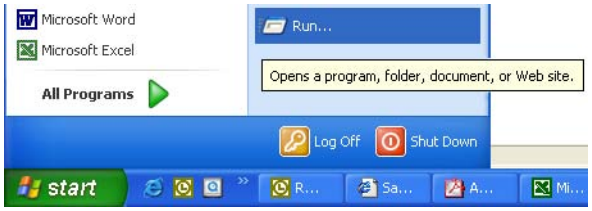
For Windows 2000/XP the COM port **Receive Buffer** and **Transmit Buffer** need to be set to 1. To set the COM port buffers do the following:

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. **Reboot 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.

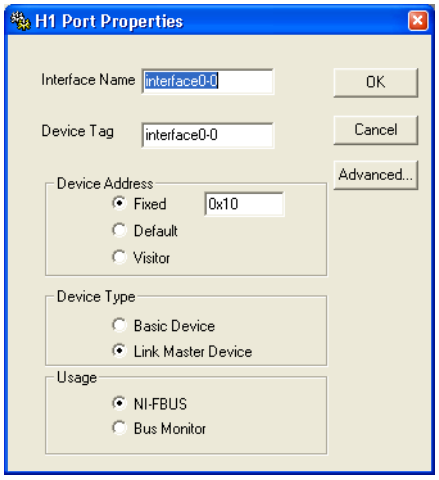


RRM/START_BAR_RUN.TIF

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*:



NIINTERFACECONFIGUTILPROPERTIES.TIF

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

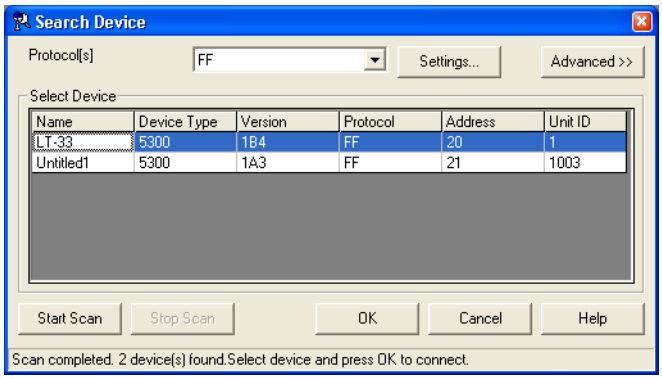
If other host systems are connected to the bus:
Device address=Visitor.
Device Type=Basic Device.
Usage=NI-FBUS.

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:



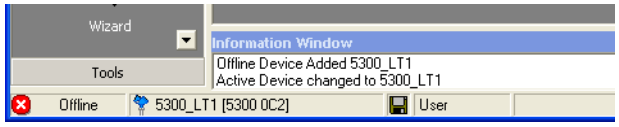
SEARCHDEVICE_53.TIF

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



STATUSBAR_OFFLINE_53.TIF / STATUSBAR_ONLINE_53.TIF

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.

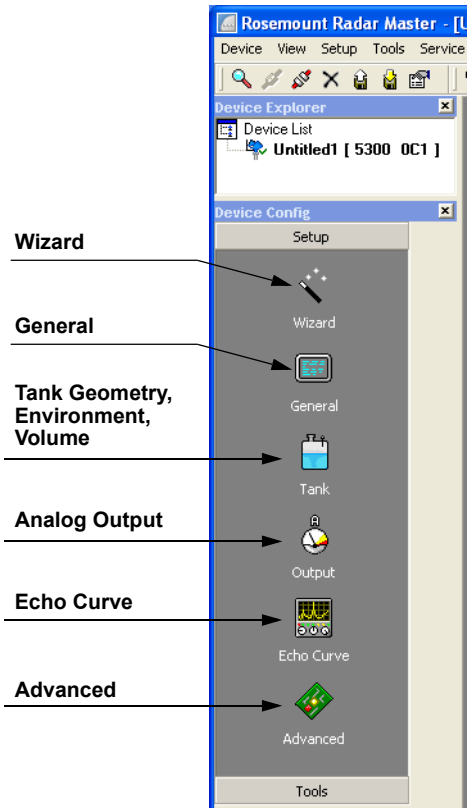
2. Select the **Measurement Units** tab.

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 5300 transmitter or if you just want to change the current settings:

Figure 5-9. Setup functions in RRM.



WORKSPACE_SETUP.TIF

1. Start the RRM software.
2. In the RRM workspace choose the appropriate icon for configuration of transmitter parameters:
   - **Wizard**: the Wizard is a tool that guides you through the basic configuration procedure of a 5300 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.

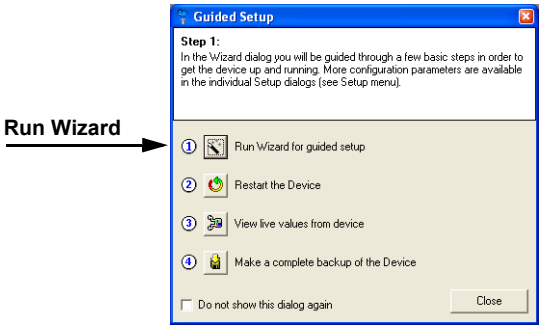
Guided Setup

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 specially useful if you are unfamiliar with the 5300 transmitter.

1. Start the Guided Setup

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



RRM/GUIDED_SETUP.TIF

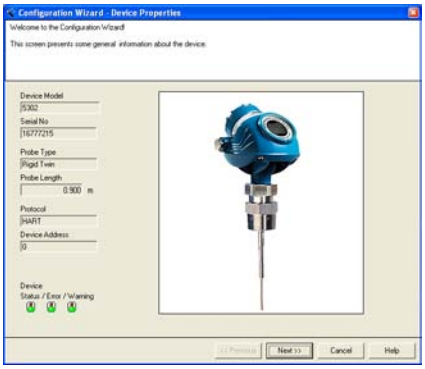
2. Start the Configuration Wizard

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

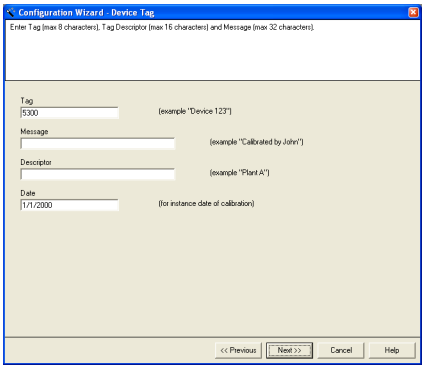


RRM/WIZARD_DEVICEPROPERTIES.TIF

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



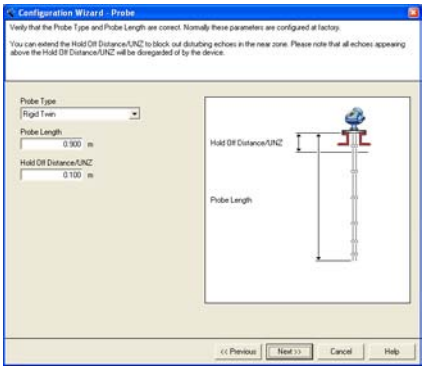
RRM/WIZARD_DEVICETAG.TIF

4. Enter Device Information

HART command: [2, 2, 1].

This window lets you 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



RRM/WIZARD_PROBE.TIF

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 factory, but if the current configuration does not match the actual probe, choose the correct **Probe Type** from the list.

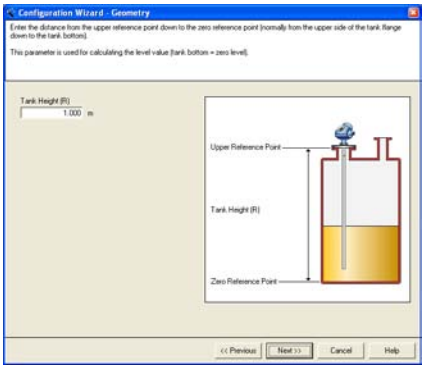
The 5300 Series transmitter automatically makes some initial calibrations based on the chosen **Probe Type**. The following Probe Types are available:

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



RRM/WIZARD_GEOMETRY.TIF

6. Geometry

HART command: [2, 1, 3].

FOUNDATION™ fieldbus parameter:

TRANSDUCER 1100>GEOM_TANK_HEIGHT

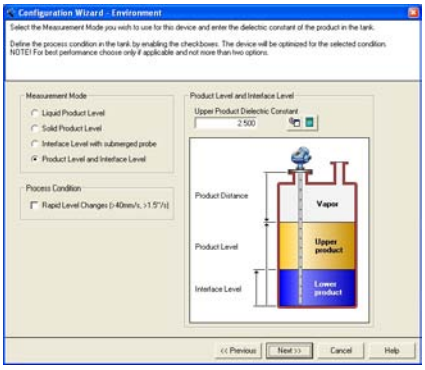
Tank Height is the distance from the Upper Reference Point to the Lower Reference Point (see Figure 5-1 on page 5-3 and Figure 5-2 on page 5-4). The Upper Reference Point is located at bottom part of the threaded adapter, or at the underside of the welded flange.

Make sure that 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 5300 transmitter.

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

Tank Environment



WIZARD_ENVIRONMENT.TIF

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 5-3 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 40 mm/s (1.5 inch/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.

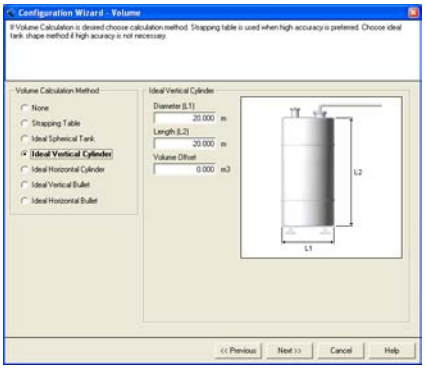
Set the **Upper Product Dielectric Constant** to a value that corresponds to the current product.

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



RRM/WIZARD_VOLUME_VC.TIF

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 5-6.

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.

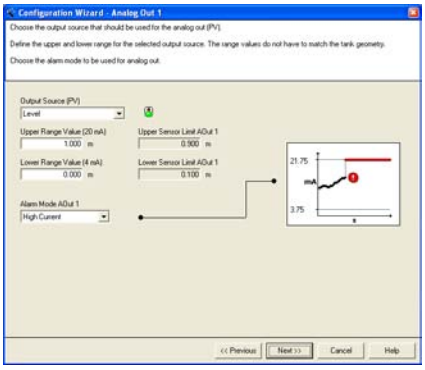
The following standard tank shapes are available:

- 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)



RRM/WIZARD_ANALOGOUT.TIF

9. Configure the Analog Output

HART command: [2,1, 6].

Analog Output is not available for FOUNDATION™ fieldbus.

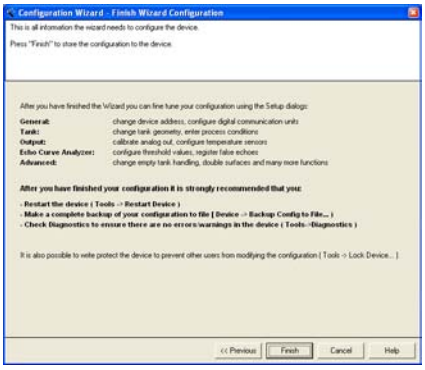
Typically, the **Primary Variable** (PV) is configured to be Product Level, Interface Level or Volume. Other variables like Product Distance, Interface Distance, Upper Product Thickness, etc. are available as well.

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 5-8* for information on Analog Output configuration.

Finish Configuration Wizard

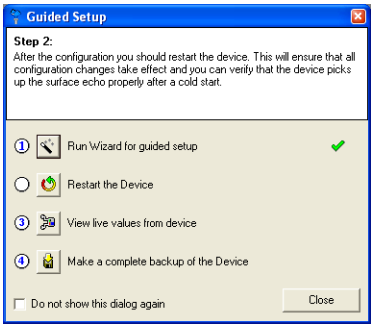


RRM/WIZARD_FINISH.TIF

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 5-17).
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.

Restart the Transmitter

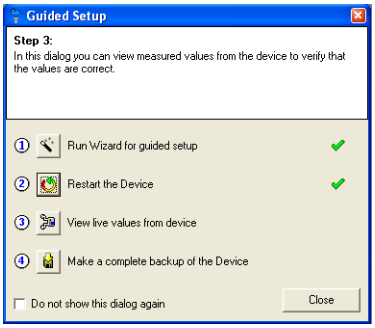


GUIDEDSETUP_RESTART.TIF

11. 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.

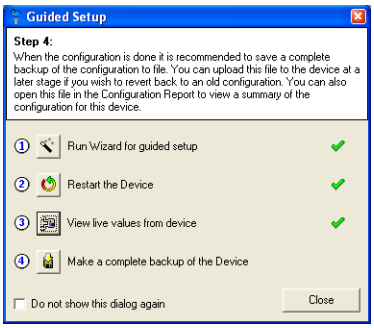
View Measured Values



GUIDEDSETUP_VIEW.TIF

12. 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



GUIDEDSETUP_BACKUP.TIF

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

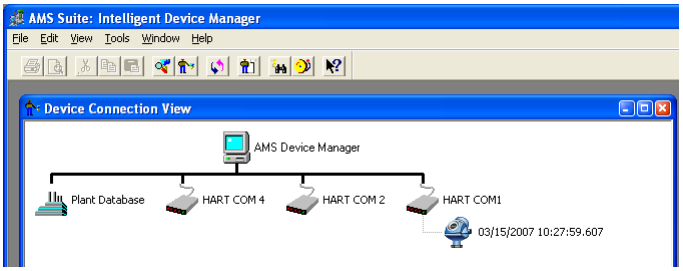
This information may be useful for:
- installing another 5300 in a similar tank since the file can be directly uploaded to a new device.
- restoring the configuration, if for any reason, configuration data is lost or accidentally modified making the device inoperable.

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

BASIC CONFIGURATION USING AMS SUITE (HART)

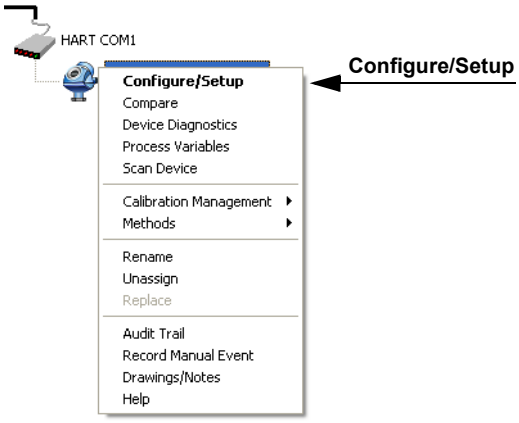
The Rosemount 5300 transmitter can be configured by using the AMS Suite software.

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



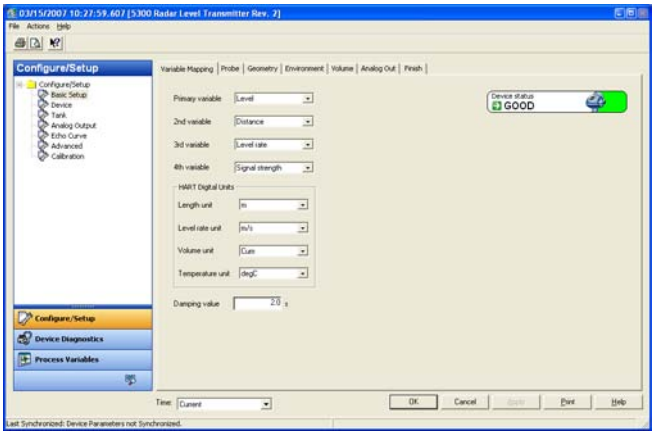
DEVICECONNECTIONVIEW.TIFIF

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



DEVICECONNECTIONVIEW_MENU.TIF

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



CONFIG_BASICSETUP.TIF

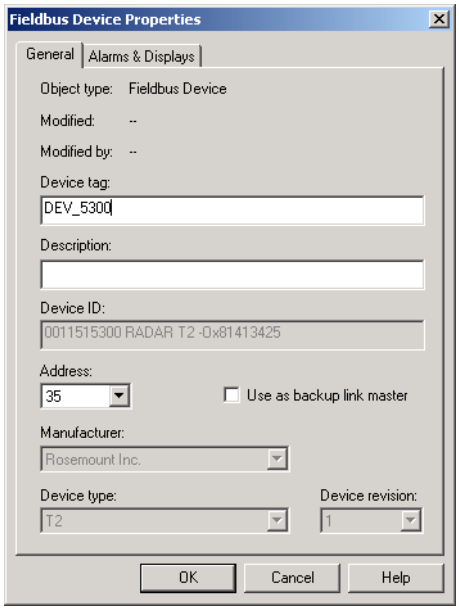
4. Choose the **Basic Setup** option.
5. Configure the transmitter by selecting the appropriate tab. See “Basic Configuration Parameters” on page 5-3 for information on the various configuration parameters.

BASIC CONFIGURATION USING DELTAV

The Rosemount 5300 Series supports DD Methods for DeltaV in order 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 do the following:

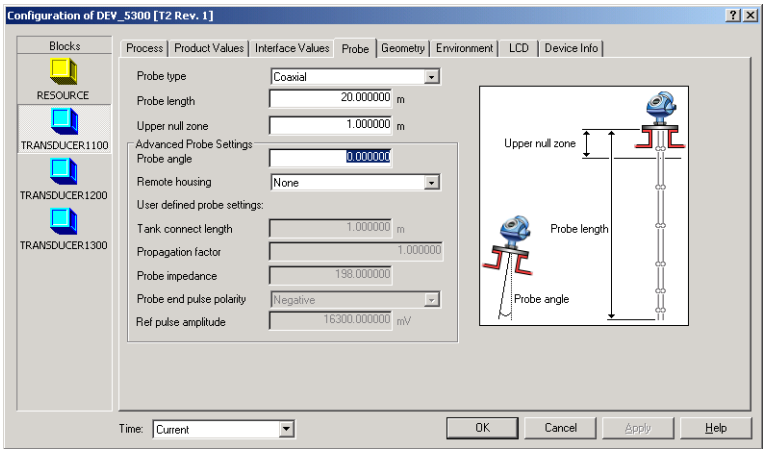
1. Select DeltaV>Engineering>DeltaV Explorer from the Start menu.
2. Navigate through the file structure to find the 5300 transmitter
3. Click the right mouse button on the 5300 transmitter icon and choose Properties:



FIELDBUSDEVICE_PROPERTIES_5300.TIF

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.



TB1100_PROBE.TIF

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 factory, but if the current configuration does not match the actual probe, choose the correct Probe Type from the list.

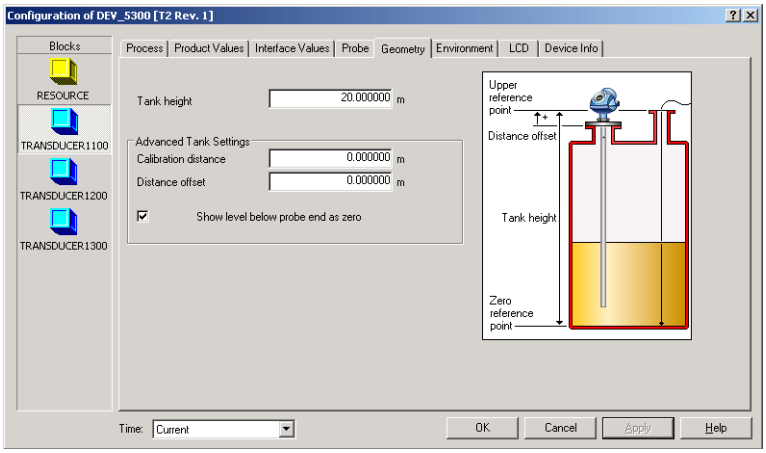
The 5300 Series transmitter automatically makes some initial calibrations based on the chosen Probe Type. The following probes are available:

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

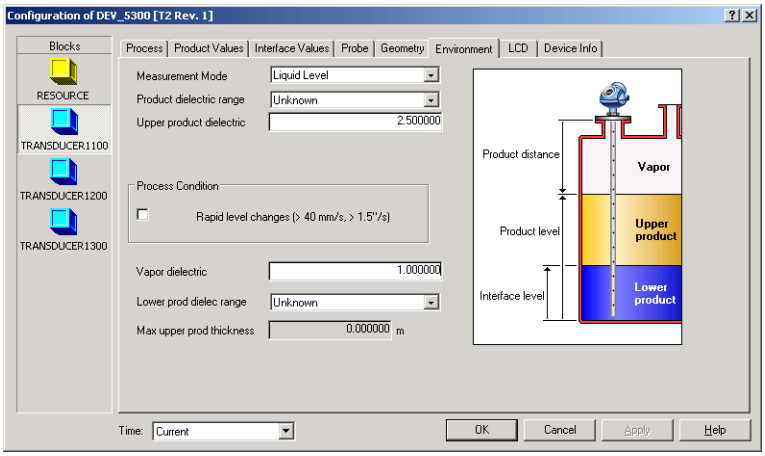


TB1100GEOMETRY.TIF

8. **Tank Height** is the distance from the Upper Reference Point to the tank bottom (see “Tank and Probe Geometry” on page 5-3). Make sure that this number is as accurate as possible.

FOUNDATION™ fieldbus parameter:
TRANSDUCER 1100>GEOM_TANK_HEIGHT.

9. Select the **Environment** tab.



TB1100_ENVIRON.TIF

10. 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

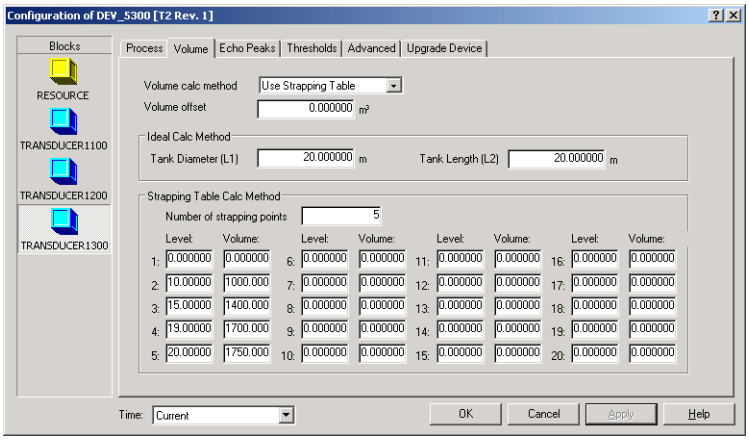
Process Conditions

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

FOUNDATION™ fieldbus parameter:

TRANSDUCER 1100>ENV_ENVIRONMENT

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



TB1300_VOLUME.TIF

12. 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.

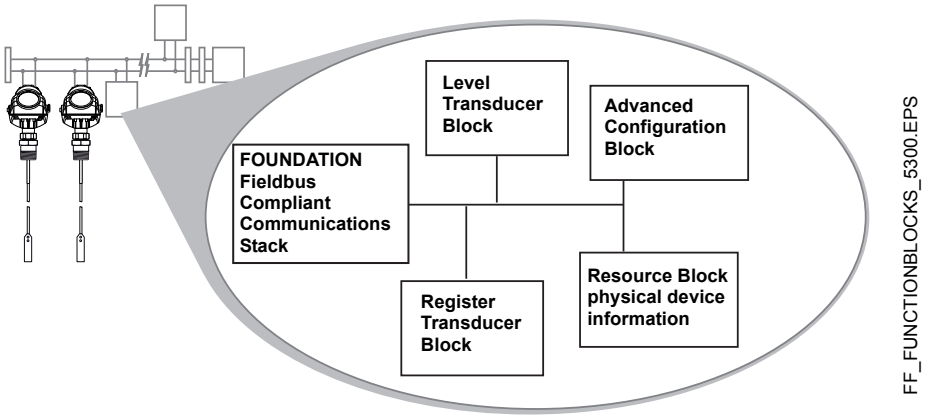
Volume Offset:
FOUNDATION™ fieldbus parameter:
TRANSDUCER 1300>VOL_VOLUME_OFFSET.

See “Volume Configuration” on page 5-6 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 (Ref. 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 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

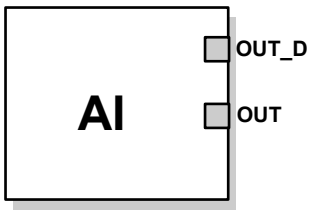
The Advanced Configuration Transducer Block contains functions such as amplitude threshold settings for filtering of disturbing echoes and noise, simulation of measurement values and strapping table for volume measurements.

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

FF_AIBLOCK

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 H: Analog-Input Block.

For more information on the different function blocks refer to *Appendix D: Level Transducer Block*, *Appendix E: Register Transducer Block*, *Appendix F: Advanced Configuration Transducer Block*, *Appendix G: Resource Transducer Block* and *Appendix H: 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 (Ref. 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), 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

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

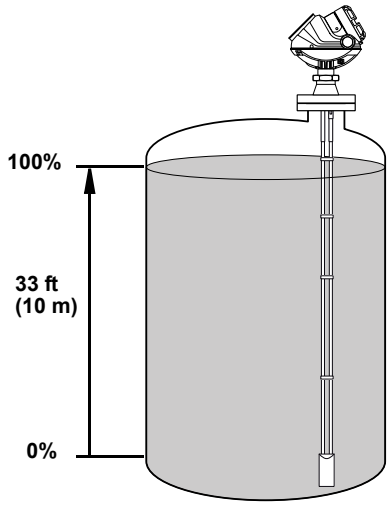
Display	Description
m^3	Cubic meter
L	Liter
in^3	Cubic inch
ft^3	Cubic feet
Yd^3	Cubic yard
Gallon	US gallon
ImpGall	Imperial gallon
Bbl	Barrel (oil, 42 US gallons)

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



FF_CONFIGEXAMPLES_5300.EPS

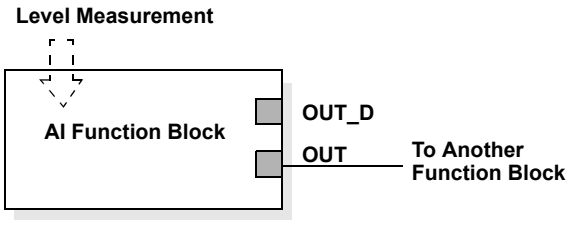
Solution

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

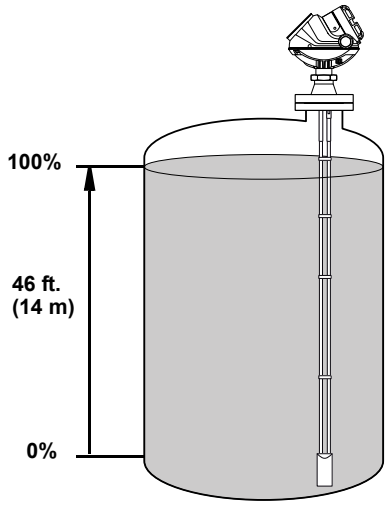


Application Example 2

Radar Level Gauge, Level value in percent (%)

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

Figure 5-14. Situation Diagram



FF_CONFIGEXAMPLES_5300.EPS

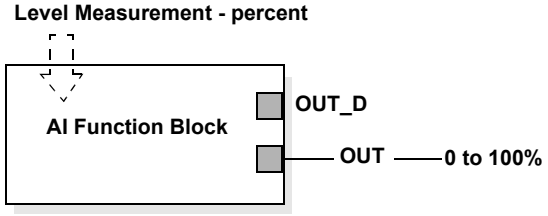
Solution

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%

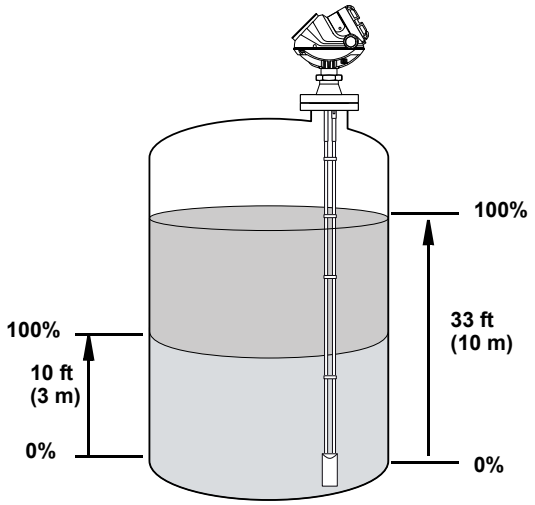


Application Example 3

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



FF_CONFIGEXMPL_INTFCE_5300.EPS

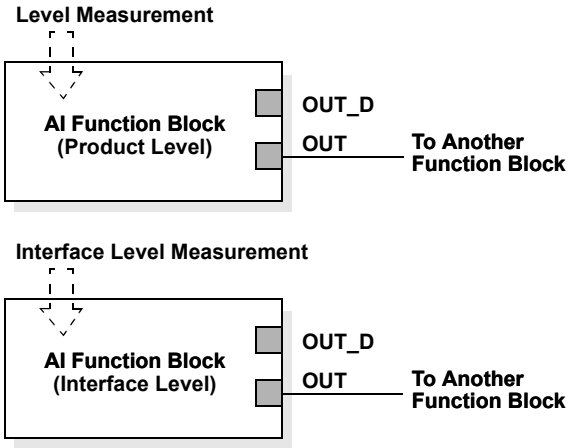
Solution

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



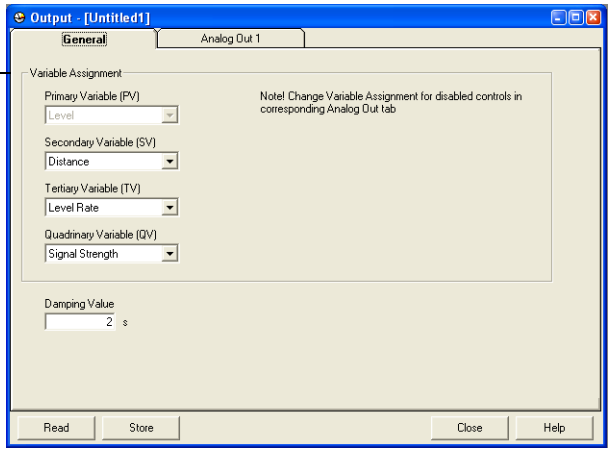
TRILOOP HART TO ANALOG CONVERTER

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 do the following:

