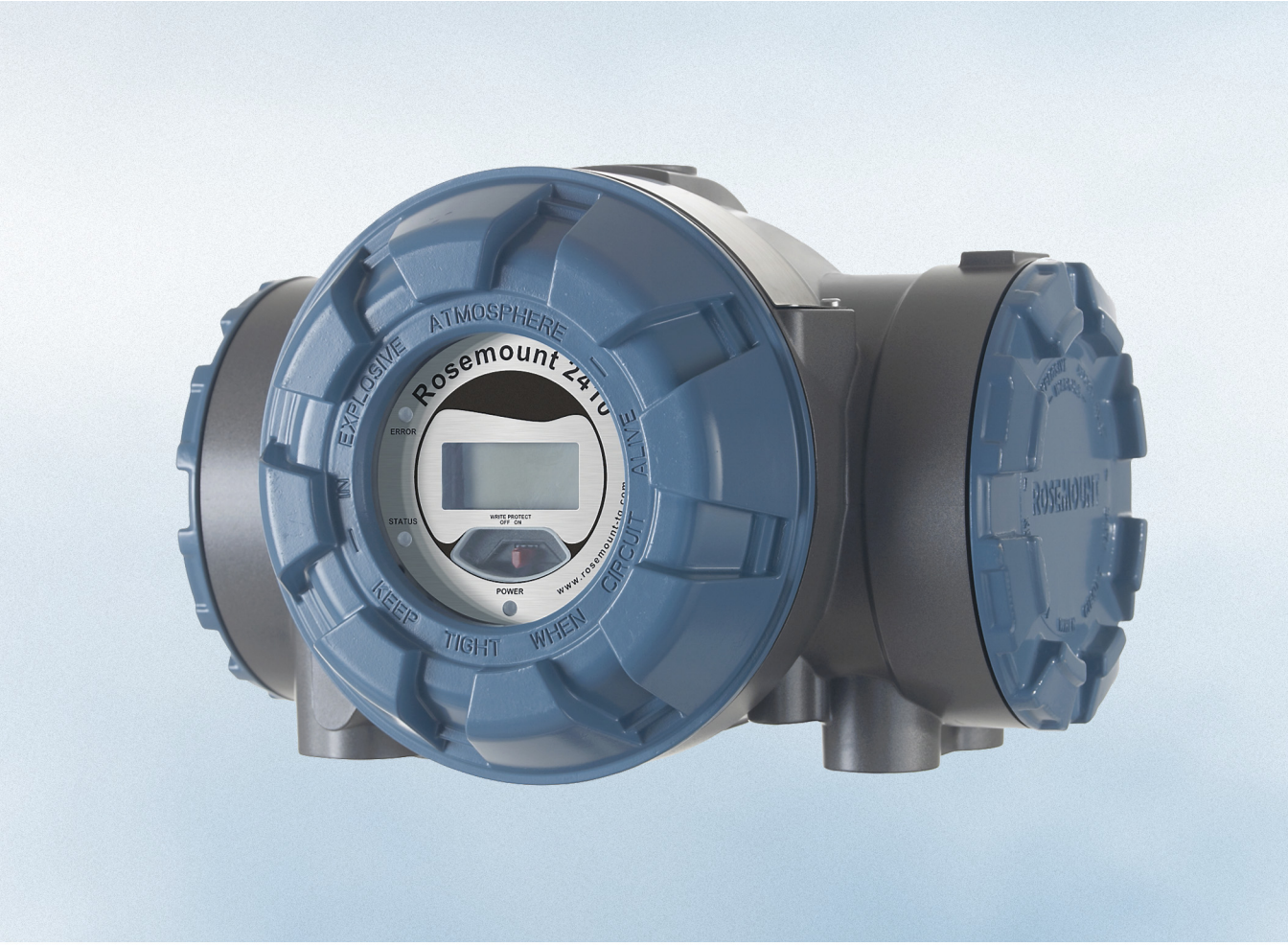
Reference Manual
300530EN, Rev BB
December 2013

Rosemount 2410

Tank Hub



FOUNDATION

ROSEMOUNT®
Tank Gauging

www.rosemount-tg.com

EMERSON™
Process Management

Rosemount 2410

Tank Hub

NOTICE

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

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

Spare Parts

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

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

⚠CAUTION

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

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

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

Cover Photo: 2410_coverfoto.tif

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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 device is consistent with the appropriate hazardous locations certifications.
- Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

Electrical shock could cause death or serious injury.

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

⚠WARNING

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

1.2 SYMBOLS

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

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

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

Protective Earth

Ground

Caution - see reference manual

Use wiring rated for maximum ambient temperature + 15 °C

Examples:

For connections in ambient temperatures up to 70 °C use wiring rated 85 °C minimum.

For connections in ambient temperatures up to 60 °C use wiring rated 75 °C minimum.

For connections in ambient temperatures up to 50 °C use wiring rated 65 °C minimum.

1.3 MANUAL OVERVIEW

This manual provides information on installation, configuration and maintenance of the Rosemount 2410 Tank Hub.

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1.4 TECHNICAL DOCUMENTATION

The Raptor Tank Gauging System includes the following documentation:

- Raptor Technical Description (704010EN)
- Rosemount 5900S Reference Manual (300520EN)
- Rosemount 2410 Reference Manual (300530EN)
- Rosemount 2240S Reference Manual (300550EN)
- Rosemount 2230 Reference Manual (300560EN)
- Raptor System Configuration Manual (300510EN)
- Rosemount 5300 Product Data Sheet (00813-0100-4530)
- Rosemount 5400 Product Data Sheet (00813-0100-4026)
- Rosemount 5300 Series Reference Manual (00809-0100-4530)
- Rosemount 5400 Series Reference Manual (00809-0100-4026)
- Rosemount TankMaster WinOpi Reference Manual (303028EN)
- Rosemount Raptor Installation Drawings

1.5 SERVICE SUPPORT

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

1.6 PRODUCT RECYCLING/DISPOSAL

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

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

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

Figure 1-1. A green label is placed on the housing of the 2410 Tank Hub

1.7 PACKING MATERIAL

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

1.7.1 Reuse and Recycling

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

1.7.2 Energy recovery

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

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

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

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

Section 2 Overview

2.1 INTRODUCTION

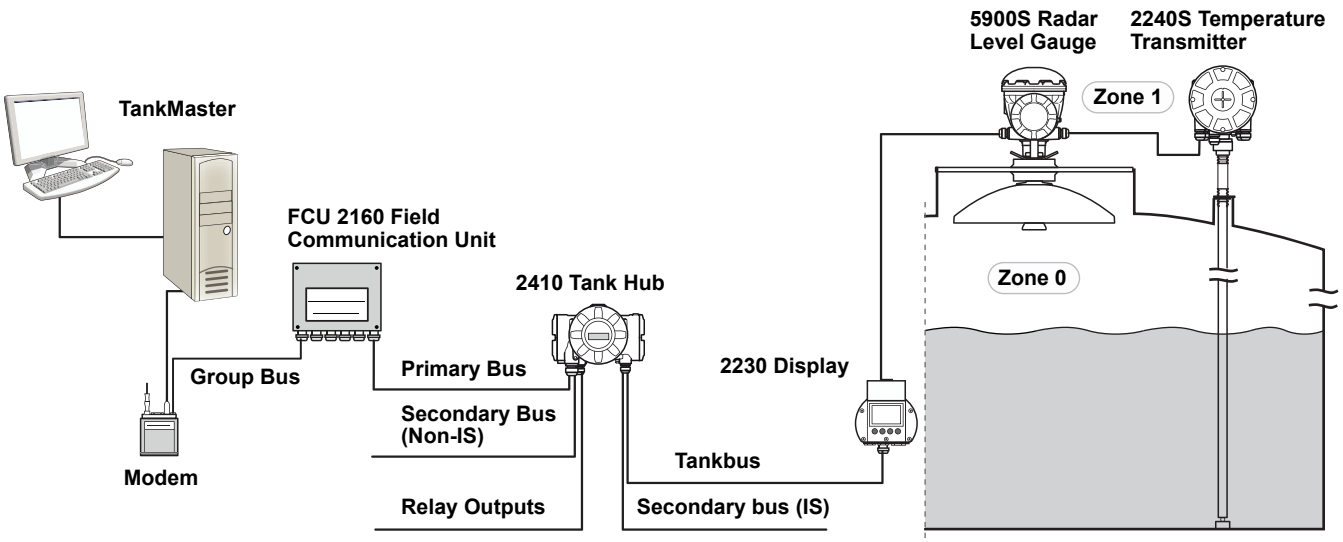
The Rosemount 2410 Tank Hub collects measurement data and status information from field devices designed for the Rosemount Raptor system via the intrinsically safe 2-wire **Tankbus**(1). The Tankbus carries both data transmission and power supply (see also “Tankbus” on page 3-8).

The Rosemount 2410 is designed for use in hazardous area Zone 1 (Class 1, Division 1) and communicates with field devices in Zone 1 via the intrinsically safe Tankbus.

The 2410 is available in two versions for single tanks or multiple tanks. The multiple tanks version supports up to 10 tanks and 16 devices.

Measurement data and status information from one or more tanks is distributed via the Primary Bus to a Rosemount 2160 Field Communication Unit (FCU). Data is buffered by the 2160 and distributed to a TankMaster PC, or a host system, whenever the FCU receives a request for data. In case no FCU is included in the system, the 2410 can communicate directly with a host computer.

Figure 2-1. System integration



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

The Rosemount 2410 has two external buses for communication with host systems. The **Primary Bus** is typically used with the TRL2 Modbus or RS-485 Modbus protocol for communication with a 2160 Field Communication Unit. If there is no 2160 included, the Primary bus can communicate directly, or via a modem, with the TankMaster PC.

The **Secondary Bus** supports various protocols such as TRL2 Modbus, Enraf, and Varec which allows you to connect to other systems as well.

The 2410 is equipped with two solid state **relays** that allows controlling external devices such as valves and pumps.

An **integral display** (optional) presents measurement data and device status such as warnings and error messages. At start-up, communication settings and optional hardware configuration is presented as well as whether it is a Single tank or Multiple tank version of the 2410 Tank Hub.

Using the input from a Rosemount 5900S Radar Level Gauge and one or two pressure sensors, the 2410 can be configured for online presentation of **Observed Density** to a host computer. The 2410 also calculates **Average Temperature** and strapping table based **Volume**.

Rosemount 2410 can be equipped with two **relays** which can be controlled by level, temperature, and water level. The output can be connected to an external system for alarm indication or process control. The relays are user configurable for normally open or closed operation.

The 2410 can be configured with up to ten “**virtual**” **relay** functions. This allows you to specify several different source variables to trigger a relay.

The Rosemount 2410 Tank Hub supports the Emerson’s Smart Wireless solution, which is based on ***Wireless*HART** the emerging industry standard for wireless field networks. By connecting to a Smart Wireless THUM™ Adapter, the Rosemount 2410 can be integrated in a wireless network to provide measurement data at greatly reduced field wiring costs.

2.1.1 Communication

The Raptor system supports various communication interfaces between a Rosemount 2410 and a TankMaster PC or other host computers as illustrated in Figure 2-2 to Figure 2-4.

Both the Primary bus and the Secondary bus can be used for either TRL2 Modbus (standard) or RS485 Modbus communication(1).

On the Secondary bus you may use other communication protocols as well, such as Enraf, Varec etc.

Figure 2-2. Typical configuration of a Rosemount 2410 and 2160 FCU connected to PC/Host

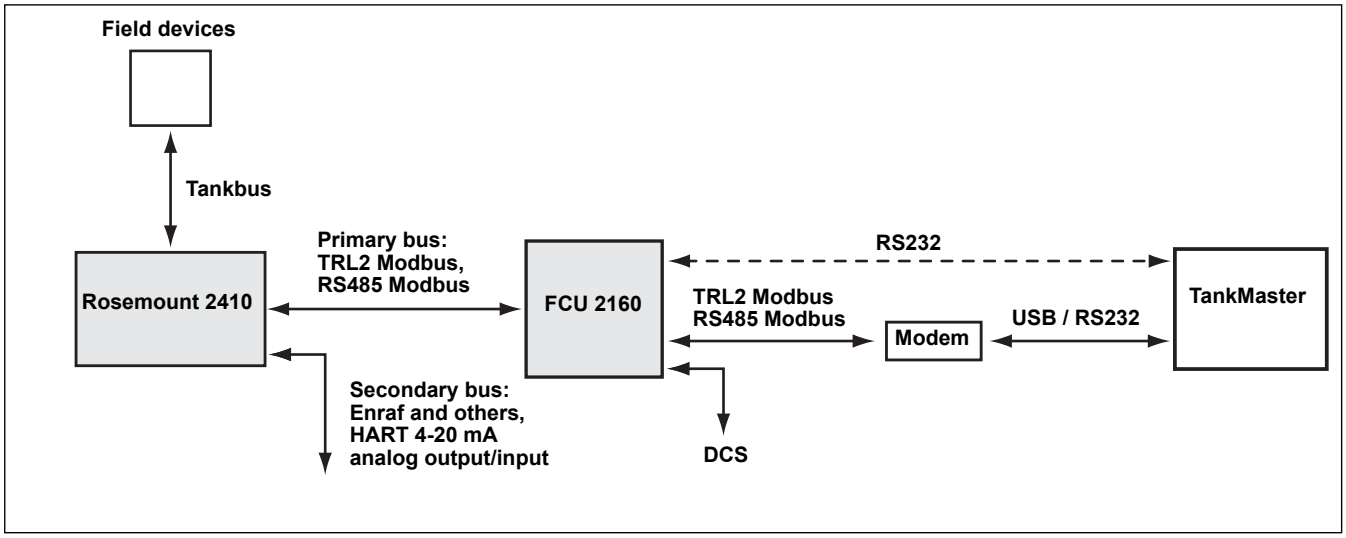
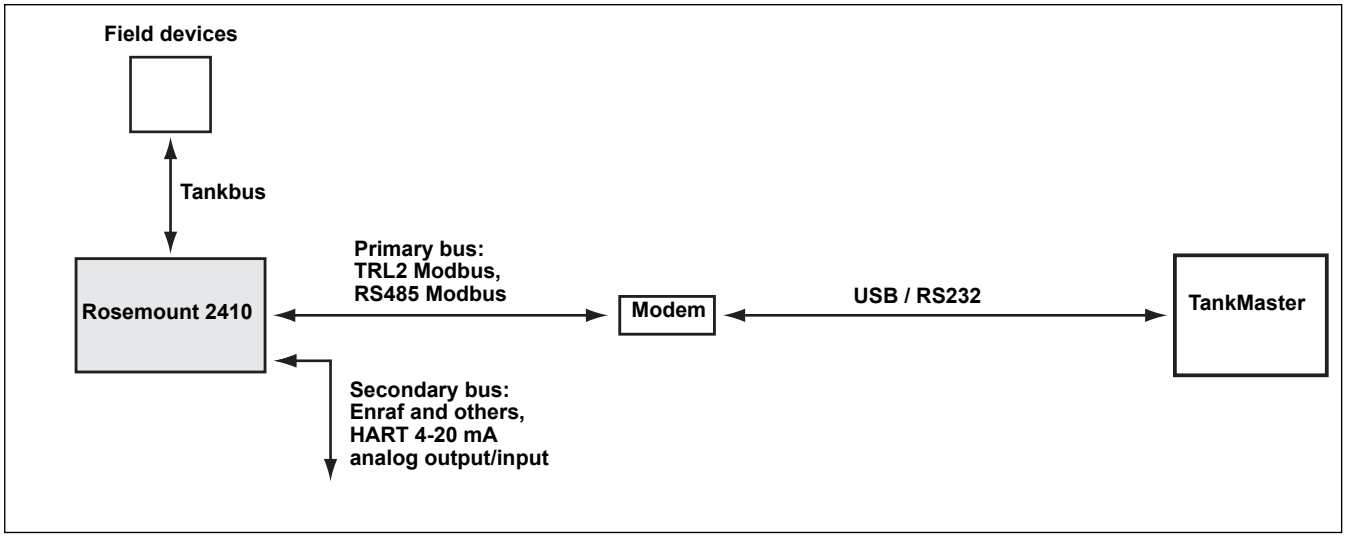


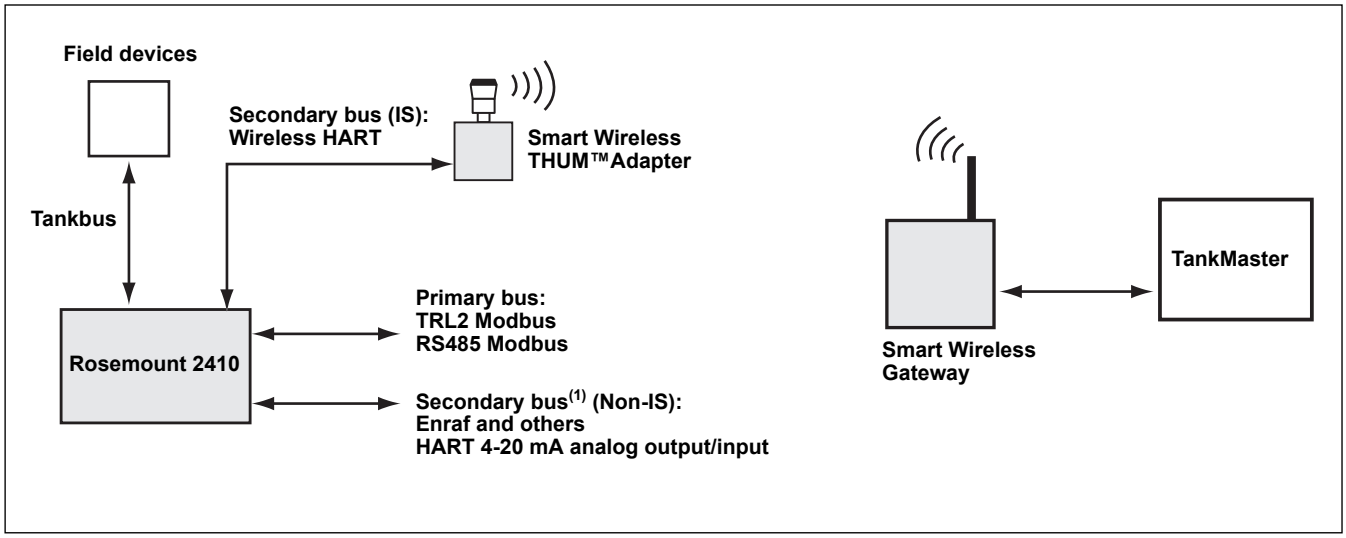
Figure 2-3. Typical configuration of a Rosemount 2410 connected to PC/Host



(1) See "Cabling for the TRL2/RS485 Bus" on page 3-22 for information on cable requirements.

A THUM Adapter, connected to the Intrinsically Safe Secondary(1) bus, allows wireless communication between a 2410 Tank Hub and a Smart Wireless Gateway.

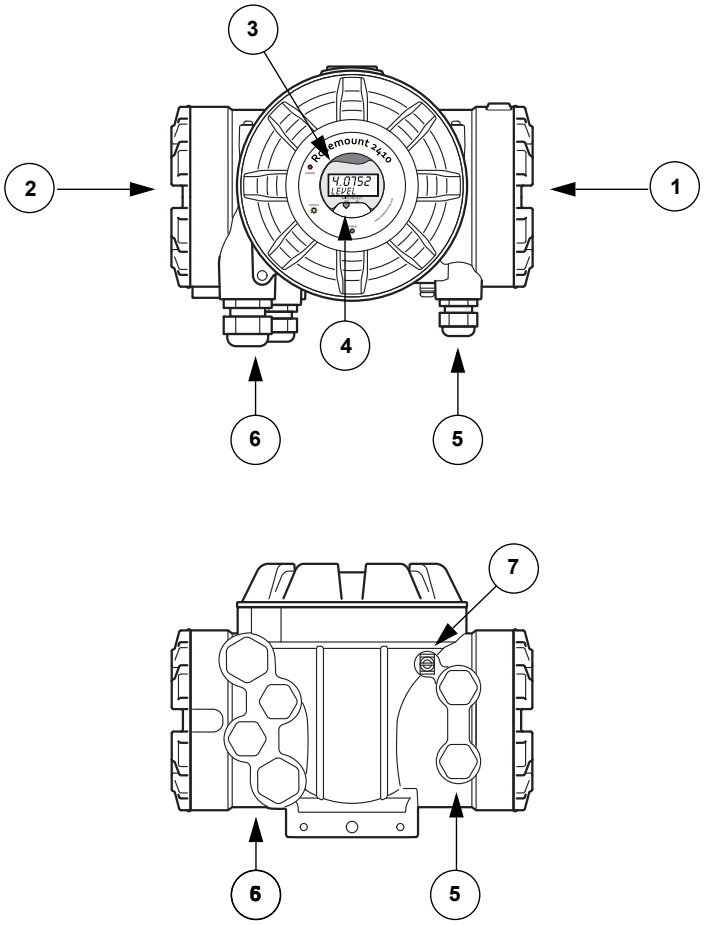
Figure 2-4. Typical configuration of a Rosemount 2410 with wireless connection to Smart Wireless Gateway and PC/Host



(1) The Non-IS Secondary Bus can not be used simultaneously with the IS HART 4-20 mA Secondary Bus.

2.2 COMPONENTS

Figure 2-5. Rosemount 2410 components



1. Intrinsically safe terminal compartment
2. Non-intrinsically safe terminal compartment
3. Integral display (optional)
4. Write protection switch
5. Cable entries for IS connection (two ½ - 14 NPT)
6. Cable entries for Non-IS connection (two ½ - 14 NPT, two ¾ - 14 NPT)
7. Grounding terminal

2.3 SYSTEM OVERVIEW

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

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

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

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

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

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

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

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

Figure 2-6. Raptor system architecture

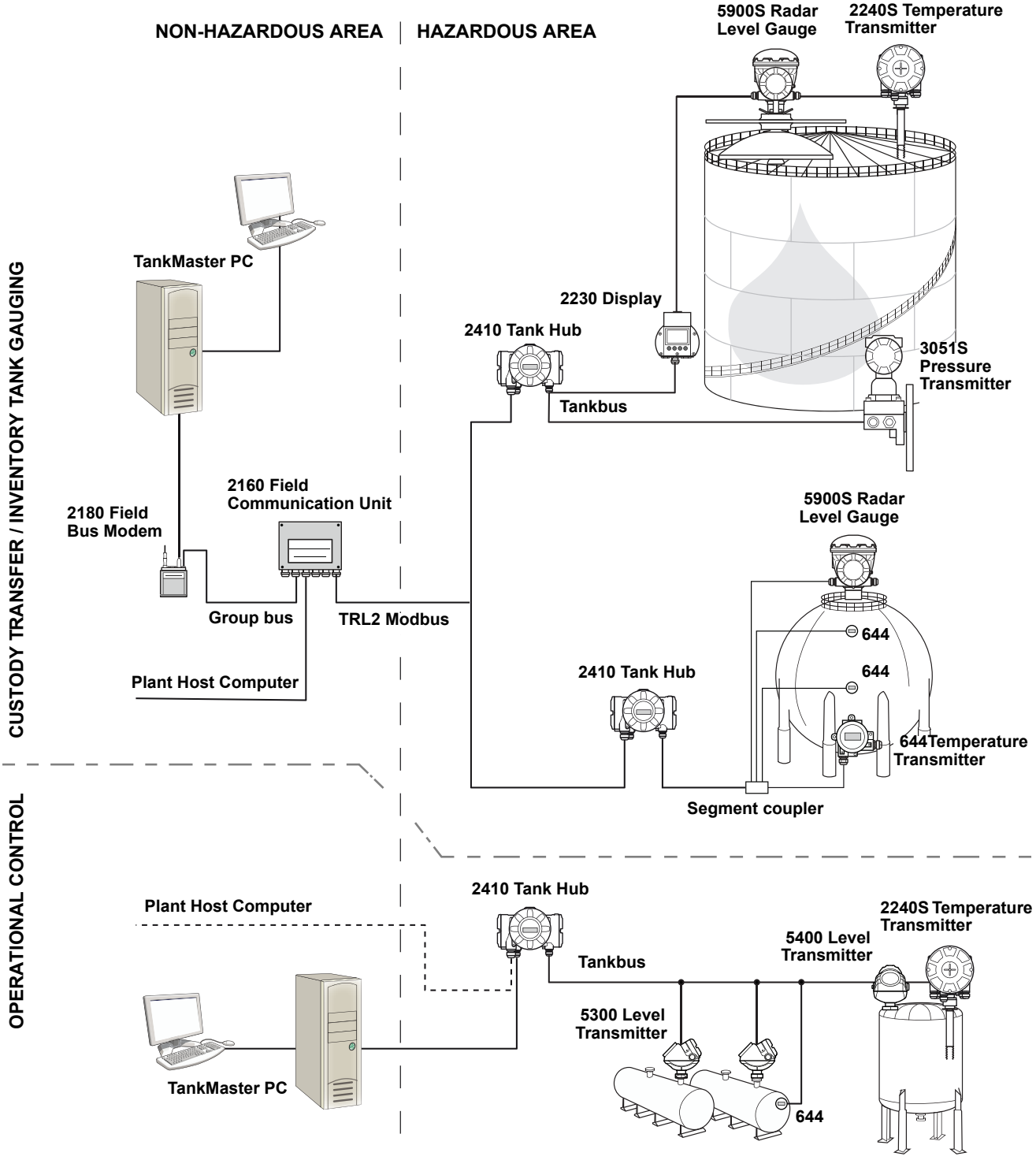
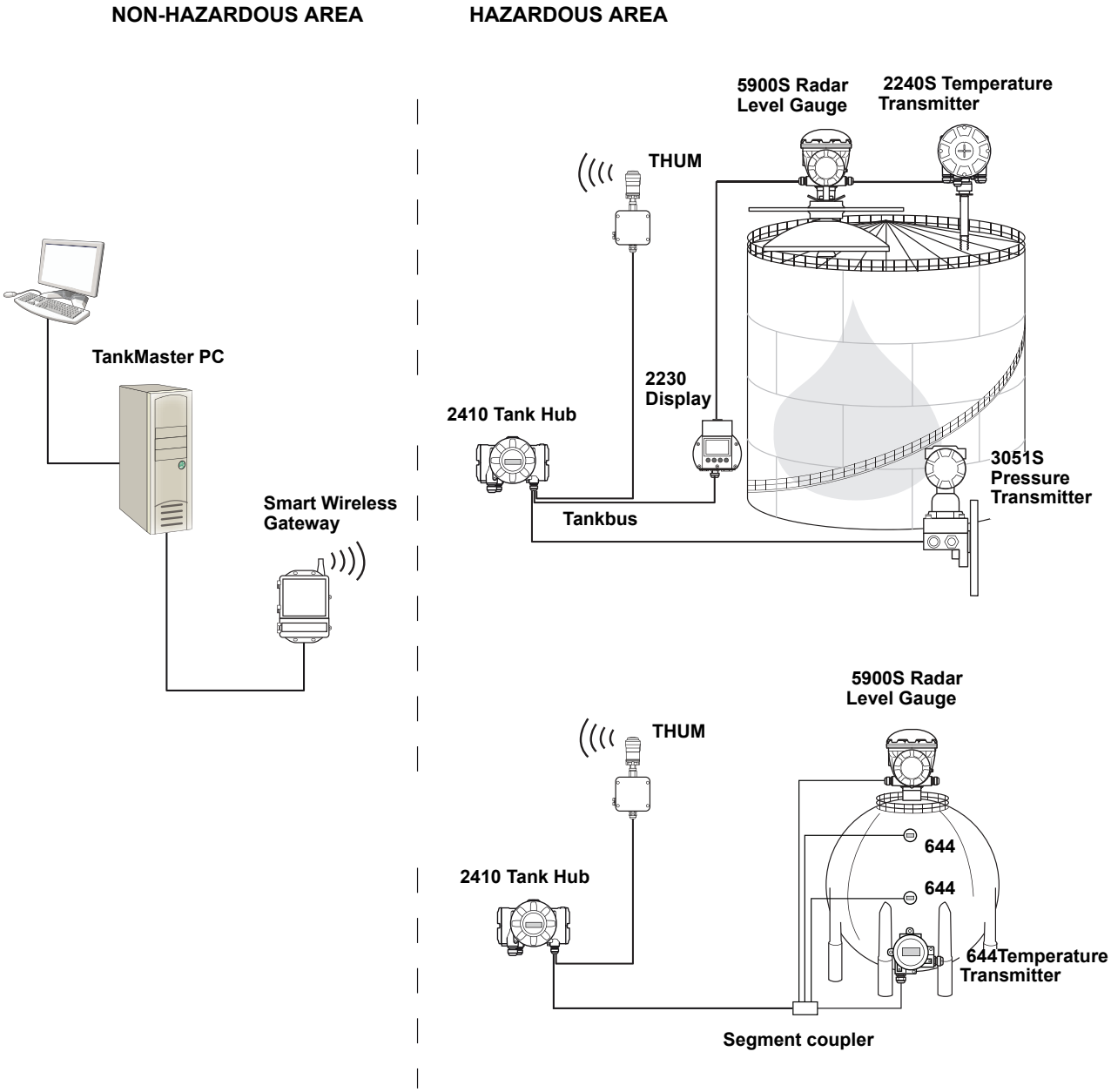


Figure 2-7. Raptor system architecture for wireless systems



TankMaster HMI Software

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

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

Rosemount 2160 Field Communication Unit

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

Rosemount 2410 Tank Hub

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

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

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

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

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

Rosemount 5900S Radar Level Gauge

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

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

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

Rosemount 5300 Guided Wave Radar

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

Rosemount 5400 Radar Level Transmitter

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

Rosemount 2240S Multi-Input Temperature Transmitter

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

Rosemount 2230 Graphical Field Display

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

Rosemount 644 Temperature Transmitter

The Rosemount 644 is used with single spot temperature sensors.

