Reference Manual
00809-0100-2240, Rev EA
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Rosemount™ 2240S Multi-Input Temperature Transmitter

EMERSON

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Rosemount™ 2240S Multi-Input Temperature Transmitter

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 Automation Solutions/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.

⚠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.

⚠WARNING

WARNING - Substitution of components may impair Intrinsic Safety.

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

AVERTISSEMENT - La substitution de composants peut compromettre la sécurité intrinsèque.

AVERTISSEMENT - Ne pas ouvrir en cas de presence d'atmosphere explosive.

⚠WARNING

Physical access

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

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

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 hand held 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 Manual overview

This manual provides installation, configuration, and maintenance information for the Rosemount™ 2240S Multi-input Temperature Transmitter. The manual is based on a typical Rosemount Tank Gauging system with a Rosemount 2410 Tank Hub connected to supported devices such as the Rosemount 2240S Temperature Transmitter. It also includes a brief overview of Foundation™ fieldbus, and provides device specific information to allow installation of a Rosemount 2240S in Foundation fieldbus networks.

Section 2: Overview provides a brief description of the various components in a Rosemount Tank Gauging system and recommended installation procedure.

Section 3: Sensor Installation covers installation considerations as well as mechanical installation of multiple spot temperature and water level sensors.

Section 4: Rosemount™ 2240S Installation covers installation considerations as well as mechanical installation of the Rosemount 2240S.

Section 5: Configuration/Operation describes how to configure the Rosemount 2240S by using tools such as Rosemount TankMaster, Rosemount 475 Field Communicator, or AMS Device Manager. This section also provides an overview of FOUNDATION fieldbus operation with the Rosemount 2240S.

Section 6: Service and Troubleshooting covers tools, troubleshooting, and various service instructions.

Appendix A: Specifications and Reference Data contains specifications, dimensional drawings, and ordering table.

Appendix B: Product Certifications contains information on approvals and certifications.

Appendix C: FOUNDATION™ FIELDBUS BLOCK INFORMATION describes the various function and transducer blocks which are used for the Rosemount 2240S.

1.3 Technical documentation

The Rosemount Tank Gauging System includes the following documentation:

1.3.1 Reference manuals

- Rosemount Tank Gauging System Configuration Manual (00809-0300-5100)
- Rosemount 2460 System Hub Reference Manual (00809-0100-2460)
- Rosemount 2410 Tank Hub Reference Manual (00809-0100-2410)
- Rosemount 5900S Radar Level Gauge Reference Manual (00809-0100-5900)
- Rosemount 5900C Radar Level Gauge Reference Manual (00809-0100-5901)
- Rosemount 5900 Proof Test Manual Supplement (00809-0200-5900)
- Rosemount 2240S Temperature Transmitter Reference Manual (00809-0100-2240)
- Rosemount 2230 Display Reference Manual (00809-0100-2230)
- Rosemount 5300 Series Reference Manual (00809-0100-4530)
- Rosemount 5408 Series Reference Manual (00809-0300-4408)
- Rosemount TankMaster Software Installation Reference Manual (00809-0400-5110)
- Rosemount TankMaster WinView Reference Manual (00809-0300-5110)
- Rosemount TankMaster WinOpi Reference Manual (00809-0200-5110)
- Rosemount TankMaster WinSetup Reference Manual (00809-0100-5110)
- Rosemount Tank Gauging Wireless System Reference Manual (00809-0100-5200)
- Rosemount TankMaster Floating Roof Monitoring Reference Manual (00809-0500-5100)

1.3.2 Product data sheets

- Rosemount Tank Gauging System Data Sheet (00813-0100-5100)
- Rosemount 2460 System Hub Product Data Sheet (00813-0100-2460)
- Rosemount 2410 Product Data Sheet (00813-0100-2410)
- Rosemount 5900S Product Data Sheet (00813-0100-5900)
- Rosemount 5900C Product Data Sheet (00813-0100-5901)
- Rosemount 2240S Product Data Sheet (00813-0100-2240)
- Rosemount 2230 Product Data Sheet (00813-0100-2230)
- Rosemount 5300 Product Data Sheet (00813-0100-4530)
- Rosemount 5408 Product Data Sheet (00813-0100-4408)
- Rosemount 565/566/765/614 Product Data Sheet (00813-0100-5565)

1.3.3 Drawings

Table 1-1. Installation drawings for the Rosemount 2240 Multi-Input Temperature Transmitter

Drawing	Issue	Title
D9240 041-912	2	Mechanical Installation Drawing
D9240 041-959	4	Electrical Installation Drawing
D7000 001-798	2	System Installation Drawing Foundation fieldbus FISCO
D7000 001-811	1	System Installation Drawing Foundation fieldbus IS Entity
D7000 005-451	2	Type 614 wiring
D9261 085-035	3	General arrangement - Leak detection temperature sensors
D9261 085-036	3	General arrangement - Cool down temperature sensors
D9261 085-039	2	Rosemount 2240/614 accessory conical connection

1.4 Service support

For service support contact the nearest *Emerson Automation Solutions/Rosemount Tank Gauging* representative. Contact information can be found on the web site Emerson Automation Solutions/Rosemount Tank Gauging.

1.5 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 placed on the transmitter housing

1.6 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.

1.6.1 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.

1.6.2 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.

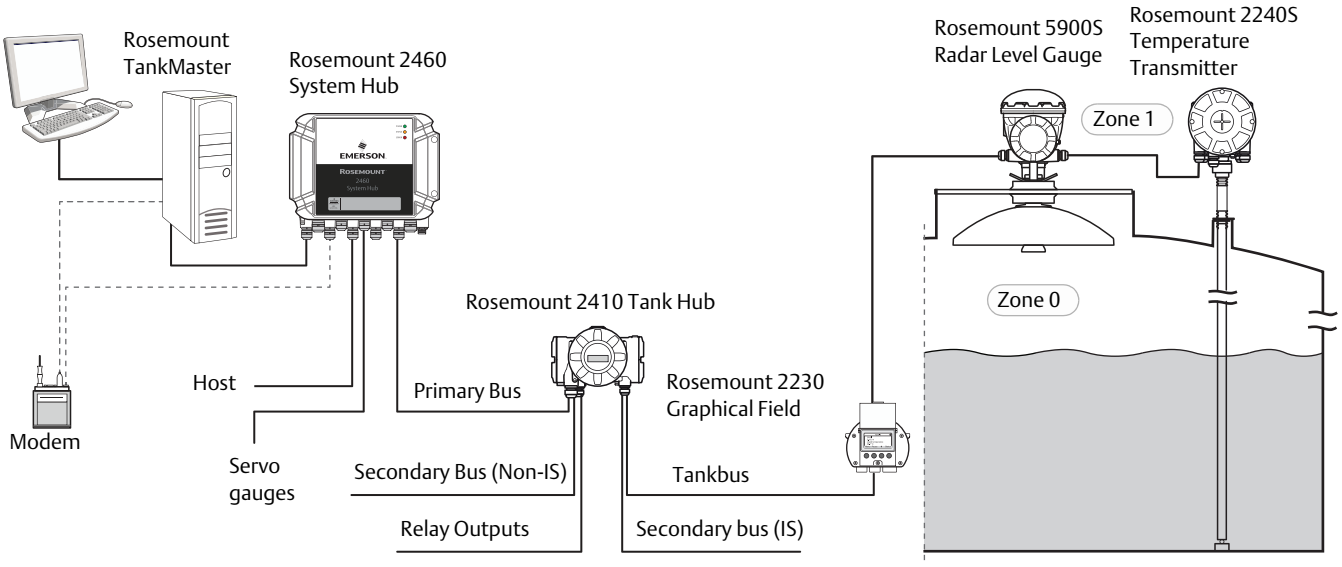
Note
Landfill is not a recycling option and should be avoided.

Section 2 Overview

2.1 Introduction

The Rosemount™ 2240S Multi-input Temperature Transmitter can connect up to sixteen 3- or 4-wire temperature spot elements and an integrated water level sensor. The Rosemount 2240S sends measurement data, such as temperature and water level, via the intrinsically safe 2-wire Tankbus[1], to a Rosemount 2410 Tank Hub. Measurement data and status information can be viewed on a PC with the Rosemount TankMaster software, as well as on the integral display of the tank hub and the Rosemount 2230 Graphical Field Display.
Data from a group of tanks is buffered by a Rosemount 2460 System Hub, and is distributed to a Rosemount TankMaster PC, or another host system, whenever the system hub receives a request for data. In case no system hub is included in the system, the tank hub can communicate directly with the host computer.

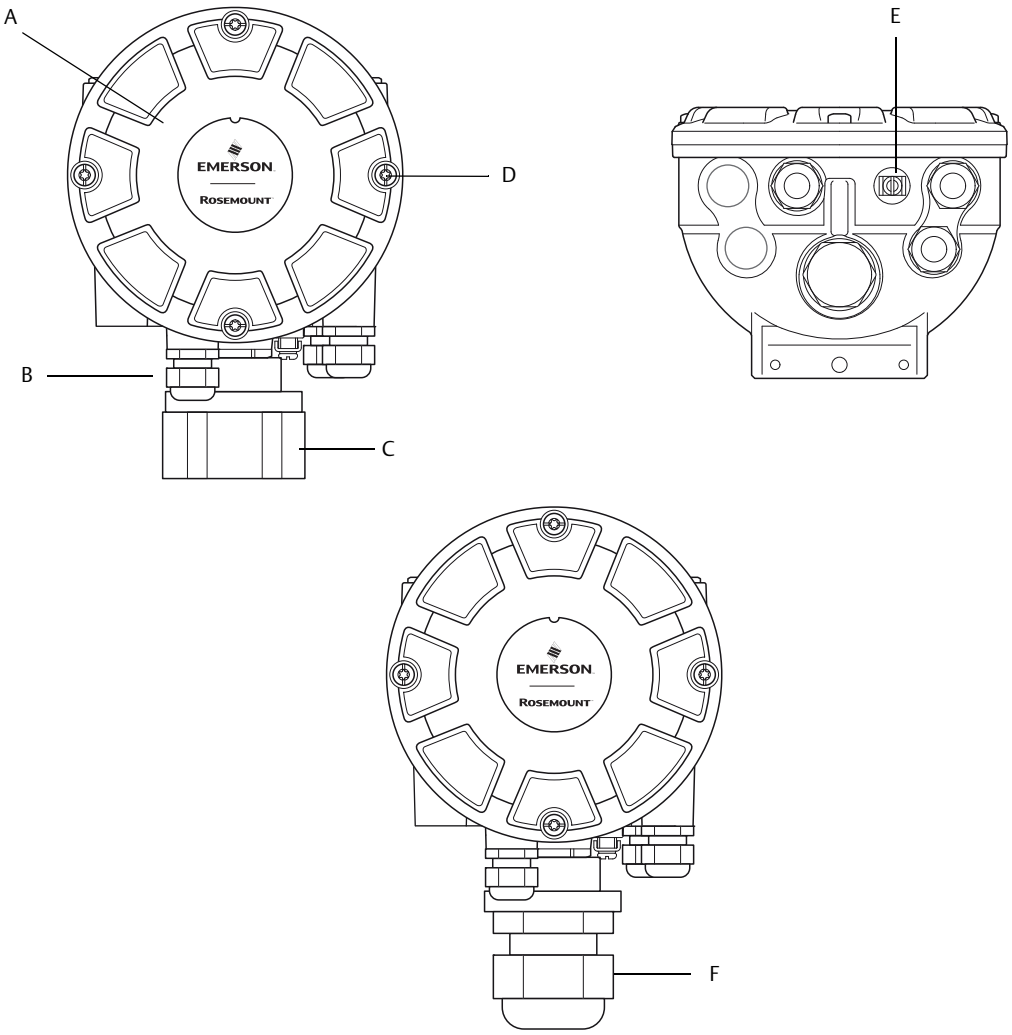
Figure 2-1. System integration



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

2.2 Components

Figure 2-2. Rosemount 2240S components



A. Cover.

B. Entries (x 3) of type ½ - 14 NPT.

C. Lock nut for connection of Multi Spot Temperature sensor and Water Level Sensors (MST/WLS).

D. Cover screws (x 4).

E. External ground screw.

F. M32 Cable gland (option for remote mounting).

2.3 System overview

The Rosemount Tank Gauging system 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 Rosemount Tank Gauging 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.

The Rosemount Tank Gauging system 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 Rosemount Tank Gauging devices, 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 Rosemount Tank Gauging 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 2-3. Rosemount Tank Gauging System Architecture

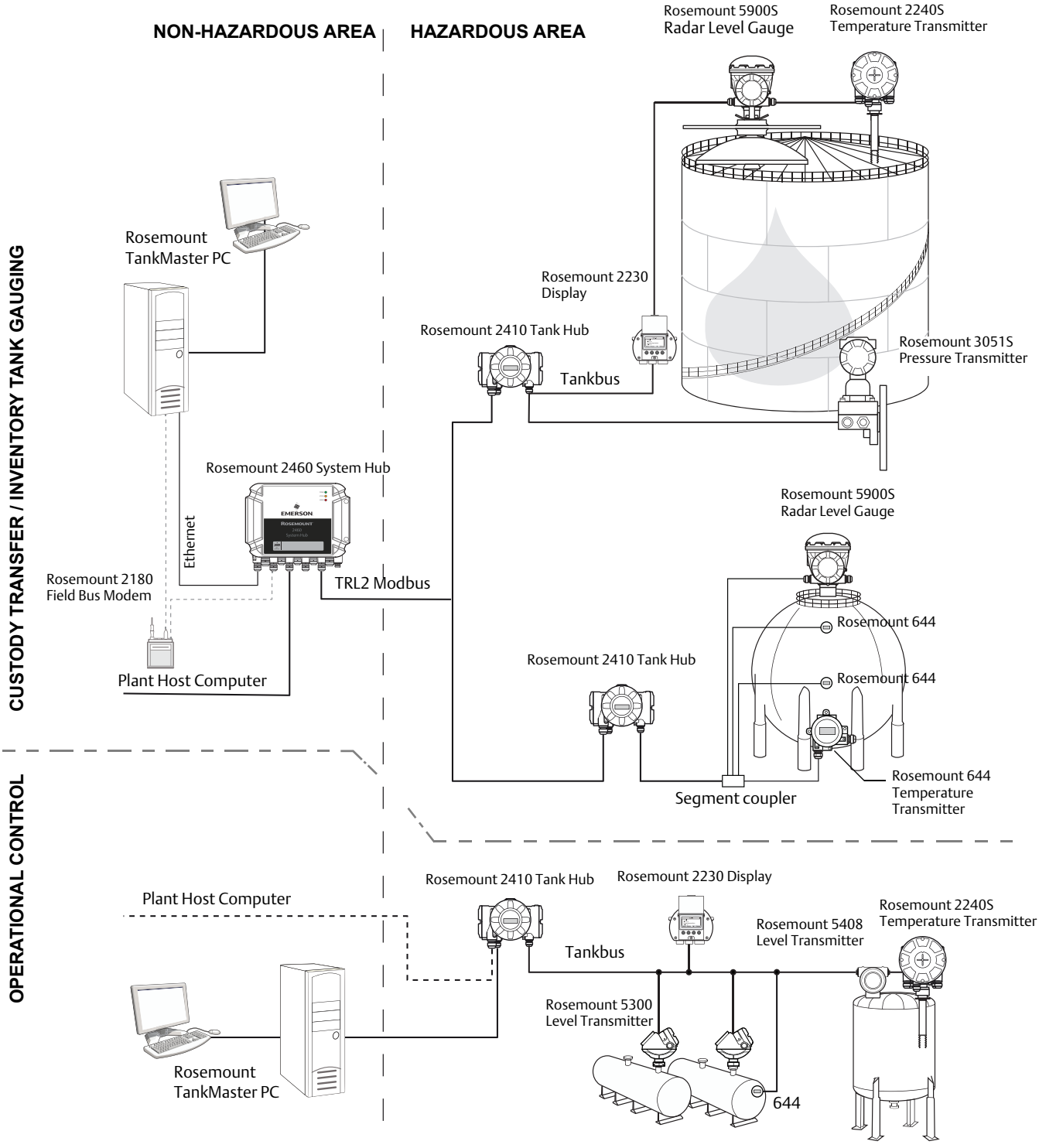


Figure 2-4. Rosemount Tank Gauging System Architecture for Wireless Systems

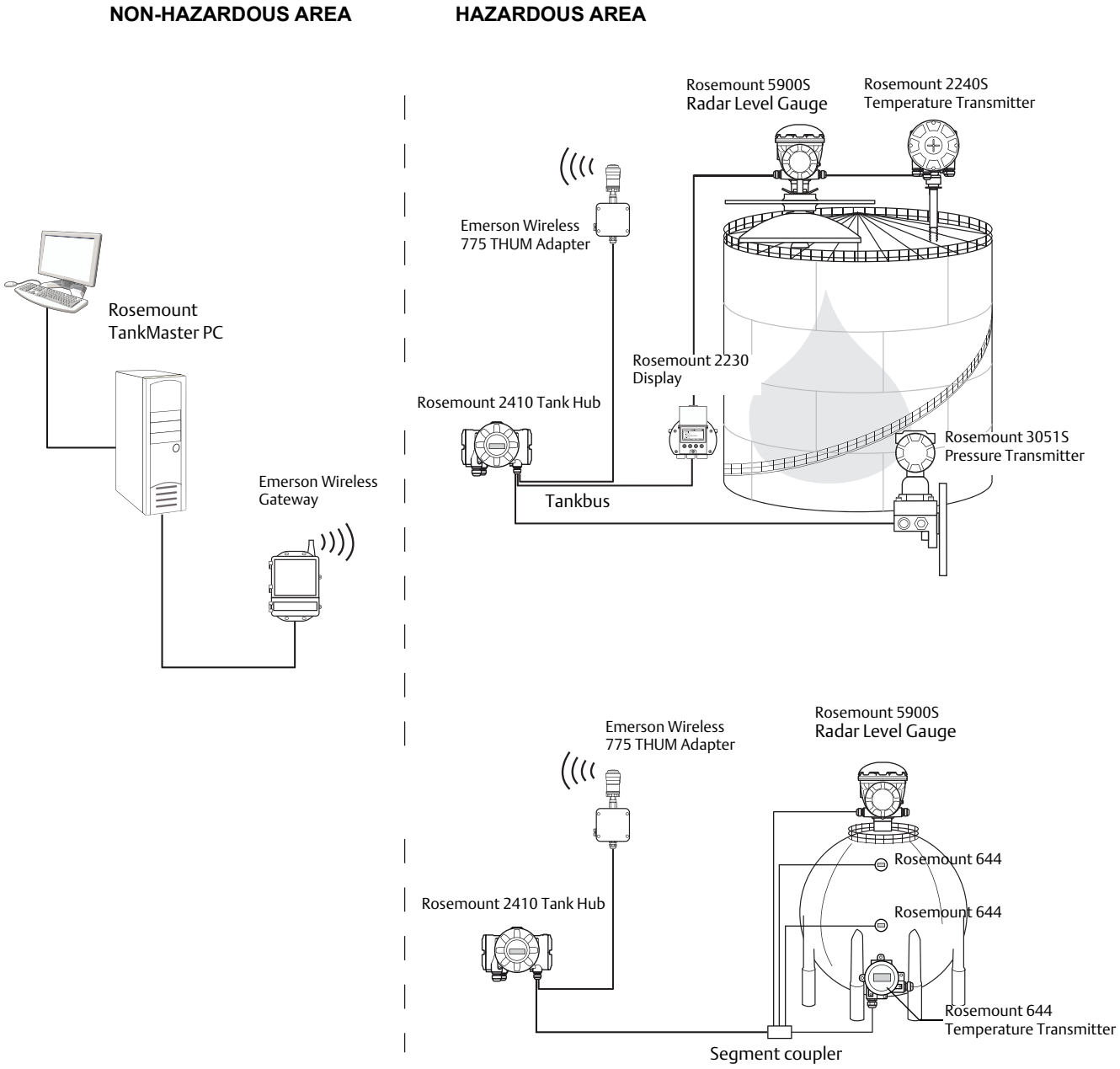


Figure 2-5. Rosemount Tank Gauging System Architecture in a FOUNDATION Fieldbus Network

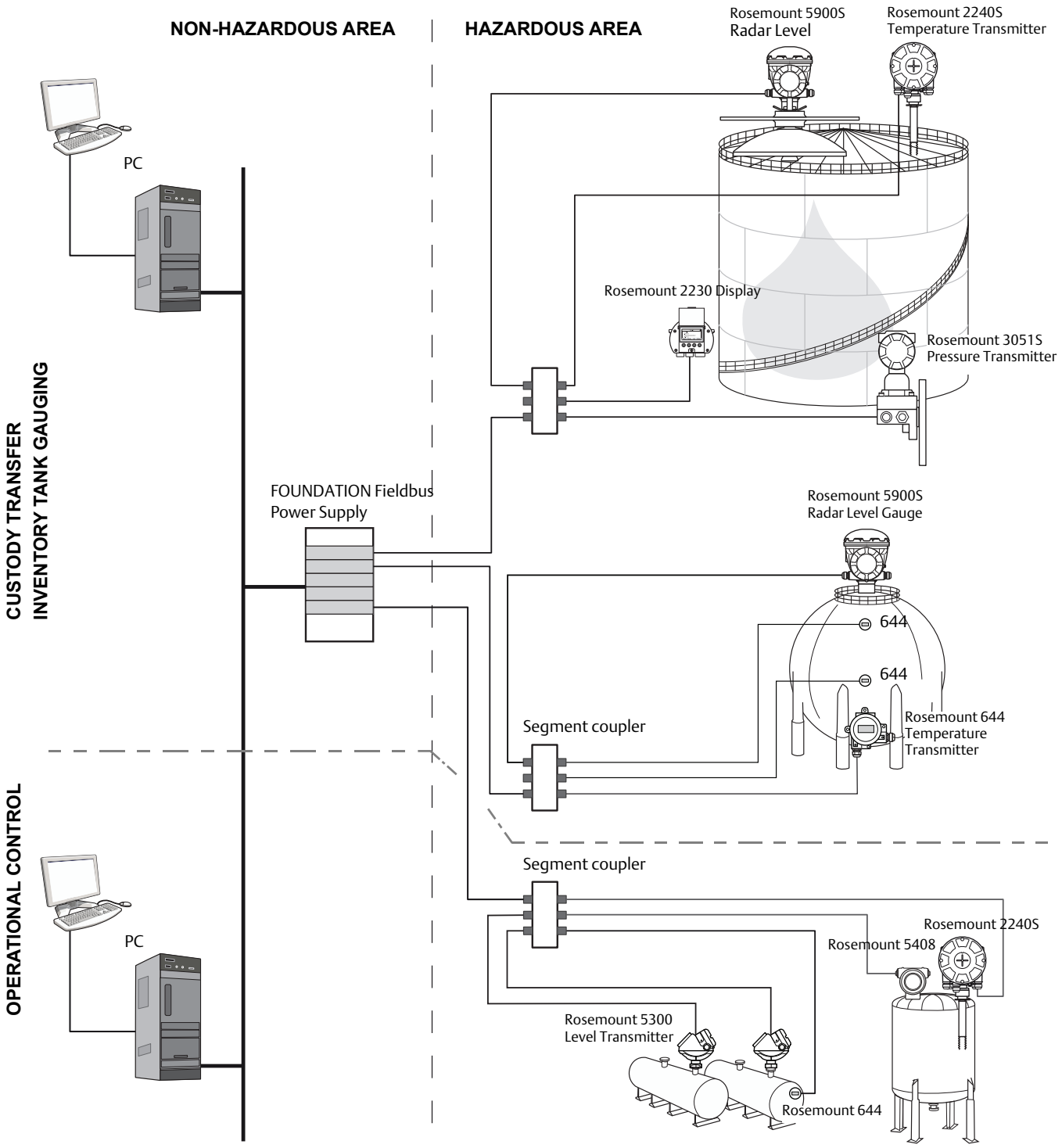
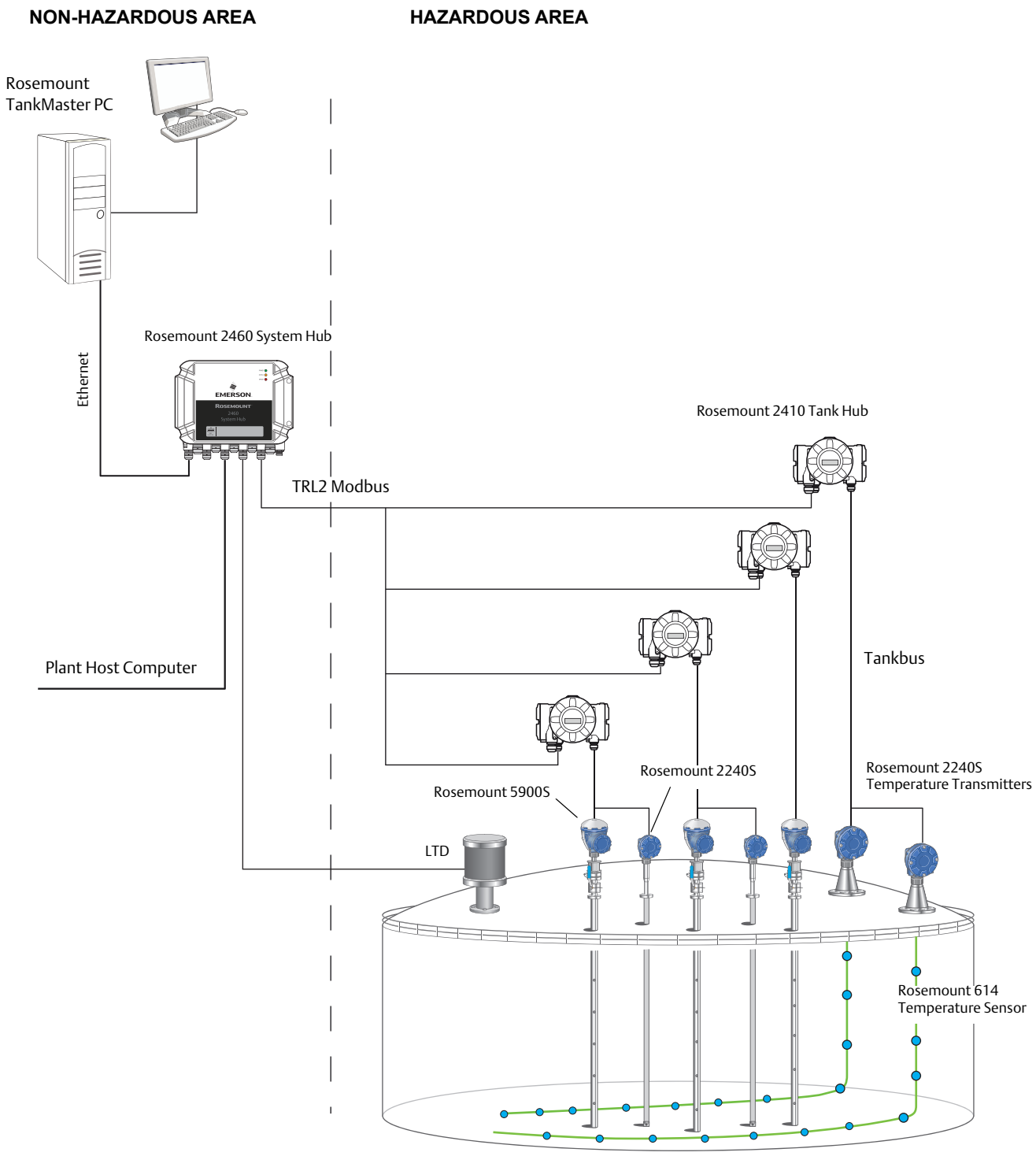


Figure 2-6. LNG Tank in Rosemount Tank Gauging System



TankMaster HMI Software

Rosemount 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 Rosemount Tank Gauging systems and other supported instruments.

TankMaster is designed to be used in the Microsoft® Windows environment providing easy access to measurement data from your Local Area Network (LAN).

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 devices in the Rosemount Tank Gauging system.

Rosemount 2460 System Hub

The Rosemount 2460 System Hub 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 system hub can immediately send data from the updated buffer memory for a group of tanks.

Measured and calculated data from one or more tanks is communicated via the Rosemount 2410 Tank Hub to the system hub buffer memory. Whenever a request is received, the system hub can immediately send data from a group of tanks to a TankMaster PC, or a host.

The Rosemount 2460 can be used to connect devices from other vendors as well, such as Honeywell® Enraf and Whessoe.

The Rosemount 2460 has eight slots for communication interface boards. These boards can be individually configured for communication with hosts or field devices. They can be ordered for various interfaces, for example TRL2, RS485, Enraf BPM, and Whessoe 0-20 mA/RS485 communication. Two slots can also be configured for RS232 communication.

One of the system hub's three Ethernet ports is used for Modbus TCP connection to host systems. By simply connecting the system hub to the existing LAN network, communication over Ethernet is established.

The system hub can provide redundancy for critical operations, by using two identical devices. The primary system hub is active and the other one is in passive mode. If the primary unit stops working properly, the secondary unit is activated and a failure message is sent to TankMaster (or a DCS system).

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 tank hub 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 Rosemount 2410 Tank Hub; one for single tank operation and one for multiple tanks operation. The multiple tanks version of the Rosemount 2410 supports up to 10 tanks and 16 devices. With the Rosemount 5300 the Rosemount 2410 supports up to 5 tanks.

The Rosemount 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 Rosemount 2410 supports Intrinsically Safe (IS) and Non-Intrinsically Safe (Non-IS) analog 4-20 mA inputs/outputs. By connecting an Emerson™ Wireless 775 THUM™ Adapter to the IS HART 4-20 mA output, the tank hub is capable of wireless communication with an Emerson Wireless Gateway in a *Wireless*HART® 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 Rosemount 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 Rosemount 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 Rosemount 5900S Radar Level Gauge has two radar modules in the same transmitter housing allowing two independent level measurements using one antenna and one tank opening.

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 Rosemount 5301 for liquid level measurements and the Rosemount 5302 for liquid level and interface measurements.

Rosemount 5408 Radar Level Transmitter

The Rosemount 5408 is a non-contacting level transmitter for accurate and reliable level measurement on small storage and buffer tanks.

The Rosemount 5408 provides accurate and reliable level measurements for metallic and non-metallic vessels. It is suitable for almost any liquid and is ideal for challenging applications with agitators, foam, high temperatures, and pressures. It is also an excellent choice for level measurement in tanks with small diameter (2- to 4-inch) stiling wells.

The narrow beam makes the Rosemount 5408 the ideal solution for bulk solids in small to medium sized silos with rapid level changes.

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 Rosemount 2230 displays can be used on a single tank.

Rosemount 644 Temperature Transmitter

The Rosemount 644 is used with single spot temperature sensors.

Rosemount 565/566/765 Multiple Spot Temperature Sensors

These multiple spot sensors offer precise measurements for liquid temperature in a wide range of applications. The Rosemount 565 provides a temperature profile by using up to sixteen Pt-100 spot elements. The Rosemount 566 is used for cryogenic applications. The Rosemount 765 has an integrated water level sensor available in open and closed versions for crude oil and lighter fuels, respectively.

Rosemount 614 Cryogenic Spot Temperature Sensor

The Rosemount 614 Cryogenic Spot Temperature Sensor is designed for temperature measurements in cryogenic and refrigerated full containment storage tanks. It is used with Rosemount 2240S Multi-Input Temperature Transmitters for applications such as leak detection between inner and outer tank, as well as skin temperature and/or cool-down monitoring.

The spot elements are wired through a mineral-insulated flexible steel cable up to 300 m (980 ft). This allows temperature measurements inside a full containment tank during the cool-down procedure and for leak detection and corner protection in the insulation space.

Rosemount 614 temperature sensors are easily integrated through a conical connection or a junction box to the Rosemount 2240S Multi-input Temperature Transmitter. Each 2240S Transmitter supports up to 16 Rosemount 614 temperature sensors.

Rosemount 3051S Pressure Transmitter

The Rosemount 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 Rosemount 3051S Pressure Transmitter near the bottom of the tank as a complement to a Rosemount 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 Rosemount 2180 is connected to the PC using either the USB or the RS232 interface.

Emerson Wireless Gateway and Emerson Wireless 775 THUM™ Adapter

An Emerson Wireless 775 THUM Adapter allows wireless communication between a Rosemount 2410 Tank Hub and an Emerson 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 *Rosemount Tank Gauging System Data Sheet* (Document No. 00813-0100-5100) for more information on the various devices and options.

2.4 Getting started

To start up a Rosemount Tank Gauging system do the following:

1. Install the TankMaster software on the control room PC.
2. Prepare the start-up by recording the information that will be needed for configuration of the various devices as described in the Rosemount Tank Gauging System Configuration Manual.
3. Connect the Rosemount 2460 System Hub to the TankMaster PC. The system hub may be connected via Modbus TCP, a Rosemount 2180 Field Bus Modem, or directly via RS232 or RS485 interface.
4. Connect the Rosemount 2410 Tank Hub to the Rosemount 2460 System Hub.
5. Connect the field devices, such as a Rosemount 5900S Radar Level Gauge and a Rosemount 2240S Multi-input Temperature Transmitter, to the Rosemount 2410 Tank Hub via the Tankbus.
6. Configure the Rosemount 2460 System Hub (if included in the system) by using the *TankMaster WinSetup* configuration software.
7. Configure the Rosemount 2410 Tank Hub by using the *TankMaster WinSetup* configuration software.
8. Configure field devices, such as the Rosemount 5900S and the Rosemount 2240S, by using the *TankMaster WinSetup* configuration software.

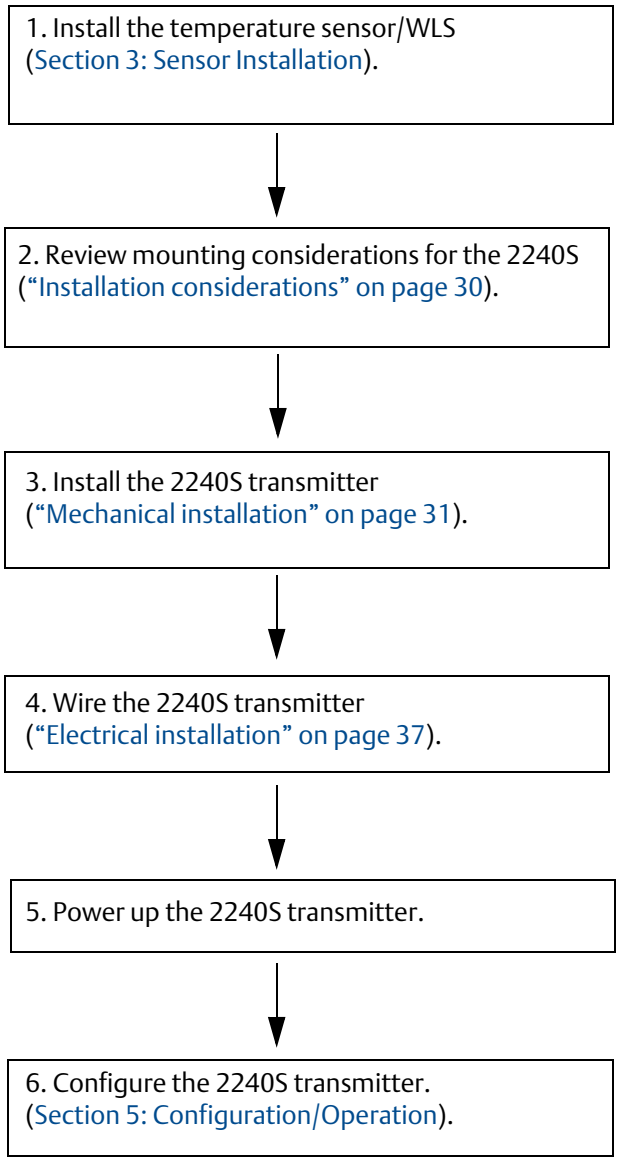
To start up Rosemount Tank Gauging devices in a FOUNDATION fieldbus system:

1. Prepare the start-up by recording the information that will be needed for configuration of the various field devices as described in the Rosemount Tank Gauging System Configuration Manual.
2. Connect the field devices, such as the Rosemount 5900S Radar Level Gauge and Rosemount 2240S Multi-input Temperature Transmitter, to the FOUNDATION fieldbus network.
3. Configure the field devices by using the AMS Device Manager.

See see the Rosemount Tank Gauging System Configuration Manual for more information on how to configure the various Rosemount Tank Gauging devices.

2.5 Installation procedure

Follow these steps for proper installation of the Rosemount 2240S:



Section 3 Sensor 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 handheld 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 Rosemount™ 2240S is off and the lines to any other external power sources are disconnected or not powered while wiring the gauge.

3.2 Installation considerations

A Multiple Spot Temperature sensor (MST) and Water Level Sensor (WLS) must be installed on the tank before installing the Rosemount 2240S Multi-input Temperature Transmitter.

The MST/WLS is normally anchored to the bottom of the tank by attaching a weight at the end of the tube. A tank expands when it is filled or warmed up, causing the roof to move slightly upwards. The weight has a shackle which allows the tube to follow the expansion.

Multiple Spot Temperature sensor (MST)

- Be careful with the flexible protection tube
- Temperature and Water Level Sensors should be located as far away as possible from heating coils and mixers.
- In case the flexible tube is damaged, please contact *Emerson Automation Solutions/Rosemount Tank Gauging*.
- Do not attempt to fix or rebuild the temperature sensor since this may cause serious malfunctions

Water Level Sensor

- Handle the Water Level Sensor carefully
- Leave the sensor protection on until the final positioning in the tank

3.3 Multiple Spot Temperature sensor

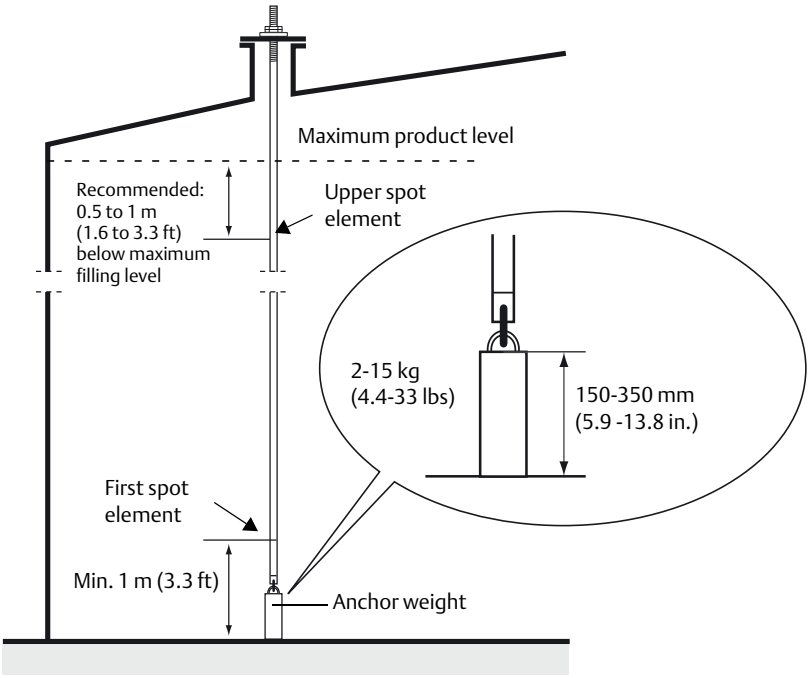
A Multiple Spot Temperature sensor (MST) typically measures the temperature with a number of Pt100 elements placed at different heights to provide a temperature profile and average temperature of the product. The spot elements are placed in a flexible gas tight tube made of stainless steel which can be anchored to the tank bottom, see "Installing a temperature sensor tube" on page 25.

Up to 16 Pt100 temperature elements can be connected to a Rosemount 2240S Multi-input Temperature Transmitter.

3.3.1 Installation on fixed roof tanks

On fixed roof tanks the MST is attached to a flange mounted on a suitable nozzle.

