Reference Manual
00809-0100-5900, Rev CA
June 2014

Rosemount 5900S

Radar Level Gauge

FOUNDATION

ROSEMOUNT®
Tank Gauging

www.rosemount-tg.com

EMERSON™
Process Management

Rosemount 5900S
Radar Level Gauge

NOTICE

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

For equipment service or support needs, contact your local Emerson Process Management/Rosemount Tank Gauging representative.

Spare Parts

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

Rosemount Tank Radar AB will not take any responsibility for faults, accidents, etc caused by non-recognized spare parts or any repair which is not made by Rosemount Tank Radar AB.

Specific ETSI Requirements (Europe)

The Rosemount 5900S is required to be installed at a permanent fixed position at a closed (not open) metallic tank or reinforced concrete tank, or similar enclosure structure made of comparable attenuating material. Flanges and attachments of the Rosemount 5900S equipment shall provide the necessary microwave sealing by design.

Manholes or connection flanges at the tank shall be closed to ensure a low-level leakage of the signal into the air outside the tank.

Installation and maintenance of the Rosemount 5900S equipment shall be performed by professionally trained individuals only.

Specific FCC Requirements (USA)

Rosemount 5900S generates and uses radio frequency energy. If it is not installed and used properly, that is, in strict accordance with the manufacturer´s instructions, it may violate FCC regulations on radio frequency emission.

Rosemount TankRadar 5900S has been FCC certified under test conditions which assume a metallic tank.

Specific IC Requirements (Canada)

Radio approvals for this device apply for installation in complete enclosed container to prevent unwanted RF emission. In open air application site license is required. Installation shall be done by trained installers, in compliance with the manufacturer's instructions.

The use of this device is on a "no-interference, no-protection" basis. That is, the user shall accept operations of high-powered radar in the same frequency band which may interfere with or damage this device. Devices found to interfere with primary licensing operations will be required to be removed at the user's expense.

Low Emission of Microwave Radiation

The microwave radiation emitted by a Rosemount 5900S radar level gauge is very low compared to limits given by the Rec. 1999/519/EC (much less than 0.1 mW). No additional safety measures are needed.

⚠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.

Cover Photo: 5900_coverphoto.tif

Table of Contents

SECTION 4
Configuration

APPENDIX C
FOUNDATION Fieldbus Block Information

Section 1 Introduction

1.1 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 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.

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.

1.2 SYMBOLS

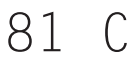
The CE marking symbolizes the conformity of the product with the applicable European Community Directives.

The EC-Type Examination Certificate is a statement of a Notified Certification Body declaring that this product meets the Essential Health and Safety Requirements of the ATEX directive

The FM APPROVED Mark indicates that the equipment is approved by FM Approvals according to applicable Approval Standards and is applicable for installation in hazardous locations

Protective Earth

Ground



External cabling must be approved for use in min. 81°C

1.3 MANUAL OVERVIEW

This manual provides installation, configuration, and maintenance information for the Rosemount 5900S Series Radar Level Gauge.

Section 2: Overview

- Gauge components
- System overview
- Antenna types
- Installation procedure

Section 3: Installation

- Installation considerations
- Mechanical installation
- Electrical installation

Section 4: Configuration

- Basic configuration
- Advanced Configuration
- Configuration using TankMaster WinSetup
- LPG configuration
- Calibration
- FOUNDATION Fieldbus Information

Section 5: Operation

- Viewing measurement data
- Alarm handling

Section 6: Service and Troubleshooting

- Service functions
- Troubleshooting
- Device and measurement status
- Error and warning codes

Appendix A: Reference Data

- Specifications
- Dimensional Drawings
- Ordering Information

Appendix B: Product Certifications

- European ATEX Directive information
- FM approvals
- Labels
- Drawings

Appendix C: Foundation Fieldbus Block Information

- Block Information
- Supported Units

1.4 TECHNICAL DOCUMENTATION

The Raptor System includes the following documents:

- Rosemount Raptor System Data Sheet (704010EN)
- Rosemount 5900S Reference Manual (00809-0100-5900)
- Rosemount 2410 Reference Manual (300530EN)
- Rosemount 2240S Reference Manual (300550EN)
- Rosemount 2230 Reference Manual (300560EN)
- Raptor System Configuration Manual (300510EN)
- Rosemount 5300 Product Data Sheet (00813-0100-4530)
- Rosemount 5400 Product Data Sheet (00813-0100-4026)
- Rosemount 5300 Series Reference Manual (00809-0100-4530)
- Rosemount 5400 Series Reference Manual (00809-0100-4026)
- Rosemount TankMaster WinOpi Reference Manual (303028EN)
- Rosemount Raptor Installation Drawings

1.5 SERVICE SUPPORT

For service support contact the nearest *Emerson Process Management/Rosemount Tank Gauging* representative. Contact information can be found on the web site www.rosemount-tg.com.

1.6 PRODUCT RECYCLING/ DISPOSAL

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

The label below is put on Rosemount Tank Gauging products as a recommendation to customers if scrapping is considered.

Recycling or disposal should be done following instructions for correct separation of materials when breaking up the units.

Figure 1-1. A green label is attached to the level gauge housing

1.7 PACKING MATERIAL

Rosemount Tank Radar AB is fully certified according to ISO 14001 environmental standards. By recycling the corrugated paperboard, or wooden boxes, used for shipping our products you can contribute to take care of the environment.

1.7.1 Reuse and Recycling

Experience has shown that wooden boxes can be used several times for various purposes. After careful disassembly the wooden parts may be reused. Metal waste may be converted.

1.7.2 Energy recovery

Products which have served their time may be divided into wood and metal components and the wood can be used as fuel in sufficient ovens.

Due to its low moisture content (approximately 7%) this fuel has a higher calorific value than ordinary wood fuel (moisture content approximately 20%).

When burning interior plywood the nitrogen in the adhesives may increase emissions of nitrogen oxides to the air 3-4 times more than when burning bark and splinter.

NOTE!
Landfill is not a recycling option and should be avoided.

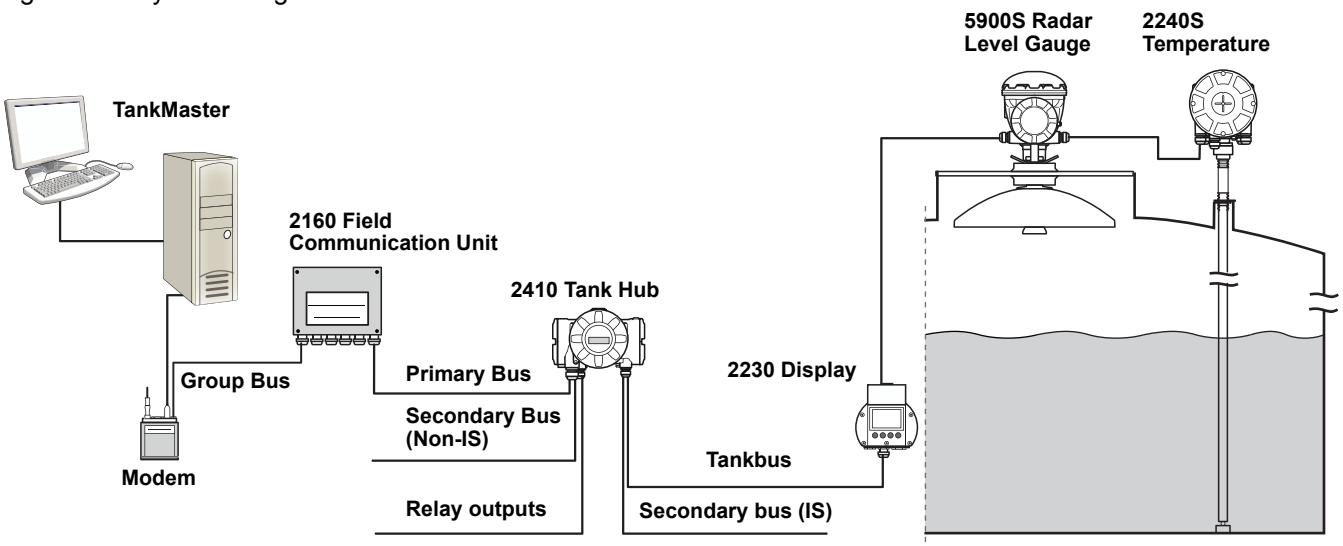
Section 2 Overview

2.1 INTRODUCTION

The *Rosemount 5900S* is a two-wire radar level gauge for high accuracy non-contact measurements. The level gauge continuously emits a radar signal with varying frequency towards the product surface. This allows very accurate level measurements by processing the difference between the frequencies of the emitted and received radar signals.

The *Rosemount 5900S* is an integral part of the flexible *Raptor* system. The advanced and robust design makes it suitable for a vast range of applications. It is designed for high accuracy level measurements as well as handling complex tank shapes and obstacles in the tank that may interfere with measurement signals.

Figure 2-1. System integration



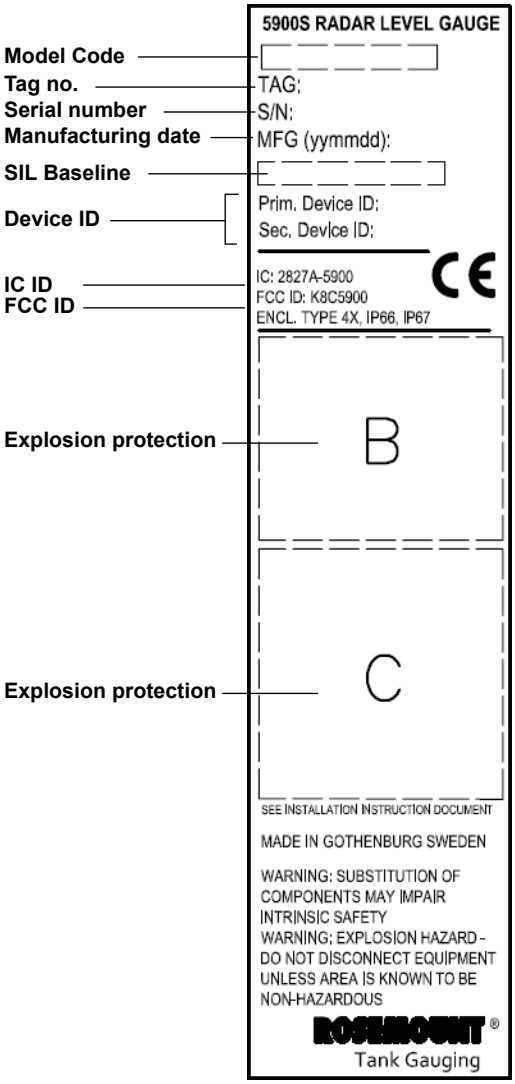
The *Rosemount 5900S* delivers measurement data and status information to a Rosemount 2410 Tank Hub via the intrinsically safe **Tankbus**(1).

Data from a group of tanks is buffered by a 2160 Field Communication Unit (FCU), and is distributed via the Group Bus to a TankMaster PC, or a host system, whenever the FCU receives a request for data.

(1) The intrinsically safe Tankbus complies with the FISCO FOUNDATION™ fieldbus standard.

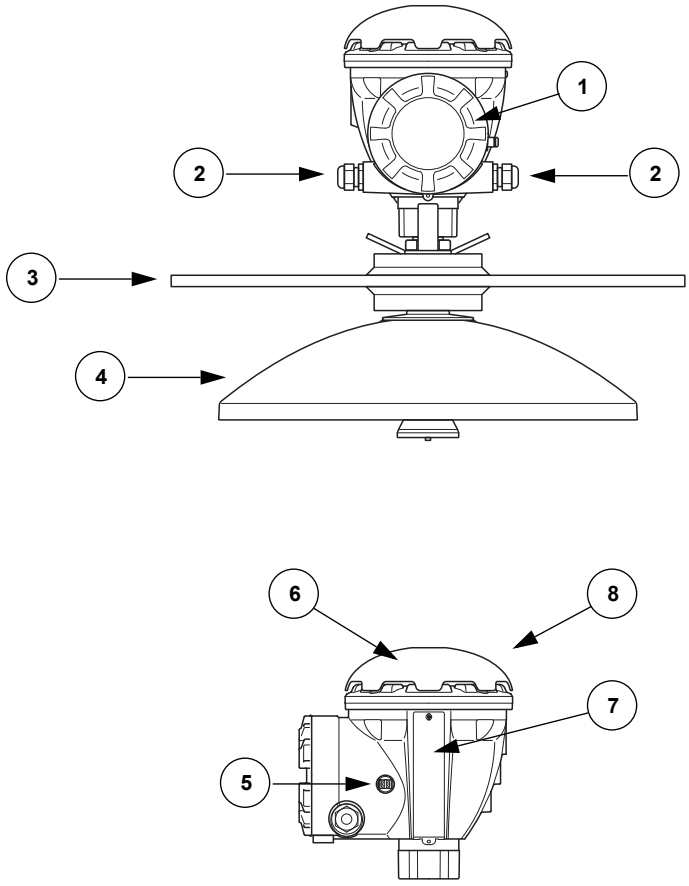
2.2 MAIN LABEL

Figure 2-2. 5900S main label



2.3 COMPONENTS

Figure 2-3. *Rosemount 5900S* components



1. Terminal compartment
2. Cable entries (½ - 14 NPT, M20 x 1.5 adapters)
3. Flange
4. Antenna
5. Grounding terminal
6. Weather protection hood
7. Label
8. Transmitter head with signal processing electronics

2.4 SYSTEM OVERVIEW

Raptor is a state-of-the art inventory and custody transfer radar tank level gauging system. It is developed for a wide range of applications at refineries, tank farms and fuel depots, and fulfills the highest requirements on performance and safety.

The field devices on the tank communicate over the intrinsically safe *Tankbus*. The Tankbus is based on a standardized fieldbus, the FISCO(1) FOUNDATION™ fieldbus, and allows integration of any device supporting that protocol. By utilizing a bus powered 2-wire intrinsically safe fieldbus the power consumption is minimized. The standardized fieldbus also enables integration of other vendors' equipment on the tank.

The *Raptor* product portfolio includes a wide range of components to build small or large customized tank gauging systems. The system includes various devices, such as radar level gauges, temperature transmitters, and pressure transmitters for complete inventory control. Such systems are easily expanded thanks to the modular design.

Raptor is a versatile system that is compatible with and can emulate all major tank gauging systems. Moreover, the well-proven emulation capability enables step-by-step modernization of a tank farm, from level gauges to control room solutions.

It is possible to replace old mechanical or servo gauges with modern *Raptor* gauges, without replacing the control system or field cabling. It is further possible to replace old HMI/SCADA-systems and field communication devices without replacing the old gauges.

There is a distributed intelligence in the various system units which continuously collect and process measurement data and status information. When a request for information is received an immediate response is sent with updated information.

The flexible *Raptor* system supports several combinations to achieve redundancy, from control room to the different field devices. Redundant network configuration can be achieved at all levels by doubling each unit and using multiple control room work stations.

(1) See documents IEC 61158-2 and IEC/TS 60079-27

Figure 2-4. Rosemount Tank Gauging System architecture

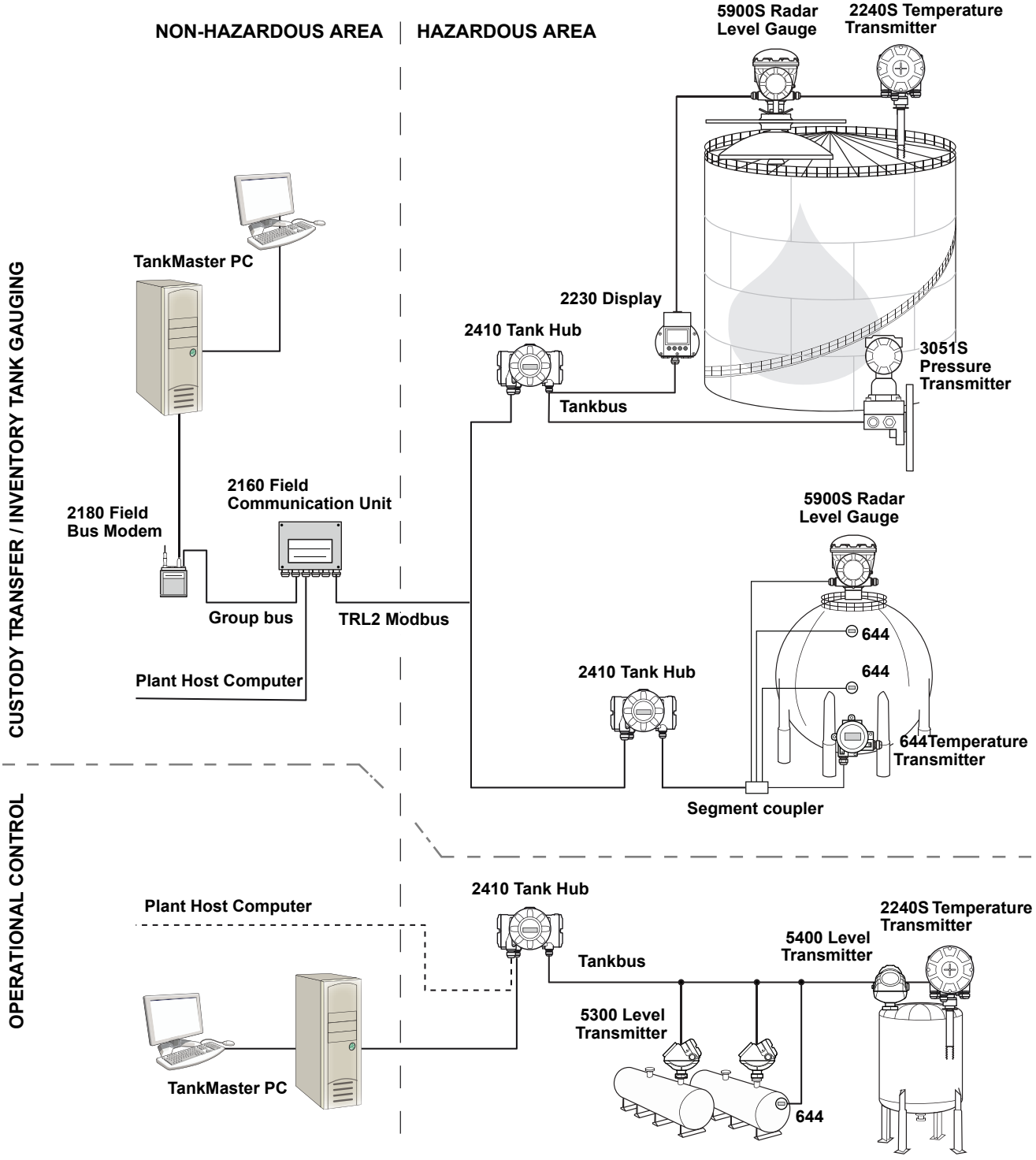


Figure 2-5. Rosemount Tank Gauging system architecture for wireless systems

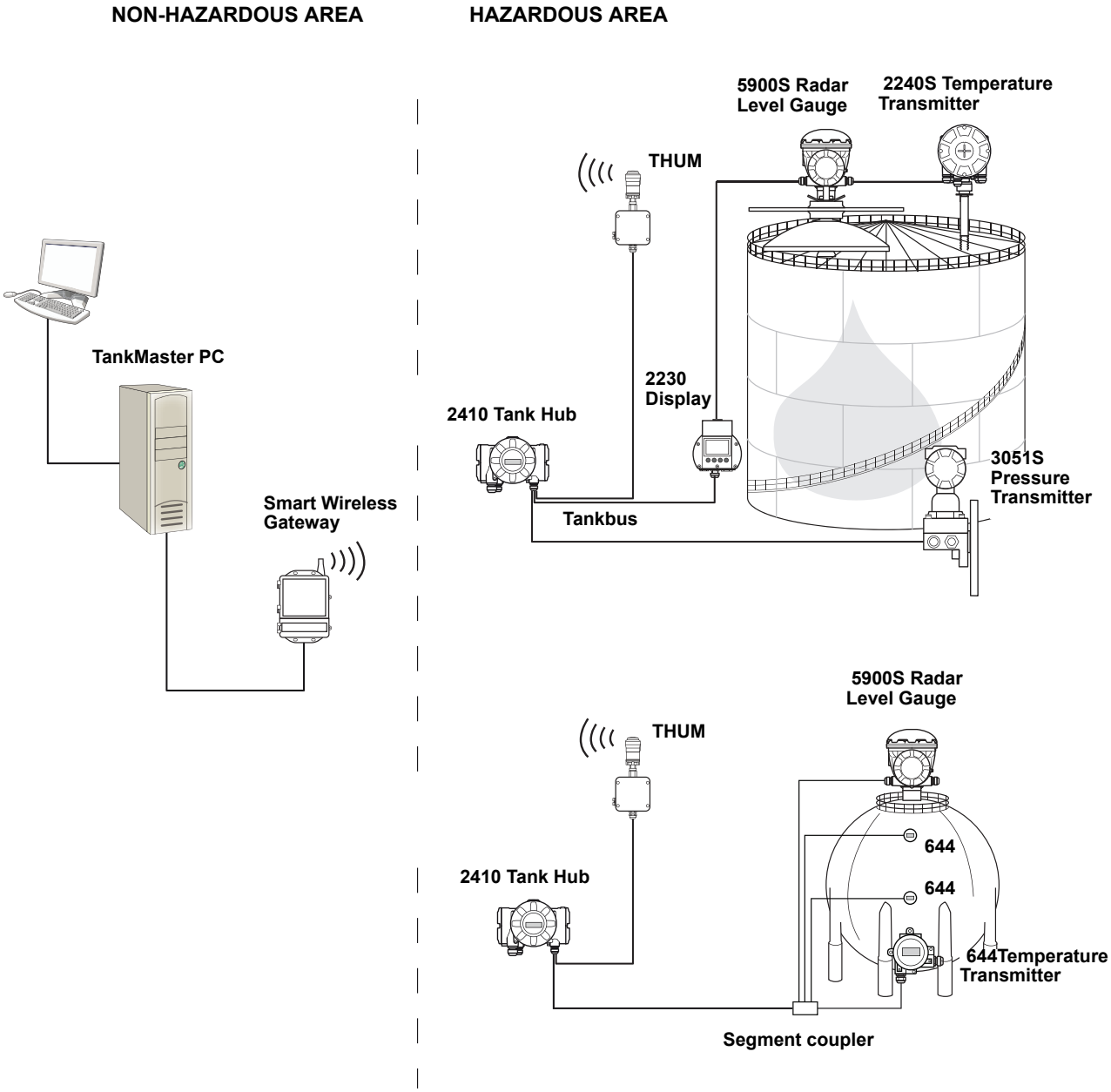
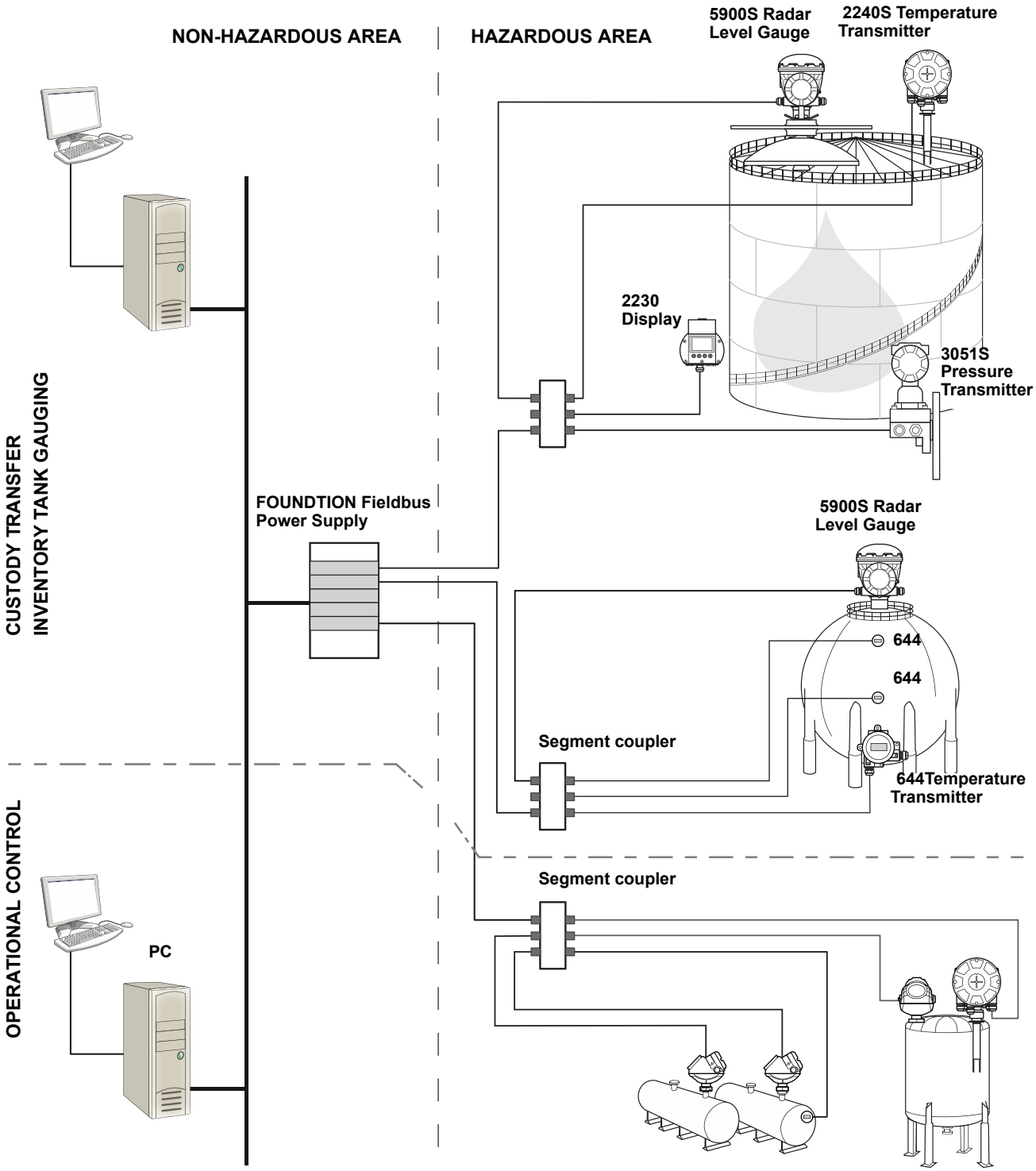


Figure 2-6. Rosemount Tank Gauging system architecture in a Foundation fieldbus network



TankMaster HMI Software

TankMaster is a powerful Windows-based Human Machine Interface (HMI) for complete tank inventory management. It provides configuration, service, set-up, inventory, and custody transfer functions for *Raptor* systems and other supported instruments.

TankMaster is designed to be used in the Microsoft Windows XP and Vista environment providing easy access to measurement data from your Local Area Network.

The *TankMaster WinOpi* program lets the operator monitor measured tank data. It includes alarm handling, batch reports, automatic report handling, historical data sampling as well as inventory calculations such as Volume, Observed Density and other parameters. A plant host computer can be connected for further processing of data.

The *TankMaster WinSetup* program is a graphical user interface for installation, configuration and service of the different devices in the *Raptor* system.

Rosemount 2160 Field Communication Unit

The 2160 Field Communication Unit (FCU) is a data concentrator that continuously polls and stores data from field devices such as radar level gauges and temperature transmitters in a buffer memory. Whenever a request for data is received, the FCU can immediately send data from a group of tanks from the updated buffer memory.

Rosemount 2410 Tank Hub

The Rosemount 2410 Tank Hub acts as a power supply to the connected field devices in the hazardous area using the intrinsically safe Tankbus.

The 2410 collects measurement data and status information from field devices on a tank. It has two external buses for communication with various host systems.

There are two versions of the 2410 for single tank or multiple tanks operation. The 2410 multiple tanks version supports up to 10 tanks and 16 devices. With the Rosemount 5300 and 5400 level transmitters the 2410 supports up to 5 tanks.

The 2410 is equipped with two relays which support configuration of up to 10 “virtual” relay functions allowing you to specify several source signals for each relay.

The 2410 supports Intrinsically Safe (IS) and Non-Intrinsically Safe (Non-IS) analog 4-20 mA inputs/outputs. By connecting a Smart Wireless THUM Adapter to the IS HART 4-20 mA output, the 2410 is capable of wireless communication with a Smart Wireless Gateway in a WirelessHART network.

Rosemount 5900S Radar Level Gauge

The *Rosemount 5900S* Radar Level Gauge is an intelligent instrument for measuring the product level inside a tank. Different antennas can be used in order to meet the requirements of different applications. The 5900S can measure the level of almost any product, including bitumen, crude oil, refined products, aggressive chemicals, LPG and LNG.

The *Rosemount 5900S* sends microwaves towards the surface of the product in the tank. The level is calculated based on the echo from the surface. No part of the 5900S is in actual contact with the product in the tank, and the antenna is the only part of the gauge that is exposed to the tank atmosphere.

The *2-in-1* version of the 5900S Radar Level Gauge has two radar modules in the same transmitter housing allowing two independent level measurements using one antenna.

Rosemount 5300 Guided Wave Radar

The Rosemount 5300 is a premium 2-wire guided wave radar for level measurements on liquids, to be used in a wide range of medium accuracy applications under various tank conditions. Rosemount 5300 includes the 5301 for liquid level measurements and the 5302 for liquid level and interface measurements.

Rosemount 5400 Radar Level Transmitter

The Rosemount 5400 is a reliable 2-wire non-contact radar level transmitter for liquids, to be used in a wide range of medium accuracy applications under various tank conditions.

Rosemount 2240S Multi-Input Temperature Transmitter

The *Rosemount 2240S* Multi-input Temperature Transmitter can connect up to 16 temperature spot sensors and an integrated water level sensor.

Rosemount 2230 Graphical Field Display

The *Rosemount 2230* Graphical Field Display presents inventory tank gauging data such as level, temperature, and pressure. The four softkeys allow you to navigate through the different menus to provide all tank data, directly in the field. The *Rosemount 2230* supports up to 10 tanks. Up to three 2230 displays can be used on a single tank.

Rosemount 644 Temperature Transmitter

The Rosemount 644 is used with single spot temperature sensors.

Rosemount 3051S Pressure Transmitter

The 3051S series consists of transmitters and flanges suitable for all kinds of applications, including crude oil tanks, pressurized tanks and tanks with / without floating roofs.

By using a 3051S Pressure Transmitter near the bottom of the tank as a complement to a 5900S Radar Level Gauge, the density of the product can be calculated and presented. One or more pressure transmitters with different scalings can be used on the same tank to measure vapor and liquid pressure.

Rosemount 2180 Field Bus Modem

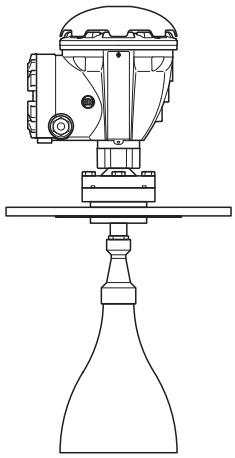
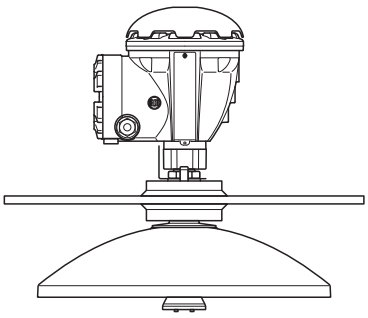
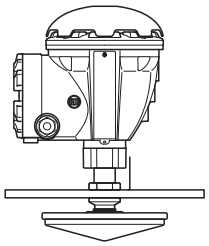
The Rosemount 2180 field bus modem (FBM) is used for connecting a TankMaster PC to the TRL2 communication bus. The 2180 is connected to the PC using either the RS232 or the USB interface.

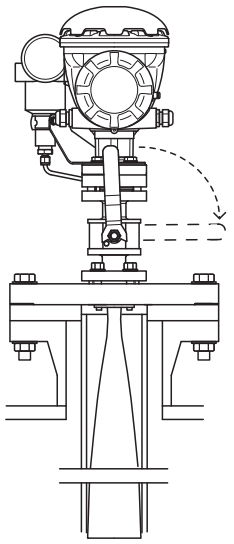
Rosemount Smart Wireless Gateway and Rosemount Smart Wireless THUM Adapter

A THUM Adapter allows wireless communication between a 2410 Tank Hub and a Smart Wireless Gateway. The gateway is the network manager that provides an interface between field devices and the TankMaster inventory software or host / DCS systems.

See the *Raptor Technical Description* (Document no. 704010en) for more information on the various devices and options.

2.5 ANTENNAS

	The *Rosemount 5900S* with **Horn Antenna** is designed for an 8 inch antenna to be used in small size openings on fixed roofs tanks. The 5900S is designed for measurements of a variety of oil products and chemicals. However, for bitumen/asphalt and similar products the Parabolic antenna is recommended.
	The *Rosemount 5900S* with **Parabolic Antenna** measures level of all types of liquids, from light products to bitumen/asphalt. The gauge is designed for mounting on tanks with fixed roofs and has custody transfer accuracy. The design of the parabolic antenna provides extreme tolerance against sticky and condensing products. The narrow beam of this antenna makes it very suitable in narrow tanks with internal structures.
	The *Rosemount 5900S* with **Still-pipe Array Antenna** is used on tanks with still pipes and with all products suited for still pipes. The gauge uses a low-loss radar propagation mode which virtually eliminates the influence of the still pipe condition. Measurement is made with highest accuracy even when the pipe is old, rusty and covered with deposits. The Still-pipe Array Antenna fits 5, 6, 8, 10, and 12 inch pipes. It can be mounted on an existing still pipe and there is no need to take the tank out of operation during installation. There are two versions of the 5900S with Still-pipe Array Antenna: fixed and hinged hatch. The hinged hatch enables full pipe size product sampling or verification hand-dips.



The *Rosemount 5900S* with **LPG/LNG Antenna** is designed for level measurements in LPG and LNG tanks. A 4 inch still-pipe is used as a wave guide for the measurement and prevents a turbulent surface from disturbing the measurement. Radar signals are transmitted inside the pipe towards the surface.

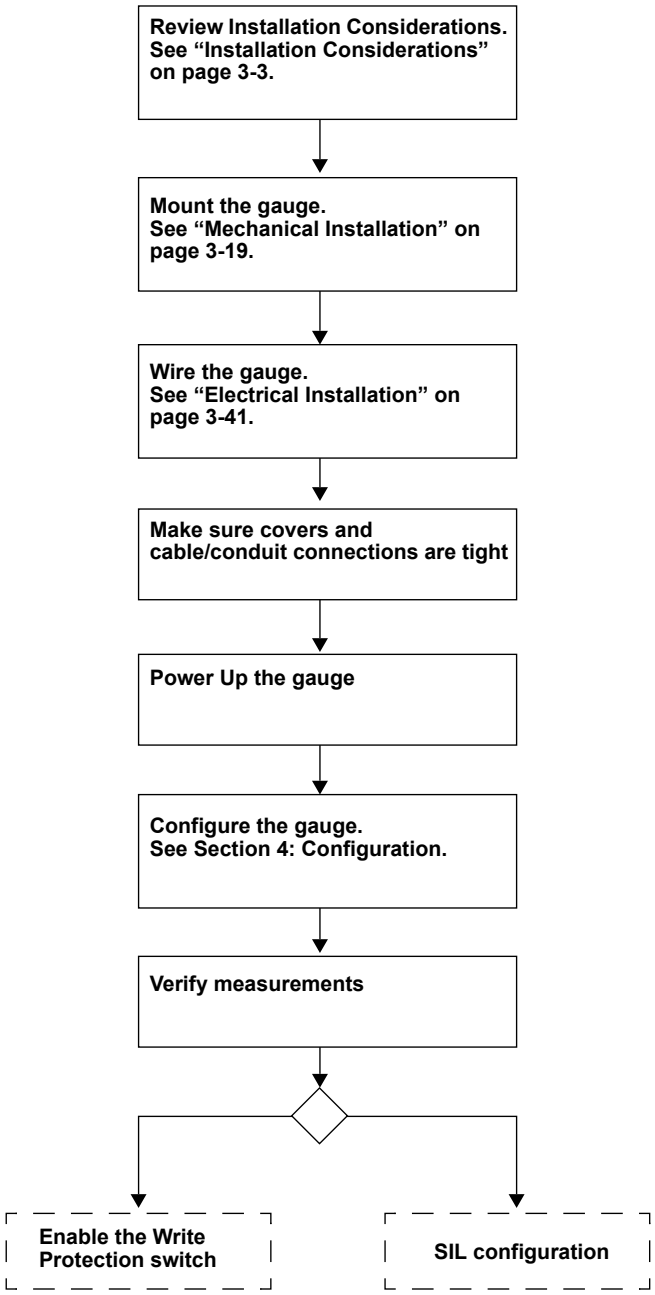
The pressure sealing is a quarts window approved for use in pressure vessels. As standard the gauge is also equipped with a fire-proof block valve and a vapor space pressure sensor.

The *Rosemount 5900S* with LPG/LNG Antenna is available in two versions for 150 PSI and 300 PSI.

The Verification Pin allows you to verify measurements without opening the tank by comparing the measured distance with the actual distance to the Verification Pin.

2.6 INSTALLATION PROCEDURE

Follow these steps for proper installation:



Section 3 Installation

3.1 SAFETY MESSAGES

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

⚠WARNING

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

Make sure only qualified personnel perform the installation.

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

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

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

Substitution of components may impair Intrinsic Safety.

⚠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 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

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

NOTICE

The device is designed for installation in complete enclosed container to prevent unwanted RF emission. Installation must be in accordance with local regulations and may require local radio approvals.

Installation in open air applications may be subject for site license approval.

Installation shall be done by trained installers, in compliance with the manufacturer's instructions.

3.2 INSTALLATION CONSIDERATIONS

When finding an appropriate location on the tank for a Rosemount 5900S Radar Level Gauge, the conditions of the tank must be carefully considered. The 5900S should be installed so that the influence of disturbing objects is kept to a minimum, preferably outside the radar signal beam.

Ensure that environmental conditions are within specified limits as listed in *Appendix A: Reference Data*.

Ensure that the Rosemount 5900S Radar Level Gauge is installed such that it is not exposed to higher pressure and temperature than specified in *Appendix A: Reference Data.*

It is the responsibility of the user to ensure that the device meets the specific inside tank installation requirements such as:

- chemical compatibility of wetted materials
- design/operation pressure and temperature

For a complete specification of the 5900S device to be installed, you can identify the model code on the attached antenna label and match with data in “Ordering Information” on page A-9.

Do not install the Rosemount 5900S in non-intended applications, for example environments where it may be exposed to extremely intense magnetic fields or extreme weather conditions.

Antennas with plastic surfaces and painted surface, may under certain extreme conditions generate an ignition-capable level of electrostatic charge. When installing in hazardous areas ensure using tools, cleaning material etc. which can not generate electrostatic charge.

See chapters 3.2.1 to 3.2.4 for requirements and recommendations to consider when installing a Rosemount 5900S Radar Level Gauge with different antenna types.

3.2.1 Horn Antenna Requirements

The Rosemount 5900S with Horn Antenna must be installed so that there are no pipes or other obstacles that could prevent the radar beam from reaching the tank bottom unobstructed. There are two flanges available; a horizontal flange for vertical installation, and an inclined flange for installation close to the tank wall.

Please refer to mechanical installation drawings for more information on the installation requirements of the Horn Antenna and service space requirements.

Nozzle Requirements

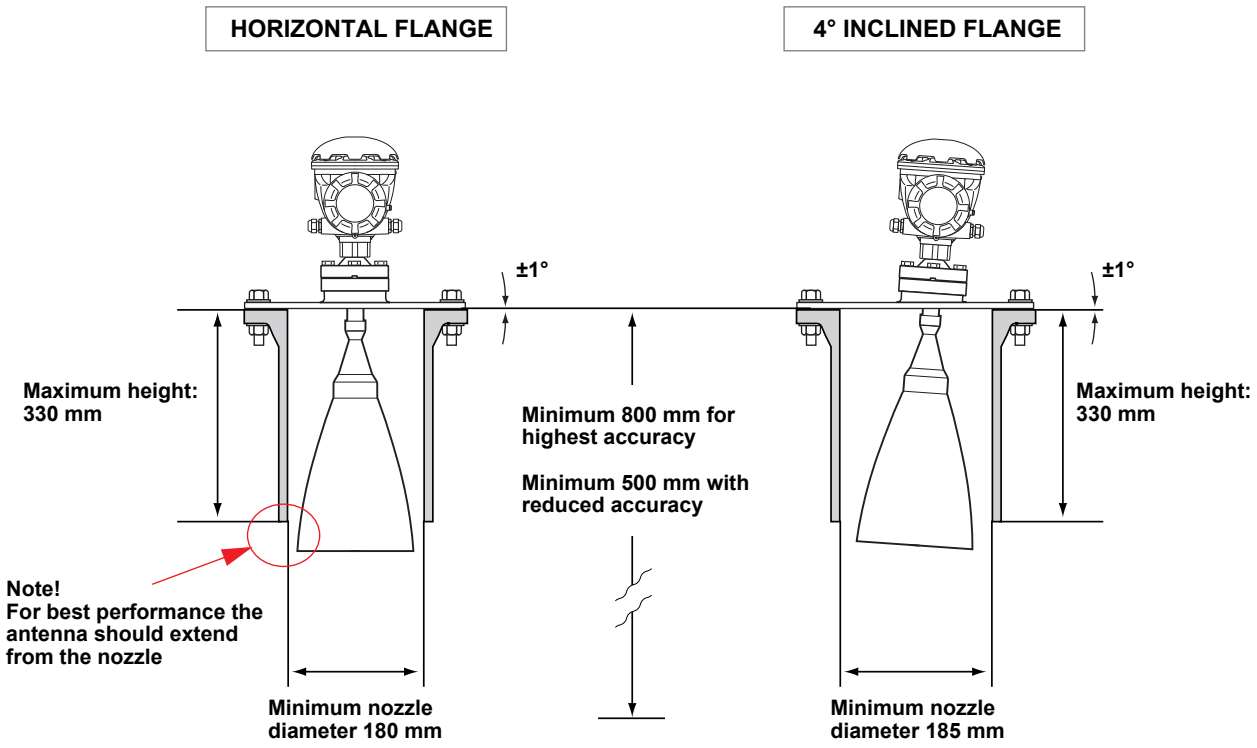
Maximum nozzle height 330 mm.

Minimum nozzle diameter:

Table 3-1. Minimum nozzle diameter for the 5900S with Horn Antenna

Flange	Minimum nozzle diameter (mm)
Horizontal flange	180
4° inclined flange	185

Figure 3-1. Nozzle requirements for the Horn Antenna Gauge



Free Space Requirements

There are two flanges available for the Horn Antenna gauge. One flange has a 4° inclination and the other is horizontal. See installation drawing for flange dimensions.

The horizontal flange can be used if the wall does not intrude into the 30° wide radar beam from the Horn Antenna. If a vertical antenna axis installation is not possible without the tank wall intruding into the radar beam, the 5900S has to be directed away from the wall by using the 4° flange. The inclination is necessary to ensure maximum accuracy.

The minimum free space distance **L**:

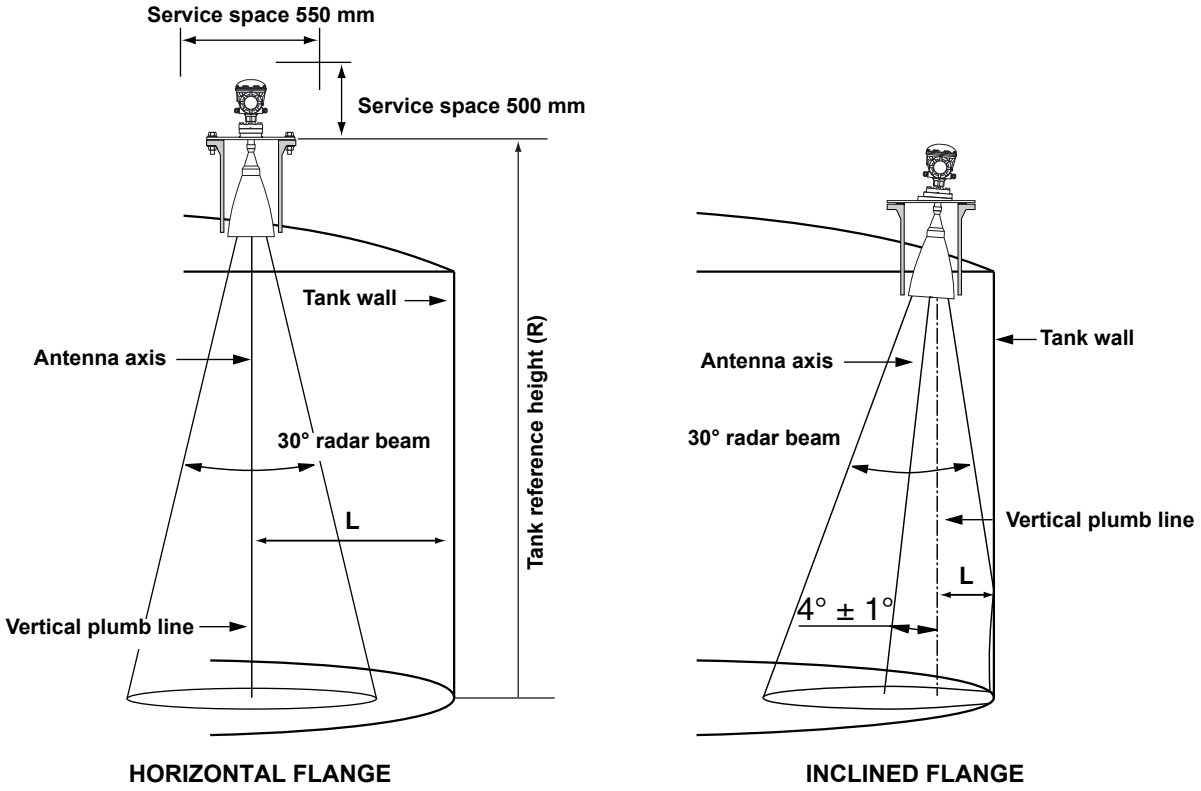
Table 3-2. Minimum distance L to tank wall for the 5900S with Horn Antenna

Flange	Minimum distance L to tank wall (m)
Horizontal flange	Rx0.2 (R=tank reference height)
4° flange	0.6(1)

(1) In exceptional cases the 5900S with Horn Antenna can be installed closer to the tank wall if required. Please contact Emerson Process Management / Rosemount Tank Gauging for advice.

In certain cases, when maximum accuracy is not required, the horizontal flange can be used even if the wall intrudes into the radar beam. In doubtful cases, please contact Emerson Process Management / Rosemount Tank Gauging or one of its representatives for advice.

Figure 3-2. Two different flange options are available

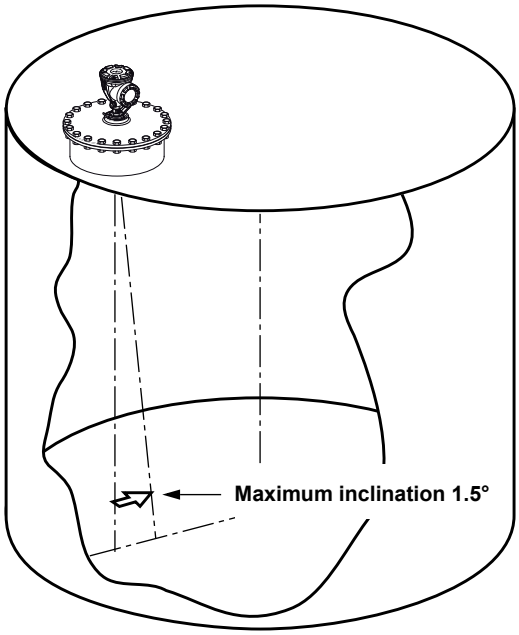


3.2.2 Parabolic Antenna Requirements

Inclination

The inclination of the Rosemount 5900S with Parabolic Antenna should not exceed 1.5 ° towards the center of the tank. For products with high condensation such as bitumen/asphalt applications, the radar beam should be directed vertically without any inclination.

Figure 3-3. Maximum inclination with Parabolic Antenna



Flange Requirements

The Rosemount 5900S with Parabolic Antenna is mounted on the tank nozzle by using the Flange Ball. It is designed for easy adjustment of gauge inclination within the specified limits.

There are two versions of the Flange Ball. One that is clamped to the flange by using a nut, and another one which is welded to the flange.

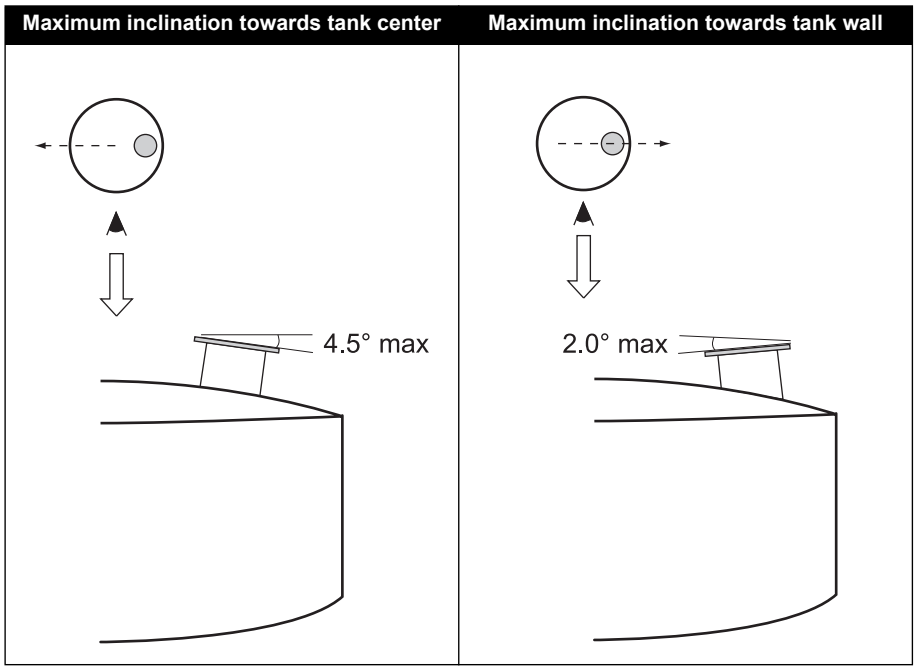
The Flange Ball has to be mounted on the flange prior to mounting the gauge on the tank nozzle.

The flange needs to fulfill certain requirements in order to ensure that the radar beam is not disturbed by the tank wall. This allows the radar signal to be reflected on the product surface and transmitted back to the level gauge at a maximum signal strength.

The tank flange has to meet the following inclination requirements (see Figure 3-4) in order to allow proper adjustment of the antenna:

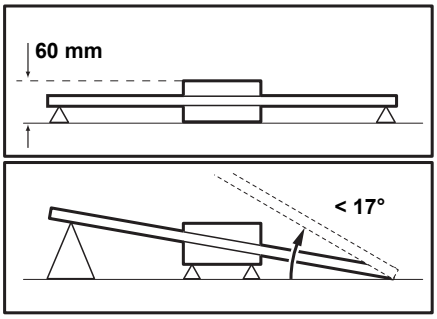
- maximum 4.5° away from the tank wall
- maximum of 2° towards the tank wall

Figure 3-4. Maximum inclination of tank flange



In case the tank flange does not meet the requirements as illustrated in Figure 3-4, the inclination requirements for the Parabolic Antenna can still be met by using the welded Flange Ball. The Flange Ball can be mounted at a maximum angle of 17° to the flange as illustrated in Figure 3-5:

Figure 3-5. Maximum inclination with welded flange

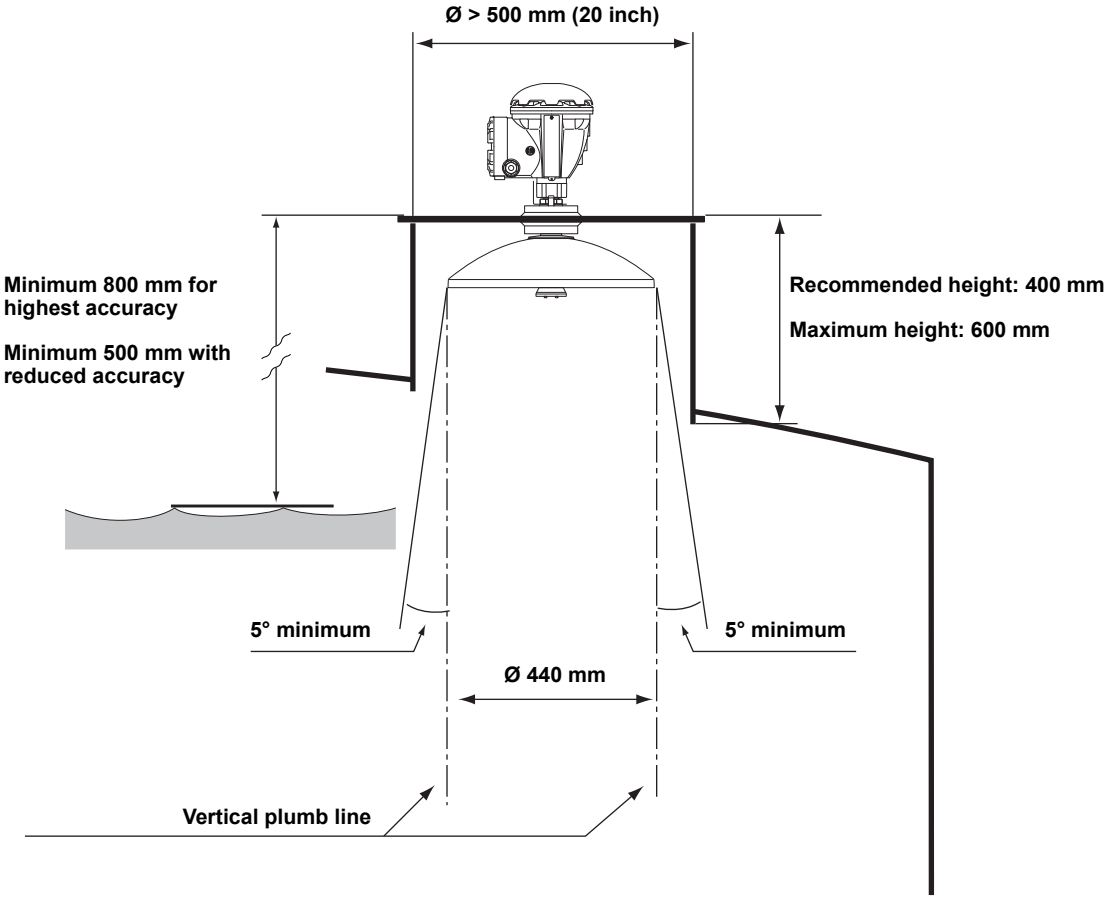


Nozzle Requirements

When installing the 5900S with Parabolic Antenna on a Ø 20" nozzle, the nozzle height must not exceed 600 mm. There has to be a free passage for the radar beam within a 5° angle from the edge of the parabolic reflector to the lower end of the nozzle.

The 5900S should be installed so that the distance between flange and product surface exceeds 800 mm. Highest accuracy is obtained for product levels below this point.

Figure 3-6. Nozzle requirements for the Rosemount 5900S with Parabolic Antenna



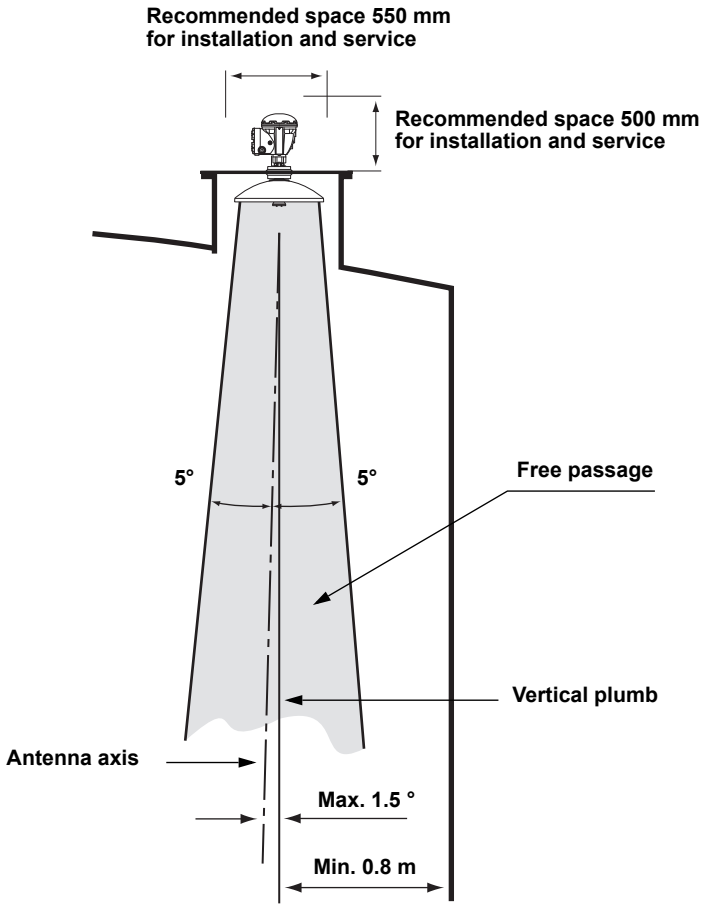
Nozzles with larger diameter may be higher than 0.6 meter as long as the requirement of 5° free passage is fulfilled.

Free Space Requirements

The radar beam of the 5900S with Parabolic Antenna is 10° wide. Obstacles (construction bars, pipes larger than Ø 2", etc.) within the radar beam are generally not accepted, as these may result in disturbing echoes. However, in most cases, a smooth tank wall or small objects will not have any significant influence on the radar beam.

The antenna axis should be located at least 800 mm from the tank wall for best performance.

Figure 3-7. Free space requirements for the Rosemount 5900S with Parabolic Antenna



For evaluation contact Emerson Process Management / Rosemount Tank Gauging.

3.2.3 Still-pipe Antenna Requirements

The Rosemount 5900S is designed for still-pipe mounting and can be mounted on existing still-pipe flanges without taking the tank out of operation. The Rosemount 5900S Still-pipe Array Antenna is available for pipe size 5, 6, 8, 10 and 12 inch.

There are two versions available in order to suit various requirements for easy installation and maintenance:

- The Rosemount 5900S Still-pipe Array Antenna **Fix** version which has a flange for easy mounting when there is no need for opening the still-pipe for hand dipping
- The Rosemount 5900S Still-pipe Array Antenna **Hatch** version suitable for still-pipes that need to be opened for hand dipping

Still-pipe Requirements

The Rosemount 5900S Still-pipe Array Antenna fits 5, 6, 8, 10 and 12 inch flanges and pipes. The adaptation is accomplished by selecting a suitable Still-pipe Array Antenna.

The still-pipe must be vertical(1) within 0.5° (0.2 m over 20 m).

Table 3-3 shows the wide range of schedules and pipe inner diameters that the Array antennas can be mounted in.

Table 3-3. Antenna size and appropriate pipe inner diameter

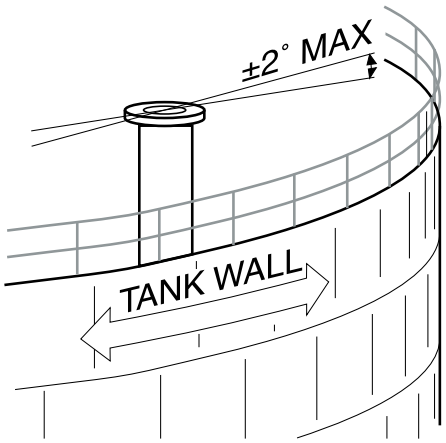
Antenna size (inch)	Antenna dimension (mm)	Suitable for pipe dimension	
		Size	Inner diameter (mm)
5	120.2	SCH10-SCH60	134.5 - 125.3
6	145.2	SCH10-SCH60	161.5 - 150.3
8	189	SCH20-SCH80	206.3 - 193.7
10	243	SCH10-SCH60	264.7 - 247.7
12	293.5	SCH 10-40-XS	314.7 - 298.5

(1) Please contact Emerson Process Management / Rosemount Tank Gauging for advice if this requirement can not be met.

Flange Requirements

The Rosemount 5900S with Still-pipe Array Antenna fits flanges of size 5, 6, 8, 10 and 12 inch. The gauge has a flange for sealing the tank. The tank flange must be horizontal within ±2°.

Figure 3-8. The flange must be horizontal within ±2°



Recommended Installation

When designing new tanks, an 8 inch still-pipe or larger is recommended. This is particularly important in tanks with sticky and viscous products. See drawing 9150 070-946 “Recommended still-pipes” for more information on recommended still-pipes for the Rosemount 5900S. Before manufacturing a new still-pipe, we recommend that you contact Emerson Process Management / Rosemount Tank Gauging for advice.

For highest performance, the total area of the slots or holes in the still-pipe must not exceed the values shown in Table 3-4 below. The listed values refer to the total area of the holes over the entire length of the pipe, regardless of its length. In some cases it is possible to allow a larger total area than stated in Table 3-4. When the limits are exceeded, please contact Emerson Process Management / Rosemount Tank Gauging for advice.

Table 3-4. Maximum area of slots and holes

Pipe Dimension (inch)	5	6	8	10	12
Max Area of Slots or Holes (m^2)	0.1	0.1	0.4	0.80	1.2

Free Space

The following free space is recommended for mounting the 5900S with Still-pipe Array Antenna:

Figure 3-9. Free space requirements for 5900S with Array antenna Fix version

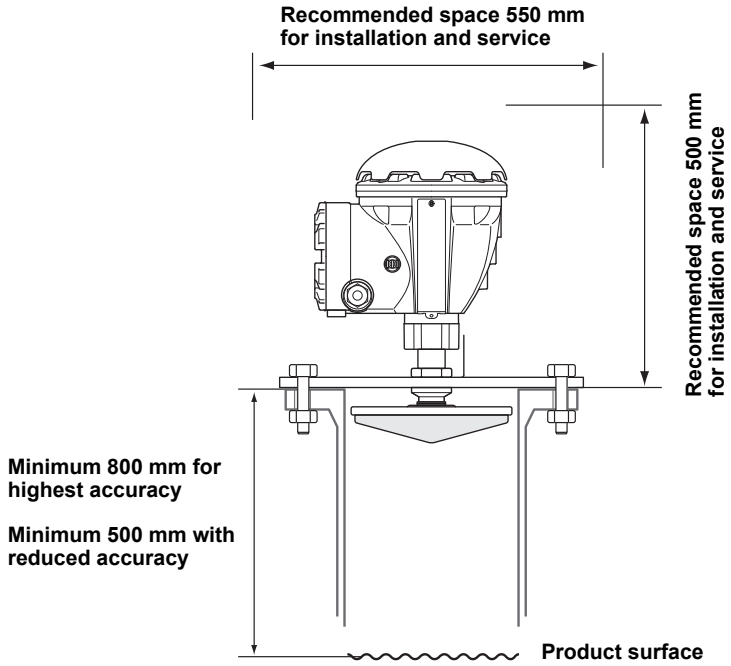
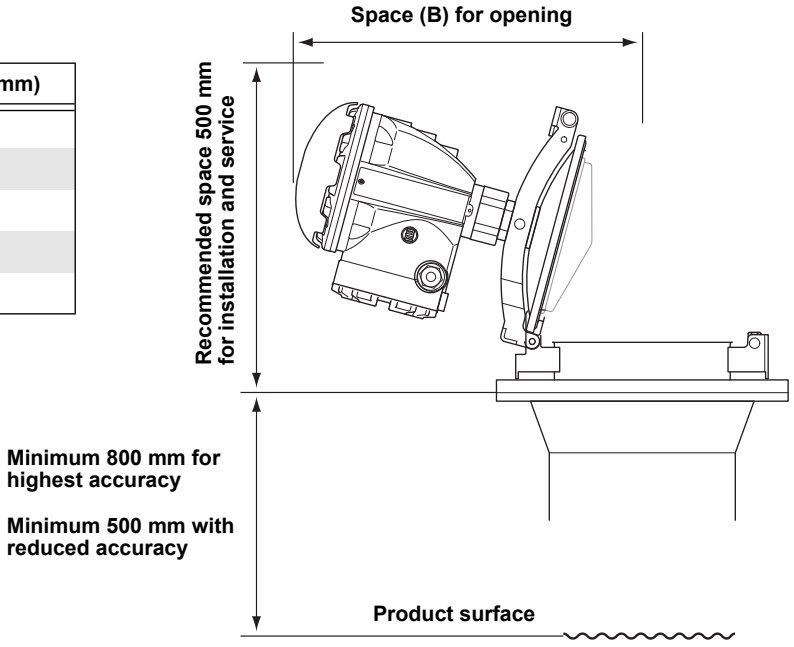


Figure 3-10. Free space requirements for 5900S with Array antenna Hatch version

Antenna size (inch)	Space B (mm)
5	470
6	470
8	480
10	490
12	490



3.2.4 LPG/LNG Antenna Requirements

Temperature and Pressure Measurement

Measurements of temperature and pressure is a prerequisite for high accuracy level measurements in LPG/LNG tanks. A Raptor system may include 5900S Radar Level Gauges, 2240S Multi-input Temperature Transmitters, 644 Temperature Transmitters as well as pressure transmitters in order to obtain all necessary measurement variables.

