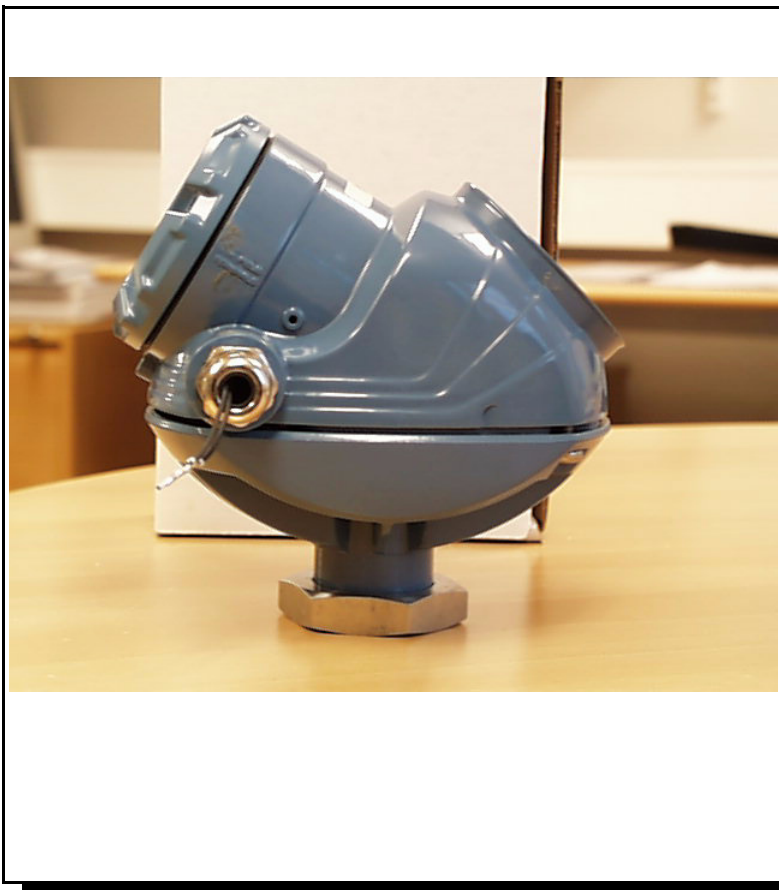


Rosemount 5400 Series

Subtitle



Rosemount 5400 Series

Rosemount 5400 Series

NOTICE

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

Within the United States, Rosemount Inc. has two toll-free assistance numbers.

Customer Central: 1-800-999-9307 (7:00 a.m. to 7:00 p.m. CST)

Technical support, quoting, and order-related questions.

North American Response Center:

Equipment service needs.

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

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

⚠ CAUTION

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

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

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

This product is designed to meet FCC and R&TTE requirements for a non-intentional radiator.

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

Rosemount 5400 Series Radar Transmitter may be protected by one or more U.S. Patents pending and foreign patents pending.

Rosemount and the Rosemount logotype are registered trademarks of Rosemount Inc.

HART is a registered trademark of the HART Communication Foundation.

Teflon, VITON, and Kalrez are registered trademarks of E.I. du Pont de Nemours & Co.

Asset Management Solutions is a trademark of Emerson Process Management.

Cover Photo: xx

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SAFETY MESSAGES

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

⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Explosions could result in death or serious injury.

- Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a HART®-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Electrical shock could cause death or serious injury.

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

⚠ WARNING

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

Rosemount 5400 Series

MANUAL OVERVIEW

This manual provides installation, configuration and maintenance information for the Rosemount 5400 Series Radar Transmitter.

Section 2: Transmitter Overview

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

Section 3: Installation

- Mounting considerations
- Mechanical installation
- Electrical installation

Section 4: Operation

- Display panel
- Configuration tool Rosemount Radar Master
- AMS
- 275/375 communicator

Section 5: Configuration/Start-Up

- Configuration instructions
- Configuration using the HART Communicator
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- Features
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Theory of Operation	page 2-1
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Antenna Selection Guide/Measuring Range	page 2-5
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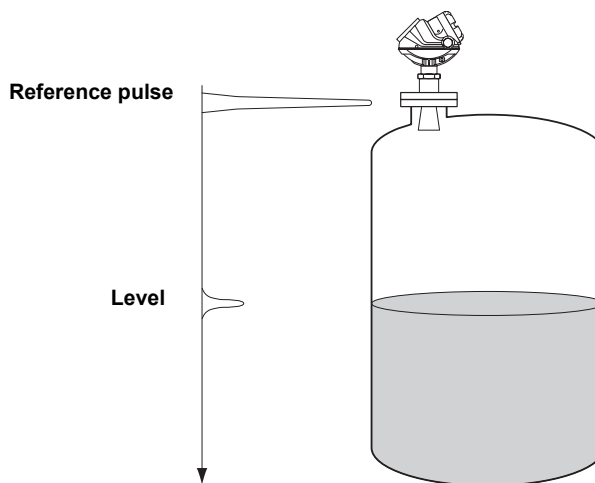
THEORY OF OPERATION

The Rosemount 5400 Series Radar Transmitter is a smart, two-wire continuous level transmitter that is based on Time Domain Reflectometry (TDR) principles. A 5400 transmitter is installed at the tank top. It emits short microwave pulses towards the product surface in the tank. When a pulse reaches the surface of the material it is measuring, part of the energy is reflected back to the antenna for subsequent processing by the transmitter electronics. The time difference between the generated and reflected pulse is detected by a micro-processor and is converted into a distance from which the total level or interface level is calculated (see below). The measured distance is often referred to as the Ullage.

The product level is calculated by using the following relation between tank height and Ullage:

$$\text{Level} = \text{Tank Height} - \text{Ullage}.$$

Figure 2-1. Measurement principle for the 5400 Series.



TDR_PRINCIPLES(2).EPS

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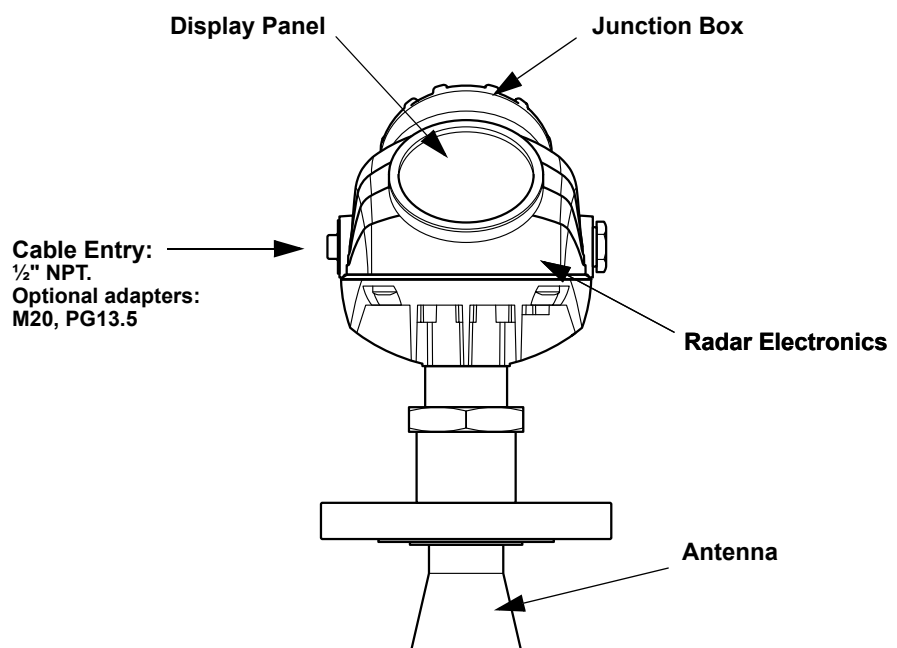
COMPONENTS OF THE TRANSMITTER

The Rosemount 5400 Series Radar Transmitter has an aluminum *transmitter housing* which contains advanced electronics for signal processing.

The *radar electronics* produces an electromagnetic pulse that is emitted through the antenna.

There are different antenna types and sizes available for various applications.

Figure 2-2. Transmitter components.



TRANSMITTER_COMPONENTS.EPS

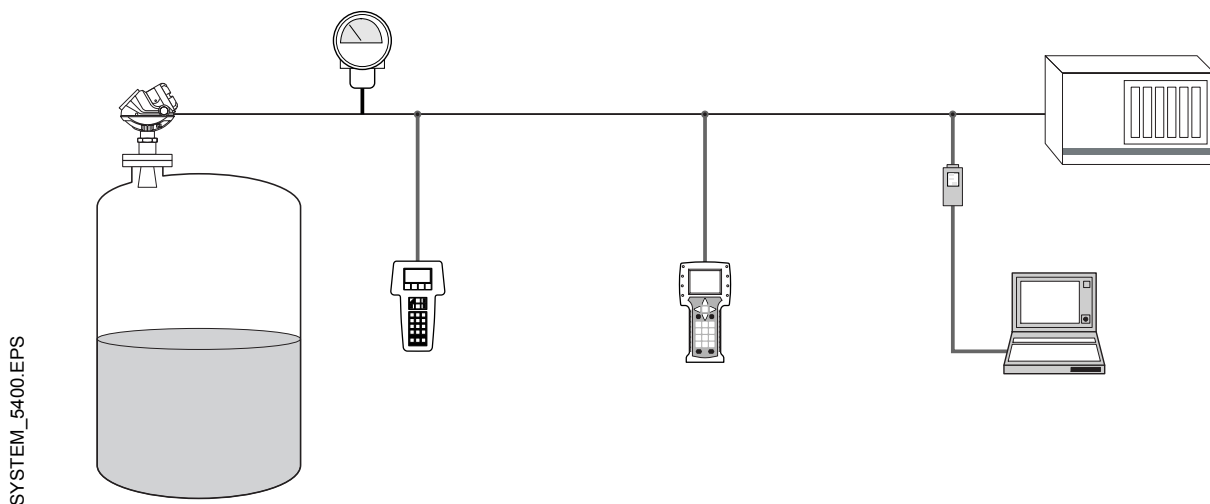
Rosemount 5400 Series

SYSTEM ARCHITECTURE

The 5400 Series Radar Level Transmitter is a powerful radar level transmitter suitable for non-contact level measurements in process tanks and other types of tanks. It is designed for easy installation and maintenance free operation.

The Rosemount 5400 Series Radar Transmitter is loop-powered which means it uses the same two wires for both power supply and output signal. The output is a 4-20 mA analog signal superimposed with a digital HART signal.

Figure 2-3. System Integration



If HART technology is used the Rosemount 5400 Series Radar Transmitter can easily be configured by using a PC and the Radar Master software package or via a hand held HART 275/375 Communicator. Radar Master offers configuration and service capabilities and functions for presentation of measurement data. The transmitter is also compatible with the AMS™ (Asset Management Solutions™) software which can be used for configuration.

For stand-alone systems, or as a complement to a PC or a control system, you can monitor level data using an analog output. As an option, your Model 5400 Radar Level Transmitter can be equipped with an easy-to-use Display Panel for monitoring measurement data.

Rosemount 5400 Series

PROCESS CHARACTERISTICS

Dielectric constant

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

Foam

How well the Rosemount 5400 Series Radar Transmitter measures in foamy applications depends upon the properties of the foam; light and airy or dense and heavy, high or low dielectrics, etc. If the foam is conductive and creamy the transmitter will probably measure the surface of the foam. If the foam is less conductive the microwaves will probably penetrate the foam and measure the liquid surface.

Stämmer detta för 5400?

Turbulence

A calm surface gives better reflection than a turbulent surface. For extremely turbulent applications the Low Frequency version of the 5400 transmitter is recommended.

Temperature/Pressure

?

Vapor

In some applications, as ammonia, there is heavy vapor above the product surface that will influence the level measurement. The Rosemount 5400 Series Radar Transmitter can be configured to compensate for the influence of vapor.

Condensation

For applications where condensation may occur the Low Frequency version of the 5400 transmitter is recommended.

Tank Characteristics

The conditions inside the tank have a significant impact on measurement performance. For more information see "Vessel Characteristics" on page 3-8.

Rosemount 5400 Series

ANTENNA SELECTION GUIDE/MEASURING RANGE

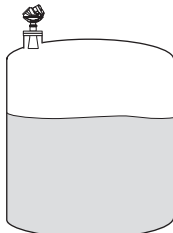
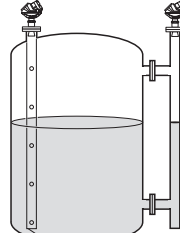
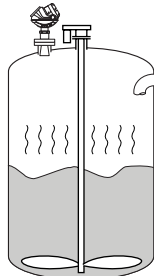
The measuring range depends on the antenna type and size, the dielectric constant (ϵ_r) of the liquid and process conditions. For optimum performance, make sure not to exceed the maximum measuring range values below. The first table shows values for the high frequency (HF) transmitter and the second table gives the low frequency (LF) transmitter values.

A: LPG/LNG, ammonia, solids...??? (dielectric constant $\epsilon_r = 1.4-1.9$).
Pipe installations only?

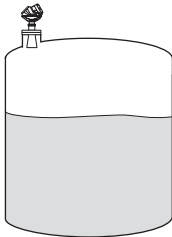
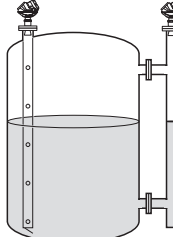
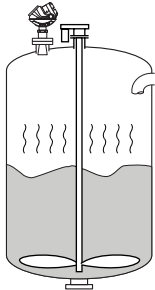
B: Oil, gasoline and other hydrocarbons, petrochemicals ($\epsilon_r = 1.9-4.0$)

C: Alcohols, concentrated acids, organic solvents, oil/water mixtures and acetone ($\epsilon_r = 4.0-10.0$)

D: Conductive liquids, e.g. water based solutions, dilute acids and alkalis ($\epsilon_r > 10.0$)

	Storage tank				Still Pipe/Bypass				Process tank			
5401 Antennas												
	Dielectric Constant											
	A	B	C	D	A	B	C	D	A	B	C	D
Cone, 2 in.	12.5 (42.x)											
Cone, 3 in.												
Cone, 4 in.												
Cone, 6 in.												
Cone, 8 in.												
Disc, 4 in.												
Disc, 6 in.												

Rosemount 5400 Series

	Storage tank				Still Pipe/Bypass				Process tank			
5402 Antennas												
	Dielectric Constant											
	A	B	C	D	A	B	C	D	A	B	C	D
Cone, 2 in.	12.5 (42.x)											
Cone, 3 in												
Cone, 4 in												
Disc, 2 in.												
Disc, 3 in.												
Disc, 4 in.												

Section 3 Installation

Safety messages	page 3-1
Installation Procedure	page 3-2
Mounting Considerations	page 3-3
Mechanical Installation	page 3-9
Electrical Installation	page 3-13

SAFETY MESSAGES

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

⚠ WARNING

Explosions could result in death or serious injury:

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

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

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

⚠ WARNING

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

Make sure only qualified personnel perform the installation.

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

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

⚠ WARNING

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

Avoid contact with leads and terminals.

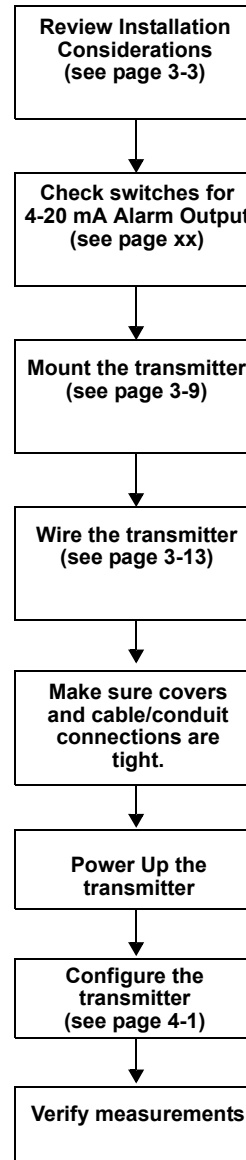
Make sure the main power to the 5400 transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

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

Rosemount 5400 Series

INSTALLATION PROCEDURE

Follow these steps for proper installation:



Rosemount 5400 Series

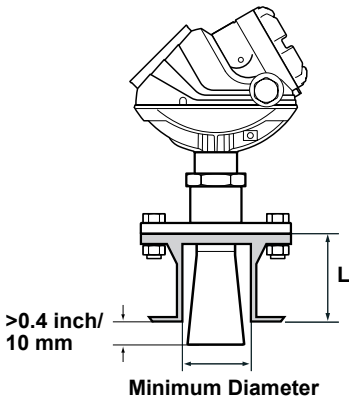
MOUNTING CONSIDERATIONS

Before you install the Rosemount 5400 Series Radar Transmitter, be sure to consider specific mounting requirements, vessel characteristics and process characteristics.

Socket Requirements

The 5400 Series is mounted on a nozzle by using appropriate flanges. For best performance it is recommended that the socket meets the following requirements:

Figure 3-1. Mounting of the 5400 Series transmitter.



SOCKETREQUIREMENTS

Table 3-1. Requirements on Socket height and width.

5401	Antenna	L _{max} (inch/mm)	Min. Diameter (inch/mm)
	Cone 4 in.	/160	/97
	Cone 6 in.	/195	/145
	Cone 8 in.	/280	/193
	Disc 4 in.		
	Disc 6 in.		
5402	Antenna	L _{max} (inch/mm)	Min. Diameter (inch/mm)
	Cone 2 in.	/160	/55
	Cone 3 in.	/160	/72
	Cone 4 in.	/235	/97

The transmitter should be installed as follows:

- The antenna must be aligned vertically.
- Choose as large antenna diameter as possible. A larger receiving area concentrates the radar beam and ensures maximum antenna gain. Increased antenna gain means greater margin for weak surface echoes. A larger antenna also results in smaller beam angle and thereby, less interference.
- For best measurement performance, the antenna should stick beneath the nozzle 0.4 inches (10 mm) or more.

Rosemount 5400 Series

Free Space

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

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

Figure 3-2. Free space recommendations.

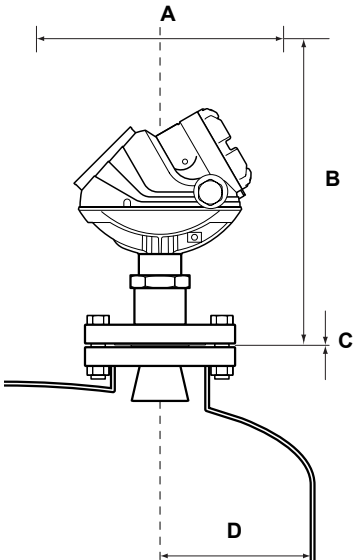


Table 3-2. Free space requirements

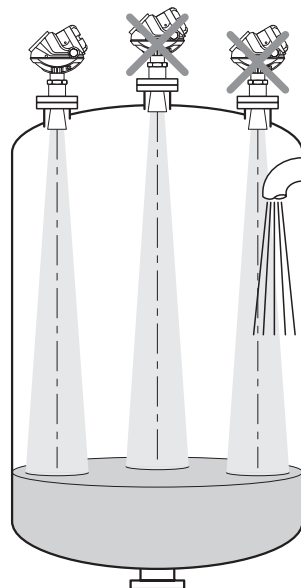
A. Service space width	Distance (inch/mm)
B. Service space height	Distance (inch/mm)
C. Inclination	Maximum angle
Cone antenna	2°
D. Minimum distance to tank wall	Distance (inch/mm)
Cone antenna	24/600

Rosemount 5400 Series

Recommended Mounting Position

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.