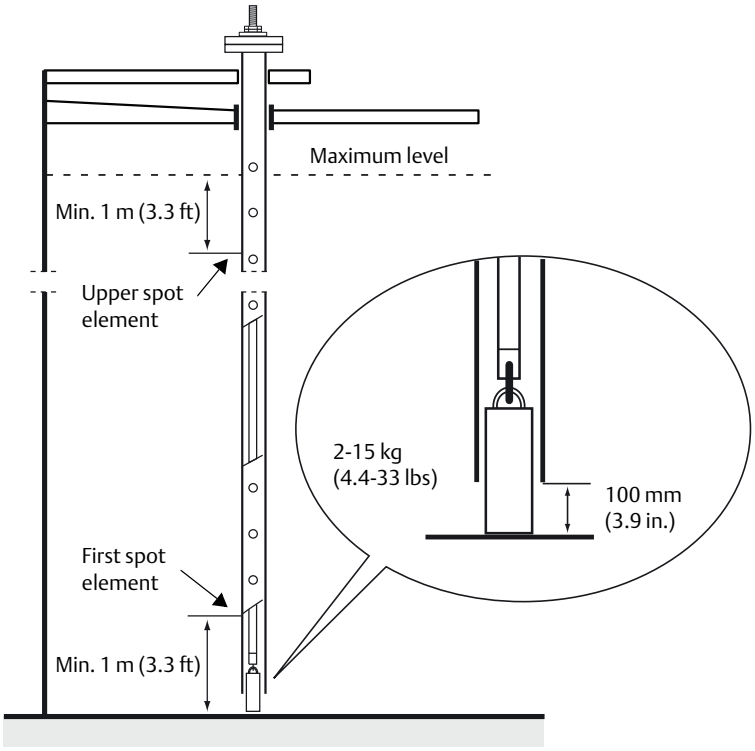
Figure 3-1. Installation of multiple spot temperature elements on fixed roof tanks



3.3.2 Installation on floating roof tanks

On floating roof tanks the temperature elements can be mounted in a still-pipe as illustrated in Figure 3-2 or in other suitable roof openings.

Figure 3-2. Installation of multiple spot temperature elements in still-pipe



3.3.3 Custody transfer applications

For Custody Transfer applications, API chapter 7 recommends a minimum of one temperature element per 3 meters (10 feet) as illustrated in Figure 3-3. *Emerson Automation Solutions/Rosemount Tank Gauging* may in some cases recommend even more temperature elements for Custody Transfer tanks, depending on how the tanks are operated.

Figure 3-3. Recommended position of temperature elements for Custody Transfer applications

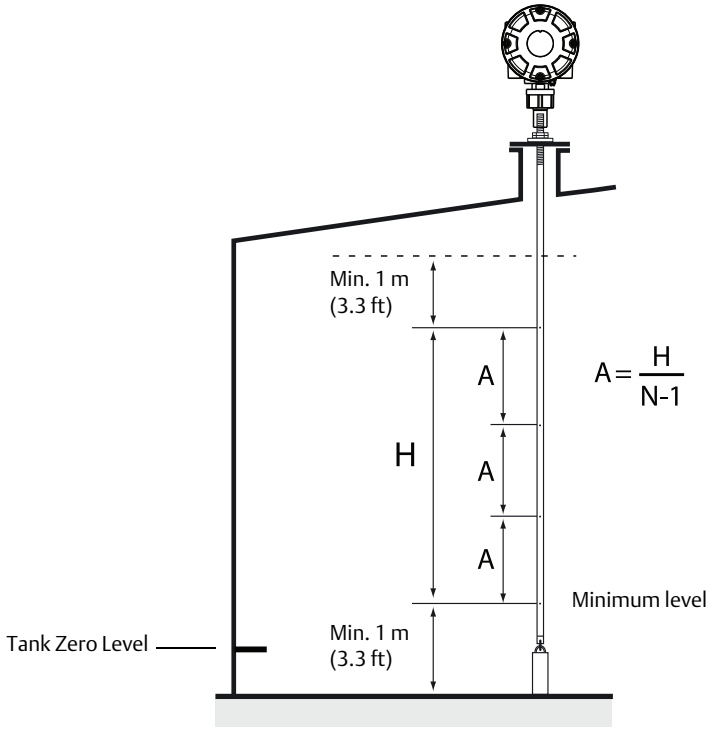


Table 3-1. Number of spot sensors for various tube lengths

Tube length	Number of temp. elements
< 9 m	4
9 - 15 m	5
> 15 m	6

Example

5 spot sensors and H=10 m.

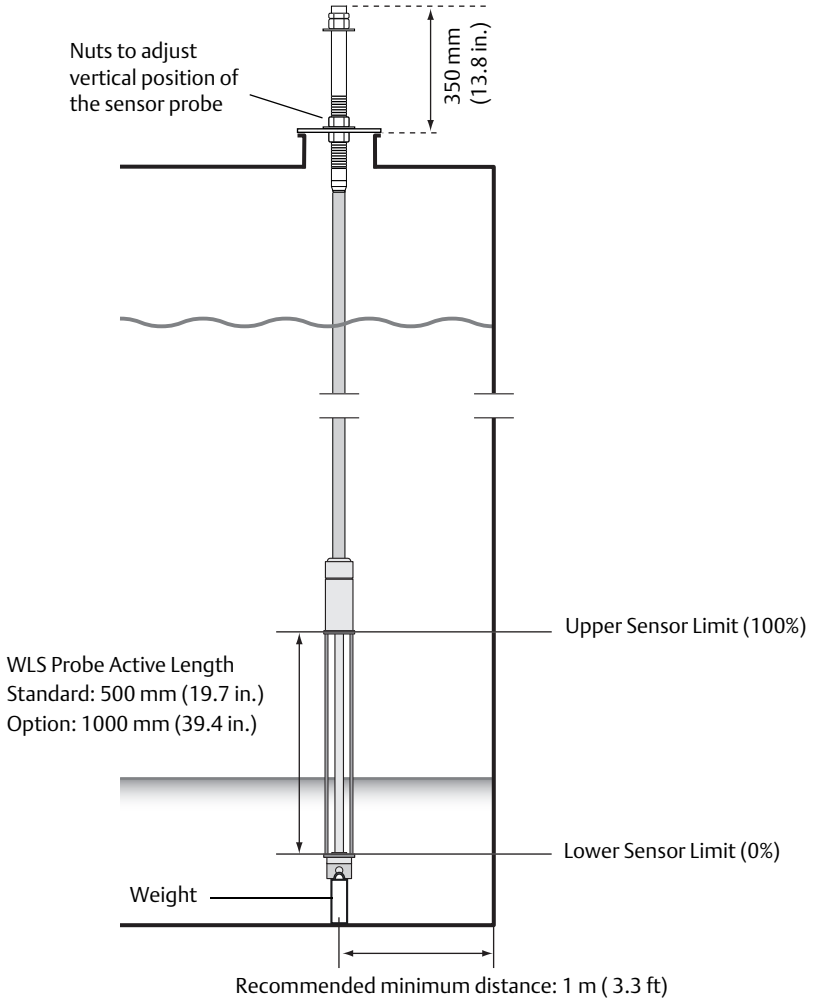
A=10/(5-1)=2.5 m.

The position of a temperature element is measured from the Tank Zero Level. See the Rosemount Tank Gauging System Configuration Manual for more information about how to use the TankMaster WinSetup software to configure temperature elements for average temperature calculations.

3.4 Water Level Sensor

The water level sensor (WLS) probe, with integrated temperature elements, is attached at the lower end of the flexible protection tube. A weight is attached to stabilize the tube as illustrated in Figure 3-4. At the upper part of the sensor probe, nuts are placed at the middle of the threaded section, 350 mm below the top of the probe. This is intended as a starting point for adjusting the vertical position of the probe.

Figure 3-4. Water Level Sensor with integrated temperature sensors



As an option, the tube may be stabilized by putting a concentric weight above the WLS probe, instead of at the end, in order to ensure that measurements are performed as close to the tank bottom as possible. Also, the eyebolt at the end of the tube can be removed.

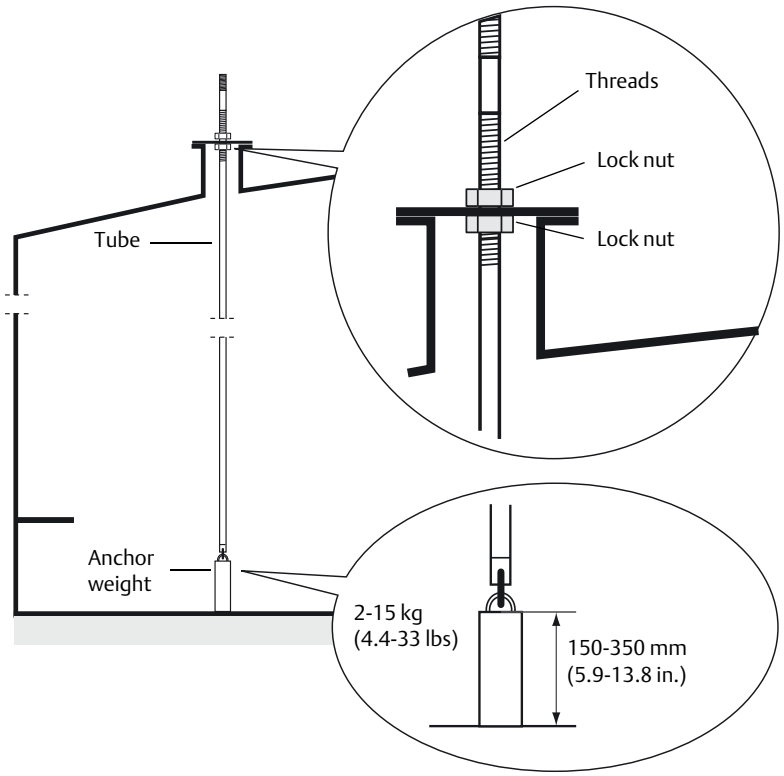
See also "Water Level Sensor calibration" on page 57 and "Water Level Sensor measuring range" on page 59 for more information on how to calibrate and configure the water level sensor.

3.5 Installing a temperature sensor tube

Follow these steps to install the temperature sensor tube:

1. Mount the anchor weight on the tube.
2. Mount the tube so that the threads at the top of the tube fits the nozzle flange as illustrated in Figure 3-5:

Figure 3-5. Adjusting the temperature sensor tube



3. When the tube is placed on the nozzle, adjust the vertical position with the lock nuts. If a weight is placed at the end of the tube, it should barely touch the tank bottom.
4. Install the Rosemount 2240S Multi-Input Temperature Transmitter, see "Mechanical installation" on page 31.

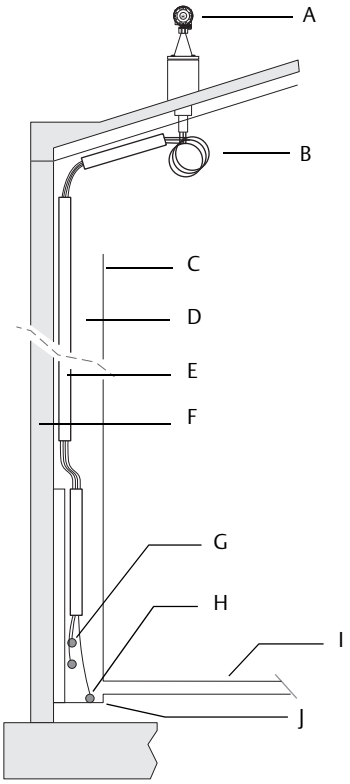
Note
Ensure that the flexible protection tube is in a vertical position to obtain correct measurement data.

3.6 Rosemount 614 Cryogenic Spot Temperature Sensor

This section shows a couple of application examples that use Rosemount 2240S Temperature Transmitters and Rosemount 614 Cryogenic Temperature Sensors in LNG full containment tanks. The Rosemount 614 is suitable for leakage detection as well as skin temperature and cool-down monitoring in LNG tanks.

3.6.1 Leakage detection on LNG full containment tank

Figure 3-6. Example of Leakage Detection Installation



A: Rosemount 2240S Multi-input Temperature Transmitter (mounted on cone connection)

B. Rosemount 614 Cryogenic Spot Temperature Sensor
Minimum bending radius=100 mm (3.9 in.)

C. Inner tank wall

D. Annular space

E. Sensor support

F. Concrete secondary container

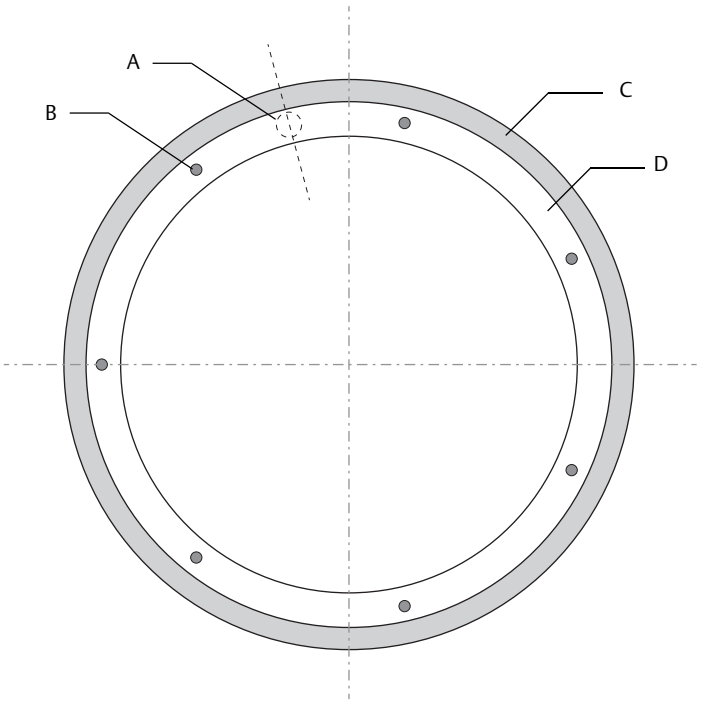
G. Rosemount 614 leak sensor at corner protection

H. Rosemount 614 leak sensor for annular space

I. Inner tank bottom

J. Second tank bottom

Figure 3-7. Typical Distribution of Temperature Sensor Elements



A. Corner protection

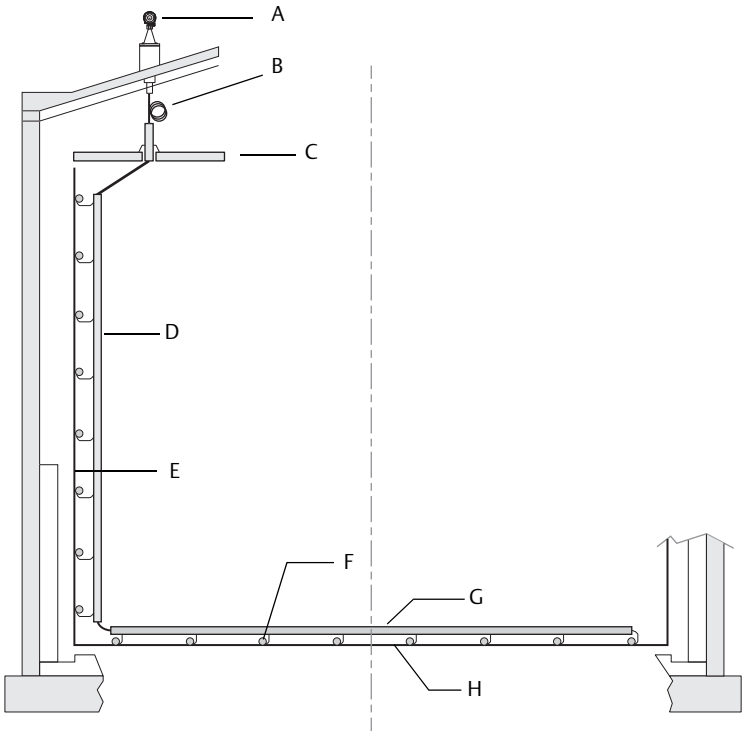
B. Temperature sensor elements

C. Concrete secondary container

D. Annular space

3.6.2 Skin temperature and cool-down monitoring on LNG tank

Figure 3-8. Example of Skin Temperature and Cool-down Monitoring Installation



A: Rosemount 2240S Multi-input Temperature Transmitter (mounted on cone connection)

B. Rosemount 614 Cryogenic Spot Temperature Sensors.
Minimum bending radius=100 mm (3.9 in.)

C. Suspend deck

D. Sensor support

E. Inner tank wall

F. Temperature sensor element

G. Sensor support for guiding sensor

H. Inner tank bottom

Section 4 Rosemount™ 2240S Installation

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.

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

⚠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 hand held 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 Rosemount 2240S is off and the lines to any other external power sources are disconnected or not powered while wiring the gauge.

4.2 Installation considerations

The information in this section covers installation considerations for the Rosemount 2240S Multi-input Temperature Transmitter in order to achieve a proper installation and optimum measurement performance.

In order to reduce the required cabling, Rosemount Tank Gauging devices, including the Rosemount 2240S, are designed for daisy-chain connection of the Tankbus and shield grounding to other field devices.

The Rosemount 2240S is designed for installation:

- on top of the MST/WLS
- on top of Rosemount 614 cone
- remote on a pipe or wall

With remote mounting of the Rosemount 2240S, the nut and sleeve at the bottom of the 2240S can be replaced by a M32 cable gland, see "Components" on page 8 and "Ordering information" on page 149.

When the Rosemount 2240S transmitter is installed in a hazardous area, ensure that the installation requirements according to "Hazardous areas" on page 40 are complied with.

Ensure that the recommended cable glands/conduits are used.

Ensure that the Tankbus is correctly terminated, see "Termination" on page 41.

Ensure that grounding is performed according to national and local electrical codes, see "Grounding" on page 38.

Do not install the Rosemount 2240S in non-intended applications, for example environments where it may be exposed to extremely intense magnetic fields or extreme weather conditions.

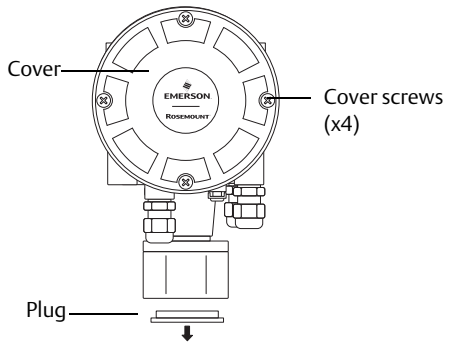
Ensure that the Rosemount 2240S is installed such that it is not exposed to higher pressure and temperature than specified in *Appendix A: Specifications and Reference Data*.

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

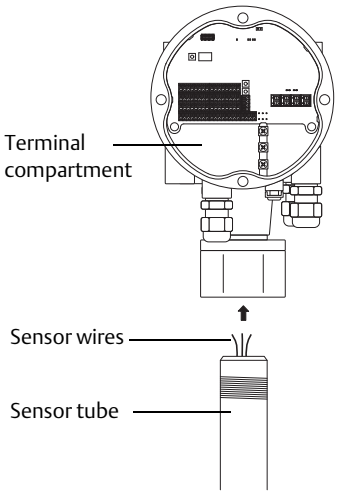
- chemical compatibility of wetted materials
- design/operation pressure and temperature

4.3 Mechanical installation

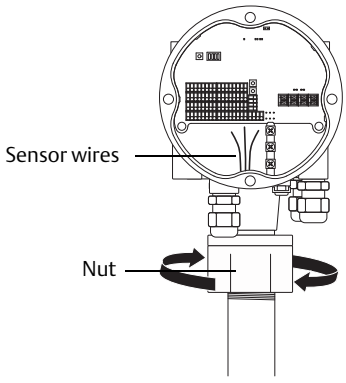
4.3.1 Mounting on top of a temperature sensor/WLS



1. Ensure that the temperature and water level sensors are properly installed as described in Section 3: Sensor Installation.
2. Unscrew the four screws and remove the cover.
3. Remove the plug that protects the cable entry at the bottom of the 2240S transmitter housing.



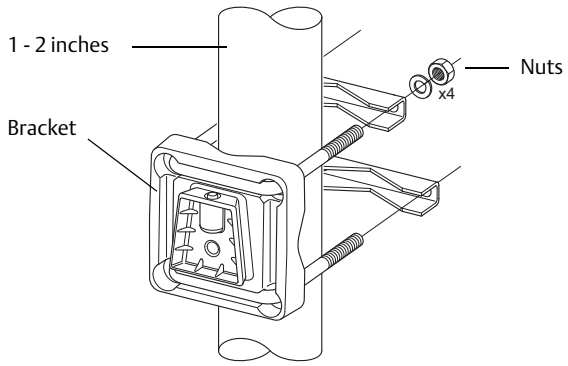
4. Attach the Rosemount 2240S transmitter on top of the temperature sensor tube.
5. Run the sensor wires into the terminal compartment.



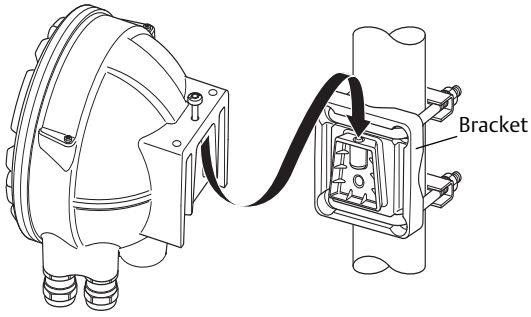
6. Tighten the nut on the transmitter by hand.
7. Proceed with electrical installation of Tankbus, temperature elements, and water level sensor. See “Electrical installation” on page 37.

4.3.2 Mounting on a pipe

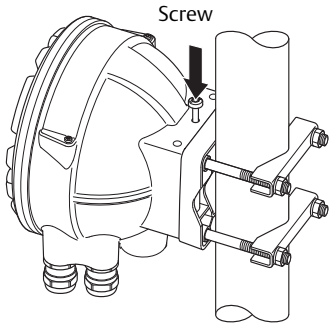
To mount Rosemount 2240S on a pipe, do the following:



1. Use the four nuts to fasten the bracket on a vertical pipe. A suitable pipe size is 1 to 2 inches.



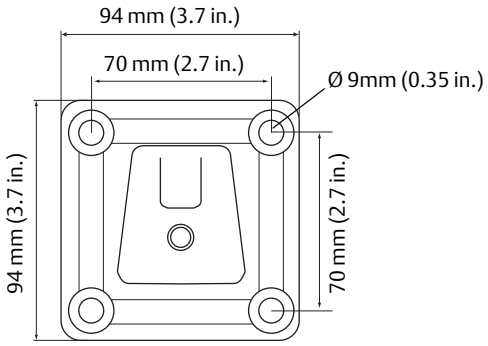
2. Attach the Rosemount 2240S transmitter to the bracket.



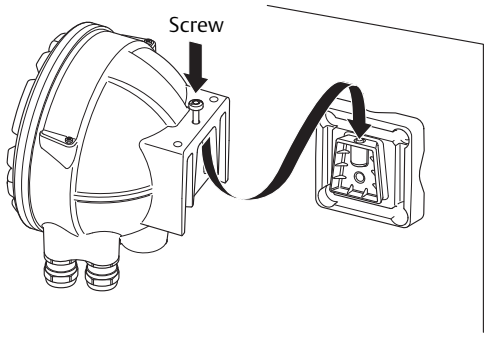
3. Secure the transmitter with the screw on top of the bracket.
4. Proceed with electrical installation of Tankbus, temperature elements, and water level sensor. See "Electrical installation" on page 37.

4.3.3 Wall mounting

To mount the Rosemount 2240S on a wall, do the following:

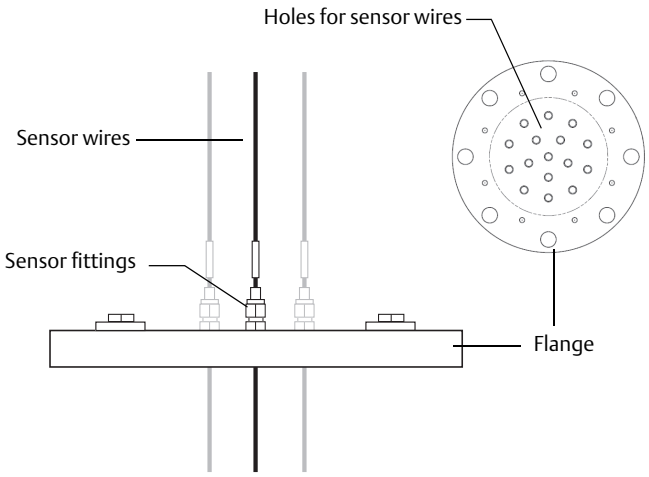


1. Drill four 9 mm (0.35 in.) holes in the wall to fit the hole pattern of the bracket.
2. Attach the bracket to the wall by using the four M8 screws.



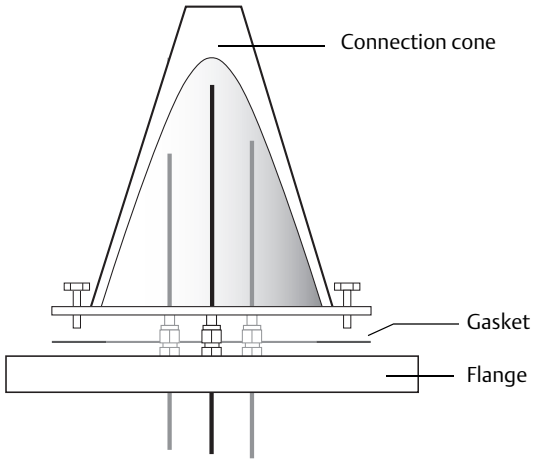
3. Attach the Rosemount 2240S transmitter to the bracket.
4. Secure the transmitter with the screw on top of the bracket.
5. Proceed with electrical installation of Tankbus, temperature elements, and water level sensor. See “Electrical installation” on page 37.

4.3.4 Mounting the connection cone and Rosemount 614 sensor

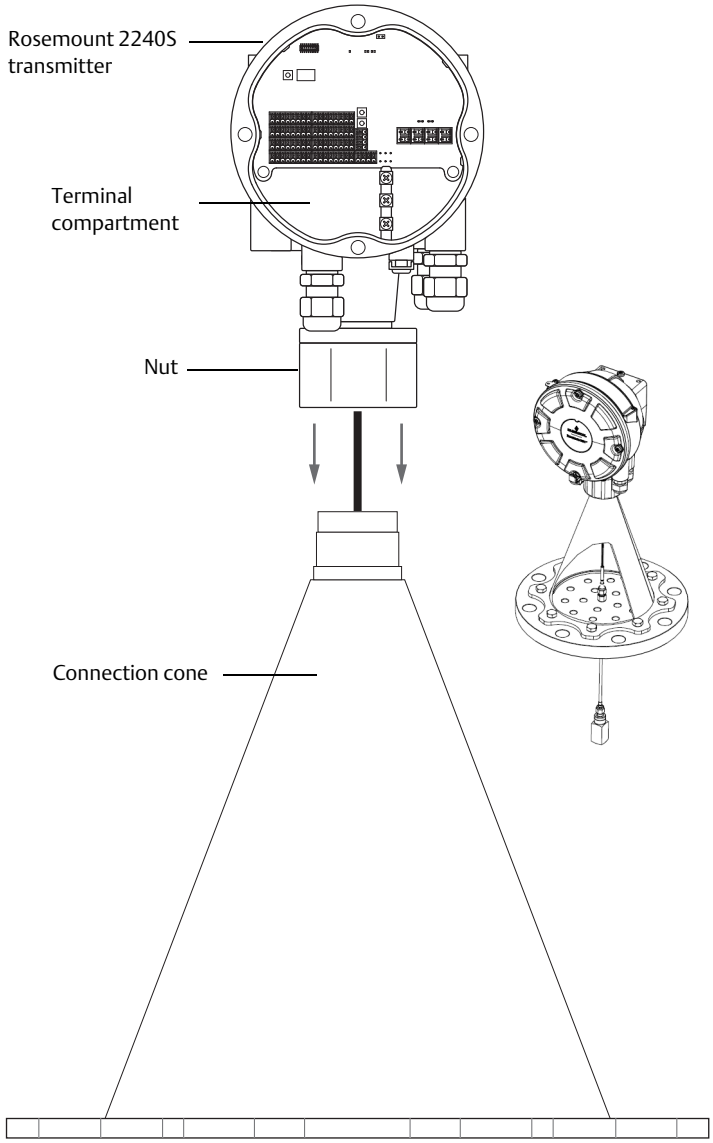


1. Ensure that sensors are properly installed in the tank.
2. Attach the Rosemount 614 temperature sensors to the flange.
3. Torque the sensor fittings to the recommended value of maximum 16 Nm. See drawing D7000 005-451.

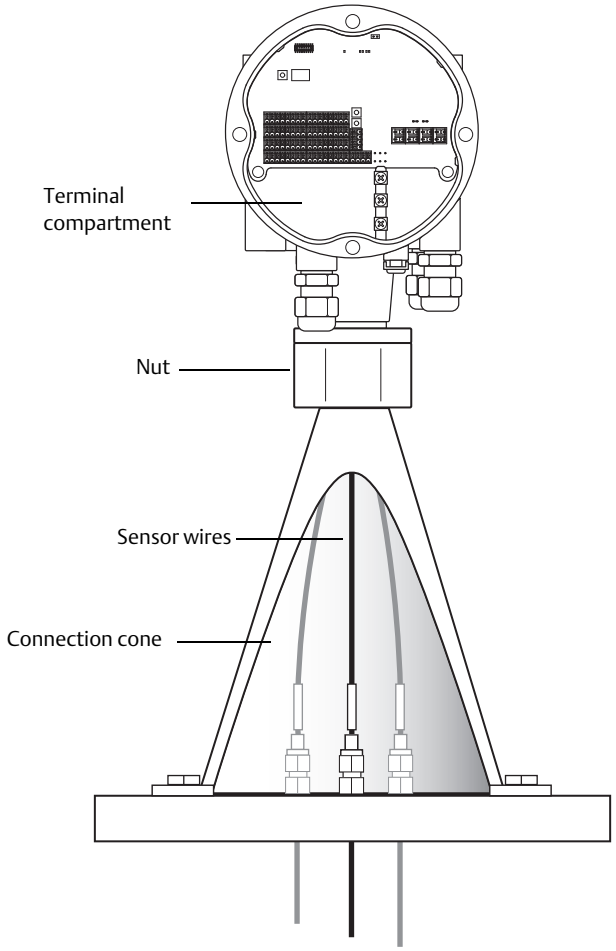
   Note that sensor fittings should not be opened once installed.



4. Attach the connection cone to the flange. Gasket and screws are shipped with the cone.
5. Pull the wires up through the opening at the top of the connection cone.



6. Remove the cover from the Rosemount 2240S terminal compartment.
7. Place the transmitter on top of the connection cone.
8. Tighten the nut by hand.



9. Run the temperature sensor wires through the sleeve at the bottom of the transmitter housing into the terminal compartment.
10. Wire the temperature sensors to the Rosemount 2240S transmitter terminal block. See "Temperature element and Water Level Sensor wiring" on page 47.

4.4 Electrical installation

4.4.1 Cable/conduit entries

The electronics housing has three entries for ½ - 14 NPT glands. Optional M20×1.5, minifast and eurofast adapters are also available.

For remote mounting, the nut and sleeve on the Rosemount 2240S can be replaced with a M32 gland for connection of temperature sensors/WLS.

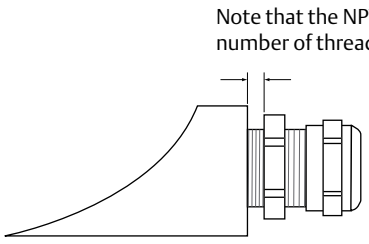
Connections must be made in accordance with local or plant electrical codes.

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

Figure 4-1. Cable Entry with NPT Threaded Gland



Ensure that glands for the cable entries meet the following requirements:

- IP class 66 and 67
- material: metal (recommended)

4.4.2 Power requirements

The Rosemount 2240S temperature transmitter is powered over the Tankbus by the Rosemount 2410 Tank Hub. The Rosemount 2240S has a current consumption of 30 mA.

When installed in a FOUNDATION fieldbus system, the Rosemount 2240S is powered by the FF segment.

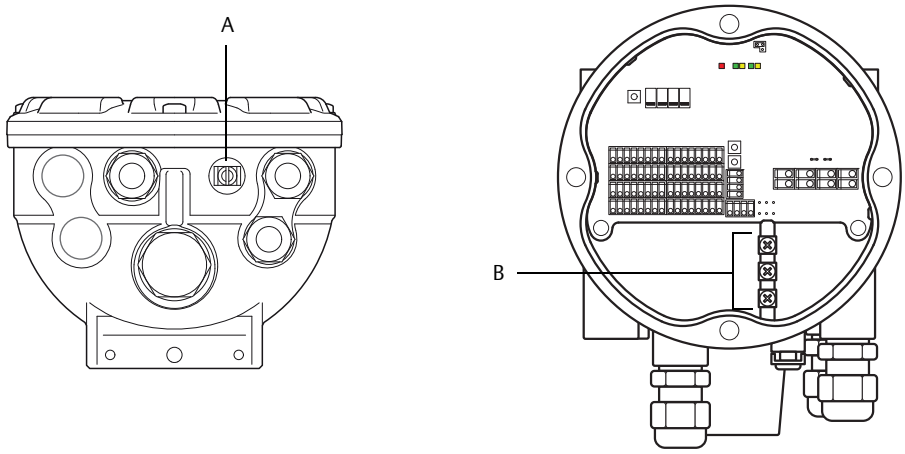
4.4.3 Grounding

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 ground with minimal impedance.

There is an external grounding screw located at the bottom of the housing and three internal grounding screws located inside the housing, see Figure 4-2 on page 38. The internal ground screws are identified by a ground symbol: ⏚.

Use the external ground terminal on the transmitter to ground the housing.

Figure 4-2. Grounding Terminals



A. External ground terminal

B. Internal ground terminals

Note
Grounding the transmitter using the threaded conduit connection may not provide a sufficient ground. Make sure the connection provides a sufficiently low impedance.

Grounding - Tankbus

Signal wiring of the fieldbus segment (Tankbus) must not be grounded. Grounding one of the signal wires may shut down the entire fieldbus segment.

Shield wire ground

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

In the Rosemount Tank Gauging system, a ground point is located at the Rosemount 2410 Tank Hub which acts as the power supply for devices on the Tankbus.

The Rosemount Tank Gauging devices are designed for “daisy-chain” connection of shield wiring in order to enable a continuous shield throughout the Tankbus network.

The shield loop-through terminal in the Rosemount 2240S is not connected to ground in order to provide electrical continuity to “daisy-chained” Tankbus cables.

4.4.4 Cable selection

Use shielded twisted pair wiring for the Rosemount 2240S 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.

Use 22 AWG to 16 AWG (0.5 to1.5 mm^2) in order to minimize the voltage drop to the transmitter.

The FISCO specification requires that cables comply with the following parameters:

Table 4-1. FISCO Cable Parameters

Parameter	Value
Loop resistance	15 to 150 Ω/km
Loop inductance	0.4 to 1 mH/km
Capacitance per unit length	45 to 200 nF/km
Maximum length of each spur cable	60 m in gas Groups IIC and IIB
Maximum length of each trunk cable	1 km in gas Group IIC and 1.9 km in gas Group IIB

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

4.4.5 Hazardous areas

When the Rosemount 2240S is installed in a hazardous area, national and local regulations and specifications in applicable certificates must be observed. See Appendix B: Product Certifications.

Note
When the temperature transmitter is powered from a certified Ex [ib] or AEx [ib] FISCO Power Supply with triplicated output voltage limitation meeting the requirements for two faults ("ia" voltage limitation), e.g. a Rosemount 2410 Tank Hub via the Tankbus, the FISCO codings according to Control Drawings 9240040-910 and 9240040-976, Note 8, apply, and the Rosemount 2240S can be connected to RTDs or other sensors located in Zone 0.

However, Rosemount 2240S with ATEX and IECEx Certifications as well as Zone classification in USA and Canada is also Ex-coded Ex ia or AEx ia (part of code) for both FISCO and Entity installations. In order to maintain this coding the Rosemount 2240S must be powered from a Power Supply coded Ex [ia] or AEx [ia]. Most general FISCO power supplies are, however, coded Ex [ib] for ATEX and IECEx and if the Rosemount 2240S is powered from such a Power Supply, which has not triplicated output voltage limitation, the Rosemount 2240S coding automatically becomes Ex ib.

This means that, in this case, neither the Rosemount 2240S itself nor any RTD or other sensors connected to the RTD terminals or RS485/Modbus terminals of the Rosemount 2240S may be located in Zone 0.

4.4.6 The Tankbus

The *Rosemount Tank Gauging* system is easy to install and wire. Field devices can be "daisy-chained" thus reducing the number of external junction boxes. Devices communicate with a Rosemount 2410 Tank Hub via the intrinsically safe Tankbus that 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 I.S. systems based on the entity concept.

Termination

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

Note
Ensure there are **two** terminators on the Tankbus, see Figure 4-3.

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

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.

If the Rosemount 2240S is not the last device in the fieldbus network, disconnect the termination jumper. See Figure 4-6 on page 45.

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 39. 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 tank hub is able to deliver 250 mA. In a Smart Wireless System the maximum current is 200 mA. Consequently, the number of field devices has to be considered so that the total current consumption is less than the available current. See section "Power Budget" in the Rosemount 2410 Reference Manual for more information.

Another requirement is to ensure that the input voltage at the field device terminals is at least 9 V. Therefore, the voltage drop in the fieldbus cables has to be taken into account.

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 39).

See the Rosemount 2410 Reference Manual for more information on segment design of a *Rosemount Tank Gauging* system.

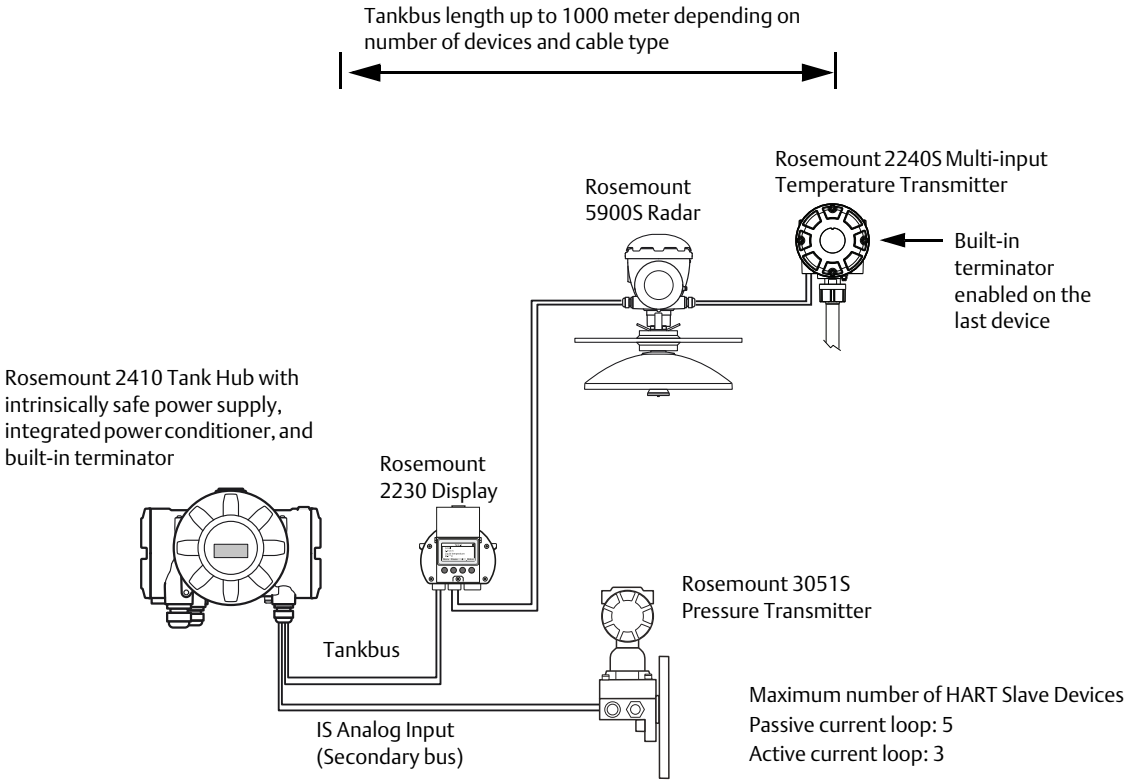
1, *FISCO=Fieldbus Intrinsically Safe Concept*

4.4.7 Typical installations

The example below (Figure 4-3) illustrates a system with daisy-chained field devices on a single tank. Terminators are installed at both ends of the Tankbus segment as required in a system that complies with the FOUNDATION fieldbus standard. 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 4-3 illustrates how an instrument such as a pressure transmitter can be connected to the intrinsically safe 4 -20 mA analog input of the Rosemount 2410 Tank Hub.