Rosemount 3051S Pressure Transmitter

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

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

Rosemount 2180 Field Bus Modem

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

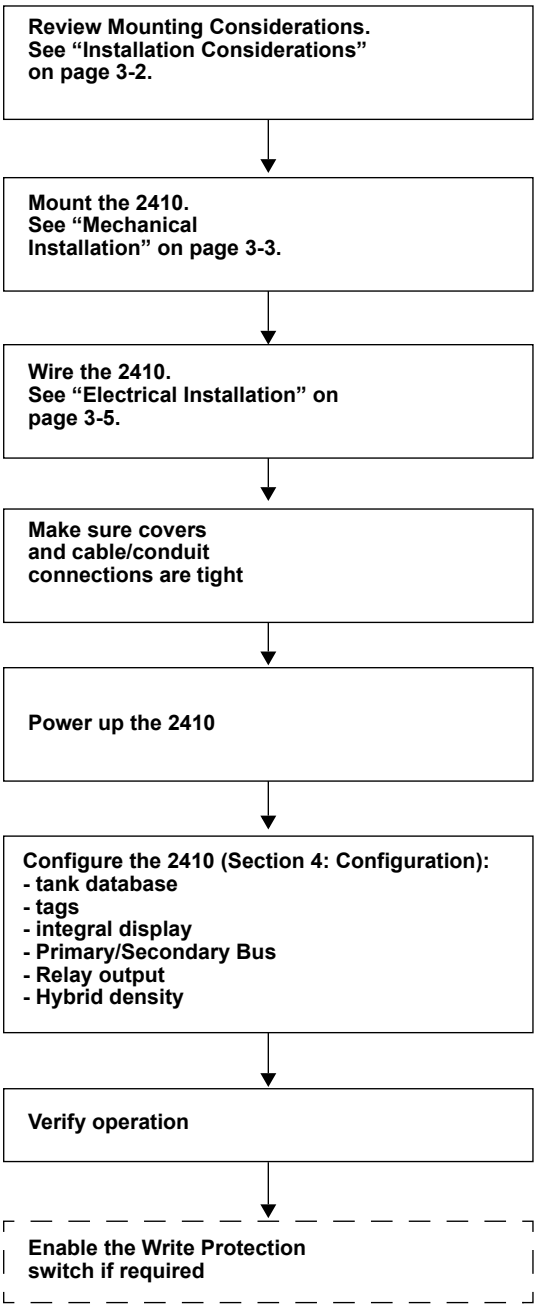
Rosemount Smart Wireless Gateway and Rosemount Smart Wireless THUM Adapter

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

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

2.4 INSTALLATION PROCEDURE

Follow these steps for a proper installation:



Section 3 Installation

3.1 SAFETY MESSAGES

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

⚠WARNING

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

Make sure only qualified personnel perform the installation.

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

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

⚠WARNING

Explosions could result in death or serious injury:

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

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

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

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

⚠WARNING

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

Avoid contact with leads and terminals.

Make sure the main power to the 2410 Tank Hub is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

3.2 INSTALLATION CONSIDERATIONS

The Rosemount 2410 Tank Hub may be installed on various locations at the plant. Mounting at the tank foot may be convenient when you would like to have easy access to measuring data, diagnostics and other information on the 2410 optional integral display.

The 2410 can also be mounted on the tank roof if this is the preferred location. In case the 2410 is exposed to long periods of sunshine, a sunshade should be used to prevent the 2410 Tank Hub from being heated to temperatures above the maximum operating temperature.

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

Ensure that the Rosemount 2410 is installed such that it is not exposed to higher pressure and temperature than specified in *Appendix A: Reference Data.*

The multi-tank version of the Rosemount 2410 Tank Hub is able to serve several tanks. In that case the 2410 may be placed at a suitable location further away from the tanks.

The 2410 is designed with two Tankbus terminals and several cable entries which allows alternative cable routings to suit various requirements.

Do not install the Rosemount 2410 in non-intended applications, for example environments where it may be exposed to extremely intense magnetic fields or extreme weather conditions.

It’s a good idea to plan the installation in order ensure that all components in the system are properly specified. The planning stage should include the following tasks:

- make a plan of the site and specify suitable locations for the devices
- consider power budget
- specify cabling and connections (for example whether devices will be “daisy-chained” or not)
- specify cable glands that will be needed for the various devices
- specify location of terminators on the Tankbus
- make a note of identification codes such as Unit ID/Device ID of each device
- assign Modbus addresses for level gauges and other tank devices to be used in the Tank Database of the 2410 and the Slave Database of the 2160 Field Communication Unit (see the Raptor System Configuration manual, document no. 300510 for more information)

See “Electrical Installation” on page 3-5 for more information on cables and glands.

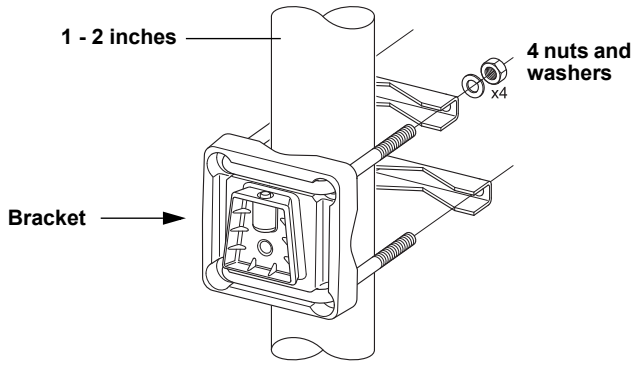
IMPORTANT
Check the 2410 Tank Hub for any signs of damage prior to installation. Ensure that the glass on the integral display is undamaged, and O-rings and gaskets are in good condition.

3.3 MECHANICAL INSTALLATION

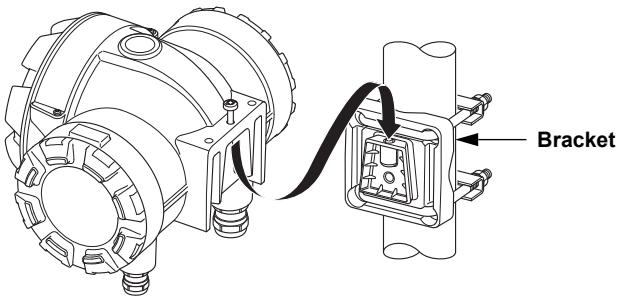
The Rosemount 2410 is designed for mounting on a pipe stand or on a wall.

NOTE!
Ensure that the 2410 is installed to minimize vibration and mechanical shock.

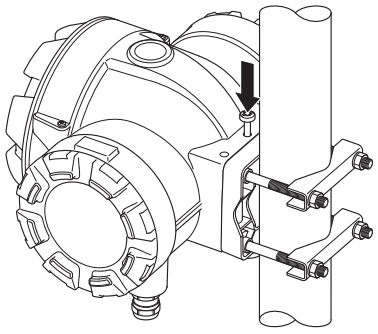
3.3.1 Pipe Mounting



1. Attach the bracket to the pipe.
2. Ensure that the 2410 is placed in a direction so that the display is clearly visible and wiring can be properly connected.
3. Tighten the nuts. Use moderate torque to ensure that the bracket does not break.

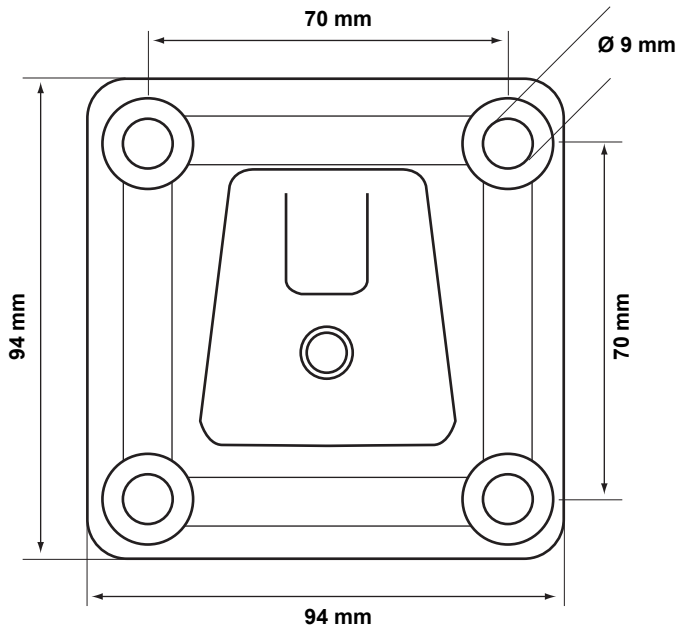


4. Attach the 2410 to the bracket by sliding it from the top downwards.

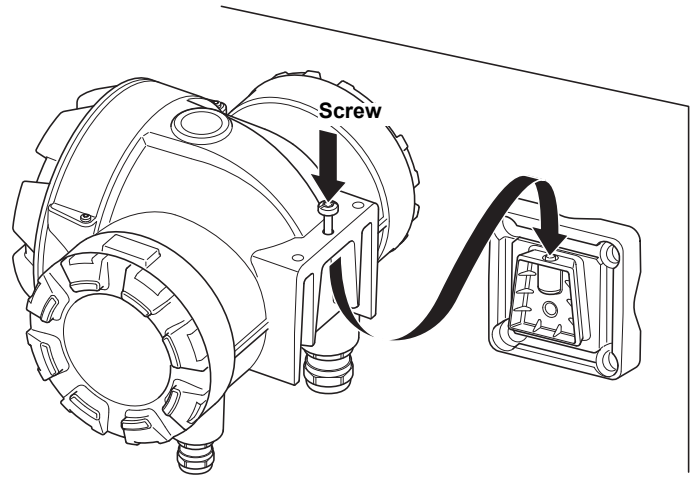


5. Secure the 2410 to the bracket by tightening the screw.

3.3.2 Wall Mounting



1. Mount the bracket on the wall by using four M8 screws and flat washers. **Note**! Countersunk screws are not suitable.



2. Attach the 2410 to the bracket and tighten the screw.

3.4 ELECTRICAL INSTALLATION

3.4.1 Cable Entries

The Rosemount 2410 electronics housing has four ½ - 14 NPT and two ¾ - 14 NPT entries. The connections must be made in accordance with local or plant electrical codes.

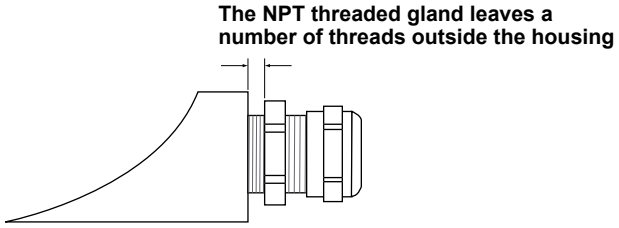
Make sure that unused ports are properly sealed to prevent moisture or other contamination from entering the terminal block compartment of the electronics housing.

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

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

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

Figure 3-1. Cable entry with NPT threaded gland



Glands must meet the following requirements for the Non-IS cable entries:

- Ex de explosion protection
- IP class 66 and 67
- material: metal (recommended)

3.4.2 Power Supply

The Rosemount 2410 Tank Hub accepts supply voltage 48 - 240 Vac (50/60 Hz) and 24 - 48 Vdc. The 2410 provides intrinsically safe power to all devices connected to the Tankbus (see “Tankbus” on page 3-8).

3.4.3 Cable Selection for Power Supply

Cables must be suitable for the supply voltage and approved for use in hazardous areas, where applicable. For instance, in the U.S., explosion-proof conduits must be used in the vicinity of the vessel.

Suitable conduits with sealing device or flame proof cable glands must be used depending on local requirements.

Appropriate cross sectional area of wires must be used in order to prevent a too high voltage drop to the connected device. Use 0.75 mm^2 to 2.5 mm^2 (18 AWG to 13 AWG) in order to minimize the voltage drop.

3.4.4 Grounding

The housing should always be grounded in accordance with national and local electrical codes. Failure to do so may impair the protection provided by the equipment. The most effective grounding method is direct connection to earth ground with minimal impedance. There are grounding screw connections inside the terminal compartments which are identified by ground symbols: ⏚ / ⏚. There is also a grounding screw on the housing.

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

Grounding - Tankbus

Signal wiring of the fieldbus segment (Tankbus) can 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 for shield wire to avoid creating a ground loop. The ground point is typically at the power supply.

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.

3.4.5 Cable Selection for the Tankbus

Use shielded twisted pair wiring for the Rosemount 2410 Series in order to comply with FISCO(1) requirements and EMC regulations. The preferred cable is referred to as type “A” fieldbus cable. The cables must be suitable for the supply voltage and approved for use in hazardous areas, where applicable. In the U.S. explosion-proof conduits may be used in the vicinity of the vessel.

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

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

Table 3-1. FISCO cable parameters

Parameter(1)	Value
Loop resistance	15 to 150 Ω/km
Loop inductance	0.4 to 1 mH/km
Capacitance	45 to 200 nF/km
Maximum length of each spur(2) cable	60 m in apparatus class IIC and IIB
Maximum length of each trunk(3) cable	1000 m in apparatus class IIC and 1900 m in apparatus class IIB

(1) For further information see requirements of the IEC 61158-2 standard, and safety requirements in IEC/TS 60079-27:2002.
(2) A spur is an unterminated part of the network.
(3) A trunk is the longest cable path between two devices on the fieldbus network, and is the part of the network which has terminations at both ends. In the Raptor system, a trunk is typically located between the 2410 Tank Hub and a splitter or the last device in a daisy-chain configuration.

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

3.4.6 Power Budget

The Rosemount 2410 Tank Hub delivers 250 mA to the Tankbus. In Smart Wireless systems a 2410 Tank Hub equipped with active analog inputs/outputs may deliver 200 mA. The number of tanks served by the 2410 depends on the type of connected field devices and their power consumption(1). Power consumption per field device is listed in Table 3-2 below:

Table 3-2. Power consumption for various Raptor devices

Field device	Power consumption
5900S Radar Level Gauge	50 mA
5900S Radar Level Gauge, 2-in-1 solution	100 mA
5300 or 5400 Series Radar Level Gauge	21 mA
Rosemount 2230 Graphical Field Display	30 mA
Rosemount 2240S Multi-input Temperature Transmitter	30 mA including MST and WLS
Rosemount 644 Temperature Transmitter	11 mA
Rosemount 3051S and Rosemount 2051 Pressure Transmitters	18 mA

The Rosemount 2410 Tank Hub is available in a single tank version as well as a multiple tank version which supports up to 10 tanks(2).

(1) May be fewer than the 16 devices per segment, stated in the FOUNDATION™ fieldbus standard.

(2) Maximum five Rosemount 5300 or 5400 level transmitters.

3.4.7 Tankbus

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

In a Raptor system the field devices communicate with a Rosemount 2410 Tank Hub via the intrinsically safe Tankbus. The Tankbus complies with the FISCO(1) FOUNDATION fieldbus standard with the Rosemount 2410 acting as a power supply to the field devices on the Tankbus.

The Rosemount 2410 is designed for use in hazardous area Zone 1 (Class 1, Division 1) and communicates with field devices via the intrinsically safe Tankbus.

Termination

A terminator is needed at each end of the trunk in a FOUNDATION fieldbus network. A trunk is defined as the longest cable path between two devices on the fieldbus network. In the Raptor system, a trunk is typically located between the 2410 Tank Hub and a splitter or the last device in a daisy-chain configuration. Generally, one terminator is placed in the fieldbus power supply, and the other one in the last device in the fieldbus network as illustrated in Figure 3-7.

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

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

Other Raptor devices such as the 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.

When adding new devices at the end of an existing FOUNDATION fieldbus network, the termination is moved to the farthest field device in order to fulfill the requirement on locating the terminator at the end of the trunk. However, in case a field device is added to the network with a short cable, this rule may be slightly bent by leaving the terminator in its original position.

Fieldbus Segment Design

When designing a FISCO fieldbus segment you will have to make sure that cabling complies with FISCO requirements as described in “Cable Selection for the Tankbus” on page 3-6.

You will also have to ensure that the total operating current of the connected field devices is within the output capability of the Rosemount 2410 Tank Hub. The 2410 is able to deliver 250(2) mA. Consequently, the total number of field devices has to be considered so that the total current consumption is less than 250 mA, see “Power Budget” on page 3-7.

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

Since the field devices on the Tankbus must have at least a 9 V input voltage at their terminals, you will have to take into account the voltage drop in the fieldbus cables. Distances are normally quite short between the Rosemount 2410 Tank Hub and field devices on the tank. In many cases you can use existing cables as long as the FISCO requirements are fulfilled (see “Cable Selection for the Tankbus” on page 3-6). Typical characteristics for such a cable is:

Table 3-3. Typical characteristics of instrumentation cable

Parameter	Value
Loop resistance	42 Ω/km
Inductance	0.65 mH/km
Capacitance	115 nF/km
Cross-sectional area	0.75 mm^2 (18 AWG)

The Rosemount 2410 outputs 12.5 Vdc. Considering the minimum voltage supply of 9 V on the field device terminals, a maximum voltage drop of 3.5 V on the Tankbus can be allowed. At a maximum current consumption of 250 mA (12.5 Vdc) with all field devices located at the far end of the Tankbus, a total “worst case” cable resistance of approximately 14 Ω (3.5 V/250 mA) is allowed. This corresponds to a cable length of 333 m (1092 ft) in case typical cable characteristics are assumed as specified in Table 3-3 on page 3-9.

However, normally the current consumption is less than 250 mA. A typical Raptor configuration would include a tank supplied with a Rosemount 5900S Radar Level Gauge, a Rosemount 2230 Graphical Field Display, a Rosemount 2240S Multi-input Temperature Transmitter, and a Rosemount 3051S Pressure Transmitter. In this case the current consumption would be 128 mA allowing a cable length of 677 m (2221 ft) between the 2410 Tank Hub and the field devices on the tank. With fewer devices on the Tankbus, an even longer cable would be allowed.

Table 3-4 shows the maximum distance between a 2410 Tank Hub and the field devices on a tank for different cable cross-sectional areas. The table shows the maximum distance to a tank at a total current consumption of 250 mA as well as for a typical installation as outlined above.

Table 3-4. Maximum distance from power source to field devices on the tank for different cable areas

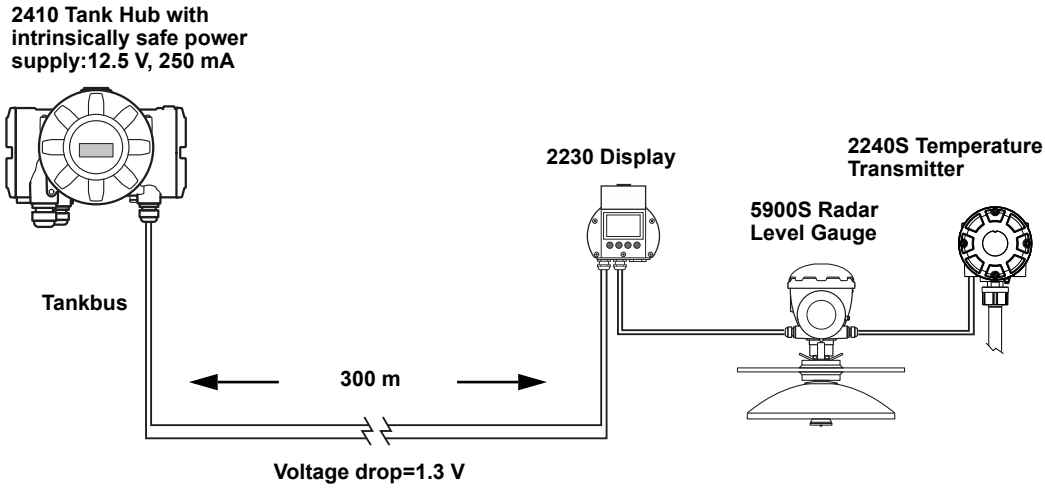
Cable characteristics		Maximum distance to tank (m/ft)	
Cross-sectional area	**Typical loop resistance (Ω/km)**	**Maximum Current consumption (250 mA)**	**Typical installation (128 mA)**
20 AWG (0.5 mm^2)	66	212 (695)	414 (1358)
18 AWG (0.75 mm^2)	42	333 (1092)	651 (2136)
17 AWG (1.0 mm^2)	33	424 (1391)	829 (2720)
16 AWG (1.5 mm^2)	26	538 (1765)	1052 (3451)

Example 1

The example illustrated in Figure 3-2 includes a tank located 300 m away from a Rosemount 2410 Tank Hub acting as power supply. In the calculations below it is assumed that the cable length between the field devices on the tank can be ignored.

The tank is equipped with the following field devices: a Rosemount 5900S Radar Level Gauge, a Rosemount 2240S Multi-input Temperature Transmitter, and a Rosemount 2230 Graphical Field Display. The total current consumption of the three devices is 110 mA (see Table 3-2).

Figure 3-2. Example installation with one tank



The total operating current of the connected field devices on the tank is 50+30+30 mA=110 mA. This is within the output capability of the Rosemount 2410 Tank Hub.

The voltage drop to the tank:
110 mA x 0.30 km x 42 Ω/km=1.4 V.

Voltage at the tank =12.5 V - 1.4 V=11.1 V.

The input voltage of 11.1 V to the field devices is above the minimum requirement of 9 V.

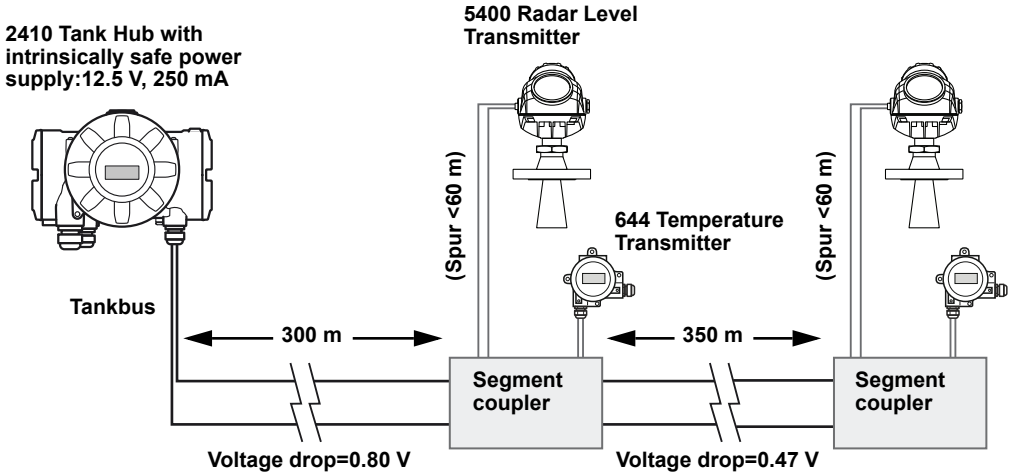
Example 2

The second example, illustrated in Figure 3-3, includes two tanks with a Rosemount 2410 Tank Hub acting as power supply to the field devices on both tanks.

The first tank is located 300 m away from the 2410 Tank Hub and the second tank a further 350 m away.

Both tanks have two field devices: a Rosemount 5400 Radar Level Transmitter and a Rosemount 644 Temperature Transmitter. The total current consumption of the two devices is 32 mA (see Table 3-2).

Figure 3-3. Example installation with two tanks



The total operating current of the connected field devices on the two tanks is 32+32 mA=64 mA. This is within the output capability of the Rosemount 2410 Tank Hub.

Voltage drop to the first tank:
64 mA x 0.30 km x 42 Ω/km=0.80 V.

Voltage at first tank =12.5 V - 0.80 V=11.70 V.

Voltage drop between first and second tank:
32 mA x 0.35 km x 42 Ω/km=0.47 V.

Voltage at second tank =12.5 V - 0.80 V - 0.47 V=11.23 V.

For both tanks the input voltage to the field devices is above the minimum requirement of 9 V.

The field devices may be connected to the Tankbus via segment couplers as illustrated in Figure 3-3. The spur length must not exceed 60 m according to the FISCO standard. In the example above, it is assumed that the voltage drop between the segment coupler and the devices can be ignored.

Tankbus Segment Coupler

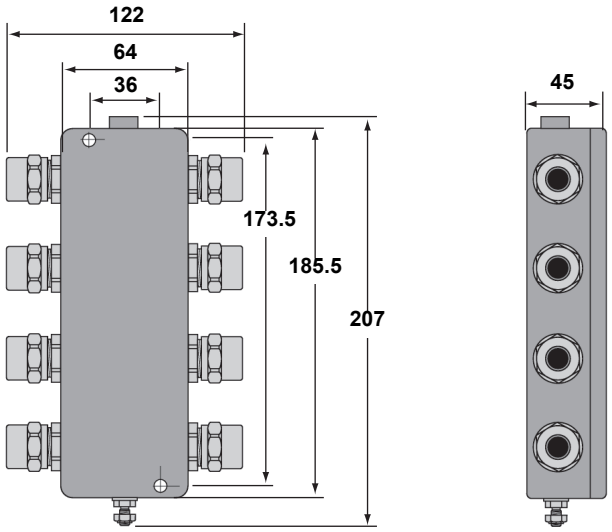
In case “daisy-chain” connection is not suitable, a Tankbus Segment Coupler(1) can be used to connect the various devices to the Raptor Tankbus.

Features:

- Entity and FISCO compliant
- adjustable short-circuit limit
- robust die-cast aluminium housing
- protection degree IP67
- integrated bus terminating resistor (switch integrated inside the housing)
- cable shielding: capacitive or direct connection to housing potential selectable via switch

NOTE!
Sufficient equipotential bonding of the installation must be ensured. The device is connected via the bolt on the housing to the system’s potentializer.