Still-pipe and Verification Pin

A still-pipe must be installed prior to the gauge installation. The still-pipe is customer supplied and should be manufactured according to the installation drawings.

Three types of steel pipe are recommended:

- DN100
- 4 inch SCH 10 stainless steel pipe
- 4 inch SCH 40 stainless steel pipe

When ordering the level gauge specify the pipe type in the Required System Information (RSI) form.

The still-pipe must be vertical within ±0.5° and the customer flange must be horizontal within ±1° as illustrated in Figure 3-11 on page 3-14.

The still-pipe is manufactured with a number of holes to allow proper circulation of the product, and to ensure equalization of product density inside and outside the pipe. The hole diameter should be 20 mm or 3/4”. All holes in the upper still-pipe section must be placed along a line on one side of the pipe.

The **Verification Pin** allows you to verify 5900S level measurements when the tank is pressurized. It is mounted on the still-pipe in a hole oriented 90 degrees to the other holes.

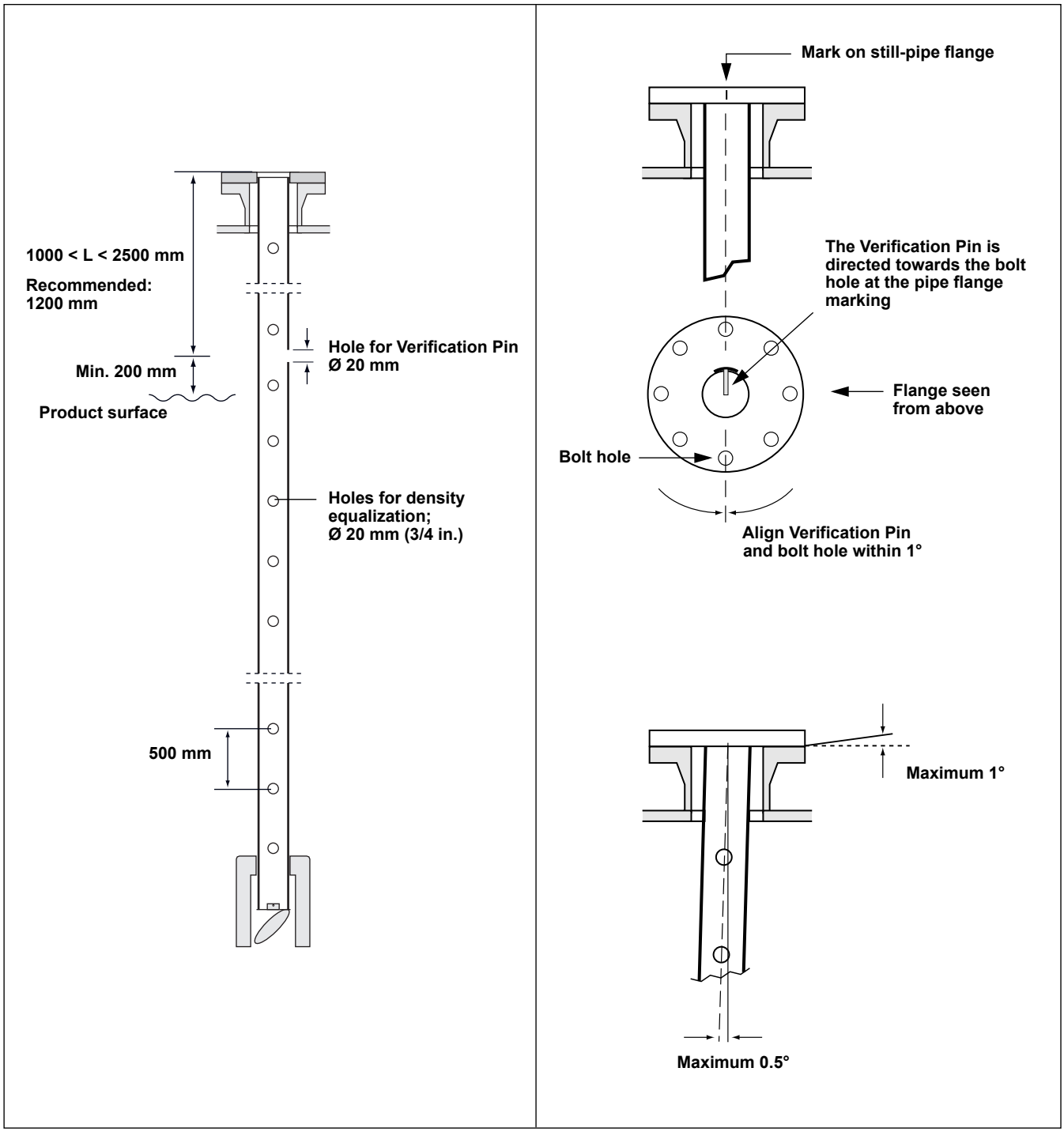
The Verification Pin should be placed at a position of **1200 mm** below the flange as illustrated in *Figure 3-11 on page 3-14*. There must be a minimum distance of **200 mm** between the Verification Pin and the maximum product level. In order to fulfill this requirement, the Verification Pin may be mounted higher, up to 1000 mm below the flange.

The Verification Pin must be aligned with a bolt hole on the still-pipe flange as illustrated in *Figure 3-11*. The Verification Pin’s position must be clearly marked on the still-pipe flange (see *Figure 3-11)* to allow proper alignment of the 5900S gauge.

See installation drawing 9240 041-910 for LPG/LNG Still-pipe for information on how to install the Verification Pin on the still-pipe. Installation instructions are enclosed with the Verification Pin and Deflection Plate.

See *“LPG Configuration” on page 4-20* and the *Raptor System Configuration Manual*, Document No. 300510EN for further information on how to configure the 5900S for LPG/LNG measurements.

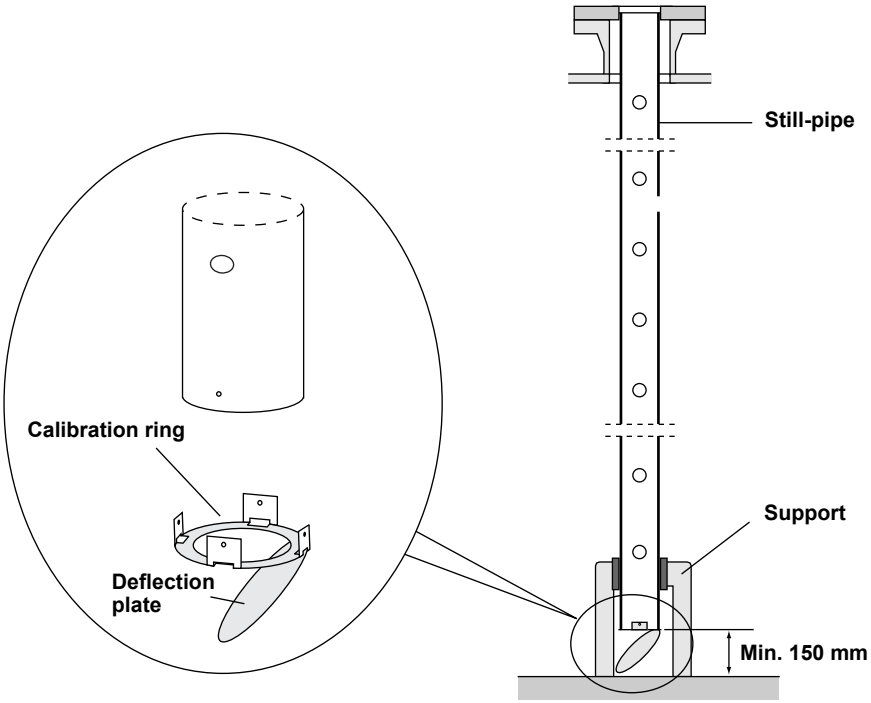
Figure 3-11. Installation of Verification Pin and inclination requirements for flange and still-pipe



Deflection Plate with Calibration Ring

A **Deflection Plate** is mounted at the lower end of the still-pipe and is integrated with a ring that is used for calibrating the gauge during the installation phase when the tank is empty. Installation instructions are enclosed with the Verification Pin and Deflection Plate.

Figure 3-12. Still-pipe with Deflection Plate and Verification Pin



The Deflection Plate can be attached to the still-pipe by using one of three methods:

- Welding
- M4 screw and nut
- Riveting

For pipe dimensions 4 inch SCH 40 and DN 100, an extra ring is needed for the Deflection Plate as illustrated in Figure 3-13 and Figure 3-14.

See *"LPG Configuration" on page 4-20* and the *Raptor System Configuration Manual*, Document No. 300510EN for further information on how to configure the 5900S for LPG/LNG measurements.

Figure 3-13. Mounting the Deflection Plate on pipe 4 inch SCH 40

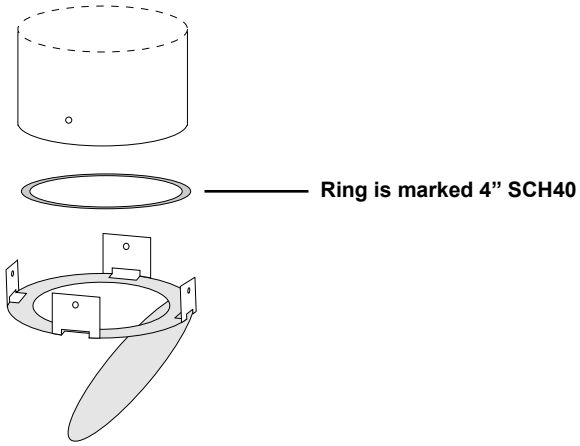
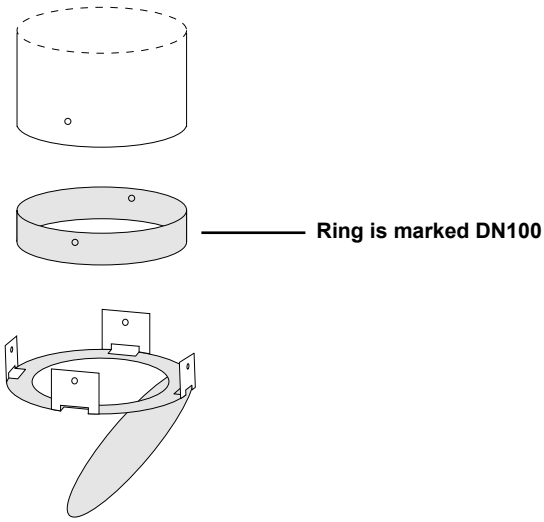


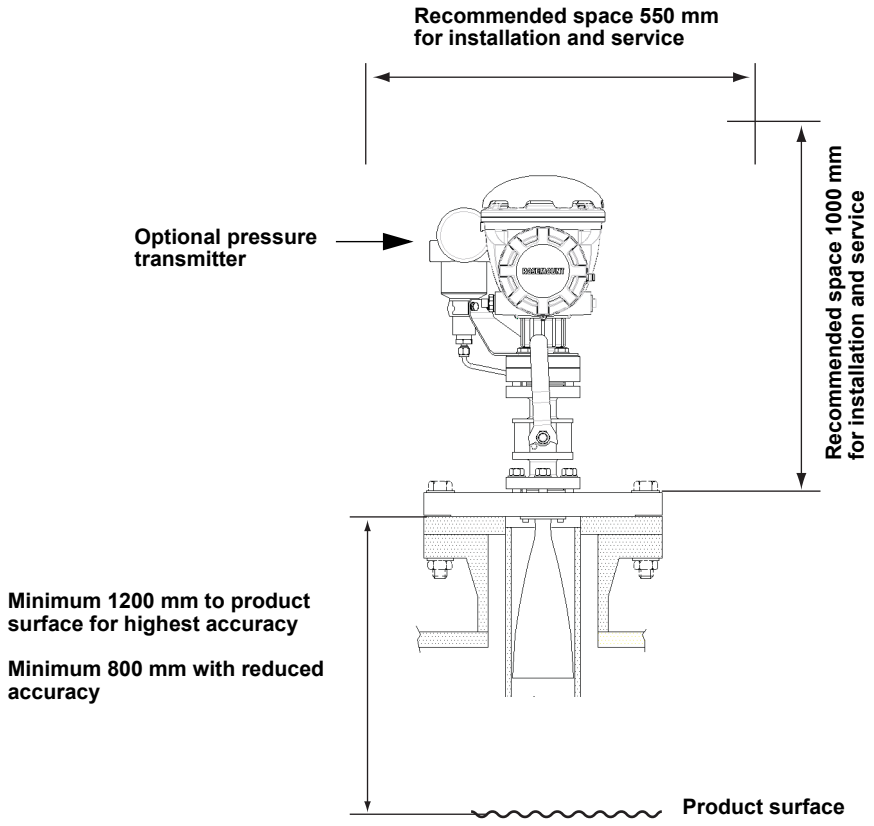
Figure 3-14. Mounting the Deflection Plate on pipe DN 100



Free Space

The following free space is recommended for mounting the 5900S with LPG/LNG Antenna:

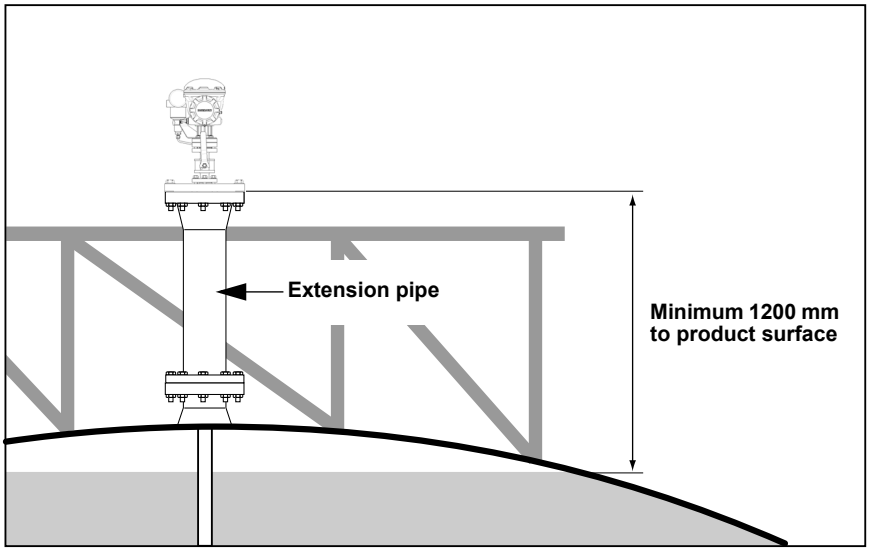
Figure 3-15. Free space requirements for 5900S with LPG/LNG antenna



Extension Pipe for Minimum Distance

The 5900S Radar Level Gauge should be placed such that there is a minimum gap of 1200 mm between the flange and the maximum product level (see “Still-pipe and Verification Pin” on page 3-13). If necessary, an extension pipe can be used to raise the level gauge. This will allow measurements closer to the top of the tank than would otherwise be possible, as illustrated in Figure 3-16.

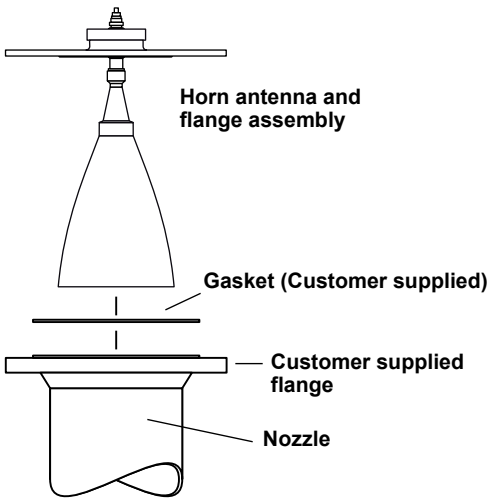
Figure 3-16. Rosemount 5900S with extension pipe



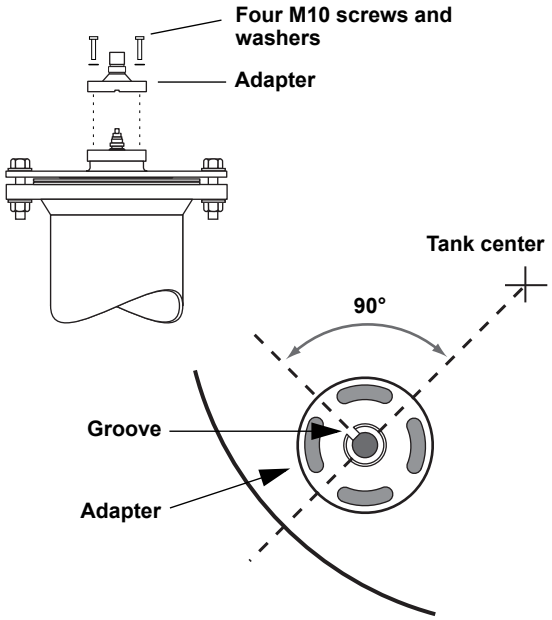
3.3 MECHANICAL INSTALLATION

3.3.1 Horn Antenna

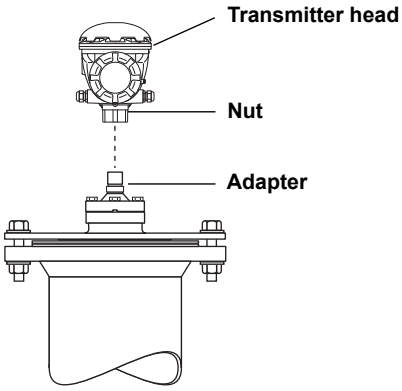
Follow this instruction when installing the Rosemount 5900S with Horn Antenna. See “Horn Antenna Requirements” on page 3-4 for information on mounting considerations before installing the gauge on the tank.



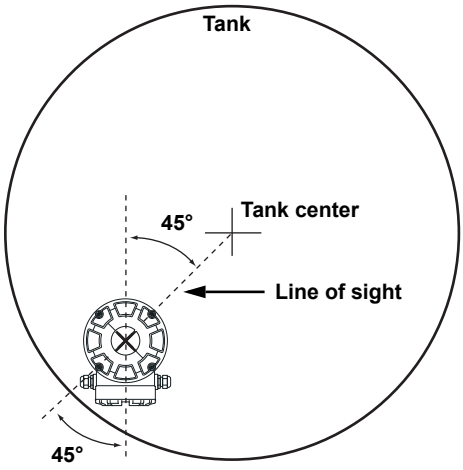
1. Check that all parts and tools are available before carrying them up to the tank roof.
2. Put a gasket on the socket and carefully insert the horn antenna and flange assembly.
3. Tighten the flange with required torque depending on gasket and flange type by using suitable screws and nuts (customer supplied).



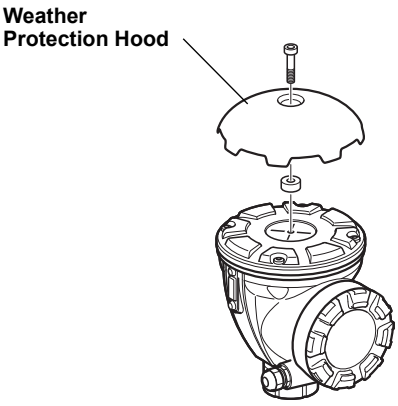
4. Put the adapter on the flange. The groove on the adapter should be directed approximately 90° to the line of sight from the nozzle to the center of the tank.
5. Tighten the four M10 screws with washers by hand so that the adapter can be rotated.



6. Put the transmitter head onto the antenna adapter.
7. Ensure that the guide pin inside the transmitter head fits the groove on the adapter.
8. Tighten the nut that connects the transmitter head to the adapter.



9. The lid on top of the transmitter head has cross hairs that can be used to properly align the 5900S gauge. In case the weather protection hood is attached, the gauge can be aligned by using a line of sight along the screws on top of the head.
10. Ensure that the gauge is directed at an angle of 45° to the line of sight from the center of the tank to the nozzle.
11. Tighten the adapter screws (4 × M10).

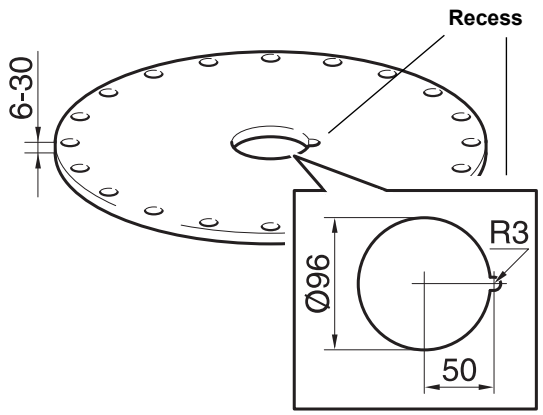


12. In case the Weather Protection Hood was removed, put it back on top of the head and tighten the screw.
13. Connect the electrical cabling and configure the gauge by using the TankMaster WinSetup software (see the *Raptor System Configuration Manual*, Document No. 300510EN)

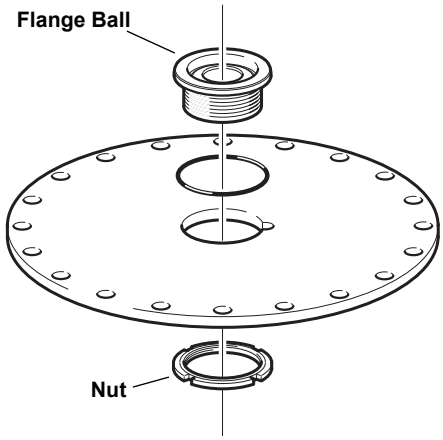
3.3.2 Parabolic Antenna

Mounting the clamped Flange Ball

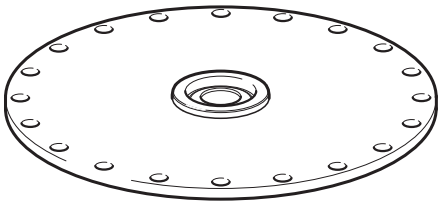
To mount the clamped Flange Ball do the following:



1. Use a flange of thickness 6 - 30 mm.
2. Make sure that the diameter of the hole is 96 mm.
   Make a small recess at one side of the flange hole.



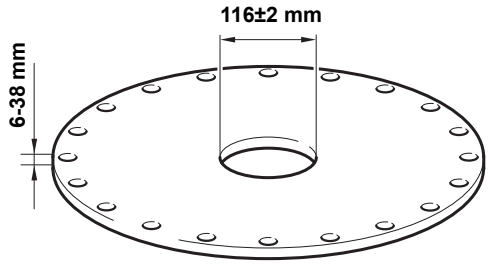
3. Put the O-ring on the flange and insert the Flange Ball into the hole. Make sure that the pin on the side of the Flange Ball fits into the recess on the flange.



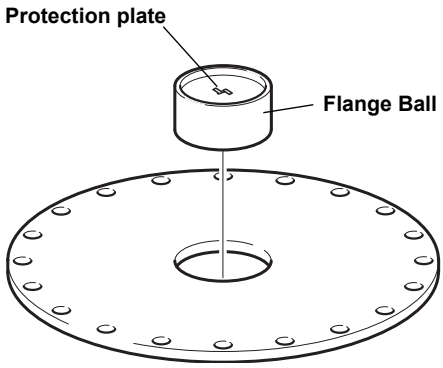
4. Tighten the nut so that the Flange Ball fits tightly to the flange (torque 50 Nm).

Mounting the welded Flange Ball

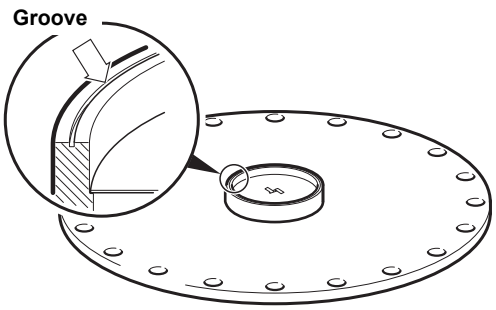
To mount the welded Flange Ball do the following:



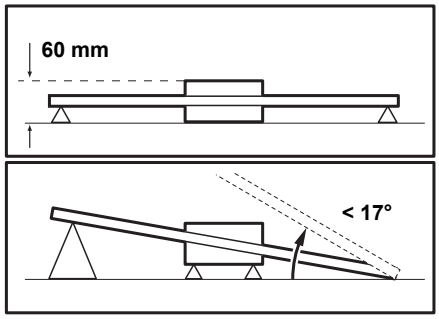
1. For horizontal mounting according to requirements in chapter “Parabolic Antenna Requirements” on page 3-6, make sure that the diameter of the hole is 116 ± 2 mm.
2. In case the flange requirements in chapter “Parabolic Antenna Requirements” on page 3-6 is not met, the hole needs to be machined to an oval shape prepared for inclined welding of the Flange Ball.



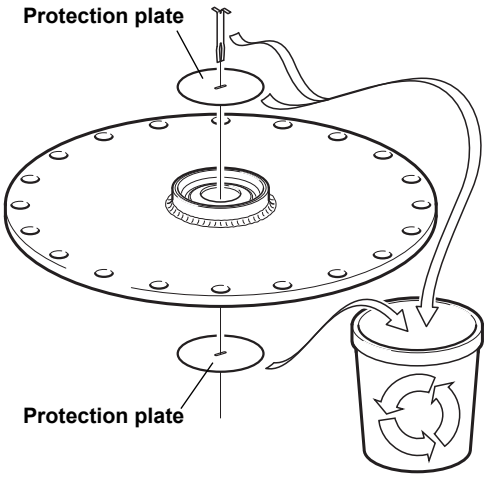
3. Let the protection plates remain on the Flange Ball until the welding is finished. These plates protect the surface of the Flange Ball from welding sparks.



4. Make sure that the Flange Ball is mounted in such a way that the grove is directed upwards when the flange is mounted on the tank nozzle.



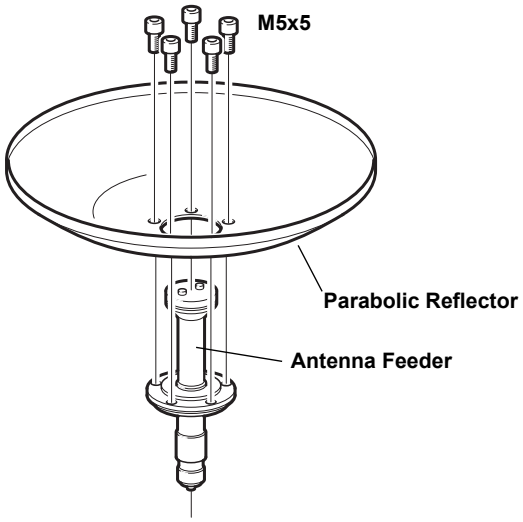
5. If the tank flange is inclined, make sure that the Flange Ball is welded so that the Flange Ball is horizontal when it is mounted on the tank. The tank flange inclination should not exceed 17 degrees.



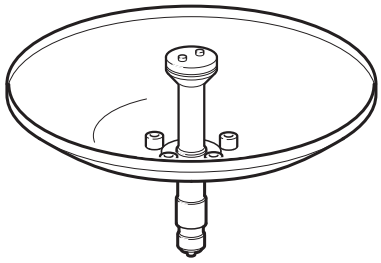
6. Remove the protection plates when the Flange Ball is welded to the flange.

Mounting the Parabolic Antenna

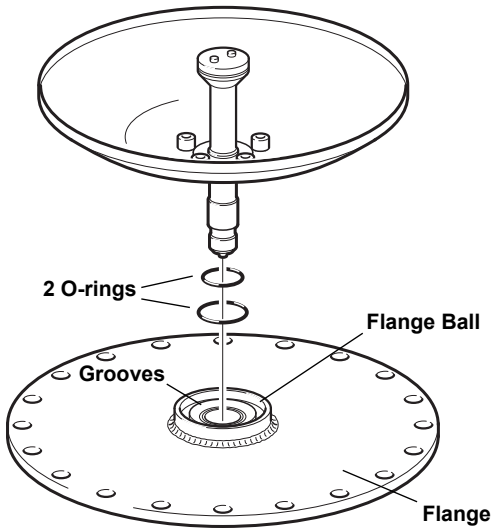
Follow this instruction when installing the Parabolic antenna. See “Parabolic Antenna Requirements” on page 3-6 for considerations before installing the gauge on the tank.



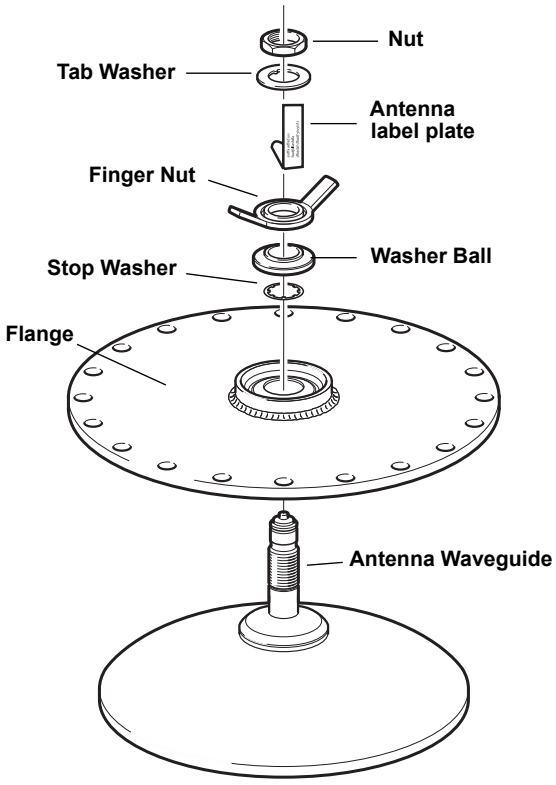
1. Check that all parts and tools are available before carrying them up to the tank top.
2. Fit the Parabolic Reflector onto the Antenna Feeder and tighten the five M5 screws.



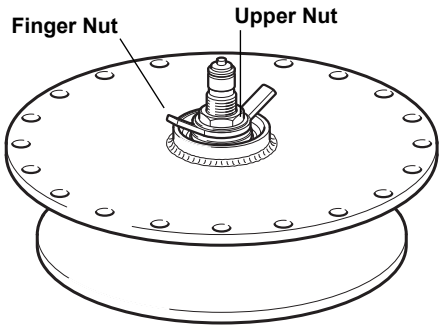
3. Tighten the screws.



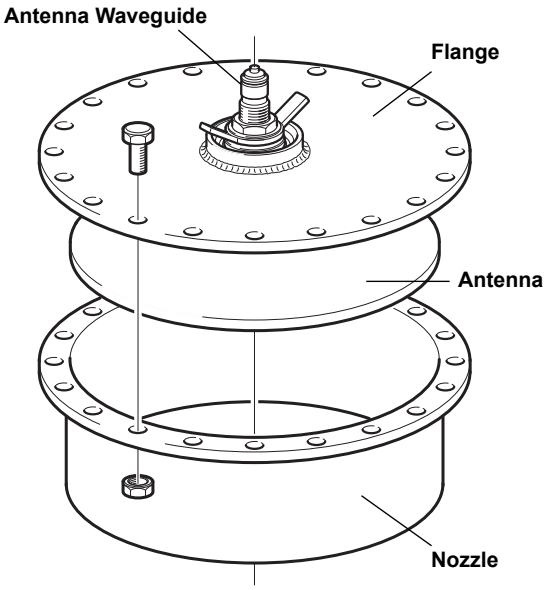
4. Put the two O-rings in the grooves on the upper surface of the Flange Ball.



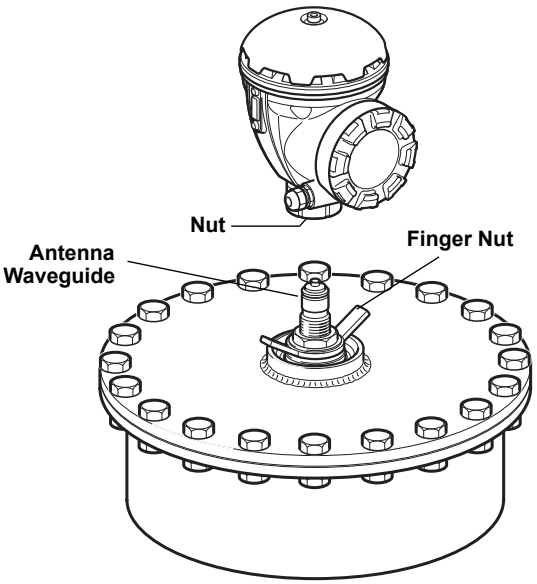
5. Turn the flange around and insert the Antenna Waveguide into the flange hole.
6. Mount the washers and nuts.
7. Note that the purpose of the Stop Washer is to prevent the antenna from falling down into the tank. Therefore it fits tightly to the Antenna Waveguide.



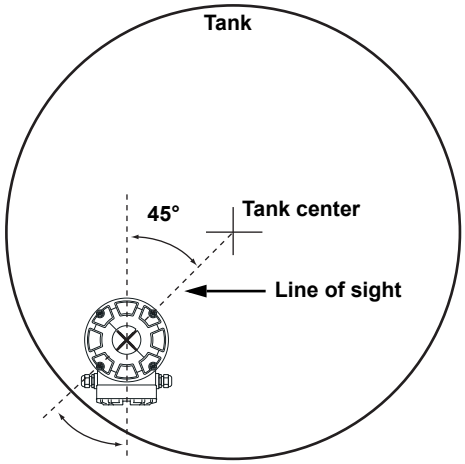
8. Tighten the finger nut and the upper nut by hand.



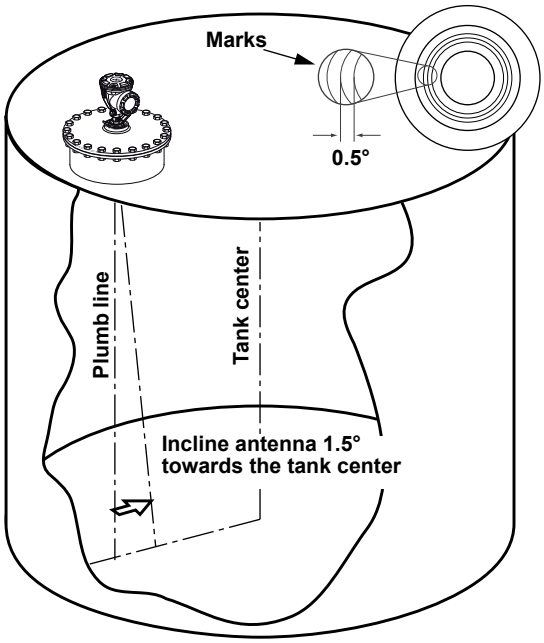
9. Place the antenna and flange assembly on the tank nozzle and tighten the flange screws.



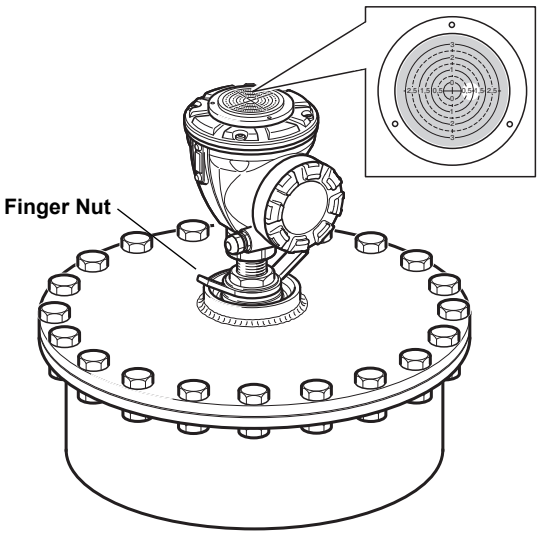
10. Put the level gauge on the Antenna Waveguide. Ensure that the guide pin inside the transmitter head fits into the groove on the Antenna Waveguide.
11. Tighten the nut that connects the transmitter head to the antenna.



12. Loosen the finger nut slightly.
13. The lid on top of the transmitter head has cross hairs that can be used to properly align the transmitter. In case the weather protection hood is attached, the 5900S can be aligned by using a line of sight along the screws on top of the transmitter head.
14. Ensure that the gauge is directed at an angle of 45° to the line of sight from the center of the tank to the wall.

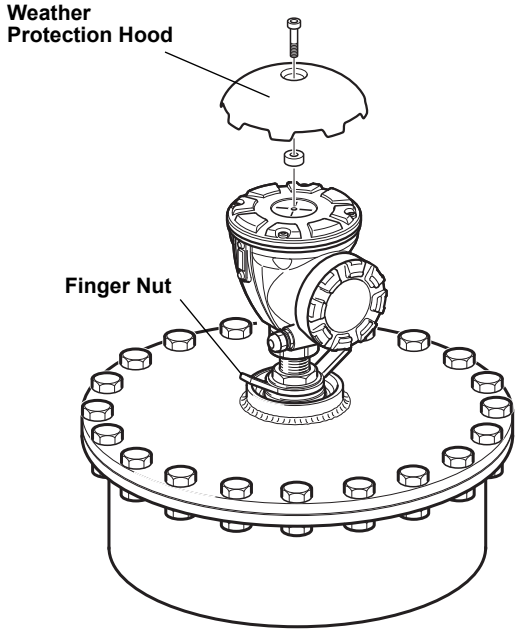


15. Use the marks on the Washer Ball to adjust the gauge so the antenna is inclined roughly 1.5° towards the center of the tank.
    Note: For products with high condensation, such as bitumen, the gauge should be mounted with 0° inclination in order to achieve maximum signal strength.
16. Tighten the finger nut.

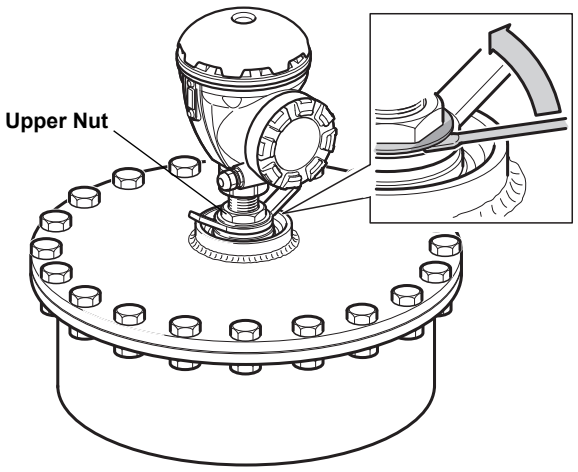


17. You may use a level (optional) to verify correct inclination of 1.5° towards the tank center. Ensure that the level is put on a flat and steady surface on top of the transmitter head.
    If needed, loosen the finger nut and adjust the gauge.

    Note: Make sure the air bubble touches, but doesn't overlap the 1.5° mark.
18. Tighten the finger nut firmly.



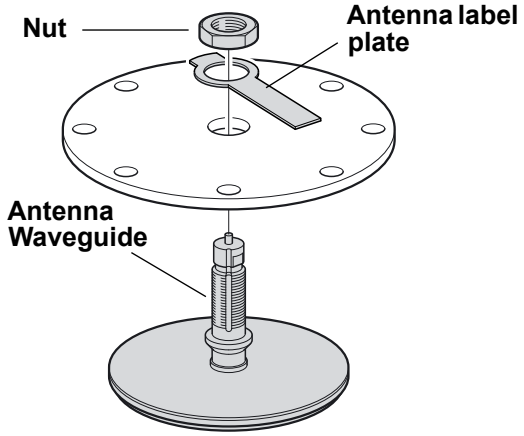
19. In case the Weather Protection Hood was removed, put it back on top of the transmitter head and tighten the screw.



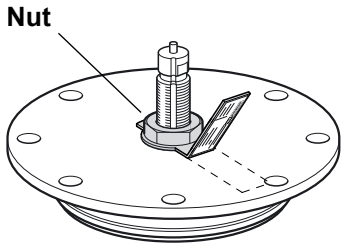
20. Tighten the upper nut to lock the finger nut (you may temporarily remove the transmitter head to make room for tools if needed), and secure by folding the tab washer over the nut.
21. Connect the electrical cabling and configure the gauge by using the TankMaster WinSetup software (see the *Raptor System Configuration Manual*, Document No. 300510EN).

3.3.3 Array Antenna - Fix version

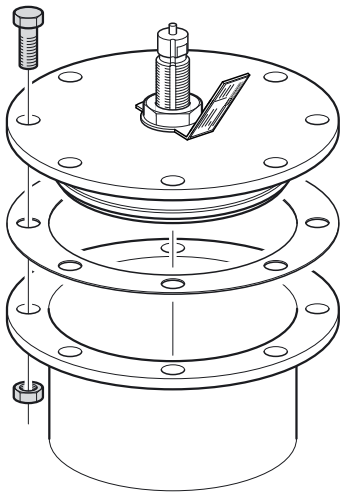
Follow this Step by Step instruction when installing the Array Antenna Fixed version. See “Still-pipe Antenna Requirements” on page 3-10 for information on mounting considerations before installing the gauge on the tank.



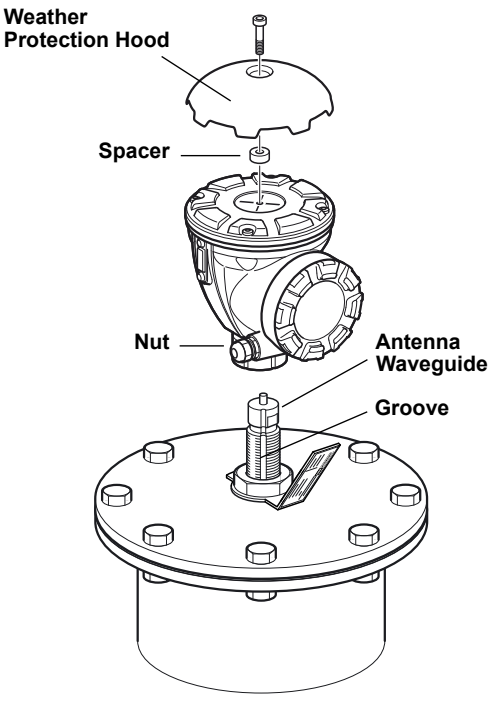
1. Insert the Antenna Waveguide into the flange hole, and place the antenna label into position, with text down.



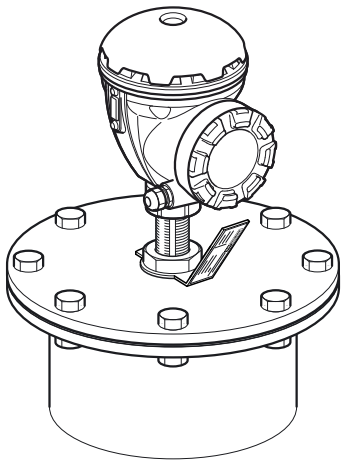
2. Tighten the nut.
3. Secure the nut by folding the tab on the label plate over the nut.
4. Bend the antenna label plate at the slot mark to a position with the text clearly visible.



5. Put the antenna and flange assembly on the tank nozzle and tighten the flange screws.

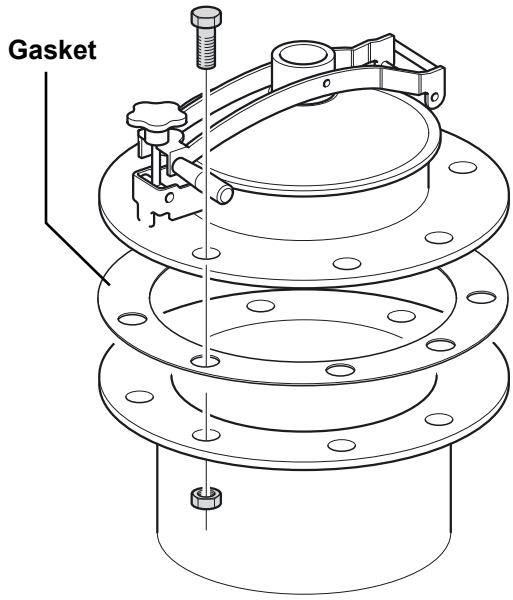


6. Carefully put the gauge on top of the Antenna Waveguide and tighten the nut. Ensure that the guide pin inside the transmitter head fits the groove on the Waveguide.
7. In case the Weather Protection Hood was removed, put it back on top of the transmitter head and tighten the screw.

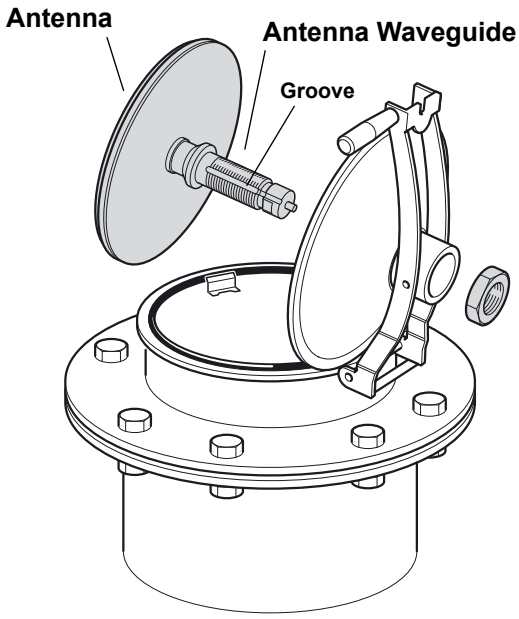
	8. Connect the electrical cabling and configure the 5900S by using the TankMaster WinSetup software, see the *Raptor System Configuration Manual* (Document No. 300510EN).

3.3.4 Array Antenna - Hinged Hatch

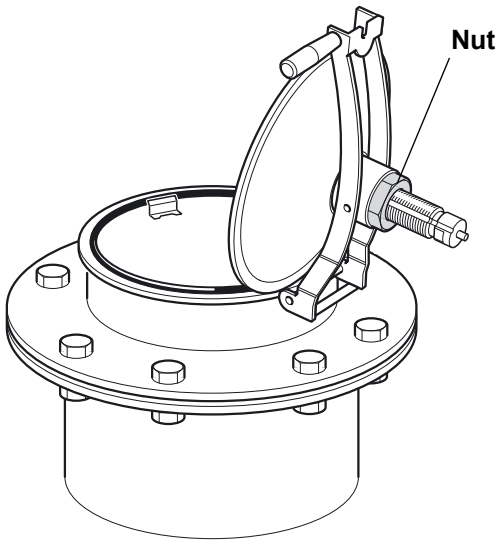
Follow this instruction when installing the Array antenna Hinged Hatch version.



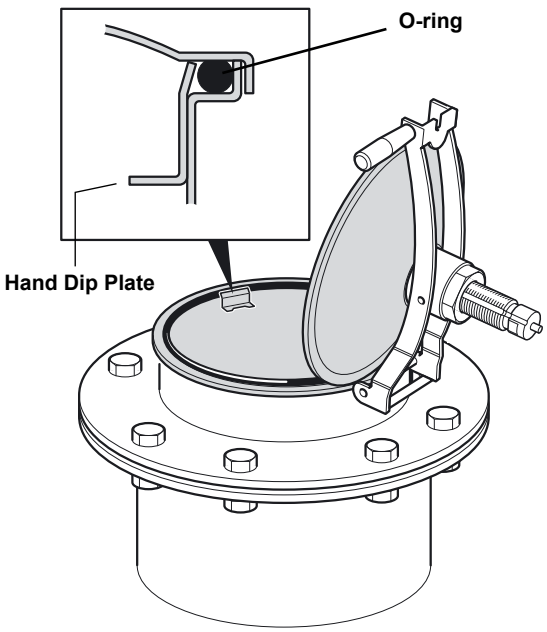
1. Mount the hatch on the nozzle. The hatch has a welded flange with a hole pattern that fits the nozzle flange.
2. Tighten the flange screws. The smaller hatches may have a couple of pin bolts in addition to the screws.



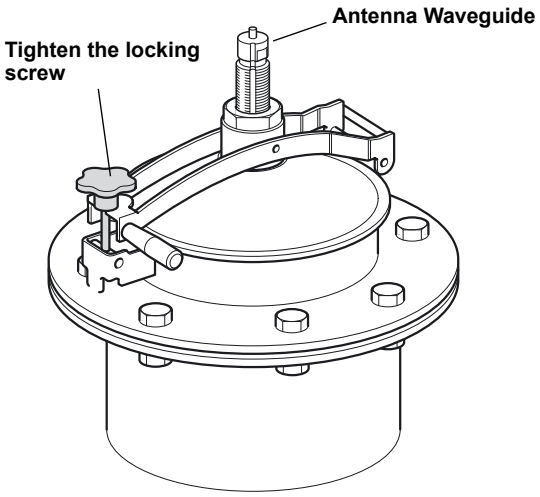
3. Mount the antenna on the lid. Ensure that the guide pin inside the lid fits the groove on the Antenna Waveguide.



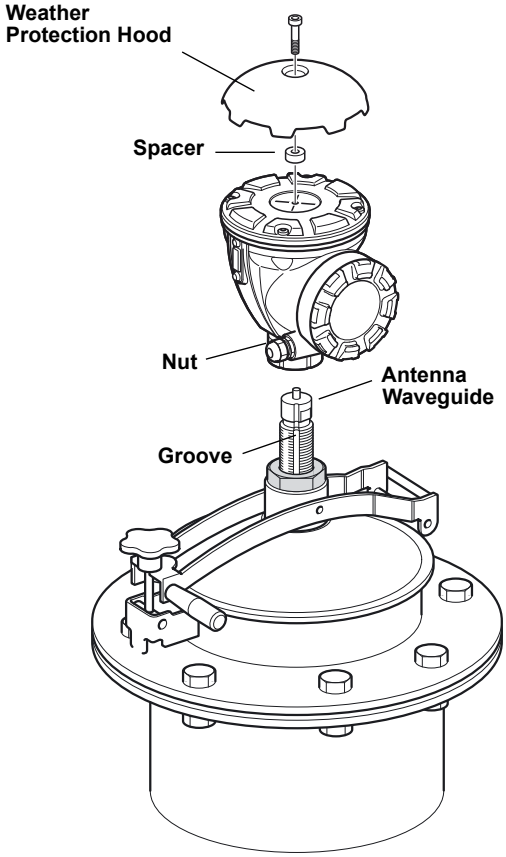
4. Tighten the nut which holds the antenna to the lid.



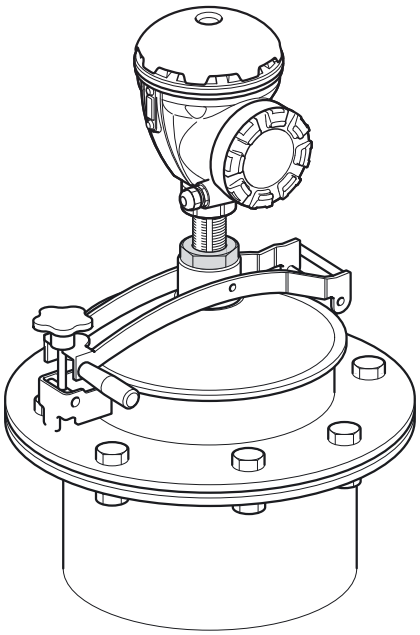
5. Check that the O-ring is properly seated all around the cover and is pressed down behind the Hand Dip Plate.



6. Close the lid and tighten the locking screw.



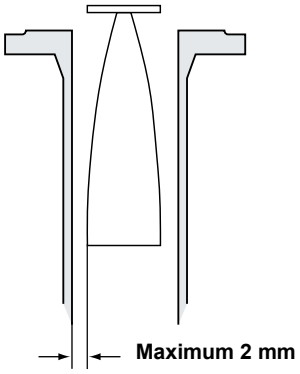
7. Carefully put the gauge on top of the Antenna Waveguide and tighten the nut. Ensure that the guide pin inside the transmitter head fits the groove on the Antenna Waveguide.
8. In case the Weather Protection Hood was removed, put it back on top of the transmitter head and tighten the screw..

	9. Connect the electrical cabling and configure the gauge by using the TankMaster WinSetup software (see the *Raptor System Configuration Manual*, Document No. 300510EN)

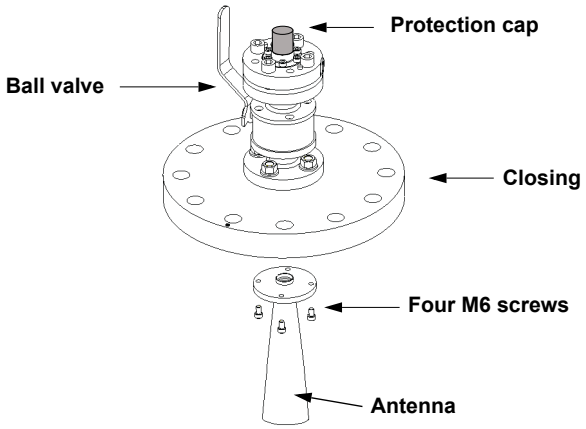
3.3.5 LPG/LNG Antenna

Follow this step by step instruction when installing the LPG/LNG antenna. See “LPG/LNG Antenna Requirements” on page 3-13 for information on mounting considerations before installing the gauge on the tank.

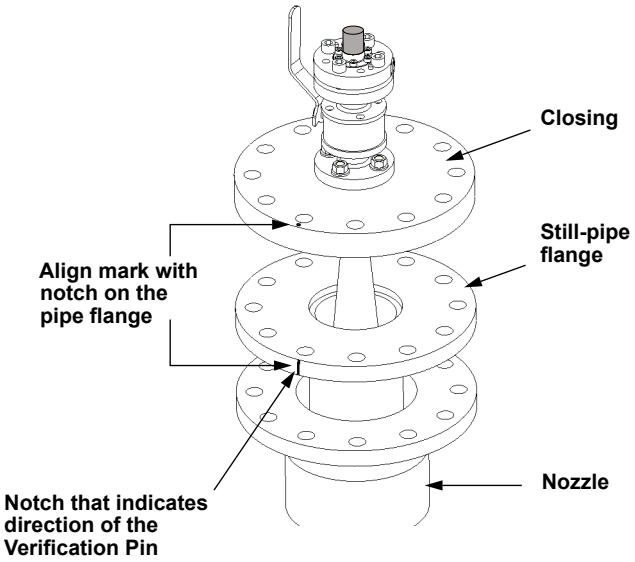
NOTE!
There must be a mark on the still-pipe flange to show the direction of the Verification Pin. Carefully check that the closing is aligned to the mark on the still-pipe flange as described below.



1. Ensure that all parts and tools are available before carrying them to the tank top.
2. Install the still-pipe according to mechanical installation drawing 9240041-910.
3. Check that the cone antenna fits into the still-pipe. The gap between the cone antenna and the pipe must not exceed 2 mm.

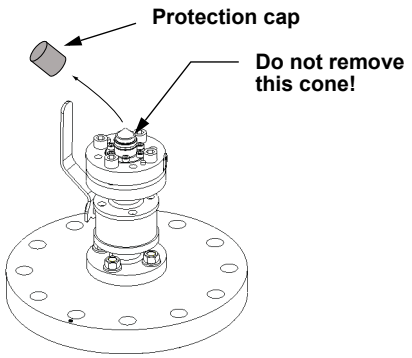


4. Mount the antenna on the closing using four M6 Allen head screws. Be careful when handling the closing and antenna assembly. It is important that the antenna is undamaged without dents.
   Let the protection cap remain on the waveguide until the antenna is installed.

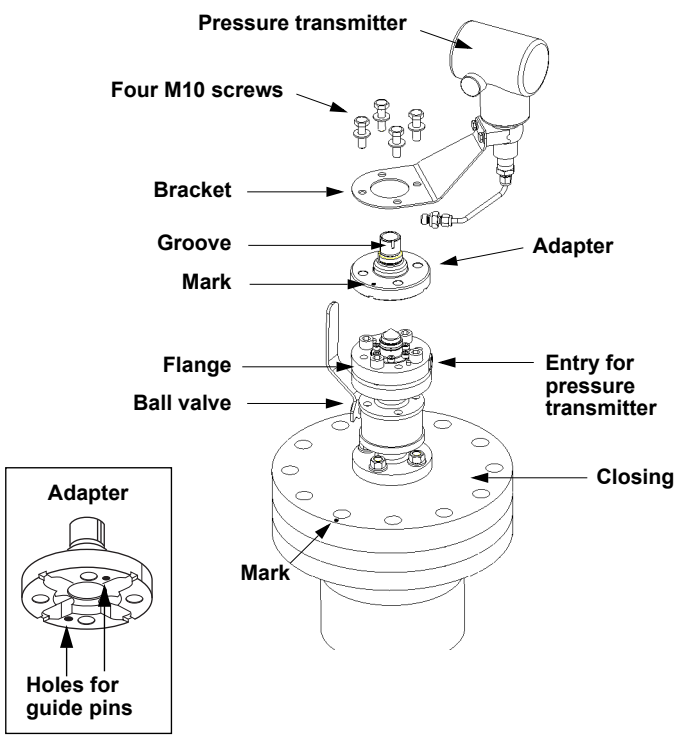


5. Place a gasket (customer supplied) on the still-pipe flange.
6. Carefully fit the antenna into the still-pipe.
7. Direct the closing so that the mark aligns with the notch on the pipe flange.
8. Tighten the closing onto the still-pipe flange (customer supplied screws and nuts).
9. The tank is now sealed and can, as far as Rosemount Tank Gauging equipment is concerned, be pressurized.

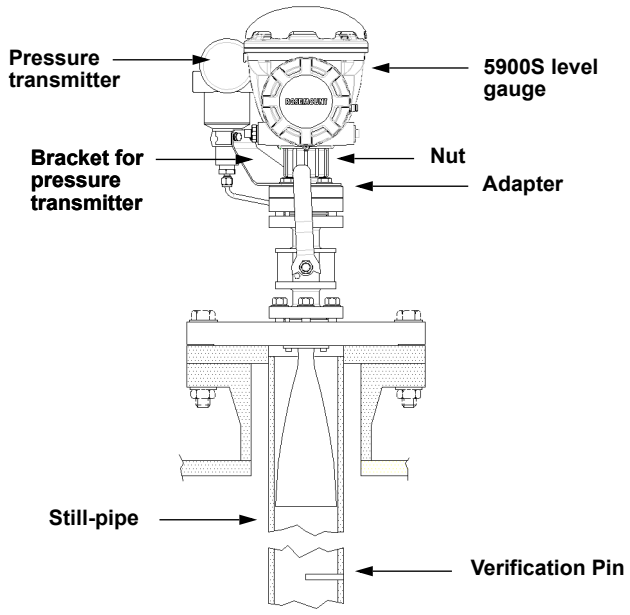
NOTE!
For a safe installation on a pressurized tank it is important that the gauge is installed in accordance with the appropriate local, national, and international standards, codes, and practices.



10. Remove the yellow protection cap from the waveguide.
    Do not remove the rubber cone.



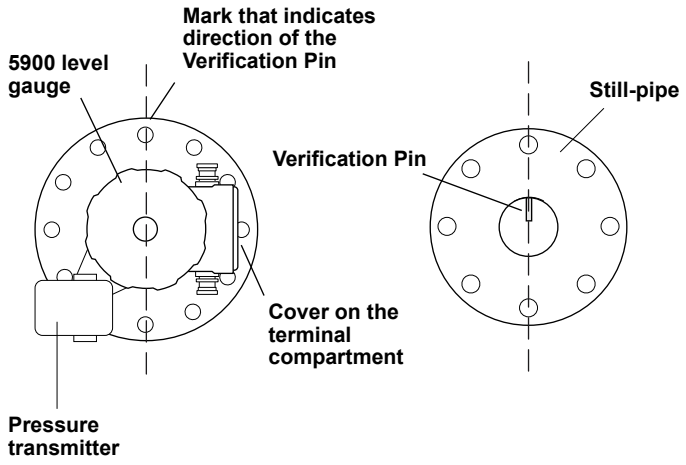
11. Put the adapter on the flange. Ensure that the guide pins on the flange fit the holes at the bottom of the adapter.
12. Ensure that the mark on top of the adapter aligns with the mark on the closing.
13. Mount the bracket and the pressure transmitter.
14. Tighten the four M10 screws with washers.
15. Connect the pipe at the pressure transmitter input to the entry on the flange and tighten the nut.



16. Put the 5900S radar gauge on the adapter. Ensure that the guide pin inside the waveguide of the 5900S fits the groove on the adapter.

    Note! The adapter has two grooves. Use the one that allows the transmitter head to be aligned with the Verification Pin as illustrated below in step 18.

    The direction of the Verification Pin is indicated by marks on the still-pipe flange and the closing. See “LPG/LNG Antenna Requirements” on page 3-13 for more information.
    (The second groove on the adapter is used for measurement verification when replacing a TankRadar Rex level gauge with a Raptor 5900S).
17. Tighten the nut that connects the transmitter head to the adapter.



18. Verify that the level gauge head is properly aligned. The cover on the terminal compartment shall be parallel with the Verification Pin.
    The notch on the still-pipe flange indicates the direction of the Verification Pin.
19. Connect the electrical cabling and configure the gauge by using the TankMaster WinSetup software, see the *Raptor System Configuration Manual* (Document no. 300510EN).
20. Configure the level gauge for LPG measurements (see *"LPG Configuration" on page 4-20*).

3.4 ELECTRICAL INSTALLATION

3.4.1 Cable/conduit entries

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

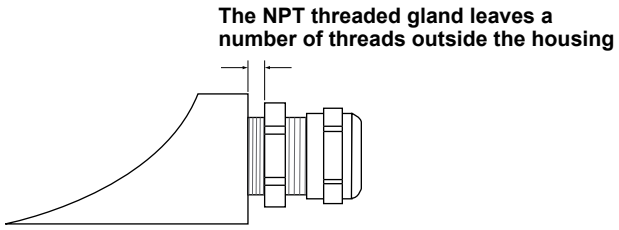
Make sure that unused ports are properly sealed to prevent moisture or other contamination from entering the terminal block compartment of the electronics housing.

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

NOTE!
It is recommended that a sealant of type PTFE is used to prevent water ingress and to enable future removal of the plug/gland.

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

Figure 3-17. Cable entry with NPT threaded gland



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

3.4.2 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 three grounding screw connections provided. Two are located inside the terminal compartment of the housing and the third is located on the housing. The internal ground screws are identified by a ground symbol: ⏚.

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

Grounding - Foundation Fieldbus

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

Shield Wire Ground

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

The *Raptor* devices designed for “daisy-chain” connection offer an isolated shield loop-through terminal in order to enable a continuous shield throughout the Tankbus network.

In order to avoid unintentional grounding points, the cable shield inside the terminal compartment must be isolated.

3.4.3 Cable Selection

Use shielded twisted pair wiring for the Rosemount 5900S Series in order to comply with FISCO[(1)] requirements and EMC regulations. The preferred cable is referred to as type “A” fieldbus cable. The cables must be suitable for the supply voltage and approved for use in hazardous areas, where applicable. In the U.S. explosion-proof conduits may be used in the vicinity of the vessel.

We recommend cable size 1.0 mm^2 or 18 AWG in order to facilitate wiring. However, cables within the range 0.5 to 1.5 mm^2 or 20 to 16 AWG can be used.

The FISCO FOUNDATION™ fieldbus specification requires that cables for the Raptor Tankbus comply with the following cable parameters:

Table 3-5. FISCO cable parameters

Parameter	Value
Loop resistance	15Ω/km to 150Ω/km
Loop inductance	0.4 mH/km to 1 mH/km
Capacitance	45 nF/km to 200 nF/km
Maximum length of each spur cable	60 m in apparatus class IIC and IIB
Maximum cable length including trunk and spurs	1000 m in apparatus class IIC and 1900 m in apparatus class IIB

3.4.4 Hazardous Areas

When the Rosemount 5900S level gauge is installed in hazardous areas, local regulations and specifications in applicable certificates must be observed.

3.4.5 Power Requirements

The Rosemount 5900S is powered over the intrinsically safe Tankbus by the Rosemount 2410 Tank Hub. The 2410 feeds the intrinsically safe fieldbus segment by acting as a FISCO power supply on the Tankbus.

When installed in a FOUNDATION Fieldbus system without a 2410 Tank Hub, the 5900S is powered by the FF segment.

3.4.6 Power Budget

The Rosemount 5900S power consumption is 50 mA for standard devices and 100 mA for the 2-in-1 versions. This has to be considered when connecting field devices to the Tankbus. See section “Power Budget” in the Rosemount 2410 Reference Manual (Document No. 300530EN) for more information.

(1) See IEC 61158-2 and IEC/TS 60079-27:2002.