Figure 3-3. It is important to consider the proper mounting position.



MOUNTING_RESTRICTIONS.EPS

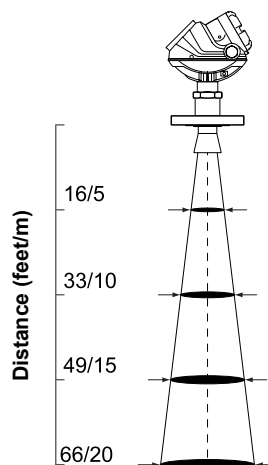
- Disturbing objects and filling inlets creating turbulence should be kept at a distance, outside the signal beam (see Figure 3-4 for beam width information).
- Avoid to install the transmitter at the centre of the tank roof.
- A bridle / still-pipe can be used to avoid interference.

Rosemount 5400 Series

Beam Width

- The transmitter should be mounted with as few fittings as possible within the beam angle.
- The flat tank wall can be located within the antenna beam angle as long as there is a minimum distance from the transmitter to the tank wall (see picture for preferred installation).

Figure 3-4. Beam width at various distances from the flange.



Beam Diameter at different distances from flange for 5401

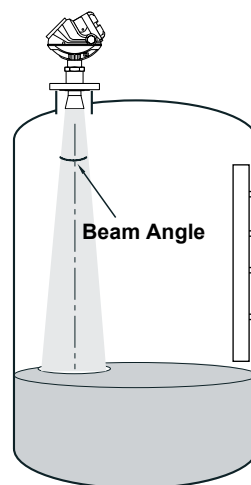
	Cone Antenna			Disc Antenna	
	4 in.	6 in.	8 in.	4 in.	6 in.
Distance	Beam Diameter, ft (m)				
16 ft (5 m)	3,5	2	1,5	3	2
33 ft (10 m)	7	4	3	6	4
49 ft (15 m)	10	6	4,5	9	5,5
66 ft (20 m)	13	8	6	12	7,5

Beam Diameter at different distances from flange for 5402

	Cone Antenna			Disc Antenna
	2 in.	3 in.	4 in.	2 in.
Distance	Beam Diameter, ft (m)			
16 ft (5 m)	1,5	1	1	2
33 ft (10 m)	3,5	2,5	1,5	4,5
49 ft (15 m)	5	3,5	2,5	6,5
66 ft (20 m)	6,5	5	3	9

Rosemount 5400 Series

Figure 3-5. Beam angle.



BEAMWIDTH2.EPSS

Beam angle for 5401

Antenna	Half Power Beam Width
Cone 2 in.	(Still Pipe)
Cone 3 in.	(Still Pipe)
Cone 4 in.	37°
Cone 6 in.	23°
Cone 8 in.	17°
Disc 4 in.	34°
Disc 6 in.	21°

Beam angle for 5402

Antenna	Half Power Beam Width
Cone 2 in.	19°
Cone 3 in.	14°
Cone 4 in.	9°
Disc 2 in.	25°

Rosemount 5400 Series

Vessel Characteristics

Heating coils, agitators and other objects in the tank may lead to noise in the measurement signal. Vertical cables causes minimal effect since the radar signal is scattered rather than directed back to the antenna.

The shape of the tank bottom affects the measurement signal when the product surface is close to the tank bottom. The 5400 Series has built-in functions which optimizes measurement performance for various bottom shapes.

Disturbing objects

The 5400 Series transmitter should be mounted so that objects such as heating coils, ladders etc. are not within the radar signal path. These objects may cause false echoes resulting in reduced measurement performance. However, the transmitter has built-in functions designed to reduce the influence from disturbing objects in case such objects can not be totally avoided.

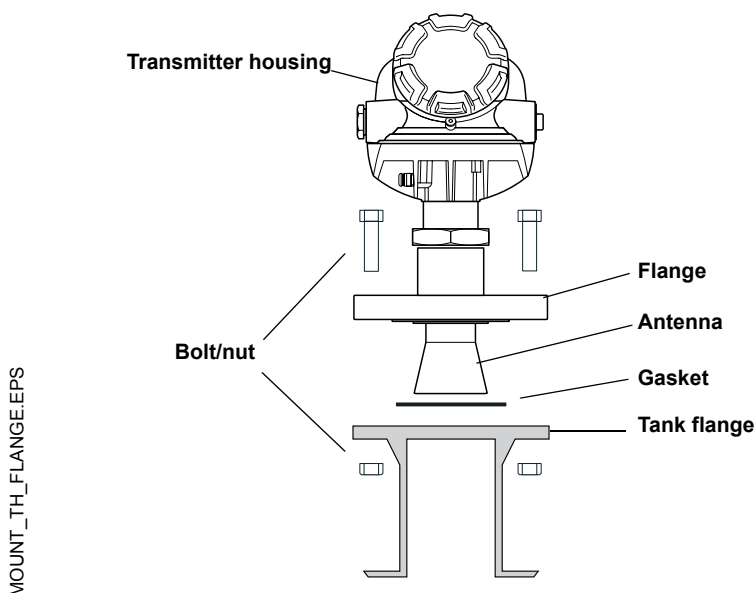
Rosemount 5400 Series

MECHANICAL INSTALLATION

Mount the transmitter on a nozzle on top of the tank. Make sure only qualified personnel perform the installation.

Mounting a standard cone antenna

Figure 3-6. Mounting the 5400
on a tank nozzle.



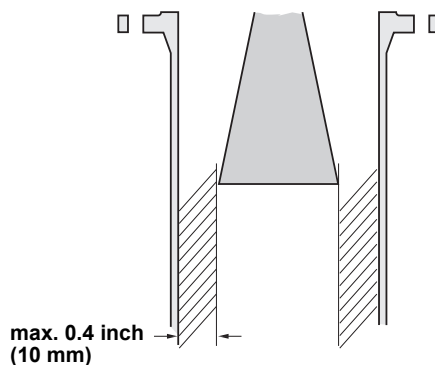
1. Place a gasket on top of the tank flange.
2. Lower the transmitter with antenna and flange into the tank nozzle.
3. Tighten the bolts and nuts.

Rosemount 5400 Series

Mounting in Still Pipes

Still Pipe mounting is recommended for tanks where surface conditions are extremely turbulent. The gap between the antenna and the Still Pipe may be up to 0.4 inch (10 mm).

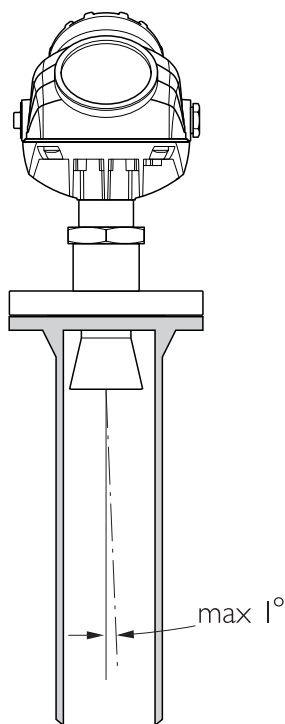
Figure 3-7. Maximum gap between antenna and Still pipe.



STILLPIPE_REQS.EPS

When the transmitter is mounted in a Still Pipe the inclination should be within 1°.

Figure 3-8. The transmitter should be vertically mounted.



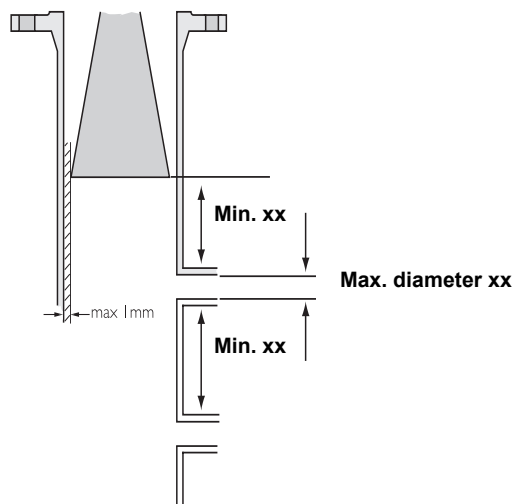
STILLPIPE_TANK.EPS

Rosemount 5400 Series

Mounting in Bypass Pipes

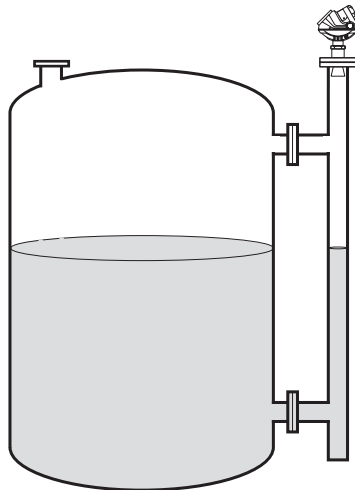
In pipes with inlet pipes in the order of 3 inch or larger the gap between the pipe and the antenna should be less than 1 mm.

Figure 3-9. Recommended specifications for bridles with pipe inlets.



BRIDLE_REQS.EPS

Figure 3-10. Bridle mounting is recommended for tanks with turbulent surface conditions.



BRIDLE.EPS

Rosemount 5400 Series

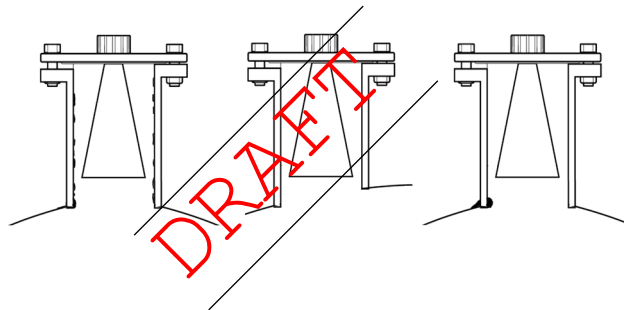
Antenna extension

The Extended Cone antenna is suitable for tanks with long nozzles or tanks where measurements should be avoided in the region close to the nozzle.

Use the Extended Cone antenna if:

- the nozzle is high
- there are disturbing objects close to the tank opening, or
- there is a rough surface at the inside of the nozzle.

Figure 3-11. Typical nozzle conditions which may decrease measurement performance.



“Disc Antenna”

Figure 3-12.

Rosemount 5400 Series

ELECTRICAL INSTALLATION

Cable/conduit entries

The electronics housing has two entries for ½ - 14 NPT. Optional M20×1.5 and PG 13.5 adapters are also available. The connections are made in accordance with local or plant electrical codes.

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

NOTE!

Use the enclosed metal plug to seal the unused port.

Grounding

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

NOTE!

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

NOTE!

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

Cable Selection

Use shielded twisted pair wiring for the Rosemount 5400 Series in order to comply with EMC regulations. The cables must be suitable for the supply voltage and approved for use in hazardous areas, where applicable. For instance, in the U.S., explosion-proof conduits must be used in the vicinity of the vessel. For the ATEX flame proof approval version of the 5400 Series, suitable conduits with sealing device or flame proof (Ex d) cable glands must be used depending on local requirements.

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

Hazardous Areas

When the 5400 transmitter is installed in hazardous area, local regulations and specifications in applicable certificates must be observed.

Rosemount 5400 Series

Power Requirements

Terminals in the transmitter housing provide connections for signal cables.

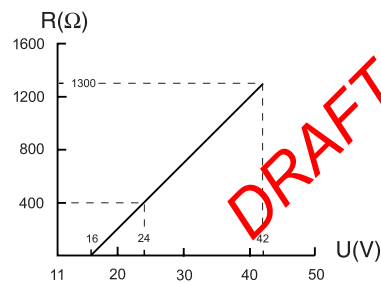
The 5400 transmitter operates with power supplies ranging from 15.5 to 45 VDC.

For Intrinsically Safe output the supply voltage must be within xx to xx VDC. For Explosion Proof/Flame Proof the supply voltage must be within xx to xx VDC.

Maximum Loop Resistance

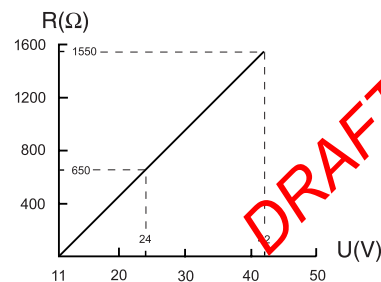
The maximum current loop resistance can be gained from the following diagrams:

Figure 3-13. Explosion Proof/Flame Proof installations.



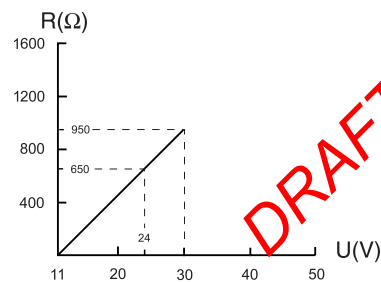
MAX_LOAD_EX_EPS

Figure 3-14. Non-hazardous installations.



MAX_LOAD_NON_INTRINSIC_EP

Figure 3-15. Intrinsically safe installations.



MAX_LOAD_INTRINSIC_EPS

Rosemount 5400 Series

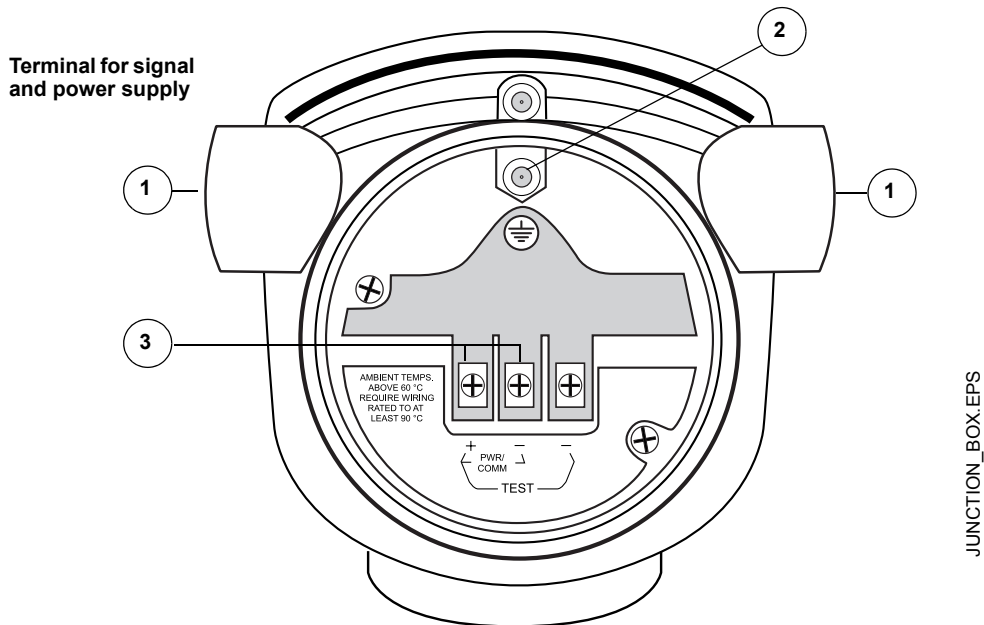
Connecting the Transmitter

The 5400 Series accepts power supplies ranging from 15.5 VDC to 45 VDC. It uses 4-20 mA power superimposed with a HART signal.

To connect the transmitter:

1. Make sure that the power supply is disconnected.
2. Remove the cover on the transmitter housing terminal side (see label).
3. Pull the cable through the cable gland/conduit.
4. Connect wires according to Figure 3-17 for non-intrinsically safe output and according to Figure 3-18 for Intrinsically safe output.
5. Replace the cover and tighten the cable gland.
6. Connect the power supply.

Figure 3-16. Junction box.



1. Cable entry.
2. Ground terminal.
3. Terminal for signal and power supply.

Rosemount 5400 Series

Non-Intrinsically Safe Output

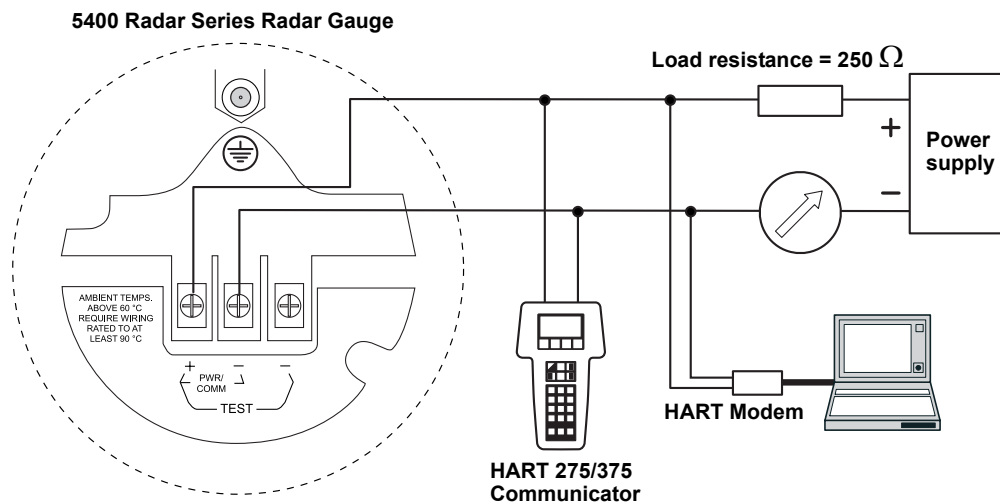
For non-intrinsically safe installations wire the transmitter as shown in Figure 3-17.

NOTE!

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

The HART 275 Communicator requires a minimum load resistance of 250 Ohm within the loop in order to function properly. For maximum loop resistance see Figure 3-13 (Explosion/Flame Proof) and Figure 3-14 (Non-hazardous installations).

Figure 3-17. Wiring for non-intrinsically safe installations.



WIRING_NON_IS.EPS

Rosemount 5400 Series

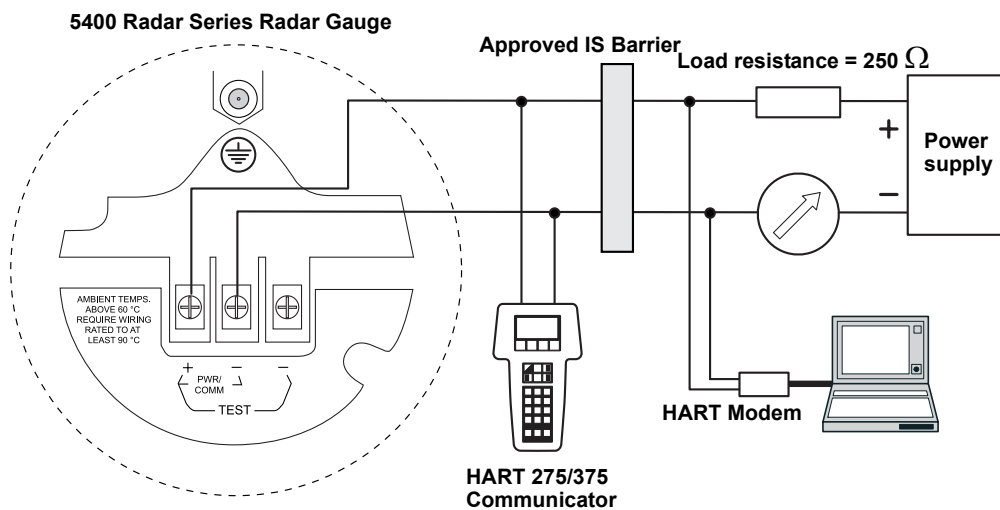
Intrinsically Safe Output

For intrinsically safe installations wire the transmitter as shown in Figure 3-18.