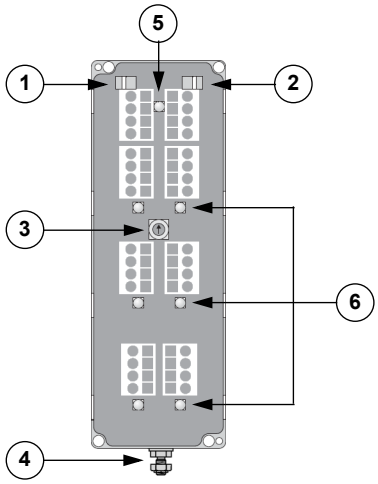
Figure 3-4. Dimensions (mm)

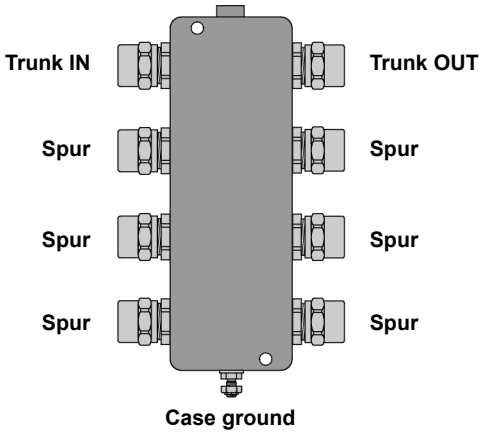


(1) Part no. 6853511-493. Contact Emerson Process Management/Rosemount Tank Gauging for more information.

Figure 3-5. Segment coupler

1. Switch for capacitive or direct connection between shield and housing potential
2. Switch for activating terminating resistor
3. Current limitation for all ports via a rotary switch; 30, 35, 45, or 60 mA
4. Connection of housing potential
5. LED power on indication
6. LED short-circuit indication





In case there are different device types connected to the segment coupler, set the current limitation switch (3) to the closest value above the largest current consumption of the connected devices. See “Power Budget” on page 3-7 for information on current consumption for various Raptor devices.

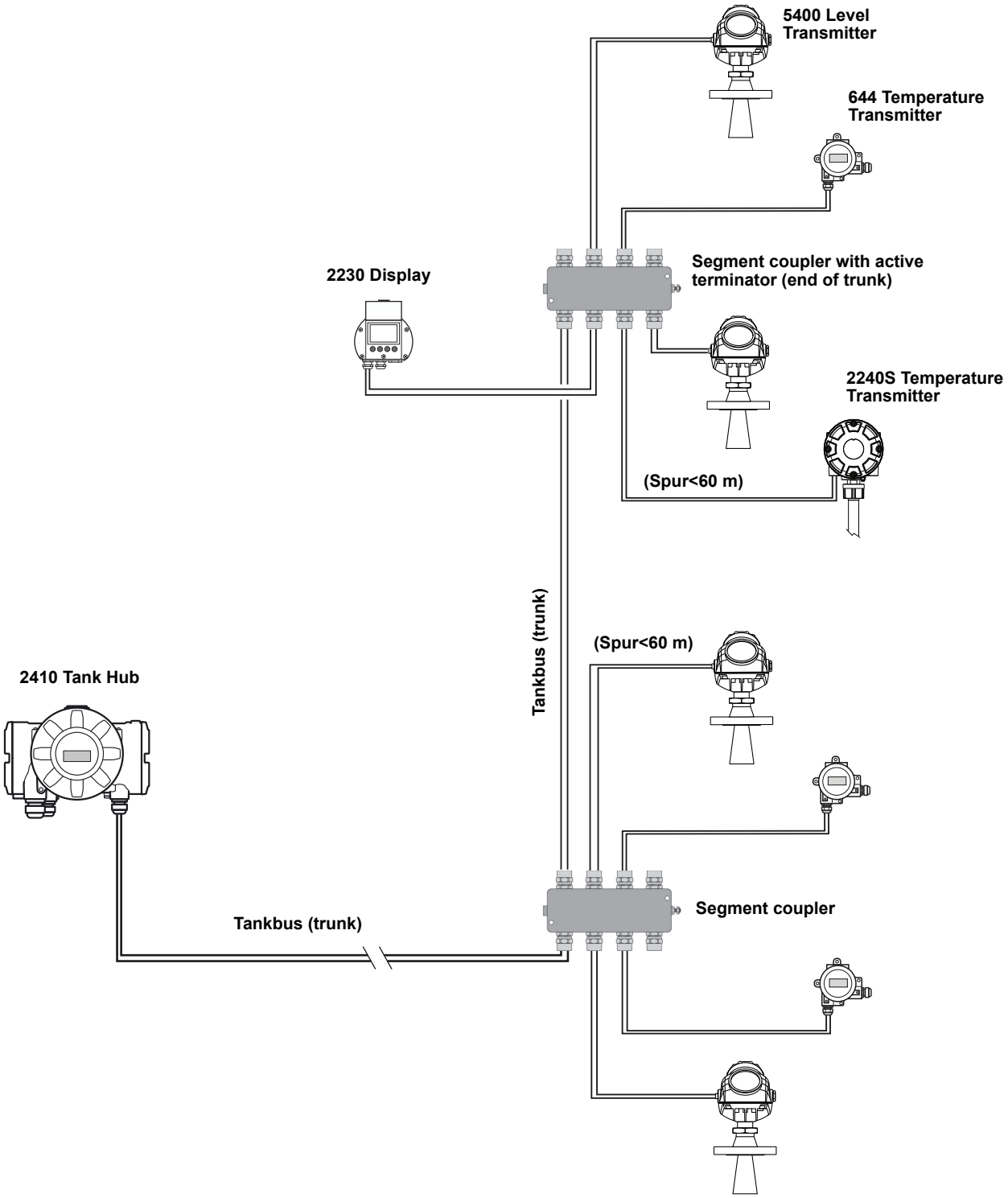
Examples

Rosemount 5900S; set the switch to 60mA.

Rosemount 5300 and 5400; set the switch to 30 mA.

Rosemount 2230; set the switch to 35 mA.

Figure 3-6. Example of Raptor system with field devices connected to the Tankbus via segment couplers

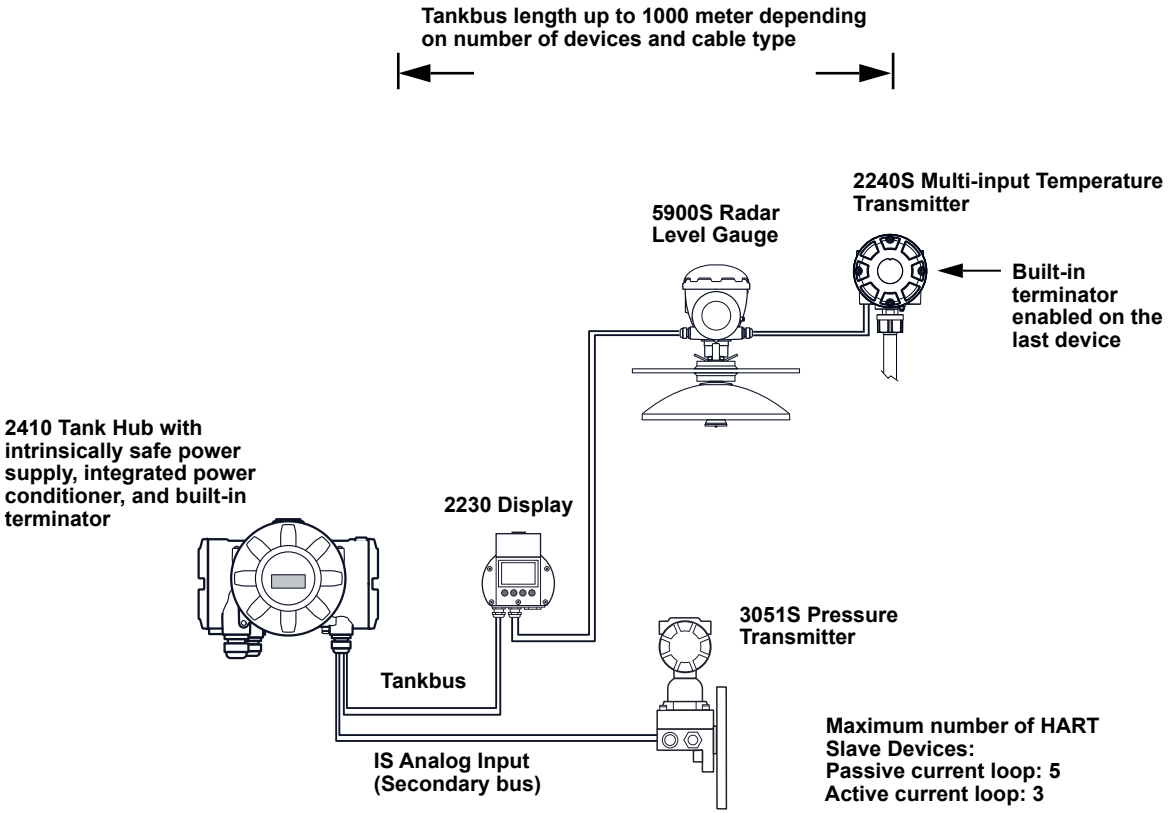


3.4.8 Typical Installations

The example below (Figure 3-7) illustrates a system with daisy-chained field devices on a single tank. Terminators are installed at both ends of the fieldbus segment as required in a FOUNDATION fieldbus system. In this example the terminators are enabled in the Rosemount 2410 Tank Hub and a field device (Rosemount 2240S) at the end of the network segment.

In addition to the field instruments on the Tankbus, Figure 3-7 illustrates how an instrument such as a pressure transmitter can be connected to the intrinsically safe 4 -20 mA analog input of the 2410 Tank Hub.

Figure 3-7. Example of a system with devices connected to a 2410 on a single tank



The maximum distance between the 2410 Tank Hub and the field devices depends on the number of devices connected to the Tankbus and cable type.

See *"Cable Selection for the Tankbus" on page 3-6* and "Tankbus" on page 3-8 for more information about cable selection and the Tankbus.

Non I.S. current loop alternative options:

1. Passive current loop. Input voltage range: 10.5 - 35 V

2. Active current loop. Output voltage range: 12.8 - 24 V @ 21.75 - 0 mA.

I.S. current loop alternative options:

1. Passive current loop. Input voltage range: 10.5 - 30 V

2. Active current loop. Output voltage range: 6.2 - 23 V @ 21.75 - 0 mA.

Note polarity for connection of polarity sensitive buses and I/O (for example RS485 and analog I/O).

See *"Intrinsically Safe Terminal Block" on page 3-30* for information on the Intrinsically Safe terminal block.

See *Appendix A: Reference Data* for more information on electrical characteristics for analog input and output.

Figure 3-8 illustrates an example with a 2-in-1 version of the 5900S in a SIL safety installation. A 4-wire cable is used to connect the Primary and Secondary Tankbuses through the same cable entry. The SIL alarm wire is connected through a separate cable entry. A junction box is used to provide sufficient number of connections for the field devices to the Primary and Secondary Tankbus.

Figure 3-8. Raptor SIL system with a 5900S connected to separate Tank buses

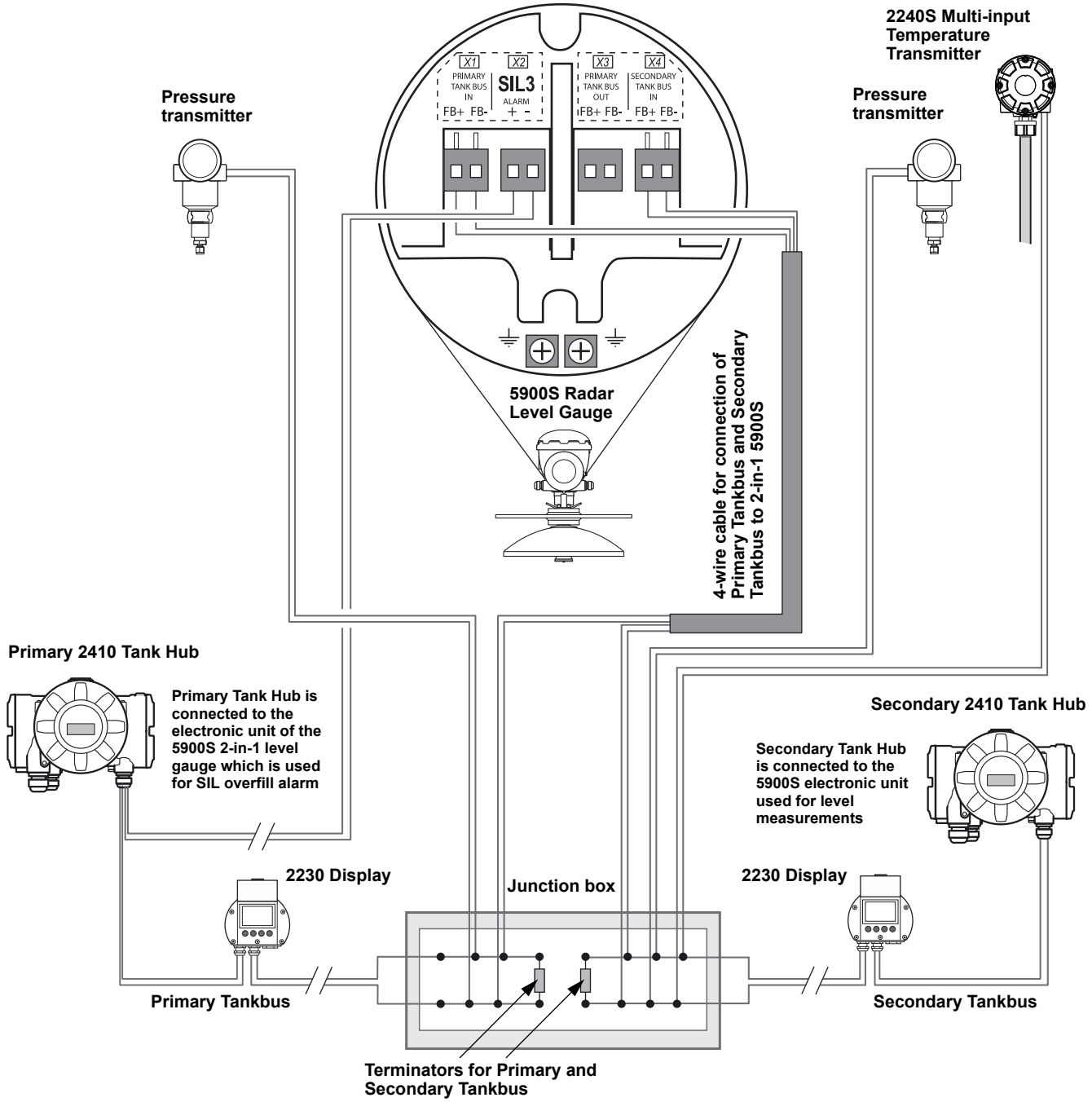
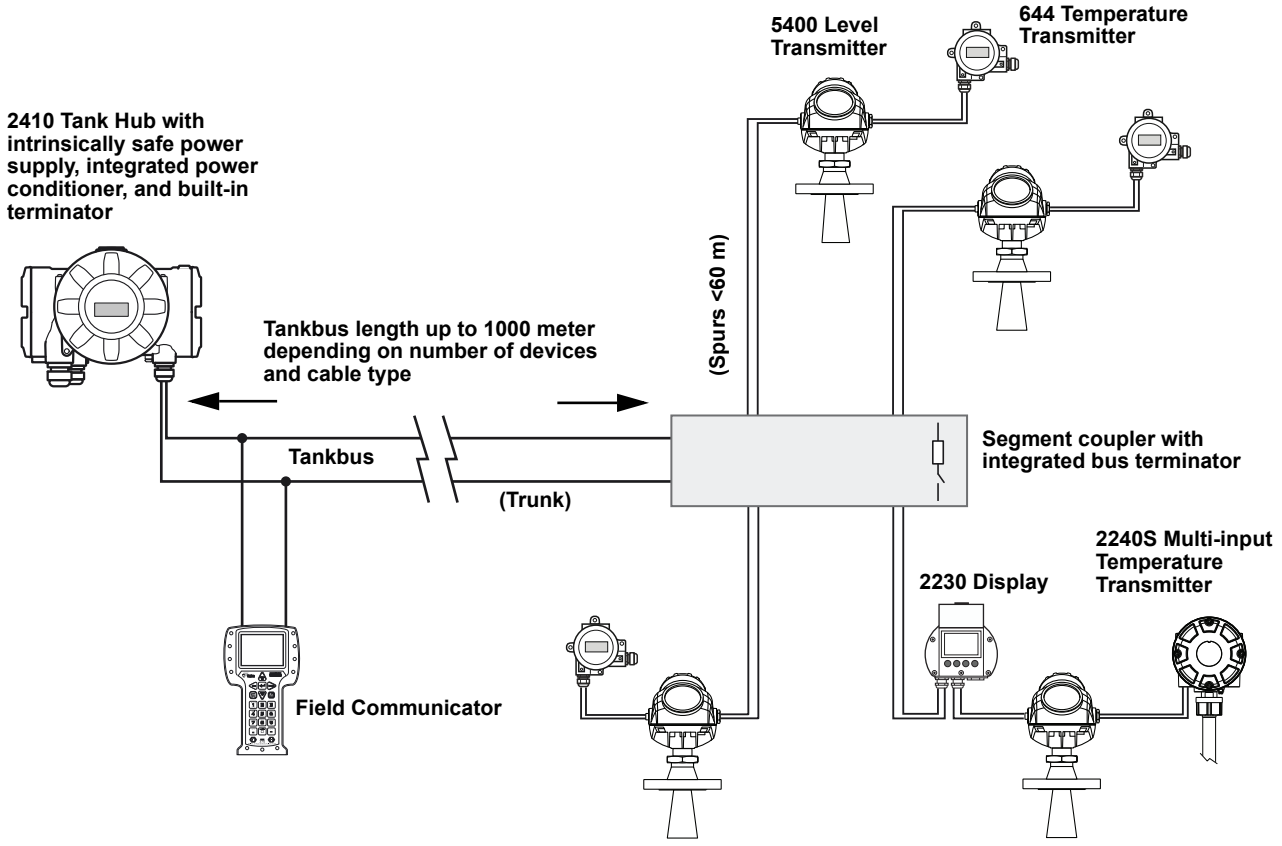


Figure 3-9 illustrates an example with four tanks connected to a Rosemount 2410 Tank Hub (requires 2410 with multiple tanks option). The field devices are connected to a segment coupler at the end of the Tankbus.

A separate bus terminator is not required if one of the Raptor field devices with built-in terminator is connected at the end of the fieldbus segment. There are other options available as well, for example using a separate terminator plugged into the segment coupler, or a segment coupler with integrated bus terminator.

Figure 3-9. Example of a Raptor system with a Rosemount 2410 connected to several tanks at the end of the Tankbus (fieldbus segment)

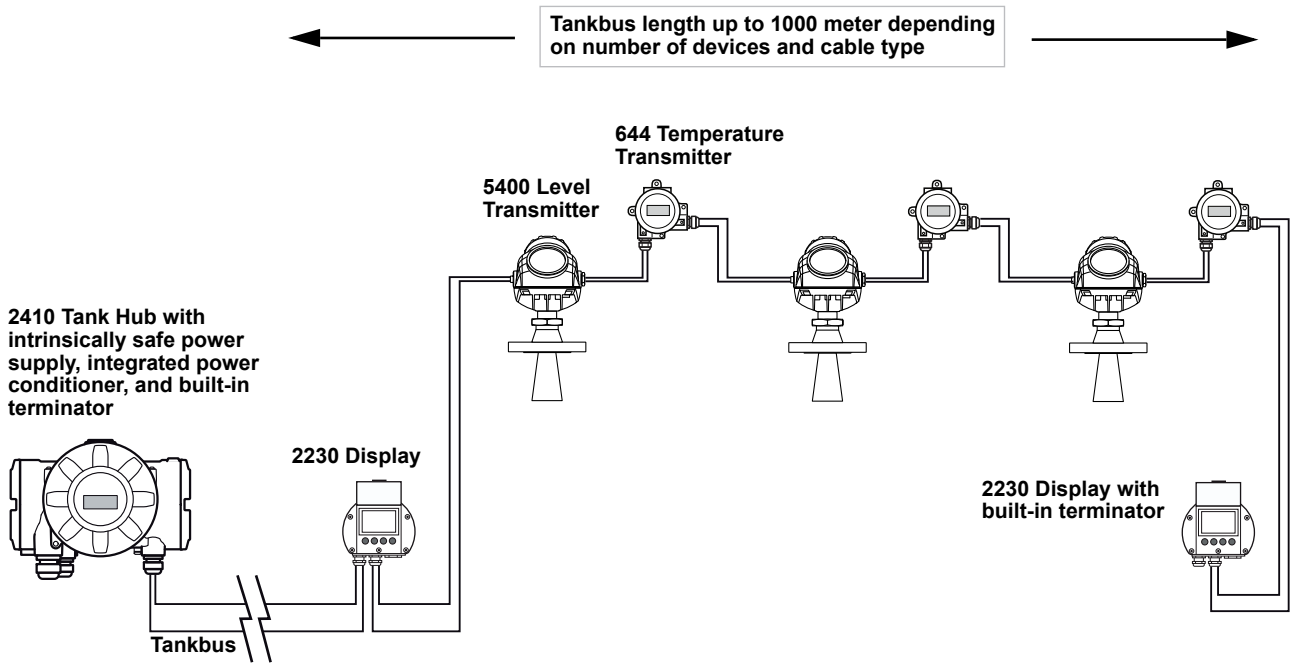


Note that the total length of the Tankbus (fieldbus segment) must be within the FISCO specifications and the spurs must not exceed 60 meter, see “Cable Selection for the Tankbus” on page 3-6.

Figure 3-10 illustrates an example with a number of tanks daisy-chained to a Rosemount 2410 Tank Hub (requires multiple tanks option).

If a Raptor field device is connected to the end of the Tankbus (fieldbus segment), the built-in terminator can be used. A separate bus terminator may be used instead.

Figure 3-10. Example of a Raptor system with several tanks daisy-chained to a Rosemount 2410

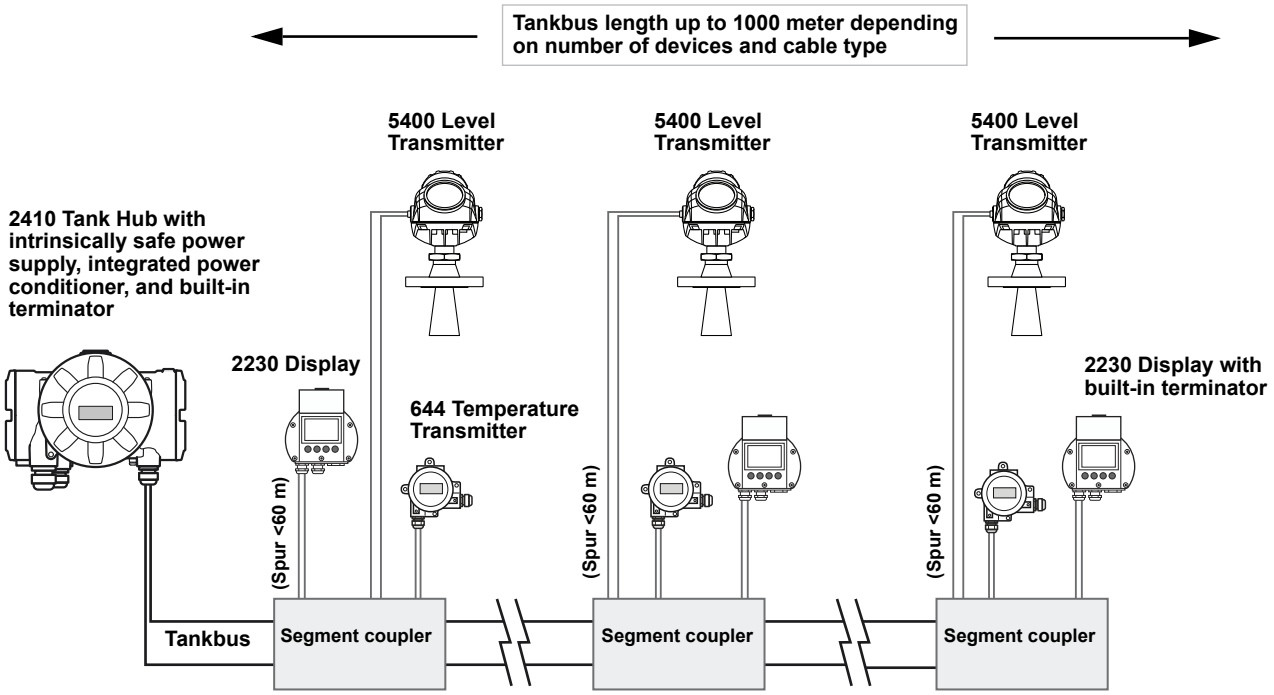


Note that the total length of the Tankbus (fieldbus segment) must be within the FISCO specifications, see “Cable Selection for the Tankbus” on page 3-6.

Figure 3-11 illustrates an example with three tanks connected to a Rosemount 2410 Tank Hub (requires multiple tanks option). For each tank the field devices are connected to the Tankbus via a segment coupler.

The fieldbus segment needs to be terminated at both ends. A terminator is enabled in the Rosemount 2410 Tank Hub. At the end of the fieldbus segment you may use the built-in terminator in one of the Raptor field devices, or an external terminator plugged into one of the devices, or a segment coupler with integrated bus terminator.

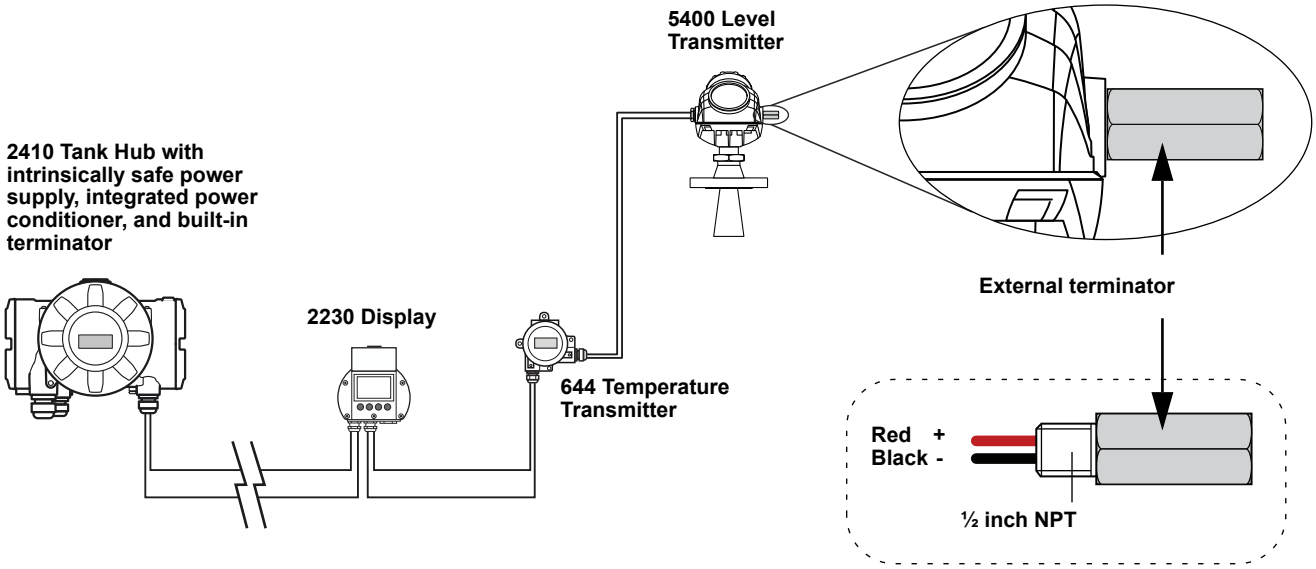
Figure 3-11. Raptor system with three tanks connected to the Tankbus via segment couplers



Note that the total length of the Tankbus (fieldbus segment) must be within the FISCO specifications and the spurs must not exceed 60 meter, see “Cable Selection for the Tankbus” on page 3-6.