3.4.7 The Raptor Tankbus

The Raptor system is easy to install and wire. Devices can be “daisy-chained” thus reducing the number of external junction boxes.

In a Raptor system devices communicate with a Rosemount 2410 Tank Hub via the intrinsically safe Tankbus. The Tankbus complies with the FISCO(1) FOUNDATION fieldbus standard. The Rosemount 2410 acts as power supply to the field devices on the Tankbus. A FISCO system enables more field devices to be connected to the segment compared to conventional IS systems based on the entity concept.

Termination

A terminator is needed at each end of a FOUNDATION Fieldbus network. Generally, one terminator is placed in the fieldbus power supply, and the other one in the last device in the fieldbus network.

NOTE!
Ensure that there are **two** terminators on the fieldbus.

In a Raptor system the Rosemount 2410 Tank Hub acts as power supply. Since the 2410 normally is the first device in the fieldbus segment, the built-in termination is enabled at factory

Other Raptor devices such as the standard version of the Rosemount 5900S Radar Level Gauge, the Rosemount 2230 Graphical Field Display, and the Rosemount 2240S Multi-input Temperature Transmitter also have built-in terminators which can easily be enabled by inserting a jumper in the terminal block when necessary.

Segment design

When designing a FISCO fieldbus segment a few requirements need to be considered. Cabling has to comply with FISCO requirements as described in “Cable Selection” on page 3-42.

You will also have to ensure that the total operating current of the connected field devices is within the output capability of the Rosemount 2410 Tank Hub. The 2410 is able to deliver 250(2) mA. Consequently, the number of field devices has to be considered so that the total current consumption is less than 250 mA, see “Power Budget” on page 3-42.

Another requirement is to ensure that all field devices have at least 9 V input voltage at their terminals. Therefore you will have to take into account the voltage drop in the fieldbus cables.

Distances are normally quite short between the Rosemount 2410 Tank Hub and field devices on the tank. In many cases you can use existing cables as long as the FISCO requirements are fulfilled (see “Cable Selection” on page 3-42).

See chapter “The Raptor Tankbus” in the *Rosemount 2410 Reference Manual* (Document no. 305030EN) for more information on segment design of a Raptor system.

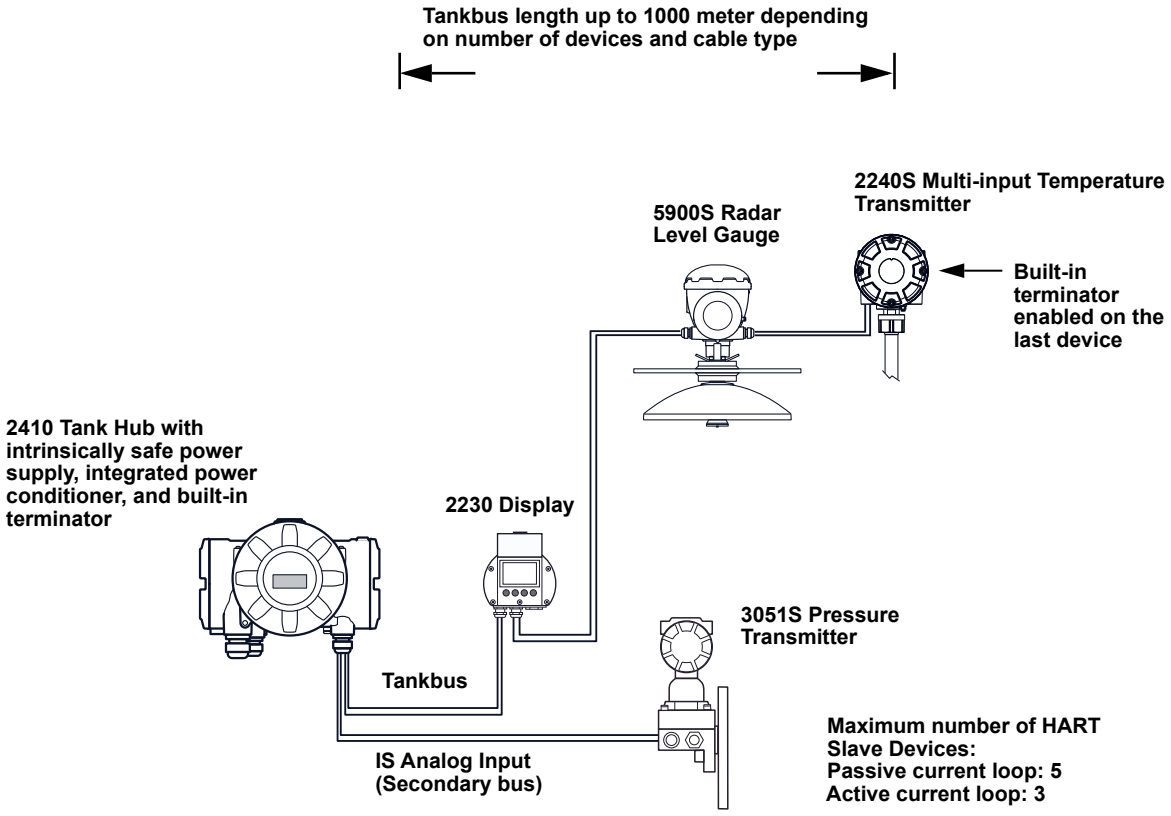
(1) FISCO=Fieldbus Intrinsically Safe Concept
(2) In Smart Wireless Systems the 2410 can deliver 200 mA on the Tankbus

3.4.8 Typical installation

The example below (Figure 3-18) illustrates a system with daisy-chained field devices on a single tank. Terminators are installed at both ends of the fieldbus segment as required in a FOUNDATION fieldbus system. In this case terminators are enabled in the Rosemount 2410 Tank Hub and a field device at the end of the network segment.

In addition to the field instruments on the Tankbus, Figure 3-18 illustrates how an instrument such as a pressure transmitter can be connected to the intrinsically safe 4 -20 mA analog input of the 2410 Tank Hub.

Figure 3-18. Example of a Tankbus connection for a single tank



The maximum distance between the 2410 Tank Hub and the field devices on the tank depends on the number of devices connected to the Tankbus and the quality of cables.

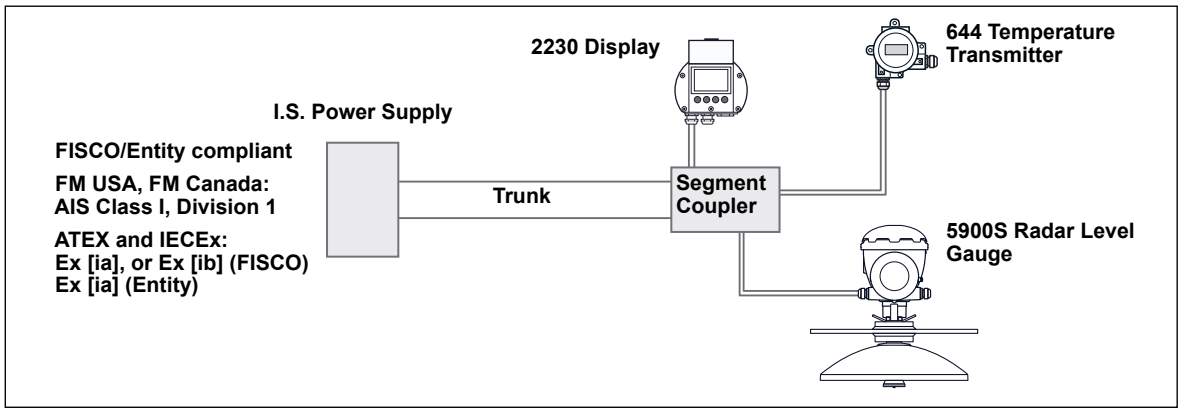
See chapter “Electrical Installation” in the *Rosemount 2410 Reference Manual* (Document no. 305030EN) for more information about cable selection, power budget, and the 2410 Tankbus.

See also “Typical Installations” in the *Rosemount 2410 Reference Manual* (Document no. 305030EN) for more examples of how to install systems that include the 2410 Tank Hub.

3.4.9 5900S in FOUNDATION fieldbus system

The Rosemount 5900S Radar Level Gauge supports the FOUNDATION fieldbus (FF) technology and lets you integrate a 5900S into an existing FF network. As long as the power supply meets certain requirements (see Figure 3-19 and Figure 3-20) the 5900S[1] will be able to operate as any other FF device.

Figure 3-19. Example of an I.S. FOUNDATION fieldbus system with Raptor devices

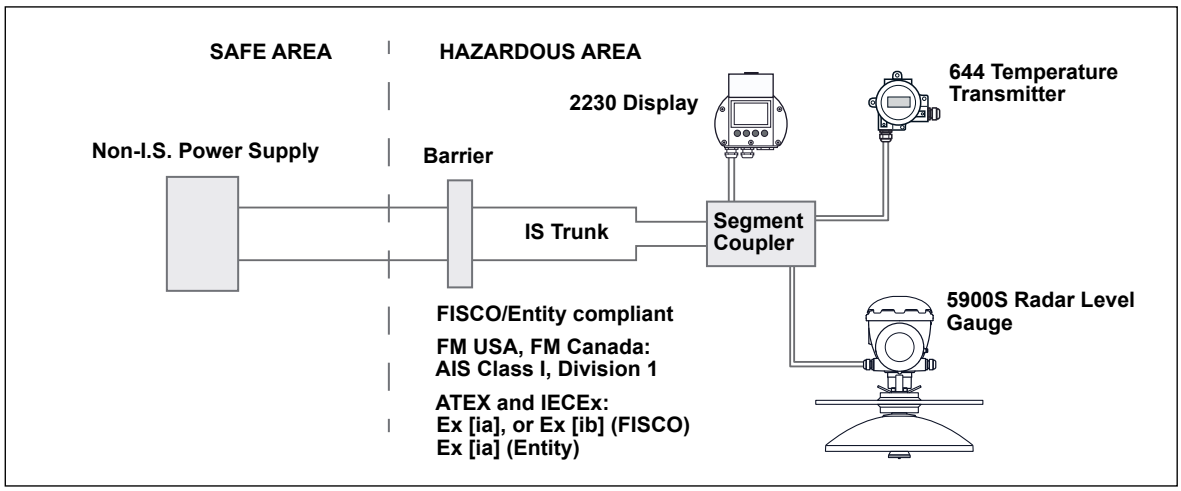


Ensure that the power supply is able to provide the total current needed for all the connected devices. See “Power Requirements” on page 3-42 and “Power Budget” on page 3-42 for further information.

Ensure that the 5900S and other devices connected to the FOUNDATION fieldbus (FF) system are compliant with the FISCO or Entity parameters of the power supply.

Ensure that the short circuit protection of the Segment Coupler[2] matches the current consumption of the connected devices.

Figure 3-20. Example of a Non-I.S. FOUNDATION fieldbus system with Raptor devices



(1) See Appendix B: Product Certifications for 5900S approval information

(2) See the Rosemount 2410 Reference Manual (Document No. 300530EN) for more information on the Segment Coupler.

3.4.10 Wiring

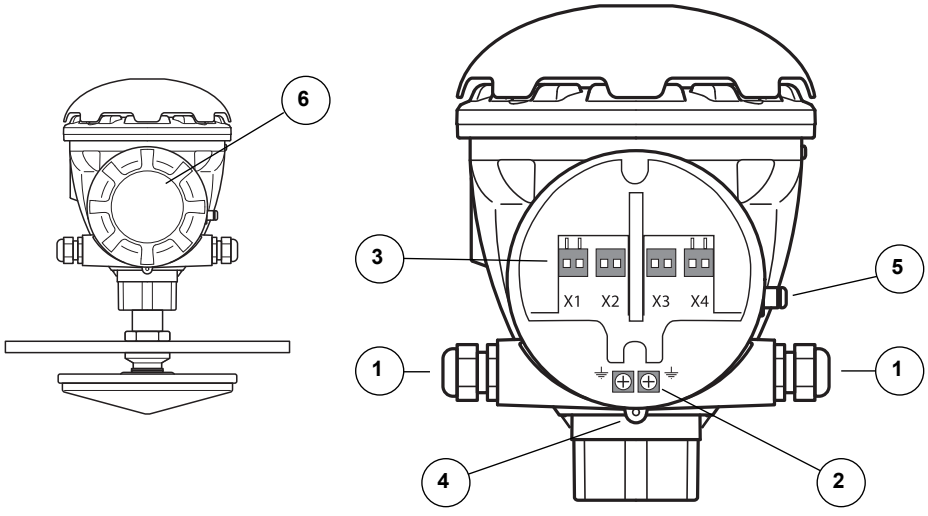
To connect the Rosemount 5900S level gauge:

⚠ 1. Ensure that the power supply is switched off.
2. Remove the cover on the terminal compartment.
3. Run the wires through the appropriate cable gland/conduits.
   Install cables with a drip loop in such a way that the lower part of the loop is under the cable/conduit entry.
4. Connect wires as described in “Terminal Blocks” on page 3-49.
5. Ensure that the positive lead is connected to the terminal marked **FB+** and the negative lead to the terminal marked **FB-**.
6. Use metal plugs to seal unused ports.

⚠ 7. Attach and tighten the cover on the terminal compartment. Make sure that the cover is fully engaged to meet explosion-proof requirements and to prevent water from entering the terminal compartment.
8. Tighten the cable gland/conduit. Note that adapters are required for M20 glands.

NOTE!
Ensure that o-rings and seats are in good condition prior to mounting the cover in order to maintain the specified level of ingress protection. The same requirements apply for cable inlets and outlets (or plugs). Cables must be properly attached to the cable glands.

Figure 3-21. Terminal compartment



① Cable glands
② Internal Ground screws
③ Terminals for signal and power supply
④ Locking screw (Flameproof version)
⑤ External Ground screw
⑥ Cover

Conductor Recommendations

Ensure that you use cables suitable for the terminal block of the 5900S. The terminal block is designed for cables that meet the specifications as illustrated below.

Figure 3-22. Conductor and insulation requirements

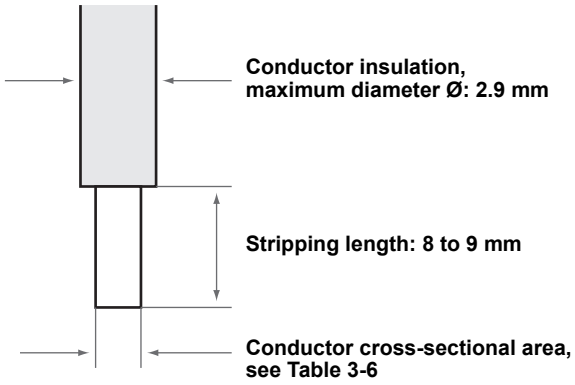


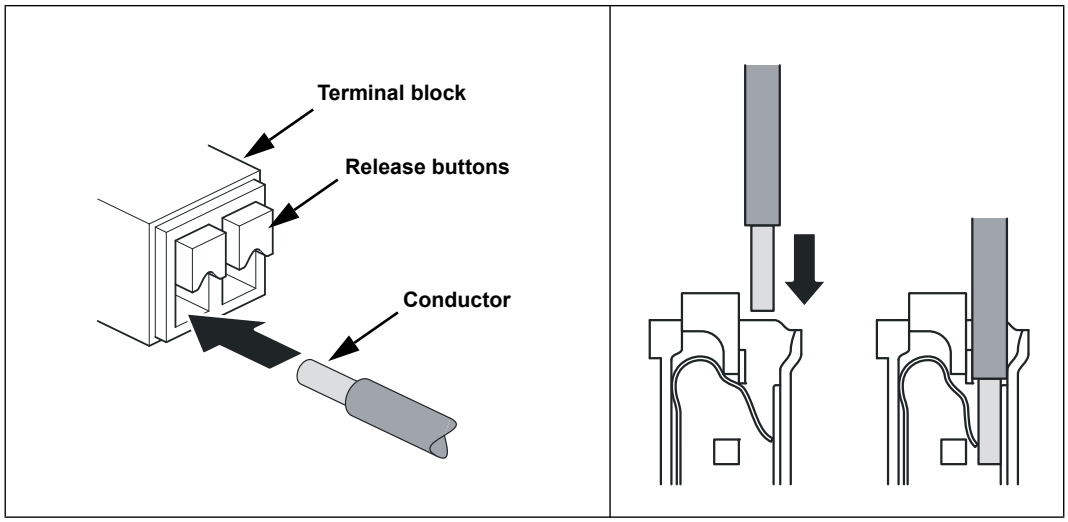
Table 3-6. Conductor cross-sectional area

Conductor connection	Cross-section	
	Minimum	Maximum
Solid	0.2 mm^2 / AWG 24	1.5 mm^2 /AWG16
Flexible	0.2 mm^2 / AWG 24	1.5 mm^2 /AWG16
With wire end ferrule	0.25 mm^2 / AWG 24	1.5 mm^2 /AWG16
With plastic collar ferrule	0.25 mm^2 / AWG 24	0.75 mm^2 /AWG19

In case conductor insulation diameter exceeds 2.9 mm it may not be possible to insert cable properly into the terminal block. In such a case the stripping length may have to be increased. Adjust stripping length such that no bare conductor appears outside the terminal when conductor is attached to the terminal block.

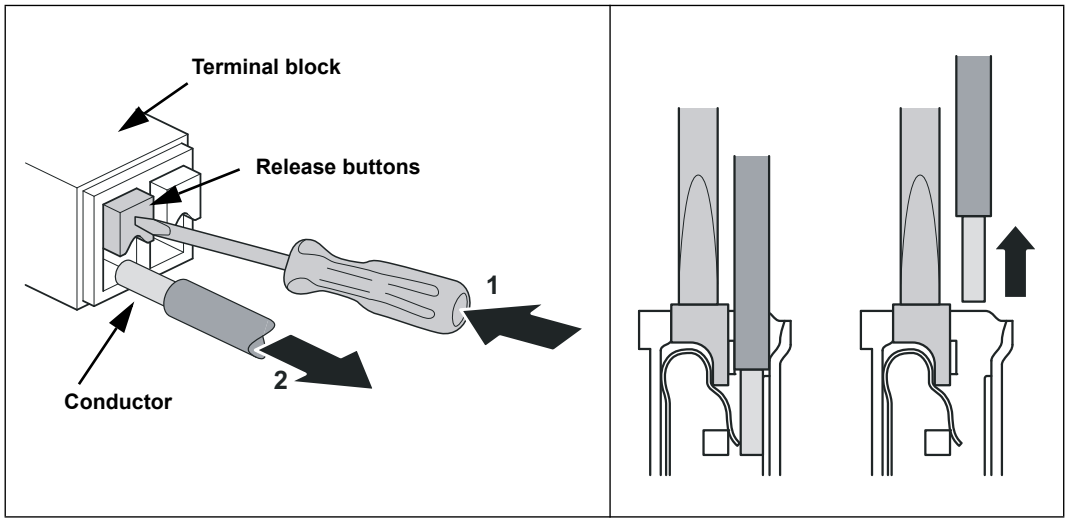
A solid conductor, or a flexible conductor with end ferrule, can easily be pushed into the terminal block without using any tools. In case a flexible (stranded) conductor is used, you will have to push the release button in order to insert the conductor.

Figure 3-23. A solid conductor or a conductor with end ferrule can easily be pushed into the terminal block



To disconnect, push the release button and remove the conductor.

Figure 3-24. Push the button to release the conductor from the terminal block



3.4.11 Terminal Blocks

Figure 3-25. Rosemount 5900S terminal compartment

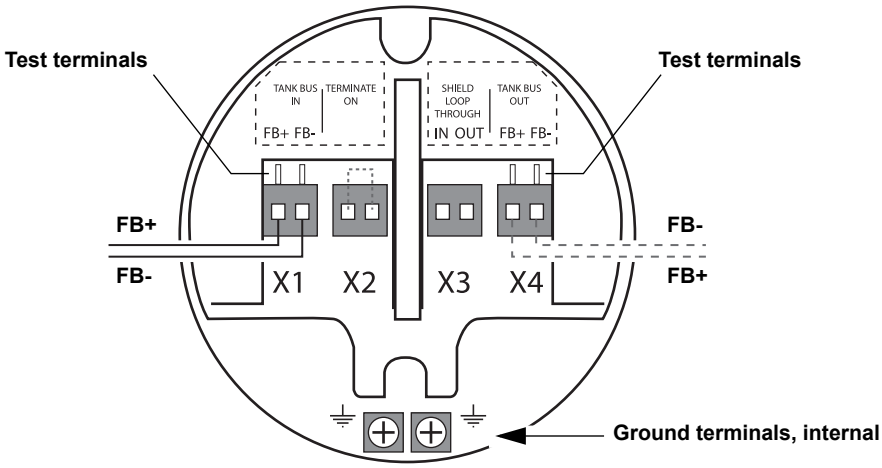


Table 3-7. Terminal block connections for the 5900S

Connection	Description
X1: Tankbus in	Intrinsically safe Tankbus input, power and communication (spur in FOUNDATION fieldbus system)
X2: Terminate on	The integrated line terminator is connected over the Tankbus when a jumper is placed in the terminal block
X3: Shield loop through	Cable shield daisy-chain connector (not grounded)
X4: Tankbus out	Tankbus output connected to X1 for optional daisy-chain connection to other devices
Test terminals	Test terminals for temporary connection of a Field Communicator

The X1 terminal is connected to the intrinsically safe Raptor Tankbus.

A jumper on the X2 terminal enables the built-in termination. The termination should be used if the Rosemount 5900S gauge is installed at the end of a Tankbus network. See “The Raptor Tankbus” on page 3-43 for more information on how to terminate the Raptor Tankbus.

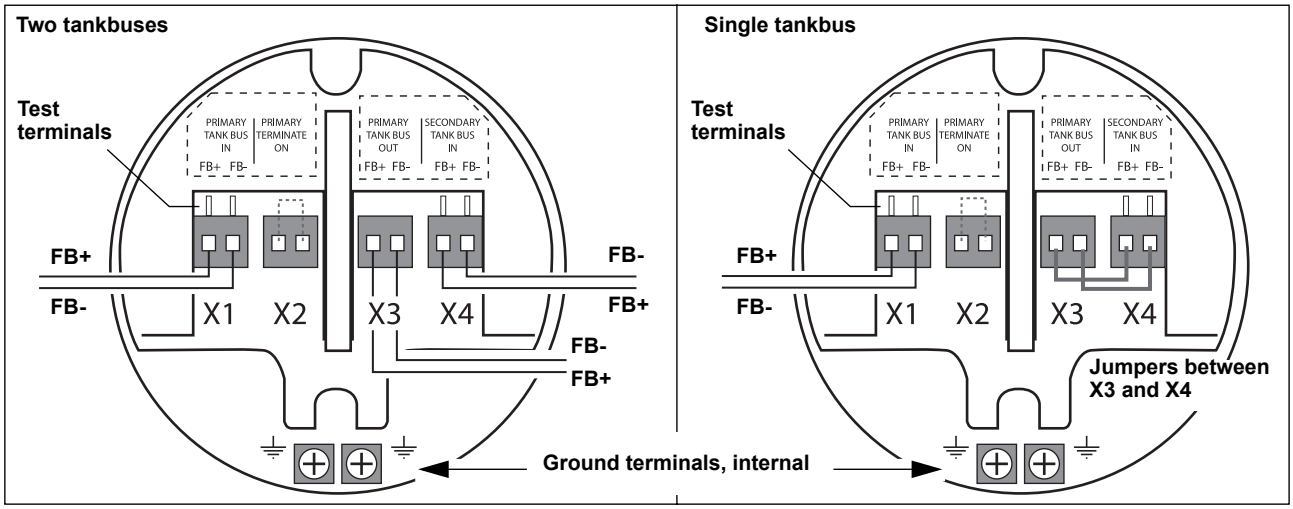
The X3 terminal is used for connecting the cable shield in order to enable a continuous shield throughout the Tankbus network.

The X4 terminal can be used for “daisy-chain” connection to other Raptor devices such as the Rosemount 2240S Multi-input Temperature Transmitter, or the Rosemount 2230 Graphical Field Display, see also Figure 3-28 on page 3-52.

Terminal Block Two-in-One Version

The Rosemount 5900S Two-in-One version can be connected to a single Tankbus or two separate Tankbuses.

Figure 3-26. Terminal compartment.2-in-1 version



When using two separate tankbuses, connect X1 to Tankbus 1 and X4 to Tankbus 2.

Table 3-8. Terminal Block connections for the 5900S with two tankbuses

Connection	Two-in-One / Two tankbuses
X1: Primary Tankbus in	Intrinsically safe Tankbus input for level gauge 1, power and communication
X2: Primary Terminate on	Termination for primary tankbus. The integrated line terminator is connected over the Tankbus when a jumper is placed in the terminal block.
X3: Primary Tankbus out	Primary Tankbus output connected to X1 for optional daisy-chain connection to other devices
X4: Secondary Tankbus in	Intrinsically safe Tankbus input for level gauge 2, power and communication
Test terminals	Test terminals for temporary connection of a Field Communicator

Connect to X1 when using a single tankbus, and jumpers between X3 and X4.

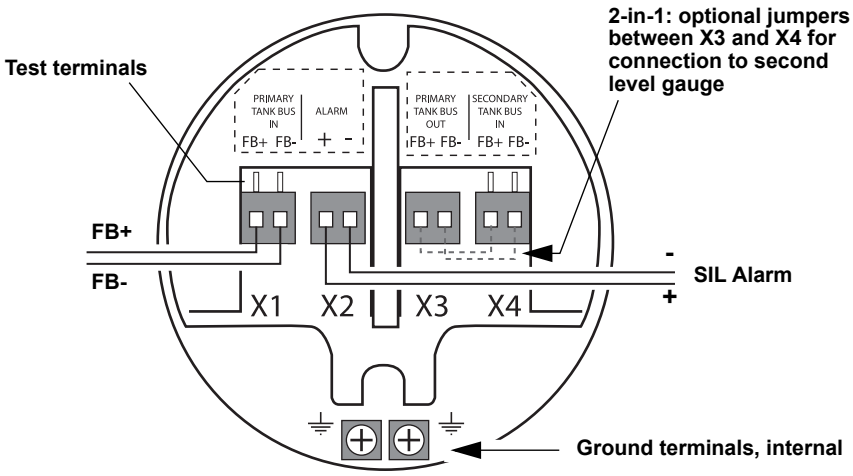
Table 3-9. Terminal Block connections for the 5900S with single tankbus

Connection	Two-in-One / Single tankbus
X1: Primary Tankbus in	Intrinsically safe Tankbus input, power and communication
X2: Primary Terminate on	Termination for primary tankbus. The integrated line terminator is connected over the Tankbus when a jumper is placed in the terminal block.
X3: Primary Tankbus out	Jumpers between X3 and X4
X4: Secondary Tankbus in	
Test terminals	Test terminals for temporary connection of a Field Communicator

Gauge Terminal Block SIL Safety System

The Rosemount 5900S has a SIL2/SIL3 alarm output which is connected to the Rosemount 2410 Tank Hub.

Figure 3-27. Terminal compartment



For the 2-in-1 SIL version of the Rosemount 5900S, optional jumpers are placed between terminals X3 and X4 for connection to the second radar level gauge.

Table 3-10. Terminal Block connections for the 5900S with SIL option

Connection	SIL Safety System
X1: Primary Tankbus in	Intrinsically safe Tankbus input, power and communication
X2: Alarm	**SIL2/SIL3 alarm output** (connect to Exi terminal block on Rosemount 2410 Tank Hub)
X3: Primary Tankbus out	Optional jumpers between X3 and X4 for connection to second level gauge of the Rosemount 5900S / 2-in-1 version
X4: Secondary Tankbus in	
Test terminals	Test terminals for temporary connection of a Field Communicator

See the *Rosemount Raptor Safety Manual for Use in Safety Instrumented Systems* (Document no. 300540en) for more information on how to setup a Raptor SIL safety system.

3.4.12 Wiring Diagrams

The standard version of the Rosemount 5900S has a single intrinsically safe fieldbus input. The 5900S has a built-in termination by short-circuiting the X2 connector.

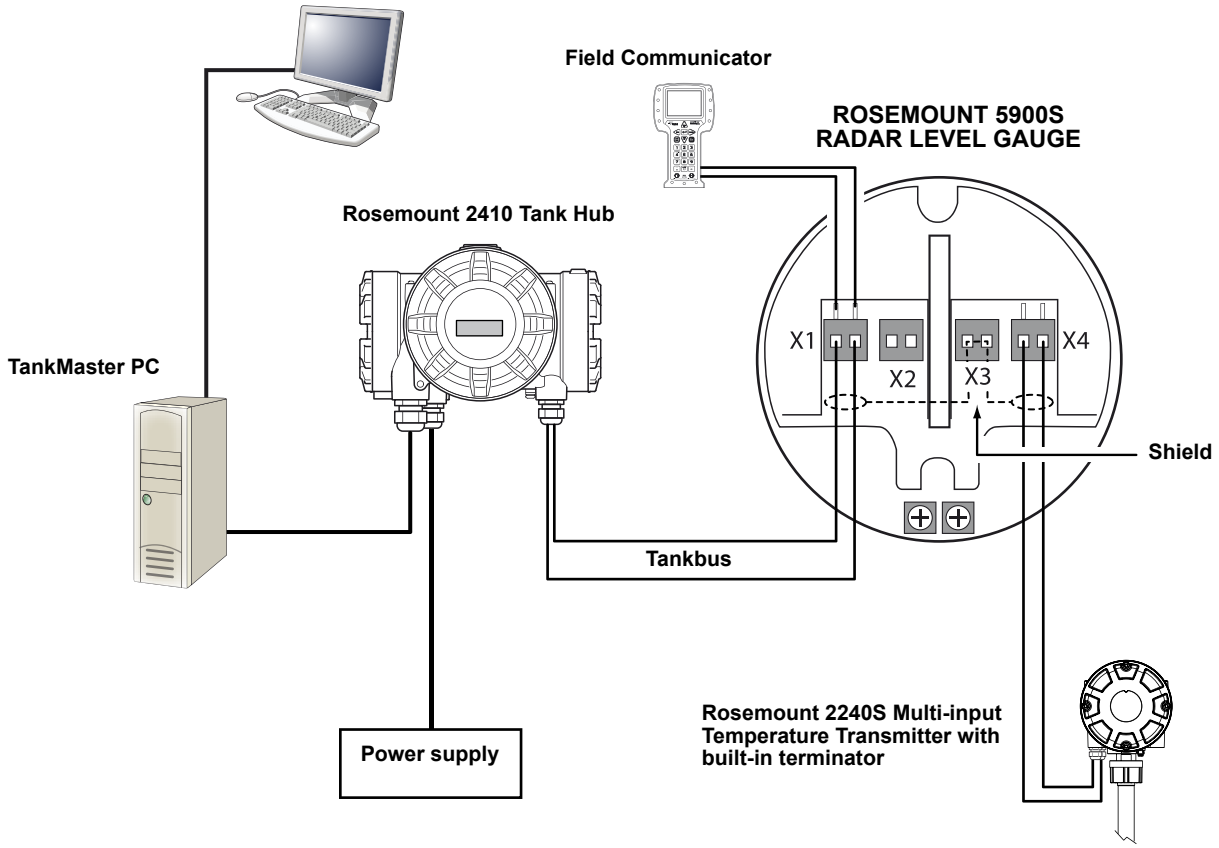
An intrinsically safe output on connector X4 can be used for “daisy-chain” connection to other devices in a Raptor system.

Connector X3 is used for a fieldbus input/output cable shield connection (separated from chassis ground).

Figure 3-28 illustrates a typical wiring diagram with a Rosemount 5900S Radar Level Gauge connected to a Rosemount 2240S Multi-input Temperature Transmitter. In this example the termination is enabled in the 2240S transmitter which is the last device on the Tankbus (see “The Raptor Tankbus” on page 3-43).

In case you prefer to connect the 2240S to the 2410 Tank Hub, you may “daisy-chain” the 5900S to the 2240S, and terminate the Tankbus by a jumper in terminal X2 on the 5900S terminal block.

Figure 3-28. 5900S wiring diagram



See also “Terminal Blocks” on page 3-49 for information on terminal block connections.

The Rosemount 5900S 2-in-1 version

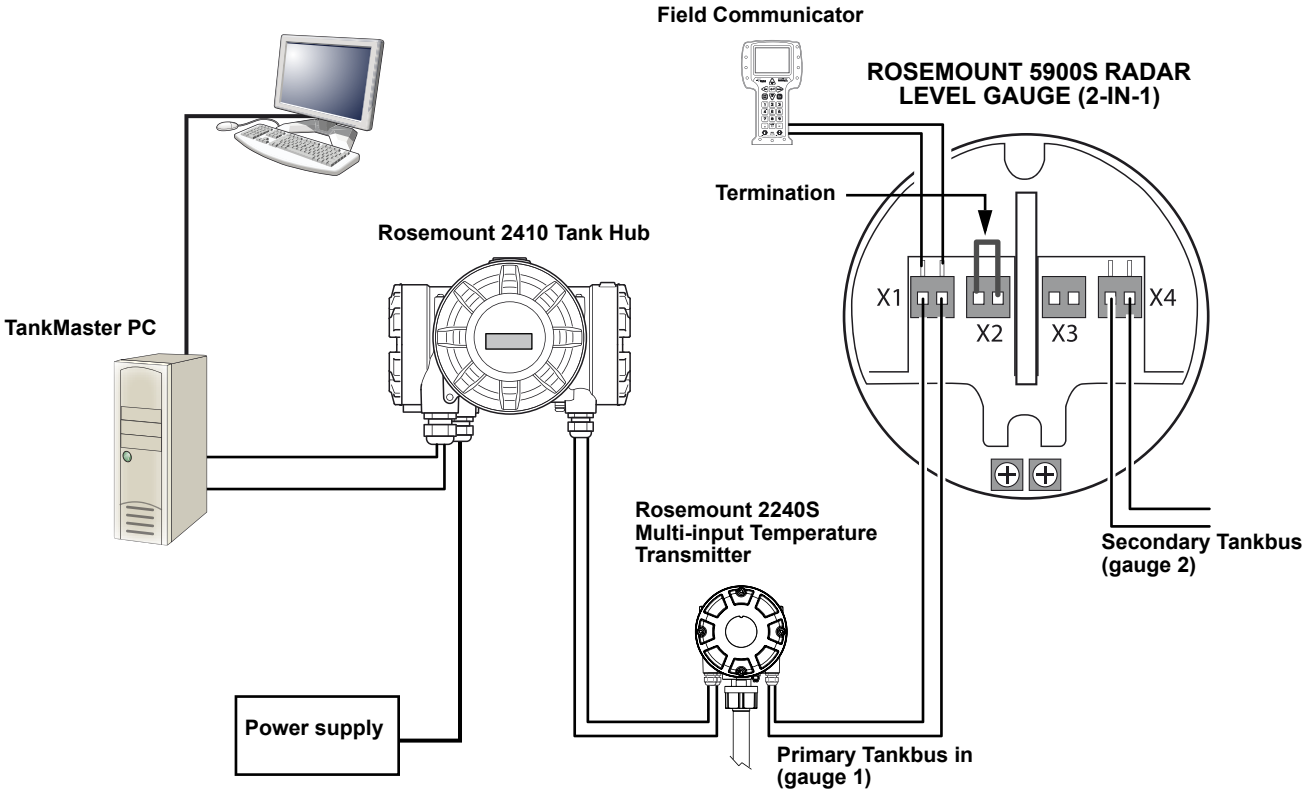
The 2-in-1 version of the Rosemount 5900S has two separate level gauges in the same housing. One of the tankbuses can be terminated in the 5900S terminal compartment.

The 2-in-1 version can be connected to two separate tankbuses as illustrated in Figure 3-29 and 3-31, or to a single tankbus as illustrated in Figure 3-30 on page 3-54.

Terminal X1 is an intrinsically safe tankbus input for level gauge 1, and terminal X4 connects to the second level gauge.

Figure 3-29 illustrates a wiring diagram with a 2-in-1 version of the Rosemount 5900S Radar Level Gauge which is “daisy-chained” to a Rosemount 2240S Multi-input Temperature Transmitter. Note that the Primary Tankbus is terminated in the 5900S terminal block (X2).

Figure 3-29. Rosemount 5900S wiring diagram for 2-in-1 version with two tankbuses

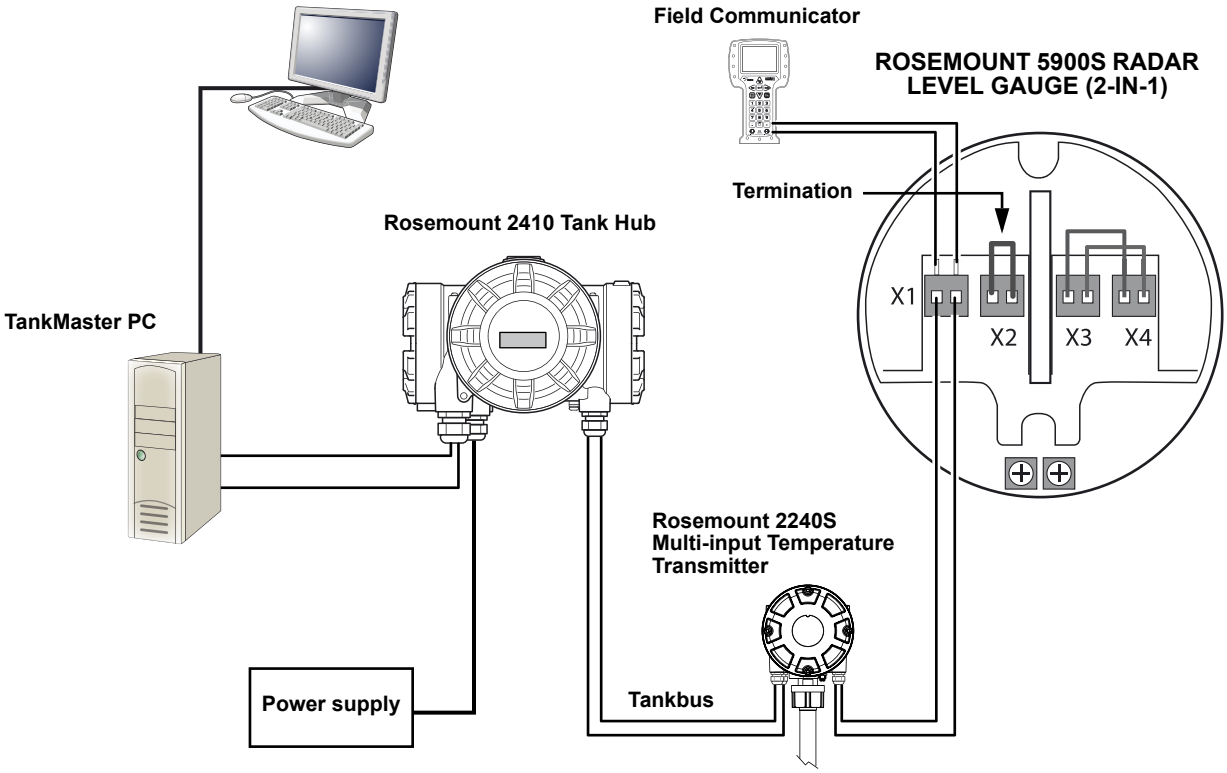


See also “Terminal Blocks” on page 3-49 for information on terminal block connections.

Figure 3-30 illustrates the 2-in-1 version of the Rosemount 5900S with a single intrinsically safe Tankbus. The Tankbus is connected to the first level gauge via terminal X1, and to the second level gauge via a jumper between terminals X3 (Primary Tankbus out) and X4 (Secondary Tankbus in).

The Tankbus termination is enabled in the 5900S terminal block (X2).

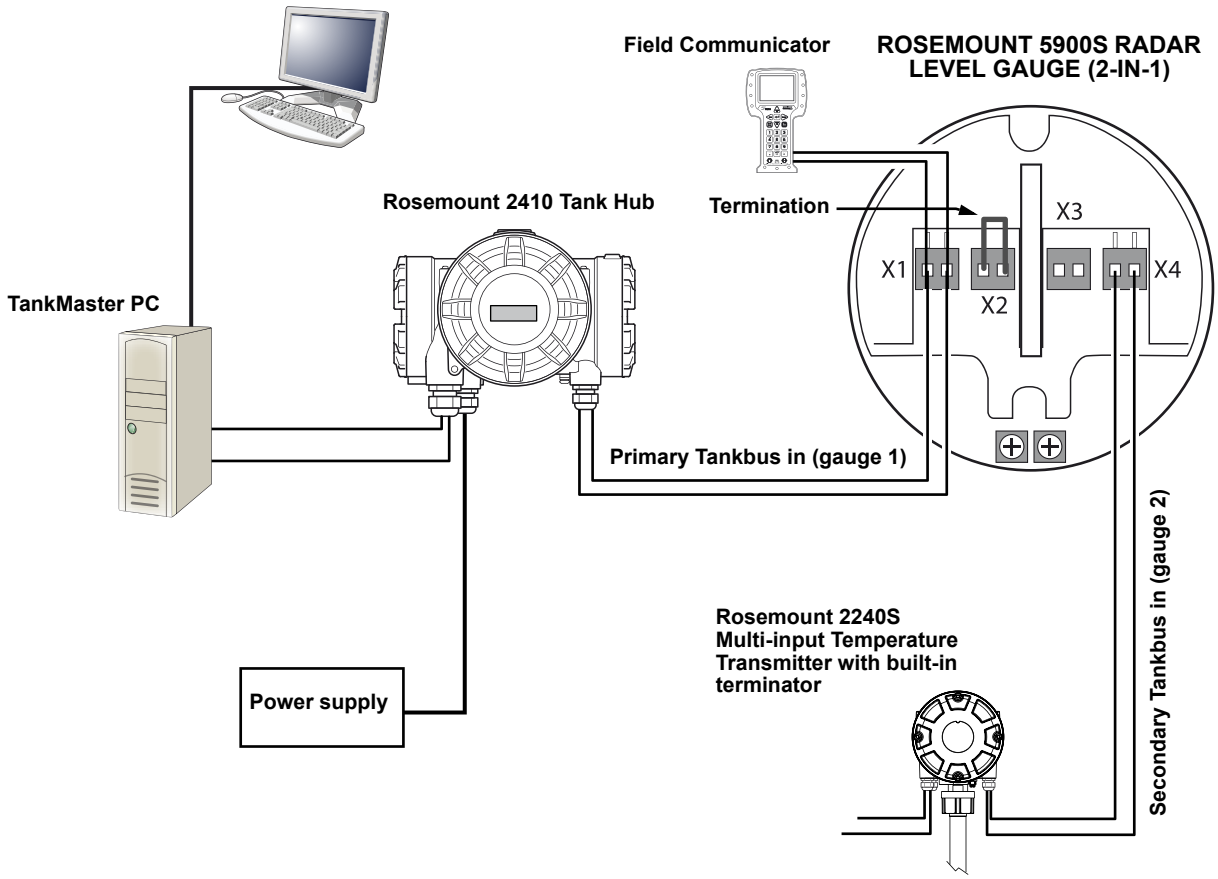
Figure 3-30. Rosemount 5900S wiring diagram for 2-in-1 version with a single tankbus



In Figure 3-31 a Rosemount 2240S transmitter is wired to the second level gauge of a 2-in-1 version of the Rosemount 5900S Radar Level Gauge.

The Primary Tankbus is terminated in the 5900S terminal block (X2). The Secondary Tankbus is terminated by enabling the built-in termination of the 2240S temperature transmitter.

Figure 3-31. Wiring diagram for Rosemount 5900S 2-in-1 version with two tankbuses



Section 4 Configuration

4.1 SAFETY MESSAGES

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

⚠WARNING

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

Make sure only qualified personnel perform the installation.

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

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

Substitution of components may impair Intrinsic Safety.

⚠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 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.

4.2 OVERVIEW

The 5900S can be installed in Rosemount Tank Gauging systems including 2160 Field Communication Units and Rosemount 2410 Tank Hubs. The 5900S also supports installation in **FOUNDATION** fieldbus systems. Installation of the 5900S is a simple and straight-forward procedure. In a Rosemount Tank Gauging system with 2410 Tank Hub and 2160 Field Communication Unit it basically includes the following steps:

1. Preparations: make a note of Unit ID, Modbus address(1), antenna type, tank geometry parameters such as tank height, tank type, strapping table
2. Set up communication protocol and communication parameters.
3. Configuration of the Rosemount 2160 Field Communication Unit.
4. Configuration of the Rosemount 2410 Tank Hub.
5. Configuration of field devices such as the Rosemount 5900S Radar Level Gauge and 2240S Multiple-Input Temperature Transmitter.
6. Calibration of the 5900S level gauge.

Installation of the 5900S in FOUNDATION fieldbus systems is supported by a complete set of Resource, Function, and Transducer blocks. You can easily integrate the 5900S level gauge into any existing FOUNDATION fieldbus network by using an appropriate configuration tool such as the AMD Device Manager. See section “FOUNDATION Fieldbus Overview” on page 4-34 for more information.

The *TankMaster WinSetup* program is the recommended tool for installation and configuration of a Rosemount 5900S Radar Level Gauge in systems that include the 2410 Tank Hub. The 5900S is preferably installed as part of the procedure when installing a Rosemount 2410 Tank Hub.

This is the standard procedure for installing a 5900S Radar Level Gauge:

1. Start by installing and configuring the 2410 Tank Hub by using the device installation wizard in TankMaster WinSetup.
2. Finish the 2410 installation procedure. Ensure that automatic installation of field devices is enabled. The 2410 Tank Hub, the 5900S Level Gauge, and other field devices on the Tankbus will automatically appear in the WinSetup workspace.
3. Configure the 5900S level gauge via the *Properties* window.

If a 5900S is added to an existing system the Rosemount 2410 tank database must be updated before the 5900S is configured. The tank database maps the 5900S to the tank on which it is installed.

A detailed description of how to install and configure a Rosemount 5900S and other devices by using the TankMaster WinSetup software is provided in the *Raptor System Configuration* manual (*Document no. 300510EN*).

NOTE!
If the system contains a 2160 Field Communication Unit (FCU) it should be installed and configured before other devices such as level gauges and temperature multiplexers.

See section “FOUNDATION Fieldbus Overview” on page 4-34 for more information on installing the 5900S in **FOUNDATION** fieldbus systems.

(1) See the System Configuration manual (Document no. 300510EN)

The Rosemount 5900S supports basic configuration which is sufficient in most cases. There are a number of advanced configuration options available as well, which may be used for special applications when further fine-tuning is needed.

4.2.1 Basic Configuration

Basic configuration includes specifying parameters for a standard configuration. This is sufficient in most cases. A basic configuration includes the following items:

- Measurement units
- Tank geometry; tank height, tank type, tank bottom type, pipe diameter, hold off distance, calibration distance, etc.
- Process conditions; rapid level changes, turbulence, foam, solids, product dielectric range
- Volume; standard tank types, strapping table
- Tank scan; analyze the 5900S measurement signal
- Empty tank handling; optimize measurements close to the tank bottom

See “Basic Configuration” on page 4-6 for more information.

4.2.2 Advanced Configuration

In addition to basic configuration, the Rosemount 5900S supports advanced functions for optimizing measurement performance in certain applications. The 5900S can be fine-tuned to handle a wide range of product properties, various tank types, disturbing objects, and turbulent conditions in the tank.

Examples of advanced functions supported by the Rosemount 5900S and the Rosemount TankMaster WinSetup configuration program:

- Surface echo tracking
- Filter settings

See “Advanced Configuration” on page 4-15 for more information.

4.2.3 Configuration Tools

Different tools are available for configuration of a Rosemount 5900S level gauge:

- Rosemount TankMaster Winsetup
- Field Communicator
- AMS Device Manager for FOUNDATION fieldbus systems
- FOUNDATION fieldbus hosts supporting DD4

The TankMaster Winsetup is a user-friendly software package that includes basic configuration options as well as advanced configuration and service functions.

For DeltaV users, the DD can be found at www.easydeltav.com. For other hosts that use Device Descriptions (DD) and DD Methods for device configuration, the latest DD versions can be found on FOUNDATION’S website at www.fieldbus.org.

4.3 CONFIGURATION USING ROSEMOUNT TANKMASTER

For a Rosemount Tank Gauging system that includes the Rosemount 2410 Tank Hub it is recommended that the Rosemount 5900S is configured by using the *TankMaster Winsetup* configuration tool. In such a system the host computer communicates with the 2410 Tank Hub via TRL2 Modbus or RS485 Modbus. By using the *TankMaster Winsetup* configuration tool, installation and configuration of the Rosemount 5900S can be performed by any of the following methods:

- as part of the installation and configuration procedure of a Rosemount 2410 Tank Hub (recommended)
- by using the TankMaster installation wizard

A Rosemount 5900S is typically installed as part of the installation procedure when installing a Rosemount 2410 Tank Hub in TankMaster WinSetup. Then the 5900S appears in the WinSetup workspace and is configured in a separate stage via the *Properties* window.

See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on using the *TankMaster WinSetup* program to configure a Rosemount 5900S Radar Level Gauge.

4.3.1 Installation Wizard

The *WinSetup* installation wizard is a tool that facilitates installation and configuration of Rosemount 5900S and other devices. This may be useful in case the 5900S was not installed as part of the 2410 installation procedure.

See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information.

The 5900S may also be installed by using the *TankMaster WinSetup* installation wizard.

NOTE!
In case the Rosemount 5900S level gauge was installed “offline” via a Rosemount 2410 Tank Hub, it needs to be configured separately via the *Properties* window.

To install a Rosemount 5900S by using the *TankMaster WinSetup* wizard do the following:

1. Start the TankMaster WinSetup program.
2. Select the **Devices** folder.
3. Click the right mouse button and select **Install New**.
4. Follow the instructions.

There are a number of configuration options available which are not included in the installation wizard. See “Basic Configuration” on page 4-6 and “Advanced Configuration” on page 4-15 for information on how to use various options such as Tank Scan, Empty Tank Handling, Surface Echo Tracking and Filter Settings.

See also the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on using the TankMaster WinSetup program to configure a Rosemount 5900S.

4.4 BASIC CONFIGURATION

4.4.1 Tank Geometry

The following parameters are used for tank geometry configuration of a Rosemount 5900S Radar Level Gauge:

Figure 4-1. Tank geometry parameters for the 5900S

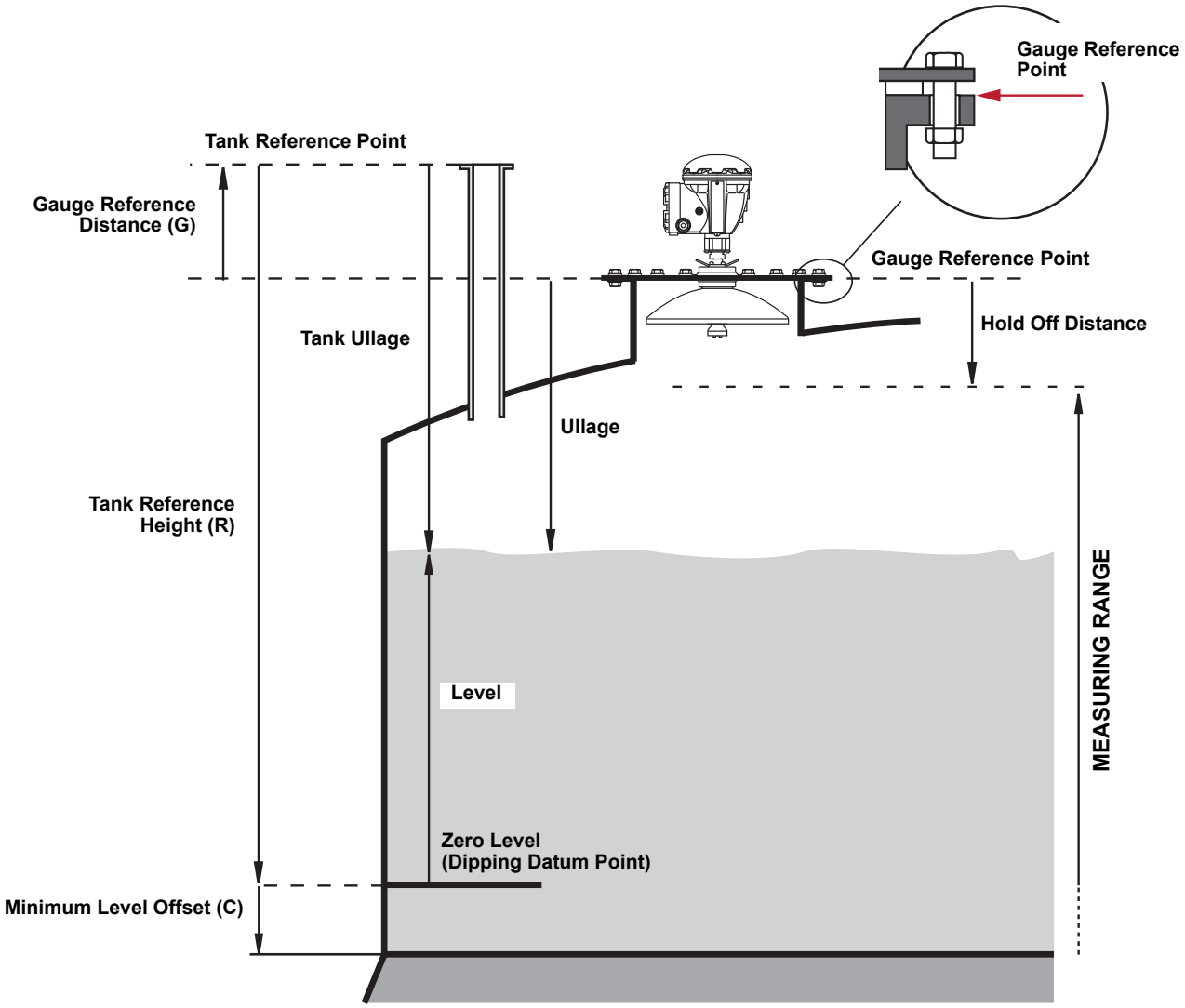
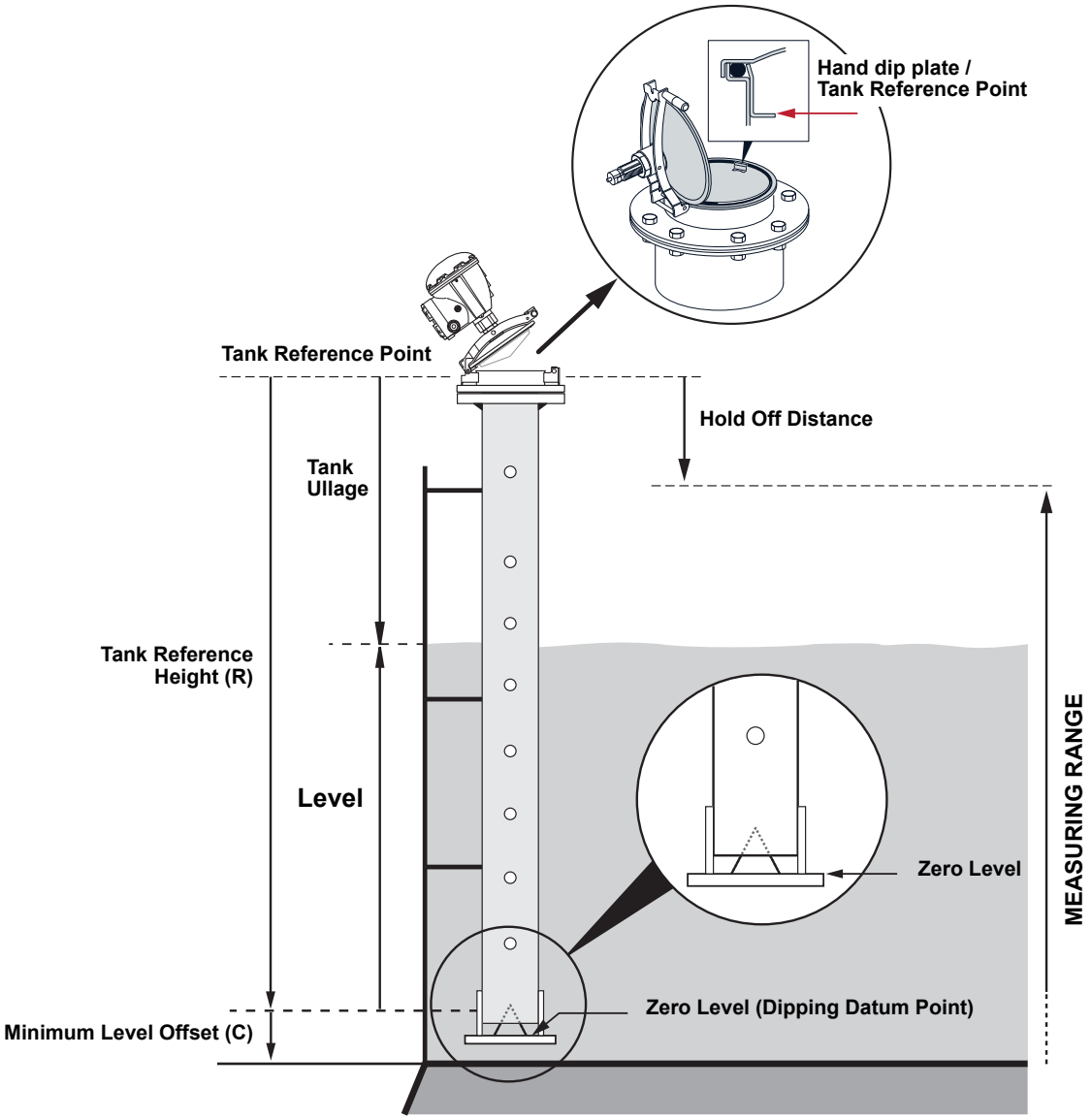


Table 4-1. Definition of tank geometry parameters

Tank Height (R)	Distance from Tank Reference Point to Zero level
Gauge Reference Distance (G)	Distance from Tank Reference Point to the Gauge Reference Point
Minimum Level Offset (C)	Distance from Zero Level to tank bottom
Hold Off Distance	Defines how close to the Gauge Reference Point levels can be measured

The 5900S with Array Antenna and hinged hatch allows you to hand dip by opening the lid and moving the gauge away from the tank opening. A hand dip plate is located inside the hatch. The plate is used as the Tank Reference Point for the tank geometry parameter Tank Height (R).

Figure 4-2. Tank geometry for Array Antenna with hinged hatch



Tank Reference Height (R)

The Tank Reference Height (R) is the distance from the hand dipping nozzle (Tank Reference Point) to the Zero Level (Dipping Datum Plate) close to, or at the bottom of the tank. For the Array Antenna with hinged hatch the reference point is located at the hand dip plate as illustrated in Figure 4-2 on page 4-7.

Gauge Reference Distance (G)

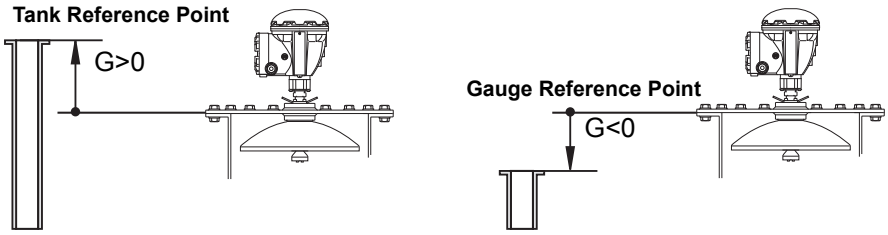
The Gauge Reference Distance (G) is measured from the Gauge Reference Point to the Tank Reference Point, which is located at the top surface of the customer's flange or manhole cover on which the level gauge is mounted as illustrated in Figure 4-1 and Figure 4-3.

For the hinged hatch version of the 5900S with Array Antenna, the Tank Reference Point and the Gauge Reference Point are located at the same position i.e. at the hand-dip plate on the Still Pipe Gauge Stand as illustrated in Figure 4-2 on page 4-7.

Set G=0 for the 5900S with Array Antenna hinged hatch version when using the hand dip plate as the Tank Reference Point (see Figure 4-2).

G is positive if the Tank Reference Point is located above the Gauge Reference Point. Otherwise G is negative.

Figure 4-3. Definition of Gauge Reference Distance



Minimum Level Offset (C)

The Minimum Level Distance (C) is defined as the distance between the Zero Level (Dipping Datum Point) and the Minimum Level of the product surface (tank bottom). By specifying a C-distance, the measuring range can be extended to the bottom of the tank.

If C>0, negative level values will be displayed when the product surface is below the Zero Level. Select the **Show negative level values as zero** check box in *TankMaster WinSetup* if you want levels below the Zero Level to be displayed as Level=0.

Measurements below the Zero Level will not be approved if the C-distance=0, i.e. the 5900S will report an invalid level.

Hold Off Distance

The Hold Off distance defines how close to the Gauge Reference Point a level value is accepted. Normally the **Hold Off** distance does not need to be changed. However, if there are disturbing echoes in the upper part of the tank, for example from the tank nozzle, you can increase the Hold Off distance in order to avoid measurements in the region close to the antenna.

Calibration Distance

Use this variable to calibrate the 5900S so that measured product levels match hand dipped levels. A minor adjustment may be necessary when the gauge is installed if, for example, there is a deviation between the actual tank height and the height given by tank drawings.

See “Calibration Using WinSetup” on page 4-29 for more information.

Pipe Diameter

When a Rosemount 5900S Radar Level Gauge is installed 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 results in a scale factor error. If locally supplied still pipes are used, make sure the inner diameter is noted before the pipe is installed.

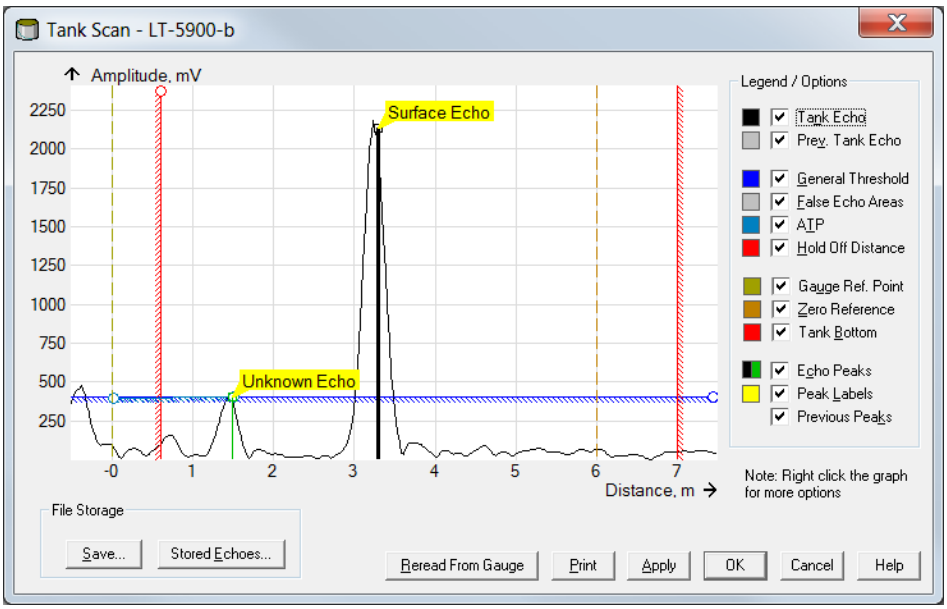
4.4.2 Tank Scan

The *Tank Scan* window is a useful tool for analyzing the Rosemount 5900S measurement signal. It allows you to view tank echoes and setup the most important parameters to enable the gauge to distinguish between the surface echo and disturbing echoes and noise.

To open the *Tank Scan* window:

1. Start the TankMaster *WinSetup* program.
2. In the *TankMaster WinSetup* workspace, click the right mouse button on the icon that represents the 5900S Radar Level Gauge.
3. From the popup menu choose the **Properties** option.
   The *RLG Properties* window appears.
4. In the *RLG Properties* window, select the *Advanced Configuration* tab.
5. Click the **Tank Scan** button to open the *Tank Scan* window:

Figure 4-4. The WinSetup Tank Scan window



6. The *Tank Scan* window contains the Graph Area, Legend/Options area, File Storage buttons, and various action buttons.

When the *Tank Scan* window is opened, the system starts reading tank data from the gauge (indicated by a progress bar in the lower right-hand corner).

The **Tank Echo** curve shows the measurement signal in graphical form. In addition to the surface echo there might be echoes from obstacles in the tank.

In the graph area you can configure the gauge to filter out echoes that originate from obstacles in the tank in order to facilitate tracking of the product surface echo.

The tank echo and echo peaks can be refreshed at any time with the **Reread From Gauge** button. The new echo curve will be shown as a black line and the previous curve as a grey line. The graph may show up to two old echo curves. An old echo peak will be marked by a small cross. This can be used to compare the existing tank signal with previous signals.

See the *Raptor System Configuration* manual *(Document No. 300510EN)* for more information on how to use the Tank Scan function.