NOTE!

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

Figure 3-18. Wiring diagram for intrinsically safe installations



The HART 275 Communicator requires a minimum load resistance within the loop of 250 Ohm in order to function properly. For maximum load resistance see Figure 3-15.

The power supply voltage ranges from xx V to xx V.

IS parameters

$U_i=30\text{ V.}$

$I_i=130\text{ mA.}$

$P_i=1\text{ W.}$

$C_i=0.$

$L_i=0.$

Rosemount 5400 Series

Section 4 Operation

Safety Messages	page 4-1
Display Panel	page 4-2
PC Configuration Software Rosemount Radar Master ..	page 4-3
AMS	page 4-8
Model 275/375 HART Communicator	page 4-9

SAFETY MESSAGES

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

⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Explosions could result in death or serious injury.

- Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a HART®-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Electrical shock could cause death or serious injury.

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

⚠ WARNING

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

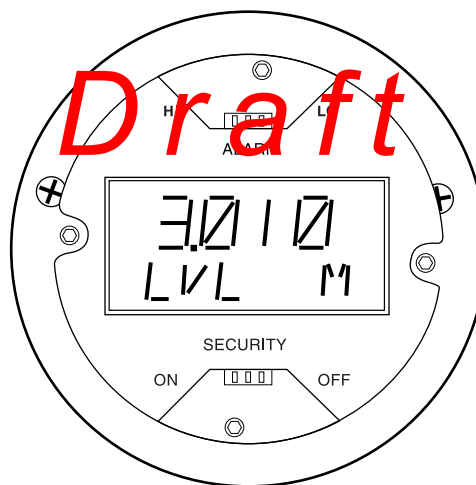
Rosemount 5400 Series

DISPLAY PANEL

Description of how the Display Panel is used for viewing data.

When the transmitter is started the Display Panel presents information such as antenna type, measurement frequency etc. When the transmitter is up and running the Display Panel presents Level, Signal Amplitude, Volume and other measurement data.

Figure 4-1. Display Panel



Rosemount 5400 Series

PC CONFIGURATION SOFTWARE ROSEMOUNT RADAR MASTER

Installing the RRM software

The Rosemount Radar Master (RRM) is a user-friendly software tool that allows you to configure the 5400 transmitter. You can choose either of the following two methods to configure a 5400 transmitter:

- Start the Wizard for a guided installation if you are un-familiar with the 5400 transmitter.
- Use the Setup function if you are already familiar with the configuration process or if you just want to change the current settings.

To install the Rosemount Radar Master:

1. Insert the installation CD into your CD-ROM drive.
2. If the installation program is not automatically started, from the windows Start Bar choose Run and type D:\Setup.exe where D is the CD-ROM drive.
3. Follow the instructions on the screen.
4. For optimum performance set COM Port Buffers to 1.

To start the RRM:

1. From the Start menu click *Programs>Saab Rosemount>Rosemount Radar Master*.
2. In the RRM Status Bar check that RRM communicates with the transmitter. If communication does not work check that the correct COM port is connected on the computer and that the COM port is properly configured, see "Specifying the COM Port" on page 4-4.

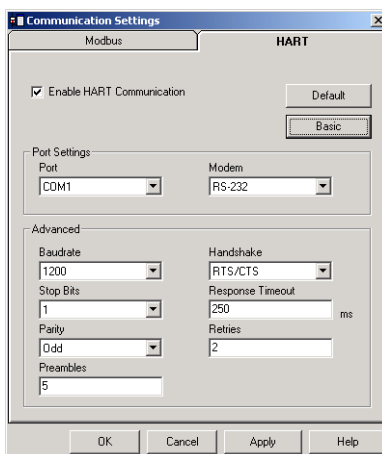


Rosemount 5400 Series

Specifying the COM Port

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

1. Select Communication Preferences from the Windows menu.



RRM/COMMUNICATIONSETTINGS.BMP

2. Check which COM port that is connected.
3. Choose the COM Port option that matches the COM Port connected to the transmitter.

To set the COM port buffers

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

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

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System Requirements

Hardware

Processor: Pentium 200MHz

Memory: 64 MB RAM

COM Port: 1 serial COM port

Graphical Card: Screen resolution of 800 x 600. 256 colors.

Hard drive space: 100 MB

Software

Operating Systems supported:

Windows 98 - service pack 3 and above

Windows NT 4 - service pack 6 and above

Windows 2000

Help In RRM

Help is accessed by pressing the F1 key or by selecting the Contents option from the Help menu. If the F1 key is pressed a help text appears with information about the window that is currently open. If a menu option is selected a help text appears with information about that particular menu.

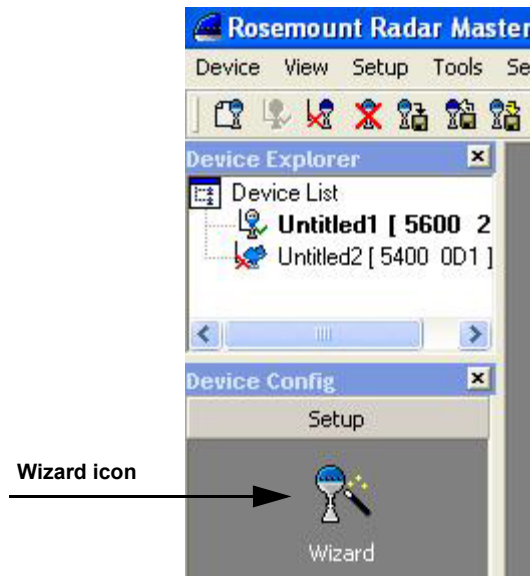
Rosemount 5400 Series

Using the Setup Wizard

To install a 5400 transmitter by using the installation **Wizard** do the following:

Figure 4-2. RRM workspace

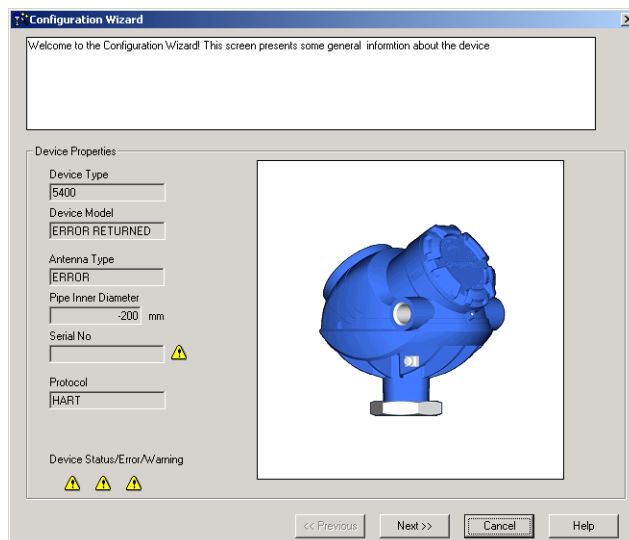
RRM/WIZARDICON.TIF



1. Start the RRM software.
2. In the RRM workspace click the Wizard icon (make sure that the Basic section is open), or choose the View>Wizard menu option.

Figure 4-3. RRM Wizard

RRM/WIZARD.TIF



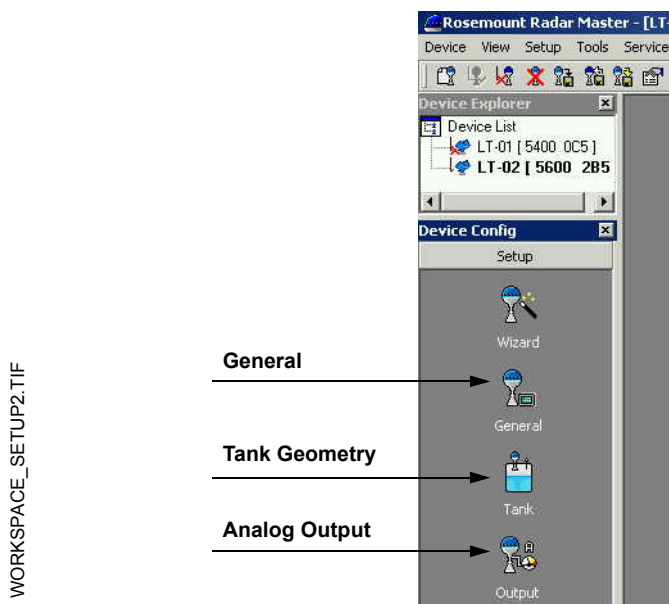
3. Click the **Next** button and follow the instructions. Now you will be guided through a number of dialogs allowing you to configure the transmitter.

Rosemount 5400 Series

Using the Setup Function

To install a 5400 transmitter by using the **Setup** function do the following:

Figure 4-4. RRM workspace



1. Start the RRM software.
2. In the RRM workspace click the appropriate icon. There are different icons available for configuration of Tank Geometry, Analog Output and general settings such as measurement units.

Rosemount 5400 Series

AMS

Kort introduktion till hur AMS används för att konfigurera 5400.

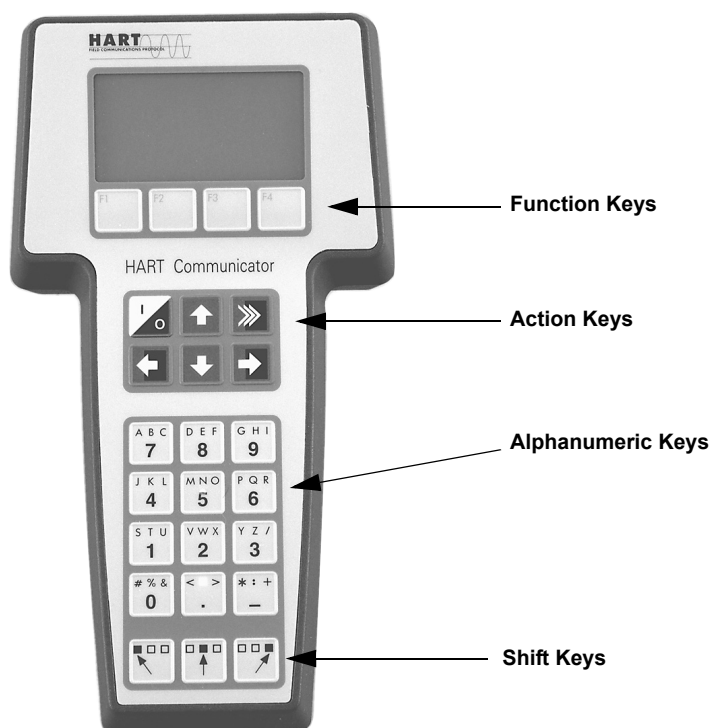
Rosemount 5400 Series

MODEL 275/375 HART COMMUNICATOR

The 5400 transmitter can be configured by using a HART 275 Communicator. The menu tree is shown in *Figure 4-6 on page 4-10*.

Appendix C: HART Communicator provides brief instructions on the use of the HART Communicator. For information on all the capabilities, refer to the HART Communicator Product Manual.

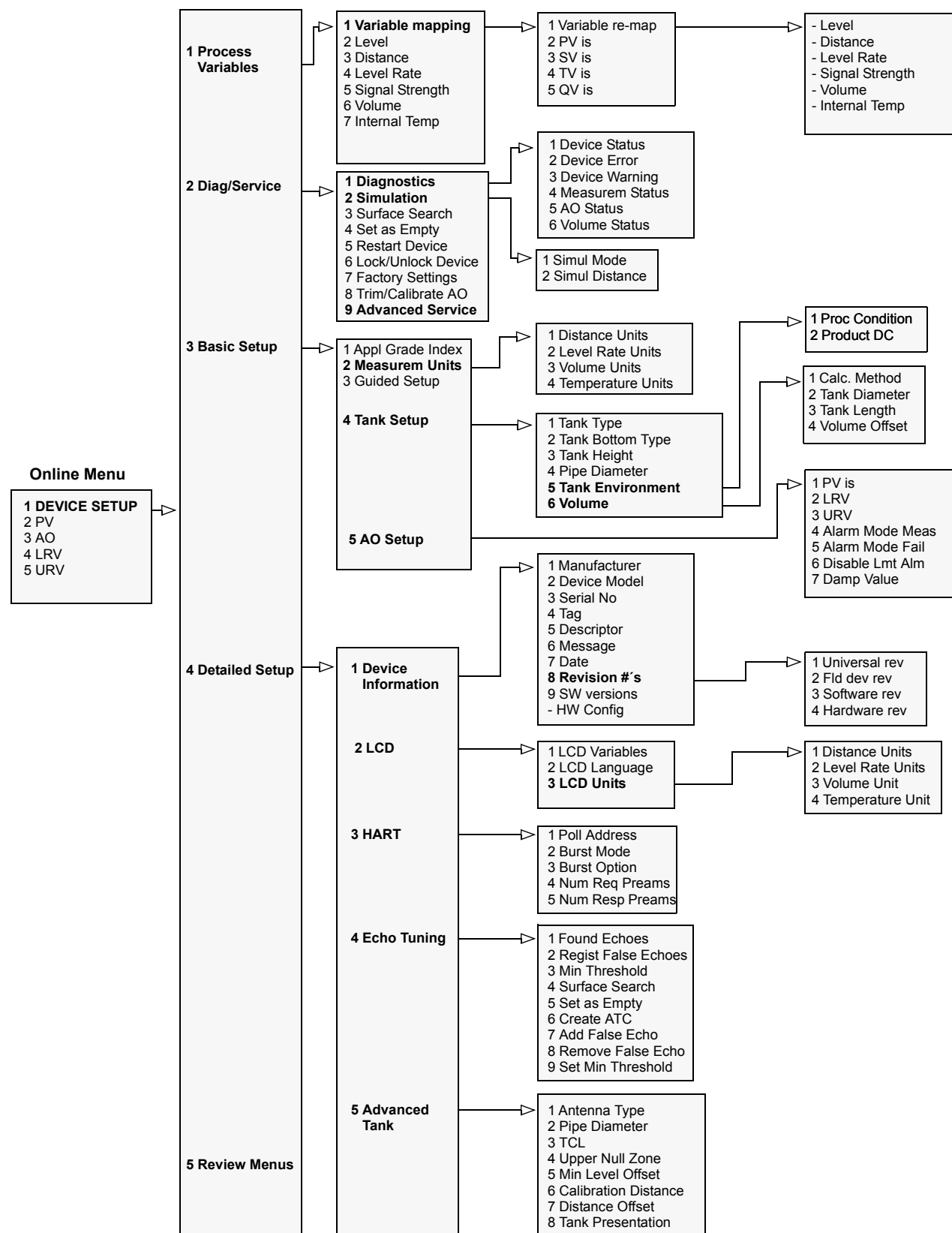
Figure 4-5. The HART 275 Communicator.



275

Rosemount 5400 Series

Figure 4-6. HART Communicator Menu Tree



Section 5 Configuration/Start-Up

Safety messages	page 5-1
Overview	page 5-2
Basic Configuration	page 5-3
Tank Geometry	page 5-3
Analog Output	page 5-6
Echo Tuning	page 5-8
Advanced Configuration	page 5-10

SAFETY MESSAGES

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

⚠ WARNING

Explosions could result in death or serious injury:

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

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

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

⚠ WARNING

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

Make sure only qualified personnel perform the installation.

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

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

Rosemount 5400 Series

OVERVIEW

The Rosemount 5400 transmitter can be pre-configured according to the ordering specifications in the Configuration Data Sheet.

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
- Remote Display Unit
- Tank Configuration
 - Tank Geometry
 - Environment/Process conditions
 - Volume
- Analog Output

Echo Tuning

Echo Tuning is used to handle special situations when there are objects in the tank which cause disturbing echoes. The following tools are available to handle such situations:

- Amplitude Threshold Curve (ATC)
- False Echo registration

Advanced Configuration

For some applications further configuration is needed in addition to the Basic Configuration. This may be due to the properties of the product or the shape of the tank. Disturbing objects and turbulent conditions in the tank may also require that advanced measures are taken.

Rosemount 5400 Series

BASIC CONFIGURATION

Measurement Units

Specify the measurement units to be used for presentation of Distance, Level Rate, Volume and Temperature values.

Display Unit

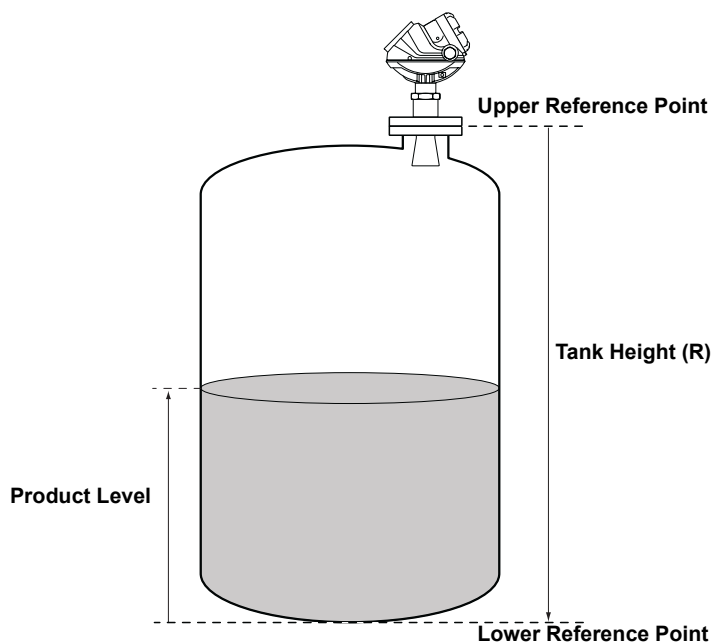
Specify the parameters to be presented on the display panel.

Tank Geometry

Tank Height

The Tank Height is the distance between the Upper Reference Point and the Lower Reference Point close to or at the bottom of the tank. The transmitter measures the distance to the product surface and subtracts this value from the Reference Gauge Height to determine the level.

Figure 5-1. Tank Geometry



TANKGEOMETRY_STANDARD.EPS

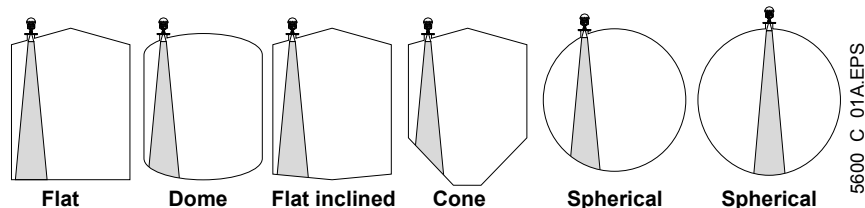
Tank Type and Tank Bottom Type

By defining *Tank Type* and *Tank Bottom Type* default values for some parameters are set. This optimizes the transmitter for a specific combination of Tank type and Tank Bottom Type. For tank types vertical cylinder and cubical, all tank bottom types are valid. For tank types *Horizontal Cylinder* and *Spherical*, the parameter Tank Bottom Type is not used. Select Tank Bottom Type *Flat Inclined* if the bottom inclination is between 10 and 30 degrees. If the inclination is less than 10 degrees but there are disturbing objects on the tank floor (like heating coils) right beneath the transmitter this selection should also be used.