In case the last device on the Tankbus has no internal terminator, an external terminator(1) according to FISCO model and Entity model can be used instead. It can be screwed into a free cable gland on the device.

Figure 3-12. Example of Raptor system with external terminator



(1) Part no. 6853511-494. Contact Emerson Process Management/Rosemount Tank Gauging for more information.

3.4.9 Cabling for the TRL2/RS485 Bus

In a Raptor system a Rosemount 2410 Tank Hub communicates with a 2160 Field Communication Unit using the TRL2/RS485 Modbus protocol, see *Section 2: Overview*.

TRL2 Bus

The TRL2 bus requires twisted and shielded pair wiring with a minimum cross-sectional area of 0.50 mm^2 (AWG 20 or similar). The maximum length of the TRL2 bus is approximately 4 km /13000 ft. The TRL2 field bus can normally use existing cables in the tank area.

Cable cross-sectional area for the TRL2 wiring should follow the recommendations in Table 3-5:

Table 3-5. Minimum cable area for the TRL2 bus

Maximum distance	Minimum cross-sectional area
3 km	0.50 mm^2 (AWG 20)
4 km	0.75 mm^2 (AWG 18)

NOTE!
Wherever two or more TRL2 buses run alongside each other, sharing the same cable or conduit tube, use twisted and shielded wire and ensure that each pair of bus wires is individually shielded in order to avoid crosstalk.

Figure 3-13. Individually shielded pair cables minimizes crosstalk

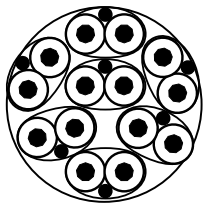


Table 3-6 shows typical cable types that can be used for connecting the TRL2 bus. Other cables of similar type may also be used.

Table 3-6. Recommended cable standards for the TRL2 bus

Type	Manufacturing standard	Core size
Signal	BS 5308 part 1, type 1	1 mm^2
Signal (armoured)	BS 5308 part 2, type 1	1 mm^2

RS485 Bus

The RS485 bus should meet the following requirements:

- twisted and shielded pair wiring
- characteristic impedance of 120 Ω
- maximum cable length 1200 m / 4000 ft.

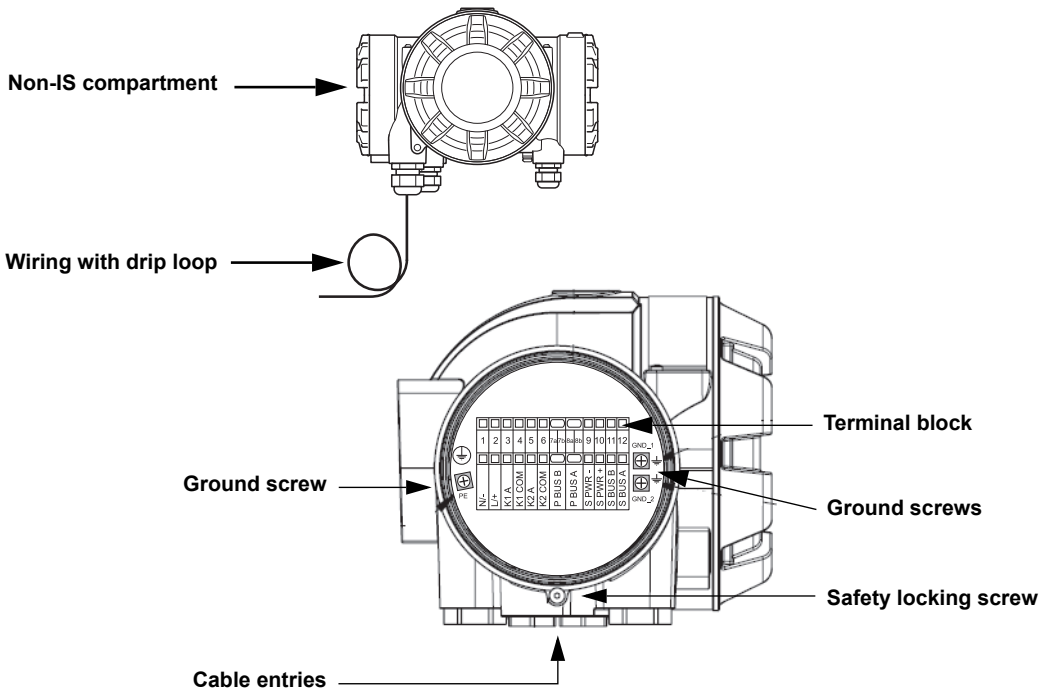
3.4.10 Non-IS Connection

The non-IS explosion-proof/flameproof compartment has a terminal block for connecting power supply, communication buses to host systems, relay outputs, and HART 4-20 mA analog input and output.

⚠ 1. Ensure that the power supply is switched off.
2. Loosen the safety locking screw.
3. Remove the cover on the non-IS terminal compartment.
4. Run the wires through the cable gland/conduit. Install wiring with a drip loop in such a way that the lower part of the loop is under the cable/conduit entry.
5. Connect wires to the terminal block. See Table 3-8 on page 3-26 for information on the terminal block connections.
6. Use the enclosed metal plug to seal any unused port.
⚠ 7. Tighten the conduits/cable glands.
⚠ 8. Attach and tighten the cover. Ensure that it is fully engaged to meet explosion-proof requirements and to prevent water from entering the terminal compartment.
9. Tighten the safety locking screw.

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

Figure 3-14. Non-IS terminal compartment



Conductor Recommendations

Ensure that you use cables suitable for the terminal block of the 2410. The terminal block is designed for cables that meet the specifications as illustrated below.

Figure 3-15. Conductor and insulation requirements

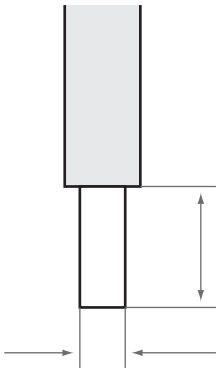
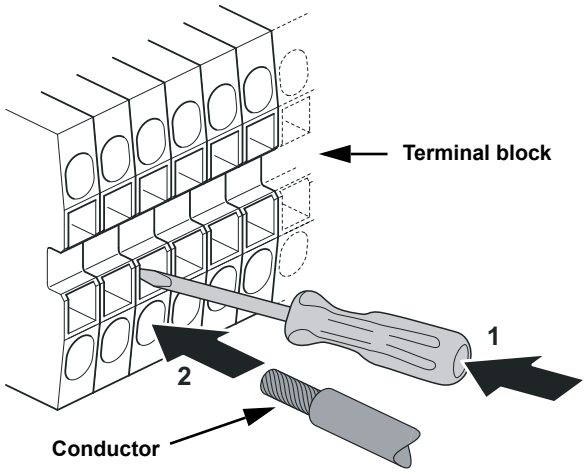


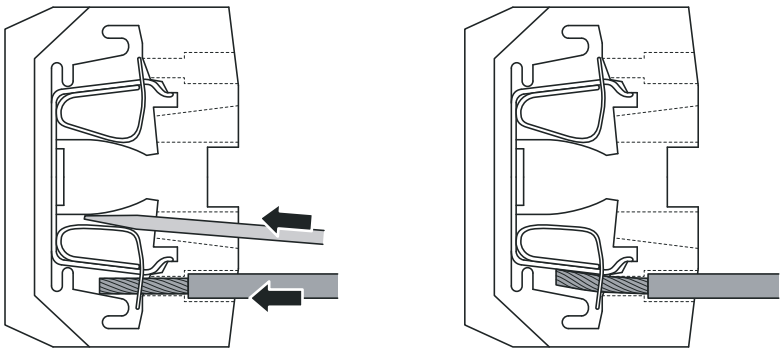
Table 3-7. Conductor cross-sectional area

Conductor connection	Cross-section (mm^2)	
	Minimum	Maximum
Solid	0.5	4
Flexible	0.5	2.5
Flexible, ferrule with plastic collar	0.5	1.5

Use a screw driver to insert the conductor into the terminal block as illustrated in Figure 3-16.

Figure 3-16. Use a screw driver to connect the conductor to the terminal block





3.4.11 Non-IS Terminal Block

Figure 3-17. Terminal block in the explosion-proof/flameproof compartment

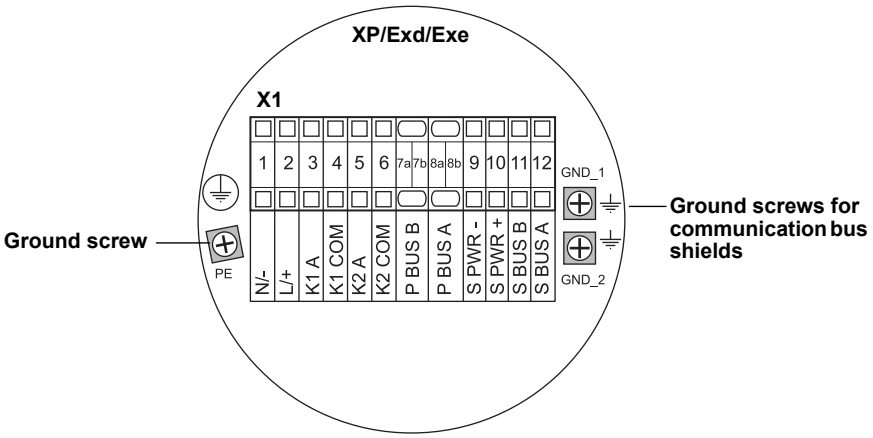


Table 3-8. Terminal assignment for non-intrinsically safe side (XP/Exd/Exe)

Terminal	Designation	Function
1	N / -	Power, Neutral / DC -
2	L / +	Power, Line / DC +
3	K1 A	Relay 1 output (optional). Hardware configurable NO/NC.
4	K1 com	Relay 1 common
5	K2 A	Relay 2 output (optional). Hardware configurable NO/NC.
6	K2 com	Relay 2 common
7a/7b	P Bus B	Primary communication bus
8a/8b	P Bus A	
9	S Pwr -	Secondary bus power - (optional)
10	S Pwr +	Secondary bus power +(optional)
11	S Bus B	Secondary communication bus - (optional)
12	S Bus A	Secondary communication bus + (optional)
PE	PE	Power supply protective ground
GND_1	GND_1	Housing chassis/shield Primary bus
GND_2	GND_2	Housing chassis/shield Secondary bus

Power Supply

The Rosemount 2410 accepts supply voltage 24-48 Vdc and 48-240 Vac (50/60 Hz).

Primary Communication Bus

The Rosemount 2410 communicates with a host or a FCU 2160 via TRL2 Modbus or RS-485 Modbus protocol.

Secondary Communication Bus

The secondary bus can be used for communication using a number of protocols such as TRL2 Modbus, HART 4-20 mA, Enraf, Varec and L&J.

Relay Outputs

There are two optional relay outputs. You can choose Normally Open (NO) or Normally Closed (NC) by setting a switch as described in “Relay Output Configuration” on page 6-15.

NO and NC refers to the contact position when a relay is deenergized. This is also referred to as the Alarm state. The terminology can be summarized as follows:

Table 3-9. Designation of relay contact positions

Normally Closed (NC)		Normally Open (NO)	
Deenergized	**Energized**	**Deenergized**	**Energized**
Closed	Open	Open	Closed
Not active	Active	Not active	Active
Alarm (Reset)	Normal	Alarm (Reset)	Normal

NOTE!
Ensure that maximum current through the relays does not exceed the specifications in Appendix A: Reference Data.

See “Relay Output” on page C-6 in *Appendix C: Advanced Configuration* for information on how to configure the relay source signal, set points etc. for the Rosemount 2410 Tank Hub.

Non-IS Terminal Block for SIL Safety Systems

For Safety Integrity Level (SIL) systems the Rosemount 2410 has a terminal block on the Non-IS side with connection to a SIL Alarm Relay output.

Figure 3-18. Non-IS (XP/Exd/Exe) terminal block

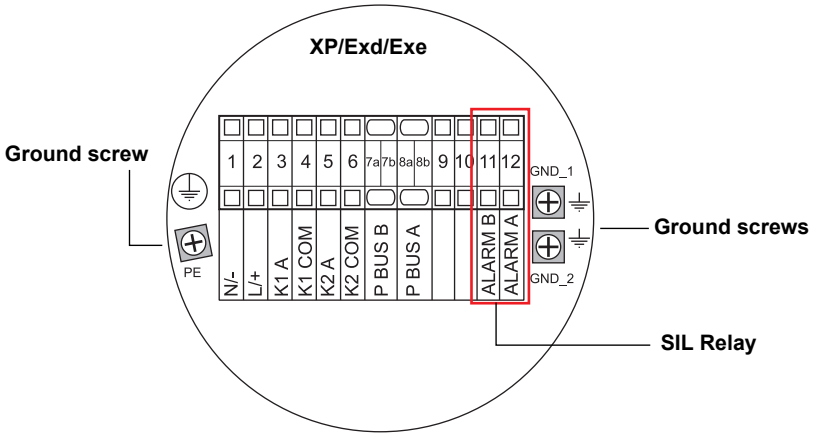


Table 3-10. Terminal assignment for SIL version of the 2410 non-IS terminal block

Terminal	Designation	Function
1	N / -	Power, Neutral / DC -
2	L / +	Power, Line / DC +
3	K1 A	Relay 1 output (optional). Hardware configurable NO/NC.
4	K1 com	Relay 1 common
5	K2 A	Relay 2 output (optional). Hardware configurable NO/NC.
6	K2 com	Relay 2 common
7a/7b	P Bus B	Primary communication bus
8a/8b	P Bus A	
9		Not used
10		Not used
11	Alarm B	**SIL Alarm Relay B**
12	Alarm A	**SIL Alarm Relay A**
PE	PE	Protective power supply ground
GND_1	GND_1	Housing chassis/shield Primary bus
GND_2	GND_2	Housing chassis/shield Secondary bus

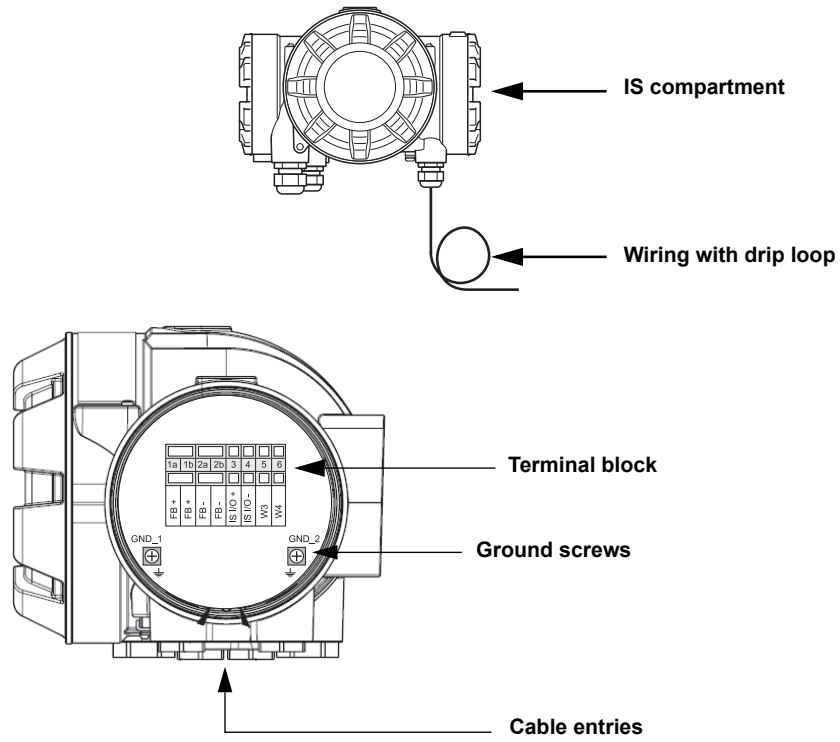
3.4.12 IS Connection

The IS compartment has a terminal block for connecting the intrinsically safe Tankbus for communication with field devices on the tank. This terminal block is also used for intrinsically safe HART 4-20 mA analog input/output communication.

⚠ 1. Make sure that the power supply is switched off.
2. Remove the cover on the IS terminal compartment.
3. Pull the cable through the cable gland/conduit. Install cables with a drip loop in such a way that the lower part of the loop is under the cable/conduit entry.
4. Connect wires according to Table 3-11 on page 3-30.
5. Use the enclosed metal plug to seal any unused port.
6. Tighten the conduit/cable gland.
⚠ 7. Attach and tighten the cover. Make sure that the cover is fully engaged to meet explosion-proof requirements and to prevent water from entering the compartment.

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

Figure 3-19. IS terminal compartment



3.4.13 Intrinsically Safe Terminal Block

The Intrinsically safe side of the Rosemount 2410 Tank Hub connects to the Tankbus which communicates with field devices on the tank.

Figure 3-20. Intrinsically safe terminal block

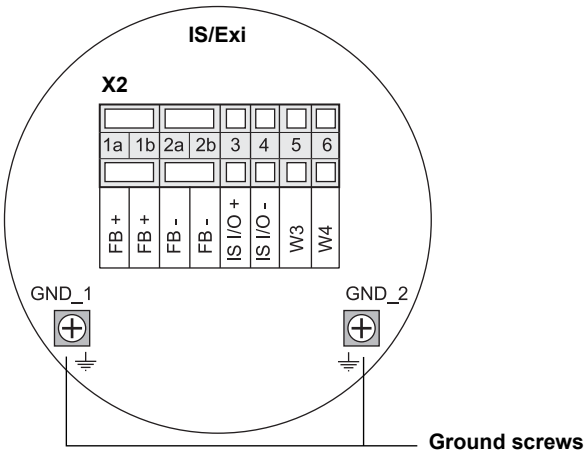


Table 3-11. Terminal assignment for intrinsically safe side

Terminal	Designation	Function
1a	**FB +**	Intrinsically Safe Tankbus positive (+) terminal
1b	**FB +**	Intrinsically Safe Tankbus positive (+) terminal
2a	**FB -**	Intrinsically Safe Tankbus negative (-) terminal
2b	**FB -**	Intrinsically Safe Tankbus negative (-) terminal
3	IS I/O+	IS Input/Output + HART / 4-20 mA (Secondary Bus)
4	IS I/O -	IS Input/Output - HART / 4-20 mA (Secondary Bus)
5	W3	Not used (future option)
6	W4	
GND_1	GND_1	Housing chassis/Tankbus shield
GND_2	GND_2	Housing chassis/Tankbus shield

Tankbus

The devices on the tank communicates with the Rosemount 2410 via the intrinsically safe Tankbus. All field devices in the Raptor system have built-in communication modems for FISCO FOUNDATION fieldbus (FF) communication and will automatically communicate with the 2410 when connected to the Tankbus.

Optional Secondary Bus

In addition to the Tankbus an optional intrinsically safe bus is available for communication with devices not compatible with FOUNDATION fieldbus. It allows you to connect devices for intrinsically safe HART 4-20 mA analog input/output communication.

IS Terminal Block for SIL Safety Systems

For Safety Integrity Level (SIL) systems the Rosemount 2410 has a terminal block with a SIL Alarm output for connection to a Rosemount 5900S Radar Level Gauge.

Figure 3-21. IS/Exi terminal block for SIL systems

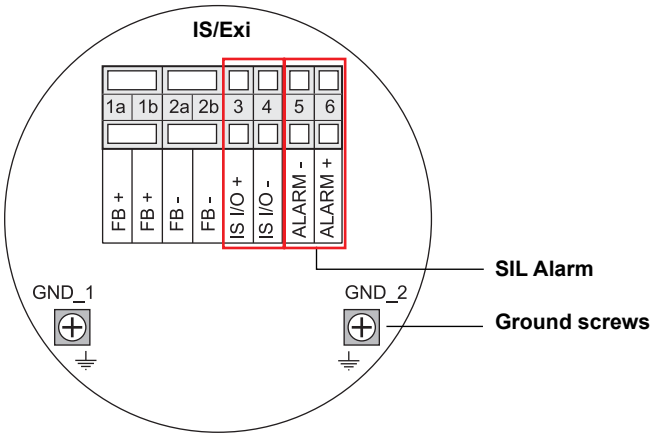


Table 3-12. Terminal assignment for SIL version of the 2410 IS terminal block

Terminal	Designation	Function
1a	FB +	Intrinsically Safe Tankbus positive (+) terminal
1b	FB +	Intrinsically Safe Tankbus positive (+) terminal
2a	FB -	Intrinsically Safe Tankbus negative (-) terminal
2b	FB -	Intrinsically Safe Tankbus negative (-) terminal
3	IS I/O+	**IS Input/Output +**
4	IS I/O -	**IS Input/Output -**
5	Alarm -	**SIL Alarm input -** (connect to terminal block on Rosemount 5900S)
6	Alarm +	**SIL Alarm input+** (connect to terminal block on Rosemount 5900S)
GND_1	GND_1	Housing chassis/Tankbus shield
GND_2	GND_2	Housing chassis/Tankbus shield