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

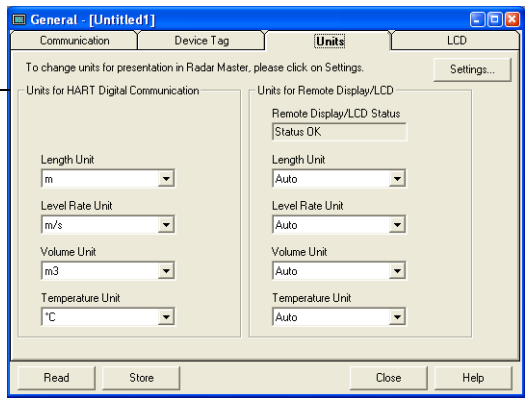
Variables Assignment



RRM-SETUP_OUTPUT_GENERAL.TIF

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

Variable Units

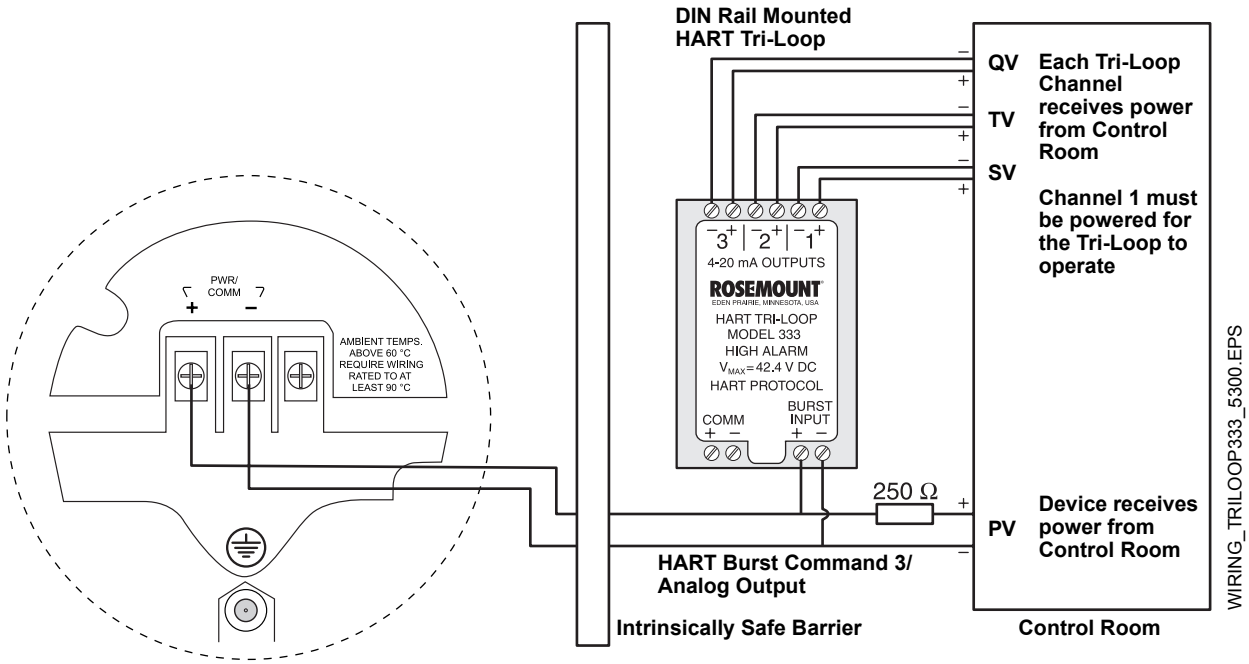


RRM-SETUP_GENERAL_UNITS.TIF

4. Set the 5300 in Burst mode.
HART command [2,2,4,4].
RRM: Setup>General/Communication.
5. Select Burst option 3=Process variables and current (Process vars/crnt).
HART command [2,2,4,5].
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

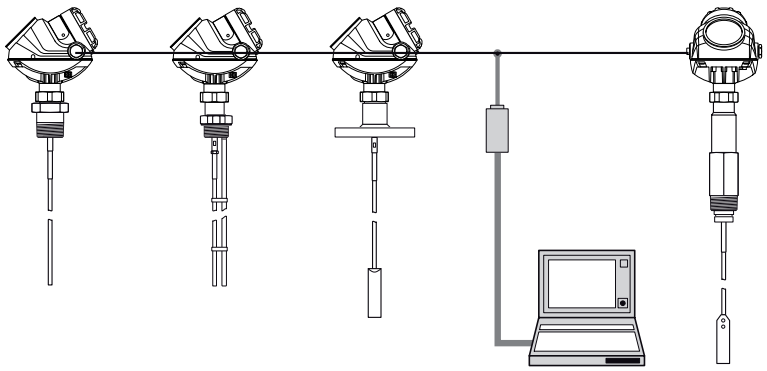
In order to turn off the Burst Mode use one of the following options:

- 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



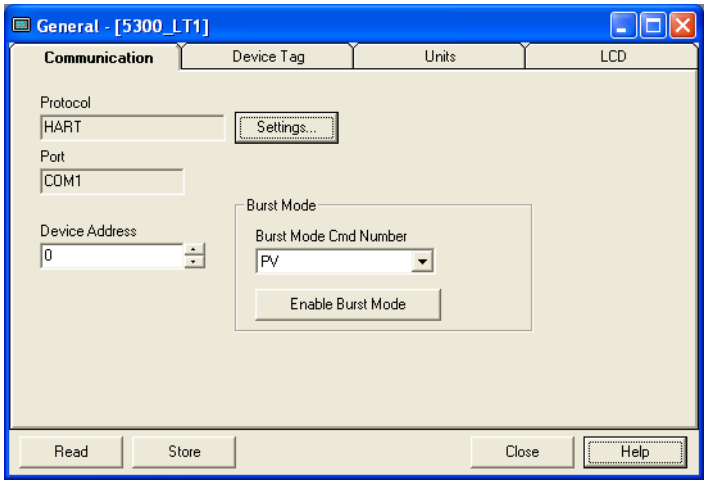
MULTIDROP_5300.EPS

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 do the following:

1. Choose the Setup>General option.



GENERAL_COMMUNICATION_5300.TIF

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 . . . . . page 6-1
Viewing Measurement Data . . . . . page 6-2

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

VIEWING MEASUREMENT DATA

Using the Display Panel

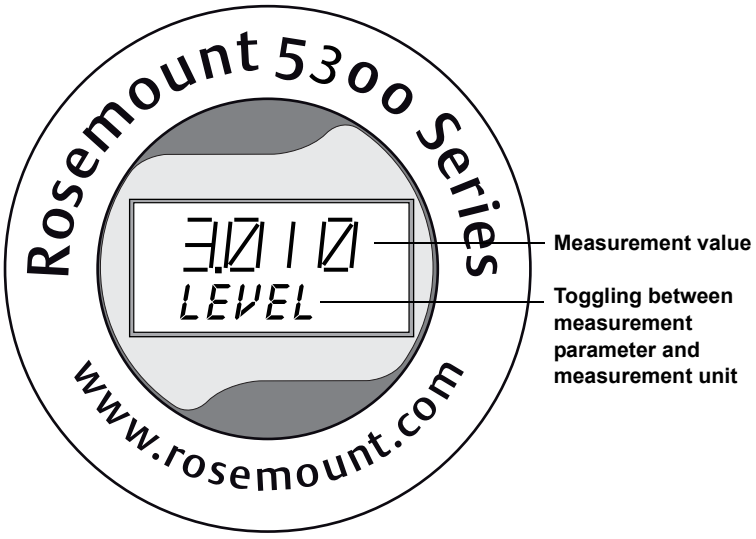
The Rosemount 5300 transmitter uses an optional Display Panel for presentation of measurement data. When the transmitter is switched on, the Display Panel presents information such as transmitter model, measurement frequency, software version, communication type (HART, FF), serial number, HART identification 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 275/375 Handheld Communicator, AMS, DeltaV or the Rosemount Radar Master software.

Figure 6-1. The 5300 Display Panel.



Error messages are listed in section “LED Error Messages” on page 7-38.

Specifying Display Panel Variables

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

Using a Handheld Communicator

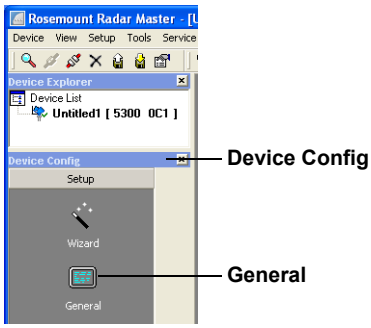
For a 275/375 Handheld Communicator the LCD settings are available with: HART command [1,2,3].

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:

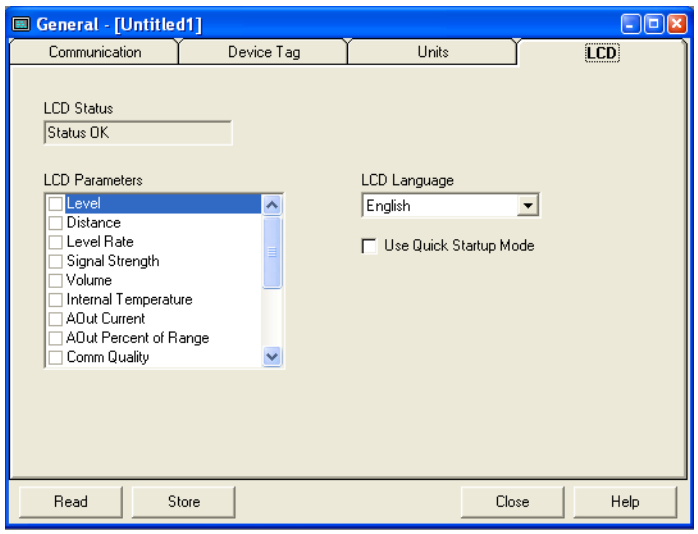
1. Choose the **General** option from the **Setup** menu, or click the General icon in the Device Configuration window.



WORKSPACE_GENERAL.TIF

2. Select the **LCD** tab.

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



RRM/GENERAL_LCD.TIF

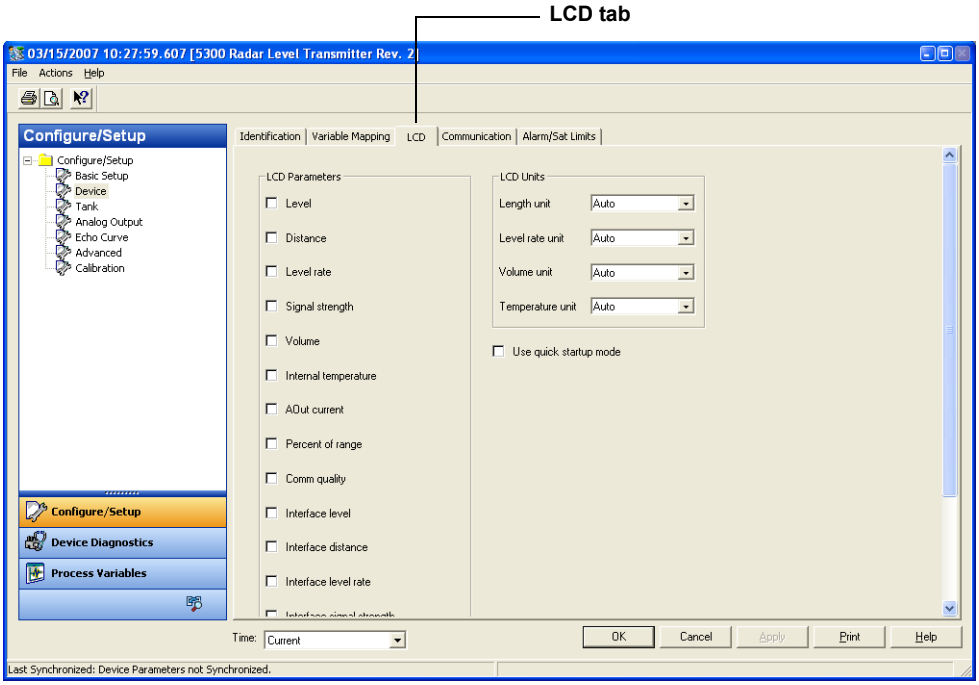
3. Select the variables you want to show on the display panel. The LCD will alternate between the selected items.
   The available LCD parameters are listed in Table 6-1 on page 6-6.
4. Click the **Store** button to save the LCD settings in the transmitter database.

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.

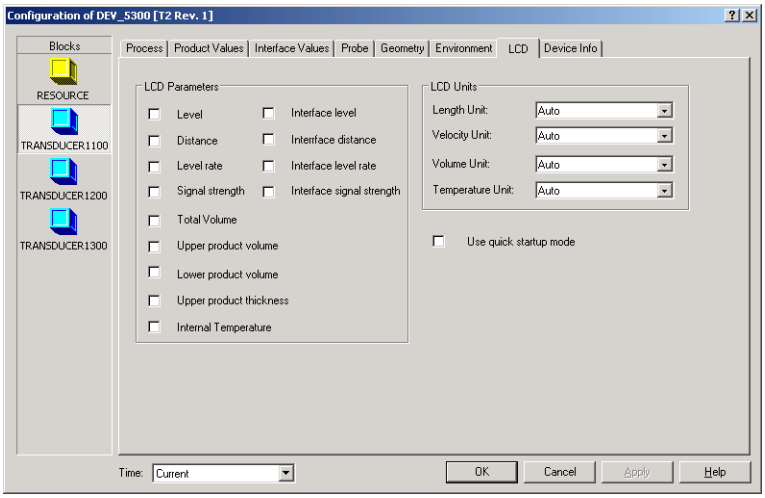


AMS_CONFIG_LCD.TIF

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.



TB1100_LCD.TIF

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

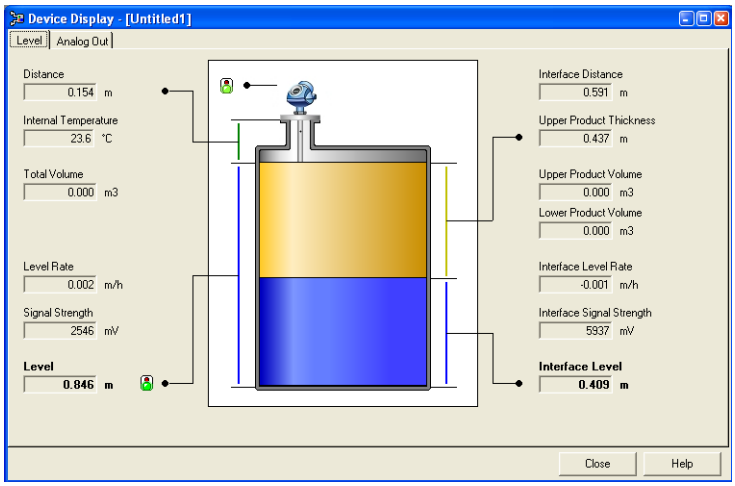
Table 6-1. LCD parameters and presentation on display

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

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:

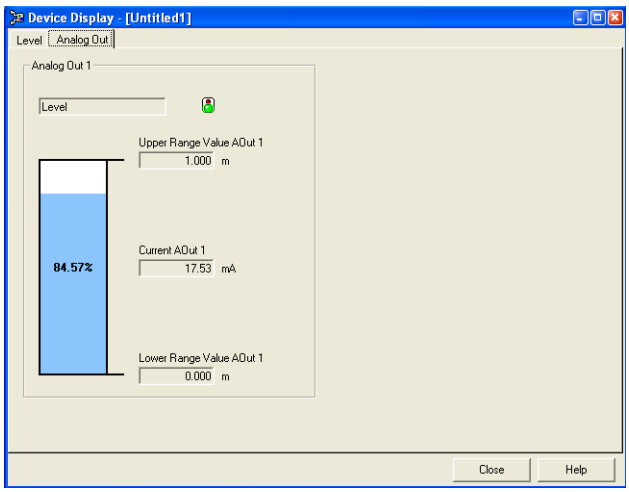
Figure 6-5. Presentation of measurement data in RRM.



RRM/DEVICE_DISPLAY_LEVEL.TIF

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.



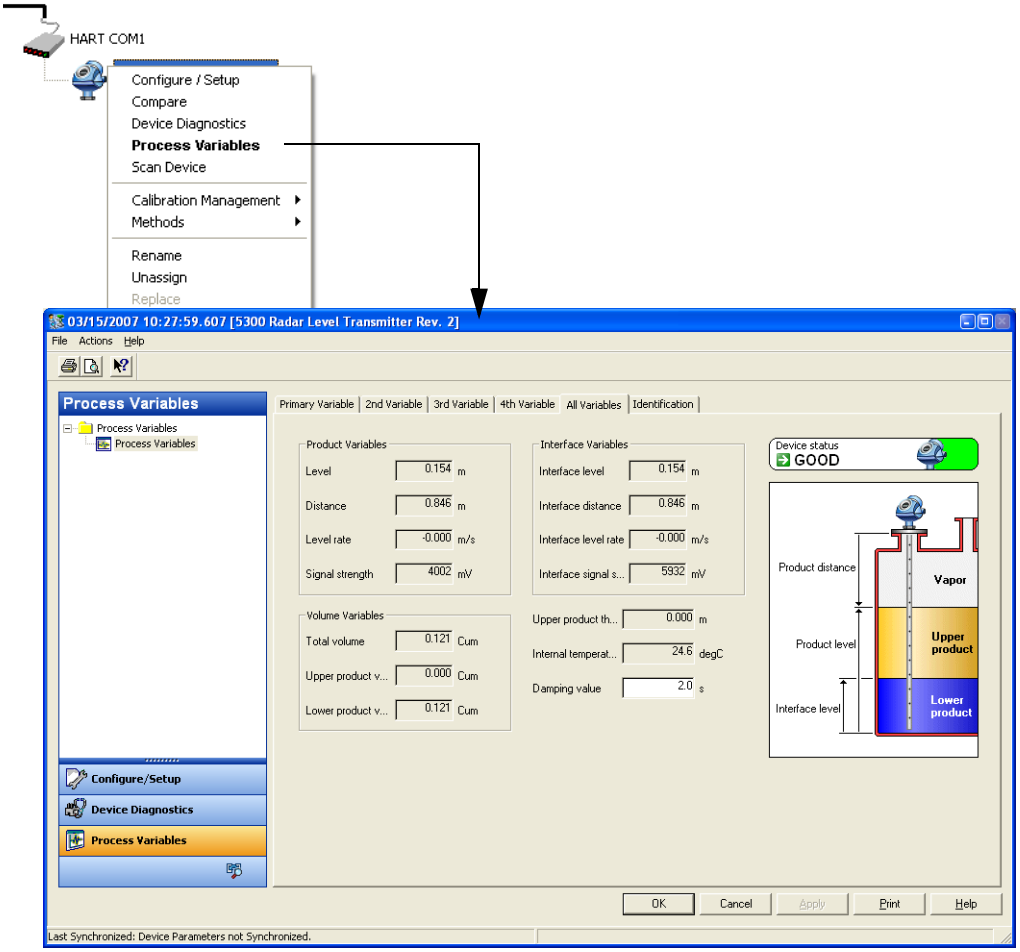
DEVICE_DISPLAY_ANALOGOUT.TIF

Viewing Measurement Data in AMS Suite

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

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.



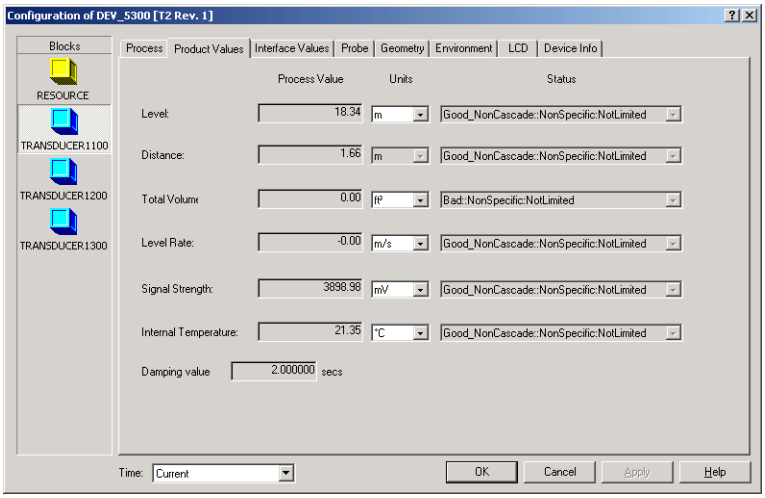
PROCESSVARIABLES_MENU.TIF
PROCESSVARIABLES_ALL.TIF

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.

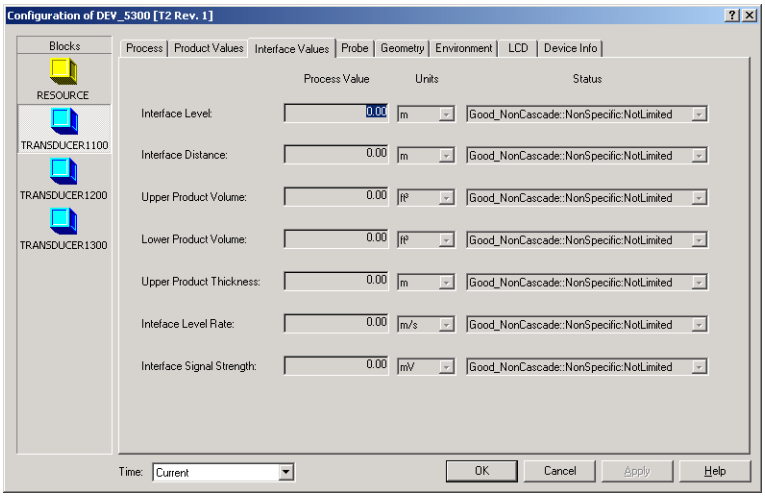
Figure 6-8. Presentation of measurement data in DeltaV for the Rosemount 5300.

Level values



TB1100_PRODVALUE.TIF

Interface Level values



TB1100_INTERFACEVALUE.TIF

Section 7 Service and Troubleshooting

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Analyzing the Measurement Signal . . . . . page 7-3
Surface Pulse Not Found . . . . . page 7-5
Disturbance Echo Handling . . . . . page 7-8
Interface Pulse not Found . . . . . page 7-9
Using the Echo Curve Analyzer . . . . . page 7-11
Interface Measurements with Fully Submerged Probes . page 7-16
Analog Output Calibration . . . . . page 7-17
Level and Distance Calibration . . . . . page 7-18
Logging Measurement Data . . . . . page 7-19
Backing Up the Transmitter Configuration . . . . . page 7-20
Diagnostics . . . . . page 7-23
Configuration Report . . . . . page 7-21
Reset to Factory Settings . . . . . page 7-22
Using the Simulation Mode . . . . . page 7-25
Enter Service Mode in RRM . . . . . page 7-26
Write Protecting a Transmitter . . . . . page 7-26
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SAFETY MESSAGES

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

.

⚠WARNING

Explosions could result in death or serious injury.

Verify that the operating environment of the gauge is consistent with the appropriate hazardous locations certifications.

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

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

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

Make sure only qualified personnel perform the installation.

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

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

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

Avoid contact with leads and terminals.

Make sure the main power to the Rosemount 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.

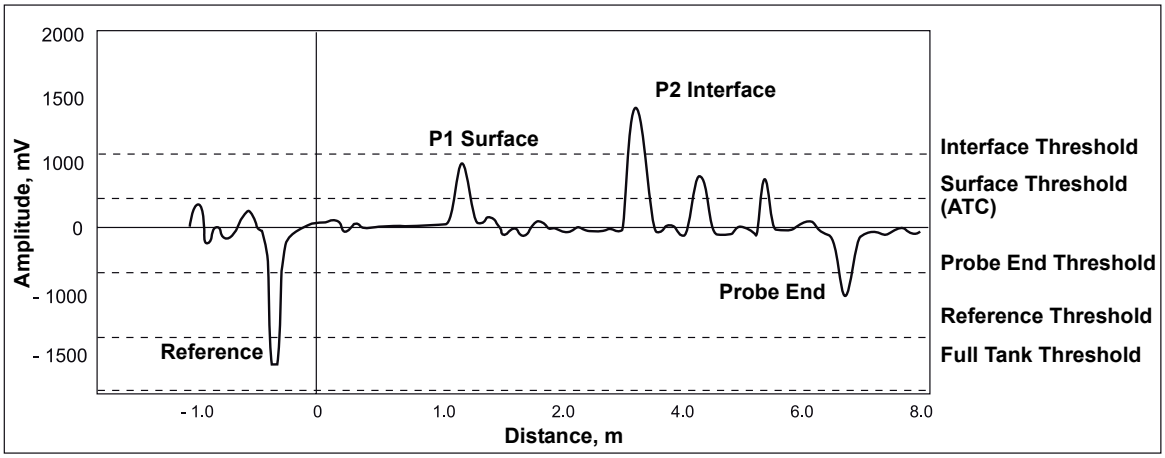
Process leaks could result in death or serious injury.

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.

ANALYZING THE MEASUREMENT SIGNAL

Rosemount Radar Master (RRM) and other tools using enhanced EDDL has powerful functions for advanced troubleshooting. By using the Echo Curve plot function you get an instant view of the tank signal. 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.

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. Is caused by reflection on the probe end.

Different amplitude thresholds are used in order 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 5300 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 7-8.

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 7-11.

SURFACE PULSE NOT FOUND

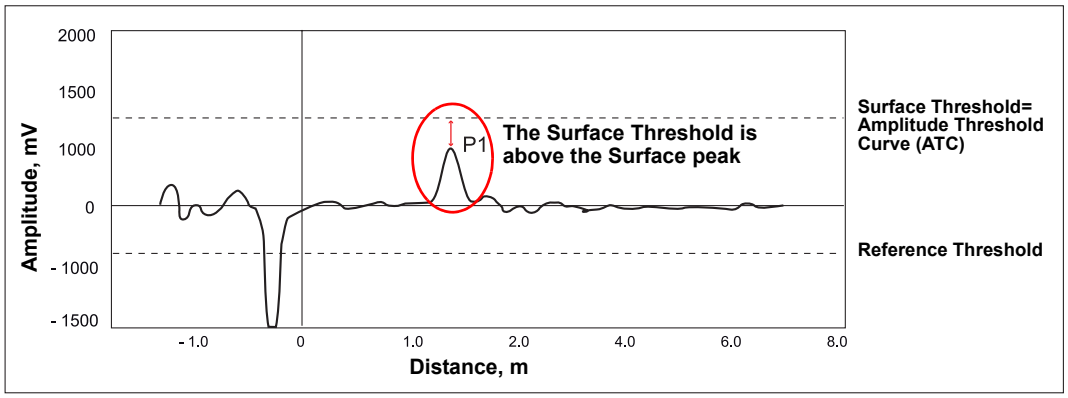
The amplitude thresholds are automatically adjusted to appropriate values in order to filter out noise and other non-valid measurements from the measurement signal.

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 5-3*). 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 allowing you to view the reflections along the probe (see "Using the Echo Curve Analyzer" on page 7-11).

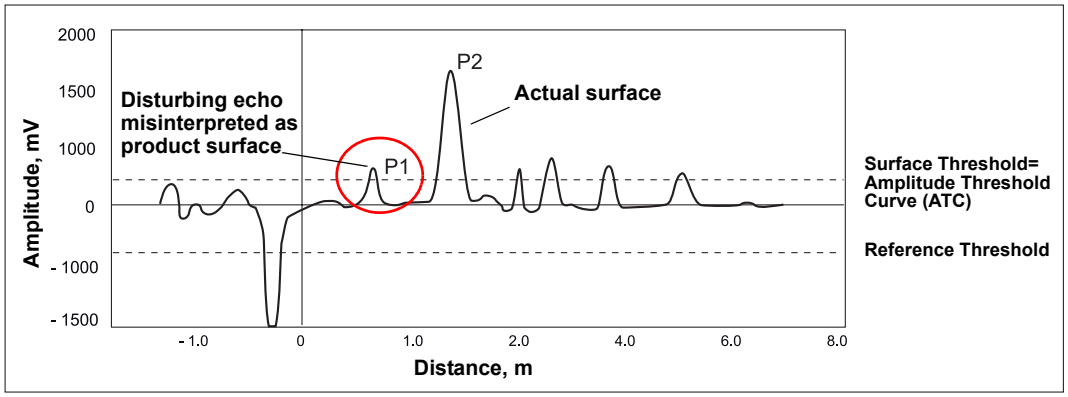
If the amplitude threshold is too high the product level will not be detected as illustrated in Figure 7-2. In a situation like this the amplitude threshold has to be lowered so that the Surface peak is not filtered out.

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



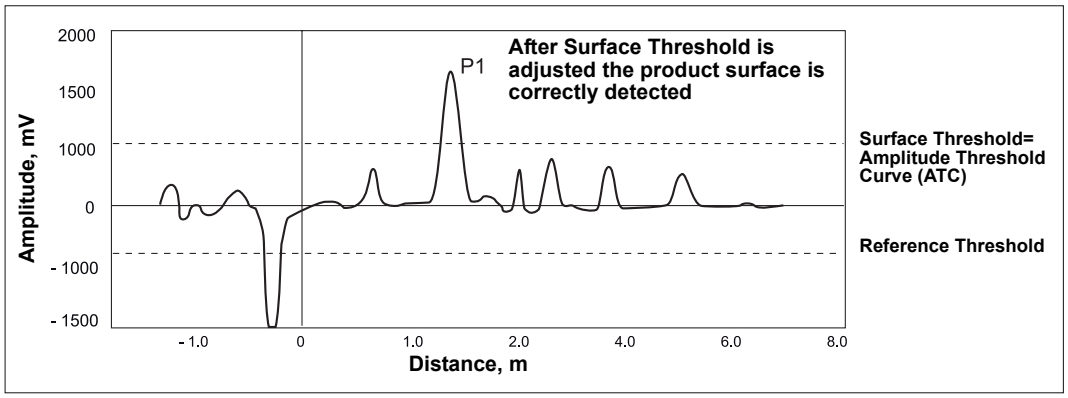
If there are disturbing objects in the tank the threshold must be carefully set in order to avoid locking on the wrong amplitude peak. In Figure 7-3 the transmitter has locked on a peak above the actual product surface, i.e. a disturbance was interpreted as the product surface, whereas the actual product 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 7-11.

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).