Rosemount 5400 Series

Table 5-1. Tank Type and Tank Bottom Type

Tank Type	Tank Bottom Type
Vertical Cylinder	Flat, Dome, Cone, Flat inclined
Horizontal Cylinder	Flat, Dome, Cone, Flat inclined
Spherical	
Cubical	Flat, Dome, Cone, Flat inclined



Pipe Diameter

When the transmitter is mounted in a still pipe the inner diameter of the pipe must be specified. The Pipe Diameter is used to compensate for the lower microwave propagation speed inside the pipe. An incorrect value will give a scale factor error. If locally supplied still-pipes are used, make sure the inner diameter is noted before the pipe is installed.

This option is only available when the transmitter is configured for Antenna Type *Pipe* or *User Defined*.

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Process Conditions

Describe the conditions in your tank according to the Tank Environment parameters for Process Conditions listed below. For best performance choose only if applicable and not more than two options.

Rapid Level Changes

Optimize the transmitter for measurement conditions where the level changes quickly due to filling and emptying of the tank. A standard configured transmitter is able to track level changes of up to 4 inch/s (100 mm/s). When the Rapid Level Changes check box is marked, the transmitter can track level changes of up to 8 inch/s (200 mm/s).

Turbulent Surface

This parameter should be used if the tank shows a turbulent surface. The reason for the turbulence might be splash loading, agitators, mixers, or boiling product. Normally the waves in a tank are quite small and cause local rapid level changes. By setting this parameter the performance of the transmitter will be improved when there are small and quickly changing amplitudes and levels.

Foam

Setting this parameter optimizes the gauge for conditions with weak and varying surface echo amplitudes.

Solid Products

Setting this parameter optimizes the transmitter for solid products, for example concrete or grains, which are not transparent for radar signals. For instance, this parameter can be used when the application is a silo with product buildup.

Product Dielectric Range

The Dielectric Constant is related to the reflectivity of the product. By setting this parameter measurement performance can be optimized. However, the transmitter will still be able to perform well even if the actual Dielectric Constant differs from the configured value.

Volume

The Volume Calculation is performed by using a predefined tank shape.

To configure the Model 5400 transmitter for volume calculations you have to choose a Volume Calculation method.

For volume calculations you can choose one of the standard tank shapes:

Sphere, Horizontal Cylinder, Vertical Cylinder, Horizontal Bullet or Vertical Bullet.

Enter the following parameters:

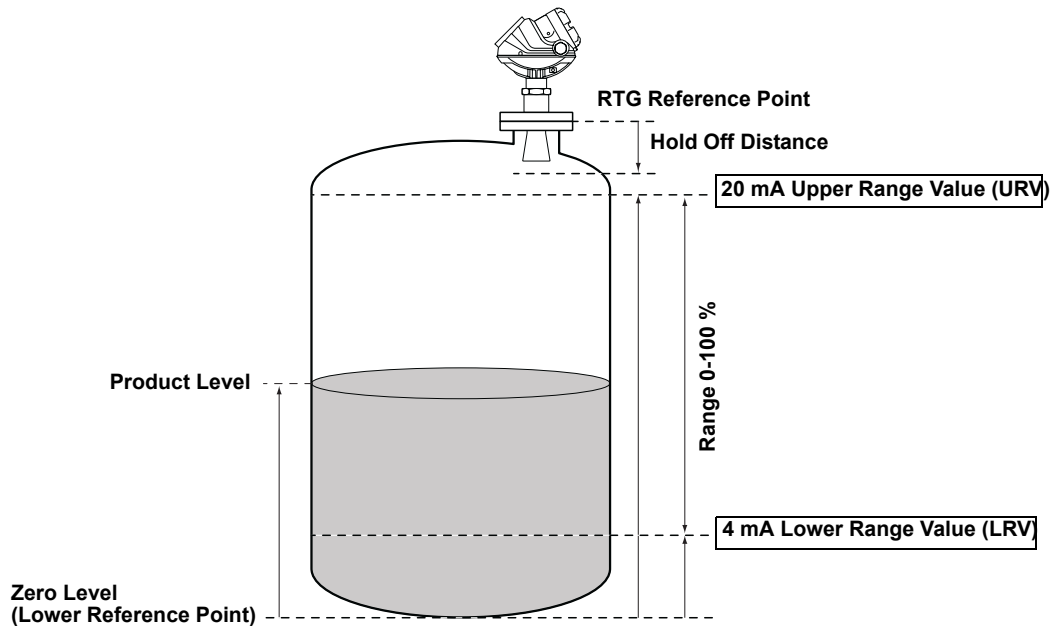
- Tank diameter (and the length if it is a horizontal tank).
- Volume Offset: Use this parameter if you do not want zero volume and zero level to match (for example if you want to include volume below the zero level.)

Rosemount 5400 Series

Analog Output

The 5400 series has the ability to handle two analog outputs which can be configured separately.

Figure 5-2. Standard Range Value settings



Output Source/Primary Variable

Select the source to control the analog output.

Upper/Lower Range Value

Enter the range values that correspond to the analog output values 4 and 20 mA. You can specify any values as long as the Upper Range Value is above the Lower Range Value. If the measured value goes beyond the measurement range, the transmitter enters the alarm mode.

The 4 mA Lower Range Value can be set to zero or any level above the Zero Level.

The 20 mA Upper Range Value should not be within the Hold Off Distance. If the 20 mA point is within the Hold Off Distance the full range of the analog output is not used, see "Hold Off Distance" on page 5-11.

Alarm Mode

Choose the desired Alarm Mode. The Alarm Mode specifies the analog output state when a measurement error occurs or when the measured value is out of range.

High: the output current is set to 22 mA.

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Low: the output current is set to 3.8 mA.

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

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

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

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

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

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ECHO TUNING

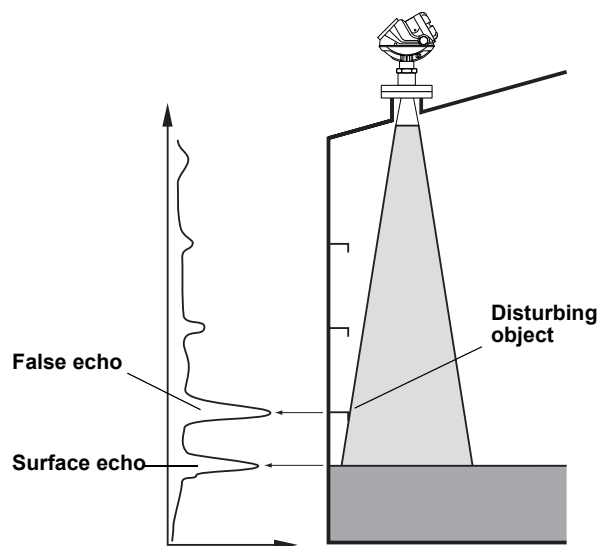
There are different methods available for disturbance echo handling with the Rosemount 5400 Series Transmitter:

- False Echo registration
- Customized Noise Threshold Table (Amplitude Threshold Curve (ATC))

Registration of False Echoes

The False Echo function is used to improve the performance of the gauge when the surface is close to a horizontal surface of a stationary object in the tank. The object causes an echo when it is above the surface. When the echoes from the surface and the object are close to each other, they might interfere and cause a decrease in performance.

Figure 5-3.



The False Echo function allows you to register disturbing echoes caused by objects in the tank in the memory of the gauge. When the surface is passing by a disturbing object, the gauge can measure with a higher reliability, when the position of the object is registered. This makes it possible to detect a product surface close to a disturbance echo even if the surface echo is weaker than the disturbing echo. See the following recommendations before you register new interfering echoes:

- Make sure that a correct amplitude threshold is set before you register any disturbance echoes.
- Keep the number of registered echoes to a minimum.
- Compare the list of interfering echoes with the tank drawing or by visible inspection of the tank. Note if there are objects like beams, heating coils, agitators etc. which correspond to the found echoes. Only register echoes which can be clearly identified as objects in the tank.
- Make sure that the level is stable before you register a disturbance echo. A fluctuating level may indicate a temporary disturbance which is not due to an interfering object.

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- Do not register a disturbance echo if the amplitude is below the general amplitude threshold.
- Do not register a disturbance echo if the amplitude is significantly smaller than the amplitude of the surface echo when the surface is at the same level as the disturbance. (In some cases weak disturbance echoes can be filtered out by creating a noise threshold table.
- It may be necessary to register new disturbance echoes at a later stage when objects have become visible due to surface movement.

Amplitude Threshold Curve

You can filter out weak disturbing echoes by creating a noise threshold table. This technique should only be used in special situations, for example at the bottom of tanks with weak disturbing echoes. In such tanks the transmitter may lock at disturbances close to the bottom when the tank is empty. Setting up a noise threshold in this region will guarantee that the transmitter starts tracking the surface when the tank is filled again. Make sure that the surface echo amplitude in the bottom region is higher than the noise threshold.

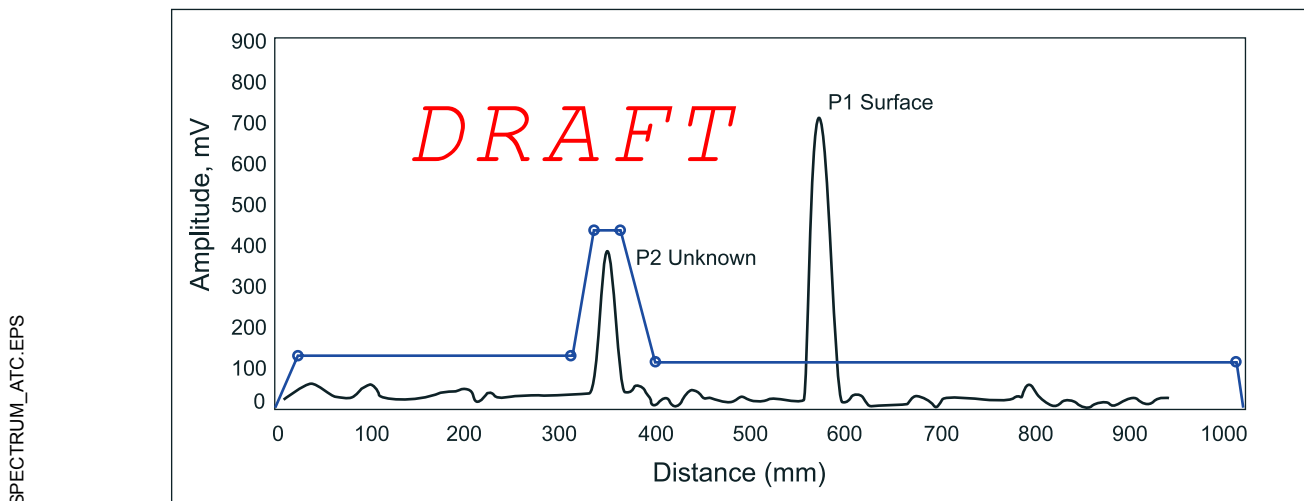
This function can also be used in areas where there occasionally are strong echoes present, i.e. to block the device from tracking "wall bounce echoes", moving cleaning gun, wide mixer blades and product mist from spray nozzles. For those large areas registering a False Echo may not be sufficient.

Furthermore, the ATC-table can be used to remove influence from the tank nozzle or a still pipe inlet at the top of the tank.

Do not create noise thresholds around echoes which are already registered as interfering echoes (see "Registration of False Echoes" on page 5-8).

The ATC function is available in the Rosemount Radar Master software.

Figure 5-4.



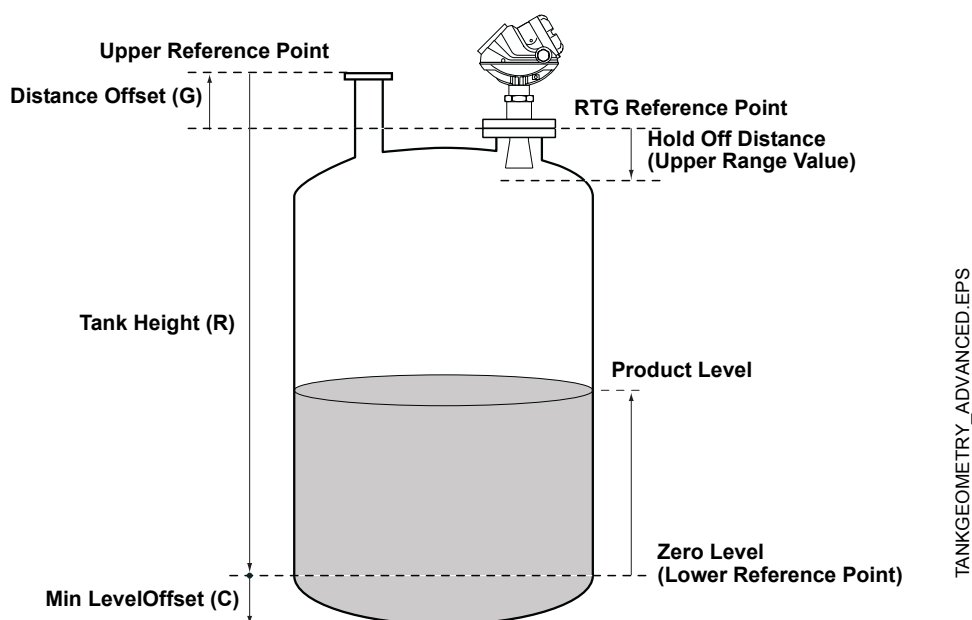
Rosemount 5400 Series

ADVANCED CONFIGURATION

The advanced transmitter configuration includes settings which can be used to fine tune the transmitter when standard settings are not sufficient for optimum performance.

Advanced Tank Geometry

Figure 5-5. Advanced Tank Geometry



Distance Offset (G)

The Distance Offset is used when the measured level by the gauge should correspond with the level value obtained by hand-dipping.

The Distance Offset (G) is defined as the distance between the upper reference point and the flange (the flange is referred to as the Transmitter's Reference Point). You can use the Distance Offset to specify your own reference point at the top of the tank. Set the Distance Offset to zero if you want the flange as upper reference point. The Distance Offset is defined as positive if you use an upper reference point above the Transmitter's Reference Point.

Minimum Level Offset (C)

The Minimum Level Offset (C) defines a lower null zone which extends the measurement range beyond the Zero Level Reference Point down to the tank bottom. The Minimum Level Offset is defined as the distance between the Zero Level (Tank Level Reference Point) and the minimum accepted level at the tank bottom. Set the Minimum Level Offset to zero if you use the tank bottom as Zero Level Reference Point. This case corresponds to the standard Tank Geometry configuration.

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Note that the Tank Height must be measured down to the Zero Level Reference Point regardless if the Zero Level Reference Point is located at the tank bottom or at an elevated point as the datum plate.

If the zero level is not defined as the tank bottom and instead is an elevated point as the datum plate, you need to define the Minimum Level Offset.

Note: The Minimum Level Offset can not be negative.

Hold Off Distance

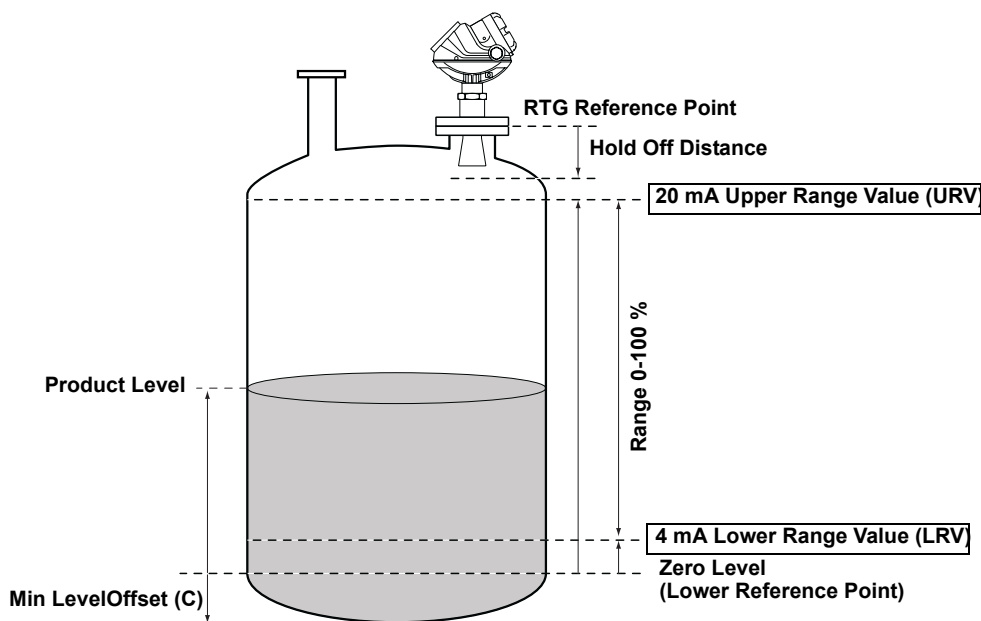
This parameter should only be changed if there are measurement problems in the upper part of the tank. Such problems may occur if there are disturbing objects close to the probe. By increasing the Hold Off Distance the measuring range is reduced.

Calibration Distance

The Calibration Distance is by default set to zero. It is used to adjust the transmitter so that measured levels match hand dipped product levels. Normally a minor adjustment is necessary. There may for example be a deviation between the actual tank height and the value stored in the transmitter database.

Advanced Analog Output Settings

Figure 5-6. Advanced Range Value settings



ANALOGOUT_ADVANCED.EPS

Rosemount 5400 Series

Antenna Type

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

This parameter is pre-configured at factory but may need to be set if a non-standard antenna is used.

Tank Connection Length

The Tank Connection Length (TCL) parameter is adjusted for each antenna type in order to optimize measurement performance. TCL is set automatically for standard antennas. For non-standard antennas (antenna type User Defined) the TCL value needs to be manually adjusted.

Empty Tank Handling

The Empty Tank Handling functions handle situations when the surface echo is close to the tank bottom:

- Tracking weak product echoes
- How to handle lost echoes

If the surface echo is lost the function makes the transmitter present a zero-level measurement, and an alarm is activated unless this alarm has been blocked.

Bottom Echo Visible

This parameter is automatically set depending on tank type and tank bottom type. By setting this parameter the bottom echo will be treated as a disturbance echo to facilitate tracking of weak surface echoes close to the tank bottom. If this parameter is not set searching for a lost surface echo is restricted to a region close to the tank bottom. Only set this parameter if the bottom echo is visible.

Check if the gauge detects the tank bottom when the tank is empty before marking the checkbox.

Empty Tank Detection Area

This function is activated by default if you have selected one of the following Tank Bottom Types: Cone, Dome, Flat Inclined, or Unknown. This function also requires that the Bottom Echo Visible checkbox is not marked. If it is marked the function is disabled.