3.4.14 Wiring Diagrams

Figure 3-22. Wiring diagram on the intrinsically safe (IS/Exi) side

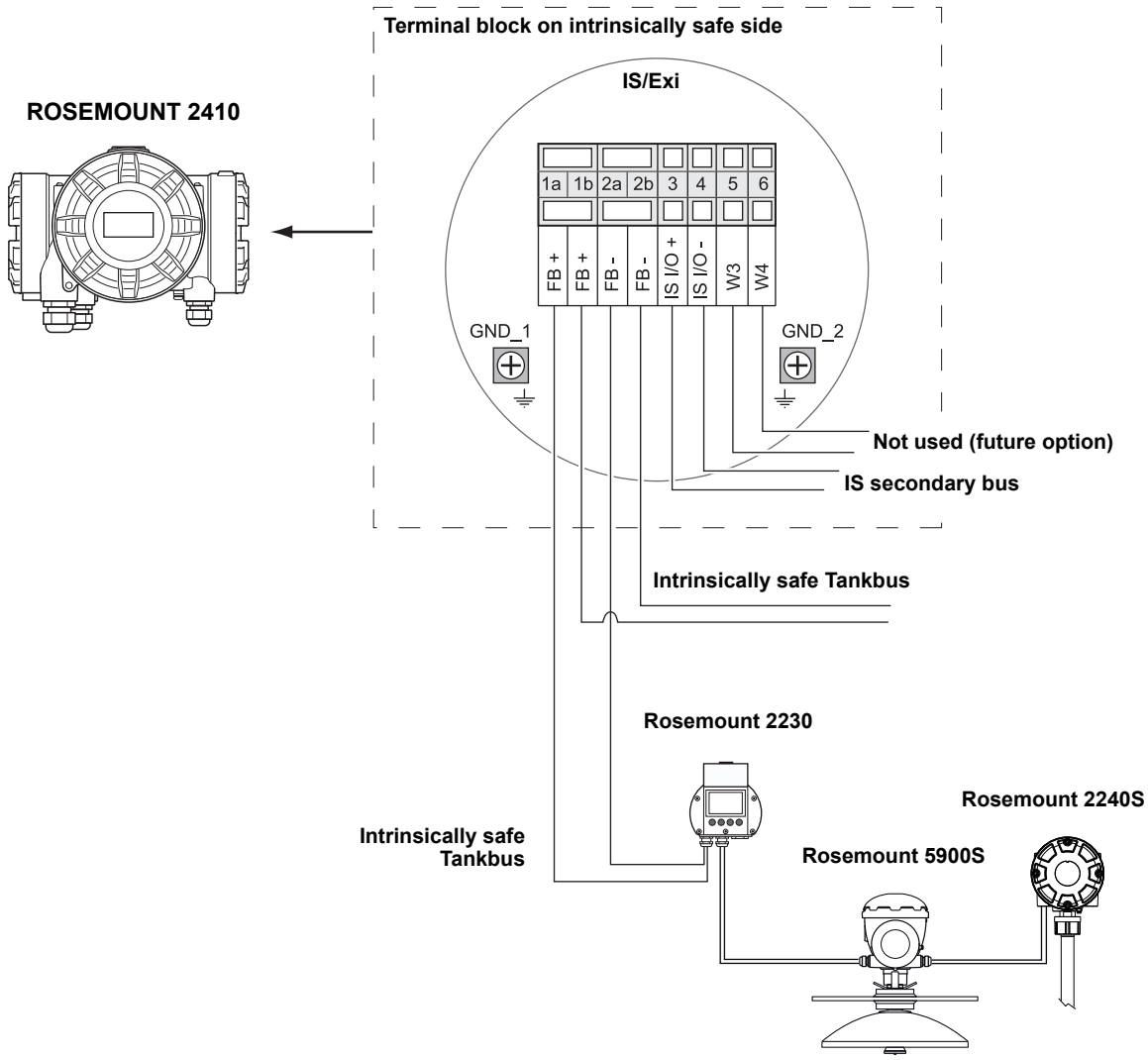


Figure 3-23. Wiring diagram on the non-intrinsically safe (XP/Exd/Exe) side

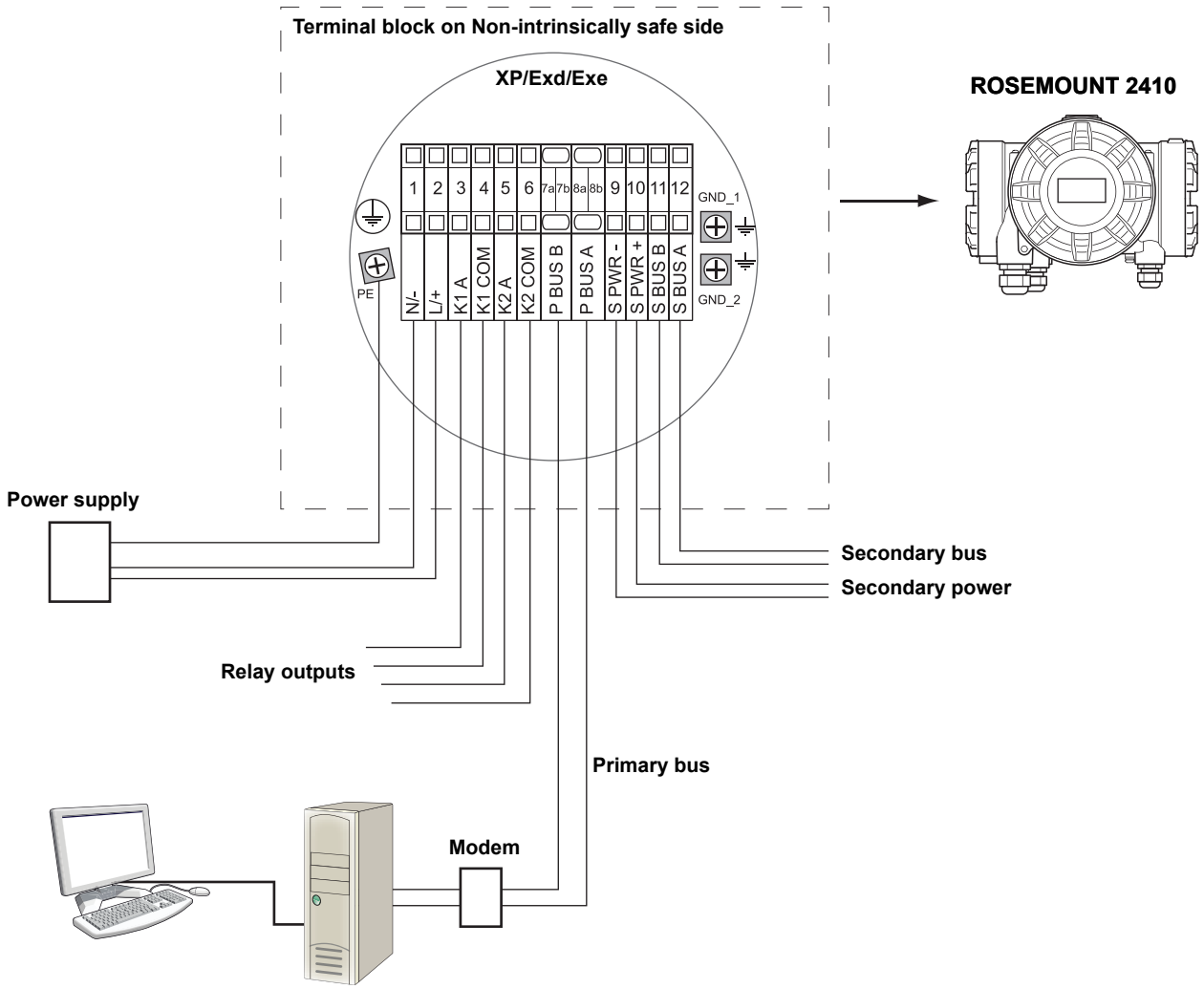
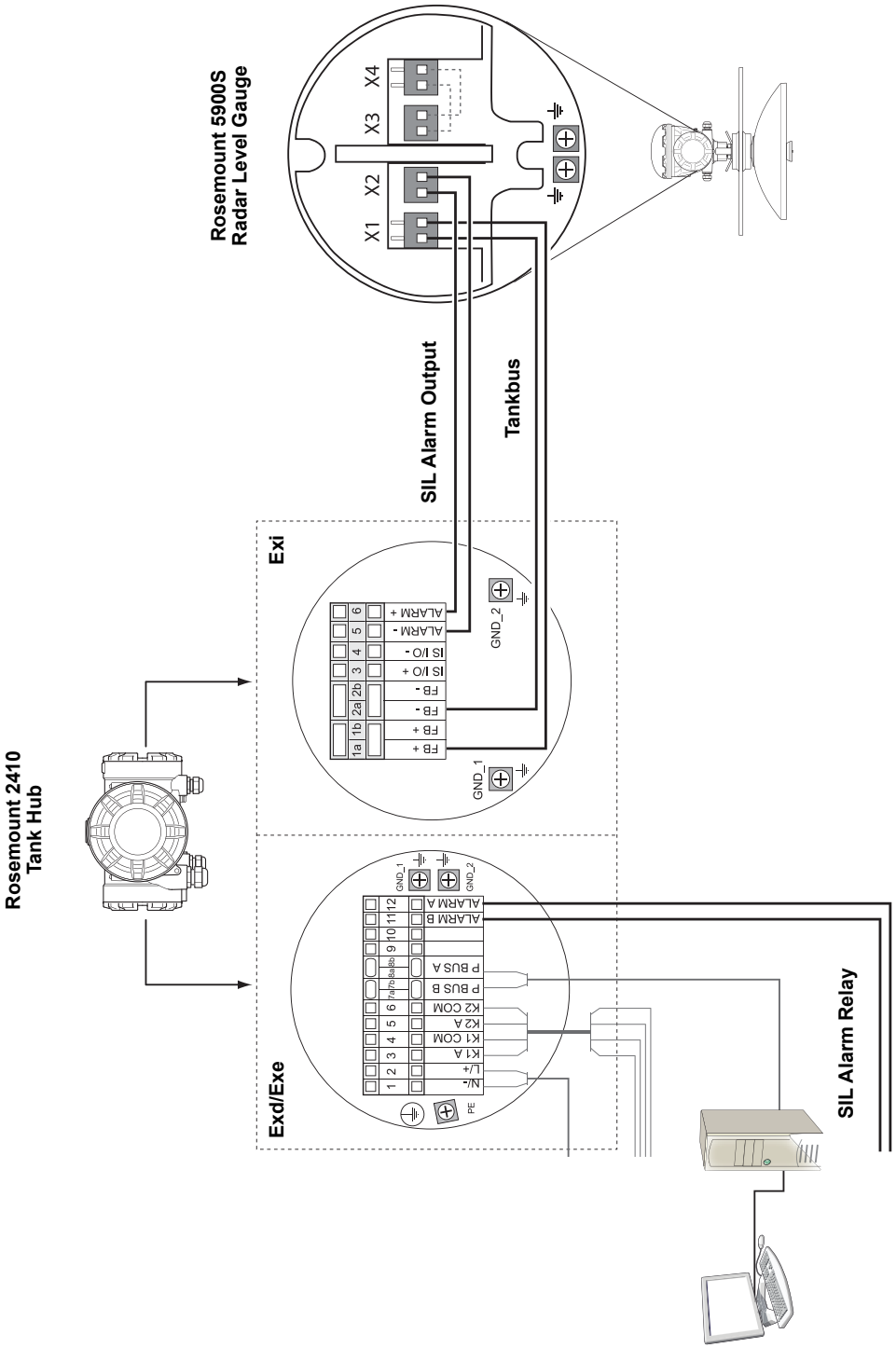


Figure 3-24. Wiring diagram for Rosemount 2410 and Rosemount 5900S in a SIL safety system



Section 4 Configuration

4.1 SAFETY MESSAGES

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

⚠WARNING

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

Make sure only qualified personnel perform the installation.

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

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

⚠WARNING

Explosions could result in death or serious injury:

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

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

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

4.2 INTRODUCTION

A Raptor system includes a wide range of devices for tank monitoring. It is a flexible and scalable system which can be adapted to various applications and small or large tank farms. A typical Raptor system includes one or more of the following devices:

- control room PC with Rosemount TankMaster program for operational control
- Field Communication Unit (FCU) that collects measurement data from Rosemount 2410 Tank Hubs
- Rosemount 2410 Tank Hub which collects measurement data from field devices on the tanks
- various field instruments such as the Rosemount 5900S Radar Level Gauge, Rosemount 2240S Multi-input Temperature Transmitter, Rosemount 2230 Graphical Field Display, Rosemount 3051S Pressure Transmitter
- Smart Wireless Gateway and Smart Wireless THUM Adapter for wireless communication between field devices and control room host system

See the Raptor Technical Description (Document no. 704010EN) for a comprehensive description of the Raptor system components.

4.3 CONFIGURATION TOOLS

The Rosemount 2410 Tank Hub is configured by using the *Rosemount TankMaster Winsetup* configuration program. Winsetup is a user-friendly software package that includes basic configuration options as well as advanced configuration and service functions.

See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on using the *TankMaster WinSetup* software to configure the Rosemount 2410 Tank Hub.

See also the *Raptor Wireless TankGauging System* reference manual (Document no. 300570EN) for information on how to set up a Rosemount 2410 in a *Wireless*HART system.

4.4 BASIC CONFIGURATION OF A ROSEMOUNT 2410

This is a general description of how to configure a Rosemount 2410 Tank Hub. The *Raptor System Configuration Manual* (Document no. 300510EN) provides a detailed description of how to use the *TankMaster WinSetup* program as a configuration tool for the Rosemount 2410.

Communication

Depending on the particular system configuration, a Rosemount 2410 Tank Hub may communicate directly with a host computer or via a 2160 field communication unit (FCU).

In case the 2410 is connected to a 2160 FCU, you will have to specify which communication protocol channel to be used.

The Rosemount 2410 has default Modbus adress=247. The address should be changed to the recommended address range. The Modbus address must match the address specified in the FCU Slave Database.

The 2410 Tank Hub can be used in a *Wireless*HART system by connecting a THUM Adapter. The THUM Adapter allows the 2410 to communicate with a host system via a Smart Wireless Gateway.

Tank Database

The 2410 has a Tank Database that maps field devices to tanks. It also stores Modbus addresses of level gauges and auxiliary tank devices (ATD) such as the 2240S Multi-input Temperature Transmitter.The Modbus addresses are used for communication with 2160 field communication units and host computers.

Device Tags

For each tank, device tags are specified for the level gauge and the auxiliary tank devices (ATD). ATD devices include all instruments on the tank except the level gauge. Device Tags are used as identifiers in TankMaster.

Integral Display

The Rosemount 2410 can be configured to present measurement data on the optional integral display. The display alternates between the selected items at a rate given by the Display Toggle Time parameter.

Measurement data such as Level, Level Rate, Free Water Level and many other tank variables can be displayed.

Measurement units for Level, Level Rate, Volume, Temperature, Density, and Pressure can be specified regardless of which units are used for presentation in, for example, the TankMaster programs.

4.5 ADVANCED CONFIGURATION

The installation wizard in *TankMaster Winsetup* comprises a basic configuration of the Rosemount 2410. There are more options available in case further configuration is needed:

- Primary/Secondary Bus configuration
- Up to ten “virtual” Relay Functions
- Hybrid Density
- Delta Level
- Analog Output
- Analog Input / HART Slave(1)

See *Appendix C: Advanced Configuration* for more information.

4.6 CONFIGURATION USING TANKMASTER WINSETUP

A Rosemount 2410 Tank Hub can easily be installed and configured by using the *TankMaster Winsetup* configuration program. The WinSetup installation wizard guides you through the basic configuration needed for starting up a Rosemount 2410.

See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on using the TankMaster WinSetup software to configure a Raptor system and a Rosemount 2410 Tank Hub.

See also the *Raptor Wireless TankGauging System* reference manual (Document no. 300570EN) for information on how to set up a *Wireless*HART system.

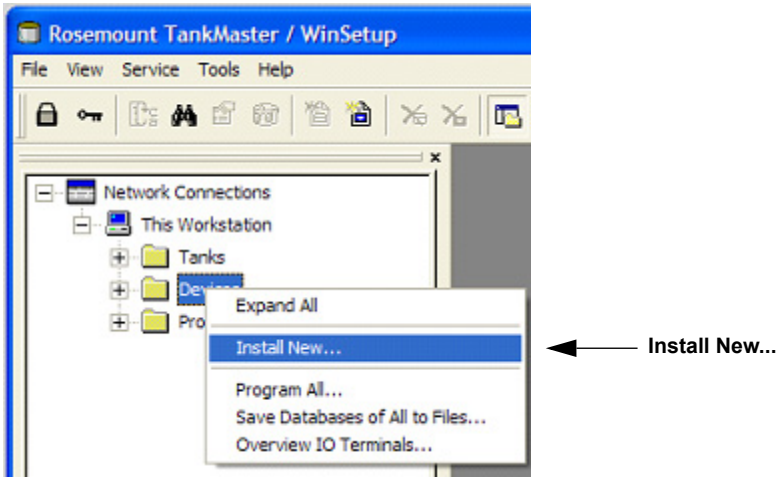
(1) Analog Input and HART Slave functions are configured in the Properties window of Auxiliary Tank Device (ATD), see “Configuration of Analog Input / HART Slave” on page C-25.

4.6.1 Installation Wizard

The TankMaster WinSetup wizard is the recommended tool for installing the Rosemount 2410. It supports basic configuration of the 2410. To configure a 2410 do the following:

1. Start the installation wizard in TankMaster WinSetup.

Figure 4-1. The installation wizard supports easy installation of the Rosemount 2410



2. Select the **Devices** folder.
3. Click the right mouse button and choose the **Install New** option.
4. Choose device type 2410 Tank Hub.
5. Follow the instructions. See the Raptor System Configuration Manual (Document no. 300510EN) for more information on using the TankMaster WinSetup program to configure the Rosemount 2410.

4.6.2 Advanced Configuration

Advanced options such as the Secondary Bus, Relay Output and Hybrid Density are available in the *Rosemount 2410 Properties* window. See *Appendix C: Advanced Configuration* for more information.

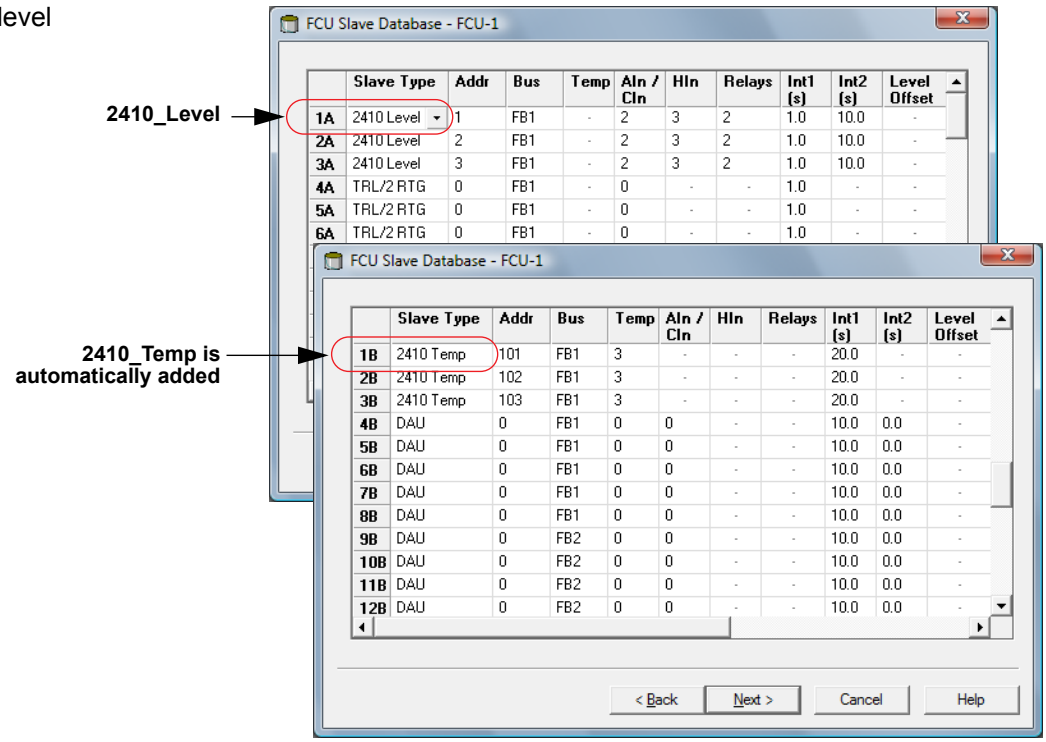
4.6.3 FCU 2160 Configuration

In case the system includes a 2160 Field Communication Unit (FCU), it has to be installed prior to installing the Rosemount 2410 Tank Hub. The following is a brief description of how to install a 2160 FCU. See the *Raptor System Configuration Manual* (Document no. 300510EN) for a more comprehensive description.

To install and configure a 2160 FCU:

1. Start the installation wizard in TankMaster WinSetup and choose Device Type=FCU 2160.
2. Enable communication with the TankMaster PC:
   - Select communication channel
   - Set the communication address
3. Configure the FCU: specify Port type (Field Bus/Group Bus), Baud rate, Data bits, Stop bits, and Parity.
4. Configure the **Slave Database**.
   Set *Slave Type=2410_Level* in the first free position of the Slave Type column.
   A *2410_Temp* device is automatically added to the Slave Database. Ensure that the **Modbus Addresses** of the connected devices are properly set. These addresses must correspond to the 2410 Tank Hub database settings (see “Basic Configuration of a Rosemount 2410” on page 4-3 for more information).

Figure 4-2. The Slave Database has to be configured for level gauges and temperature transmitters



Section 5 Operation

5.1 SAFETY MESSAGES

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

⚠WARNING

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

Make sure only qualified personnel perform the installation.

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

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

⚠WARNING

Explosions could result in death or serious injury:

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

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

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

5.2 INTEGRAL DISPLAY

The Rosemount 2410 Tank Hub can be equipped with an optional integral display for presentation of measurement data and diagnostics. When the device is switched on, the display presents information such as device model, communication protocol (Modbus, Enraf, etc.) and adress, relay configuration, software version, serial number, unit ID, and write protection status. See Table 5-2 on page 5-4 for more information on start-up information.

When the 2410 is up and running the display presents Level, Signal Amplitude, Volume and other measurement variables depending on how the display is configured. The available parameters are listed in Table 5-1 on page 5-3.

The display has two rows for data presentation. The upper row shows tank name (up to six characters) and measurement values. The lower row shows variable type and measurement unit.

You can specify which variables to present on the display by using a configuration tool such as the *Rosemount TankMaster WinSetup* program, see “Specifying Display Variables” on page 5-8 for more information.

The display toggles between different measurement values and units at a rate which can be configured by using the *WinSetup* program.

Figure 5-1. The Rosemount 2410 integral display

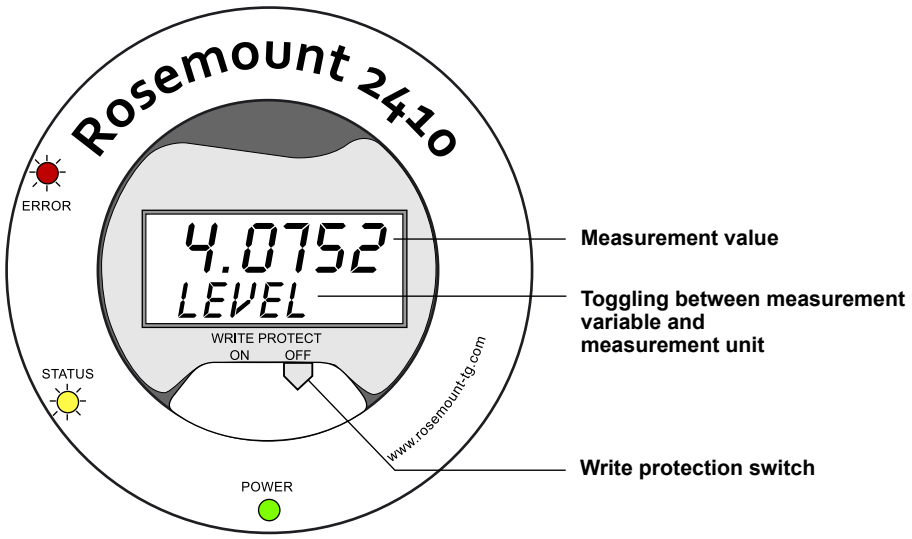


Table 5-1. Measurement variables and presentation on the Rosemount 2410 display

Variable	Presentation on display	Description
Level	LEVEL	Product level
Ullage	ULLAGE	Distance from the upper reference point to the product surface
Level Rate	LRATE	The speed of level movement up or down
Signal Strength	SIGN S	Signal amplitude of the surface echo
Free Water Level	FWL	Free water level at the bottom of the tank
Vapor Pressure	VAP P	Automatic or manual Vapor Pressure value
Liquid Pressure	LIQ P	Automatic or manual Liquid Pressure value
Air Pressure	AIR P	Automatic or manual Air Pressure value
Ambient Temperature	AMB T	Automatic or manual Ambient Temperature value
Vapor Average Temperature	VAP T	Average temperature of vapor above the product surface
Liquid Average Temperature	LIQ T	Average temperature for all spot sensors submersed in liquid
Tank Average Temperature	TANK T	Average value of all temperature sensors in the tank
Spot 1 Temperature	TEMP 1	Temperature value for spot sensor no. 1
Spot n Temperature	TEMP n	Temperature value for spot sensor no. “n”
Spot 16 Temperature	TEMP 16	Temperature value for spot sensor no. 16
Observed Density	OBS D	Automatic or manual Observed Density
Reference Density	REF D	Product density at standard reference temperature 15°C (60°F)
Volume	TOV	Total observed volume
Flow Rate	F RATE	Flow rate
User Defined 1	UDEF 1	Up to 5 user defined variables
Tank Height	TANK R	Distance from Tank Reference Point to Zero Level
Delta Level	ΔLVL	The difference between two level values

5.3 START-UP INFORMATION

When the Rosemount 2410 starts up, all LCD segments light up for approximately 5 seconds. The start-up information appears on the display when the software initialization procedure is finished. The Primary Bus configuration appears first, followed by the Secondary Bus configuration. Each item appears a few seconds on the display:

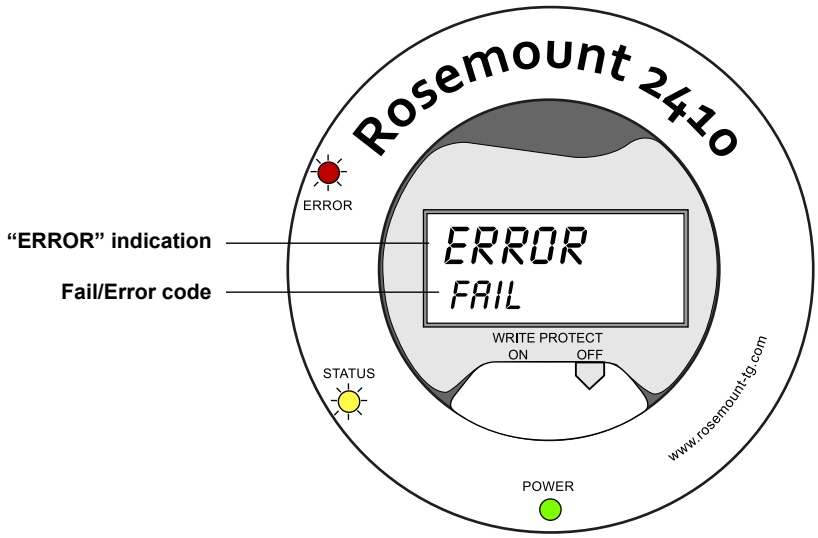
Table 5-2. Start-up information on the 2410 display

Item	Example
Model number and type (multiple / single tank version)	2410 MULTI
Primary communication bus hardware option (TRL2, RS485, Enraf GPU, HART master, HART slave)	PR HW RS-485 HART M HART S SIL AR
Primary communication bus protocol	PRI MODBUS
Primary Bus communication address	ADDR 247
Primary Bus communication settings (Baud rate, stop bits and parity)	9600 2 0
Secondary communication bus hardware option (TRL2, RS485, Enraf GPU, HART wireless, HART master, HART slave)	EN GPU HART W HART M HART S SIL AR
Secondary communication bus protocol	SEC ENRAF
Secondary Bus communication address	
Secondary Bus commuincation settings (Baud rate, stop bits and parity)	
Software version	1.B1 SW
Serial number	SN 12 345678
Unit ID (when Modbus is available on Primary or Secondary bus)	UNID 23456
Write protection status (ON/OFF)	ON W PROT
Relay option	--K2 RELAY

5.4 ERROR MESSAGES

In addition to presenting measurement values, the display can show software and hardware error messages. In case of an error, the upper row shows “ERROR” and the lower row toggles between “FAIL” and the error code.

Figure 5-2. Error codes can be presented on the 2410 display



The following error codes are used:

Table 5-3. List of error codes and messages that may appear on the display

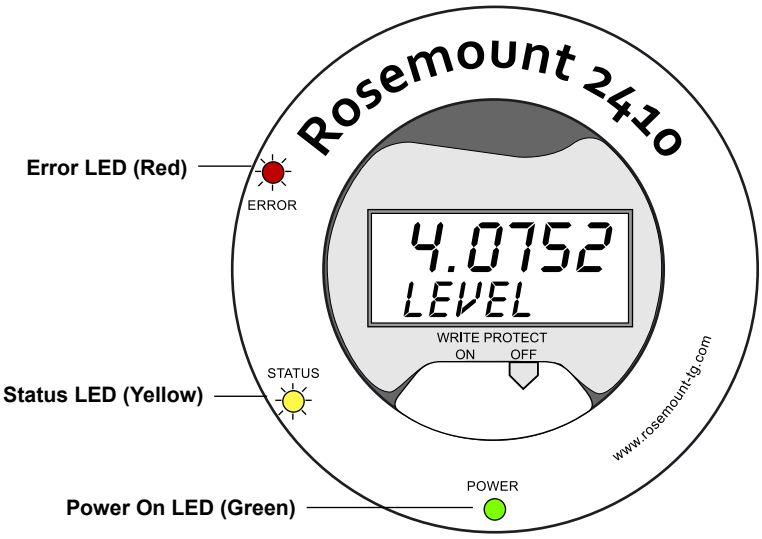
Code	Error
RAM	Ram failure
FPROM	FPROM
HREG	Holding register error
OMEM	Other memory error
SYS	System error
DPLY	Display error
AUX	AUX
FF ST	FF stack
TBUS	Tank Bus
HOST C	Host
D MNGR	Data manager
CFG	Invalid Configuration
SW	Software

See “Error Messages” on page 6-26 for more information.

5.5 LED

There are three Light Emitting Diodes (LED) on the Rosemount 2410 front for status and error information.

Figure 5-3. The Rosemount 2410 has three LEDs



The following color codes are used for the 2410 LEDs:

Table 5-4. LED color codes

LED Type	Color	Description
Power On	Green	The green LED indicates that the 2410 is powered on.
Status	Yellow	The yellow Status LED blinks at a constant rate of one flash every other second in normal operation to indicate the the 2410 software is running
Error	Red	The red Error LED is turned off in normal operation. If an error occurs, the Error LED flashes a sequence that corresponds to a certain error code, see “LED” on page 5-6.

5.5.1 LED Start-Up Information

When the 2410 is starting, both the Status and the Error LEDs indicate possible hardware or software errors as shown in Table 5-5 below:

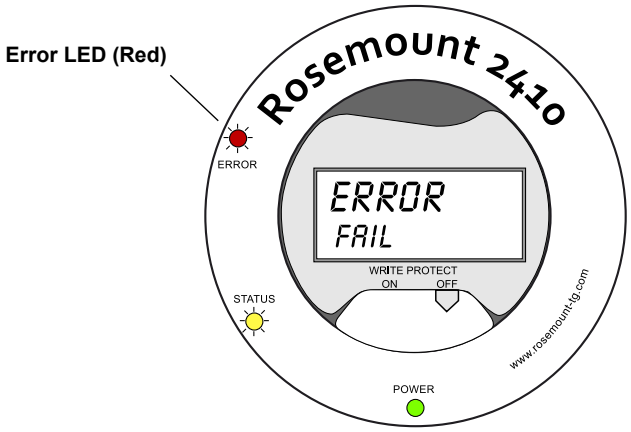
Table 5-5. LEDs are used for error indication at 2410 start-up

Error type	Status LED	Error LED	Description
Hardware	Blinking	Blinking	Status and Error are blinking simultaneously
Checksum	Blinking	Blinking	Status and Error are toggling
Other	On	Blinking	Unknown error

5.5.2 Error LED

In normal operation the Error LED (Red) is turned off. In case a device error occurs, the LED will flash a sequence that corresponds to the error code followed by a five second pause.

Figure 5-4. Error codes are presented by the Error LED



The following errors codes may appear:

Table 5-6. LED error codes

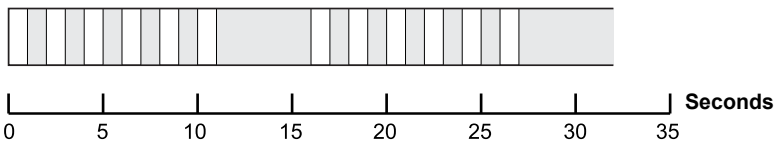
Code	Error type	Code	Error type
1	FPROM	7	Aux
2	HREG	8	FF stack
3	Software	9	Tankbus
4	Other memory error	10	Host communication
5	System	11	Data manager
6	Display	12	Configuration

Example

In case of a device error, the red LED will repeat a flash sequence that corresponds to the particular type of error that ocurred. For example, in case of a Display error (code=6), the LED will show a sequence of 6 flashes followed by a 5 seconds pause. After the pause the flashing starts over again in the same manner. This flash/pause sequence will be continously repeated.

