Reference Manual
00809-0100-4530, Rev GC
June 2023

Rosemount™ 5300 Level Transmitter

Guided Wave Radar

HART COMMUNICATION PROTOCOL IEC WirelessHART FOUNDATION Modbus

EMERSON™

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.

For technical assistance, contacts are listed below:

Customer Central

Technical support, quoting, and order-related questions.

- United States - 1-800-999-9307 (7:00 am to 7:00 pm CST)
- Asia Pacific- 65 777 8211

North American Response Center

Equipment service needs.

- 1-800-654-7768 (24 hours a day — includes Canada)
- Outside of these areas, contact your local Emerson representative.

⚠ WARNING

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

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

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

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

⚠ WARNING

Explosions could result in death or serious injury.

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

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

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

To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure 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 the leads and terminals.

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

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.

Eliminate the risk of Electrostatic Discharge (ESD) discharge prior to dismounting the transmitter head. Probes may generate an ignition-capable level of electrostatic charge under extreme conditions. During any type of installation or maintenance in a potentially explosive atmosphere, the responsible person should ensure that any ESD risks are eliminated before attempting to separate the probe from the transmitter head.

⚠ WARNING

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) may also jeopardize safety and is not allowed under any circumstances.

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

⚠ WARNING

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental in protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

NOTICE

The products described in this document are NOT designed for nuclear-qualified applications. Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings. For information on Rosemount nuclear-qualified products, contact your local Emerson Sales Representative.

⚠ CAUTION

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.

⚠ CAUTION

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

Contents

1 Introduction

1.1 Using this manual

This manual provides installation, configuration, and maintenance information for the Rosemount™ 5300 Level Transmitter.

Transmitter overview contains an introduction to theory of operation and description of the transmitter. Information on applications, process and vessel characteristics, and a probe selection guide are also included.

Mechanical installation contains mounting considerations and mechanical installation instructions.

Electrical installation contains electrical installation instructions.

Configuration provides instructions on configuration of the transmitter using a handheld communicator, the Rosemount Radar Master software, AMS Device Manager, and DeltaV™.

Operation contains operation techniques such as viewing measurement data and display functionality.

Service and troubleshooting provides troubleshooting techniques for the most common operating problems, as well as diagnostic and error messages, and service instructions.

Specifications and reference data supplies reference and specification data, as well as ordering information for spare parts and accessories.

Configuration parameters provides extended information about the configuration parameters.

Advanced configuration provides instructions on how to use the functions Dynamic Vapor Compensation, Signal Quality Metrics, and Probe End Projection.

Remote mounting contains mechanical installation instructions and configuration for remote housing.

FOUNDATION™ Fieldbus Block Information provides information regarding the function blocks.

HART® to Modbus® Converter (HMC) module describes the operation of the HART® to Modbus® Converter (HMC).

1.2 Product certifications

See the Rosemount 5300 Product Certifications document for detailed information on the existing approvals and certifications.

1.3 Product recycling/disposal

Consider recycling equipment and packaging. Dispose of the product and packaging in accordance with local and national legislation.

Related information

Service support

2 Transmitter overview

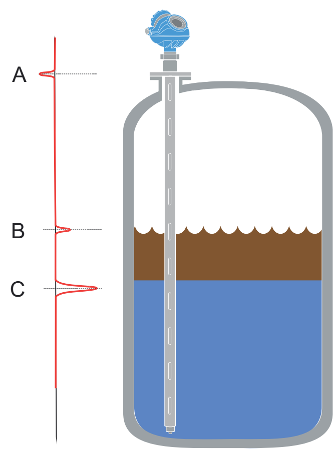
2.1 Measurement principle

Low power, nano-second microwave pulses are guided down a probe submerged in the process media. When a microwave pulse reaches a medium with a different dielectric constant, part of the energy is reflected back to the transmitter.

The transmitter uses the residual wave of the first reflection for measuring the interface level. 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.

The time difference between the transmitted and the reflected pulse is converted into a distance, and the total level or interface level is then calculated. The reflection intensity depends on the dielectric constant of the product: the higher dielectric constant value, the stronger reflection.

Figure 2-1: Measurement Principle



A. Reference pulse
B. Level
C. Interface level

2.2 Application examples

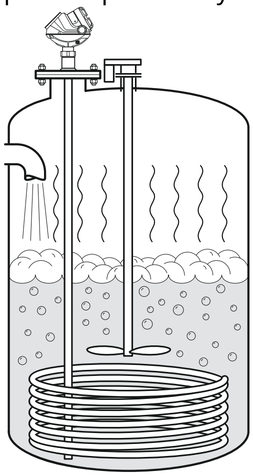
The Rosemount 5300 Level Transmitter is suited for aggregate (total) level measurements on most liquids, semi-liquids, solids, and liquid/liquid interfaces.

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

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

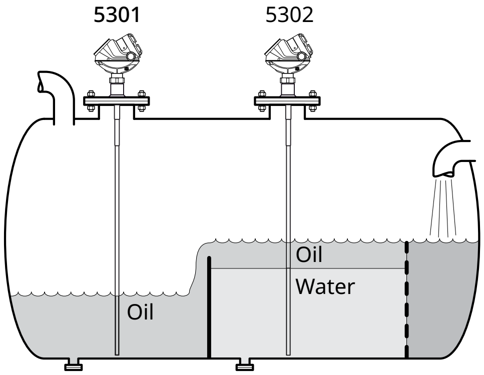
Boiling conditions with vapor and turbulence

The Rosemount 5300 Level 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.



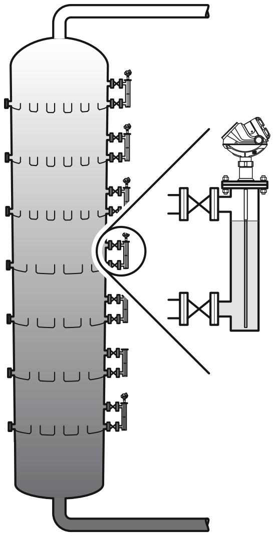
Separators, accumulators, and production tanks

The Rosemount 5302 measures both level and interface level in a separator tank.



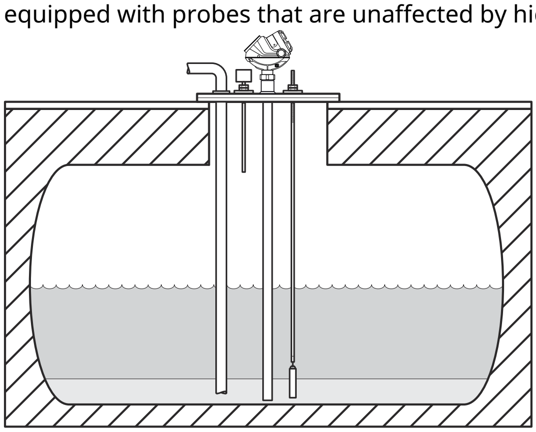
Chamber applications

The Rosemount 5300 Level Transmitter is well suited for chamber applications, such as distillation columns.



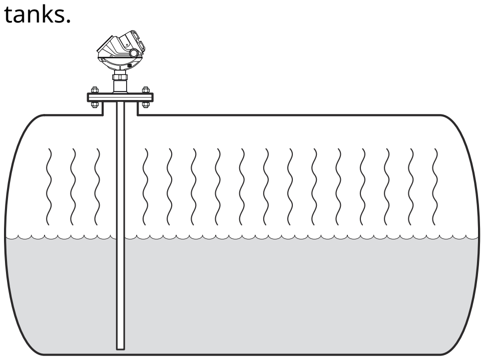
Waste tanks and sump pits

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



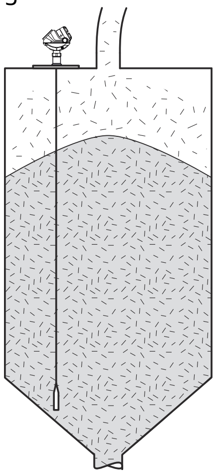
Ammonia, LNG and LPG tanks

Guided wave radar technology provides reliable measurements in ammonia, LNG, and LPG tanks.



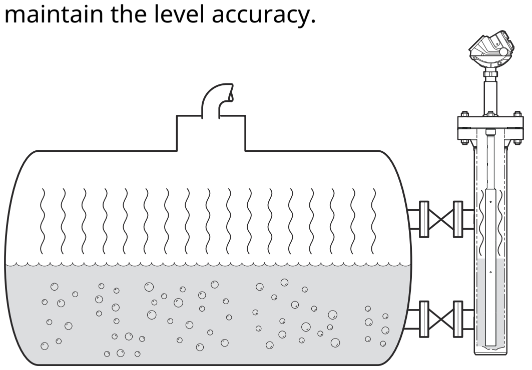
Solids measurement

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



High-pressure saturated steam applications

The Rosemount 5300 Level Transmitter with Dynamic Vapor Compensation will automatically compensate for dielectric changes in high pressure steam applications and maintain the level accuracy.



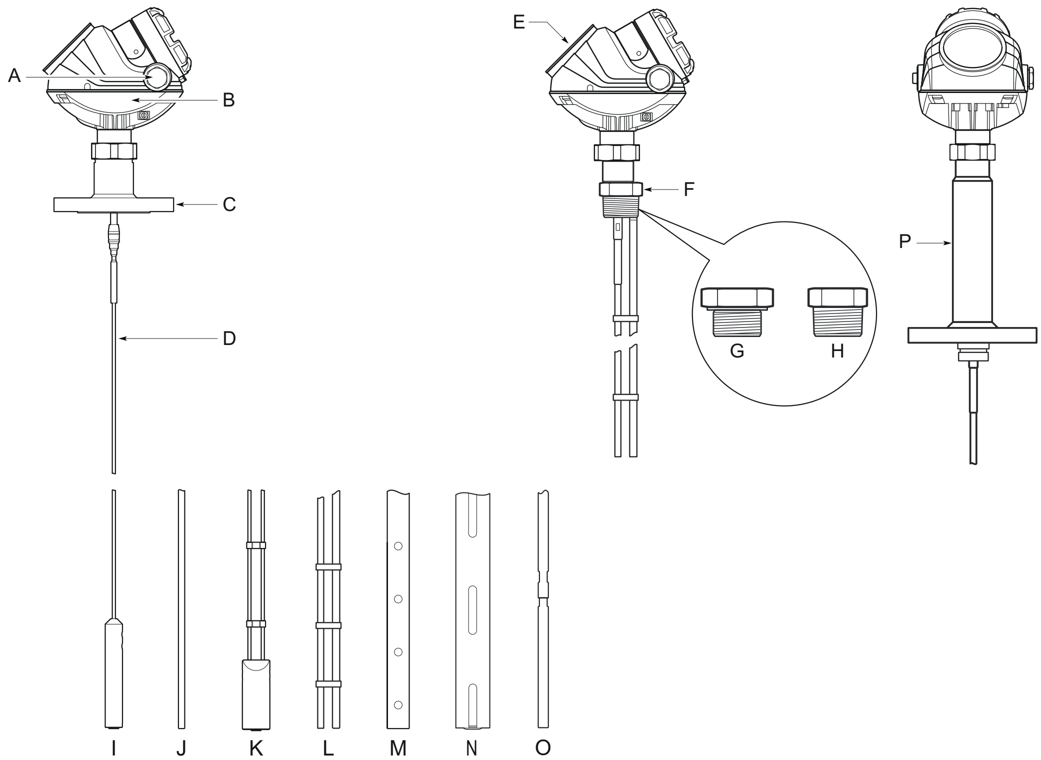
2.3 Components of the transmitter

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

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

There are different probe types available for various applications: rigid twin lead, flexible twin lead, rigid single lead, segmented rigid single lead, flexible single lead, coaxial, and large coaxial.

Figure 2-2: Transmitter Components

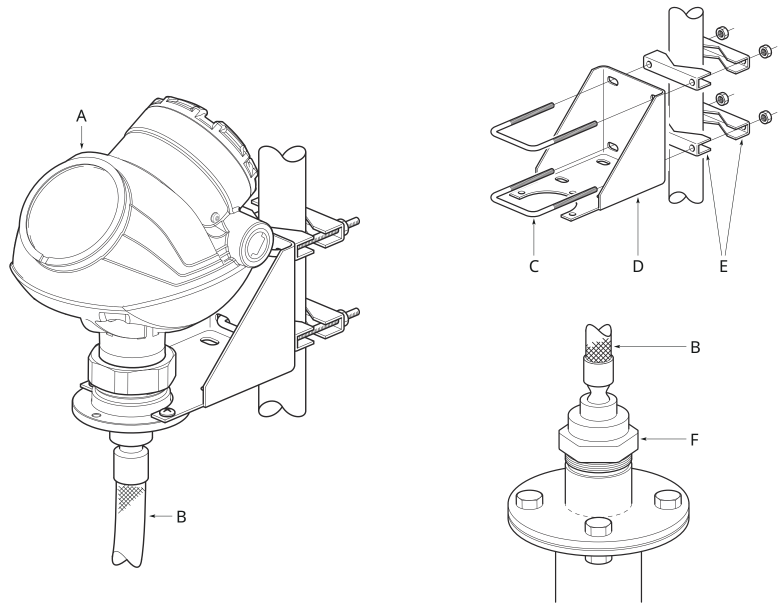


A. Cable entry: ½-in. NPT; Optional adapters: M20, eurofast®, minifast®
B. Radar electronics
C. Flanged process connections
D. Probe
E. Dual compartment housing
F. Threaded process connections
G. BSPP (G)
H. NPT
I. Flexible single lead with weight
J. Rigid single lead
K. Flexible twin lead with weight
L. Rigid twin lead
M. Coaxial
N. Large coaxial
O. Segmented rigid single lead probe
P. HTHP version

2.3.1 Remote housing components

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

Figure 2-3: Remote Housing Components



A. *Dual compartment housing*
B. *Cable remote connection*
C. *U-bolt*
D. *Bracket*
E. *Clamping brackets*
F. *M50 nut*

2.4 System integration

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

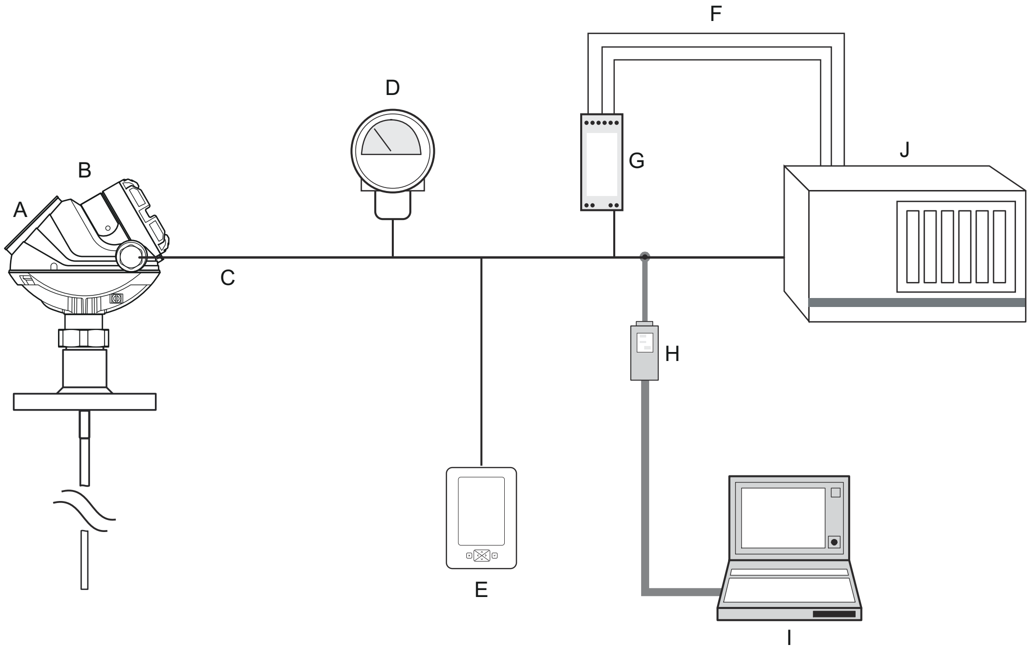
By using the optional Rosemount 333 HART Tri-Loop™, the digital HART signal can be converted into three additional 4-20 mA analog signals. With the HART protocol, multidrop configuration is possible. In this case, communication is restricted to digital, since current is fixed to the 4 mA minimum value.

The transmitter can be combined with the Emerson Wireless 775 THUM™ Adapter to wirelessly communicate HART data with IEC 62591 (*Wireless*HART®) technology.

In addition, the transmitter can be connected to a Rosemount 751 Field Signal Indicator for 4-20 mA / HART, a Rosemount 752 Remote Indicator for FOUNDATION Fieldbus, or it can be equipped with an integral display.

The transmitter can easily be configured using a handheld communicator or a PC with the Rosemount Radar Master software. Rosemount 5300 Level Transmitters can also be configured with the AMS Device Manager and DeltaV™ software, and other tools supporting Electronic Device Description Language (EDDL) functionality.

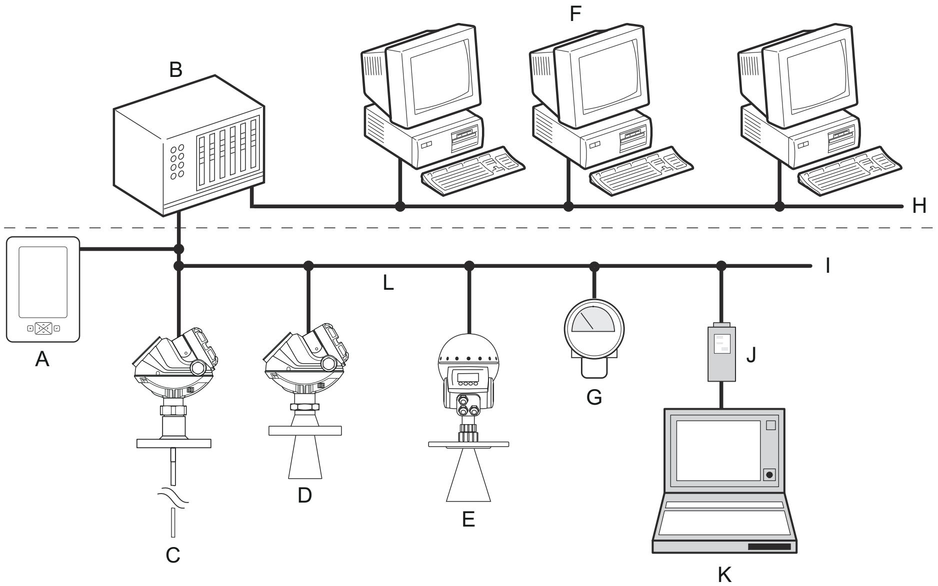
Figure 2-4: HART System Architecture



A. *Integral display*
B. *Rosemount 5300 Level Transmitter*
C. *4-20 mA/HART*
D. *Rosemount 751 Field Signal Indicator*
E. *Handheld communicator*
F. *3 x 4-20 mA*
G. *Rosemount 333 HART Tri-Loop*
H. *HART modem*
I. *Rosemount Radar Master or AMS Device Manager*
J. *DCS*

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

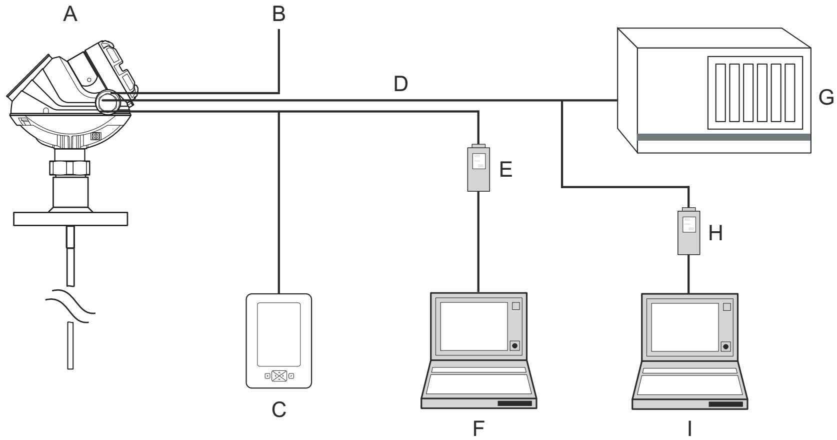
Figure 2-5: FOUNDATION Fieldbus System Architecture



A. Handheld communicator
B. Host/DCS system (e.g. DeltaV)
C. Rosemount 5300
D. Rosemount 5400
E. Rosemount 5600
F. Maintenance
G. Display
H. H2 - High speed field bus
I. H1 - Low speed field bus
J. Fieldbus modem
K. PC with Rosemount Radar Master
L. Max cable length: 6200 ft. (1900 m)

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

Figure 2-6: HART to Modbus System Architecture



A. Rosemount 5300
B. Power
C. Handheld communicator
D. Modbus, Levelmaster Emulation/RS-485
E. HART modem
F. PC 5300 Setup in Rosemount Radar Master
G. Control System
H. RS-232/RS-485 Converter
I. PC 5300 Setup in Rosemount Radar Master via Tunneling

2.5 Probe selection guide

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

Table 2-1: Probe Selection Guide

G=Good, NR=Not Recommended, AD=Application Dependent (consult factory)

	Rigid single lead, segmented rigid single lead	Flexible single lead	Coaxial	Large coaxial	Rigid twin lead	Flexible twin lead
Measurements						
Level	G	G	G	G	G	G
Interface (liquid/liquid)	G	G	G	G	G	G
Process medium characteristics						
Changing density	G	G	G	G	G	G
Changing dielectric(1)	G	G	G	G	G	G
Wide pH variations	G	G	G	G	G	G
Pressure changes	G	G	G	G	G	G
Temperature changes	G	G	G	G	G	G

Table 2-1: Probe Selection Guide *(continued)*

	Rigid single lead, segmented rigid single lead	Flexible single lead	Coaxial	Large coaxial	Rigid twin lead	Flexible twin lead
Condensing vapors	G	G	G	G	G	G
Bubbling/boiling surfaces	G	AD	G	G	G	G
Foam (mechanical avoidance)	NR	NR	AD	AD	NR	NR
Foam (top of foam measurement)	AD	AD	NR	AD	AD	AD
Foam (foam and liquid measurement)	AD	AD	NR	AD	AD	AD
Clean liquids	G	G	G	G	G	G
Liquid with very low dielectric constants	G	G(2)	G	G	G	G(2)
Coating/sticky liquids	AD(3)	AD	NR	AD	NR	NR
Viscous liquids	AD(3)	G	NR	AD	AD	AD
Crystallizing liquids	AD	AD	NR	AD	NR	NR
Solids, granules, powders	AD	G	NR	NR	NR	NR
Fibrous liquids	G	G	NR	AD	NR	NR
Tank environment considerations						
Probe is close (<12 in./30 cm) to tank wall / disturbing objects	AD	AD	G	G	G	G
Probe might touch tank wall, nozzle or disturbing objects	NR	NR	G	G	NR	NR
Turbulence	G	AD	G	G	G	AD
Turbulent conditions causing breaking forces	NR	AD	NR	AD	NR	AD
Tall, narrow nozzles	AD	AD	G	G	AD	AD
Angled or slanted surface (viscous or solids materials)	G	G	NR	AD	AD	AD
Liquid or vapor spray might touch probe above surface	NR	NR	G	G	NR	NR
Disturbing Electromagnetic interference in tank	AD	AD	G	G	AD	AD
Cleanability of probe	G	G	NR	AD	AD	AD

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

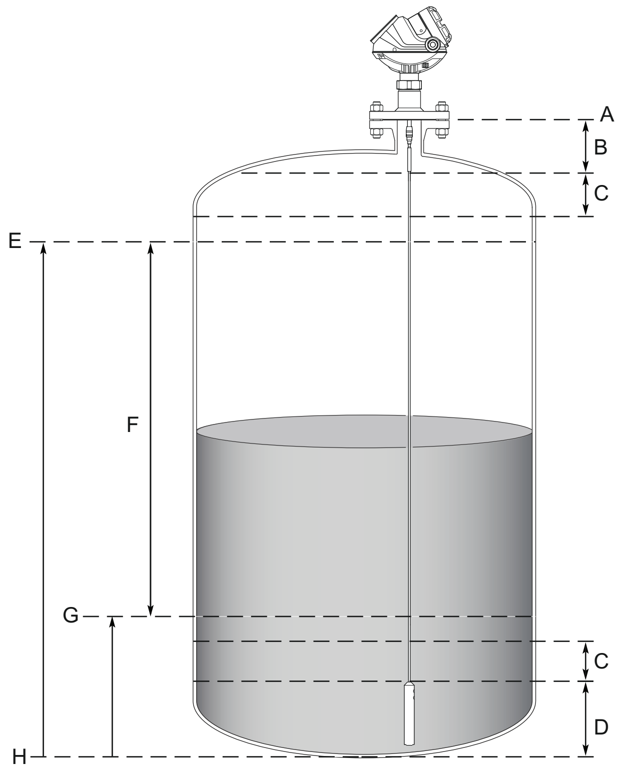
(3) *For viscous or sticky applications, it is not recommended to use centering discs mounted along the probe.*

2.6 Measuring range

The measuring range depends on probe type, dielectric constant of the product, and installation environment, and is limited by the Blind Zones at the very top and bottom of the probe. In the Blind Zones, the accuracy exceeds ±1.18 in. (30 mm), and measurements may not be possible. Measurements close to the Blind Zones will have reduced accuracy.

Figure 2-7 illustrates how the measuring range is related to the Blind Zones and the areas with reduced accuracy.

Figure 2-7: Blind Zones and Areas with Reduced Accuracy



A. Upper Reference Point
B. Upper Blind Zone
C. Reduced accuracy
D. Lower Blind Zone
E. 20mA
F. Range 0 -100 %
G. 4mA
H. Zero Reference Point

Note
Measurements may not be possible in the Blind Zones, and measurements close to the Blind Zones will have reduced accuracy. Therefore, the 4-20 mA points should be configured outside these zones.

Related information

Accuracy over measuring range

2.7 Process characteristics

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

2.7.1 Contamination/product build-up

Heavy contamination or product build-up on the probe should be avoided since it may decrease the sensitivity of the transmitter and lead to measurement errors.

For viscous or sticky applications, it is important to choose a suitable probe. Periodic cleaning may also be required.

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

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

Related information

Contamination/product build-up

2.7.2 Bridging

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

2.7.3 Foam

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

2.7.4 Vapor

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

2.7.5 Boiling hydrocarbons

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

Related information

Probe end projection

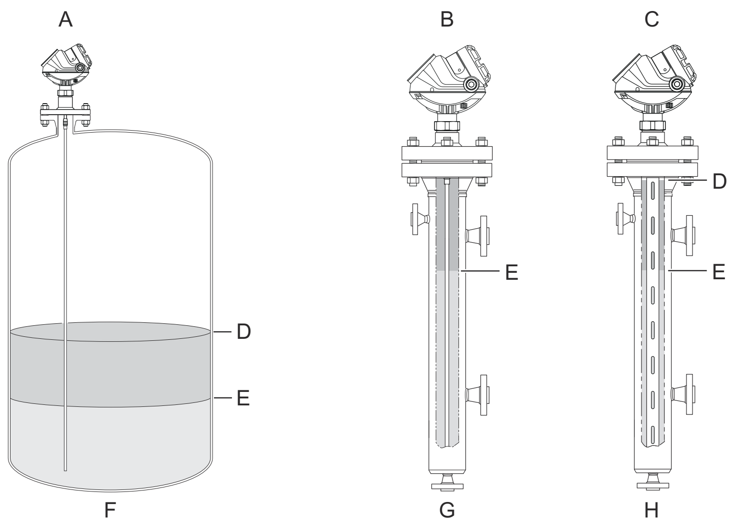
2.7.6 Interface measurements

The Rosemount 5302 is a good choice for measuring the interface of oil and water, or other liquids with significant dielectric differences.

It is also possible to measure interface with a Rosemount 5301 in applications where the probe is fully submerged in the liquid, using the submerged probe mode.

Rosemount 5302 with the large coaxial probe provides the ability to continuously keep track of both level and interface level in fully submerged applications. The product level and interface level mode must be selected.

Figure 2-8: Interface Level Measurement



A. Rosemount 5302
B. Rosemount 5301
C. Rosemount 5302 with large coaxial probe
D. Product level
E. Interface level
F. Product level and interface level
G. Interface level with submerged probe
H. Product level and interface level with submerged probe

2.8 Vessel characteristics

2.8.1 Heating coils, agitators

Because the radar signal is transmitted along a probe, the transmitter is generally not affected by objects in the tank. Avoid physical contact with metallic objects when twin lead or single lead probes are used.

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

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

2.8.2 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 no effect on the measurement performance. The transmitter handles flat or dish-bottom tanks equally well.

3 Mechanical installation

3.1 Safety messages

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

⚠ WARNING

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

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

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

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

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure 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.

Eliminate the risk of Electrostatic Discharge (ESD) discharge prior to dismounting the transmitter head. Probes may generate an ignition-capable level of electrostatic charge under extreme conditions. During any type of installation or maintenance in a potentially explosive atmosphere, the responsible person should ensure that any ESD risks are eliminated before attempting to separate the probe from the transmitter head.

⚠ WARNING

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

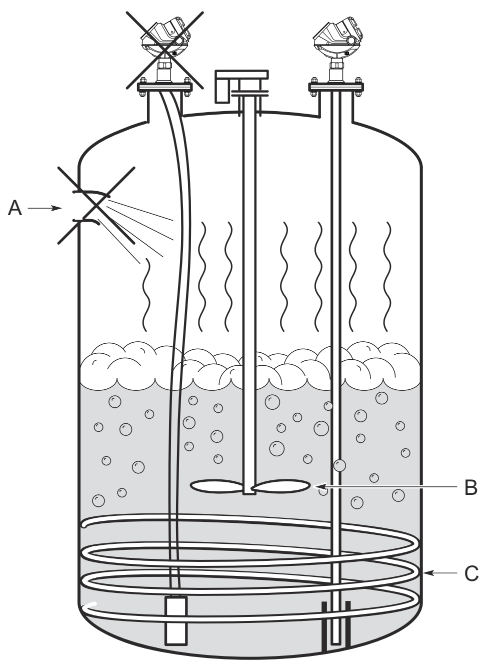
Unauthorized changes to the product are strictly prohibited as they may unintentionally and unpredictably alter performance and jeopardize safety. Unauthorized changes that interfere with the integrity of the welds or flanges, such as making additional perforations, compromise product integrity and safety.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

3.2 Installation and mounting considerations

3.2.1 Recommended mounting position for liquids

When finding an appropriate mounting position for the transmitter, the conditions of the tank must be carefully considered. The transmitter should be mounted so that the influence of disturbing objects is reduced to a minimum. For easy access to the transmitter, ensure that it is mounted with sufficient service space.

Figure 3-1: Mounting Position



A. Inlet pipe
B. Agitator
C. Heating coils

The following guidelines should be considered when mounting the transmitter:

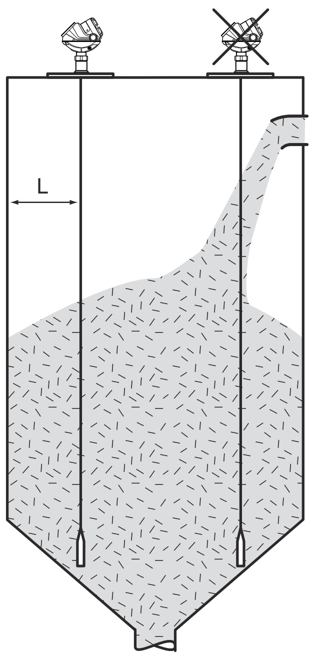
- Do not mount close to inlet pipes.

- Do not mount close to agitators. If the probe can move to within 12 in. (30 cm) away from an agitator, the probe should be anchored.
- If the probe tends to sway due to turbulent conditions in the tank, the probe should be anchored.
- Avoid mounting close to heating coils.
- Position the probe such that it is subject to a minimum of lateral force.
- The probe should not come into contact with the nozzle or other objects in the tank.

Note
Violent fluid movements causing high sideway forces may break rigid probes.

3.2.2 Recommended mounting for solids

Figure 3-2: Recommended Mounting for Solids



Consider the following guidelines when mounting the transmitter:

- Do not mount near inlet pipes in order to avoid product filling on the probe.
- Regularly check the probe for defects.
- It is recommended that the vessel be empty during installation.
- For concrete vessels, the distance (L) between the probe and the wall should be at least 20 in. (500 mm).
- Stabilize the probe for side forces, by attaching the probe to the tank bottom. For solids, use the 0.24 in. (6 mm) probe, because of the higher tensile strength. The probe should have a sag of ≥ 1 in./100 in. (10 mm/m) to prevent probe damage. See Anchor the probe 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.

- Product build-up on the silo walls near the probe may interfere with measurements. Choose a mounting position where the probe is not in contact with, or close to, the product build-up.

3.2.3 Considerations for solid applications

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

Table 3-1: Tensile Strength and Collapse Load

Probe type	Tensile strength	Collapse load
0.16-in. (4 mm) diameter	Minimum 2698 lb (12 kN)	Maximum 3597 lb (16 kN)
0.24-in. (6 mm) diameter	Minimum 6519 lb (29 kN)	Maximum 7868 lb (35 kN)

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

- There might be considerable down-pull forces on silo roofs caused by the media, so the silo roof must withstand the maximum probe tensile load.
- The tensile load depends on silo size, material density, and the friction coefficient. Forces increase with the buried length, the silo, and probe diameter.
- In critical cases, such as for products with a risk for build-up, use a 0.24 in. (6 mm) probe.
- Depending on position, forces on probes are two to ten times greater on probes with tie-down, than on probes with ballast weights(1).
- PTFE coated probes are not recommended for solid applications.

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

Table 3-2: Tensile Load for Unanchored 0.16 in. (4 mm) Flexible Single Lead Probe, lb (kN)

Material	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)
Wheat	670 (3)	1120 (5)	1800 (8)	4500 (20) (1)
Polypropylene pellets	340 (1.5)	670 (3)	810 (3.6)	2360 (10.5)
Cement	900 (4)	2020 (9)	2470 (11)	7310 (32.5)(1)

(1) Exceeds tensile strength limit.

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

Table 3-3: Tensile Load for Unanchored 0.24 in. (6 mm) Flexible Single Lead Probe, lb (kN)

Material	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)
Wheat	900 (4)	1690 (7.5)	2810 (12.5)	6740 (30)(1)
Polypropylene pellets	450 (2)	920(4.1)	1190 (5.3)	3510 (15.6)
Cement	1350 (6)	2920 (13)	3600 (16)	10790 (48)(1)

(1) *Exceeds tensile strength limit.*

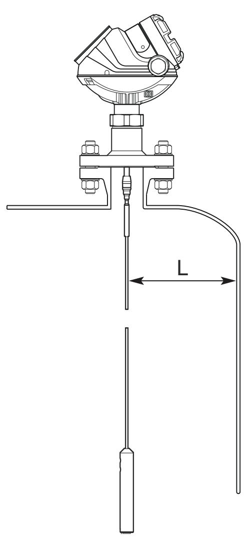
Note
For environments where electrostatic discharges are likely to occur, such as plastic pellets, it is recommended that the probe end is grounded.

3.2.4 Free space requirement

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

If the probe is mounted close to a wall, nozzle or other tank obstruction, noise might appear in the level signal. Therefore the following minimum clearance, according to Table 3-4, must be maintained.

Figure 3-3: Free Space Requirement



L. Clearance to tank wall

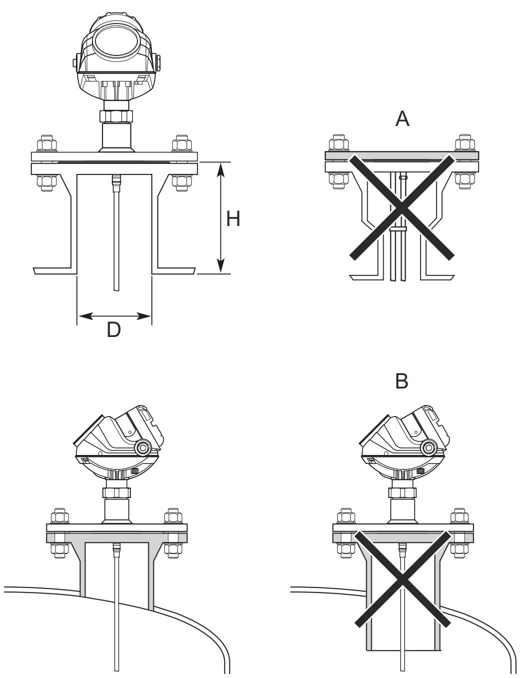
Table 3-4: Recommended Minimum Free Space for Optimal Performance

Probe type	Condition	Minimum clearance (L)
Rigid single lead/Segmented rigid single lead[(1)]	Smooth metal tank wall	4 in. (100 mm)
	Disturbing objects such as pipes and beams Plastic, concrete or rugged metal tank wall	16 in. (400 mm) 20 in. (500 mm)[(2)]
Flexible single	Smooth metal tank wall	4 in. (100 mm)
	Disturbing objects such as pipes and beams Plastic, concrete or rugged metal tank wall	20 in. (500 mm)
Coaxial/Large coaxial[(1)]	N/A	0 in. (0 mm)
Rigid twin lead	N/A	4 in. (100 mm)
Flexible twin	N/A	4 in. (100 mm)

(1) Minimum clearance from tank bottom for the coaxial, large coaxial and rigid single probes is 0.2 in. (5 mm).
(2) Applies to measurements with DC 1.4 or lower.

3.2.5 Flange connection on nozzles

Figure 3-4: Mounting in Nozzles



A. Avoid nozzles with reducer (unless using coaxial probe).
B. Confirm the nozzle does not extend into the tank.

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 3-5.

Table 3-5: Nozzle Considerations for Optimal Performance

	Single (rigid/segmented/ flexible)	Coaxial/Large coaxial	Twin (rigid/ flexible)
Recommended nozzle diameter (D)	6 in. (150 mm)	> probe diameter	4 in. (100 mm)
Minimum nozzle diameter (D)(1)	2 in. (50 mm)	> probe diameter	2 in. (50 mm)
Recommended nozzle height (H)(2)	4 in. (100 mm) + nozzle diameter(3)	N/A	4 in. (100 mm) + nozzle diameter

(1) *The Trim Near Zone (TNZ) function may be necessary or an Hold Off Distance/Upper Null Zone (UNZ) setup may be required to mask the nozzle.*
(2) *Longer nozzles may be used in certain applications. Consult your local Emerson representative for details.*
(3) *For nozzles taller than 4 in. (100 mm), the long stud version is recommended (option code LS) to prevent the flexible portion from touching the edge of the nozzle.*

Note
The probe must not be in contact with the nozzle (except for the coaxial probe). If the nozzle diameter is less than recommended, the measuring range may be reduced.

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

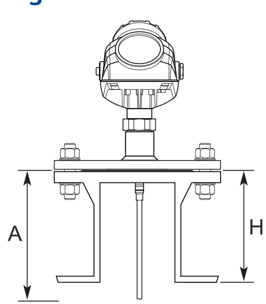
Related information

Change the hold off distance/upper null zone
Trim near zone function

Narrow nozzles

For narrow nozzles, it may be necessary to increase the Hold Off Distance/UNZ to reduce the measuring range in the upper part of the tank. Amplitude Threshold adjustments may also be needed in this case. A Trim Near Zone is recommended in most nozzle installations, for example, when there are disturbing obstacles in the near zone.

Figure 3-5: Hold Off Distance/UNZ for Narrow Nozzles

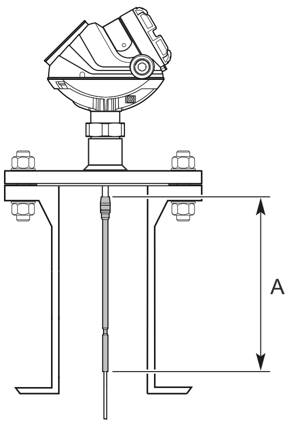


A. Hold Off Distance/UNZ

Long stud

A long stud is recommended for single flexible probes in a tall nozzle.

Figure 3-6: A Single Flexible Probe with a Long Stud



A. Long Stud (9.8 in./250 mm)

3.2.6 Installation in still pipe/chamber

General chamber considerations

Dimensioning the chamber/pipe correctly and selecting the appropriate probe is key to the success in these applications. When selecting a smaller chamber/pipe diameter, such as 2-in., a flexible probe is not suitable due to the chance of it coming into contact with the walls. Also, relatively large side inlets may interfere with the signal.

When gas lift and/or turbulence may occur (e.g. boiling hydrocarbons), a 3- or 4-in. chamber/pipe diameter is recommended for maximum measurement reliability. This is especially true in high pressure and high temperature installations.

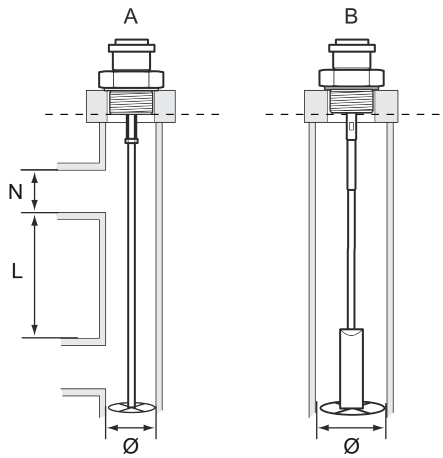
Table 3-6: Recommended and Minimum Chamber/Still Pipe Diameters for Different Probes

Probe type	Recommended diameter	Minimum diameter
Rigid single/segmented rigid single	3 or 4 in. (75 or 100 mm)	2 in. (50 mm)
Flexible single	4 in. (100 mm)	Consult your local Emerson representative
Rigid twin(1)	3 or 4 in. (75 or 100 mm)	2 in. (50 mm)
Flexible twin(1)	4 in. (100 mm)	Consult your local Emerson representative
Coaxial	3 or 4 in. (75 or 100 mm)	1.5 in. (37.5 mm)
Large coaxial	3 or 4 in. (75 or 100 mm)	2 in. (50 mm)(2)

(1) The center rod must be placed more than 0.6 in. (15 mm) away from the pipe wall.
(2) Applicable to pipe schedule up to 40s,40. For higher pipe schedule consult your local Emerson representative.

Note
Metal pipes are preferred, especially in applications with low dielectric constant, to avoid disturbances from objects near the pipe.

Figure 3-7: Mounting Single Probe in Chamber/Still Pipe



A. Rigid single/segmented rigid single
B. Flexible single

Inlet pipe diameter N < Ø

Effective measuring range L ≥12 in. (300 mm).

Related information

Best Practices for Using Radar in Still Pipes and Chambers Technical Note
Dimensional drawings

Rosemount chamber

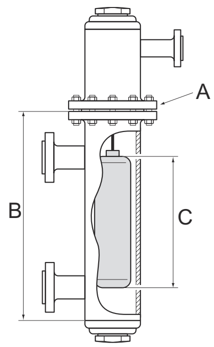
A Rosemount chamber allows external mounting of process level instrumentation. It supports a variety of process connections, and optional drain and vent connections. The standard Rosemount chambers are designed according to ASME B31.3. Rosemount chambers compliant with the Pressure Equipment Directive (PED) are available. Customer specific engineered solutions for Rosemount chambers are available upon request. Use option code XC to order together with the Rosemount 5300 Series Transmitters.

Use a centering disc the same diameter as the chamber if the probe length >3.3 ft. (1 m). See Table 3-9 for which disc to use.

Existing chamber

A Rosemount 5300 Level Transmitter is the perfect replacement in an existing displacer chamber. Proprietary flanges are offered, enabling use of existing chambers to make installation easy.

Figure 3-8: Existing Displacer Chamber



A. Replace chamber flange
B. Probe length
C. Displacer length

Considerations when changing to Rosemount 5300:

- The Rosemount 5300 Level Transmitter flange choice and probe length must be correctly matched to the chamber. Both standard ASME and EN (DIN), as well as proprietary chamber flanges, are available. See Proprietary flanges to identify the proprietary flanges.
- See Table 3-9 for guidelines on which disc size to use.
- See Table 3-7 for guidelines on the required probe length.

Table 3-7: Required Probe Length in Chambers

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

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

For additional information, see the Replacing Displacers with Guided Wave Radar Technical Note.

Probe type in chamber considerations

When installing a Rosemount 5300 in a chamber, a large coaxial or a single lead probe is recommended. The large coaxial probe should always be considered first whenever the application and dimensions of the chamber allow for it.

Large coaxial probes are the preferred choice for installation in chambers with limited space above and below the process connections. This type of probe has the best interface resolution and outstanding performance with low dielectric fluids. It is also unaffected by external disturbances such as protruding welds and side taps.

Single rigid probes are suitable for chamber installations. When used in a metal, small diameter pipe, single rigid probes offer a stronger return signal than when used in open applications. This makes them suitable for low dielectric and interface applications. In addition, for applications with highly viscous media where build up is likely to occur, single rigid probes is the best choice.

Single flexible probes may be used in longer bypass chambers, but care must be taken to ensure that the probe is suspended in a true vertical position and does not touch the pipe wall. If flexible probes are to be used, the bypass chambers should be 4 in. (100 mm) or larger in diameter to allow room for some flexing.

The probe must not touch the chamber wall, should extend the full height of the chamber, but not touch the bottom of the chamber. The probe length determines if a single rigid or single flexible probe should be used:

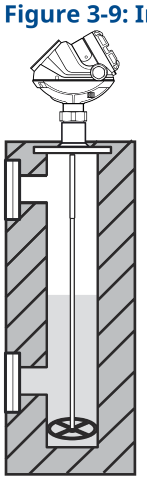
- Less than 19.7 ft. (6.0 m): Rigid single probe is recommended. Use a centering disc for probe > 3.3 ft. (1 m). When mounting space is limited, use a flexible single probe with a weight and centering disc.
- More than 19.7 ft. (6.0 m): Use flexible single probe with a weight and centering disc.[2]

Insulation of the chamber

For hot applications, the chamber should always be insulated to prevent personal injuries and to reduce the amount of energy needed for heating. See Figure 3-9. It is often an advantage, and sometimes even required, for the radar measurement:

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

Figure 3-9: Insulated Chamber



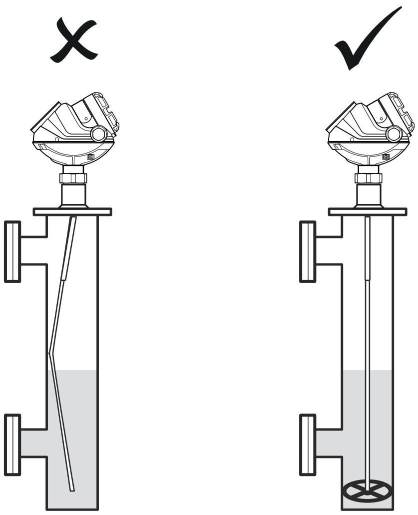
See Insulated tanks for more information.

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

Centering disc for pipe installations

To prevent the probe from contacting the chamber or pipe wall, centering discs are available for flexible single, rigid single, and flexible twin lead probes. The disc is attached to the end of the probe. Discs are made of stainless steel, Alloy C-276, Alloy 400, Alloy 825, Duplex 2205, or PTFE. The centering disc in PTFE is not available for HTHP probes.

Figure 3-10: Prevent the Probe from Contacting the Wall



For the segmented rigid single lead probe, up to five PTFE centering discs can be mounted along the probe, but keep a minimum distance of two segments between the discs. Additionally, a disc in SST or PTFE (part number 03300-1655-xxxx) can be attached to the end of the probe.

When mounting a centering disc, it is important that it fits correctly in the chamber/pipe. See Figure 3-11 for Dimension D. Table 3-9 shows which centering disc diameter to choose for a particular pipe. Table 3-10 shows which centering disc diameter to choose for a Rosemount chamber.

Figure 3-11: Dimension D for Centering Discs

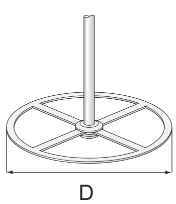


Table 3-8: Centering Disc Dimensions

Disc size	Actual disc diameter (D)
2-in.	1.8 in. (45 mm)
3-in.	2.7 in. (68 mm)
4-in.	3.6 in. (92 mm)
6-in.	5.55 in. (141 mm)
8-in.	7.40 in. (188 mm)

Table 3-9: Centering Disc Size Recommendation for Different Pipe Schedules

Pipe size	Pipe schedule			
	5s, 5 and 10s,10	40s, 40 and 80s, 80	120	160
2-in.	2-in.	2-in.	N/A(1)	N/A(2)
3-in.	3-in.	3-in.	N/A(1)	2-in.
4-in.	4-in.	4-in.	3-in.	3-in.
5-in.	4-in.	4-in.	4-in.	4-in.
6-in.	6-in.	6-in.	4-in.	4-in.
7-in.	N/A(1)	6-in.	N/A(1)	N/A(1)
8-in.	8-in.	8-in.	6-in.	6-in.

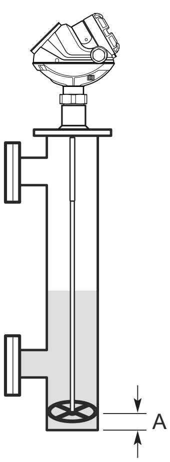
(1) *Schedule is not available for pipe size.*
(2) *No centering disc is available.*

Table 3-10: Centering Disc Size Recommendations for Rosemount Chambers

Chamber size	Chamber rating	Centering disc
3-in.	Up to Class 600/PN 100	3-in.
	Class 900, 1500/PN160, 250	2-in.
3-in. T-piece	Up to Class 600/PN 100	2-in.
4-in.	Up to Class 600/PN 100	4-in.
	Class 900, 1500/PN160, 250	3-in.

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

Figure 3-12: Clearance Distance between the Probe End and the Chamber Bottom

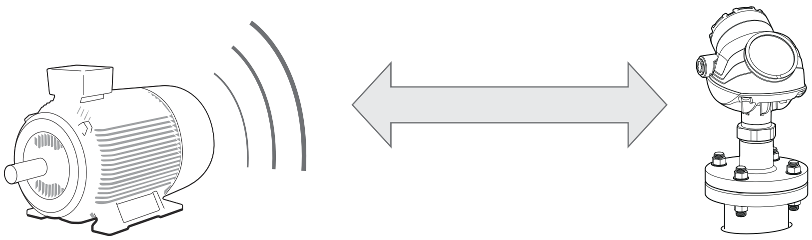


A. *A clearance distance of 1 in. (25 mm) between the probe end and the chamber bottom is recommended.*

3.2.7 Installation in non-metallic tanks and open-air applications

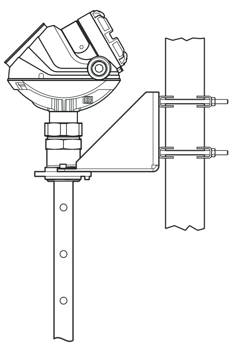
Avoid major sources of electrical disturbance in proximity of the installation (e.g. electrical motors, stirrers, servo mechanisms).

Figure 3-13: Avoid Electromagnetic Disturbances



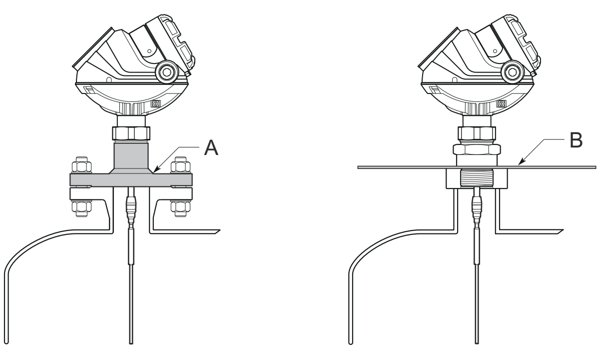
For clean liquids, use a coaxial probe to reduce effect of potential electrical disturbances.

Figure 3-14: Coaxial Probe in an Open-Air Application



For optimal single lead probe performance in non-metallic tanks, the probe must be mounted with a metal flange, or screwed in to a metal sheet (d > 14 in./350 mm) if a threaded version is used.

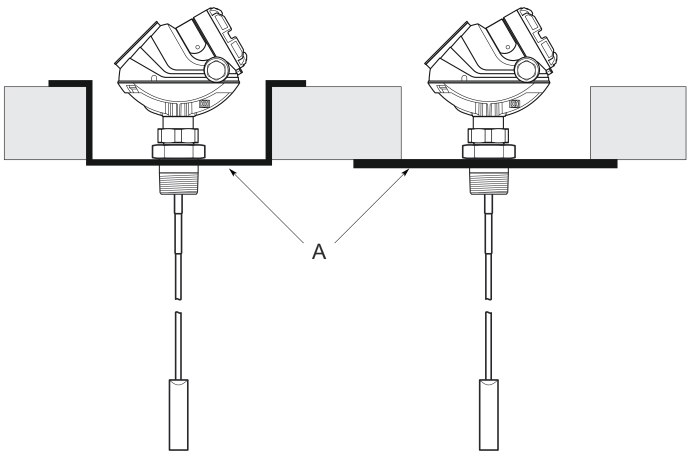
Figure 3-15: Mounting in Non-Metallic Tanks



A. Metal flange
B. Metal sheet (d > 14 in./350 mm)

3.2.8 Installation in concrete silos

Figure 3-16: Installation in Concrete Silos



A. Metal

3.2.9 Minimum distance between two single probes

When installing multiple Rosemount 5300 Level Transmitters with single probes in the same tank, ensure to place the devices at proper distance from each other to avoid the risk of interference caused by cross-talk. Table 3-11 provides recommended minimum distance between two probes. A coaxial probe or a probe installed in a still pipe will not cause any cross-talk.

Table 3-11: Minimum Distance between Single Probes

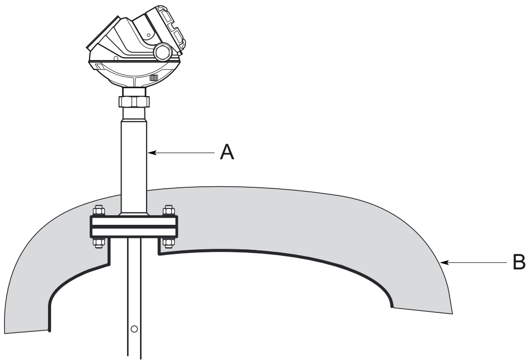
Product	Minimum distance between probes
Oil (DC = 2.1)	5.2 ft. (1.6 m)
Water (DC = 80)	3.3 ft. (1.0 m)

3.2.10 Insulated tanks

When the Rosemount 5300 is installed in high temperature applications, consider the maximum ambient temperature. See Temperature limits for details.

Tank insulation should not exceed 4 in. (100 mm) above the top of the process connection.

Figure 3-17: Tank Insulation



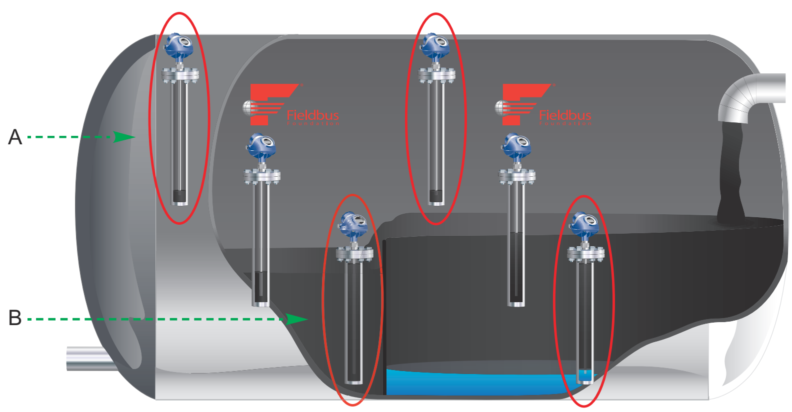
A. *HTHP version*
B. *Tank insulation*

3.2.11 Installation and configuration considerations for ESD systems

Figure 3-18 shows a common example of an Emergency Shutdown (ESD) system in a separator. High-high and low-low transmitters act as redundant safeguards. They will trigger emergency shutdowns or redirect flow of the application. In addition, there are one or several process control units that continuously measure and report the actual level in the tank to the host system and operators.

The high-high unit will always be empty during normal operation, and will indicate empty in the host system. The low-low unit will always be full during normal operation, and will indicate full in the host system as well.

Figure 3-18: ESD System in a Separator

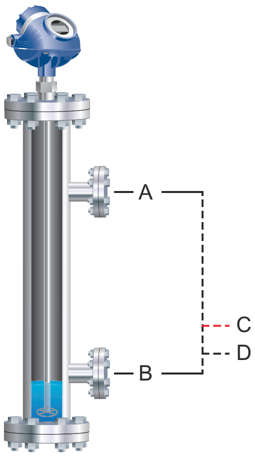


A. *High-high unit*
B. *Low-low unit*

High-high unit

The alarm levels must be located near the bottom inlet with considerable margin to the Blind Zones to ensure robust and accurate readings. See Set alarm limits for further information.

Figure 3-19: High-High Unit

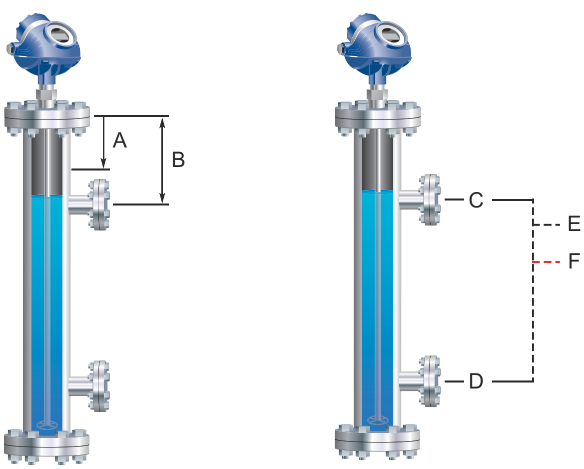


A. *20 mA*
B. *4 mA*
C. *Shutdown*
D. *Warning*

Low-low unit

The distance from flange to upper inlet must be at least 20 in. (500 mm). If this requirement is not met, a spool piece can be added. When the requirement of 20 in. (500 mm) is met, an Upper Null Zone (UNZ) of 14 in. (350 mm) must be configured, so that any disturbance in the near zone above the upper inlet is ignored.

Figure 3-20: Low-Low Unit



A. *UNZ = 14 in. (350 mm)*
B. *Minimum 20 in. (500 mm)*
C. *20 mA*
D. *4 mA*
E. *Warning*
F. *Shutdown*

3.2.12 Shipboard installations

Transmitters with aluminum housing are not approved for open deck installations.

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

3.3 Shorten the probe

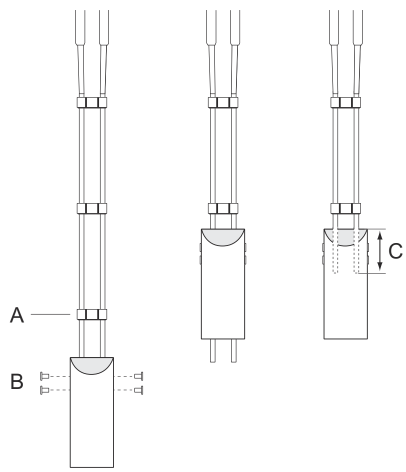
3.3.1 Shorten the flexible single/twin lead probe

Prerequisites

Note
The PTFE covered probes must not be cut in field.

Ensure that at least 1.6 in. (40 mm) of the cable is inserted when the weight is replaced.

Figure 3-21: Shortening of Flexible Twin/Single Lead Probe



A. Spacer
B. Screws
C. Minimum: 1.6 in. (40 mm)

Procedure

1. Mark off the required probe length. Add at least 1.6 in. (40 mm) to the required probe length to be inserted into the weight.
2. Loosen the screws.
3. Slide the weight upwards as much as needed in order to cut the probe.

   If the weight is removed from the cables, preferably apply electrical tape to the cables before cutting, in order to avoid the cables to unwind.
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.

Table 3-12: Required Torque and Hex Key Dimensions

Probe		Required torque	Hex key dimension
Flexible twin lead		4.4 ft-lb (6 Nm)	4 mm
Flexible single lead	4 mm wire, stainless steel	3.7 ft-lb (5 Nm)	4 mm
	4 mm wire, Alloy C-276	1.8 ft-lb (2.5 Nm)	3 mm
	4 mm wire, Alloy 400	1.8 ft-lb (2.5 Nm)	3 mm
	4 mm wire, Duplex 2205	1.8 ft-lb (2.5 Nm)	3 mm
	6 mm wire	7.4 ft-lb (10 Nm)	5 mm

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

Postrequisites

After shortening the probe be sure to update the transmitter configuration to the new probe length.

Related information

Probe length

3.3.2 Shorten the rigid single lead probe

Prerequisites

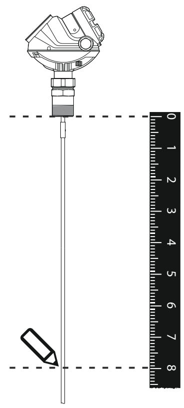
The minimum probe length is 15.7 in. (400 mm).

Note
The PTFE covered probes must not be cut in field.

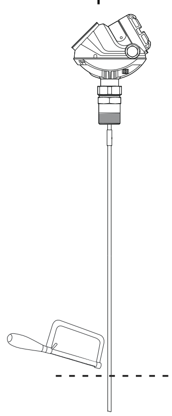
Note
Ensure the lead is fixed while cutting.

Procedure

1. Mark where to cut the probe.



2. Cut the probe at the mark.



Postrequisites

After shortening the probe be sure to update the transmitter configuration to the new probe length.

Related information

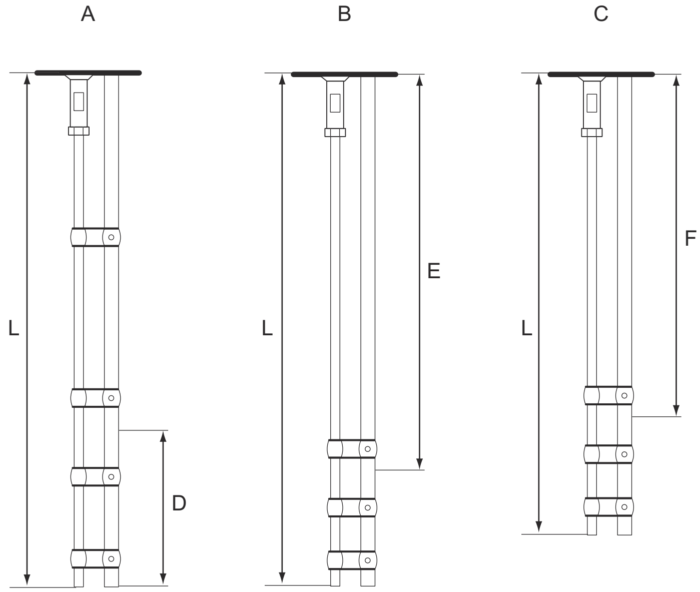
Probe length

3.3.3 Shorten the rigid twin lead probe

Prerequisites

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

Figure 3-22: Maximum Shortening of Rigid Twin Lead Probe



A. L > 46.5 in. (1180 mm)
B. 20.5 in. < L < 46.5 in. (520 mm < L < 1180 mm)
C. 15.7 in. < L < 20.5 in. (400 mm < L < 520 mm)
D. Maximum shortening length: 19.7 in. (500 mm)
E. Minimum probe length: 20.5 in. (520 mm)
F. Minimum probe length: 15.7 in. (400 mm)

Procedure

Cut the rods to the desired length:

- You may cut up to 19.7 in. (500 mm) from the probe end for probe length L above 46.5 in. (1180 mm)
- For probe length 20.5 to 46.5 in. (520 to 1180 mm) the minimum length is 20.5 in. (520 mm)
- For probe length 15.7 to 20.5 in. (400 to 520 mm) the minimum length is 15.7 in. (400 mm)

Postrequisites

After shortening the probe be sure to update the transmitter configuration to the new probe length.

Related information

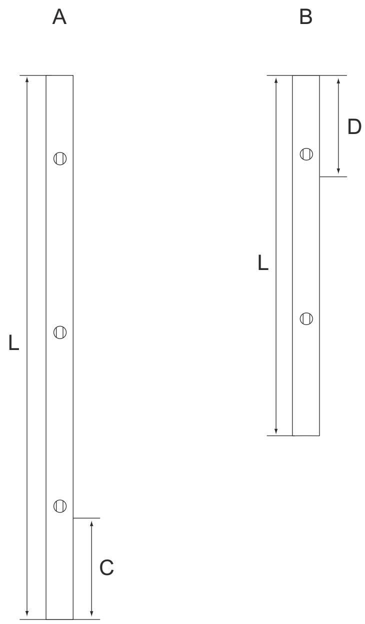
Probe length

3.3.4 Shorten the coaxial probe

Prerequisites

Note
The HTHP coaxial probe must not be cut in field.

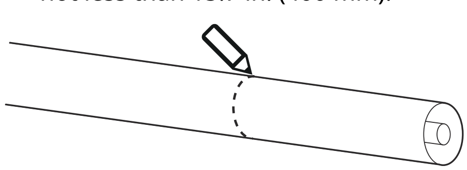
Figure 3-23: Maximum Shortening of Coaxial Probe



A. Ordered probe length (L) > 49 in. (1250 mm)
B. Ordered probe length (L) ≤ 49 in. (1250 mm)
C. Maximum shortening length: 23.6 in. (600 mm)
D. Minimum probe length: 15.7 in. (400 mm)

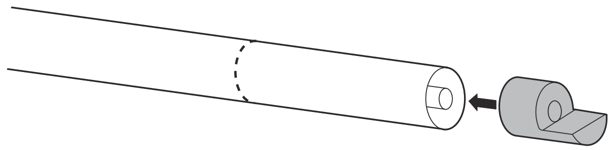
Procedure

1. Mark where to cut the probe.
   - Pipes longer than 49 in. (1250 mm) can be shortened by as much as 23.6 in. (600 mm).
   - Pipes shorter than 49 in. (1250 mm) can be cut as long as the remaining length is not less than 15.7 in. (400 mm).

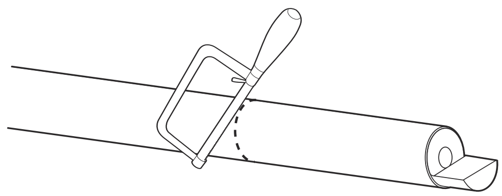


2. Insert the centering piece.

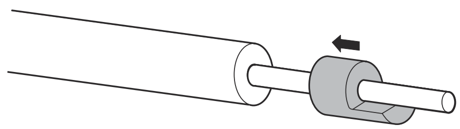
   The centering piece is delivered from factory and should be used to prevent the spacers centering the rod from coming loose.



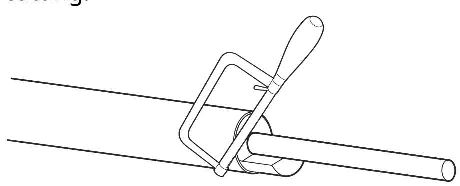
3. Cut the tube to the desired length.



4. Move the centering piece.



5. Cut the rod inside the tube. Ensure the rod is fixed with the centering piece while cutting.



Postrequisites

After shortening the probe be sure to update the transmitter configuration to the new probe length.

Related information

Probe length

3.4 Mount a centering disc

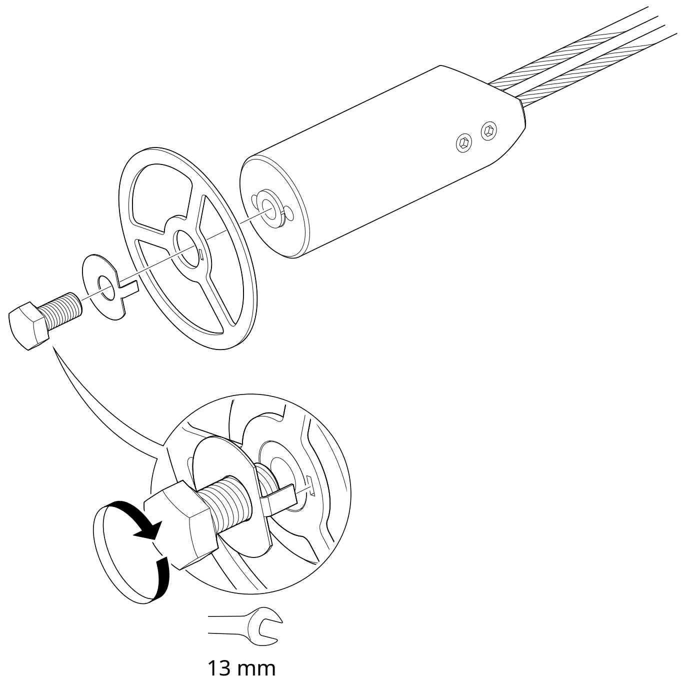
3.4.1 Mount a centering disc on flexible single/twin lead probe

Prerequisites

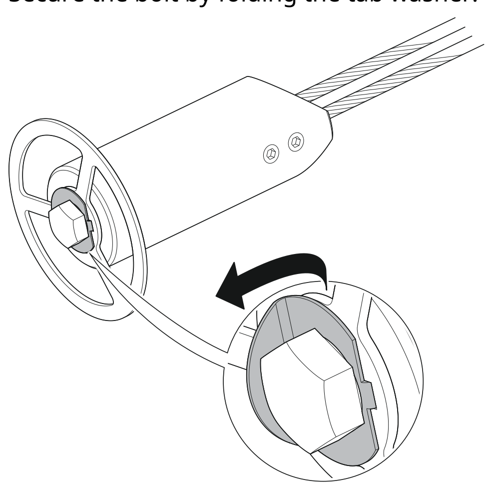
Note
When using centering discs made of PTFE, note that the maximum temperature is 482 °F (250 °C).

Procedure

1. Mount the centering disc at the end of the weight.



2. Secure the bolt by folding the tab washer.

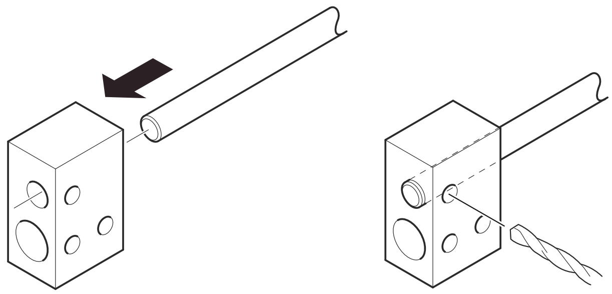


3.4.2 Mount a centering disc on rigid single lead probe (8 mm)

Note
Centering discs shall not be used with PTFE covered probes.

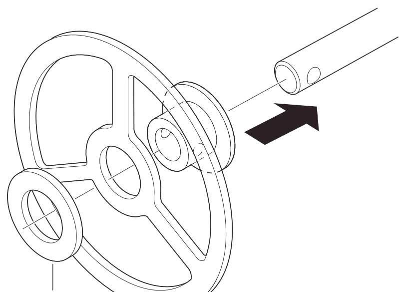
Procedure

1. Drill one hole using the drilling fixture (included in your shipment).

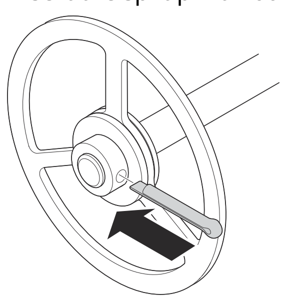


2. Mount the bushing, centering disc, and washer at the probe end.

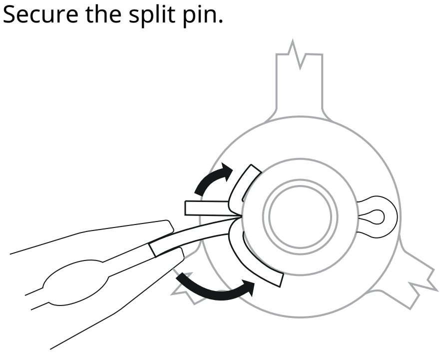
Note
Do not mount the washer (A) if the centering disc material is PTFE, Alloy C-276, Duplex 2205, or Alloy 400.



3. Insert the split pin through the bushing and the probe.



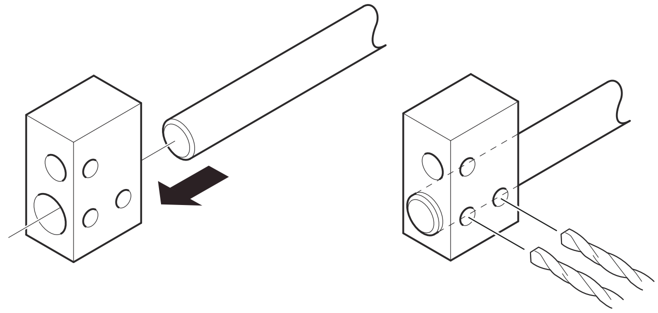
4. Secure the split pin.



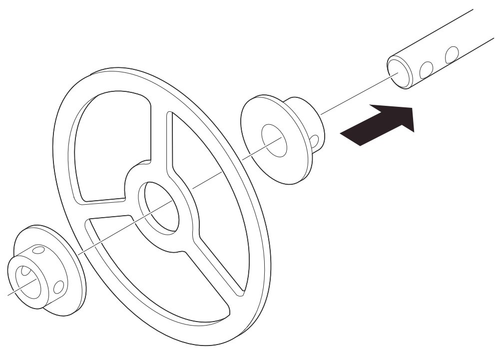
3.4.3 Mount a centering disc on rigid single lead probe (13 mm)

Procedure

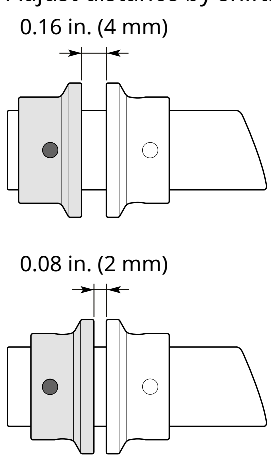
1. Drill two holes using the drilling fixture (included in your shipment).



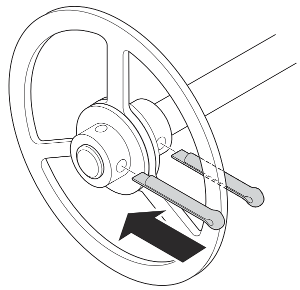
2. Mount the bushings and centering disc at the probe end.



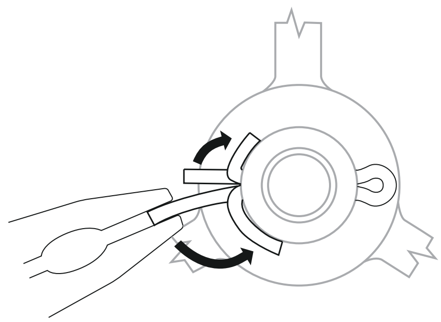
3. Adjust distance by shifting hole for split pin in lower bushing.



4. Insert the split pins through the bushings and the probe.



5. Secure the split pins.



3.5 Mount device on tank

Mount the transmitter with flange on a nozzle on top of the tank. The transmitter can also be mounted on a threaded or Tri Clamp connection.

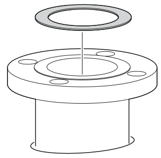
3.5.1 Tank connection with flange

Prerequisites

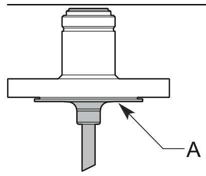
Note
PTFE covered probes must be handled carefully to prevent damage to the coating.

Procedure

1. Place a suitable gasket on top of the tank flange.

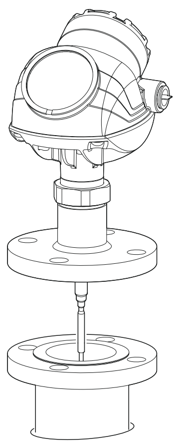


Note
Gasket should not be used for PTFE covered probe with protective plate.

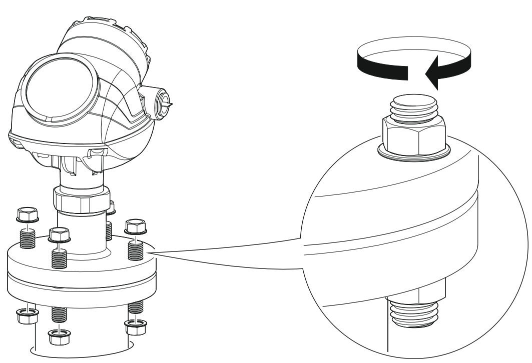


A. PTFE covered probe with protective plate

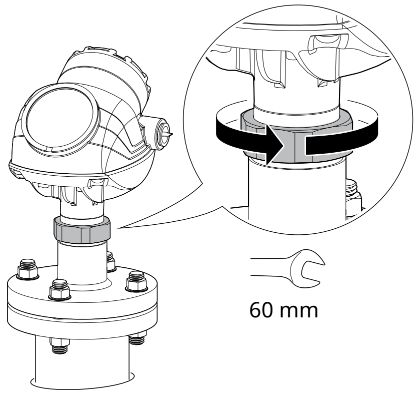
2. Lower the transmitter and probe with flange into the tank.



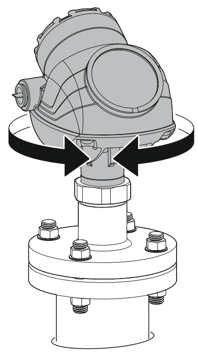
3. Tighten bolts and nuts with sufficient torque for the flange and gasket choice.



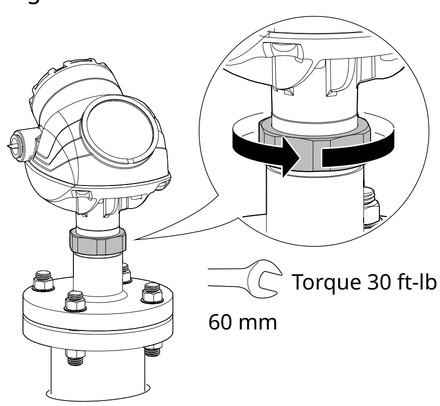
4. Loosen the nut that connects the transmitter head to the probe slightly.



5. Rotate the transmitter housing so the cable entries/display face the desired direction.



6. Tighten the nut.



3.5.2 Tank connection with loose flange (plate design)

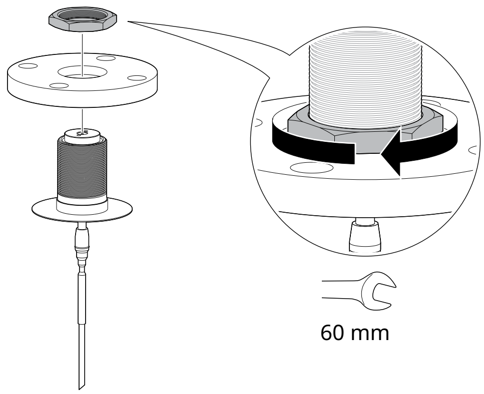
The transmitter is delivered with head, flange and probe assembled into one unit. If, for some reason, these parts have been disassembled, mount the transmitter as described below.

Prerequisites

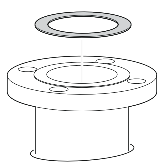
Note
PTFE covered probes must be handled carefully to prevent damage to the coating.

Procedure

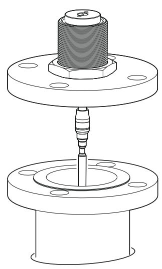
1. Mount the flange on the probe and tighten the flange nut.



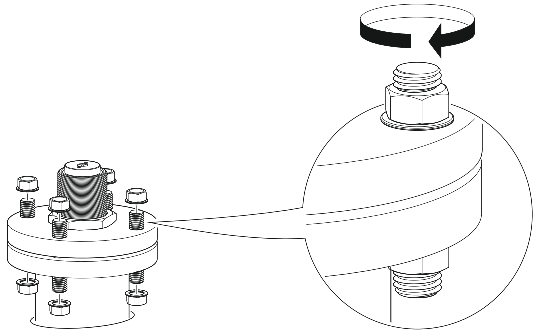
2. Place a suitable gasket on top of the tank flange.



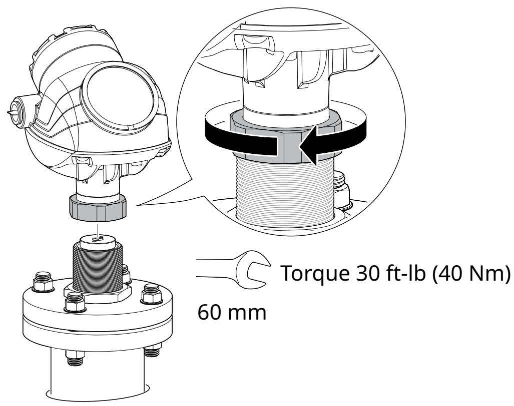
3. Lower the probe with flange into the tank.



4. Tighten bolts and nuts with sufficient torque for the flange and gasket choice.



5. Mount the transmitter head.



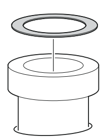
3.5.3 Threaded tank connection

Prerequisites

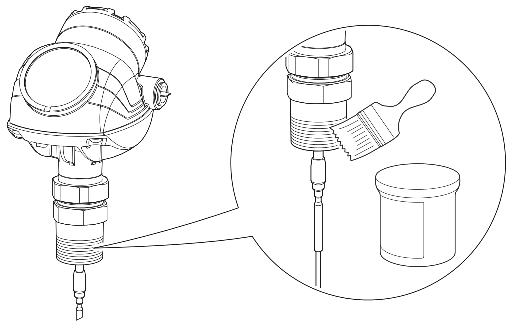
Note
PTFE covered probes must be handled carefully to prevent damage to the coating.

Procedure

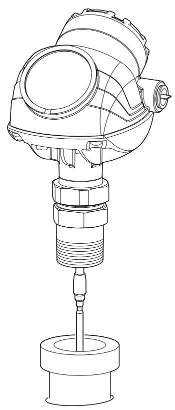
1. For adapters with BSPP (G) threads, place a suitable gasket on top of the tank flange.



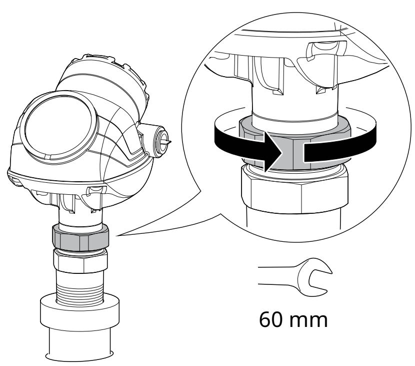
2. For adapters with NPT threads, use anti-seize paste or PTFE tape according to your site procedures.



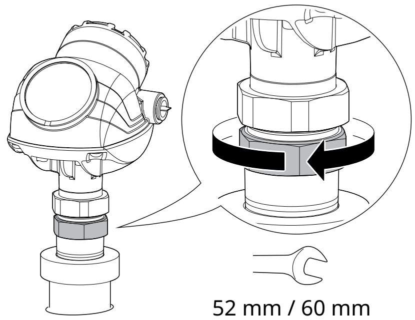
3. Lower the transmitter and probe into the tank.



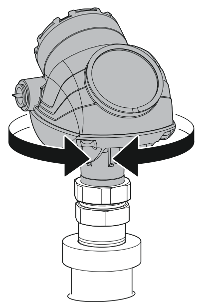
4. Loosen the nut that connects the transmitter head to the probe slightly.



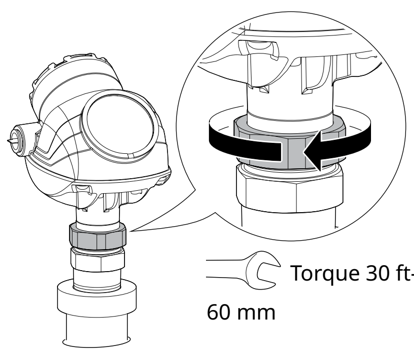
5. Screw the adapter into the process connection.



6. Rotate the transmitter housing so the cable entries/display face the desired direction.



7. Tighten the nut.

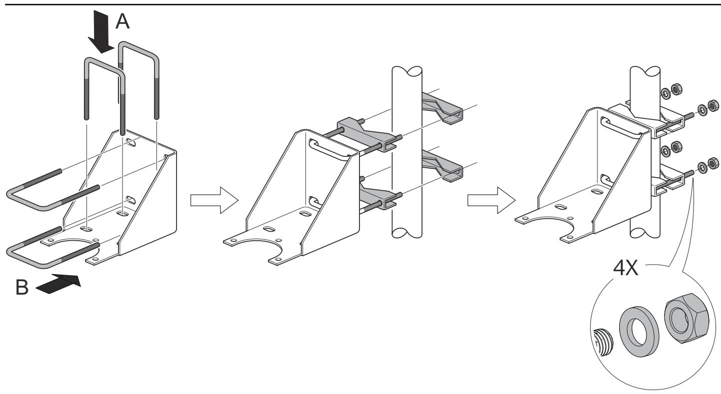


3.5.4 Bracket mounting

Procedure

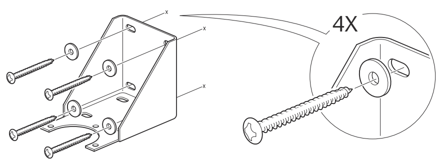
1. Mount the bracket to the pipe/wall.

   On pipe:

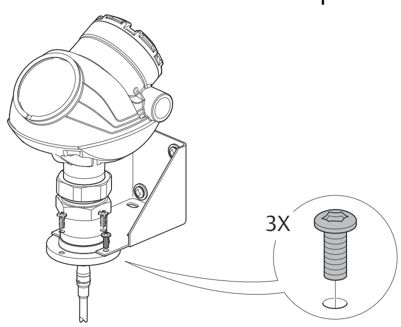


A. Horizontal pipe
B. Vertical pipe

On wall:



2. Mount the transmitter with probe to the bracket.



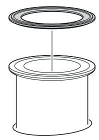
3.5.5 Tank connection with Tri Clamp

Prerequisites

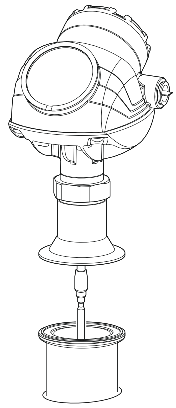
Note
PTFE covered probes must be handled carefully to prevent damage to the coating.

Procedure

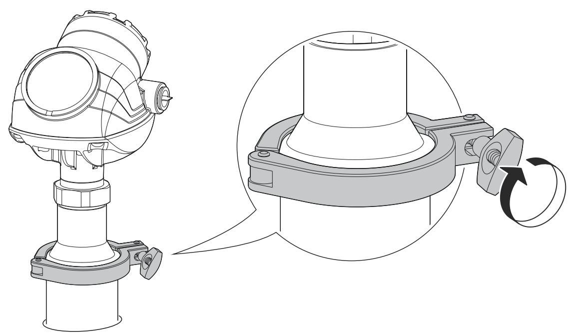
1. Place a suitable gasket on top of the tank flange.



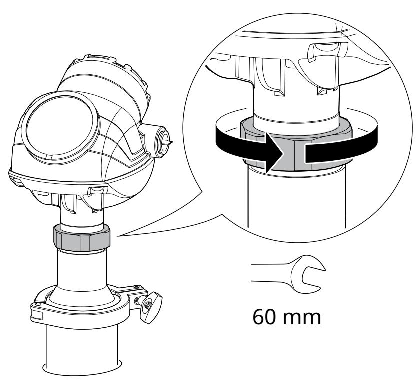
2. Lower the transmitter and probe into the tank.



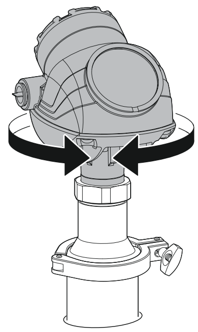
3. Tighten the clamp to the recommended torque (see the manufacturer's instruction manual).



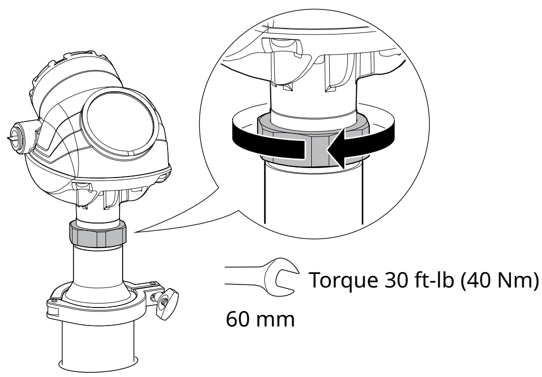
4. Loosen the nut that connects the transmitter head to the probe slightly.