Figure 4-3. Example of a Tankbus Connection for a Single Tank



The maximum distance between the Rosemount 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.

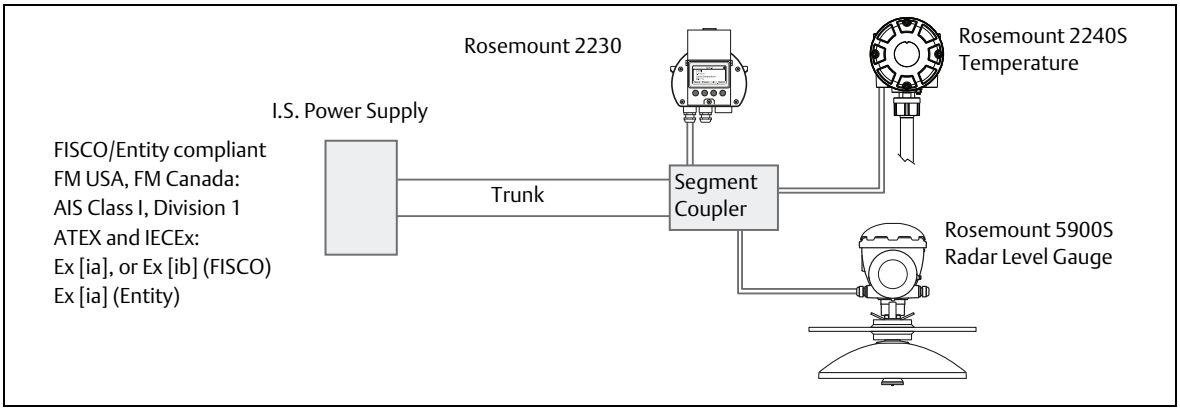
See chapter “Electrical Installation” in the Rosemount 2410 Reference Manual for more information about cable selection, power budget, and the Tankbus.

See chapter “Typical Installations” in the Rosemount 2410 Reference Manual for more examples of how to install systems that include the Rosemount 2410 Tank Hub.

4.4.8 Rosemount™ 2240S in FOUNDATION Fieldbus system

The Rosemount 2240S supports the FOUNDATION fieldbus (FF) technology and lets you integrate a Rosemount 2240S into an existing FF network. As long as the power supply meets certain requirements (see Figure 4-4 and Figure 4-5) the 2240S(1) will be able to operate as any other FF device.

Figure 4-4. Example of an I.S. FOUNDATION fieldbus System with Rosemount Devices

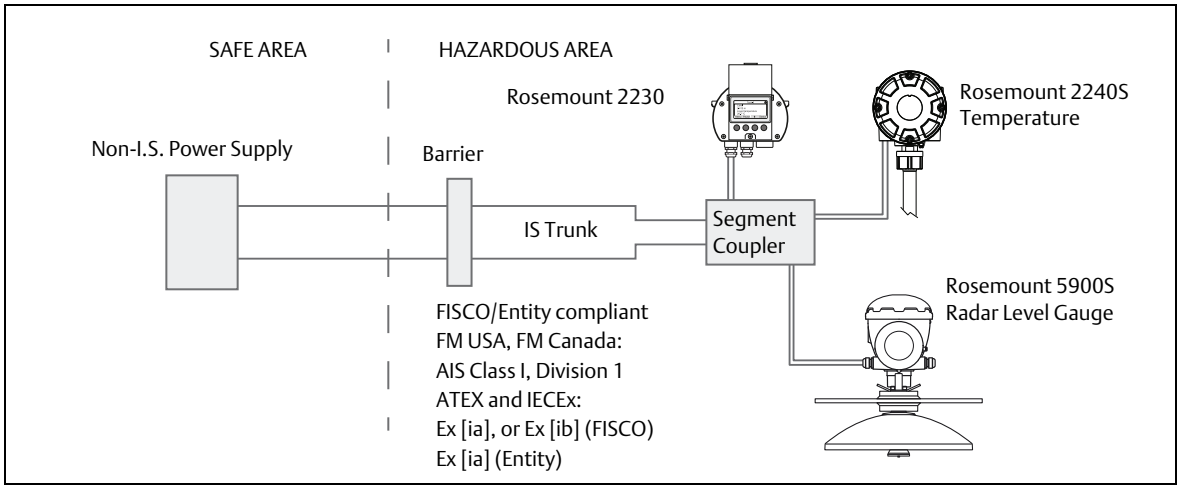


Ensure that the power supply is able to provide the total current needed for all the connected devices. See "Power requirements" on page 37 for further information.

Ensure that the Rosemount 2240S 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 4-5. Example of a Non-I.S. FOUNDATION Fieldbus System with Rosemount Devices



1, *See Appendix B: Product Certifications for Rosemount 2240S approval information*
2, *See the Rosemount 2410 Reference Manual (Document No. 300530EN) for more information on the Segment Coupler.*

4.4.9 Tankbus wiring

To connect a Rosemount 2240S:

⚠

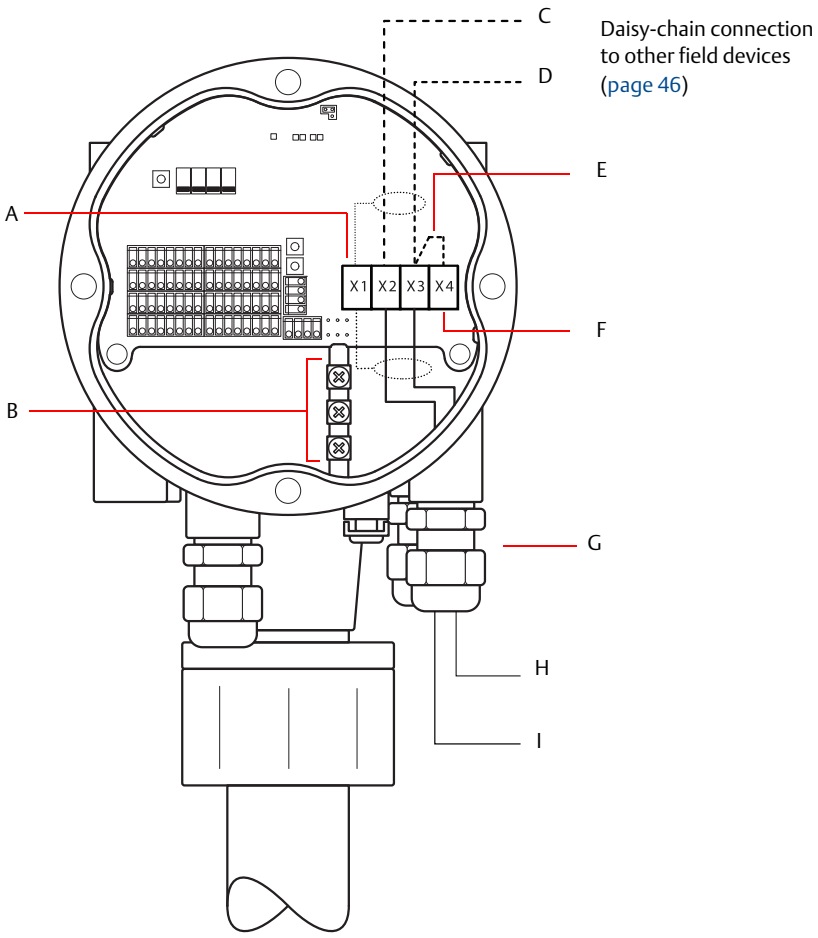
1. Ensure that the power supply is switched off.
2. Loosen the four screws and remove the cover from the terminal compartment.
3. Run the Tankbus wires through the appropriate cable glands or conduits.
4. Connect the Tankbus wires to the X2 and X3 terminals as shown in Figure 4-6 on page 45.
5. Connect the cable shield to the terminal marked X1.
6. In case the Rosemount 2240S is installed at the end of a Tankbus network, enable the termination by using a jumper between terminals X3 and X4 as shown in Figure 4-6 on page 45.
7. Use metal plugs to seal unused ports.
8. In order to prevent water from entering the terminal compartment, ensure the cover sealing is placed in the correct position.

⚠

9. The cover on the terminal compartment should be tightened to mechanical stop (metal to metal). Make sure the cover is fully engaged to meet explosion-proof requirement and to prevent water from entering the terminal compartment.
10. Tighten the conduit/cable glands. 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). It is recommended that the O-ring is replaced when the cover is opened. O-rings are available as spare parts. Cables must be properly attached to the cable glands.

Figure 4-6. Rosemount 2240S Terminal Compartment



A. X1: Cable Shield

B. Internal grounding terminals

C. X2: Tankbus (+) output

D. X3: Tankbus (-) output

E. Jumper to invoke built-in termination

F. X4: Tankbus terminator

G. Cable glands for Tankbus wires and temperature elements

H. X3: Tankbus (-) input

I. X2: Tankbus (+) input

4.4.10 Daisy-chain connection

The Rosemount Tank Gauging system supports daisy-chain connection of devices to the Tankbus. To daisy-chain the Rosemount 2240S to other devices do the following:

⚠ 1. Make sure the power supply is switched off.

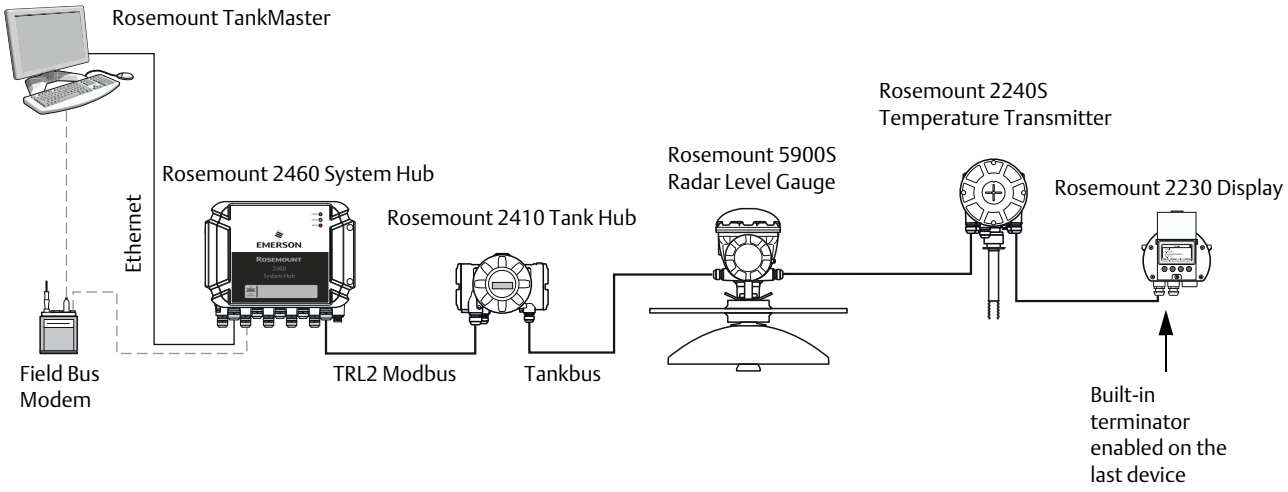
2. Loosen the four screws and remove the cover from the terminal compartment.
3. Disconnect the termination jumper from the X3 terminal, see Figure 4-6 on page 45.
4. Run the Tankbus cable into the Rosemount 2240S through an appropriate gland.
5. Connect the Tankbus wires to the **X2 output** and **X3 output** terminals as illustrated in Figure 4-6.
6. Connect the cable shield to the X1 terminal.

⚠ 7. Attach and tighten the cover on the terminal compartment. Ensure the cover sealing is placed in the correct position.

8. Tighten the conduit/cable glands. Note that adapters are required for M20 glands.

A typical wiring diagram with a Rosemount 2240S is illustrated in Figure 4-7. In the example below the 2240S is daisy-chained to a Rosemount 5900S Radar Level Gauge and a Rosemount 2230 Graphical Field Display.

Figure 4-7. Rosemount 2240S Wiring Diagram



Ensure that there are only two terminators enabled on the Tankbus. In the example above, one terminator is enabled in the Rosemount 2410 Tank Hub. The second terminator is enabled in the terminal compartment of the Rosemount 2230 Display since this is the last device on the Tankbus segment. Incorrect terminations may cause malfunctioning communication on the Tankbus.

4.4.11 Temperature element and Water Level Sensor wiring

The Rosemount 2240S is compatible with multiple element Resistance Temperature Detectors (RTDs). A Rosemount 2240S can connect up to sixteen 3- or 4-wire temperature spot elements.

Three connection types are supported: 3-wire with common return, 3-wire individual spot, and 4-wire individual spot. The Rosemount 2240S is also compatible with averaging sensor types. A maximum of 16 elements can be connected to a Rosemount 2240S transmitter.

The Rosemount 2240S is also equipped with a RS485/Modbus terminal for connection of a Water Level Sensor.

Note
If an averaging temperature detector is connected to the Rosemount 2240S, a DIP switch must be set, see "DIP Switches" on page 66 for more information.

When a Rosemount 2240S transmitter is mounted on top of a MST/WLS or a Rosemount 614 cone connection, the sensor wires will enter the terminal compartment through the sleeve at the bottom of the Rosemount 2240S housing.

In case a Rosemount 2240S is mounted on a pipe or a wall (see "Mechanical installation" on page 31), the sleeve and nut can be replaced by an M32 cable gland, see Figure 2-2 on page 8.

There are three wiring types that can be used for temperature elements connected to a Rosemount 2240S. The number of elements that can be connected varies depending on the type of temperature sensor that is used as illustrated in Table 4-2:

Table 4-2. Number of Temperature Elements for Various Temperature Sensors and Wiring Types

Multiple Spot Temperature Sensor	3-wire common return	3-wire individual	4-wire individual
Rosemount 565	1-16 elements	1-16 elements	1-16 elements
Rosemount 566	1-16 elements	1-16 elements	1-16 elements
Rosemount 765	1-16 elements	1-14 elements	1-10 elements
Rosemount 614	NA	1-16 elements	1-16 elements

See Rosemount Tank Gauging System Data Sheet for more information on various Multiple Spot Temperature Sensors.

Note
Temperature elements must be connected in the order 1, 2, 3 etc. without any gaps (e.g 10 elements must be connected to channel 1-10).

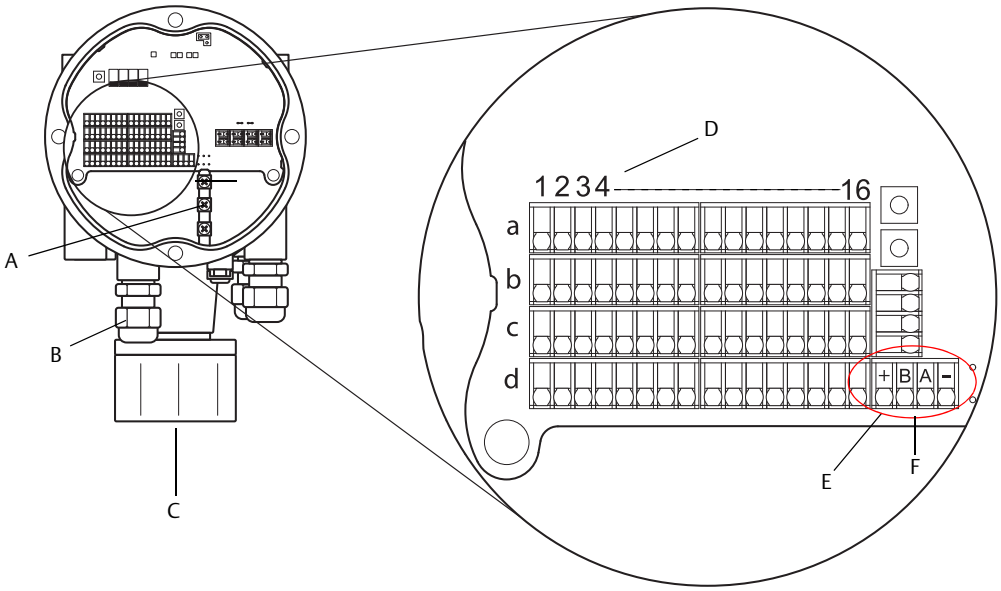
Note
Use terminals "b", "c", and "d" for 3-wire connections.

To connect the sensor wires for a temperature detector to a Rosemount 2240S do the following:

⚠
1. Make sure the power supply is switched off.
2. Loosen the four screws and remove the cover from the terminal compartment.
3. Run the wires for temperature elements and water level sensor through the sleeve at the bottom of the transmitter housing, see Figure 4-8.
   If the 2240S transmitter is mounted on a wall or pipe (remote mounting), run the sensor wires through the appropriate cable gland/conduit entry, see Figure 2-2 on page 8.
4. Connect the **temperature sensor** wires to the terminals marked “1” to “16” and “a”, “b”, “c”, and “d”. Refer to Figure 4-9, Figure 4-10, and Figure 4-11 depending on the sensor type and measurement method that is used.
5. Connect the red, green, white, and black **water level sensor** wires to the **RS485/Modbus** terminal as shown in Figure 4-8.
6. Connect the shield on the water level sensor cable to one of the ground terminals.
7. Make sure the cover sealing is placed in the correct position.

⚠
8. Attach the cover on the terminal compartment and tighten the four screws.
9. Tighten the cable glands.

Figure 4-8. Terminal for Connection of Temperature Elements



A.Internal grounding terminals

B. Cable entries

C. Cable entry for integrated MST/WLS sensor

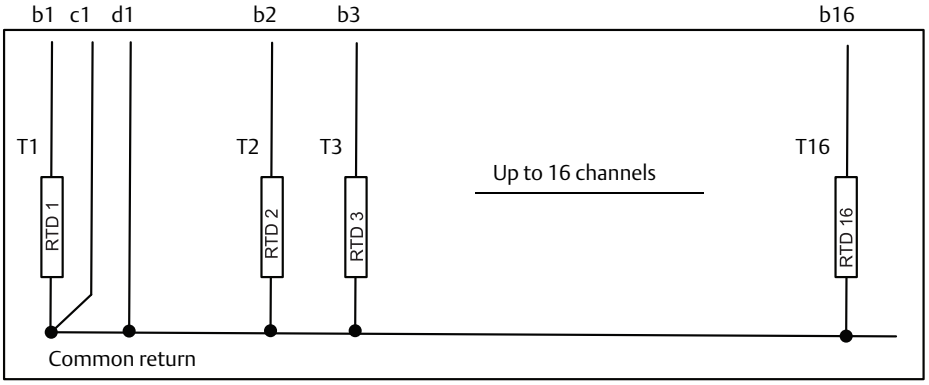
D. RTD channel numbers (1 .. 16)

E. RS485/Modbus terminal

F. Wire color: Red (+), Green (B), White (A), Black (-)

The following wiring methods are supported:

Figure 4-9. 3-wire with Common Return



Note
Black wires (common/individual return) must always be connected to the c- and d- terminals on left-hand side of the terminal block.

Figure 4-10. 3-wire Individual Spot

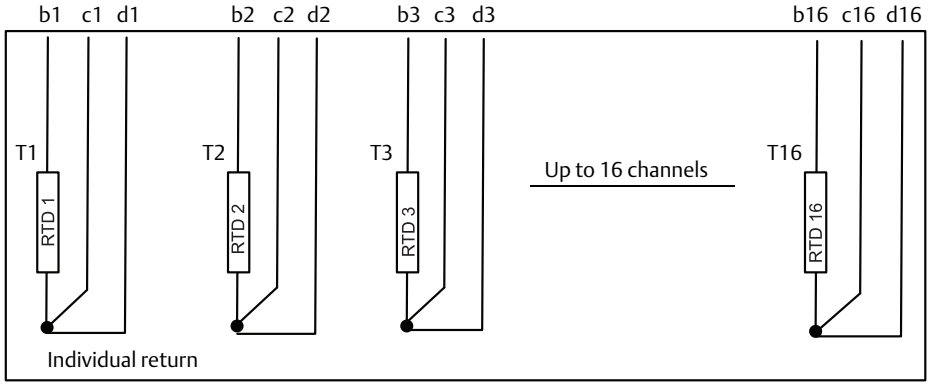
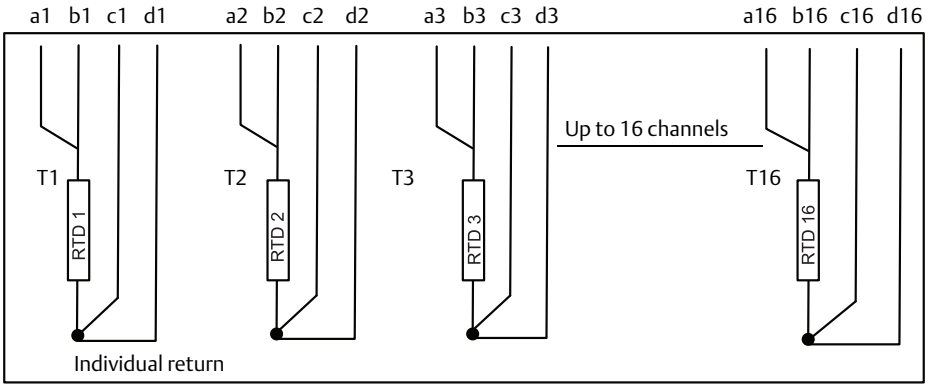


Figure 4-11. 4-wire individual Spot



Cable color coding

Table 4-3. Cable Colors for the Rosemount 565/566/765 Temperature Sensors

Temperature Element	Color
T1	Brown
T2	Red
T3	Orange
T4	Yellow
T5	Green
T6	Blue
T7	Violet
T8	Grey
T9	White
T10	Pink
T11	Brown/Black
T12	Red/Black
T13	Orange/Black
T14	Yellow/Black
T15	Green/Black
T16	Blue/Black

Section 5 Configuration/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 FF 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 Introduction

This chapter provides information about configuration of the Rosemount™ 2240S Multi-input Temperature Transmitter regardless of the configuration tool used. However, you will find frequent references to TankMaster WinSetup, which is the recommended configuration tool.

It is important that configuration is properly prepared by listing the appropriate Modbus addresses, device tags, and tank tags.

5.2.1 Configuration procedure

Basically, a Rosemount 2240S can be installed and configured by one of the following methods:

- As part of the installation of a Rosemount 2410 Tank Hub. This is the standard procedure when a new system is installed, see the Rosemount Tank Gauging System Configuration Manual.
- As a separate device, connected to the Tankbus of a Rosemount 2410 in an existing Rosemount Tank Gauging system. The device is configured with a suitable tool, such as TankMaster WinSetup.
- As a separate device in a FOUNDATION™ fieldbus system. AMS Device Manager may be used for configuration.

5.2.2 Parameters

Temperature elements

The basic configuration includes parameters for a standard configuration which is sufficient in most cases. The following parameters are configured:

- number of temperature elements
- temperature element type (Spot or Average)
- position in tank
- temperature elements excluded from average calculation
- minimum distance between element and product surface for element to be included in average temperature calculation (insert distance)

Water Level Sensor

Configuration of the water level sensor includes:

- level offset (difference between tank zero level and water zero level)
- probe length
- upper and lower dead zone

5.2.3 Configuration tools

Different tools are available for configuration of a Rosemount 2240S:

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

TankMaster is an *Emerson Automation Solutions/Rosemount Tank Gauging* inventory management software package for installation and configuration of level gauging equipment.

The WinSetup package provides you with powerful and easy-to-use tools for installation and configuration, see the Rosemount Tank Gauging System Configuration Manual.

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.

5.3 Basic configuration

Temperature elements and a Water Level Sensor can be connected to the Rosemount 2240S Multi-input Temperature Transmitter.

5.3.1 Temperature elements

The Rosemount 2240S Multi-input Temperature Transmitter supports the configuration options listed in Table 5-1 for connected temperature elements. These options can be configured in TankMaster WinSetup via the *22XX ATD* window (the *Average Temperature Calculation* and *2240 MTT Temperature Sensor* tabs). For FOUNDATION fieldbus systems the AMS Device Manager can be used.

Table 5-1. Rosemount 2240S Temperature Element Configuration

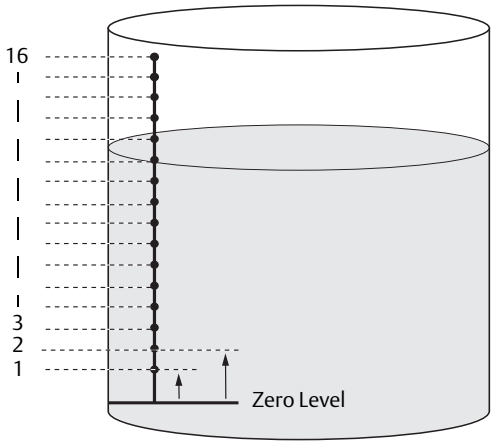
Settings	Description
Number of sensor temperature elements	Maximum 16 temperature elements(1).
Sensor type	Spot or average sensor types are supported.
Temperature sensor element position in tank	Specify the position of each temperature element in the tank, see "Temperature sensor element positions" on page 55.
Exclude spot sensor element from tank average temperature calculation	You can exclude certain spot elements from the average temperature calculation, see "Tank average temperature calculation" on page 55.
Insert distance	Minimum distance between element and surface for element to be included in average calculation, see "Insert distance" on page 56.
Default Sensor Configuration	This option controls whether the temperature sensor is automatically configured based on the "Averaging RTD" DIP switch setting, or if manual configuration is required. Default configuration means that the sensor is configured according to a specific default setting. See "DIP Switches" on page 66 for more information.
Conversion method	• Auto • PT100 (spot) • CU90 (average) • CU90US • User-defined (see "Conversion methods" on page 69): - linearization table - formula - individual formula
Temperature range	Measurement range of the temperature elements
Sensor wiring (Connection)	Type of sensor wiring: • 3 wire spot or average with common return • 3 wire independent spot • 4 wire independent spot

1. The Rosemount 2460 System Hub supports 16 elements and the Rosemount 2160 Field Communication Unit supports a maximum of 14 temperature spot elements. However, Average Temperature will be correctly calculated by a Rosemount 2410 Tank Hub connected to a Rosemount 2240S with 16 temperature elements regardless if the tank hub is connected to a Rosemount 2460 or a Rosemount 2160.

Temperature sensor element positions

The temperature elements are numbered from the bottom of the tank and upwards. Enter the position of each element, measured as the distance from the Zero Level (Dipping Datum Plate) to the temperature element. If you use average temperature elements, enter the position of the terminating level of each sensor element.

Figure 5-1. Temperature sensor element positions



Tank average temperature calculation

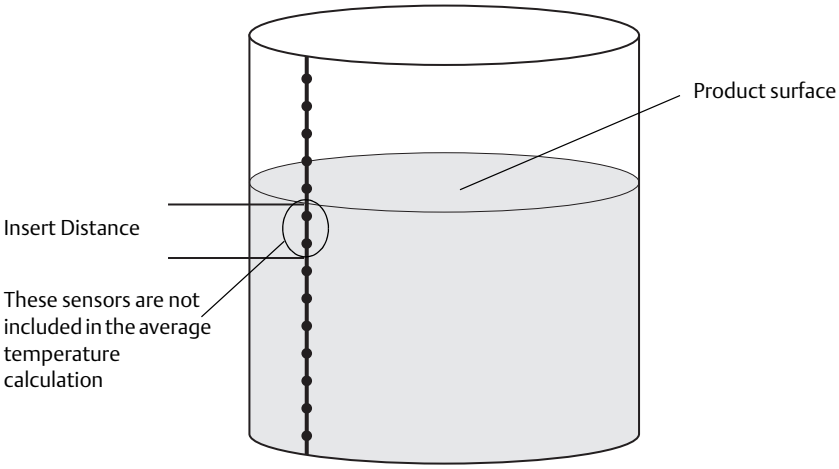
You can exclude certain spot elements from the average temperature calculation. This may be useful if, for example, the temperature close to the surface or close to the bottom of the tank deviates significantly from the temperature in the rest of the tank. This may also be accomplished by setting an appropriate value for the Insert Distance parameter, see "Insert distance" on page 56.

Note
A faulty temperature sensor will affect the temperature calculation. For more information see "Ground fault detection" on page 115.

Insert distance

You can specify a minimum distance between the product surface and the first temperature spot element to be included in the average temperature calculation. If the temperature spot element is within or above the Insert Distance, the element will be excluded from the calculation.

Figure 5-2. Insert distance



This function may be useful if the temperature of the atmosphere above the product surface significantly deviates from the temperature of the product itself, resulting in large temperature gradients close to the product surface. By specifying an Insert Distance, temperature elements within this region can be excluded from average temperature calculations.

The Insert Distance function can also be used to compensate for inaccuracies in the measured temperature element positions, in order to make sure that elements above the product surface are not included in the average temperature calculation. If, for example, temperature element positions are measured with an accuracy of 10 mm, setting the minimum distance to at least 10 mm will guarantee that sensors above the surface are not included in the average temperature calculations.

5.3.2 Water Level Sensor calibration

The Water Level Sensor (WLS) measures the free water level below an oil surface. The WLS can be combined with Multiple Spot Temperature sensors.

The WLS is factory calibrated for air. The factory calibration values are stored in a separate write protected Holding Register area.

The following parameters are stored in the factory calibration:

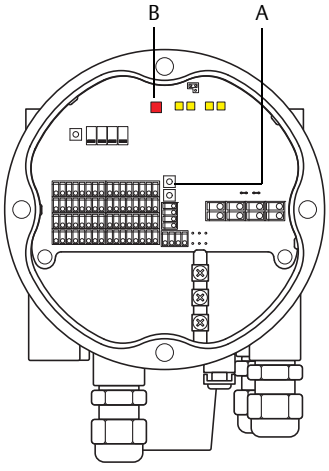
- Full = The measured capacitance value when the probe is completely covered with water
- Empty = The measured capacitance value when the probe is completely covered by the reference product

In case the dielectric constant of the product differs from factory calibration you will need to perform a new empty calibration. In this case empty means that there is no water, i.e. the sensor is fully immersed in oil.

Calibration procedure

1. Lift the Water Level Sensor from the bottom of the tank and ensure the sensor is covered by the product (oil) only.
2. Wait five minutes.
3. Press the **WLS Calibration** button (A) on the Rosemount 2240S transmitter for at least two seconds to start calibration (see Figure 5-3). Calibration is indicated with a steady LED light for about 10 seconds, then it is turned off.
4. When calibration is finished the status LED lights up with a steady light for about ten seconds. In case of a calibration error, the LED blinks at a high frequency for 10 seconds, see Figure 5-4.
5. Wait for the **Status LED** (B) to turn from a steady light to normal LED status (blinking with 2 seconds interval).
6. Once the calibration process is completed, anchor the Water Level Sensor to the bottom of the tank.

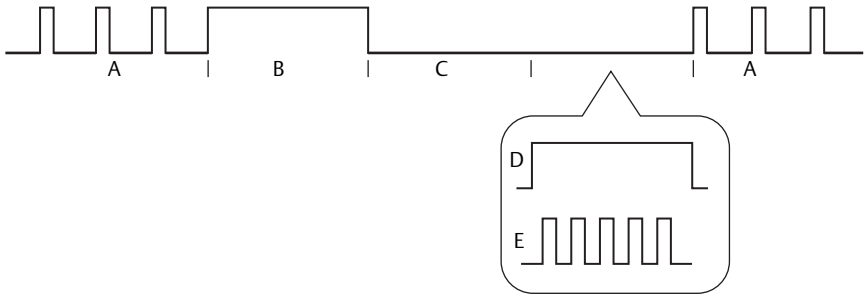
Figure 5-3. ZERO button and LED status signal



A. WLS Calibration
B. LED status signal

The different phases of the calibration process are indicated by the LED inside the Rosemount 2240S housing as shown in Figure 5-4.

Figure 5-4. Calibration status indicated by LED



A. Normal

B. Calibration starts (10 s)

C. Calibration ongoing (10 s)

D. Calibration OK (10 s)

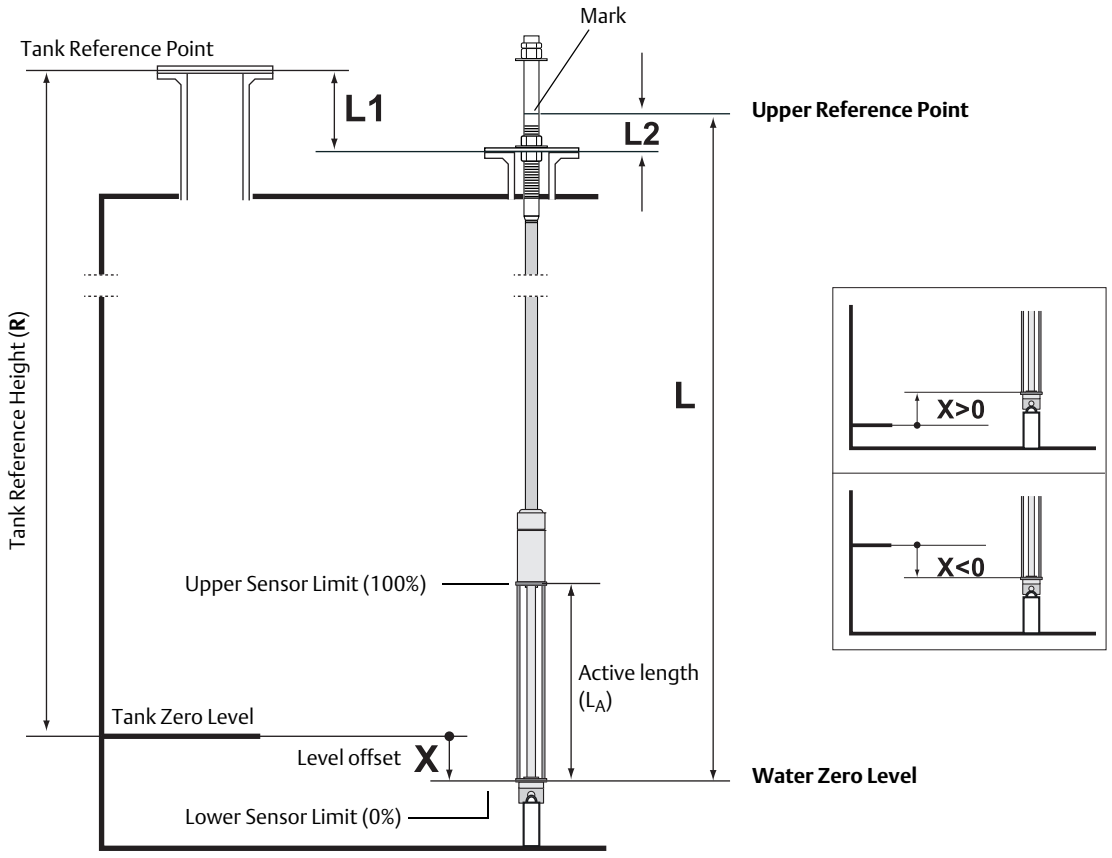
E. Calibration FAILED (10 s)

5.3.3 Water Level Sensor measuring range

Reference Points

The Water Level Sensor has two reference points, the **Upper Reference Point** and the **Water Zero Level**, which are marked on the probe. The positions are given in Figure 5-5 below:

Figure 5-5. Tank geometry for the water level sensor



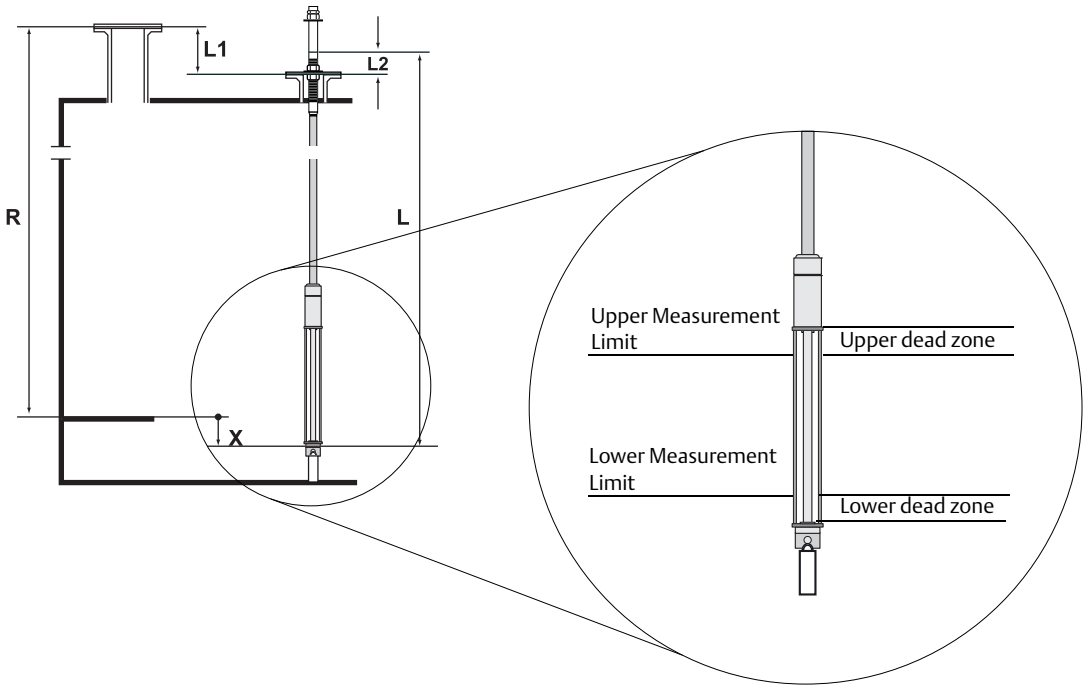
Level offset

The Level Offset **X**, referred to as the distance between Tank Zero Level and Water Zero Level, needs to be considered when configuring the WLS. **X** can be calculated from known tank distances as described in "Converting from WLS to tank reference system" on page 61. The various distances are illustrated in Figure 5-5 and Figure 5-7 on page 62.

Upper and lower dead zone

The *Upper Dead Zone* and the *Lower Dead Zone* are regions within the active length of the water level sensor which can be used to reduce the measurement range. This can be useful in case there is no distinct interface between water and oil. See the Rosemount Tank Gauging System Configuration Manual for information about how to configure the Dead Zones. See also Figure 5-7 on page 62.

Figure 5-6. WLS Measurement Limit and Dead Zones



Converting from WLS to tank reference system

To convert from the reference system of the water level sensor (WLS) to the reference system of the tank, the distance **X** needs to be calculated by using the following formula:

X = (R-L1) - (L-L2)

X=distance between the Tank Zero Level and the Water Zero Level.

L=distance between Water Zero Level and mark on the upper part of the WLS.

R= Tank Reference Height. This is the distance between the Tank Reference Point and the Tank Zero Level.

L1=distance between the Tank Reference Point and the temperature sensor flange.

L2=distance between the mark on the top of the WLS and the temperature sensor flange.

See Figure 5-5 on page 59 for illustration of the different geometry parameters related to the water level sensor.