Display error (code 6) appears with the following Error LED (red) flash sequence as illustrated in Figure 5-5:

Figure 5-5. Error code flash sequence



See “Error Messages” on page 6-26 for more information.

5.6 SPECIFYING DISPLAY VARIABLES

The Rosemount 2410 can be configured to present measurement data on the optional integral display. Measurement data such as Level, Level Rate, Free Water Level and many other tank variables can be displayed.

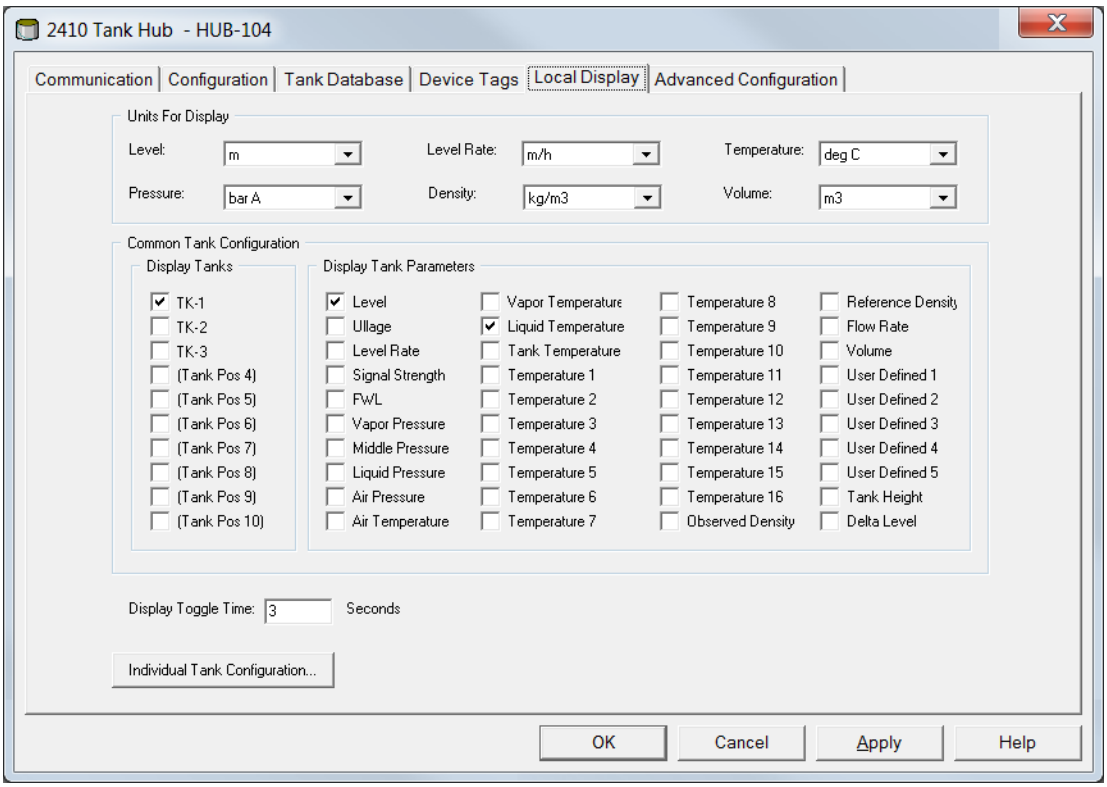
Measurement units for Level, Volume, Temperature, Density, Pressure, and Weight can be specified.

The display will alternate between the selected items at a rate given by the *Display Toggle Time* parameter.

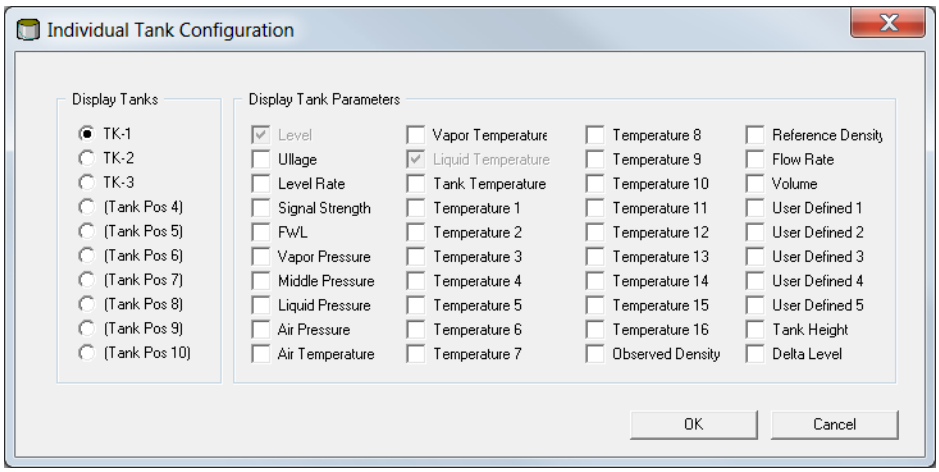
The display can easily be set up to show tanks and measurement variables when the 2410 is installed and configured with the *Rosemount TankMaster WinSetup* program. The current display settings can be changed at any time in the *2410 Local Display* window as shown in Figure 5-6 below:

1. In the *TankMaster WinSetup* configuration program click the right mouse button on the Rosemount 2410 icon.
2. Choose the **Properties** option.
3. In the *2410 Tank Hub* window select the *Local Display* tab.

Figure 5-6. The local display can be configured by using the *Rosemount TankMaster Winsetup* configuration software



4. Select the desired tanks and tank parameters such as Level, Temperature, Vapor Pressure, or any other preferred tank parameter.
5. Choose measurement units for the 2410 integral display. The first time the *Local Display* tab is opened, the same measurement units are used as specified in the TankMaster WinSetup *Server Preferences/Units* window.
6. Click the **Individual Tank Configuration** button in case you would like to specify different display settings for different tanks:



7. Click the OK button to save the configuration and close the window.
8. In the *2410 Tank Hub* window click the OK button to save the configuration and close the window.

See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on using the *TankMaster Winsetup* PC software to configure the Rosemount 2410 Tank Hub.

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 device is consistent with the appropriate hazardous locations certifications.

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

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

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

6.2 SERVICE

This section briefly describes functions which may be useful for service and maintenance of a Rosemount 2410 Tank Hub. If not otherwise stated, most examples are based on using the *TankMaster WinSetup* tool to access these functions. See the *Raptor System Configuration Manual (Document No. 300510EN)* for more information on how to use the *TankMaster WinSetup* program.

6.2.1 Viewing Input and Holding Registers

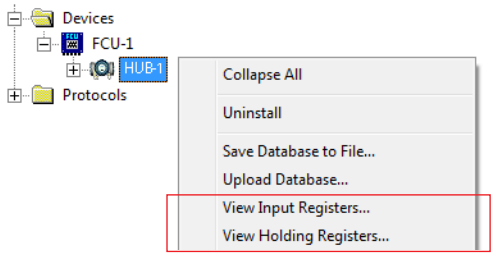
Measured data is continuously stored in **input registers** of the Rosemount 2410 Tank Hub. By viewing the Input registers you can check that the device is working properly.

The **holding registers** store various parameters which are used to configure the 2410 for various applications.

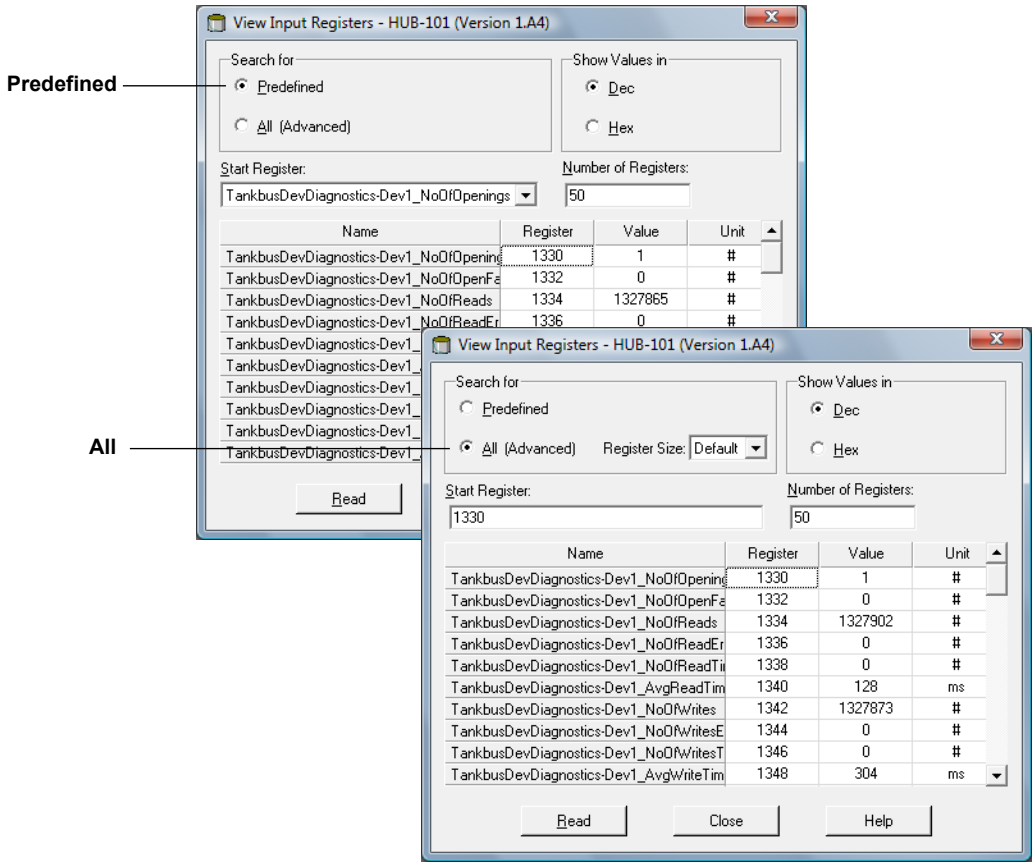
By using the Rosemount TankMaster *WinSetup* program, holding registers can be edited simply by typing a new value in the appropriate value input field. Some holding registers can be edited in a separate window. In this case individual data bits can be changed.

To view Input or Holding registers of a 2410 do the following:

1. Start the TankMaster **WinSetup** program.



2. In the *TankMaster WinSetup* workspace window, click the right mouse button on the Rosemount 2410 Tank Hub 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** for a basic selection of registers. Choose the **All** option if you would like to view a range of registers by your own choice. For the All option, specify a range of registers by setting a start value in the **Start Register** input field, and the total number of registers to be displayed in the **Number of Registers** field (1-500). Up to 50 registers is recommended for a quick update of the list.
5. Click the **Read** button to update the *View Input/Holding Registers* window with fresh device data.

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 *Rosemount Raptor System Configuration Manual (document no. 300510EN)*.

6.2.3 Device Live List

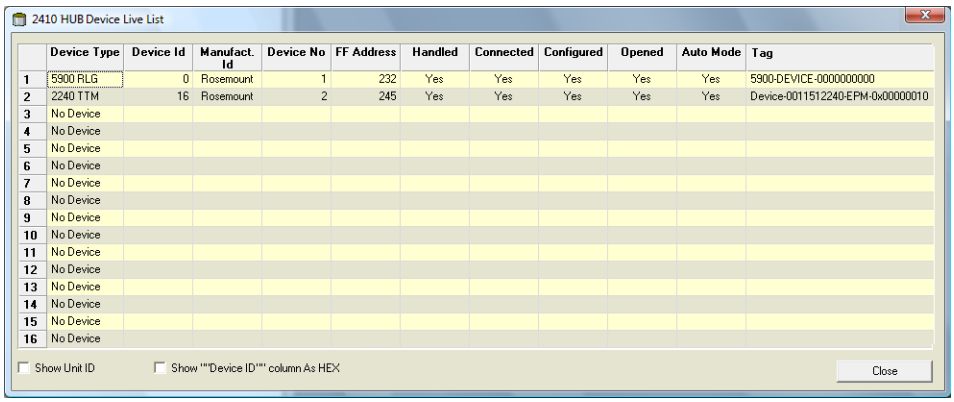
The **2410 Hub Device Live List** lets you view devices connected to the Tankbus. You can, for example, see the Device Id, Tag, and whether the devices are configured or not.

The Device Live List is useful when you are going to configure devices in a Raptor system, in order to verify that the required devices are connected to the Tankbus.

To view the Device Live List:

1. Start the *TankMaster WinSetup* program.
2. Select the Rosemount 2410 icon in the *TankMaster WinSetup* workspace.
3. Click the right mouse button and choose the **Live List** option.

Figure 6-1. The 2410 Tank Hub *Device Live List* window shows devices connected to the tankbus



The *2410 Tank Hub Device Live List* window shows the following information:

Table 6-1. Device Live List description

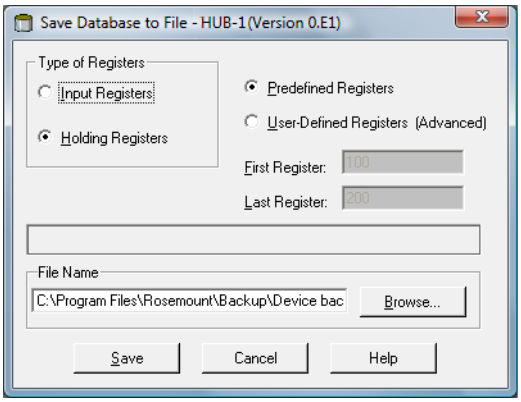
Item	Description
Device Type	Examples of supported devices: Rosemount 5900S, 2410, 2240S, 2230, 5300, 5400, 848T, and 3051S. For unknown devices the device type number is shown.
Device ID (Unit ID)	A.unique code that identifies a particular device. You can choose to view the device ID in decimal or hex format depending on what format is supported by the device.
Manufact Id	Identifies the manufacturer.
Device No	Index used to identify devices by the FF stack.
FF Address	FOUNDATION Fieldbus address used for communication on the Tankbus.
Handled	Bit 0 of the Live List Status input register which indicates the current Tankbus communication status of the device.
Connected	“No” means that the device has been disconnected from the Tankbus.
Configured	“Yes” indicates that the device is configured in the 2410 tank database, i.e. the device is mapped to a particular tank.
Opened	Bit 1 of the Live List Status input register which indicates the current Tankbus communication status of the device.
Auto Mode	“Yes” in normal operation. “No” indicates that the device is in Out of Service mode.
Tag	A removable tag provided with the device lets you identify the device to a physical location. This field shows the Tag number of the device (when available).

6.2.4 Configuration Backup

Input and Holding Registers of the Rosemount 2410 Tank Hub can be stored on disk, which can be useful for backup purposes and troubleshooting. You can save a predefined set of Holding Registers to make a backup copy of the current 2410 Tank Hub configuration.

To save the current configuration to file do the following:

1. Start the *TankMaster WinSetup* program.
2. In the *TankMaster WinSetup* workspace window, click the right mouse button on the device icon.
3. Choose the **Devices/Save Database to File** option, or from the **Service** menu choose **Devices/Save Database to File**.



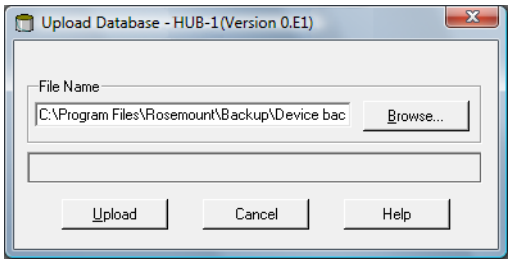
4. In the *Save Database to File* window choose **Holding** registers and the **Predefined Registers** option (the User-Defined option should only be used for advanced service).
5. Click the **Browse** button, select a destination folder and type a name for the backup file.
6. Click the **Save** button to save the database backup.

6.2.5 Configuration Recovery

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

To load a backup database do the following:

1. In the *TankMaster WinSetup* workspace select the 2410 Tank Hub icon that represents the device for which you want to load a new database.
2. Click the right mouse button and choose the **Devices/Upload Database** option, or from the **Service** menu choose **Devices/Upload Database**.



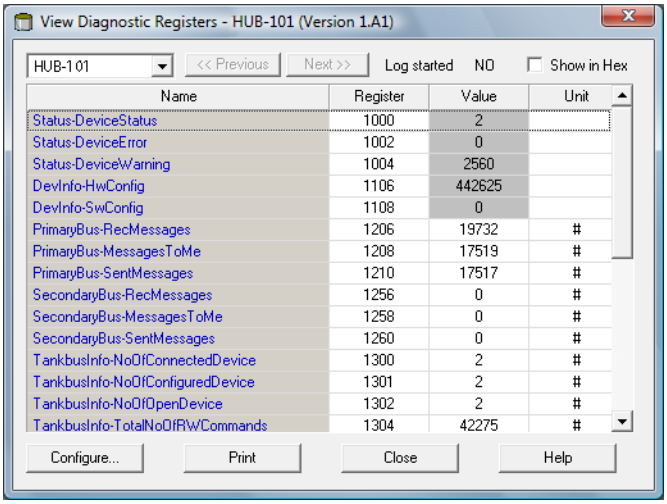
3. Type a file path and file name, or click the **Browse** button and choose the database file to be uploaded.
4. Click the **Upload** button.

6.2.6 Diagnostics

TankMaster WinSetup offers the option to view diagnostic registers for the Rosemount 2410 Tank Hub. The diagnostic registers are selected from available Input and Holding Registers to provide a quick overview of the current device status. For a more comprehensive troubleshooting you may use the View Input Registers function (see also section “Viewing Input and Holding Registers” on page 6-2).

To view and configure the diagnostic registers:

1. In the *TankMaster WinSetup* workspace select the 2410 Tank Hub icon.
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.

A grey background color of a table cell in the Value column means that the register is of either Bitfield or ENUM type. By double-clicking the cell, an *Expanded Bitfield/ENUM* window can be opened for this type of register.

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

The **Configure** button lets you open the *Configure Diagnostic Registers* window, allowing you to change the list of registers to be displayed in the *View Diagnostic Registers* window.

The *Configure Diagnostic Registers* window also has a **Log Setup** button for access to the *Register Log Scheduling* window which allows you to setup a log schedule for automatic start and stop of register logging. See “Logging Measurement Data” on page 6-17 for more information

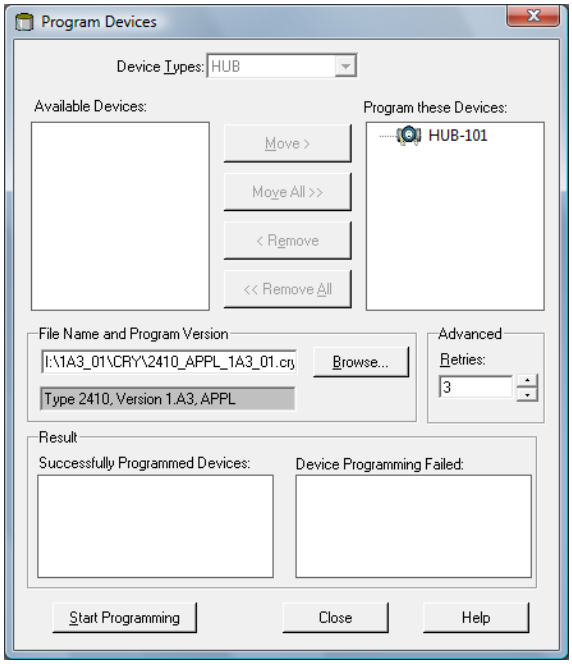
See the *Raptor System Configuration Manual (Document No. 300510EN)* for more information on the View Diagnostic Registers function.

6.2.7 Device Software Upgrade

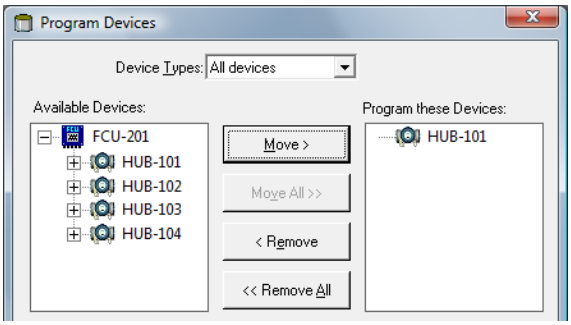
The Rosemount TankMaster WinSetup program allows you to upgrade the 2410 Tank Hub and other *Raptor* devices with new software.

To upgrade a device with new software do the following:

1. Ensure that the latest versions of *.ini-files are installed on the TankMaster PC. New *.ini files can easily be installed by running the TankMaster setup program located in the **DeviceIniFiles** folder on the TankMaster installation CD.
2. Ensure that the 2410 Tank Hub communicates with TankMaster without any interruptions or disturbances.
3. In the *TankMaster WinSetup* workspace window (Logical View) open the **Devices** folder and select the icon that represents the 2410 Tank Hub to be upgraded (or select the Devices folder to allow multiple devices programming).
4. Click the right mouse button and choose the **Program** option (**Program All** option for multiple devices programming).



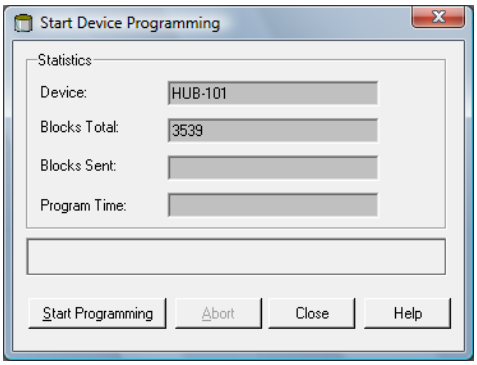
5. The 2410 will automatically appear in the *Program These Devices* pane.
6. In case you wish to upgrade several 2410 Tank Hubs simultaneously, you may use the multiple programming options:
   a. In the *TankMaster WinSetup* workspace window select the **Devices** folder.
   b. Click the right mouse button and choose the **Program All** option to open the *Program Devices* window:



c. From the **Available Devices** pane choose a 2410 Tank Hub to be programmed and click the **Move** button.

d. Repeat for each device to be programmed.
Use the **Remove** button if you want to change the list of devices to be programmed.

7. Click the **Browse** button to locate the flash program file. A flash file is identified by file extension ***.cry.**
For a 2410 Tank Hub, a flash file name may typically look like: *2410_APPL_xxx_yy.cry*, where “x” and “y” indicate software version.
8. In the *Program Devices* window click the **Start Programming** button. Now the *Start Device Programming* window appears:

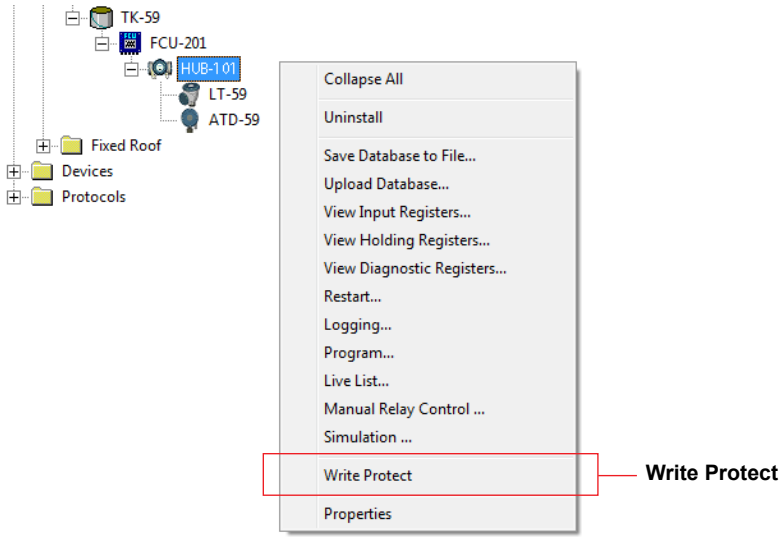


9. Click the **Start Programming** button to activate device programming.
10. Programming may take up to two hours for a 2410 Tank Hub connected to a TankMaster PC via a 2160 Field Communication Unit. The programming procedure will continue with one device after the other until all Tank Hubs selected in the *Program Devices* window are upgraded. By connecting a 2410 directly to a host computer, and using the RS485 Modbus protocol at a maximum baud rate of 38400, programming time may be reduced to 5 to 10 minutes (see “Primary Bus” on page C-4 for information on how to configure the Primary Bus).
11. The 2410 operates as normal during the reprogramming procedure. Once programming is finished, the 2410 will automatically perform a restart indicated by “WAIT” on the integral display for a couple of minutes.

6.2.8 Write Protection

A Rosemount 2410 Tank Hub can be write protected to avoid unintentional configuration changes when using the TankMaster programs. To write protect the 2410 Tank Hub:

1. Start the *TankMaster WinSetup* program.
2. In the *WinSetup* workspace select the *Logical View* tab.
3. Click the right mouse button on the device icon that represents the 2410 Tank Hub:



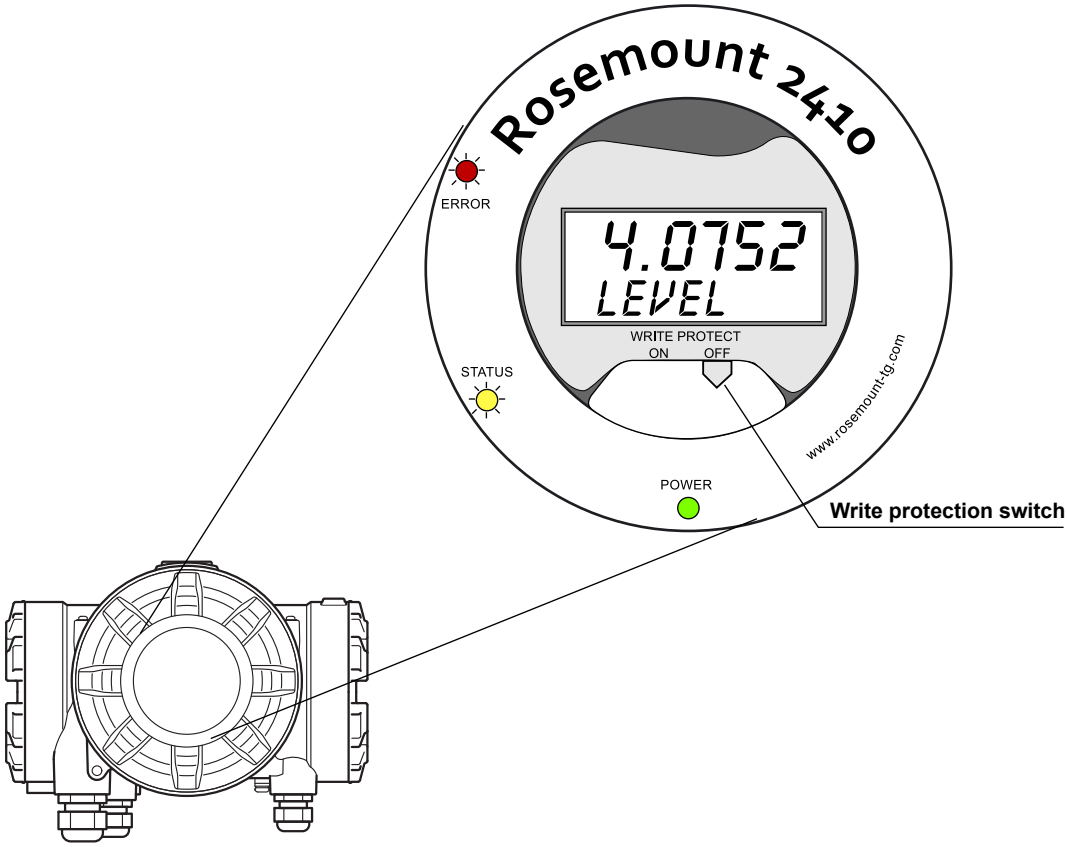
4. Choose the **Write Protect** option to open the *2410 Tank Hub Write Protect* window:

5. Choose **Protected** in the **New State** drop-down list.
6. Click the Apply button to save the new state, or click the OK button to save the write protect state and close the *Write Protect* window.