5. Rotate the transmitter housing so the cable entries/display face the desired direction.



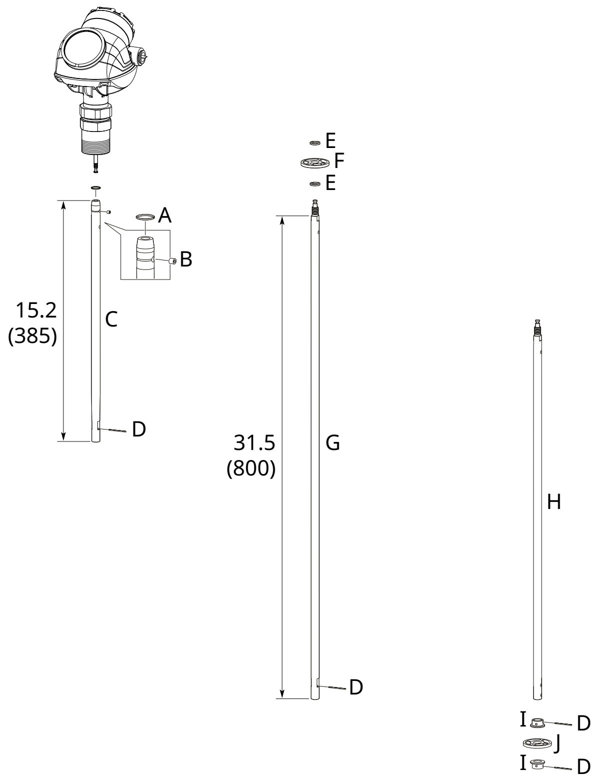
6. Tighten the nut.



3.5.6 Segmented probe

Segmented probe parts

Figure 3-24: Segmented Probe Parts



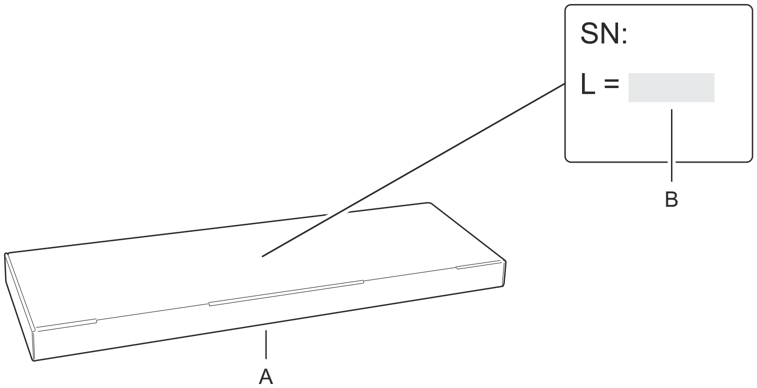
A. Safety ring
B. Screw
C. Top segment
D. Split pin
E. PTFE washer (optional)
F. Centering disc in PTFE (optional)
G. Middle segment
H. Bottom segment (length varies depending on total probe length)
I. Bushing (for the centering disc at the probe end)
J. Bottom centering disc in PTFE or stainless steel (optional)

Verifying probe length

Segmented probe ordered with model code 4S

Before installation, verify the probe length (L) on the label.

Figure 3-25: Label



A. Probe segments box
B. Probe length

Segmented probe ordered as spare part kit

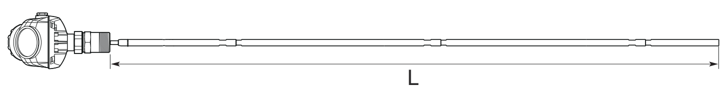
Before installation, the number of segments that add up to the desired probe length must be determined. Also, the bottom segment may need to be shortened.

Adjust the probe length

Procedure

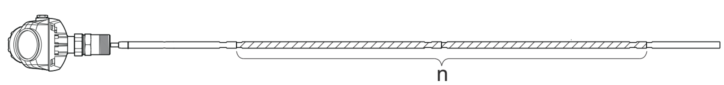
1. Determine L, the desired probe length.

L, desired probe length:



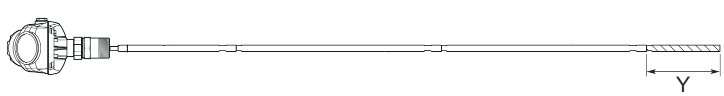
2. Determine n, the number of middle segments needed for the desired probe length. See Determination of probe segments.

n, number of middle segments:

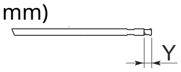
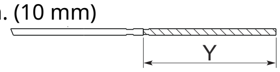
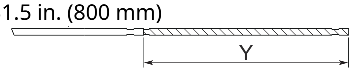


3. Calculate Y, the length of the bottom segment. See Determination of probe segments.

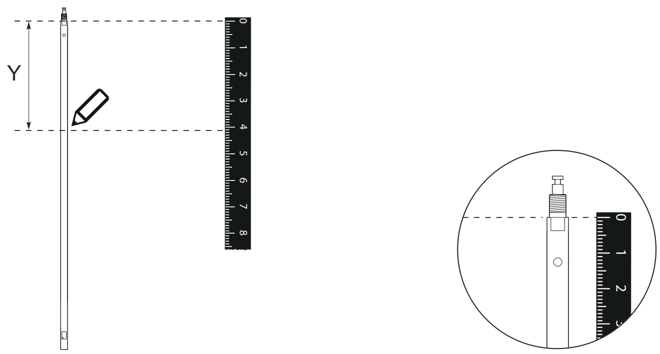
Y, length of bottom segment:



4. Continue as follows:

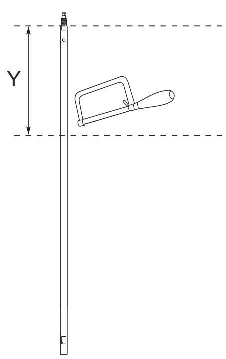
Length of bottom segment (Y)	Action
Y < 0.4 in. (10 mm) 	• Continue with Step 7. Do not use the bottom segment.
Y ≥ 0.4 in. (10 mm) 	• Continue with Step 5 and cut the bottom segment.
Y = 31.5 in. (800 mm) 	a. Add one extra middle segment to the calculated n. b. Continue with Step 7.

5. Mark where to cut the bottom segment.

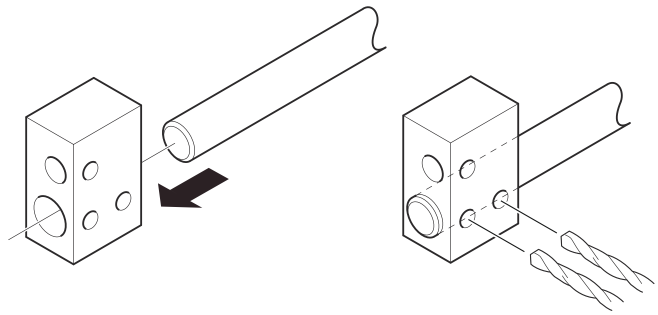


6. Cut the bottom segment at the mark.

Note
Ensure the bottom segment is fixed while cutting.



7. Optional: If a bottom centering disc is ordered, then drill two holes on the bottom segment using the drilling fixture.



Determination of probe segments

Table 3-13: Determination of Probe Segments for Standard Seal

Desired probe length (L)		Number of middle segments (n)	Length of bottom segment (Y)	
in.	mm		in.	mm
15.8 ≤ L ≤ 47.2	400 ≤ L ≤ 1200	0 pc	Y = L -15.8	Y = L - 400
47.2 < L ≤ 78.7	1200 < L ≤ 2000	1 pc	Y = L - 47.2	Y = L - 1200
78.7 < L ≤ 110.2	2000 < L ≤ 2800	2 pcs	Y = L - 78.7	Y = L - 2000
110.2 < L ≤ 141.7	2800 < L ≤ 3600	3 pcs	Y = L - 110.2	Y = L - 2800
141.7 < L ≤ 173.2	3600 < L ≤ 4400	4 pcs	Y = L - 141.7	Y = L - 3600
173.2 < L ≤ 204.7	4400 < L ≤ 5200	5 pcs	Y = L - 173.2	Y = L - 4400
204.7 < L ≤ 236.2	5200 < L ≤ 6000	6 pcs	Y = L - 204.7	Y = L - 5200
236.2 < L ≤ 267.7	6000 < L ≤ 6800	7 pcs	Y = L - 236.2	Y = L - 6000
267.7 < L ≤ 299.2	6800 < L ≤ 7600	8 pcs	Y = L - 267.7	Y = L - 6800
299.2 < L ≤ 330.7	7600 < L ≤ 8400	9 pcs	Y = L - 299.2	Y = L - 7600
330.7 < L ≤ 362.2	8400 < L ≤ 9200	10 pcs	Y = L - 330.7	Y = L - 8400
362.2 < L ≤ 393.7	9200 < L ≤ 10000	11 pcs	Y = L - 362.2	Y = L - 9200

Table 3-14: Determination of Probe Segments for HTHP/HP/C Seal

Desired probe length (L)		Number of middle segments (n)	Length of bottom segment (Y)	
in.	**mm**		**in.**	**mm**
17.3 ≤ L ≤ 48.8	440 ≤ L ≤ 1240	0 pc	Y = L -17.3	Y = L - 440
48.8 < L ≤ 80.3	1240 < L ≤ 2040	1 pc	Y = L - 48.8	Y = L - 1240
80.3 < L ≤ 111.8	2040 < L ≤ 2840	2 pcs	Y = L - 80.3	Y = L - 2040
111.8 < L ≤ 143.3	2840 < L ≤ 3640	3 pcs	Y = L - 111.8	Y = L - 2840
143.3 < L ≤ 174.8	3640 < L ≤ 4440	4 pcs	Y = L - 143.3	Y = L - 3640
174.8 < L ≤ 206.3	4440 < L ≤ 5240	5 pcs	Y = L - 174.8	Y = L - 4440
206.3 < L ≤ 237.8	5240 < L ≤ 6040	6 pcs	Y = L - 206.3	Y = L - 5240
237.8 < L ≤ 269.3	6040 < L ≤ 6840	7 pcs	Y = L - 237.8	Y = L - 6040
269.3 < L ≤ 300.8	6840 < L ≤ 7640	8 pcs	Y = L - 269.3	Y = L - 6840
300.8 < L ≤ 332.3	7640 < L ≤ 8440	9 pcs	Y = L - 300.8	Y = L - 7640
332.3 < L ≤ 363.8	8440 < L ≤ 9240	10 pcs	Y = L - 332.3	Y = L - 8440
363.8 < L ≤ 393.7	9240 < L ≤ 10000	11 pcs	Y = L - 363.8	Y = L - 9240

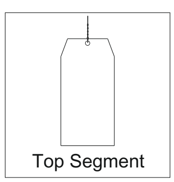
Assemble the segmented probe

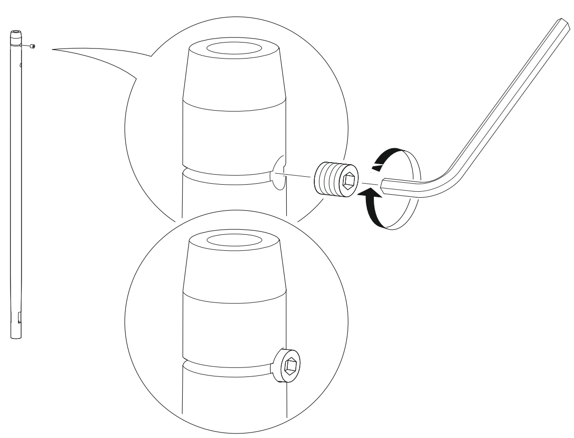
Prerequisites

Note
If there is enough space beside the tank, the probe can be assembled before inserting it into the tank.

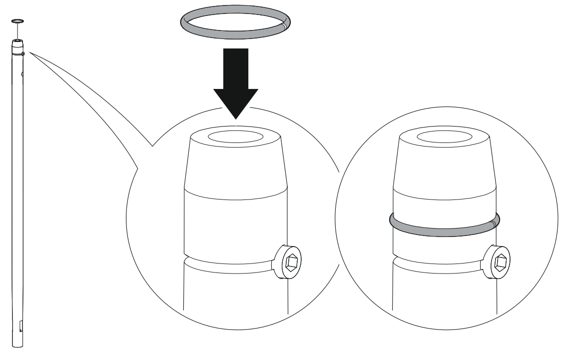
Procedure

1. Insert the stop screw to the top segment. Tighten approximately two turns.

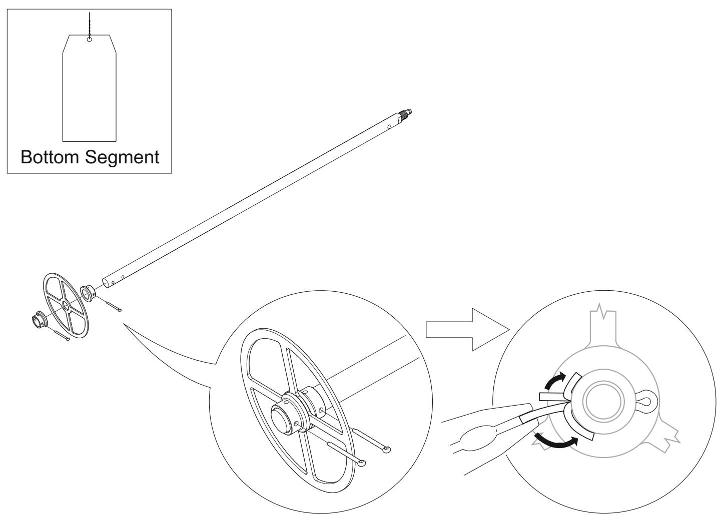




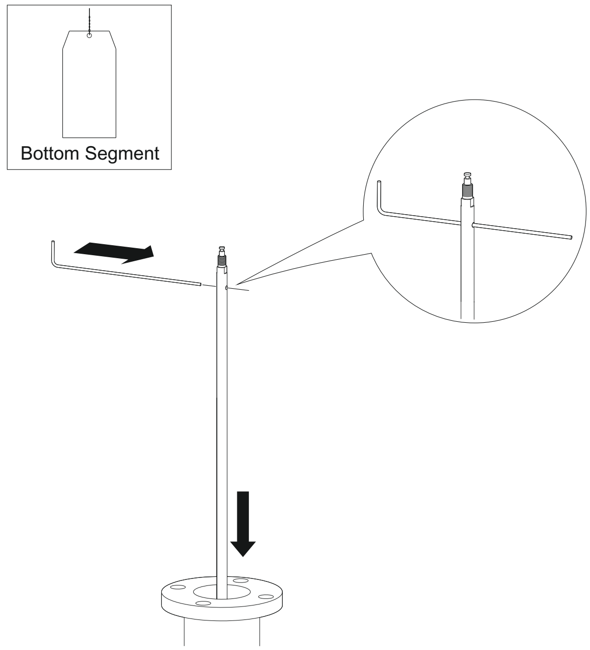
2. Pre-assemble the safety ring.



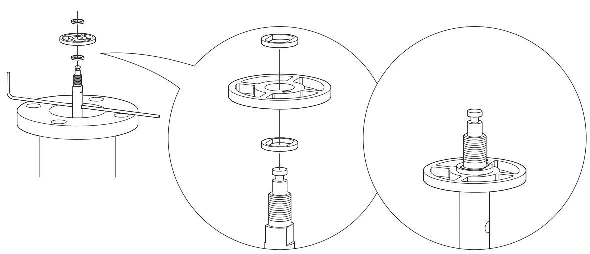
3. Optional: If ordered, mount the centering disc on the bottom segment of the probe.



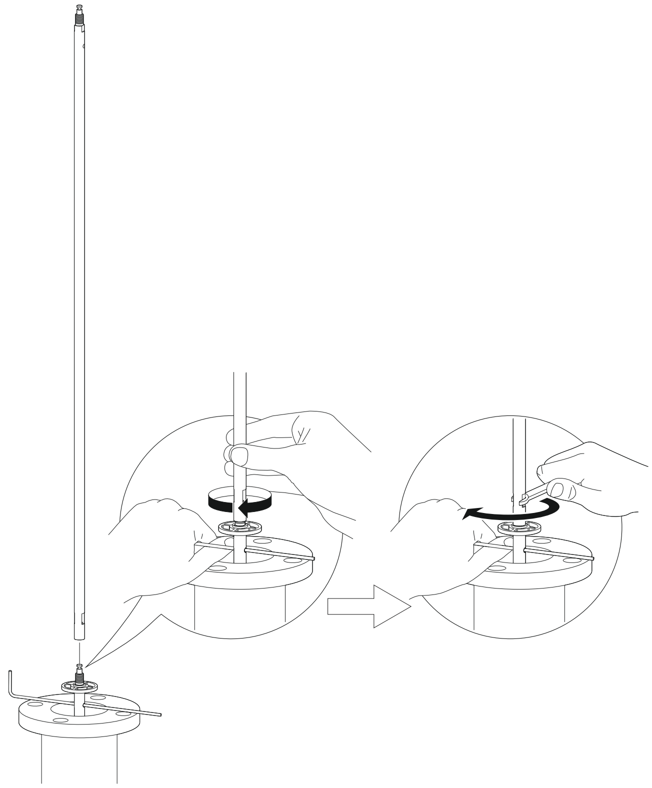
4. Insert the support tool.



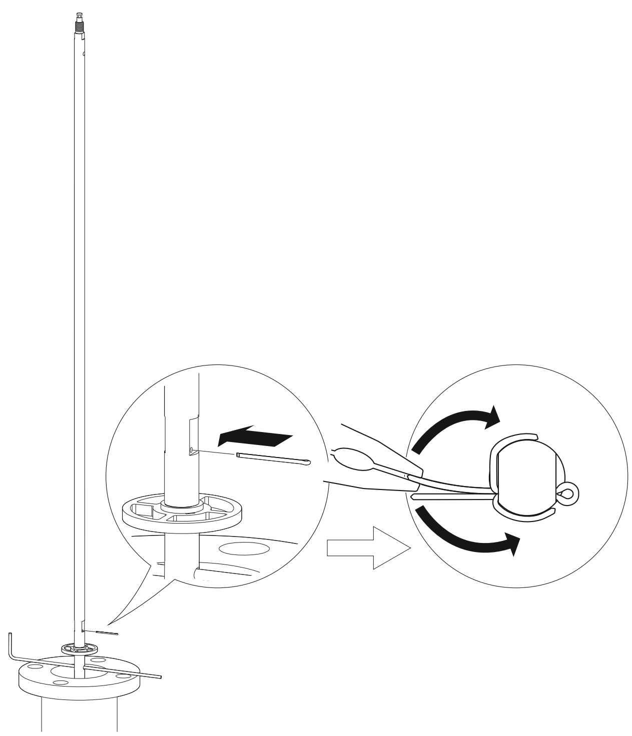
5. Optional: If ordered, mount the centering disc.
   - Maximum five pcs/probe
   - Minimum two segments between each centering disc



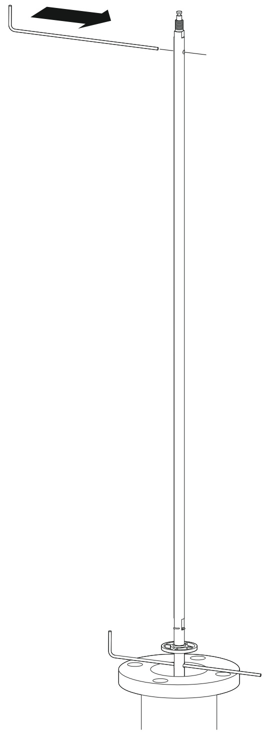
6. Mount a middle segment (hand tight).



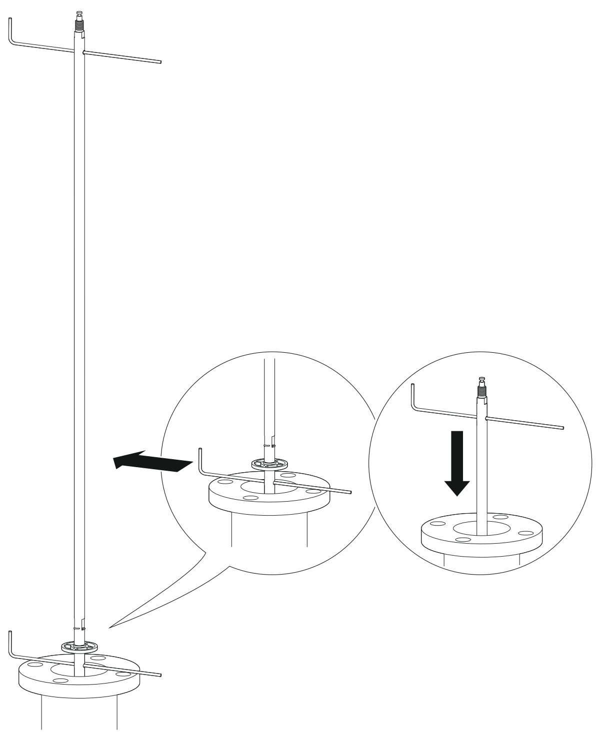
7. Secure the split pin.



8. Insert the second support tool.



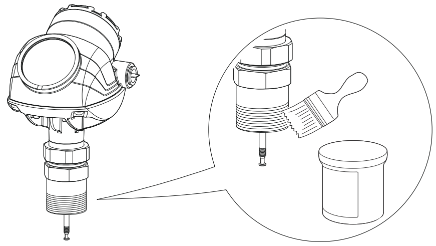
9. Remove the first support tool and lower the probe into the tank.



10. Repeat Step 5-Step 9 until all segments are mounted. Be sure to finish with the top segment of the probe.

11. Seal and protect threads. Use anti-seize paste or PTFE tape according to your site procedures.

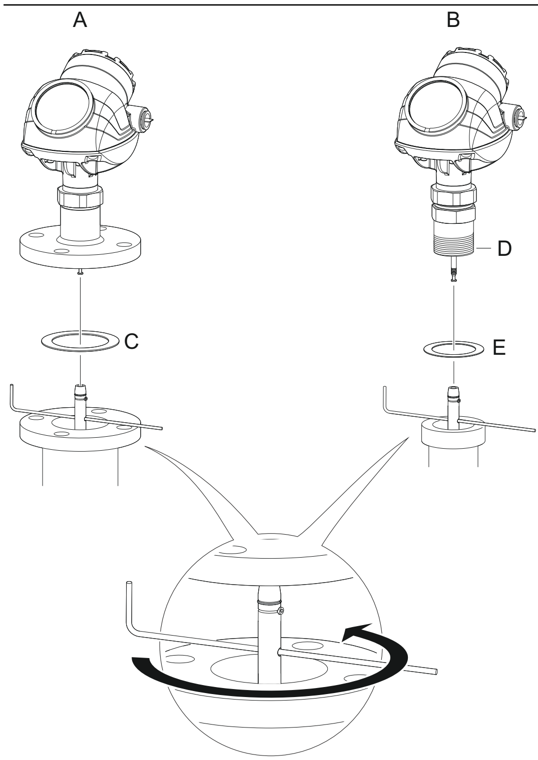
    ⚠ Only for NPT threaded tank connection.



12. Attach the probe to the device.

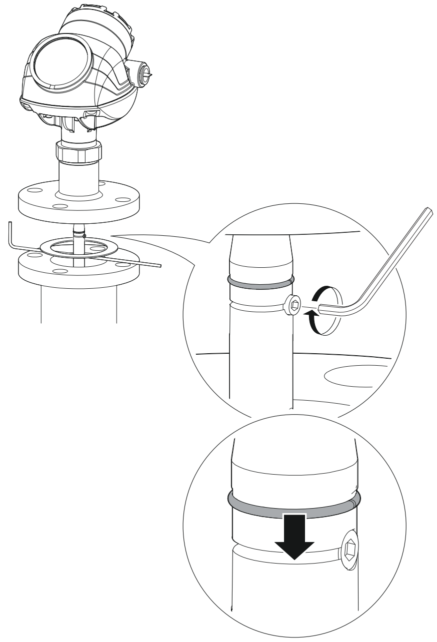
Note

For safety reasons, at least two people are needed when mounting the device. Hold the device above the tank. High loads can break the support tool.

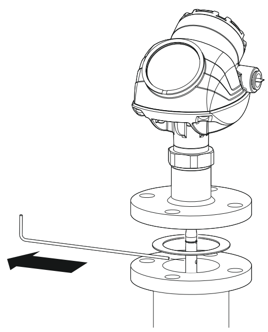


A. Flange/Tri Clamp
B. Threaded
C. Gasket
D. Sealant on threads (NPT)
E. Gasket (BSPP (G))

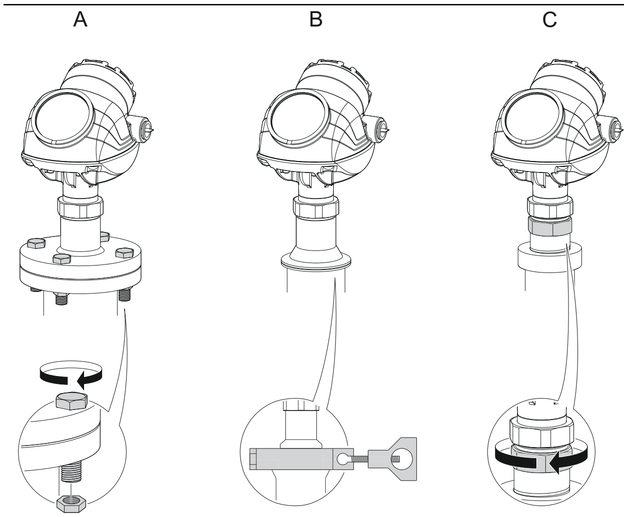
13. Tighten the stop screw and slide the safety ring into the groove.



14. Remove the support tool.

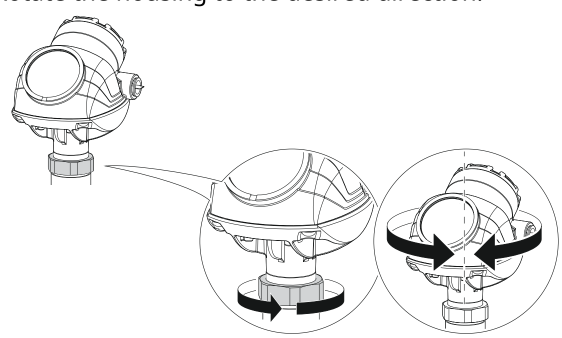


15. Mount the device on the tank.

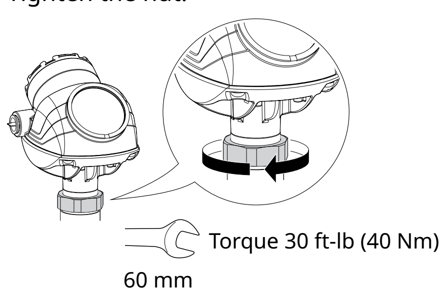


A. Flange
B. Tri Clamp
C. Threaded

16. Rotate the housing to the desired direction.



17. Tighten the nut.



3.6 Anchor the probe

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.

Flexible single/twin lead probe

The flexible single lead probe itself can be used for anchoring. Pull the probe rope through a suitable anchoring point (e.g. a welded eye), and fasten it with a chuck.

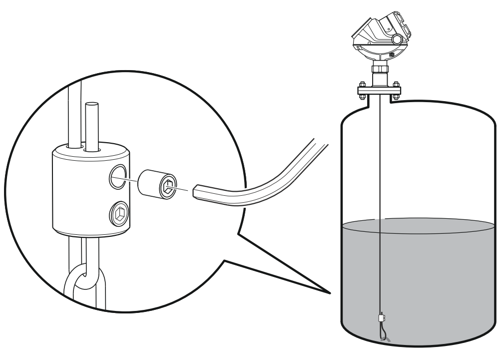
Table 3-15: Required Torque and Hex Key Dimensions

Probe		Required torque	Hex key dimension
Flexible twin lead		4.4 ft-lb (6 Nm)	4 mm
Flexible single lead	4 mm wire, stainless steel	3.7 ft-lb (5 Nm)	4 mm
	4 mm wire, Alloy C-276	1.8 ft-lb (2.5 Nm)	3 mm
	4 mm wire, Alloy 400	1.8 ft-lb (2.5 Nm)	3 mm
	4 mm wire, Duplex 2205	1.8 ft-lb (2.5 Nm)	3 mm
	6 mm wire	7.4 ft-lb (10 Nm)	5 mm

The length of the loop will add to the Blind Zone. The location of the chuck will determine the beginning of the Blind Zone.

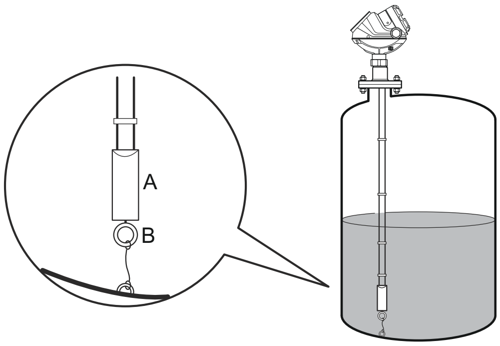
The Probe Length should be configured as the distance from the Upper Reference Point to the top of the chuck.

Figure 3-26: Flexible Single Lead Probe with Chuck



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.

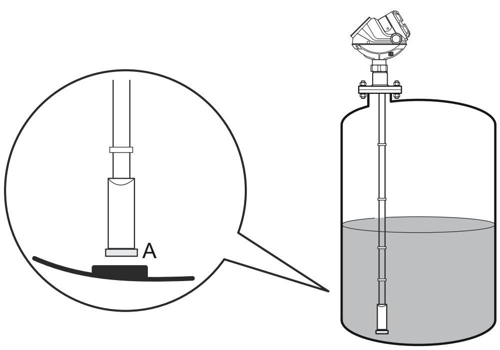
Figure 3-27: Flexible Twin/Single Lead Probe with Weight and Ring



A. *Weight with internal threads M8x14*
B. *Ring*

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.

Figure 3-28: Flexible Twin/Single Lead Probe with Weight and Magnet

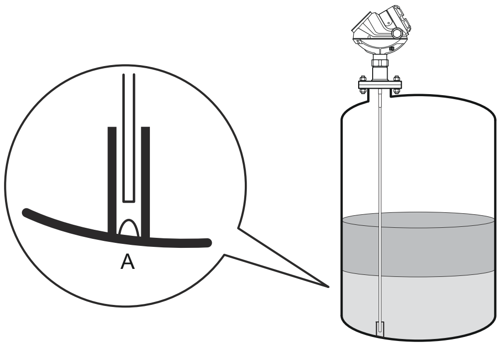


A. *Magnet*

Rigid single lead probe

The rigid single lead probe can be guided by a tube welded on the tank bottom. Tubes are customer supplied. Ensure that the probe can move freely in order to handle thermal expansion. The measurement accuracy will be reduced close to the tube opening.

Figure 3-29: Rigid Single Lead Probe with Tube

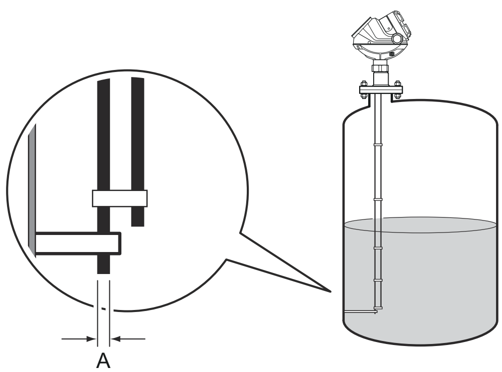


A. Drain

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. Ensure the probe is only guided and not fastened in the fixture to be able to move freely for thermal expansion.

Figure 3-30: Rigid Twin Lead Probe Secured to the Tank Wall

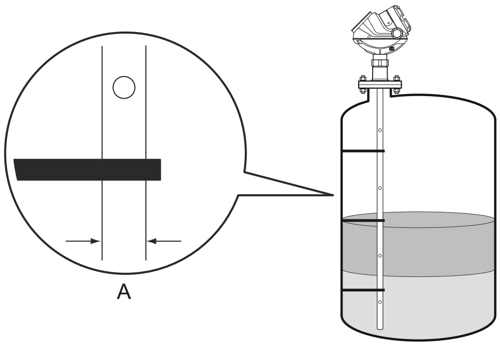


A. Ø 0.3 in. (8 mm)

Coaxial probe

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

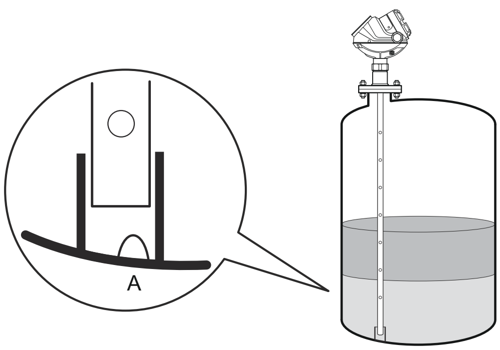
Figure 3-31: Coaxial Probe Secured to the Tank Wall



A. Coaxial: Ø 1.1 in. (28 mm), Large coaxial: Ø 1.7 in. (42 mm)

The coaxial probe can be guided by a tube welded on the tank bottom. Tubes are customer supplied. Ensure that the probe can move freely in order to handle thermal expansion. The measurement accuracy will be reduced close to the tube opening.

Figure 3-32: Coaxial Probe with Tube



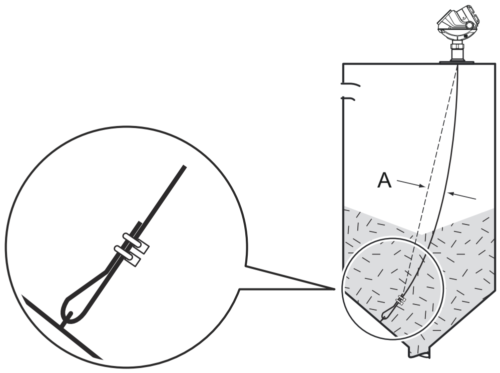
A. Drain

Solids applications

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

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

Figure 3-33: Flexible Single Lead Probe with Two Clamps



A. ≥ 10 mm/m

4 Electrical installation

4.1 Safety messages

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

⚠ WARNING

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

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

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

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

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure 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

Explosions could result in death or serious injury.

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

Before connecting a handheld communicator in an explosive atmosphere, be sure that 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

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

Avoid contact with the leads and terminals.

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

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.

4.2 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.

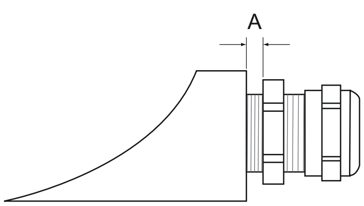
Make sure that unused ports are properly sealed to prevent moisture or other contamination from entering the terminal block compartment of the electronics housing.

Note
Use the enclosed metal plugs to seal unused ports. The plastic plugs mounted at delivery are not sufficient as seal!

Note
Thread sealing (PTFE) tape or paste on male threads of conduit is required to provide a water/dust tight conduit seal and to meet the required degree of ingress protection as well as to enable future removal of the plug/gland.

NPT is a standard for tapered threads. Engage the gland with 5 to 6 threads. Note that there will be a number of threads left outside the housing as illustrated in Figure 4-1.

Figure 4-1: Cable Entry with NPT Threaded Gland



A. The NPT threaded gland leaves a number of threads outside the housing

Ensure that glands for the cable entries meet requirements for IP class 66 and 67.

4.3 Grounding

Ensure grounding is done (including IS ground inside Terminal compartment) according to Hazardous Locations Certifications, national and local electrical codes.

Grounding is essential for Hazardous Location safety (even for Flameproof/Explosion Proof versions). A ground cable with a cross-sectional area of ≥ 4 mm^2 must be used.

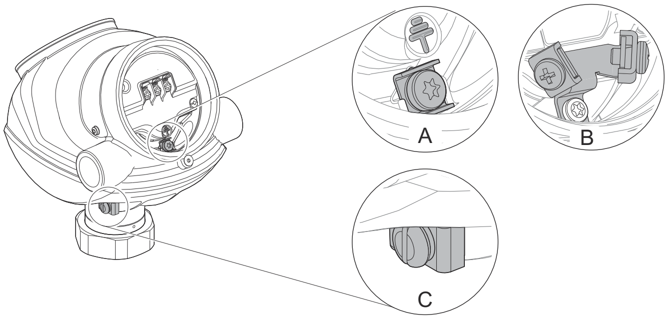
Note
Grounding the transmitter via threaded conduit connection may not provide sufficient ground.

Note
In the explosion-proof/flameproof version, the electronics is grounded via the transmitter housing. After installation and commissioning ensure that no ground currents exist due to high ground potential differences in the installation.

Transmitter housing grounding

The most effective transmitter housing grounding method is a direct connection to earth ground with minimal (< 1 Ω) impedance. There are two grounding screw connections provided (see Figure 4-2).

Figure 4-2: Ground Screws



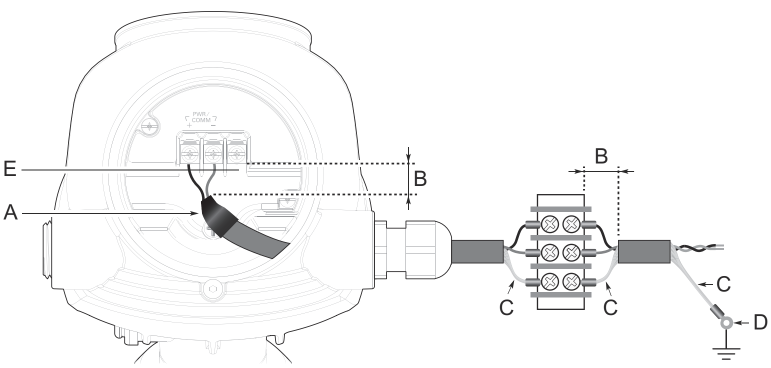
A. *Internal ground screw, torque 28 in-lb (3.2 Nm)*
B. *Internal ground twin-screws for Hazardous locations certifications CSA/Canada, torque 10 in-lb (1.2 Nm)*
C. *External ground screw, torque 36 in-lb (4.1 Nm)*

Signal cable shield grounding

Ensure the instrument cable shield is:

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

Figure 4-3: Cable Shield and Signal Wire Insulation



A. *Insulate shield*
B. *Minimize distance*
C. *Trim shield and insulate*
D. *Connect shield back to the power supply ground*
E. *Signal cable insulation must extend into the interior of each separate terminal*

4.3.1 Grounding - FOUNDATION™ Fieldbus

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

Shield wire ground

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

4.4 Cable selection

Use shielded twisted pair wiring for the Rosemount™ 5300 Level Transmitter 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 and the IECEx flameproof versions of the Rosemount 5300 Level Transmitter, suitable conduits with sealing device or flameproof Ex d) cable glands must be used depending on local requirements.

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

Note
Avoid running instrument cable next to power cables in cable trays or near heavy electrical equipment.

4.5 Hazardous areas

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

4.6 4-20 mA/HART® communication

4.6.1 Power requirements

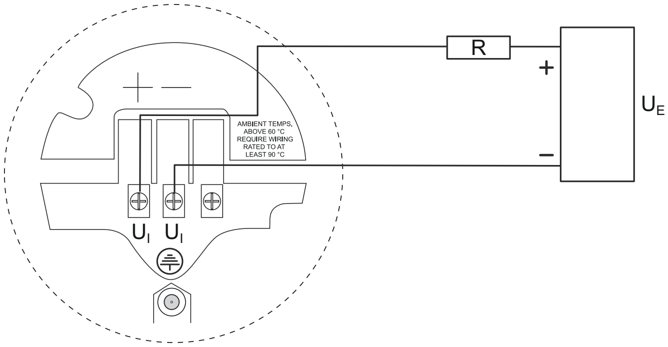
Terminals in the transmitter housing provide connections for signal cables. The Rosemount 5300 Level Transmitter is loop-powered and operates with the following power supplies:

Table 4-1: External Power Supply for HART

Approval type	Input voltage (U_i)(1)
None	16 - 42.4 Vdc
Non-sparking/Energy Limited	16 - 42.4 Vdc
Intrinsically Safe	16 - 30 Vdc
Explosion-proof/Flameproof	20 - 42.4 Vdc

(1) *Reverse polarity protection.*

Figure 4-4: External Power Supply for HART



R = Load Resistance (Ω)

U_E = External Power Supply Voltage (Vdc)

U_i = Input Voltage (Vdc)

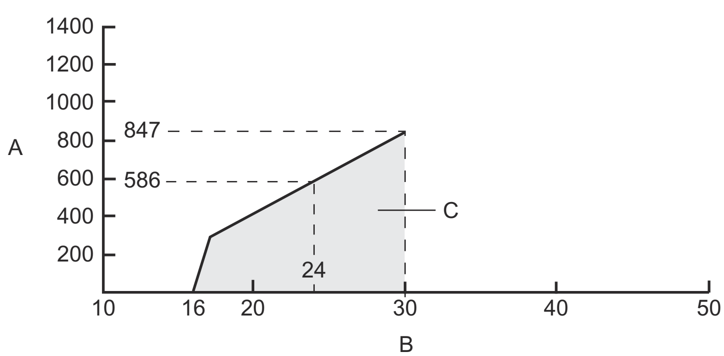
Table 4-2: Minimum Input Voltage (U_i) at Different Currents

Hazardous approval	Current	
	3.75 mA	21.75 mA
	Minimum input voltage (U_i)	
Non-hazardous installations, intrinsically safe installations and Non-sparking installations	16 Vdc	11 Vdc
Explosion-proof/flameproof installations	20 Vdc	15.5 Vdc

4.6.2 Load limitations

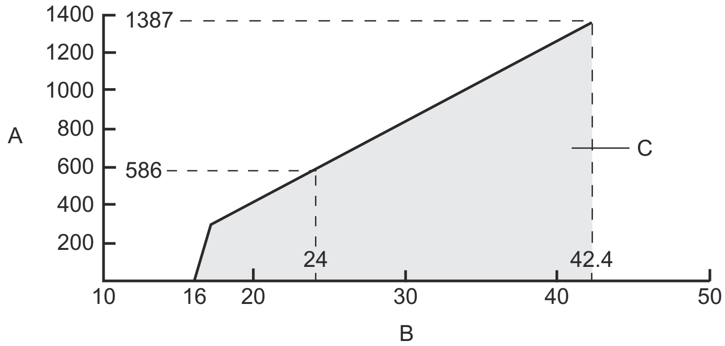
For HART® communication, a minimum loop resistance of 250 Ω is required. Maximum loop resistance is determined by the voltage level of the external power supply, as given by the following diagrams:

Figure 4-5: Intrinsically Safe Installations



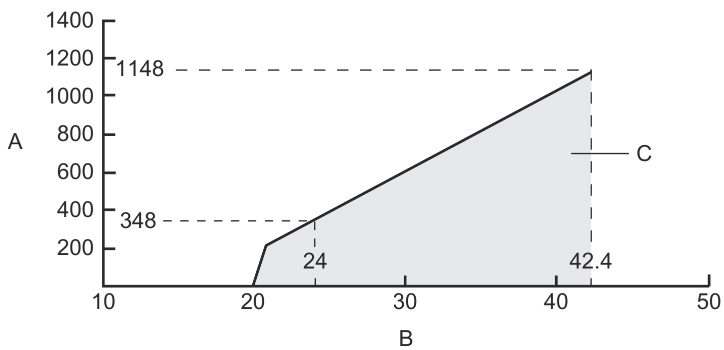
A. Loop Resistance (Ohms)
B. External Power Supply Voltage (Vdc)
C. Operating region

Figure 4-6: Non-Hazardous and Non-Sparking/Energy Limited Installations



A. Loop Resistance (Ohms)
B. External Power Supply Voltage (Vdc)
C. Operating region

Figure 4-7: Explosion-Proof/Flameproof (Ex d) Installations



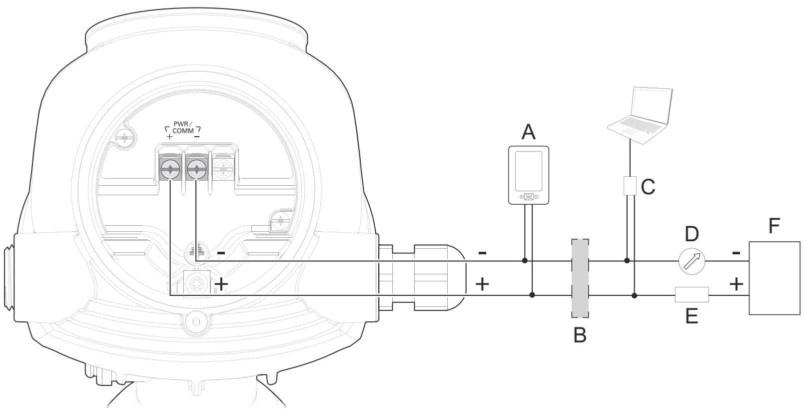
A. Loop Resistance (Ohms)
B. External Power Supply Voltage (Vdc)
C. Operating region

Note

For the Ex d case, the diagram is only valid if the load resistance is at the + side and if the - side is grounded, otherwise the maximum load resistance is limited to 435 Ω.

4.6.3 Wiring diagram

Figure 4-8: Wiring Diagram for 4-20 mA/HART®



A. *Handheld communicator*
B. *Approved IS barrier (for Intrinsically Safe installations only)*
C. *HART modem*
D. *Current meter*
E. *Load resistance (≥250 Ω)*
F. *Power supply*

Note
Rosemount 5300 Level Transmitters with flameproof/explosion-proof output have a built-in barrier; no external barrier needed.

For flameproof/explosion-proof applications the resistance between the negative terminal on the transmitter and the power supply must not exceed 435 Ω.

Note
For flameproof/explosion-proof installations, ensure the transmitter is grounded to the internal ground terminal inside the terminal compartment in accordance with national and local electrical codes.

Note
For intrinsically safe installations, ensure the instruments in the loop are installed in accordance with intrinsically safe field wiring practices and system control drawings when applicable.

4.7 HART® to Modbus® converter (HMC)

4.7.1 External power supply

The input voltage U_i for Modbus is 8-30 Vdc (max. rating).

4.7.2 Signal wiring

For the RS-485 bus, use shielded twisted pair wiring, preferably with an impedance of 120 Ω (typically 24 AWG) in order to comply with the EIA-485 standard and EMC regulations. The maximum cable length is 4000 ft./1200 m.

4.7.3 Power supply cabling

The power supply cables must be suitable for the supply voltage and ambient temperature, and approved for use in hazardous areas, where applicable.

4.7.4 Ground (common mode) voltage limit

± 7 V

4.7.5 Bus termination

Standard RS-485 bus termination per EIA-485

4.7.6 Connection terminals

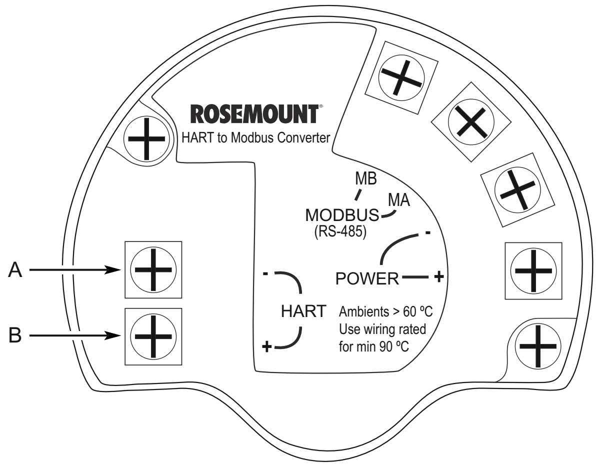
The connection terminals are described in Table 4-3.

Table 4-3: Connection Terminals

Connector label	Description	Comment
HART +	Positive HART connector	Connect to PC with Rosemount Radar Master software, handheld communicator, or other HART configurators.
HART -	Negative HART connector	
MA	Modbus RS-485 B connection (RX/TX+)[1]	Connect to RTU
MB	Modbus RS-485 A connection (RX/TX-)[1]	
POWER +	Positive power input terminal	Apply +8 Vdc to +30 Vdc (max. rating)
POWER -	Negative power input terminal	

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

Figure 4-9: Connection Terminals for Rosemount 5300 with HART to Modbus Converter



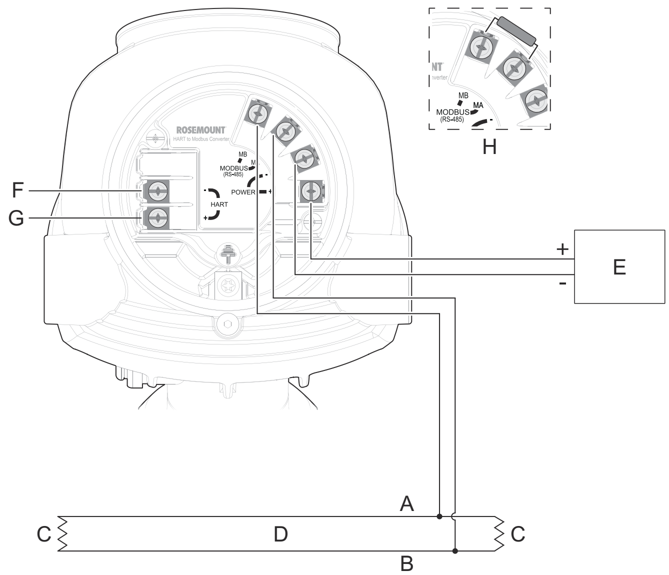
A. HART -
B. HART +

4.7.7 RS-485 bus

- The Rosemount 5300 Level Transmitter does not provide electrical isolation between the RS-485 bus and the transmitter power supply.
- Maintain a bus topology and minimize stub length.
- The RS-485 bus needs to be terminated once at each end, but should not be terminated elsewhere on the bus.

4.7.8 Wiring diagram

Figure 4-10: Wiring Diagram for RS-485 with Modbus®



A. *"A" line*
B. *"B" line*
C. *120 Ω*
D. *RS-485 Bus*
E. *Power supply*
F. *HART -*
G. *HART +*
H. *If it is the last transmitter on the bus, connect the 120 Ω termination resistor.*

Note
Rosemount 5300 Level Transmitters with Flameproof/Explosion-proof output have a built-in barrier; no external barrier needed.(3)

4.7.9 Installation cases

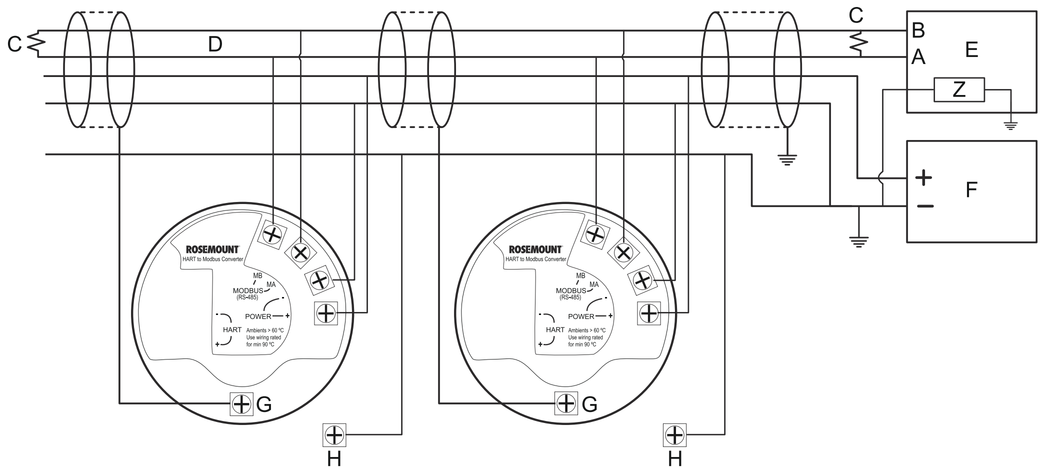
- Use common ground for Modbus Master and power supply.
- The power cables and RS-485 bus are in the same cable installation.
- A ground cable is installed and shall be used (cable size > 4 mm according to IEC60079-14, or size according to applicable national regulations and standards). A properly installed threaded conduit connection may provide sufficient ground.
- The cable shielding is grounded at master site (optional).

Note
⚠ The HART to Modbus Converter (HMC) equipped transmitter contains intrinsically safe circuits that require the housing to be grounded in accordance with national and local electrical codes. Failure to do so may impair the protection provided by the equipment.

(3) *An external galvanic isolator is always recommended to be used for Flameproof/Explosion-proof installations.*

Install the Rosemount 5300 Level Transmitter as shown in Figure 4-11. Up to 32 devices may be wired on one RS-485 bus using a multidrop wiring topology.

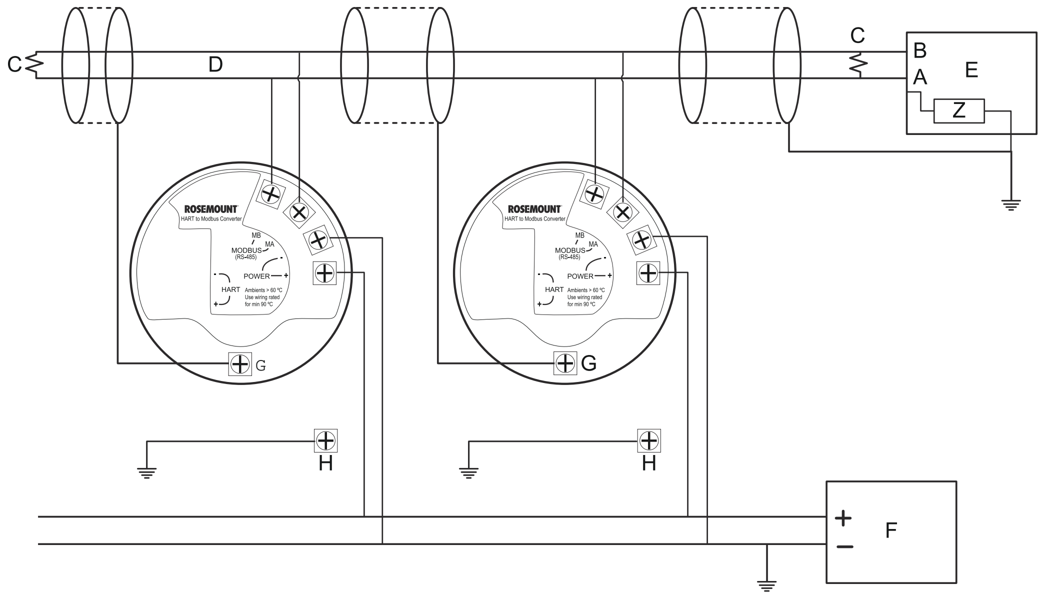
Figure 4-11: Multidrop Connection of Rosemount 5300 Level Transmitters



A. "A" line
B. "B" line
C. 120Ω
D. RS-485 bus
E. Modbus Master
F. Power supply
G. Internal ground screw
H. External ground screw

Alternatively, the Rosemount 5300 Level Transmitter can be installed as shown in Figure 4-12. If this wiring layout is used, there is an increased risk for communication disturbances due to differences in potential between grounding points. By using the same grounding point for Modbus Master and power supply, this risk is reduced.

Figure 4-12: Alternative Multidrop Connection of Rosemount 5300 Level Transmitters

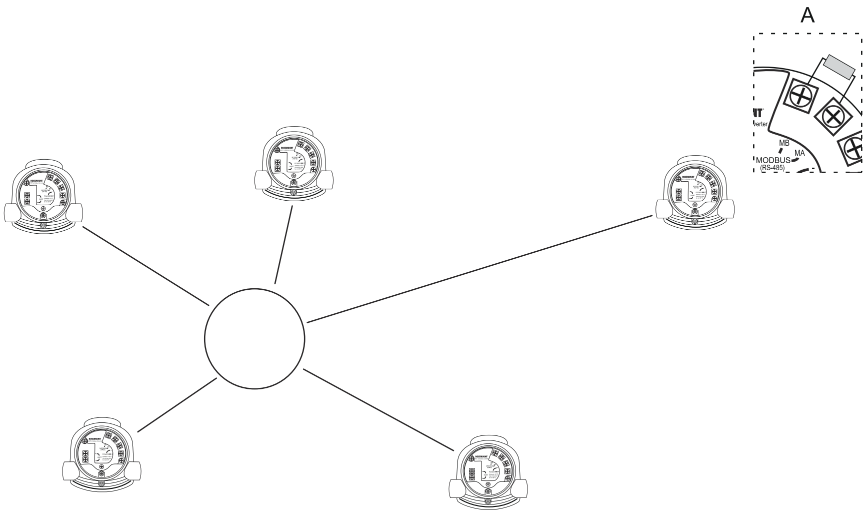


A. "A" line
B. "B" line
C. 120Ω
D. RS-485 bus
E. Modbus Master
F. Power supply
G. Internal ground screw
H. External ground screw

Star topology

For a star topology connection of the Rosemount 5300 Level Transmitter, the transmitter with the longest cable run needs to be fitted with a 120 Ω termination resistor.

Figure 4-13: Star Topology Connection of Rosemount 5300



A. 120 Ω termination resistor

4.7.10 External HART® devices (slaves)

The HART to Modbus® Converter (HMC) supports up to four external HART devices. The external devices are separated by using the HART address. The address must be different between the external devices and only addresses 1 to 5 are allowed for multiple slaves. Connect the devices one at a time and change the short address prior to connecting the next device by using a HART Configuration Tool such as Rosemount Radar Master, or a handheld communicator.

Note

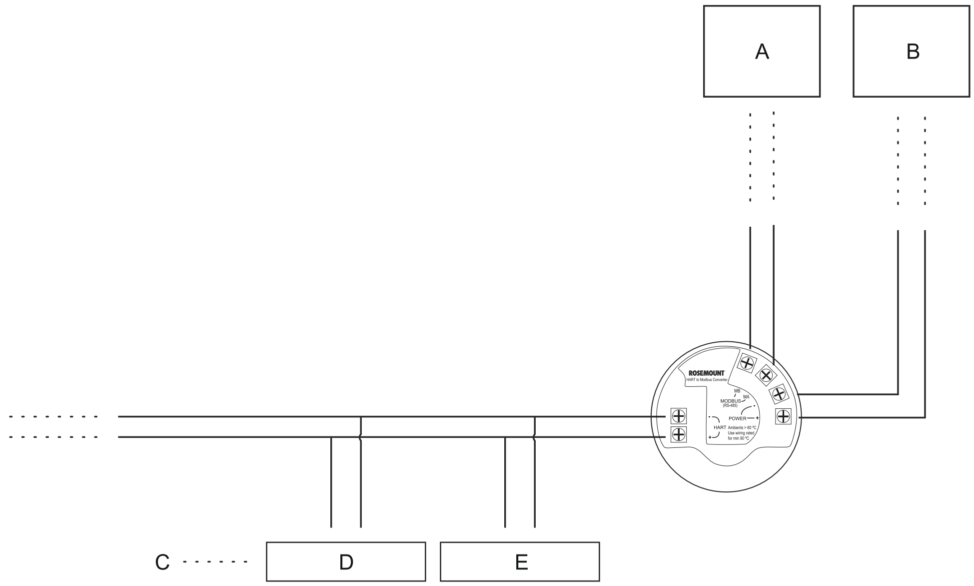
The power supply from the HMC to external HART devices is not intrinsically safe. In a hazardous environment, any external HART device connected to the HMC must have Flameproof/Explosion-proof certification.

The HMC cyclically polls the HART devices for measurement values. The update rate depends on the number of connected devices and is shown in Table 4-4.

Table 4-4: Approximate Update Rates for Measurement Values

Number of devices (slaves)	Approximate update rate
1	2 seconds
2	3 seconds
3	4 seconds
4	5 seconds
5	5 seconds

Figure 4-14: The HMC Module Supports up to Four External Devices (Slaves)



A. *RS-485 bus*
B. *Power supply*
C. *Up to four external devices*
D. *External HART device 2*
E. *External HART device 1*

4.8 FOUNDATION™ Fieldbus

4.8.1 Power requirements

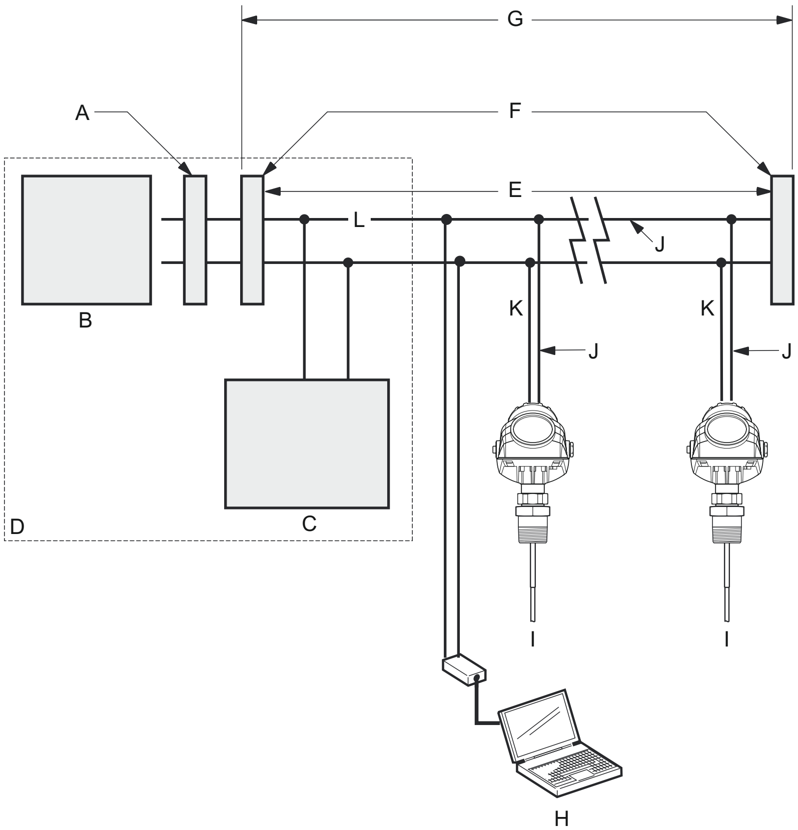
Terminals in the transmitter housing provide connections for signal cables. The Rosemount 5300 Level Transmitter is powered over FOUNDATION™ Fieldbus with standard fieldbus power supplies. The transmitter operates with the following power supplies:

Table 4-5: External Power Supply for FOUNDATION Fieldbus

Approval type	Power supply (Vdc)
None	9 - 32
Non-sparking/Energy limited	9 - 32
Intrinsically Safe	9 - 30
FISCO	9 - 17.5
Explosion-proof/flameproof	16 - 32

4.8.2 Connecting fieldbus devices

Figure 4-15: Rosemount 5300 Level Transmitter Field Wiring

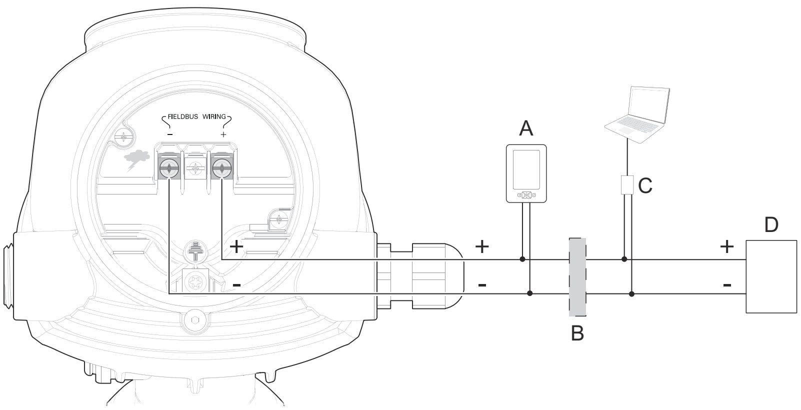


A. Integrated power conditioner and filter
B. Power supply
C. FOUNDATION™ Fieldbus configuration tool
D. (The power supply, filter, first terminator, and configuration tool are typically located in the control room.)
E. Fieldbus segment
F. Terminators
G. 6234 ft. (1900 m) maximum (depending upon cable characteristics)
H. Configuration with Rosemount Radar Master (in a fieldbus system hooked up on fieldbus segment)
I. Fieldbus devices on segment
J. Signal wiring
K. (Spur)
L. (Trunk)

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

4.8.3 Wiring diagram

Figure 4-16: Wiring Diagram for FOUNDATION Fieldbus



A. Handheld communicator
B. Approved IS barrier (for Intrinsically Safe installations only)
C. FOUNDATION Fieldbus modem
D. Power supply

Note
Rosemount 5300 Level Transmitters with flameproof/explosion-proof output have a built-in barrier; no external barrier needed.

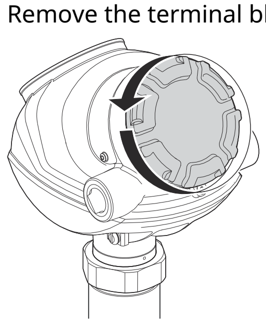
Note
For intrinsically safe installations, ensure the instruments in the loop are installed in accordance with intrinsically safe field wiring practices.

Note
For explosion-proof/flameproof installations, ensure the transmitter is grounded to the internal ground terminal inside the terminal compartment in accordance with national and local electrical codes.

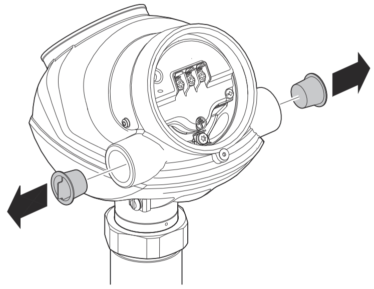
4.9 Connect wiring and power up

Procedure

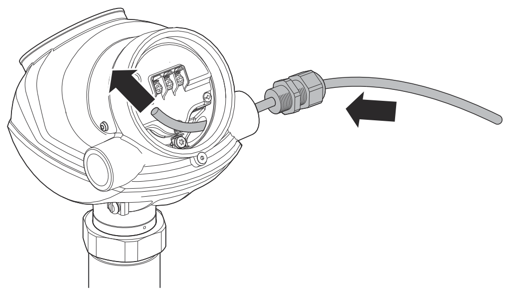
1. ⚠ Confirm the power supply is switched off.
2. Remove the terminal block cover.



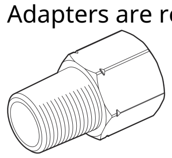
3. Remove the plastic plugs.



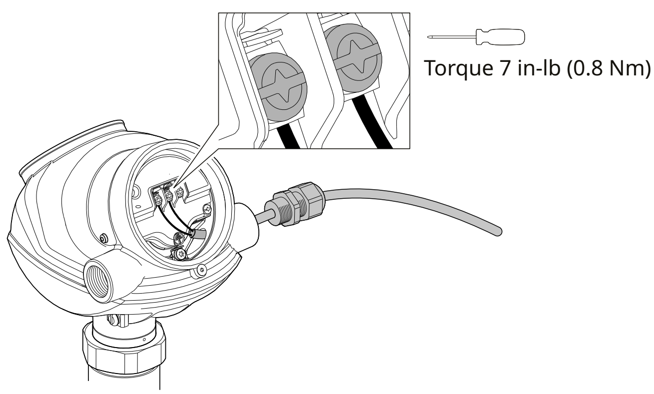
4. Pull the cable through the cable gland/conduit.



Adapters are required if M20 glands are used.



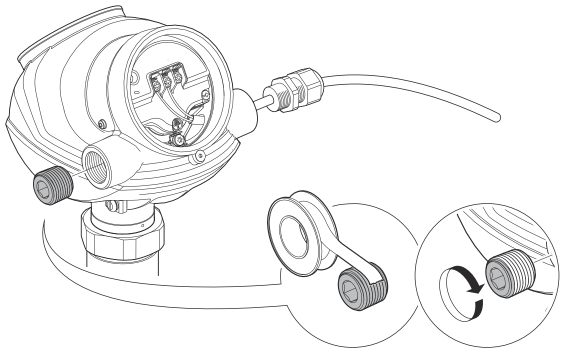
5. Connect the cable wires (see Figure 4-8, Figure 4-16, and Figure 4-10).



6. Ensure proper grounding.

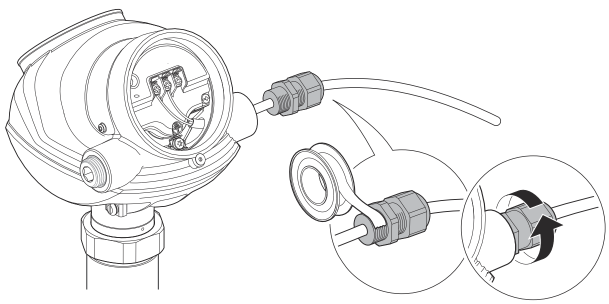
7. Use the enclosed metal plug to seal any unused port.

Note
Apply PTFE tape or other sealant to the threads.

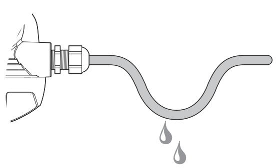


8. Tighten the cable gland.

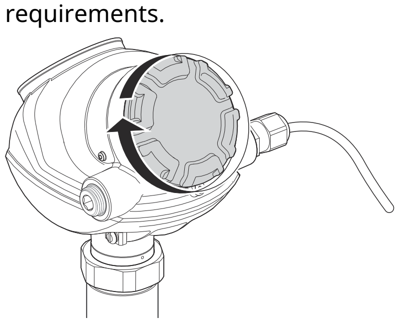
Note
Apply PTFE tape or other sealant to the threads.



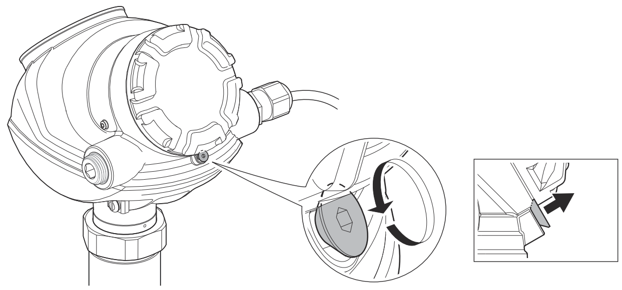
Note
Be sure to arrange the wiring with a drip loop.



9. ⚠ Mount the cover making sure the cover is secure to meet explosion-proof requirements.



10. Turn the jam screw counterclockwise until it contacts the cover.
    ⚠ Required for flameproof installations only.



11. Connect the power supply.

4.10 Optional devices

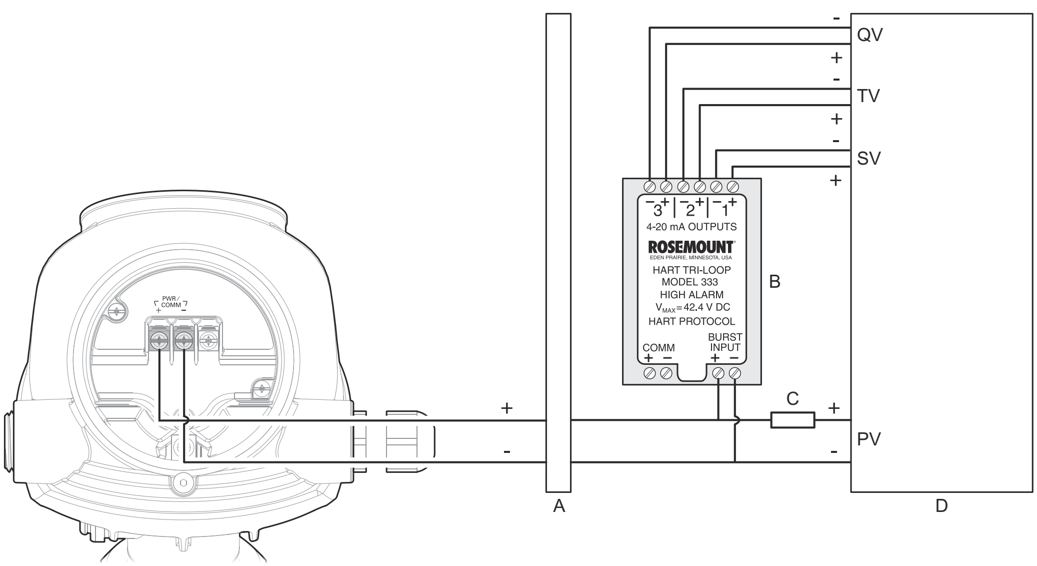
4.10.1 Rosemount™ 333 HART® Tri-Loop™

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

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

The transmitter receives power from control room.

Figure 4-17: Example Installation of Rosemount 333 with Rosemount 5300



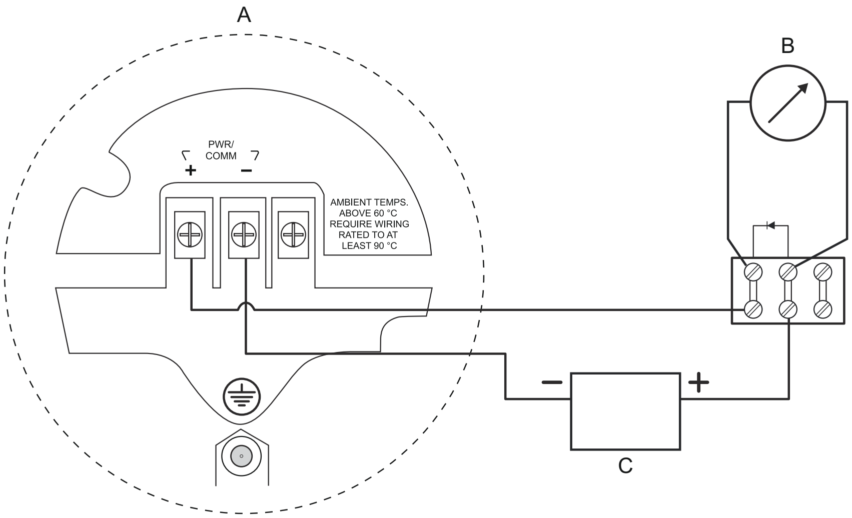
A. *Approved IS barrier*
B. *DIN rail mounted Rosemount 333*
C. *Load resistance (≥250 Ω)*
D. *Control room*

Related information

Rosemount 333 Reference Manual

4.10.2 Rosemount 751 Field Signal Indicator

Figure 4-18: Wiring Diagram for a Rosemount 5300 Transmitter with Rosemount 751 Field Signal Indicator



A. Rosemount 5300 Level Transmitter
B. Rosemount 751 Field Signal Indicator
C. Power supply

5 Configuration

5.1 Safety messages

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

⚠ WARNING

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

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

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

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

⚠ WARNING

Explosions could result in death or serious injury.

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

Before connecting a handheld communicator in an explosive atmosphere, be sure that 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.

5.2 Overview

The configuration of a Rosemount™ 5300 Level Transmitter is normally a simple and straightforward task. The complete configuration of a Rosemount 5300 Level Transmitter includes basic configuration, echo tuning, and advanced configuration. This section describes basic configuration.

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

It is highly recommended that prior to changing any parameters, save your current configuration as a backup file. If for any reason configuration data is lost or accidentally modified making the device inoperable, this backup file can be reloaded into the device.

5.2.1 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

5.2.2 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 Amplitude Threshold Curve (ATC) which lets you filter out single disturbing echoes. See Amplitude threshold curve for more information.

5.2.3 LCD configuration

It is possible to specify the variables to be presented on the display panel. See also Specify display panel variables.

5.2.4 Advanced configuration

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

5.2.5 Configuration tools

The transmitter can be configured using:

- Rosemount Radar Master (RRM). Note that RRM is recommended for advanced configuration features. See Basic configuration using Rosemount Radar Master for information on how to use RRM for configuration of the Rosemount 5300 Level Transmitter.
- Device Descriptor (DD) based systems, e.g. AMS Device Manager, 475 Field Communicator, AMS Trex™ Device Communicator, and DeltaV™, or any other EDDL or enhanced-EDDL host. See Basic configuration using AMS Device Manager and handheld communicator and Basic configuration using DeltaV (only for FOUNDATION™ Fieldbus), for information on how to use DDs for configuration of the Rosemount 5300 Level Transmitter.

  See Menu tree for AMS Device Manager and handheld communicator menu tree structure.

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

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

5.3 Host system integration

5.3.1 Confirm system readiness (HART® only)

Confirm HART® revision capability

If using HART based control or asset management systems, confirm the HART capability of those systems prior to transmitter installation. Not all systems are capable of communicating with HART Revision 7 protocol.

Transmitters with a firmware version 2F0 or later can be configured for either HART Revision 5 or 7.

Confirm correct device driver

Procedure

- Verify that the latest Device Driver (DD/DTM™) is loaded on your systems to ensure proper communication. See Table 5-1.
- Download the latest Device Driver from Emerson.com/DeviceInstallKits.

Table 5-1: Rosemount 5300 Device Revisions and Files

Firmware version(1)	Find Device Driver	
	HART® Universal Revision	Device Revision(2)
2F0 or later	7	4
	5	3
2A2 - 2E0	5	3

(1) *Firmware version is printed on the transmitter head label (e.g. SW 2E0), or can be found in Rosemount Radar Master (select **Device** → **Properties**).*
(2) *Device revision is printed on the transmitter head label (e.g. HART Dev Rev 4).*

Switch HART® revision mode

If the HART configuration tool is not capable of communicating with HART Revision 7, the device will load a generic menu with limited capability. To switch the HART revision mode from the generic menu:

Procedure

1. Locate the "Message" field.
2. In the Message field, enter **HART5** or **HART7** and then 27 trailing spaces.

5.3.2 Set alarm limits

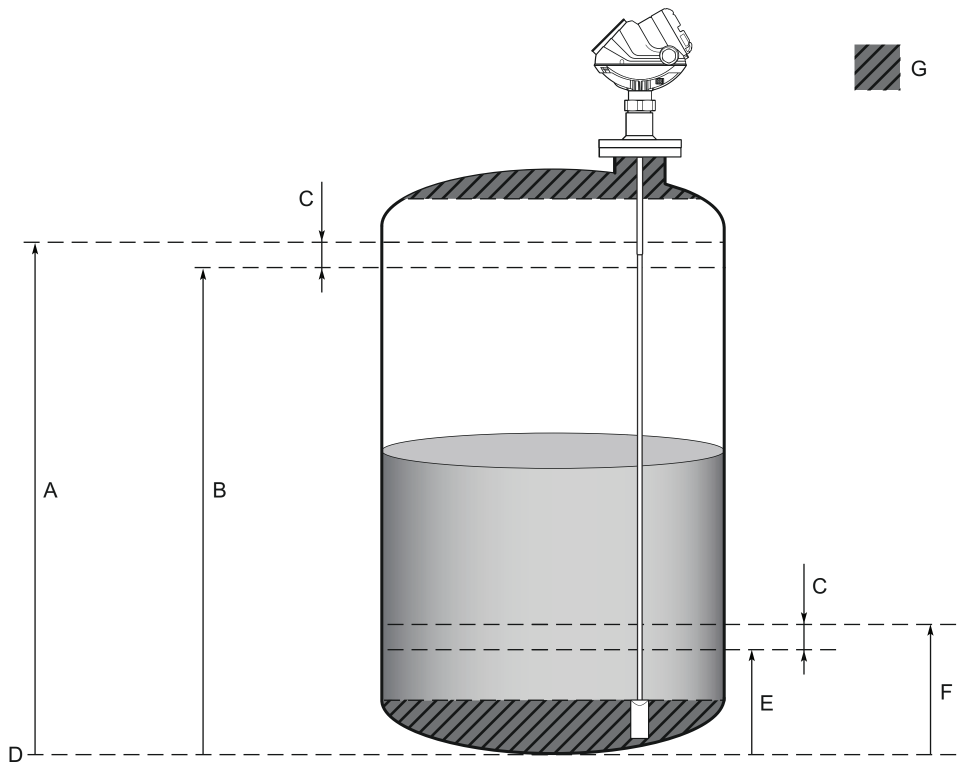
The alarm limits that are set in the host system need to be adjusted for the expected maximum product level rate and configured Damping Value.

When setting the high alarm limit, a safety margin (see Figure 5-1) should be subtracted from the desired high alarm limit. For the low alarm limit, the same safety margin should be added to the desired low alarm limit.

The safety margin ensures that the response time of the device is taken into account when specifying the alarm limits. See Table 5-2 or Table 5-3 (if Signal Quality Metrics is turned on) to determine the safety margin for your application.

Note
Alert limit values must be outside the Blind Zones and preferable outside areas with reduced accuracy.

Figure 5-1: Safety Margin for Alarm Limits



A. Desired high alarm limit
B. High alarm limit
C. Safety margin
D. Zero reference point
E. Desired low alarm limit
F. Low alarm limit
G. Blind Zones

Table 5-2: Safety Margin in Inches and Millimeters

Level rate in/min (mm/min)	Damping value			
	2 s (default)	**10 s**	**20 s**	**50 s**
Level Rate > 6.40 (160)	0.25 × Level Rate	0.60 × Level Rate	0.90 × Level Rate	1.90 × Level Rate
2.35 (60) < Level Rate < 6.40 (160)	0.50 × Level Rate	0.85 × Level Rate	1.15 × Level Rate	2.15 × Level Rate
1.05 (25) < Level Rate < 2.35 (60)	0.90 × Level Rate	1.25 × Level Rate	1.60 × Level Rate	2.60 × Level Rate
Level Rate < 1.05 (25)	1.75 × Level Rate	2.10 × Level Rate	2.40 × Level Rate	3.40 × Level Rate

Table 5-3: Safety Margin in Inches and Millimeters with Signal Quality Metrics Turned On

Level rate in/min (mm/min)	Damping value			
	2 s (default)	10 s	20 s	50 s
Level Rate > 6.40 (160)	0.40 × Level Rate	0.65 × Level Rate	1.00 × Level Rate	2.00 × Level Rate
2.35 (60) < Level Rate < 6.40 (160)	0.85 × Level Rate	1.10 × Level Rate	1.45 × Level Rate	2.45 × Level Rate
1.05 (25) < Level Rate < 2.35 (60)	1.55 × Level Rate	1.85 × Level Rate	2.15 × Level Rate	3.15 × Level Rate
Level Rate < 1.05 (25)	3.05 × Level Rate	3.30 × Level Rate	3.65 × Level Rate	4.65 × Level Rate

Procedure

1. Identify maximum product level rate for the application.
2. Note configured Damping Value.
   a) In Rosemount Radar Master, select **Setup** → **Advanced**.
   b) Select the **Echo Tracking** tab.
3. Calculate where to position the high alarm limit in your host system.
   a) Determine desired high alarm limit.
   b) Subtract safety margin from the desired high alarm limit according to Table 5-2 (or Table 5-3 if Signal Quality Metrics is turned on).
4. Calculate where to position the low alarm limit in your host system.
   a) Determine desired low alarm limit.
   b) Add safety margin to the desired low alarm limit according to Table 5-2 (or Table 5-3 if Signal Quality Metrics is turned on).

Determine high alarm limit

Maximum product level rate = 100 mm/min Damping Value = 10 s

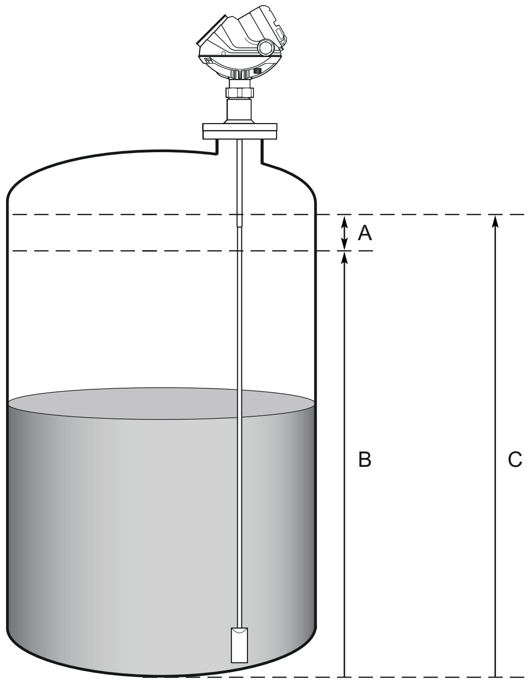
The Signal Quality Metrics is turned off in this example, so the safety margin is calculated using Table 5-2.

Safety margin = 0.85 × Level Rate = 0.85 × 100 = 85 mm

Desired high level alarm limit = 8500 mm

High alarm limit = Desired high alarm limit - Safety margin = 8500 - 85 = 8415 mm

Figure 5-2: Example - Determine High Alarm Limit



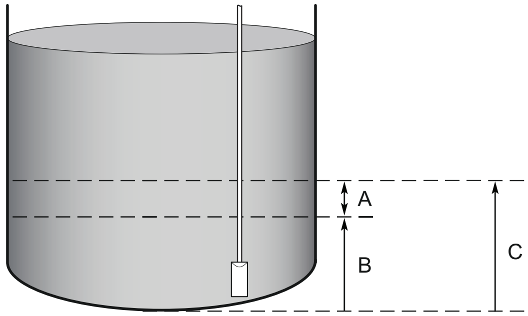
A. *Safety margin = 85 mm*
B. *High alarm limit = 8500 - 85 = 8415 mm*
C. *Desired high alarm limit = 8500 mm*

Determine low alarm limit

Desired low level alarm limit = 300 mm

Low alarm limit = Desired low alarm limit + Safety margin = 300 + 85 = 385 mm

Figure 5-3: Example - Determine Low Alarm Limit



A. *Safety margin = 85 mm*
B. *Desired low alarm limit = 300 mm*
C. *Low alarm limit = 300 + 85 = 385 mm*

5.4 Establish HART® communication for transmitter with HART to Modbus® Converter

Configuration is done by sending HART commands through the HART to Modbus Converter (HMC) to the 5300 Level Transmitter electronics. To establish HART communication, connect to the MA/MB terminals, or to the HART terminals.

5.4.1 Connect to the MA/MB terminals

The Rosemount 5300 Level Transmitter can be configured with Rosemount Radar Master using the MA, MB terminals.

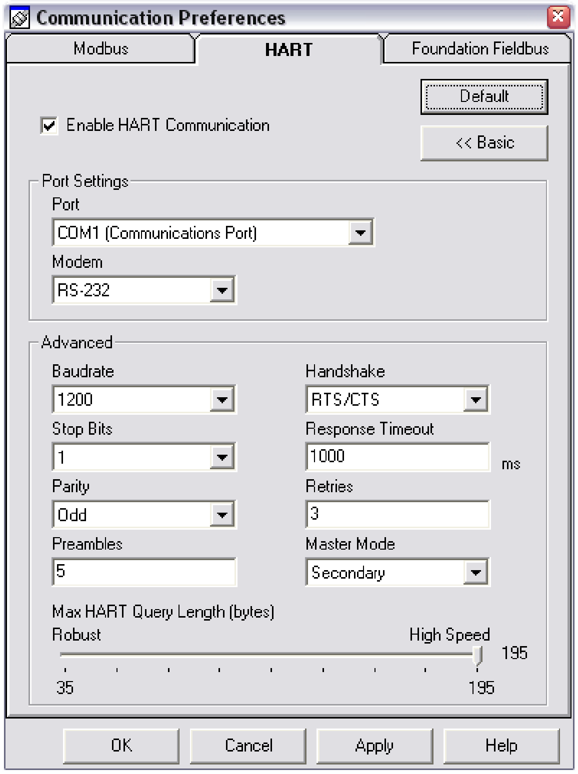
Prerequisites

An RS-485 Converter is required to connect to the transmitter.

Procedure

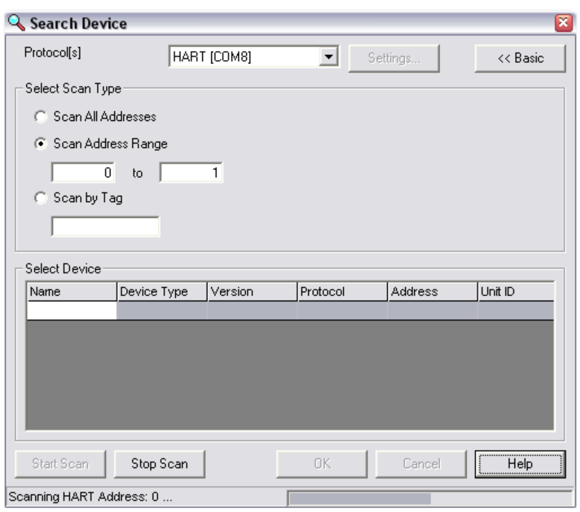
1. Connect the RS-485 Converter to the MA, MB connectors.
2. Start Rosemount Radar Master.
3. Enable HART communication and set communication preferences.
    a) Select **View** → **Communication Preferences**.
    b) Select the **HART** tab.
    c) Select the **Enable HART Communication** checkbox.
    d) In the ***Port*** list, select the COM port number that the RS-485 Converter is connected to.

e) Select **Advanced** and use the following settings:



f) Select **OK**.