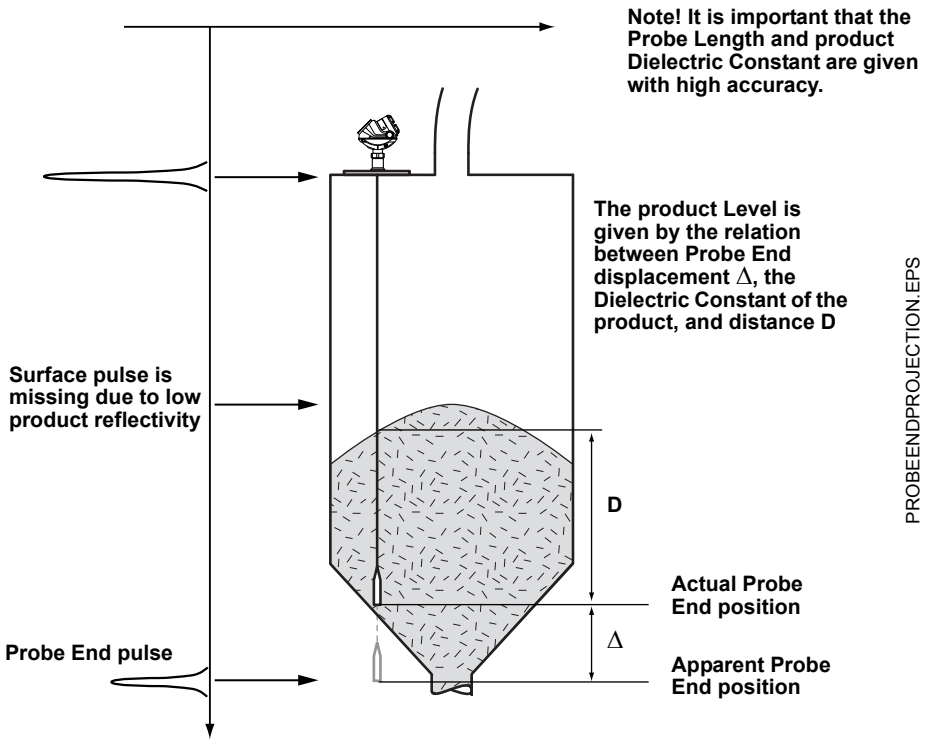
A product with very low reflectivity is characterized by its low dielectric constant. Such a product reflects relatively small amounts of the microwave energy emitted from the 5300 transmitter, and most of it is transmitted through the product. Consequently, situations may occur where the surface pulse 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 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 7-11*).

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 7-5.

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

Figure 7-5. The properties of the product makes the probe end pulse appear to be below the actual probe end.



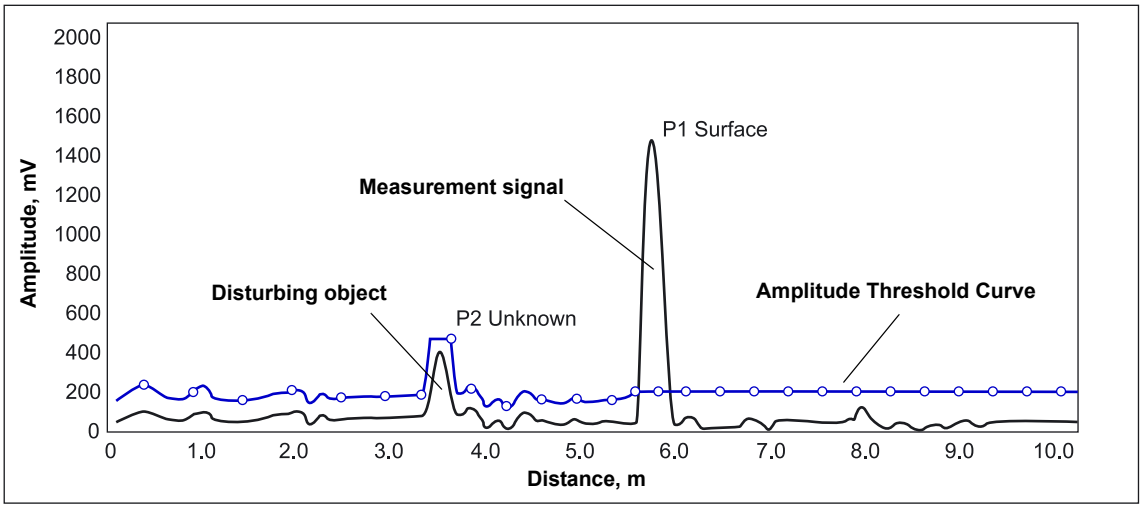
DISTURBANCE ECHO HANDLING

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 7-6 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 7-6. 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 a case 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:

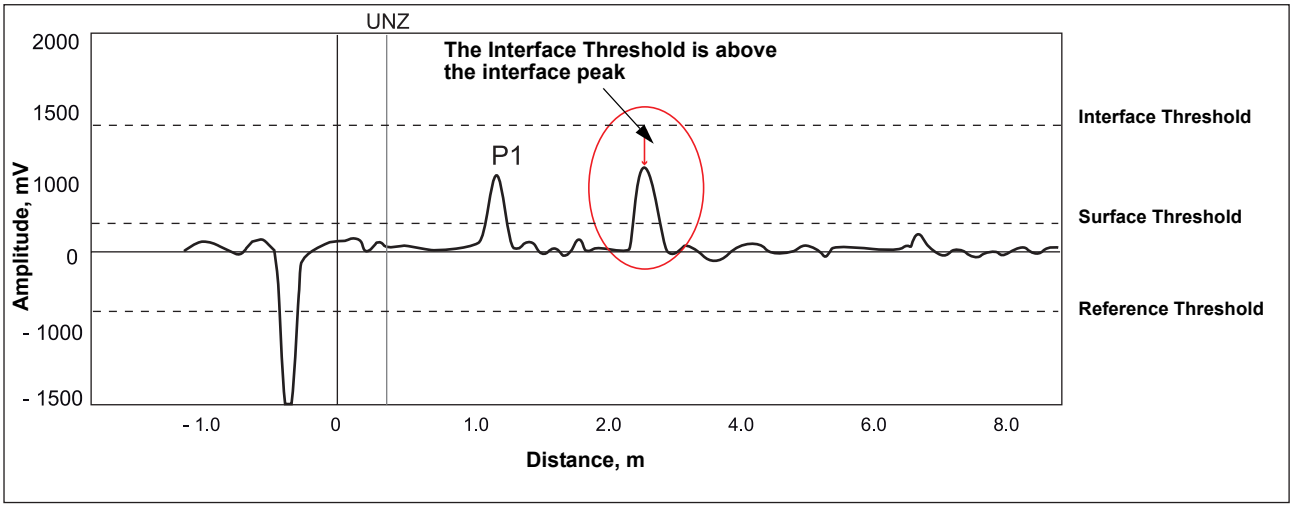
- The Interface Threshold should be approximately 50% of the interface signal amplitude.
- If possible, the Interface Threshold should be higher than the Surface Threshold.

You can use the RRM software or a 375 Field Communicator to change the amplitude thresholds, see “Using the Echo Curve Analyzer” on page 7-11 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-10.

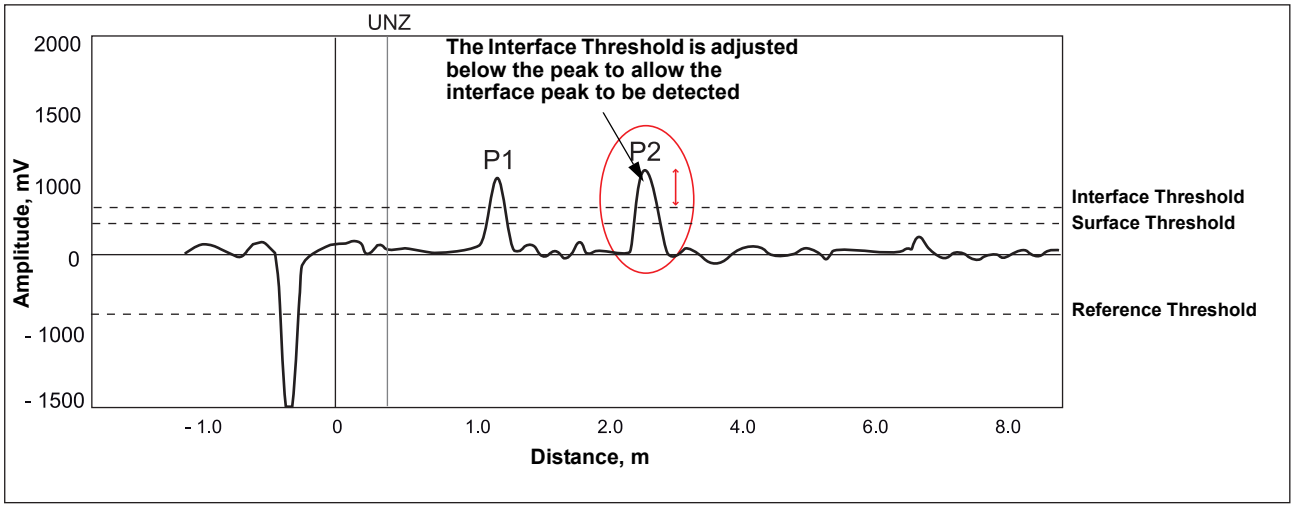
Figure 7-7 illustrates a situation where the Interface Threshold is too high. The signal amplitude peak at the interface between the upper and lower products is not detected in this case.

Figure 7-7. 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 7-8:

Figure 7-8. After changing the amplitude threshold the transmitter detects the interface



USING THE ECHO CURVE ANALYZER

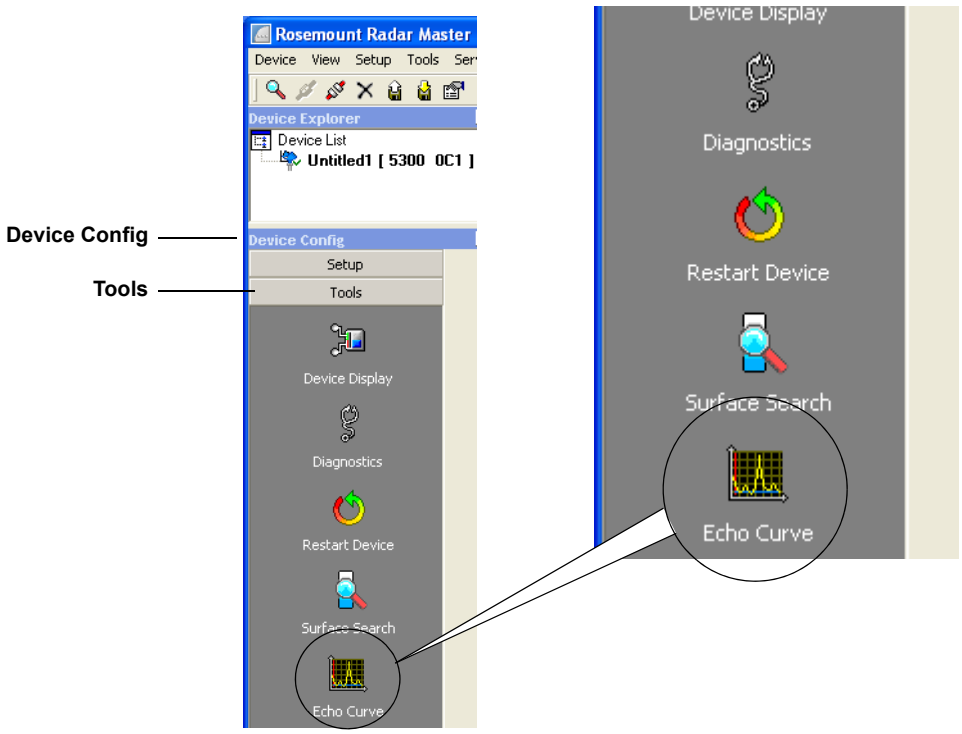
The *Echo Curve Analyzer* in *Rosemount Radar Master* (RRM) lets you view the measurement signal amplitude from the top to the bottom of the tank. It includes functions for viewing and recording the Echo Curve, and advanced functions for configuration of amplitude thresholds

Using the Rosemount Radar Master

To plot the measurement signal:

1. Start the Rosemount Radar Master program.
2. Open Device Config/Tools (or Device Config/Setup).
3. Click the Echo Curve icon (see Figure 7-9).

Figure 7-9. The Echo Curve function is a useful tool for signal analysis.



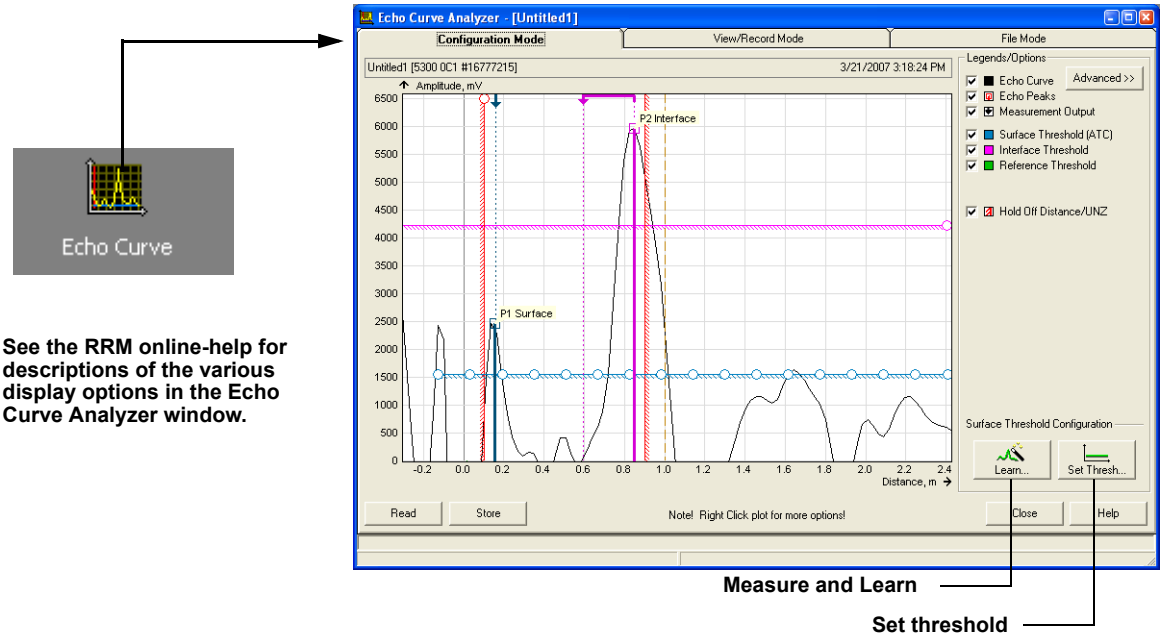
DEVICECONFIG_TOOLS.TIF

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 7-10. 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.

RRM/ECHOCURVE_ANALYZER_CONFIG.TIF

The **Measure and Learn** function in *Rosemount Radar Master* automatically creates an Amplitude Threshold Curve (ATC) which is used by the 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 7-8*.

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-6 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.

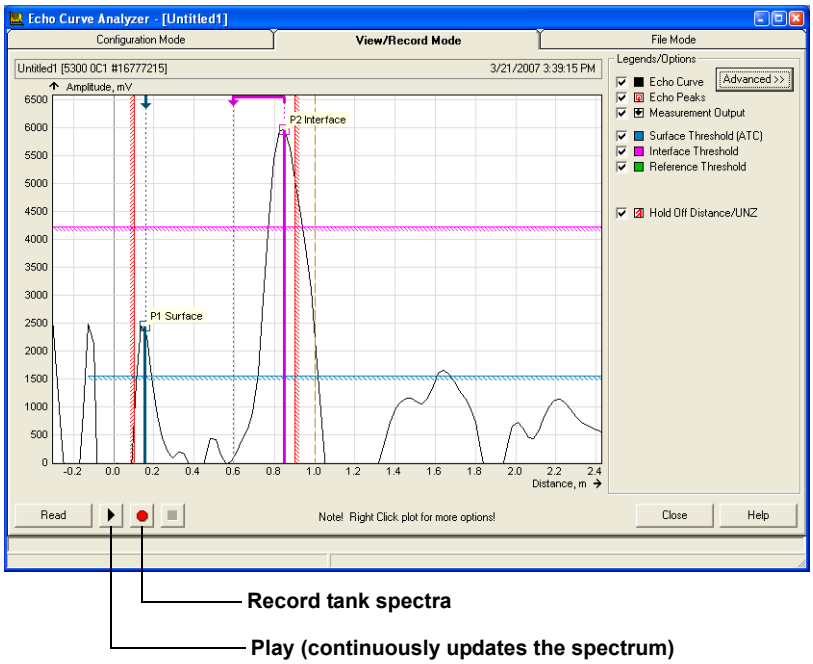
See also "Threshold Settings" on page C-6 for more information on how to adjust amplitude thresholds.

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 7-11. A Echo Curve plot in View/Record mode.



RRM/SPECTRUM_VIEW_ADVANCED.TIF

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

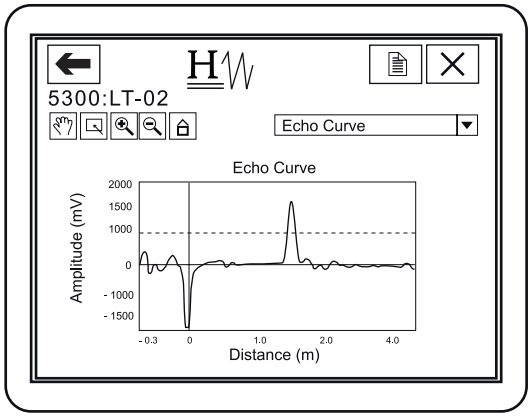
The 375 Field Communicator supports the Electronic Device Description Language (EDDL) with enhancements that allows you to view the Echo Curve, create an Amplitude Threshold Curve (ATC) and specify amplitude thresholds such as the Surface Threshold, Interface Threshold and Reference Threshold.

Viewing the Echo Curve

To view the Echo Curve do the following:

1. Select HART command [2, 5, 2].
   FOUNDATION™ fieldbus parameter:
   TRANSDUCER 1300>AMPLITUDE_THRESHOLD_CURVE

   The Echo Curve appears on the display:



375_ECHOCURVE_5300.EPS

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.

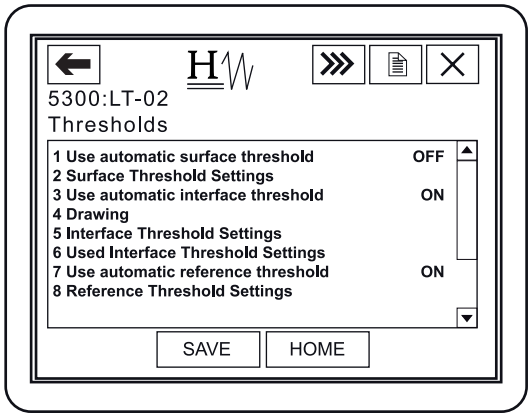
   The Echo Curve plot also shows an ATC if available. See *"Threshold Settings" on page 7-14* for information on how to create an ATC with the *Measure and Learn* function.

Threshold Settings

To adjust the amplitude thresholds do the following:

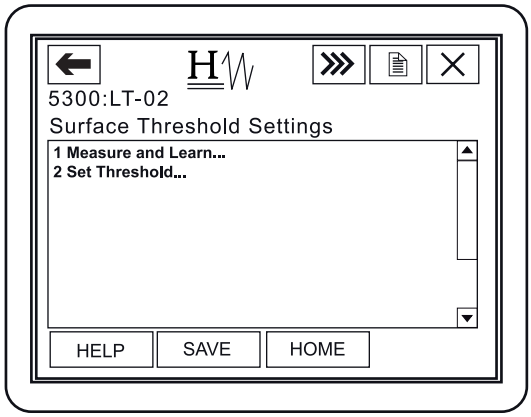
1. Select HART command [2, 5, 3].
   FOUNDATION™ fieldbus parameter:
   TRANSDUCER 1300>PROBE_END_THRESH
   TRANSDUCER 1300>REFERENCE_THRESH
   TRANSDUCER 1300>INTERFACE_THRESH
   TRANSDUCER 1300>FULL_TANK_THRESH_OFFSET

   The different threshold options appear on the display:



375_THRESHOLDS_5300.EPS

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



375_SURFACETHRESHOLD_5300.EPS

3. Option *1 Measure and Learn* lets you create an Amplitude Threshold Curve (ATC), see *"Amplitude Threshold Curve" on page 7-8* 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 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 7-12, 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.

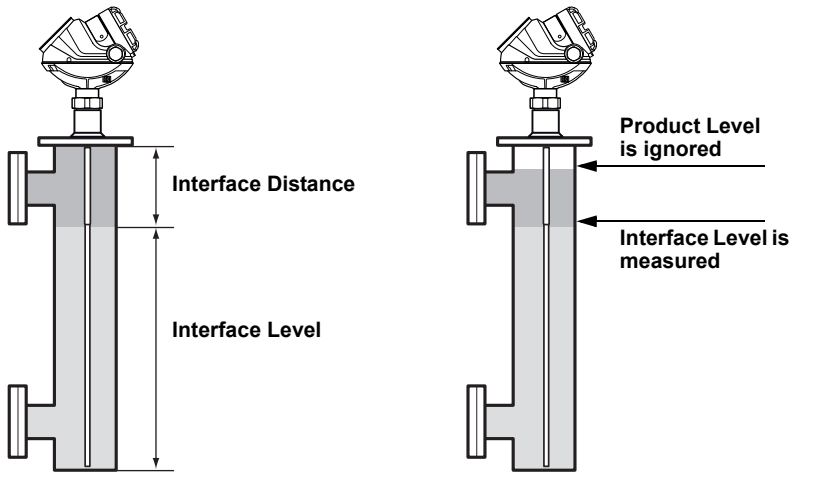
Choose the *Interface Level with Submerged Probe* option.

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 7-12. Interface Level measurements in a full bridle pipe.



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 7-11.

ANALOG OUTPUT CALIBRATION

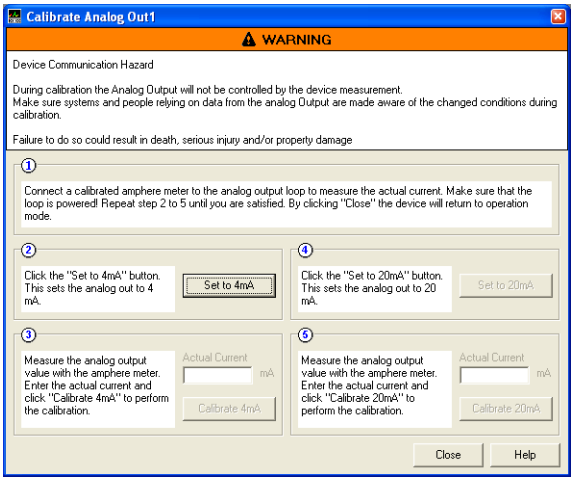
This function lets you calibrate the Analog Output by comparing the actual output current with the nominal 4 mA and 20 mA currents. Calibration is done at factory and normally the transmitter does not need to be recalibrated.

The Analog Output Calibration function is available via the HART command [2, 7, 1].

In RRM this function is available via Setup>Output.

To calibrate the Analog Output current do the following:

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.



CALIBRATE_ANALOGOUT.TIF

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

LEVEL AND 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.

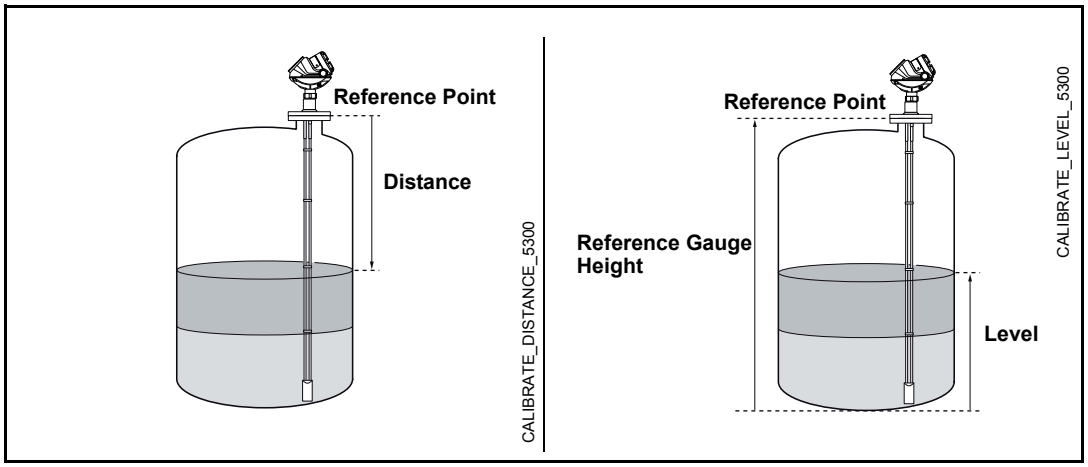
Distance calibration

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],
   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 7-13. Distance and Level calibration

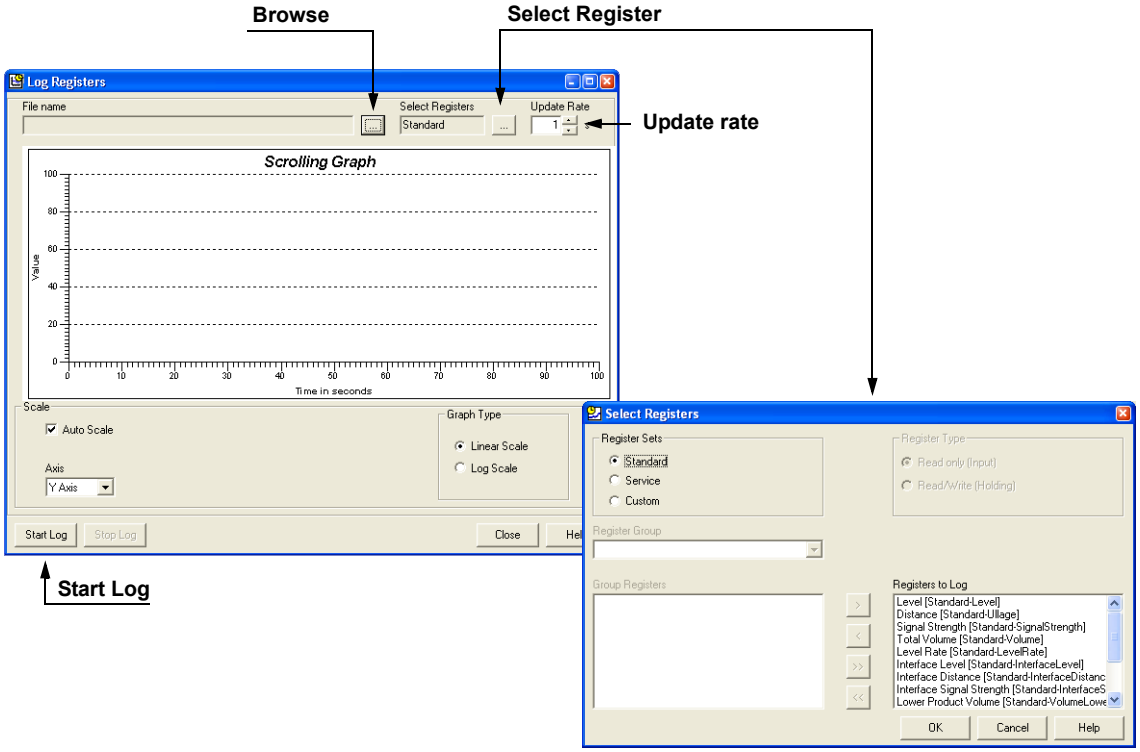


LOGGING MEASUREMENT DATA

By using the Log Device Registers function in the *Rosemount Radar Master* (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 7-14. The Log Registers function can be used to verify that the transmitter works properly.



LOGREGISTERS.TIF/LOGREGISTERSSELECTREGISTERS.TIF

To start logging do the following:

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.

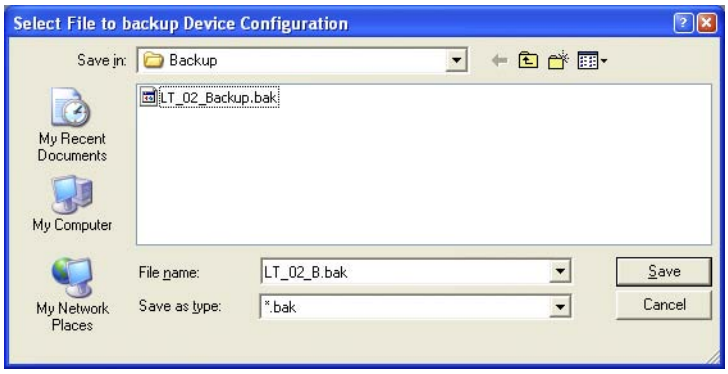
BACKING UP THE TRANSMITTER CONFIGURATION

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 7-15. It is recommended that the transmitter configuration is stored in a backup file.



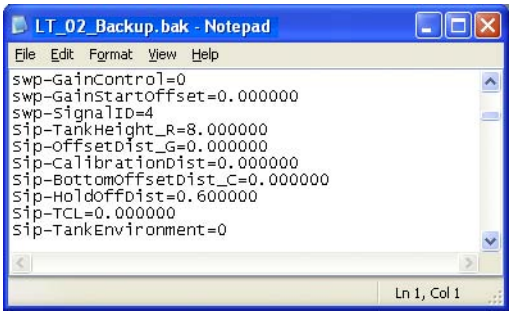
RRM/BACKUP.TIF

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 Rosemount Radar Master software:



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

Figure 7-16. The configuration backup file can be viewed in a word processor program.