6.2.9 Write Protection Switch

A switch on the front of the Rosemount 2410 Tank Hub can be used to prevent unauthorized changes of the holding register database.

Figure 6-2. The 2410 Tank Hub write protection switch on the built-in integral display



6.2.10 Simulation Mode

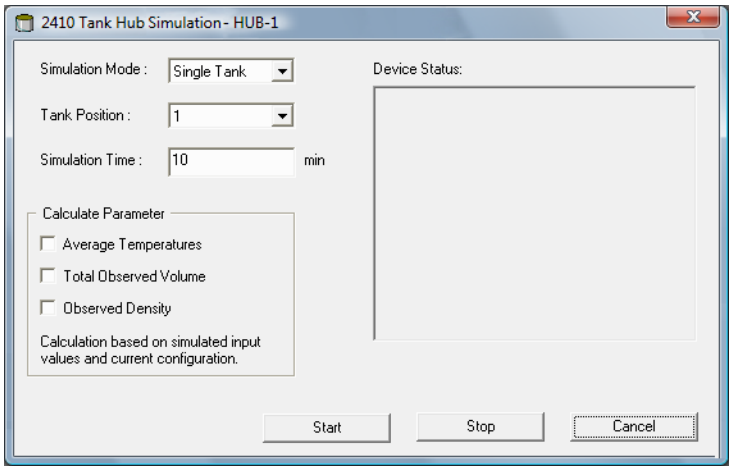
The Simulation Mode function lets you verify communication between a Rosemount 2410 Tank Hub and a host system without connecting actual field devices. The *2410 Tank Hub Simulation* window allows you to choose which parameters to be calculated by the 2410. The calculations are based on input from simulated tank measurement data such as product level, average temperature, liquid pressure, and other variables.

The **Simulation HREGS** holding registers (starting with register number 3800) lets you specify the desired simulation data.

For information on how to view and edit holding registers, see “Viewing Input and Holding Registers” on page 6-2 or the *Raptor System Configuration Manual (Document No. 300510EN)*.

1. In the *TankMaster WinSetup* workspace select the 2410 icon.
2. Click the right mouse button and choose the **Simulation** option to open the *2410 Tank Hub Simulation* window:

Figure 6-3. Simulation window in TankMaster WinSetup

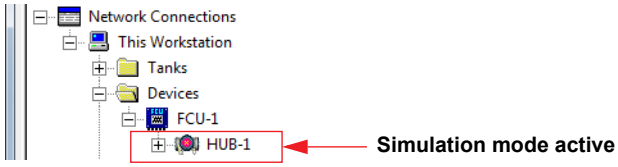


3. Choose simulation mode Single Tank and the desired tank in the Tank Position field, or choose the All option to simulate all tanks connected to the 2410. Tank Position refers to the position in the 2410 tank database.
4. In the Simulation Time field, enter for how long the simulation will continue.
   Simulation can be stopped at any time by pressing the Stop button.
5. Calculate Parameter:
   in the standard configuration the check-boxes are unchecked, which means that each simulation parameter is given a specific standard simulation value as specified in the simulation holding register area:

Simulation Parameter	Simulation Holding Register
Average Temperature	HR3868
Total Observed Volume	HR3994
Observed Density	HR3976

6. Click the **Start** button to start simulating the tank parameters.
7. In the WinSetup workspace the 2410 icon changes to the following appearance to indicate that Simulation Mode is active:

Figure 6-4. Simulation mode active is indicated in the WinSetup workspace



NOTE
Simulation continues for the specified period of time. It can also be stopped manually at any time by pressing the Stop button in the *Simulation* window.

Advanced Simulation

1. If a *Calculate Parameter* check-box is selected, the simulation parameter is calculated based on input data from the holding registers **Simulation HREGS** 3800 to 4056. You can simulate one or more parameters simultaneously.

   To simulate **Product Temperature**, the temperature element positions must be configured. Right-click the auxiliary tank device (ATD) icon in the WinSetup workspace, choose the Properties option, and select the *Average Temperature Calculation* tab. See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information. The resulting Product Temperature is available in input register **IR2100** (tank 1). It is also available in input register area starting with **IR30000** (IR30044 for tank 1).

   The Volume Calculation function must be activated in order to enable advanced **Volume** simulation. See “Volume Configuration” on page C-14 for more information.
   The volume calculation result is presented in input register **IR4702**, **IR3400** (tank 1) and in input register area starting with **IR30000** (IR30148 for tank 1).

   To simulate **Observed Density** the Hybrid Density function must be activated. See “Hybrid Density Calculation” on page C-10 for more information.
   The resulting Observed Density is available in input register **IR3500** (tank 1). It is also available in input register area starting with **IR30000** (IR30116 for tank 1).
2. Click the **Start** button to start simulating the selected tank parameters.

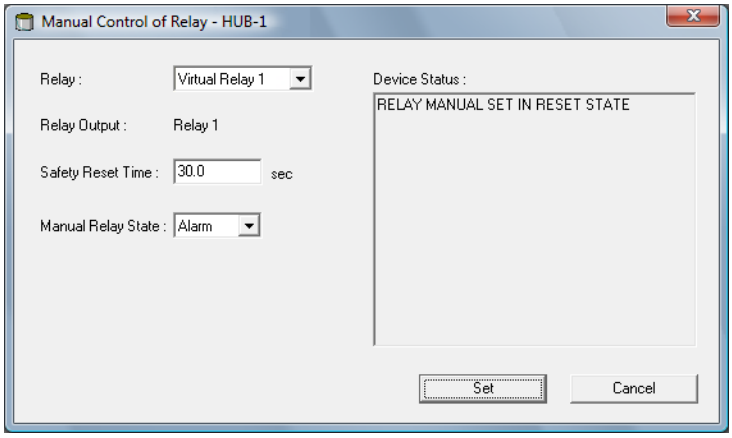
6.2.11 Testing the Relays

The Manual Control of Relay function lets you manually open or close the Rosemount 2410 Tank Hub built-in relays in order to verify the relay function. After the specified Safety Reset Time the relay automatically returns to normal mode.

To change relay state by using the *TankMaster WinSetup* program do the following:

1. In the *TankMaster WinSetup* workspace select the 2410 icon.
2. Click the right mouse button and choose **Manual Control Relay**.

Table 6-2. Manual control of relay function



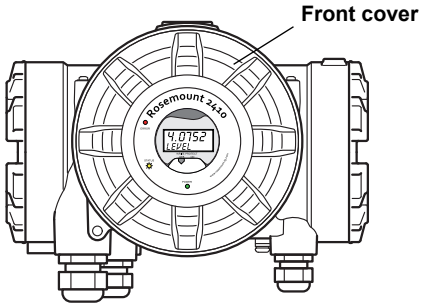
3. Select the virtual relay functions to be tested; Virtual Relay 1, Virtual Relay 2, etc.
   Up to ten virtual relay functions can be configured for a 2410 Tank Hub. See “Advanced Configuration in Winsetup” on page C-3 and “Relay Output” on page C-6 for more information.
4. Specify a Safety Reset Time. This value specifies the time period for the relay to stay in the test state. When the specified period of time has elapsed, the relay automatically returns to the original state. The relay will reset even if communication with the TankMaster PC would fail.
5. Choose the desired **Manual Relay State**. Available options are Alarm, Normal, and Toggle.
6. Click the **Set** button. Now the selected relay changes state for the specified number of seconds and then returns to the previous state.

6.2.12 Relay Output Configuration

To change the Normally Open/Normally Closed settings of the K1 and K2 relays, do the following:

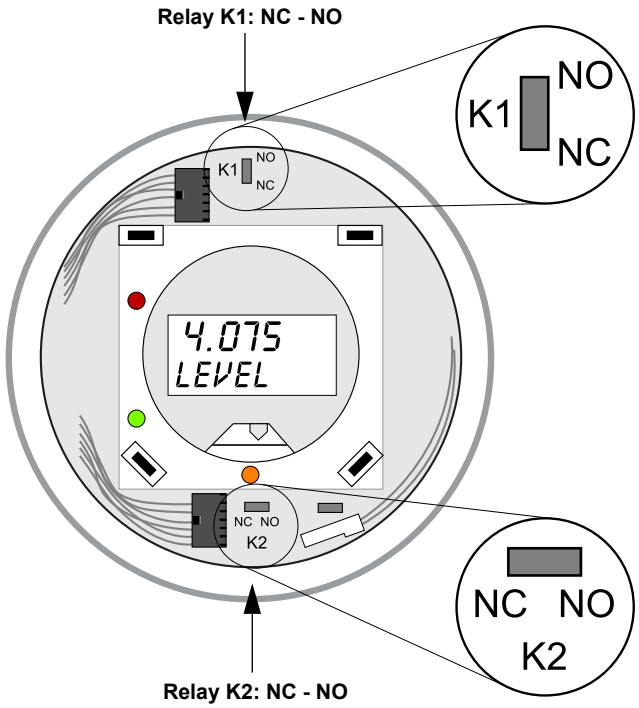
⚠ 1. Disconnect the power supply.

Figure 6-5. Rosemount 2410 Tank Hub front view



2. Remove the front cover.
3. Remove the plastic display cover.
4. Switch the jumpers to the desired settings: Normally Open or Normally Closed.

Figure 6-6. Normally Open/Normally Closed settings for relays K1 and K2 can be configured with a jumper



5. Replace the plastic display cover and the front cover.

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

6.2.13 Loading the Default Database

The various configuration parameters of the 2410 Tank Hub is stored in a **Holding Register** database. The **Holding Register** factory setting is stored in the **default database**. *TankMaster WinSetup* offers the option to load the default database. This may be useful if, for example, you would like to try out new database settings and then be able to reload the original factory settings.

In case error messages appear or other problems occur concerning the database, troubleshooting the cause of these problems is recommended before loading the default database.

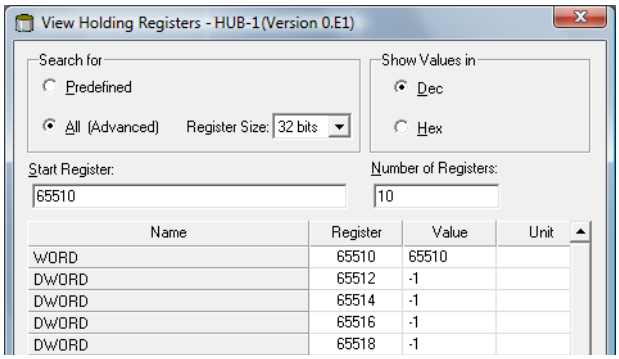
It is recommended that the current database is backed up before the Default Database is loaded. See “Configuration Backup” on page 6-5 for information on how to save the current database.

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

NOTE!
When the default database is loaded to the 2410 Tank Hub measurement units are reset to Metric Units.

To load the default database:

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

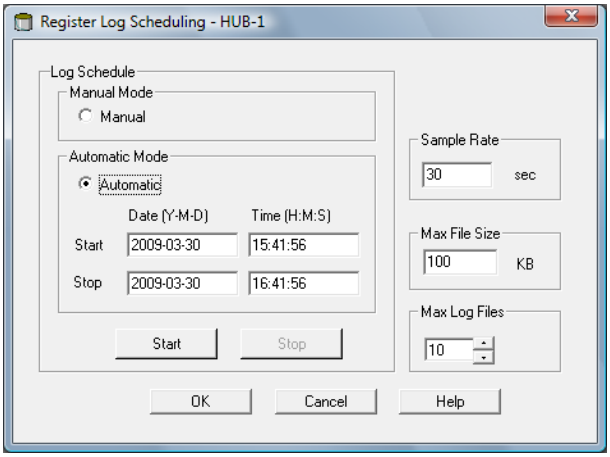


4. Type 65510 in the **Value** input field.
5. Click the **Apply** button to load the default database.
6. Finish by clicking the **Close** button.
7. Verify that measurement units are compatible with the current host system configuration.

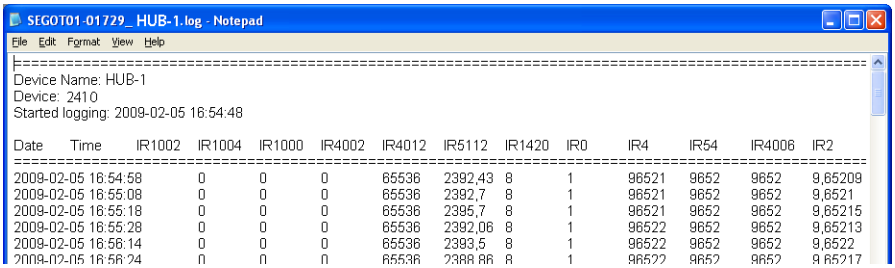
6.2.14 Logging Measurement Data

The Rosemount 2410 supports logging of diagnostic registers. This function is useful for verifying that the gauge works properly. The logging function can be accessed by using the *TankMaster WinSetup* program. To start logging do the following:

1. Start the *TankMaster WinSetup* program.
2. Select the Rosemount 2410 Tank Hub icon in the *WinSetup* workspace.
3. Click the right mouse button and choose **Logging**:



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



6.3 TROUBLESHOOTING

Table 6-3. Troubleshooting chart

Symptom	Possible cause	Action
No contact with the Rosemount 2410 Tank Hub	Wiring	• 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 the 2410 Tank Hub is connected to the right communication port on the control room PC (if no FCU is used).
	RS485 wiring	• Check for proper polarity at the terminals.
	Field Bus Modem (FBM)	• Check the LEDs for proper communication. • Check that the FBM is connected to the right port on the control room PC. • Check that the FBM is connected to the right port on the 2160 Field Communication Unit (FCU).
	Connection to FCU 2160	• Check that the 2410 Primary/Secondary bus is connected to the right field bus port on the FCU 2160. • Check communication port LED:s inside the 2160 Field Communication Unit (FCU).
	Configuration of FCU 2160	• Check the communication address specified for the 2410 in the FCU Slave Database. • Check configuration of communication parameters for the FCU Fieldbus ports. • Check that the correct communication channel is selected. See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on how to configure the FCU 2160.
	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).
	Hardware failure	• Check the 2410 Tank Hub; check the Error LED or the integral display for information. • Check the Field Communication unit (FCU). • Check the Field Bus Modem. • Check the communication port on the control room PC. • Check that there are no devices connected to the Primary/Secondary bus which are not powered. • Contact Emerson Process Management/Rosemount TankGauging service department.
	Software failure	• Restart the 2410 by disconnecting and connecting the power supply (note the communication parameters that appear on the display during startup).

Symptom	Possible cause	Action
No communication with one or more devices on the Tankbus	Wiring	• Check that the devices appear in the *Device Live List* (see “Device Live List” on page 6-4). • Check diagnostics information, see “Diagnostics” on page 6-7 for warning or error messages. • 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 diagnostics information (see “Diagnostics” on page 6-7) for information that indicate bad communication on the Tankbus: - Input registers 1300 to 1328 provide general information on Tankbus communication - Input registers 1330 to 1648 provide information on specific devices on the Tankbus. • Check diagnostics information (see “Diagnostics” on page 6-7) for possible hardware faults that indicate short circuits or ground faults: - check Input Register 1326 for short circuits - check Input Register 1328 for ground faults. • Check that there are no multiple shield grounding points • Check that the cable shield is grounded at the power supply end (2410 Tank Hub) only. • Check that the cable shield is continuous throughout the Tankbus network. • Check that the shield inside the instrument housing does not come into contact with the housing. • Check that there is no water in conduits. • Check for proper polarity at the terminals (Rosemount 5300 and 5400). • Use shielded twisted pair wiring. • Connect wiring with drip loops. • Check the loop impedance.
	Incorrect Tankbus termination	• Check that there are two terminators on the Tankbus (see section “Tankbus” on page 3-8). • Check that terminations are placed at both ends of the Tankbus. • Check that the built-in termination in the 2410 Tank Hub is enabled.
	Too many devices on the Tankbus	• Check that the total current consumption of the devices on the Tankbus is less than 250 mA, see “Power Budget” on page 3-7. • Remove one or more devices from the Tankbus. The 2410 Tank Hub supports a single tank. The multiple tank version of the 2410 supports up to 10 tanks.
	Cables are too long	• Check that the input voltage on the device terminals is 9 V or more (see section “Tankbus” on page 3-8).
	Software or hardware failure	• Check diagnostics information, see “Diagnostics” on page 6-7. • Check Device Status input register, see “Device Status” on page 6-23. • Contact Emerson Process Management/Rosemount TankGauging service department.

Symptom	Possible cause	Action
TankMaster does not present measurement data from one or more devices connected to the Tankbus. The devices communicate on the Tankbus and appear in the Device Live List.	Incorrect configuration of the 2160 FCU slave database	• Check the Modbus communication addresses in the 2160 FCU slave database. In TankMaster WinSetup open the *FCU Properties/Slave Database* window. See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on how to configure the 2160 FCU slave database.
	Incorrect configuration of the 2410 tank database	• Check the 2410 tank database; ensure that the device is available and mapped to the right tank. • Check the 2410 tank database configuration; verify that the *ATD Modbus* address is equal to the *2410 Temp* Modbus address in the FCU Slave Database. • Check the 2410 tank database configuration; verify that the *Level Modbus* address is equal to the *2410 Level* Modbus address in the FCU Slave Database. • See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on how to configure the FCU 2160 slave database and the 2410 tank database.
	Software or hardware failure	• Check diagnostics information, see “Diagnostics” on page 6-7. • Check Device Status input register, see “Device Status” on page 6-23. • Contact Emerson Process Management/Rosemount TankGauging service department.
	Too many devices connected to the Tankbus	• Check the model code to find out what type of 2410 Tank Hub that is used: Single tank or Multiple tank version. • Change to a 2410 Tank Hub for multiple tanks.
Incorrect temperature reading from temperature transmitter	Configuration error	• Check configuration of the temperature transmitter; in TankMaster Winsetup open Properties for the ATD device associated with the tank. • See the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on how to configure ATD devices such as a Rosemount 2240S Multi-Input Temperature Transmitter.
	Measurement units are not compatible with host system	If default database is loaded to the 2410 Tank Hub, do one of the following: • in TankMaster WinSetup verify system units and re-install the tank associated with the 2410 Tank Hub • update Holding Registers with correct measurement units
	Hardware failure	• Check diagnostics information, see “Diagnostics” on page 6-7. • Check temperature elements. • Contact Emerson Process Management/Rosemount TankGauging service department.

Symptom	Possible cause	Action
Incorrect level reading from radar level gauge	Configuration error	• Check configuration of the level gauge; in TankMaster Winsetup open Properties for the level gauge associated with the tank. • See the *Rosemount 5900S Reference Manual* (Document no. 300520en) and the *Raptor System Configuration Manual* (Document no. 300510EN) for more information on how to configure a Rosemount 5900S Radar Level Gauge.
	Measurement units are not compatible with host system	If default database is loaded to the 2410 Tank Hub, do one of the following: • in TankMaster WinSetup verify system units and re-install the tank associated with the 2410 Tank Hub • update Holding Registers with correct measurement units
	Hardware failure	• Check diagnostics information, see “Diagnostics” on page 6-7. • Contact Emerson Process Management/Rosemount TankGauging service department.
No output on the 2410 integral display	Hardware failure	• Check the model code to verify that the 2410 was ordered with the LCD display option. • Check display connection. • Check diagnostics information, see “Diagnostics” on page 6-7. • Contact Emerson Process Management/Rosemount TankGauging service department.
The Error LED (red) is blinking	Various reasons such as hardware or software failure, communication, or configuration error	• See “Error Messages” on page 5-5 and “Error Messages” on page 6-26. • Check Device Status input register (see “Device Status” on page 6-23).
The Status LED (yellow) is blinking	Normal operation. The yellow Status LED blinks at a constant rate of one flash every other second.	• See “LED” on page 5-6 for more information.
Configuration can not be saved	Write protection switch is set to the ON position	• Check write protection switch on the display, see “Write Protection Switch” on page 6-11.
	The 2410 is write protected in TankMaster WinSetup	• Check write protection in TankMaster WinSetup, see “Write Protection” on page 6-10.
	Application software installed which is incompatible with current holding register setup	• Reset holding registers to the default database setting, see “Loading the Default Database” on page 6-16 and restart the 2410 Tank Hub.
	Corrupt holding registers	• Reset holding registers to the default database setting, see “Loading the Default Database” on page 6-16 and restart the 2410 Tank Hub.

Symptom	Possible cause	Action
2410 icon in TankMaster WinSetup is red	Simulation mode active	• Stop simulation mode; open WinSetup *Set Simulation Mode* window and click the Stop button.
All measurement values are indicated with “SensFail” in the WinSetup *Tank View* window, and with “Error” in the WinOpi *Tank View* window.	Map conflict. One or more tank measurement variables are mapped to the wrong source parameter. For example: Vapor Temperature is mapped to Manual Value.	• Check diagnostics information (see “Diagnostics” on page 6-7) for possible Device Warning messages: - in case there is a “Data Manager” warning, check Input Register 6244 - if register 6244 indicates a “TMV Mapping” warning check Input Registers 6260 to 6270 for tank measurement variable mapping conflicts • In TankMaster Winsetup, right-click the ATD device icon associated with the current tank, and click the Properties option. In the *22XX ATD* window select the *Advanced Parameter Source Configuration* tab. Check that tank measurement variables are mapped to the right source parameters.

6.3.1 Device Status

The current device status is shown in **Input Register 1000**. You can view the device status register by opening the *Diagnostic* window (see "Diagnostics" on page 6-7) or the *View Input Registers* window (see "Viewing Input and Holding Registers" on page 6-2).

Double-clicking the Value field of the Device Status register opens an expanded bitfield window with information on the current device status as shown in Figure 6-7.

Figure 6-7. Input Register Device Status

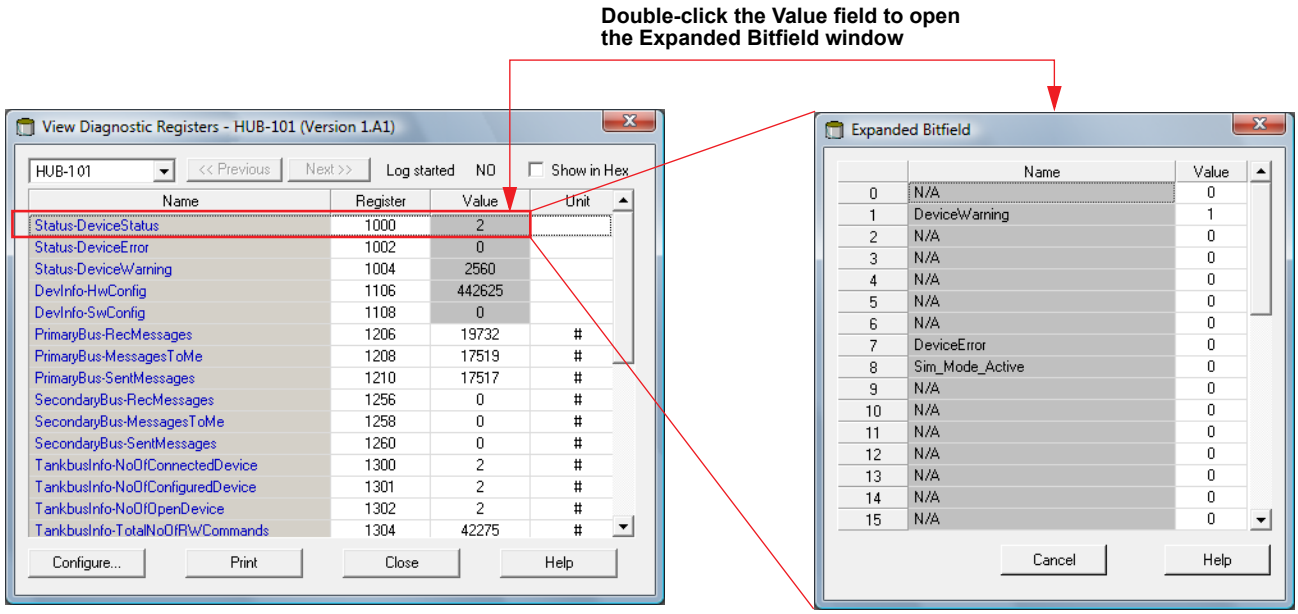


Table 6-4. Device status messages

Message	Bit no.	Description	Action
Device Warning	1	A device warning is active.	See "Warning Messages" on page 6-24 for details.
Device Error	7	A device error is active.	See "Error Messages" on page 6-26 for details.
Simulation Mode Active	8	Simulation mode active.	Stop Simulation mode.
Write Protected	18	The device is write protected with a switch or in the TankMaster WinSetup program.	Check the write protection switch, see "Write Protection Switch" on page 6-11. Check write protection state in TankMaster WinSetup, see "Write Protection" on page 6-10.

6.3.2 Warning Messages

Warning messages are displayed in the Rosemount Tankmaster program. **Input Register 1004** provides an overview of active device warnings (see "Diagnostics" on page 6-7 or "Viewing Input and Holding Registers" on page 6-2 for information on how to view diagnostics and various Input registers in TankMaster WinSetup).

For each warning message that may appear in Input register 1004, detailed information can be found in Input registers 6200 to 6248 as shown in Table 6-5.

Table 6-5. Warning message descriptions

Message	Description	Action
RAM warning	Input register no. 6200.	Contact Emerson Process Management/Rosemount TankGauging service department.
FPROM warning	Input register no. 6204.	
Hreg warning	Input register no. 6208.	
SW warning	Input register no. 6212.	
Other memory warning	Input register no. 6216. Bit 1: Stack	
System warning	Input register no. 6220.	
Display warning	Input register no. 6224. Bit 0: Communication Bit 1: Configuration	
Aux warning	Input register no. 6228. Bit 0: Internal temperature Bit 1: Power	
FF stack warning	Input register no. 6232.	
Tankbus communication warning	Input register no. 6236. Bit 0: Device restarted Bit 1: Device open failed Bit 2: Device address changed Bit 3: Live List no free position Bit 4: Port changed Bit 5: Exceeded FF number of retries Bit 6: Power failure Bit 7: Ground failure	
Host communication warning	Input register no. 6240. Bit 0: Multiple configuration Bit 1: Primary bus configuration Bit 2: Secondary bus configuration	
Data Manager warning	Input register no. 6244. Bit 0: Frozen data Bit 1: TMV mapping	
Configuration warning	Input register no. 6248. Bit 0: Invalid strapping table Bit 1: Tank configuration Bit 11: Model Code invalid string Bit 12: Model Code invalid code	

Message	Description	Action
Map conflict tank no.	Input register no. 6260	Check that tank measurement variables are mapped to the right source parameters (In TankMaster Winsetup, right-click the ATD device icon associated with the current tank, and click the Properties option. In the *22XX ATD* window select the *Advanced Parameter Source Configuration* tab.) Contact Emerson Process Management/Rosemount TankGauging service department.
Map conflict TMV type (TMV=Tank Measurement Variable)	Input register no. 6262 0: TMV Level 1: TMV Ullage 2: TMV Level Rate 3: TMV Signal Strength 4: TMV Free Water Level 5: TMV Vapor Pressure 6: TMV Liquid Pressure 7: TMV Air Pressure 8: TMV Ambient Temperature 9: TMV Vapor Avg Temperature 10: TMV Liquid Avg Temperature 11: TMV Tank Avg Temperature 12-27: TMV Temp1 - TMV Temp 16 50: TMV Observed Density 51: TMV Reference Density 52: TMV Flow Rate 53: TMV Tank Volume 54: TMV Tank Height 55: TMV Middle Pressure 56: TMV Delta Level 60-64: TMV USER DEF 1 - 5	
Map conflict device 1	Input register no. 6264	
Map conflict device 1 TV no. (TV=Tank Variable)	Input register no. 6266 TV number 0 - 1019 (Level, Ullage, Level Rate, Signal Strength etc.)	
Map conflict device 2	Input register no. 6268	
Map conflict device 2 TV no. (TV=Tank Variable)	Input register no. 6270 TV number 0 - 1019 (Level, Ullage, Level Rate, Signal Strength etc.)	
Internal map conflict	Input register no. 6272 Bit 1: TMV Vapor average temperature Bit 2: TMV Liquid average temperature Bit 3: TMV Tank average temperature Bit 4: TMV Observed Density Bit 5: TMV Reference Density Bit 6: TMV Tank Volume Bit 7: Mult TV Map Bit 8: TMV Internal Map Bit 9: TMV Arithmetic Value	

6.3.3 Error Messages

Error messages may be displayed on the Rosemount 2410 integral display and in the Rosemount Tankmaster program. You also have the option to view **Input Register 1002** for an overview of active device errors (see "Diagnostics" on page 6-7 or "Viewing Input and Holding Registers" on page 6-2 for information on how to view diagnostics and various Input registers with TankMaster WinSetup).