Sensor limits

Conversion from the WLS reference system to the tank reference system is handled by the Rosemount 2240S transmitter. In the tank reference system, the Lower Sensor Limit (0%) and the Upper Sensor Limit (100%) are given by the following formulas:

Upper Sensor Limit (100%) = L_A + X

Lower Sensor Limit (0%) = X

where L_A is the active length of the Water Level Sensor, and X is the distance between the Water Zero Level and the Tank Zero Level (Minimum Water Distance) as described above. See Figure 5-5 on page 59 and examples in section "Configuration examples" on page 63.

Upper and lower measurement limit

In case Upper and Lower Dead Zones are used to reduce the measurement range (see "Upper and lower dead zone" on page 60), the resulting measurement limits are calculated using the following formulas:

Upper Measurement Limit (100%) = (L_A + X) - UDZ

Lower Measurement Limit (0%) = X + LDZ,

where

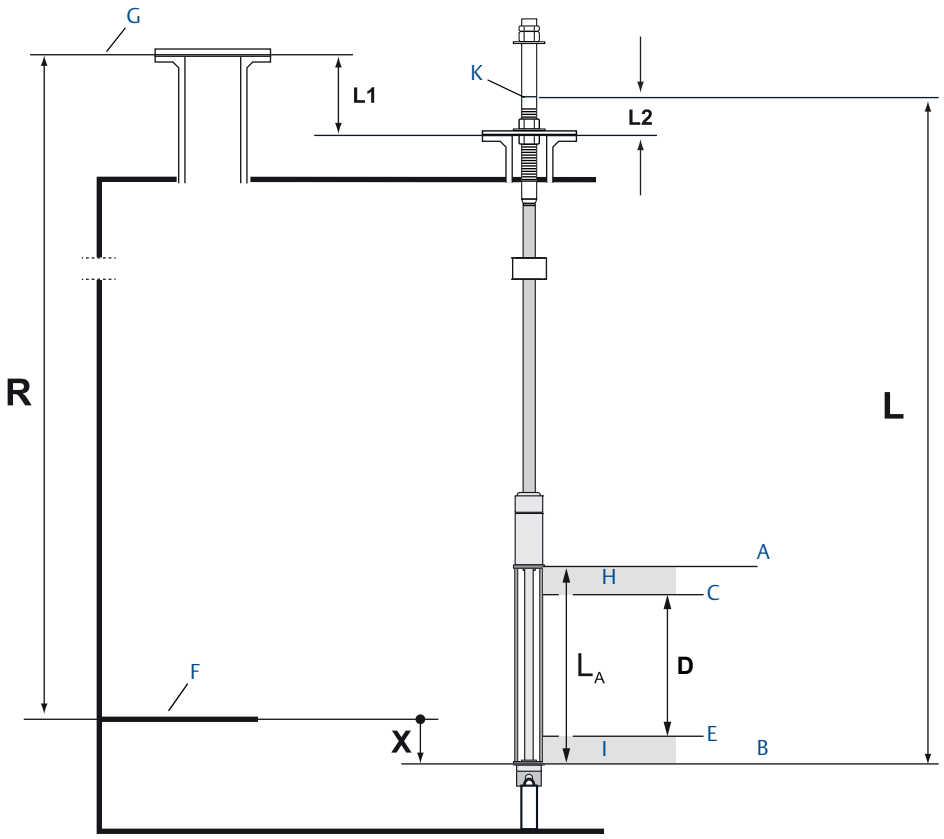
L_A=active length of the water level sensor

UDZ=Upper Dead Zone

LDZ=Lower Dead Zone

See Figure 5-6 on page 60 for an illustration of how the measurement range is affected by the Upper and Lower Dead Zones.

Figure 5-7. Measurement range and geometry parameters



A. Upper Sensor Limit (100%)
B. Lower Sensor Limit (0%)
C. Upper measurement Limit
D. Measurement range
E. Lower measurement Limit
F. Tank Zero Level
G. Tank Reference Point
H. Upper Dead Zone
I. Lower Dead Zone
K. Upper Reference Point
L. Distance between Water Zero Level and mark on the upper part of the WLS
L1. Distance between the Tank Reference Point and the temperature sensor flange
L2. Distance between the mark on the top of the WLS and the temperature sensor flange
X. Level offset
R. Tank Reference Height. The distance between the Tank Reference Point and Tank Zero Level.

Configuration examples

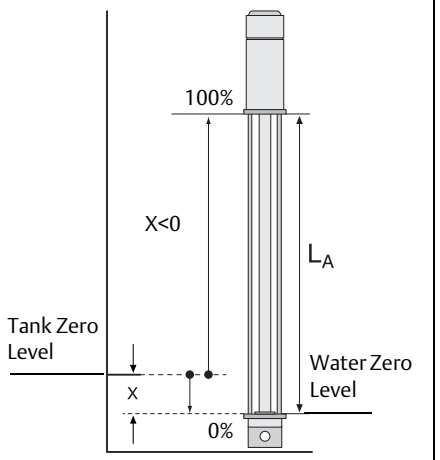
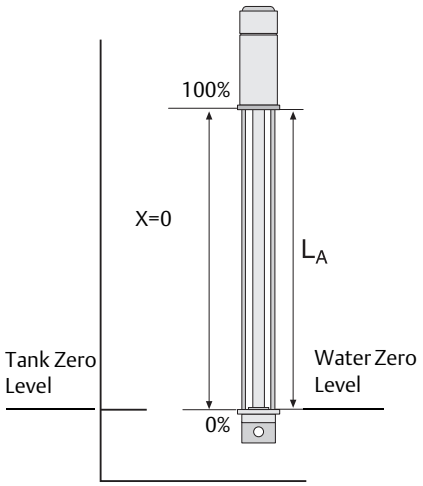
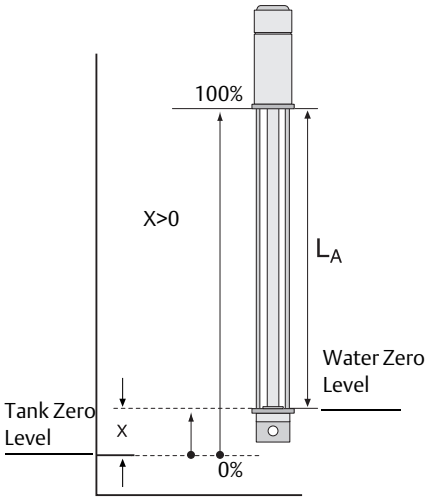
Configuration of the water level sensor can basically be divided into three different cases as illustrated in Table 5-2 below.

X<0: Water Zero Level is located below the Tank Zero Level.

X=0: Water Zero Level is located at the same position as the Tank Zero Level.

X>0: Water Zero Level is located above the Tank Zero Level.

Table 5-2. WLS Configuration

Water Zero Level (0%) is below Tank Zero Level:	**Water Zero Level (0%) is equal to Tank Zero Level**:	**Water Zero Level (0%) is above Tank Zero Level**:
X<0	**X=0**	**X>0**
Example: **L_A**=500 mm, **X**= -50 mm.	Example: **L_A**=500 mm, **X**=0 mm.	Example: **L_A**=500 mm, **X**=70 mm.
LSL (0%)= -50 mm.	LSL (0%) = 0 mm.	LSL (0%) = 70 mm.
USL(100%) = 500 + (-50)=450 mm.	USL (100%) = 500 mm.	USL (100%)= 500 + 70=570 mm.
		

LSL=Lower Sensor Limit

USL=Upper Sensor Limit

L_A=Active Length

5.4 LED signals

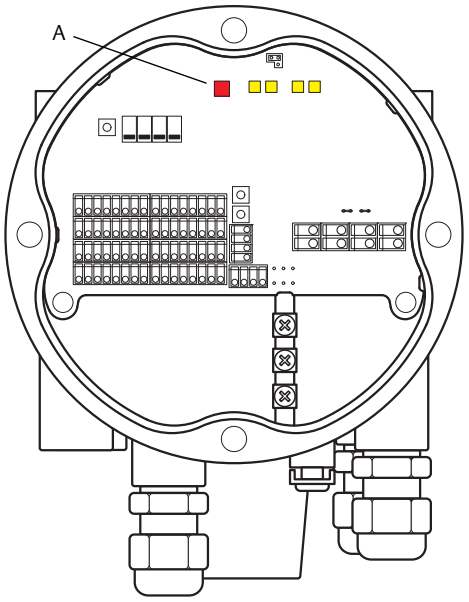
The Rosemount 2240S Multi-input Temperature Transmitter is equipped with Light Emitting Diodes (LED) in order to indicate status and communication.

5.4.1 Status LED

The status LED indicates:

- normal operation by flashing every other second
- calibration of the water level sensor, see "Water Level Sensor calibration" on page 57
- error codes

Figure 5-8. Status LED



A. Status LED

Error codes

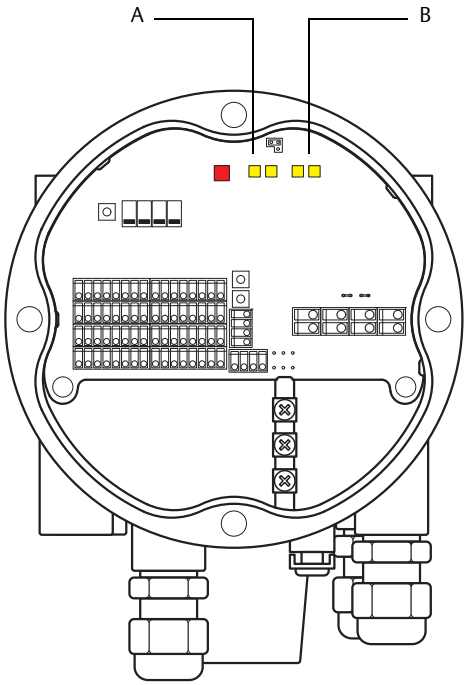
The status LED indicates error codes by using different blinking sequences. In normal operation the LED flashes once every other second. When an error occurs, the LED flashes a sequence that corresponds to a code number followed by a five second pause. This sequence is continuously repeated (for more information see "Device error LED signals" on page 117).

5.4.2 Communication LEDs

There are two pairs of LEDs that indicate communication status for the Rosemount 2240S Multi-input Temperature Transmitter:

- when a Water Level Sensor (WLS) is connected, two LED signals indicate that measurement and status information is communicated over the Sensor bus to the temperature transmitter
- two LEDs indicate that the temperature transmitter communicates with a Rosemount 2410 Tank Hub over the Tankbus

Figure 5-9. Communication LEDs



A: WLS - receive and transmit

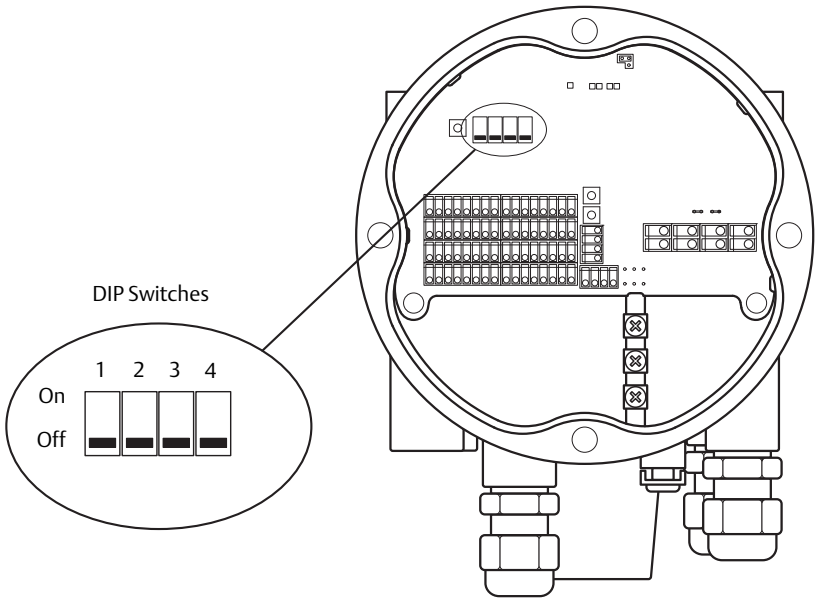
B. Tankbus - receive and transmit

5.5 Switches and reset buttons

5.5.1 DIP Switches

The Rosemount 2240S is equipped with four DIP switches, see Figure 5-10.

Figure 5-10. DIP Switches



The switches control the following settings:

Table 5-3. DIP Switches

Number	Function	Description
1	SIMULATE	Enables simulation of temperature measurements and Field diagnostic alerts.
2	WRITE PROTECT	Enables write protection of configuration data.
3	SPARE	Not used
4	AVERAGING RTD	Enables the use of an average temperature sensor, see "Tank average temperature calculation" on page 55.

The simulate switch

The **Simulate** switch can be used to simulate a resistance value from temperature elements. For FOUNDATION fieldbus systems it enables simulation of Field Diagnostics alerts as well.

The write protect switch

The **Write Protect** switch prevents unauthorized configuration changes by locking the Rosemount 2240S database registers.

Configuration using the Average DIP switch

The Average switch enables configuration of the Rosemount 2240S according to the default settings in Table 5-4:

Table 5-4. Configuration Parameters

Configuration Parameter	Switch in on position (Average)	Switch in off position (default)
Element Type	Average	Spot
Element Wiring	Common Return See Figure 4-9 on page 49	Common Return See Figure 4-9 on page 49
Conversion Method	Cu90	Pt100

In the *TankMaster WinSetup* configuration tool, default sensor configuration can be enabled in the configuration window for the Rosemount 2240S transmitter (*2240 MTT Temperature Sensor* tab in the *22XX ATD* window).

In case the installation does not match the default setting, you will have to configure the temperature sensor manually. See configuration of ATD devices in the Rosemount Tank Gauging System Configuration Manual for more information.

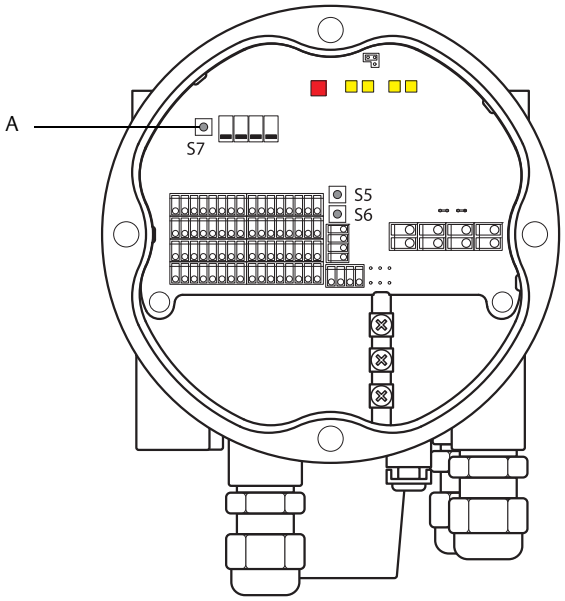
Note
Manual configuration may override the switch settings.

For more information on the various configuration parameters, see "Basic configuration" on page 54.

5.5.2 Reset button

Use the reset button to force a restart of the processor (for more information see "Reset and WLS calibration" on page 116).

Figure 5-11. Reset button



A: Reset

5.6 Configuration using TankMaster WinSetup

The TankMaster software package provides you with powerful and easy-to-use tools for installation and configuration of a Rosemount Tank Gauging system. See the Rosemount Tank Gauging System Configuration Manual for more information on how to configure Auxiliary Tank Devices (ATD) such as the Rosemount 2240S.

5.6.1 Advanced configuration

Average temperature calculation weight factor

You can specify a weight factor for each temperature element used in the tank average temperature calculation. This allows you to rate selected temperature elements with a larger impact on the average temperature calculation than the other elements. This is primarily used for LPG tanks.

Conversion methods

When using a resistance temperature element, the resistance values can be converted to temperature values by using:

- a linearization table
- a formula
- an individual formula for each temperature element

Adjustment after sensor calibration

If the temperature sensor was ordered with sensor calibration including Callendar-Van Dusen constants the constants must be entered for each individual element using the conversion method "User Defined Individual Formula" to achieve maximum accuracy.

See the Rosemount Tank Gauging System Configuration Manual for more information.

5.7 FOUNDATION™ fieldbus overview

This section provides a brief overview of FOUNDATION fieldbus block operation with the Rosemount 2240S Multi-Input Temperature Transmitter.

For detailed information about FOUNDATION fieldbus technology and function blocks used in the Rosemount 2240S Series, refer to *Appendix C: FOUNDATION™ Fieldbus Block Information* and the FOUNDATION Fieldbus Block Manual (Document No. 00809-0100-4783).

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

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

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

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

Resource block

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

Measurement transducer block (TB1100)

The Measurement transducer block contains parameters for configuration of the Rosemount 2240S for temperature measurements as well as temperature measurement data. It contains device information including diagnostics and the ability to configure, set to factory defaults and restart the temperature transmitter.

Register transducer block (TB1200)

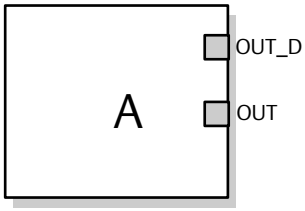
The Register transducer block allows a service engineer to access all database registers in the device.

Average Temperature transducer block (TB1300)

The Average Temperature transducer block contains parameters for configuration of average temperature calculations for the 2240S Multi-Input Temperature Transmitter.

Analog Input block

Figure 5-12. 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 163* and *"Analog Input block" on page 77*.

Multiple Analog Input block

The Multiple Analog Input (MAI) block makes the temperature elements available to other function blocks.

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.

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.

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.

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

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 83* and *"Analog output block" on page 167*.

Function block summary

The following function blocks are available for the Rosemount 2240S Series:

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

For detailed information about FOUNDATION fieldbus technology and function blocks used in the Rosemount 2240S Series, refer to the FOUNDATION Fieldbus Block Manual (Document No. 00809-0100-4783).

5.8 Device capabilities

5.8.1 Link active scheduler

The Rosemount 2240S 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 Rosemount 2240S will take over 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.

5.8.2 Device addressing

FOUNDATION fieldbus devices use addresses divided into four sub ranges as shown in Table 5-5.

Table 5-5. Address Ranges for FOUNDATION Fieldbus Devices

Address range (decimal)	Address range (hexadecimal)	Allocation
0 through 15	00 through 0F	Reserved
16 through 247	10 through F7	Permanent devices
248 through 251	F8 through FB	New or decommissioned devices
252 through 255	FC through FF	Temporary (“visitor”) devices. Example: 375/475 communicator

5.8.3 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 5-6. Communication Parameters

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

Block Execution Times

Table 5-7. Execution Times

Block	Execution time (ms)
Multiple Analog Input (MAI)	15
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

5.9 General block information

5.9.1 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

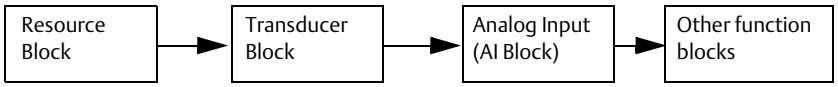
In this mode, variables that are passed out of the block can be manually set for testing or override purposes.

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 2240S. For more information, see the Function Block manual, document 00809-0100-4783.

Note
When an upstream block is set to OOS, this will impact the output status of all downstream blocks. Figure 5-13 below depicts the hierarchy of blocks.

Figure 5-13. Block Hierarchy



5.9.2 Block instantiation

The Rosemount 2240S supports the use of Function Block Instantiation. This means that 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.

5.9.3 Factory configuration

The following fixed configuration of function blocks is provided:

Table 5-8. Available Function Blocks for the Rosemount 2240S

Function Block	Index	Default Tag	Available
Analog Input(1)	1400	AI 1400	Default, permanent
Analog Input	1500	AI 1500	Default, permanent
Analog Input	1600	AI 1600	Default, permanent
Analog Input	1700	AI 1700	Default, permanent
Analog Input	1800	AI 1800	Default, permanent
Analog Input	1900	AI 1900	Default, permanent
Analog Output(2)	2000	AO 2000	Default, permanent
Multiple Analog Input	2100	MAI 2100	Default, permanent
Multiple Analog Input	2200	MAI 2200	Default, permanent
Input Selector	2300	ISEL 2300	Default, deletable
Input Selector	2400	ISEL 2400	Default, deletable
PID	2500	PID 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
Control Selector	3000	CSEL 3000	Default, deletable

1. See "Factory supplied AI blocks" on page 79 for more information.
2. See "Analog Output block" on page 83 for more information.

5.10 Analog Input block

5.10.1 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 5-9. AI Block Channels for the Rosemount 2240S

AI Block Parameter	TB Channel Value	Process Variable
Internal Temperature	1	CHANNEL_HOUSING_TEMPERATURE
Auxiliary device value	2	CHANNEL_SB_VALUE
Water level	3	CHANNEL_WATER_LEVEL
Pressure	4	CHANNEL_PRESSURE
Average liquid temperature	5	CHANNEL_ TEMP_AVERAGE_LIQUID
Average vapor temperature	6	CHANNEL_ TEMP_AVERAGE_VAPOR
Average Tank Temperature	7	CHANNEL_ TANK_TEMPERATURE

L_TYPE

The L_TYPE parameter defines the relationship of the transmitter measurement (Housing Temperature, Auxiliary Device Value, Water Level, Pressure, Average Liquid Temperature, Average Vapor Temperature, Tank Temperature) to the desired output of the AI Block. The relationship can be direct or indirect root.

Direct

Select direct when the desired output will be the same as the transmitter measurement (Housing Temperature, Auxiliary Device Value, Water Level, Pressure, Average Liquid Temperature, Average Vapor Temperature, Tank Temperature).

Indirect

Select indirect when the desired output is a calculated measurement based on the transmitter measurement (e.g. level value displayed in percentage of full span based on measured product level). 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 178).

5.10.2 Factory supplied AI blocks

The Rosemount 2240S is supplied with six pre-configured AI blocks according to Table 5-10. The block configuration can be changed if needed.

Table 5-10. Factory Supplied AI Blocks

AI Block	Channel	L-Type	Units
1	CHANNEL_ TEMP_AVERAGE_LIQUID	Direct	deg C
2	CHANNEL_ TEMP_AVERAGE_VAPOR	Direct	deg C
3	CHANNEL_ TANK_TEMPERATURE	Direct	deg C
4	CHANNEL_WATER_LEVEL	Direct	meter
5	CHANNEL_HOUSING_TEMPERATURE	Direct	deg C
6	CHANNEL_PRESSURE	Direct	bar

5.10.3 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.

5.10.4 Simulation

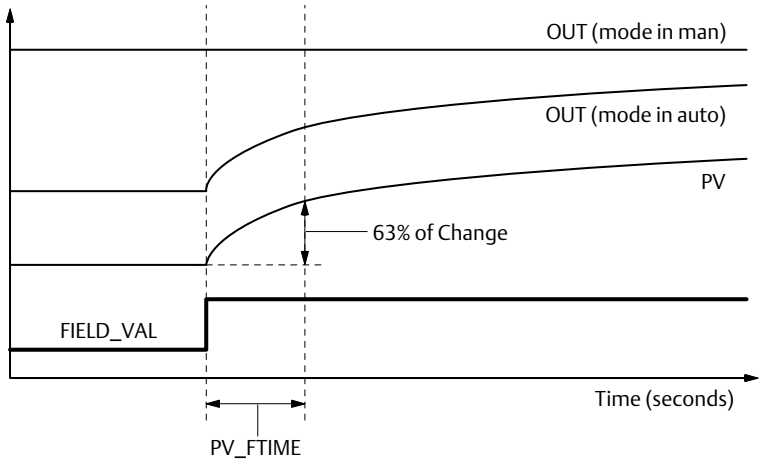
To perform lab test of process variables and alerts, you can either change the mode of the AI block to manual and adjust the output value, or you can enable simulation through the configuration tool and manually enter a value for the measurement value and its status. In both cases, you must first set the SIMULATE switch (1) on the field device to the ON position, see "Switches and reset buttons" on page 66.

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

5.10.5 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 5-14. Analog Input Function Block Timing Diagram



5.10.6 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).

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

Indirect

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

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

**** OUT_SCALE values**

Indirect Square Root

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

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

**** OUT_SCALE values**

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

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.

5.10.7 Process alarm

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

5.10.8 Alarm priority

Alarms are grouped into five levels of priority:

Table 5-11. Alarm Level Priority

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

5.11 Analog Output block

The Rosemount 2240S is supplied with a pre-configured Analog Output (AO) block according to Table 5-13. The block configuration can be changed if needed. See "Analog output block" on page 167 for more information.

5.11.1 CHANNEL

Select the channel that corresponds to the desired sensor measurement:

Table 5-12. AO Block Channels for the Rosemount 2240S

AO Block Parameter	TB Channel Value	Process Variable
Level	1	CHANNEL_LEVEL

Table 5-13. Factory Supplied AO Block for the Rosemount 2240S

AO Block	Channel	Units
1	CHANNEL_LEVEL	m

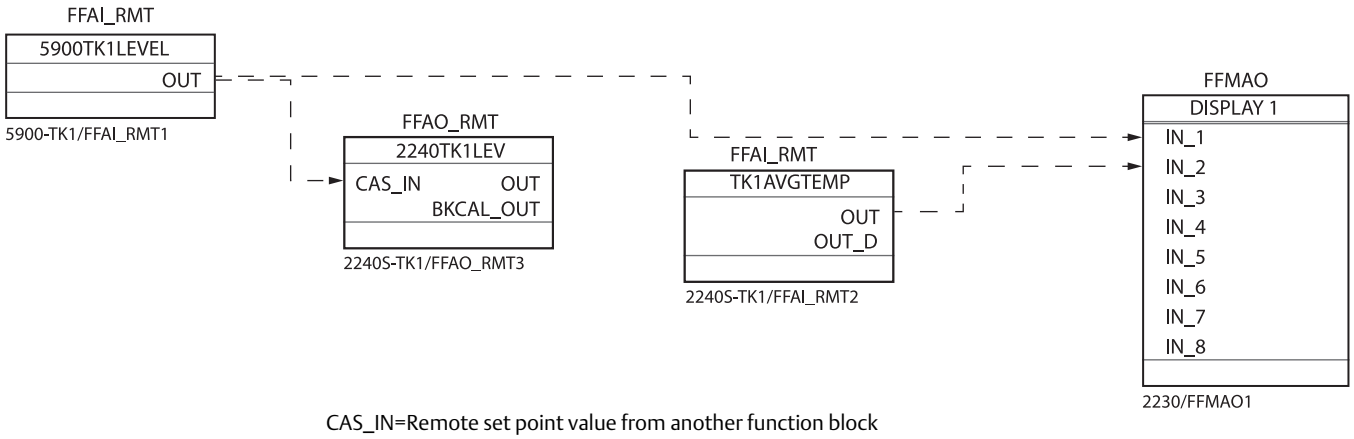
5.11.2 XD_SCALE

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

5.11.3 Application example

This example shows a Rosemount 2240S Multi-Input Temperature Transmitter configured for receiving level measurement data from a level device such as the Rosemount 5900S Radar Level Gauge.

Figure 5-15. Function block configuration of a Rosemount 2240S using DeltaV™ Control Studio



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

Note that XD_SCALE units must be the same in the AI block and the AO block.

5.12 Multiple Analog Input blocks

5.12.1 Configure the MAI blocks

The MAI Block is used for temperature element output. It has the ability to process up to eight temperature element measurements and make them available to other function blocks. The output values from the MAI block are in engineering units and contain a status.

CHANNEL

Select the channel that corresponds to the desired sensor measurement:

Table 5-14. MAI Block Channels for the Rosemount 2240S

MAI Block Parameter	TB Channel Value	Process Variable
Temperature element value	1-8	CHANNEL_TEMP_1 to CHANNEL_TEMP_8
Temperature element value	9-16	CHANNEL_TEMP_9 to CHANNEL_TEMP_16

Unit

The MAI function block channel data will use the same unit as specified in the parameter TEMPERATURE_UNIT in the Measurement Transducer block TB 1100.

5.12.2 Factory Supplied MAI blocks

The Rosemount 2240S is supplied with two pre-configured MAI blocks according to Table 5-15.

Table 5-15. Factory Supplied MAI Blocks for the Rosemount 2240S

MAI Block	Channel	Units
1	CHANNEL 1-8	deg C
2	CHANNEL 9-16	deg C

5.13 Resource block

5.13.1 FEATURES and FEATURES_SEL

The FEATURES parameter is read only and defines which features are supported by the Rosemount 2240S. Below is a list of the FEATURES supported by the Rosemount 2240S temperature transmitter.

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 2240S is HARD W LOCK. Choose one or more of the supported features if any.

UNICODE

All configurable string variables in the Rosemount 2240S, 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 Rosemount 2240S 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.

Table 5-16 on page 87 displays all possible configurations of the WRITE_LOCK parameter.

Table 5-16. Write_Lock Parameter

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

5.13.2 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.

5.13.3 Field diagnostic alerts

The Resource Block acts as a coordinator for Field Diagnostic alerts. There are four alarm parameters (FD_FAIL_ALM, FD_OFFSPEC_ALM, FD_MAINT_ALM, and FD_CHECK_ALM) which contain information regarding some of the device errors which are detected by the transmitter software.

There is a FD_RECOMMEN_ACT parameter which is used to display the recommended action text for the highest priority alarm. FD_FAIL_ALM has the highest priority followed by FD_OFFSPEC_ALM, FD_MAINT_ALM, and FD_CHECK_ALM which has the lowest priority.

Failure alerts

A *Failure* alert indicates a condition 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 FD_FAIL_ALM specifically, they are described below.

FD_FAIL_MAP

This parameter maps conditions to be detected as active for this alarm category. Thus the same condition may be active in all, some, or none of the four alarm categories. The parameter contains a list of conditions in the device which makes the device non-operational that will cause an alarm to be sent. Below is a list of the conditions with the highest priority first. This priority is not the same as the FD_FAIL_PRI parameter described below. It is hard coded within the device and is not user configurable.

1. Software Failure
2. Database Error
3. Auxiliary Device Error
4. Electronics Failure - Main Board
5. Memory Failure - FF I/O Board
6. Internal Communication Failure
7. Electronics Failure - FF I/O Board

FD_FAIL_MASK

This parameter will mask any of the failed conditions listed in FD_FAIL_MAP. A bit on means that the condition is masked out from alarming and being broadcast to the host through the alarm parameter.

FD_FAIL_PRI

Designates the alarming priority of the FD_FAIL_ALM, see “Alarm priority” on page 82. The default is 0 and the recommended values are between 8 and 15.

FD_FAIL_ACTIVE

This parameter displays which of the conditions is active.

FD_FAIL_ALM

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

Out of specification alarms

An *Out of Specification* alarm indicates that the device operates out of the specified measurement range. If the condition is ignored, the device will eventually fail. There are five parameters associated with FD_OFFSPEC_ALM, they are described below.

FD_OFFSPEC_MAP

The FD_OFFSPEC_MAP parameter contains a list of conditions indicating that the device or some part of the device operates out of specification. Below is a list of the conditions with the highest priority first. This priority is not the same as the *FD_OFFSPEC_PRI* parameter described below. It is hard coded within the device and is not user configurable.

1. Device Simulation Active
2. Auxiliary Device Measurement Failure
3. Internal Temperature Out of Limits
4. Average Temperature Measurement Failure
5. Temperature Measurement Failure
6. Invalid Model Code
7. Configuration Error

FD_OFFSPEC_MASK

The FD_OFFSPEC_MASK parameter will mask any of the failed conditions listed in FD_OFFSPEC_MAP. A bit on means that the condition is masked out from alarming and being broadcast to the host through the alarm parameter.

FD_OFFSPEC_PRI

This parameter designates the alarming priority of the FD_OFFSPEC_ALM, see “Alarm priority” on page 82. The default is 0 and the recommended values are 3 to 7.

FD_OFFSPEC_ACTIVE

The FD_OFFSPEC_ACTIVE parameter displays which of the conditions is detected as active.

FD_OFFSPEC_ALM

An alarm indicating that the device operates out of the specified measurement range. If the condition is ignored, the device will eventually fail.

Maintenance required alerts

A *Maintenance required* alert 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 FD_MAINT_ALM, they are described below.

FD_MAINT_MAP

The FD_MAINT_MAP parameter contains a list of conditions indicating that the device or some part of the device needs maintenance soon. The priority is not the same as the MAINT_PRI parameter described below. It is hard coded within the device and is not user configurable.

Note that maintenance alarms are not enabled by default for the Rosemount 2240S.

Below is a list of the conditions:

1. Auxiliary Device Measurement Close to Limit

FD_MAINT_MASK

The FD_MAINT_MASK parameter will mask any of the failed conditions listed in FD_MAINT_MAP. A bit on means that the condition is masked out from alarming and being broadcast to the host through the alarm parameter.

FD_MAINT_PRI

FD_MAINT_PRI designates the alarming priority of the FD_MAINT_ALM, see “Alarm priority” on page 82. The default is 0 and the recommended values are 3 to 7.

FD_MAINT_ACTIVE

The FD_MAINT_ACTIVE parameter displays which of the conditions is active.

FD_MAINT_ALM

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

Function Check Alarms

A *Function Check* alarm indicates that the device is temporary non-valid due to some activities, for example maintenance, on the device.

There are five parameters associated with FD_CHECK_ALM, they are described below.

FD_CHECK_MAP

The FD_CHECK_MAP 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:

1. Check function

FD_CHECK_MASK

The FD_CHECK_MASK parameter will mask any of the failed conditions listed in FD_CHECK_MAP. A bit on means the condition is masked out from alarming and being broadcast to the host through the alarm parameter.

FD_CHECK_PRI

FD_CHECK_PRI designates the alarming priority of the FD_CHECK_ALM, see "Alarm priority" on page 82. The default is 0 and the recommended values are 1 or 2.

FD_CHECK_ACTIVE

The FD_CHECK_ACTIVE parameter displays which of the conditions is active.

FD_CHECK_ALM

FD_CHECK_ALM is an alarm indicating that the device output is temporary invalid due to on-going work on the device.

5.13.4 Recommended actions for alerts

The FD_RECOMMEN_ACT and RECOMMENDED_ACTION parameters display text strings that will give a recommended course of action to take based on which type and which specific event of the alerts that is active (See Table 6-12 on page 136).

5.13.5 Alarm priority

Alarms are grouped into five levels of priority:

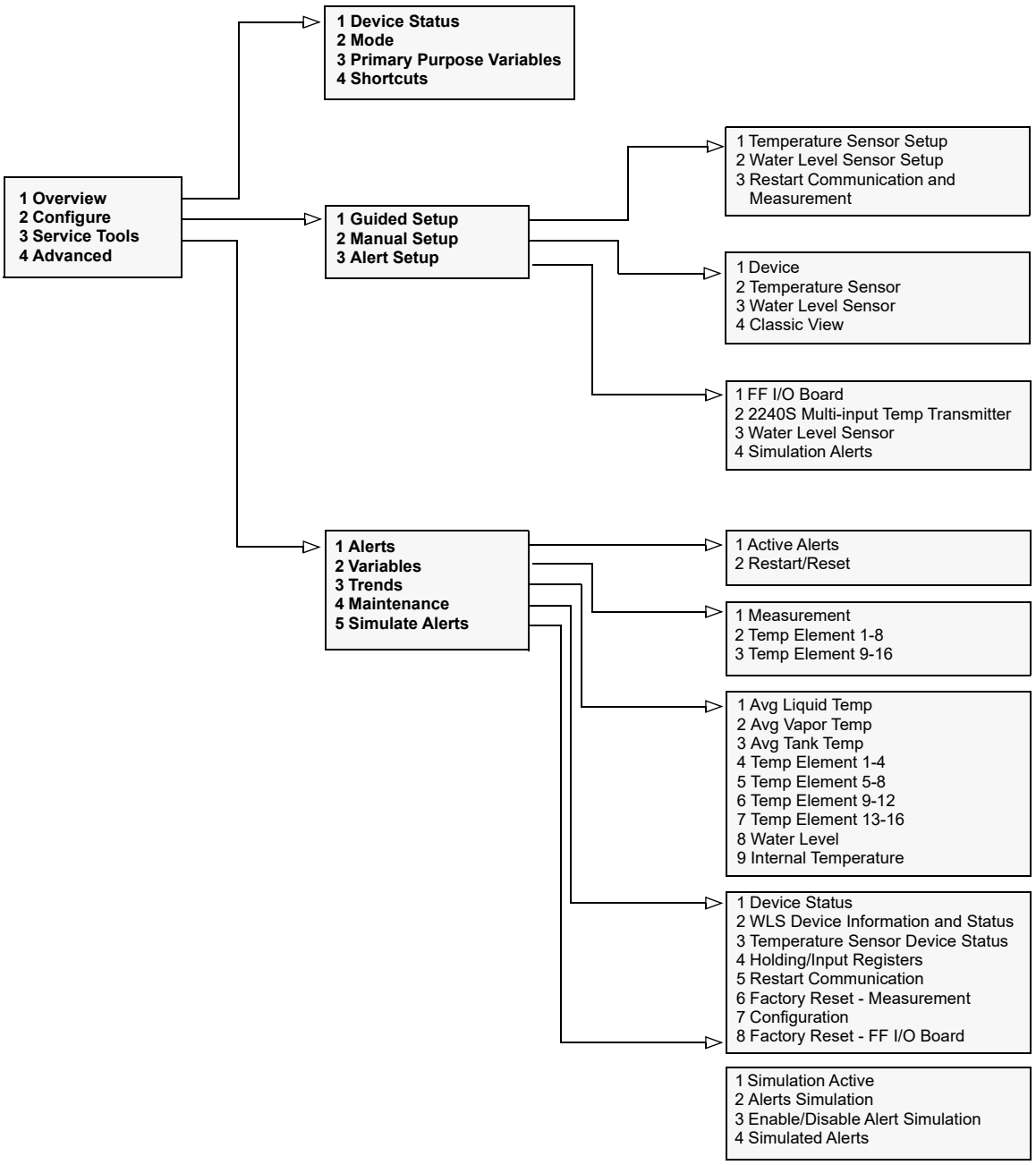
Table 5-17. Alarm Level Priority

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

5.14 Configuration using a field communicator

The Rosemount 2240S can be configured using a field communicator such as the Rosemount AMS Trex™ Device Communicator or the Rosemount 475 Field Communicator. The menu tree below shows available options for configuration and service. See "Basic configuration" on page 54 for more information.

Figure 5-16. Field Communicator Menu Tree



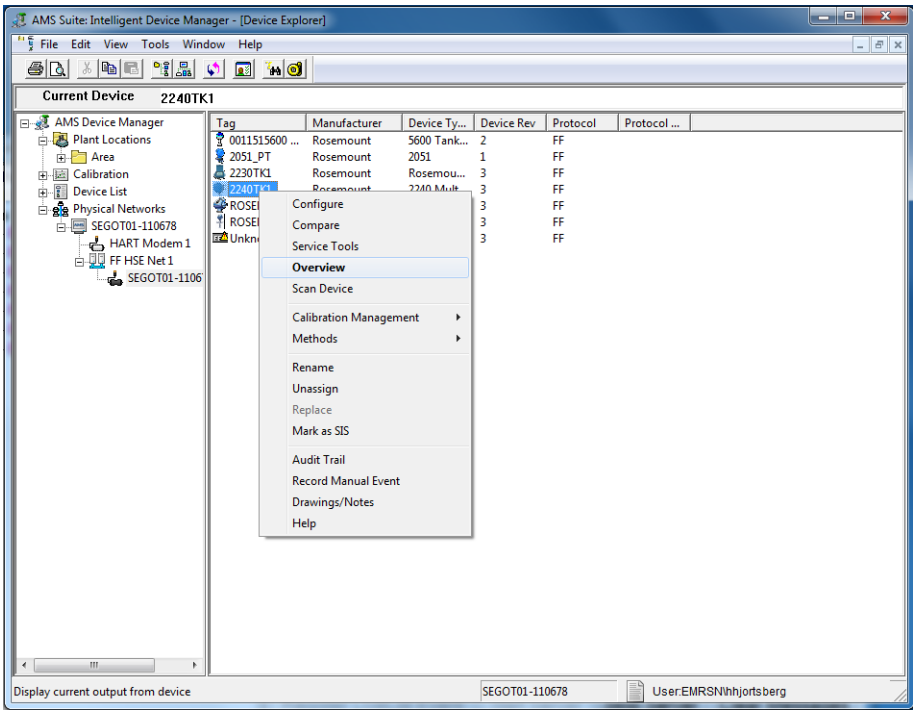
5.15 Configuration using AMS Device Manager

The Rosemount 2240S supports DD Methods to facilitate device configuration. The following description shows how to use the AMS Device Manager application to configure the Rosemount 2240S in a FOUNDATION fieldbus system. For more information on configuration parameters see "Basic configuration" on page 54.