RRM/BACKUP_VIEW.TIF

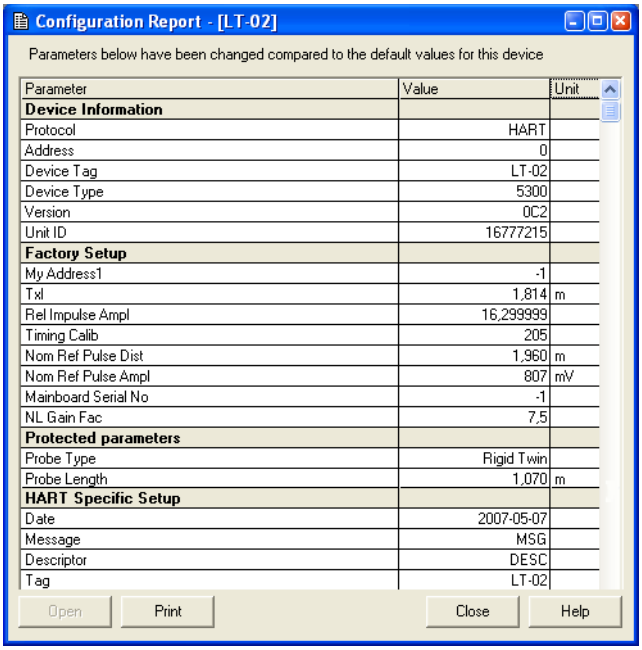
See also *"Configuration Report" on page 7-21* for further information on viewing backup files.

CONFIGURATION REPORT

This function in *Rosemount Radar Master* (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 7-17. The Configuration Report window in Rosemount Radar Master.



CONFIGREPORT_53.TIF

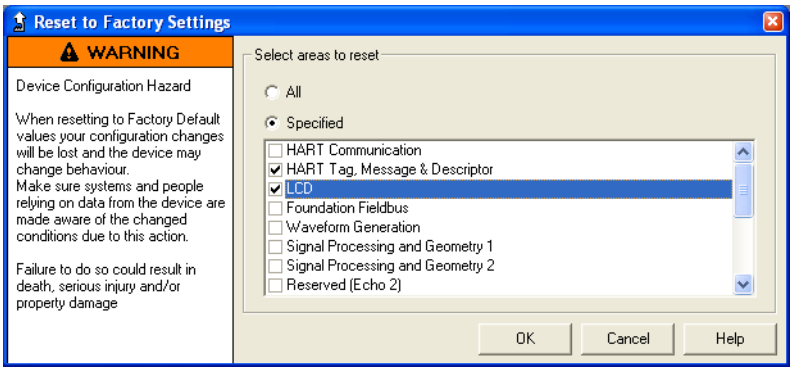
Information on probe type, software versions, software and hardware configuration and unit code is presented.

RESET TO FACTORY SETTINGS

This function resets all or a specific part of the holding registers to factory settings. 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 7-18. The Reset to Factory Settings window in RRM.



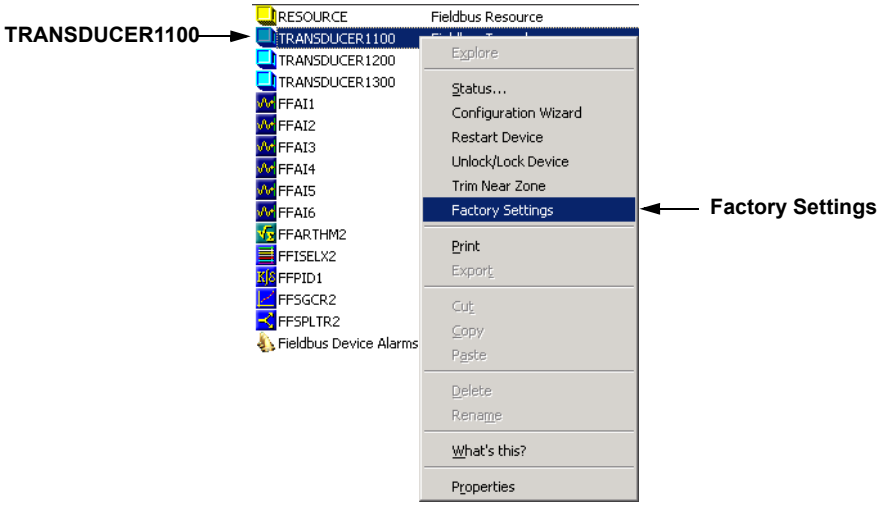
RESETTOFACTORY.TIF

AMS Suite: Tools/Service>Factory Settings.

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

DeltaV:

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



DELTA_V / TB1100_MENU_FACTORY.TIF

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

DIAGNOSTICS

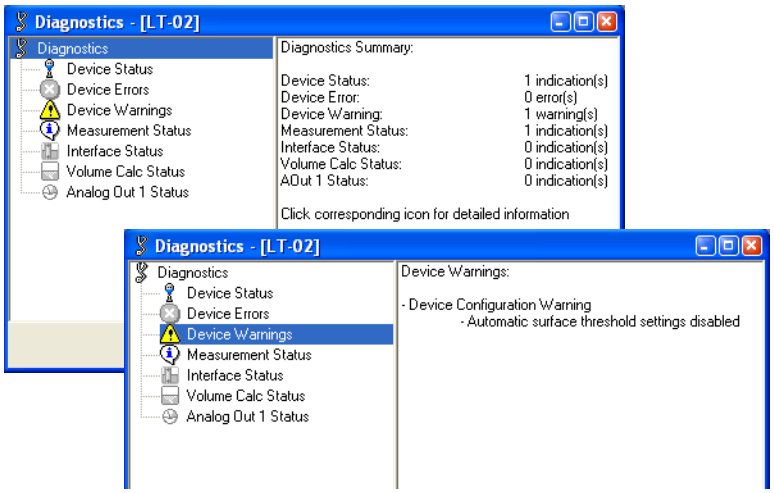
The following information about the device can be retrieved:

- device status, see “Device Status” on page 7-32.
- device errors, see “Errors” on page 7-33.
- device warnings, see “Warnings” on page 7-34.
- measurement status, see “Measurement Status” on page 7-35.
- volume status, see “Volume Calculation Status” on page 7-36.
- analog output status, see “Analog Output Status” on page 7-37.

Rosemount Radar Master

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

Figure 7-19. The Diagnostics window in Rosemount Radar Master.

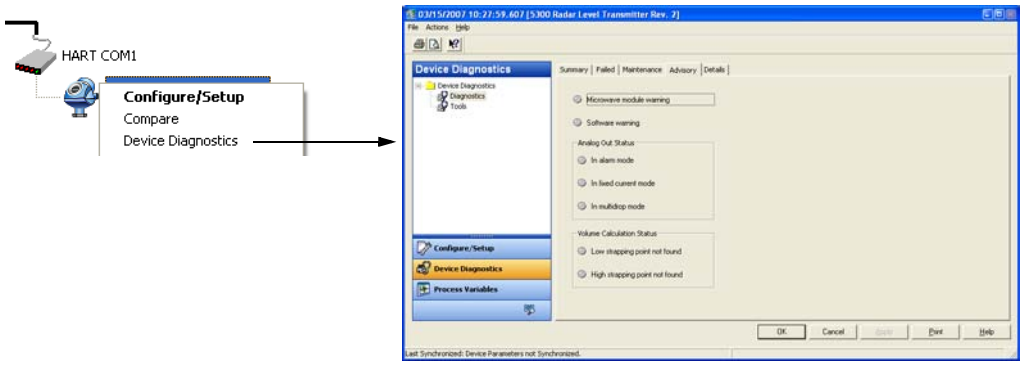


DIAGNOSTICS_LT02_WARNINGS.TIF / DIAGNOSTICS_LT02.TIF

AMS

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

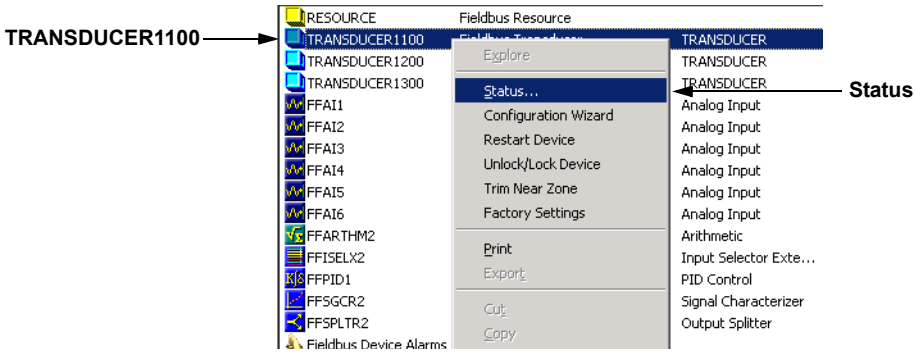
Figure 7-20. Device Diagnostics window in AMS Suite.



AMS/DIAGNOSTICS_ADVISORY.TIF

DeltaV

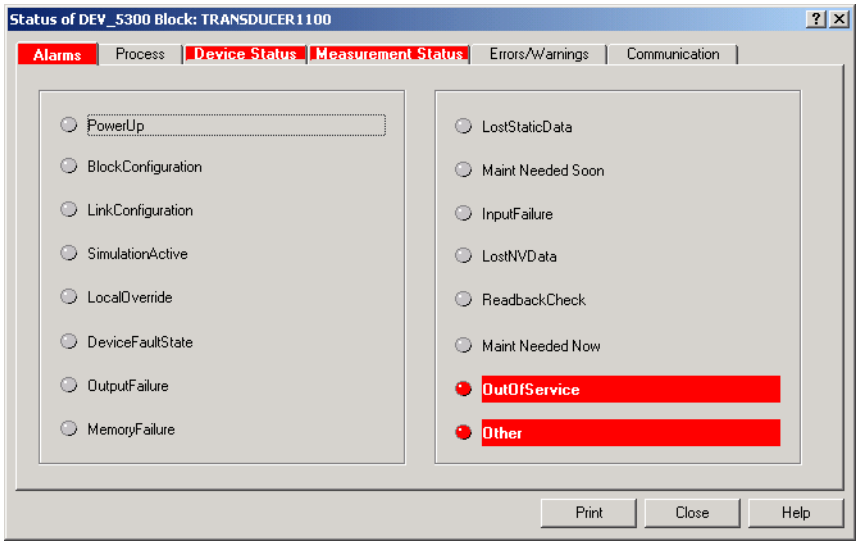
1. In the DeltaV Explorer select the desired transmitter icon and click the right mouse button on the **Transducer 1100** block icon:



DELTA_V / TB1100_MENU_STATUS.TIF

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 7-21. The Status window in DeltaV shows various status information.



TB1100_STATUS.TIF

HART command

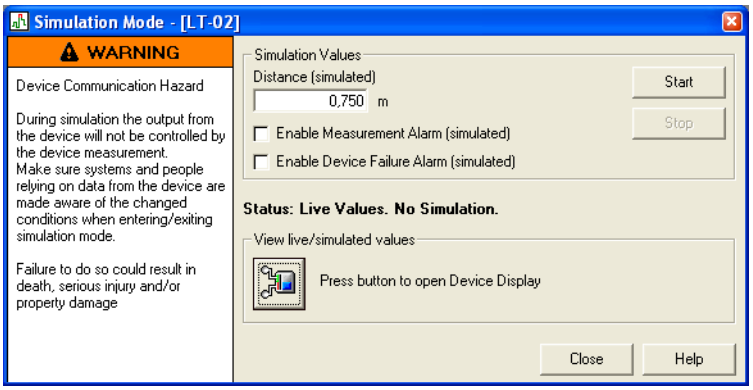
For a 375 Field Communicator the corresponding HART command for the Diagnostics option is [3, 1].

USING THE SIMULATION MODE

This function can be used to simulate measurements and alarms.

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

Figure 7-22. The Simulation Mode window in RRM.



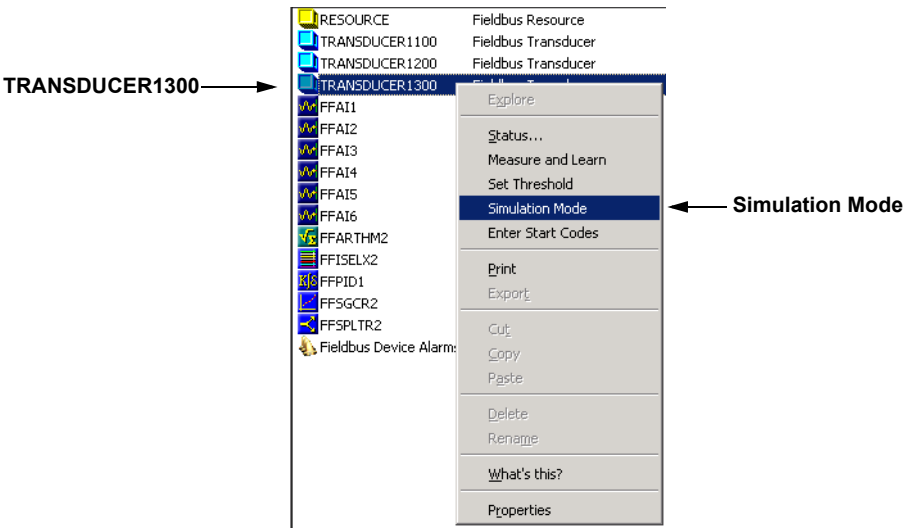
SIMULATIONMODE_53.TIF

AMS Suite: Tools>Service>Simulation Mode.

HART Command: [3, 2].

DeltaV:

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



DELTA_V / TR1300_MENU.TIF

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

WRITE PROTECTING A TRANSMITTER

A 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 in order to facilitate service and maintenance of the transmitter.

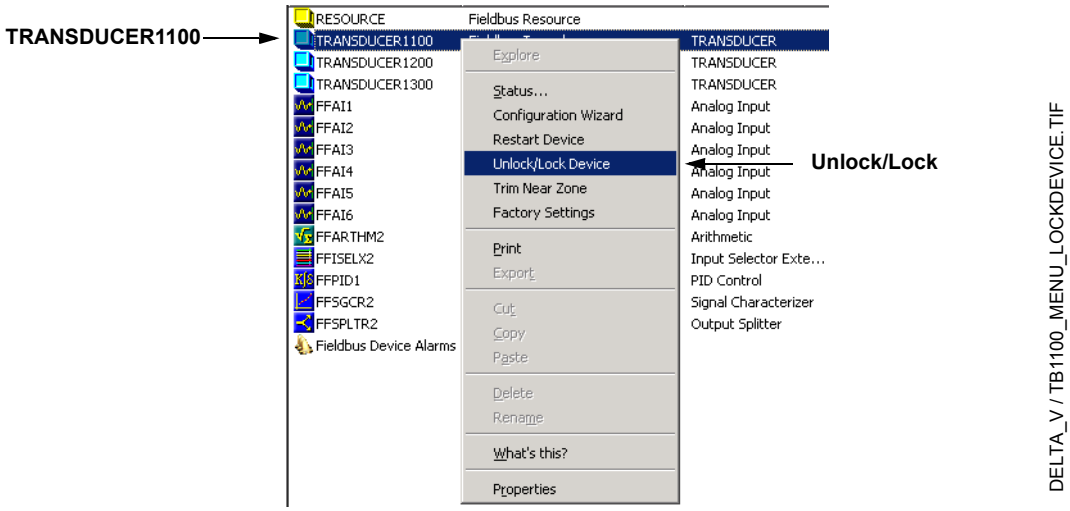
RRM: Tools>Lock/Unlock Configuration Area.

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 *Rosemount Radar Master* (RRM) service functions for advanced users are available for the 5300 Series transmitter. By setting RRM into the 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**. By viewing the contents of the Input Registers advanced users can check that the transmitter works properly.

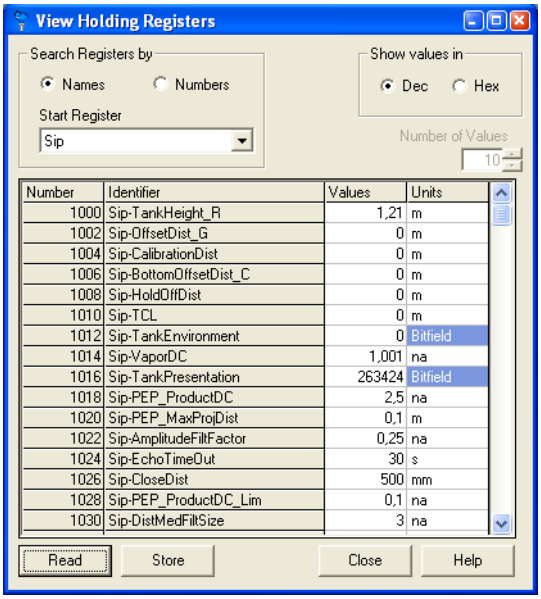
The **Holding Registers** store various transmitter parameters such as configuration data used to control the measurement performance.

By using the *Rosemount Radar Master* (RRM) program, 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.

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

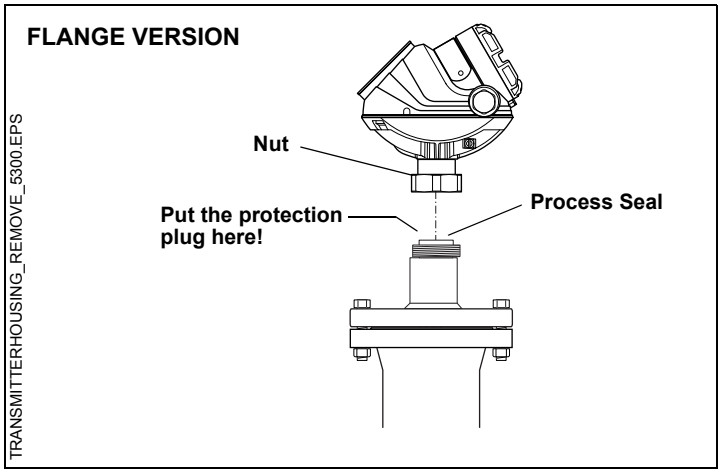
1. Choose the **Enter Service Mode** option from the **Service** menu.
2. Type the password (default password is “admin”). Now the View Input and View Holding Registers options are available.
3. Choose the **View Input/Holding Registers** option from the **Service** menu.
4. Click the Read button. To 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 7-23. Holding and Input Registers can be viewed in RRM.

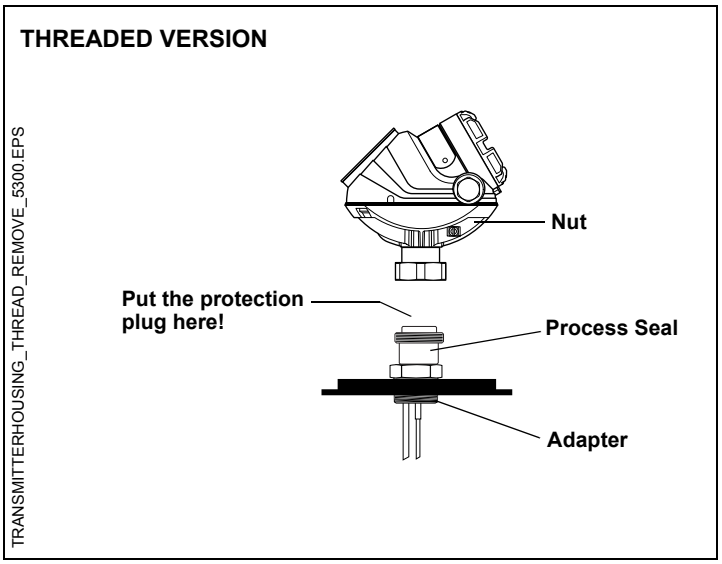


RRM_VIEWHOLDREG_53.TIF

REMOVING THE TRANSMITTER HEAD

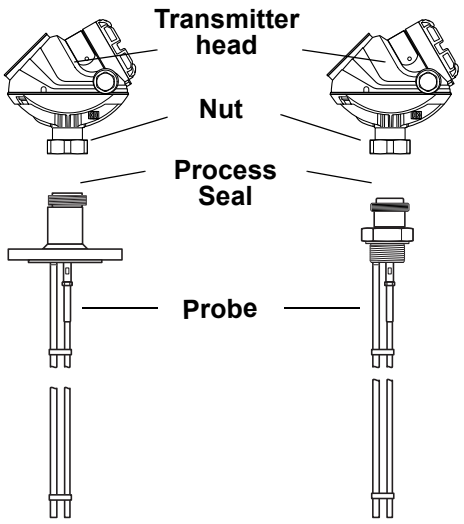


1. Loosen the nut that connects the transmitter housing to the Process Seal.
2. ⚠ Carefully lift the transmitter head.
3. Make sure that the upper surface of the Process Seal is clean and the spring-loaded pin at the center of the Process Seal is properly inserted (the pin should move back when pushed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



NOTE
Do not remove the Process Seal from the adapter!

CHANGING THE PROBE



PROBE_CHANGE_5300.EPS

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. Fine tune by using the **Trim Near Zone** function:
   HART Fast Key sequence [2, 6, 3]
   or
   in RRM click the **Advanced** icon in the Device Config/Setup toolbar and select the **Near Zone** tab in the *Advanced Configuration* window.
9. Verify that the transmitter measures correct product level, otherwise see “Level and Distance Calibration” on page 7-18.

DIAGNOSTIC MESSAGES

Troubleshooting

If there is a malfunction despite the absence of diagnostic messages, see Table 7-1 for information on possible causes.

Table 7-1. 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 this is the case, 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.	• Check that correct COM Port is selected in the HART server (see “Specifying the COM Port” on page 5-14. • Check wiring diagram. • Verify that the 250 Ohm 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.
Analog Out is set in Alarm.		View the Diagnostic window, see “Diagnostics” on page 7-23 in order 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 5-3).
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.		View the Diagnostic window, see “Diagnostics” on page 7-23, in order 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 7-9. • Check the Upper Product Dielectric constant, see "Basic Configuration Parameters" on page 5-3.
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 7-8. • 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 Rosemount 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 Rosemount Service Department.
Volume Measurement Failure		• Restart gauge • Check gauge configuration using PC Based configuration tool
No surface echo		• Check signal strength • Restart transmitter
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 Rosemount 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 the Rosemount Radar Master (RRM) program are shown in Table 7-2:

Table 7-2. Device status.

Message	Description	Action
Running Boot Software	The application software could not be started.	Contact Rosemount Service Department.
Device Warning	A device warning is active.	See Warning Messages for details.
Device Error	A device error is active.	See Error Messages for details.
Simulation Mode 0	The simulation mode is active.	Turn off the simulation mode.
Simulation Mode 1	The advanced simulation mode is active.	To turn off the Advanced Simulation mode set Holding Register 3600=0 (see “Viewing Input and Holding Registers” on page 7-27).
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 Rosemount 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 275/375 Handheld Communicator, in AMS or in the Rosemount Radar Master (RRM) program, are shown in Table 7-3. Errors normally result in Analog Output alarm.

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

Table 7-3. 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 Rosemount 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 Rosemount 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 Rosemount service department if the problem persists.
Microwave Module error	An error in the microwave module.	Contact Rosemount service department.
LCD error	An error in the LCD is detected.	Contact Rosemount service department.
Modem error	An error in the modem used for digital communication has been detected.	Contact Rosemount service department.
Analog out error	An error in the Analog Out Module.	Contact Rosemount service department.
Internal temperature error	An error in the internal temperature measurement. -40 ºC<Internal Temperature<85 ºC.	Contact Rosemount service department.
Other hardware error	An unspecified hardware error has been detected.	Contact Rosemount service department.
Measurement error	A serious measurement error has been detected.	Contact Rosemount 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 Rosemount service department if the problem persists.
Software error	An error has been detected in the transmitter software.	Contact Rosemount service department.

Warnings

Table 7-4 shows a list of diagnostic messages that may be displayed on the Integral Display, on the 275/375 Handheld Communicator or in the Rosemount Radar Master (RRM) program. Warnings are less serious than errors and in most cases do not result in Analog Output alarms.

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

Table 7-4. Warning messages.

Message	Description	Action
RAM warning	See Diagnostics (RRM: Tools>Diagnostics) for further information on a warning message. See also “Diagnostics” on page 7-23.	
FPROM warning		
Hreg warning		
MWM warning		
LCD warning		
Modem warning		
Analog out warning		
Internal temperature warning		
Other hardware warning		
Measurement warning		
Config warning		
SW warning		

Measurement Status

Measurement Status messages that may appear on the Integral Display, on the 275/375 Handheld Communicator, in DeltaV or in the Rosemount Radar Master (RRM) program are shown in Table 7-5:

Table 7-5. 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.
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 Rosemount 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 Rosemount service department.
No surface echo	The Surface Echo Pulse can not be detected. Possible cause: • Wrong surface threshold. • Liquid level in Dead 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.
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 is simulated.	Check Volume Status for details.
Simulation Mode 0	The simulation mode is active. The given measurements is simulated.	Turn off the simulation mode.
Simulation Mode 1	The advanced simulation mode is active.	To turn off the Advanced Simulation mode set Holding Register 3600=0 (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.
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 5-5. 2. In the Transition Zones the level may jump to Full Tank/End of Probe, see “Transition Zones” on page 2-9. 3. See “Disturbance Echo Handling” on page 7-8.

Interface Status

Interface Status messages that may appear on the Integral Display, on the 275/375 Handheld Communicator, in DeltaV or in the Rosemount Radar Master (RRM) program are shown in Table 7-5:

Table 7-6. 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 7-9.
Can't measure interface on horizontal probe	Interface can not 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 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 275/375 Handheld Communicator or in the Rosemount Radar Master (RRM) program are shown in Table 7-7:

Table 7-7. 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 275/375 Handheld Communicator or in the Rosemount Radar Master (RRM) program are shown in Table 7-8:

Table 7-8. 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.

LED ERROR MESSAGES

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

Figure 7-24. 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.

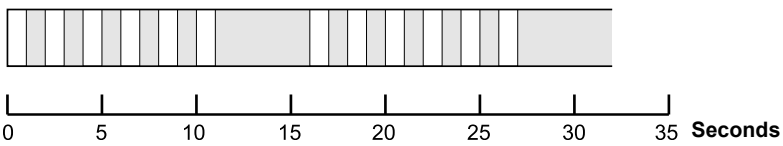
The following errors can be displayed:

Table 7-9. 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 7-10 through Table 7-12 to determine the appropriate corrective action.

Block Errors

Table 7-10 lists conditions reported in the BLOCK_ERR parameter.

Table 7-10. 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 7-11. Resource Block SUMMARY_STATUS messages

Condition Name
Uninitialized
No repair needed
Repairable
Call Service Center

Table 7-12. 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 7-13. Transducer Block BLOCK_ERR messages

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

Table 7-14. 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 7-16 to determine the appropriate corrective action.

Table 7-15. AI BLOCK_ERR Conditions

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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 7-16. 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 target mode set to OOS. 2. Resource Block OUT OF SERVICE.
	BLOCK_ERR reads CONFIGURATION ERROR	1. Check CHANNEL parameter (see "CHANNEL" on page 5-38). 2. Check L_TYPE parameter (see "L_TYPE" on page 5-38). 3. Check XD_SCALE engineering units. (see "XD_SCALE and OUT_SCALE" on page 5-39.
	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 5-39).
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 5-39.
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 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 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 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.

Appendix A Reference Data

Specifications . . . . . **page A-1**
Dimensional drawings . . . . . **page A-8**
Ordering Information . . . . . **page A-16**
Spare Parts . . . . . **page A-23**

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).
Start-up Time	< 40 s
Measuring Performance	
Reference Accuracy	± 0.12 in. (3 mm) or 0.03% of measured distance, whichever is greatest.(1)
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, Analog Output Current(2) and % of Range(2), 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.

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 V dc (16-30 V dc in IS applications, 20-42.4 Vdc in Explosionproof / Flameproof applications). FOUNDATION™ fieldbus: 9-32 V dc (9-30 V dc in IS applications, and 16-32 V dc in Explosionproof / Flameproof applications). FISCO, IS applications: 9-17.5 V dc.
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: 1.3 ft (0.4 m) to 9.8 ft (3 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	• 316 / 316L SST (EN 1.4404), PTFE, PFA(3) and O-ring materials (model code 1) or • Hastelloy® C-276 (UNS N10276), PTFE, PFA(3) and O-ring materials (model code 2) or • Monel® 400 (UNS N04400), PTFE, PFA(3) and O-ring materials (model code 3) • PTFE(4) (model code 7) or • PTFE(4), 316 L SST (EN 1.4404) and O-ring materials (model code 8) • 316L SST (EN 1.4404), Ceramic (Al_2O_3), Graphite (HTHP Probe, model code H) • 316L SST (EN 1.4404), Ceramic (Al_2O_3), Graphite, PFA (HP Probe, model code P) See “Ordering Information” on page A-16.
Dimensions	See “Dimensional drawings” on page A-8.
Probe Angle	0 to 90 degrees.
Housing / Enclosure	Polyurethane-covered Aluminum.
Flanges, Threads	See “Ordering Information” on page A-16.
Height Above Flange	See “Ordering Information” on page A-16.

Weight	Transmitter Head (TH): 4.4 lbs (2 kg). Flange: depends on flange size. Coaxial probe: 0.67 lbs/ft (1 kg/m). Rigid Single Lead probe: 0.27 lbs/ft (0.4 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(5)	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) See temperature and pressure diagrams on page A-4.
Process Pressure(5)	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). 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.
Electromagnetic Compatibility	Emission and Immunity: EMC directive 89/336/EEC. EN61326-1:1997 incl. A1:1998 and A2:2001. 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) Not applicable for FOUNDATION™ fieldbus.
(3) PFA is a fluoropolymer with properties similar to PTFE.
(4) 1 mm PTFE cover.
(5) 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) or NPT or BSP/G threads(2). See “Ordering Information” on page A-16).

Flange mating face dimensions follow ANSI B 16.5, JIS B2220, and EN 1092-1 (DIN 2527) standards for blind flanges. Fisher and Masoneilan flanges are also available.

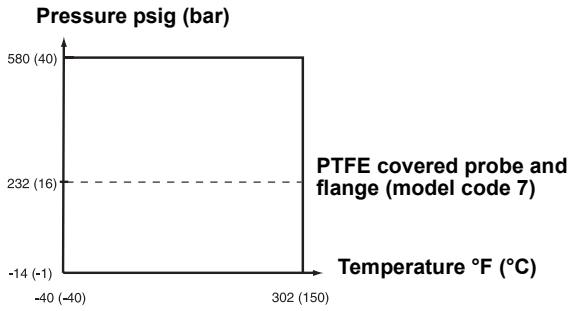
Flanged Hastelloy®, Monel® and PTFE covered probes have a tank connection design with a protective plate made of the same material as the probe, to prevent the 316L / EN 1.4404 SST flange from being exposed to the tank atmosphere.

The diagrams below show temperature and pressure ratings for the following tank connection types:

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

NOTE!
Final rating may be lower depending on flange and o-ring selection.

Figure A-1. Maximum process temperature and pressure diagram for standard tank connections.