4.4.3 Empty Tank Handling

The Rosemount 5900S **Empty Tank Handling** function handles situations when the surface echo is close to the tank bottom. It has the ability to:

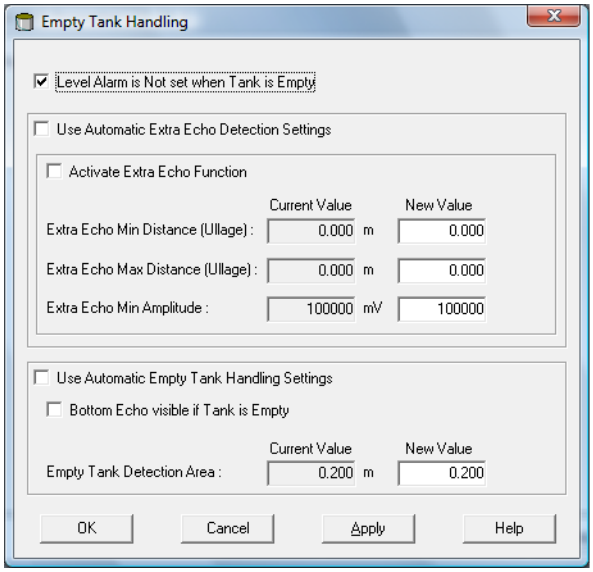
- track weak product echoes
- handle lost echoes

If the surface echo is lost this function makes the 5900S present a zero-level measurement.

To open the *Empty Tank Handling* window:

1. In the *TankMaster WinSetup* workspace, click the right mouse button on the icon that represents the desired 5900S Radar Level Gauge.
2. From the popup menu choose the **Properties** option.
   The *RLG Properties* window appears.
3. In the *RLG Properties* window, select the *Advanced Configuration* tab.
4. Click the **Empty Tank Handling** button:

Figure 4-5. The WinSetup *Empty Tank Handling* window



Level Alarm is not set when Tank is Empty

In case the product surface echo is lost in the Empty Tank Detection Area close to the tank bottom, the device will enter Empty Tank state and an Invalid Level Alarm is triggered (appears in the *Diagnostics* window).

Enable this check box if you don't want the alarm to be triggered when the gauge enters empty tank state.

Activate Extra Echo Function

The **Extra Echo Detection** function is used for tanks with a dome or conical bottom shape provided the tank bottom does not produce a strong echo when the tank is empty. This function results in more robust measurements near the tank bottom.

For tanks with a conical bottom, an echo may appear beneath the actual tank bottom when the tank is empty. If the device is not able to detect the tank bottom this function can be used to ensure that the device stays in empty tank state as long as this extra echo is present.

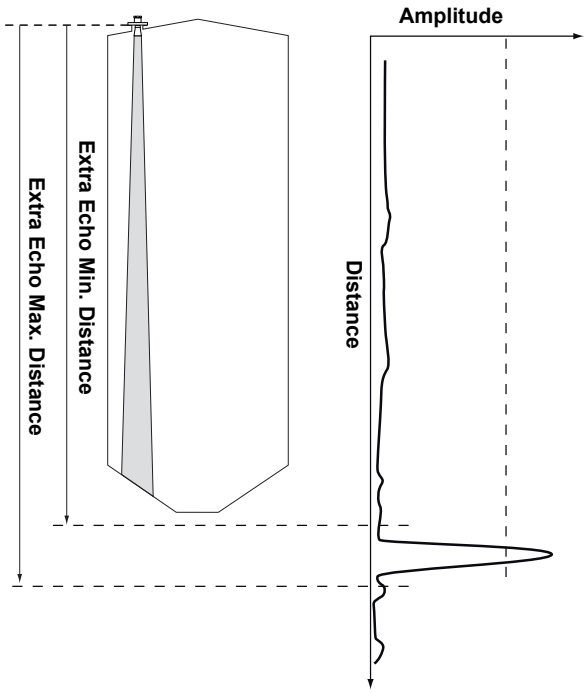
You can find out if such an echo exists by using the Tank Scan function when the tank is empty. Ensure that the scan extends below the tank bottom. The tank spectrum can be used to find suitable values for parameters such as the **Extra Echo Min Distance**, **Extra Echo Max Distance** and **Extra Echo Min Amplitude**. The tank is considered empty when an echo appears within the Min and Max Distance at an amplitude above the specified threshold.

Extra Echo Min Distance
Defines the minimum distance to the extra echo. This parameter should be greater than the Tank Height.

Extra Echo Max Distance
Defines the maximum distance to the extra echo. This parameter should be greater than the Extra Echo Min Distance.

Extra Echo Min Amplitude
Defines the minimum signal strength of the extra echo. If the signal strength exceeds this value and is found in the region between Min Distance and Max Distance, the device stays in empty tank state and presents Level=0.

Figure 4-6. The Extra Echo Function



Bottom Echo Visible if Tank is Empty

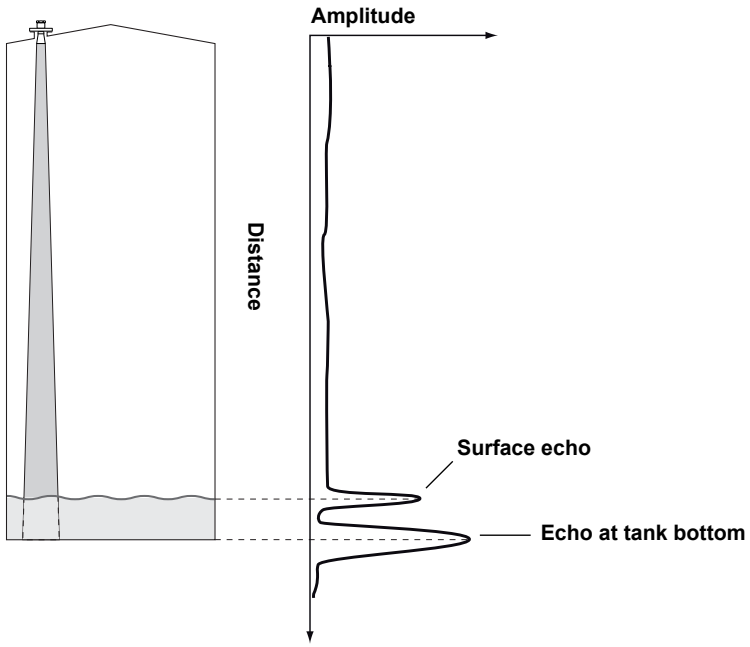
By using this function the level gauge will be able to track relatively weak surface echoes close to the tank bottom by treating the bottom echo as a disturbance echo. This function may be useful for products which are relatively transparent for microwaves such as oil.

Before activating this function, you should use the WinSetup/Tank Scan function to find out if there is a clearly visible echo at the tank bottom when the tank is empty. If this is the case, the *Bottom Echo Visible If Tank Is Empty* check box in the *Empty Tank Handling* window should be marked.

If the *Bottom Echo Visible...* function is disabled, searching for the product surface echo is limited to a region close to the tank bottom (Empty Tank Detection Area).

If there is no strong bottom echo interfering with the surface echo, mark the *Use Automatic Empty Tank Handling Settings* check box to let the level gauge automatically control the empty tank handling function.

Figure 4-7. Bottom Echo Visible



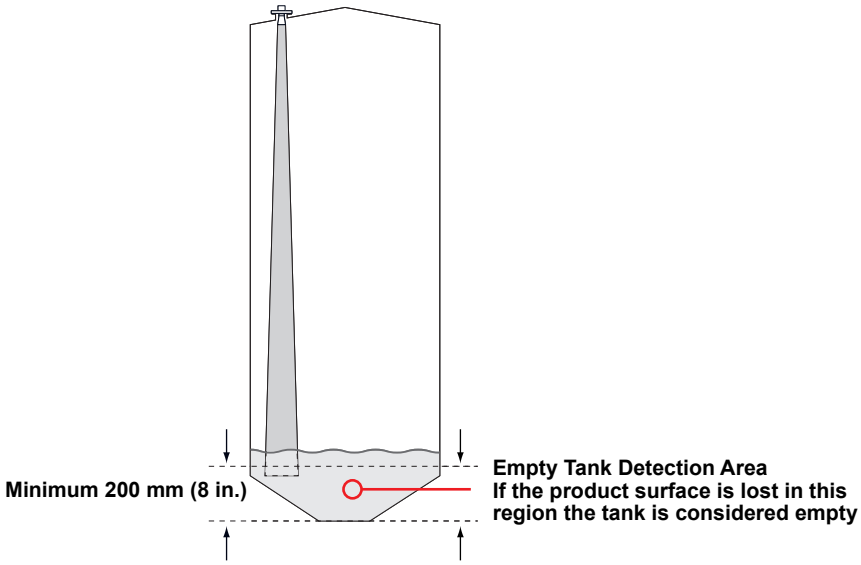
Empty Tank Detection Area

The Empty Tank Detection Area defines a range within a lower limit of 200 mm (8 in.) above the tank bottom. If the surface echo is lost in this region, the tank is considered empty (the device enters Empty Tank State) and the level gauge presents a zero level reading.

If the tank is empty the 5900S level gauge searches for the product surface in a region 2 x Empty Tank Detection Area. It is important that there are no disturbances in this area, since when a new echo is found it is considered to be the product surface. To ensure robust measurements in this region, disturbances may need to be filtered out.

The Empty Tank Detection Area is only used if there is no visible bottom echo. The *Bottom Echo Visible if Tank is Empty* function shall be disabled.

Figure 4-8. Empty Tank Detection Area



4.5 ADVANCED CONFIGURATION

There are a number of advanced configuration options for the Rosemount 5900S gauge which may be useful in certain situations. These options are available via TankMaster Winsetup and the *5900 RLG Properties* window.

4.5.1 Environment

Foam

You can use this parameter to optimize the gauge for conditions with low and varying surface echo amplitudes such as foam. When the foam is light and airy the actual product level is measured. For heavy and dense foam the transmitter measures the level of the upper surface of the foam.

Turbulent Surface

Splash loading, agitators, mixers, or boiling products may cause a turbulent surface. Normally the waves in a tank are quite small and cause local rapid level changes. By setting the Turbulent Surface parameter the performance of the level gauge will be improved when there are small and quickly changing amplitudes and levels.

Rapid Level Changes

Optimize the level gauge for measurement conditions where the product level changes quickly due to filling and emptying of the tank. The Rosemount 5900S is able to track level changes of up to 1.5 inch/s (40 mm/s). The *Rapid Level Changes* function allows the 5900S to track level changes of up to 8 inch/s (200 mm/s).

The *Rapid Level Changes* function shall not be used in normal conditions when the product surface moves slowly.

Solid Products

Setting this parameter optimizes the gauge 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 build-up.

Product Dielectric Range

The Dielectric Constant is related to the reflectivity of the product. This parameter can be used to optimize measurement performance. However, the level gauge will still be able to perform well even if the actual Dielectric Constant differs from the configured value.

4.5.2 Tank Shape

The **Tank Type** and **Tank Bottom Type** parameters optimize the 5900S for various tank geometries and for measurements close to the tank bottom.

4.5.3 Surface Echo Tracking

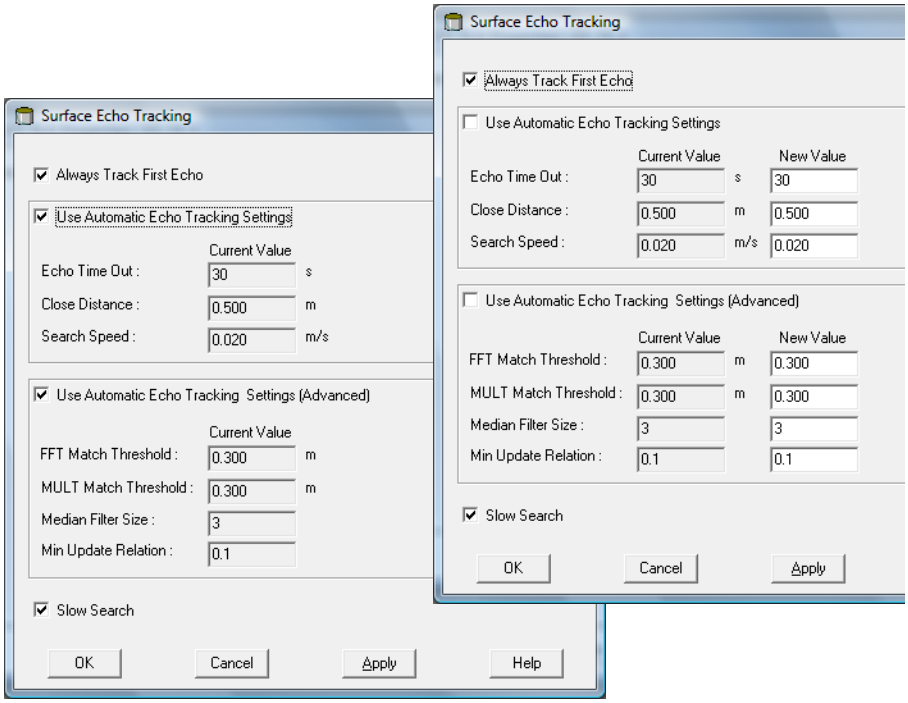
The Surface Echo Tracking function can be used to eliminate problems with certain types of ghost echoes below the product surface. This may, for example, occur in still-pipes as a result of multiple reflections between the pipe wall, flange and antenna. In the tank spectrum these echoes appear as amplitude peaks at various distances below the product surface.

To activate this function, ensure that there are no disturbing echoes above the product surface and select the *Always Track First Echo* check box.

To open the *Surface Echo Tracking* window:

1. In the *TankMaster WinSetup* workspace, click the right mouse button on the desired 5900S Radar Level Gauge icon.
2. Choose the **Properties** option from the popup menu.
3. In the *RLG Properties* window, select the *Advanced Configuration* tab.
4. Click the **Surface Echo Tracking** button:

Figure 4-9. The WinSetup *Surface Echo Tracking* window



Echo Time Out

Use *Echo Time Out* to define the delay time until the gauge will start searching for a surface echo after it has been lost. Until this period of time has elapsed, the gauge will not start searching or trigger any alarms.

Close Distance

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 ±Close Distance. Echoes outside this window will not be considered as surface echoes. The level gauge will immediately jump to the strongest echo (highest amplitude) inside this window. If there are rapid level changes in the tank, you may need to increase the Close Distance window in order to prevent the gauge from missing any level changes. On the other hand, if the Close Distance window is too large, the gauge might select an invalid echo as the surface echo.

Slow Search

The *Slow Search* function controls the search behavior if the product surface echo is lost, and may typically be used for tanks with turbulent conditions. The gauge starts searching for the surface at the last known product level, and gradually increases the search region until the product surface is found. When this function is disabled, the gauge searches through the whole tank.

Search Speed

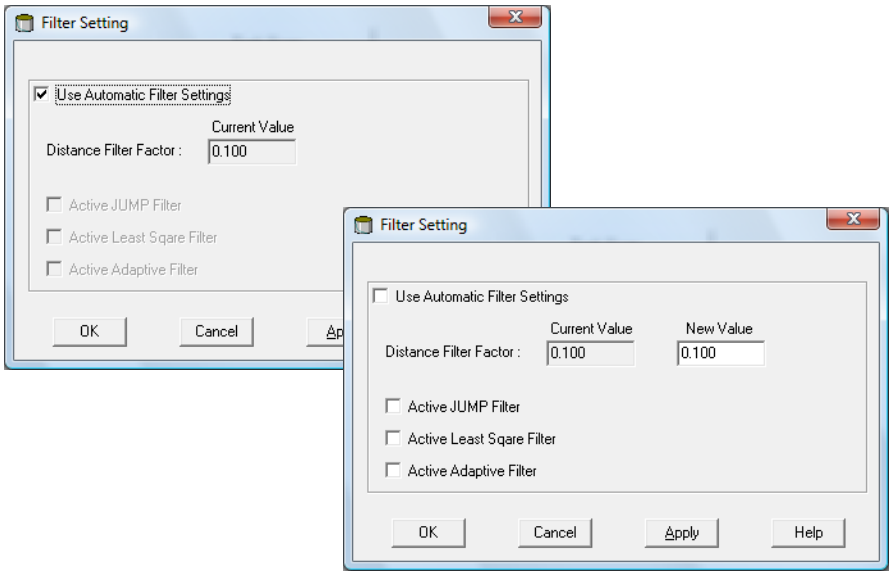
The Search Speed parameter indicates how quickly the search region (Slow Search window) is expanded when the *Slow Search* function is active.

4.5.4 Filter Setting

To open the *Filter Setting* window:

1. In the *TankMaster WinSetup* workspace, click the right mouse button on the desired 5900S Radar Level Gauge icon.
2. Choose the **Properties** option from the popup menu.
3. In the *RLG Properties* window, select the *Advanced Configuration* tab.
4. Click the **Filter Setting** button:

Figure 4-10. The WinSetup Filter Setting window



Distance Filter Factor

This parameter defines the amount of product level filtering (1 = 100%).

A low Filter Factor means that a new level value is calculated by adding a small fraction (for instance 1%) of the level change to the last known level value. It makes the level value steady but the device reacts slowly to level changes in the tank.

A high Filter Factor means that a larger fraction of the level change is added to the current level value. This setting makes the device react quickly to level changes but the presented level value can sometimes be somewhat jumpy.

Jump Filter

The Jump Filter is typically used for applications with turbulent surface and makes the echo tracking work smoother as the level passes, for example, an agitator. If the surface echo is lost and a new surface echo is found, the Jump Filter makes the level gauge wait some time before it jumps to the new echo. In the mean time the gauge decides whether the new echo can be considered a valid echo.

The Jump Filter does not use the Distance Filter Factor and can be used at the same time as the Least Square or the Adaptive Filter functions.

Least Square Filter

The Least Square filter gives increased accuracy for slow filling or emptying of a tank. The level value follows the surface with high accuracy and without delay as the level changes. The Least Square filter can not be used at the same time as the Adaptive Filter.

Adaptive Filter

The Adaptive Filter automatically adapts to the movement of the surface level. It tracks product level fluctuations and continuously adjusts the filter grade accordingly. The filter can preferably be used in tanks in which fast tracking of level changes are important and turbulence occasionally cause unstable level readings.

4.6 LPG CONFIGURATION

4.6.1 Preparations

Before starting configuration of the Rosemount 5900S for LPG measurements, ensure that all mechanical installations are made according to instructions, and all external sensors such as pressure and temperature sensors are properly connected.

Make sure that the position of the Verification Pin is accurately measured and the inner diameter of the still-pipe is available.

Install the tank and the Rosemount 5900S level gauge in TankMaster WinSetup as described in the *Raptor System Configuration Manual* (Document no. 300510EN). Ensure that the appropriate tank and device types are selected, and the temperature and pressure sensors are properly configured. Check that the gauge communicates with the TankMaster PC.

For 5900S with FOUNDATION fieldbus the LPG Setup is described in “LPG Setup Using DeltaV / AMS Device Manager” on page 4-77.

Highly pressurized vapor above the product surface affects the propagation speed of microwaves. The Rosemount 5900S level gauge is able to compensate for this, thus avoiding deviations in measured level due to the vapor.

When the gauge is installed on the empty tank, calibrate the gauge and configure for LPG measurements.

To install a Rosemount 5900S for LPG measurements perform the following major steps:

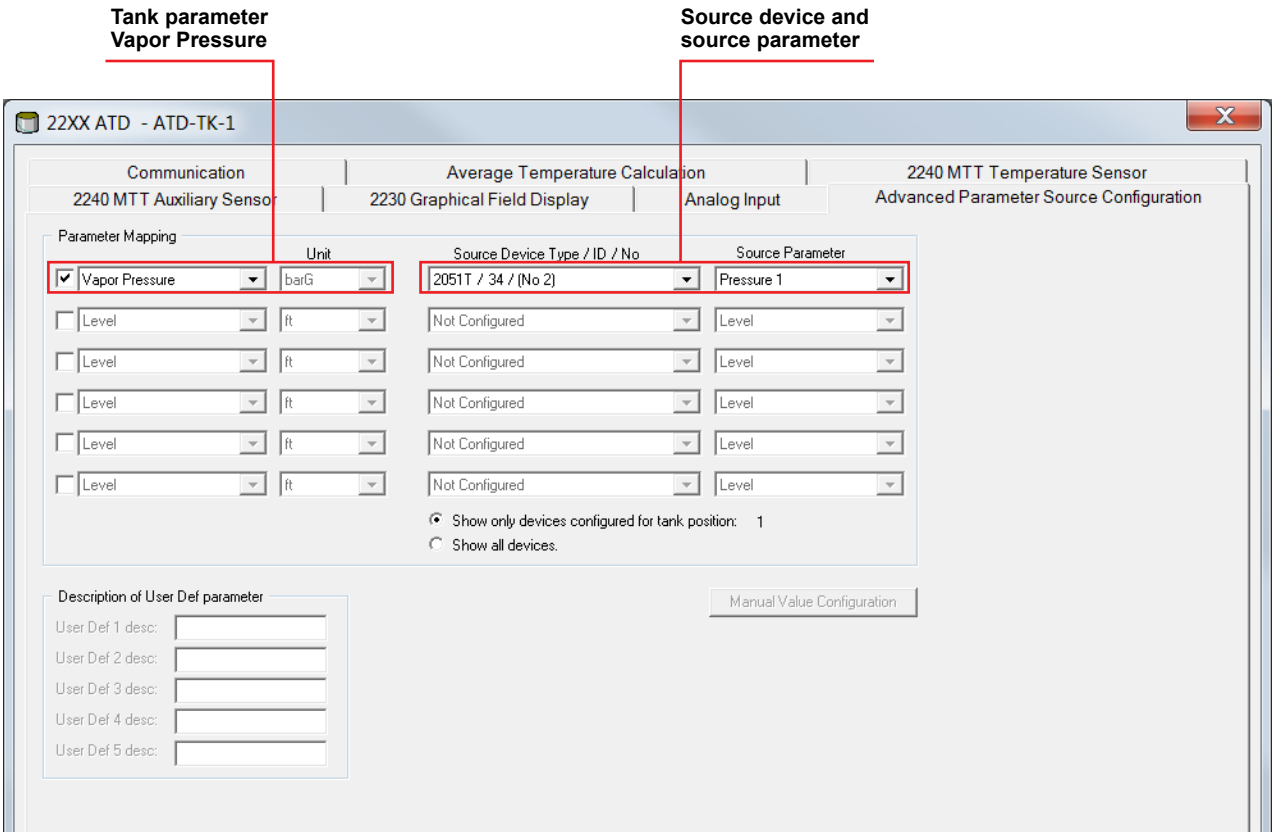
a. Install the 5900S gauge on the still-pipe. Measure the exact distance to the Verification Pin.
b. Use TankMaster Winsetup to configure the 5900S according to the standard procedure for installation of a Rosemount 5900S level gauge (see the *Raptor System Configuration Manual* (Document no. 300510EN).
c. Configure the vapor pressure sensor.
d. Calibrate the 5900S.
e. Configure the Verification Pin.
f. Confirm position of Verification Pin.
g. Set up the Correction Method that applies to the particular type of product in the tank.

The LPG installation procedure using TankMaster Winsetup is described in section “LPG Setup Using TankMaster” on page 4-21.

4.6.2 LPG Setup Using TankMaster

In the following description it is assumed that the Rosemount 5900S with LPG/LNG Antenna is installed on the tank, and a basic configuration is performed as described in the *Raptor System Configuration Manual* (Document no. 300510EN). To configure the 5900S for LPG measurements, do the following:

1. Ensure that the tank is empty and the tank atmosphere contains air only.
2. Check that the ball valve (optional) on the gauge is open.
3. Ensure that a **Vapor Pressure** source device is configured.
   Open the *ATD Properties* window and select the *Advanced Parameter Source Configuration* tab. This tab lets you map tank parameters such as Vapor Pressure to source devices connected to the Tankbus.

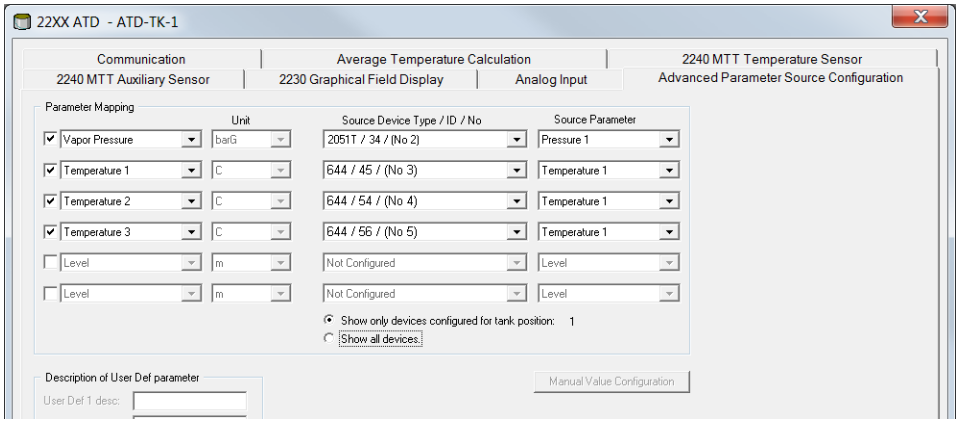


NOTE!
Pressure measurement is not required for correction method **One or more known gases, known mixratio** (see step 11 on page 4-28).

4. **Vapor Temperature** is automatically mapped to a Rosemount 2240S Multi-input Temperature Transmitter. It is calculated as the average value of temperature readings from all elements above the product surface.

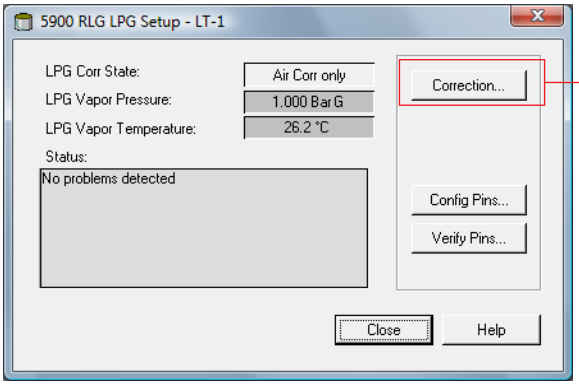
Rosemount 644 Temperature Transmitters have to be mapped manually in order to provide input for Vapor Temperature and Average Liquid Temperature calculations. Note that the actual Vapor Temperature and Liquid Temperature tank parameters are not mapped. The output from each 644 transmitter on the tank is mapped to separate temperature tank parameters. The resulting Vapor Temperature will be calculated based on the output from 644 transmitters located above the current product surface.
The following example shows how to configure three 644 transmitters as parameter source devices:

a. Choose *Temperature 1* in the Parameter Mapping list for the first 644 Temperature Transmitter.
   In case there are more than one 644 transmitters on the tank, they will have to be mapped as well:
   For the second and third 644 transmitter, choose *Temperature 2* and *Temperature 3* in the Parameter Mapping list.
b. In the Source Device Type field, for each temperature parameter (*Temperature 1, 2, 3*) choose the actual 644 transmitter to be used as source device as illustrated below.
c. In the Source Parameter list, choose *Temperature 1*. Note that *Temperature 1* is the source parameter designation for temperature output from a Rosemount 644 Temperature Transmitter.

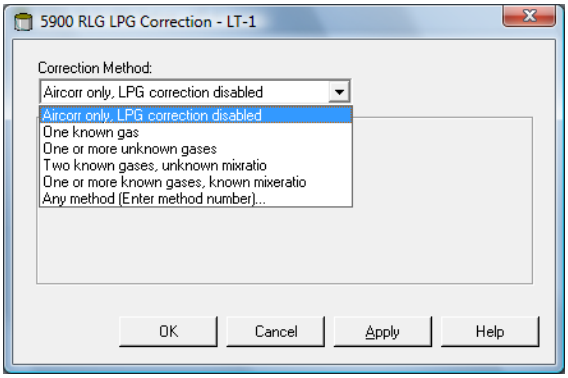


NOTE!
Ensure that temperature element positions are properly configured. This is normally done in the basic configuration of the 5900S level gauge and is required for proper calculation of Vapor Temperature and Average Liquid Temperature.

5. In the TankMaster WinSetup work space choose the *Logical View* tab. Select the icon that represents the radar level gauge, click the right mouse button and choose **LPG Setup**.



6. In the *LPG Setup* window click the **Correction** button.



7. Choose **Air Correction Only** from the list of correction methods and click the OK button. This setting is used during the Pin Verification procedure. When the LPG Setup is finished and the tank is going to be put into operation, the correction method needs to be changed to a method that applies to the particular type of product that is used.

NOTE!
The Air Correction Only option shall only be used when the tank atmosphere contains air and no other gases.

8. Calibrate.

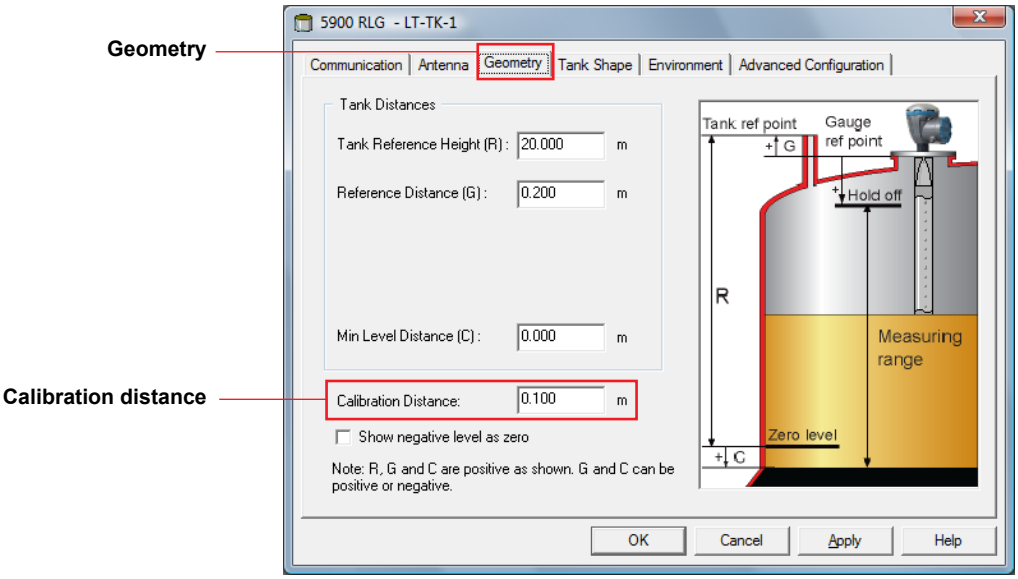
Ensure that there is no liquid above the calibration ring(1) at the end of the still-pipe when calibrating the gauge. When there is no product above the calibration ring, this is the only object that will be detected by the gauge. Consequently, the resulting product level presented by the 5900S will be equal to the position of the calibration ring measured from the Zero Level near the bottom of the tank.

Check the distance measured by the 5900S from the Gauge Reference Point to the calibration ring. This is referred to as the Ullage value defined by:

Ullage = **R** - **L**, where:

- **R** is the tank height measured from the *Tank Reference Point* to the *Zero Level.*
  For LPG tanks the calibration ring is used as Zero Level and the *Tank Reference Point* is equal to the *Gauge Reference Point*.
- **L** is the product level measured from the *Zero Level*. See also “Tank Geometry” on page 4-6.

If the Ullage value is not equal to the actual distance between the Gauge Reference Point and the calibration ring, open the *TankMaster WinSetup Properties* window (right-click the device icon and choose Properties), choose the *Geometry* tab and adjust the **Calibration Distance**:

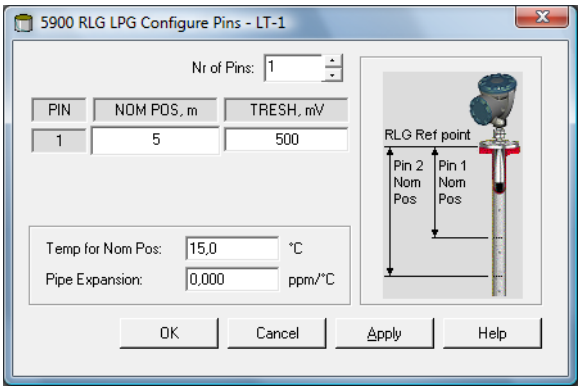


NOTE!
It is important that the Inner Diameter of the still-pipe is properly configured. Open the *Antenna* tab in case you would like to verify the Inner Diameter configuration.

See “LPG/LNG Antenna Requirements” on page 3-13 for more information on still-pipe requirements for 5900S with LPG/LNG Antenna.

(1) See “LPG/LNG Antenna Requirements” on page 3-13.

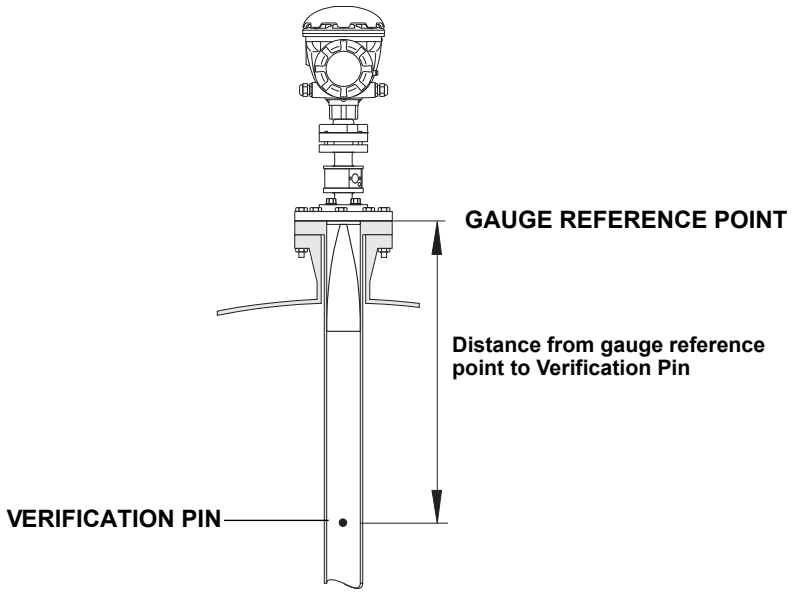
9. Configure the Verification Pin.
   In the *LPG Setup* window click the **Config Pins** button to open the *LPG Configure Pins* window:



   Enter the position of the Verification Pin. The position is measured from the *Gauge Reference Point* to the actual position of the Verification Pin.

   Since hand dipping can not be performed in high pressurized tanks, Emerson Process Management / Rosemount Tank Gauging has developed a unique method to verify level gauging in such tanks. The method is based on measurements in a special radar wave propagation mode against a fixed Verification Pin in order to verify the measurement.

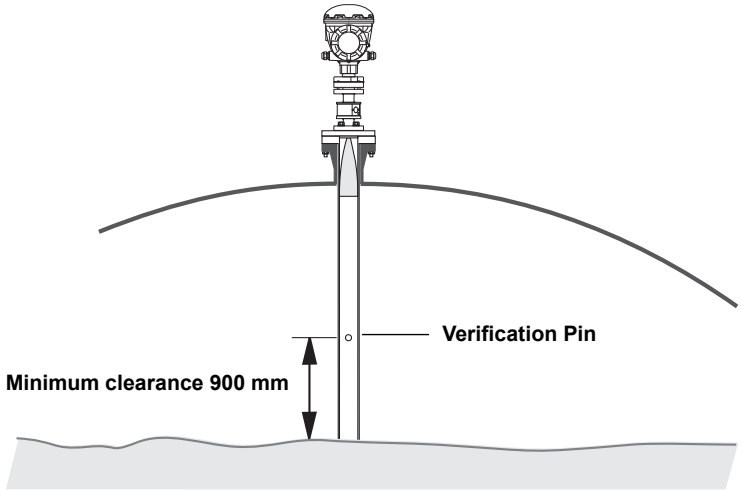
NOTE!
The value entered in the **Nominal Pos** field refers to the mechanical distance from the Gauge Reference Point to the actual Verification Pin. This value will only act as a starting point for the verification process in which the **electrical distance** from the Gauge Reference Point to the Verification Pin is calculated. In most cases the electrical distance deviates from the actual mechanical distance.



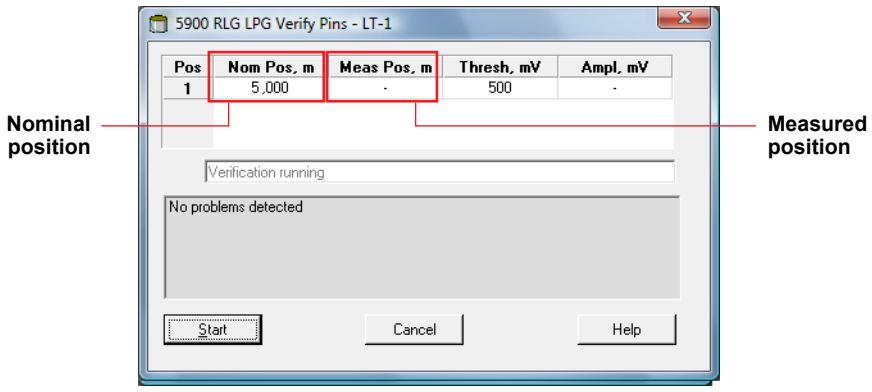
Ensure that the Threshold value is 500 mV.

The amplitude of the echo from the Verification Pin must be above the threshold value in order to appear in the *LPGVerify* window (see *"Verify the gauge measurement." on page 4-27*). In case the Verification Pin does not show up, it is possible to use a smaller threshold value. Check that the product level is not above the Verification Pin.

NOTE!
When the product surface is close to a Verification Pin, the radar echoes from the Verification Pin and the product surface interfere. This may reduce the accuracy of the measured distance to the Verification Pin. It is recommended that verification is not performed if the distance between the Verification Pin and the product surface is less than 900 mm (see "LPG/LNG Antenna Requirements" on page 3-13).



10. Verify the gauge measurement.
    a. In the *LPG Setup* window click the **Verify Pins** button in order to open the *LPG Verify Pins* window. Ensure that the **Nominal Position** of the Verification Pin appears:

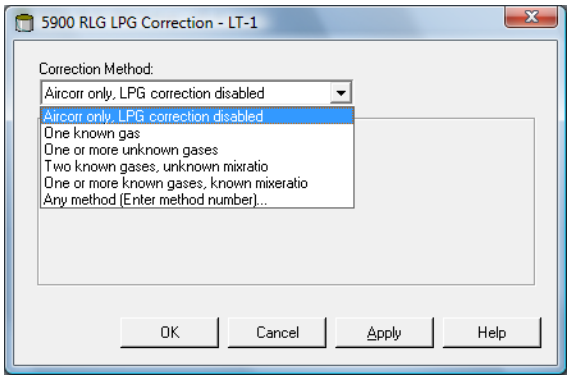


    b. In the *LPG Verify Pins* window, click the **Start** button to start the verification process.
    c. When verification is finished, the position measured by the level gauge appears in the **Measured Position** field.
    d. Note the position of the Verification Pin that is presented in the Measured Position field. If the position deviates from the **Nominal Position**, return to the *LPG Configure Pins* window and enter the measured position in the **Nominal Position** field (in the *LPG Setup* window click the **Config Pins** button, see step 9 on page 4-25).

NOTE!
The nominal position that was entered the first time refers to the **mechanical distance**. The measured position refers to the **electrical distance** which is the distance “seen” by the level gauge.

    e. Repeat steps **a** to **d** until the message “Successful Verification” appears, indicating that Nominal Position corresponds to Measured Position.

11. Choose correction method.
    There are several options available depending on gas mixture in the tank. In the *LPG Setup* window click the **Correction** button to open the *LPG Correction* window:



Choose one of the following correction methods:

a. Air Correction.
   This method should only be used when there is no vapor in the tank, i.e. when the tank is empty and contains air only. It is used in the initial step when calibrating the 5900S.

b. One known gas.
   This method may be used when there is only one gas type in the tank. It provides the highest accuracy among the different correction methods. Note that even small amounts of another gas reduces the accuracy.

c. One or more unknown gases.
   Use this method for hydrocarbons, for example Propane/Buthane, when the exact mixture is not known.

d. Two gases with unknown mixratio.
   This method is suitable for a mixture of two gases even if the mixratio is not known.

e. One or more known gases with known mixratio.
   This method may be used when there is a well known mixture of up to 4 products in the tank.

Now the Rosemount 5900S level gauge is ready to measure the product level when the tank is put into operation.

4.7 CALIBRATION USING WINSETUP

The **Calibrate** function is a TankMaster WinSetup tool that lets you adjust a Rosemount 5900S level gauge in order to minimize the offset between actual (hand dipped) product levels and the values measured by the level gauge. By using the Calibrate function you can optimize measurement performance over the whole measurement range from the top to the bottom of the tank.

The Calibration function calculates a Calibration Distance based on fitting a straight line to the deviations between hand dipped levels and levels measured by the transmitter.

The Calibration function is specially suitable for a Rosemount 5900S with Still-pipe Array Antenna. The radar propagation velocity is affected by the still-pipe. Based on the pipe inner diameter, the 5900S automatically compensates for the pipe influence. Since the average pipe diameter may be difficult to determine accurately, a minor calibration is often needed. The Calibrate function automatically calculates a Correction Factor in order to optimize the 5900S measurements along the still-pipe.

Procedure

The adjustment process includes the following steps:

1. Record the hand dipped ullage values and the corresponding values measured by the level gauge.
2. Enter the hand dipped level values and the level gauge values into the WinSetup *Calibration Data* window (see “To enter calibration data” on page 4-31).
3. Inspect the resulting calibration graph and, if necessary, exclude measurement points which should not be used in the adjustment calculation.

Required information

Make sure that the following information is available when you intend to use the **Calibrate** function in TankMaster WinSetup:

- A list of hand dipped ullage values.
- A list of level values measured by the 5900S that correspond to the hand dipped ullage/level values.

Hand dipping

Staff

Only one person should perform manual ullage measurements in order to guarantee good repeatability between measurements.

Hand dip tape

Use only one tape for the calibration. The tape should be made of steel and calibrated by an approved testing institute. It must also be free from bends and kinks. The thermal expansion factor and calibration temperature shall also be provided.

Dip hatch

A dip hatch should be available close to the level gauge. If the dip hatch is far away from the level gauge, differences in roof movements may result in large errors.

Procedure

Follow these instructions when you make hand dip measurements:

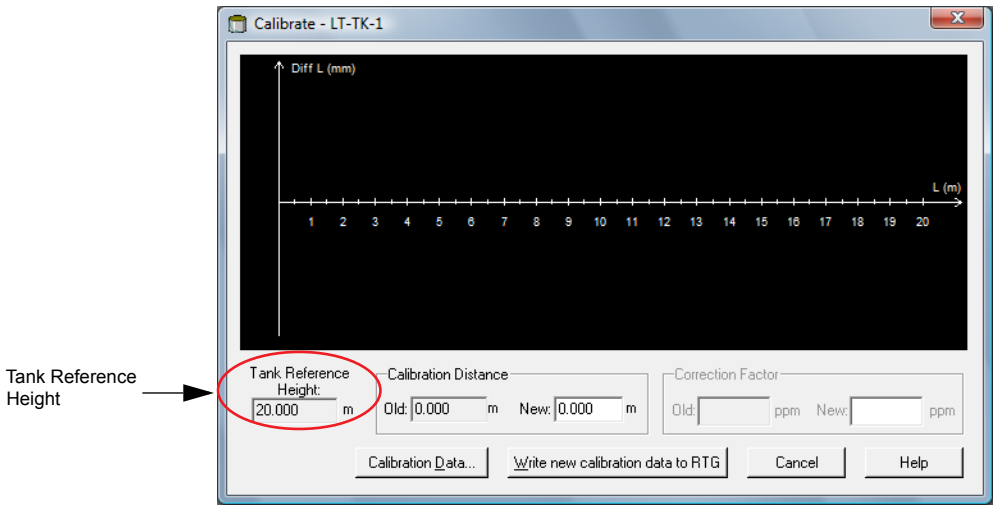
- hand dip until three consecutive readings within 1 mm are obtained
- correct the tape according to the calibration record
- note the hand dipped ullage and the gauge level reading simultaneously

Do not calibrate when

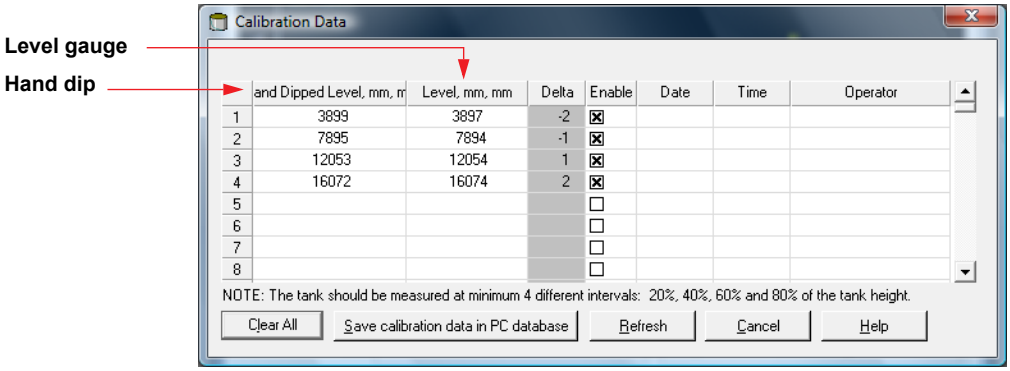
- the tank is being emptied or filled
- agitators are running
- when there are windy conditions
- when there is foam on the product surface

To enter calibration data

1. In the TankMaster WinSetup workspace window select the 5900S level gauge to be calibrated.
2. Click the right mouse button and choose **Calibrate**, or choose **Calibrate** from the **Service/Devices** menu.



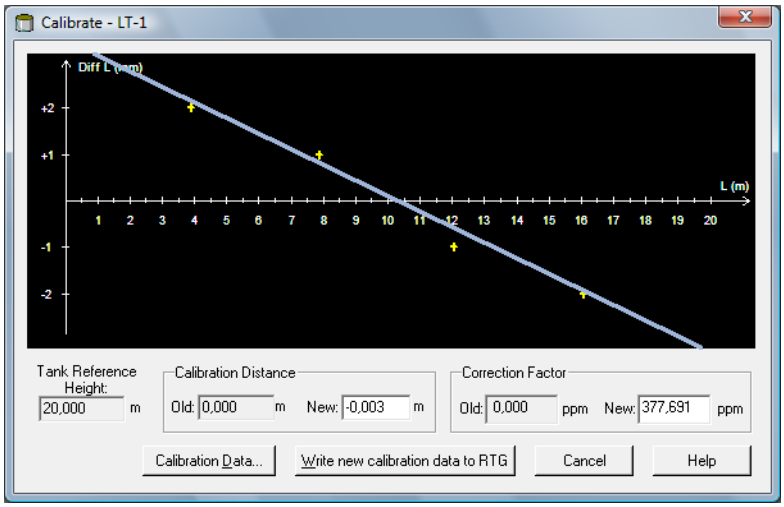
3. The *Calibrate* window is empty before any data is entered. Ensure that the gauge communicates properly with TankMaster by verifying that the **Tank Reference Height** appears in the lower left corner.
4. Click the **Calibration Data** button.



5. Enter hand dipped level values and the corresponding levels measured by the 5900S level gauge. It is recommended that the hand dipped levels are based on the average value of three consecutive measurements within 1 mm. For further information see “Hand dipping” on page 4-29.

NOTE!
Measurement unit mm is used in the *Calibration Data* window.

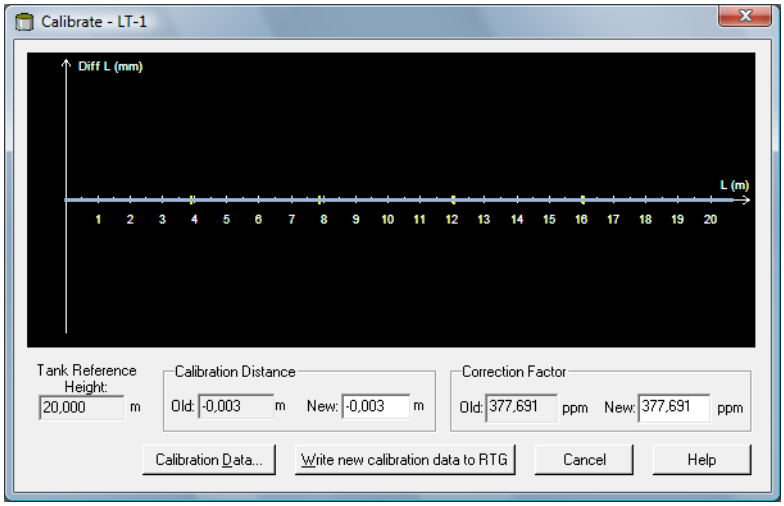
6. Click the **Refresh** button. Now WinSetup calculates the deviations between hand dipped and measured levels.
7. Click the **Save Calibration Data in PC Database** button in order to save the entered values and return to the *Calibrate* window.



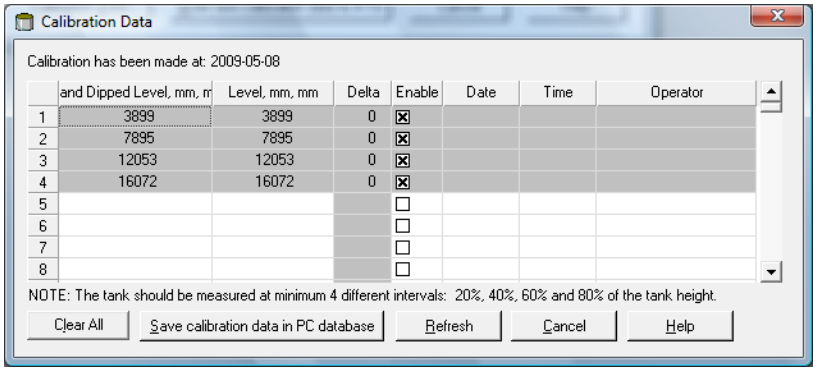
8. The *Calibrate* window displays a straight line fitted through measurement points that represent the difference between hand dipped level values, and values measured by the level gauge. For still pipe antennas a sloping line is displayed, otherwise the line is horizontal. The slope is due to the linear impact by the still pipe on the microwave velocity of propagation.
9. Check that the line fits well to the measurement points. If a point deviates significantly from the line, it can be excluded from the calculations. Open the *Calibration Data* window (click the **Calibration Data** button) and uncheck the corresponding check box in the **Enable** column.
10. Click the **Write new calibration data to RTG** button to save the current calibration data to the level gauge database registers.

NOTE!
By clicking the **Write new calibration data to RTG** button, the Level values in the *Calibration Data* window are recalculated and the old Calibration Data is replaced.

Now you can check the calibration result by opening the *Calibration* window again:



Note that all measured values are adjusted according to the calculated Calibration Distance and Correction Factor. In the *Calibration Data* window you can also see that the level values measured by the 5900S gauge are adjusted. Of course, the hand dipped levels are unaltered.



NOTE!
When calibration is finished do not change the Calibration Distance in the Properties/Tank Geometry window.

4.8 FOUNDATION FIELDBUS OVERVIEW

This section covers basic configuration procedures for the Rosemount 5900S Radar Level Gauge with FOUNDATION Fieldbus.

For detailed information about FOUNDATION Fieldbus technology and function blocks used in the Rosemount 5900S Series, refer to *Appendix C: Foundation Fieldbus Block Information* and the FOUNDATION Fieldbus Blocks Manual (Document No. 00809-0100-4783).

4.8.1 Block Operation

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

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

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

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

Resource Block

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

Measurement Transducer Block (TB1100)

The Measurement Transducer Block contains device information including diagnostics and the ability to configure, set to factory defaults and restart the level gauge.

Register Transducer Block (TB1200)

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

Advanced Configuration Transducer Block (TB1300)

The Advanced Configuration Transducer Block contains parameters for setup and configuration of the advanced level measurement and echo tracking functions.

Volume Transducer Block (TB1400)

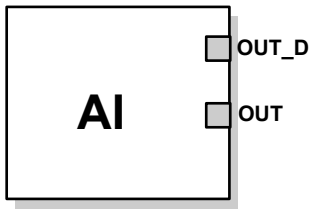
The Volume Transducer Block contains parameters for configuration of volume calculations.

LPG Transducer Block (TB1500)

The LPG Transducer Block contains parameters for setup and configuration of the LPG calculations, and for verification and status of the corrections.

Analog Input Block

Figure 4-11. Analog-Input Block



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

The Analog Input (AI) Function Block processes field device measurements and makes them available to other function blocks. The output value from the AI block is in engineering units and contains a status indicating the quality of the measurement. The measuring device may have several measurements or derived values available in different channels. Use the channel number to define the variable that the AI block processes and passes on to linked blocks. For further information refer to *"Analog Input Block" on page C-6* and *"Analog Input Block" on page 4-41*.

PID Block

The PID Function Block combines all of the necessary logic to perform proportional/integral/derivative (PID) control. The block supports mode control, signal scaling and limiting, feed forward control, override tracking, alarm limit detection, and signal status propagation.

The block supports two forms of the PID equation: Standard and Series. You can choose the appropriate equation using the MATHFORM parameter. The Standard ISA PID equation is the default selection.

Input Selector Block

The Input Selector (ISEL) Function Block can be used to select the first good, Hot Backup, maximum, minimum, or average of as many as eight input values and place it at the output. The block supports signal status propagation.

Arithmetic Block

The Arithmetic (ARTH) Function Block provides the ability to configure a range extension function for a primary input. It can also be used to compute nine different arithmetic functions.

Signal Characterizer Block

The Signal Characterizer (SGCR) Function Block characterizes or approximates any function that defines an input/output relationship. The function is defined by configuring as many as twenty X,Y coordinates. The block interpolates an output value for a given input value using the curve defined by the configured coordinates. Two separate analog input signals can be processed simultaneously to give two corresponding separate output values using the same defined curve.

Integrator Block

The Integrator (INT) Function Block integrates one or two variables over time.

This block will accept up to two inputs, has six options how to totalize the inputs, and two trip outputs. The block compares the integrated or accumulated value to pre-trip and trip limits and generates discrete output signals when the limits are reached.

Control Selector Block

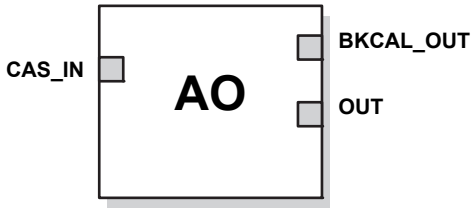
The Control Selector Function Block selects one of two or three inputs to be the output. The inputs are normally connected to the outputs of PID or other function blocks. One of the inputs would be considered Normal and the other two overrides.

Output Splitter Block

The Output Splitter Function Block provides the capability to drive two control outputs from a single input. It takes the output of one PID or other control block to control two valves or other actuators.

Analog Output Block

Figure 4-12. Analog-Output Block



CAS_IN =The remote setpoint value from another function block
BKCAL_OUT =The value and status required by the BKCAL_IN input of another block to prevent reset windup and to provide bumpless transfer to closed loop control.
OUT =The block output and status.

The Analog Output Function Block accepts an output value from a field device and assigns it to a specified I/O channel. For further information refer to *“Analog Output Block” on page C-9* and *“Analog Output Block” on page 4-48*.

Function Block Summary

The following function blocks are available for the Rosemount 5900S Series:

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

For detailed information about FOUNDATION Fieldbus technology and function blocks used in the Rosemount 5900S Series, refer to the FOUNDATION Fieldbus Block Manual (Document No. 00809-0100-4783).

4.9 DEVICE CAPABILITIES

4.9.1 Link Active Scheduler

The Rosemount 5900S can be designated to act as the backup Link Active Scheduler (LAS) in the event that the LAS is disconnected from the segment. As the backup LAS, the 5900S will take over the management of communications until the host is restored.

The host system may provide a configuration tool specifically designed to designate a particular device as a backup LAS. Otherwise, this can be configured manually.

4.9.2 Capabilities

Virtual Communication Relationship (VCRs)

There are a total of 20 VCRs. One is permanent and 19 are fully configurable by the host system. 40 link objects are available.

Table 4-2. Communication parameters

Network Parameter	Value
Slot Time	8
Maximum Response Delay	5
Minimum Inter PDU Delay	8

Block Execution Times

Table 4-3. Execution times

Block	Execution time (ms)
Analog Input (AI)	10
Analog Output	10
Proportional/Integral/Derivative (PID)	15
Signal Characterizer (SGCR)	10
Integrator (INT)	10
Arithmetic (ARTH)	10
Input Selector (ISEL)	10
Control Selector (CS)	10
Output Splitter (OS)	10

4.10 GENERAL BLOCK INFORMATION

4.10.1 Modes

⚠ Changing Modes

To change the operating mode, set the MODE_BLK.TARGET to the desired mode. After a short delay, the parameter MODE_BLOCK.ACTUAL should reflect the mode change if the block is operating properly.

Permitted Modes

It is possible to prevent unauthorized changes to the operating mode of a block. To do this, configure MODE_BLOCK.PERMITTED to allow only the desired operating modes. It is recommended to always select OOS as one of the permitted modes.

Types of Modes

For the procedures described in this manual, it will be helpful to understand the following modes:

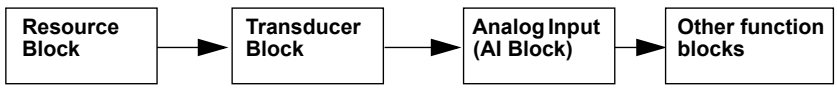
AUTO
The functions performed by the block will execute. If the block has any outputs, these will continue to update. This is typically the normal operating mode.

Out of Service (OOS)
The functions performed by the block will not execute. If the block has any outputs, these will typically not update and the status of any values passed to downstream blocks will be “BAD”. To make some changes to the configuration of the block, change the mode of the block to OOS. When the changes are complete, change the mode back to AUTO.

MAN
In this mode, variables that are passed out of the block can be manually set for testing or override purposes.

Other Types of Modes
Other types of modes are Cas, RCas, ROut, IMan and LO. Some of these may be supported by different function blocks in the Rosemount 5900S. For more information, see the Function Block manual (Document No. 00809-0100-4783).

NOTE
When an upstream block is set to OOS, this will impact the output status of all downstream blocks. The figure below depicts the hierarchy of blocks:



4.10.2 Block Instantiation

The Rosemount 5900S supports the use of Function Block Instantiation. When a device supports block instantiation, the number of blocks and block types can be defined to match specific application needs.The number of blocks that can be instantiated is only limited by the amount of memory within the device and the block types that are supported by the device. Instantiation does not apply to standard device blocks like the Resource and Transducer Blocks.

By reading the parameter “FREE_SPACE” in the Resource block you can determine how many blocks you can instantiate. Each block that you instantiate takes up 4.6% of the “FREE_SPACE”.

Block instantiation is done by the host control system or configuration tool, but not all hosts implement this functionality. Please refer to your specific host or configuration tool manual for more information.

4.10.3 Factory Configuration

The following fixed configuration of function blocks is provided:

Table 4-4. Function blocks for the 5900S

Function Block	Index	Default Tag	Available
Analog Input(1)	1600	AI 1600	Fixed
Analog Input	1700	AI 1700	Fixed
Analog Input	1800	AI 1800	Fixed
Analog Input	1900	AI 1900	Fixed
Analog Input	2000	AI 2000	Fixed
Analog Input	2100	AI 2100	Fixed
Analog Output(2)	2200	AO 2200	Default, deletable
Analog Output	2300	AO 2300	Default, deletable
PID	2400	PID 2400	Default, deletable
Control Selector	2500	CSEL 2500	Default, deletable
Output Splitter	2600	OSPL 2600	Default, deletable
Signal Characterizer	2700	CHAR 2700	Default, deletable
Integrator	2800	INTEG 2800	Default, deletable
Arithmetic	2900	ARITH 2900	Default, deletable
Input Selector	3000	ISEL 3000	Default, deletable

(1) See “Factory Supplied AI Blocks” on page 4-42 for more information.
(2) See “Analog Output Block” on page 4-48 for more information.

4.11 ANALOG INPUT BLOCK

4.11.1 Configure the AI Block

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

CHANNEL

Select the channel that corresponds to the desired sensor measurement:

Table 4-5. AI block channels for the 5900S

AI Block Parameter	TB Channel Value	Process Variable
Level	1	CHANNEL_LEVEL
Distance	2	CHANNEL_DISTANCE
Level Rate	3	CHANNEL_LEVELRATE
Signal Strength	4	CHANNEL_SIGNAL_STRENGTH
Internal Temperature	5	CHANNEL_HOUSING_TEMPERATURE
Volume	6	CHANNEL_VOLUME

L_TYPE

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

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

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

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

XD_SCALE and OUT_SCALE

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

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

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

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

Engineering Units

NOTE!
To avoid configuration errors, only select Engineering Units for XD_SCALE and OUT_SCALE that are supported by the device (see “Supported Units” on page C-27.

4.11.2 Factory Supplied AI Blocks

The Rosemount 5900S is supplied with six pre-configured AI blocks according to Table 4-6. The block configuration can be changed if needed.

Table 4-6. Factory supplied AI blocks for the 5900S

AI Block	Channel	L-Type	Units
1	CHANNEL_LEVEL	Direct	Meter
2	CHANNEL_DISTANCE	Direct	Meter
3	CHANNEL_LEVELRATE	Direct	Meter per hour
4	CHANNEL_SIGNAL_STRENGTH	Direct	mV
5	CHANNEL_HOUSING_TEMPERATURE	Direct	deg C
6	CHANNEL_VOLUME	Direct	m^3

4.11.3 Application Example

Level Value

A 5900S Radar Level Gauge measures the product level in a 15 m high tank.

Table 4-7. Analog Input function block configuration for a 5900S level gauge

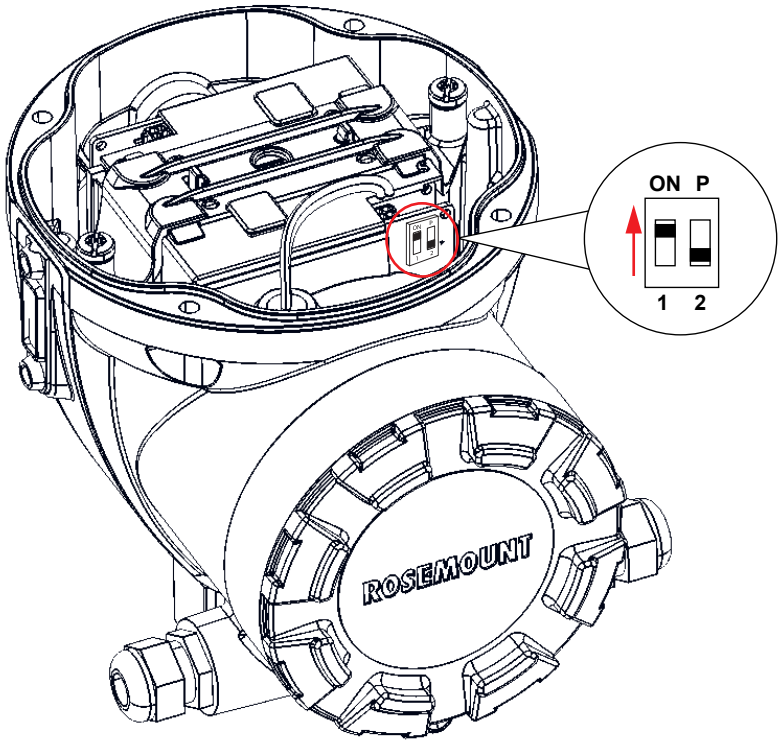
Parameter	Configured Values
L_TYPE	Direct
XD_SCALE	EU_0=0. EU_100=15. Engineering unit=meter.
OUT_SCALE	EU_0=0. EU_100=15. Engineering unit=meter.
CHANNEL	CH1: Level

4.11.4 Simulation

To perform lab test of process variables and alerts, you can either change the mode of the AI block to manual and adjust the output value, or you can enable simulation through the configuration tool and manually enter a value for the measurement value and its status. In both cases, you must first set the SIMULATE switch (1) on the field device to the ON position.

With simulation enabled, the actual measurement value has no impact on the OUT value or the status.