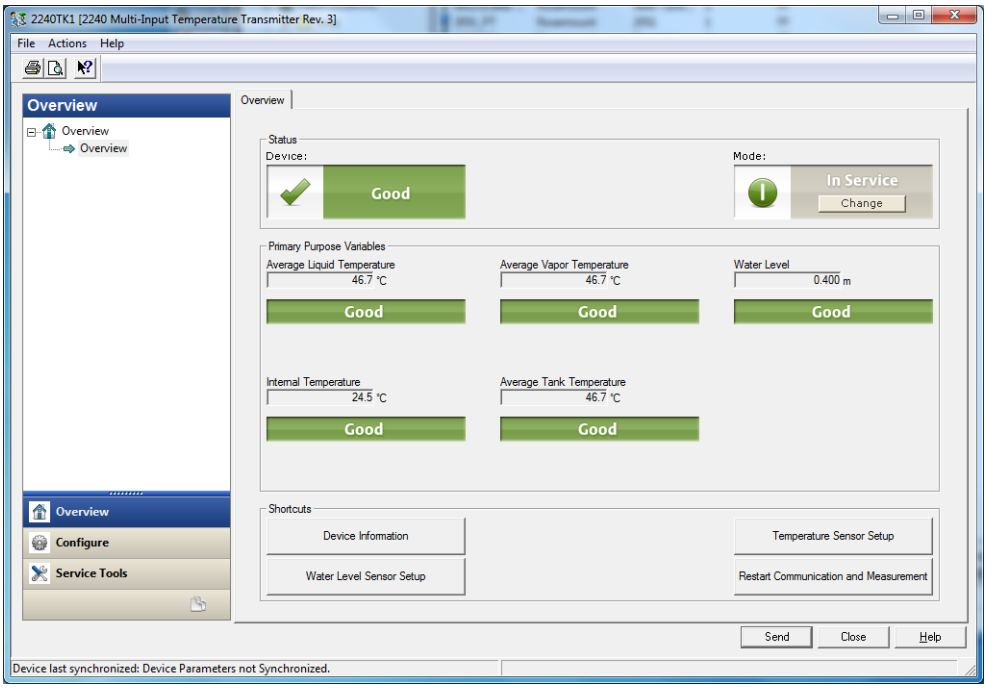
5.15.1 Starting the Guided Setup

To configure the Rosemount 2240S in AMS:

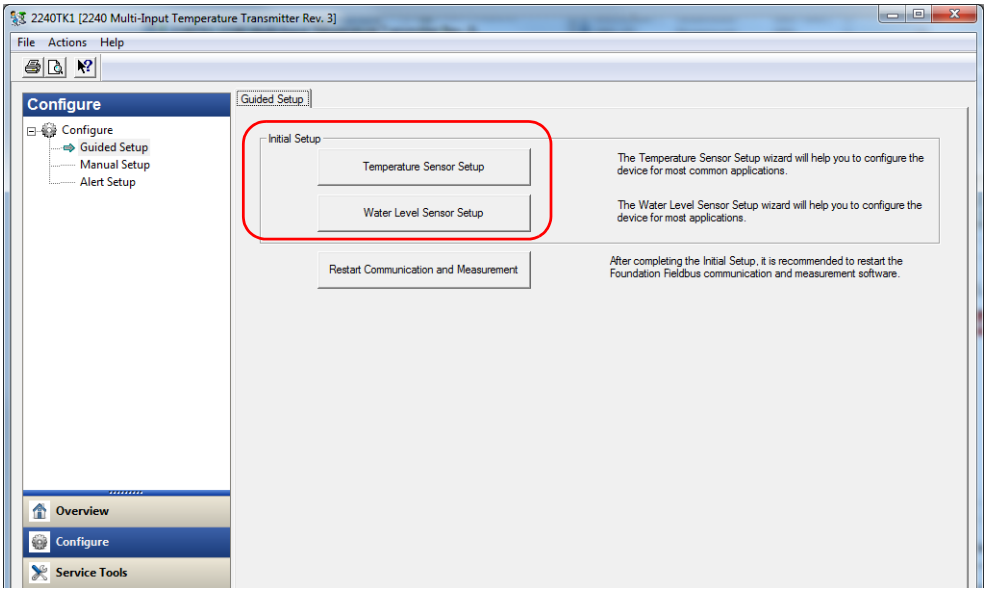
1. From the Start menu; open the AMS Device Manager application.
2. Open the *View>Device Explorer*.
3. Double-click the FF network icon and expand the network node to view the devices.
4. Right-click or double-click the desired gauge icon to open the list of menu options:



5. Choose the **Overview** option.

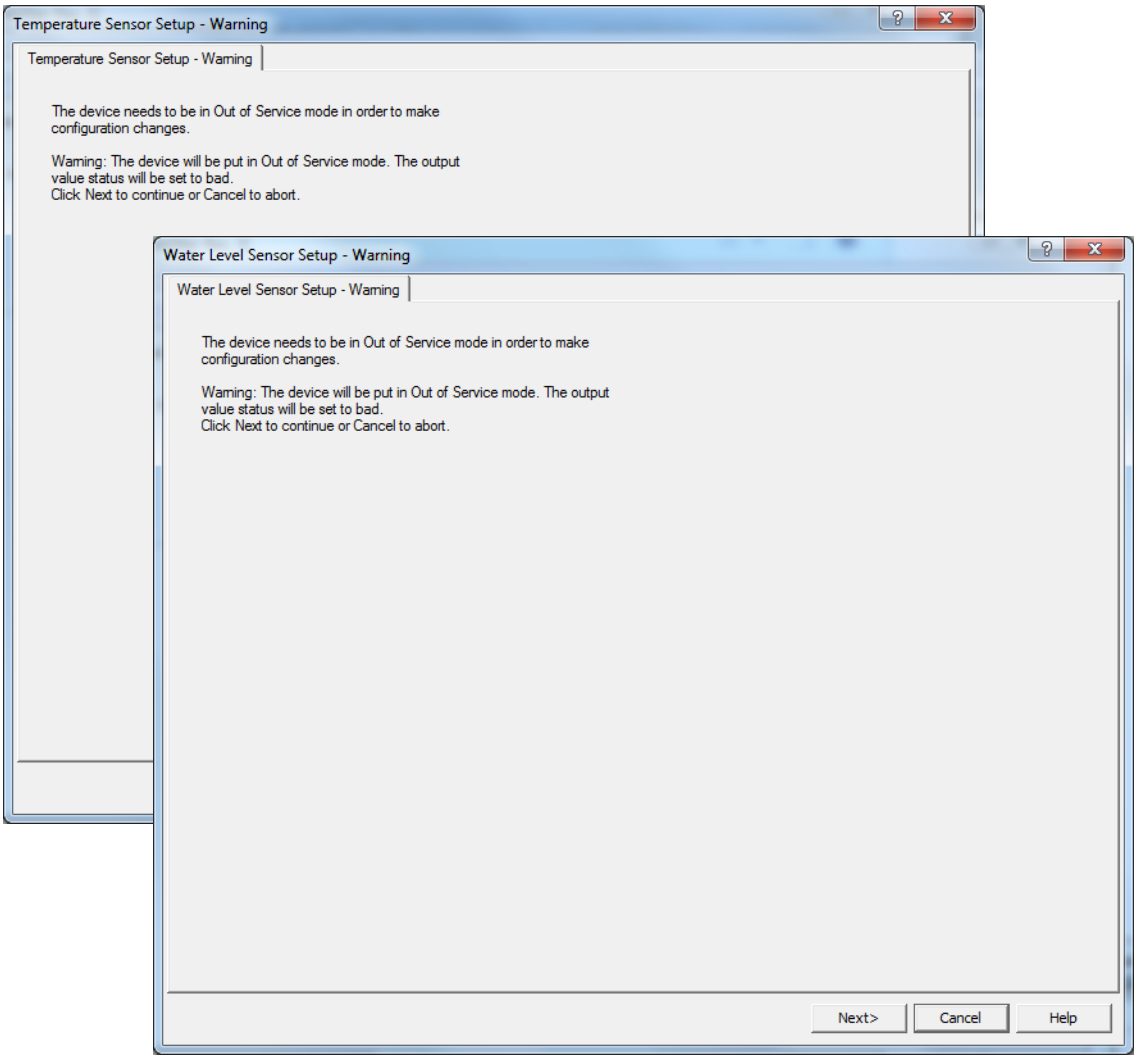


6. Click the **Change** button and set the device to **Out Of Service** (OOS) mode. In case you don't change device mode now, it will automatically switch to Out Of Service when starting the Measurement Setup wizard.
7. Select the **Configure** option.
8. Select **Guided Setup**.



9. Click the desired sensor setup button to start the configuration wizard. The **Temperature / Water Level Sensor Setup** wizards facilitate configuration of the device for most common applications. The wizard will put the device in **Out of Service** mode until the wizard is finished. See the Configure/Manual Setup option for access to an extended range of configuration parameters.

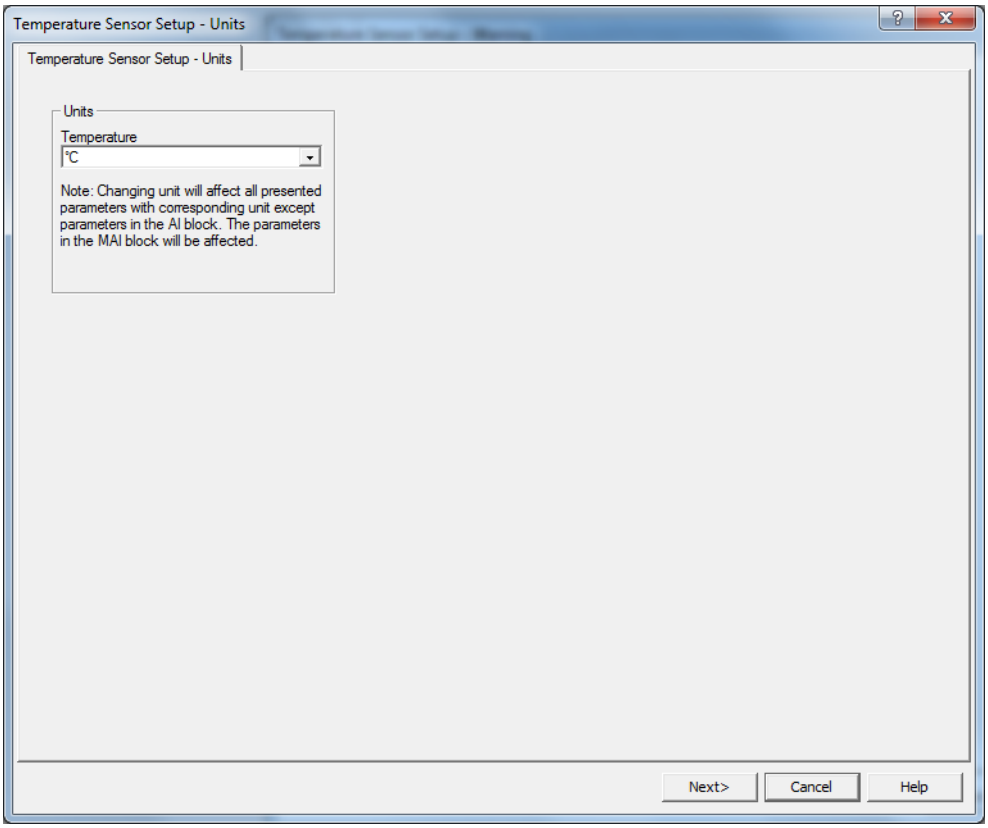
10. In case the device was not set to **Out Of Service** mode, a warning message will appear that the device needs to be in **Out Of Service** mode in order to make configuration changes.



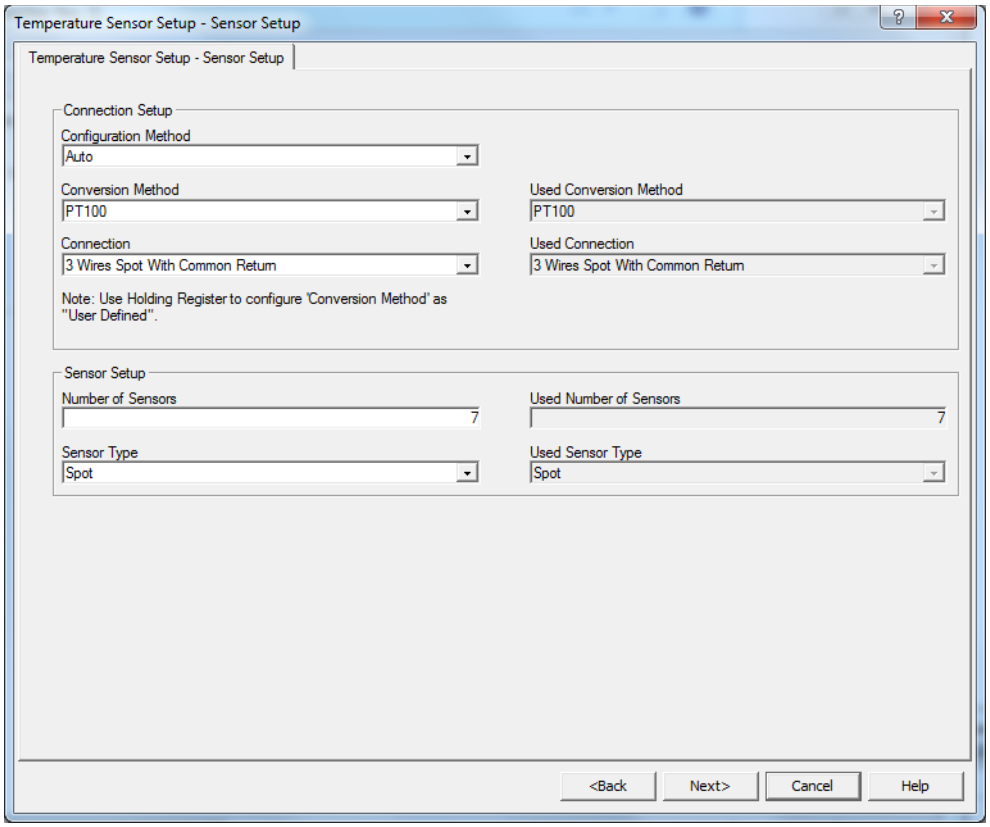
11. Click the **Next** button to proceed. The temperature transmitter will automatically be set to **Out Of Service** (OOS) mode, and the *Temperature / Water Level Sensor Setup - Units* window appears.

5.15.2 Temperature sensor setup

1. Start the Guided Setup as described in "Starting the Guided Setup" on page 94.



2. Choose the desired measurement unit for Temperature. Parameters in the Multiple Analog Input (MAI) blocks and other blocks using temperature unit will be affected. Note that parameters in the Analog Input block are not affected.
3. Click the **Next** button to open the *Temperature Sensor Setup - Sensor Setup* window.



4. This window lets you configure the following:
   - Configuration method
   - Conversion method
   - Connection
   - Number of sensors
   - Sensor type

See "Basic configuration" on page 54 for details on how to configure the temperature sensor.

FOUNDATION Fieldbus parameters:

TRANSDUCER BLOCK 1100>CONFIG_METHOD

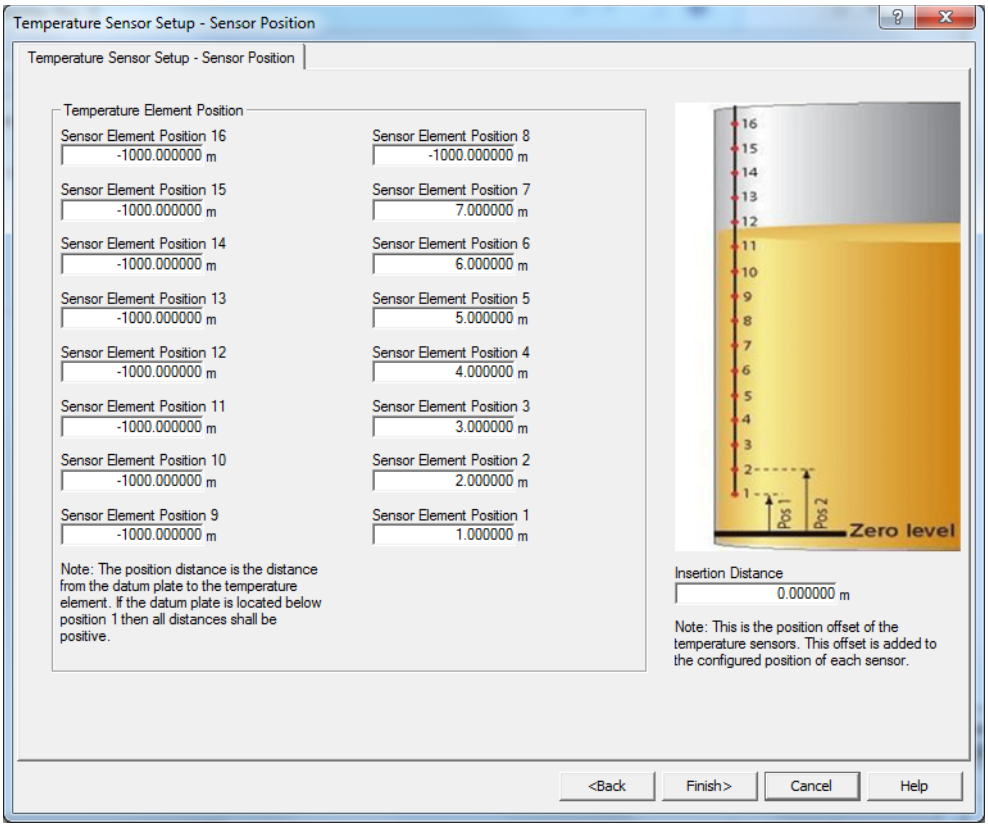
TRANSDUCER BLOCK 1100>CONVERSION_METHOD

TRANSDUCER BLOCK 1100>SENSOR_CONNECTION

TRANSDUCER BLOCK 1100>NUMBER_OF_SENSORS

TRANSDUCER BLOCK 1100>SENSOR_TYPE

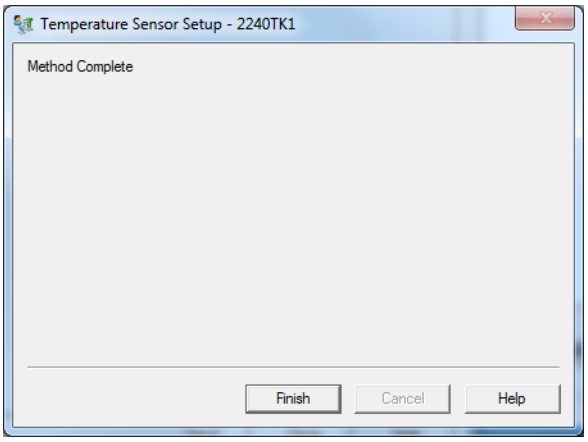
5. Click the **Next** button to open the *Temperature Sensor Setup - Sensor Position* window.



6. The temperature elements are numbered from the bottom of the tank and upwards. Enter the position of each element, measured as the distance from the Zero Level (Dipping Datum Plate) to the temperature element. If you use average temperature elements, enter the position of the terminating level of each sensor element.

   FOUNDATION Fieldbus parameters:
   TRANSDUCER BLOCK 1300>INSERTION_DISTANCE
   TRANSDUCER BLOCK 1300>SENSOR_POSITION_N

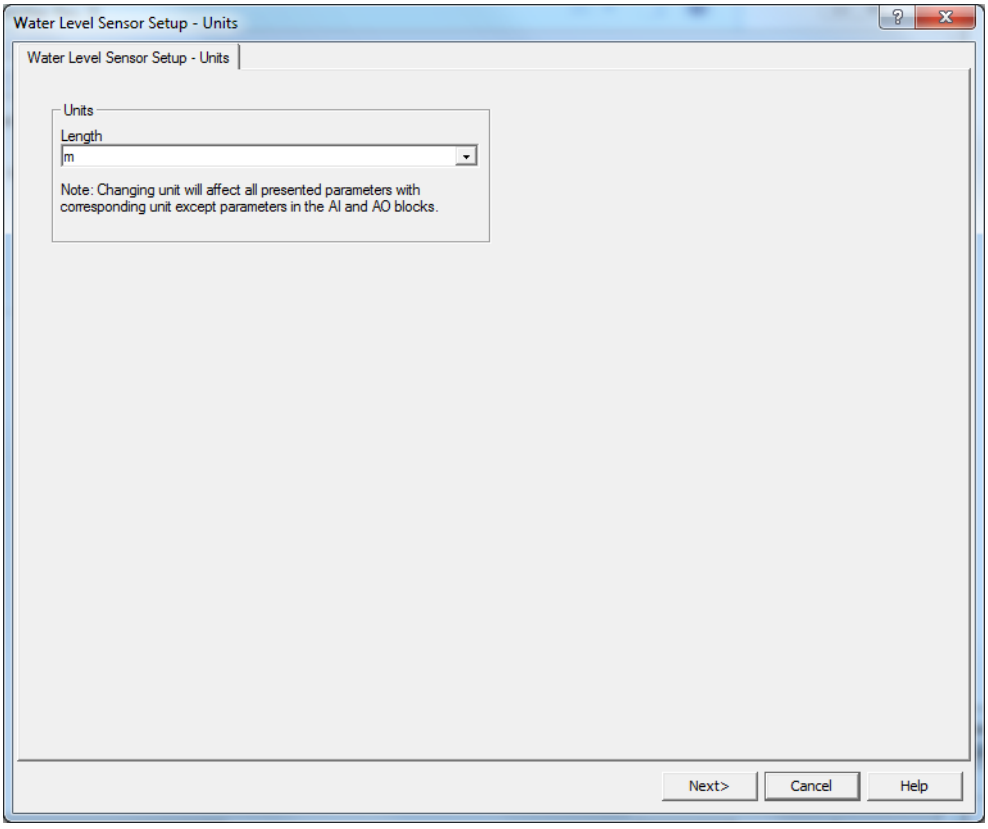
7. Click the **Finish** button.



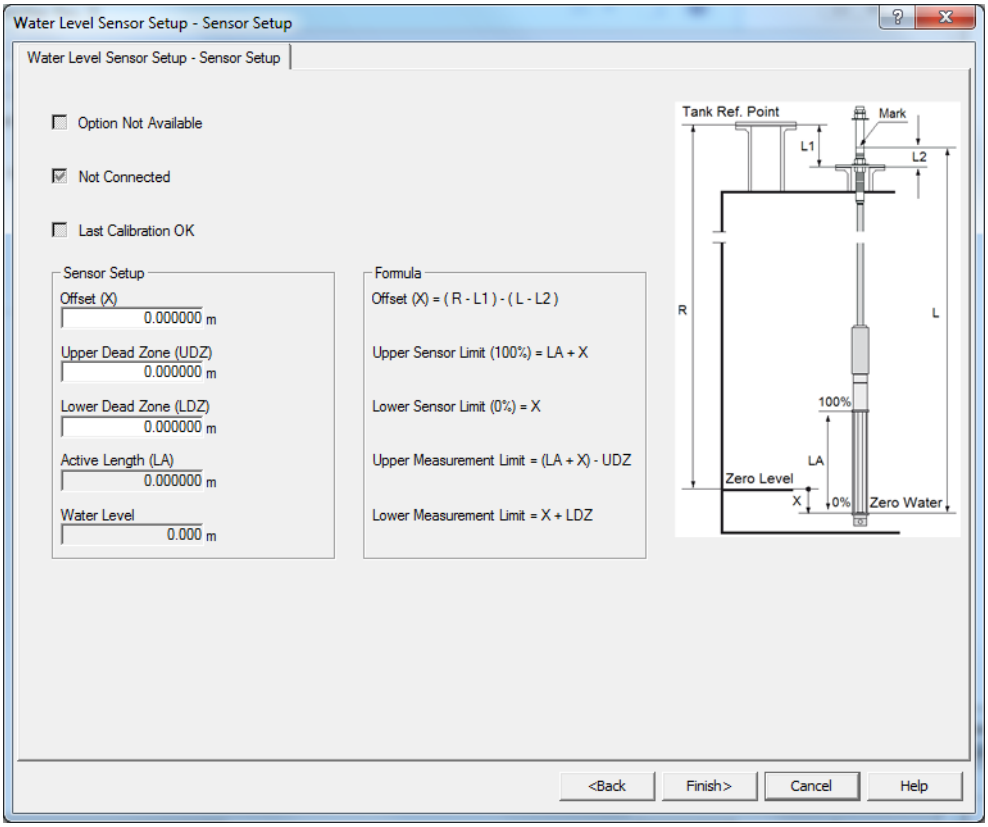
8. In the *Temperature Sensor Setup* window click the **Finish** button and return to the *Guided Setup* tab.
9. Continue with the Water Level Sensor Setup guide.

5.15.3 Water level sensor setup

1. Start the Guided Setup as described in "Starting the Guided Setup" on page 94.



2. Choose the desired measurement unit. Note that parameters in the Analog Input block are not affected.
3. Click the **Next** button to open the *Water Level Sensor Setup - Sensor Setup* window.



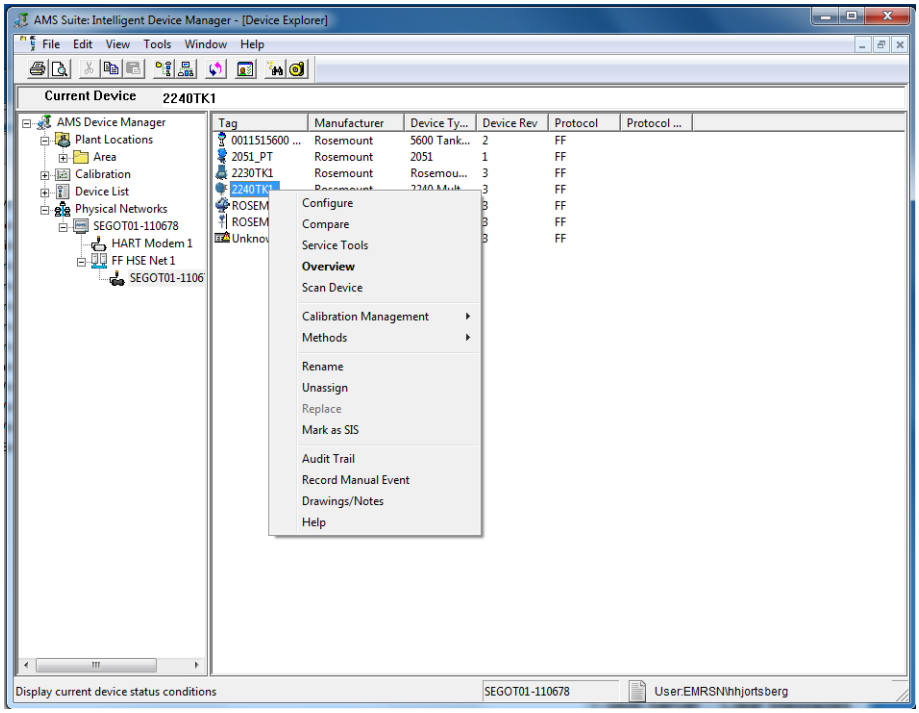
4. See sections "Water Level Sensor calibration" on page 57 and "Water Level Sensor measuring range" on page 59 for details on how to calibrate and configure the Water Level Sensor. These sections describe the tank geometry and how to calculate the Level Offset (X) parameter.

   FOUNDATION Fieldbus parameters:
   TRANSDUCER BLOCK 1100>SB_STATUS
   TRANSDUCER BLOCK 1100>WLS_CALIBRATION
   TRANSDUCER BLOCK 1100>SB_UPPER_DEAD_ZONE
   TRANSDUCER BLOCK 1100>SB_LOWER_DEAD_ZONE
   TRANSDUCER BLOCK 1100>WATER_LEVEL

5. Click the **Finish** button to finish the WLS configuration and close the *Sensor Setup* window.

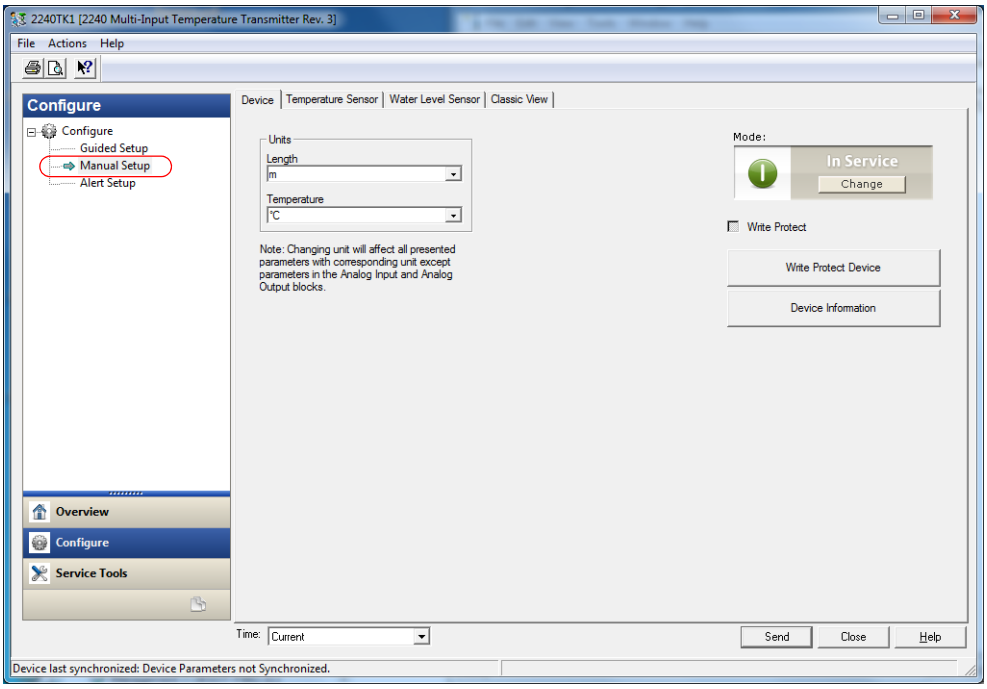
5.15.4 Manual setup

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



5. Select the **Configure** option.

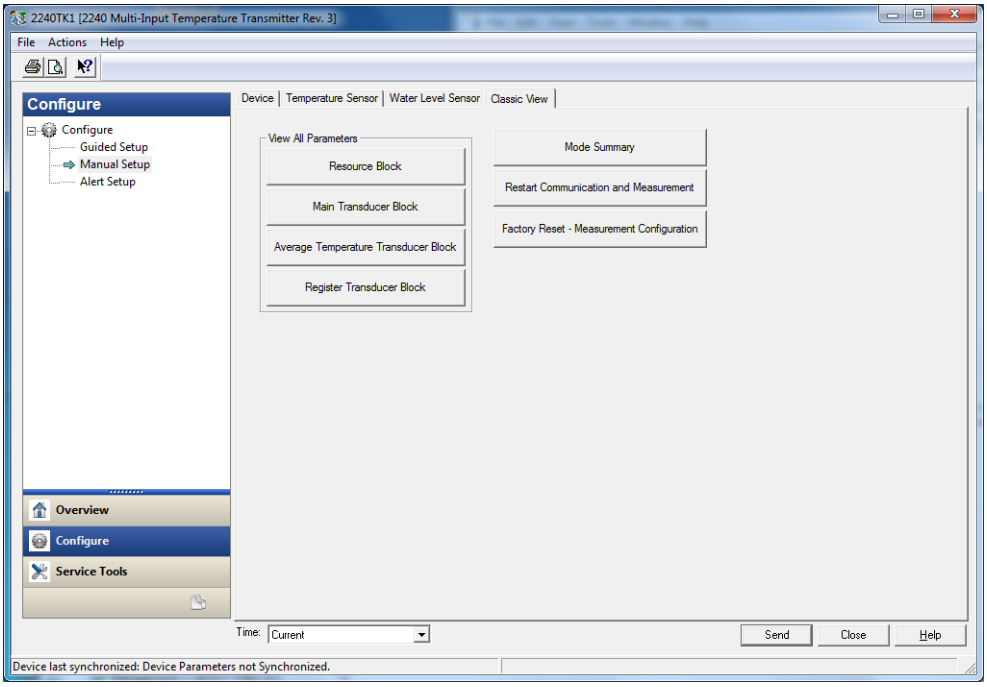
6. Select the **Configure>Manual Setup** option.



7. Set the device to Out Of Service (OOS) mode by clicking the **Change** button.
8. Select the desired tab (*Device*, *Temperature Sensor*, *Water Level Sensor*, etc.) and configure the device.
9. The *Device* tab lets you configure display units. It also provides the option to write protect the Rosemount 2240S.
10. In addition to the *Device* tab there are various tabs that give you access to options such as temperature sensor configuration and water level sensor configuration.
11. When configuration is finished, click the **Send** button to store the current configuration in the device database.
12. Press the **Change** button to set the device back to operating (Auto) mode.
13. Press the **Close** button to close the window.

Classic view

The *Classic View* gives you access to the different FOUNDATION fieldbus blocks. Also **Mode Summary** and **Factory Reset** and **Restart** is available from this window.



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

The **Main Transducer Block** contains parameters for configuration of the Rosemount 2240S . It contains device information including diagnostics and the ability to configure, set to factory defaults and restart the Rosemount 2240S.

The **Average Temperature Transducer Block** contains parameters for configuration of average temperature calculations for the Rosemount 2240S Multi-Input Temperature Transmitter for use in a FOUNDATION fieldbus system.

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

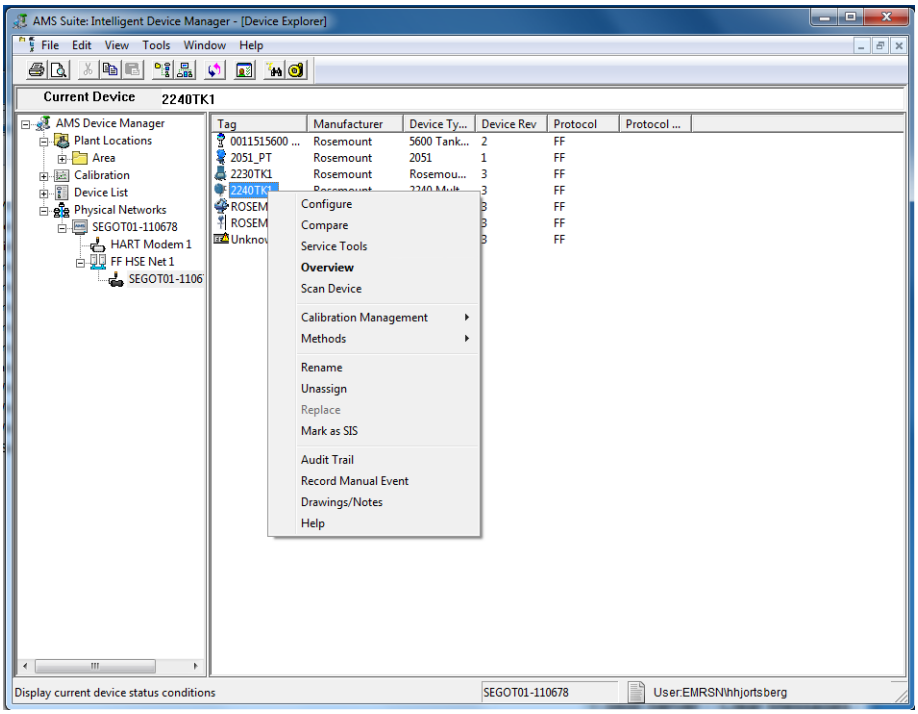
5.16 Alert setup

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

For details on how to view active alerts see "Viewing active alerts in AMS Device Manager" on page 133.

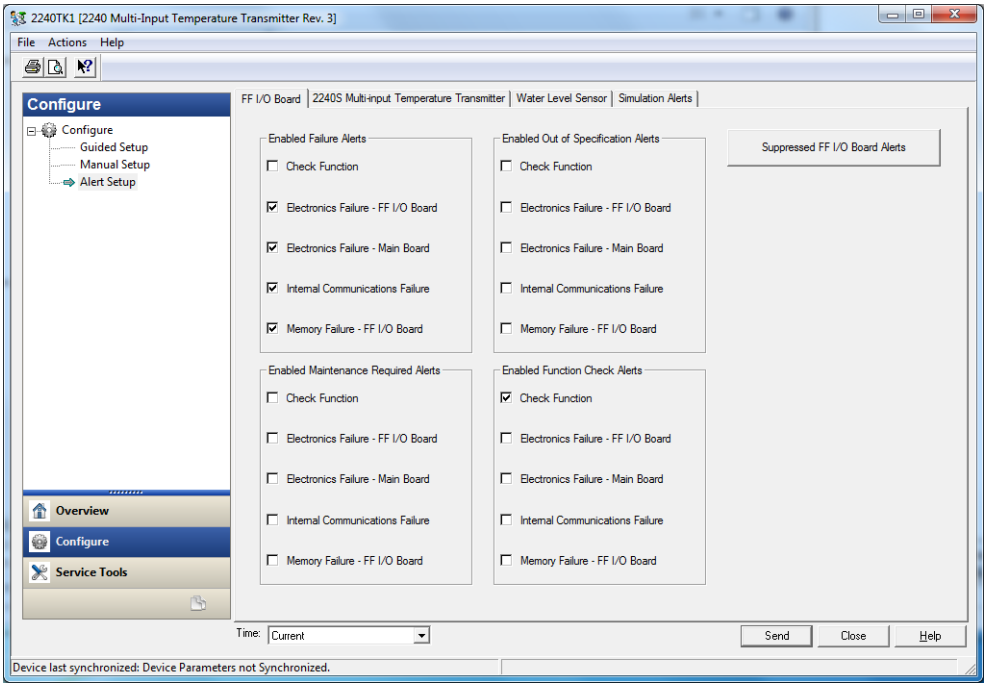
To open the *Alert Setup* window:

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. Select the **Configure** option.

6. Select the **Configure>Alert Setup** option.



7. Select the desired tab (FF I/O Board, 2240S Multi-input Temperature Transmitter, Water Level Sensor, Simulation Alerts).
8. Configure alerts for the different error types. The first time this window is opened, the default setup of error types and alerts (Failure, Maintenance Required, Out of Specification, and Function Check) will appear, see "Alert default settings" on page 108.
9. You may change the configuration for each error type by selecting the appropriate check box to match your requirements. Note that it is possible to map an error condition to several alert categories if desired.
10. See "Alert default settings" on page 108 for information on the default setup for error types and alerts (Failure, Maintenance, Out of Specification, and Function Check).
11. Click the **Send** button to save the current alert setup once the configuration is finished.

5.16.1 Alert default settings

The following default settings are used for the Rosemount 2240S Multi-input Temperature Transmitter. You may configure error types in a different way if you like. For example, the *Temperature Measurement Failure* error is disabled by default. The *Alert Setup* window allows you to enable the alert as *Failure*, *Out of Specification*, *Maintenance Required*, or *Function Check* instead.