The transmitter will search for the surface echo within the Empty Tank Detection Area. The Empty Tank Detection Area is calculated as a percentage of Tank Height (R) + Minimum Level Offset (C) - Distance Offset (G). It has a lower limit of 400 mm and a higher limit of 1000 mm. Used Empty Tank Detection

Area is shown in Advanced Setup and can be adjusted manually if required.

Since the transmitter will search for the surface echo in the Empty Tank Detection Area, it is important that there are no disturbances in this area. If there are disturbances it may need to be filtered out.

Tank Bottom Projection

This function handles situations close to the tank bottom and may enhance measurement performance in the tank bottom region. In this region the signal from the actual tank bottom may in some cases be significantly stronger than the measurement signal from the product surface.

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Extra Echo

Extra Echo Detection is used for tanks with domed or conical bottom types and when no strong echo from the tank bottom exists when the tank is empty. When the tank is empty an echo beneath the actual tank bottom can sometimes be seen.

Level Alarm is not set when Tank is Empty

If the echo from the product is lost in an area close to the tank bottom (Empty Tank Detection Area), the device will enter empty tank state and an alarm is triggered. (If the device is still able to measure the level, no alarm will be triggered even if the level is close to the tank bottom.) Two types of alarms are triggered:

- Invalid Level is set which can be seen in the Diagnostics window (see Diagnostics)
- The Analog Out for level will go into Alarm Mode (see Output – Analog Out 1 or Output – Analog Out 2).

Full Tank Handling

Level Alarm is Not Set when Tank is Full

If the surface echo is lost close to the top of the tank, the level value will normally be displayed as “invalid”. Set this parameter to suppress the “invalid” display.

NOTE

By setting this parameter the analog output will not enter alarm mode for invalid levels close to the antenna.

Full Tank Detection Area

This parameter defines a range where it is accepted to lose the echo from the product. If the echo is lost in this range the tank is considered full (the device enters Full Tank State) and the device will present max level indication.

When the tank is full the device looks in 2 x Full Tank Detection Area for the product surface. When a new echo is found in this range it is considered to be the product surface.

Level above Hold Off Distance Possible

Enable the checkbox if the level may rise above the Hold Off Distance (UNZ) and you want to consider the tank as full in that case. Normally the device will always be able to track the surface and the product level will never rise that high. If the checkbox is not enabled and the surface is lost at the top of the tank the device searches for a surface echo within the whole tank.

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Double Bounce

Some radar waves are reflected against the tank roof and back to the surface before they are detected by the transmitter. Normally, these signals have a low amplitude and are therefore neglected by the transmitter. For spherical and horizontal cylinder tanks, in some case the amplitude may be strong enough to lead the transmitter to interpret the double bounce as the surface echo. By setting the *Double Bounce Possible* parameter this type of measurement situation may be improved. This function should only be used if the problem of double bounces can not be solved by changing the mechanical installation.

Surface Echo Tracking

Slow Search

This variable controls how to search for the surface if a surface echo is lost. With this parameter set the transmitter starts searching for the surface at the last known position, and gradually increases the width of the search region until the surface is found. If this variable is not set the transmitter searches through the whole tank. This parameter may typically be used for tanks with turbulent conditions.

Slow Search Speed

If the surface echo is lost, the transmitter starts to search around the last known level to find the surface echo again. This parameter indicates how fast it should expand the search window.

Double Surface

Indicates that there are two liquids or foam in the tank resulting in two reflecting surfaces. The upper liquid or foam layer must be partly transparent to the radar signal.

If this function is activated, you can specify which surface to select by using the Select Lower Surface parameter.

Upper Product Dielectric Constant

This is the dielectric constant for the upper product if there is a Double Surface situation. A more precise value results in better accuracy for the lower surface level.

Select Lower Surface

This function should only be used if Double Surface is set. If Select Lower Surface is set the lower surface will be presented as the product surface. If not set the upper surface is tracked.

Echo Timeout

Use Echo Timeout to define the time in seconds before the transmitter will start to search for a surface echo after it has been lost. After an echo has been lost, the transmitter will not start searching or set Invalid Level until this time has elapsed.

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Close Distance Window

This parameter defines a window centered at the current surface position in which new surface echo candidates can be selected. The size of the window is $\pm \text{CloseDist}$. Echoes outside this window will not be considered as surface echoes. The transmitter will without delay jump to the strongest echo inside this window. If there are rapid level changes in the tank, the value of the Close Distance Window could be increased to prevent the transmitter from missing level changes. On the other hand, a too large value might cause the transmitter to select an invalid echo as the surface echo.

Filter Settings

Damping Value

The Damping Value defines the level value filtering rate. A low value will give the new level value by adding a small portion (for instance 1%) of the level change to the previous level value. A Damping Value setting typically takes the latest measurement and presents it as the new level. This implies that a low factor setting makes the level value steady but the gauge reacts slowly to level changes in the tank. A high factor setting makes the gauge react quickly to level changes but the level value can be somewhat jumpy.

Activate Jump Filter

If the surface echo is lost and a new surface echo is found, the Jump Filter tells the transmitter to wait for some time before it jumps to the new echo. During that time the new echo has to be a valid echo. The Jump Filter does not use the Distance Filter Factor and can be used in parallel to the Least Square Filter or the Adaptive Filter. The Jump Filter is typically used for applications with turbulent surface and makes the echo tracking work smoother as the level passes the agitator.

Rosemount 5400 Series

Section 6 Service and Troubleshooting

Safety Messages	page 6-1
Service	page 6-2
Troubleshooting	page 6-7

SAFETY MESSAGES

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

⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Explosions could result in death or serious injury.

- Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a HART®-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Any substitution of non-recognized parts may jeopardize safety. Repair, e.g. substitution of components etc., may also jeopardize safety and is under no circumstances allowed.
- Substitution of components may impair Intrinsic Safety.
- To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.
- To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing. (*Krav från FM?*)
- Do not reset circuit breaker unless power has been removed from the equipment or the area is known to be non-hazardous. (*Nonincendive ?*)



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SERVICE

The functions mentioned in this section are all available in the *Rosemount Radar Master* (RRM) configuration program.

Analog Output Calibration

Viewing Input and Holding Registers

Measured data is continuously stored in the Input registers. By viewing the contents of the Input registers you can check that the device works properly.

The Holding registers store various transmitter parameters used to control the measurement performance.

By using the RRM program most Holding registers can be edited by simply typing a new value in the appropriate Value input field. Some holding registers can be edited in a separate window. In this case you can choose from a list of options or you can change separate data bits.

Logging Measurement Data

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

Saving the Transmitter Configuration

Use this RRM option to save the configuration parameters to the configuration file associated with the device.

If a similar device needs to be installed, parameters in the saved file can be uploaded directly to the new device.

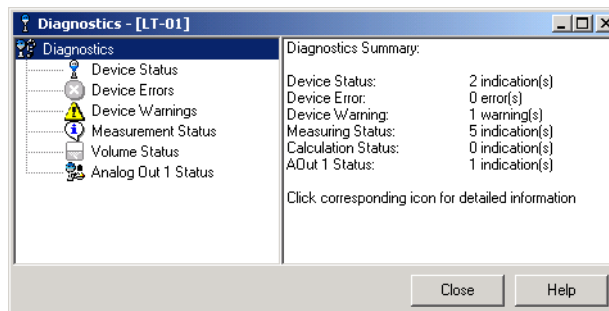
Rosemount 5400 Series

Diagnostics

By using the RRM software the following information about the device can be retrieved:

- device status
- device errors
- device warnings
- measurement status
- volume status
- analog output status

Figure 6-1. The Diagnostics window in Rosemount Radar Master.

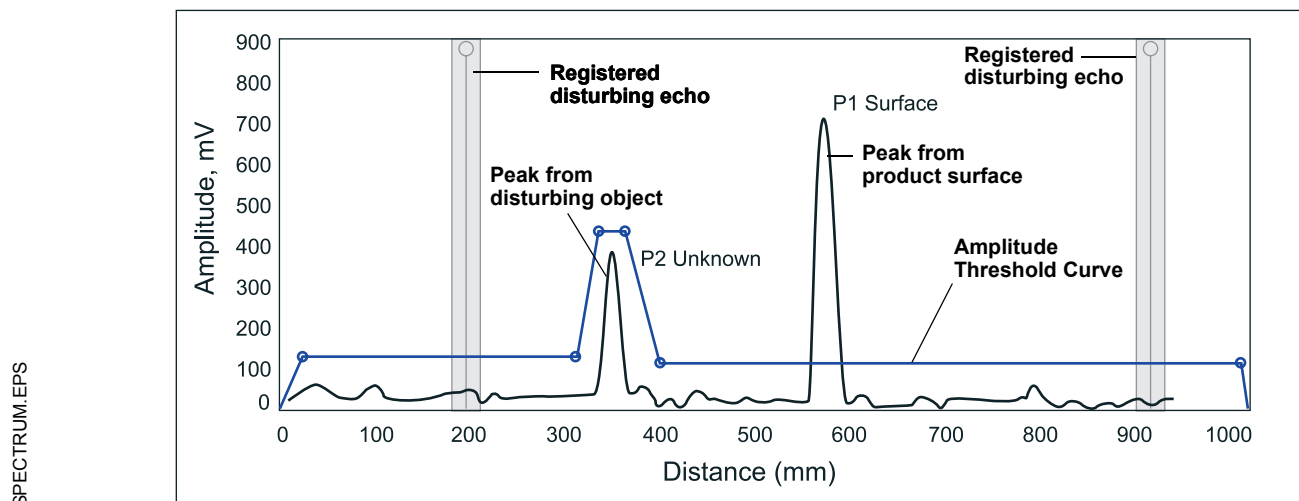


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Using the Spectrum Analyzer

The Spectrum Analyzer in *Rosemount Radar Master* (RRM) lets you view the measurement signal amplitude along the tank. Each radar echo is displayed as a peak in the signal plot. This is a useful tool for obtaining a view of the tank conditions. The Spectrum Analyzer also lets you register disturbing echoes and create an Amplitude Threshold Curve (see Section 5: Echo Tuning for further information).

Figure 6-2.



To be continued...

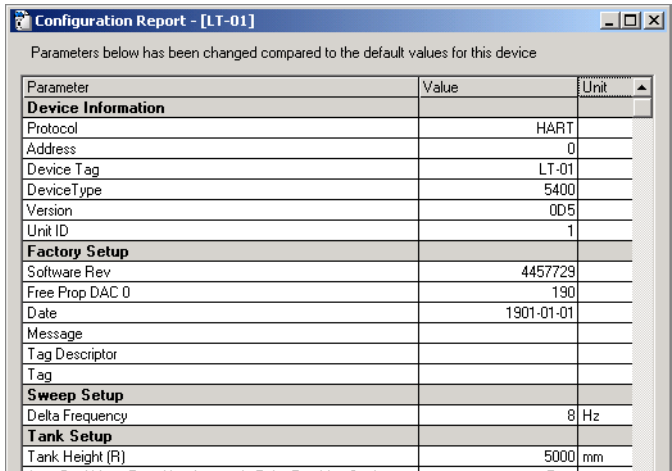
Rosemount 5400 Series

Configuration Report

This function in *Rosemount Radar Master* (RRM) shows what configuration changes have been done to the transmitter compared to the default configuration. The report compares a specified backup file with the current transmitter configuration.

Information on antenna type, software versions, software and hardware configuration, operation time, error status and unit code is presented.

Figure 6-3. The Configuration Report window in Rosemount Radar Master.



Parameter	Value	Unit
Device Information		
Protocol	HART	
Address	0	
Device Tag	LT-01	
DeviceType	5400	
Version	005	
Unit ID	1	
Factory Setup		
Software Rev	4457729	
Free Prop DAC 0	190	
Date	1901-01-01	
Message		
Tag Descriptor		
Tag		
Sweep Setup		
Delta Frequency	8	Hz
Tank Setup		
Tank Height (R)	5000	mm

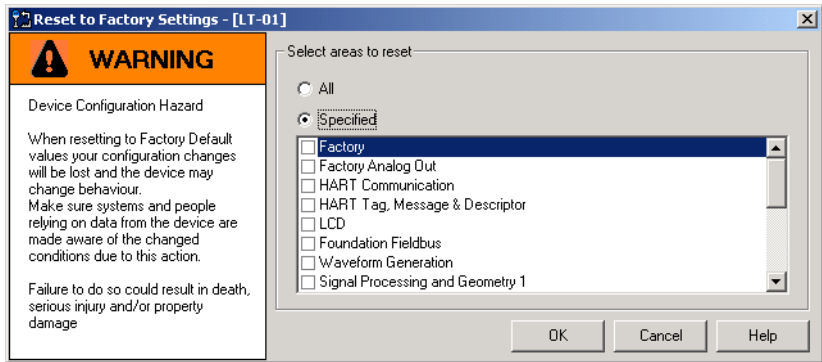
Surface Search

The *Surface Search* command triggers a search for the product surface. Use this function if, for example, the measured level has stuck on a disturbing object in the tank.

Reset to Factory Settings

Resets all or a specific part of the holding registers to factory settings.

Figure 6-4. The Reset to Factory Settings window in RRM.



WARNING
Device Configuration Hazard
When resetting to Factory Default values your configuration changes will be lost and the device may change behaviour. Make sure systems and people relying on data from the device are made aware of the changed conditions due to this action. Failure to do so could result in death, serious injury and/or property damage.

Select areas to reset
☐ All
☒ Specified
☐ Factory
☐ Factory Analog Out
☐ HART Communication
☐ HART Tag, Message & Descriptor
☐ LCD
☐ Foundation Fieldbus
☐ Waveform Generation
☐ Signal Processing and Geometry 1

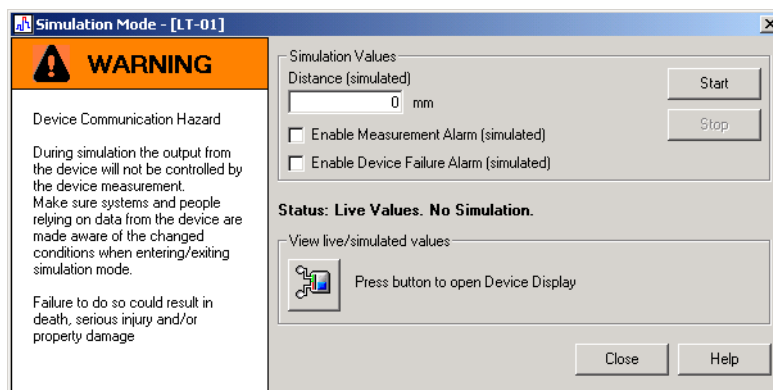
OK Cancel Help

Using the Simulation Mode

This function can be used to simulate measurements and alarms.

Rosemount 5400 Series

Figure 6-5. The Reset to Factory Settings window in RRM.



Enable Software Options

(Change Start Code)

To be continued...

Enter Service Mode

In *Rosemount Radar Master* (RRM) some useful service functions are available for the 5400 Series transmitter. By setting RRM into the Service Mode all the Service menu options in RRM are enabled. The default password for enabling the Service Mode is “admin”. The password can be changed by selecting the *Change Password* option from the Service menu.

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TROUBLESHOOTING

Troubleshooting

If there is a malfunction despite the absence of diagnostic messages, see Table 6-1 for information on possible causes.

Table 6-1. Troubleshooting chart

Symptom	Possible cause	Action
No level reading	•	• Check the power supply. • Check the cables for serial data communication.
No HART communication.	• COM Port configuration does not match the connected COM Port. • Cables may be disconnected. • Wrong HART addresss is used. • Hardwafe failure.	• Check that correct COM Port is selected in the HART server (see "Specifying the COM Port" on page 4-4). • Check wiring diagram. • Verify that the 250 Ohm resistor is in the loop. • Check cables. • Make sure that correct HART short address is used. Try address=0. • Check Analog Output current value to verify that transmitter hardware works.
Analog Out is set in Alarm.		Use the command "Read Gauge Status" in order to check active errors.
P2 is detected but Level is incorrectly reported as Full or Empty.		Use the command "Read Gauge Status" and check if the warning "Probe Immersed" is active. If this is the case check that: • the transmitter is configured with correct probe type, • the reference pulse (P1) is below amplitude threshold T4. If not, adjust T4 to an appropriate value.
Incorrect level reading.	• Configuration error. • Disturbing objects in the tank.	• Check the Reference Gauge Height parameter. • Check status information and diagnostic information. • Check that the transmitter has not locked on an interfering object.
Integral display does not work.		• Check the display configuration. • Check loop power. • Check Display connection.

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Errors.

Table 6-2 is a list of diagnostic messages that may be displayed on the Integral Display, on the Model 275 HART Communicator, in AMS or by the Rosemount Radar Master (RRM) software. Errors normally result in Analog Output alarm.

Errors are indicated in RRM by...

To see the error message do one of the following...

To be continued...

Table 6-2. Error messages.

Message	Description	Action
Invalid configuration.	At least one configuration parameter is outside allowed range. NOTE: the default values are used until the problem is solved.	• Load default database and restart the transmitter. • Contact Saab Rosemount service department if the problem persists.
RAM failure was detected during startup test.	The transmitter performs an immediate reset.	Contact Rosemount service department.
FEPROM failure was detected during startup test.	The transmitter performs an immediate reset.	Contact Rosemount service department.
Waveform acquisition failure.	This error is probably caused by hardware failure.	Contact Rosemount service department.
EEPROM factory checksum.	Checksum error in the factory configuration parameters. Can be caused by power failure during configuration or by hardware error. NOTE: the default values are used until the problem is solved.	Contact Rosemount service department.
EEPROM user checksum error.	Caused by error in the User Configuration parameters. Can be caused by power failure during configuration or by hardware error. NOTE: the default values are used until the problem is solved	• Load default database and restart the transmitter. • Contact Saab Rosemount service department if the problem persists.
Software error.		Contact Rosemount service department.

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Warnings.

Table 6-3 is a list of diagnostic messages that may be displayed on the Integral Display, on the Model 275 HART Communicator or by the Rosemount Radar Master (RRM) software. Warnings are less serious than errors and in most cases do not result in Analog Output alarms.

Warnings are indicated by...

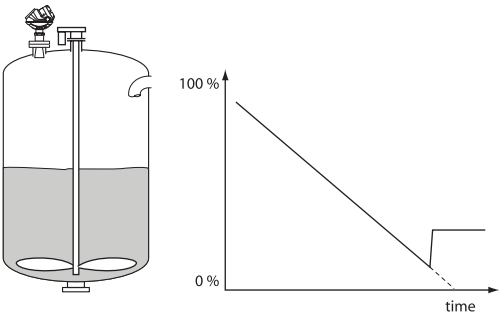
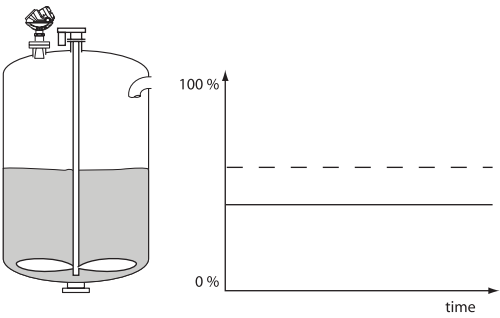
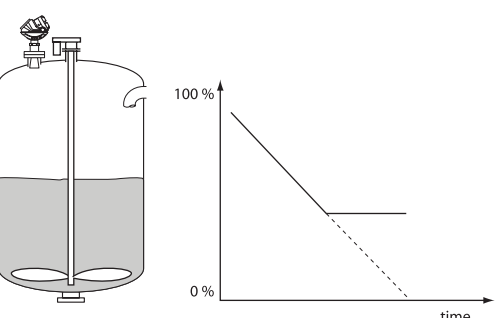
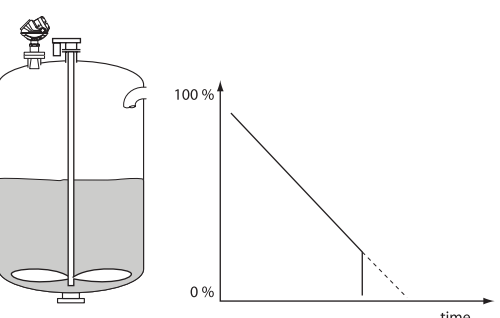
To see the warning message do one of the following...