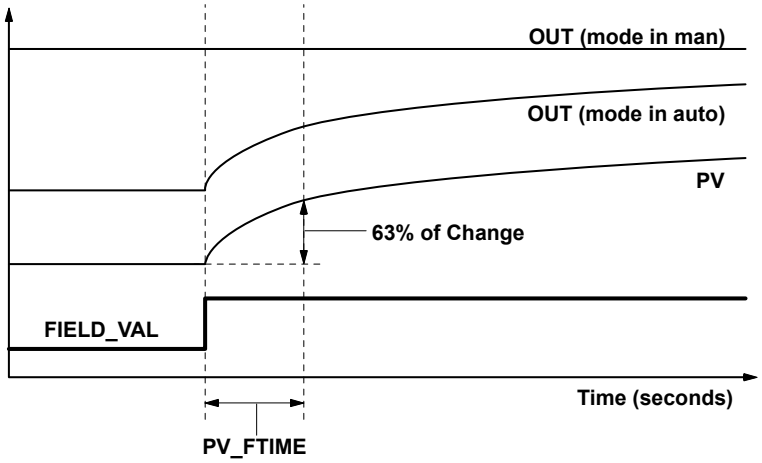
Figure 4-13. Simulation switch



4.11.5 Filtering

The filtering feature changes the response time of the device to smooth variations in output readings caused by rapid changes in input. You can adjust the filter time constant (in seconds) using the PV_FTIME parameter. Set the filter time constant to zero to disable the filter feature.

Figure 4-14. Analog Input Function Block Timing Diagram



4.11.6 Signal Conversion

You can set the signal conversion type with the Linearization Type (L_TYPE) parameter. You can view the converted signal (in percent of XD_SCALE) through the FIELD_VAL parameter.

$$\text{FIELD\_VAL} = \frac{100 \times (\text{Channel Value} - \text{EU*@0\%})}{(\text{EU*@100\%} - \text{EU*@0\%})}$$

*** XD_SCALE values**

You can choose from direct or indirect signal conversion with the L_TYPE parameter.

Direct

Direct signal conversion allows the signal to pass through the accessed channel input value (or the simulated value when simulation is enabled).

$$PV = \text{Channel Value}$$

Indirect

Indirect signal conversion converts the signal linearly to the accessed channel input value (or the simulated value when simulation is enabled) from its specified range (XD_SCALE) to the range and units of the PV and OUT parameters (OUT_SCALE).

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

**** OUT_SCALE values**

Indirect Square Root

Indirect Square Root signal conversion takes the square root of the value computed with the indirect signal conversion and scales it to the range and units of the PV and OUT parameters.

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

**** OUT_SCALE values**

When the converted input value is below the limit specified by the LOW_CUT parameter, and the Low Cutoff I/O option (IO_OPTS) is enabled (True), a value of zero is used for the converted value (PV). This option is useful to eliminate false readings when the differential pressure measurement is close to zero, and it may also be useful with zero-based measurement devices such as flowmeters.

NOTE!
Low Cutoff is the only I/O option supported by the AI block. You can set the I/O option in **Manual** or **Out of Service** mode only.

4.11.7 Modes

The AI Function Block supports three modes of operation as defined by the MODE_BLK parameter:

- **Manual (Man)** The block output (OUT) may be set manually
- **Automatic (Auto)** OUT reflects the analog input measurement or the simulated value when simulation is enabled
- **Out of Service (O/S)** The block is not processed. FIELD_VAL and PV are not updated and the OUT status is set to Bad: Out of Service. The BLOCK_ERR parameter shows Out of Service. In this mode, you can make changes to all configurable parameters. The target mode of a block may be restricted to one or more of the supported modes.

4.11.8 Process Alarms

Process Alarm detection is based on the OUT value. You can configure the alarm limits of the following standard alarms:

- High (HI_LIM)
- High high (HI_HI_LIM)
- Low (LO_LIM)
- Low low (LO_LO_LIM)

In order to avoid alarm chattering when the variable is oscillating around the alarm limit, an alarm hysteresis in percent of the PV span can be set using the ALARM_HYS parameter.

The priority of each alarm is set in the following parameters:

- HI_PRI
- HI_HI_PRI
- LO_PRI
- LO_LO_PRI

4.11.9 Alarm Priority

Alarms are grouped into five levels of priority:

Table 4-8. Alarm levels of priority

Priority Number	Priority Description
0	The priority of an alarm condition changes to 0 after the condition that caused the alarm is corrected.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator, but does not require operator attention (such as diagnostics and system alerts).
3-7	Alarm conditions of priority 3 to 7 are advisory alarms of increasing priority.
8-15	Alarm conditions of priority 8 to 15 are critical alarms of increasing priority.

4.11.10 Status Handling

Normally, the status of the PV reflects the status of the measurement value, the operating condition of the I/O card, and any active alarm condition. In Auto mode, OUT reflects the value and status quality of the PV. In Man mode, the OUT status constant limit is set to indicate that the value is a constant and the OUT status is *Good*.

The **Uncertain** - EU range violation status is always set and the PV status is set high- or low-limited if the sensor limits for conversion are exceeded.

In the STATUS_OPTS parameter, you can select from the following options to control the status handling:

BAD if Limited – sets the OUT status quality to *Bad* when the value is higher or lower than the sensor limits.

Uncertain if Limited – sets the OUT status quality to *Uncertain* when the value is higher or lower than the sensor limits.

Uncertain if in Manual mode – The status of the Output is set to *Uncertain* when the mode is set to Manual.

NOTE!
The instrument must be in **Manual** or **Out of Service** mode to set the status option.
The AI block only supports the **BAD if Limited** option. Unsupported options are not grayed out; they appear on the screen in the same manner as supported options.

4.11.11 Advanced Features

The AI function block provided with Rosemount fieldbus devices provides added capability through the addition of the following parameters:

ALARM_TYPE – Allows one or more of the process alarm conditions detected by the AI function block to be used in setting its OUT_D parameter.

OUT_D – Discrete output of the AI function block based on the detection of process alarm condition(s). This parameter may be linked to other function blocks that require a discrete input based on the detected alarm condition.

VAR_SCAN – Time period in seconds over which the variability index (VAR_INDEX) is computed.

VAR_INDEX – Process variability index measured as the integral of average absolute error between PV and its mean value over the previous evaluation period. This index is calculated as a percent of OUT span and is updated at the end of the time period defined by VAR_SCAN.

4.12 ANALOG OUTPUT BLOCK

The Rosemount 5900S is supplied with two pre-configured Analog Output (AO) blocks according to Table 4-10. The block configuration can be changed if needed. See *"Analog Output Block" on page C-9* for more information.

CHANNEL

Select the channel that corresponds to the desired sensor measurement:

Table 4-9. AO block channels for the 5900S

AO Block Parameter	TB Channel Value	Process Variable
Vapor Temperature	7	CHANNEL_VAPOR_TEMPERATURE
Pressure	8	CHANNEL_PRESSURE
User Defined	9	CHANNEL_USERDEFINED
Tank Temperature	10	CHANNEL_TANK_TEMPERATURE

Table 4-10. Factory supplied AO blocks for the 5900S

AO Block	Channel	Units
1	CHANNEL_VAPOR_TEMPERATURE	deg C
2	CHANNEL_PRESSURE	bar

XD_SCALE

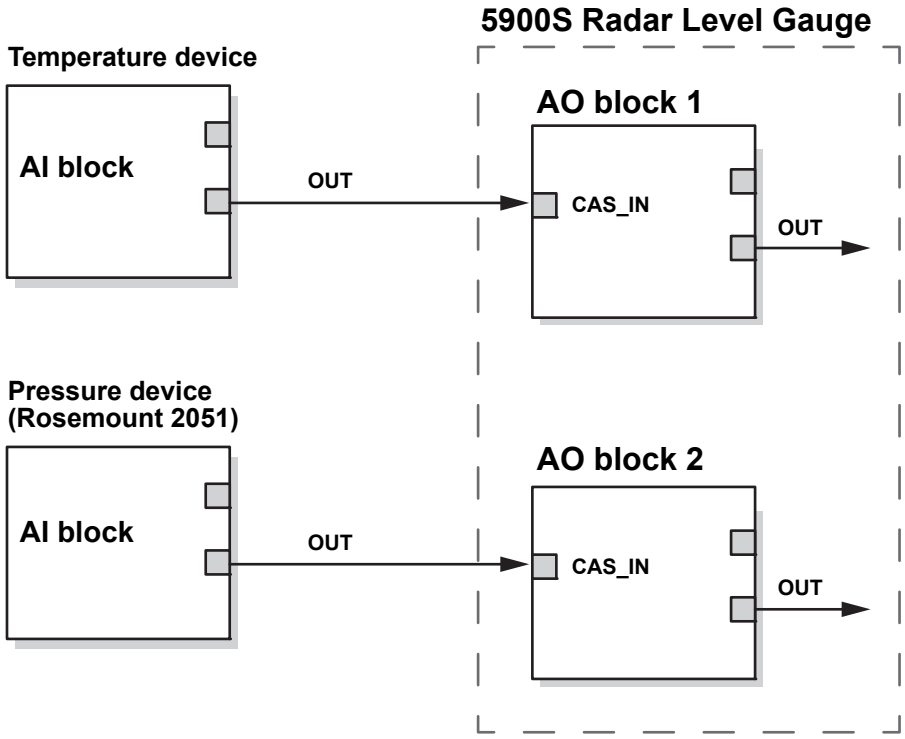
The XD_SCALE includes three parameters: 0%, 100%, and engineering units. Set the XD_SCALE engineering unit to represent the unit for the AO block channel value.

4.12.1 Application Example

LPG

A 5900S Radar Level Gauge configured for LPG measurements with temperature and pressure sensors.

Table 4-11. Function block configuration for a 5900S level gauge in a LPG application



CAS_IN =Remote setpoint value from another function block
OUT =Block output and status.

4.13 RESOURCE BLOCK

4.13.1 FEATURES and FEATURES_SEL

The FEATURES parameter is read only and defines which features are supported by the 5900S. Below is a list of the FEATURES the 5900S supports.

FEATURES_SEL is used to turn on any of the supported features that are found in the FEATURES parameter. The default setting of the Rosemount 5900S is HARD W LOCK. Choose one or more of the supported features if any.

UNICODE

All configurable string variables in the 5900S, except tag names, are octet strings. Either ASCII or Unicode may be used. If the configuration device is generating Unicode octet strings, you must set the Unicode option bit.

REPORTS

The 5900S supports alert reports. The Reports option bit must be set in the features bit string to use this feature. If it is not set, the host must poll for alerts. If this bit is set, the transmitter will actively report alerts.

SOFT W LOCK and HARD W LOCK

Inputs to the security and write lock functions include the hardware security switch, the hardware and software write lock bits of the FEATURE_SEL parameter, the WRITE_LOCK parameter, and the DEFINE_WRITE_LOCK parameter.

The WRITE_LOCK parameter prevents modification of parameters within the device except to clear the WRITE_LOCK parameter. During this time, the block will function normally updating inputs and outputs and executing algorithms. When the WRITE_LOCK condition is cleared, a WRITE_ALM alert is generated with a priority that corresponds to the WRITE_PRI parameter.

The FEATURE_SEL parameter enables the user to select a hardware or software write lock or no write lock capability. To enable the hardware security function, enable the HARDW_LOCK bit in the FEATURE_SEL parameter. When this bit has been enabled the WRITE_LOCK parameter becomes read only and will reflect the state of the hardware switch.

In order to enable the software write lock, the SOFTW_LOCK bit must be set in the FEATURE_SEL parameter. Once this bit is set, the WRITE_LOCK parameter may be set to “Locked” or “Not Locked.” Once the WRITE_LOCK parameter is set to “Locked” by the software lock, all user requested writes as determined by the DEFINE_WRITE_LOCK parameter shall be rejected.

The DEFINE_WRITE_LOCK parameter allows the user to configure whether the write lock functions (both software and hardware) will control writing to all blocks, or only to the resource and transducer blocks. Internally updated data such as process variables and diagnostics will not be restricted by the security switch.

The following table displays all possible configurations of the WRITE_LOCK parameter.

FEATURE_SEL HARDW_LOCK bit	FEATURE_SEL SOFTW_LOCK bit	SECURITY SWITCH	WRITE_LOCK	WRITE_LOCK Read/Write	DEFINE_WRITE_ LOCK	Write access to blocks
0 (off)	0 (off)	NA	1 (unlocked)	Read only	NA	All
0 (off)	1 (on)	NA	1 (unlocked)	Read/Write	NA	All
0 (off)	1 (on)	NA	2 (locked)	Read/Write	Physical	Function Blocks Only
0 (off)	1 (on)	NA	2 (locked)	Read/Write	Everything	None
1 (on)	0 (off)(1)	0 (unlocked)	1 (unlocked)	Read only	NA	All
1 (on)	0 (off)	1 (locked)	2 (locked)	Read only	Physical	Function Blocks Only
1 (on)	0 (off)	1 (locked)	2 (locked)	Read only	Everything	None

(1) The hardware and software write lock select bits are mutually exclusive and the hardware select has the highest priority. When the HARDW_LOCK bit if set to 1 (on), the SOFTW_LOCK bit is automatically set to 0 (off) and is read only.

4.13.2 MAX_NOTIFY

The MAX_NOTIFY parameter value is the maximum number of alert reports that the resource can have sent without getting a confirmation, corresponding to the amount of buffer space available for alert messages. The number can be set lower, to control alert flooding, by adjusting the LIM_NOTIFY parameter value. If LIM_NOTIFY is set to zero, then no alerts are reported.

4.13.3 PlantWeb™ Alerts

The Resource Block will act as a coordinator for PlantWeb alerts. There will be three alarm parameters (FAILED_ALARM, MAINT_ALARM, and ADVISE_ALARM) which will contain information regarding device errors detected by the transmitter software. There will be a RECOMMENDED_ACTION parameter which will be used to display the recommended action text for the highest priority alarm, and a HEALTH_INDEX parameter (0 - 100) indicating the overall health of the device. FAILED_ALARM will have the highest priority followed by MAINT_ALARM, and ADVISE_ALARM will be the lowest priority.

FAILED_ALARMS

A failure alarm indicates a failure within a device that will make the device or some part of the device non-operational. This implies that the device is in need of repair and must be fixed immediately. There are five parameters associated with FAILED_ALARMS specifically, they are described below.

FAILED_ENABLE
This parameter contains a list of failures in the device which makes the device non-operational that will cause an alarm to be sent. Below is a list of the failures in order of priority from 1 to 5, where 5 is the highest priority. This priority is not the same as the FAILED_PRI parameter described below. It is hard coded within the device and is not user configurable.

1. Software Incompatibility Error
2. Memory Failure - FF I/O Board
3. Device Error
4. Internal Communication Failure
5. Electronics Failure

FAILED_MASK
This parameter will mask any of the failed conditions listed in FAILED_ENABLE. A bit on means that the condition is masked out from alarming and will not be reported.

FAILED_PRI
Designates the alarming priority of the FAILED_ALM, see “Alarm Priority” on page 4-46. The default is 0 and the recommended values are between 8 and 15.

FAILED_ACTIVE
This parameter displays which of the alarms are active.

FAILED_ALM
Alarm indicating a failure within a device which makes the device non-operational.

MAINT_ALARMS

A maintenance alarm indicates that the device or some part of the device needs maintenance soon. If the condition is ignored, the device will eventually fail. There are five parameters associated with MAINT_ALARMS, they are described below.

MAINT_ENABLE
The MAINT_ENABLE parameter contains a list of conditions indicating that the device or some part of the device needs maintenance soon. Below is a list of the conditions in order of priority from 1 to 2, where 2 is the highest priority. This priority is not the same as the MAINT_PRI parameter described below. It is hard coded within the device and is not user configurable.

Below is a list of the conditions(1):

1. Device Major Information
2. Device Warning

MAINT_MASK
The MAINT_MASK parameter will mask any of the failed conditions listed in MAINT_ENABLED. A bit on means that the condition is masked out from alarming and will not be reported.

MAINT_PRI
MAINT_PRI designates the alarming priority of the MAINT_ALM, see “Alarm Priority” on page 4-46. The default is 0 and the recommended values are 3 to 7.

MAINT_ACTIVE
The MAINT_ACTIVE parameter displays which of the alarms are active.

MAINT_ALM
An alarm indicating that the device needs maintenance soon. If the condition is ignored, the device will eventually fail.

(1) Note that maintenance alarms are not enabled by default.

ADVISE_ALARMS

An advisory alarm indicates informative conditions that do not have a direct impact on the primary functions of the device. There are five parameters associated with ADVISE_ALARMS, they are described below.

ADVISE_ENABLE
The ADVISE_ENABLE parameter contains a list of informative conditions that do not have a direct impact on the primary functions of the device. Below is a list of the conditions in order of priority from 1 to 2, where 2 is the highest priority. This priority is not the same as the ADVISE_PRI parameter described below. It is hard coded within the device and is not user configurable.

Below is a list of the advisories(1):

1. Device Minor Information
2. PlantWeb Alerts Simulation Active

ADVISE_MASK
The ADVISE_MASK parameter will mask any of the failed conditions listed in ADVISE_ENABLE. A bit on means the condition is masked out from alarming and will not be reported.

ADVISE_PRI
ADVISE_PRI designates the alarming priority of the ADVISE_ALM, see “Alarm Priority” on page 4-46. The default is 0 and the recommended values are 1 or 2.

ADVISE_ACTIVE
The ADVISE_ACTIVE parameter displays which of the advisories is active.

ADVISE_ALM
An alarm that indicates advisory alarms. These conditions do not have a direct impact on the process or device integrity.

Recommended Actions for PlantWeb Alerts

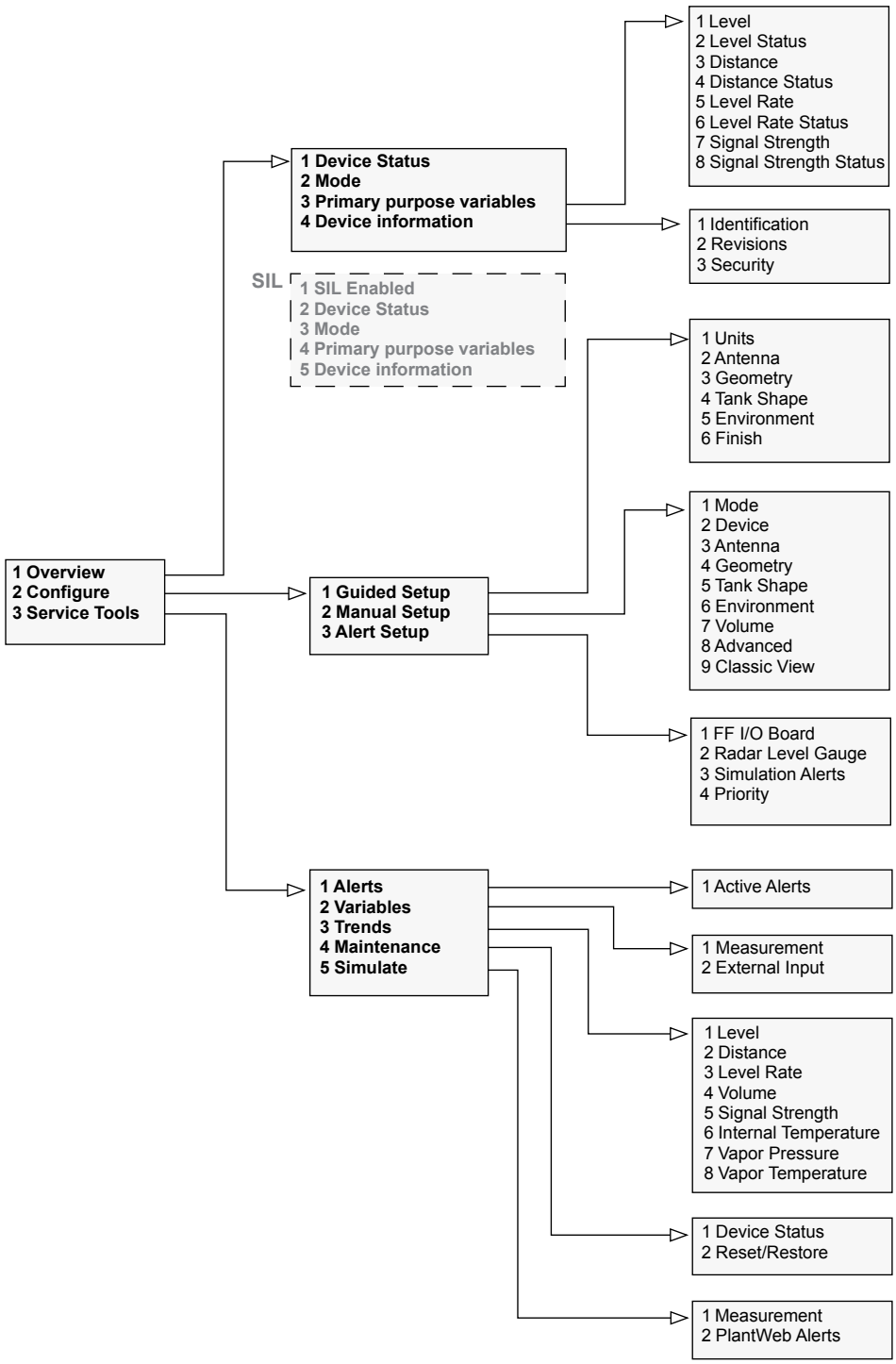
The RECOMMENDED_ACTION parameter displays a text string that will give a recommended course of action to take based on which type and which specific event of the PlantWeb alerts is active (See Table 6-10 on page 6-29).

(1) Note that advisory alarms are not enabled by default.

4.14 475 FIELD COMMUNICATOR MENU TREE

The 5900S can be configured by using a 475 Field Communicator. The menu tree below shows the available options for configuration and service.

Figure 4-15. Field Communicator Menu Tree



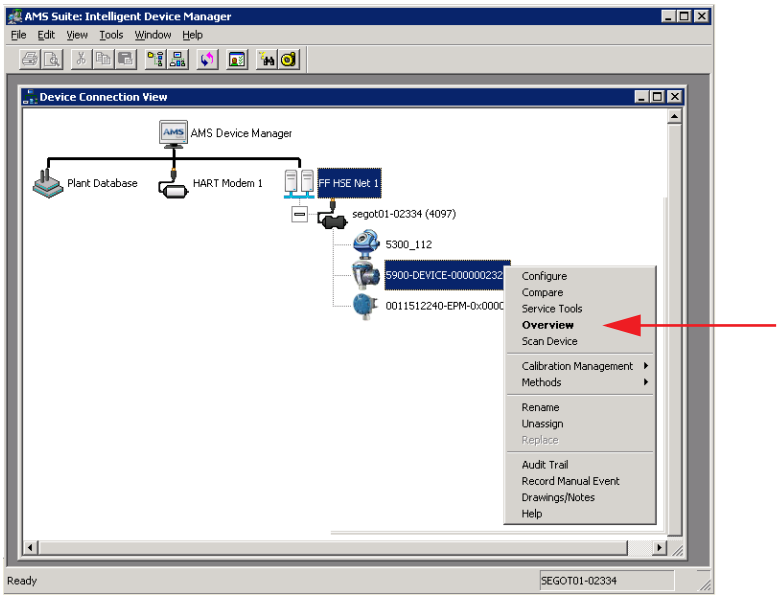
4.15 CONFIGURATION USING AMS DEVICE MANAGER

The Rosemount 5900S supports DD Methods to facilitate device configuration. The following description shows how to use the AMS Device Manager application to configure the Rosemount 5900S in a FOUNDATION fieldbus system.

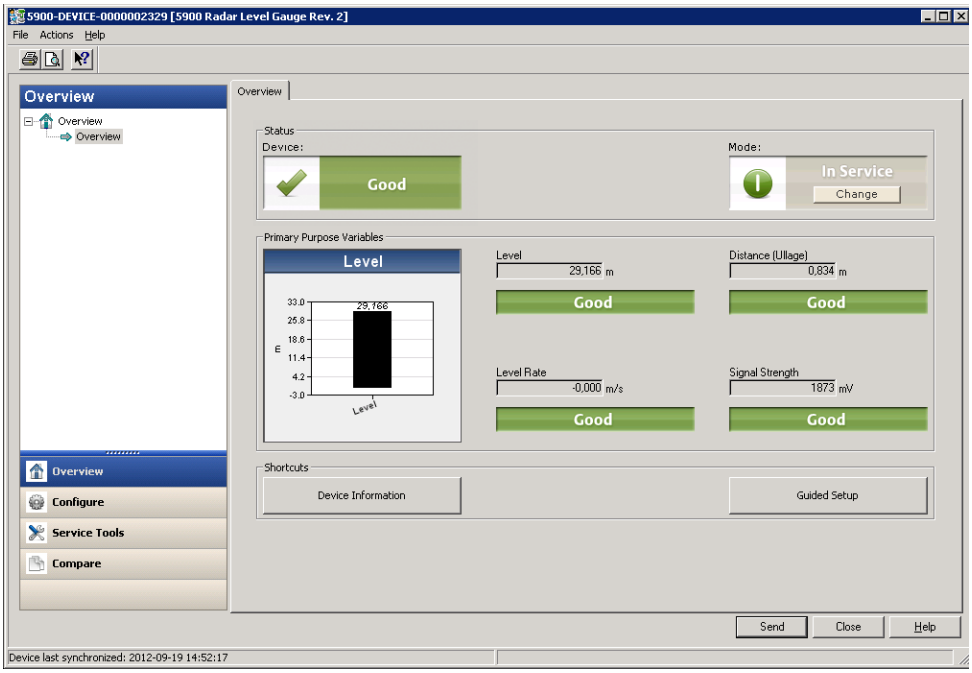
For more information on configuration parameters see “Basic Configuration” on page 4-6 and “Advanced Configuration” on page 4-15.

To configure the Rosemount 5900S in AMS Device Manager application:

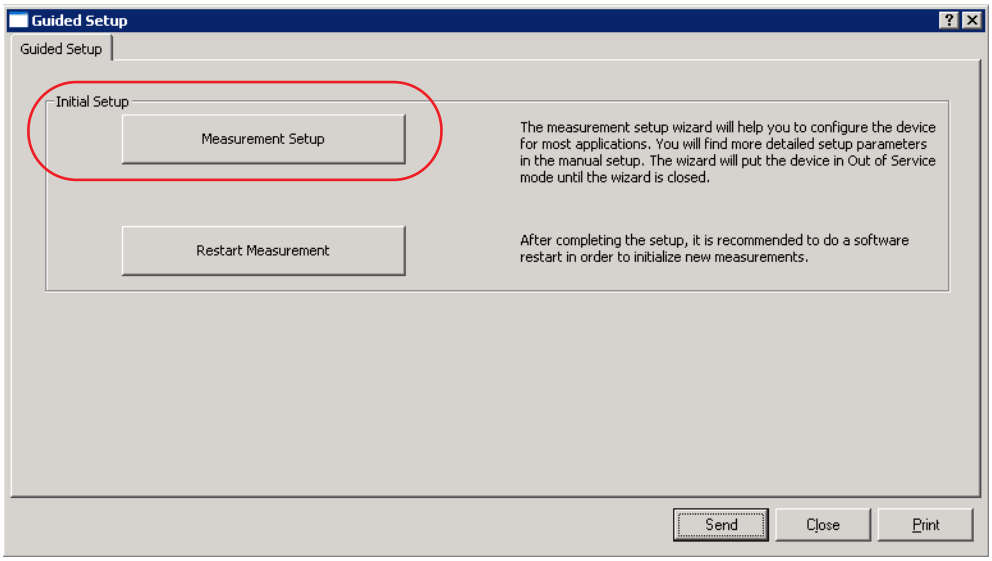
1. Open the *View>Device Connection View*.
2. Double-click the FF network icon and expand the network node to view the devices.
3. Right-click or double-click the desired gauge icon to open the list of menu options:



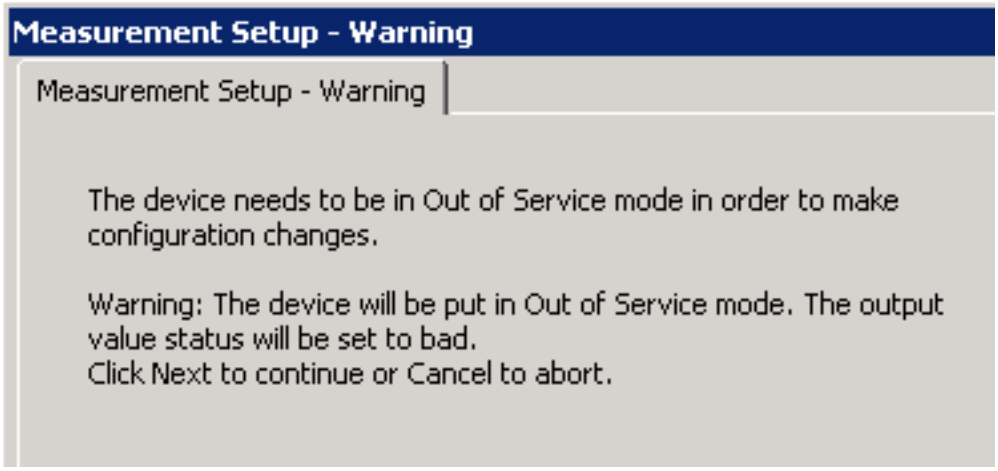
4. Choose the **Overview** option.



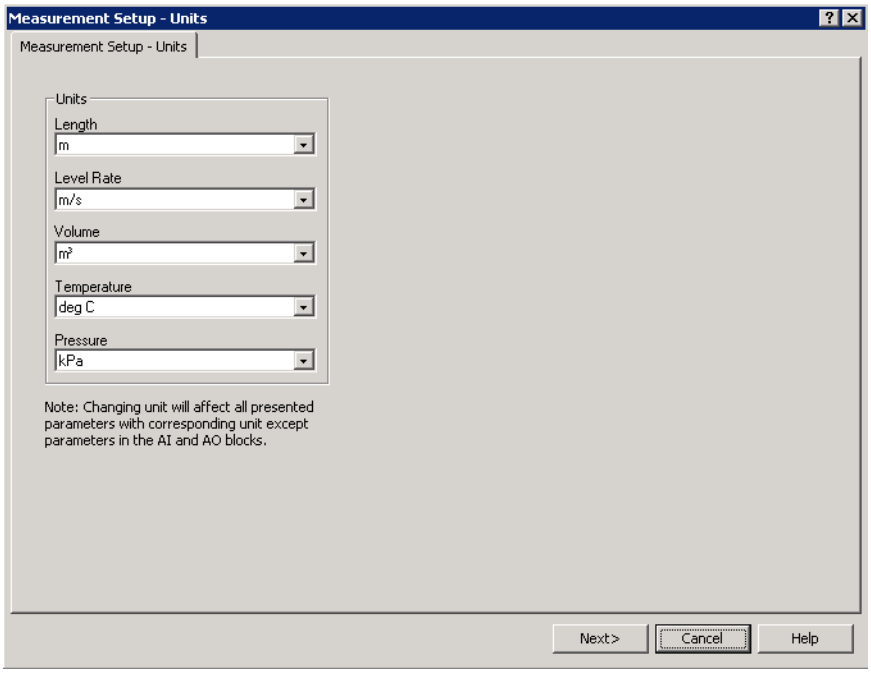
5. Click the **Change** button and set the device to **Out Of Service** (OOS) mode. In case you don't change device mode now, it will automatically be changed when starting the **Measurement Setup** wizard.
6. Click the **Guided Setup** button to open the *Guided Setup* window.



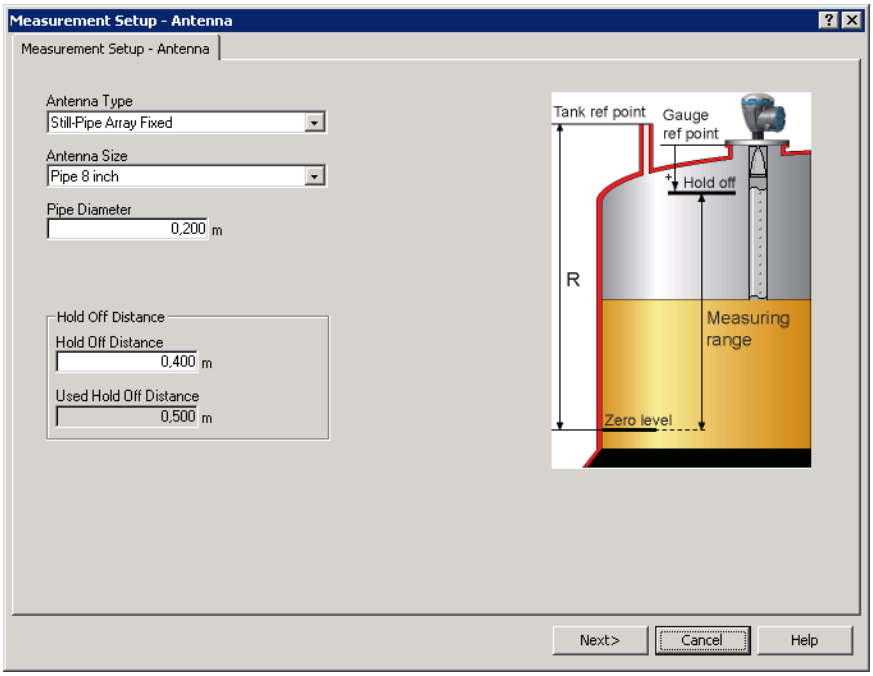
7. Click the **Measurement Setup** button to start the configuration wizard. In case the device was not set to **Out Of Service** mode, a warning message will appear that the device needs to be in **Out Of Service** mode in order to make configuration changes:



8. Click the Next button to proceed. The 5900S level gauge will automatically be set to **Out Of Service** (OOS) mode, and the *Measurement Setup - Units* window appears:



9. Choose measurement units for Length, Level Rate, Volume, Temperature, and Pressure. Note that parameters in the Analog Input block are not affected.
10. Click the Next button to open the *Measurement Setup - Antenna* window.



11. Choose one of the predefined **Antenna Types** to match the antenna attached to the 5900S Radar Level Gauge.
    For Still-pipe Array antennas the antenna size is also required. Sizes ranging from 5 to 12 inch are available.
    Enter the **Pipe Diameter** if the 5900S is installed in a Still-pipe.
12. Click the Next button to open the *Measurement Setup - Geometry* window.

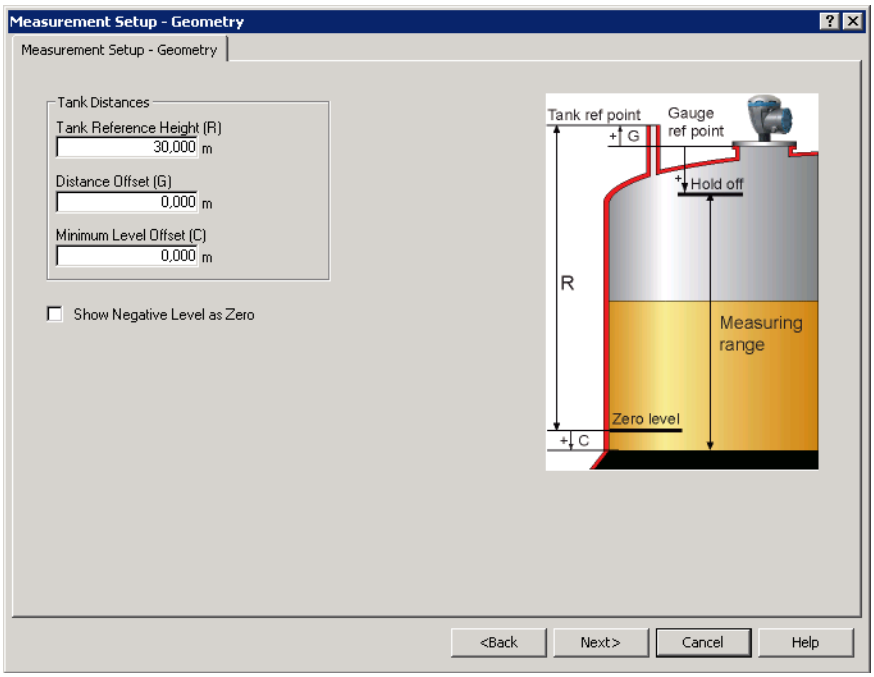
FOUNDATION Fieldbus parameters:

TRANSDUCER 1100>ANTENNA_TYPE

TRANSDUCER 1100>ANTENNA_SIZE

TRANSDUCER 1100>PIPE_DIAMETER

TRANSDUCER 1100>HOLD_OFF_DIST



13. **Tank Reference Height (R)** is the distance from the Tank Reference Point to the Zero Level near the tank bottom. Ensure that this number is as accurate as possible.
14. The **Reference Distance (G)** is the distance between the Tank Reference Point and the Gauge Reference Point, which is located at the upper surface of the nozzle flange or manhole cover on which the gauge is mounted. G is positive if the Tank Reference Point is located above the Gauge Reference Point, otherwise G is negative.
15. The **Minimum Level Distance (C)** is defined as the distance between the Zero Level (Dipping Datum Point) and the minimum level (tank bottom) for the product surface. By specifying a C-distance the measuring range can be extended to the bottom of the tank.

    C>0: the 5900S presents negative level values when the product surface is below the Zero Level.
    You can use the **Show negative level values as zero** check box if you wish to present product levels below the Zero Level (Datum plate) as equal to zero.

FOUNDATION Fieldbus parameters:

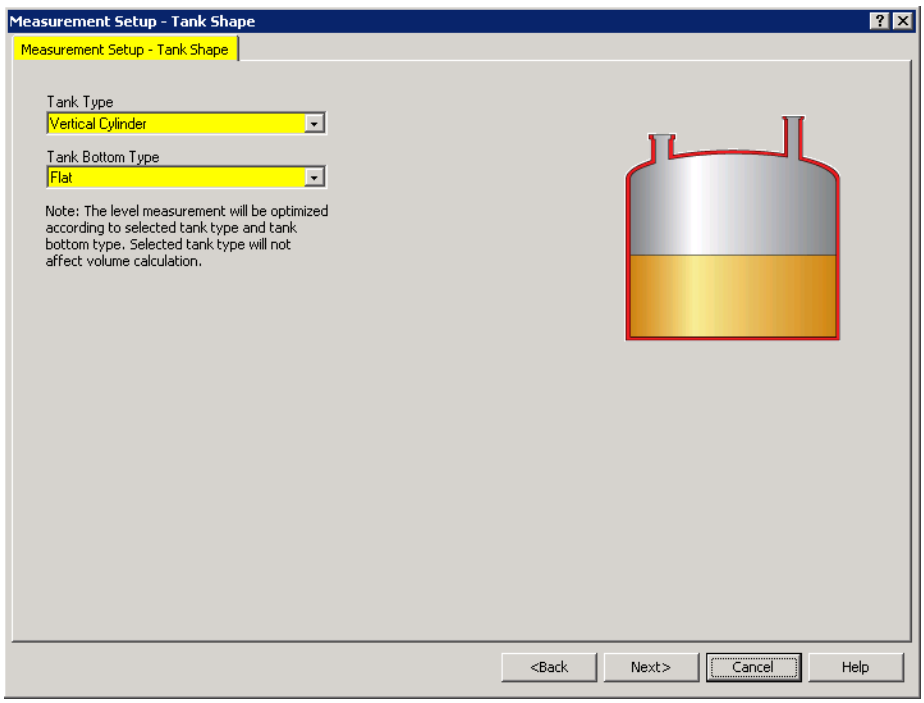
TRANSDUCER 1100>TANK_HEIGHT_R

TRANSDUCER 1100>OFFSET_DIST_G

TRANSDUCER 1100>BOTTOM_OFFSET_DIST_C

TRANSDUCER 1100>TANK_PRESENTATION

16. Click the Next button and proceed to the *Measurement Setup - Tank Shape* window:

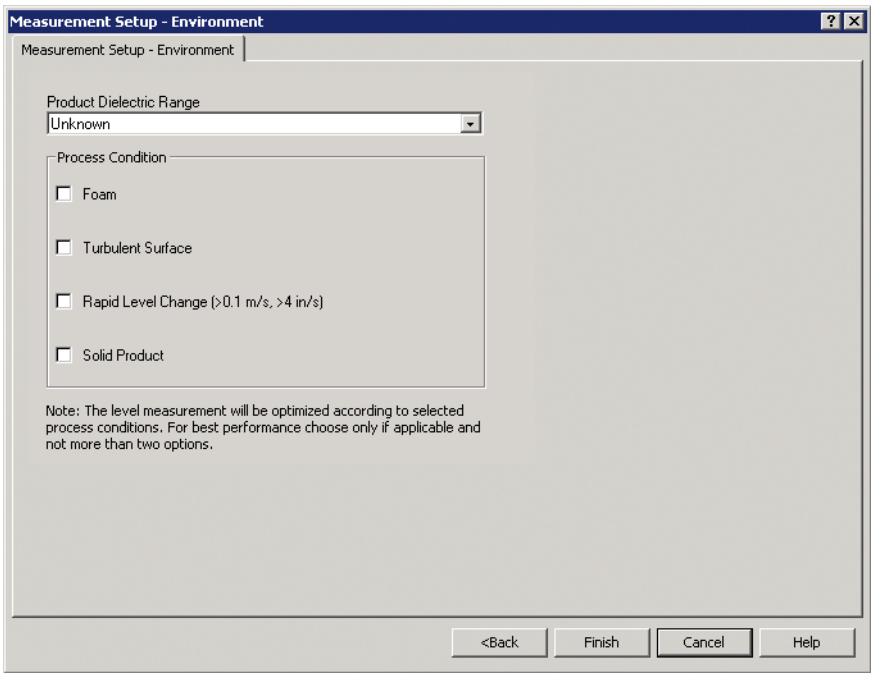


17. Select a Tank Type option that matches the actual tank. Choose Unknown if none of the available options is applicable.
18. Select Tank Bottom Type that matches the actual tank. Choose Unknown if no option is applicable.
19. Click the Next button to open the *Measurement Setup - Environment* window.

FOUNDATION Fieldbus parameters:

TRANSDUCER 1100>TANK_SHAPE

TRANSDUCER 1100>TANK_BOTTOM_TYPE



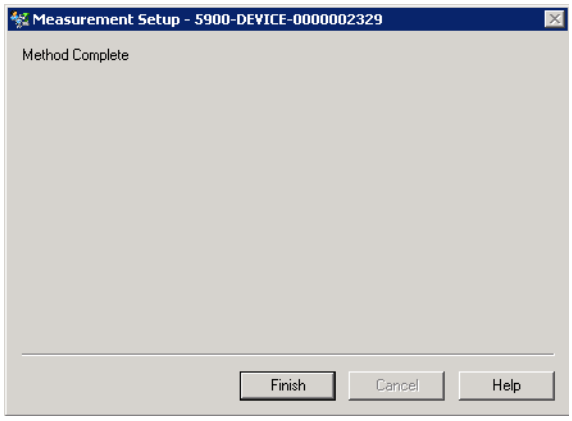
20. Select check boxes that correspond to the conditions in the tank. Use as few options as possible. It is recommended that no more than two options are used simultaneously.
21. Choose Product Dielectric Range from the drop-down list. Use the Unknown option if the correct value range is unknown or if the contents of the tank is changing on a regular basis.

FOUNDATION Fieldbus parameters:

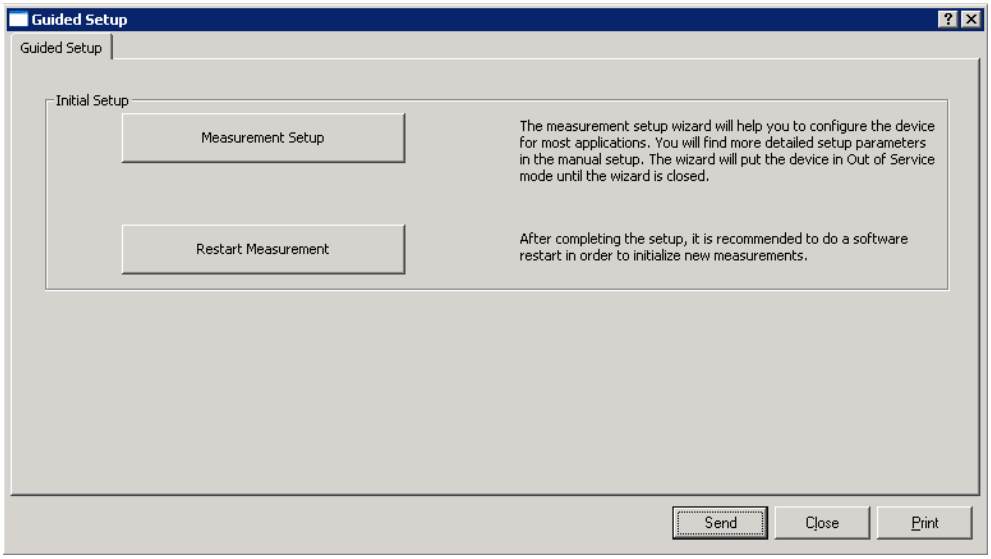
TRANSDUCER 1100>PRODUCT_DC

TRANSDUCER 1100>TANK_ENVIRONMENT

22. Click the **Finish** button.



23. In the *Measurement Setup* window click the **Finish** button and return to the *Guided Setup* tab.



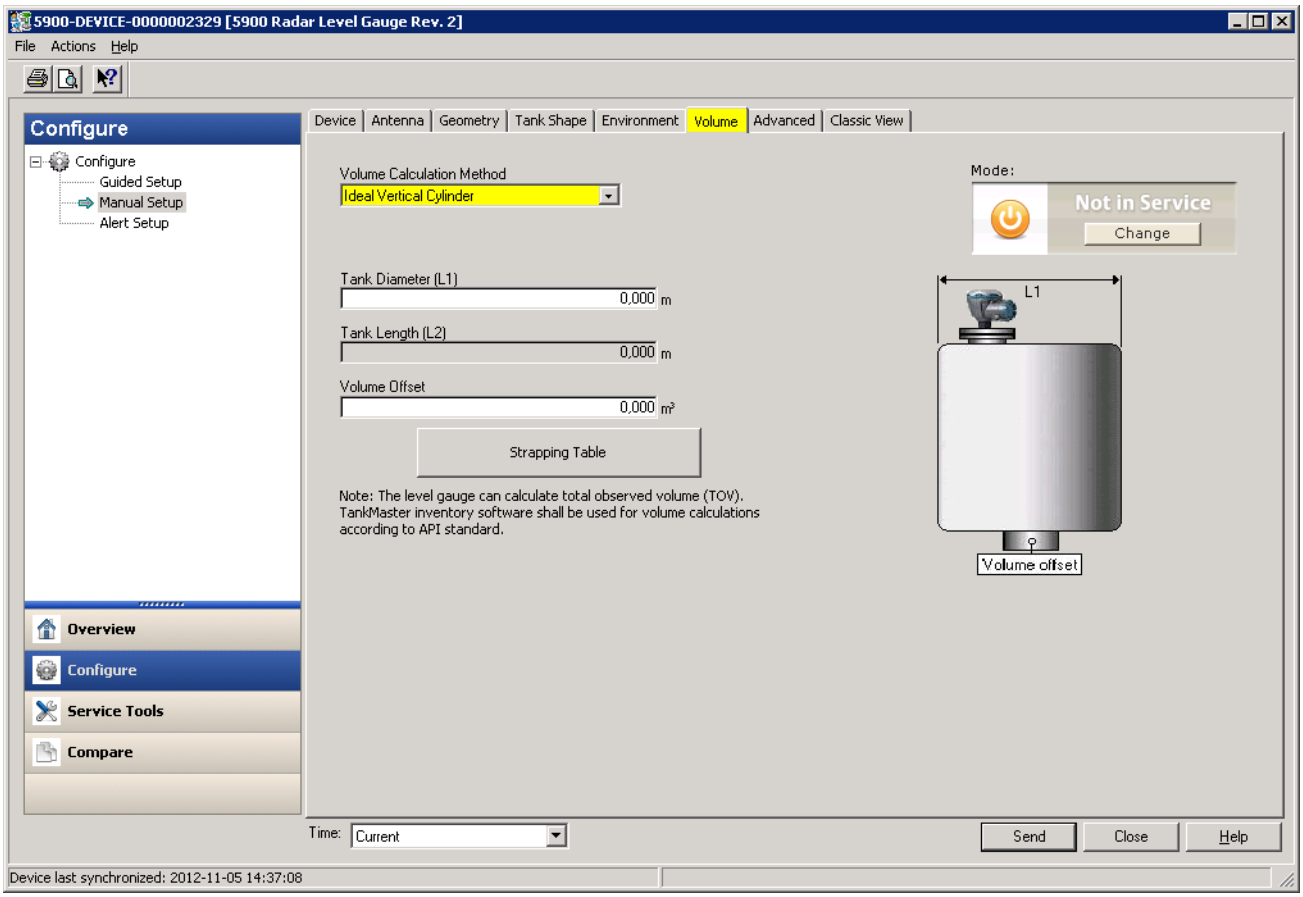
24. When the Guided Setup is finished, it is recommended that the 5900S is restarted by clicking the **Restart Measurement** button(1).
25. Now you can continue with volume configuration and advanced configuration if desired. See “Volume configuration” on page 4-64 and “Advanced configuration” on page 4-65.

(1) Restarting the 5900S does not affect the Foundation fieldbus communication.

4.15.1 Volume configuration

To open the Volume configuration option:

1. Open the AMS Device Manager application.
2. Open Configure>Manual Setup>Volume.



The Volume tab lets you configure the 5900S for volume measurements. You can choose a calculation method based on one of the pre-defined standard tank types or the Strapping Table option. The Strapping Table can be used in case a standard tank type does not provide sufficient accuracy.

Depending on the chosen Volume Calculation Method, i.e. Ideal Sphere, Vertical or Horizontal Cylinder, you will need to specify one or both of the two parameters Tank Diameter (L1) and Tank Length (L2).

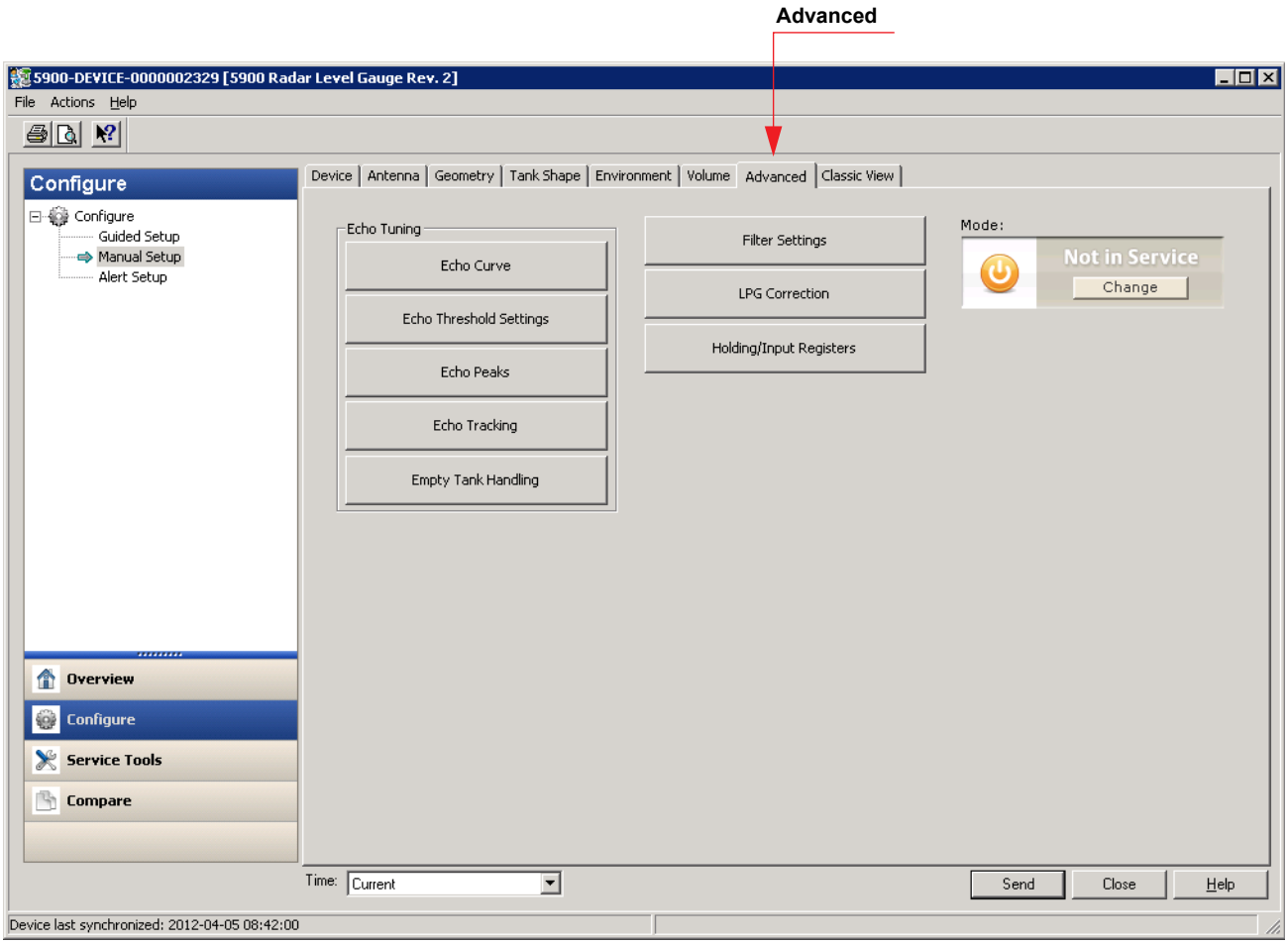
A Volume Offset parameter can be specified if you like to use a non-zero volume for the zero level. This may be useful if you would like to include the product volume below the zero level in the total volume.

4.15.2 Advanced configuration

Several advanced configuration options are available for the Rosemount 5900S Radar Level Gauge. These may be used to optimize measurement performance for certain applications.

To find the advanced configuration options:

1. Open the AMS Device Manager application.
2. Open Configure>Manual Setup>Advanced.

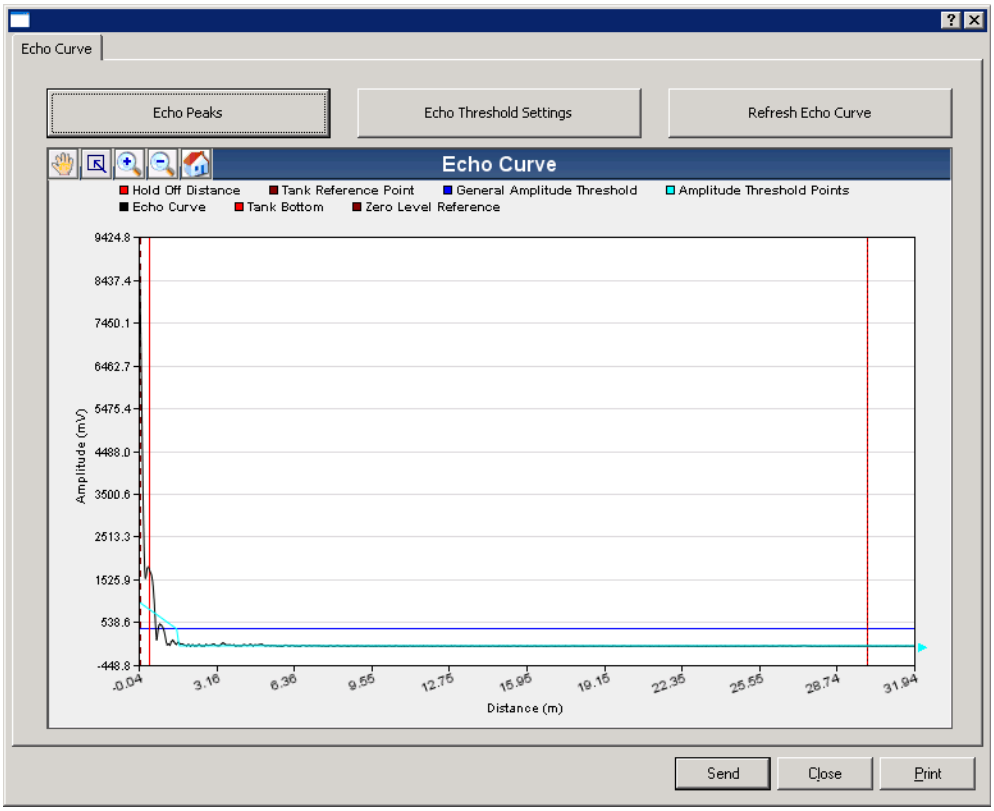


The *Advanced Configuration* window offers several functions for optimizing the 5900S level gauge for various measurement conditions. For example, the Echo Threshold Settings function lets you create an Amplitude Threshold table to filter out echoes from disturbing objects.

See “Advanced Configuration” on page 4-15 for more information on how to use various options such as Echo Curve (Tank Scan), Empty Tank Handling, Surface Echo Tracking and Filter Settings.

Echo Curve

The *Echo Curve* window lets you analyze the measurement signal from a Rosemount 5900S. It allows you to view tank echoes and configure parameters to enable the gauge to distinguish between surface echoes and disturbing echoes and noise. For details see “Tank Scan” on page 4-10.



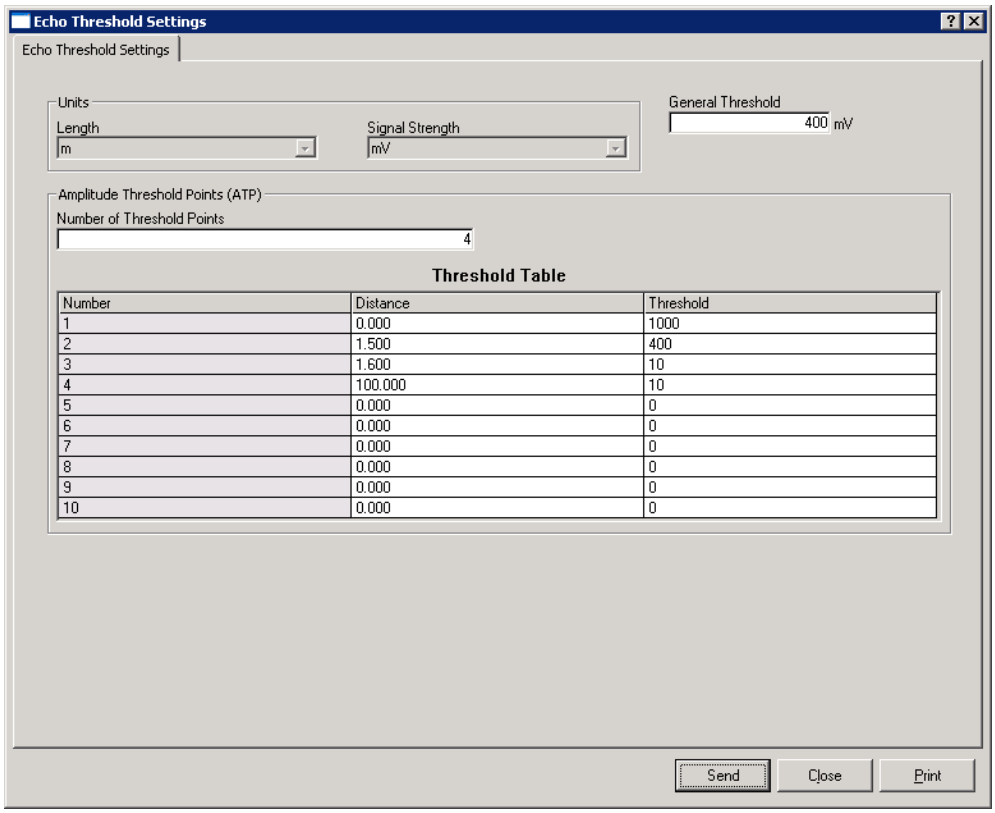
The **Echo Peaks** button lets you open the *Echo Peaks* window which allows you to register false echoes.

The **Echo Threshold Settings** button opens the *Echo Threshold Settings* window which lets you set a general amplitude threshold to filter out noise. You may also create a customized amplitude threshold curve to optimize disturbing echo filtering.

For more information see chapter “Service Functions/Tank Scan” in the *Raptor System Configuration* manual *(Document No. 300510EN).*

Echo Threshold Settings

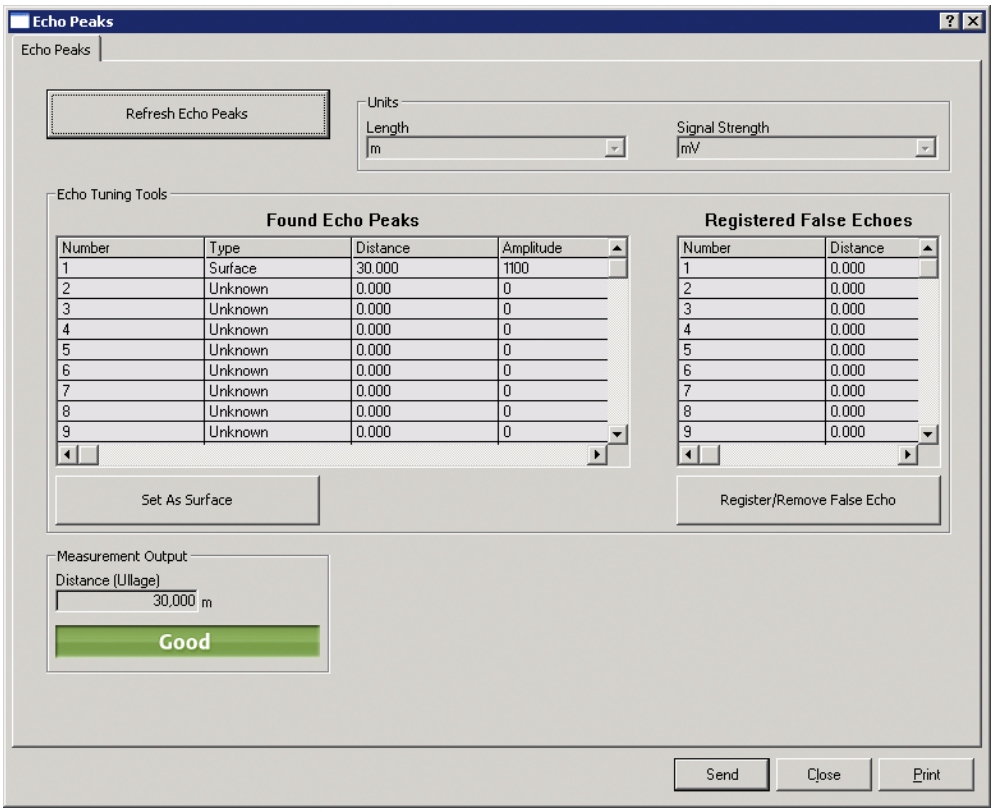
The *Echo Threshold Settings* window lets you create a general amplitude threshold to filter out noise. You may also create a customized amplitude threshold curve to optimize disturbing echo filtering.



Echo Peaks

The *Echo Peaks* window lets you register false echoes. You may also point out which peak is the actual product surface. This function may be useful to facilitate surface echo tracking in a tank with many disturbing objects.

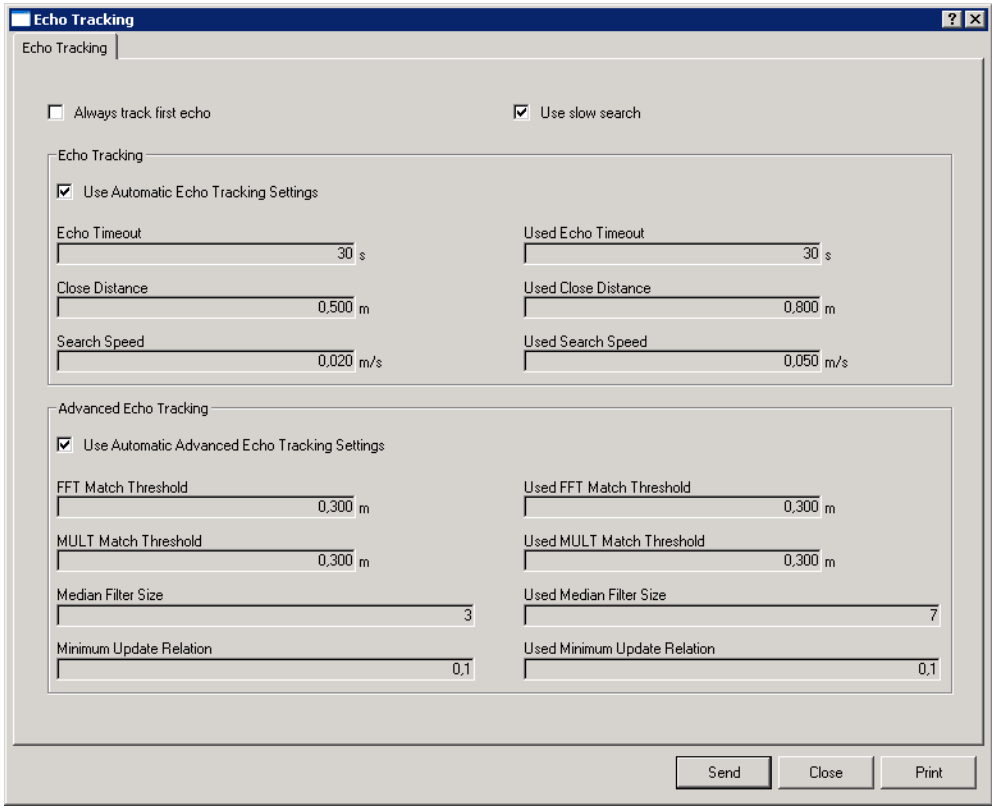
When using this function you should check that registered echoes correspond to actual objects in the tank.