4. Connect the power wires (or cycle power) to the transmitter.
5. Wait 20 seconds, and then search for and connect to device.
   a) Select **Device** → **Search**.
   b) Ensure HART address 1 is being scanned.



   c) Select **Start Scan**.
      After a while the ***Search Device*** window presents a list of found transmitters.

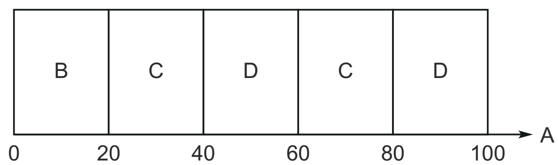
   d) Select the device from the list and select **OK** to connect.

6. After completing the configuration, disconnect the RS-485 Converter, connect the Modbus communication wires and cycle power to the transmitter.
7. Verify communication between the transmitter and the RTU is established (can take up to 60 seconds from startup).

RS-485 communication after startup

The transmitter will try to establish communication using different protocols during 20 second time-slots from time of startup.

Figure 5-4: RS-485 Communication after Startup



A. Time (s)
B. Modbus RTU
C. HART
D. Configured protocol (Modbus RTU, Levelmaster, or Modbus ASCII)

The transmitter will continue to use a communication protocol once communication has been established.

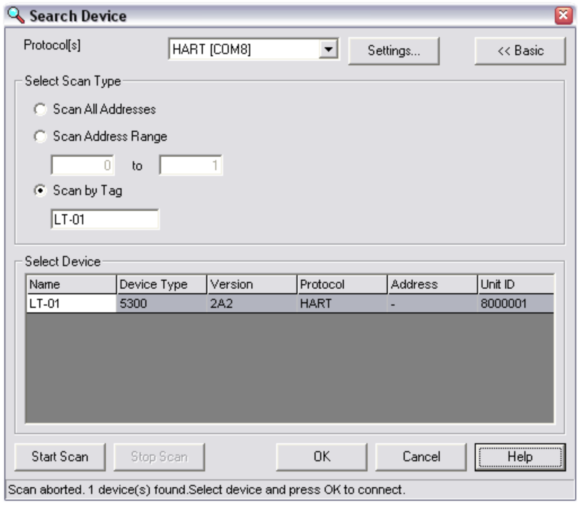
Establish communication when multiple 5300/5400 Modbus units are on the bus

By default, the transmitters have HART address 1. It will not be possible to establish communication on HART address 1 if several transmitters have the same address. In this case, there are alternative solutions to establish communication:

Procedure

1. Select **Device** → **Search**.
2. In the *Search Device* window, select **Scan by Tag**.

3. Enter the HART Device Tag of the transmitter. Communication can now be established with an individual transmitter even if several devices have the same HART address.



4. Ensure the Rosemount 5300 is alone on bus. Disconnect or turn off power from any other devices.

5.4.2 Connect to the HART terminals

To configure the Rosemount 5300 Level Transmitter, connect the communicator or PC to the HART terminals using a HART modem. Both the configuration tool and the RS-485 bus can be connected simultaneously. Configuration data is sent with HART commands through the HART to Modbus Converter (HMC) to the Rosemount 5300 Level Transmitter electronics. Note that the power supply must be connected during configuration.

Note
Measurement data is not updated to the Modbus Master when a configuration tool is connected.

Related information

Connection terminals

5.5 Change Modbus communication parameters

5.5.1 Change Modbus communication parameters using Rosemount Radar Master

To change the Modbus address and communication parameters in Rosemount Radar Master:

Prerequisites

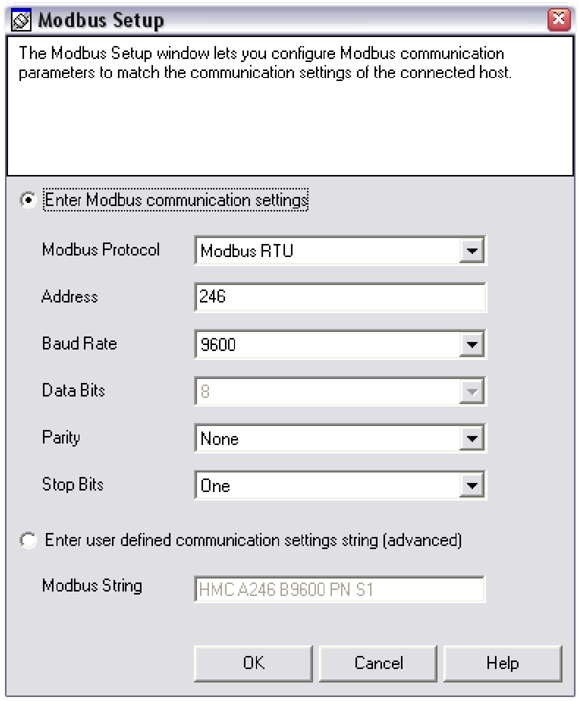
To change Modbus communication parameters, the Rosemount 5300 Level Transmitter must use HART address 1, the default address.

Procedure

1. Start Rosemount Radar Master and connect to the transmitter.

2. Select **Setup** → **General**.
3. Select the **Communication** tab.
4. Select **Modbus Setup**.
5. In the ***Modbus Setup*** window, select **Enter Modbus communication settings**.

   It is also possible to enter a user-defined Modbus message in the ***Modbus String*** area.



6. Select Modbus protocol and type the desired Modbus address.
7. Enter the baud rate, parity, and stop bits, then select **OK**.

Postrequisites

After changing communication parameters, disconnect the HART modem and wait at least 60 seconds for the change to take effect. In case the MA/MB terminals are used for connection to the HART to Modbus Converter (HMC), disconnect the RS-485 Converter, cycle power to the transmitter and wait up to 60 seconds for the change to take effect.

5.5.2 Change Modbus communication parameters using a handheld communicator

The Modbus communication parameters can be changed by entering a text string in the HART Message parameter.

Prerequisites

To change Modbus communication parameters, the Rosemount 5300 must use HART address 1, the default address.

Procedure

1. Select: **Overview** → **Device Information** → **Identification**.
2. Enter desired string into the **Message** area.

Postrequisites

After changing communication parameters, disconnect the handheld communicator and wait up to 60 seconds for the change to take effect.

5.6 Basic configuration using Rosemount Radar Master

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

- Guided Setup if you are unfamiliar with the Rosemount 5300 Level Transmitter (see Guided setup).
- Setup functions if you are already familiar with the configuration process or for changes to the current settings (Using the setup functions).

5.6.1 System requirements

Hardware

	Minimum	Recommended
Processor	Pentium 200 MHz	Pentium 1 GHz
Memory	64 MB RAM	128 MB RAM
Graphical card	Screen resolution of 800 x 600	Screen resolution of 1024 x 768
COM Port	1 serial COM port or 1 USB port	
Hard drive space	100 MB	

Software

Operating systems supported:

- Windows 2000 - Service pack 3
- Windows XP - Service pack 2 and Service pack 3
- Windows 7 - 32-bit and 64-bit versions

5.6.2 Help in RRM

To open the Help window:

Procedure

Select **Help** → **Contents**.
Help is also available from a Help button in most windows.

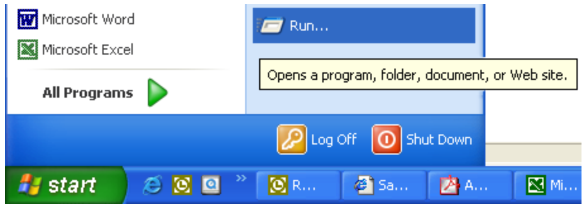
5.6.3 Installing the RRM software for HART® communication

To install the Rosemount Radar Master:

Procedure

1. Insert the installation CD into your CD-ROM drive.

2. If the installation program is not automatically started, choose **Run** from the Windows Start bar.

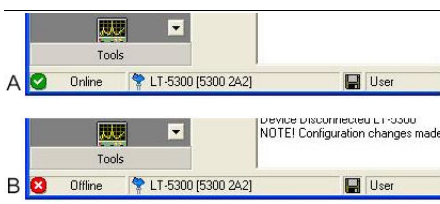


3. Type `D:\RRM\Setup.exe`, where D is the CD-ROM drive.
4. Follow the instructions on the screen.
5. Confirm that HART is chosen as default protocol.
6. For Windows 2000/XP/7, set COM port buffers to 1, see Set the COM port buffers.

Getting started

Procedure

1. Click the **Start** button, and then select **All Programs** → **Rosemount** → **Rosemount Radar Master** or click the RRM icon in the Windows workspace.
2. If the *Search Device* window did not appear automatically, then select **Device** → **Search**.
3. In the *Search Device* window, choose communication protocol HART.
4. If you want to specify start and stop address, then select **Advanced**.
5. Click the **Start Scan** button. Now RRM searches for the transmitter.
   After a while the *Search Device* window presents a list of found transmitters.
6. Select the desired transmitter and select **OK** to connect.
7. If communication does not work, check that the correct COM port is connected to the computer and that the COM port is properly configured, see Specify the COM port. You may also check in the *Communication Preferences* window that HART communication is enabled.
8. In the RRM Status Bar, verify that RRM communicates with the transmitter.



A. RRM communicates with the transmitter
B. No communication with the transmitter

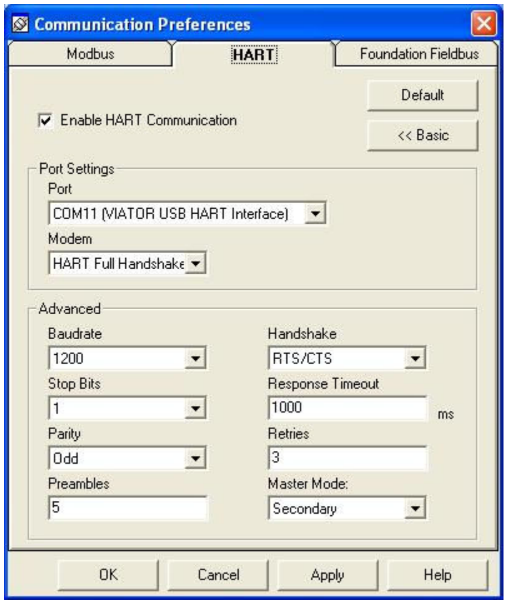
5.6.4 Specify the COM port

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

Procedure

1. In RRM, select **View** → **Communication Preferences**.

2. Select the **HART** tab.



3. Select the **Enable HART Communication** checkbox.
4. Check which COM port the modem is connected to.
5. Choose the COM port option that matches the actual COM port on the PC that the transmitter is connected to.

5.6.5 Set the COM port buffers

For Windows 2000/XP/7 the COM port Receive Buffer and Transmit Buffer need to be set to 1. To set the COM port buffers:

Procedure

1. In the MS Windows Control Panel, open the **System** option.
2. Select the **Hardware** tab, and then select **Device Manager**.
3. Expand the **Ports** node in the tree view.
4. Righ-click the selected COM port and select **Properties**.
5. Select the **Port Settings** tab, and then select **Advanced**.
6. Drag the **Receive Buffer** slider to 1.
7. Drag the **Transmit Buffer** slider to 1.
8. Select **OK**.
9. Restart the computer.

5.6.6 Installing the RRM software for FOUNDATION™ Fieldbus

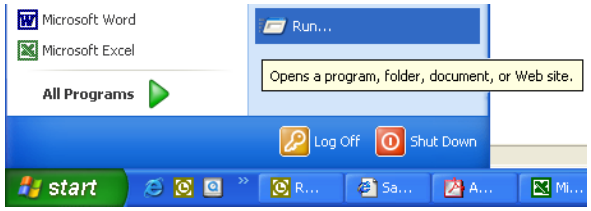
To install the Rosemount Radar Master for FOUNDATION Fieldbus communication:

Procedure

1. Start by installing the *National Instruments Communication Manager* software.

   See National Instruments manual (Getting started with your PCMCIA-FBUS and the NI-FBUS® software) for more information.

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

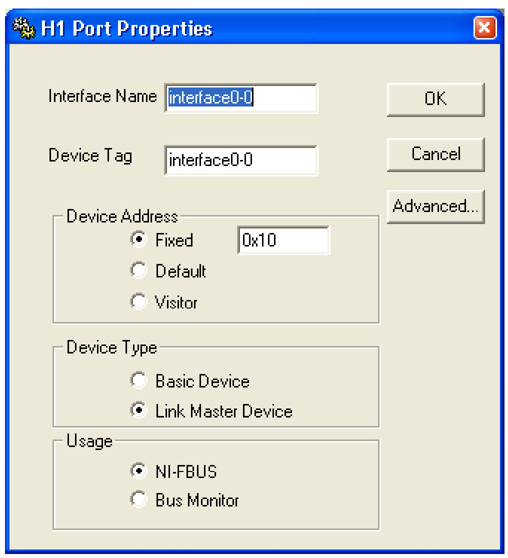


4. Type `D:\RRM\Setup.exe` where D is the CD-ROM drive.
5. Follow the instructions on the screen.
6. Confirm that FOUNDATION Fieldbus is chosen as default protocol.

Getting started

Procedure

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



If only Rosemount Radar Master is connected to the bus:

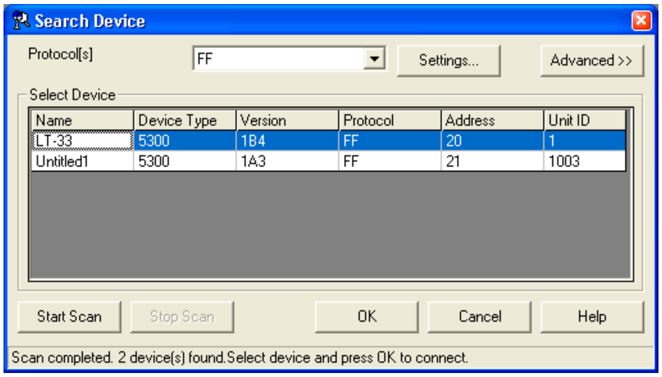
- Device address = Fixed
- Device Type = Link Master Device
- Usage = NI-FBUS

If other host systems are connected to the bus:

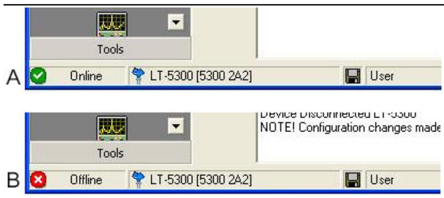
- Device address = Visitor
- Device Type = Basic Device
- Usage = NI-FBUS

2. Click the **Start** button, and then select **All Programs** → **Rosemount** → **Rosemount Radar Master** or click the RRM icon in the Windows workspace.

3. If the National Instruments Communication Manager server is not running, select **Yes** when RRM displays a request for starting the server.
4. If the *Search Device* window did not appear automatically, then select **Device** → **Search**.
5. In the *Search Device* window, choose communication protocol FOUNDATION Fieldbus (if not already selected).
6. If you want to specify start and stop address, then select **Advanced**.
7. Select **Start Scan**. Now RRM searches for the transmitter.
   After a while RRM shows the transmitters found on the bus.



8. Select the desired transmitter and select **OK** to connect.
9. In the RRM Status Bar, verify that RRM communicates with the transmitter.



A. RRM communicates with the transmitter
B. No communication with the transmitter

5.6.7 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:

Procedure

1. Select **View** → **Application Preferences**.
2. Select the **Measurement Units** tab.
3. Choose the desired units for length, level rate, volume, and temperature.

5.6.8 Using the setup functions

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

Procedure

1. Start the RRM software.

2. In the RRM workspace choose the appropriate icon for the configuration of transmitter parameters:

Figure 5-5: Device Config Window

Table 5-4: Setup Functions in RRM

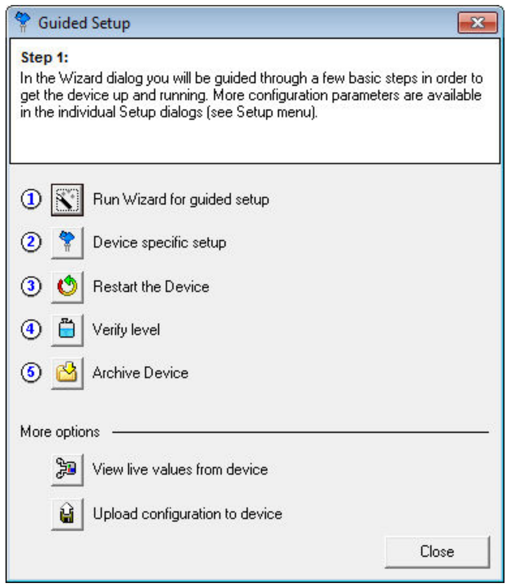
Icon	Description
Wizard	The Wizard is a tool that guides you through the basic configuration procedure of a Rosemount 5300 Level Transmitter.
General	Configuration of general settings such as communication parameters, device tag, and measurement units. This window also lets you configure which LCD variables to be displayed.
Tank	Configuration of probe, tank geometry, tank environment, and volume
Output	Configuration of analog and digital output
Echo Curve	Disturbance echo handling
Advanced	Advanced configuration

5.6.9 Guided setup

The following description shows how to use the Guided Setup in Rosemount Radar Master. The Guided Setup is useful if you are unfamiliar with the Rosemount 5300 Level Transmitter.

Procedure

1. Start the Guided Setup.
    a) Start Rosemount Radar Master. It automatically presents a list of available transmitters.
    b) Select the desired transmitter. Now the transmitter is connected and the *Guided Setup* window appears automatically:

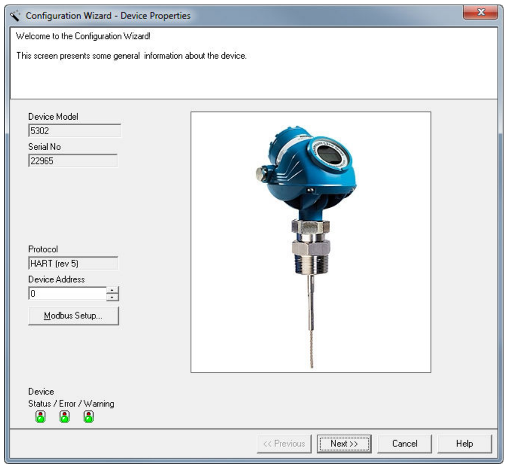


2. In the *Guided Setup* window, select **Run Wizard for guided setup** and follow the instructions. Now you will be guided through a short transmitter installation procedure.

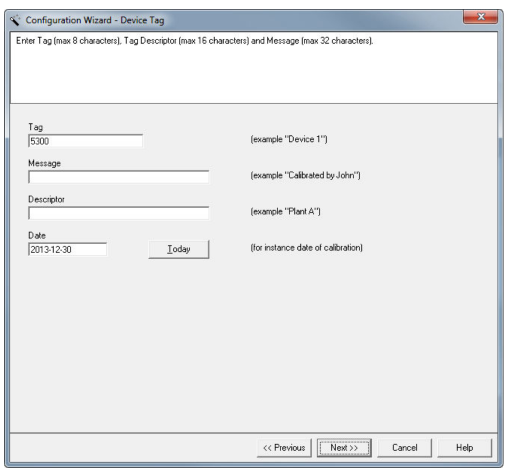
Note
The *Guided Setup* is an extended installation guide that includes more than just the configuration Wizard. It can be disabled by unchecking the **Open Guided Setup dialog after Connect** check box in the *Application Preferences* window (select **View** → **Application Preferences**, and then select the **View Options** tab).

3. In the *Device Properties* window, check that the information complies with the ordering information.

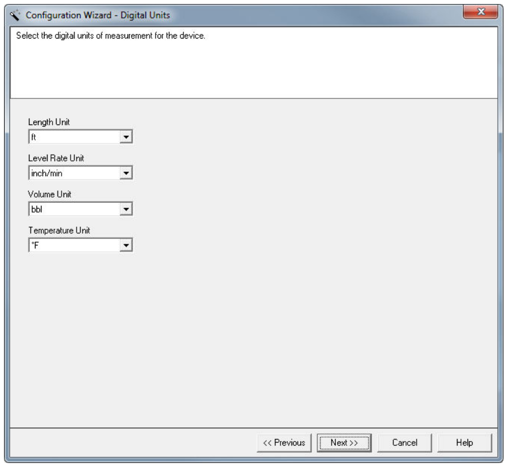
   The *Device Properties* window presents general information stored in the transmitter database such as device model, serial number, communication protocol and device address.

4. (Optional) In the *Device Tag* window, enter tag, message, descriptor, and date. The information is not required for the operation of the transmitter and can be left out if desired.

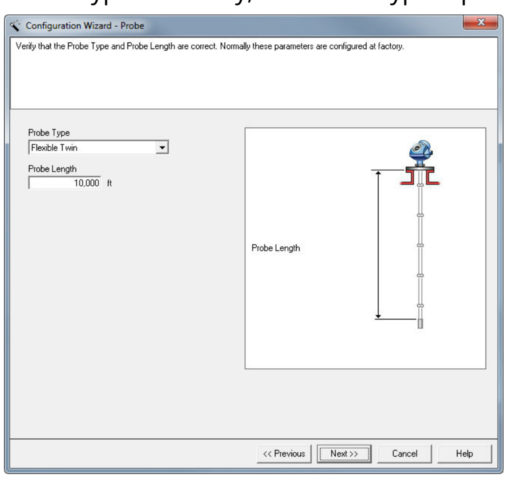
   

5. In the *Digital Units* window, select the digital units of measurement for the device.



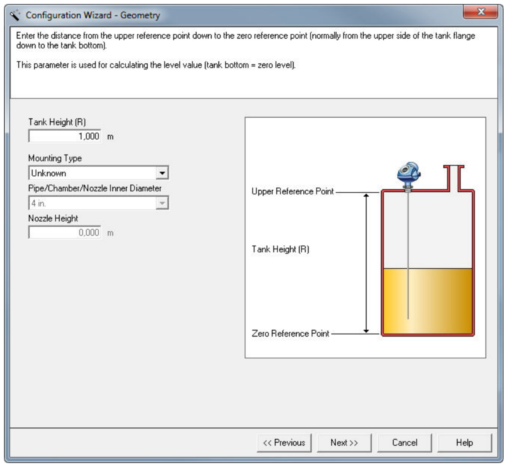
6. In the *Probe* window, check configuration of Probe Type. The following Probe Types are available:
   - Rigid twin
   - Flexible twin
   - Coaxial, coaxial HP/C, coaxial HTHP
   - Coaxial Large, Coaxial Large HP/C
   - Rigid single, rigid single HTHP/HP/C, rigid single PTFE
   - Flexible single, flexible single HTHP/HP/C, flexible single PTFE

   The transmitter automatically makes some initial calibrations based on the selected Probe Type. Normally, the Probe Type is pre-configured at the factory.



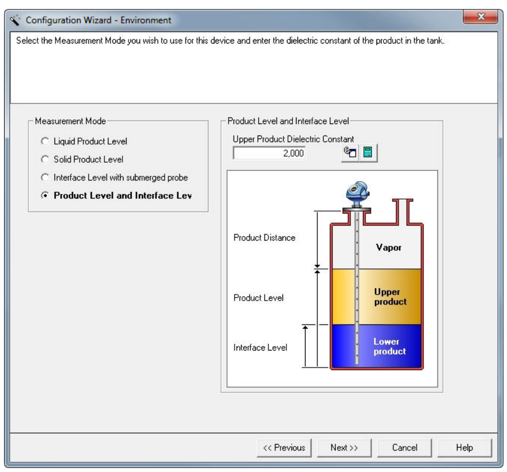
7. Check the entered Probe Length.

8. In the *Geometry* window, set the tank geometry parameters.



   a) Enter the **Tank Height**.
   b) Select the **Mounting Type**.
   c) If using pipe, chamber or nozzle, then select the **Pipe/Chamber/Nozzle Inner Diameter**.
   d) If using nozzle, then enter the **Nozzle Height**.

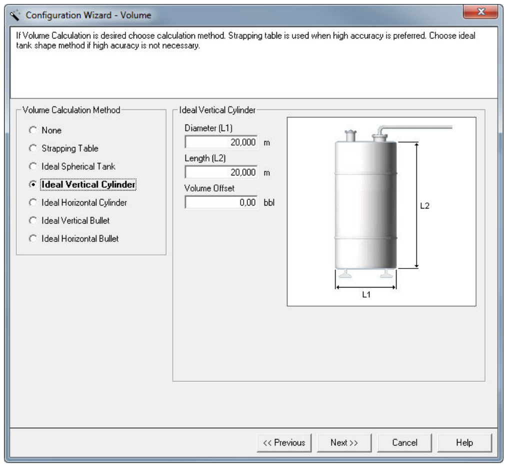
9. In the *Environment* window, specify tank environment.



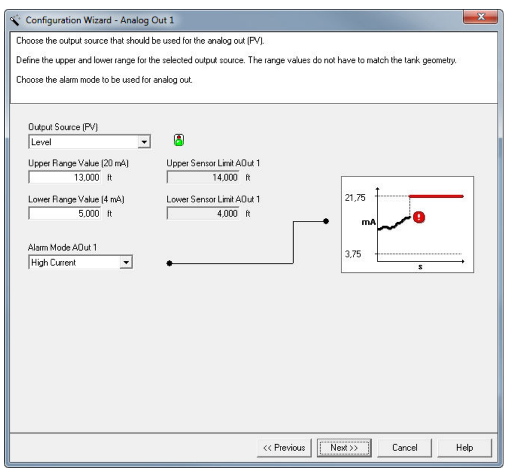
   a) Select the **Measurement Mode**.
   b) Enter the **Product Dielectric Range**/**Upper Product Dielectric Constant**.

10. In the *Volume* window, select the **Volume Calculation Method**. Choose from:
    - None (if volume calculation is not desired at all)
    - Strapping table (if the actual tank does not match any of the available options for pre-defined tanks, or if higher calculation accuracy is desired)
    - Ideal spherical tank
    - Ideal vertical cylinder
    - Ideal horizontal cylinder

- Ideal vertical bullet
- Ideal horizontal bullet



11. If an ideal tank shape is selected, then enter the **Diameter** and **Length** (not for spherical tanks).
12. If **Strapping Table** is selected, starting at the bottom of the tank, for each new point, enter the total volume up to the specified level value.
13. (Optional) Enter the **Volume Offset** value.
14. (HART only) In the *Analog Out 1* window, configure the analog output.

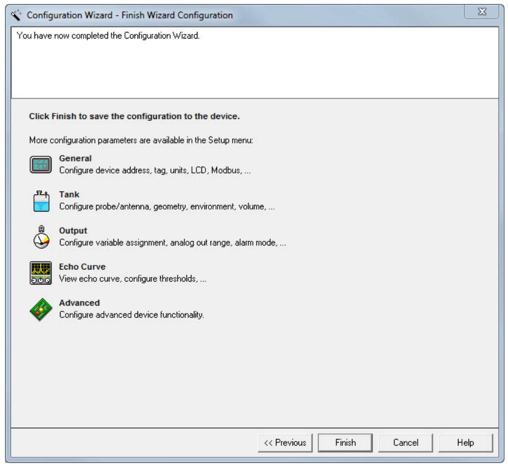


a) In the *Output Source (PV)* list, select the desired transmitter variable to use for the analog output.

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

c) In the *Alarm Mode AOut 1* list, select the **Alarm Mode** you want to use for your analog out channel.

15. In the *Finish Configuration Wizard* window, select **Finish** and continue with the next step in the guided setup.



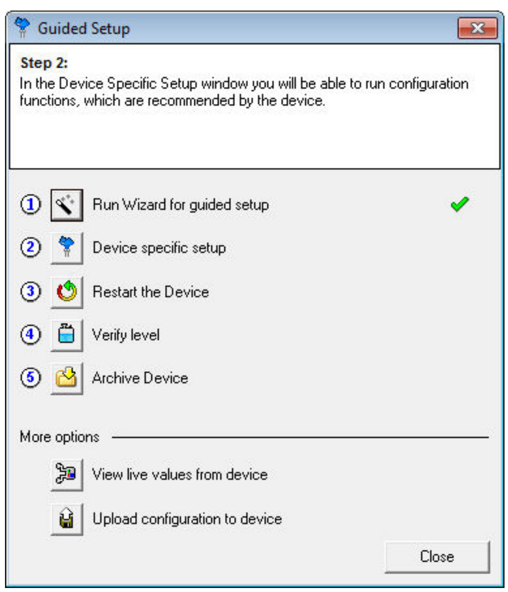
This is the last window in the Configuration Wizard concluding the basic configuration. The current configuration can be changed at any time using the setup windows (General, Tank, Output etc., see Using the setup functions). The setup windows contain further options not available in the Configuration Wizard.

Device specific setup

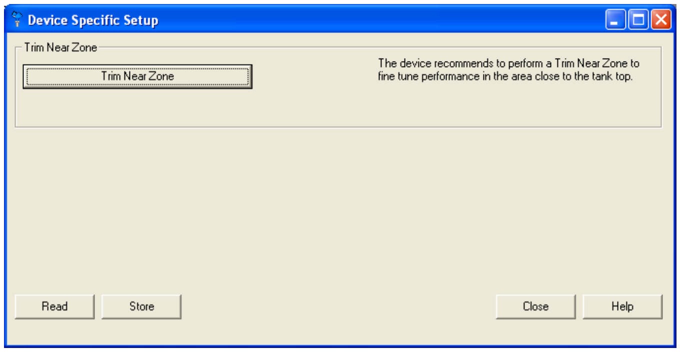
The Device Specific Setup provides additional configuration functions, as recommended by the device.

Procedure

1. In the *Guided Setup* window, select **Device specific setup** and follow the on-screen instructions.



This window shows if any additional configuration is needed.



2. Choose the tank material if recommended.
3. Proceed to Restart the device if no configuration is needed.

Related information

Trim near zone function
Probe end projection
Dielectric constant settings

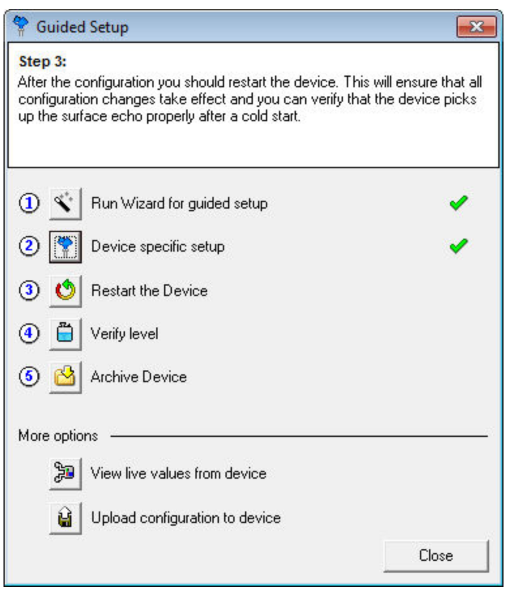
Restart the device

When the transmitter is configured, it should be restarted to ensure that all configuration changes are properly activated and the transmitter performs as expected.

Procedure

In the *Guided Setup* window, select **Restart the Device**.

It may take up to 60 seconds until measurement values are updated.



Run verify level

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

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

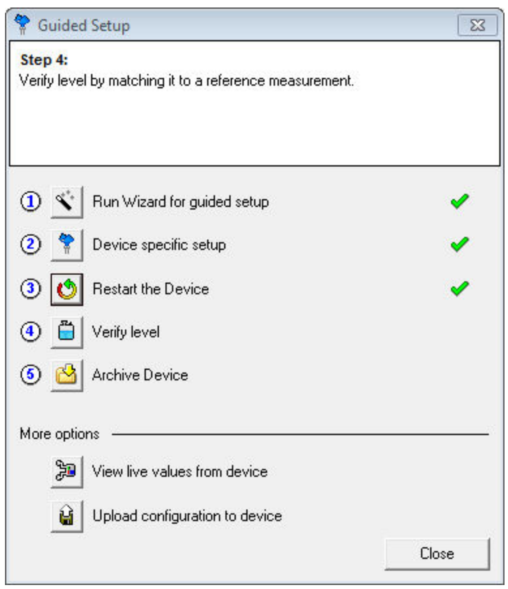
Prerequisites

Ensure that:

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

Procedure

1. In the *Guided Setup* window, select **Verify level** to check your level measurement.



2. Follow the on-screen instructions.

Note
The offset (Calibration Distance parameter) is automatically set after completing the Verify Level method. An offset greater than 4 in. (100 mm) indicates a problem with the level measurement. Re-check configuration parameters. If these are correct, then view an echo plot and evaluate thresholds.

Related information

Calibration distance

Archive device

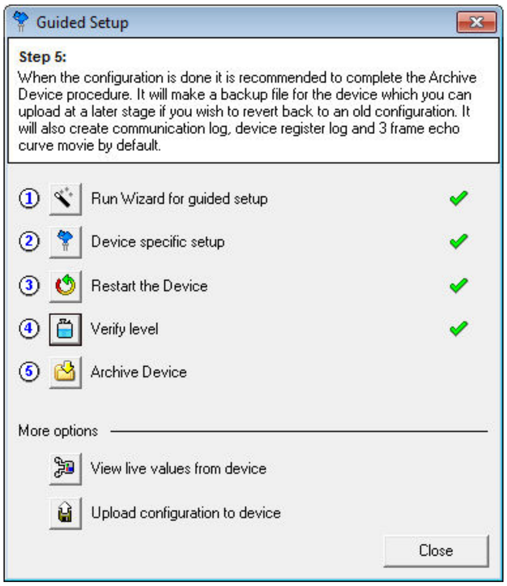
When configuration is finished, it is recommended that the configuration is saved to a backup file.

The backup file may be useful to:

- Install another Rosemount 5300 Level Transmitter in a similar tank since the file can be directly uploaded to a new device.
- Restore the configuration, if for any reason, configuration data is lost or accidentally modified making the device inoperable.

Procedure

In the *Guided Setup* window, select **Archive Device**.



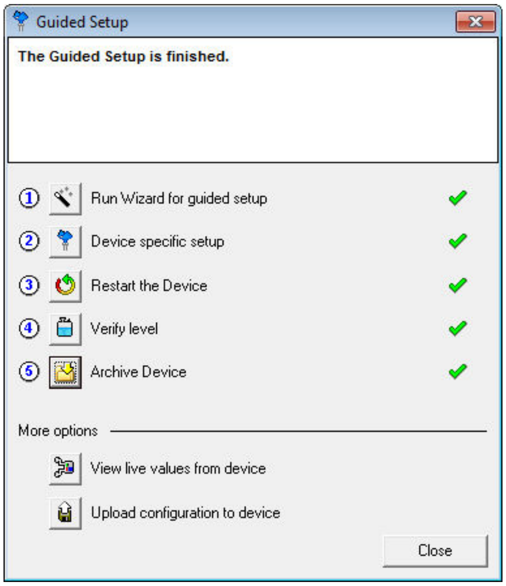
The Archive Device function will create an information package for support purposes. The package includes a complete backup of the device, several logs, and echo curves.

View live values from device

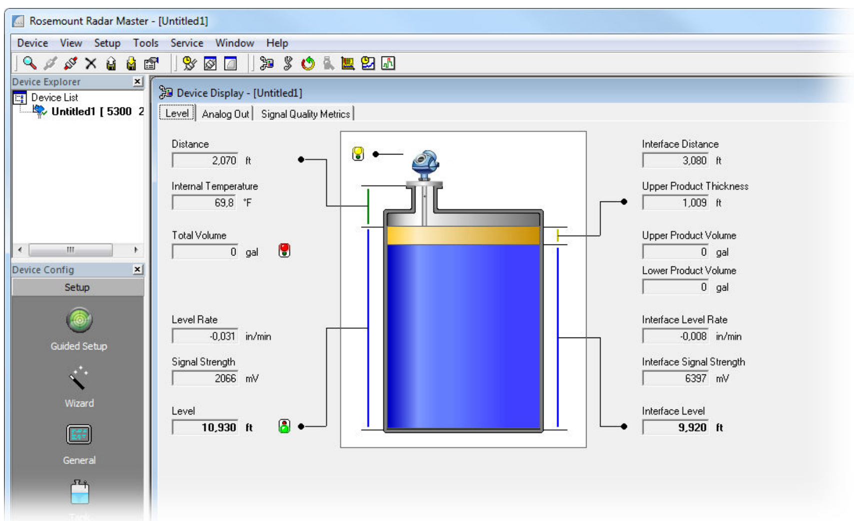
View live values from device to verify that the transmitter works correctly.

Procedure

1. In the *Guided Setup* window, select **View live values from device**.



2. Verify the transmitter works correctly. If the measured values seem incorrect, configuration settings may need to be adjusted.



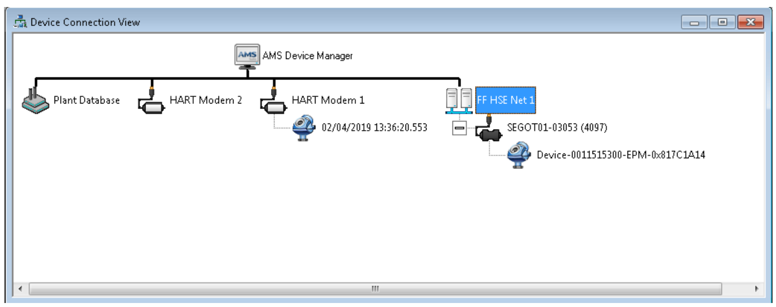
5.7 Basic configuration using AMS Device Manager and handheld communicator

See Basic configuration parameters for information on the various configuration parameters.

5.7.1 Connect to device using AMS Device Manager

Procedure

1. Start AMS Device Manager.
2. Select **View** → **Device Connection View**.
3. In the *Device Connection View*, double-click the modem icon.
4. Double-click the device icon.



5.7.2 Connect to device using a handheld communicator

Procedure

Turn on the handheld communicator and connect to the device.

5.7.3 Configure device

Configure HART® devices

Procedure

1. Select **Configure** → **Guided Setup**.
2. Select **Level Measurement Setup** and follow the instructions.
3. Select **Device Specific Setup**.
4. Run **Verify Level** to check your level measurement.
5. (Optional) Select **Volume Setup**.
6. (Optional) Select **Display Setup**.

FOUNDATION™ Fieldbus

Procedure

1. Select **Configure** → **Guided Setup**.
2. Select **Level Measurement Setup** and follow the instructions.
3. (Optional) Select **Volume Calculation Setup**.

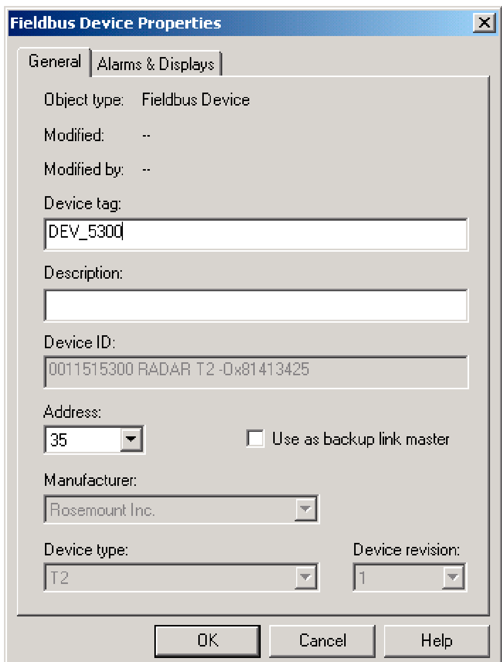
4. (Optional) Select **Device Specific Setup**.
5. (Recommended) Select **Restart Measurement**.

5.8 Basic configuration using DeltaV

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

Procedure

1. From the **Start** menu, select **DeltaV** → **Engineering** → **DeltaV Explorer**.
2. Navigate through the file structure to find the Rosemount 5300 Level Transmitter.
3. Right-click the Rosemount 5300 Level Transmitter icon and select **Properties**.



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.

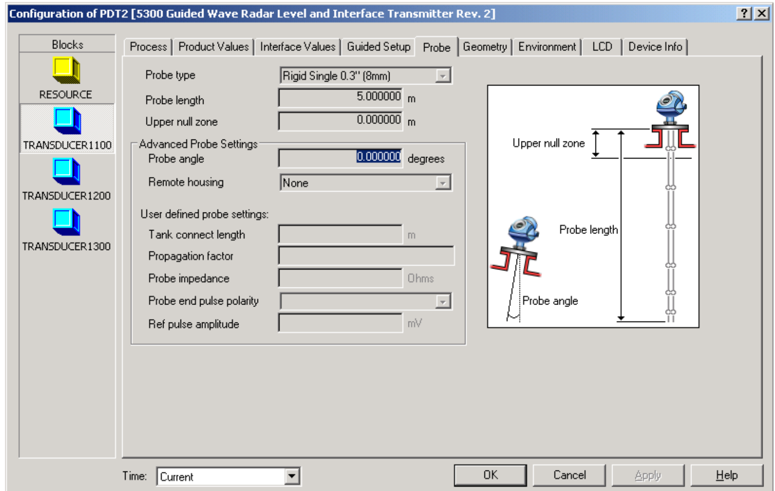
4. Check that the general information complies with the ordering information. General information such as device type (Rosemount 5300), manufacturer, device ID are presented.

   The Rosemount 5300 Level Transmitter device ID consists of the following components: Manufacturer ID-Model-Serial Number.

   #### Example

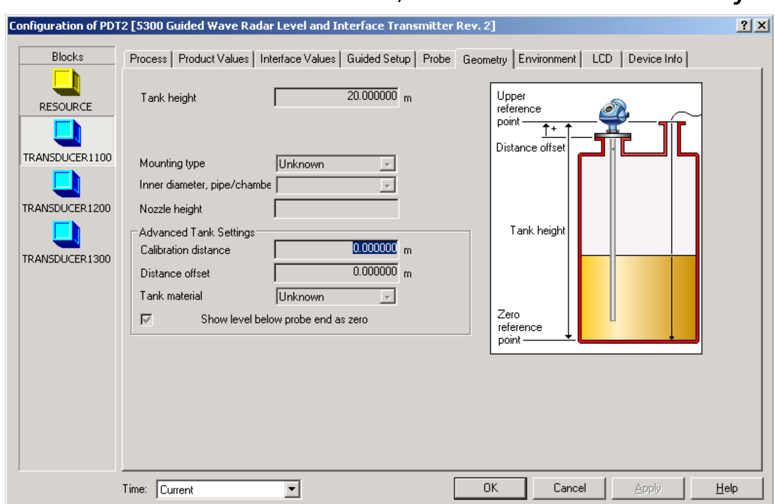
   0011515300 Radar T2-0x81413425
5. In the *DeltaV Explorer*, select the desired transmitter and choose the **Configure** option.

6. Select the **TRANSDUCER1100** block, and then select the **Probe** tab.



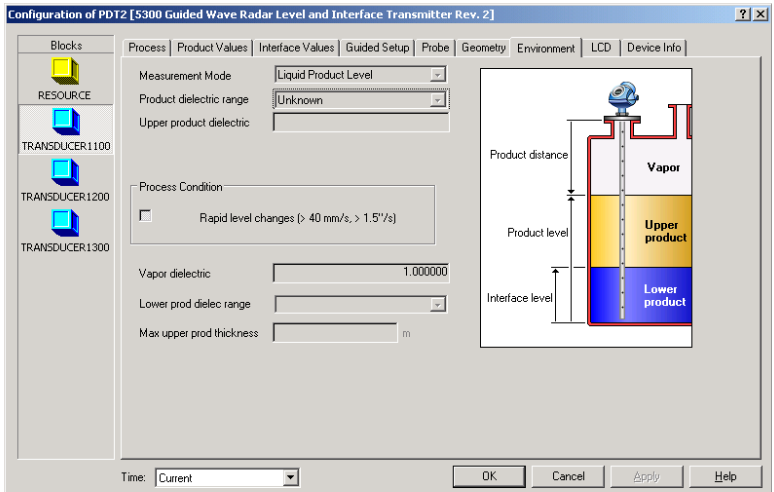
7. Check configuration of Probe Type. The following Probe Types are available:
   - Rigid twin
   - Flexible twin
   - Coaxial, coaxial HP/C, coaxial HTHP
   - Coaxial large, Coaxial large HP/C
   - Rigid single, rigid single HTHP/HP/C, rigid single PTFE
   - Flexible single, flexible single HTHP/HP/C, flexible single PTFE

   The transmitter automatically makes some initial calibrations based on the selected Probe Type. Normally, the Probe Type is pre-configured at the factory.
8. Check the entered Probe Length.
9. Select the **TRANSDUCER1100** block, and then select the **Geometry** tab.

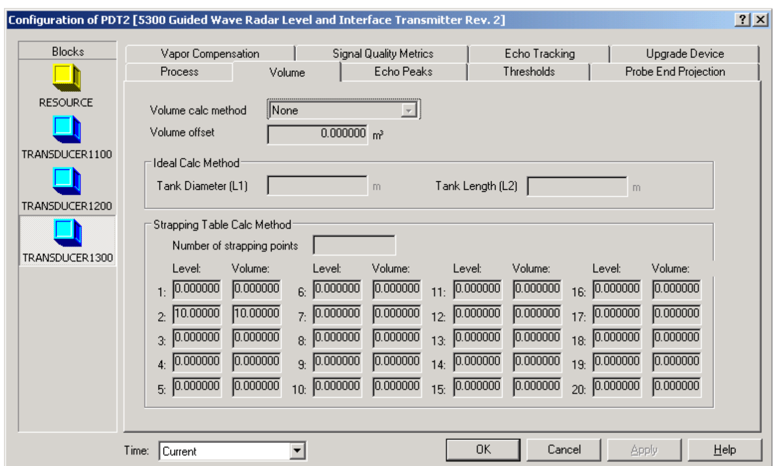


10. Enter the **Tank Height**.
11. Select the **Mounting Type**.
12. If using pipe, chamber or nozzle, then select the **Inner Diameter**.

13. If using nozzle, then enter the **Nozzle Height**.
14. Select the **Environment** tab.



15. Select the **Measurement Mode**.
16. Enter the **Product Dielectric Range/Upper Product Dielectric**.
17. Select the **Rapid level changes** check-box only if the surface is moving quickly up or down at rates over 1.5 in./s (40 mm/s).
18. To configure volume calculation, select the **TRANSDUCER1300** block, and then select the **Volume** tab.



19. In the *Volume Calc method* list, select the **Volume Calculation Method**. Choose from:
    - None (if volume calculation is not desired at all)
    - Use strapping table (if the actual tank does not match any of the available options for pre-defined tanks, or if higher calculation accuracy is desired)
    - Sphere
    - Vertical cylinder
    - Horizontal cylinder
    - Vertical bullet

- Horizontal bullet

20. If an ideal tank shape is selected, then enter the **Tank Diameter** and **Tank Length** (not for spherical tanks).
21. If **Strapping Table** is selected, starting at the bottom of the tank, for each new point, enter the total volume up to the specified level value.
22. (Optional) Enter the **Volume Offset** value.

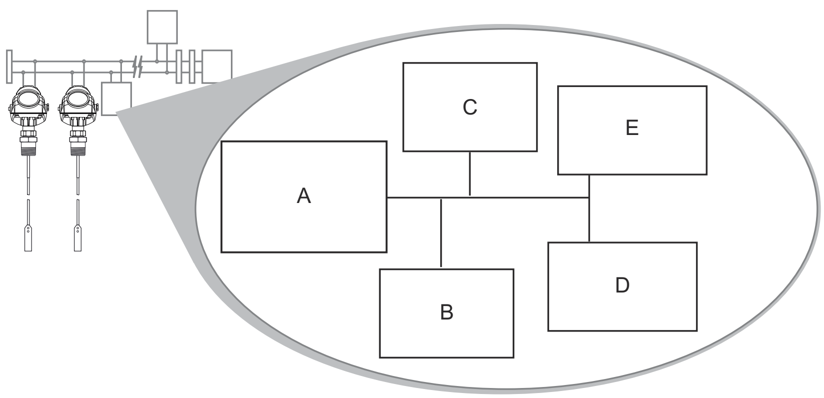
5.9 FOUNDATION™ Fieldbus overview

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

For detailed information about FOUNDATION Fieldbus technology and function blocks, refer to the Rosemount 5300 FOUNDATION Fieldbus Block Reference Manual.

Figure 5-6 illustrates how the signals are channeled through the transmitter.

Figure 5-6: Function Block Diagram for the Rosemount 5300 with FOUNDATION Fieldbus



A. FOUNDATION Fieldbus compliant communications stack
B. Register transducer block
C. Level transducer block
D. Resource block physical device information
E. Advanced configuration block

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.

5.9.1 Assigning device tag and node address

A Rosemount 5300 Level 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:

Procedure

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

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

5.9.2 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.

Resource block

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

Related information

Resource Transducer Block

Register transducer block

The register transducer block allows a service engineer to access all database registers in the device.

Related information

Register Transducer Block

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.

Related information

Advanced Configuration Transducer Block

Level transducer block

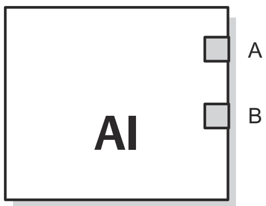
The level transducer block contains transmitter information including diagnostics and the ability to configure, set to factory defaults and restarting the transmitter.

Related information

Level Transducer Block

Analog Input block

Figure 5-7: Analog Input Block



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

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.

Related information

Analog-Input Block

Function block summary

The following function blocks are available for the Rosemount 5300 Level Transmitter:

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

For detailed information about FOUNDATION Fieldbus technology and function blocks used in the Rosemount 5300 Level Transmitter, refer to the FOUNDATION Fieldbus Blocks Reference Manual .

5.10 Configure the alarm output for the Modbus® transmitter

The output from the Modbus transmitter in case of an error (such as a field device malfunction) can be configured.

Use the Modbus string to configure the alarm output. The values for Modbus registers corresponding to PV, SV, TV, and QV will be changed accordingly (applicable registers in area 1300, 2000, 2100, and 2200).

Prerequisites

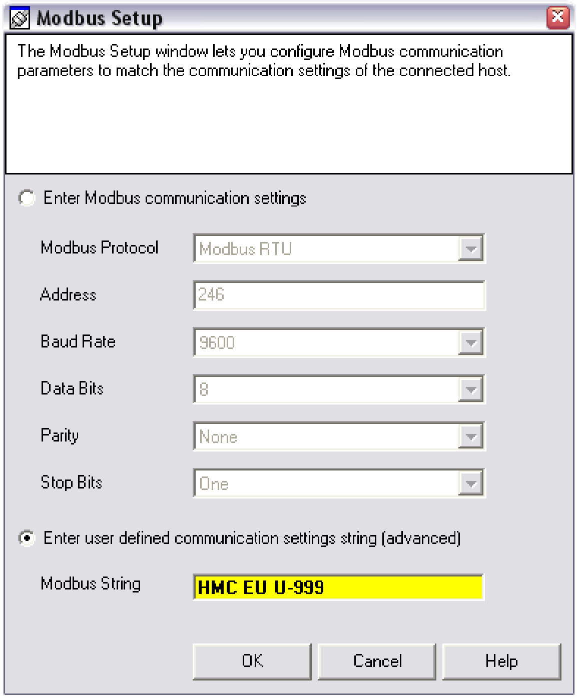
If the Modbus communication setup has been changed, but the transmitter has not yet started to use the new configuration, then you need to disconnect the HART modem and wait up to 60 seconds for the change to take effect.

In case the MA/MB terminals are used for connection to the HART to Modbus Converter (HMC), disconnect the RS-485 Converter, cycle power to the transmitter and wait up to 60 seconds for the change to take effect.

The Modbus communication settings will otherwise be lost if you write a new message to the transmitter.

Procedure

1. Start Rosemount Radar Master and connect to the transmitter.
2. Select **Setup** → **General**.
3. Select the **Communication** tab.
4. Select **Modbus Setup**.
5. Select **Enter user defined communication settings string (advanced)**.
6. Enter the Modbus string, and select **OK**.



Postrequisites

After changing the Alarm Output configuration, disconnect the HART modem and wait up to 60 seconds for the change to take effect. In case the MA/MB terminals are used for connection to the HMC, disconnect the RS-485 Converter, cycle power to the transmitter, and wait up to 60 seconds for the change to take effect.

5.10.1 Modbus alarm output strings

Table 5-5: Available Alarm Output Text Strings

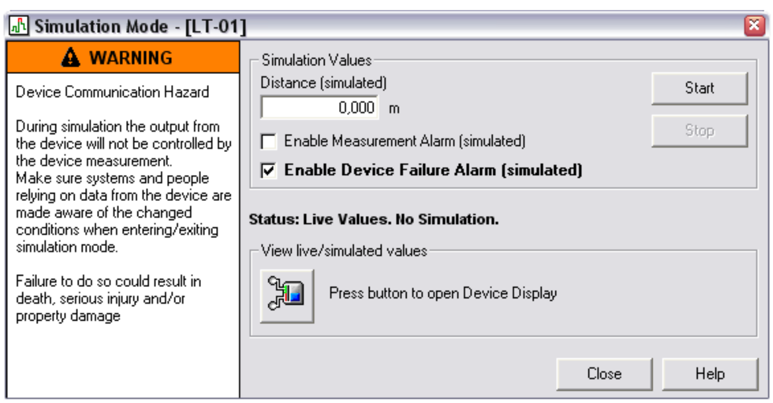
Protocol	String	Alarm output
Modbus RTU	HMC EN	Not a number (NaN), default
	HMC EF	Freeze, hold last value
	HMC EU U-0.1	User defined value, -0.1 in this example
Levelmaster	HMC M2 EH	High value, 999.99, default
	HMC M2 EL	Low value, -99.99
	HMC M2 EF	Freeze, hold last value
	HMC M2 EU U0	User defined value (range -99.99 to 999.99), 0 in this example
Modbus ASCII	HMC M1 EN	Not a number (NaN), default
	HMC M1 EF	Freeze, hold last value
	HMC M1 EU U-0.1	User defined value (range -99.99 to 999.99), -0.1 in this example

5.10.2 Verify alarm output

To verify the alarm output, use Rosemount Radar Master to simulate a device failure:

Procedure

1. Establish HART communication with the transmitter through Rosemount Radar Master.
2. Select **Tools** → **Simulation Mode**.



3. Select **Enable Device Failure Alarm (simulated)**.
4. Select **Start**.
5. Disconnect HART modem.
6. Verify that the configured alarm output is available in the Modbus host.
7. Use Rosemount Radar Master to turn off simulation mode.

5.10.3 Use status information to evaluate measurement validity

The transmitter updates status information about the current measurement, and this status information is available as a bitfield register through Modbus communication.

By monitoring the status information it is possible to determine if the current measurement output value is valid.

Related information

Common Modbus host configuration

5.10.4 Use Heartbeat to detect errors

By reading and evaluating the Heartbeat value from the device, it is possible to verify that the communication link between the transmitter, HMC, RTU and even the control system communicating with the RTU is working.

Assign Heartbeat to one of the transmitter variables (SV, TV, or QV). Heartbeat is increased by one for each measurement cycle in the device (until it eventually starts over at zero again).

In case this value is not updated, it means that the communication link is broken.

5.11 Tri-Loop™ HART®-to-Analog converter

The Rosemount 333 HART® Tri-Loop™ HART-to-Analog signal converter is capable of converting a digital HART Burst signal into three additional 4-20 mA analog signals.

Related information

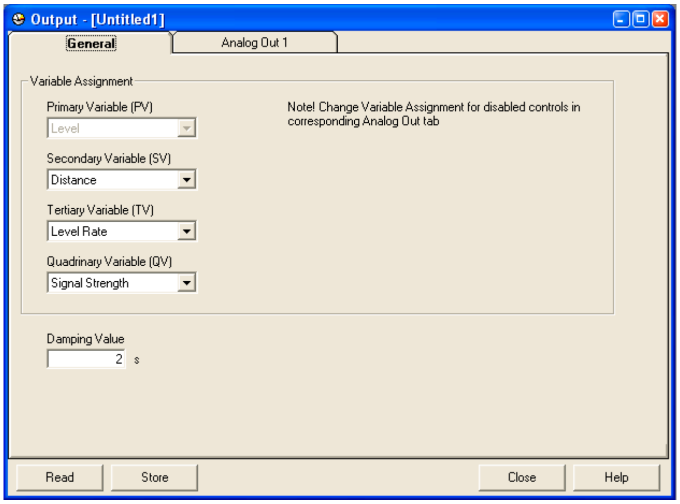
Rosemount 333 Reference Manual

5.11.1 Set the level transmitter up for HART Tri-Loop using Rosemount Radar Master

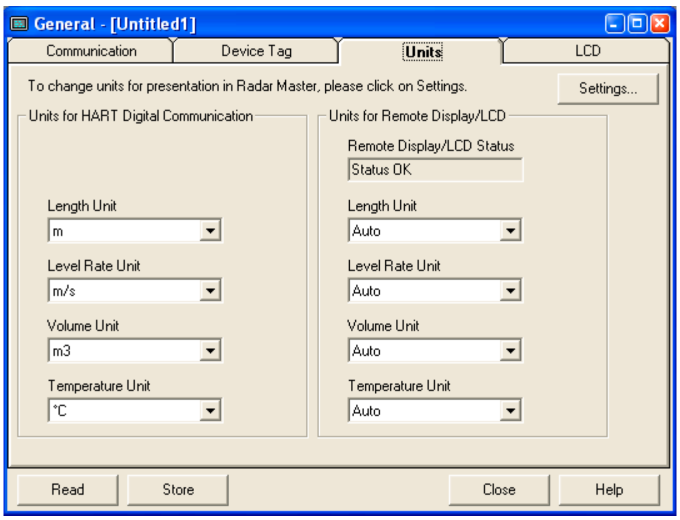
To set the Rosemount 5300 Level Transmitter up for the HART Tri-Loop:

Procedure

1. Make sure the Rosemount 5300 Level Transmitter is properly configured.
2. Assign transmitter variables Primary Variable, Secondary Variable etc. Select**Setup** → **Output/General**.



3. Configure variable units: length, level rate, volume and temperature. Select: **Setup** → **General/Units**.



4. Set the Rosemount 5300 to Burst Mode. Select **Setup** → **General/Communication**.

Note

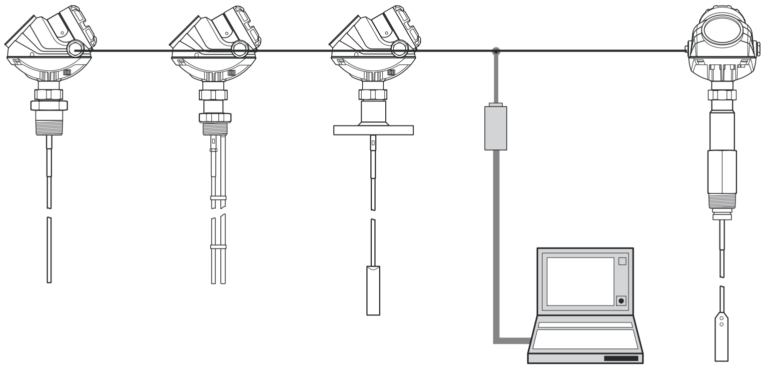
Using a HART revision 7 device, the Rosemount 5300 Level Transmitter supports up to 3 Burst messages. It can burst Cmd 1, 2, 3, 9, 33, 48. For command aggregation, Cmd78 is used. Supported burst trigger modes in HART 7: Continuous, Windowed, Falling, and Rising.

5. Select burst option 3 = process variables and current (process vars/crnt).
6. Prior to exiting the configuration, note the selected variables for SV, TV, and QV, and the units set for each of the variables. The same configuration must be used for the Rosemount 333.

5.12 HART® multi-drop configuration

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

Figure 5-8: Multidrop Connection

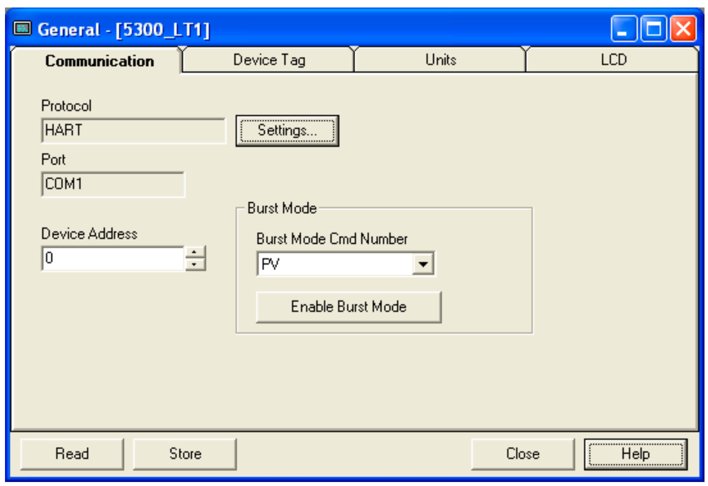


5.12.1 Change the poll address using Rosemount Radar Master

To set the desired address for multidrop operation:

Procedure

1. Select **Setup** → **General**.
2. Select the **Communication** tab.



3. Set the desired address for multidrop operation.
   - HART 5: addresses between 1 and 15
   - HART 7: addresses between 1 and 63
4. Click the **Store** button to save the new address.

5.12.2 Change the poll address using a handheld communicator

To set the desired address for multidrop operation:

Procedure

1. Select **Configure** → **Manual Setup** → **Device Setup** → **HART** → **Comm Settings**.
2. Set **Poll addr** to the desired address for multidrop operation.
   - HART 5: addresses between 1 and 15

- HART 7: addresses between 1 and 63

3. Select **Send** to save the new address.

6 Operation

6.1 Safety messages

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

⚠ WARNING

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

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

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

⚠ WARNING

Explosions could result in death or serious injury.

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

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

⚠ WARNING

Electrical shock could cause death or serious injury.

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

⚠ WARNING

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

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

⚠ WARNING

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

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

6.2 Using the display panel

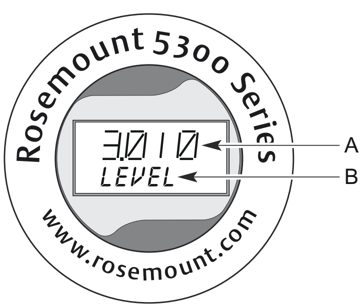
The Rosemount™ 5300 Level Transmitter uses an optional display panel for presentation of measurement data. When the transmitter is switched on, the display panel presents information such as transmitter model, measurement frequency, software version, communication type (HART®, FF), serial number, HART 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 Specify display panel variables). The available LCD parameters are listed in Table 6-1.

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 two seconds. The lower row toggles between parameter name and measurement unit each second.

Variables to be presented are configurable by using a handheld communicator, AMS Device Manager, DeltaV™ or the Rosemount Radar Master software.

Figure 6-1: The Rosemount 5300 Level Transmitter Display Panel



A. Measurement value
B. Toggling between measurement parameter and measurement unit

Error messages are listed in LCD error messages.

Table 6-1: LCD Parameters and Presentation on Display

Parameter	Presentation on display	Description
Level	LEVEL	Product level

Table 6-1: LCD Parameters and Presentation on Display *(continued)*

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

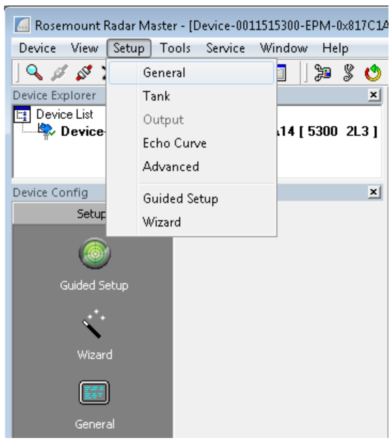
6.3 Specify display panel variables

6.3.1 Specify display panel variables using Rosemount Radar Master

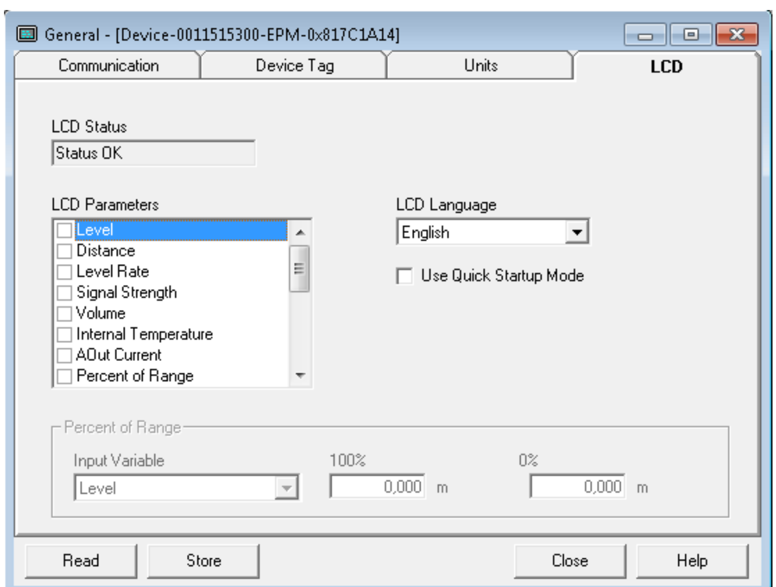
Specify variables and corresponding measurement units to be presented on the display panel (LCD) screen:

Procedure

1. Select **Setup** → **General**, or select the **General** icon in the *Device Config* window.



2. Select the **LCD** tab.



3. Select the variables to be shown on the display panel.
   a) Select the **Store** button to save the LCD settings in the transmitter database.
4. Select the **Units** tab.
5. Select the desired measurement units.

a) Select the **Store** button to save the LCD settings in the transmitter database.

6.3.2 Specify display panel variables using AMS Device Manager

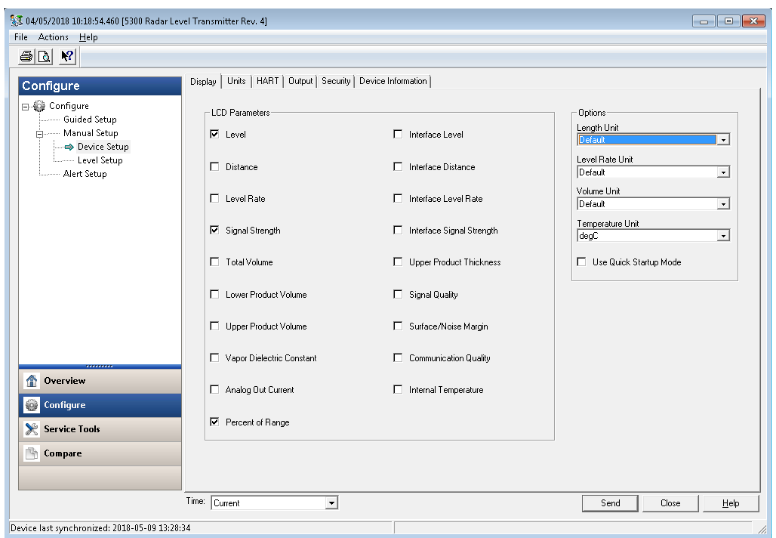
Specify variables and corresponding measurement units to be presented on the display panel (LCD) screen:

Procedure

1. HART®: Select **Configure** → **Manual Setup** → **Device Setup**.

   FOUNDATION™ Fieldbus: Select **Configure** → **Manual Setup**

2. Select the **Display** tab.
3. Select the desired variables and measurement units to be displayed on the LCD display.



4. Select **Send** to save the configuration and close the window.

6.3.3 Specify display panel variables using a handheld communicator

Specify variables and corresponding measurement units to be presented on the display panel (LCD) screen:

Procedure

1. Specify LCD parameters:
   a) HART®: Select **Configure** → **Manual Setup** → **Device Setup**.

      FOUNDATION™ Fieldbus: Select **Configure** → **Manual Setup**

   b) Select **Display**.
   c) Select **LCD Parameters**.
   d) Select the desired variables to be displayed on the LCD display.
   e) Select **Send**, and follow the instructions.

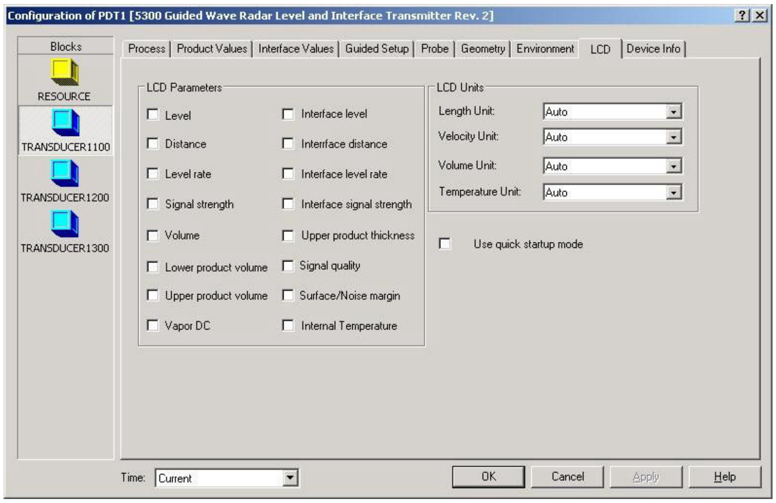
2. Specify measurment units:
    a) HART: Select **Configure** → **Manual Setup** → **Device Setup**.
       FOUNDATION Fieldbus: Select **Configure** → **Manual Setup**.
    b) HART: Select **Units**.
       FOUNDATION Fieldbus: Select **LCD Units**.
    c) Specify desired measurement units.
    d) Select **Send**, and follow the instructions.

6.3.4 Specify display panel variables using DeltaV

To specify which variables to view on the display panel (LCD) screen and the corresponding measurement units:

Procedure

1. Right-click the transmitter icon and choose the **Properties** option.
2. Select the **Transducer1100** block.
3. Select the **LCD** tab.



4. Select the variables to be shown on the display panel.
5. Select the desired LCD 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.
6. Select **OK** to save the LCD settings in the transmitter database.

6.4 View measurement data

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

6.4.1 View measurement data in Rosemount Radar Master

To view measurement data in Rosemount Radar Master:

Procedure

1. Select **Tools** → **Device Display**.

2. Select the desired group of measurement values to view.
   - To view measurement data such as level, signal strength, etc., select the **Level** tab.
   - To view the analog output signal, select the **Analog Out** tab.
   - To view signal quality and surface/noise margin, select the **Signal Quality Metrics** tab.

Figure 6-2: Presentation of Measurement Data in Rosemount Radar Master

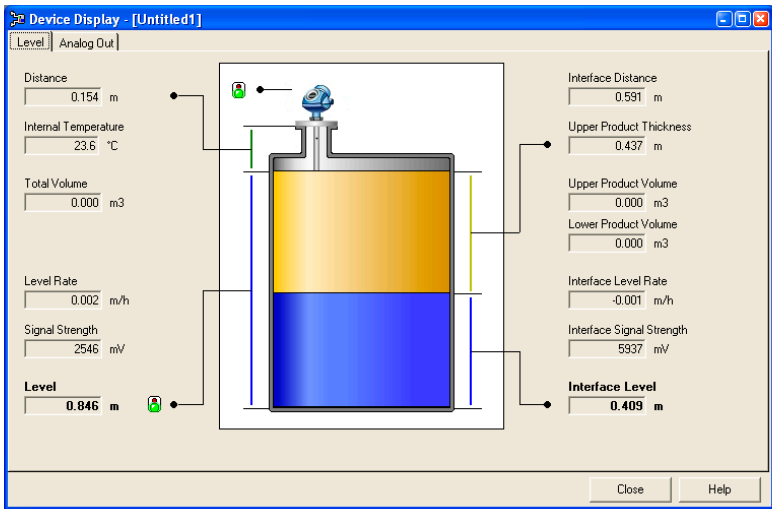
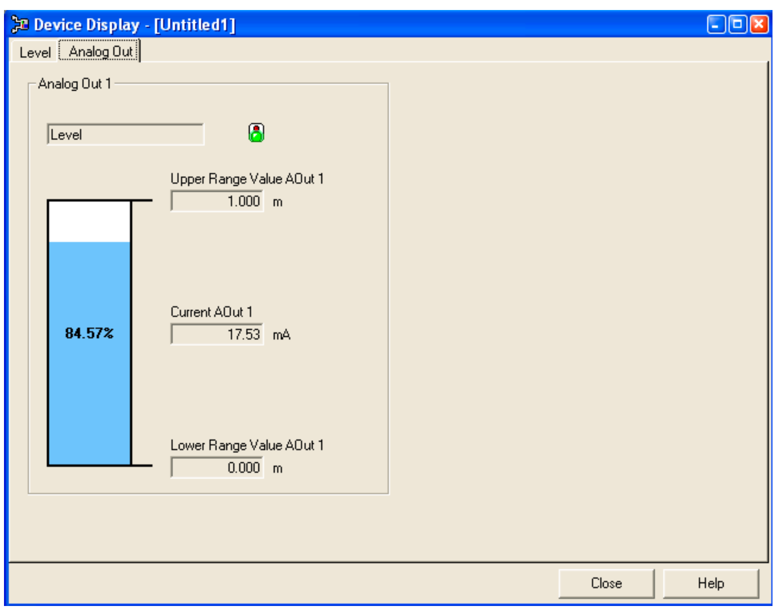


Figure 6-3: Presentation of Analog Output Value in Rosemount Radar Master



6.4.2 View measurement data in AMS Device Manager and handheld communicator

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

Procedure

1. Select **Service Tools** → **Variables**.
2. HART®: Select **Mapped Variable**, **Process**, **Device**, or **Signal Quality**.

   FOUNDATION™ Fieldbus: Select **Product Variables**, **Interface Variables** or **Signal Quality Metrics**.

6.4.3 View measurement data in DeltaV

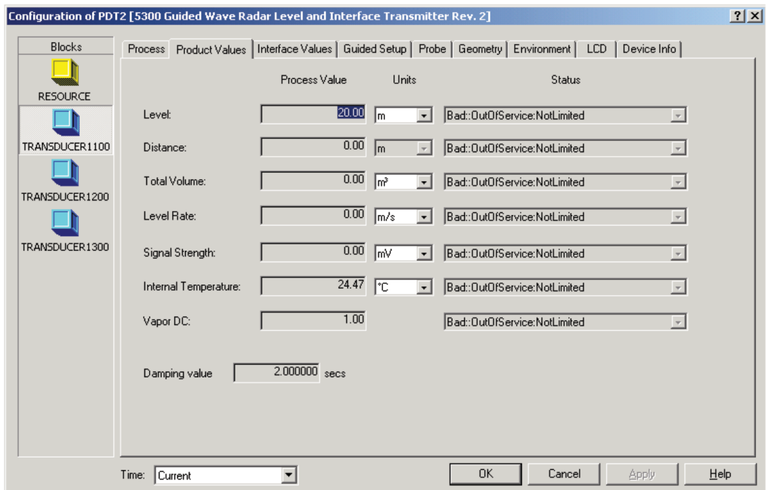
Procedure

1. Right-click the transmitter icon and choose the **Properties** option.
2. Select the **Transducer1100** block.

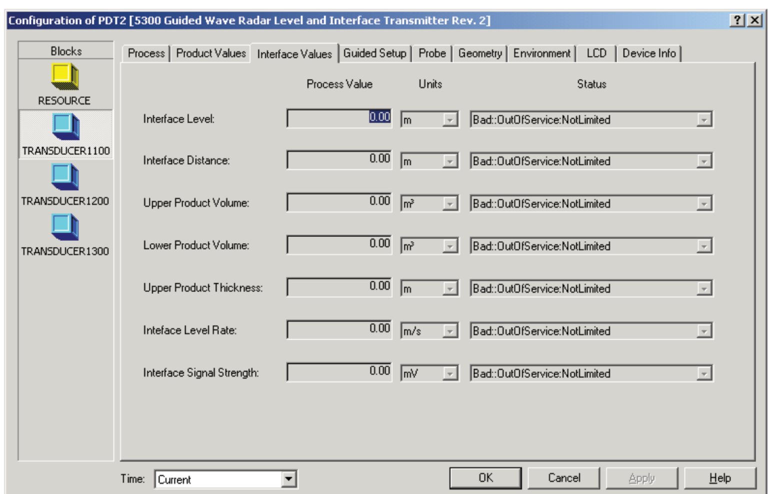
3. Select the desired group of measurement values to view.
   - To view level values such as Level and Distance, select the **Product Values** tab.
   - To view interface measurement values, select the **Interface Values** tab.

Figure 6-4: Presentation of Measurement Data in DeltaV for the Rosemount 5300

A



B



A. Level values
B. Interface level values

7 Service and troubleshooting

7.1 Safety messages

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

⚠ WARNING

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

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

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

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

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure 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

Explosions could result in death or serious injury.

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

Before connecting a handheld communicator in an explosive atmosphere, be sure that 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

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

Avoid contact with the leads and terminals.

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

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

⚠ WARNING

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

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

7.2 View diagnostics

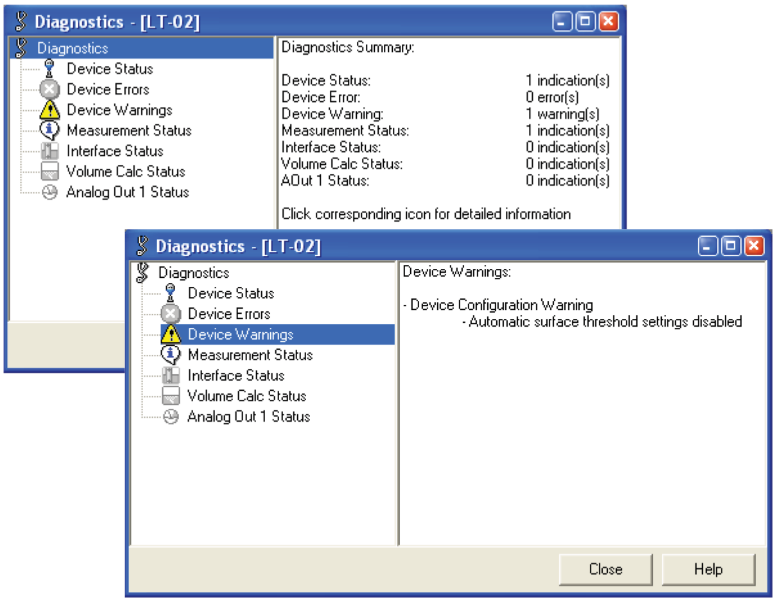
7.2.1 View diagnostics in Rosemount Radar Master

To view the *Diagnostics* window in Rosemount Radar Master:

Procedure

Select **Tools** → **Diagnostics**.

Figure 7-1: The Diagnostics Window in Rosemount Radar Master



Related information

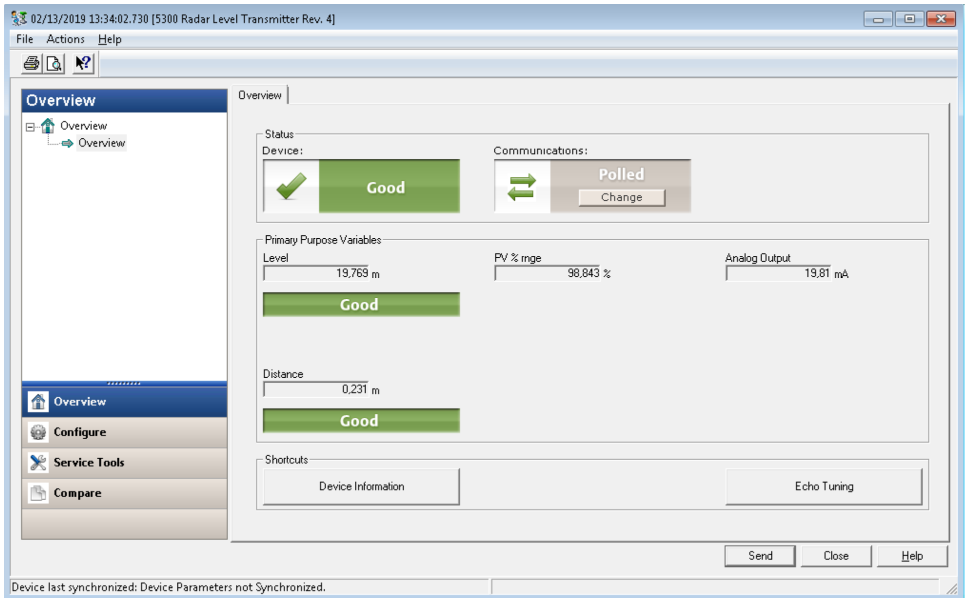
[Device status]
[Errors]
[Warnings]
[Measurement status]
[Interface status]
[Volume calculation status]
[Analog output status]

7.2.2 View device status in AMS Device Manager

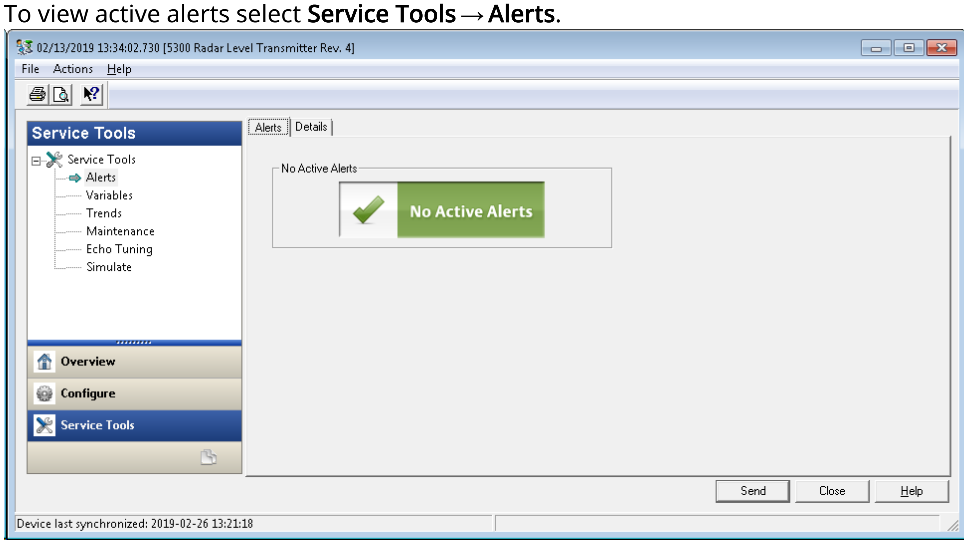
To view the device status and active alerts in AMS Device Manager:

Procedure

1. To view device status select **Overview**.



2. To view active alerts select **Service Tools** → **Alerts**.



Related information

Diagnostic messages per NAMUR NE 107 (HART)
Diagnostic messages per NAMUR NE 107 (FOUNDATION Fieldbus)

7.2.3 View device status using a handheld communicator

To view the device status and active alerts usinga a handheld commnicator:

Procedure

1. To view device status select **Overview**.
2. To view active alerts select **Service Tools** → **Alerts**.

Related information

Diagnostic messages per NAMUR NE 107 (HART)
Diagnostic messages per NAMUR NE 107 (FOUNDATION Fieldbus)

7.3 Diagnostic messages

7.3.1 Diagnostic messages per NAMUR NE 107 (HART®)

Diagnostic messages per NAMUR NE 107 are listed in Table 7-1 and Table 7-2.

Table 7-1: Status - Failure

Message	Description	Recommended actions
Volume measurment failure - Invalid Volume	Reasons may be multiple: • Incorrect volume configuration • Level measurement invalid	1. If **Level Measurement Failure** is active, clear that alert first. 2. Check volume configuration. 3. Load default database to the device and reconfigure it. 4. If error persists it might indicate a hardware error, replace the transmitter head.
Level/Interface Measurement Failure	No valid level reading. Reasons may be multiple: • No valid surface echo peak in the measuring range. • Incorrect transmitter configuration.	1. Analyze echo curve for reason and check device configuration. 2. Check device physical installation (for instance probe contamination). 3. Load default database to the device and reconfigure it. 4. If error persists it might indicate a hardware error, replace the transmitter head.
Probe Missing	The transmitter cannot detect the probe.	1. Check that the probe is properly connected.
Sensor Database (HREG) error	The device has found an error in the configuration database.	1. Load default database to the device to clear the error. 2. Reconfigure the device. 3. If the alert persists, replace the transmitter head.

Table 7-1: Status - Failure *(continued)*

Message	Description	Recommended actions
Electronics Failure (RAM Error)	The device has detected a fault with an electrical component on the main board electronics module assembly.	1. Replace transmitter head.
Electronics Failure (FPROM Error)		
Electronics Failure (Microwave Module Error)		
Electronics Failure (Analog Output Error)		
Electronics Failure (Modem Error)		
Electronics Failure (Hardware Error)		
Electronics Failure (Other Memory Error)		
Software Error	The device software has encountered an error. Reasons may be multiple, including too low supplied voltage, or an error being simulated.	1. Make sure that enough voltage is supplied to the device. 2. Restart the device. 3. Turn off simulation of device failure. 4. If the alert persists, replace the transmitter head.
Internal Temperature Critical	The internal temperature of the device has reached critical levels and the integrity of the device electronics has been compromised. Ambient temperature should not exceed device specifications (-40 °C to +80 °C).	1. Replace the transmitter head.
High Level Supervision Alarm	The product in the tank is at a critically high level.	1. Remove product from the tank.

Table 7-2: Status - Maintenance Request

Message	Description	Recommended actions
Loop Current Fixed	The analog output channel has been set to a fixed output.	1. Put the analog output channel back to variable output.
Device Simulation Active	The measurement output from the device is currently being simulated.	1. Use the **Simulation Mode** method to enable or disable simulation.
Internal temperature out of limits	Internal temperature is outside its limits (-40 °C to +80 °C).	1. Check ambient temperature at installation site.
Configuration Warning - Unsupported Combination of Functions	Please consult the reference manual for details.	1. Check device configuration.
Configuration Warning - Function not Supported	Support for the configured functions has not been purchased.	1. Upgrade the device. 2. Set measurement mode to **Level**. 3. Turn off Signal Quality Metrics. 4. Turn off Vapor Compensation.

Table 7-2: Status - Maintenance Request *(continued)*

Message	Description	Recommended actions
Configuration Error - Vapor Compensation not Calibrated	The vapor compensation function need to be calibrated to work properly.	1. Run the **Calibrate Vapor Compensation** function.
Measurement Error - Vapor Compensation Reflector Not Found	The device cannot find the reference reflector echo.	1. Check that the correct reference reflector is configured. 2. Check that the correct probe is attached. 3. Check if the probe needs to be cleaned. 4. Recalibrate vapor compensation.
Configuration Error - Invalid Volume Strapping Table	The volume calculation strapping table is incorrectly configured.	1. Check that the values in the strapping table are entered in increasing order. 2. Check that the number of strapping points to use is correct.
Configuration Error	Configuration Error	1. Load the default database to the device. 2. Restart measurement. 3. Reconfigure the device. 4. Contact Rosemount customer support.
Loop Current Saturated	The analog output channel is saturated because the level measurement is outside the configured analog output limits.	1. Check the analog output configuration.
Volume measurement warning - Level is out of Range	The level measurement is outside the configured volume range.	1. Check volume configuration.
Measurement Warning - Probe End Projection DC Estimation Limited	Probe End Projection DC estimation is outside the configured limit.	1. Check **Probe End Projection** configuration.
Measurement Warning - Vapor DC Estimation Limited	Vapor DC estimation is outside the configured limit.	1. Check **Vapor DC** configuration.
Measurement Warning - Interface Close To Maximum Range	The interface is close to the maximum the device can handle. If the interface thickness increases, the device may lose the interface echo.	1. Decrease the interface thickness in the tank.
Low Signal Quality Margin	Signal Quality is below the configured alarm level.	1. Clean any product buildup from the probe. 2. If the probe is corroded, consider replacing it.
Low Surface/Noise Margin	Surface/Noise Margin is below the configured alarm level.	1. Clean any product buildup from the probe. 2. If the probe is corroded, consider replacing it.
Level Supervision Test Mode Active - Test Mode Active	The device is in test mode and is not reporting actual information. Measurement output currently corresponds to position of verification reflector.	1. Use the **Start/Stop Test Mode** method for Level Supervision to start or stop test mode.

7.3.2 Diagnostic messages per NAMUR NE 107 (FOUNDATION™ Fieldbus)

Diagnostic messages per NAMUR NE 107 are listed in Table 7-3 to Table 7-5.