Table 6-3. Warning messages.

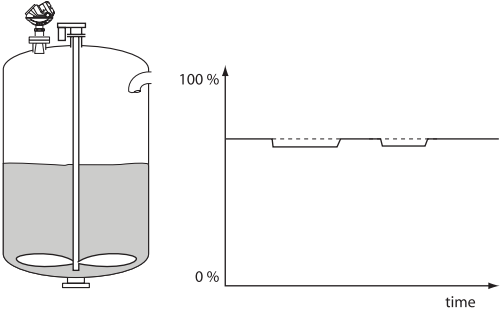
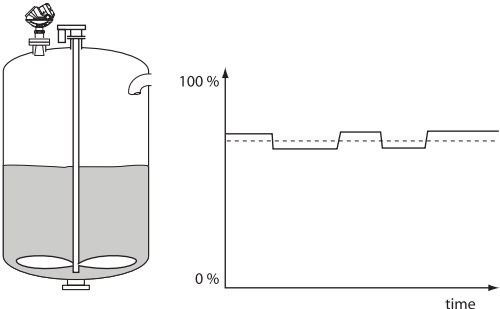
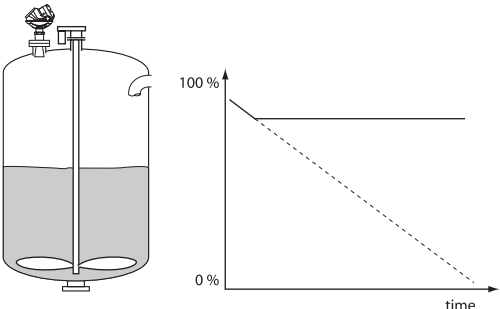
Message	Description	Action
No level pulse is found.	Possible cause: • Wrong threshold level T2. • Liquid level in Dead Zone or below probe end.	• View the waveform plot and check amplitude threshold T2.
Internal temperature out of range.	-40 °C<Internal Temperature<85 °C.	Contact Rosemount service department.
Volume computation warning.	• Volume configuration error. • Strapping table error.	• Check that correct tank type is selected for volume configuration. • Check that tank dimensions for volume are correct. • If strapping table is used, check the level vs. volume points.

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Application Errors.

APPLICATION_ERROR_1.EPS  The diagram shows a tank with a level transmitter. The graph plots level percentage (0% to 100%) against time. A solid line shows the level decreasing linearly. At a certain point, the level jumps to a higher value (indicated by a dashed line) and then continues to decrease linearly. A horizontal line at the bottom of the tank indicates the sloping bottom.	Level jumps to a higher level near the bottom of the tank.	May be caused by sloping tank bottom. Action: • Make sure that parameter <i>Bottom always visible</i> is not set. • Increase parameter <i>Empty Tank Detection Area</i> if measurement in this region is not crucial. • Increase the <i>CFAR threshold</i> value.
APPLICATION_ERROR_2.EPS  The diagram shows a tank with a level transmitter. The graph plots level percentage (0% to 100%) against time. A solid line shows the level decreasing linearly. A dashed horizontal line is shown above the solid line, indicating an incorrect level measurement.	Incorrect Level.	Action: Check tank geometry configuration.
APPLICATION_ERROR_3.EPS  The diagram shows a tank with a level transmitter. The graph plots level percentage (0% to 100%) against time. A solid line shows the level decreasing linearly. At a certain point, the level drops to a lower value (indicated by a dashed line) and then continues to decrease linearly. A horizontal line at the bottom of the tank indicates the sloping bottom.	Measured value gets stuck.	May be caused by disturbing object in the tank Action: • Remove disturbing object. • Move the transmitter to another position. • Use the Echo Tuning function in RRM to register the false echo that causes the transmitter to lock on the wrong level.
APPLICATION_ERROR_EMPTY.EPS  The diagram shows a tank with a level transmitter. The graph plots level percentage (0% to 100%) against time. A solid line shows the level decreasing linearly. At a certain point, the level drops to 0% (indicated by a dashed line) and then continues to decrease linearly. A horizontal line at the bottom of the tank indicates the sloping bottom.	Measured value drops to empty tank.	May be caused by strong echoes from the tank bottom when product is slightly transparent. Action: • Make sure that parameter <i>Bottom always visible</i> is set.

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APPLICATION_ERROR_JUMFLOW.EPS  The diagram shows a tank with a radar level sensor. The graph plots level percentage (0% to 100%) against time. A solid line shows the measured level, which is initially at a steady state and then drops to a lower level. A dashed line shows the true level, which remains at the original steady state.	Measured level jumps to a lower value.	May be caused by: • Radar echo bouncing off from the surface to the tank roof and back to the surface. • Product with very high reflectivity that causing very strong echoes. • Two products layered in the tank. Action: • Move the transmitter away from the center of the tank roof. • Enable the <i>Double Bounce</i> function. • Enable the <i>Double Surface</i> function
APPLICATION_ERROR_AROUNDSTABLE.EPS  The diagram shows a tank with a radar level sensor. The graph plots level percentage (0% to 100%) against time. A solid line shows the measured level, which oscillates around a steady state. A dashed line shows the true level, which remains at the original steady state.	Measured level oscillates around a steady value.	May be caused by: • Foam on the product surface. • Turbulent product surface. Action: • Enable the Tank Environment <i>Foam</i> parameter. • Enable the Tank Environment <i>Turbulent Surface</i> parameter.
APPLICATION_ERROR_TOP.EPS  The diagram shows a tank with a radar level sensor. The graph plots level percentage (0% to 100%) against time. A solid line shows the measured level, which starts at a steady state and then rises to 100%, where it gets stuck. A dashed line shows the true level, which continues to rise linearly.	Measured level gets stuck near the top of the tank.	May be caused by: • Antenna tip ends inside the tank nozzle. • Disturbing objects near the antenna. Action: • Cut the nozzle. • Increase the <i>Hold Off</i> distance.

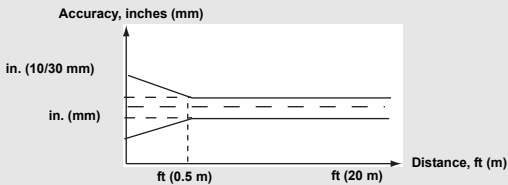
Rosemount 5400 Series

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Appendix A Reference Data

Specifications	page A-1
Dimensional drawings	page A-3
Ordering Information	page A-4
Spare Parts	page A-8

SPECIFICATIONS

General	
Product	Rosemount 5400 Series Radar Level Transmitter.
Measurement Principle	Pulsed, free propagating radar. 5401: ~6 GHz 5402: ~26 GHz
Reference Conditions	Free space reflection from flat metal plate, ambient temperature and pressure, minimum damping
Microwave Output Power	TBD
Beam Angle	5401: 2, 3, 4, 6, 8 in. cone 5401: 6, 8 in. disc 5402: 2, 3, 4 in. cone 5402: 2, 3, 4 in. disc
Measuring Performance	
Instrument Accuracy	± 0.1 in. (± 3 mm)
Resolution	0.04 in. (1 mm)
Repeatability	± 0.04 in. (± 1 mm) at 5 m distance.
Ambient Temperature Effect	± 0.005 % of measured distance per 50°F (10°C)
Update Interval	1 per second.
Measuring Range	0-98.4 ft (0-30 m) from antenna tip, measured from mounting flange face???Kan man ange ett nedre samt ett övre värde för samtliga antenner (då får man med övre dödzon, eller vad vi väljer att kalla denna parameter för, per automatik). See Measuring range for details. Near zone accuracy?. Olika 5401/5402/cone/disc/storlekar. Hur presentera?
	
Level Rate	10 mm/s as default, adjustable to 200 mm/s.
MTBF	> 80 years @ 77°F (25°C).
Display / Configuration	
Integral Display	The 6-digit local integral display can toggle between all process variables (level, distance, volume, internal temperature, peak amplitudes, percentage of range, analog current out) and has 15 mm digit size. It also shows diagnostics and error information. Note! The display cannot be used for configuration purposes.

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Output Variables	Level, Distance and Volume
Output Units	Level and Distance: ft, inch, m, cm or mm Volume: ft ³ , inch ³ , US gals, Imp gals, barrels, yd ³ , m ³ or liters
Configuration Tools	RRM, HART 275 / 375, AMS
Electric	
Power Supply	Loop-powered (2-wire), 11-42 VDC
Power Consumption	TBD
Output	Alternative 1: HART® + 4-20 mA current loop (non-IS or IS option) Alternative 2: Foundation fieldbus (optional IS version)
Signal on Alarm	Standard: Low=3.75 mA, High=21.75 mA NAMUR NE43: Low=3.6 mA, High=22.5 mA
Linearity	TBD.
Temperature Drift	TBD, sid 41?
Output Impedance	TBD
External Loop Resistance	See diagrams on page 12
IS Parameters	See "Hazardous Locations Certifications" on page 13
Cable Entry	M20x1.5, 1/2 in
Output Cabling	18-12 AWG?
Mechanical	
Antennas	2, 3, 4, 6, 8 in. See "Antennas" on page 7, pageA-4 and A-6.
Antenna Material Exposed to Tank Atmosphere	316 / 316L SST, Teflon (PTFE or equivalent) and O-ring material (see "Ordering Information" on page 15 and A-6)
Housing / Enclosure	Polyurethane-covered Aluminum
Dimensions	See "Dimensional Drawings" on page 14.
Height above flange	TBD
Weight, excl. flange	TBD
Flanges / Threads	See "Ordering Information" on page 15 and A-6.
Nozzle Height	Up to 20 in. (500 mm)
Environment	
Ambient Temperature	-40°F to 176°F (-40°C to 80°C). For the LCD display, the temperature range is -4°F to 130°F (-20°C to 55°C)
Storage Temperature	-58°F to 194°F (-50°C to 90°C)
Process Temperature	-40°F to 392°F (-40°C to 200°C)
Process Pressure	Full vacuum to 580 psig (-1 bar to 40 bar) at 302°F (150°C)
Humidity	0 - 100% Relative Humidity, 100 % Relative Humidity at 176°F (80°C)
Factory Sealed	Yes.
Ingress Protection	NEMA 4X, IP65, 66, 67
EU Directive compliance	CE mark, 93/68/EEC (complies with applicable directives: R&TTE, EMC, ATEX)
ATEX directive	94/9/EC
Overfill Protection Approval	WHG overfill protection
Telecommunication (FCC and R&TTE)	FCC part 15 (1998) subpart B and R&TTE (EU directive 1999/5/EC). Considered to be an unintentional radiator under the Part 15 rules.
Vibration Resistance	According to IACS UR E10
Electromagnetic Compatibility	Emission and Immunity: EMC directive 89/336/EEC (CISPR16 Class A level) and NAMUR recommendations NE21, closed metal tanks.???
EMI/RFI	in addition to requirements for CE mark NAMUR????
Transient / Built-in Lightning Protection	Complies with IEEE 587 Category B transient protection and IEEE 472 surge protection
Pressure Equipment Directive (PED)	Compliance.
Ordinary Location FM 3810	Compliance.
Boiler Approval CSA B51-97	Compliance.

Rosemount 5400 Series

DIMENSIONAL
DRAWINGS

Figure A-1. Dimensions of 5401
Series transmitter Low
Frequency version with cone
antenna.

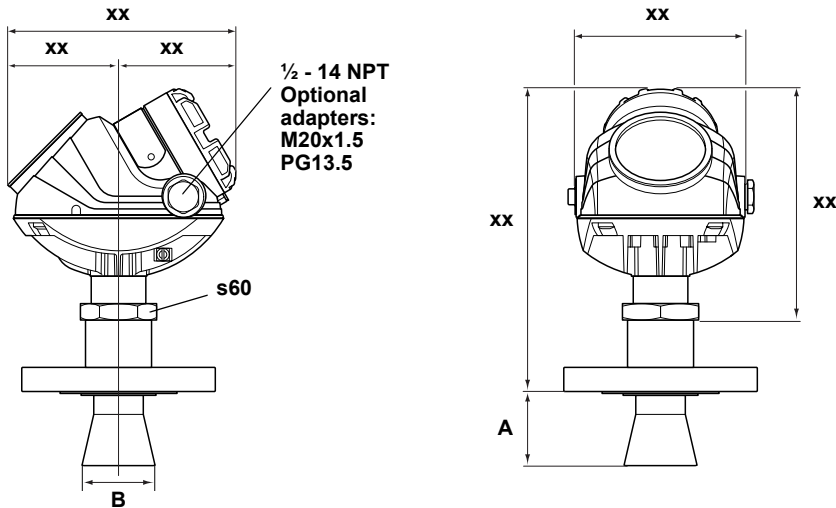
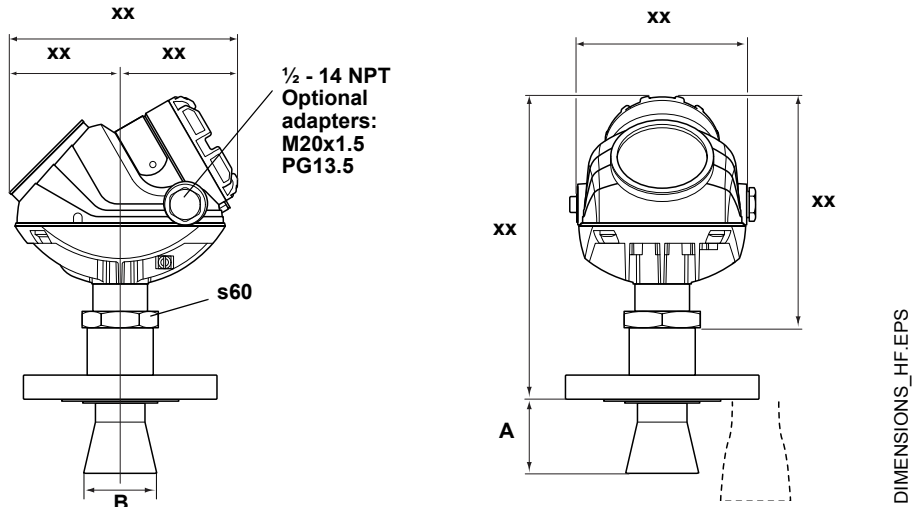


Figure A-2. Dimensions of 5402
Series transmitter High
Frequency version with cone
antenna.



5401		
Cone size (inch)	A	B
2	100 (4.0)	
3		
4		
6		
8		

5402		
Cone size (inch)	A	B
2	100 (4.0)	
3		
4		

Rosemount 5400 Series

ORDERING INFORMATION

Model Code for Rosemount 5401, Low Frequency (C-band)

Model	Product Description	
5401	Low frequency version	
Code	Housing Material	
A	Polyurethane-covered Aluminum	
Code	Signal Output	
H	4-20 mA with HART® communication	
F	FOUNDATION™ fieldbus (AI block only)	
Code	Conduit / Cable Threads	
1	1/2 inch - 14 NPT	
2	M20 x 1.5 adapter	
Code	Product Certifications	
NA	No Hazardous Locations Certifications	
E1	ATEX Flameproof	
I1	ATEX Intrinsic Safety	
IA	ATEX FISCO Intrinsic Safety (requires FOUNDATION™ fieldbus Signal Output)	
E5	FM Explosion Proof	
I5	FM Intrinsic Safety and Non-incendive	
IE	FM FISCO Intrinsic Safety (requires FOUNDATION™ fieldbus Signal Output)	
E6	CSA Explosion Proof	
I6	CSA Intrinsic Safety	
IF	CSA FISCO Intrinsic Safety (requires FOUNDATION™ fieldbus Signal Output)	
Code	Antenna - Size and Material	
	Cone Antennas	
2S	2 in. DN 50, 316 / 316 L SST (EN 1.4404)	(pipe installations only)
3S	3 in. DN 80, 316 / 316 L SST (EN 1.4404)	(pipe installations only)
4S	4 in. DN 100, 316 / 316 L SST (EN 1.4404)	
6S	6 in. DN 150, 316 / 316 L SST (EN 1.4404)	
8S	8 in. DN 200, 316 / 316 L SST (EN 1.4404)	
	PTFE Disc Antennas	
4P	4 in. PTFE, DN 100, 316 / 316 L SST (EN 1.4404)	
6P	6 in. PTFE, DN 150, 316 / 316 L SST (EN 1.4404)	
	Other Antennas	
XX	Customer specific	
Code	Tank Sealing	
PV	PTFE with Viton o-rings	
PK	PTFE with Kalrez 6375 o-rings	
PE	PTFE with EPDM o-rings	
PB	PTFE with Buna-N o-rings	
PD	PTFE disc antenna (o-rings not needed)	(only for disc antenna)
Code	Process Connection and Material	
	ANSI Flanges	
AA	2 inch, 150 lbs, 316 / 316 L SST (EN 1.4404)	
AB	2 inch, 300 lbs, 316 / 316 L SST (EN 1.4404)	
BA	3 inch, 150lbs, 316 / 316 L SST (EN 1.4404)	
BB	3 inch, 300 lbs, 316 / 316 L SST (EN 1.4404)	
CA	4 inch, 150 lbs, 316 / 316 L SST (EN 1.4404)	
CB	4 inch, 300 lbs, 316 / 316 L SST (EN 1.4404)	
DA	6 inch, 150 lbs, 316 / 316 L SST (EN 1.4404)	
EA	8 inch, 150 lbs, 316 / 316 L SST (EN 1.4404)	
Code	Process Connection and Material, continued (5401)	
	DIN Flanges	

Rosemount 5400 Series

HB	DN 50 PN 40, 316 / 316 L SST (EN 1.4404)
IB	DN 80 PN 40, 316 / 316 L SST (EN 1.4404)
JA	DN 100 PN 16, 316 / 316 L SST (EN 1.4404)
JB	DN 100 PN 40, 316 / 316 L SST (EN 1.4404)
KA	DN 150 PN 16, 316 / 316 L SST (EN 1.4404)
LA	DN 200 PN 16, 316 / 316 L SST (EN 1.4404)
JIS Flanges	
TA	10 K 50 A, 316 / 316 L SST (EN 1.4404)
UA	10 K 80 A, 316 / 316 L SST (EN 1.4404)
VA	10 K 100 A, 316 / 316 L SST (EN 1.4404)
YA	10 K 150 A, 316 / 316 L SST (EN 1.4404)
ZA	10 K 200 A, 316 / 316 L SST (EN 1.4404)
Other Flanges	
XX	Customer specific
Code	Options
M1	Integral digital display
BT	Bar Code Tag with tag number and purchase order number
T1	Transient Protection Terminal Block (standard with FISCO)
SP	Weather Protection Shield
GS	Guaranteed start-up at -58°F (-50°F)
Software Configuration	
C1	Factory configuration (CDS required with order)
Alarm Limit Configuration	
C4	NAMUR alarm and saturation levels, high alarm
C5	NAMUR alarm and saturation levels, low alarm
C8	Low alarm ⁽¹⁾ (standard Rosemount alarm and saturation levels)
Special Certificates	
Q4	Calibration Data Certificate
Q8	Material Traceability Certification per EN 10204 3.1B ⁽²⁾
Special Procedures	
P1	Hydrostatic testing
Overfill	
U1	Overfill protection according to German WHG/TÜV
Plantweb Functionality	
A1	Regulatory Control: PID. (Requires FOUNDATION™ fieldbus)
D1	Diagnostics suite
Antenna Extensions	
S1	100 mm, 316 / 316 L SST (EN 1.4404)
S2	200 mm, 316 / 316 L SST (EN 1.4404)
S3	300 mm, 316 / 316 L SST (EN 1.4404)
Customer Special	
XX	Special option
Typical Model Number: 5401 A F 1 IA 4P PD CA - M1 C1 A1	

(1) Standard alarm setting is freeze (high)?????