PRESSURE_TEMP_STANDARD.EPS

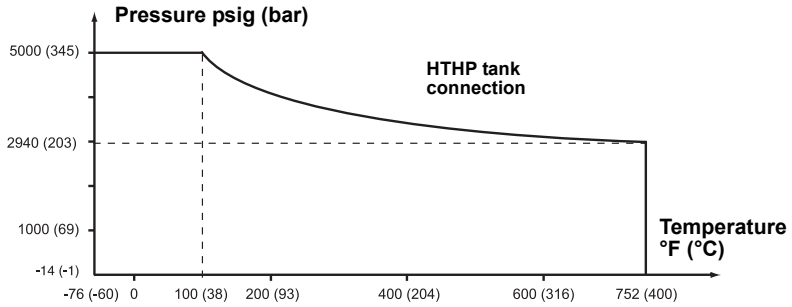
The following table gives the temperature ranges for tank seal with different O-ring material (applicable for the Standard Tank Connection):

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)

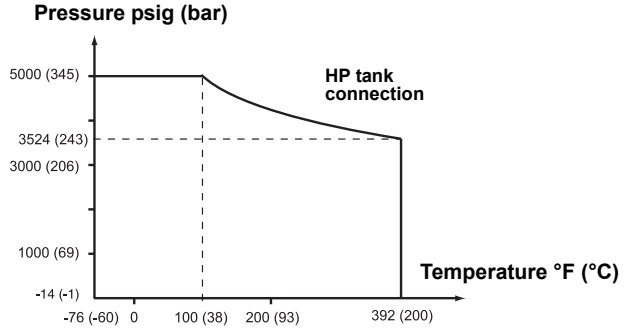
(1) EN (DIN), ANSI, Fisher or Masoneilan.
(2) 1 or 1.5 in. depending on probe type

Figure A-2. Maximum process temperature and pressure diagram for HTHP tank connection.



PRESSURE_TEMP_HTHP.EPS

Figure A-3. Maximum process temperature and pressure diagram for HP tank connection.



PRESSURE_TEMP_HP.EPS

The HP and HTHP versions have a ceramic tank seal, and graphite gaskets - no O-rings are used. The final rating depends on flange/thread selection.

The difference between the HP and HTHP versions is spacer material; PFA for HP, and ceramic for HTHP. Ceramic spacers allow for usage in applications with higher temperature. The HP and HTHP versions also manage lower temperatures than the standard version.

Flange Rating Standards

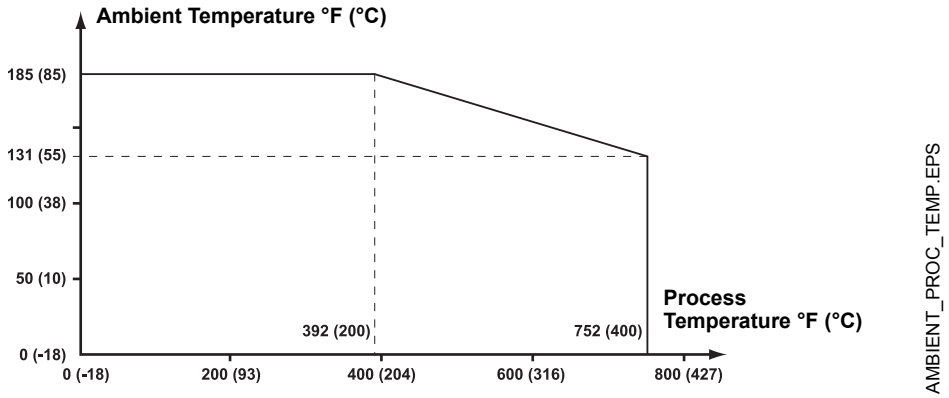
- ANSI:
  According to ANSI B16.5 Table 2-2.3.
  Standard: Max. 302 °F/580 psig
  (150 °C/40 Bar).
  HP/HTHP: Up to Class 2500.
- EN:
  According to EN 1092-1 Table 18, material group 13E0.
  Standard: Max. 302 °F/580 psig
  (150 °C/40 Bar).
  HP/HTHP: Up to PN 320.
- Fisher & Masoneilan:
  According to ANSI B16.5 Table 2-2.3.
  Standard: Max. 302 °F/580 psig
  (150 °C/40 Bar).
  HP/HTHP: 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: 10K/20K/200C.
  HTHP: 10K/20K/400C

Ambient Temperature

When the Rosemount 5300 is installed in high temperature applications, it is important that the maximum ambient temperature is considered. Tank insulation should not exceed 4 inches (10 cm) for high temperature and pressure seal.

The diagram below shows the maximum ambient temperature vs. process temperature:

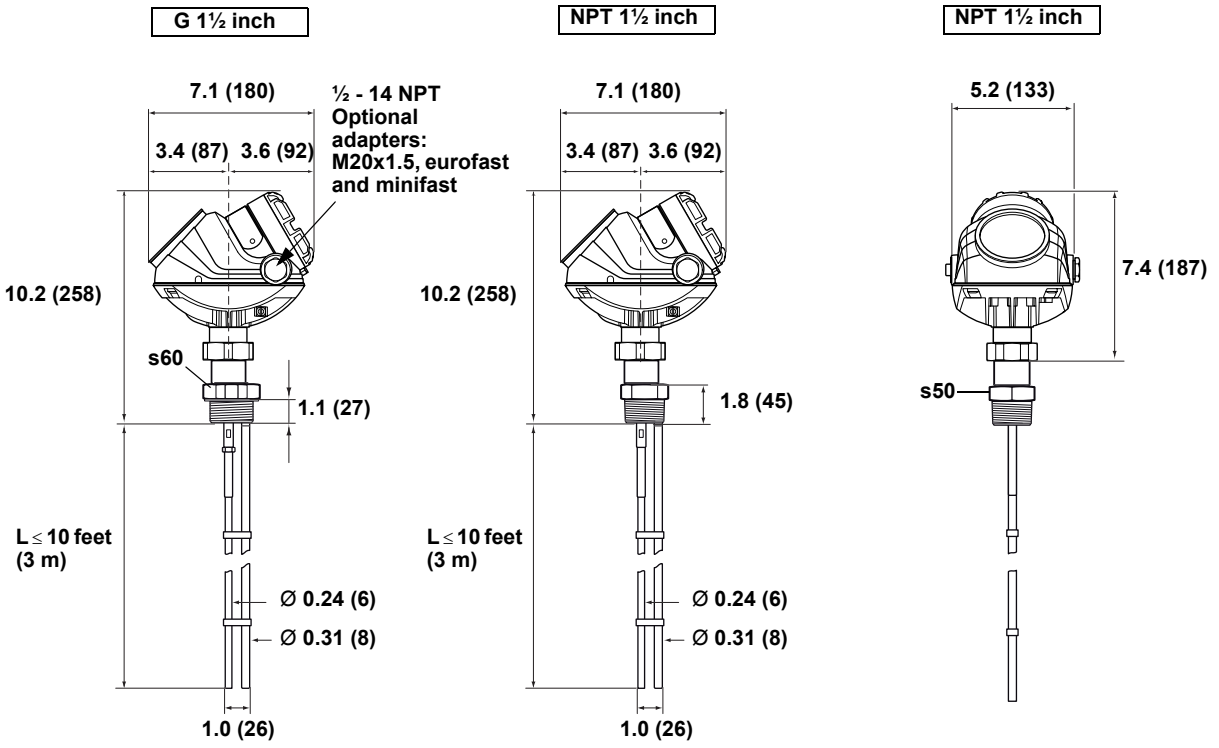
Figure A-4. Maximum ambient temperature vs. process temperature.

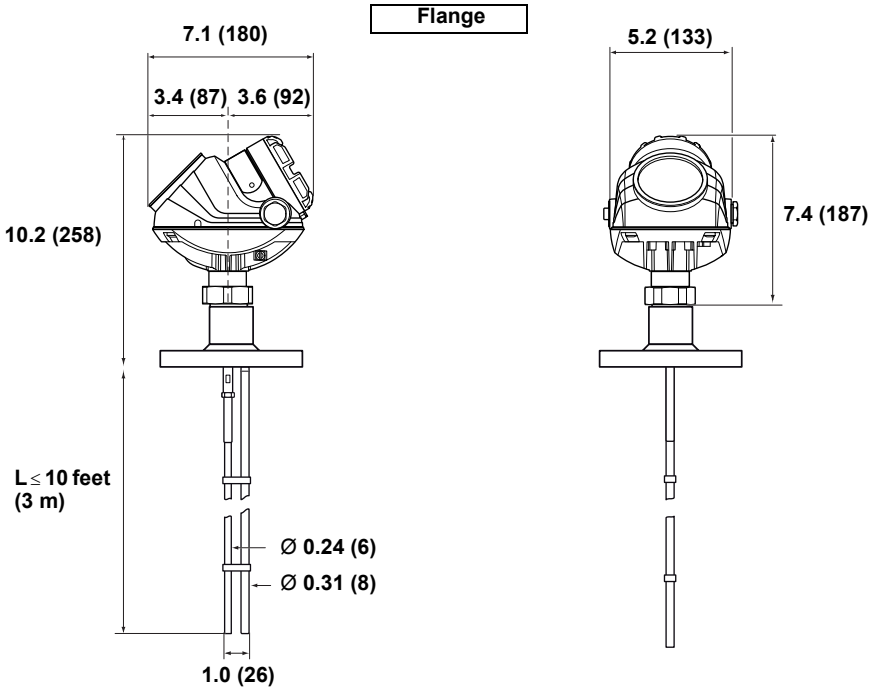


NOTE!
Maximum ambient temperature also depends on hazardous locations certfications.

DIMENSIONAL DRAWINGS

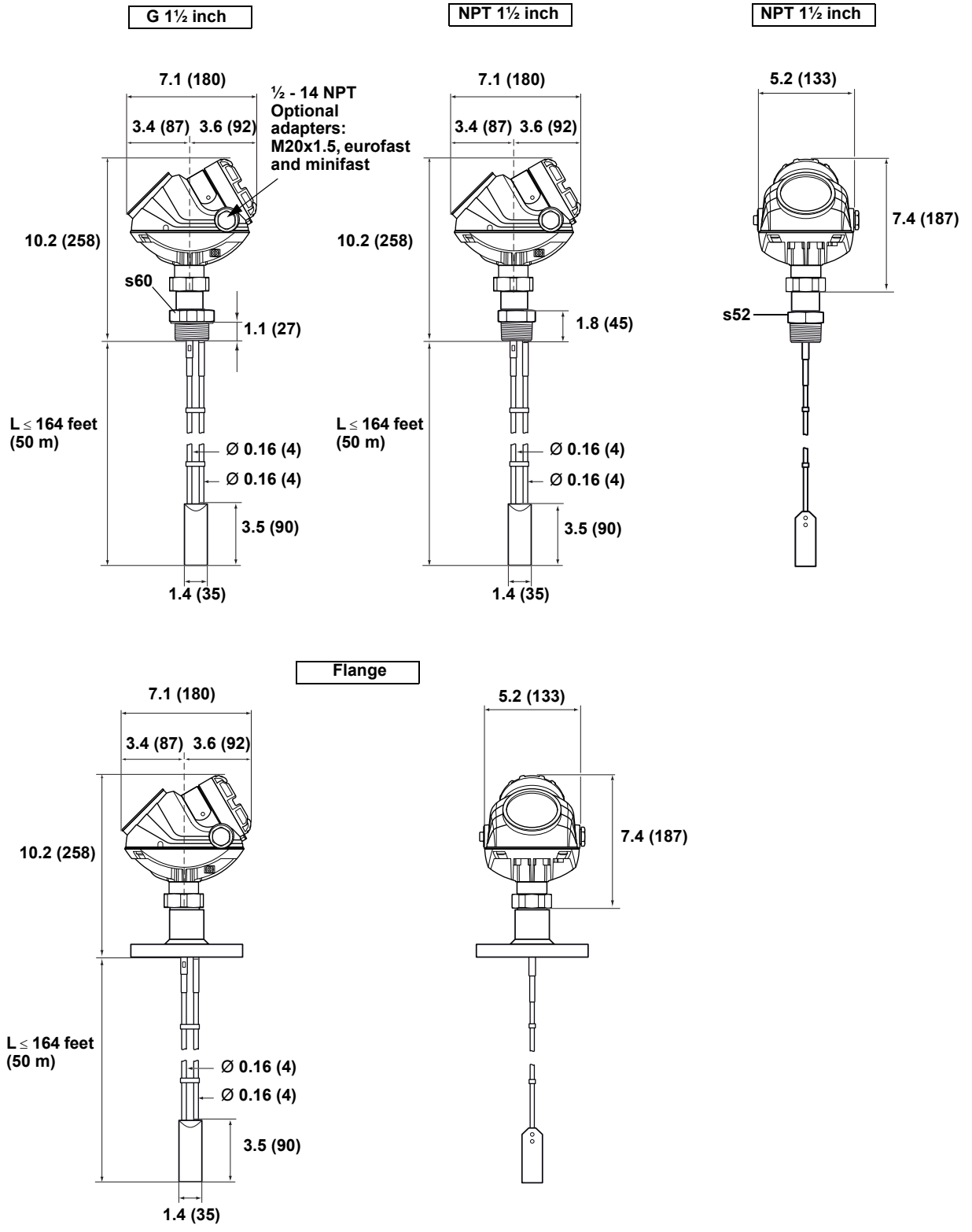
Figure A-5. Rigid Twin Lead





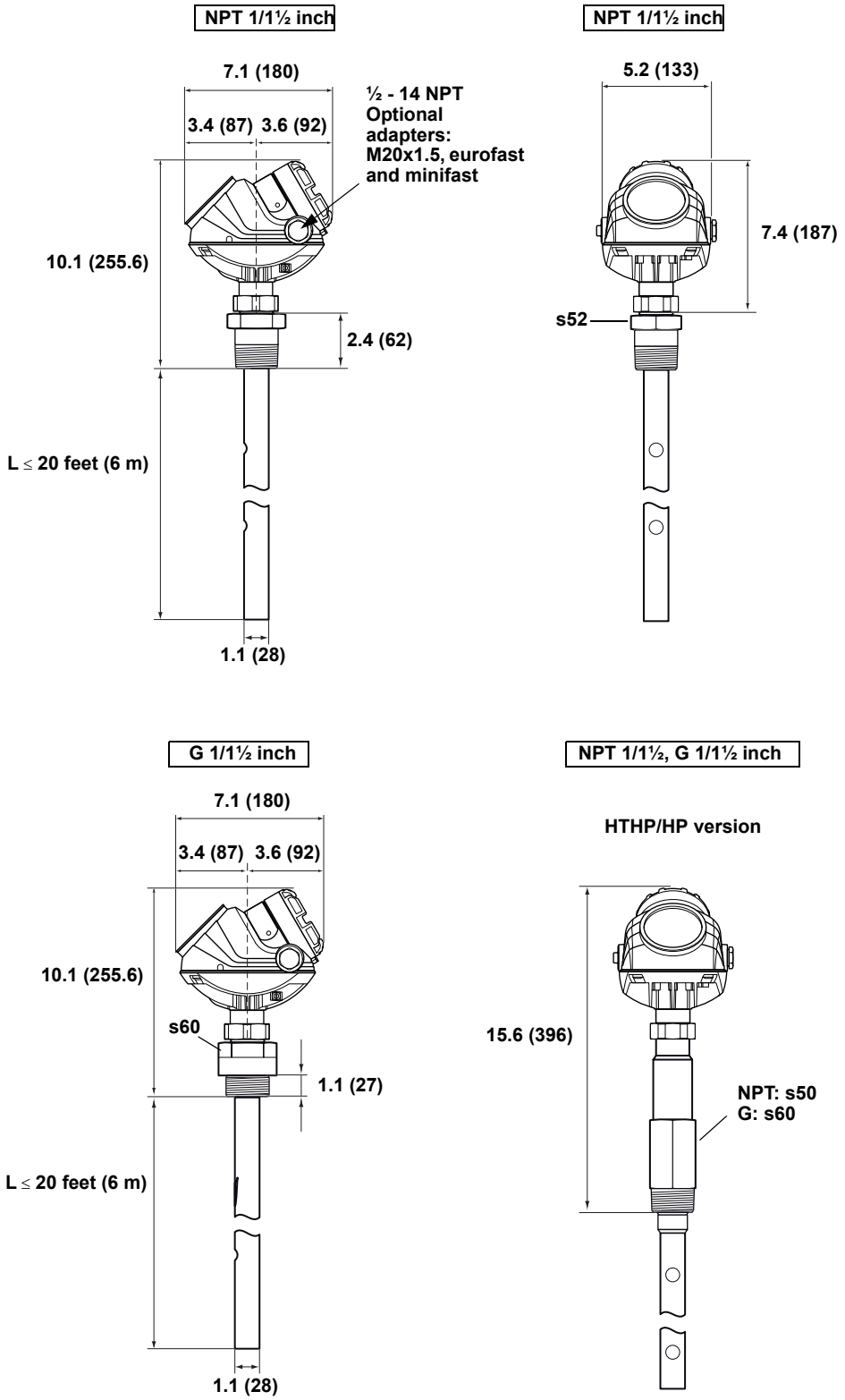
Dimensions are in inches (millimeter).

Figure A-6. Flexible Twin Lead



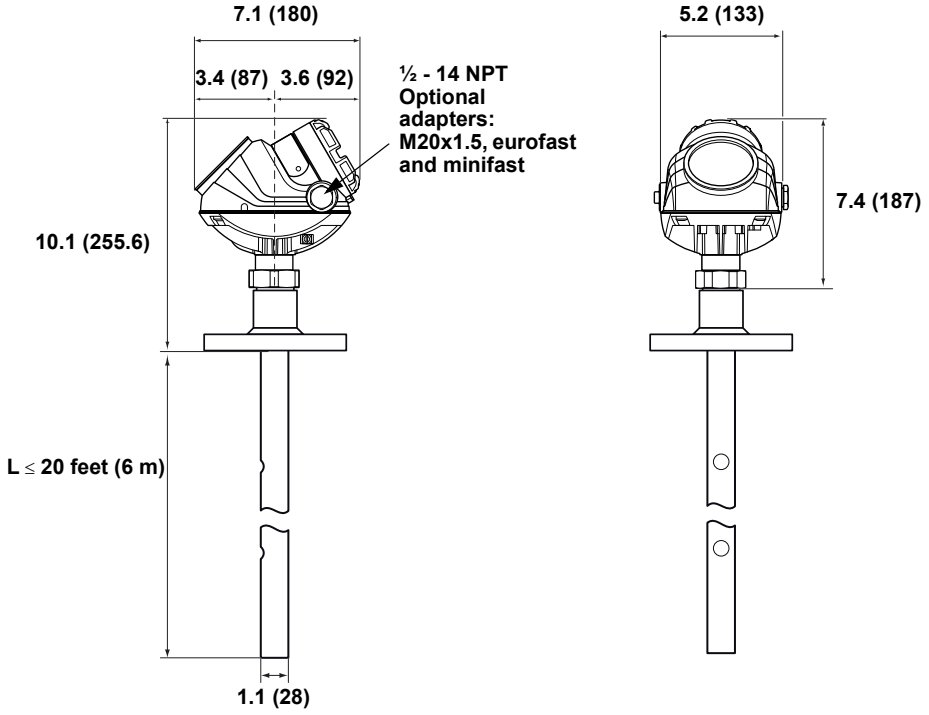
Dimensions are in inches (millimeter).

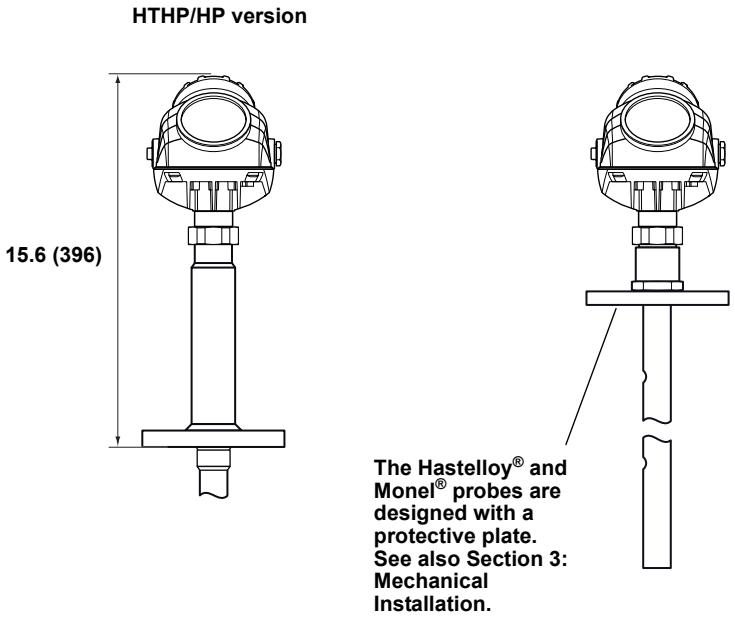
Figure A-7. Coaxial probe with threaded connection



Dimensions are in inches (millimeter).

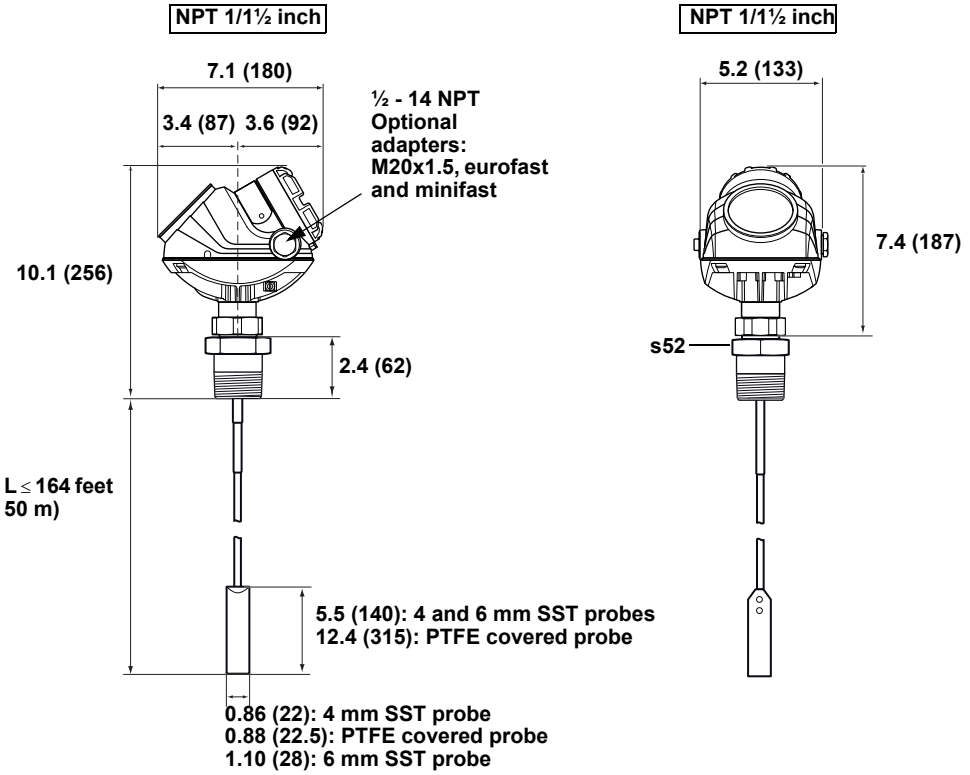
Figure A-8. Coaxial probe with flange connection

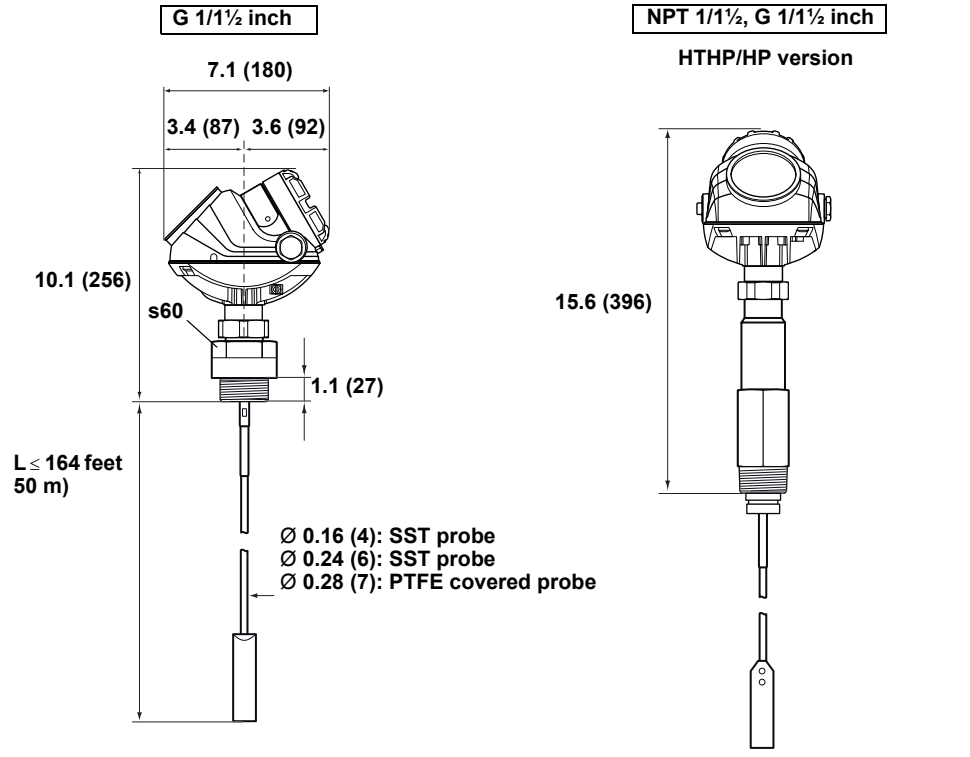




Dimensions are in inches (millimeter).

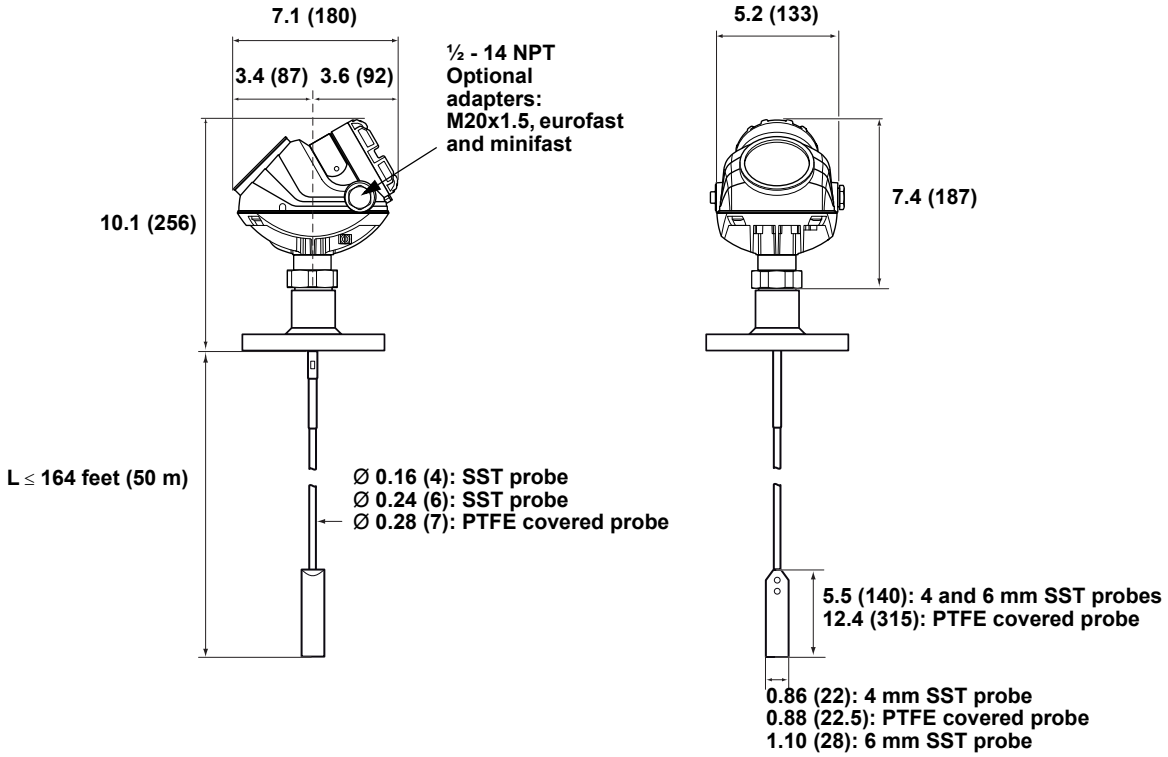
Figure A-9. Flexible Single Lead
with threaded connection

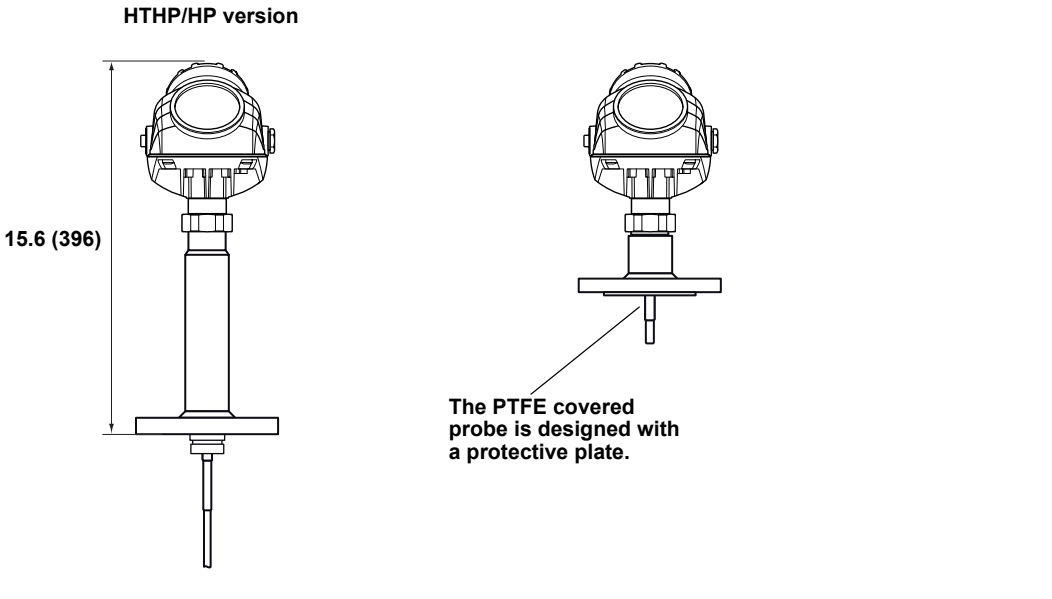




Dimensions are in inches (millimeter).