Multi-input temperature transmitter

Table 5-18. Default Alert Configuration for Multi-input Temperature Transmitter

Error type	Default configuration	Enabled / Disabled
Average Temperature Measurement Failure	NA	Disabled
Configuration Error	Out of Specification	Enabled
Database error	Failure	Enabled
Internal Temperature Out of Limits	Out of Specification	Enabled
Invalid Model Code	Out of Specification	Enabled
Software failure	Failure	Enabled
Temperature Measurement Failure	NA	Disabled

FF I/O board

Table 5-19. Default Alert Configuration for FF I/O Board

Error type	Default configuration	Enabled / Disabled
Check function	Function Check	Enabled
Electronics failure - FF I/O Board	Failure	Enabled
Electronics failure - Main Board	Failure	Enabled
Internal communication failure	Failure	Enabled
Memory failure FF I/O Board	Failure	Enabled

Water level sensor

Table 5-20. Default Alert Configuration for Water Level Sensor

Error type	Default configuration	Enabled / Disabled
Auxiliary Device Error	Failure	Enabled
Auxiliary Device Measurement Close to Limit	NA	Disabled
Auxiliary Device Measurement Failure	NA	Disabled

Simulation alerts

Table 5-21. Default alert Configuration for Simulation

Error type	Default configuration	Enabled / Disabled
Device Simulation Active	Out of Specification	Enabled

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.

⚠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 Field 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

The Rosemount 2240S Multi-input Temperature Transmitter has no moving parts and requires a minimal amount of scheduled hardware maintenance. In case of a malfunction, check for an external cause and use the diagnostics presented below.

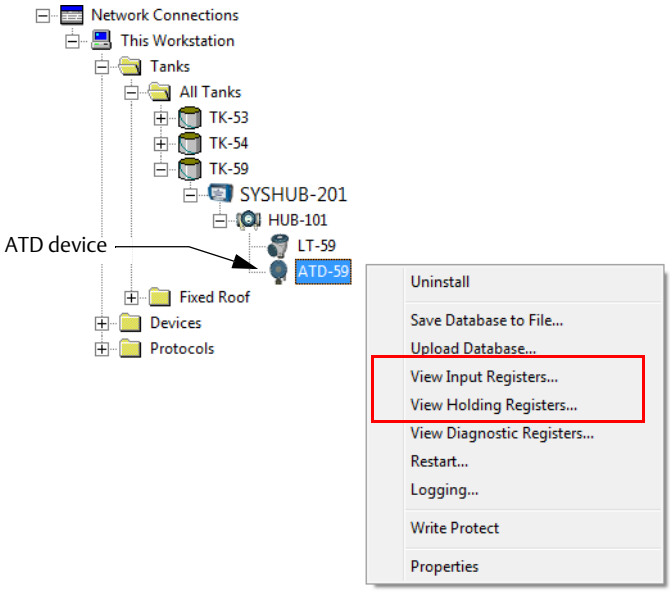
6.2.1 Viewing input and holding registers

Transmitter data is stored in Input Registers. By viewing the contents of the input registers, advanced users can check that the Rosemount 2240S works properly.

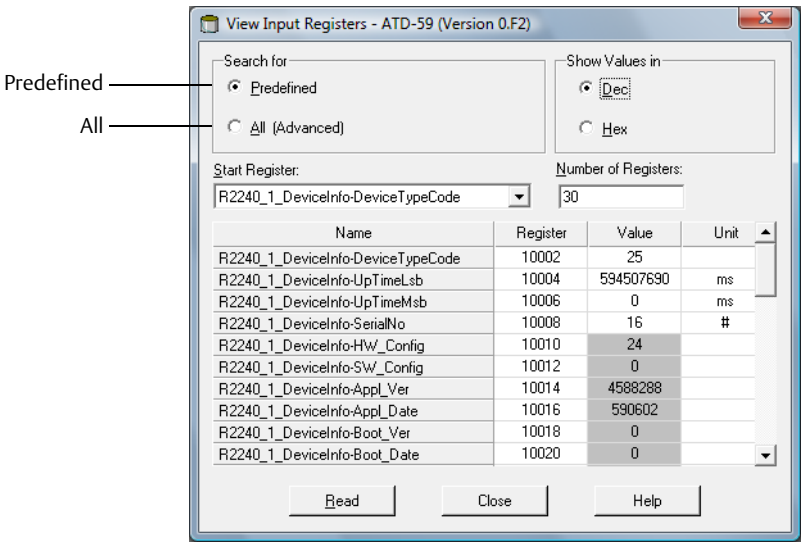
The Holding Registers store various parameters such as configuration data used to control measurement performance. By using the TankMaster WinSetup configuration tool, most Holding Registers can be edited simply by typing a new value in the appropriate value input field.

To view Input or Holding Registers for a Rosemount 2240S, do the following:

1. Start the TankMaster WinSetup program.



2. In the *TankMaster WinSetup* workspace click the right mouse button on the ATD device icon.
3. Choose the **View Input Registers** or **View Holding Registers** option, or from the **Service** menu choose **Devices>View Input Registers / View Holding Registers**.



4. Choose **Predefined** if you like to view a basic selection of registers.
   Choose the **All** option if you want to select a certain range of registers by your own choice. You can specify 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(1).
5. Click the **Read** button to update the *View Input/Holding Registers* window with fresh device data.

For information on how to view database registers in AMS, see "Viewing input and holding registers" on page 142.

6.2.2 Editing holding registers

Most Holding Registers can be edited simply by typing a new value in the appropriate Value input field. Some Holding Registers (marked grey in the Value column) can be edited in a separate window. In this case you can choose from a list of options or you can change separate data bits.

For more information see the RosemountTank Gauging System Configuration Manual.

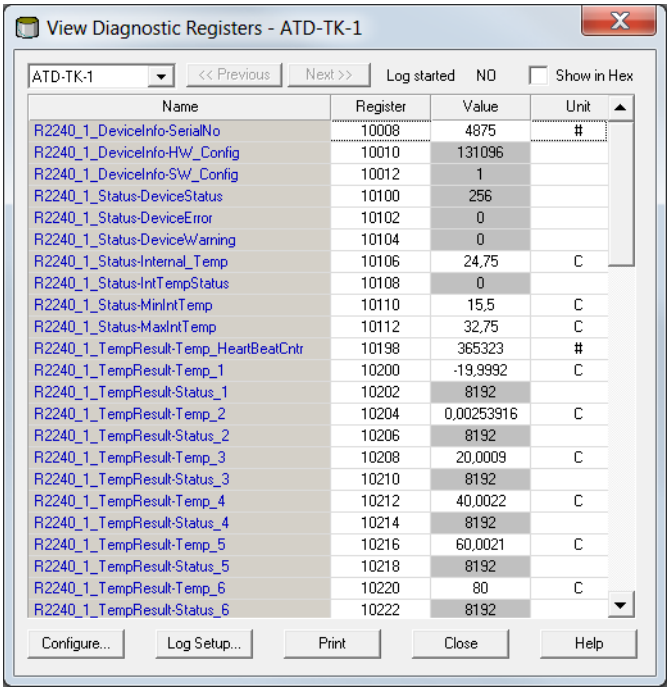
1, *Note that Input Register data from the Rosemount™ 2240S transmitter is temporarily stored in the Input Register database of the Rosemount 2410 Tank Hub. The Input Registers presented in TankMaster WinSetup refer to the internal register area of the Rosemount 2410. Therefore, for tank 1 you will have to add 10000 to the Rosemount 2240S internal register number as given by Table 6-4 in order to find the register presented by WinSetup. For tank 2 (requires a Rosemount 2410 with the multi-tank option) you will have to add 12000, for tank 3 you will have to add 14000, and so on.*

6.2.3 Diagnostics

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

To view and configure the diagnostic registers:

1. Select the ATD device icon in the *TankMaster WinSetup* workspace.
2. Click the right mouse button and choose **View Diagnostic Registers**.



The register values in the *View Diagnostic Registers* window are of “read only” type. They are loaded from the device as the window is opened.

In the Value column a grey background color in a table cell means that the register is of either Bitfield or ENUM type. An expanded Bitfield/ENUM window can be opened for this type of register by double-clicking the table cell.

If desired, the values can be presented in hexadecimal format. 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 figures.

The **Configure** button lets you open the *Configure Diagnostic Registers* window to change the list of registers to be displayed in the *View Diagnostic Registers* window. See the Rosemount Tank Gauging System Configuration Manual for more information.

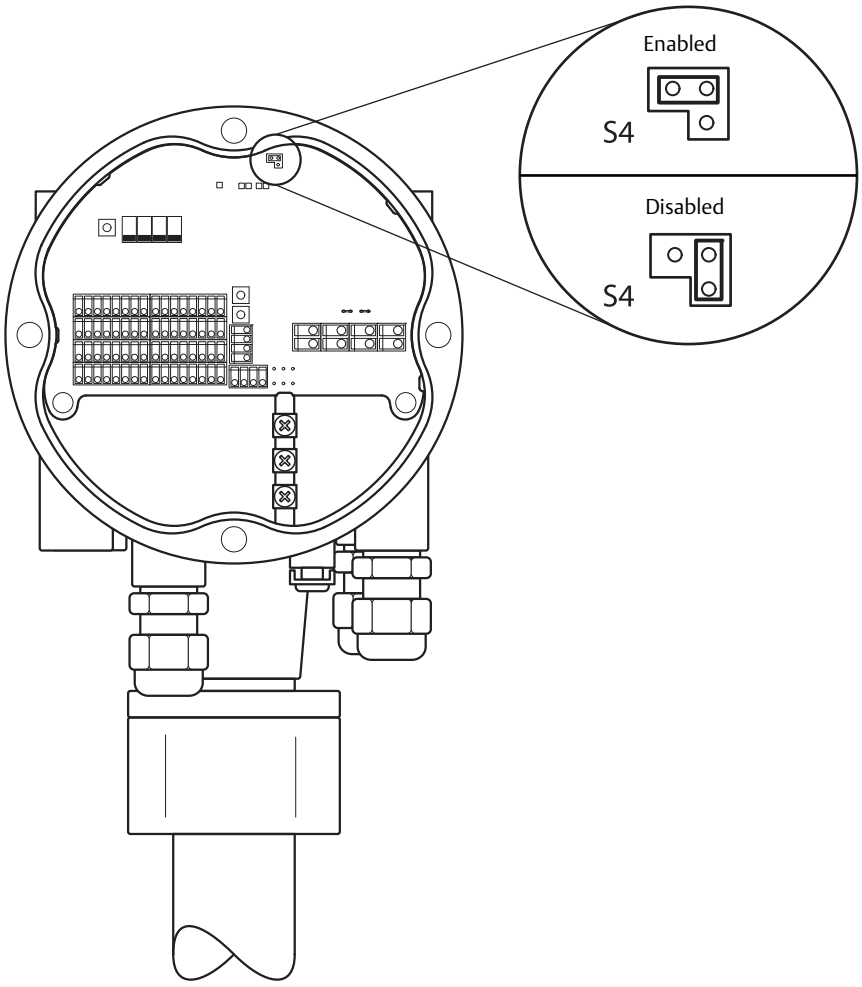
In the *Configure Diagnostic Registers* window a **Log Setup** button provides access to the *Register Log Scheduling* window which allows you to setup a log schedule for automatic start and stop of register logging.

6.2.4 Ground fault detection

The Rosemount 2240S has a built-in function for ground fault detection. When the ground fault detector is enabled, a faulty temperature sensor is indicated in a status register (see "Temperature element status" on page 130). A single fault will affect the measurement on all channels.

If one of the temperature elements fails, for example caused by a short circuit to ground, you can change the jumper setting to temporarily disable ground fault detection, see Figure 6-1.

Figure 6-1. Jumper for Ground Leakage Detection



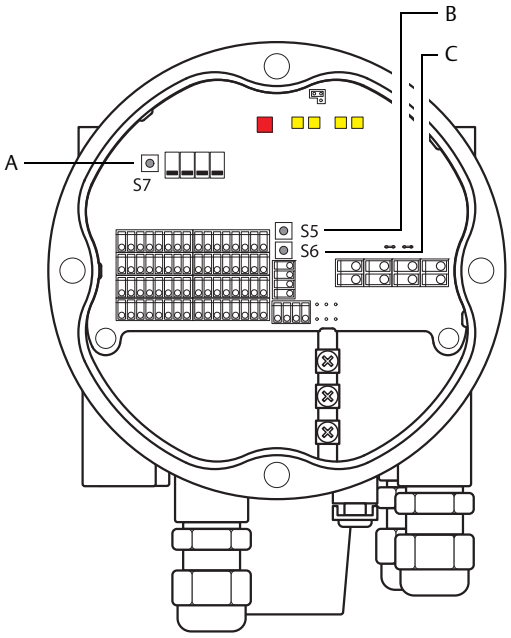
Note
Ground fault detection should only be used as a temporary solution in case of a malfunctioning temperature element. The faulty temperature element must be replaced for accurate measurement. See "Test and simulation" on page 119.

6.2.5 Reset and WLS calibration

Resetting the Rosemount™ 2240S Multi-input Temperature Transmitter

The RESET button (S7) can be used to force a restart of the Rosemount 2240S Multi-input Temperature Transmitter. Restarting the transmitter has the same effect as switching off and on the power supply.

Figure 6-2. Reset button and WLS Calibration



A. RESET transmitter (S7)

B. WLS Calibration (S5)

C. RESET water level sensor (S6)

Calibrating the Water Level Sensor

The Rosemount 2240S has a push-button for calibrating the Water Level Sensor (WLS).

Press the **WLS Calibration** push-button (S5) for at least two seconds to send a zero water level calibration command to the WLS. While the calibration process is running, the current status is indicated with the status LED, see "Status LED" on page 64.

See "Water Level Sensor calibration" on page 57 for more information on how to calibrate the WLS.

Resetting WLS to factory calibration

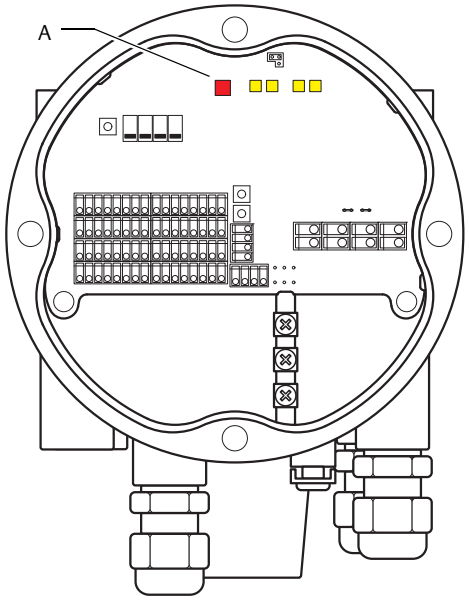
The Rosemount 2240S has a push-button for resetting the WLS to factory calibration settings corresponding to air.

Press the **RESET WLS** (S6) and the **WLS Calibration** (S5) buttons simultaneously for at least two seconds to perform a reset of the WLS to factory calibration.

6.2.6 Device error LED signals

Inside the transmitter housing, the Rosemount 2240S has a red Light Emitting Diode (LED) that presents the current transmitter status. The LED uses different blinking sequences for presentation of various error types.

Figure 6-3. Error Signals



A. Status LED (red)

In normal operation, the LED flashes once every other second. In case of an error, the LED flashes a sequence that corresponds to the device error code number (see Table 6-1) followed by a four second pause. The code sequence is continuously repeated.

The following error codes can be presented by the LED:

Table 6-1. Status LED Error Codes

LED Status Code	Error Type
0	RAM error
1	FPROM error
2	HREG error
3	SW error
4	Other memory error
9	Internal temperature error
11	Measurement error
12	Configuration error

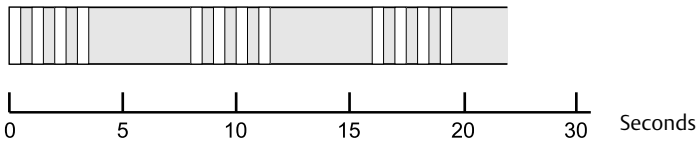
See “Device errors” on page 128 for more information about the different error messages.

An example of a flash sequence is illustrated in Figure 6-4.

Example

Error code 4 (Other memory error) is displayed as the following LED flash sequence:

Figure 6-4. Example of an Error Code Flash Sequence



Note
In case there are several simultaneous errors only the first detected error is indicated by the LED.

6.2.7 Test and simulation

Test terminal for temperature elements

The Rosemount 2240S has a built-in simulator for temperature elements which allows you to verify the measuring electronics.

The built-in test facility comprises one 100±0.1 Ohm resistor and four 10±0.1 Ohm resistors to simulate a temperature element (RTD) with a long cable connection.

To check a measuring channel:

1. Connect the test terminals to the corresponding input terminals as shown in table Table 6-2:

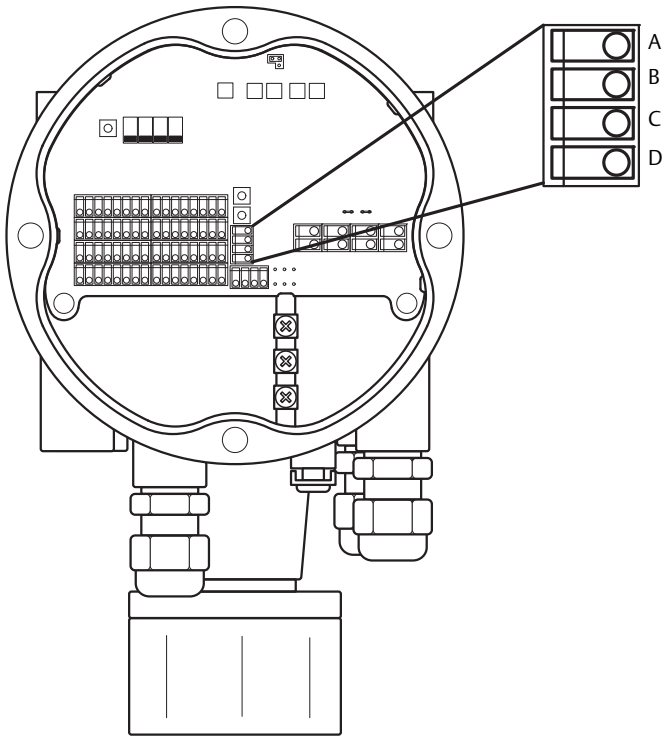
Table 6-2. Test terminal connections

4-wire	3-wire	3-wire common return(1)
a - a b - b c - c d - d	a - No connection b - b c - c d - d	a - No connection b - b c - 1c d - 1d

1. To check a channel for 3-wire common return operation, the element on channel 1 must be disconnected and replaced by the test terminal c and d connections

2. Check the connected input channel. It should read 0±0.3°C (4-wire independent spot), 0±0.6°C (3-wire independent spot) or 0±0.6°C (3-wire common return).

Figure 6-5. Test terminal for Temperature Elements

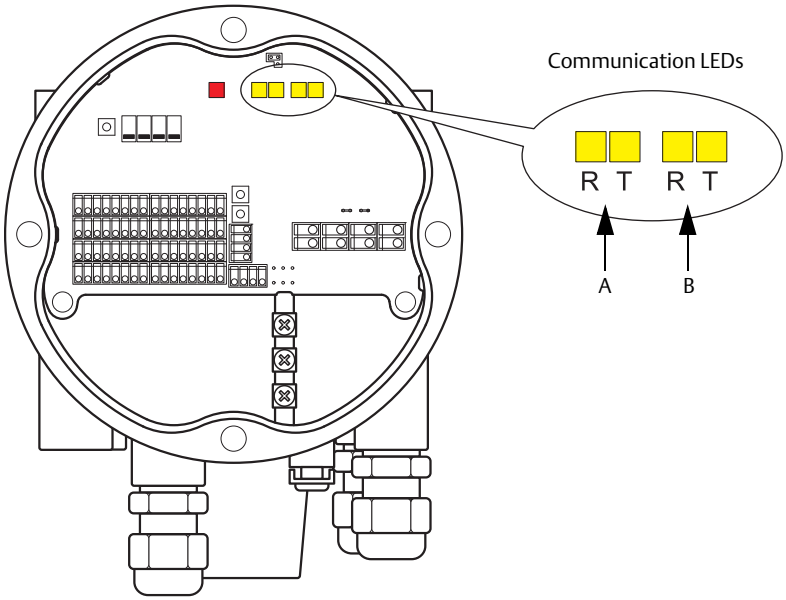


6.2.8 Communication

The Rosemount 2240S has four yellow LEDs that indicate communication on the Sensor Bus and the Tankbus.

The two LEDs on the left indicate *Receive* and *Transmit* for the **Sensor bus**. The two LEDs on the right indicate *Receive* and *Transmit* for the **Tankbus**.

Figure 6-6. Communication Status



A: Sensor bus

B. Tankbus

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 Rosemount 2410 Tank Hub and Rosemount 2460 System Hub are not applicable for FOUNDATION™ fieldbus systems.

Table 6-3. Troubleshooting chart for the Rosemount 2240S Multi-input Temperature Transmitter

Symptom	Possible cause	Action
No communication with the Rosemount 2240S	Wiring	• Check that the device appears in the *Device Live List*, see the Rosemount 2240S Multi-input Temperature Transmitter Reference Manual. • 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 (Rosemount 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 tank hub wiring.
	Cables are too long	• Check that the input voltage on the device terminals is 9 V or more.
	Hardware failure	• Check the Rosemount 2240S Error LED:s (see "Device error LED signals" on page 117). • Check the Rosemount 2460 System Hub. • Check the Rosemount 2180 Field Bus Modem. • Check the communication port on the control room PC. • Contact Emerson Automation Solutions/Rosemount TankGauging service department.
	Software failure	• Restart the Rosemount 2240S with the Reset button or by using the Restart command in TankMaster WinSetup. • Restart all devices by disconnecting and connecting the power supply to the Rosemount 2410 Tank Hub. • Contact Emerson Automation Solutions/Rosemount TankGauging service department.
	Field Bus Modem (FBM)	• Check that the Rosemount 2180 Field Bus Modem is connected to the right port on the control room PC. • Check that the Rosemount 2180 modem is connected to the right port on the Rosemount 2460 System Hub.

Symptom (continued)	Possible cause	Action
No communication with the Rosemount 2240S	Incorrect termination on the Tankbus	• Check that there are two terminators on the Tankbus. Normally the built-in termination in the Rosemount 2410 Tank Hub is enabled. • Check that terminations are placed at both ends of the Tankbus. • In a FOUNDATION fieldbus system make sure that the last device in the segment has a termination.
	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 Tank Hub Reference Manual for more information. • Remove one or more devices from the Tankbus. The Rosemount 2410 Tank Hub supports a single tank. The multiple tank version supports up to 10 tanks.
	Connection to Rosemount 2460 System Hub	• Check that the right field port on the Rosemount 2460 System Hub is connected to the Primary bus on the Rosemount 2410 Tank Hub. • Check communication port LED:s inside the Rosemount 2460 System Hub.
	Incorrect configuration of Rosemount 2460 System Hub	• Check the Modbus communication address specified for the appropriate ATD device, i.e. the device that represents the Rosemount 2240S Multi-input Temperature Transmitter in the Rosemount 2460 System Hub's tank database. For the single tank version, this address is equal to the Modbus address of the Rosemount 2410 Tank Hub itself. • Check configuration of communication parameters for the Rosemount 2460 System Hub field ports. • Check that the correct communication channel is selected. See the Rosemount Tank Gauging System Configuration Manual for more information on how to configure a system hub.
	Incorrect configuration of Rosemount 2410 tank database	• Check the Rosemount 2410's tank database; ensure that the transmitter is available and mapped to the right tank. • Rosemount 2410 tank database; check that the *ATD Modbus* address is equal to the *2410 Temp* Modbus address in the Rosemount 2460 System Hub's tank database. • See the Rosemount Tank Gauging System Configuration Manual for more information on how to configure the tank databases of the Rosemount 2460 System Hub and the Rosemount 2410 Tank Hub.
	Connection to Rosemount 2410 Tank Hub	• Check wiring to the Rosemount 2410 Tank Hub. • Check the Rosemount 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).
No communication with the Rosemount 2240S	FOUNDATION fieldbus network: No temporary address available in the FOUNDATION fieldbus segment	There is more than four new devices on the FOUNDATION fieldbus segment. Wait until a temporary address is available.
	FOUNDATION fieldbus network: The device address is within a range that is not probed by the Link Active Scheduler (LAS)	Make sure that the device address is scanned by the LAS.

Symptom (continued)	Possible cause	Action
No temperature or water level reading	Communication failure	• Check wiring. • Check the Rosemount 2240S Modbus communication address. See the Rosemount Tank Gauging System Configuration Manual for more information on how to setup the ATD Modbus address. • Check configuration of the tank database in the Rosemount 2410 Tank Hub. • Check configuration of the Rosemount 2460 tank database.
	Configuration	• Check that the Rosemount 2240S is properly configured. See the Rosemount Tank Gauging System Configuration Manual for more information on how to use TankMaster Winsetup for configuration of temperature elements connected to the Rosemount 2240S.
	Incorrect tank database configuration of Rosemont 2460 System Hub	• Check the Modbus communication address in the Rosemount 2460 System Hub tank database. In TankMaster WinSetup open the *2460 Properties/Tank Database* window. • See the Rosemount Tank Gauging System Configuration Manual for more information on how to configure the tank database of the Rosemount 2460 System Hub.
	Incorrect tank database configuration of Rosemount 2410 Tank Hub	• Check the Rosemount 2410 tank database; ensure that the device is available and mapped to the right tank. • Rosemount 2410 Tank Hub tank database; check that the *ATD Modbus* address is equal to the *2410 Temp* Modbus address in the Rosemount 2460 System Hub tank database. • See the Rosemount Tank Gauging System Configuration Manual for more information on how to configure the Rosemount 2460 tank database and the Rosemount 2410 tank database.
	Software or hardware failure	• Check diagnostics information, see "Diagnostics" on page 114. • Check Device Status input register, see "Device status" on page 125. • Use the built-in temperature element simulator to check the Rosemount 2240S electronics, see "Test and simulation" on page 119. • Replace malfunctioning temperature elements. • Contact Emerson Automation Solutions/Rosemount TankGauging service department.
	Missing option in Model Code	• Check the main label to verify that the Auxiliary Input option was included in Model Code to allow connection of water level sensor (see also Input Registers 900-949)

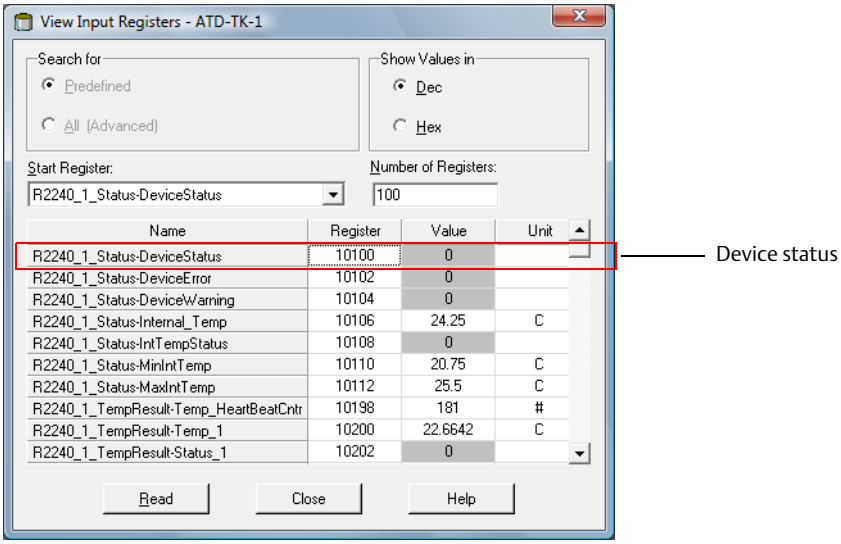
Symptom (continued)	Possible cause	Action
Incorrect temperature measurement	Incorrect configuration	• Check temperature element configuration. See the Rosemount Tank Gauging System Configuration Manual for more information on how to use TankMaster Winsetup for configuration of temperature elements connected to the Rosemount 2240S. • Check status and diagnostics information, see "Diagnostics" on page 114. • Check Model Code to verify that the correct options are available.
	Temperature element failure	• Check diagnostics information, see "Diagnostics" on page 114. • Check Device Status input register, see "Device status" on page 125. • Check temperature element status, see "Temperature element status" on page 130. • Use the built-in temperature element simulator to check the Rosemount 2240S electronics, see "Test and simulation" on page 119. • Replace malfunctioning temperature elements.
Configuration can not be saved	Write protection switch is set to the ON position	• Check write protection switch, see "DIP Switches" on page 66.
The Status LED is blinking error codes	Rosemount 2240S transmitter, temperature element, or Water Level Sensor error	• Check the Rosemount 2240S for possible hardware or software errors. • Check temperature elements. • Check Water Level Sensor. • See "Device error LED signals" on page 117. • See "Device errors" on page 128. • Check Device Status input register (see "Device status" on page 125). • Contact Emerson Automation Solutions/Rosemount TankGauging service department.
Rosemount 2240S icon in TankMaster WinSetup is red	Simulation mode active	• Stop Simulation mode by setting the Simulate switch to OFF (see "DIP Switches" on page 66). • Stop Simulation mode in TankMaster WinSetup (open WinSetup *Set Simulation Mode* window and click the Stop button).

6.3.1 Device status

Table 6-4 on page 126 shows a list of device status messages for the Rosemount 2240S Multi-input Temperature Transmitter. Messages may appear on the display of a Rosemount 2410 Tank Hub, and in the Rosemount Tankmaster program (See "Viewing input and holding registers" on page 112 for more information on how to view Input registers).

TankMaster WinSetup is a useful tool for diagnostics and troubleshooting a Rosemount 2240S transmitter. The *View Input Registers* function allows you to view the current device status and search for the root cause of warnings and errors.

Figure 6-7. Device Status Input Registers in TankMaster WinSetup



Detailed information about device status can be found in Input Registers 100[1] to 112 as shown in Table 6-4.

1, *Note that Input Register data from the Rosemount 2240S transmitter is temporarily stored in the Input Register database of the 2410 Tank Hub. The Input Registers presented in TankMaster WinSetup refer to the internal register area of the 2410. Therefore, for tank 1 you will have to add 10000 to the Rosemount 2240S internal register number as given by Table 6-4 in order to find the register presented by WinSetup. For tank 2 (requires a 2410 with the multi-tank option) you will have to add 12000, for tank 3 you will have to add 14000, and so on.*

Table 6-4. Status registers for the Rosemount 2240S Multi-input Temperature Transmitter

Message	Description	Action
Device Status	Input register no. 100[1]. Bit 1: Device warning Bit 7: Device error Bit 8: Simulation Mode Active Bit 9: PTB Mode Active Bit 10: PTB Resistance Out Of Limit Bit 16: FF Block Out of Service (1.B0) Bit 18: Device Write Protected Bit 19: Factory setting used (default database)	Contact Emerson Automation Solutions/Rosemount TankGauging service department for support.
Device error	Input register no. 102. Bit 0: RAM Error Bit 1: FPROM Error Bit 2: HREG Error Bit 3: SW Error Bit 4: Other memory error Bit 6: Reserved for Display error Bit 7: Reserved for Modem error Bit 9: Internal temperature error Bit 10: Other HW error Bit 11: Measurement Error Bit 12: Configuration error	See "Device errors" on page 128 for more information on the various error types. Contact Emerson Automation Solutions/Rosemount TankGauging service department for support.
Device warning	Input register no. 104. Bit 0: RAM Warning Bit 1: FPROM Warning Bit 2: HREG Warning Bit 3: SW Warning Bit 4: Other memory warning Bit 6: Reserved for Display warning Bit 7: Reserved for Modem warning Bit 9: Internal Temperature Warning Bit 10: Other HW warning Bit 11: Measurement warning Bit 12: Config warning	See "Device warnings" on page 127 for more information on the various warnings. Contact Emerson Automation Solutions/Rosemount TankGauging service department for support.
Internal temp	Input register no. 106. Internal temperature.	Contact Emerson Automation Solutions/Rosemount TankGauging service department for support.
Internal temp status	Input register no. 108. Bit 0: Internal temperature out of limits Bit 1: Temperature Device Error Bit 15: Internal temperature not valid	
MinIntTemp	Input register no. 110. Minimum measured internal temperature.	
MaxIntTemp	Input register no. 112. Maximum measured internal temperature.	

1. The register number refers to the internal Input Register in the Rosemount 2240S database.

6.3.2 Device warnings

Table 6-5 shows a list of warning messages for the Rosemount 2240S Multi-input Temperature Transmitter. The warnings may appear on the display of a Rosemount 2410 Tank Hub and in the Rosemount Tankmaster program. Warnings are less serious than errors.

Detailed information about the different warning messages can be found in Input registers 1050 to 1074 as shown in Table 6-5. See "Viewing input and holding registers" on page 112 for more information on how to view Input registers.

Table 6-5. Device warnings for the Rosemount 2240S Multi-input Temperature Transmitter

Message	Description	Action
RAM warning	Input register no. 1050(1). Bit 0: stack is low	Contact Emerson Automation Solutions/Rosemount TankGauging service department.
HREG warning	Input register no. 1054. Bit 0: default Holding register values used	
SW warning	Input register no. 1056. Bit 1: stack low (less than 10 % left of stack) Bit 2: software startup Bit 8: FF diagnostics	
Internal temperature warning	Input register no. 1068. Bit 0: out of range.	
Other HW warning	Input register no. 1070. Bit 9: PTB reference out of limits.	
Configuration warning	Input register no. 1074. Bit 0: Invalid linear table Bit 1: Non continuous sensor positions Bit 2: Median filter not odd Bit 3: No configuration of water level sensor available Bit 8: Number of configured sensors exceeds model code value Bit 9: Sensor type not supported in model code Bit 10: Sensor bus not supported in model code Bit 11: Invalid model code string Bit 12: Invalid model code	

1. The register number refers to the internal Input Register in the Rosemount 2240S database.

6.3.3 Device errors

Table 6-6 shows a list of error messages for the Rosemount 2240S Multi-input Temperature Transmitter. The error messages may appear on the display of a Rosemount 2410 Tank Hub and in the Rosemount Tankmaster program.

Detailed information about the different error messages can be found in Input registers 1100 to 1134 as shown in Table 6-6. See "Viewing input and holding registers" on page 112 for more information on how to view Input Registers.

Table 6-6. Device errors for the Rosemount 2240S Multi-input Temperature Transmitter

Message	Description	Action
RAM error	Input register no. 1100[1]. Bit 0: RAM The message indicates a serious working memory problem.	Contact Emerson Automation Solutions/Rosemount TankGauging service department.
FPROM error	Input register no. 1102. The message indicates a serious FPROM error. Bit 0: Checksum error Bit 4: Boot checksum Bit 5: Boot version Bit 6: Application checksum Bit 7: Application version	
Hreg error	Input register no. 1104. Bit 0: Checksum error Bit 1: Limit error, out of range Bit 2: Software version error Bit 3: HREG read error Bit 4: HREG write error	
SW error	Input register no. 1106. Bit 0: Undefined software error Bit 1: Task not running Bit 2: Out of stack space Bit 3: Unused RAM access Bit 4: Divide by zero error Bit 5: Reset counter overflow Bit 15: Simulated SW error	
Other memory error	Input register no. 1108. Bit 0: NVRAM access	
ITemp error	Input register no. 1118. Internal temperature error. Bit 0: Internal temperature out of range Bit 1: Communication error with temperature chip Bit 2: Temperature device error	
Measurement error	Input register no. 1122. Bit 0: A/D communication error Bit 1: Reference resistor error Bit 2: Power supply error Bit 3: A/D time-out	• Check power supply • Contact Emerson Automation Solutions/Rosemount TankGauging service department.
Configuration error	Input register no. 1124. Bit 1: Unit not Supported	Choose a supported measurement unit and reset the Rosemount 2240S transmitter
numHidden errors	Input register no. 1132. Number of hidden errors	Contact Emerson Automation Solutions/Rosemount TankGauging service department.
numOther errors	Input register no. 1134. Number of other errors.	

1. The register number refers to the internal Input Register in the Rosemount 2240S database.

6.3.4 Measurement status for the WLS

Table 6-7 shows measurement status for a water level sensor connected to a Rosemount 2240S Multi-input Temperature Transmitter.

You can view status registers by using the *View Diagnostic Registers* function or the *View Input Registers* function in TankMaster WinSetup, see "Diagnostics" on page 114 and "Viewing input and holding registers" on page 112.

Table 6-7. Measurement status for water level sensor

Message	Description
Status	Input register no. 500[1]. Bit 0: No Device Connected Bit 1: Device reports value under or above 15% Bit 2: Saturated Low Bit 3: Saturated High Bit 4: Relative Pressure Bit 7: Saturated Bit 8: In Calibration Mode Bit 11: Frozen Value Bit 12: Option Not Available Bit 13: Power Up Bit 14: SW HW Error Bit 15: Invalid
Primary Variable (PV)	Input register no. 502. Primary value from the connected sensor
Unit	Input register no. 504. Measurement unit such as Feet, Meters, Inches etc. 7 Bars 8 Millibars 10 Kilograms_per_square_centimeter 11 Pascals 12 Kilopascals 13 Torr 14 Atmospheres 44 Feet 45 Meters 47 Inches 48 Centimeters 49 Millimeters 250 Not_Used 251 None 252 Unknown 253 Special

1. The register number refers to the internal Input Register in the Rosemount 2240S database.

6.3.5 Temperature element status

Table 6-8 shows measurement status messages for temperature elements connected to a Rosemount 2240S Multi-input Temperature Transmitter.

You can view status registers by using the *View Diagnostic Registers* function or the *View Input Registers* function in TankMaster WinSetup, see "Diagnostics" on page 114 and "Viewing input and holding registers" on page 112.

Table 6-8. Status registers for temperature elements connected to a Rosemount 2240S

Message	Description
Temp_1	Input register no. 200(1). Temperature measured by element no. 1
Status_1	Input register no. 202 Status for temperature element 1: Bit 0: Not Connected or disabled by SW (This causes the Temperature value to be -300 °C). Bit 1: Temperature is under the Lower Temperature Limit Bit 2: Temperature is above the Upper Temperature Limit. Bit 3: Measured resistance is outside the linearization table (This causes the Temperature value to be -300 °C). Bit 4: Sensor short circuit Bit 5: Sensor short circuit to ground Bit 6: Sensor open circuit Bit 7: ADC communication error Bit 8: ADC HW error Bit 9: MI Approved Value Bit 10: Invalid Linearization Table (This bit causes the Temp. value to be -300). Bit 11: Invalid conversion formula. Check the constants in the User defined formula. Bit 12: Power up. Bit 13: Simulated Value Bit 14: ADC data is not valid. Bit 15: Invalid Data.
--	--
Temp_16	Input register no. 260. Temperature measured by element no. 16. See above.
Status_16	Input register no. 262. Status for temperature element 16. See above.

1. The register number refers to the internal Input Register in the Rosemount 2240S database.

6.4 Resource block error and status messages

Table 6-9. 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.
Device Fault State Set	This bit is set when FAULT_STATE is active in device
Memory Failure	This bit is set when FD Electronics Failure condition is generated
Lost Static Data	This bit is set when NV checksum fails or NV is not initialized for static parameter
Lost NV Data	This bit is set when NV checksum fails or NV is not initialized for Non-Volatile parameter
Power up	This bit is set when resource block is in initialization state or at the time of device power up.
Out of Service	The actual mode is out of service.

6.5 Transducer block error messages

Error conditions that may appear in the Transducer block.

Table 6-10. Transducer Block BLOCK_ERR messages

Condition Name	Description
Other error	Set whenever XD_ERROR is non-zero. See also "Service tools in AMS Device Manager" on page 138.
Out of Service	The actual mode is out of service.