Table 7-3: Status - Failed

Message	Description	Recommended actions
Electronics Failure – Main Board	The device has detected a fault with an electrical component on the main board electronics module assembly.	1. Replace the transmitter head.
Electronics Failure – Output board	The device has detected a fault with an electrical component on the output board electronics module assembly.	1. Replace the transmitter head.
Internal Communication Failure	The communication between the main board and the output board has been lost.	1. Replace the transmitter head.
Memory Failure – Output Board	Configuration data has been corrupted or pending configuration changes have been lost due to loss of power before storage could complete.	1. Restart the device. 2. Reconfigure the device. 3. If error persists, it may indicate a faulty memory chip. Replace the transmitter head.
Internal Temperature Critical	The internal temperature of the device has reached critical levels and the integrity of the device electronics may be compromised. Environmental temperature should not exceed device specifications.	1. Verify that ambient temperature is within the specified range. 2. Remote mount the transmitter head away from the process and environmental conditions. 3. Restart the device. 4. If the condition persists, replace the device.
Software Failure	The device software has encountered an error. Reasons may be multiple, including too low supplied voltage, or an error being simulated.	1. Make sure that enough voltage is supplied to the device. 2. Restart the device. 3. Turn off simulation of device failure. 4. If the alert persists, replace the transmitter head.
Software Incompatibility Error	Fieldbus software and main firmware versions are incompatible.	1. Replace the transmitter head.
Probe Missing	The transmitter cannot detect the probe.	1. Check that the probe is properly connected.
Sensor Database Error	The device has found an error in the configuration database.	1. Load default database to the device to clear the error and restart device. 2. Reconfigure the device. 3. If the alert persists, replace the transmitter head.

Table 7-4: Status - Function Check

Message	Description	Recommended actions
Check function	One or more Transducer Blocks are in Out of Service mode.	1. Return Transducer Block to **Auto** mode.

Table 7-5: Status - Maintenance Required

Message	Description	Recommended actions
Level/Interface Measurement Failure	There is no valid level reading. Reasons may be multiple: • No valid surface echo peak in the measuring range • Incorrect transmitter configuration	1. Analyze echo curve for reason and check device configuration. 2. Check device installation (for instance probe contamination). 3. Load default database to the device and reconfigure it. 4. If error persists it might indicate a hardware error. Replace the transmitter head.
Volume Measurement Failure	Reasons may be multiple: • Incorrect volume configuration • Level measurement invalid	1. If **Level Measurement Failure** is active, clear that alert first. 2. Check volume configuration 3. Load default database to the device and reconfigure it. 4. If error persists it might indicate a hardware error, replace the transmitter head.
Volume Measurement Warning	The level measurement is outside the configured volume range.	1. Check volume configuration.
Internal Temperature Out of Limit	The temperature of the electronics board has exceeded the transmitter's operating range.	1. Verify that ambient temperature is within the operating range. 2. Restart the device. 3. Remote mount the transmitter head away from the process and environmental conditions. 4. If the condition persists, replace the device.
Measurement Error	The device cannot find the reference reflector echo.	1. Check that the correct reference reflector is configured. 2. Check that the correct probe is attached. 3. Check if probe needs to be cleaned. 4. Recalibrate **Vapor Compensation**.

Table 7-5: Status - Maintenance Required *(continued)*

Message	Description	Recommended actions
Measurement Warning	The interface is close to the maximum the device can handle. If the interface thickness increases, the device may lose the interface echo.	1. If **Interface Thickness Close to Max** is checked, decrease the thickness interface in the tank
	Probe End Projection Dielectric Constant estimation is outside the configured limit.	1. If **Probe End Projection DC Estimation Limited** is checked, check **Probe End Projection** configuration.
	Vapor Dielectric Constant estimation is outside the configured limit	1. If **Vapor DC Estimation Limited** is checked, check **Vapor Dielectric Constant** configuration.
Configuration Error	Start Code and Measurement Mode Mismatch.	If **Start code and Measurement Mode Mismatched** is checked: 1. Upgrade the device. 2. Set measurement mode to **Level**.
	The volume calculation strapping table is incorrectly configured.	If **Invalid Strapping Table** is checked: 1. Check that the values in the strapping table are entered in increasing order. 2. Check that the number of strapping points to use is correct.
	The vapor compensation function needs to be calibrated to work properly.	If **Vapor Compensation Not Calibrated** is checked: 1. Run the **Calibrate Vapor Compensation** function.
	Other Configuration Error.	If **Configuration Error** is checked: 1. Load the default database to the device. 2. Restart measurement. 3. Reconfigure the device. 4. Contact Rosemount customer support.
Configuration Warning	Unsupported combination of functions.	1. if **Unsupported Combination of Functions** is checked, check device configuration.
	Support for the configured functions has not been purchased.	If **Signal Quality Not Supported** or **Vapor Compensation not supported** is checked: 1. Upgrade the device. 2. Turn off Signal Quality Metrics. 3. Turn off Vapor Compensation.
	Process Seal and Probe Type Mismatch.	1. If **Process Seal and Probe Type Mismatch** is checked, check configuration of Probe Type and Process Seal using Rosemount Radar Master.
	Unsupported Probe Type.	1. If **Unsupported Probe Type** is checked, check Probe Type configuration.
Device Simulation Active	The measurement output from the device is currently being simulated.	1. Use **Start/Stop Device Simulation** to enable or disable simulation.

Table 7-5: Status - Maintenance Required *(continued)*

Message	Description	Recommended actions
Signal Quality Low	The Signal Quality is below the defined alert limit.	1. Take action based on your intended use of this alert. 2. Clean the probe. 3. If no actions are necessary, consider to change the limit.
Surface/Noise Margin Low	The Surface/Noise Margin is below the defined alert limit.	1. Take action based on your intended use of this alert. 2. Clean the probe. 3. If no actions are necessary, consider changing the limit.

7.3.3 Status messages in Rosemount Radar Master

Device status

Device status messages that may appear on the display or in Rosemount Radar Master are shown in Table 7-6:

Table 7-6: Device status

Message	Description	Action
Running Boot Software	The application software could not be started.	Contact Emerson Service Department.
Device Warning	A device warning is active.	See Warning Messages for details.
Device Error	A device error is active.	See Error Messages for details.
Sim Mode 0 Active	The simulation mode is active.	Turn off the simulation mode in Rosemount Radar Master, select Tools, Simulation Mode, and click the Stop button.
Advanced Simulation Mode Active	The advanced simulation mode is active.	To turn off the Advanced Simulation mode, set Holding Register 3600=0 (see View/edit holding registers).
Interface Invalid	The interface measurement is invalid.	Check the Error Messages, Warning Messages, and the Interface Status for details.
Invalid Measurement	The level measurement is invalid.	Check Error Messages, Warning Messages, and Measurement Status for details.
User Register Area Write Protected	The configuration registers are write protected.	Use the Lock/Unlock function to turn off the write protection (see Write protection).
Write Protected Jumper Set	Write protection jumper on the display is enabled.	Remove the write protection jumper.
Factory Settings Used	The factory default configuration is used.	The transmitter has lost its calibration. Contact Emerson 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 display or in Rosemount Radar Master are shown in Table 7-7. Errors normally result in Analog Output alarm.

Errors are indicated in Rosemount Radar Master in the *Diagnostics* window.

Table 7-7: Error Messages

Message	Description	Action
RAM error	An error in the gauge data memory (RAM) has been detected during the startup tests. **Note** This automatically resets the gauge.	Contact Emerson service department.
FPROM error	An error in the gauge program memory (FPROM) has been detected during the startup tests. **Note** This automatically resets the gauge.	Contact Emerson service department.
Database (Hreg) error	An error in the transmitter configuration memory (EEPROM) has been detected. The error is either a checksum error that can be solved by loading the default database or a hardware error. **Note** The default values are used until the problem is solved.	Load default database and restart the transmitter. Contact Emerson service department if the problem persists.
Microwave Module error	An error in the microwave module.	Contact Emerson service department.
LCD error	An error in the LCD is detected.	Contact Emerson service department.
Modem error	An error in the modem used for digital communication has been detected.	Contact Emerson service department.
Analog out error	An error in the Analog Out Module.	Contact Emerson service department.
Internal temperature error	An error in the internal temperature measurement. -40 °C<Internal Temperature<85 °C.	Contact Emerson service department.
Other hardware error	An unspecified hardware error has been detected.	Contact Emerson service department.
Measurement error	A serious measurement error has been detected.	Contact Emerson 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) • Configure the transmitter or upload a backup configuration file (see Upload a backup configuration to device) • Contact Emerson service department if the problem persists
Software error	An error has been detected in the transmitter software.	Contact Emerson service department.

Warnings

Table 7-8 shows a list of diagnostic messages that may be displayed on the display or in Rosemount Radar Master. Warnings are less serious than errors and in most cases do not result in Analog Output alarms.

In Rosemount Radar Master, warnings are indicated in the *Diagnostics* window.

Table 7-8: Warning Messages

Message	Description	Action
RAM warning	See Diagnostics (Rosemount Radar Master: **Tools** → **Diagnostics**) for further information on a warning message. Also see View diagnostics in Rosemount Radar Master.	
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 display or in Rosemount Radar Master are shown in Table 7-9:

Table 7-9: Measurement Status

Message	Description	Action
Full tank	The level measurement is in Full Tank state. The transmitter waits for the surface echo to be detected at the top of the tank.	No action needed.
Empty tank	The level measurement is in Empty Tank state. The transmitter waits for the surface echo to be detected at the bottom of the tank.	No action needed.
Probe missing	Probe is not detected.	Check that the probe is correctly mounted. Check the connection between probe and transmitter head.
Seal contaminated	Suspected contamination of the seal has been detected.	Check if the seal connection with the probe is contaminated.
Reference pulse calculated	The position of the reference pulse is calculated from the internal reference pulse.	No action needed.
Reference pulse invalid	An error in the reference pulse in the last sampled tank signal.	Check Warning messages. If MicroWave Module (MWM) Warning is active, this might indicate a transmitter error. Contact Emerson Service Department.

Table 7-9: Measurement Status *(continued)*

Message	Description	Action
DeltaF not at setpoint	The DeltaF is not correctly regulated.	Check Warning Messages. If MicroWave Module (MWM) Warning is active, this might indicate a transmitter error. Contact Emerson Service Department.
Tank signal clip warning	The last Tank Signal was clipped.	Check Warning Messages. If MWM Warning is active, this might indicate a transmitter error. Contact Emerson Service Department.
No surface echo found	The Surface Echo Pulse cannot be detected. Possible cause: • Wrong surface threshold • Liquid level in Blind Zone or below probe end	Check if the configuration can be changed so that the surface echo can be tracked in this current region. View the Echo Curve plot and check surface threshold.
Predicted level	The presented level is predicted. The surface echo could not be detected.	Check if the configuration can be changed so that the surface echo can be tracked in this current region. View the Echo Curve plot and check surface threshold.
No reference echo	The Reference Echo Pulse cannot be detected. Possible cause: • 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.
Reduced reference echo	The reference echo has been found with reduced amplitude.	No action needed.
In full tank state	The level measurement is in the full tank state, waiting for a surface echo detection at the top of the tank.	No action needed.
Sampling failed	The sampling of the last tank signal failed.	Check Warning Messages.
Invalid volume value	The given volume value is invalid. The given measurements are simulated.	Check Volume Status for details.
Sim mode 0 active	The simulation mode is active. The given measurements are simulated.	Turn off the simulation mode.
Advanced Simulation Mode active	The advanced simulation mode is active.	To turn off the Advanced Simulation mode, set Holding Register 3600=0 (see View/edit holding registers).
Invalid Lower Volume Value	The given lower volume value is invalid.	Check Lower Volume Status for details.
Invalid Upper Volume Value	The given upper volume value is invalid.	Check Upper Volume Status for details.
Using probe end projection measurement	The probe end projection is active in the transmitter software.	No action needed.
Reference echo present	An echo has been detected in the reference zone.	No action needed.

Table 7-9: Measurement Status *(continued)*

Message	Description	Action
Sudden level jump detected	This may result from various measurement problems, such as: • Rapid level changes • Surface level within Blind Zone • Disturbing echo	Check the tank to find out what causes problem to track the surface. • Set the Rapid Level Changes parameter, see Rapid level changes. • In the Blind Zones, the level may jump to Full Tank/End of Probe • See Disturbance echo handling.
Nearzone echo present	An echo has been detected in the nearzone.	No action needed.
Nonlinear gain used	The nonlinear gain is enabled.	No action needed.
Nearzone measurement	The current sweep can be used as a measurement of the nearzone.	No action needed.

Interface status

Interface status messages that may appear on the display or in Rosemount Radar Master are shown in Table 7-10:

Table 7-10: 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	No action needed.
	Interface threshold to high	Adjust Interface threshold, see Example 2: Interface peak not found.
Can't measure interface on horizontal probe	Interface cannot be measured when the probe is horizontally mounted.	Change the probe mounting or turn off interface measurement by changing the measurement mode.
Can't handle max possible interface thickness	With the current configuration, the maximum measurement range is too short to guarantee that the interface echo can always be found.	Accept the limitation or change the tank environment and device configuration.
Interface thickness close to max range	The interface is close to the limit where it will be lost due to the limited maximum measurement range.	No action needed but the interface echo may be lost if the upper product thickness increases.
Interface set to max thickness	No interface echo found. The upper product thickness is set the maximum value of the current level measurement.	No action needed.
Interface thickness greater than probe length	The interface was found below the probe end.	The Upper Product Dielectric Constant is probably incorrect.

Volume calculation status

Volume calculation status messages that may appear on the display or in Rosemount Radar Master are shown in Table 7-11:

Table 7-11: 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 display or in Rosemount Radar Master are shown in Table 7-12.

Note
Analog output status messages may not appear on the integral display while the Rosemount 5300 Level Transmitter runs in HART 7 multidrop mode.

Table 7-12: 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.

7.4 LCD error messages

Figure 7-2: The Rosemount 5300 Display Panel Displaying an Error Message

Table 7-13: Error Messages Displayed on the Rosemount 5300 Display Panel

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

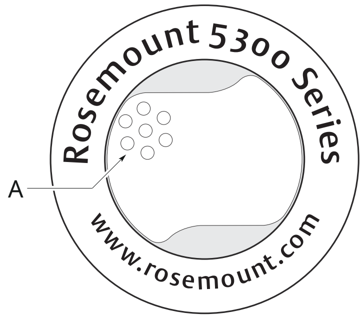
Related information

Errors

7.5 LED error messages

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

Figure 7-3: Rosemount 5300 Level Transmitter with LED



A. *Flashing LED*

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:

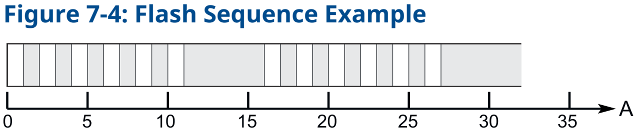
Table 7-14: LED Error Codes

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:

Figure 7-4: Flash Sequence Example



A. *Seconds*

7.6 FOUNDATION™ Fieldbus error messages

7.6.1 Resource block

This section describes error conditions found in the Resource block. Read Table 7-15 through Table 7-17 to determine the appropriate corrective action.

Block errors

Table 7-15 lists conditions reported in the BLOCK_ERR parameter.

Table 7-15: 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 7-16: Resource Block Summary_Status Messages

Condition name
Uninitialized
No repair needed
Repairable
Call Service Center

Table 7-17: Resource Block DETAILED_STATUS with Recommended Action Messages

Condition name	RECOMMENDED action
LOI Transducer block error	• Restart processor • Check display connection • Call service center
Sensor Transducer block error	• Restart processor • Check Rosemount 5300 cable • Call service center
Mfg. Block integrity error	• Restart processor • Call service center

Table 7-17: Resource Block DETAILED_STATUS with Recommended Action Messages *(continued)*

Condition name	RECOMMENDED action
Non-Volatile memory integrity error	• Restart processor • Call service center
ROM integrity error	• Restart processor • Call service center

7.6.2 Transducer Block

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

Table 7-18: Transducer Block Block_Err Messages

Condition name and description
Other
Out of Service: The actual mode is out of service

Table 7-19: 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.

7.6.3 Analog Input (AI) function block errors

Table 7-20 describes error conditions that are supported by the AI Block. Read Table 7-21 to determine the appropriate corrective action.

Table 7-20: AI BLOCK_ERR Conditions

Condition number	Condition name	Description
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.
15	Out of Service	The actual mode is out of service.

Table 7-21: 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)	• AI Block target mode set to OOS. • Resource Block OUT OF SERVICE.
	BLOCK_ERR reads CONFIGURATION ERROR	• Check CHANNEL parameter (see CHANNEL). • Check L_TYPE parameter (see L_TYPE). • Check XD_SCALE engineering units. (see XD_SCALE and OUT_SCALE).
	BLOCK_ERR reads POWERUP	Download Schedule into block. Refer to host for downloading procedure.
	BLOCK_ERR reads BAD INPUT	• Sensor Transducer Block Out Of Service (OOS). • Resource Block Out of Service (OOS).
	No BLOCK_ERR but readings are not correct. If using Indirect mode, scaling could be wrong	• Check XD_SCALE parameter. • Check OUT_SCALE parameter. (see XD_SCALE and OUT_SCALE).
OUT parameter status reads UNCERTAIN and substatus reads EngUnitRangViolation	Out_ScaleEU_0 and EU_100 settings are incorrect.	See XD_SCALE and OUT_SCALE.
Mode will not leave OOS	Target mode not set	Set target mode to something other than OOS.
	Configuration error	BLOCK_ERR will show the configuration error bit set. The following are parameters that must be set before the block is allowed out of OOS: CHANNEL must be set to a valid value and cannot be left at the initial value of 0. XD_SCALE.UNITS_INDX must match the units in the transducer block channel value. L_TYPE must be set to Direct, Indirect, or Indirect Square Root and cannot be left at the initial value of 0.
	Resource block	The actual mode of the Resource block is OOS. See Resource Block Diagnostics for corrective action.
	Schedule	Block is not scheduled and therefore cannot execute to go to Target Mode. Schedule the block to execute.
Process and/or block alarms will not work	Features	FEATURES_SEL does not have Alerts enabled. Enable the Alerts bit.
	Notification	LIM_NOTIFY is not high enough. Set equal to MAX_NOTIFY.
	Status Options	STATUS_OPTS has Propagate Fault Forward bit set. This should be cleared to cause an alarm to occur.

Table 7-21: Troubleshooting the AI Block *(continued)*

Symptom	Possible causes	Recommended actions
Value of output does not make sense	Linearization Type	L_TYPE must be set to Direct, Indirect, or Indirect Square Root and cannot be left at the initial value of 0.
	Scaling	Scaling parameters are set incorrectly: XD_SCALE.EU0 and EU100 should match that of the transducer block channel value. OUT_SCALE.EU0 and EU100 are not set properly.
Cannot set HI_LIMIT, HI_HI_LIMIT, LO_LIMIT, or LO_LO_LIMIT Values	Scaling	Limit values are outside the OUT_SCALE.EU0 and OUT_SCALE.EU100 values. Change OUT_SCALE or set values within range.

7.7 Troubleshooting guide

If there is a malfunction despite the absence of diagnostic messages, see Table 7-22 for information on possible causes.

Table 7-22: 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 View diagnostics in order to check active status messages • Check if "Probe Missing" is active. If it is, check the probe connection
No HART communication.	• COM Port configuration does not match the connected COM Port • Cables may be disconnected • Wrong HART address is used • Hardware failure • HART resistor	• Check that correct COM Port is selected in the HART server (see Specify the COM port) • Check wiring diagram • Verify that the 250 Ω resistor is in the loop. • Check cables • Ensure that correct HART short address is used. Try address=0 • Check Analog Output current value to verify that transmitter hardware works • Check that the correct settings are used in Rosemount Radar Master. Select Device, Search from the menu. Click Settings and HART tab. Ensure the values are properly chosen. The standard values are shown in Specify the COM port.

Table 7-22: Troubleshooting Chart *(continued)*

Symptom	Possible cause	Action
Analog Out is set in Alarm.	Measurement or transmitter failure.	View the Diagnostic window, see View diagnostics 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 Measurement mode).
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	No action required.
	Surface pulse and Interface pulse are very close	Use the Echo Curve plot to verify that the surface and interface are close, see Analyzing the measurement signal.
Surface pulse is detected, but Level is incorrectly reported as Full or Empty.	• Wrong Probe Type set • Bad Reference Threshold value	View the Diagnostics window, see View diagnostics, 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
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
	Large coaxial probe is used	No action
Incorrect Interface Level reading.	• Interface threshold incorrect • Upper Product Dielectric constant incorrect	• Adjust Interface threshold, see Example 2: Interface peak not found • Check the Upper Product Dielectric constant, see Upper product dielectric constant
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 • Adjust the Surface amplitude threshold, see Example 1: Product surface peak not found

Table 7-22: Troubleshooting Chart *(continued)*

Symptom	Possible cause	Action
Both Surface pulse and Interface pulse are detected, but no interface is present in the tank.	Double bounce handling does not work properly.	Verify that the following parameters are correctly configured: • Nozzle Height • Upper Product Dielectric Constant • Lower Product Dielectric Constant
Integral display does not work.		• Check the display configuration • Check loop power • Check Display connection • Contact Emerson Service Department (1)
FOUNDATION Fieldbus Card to Transmitter Communication Fault		• Verify Device Mode setting, should be FOUNDATION Fieldbus (Parameter: ENV_DEVICE_MODE) • Restart method from Resource Block • Reboot gauge (Cycle Power)
Level Measurement Failure		• Check Power Supply • Check the gauge configuration (Transducer Block) • Check that the mechanical installation is correct
Temperature Measurement Failure		• Check ambient temperature (2) • Restart gauge • Contact Emerson Service Department
Volume Measurement Failure		• Restart gauge • Check gauge configuration using PC Based configuration tool
No surface echo		• Check signal strength • Restart transmitter • See Example 1: Product surface peak not found
DB Error/ Microwave Unit Error/ Configuration Error/ Other Error		• Restart transmitter • Set database to default; load default Database • Download Application Software • Call Service Center
SW Error/ Display Error/ Analog Out Error		• Restart transmitter • Call Service Center

(1) *A malfunctioning display panel may only be replaced by service personnel at the Emerson service department. A display must not be replaced when the transmitter is in operation.*

(2) If the Rosemount 5300 Level Transmitter has been exposed to temperatures outside the specified limits, the device may stop its normal operation.

7.7.1 Troubleshooting the HART® to Modbus® Converter

No communication on RS-485 bus (MA, MB)

Recommended actions

1. Check that the cables are connected.
2. Check that PWR+ is connected to + and PWR- is connected to - on the power supply.
3. Ensure the Rosemount 5300 Level Transmitter is supplied with 8-30 Vdc (max. rating).
4. Try alternating MA/MB if you are unsure of the polarity.
5. If an RS-485 converter is used, make sure it is properly installed and configured.
6. The last Rosemount 5300 Level Transmitter may need a terminating 120Ω resistor connected between MA and MB.

No communication in RRM using HART+, HART-

Recommended actions

1. Verify the HART modem is properly connected.
2. Check if device is at an alternate HART address (default 1).

No communication in RRM using MA, MB

Recommended actions

1. Check if device is at an alternate HART address (default 1).
2. Cycle the power and wait 20 seconds before polling.

Related information

No communication on RS-485 bus (MA, MB)

No communication with Modbus RTU protocol

Recommended actions

1. Make sure the Modbus communication protocol configuration is done properly.
2. Make sure the Modbus RTU address is unique on the bus.
3. Cycle the power and try to connect.
4. Check the RTU communication settings.

Related information

No communication on RS-485 bus (MA, MB)
Modbus communication protocol configuration

No communication with Modbus ASCII protocol

Recommended actions

1. Make sure the Modbus communication protocol configuration is done properly.

2. Make sure the Modbus ASCII address is unique on the bus.
3. Cycle the power, waiting 40 seconds before communication begins.
4. Check the RTU communication settings.

Related information

No communication on RS-485 bus (MA, MB)
Modbus communication protocol configuration

No communication with Levelmaster protocol

Recommended actions

1. Make sure the Modbus communication protocol configuration is done properly.
2. Make sure the Levelmaster address is unique on the bus.
3. Cycle the power, waiting 40 seconds before communication begins.
4. Check the RTU communication settings.

Related information

No communication on RS-485 bus (MA, MB)
Modbus communication protocol configuration

7.8 Service and troubleshooting tools

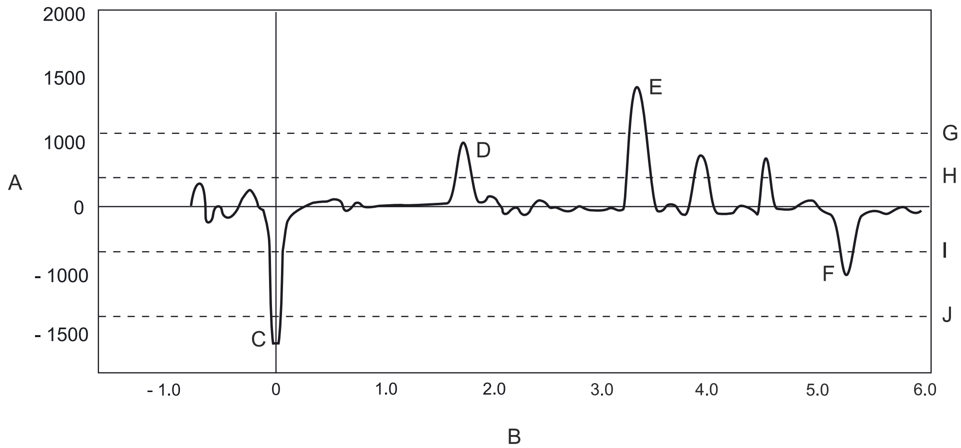
7.8.1 Analyzing the measurement signal

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

Note

Figure 7-5 illustrates the key elements of a theoretical echo curve. In an actual echo curve, the probe end pulse and the probe end echo threshold line are not visible in an interface application, they are shown for illustration purposes only.

Figure 7-5: The Echo Curve Function Presents All Visible Echoes



A. Amplitude, mV
B. Distance, m
C. Reference
D. P1 Surface
E. P2 Interface
F. Probe End
G. Interface Threshold
H. Surface Threshold (ATC)
I. Probe End Threshold
J. Reference Threshold

Echo peaks

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

Reference peak

This peak is caused by the transition between transmitter and the tank vapor space or air. It is used by the transmitter as a starting reference point for distance to the level surface. The echo peak amplitude depends on the probe type and installation geometry.

Note
No reference peak will be included in the echo curve of a large coaxial probe. An internal reference point is used for the large coaxial probe.

Product surface peak

This peak indicates the product level and is caused by a reflection from the product surface.

The signal strength of the reflection depends on the dielectric constant of the product. Product with a high dielectric constant (for example water) gives better reflection (a strong signal amplitude) than product with a low dielectric constant (for example oil).

Interface peak

This peak indicates the interface level. The peak is caused by reflection from the interface between an upper product and a bottom product with a relatively high dielectric constant. This peak is identified when the measurement mode is set to Product Level and Interface Level or Interface Level with Submerged Probe.

Probe end peak

It is caused by reflection from the probe end. If the probe is grounded, the peak will be positive. If the probe end is submerged in a high dielectric media, such as water, it will not be visible.

7.8.2 The echo curve analyzer

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

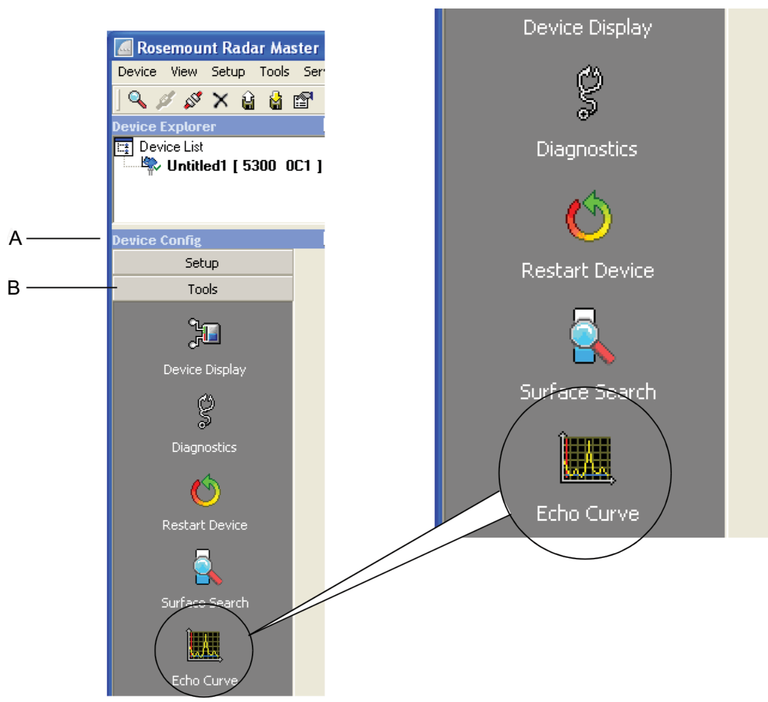
Use the echo curve analyzer in Rosemount Radar Master

To plot the measurement signal:

Procedure

1. Start Rosemount Radar Master.
2. Open **Device Config/Tools** (or **Device Config/Setup**).
3. Select the **Echo Curve** icon.

Figure 7-6: The Echo Curve Function Is a Useful Tool for Signal Analysis



A. Device Config
B. Tools

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

The configuration mode tab

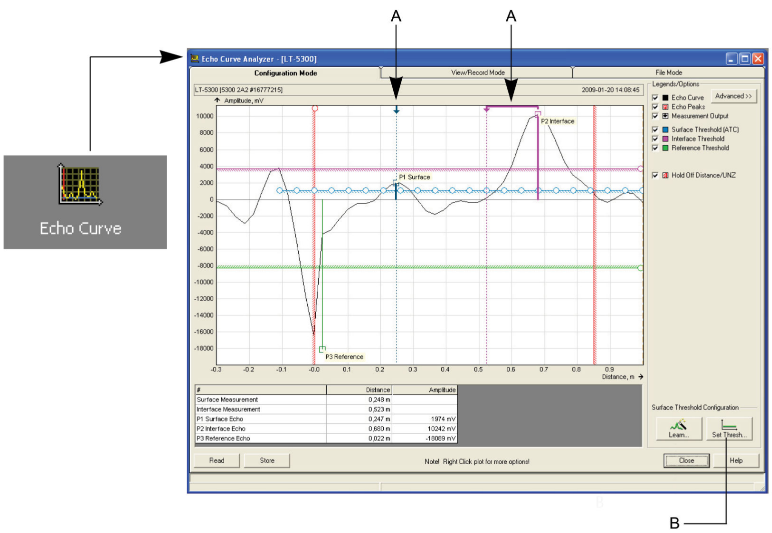
The Configuration Mode tab lets you adjust the different amplitude thresholds. When clicking the **Echo Curve** icon under *Device Config/Setup*, the *Echo Curve Analyzer* window appears with the **Configuration Mode** tab selected.

See the Rosemount Radar Master online-help for descriptions of the various display options in the *Echo Curve Analyzer* window.

Note

By manually changing the amplitude thresholds in the Echo Curve plot, the Automatic mode is disabled for the corresponding threshold (see Amplitude thresholds for more information on how to adjust the amplitude thresholds).

Figure 7-7: Echo Curve Analyzer Plot in Configuration Mode



A. Measurement Output
B. Set Threshold

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

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

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

Modify ATC

The ATC can also be manually edited if further fine tuning is needed.

Procedure

Click and drag one circle at the time in the ATC in order to raise or lower the threshold at a certain position in the tank. You may zoom in (left click and drag) for higher resolution when modifying ATC points.

Set surface threshold to a fixed value

Procedure

Select the **Set Threshold** button to set the ATC to a fixed value (a horizontal line).

Set interface threshold

Procedure

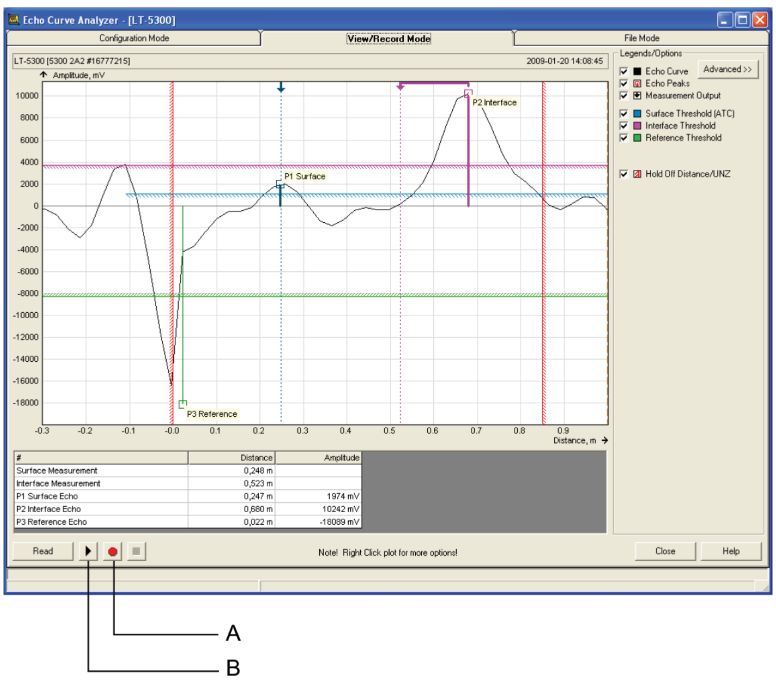
Drag the circle on the right hand side to modify the threshold or right click the circle and select **Properties** to enter a value.

The view/record mode tab

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 7-8: An Echo Curve Plot in View/Record Mode



A. Record tank spectra
B. Play (continuously updates the spectrum)

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 mode tab

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.

Use the echo curve analyzer with a handheld communicator

Using a handheld communicator that supports the Electronic Device Description Language (EDDL) with enhancements 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.

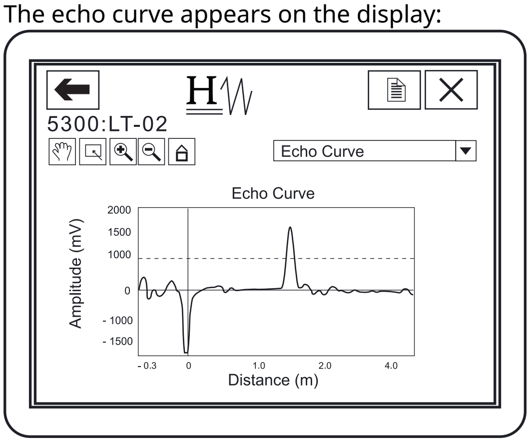
View the echo curve

To view the echo curve:

Procedure

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

   The echo curve appears on the display:

2. Use the Hand and Zoom tools to view specific parts of the Echo Curve.

   The drop down list allows you to choose items, such as the different amplitude thresholds, to be displayed in the plot.

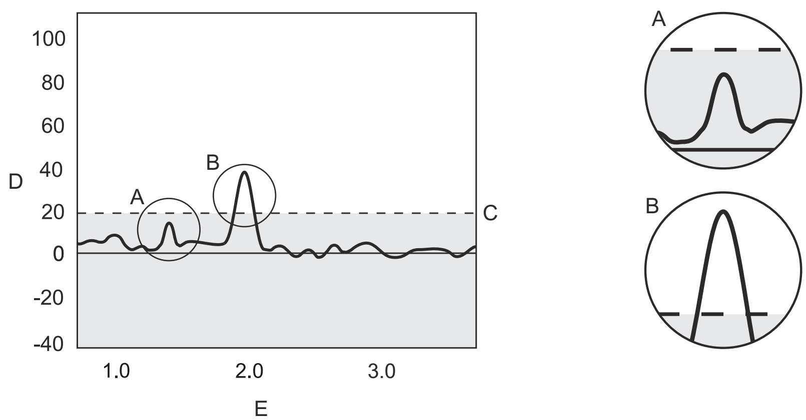
   The echo curve plot also shows an ATC if available. See Adjust thresholds using a handheld communicator for further threshold options.

7.8.3 Amplitude thresholds

Measurement with the Rosemount 5300 is based on the fact that the radar signal pulses are reflected by the product surface and the interface between two liquids. Signal amplitude thresholds are used to separate the measurement signal from disturbing echoes and noise.

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, as illustrated in Figure 7-9. 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.

Figure 7-9: Threshold Principle



A. *The echo peak is below the threshold (dotted line) and is suppressed by the device.*
B. *This echo peak is interpreted as the product surface, since it is the first peak closest to device that is above the surface threshold.*
C. *Threshold*
D. *Amplitude*
E. *Distance*

By default, the device automatically calculates threshold values depending on the measurement mode, various dielectric constant values and process conditions that you have configured. The configured Upper Product Dielectric Constant is used for setting the automatically calculated amplitude thresholds. Normally no other threshold adjustment is needed. But if the transmitter still does not track for example the product surface, it may be necessary to manually adjust the thresholds.

Reference threshold

Threshold to filter out noise in the echo curve for detection of the Reference peak. The reference peak is a strong negative echo very close to the device.(4)

Surface threshold

Threshold to filter out noise in the echo curve for detection of the Surface. Noise below the threshold is suppressed. The first echo peak closest to the device that crosses and is above the Surface Threshold is the surface echo.

The surface threshold is designed as a number of individually adjustable amplitude threshold points, the Amplitude Threshold Curve (ATC), see Amplitude threshold curve.

Interface threshold

Threshold to filter out noise in the echo curve for detection of the Interface. The first echo peak after the surface echo that crosses and is above the Interface Threshold is the interface echo.

(4) *The reference threshold has no impact on the large coaxial probes since an internal reference point is used for those probes.*

Full tank threshold

Note
By default, the Full Tank Threshold Offset value is 0 (function is not used). Do not use this function unless you are qualified.

The Full Tank threshold is related to the Reference Threshold, and can be used for detecting that the tank is full.(5) 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.

By default, this value is 0 (function is not used). This is because highly contaminated or condensed tank-seals, and turbulent or boiling surfaces, which can cause splashing, may cause function to be triggered.

Probe end threshold

Threshold to filter out noise in the echo curve for detection of the Probe End peak. The probe end peak is a fairly strong positive or negative echo (depending on probe type) that is present at the probe end when tank is empty.

Guidelines for setting the amplitude thresholds

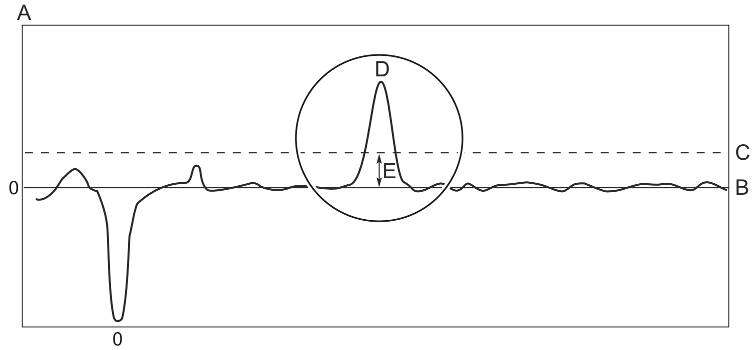
Normally, the amplitude thresholds are automatically set by the transmitter, and no manual settings are needed. However, due to the properties of the product, it may in rare cases be necessary to adjust the amplitude thresholds for optimum measurement performance.

Guidelines for setting the surface threshold

Before changing the Surface Threshold, ensure the product level is at least 20 in. (0.5 m) from the lower side of the device flange.

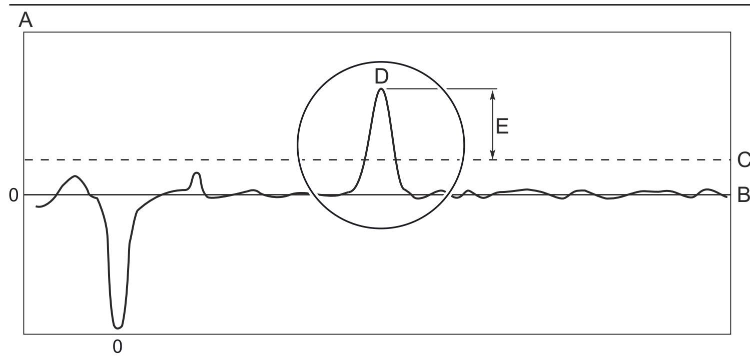
- Surface Thresholds should never be set to values less than:
  - 700 mV at distance 0-20 ft. (0-6 m) from the upper reference point.
  - 500 mV at distance more than 20 ft. (6 m) from the upper reference point.
- Set the Surface Threshold to about ⅓ of the weakest surface echo amplitude in the measuring range.

(5) *The full tank threshold has no impact on the large coaxial probes since an internal reference point is used for those probes.*



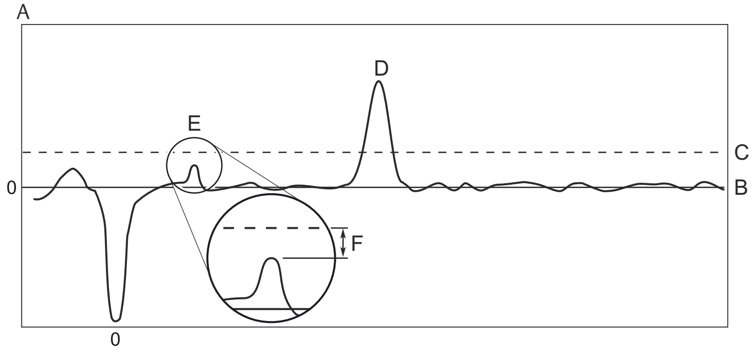
A. Amplitude (mV)
B. Distance
C. Surface Threshold
D. Surface echo
E. About ⅓ of surface echo amplitude

- Ensure to include a 500 mV margin between the Surface Threshold and the surface echo amplitude over the entire measuring range. For best performance, verify margin by lowering the product surface, or if not possible by using Figure 7-10 to Figure 7-12.



A. Amplitude (mV)
B. Distance
C. Surface Threshold
D. Surface echo
E. At least 500 mV margin

- Surface Threshold should be at least 500 mV greater than the amplitude of disturbances.



A. Amplitude (mV)
B. Distance
C. Surface Threshold
D. Surface echo
E. Disturbance
F. At least 500 mV margin

Contact your local Emerson representative if the transmitter is still having difficulties to track the product surface after applying the guidelines.

Guidelines for setting the interface threshold

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

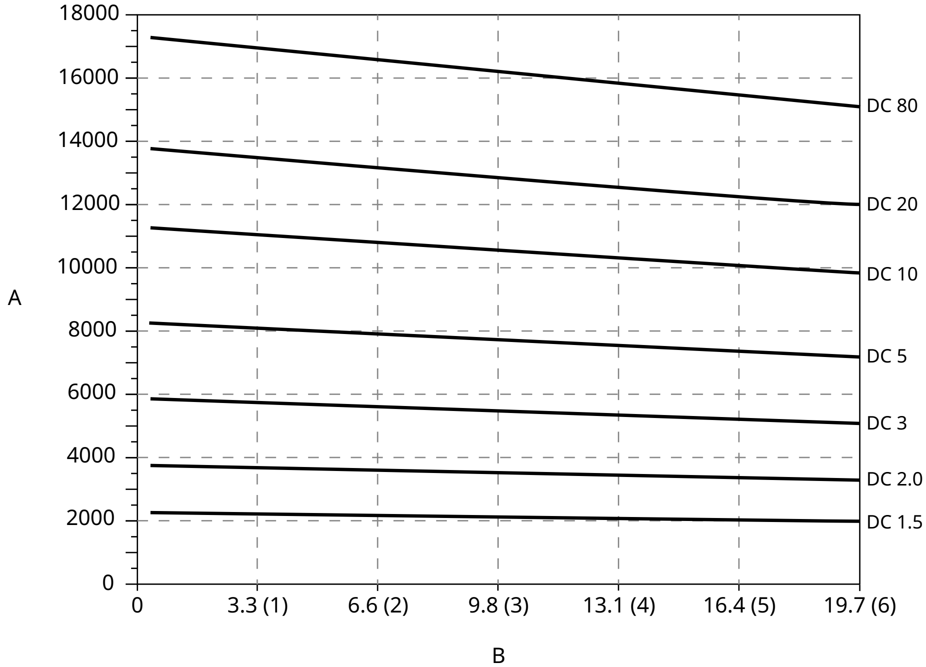
Typical surface echo amplitudes and thresholds

Figure 7-10 to Figure 7-12 shows typical signal amplitude of the surface echo (signal strength) at different distances to the surface. The signal amplitude of the surface echo depends on the dielectric constant of the product. Product with a high dielectric constant (for example water) gives better reflection (a strong signal amplitude) than product with a low dielectric constant (for example oil).

Note
The amplitude of the surface echo is also depended on the distance to the product surface. Since the signal is attenuated along the probe, the surface echo will be strongest close to the tank top, and then weaker further away from the tank top. In addition, the signal amplitude of the surface echo can vary because of product, foam, turbulence, ambient temperature and so on.

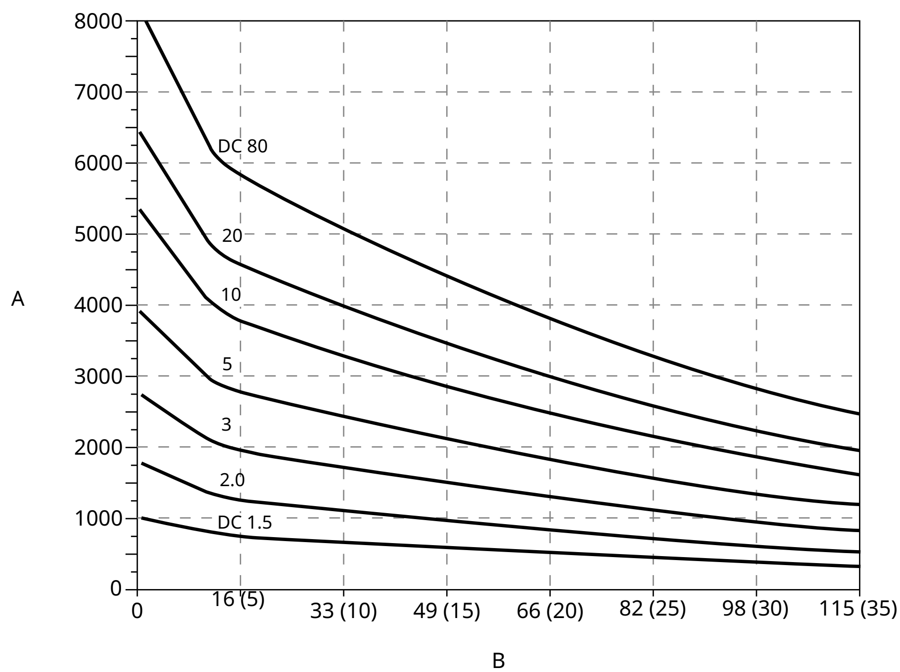
The values in Figure 7-10 to Figure 7-12 are estimations. Significantly different Surface Threshold values may have to be used to handle special tank conditions and applications.

Figure 7-10: Typical Surface Echo Amplitude for Coaxial/Large Coaxial Probes



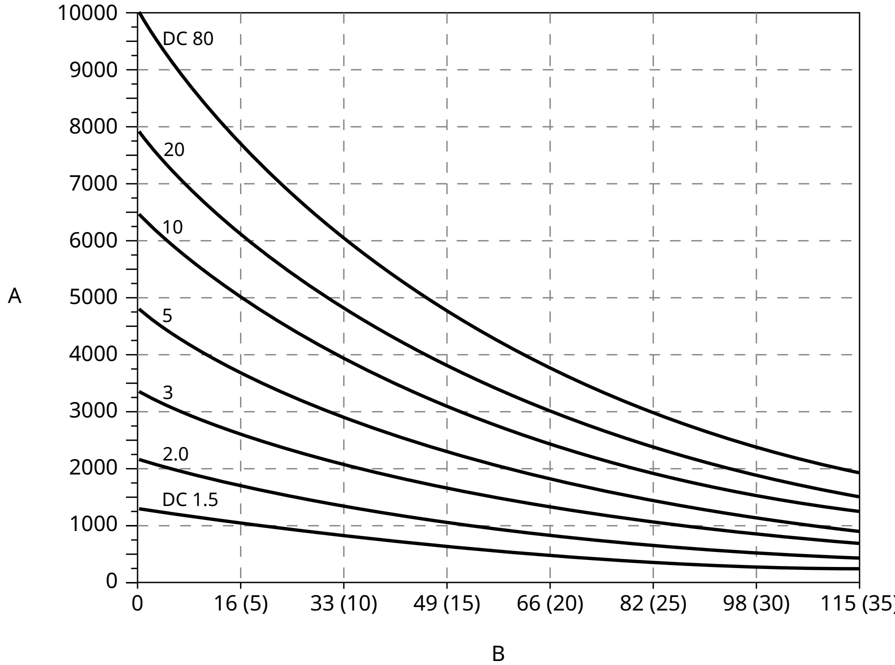
A. *Amplitude (mV)*
B. *Distance, ft. (m)*

Figure 7-11: Typical Surface Echo Amplitude for Single Lead Probes



A. *Amplitude (mV)*
B. *Distance, ft. (m)*

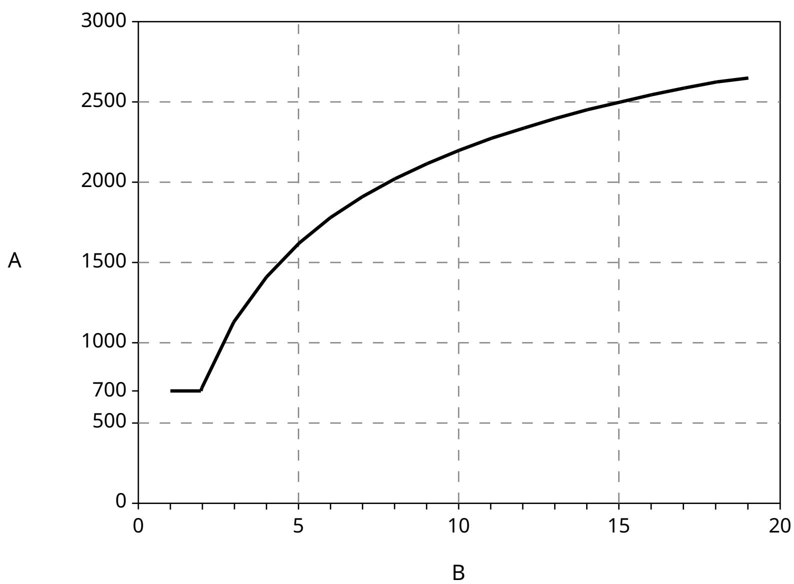
Figure 7-12: Typical Surface Echo Amplitude for Twin Flex Probe



A. *Amplitude (mV)*
B. *Distance, ft. (m)*

Figure 7-13 shows typical surface thresholds for different values of the upper product dielectric constant.

Figure 7-13: Typical Surface Threshold Values



A. *Amplitude (mV)*
B. *Dielectric constant of upper product*

Adjust thresholds using Rosemount Radar Master

Normally, the amplitude thresholds are automatically set by the Rosemount 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. Rosemount Radar Master supports threshold settings in the *Advanced Configuration* window.

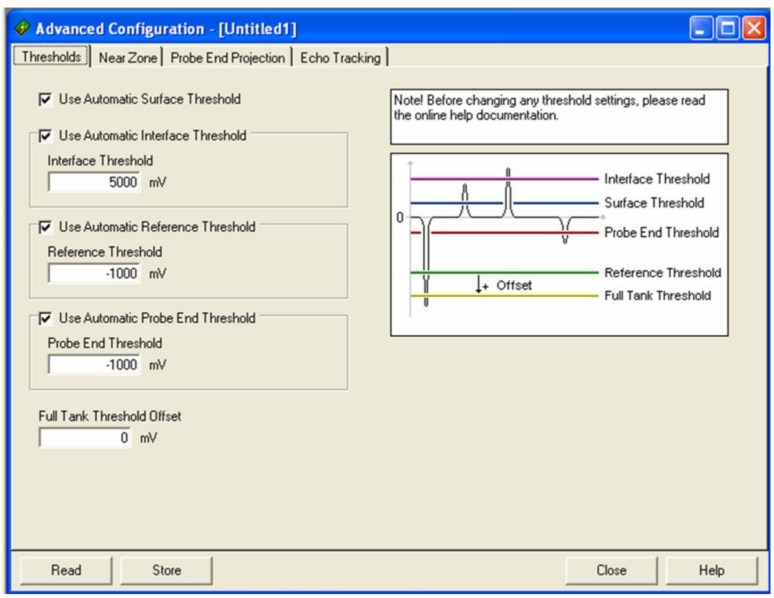
Prerequisites

Note
Before changing the amplitude thresholds, check that the Upper Product Dielectric Constant parameter is set as accurately as possible. The Upper Product Dielectric Constant is used for setting the automatically calculated amplitude thresholds.

Procedure

1. Select **Setup** → **Advanced**.
2. Select the **Thresholds** tab.

Figure 7-14: Threshold Settings in RRM



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

Adjust thresholds using a handheld communicator

To adjust the amplitude thresholds:

Prerequisites

Note
Before changing the amplitude thresholds, check that the Upper Product Dielectric Constant parameter is set as accurately as possible. The Upper Product Dielectric Constant is used for setting the automatically calculated amplitude thresholds.

Procedure

1. HART: Select HART **Service Tools** → **Echo Tuning** → **Thresholds**.
   FOUNDATION Fieldbus: Select HART **Service Tools** → **Echo Tuning** → **Echo Tuning**.
   The different threshold options appear on the display.
2. Open the desired option. For example, to specify a constant Surface Threshold:
   HART: Select **Surface** → **Set Threshold**.
   FOUNDATION Fieldbus: Select option **Surface Threshold** → **Set Threshold**.
   See also Analyzing the measurement signal and Amplitude thresholds for more information on how to use the amplitude thresholds.
3. Select **Save** and follow the instructions.

Automatic surface threshold

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

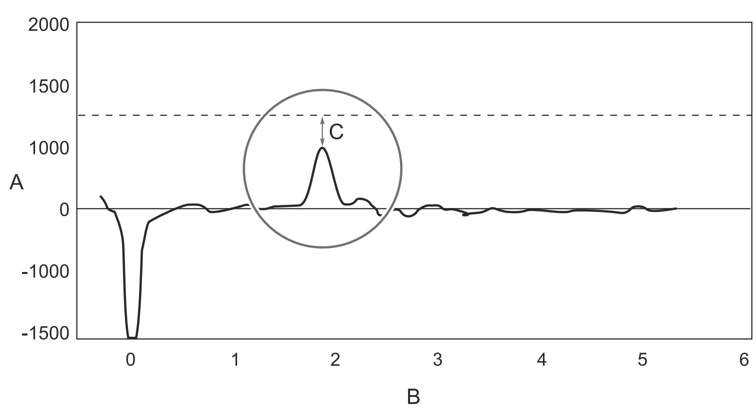
Note that by enabling the Automatic Surface threshold setting, the Amplitude Threshold Curve (ATC) is replaced by a constant threshold value.

The Surface threshold can also be manually set by using the Set Threshold function (see The configuration mode tab).

Example 1: Product surface peak not found

If the transmitter does not track the product surface correctly, it may be necessary to adjust the threshold values. In Figure 7-15, the Surface Threshold is too high and as a result the product level will not be detected. In a situation like this, the Surface Threshold has to be lowered so that the surface peak is not filtered out.

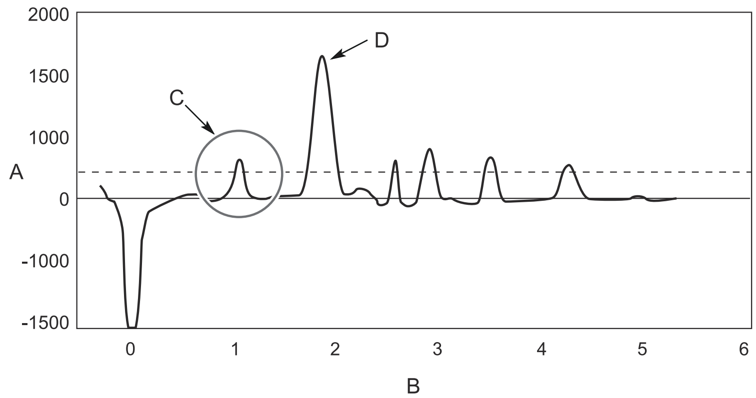
Figure 7-15: Surface Threshold Is Too High



A. Amplitude
B. Distance
C. Surface Threshold is above the Product Surface peak. Surface Threshold= Amplitude Threshold Curve (ATC)

If there are disturbing objects in the tank, the Surface Threshold must be carefully set to avoid locking on the wrong amplitude peak. In Figure 7-16, the Surface Threshold is too low, and as a result the transmitter has locked on a peak above the actual product surface. A disturbance was interpreted as the product surface, since this was the first amplitude peak closest to device that went above Surface Threshold. The actual product surface was interpreted as the interface or the probe end.

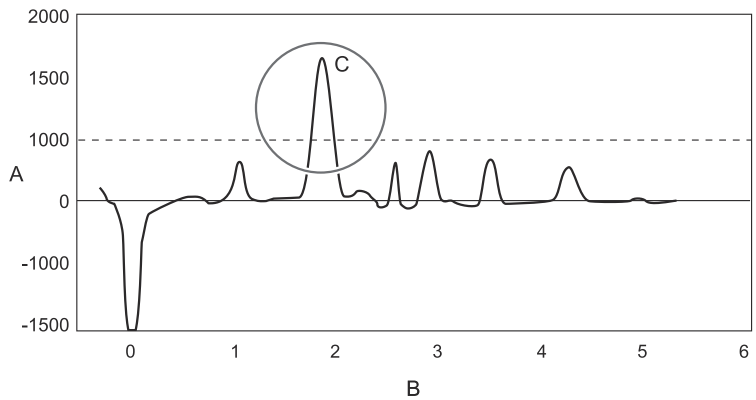
Figure 7-16: Surface Threshold Is Too Low



A. Amplitude
B. Distance
C. Disturbing echo misinterpreted as product surface
D. Actual product surface

By adjusting the Surface Threshold the product surface is properly detected as illustrated in Figure 7-17.

Figure 7-17: Echo Curve Plot after Surface Threshold Was Adjusted



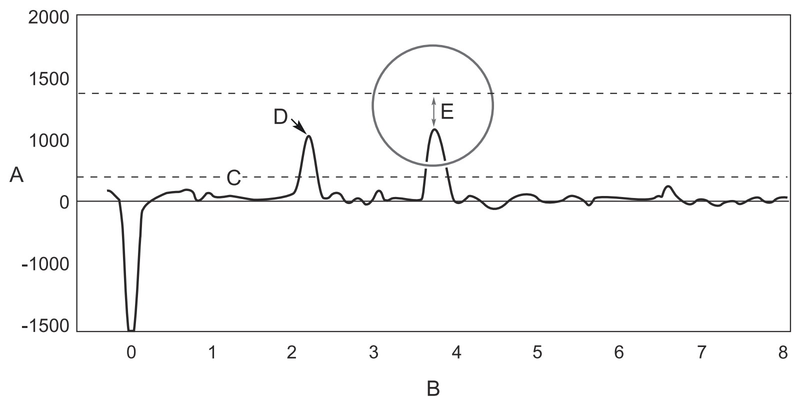
A. Amplitude
B. Distance
C. After Surface Threshold is adjusted the product surface is correctly detected.

Example 2: Interface peak 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 from the interface is relatively low and difficult for the transmitter to detect. In such a case it may be possible to detect the reflected signal from the interface if the Interface Threshold is adjusted.

Figure 7-18 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.

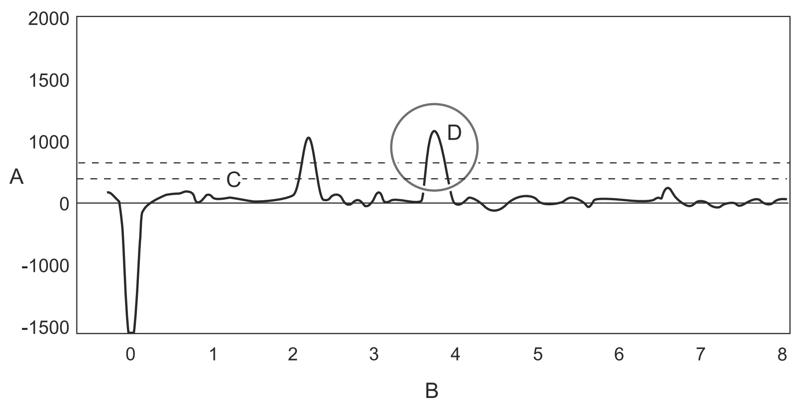
Figure 7-18: Echo Curve Plot Indicating that the Interface Threshold for the Interface Peak Is Too High



A. Amplitude
B. Distance
C. Surface Threshold
D. Product Surface Peak
E. The Interface Threshold is above the Interface Peak.

By adjusting Interface Threshold, the peak at the interface between the upper and lower products is detected as illustrated in Figure 7-19.

Figure 7-19: After Changing the Interface Threshold the Transmitter Detects the Interface



A. Amplitude
B. Distance
C. Surface Threshold
D. After Interface Threshold is adjusted the interface is correctly detected.

If the Lower Product Dielectric Constant is known, the corresponding configuration parameter can be changed as an alternative to adjusting the amplitude thresholds.

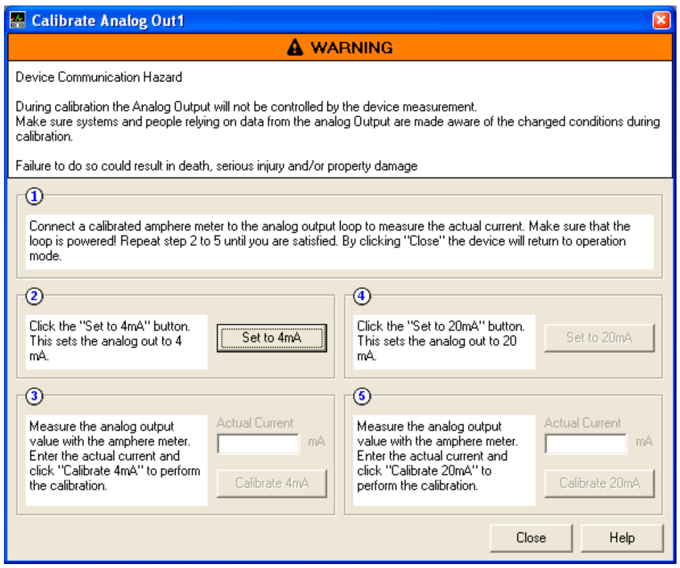
7.8.4 Calibrate analog output using Rosemount Radar Master

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

Procedure

1. Start Rosemount Radar Master and connect to device.
2. Select **Setup** → **Output**.
3. Select the **Analog Out 1** tab.
4. Select the **Calibrate DAC** button.

   If the **Calibrate DAC** button is hidden, then select **Advanced** for more options.
5. Follow the on-screen instructions to calibrate the 4 mA and the 20 mA outputs.



7.8.5 Logging measurement data

By using the Log Device Registers function in the Rosemount Radar Master 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.

Procedure

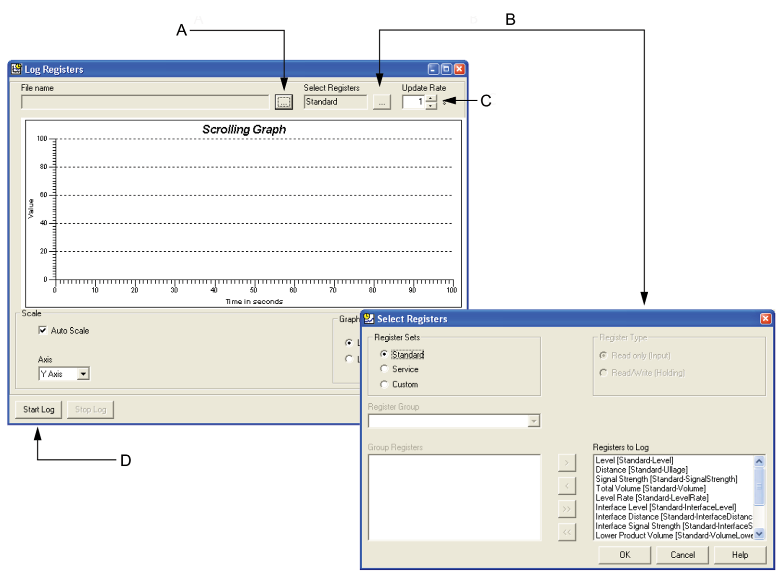
1. In Rosemount Radar Master, select **Tools** → **Log Device Registers.**
2. In the *Log Registers* window, select the **Browse** button.
3. Type your desired file name.
4. Browse to the desired directory, and then select **Save**.
5. Select the **Select Register** button.

6. Select the desired registers to be logged. There are three options available:

Option	Description
Standard	Logs the most common registers and are often sufficient.
Service	If you experience problems with your device you may be asked to send a Service Log to our service department.
Custom	Define your own set of parameters to log.

7. If **Custom** is selected, then:
    a) Select **Read only (Input)** or **Read/Write (Holding)**.
    b) In the *Register Group* list, select select the desired register group.
    c) Under *Group Registers*, select one of the parameters, and then select the right arrow button (>), or select the double arrow button (>>) to add the whole group.
8. Enter the update rate. An update rate of for example 10 seconds means that the plot will be updated every 10 seconds.
9. Select the **Start Log** button. The logging will proceed until stopped by clicking the **Stop Log** button.

Figure 7-20: The Log Registers Function



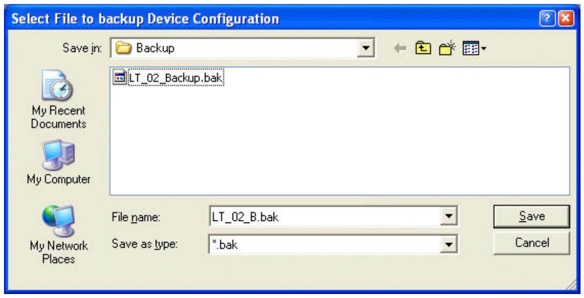
A. Browse
B. Select register
C. Update rate
D. Start log

7.8.6 Backing up the transmitter configuration

Use this Rosemount Radar Master 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.

Procedure

1. In Rosemount Radar Master, select **Device** → **Backup Config to File**.
2. Browse to the desired directory.



3. Type a name of the backup file, and then select **Save**.
   Now the transmitter configuration is stored.

7.8.7 Upload a backup configuration to device

To upload a backup configuration using Rosemount Radar Master:

Procedure

Select **Device** → **Upload Config to Device**.

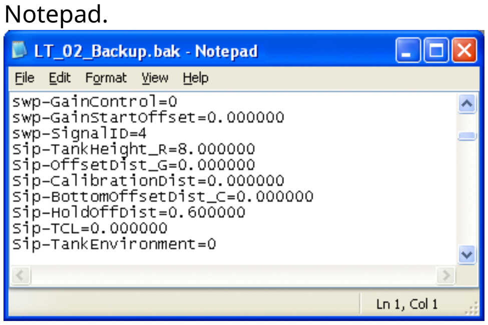
7.8.8 View backup files

The backup file can be viewed by using the Backup File Reader which is installed with the Rosemount Radar Master software.

Procedure

Click the **Start** button, and then select **All Programs** → **Rosemount** → **Radar Master Tools** → **Backup File Reader**.

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



See also Open the configuration report for further information on viewing backup files.

7.8.9 Open the configuration report

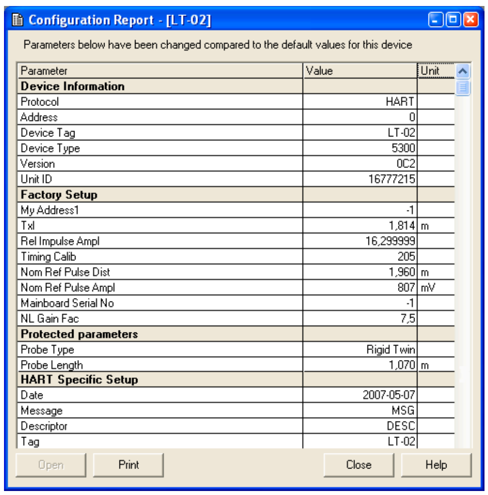
The configuration report shows what configuration changes have been done to the transmitter compared to the factory configuration. The report compares a specified backup file with the default transmitter configuration.

Procedure

1. In Rosemount Radar Master, select **Tools** → **Configuration Report**.
2. Browse to desired backup file to generate the configuration report from, and then select **Open**.

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

Figure 7-21: The Configuration Report Window in Rosemount Radar Master



7.8.10 Reset to factory settings

Reset to factory settings using Rosemount Radar Master

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

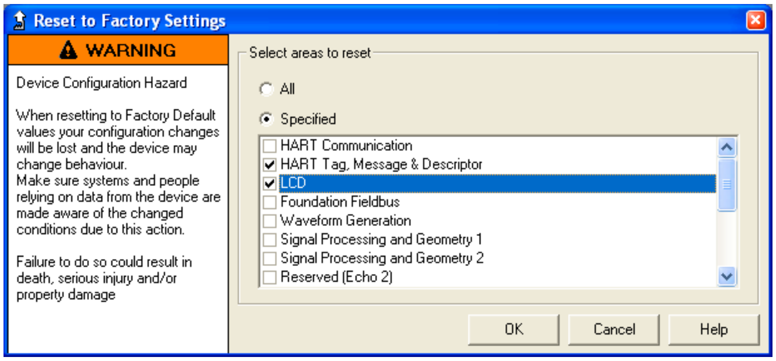
Prerequisites

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

Procedure

Select **Tools** → **Factory Settings**.

Figure 7-22: The Reset to Factory Settings Window in Rosemount Radar Master



Reset to factory settings using AMS Device Manager

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

Prerequisites

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

Procedure

1. Select option **Service Tools** → **Maintenance** → **Reset/Restore**.
2. HART: Select the **Restore Default Settings** button and follow the instructions.

   FOUNDATION Fieldbus: Select the **Reset to Factory Default** button and follow the instructions.

Reset to factory settings using DeltaV

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

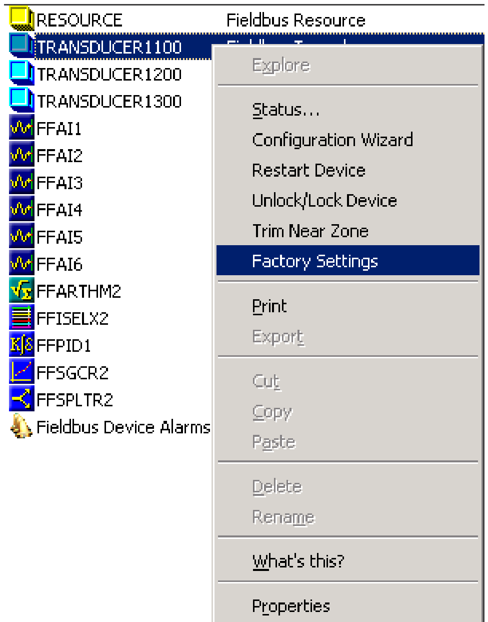
Prerequisites

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

Procedure

1. In the *DeltaV™ Explorer*, select the desired transmitter icon, and then right-click the **TRANSDUCER1100** block icon.

2. Select **Factory Settings**.



7.8.11 Use the simulation mode

Use the simulation mode with Rosemount Radar Master

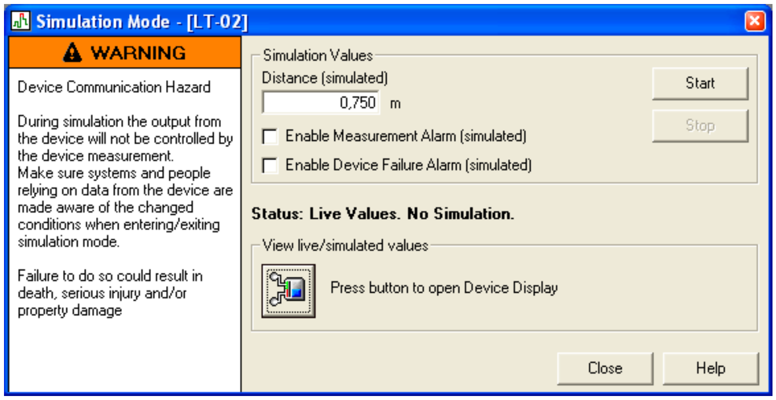
This function can be used to simulate measurements and alarms.

Procedure

1. Select **Tools** → **Simulation Mode**.
2. In the *Distance (simulated)* box, type the desired value.
3. To simulate a measurement alarm, select the **Enable Measurement Alarm (simulated)** checkbox.
4. To simulate a failure alarm (e.g. an internal hardware failure), select the **Enable Device Failure Alarm (simulated)** checkbox.

5. Select **Start**.

Figure 7-23: The Simulation Mode Window in Rosemount Radar Master



Use the simulation mode with AMS Device Manager

This function can be used to simulate measurements and alarms.

Procedure

1. HART: Select **Service Tools** → **Simulate** → **Simulate**.
   FOUNDATION Fieldbus: **Service Tools** → **Simulate** → **Measurement**.
2. Select the **Start/Stop Device Simulation** button and follow the instructions.

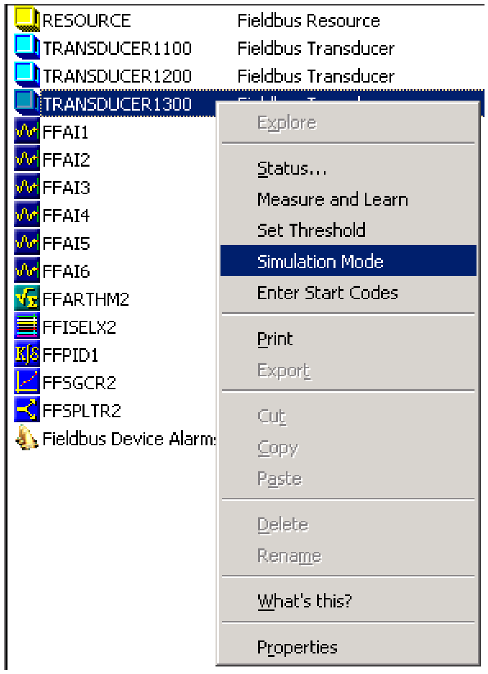
Use the simulation mode with DeltaV

This function can be used to simulate measurements and alarms.

Procedure

1. In the *DeltaV™ Explorer*, select the desired transmitter icon, and then right-click the **TRANSDUCER1300** block icon.

2. Select **Simulation Mode**.



7.8.12 Enter service mode in Rosemount Radar Master

Service functions for advanced users are available in Rosemount Radar Master. All options in the Service menu are enabled when entering the service mode.

Procedure

1. Select **Service** → **Enter Service Mode**.
2. Type the password and select **Submit**.
   The default password is "admin".

7.8.13 Change password for the service mode

To change the password for enabling all options in the Service menu:

Procedure

1. Select **Service** → **Change Password**.
2. Type your current password.
3. Type a new password.

7.8.14 View input registers

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

Procedure

1. In Rosemount Radar Master, enter the service mode.
   a) Select **Service** → **Enter Service Mode**.

   b) Type the password and select **Submit**.
      The default password is "admin".

2. Select **Service** → **View Input Registers**.
3. Select the **Dec** or **Hex** checkbox as desired.

Option	Description
Dec	Display values in decimal format.
Hex	Display values in hexadecimal (Hex) format.

4. In the *View Input Registers* window, do one of the following:
   - To search for registers by name, select the **Names** checkbox, and then in the list, select the desired register group.
   - To search for registers by entering the register number, select the **Numbers** checkbox, and then type the desired register number and the number of registers to read.
5. Select **Read**.

7.8.15 View/edit holding registers

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

Prerequisites

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

Procedure

1. In Rosemount Radar Master, enter the service mode.
   a) Select **Service** → **Enter Service Mode**.
   b) Type the password and select **Submit**.
      The default password is "admin".
2. Select **Service** → **View Holding Registers**.
3. Select the **Dec** or **Hex** checkbox as desired.

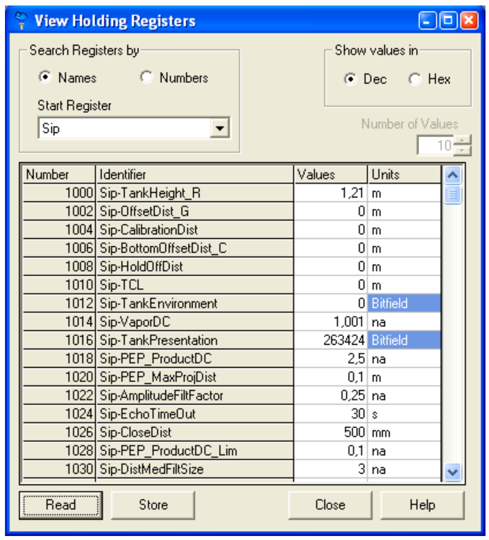
Option	Description
Dec	Display values in decimal format.
Hex	Display values in hexadecimal (Hex) format.

4. In the *View Holding Registers* window, do one of the following:
   - To search for registers by name, select the **Names** checkbox, and then in the list, select the desired register group.
   - To search for registers by entering the register number, select the **Numbers** checkbox, and then type the desired register number and the number of registers to read.

5. Select **Read**.
6. To change a holding register value, type a new value in the corresponding value field.

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

Figure 7-24: Holding and Input Registers Can Be Viewed in Rosemount Radar Master



7.8.16 Write protection

Write protect a transmitter using Rosemount Radar Master

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

Procedure

1. Select **Tools → Lock/Unlock Configuration Area**.
2. Type the password to lock/unlock, and then select **OK**.

Write protect a transmitter using AMS Device Manager or a handheld communicator

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

Procedure

1. HART®: Select **Overview → Device Information → Alarm and Security → Security**.

   FOUNDATION Fieldbus: Select **Overview → Device Information → Security**.
2. HART: Select **Write Protect** and follow the instructions.

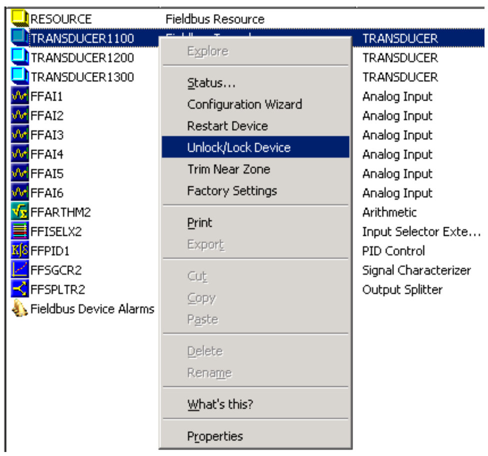
FOUNDATION Fieldbus: Select **Write Protect Level** or **Write Protect All**, and follow the instructions.

Write protect a transmitter using DeltaV

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

Procedure

1. In the *DeltaV™ Explorer*, select the transmitter icon, and right-click the **TRANSDUCER1100** block icon.
2. Select **Unlock/Lock Device**.



7.8.17 Upgrade the HART® to Modbus® Converter firmware

The HMC's firmware is upgraded using Rosemount Radar Master.

Prerequisites

Note
All settings in the HART to Modbus converter (HMC) will be lost after upgrading the transmitter. Reconfiguration of Modbus communication setup and alarm handling is required after completing the upgrade.

Note
During firmware upgrade, the HMC Modbus RTU address must be 246, the default address. Ensure to disconnect other Modbus RTU devices that are connected and have address 246.

Note
Do not interrupt communication between the PC and the Rosemount 5300 Level Transmitter during the firmware upload.

Procedure

1. Start Rosemount Radar Master.
2. Enable Modbus communication and set communication preferences.
   a) Select **View** → **Communication Preferences**.
   b) Select the **Modbus** tab.

c) Select the **Enable Modbus Communication** checkbox.

d) In the ***Port*** list, select the COM port number that the RS-485 Converter is connected to.

e) Select **Advanced** and use the following settings:

- Modem: RS-485
- Baudrate: According to configuration in HMC (default 9600)
- Stop Bits: According to configuration in HMC (default 1)
- Parity: According to configuration in HMC (default None)
- Handshake: RTS/CTS
- Response Timeout: 1000 ms
- Retries: 3

f) Select **OK**.

3. Search for and connect to device.

   a) Select **Device** → **Search** to open the ***Search Device*** window.

   If the HMC is configured for Modbus ASCII or Levelmaster communication, cycle the power to the transmitter and then open the ***Search Device*** window. The HMC will then communicate using Modbus RTU for 20 seconds and under that time it is possible to connect with Rosemount Radar Master.

   b) In the ***Protocols(s)*** list, verify that Modbus is selected.

   c) Select **Scan Address Range**, and type a start and end address.

   The default HMC Modbus address is 246.

   d) Select **Start Scan**.

   e) Select **OK** to connect when the device is found.

4. Ensure the HMC Modbus address is set to 246 (the default address).

   a) Select **Setup** → **General**.

   b) In the ***Device Address*** box, type `246` and select **Store**.

5. Enter service mode.

   a) Select **Service** → **Enter Service Mode**.

   b) Type the password and select **Submit**.

   The default password is "admin".

6. Upload HMC firmware to device.

   a) Select **Service** → **Upload Firmware**.

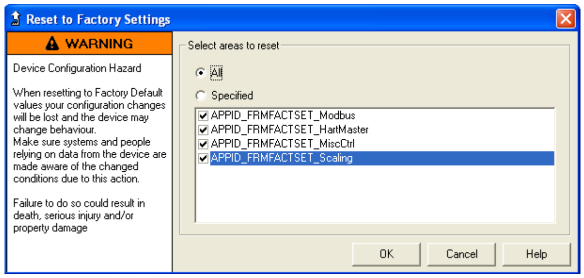
   b) Select **Browse** and navigate to the folder containing the HMC firmware file.

   c) Select the ".cry" file, and select **Open**.

   d) In the ***Upload Firmware*** window, select **Upload** to start the firmware upgrade.

7. When upload is finished, select **Tools** → **Diagnostics**.
8. Select **Device Errors** and check for “Checksum”.

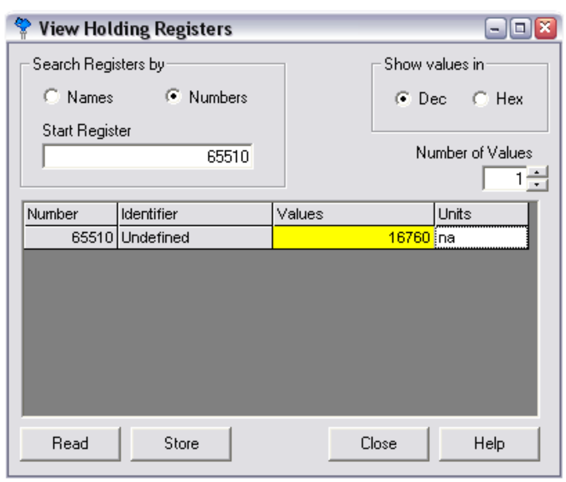
9. If "Checksum" is on the list, then do the following:
   a) Select **Tools** → **Factory Settings**.
   b) Select **All** and then select **OK**.



   c) Select **Yes**.

Note
An error message might be displayed when performing the Reset to Factory Settings operation. The operation has been successful if the checksum error has been cleared.

10. Select **Tools** → **Restart Device**.
11. Select **Tools** → **Diagnostics**, and then select **Device Errors** to verify that the "Checksum" error is no longer present.
12. If the "Checksum" error is still present, then do the following:
   a) Select **Service** → **View Holding Registers**.
   b) Select **Numbers**.
   c) In the ***Start Register*** box, type `65510`, and then select **Read**.
   d) Type the value `16760` for register 65510 and select **Store**.



13. Select **Tools** → **Restart Device**.

14. If the HMC is configured for Modbus ASCII or Levelmaster communication, then proceed with the following:
    a) Close Rosemount Radar Master and disconnect the RS-485 converter from the HMC.
    b) Cycle the power to the HMC to exit the Modbus RTU communication mode.

7.9 Application challenges

7.9.1 Handling disturbances at top of tank

In addition to using the ATC, the Rosemount 5300 Level Transmitter supports alternative methods to filter out disturbances at the top of the tank, such as the Trim Near Zone and the Hold Off Distance/Upper Null Zone functions, which can be used to handle disturbances from narrow nozzles or nozzles with rough edges.

Trim near zone function

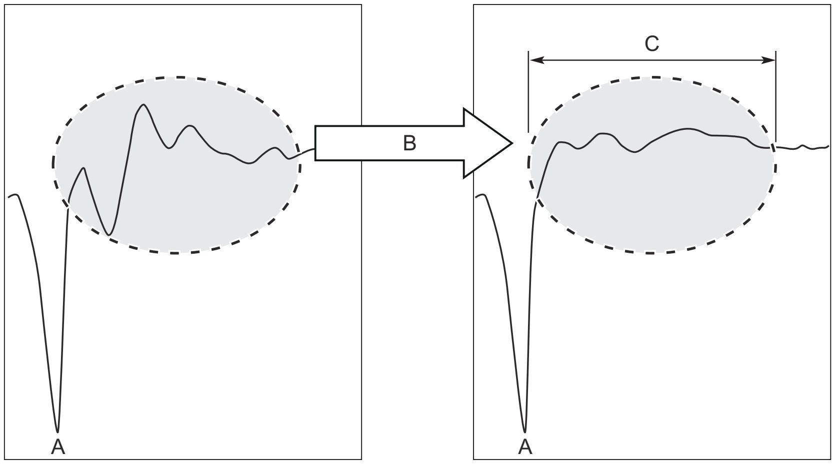
The Trim Near Zone function is used to fine tune performance in the area close to the tank top (Near Zone). The Near Zone stretches about 3.3 ft (1 m) into the tank from the lower side of the device flange.

The device will learn how the echo curve in the Near Zone looks like and use this for enhancing accuracy when the surface echo is within the Near Zone. When leaving factory, the near zone measurement has been fine tuned. The factory setting is normally sufficient and does not 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 (for instance if there are disturbance echoes caused by the tank nozzle, or if you have exchanged the probe). Trimming means that the measurement performance in the Near Zone is maintained even under these conditions and prevents false echo indication.

Figure 7-25 describes the Trim Near Zone function and its effect on the echo curve. This effect is only visible if measurement conditions so require.

Figure 7-25: Echo Curve Before and After Trim Near Zone



A. Reference Peak
B. Trim Near Zone
C. 0-3.3 ft (0-1 m)

Perform trim near zone using Rosemount Radar Master

The Trim Near Zone function is used to fine tune performance in the area close to the tank top (Near Zone).

Prerequisites

Before performing the Trim Near Zone, ensure that:

- There is product in the tank.
- The product level is below the Near Zone region (0-3.3 ft (0-1 m) below the Upper Reference Point).
- The ambient temperature is within 72 °F (40 °C) of the expected ambient operating temperature.

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

Note
For firmware version 2.A2 or later the Trim Near Zone is not possible in combination with narrow nozzles, as defined below:

- 50 mm < Nozzle height < 300 mm
- Nozzle diameter < 2 in. for all single probes (except 13 mm single rigid)
- Nozzle diameter < 3 in. for 13 mm single rigid

Note
Trim Near Zone is not available for large coaxial probes.

Note
For devices with option code BR5, refer to the Rosemount 5300 Single Probes with Cold Temperature Option Code BR5 Manual Supplement.

Procedure

1. Select **Setup** → **Advanced**.
2. Select the **Near Zone** tab.
3. Select **Trim Near Zone** and follow the on-screen instructions.
4. When near zone trimming is complete, restart the device.
    a) Select **Tools** → **Restart Device**.

Perform trim near zone using AMS or a handheld communicator

The Trim Near Zone function is used to fine tune performance in the area close to the tank top (Near Zone).

Prerequisites

Before performing the Trim Near Zone, ensure that:

- There is product in the tank.
- The product level is below the Near Zone region (0-3.3 ft (0-1 m) below the Upper Reference Point).
- The ambient temperature is within 72 °F (40 °C) of the expected ambient operating temperature.

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

Note
For firmware version 2.A2 or later the Trim Near Zone is not possible in combination with narrow nozzles, as defined below:

- 50 mm < Nozzle height < 300 mm
- Nozzle diameter < 2 in. for all single probes (except 13 mm single rigid)
- Nozzle diameter < 3 in. for 13 mm single rigid

Note
Trim Near Zone is not available for large coaxial probes.

Note
For devices with option code BR5, refer to the Rosemount 5300 Single Probes with Cold Temperature Option Code BR5 Manual Supplement.

Procedure

1. HART®: Select **Overview** → **Echo Tuning**.

    FOUNDATION™ Fieldbus: **Configure** → **Manual Setup** → **Avanced**.
2. Select **Near Zone** → **Trim Near Zone** and follow the instructions.
3. When near zone trimming is complete, restart the device.
    a) HART: Select **Service Tools** → **Maintenance**.