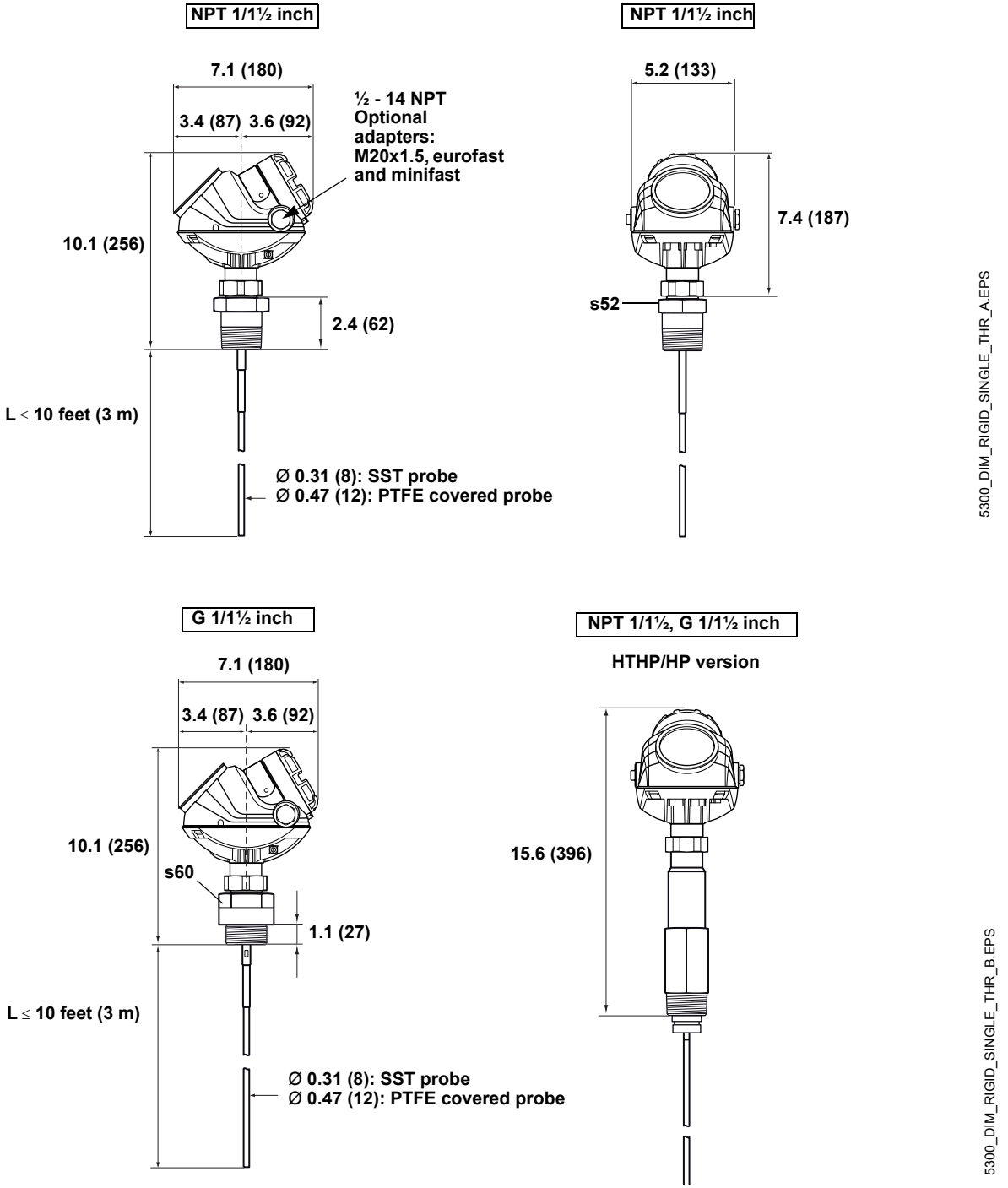
Figure A-10. Flexible Single Lead with flange connection





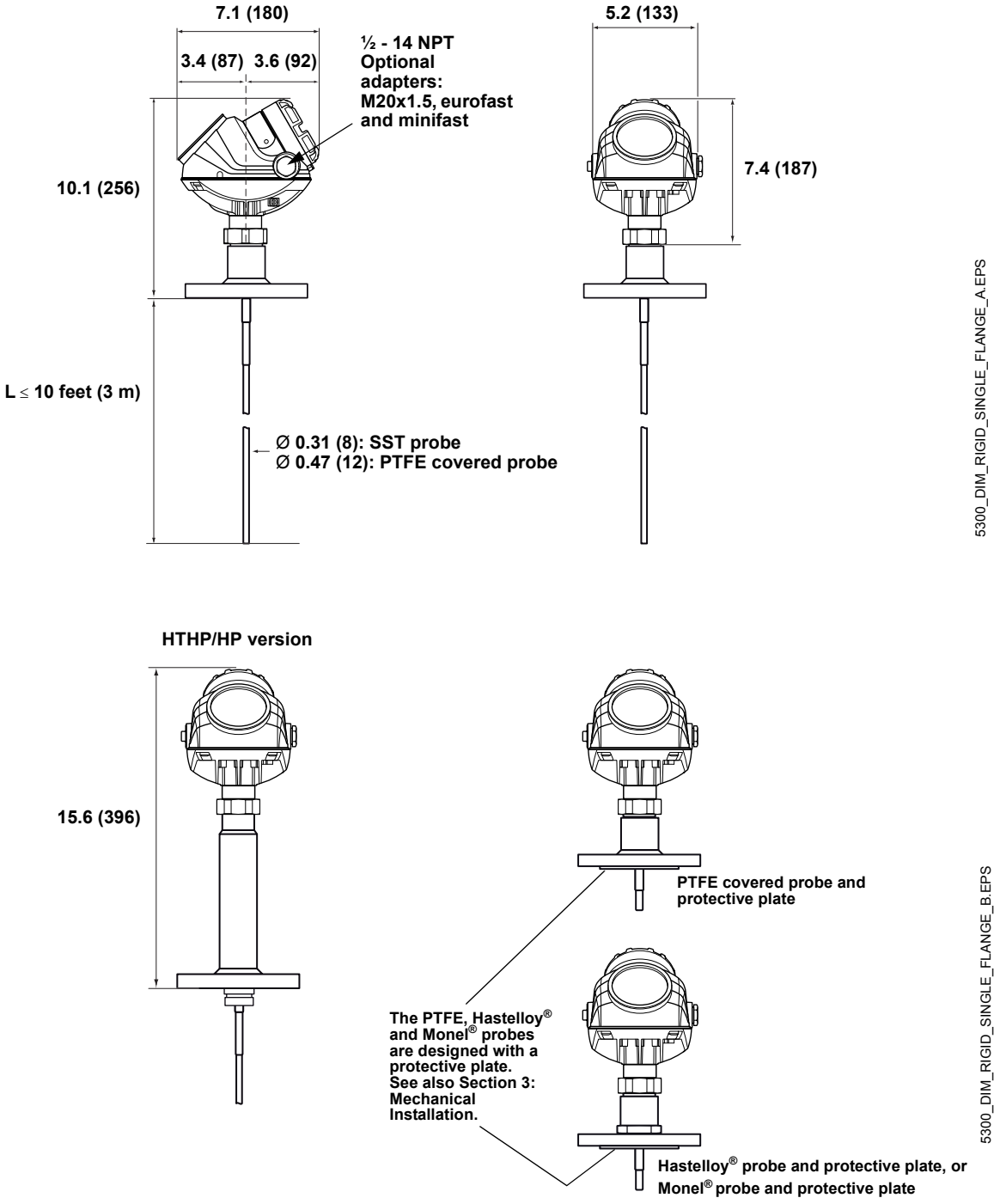
Dimensions are in inches (millimeter).

Figure A-11. Rigid Single Lead with threaded connection



Dimensions are in inches (millimeter).

Figure A-12. Rigid Single Lead with flange connection



Dimensions are in inches (millimeter).

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		
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 Temp / 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, 5A, 5B (only SST)
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, 5B (only SST)
Code	**Material of Construction(4): Process Connection / Probe**		**Probe Type**
1	316 / 316 L SST (EN 1.4404)		All
2	Hastelloy® C-276 (UNS N10276). With plate design if flanged version.		3A, 3B and 4A
3	Monel® 400 (UNS N04400). With plate design if flanged version.		3A, 3B and 4A
7	PTFE covered probe and flange. With plate design.		4A and 5A
8	PTFE covered probe		4A and 5A
Code	**Sealing, O-ring Material (Consult factory for other o-ring materials)**		
N	None(5)		
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 or 1.5 in. Thread	Min: 1 ft 4 in. (0.4 m). Max: 9 ft 10 in. (3 m)
2A	Flexible Twin Lead with weight (7)	Flange or 1.5 in. Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
3A	Coaxial (for level measurement)(6)	Flange, 1(7) or 1.5 in. 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(7) or 1.5 in. Thread	Min: 1 ft 4 in. (0.4 m). Max: 19 ft 8 in. (6 m)
4A	Rigid Single Lead	Flange, 1(7) or 1.5 in. Thread	Min: 1 ft 4 in. (0.4 m). Max: 9 ft 10 in. (3 m)
5A	Flexible Single Lead with weight	Flange, 1(7) or 1.5 in. Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
5B	Flexible Single Lead with chuck(8)	Flange, 1(7) or 1.5 in. Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)

Code	Probe Length Units
E	English (feet, in.)
M	Metric (meters, centimeters)
Code	**Total Probe Length [9] (feet/m)**
xxx	0-164 ft or 0-50 m
Code	**Total Probe Length [9] (in./cm)**
xx	0-11 in. or 0-99 cm
Code	**Process Connection - Size / Type (consult factory for other process connections)**
ANSI Flanges in 316L SST (EN 1.4404)	
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 in 316L SST (EN 1.4404)	
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
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

Code	Process Connection - Size / Type (consult factory for other process connections)	
JE	DN100, PN160. HTHP / HP units	
JF	DN100, PN250. HTHP / HP units	
KA	DN150, PN16	
JIS Flanges in 316L SST (EN 1.4404)		
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		**Probe Type**
RA	1 ½ in. NPT thread	All
RB	1 in. NPT thread	3A, 3B, 4A, 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, 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	
E5	FM Explosion Proof	
E6	CSA Explosion Proof	
E7	IECEx Flameproof	
I1	ATEX Intrinsic Safety	
IA	ATEX FISCO Intrinsic Safety(10)	
I5	FM Intrinsic Safety and Non-Incendive	
IE	FM FISCO Intrinsic Safety(10)	
I6	CSA Intrinsic Safety	
IF	CSA FISCO Intrinsic Safety(10)	
I7	IECEx Intrinsic Safety	
IG	IECEx FISCO Intrinsic Safety(10)	
KA	ATEX, FM, CSA Flameproof/Explosionproof	
KB	ATEX, FM, IECEx Flameproof/Explosionproof	
KC	ATEX, CSA, IECEx Flameproof/Explosionproof	
KD	FM, CSA, IECEx Flameproof/Explosionproof	
KE	ATEX, FM, CSA Intrinsic Safety	
KF	ATEX, FM, IECEx Intrinsic Safety	
KG	ATEX, CSA, IECEx Intrinsic Safety	

Code	Hazardous Locations Certifications	
KH	FM, CSA, IECEx Intrinsic Safety	
KI	FISCO - ATEX, FM, CSA Intrinsic Safety(10)	
KJ	FISCO - ATEX, FM, IECEX Intrinsic Safety(10)	
KK	FISCO - ATEX, CSA, IECEX Intrinsic Safety(10)	
KL	FISCO - FM, CSA, IECEX Intrinsic Safety(10)	
Code	**Options**	
M1	Integral digital display	
P1	Hydrostatic testing(11)	
N2	NACE material recommendation per MR 0175 (12)	
LS	Long stud(13) 9.8 in (250 mm) for flexible single lead probe to prevent contact with wall/nozzle. Standard height is 3.9 in (100 mm) for probes 5A and 5B	
T1	Transient Protection Terminal Block (standard with FISCO options)	
Sx and Px - Centering Discs		**Outer Diameter**
S2	2 in. Centering disc SST(14)	1.8 in. (45 mm)
S3	3 in. Centering disc SST(14)	2.7 in. (68 mm)
S4	4 in. Centering disc SST(14)	3.6 in. (92 mm)
S6	6 in. Centering disc SST(14)	5.55 in. (141 mm)
S8	8 in. Centering disc SST(14)	7.40 in. (188 mm)
P2	2 in. Centering disc PTFE(15)	1.8 in. (45 mm)
P3	3 in. Centering disc PTFE(15)	2.7 in. (68 mm)
P4	4 in. Centering disc PTFE(15)	3.6 in. (92 mm)
P6	6 in. Centering disc PTFE(15)	5.55 in. (141 mm)
P8	8 in. Centering disc PTFE(15)	7.40 in. (188 mm)
Cx - 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 (16) (standard Rosemount alarm and saturation levels)	
Qx - Special Certifications		
Q4	Calibration Data Certification	
Q8	Material Traceability Certification per EN 10204 3.1(17)	

(1) Not available with Flame/Explosionproof approvals (E1, 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). Only for SST ("Material of Construction", code 1).
(4) For other materials, consult factory.
(5) Requires High Temperature High Pressure (code H) or High Pressure (code P) probe.
(6) Requires model 5301.
(7) Available with standard temperature and pressure only (code S).
(8) Extra length for fastening is added in factory.
(9) 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.
(10) Requires Foundation™ fieldbus signal output (U_i parameter listed in Appendix B: Product Certifications).
(11) For standard tank connection only available with flange .
(12) Valid for probe type 3A, 3B and 4A.
(13) Not available with PTFE covered probes.
(14) Available for SST probes, type 2A, 4A and 5A.
(15) Available for SST probes, type 2A, 4A and 5A, except for HTHP.
(16) The standard alarm setting is high.
(17) Certificate includes all pressure retaining wetted metal parts.

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		
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 / 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 or 1.5 in. Thread	Min: 3 ft 4 in. (1 m). Max: 115 ft. (35 m)
5B	Flexible Single Lead with chuck, 4 mm(4)	Flange, 1 or 1.5 in. Thread	Min: 3 ft 4 in. (1 m). Max: 115 ft. (35 m)
6A	Flexible Single Lead with weight, 6 mm	Flange, 1 or 1.5 in. Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft. (50 m)
6B	Flexible Single Lead with chuck, 6 mm(4)	Flange, 1 or 1.5 in. Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft. (50 m)
Code	**Probe Length Units**		
E	English (feet, in.)		
M	Metric (meters, centimeters)		
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 factory for other process connections)	
ANSI Flanges in 316L SST (EN 1.4404)		
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 in 316L SST (EN 1.4404)		
HB	DN50, PN40	
IA	DN80, PN16	
IB	DN80, PN40	
JA	DN100, PN16	
JB	DN100, PN40	
KA	DN150, PN16	
JIS Flanges in 316L SST (EN 1.4404)		
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		**Probe Type**
RA	1 ½ in. NPT thread	All
RB	1 in. NPT thread	3A, 3B, 4A, 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, 5A, 5B, standard temperature and pressure

Code	Hazardous Locations Certifications
NA	No Hazardous Locations Certifications
E1	ATEX Flameproof
E5	FM Explosion Proof
E6	CSA Explosion Proof
E7	IECEx Flameproof
I1	ATEX Intrinsic Safety
IA	ATEX FISCO Intrinsic Safety(6)
I5	FM Intrinsic Safety and Non-Incendive
IE	FM FISCO Intrinsic Safety(6)
I6	CSA Intrinsic Safety
IF	CSA FISCO Intrinsic Safety(6)
I7	IECEx Intrinsic Safety
IG	IECEx FISCO Intrinsic Safety(6)
KA	ATEX, FM, CSA Flameproof/Explosionproof
KB	ATEX, FM, IECEx Flameproof/Explosionproof
KC	ATEX, CSA, IECEx Flameproof/Explosionproof
KD	FM, CSA, IECEx Flameproof/Explosionproof
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(6)
KJ	FISCO - ATEX, FM, IECEX Intrinsic Safety (6)
KK	FISCO - ATEX, CSA, IECEX Intrinsic Safety(6)
KL	FISCO - FM, CSA, IECEX Intrinsic Safety(6)
Code	**Options**
M1	Integral digital display
P1	Hydrostatic testing(7)
LS	Long stud 9.8 in (250 mm) for flex. 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)
Cx - 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 (8) (standard Rosemount alarm and saturation levels)
Qx - Special Certifications	
Q4	Calibration Data Certification
Q8	Material Traceability Certification per EN 10204 3.1(9)

(1) Not available with Flame/Explosionproof approvals (E1, 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 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 3-2 for more probe length guidance.
(6) Requires Foundation™ fieldbus signal output.
(7) Available for flanged connection.
(8) The standard alarm setting is high.
(9) Certificate includes all pressure retaining wetted metal 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
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 factory for other process connections)**
Code	**Process Connection - Size / Type (consult factory for other process connections)**
NA	Not Applicable
Code	**Hazardous Locations Certifications**
NA	No Hazardous Locations Certifications
E1	ATEX Flameproof
E5	FM Explosion Proof
E6	CSA Explosion Proof
E7	IECEx Flameproof
I1	ATEX Intrinsic Safety
IA	ATEX 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
IF	CSA FISCO Intrinsic Safety(2)
I7	IECEx Intrinsic Safety
IG	IECEx FISCO Intrinsic Safety(2)
KA	ATEX, FM, CSA Flameproof/Explosionproof
KB	ATEX, FM, IECEx Flameproof/Explosionproof
KC	ATEX, CSA, IECEx Flameproof/Explosionproof
KD	FM, CSA, IECEx Flameproof/Explosionproof
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)
Cx - 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 (3) (standard Rosemount alarm and saturation levels)
Qx - Special Certifications	
Q4	Calibration Data Certification

(1) Not available with Flame/Explosionproof approvals (E1, E5, E6, E7, KA, KB, KC, and KD)
(2) Requires Foundation™ fieldbus signal output.
(3) 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, 5A, 5B (only SST)
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, 5B (only SST)
Code	**Material of Construction[3]: Process Connection / Probe**		**Probe Type**
1	316 / 316 L SST (EN 1.4404)		All
2	Hastelloy® C-276 (UNS N10276). With plate design if flanged version.		3A, 3B and 4A
3	Monel® 400 (UNS N04400). With plate design if flanged version.		3A, 3B and 4A
7	PTFE covered probe and flange. With plate design.		4A and 5A, (requires flanged versions)
8	PTFE covered probe		4A and 5A
Code	**Sealing, O-ring Material (Consult factory for other o-ring materials)**		
N	None[4]		
V	Viton® fluoroelastomer		
E	Ethylene Propylene		
K	Kalrez® 6375 perfluoroelastomer		
B	Buna-N		
Code	**Probe Type**	**Process Connection**	**Probe Lengths**
1A	Rigid Twin Lead[5]	Flange or 1.5 in. Thread	Min: 1 ft 4 in. (0.4 m). Max: 9 ft 10 in. (3 m)
2A	Flexible Twin Lead with weight[5]	Flange or 1.5 in. Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
3A	Coaxial (for level measurement)[6]	Flange, 1[5] or 1.5 in. 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[5] or 1.5 in. Thread	Min: 1 ft 4 in. (0.4 m). Max: 19 ft 8 in. (6 m)
4A	Rigid Single Lead	Flange, 1[5] or 1.5 in. Thread	Min: 1 ft 4 in. (0.4 m). Max: 9 ft 10 in. (3 m)
5A	Flexible Single Lead with weight	Flange, 1[5] or 1.5 in. Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
5B	Flexible Single Lead with chuck[7]	Flange, 1[5] or 1.5 in. Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
6A	Flexible Single Lead with weight, 6 mm[8]	Flange, 1 or 1.5 in. Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft. (50 m)
6B	Flexible Single Lead with chuck, 6 mm[7],[8]	Flange, 1 or 1.5 in. Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft. (50 m)

Code	Probe Length Units
E	English (feet, in.)
M	Metric (meters, centimeters)
Code	**Total Probe Length [9] (feet/m)**
xxx	0-164 ft or 0-50 m
Code	**Total Probe Length [9] (in./cm)**
xx	0-11 in. or 0-99 cm
Code	**Process Connection - Size / Type (consult factory for other process connections)**
ANSI Flanges in 316L SST (EN 1.4404)	
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 in 316L SST (EN 1.4404)	
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
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

Code	Process Connection - Size / Type (consult factory for other process connections)	
JE	DN100, PN160. HTHP / HP units	
JF	DN100, PN250. HTHP / HP units	
KA	DN150, PN16	
JIS Flanges in 316L SST (EN 1.4404)		
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		**Probe Type**
RA	1 ½ in. NPT thread	All
RB	1 in. NPT thread	3A, 3B, 4A, 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, 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(10)	
N2	NACE material recommendation per MR 0175 (11)	
LS	Long stud(12) 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.	
Sx and Px - Centering Discs		**Outer Diameter**
S2	2 in. Centering disc SST(13)	1.8 in. (45 mm)
S3	3 in. Centering disc SST(13)	2.7 in. (68 mm)
S4	4 in. Centering disc SST(13)	3.6 in. (92 mm)
S6	6 in. Centering disc SST(13)	5.55 in. (141 mm)
S8	8 in. Centering disc SST(13)	7.40 in. (188 mm)
P2	2 in. Centering disc PTFE(14)	1.8 in. (45 mm)
P3	3 in. Centering disc PTFE(14)	2.7 in. (68 mm)
P4	4 in. Centering disc PTFE(14)	3.6 in. (92 mm)
P6	6 in. Centering disc PTFE(14)	5.55 in. (141 mm)
P8	8 in. Centering disc PTFE(14)	7.40 in. (188 mm)
Qx - Special Certifications		
Q8	Material Traceability Certification per EN 10204 3.1(15)	

(1) Process seal rating. Final rating depends on flange and O-ring selection.
(2) Requires option None for sealing (no O-ring). Only for SST ("Material of Construction", code 1).
(3) For other materials, consult factory.

(4) Requires High Temperature High Pressure (code H) or High Pressure (code P) probe.
(5) Available for standard temperature and pressure only (code S).
(6) Requires model 5301.
(7) Extra length for fastening is added in factory.
(8) Requires model 5303.
(9) 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 3-2 for more probe length guidance.
(10) For standard tank connection only available with flange .
(11) Valid for probe type 3A, 3B and 4A.
(12) Not available with PTFE covered probes.
(13) Available for SST probes, type 2A, 4A,5A and 6A.
(14) Available for SST probes, type 2A, 4A, 5A and 6A except for HTHP.
(15) 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)	
03300-1655-0001	Kit, 2 Inch Centering Disk, SST, Rigid Single
03300-1655-0002	Kit, 3 Inch Centering Disk, SST, Rigid Single
03300-1655-0003	Kit, 4 Inch Centering Disk, SST, Rigid Single
03300-1655-0004	Kit, 6 Inch Centering Disk, SST, Rigid Single
03300-1655-0005	Kit, 8 Inch Centering Disk, SST, Rigid Single
03300-1655-0006	Kit, 2 Inch Centering Disk, PTFE, Rigid Single
03300-1655-0007	Kit, 3 Inch Centering Disk, PTFE, Rigid Single
03300-1655-0008	Kit, 4 Inch Centering Disk, PTFE, Rigid Single
03300-1655-0009	Kit, 6 Inch Centering Disk, PTFE, Rigid Single
03300-1655-0010	Kit, 8 Inch Centering Disk, PTFE, Rigid Single
03300-1655-1001	Kit, 2 Inch Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1002	Kit, 3 Inch Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1003	Kit, 4 Inch Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1004	Kit, 6 Inch Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1005	Kit, 8 Inch Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1006	Kit, 2 Inch Centering Disk, PTFE, Single / Twin Flex Lead
03300-1655-1007	Kit, 3 Inch Centering Disk, PTFE, Single / Twin Flex Lead
03300-1655-1008	Kit, 4 Inch Centering Disk, PTFE, Single / Twin Flex Lead
03300-1655-1009	Kit, 6 Inch Centering Disk, PTFE, Single / Twin Flex Lead
03300-1655-1010	Kit, 8 Inch Centering Disk, PTFE, Single / Twin Flex Lead

(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.

Appendix B Product Certifications

Safety messages . . . . . page B-1
EU Conformity . . . . . page B-2
European ATEX Directive Information . . . . . page B-3
Factory Mutual (FM) Approvals . . . . . page B-8
Canadian Standards Association (CSA) Approval . . . . . page B-11
IECEx Approval . . . . . page B-14
Combination Approvals . . . . . page B-19
Approval Drawings . . . . . page B-19

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 ≤ Ta ≤ +70 °C)(1)
- 4-20 mA/HART model: Ui=30 V, Ii=130 mA, Pi=1.0 W, Ci=7.26 nF, Li=0.
- Nemko ATEX certificate number: Nemko 04ATEX1073X
- Installation Drawing: 9240 030-938

Special Conditions for Safe Use (X):

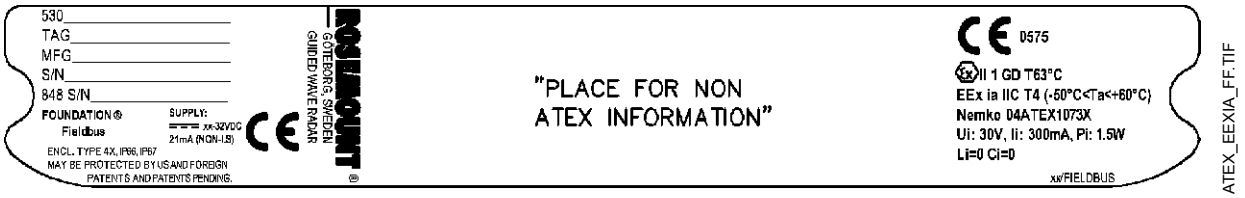
The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

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

  CE 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 ≤ Ta ≤ +60 °C)
- FOUNDATION™ fieldbus model: Ui=30 V dc, Ii=300 mA, Pi=1.5 W, Ci=0 nF, Li=0 H.
- Nemko ATEX certificate number: Nemko 04ATEX1073X
- Installation Drawing: 9240 030-938

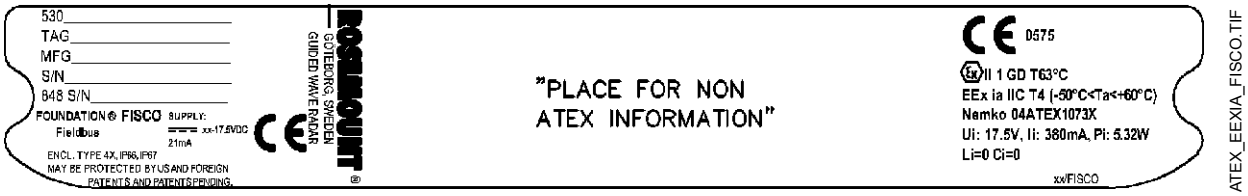
Special Conditions for Safe Use (X):

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

  CE 0575
- Complete model number
- The serial number of the device
- Year of construction
- Marking for explosion protection:

  Ex **II 1 GD T63˚C**
- EEx ia IIC T4 (-50 °C ≤ Ta ≤ +60 °C)
- FISCO model: Ui=17.5 V dc, Ii=380 mA, Pi=5.32 W, Li=Ci=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



ATEX_EEXIAD.TIF

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:

  Ex II 1/2 GD T73˚C

- EEx iad IIC T4 (-40 °C<Ta< +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<Ta< +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.

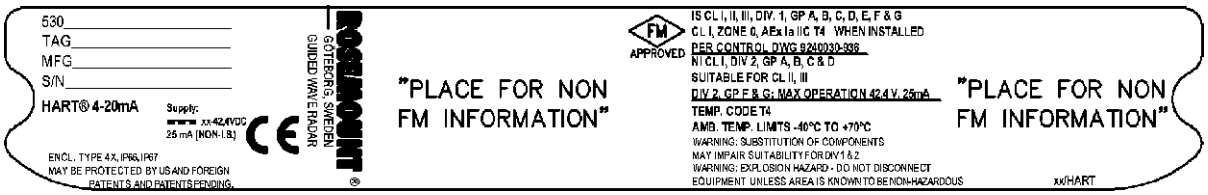
Impact and friction hazards need then to be considered according to EN 50284 clause 4.3.1 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in category II 1 G.

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-6. 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.

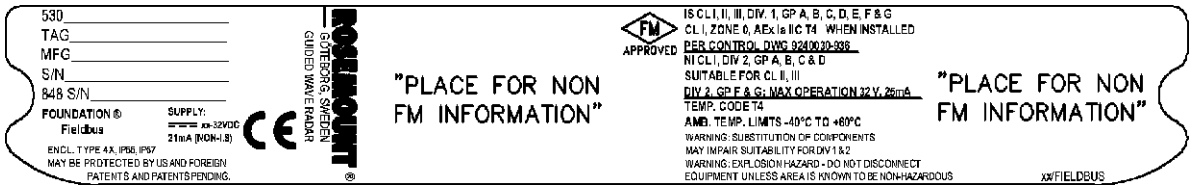
Non-incendive for Class I, Division 2, Groups A, B, C and D.

Suitable for Class II, III, Division 2, Groups F and G.

4-20 mA/HART model: Ui=30 V, Ii=130 mA, Pi=1.0 W, Ci=7.26 nF, Li=0. Max operation 42.4 V, 25 mA.

Temperature code T4.
Ambient Temperature Limits: -50 °C to + 70 °C.

Figure B-7. Approval Labels
Factory Mutual (FM) Foundation Fieldbus model



FM_IS_NI_FF.TIF

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.