6.6 Analog Input (AI) function block

Table 6-11 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 6-11. BLOCK_ERR Conditions

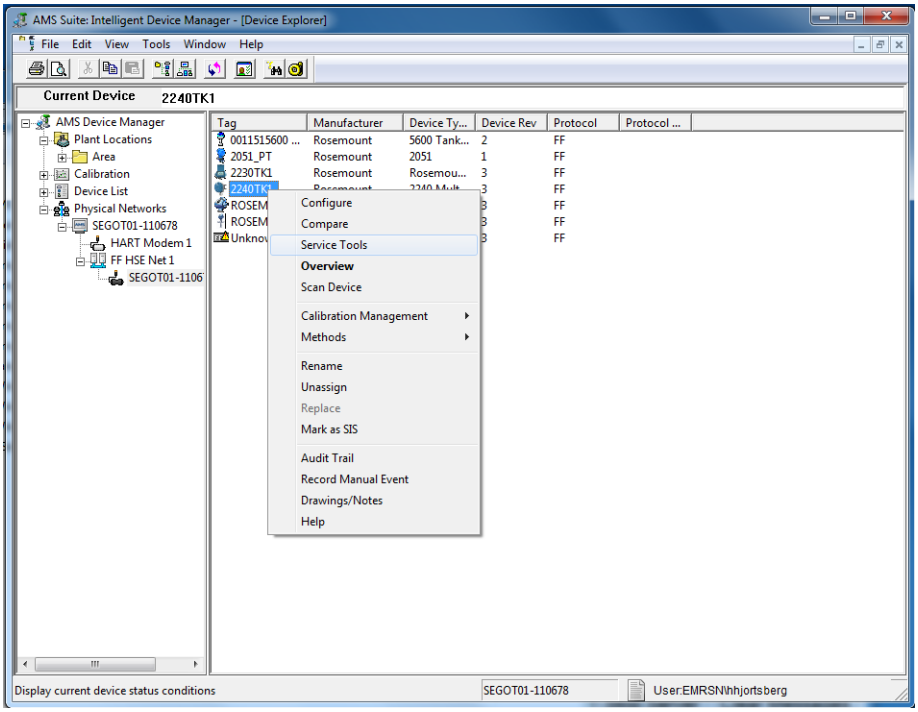
Condition Number	Condition Name and Description
0	*Other*
1	Block Configuration Error: the selected channel carries a measurement that is incompatible with the engineering units selected in XD_SCALE, the L_TYPE parameter is not configured, or CHANNEL = zero.
2	*Link Configuration Error*
3	Simulate Active: 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 Alerts

The AMS Device Manager lets you view active alerts. The alarm parameters FD_FAIL_ALM, FD_OFF-SPEC_ALM, FD_MAINT_ALM, and FD_CHECK_ALM contain information regarding some of the device errors. Active error conditions are displayed in the FD_xxx_ACTIVE parameter and can easily be listed by using the Service Tools option in AMS Device Manager. See "Field diagnostic alerts" on page 88 for more information on the different alert types.

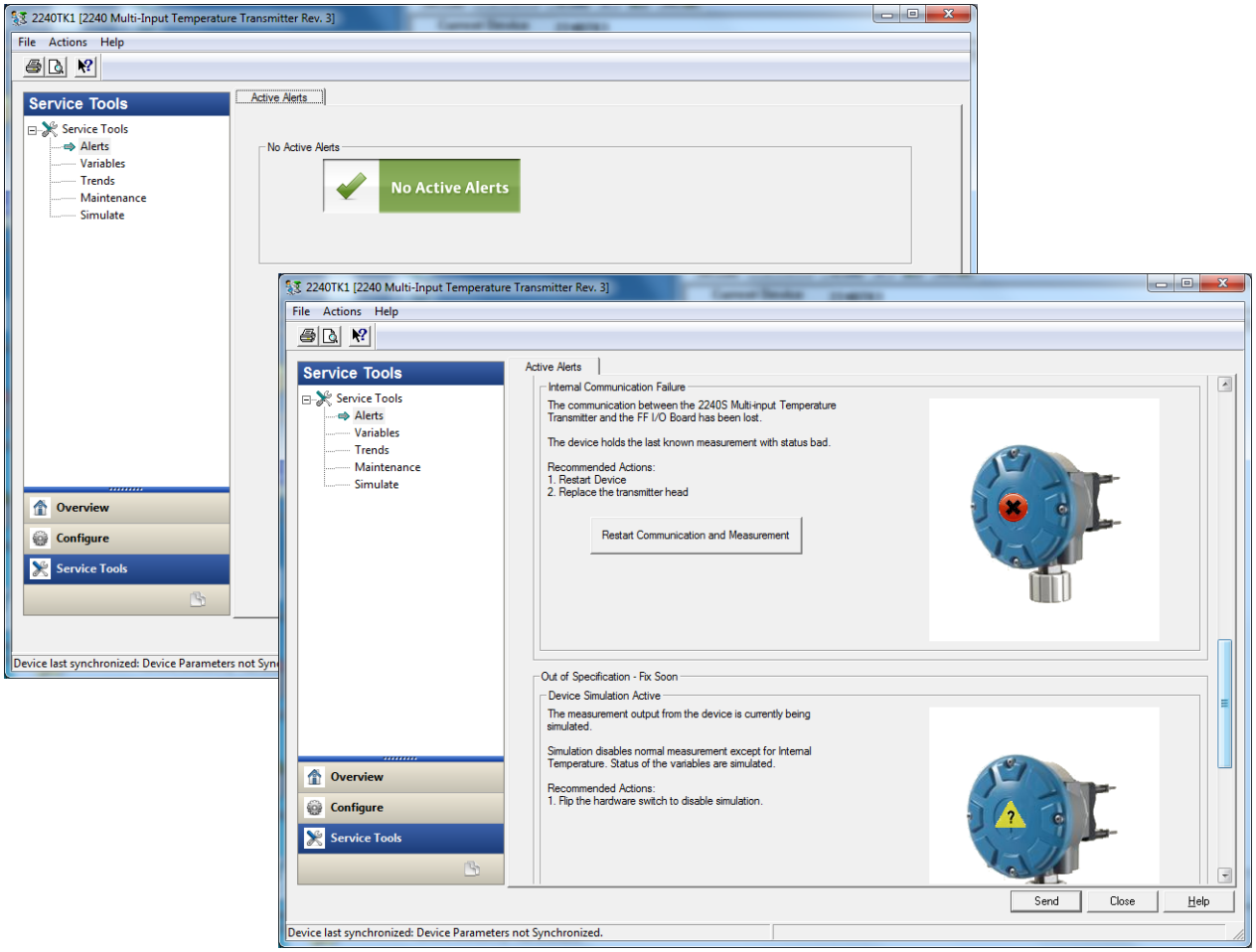
6.7.1 Viewing active alerts in AMS Device Manager

1. From the **Start** menu; open the AMS Device Manager application.
2. Open the *View>Device Explorer 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. Select the **Service Tools** option.

6. Select the **Service Tools>Alerts** option.

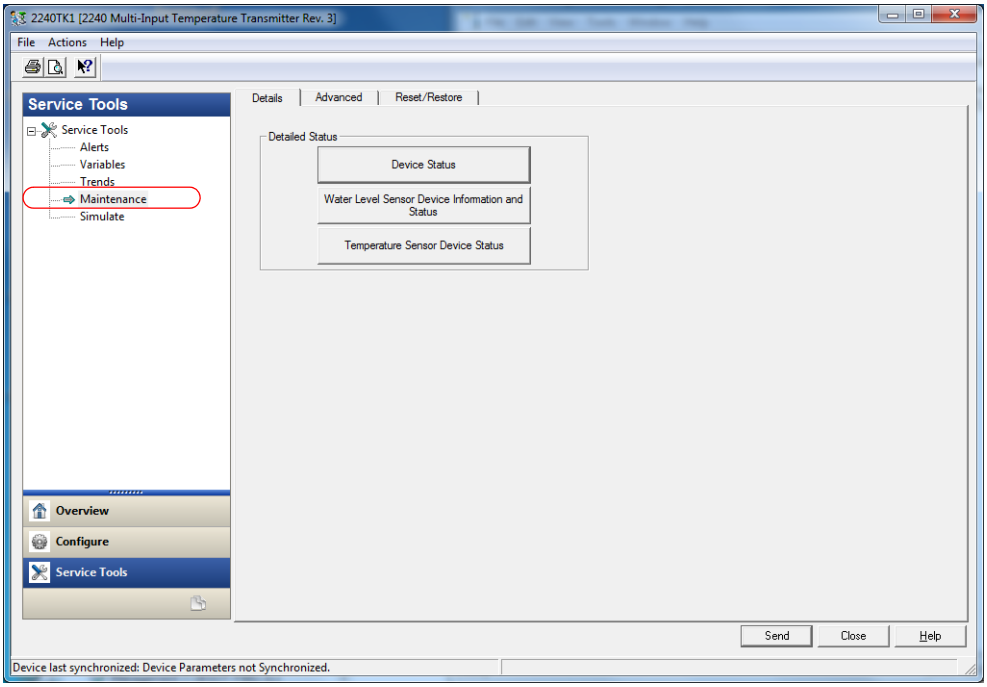


7. The *Active Alerts* tab shows the alerts that are currently active. All types of alerts can be shown; Failure, Out of Specification, Maintenance Required, and Function Check. A brief description of the error is presented as well as the recommended action.
8. Alerts are listed in order of priority beginning with Failure. By scrolling down you will see Out of Specification, Maintenance Required, and Function Check alerts as well. See "Viewing device status in AMS Device Manager" on page 135 for more information.

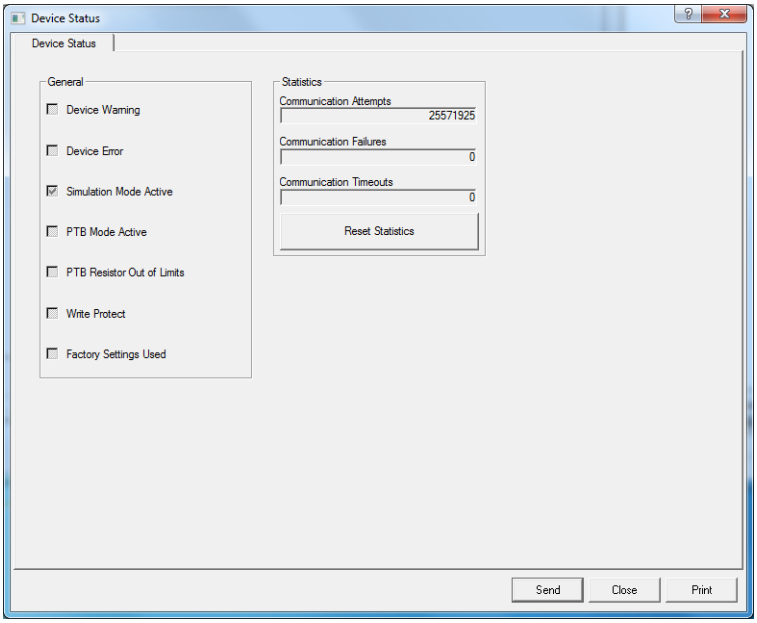
6.7.2 Viewing device status in AMS Device Manager

To view a summary of active errors and warnings:

1. Select the **Maintenance** option.



2. Click the **Device Status** button . This is an example of what it may look like:



See “Alert setup” on page 106 for details on how to setup alerts for the Rosemount 2240S temperature transmitter.

6.7.3 Recommended actions

The FD_RECOMMEN_ACT 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 alert is active, see Table 6-12.

Table 6-12. Recommended Actions for Alerts

Alert Type	Description	Recommended Action
Failure	Software failure	The software is corrupt. Variable status is set to BAD. 1. Restart the device. 2. Contact Emerson Automation Solutions /Rosemount TankGauging service department.
	Database error	The device has detected an error in the measurement configuration database. 1. Load default database to the device. 2. Restart the device. 3. Reconfigure the device.
	Auxiliary Device error	Replace the auxiliary device (Rosemount 2240S transmitter).
	Electronics failure - Main board	The device has detected an irreversible electronics error. 1. Replace the device.
	Electronics failure - FF I/O board	The device has detected an irreversible electronics error. 1. Replace the device.
	Memory failure - FF I/O board	Configuration data has been corrupted or pending configuration changes have been lost due to loss of power before storage could complete. 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. 1. Do a factory reset – FF I/O Board. 2. If error persists, it may indicate a faulty memory chip. Replace the transmitter head.
	Internal communication failure	Communication between the Rosemount 2240S Multi-input Temperature Transmitter and the FF I/O board has been lost. The device holds the last known measurement with status BAD. 1. Restart Device 2. Replace the transmitter head

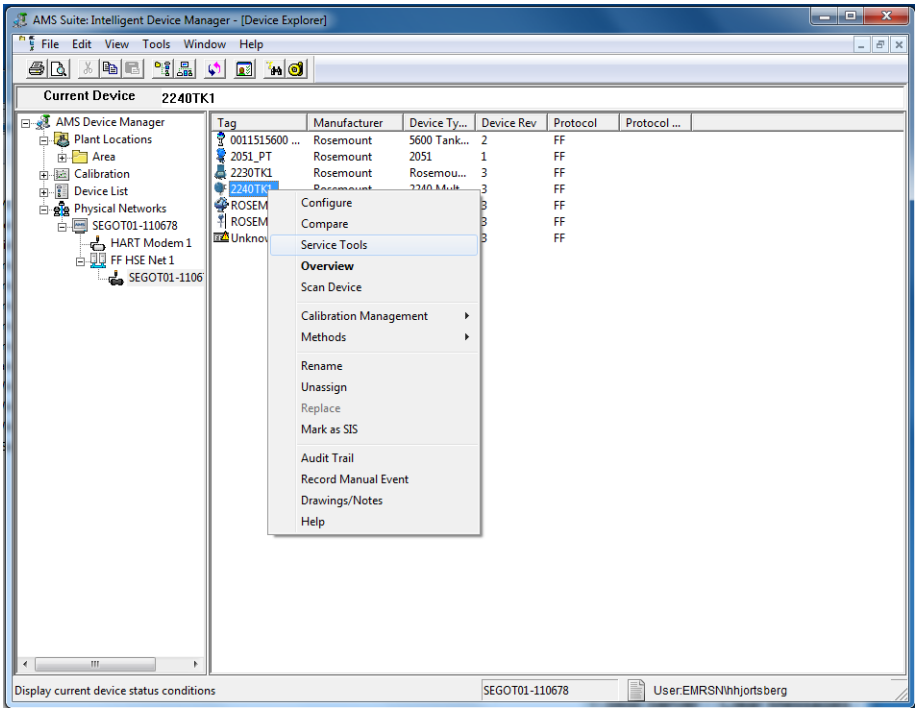
Alert Type	Description (continued)	Recommended Action
Out of Specification	Device simulation active	Measurement output from the device is currently being simulated. Simulation disables normal measurement except for Internal Temperature. Status of the variables is SIMULATED. Flip the hardware switch to disable simulation.
	Auxiliary device measurement failure	The water level measurement is invalid. 1. Check detailed status. 2. Check water level configuration. 3. Contact Emerson Automation Solutions /Rosemount TankGauging service department.
	Internal temperature out of limits	Check ambient temperature at installation site.
	Average Temperature measurement failure	Average temperature calculation incorrect. Multiple reasons are possible. Cause may be invalid configuration or variable value out of limits/invalid. Average Temperature Measurement Failure is also active if Temperature Measurement Failure is active. 1. Check Temp Sensor Device Status for information. 2. Check that level input is valid. 3. If Temperature Measurement Failure is active, clear that alert first or exclude the faulty spot to enable average temperature calculations. 4. Check average temperature configuration. 5. Contact Emerson Automation Solutions /Rosemount TankGauging service department.
	Temperature measurement failure	One or more of the temperature elements has a measurement failure. 1.Check sensor wiring connection. 2. If wiring is correct it may indicate a hardware fault. Exclude temperature sensor element or exchange the temperature element.
	Invalid model code	Contact Emerson /Rosemount TankGauging service department.
	Configuration error	A configuration error has occurred. Reasons may be multiple. 1. Check the configuration. 2. Reset measurement configuration to default values. 3. Restart the device.
Maintenance Required	Auxiliary Device Measurement Close to Limit	Measured pressure is close to limit.
Function Check	Check function	Regular preparation work is in progress. One or more Transducer Blocks are in Out of Service mode. 1. Return Transducer Block to Auto mode.

6.8 Service tools in AMS Device Manager

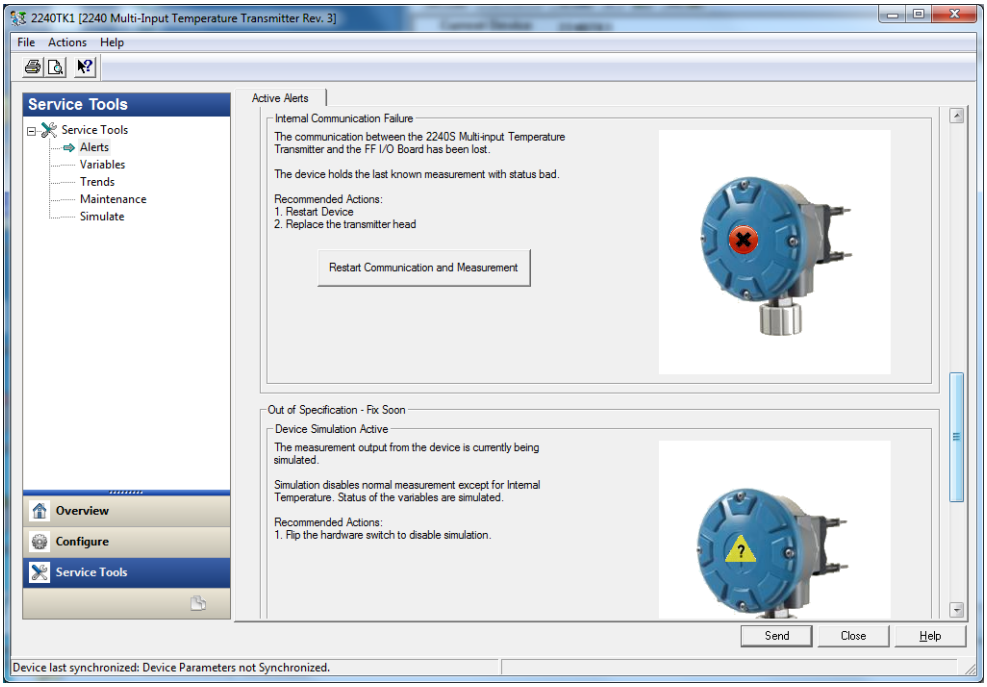
6.8.1 Service tools window

AMS Device Manager supports a number of service functions for the Rosemount™ 2240S transmitter. To access the various service tools:

1. Start AMS Device Manager and open the *View>Device Explorer 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 Rosemount 2240S device icon to open the list of menu options.



4. Select **Service Tools**.

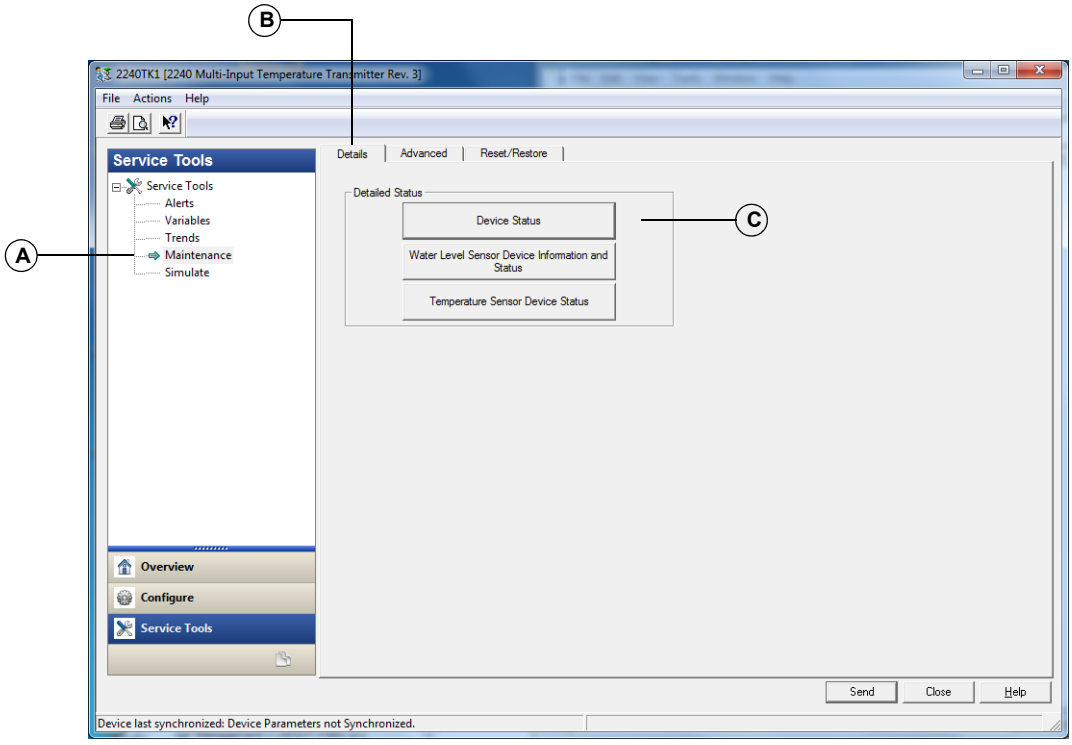


5. In the Navigation Pane select the desired **Service Tools** option.

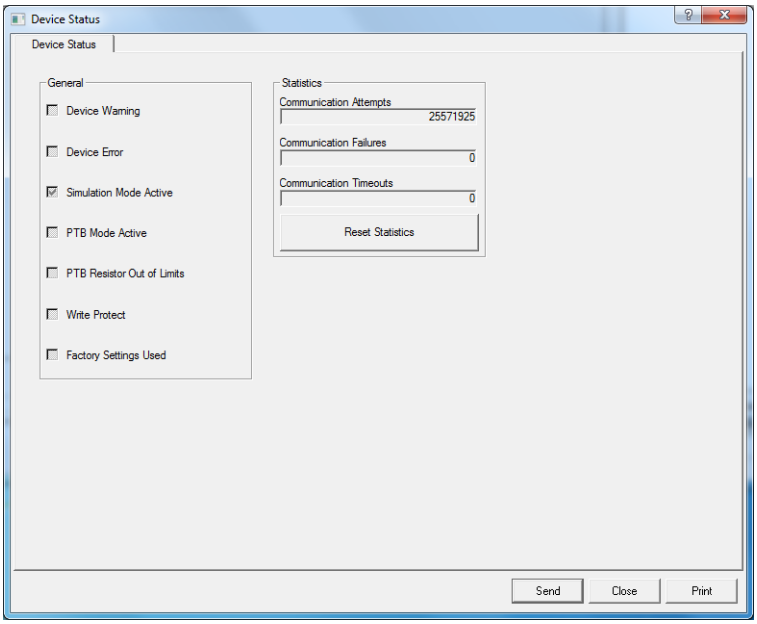
6.8.2 Device status

To view the current device status:

1. In AMS Device Manager open **Service Tools** as shown in *"Service tools window" on page 138*.
2. In the Navigation Pane select the **Maintenance** (A) option.



3. Select the **Details** (B) tab
4. Click the **Device Status** (C) button. In addition to *Device Status* there are also buttons for *WLS Device Information* and Status as well as *Temperature Sensor Device Status*.

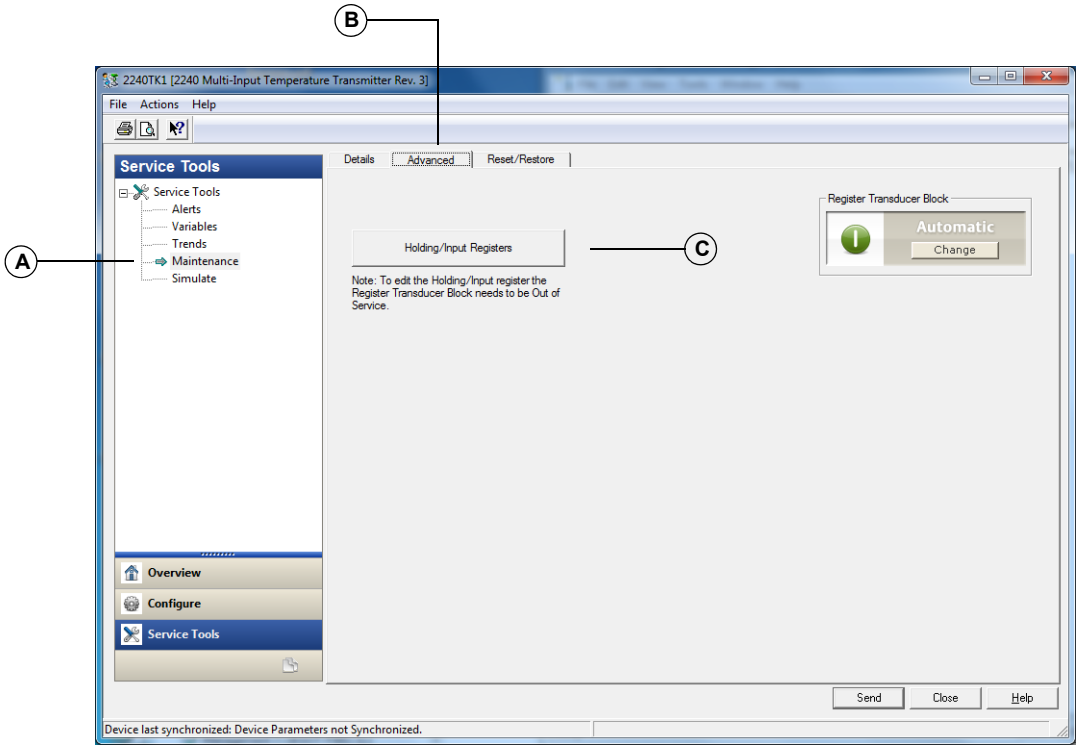


In the *Device Status* tab, check boxes indicate the current status of the device grouped in separate categories. See also "Device status" on page 125.

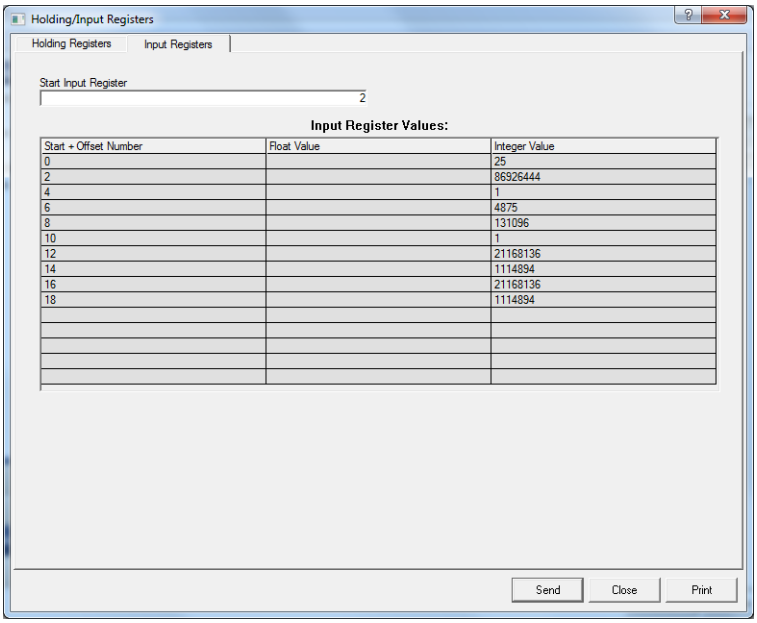
6.8.3 Viewing input and holding registers

To view Input or Holding registers for a Rosemount 2240S:

1. In AMS Device Manager open **Service Tools** as shown in *"Service tools window" on page 138*.
2. In the Navigation Pane select the **Maintenance** (A) option



3. Select the **Advanced** (B) tab
4. Click the **Holding/Input Registers** (C) button.



5. Select one of the tabs *Holding Registers* or *Input Registers*, depending on what type of register you are interested in.
6. Type a start value in the Start Holding/Input Register field, and press the **Send** button to get the current register values.

Appendix A Specifications and Reference Data

A.1 Performance specifications

A.1.1 Temperature conversion accuracy

±0.05 °C (±0.05 °F)
Over measuring range and ambient temperature 20 °C (68 °F)

A.1.2 Ambient temperature effect

±0.05 °C (±0.09 °F) within the total range, -40 to 70 °C (-40 to 158 °F)

A.1.3 Temperature measuring range

Supports -200 to 250 °C (-328 to 482 °F) for Pt-100

A.1.4 Resolution

± 0.1 °C (± 0.1 °F) according to API chapter 7 and 12

A.1.5 Update time

4 s

A.2 General specifications

A.2.1 Number of spot elements and wiring

Up to 16 RTD spot elements or averaging sensors can be connected to a Rosemount™ 2240S.

Rosemount temperature / water level sensors (models 565, 566, and 765)

Three wiring types can be used:

- 3-wire RTD with common return (1-16 spot elements)
- 3-wire RTD individual:
  - 1-16 spot elements with Rosemount 565 and 566
  - 1-14 spot elements with Rosemount 765
- 4-wire RTD individual:
  - 1-16 spot elements with Rosemount 565 and 566
  - 1-10 spot elements with Rosemount 765

Rosemount 614 temperature sensor

The following wiring types can be used:

- 3-wire RTD individual (1-16 spot elements)
- 4-wire RTD individual (1-16 spot elements)

A.2.2 Standard temperature sensor types

Supports Pt-100 (according to IEC/EN60751, ASTM E1137) and Cu-90

A.2.3 Metrology sealing possibility

Yes

A.2.4 Write protect switch

Yes

A.3 Configuration specifications

A.3.1 Configuration tool

TankMaster WinSetup is the recommended tool for easy configuration of Rosemount 2240S. The Tankbus autoconfiguration feature, handled by the Rosemount 2410 Tank Hub, supports Rosemount 2240S.

A.3.2 Configuration parameters (examples)

Temperature

- Number of temperature sensor elements
- Temperature element type (spot or average)
- Temperature element position in tank

Water Level Sensor

- Level offset (difference between tank zero level and water zero level)
- Probe length (autoconfigured by Rosemount 765)

A.3.3 Output variables and units

Spot and average temperature: °C (Celsius), and °F (Fahrenheit)
Free water level (FWL): meter, centimeter, millimeter, feet, or inch

A.4 FOUNDATION fieldbus characteristics

A.4.1 Polarity sensitive

No

A.4.2 Quiescent current draw

30 mA

A.4.3 Lift-off minimum voltage

9.0 VDC

A.4.4 Device capacitance / inductance

See "Product Certifications" on page 151

A.4.5 Class (Basic or Link Master)

Link Master (LAS)

A.4.6 Number of available VCRs

Maximum 20, including one fixed

A.4.7 Links

Maximum 40

A.4.8 Minimum slot time/maximum response delay/minimum intermessage delay

8 / 5 / 8

A.4.9 Blocks and Execution time

1 Resource block,
3 Transducer blocks (Temperature, Register, AVG_Temp),
2 Multiple Analog Input (MAI) blocks: 15 ms,
6 Analog Input (AI) blocks: 10 ms,
1 Analog Output (AO) block: 10 ms,
1 Signal Characterizer (SGCR) blocks: 10 ms,
1 Proportional/Integral/Derivate (PID) block: 15 ms,
1 Integrator (INT) block: 10 ms
1 Arithmetic (ARTH) block: 10 ms,
2 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 no. 00809-0100-4783)

A.4.10 Instantiation

Yes

A.4.11 Conforming FOUNDATION fieldbus

ITK 6

A.4.12 Field Diagnostics support

Yes

A.4.13 Action support wizards

Restart/stop measurement, write protect device, factory reset - measurement configuration, reset statistics, start/stop device simulation

A.4.14 Advanced diagnostics

Failures/Out of specification/Maintenance required alerts: Software, memory/database, electronics, internal communication, simulation, auxiliary device, auxiliary device measurement, ambient temperature, average temperature measurement, temperature measurement, configuration

A.5 Electrical specifications

A.5.1 Power supply

- FISCO: 9.0-17.5 VDC polarity insensitive
- Entity: 9.0-30.0 VDC polarity insensitive

A.5.2 Internal power consumption

0.5 W

A.5.3 Bus current draw

30 mA

A.5.4 Tankbus cabling

0.5-1.5 mm² (AWG 22-16), twisted shielded pairs

A.5.5 Built-in Tankbus terminator

Yes (to be connected if required)

A.5.6 Tankbus to sensor isolation

Minimum 700 V_{AC}

A.5.7 Auxiliary sensor input

Digital bus connection for water level sensor

A.6 Mechanical specifications

A.6.1 Housing material

Polyurethane-coated die-cast aluminum

A.6.2 Cable entry (connection/glands)

Three ½ - 14 NPT entries for cable glands or conduits. Two metal plugs to seal any unused ports are enclosed in the 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

A.6.3 565/566/765 connection

M33 x 1.5 female threaded connection

Optional:

- An M32 adapter or M32 gland can be used if the Rosemount 2240S is installed away from the sensor

A.6.4 Rosemount 614 cone connection

Optional cone with M33 x 1.5 female threaded connection.

A.6.5 Installation

The Rosemount 2240S can be installed directly on top of the temperature / water level sensor or remotely installed on a 33.4-60.3 mm (1 to 2-in) pipe or on a wall

A.6.6 Weight

2.8 kg (6.2 lbs)

A.7 Environmental specifications

A.7.1 Ambient temperature

-40 to 70 °C (-40 to 158 °F).
Minimum start-up temperature -50 °C (-58 °F)

A.7.2 Storage temperature

-50 to 85 °C (-58 to 185 °F)

A.7.3 Humidity

0-100% relative humidity

A.7.4 Ingress protection

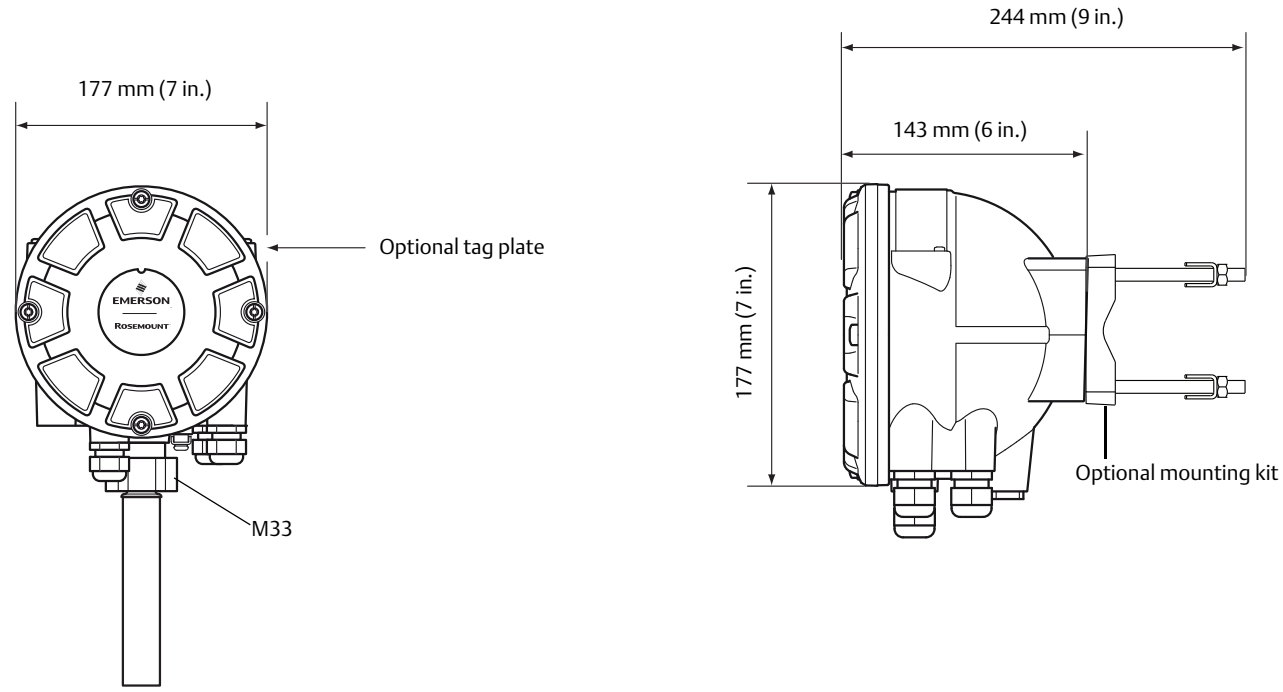
IP 66 and 67 (Nema 4X)

A.7.5 Transient / built-in lightning protection

According to IEC 61000-4-5, level 1 kV line to ground. Complies with IEEE 587 Category B transient protection and IEEE 472 surge protection

A.8 Dimensional drawings

Figure A-1. Dimensions Rosemount 2240S



Can be installed with a multiple spot temperature sensor.

Can be installed separately on a 33.4-60.3 mm (1 to 2-in.) pipe, or on a wall.

Dimensions are in millimeters (inch)

A.9 Ordering information

Table A-1. Rosemount 2240S Multi-input Temperature Transmitter ordering information

Model	Product Description
2240S	Multi-input Temperature Transmitter
Performance Class	
P	Premium
Number of Temperature Sensor Inputs	
16[1]	Up to 16xRTD spot elements
08[1]	Up to 8xRTD spot elements
04[1]	Up to 4xRTD spot elements
00[2]	None
Temperature Elements Wiring	
4	4-wire or 3-wire (individual or common return)
0[2]	None (for water level only, no temperature sensors)
Auxiliary Inputs	
A[2]	Rosemount 765 temperature and water level sensor input
0	None
Tankbus: Power and Communication	
F	Bus powered 2-wire FOUNDATION fieldbus (IEC 61158)
Hazardous Location Certification	
I1	ATEX Intrinsic Safety
I7	IECEx Intrinsic Safety
I5	FM-US Intrinsic Safety
I6	FM-Canada Intrinsic Safety
I2	Brazil Inmetro Intrinsic Safety
IP	KC Intrinsic Safety (South Korea)
I4	Japan Intrinsic Safety
IM	Technical Regulations Customs Union (EAC) Intrinsic Safety
NA	No Hazardous Location Certification

Table A-1. Rosemount 2240S Multi-input Temperature Transmitter ordering information

Custody Transfer Type Approval	
C[3][4][5]	PTB (German W&M approval)
G[4][5]	GUM (Poland)
K[4][5]	GOST (Kazakhstan)
S[4][5]	GOST (Russia)
0	None
Housing	
A	Standard enclosure (polyurethane-covered aluminum IP 66/67)
Cable/Conduit Connections	
1	½-14 NPT, female thread (Includes 2 plugs)
2	M20 x 1.5 Adapters, female thread (Includes 2 plugs, and 3 adapters)
G[6]	Metal cable glands (½-14 NPT)
E	Eurofast male connector and ½-14 NPT (1 connector, 2 plugs included)
M	Minifast male connector and ½-14 NPT (1 connector, 2 plugs included)
Mechanical Installation	
M[7]	Prepared for integrated installation with Rosemount 565, 566, or 765 (standard) temperature sensor
W[8]	Installation kit for wall mounting
P[8]	Installation kit for wall and pipe mounting (1-2 in. vertical and horizontal pipes)
Options - none or multiple selections are possible	
WR3	3-year limited warranty
WR5	5-year limited warranty
ST	Engraved SST tag plate
Q1	Certificate of conformance
Q4	Calibration Certificate
Q7	Printed copy of hazardous location certificate
Typical Model Number: 2240S P 16 4 A F I1 0 A 1 M ST	

1. Temperature sensors of Pt-100 or Cu-90 type, for use in -200 to 250 °C (-328 to 482 °F), can be connected to the Rosemount 2240S.
2. Water level sensor only requires Number of Temperature Sensor Inputs code 00, Leads per Temperature Element code 0, and Auxiliary Inputs code A.
3. Approval plate, sealing kit and Eich adapter included. One spot position used for external reference.
   Available spot elements in Number of Temperature Sensor Inputs = 15, 7 or 3.
4. Requires Rosemount 2410 Tank Hub with corresponding Custody Transfer Type Approval.
5. Requires one out of following displays: 2410 with integral display, Rosemount 2230 with corresponding Custody Transfer Type Approval, or TankMaster
6. Min. temperature -20 °C (-4 °F). ATEX / IECEx. Exe approved. Includes 2 plugs, and 3 glands (Includes an M32 gland if combined with Mechanical Installation
   code W or P).
7. M33x1.5 female threaded connection. As standard, the transmitter is not pre-assembled with any temperature sensor.
8. For separate installation of temperature sensor and transmitter.