Echo Tracking

The Surface Echo Tracking function can be used to eliminate problems with certain types of “ghost” echoes below the product surface. This may, for example, occur in Still-pipes as a result of multiple reflections between the pipe wall, flange and antenna. In the tank spectrum these echoes appear as amplitude peaks at various distances below the product surface.

To activate this function, ensure that there are no disturbing echoes above the product surface and select the *Always Track First Echo* check box.

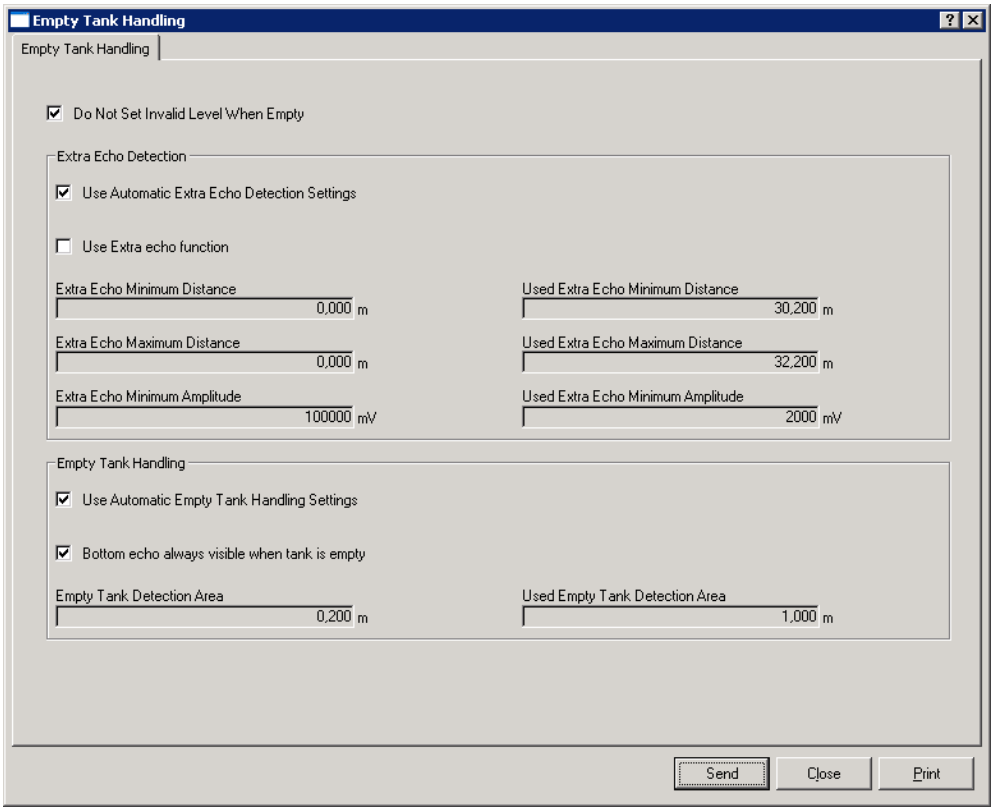


For details see “Surface Echo Tracking” on page 4-16.

Empty Tank Handling

The **Empty Tank Handling** function facilitates surface tracking close to the tank bottom for products with a low dielectric constant. Such products are relatively transparent for microwaves, and strong echoes from the tank bottom may interfere with the relatively weak measurement signal from the surface. Using this function may therefore improve measurement performance when the product surface is close to the tank bottom.

In case the product surface echo is lost in the **Empty Tank Detection Area** close to the tank bottom, the device will enter Empty Tank state and an Invalid Level alarm is triggered.

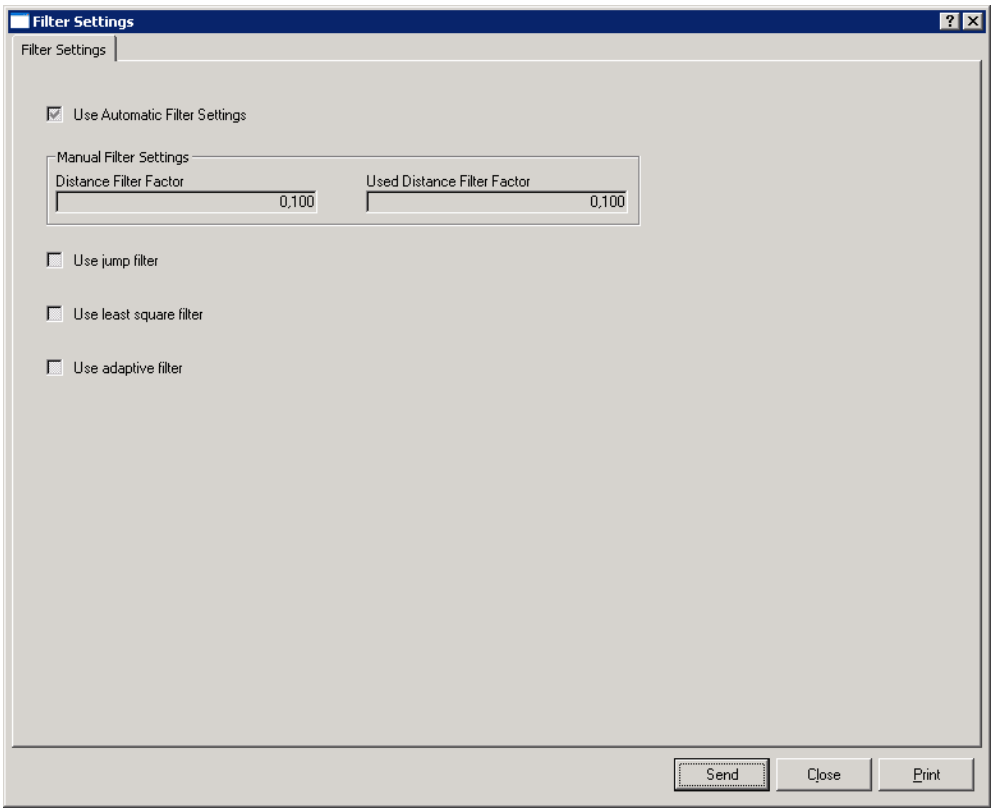


The **Extra Echo Detection** function is used for tanks with a dome or conical bottom shape provided the tank bottom does not produce a strong echo when the tank is empty. For tanks with a conical bottom, an echo may appear beneath the actual tank bottom when the tank is empty. If the device is not able to detect the tank bottom this function can be used to ensure that the device stays in empty tank state as long as this extra echo is present.

For further details see “Empty Tank Handling” on page 4-11.

Filter Settings

The *Filter Settings* window provides various functions for optimizing echo tracking depending on tank conditions and movement of the product surface.



The **Distance Filter Factor** defines the amount of product level filtering (1 = 100%).

A low Filter Factor makes the level value steady but the device reacts slowly to level changes in the tank.

A high Filter Factor makes the device react quickly to level changes but the presented level value can sometimes be somewhat jumpy.

The **Jump Filter** is typically used for applications with turbulent surface and makes the echo tracking work smoother as the level passes, for example, an agitator.

The **Least Square Filter** provides increased accuracy for slow filling or emptying of a tank. The Least Square filter can not be used at the same time as the Adaptive Filter.

The **Adaptive Filter** automatically adapts to the movement of the surface level. It tracks product level fluctuations and continuously adjusts the filter grade accordingly. The filter can preferably be used in tanks in which fast tracking of level changes are important and turbulence occasionally cause unstable level readings.

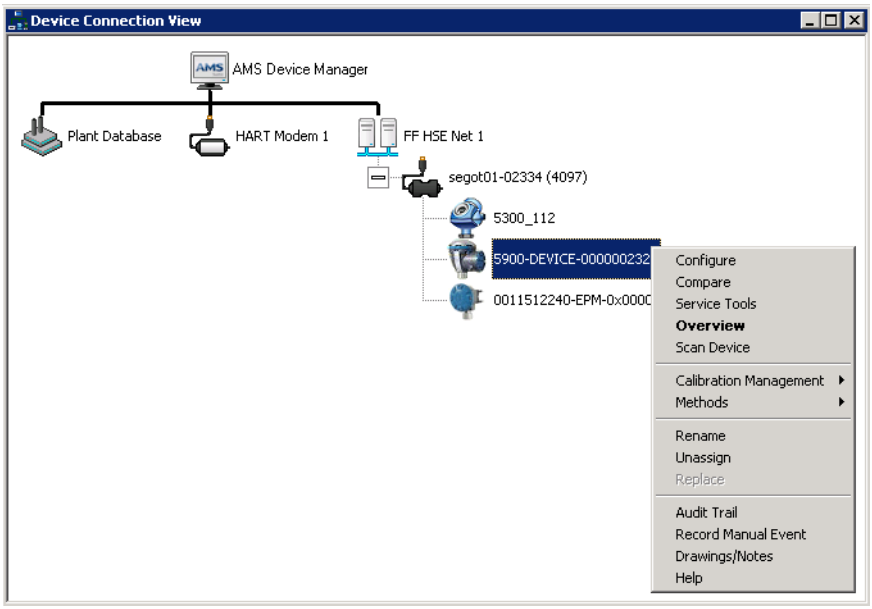
4.16 PLANTWEB ALERT SETUP

The *Alert Setup* window allows you to configure and enable/disable Plantweb Alerts.

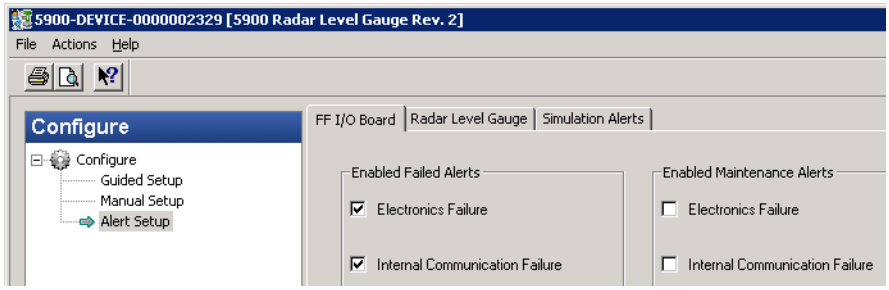
For details on how to view active alerts see “Viewing Active Alerts in AMS” on page 6-26.

To open the *Alert Setup* window:

1. From the Start menu; open the AMS Device Manager application.
2. Open the *View>Device Connection View*.
3. Double-click the FF network icon and expand the network node.
4. Right-click or double-click the desired gauge icon to open the list of menu options.



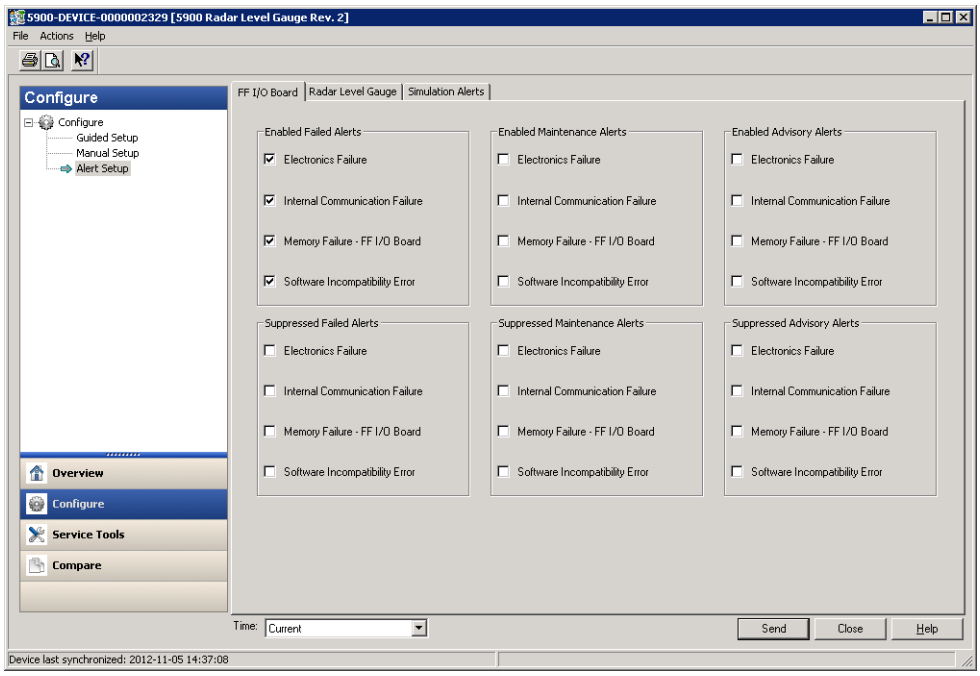
5. Click the right mouse button and choose the **Configure** option.



6. Select the **Alert Setup** option.
7. Select the desired tab (FF I/O Board, Radar Level Gauge).
8. Specify alerts for the different error types.

4.16.1 FF I/O Board

Default alert setup for FF I/O Board:

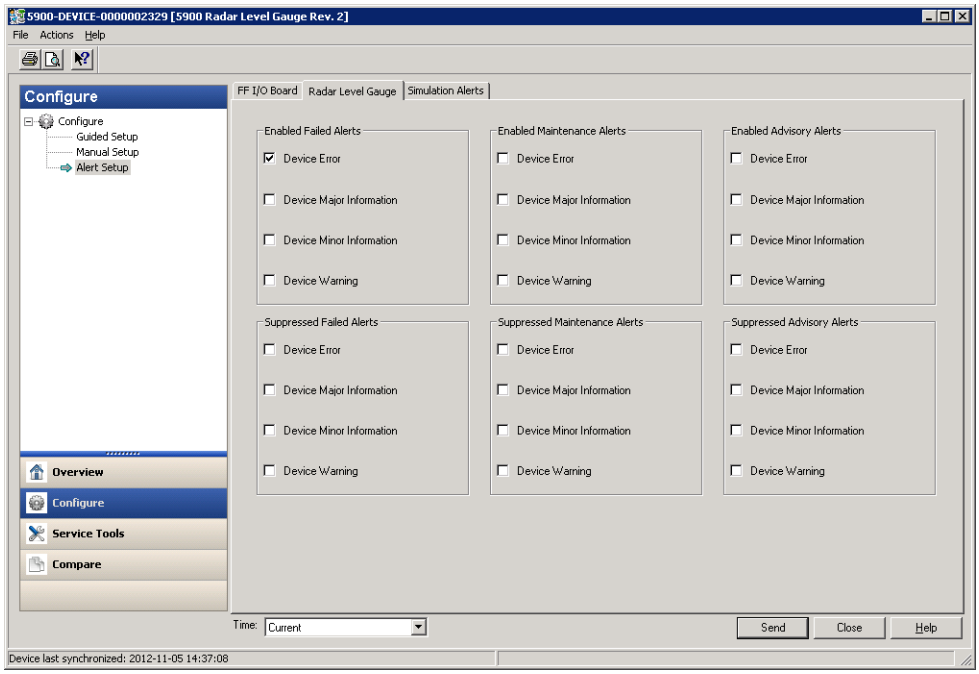


To configure the alerts:

1. For each error type select the check box for the desired alert type (Failed, Maintenance, Advisory).
2. Click the Send button.

4.16.2 Radar Level Gauge

Default alert setup for Radar Level Gauge:

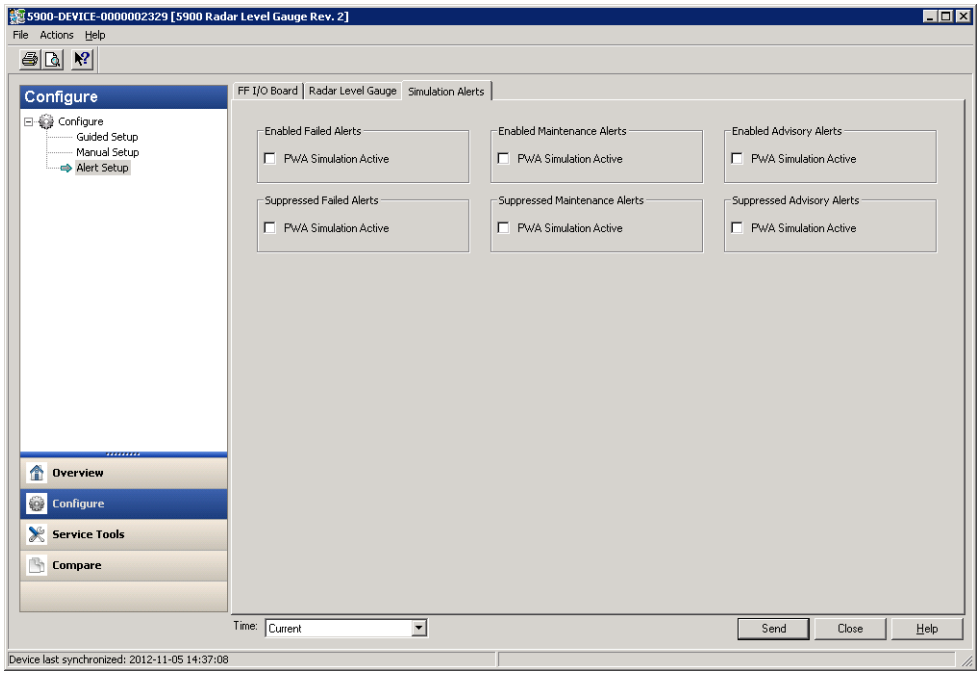


To configure the alerts:

1. For each error type select the check box for the desired alert type (Failed, Maintenance, Advisory).
2. Click the Send button.

4.16.3 Simulation

Note that when simulating PlantWeb Alerts, only those alerts which are setup according to the default configuration will be simulated, see section “Alert Default Settings” on page 4-76.



4.16.4 Alert Default Settings

The following default settings are used for the FF I/O Board and the Radar Level Gauge. You may configure error types in a different way if you like. For example, the *Device major information* error is configured as a Maintenance alert for the Radar Level Gauge by default. The *Alert Setup* window allows you to enable the alert as Failed or Advisory instead. However, when simulating Plant Web Alerts, only those alerts which are setup according to the default configuration will be seen. So the *Device major information* error can be simulated if it is configured as a Maintenance alert, otherwise not.

FF I/O Board

Table 4-12. Default Plantweb Alert configuration for FF I/O Board

Error type	Default configuration	Enabled / Disabled
Electronic failure	Failed alert	Enabled
Internal communication failure	Failed alert	Enabled
Memory Failure	Failed alert	Enabled
Software Incompatibility Error	Failed alert	Enabled

Radar Level Gauge

Table 4-13. Default Plantweb Alert configuration for Radar Level Gauge

Error type	Default configuration	Enabled / Disabled
Device error	Failed alert	Enabled
Device major information	Maintenance alert	Disabled
Device minor information	Advisory alert	Disabled
Device warning	Maintenance alert	Disabled

Simulation

Table 4-14. Default Plantweb Alert configuration for Simulation

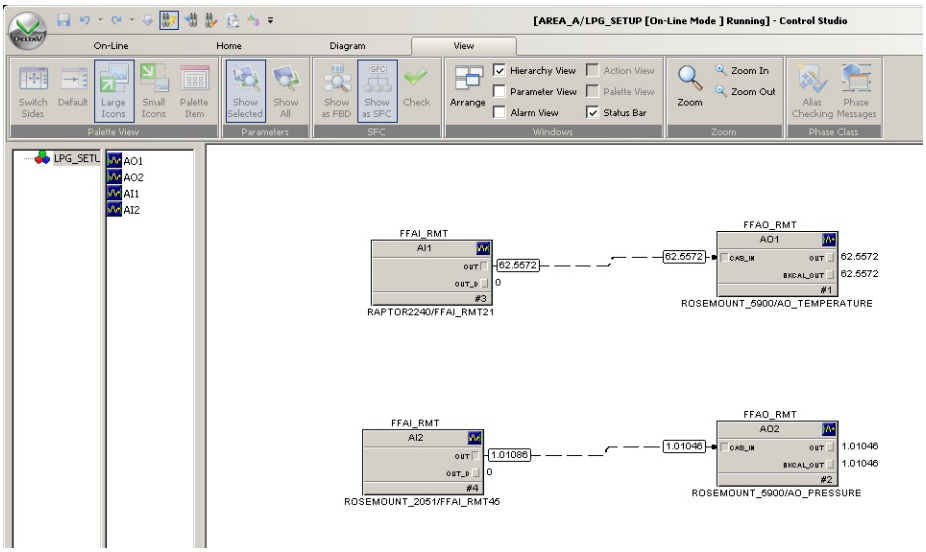
Error type	Default configuration	Enabled / Disabled
PWA Simulation Active	Maintenance alert	Disabled

4.17 LPG SETUP USING DELTAV / AMS DEVICE MANAGER

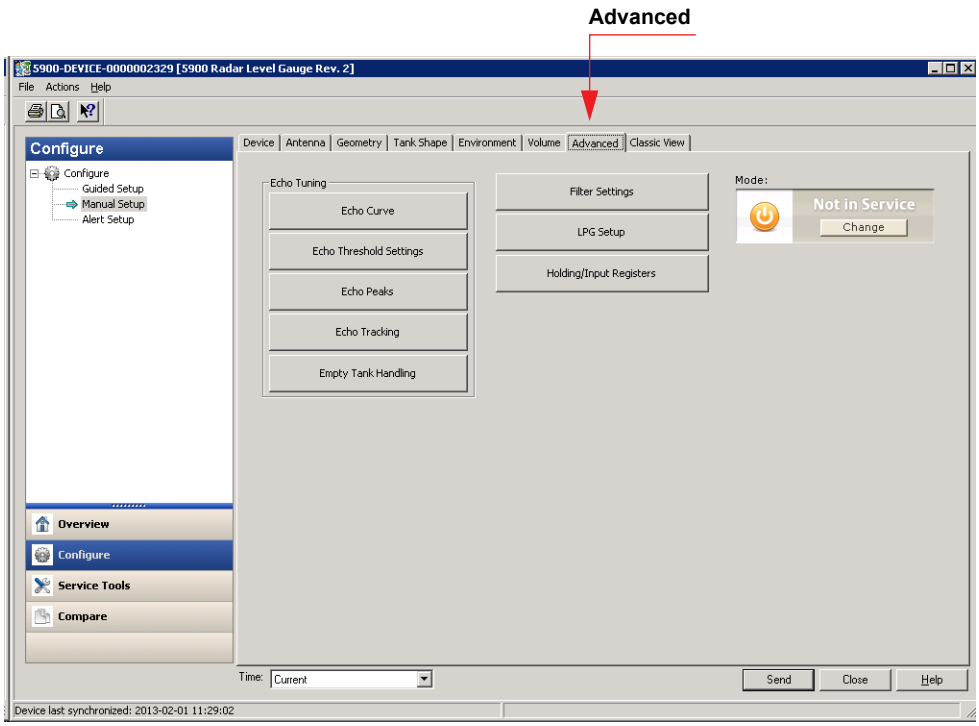
The Rosemount 5900S can be setup in a FOUNDATION fieldbus system for LPG applications. DeltaV/AMS Device Manager supports configuration as described on the following pages. Prior to performing the LPG Setup it is recommended that you read “Preparations” on page 4-20 for information on how to prepare a 5900S for LPG configuration.

To configure a 5900S for LPG applications:

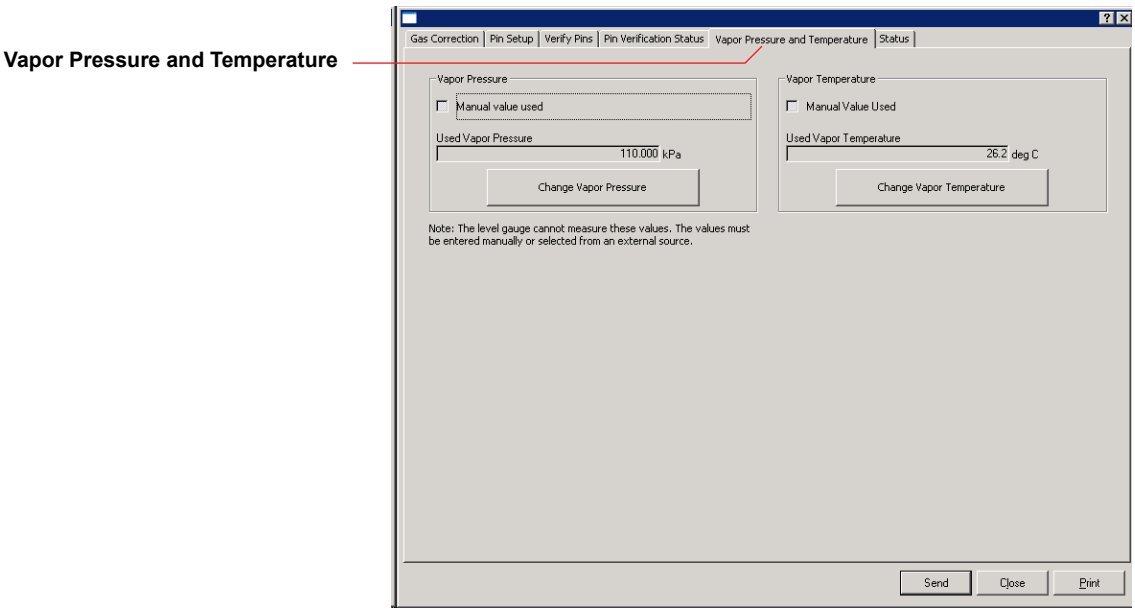
1. Open *Control Studio* or some other appropriate tool for configuration of FOUNDATION fieldbus function blocks.



2. Ensure that the **Analog Output** blocks are connected to the appropriate devices for **Vapor Temperature** and **Vapor Pressure**.
3. In *DeltaV/AMS Device Manager*, open the *View>Device Connection View*.
4. Double-click the FF network icon and expand the network node to view the devices.
5. Right-click or double-click the 5900S level gauge icon to open the list of menu options.
6. Choose the **Configure** option.
7. Choose **Manual Setup** and select the *Advanced* tab.

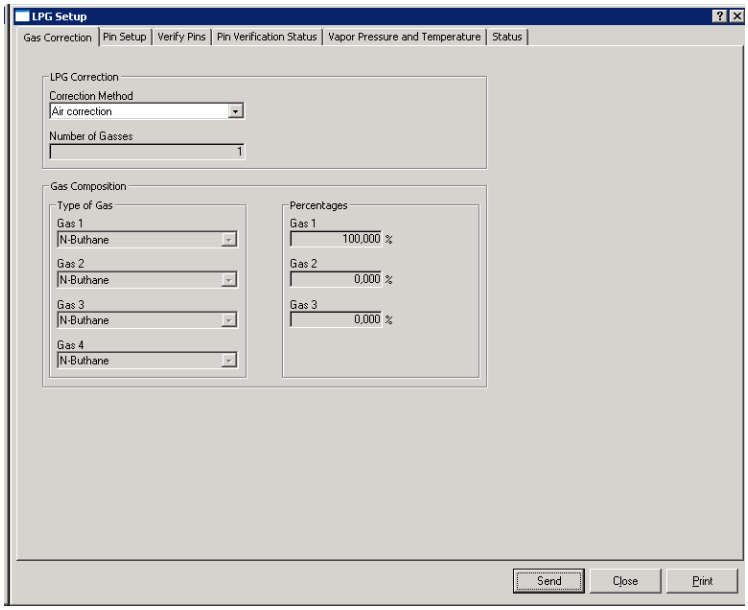


8. Click the **LPG Setup** button.
9. Select the *Vapor Pressure and Temperature* tab.



10. Verify that **Vapor Pressure** and **Vapor Temperature** appear in the corresponding fields. If not, check that the devices are properly wired and the Analog Output blocks are configured in, for example, Control Studio.

11. Select the *Gas Correction* tab.

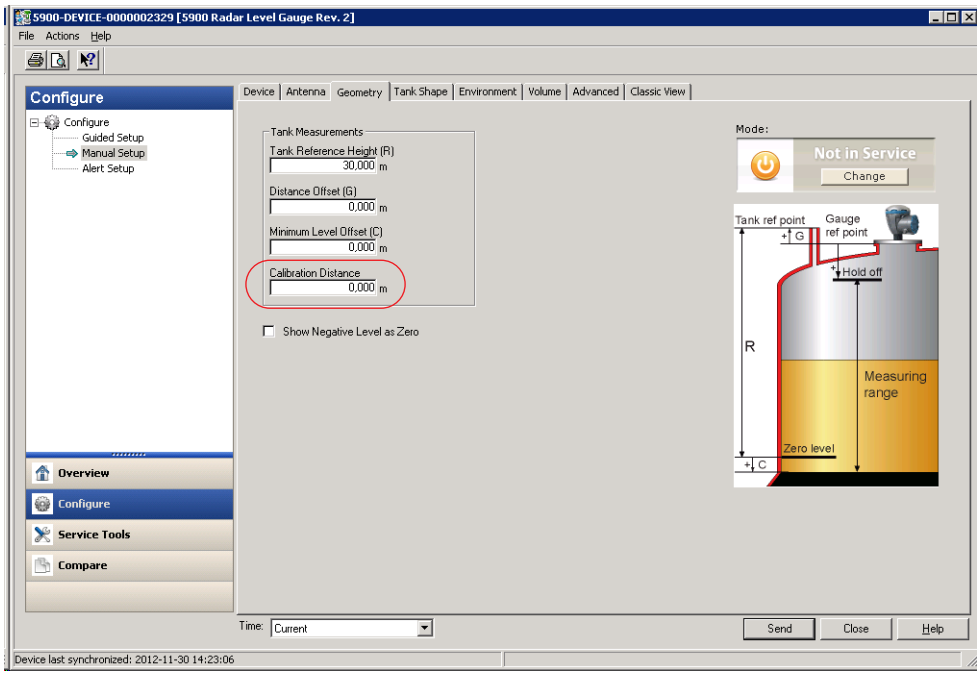


12. Choose correction method **Air Correction**. This setting is used during the Pin Verification procedure. When the LPG Setup is finished, and the tank is ready to be put into operation, the correction method must be set to correspond with the type of product in the tank.

FOUNDATION Fieldbus parameters:

TRANSDUCER 1500>LPG_CORRECTION_METHOD

13. Calibrate. Check the distance to the calibration ring at the end of the still-pipe as measured by the 5900S Radar Level Gauge. Adjust the *Calibration Distance* in case the measured distance is not equal to the actual distance between the Tank Reference Point and the calibration ring. See “Tank Geometry” on page 4-6 for more information on tank geometry settings.



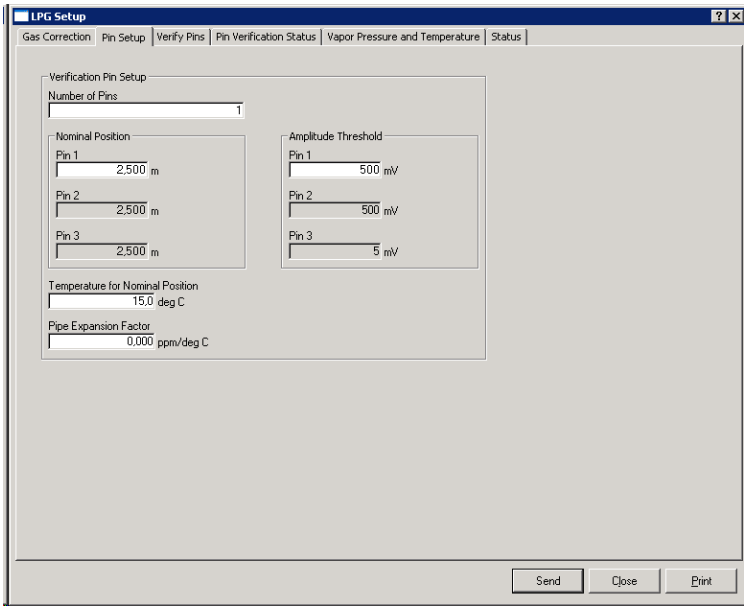
NOTE!
It is important that the Inner Diameter of the still-pipe is properly configured. Open the *Antenna* tab in case you would like to verify the Inner Diameter configuration.

See “LPG/LNG Antenna Requirements” on page 3-13 for more information on still-pipe requirements for the 5900S with LPG/LNG Antenna.

FOUNDATION Fieldbus parameter:

TRANSDUCER 1100>CALIBRATION_DIST

14. Select the *Pin Setup* tab to configure the Verification Pin.



15. Enter nominal position. Normally, there is one verification pin placed at 2500 mm below the flange. In case there are two or three verification pins, enter nominal position for each one. In addition to that, a calibration ring should be installed at the bottom end of the still-pipe. It will be used for calibrating the tank geometry parameters. See *"LPG/LNG Antenna Requirements" on page 3-13* for more information.
The Pipe Expansion Factor lets you compensate for thermal expansion of the still-pipe.

FOUNDATION Fieldbus parameters:

TRANSDUCER 1500>LPG_NUMBER_OF_PINS

TRANSDUCER 1500>LPG_PIN1_CONFIGURATION

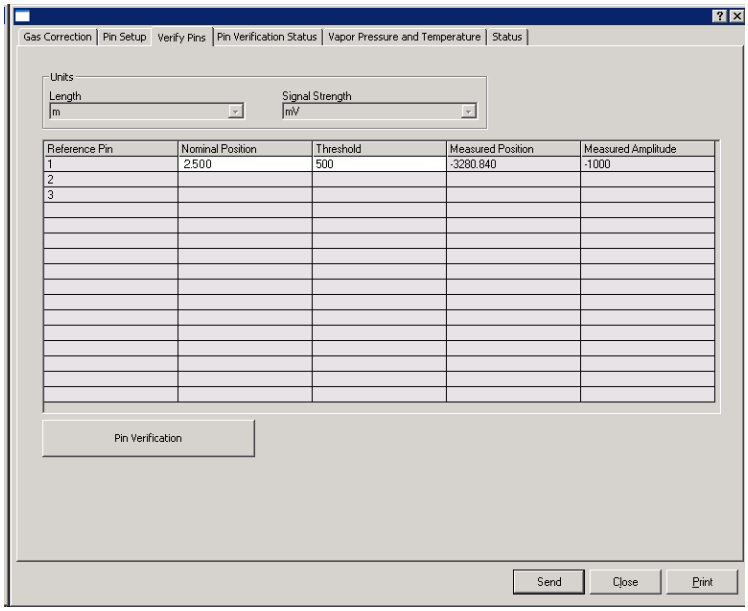
TRANSDUCER 1500>LPG_PIN2_CONFIGURATION

TRANSDUCER 1500>LPG_PIN3_CONFIGURATION

TRANSDUCER 1500>LPG_PIN_TEMPERATURE

TRANSDUCER 1500>LPG_PIN_TEMP_EXP_PPM

16. Verify pin position:
    a. Open the *Verify Pins* tab.



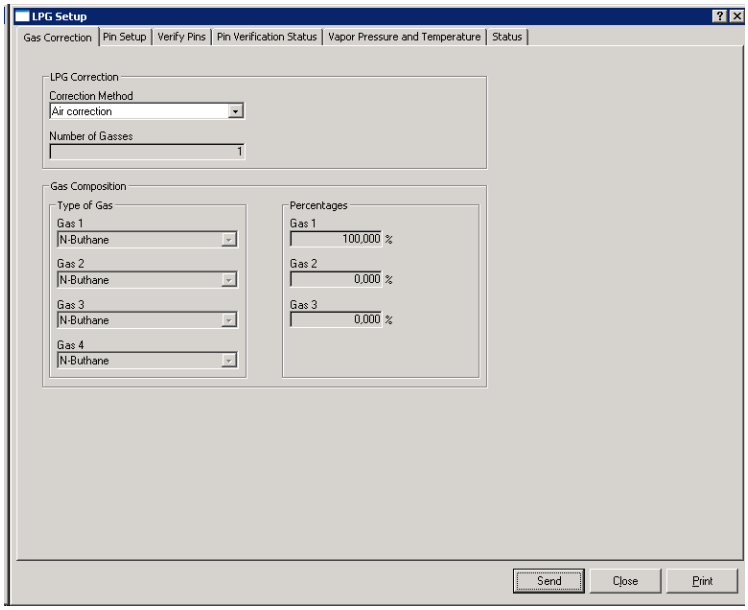
    b. Click the **Pin Verification** button to start the verification process.
    c. Compare **Measured Position** with **Nominal Position** (actual position of the Verification Pin in the Still-pipe).
    d. In case the Measured Position deviates from the Nominal Position, note the Measured Position and return to the *Pin Setup* tab.
    e. Enter the Measured position into the Nominal Position field and click the Send button.
    f. Repeat steps a. to e. until the message “Successful Verification” appears, indicating that Nominal Position corresponds to the Measured Position.

FOUNDATION Fieldbus parameters:

TRANSDUCER 1500>LPG_VER_PIN1_

TRANSDUCER 1500>LPG_PIN1_CONFIGURATION

17. Select the Gas Correction tab.



18. Choose the appropriate correction method for the product in the tank.

FOUNDATION Fieldbus parameters:

TRANSDUCER 1500>LPG_CORRECTION_METHOD

TRANSDUCER 1500>LPG_NUMBER_OF_GASSES

TRANSDUCER 1500>LPG_GAS_TYPE1

TRANSDUCER 1500>LPG_GAS_PERC1

TRANSDUCER 1500>LPG_GAS_TYPE2

TRANSDUCER 1500>LPG_GAS_PERC2

TRANSDUCER 1500>LPG_GAS_TYPE3

TRANSDUCER 1500>LPG_GAS_PERC3

TRANSDUCER 1500>LPG_GAS_TYPE4

Choose one of the following correction methods:

a. Air Correction.
   This method should only be used when there is no vapor in the tank, i.e. when the tank is empty and contains air only. It is used in the initial step when calibrating the 5900S.

b. One known gas.
   This method may be used when there is only one gas type in the tank. It provides the highest accuracy among the different correction methods. Note that even small amounts of another gas reduces the accuracy.

c. One or more unknown gases.
   Use this method for hydrocarbons, for example Propane/Buthane, when the exact mixture is not known.
d. Two gases with unknown mixratio.
   This method is suitable for a mixture of two gases even if the mixratio is not known.
e. One or more known gases with known mixratio.
   This method may be used when there is a well known mixture of up to 4 products in the tank.

Now the Rosemount 5900S level gauge is ready to measure the product level when the tank is put into operation.

Section 5 Operation

5.1 SAFETY MESSAGES

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

⚠WARNING

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

Make sure only qualified personnel perform the installation.

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

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

⚠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.

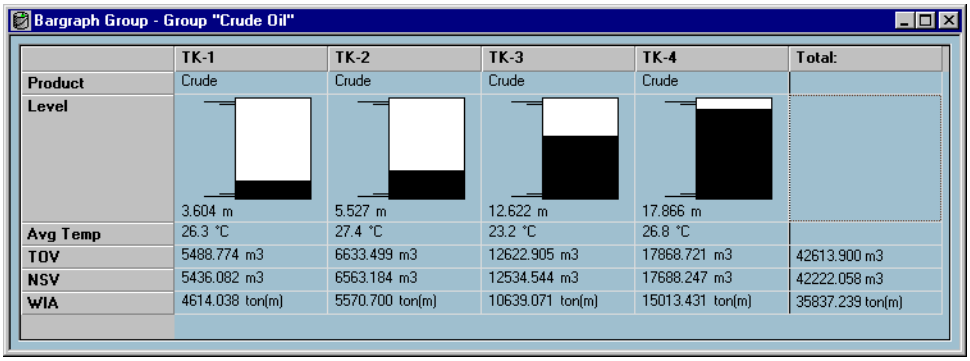
Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

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

5.2 VIEWING MEASUREMENT DATA IN TANKMASTER

The Rosemount TankMaster program has several options for viewing measurement and inventory data for single tanks and tank groups. TankMaster also offers the option to create custom views with your own set of parameters. See the *TankMaster WinOpi Reference Manual* (Document No. 303028EN) for more information.

Figure 5-1. Example of a bargraph view in TankMaster WinOpi



5.3 ALARM HANDLING

The *Rosemount TankMaster WinOpi* program supports a wide range of alarm functions. Alarms can be set for various measurement data such as Level, Average Temperature, and Vapor Pressure. Alarm limits can also be specified for inventory data such as Net Standard Volume (NSV).

Active alarms can be shown in the *Alarm Summary* window. The Alarm Log lets you view alarms that are no longer active. The Alarm Log can be saved to disk for future reference.

See the *TankMaster WinOpi Reference Manual* (Document No. 303028EN) for more information.

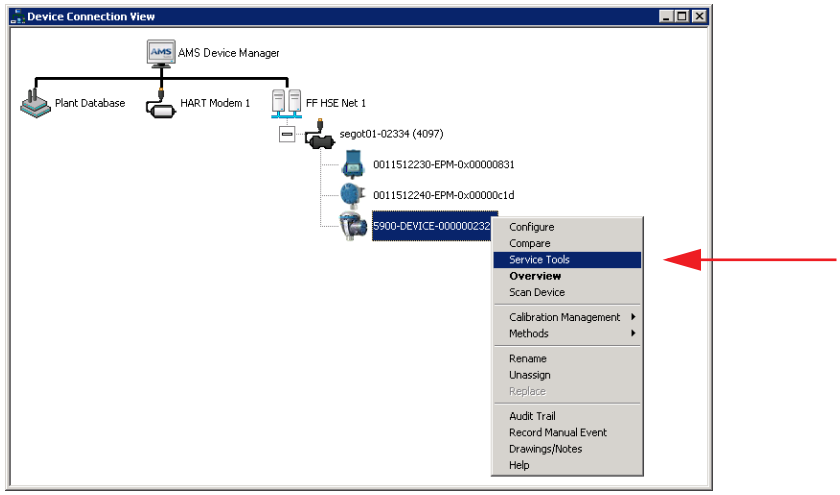
5.3.1 PlantWeb Alerts

For information on how to setup and view active PlantWeb Alerts see “PlantWeb™ Alerts” on page 4-52 and “PlantWeb Alerts” on page 6-26.

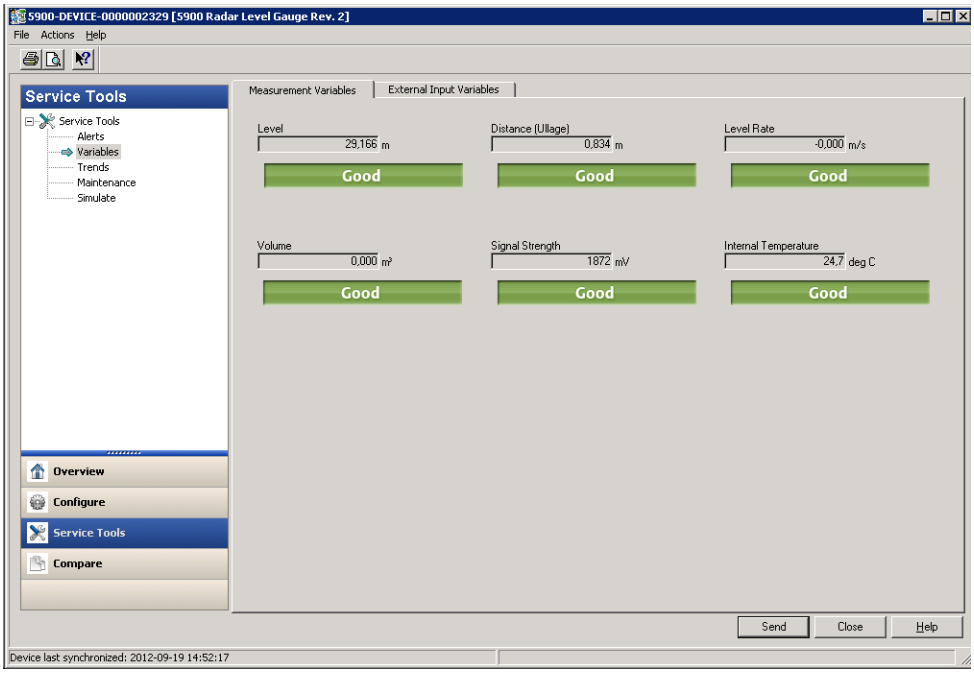
5.4 VIEWING MEASUREMENT DATA IN AMS SUITE

To view measurement data such as Level, Volume, Level Rate, and Signal Strength in AMS Device Manager:

1. Open the *View>Device Connection View*.
2. Double-click the FF network icon and expand the network node to view the devices.
3. Right-click or double-click the desired 5900S gauge icon to open the list of menu options:



4. Choose the **Service Tools** option.



Section 6 Service and Troubleshooting

6.1 SAFETY MESSAGES

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

⚠WARNING

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

Make sure only qualified personnel perform the installation.

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

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

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

Substitution of components may impair Intrinsic Safety.

⚠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 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.

6.2 SERVICE

This section briefly describes functions which may be useful for service and maintenance of a Rosemount 5900S Radar Level Gauge. If not otherwise stated, most examples are based on using the *TankMaster WinSetup* tool to access these functions. See the *Raptor System Configuration Manual (Document No. 300510EN)* for more information on how to use the *TankMaster WinSetup* program.

6.2.1 Viewing Input and Holding Registers

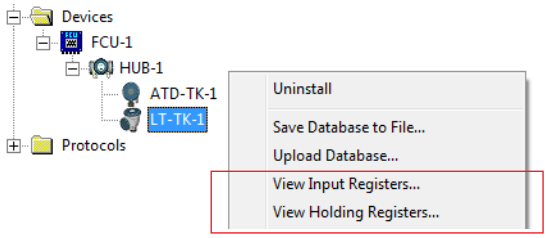
Measured data is continuously stored in **Input Registers** of the Rosemount 5900S Radar Level Gauge. By viewing the Input registers you can check that the device is working properly.

The **Holding Registers** store various parameters which are used to configure the Rosemount 5900S Radar Level Gauge for various applications.

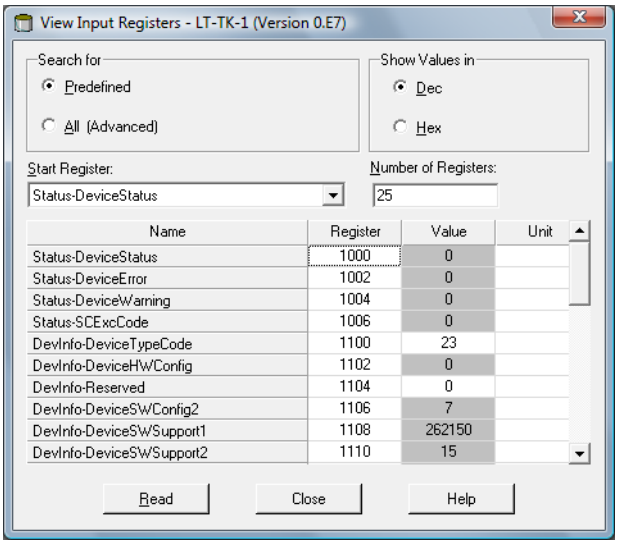
By using the Rosemount TankMaster *WinSetup* program, Holding Registers can be edited simply by typing a new value in the appropriate value input field. Some Holding Registers can be edited in a separate window. In this case individual data bits can be changed.

To view input or holding registers of a 5900S do the following:

1. Start the TankMaster **WinSetup** program.
2. In the TankMaster WinSetup workspace window select the Rosemount 5900S Radar Level Gauge:



3. Click the right mouse button and choose the **View Input/View Holding Registers** option, or from the **Service** menu choose **Devices>View Input/View Holding Registers**.



4. Choose **Predefined** to see a basic selection of registers. Choose the **All** option to view a range of registers by your own choice.
   For the **All** option, you have to specify a range of registers by setting a start value in the **Start Register** input field, and the total number of registers to be displayed in the **Number of Registers** field (1-500). Up to 50 registers is recommended for a quick update of the list.
5. Click the **Read** button. Now the Value column is updated with the current register values.

See the *Raptor System Configuration* manual *(Document No. 300510EN)* for information on how to edit holding registers.

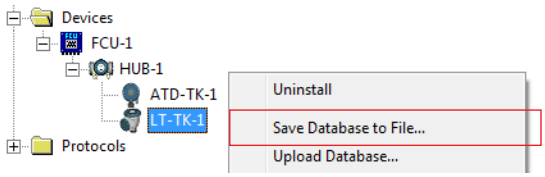
6.2.2 Backing Up the Gauge Configuration

Input and holding registers of the Rosemount 5900S Radar Level Gauge can be stored on disk. This can be useful for backup purposes and troubleshooting. You can save a predefined set of holding registers to make a backup copy of the current gauge configuration. The backup file can be used to restore configuration of the 5900S at a later stage.

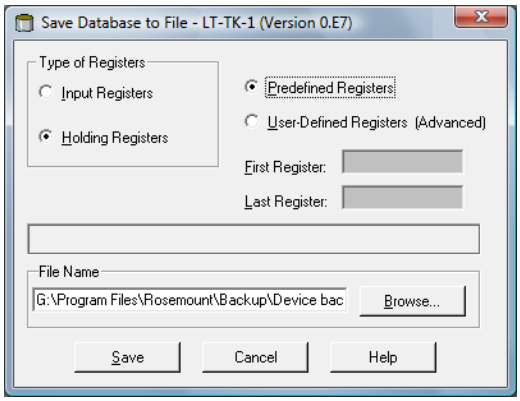
Single device

To save the current configuration to file for a single 5900S do the following:

1. Start the TankMaster **WinSetup** program.
2. In the WinSetup workspace window, click the right mouse button on the 5900S gauge icon.



3. Choose the **Devices/Save Database to File** option.
   This option is also available from the **Service/Devices** menu.

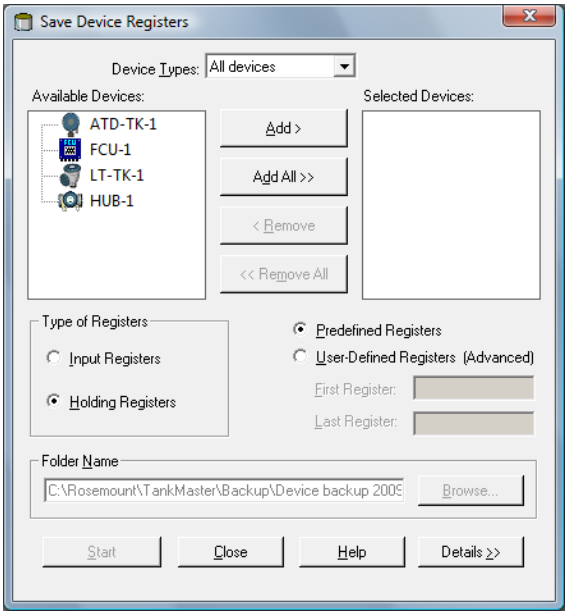


4. Choose the **Holding Registers** and **Predefined Registers** options (the User-Defined option should only be used for advanced service).
5. Click the **Browse** button, select a folder and type a name for the backup file.
6. Click the **Save** button to start saving the database registers.

Multiple devices

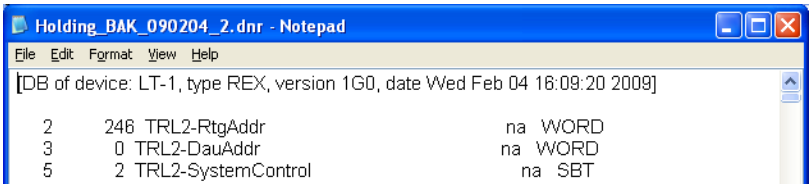
To save a backup copy of the current configuration for multiple devices, do the following:

1. Start the TankMaster **WinSetup** program.
2. In the TankMaster WinSetup workspace window select the **Devices** folder.
3. Click the right mouse button and choose the **Devices/Save Database of All to Files** option.
   This option is also available from the **Service/Devices** menu.



4. Select a device from the **Available Devices** pane and click the **Add** button in order to move it to the **Selected Devices** pane. Repeat for all devices you wish to include.
5. Choose the **Holding Registers** and **Predefined Registers** options (the User-Defined option should only be used for advanced service).
6. Click the **Browse** button, select a folder and type a name for the backup file.
7. Click the **Start** button to save the database backup.

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

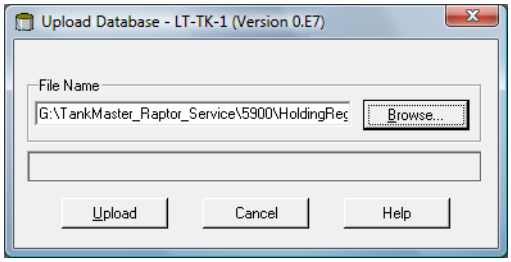


6.2.3 To Recover a Backup Configuration Database

TankMaster WinSetup lets you replace the current Holding Register database with a backup database stored on disk. This can be useful, for example, if you want to recover lost configuration data.

To load a Holding Register database do the following:

1. Select the device in the *Workspace* window for which you want to load a new database.
2. Click the right mouse button and choose the **Devices/Upload Database** option, or from the **Service** menu choose **Devices/Upload Database**.



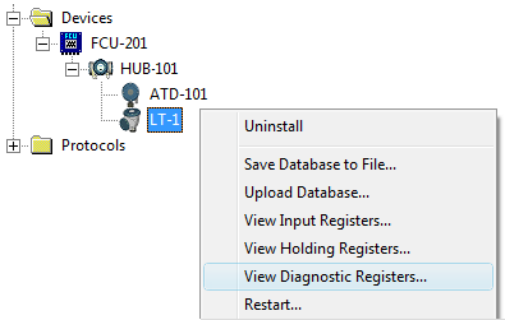
3. Click the **Browse** button and choose a database file to be uploaded, or type a path and file name.
4. Click the **Upload** button.

6.2.4 Diagnostics

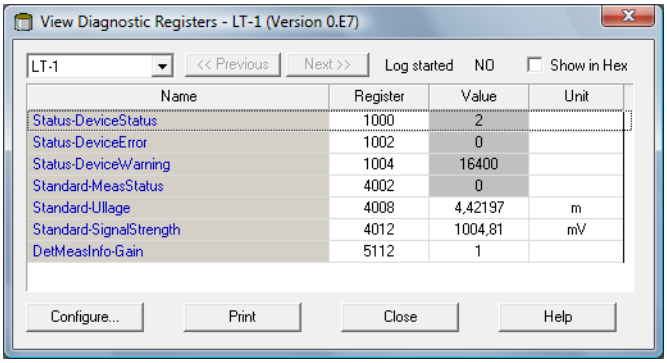
The *TankMaster WinSetup* program lets you view the current device status. The *View Diagnostic Register* window shows a selection of database registers that gives you an instant view of how the gauge operates. You may also configure the window by adding registers of special interest.

To view and configure the diagnostic registers:

1. Select the 5900S gauge icon in the *TankMaster WinSetup* workspace.



2. Click the right mouse button and choose **View Diagnostic Registers**.



The register values in the diagnostics window are of *read only* type. They are loaded from the device as the window is opened.

A grey background color of the table cell in the Value column means that the register is of either Bitfield or ENUM type. An expanded Bitfield/ENUM window can be opened for this type of register. Double-click the cell to open the Expanded Bitfield/ENUM window.

If needed, the values can be presented as hexadecimal numbers. This applies to registers of the Bitfield and ENUM types. Select the **Show in Hex** check box to present Bitfield and ENUM registers as hexadecimal numbers.

The **Configure** button lets you open the *Configure Diagnostic Registers* window where you can change the list of registers to be displayed in the *View Diagnostic Registers* window. See the *Raptor System Configuration Manual (Document No. 300510EN)* for more information.

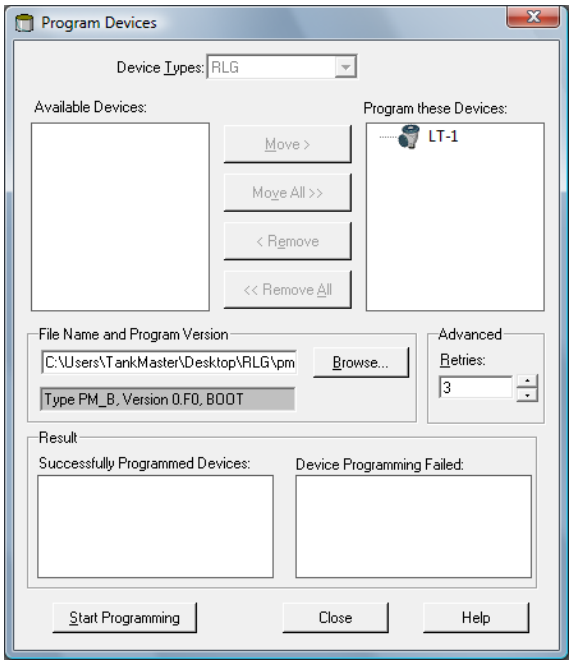
The *Configure Diagnostic Registers* window also has a **Log Setup** button for access to the *Register Log Scheduling* window which allows you to setup a log schedule for automatic start and stop of register logging. See “Logging Measurement Data” on page 6-13 for more information.

6.2.5 Upgrading the Gauge Software

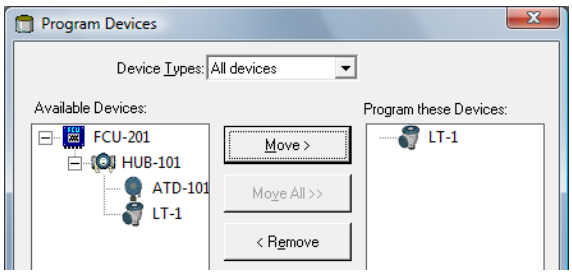
TankMaster WinSetup includes the option to upgrade 5900S Radar Level Gauges with new application software.

To upload a new program do the following:

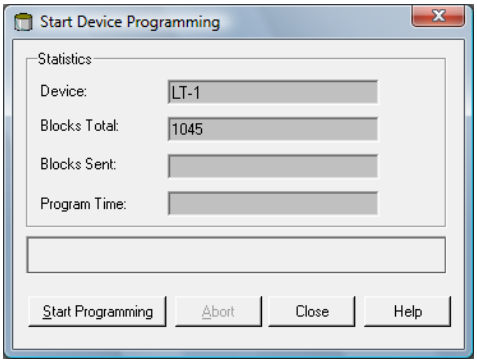
1. Ensure that the 5900S Radar Level Gauge has a stable communication with TankMaster.
2. In the *TankMaster WinSetup* workspace window (Logical View) open the **Devices** folder and select the 5900S gauge to be upgraded (or select the Devices folder to allow multiple devices programming).
3. Click the right mouse button and choose the **Program** option (**Program All** option for multiple devices programming).



4. The 5900S gauge will automatically appear in the *Program These Devices* pane
5. In case the **Devices** folder was selected for multiple programming, choose the 5900S gauge to be programmed from the **Available Devices** pane and click the **Move** button.



6. Repeat for each 5900S gauge to be programmed.
   Use the **Remove** button if you wish to change the list of devices to be programmed.
7. Click the **Browse** button to locate the flash program file. File extension *.cry are used for these files.
8. Click the **Start Programming** button. Now the *Start Device Programming* window appears.

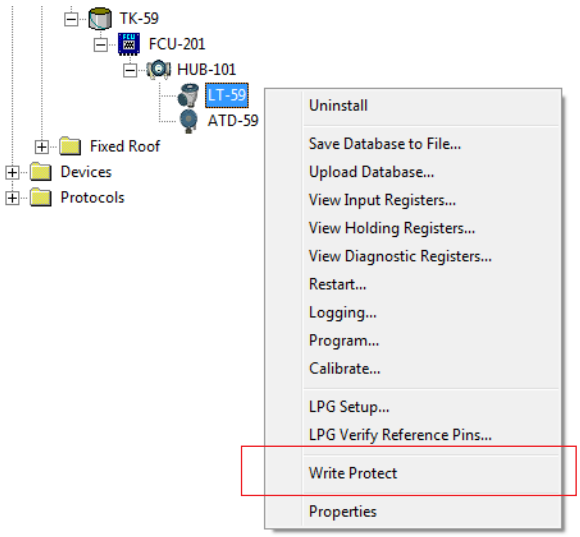


9. Click the **Start Programming** button to activate device programming.
   If a 2160 Field Communication Unit (FCU) is used, a maximum of 25 devices can be programmed. If there are more devices the programming must be divided in two steps.
10. Update the TankMaster installation by adding the new *.ini files for the 5900S gauge to the TankMaster installation folder.
    Two *.ini files are used for the 5900S, **RLG.ini** and **RLG0xx.ini**, where xx is the identification code of the 5900S gauge application software.
    The RLG.ini file is copied to the *C:\Program Files\Rosemount\Server folder*.
    The RLG0xx.ini file is copied to the *C:\Program Files\Rosemount\Shared* folder.

6.2.6 Write Protection

A Rosemount 5900S Radar Level Gauge can be software write protected by using a password to avoid unintentional configuration changes. Software write protection locks the holding register database.

1. Start the *TankMaster WinSetup* program.
2. In the *WinSetup* workspace select the *Logical View* tab.
3. Click the right mouse button on the 5900S gauge icon.



4. Choose the **Write Protect** option to open the *Write Protect* window.

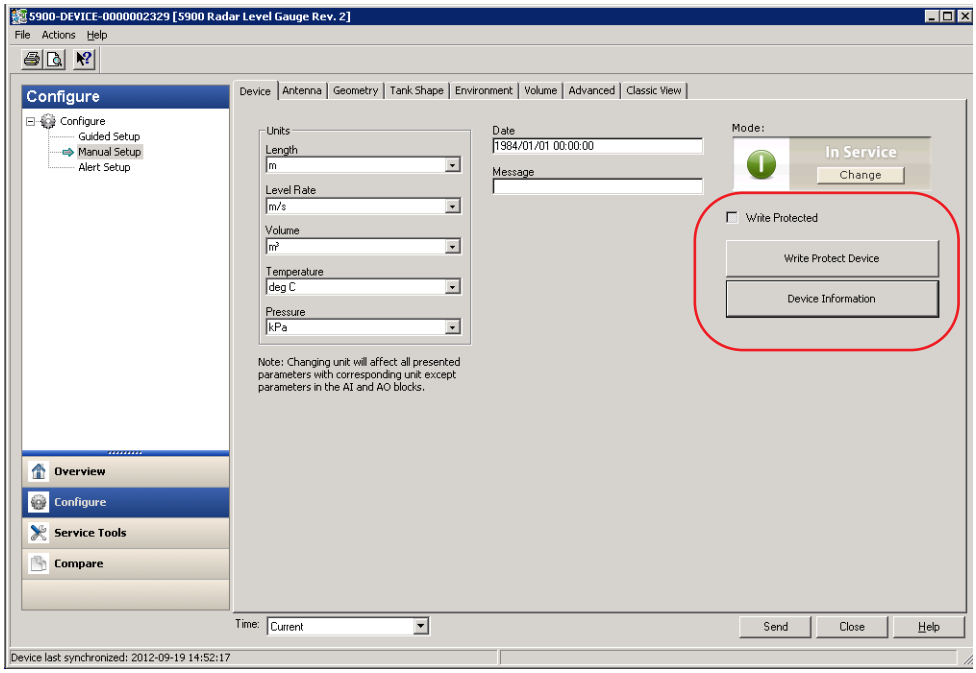
5. Ensure that **New State** is set to **Protected** and click the Apply button to save the new state
6. Click the OK button to close the *Write Protect* window. Now the holding register database is locked. As long as the gauge is write protected no configuration changes can be made.

To unlock the device:

1. Choose the **Write Protect** option to open the *Write Protect* window.
2. Set the **New State** to **Not Protected**.
3. Click the Apply button to save the new state
4. Click the OK button to close the window.

AMS

In AMS Device Manager the Write Protection function is available in the *Device* tab under Configure > Manual Setup.



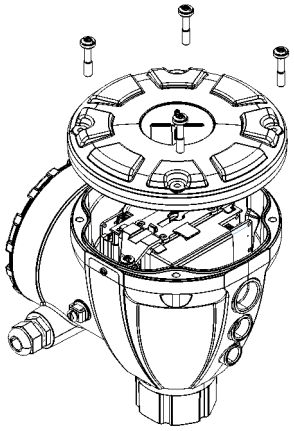
A check box indicates whether the device is write protected or not.

To lock the device:

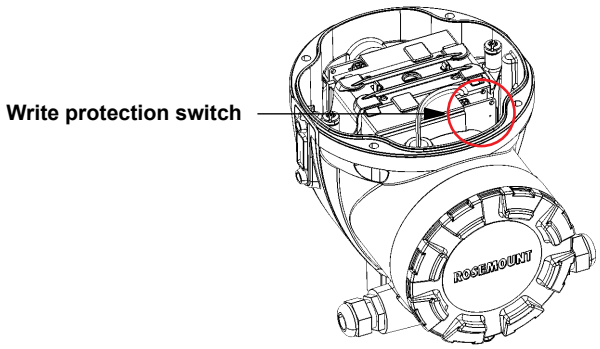
1. Click the **Write Protect Device** button.
2. Enter a password.