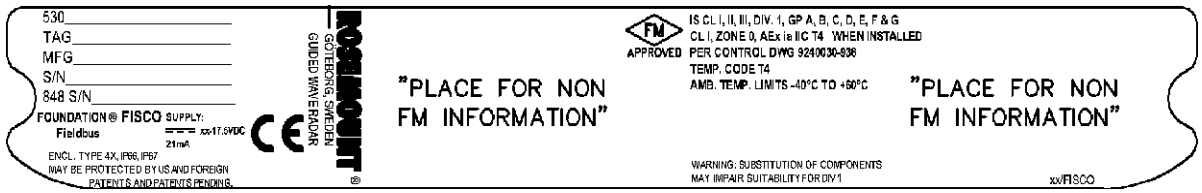
Non-incendive for Class I, Division 2, Groups A, B, C and D.

Suitable for Class II, III, Division 2, Groups F and G;

FOUNDATION™ fieldbus model: Ui=30 V dc, Ii=300 mA, Pi=1.3 W, Ci=0 nF, Li=0 H. Max operation 32 V, 25 mA.

Temperature code T4.
Ambient Temperature Limits: -50 °C to + 60 °C

Figure B-8. Approval Labels
Factory Mutual (FM) FISCO model



FM_IS_NI_FISCO.TIF

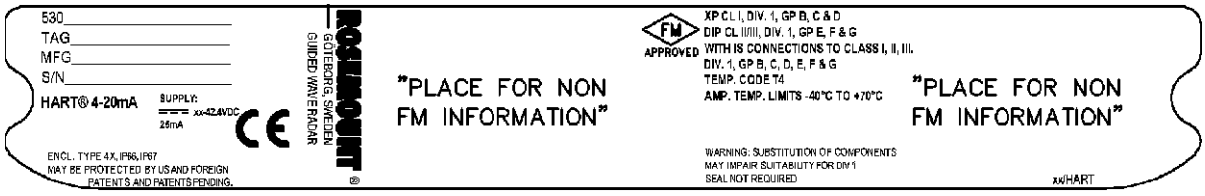
IE Intrinsically Safe for Class I, II, III, Division 1, Groups A, B, C, D, E, F and G.
Class I, Zone 0, AEX ia IIC T4 when installed per Control Drawing: 9240030-936.

FISCO model: Ui=17.5 V dc, Ii=380 mA, Pi=5.32 W, Li=Ci=0.

Temperature code T4.
Ambient Temperature Limits: -50 °C to + 60 °C

Explosion Proof

Figure B-9. Approval Labels
Factory Mutual (FM) HART model



E5 Explosion-Proof for Class I, Division 1, Groups B, C and D.

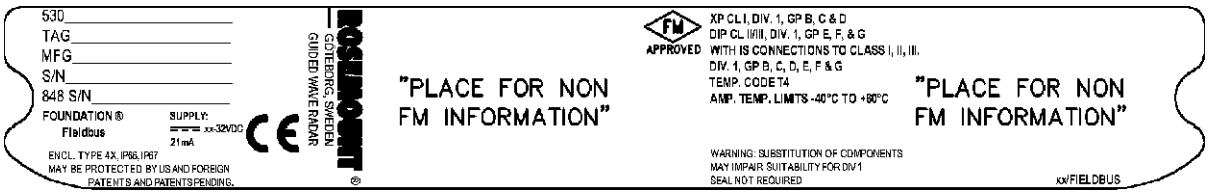
Dust-Ignition proof for Class II/III, Division 1, Groups E, F and G with intrinsically safe connections to Class I, II, III, Div 1, Groups B, C, D, E, F and G.

Temperature code T4.

Ambient temperature limits: -40 °C to + 70 °C.

Seal not required.

Figure B-10. 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: -40°C to + 60°C.

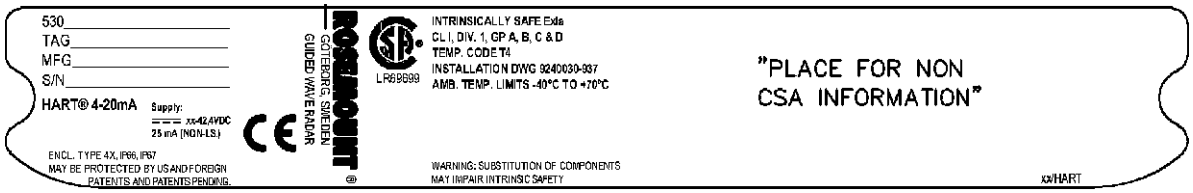
Seal not required.

CANADIAN STANDARDS ASSOCIATION (CSA) APPROVAL

Cert. no. 1514653

Intrinsic Safety

Figure B-11. Approval Label Canadian Standards Association (CSA) HART model



CSA_IS.TIF

I6 Intrinsically Safe Ex ia.

Class I, Division 1, Groups A, B, C and D.

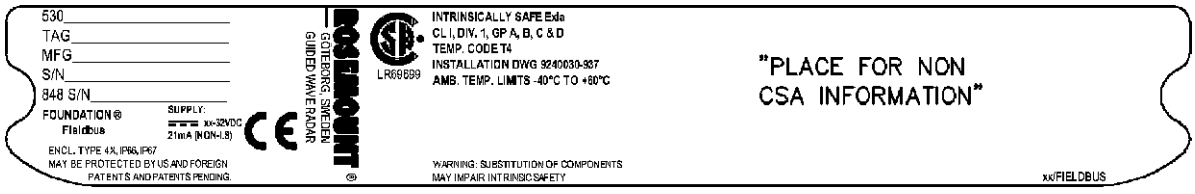
Temperature code T4.

4-20 mA/HART model: Ui=30 V, Ii=130 mA, Pi=1.0 W, Ci=7.3 nF, Li=0 H.

Installation Drawing: 9240 030-937.

Ambient temperature limits: -50 °C to + 70 °C.

Figure B-12. Approval Label Canadian Standards Association (CSA) Foundation Fieldbus model



CSA_IS_FF.TIF

I6 Intrinsically Safe Ex ia.

Class I, Division 1, Groups A, B, C and D.

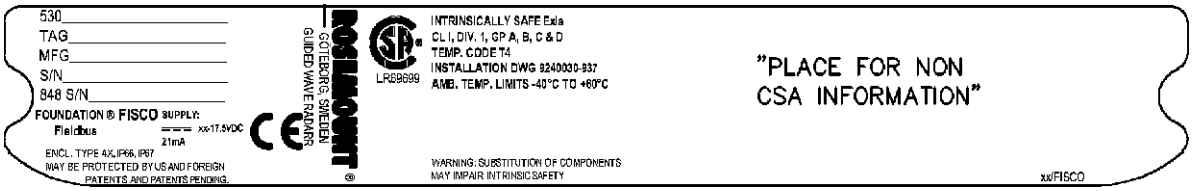
Temperature code T4.

FOUNDATION™ fieldbus model: Ui=30 V dc, Ii=300 mA, Pi=1.3 W, Ci=0 nF, Li=0 H.

Control Drawing: 9240 030-937.

Ambient temperature limits: -50 °C to + 60 °C

Figure B-13. 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: Ui=17.5 V dc, Ii=380 mA, Pi=5.32 W, Ci=0 nF, Li=0 H.

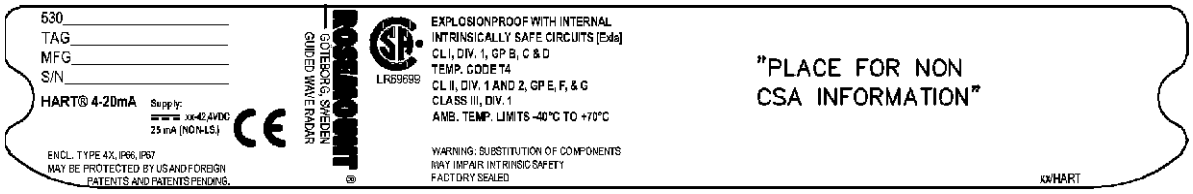
Control Drawing: 9240 030-937.

Ambient temperature limits: -50 °C to + 60 °C

Explosion Proof

Cert. no. 1514653.

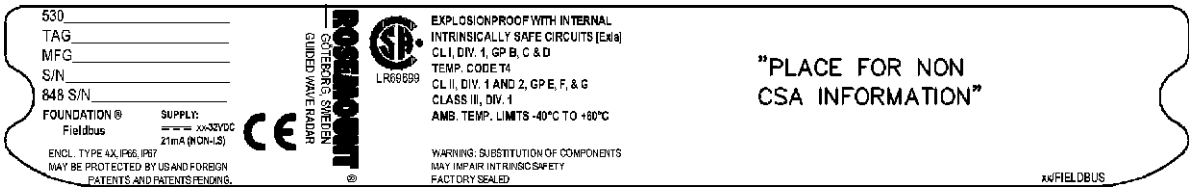
Figure B-14. Approval Label Canadian Standards Association (CSA) HART model



CSA_XP_DIP.TIF

E6 Explosionproof 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 -40 °C to +70 °C.
Factory sealed.

Figure B-15. Approval Label Canadian Standards Association (CSA) Foundation Fieldbus model



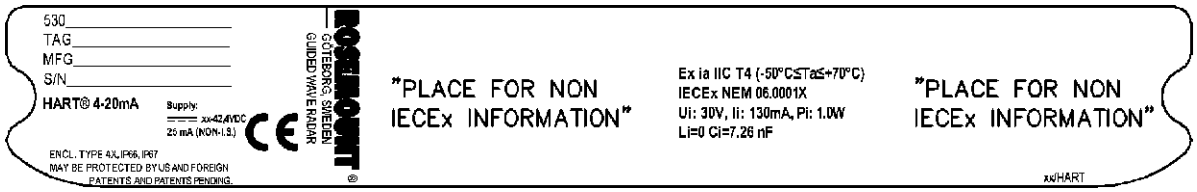
CSA_XP_DIP_FF.TIF

E6 Explosionproof 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 -40 °C to +60 °C.
Factory sealed.

IECEX APPROVAL

Intrinsic Safety

Figure B-16. 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: Ui=30 V, Ii=130 mA, Pi=1 W, Ci=7.26 nF, Li=0 mH.

Installation Drawing: 9240 030-938.

Conditions of Certification

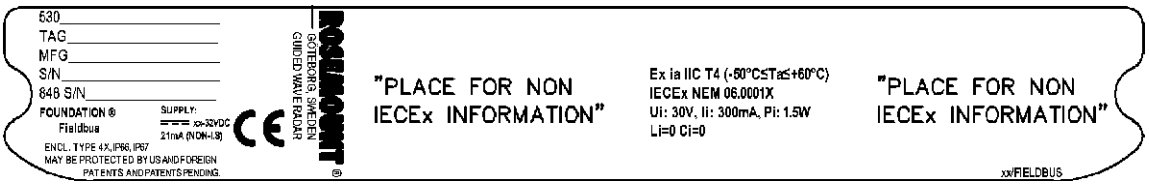
The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

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-17. Approval Label
IECEx Foundation Fieldbus
model



IECEX_EXIA_FF.TIF

I7 Intrinsically Safe

Ex ia IIC T4 (T_{amb} = -50 °C to +60 °C).

IECEx NEM 06.0001X.

FOUNDATION™ fieldbus: Ui=30 V, Ii=300 mA, Pi=1.5 W, Ci=0 nF, Li=0 mH.

Installation Drawing: 9240 030-938.

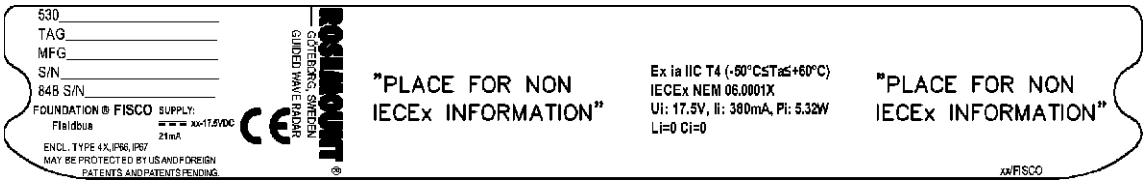
Conditions of Certification

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-18. Approval Label
IECEx FISCO model



IECEX_EXIA_FISCO.TIF

IG Intrinsically Safe

Ex ia IIC T4 (T_{amb} = -50 °C to +60 °C).

IECEx NEM 06.0001X.

FISCO: Ui=17.5 V, Ii=380 mA, Pi=5.32 W, Ci=0 nF, Li=0 mH.

Installation Drawing: 9240 030-938.

Conditions of Certification

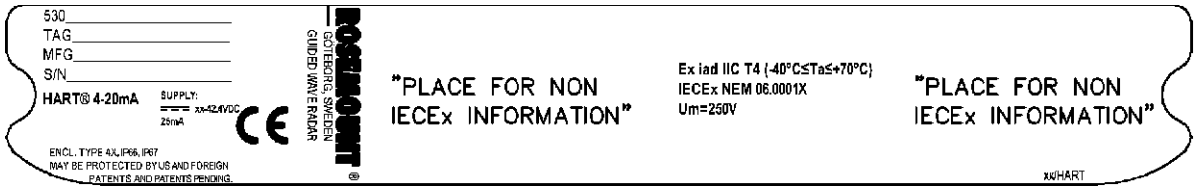
The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

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-19. Approval Labels
IECEx HART



IECEX_EXIAD.TIF

E7 Flameproof

Ex iad IIC T4 (T_{amb} :-40° C to +70 °C).

IECEx NEM 06.0001X.

U_m=250 VAC

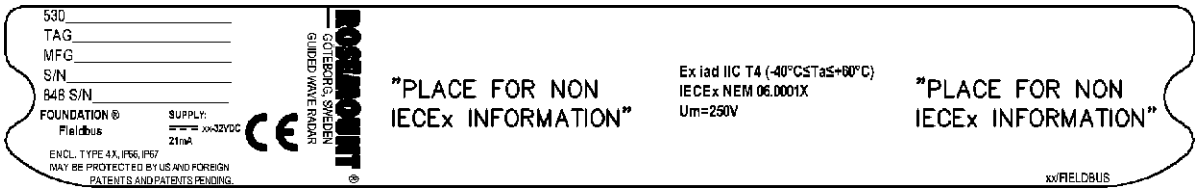
Conditions of Certification

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-20. 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/Explosionproof
KB ATEX, FM, IECEx Flameproof/Explosionproof
KC ATEX, CSA, IECEx Flameproof/Explosionproof
KD FM, CSA, IECEx Flameproof/Explosionproof
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.

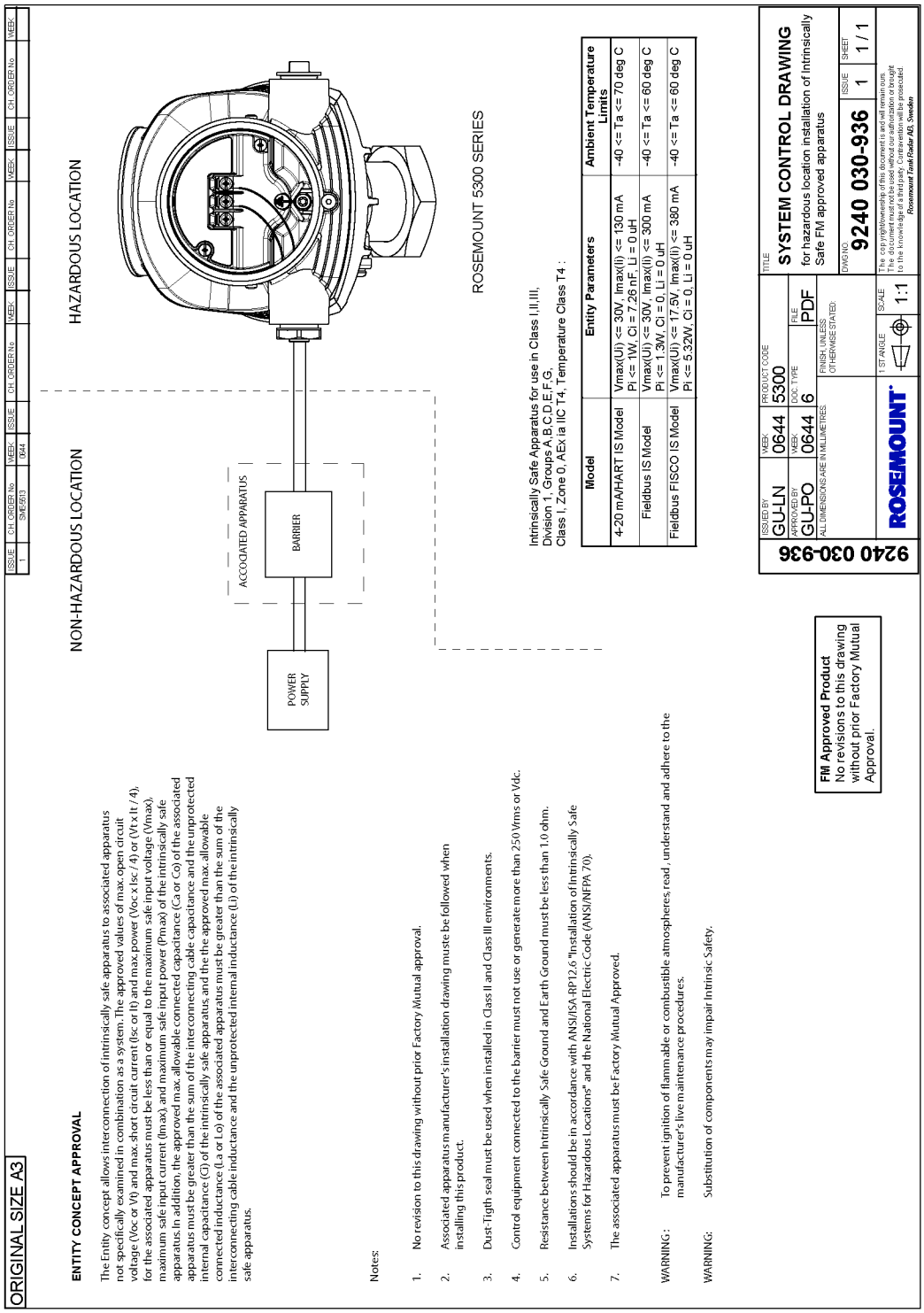
Rosemount drawing 9240030-937:

Installation Drawing for hazardous location installation of CSA approved apparatus.

Rosemount drawing 9240030-938:

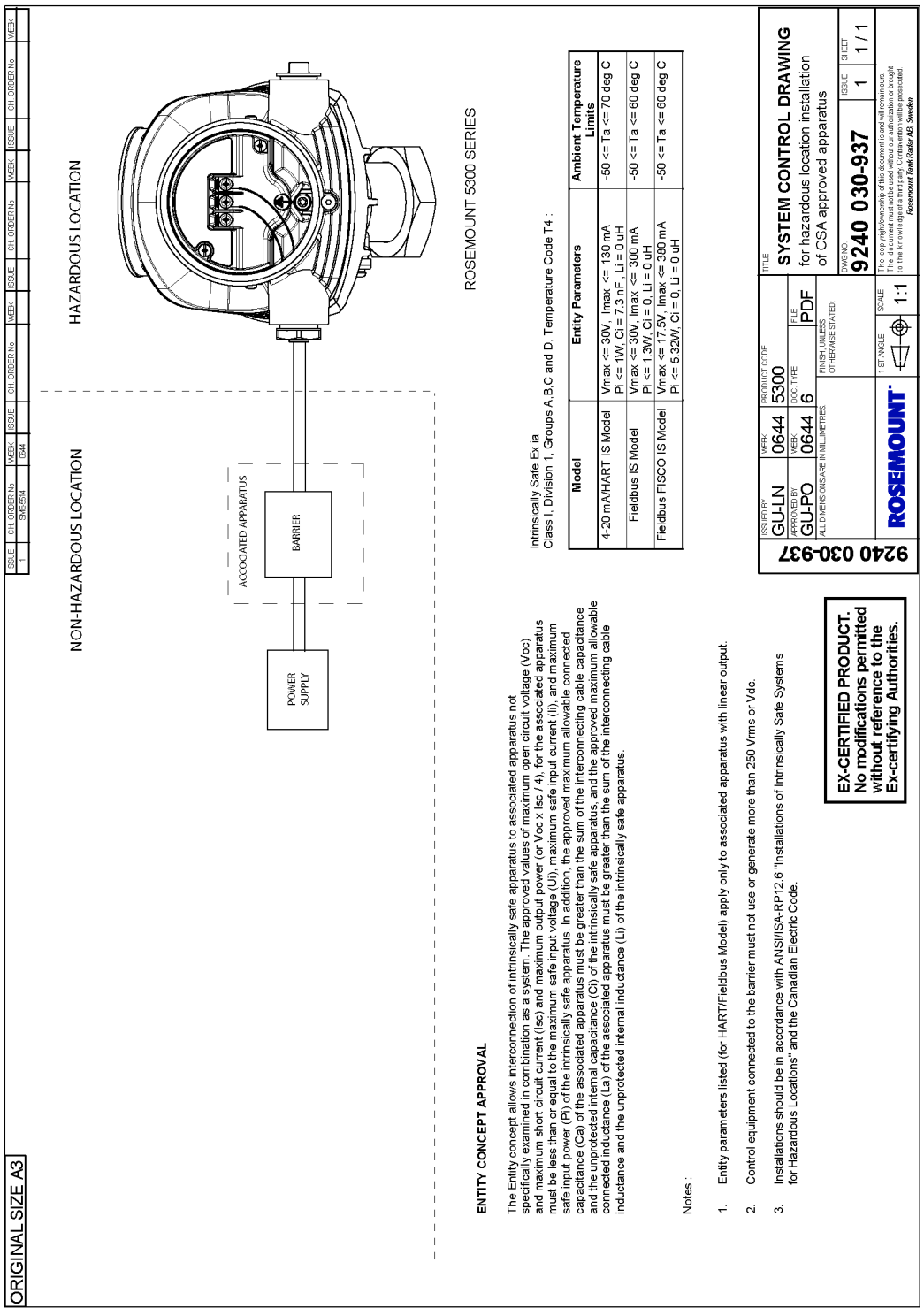
Installation Drawing for hazardous location installation of ATEX and IECEx approved apparatus.

Figure B-21. System Control Drawing for hazardous location installation of intrinsically safe FM approved apparatus.



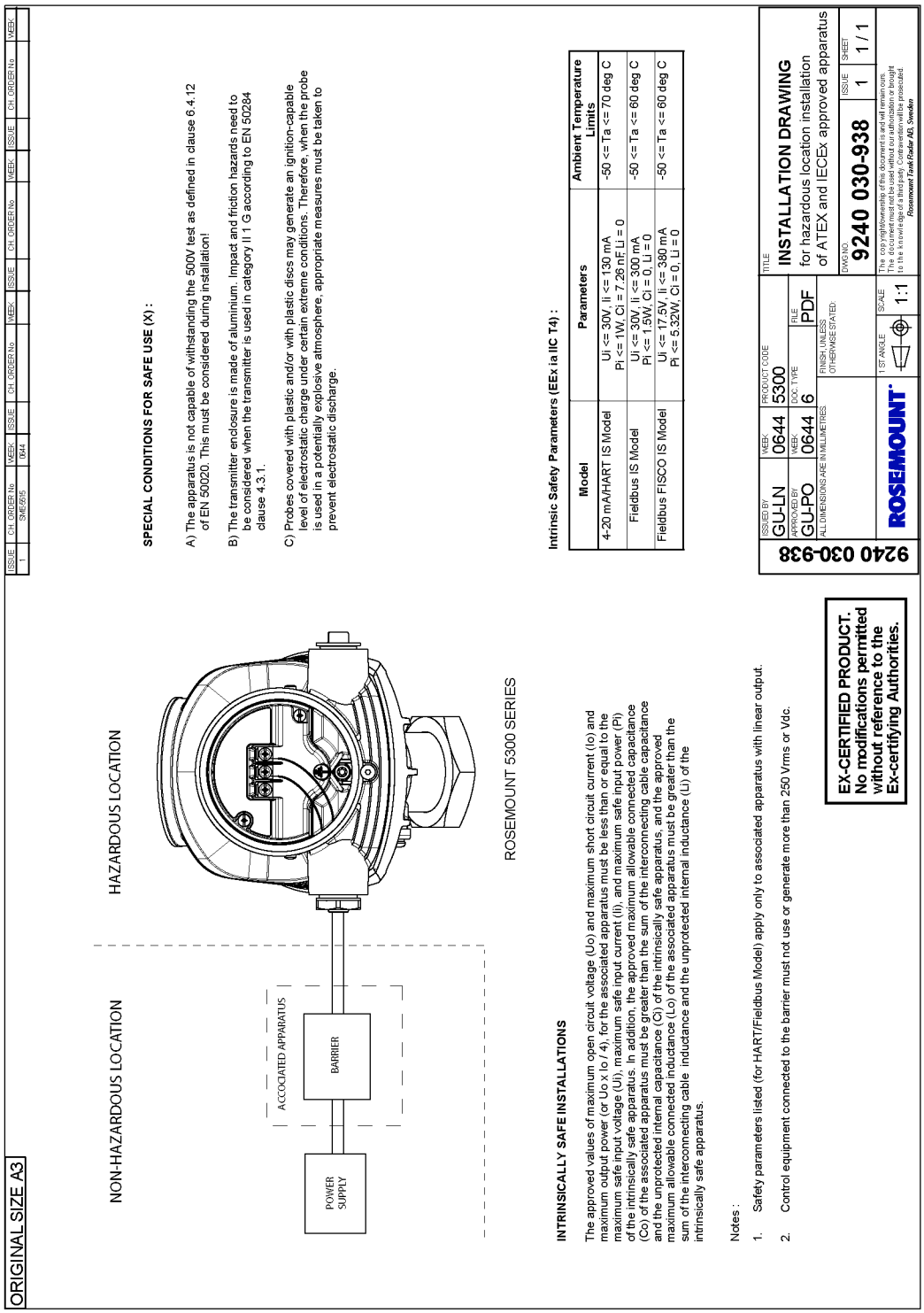
9240030-936_I01.TIF

Figure B-22. Installation Drawing for hazardous location installation of intrinsically safe CSA approved apparatus.



9240030-937_I01.TIF

Figure B-23. Installation Drawing for hazardous location installation of intrinsically safe ATEX and IECEx approved apparatus.



9240030-938_I01.TIF

Appendix C Advanced Configuration

Safety messages . . . . . page C-1
User defined Upper Reference Point . . . . . page C-3
Handling of Disturbances from Nozzle . . . . . page C-4
Threshold Settings . . . . . page C-6
Probe End Projection . . . . . page C-8
Dielectric Constant Settings . . . . . page C-10

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.

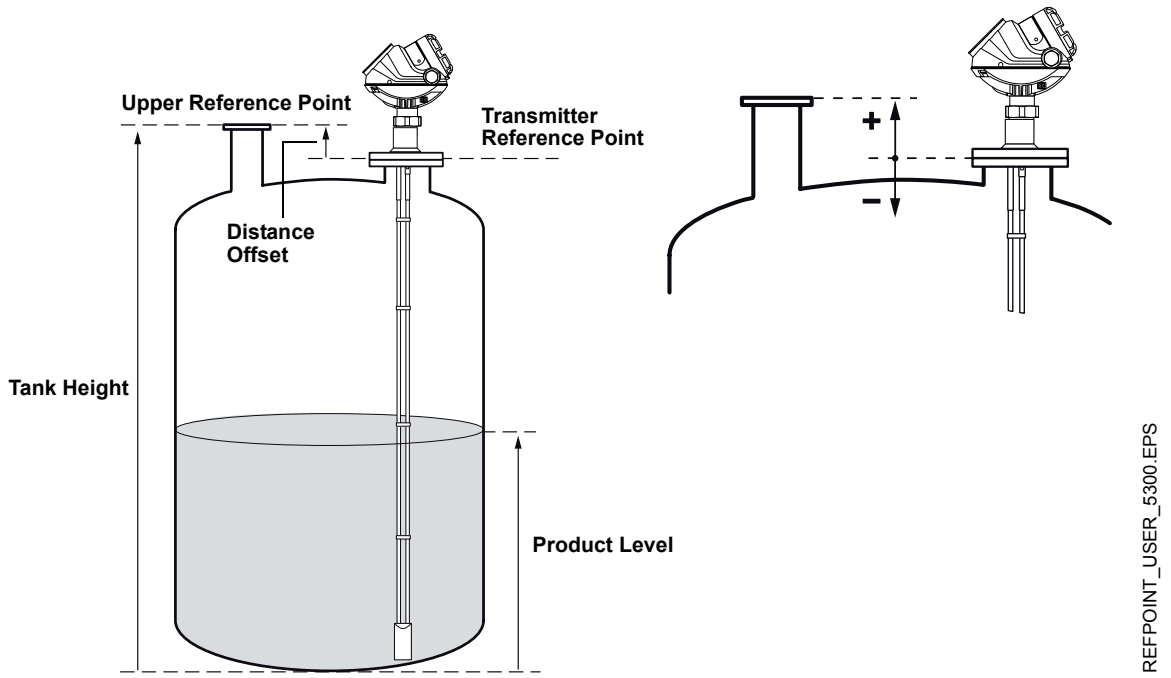
Make sure the mains power to the Radar Transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

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 do the following:

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 275/375 Handheld Communicator the Distance Offset is available as HART Fast Key sequence [2, 3, 2] or [2, 1, 3].

   FOUNDATION™ fieldbus parameter:
   TRANSDUCER 1100>GEOM_OFFSET_DIST.

   The Distance Offset is also available In *Rosemount Radar Master* (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

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 0-10 in. (0-0.25 m) below the Upper Reference Point) is normally somewhat limited. However, the 5300 transmitter is equipped with 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. This may for example be the case if a Single Lead probe is mounted in a small nozzle, or if there are disturbing obstacles in the Near Zone. The trimming means that the measurement performance in the Near Zone is maintained even under these conditions and prevents false echo indication.

Make sure that the product level is below the Near Zone region (0-1.6 ft. (0-0.5 m) below the Upper Reference Point).

To trim the Near Zone performance with a 375 Field Communicator do the following:

1. Select the HART command [2, 6, 3].
2. Select the Trim Near Zone option.

To trim the Near Zone performance by using the Rosemount Radar Master (RRM) do the following:

1. Start the RRM.
2. Click the **Advanced** icon in the Device Config/Setup toolbar.
3. Select the **Near Zone** tab in the *Advanced Configuration* window.
4. Click the **Trim Near Zone** button.

NOTE!
The Trim Near Zone function should only be used for reducing impact from stationary disturbances. It is not suitable for occasional disturbances.