       FOUNDATION Fieldbus: Select **Service Tools** → **Maintenance** → **Reset/Restart**.
    b) Select **Restart Device**.

Reset trim near zone using Rosemount Radar Master

To reset the Trim Near Zone function to factory settings:

Procedure

1. Select **Setup** → **Advanced**.
2. Select the **Near Zone** tab.
3. Select **Trim Near Zone**.
4. Select **Reset near zone trimming to factory settings**, and then select **OK**.

Reset trim near zone using AMS or a handheld communicator

To reset the Trim Near Zone function to factory settings:

Procedure

1. HART®: Select **Overview** → **Echo Tuning**.
   FOUNDATION™ Fieldbus: **Configure** → **Manual Setup** → **Advanced**.
2. Select **Near Zone** → **Reset near zone trimming to factory settings** and follow the instructions.

Change the hold off distance/upper null zone

Change the hold off distance/upper null zone using Rosemount Radar Master

The Hold Off Distance/Upper Null Zone (UNZ) defines a zone close to the transmitter where echoes are ignored. This zone can be extended to block out disturbing echoes at the top of the tank.

Prerequisites

Note
By adjusting the Hold Off Distance/UNZ, the measuring range is reduced.

Note
Before changing the Hold Off Distance/UNZ, check entered value for the high alarm limit. The high alarm limit must be outside the Hold Off Distance/UNZ.

Procedure

1. Use the Echo Curve plot to verify if there are disturbances in the upper part of the tank.
2. Set the Hold Off Distance/UNZ to the desired value.
   a) Select **Setup** → **Tank**.
   a) Select the **Probe** tab.
   b) In the ***Hold Off Distance/UNZ*** box, type the desired value.
   c) Select **Store**.

Related information

Use the echo curve analyzer in Rosemount Radar Master
Hold off distance/upper null zone (UNZ)

Change the hold off distance/upper null zone using a handheld communicator

The Hold Off Distance/Upper Null Zone (UNZ) defines a zone close to the transmitter where echoes are ignored. This zone can be extended to block out disturbing echoes at the top of the tank.

Prerequisites

Note
By adjusting the Hold Off Distance/UNZ, the measuring range is reduced.

Note
Before changing the Hold Off Distance/UNZ, check entered value for the high alarm limit. The high alarm limit must be outside the Hold Off Distance/UNZ.

Procedure

1. Use the Echo Curve plot to verify if there are disturbances in the upper part of the tank.
2. Set the Hold Off Distance/UNZ to the desired value.
   a) HART®: Select **Configure** → **Manual Setup** → **Level Setup** → **Probe**.
   FOUNDATION™ Fieldbus: Select **Configure** → **Manual Setup** → **Probe**.
   b) Set **Upper Null Zone** to the desired value.
   c) Select **Send**.

Related information

Use the echo curve analyzer with a handheld communicator
Hold off distance/upper null zone (UNZ)

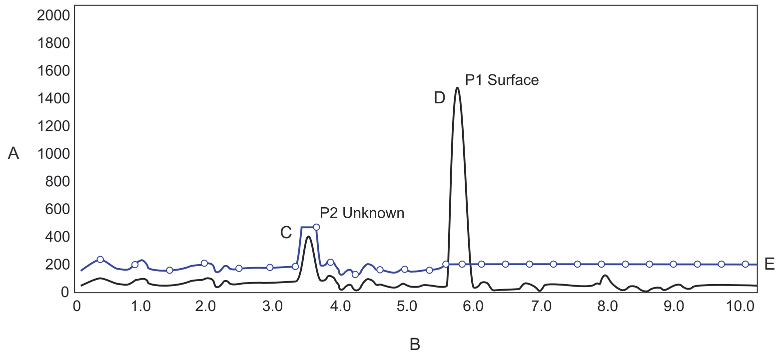
7.9.2 Disturbance echo handling

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 Level Transmitter.

Amplitude threshold curve

As shown in Figure 7-26, 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 7-26: Disturbing Echoes Can Be Filtered out by Creating an Amplitude Threshold



A. Amplitude, mV
B. Distance, m
C. Disturbing object
D. Measurement signal
E. Amplitude Threshold Curve

Signal quality metrics

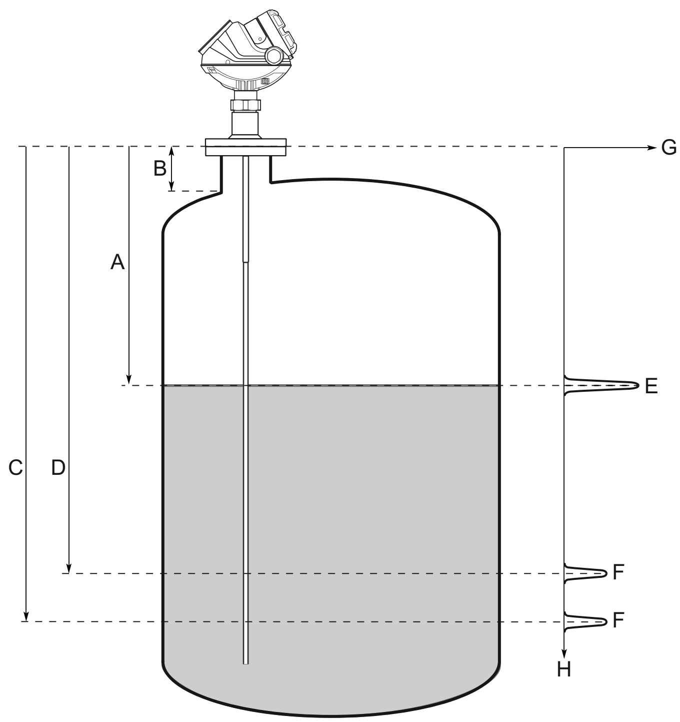
Build up on the probe and different surface conditions are factors that can affect signal and noise levels. Signal Quality Metrics can give an indication of how good the surface signal is compared to the noise. For more information, see Signal Quality Metrics.

7.9.3 Double bounce handling

A double bounce echo occurs when a radar signal bounces back and forth between the product surface and the tank roof before it is detected by the transmitter. Double bounces are most likely to appear in metal water tanks. When using interface measurement to detect a potential oil layer on top of the water, an unidentified double bounce echo peak could cause problems being interpreted as an interface echo peak.

Normally, these echo peaks are identified and discarded as double bounce peaks by the Rosemount 5300. Both the echo peak amplitude and position are used to identify a double bounce.

Figure 7-27: Double Bounce Echo Peak Position



A. *Surface distance*
B. *Nozzle height*
C. *Distance to potential double bounce = Surface distance × 2*
D. *Distance to potential double bounce = (Surface distance × 2) - Nozzle height*
E. *Surface echo peak*
F. *Double bounce echo peaks*
G. *Signal amplitude*
H. *Distance*

Required settings for effective double bounce identification

- The position of a potential double bouce echo peak is related to the nozzle hight. A properly configured nozzle height is therefor essential to achieve an efficient double bounce handling.
- The configured dielectic constants are included in the evaluation of the echo peak amplitude and should therefore also be set correctly.

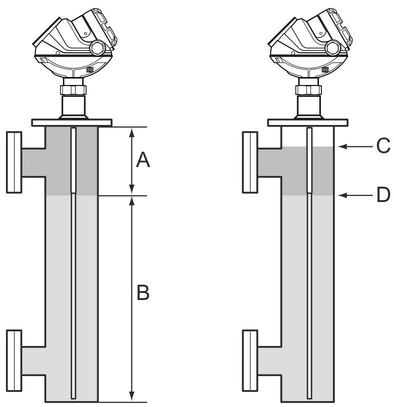
Related information

Upper product dielectric constant

7.9.4 Interface level with submerged probe

The measurement mode Interface Level with Submerged Probe is used to handle interface measurements when the product level is not visible, for example in a full chamber pipe as illustrated in Figure 7-28. In this case the probe is fully submerged into the upper product, and only the interface level is detected by the transmitter.

Figure 7-28: Interface Level Measurements in a Full Chamber



A. Interface distance
B. Interface level
C. Product level is ignored
D. Interface level is measured

Even if the upper product level drops, it is ignored by the transmitter which continues to measure only the interface level. If the product level drops, the air filled region in the upper part of the pipe will slightly reduce the measurement accuracy of the interface level. To achieve high accuracy in this measurement mode, the probe must be fully submerged, or a Rosemount 5302 for Level and Interface measurements should be used.

Set the measurement mode using Rosemount Radar Master

To set the measurement mode to Interface Level with Submerged Probe:

Prerequisites

Note
Do not set measurement mode to Interface Level with Submerged Probe for applications where both product level and interface level should be measured.

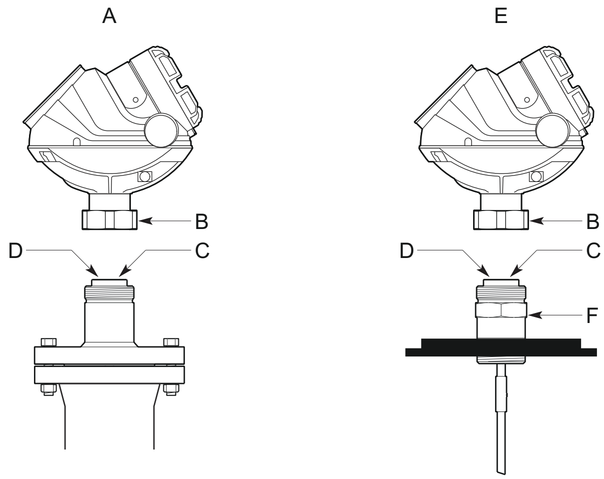
Procedure

1. Select **Setup** → **Tank**.
2. Select the **Environment** tab.
3. Under *Measurement Mode*, select the **Interface Level with submerged probe** checkbox.
4. Select **Store**.

Note
Adjust Interface Threshold if the interface level pulse is not detected. Note that in submerged mode the interface is picked up by the surface threshold.

7.10 Replace the transmitter head

Figure 7-29: Transmitter Head Replacement



- A. *Flanged version*
- B. *Nut*
- C. *Process seal*
- D. *Put the protection plug here*
- E. *Threaded version*
- F. *Adapter*

Prerequisites

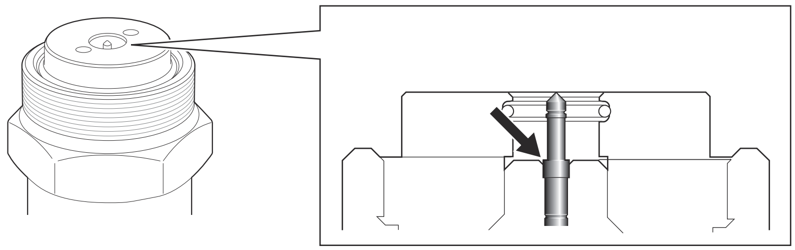
Note
If the transmitter head must be removed from the probe, ensure that the process seal is carefully protected from dust and water.

Procedure

1. Loosen the nut that connects the transmitter head to the process seal.
2. ⚠ Carefully lift the transmitter head.
3. On the probe, ensure that the upper surface of the process seal is clean and free from dust and water. Wipe it clean with a dry and lint-free cloth.

4. Verify the spring-loaded pin at the center of the process seal is properly inserted. When inserted properly, only the plunger is seen above the edge inside the seal hole.

   Note
   Do not remove the process seal from the adapter.



5. If the transmitter head is not mounted directly, attach the protection plug to the process seal to protect the exposed parts from dust and water. If a protection plug is not available, then cover the process seal with a plastic bag.
6. Rotate the new transmitter head so the device display faces the desired direction.
7. Tighten the nut. Max torque is 30 ft-lb (40 Nm).

Postrequisites

Configure the transmitter.

Related information

Configuration

7.11 Changing a probe

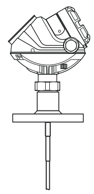
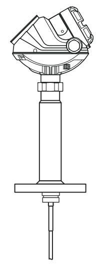
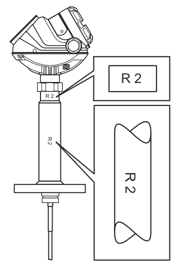
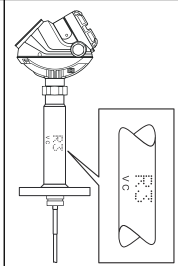
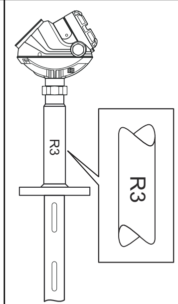
7.11.1 Probe and firmware compatibility

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

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

Only probes with both R3 and VC marking are compatible with the Dynamic Vapor Compensation function. See Check if Dynamic Vapor Compensation function is supported to determine if the Dynamic Vapor Compensation function is supported by the transmitter head.

Table 7-23: Compatibility between Firmware Version and Probe Type

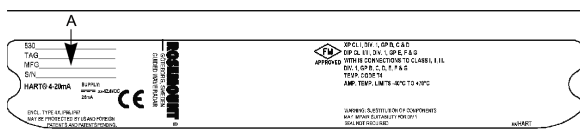
Firmware version	Probe type				
	Standard	**HP/HTHP without R2 marking**	**HP/HTHP/C with R2 marking only(1)**	**HTHP with both R3 and VC marking**	**Large coaxial HP/C**
					
Earlier than 1.A4	Yes	Yes	No	No	No
1.A4	Yes	Yes(2)	Yes	No	No
2.A2 - 2.F0	Yes	Yes(2)	Yes(3)	No	No
2.H0 -2.J0	Yes	Yes (2)	Yes (3)	Yes(4)	No
2.L3 or later	Yes	Yes (2)	Yes (3)	Yes(4)	Yes

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

7.11.2 Check firmware and probe version

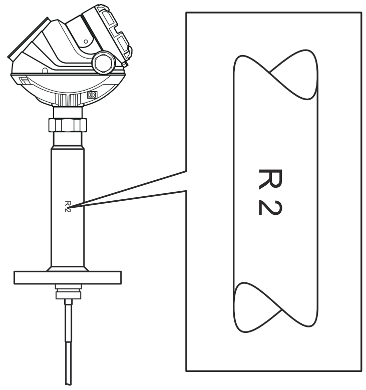
Procedure

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



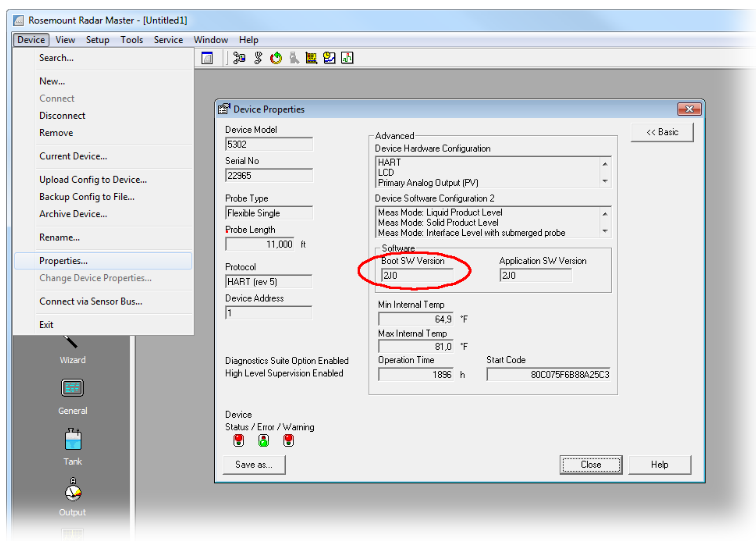
A. Manufacturing Date Before 080618 (YYMMDD)

2. Check the marking on the probe.



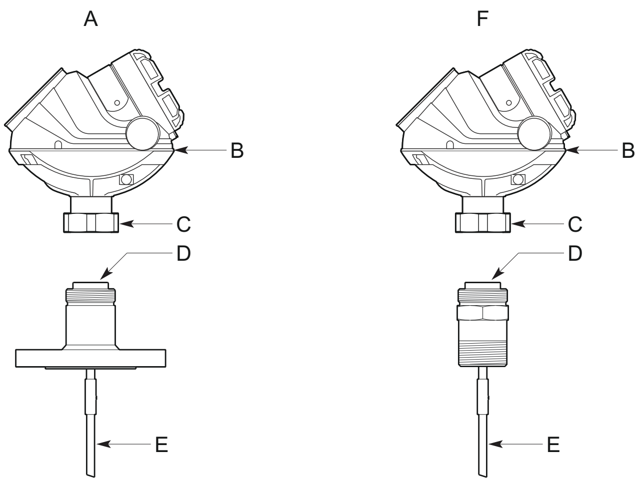
3. Check the software revision number (firmware version).
   a) In Rosemount Radar Master, select **Device** → **Properties**.

Figure 7-30: Software Revision Number



7.11.3 Replace the probe

Figure 7-31: Probe Replacement



A. *Flange version*
B. *Transmitter head*
C. *Nut*
D. *Process seal*
E. *Probe*
F. *Threaded version*

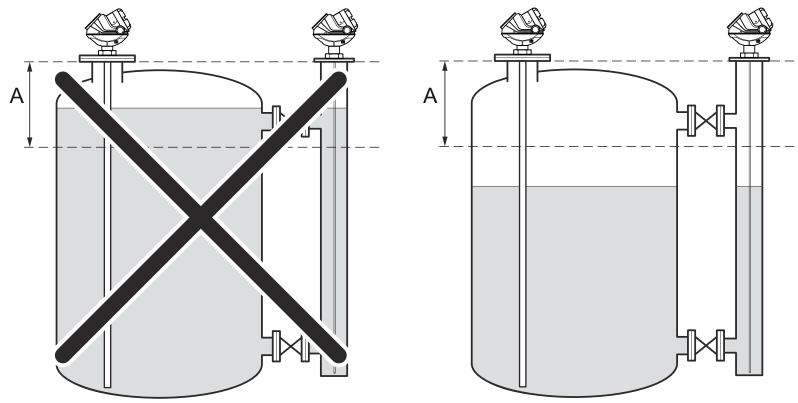
Procedure

1. Loosen the nut.
2. ⚠ Remove the transmitter head from the old probe. Be sure to protect the transmitter head bottom from dust and water.
3. On the new probe, ensure that the protection plug is removed and the upper surface of the process seal is clean. Also verify 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. Tighten the nut. Max torque is 30 ft-lb (40 Nm).
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.
    a) In Rosemount Radar Master, select **Setup** → **Tank**.
    b) Select the **Probe** tab.
    c) In the **Probe Type** list, select desired probe type.
7. Measure the Probe Length and enter the measured value.
    a) In Rosemount Radar Master, select **Setup** → **Tank**.
    b) Select the **Probe** tab.
    c) In the **Probe Length** box, enter the measured Probe Length value.
8. In certain cases, a fine tune by using the Trim Near Zone function is necessary.

a) In Rosemount Radar Master, select **Setup** → **Guided Setup** → **Device specific setup** to find out if this is needed.

When using the Trim Near Zone function, product level in the vessel must be lowered beneath the Near Zone to get precise measurement data (see Figure 7-32).

Figure 7-32: Product Level Lowered beneath the Near Zone



A. Near Zone, 40 in. (1 m)

9. Run Verify Level to check your level measurement.

Related information

Probe length
Run verify level

7.12 Service support

To expedite the return process, refer to Emerson.com and contact the nearest Emerson representative.

⚠ CAUTION

Individuals who handle products exposed to a hazardous substance can avoid injury if they are informed of and understand the hazard. Returned products must include a copy of the required Safety Data Sheet (SDS) for each substance.

Emerson representatives will explain the additional information and procedures necessary to return goods exposed to hazardous substances.

A Specifications and reference data

A.1 Performance specifications

A.1.1 General

Reference conditions

Single Standard probe, 77 °F (25 °C) in water (DC=80) and ambient pressure in a 4-in. pipe using Trim Near Zone function.

Reference accuracy

± 0.12 in. (3 mm) or 0.03% of measured distance, whichever is greatest

For probes with spacers, the accuracy may deviate close to the spacers. Accuracy may be affected by remote housing.

Repeatability

± 0.04 in. (1 mm)(6)

Ambient temperature effect

± 0.008 in. (0.2 mm) /°K or ± 30 ppm/°K of measured value, whichever is greatest(7)

Electromagnetic interference effect

- Shielded cable: ± 0.2 in. (5 mm)(8)
- Unshielded cable: ± 2 in. (50 mm)(8)

For FOUNDATION™ Fieldbus units it may be required to ground the signal cable shield at the power supply and transmitter to achieve optimum performance.

Thresholds may need to be adjusted, see Guidelines for setting the amplitude thresholds for general guidelines on manual threshold settings.

Update interval

Minimum 1 update per second

A.1.2 Environment

Vibration resistance

- Aluminum housing: Level 1 IEC 60770-1/IEC 61298-3 ed 1 chapter 7, IACS E10
- Stainless Steel housing: IACS E10

(6) *In accordance with IEC 60770-1. See the IEC 60770-1 standard for a definition of radar specific performance parameters and if applicable corresponding test procedures.*
(7) *For the BR5 option code with ambient temperatures between -67 °F (-55 °C) and -40 °F (-40 °C), the ambient temperature effect is ± 0.012 in. (0.3 mm) /°K or ± 45 ppm/°K of measured value, whichever is greatest.*
(8) *Deviation through electromagnetic interference according to EN 61326.*

Electromagnetic compatibility

Emission and Immunity: EMC directive 2014/30/EU, EN 61326-1:2013, and EN61326-3-1:2006.

NAMUR recommendations: NE21[9]

CE-mark

Complies with applicable directives (EMC, ATEX).

Built-in lightning protection

EN 61326, IEC 61000-4-5, level 2kV (6kV with T1 terminal block)

Contamination/product build-up

- Single lead probes are preferred when there is a risk of contamination (because build-up can result in the product bridging across the two leads for twin versions; between the inner lead and outer pipe for the coaxial versions).
- For viscous or sticky applications, PTFE probes are recommended. Periodic cleaning may also be required.
- For viscous or sticky applications, it is not recommended to use centering discs mounted along the single lead probe.
- Signal Quality Metrics (option code D01, or DA1) can be used to determine when to clean the probe. Transmitters equipped with the Diagnostics Suite option can calculate Signal Quality Metrics.

Table A-1: Maximum Recommended Viscosity and Contamination/Build-up

Probe type	Maximum viscosity	Contamination/build-up
Single lead	8000 cP[(1)(2)]	Build-up allowed
Twin lead/Large coaxial	1500 cP	Thin build-up allowed, but no bridging
Coaxial	500 cP	Not recommended

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

A.1.3 Measuring range

See Table A-2 and Table A-3 for each probe's measuring range and minimum dielectric constant. Due to the measuring range depending on the application and factors described below, the values are a guideline for clean liquids. For more information, ask your local Emerson representative.

Note
For Remote Housing, see Table A-4 and Table A-5 for the maximum recommended measuring range for different remote housing lengths, installation types, dielectric constants, and probe types.

(9) *Namur NE21 not available with option code QT.*

Different parameters (factors) affect the echo and therefore 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 may affect measuring performance.
- Heavy product build-up or contamination on the probe should be avoided since it can reduce measuring range and might cause erroneous level readings.

Table A-2: Maximum Measuring Range

Probe type	Maximum measuring range
Rigid single lead/segmented rigid single lead	9 ft. 10 in. (3 m) for 8 mm probes (code 4A) 19 ft. 8 in. (6 m) for 13 mm probes (code 4B) 32 ft. 9 in. (10 m) for 13 mm probes (code 4S)
Flexible single lead	164 ft. (50 m)[1]
Coaxial	19 ft. 8 in. (6 m)
Large coaxial	19 ft. 8 in. (6 m)
Rigid twin lead	9 ft. 10 in. (3 m)
Flexible twin lead	164 ft. (50 m)

(1) Maximum measuring range for Duplex 2205 probes type 5A and 5B is 105 ft. (32 m).

Table A-3: Minimum Dielectric Constant

Probe type	Minimum dielectric constant			
	Std	HP	HTHP	C
Rigid single lead/ segmented rigid single lead	1.4[1][2] (1.25 if installed in a metallic bypass or stilling well)	1.6[1][2] (1.4 if installed in a metallic bypass or stilling well)		
Flexible single lead	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] 3, up to 138 ft. (42 m) 4, up to 151 ft. (46 m) 6, up to 164 ft. (50 m)	1.6, 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] 3, up to 138 ft. (42 m) 4, up to 151 ft. (46 m) 6, up to 164 ft. (50 m)		
Coaxial	1.2	1.4	2.0	1.4
Large coaxial	1.2	1.4	N/A	1.4
Rigid twin lead	1.4	N/A	N/A	N/A
Flexible twin lead	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)	N/A	N/A	N/A

(1) Probe end projection software function will improve the minimum measurable dielectric constant. Consult the factory for details.
(2) May be lower depending on installation.

(3) *Up to 49 ft. (15 m) for Duplex 2205 probes type 5A and 5B.*

Table A-4: Remote Housing Measuring Range for Tank Installations, ft. (m)

Probe type[1]	1 m remote housing			2 m remote housing			3 m remote housing		
	DC 1.4	DC 2	DC 80	DC 1.4	DC 2	DC 80	DC 1.4	DC 2	DC 80
Rigid single 8 mm	4 (1.25)	4 (1.25)	10 (3)[2]	9 (2.75)	9 (2.75)	10 (3)[2]	10 (3)	10 (3)	10 (3)
Rigid single 13 mm	4 (1.25)	4 (1.25)	19 (6)[2]	9 (2.75)	9 (2.75)	19 (6)[2]	14 (4.25)	14 (4.25)	19 (6)[2]
Segmented rigid single	4 (1.25)	4 (1.25)	33 (10)[2]	9 (2.75)	9 (2.75)	33 (10)[2]	14 (4.25)	14 (4.25)	33 (10)[2]
Flexible single	4 (1.25)	4 (1.25)	159 (48.5)[2]	9 (2.75)	9 (2.75)	154 (47)[2]	14 (4.25)	14 (4.25)	149 (45.5)[2]
Coaxial/Large coaxial	19 (6)	19 (6)	19 (6)	19 (6)	19 (6)	19 (6)	19 (6)	19 (6)	19 (6)
Rigid twin	4 (1.25)	4 (1.25)	10 (3)[2]	9 (2.75)	9 (2.75)	10 (3)[2]	10 (3)[2]	10 (3)[2]	10 (3)[2]
Flexible twin	4 (1.25)	98 (30)[2]	159 (48.5)[2]	9 (2.75)	98 (30)[2]	154 (47)[2]	14 (4.25)	98 (30)[2]	149 (45.5)[2]

(1) *Validated for ambient temperature range -40 °F to 185 °F (-40 °C to 85 °C).*
(2) *Accuracy may be affected up to ± 1.2 in. (30 mm).*

Table A-5: Remote Housing Measuring Range for Chamber/Pipe Installations < 4 in. (100 mm), ft. (m)

Probe type[1]	1 m remote housing			2 m remote housing			3 m remote housing		
	DC 1.4	DC 2	DC 80	DC 1.4	DC 2	DC 80	DC 1.4	DC 2	DC 80
Rigid single 8 mm	4 (1.25)	10 (3)[2]	10 (3)	9 (2.75)	10 (3)[2]	10 (3)	10 (3)	10 (3)	10 (3)
Rigid single 13 mm	19 (6)[2]	19 (6)[2]	19 (6)[2]	19 (6)[2]	19 (6)[2]	19 (6)	19 (6)	19 (6)	19 (6)
Segmented rigid single	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)	33 (10)	33 (10)	33 (10)
Flexible single[3]	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)[2]
Coaxial/Large coaxial	19 (6)	19 (6)	19 (6)	19 (6)	19 (6)	19 (6)	19 (6)	19 (6)	19 (6)
Rigid twin	10 (3)[2]	10 (3)[2]	10 (3)[2]	10 (3)[2]	10 (3)[2]	10 (3)[2]	10 (3)[2]	10 (3)[2]	10 (3)[2]
Flexible twin[3]	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)[2]	33 (10)[2]

(1) *Validated for ambient temperature range -40 °F to 185 °F (-40 °C to 85 °C).*
(2) *Accuracy may be affected up to ± 1.2 in. (30 mm).*
(3) *Required chamber/pipe size is 3 or 4 in. (75 -100 mm).*

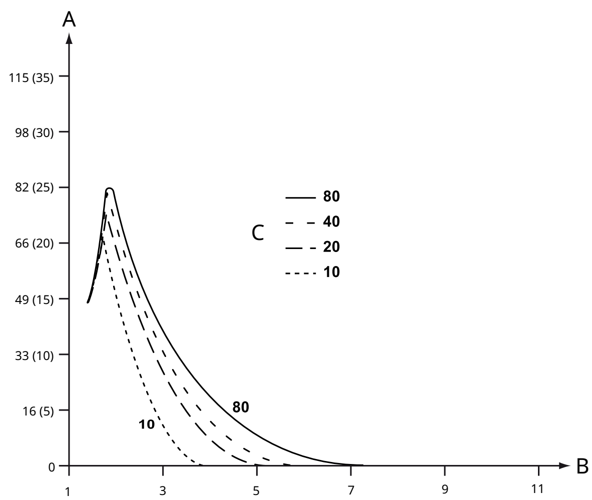
Interface measuring range

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

Typical applications include interfaces between oil/oil-like and water/water-like liquids, with a low (<3) dielectric constant for the upper product and a high (>20) dielectric constant for the lower product. For such applications, the maximum measuring range is limited by the length of the coaxial, large coaxial, rigid twin, and rigid single lead probes.

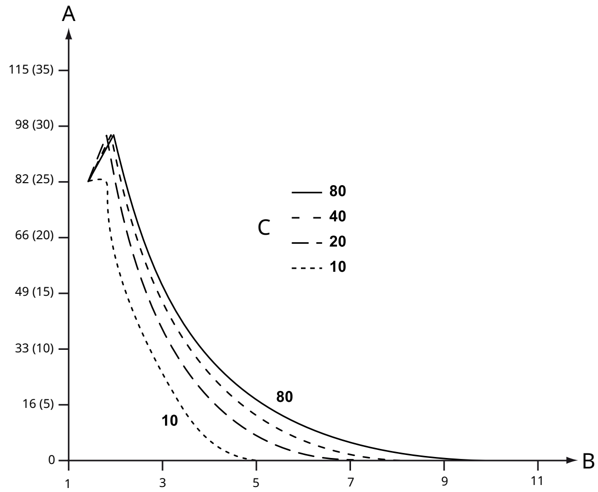
For flexible probes, the maximum measuring range is reduced by the maximum upper product thickness, according to the diagram below. However, characteristics may vary between the different applications. Maximum distance to the interface is 164 ft. (50 m) minus the maximum upper product thickness.

Figure A-1: Maximum Upper Product Thickness for the Flexible Single Lead Probe



A. Maximum upper product thickness, ft. (m)
B. Upper product dielectric constant
C. Lower product dielectric constant

Figure A-2: Maximum Upper Product Thickness for the Flexible Twin Lead Probe



A. *Maximum upper product thickness, ft. (m)*
B. *Upper product dielectric constant*
C. *Lower product dielectric constant*

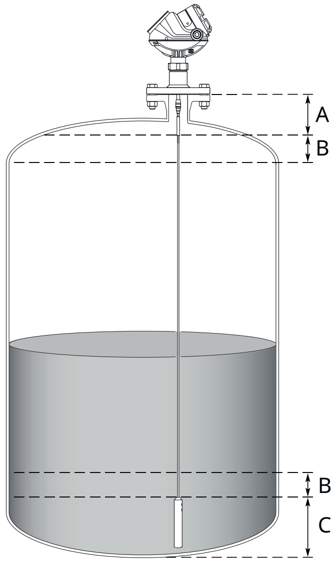
A.1.4 Accuracy over measuring range

The measuring range depends on probe type, dielectric constant of the product and installation environment, and is limited by the Blind Zones at the very top and bottom of the probe. In the Blind Zones, the accuracy exceeds ±1.18 in. (30 mm), and measurements may not be possible. Measurements close to the Blind Zones will have reduced accuracy.

The following conditions will impact the Blind Zones:

- If the single lead probes or twin probes are installed in a nozzle, the nozzle height shall be added to the specified Upper Blind Zone.
- The measuring range for the PTFE covered flexible single lead probe includes the weight when measuring on a high dielectric media.
- When using a metallic centering disc, the Lower Blind Zone is 8 in. (20 cm), including weight if applicable. When using a PTFE centering disc, the Lower Blind Zone is not affected.

Figure A-3: Blind Zones

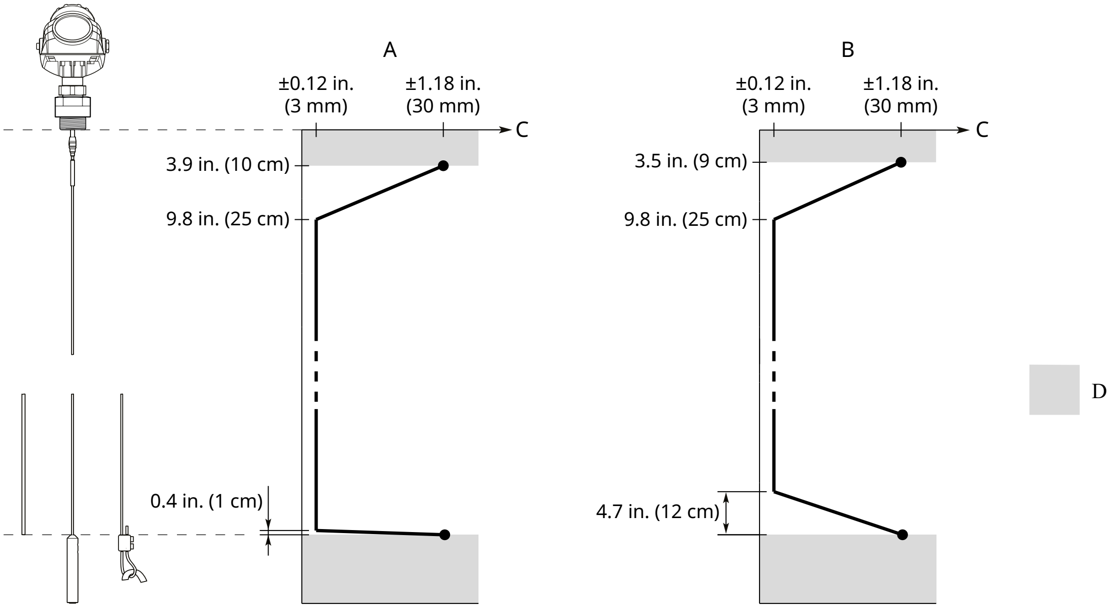


A. Upper Blind Zone
B. Reduced accuracy
C. Lower Blind Zone

Note
Measurements may not be possible in the Blind Zones, and measurements close to the Blind Zones will have reduced accuracy. Therefore, the 4-20 mA points should be configured outside these zones.

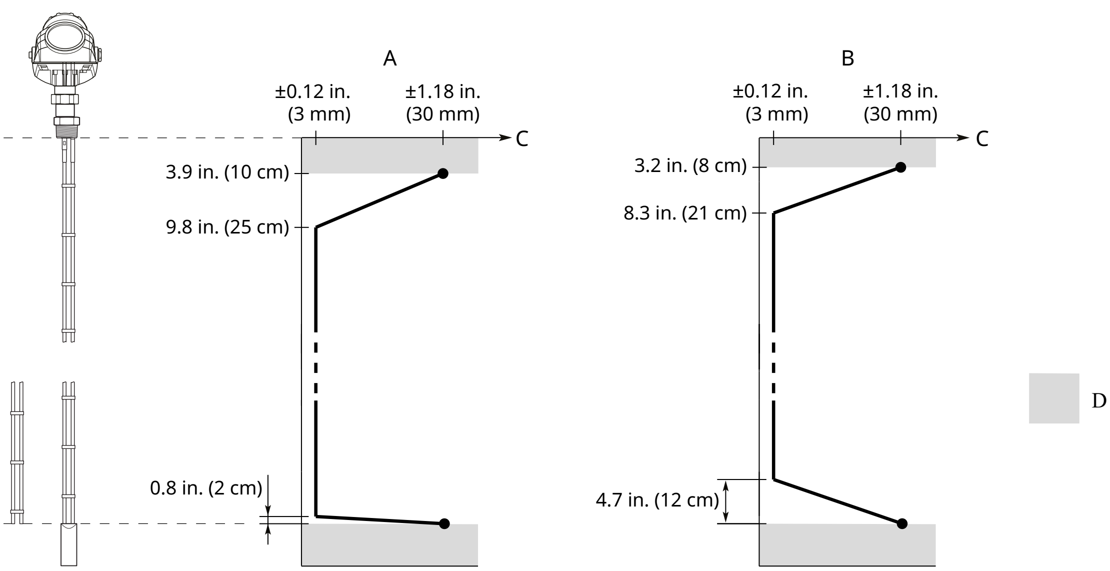
Figure A-4 , Figure A-5, Figure A-6, and Figure A-7 illustrate the accuracy over measuring range at reference condition with alternating probe types and varying dielectric constant of the product.

Figure A-4: Accuracy Over Measuring Range for Single Lead Probes (Rigid/Segmented Rigid/Flexible)



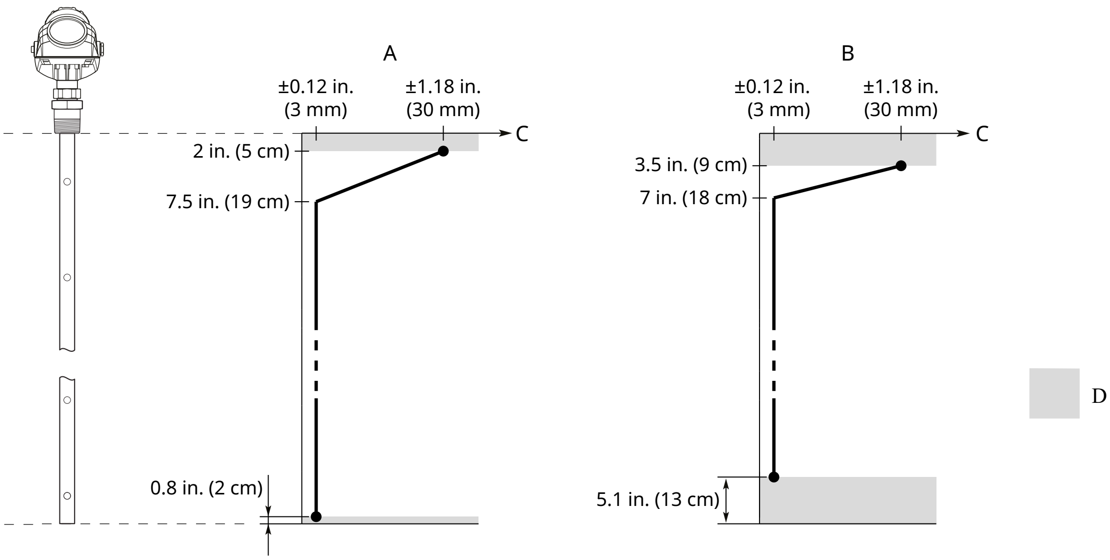
A. Water (DC = 80)
B. Oil (DC = 2)
C. Accuracy
D. Blind Zone

Figure A-5: Accuracy Over Measuring Range for Twin Lead Probes



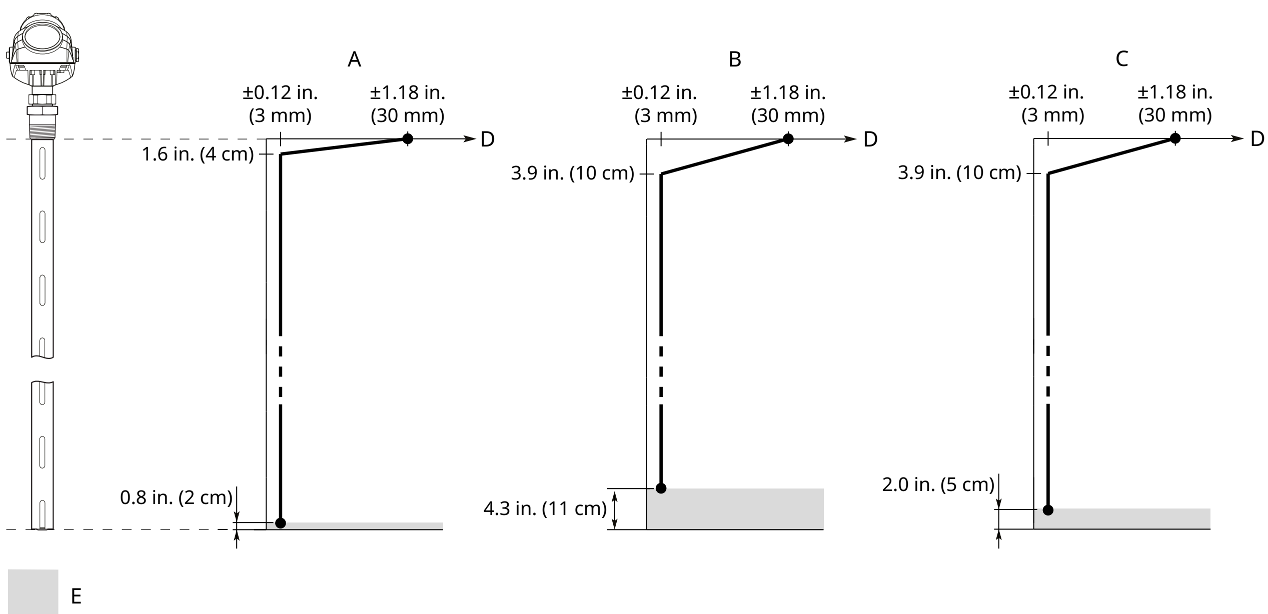
A. Water (DC = 80)
B. Oil (DC = 2)
C. Accuracy
D. Blind Zone

Figure A-6: Accuracy Over Measuring Range for Coaxial Probe



- *A. Water (DC = 80)*
- *B. Oil (DC = 2)*
- *C. Accuracy*
- *D. Blind Zone*

Figure A-7: Accuracy Over Measuring Range for Large Coaxial Probe



- *A. Water (DC = 80)*
- *B. Oil (DC = 2), Liquid product level measurement mode*
- *C. Oil (DC = 2), Liquid product level and interface level measurement mode*
- *D. Accuracy*
- *E. Blind Zone*

A.2 Functional specifications

A.2.1 General

Field of application

Liquids and semi-liquids level and/or liquid/liquid interfaces or solids level

- Model 5301, for liquid level or submerged interface measurements
- Model 5302, for liquid level, liquid level and interface, or solid level measurements
- Model 5303, for solid level measurements

Measurement principle

Time Domain Reflectometry (TDR)

Related information

Measurement principle

Microwave output power

Nominal 300 µW, Max. 45 mW

EMC

FCC part 15 subpart B and EMC Directive (2014/30/EU). Considered to be an unintentional radiator under the Part 15 rules.

Humidity

0 to 100% relative humidity

Safety response time

< 8 s at damping value 2 s

The safety response time will be a function of the configured damping value.

Start-up time

< 40 s(10)

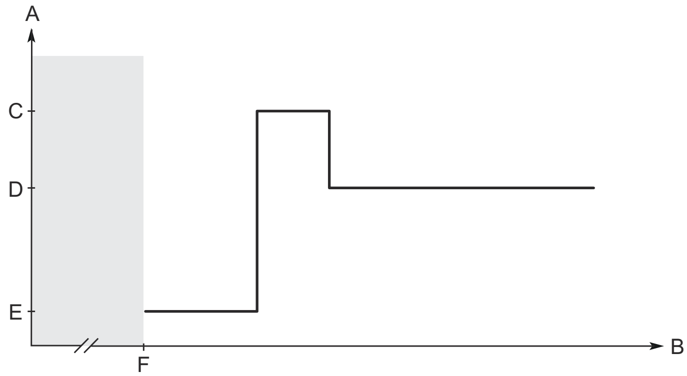
A.2.2 Start-up sequence

For the Rosemount™ 5300, the radar will first go to Low Alarm current for nine seconds during boot-up followed by nine seconds of High Alarm or Low Alarm current depending on alarm mode. After that measurement is re-established and the 4-20mA output settles at the actual level value.(11) Refer to Figure A-8 and Figure A-9. If a different start-up behavior is preferred, contact your local Emerson representatives.

(10) The start-up time is extended with five additional minutes for option code BR5 at temperatures below -40 °F (-40 °C). Refer to Start-up sequence.

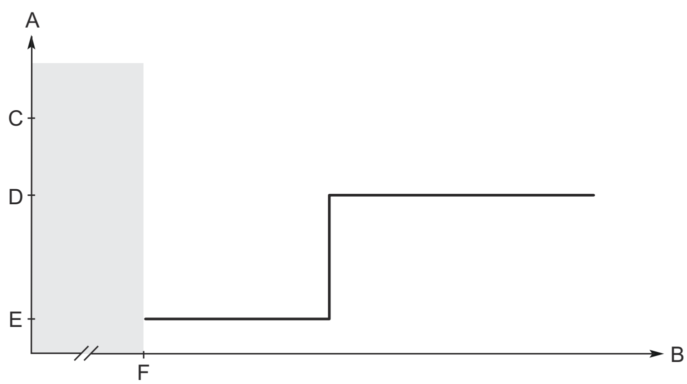
(11) For devices with option code BR5 at temperatures below -40 °F (-40 °C), the start-up sequence is delayed for five minutes with an undefined current value.

Figure A-8: Start-Up Sequence, Alarm Mode High



A. *Current, mA*
B. *Time, s*
C. *High Alarm current (Rosemount or Namur value, according to configuration)*
D. *Actual level value*
E. *Low Alarm current (Rosemount or Namur value, according to configuration)*
F. *For option code BR5 at temperatures below -40 °F (-40 °C): Five minutes delay with an undefined current value*

Figure A-9: Start-Up Sequence, Alarm Mode Low



A. *Current, mA*
B. *Time, s*
C. *High Alarm current (Rosemount or Namur value, according to configuration)*
D. *Actual level value*
E. *Low Alarm current (Rosemount or Namur value, according to configuration)*
F. *For option code BR5 at temperatures below -40 °F (-40 °C): Five minutes delay with an undefined current value*

A.2.3 4-20 mA HART®

Output

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

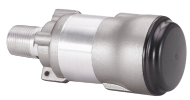
The default output is HART Revision 7. To order HART Revision 5 factory configured, add option code HR5. The device can also be field configured to HART Revision 5 if needed.

Signal wiring

Recommended output cabling is twisted shielded pairs, 24-12 AWG.

Emerson Wireless 775 THUM™ Adapter

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



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

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

Power requirements

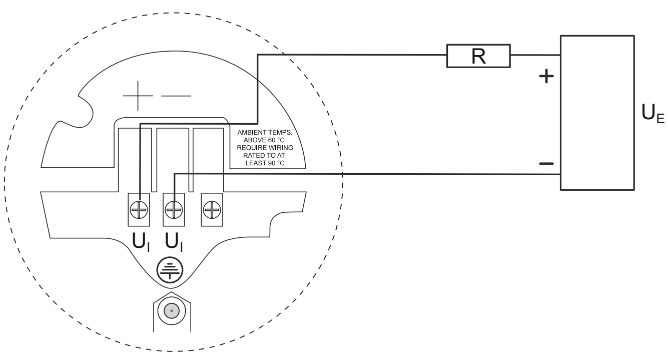
Terminals in the transmitter housing provide connections for signal cables. The Rosemount 5300 Level Transmitter is loop-powered and operates with the following power supplies:

Table A-6: External Power Supply for HART

Approval type	Input voltage (U_i)(1)
None	16 - 42.4 Vdc
Non-sparking/Energy Limited	16 - 42.4 Vdc
Intrinsically Safe	16 - 30 Vdc
Explosion-proof/Flameproof	20 - 42.4 Vdc

(1) *Reverse polarity protection.*

Figure A-10: External Power Supply for HART



R = Load Resistance (Ω)

U_E = External Power Supply Voltage (Vdc)

U_i = Input Voltage (Vdc)

Table A-7: Minimum Input Voltage (U_i) at Different Currents

Hazardous approval	Current	
	3.75 mA	21.75 mA
	Minimum input voltage (U_i)	
Non-hazardous installations, intrinsically safe installations and Non-sparking installations	16 Vdc	11 Vdc
Explosion-proof/flameproof installations	20 Vdc	15.5 Vdc

Signal on alarm

	High	Low
Standard	21.75 mA	3.75 mA
Namur NE43	22.50 mA	3.60 mA

Saturation levels

	High	Low
Standard	20.8 mA	3.9 mA
Namur NE43	20.5 mA	3.8 mA

A.2.4 FOUNDATION™ Fieldbus

Power requirements

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

Table A-8: External Power Supply for FOUNDATION Fieldbus

Approval type	Power supply (Vdc)
None	9 - 32
Non-sparking/Energy limited	9 - 32
Intrinsically Safe	9 - 30
FISCO	9 - 17.5
Explosion-proof/flameproof	16 - 32

Quiescent current draw

22 mA

Blocks and execution time

Block	Execution time
1 Resource	N/A
3 Transducer	N/A
6 Analog Input (AI)	10 ms
1 Proportional/Integrate/Derivate (PID)	15 ms
1 Signal Characterizer (SGCR)	10 ms
1 Integrator (INT)	10 ms
1 Arithmetic (ARTH)	10 ms
1 Input Selector (ISEL)	10 ms
1 Control Selector (CS)	10 ms
1 Output Splitter (OS)	10 ms

FOUNDATION Fieldbus class (basic or Link Master)

Link Master (LAS)

Number of available VCRs

Maximum 20, including one fixed

FOUNDATION Fieldbus instantiation

Yes

Conforming FOUNDATION™ Fieldbus

ITK 6.0.1

FOUNDATION Fieldbus alerts

- Field diagnostics alerts
- Plantweb™ Insight alerts

A.2.5 Modbus®

Output

The RS-485 Modbus version communicates by Modbus RTU, Modbus ASCII, and Levelmaster protocols.

8 data bits, 1 start bit, 1 stop bit, and software selectable parity.

Baud Rate	1200, 2400, 4800, 9600 (default), and 19200 bits/s
Address Range	1 to 255 (default device address is 246)

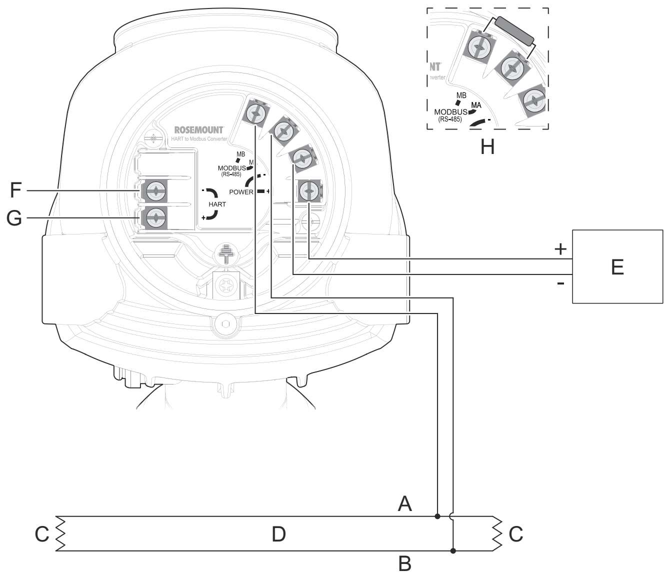
HART communication is used for configuration via the HART terminals or tunneling via the RS-485.

External power supply

The input voltage U_i for Modbus is 8-30 Vdc (max. rating).

Wiring diagram

Figure A-11: Wiring Diagram for RS-485 with Modbus®



A. "A" line
B. "B" line
C. 120 Ω
D. RS-485 Bus
E. Power supply
F. HART -
G. HART +
H. If it is the last transmitter on the bus, connect the 120 Ω termination resistor.

Note
Rosemount 5300 Level Transmitters with Flameproof/Explosion-proof output have a built-in barrier; no external barrier needed.(12)

Power consumption

- < 0.5 W (with HART address=1)
- < 1.2 W (incl. four HART slaves)

Note
The Rosemount 5300 Level Transmitter with Modbus protocol is configured to HART address 1 at factory. This reduces power consumption by locking the analog output at 4 mA.

(12) An external galvanic isolator is always recommended to be used for Flameproof/Explosion-proof installations.

A.2.6 Display and 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.

Configuration tools

- Rosemount Radar Master (included in the delivery)
- Device Descriptor (DD) based systems, e.g. AMS Device Manager, handheld communicator, and DeltaV™
- Device Type Manager (DTM™) based systems (compliant with version 1.2 of the FDT®/DTM specification), supporting configuration in for instance Yokogawa Fieldmate/ PRM, E+H FieldCare®, and PACTware™

Output units

- Level, Interface and Distance: ft., in., m, cm, or mm
- Level Rate: ft./s, m/s, in./min, m/h
- Volume: ft.^{3}, in.^{3}, US gals, Imp gals, barrels, yd^3, m^3, or liters
- Temperature: °F and °C

Output variables

Table A-9: Output Variables

Variable	5301	5302	5303	PV, SV, TV, QV
Level	✓	✓	✓	✓
Distance to Level (Ullage)	✓	✓	✓	✓
Level Rate	✓	✓	✓	✓
Signal Strength	✓	✓	✓	✓
Volume	✓	✓	✓	✓
Internal Temperature	✓	✓	✓	✓
Interface Level	(✓)(1)	✓	N/A	✓
Interface Distance	(✓)(1)	✓	N/A	✓
Interface Level Rate	(✓)(1)	✓	N/A	✓
Interface Signal Strength	(✓)(1)	✓	N/A	✓
Upper Layer Thickness	(✓)(1)	✓	N/A	✓
Lower Volume	(✓)(1)	✓	N/A	✓
Upper Volume	(✓)(1)	✓	N/A	✓
Signal Quality	✓	✓	✓	(✓)(2)
Surface/Noise Margin	✓	✓	✓	(✓)(2)
Vapor DC	✓	N/A	N/A	(✓)(2)
Analog Output Current(3)(4)	✓	✓	✓	N/A
% of Range(4)	✓	✓	✓	N/A

(1) *Interface measurement only for fully submerged probe.*
(2) *Not available as primary variable.*
(3) *Not available for FOUNDATION™ Fieldbus, Modbus® Signal Output, or for HART® units in fixed current mode.*
(4) *LCD display variable only.*

Damping

0-60 s (2 s, default value)

A.2.7 Diagnostics

General

Transmitter diagnostics with alerts include hardware and software errors, electronics temperature, probe missing, and invalid measurement and configuration error diagnostics. In addition to this, echo curve and variable logging including signal strength facilitate easy on-line troubleshooting.

Alerts

The transmitter is compliant with NAMUR NE 107 Field Diagnostics for standardized device diagnostic information (only available for FOUNDATION™ Fieldbus or HART®).

Diagnostics Suite

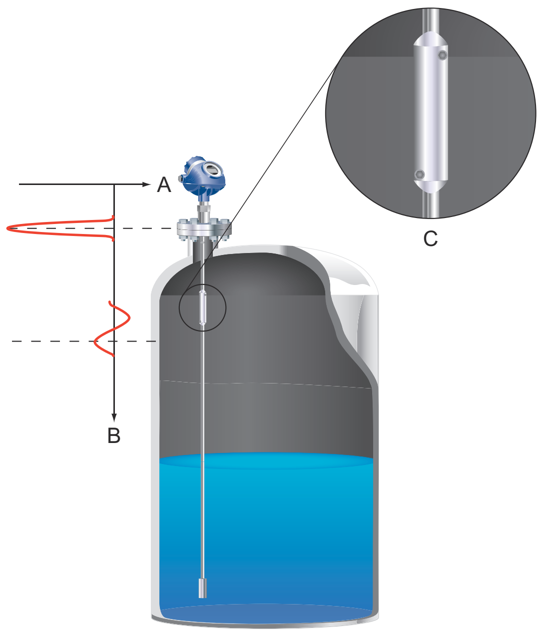
Signal Quality Metrics

Diagnostics package that monitors the relations between surface, noise and threshold. The function can be used to detect abnormal conditions in the process such as probe contamination or sudden loss of signal strength. Signal Quality Metrics parameters are available as Output Variables in Rosemount Radar Master, and can be sent to Distributed Control System (DCS) to trigger an alarm.

Verification reflector

The reflector, which is available with single lead flexible probes, is used to test and continuously verify that the transmitter is functioning properly in both tank and chamber/ pipe installations. Compared to traditional diagnostics that only monitor the transmitter electronics, the reflector can also be used to diagnose the upper parts of the probe inside the tank for e.g. build-up, corrosion monitoring and other process related conditions.

Figure A-12: Verification Reflector



A. Amplitude
B. Distance
C. Reflector

The primary use-cases for the reflector are:

- Verification of transmitter and probe (i.e. proof-testing)
- High level supervision (i.e. continuous monitoring of high level condition)

Verification

During commissioning, the location and amplitude characteristics of the reflector are stored in the transmitter. When the test procedure is later initiated, the stored reflector data is compared to the current measurement to verify the integrity of the measurement electronics and upper part of the probe.

During the test, the transmitter will output a level corresponding to the reflector position, which can be used to verify the integrity of the transmitter output.

High level supervision

Additionally, the reflector's unique echo characteristics aid the transmitter to locate a liquid surface above the reflector, thereby offering increased reliability to detect high level conditions at a user selectable limit.

The transmitter continuously monitors the status of the reflector and abnormal conditions generate alarms and alerts as appropriate.

Limitations for verification reflector

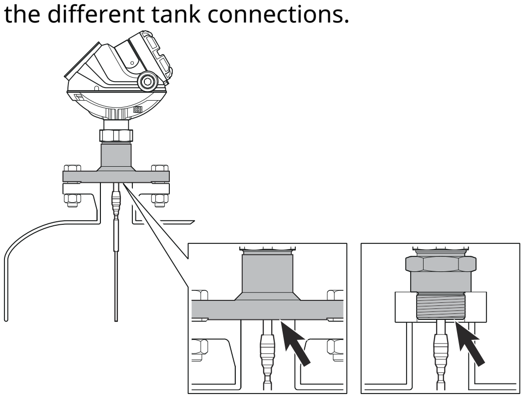
Application	Not to be used in fully submerged applications
Minimum dielectric constant	2.4 (for option code HL1) 2.0 (for option codes HL2 and HL3)

More information

For more information and installation requirements, refer to the High Level Supervision Manual Supplement.

A.2.8 Process temperature and pressure rating

Process Temperature and Pressure - Max Rating gives the maximum process temperature (measured at the lower part of the flange or threaded connection) and pressure rating for the different tank connections.



For standard tank connection, final rating may be lower depending on flange, material of construction, and O-ring selection. Table A-10 gives the temperature ranges for standard tank seals with different O-ring materials.

Table A-10: Temperature and Pressure Ranges for Standard Tank Seals with Different O-ring Material

O-ring material	Temperature °F (°C) in air		Pressure psig (bar)
	Minimum(1)	Maximum	Maximum
Fluoroelastomer (FKM)	-22 (-30)	302 (150)	754 (52)
Ethylene Propylene (EPDM)	-40 (-40)	266 (130)	754 (52)
Kalrez® Perfluoroelastomer (FFKM)	14 (-10)	302 (150)	754 (52)
Nitrile Butadiene (NBR)	-31 (-35)	230 (110)	580 (40)
Fluorosilicone (FVMQ)	-49 (-45)	302 (150)	754 (52)

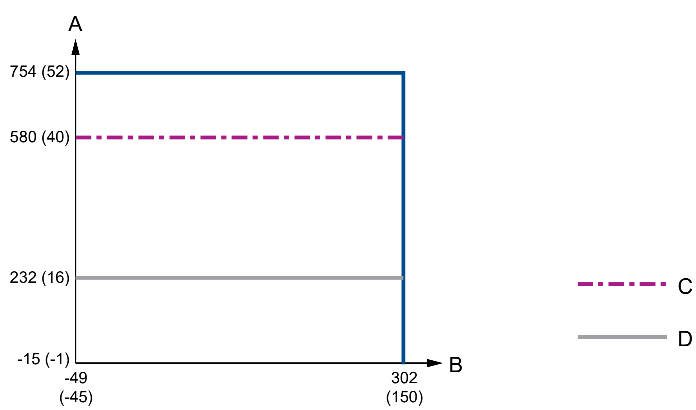
(1) The O-ring can be stored at lower temperatures (refer to Table A-11).

Note
Always check the chemical compatibility of the O-ring material with your application. If the O-ring material is not compatible with its chemical environment, the O-ring may eventually malfunction.

No wetted O-rings are used in the HTHP, HP, and C versions. Final rating may be lower depending on flange and material of construction selection.

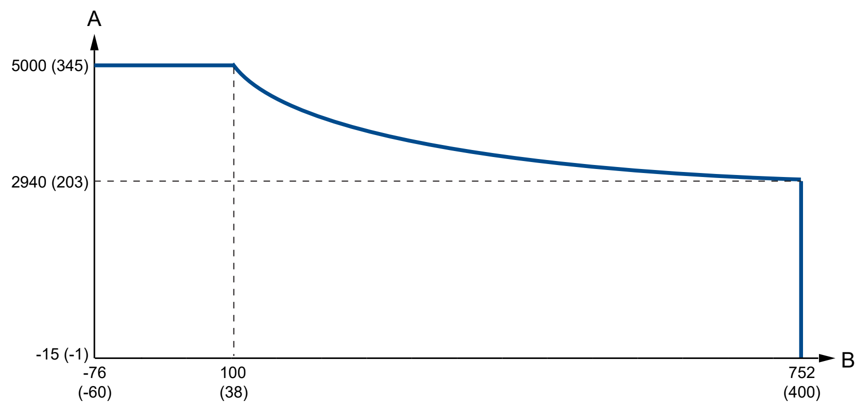
Process Temperature and Pressure - Max Rating

Figure A-13: Standard Tank Connection (Code S)



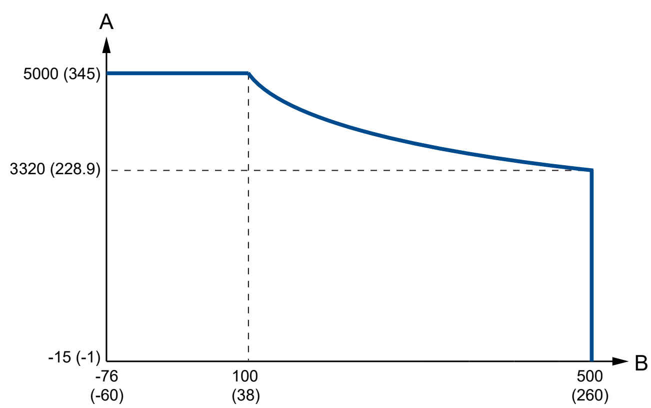
A. Pressure psig (bar)
B. Temperature °F (°C)
C. O-ring material code B (Nitrile Butadiene)
Country certification code J7 (Indian Boiler Regulation)
Overfill prevention code U1 (Overfill prevention according to WHG/TUV)
Protective plate: Alloy C-276 (Material of construction code 2) or Alloy 400 (Material of construction code 3)
D. Protective plate: PTFE (Material of construction code 7)

Figure A-14: HTHP - High Temperature and High Pressure Tank Connection (Code H)



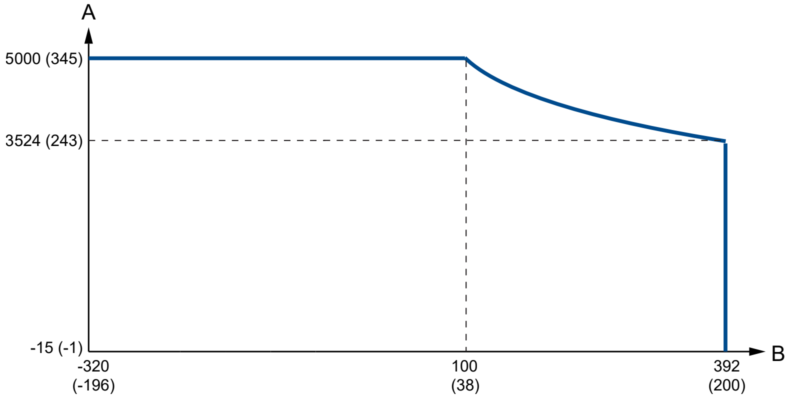
A. Pressure psig (bar)
B. Temperature °F (°C)

Figure A-15: HP - High Pressure Tank Connection (Code P)



A. Pressure psig (bar)
B. Temperature °F (°C)

Figure A-16: C - Cryogenic Temperature Tank Connection (Code C)

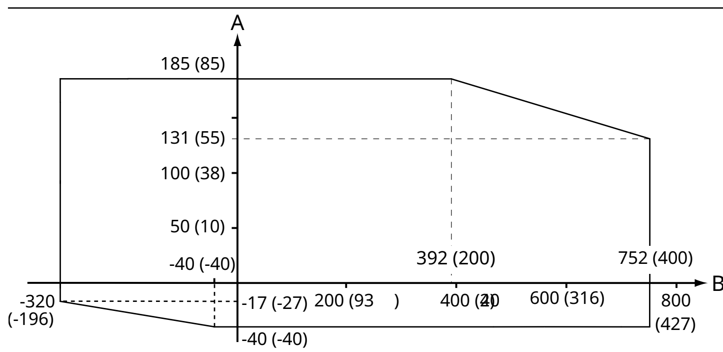


A. Pressure psig (bar)
B. Temperature °F (°C)

A.2.9 Temperature limits

The maximum and minimum ambient temperature for the electronics depends on the process temperature (as described by Figure A-17 and Figure A-18) and on the approval (see Product certifications).

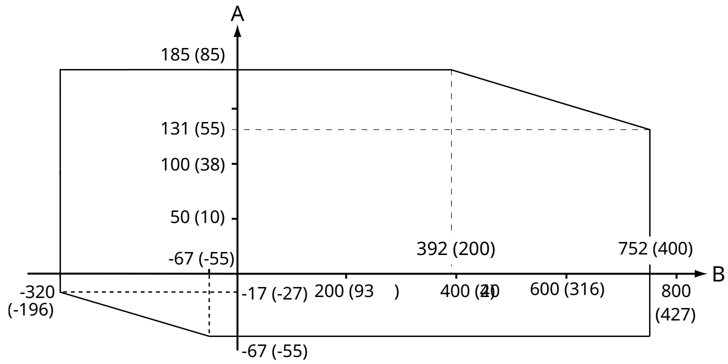
Figure A-17: Ambient Temperature vs. Process Temperature



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

For additional information, refer to Table A-11.

Figure A-18: Ambient Temperature vs. Process Temperature with Option Code BR5



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

Note
Nozzle insulation for the HTHP version (Operating Temperature and Pressure code H) should not exceed 4 in. (10 cm) of height above the flange.

Note
In applications where the ambient temperature exceeds the limits of the electronics, a Remote Mounting connection can be used. The maximum temperature for the Remote Mounting connection at the vessel connection point is 302 °F (150 °C).

The heat sink installation option is mandatory for flanges Class 2500/PN250 or higher in Dynamic Vapor Compensation applications. For flanges Class 1500/PN160 the heat sink option is highly recommended.

Table A-11: Ambient Temperature Limits

Description	Operating limit	Storage limit
Without integral display	-40 °F to 185 °F (-40 °C to 85 °C)(1)	-58 °F to 194 °F (-50 °C to 90 °C)
With integral display	-40 °F to 158 °F (-40 °C to 70 °C)(1)(2)	-40 °F to 185 °F (-40 °C to 85 °C)
Option code BR5 without integral display	-67 °F to 185 °F (-55 °C to 85 °C)	-76 °F to 194 °F (-60 °C to 90 °C)
Option code BR5 with integral display	-67 °F to 158 °F (-55 °C to 70 °C)(2)	-76 °F to 185 °F (-60 °C to 85 °C)

(1) *Certain model codes supplied to Asia-Pacific region have a minimum temperature of -4 °F (-20 °C). Consult factory if operation at ambient temperature -40 °F (-40 °C) is required.*
(2) *Integral display may not be readable and device display updates will be slower at temperatures below -4 °F (-20 °C).*

A.2.10 Flange rating

ASME flange rating

316 up to Class 1500 flanges according to ASME B16.5 Table 2-2.2 and 316L for Class 2500 flanges according to ASME B16.5 Table 2-2.3:

- Standard: Maximum 302 °F/754 psig (150 °C/52 Bar)

- HP: Class 2500 up to maximum 500 °F (260 °C)
- C: Class 2500 up to maximum 392 °F (200 °C)
- HTHP: Class 2500 up to maximum 752 °F (400 °C)

Alloy C-276 (UNS N10276) according to ASME B16.5 Table 2-3.8:

- Standard: Maximum 302 °F/754 psig (150 °C/52 Bar)
- HP: Class 1500 up to maximum 500 °F (260 °C)
- HTHP: Class 1500 up to maximum 752 °F (400 °C)

Alloy 825 (UNS N08825) according to ASME B16.5 Table 2-3.8:

- Standard: Maximum 302 °F/754 psig (150 °C/52 Bar)
- HP: Class 1500 up to maximum 500 °F (260 °C)
- HTHP: Class 1500 up to maximum 752 °F (400 °C)

Duplex 2205 (UNS S31803) according to ASME B16.5 Table 2-2.8:

- Standard: Maximum 302 °F/754 psig (150 °C/52 Bar)
- HP: Class 1500, -51 °F (-46 °C) up to maximum 500 °F (260 °C)
- HTHP: Class 1500, -51 °F (-46 °C) up to maximum 599 °F (315 °C)

EN flange rating

EN 1.4404 according to EN 1092-1 material group 13E0:

- Standard: Maximum 302 °F/754 psig (150 °C/52 Bar)
- HP: PN 320 up to maximum 500 °F (260 °C)
- C: PN 320 up to maximum 392 °F (200 °C)
- HTHP: PN 320 up to maximum 752 °F (400 °C)

Alloy C-276 (UNS N10276) according to EN 1092-1 material group 12E0:

- Standard: Maximum 302 °F/754 psig (150 °C/52 Bar)
- HP: PN 320 up to maximum 500 °F (260 °C)
- HTHP: PN 320 up to maximum 752 °F (400 °C)

Duplex 2205 (EN 1.4462) according to EN 1092-1 material group 16E0:

- Standard: Maximum 754 psig (52 Bar), -22 °F (-30 °C) up to maximum 302 °F (150 °C)(13)
- HP: PN 320, -22 °F (-30 °C) up to maximum 482 °F (250 °C)(13)
- HTHP: PN 320, -22 °F (-30 °C) up to maximum 482 °F (250 °C)(13)

JIS flange rating

316 according to JIS B2220 material group 2.2:

- Standard: Maximum 302 °F/754 psig (150 °C/52 Bar)
- HP: Maximum temperature 260 °C. Final rating depends on flange.
- C: Maximum temperature 200 °C. Final rating depends on flange.
- HTHP: Maximum temperature 400 °C. Final rating depends on flange.

(13) Minimum and maximum temperature limit due to EN13445-2.

Fisher and Masoneilan flange rating

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

- Standard: Maximum 302 °F/754 psig (150 °C/52 Bar)
- HP: Class 600 up to maximum 260 °C
- C: Class 600 up to maximum 200 °C
- HTHP: Class 600 up to maximum 400 °C

A.2.11 Tri Clamp rating

Tri Clamp is available for the standard temperature and pressure seal.

Table A-12: Tri Clamp Rating

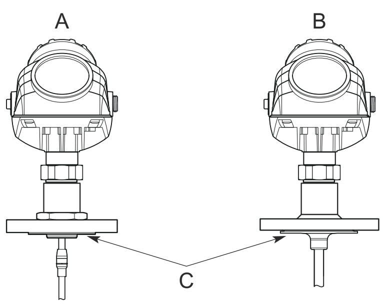
Size	Maximum pressure(1)
1½-in. (37.5 mm)	232 psig (16 bar)
2-in. (50 mm)	232 psig (16 bar)
3-in. (75 mm)	145 psig (10 bar)
4-in. (100 mm)	145 psig (10 bar)

(1) *The final rating depends on the clamp and gasket.*

A.2.12 Plate design

Certain models of flanged alloy and PTFE covered probes have a tank connection design with a protective flange plate that prevents the backing flange from being exposed to the tank atmosphere. The protective flange plate is manufactured in the same material as the probe. The backing flange is made of 316L/EN 1.4404 for alloy probes, and 316/1.4404 for PTFE covered probes.

Figure A-19: Protective Plate



A. *Alloy probe and protective plate*
B. *PTFE covered probe and protective plate*
C. *Protective plate*

PTFE protective plate

Flange rating according to SST backing flange ASME B16.5 Table 2-2.2, EN 1092-1 material group 13E0, and JIS B2220 material group 2.3.

- Standard: Maximum 302 °F/232 psig (150 °C/16 Bar)

Alloy C-276 protective plate

Flange rating according to SST backing flange ASME B16.5 Table 2-2.3, EN 1092-1 material group 13E0, and JIS B2220 material group 2.3.

- Standard: Maximum 302 °F/580 psig (150 °C/40 Bar). Flange plate design is available up to Class 300/PN 40
- HP: Maximum temperature 260 °C. Flange plate design is available up to Class 600/PN 63
- HTHP: Maximum temperature 400 °C. Flange plate design is available up to Class 600/PN 63

Alloy 400 protective plate

Flange rating according to SST backing flange ASME B16.5 Table 2-2.3, EN 1092-1 material group 13E0, and JIS B2220 material group 2.3.

- Standard: Maximum 302 °F/580 psig (150 °C/40 Bar). Flange plate design is available up to Class 300/PN 40

A.2.13 Conditions used for flange strength calculations

See Table A-13 to Table A-17 for the conditions used for flange strength calculations.

Table A-13: 316/316L Flanges

Standard	Bolting material	Gasket		Flange material	Hub material
		Standard/HP/ HTHP/C	HP/HTHP/C		
ASME	Stainless steel SA193 B8M Cl.2	Soft (1a) with min. thickness 1.6 mm	Spiral wound gasket with nonmetallic filler (1b)	Stainless steel A182 Gr. F316	Stainless steel SA479M 316
EN, JIS	EN 1515-1/-2 group 13E0, A4-70	Soft (EN 1514-1) with min. thickness 1.6 mm	Spiral wound gasket with nonmetallic filler (EN 1514-2)	Stainless steel A182 Gr. F316 and EN 10222-5-1.4404	Stainless steel SA479M 316, and EN 10272-1.4404

Table A-14: Process Connection with Plate Design

Standard	Bolting material	Gasket		Flange material	Hub material
		Standard/HP/ HTHP/C	HP/HTHP/C		
ASME	Stainless steel SA193 B8M Cl.2	Soft (1a) with min. thickness 1.6 mm	Spiral wound gasket with nonmetallic filler (1b)	Stainless steel A182 Gr. F316L/ F316	SB574 Gr. N10276 or SB164 Gr. N04400
EN, JIS	EN 1515-1/-2 group 13E0, A4-70	Soft (EN 1514-1) with min. thickness 1.6 mm	Spiral wound gasket with nonmetallic filler (EN 1514-2)	Stainless steel A182 Gr. F316L/ F316 and EN 10222-5-1.4404	

Table A-15: Alloy C-276 Flanges

Standard	Bolting material	Gasket		Flange material	Hub material
		Standard/HP/ HTHP	HP/HTHP		
ASME	UNS N10276	Soft (1a) with min. thickness 1.6 mm	Spiral wound gasket with nonmetallic filler (1b)	SB462 Gr. N10276 (solution annealed condition) or SB575 Gr. N10276 (solution annealed condition)	SB574 Gr. N10276
EN		Soft (EN 1514-1) with min. thickness 1.6 mm	Spiral wound gasket with nonmetallic filler (EN 1514-2)		

Table A-16: Alloy 825 Flanges

Standard	Bolting material	Gasket		Flange material	Hub material
		Standard/HP/ HTHP	HP/HTHP		
ASME	A193 B7 or A320 L7	Soft (1a) with min. thickness 1.6 mm	Spiral wound gasket with nonmetallic filler (1b)	SB564 Gr. N08825 (solution annealed condition)	SB425 Gr. N08825 (solution annealed condition)

Table A-17: Duplex 2205 Flanges

Standard	Bolting material	Gasket		Flange material	Hub material
		Standard/HTHP	HP/HTHP		
ASME	A193 B7 or A320 L7	Soft (1a) with min. thickness 1.6 mm	Spiral wound gasket with nonmetallic filler (1b)	Duplex stainless steel SA/A182 F51 and EN10222-5-1.4462	Stainless steel SA479M S31803 and EN 10272-1.4462
EN	Bumax® 88	Soft (EN 1514-1) with min. thickness 1.6 mm	Spiral wound gasket with nonmetallic filler (EN 1514-2)		

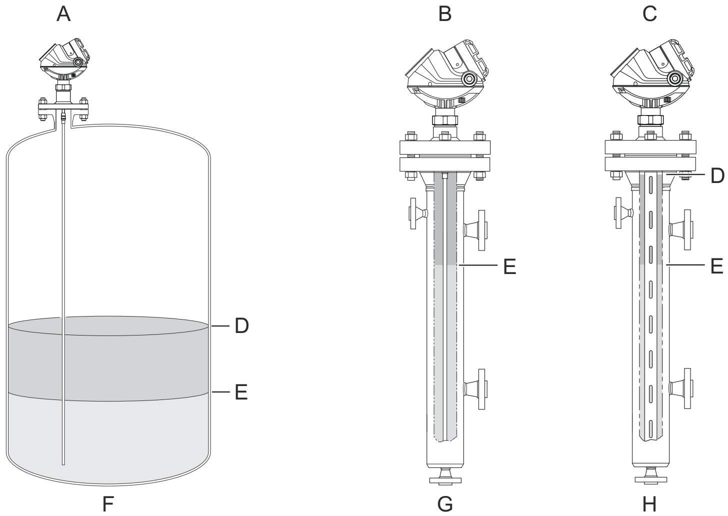
A.2.14 Interface measurements

The Rosemount 5302 is a good choice for measuring the interface of oil and water, or other liquids with significant dielectric differences.

It is also possible to measure interface with a Rosemount 5301 in applications where the probe is fully submerged in the liquid, using the submerged probe mode.

Rosemount 5302 with the large coaxial probe provides the ability to continuously keep track of both level and interface level in fully submerged applications. The product level and interface level mode must be selected.

Figure A-20: Interface Level Measurement



A. Rosemount 5302
B. Rosemount 5301
C. Rosemount 5302 with large coaxial probe
D. Product level
E. Interface level
F. Product level and interface level
G. Interface level with submerged probe
H. Product level and interface level with submerged probe

Interface measurement considerations

If interface is to be measured, follow these criteria:

- The dielectric constant of the upper product should be known and should not vary. The Rosemount Radar Master software has a built-in dielectric constant calculator to help the user estimate the upper product dielectric constant.
- The dielectric constant of the upper product must have a lower dielectric constant than the lower product to have a distinct reflection.
- The difference between the dielectric constants for the two products must be larger than 6.
- The maximum dielectric constant for the upper product is 7 for the single lead probes, 10 for the coaxial probes, and 8 for the twin lead probes.

Table A-18: Minimum Detectable Upper Product Thickness

Probe type	Minimum Detectable Upper Product Thickness
Large coaxial	1 in. (2.5 cm)(1)
Single lead	2.4 in. (6 cm)
Twin lead	5.1 in. (13 cm)
Coaxial (standard/HP/C)	2.8 in. (7 cm)
Coaxial (HTHP)	8 in. (20 cm)

(1) *Depending on application characteristics such as the upper product dielectric constant.*

Related information

Interface measuring range

Emulsion layers

Sometimes there is an emulsion layer (mix of the products) between the two products which can affect interface measurements. For guidelines on emulsion situations, consult your local Emerson representative.

A.2.15 High pressure steam applications

Considerations

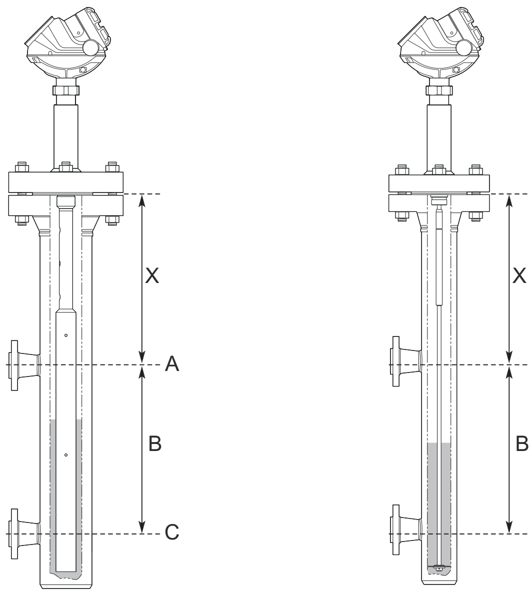
Saturated steam under high pressure can influence radar level transmitter measurements. Rosemount 5301 with Dynamic Vapor Compensation will automatically compensate for this and maintain the level accuracy.

- Probe type 3V (for 3- to 4-in. chambers) or 4U (for 2-in. chambers) must be used.
- Mount in a 2-, 3-, or 4-in. bypass chamber with flanges appropriately sized for the pressure and temperature of the application.
- Dynamic Vapor Compensation requires a minimum distance X from the flange to the surface level in order to measure the change in the vapor dielectric constant. If the level rises within this area, the unit switches over to static compensation, using the last known vapor dielectric constant.

Table A-19: Minimum Distance X

Reference reflector type		Minimum distance X
Length	Option code	
Short, 14 in. (350 mm)	R1	22 in. (560 mm)
Long, 20 in. (500 mm)	R2	28 in. (710 mm)

Figure A-21: Minimum Distance X and Minimum Measuring Span



A. Level: 100%
B. Minimum measuring span: 12 in. (300 mm)
C. Level: 0%

- Always ensure there are no disturbances from inlets etc. close to the reference reflector end when using probe type 4U.

Select reference reflector

- The long reflector, 20 in. (500 mm), has the best accuracy and is recommended for all chambers where the dimensions of the chamber allow for it.
- If the distance from the flange to the upper inlet is less than 28 in. (710 mm), the short reflector should be chosen. This distance is a minimum when dynamic compensation is required within the whole measuring range from the lower to the upper inlet. If this is not required, the long reflector can be used and dynamic compensation is possible up to 28 in. (710 mm) from the flange.

For more information, refer to the High Pressure Steam Applications Technical Note.

A.3 Physical specifications

A.3.1 Material selection

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

A.3.2 Engineered solutions

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

A.3.3 Housing and enclosure

Type

- Dual compartment (terminal compartment and the electronics are completely separated).
- Two entries for conduit or cable connections.
- The transmitter housing is separable from probe assembly.
- The transmitter housing can be rotated in any direction.

Electrical connection

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.

Recommended output cabling is twisted shielded pairs, 24-12 AWG.

Housing material

Polyurethane-covered Aluminum (Aluminum alloy A360, maximum 0.6 percent Cu), or Stainless Steel Grade CF8M (ASTM A743)

Ingress protection

NEMA® 4X, IP 66, IP67

Factory sealed

Yes

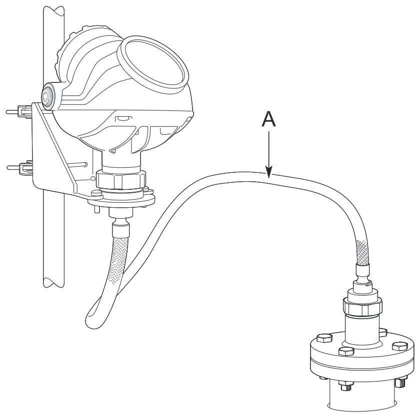
Weight

- Aluminum transmitter head: 4.4 lb (2 kg)
- SST transmitter head: 10.8 lb (4.9 kg)

A.3.4 Remote housing mounting

Kit that includes a flexible armored extension cable and a bracket for wall or pipe mounting.

Figure A-22: Remote Housing Mounting

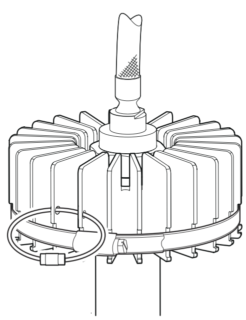


A. Remote Housing Mounting Cable: 3, 6, or 9 ft (1, 2, or 3 m)

A.3.5 Heat sink

The heat sink is used for remote housing mounting to keep the temperature at the vessel connection point at a maximum of 302 °F (150 °C). The heat sink installation option is available for Rosemount 5300 with Dynamic Vapor Compensation (DVC). Heat sink is mandatory for DVC probes with flanges Class 2500/PN250 or higher and highly recommended for Class 1500/PN160.

Figure A-23: Heat Sink



A.3.6 Tank connection

The tank connection consists of a tank seal, a flange, Tri Clamp, or NPT or BSPP (G) threads.

A.3.7 Flange dimensions

Follows ASME B16.5, JIS B2220, and EN 1092-1 standards for blind flanges.

Related information

Standard flanges

Proprietary flanges

A.3.8 Vented flanges

Available with Masoneilan and Fisher vented flanges. Vented flanges must be ordered as accessories with a 1½-in. NPT threaded process connection (code RA); see Proprietary flanges. As an alternative to a vented flange, it is possible to use a flushing connection ring on top of the standard nozzle.

A.3.9 Tri Clamp connection

Follows ISO 2852 standard.

A.3.10 Pressure Equipment Directive (PED)

Complies with 2014/68/EU article 4.3

A.3.11 Probes

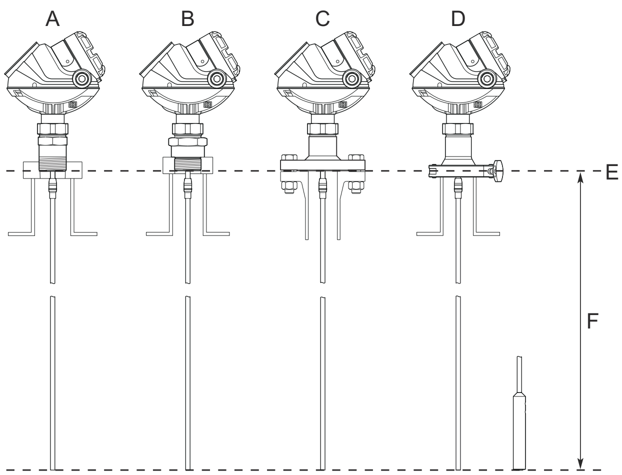
Probe versions

Coaxial, large coaxial, rigid twin and rigid single lead, segmented rigid single lead, flexible twin and flexible single lead. Probes can be ordered in different materials and options for extreme temperatures and pressure.

Total probe length

This is defined from the Upper Reference Point to the end of the probe (weight included, if applicable).

Figure A-24: Total Probe Length



A. NPT
B. BSPP (G)
C. Flange
D. Tri Clamp
E. Upper reference point
F. Total probe length

Select the probe length according to the required measuring range (the probe must be hung and fully extended through the entire distance where level readings are desired).

Cut-to-fit probes

All probes can be cut in field, except for the HTHP coaxial probe and the PTFE covered probe.

However, there are some restrictions for the standard and HP/C coaxial probes: Probes over 4.1 ft. (1.25 m) can be cut up to 2 ft. (0.6 m). Shorter probes can be cut to the minimum length of 1.3 ft. (0.4 m).

Flexible single lead probes can be cut to the minimum length of 3.3 ft. (1.0 m).

Minimum and maximum probe length

Probe type	Probe length
Flexible single lead	3.3 to 164 ft. (1 to 50 m)
Rigid single lead (0.3 in./8 mm)	1.3 to 9.8 ft. (0.4 to 3 m)
Rigid single lead (0.5 in./13 mm)	1.3 to 19.7 ft. (0.4 to 6 m)
Segmented rigid single lead	1.3 to 32.8 ft. (0.4 to 10 m)
Flexible twin lead	3.3 to 164 ft. (1 to 50 m)
Rigid twin lead	1.3 to 9.8 ft. (0.4 to 3 m)
Coaxial	1.3 to 19.7 ft. (0.4 to 6 m)
Large coaxial	1.0 to 19.7 ft. (0.3 to 6 m)

Probe angle

0 to 90 degrees from vertical axis

Note
Models with QT option code should not be installed in angled probe installations.