6.2.7 Write Protection Switch

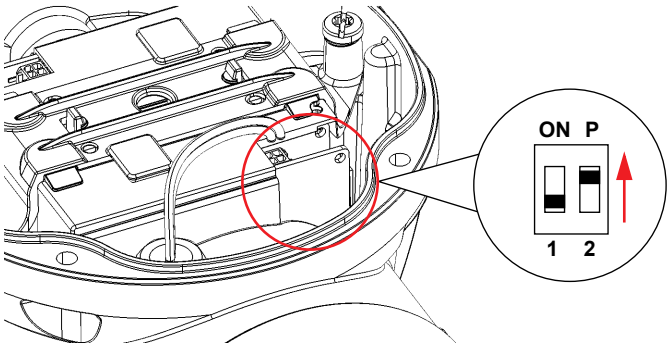
A switch can be used to prevent unauthorized changes in the Rosemount 5900S Radar Level Gauge database. The switch also prevents modification of FOUNDATION fieldbus parameters. To write protect the 5900S do the following:



1. Check if there is any screw that is sealed. Contact Emerson Process Management/Rosemount Tank Gauging before breaking the seal if warranty is still valid. Completely remove the seal so that it does not damage the threads.
2. Loosen the screws and remove the cover.



3. Locate the write protection switch. It is switch no. 2 marked **P**.



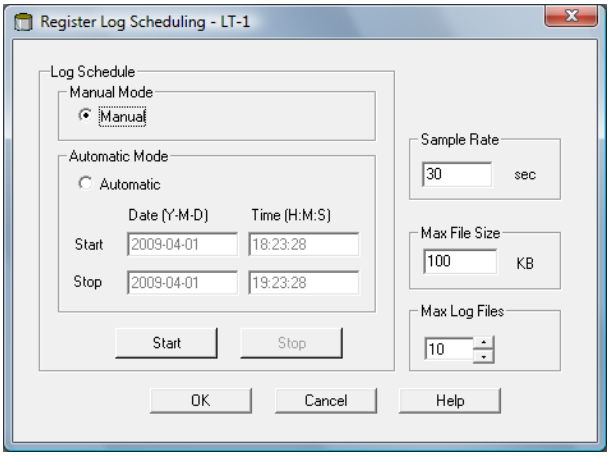
4. To write protect the 5900S move the right-hand switch **P** to the upper position.
5. Check that contact surfaces on the housing and cover are clean. Replace the cover and tighten the screws. Make sure that the cover is fully engaged to meet explosion-proof requirements and to prevent water from entering the terminal compartment.

NOTE!
Ensure that o-rings and seats are in good condition prior to mounting the cover in order to maintain the specified level of ingress protection.

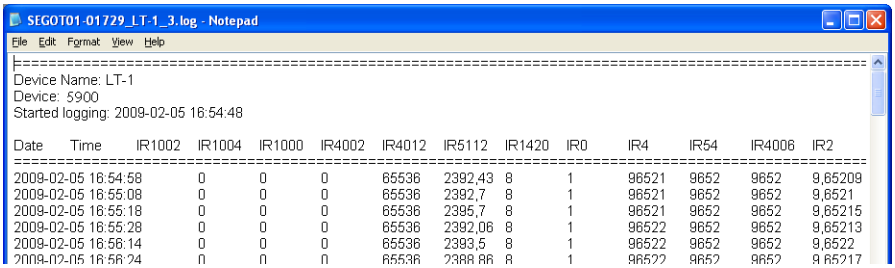
6.2.8 Logging Measurement Data

The Rosemount 5900S Radar Level Gauge supports logging of diagnostic registers. This function is useful for verifying that the gauge works properly. The logging function can be accessed by using the *TankMaster WinSetup* program. To start logging do the following:

1. Start the *TankMaster WinSetup* program.
2. Select the 5900S gauge icon in the *WinSetup* workspace.
3. Click the right mouse button and choose **Logging**.



4. The Manual mode lets you start logging at any time. In Automatic mode you have to specify a Start and Stop time.
5. The resulting log file will not exceed the size specified by the Max File Size parameter.
   In automatic mode, logging will proceed until the stop date and time is reached.
   In manual mode logging will proceed until it is stopped by clicking the Stop button.
   When the number of log files has reached the Max Log Files value, TankMaster starts replacing the contents of existing log files.
6. Log files are stored in plain text file format and can be viewed in any word processing program. They are stored in the following folder: **C:\Rosemount\TankMaster\Setup\Log**, where C is the disk drive where the TankMaster software is installed.
   The log file contains the same input registers as the *View Diagnostic Registers* window, see “Diagnostics” on page 6-7.
   You can change which input registers to be included in the log file by configuring the *View Diagnostic Registers* window, see the *Raptor System Configuration Manual (Document No. 300510EN)* for more information.



6.2.9 Loading the Default Database

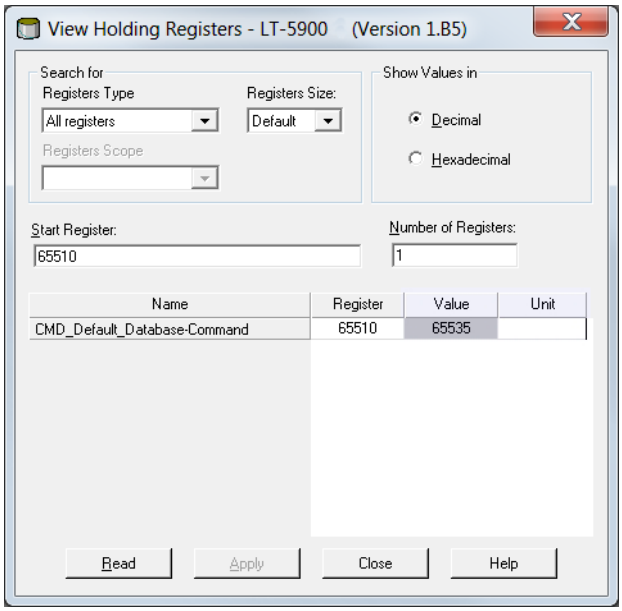
The **Default Database** is the original factory settings of the holding register database.

TankMaster WinSetup offers the option to load the **Default Database**. This can be useful if, for example, you want to try new database settings and then want to reload the original factory settings, or when tank conditions have been altered. If error messages appear or other problems occur concerning the Database a troubleshooting is recommended before loading the **Default Database**.

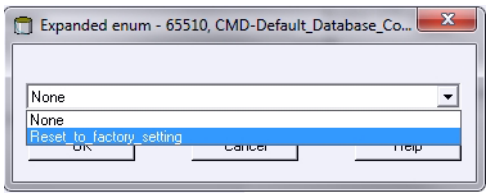
NOTE!
The device address remains unaltered when the default database is loaded.

To load the default database

1. Select the desired device icon in the *TankMaster WinSetup* workspace window.
2. Click the right mouse button and choose the **View Holding Register** option.
3. Choose the **All** option and type **65510** in the **Start Register** input field. Type the desired number of registers to be displayed in the **Number of Registers** field and click the **Read** button.



4. Double-click in the **Value (65535)** field.



5. From the drop-down list, select the **Reset_to _factory_setting** option.
6. Click the **OK** button.

6.3 TROUBLESHOOTING

This section describes various problems that may occur due to malfunctioning devices or incorrect installations. Note that symptoms and actions related to the 2410 Tank Hub and 2160 Field Communication unit (FCU) are not applicable for FOUNDATION fieldbus systems.

Table 6-1. Troubleshooting chart for the Rosemount 5900S

Symptom	Possible cause	Action
No communication with the 5900S Radar Level Gauge	Wiring	• Check that the device appears in the *Device Live List*, see the Rosemount 2410 Reference Manual (Document No. 300530EN) for more information • Check that wires are properly connected to the terminals • Check for dirty or defective terminals • Check wire insulation for possible short circuits to ground • Check that there are no multiple shield grounding points • Check that the cable shield is grounded at the power supply end (2410 Tank Hub) only • Check that the cable shield is continuous throughout the Tankbus network • Check that the shield inside the instrument housing does not come into contact with the housing • Check that there is no water in conduits • Use shielded twisted pair wiring • Connect wiring with drip loops • Check the 2410 Tank Hub wiring
	Incorrect Tankbus termination	• Check that there are two terminators on the Tankbus. Normally the built-in termination in the 2410 Tank Hub is enabled. • Check that terminations are placed at both ends of the Tankbus
	Too many devices on the Tankbus	• Check that the total current consumption of the devices on the Tankbus is less than 250 mA. See the Rosemount 2410 Reference Manual (Document no. 305030en) for more information. • Remove one or more devices from the Tankbus. The 2410 Tank Hub supports a single tank. The multiple tank version of the 2410 supports up to 10 tanks.
	Cables are too long	• Check that the input voltage on the device terminals is 9 V or more
	Hardware failure	• Check the 5900S Radar Level Gauge • Check the Field Communication unit (FCU) • Check the Field Bus Modem • Check the communication port on the control room PC • Contact Emerson Process Management/Rosemount TankGauging service department
	Software failure	• Restart the 5900S gauge. Use for example the Restart command in TankMaster WinSetup. • Restart all devices by disconnecting and connecting the power supply to the 2410 Tank Hub • Contact Emerson Process Management/Rosemount TankGauging service department

Symptom	Possible cause	Action
	Field Bus Modem (FBM)	• Check that the FBM is connected to the right port on the control room PC • Check that the FBM is connected to the right port on the 2160 Field Communication Unit (FCU)
	Connection to 2160 FCU	• Check that the right field bus port on the 2160 FCU is connected to the Primary bus on the 2410 Tank Hub • Check communication port LED:s inside the Field Communication Unit 2160 (FCU)
	Incorrect configuration of 2160 FCU	• Check the Modbus communication addresses of the 5900S Radar Level Gauge and the 2410 Tank Hub in the FCU slave database • Check configuration of communication parameters for the FCU Fieldbus ports • Check that the correct communication channel is selected See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on how to configure the 2160 FCU
	Incorrect configuration of 2410 tank database	• Check the 2410 tank database; ensure that the device is available and mapped to the right tank • 2410 tank database; in TankMaster WinSetup open the *2410 Tank Hub /Tank Database* window and check that the *Level Modbus* address is equal to the *2410 Level* Modbus address in the FCU slave database • See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on how to configure the 2410 tank database.
	Connection to 2410 Tank Hub	• Check wiring to the 2410 Tank Hub • Check the 2410 Tank Hub; check the Error LED or the integral display for information
	Configuration of communication protocol	In TankMaster WinSetup/Protocol Channel Properties: • check that the protocol channel is enabled • check the protocol channel configuration (port, parameters, modem)

Symptom	Possible cause	Action
No level measurement	Communication failure	• Check wiring • Check the Modbus communication address for the 5900S Radar Level Gauge. See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on how to setup the Modbus address of a 5900S Radar Level Gauge. • Check configuration of the tank database in the 2410 Tank Hub • Check configuration of the 2160 FCU slave database
	Configuration	• Check that the 5900S is configured (see the *Raptor System Configuration Manual* (Document no. 300510EN) for more information)
	Incorrect configuration of the FCU slave database	• Check the Modbus communication address in the FCU slave database. In TankMaster WinSetup open the *FCU Properties/Slave Database* window and check that the *2410 Level* Modbus address in the FCU Slave Database is equal to the *Level Modbus* address in the 2410 tank database. • See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on how to configure the 2160 FCU slave database.
	Incorrect configuration of the 2410 tank database	• Check the 2410 Tank Database; ensure that the device is available and mapped to the right tank • 2410 Tank Database; in TankMaster WinSetup open the *2410 Tank Hub /Tank Database* window and check that the *Level Modbus* address is equal to the *2410 Level* Modbus address in the FCU Slave Database • See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on how to configure the 2410 tank database.
	Software or hardware failure	• Check diagnostics information, see “Diagnostics” on page 6-7 • Check Device Status input register, see “Device Status” on page 6-19 • Contact Emerson Process Management/Rosemount Tank Gauging service department

Symptom	Possible cause	Action
Incorrect level measurement	Incorrect configuration	• Check configuration of tank geometry and antenna parameters: - Tank Reference Height (R) - Gauge Reference Distance (G) - Calibration Distance - Antenna Type - Antenna size (Still pipe Array) See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on how to use TankMaster WinSetup for configuration of tank geometry and antenna parameters. • Verify that the mechanical installation of the 5900S gauge fulfills installation requirements. Check for example: - nozzle height and diameter - obstacles in the vicinity of the nozzle - distance to tank wall - inclination - total slot/hole are in still pipe See chapter 3.2 “Installation Considerations”. • Check configuration of Environment parameters such as *Foam*, *Turbulent Surface* etc. and other advanced configuration options. WinSetup: 5900S Properties/Environment, 5900S Properties/Advanced Configuration. • Check status and diagnostics information, see “Diagnostics” on page 6-7.
	Disturbing objects in the tank	• Check that the 5900S has not locked on an interfering object in the tank • Use the Tank Scan function in TankMaster WinSetup to analyze the measurement signal: - Check if there are any disturbing echoes from obstacles in the tank - Check if there is a strong echo at the bottom of the tank; use deflection plate at the end of still pipe. See the *Raptor System Configuration Manual* for more information on how to use the Tank Scan function
The level gauge configuration can not be saved	The gauge is write protected	• Check position of the write protection switch and make sure that it is in the OFF position, see “Write Protection Switch” on page 6-12. • Check write protection setting in TankMaster WinSetup, see “Write Protection” on page 6-10.

6.3.1 Device Status

Device Status messages that may appear on the display of the Rosemount 2410 Tank Hub, or in the Rosemount TankMaster program, are shown in Table 6-2. Device Status can be found in Input register 4000. See “Viewing Input and Holding Registers” on page 6-2 for more information on how to view Input registers.

Table 6-2. Device status messages

Message	Description	Action
Running Boot Software	• The application software could not be started. • The application SW is not loaded in the flash memory • The previous upload of the flash SW failed	Reprogram the gauge with new software. Contact Emerson Process Management/Rosemount TankGauging service department.
Device Warning	A device warning is active.	See “Warning Messages” on page 6-20 for details.
Device Error	A device error is active.	See “Error Messages” on page 6-21 for details.
BOOT Beta Version	Beta version of boot program used	Ensure that approved software is used
APPL Beta Version	Beta version of application program used	Ensure that approved software is used
Level correction error	The LPG module is enabled but the module is either incorrectly configured, or there is no sensor input data for pressure or temperature.	See Input register 4702 *LPGIregArea-LPG_Corr_Error* for more information.
Invalid Measurement	The level gauge indicates that measurement is invalid. This may be caused by an actual measurement problem or some other error indication.	Check Error Messages, Warning Messages and Measurement Status for details.
Write Protected	The configuration registers are write protected.	Do one of the following: 1. Use the Lock/Unlock function to turn off the software write protection. 2. Change position of the Write Protection switch to OFF.
Default Database	All configuration registers are set to default values.	Ensure that device calibration is valid.
Simulation Active	The 5900S is in simulation mode	Reset 5900S simulation mode.
RM Reprogramming In Progress	New software is downloaded to the 5900S Radar Level Gauge	Verify 5900S operation when reprogramming is finished

6.3.2 Warning Messages

Table 6-3 shows a list of Warning messages that may appear on the integral display of the Rosemount 2410 Tank Hub and in the Rosemount TankMaster program. You also have the option to view **Input Register 1004** for an overview of active device warnings. Warnings are less serious than errors.

For each warning message that may appear, detailed information can be found in Input registers 6100 to 6130 as shown in Table 6-3.

Table 6-3. Warning messages

Message	Description	Action
RAM warning	Input register no. 6100. Bit 0: DSP Stack Bit 1: DSP RAM low	Contact Emerson Process Management/Rosemount TankGauging service department.
FPROM warning	Input register no. 6102.	
HREG warning	Input register no. 6104. Bit 0: DSP Factory holding registers	Load default database and restart the 5900S. Contact Emerson Process Management/Rosemount TankGauging service department if the problem persists.
Other memory warning	Input register no. 6106.	Contact Emerson Process Management/Rosemount TankGauging service department
MWM warning	Input register no. 6108. Bit 1: Version mismatch between PM and RM	
RM warning	Input register no. 6110 Bit 1: SW config Bit 5: FPROM Checksum Bit 6: FPROM Version Bit 9: HREG Checksum Bit 10: HREG Limit Bit 11: HREG Write Bit 12: HREG Read Bit 13: HREG Version Bit 14: MWM Invalid Id Bit 30: SW Serious Warning	
Other hardware warning	Input register no. 6122.	
Configuration warning	Input register no. 6128. Bit 0: Super Test Active Bit 1: ATP Table Invalid Bit 2: Special Correction Table Invalid Bit 3: Near Zone Correction Table Invalid Bit 4: Config Model Code invalid Bit 5: Config LPG Pins Visible Bit 6: Config LPG Error Bit 7: Simulation Mode Used Bit 8: Default Sweep Mode Used Bit 9: Test Sweep used Bit 10: ACT Table Invalid Bit 11: UCT Table Invalid Bit 12: Simple Simulation Mode Warning Bit 13: Ramp Simulation Mode Warning Bit 14: TSM Filter Too Narrow Bit 15: MMS Offset Update disabled	• Load the default database and restart the level gauge, see “Loading the Default Database” on page 6-14. • Configure the level gauge or load a backup configuration file (see “To Recover a Backup Configuration Database” on page 6-6). • Contact Rosemount TankGauging service department if the problem persists.
SW warning	Input register no. 6130. Bit 8: DSP Undefined software warning	Contact Emerson Process Management/Rosemount TankGauging service department

6.3.3 Error Messages

Table 6-4 shows a list of error messages that may appear on the integral display of the Rosemount 2410 Tank Hub and in the Rosemount TankMaster program. You also have the option to view **Input Register 1002** for an overview of active device errors.

For each error message that may appear, detailed information can be found in Input registers 6000 to 6030 as shown in Table 6-4.

Table 6-4. Error messages for the Rosemount 5900S

Message	Description	Action
RAM error	Input register no. 6000. A gauge data memory (RAM) error has been detected during the startup tests. Note: this automatically resets the gauge. Serious RAM problem: Bit 0: DSP RAM Bit 1: DSP stack Bit 2: DSP RAM checksum Bit 3: DSP RAM low	Contact Emerson Process Management/Rosemount TankGauging service department
FPROM error	Input register no. 6002. An error in the gauge program memory (FPROM) has been detected during the startup tests. Note: this automatically resets the gauge. Serious FPROM problem: Bit 0: DSP Boot checksum Bit 1: DSP Boot version Bit 2: DSP Application checksum Bit 3: DSP Application version Bit 4: FPROM device Bit 5: FPROM erase Bit 6: FPROM write Bit 7: FPROM active block not used	
Database (Hreg) error	Input register no. 6004. An error in the transmitter configuration memory (EEPROM) has been detected. The error is either a checksum error that can be solved by loading the default database or a hardware error. NOTE: the default values are used until the problem is solved. The following bits indicate a serious Holding register problem: Bit 0: DSP checksum Bit 1: DSP limit Bit 2: DSP version Bit 3: Write error	Load default database and restart the Rosemount 5900S Radar Level Gauge. Contact Emerson Process Management/Rosemount TankGauging service department if the problem persists.

Message	Description	Action
Other Memory error	Input register no. 6006.	Contact Emerson Process Management/Rosemount TankGauging service department.
Microwave Module error	Input register no. 6008. Bit 0: Not connected	
RM error	Input register no. 6010 Bit 1: SW configuration Bit 5: FPROM Checksum Bit 6: FPROM Version Bit 9: HREG Checksum Bit 10: HREG Limit Bit 11: HREG Write Bit 12: HREG Read Bit 13: HREG Version Bit 14: MWM Invalid Id Bit 30: SW Serious Error	
Other hardware error	Input register no. 6022. An unspecified hardware error has been detected. Bit 0: Internal Temp Out of Range	
Configuration error	Input register no. 6028. At least one configuration parameter is outside allowed range. NOTE: the default values are used until the problem is solved. Bit 0: Start Code Bit 1: FF Unit Conversion	• Load the default database and restart the level gauge, see “Loading the Default Database” on page 6-14. • Configure the level gauge or load a backup configuration file (see “To Recover a Backup Configuration Database” on page 6-6). • Contact Rosemount TankGauging service department if the problem persists.
Software error	Input register no. 6030. An error has been detected in the 5900S gauge software. Bit 0: DSP Undefined SW Error Bit 1: DSP Task Not Running Bit 3: Simulated error	Contact Emerson Process Management/Rosemount TankGauging service department

6.3.4 Measurement Status

Measurement Status information can be found by viewing Input register 4002. Table 6-5 presents the various status bits that may appear:

Table 6-5. Measurement status for the Rosemount 5900S

Message	Description	Action
Full tank	The level measurement is in Full Tank state. The transmitter waits for the surface echo to be detected at the top of the tank.	The transmitter leaves the Full Tank state when the product surface gets below the Full Tank Detection Area.
Empty tank	The level measurement is in Empty Tank state. The transmitter waits for the surface echo to be detected at the bottom of the tank.	The transmitter leaves the Empty Tank state when the product surface gets above the Empty Tank Detection Area. See “Empty Tank Handling” on page 4-11.
Dirty antenna	The antenna is so contaminated that the level measurement might be affected.	Clean the antenna.
Sweep linearization warning	The sweep is not correctly linearized.	Check Warning messages. If MWM Warning is active this might indicate a transmitter error. Contact Emerson Process Management/Rosemount TankGauging service department.
Tank signal clip warning	The last Tank Signal was clipped.	Check Warning Messages. If MWM Warning is active this might indicate a transmitter error. Contact Emerson Process Management/Rosemount TankGauging service department.
No surface echo	The Surface Echo Pulse can not be detected.	Check if the configuration can be changed so that the surface echo can be tracked in this current region.
Predicted level	The presented level is predicted. The surface echo could not be detected.	See *No surface echo* above.
Sampling failed	The sampling of the last tank signal failed.	Check Warning Messages.
Invalid volume value	The given volume value is invalid.	Check Volume Status for details.
Simulation Mode	The simulation mode is active. The presented measurement values are simulated.	No action needed.
Advanced Simulation Mode	The advanced simulation mode is active. The given measurements are simulated.	To turn off the Advanced Simulation mode set Holding Register 3600=0 (see “Viewing Input and Holding Registers” on page 6-2).
Tracking Extra Echo	The transmitter is in the empty tank state tracking an extra echo.	Verify that the level gauge tracks the product surface when the tank is filled.
Bottom Projection Active	The bottom projection function is active.	Verify that the level gauge properly tracks the product surface.
Pipe Measurement Enabled	Pipe Measurement is active.	No action needed.
Surface close to registered false echo.	Close to a registered false echo measurement accuracy may be slightly reduced.	By using the Register False Echo function the transmitter can track the product surface in the vicinity of disturbing objects.
Sudden level jump detected.	This may result from various measurement problems.	Check interior of the tank to find out what causes the problem tracking the surface.

6.4 RESOURCE BLOCK

Error conditions found in the Resource block.

Table 6-6. Resource Block BLOCK_ERR messages

Condition Name	Description
Block configuration error	Configuration Error is used to indicate that you have selected an item in FEATURES_SEL or CYCLE_SEL that was not set in FEATURES or CYCLE_TYPE, respectively
Simulate active	This indicates that the simulation switch is in place. This is not an indication that the I/O blocks are using simulated data
Power up	
Out of Service	The actual mode is out of service

Table 6-7. Resource Block DETAILED_STATUS messages

Condition Name	Recommended action
Sensor Transducer block error	1. Restart processor 2. Call service center
Manufacturing block error	1. Restart processor 2. Call service center
Non-volatile memory error	1. Restart processor 2. Call service center
ROM integrity error	1. Restart processor 2. Call service center

6.5 TRANSDUCER BLOCK

Error conditions found in the Transducer block.

Table 6-8. Transducer Block BLOCK_ERR messages

Condition Name	Description
Other error	Set whenever XD_ERROR is non-zero. See also “Viewing Device Status in AMS” on page 6-30.
Out of Service	The actual mode is out of service.

6.6 ANALOG INPUT (AI) FUNCTION BLOCK

Table 6-9 lists conditions reported in the BLOCK_ERR parameter. Conditions in bold type are available for the Analog Input block. Conditions in *italics* are inactive for the AI block and are given here only for your reference.

A block alarm will be generated whenever the BLOCK_ERR has an error bit set. The types of block error for the AI block are defined below in bold type.

Table 6-9. BLOCK_ERR Conditions

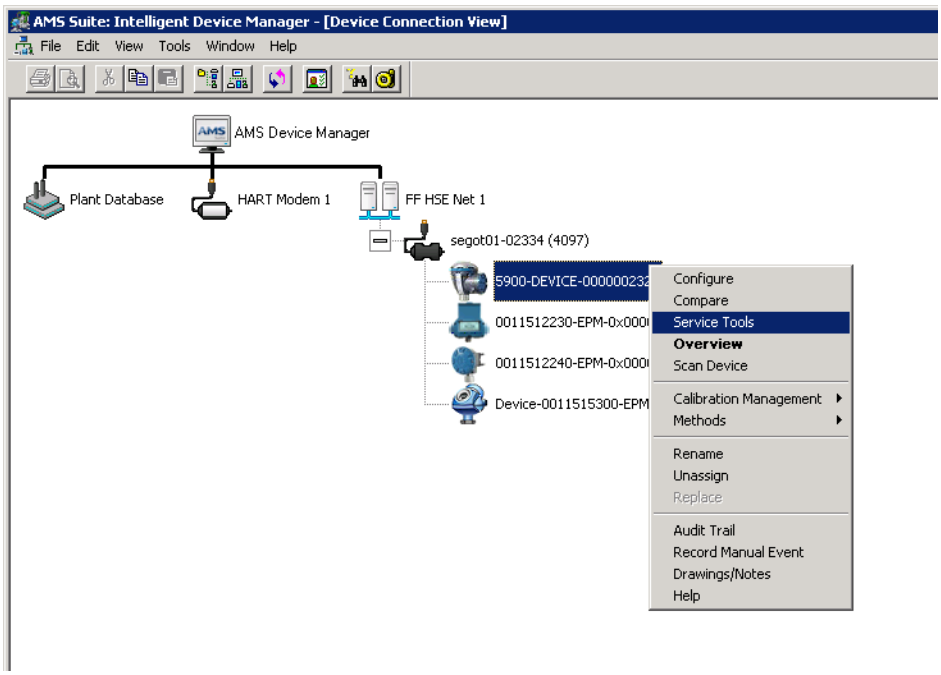
Condition Number	Condition Name and Description
0	*Other*
1	**Block Configuration Error:** the selected channel carries a measurement that is incompatible with the engineering units selected in XD_SCALE, the L_TYPE parameter is not configured, or CHANNEL = zero.
2	*Link Configuration Error*
3	**Simulate Active:** Simulation is enabled and the block is using a simulated value in its execution.
4	*Local Override*
5	*Device Fault State Set*
6	*Device Needs Maintenance Soon*
7	**Input Failure/Process Variable has Bad Status:** The hardware is bad, or a bad status is being simulated.
8	**Output Failure:** The output is bad based primarily upon a bad input.
9	*Memory Failure*
10	*Lost Static Data*
11	*Lost NV Data*
12	*Readback Check Failed*
13	*Device Needs Maintenance Now*
14	*Power Up*
15	**Out of Service:** The actual mode is out of service.

6.7 PLANTWEB ALERTS

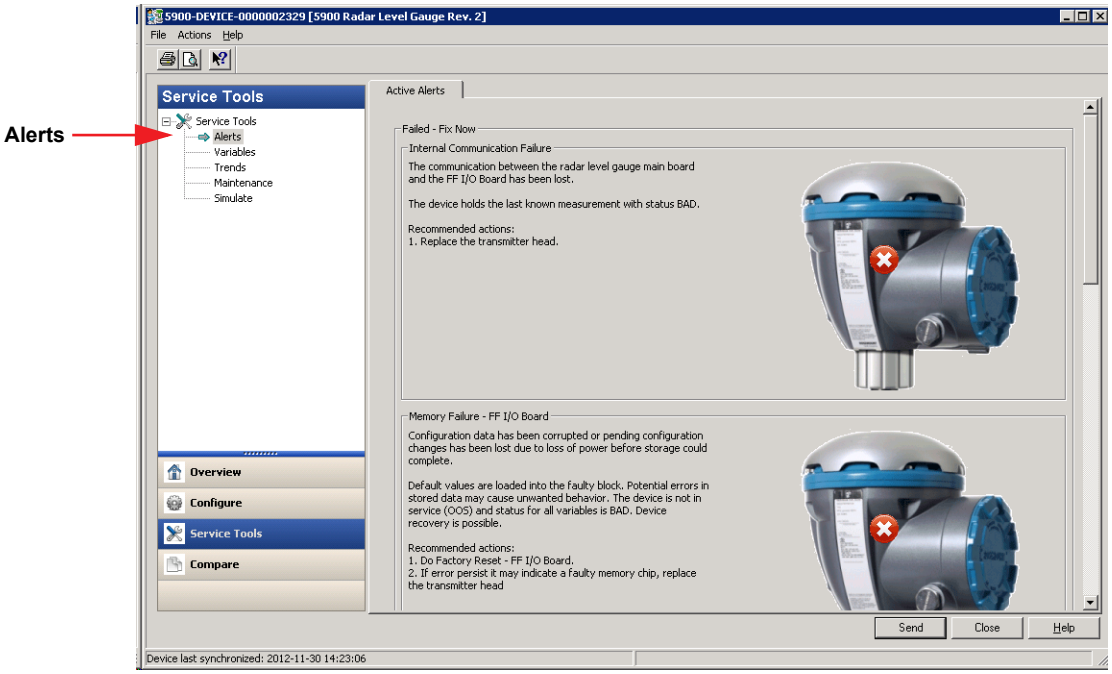
The AMS Device Manager lets you view active PlantWeb alerts. The three alarm parameters (FAILED_ALARM, MAINT_ALARM, and ADVISE_ALARM) contain information regarding some of the device errors. They can easily be listed by using the Service Tools option in AMS. See “PlantWeb™ Alerts” on page 4-52 for more information on the different PlantWeb alert types.

6.7.1 Viewing Active Alerts in AMS

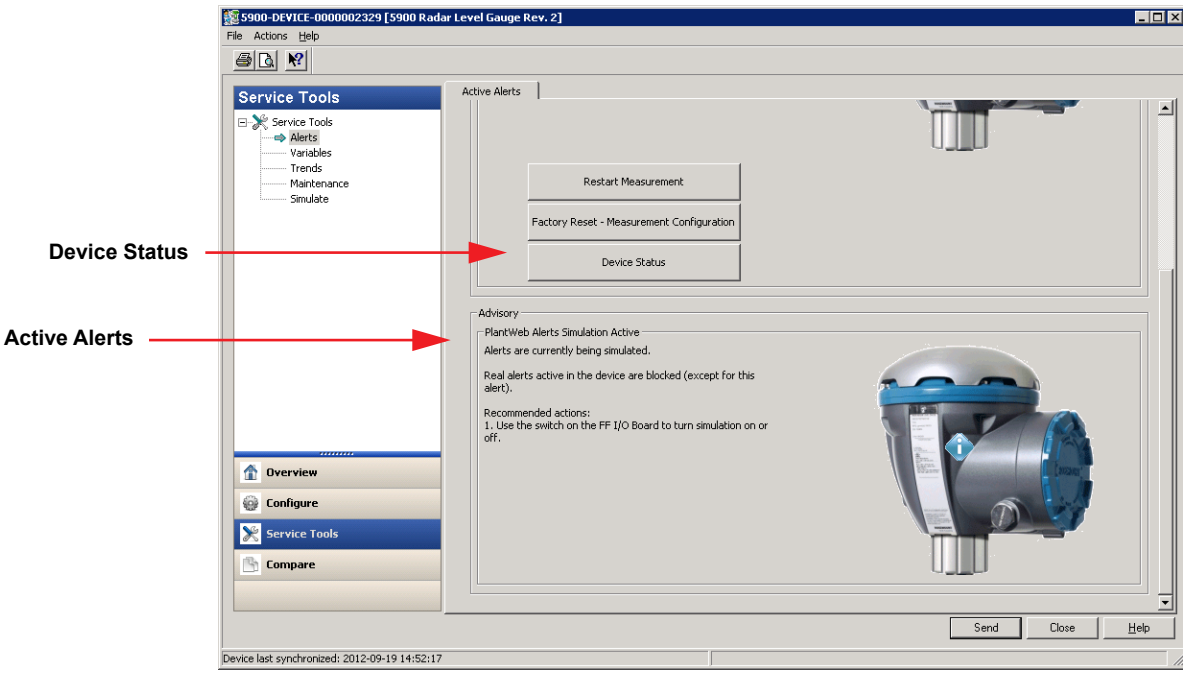
1. From the Start menu; open the AMS Device Manager application.
2. Open the *View>Device Connection View*.
3. Double-click the FF network icon and expand the network node to view the devices.
4. Right-click or double-click the desired gauge icon to open the list of menu options:



5. Choose the **Service Tools** option:

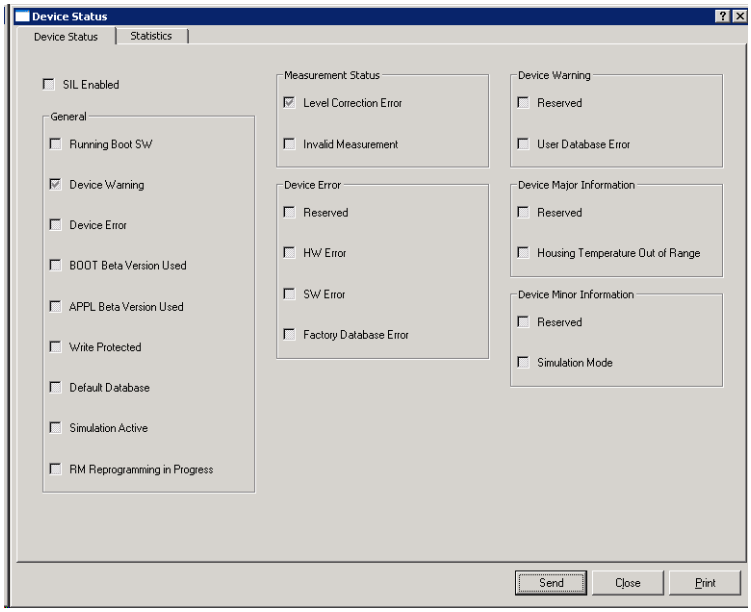


6. In the Navigation Pane select the **Alerts** option. The Active Alerts tab shows the PlantWeb Alerts that are currently active. All types of alerts can be shown; Failed, Maintenance, and Advisory. A brief description of the error is presented as well as the recommended action.
7. Alerts are listed in order of priority beginning with Failed. By scrolling down you will see Maintenance and Advisory alerts as well.



See “Plantweb Alert Setup” on page 4-72 for details on how to setup PlantWeb alerts for the 5900S Radar Level Gauge.

8. Click the **Device Status** button (if available) to view a summary of active device information such as errors and warnings. This is an example of what it may look like:



The *Device Status* window shows Errors, Warnings, and Status information related to the 5900S gauge. Note that this window does not show active PlantWeb Alerts.

6.7.2 Recommended Actions

The RECOMMENDED_ACTION parameter displays a text string that will give a recommended course of action to take based on which type and which specific event of the PlantWeb alerts are active, see Table 6-10.

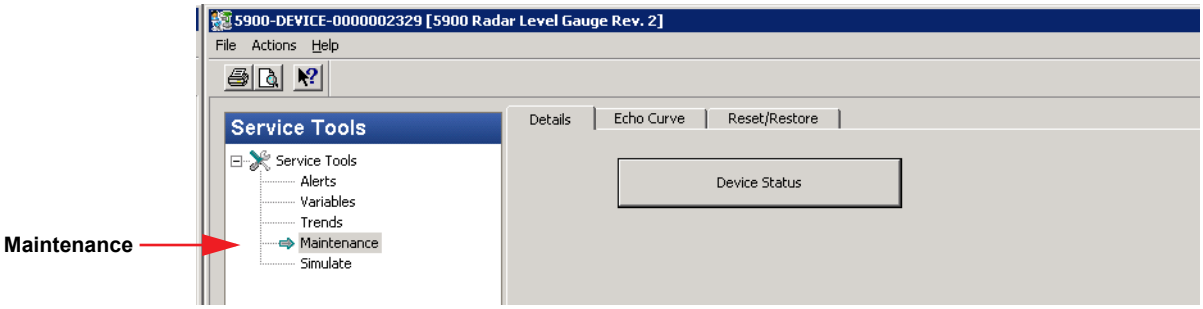
Table 6-10. RECOMMENDED_ACTION

	Alarm Type	Failed/Maint/Advise Active Event	Recommended Action
PlantWeb Alerts	None	None	No action required
	Advisory	Device Minor Information	Check configuration of the device. See Device Status for more information on the error source (see “Viewing Device Status in AMS” on page 6-30).
		PWA Simulation Active	Use the switch on the Fieldbus electronics board to turn simulation on or off.
	Maintenance	Device Major Information	Check the mechanical installation and environment. See Device Status for more information on the error source (see “Viewing Device Status in AMS” on page 6-30).
		Device Warning	Load default database to the device and reconfigure it.
	Failed	Software Incompatibility Error	Upgrade firmware or replace the device.
		Non-Volatile Memory Failure - FF I/O Board	Configuration data has been corrupted or pending configuration changes has been lost due to power loss before data storage was completed. Default values are loaded into the faulty block. Potential errors in stored data may cause unwanted behavior. The device is not in service (OOS) and status for all variables is BAD. Device recovery is possible. Recommended actions: 1. Do Factory Reset - FF I/O Board. 2. If error persists, it may indicate a faulty memory chip. Replace the device.
		Device Error	Replace the device.
		Internal Communication Failure	Replace device (FF to gauge communication fault).
		Electronics Failure	Replace the device.

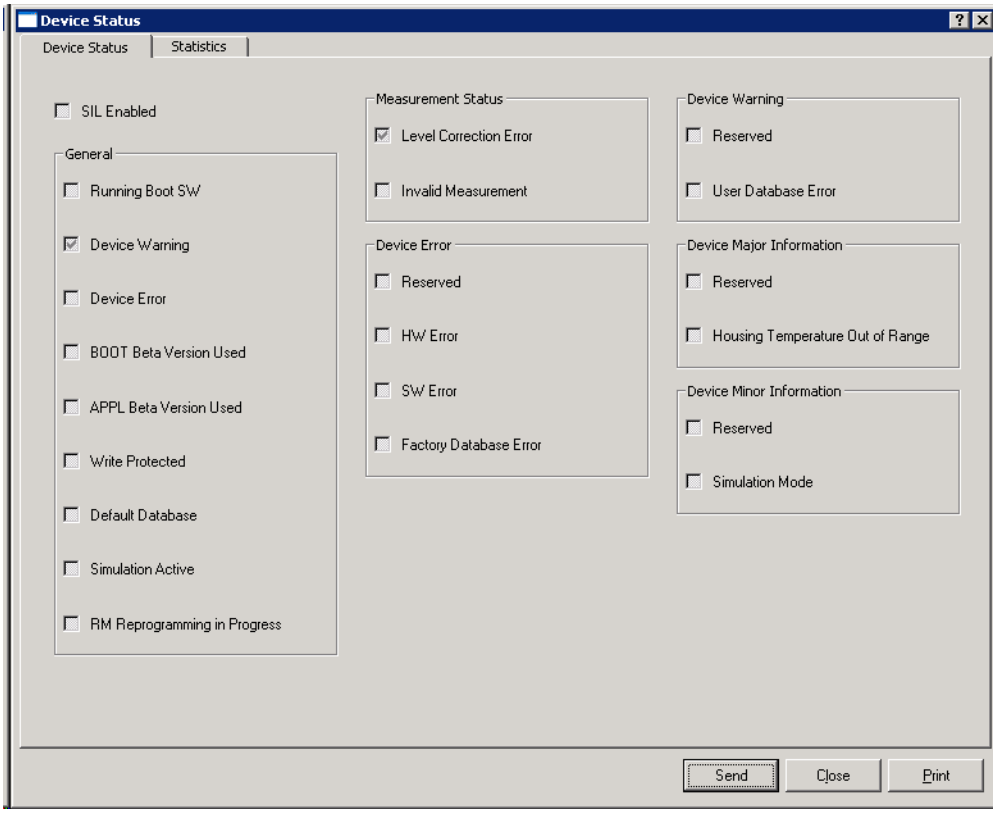
6.8 VIEWING DEVICE STATUS IN AMS

To view the current device status:

1. Start AMS Device Manager and open the *View>Device Connection View*.
2. Double-click the FF network icon and expand the network node to view the devices.
3. Right-click or double-click the desired gauge icon to open the list of menu options.
4. Choose **Service Tools**.



5. In the Navigation Pane select the **Maintenance** option
6. Select the **Details** tab and click the **Device Status** button.



In the *Device Status* tab, check boxes indicate the current status of the device grouped in separate categories. See also “Device Status” on page 6-19.

Appendix A Reference Data

A.1 SPECIFICATIONS

General	
Product	Rosemount 5900S Radar Level Gauge
Measurement principle	FMCW (Frequency Modulated Continuous Wave)
Antennas	Horn antenna, parabolic antenna, still-pipe array antenna, LPG/LNG antenna
Instrument accuracy(1)	± 0.5 mm (0.020 in.)
Temperature stability	Typically < ± 0.5 mm (0.020 in.) in -40 to +70 °C (-40 to +158 °F)
Fieldbus (standard)	FOUNDATION™ fieldbus FISCO (Tankbus)
Update time	New measurement every 0.3 s
Repeatability	0.2 mm (0.008 in.)
Maximum level rate	Up to 200 mm/s
Metrology sealing possibility	Yes
Legal custody transfer type approval	OIML R85:2008, and national certifications such as PTB, NMi etc
Hazardous location certifications	ATEX, FM-C, FM-US, IECEx, and national certifications. For details see Appendix B: Product Certifications.
Safety/overfill	SIL 2 and SIL 3 certified. TÜV tested and WHG approved for overfill prevention. For national approvals, consult your local Rosemount Tank Gauging representative
CE-mark	93/68/EEC: complies with applicable EU directives (EMC, ATEX, LVD, and R&TTE). Based on the low emitted effects from the gauges (below 0.1 mW) compared to limits given by the Rec. 1999/519/EC, no additional measures are needed
Ordinary location certification	Complies with FM 3810:2005 and CSA: C22.2 No. 1010.1
SIL Certification	The SIL safety certificate, issued by exida, includes the SIL alarm channel within the 5900S Radar Level Gauge and the 2410 Tank Hub. Both units are SIL 2 and SIL 3 capable according to IEC 61508, parts 1-7. Certificate number is Rosemount 091243 P0017 C001.
OIML R85:2008 accuracy certification	The OIML metrology certificate, issued by the SP Technical Research Institute of Sweden, covers the Rosemount Tank Gauging system, including the level gauges equipped with different antennas. Certificate number is R85/2008-SE-11.01.
National metrological approvals	Other national legal custody transfer certifications like PTB, MNi etc are available (see “Ordering Information” on page A-9)
German WHG certification	The certificate for the 5900S radar level gauge and the 2410 Tank Hub is issued by DIBt (Deutsches Institut für Bautechnik) according to the German WHG regulations for overfill prevention. It is based on technical evaluation and testing conducted by TÜV NORD CERT GmbH. Certificate number is Z-65.16-500.
Communication / Display / Configuration	
Output variables and units	Level, and ullage: meter, centimeter, millimeter, feet, or inch Level rate: meter/second, meter/hour, feet/second, feet/hour, inch/minute Signal strength: mV
Configuration tools	Rosemount TankMaster WinSetup, Field Communicator

FOUNDATION™ fieldbus characteristics	
Polarity sensitive	No
Quiescent current draw	51 mA
Lift-off minimum voltage	9.0 VDC
Device capacitance / inductance	See Appendix B: Product Certifications
Class (Basic or Link Master)	Link Master (LAS)
Number of available VCRs	Maximum 20, including one fixed
Links	Maximum 40
Minimum slot time / maximum response delay / minimum intermessage delay	8 /5 /8
Blocks and Execution time	1 **Resource** block 5 **Transducer** blocks (Level, Register, Adv_Config, Volume, and LPG) 6 **Analog Input** (AI) blocks: 10 ms , 2 **Analog Output** (AO) blocks: 10 ms 1 **Proportional/Integral/Derivate** (PID) block: 15 ms 1 **Signal Characterizer** (SGCR) block: 10 ms, 1 **Integrator** (INT) block: 10 ms, 1 **Arithmetic** (ARTH) block: 10 ms, 1 **Input Selector** (ISEL) block: 10 ms 1 **Control Selector** (CS) block: 10 ms, 1 **Output Splitter** (OS) block: 10 ms For more information, see the FOUNDATION™ fieldbus Blocks manual (document number 00809-0100-4783)
Instantiation	Yes
Conforming FOUNDATION™ fieldbus	ITK 5.2
PlantWeb alert support	Yes
Action support wizards	Restart measurement, write protect device, factory reset - measurement configuration, start/stop device simulation, set as surface, reset statistics, change all modes, register/remove false echo, refresh echo peaks, pin verification, change vapor pressure, change vapor temperature
Advanced diagnostics	Software, memory/database, electronics, internal communication, simulation, level correction, level measurement, ambient temperature, vapor pressure/temperature correction, LPG verification pin, and manual measurement values
Electric	
Tankbus cabling	0.5-1.5 mm^2 (AWG 22-16), twisted shielded pairs
Power supply	Input voltage U_i for FOUNDATION™ fieldbus: • 9.0 to 32 VDC • 9.0 to 17.5 VDC in FISCO applications • 9.0 to 30 VDC in I.S. applications See Appendix B: Product Certifications for information on FISCO and Entity parameters. See also “Typical installation” on page 3-44.
Bus current draw	50 mA (100 mA for the 2-in-1 version)
Microwave output power	< 1 mW (see also Raptor Technical Description)
Mechanical	
Housing material & surface treatment	Polyurethane-coated die-cast aluminum
Cable entry (connection/glands)	Two ½ - 14 NPT entries for cable glands or conduits. One metal plug to seal any unused port is enclosed in the transmitter delivery. Optional: • M20 x 1.5 conduit / cable adapter • Cable glands in metal (½ - 14 NPT) • 4-pin male Eurofast connector or A size Mini 4-pin male Minifast connector
Dimensions	See “Dimensional Drawings” on page A-5
Total weight	**5900S transmitter head:** 5.1 kg (11.2 lbs) for the single version and 5.4 kg (11.9 lbs) for the 2-in-1 version **5900S with horn antenna:** Appr. 12 kg (26 lbs) **5900S with parabolic antenna:** Appr. 17 kg (37 lbs) **5900S with still-pipe array antenna:** Appr. 13.5-24 kg (30-53 lbs) **5900S with LPG/LNG antenna:** Appr. 30 kg (66 lbs) for 6-in. 150 psi, and 40 kg (88 lbs) for 6-in. 300 psi

Environment	
Ambient operating temperature	-40 to +70 °C (-40 to +158 °F). Minimum start-up temperature is -50 °C (-58 °F)
Storage temperature	-50 to +85 °C (-58 to +185 °F)
Humidity	0-100% relative humidity
Ingress protection	IP 66/67 and Nema 4X
Vibration resistance	IEC 60770-1 level 1 and IACS UR E10 test 7
Telecommunication	Compliance with: • FCC 15B Class A, and 15C • R&TTE (EU directive 99/5/EC) ETSI EN 302372; EN 50371 • IC (RSS210-5)
Electromagnetic compatibility	• EMC (EU directive 2004/108/EC) EN 61326-1; EN 61326-3-1 • OIML R85:2008
Transient / built-in lightning protection	According to IEC 61000-4-5, level 2 kV line to ground. Complies with IEEE 587 Category B transient protection and IEEE 472 surge protection
Pressure Equipment Directive (PED)	97/23/EC
Low Voltage Directive (LVD)	LVD (EU directive 2006/95/EC) EN/IEC 61010-1
5900S standard version	
Built-in Tankbus terminator	Yes (to be connected if required)
Daisy chain possibility	Yes
5900S 2-in-1 version	
Instrument accuracy(1)	± 0.5 mm (0.020 in.)(2)
Separation	Galvanically separated gauge electronics, and shared antenna for the two units
Wiring	Separated or common
Tank hub connection	• Connection of both units to one hub, or • Separate connection of units to two different hubs
Built-in Tankbus terminator	Single Tankbus connection: Yes (to be connected if required) Dual Tankbus connection: Possible to terminate the primary Tankbus
Daisy chain possibility	No
5900S SIL version	
Separation	Galvanically separated gauge electronics, and shared antenna for the SIL 3 version
Built-in Tankbus terminator	No
Daisy chain possibility	No
Electric properties for intrinsically safe alarm signal	12.5 VDC, 1-2 mA for normal condition (no alarm)
Wiring	• Additional separate 2-wire cable for alarm or • A single cable incorporating two 2-wire cables (alarm and level) For cable specification, see page A-2
5900S with parabolic antenna	
Operating temperature in tank	Max. +230 °C (+445 °F)
Measuring range	0.8 to 30 m (2.6 to 100 ft) below flange Possibility to measure 0.5 to 50 m (1.6 to 164 ft). Accuracy may be reduced For longer measuring range, please consult your Rosemount Tank Gauging representative
Pressure range	Clamped/threaded: -0.2 to 0.2 bar (-2.9 to 2.9 psig) Welded: -0.2 to 10 bar (-2.9 to 145 psig)
Material exposed to tank atmosphere	Antenna: material corresponds to AISI 316/316L and EN 1.4401 /1.4404 Sealing: PTFE O-ring: FEP fluoropolymer
Antenna dimension	440 mm (17 in.)
Manway size	500 mm (20-in.) opening
Tank connection	The gauge is clamped in a 96 mm (3.78 in.) diameter hole, or welded in a 117 mm (4.61 in.) diameter hole

5900S with horn antenna	
Operating temperature in tank	Max. +230 °C (+445 °F)
Measuring range	0.8 to 20 m (2.6 to 65 ft) below flange Possibility to measure 0.5 to 30 m (1.6 to 100 ft). Accuracy may be reduced
Pressure range	-0.2 to 2 bar (-2.9 to 29 psig)
Material exposed to tank atmosphere	Antenna and flange: material corresponds to AISI 316/316L and EN 1.4401 /1.4404 Sealing: PTFE O-ring: Viton fluoroelastomer
Antenna dimension	175 mm (7 in.)
Nozzle diameter	Minimum 200 mm (8 in.)
Tank connection	8 in. hole pattern according to ANSI 8 in. Class 150 / DN 200 PN 10. The flange can be horizontal or 4° inclined for installation close to the tank wall. Other flanges are available on request
5900S with still-pipe array antenna	
Operating temperature in tank	-40 to 120 °C (-40 to 248 °F)
Measuring range	0.8 to 30 m (2.6 to 100 ft) below flange Possibility to measure 0.5 to 40 m (1.6 to130 ft). Accuracy may be reduced For longer measuring range, please consult your Rosemount Tank Gauging representative
Pressure range	Fixed version: -0.2 to 2 bar (-2.9 to 29 psig) at 20 °C Hinged hatch version: -0.2 to 0.5 bar (-2.9 to 7.2 psig) for 5 to 8-in. pipes -0.2 to 0.25 bar (-2.9 to 3.6 psig) for 10 and 12-in. pipes
Material exposed to tank atmosphere	Antenna: Polyphenylenesulphide (PPS) Sealing: PTFE O-ring: Fluorosilicone Flange: material corresponds to AISI 316/316L and EN 1.4401 /1.4404
Still-pipe dimensions	5-, 6-, 8-, 10- or 12 in.
Tank connection	8 in. hole pattern according to ANSI 8 in. Class 150 / DN 200 PN 10
5900S with LPG/LNG antenna	
Operating temperature at ball valve	-55 to 90 °C (-67 to 194 °F)
Operating temperature in tank	-170 to 90 °C (-274 to 194 °F)
Measuring range	1.2 m to 30 m (3.9 to 100 ft) below flange Possibility to measure 0.8 to 60 m (2.6 to 200 ft). Accuracy may be reduced For longer measuring range, please consult your Rosemount Tank Gauging representative
Pressure range	-1 to 25 bar (-14.5 to 365 psig). Note! Flanges may have higher pressure rating than 25 bar, but maximum tank pressure is still 25 bar
Pressure sensor (option)	Rosemount 2051. It is available with different hazardous location certifications. For more information see the 2051 Product Data Sheet (document number 00813-0100-4101)
Material exposed to tank atmosphere	Antenna and flange: material corresponds to AISI 316/316L and EN 1.4401 /1.4404 Sealing: Quartz and PTFE
Still-pipe dimension compatibility	Antenna choices for 4-in. sch. 10, 4-in. sch 40, or 100 mm (99 mm inner diameter) still-pipe dimensions
Flange size & rating	4 in. class 150/300 6 in. class 150/300 8 in. class 150/300

(1) Instrument accuracy is under reference conditions. Reference conditions are: Measurement in test bench at Rosemount Tank Radar AB in Göteborg Sweden. Test bench is calibrated minimum yearly by an accredited laboratory (SP Technical Research Institute of Sweden. Measuring range is up to 30 m (98 ft). Ambient temperature and humidity is close to constant during tests. Total uncertainty in test bench is below 0.15 mm (0.006 in.).

(2) Some degradation of accuracy may be expected on the secondary unit.

A.2 DIMENSIONAL DRAWINGS

Figure A-1. Dimensions of Rosemount 5900S with Horn antenna

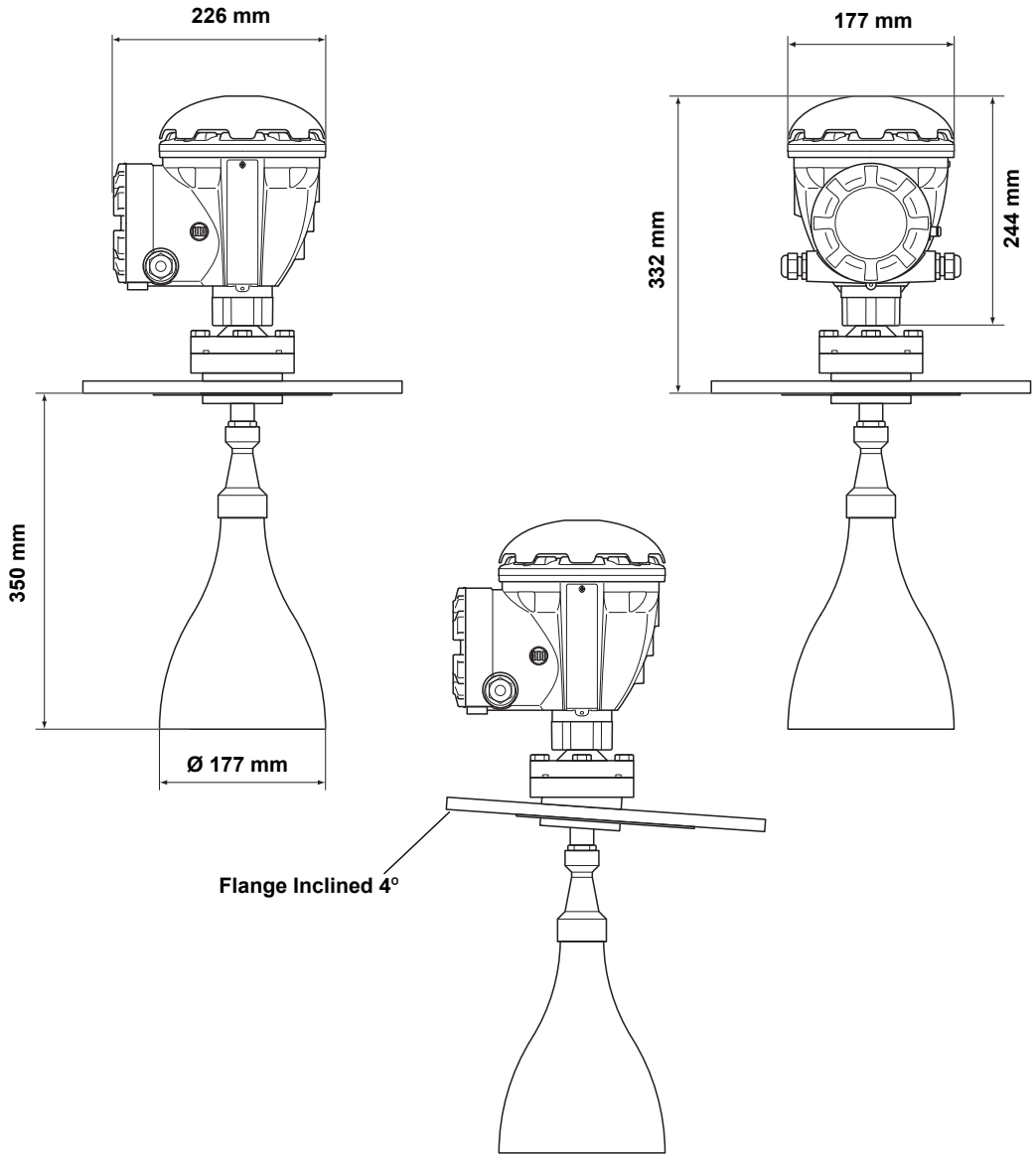


Figure A-2. Dimensions of Rosemount 5900S with Parabolic antenna

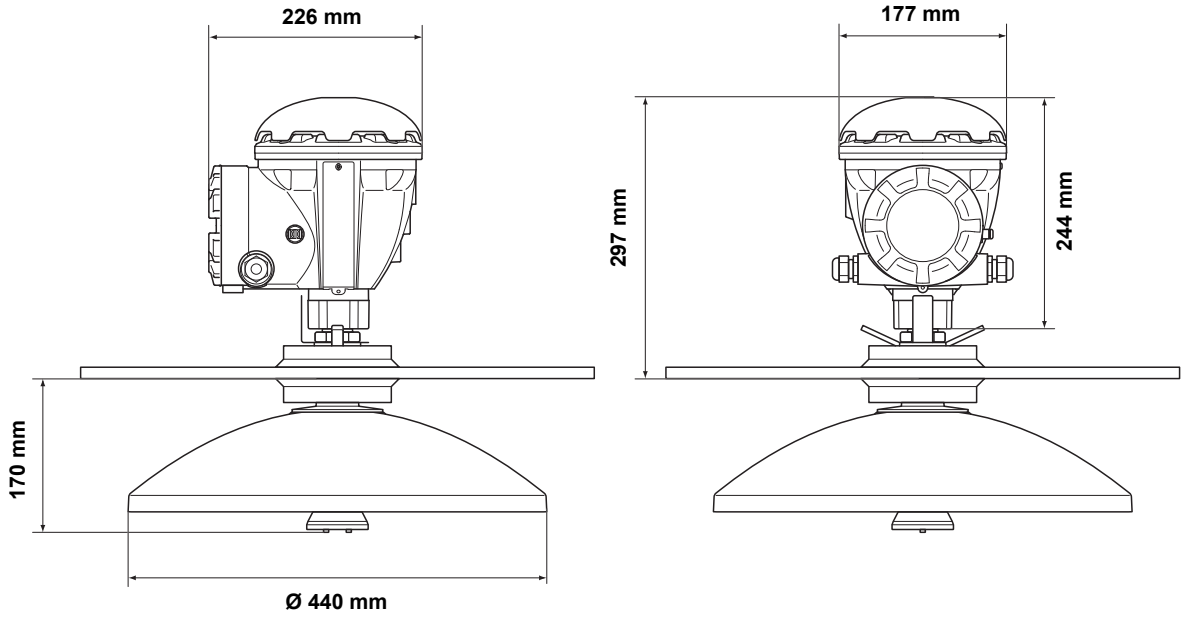


Figure A-3. Dimensions of Rosemount 5900S with Still-Pipe Array antenna

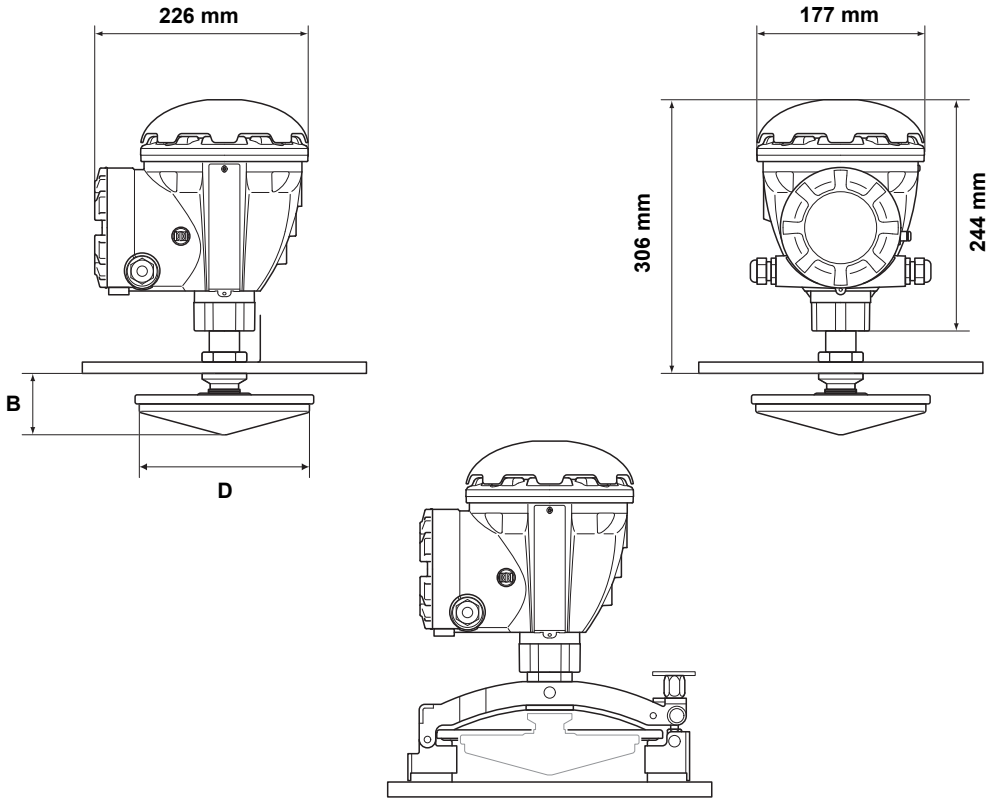
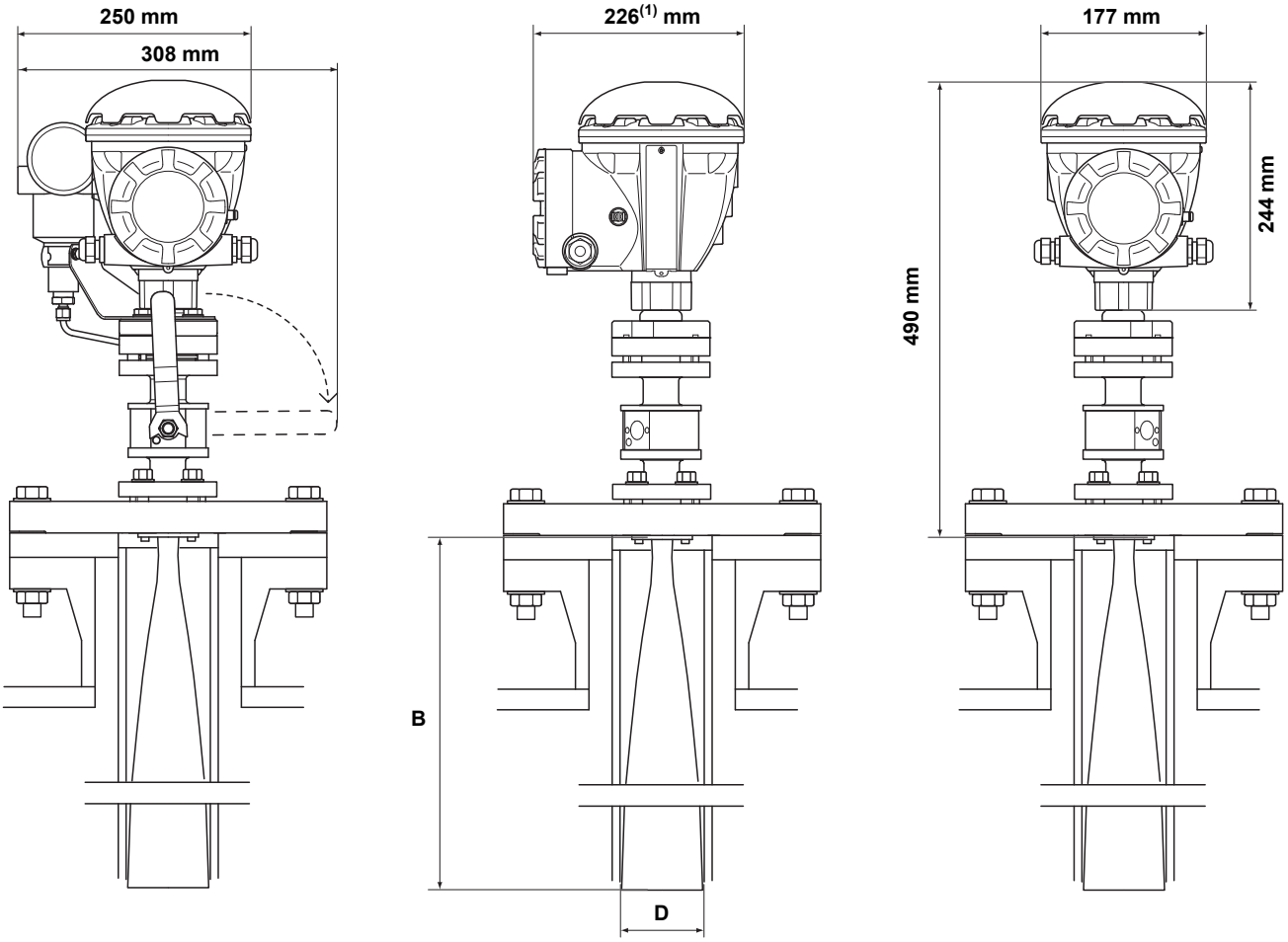


Table A-1. Available sizes for Still-Pipe Array Antenna

Antenna diameter (D)	B (mm)
5 in. / DN125 (Ø 120 mm)	56
6 in. / DN150 (Ø 145 mm)	59
8 in. / DN200 (Ø 189 mm)	65
10 in. / DN250 (Ø 243 mm)	73
12 in. / DN300 (Ø 293 mm)	79

Figure A-4. Dimensions of Rosemount 5900S with LPG/LNG Still-Pipe antenna



(1) 302 mm with pressure transmitter

Table A-2. Available sizes for LPG/LNG Still-Pipe antenna

Antenna diameter (D)	B (mm)
4 in. Sch10 (Ø 107 mm)	752
4 in. Sch40 (Ø 101 mm)	534
DN100 (Ø 99 mm)	502

A.3 ORDERING INFORMATION

A.3.1 Transmitter Head (TH)

Model (Pos 1)	Product Description	Note
5900S	Radar Level Gauge	
Code (Pos 2)	**Performance Class**	**Note**
P	Premium: ±0.5 mm (0.020 in.) instrument accuracy	
Code (Pos 3)	**Safety Certification (SIS)**	**Note**
3	SIL 3-certification as per IEC 61508[(1)]	Requires Rosemount 2410 with Relay Output (SIS/SIL), code 3. 1oo2 configuration: alarm if one of the two gauges is in alarm mode
2	SIL 2-certification as per IEC 61508	Requires Rosemount 2410 with Relay Output (SIS/SIL), code 2
F	None. Ready for upgrade of safety certification (SIS)	
0	None	
Code (Pos 4)	**Redundancy**	**Note**
2	2-in-1; Independent radar level gauge electronics	See “5900S 2-in-1 version” on page A-3
F	None. Ready for upgrade to 2-in-1	
1	None. Single radar level gauge electronics	
Code (Pos 5)	**Tankbus: Power and Communication**	**Note**
F	Bus powered 2-wire FOUNDATION™ fieldbus (IEC 61158)	
Code (Pos 6)	**Hazardous Location Certification**	**Note**
I1	ATEX Intrinsic Safety	
I2	Brazil Inmetro Intrinsic Safety	
I5	FM-US Intrinsic Safety	
I6	FM-Canada Intrinsic Safety	
I7	IECEx Intrinsic Safety	
KA	ATEX Intrinsic Safety+FM-US Intrinsic Safety[(2)]	
KC	ATEX Intrinsic Safety+IECEx Intrinsic Safety[(2)]	
KD	FM-US Intrinsic Safety+FM-Canada Intrinsic Safety[(2)]	
NA	None	
Code (Pos 7)	**Custody Transfer Type Approval**	**Note**
R[(3)(4)]	OIML R85 E 2008 performance certification	
C[(3)(4)]	PTB Eich (approval plate and sealing kit included)	
N[(4)(5)]	NMi (the Netherlands W&M)	
A[(3)(4)]	CMI (Czech Republic W&M approval)	
E[(3)(4)]	TJA (Estonia W&M approval)	
Y[(3)(4)]	Justervesenet (Norway W&M approval)	
M[(4)(5)]	BMS (Belgium W&M approval)	
W[(3)(4)]	METAS (Switzerland W&M approval)	
0	None	
Code (Pos 8)	**Radar Measurement Method**	**Note**
1	10 GHz FMCW radar technology	
2	10 GHz FMCW radar technology for the US market	
Code (Pos 9)	**Housing**	**Note**
A	Standard enclosure	Polyurethane-covered aluminium. IP 66/67

Code (Pos 10)	Cable / Conduit Connections	Note
1	½ - 14 NPT	Female thread. 1 plug included
2	M20 x 1.5 adapters	Female thread. 2 adapters and 1 plug included
G	Metal cable glands (½ - 14 NPT)	Min. temperature -20 ˚C (-4 ˚F). ATEX / IECEx Exe approved. 2 glands and 1 plug included
E	Eurofast male connector	1 plug included
M	Minifast male connector	1 plug included

(1) Requires Pos 4 “Redundancy” code 2 (2-in-1).
(2) Not available with LPG/LNG antenna.
(3) Requires Rosemount 2410 Tank Hub with the corresponding custody transfer type approval. Integral 2410 display or Rosemount 2230 display or TankMaster required.
(4) Requires calibration certificate (Q4 on page A-13)
(5) Requires options code S4

A.3.2 Antenna Selection

Choose one of the following antennas.