(2) Option available for pressure retaining wetted parts.

Rosemount 5400 Series

Model Code for Rosemount 5402, High Frequency (K-band)

Model	Product Description	
5402	High frequency version	
Code	Housing Material	
A	Polyurethane-covered Aluminum	
Code	Signal Output	
H	4-20 mA with HART® communication	
F	FOUNDATION™ fieldbus (AI block only)	
Code	Conduit / Cable Threads	
1	1/2 inch - 14 NPT	
2	M20 x 1.5 adapter	
Code	Product Certifications	
NA	No Hazardous Locations Certifications	
E1	ATEX Flameproof	
I1	ATEX Intrinsic Safety	
IA	ATEX FISCO Intrinsic Safety (requires FOUNDATION™ fieldbus Signal Output)	
E5	FM Explosion Proof	
I5	FM Intrinsic Safety and Non-incendive	
IE	FM FISCO Intrinsic Safety (requires FOUNDATION™ fieldbus Signal Output)	
E6	CSA Explosion Proof	
I6	CSA Intrinsic Safety	
IF	CSA FISCO Intrinsic Safety (requires FOUNDATION™ fieldbus Signal Output)	
Code	Antenna - Size and Material	
	Cone Antennas	
2S	2 in. DN 50, 316 / 316 L SST (EN 1.4404)	(pipe installations only)
3S	3 in. DN 80, 316 / 316 L SST (EN 1.4404)	(pipe installations only)
4S	4 in. DN 100, 316 / 316 L SST (EN 1.4404)	
	PTFE Disc Antennas	
2P	2 in. PTFE, DN 50, 316 / 316 L SST (EN 1.4404)	
3P	3 in. PTFE, DN 80, 316 / 316 L SST (EN 1.4404)	
4P	4 in. PTFE, DN 100, 316 / 316 L SST (EN 1.4404)	
	Other Antennas	
XX	Customer specific	
Code	Tank Sealing	
PV	PTFE with Viton o-rings	
PK	PTFE with Kalrez 6375 o-rings	
PE	PTFE with EPDM o-rings	
PB	PTFE with Buna-N o-rings	
PD	PTFE disc antenna (o-rings not needed)	(only for disc antenna)
Code	Process Connection and Material	
	ANSI Flanges	
AA	2 inch, 150 lbs, 316 / 316 L SST (EN 1.4404)	
AB	2 inch, 300 lbs, 316 / 316 L SST (EN 1.4404)	
BA	3 inch, 150lbs, 316 / 316 L SST (EN 1.4404)	
BB	3 inch, 300 lbs, 316 / 316 L SST (EN 1.4404)	
CA	4 inch, 150 lbs, 316 / 316 L SST (EN 1.4404)	
CB	4 inch, 300 lbs, 316 / 316 L SST (EN 1.4404)	
DA	6 inch, 150 lbs, 316 / 316 L SST (EN 1.4404)	
EA	8 inch, 150 lbs, 316 / 316 L SST (EN 1.4404)	
IB	DN 80 PN 40, 316 / 316 L SST (EN 1.4404)	
JA	DN 100 PN 16, 316 / 316 L SST (EN 1.4404)	
JB	DN 100 PN 40, 316 / 316 L SST (EN 1.4404)	
Code	Process Connection and Material, continued (5402)	

Rosemount 5400 Series

DIN Flanges	
HB	DN 50 PN 40, 316 / 316 L SST (EN 1.4404)
KA	DN 150 PN 16, 316 / 316 L SST (EN 1.4404)
LA	DN 200 PN 16, 316 / 316 L SST (EN 1.4404)
JIS Flanges	
TA	10 K 50 A, 316 / 316 L SST (EN 1.4404)
UA	10 K 80 A, 316 / 316 L SST (EN 1.4404)
VA	10 K 100 A, 316 / 316 L SST (EN 1.4404)
YA	10 K 150 A, 316 / 316 L SST (EN 1.4404)
ZA	10 K 200 A, 316 / 316 L SST (EN 1.4404)
Other Flanges	
XX	Customer specific
Code	Options
M1	Integral digital display
BT	Bar Code Tag with tag number and purchase order number
T1	Transient Protection Terminal Block (standard with FISCO)
SP	Weather Protection Shield
GS	Guaranteed start-up at -58°F (-50°F)
Software Configuration	
C1	Factory configuration (CDS required with order)
Alarm Limit Configuration	
C4	NAMUR alarm and saturation levels, high alarm
C5	NAMUR alarm and saturation levels, low alarm
C8	Low alarm ⁽¹⁾ (standard Rosemount alarm and saturation levels)
Special Certificates	
Q4	Calibration Data Certificate
Q8	Material Traceability Certification per EN 10204 3.1B ⁽²⁾
Special Procedures	
P1	Hydrostatic testing
Overfill	
U1	Overfill protection according to German WHG/TÜV
Plantweb Functionality	
A1	Regulatory Control: PID. (Requires FOUNDATION™ fieldbus)
D1	Diagnostics suite
Antenna Extensions	
S1	100 mm, 316 / 316 L SST (EN 1.4404)
S2	200 mm, 316 / 316 L SST (EN 1.4404)
S3	300 mm, 316 / 316 L SST (EN 1.4404)
Customer Special	
XX	Special option
Typical Model Number: 5401 A F 1 IA 4P PD CA - M1 C1 A1	

(1) Standard alarm setting is freeze (high)?????

(2) Option available for pressure retaining wetted parts.

Rosemount 5400 Series

SPARE PARTS

Spare parts list Transmitter head Model 5401/5402

Model	Product Description
5401HF	High frequency version, 26 GHz
5401LF	Low frequency version, 6 GHz
Code	Cone Antenna - Size and Material
	Stainless Steel 316L (1.4...)
2S	2 in. DN 50 (pipe installations only)
3S	3 in. DN 80 (pipe installations only)
4S	4 in. DN 100
6S	6 in. DN 150 (only available for 5401LF)
8S	8 in. DN 200 (only available for 5401LF)
	Hastelloy (HC..)
2H	2 in. DN 50 (pipe installations only)
3H	3 in. DN 80 (pipe installations only)
4H	4 in. DN 100
6H	6 in. DN 150 (only available for 5401LF)
8H	8 in. DN 200 (only available for 5401LF)
Code	Antenna Extensions (delivered in same material as antenna)
XX	No antenna extension
X1	100 mm
X2	200 mm
X3	300 mm
Code	Tank Sealing
PV	PTFE with Viton o-rings
PK	PTFE with Kalrez o-rings
PE	PTFE with EPDM o-rings
Code	Flange Process Connection
	ANSI Flanges
AA	2 inch, 150 lbs
AB	2 inch, 300 lbs
AC	2 inch, 600 lbs
BA	3 inch, 150lbs
BB	3 inch, 300 lbs
BC	3 inch, 600 lbs
CA	4 inch, 150 lbs
CB	4 inch, 300 lbs
CC	4 inch, 600 lbs
DA	6 inch, 150 lbs
DB	6 inch, 300 lbs
DC	6 inch, 600 lbs
EA	8 inch, 150 lbs
EB	8 inch, 300 lbs
EC	8 inch, 600 lbs
	DIN Flanges
HA	DN 50 PN 16
HB	DN 50 PN 40
HC	DN 50 PN 64
IA	DN 80 PN 16
IB	DN 80 PN 40
IC	DN 80 PN 64
JA	DN 100 PN 16
JB	DN 100 PN 40
JC	DN 100 PN 64
Code	Flange Process Connection

Rosemount 5400 Series

KA	DN 150 PN 16
KB	DN 150 PN 40
Code	Flange Process Connection, continued
DC	DN 150 PN 64
EA	DN 200 PN 16
EB	DN 200 PN 40
EC	DN 200 PN 64
	JIS Flanges
PA	
PB	
PC	
QA	
QB	
QC	
RA	
RB	
RC	
SA	
SB	
SC	
TA	
TB	
TC	
Code	Signal Output
H	4-20 mA with HART® communication
F	Fieldbus Foundation
Code	Housing Material
A	Polyurethane-covered Aluminum
Code	Conduit / Cable Threads
1	1/2 inch - 14 NPT
2	M20 x 1.5 adapter
3	PG 13.5 adapter
Code	Product Certifications
NA	No Hazardous Locations Certifications
E1	ATEX Flameproof
E4	JIS Flameproof
E5	FM Explosion Proof
E6	CSA Explosion Proof
E7	SAA Flameproof
E?	GOSStandart Flameproof
E?	GP (China) Flameproof
I1	ATEX Intrinsic Safety
I4	JIS Intrinsic Safety
I5	FM Intrinsic Safety and Non-incendive
I6	CSA Intrinsic Safety
I7	SAA Intrinsic Safety
I?	GOSStandart Intrinsic Safety
I?	GP (China) Intrinsic Safety
IA	ATEX FISCO Intrinsic Safety (requires Fieldbus Foundation Signal Output)
ID	JIS FISCO Intrinsic Safety (requires Fieldbus Foundation Signal Output)
IE	FM FISCO Intrinsic Safety (requires Fieldbus Foundation Signal Output)
IF	CSA FISCO Intrinsic Safety (requires Fieldbus Foundation Signal Output)
IG	SAA FISCO Intrinsic Safety (requires Fieldbus Foundation Signal Output)
??	Overfill protection according to German WHG/TÜV
??	Telecom certification for non-metal tanks
Typical Model Number: 5401LF 2S XX PV AA H A 1 E1 M1 ?? C1	

Rosemount 5400 Series

Appendix B Hazardous Approvals

Safety messages	page B-1
European Atex Directive Information	page B-3
Hazardous Locations Certifications	page B-5
Approval Drawings	page B-7

SAFETY MESSAGES

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

⚠ WARNING

Explosions could result in death or serious injury:

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

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

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

⚠ WARNING

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

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

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

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

Substitution of components may impair Intrinsic Safety.

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



 WARNING

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

Avoid contact with leads and terminals.

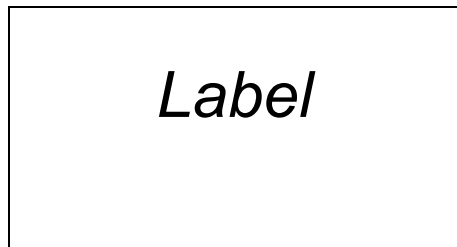
Make sure the main power to the Radar Transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

EUROPEAN ATEX DIRECTIVE INFORMATION

Intrinsic Safety

The Rosemount 5400 Series Transmitter that has the following label attached has been certified to comply with Directive 94/9/EC of the European Parliament and the Council as published in the Official Journal of the European Communities No. L 100/1 on 19-April-1994.

Figure B-1. Approval Label
ATEX (KEMA) and Name Plate



The following information is provided as part of the label of the transmitter:

- Name and address of the manufacturer (Rosemount).
- CE Conformity Marking



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



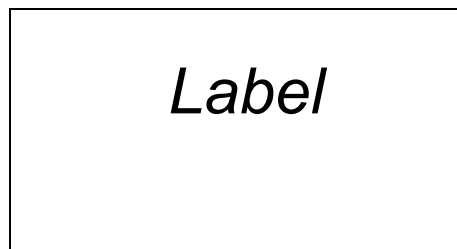
- EEx ia IIC T4 ($-40\text{ }^{\circ}\text{C} \leq T_a \leq +70\text{ }^{\circ}\text{C}$)
U_i=xx V
I_i=xx mA
P_i=x W
C_i=x, L_i=x
- xx ATEX certificate number:

Rosemount 5400

Flame Proof

The Rosemount 5400 Series Transmitter that has the following label attached has been certified to comply with Directive 94/9/EC of the European Parliament and the Council as published in the Official Journal of the European Communities No. L 100/1 on 19-April-1994.

Figure B-2. Approval Label
ATEX (KEMA) and Name Plate



The following information is provided as part of the label of the transmitter:

- Name and address of the manufacturer (Rosemount).
- CE Conformity Marking



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



- EEx d[ia]ia IIC T4 (-40 °C < Ta < +70 °C)
- KEMA ATEX certificate number: KEMA 01ATEXyyyy

HAZARDOUS LOCATIONS CERTIFICATIONS

Factory Mutual (FM) Approvals

Figure B-3. Approval Labels
Factory Mutual (FM)

The Rosemount 5400 Series Transmitters that have the following labels attached have been certified to comply with the requirements of the approval agencies noted.



- E5** Explosion-Proof for Class I, Division 1, Groups A, B, C and D.
Dust-Ignition proof for Class II/III, Division 1, Groups E, F and G; with intrinsically safe connections to Class I, II, III, Div 1, Groups A, B, C, D, E, F and G.
Temperature class T4 @+70 °C.
Ambient temperature limits: -40°C to + 70°C
Factory Sealed.
- I5** Intrinsically Safe for Class I, II, III, Division 1, Groups A, B, C, D and G.
Intrinsically Safe for Class I, Zone 0, AEX ia IIC T4 Ta=70°C.
Temperature code T4 at 70°C max ambient.
Control Drawing: xxx.
Non-incendive for Class I, Division 2, Groups A, B, C and D.
Suitable for Class II, III, Division 2, Groups F and G.
Non-incendive maximum operating parameters: 42 V, 25 mA.
Temperature code T4 at 70°C max ambient.

Rosemount 5400

Canadian Standards Association (CSA) Approval

Cert. no. xxxx.

Figure B-4. Approval Label
Canadian Standards Association
(CSA)



- E6** Explosion-Proof for Class I, Division 1, Groups C and D.
Dust Ignition Proof for Class II, Div. 1 and 2, Groups E, F and G.
Dust-Ignition proof for Class III, Division 1, Hazardous Locations
[Ex ia IIC T4] Ex ia IIC T4.
Ambient temperature limits: -40°C to + 70°C.
Factory Sealed.
- I6** Intrinsically Safe: Ex ia IIC T4.
Intrinsically Safe for Class I, Division 1, Groups A, B, C and D.
Temperature code T4.
Control Drawing: xxxx.
Non-incendive for Class III, Division 1, Hazardous Locations.
Non-incendive for Class I, Division 2, Groups A, B, C and D.
Ambient temperature limits: -40 °C to + 70 °C.

APPROVAL DRAWINGS

This section contains Factory Mutual installation drawings and Canadian Standards installation drawings. You must follow the installation guidelines presented in order to maintain certified ratings for installed transmitters.

This section contains the following drawings:

Saab Rosemount drawing 91500xx-xxx, Issue 1:

System Control Drawing for hazardous location installation of intrinsically safe FM approved apparatus.

Saab Rosemount drawing 91500xx-xxx, Issue 1:

System Control Drawing for hazardous location installation of CSA approved apparatus.

Figure B-5. System Control Drawing for hazardous location installation of intrinsically safe FM approved apparatus.

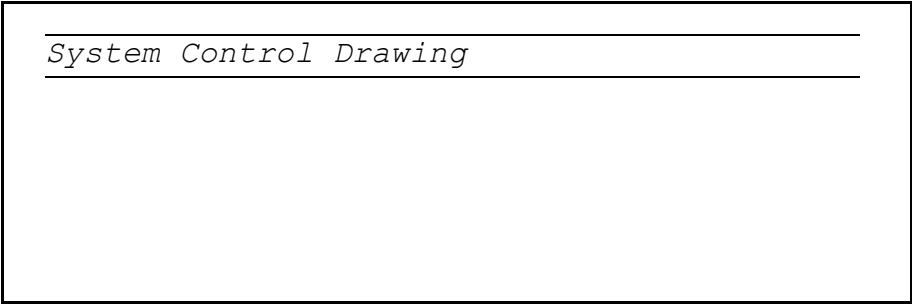
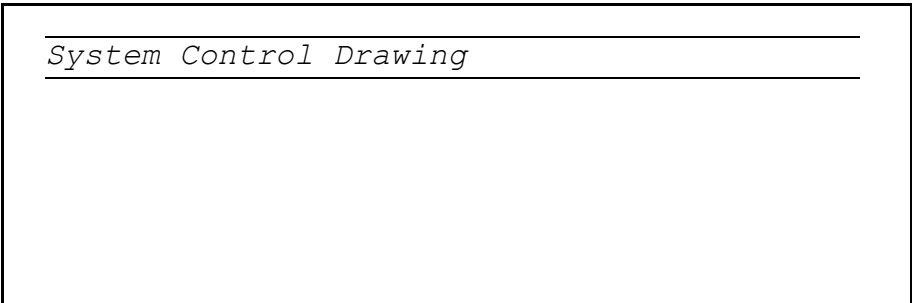


Figure B-6. System Control Drawing for hazardous location installation of CSA approved apparatus.



Rosemount 5400

Appendix C HART Communicator

Introduction	page C-1
Safety Messages	page C-1
Connections	page C-5
Basic Features	page C-6
Menus and Functions	page C-8

INTRODUCTION

This appendix provides an introduction to using the HART Communicator with the Rosemount Model 5400 transmitter, including the HART Communicator keypad, connections, menu structure and Fast Key sequence features.

The HART Communicator manual provides detailed instructions on the use and features of the HART Communicator. This brief summary will familiarize you with the HART Communicator but is not meant to replace the HART Communicator manual. For information on all the capabilities of the HART Communicator, refer to the HART Communicator Product Manual (document 00809-0100-4275).

SAFETY MESSAGES

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

⚠ WARNING

Explosions could result in death or serious injury:

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

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

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

 WARNING

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

Make sure only qualified personnel perform the installation.

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

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

As a matter of routine, the Model 3300 transmitter and all other equipment in your tank should be shut off prior to entering the tank.