To reset the transmitter to factory settings by using the Rosemount Radar Master (RRM) do the following:

1. Start the RRM.
2. From the Tools menu, choose the **Factory Settings** option.

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.

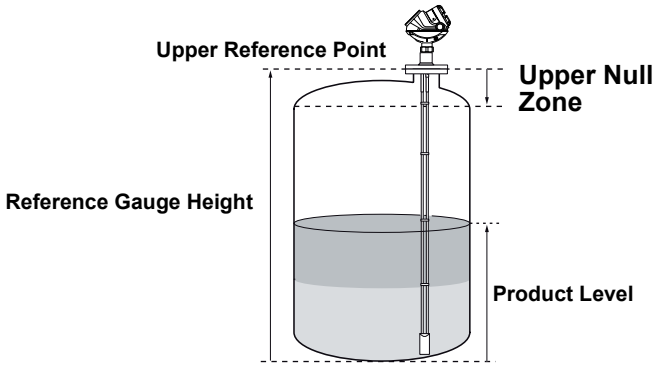
To set the Upper Null Zone with a 375 Field Communicator do the following:

1. Select the HART command [2, 1, 2].
2. Select the Upper Null Zone option.
3. Enter the desired value.

To set the Upper Null Zone with Rosemount Radar Master do the following:

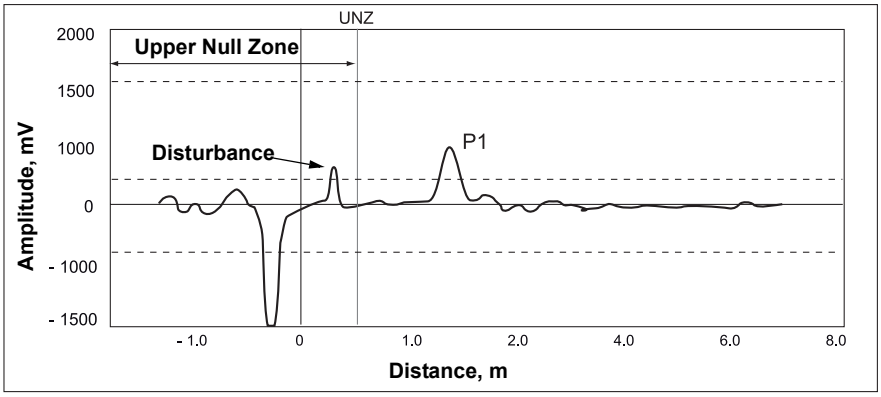
1. Start the **Rosemount Radar Master** (RRM).
2. Click the **Tank** icon in the Device Config/Setup toolbar.
3. Select the **Probe** tab in the *Tank* window.
4. Type the desired value in the Upper Null Zone field.
5. Click the OK button. Now the Upper Null Zone is stored in the transmitter memory.

Figure C-2. Upper Null Zone



UPPERNULLZONE_5300.EPS

Figure C-3. Identifying the Upper Null Zone in the Echo Curve plot



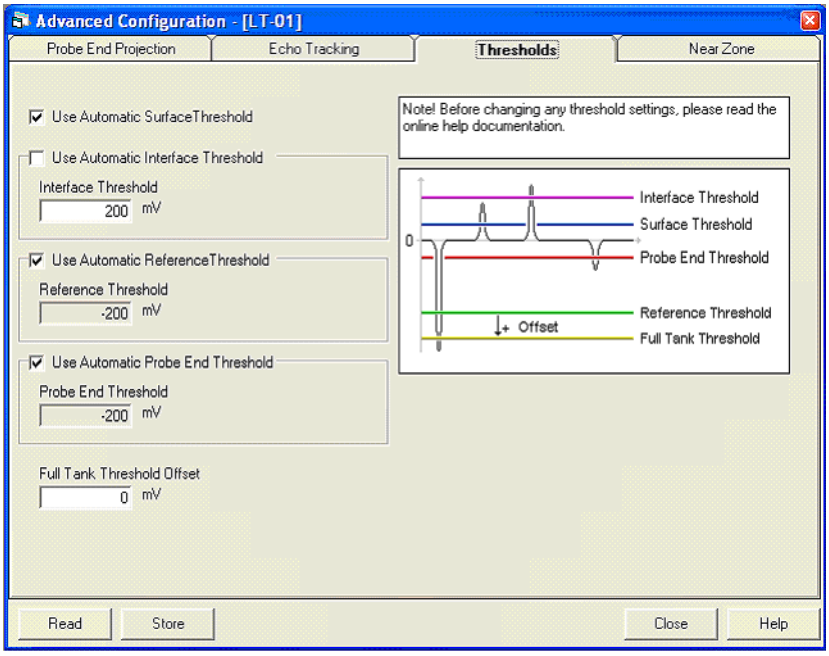
ECHOCURVE_UNZ.EPS

THRESHOLD SETTINGS

Measurements 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 in order 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. The *Rosemount Radar Master* (RRM) supports threshold settings in the *Advanced Configuration* window:

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

Figure C-4. Threshold settings in *Rosemount Radar Master* (RRM).



ADVANCED_THRESHOLDS.TIF

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 7-11 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 7-12*).

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 “Probe End Projection” on page C-8), 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 following example the following assumptions are made (note the negative sign):

Reference Echo peak amplitude = -2000 mV.

Reference Threshold = -1000 mV.

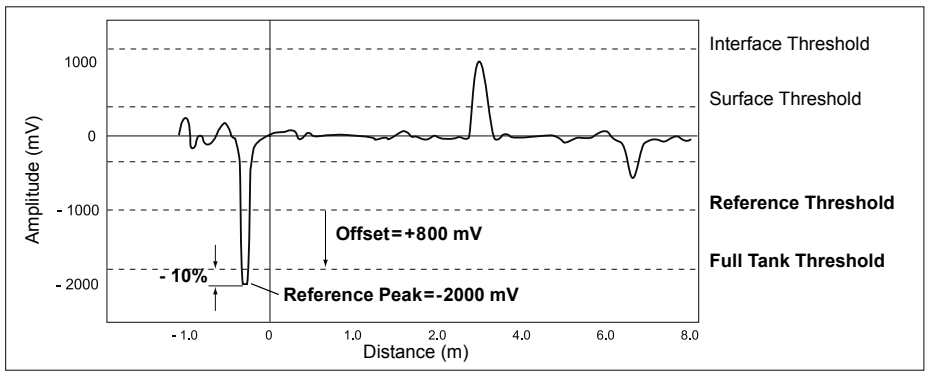
The target position for the Full Tank Threshold is at 10% below the Reference Echo peak amplitude. In this example it means that the Full Tank Threshold should be located at 10% below the Reference peak at -2000 mV:

-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.

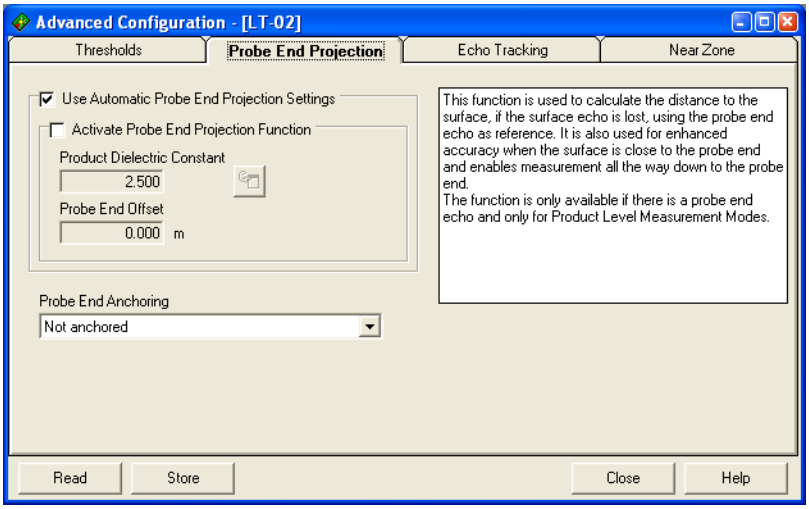
Figure C-5. Example of how to specify the Full Tank Threshold



PROBE END PROJECTION

The *Rosemount Radar Master* (RRM) supports the Probe End Projection function in the *Advanced Configuration* window:

1. Click the **Advanced** icon in the Device Config/Setup toolbar.
2. Select the **Probe End Projection** tab in the *Advanced Configuration* window:



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Figure C-6. The Probe End Projection function is supported in *Rosemount Radar Master* (RRM).

This function uses the probe end echo as reference, in case the surface echo is lost, to calculate the surface echo position.

Microwaves propagate slower through the product substance than through air, and the probe end echo will appear below the probe end when there is a product in the tank. By using the fact that the actual position of the probe end is known, it is possible to calculate the surface echo position as long the product Dielectric Constant and the Probe Length are accurately given.

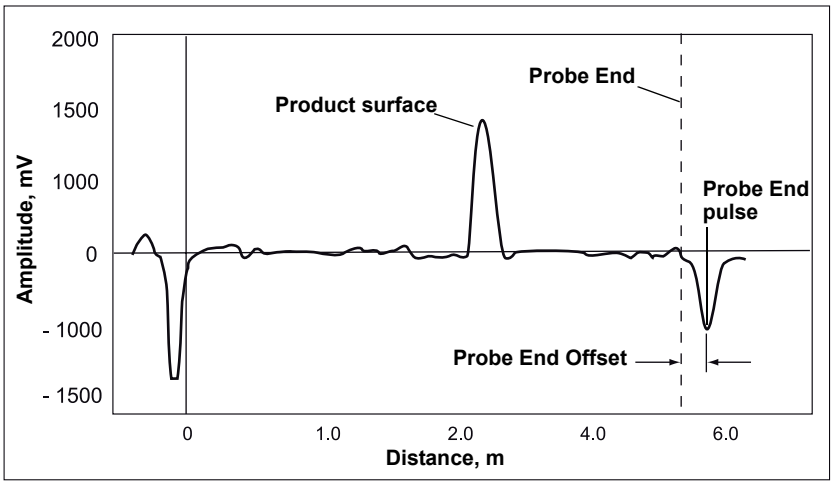
For most probe types, the automatic Probe End Projection settings can be used. When the **Flexible Single Lead** probe is used, and the wire probe is anchored to the tank bottom, the manual Probe End Projection needs to be activated. In this case the anchoring makes it difficult to determine the exact location of the probe end. The Probe End pulse may appear below the actual probe end. Consequently, the actual probe length may be slightly different from the length given by the Probe Length parameter. The Probe End Offset is used to take care of this.

To configure the Rosemount 5300 for Probe End Projection:

1. Deselect the Use Automatic Probe End Projection Settings check box.
2. Select the Activate Probe End Projection Function check box.
3. Enter the Product Dielectric Constant.
   Click the Dielectric Constant Chart button if you want to search for the dielectric constant of a certain product. It is important that this value is as accurate as possible, since the Dielectric Constant is one of the key parameters that the transmitter uses when calculating the position of the product surface.

4. Enter Probe End Offset.
   This parameter refers to the difference between the actual position of the Probe End, and the position as “seen” by the transmitter in an empty tank when the probe is anchored to the tank bottom. The Probe End Offset can be measured in an empty tank by using the Echo Curve Analyzer. Measure the distance from the Probe End position (Probe End vertical line in the plot) to the Probe End pulse, i.e. to the center of the first echo peak which appears below the Probe End

Figure C-7. Probe End offset can be measured by using the Echo Curve Analyzer in RRM.



NOTE
The Probe End Offset is a parameter used to calibrate the transmitter when the Probe End pulse appears below the actual probe end. This must not be mixed up with the displacement caused by the reduced propagation speed of the measurement signal when it travels through the product (see “Probe End Projection” on page 7-7).

5. If the probe is anchored to the tank bottom, select the appropriate option from the Probe End Anchoring list.
6. Click the Store button to save the configuration.

NOTE
This function is not available for probes without probe end echo and only for Liquid/Solid Product Level measurement modes.

NOTE
For best performance it is important that the Probe Length and the product Dielectric Constant are given with high accuracy.

DIELECTRIC CONSTANT SETTINGS

Vapor

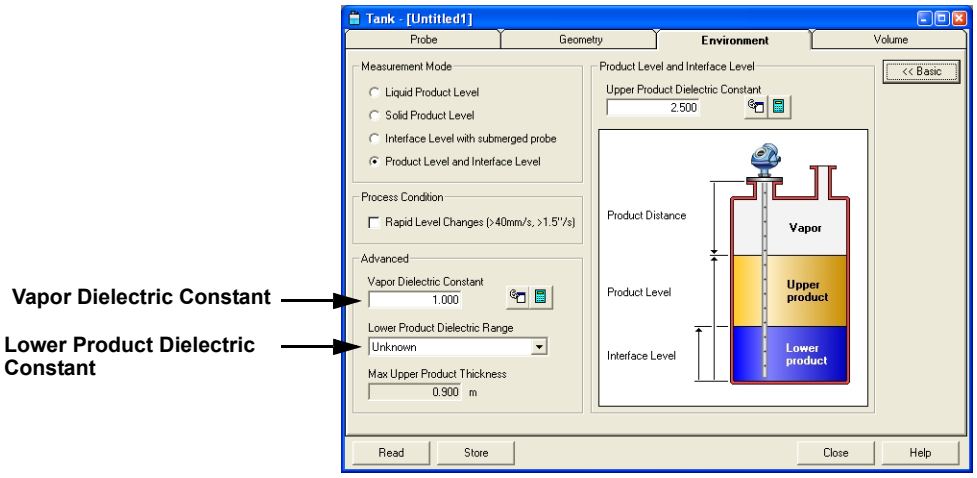
In some applications there is heavy vapor above the product surface having a significant influence on the level measurement. This may for example be the case for saturated water vapor under high pressure. In such cases the vapor dielectric can be entered to compensate for this effect.

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 do the following:

1. Start the Rosemount Radar Master.
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-8. Dielectric constants can be adjusted in the Tank Environment window.



TANK_ENVIRONMENT_ADVANCED.TIF

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-8.

You can also make special adjustments by trimming the appropriate amplitude thresholds, see section “Interface Pulse not Found” on page 7-9 for further information.

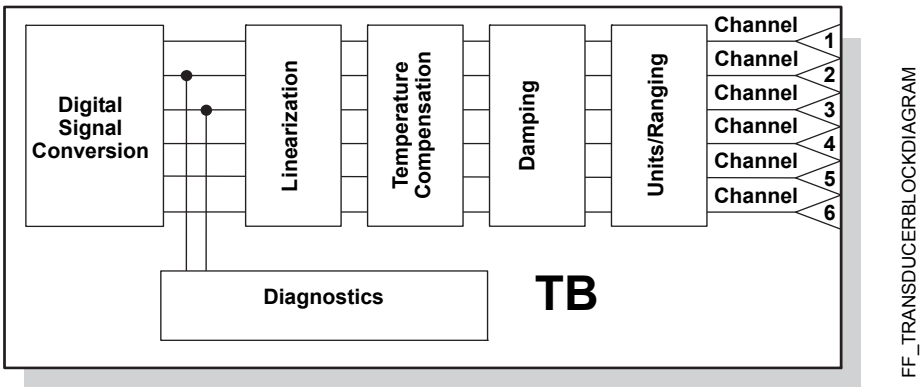
Appendix D Level Transducer Block

Overview . . . . . page D-1
Parameters and Descriptions . . . . . page D-2
Supported Units . . . . . page D-7
Diagnostics Device Errors . . . . . page D-8

OVERVIEW

This section contains information on the 5300 Level Transducer Block (TB). Descriptions of all Transducer Block parameters, errors, and diagnostics are listed.

Figure D-1. Transducer Block Diagram



Definition

The transducer block contains the actual measurement data, including a level and distance reading. Channels 1–13 are assigned to these measurements (see Figure D-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 D-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

PARAMETERS AND DESCRIPTIONS

Table D-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 H-4
RADAR_ULLAGE	16	Distance (Ullage)
RADAR_LEVELRATE	17	Level Rate
RADAR_LEVELRATE_RANGE	18	See Table H-5
RADAR_LEVEL_SIGNAL_STRENGTH	19	Signal strength
RADAR_LEVEL_SIGNAL_STRENGTH_RANGE	20	See Table H-7
RADAR_VOLUME	21	Volume
RADAR_VOLUME_RANGE	22	See Table H-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 Rosemount Service Department for more information
PROBE_IMPEDANCE	36	This parameter is used for User Defined probes only. Please contact Rosemount Service Department for more information
TCL	37	This parameter is used for User Defined probes only. Please contact Rosemount Service Department for more information

Parameter	Index Number	Description
PROPAGATION_FACTOR	38	This parameter is used for User Defined probes only. Please contact Rosemount Service Department for more information
REF_PULSE_AMPL	39	This parameter is used for User Defined probes only. Please contact Rosemount 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
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

Parameter	Index Number	Description
MEAS_STATUS	73	
INTERFACE_STATUS	74	
REMOTE_HOUSING	75	

Table D-3. Probe Type

VALUE	PROBE_TYPE
0	User defined
1	Rigid Twin
2	Flexible Twin
3	Coaxial
4	Rigid Single
5	Flexible Single
10	Coaxial HTHP
11	Coaxial HP
12	Rigid Single HTHP/HP
13	Flexible Single HTHP/HP
20	Rigid Single PTFE
21	Flexible Single PTFE

Table D-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 D-5. Environment

Bit Number	Value of ENV_ENVIRONMENT	Description
28	0x10000000	Rapid Changes

Table D-6. Presentation

Bit Number	Value of ENV_PRESENTATION	Description
8	0x00000100	Show negative levels as zero
10	0x00000400	Probe End Projection
18	0x00040000	Use jump filter
22	0x00400000	Show level below probe end as zero

Table D-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
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

Table D-8. Product Dielectrical Range

VALUE	ENV_DIELECTR_CONST
0	1.4 - 1.9 (e.g. liquified gas, plastics)
1	1.9-2.5 (eg Oil Based)
2	2.5-4 (eg Oil Based)
3	4-10 (eg Alcohol, Acids)
4	>10 (eg Waterbased)
5	Unknown

Table D-9. Measurement Mode

VALUE	ENV_DIELECTR_CONST
0	Liquid Level
1	Product amd Interface
2	Solid Level
3	Submerged

SUPPORTED UNITS

Unit Codes

Table D-10. Length

Value	Display	Description
1010	m	meter
1012	cm	centimeter
1013	mm	millimeter
1018	ft	feet
1019	in	inch

Table D-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 D-12. Temperature

Value	Display	Description
1001	°C	Degree Celsius
1002	°F	Degree Fahrenheit

Table D-13. Signal Strength

Value	Display	Description
1243	mV	millivolt

Table D-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

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 D-15 on page D-8 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 D-15. Start with the first corrective action and then try the second.

Table D-15. 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 device
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		
21	0x00200000		
22	0x00400000		
23	0x00800000	BaseLine too low	
24	0x01000000	BaseLine too high	
25	0x02000000	Gain control	
26	0x04000000		
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 E 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 D: 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 E-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 shall be displayed here
INP_REG_1_INT_DEC	17	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
INP_REG_2_TYPE	18	Register type
INP_REG_2_FLOAT	19	If the register contains a float value it shall be displayed here
INP_REG_2_INT_DEC	20	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
INP_REG_3_TYPE	21	Register type
INP_REG_3_FLOAT	22	If the register contains a float value it shall be displayed here
INP_REG_3_INT_DEC	23	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
INP_REG_4_TYPE	24	Register type
INP_REG_4_FLOAT	25	If the register contains a float value it shall be displayed here
INP_REG_4_INT_DEC	26	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
INP_REG_5_TYPE	27	Register type
INP_REG_5_FLOAT	28	If the register contains a float value it shall be displayed here
INP_REG_5_INT_DEC	29	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
INP_REG_6_TYPE	30	Register type
INP_REG_6_FLOAT	31	If the register contains a float value it shall be displayed here
INP_REG_6_INT_DEC	32	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
INP_REG_7_TYPE	33	Register type
INP_REG_7_FLOAT	34	If the register contains a float value it shall be displayed here
INP_REG_7_INT_DEC	35	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
INP_REG_8_TYPE	36	Register type
INP_REG_8_FLOAT	37	If the register contains a float value it shall be displayed here
INP_REG_8_INT_DEC	38	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
INP_REG_9_TYPE	39	Register type
INP_REG_9_FLOAT	40	If the register contains a float value it shall be displayed here
INP_REG_9_INT_DEC	41	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
INP_REG_10_TYPE	42	Register type
INP_REG_10_FLOAT	43	If the register contains a float value it shall be displayed here
INP_REG_10_INT_DEC	44	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
DB_REG_1_TYPE	45	Register type
DB_REG_1_FLOAT	46	If the register contains a float value it shall be displayed here
DB_REG_1_INT_DEC	47	If the register contains a DWORD value and *dec* is chosen, it shall 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 shall be displayed here
DB_REG_2_INT_DEC	50	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
DB_REG_3_TYPE	51	Register type
DB_REG_3_FLOAT	52	If the register contains a float value it shall be displayed here
DB_REG_3_INT_DEC	53	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
DB_REG_4_TYPE	54	Register type
DB_REG_4_FLOAT	55	If the register contains a float value it shall be displayed here
DB_REG_4_INT_DEC	56	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
DB_REG_5_TYPE	57	Register type
DB_REG_5_FLOAT	58	If the register contains a float value it shall be displayed here
DB_REG_5_INT_DEC	59	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
DB_REG_6_TYPE	60	Register type
DB_REG_6_FLOAT	61	If the register contains a float value it shall be displayed here
DB_REG_6_INT_DEC	62	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
DB_REG_7_TYPE	63	Register type
DB_REG_7_FLOAT	64	If the register contains a float value it shall be displayed here
DB_REG_7_INT_DEC	65	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
DB_REG_8_TYPE	66	Register type
DB_REG_8_FLOAT	67	If the register contains a float value it shall be displayed here
DB_REG_8_INT_DEC	68	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
DB_REG_9_TYPE	69	Register type
DB_REG_9_FLOAT	70	If the register contains a float value it shall be displayed here
DB_REG_9_INT_DEC	71	If the register contains a DWORD value and *dec* is chosen, it shall be displayed here
DB_REG_10_TYPE	72	Register type
DB_REG_10_FLOAT	73	If the register contains a float value it shall be displayed here
DB_REG_10_INT_DEC	74	If the register contains a DWORD value and *dec* is chosen, it shall 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 F Advanced Configuration Transducer Block

OVERVIEW

The Advanced Configuration Transducer Block contains functions for 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 F-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	
REFERENCE_THRESH	21	
INTERFACE_THRESH	22	
FULL_TANK_THRESH_OFFSET	23	
PEP_PRODUCT_DC	24	
AUTO_CONF_MEAS_FUNC	25	
ECHO_TIME_OUT	26	
CLOSE_DIST	27	
USED_PROBE_END_THRESH	28	
USED_REFERENCE_THRESH	29	
USED_INTERFACE_THRESH	30	
USED_TANK_PRESENTATION	31	
USED_ECHO_TIME_OUT	32	
USED_CLOSE_DIST	33	
SW_SUPPORT2	34	
USED_HOLD_OFF_DIST	35	
USED_PEP_PRODUCT_DC	36	
START_CODE	37	
UNIT_CODE	38	
ENV_SET_START_CODE	39	
PROBE_END_ANCHORING	40	
PEP_PROBE_END_OFFSET	41	
USED_PEP_ PROBE_END_OFFSET	42	
VOL_VOLUME_CALC_METHOD	43	Tank geometry
VOL_IDEAL_DIAMETER	44	Tank diameter
VOL_IDEAL_LENGTH	45	Tank length
VOL_VOLUME_OFFSET	46	Volume offset
VOL_STRAP_TABLE_LENGTH	47	Number of strap points
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.
ECHO_WRITE	51	Echo Found/False Record.

Appendix G Resource Transducer Block

Overview . . . . . page G-1
Parameters and Descriptions . . . . . page G-1

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 of 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 5600 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. See Error! Reference source not found. 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	If set, no writes from anywhere are allowed, except to clear WRITE_LOCK. Block inputs 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 parameters (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 with the highest priority first.

1.Microwave Unit
2.Electronics
3.Configuration
4.Invalid Strapping Table
5.NV Memory
6.IO
7.Hardware Electronics
8.Level Measurement
9.Volume Measurement

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 G-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 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 the device or some part of the device needs maintenance soon.

Below is a list of the conditions with the highest priority first.

1.Antenna Contamination
2.Hardware Warning
3.Configuration Warning
4.Temperature/Volume Warning

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 G-7. The default is 0 and the recommended values is 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 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 device's primary functions 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 device's primary functions. Below is a list of the advisories with the highest priority first.

1.Gauge Simulation Active
2.NV Writes Deferred
3.PWA Simulate Active

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 G-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)

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

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.

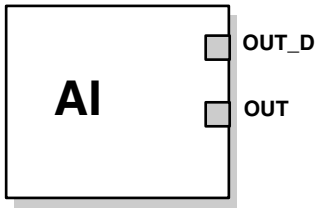
Table G-1. RB.RECOMMENDED_ACTION

	Alarm Type	Failed/Maint/Advise Active Event	Recommended Action Text String
PlantWeb Alerts	None	None	No action required
	Advisory	NV Writes Deferred	Non-volatile writes have been deferred, leave the device powered until the advisory goes away.
		Gauge Simulation Active	Use Simulation Method under advanced configuration tool to get the device out of Simulation Mode.
		PWA Simulation Active	Disable simulation to return to process monitoring and control.
	Maintenance	Hardware Warning	Replace the device.
		Antenna Contamination	Clean the antenna.
		Configuration Warning	Load default database and configure the device.
		Temperature/Volume Warning	1. Check ambient temperature at installation site 2. Verify Strapping Table.
	Failed	Electronics Failure	Replace the Fieldbus Electronics Board.
		NV Memory Failure	Reset the device then download the Device Configuration.
		IO Failure	Replace the device.
		Microwave Unit Error	Replace the device.
		Configuration Error	Load default database and reconfigure the device.
		Invalid Strapping Table	Check that the strapping table values are input in ascending order.
		Hardware Electronics Failure	Replace the device.
		Level Measurment Failure	Check the device configuration.
		Volume Measurment Failure	Check the volume configuration.

Appendix H Analog-Input Block

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Figure H-1. Analog-Input Block



FIELDBUS-FBUS_31A

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 H-2 on page H-4 illustrates the internal components of the AI function block, and Table H-1 lists the AI block parameters and their units of measure, descriptions, and index numbers.

Table H-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.

Parameter	Index Number	Units	Description
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.
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

Parameter	Index Number	Units	Description
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 H-2. Analog Input Function Block Schematic

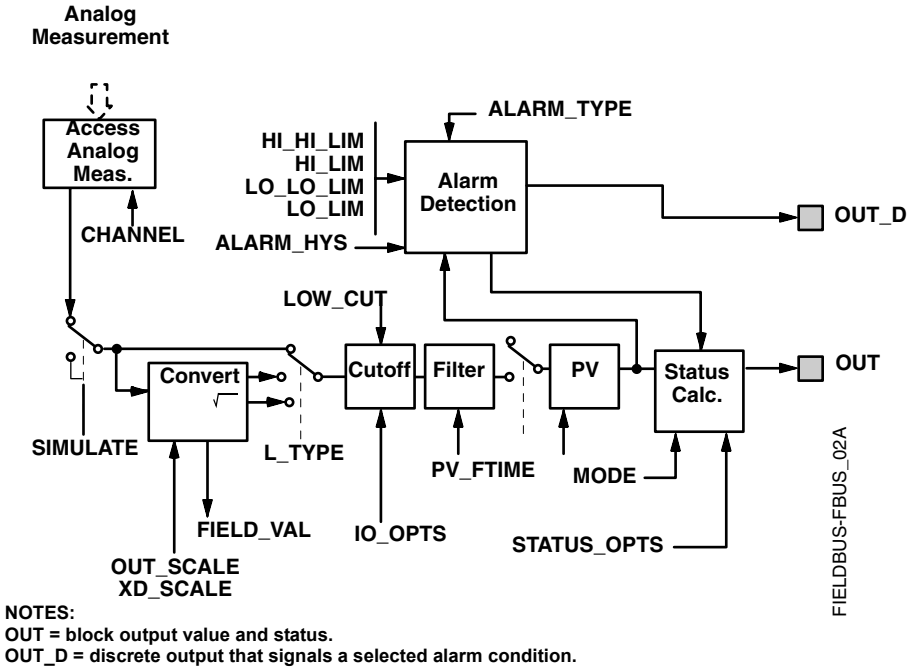
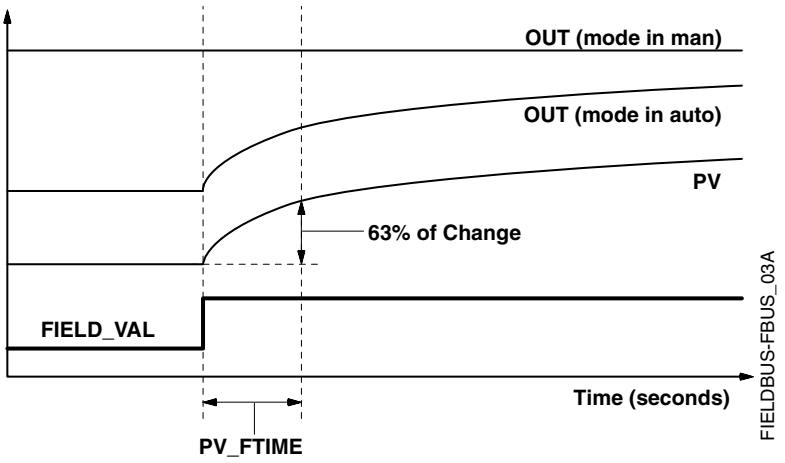


Figure H-3. Analog Input Function Block Timing Diagram



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..

$$\text{PV} = \sqrt{\left(\frac{\text{FIELD_VAL}}{100}\right)} \times (\text{EU**@100\%} - \text{EU**@0\%}) + \text{EU**@0\%}$$

**** 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 H-2 lists conditions reported in the BLOCK_ERR parameter.

Table H-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 H-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.

NOTES
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

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 H-4. Length

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

Table H-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 H-6. Temperature

Display	Description
°C	Degree Celsius
°F	Degree Fahrenheit

Table H-7. Signal Strength

Display	Description
mV	millivolt

Table H-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

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