Tensile strength

- 0.16 in. (4 mm) Flexible single lead SST: 2698 lb (12 kN)
- 0.16 in. (4 mm) Flexible single lead Alloy C-276: 1574 lb (7 kN)
- 0.16 in. (4 mm) Flexible single lead Alloy 825: 1574 lb (7 kN)
- 0.16 in. (4 mm) Flexible single lead Alloy 400: 1124 lb (5 kN)
- 0.16 in. (4 mm) Flexible single lead Duplex 2205: 1349 lb (6 kN)
- 0.24 in. (6 mm) Flexible single lead SST: 6519 lb (29 kN)
- Flexible twin lead SST: 2023 lb (9 kN)

Collapse load

- 0.16 in. (4 mm) Flexible single lead SST: 3597 lb (16 kN)
- 0.16 in. (4 mm) Flexible single lead Alloy C-276: 1798 lb (8 kN)
- 0.16 in. (4 mm) Flexible single lead Alloy 825: 1798 lb (8 kN)
- 0.16 in. (4 mm) Flexible single lead Alloy 400: 1349 lb (6 kN)
- 0.16 in. (4 mm) Flexible single lead Duplex 2205: 1574 lb (7 kN)
- 0.24 in. (6 mm) Flexible Single Lead SST: 7868 lb (35 kN)

Sideway capacity

- Rigid single lead/Segmented rigid single lead: 4.4 ft. lbf, 0.44 lb at 9.8 ft. (6 Nm, 0.2 kg at 3 m)
- Rigid twin lead: 2.2 ft. lbf, 0.22 lb at 9.8 ft. (3 Nm, 0.1 kg at 3 m)
- Coaxial/Large coaxial: 73.7 ft. lbf, 3.7 lb at 19.7 ft. (100 Nm, 1.67 kg at 6 m)

A.3.12 Material exposed to tank atmosphere

Table A-20: Standard Probe (Operating Temperature and Pressure Code S)

Material of construction code	Material exposed to tank atmosphere
1 (probe types 6A and 6B)	316L/316 (EN 1.4404)(1), Duplex 2507 (UNS S32750/EN 1.4410), PTFE, PFA, silicone grease, and O-ring materials
1 (all other probe types)	316L/316 (EN 1.4404)(1), PTFE, PFA, silicone grease, and O-ring materials
2 and H	Alloy C-276 (UNS N10276), PTFE, PFA, silicone grease, and O-ring materials
3	Alloy 400 (UNS N04400), Alloy K500 (UNS N05500), PTFE, PFA, silicone grease, and O-ring materials
7	PTFE (1 mm PTFE cover)
8	316L/316 (EN 1.4404), PTFE, silicone grease, and O-ring materials
D	Duplex 2205 (UNS S31803/EN 1.4462), Duplex 2507 (UNS S32750/EN 1.4410), PTFE, PFA, silicone grease, and O-ring materials
E	Alloy 825 (UNS N08825), PTFE, PFA, silicone grease, and O-ring materials

(1) *For flexible single/twin lead probes only.*

Table A-21: HTHP Probe (Operating Temperature and Pressure Code H)

Material of construction code	Material exposed to tank atmosphere
1 (probe types 3V and 4U)	316L/316 (EN 1.4404), Ceramic (Al_2O_3), Graphite, and Alloy C-276 (UNS N10276)
1 (all other probe types)	316L/316 (EN 1.4404)(1), Ceramic (Al_2O_3), Graphite, Alloy C-276 (UNS N10276), and Alloy 718 (UNS N07718)
2 and H	Alloy C-276 (UNS N10276), Ceramic (Al_2O_3), Graphite, and Alloy 718 (UNS N07718)
D	Duplex 2205 (UNS S31803/EN 1.4462), Ceramic (Al_2O_3), Graphite, Alloy C-276 (UNS N10276), and Alloy 718 (UNS N07718)
E	Alloy 825 (UNS N08825), Ceramic (Al_2O_3), Graphite, Alloy C-276 (UNS N10276), and Alloy 718 (UNS N07718)

(1) *For flexible single lead probes only.*

Table A-22: HP Probe (Operating Temperature and Pressure code P)

Material of construction code	Material exposed to tank atmosphere
1 (probe type 3C)	316L/316 (EN 1.4404), Ceramic (Al_2O_3), Graphite, PTFE, and Alloy C-276 (UNS N10276)
1 (all other probe types)	316L/316 (EN 1.4404)(1), Ceramic (Al_2O_3), Graphite, PFA, PTFE, Alloy C-276 (UNS N10276), and Alloy 718 (UNS N07718)
2 and H	Alloy C-276 (UNS N10276), Ceramic (Al_2O_3), Graphite, PFA, PTFE, and Alloy 718 (UNS N07718)
D	Duplex 2205 (UNS S31803/EN 1.4462), Ceramic (Al_2O_3), Graphite, PFA, PTFE, Alloy C-276 (UNS N10276), and Alloy 718 (UNS N07718)

Table A-22: HP Probe (Operating Temperature and Pressure code P) *(continued)*

Material of construction code	Material exposed to tank atmosphere
E	Alloy 825 (UNS N08825), Ceramic (Al_2O_3), Graphite, PFA, PTFE, Alloy C-276 (UNS N10276), and Alloy 718 (UNS N07718)

(1) *For flexible single lead probes only.*

Table A-23: Cryogenic Probe (Operating Temperature and Pressure code C)

Material of construction code	Material exposed to tank atmosphere
1 (probe type 3C)	316L/316 (EN 1.4404), Ceramic (Al_2O_3), Graphite, PTFE, and Alloy C-276 (UNS N10276)
1 (all other probe types)	316L/316 (EN 1.4404)(1), Ceramic (Al_2O_3), Graphite, PFA, PTFE, Alloy C-276 (UNS N10276), and Alloy 718 (UNS N07718)

(1) *For flexible single lead probes only.*

A.3.13 Weight

Table A-24: Flange and Probes

Item	Weight
Flange	Depends on flange size
Flexible single lead probe	0.05 lb/ft. (0.08 kg/m)
Rigid single lead probe (0.3-in./8 mm)	0.27 lb/ft. (0.4 kg/m)
Rigid single lead probe (0.5-in./13 mm)	0.71 lb/ft. (1.06 kg/m)
Segmented rigid single lead probe	0.71 lb/ft. (1.06 kg/m)
Flexible twin lead probe	0.09 lb/ft. (0.14 kg/m)
Rigid twin lead probe	0.40 lb/ft. (0.6 kg/m)
Coaxial probe	0.67 lb/ft. (1 kg/m)
Large coaxial probe	1.48 lb/ft. (2.2 kg/m)

Table A-25: End Weight

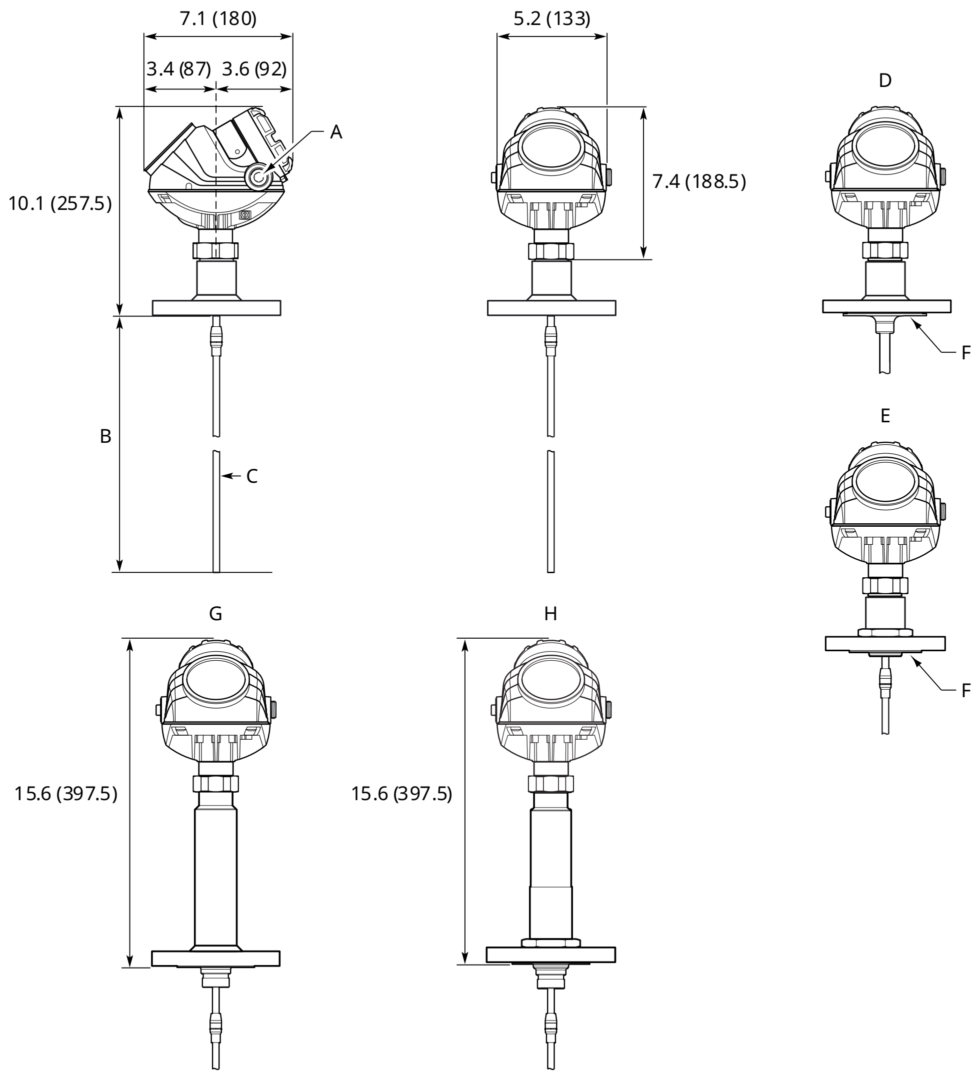
Item	Weight
Standard weight for flexible single lead probe (0.16-in./4 mm)	0.88 lb (0.40 kg)
Short weight (W2) for flexible single lead probe (0.16-in./4 mm)	0.88 lb (0.40 kg)
Heavy weight (W3) for flexible single lead probe (0.16-in./4 mm)	2.43 lb (1.10 kg)
Weight for flexible single lead probe (0.24-in./6 mm)	1.2 lb (0.55 kg)
Weight for PTFE covered flexible single lead	2.2 lb (1 kg)
Weight for twin lead probe	1.3 lb (0.60 kg)

A.3.14 End weight options

A short weight is available for the single flexible probe. It is used for measuring close to the probe end and shall be used where the measuring range must be maximized. The height is 2 in. (50 mm) and the diameter is 1.5 in. (37.5 mm). The option code is W2.

A.4 Dimensional drawings

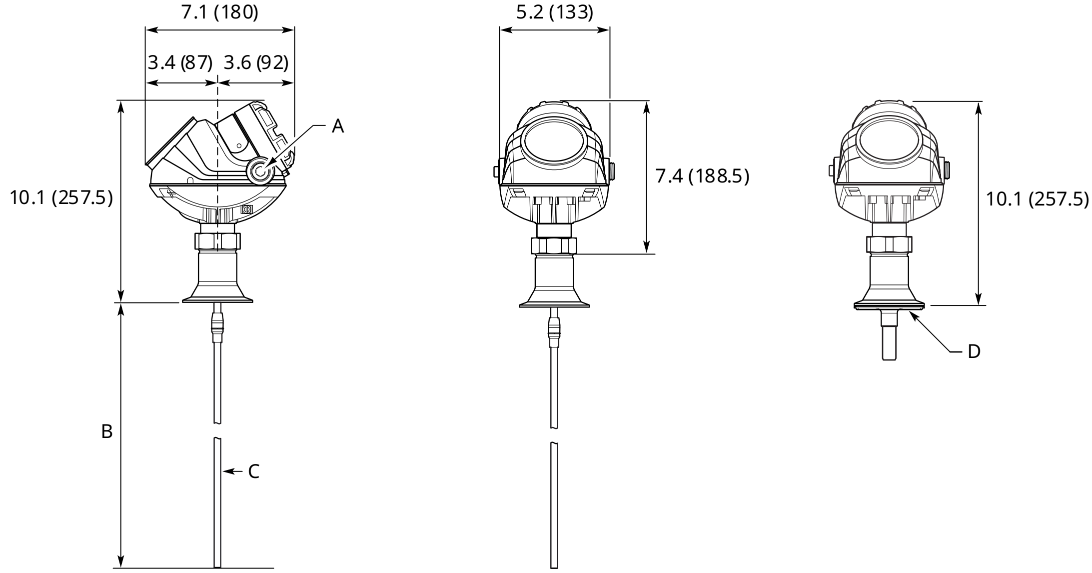
Figure A-25: Rigid Single Lead Probe with Flange Connection



A. ½ - 14 NPT; optional adapters: M20x1.5, eurofast® and minifast®
B. L ≤ 10 ft. (3 m) for Ø 0.31 (8); L ≤ 20 ft. (6 m) for Ø 0.51 (13)
C. Ø 0.31 (8); Ø 0.51 (13); Ø 0.47 (12) for PTFE covered probe
D. PTFE covered probe and protective plate
E. Alloy probe and protective plate
F. The PTFE and Alloy probes are designed with a protective plate.
G. HTHP/HP/C version
H. HTHP/HP Plate Design (Option for Alloy versions)

Dimensions are in inches (millimeters).

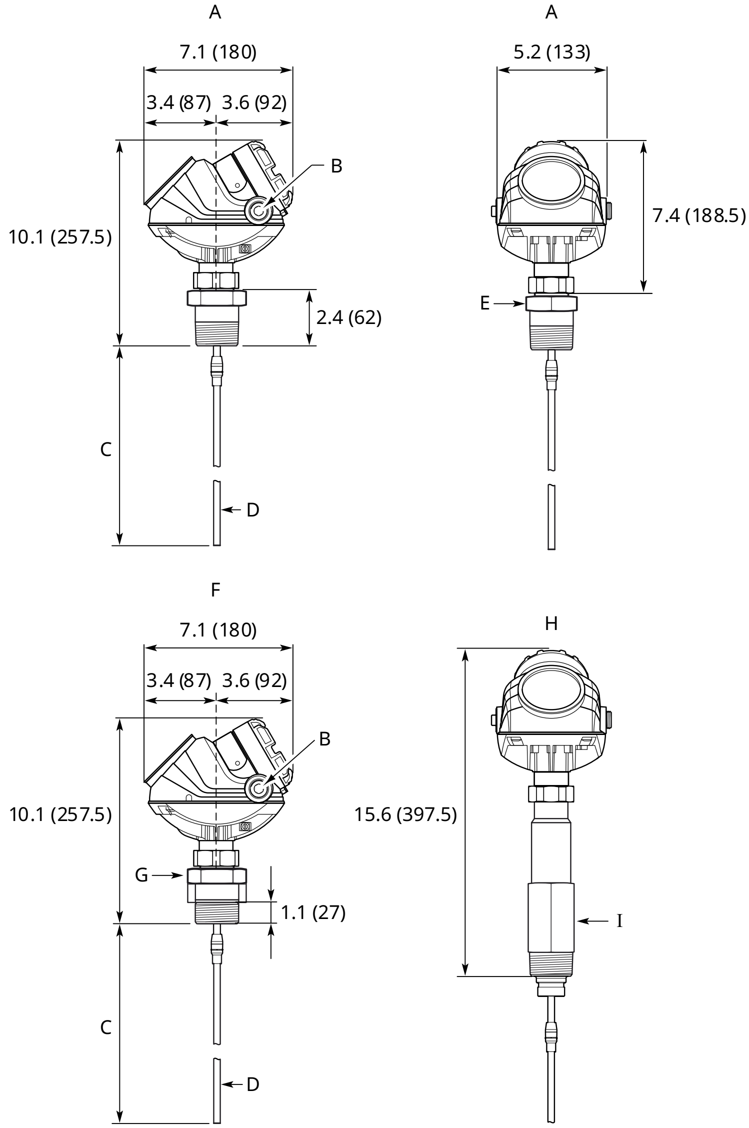
Figure A-26: Rigid Single Lead Probe with Tri Clamp Connection



A. *½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast*
B. *L ≤ 10 ft. (3 m) for Ø 0.31 (8); L ≤ 20 ft. (6 m) for Ø 0.51 (13)*
C. *Ø 0.31 (8); Ø 0.51 (13); Ø 0.47 (12) for PTFE covered probe*
D. *PTFE covered probe and protective plate*

Dimensions are in inches (millimeters).

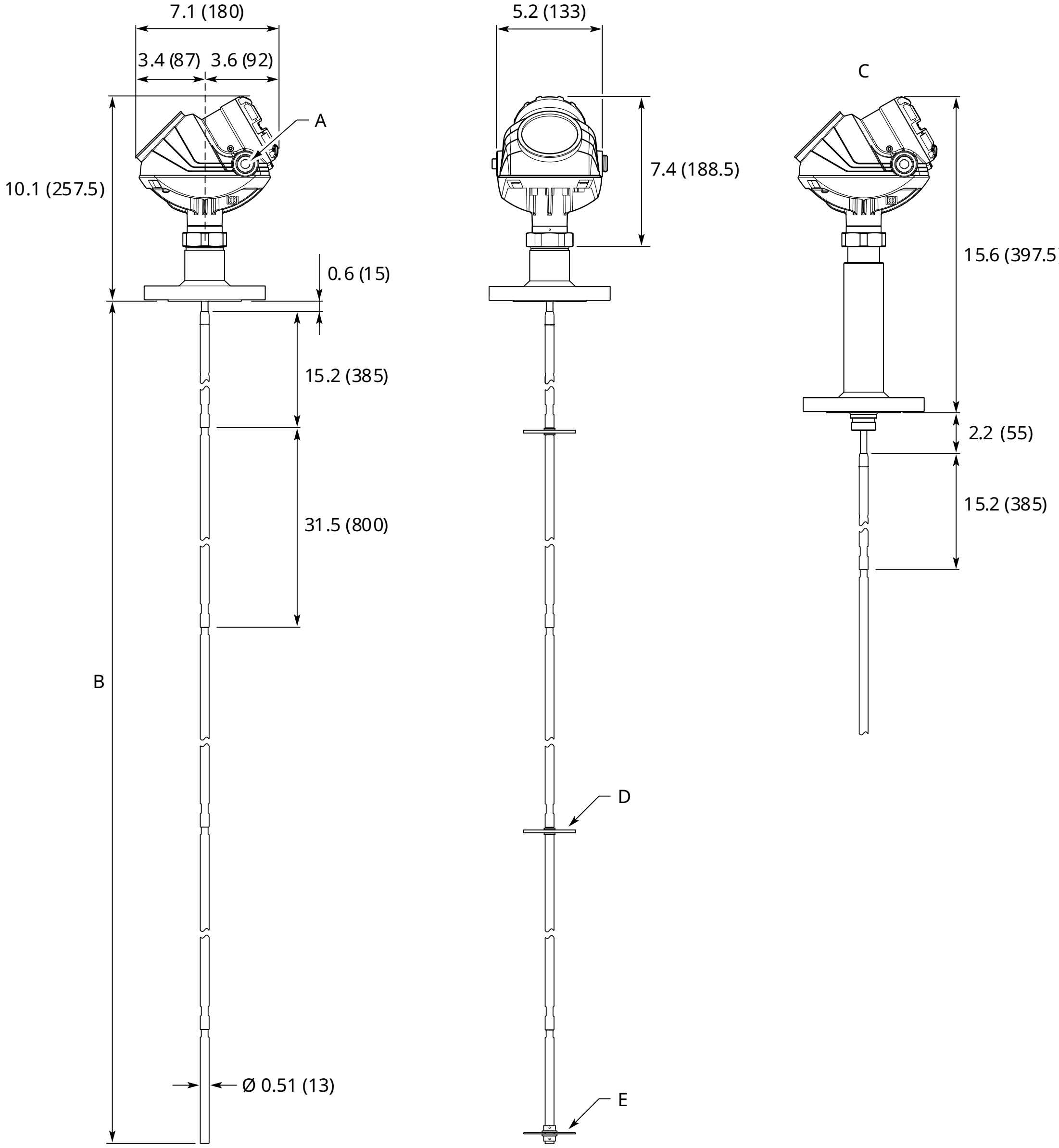
Figure A-27: Rigid Single Lead with Threaded Connection



A. NPT 1/1½/2 in.
B. ½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast
C. L ≤ 10 ft. (3 m) for Ø 0.31 (8); L ≤ 20 ft. (6 m) for Ø 0.51 (13)
D. Ø 0.31 (8); Ø 0.51 (13); Ø 0.47 (12) for PTFE covered probe
E. 1 in. / 1½ in.: s52; 2 in.: s60
F. G 1/1½ in.
G. 1 in.: s52; 1½ in.: s60
H. NPT 1½, G 1½ in. (HTHP/HP/C version)
I. NPT: s50; G: s60

Dimensions are in inches (millimeters).

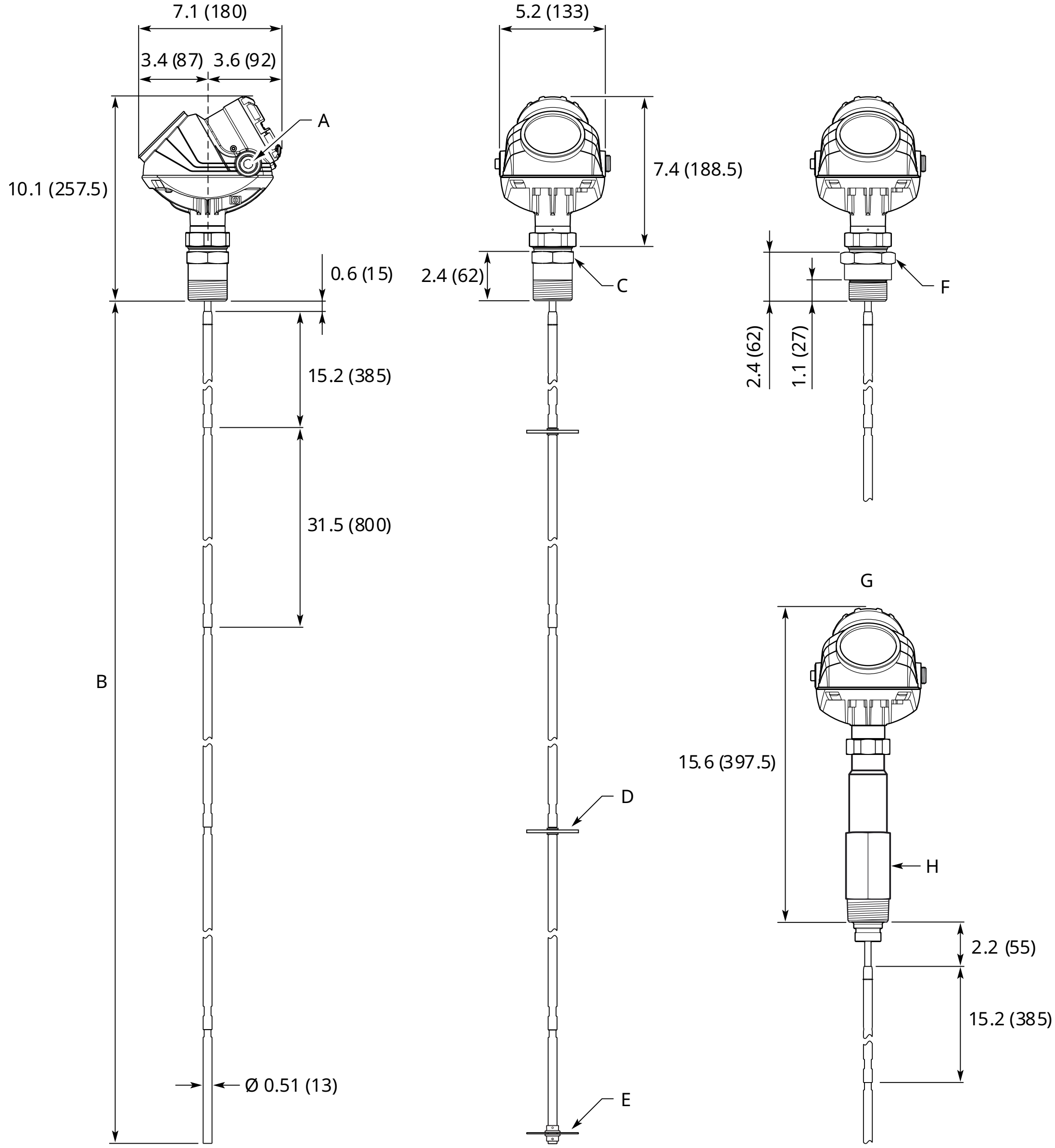
Figure A-28: Segmented Rigid Single Lead Probe with Flange Connection



A. ½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast
B. L ≤ 33 ft. (10 m)
C. HTHP/HP/C version
D. Optional: PTFE centering disc
E. Optional: Bottom centering disc (SST or PTFE)

Dimensions are in inches (millimeters).

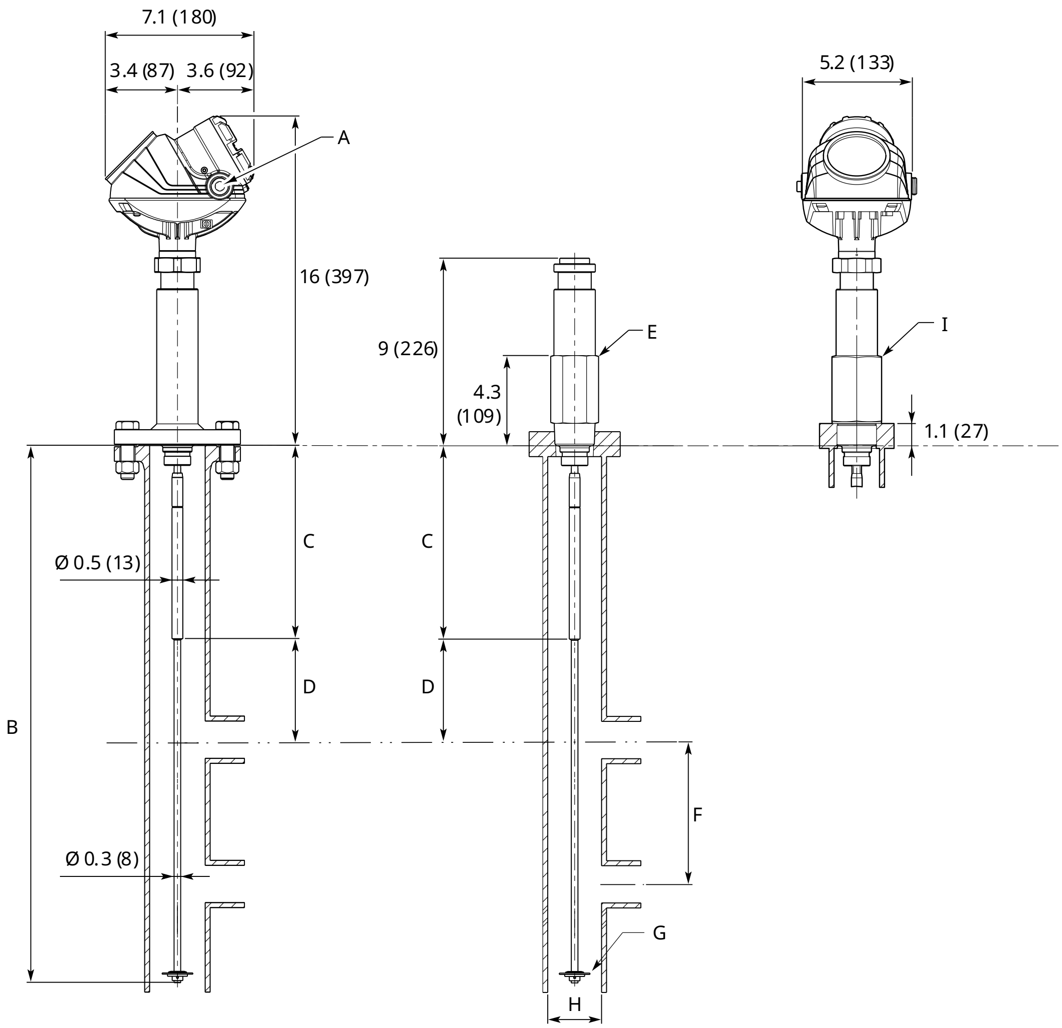
Figure A-29: Segmented Rigid Single Lead Probe with Threaded Connection



A. ½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast
B. L ≤ 33 ft. (10 m)
C. NPT 1 in., s52; NPT 1½ in., s52; NPT 2 in., s60
D. Optional: PTFE centering disc
E. Optional: Bottom centering disc (SST or PTFE)
F. BSP-G 1 in., s52; BSP-G 1½ in., s60
G. HTHP/HP/C version
H. NPT 1½ in., s50; BSP-G 1½ in., s60

Dimensions are in inches (millimeters).

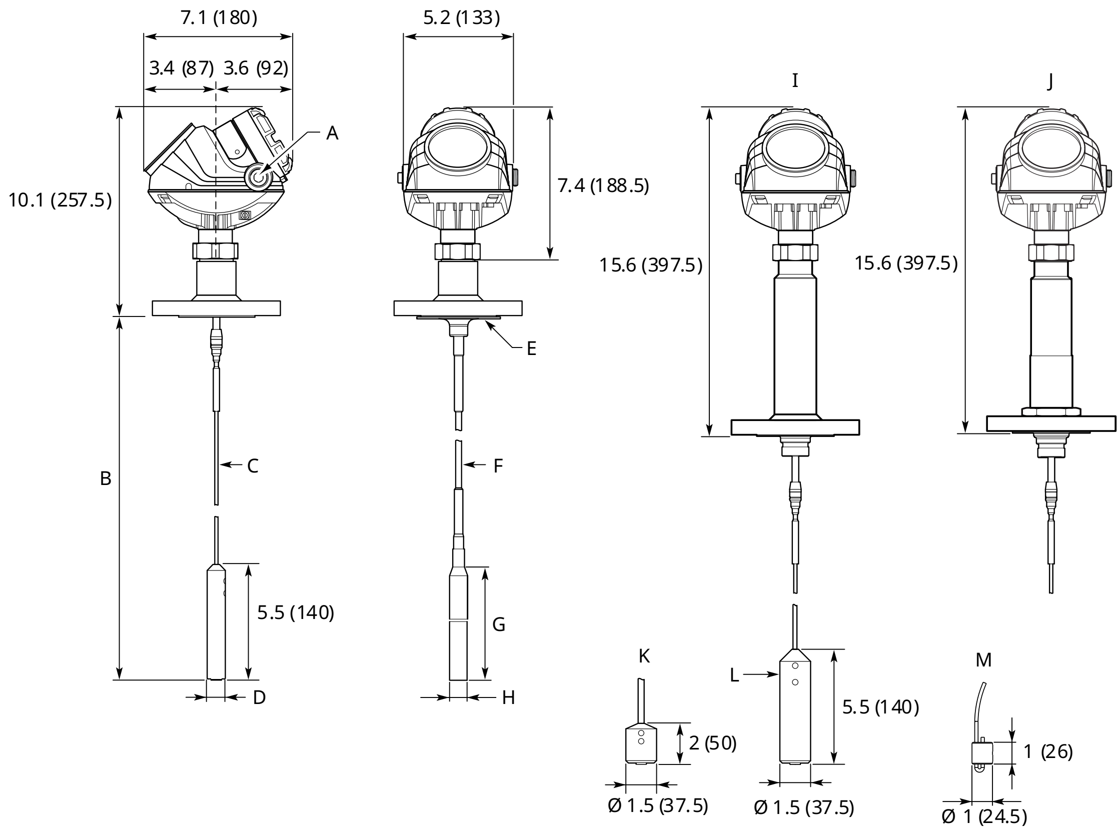
Figure A-30: Single Rigid Vapor Probe for 2-in. Chambers



A. ½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast
B. L ≤ 10 ft. (3 m)
C. Short reflector: 13.8 (350); Long reflector: 19.7 (500)
D. Minimum 8.3 in. (210 mm) distance between water surface and reflector end
E. NPT 1½ in., s50
F. Min. 12 in. (300 mm)
G. 1½-in. centering disc, Ø 1.46 (37)
H. Pipe inner diameter: Ø 1.5 (38) - Ø 2.05 (52)
I. BSP-G 1½ in., s60

Dimensions are in inches (millimeters).

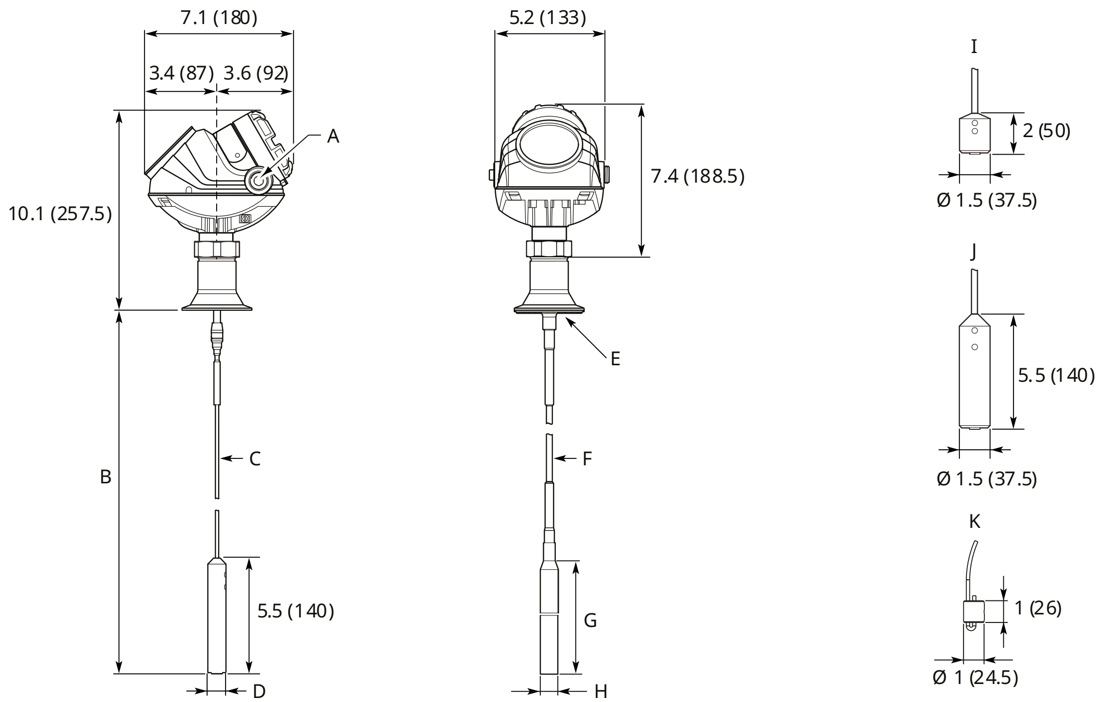
Figure A-31: Flexible Single Lead Probe with Flange Connection



- *A. ½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast*
- *B. L ≤ 164 ft. (50 m)*
- *C. Ø 0.16 (4); Ø 0.24 (6)*
- *D. 4 mm probe: Ø 0.86 (22); 6 mm probe: Ø 1.10 (28)*
- *E. The PTFE covered probe is designed with a protective plate*
- *F. Ø 0.28 (7) for PTFE covered probe*
- *G. 17.1 (434) for PTFE covered probe*
- *H. Ø 0.88 (22.5) for PTFE covered probe*
- *I. HTHP/HP/C version*
- *J. HTHP/HP/C Plate Design (Option for Alloy versions)*
- *K. Short weight (option W2)*
- *L. Heavy weight (option W3)*
- *M. Chuck*

Dimensions are in inches (millimeters).

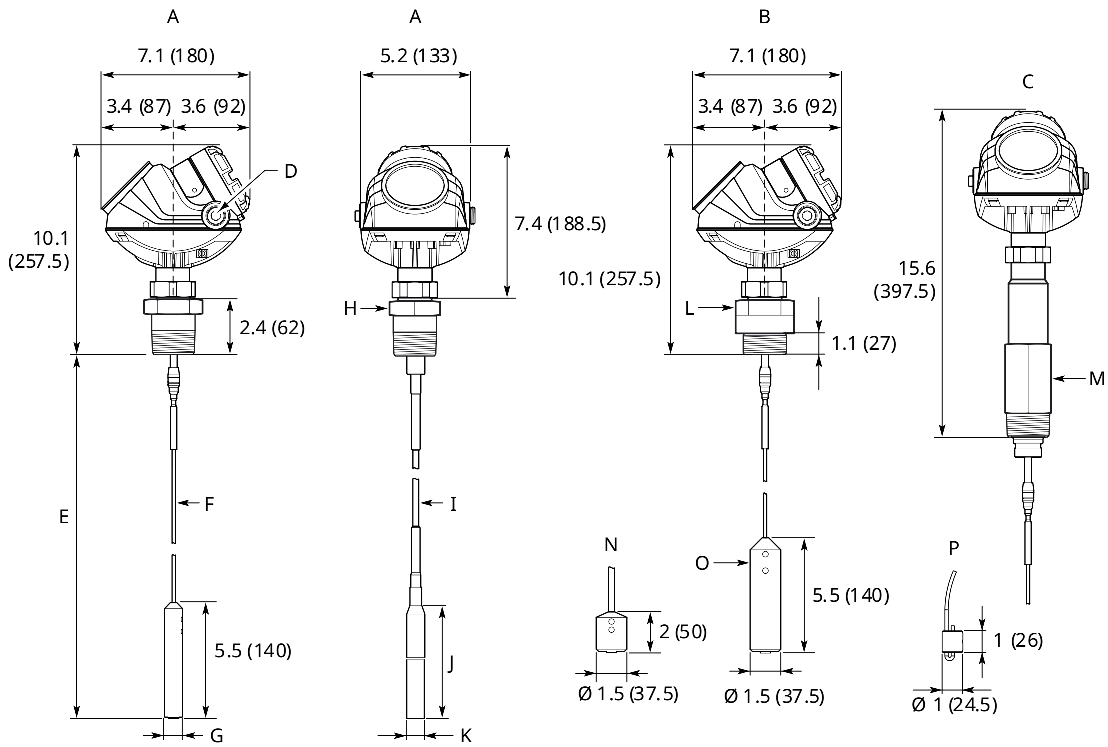
Figure A-32: Flexible Single Lead Probe with Tri Clamp Connection



A. ½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast
B. L ≤ 164 ft. (50 m)
C. Ø 0.16 (4); Ø 0.24 (6)
D. 4 mm probe: Ø 0.86 (22); 6 mm probe: Ø 1.10 (28)
E. The PTFE covered probe is designed with a protective plate
F. Ø 0.28 (7) for PTFE covered probe
G. 17.1 (434) for PTFE covered probe
H. Ø 0.88 (22.5) for PTFE covered probe
I. Short weight (option W2)
J. Heavy weight (option W3)
K. Chuck

Dimensions are in inches (millimeters).

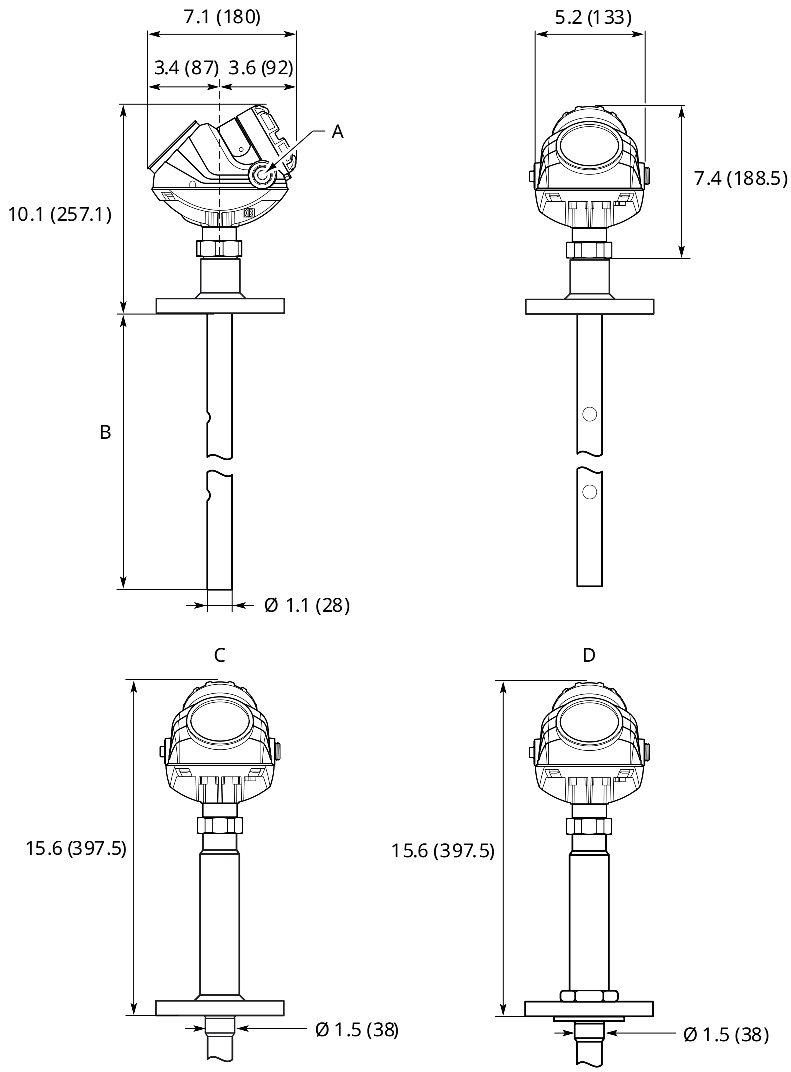
Figure A-33: Flexible Single Lead with Threaded Connection



A. NPT 1/1½/2 in.
B. G 1/1½ in.
C. NPT 1½, G 1½ in. (HTHP/HP/C version)
D. ½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast
E. L ≤ 164 ft. (50 m)
F. Ø 0.16 (4); Ø 0.24 (6)
G. 4 mm probe: Ø 0.86 (22); 6 mm probe: Ø 1.10 (28)
H. 1 in. / 1½ in.: s52; 2 in.: s60
I. Ø 0.28 (7) for PTFE covered probe
J. 17.1 (434) for PTFE covered probe
K. Ø 0.88 (22.5) for PTFE covered probe
L. 1 in.: s52; 1½ in.: s60
M. NPT: s50; G: s60
N. Short weight (option W2)
O. Heavy weight (option W3)
P. Chuck

Dimensions are in inches (millimeters).

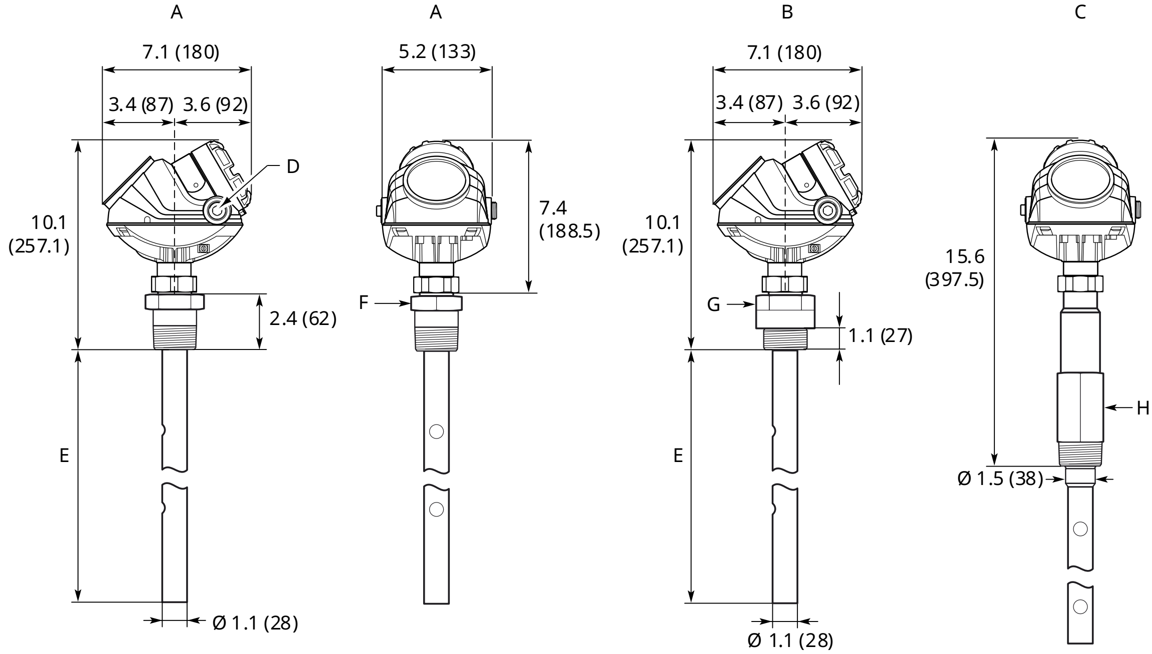
Figure A-34: Coaxial probe with Flange Connection



- *A. ½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast*
- *B. L ≤ 20 ft. (6 m)*
- *C. HTHP/HP/C version*
- *D. HTHP/HP Plate Design (Option for Alloy versions)*
- *E. The Alloy probes are designed with a protective plate*

Dimensions are in inches (millimeters).

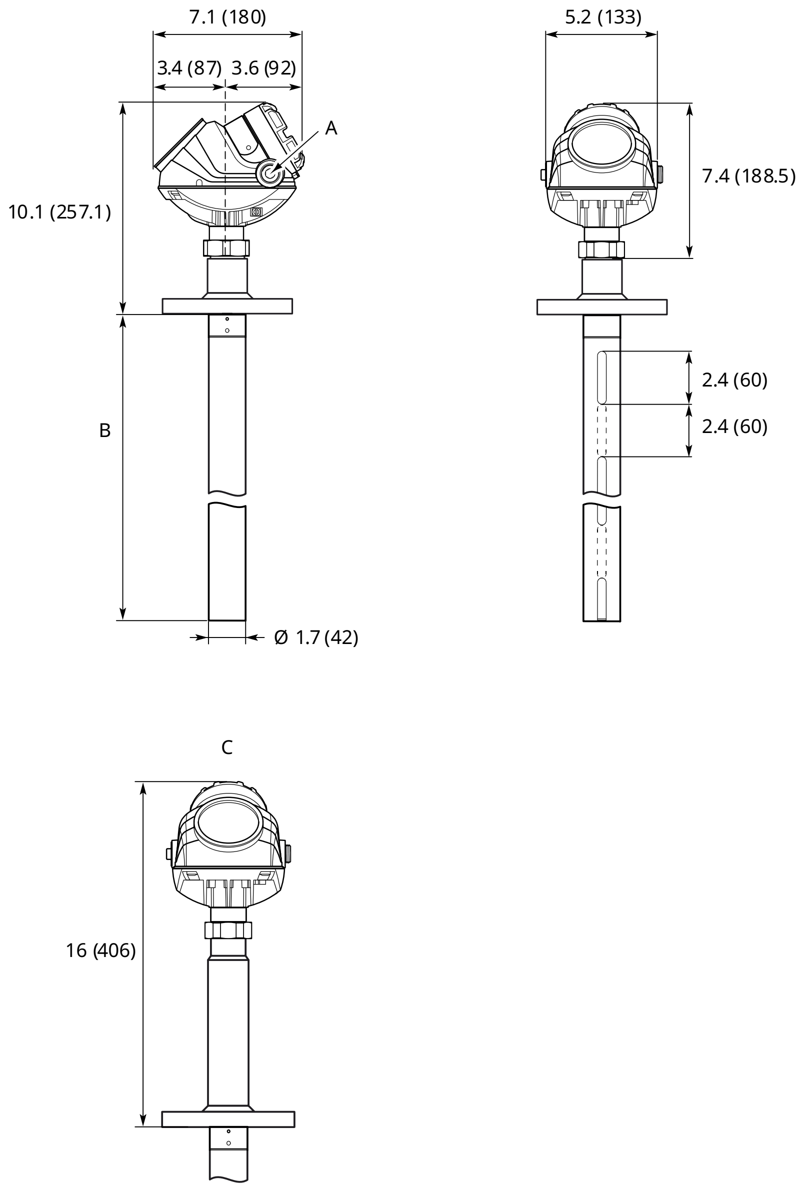
Figure A-35: Coaxial Probe with Threaded Connection



A. NPT 1/1½/2 in.
B. G 1/1½ in.
C. NPT 1½, G 1½ inch (HTHP/HP/C version)
D. ½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast
E. L ≤ 20 ft (6 m)
F. 1 in., 1½ in.: s52; 2 in.: s60
G. 1 in.: s52; 1½ in.: s60
H. NPT: s50; G: s60

Dimensions are in inches (millimeters).

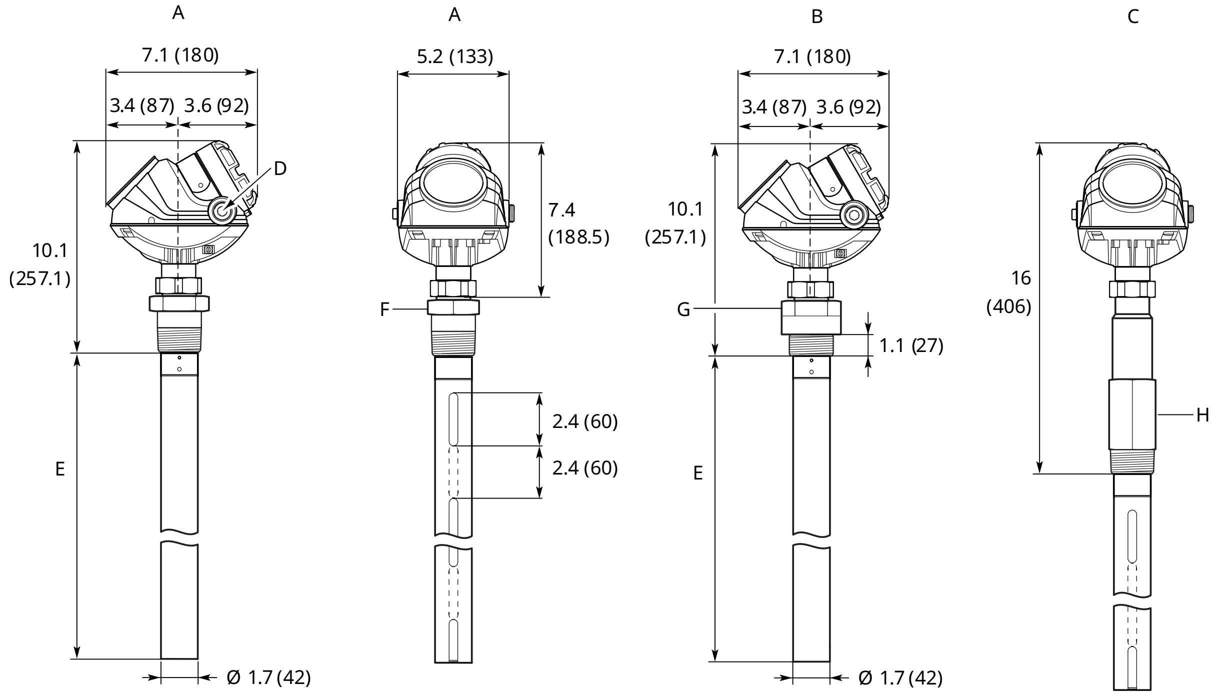
Figure A-36: Large Coaxial Probe with Flange Connection



A. ½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast
B. L ≤ 20 ft. (6 m)
C. HP/C version

Dimensions are in inches (millimeters).

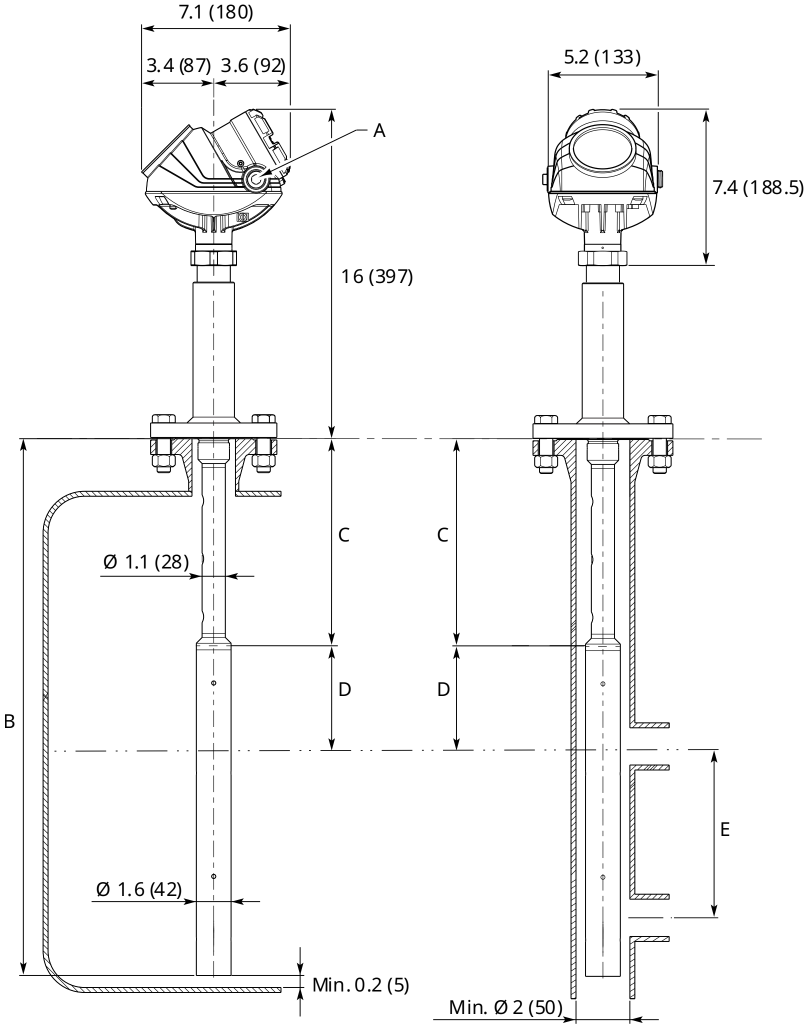
Figure A-37: Large Coaxial Probe with Threaded Connection



A. NPT 1½/2 in.
B. G 1½ in.
C. NPT 1½, G 1½ in. (HP/C version)
D. ½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast
E. L ≤ 20 ft. (6 m)
F. 1½ in.: s52; 2 in.: s60
G. 1½ in.: s60
H. NPT: s50; G: s60

Dimensions are in inches (millimeters).

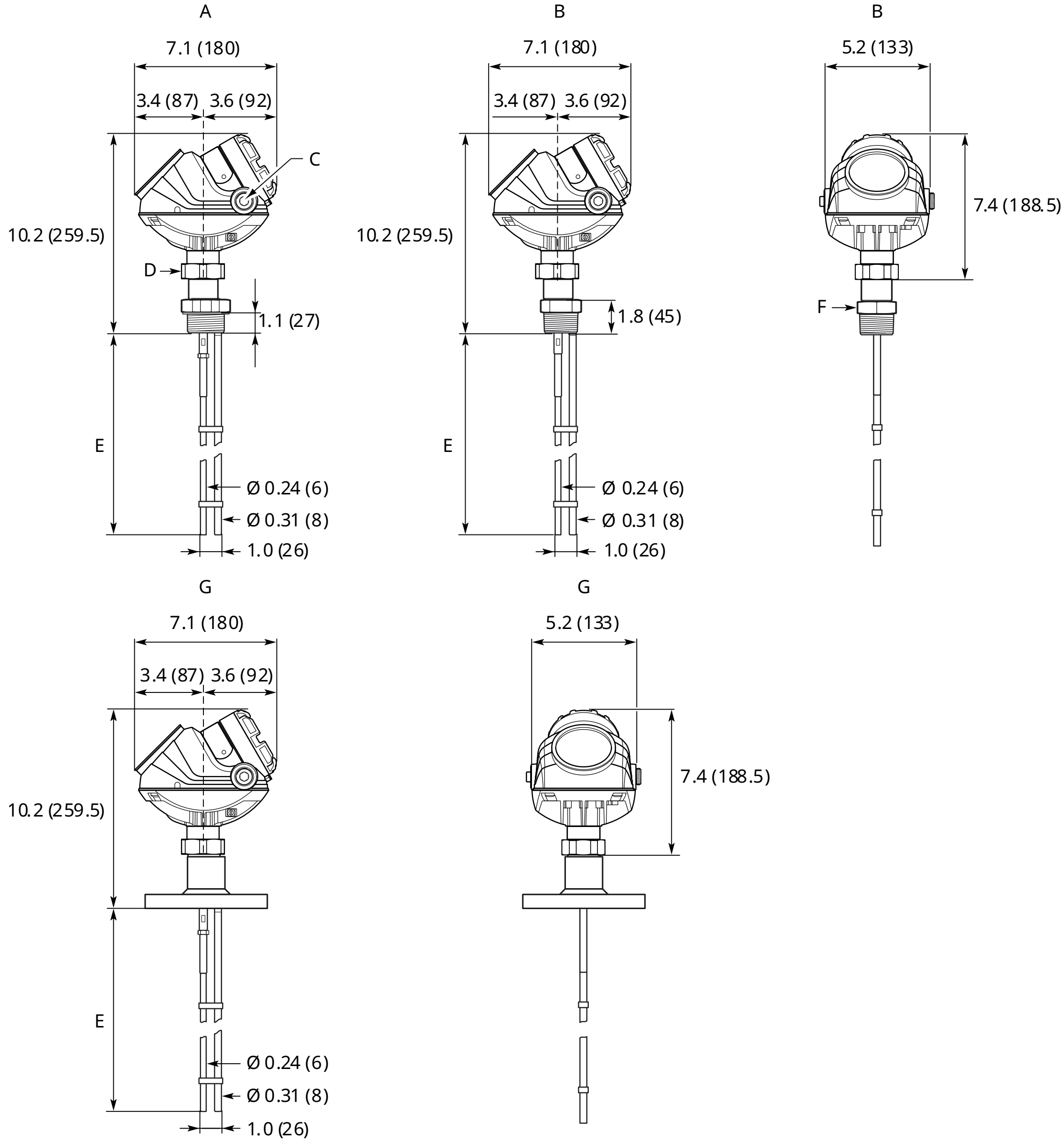
Figure A-38: Integrated Still Pipe Vapor Probe for 3-in. Chambers and above



A. ½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast
B. L ≤ 13 ft. 1 in. (4 m)
C. Short reflector: 13.8 (350); Long reflector: 19.7 (500)
D. Minimum 8.3 in. (210 mm) distance between water surface and reflector end
E. Minimum 12 in. (300 mm)

Dimensions are in inches (millimeters).

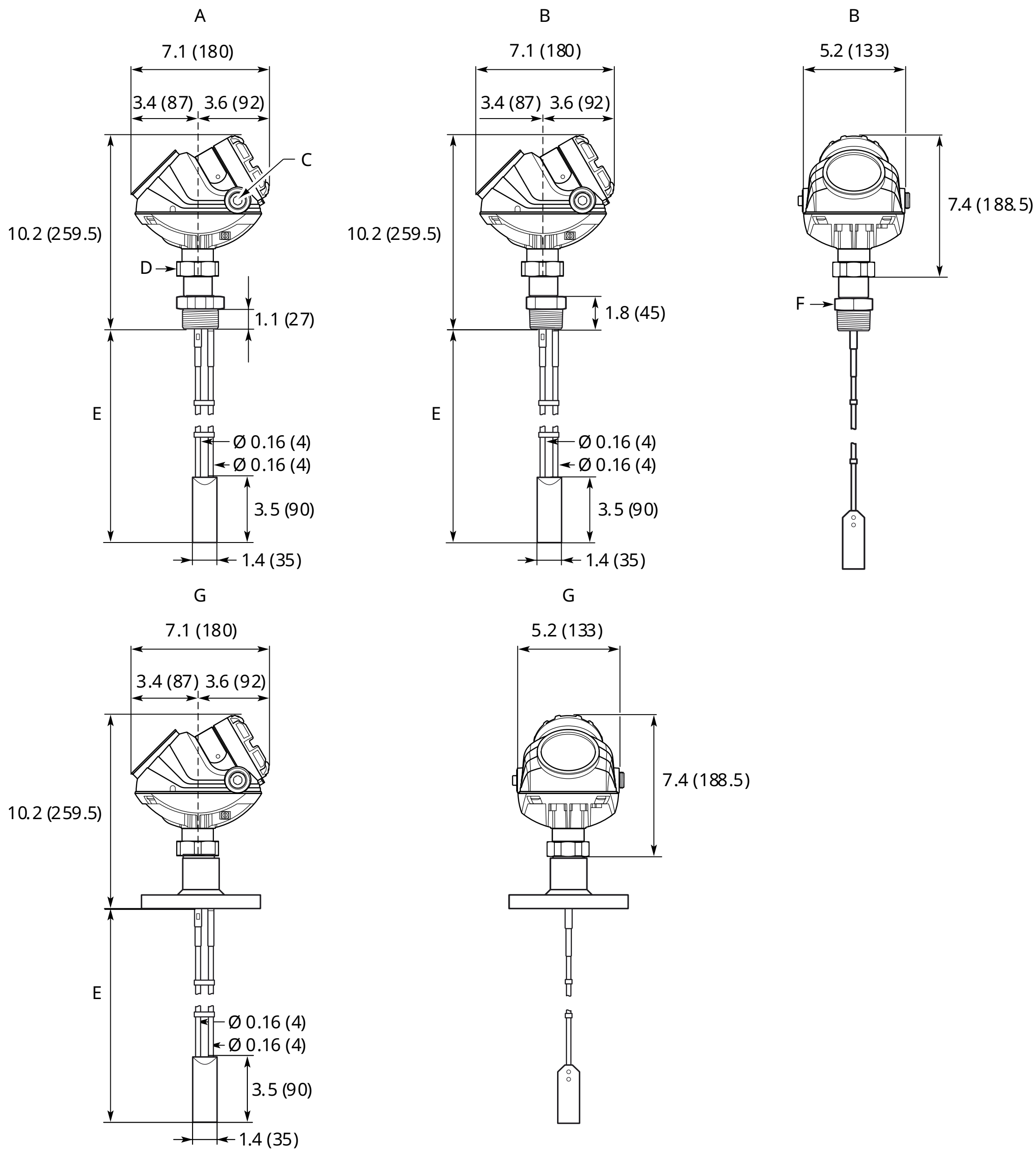
Figure A-39: Rigid Twin Lead Probe



A. G 1½ in.
B. NPT 1½ / 2 in.
C. ½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast
D. s60
E. L ≤ 10 ft. (3 m)
F. 1½ in.: s52; 2 in.: s60
G. Flange

Dimensions are in inches (millimeters).

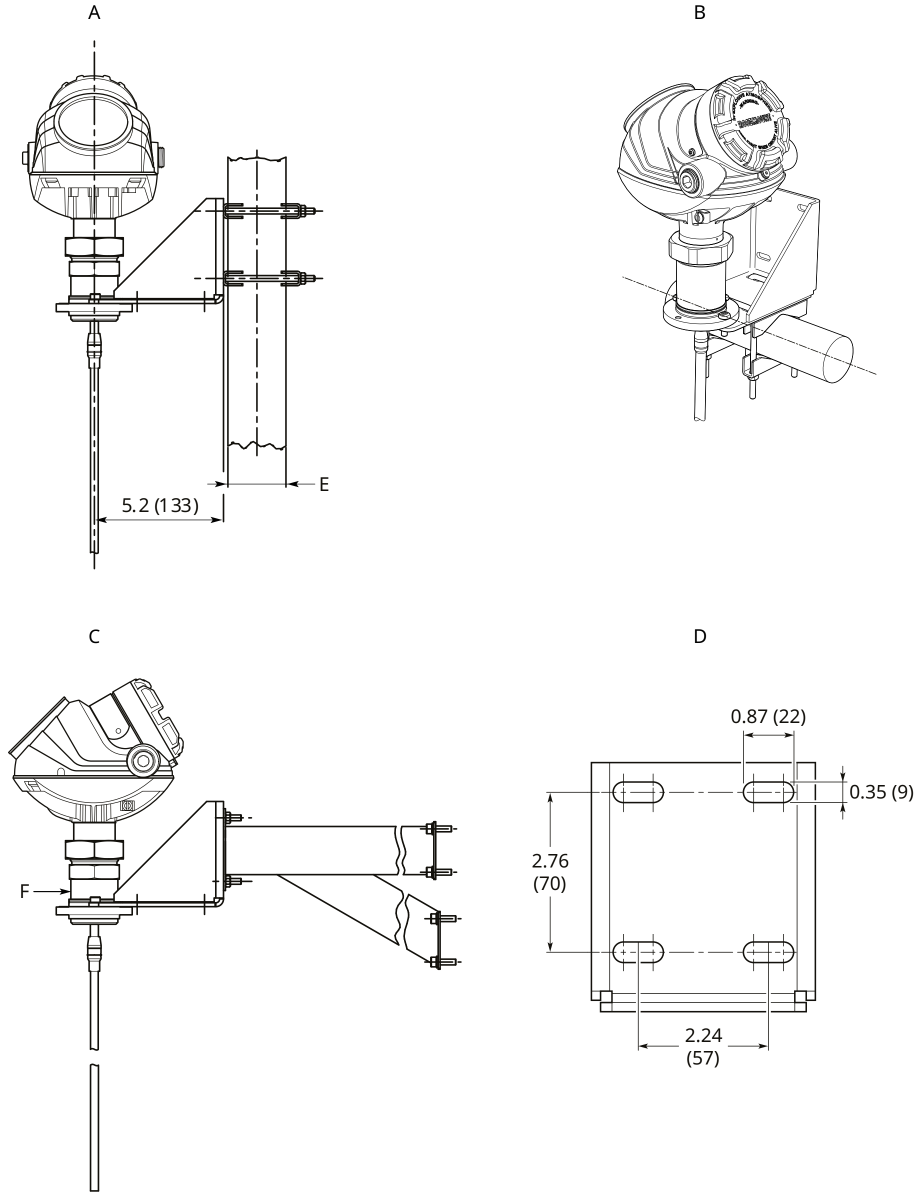
Figure A-40: Flexible Twin Lead Probe



A. G 1½ in.
B. NPT 1½ / 2 in.
C. ½ - 14 NPT; optional adapters: M20x1.5, eurofast and minifast
D. s60
E. L ≤ 164 ft. (50 m)
F. 1½ in.: s52; 2 in.: s60
G. Flange

Dimensions are in inches (millimeters).

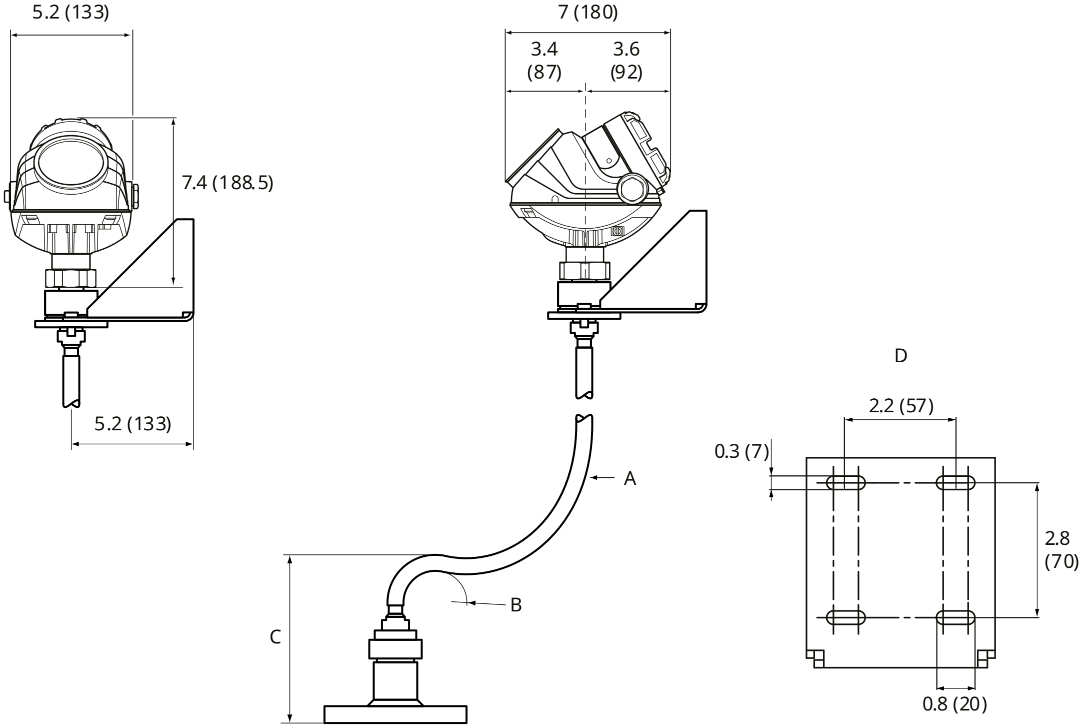
Figure A-41: Mounting Bracket (Option Code BR)



A. *Pipe mounting (vertical pipe)*
B. *Pipe mounting (horizontal pipe)*
C. *Wall mounting*
D. *Hole pattern for wall mounting*
E. *Pipe diameter: max 2.5 in. (64 mm)*
F. *NPT 1½-in.*

Dimensions are in inches (millimeters).

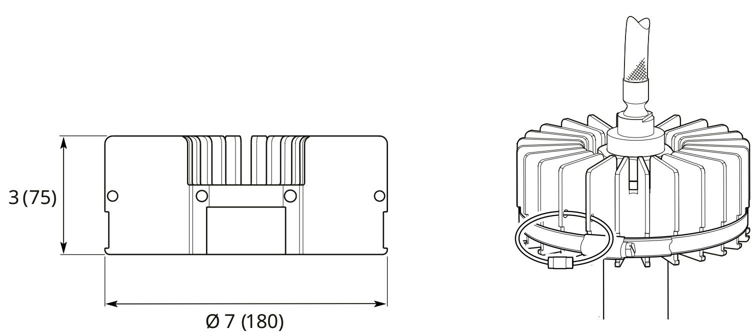
Figure A-42: Remote Housing (Option Code B1, B2, B3)



- A. *3, 6, 9 ft. (1, 2, or 3 m)*
- B. *R_{min}: 1.4 (35)*
- C. *H_{min}: 7.3 (185) for Standard variant; 12.8 (325) for HTHP/HP/C variant*
- D. *Hole pattern for remote housing wall mounting*

Dimensions are in inches (millimeters).

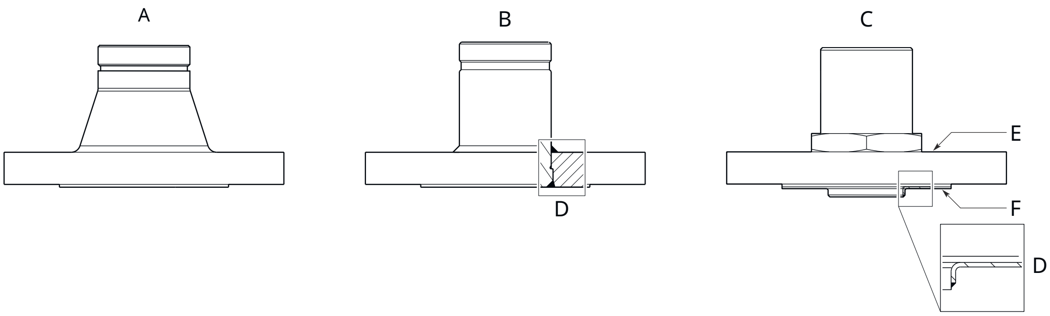
Figure A-43: Heat Sink (Option Code HS)



Dimensions are in inches (millimeters).

A.5 Standard flanges

Figure A-44: Flange Connection



A. *Forged one-piece*
B. *Welded construction*
C. *Protective plate design*
D. *Weld*
E. *Backing flange*
F. *Protective plate*

Table A-26: Standard Flanges

Standard	Face type(1)	Plate surface finish, R_a
ASME B16.5	Raised face	125-250 μin
	Ring type joint	< 63 μin
EN 1092-1	Type A flat face	3.2-12.5 μm
	Type B2 raised face	0.8-3.2 μm
	Type C tongue face	0.8-3.2 μm
	Type E spigot face	3.2-12.5 μm
JIS B2220	Raised face	3.2-6.3 μm

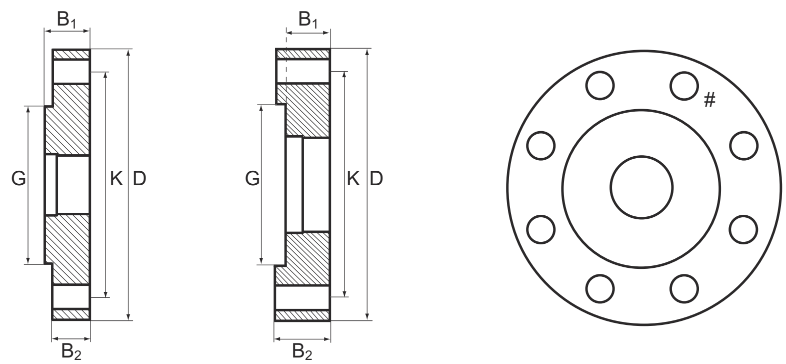
(1) *Face gasket surface is serrated per mating standard.*

Table A-27: Standard Flanges, Protective Plate

Standard	Face type including protective plate	Plate surface finish, R_a
ASME B16.5	Raised face	3.2-6.3 μm
EN 1092-1	Raised face	3.2-6.3 μm
JIS B2220	Raised face	3.2-6.3 μm

A.6 Proprietary flanges

Figure A-45: Proprietary Flanges



D: Outside diameter

B_1: Flange thickness with gasket surface

B_2: Flange thickness without gasket surface

$F=B_1-B_2$: Gasket surface thickness

G: Gasket surface diameter

Bolts: Number of bolts

K: Bolt hole circle diameter

Dimensions are in inches (millimeters).

Note
Dimensions may be used to aid in the identification of installed flanges. It is not intended for manufacturing use.

Table A-28: Dimensions of Proprietary Flanges

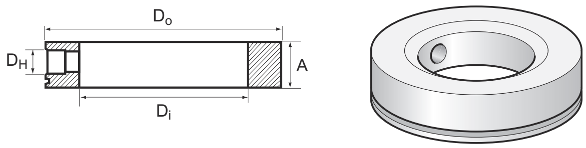
Special flanges(1)	D	B_1	B_2	F	G	# Bolts	K
Fisher™ 249B/259B(2)	9.00 (228.6)	1.50 (38.2)	1.25 (31.8)	0.25 (6.4)	5.23 (132.8)	8	7.25 (184.2)
Fisher 249C(3)	5.69 (144.5)	0.94 (23.8)	1.13 (28.6)	-0.19 (-4.8)	3.37 (85.7)	8	4.75 (120.65)
Masoneilan™(2)	7.51(191.0)	1.54 (39.0)	1.30 (33.0)	0.24 (6.0)	4.02 (102.0)	8	5.87 (149.0)

(1) *These flanges are also available in a vented version. Vented flanges must be ordered with a 1½-in. NPT threaded process connection (code RA).*
(2) *Flange with raised face.*
(3) *Flange with recessed face.*

For information about flange temperature and pressure ratings, see Fisher and Masoneilan flange rating.

A.7 Flushing connection rings

Figure A-46: Flushing Connection Rings



A. Height: 0.97 in. (24.6 mm)

Table A-29: Dimensions of Flushing Connection Rings

Flushing connection rings	D_i	D_o	D_H
2-in. ANSI(1)	2.12 (53.8)	3.62 (91.9)	¼-in. NPT
3-in. ANSI(1)	3.60 (91.4)	5.00 (127.0)	¼-in. NPT
4-in. ANSI(1)/DN100	3.60 (91.4)	6.20 (157.5)	¼-in. NPT
DN50	2.40 (61.0)	4.00 (102.0)	¼-in. NPT
DN80	3.60 (91.4)	5.43 (138.0)	¼-in. NPT

(1) *Up to Class 2500.*

A.8 Spare parts list - transmitter head

A.8.1 Required model components

Model

Code	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 Solids Level Transmitter	★

Signal output

Code	Description	
H	4-20 mA with HART communication (default output from factory is HART 7, add option code HR5 for HART 5)	★
F	FOUNDATION Fieldbus	★
M	RS-485 with Modbus communication	★
U	Rosemount 2410 Tank Hub connectivity	

Related information

4-20 mA HART
FOUNDATION Fieldbus
Modbus

Housing material

Code	Description	
A	Polyurethane-covered Aluminum (Aluminum alloy A360, maximum 0.6 percent Cu)	★
S	Stainless Steel, Grade CF8M (ASTM A743)	

Conduit / cable threads

Code	Description		
1	½ - 14 NPT	1 plug included	★
2	M20 x 1.5 adapter	1 adapter and 1 plug included	★
4	2 pcs M20 x 1.5 adapter	2 adapters and 1 plug included	★
G(1)(2)	Metal cable gland (½ - 14 NPT)	2 glands and 1 plug included	★
E(3)	M12, 4-pin, male connector (eurofast®)	1 plug included	★
M(3)	A size Mini, 4-pin, male connector (minifast®)	1 plug included	★

(1) Not available with explosion-proof or flameproof approvals.
(2) Minimum temperature is -20 °C (-4 °F).
(3) Not available with explosion-proof, flameproof, or increased safety approvals.

Operating temperature and pressure

Code	Description	
N	Not Applicable	★

Material of construction: Process connection / probe

Code	Description	
0	Not Applicable	★

Sealing O-ring material

Code	Description	
N	Not Applicable	★

Probe type

Code	Description	
0N	None	★

Probe length units

Code	Description	
N	Not Applicable	★

Total probe length (feet/m)

Code	Description	
000	Not Applicable	★

Total probe length (in./cm)

Code	Description	
00	Not Applicable	★

Process Connection - size / type

Code	Description
NA	Not Applicable

Hazardous locations certifications

Code	Description	
NA	No Hazardous Locations Certifications	★
E1(1)	ATEX/UKEX Flameproof	★
E3(1)	China Flameproof	★
E5(1)	USA Explosion-proof	★
E6(1)	Canadian Explosion-proof	★
E7(1)	IECEx Flameproof	★
I1	ATEX/UKEX Intrinsic Safety	★
IA(2)	ATEX/UKEX FISCO Intrinsic Safety	★
I3	China Intrinsic Safety	★
IC(2)	China FISCO Intrinsic Safety	★
I5	USA Intrinsic Safety and Non-Incendive	★
IE(2)	USA FISCO Intrinsic Safety	★
I6	Canadian Intrinsic Safety	★
IF(2)	Canadian FISCO Intrinsic Safety	★
I7	IECEx Intrinsic Safety	★
IG(2)	IECEx FISCO Intrinsic Safety	★
E2(1)	INMETRO Flameproof	
EM(1)	Technical Regulations Customs Union (EAC) Flameproof	
I2	INMETRO Intrinsic Safety	
IB(2)	INMETRO FISCO Intrinsic Safety	
IM	Technical Regulations Customs Union (EAC) Intrinsic Safety	
IN(2)	Technical Regulations Customs Union (EAC) FISCO Intrinsic Safety	
EW	India PESO Flameproof	
IW	India PESO Intrinsic Safety	

Code	Description	
E4(1)	Japan Flameproof	
EP(1)(3)	Republic of Korea Flameproof	
KA(1)	ATEX/UKEX, USA, Canadian Flameproof/Explosion-proof	
KB(1)	ATEX/UKEX, USA, IECEx Flameproof/Explosion-proof	
KC(1)	ATEX/UKEX, Canadian, IECEx Flameproof/Explosion-proof	
KD(1)	USA, Canadian, IECEx Flameproof/Explosion-proof	
KE	ATEX/UKEX, USA, Canadian Intrinsic Safety	
KF	ATEX/UKEX, USA, IECEx Intrinsic Safety	
KG	ATEX/UKEX, Canadian, IECEx Intrinsic Safety	
KH	USA, Canadian, IECEx Intrinsic Safety	
KI(2)	FISCO - ATEX/UKEX, USA, Canadian Intrinsic Safety	
KJ(2)	FISCO - ATEX/UKEX, USA, IECEX Intrinsic Safety	
KK(2)	FISCO - ATEX/UKEX, Canadian, IECEX Intrinsic Safety	
KL(2)	FISCO - USA, Canadian, IECEX Intrinsic Safety	
N1	ATEX/UKEX Increased Safety	
N7	IECEx Increased Safety	

(1) *Probes are intrinsically safe.*
(2) *Requires FOUNDATION Fieldbus signal output (U_i parameter listed in Product Certifications).*
(3) *The EP (Republic of Korea Flameproof) certificate is based on the E7 (IECEx Flameproof) certificate, therefore model code E7 is stated in the certificate instead of EP.*

Related information

Product certifications

A.8.2 Additional options

Display

Code	Description	
M1	Integral digital display	★

Communication

Code	Description	
HR5	4–20 mA with digital signal based on HART 5 protocol (default output from factory is HART 7, add option code HR5 for HART 5)	★

Factory configuration

Code	Description	
C1	Factory configuration per Configuration Data Sheet	★

Alarm limits

Code	Description	
C4	NAMUR alarm and saturation levels, high alarm	★
C5	NAMUR alarm and saturation levels, low alarm	★
C8(1)	Standard Rosemount alarm and saturation levels, low alarm	★

(1) *The standard alarm setting is high.*

Special quality assurance

Code	Description	
Q4	Calibration data certificate	★

Safety certifications

Code	Description	
QS	Prior-use certificate of FMEDA Data. Only available with HART 4-20 mA output (output code H).	★
QT	Safety-certified to IEC 61508 with certificate of FMEDA data. Only available with HART 4-20 mA output (output code H).	★

Related information

Rosemount 5300 Safety Manual

Country certification

Code	Description	
J8(1)(2)	EN Boiler (European Boiler Approval in accordance with EN 12952-11 and EN 12953-9)	★

(1) *Only available with Signal output code H.*
(2) *Suitable for use as a level sensor part of a limiting device, in accordance with EN 12952-11 and EN 12953-9.*

Marine / shipboard approvals

Transmitters with aluminum housing are not approved for open deck installations.

Code	Description	
SBS	American Bureau of Shipping Type Approval	★
SDN	Det Norske Veritas Germanischer Lloyd (DNV GL) Type Approval	★
SLL	Lloyd's Register Type Approval	★
SKR	Korean Register Type Approval	★
SBV	Bureau Veritas Type Approval	★
SNK	Nippon Kaiji Kyokai Type Approval	★
SRS	Russian Maritime Register of Shipping	★

Transient protection

Code	Description	
T1	Transient Protection Terminal Block. Selectable with HART 4-20 mA output (output code H). Already included in all FOUNDATION Fieldbus variations.	★

Diagnostic functionality

Code	Description	
D01	FOUNDATION Fieldbus Diagnostics Suite (includes Signal Quality Metrics diagnostics(1))	★
DA1	HART Diagnostics Suite (includes Signal Quality Metrics diagnostics(1))	★

(1) Signal Quality Metrics diagnostics is not compatible with interface measurement where the probe is fully submerged.

Cold temperature

Code	Description	
BR5(1)(2)(3)(4)	-67 °F (-55 °C) cold temperature	

(1) Only available for end-destination countries within the EAC Economic Union (Russia, Belarus, Kazakhstan, Armenia, and Kyrgyzstan).
(2) Consider any temperature limitations dependent on Material of construction, Hazardous locations certifications, and/or O-ring selection.
(3) Not available with option code QS or U1.
(4) For ambient temperatures between -67 °F (-55 °C) and -40 °F (-40 °C), the ambient temperature effect is ± 0.012 in. (0.3 mm) /°K or ± 45 ppm/°K of measured value, whichever is greatest. Other performance specifications apply to ambient temperatures between –40 °F (–40 °C) and 185 °F (85 °C).

Overfill prevention

Code	Description	
U1	Overfill prevention according to WHG/TUV	★

Extended product warranty

Code	Description	
WR3	3-year limited warranty	★
WR5	5-year limited warranty	★

Remote housing

Not available with Marine/shipboard approvals.

Code	Description	
B1	1 m/3.2 ft. Remote housing mounting cable and 316L bracket	
B2	2 m/6.5 ft. Remote housing mounting cable and 316L bracket	
B3	3 m/9.8 ft. Remote housing mounting cable and 316L bracket	

Related information

Dimensional drawings

Specials

Code	Description	
RXXXX	Custom engineered solutions beyond standard model codes. Consult factory for details.	

Related information

Engineered solutions

A.9 Spare parts list - probe

A.9.1 Required model components

Model

Code	Description
5309	Spare probe

Signal output

Code	Description	
N	Not Applicable	★

Housing material

Code	Description
N	Not Applicable

Conduit / cable threads

Code	Description
0	Not Applicable

Operating temperature and pressure

Process seal rating. Final rating depends on Material of construction, Flange, and O-ring selection.

Code	Description		Probe type	
Standard (Std)				
S	Design and operating temperature: -40 to 302 °F (-40 to 150 °C)	Design and operating pressure: -15 to 754 psig (-1 to 52 bar)(1)	1A, 2A, 3A, 3B, 3C, 4A, 4B, 4S, 5A, and 5B	★

Code	Description		Probe type	
High Pressure (HP)				
P[2]	Design temperature: -76 to 752 °F (-60 to 400 °C)[3]	Design and operating pressure: -15 to 5000 psig (-1 to 345 bar)	3A, 3B, 3C, 4A, 4B, 4S, 5A, and 5B	★
	Operating temperature: -76 to 500 °F (-60 to 260 °C)[4]			
High Temperature / High Pressure (HTHP)				
H[2][5]	Design and operating temperature: -76 to 752 °F (-60 to 400 °C)	Design and operating pressure: -15 to 5000 psig (-1 to 345 bar)	3A, 3B, 3V, 4A, 4B, 4S, 4U, 5A, and 5B	★
Cryogenic Temperature (C)				
C[2]	Design and operating temperature: -320 to 392 °F (-196 to 200 °C)	Design and operating pressure: -15 to 5000 psig (-1 to 345 bar)	3A, 3B, 3C, 4A, 4B, 4S, 5A, 5B (Only SST)	

(1) *Maximum pressure is 580 psig (40 bar) for O-ring material code B (Nitrile Butadiene), Country certification code J7, Overfill prevention code U1, and Material of construction code 2 or 3.*
(2) *Requires option None for sealing (no O-ring).*
(3) *Pressure retaining parts are designed for up to 752 °F (400 °C), maximum operating temperature is 500 °F (260 °C).*
(4) *Maximum operating temperature is 482 °F (250 °C) for option code U1.*
(5) *For applications where operating temperature cycles exclusively below 500 °F / 260 °C, and other applications where a large amount of contamination is present, the High Pressure (HP) or Standard (Std) seal should be used, if process conditions allow.*

Related information

Process temperature and pressure rating
Flange rating
Plate design
Tri Clamp rating

Material of construction: Process connection / probe

For other materials, consult the factory.

Code	Description	Probe type	Valid operation temperature and pressure	
1[1]	316/316L/EN 1.4404	All	S, H, P, C	★
2	Alloy C-276 (UNS N10276). With plate design if flanged version. Up to class 600/PN 63 for HTHP/HP probes.	3A, 3B, 4A, 4B, 5A, 5B	S, H, P	
3	Alloy 400 (UNS N04400). With plate design if flanged version.	3A, 3B, 4A, 4B, 5A, 5B	S	
7	PTFE covered probe and flange. With plate design.	4A and 5A	S	
8	PTFE covered probe	4A and 5A	S	

Code	Description	Probe type	Valid operation temperature and pressure	
H	Alloy C-276 (UNS N10276) process connection, flange, and probe	3A, 3B, 4A, 4B, 5A, 5B	S, H, P	
D	Duplex 2205 (EN 1.4462/UNS S31803) process connection, flange, and probe	4B, 5A, 5B	S, H, P	
E	Alloy 825 (UNS N08825) process connection, flange, and probe	4B, 5A, 5B	S, H, P	

(1) *ASME flanges dual certified 316/316L.*

Sealing O-ring material

For other materials, consult the factory.