Parabolic Antenna

Code (Pos 11)	Antenna	Note
1P	Parabolic antenna	
Code (Pos 12)	**Antenna Size**	**Note**
F	20 in. / DN 500, Ø=440 mm (17.3 in.)	
Code (Pos 13)	**Antenna Material**	**Note**
S	Stainless steel (material type corresponding to AISI 316/316L and EN 1.4401 /1.4404)	
Code (Pos 14)	**Tank Seal**	**Note**
PF	PTFE with FEP fluoropolymer o-ring	
Code (Pos 15)	**Tank Connection**	**Note**
WE	Welded installation	Flange not included
CL	Clamped/threaded installation	Flange not included
Code (Pos 16)	**Special**	**Note**
0	None	

Horn Antenna

Code (Pos 11)	Antenna	Note
1H	Horn antenna	
Code (Pos 12)	**Antenna Size**	**Note**
8	8 in. / DN 200, Ø=175 mm (6.9 in.)	
Code (Pos 13)	**Antenna Material**	**Note**
S	Stainless steel (material type corresponding to AISI 316/316L and EN 1.4401 /1.4404)	
Code (Pos 14)	**Tank Seal**	**Note**
PV	PTFE with Viton fluoroelastomer o-ring	
Code (Pos 15)	**Tank Connection**	**Note**
ANSI Flanges (SST AISI 316 / 316 L)		
8A	8 in. Class 150	
8Z	8 in. Class 150, 4° inclined	
EN Flanges (SST EN 1.4401 / 1.4404)		
LA	DN 200 / PN 10	
LZ	DN 200 / PN 10, 4° inclined	
Code (Pos 16)	**Special**	**Note**
0	None	

Still-pipe Array Antenna

Code (Pos 11)	Antenna	Note
1A	Still-pipe array antenna	
Code (Pos 12)	**Antenna Size**	**Note**
5	5 in. / DN 125, Ø=120 mm (4.7 in.)	
6	6 in. / DN 150, Ø=145 mm (5.7 in.)	
8	8 in. / DN 200, Ø=189 mm (7.4 in.)	
A	10 in. / DN 250, Ø=243 mm (9.8 in.)	
B	12 in. / DN 300, Ø=293 mm (11.8 in.)	
Code (Pos 13)	**Antenna Material**	**Note**
S	Stainless steel (AISI 316L / EN 1.4404) and PPS (Polyphenylenesulphide)	
Code (Pos 14)	**Tank Seal**	**Note**
FF	Fixed flange installation with fluorosilicone o-ring	
HH	Integrated hatch installation with fluorosilicone o-ring	
Code (Pos 15)	**Tank Connection**	**Note**
ANSI Flanges (SST AISI 316 L)		
5A	5 in. Class 150	
6A	6 in. Class 150	
8A	8 in. Class 150	
AA	10 in. Class 150	
BA	12 in. Class 150	
EN Flanges (SST EN 1.4404)		
KA	DN 150 PN 16	
LA	DN 200 PN 10	
MB	DN 250 PN 16	
Code (Pos 16)	**Special**	**Note**
0	None	
C	Clamp flange in galvanized steel (for still-pipes without a flange)	Same size as tank connection

LPG/LNG Antenna

Code (Pos 11)	Antenna	Note
G1	LNG still-pipe antenna	Including integrated ball valve
G2	LPG still-pipe antenna	Including integrated ball valve and pressure transmitter
Code (Pos 12)	**Antenna Size**	**Note**
A	4 in. Schedule 10, Ø=107 mm (4.2 in.)	
B	4 in. Schedule 40, Ø=101 mm (4.0 in.)	
D	DN 100, Ø=99 mm (3.9 in.)	
Code (Pos 13)	**Antenna Material**	**Note**
S	Stainless steel (material type corresponding to AISI 316/316L and EN 1.4401 /1.4404)	
Code (Pos 14)	**Tank Seal**	**Note**
QA	Quartz sealing	
Code (Pos 15)	**Tank Connection**	**Note**
ANSI Flanges (SST AISI 316L)		
4A	4 in. Class 150	
4B	4 in. Class 300	
6A	6 in. Class 150	
6B	6 in. Class 300	
8A	8 in. Class 150	
8B	8 in. Class 300	
Code (Pos 16)	**Special**	**Note**
V	Measurement verification kit	Includes one verification pin and a pipe-end deflector kit
0	None	

A.3.3 5900S Radar Level Gauge Options

Code	Options – none or multiple selections are possible. Specify in the same order as below	Note
QT	IEC 61508 certificate and FMEDA-data(1)	
Q4	Calibration certificate	
S4	Witnessed calibration certificate	Calibration certificate witnessed by factory selected third part metrology certified institute
Q8	Antenna material traceability certification per EN 10204 3.1(2)	
ST	Engraved SST tag plate	
P1	Antenna hydrostatic pressure testing	
U1(3)	TÜV/DIBt WHG Approval for Overfill protection	

(1) Requires Pos 3 "Safety Certification (SIS)" code 2 or 3 (SIL 3 or SIL 2).
(2) Certificate includes all pressure retaining wetted parts.
(3) Requires one or more relay outputs in the Rosemount 2410 Tank Hub

Model code example, Rosemount 5900S with still-pipe array antenna

5900S - P 3 2 F I1 R 1 A 1 - 1A 8 S HH 8A 0 - QT Q4

Appendix B Product Certifications

B.1 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 communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

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

⚠WARNING

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

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

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

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

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

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

⚠WARNING

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

Avoid contact with leads and terminals.

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

Antennas with non-conducting surfaces may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the antenna is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

B.2 EU CONFORMITY

The EC declaration of conformity for all applicable European directives for this product can be found on the Rosemount Tank Gauging website at www.rosemount-tg.com. A hard copy may be obtained by contacting our local sales representative.

B.3 HAZARDOUS LOCATIONS CERTIFICATIONS

The Rosemount 5900S Series level gauges that have the following labels attached have been certified to comply with the requirements of the approval agencies noted.

B.3.1 Factory Mutual US Approvals

Certificate of Compliance: 3035466.

Figure B-1. Factory Mutual Intrinsic Safety US Approval Label

I5

FISCO Field Device

Intrinsically Safe for Class I, II, III, Division 1, Groups A, B, C, D, E, F, and G

Class I, Zone 0/1 AEx ia IIC

For each channel: Ui=17.5 V, Ii=380 mA, Pi=5.32 W, Ci=1.1 nF, Li=1.5 µH

Entity

Intrinsically Safe for Class I, II, III, Division 1, Groups A, B, C, D, E, F, and G

Class I, Zone 0/1 AEx ia IIC

For each channel: Ui=30 V, Ii=300 mA, Pi=1.3 W, Ci=1.1 nF, Li=1.5 µH

Dust Ignition Proof for Class II/III, Division 1, Groups E, F and G

Temperature Code T4

Install per Control Drawing 9240040-917

Ambient Temperature Limits: -50°C to +80°C

Special Conditions of Use

1. Parabolic and Array antennas with plastic surfaces and the surface of the painted housing may, under certain extreme conditions, generate an ignition-capable level of electrostatic charge. Appropriate measures must be taken to prevent electrostatic discharge.
2. Class I, Zone 0/1 notation: For installation in Zone classified locations, the Rosemount 5900 Radar Level Gauge was evaluated so that an [ib] associated apparatus can connect to it restricting the installation of the electronics to a Zone 1 location while still allowing the antenna to enter a Zone 0 location.

B.3.2 Factory Mutual Canadian Approvals

Certificate of Compliance: 3035466C.

Figure B-2. Factory Mutual Intrinsic Safety Canadian Approval Label

I6

FISCO Field Device

Intrinsically Safe for Class I, II, III, Division 1, Groups A, B, C, D, E, F, and G

Ex ia IIC

For each channel: Ui=17.5 V, Ii=380 mA, Pi=5.32 W, Ci=1.1 nF, Li=1.5 µH

Entity

Intrinsically Safe for Class I, II, III, Division 1, Groups A, B, C, D, E, F, and G

Ex ia IIC

For each channel: Ui=30 V, Ii=300 mA, Pi=1.3 W, Ci=1.1 nF, Li=1.5 µH

Dust Ignition Proof for Class II/III, Division 1, Groups E, F and G

Temperature Code T4

Install per Control Drawing 9240040-917

Ambient Temperature Limits: -50 °C to +80 °C

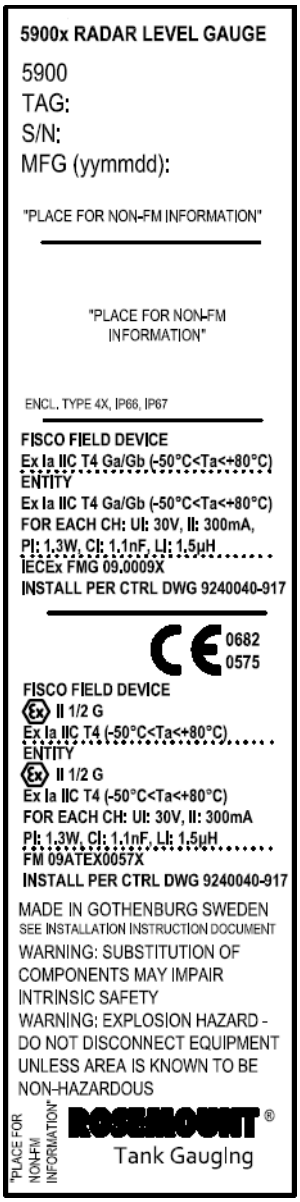
Special Conditions of Use

1. Parabolic and Array antennas with plastic surfaces and the surface of the painted housing may, under certain extreme conditions, generate an ignition-capable level of electrostatic. Appropriate measures must be taken to prevent electrostatic discharge.

B.3.3 European ATEX Directive Information

The Rosemount 5900S Series Level Gauge 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-3. ATEX Intrinsic Safety Approval Label



I1 The following information is provided as part of the label of the transmitter:

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

  CE 0682 0575
- Model number
- Serial number of the device
- Year of construction
- ATEX EC-Type Examination Certificate Number FM 09ATEX0057X
- Install per Control Drawing 9240040-917

FISCO Field Device

Ex II 1/2 G

- Ex ia IIC T4 (-50 °C <Ta< +80 °C)
- For each channel: Ui=17.5 V, Ii=380 mA, Pi=5.32 W, Ci=1.1 nF, Li=1.5 µH

Entity

Ex II 1/2 G

- Ex ia IIC T4 (-50 °C <Ta< +80 °C)
- For each channel: Ui=30 V, Ii=300 mA, Pi=1.3 W, Ci=1.1 nF, Li=1.5 µH

Special Conditions for Safe Use (X)

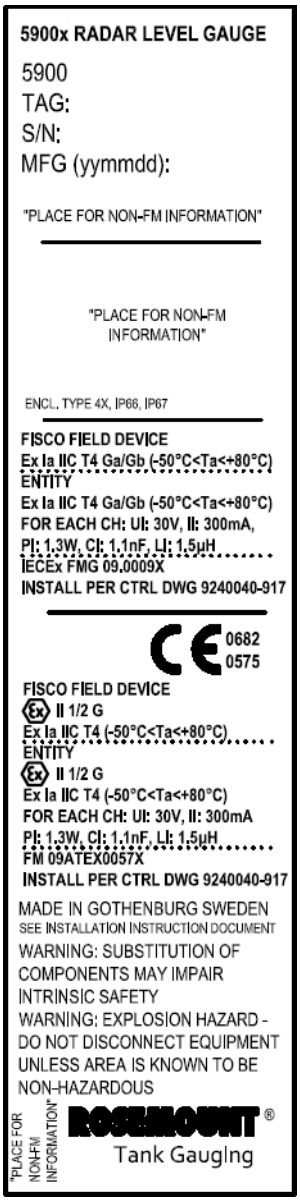
1. The enclosure contains aluminum and is considered to present a potential risk of ignition by impact or friction. Care must be taken during installation and use to prevent impact or friction.
2. Parabolic and Array antennas with plastic surfaces and the painted surface of the enclosure may, under certain extreme conditions, generate an ignition-capable level of electrostatic charge for IIC applications. Therefore, when these antennas are used in Category 1G, Group IIC, appropriate measures must be taken to prevent electrostatic discharge.
3. Category 1/2 notation: The Rosemount 5900 Radar Level Gauge was evaluated so that an [ib] associated apparatus can connect to it restricting the installation of the electronics to a Zone 1 location while still allowing the antenna to enter a Zone 0 location.

B.3.4 IECEx Approval

I7 The following information is provided as part of the label of the transmitter:

- Name and address of the manufacturer (Rosemount)
- Model number
- Serial number of the device
- IECEx Certificate of Conformity Number IECEx FMG 09.0009X
- Install per Control Drawing 9240040-917

Figure B-4. IECEx Intrinsic Safety Approval Label



FISCO Field Device

- Ex ia IIC T4 Ga/Gb (-50 °C<Ta<+80 °C)
- For each channel: Ui=17.5 V, Ii=380 mA, Pi=5.32 W, Ci=1.1 nF, Li=1.5 µH

Entity

- Ex ia IIC T4 Ga/Gb (-50 °C<Ta<+80 °C)
- For each channel: Ui=30 V, Ii=300 mA, Pi=1.3 W, Ci=1.1 nF, Li=1.5 µH

Special Conditions of Certification (X):

1. The enclosure contains aluminum and is considered to present a potential risk of ignition by impact or friction. Care must be taken during installation and use to prevent impact or friction.
2. Parabolic and Array antennas with plastic surfaces and the painted surface of the enclosure may, under certain extreme conditions, generate an ignition-capable level of electrostatic charge for IIC applications. Therefore, when these antennas are used in Category EPL Ga, Group IIC, appropriate measures must be taken to prevent electrostatic discharge.
3. Ga/Gb notation: The Rosemount 5900 Radar Level Gauge was evaluated so that an [ib] associated apparatus can connect to it restricting the installation of the electronics to a Zone 1 location while still allowing the antenna to enter a Zone 0 location.

B.4 APPROVAL DRAWINGS

Follow the installation guidelines presented in Factory Mutual system control drawings in order to maintain certified ratings for installed devices.

The following drawing is included in the documentation for the Rosemount 5900S Radar Level Gauge:

9240040-917 System Control Drawing for hazardous location installation of intrinsically safe FM ATEX, FM IECEx, FM-US, and FM-C approved apparatus.

See the “Manuals & Drawings” CD ROM that is shipped with the 5900S Radar Level Gauge for electronic copies of the system control drawings.

Drawings are also available on the Rosemount Tank Gauging web site: www.rosemount-tg.com.

Appendix C FOUNDATION Fieldbus Block Information

C.1 RESOURCE BLOCK

This section contains information on the Resource Block of the Rosemount 5900S Radar Level Gauge.

The resource block defines the physical resources of the device. The resource block also handles functionality that is common across multiple blocks. The block has no linkable inputs or outputs.

Table C-1. Resource Block Parameters

Index Number	Parameter	Description
38	ACK_OPTION	Selection of whether alarms associated with the function block will be automatically acknowledged.
82	ADVISE_ACTIVE	Enumerated list of advisory conditions within a device.
83	ADVISE_ALM	Alarm indicating advisory alarms. These conditions do not have a direct impact on the process or device integrity.
80	ADVISE_ENABLE	Enabled ADVISE_ALM alarm conditions. Corresponds bit for bit to the ADVISE_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected.
81	ADVISE_MASK	Mask of ADVISE_ALM. Corresponds bit by bit to ADVISE_ACTIVE. A bit on means that the condition is masked out from alarming.
79	ADVISE_PRI	Designates the alarming priority of the ADVISE_ALM
37	ALARM_SUM	The current alarm status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
04	ALERT_KEY	The identification number of the plant unit.
36	BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alarm is entered in the subcode field. The first alarm to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the larm reporting task, another block alarm may be reported without clearing the Active status, if the subcode has changed.
06	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
30	CLR_FSTATE	Writing a Clear to this parameter will clear the device FAIL_SAFE if the field condition has cleared.
33	CONFIRM_TIME	The time the resource will wait for confirmation of receipt of a report before trying again. Retry will not happen when CONFIRM_TIME=0.
20	CYCLE_SEL	Used to select the block execution method for this resource. The Rosemount 5900S supports the following: Scheduled: Blocks are only executed based on the function block schedule. Block Execution: A block may be executed by linking to another blocks completion.
19	CYCLE_TYPE	Identifies the block execution methods available for this resource.
09	DD_RESOURCE	String identifying the tag of the resource which contains the Device Description for this resource.
13	DD_REV	Revision of the DD associated with the resource - used by an interface device to locate the DD file for the resource.
60	DEFINE_WRITE_LOCK	Allows the operator to select how WRITE_LOCK behaves. The initial value is “lock everything”. If the value is set to “lock only physical device” then the resource and transducer blocks of the device will be locked but changes to function blocks will be allowed.
55	DETAILED_STATUS	Indicates the state of the transmitter. See detailed status codes in section “Resource Block” on page 6-24.

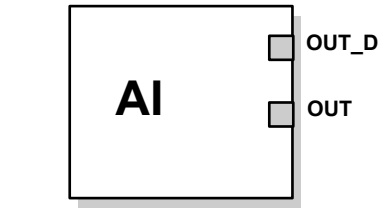
Index Number	Parameter	Description
12	DEV_REV	Manufacturer revision number associated with the resource - used by an interface device to locate the DD file for the resource.
43	DEV_STRING	This is used to load new licensing into the device. The value can be written but will always read back with a value of 0.
11	DEV_TYPE	Manufacturer's model number associated with the resource - used by interface devices to locate the DD file for the resource.
46	DIAG_OPTION	Indicates which diagnostics licensing options are enabled.
42	DISTRIBUTOR	Reserved for use as distributor ID. No Foundation enumerations defined at this time.
67	DOWNLOAD_MODE	Gives access to the boot block code for over-the-wire downloads. 0 = Uninitialized 1 = Run mode 2 = Download mode
28	FAULT_STATE	Condition set by loss of communication to an output block, fault promoted to an output block or physical contact. When FAIL_SAFE condition is set, then output function blocks will perform their FAIL_SAFE actions.
72	FAILED_ACTIVE	Enumerated list of failure conditions within a device.
73	FAILED_ALM	Alarm indicating a failure within a device which makes the device non-operational.
70	FAILED_ENABLE	Enabled FAILED_ALM alarm conditions. Corresponds bit for bit to the FAILED_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected.
71	FAILED_MASK	Mask of FAILED_ALM. Corresponds bit of bit to FAILED_ACTIVE. A bit on means that the condition is masked out from alarming.
69	FAILED_PRI	Designates the alarming priority of the FAILED_ALM.
45	FB_OPTION	Indicates which function block licensing options are enabled.
17	FEATURES	Used to show supported resource block options. The supported features are: • HARD_WRITE_LOCK_SUPPORT • SOFT_WRITE_LOCK_SUPPORT • REPORT_SUPPORT • UNICODE_SUPPORT • MULTI_BIT ALARM • RESTART/RELINK AFTER FB ACTION
18	FEATURES_SEL	Used to select resource block options.
54	FINAL_ASSY_NUM	The same final assembly number specified or set by the customer.
24	FREE_SPACE	Percent of memory available for further configuration. Zero in a preconfigured device.
25	FREE_TIME	Percent of the block processing time that is free to process additional blocks.
14	GRANT_DENY	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device.
15	HARD_TYPES	The types of hardware available as channel numbers.
52	HARDWARE_REV	Hardware revision of the hardware that has the resource block in it.
84	HEALTH_INDEX	Parameter representing the overall health of the device, 100 being perfect and 1 being non-functioning. The value is based on the active PWA alarms.
41	ITK_VER	Major revision number of the inter operability test case used in certifying this device as interoperable. The format and range are controlled by the Fieldbus Foundation.
32	LIM_NOTIFY	Maximum number of unconfirmed alert notify messages allowed.
77	MAINT_ACTIVE	Enumerated list of maintenance conditions within a device.
78	MAINT_ALM	Alarm indicating the device needs maintenance soon. If the condition is ignored, the device will eventually fail.
75	MAINT_ENABLE	Enabled MAINT_ALM alarm conditions. Corresponds bit for bit to the MAINT_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected.

Index Number	Parameter	Description
76	MAINT_MASK	Mask of MAINT_ALM. Corresponds bit of bit to MAINT_ACTIVE. A bit on means that the condition is masked out from alarming.
74	MAINT_PRI	Designates the alarming priority of the MAINT_ALM
10	MANUFAC_ID	Manufacturer identification number – used by an interface device to locate the DD file for the resource.
31	MAX_NOTIFY	Maximum number of unconfirmed notify messages possible.
22	MEMORY_SIZE	Available configuration memory in the empty resource. To be checked before attempting a download.
57	MESSAGE_DATE	Date associated with the MESSAGE_TEXT parameter.
58	MESSAGE_TEXT	Used to indicate changes made by the user to the device's installation, configuration, or calibration.
21	MIN_CYCLE_T	Time duration of the shortest cycle interval of which the resource is capable.
47	MISC_OPTION	Indicates which miscellaneous licensing options are enabled.
05	MODE_BLK	The actual, target, permitted, and normal modes of the block: Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for actual
23	NV_CYCLE_T	Minimum time interval specified by the manufacturer for writing copies of NV parameters to non-volatile memory. Zero means it will never be automatically copied. At the end of NV_CYCLE_T, only those parameters which have changed need to be updated in NVRAM.
53	OUTPUT_BOARD_SN	Output board serial number.
85	PWA_SIMULATE	Parameter allowing simulation of PWA alarms.
51	RB_SFTWR_REV_ALL	The string contains the following fields: Major rev: 1-3 characters, decimal number 0-255 Minor rev: 1-3 characters, decimal number 0-255 Build rev: 1-5 characters, decimal number 0-255 Time of build: 8 characters, xx:xx:xx, military time Day of week of build: 3 characters, Sun, Mon,... Month of build: 3 characters, Jan, Feb. Day of month of build: 1-2 characters, decimal number 1-31 Year of build: 4 characters, decimal Builder: 7 characters, login name of builder
50	RB_SFTWR_REV_BUILD	Build of software that the resource block was created with.
48	RB_SFTWR_REV_MAJOR	Major revision of software that the resource block was created with.
49	RB_SFTWR_REV_MINOR	Minor revision of software that the resource block was created with.
68	RECOMMENDED_ACTION	Enumerated list of recommended actions displayed with a device alert.
16	RESTART	Allows a manual restart to be initiated. Several degrees of restart are possible. They are the following: 1 Run – nominal state when not restarting 2 Restart resource – not used 3 Restart with defaults – set parameters to default values. See START_WITH_DEFAULTS below for which parameters are set. 4 Restart processor – does a warm start of CPU.
07	RS_STATE	State of the function block application state machine.
62	SAVE_CONFIG_BLOCKS	Number of EEPROM blocks that have been modified since last burn. This value will count down to zero when the configuration is saved.
61	SAVE_CONFIG_NOW	Allows the user to optionally save all non-volatile information immediately.
65	SECURITY_IO	Status of security switch.
59	SELF_TEST	Instructs resource block to perform self-test. Tests are device specific.
29	SET_FSTATE	Allows the FAIL_SAFE condition to be manually initiated by selecting Set.

Index Number	Parameter	Description
26	SHED_RCAS	Time duration at which to give up on computer writes to function block RCas locations. Shed from RCas shall never happen when SHED_ROUT = 0
27	SHED_ROUT	Time duration at which to give up on computer writes to function block ROut locations. Shed from ROut shall never happen when SHED_ROUT = 0
64	SIMULATE_IO	Status of simulate switch.
66	SIMULATE_STATE	The state of the simulate switch: 0 = Uninitialized 1 = Switch off, simulation not allowed 2 = Switch on, simulation not allowed (need to cycle jumper/switch) 3 = Switch on, simulation allowed
01	ST_REV	The revision level of the static data associated with the function block.
63	START_WITH_DEFAULTS	0 = Uninitialized 1 = do not power-up with NV defaults 2 = power-up with default node address 3 = power-up with default pd_tag and node address 4 = power-up with default data for the entire communications stack (no application data)
03	STRATEGY	The strategy field can be used to identify grouping of blocks.
56	SUMMARY_STATUS	An enumerated value of repair analysis. 0 = Uninitialized 1 = No repair needed 2 = Repairable 3 = Call service center
02	TAG_DESC	The user description of the intended application of the block.
08	TEST_RW	Read/write test parameter - used only for conformance testing.
35	UPDATE_EVT	This alert is generated by any change to the static data.
40	WRITE_ALM	This alert is generated if the write lock parameter is cleared.
34	WRITE_LOCK	When hardware write protection is selected, WRITE_LOCK becomes an indicator of the jumper setting and is unavailable for software write protection. When software write lock is selected, and WRITE_LOCK is set, no writings from anywhere else are allowed, except to clear WRITE_LOCK. Block input will continue to be updated.
39	WRITE_PRI	Priority of the alarm generated by clearing the write lock.
44	XD_OPTION	Indicates which transducer block licensing options are enabled.

C.2 ANALOG INPUT BLOCK

Figure C-1. Analog-Input Block



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

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

The AI block supports alarming, signal scaling, signal filtering, signal status calculation, mode control, and simulation. In Automatic mode, the block's output parameter (OUT) reflects the process variable (PV) value and status. In Manual mode, OUT may be set manually. The Manual mode is reflected on the output status. A discrete output (OUT_D) is provided to indicate whether a selected alarm condition is active. Alarm detection is based on the OUT value and user specified alarm limits. Table C-2 lists the AI block parameters and their units of measure, descriptions, and index numbers.

Figure C-2. Analog Input Function Block Schematic

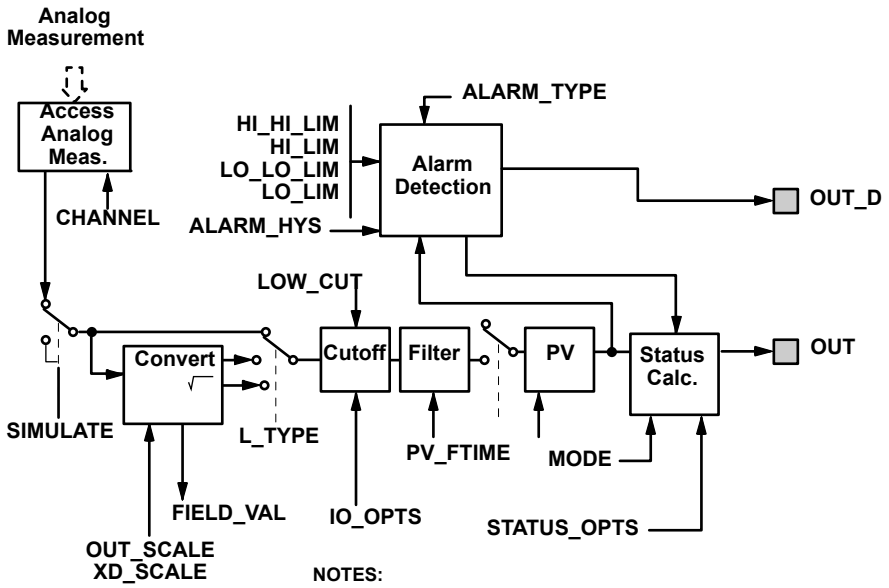


Table C-2. Definitions of Analog Input Function Block System Parameters

Parameter	Index Number	Units	Description
ACK_OPTION	23	None	Used to set auto acknowledgment of alarms.
ALARM_HYS	24	Percent	The amount the alarm value must return within the alarm limit before the associated active alarm condition clears.
ALARM_SEL	38	None	Used to select the process alarm conditions that will cause the OUT_D parameter to be set.
ALARM_SUM	22	None	The summary alarm is used for all process alarms in the block. The cause of the alarm is entered in the subcode field. The first alarm to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alarm reporting task, another block alarm may be reported without clearing the Active status, if the subcode has changed.
ALERT_KEY	04	None	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
BLOCK_ALM	21	None	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alarm is entered in the subcode field. The first alarm to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alarm reporting task, another block alarm may be reported without clearing the Active status, if the subcode has changed.
BLOCK_ERR	06	None	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
CHANNEL	15	None	The CHANNEL value is used to select the measurement value. You must configure the CHANNEL parameter before you can configure the XD_SCALE parameter. See “Analog Input Block” on page 4-41.
FIELD_VAL	19	Percent	The value and status from the transducer block or from the simulated input when simulation is enabled.
GRANT_DENY	12	None	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device.
HI_ALM	34	None	The HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
HI_HI_ALM	33	None	The HI HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
HI_HI_LIM	26	EU of PV_SCALE	The setting for the alarm limit used to detect the HI HI alarm condition.
HI_HI_PRI	25	None	The priority of the HI HI alarm.
HI_LIM	28	EU of PV_SCALE	The setting for the alarm limit used to detect the HI alarm condition.
HI_PRI	27	None	The priority of the HI alarm.
IO_OPTS	13	None	Allows the selection of input/output options used to alter the PV. Low cutoff enabled is the only selectable option.
L_TYPE	16	None	Linearization type. Determines whether the field value is used directly (Direct) or is converted linearly (Indirect).
LO_ALM	35	None	The LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
LO_LIM	30	EU of PV_SCALE	The setting for the alarm limit used to detect the LO alarm condition.
LO_LO_ALM	36	None	The LO LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
LO_LO_LIM	32	EU of PV_SCALE	The setting for the alarm limit used to detect the LO LO alarm condition.
LO_LO_PRI	31	None	The priority of the LO LO alarm.
LO_PRI	29	None	The priority of the LO alarm.
LOW_CUT	17	%	If percentage value of transducer input fails below this, PV = 0.

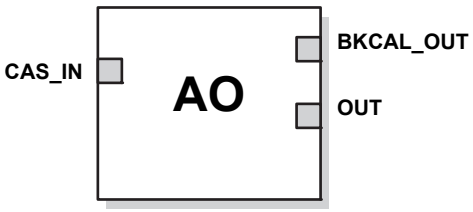
Parameter	Index Number	Units	Description
MODE_BLK	05	None	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
OUT	08	EU of OUT_SCALE	The block output value and status.
OUT_D	37	None	Discrete output to indicate a selected alarm condition.
OUT_SCALE	11	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with OUT.
PV	07	EU of XD_SCALE	The process variable used in block execution.
PV_FTIME	18	Seconds	The time constant of the first-order PV filter. It is the time required for a 63% change in the IN value.
SIMULATE	09	None	A group of data that contains the current transducer value and status, the simulated transducer value and status, and the enable/disable bit.
STRATEGY	03	None	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ST_REV	01	None	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
TAG_DESC	02	None	The user description of the intended application of the block.
UPDATE_EVT	20	None	This alert is generated by any change to the static data.
VAR_INDEX	39	% of OUT Range	The average absolute error between the PV and its previous mean value over that evaluation time defined by VAR_SCAN.
VAR_SCAN	40	Seconds	The time over which the VAR_INDEX is evaluated.
XD_SCALE	10	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with the channel input value.

C.2.1 Simulation

To perform lab test of process variables and alerts, you can either change the mode of the AI block to manual and adjust the output value, or you can enable simulation through the configuration tool and manually enter a value for the measurement value and its status. In both cases, you must first set the SIMULATE switch (1) on the field device to the ON position, see “Simulation” on page 4-43.

With simulation enabled, the actual measurement value has no impact on the OUT value or the status.

C.3 ANALOG OUTPUT BLOCK



CAS_IN =The remote setpoint value from another function block

BKCAL_OUT =The value and status required by the BKCAL_IN input of another block to prevent reset windup and to provide bumpless transfer to closed loop control.

OUT =The block output and status.

The Analog Output (AO) function block assigns an output value to a field device through a specified I/O channel. The block supports mode control, signal status calculation, and simulation. Table C-3 lists the definitions of the system parameters. See also “Analog Output Block” on page 4-48.

Table C-3. Analog Output Function Block System Parameters

Parameter	Units	Description
BKCAL_OUT	EU of PV_SCALE	The value and status required by the BKCAL_IN input of another block to prevent reset windup and to provide bumpless transfer to closed loop control.
BLOCK_ERR	None	The summary of active error conditions associated with the block. The block errors for the AnalogOutput block are Simulate Active, Input Failure/Process Variable has Bad Status,Output Failure, Read back Failed, and Out of Service..
CAS_IN	EU of PV_SCALE	The remote setpoint value from another function block.
IO_OPTS	None	Allows you to select how the I/O signals are processed. The supported I/O options for the AO function block are SP_PV Track in Man, Increase to Close, and Use PV for BKCAL_OUT.
CHANNEL	None	Defines the output that drives the field device. See “Analog Output Block” on page 4-48.
MODE	None	Enumerated attribute used to request and show the source of the setpoint and/or output used by the block.
OUT	EU of XD_SCALE	The primary value and status calculated by the block in Auto mode. OUT may be set manually in Man mode.
PV	EU of PV_SCALE	The process variable used in block execution. This value is converted from READBACK to show the actuator position in the same units as the setpoint value.
PV_SCALE	None	The high and low scale values, the engineering units code, and the number of digits to the right of the decimal point associated with the PV.
READBACK	EU of XD_SCALE	Themeasured or implied actuator position associated with the OUT value.

Parameter	Units	Description
SIMULATE	EU of XD_SCALE	Enables simulation and allows you to enter an input value and status.
SP	EU of PV_SCALE	The target block output value (setpoint).
SP_HI_LIM	EU of PV_SCALE	The highest setpoint value allowed.
SP_LO_LIM	EU of PV_SCALE	The lowest setpoint value allowed.
SP_RATE_DN	EU of PV_SCALE per second	Ramp rate for downward setpoint changes. When the ramp rate is set to zero, the setpoint is used immediately.
SP_RATE_UP	EU of PV_SCALE per second	Ramp rate for upward setpoint changes. When the ramp rate is set to zero, the setpoint is used immediately.
SP_WRK	EU of PV_SCALE	The working setpoint of the block. It is the result of setpoint rate-of-change limiting. The value is converted to percent to obtain the block's OUT value.

C.3.1 Setting the Output

To set the output for the AO block, you must first set the mode to define the manner in which the block determines its setpoint. In Manual mode the value of the output attribute (OUT) must be set manually by the user, and is independent of the setpoint. In Automatic mode, OUT is set automatically based on the value specified by the setpoint (SP) in engineering units and the I/O options attribute (IO_OPTS). In addition, you can limit the SP value and the rate at which a change in the SP is passed to OUT.

In Cascade mode, the cascade input connection (CAS_IN) is used to update the SP. The back calculation output (BKCAL_OUT) is wired to the back calculation input (BKCAL_IN) of the upstream block that provides CAS_IN. This provides bumpless transfer on mode changes and windup protection in the upstream block. The OUT attribute or an analog readback value, such as valve position, is shown by the process value (PV) attribute in engineering units.

To support testing, you can enable simulation, which allows you to manually set the channel feedback. There is no alarm detection in the AO function block.

To select the manner of processing the SP and the channel output value configure the setpoint limiting options, the tracking options, and the conversion and status calculations.

C.4 MEASUREMENT TRANSDUCER BLOCK

The Measurement Transducer block contains the actual measurement data, including a level and distance reading. The transducer block includes information about sensor type, engineering units, and all parameters needed to configure the transmitter.

Table C-4. Measurement Transducer Block Parameters

Index Number	Parameter	Description
1	ST_REV	The revision level of the static data associated with the function block. The revision value increments each time a static parameter value in the block is changed.
2	TAG_DESC	The user description of the intended application of the block.
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	MODE_BLK	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
6	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	UPDATE_EVT	This alert is generated by any change to the static data
8	BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
9	TRANSDUCER_DIRECTORY	Directory that specifies the number and starting indices of the transducers in the transducer block.
10	TRANSDUCER_TYPE	Identifies the transducer.
11	XD_ERROR	A transducer block alarm subcode.
12	COLLECTION_DIRECTORY	A directory that specifies the number, starting indices, and DD Item ID’s of the data collections in each transducer within a transducer block.
13	RADAR_LEVEL_TYPE	
14	HOUSING_TEMPERATURE	Internal temperature of the level gauge electronics
15	TEMPERATURE_UNIT	Measurement unit for temperature

16	LEVEL	Distance from the zero level (tank bottom) to the product surface
17	LENGTH_UNIT	Length Unit
18	LEVEL_RATE	Velocity at which the product surface is moving
19	LEVEL_RATE_UNIT	Level Rate Unit
20	ENV_DEVICE_MODE	Service Mode (see Table C-5)
21	DIAGN_DEVICE_ALERT	Errors and warnings for 2410 Tank Hub usage. See Table C-14 on page C-16.
22	DEVICE_VERSION_NUMBER	PM card SW version number
23	DIAGN_REVISION	PM revision
24	SERIAL_NO	Main Label Device ID
25	STATS_ATTEMPTS	Total number of messages sent to PM
26	STATS_FAILURES	Total number of failed messages to PM
27	STATS_TIMEOUTS	Total number of timed-out messages to PM
28	FF_DEVICE_NUMBER	CM board serial number
29	FF_WRITE_PROTECT	CM board write protection status
30	P1451_SLAVE_STATS	Communication statistics
31	P1451_HOST_STATS	Communication statistics
32	DISTANCE	Distance from the tank reference point (normally the lower side of the flange) to the product surface
33	SIGNAL_STRENGTH	Amplitude of the echo from the product surface. A high value indicates a good reflection by the surface
34	SIGNAL_STRENGTH_UNI	Signal strength unit
35	ANTENNA_TYPE	Antenna type on the device (see Table C-6)
36	TCL	Tank Connection Length. Electrical distance between the transmitter's reference point and the microwave unit. Only for user defined antennas.
37	PIPE_DIAMETER	Still-pipe inner diameter, see “Tank Geometry” on page 4-6.
38	HOLD_OFF_DIST	Hold Off Distance defines how close to the gauge’s reference point a level measurement is accepted, see “Tank Geometry” on page 4-6.
39	ANTENNA_SIZE	Still-pipe Array antenna size
40	OFFSET_DIST_G	Gauge Reference Distance (G), see “Tank Geometry” on page 4-6. Use the Distance Offset (G) if a reference point other than the lower side of the device flange is required.
41	TANK_HEIGHT_R	Tank Reference Height (R) is defined as the distance between the upper reference point and the lower reference point (zero level). See “Tank Geometry” on page 4-6.
42	BOTTOM_OFFSET_DIST_C	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. See “Tank Geometry” on page 4-6.
43	CALIBRATION_DIST	Calibration Distance is by default set to zero. It is used to adjust the level measurement so that measured levels match hand dipped levels. See “Tank Geometry” on page 4-6.
44	TANK_SHAPE	Tank Type (see “Tank Shape” on page 4-15 and Table C-8). Optimizes the 5900S for various tank geometries.

45	TANK_BOTTOM_TYPE	Tank Bottom Type. Optimizes the 5900S for measurements close to the tank bottom. See Table C-9.
46	TANK_ENVIRONMENT	Tank Environment. See “Environment” on page 4-15. Mark the check boxes that correspond to the conditions in your tank. For best performance you should not choose more than two options. See Table C-10.
47	TANK_PRESENTATION	Tank Presentation. See Table C-11.
48	PRODUCT_DC	Product dielectric constant
49	ENV_WRITE_PROTECT	Write protect
50	RM_VERSION_NUMBER	RM card version number
51	DEVICE_MODEL	Device Model
52	TANK_EXPANSION_COEFF	Tank Expansion Coefficient
53	TANK_CALIB_AVG_TEMP	Tank Calibration Average Temperature
54	DAMPING_VALUE	Damping Value
55	HEART_BEAT_COUNT	This number should be incrementing. It is an indication that the device is alive.
56	DEVICE_STATUS	Device Status. See also “Device Status” on page 6-19.
57	DEVICE_COMMAND	Command
58	VOLUME	Product volume in the tank. A value of 0 could indicate that the volume calculation is not enabled.
59	VOLUME_UNIT	Unit code for all volume parameters
60	MODEL_CODE	Model code
61	FF_SUPPORT_INFO	FF Support Information
62	FF_APPL_VERSION_NUMBER	CM version number
63	SENSOR_DIAGNOSTICS	Sensor Diagnostics
64	VAPOR_PRESSURE	Tank vapor pressure. Data provided from AO block.
65	VAPOR_TEMPERATURE	Tank vapor temperature. Data provided from AO block.
66	USER_DEFINED	User Defined value
67	TANK_TEMPERATURE	Tank Temperature
68	PRESSURE_UNIT	Pressure Unit
69	USED_HOLD_OFF	Used Hold Off Distance

Table C-5. Device Mode

VALUE	ENV_DEVICE_MODE
0	Normal operation
2	Restart device
3	Set device to factory default

Table C-6. Antenna Type

VALUE	ANTENNA_TYPE
5001	Still-Pipe Array Fixed
5002	Still-Pipe Array Hatch
3002	Parabolic
2001	Horn
6001	LPG/LNG 150 psi Valve
6002	LPG/LNG 150 psi
6011	LPG/LNG 300 psi Valve
6012	LPG/LNG 300 psi
6021	LPG/LNG 600 psi Valve
6022	LPG/LNG 600 psi
7041	Cone 4 in. PTFE
7042	Cone 4 in. Quartz
7061	Cone 6 in. PTFE
7062	Cone 6 in. Quartz
7081	Cone 8 in. PTFE
7082	Cone 8 in. Quartz
3001	Parabolic 2930
4001	Still-Pipe 2940/3940
4501	Still-Pipe 2945/3945
1000	User defined Free Propagation
1001	User defined Still-Pipe
1003	User defined Still-Pipe Array

Table C-7. Antenna Size

VALUE	ANTENNA_SIZE
0	Pipe 5 inch
1	Pipe 6 inch
2	Pipe 8 inch
3	Pipe 10 inch
4	Pipe 12 inch

Table C-8. Tank Shape

VALUE	TANK_SHAPE
0	Unknown
1	Vertical Cylinder
2	Horizontal Cylinder
3	Spherical
4	Cubical
5	Floating Roof

Table C-9. Tank Bottom Type

VALUE	TANK_BOTTOM_TYPE
0	Unknown
1	Flat
2	Dome
3	Cone
4	Flat Inclined

Table C-10. Environment

VALUE	TANK_ENVIRONMENT
2	Rapid Level Change (>0.1 m/s, >4 in/s)
8	Turbulent Surface
10	Foam
20	Solid Product

Table C-11. Tank Presentation

VALUE	TANK_PRESENTATION
0	
0x00000001	Level above min distance possible
0x00000002	Predicting allowed
0x00000004	Bottom echo always visible when tank is empty
0x00000008	Tank contains double bounces
0x00000010	Use slow search
0x00000020	Enable double surface function
0x00000040	Select lower surface
0x00000080	Reserved
0x00000100	Show negative level as zero
0x00000200	Use monotone level ullage presentation
0x00000400	Use bottom projection
0x00000800	Reserved
0x00001000	Invalid level is NOT set if tank is empty or full
0x00002000	Do not set invalid level when empty
0x00004000	Do not set invalid level when full
0x00008000	Reserved
0x00010000	Use extra echo function
0x00020000	Always track first echo
0x00040000	Use harder level rate filtering around beams
0x00080000	Reserved

Table C-12. Product dielectric constant

VALUE	PRODUCT_DC
0	Unknown
1	Range (< 2.5)
2	Range (< 2.5 - 4)
3	Range (< 4 -10)
4	Range (>10)

Table C-13. Device Satus

VALUE	DEVICE_STATUS
0x00000001	Reserved
0x00000002	Running Boot SW
0x00000004	Device Warning
0x00000100	Device Error
0x00000800	BOOT Beta version used
0x00001000	APPL Beta version used
0x00008000	Level correction error
0x00010000	Invalid measurement
0x00020000	Write protected
0x00040000	Default database
0x00800000	Simulation active
0x02000000	SIL Enabled
0x20000000	RM reprogramming in progress

C.4.1 Diagnostic Device Alerts

Table C-14 lists conditions reported in the DIAGN_DEVICE_ALERT parameter.

Table C-14. Device Alerts

Value	Description
	No alarm active
0x0008 0000	Database error
0x0010 0000	Hardware error
0x0020 0000	Configuration error
0x0040 0000	Software error
0x1000 0000	Simulation Mode
0x2000 0000	Software write protected

C.5 VOLUME TRANSDUCER BLOCK

Table C-15. Volume Transducer Block parameters

Index Number	Parameter	Description
1	ST_REV	The revision level of the static data associated with the function block. The revision value increments each time a static parameter value in the block is changed.
2	TAG_DESC	The user description of the intended application of the block.
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	MODE_BLK	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
6	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	UPDATE_EVT	This alert is generated by any change to the static data
8	BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
9	TRANSDUCER_DIRECTORY	Directory that specifies the number and starting indices of the transducers in the transducer block.
10	TRANSDUCER_TYPE	Identifies the transducer.
11	XD_ERROR	A transducer block alarm sub code.
12	COLLECTION_DIRECTORY	A directory that specifies the number, starting indices, and DD Item ID’s of the data collections in each transducer within a transducer block.
13	LENGTH_UNIT	Same as in measurement transducer block
14	VOLUME_UNIT	Same as in measurement transducer block
15	VOLUME	Calculated volume and status
16	VOLUME_STATUS	Detailed status
17	LEVEL	Used level value
18	VOLUME_ CALC_METHOD	Used volume calculation method
19	VOLUME_IDEAL_DIAMETER	Diameter for pre-defined standard tank type

20	VOLUME_IDEAL_LENGTH	Length for pre-defined standard tank type
21	VOLUME_OFFSET	Lets you use a non-zero volume for the zero level. Can be used in case you want to include the product volume below the zero level.
22	VOLUME_INTERPOLATE_METHOD	Interpolation method for levels between strapping table points
23	VOLUME_ STRAP_TABLE_LENGTH	Number of strapping table points
24	STRAP_LEVEL_1_30	Level values for strapping points 1 to 30
25	STRAP_VOLUME_1_30	Volume values for strapping points 1 to 30

C.6 REGISTER TRANSDUCER BLOCK

The Register Transducer Block allows access to Database registers and Input registers of the Rosemount 5900S Radar Level Gauge. This makes it possible to read a selected set of register directly by accessing the memory location.

The Register Transducer Block is only available with advanced service.

⚠CAUTION

Since the Register Transducer Block allows access to most registers in the 5900S, which includes the registers set by the Methods and Configuration screens in the Level Transducer Block (see *"Measurement Transducer Block" on page C-11*), it should be handled with care and ONLY to be changed by trained and certified service personnel, or as guided by Emerson Process Management/Rosemount Tank Gauging support personnel.

Table C-16. Register Transducer Block parameters

Index Number	Parameter	Description
1	ST_REV	The revision level of the static data associated with the function block. The revision value increments each time a static parameter value in the block is changed.
2	TAG_DESC	The user description of the intended application of the block.
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	MODE_BLK	The actual, target, permitted, and normal modes of the block. Target: The mode to "go to" Actual: The mode the "block is currently in" Permitted: Allowed modes that target may take on Normal: Most common mode for target
6	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	UPDATE_EVT	This alert is generated by any change to the static data
8	BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.

9	TRANSDUCER_DIRECTORY	Directory that specifies the number and starting indices of the transducers in the transducer block.
10	TRANSDUCER_TYPE	Identifies the transducer.
11	XD_ERROR	A transducer block alarm sub code.
12	COLLECTION_DIRECTORY	A directory that specifies the number, starting indices, and DD Item ID's of the data collections in each transducer within a transducer block.
13	TRANSDUCER_TYPE_VER	
14	RB_PARAMETER	
15-44	INP_REG_n_TYPE	Describes characteristics of input register n. Indicates requested value is displayed as a floating point (/ decimal) number.
	INP_REG_n_FLOAT	Input register n value, displayed as floating point number
	INP_REG_n_INT_DEC	Input register n value, displayed as decimal number
45-74	DB_REG_n_TYPE	Describes characteristics of holding register n. Indicates requested value is displayed as a floating point (/ decimal) number.
	DB_REG_n_FLOAT	Holding register n value, displayed as floating point number.
	DB_REG_n_INT_DEC	Holding register n value, displayed as decimal number.
75	RM_COMMAND	Defines what action to perform; Read Input/Holding Register, Restart Device, Poll Program Complete.
76	RM_DATA	
77	RM_STATUS	
78	INP_SEARCH_START_NBR	Input register search start number
79	DB_SEARCH_START_NBR	Holding register search start number

C.7 ADVANCED CONFIGURATION TRANSDUCER BLOCK

Table C-17. Advanced Configuration Transducer Block parameters

Index Number	Parameter	Description
1	ST_REV	The revision level of the static data associated with the function block. The revision value increments each time a static parameter value in the block is changed.
2	TAG_DESC	The user description of the intended application of the block.
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	MODE_BLK	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
6	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	UPDATE_EVT	This alert is generated by any change to the static data
8	BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
9	TRANSDUCER_DIRECTORY	Directory that specifies the number and starting indices of the transducers in the transducer block.
10	TRANSDUCER_TYPE	Identifies the transducer.
11	XD_ERROR	A transducer block alarm sub code.
12	COLLECTION_DIRECTORY	A directory that specifies the number, starting indices, and DD Item ID’s of the data collections in each transducer within a transducer block.

13	AUTO_CONF_MEAS_FUNC	Check box to enable manual settings of affected parameters
14	USED_EXTRA_ECHO_MIN_ULLAGE	Parameters and functions for Empty Tank Handling. See “Empty Tank Handling” on page 4-11 for more information.
15	USED_EXTRA_ECHO_MAX_ULLAGE	
16	USED_EXTRA_ECHO_MIN_AMPL	
17	EXTRA_ECHO_MIN_ULLAGE	
18	EXTRA_ECHO_MAX_ULLAGE	
19	EXTRA_ECHO_MIN_AMPL	
20	USED_EMPTY_TANK_DETECTION_AREA	
21	EMPTY_TANK_DETECTION_AREA	
22	USED_ECHO_TIMEOUT	Parameters and functions for Echo Tracking. See “Surface Echo Tracking” on page 4-16 for more information.
23	USED_CLOSE_DIST	
24	USED_SLOW_SEARCH_SPEED	
25	USED_FFT_MATCH_THRESH	
26	USED_MULT_MATCH_THRESH	
27	USED_MED_FILTER_SIZE	
28	USED_MIN_UPDATE_RELATION	
29	ECHO_TIMEOUT	
30	CLOSE_DIST	
31	SEARCH_SPEED	
32	FFT_MATCH_THRESHOLD	
33	MULT_MATCH_THRESHOLD	
34	MED_FILTER_SIZE	
35	MIN_UPDATE_RELATION	
36	USED_DIST_FILTER_FACTOR	Parameters for Filter Settings. See “Filter Setting” on page 4-18 for more information.
37	DIST_FILTER_FACTOR	
38	USE_LEVEL_MONITORING	A function which continuously scans the upper zone in the tank for new echoes. If an echo is found, which is not the present tracked surface, the function will initiate an instant jump to the upper echo. See Table C-21.
39	DOUBLE_BOUNCE_OFFSET	Used for advanced configuration of spherical and horizontal cylinder tanks in case multiple reflections lead to incorrect interpretation of product surface level.
40	UPPER_PRODUCT_DC	Upper product dielectric constant
41	TANK_PRESENTATION_2	See Table C-11.
42	AMPLITUDE_THRESHOLD	Echoes with amplitudes below the General Amplitude Threshold will be disregarded. Use this parameter to filter out noise.
43	ATP_LENGTH	Number of points in the Amplitude Threshold Point (ATP) table.
44	LENGTH_UNIT	Measurement unit for length parameters such as product level
45	LEVEL_RATE_UNIT	Measurement unit for level rate parameters.
46	SIGNAL_STRENGTH_UNIT	Measurement unit for amplitude of measurement signal.

47	ECHO_UPDATE	Refresh echo information in parameters 49 to 51. See Table C-19.
48	ECHO_COMMAND	Save found echo as a registered false echo. Remove echo from registered false echo list. See Table C-20.
49	ECHO_DISTANCE	Distance to found echo.
50	ECHO_AMPLITUDE	Signal Amplitude of found echo.
51	ECHO_CLASS	Classification of found echo, see Table C-18.
52	ECHO_FALSE	Distance to registered false echo
53	ATP_DISTANCE	You can filter out weak disturbing echoes by creating a noise threshold table defined by ATP Distance and ATP Threshold points.
54	ATP_THRESHOLD	Amplitude threshold. See ATP_DISTANCE.

Table C-18. Echo classification

VALUE	Description
0	Unknown
1	Irrelevant
2	Surface
3	False echo
4	Double Bounce
5	Secondary Surface
6	Tank Bottom Echo
7	Beam below surface
8	Beam above surface
9	LPG pin

Table C-19. Echo update

VALUE	Description
0	Uninitialized
1	Normal operation
2	Read a snapshot of found echoes

Table C-20. Echo command

VALUE	Description
0	Uninitialized
1	Add false echo
2	Remove false echo

Table C-21. Use level monitoring

VALUE	Description
0	Uninitialized
1	No
2	Yes

C.8 LPG TRANSDUCER BLOCK

The LPG transducer block contains parameters for setup and configuration of LPG calculations. It also contains parameters for verification and status of LPG corrections.

To be usable, the main transducer block has to include the appropriate source devices for gas pressure and gas temperature measurements.

See *"LPG Configuration" on page 4-20* and *"LPG Setup Using DeltaV / AMS Device Manager" on page 4-77* for more information on how to configure the 5900S for LPG measurement. See also the application example in "Analog Output Block" on page 4-48.

Table C-22. LPG-Hybrid Transducer Block parameters

Index Number	Parameter	Description
1	ST_REV	The revision level of the static data associated with the function block. The revision value increments each time a static parameter value in the block is changed.
2	TAG_DESC	The user description of the intended application of the block.
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	MODE_BLK	The actual, target, permitted, and normal modes of the block. Target: The mode to "go to" Actual: The mode the "block is currently in" Permitted: Allowed modes that target may take on Normal: Most common mode for target
6	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	UPDATE_EVT	This alert is generated by any change to the static data
8	BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
9	TRANSDUCER_DIRECTORY	Directory that specifies the number and starting indices of the transducers in the transducer block.
10	TRANSDUCER_TYPE	Identifies the transducer.
11	XD_ERROR	A transducer block alarm sub code.

12	COLLECTION_DIRECTORY	A directory that specifies the number, starting indices, and DD Item ID's of the data collections in each transducer within a transducer block.
13	LPG_SPECIAL_CONTROL	Special Control
14	LPG_CORRECTION_METHOD	Correction method
15	LPG_NUMBER_OF_GASSES	Number of gases
16	LPG_GAS_TYPE1	Gas type 1
17	LPG_GAS_PERC1	Percentage of gas type 1 in mixture of gases
18	LPG_GAS_TYPE2	Gas type 2
19	LPG_GAS_PERC2	Percentage of gas type 2 in mixture of gases
20	LPG_GAS_TYPE3	Gas type 3
21	LPG_GAS_PERC3	Percentage of gas type 3 in mixture of gases
22	LPG_GAS_TYPE4	Gas type 4
23	LPG_NUMBER_OF_PINS	Number of verification pins in the Still-pipe
24	LPG_PIN1_CONFIGURATION	Nominal position of Verification pin 1
25	LPG_PIN2_CONFIGURATION	Nominal position of Verification pin 2
26	LPG_PIN3_CONFIGURATION	Nominal position of Verification pin 3
27	LPG_PIN_TEMPERATURE	Ambient temperature when Verification Pin nominal position was entered.
28	LPG_PIN_TEMP_EXP_PPM	Expansion coefficient of still-pipe with verification pin
29	LPG_CORRECTION_ERROR	Correction error
30	LPG_CORRECTION_STATUS	Correction status
31	LPG_USED_GAS_PRESSURE	Gas pressure
32	LPG_USED_GAS_PRESSURE_STATUS	Gas pressure status
33	LPG_USED_GAS_TEMP	Gas temperature
34	LPG_USED_GAS_TEMP_STATUS	Status of gas temperature measurement
35	LPG_VERIFICATION_STATE	
36	LPG_VERIFICATION_FAILURES	
37	LPG_VERIFICATION_WARNINGS	
38	LPG_VER_PIN1_MEAS	Measured position of verification pin 1
39	LPG_VER_PIN2_MEAS	Measured position of verification pin 2
40	LPG_VER_PIN3_MEAS	Measured position of verification pin 3
41	LPG_USER_GASPRESS_VALUE	
42	LPG_USER_GASTEMP_VALUE	
43	LPG_VERPIN_CORRPOS_1	Nominal position of verification pin 1
44	LPG_VERPIN_CORRPOS_2	Nominal position of verification pin 2
45	LPG_VERPIN_CORRPOS_3	Nominal position of verification pin 3
46	LPG_CORR_PPM	Pipe expansion coefficient
47	DEVICE_COMMAND	Command
48	LENGTH_UNIT	Measurement unit for length, see "Supported Units" on page C-27.
49	PRESSURE_UNIT	Measurement unit for pressure, see "Supported Units" on page C-27
50	TEMPERATURE_UNIT	Measurement unit for temperature, see "Supported Units" on page C-27
51	SIGNAL_STRENGTH_UNIT	Measurement unit for signal strength, see "Supported Units" on page C-27

C.8.1 Correction Method

Table C-23. Identification number for various LPG correction methods

Value	Description
0	Air correction
1	One known gas
2	One or more unknown gases
3	Two gases, unknown mix ratio
4	Stable composition
100	Correction method 100
101	Correction method 101

C.8.2 Gas Type

Table C-24. Identification number for various gas types

Value	Description
0	User gas 0
1	User gas 1
2	Default gas
3	Ammonia
4	N-Buthane
5	Isobuthane
6	Ethylene
7	Propadiene
8	Propylene
9	Propane
10	Air
11	Pentane
12	Isobuthylene
13	Chloroethylene
14	Nitrogen
100	LPG Gas 100
101	LPG Gas 101
102	LPG Gas 102

C.9 SUPPORTED UNITS

C.9.1 Unit Codes

Table C-25. Length units

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

Table C-26. Level Rate units

ID	Display	Description
1061	m/s	meter / second
1063	m/h	meter / hour
1067	ft/s	feet / second
1069	in/m	inch / minute
1073	ft/h	feet / hour

Table C-27. Temperature units

ID	Display	Description
1000	K	Kelvin
1001	°C	Degree Celsius
1002	°F	Degree Fahrenheit

Table C-28. Signal Strength units

ID	Display	Description
1243	mV	millivolt

Table C-29. Volume units

ID	Display	Description
1034	m^3	Cubic meter
1043	ft^3	Cubic feet
1048	Gallon	US gallon
1051	Bbl	Barrel

Table C-30. Pressure units

ID	Display	Description
1130	Pa	Pascal
1133	kPa	Kilo Pascal
1137	Bar	Bar
1138	mBar	Millibar
1140	atm	Atmospheres
1141	psi	pounds / sqaure inch
1590	bar G	bar Gauge relative
1597	bar A	bar Absolute

Index

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Emerson Process Management

Rosemount Tank Gauging
Box 130 45
SE-402 51 Göteborg
SWEDEN
Tel (International): +46 31 337 00 00
Fax (International): +46 31 25 30 22
E-mail: sales.rtg@emerson.com
www.rosemount-tg.com

EMERSON™
Process Management