Figure C-1. HART Communicator Tree

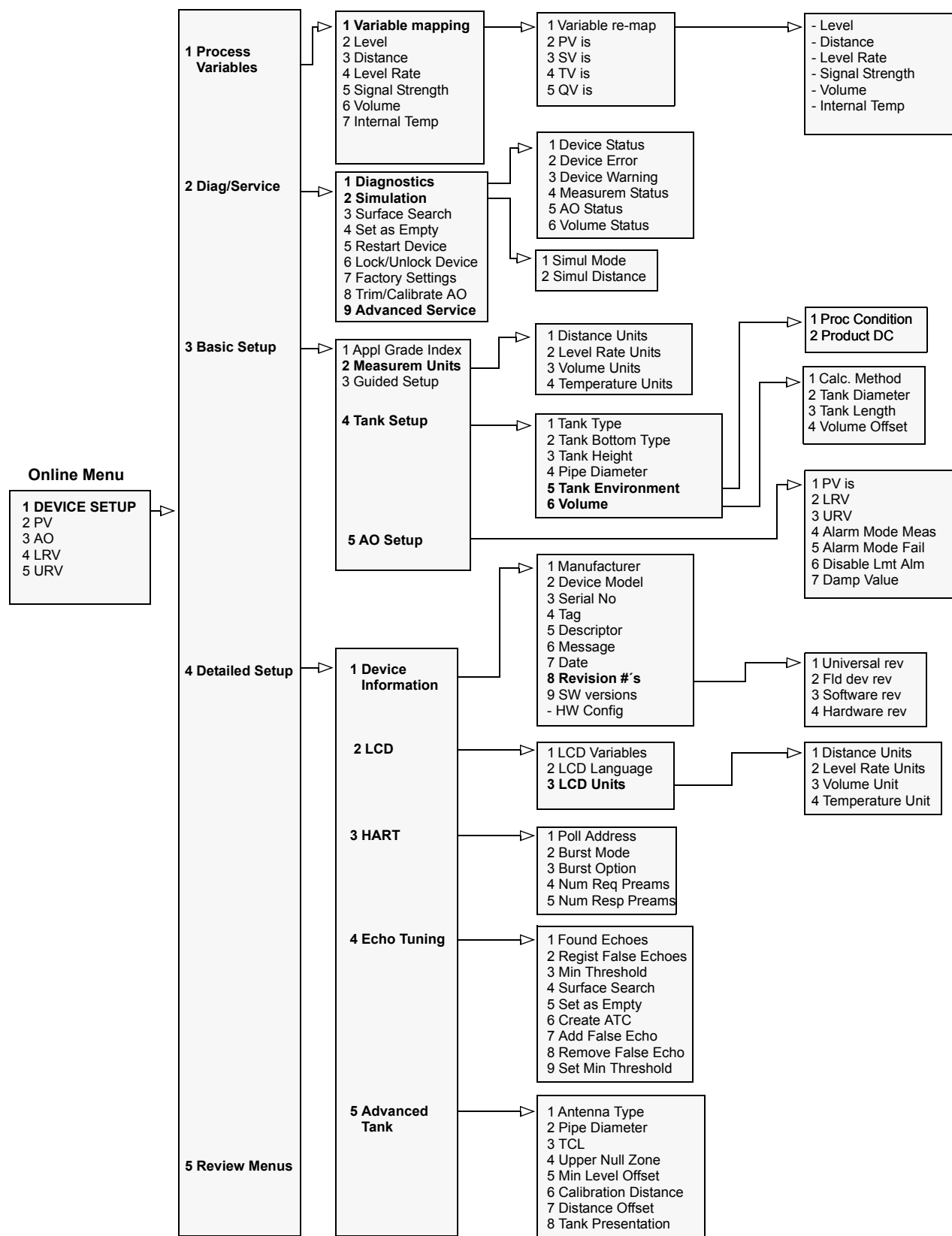


Table C-1. HART Fast Key Sequences

Ska anpassas till 5400!

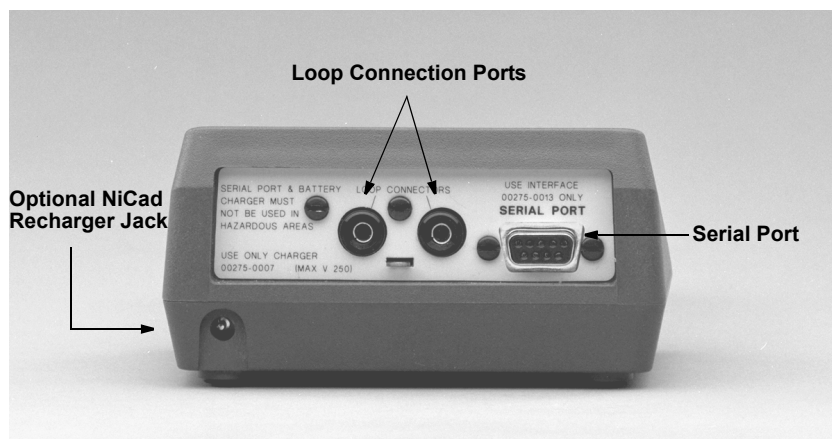
Function	HART Fast Key
Device Information	1, 4, 1
Display Language	1, 4, 2, 2
Display Variables	1, 4, 2, 1
Level Units	1, 3, 2, 1
Loop Test	1, 2, 2
Lower Range Value (LRV) (4 mA)	1, 3, 3
Master Reset	1, 2, 1, 2
Measurement Mode	1, 3, 9
Poll Address	1, 4, 5, 2, 1
Primary Variable	1, 1, 1, 1
Antenna Type	1, 4, 5, 1
Product Dielectric	1, 3, 8
Range Values	1, 3, 3, 2
Reference Gauge Height	1, 3, 4
Strapping Table	1, 4, 3, 4
Tag	1, 3, 1
Tank Type	1, 4, 3, 1
Tank Diameter	1, 4, 3, 2
Temperature Units	1, 3, 2, 3
Upper Null Zone	1, 4, 4, 5
Upper Range Value (URV) (20 mA)	1, 3, 3
Vapor Dielectric	1, 3, 7
Variable Remapping	1, 1, 1, 1
Volume Units	1, 3, 2, 2

CONNECTIONS

The HART Communicator exchanges information with the 5400 Series transmitters from the control room, the instrument site, or any wiring termination point in the loop. The HART Communicator should be connected in parallel with the transmitter. Use the loop connection ports on the rear panel of the HART Communicator (see Figure C-2). The connections are non-polarized.

 Do not make connections to the serial port or NiCad recharger pack in an explosive atmosphere.

Figure C-2. Rear connection panel with Optional NiCad Recharger Jack



008AB

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

NOTE

The HART Communicator needs a minimum of 250 ohms resistance in the loop to function properly. The HART Communicator does not measure loop current directly.

NOTE

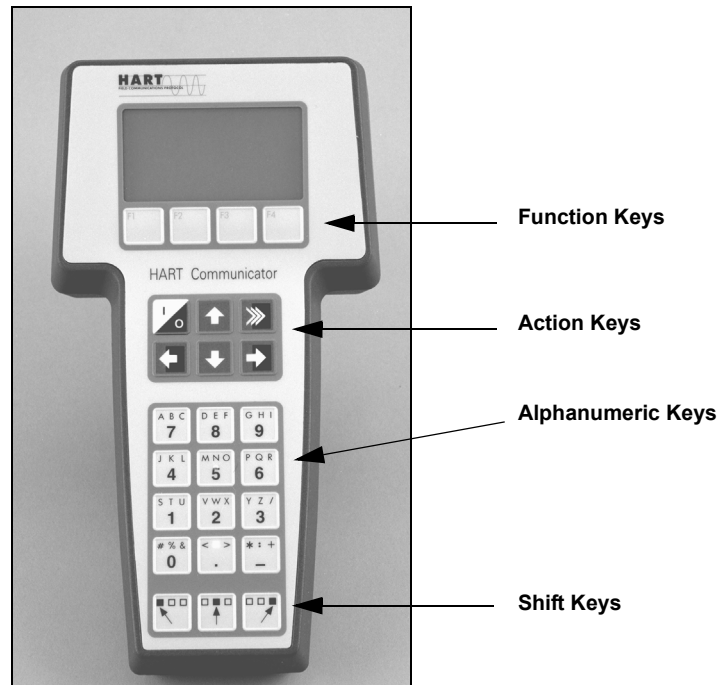
Loop must be broken to insert the 250 ohm load resistor.

Rosemount 5400 Series

BASIC FEATURES

The keys of the HART Communicator include action keys, function keys, alphanumeric keys, and shift keys.

Figure C-3. 275 HART Communicator



011AB

Action Keys

As shown in Figure C-3, the action keys are the six blue, white, and black keys located above the alphanumeric keys. The function of each key is described as follows

ON/OFF Key

Use this key to power the HART Communicator. When the communicator is turned on, it searches for a gauge on the 4–20 mA loop. If a device is not found, the communicator displays the message, “No Device Found. Press OK.”

If a HART-compatible device is found, the communicator displays the Online Menu with device ID and tag.

If a HART-compatible device is found, the communicator displays the Online Menu with device ID and tag.

Directional Keys

Use these keys to move the cursor up, down, left, or right. The right arrow key also selects menu options, and the left arrow key returns to the previous menu.

HOT Key

Use this key to quickly access important, user-defined options when connected to a HART-compatible device. Pressing the Hot Key turns the HART Communicator on and displays the Hot Key Menu. See Customizing the Hot Key Menu in the HART Communicator manual for more information.

Function Keys



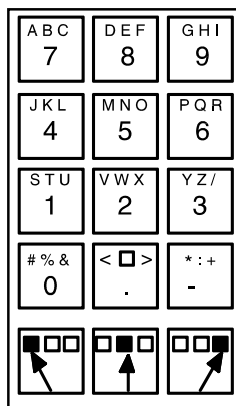
Use the four software-defined function keys, located below the LCD, to perform software functions. On any given menu, the label appearing above a function key indicates the function of that key for the current menu.

As you move among menus, different function key labels appear over the four keys. For example, in menus providing access to online help, the **HELP** label may appear above the F1 key. In menus providing access to the Home Menu, the **HOME** label may appear above the F3 key. Press the key to activate the function. See the HART Communicator manual for details on specific Function Key definitions.

Alphanumeric and Shift Keys

The Alphanumeric keys perform two functions: fast selection of menu options (refer to HART Fast Key Feature in this section) and data entry.

Figure C-4. HART Communicator Alphanumeric and Shift Keys



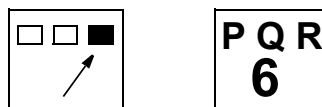
Some menus require data entry. Use the Alphanumeric and Shift keys to enter all alphanumeric information into the HART Communicator. If you press an Alphanumeric key alone from within an edit menu, the bold character in the center of the key appears. These large characters include the numbers zero through nine, the decimal point (.), and the dash symbol (–).

To enter an alphabetic character:

1. Press the Shift key that corresponds to the position on the Alphanumeric key of the letter you want.
2. Press the Alphanumeric key.

For example, to enter the letter R, first press the right Shift key, then the “6” key (see Figure C-5). Do not press these keys simultaneously, but one after the other.

Figure C-5. Data Entry Key Sequence



MENUS AND FUNCTIONS

The HART Communicator is a menu driven system. Each screen provides a menu of options that can be selected or provides direction for input of data, warnings, messages, or other instructions.

Main Menu

When the HART Communicator is turned on, one of two menus appears: the Online Menu or the Main Menu.

If the HART Communicator is connected to an operating loop, the communicator finds the device and displays the Online Menu.

If it is not connected to a loop, the communicator indicates that no device was found. When you press OK (F4), it displays the Main Menu.

The Main Menu provides the following options:

- *Offline* – The Offline option provides access to offline configuration data and simulation functions.
- *Online* – The Online option checks for a device and if it finds one, brings up the Online Menu. Online communication with the 3300 Series Transmitter automatically loads the current gauge data to the HART Communicator.
- *Transfer* – The Transfer option provides access to options for transferring data either from the HART Communicator (memory) to the 3300 Series Transmitter (device) or vice versa. Transfer is used to move offline data from the HART Communicator to the gauge, or to retrieve data from a gauge for offline revision.
- *Frequency Device* – The Frequency Device option displays the frequency output and corresponding pressure output of current-to-pressure transmitters.
- *Utility* – The Utility option provides access to the contrast control for the HART Communicator LCD screen and to the autopoll setting used in multidrop applications.

To select an option from the menu, you can use the up and down arrow keys and the select (right arrow) key or you can simply press the corresponding number on the alphanumeric keypad to “fast select” the option.

After selecting a Main Menu option, the HART Communicator provides the information you need to complete the operation. If further details are required, consult the *HART Communicator* manual.

Online Menu

The Online Menu can be selected from the Main Menu or it appears automatically if the HART Communicator is connected to an active loop and can detect an operating 3300 transmitter.

Online mode is used for direct evaluation of a particular meter, re-configuration, changing parameters, maintenance, and other functions.

When configuration variables are reset in online mode, the new settings are not activated until the data is sent to the gauge. Press SEND (F2) when it is activated to update the process variables of the 3300 transmitter.

NOTE

The Main Menu can be accessed from the Online Menu. Press the left arrow action key to deactivate the online communication with the gauge and to activate the Main Menu options.

HART Fast Key Feature

The HART Fast Key feature provides quick online access to gauge variables and functions. Instead of stepping your way through the menu structure using the Action Keys, you can press a HART Fast Key sequence to move from the Online Menu to the desired variable or function. On-screen instructions guide you through the rest of the screens.

The HART Fast Key sequences are made up of the series of numbers corresponding to the individual options in each step of the menu structure. For example, from the Online Menu you can change the **Date**. Following the menu structure, you would:

1. Press 1 to reach **Device Setup**.
2. Press 4 for **Detailed Setup**.
3. Press 1 for **Device Information**.
4. Press 5 for **Date**.

So, the corresponding HART Fast Key sequence is **1, 4, 1, 5**.

HART Fast Keys are operational only from the Online Menu. If you use them consistently, you return to the Online Menu by pressing HOME (F3) when it is available. If you do not start at the Online Menu, the HART Fast Keys will not function properly.

Use Table C-1, an alphabetical listing of online functions, to find the corresponding HART Fast Keys. These codes are applicable only to the 3300 Series and the HART Communicator.

Hart Communicator Diagnostic Messages

The following table is a list of messages used by the HART Communicator and their corresponding descriptions.

Variable parameters within the text of a message are indicated with *<variable label>*.

Reference to the name of another message is identified by *<message>*.

Table C-2. HART Communicator Diagnostic Messages

Message	Description
Add item for ALL device types or only for this ONE device type.	Asks the user whether the hot key item being added should be added for all device types or only for the type of device that is connected.
Command Not Implemented	The connected device does not support this function.
Communication Error	Either a device sends back a response indicating that the message it received was unintelligible, or the HC cannot understand the response from the device.
Configuration memory not compatible with connected device	The configuration stored in memory is incompatible with the device to which a transfer has been requested.
Device Busy	The connected device is busy performing another task.
Device Disconnected	Device fails to respond to a command.
Device write protected	Device is in write-protect mode. Data can not be written.
Device write protected. Do you still want to shut off?	Device is in write-protect mode. Press YES to turn the HC off and lose the unsent data.
Display value of variable on hotkey menu?	Asks whether the value of the variable should be displayed adjacent to its label on the hotkey menu if the item being added to the hotkey menu is a variable.
Download data from configuration memory to device	Prompts user to press SEND softkey to initiate a memory to device transfer.
Exceed field width	Indicates that the field width for the current arithmetic variable exceeds the device-specified description edit format.
Exceed precision	Indicates that the precision for the current arithmetic variable exceeds the device-specified description edit format.
Field device has malfunctioned due to a Hardware Error or Failure	The 3300 transmitter may simply be configured incorrectly (20 mA point in upper Null Zone, etc.) Verify the configuration.
Ignore next 50 occurrences of status?	Asked after displaying device status. Softkey answer determines whether next 50 occurrences of device status will be ignored or displayed.
Illegal character	An invalid character for the variable type was entered.
Illegal date	The day portion of the date is invalid.
Illegal month	The month portion of the date is invalid.
Illegal year	The year portion of the date is invalid.
Incomplete exponent	The exponent of a scientific notation floating point variable is incomplete.
Incomplete field	The value entered is not complete for the variable type.
Looking for a device	Polling for multidropped devices at addresses 1–15.
Mark as read only variable on hotkey menu?	Asks whether the user should be allowed to edit the variable from the hotkey menu if the item being added to the hotkey menu is a variable.
No device configuration in configuration memory	There is no configuration saved in memory available to re-configure offline or transfer to a device.
No Device Found	Poll of address zero fails to find a device, or poll of all addresses fails to find a device if auto-poll is enabled.
No hotkey menu available for this device.	There is no menu named “hotkey” defined in the device description for this device.
No offline devices available.	There are no device descriptions available to be used to configure a device offline.
No simulation devices available.	There are no device descriptions available to simulate a device.
No UPLOAD_VARIABLES in ddl for this device	There is no menu named “upload_variables” defined in the device description for this device. This menu is required for offline configuration.
No Valid Items	The selected menu or edit display contains no valid items.
OFF KEY DISABLED	Appears when the user attempts to turn the HC off before sending modified data or before completing a method.
Online device disconnected with unsent data. RETRY or OK to lose data.	There is unsent data for a previously connected device. Press RETRY to send data, or press OK to disconnect and lose unsent data.
Out of memory for hotkey configuration. Delete unnecessary items.	There is no more memory available to store additional hotkey items. Unnecessary items should be deleted to make space available.

Table C-2. HART Communicator Diagnostic Messages

Message	Description
Overwrite existing configuration memory	Requests permission to overwrite existing configuration either by a device-to-memory transfer or by an offline configuration. User answers using the softkeys.
Press OK...	Press the OK softkey. This message usually appears after an error message from the application or as a result of HART communications.
Restore device value?	The edited value that was sent to a device was not properly implemented. Restoring the device value returns the variable to its original value.
Save data from device to configuration memory	Prompts user to press SAVE softkey to initiate a device-to-memory transfer.
Saving data to configuration memory.	Data is being transferred from a device to configuration memory.
Sending data to device.	Data is being transferred from configuration memory to a device.
There are write only variables which have not been edited. Please edit them.	There are write-only variables which have not been set by the user. These variables should be set or invalid values may be sent to the device.
There is unsent data. Send it before shutting off?	Press YES to send unsent data and turn the HC off. Press NO to turn the HC off and lose the unsent data.
Too few data bytes received	Command returns fewer data bytes than expected as determined by the device description.
Transmitter Fault	Device returns a command response indicating a fault with the connected device.
Units for <variable label> has changed. Unit must be sent before editing, or invalid data will be sent.	The engineering units for this variable have been edited. Send engineering units to the device before editing this variable.
Unsent data to online device. SEND or LOSE data	There is unsent data for a previously connected device which must be sent or thrown away before connecting to another device.
Use up/down arrows to change contrast. Press DONE when done.	Gives direction to change the contrast of the HC display.
Value out of range	The user-entered value is either not within the range for the given type and size of variable or not within the min/max specified by the device.
<message> occurred reading/writing <variable label>	Either a read/write command indicates too few data bytes received, transmitter fault, invalid response code, invalid response command, invalid reply data field, or failed pre- or post-read method; or a response code of any class other than SUCCESS is returned reading a particular variable.
<variable label> has an unknown value. Unit must be sent before editing, or invalid data will be sent.	A variable related to this variable has been edited. Send related variable to the device before editing this variable.

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