Code	Description	
N(1)	None	★
V	Fluoroelastomer (FKM)	★
E	Ethylene Propylene (EPDM)	★
K	Kalrez® Perfluoroelastomer (FFKM)	★
B	Nitrile Butadiene (NBR)	★
F	Fluorsilicone (FVMQ)	★

(1) *Requires Operating Temperature and Pressure code H, P, or C.*

Probe type

Code	Description	Process connections	Probe lengths	
3B	Coaxial, perforated. For level and interface measurement.	Flange / 1-in.(1), 1½-in., 2- in.(1) Thread	Min: 1 ft. 4 in. (0.4 m) Max: 19 ft. 8 in. (6 m)	★
3C(2)	Large coaxial, perforated. For level and interface measurement.	Flange / 1½-in., 2- in.(1) Thread	Min: 1 ft. (0.3 m) Max: 19 ft. 8 in. (6 m)	★
3V(3)(4)(5)	Integrated Still Pipe Vapor Probe. For 3-in. chambers and above. Refer to "Options" to specify reference reflector length.	Flange	Min: 2 ft. 11 in. (0.9 m) for the short reflector (R1 option) Min: 3 ft. 7 in. (1.1 m) for the long reflector (R2 option) Max: 13 ft. 1 in. (4 m)	★
4A	Rigid Single Lead (8 mm)	Flange / 1- in.(1), 1½-in., 2- in.(1) Thread / Tri Clamp	Min: 1 ft. 4 in. (0.4 m) Max: 9 ft. 10 in. (3 m)	★
4B	Rigid Single Lead (13mm)	Flange / 1-in., 1½-in., 2-in. Thread / Tri Clamp	Min: 1 ft. 4 in. (0.4 m) Max: 19 ft. 8 in. (6 m)	★
4U(3)(4)(5)	Single Rigid Vapor Probe (equip with a 1½-in. centering disc). For 2-in. chambers. Refer to "Options" to specify reference reflector length.	Flange / 1½-in. Thread	Min: 2 ft. 11 in. (0.9 m) for the short reflector (R1 option) Min: 3 ft. 7 in. (1.1 m) for the long reflector (R2 option) Max: 9 ft. 10 in. (3 m)	★

Code	Description	Process connections	Probe lengths	
5A(6)	Flexible Single Lead with weight	Flange / 1-in.(1), 1½-in., 2-in.(1) Thread / Tri Clamp	Min: 3 ft. 4 in. (1 m) Max: 164 ft. (50 m)(7)	★
5B(8)	Flexible Single Lead with chuck	Flange / 1-in.(1), 1½-in., 2-in.(1) Thread / Tri Clamp	Min: 3 ft. 4 in. (1 m) Max: 164 ft. (50 m)(7)	★
1A(1)	Rigid Twin Lead	Flange / 1½-in., 2-in.(1) Thread	Min: 1 ft. 4 in. (0.4 m) Max: 9 ft. 10 in. (3 m)	
2A(1)	Flexible Twin Lead with weight	Flange / 1½-in., 2-in.(1) Thread	Min: 3 ft. 4 in. (1 m) Max: 164 ft. (50 m)	
3A(9)	Coaxial (for level measurement)	Flange / 1-in.(1), 1½-in., 2-in.(1) Thread	Min: 1 ft. 4 in. (0.4 m) Max: 19 ft. 8 in. (6 m)	
4S	Segmented Rigid Single Lead (13mm)	Flange / 1-in., 1½-in., 2-in.Thread / Tri Clamp	Min: 1 ft. 4 in. (0.4 m) Max: 32 ft. 9 in. (10 m)	
6A(10)	Flexible Single Lead with weight, 6 mm	Flange / 1-in., 1½-in., 2-in.Thread	Min: 3 ft. 4 in. (1 m) Max: 164 ft. (50 m)	★
6B(10)	Flexible Single Lead with chuck, 6 mm	Flange / 1-in., 1½-in., 2-in.Thread	Min: 3 ft. 4 in. (1 m) Max: 164 ft. (50 m)	★

(1) Only available with Operating Temperature and Pressure code S.
(2) Requires firmware version 2.L3 or later.
(3) Only available with Operating Temperature and Pressure code H.
(4) Not available with Remote housing code B1 or B2.
(5) Probe type 3V or 4U together with flanges Class 2500/PN250 or higher requires installation option code HS (Heat sink).
(6) 0.79 lb (0.36 kg) standard weight for flexible single lead probe. L=5.5 in. (140 mm). For PTFE covered probes: 2.2 lb (1 kg) standard weight for flexible single lead probe. L=17.1 in. (434 mm).
(7) Maximum probe length for Duplex 2205 probes is 105 ft (32 m).
(8) Extra length for fastening is added in factory.
(9) Requires model 5301.
(10) 1.2 lb (0.56 kg) standard weight for flexible single lead probe. L=5.5 in. (140 mm).

Probe length units

Code	Description	
E	English (feet, inches)	★
M	Metric (meters, centimeters)	★

Total probe length (feet/m)

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.

Code	Description	
XXX	0-164 ft. or 0-50 m	★

Related information

Total probe length

Total probe length (inch/cm)

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.

Code	Description	
XX	0 - 11 in. or 0-99 cm	★

Related information

Total probe length

Process connection - size / type

For other process connections, consult the factory.

Code	Description			
ASME flanges[1]		Material of construction	Operating temperature and pressure	
AA[2]	2-in. Class 150, RF (Raised Face Type)	1, 2, 3, 7, 8, H, D, E	S, H, P, C	★
AB[2]	2-in. Class 300, RF (Raised Face Type)	1, 2, 3, 7, 8, H, D, E	S, H, P, C	★
AC	2-in. Class 600, RF (Raised Face Type)	1, 2, H, D, E	H, P, C	★
AD	2-in. Class 900, RF (Raised Face Type)	1, H, D, E	H, P, C	★
BA[2]	3-in. Class 150, RF (Raised Face Type)	1, 2, 3, 7, 8, H, D, E	S, H, P, C	★
BB[2]	3-in. Class 300, RF (Raised Face Type)	1, 2, 3, 7, 8, H, D, E	S, H, P, C	★
BC	3-in. Class 600, RF (Raised Face Type)	1, 2, H, D, E	H, P, C	★
BD	3-in. Class 900, RF (Raised Face Type)	1, H, D, E	H, P, C	★
CA[2]	4-in. Class 150, RF (Raised Face Type)	1, 2, 3, 7, 8, H, D, E	S, H, P, C	★
CB[2]	4-in. Class 300, RF (Raised Face Type)	1, 2, 3, 7, 8, H, D, E	S, H, P, C	★
CC	4-in. Class 600, RF (Raised Face Type)	1, 2, H, D, E	H, P, C	★
CD	4-in. Class 900, RF (Raised Face Type)	1, H, D, E	H, P, C	★
AE	2-in. Class 1500, RF (Raised Face Type)	1, H, D, E	H, P, C	
AF	2-in. Class 2500, RF (Raised Face Type)	1	H, P, C	
AI	2-in. Class 600, RTJ (Ring Type Joint)	1, H, D, E	H, P, C	
AJ	2-in. Class 900, RTJ (Ring Type Joint)	1, H, D, E	H, P, C	
AK	2-in. Class 1500, RTJ (Ring Type Joint)	1, H, D, E	H, P, C	
BE	3-in. Class 1500, RF (Raised Face Type)	1, H, D, E	H, P, C	
BF	3-in. Class 2500, RF (Raised Face Type)	1	H, P, C	
BI	3-in. Class 600, RTJ (Ring Type Joint)	1, H, D, E	H, P, C	
BJ	3-in. Class 900, RTJ (Ring Type Joint)	1, H, D, E	H, P, C	
BK	3-in. Class 1500, RTJ (Ring Type Joint)	1, H, D, E	H, P, C	
CE	4-in. Class 1500, RF (Raised Face Type)	1, H, D, E	H, P, C	
CI	4-in. Class 600, RTJ (Ring Type Joint)	1, H, D, E	H, P, C	

Code	Description			
CJ	4-in. Class 900, RTJ (Ring Type Joint)	1, H, D, E	H, P, C	
CK	4-in. Class 1500, RTJ (Ring Type Joint)	1, H, D, E	H, P, C	
DA	6-in. Class 150, RF (Raised Face Type)	1, 2, 3, 7, 8, H	S, H, P, C	
DB	6-in. Class 300, RF (Raised Face Type)	1, 2, 3, 7, 8, H	S, H, P, C	
EN 1092-1 flanges		Material of construction	Operating temperature and pressure	
HB	DN50, PN40, Type A flat face	1, 2, 3, 7, 8	S, H, P, C	★
HC	DN50, PN63, Type A flat face	1, 2, 3	H, P, C	★
HD	DN50, PN100, Type A flat face	1	H, P, C	★
IA	DN80, PN16, Type A flat face	1, 2, 3, 7, 8	S, H, P, C	★
IB	DN80, PN40, Type A flat face	1, 2, 3, 7, 8	S, H, P, C	★
IC	DN80, PN63, Type A flat face	1, 2, 3	H, P, C	★
ID	DN80, PN100, Type A flat face	1	H, P, C	★
JA	DN100, PN16, Type A flat face	1, 2, 3, 7, 8	S, H, P, C	★
JB	DN100, PN40, Type A flat face	1, 2, 3, 7, 8	S, H, P, C	★
JC	DN100, PN63, Type A flat face	1, 2, 3	H, P, C	★
HI	DN50, PN40, Type E spigot face	1, 8	S, H, P, C	
HP	DN50, PN16, Type C tongue face	1, 8	S, H, P, C	
HQ	DN50, PN40, Type C tongue face	1, 8	S, H, P, C	
IE	DN80, PN160, Type B2 raised face	1	H, P, C	
IH	DN80, PN16, Type E spigot face	1, 8	S, H, P, C	
II	DN80, PN40, Type E spigot face	1, 8	S, H, P, C	
JE	DN100, PN160, Type B2 raised face	1	H, P, C	
JH	DN100, PN16, Type E spigot face	1, 8	S, H, P, C	
JI	DN100, PN40, Type E spigot face	1, 8	S, H, P, C	
JQ	DN100, PN40, Type C tongue face	1, 8	S, H, P, C	
KA	DN150, PN16, Type A flat face	1, 2, 3, 7, 8	S, H, P, C	
KB	DN150, PN40, Type A flat face	1, 2, 3, 7, 8	S, H, P, C	
KH	DN150, PN16, Type E spigot face	1, 8	S, H, P, C	
NI	DN65, PN40, Type E spigot face	1, 8	S, H, P, C	
JIS flanges		Material of construction	Operating temperature and pressure	
UA	50A, 10K, RF (Raised Face Type)	1, 2, 3, 7, 8	S, H, P, C	★
VA	80A, 10K, RF (Raised Face Type)	1, 2, 3, 7, 8	S, H, P, C	★
XA	100A, 10K, RF (Raised Face Type)	1, 2, 3, 7, 8	S, H, P, C	★

Code	Description			
Threaded connections		Material of construction	Probe type	
RA	1½-in. NPT thread	1, 2, 3, 8, H, D	1A, 2A, 3A, 3B, 3C, 4A, 4B, 4S, 4U, 5A, 5B	★
RC	2-in. NPT thread	1, 8	1A, 2A, 3A, 3B, 3C, 4A, 4B, 4S, 5A, 5B, standard temperature and pressure	★
RB	1-in. NPT thread	1, 8	3A, 3B, 4A, 4B, 4S, 5A, 5B, standard temperature and pressure	
SA	1½-in. BSP (G 1½-in.) thread	1, 2, 3, 8, H, D	1A, 2A, 3A, 3B, 3C, 4A, 4B, 4S, 4U, 5A, 5B	
SB	1-in. BSP (G 1-in.) thread	1, 8	3A, 3B, 4A, 4B, 4S, 5A, 5B, standard temperature and pressure	
Tri Clamp fittings(3)		Material of construction	Probe type	
FT	1½-in. Tri Clamp	1, 7, 8	4A, 5A, 5B standard temperature and pressure	
AT	2-in. Tri Clamp	1, 7, 8	4A, 4B, 5A, 5B, 4S standard temperature and pressure	
BT	3-in. Tri Clamp	1, 7, 8	4A, 4B, 5A, 5B, 4S standard temperature and pressure	
CT	4-in. Tri Clamp	1, 7, 8	4A, 4B, 5A, 5B, 4S standard temperature and pressure	
Proprietary flanges		Material of construction	Operating temperature and pressure	
TF	Fisher - proprietary 316/316L (for 249B, 259B chambers) Torque Tube Flange	1, 7, 8	S, H, P, C	★
TT	Fisher - proprietary 316/316L (for 249C chambers) Torque Tube Flange	1, 7, 8	S, H, P, C	★
TM	Masoneilan - proprietary 316/316L Torque Tube Flange	1, 7, 8	S, H, P, C	★
Special process connection				
XX	Special Process Connection			

(1) Design according to ASME B31.3. No code stamp or ASME certificate available.
(2) Forged one-piece flange provided for Standard (Std) seal together with Material of construction code 1, 7 or 8, and Probe type code 3A, 3B, 3V, 4A, 4B, 4U, 4S, 5A, or 5B. Welded construction provided for other combinations.
(3) Follows ISO 2852 standard.

Hazardous locations certifications

Code	Description	
NA	Not Applicable	★

A.9.2 Additional options

Hydrostatic testing

Available for tank connection with flange.

Code	Description	
P1	Hydrostatic testing, including certificate	★

Welding procedure qualification record documentation

Only applies to flanged process connections with welded construction or protective plate design.

Weldings in accordance with EN/ISO standards.

Code	Description	
Q66	Welding Procedure Qualification Record (WPQR)	★
Q67	Welder Performance Qualification (WPQ)	★
Q68	Welding Procedure Specification (WPS)	★

Material traceability certification

Certificate includes all pressure retaining wetted parts.

Code	Description	
Q8	Material traceability certification consistent with ISO10474-3.1:2013 / EN10204-3.1:2004	★

Positive material identification certificate

Code	Description	
Q76	Positive material identification certificate of conformance	★

Country certification

Code	Description	
J1	Canadian Registration Number (CRN)	★
J2(1)	ASME B31.1	★
J7(2)(3)	Indian Boiler Regulation (For witnessed Form III-C from factory, order certificate Q47 on separate line Item)	
J8(4)(5)	EN Boiler (European Boiler Approval in accordance with EN 12952-11 and EN 12953-9)	★

(1) *Design and manufacturing according to ASME B31.1. No code stamp or ASME certificate available. Welding in accordance with ASME IX.*
(2) *Only available with Material of construction code 1, Operating temperature and pressure code S, H, or P, Probe type 3A, 3B, 3V, 4U, 4A, 4B, 4S, 5A, or 5B, together with ASME flanges size 2-in, 3-in, or 4-in.*
(3) *Process connection will only be provided as a welded construction.*
(4) *Only available with Signal output code H and Probe type code 3V or 4U.*
(5) *Suitable for use as a level sensor part of a limiting device, in accordance with EN 12952-11 and EN 12953-9.*

Dye penetration test certificate

Only applies to flanged process connections with welded construction or protective plate design.

Code	Description	
Q73	Certificate of liquid penetrant inspection	★

Materials certification

Available for probe type 3A, 3B, 3C, 4A, 4B, 4S, and PTFE-coated 5A.

Code	Description	
N2	NACE® material recommendation per NACE MR0175/ISO 15156 and NACE MR0103/ISO 17945	★

Installation options

Code	Description	
LS(1)	Long stud 9.8 in (250 mm) for flexible single lead probe to prevent contact with wall/nozzle. Standard stud length is 3.9 in (100 mm) for probes 5A and 5B.Standard stud length is 5.9 in (150 mm) for probes 6A and 6B.	★
BR	316L Mounting Bracket for 1½-in. NPT Process Connection (RA)	
HS(2)	Heat sink	

(1) Not available with PTFE covered probes.
(2) Requires Remote housing code B3, and Probe type code 3V or 4U.

Related information

Dimensional drawings

Weight and anchoring options for flexible single probes

Code	Description	
W3	Heavy Weight (for most applications)	★
W2	Short Weight (when measuring close to the probe end)	

Related information

Dimensional drawings

Weight assembly options for flexible single probes

Code	Description	
WU	Weight or chuck not mounted on the probe	★

Verification reflectors (high level supervision)

Only available with HART 4-20 mA output (code H), standard operating temperature and pressure (code S), material of construction (code 1), and flexible single lead probes (probe type 5A or 5B).

Code	Description	
HL1	Verification reflector for 3- to 6-in. pipe/chamber (High Level Supervision).	
HL2	Verification reflector for 8-in. pipe/chamber (High Level Supervision).	
HL3	Verification reflector for tanks and 10-in. or wider pipe/chamber (High Level Supervision).	

Related information

Verification reflector

Extended product warranty

Code	Description	
WR3	3-year limited warranty	★
WR5	5-year limited warranty	★

Centering discs

Code	Description	Outer diameter	
S2(1)	2-in. Centering disc	1.8 in. (45 mm)	★
S3(1)	3-in. Centering disc	2.7 in. (68 mm)	★
S4(1)	4-in. Centering disc	3.6 in. (92 mm)	★
P2(2)	2-in. Centering disc PTFE	1.8 in. (45 mm)	★
P3(2)	3-in. Centering disc PTFE	2.7 in. (68 mm)	★
P4(2)	4-in. Centering disc PTFE	3.6 in. (92 mm)	★
S6(1)	6-in. Centering disc	5.55 in. (141 mm)	
S8(1)	8-in. Centering disc	7.40 in. (188 mm)	
P6(2)	6-in. Centering disc PTFE	5.55 in. (141 mm)	
P8(2)	8-in. Centering disc PTFE	7.40 in. (188 mm)	

(1) *Available for SST, Alloy C-276, Alloy 400, Alloy 825, and Duplex 2205 probes, type 2A, 4A, 4B, 4S, and 5A. Same disc material as probe material.*
(2) *Available for probe types 2A, 4A, 4B, 4S, and 5A. Not available with Operating Temperature and Pressure code H or Material of Construction codes 7 and 8.*

Related information

Centering disc for pipe installations

Reference reflectors for dynamic vapor compensation probes

Required for probe type 3V and 4U.

Code	Description	
R1	Short reflector. Length=14 in. (350 mm)	
R2	Long reflector. Length=20 in. (500 mm)	

Related information

Select reference reflector

Assemble/consolidate to chamber

Selecting the XC option code on the Rosemount 5300 and a Rosemount chamber will result in matching, consolidating, configuring, and shipping of the two products in one crate. Note that the flange bolts are only hand-tightened. Long rigid single lead probes (>8 ft./2.5 m) are ship separately in order to reduce transportation risk damage.

Code	Description	
XC	Consolidate to Chamber	★

Related information

Rosemount chamber

Specials

Code	Description	
RXXXX	Custom engineered solutions beyond standard model codes. Consult factory for details.	

Related information

Engineered solutions

A.10 Accessories

A.10.1 Weight kit

Item number	Description	
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	

A.10.2 Centering discs for rigid single lead probe (d=0.3 in./8 mm)

If a centering disc is required for a flanged probe, the centering disc can be ordered with options Sx or Px 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 in this table.

For other materials, consult the factory.

Item number	Description	Outer diameter	
03300-1655-0001	Kit, 2-in. Centering disc, SST	1.8 in. (45 mm)	★
03300-1655-0006	Kit, 2-in. Centering disc, PTFE	1.8 in. (45 mm)	★
03300-1655-0002	Kit, 3-in. Centering disc, SST	2.7 in. (68 mm)	★
03300-1655-0007	Kit, 3-in. Centering disc, PTFE	2.7 in. (68 mm)	★
03300-1655-0003	Kit, 4-in. Centering disc, SST	3.6 in. (92 mm)	★
03300-1655-0008	Kit, 4-in. Centering disc, PTFE	3.6 in. (92 mm)	★
03300-1655-0004	Kit, 6-in. Centering disc, SST	5.55 in. (141 mm)	
03300-1655-0009	Kit, 6-in. Centering disc, PTFE	5.55 in. (141 mm)	
03300-1655-0005	Kit, 8-in. Centering disc, SST	7.40 in. (188 mm)	
03300-1655-0010	Kit, 8-in. Centering disc, PTFE	7.40 in. (188 mm)	

Related information

Centering disc for pipe installations

A.10.3 Centering discs for rigid single lead probe (d=0.5 in./13 mm)

If a centering disc is required for a flanged probe, the centering disc can be ordered with options Sx or Px 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 in this table.

For other materials, consult the factory.

Item number	Description	Outer diameter	
03300-1655-0301	Kit, 2-in. Centering disc, SST	1.8 in. (45 mm)	★
03300-1655-0306	Kit, 2-in. Centering disc, PTFE	1.8 in. (45 mm)	★

Item number	Description	Outer diameter	
03300-1655-0302	Kit, 3-in. Centering disc, SST	2.7 in. (68 mm)	★
03300-1655-0307	Kit, 3-in. Centering disc, PTFE	2.7 in. (68 mm)	★
03300-1655-0303	Kit, 4-in. Centering disc, SST	3.6 in. (92 mm)	★
03300-1655-0308	Kit, 4-in. Centering disc, PTFE	3.6 in. (92 mm)	★
03300-1655-0304	Kit, 6-in. Centering disc, SST	5.55 in. (141 mm)	
03300-1655-0309	Kit, 6-in. Centering disc, PTFE	5.55 in. (141 mm)	
03300-1655-0305	Kit, 8-in. Centering disc, SST	7.40 in. (188 mm)	
03300-1655-0310	Kit, 8-in. Centering disc, PTFE	7.40 in. (188 mm)	

Related information

Centering disc for pipe installations

A.10.4 Snap-on centering discs for flexible single lead probes

Maximum temperature for the snap-on centering discs is 392 °F (200 °C).

Item number	Description	
03300-1658-0001	Kit, 2- to 4-in. snap-on centering disc, PEEK, 1 pc	
03300-1658-0002	Kit, 2- to 4-in. snap-on centering disc, PEEK, 3 pcs	
03300-1658-0003	Kit, 2- to 4-in. snap-on centering disc, PEEK, 5 pcs	

A.10.5 Centering discs for flexible single/twin lead probes

If a centering disc is required for a flanged probe, the centering disc can be ordered with options Sx or Px 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 in this table.

For other materials, consult the factory.

Item number	Description	Outer diameter	
03300-1655-1001	Kit, 2-in. Centering disc, SST	1.8 in. (45 mm)	★
03300-1655-1006	Kit, 2-in. Centering disc, PTFE	1.8 in. (45 mm)	★
03300-1655-1002	Kit, 3-in. Centering disc, SST	2.7 in. (68 mm)	★
03300-1655-1007	Kit, 3-in. Centering disc, PTFE	2.7 in. (68 mm)	★
03300-1655-1003	Kit, 4-in. Centering disc, SST	3.6 in. (92 mm)	★
03300-1655-1008	Kit, 4-in. Centering disc, PTFE	3.6 in. (92 mm)	★
03300-1655-1004	Kit, 6-in. Centering disc, SST	5.55 in. (141 mm)	
03300-1655-1009	Kit, 6-in. Centering disc, PTFE	5.55 in. (141 mm)	
03300-1655-1005	Kit, 8-in. Centering disc, SST,	7.40 in. (188 mm)	
03300-1655-1010	Kit, 8-in. Centering disc, PTFE	7.40 in. (188 mm)	

Related information

Centering disc for pipe installations

A.10.6 Centering discs for mounting between segments (probe type 4S only)

Item number	Description	Outer diameter	
03300-1656-1002	2-in. Centering disc (1 pc), PTFE, Segmented rigid single lead	1.8 in. (45 mm)	
03300-1656-1003	3-in. Centering disc (1 pc), PTFE, Segmented rigid single lead	2.7 in. (68 mm)	
03300-1656-1004	4-in. Centering disc (1 pc), PTFE, Segmented rigid single lead	3.6 in. (92 mm)	
03300-1656-1006	6-in. Centering disc (1 pc), PTFE, Segmented rigid single lead	5.55 in. (141 mm)	
03300-1656-1008	8-in. Centering disc (1 pc), PTFE, Segmented rigid single lead	7.40 in. (188 mm)	
03300-1656-3002	2-in. Centering disc (3 pcs), PTFE, Segmented rigid single lead	1.8 in. (45 mm)	
03300-1656-3003	3-in. Centering disc (3 pcs), PTFE, Segmented rigid single lead	2.7 in. (68 mm)	
03300-1656-3004	4-in. Centering disc (3 pcs), PTFE, Segmented rigid single lead	3.6 in. (92 mm)	
03300-1656-3006	6-in. Centering disc (3 pcs), PTFE, Segmented rigid single lead	5.55 in. (141 mm)	
03300-1656-3008	8-in. Centering disc (3 pcs), PTFE, Segmented rigid single lead	7.40 in. (188 mm)	
03300-1656-5002	2-in. Centering disc (5 pcs), PTFE, Segmented rigid single lead	1.8 in. (45 mm)	
03300-1656-5003	3-in. Centering disc (5 pcs), PTFE, Segmented rigid single lead	2.7 in. (68 mm)	
03300-1656-5004	4-in. Centering disc (5 pcs), PTFE, Segmented rigid single lead	3.6 in. (92 mm)	
03300-1656-5006	6-in. Centering disc (5 pcs), PTFE, Segmented rigid single lead	5.55 in. (141 mm)	
03300-1656-5008	8-in. Centering disc (5 pcs), PTFE, Segmented rigid single lead	7.40 in. (188 mm)	

A.10.7 Segmented rigid single lead probe spare part kit

Item number	Description	
03300-0050-0001	15.2 in. / 385 mm Segment for Top connection (1 pc)	
03300-0050-0002	31.5 in. / 800 mm Segment (1 pc)	
03300-0050-0003	31.5 in. / 800 mm Segment (3 pcs)	
03300-0050-0004	31.5 in. / 800 mm Segment (5 pcs)	
03300-0050-0005	31.5 in. / 800 mm Segment (12 pcs)	

A.10.8 Vented flanges

1-½ in. NPT threaded connection (RA) is required.

Not available with Country certification option code J1, J2, J7, or J8.

Not available for Probe type code 3C.

Item number	Description	
03300-1812-0092	Fisher™ (249B, 259B), one ¼-in. NPT connection, 316/316L	
03300-1812-0093	Fisher (249C), one ¼-in. NPT connection, 316/316L	
03300-1812-0091	Masoneilan™, one ¼-in. NPT connection, 316/316L	

A.10.9 Flushing connection rings

Not available with Country certification option code J1, J2, J7, or J8.

Item number	Description	
DP0002-2111-S6	2-in. ANSI, one ¼-in. NPT connection, 316L	
DP0002-3111-S6	3-in. ANSI, one ¼-in. NPT connection, 316L	
DP0002-4111-S6	4-in. ANSI/DN100, one ¼-in. NPT connection, 316L	
DP0002-5111-S6	DN50, one ¼-in. NPT connection, 316L	
DP0002-8111-S6	DN80, one ¼-in. NPT connection, 316L	

A.10.10 HART modem and cables

Item number	Description	
03300-7004-0002	MACTek® VIATOR® HART Modem and cables (USB connection)	★
03300-7004-0001	MACTek VIATOR HART Modem and cables (RS232 connection)	★

A.10.11 Remote housing mounting spare part kit

Item number	Description	
03300-7006-0001	1 m / 3.2 ft. Remote Housing Mounting Cable and 316L Bracket	
03300-7006-0002	2 m / 6.5 ft. Remote Housing Mounting Cable and 316L Bracket	
03300-7006-0003	3 m / 9.8 ft. Remote Housing Mounting Cable and 316L Bracket	

A.10.12 Heat sink

Item number	Description	
05300-7001-0001	Heat sink	

A.10.13 Verification reflector (high level supervision) spare part kit

Requires Rosemount 5300 firmware version 2.H0 or later.

Item number	Description	
05300-7200-0001	For 3- to 8-in. pipe/chamber (inner diameter)	
05300-7200-0002	For tanks or 10-in. pipe/chamber (inner diameter) or wider	

B Configuration parameters

B.1 Menu tree

This section provides the menu tree structure with various configuration parameters for AMS Device Manager and handheld communicator:

Figure B-1: Menu Tree for Field Communicator – HART 5 (DD 0303)

- Process variables
  - Primary variable
  - 2nd
  - 3rd
  - 4th
  - All variables
  - Signal Quality Metrics
  - Identification
- Setup
  - Basic Setup
    - Variable mapping
    - Probe
    - Geometry
    - Environment
    - Volume
    - Analog output
    - Finish
  - Device
    - Identification
    - Variable mapping
    - LCD
    - Communication
    - Alarm/sat. limits
  - Tank
    - Probe
    - Geometry
    - Environment
    - Volume
  - Analog output
    - Analog out
    - Alarm/sat. limits
  - Echo tuning
    - Echo peaks
    - Thresholds
  - Echo curve
    - Echo curve
  - Advanced
    - Near zone
    - Probe End Projection
    - Dynamic Vapor Compensation
    - Signal Quality Metrics
    - Echo tracking
  - Calibration
    - Analog output
- Diagnostics/ Tools
  - Diagnostics
  - Tools
- Primary variable value
- Analog out
- Distance
- Signal strength

Figure B-2: Menu Tree for AMS Device Manager and Handheld Communicator – HART 5 (DD 0305) and HART 7 (DD 0404)

- Overview
  - Device Status
  - Communication Status *
  - (Simulation Active)
  - Primary Purpose Variables *
  - Echo Tuning
  - Device Information
    - Identification
    - Revisions
    - Alarm and Security
    - Upgrade Device
- Configure
  - Guided Setup
    - Level Measurement Setup
    - Device Specific Setup
    - Verify Level
    - Volume Setup
    - Display Setup
    - Echo Tuning
  - Manual Setup > Device Setup
    - Display
    - Units
    - HART
    - Analog Output
    - Security
    - Device Information
  - Manual Setup > Level Setup
    - Probe
    - Geometry
    - Environment
    - Volume
    - Probe End Projection
    - Vapor Compensation
  - Alert Setup
    - Signal Quality Metrics
    - Level Supervision
- Service Tools
  - Alerts
  - Variables
    - Mapped Variables
    - Process *
    - Device
    - Signal Quality
  - Trends
  - Maintenance
    - Restart Device
    - Restore Defaults
  - Echo Tuning
    - Thresholds
    - Tracking
    - Near Zone
    - Echo Curve
  - Simulate
    - Device Simulation
    - Simulation Mode Active

* HART7 only.

Figure B-3: Menu Tree for AMS Device Manager and Handheld Communicator – FOUNDATION™ Fieldbus (DD 0404)

- Overview
  - Device Status
  - Simulation Active
  - Mode
  - Primary Purpose Variables
  - Guided Setup
  - Device Information
    - Identification
    - Revisions
    - Security
    - Upgrade Device
- Configure
  - Guided Setup
    - Level Measurement Setup
    - Volume Calculation Setup
    - Device Specific Setup
    - Restart Measurement
    - Level Config Write Protected
  - Manual Setup
    - Mode
    - Device
    - Probe
    - Geometry
    - Environment
    - Volume
    - Display
    - Advanced
      - Near Zone
      - Echo Tracking
      - Probe End Projection
      - Vapor Compensation
      - Holding/Input Registers
    - Classic View
      - All Block Parameters
      - Block Mode Summary
      - Reset to Factory Default
  - Alert Setup
    - Signal Quality Metrics
    - Electronics
    - Measurement – Output
    - Measurement – General
    - HW/Config
    - Software/Simulation
- Service Tools
  - Alerts
  - Variables
    - Product Variables
    - Interface Variables
    - Signal Quality Metrics
  - Trends
  - Maintenance
    - Details
    - Reset/Restore
  - Echo Tuning
    - Echo Tuning
    - Echo Curve
  - Simulate
    - Measurement
    - Alerts

B.2 Basic configuration parameters

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

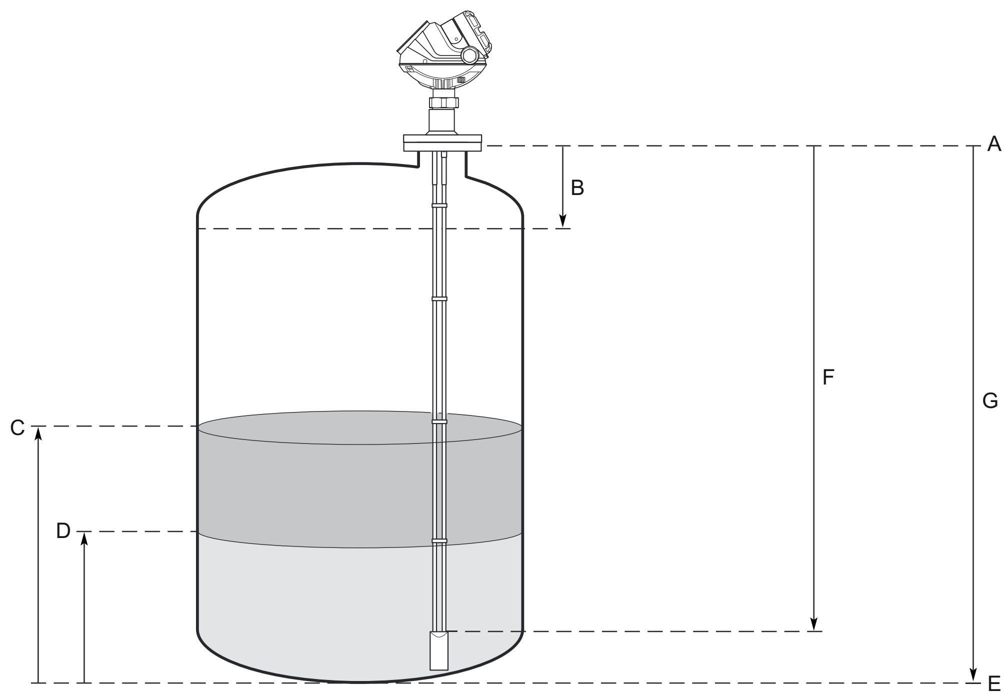
B.2.1 Measurement units

Measurement units can be specified for presentation of level/interface level, level rate, volume, and temperature values.

B.2.2 Tank and probe geometry

The basic transmitter configuration includes setting the tank geometry parameters.

Figure B-4: Tank Geometry

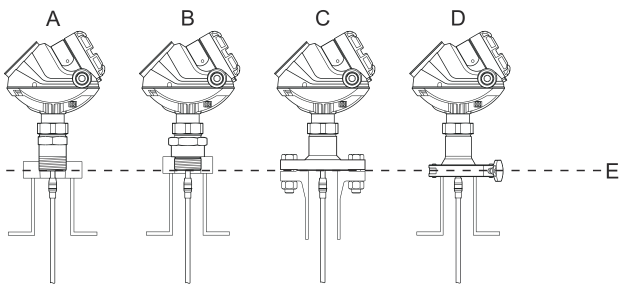


A. Upper reference point
B. Hold Off Distance/Upper Null Zone (UNZ)
C. Product level
D. Interface level
E. Zero reference point
F. Probe length
G. Tank height

Upper Reference Point

The Upper Reference Point is located at the underside of the threaded adapter, transmitter flange, or Tri Clamp®, as illustrated in Figure B-5.

Figure B-5: Upper Reference Point



A. *NPT*
B. *BSPP (G)*
C. *Flange*
D. *Tri Clamp*
E. *Upper Reference Point*

Tank height

The Tank Height is the distance from the Upper Reference Point to the bottom of the tank (Zero Reference Point). The transmitter measures the distance to the product surface and subtracts this value from the Tank Height to determine the level.

Ensure the Tank Height is as accurate as possible, since a Tank Height error results in a corresponding level value offset error.

When setting the Tank Height, keep in mind that this value is used for all level measurements performed by transmitter. The Tank Height must be set in linear (level) units, such as feet or meters, regardless of primary variable assignment.

Mounting type

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

Table B-1: Mounting Types

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

Inner diameter

Used with pipe, chamber, and nozzle installations.

Nozzle height

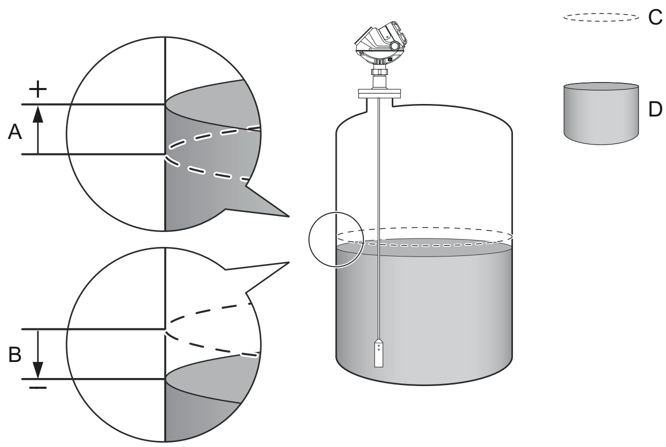
For nozzle installations

Calibration distance

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

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

Figure B-6: Calibration Distance



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

Non-metallic (e.g. plastic) vessels and installation geometry may introduce an offset for the zero reference point. This offset may be up to ± 1 in. (25 mm). The offset can be compensated for by using Calibration Distance.

Related information

Run verify level

Probe length

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

For flexible single lead probes anchored with chuck, the Probe Length should be configured as the distance from the Upper Reference Point to the top of the chuck.

For flexible single lead probes anchored with clamps, the Probe Length should be configured as the distance from the Upper Reference Point to the upper clamp.

This parameter is pre-configured at factory. The probe length must be changed if the probe is shortened, or if you have ordered a spare transmitter head.

Related information

Upper Reference Point

Anchor the probe

Probe type

The transmitter is designed to optimize measurement performance for each probe type. The transmitter automatically makes an initial calibration based on the type of probe that is used.

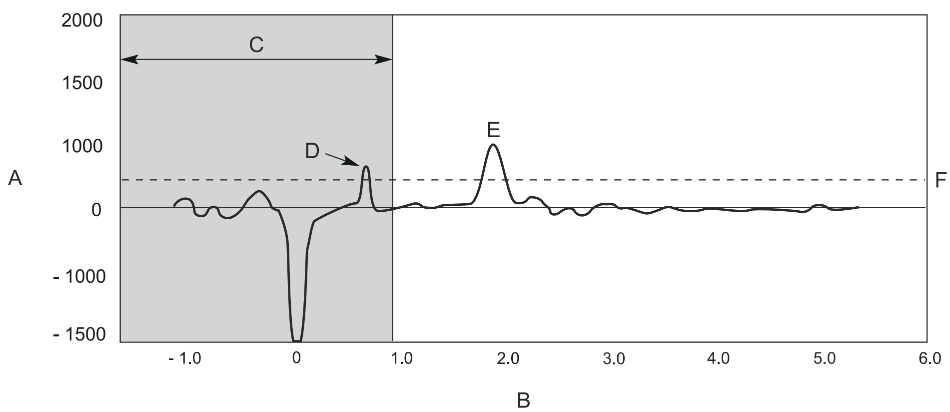
This parameter is pre-configured at factory and only needs to be set if the probe is changed to another type, or if you have installed a spare transmitter.

Select the type of probe that is mounted to the transmitter. Select User Defined probe if your probe can not be found in the list or if you have done modifications to a standard probe.

Hold off distance/upper null zone (UNZ)

The Hold Off Distance/UNZ defines how close to the device's Upper Reference Point a level value is accepted. You can extend Upper Null Zone to block out disturbing echoes close to the tank top, caused by for example a narrow nozzle with rough walls, obstacles close to the probe, or a nozzle that protrudes into the tank.

Figure B-7: Identifying the Hold Off Distance/UNZ in the Echo Curve Plot



A. *Amplitude, mV*
B. *Distance, m*
C. *Hold Off Distance/UNZ*
D. *Disturbance*
E. *Surface peak*
F. *Surface Threshold*

By adjusting the Hold Off Distance/UNZ, the measuring range is reduced. The Hold Off Distance/UNZ is equal to zero in the default configuration.

Related information

Change the hold off distance/upper null zone

B.2.3 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 B-2: List of Measurement Modes for Different Rosemount 5300 Models

Model	Measurement mode
Rosemount 5301	• Liquid product level [1] • Interface level with submerged probe
Rosemount 5302	• Liquid product level • Product level and interface level[1] • Interface level with submerged probe • Solid product level
Rosemount 5303	• Solid product level[1]

(1) Default setting.

The measurement mode Interface level with submerged probe is used for applications where the probe is fully submerged in liquid. In this mode, the transmitter ignores the upper product level. See Interface level with submerged probe for more information.

Note
Only use Interface level with submerged probe for applications where the interface is measured with a fully submerged probe.

Rapid level changes

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

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

Product dielectric range

Note
Applicable to “Liquid Product Level” and “Solid Product Level” measurement modes.

Enter the range of the dielectric constant (DC) for the product in the tank. The selected range of dielectric constant is used for setting the automatically calculated amplitude thresholds.

Upper product dielectric constant

Note
Applicable to “Interface Level with submerged” and “Product Level and Interface Level” measurement modes.

The Upper Product Dielectric Constant (DC) should be entered as accurately as possible. The dielectric constant of the upper product is essential for calculating the interface level and the upper product thickness. In addition, this value is used for setting the automatically calculated amplitude thresholds.

If the dielectric constant of the lower product is significantly smaller than the dielectric constant of water, you may need to make special adjustments. The dielectric constant of water is 80.

Related information

Interface measurements
Example 2: Interface peak not found

Use the dielectric constant chart in Rosemount Radar Master

The Dielectric Constant Chart lists the dielectric constant of a large number of products.

Procedure

1. Select **Setup** → **Tank**.
2. Select the **Environment** tab.
3. Select the **Dielectric Constant Chart** button.

Use the upper product dielectric constant calculator in Rosemount Radar Master

The Upper Product Dielectric Constant 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
- The upper product thickness presented by the transmitter

Procedure

1. Select **Setup** → **Tank**.
2. Select the **Environment** tab.
3. Select the **Upper Product Dielectric Constant Calculator** button.

B.2.4 Volume

Volume calculation method

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

Tank type

You can choose one of the following options:

- Strap table
- Vertical cylinder
- Horizontal cylinder
- Vertical bullet
- Horizontal bullet
- Sphere
- None

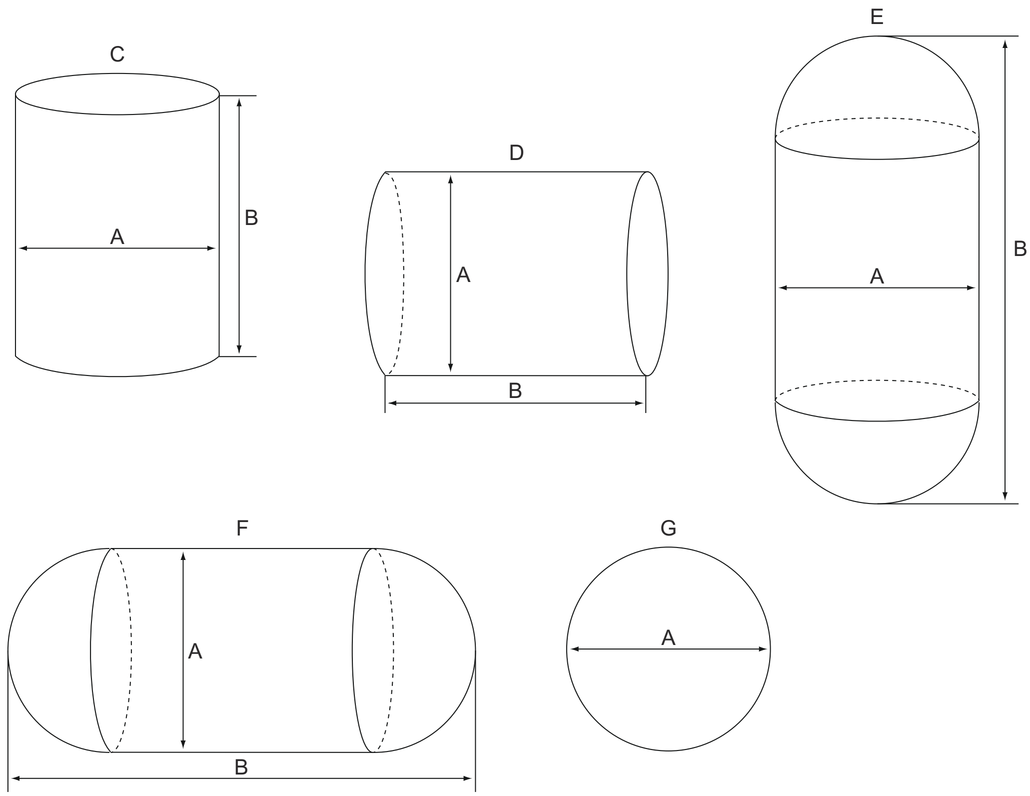
Strapping table

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

Strapping table requires entering level-volume pairs in a table (maximum 20 points). Use most of the strapping points in regions where the tank shape is non-linear. Starting at the bottom of the tank, for each new point, enter the total volume up to the specified level value.

Standard tank shapes

Figure B-8: Standard Tank Shapes



A. *Diameter*
B. *Height*
C. *Vertical cylinder*
D. *Horizontal cylinder*
E. *Vertical bullet*
F. *Horizontal bullet*
G. *Sphere*

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.

Volume offset

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

B.2.5 Analog output (HART®)

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

Output source/primary variable

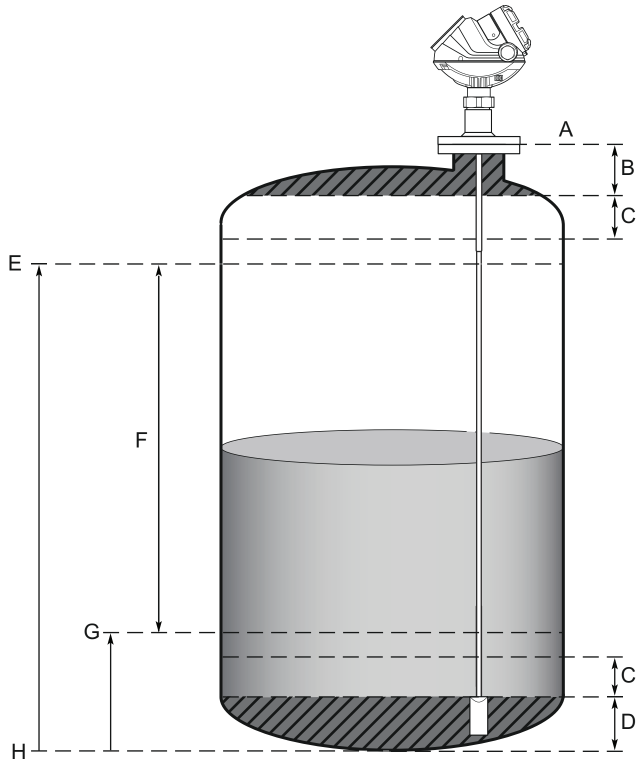
Specify the source to control the analog output. Typically, the Primary Value is configured to be the product level.

For Rosemount 5300 with Modbus protocol, ensure the measurement unit of the Primary Variable (PV) , matches the configuration of the Modbus Host since the transmitter output value does not include any information on associated measurement units.

Upper/lower range value

Enter the range values that correspond to the analog output values 4 and 20 mA. 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.

Figure B-9: Example of Range Value Settings



A. *Upper Reference Point*
B. *Upper Blind Zone*
C. *Reduced accuracy*
D. *Lower Blind Zone*
E. *20 mA, Upper Range Value = 100%*
F. *Range 0 -100 %*
G. *4 mA, Lower Range Value = 0%*
H. *Zero Reference Point (Level=0)*

Note

Measurements may not be possible in the Blind Zones, and measurements close to the Blind Zones will have reduced accuracy. Therefore, the 4-20 mA points should be configured outside these zones.

Also ensure the 20 mA value is below the Hold Off Distance/Upper Null Zone (UNZ).

Alarm mode

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

Table B-3: Alarm Modes

Option	Description
High	The output current is set to the high alarm limit.
Low	The output current is set to the low alarm limit

Table B-3: Alarm Modes *(continued)*

Option	Description
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 B-4: 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 B-5: 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

C Advanced configuration

C.1 Safety messages

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

⚠ WARNING

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

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

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

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

⚠ WARNING

Explosions could result in death or serious injury.

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

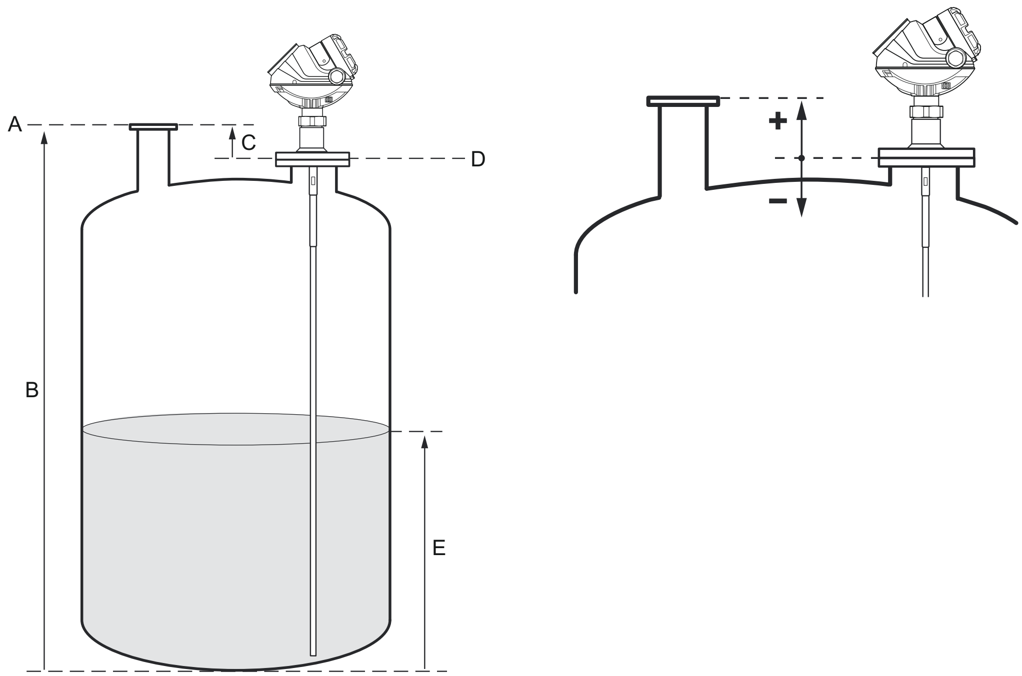
Before connecting a handheld communicator in an explosive atmosphere, be sure that the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

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

C.2 Set user defined upper reference point

An Upper Reference Point other than the standard Transmitter Reference Point can be specified by setting the Distance Offset parameter as illustrated in Figure C-1.

Figure C-1: Specify Upper Reference Point Using Distance Offset Parameter



A. Upper Reference Point
B. Tank Height
C. Distance Offset
D. Transmitter Reference Point
E. Product Level

Procedure

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.
    a) In Rosemount Radar Master, select **Setup** → **Tank**.
    b) Select the **Geometry** tab.
    c) Click the **Advanced** button for more options.
    d) In the ***Distance Offset (G)*** box, type the desired value.

C.3 Probe end projection

Probe End Projection is used for two purposes:

- Use the probe end echo as reference, in case the surface echo is lost, to calculate the surface echo position.
- Use the probe end echo as reference when the surface echo is close to the probe end to enhance accuracy of the surface echo position.

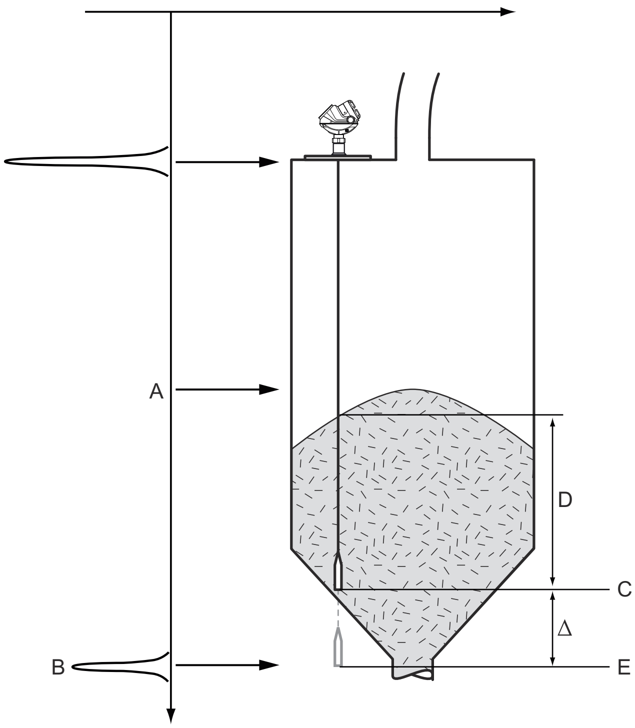
By using the Probe End Projection function, the device is capable of measuring the product level even if the surface echo is lost. The Probe End Projection is suited for challenging applications with very poor reflectivity (low dielectric constant). Due to the poor reflectivity of the product, situations may occur where the surface pulse is invisible to the transmitter at long measuring ranges.

If the surface becomes invisible, the device will revert to use the probe end, and the most recently estimated value of the dielectric constant to calculate the surface. Once the surface reappears, the device will immediately use direct measurement on the surface again. The calculated surface value is less accurate than the value with direct measurement.

When the microwaves emitted by the Rosemount 5300 Transmitter propagate through the product in the tank, the probe end echo appears to be located below the actual probe end. The apparent displacement of the probe end echo peak 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 Use the echo curve analyzer in Rosemount Radar Master).

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 echo peak. The difference is related to the properties of the product, i.e. the Dielectric Constant, and the distance D travelled by the measurement signal through the product, see Figure C-2.

Figure C-2: The Probe End Projection Function



The product Level is given by the relation between Probe End displacement Δ, the Dielectric Constant of the product, and distance D.

A. *Surface pulse is missing due to low product reflectivity*
B. *Probe End pulse*
C. *Actual Probe End position*
D. *Distance*
E. *Apparent Probe End position*

Note
It is important that the Probe Length and product Dielectric Constant are given with high accuracy.

C.3.1 Setup the probe end projection

Prerequisites

Note
Assure that the Mounting Type, Probe Type, and Probe Length have been assigned correct values before configuring the Probe End Projection.

Note
This function is only available for liquid/solid product level measurement modes (i.e. not available for interface or fully submerged interface measurement modes) and a well defined probe end echo (i.e. ensure that the probe end/centering disc/weight is either always in contact with the tank wall or never in contact with the tank wall).

Probe End Projection can be configured using a guide. When the tank is empty, the guided setup will be able to accurately calibrate probe end offset and probe end pulse polarity.

You will be asked to insert an initial value for the Product DC. This is the value for the product dielectric constant that the device uses as a start point for estimation. This value must be as accurate to the actual value of the dielectric constant as possible.

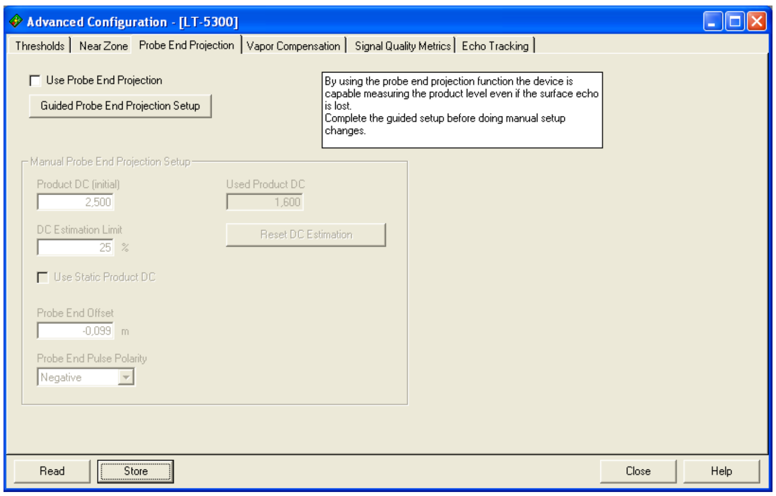
When the tank is filled, the guided setup will be able to estimate the Product DC. This value is used as an initial value for future estimation of the Product DC.

For best performance, complete the guided setup with an empty tank and then a second time with a filled tank, but do not overwrite the empty tank calibration.

Procedure

1. Select **Setup** → **Advanced**.
2. Select the **Probe End Projection** tab.
3. Select **Guided Probe End Projection Setup** and follow the on-screen instructions.

Figure C-3: Probe End Projection Setup



Optional configurations

DC estimation limit

This is a limit for the product dielectric constant estimation. The limit is a percentage, saying how much the estimated product DC is allowed to differ from the initial product DC value. If the estimation goes outside this limit, a warning will be generated.

Used product DC

This is the estimated product dielectric constant that the device will use for Probe End Projection.

Reset DC estimation

Resets DC estimation to the configured initial value, forcing the device to start over estimating the product DC.

Use static product DC

Check this setting if you do not want the device to estimate the product DC. This will force the device to use the configured initial product DC.

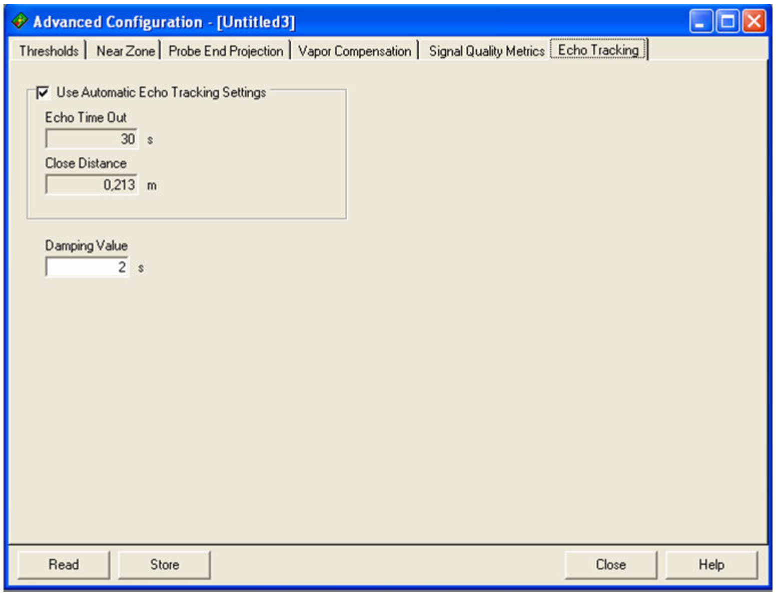
C.4 Adjust the echo tracking settings

Measurement with the Rosemount 5300 is based on the fact that the radar signal pulses are reflected by the product surface. Different parameters are used to track the measurement signal to achieve a reliable and stable measurement. Normally, the echo tracking parameters are automatically set by the transmitter, and no manual settings are needed. However, due to the properties of the product, in rare cases it may be necessary to adjust the echo tracking settings for optimum measurement performance.

Procedure

1. In Rosemount Radar Master, select **Setup** → **Advanced**.
2. Select the **Echo Tracking** tab.
3. To adjust the echo tracking settings, clear the **Use automatic echo tracking settings** checkbox.
4. Set **Echo Timeout** and **Close Distance** to the desired values.

Figure C-4: Echo Tracking in Rosemount Radar Master



C.4.1 Use automatic echo tracking settings

When this check-box is selected, the transmitter automatically sets the echo tracking parameters to a constant value based on the configured tank environment and measurement mode.

C.4.2 Echo time out

This parameter defines the time in seconds before the device should start to search for a surface echo outside the Close Distance window after it was lost. After an echo was lost, the device does not start searching (or set Invalid Level) until the specified time has elapsed. In some applications, especially with solid products or applications with foam, the surface echo may disappear for periods of time. This value can be increased to prevent the device from entering alarm mode too early after the surface is lost.

C.4.3 Close distance

The Close Distance defines a window centered at the current surface position where new surface echo candidates can be selected. The size of the window is ±Close Distance. Echoes outside this window will not be considered as surface echoes. The device will without delay jump to the strongest echo within this window. This value can be increased if there are rapid level changes in the tank. If the value is too large the device might select an invalid echo as the surface echo.

C.4.4 Damping value

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

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

C.5 Dielectric constant settings

C.5.1 Vapor dielectric constant

In some applications, there is heavy vapor above the product surface having a significant influence on the level measurement. 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 dielectric constant of vacuum. Normally this value does not need to be changed since the effect on measurement performance is very small for most vapors.

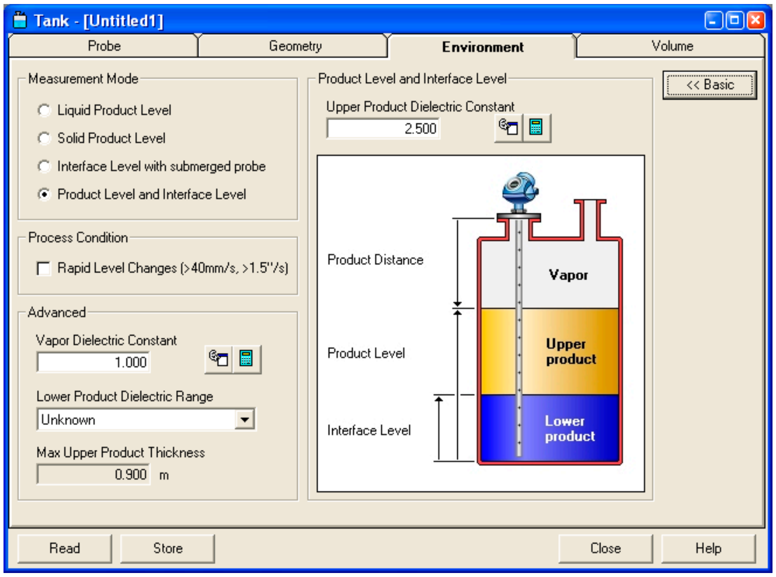
For applications with a varying pressure and/or temperature, certain models of the Rosemount 5300 Level Transmitter have a built-in function that automatically compensates for varying vapor dielectric constants.

C.5.2 Adjust the vapor dielectric constant

Procedure

1. In Rosemount Radar Master, select **Setup** → **Tank**.
2. Select the **Environment** tab.
3. Select the **Advanced** button for more options.
4. In the *Vapor Dielectric Constant* box, the desired value. You may also use the Vapor Dielectric Calculator or the Vapor Dielectric Chart to find the correct value.

Figure C-5: Dielectric Constants Can Be Adjusted in the Tank Environment Window



C.5.3 Adjust the lower product dielectric range

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.

Prerequisites

Special adjustments can also be made by trimming the appropriate amplitude thresholds. See Example 2: Interface peak not found for further information.

Procedure

1. In Rosemount Radar Master, select **Setup** → **Tank**.
2. Select the **Environment** tab.
3. Select the **Advanced** button for more options.
4. In the *Lower Product Dielectric Range* list, select the desired range.

C.6 Dynamic Vapor Compensation

Rosemount 5300 Level Transmitter is based on the Time Domain Reflectometry (TDR) technology where low power nanosecond microwave pulses are guided down a probe submerged in the process media. When a radar pulse reaches a media with a different dielectric constant, part of the energy is reflected to the transmitter. The time difference between the transmitted pulse and the reflected pulse is converted into a distance from which the total level or interface level is calculated.

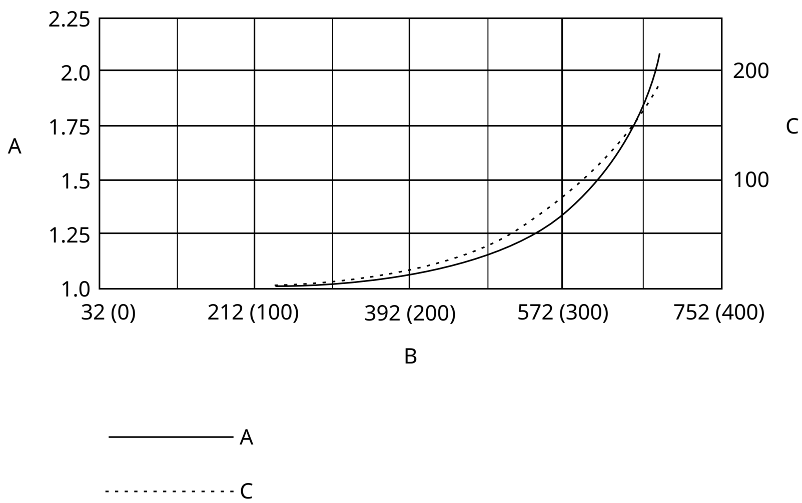
For radar level gauging, the actual measured quantity is the propagation time through the empty space between the radar level transmitter and the liquid surface. For typical radar level transmitter accuracy, the propagation speed of the radar signal should be close to the velocity of light in vacuum. However, in some important cases, the deviation is not negligible and must be taken into account for accuracy. High tank pressure in combination with certain gases is an example.

High pressure water steam can influence radar level transmitter measurements. This is due to the high pressure as well as the polar structure of water molecules. In such cases, the Rosemount 5300 Level Transmitter can be configured for compensation for this effect.

Water has high critical temperature and pressure (705 °F / 374 °C and 3205 psi / 221 bar, respectively). However, Dynamic Vapor Compensation has a maximum temperature and pressure of 676 °F / 358 °C and 2610 psi / 180 bar. Above these limits, level measurement may not be possible since the separation between gas and liquid becomes indistinct.

In a closed vessel containing water liquid and water vapor, existing databases (referred to as a Mollier diagram) have been used to calculate pressure and vapor density, and deduce the dielectric constant of the vapor from this. The dielectric constant changes as given in Figure C-6.

Figure C-6: Dielectric Constant versus Temperature for Saturated Water Vapor



A. Dielectric constant
B. Temperature (°F/°C)
C. Pressure (bar)

The standard version of a Rosemount 5300 Level Transmitter can be configured for static compensation of vapor by manually entering the dielectric constant of vapor. For applications with a varying pressure and/or temperature, certain models of the Rosemount 5300 have a built-in function (Dynamic Vapor Compensation) that automatically compensates for varying vapor dielectric constants.

The Rosemount 5300 uses a reference reflector mounted on the probe at a certain distance to estimate the dielectric constant of the vapor. The transmitter knows where the reference reflector pulse should have been if there were no vapor present. However, since there is vapor in the tank, the reference reflector pulse will appear beyond the actual reflector point. The distance between the actual reflector point and the apparent reflector point will be used to calculate the vapor dielectric constant. The calculated dielectric constant is then dynamically used to compensate for changes in vapor dielectric constant, resulting in a final accuracy down to ± 2% of measured distance (ullage). The accuracy may be reduced to ± 6% in certain conditions, such as rapid changes in temperature, pressure, and dielectric constant.

C.6.1 Check if Dynamic Vapor Compensation function is supported

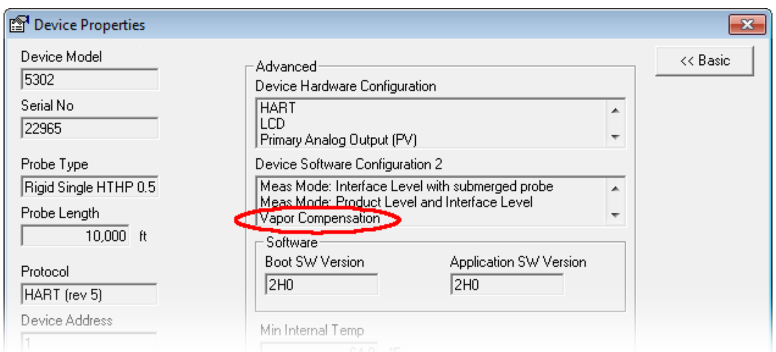
Prerequisites

Note
Vapor compensation is supported for Product Level measurement mode only.

Procedure

To check if the Dynamic Vapor Compensation function is supported, do one of the following:

- Check that 3V or 4U is mentioned in the model code on the transmitter head. Model Code: 530xxxxxxx3Vxxxxxxxxx or 530xxxxxxx4Uxxxxxxxxx
- Check that "Vapor Compensation" is mentioned in the *Device Software Configuration 2* list.
    a. Start Rosemount Radar Master and connect to device.
    b. Right-click on the device and select **Properties**.

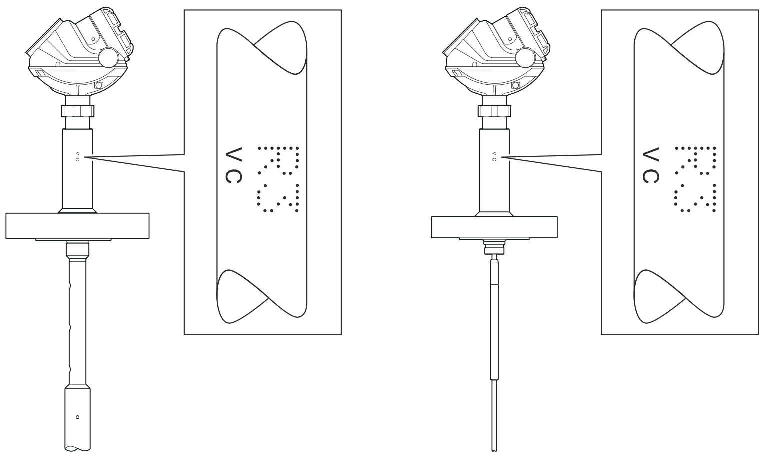


C.6.2 Review installation guidelines

The following installation guidelines should be considered when mounting the transmitter:

- Only probe type 3V or 4U must be used. Check the "VC" and "R3" marking on the seal.

Figure C-7: "VC" and "R3" Marking



A. Probe type 3V (coaxial) for 3-4 in. chambers
B. Probe type 4U (rigid single) for 2 in. chambers

- The maximum probe length is 13 ft. 1 in. (4 m) for probe type 3V and 9 ft. 10 in. (3 m) for probe type 4U.
- Pipe/Chamber is the only supported mounting type. See below for supported pipe inner diameters:

Probe type	Chamber size	Supported pipe inner diameter
3V	3 to 4 in.	Minimum 2 in. (50 mm)
4U	2 in.	1.5 to 2.05 in. (38 to 52 mm)

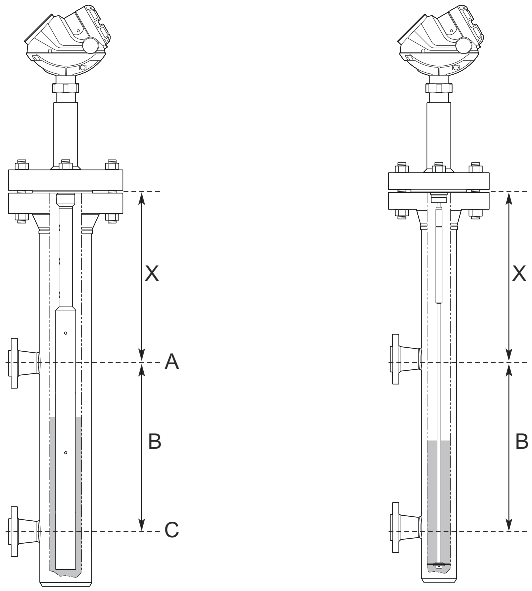
- Probe End Projection is disabled when Vapor Compensation is enabled.
- Trim Near Zone shall not be used when Dynamic Vapor Compensation is used.
- Dynamic Vapor Compensation requires a minimum distance X from the flange to the surface level to measure the change in the vapor dielectric constant. If the level rises within this area, the unit switches over to static compensation, using the last known vapor dielectric constant.

Table C-1: Minimum Distance X

Reference reflector type		Minimum distance X
Length	**Option code (1)**	
Short, 14 in. (350 mm)	R1	22 in. (560 mm)
Long, 20 in. (500 mm)	R2	28 in. (710 mm)

(1) *Check model code on the transmitter label.*

Figure C-8: Minimum Distance X and Minimum Measuring Span

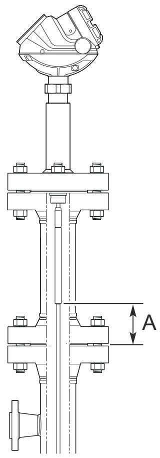


A. Level: 100%
B. Minimum measuring span: 12 in. (300 mm)
C. Level: 0%

- The minimum measuring span for the Dynamic Vapor Compensation functionality is 12 in. (300 mm).
- The long reflector, 20 in. (500 mm), has the best accuracy and is recommended for all chambers where the dimensions of the chamber allow for it.
- If the distance from the flange to the upper inlet is less than 28 in. (710 mm), the short reflector should be chosen. This distance is a minimum when dynamic compensation is required within the whole measuring range from the lower to the upper inlet. If this is not required, the long reflector can be used and dynamic compensation is possible up to 28 in. (710 mm) from the flange.
- If a Rosemount 5300 GWR transmitter is ordered from Rosemount together with a Rosemount 9901 Chamber, these space requirements are met by using the option code G1 or G2 for the chamber. G1 is used with the short reference reflector and G2 is used with the long reference reflector.

  If an existing chamber is used, which does not meet these space requirements, a spool piece can be added. For the 4U probe, the spool piece needs to be at least 2 in. (50 mm) longer or shorter than the reference reflector, to ensure that there are no disturbances from welds close to the reference reflector end. For a spool piece with the 3V probe, this is not a requirement.

Figure C-9: Spool Piece Requirement for the 4U Probe



A. *For the 4U probe, the spool piece needs to be at least 2 in. (50 mm) longer or shorter than the reference reflector.*

C.6.3 Calibrate Dynamic Vapor Compensation function

Check if calibration is needed on-site

Type	Action
Probe type 3V (coaxial) with/without remote housing	The Dynamic Vapor Compensation function of this Rosemount 5300 Level Transmitter has been calibrated at factory. Calibration is only needed if: • The transmitter is reset to factory settings. Reset removes pre-calibration of the Dynamic Vapor Compensation function. • A spare or replacement Rosemount 5300 Transmitter head is mounted on the supplied Dynamic Vapor Compensation probe.
Probe type 4U (rigid single)	Calibration is always needed on-site during the commission phase.

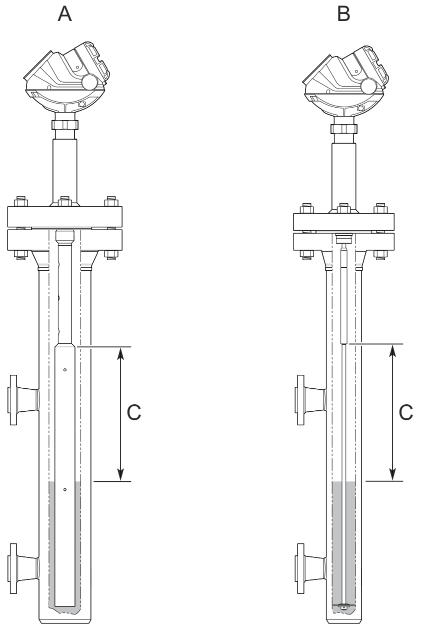
Note
When installing a device with Dynamic Vapor Compensation, do not upload a backup file from another device.

Perform calibration using Rosemount Radar Master

Prerequisites

- The surface level must be at least 20 in. (0.5 m) below the end of the reference reflector. (It is recommended to empty the chamber.)

Figure C-10: Surface Level



A. *Probe type 3V for 3- to 4-in. chambers*
B. *Probe type 4U for 2-in. chambers*
C. *Minimum 20 in. (0.5 m)*

- Perform the calibration at ambient pressure and temperature conditions (i.e. when the vapor dielectric constant is close to one).
- When using remote housing, confirm it is fully assembled before calibrating the Vapor Compensation function.

Procedure

1. Verify the basic configuration for device has been performed.
2. Ensure the correct probe type is selected.
   a) Select **Setup** → **Tank**.
   b) Select the **Probe** tab.
   c) In the *Probe type* list, select **Coaxial HTHP** for probe type 3V or **Rigid Single HTHP 0.3″ (8mm)** for probe type 4U.
   d) Select **Store**.
3. Check that Mounting Type is set to Pipe/Chamber and select inner diameter.
   a) Select **Setup** → **Tank**.
   b) Select the **Geometry** tab.
   c) In the *Mounting Type* list, select **Pipe/Chamber**.
   d) In the *Inner Diameter, Pipe/Chamber/Nozzle* list, select the corresponding inner diameter.
   e) Select **Store**.
4. Select **Setup** → **Advanced**.

5. Select the **Vapor Compensation** tab.
6. In the *Reference Reflector Type* list, select reference reflector as appropriate, and then select **Store**.

Option	Description
Coax, l=350 mm	Use this option for probe type 3V with short reflector
Coax, l=500 mm	Use this option for probe type 3V with long reflector
d=13 mm, l=350 mm	Use this option for probe type 4U with short reflector
d=13 mm, l=500 mm	Use this option for probe type 4U with long reflector

7. Select the **Use Vapor Compensation** checkbox, and then select **Store**.
8. Select **Calibrate Vapor Compensation** and follow the on-screen instructions.

Note
When the Dynamic Vapor Compensation function has been calibrated, ensure the Probe Type, Mounting Type, Inner Diameter, Reference Reflector Type, and remote connection (if used) remain set as they were during calibration.

If changing the configuration of these parameters, the Dynamic Vapor Compensation function will be deactivated, and the device error "Vapor Compensation Not Factory Calibrated" appears. Correct the parameter that has been changed, and restart the device.

9. When the calibration is finished, restart the device.
   a) Select **Tools** → **Restart Device**.

Postrequisites

Verify the echo peak from the reference reflector is marked in the echo curve plot.

Related information

Verify the echo peak from the reference reflector

Perform calibration using AMS Device Manager

Prerequisites

- The surface level must be at least 20 in. (0.5 m) below the end of the reference reflector. (It is recommended to empty the chamber.)
- Perform the calibration at ambient pressure and temperature conditions (i.e. when the vapor dielectric constant is close to one).
- When using remote housing, confirm it is fully assembled before calibrating the Vapor Compensation function.

Procedure

1. Verify the basic configuration for device has been performed.
2. Ensure the correct probe type is selected.
   a) HART®: Select **Configure** → **Manual Setup** → **Level Setup**.

FOUNDATION™ Fieldbus: Select **Configure → Manual Setup**.

b) Select the **Probe** tab.

c) In the *Probe type* list, select **Coaxial HTHP** for probe type 3V or **Rigid Single HTHP 0.3″ (8mm)** for probe type 4U.

d) Select **Send**.

3. Check that Mounting Type is set to Pipe/Chamber and select inner diameter.

   a) HART: Select **Configure → Manual Setup → Level Setup**.

   FOUNDATION Fieldbus: Select **Configure → Manual Setup**.

   b) Select the **Geometry** tab.

   c) In the *Mounting Type* list, select **Pipe/Chamber**.

   d) In the *Inner Diameter, Pipe/Chamber/Nozzle* list, select the corresponding inner diameter.

   e) Select **Send**.

4. HART: Select **Configure → Manual Setup → Level Setup**.

   FOUNDATION Fieldbus: Select **Configure → Manual Setup → Advanced**.

5. HART: Select the **Vapor Compensation** tab.

   FOUNDATION Fieldbus: Select the **Vapor Compensation Setup** button.

6. In the *Reference Reflector Type* list, select reference reflector as appropriate, and then select **Next**.

Option	Description
Coax, l=350 mm (RR B3 in old DD versions)	Use this option for probe type 3V with short reflector
Coax, l=500 mm (RR B4 in old DD versions)	Use this option for probe type 3V with long reflector
d=13 mm, l=350 mm (RR A6 in old DD versions)	Use this option for probe type 4U with short reflector
d=13 mm, l=500 mm (RR B2 in old DD versions)	Use this option for probe type 4U with long reflector

7. HART: Select the **Use Vapor Compensation** checkbox, and then select **Send**.

   FOUNDATION Fieldbus: In the *Use Vapor Compensation* list, select **Yes**, and then select **Next**.

8. Select the **Calibrate Vapor Compensation** button and follow the on-screen instructions.

   Note
   When the Dynamic Vapor Compensation function has been calibrated, ensure the Probe Type, Mounting Type, Inner Diameter, Reference Reflector Type, and remote connection (if used) remain set as they were during calibration.

   If changing the configuration of these parameters, the Dynamic Vapor Compensation function will be deactivated, and the device error "Vapor Compensation Not Factory Calibrated" appears. Correct the parameter that has been changed, and restart the device.

9. When the calibration is finished, restart the device.
   a) Select **Service Tools** → **Maintenance**.
   b) (FOUNDATION Fieldbus only) Select the **Reset/Restore**.
   c) Select **Restart Device**.

Postrequisites

Verify the echo peak from the reference reflector is marked in the echo curve plot.

Related information

Verify the echo peak from the reference reflector

Verify the echo peak from the reference reflector

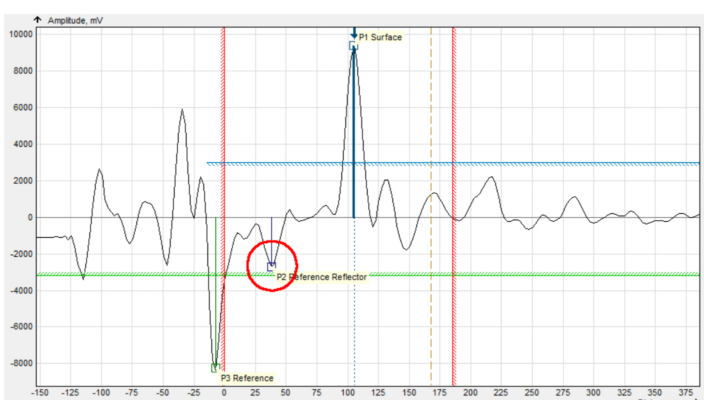
Verify that the echo peak from the reference reflector is marked "P2 Reference Reflector" in the echo curve plot.

Procedure

1. In Rosemount Radar Master, select **Setup** → **Echo Curve**.
2. If the echo curve is not read automatically, select **Read**.
3. Verify that the echo peak from the reference reflector is marked "P2 Reference Reflector" in the echo curve plot, as illustrated in Figure C-11.

   Probes will have the reflector end either at 1.1 ft. (0.35 m) or at 1.6 ft. (0.5 m), depending on if the probe has a short or a long reflector.

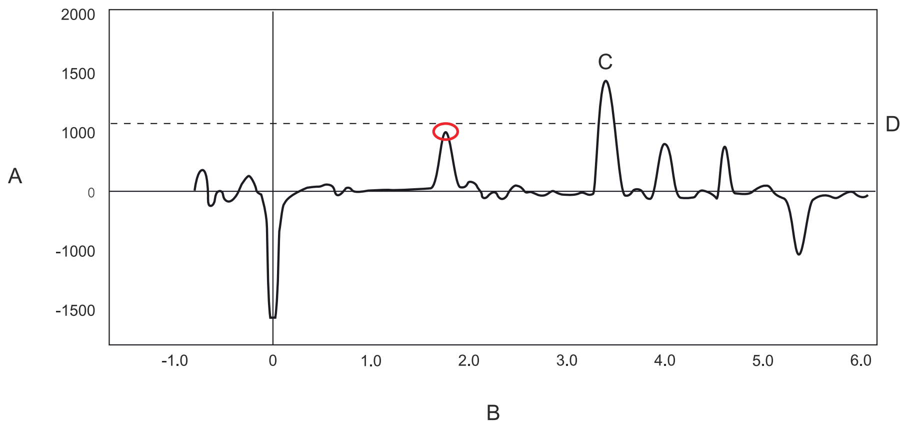
Figure C-11: Echo Curve Showing Echo Peak from Reference Reflector (Plot from 2-inch Chamber with Short Reference Reflector)



C.7 Signal Quality Metrics

Signal Quality Metrics indicates the surface signal integrity compared to the noise. It can be used to schedule maintenance to clean the probe or detect and monitor turbulence, boiling, foam and emulsions.

Figure C-12: Echo Curve Showing Surface Peak Amplitude, Noise Peak Amplitude, and Surface Threshold



A. Amplitude, mV
B. Distance, m
C. Surface peak amplitude (P1)
D. Surface Threshold=Amplitude Threshold Curve (ATC)

Signal quality

Signal Quality is a measurement of the surface peak amplitude (P1) compared to the surface threshold (ATC) and the smallest marginal between the noise and the ATC above the surface (indicated with a circle) compared to the ATC. The Signal Quality spans from 0 to 10, where 0 indicates a low margin, and 10 indicates a high margin. It indicates how much margin there is until the noise peak is indicated as the surface level.

Note
The signal amplitude and the noise margin depend on probe type and application conditions, as well as the condition of the probe. Even if the probe is clean, the Signal Quality may not be a 10.

Surface/noise margin

Surface/Noise Margin is the relationship between surface peak amplitude and the amplitude of the strongest noise peak above the surface. The Surface/Noise Margin spans from 0 to 10, where 0 indicates a low margin, and 10 indicates a high margin. It indicates how much disturbance the device can handle in the tank.

Note
The signal amplitude and the noise margin depend on probe type and application conditions, as well as the condition of the probe. Even if the probe is clean, the Surface/Noise Margin may not be a 10.

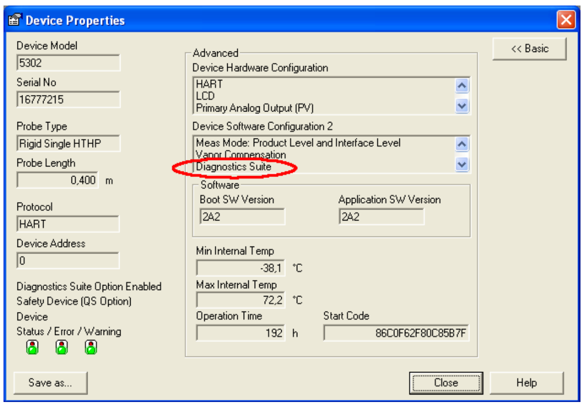
C.7.1 Check if Signal Quality Metrics is supported

Procedure

To check if Signal Quality Metrics is supported, do one of the following:

- Check that DA1 or D01 is mentioned in the model code on the transmitter head.
- Check that "Diagnostics Suite" is mentioned in the *Device Software Configuration 2* list.
    a. Start Rosemount Radar Master and connect to device.
    b. Right-click on the device and select **Properties**.

Figure C-13: Check if Signal Quality Metrics is Supported



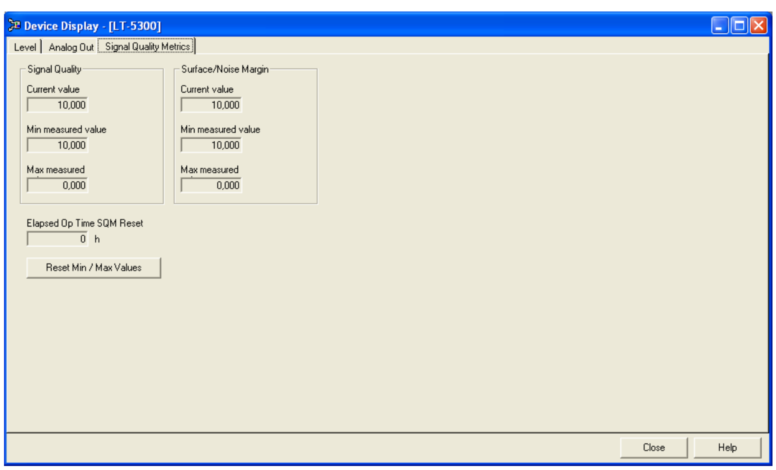
C.7.2 View signal quality metrics

To view Signal Quality Metrics in Rosemount Radar Master:

Procedure

1. Select **Tools** → **Device Display**.
2. Select the **Signal Quality Metrics** tab.

Figure C-14: View Signal Quality Metrics Values



C.7.3 Configure transmitter variables for signal quality metrics

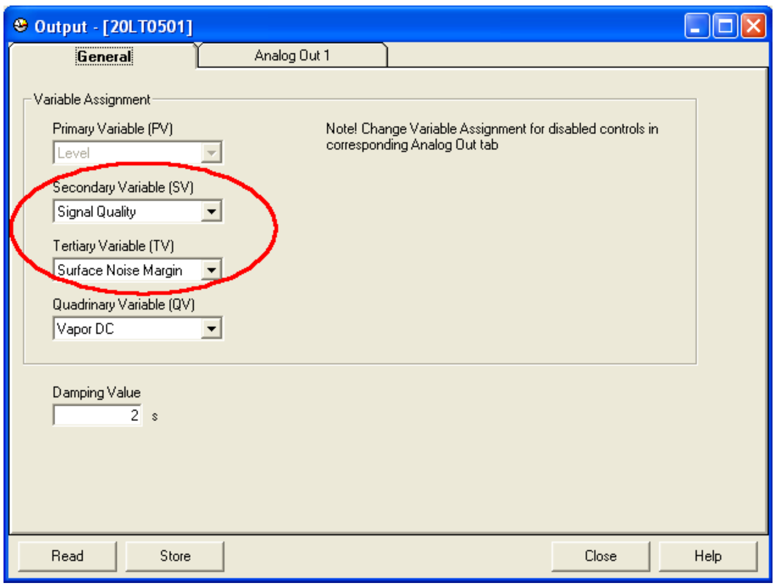
Signal Quality Metrics can be assigned to Transmitter Variables (SV, TV, or QV).

Variables can be sent to Distributed Control System (DCS) to trigger an alarm. Suitable trigger levels vary from application to application. Guidelines for appropriate values can be determined by logging Signal Quality Metrics over time and viewing minimum/maximum values. The Signal Quality alarm trigger value should be at least 1, but a better guideline is 2-3.