Appendix B Product Certifications

Rev 2.8

B.1 European Directive Information

The most recent revision of the EU Declaration of Conformity can be found at Emerson.com/Rosemount.

B.2 Ordinary Location Certification

As standard, the transmitter has been examined and tested to determine that the design meets the basic electrical, mechanical, and fire protection requirements by a nationally recognized test laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

B.3 Installing Equipment in North America

The US National Electrical Code (NEC) and the Canadian Electrical Code (CEC) permit the use of Division marked equipment in Zones and Zone marked equipment in Divisions. The markings must be suitable for the area classification, gas, and temperature class. This information is clearly defined in the respective codes.

B.4 USA

I5 Intrinsic Safety (IS)
Certificate: FM 3035518

Standards: FM Class 3600 – 2011;
FM Class 3610 – 2010;
FM Class 3810 – 2005;
ANSI/ISA 60079-0 – 2013;
ANSI/ISA 60079-11 – 2013;
ANSI/ISA 60079-26 – 2011;
ANSI/IEC 60529 – 2004;
ANSI/NEMA 250 – 2008

Markings: IS / I,II,III / 1 / ABCDEFG / T4 Ta = -50°C to 70°C; 9240040-910 Entity/FISCO; Type 4X/IP66/IP67 I / 0 / AEx ia IIC / T4 Ta = -50°C to 70°C; 9240040-910 Entity/FISCO; Type 4X/IP66/IP67 I / 1 / AEx ib [ia] IIC T4 Ta = -50°C to 70°C;
9240040-910 FISCO; Type 4X/IP66/IP67

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.
2. Rating I / 1 / AEx ib [ia] IIC T4 Ta = -50°C to 70°C; 9240040-910 FISCO; Type 4X/IP66/IP67 is only applicable when supplied from an FM certified AEx [ib] FISCO Power Supply with triplicate output voltage limitation meeting the requirements for two faults ("ia" voltage limitation).
3. The Rosemount 2240S Multi-Input Temperature Transmitter will not pass the 500Vrms dielectric strength test and this must be taken into account during installation.

	Ui	Ii	Pi	Ci	Li
Entity parameters	30 V	300 mA	1.3 W	2.2 nF	2 µH
FISCO parameters	17.5V	380 mA	5.32 W	2.2 nF	2 µH

B.5 Canada

I6 CSA Intrinsically Safe

Certificate: 3035518C

Standards: CSA-C22.2 No. 157-92 1992 (2012),
CSA-C22.2 No. 1010-1 2004 (2009),
CSA-C22.2 No. 25-1966 1992 (2009),
CSA-C22.2 No. 60529-05 2005 (2010),
CSA-C22.2 No. E60079-0 2011,
CSA-C22.2 No. E60079-11 2011,
CSA-C22.2 No. 94 2011

Markings:

IS / I,II,III / 1 / ABCDEFG / T4 Ta = -50°C to 70°C;
9240040-910 Entity/FISCO; Type 4X/IP66/IP67

I / 0 / Ex ia IIC / T4 Ta = -50°C to 70°C
9240040-910 Entity/FISCO; Type 4X/IP66/IP67

I / 1 / Ex ib [ia] IIC T4 Ta = -50°C to 70°C
9240040-910 FISCO; Type 4X/IP66/IP67

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.
2. Rating I / 1 / Ex ib [ia] IIC T4 Ta = -50°C to 70°C 9240040-910 FISCO; Type 4X/IP66/IP67 is only applicable when supplied from an FM certified Ex [ib] FISCO Power Supply with triplicate output voltage limitation meeting the requirements for two faults ("ia" voltage limitation).
3. The Rosemount 2240S Multi-Input Temperature Transmitter will not pass the 500Vrms dielectric strength test and this must be taken into account during installation

	Ui	Ii	Pi	Ci	Li
Entity parameters	30 V	300 mA	1.3 W	2.2 nF	2 µH
FISCO parameters	17.5V	380 mA	5.32 W	2.2 nF	2 µH

B.6 Europe

I1 ATEX Intrinsic Safety

Certificate: FM09ATEX0047X

Standards: EN 60079-0:2012,
EN 60079-11:2012,
EN 60079-26:2007,
EN 60529:2013

Markings: Ⓔx FISCO Field Device

II 1 G Ex ia IIC T4 Ta = -50°C to 70°C Entity/FISCO; IP66, IP67

II 2(1) G Ex ib [ia] IIC T4 Ta = -50°C to 70°C FISCO; IP66, IP67

Special Conditions for Safe Use (X):

1. The enclosure contain 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. Rating II 2(1) G Ex ib [ia] IIC T4 Ta = -50°C to 70°C FISCO 9240040-976; IP66, IP67 is only applicable when supplied from a certified Ex [ib] FISCO Power Supply with triplicate output voltage limitation meeting the requirements for two faults ("ia" voltage limitation).
3. The Rosemount 2240S Multi-input Temperature Transmitter will not pass the 500Vrms dielectric strength test and this must be taken into account during installation.

	Ui	Ii	Pi	Ci	Li
Entity parameters	30 V	300 mA	1.3 W	2.2 nF	2 µH
FISCO parameters	17.5V	380 mA	5.32 W	2.2 nF	2 µH

B.7 International

I7 IECEx Intrinsic Safety

Certificate: IECEx FMG 10.0010X

Standards: IEC 60079-0:2011,
IEC 60079-11:2011,
IEC 60079-26:2006

Markings: Ex ia IIC Ga; Entity/FISCO; IP66/IP67
Ex ib IIC [ia Ga] Gb; FISCO; IP66/IP67

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. Rating Ex ib IIC [ia Ga] Gb; FISCO 9240040-976; IP66/IP67 is only applicable when supplied from a certified Ex [ib] FISCO Power Supply with triplicate output voltage limitation meeting the requirements for two faults ("ia" voltage limitation).
3. The Rosemount 2240S Multi-input Temperature Transmitter will not pass the 500Vrms dielectric strength test and this must be taken into account during installation.

	Ui	Ii	Pi	Ci	Li
Entity parameters	30 V	300 mA	1.3 W	2.2 nF	2 µH
FISCO parameters	17.5V	380 mA	5.32 W	2.2 nF	2 µH

B.8 Brazil

I2 INMETRO Intrinsic Safety

Certificate: UL-BR 17.0927X

Standards: ABNT NBR IEC 60079-0:2013,
ABNT NBR IEC 60079-11:2013
ABNT NBR IEC 60079-26:2016

Markings: Ex ia IIC T4 Ga (Entity)
Ex ib IIC [ia Ga] T4 Gb (FISCO)
Tamb = -50 °C a +70 °C, IP 66/67

Special Conditions for Safe Use (X):

1. See certificate for special conditions.

	Ui	Ii	Pi	Ci	Li
Entity parameters	30 V	300 mA	1.3 W	2.2 nF	2 µH
FISCO parameters	17.5V	380 mA	5.32 W	2.2 nF	2 µH

B.9 EAC

IM Technical Regulations Customs Union (EAC) Intrinsic Safety

Certificate: RU C-SE.AA87.B.00350

Markings: FISCO field mounted device
0Ex ia IIC T4 Ga X
1Ex ib [ia Ga] llC T4 Gb X
Tamb = -50 °C to+70 °C, IP 66/67

Special Conditions for Safe Use (X):

1. See certificate for special conditions.

	Ui	Ii	Pi	Ci	Li
Entity parameters	30 V	300 mA	1.3 W	2.2 nF	2 µH
FISCO parameters	17.5V	380 mA	5.32 W	2.2 nF	2 µH

B.10 Japan

I4 Intrinsic safe

Certificate: CML 17JPN2123X

Markings: Ex ib [ia Ga] IIC T4 Gb, -50°C ≤ Ta ≤ +70°C

Special Conditions for Safe Use (X):

1. See certificate for special conditions.

	Ui	Ii	Pi	Ci	Li
FISCO parameters	17.5V	380 mA	5.32 W	2.2 nF	2 µH

B.11 Republic of Korea

IP Korea Intrinsic safe

Certificate: 11-KB4BO-0065X

Markings: FISCO Field Device (Fieldbus Terminal)
Ex ia IIC T4

	Ui	Ii	Pi	Ci	Li
Entity parameters	30 V	300 mA	1.3 W	2.2 nF	2 µH
FISCO parameters	17.5V	380 mA	5.32 W	2.2 nF	2 µH

Special Conditions for Safe Use (X):

1. See certificate for special conditions.

B.12 India

IW Intrinsic safe

Certificate: P382295/1

Markings: Ex ia IIC Ga
Ex ib IIC (ia Ga) Gb

Special Conditions for Safe Use (X):

1. See certificate for special conditions.

B.13 Conduit plugs and adapters

IECEx Flameproof and Increased Safety

Certificate: IECEx FMG 13.0032X

Standards: IEC60079-0:2011,
IEC60079-1:2007,
IEC60079-7:2006-2007

Markings: Ex de IIC Gb

ATEX Flameproof and Increased Safety

Certificate: FM13ATEX0076X

Standards: EN60079-0:2012,
EN60079-1:2007,
IEC60079-7:2007

Markings: Ⓔx II 2 G Ex de IIC Gb

B.13.1 Conduit Plug Thread Sizes

Thread	Identification Mark
M20 x 1.5	M20
½ - 14 NPT	½ NPT

B.13.2 Thread Adapter Thread Sizes

Male Thread	Identification Mark
M20 x 1.5 – 6g	M20
½ - 14 NPT	½ - 14 NPT
¾ - 14 NPT	¾ - 14 NPT
Female Thread	**Identification Mark**
M20 x 1.5 – 6H	M20
½ - 14 NPT	½ - 14 NPT
G1/2	G1/2

Special Conditions for Safe Use (X):

1. When the thread adapter or blanking plug is used with an enclosure in type of protection increased safety “e” the entry thread shall be suitably sealed in order to maintain the ingress protection rating (IP) of the enclosure.See certificate for special conditions.
2. The blanking plug shall not be used with an adapter.
3. Blanking Plug and Threaded Adapter shall be either NPT or Metric thread forms. G½ thread forms are only acceptable for existing (legacy) equipment installations.

B.14 Custody Transfer

Australia Custody Transfer

Certificate: No 5/1/7

Standards: Regulation 60: National Measurement Regulations 1999

Belgium Custody Transfer

BMS Certificate: NR. P6.0.014.02-B-16

Croatia Custody Transfer

Certificate: 558-02-01_01-15-2

Czech Republic Custody Transfer

Certificate: 0111-CS-C022-10

Estonia Custody Transfer

Certificate: TJA 6.13-3_15.09.11

France Custody Transfer

Certificate: No. LNE-24609

Germany Custody Transfer

Certificate: PTB-1.5-4058175 (Rosemount Tank Gauging system)

India Custody Transfer

Certificate: IND/13/12/191

Indonesia Custody Transfer

Certificate: DITJEN MIGAS CT approval 26.10.2010

Italy Custody Transfer

Certificate: 183349 (Rosemount Tank Gauging system)

Malaysia Custody Transfer

Certificate: ATS 09-11

Netherlands Custody Transfer

NMI Certificate: TC7982

Norway Custody Transfer

Certificate: No. N-11-7146

Poland Custody Transfer

Certificate: ZT-7 2013

Portugal Custody Transfer

Certificate: P12_101.12_31

Serbia Custody Transfer

Certificate: 393-7_0-01-2088

South Africa Custody Transfer

Certificate: SAEx S11-065

Switzerland Custody Transfer

Certificate: Zulassungszertifikat CH-L-11127-01

Russia Custody Transfer

GOST Pattern Approval

Certificate:
SE.C.32.639.A No. 68126 (2240),
OC.C.29.010.A No. 70348 (Rosemount Tank Gauging system)
OC.C.29.010.A No. 70349 (Rosemount Tank Gauging system)

Kazakhstan Custody Transfer

GOST Pattern Approval

Certificate: KZ.02.02.06184-2018 (2240)
KZ.02.02.06533-2018 (Rosemount Tank Gauging system)

OIML Custody Transfer

Certificate: R85-2008-SE-11.01

B.15 Approval Drawings

Follow the installation guidelines presented in Factory Mutual system control drawings in order to maintain certified ratings for installed devices.

The following drawings are included in the documentation for the Rosemount 2240S Multi-Input Temperature Transmitter:

- 9240040-910 System Control Drawing for hazardous location installation of intrinsically safe FM-US and FM-C approved apparatus
- 9240040-976 System Control Drawing for hazardous location installation of intrinsically safe FM ATEX and FM IECEx approved apparatus

Electronic copies of the system control drawings can also be found on the “Manuals & Drawings” CD ROM that is shipped with the Rosemount 2240S Multi-Input Temperature Transmitter.

Appendix C FOUNDATION™ Fieldbus Block Information

C.1 Resource block

This section contains information on the Resource Block of the Rosemount™ 2240S Multi-Input Temperature Transmitter.

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
01	ST_REV	The revision level of the static data associated with the function block.
02	TAG_DESC	The user description of the intended application of the block.
03	STRATEGY	The strategy field can be used to identify grouping of blocks.
04	ALERT_KEY	The identification number of the plant unit.
05	MODE_BLK	The actual, target, permitted, and normal modes of the block: Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for actual
06	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
07	RS_STATE	State of the function block application state machine.
08	TEST_RW	Read/write test parameter - used only for conformance testing.
09	DD_RESOURCE	String identifying the tag of the resource which contains the Device Description for this resource.
10	MANUFAC_ID	Manufacturer identification number – used by an interface device to locate the DD file for the resource.

Index Number	Parameter	Description
11	DEV_TYPE	Manufacturer's model number associated with the resource - used by interface devices to locate the DD file for the resource.
12	DEV_REV	Manufacturer revision number associated with the resource - used by an interface device to locate the DD file for the resource.
13	DD_REV	Revision of the DD associated with the resource - used by an interface device to locate the DD file for the resource. The DD_REV specifies the minimum DD revision that is compatible with the device (within the same device revision). A vendor can release an updated DD with the DD_REVISION higher than the DD_REV. This allows a vendor to release an updated DD files set that will be compatible with an existing device revision in the field. The host can always load a higher DD_REVISION for a given DEV_REV/DEV_REVISION. As per Foundation requirement the DD_REV will always be 01.
14	GRANT_DENY	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device.
15	HARD_TYPES	The types of hardware available as channel numbers.
16	RESTART	Allows a manual restart to be initiated. Several degrees of restart are possible. They are the following: 1 Run – is the passive state of the parameter 2 Restart resource – not used 3 Restart with defaults – intended to reset parameters to default values, i.e. their value before any configuration was done 4 Restart processor – does a warm start of CPU
17	FEATURES	Used to show supported resource block options. The supported features are: • HARD_WRITE_LOCK_SUPPORT • SOFT_WRITE_LOCK_SUPPORT • REPORT_SUPPORT • UNICODE_SUPPORT • MULTI_BIT ALARM • FAULT_STATE_SUPPORT
18	FEATURES_SEL	Used to select resource block options.
19	CYCLE_TYPE	Identifies the block execution methods available for this resource.
20	CYCLE_SEL	Used to select the block execution method for this resource. The Rosemount 2240S supports the following: ■ Scheduled. Blocks are only executed based on the function block schedule. ■ Block Execution. A block may be executed by linking to another blocks completion.
21	MIN_CYCLE_T	Time duration of the shortest cycle interval of which the resource is capable.
22	MEMORY_SIZE	Available configuration memory in the empty resource. To be checked before attempting a download.
23	NV_CYCLE_T	Minimum time interval specified by the manufacturer for writing copies of NV parameters to non-volatile memory. Zero means it will never be automatically copied. At the end of NV_CYCLE_T, only those parameters which have changed need to be updated in NVRAM.
24	FREE_SPACE	Percent of memory available for further configuration. Zero in a pre-configured device.

Index Number	Parameter	Description
25	FREE_TIME	Percent of the block processing time that is free to process additional blocks.
26	SHED_RCAS	Time duration at which to give up on computer writes to function block RCas locations. Shed from RCas shall never happen when SHED_ROUT = 0
27	SHED_ROUT	Time duration at which to give up on computer writes to function block ROut locations. Shed from ROut shall never happen when SHED_ROUT = 0
28	FAULT_STATE	Condition set by loss of communication to an output block, fault promoted to an output block or physical contact. When FAIL_SAFE condition is set, then output function blocks will perform their FAIL_SAFE actions.
29	SET_FSTATE	Allows the FAIL_SAFE condition to be manually initiated by selecting Set.
30	CLR_FSTATE	Writing a Clear to this parameter will clear the device FAIL_SAFE if the field condition has cleared.
31	MAX_NOTIFY	Maximum number of unconfirmed notify messages possible.
32	LIM_NOTIFY	Maximum number of unconfirmed alert notify messages allowed.
33	CONFIRM_TIME	The time the resource will wait for confirmation of receipt of a report before trying again. Retry will not happen when CONFIRM_TIME=0.
34	WRITE_LOCK	When hardware write protection is selected, WRITE_LOCK becomes an indicator of the jumper setting and is unavailable for software write protection. When software write lock is selected, and WRITE_LOCK is set, no writings from anywhere else are allowed, except to clear WRITE_LOCK. Block input will continue to be updated.
35	UPDATE_EVT	This alert is generated by any change to the static data.
36	BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alarm is entered in the subcode field. The first alarm to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alarm reporting task, another block alarm may be reported without clearing the Active status, if the subcode has changed.
37	ALARM_SUM	The current alarm status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
38	ACK_OPTION	Selection of whether alarms associated with the function block will be automatically acknowledged.
39	WRITE_PRI	Priority of the alarm generated by clearing the write lock.
40	WRITE_ALM	This alert is generated if the write lock parameter is cleared.
41	ITK_VER	Major revision number of the inter operability test case used in certifying this device as interoperable. The format and range are controlled by the Fieldbus Foundation.
42	FD_VER	A parameter equal to the value of the major version of the Field Diagnostics specification that this device was designed to.

Index Number	Parameter	Description
43	FD_FAIL_ACTIVE	This parameter reflects the error conditions that are being detected as active as selected for this category. It is a bit string, so that multiple conditions may be shown.
44	FD_OFFSPEC_ACTIVE	
45	FD_MAINT_ACTIVE	
46	FD_CHECK_ACTIVE	
47	FD_FAIL_MAP	This parameter maps conditions to be detected as active for this alarm category. Thus the same condition may be active in all, some, or none of the 4 alarm categories.
48	FD_OFFSPEC_MAP	
49	FD_MAINT_MAP	
50	FD_CHECK_MAP	
51	FD_FAIL_MASK	This parameter allows the user to suppress any single or multiple conditions that are active, in this category, from being broadcast to the host through the alarm parameter. A bit equal to '1' will mask i.e. inhibit the broadcast of a condition, and a bit equal to '0' will unmask i.e. allow broadcast of a condition.
52	FD_OFFSPEC_MASK	
53	FD_MAINT_MASK	
54	FD_CHECK_MASK	
55	FD_FAIL_ALM	This parameter is used primarily to broadcast a change in the associated active conditions, which are not masked, for this alarm category to a Host System.
56	FD_OFFSPEC_ALM	
57	FD_MAINT_ALM	
58	FD_CHECK_ALM	
59	FD_FAIL_PRI	This parameter allows the user to specify the priority of this alarm category.
60	FD_OFFSPEC_PRI	
61	FD_MAINT_PRI	
62	FD_CHECK_PRI	
63	FD_SIMULATE	This parameter allows the conditions to be manually supplied when simulation is enabled. When simulation is disabled both the diagnostic simulate value and the diagnostic value tracks the actual conditions. The simulate jumper is required for simulation to be enabled and while simulation is enabled the recommended action will show that simulation is active. Elements: see Table C-2 on page 162.
64	FD_RECOMMEN_ACT	This parameter is a device enumerated summarization of the most severe condition or conditions detected. The DD help should describe by enumerated action, what should be done to alleviate the condition or conditions. 0 is defined as Not Initialized, 1 is defined as No Action Required, all others defined by manufacturer.
65	FD_EXTENDED_ACTIVE	An optional parameter or parameters to allow the user finer detail on conditions causing an active condition in the FD_*_ACTIVE parameters.
66	FD_EXTENDED_MAP	An optional parameter or parameters to allow the user finer control on enabling conditions contributing to the conditions in FD_*_ACTIVE parameters.
67	COMPATIBILITY_REV	This parameter is used when replacing field devices. The correct value of this parameter is the DEV_REV value of the replaced device.
68	HARDWARE_REVISION	Hardware revision.
69	SOFTWARE_REV	Software revision of source code with resource block.

Index Number	Parameter	Description
70	PD_TAG	PD tag description of device.
71	DEV_STRING	This is used to load new licensing into the device. The value can be written but will always read back with a value of 0.
72	DEV_OPTIONS	Indicates which miscellaneous device licensing options are enabled.
73	OUTPUT_BOARD_SN	Output board serial number. For the Rosemount 2240S this is the same as Main Label Device ID which can be found on the main label that is attached to the housing.
74	FINAL_ASSY_NUM	Final assembly number given by manufacturer.
75	DOWNLOAD_MODE	Gives access to the boot block code for over-the-wire downloads. 0 = Uninitialized 1 = Run mode 2 = Download mode
76	HEALTH_INDEX	Parameter representing the overall health of the device, 100 being perfect and 1 being non-functioning. The value is based on the active PWA alarms.
77	FAILED_PRI	Designates the alarming priority of the FAILED_ALM and also used as switch b/w FD and legacy PWA. If value is greater than or equal to 1 then PWA alerts will be active in device else device will have FD alerts.
78	RECOMMENDED_ACTION	Enumerated list of recommended actions displayed with a device alert.
79	FAILED_ALM	Alarm indicating a failure within a device which makes the device non-operational.
80	MAINT_ALM	Alarm indicating the device needs maintenance soon. If the condition is ignored, the device will eventually fail.
81	ADVISE_ALM	Alarm indicating advisory alarms. These conditions do not have a direct impact on the process or device integrity.
82	FAILED_ENABLE	Enabled FAILED_ALM alarm conditions. Corresponds bit for bit to the FAILED_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected. This parameter is the Read Only copy of FD_FAIL_MAP.
83	FAILED_MASK	Mask of FAILED_ALM. Corresponds bit of bit to FAILED_ACTIVE. A bit on means that the condition is masked out from alarming. This parameter is the Read Only copy of FD_FAIL_MASK.
84	FAILED_ACTIVE	Enumerated list of failure conditions within a device. All open bits are free to be used as appropriate for each specific device. This parameter is the Read Only copy of FD_FAIL_ACTIVE.
85	MAINT_PRI	Designates the alarming priority of the MAINT_ALM
86	MAINT_ENABLE	Enabled MAINT_ALM alarm conditions. Corresponds bit for bit to the MAINT_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected. This parameter is the Read Only copy of FD_OFFSPEC_MAP
87	MAINT_MASK	Mask of MAINT_ALM. Corresponds bit of bit to MAINT_ACTIVE. A bit on means that the condition is masked out from alarming. This parameter is the Read Only copy of FD_OFFSPEC_MASK.
88	MAINT_ACTIVE	Enumerated list of maintenance conditions within a device. This parameter is the Read Only copy of FD_OFFSPEC_ACTIVE.

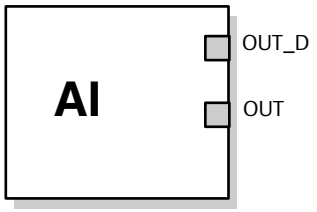
Index Number	Parameter	Description
89	ADVISE_PRI	Designates the alarming priority of the ADVISE_ALM
90	ADVISE_ENABLE	Enabled ADVISE_ALM alarm conditions. Corresponds bit for bit to the ADVISE_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected. This parameter is the Read Only copy of FD_MAINT_MASK & FD_CHECK_MASK.
91	ADVISE_MASK	Mask of ADVISE_ALM. Corresponds bit by bit to ADVISE_ACTIVE. A bit on means that the condition is masked out from alarming. This parameter is the Read Only copy of FD_MAINT_MASK & FD_CHECK_MASK.
92	ADVISE_ACTIVE	Enumerated list of advisory conditions within a device. All open bits are free to be used as appropriate for each specific device. This parameter is the Read Only copy of FD_MAINT_ACTIVE & FD_CHECK_ACTIVE.

Table C-2. FD_SIMULATE elements

Index	Parameter	Data Type	Size	Description
1	Diagnostic Simulate Value	Bit string	4	Writable. Used for diagnostics when simulation is enabled
2	Diagnostic Value	Bit string	4	Current diagnostics detected by the device.
3	Enable	Unsigned 8	1	Enable/Disable simulation. Dynamic, so simulation will always be disabled after a device restart.

C.2 Analog input block

Figure C-1. Analog Input Block



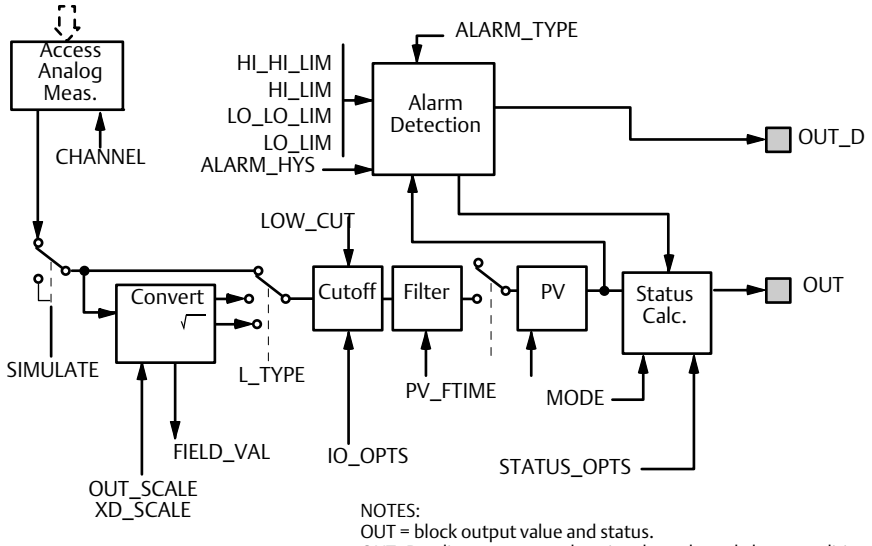
OUT=The block output value and status
OUT_D=Discrete output that signals a selected alarm condition

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-1 lists the AI block parameters and their units of measure, descriptions, and index numbers.

Figure C-2. Analog Input Function Block Schematic

Analog Measurement



NOTES:
OUT = block output value and status.
OUT_D = discrete output that signals a selected alarm condition.

Table C-3. 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. Refer to the appropriate device manual for information about the specific channels available in each device. You must configure the CHANNEL parameter before you can configure the XD_SCALE parameter. See "Analog Input block" on page 77.
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).

Parameter	Index Number	Units	Description
LO_ALM	35	None	The LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
LO_LIM	30	EU of PV_SCALE	The setting for the alarm limit used to detect the LO alarm condition.
LO_LO_ALM	36	None	The LO LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
LO_LO_LIM	32	EU of PV_SCALE	The setting for the alarm limit used to detect the LO LO alarm condition.
LO_LO_PRI	31	None	The priority of the LO LO alarm.
LO_PRI	29	None	The priority of the LO alarm.
LOW_CUT	17	%	If percentage value of transducer input fails below this, PV = 0.
MODE_BLK	05	None	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
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.

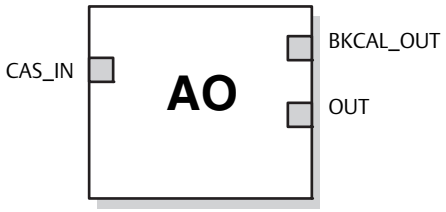
C.2.1 Simulation

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 "Switches and reset buttons" on page 66.

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

C.3 Analog output block

Figure 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-4 lists the definitions of the system parameters. See also "Analog Output block" on page 83.

Table C-4. 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 Analog Output 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 set point 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.
MODE	None	Enumerated attribute used to request and show the source of the set point 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 set point 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	The measured or implied actuator position associated with the OUT value.
SIMULATE	EU of XD_SCALE	Enables simulation and allows you to enter an input value and status.

Parameter	Units	Description
SP	EU of PV_SCALE	The target block output value (set point).
SP_HI_LIM	EU of PV_SCALE	The highest set point value allowed.
SP_LO_LIM	EU of PV_SCALE	The lowest set point value allowed.
SP_RATE_DN	EU of PV_SCALE per second	Ramp rate for downward set point changes. When the ramp rate is set to zero, the set point is used immediately.
SP_RATE_UP	EU of PV_SCALE per second	Ramp rate for upward set point changes. When the ramp rate is set to zero, the set point is used immediately.
SP_WRK	EU of PV_SCALE	The working set point of the block. It is the result of set point rate-of-change limiting. The value is converted to percent to obtain the block's OUT value.

C.4 Register transducer block

The Register Transducer Block allows access to Database registers and Input registers of the Rosemount™ 2240S Multi-input Temperature Transmitter. This makes it possible to read a selected set of register directly by accessing the memory location.

The Register Transducer Block is only available with advanced service.

⚠ CAUTION

Since the Register Transducer Block allows access to most registers in the Rosemount 2240S, which includes registers set by the Methods and Configuration screens in the Measurement Transducer Block (see *"Measurement transducer block" on page 171*), it should be handled with care and ONLY to be changed by trained and certified service personnel, or as guided by Emerson Automation Solutions/ Rosemount Tank Gauging support personnel.

Table C-5. Register Transducer Block Parameters

Index Number	Parameter	Description
1	ST_REV	The revision level of the static Bdata associated with the function block. The revision value increments each time a static parameter value in the block is changed.
2	TAG_DESC	The user description of the intended application of the block.
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	MODE_BLK	The actual, target, permitted, and normal modes of the block. Target: The mode to "go to" Actual: The mode the "block is currently in" Permitted: Allowed modes that target may take on Normal: Most common mode for target
6	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	UPDATE_EVT	This alert is generated by any change to the static data
8	BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
9	TRANSDUCER_DIRECTORY	Directory that specifies the number and starting indices of the transducers in the transducer block.
10	TRANSDUCER_TYPE	Identifies the transducer.
11	TRANSDUCER_TYPE_VER	
12	XD_ERROR	A transducer block alarm sub code.

Index Number	Parameter	Description
13	COLLECTION_DIRECTORY	A directory that specifies the number, starting indices, and DD Item ID's of the data collections in each transducer within a transducer block.
14	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.5 Measurement transducer block

The Measurement Transducer block contains the actual measurement data, including temperature, water level readings, and pressure. Channels 1-10 are assigned to these measurements. The transducer block includes information about sensor type, engineering units, and all parameters needed to configure the transmitter.

Table C-6. 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	TRANSDUCER_TYPE_VER	
12	XD_ERROR	A transducer block alarm subcode. Provides additional error codes related to transducer blocks.
13	COLLECTION_DIRECTORY	A directory that specifies the number, starting indices, and DD Item ID’s of the data collections in each transducer within a transducer block.
14	HOUSING_TEMPERATURE	Temperature inside radar gauge housing
15	TEMPERATURE_UNIT	Measurement unit for temperature
16	WATER_LEVEL	Water level at the bottom of the tank
17	WATER_LEVEL_UNIT	Measurement unit for Water Level

Index Number	Parameter	Description
18	PRESSURE	Pressure
19	PRESSURE_UNIT	Measurement unit for Pressure
20	ENV_DEVICE_MODE	Restart/Reset Device to factory default
21	DIAGN_DEVICE_ALERT	Plant web alerts, see Table C-13 on page 175
22	DEVICE_VERSION_NUMBER	Device software version number
23	DIAGN_REVISION	Internal revision number
24	SERIAL_NO	Device ID for the gauge (serial number)
25	STATS_ATTEMPTS	Internal communication attempts
26	STATS_FAILURES	Internal communication failures
27	STATS_TIMEOUTS	Internal communication timeouts
28	FF_DEVICE_NUMBER	Unit ID (serial number) for FF card
29	FF_WRITE_PROTECT	FF write protect status. The device is write protected by a hardware switch.
30	P1451_SLAVE_STATS	P1451 Slave Stats
31	P1451_HOST_STATS	P1451 Host Stats
32	NUMBER_OF_SENSORS	Number of temperature sensor elements connected to the Rosemount 2240S
33	CONVERSION_METHOD	Conversion method that matches the temperature sensor element type, see Table C-7.
34	SENSOR_TYPE	Select if the multiple spot temperature sensor elements are of spot type or average type, see Table C-8.
35	SENSOR_CONNECTION	Type of connection used for the multiple spot temperature sensor, see Table C-9.
36	TEMP_RANGE_MIN	Minimum temperature supported by the temperature element. A temperature value below this limit will set the temperature measurement to invalid.
37	TEMP_RANGE_MAX	Maximum temperature supported by the temperature element. A temperature value above this limit will set the temperature measurement to invalid.
38	CONFIG_METHOD	Select “Auto” if the temperature transmitter shall use automatic settings. The automatic settings are controlled by a dip switch located at the Rosemount 2240S connection terminals. See Table C-10.
39	TEMP_1	Temperature for element no. 1
40	TEMP_STATUS_1	Status of temperature element no.1
...	...	
69	TEMP_16	Temperature for element no. 16
70	TEMP_STATUS_16	Status of temperature element no.16
71	SB_DEVICE_ID	ID of device connected to the sensor bus, see Table C-11.
72	SB_SW VERSION	Software version of the device connected to the sensor bus
73	SB_HW_TYPE	Hardware type of the device connected to the sensor bus

Index Number	Parameter	Description
74	SB_STATUS	Status of the device connected to the sensor bus
75	SB_PV	Auxiliary device primary value
76	SB_UNIT	Measurement unit code for the device connected to the sensor bus
77	SB_HEART_BEAT_CNT	This number should be incrementing. It is an indication that the auxiliary device is alive.
78	SB_MEAS_OFFSET	Distance between tank zero level and water zero level; WLS Offset (X)
79	SB_LOWER_DEAD_ZONE	Lower region within the active length of the water level sensor which can be used to reduce the measurement range; WLS Lower Dead Zone (LDZ)
80	SB_UPPER_DEAD_ZONE	Upper region within the active length of the water level sensor which can be used to reduce the measurement range; WLS Upper Dead Zone (UDZ)
81	SB_LOWER_SENSOR_LIMIT	Auxiliary device lower sensor limit
82	SB_UPPER_SENSOR_LIMIT	Auxiliary device upper sensor limit
83	USED_NUMBER_OF_SENSORS	Used number of temperature sensor elements
84	USED_CONVERSION_METHOD	Used conversion method
85	USED_SENSOR_TYPE	Used sensor type
86	USED_SENSOR_CONNECTION	Used connection (sensor wiring)
87	USED_TEMP_RANGE_MIN	Used minimum temperature range
88	USED_TEMP_RANGE_MAX	Used maximum temperature range
89	DEVICE_STATUS	Device status
90	DEVICE_COMMAND	Device command
91	AVERAGE_TEMP_INFO	Average temperature information
92	FF_SUPPORT_INFO	FF Support Info
93	WLS_CALIBRATION	Water Level Sensor calibration. Shows the water level sensor calibration status and active length.
94	SENSOR_DIAGNOSTICS	Sensor diagnostics
95	MODEL_CODE	Device model code
96	TEMP_HEART_BEAT_CNT	This number should be incrementing. It is an indication that the auxiliary device is alive.
97	MEASUREMENT_TYPE	Device identification

Table C-7. Conversion Method

VALUE	CONVERSION_METHOD
0	User defined linearization table
1	User defined formula
2	PT100
3	CU90
4	User defined individual formula
5	CU90 US

Table C-8. Sensor Type

VALUE	SENSOR_TYPE
0	Spot
1	Average

Table C-9. Sensor Connection

VALUE	SENSOR_CONNECTION
1	3 wires spot with common return
3	3 wires independent return
4	4 wires independent return

Table C-10. Configuration method

VALUE	CONFIG_METHOD
0	Reserved
1	Auto
2	Manual

Table C-11. Sensor Bus device ID

VALUE	SB_DEVICE_ID
0	Nothing connected
113	Pressure sensor
121	Water level sensor WLS

Table C-12. Water Level Sensor calibration

VALUE	WLS_CALIBRATION
0x00000001	Empty calibration mode active
0x00000002	Full calibration mode active
0x00000004	WLS calibration 2
0x00000008	WLS calibration 3
0x00000010	Last calibration OK
0x00000020	Last calibration failed
0x00000040	Last calibration attempt denied

C.5.1 Diagnostic device alerts

Table C-13 lists conditions reported in the DIAGN_DEVICE_ALERT parameter.

Table C-13. Diagnostic Device Alerts

Value	Description
	No alarm active
0x00100000	Database error
0x00200000	Hardware error
0x00400000	Configuration error
0x00800000	Software error
0x20000000	Simulation mode
0x40000000	Software write protected

C.6 Average temperature transducer block

The Average Temperature Transducer block contains temperature measurement data and configuration parameters.

Table C-14. Average Temperature Transducer Block Parameters

Index Number	Parameter	Description
1	ST_REV	The revision level of the static data associated with the function block. The revision value increments each time a static parameter value in the block is changed.
2	TAG_DESC	The user description of the intended application of the block.
3	STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	MODE_BLK	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
6	BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	UPDATE_EVT	This alert is generated by any change to the static data.
8	BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
9	TRANSDUCER_DIRECTORY	Directory that specifies the number and starting indices of the transducers in the transducer block.
10	TRANSDUCER_TYPE	Identifies the transducer.
11	TRANSDUCER_TYPE_VER	
12	XD_ERROR	A transducer block alarm sub code. Provides additional error codes related to transducer blocks.
13	COLLECTION_DIRECTORY	A directory that specifies the number, starting indices, and DD Item ID’s of the data collections in each transducer within a transducer block.
14	TEMPERATURE_UNIT	Measurement Unit for all temperature parameters
15	LENGTH_UNIT	Measurement Unit for all length parameters
16	TEMP_AVERAGE_LIQUID	Average Liquid Temperature
17	STATUS_AVG_LIQUID	Average Liquid Temperature Status
18	TEMP_AVERAGE_VAPOR	Average Vapor Temperature
19	STATUS_AVG_VAPOR	Average Vapor Temperature Status
20	TANK_TEMPERATURE	Average Tank Temperature

Index Number	Parameter	Description
21	STATUS_TANK_TEMP	Average Tank Temperature Status
22	EXCLUDE_SENSOR	Exclude Sensor. It is possible to exclude a temperature spot sensor from the average calculation if the spot sensor is broken or delivers erroneous measurement values.
23	INSERTION_ DISTANCE	Insertion Distance. This is the position offset for temperature sensors. This offset is added to the configured position of each sensor.
24 ... 39	SENSOR_POSITION_1 ... SENSOR_ POSITION _16	Sensor Position for element no. 1 to 16. Enter the position of each sensor element, measured as the distance from the zero level (dipping datum plate) to the sensor element. If average temperature sensor elements are used, enter the position of the terminating level of each sensor element.
40	LEVEL	Level value used for average temperature calculation

C.7 Supported units

The Rosemount™ 2240S Multi-input Temperature Transmitter supports the following units:

Table C-15. Temperature

Value	Display	Description
1000	K	Kelvin
1001	deg C	Degree Celsius
1002	deg F	Degree Fahrenheit

Table C-16. Length

Value	Display	Description
1010	m	Meter
1012	cm	Centimeter
1013	mm	Millimeter
1018	ft	Feet
1019	in	Inch

Table C-17 lists supported units for Water Level Sensor (WLS) connected to the Sensor Bus.

Table C-17. Sensor Bus units

Value	Description
44	Feet
45	Meter
47	Inch
48	Centimeter
49	Millimeter

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Numerics

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