Procedure

Select **Setup** → **Output**.

Figure C-15: Configure Transmitter Variables for Signal Quality Metrics



C.8 Switch alarm limits (HART® only)

C.8.1 Switch alarm limits using AMS Device Manager

The alarm limits can be set to either Rosemount or NAMUR NE43 values.

Prerequisites

Requires firmware version 2.L3 or later.

Procedure

1. Select **Configure** → **Manual Setup** → **Device Setup**.
2. Select the **Analog Output** tab.

   The *Alarm Output Level* drop-down list displays the current alarm limit option.
3. Click the **Configure Alarm and Saturation Limits** button.
4. Select the desired alarm limit option, and then select **Next**.
5. Select **Finish** when the *Method Complete* message appears.

C.8.2 Switch alarm limits using handheld communicator

The alarm limits can be set to either Rosemount or NAMUR NE43 values.

Prerequisites

Requires firmware version 2.L3 or later.

Procedure

1. Select **Configure** → **Manual Setup** → **Device Setup**.
2. Select **Analog Output**.
   The current alarm limit option is presented.
3. Select **Alarm Level**.
4. Select the desired alarm limits option.
5. Select **Send** and follow the instructions.

C.9 Detecting thin interface layers

The Rosemount 5300 software uses an algorithm to enhance detection of thin interface layers. The algorithm is active for interface measurements where the upper product thickness is about 10 in. (25 cm) or less.

The thin layer detection function is enabled by default. In rare cases it might be relevant to disable thin layer detection, like the following situations:

1. Interface measurements in the upper part of HP/HTHP probes
   The thin layer detection functionality is impaired for measurement at the top of the HP/HTHP probes, approximately the top 60 cm. For interface measurements in this area the thin layer functionality may not work as desired.
2. Applications with disturbances from nozzle or other physical objects
   For interface measurements exposed to disturbances, the perfomance of the thin layer detection functionality might be affected. Tank disturbances can origin from the nozzle or objects in the tank e.g. spacers. Minor disturbances might decrease the thin layer detection accuracy. Larger disturbances can cause the thin interface detection to not work properly.

Related information

Interface measurements

C.9.1 Enable/disable thin layer detection using Rosemount Radar Master

The thin layer detection is initially enabled. It can be set to enabled or disabled.

Prerequisites

The thin layer detection is only applicable to:

- Firmware version 2.L3 or later.
- Measurement mode: Level and Interface Level.
- Probe types: Single lead or Coaxial/Large coaxial (standard/HP/C).

Note
When the thin layer detection is disabled, the minimum detectable upper product thickness is increased, typically 5.1 in. (13 cm).

Procedure

1. Select **Setup** → **Tank**.
2. Select the **Environment** tab.
3. Under *Advanced* select/deselect the **Thin Layer Detection** checkbox to enable/disable the thin layer detection.
4. Select **Store**.

C.9.2 Enable/disable thin layer detection using AMS Device Manager

The thin layer detection is initially enabled. It can be set to enabled or disabled.

Prerequisites

The thin layer detection is only applicable to:

- Firmware version 2.L3 or later.
- Measurement mode: Level and Interface Level.
- Probe types: Single lead or Coaxial/Large coaxial (standard/HP/C).

Note
When the thin layer detection is disabled, the minimum detectable upper product thickness is increased, typically 5.1 in. (13 cm).

Procedure

1. HART®: Select **Configure** → **Manual Setup** → **Level Setup**.
   FOUNDATION™ Fieldbus: Select **Configure** → **Manual Setup**.
2. Select the **Environment** tab.
   The *Use Thin Layer Detection* check box displays the current state of the thin layer detection, enabled or disabled.
3. Click the **Thin Layer Detection** button.
4. Select desired option to enable or disable the thin layer detection, and then select **Next**.
5. Select **Finish** when the *Method Complete* message appears.

C.9.3 Enable/disable thin layer detection using handheld communicator

The thin layer detection is initially turned on. It can be set to on or off.

Prerequisites

The thin layer detection is only applicable to:

- Firmware version 2.L3 or later.
- Measurement mode: Level and Interface Level.
- Probe types: Single lead or Coaxial/Large coaxial (standard/HP/C).

Note
When the thin layer detection is disabled, the minimum detectable upper product thickness is increased, typically 5.1 in. (13 cm).

Procedure

1. HART®: Select **Configure** → **Manual Setup** → **Level Setup** → **Environment**.
   FOUNDATION™ Fieldbus: Select **Configure** → **Manual Setup** → **Environment**.
2. Select **Thin Layer Detection**.
   The current state of the thin layer detection is presented.
3. Set thin layer detection to desired state.
4. Select **Send** and follow the instructions.

D Remote mounting

D.1 Remote housing, new units

Remote Housing can be used to place the head apart from the probe if it is in a hot or vibrating place. With Remote Housing, you can place the transmitter head in a better position to be able to read the display, for example.

The remote housing assembly is shipped with the transmitter head mounted on the probe and the remote connection in a separate box.

The transmitter head must have the remote connection installed before functioning.

The parts in the shipping unit consist of:

- Transmitter head mounted on probe
- Remote connection
  - — Bracket kit
  - — Bracket (1 pcs)
  - — Clamping bracket (4 pcs)
  - — U-bolt (2 pcs)
  - — Screw (3 pcs)
  - — Nut (4 pcs)

D.2 Remote connection, field retrofit

To upgrade a currently installed Rosemount™ 5300 Level Transmitter with a remote housing, the embedded software needs revision 2.A2 or later, and the Spare Part Kit (03300-7006-000X) must be ordered. The position X corresponds to the remote housing cable length in meters.

The Rosemount 5300 Level Transmitter head must be configured for remote housing to work.

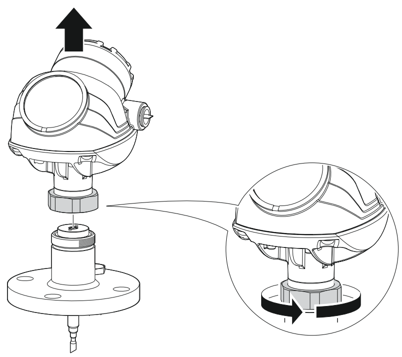
The Spare Part Kit consists of:

- Remote connection
- Bracket kit
  - — Bracket (1 pcs)
  - — Clamping bracket (4 pcs)
  - — U-bolt (2 pcs)
  - — Screw (3 pcs)
  - — Nut (4 pcs)

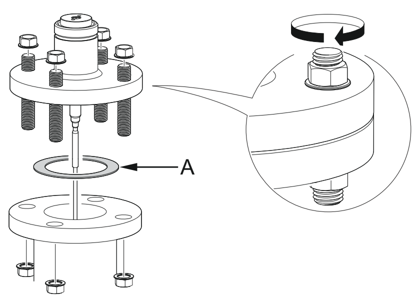
D.3 Install remote housing

Procedure

1. Carefully remove the transmitter.

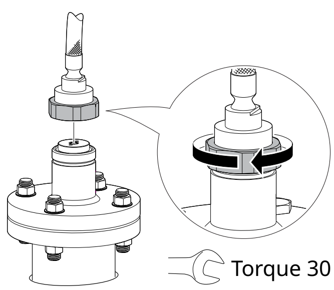


2. If installing a new unit, mount the probe on tank.



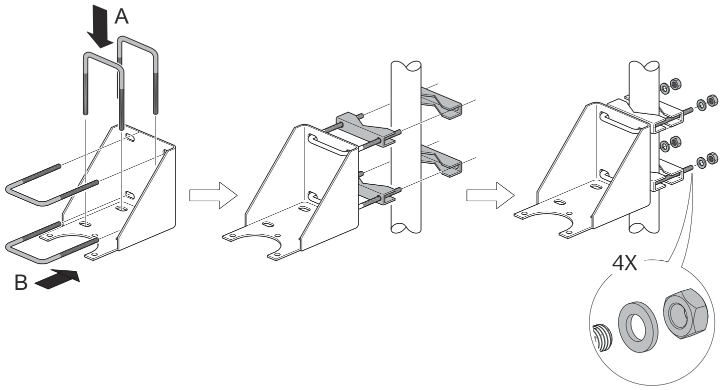
A. Gasket

3. Mount the remote connection on the probe.



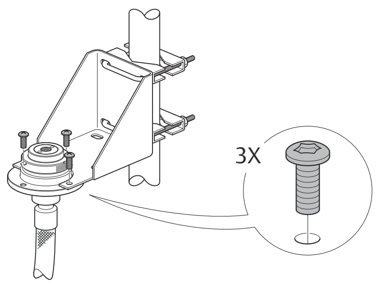
Note
Re-tighten after 24 hours and again after the first temperature cycle. Check at regular intervals and re-tighten if necessary.

4. Mount the bracket to the pipe.

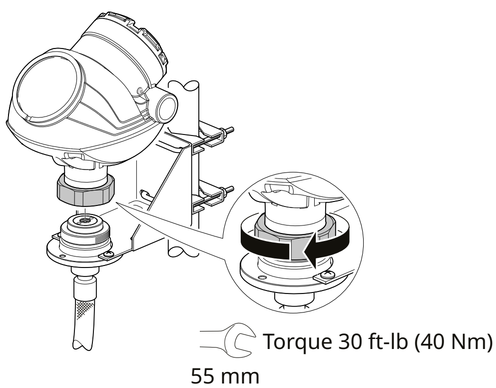


A. Horizontal pipe
B. Vertical pipe

5. Fasten the housing support.



6. Mount the transmitter head.



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

D.4 Remote housing configuration in Rosemount Radar Master

When using remote housing, the remote connection length should be configured. If the Remote Housing is ordered with a transmitter, it is configured in the factory.

Prerequisites

Note
When disconnecting a remote housing cable from a probe in low temperatures, -22 °F (-30 °C), Rosemount Radar Master may not show that the probe is missing.

Procedure

1. Select **Setup** → **Tank**.
2. Select the **Probe** tab.
3. Select the **Advanced** button.
4. In the *Remote Housing* list, select the remote housing length.
5. Select **Store**.

E FOUNDATION™ Fieldbus Block Information

E.1 Resource Transducer Block

E.1.1 Resource block parameters

This section contains information on the resource block of the Rosemount 5300.

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.

Table E-1: Resource Block Parameters

Index Number	Parameter	Description
01	ST_REV	The revision level of the static data associated with the function block.
02	TAG_DESC	The user description of the intended application of the block.
03	STRATEGY	The strategy field can be used to identify grouping of blocks.
04	ALERT_KEY	The identification number of the plant unit.
05	MODE_BLK	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
06	BLOCK_ERR	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.
07	RS_STATE	State of the function block application state machine.
08	TEST_RW	Read/write test parameter - used only for conformance testing.
09	DD_RESOURCE	String identifying the tag of the resource which contains the Device Description for this resource.
10	MANUFAC_ID	Manufacturer identification number – used by an interface device to locate the DD file for the resource.
11	DEV_TYPE	Manufacturer’s model number associated with the resource - used by interface devices to locate the DD file for the resource.
12	DEV_REV	Manufacturer revision number associated with the resource - used by an interface device to locate the DD file for the resource.

Table E-1: Resource Block Parameters *(continued)*

Index Number	Parameter	Description
13	DD_REV	Revision of the DD associated with the resource - used by an interface device to locate the DD file for the resource. The DD_REV specifies the minimum DD revision that is compatible with the device (within the same device revision). A vendor can release an updated DD with the DD_REVISION higher than the DD_REV. This allows a vendor to release an updated DD files set that will be compatible with an existing device revision in the field. The host can always load a higher DD_REVISION for a given DEV_REV/DEV_REVISION. As per Foundation requirement the DD_REV will always be 01.
14	GRANT_DENY	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device.
15	HARD_TYPES	The types of hardware available as channel numbers.
16	RESTART	Allows a manual restart to be initiated. Several degrees of restart are possible. They are the following: 1 Run – is the passive state of the parameter 2 Restart resource – not used 3 Restart with defaults – intended to reset parameters to default values, i.e. their value before any configuration was done 4 Restart processor – does a warm start of CPU
17	FEATURES	Used to show supported resource block options. The supported features are: • SOFT_WRITE_LOCK_SUPPORT • REPORT_SUPPORT • UNICODE_SUPPORT • MULTI_BIT_ALARM • RESTART/RELINK AFTER FB ACTION
18	FEATURES_SEL	Used to select resource block options.
19	CYCLE_TYPE	Identifies the block execution methods available for this resource.
20	CYCLE_SEL	Used to select the block execution method for this resource. The Rosemount 5300 supports the following: Scheduled: Blocks are only executed based on the function block schedule. Block Execution: A block may be executed by linking to another blocks completion.
21	MIN_CYCLE_T	Time duration of the shortest cycle interval of which the resource is capable.
22	MEMORY_SIZE	Available configuration memory in the empty resource. To be checked before attempting a download.
23	NV_CYCLE_T	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.
24	FREE_SPACE	Percent of memory available for further configuration. Zero in a pre-configured device.
25	FREE_TIME	Percent of the block processing time that is free to process additional blocks.

Table E-1: Resource Block Parameters *(continued)*

Index Number	Parameter	Description
26	SHED_RCAS	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
27	SHED_ROUT	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
28	FAULT_STATE	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.
29	SET_FSTATE	Allows the FAIL_SAFE condition to be manually initiated by selecting Set.
30	CLR_FSTATE	Writing a Clear to this parameter will clear the device FAIL_SAFE if the field condition has cleared.
31	MAX_NOTIFY	Maximum number of unconfirmed notify messages possible.
32	LIM_NOTIFY	Maximum number of unconfirmed alert notify messages allowed.
33	CONFIRM_TIME	The time the resource will wait for confirmation of receipt of a report before trying again. Retry will not happen when CONFIRM_TIME=0.
34	WRITE_LOCK	When hardware write protection is selected, WRITE_LOCK becomes an indicator of the jumper setting and is unavailable for software write protection. When software write lock is selected, and WRITE_LOCK is set, no writings from anywhere else are allowed, except to clear WRITE_LOCK. Block input will continue to be updated.
35	UPDATE_EVT	This alert is generated by any change to the static data.
36	BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alarm is entered in the subcode field. The first alarm to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alarm reporting task, another block alarm may be reported without clearing the Active status, if the subcode has changed.
37	ALARM_SUM	The current alarm status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
38	ACK_OPTION	Selection of whether alarms associated with the function block will be automatically acknowledged.
39	WRITE_PRI	Priority of the alarm generated by clearing the write lock.
40	WRITE_ALM	This alert is generated if the write lock parameter is cleared.
41	ITK_VER	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.
42	FD_VER	A parameter equal to the value of the major version of the Field Diagnostics specification that this device was designed to.
43	FD_FAIL_ACTIVE	This parameter reflects the error conditions that are being detected as active as selected for this category. It is a bit string, so that multiple conditions may be shown.
44	FD_OFFSPEC_ACTIVE	
45	FD_MAINT_ACTIVE	
46	FD_CHECK_ACTIVE	
47	FD_FAIL_MAP	This parameter maps conditions to be detected as active for this alarm category. Thus the same condition may be active in all, some, or none of the 4 alarm categories.
48	FD_OFFSPEC_MAP	

Table E-1: Resource Block Parameters *(continued)*

Index Number	Parameter	Description
49	FD_MAINT_MAP	
50	FD_CHECK_MAP	
51	FD_FAIL_MASK	This parameter allows the user to suppress any single or multiple conditions that are active, in this category, from being broadcast to the host through the alarm parameter. A bit equal to '1' will mask i.e. inhibit the broadcast of a condition, and a bit equal to '0' will unmask i.e. allow broadcast of a condition.
52	FD_OFFSPEC_MASK	
53	FD_MAINT_MASK	
54	FD_CHECK_MASK	
55	FD_FAIL_ALM	This parameter is used primarily to broadcast a change in the associated active conditions, which are not masked, for this alarm category to a Host System.
56	FD_OFFSPEC_ALM	
57	FD_MAINT_ALM	
58	FD_CHECK_ALM	
59	FD_FAIL_PRI	This parameter allows the user to specify the priority of this alarm category.
60	FD_OFFSPEC_PRI	
61	FD_MAINT_PRI	
62	FD_CHECK_PRI	
63	FD_SIMULATE	This parameter allows the conditions to be manually supplied when simulation is enabled. When simulation is disabled both the diagnostic simulate value and the diagnostic value tracks the actual conditions. The simulate jumper is required for simulation to be enabled and while simulation is enabled the recommended action will show that simulation is active. Elements: see Table E-2.
64	FD_RECOMMEN_ACT	This parameter is a device enumerated summarization of the most severe condition or conditions detected. The DD help should describe by enumerated action, what should be done to alleviate the condition or conditions. 0 is defined as Not Initialized, 1 is defined as No Action Required, all others defined by manufacturer.
65	FD_EXTENDED_ACTIVE	An optional parameter or parameters to allow the user finer detail on conditions causing an active condition in the FD_*_ACTIVE parameters.
66	FD_EXTENDED_MAP	An optional parameter or parameters to allow the user finer control on enabling conditions contributing to the conditions in FD_*_ACTIVE parameters.
67	COMPATIBILITY_REV	This parameter is used when replacing field devices. The correct value of this parameter is the DEV_REV value of the replaced device.
68	HARDWARE_REVISION	Hardware revision.
69	SOFTWARE_REV	Software revision of source code with resource block.
70	PD_TAG	PD tag description of device.
71	DEV_STRING	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.
72	DEV_OPTIONS	Indicates which miscellaneous device licensing options are enabled.
73	OUTPUT_BOARD_SN	Output board serial number. For the Rosemount 5300 this is the same as Main Label Device ID which can be found on the main label that is attached to the housing.

Table E-1: Resource Block Parameters *(continued)*

Index Number	Parameter	Description
74	FINAL_ASSY_NUM	Final assembly number given by manufacturer.
75	DOWNLOAD_MODE	Gives access to the boot block code for over-the-wire downloads. 0 = Uninitialized 1 = Run mode 2 = Download mode
76	HEALTH_INDEX	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.
77	FAILED_PRI	Designates the alarming priority of the FAILED_ALM and also used as switch b/w FD and legacy PWA. If value is greater than or equal to 1 then PWA alerts will be active in device else device will have FD alerts.
78	RECOMMENDED_ACTION	Enumerated list of recommended actions displayed with a device alert.
79	FAILED_ALM	Alarm indicating a failure within a device which makes the device non-operational.
80	MAINT_ALM	Alarm indicating the device needs maintenance soon. If the condition is ignored, the device will eventually fail.
81	ADVISE_ALM	Alarm indicating advisory alarms. These conditions do not have a direct impact on the process or device integrity.
82	FAILED_ENABLE	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. This parameter is the Read Only copy of FD_FAIL_MAP.
83	FAILED_MASK	Mask of FAILED_ALM. Corresponds bit of bit to FAILED_ACTIVE. A bit on means that the condition is masked out from alarming. This parameter is the Read Only copy of FD_FAIL_MASK.
84	FAILED_ACTIVE	Enumerated list of failure conditions within a device. All open bits are free to be used as appropriate for each specific device. This parameter is the Read Only copy of FD_FAIL_ACTIVE.
85	MAINT_PRI	Designates the alarming priority of the MAINT_ALM
86	MAINT_ENABLE	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. This parameter is the Read Only copy of FD_OFFSPEC_MAP.
87	MAINT_MASK	Mask of MAINT_ALM. Corresponds bit of bit to MAINT_ACTIVE. A bit on means that the condition is masked out from alarming. This parameter is the Read Only copy of FD_OFFSPEC_MASK.
88	MAINT_ACTIVE	Enumerated list of maintenance conditions within a device. This parameter is the Read Only copy of FD_OFFSPEC_ACTIVE.
89	ADVISE_PRI	Designates the alarming priority of the ADVISE_ALM.

Table E-1: Resource Block Parameters *(continued)*

Index Number	Parameter	Description
90	ADVISE_ENABLE	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. This parameter is the Read Only copy of FD_MAINT_MASK & FD_CHECK_MASK.
91	ADVISE_MASK	Mask of ADVISE_ALM. Corresponds bit by bit to ADVISE_ACTIVE. A bit on means that the condition is masked out from alarming. This parameter is the Read Only copy of FD_MAINT_MASK & FD_CHECK_MASK.
92	ADVISE_ACTIVE	Enumerated list of advisory conditions within a device. All open bits are free to be used as appropriate for each specific device. This parameter is the Read Only copy of FD_MAINT_ACTIVE & FD_CHECK_ACTIVE.

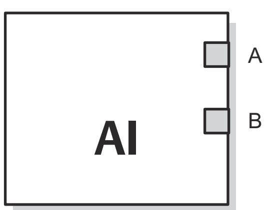
Table E-2: FD_SIMULATE elements

Index	Parameter	Data Type	Size	Description
1	Diagnostic Simulate Value	Bit string	4	Writable. Used for diagnostics when simulation is enabled
2	Diagnostic Value	Bit string	4	Current diagnostics detected by the device.
3	Enable	Unsigned 8	1	Enable/Disable simulation. Dynamic, so simulation will always be disabled after a device restart.

E.2 Analog-Input Block

E.2.1 Analog Input block system parameters

Figure E-1: Analog-Input Block



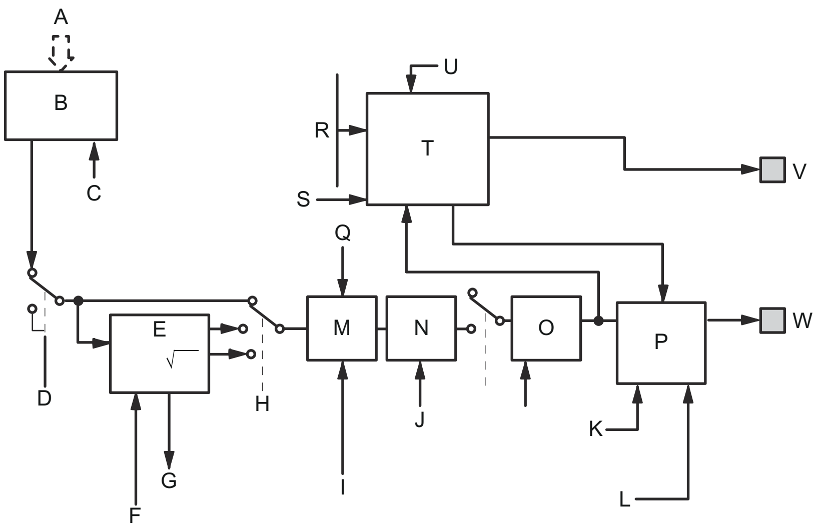
A. OUT_D = Discrete output that signals a selected alarm condition
B. OUT = The block output value and status

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.

Table E-3 lists the AI block parameters and their units of measure, descriptions, and index numbers.

Figure E-2: Analog Input Function Block Schematic



A. Analog Measurement
B. Access Analog Measurement
C. CHANNEL
D. SIMULATE
E. Convert
F. OUT_SCALE; XD_SCALE
G. FIELD_VAL
H. L_TYPE
I. IO_OPTS
J. PV_FTIME
K. MODE
L. STATUS_OPTS
M. Cutoff
N. Filter
O. PV
P. Status Calc.
Q. LOW_CUT
R. HI_HI_LIM; HI_LIM; LO_LO_LIM; LO_LIM
S. ALARM_HYS
T. Alarm Detection
U. ALARM_TYPE
V. OUT_D = discrete output that signals a selected alarm condition
W. OUT = block output value and status

Table E-3: Definitions of Analog Input Function Block System Parameters

Index Number	Parameter	Units	Description
01	ST_REV	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.
02	TAG_DESC	None	The user description of the intended application of the block.
03	STRATEGY	None	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
04	ALERT_KEY	None	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
05	MODE_BLK	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
06	BLOCK_ERR	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.
07	PV	EU of XD_SCALE	The process variable used in block execution.
08	OUT	EU of OUT_SCALE	The block output value and status.
09	SIMULATE	None	A group of data that contains the current transducer value and status, the simulated transducer value and status, and the enable/ disable bit.
10	XD_SCALE	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.
11	OUT_SCALE	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with OUT.
12	GRANT_DENY	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.
13	IO_OPTS	None	Allows the selection of input/output options used to alter the PV. Low cutoff enabled is the only selectable option.
14	STATUS_OPTS	None	Allows you to select option for status handling and processing.
15	CHANNEL	None	The CHANNEL value is used to select the measurement value. You must configure the CHANNEL parameter before you can configure the XD_SCALE parameter.
16	L_TYPE	None	Linearization type. Determines whether the field value is used directly (Direct) or is converted linearly (Indirect).
17	LOW_CUT	%	If percentage value of transducer input fails below this, PV = 0.
18	PV_FTIME	Seconds	The time constant of the first-order PV filter. It is the time required for a 63 percent change in the IN value.
19	FIELD_VAL	Percent	The value and status from the transducer block or from the simulated input when simulation is enabled.
20	UPDATE_EVT	None	This alert is generated by any change to the static data.

Table E-3: Definitions of Analog Input Function Block System Parameters *(continued)*

Index Number	Parameter	Units	Description
21	BLOCK_ALM	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.
22	ALARM_SUM	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.
23	ACK_OPTION	None	Used to set auto acknowledgment of alarms.
24	ALARM_HYS	Percent	The amount the alarm value must return within the alarm limit before the associated active alarm condition clears.
25	HI_HI_PRI	None	The priority of the HI HI alarm.
26	HI_HI_LIM	EU of PV_SCALE	The setting for the alarm limit used to detect the HI HI alarm condition.
27	HI_PRI	None	The priority of the HI alarm.
28	HI_LIM	EU of PV_SCALE	The setting for the alarm limit used to detect the HI alarm condition.
29	LO_PRI	None	The priority of the LO alarm.
30	LO_LIM	EU of PV_SCALE	The setting for the alarm limit used to detect the LO alarm condition.
31	LO_LO_PRI	None	The priority of the LO LO alarm.
32	LO_LO_LIM	EU of PV_SCALE	The setting for the alarm limit used to detect the LO LO alarm condition.
33	HI_HI_ALM	None	The HI HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
34	HI_ALM	None	The HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
35	LO_ALM	None	The LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
36	LO_LO_ALM	None	The LO LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
37	OUT_D	None	Discrete output to indicate a selected alarm condition.
38	ALARM_SEL	None	Used to select the process alarm conditions that will cause the OUT_D parameter to be set.
39	STDDEV	Percent	Standard deviation of the measurement.
40	CAP_STDDEV	Seconds	Capability standard deviation, the best deviation that can be achieved.

E.2.2 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.

E.2.3 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:

Table E-4: AI Block Channels

AI block	TB channel value	Process variable
Level	1	CHANNEL_RADAR_LEVEL
Ullage	2	CHANNEL_RADAR_ULLAGE
Level rate	3	CHANNEL_RADAR_LEVELRATE
Signal strength	4	CHANNEL_RADAR_SIGNAL_STRENGTH
Volume	5	CHANNEL_RADAR_VOLUME
Internal temperature	6	CHANNEL_RADAR_INTERNAL_TEMPERATURE
Upper product volume	7	CHANNEL_UPPER_PRODUCT_VOLUME
Lower product volume	8	CHANNEL_LOWER_ PRODUCT_VOLUME
Interface distance	9	CHANNEL_INTERFACE_ DISTANCE
Upper product thickness	10	CHANNEL_UPPER_ PRODUCT_THICKNESS
Interface level	11	CHANNEL_INTERFACE_LEVEL
Interface level rate	12	CHANNEL_INTERFACE_ LEVELRATE
Interface signal strength	13	CHANNEL_INTERFACE_ SIGNALSTRENGTH
Signal quality	14	CHANNEL_SIGNAL_QUALITY
Surface/noise margin	15	CHANNEL_ SURFACE_NOISE_MARGIN
Vapor DC	16	CHANNEL_VAPOR_DC

L_TYPE

The L_TYPE parameter defines the relationship of the transmitter measurement (level, distance, level rate, signal strength, volume, and average temperature) to the desired output of the AI block. The relationship can be direct or indirect root.

Direct Select direct when the desired output will be the same as the transmitter measurement (level, distance, level rate, signal strength, volume, and internal temperature).

Indirect Select indirect when the desired output is a calculated measurement based on the transmitter measurement (level, distance, level rate, signal strength, volume, and internal temperature). The relationship between the transmitter measurement and the calculated measurement will be linear.

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

XD_SCALE and OUT_SCALE

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

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

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

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

Engineering units

Note
To avoid configuration errors, only select engineering units for XD_SCALE and OUT_SCALE that are supported by the device.

Related information

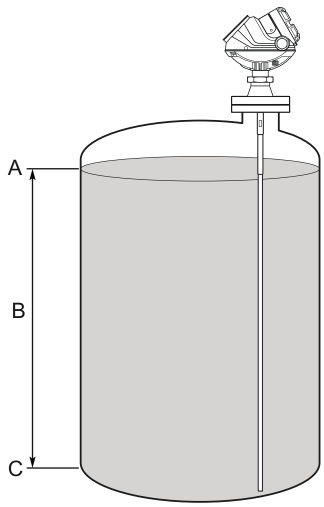
Supported units

Application example 1

Radar level transmitter, level value

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

Figure E-3: Situation Diagram



A. 100%
B. 33 ft. (10 m)
C. 0%

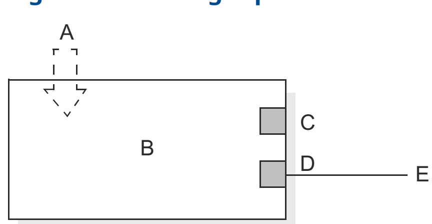
Solution

Table E-5 lists the appropriate configuration settings, and Figure E-4 illustrates the correct function block configuration.

Table E-5: 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 E-4: Analog Input Function Block Diagram for a Typical Level Transmitter



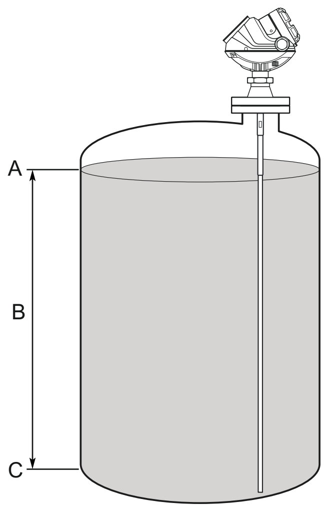
A. Level measurement
B. AI function block
C. OUT_D
D. OUT
E. To another function block

Application example 2

Radar level gauge, level value in percent (%)

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

Figure E-5: Situation Diagram



A. 100%
B. 46 ft. (14 m)
C. 0%

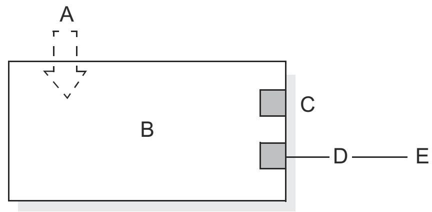
Solution

Table E-6 lists the appropriate configuration settings, and Figure E-6 illustrates the correct function block configuration.

Table E-6: 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 E-6: Function Block Diagram for a Level Transmitter Where Level Output is Scaled between 0-100%



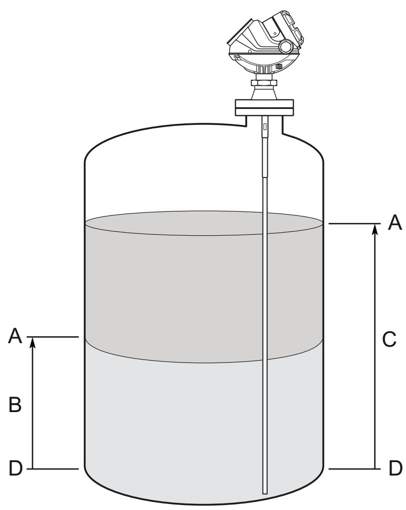
A. Level measurement - percent
B. AI function block
C. OUT_D
D. OUT
E. 0 to 100%

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 E-7: Situation Diagram



A. 100%
B. 10 ft. (3 m)
C. 33 ft. (10 m)
D. 0%

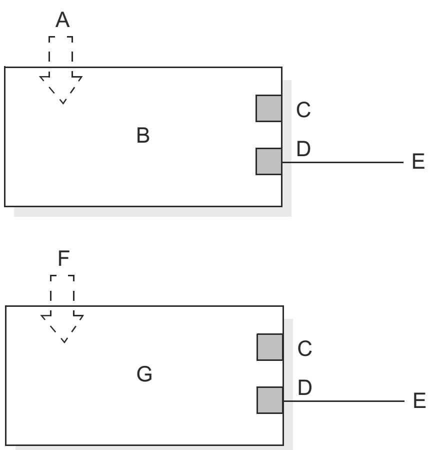
Solution

Table E-7 lists the appropriate configuration settings, and Figure E-8 illustrates the correct function block configuration.

Table E-7: 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 E-8: Analog Input Function Block Diagram for a Level and Interface Transmitter



A. Level measurement
B. AI function block (product level)
C. OUT_D
D. OUT
E. To another function block
F. Interface level measurement
G. AI function block (interface level)

E.2.4 Process alarms

Process Alarm detection is based on the OUT value. Configure the alarm limits of the following standard alarms:

- High (HI_LIM)
- High high (HI_HI_LIM)
- Low (LO_LIM)
- Low low (LO_LO_LIM)

To avoid alarm chattering when the variable is oscillating around the alarm limit, an alarm hysteresis in percent of the PV span can be set using the ALARM_HYS parameter.

The priority of each alarm is set in the following parameters:

- HI_PRI

- HI_HI_PRI
- LO_PRI
- LO_LO_PRI

Alarm priority

Alarms are grouped into five levels of priority:

Table E-8: Alarm 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.

E.2.5 Status options

Status Options (STATUS_OPTS) supported by the AI block are shown below.

Propagate fault forward If the status from the sensor is Bad, Device failure or Bad, Sensor failure, propagate it to OUT without generating an alarm. The use of these sub-status in OUT is determined by this option. Through this option, the user may determine whether alarming (sending of an alert) will be done by the block or propagated downstream for alarming.

Uncertain if limited Set the output status of the Analog Input block to Uncertain if the measured or calculated value is limited.

BAD if limited Set the output status to Bad if the sensor is violating a high or low limit.

Uncertain if Man mode Set the output status of the Analog Input block to Uncertain if the actual mode of the block is Man.

Note
The instrument must be in Out of Service mode to set the status option.

E.2.6 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.

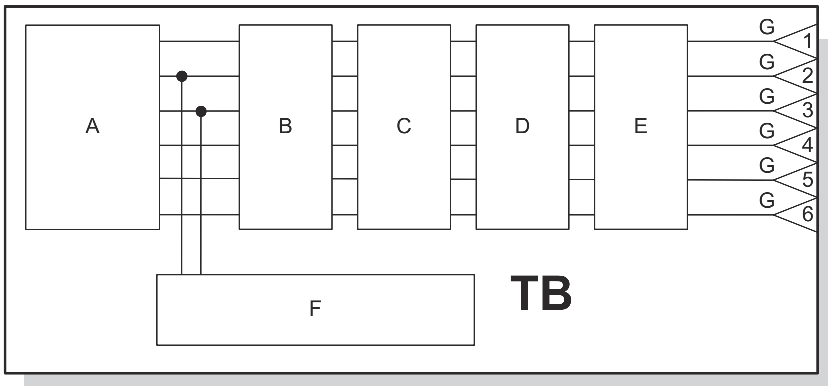
STD_DEV and CAP_STDDEV Diagnostic parameters that can be used to determine the variability of the process.

E.3 Level Transducer Block

E.3.1 Overview

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

Figure E-9: Transducer Block Diagram



A. Digital Signal Conversion
B. Linearization
C. Temperature Compensation
D. Damping
E. Units/Ranging
F. Diagnostics
G. Channel

Definition

The transducer block contains the actual measurement data, including a level and distance reading. Channels 1–16 are assigned to these measurements (see Figure E-9). 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 Level Transmitter are the following:

Table E-9: 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

Table E-9: Channel Assignments *(continued)*

Channel Name	Channel Number	Process variable
Lower Product Volume	8	CHANNEL_LOWER_ PRODUCT_VOLUME
Interface Distance	9	CHANNEL_INTERFACE_ DISTANCE
Upper Product Thickness	10	CHANNEL_UPPER_ PRODUCT_THICKNESS
Interface Level	11	CHANNEL_INTERFACE_LEVEL
Interface Level Rate	12	CHANNEL_INTERFACE_ LEVELRATE
Interface Signal Strength	13	CHANNEL_INTERFACE_ SIGNALSTRENGTH
Signal Quality	14	CHANNEL_SIGNAL_QUALITY
Surface/Noise Margin	15	CHANNEL_ SURFACE_NOISE_MARGIN
Vapor DC	16	CHANNEL_VAPOR_DC

E.3.2 Level transducer block parameters

Table E-10: Level Transducer Block Parameters and Descriptions

Index Number	Parameter	Description
1	ST_REV	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.
2	TAG_DESC	The user description of the intended application of the block.
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	MODE_BLK	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
6	BLOCK_ERR	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.
7	UPDATE_EVT	This alert is generated by any change to the static data.
8	BLOCK_ALM	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.
9	TRANSDUCER_DIRECTORY	Directory that specifies the number and starting indices of the transducers in the transducer block.
10	TRANSDUCER_TYPE	Identifies the transducer.
11	TRANSDUCER_TYPE_VER	Transducer type version
12	XD_ERROR	A transducer block alarm subcode.
13	COLLECTION_DIRECTORY	A directory that specifies the number, starting indices, and DD Item ID’s of the data collections in each transducer within a transducer block.
14	RADAR_LEVEL	Level
15	RADAR_LEVEL_RANGE	See Table E-21
16	RADAR_ULLAGE	Distance (Ullage)
17	RADAR_LEVELRATE	Level rate
18	RADAR_LEVELRATE_RANGE	See Table E-22
19	RADAR_LEVEL_SIGNAL_STRENGTH	Signal strength
20	RADAR_LEVEL_SIGNAL_STRENGTH_RANGE	See Table E-24

Table E-10: Level Transducer Block Parameters and Descriptions *(continued)*

Index Number	Parameter	Description
21	RADAR_VOLUME	Volume
22	RADAR_VOLUME_RANGE	See Table E-25
23	RADAR_INTERNAL_TEMPERATURE	Internal temperature
24	RADAR_INTERNAL_TEMPERATURE_RANGE	Range, unit and number of decimals
25	VOLUME_UPPER	The calculated volume value of the upper product at the current level and interface
26	VOLUME_LOWER	The calculated volume value of the lower product at the current interface
27	INTERFACE_DISTANCE	The distance to the interface (from the upper reference point).
28	UPPER_PRODUCT_THICKNESS	The thickness of the upper product (from the surface value to the interface value).
29	INTERFACE_LEVEL	The current interface level value (from the zero level reference point and up to the interface).
30	INTERFACE_LEVELRATE	The current velocity at which the interface is moving. A positive value indicates the interface is moving up.
31	INTERFACE_SIGNAL_STRENGTH	The current signal strength of the interface echo.
32	PROBE_TYPE	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.
33	PROBE_LENGTH	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.
34	PROBE_ANGLE	Defines the angle compared to the plumb line at which the device with probe is mounted (0°means that probe is mounted vertically).
35	PROBE_END_PULSE_POLARITY	This parameter is used for User Defined probes only. Contact Emerson™ Service Department for more information
36	PROBE_IMPEDANCE	This parameter is used for User Defined probes only. Contact Emerson Service Department for more information
37	TCL	This parameter is used for User Defined probes only. Contact Emerson Service Department for more information
38	PROPAGATION_FACTOR	This parameter is used for User Defined probes only. Contact Emerson Service Department for more information
39	REF_PULSE_AMPL	This parameter is used for User Defined probes only. Contact Emerson Service Department for more information
40	GEOM_TANK_HEIGHT	Tank height (R)
41	GEOM_HOLD_OFF_DIST	Hold off distance

Table E-10: Level Transducer Block Parameters and Descriptions *(continued)*

Index Number	Parameter	Description
42	VAPOR_DC	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
43	UPPER_PRODUCT_DC	Enter the Upper Product Dielectric Constant (DC) as dielectric accurate as possible. This value affects the accuracy of the interface level measurement
44	LOWER_PRODUCT_DC_RANGE	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
45	PRODUCT_DIELEC_RANGE	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
46	MEAS_MODE	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
47	DAMPING_VALUE	Damping value
48	GEOM_OFFSET_DIST	Distance offset
49	GEOM_CALIBRATION_DIST	Calibration distance
50	LCD_SETTINGS	Use quick startup mode
51	LCD_PARAMETERS	Parameters to show
52	LCD_LANGUAGE	Language on display
53	LCD_LENGTH_UNIT	Length unit on display
54	LCD_VOLUME_UNIT	Volume unit on display
55	LCD_TEMPERATURE_UNIT	Temperature unit on display
56	LCD_VELOCITY_UNIT	Velocity unit on display
57	MAX_INTERNAL_TEMPERATURE	The maximum temperature that has been measured inside the device during operation
58	MIN_INTERNAL_TEMPERATURE	The minimum temperature that has been measured inside the device during operation
59	OPERATION TIME	The total number of hours the device has been in operation
60	ENV_ENVIRONMENT	Process condition
61	ENV_PRESENTATION	Tank presentation
62	ENV_DEVICE_MODE	Service mode
63	ENV_WRITE_PROTECT	Write protect
64	DIAGN_DEV_ALERT	Errors, Warnings, Status, Plant web alerts
65	DIAGN_VERSION	Gauge SW version
66	DIAGN_REVISION	P1451 revision

Table E-10: Level Transducer Block Parameters and Descriptions *(continued)*

Index Number	Parameter	Description
67	DIAGN_DEVICE_ID	Device ID for the gauge.
68	DIAGN_DEVICE_MODEL	Type of 5300. LF or HF
69	STATS_ATTEMPTS	The total number of messages sent to the transducer A/D board
70	STATS_FAILURES	The total number of failed A/D board message attempts
71	STATS_TIMEOUTS	The total number of timed out A/D board message attempts
72	MAX_UPPER_PRODUCT_THICKNESS	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
73	MEAS_STATUS	Measurement status
74	INTERFACE_STATUS	Interface status
75	REMOTE_HOUSING	Select the length of the remote housing connection used in the installation.
76	MEAS_VAPOR_DC	Measured Vapor Dielectric Constant
77	SPEC_CONFIG_TNZ	Configure Trim Near Zone
78	SPEC_CONFIG_PEP	Configure Probe End Projection
79	SPEC_CONFIG_TANK_MATERIAL	Configure Tank Material
80	SPEC_CONFIG_VC	Configure Vapor Compensation
81	VC_WARNING	Vapor Compensation Warning
82	PEP_STATUS	Probe End Projection Status
83	TANK_MATERIAL	Tank material
84	SW_SUPPORT2	Defines what options are enabled in the device.
85	MOUNTING_TYPE	Mounting type
86	PIPE_DIAMETER	Inner diameter, pipe/chamber/nozzle
87	NOZZLE_HEIGHT	Nozzle height
88	DEVICE_HW_CONFIG	
89	DEVICE_STATUS	Device status
90	VOLUME_STATUS	Volume status
91	MWM_WARNING	Sweep dump active
92	MEAS_WARNING	Probe End Projection DC est limited
93	CONFIG_WARNING	Configuration warning
94	VAPOR_COMP_STATUS	Vapor Compensation Status
95	P1451_SLAVE_STATS	
96	P1451_HOST_STATS	

Table E-10: Level Transducer Block Parameters and Descriptions *(continued)*

Index Number	Parameter	Description
97	FF_SUPPORT_INFO	
98	SENSOR_DIAGNOSTICS	
99	HEART_BEAT_COUNT	

Table E-11: Probe Type

VALUE	PROBE_TYPE
0	User defined
1	Rigid Twin
2	Flexible Twin
3	Coaxial
4	Rigid Single 0.3 in. (8 mm)
5	Flexible Single
10	Coaxial HTHP
11	Coaxial HP/C
12	Rigid Single HTHP/HP 0.3 in. (8 mm)
13	Flexible Single HTHP
20	Rigid Single PTFE
21	Flexible Single PTFE
30	Rigid Single HP/C 0.3 in. (8 mm)
31	Flexible Single HP
32	Flexible Single PA
33	Rigid Single 0.5 in. (13 mm)
40	Rigid Single HTHP 0.5 in. (13 mm)
41	Rigid Single HP/C 0.5 in. (13 mm)
42	Large coaxial
43	Large coaxial HP/C

Table E-12: 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 E-13: Environment

Bit Number	Value of ENV_ENVIRONMENT	Description
2	0x00000004	Turbulent
3	0x00000008	Foam
28	0x10000000	Rapid Changes

Table E-14: Presentation

Bit Number	Value of ENV_PRESENTATION	Description
28	0x10000000	Do Not Use Full Tank State
2	0x00000002	Use 3300 Full and Empty Detect Areas
3	0x00000004	Disable PEP PE Sign Change Logic
8	0x00000100	Show Negative Level as Zero
10	0x00000400	Probe End Projection
11	0x00000800	Do Not Use Automatic PEP DC Estimation
12	0x00001000	Do Not Reject Possible Double Bounces
18	0x00040000	Use Jump Filter
22	0x00400000	Show Level below Probe End as Zero
23	0x00800000	Use Vapor Compensation
24	0x01000000	Calculate Signal Quality Metrics

Table E-15: LCD Parameters

Bit Number	Value of LCD_PARAMETERS	Description
28	0x10000000	Level
1	0x00000002	Distance
2	0x00000004	Level Rate
3	0x00000008	Signal Strength
4	0x00000010	Volume
5	0x00000020	Internal Temperature
6	0x00000040	Analog Out Current
7	0x00000080	Percent Of Range
8	0x00000100	Com Quality
9	0x00000200	Interface Level
10	0x00000400	Interface Distance
11	0x00000800	Interface Level Rate
12	0x00001000	Interface Signal Strength
13	0x00002000	Upper Product Thickness
14	0x00004000	Lower Volume
15	0x00008000	Upper Volume
16	0x00010000	Signal Quality
17	0x00020000	Surface Noise Margin
18	0x00040000	Vapor DC

Table E-16: Product Dielectrical Range

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

Table E-17: Measurement Mode

VALUE	MEAS_MODE
0	Liquid Product Level
1	Product Level and Interface Level
2	Solid Product Level
3	Interface Level with Submerged Probe

E.3.3 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 E-18 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 E-18. Start with the first corrective action and then try the second.

Table E-18: Device Errors Diagnostics

Bit Number	Value of DIAGN_DEV_ALERT	Description	Corrective action
	0	No alarm active	
0	0x00000001	Reserved	
1	0x00000002	FF card to gauge comm fault	Replace gauge
2	0x00000004	Level measurement failure	Verify device installation and configuration
3	0x00000008	Temperature measurement failure	Check ambient temperature. If ambient temperature ok replace the device.
4	0x00000010	Volume measurement failure	Check volume configuration
5	0x00000020	Database Error	Load default database to the device and reconfigure the device
6	0x00000040	HW Error	Replace device
7	0x00000080	Microwave Unit Error	Replace device
8	0x00000100	Configuration Error	Load default database to the device and reconfigure the device
9	0x00000200	SW Error	Replace device
10	0x00000400	Invalid Strap Table	Check the Strapping Table configuration
11	0x00000800	Internal Temp Warning	Check ambient temperature at installation site
12	0x00001000	Database Warning	Check the device configuration
13	0x00002000	HW Warning	Check device installation and configuration
14	0x00004000	Microwave Unit Warning	Check device installation and configuration
15	0x00008000	Configuration Warning	Check the device configuration
16	0x00010000	SW Warning	Check device installation and configuration
17	0x00020000	Simulation Mode	Use Simulation Method under advanced configuration tool to get the device out of Simulation Mode
18	0x00040000	Volume Range Warning	Verify Strapping Table
19	0x00080000	Software Write Protected	

Table E-18: Device Errors Diagnostics *(continued)*

Bit Number	Value of DIAGN_DEV_ALERT	Description	Corrective action
20	0x00100000	Vapor Compensation Not Calibrated	
21	0x00200000	Vapor DC Estimation Limited	
22	0x00400000	Reference Reflector Not Found	
23	0x00800000	BaseLine too low	
24	0x01000000	BaseLine too high	
25	0x02000000	Gain control	
26	0x04000000	Unsupported Combination of Functions	
27	0x08000000		
28	0x10000000		
29	0x20000000	Probe Missing	Check probe connection
30	0x40000000	Interface Measurement Failure	Check interface measurement configuration
31	0x80000000	Hardware Write Protected	

E.4 Register Transducer block parameters

The Register Transducer block allows access to Database registers and Input registers. 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 the Register Transducer block allows access to most registers, it should be handled with care and ONLY to be changed by trained and certified service personnel, or as guided by Emerson Automation Solutions support personnel.

Table E-19: Register Transducer Block Parameters

Index Number	Parameter	Description
1	ST_REV	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.
2	TAG_DESC	The user description of the intended application of the block.
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	MODE_BLK	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
6	BLOCK_ERR	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.
7	UPDATE_EVT	This alert is generated by any change to the static data
8	BLOCK_ALM	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.
9	TRANSDUCER_DIRECTORY	Directory that specifies the number and starting indices of the transducers in the transducer block.
10	TRANSDUCER_TYPE	Identifies the transducer.
11	TRANSDUCER_TYPE_VER	Transducer type version
12	XD_ERROR	A transducer block alarm sub code.
13	COLLECTION_DIRECTORY	A directory that specifies the number, starting indices, and DD Item ID’s of the data collections in each transducer within a transducer block.
14	RB_PARAMETER	

Table E-19: Register Transducer Block Parameters *(continued)*

Index Number	Parameter	Description
15-44	INP_REG_n_TYPE	Describes characteristics of input register n. Indicates requested value is displayed as a floating point (/ decimal) number.
	INP_REG_n_FLOAT	Input register n value, displayed as floating point number
	INP_REG_n_INT_DEC	Input register n value, displayed as decimal number
45-74	DB_REG_n_TYPE	Describes characteristics of holding register n. Indicates requested value is displayed as a floating point (/ decimal) number.
	DB_REG_n_FLOAT	Holding register n value, displayed as floating point number.
	DB_REG_n_INT_DEC	Holding register n value, displayed as decimal number.
75	RM_COMMAND	Defines what action to perform; Read Input/Holding Register, Restart Device, Poll Program Complete.
76	RM_DATA	RM_DATA is used by the configuration tool to read/write data from and to device.
77	RM_STATUS	Status of last executed command
78	INP_SEARCH_START_NBR	Input register search start number
79	DB_SEARCH_START_NBR	Holding register search start number

E.5 Advanced Configuration Transducer Block

E.5.1 Overview

The Advanced Configuration Transducer Block contains functions for the advanced configuration of the Rosemount™ 5300 Level 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.

E.5.2 Advanced configuration transducer block parameters

Table E-20: Advanced Configuration Transducer Block Parameters

Index Number	Parameter	Description
1	ST_REV	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.
2	TAG_DESC	The user description of the intended application of the block.
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	MODE_BLK	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
6	BLOCK_ERR	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.
7	UPDATE_EVT	This alert is generated by any change to the static data.
8	BLOCK_ALM	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.
9	TRANSDUCER_DIRECTORY	Directory that specifies the number and starting indices of the transducers in the transducer block.
10	TRANSDUCER_TYPE	Identifies the transducer. 100 = Standard pressure with calibration
11	TRANSDUCER_TYPE_VER	Transducer type version
12	XD_ERROR	A transducer block alarm subcode.

Table E-20: Advanced Configuration Transducer Block Parameters *(continued)*

Index Number	Parameter	Description
13	COLLECTION_DIRECTORY	A directory that specifies the number, starting indices, and DD Item ID's of the data collections in each transducer within a transducer block.
14	AMPLITUDE_THRESHOLD_CURVE	ATC: filters out weak disturbance echoes and noise.
15	SIMULATION_MODE	Simulation of measurement values.
16	SET_CONSTANT_THRESHOLD	A constant amplitude threshold can be used to filter out noise.
17	RADAR_LEVEL_RANGE	See Table E-21
18	RADAR_LEVEL_ SIGNAL_STR_RANGE	See Table E-24
19	RADAR_VOLUME_RANGE	See Table E-25
20	ENV_PRESENTATION	
21	PROBE_END_THRESH	This threshold is used to locate the probe end echo. The probe end echo is used by the device to know when the tank is empty, but is sometimes also useful when no surface echo can be found.
22	REFERENCE_THRESH	This threshold is used to locate the reference echo.
23	INTERFACE_THRESH	This threshold is used to block out disturbing echoes and noise when locating the interface echo.
24	FULL_TANK_THRESH_OFFSET	By adding an offset to the Reference Threshold it is possible for the device to determine when the tank is full. If the reference echo amplitude is between the Reference Threshold and the Full Tank Threshold then the tank is considered full.
25	PEP_PRODUCT_DC	Enter the product dielectric constant for the product in the tank.
26	AUTO_CONF_MEAS_FUNC	
27	ECHO_TIME_OUT	Change this parameter to define the time in seconds before the device should start to search for a surface echo after it has been lost.
28	CLOSE_DIST	This parameter defines a window centered at the current surface position where new surface echo candidates can be selected. The size of the window is +/-Close Distance. Echoes outside this window will not be considered as surface echoes.
29	USED_PROBE_END_THRESH	Probe End Threshold currently used in the device.
30	USED_REFERENCE_THRESH	Reference Threshold currently used in the device.
31	USED_INTERFACE_THRESH	Interface Threshold currently used in the device.
32	USED_TANK_PRESENTATION	
33	USED_ECHO_TIME_OUT	Echo Timeout currently used in the device.
34	USED_CLOSE_DIST	Close Distance currently used in the device.
35	SW_SUPPORT2	Defines what options are enabled in the device.
36	USED_HOLD_OFF_DIST	The Hold Off Distance/Upper Null Zone currently used in the device.

Table E-20: Advanced Configuration Transducer Block Parameters *(continued)*

Index Number	Parameter	Description
37	USED_PEP_PRODUCT_DC	Product Dielectric currently used in the device.
38	START_CODE	This code determines what options are available in your device. Do not change your Start Code unless you have received a valid one. Use Enter Start Codes method to change it.
39	UNIT_CODE	Unit code 1 -4 can be sent to your local Emerson™ representative in order to receive new Start Codes for upgrading your device.
40	ENV_SET_START_CODE	Set Start Code
41	PROBE_END_ANCHORING	Select if the probe end is anchored to the tank bottom or not.
42	PEP_PROBE_END_OFFSET	Probe end offset
43	USED_PEP_ PROBE_END_OFFSET	
44	VOL_VOLUME_CALC_METHOD	Choose what kind of volume calculation method to use.
45	VOL_IDEAL_DIAMETER	Diameter of the tank (only for ideal tank shapes).
46	VOL_IDEAL_LENGTH	Length/height of the tank (only for ideal tank shapes).
47	VOL_VOLUME_OFFSET	Use this parameter to add a volume to each calculated volume value. The volume can for instance correspond to a sump volume that you wish to add to your calculation.
48	VOL_STRAP_TABLE_LENGTH	Number of points to use in the strapping table.
49	VOL_STRAP_LEVEL	Strap value level 1-20 points
50	VOL_STRAP_VOLUME	Strap value volume 1-20 points
51	ECHO_UPDATE	
52	ECHO_FOUND_DISTANCE	Distance to found echo peaks
53	ECHO_FOUND_AMPLITUDE	Signal amplitude of found echo peaks
54	ECHO_FOUND_CLASS	Echo peak types
55	PEP_STATUS	Probe End Projection Status
56	PEP_PRODUCT_DC_LIMIT	Probe End Projection Dielectric Constant Limit
57	PROBE_END_PULSE_POLARITY	Probe End Pulse Polarity
58	USED_MAX_VAPOR_DC	
59	REF_REFLECTOR_TYPE	Reference Reflector Type
60	VAPOR_DC_FILTER_FACTOR	Vapor Dielectric Constant Filter Factor
61	SIGNAL_QUALITY	Product surface echo amplitude compared to surface threshold (ATC) and noise. Zero indicates a bad signal quality and 10 a good signal quality.
62	MIN_SIGNAL_QUALITY	Minimum signal quality since the last time Signal Quality Metrics were reset.
63	MAX_SIGNAL_QUALITY	Maximum signal quality since the last time 'Signal Quality Metrics' were reset.

Table E-20: Advanced Configuration Transducer Block Parameters *(continued)*

Index Number	Parameter	Description
64	TIME_SINCE_LAST_RESET	Operation time elapsed since the last time 'Signal Quality Metrics' were reset.
65	SURFACE_NOISE_MARGIN	Surface/Noise Margin
66	MIN_SURFACE_NOISE_MARGIN	Minimum Surface/Noise Margin
67	MAX_SURFACE_NOISE_MARGIN	Maximum Surface/Noise Margin
68	VAPOR_COMP_STATUS	Vapor Compensation Status
69	DEVICE_COMMAND	
70	DEVICE_COMMAND_STATUS	
71	RADAR_INTERNAL_TEMPERATURE_RANGE	
72	MAX_PRESSURE	
73	MAX_TEMPERATURE	
74	MAX_VAPOR_DC	Maximum Vapor Dielectric Constant
75	MEAS_STATUS	Measurement Status
76	CENTERING_DISC	Specify if there is any centering disc close to the probe end and what material that disc is made of.
77	PEP_TRIM_EMPTY_FAILURE	Probe End Projection - Trim Empty Failure
78	PEP_TRIM_FILL_FAILURE	Probe End Projection - Fill Failure
79	PEP_RAW_PRODUCT_DC_EST	Probe End Projection - Raw Product Dielectric Constant Estimation
80	PEP_RAW_DC_EST_USED_DISTANCE	
81	USE_PROBE_END_PROJECTION	Use Probe End Projection
82	USE_STATIC_PRODUCT_DC	Use Static Product Dielectric Constant
83	CALCULATE_SIGNAL_QUALITY_METRICS	Calculate Signal Quality Metrics
84	USE_VAPOR_COMPENSATION	Use Vapor Compensation
85	SPEC_CONFIG_PEP	Configure Probe End Projection
86	SPEC_CONFIG_VC	Configure Vapor Compensation
87	SIGNAL_QUALITY_ALERT_LIMIT	Alert limit for low Signal Quality
88	SURFACE_NOISE_MARGIN_ALERT_LIMIT	Alert limit for low Surface/Noise Margin

E.6 Supported units

Unit codes

Table E-21: Length Units

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

Table E-22: Level Rate Units

ID	Display	Description
1061	m/s	meter / second
1063	m/h	meter / hour
1067	ft/s	feet / second
1069	in/m	inch / minute

Table E-23: Temperature Units

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

Table E-24: Signal Strength Units

ID	Display	Description
1243	mV	millivolt

Table E-25: Volume Units

ID	Display	Description
1034	m^3	Cubic meter
1038	L	Liter
1042	in^3	Cubic inch
1043	ft^3	Cubic feet
1044	Yd^3	Cubic yard
1048	Gallon	US gallon
1049	ImpGall	Imperial gallon
1051	Bbl	Barrel

Table E-26: Time Units

ID	Display	Description
1054	s	Seconds

Table E-27: Percent

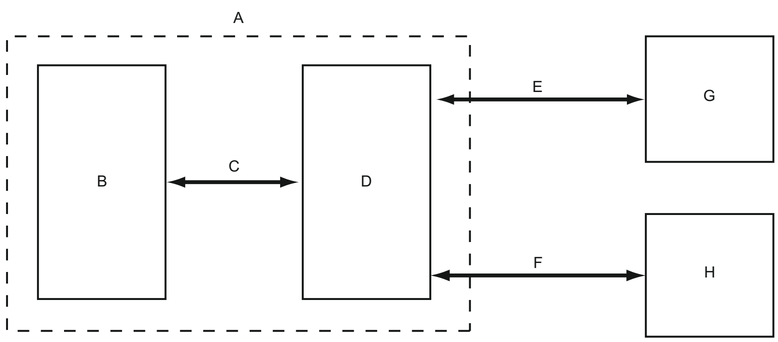
ID	Display	Description
1342	%	Percent

F HART® to Modbus® Converter (HMC) module

The Rosemount 5300 Level Transmitter is a Modbus compatible measurement device that supports communication with a Remote Terminal Unit (RTU) using a subset of read, write, and diagnostic commands used by most Modbus compatible host controllers. The transmitter also supports communication through Levelmaster and Modbus ASCII protocols.

The HART to Modbus Converter (HMC) module is located inside the Rosemount 5300 Level Transmitter enclosure and provides power to and communicates with the transmitter through a HART® interface.

Figure F-1: System Overview



A. *Rosemount 5300 enclosure*
B. *Rosemount 5300 electronics*
C. *HART signals*
D. *HART to Modbus Converter*
E. *Modbus and Levelmaster communication*
F. *HART signals*
G. *Remote Terminal Unit*
H. *Rosemount Radar Master/Handheld communicator*

During normal operation, the HMC "mirrors" the contents of process variables from the Rosemount 5300 Level Transmitter to the Modbus registers. To configure the Rosemount 5300 Level Transmitter, it is possible to connect a configuration tool to the HMC.

F.1 Workflow for commissioning a transmitter with Modbus® protocol

Procedure

1. Mount the transmitter on the tank.
2. Connect the power and communication wires.
3. Establish HART® communication with the transmitter. Do one of the following:
    - Connect to the MA/MB terminals (tunneling mode).
    - Connect to the HART terminals.

4. Configure the transmitter.
5. Configure the Modbus communication.
6. Configure Modbus host.
7. Verify output values as reported by the transmitter.

F.2 Modbus® communication protocol configuration

The Rosemount 5300 Level Transmitter can communicate with RTUs using Modbus RTU (often referred to as just "Modbus"), Modbus ASCII, and Levelmaster (also known as "ROS," "Siemens," or "Tank" protocol).

Table F-1: List of RTU Supported Protocols

RTU	Protocols
ABB Totalflow	Modbus RTU, Levelmaster
Bristol™ ControlWave™ Micro	Modbus RTU
Emerson ROC800 Series	Modbus RTU, Levelmaster(1)
Emerson FloBoss™ 107	Modbus RTU, Levelmaster(1)
Kimray® Inc. DACC™ 2000/3000	Levelmaster
ScadaPack	Modbus RTU
Thermo Electron Autopilot	Modbus RTU, Levelmaster

(1) *Levelmaster protocol should be used when using the Emerson Digital Level Sensor (DLS) User Program or Application Module together with the device. Use Modbus RTU in other cases.*

Modbus ASCII is not commonly used, since it doubles the amount of bytes for the same message as the Modbus RTU.

If you do not have any of these RTUs, check your RTU manual to see which protocols it supports.

F.2.1 Modbus® RTU communication setup

The Rosemount 5300 is configured with the default Modbus RTU address 246, and with the following Modbus RTU communication parameter default settings:

Table F-2: Modbus RTU Communication Parameters

Parameter	Default Value	Configurable Values
Baud Rate	9600	1200, 2400, 4800, 9600, 19200
Start Bits(1)	One	One
Data Bits(1)	Eight	Eight
Parity	None	None, Odd, Even
Stop Bits	One	One or Two
Address range	246	1-255

(1) *Start Bits and Data Bits cannot be changed.*

To reset the communication parameters to default Modbus RTU settings, use the following Modbus Message:

```
HMC
```

Modbus RTU parameter configuration

You want to use address 44 for the Rosemount 5300 Level Transmitter, and the following communication parameters are used by the host:

Table F-3: Communication Parameters Used by the Host (Example)

Parameter	Value
Baud Rate	4800
Start Bits	One
Data Bits	Eight
Parity	Odd
Stop Bits	Two

To configure the Rosemount 5300 Level Transmitter to communicate with the Host in this example, the following text string is written to the HART Slave 1 message area:

```
HMC A44 B4800 PO S2.
```

HMC These three letters are used for safety and will eliminate the risk of changing the configuration data by mistake.

A44 A indicates that the following number is the new address (address 44). Leading zeroes are not needed.

B4800 B indicates that the following number is the new baud rate (1200, 2400, 4800, 9600, 19200).

PO P identifies the following letter as parity type (O = odd, E = even, and N = none).

S2 S indicates that the following figure is the number of stop bits (1 = one, 2 = two).

Only values that differ from the current values need to be included. For example, if only the address is changed, the following text string is written into the 5300 (HART Slave 1) message area:

```
HMC A127,
```

indicates that 127 is the new address.

F.2.2 Levelmaster communication setup

The default and configurable parameter values can be found in Table F-4.

Table F-4: Levelmaster Communication Parameters

Parameter	Default value	Configurable value
Baud Rate	9600	1200, 2400, 4800, 9600, 19200
Start Bits	One	One
Data Bits	Seven	Seven, Eight
Parity	None	None, Odd, Even

Table F-4: Levelmaster Communication Parameters *(continued)*

Parameter	Default value	Configurable value
Stop Bits	One	One or Two
Address	1	1-99

To reset the communication parameters to default Levelmaster settings, use the following Modbus Message:

```
HMC M2
```

Levelmaster parameter configuration

You want to use address 2 for the Rosemount 5300 Level Transmitter and the host uses the following parameters:

Table F-5: Levelmaster Communication Parameters

Parameter	Value
Baud Rate	9600
Start Bits	One
Data Bits	Seven
Parity	None
Stop Bits	One

To configure the Rosemount 5300 Level Transmitter to communicate with the host in this example, the following text string is written to the Modbus message area:

```
HMC M2 A2 B9600 D7 PN S1.
```

Note
Include all the parameters when writing to the message area.

Note that an address must be unique on the bus.

HMC These three letters are used for safety and will eliminate the risk of changing the configuration data by mistake.

M2 This means that the Levelmaster protocol is to be used.

A2 A indicates that the following is the new address (address 2). Leading zeroes are not needed.

B9600 B indicates that the following number is the new baud rate (1200, 2400, 4800, 9600, 19200).

D7 D indicates that the following data bits are to be used (7 = seven, 8 = eight).

PN P identifies the following letter as parity type (O = odd, E = even, and N = none).

S1 S indicates that the following figure is the number of stop bits (1 = one, 2 = two).

Note
Start bits are not configurable and cannot be set.

Implemented Levelmaster functions

See Table F-6 for a description of the implemented Levelmaster functions in the HMC.

Table F-6: Implemented Functions of Levelmaster Protocol

Input format	Description	Output format
UnnN?	Return ID number	UnnNnnCcccc
UnnNmm	Set ID number	UnnNOKCcccc
UnnF?	Return number of floats	UnnFxCcccc
UnnFx?	Set number of floats	UnnFOKCcccc
Unn?	Return floats and other data	UnnDddd.ddFfffEeeeeWwwwCcccc(1)

(1) *In this case, number of floats is set to 1. If number of floats is set to 2, the Output Format would be: UnnDddd.ddDddd.ddFfffEeeeeWwwwCcccc*

Note
If one float is sent, it is "Float1". If two floats are sent, it is "Float 1" before "Float 0".

Table F-7: Letters and Expressions

Letter	Description
nn	nn is used to identify slave to respond; nn is a number 00-99 or ** (wildcard). The EmulCtrl Address Holding register can be configured to a higher value than 99. In that case, the address will be truncated to 99.
mm	mm is the new ID number for the slave; mm is a number 00-99.
x	x is the number of floats returned when slave receives Unn?, x is a number 0-2.
cccc	Is the 16 bit CRC checksum, cccc are hexadecimal characters.
ddd.dd	ddd.dd is the distance value from slave 1. Note that the first d can also be a '-' (minus).
Float 1	Slave 1 PV.
Float 0	Slave 1 SV.
fff	The temperature value. Configured by Holding Register 3208 in HMC.(1)
eeee	An error value. Bit 0: Invalid SV value (Float 0). Bit 8: Invalid Temperature value. Bit 12: Invalid PV value (Float 1).
Wwww	A warning value, not used in this implementation.

(1) *Any of the four available variables from any of the five HART slaves can be selected as the temperature source. The least four significant bits (bit 0-3) select the variable number. Bits 4-7 select the HART slave address. If invalid values are used, the temperature value will be invalid, with no Error bit set. For example, if we want to use FV from HART Slave 3 as temperature source, we have to write the value 34 Hex (52 decimal).*

F.2.3 Modbus ASCII communication setup

The parameter, default, and configurable values are shown in Table F-8.

Table F-8: Modbus ASCII Communication Parameters

Parameter	Default value	Configurable values
Baud Rate	9600	1200, 2400, 4800, 9600, 19200
Start Bits	One	One
Data Bits	Seven	Seven, Eight
Parity	None	None, Odd, even
Stop Bits	One	One or Two
Address	1	1-255

To reset the communication parameters to default Modbus ASCII settings, use the following Modbus message:

```
HMC M1
```

Modbus ASCII parameter configuration

You want to use address 246 for the Rosemount 5300 Level Transmitter and the host uses the following parameters:

Table F-9: Parameters Used by the Host (In Case of Modbus ASCII, Example)

Parameter	Value
Baud Rate	9600
Start Bits	One
Data Bits	Seven
Parity	None
Stop Bits	One

To configure the Rosemount 5300 Level Transmitter to communicate with the host in this example, the following text string is written to the Modbus message area:

```
HMC M1 A246 B9600 D7 PN S1.
```

Note
Include all the parameters when writing to the message area.

Note that an address must be unique on the bus.

HMC These three letters are used for safety and will eliminate the risk of changing the configuration data by mistake.

M1 This means that the Modbus ASCII protocol is to be used.

A246 A indicates that the following number is the new address (address 246). Leading zeroes are not needed.

B9600 B indicates that the following number is the new baud rate (1200, 2400, 4800, 9600, 19200).

D7 D indicates that the following data bits are to be used (7 = seven, 8 = eight).

PN P identifies the following letter as parity type (O = odd, E = even, and N = none).

S1 S indicates that the following figure is the number of stop bits (1 = one, 2 = two).

Note
Start bits are not configurable and cannot be set.

F.3 Common Modbus® host configuration

When using Modbus RTU or Modbus ASCII, the registers to receive status and variables must be configured in the host system.

The transmission of single-precision (4 bytes) IEEE 754 floating point numbers can be rearranged in different byte orders specified by the Floating Point Format Code. The format code information, stated for each Remote Terminal Unit (RTU) respectively, specifies which registers to poll from the Rosemount 5300 Level Transmitter in order for the RTU to correctly interpret floating point numbers. The byte transmission order for each format code is demonstrated in Table F-10.

Table F-10: Byte Transmission Order is Specified by the Floating Point Format Code

Format Code	Byte transmission order	Description
0	[AB] [CD]	Straight word order, most significant byte first
1	[CD] [AB]	Inverse word order, most significant byte first
2	[DC] [BA]	Inverse word order, least significant byte first
3	[BA] [DC]	Straight word order, least significant byte first

Note
Some Modbus hosts cannot read the information described here using Input Registers (Modbus function code 4). The Input Register information can also be read using Holding Register (Function code 3). In this case, Input Register number + 5000 is used as Holding Register number.

Between host system and device, it is recommended to use 60 seconds or less between polls, and three retries.

F.3.1 Input registers

The register area starting with 1300 can be configured to have any of the four format codes. The configuration is done by setting FloatingPointFormatCode register (holding register 3000) to 0-3. This configuration can be done with the Rosemount Radar Master program.

Note
Depending on the slave number the Rosemount 5300 Level Transmitter is using, different registers must be used with the default slave number being 1. Slave number is determined by the HART address.

Table F-11: Output Variables for the Configurable Floating Point Format (Default Code 1)

Register Name	Register Number	Note
Slave 1 Status Conf	1300	Bit information in bitfield. Bit 0: Invalid Measurement Slave 1 PV. Bit 1: Invalid Measurement Slave 1 Non PV. Bit 2: Invalid Measurement Slave 1 Non PV. Bit 3: Invalid Measurement Slave 1 Non PV. Bit 14: HART bus busy (slave in burst or other master present) Bit 15: HTM Task not running (option not available). **Note** Bit 1-3 is set when Invalid Measurement of Slave 1 Non PV. i.e. all three bits are set simultaneously.
Slave 1 PV Conf	1302	Primary variable from slave 1 represented in IEEE 754 format, using the byte order set in the FloatingPointFormatCode register.
Slave 1 SV Conf	1304	Secondary variable from slave 1 represented in IEEE 754 format, using the byte order set in the FloatingPointFormatCode register.
Slave 1 TV Conf	1306	Tertiary variable from slave 1 represented in IEEE 754 format, using the byte order set in the FloatingPointFormatCode register.
Slave 1 FV Conf	1308	Fourth variable from slave 1 represented in IEEE 754 format, using the byte order set in the FloatingPointFormatCode register.
Slave 2 data	1310-1318	Same data as for Slave 1.
Slave 3 data	1320-1328	Same data as for Slave 1.
Slave 4 data	1330-1338	Same data as for Slave 1.
Slave 5 data	1340-1348	Same data as for Slave 1.

The Rosemount 5300 Level Transmitter register area starting with register 2000 is used for hosts that require Floating Point Format Code 0 (see Table F-12).

Table F-12: Output Variables for Floating Point Format Code 0

Register Name	Register Number	Note
Slave 1 Status	2000	Bit information in bitfield: Bit 0: Invalid Measurement Slave 1 PV. Bit 1: Invalid Measurement Slave 1 SV. Bit 2: Invalid Measurement Slave 1 TV. Bit 3: Invalid Measurement Slave 1 FV. Bit 14: HART bus busy (slave in burst or other master present) Bit 15: HTM Task not running (option not available). **Note** Bit 1-3 is set when Invalid Measurement of Slave 1 Non PV, i.e. all three bits are set simultaneously.
Slave 1 PV	2002	Primary variable from slave 1 represented in IEEE 754 format, using Floating Point Format Code 0.
Slave 1 SV	2004	Secondary variable from slave 1 represented in IEEE 754 format, using Floating Point Format Code 0.
Slave 1 TV	2006	Tertiary variable from slave 1 represented in IEEE 754 format, using Floating Point Format Code 0.
Slave 1 FV (QV)	2008	Fourth variable from slave 1 represented in IEEE 754 format, using Floating Point Format Code 0.

Floating Point Format Codes 2 and 3 use register areas 2100 and 2200, respectively (see Table F-13 and Table F-14).

Table F-13: Output Variables for Floating Point Format Code 2

Register Name	Register Number	Note
Slave 1 Status	2100	Bit information in bitfield: Bit 0: Invalid Measurement Slave 1 PV. Bit 1: Invalid Measurement Slave 1 SV. Bit 2: Invalid Measurement Slave 1 TV. Bit 3: Invalid Measurement Slave 1 FV. Bit 14: HART bus busy (slave in burst or other master present) Bit 15: HTM Task not running (option not available). **Note** Bit 1-3 is set when Invalid Measurement of Slave 1 Non PV, i.e. all three bits are set simultaneously.
Slave 1 PV	2102	Primary variable from slave 1 represented in IEEE 754 format, using Floating Point Format Code 2.
Slave 1 SV	2104	Secondary variable from slave 1 represented in IEEE 754 format, using Floating Point Format Code 2.
Slave 1 TV	2106	Tertiary variable from slave 1 represented in IEEE 754 format, using Floating Point Format Code 2.
Slave 1 FV (QV)	2108	Fourth variable from slave 1 represented in IEEE 754 format, using Floating Point Format Code 2.

Table F-14: Output Variables for Floating Point Format Code 3

Register Name	Register Number	Note
Slave 1 Status	2200	Bit information in bitfield: Bit 0: Invalid Measurement Slave 1 PV. Bit 1: Invalid Measurement Slave 1 SV. Bit 2: Invalid Measurement Slave 1 TV. Bit 3: Invalid Measurement Slave 1 FV. Bit 14: HART bus busy (slave in burst or other master present) Bit 15: HTM Task not running (option not available). **Note** Bit 1-3 is set when Invalid Measurement of Slave 1 Non PV, i.e. all three bits are set simultaneously.
Slave 1 PV	2202	Primary variable from slave 1 represented in IEEE 754 format, using Floating Point Format Code 3.
Slave 1 SV	2204	Secondary variable from slave 1 represented in IEEE 754 format, using Floating Point Format Code 3.
Slave 1 TV	2206	Tertiary variable from slave 1 represented in IEEE 754 format, using Floating Point Format Code 3.
Slave 1 FV (QV)	2208	Fourth variable from slave 1 represented in IEEE 754 format, using Floating Point Format Code 3.

F.3.2 Measurement units

Measurement units for the various HART slaves are stored in input registers as a Unit Code presented in Table F-15.

Table F-15: Measurement Units and Corresponding Input Registers

Register Name	Register Number
Slave 1 PV Units	104
Slave 1 SV Units	108
Slave 1 TV Units	112
Slave 1 FV (QV) Units	116

Conversion from Unit Code to measurement unit is given in Table F-16.

Table F-16: Conversion of Unit Code to Measurement Unit

Measurement	Unit Code	Measurement Unit
Volume	40	US Gallon
	41	Liters
	42	Imperial Gallons
	43	Cubic Meters
	46	Barrels
	111	Cubic Yards
	112	Cubic Feet
	113	Cubic Inches
Length	44	Feet
	45	Meters
	47	Inches
	48	Centimeters
	49	Millimeters
Temperature	33	Degree Fahrenheit
	32	Degree Celsius

F.4 Specific Modbus® host configuration

The Remote Terminal Unit needs to be configured to communicate and correctly interpret data when reading input registers from the Rosemount 5300 Level Transmitter.

Baud rate

The specified Baud Rates are recommendations. If other Baud Rates are used, make sure the Rosemount 5300 Level Transmitter and the RTU are configured for the same communication speed.

Floating point format code

See Common Modbus® host configuration.

RTU data type

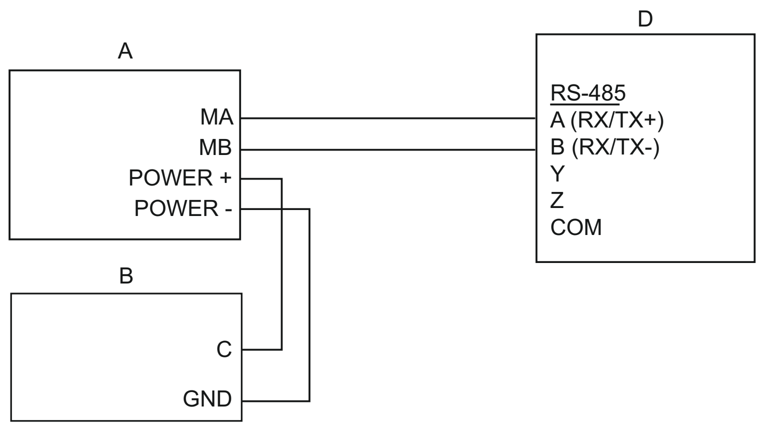
The RTU data type specifies which configuration to use in the RTU in order for the RTU to correctly interpret a floating point number transmitted from the Rosemount 5300 Level Transmitter with Modbus.

Input register base number

Data registers in the Rosemount 5300 Level Transmitter with Modbus are numbered exactly as they are transmitted in the Modbus communication. Some RTUs use different naming conventions and to configure the RTU to poll the correct registers from the Rosemount 5300 Level Transmitter Modbus, an Input Register Base Number is stated for each RTU respectively. For example, if the input register base number is 1 for the RTU, the Rosemount 5300 Level Transmitter Modbus input register 1302 has to be entered in the RTU address as input register 1303.

F.4.1 Emerson ROC800 Series

Figure F-2: Wiring Diagram for Connecting Rosemount 5300 Modbus to Emerson ROC800 Series



A. Rosemount 5300 Modbus
B. Power supply
C. + 8 to + 30 Vdc (max. rating)
D. ROC800 Series

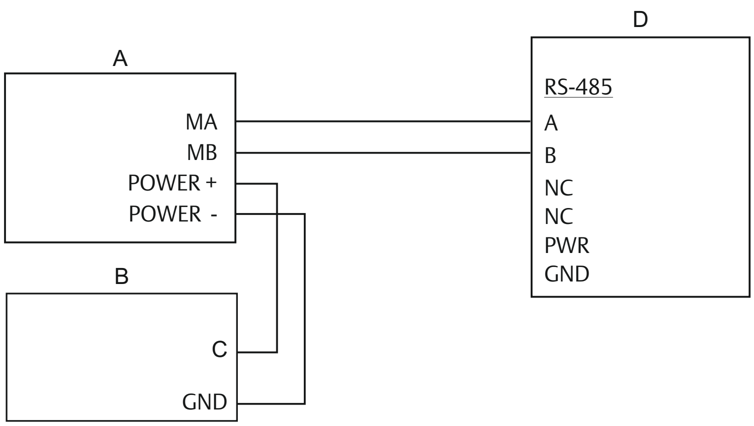
Table F-17: Parameter Values (In Case of Emerson ROC800 Series)

Parameter	Value
Baud Rate	9600
Floating Point Format Code	0
RTU Data Type	Conversion Code 66
Input Register Base Number	0

The Input Register Base Number needs to be added to the Input Register address of the Rosemount 5300 Level Transmitter. In this case, register 1300 needs to have 1300 entered as the address.

F.4.2 Emerson FloBoss 107

Figure F-3: Wiring Diagram for Connecting Rosemount 5300 Modbus to Emerson FloBoss 107



A. Rosemount 5300 Modbus
B. Power supply
C. + 8 to + 30 Vdc (max. rating)
D. FloBoss 107

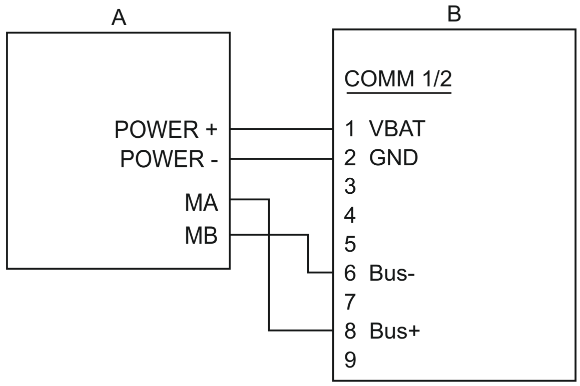
Table F-18: Parameter Values (In Case of Emerson FloBoss 107)

Parameter	Value
Baud Rate	9600
Floating Point Format Code	0
RTU Data Type	Conversion Code 66
Input Register Base Number	0

The Input Register Base Number needs to be added to the Input Register address of the Rosemount 5300 Level Transmitter. In this case, register 1300 needs to have 1300 entered as the address.

F.4.3 ABB TotalFlow

Figure F-4: Wiring Diagram for Connecting Rosemount 5300 Modbus to ABB TotalFlow



A. Rosemount 5300 Modbus
B. TOTALFLOW

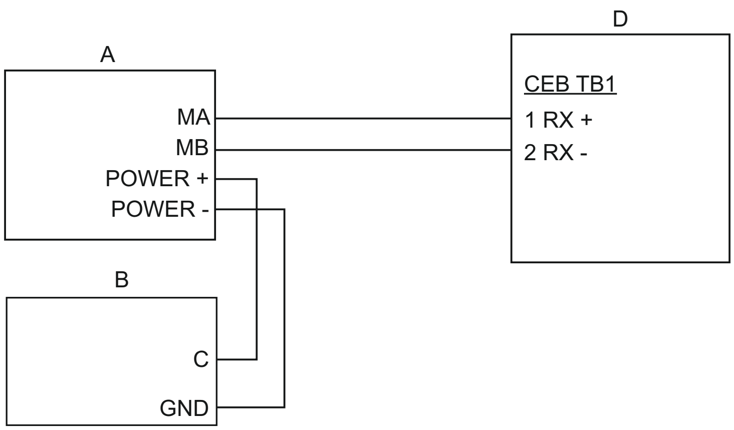
Table F-19: Parameter Values (In Case of ABB TotalFlow)

Parameter	Value
Baud Rate	9600
Floating Point Format Code	0
RTU Data Type	16 Bit Modicon
Input Register Base Number	1

The Input Register Base Number needs to be added to the Input Register address of the Rosemount 5300 Level Transmitter. In this case, register 1302 needs to have 1303 entered as the address etc.

F.4.4 Thermo Electron Autopilot

Figure F-5: Wiring Diagram for Connecting Rosemount 5300 Modbus to Thermo Electron Autopilot



A. Rosemount 5300 Modbus
B. Power supply
C. + 8 to + 30 Vdc (max. rating)
D. AutoPILOT

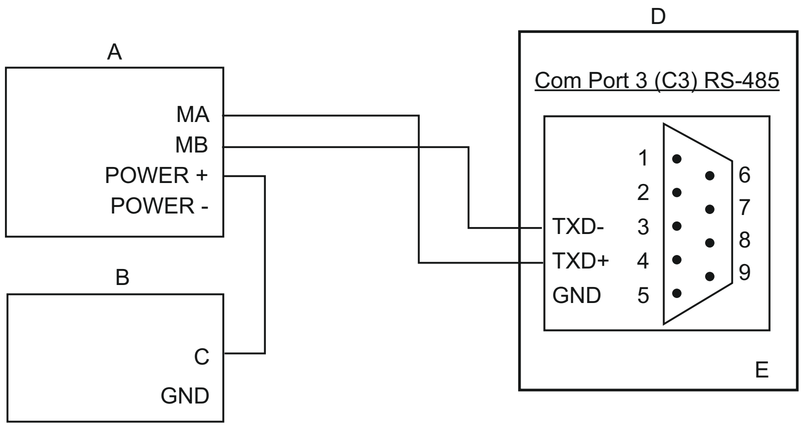
Table F-20: Parameter Values (In Case of Thermo Electron Autopilot)

Parameter	Value
Baud Rate	9600
Floating Point Format Code	1
RTU Data Type	IEEE Flt 2R
Input Register Base Number	0

The Input Register Base Number needs to be added to the Input Register address of the Rosemount 5300 Level Transmitter. In this case, register 1302 needs to have 1302 entered as the address etc.

F.4.5 Bristol ControlWave Micro

Figure F-6: Wiring Diagram for Connecting Rosemount 5300 Modbus to Bristol ControlWave Micro



A. Rosemount 5300 Modbus
B. Power supply
C. + 8 to + 30 Vdc (max. rating)
D. ControlWave Micro
E. DB9 Male

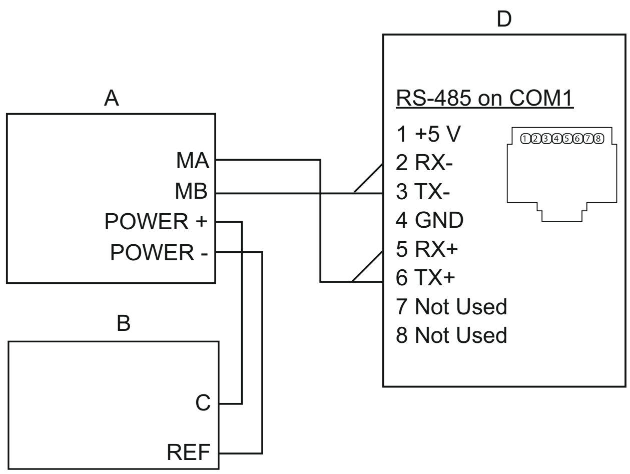
Table F-21: Parameter Values (In Case of Bristol ControlWave Micro)

Parameter	Value
Baud Rate	9600
Floating Point Format Code	2 (FC 4)
RTU Data Type	32-bit registers as 2 16-bit registers
Input Register Base Number	1

The Input Register Base Number needs to be added to the Input Register address of the Rosemount 5300 Level Transmitter. In this case, register 1302 needs to have 1303 entered as the address etc.

F.4.6 ScadaPack

Figure F-7: Wiring Diagram for Connecting Rosemount 5300 Modbus to SCADAPack 32



A. Rosemount 5300 Modbus
B. Power supply
C. + 8 to + 30 Vdc (max. rating)
D. SCADAPack32

Table F-22: Parameter Values (In Case of SCADAPack 32)

Parameter	Value
Baud Rate	9600
Floating Point Format Code	0
RTU Data Type	Floating Point
Input Register Base Number	30001

The Input Register Base Number needs to be added to the Input Register address of the Rosemount 5300 Level Transmitter. In this case, register 1302 needs to have 31303 entered as the address etc.

F.4.7 Kimray Inc. DACC 2000/3000

Table F-23 shows input types in Kimray Inc. IMI software and the corresponding value. The communication port must be configured to use “Tank Levels” protocol.

Table F-23: Kimray Inc. Input Types and Corresponding Values

Kimray Inc. Input Type	Rosemount 5300 Variable	Format
Tank Level1	PV	ddd.dd.alt. -dd.dd
Tank Level2	SV	ddd.dd.alt -dd.dd

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