For each error message that may appear in Input register 1002, detailed information can be found in Input registers 6100 to 6124 as shown in Table 6-6.

Table 6-6. Error message descriptions

Message	Description	Action
RAM error	Input register no. 6100. A gauge data memory (RAM) error has been detected during the startup tests. Note: this automatically resets the gauge.	Contact Emerson Process Management/Rosemount TankGauging service department.
FPROM error	Input register no. 6102: Bit 0: checksum Bit 1: Application version Bit 2: Application checksum	Probably a checksum error in the application software. Try to reprogram the 2410.
HREG error	Input register no. 6104: Bit 0: Checksum Bit 1: Limit Bit 2: Version Bit 3: Read Bit 4: Write	Probably a checksum error caused by power failure between a configuration change and CRC update. Reset to factory configuration (see "Loading the Default Database" on page 6-16) and reconfigure the 2410. Use the Reset command before checking the 2410 Error status.
SW error	Input register no. 6106: Bit 0: Undefined SW Error Bit 1: Task Not Running Bit 2: Out of stack space Bit 3: Unused RAM access Bit 4: Divide by zero Bit 5: Reset Counter Overflow Bit 15: Simulated SW Error	The 2410 SW is having trouble running stable. Switch off the power to the 2410 for at least one minute. Switch power on again. If the problem persists, contact Emerson Process Management/Rosemount TankGauging service department.

Message	Description	Action
Other Memory Error	Input register no. 6108: Bit 0: CheckSum Bit 1: Stack	Contact Emerson Process Management/Rosemount TankGauging service department
Sys Error	Input register no. 6110. Bit 0: Task Supervisor	
Display Error	Input register no. 6112. Bit 0: Hardware Bit 1: Com Bit 2: Configuration	
Aux Error	Input register no. 6114. Bit 0: Internal temperature out of limits Bit 1: Internal temp measurement failed Bit 2: Internal temperature device failed Bit 3: Relay 1 Bit 4: Relay 2 Bit 5: Power	
FF Stack Error	Input register no. 6116.	
Tankbus Communication Error	Input register no. 6118. Bit 0: Unknown device connected to the Tankbus	
Host Communication Error	Input register no. 6120. Bit 1: Hardware Primary modem Bit 2: Hardware Secondary modem Bit 3: Illegal Primary modem Bit 4: Illegal Secondary modem	
Data Manager Error	Input register no. 6122. Bit 1: Tank configuration	
Configuration Error	Input register no. 6124.	

Appendix A Reference Data

A.1 SPECIFICATIONS

General	
Product	Rosemount 2410 Tank Hub
Single tank version	• Supports one 5900S 2-in-1 gauge or two radar level gauges, type 5300, 5400, or 5900S • Total Observed Volume (TOV) calculation with 100-point strapping table
Multiple tank version	For a 5300/5400/5900S system configuration: • The software supports 16 field devices and 10 tanks per hub • Maximum five gauges, type 5300 or 5400 per hub The actual number of tanks/instruments a hub supports depends on the configuration, which types of units are connected and how many. See “Power Budget” on page 3-7. • Hybrid calculations (mass and density) for up to three tanks • Total Observed Volume (TOV) calculation with 100-point strapping table for one tank
Examples of connected field devices	Radar Level Gauges (type 5900S(1), 5300, and 5400), Rosemount 2240S Multi-input Temperature Transmitter, Rosemount 644 Temperature Transmitter, Temperature / Water Level Sensors, Rosemount 3051S Scalable Pressure Transmitter, Rosemount 2230 Graphical Display
Start-up time	Less than 30 s
Legal custody transfer type approval	OIML R85:2008, and national certifications such as PTB, NMi etc
Hazardous location certifications	ATEX, FM-C, FM-US, IECEx, and national certifications. For details, see “Appendix B: Product Certifications” and “Ordering Information” on page A-5.
Safety/overfill	SIL 2 and SIL 3 certified. TÜV tested and WHG approved for overfill prevention. For national approvals, consult your local Rosemount Tank Gauging representative
CE-mark	Complies with applicable EU directives (EMC, ATEX)
Ordinary location certification	Complies with FM 3810:2005 and CSA: C22.2 No. 1010.1
Communication / Display / Configuration	
Tankbus	The intrinsically safe side of the Rosemount 2410 connects to the Tankbus which communicates with field devices on the tank using FOUNDATION™ fieldbus
Fieldbus	**Primary fieldbus:** Rosemount 2410 communicates with a host or a field communication unit via TRL2 Modbus, RS485 Modbus, Enraf or HART **Secondary fieldbus(2):** TRL2 Modbus, Enraf (other options available soon), *Wireless*HART for Smart Wireless THUM™ Adapter
Relay outputs	**SIL safety relay output(3):** One SIL 2/SIL 3 certified relay is available for overfill prevention. This non-intrinsically safe solid state relay is closed/energized during normal operation Maximum voltage and current: 260 VAC/VDC, 80 mA **Relay outputs (Non-SIL):** Maximum two relays, controlled by 10 independent virtual relay functions which can be configured for different tanks and process variables. The two non-intrinsically safe solid state relays are user configurable for normally energized or de-energized operation. Maximum voltage and current: 350 VAC/VDC, 80 mA

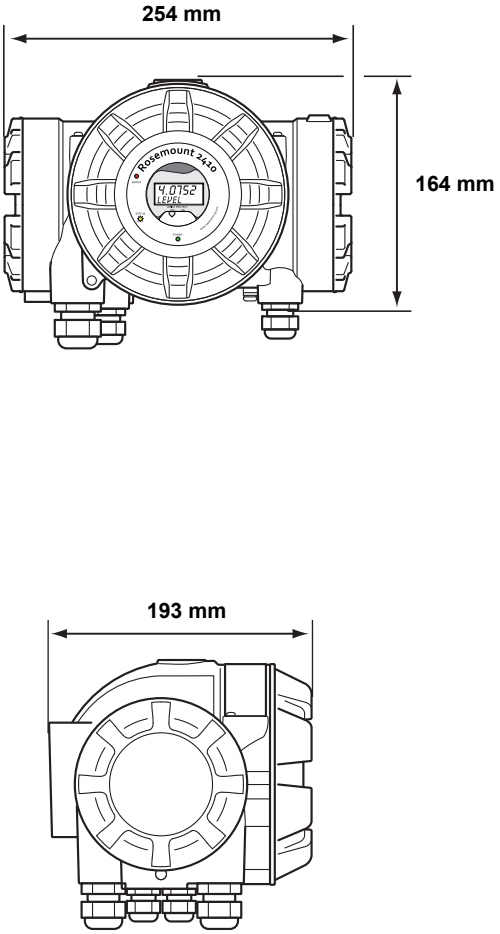
Analog input/output electrical characteristics	**Analog Input** Maximum number of input channels: 1 Input Current range: 0 - 23 mA Configurable Min and Max alarm limits. Lift-off voltage (Passive IS and NON-IS): 10.5V Max input voltage (Passive IS and NON-IS): 30V Output voltage (Active): Non-IS: 22 ±2.0V (open loop); 20.8 ±2.0V@3,75 mA; 14.8 ±2.0V @ 21.75 mA IS: 21 ±2.0V (open loop); 18.8 ±2.0V@3,75 mA; 8.2 ±2.0V @ 21.75 mA See 'Product Certifications' for IS parameters HART Master: Maximum 5 HART Slave Devices (Passive). Maximum 3 HART Slave Devices (Active). **Analog Output:** Maximum number of output channels: 1 Output range: 3.5-23 mA SW Configurable High and Low Alarm Limits. Separate SW Configurable Alarms for process failures and HW failure. Low voltage and invalid loop current detection. Lift-off voltage (Passive IS and NON-IS): 10.5V Max input voltage (Passive IS and NON-IS): 30V Output voltage (Active): Non-IS: 22 ±2.0V (open loop); 22.8 ±2.0V@3,75 mA; 16.8 ±2.0V @ 21.75 mA IS: 21 ±2.0V (open loop); 20.8 ±2.0V@3,75 mA; 10.2 ±2.0V @ 21.75 mA See Product Certifications for IS parameters HART slave configurable HART 5 or HART7[(4)] (HART 5 default)
Integral display output variables	The integral digital read-out display can toggle between: level, level rate, ullage, signal strength, volume (TOV), liquid average temperature, 1-16 spot temperature, vapor average temperature, ambient temperature, free water level, vapor pressure, liquid pressure, air pressure, observed density, reference density, and flow rate
Display output units[(5)]	Level, free water level, and ullage: meter, millimeter, feet, or imperial 1/16 Level rate: meter/second, meter/hour, feet/second, or feet/hour Flow rate: $meter^3$/hour, liter/minute, barrel/hour, or US gallon/hour Total Observed Volume (TOV): $meter^3$, liters, barrel, or US gallon Temperature: °F, °C, or °K Pressure: psi, psiA, psiG, bar, barA or barG, atm, Pa, or kPa Density: kg/m^3, °API, or 60/60DegF Signal strength: mV
Configuration tools	Rosemount TankMaster
Autoconfiguration support	Yes (Tankbus addressing)
Electric	
Power supply (nominal values)	24-48 VDC or 48-240 VAC, 50/60 Hz
Power consumption	Max. 20 W depending on configuration
Cable entry (connection/glands)	Non-IS side: Two ½ - 14 NPT and Two ¾-14 NPT entries for cable glands or conduits IS side: Two ½ - 14 NPT entries for cable glands or conduits Three metal plugs to seal any unused ports are included in the delivery. Optional: • M20 x 1.5 and M25 x 1.5 conduit / cable adapter • Cable glands in metal (½ - 14 NPT and ¾-14 NPT) • 4-pin male Eurofast connector or A size Mini 4-pin male Minifast connector
Tankbus cabling	0.5-1.5 mm^2 (AWG 22-16), twisted shielded pairs
Power and relay cabling	0.5-2.5 mm^2 (AWG 22-14), twisted shielded pairs
Maximum Tankbus cable lengths	Depends on cable. See “Cable Selection for the Tankbus” on page 3-6 for FISCO cable parameters.
Built-in Tankbus terminator	Yes (to be disconnected if required)

Mechanical	
Housing material	Polyurethane-covered die-cast aluminum
Installation	Can be installed on a 33.4-60.3 mm (1-2 in.) diameter pipe or wall
Dimensions	See “Dimensional drawings” on page A-4.
Weight	4.7 kg (10.4 lbs)
Environment	
Ambient temperature	-40 to 70 °C (-40 to 158 °F). Minimum start-up temperature is -50 °C (-58 °F). With LCD display: -25 to 70 °C (-13 to 158 °F)
Storage temperature	-50 to 85 °C (-58 to 185 °F) With LCD display: -40 to 85 °C (-40 to 185 °F)
Humidity	0 - 100% relative humidity
Ingress protection	IP 66 and IP 67 (Nema 4X)
Metrology sealing possibility	Yes
Write protect switch	Yes
Transient / built-in lightning protection	According to IEC 61000-4-5, level 4 kV line to ground. Complies with IEEE 587 Category B transient protection and IEEE 472 surge protection

(1) One Rosemount 5900S with 2-in-1 solution or maximum two Rosemount 5900S gauges installed on separate tanks can be connected to one tank hub. If two Rosemount 5900S gauges are installed on the same tank, two separate tank hubs are required.
(2) Not available with SIL option.
(3) Can not be combined with a secondary fieldbus.
(4) HCF registration is pending.
(5) Density, mass, and more volume parameters are calculated in Rosemount TankMaster (GOV, GSV, NSV, WIA/WIV).

A.2 DIMENSIONAL DRAWINGS

Figure A-1. Rosemount 2410 dimensions



A.3 ORDERING INFORMATION

Model (Pos 1)	Product Description	Note
2410	Tank Hub	
Code (Pos 2)	**Tankbus: Number of Tanks**	**Note**
S	Single tank	
M	Multiple tanks	Maximum 5 Rosemount 5300/5400 transmitters can be connected to one Tank Hub
Code (Pos 3)	**Tankbus: Power and Communication**	**Note**
F	Intrinsically safe FOUNDATION™ fieldbus (IEC 61158) power supply	
Code (Pos 4)	**Primary Fieldbus**	**Note**
R	TRL2 Modbus (standard)	
4	RS485 Modbus	
E	Enraf Bi-phase Mark GPU(1)	
Code (Pos 5)	**Secondary Fieldbus**	**Note**
R	TRL2 Modbus (standard)(2)	
E	Enraf Bi-phase Mark GPU	
W	*Wireless*HART (IEC 62591) connectivity (IS)(3)	
A	Analog Output 4-20 mA/HART, active (Non-IS)	For connection to a 3rd party system. Integrated power-supply. Maximum Tankbus current is reduced to 200 mA
C	Analog Output 4-20 mA/HART, active (IS)	For connection to a 3rd party system. Integrated power-supply. Maximum Tankbus current is reduced to 200 mA
B	Analog Output 4-20 mA/HART, passive (Non-IS)	For connection to a 3rd party system
D	Analog Output 4-20 mA/HART, passive (IS)	For connection to a 3rd party system
6	Analog Input 4-20 mA/HART, active (Non-IS)	For connection of a 3rd party instrument. Integrated power-supply. Max Tankbus current reduced to 200 mA
8	Analog Input 4-20 mA/HART, active (IS)	For connection of a 3rd party instrument. Integrated power-supply. Max Tankbus current reduced to 200 mA
7	Analog Input 4-20 mA/HART, passive (Non-IS)	For connection of a 3rd party instrument
9	Analog Input 4-20 mA/HART, passive (IS)	For connection of a 3rd party instrument
F	None, but ready for upgrade of secondary bus(4)	
0	None	
Code (Pos 6)	**Relay Output (SIS/SIL)**	**Note**
3	SIL 3-certified output as per IEC 61508(5)	Requires Rosemount 5900S with Safety Certification (SIS), code 3
2	SIL 2-certified output as per IEC 61508(5)	Requires Rosemount 5900S with Safety Certification (SIS), code 2
F	None, but ready for upgrade of safety certification (SIS)(6)	
0	None	
Code (Pos 7)	**Relay Output (Non-SIS/SIL)**	**Note**
2	Two (2xSPST)	
1	One (1xSPST)	
F	None. Ready for upgrade of Relay Output (Non-SIS/SIL)	
0	None	

Code (Pos 8)	Integral Display	Note
1	LCD	
0	None	
Code (Pos 9)	**Power Supply**	**Note**
P	Extended input range: 48-240 VAC at 50/60 Hz, and 24-48 VDC	
Code (Pos 10)	**Software**	**Note**
S	Standard	
Code (Pos 11)	**Hazardous Location Certification**	**Note**
E1	ATEX Flameproof with intrinsically safe output	
E5	FM-US Explosionproof with intrinsically safe output	
E6	FM-Canada Explosionproof with intrinsically safe output	
E7	IECEx Flameproof with intrinsically safe output	
K1	ATEX Flameproof + FM-US Explosionproof	
K3	ATEX Flameproof + IECEx Flameproof	
K4	FM-US Explosionproof + FM-Canada Explosionproof	
NA	No hazardous location certification	
Code (Pos 12)	**Custody Transfer Type Approval**	**Note**
R	OIML R85 E(7) 2008 performance certification	
0	None	
Code (Pos 13)	**Housing**	**Note**
A	Standard enclosure	Polyurethane-covered aluminium. IP 66/67
Code (Pos 14)	**Cable/Conduit Connections**	**Note**
1	½–14 NPT and ¾-14 NPT	Female thread. Includes 3 plugs
2	M20 x1.5 and M25x1.5 adapters	Female thread. Includes 3 plugs, and 3 adapters
G	Metal cable glands (½-14 and ¾-14 NPT)	Min. temperature -20 ˚C (-4 ˚F). ATEX / IECEx Exe approved. Includes 3 plugs, and 3 glands
E	Eurofast male, ½–14 NPT and ¾-14 NPT	Includes 3 plugs
M	Minifast male, ½–14 NPT and ¾-14 NPT	Includes 3 plugs
Code (Pos 15)	**Mechanical Installation**	**Note**
P	Mounting kit for both wall and pipe installation	1-2 in. vertical or horizontal pipes
W	Mounting kit for wall installation	
0	None	
Code	**Options – none or multiple selections are possible**	**Note**
QT	IEC 61508 certificate and FMEDA-data(8)	
ST	Engraved SST tag plate	
Model Code Example: 2410 - S F R 0 3 2 1 P S E1 R A 1 P - ST		

(1) Requires Secondary Fieldbus (Pos 5), code A-F, W, 0, 6-9.
(2) Requires Primary Fieldbus (Pos 4) code R or 4.
(3) Requires a separate Smart Wireless THUM™ Adapter (not included). Maximum Tankbus (FF) current is reduced to 200 mA.
(4) Requires Relay Output (Pos 6) code 0 or F.
(5) Requires Secondary Fieldbus (Pos 5), code 0 or Primary Fieldbus (Pos 4) code 4 and Secondary Fieldbus (Pos 5) code W, C, D, 8 or 9.
(6) Requires Secondary Fieldbus (Pos 5), code 0 or F.
(7) Requires a Rosemount 5900S gauge with the corresponding custody transfer approval. A Rosemount 2230 display or TankMaster is required for an approved read-out.
(8) Requires Relay Output (Pos 6) code 2 or 3 (SIL 3 or SIL 2).

Appendix B Product Certifications

B.1 SAFETY MESSAGES

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

⚠WARNING

Explosions could result in death or serious injury:

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

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

Do not remove the device covers in explosive atmospheres when the circuit is alive.

⚠WARNING

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

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

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

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

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

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

⚠WARNING

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

Avoid contact with leads and terminals.

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

B.2 EU CONFORMITY

The EC declaration of conformity for all applicable European directives for this product can be found on the Rosemount website at www.rosemount.com. A hard copy may be obtained by contacting our local sales representative.

B.3 HAZARDOUS LOCATIONS CERTIFICATIONS

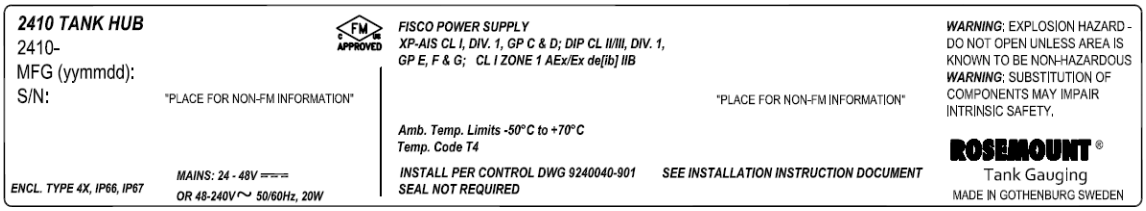
The Rosemount 2410 Tank Hubs that have the following labels attached have been certified to comply with the requirements of the approval agencies noted.

B.3.1 Factory Mutual US Approvals

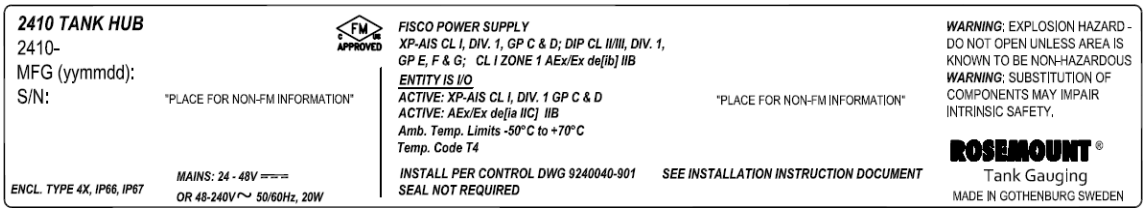
Certificate of Compliance: 3035492.

Figure B-1. Factory Mutual US approval labels

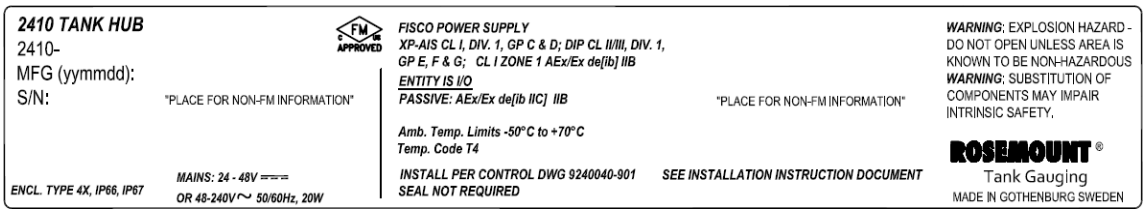
No Current Loop



Active Current Loop



Passive Current Loop



E5

FISCO Power Supply

Explosion Proof Class I, Division 1, Groups C and D

Dust-ignitionproof Class II and III, Division 1, Groups E, F, and G

Associated Intrinsically Safe Class I, Division 1, Groups C and D

Class I Zone 1 AEx de[ib] IIB

U_o=15V, I_o=354mA, P_o=5.32W

HART/4-20 mA ENTITY IS I/O Option

Active Current Loop

XP-AIS CL I, DIV. 1 GP C & D

AEx de[ia IIC] IIB

U_o = 23.1 V, I_o = 95.3 mA, P_o = 550 mW

Group IIC: $C_o \leq 0.14$ μF, $L_o \leq 3.9$ mH

Group C, IIB: $C_o \leq 1.0$ μF, $L_o \leq 15$ mH

Group D, IIA: $C_o \leq 3.67$ μF, $L_o \leq 33$ mH

Passive Current Loop

AEx de[ib IIC] IIB

U_i = 30.0 V, I_i = 300 mA, C_i = 0 μF, L_i = 0 mH

Ambient Temperature Limits: -50 °C to +70 °C

Temperature Code T4

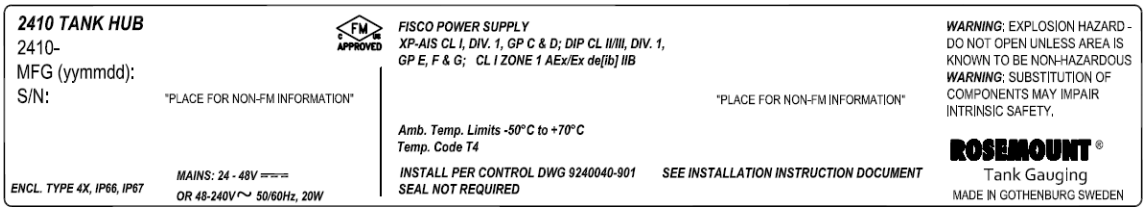
Install per Control Drawing 9240040-901

B.3.2 Factory Mutual Canadian Approvals

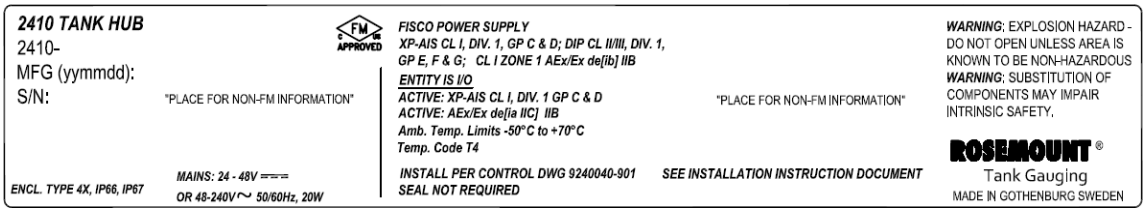
Certificate of Compliance: 3035492C.

Figure B-2. Factory Mutual Canadian approval labels

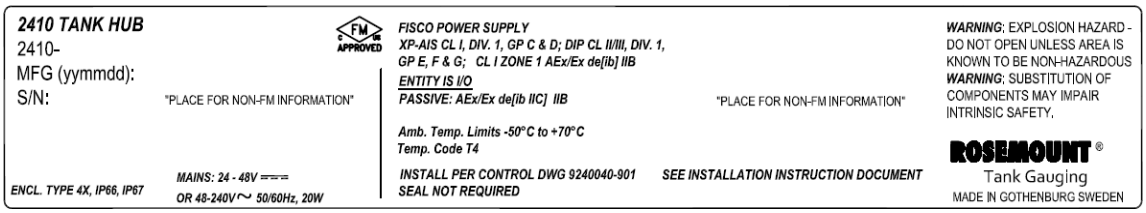
No Current Loop



Active Current Loop



Passive Current Loop



E6

FISCO Power Supply

Explosion Proof Class I, Division 1, Groups C and D

Dust-ignitionproof Class II and III, Division 1, Groups E, F, and G

Associated Intrinsically Safe for Class I, Division 1, Groups C and D

Class I Zone 1 Ex de[ib] IIB

U_o=15V, I_o=354mA, P_o=5.32W

HART/4-20 mA ENTITY IS I/O Option

Active Current Loop

XP-AIS CL I, DIV. 1 GP C & D

Ex de[ia IIC] IIB

U_o = 23.1 V, I_o = 95.3 mA, P_o = 550 mW

Group IIC: $C_o \leq 0.14$ μF, $L_o \leq 3.9$ mH

Group C, IIB: $C_o \leq 1.0$ μF, $L_o \leq 15$ mH

Group D, IIA: $C_o \leq 3.67$ μF, $L_o \leq 33$ mH

Passive Current Loop

Ex de[ia IIC] IIB

U_i = 30.0 V, I_i = 300 mA, C_i = 0 μF, L_i = 0 mH

Ambient Temperature Limits: -50 °C to +70 °C

Temperature Code T4

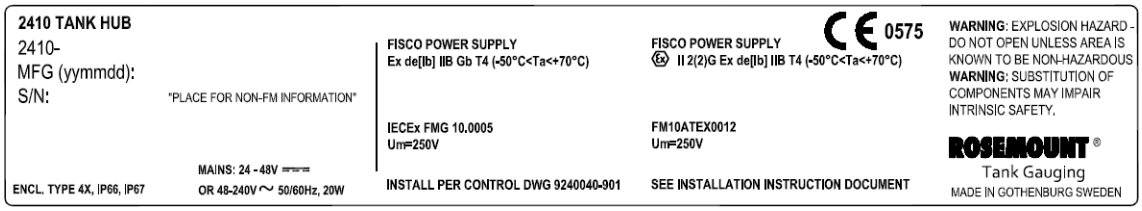
Install per Control Drawing 9240040-901

B.3.3 European ATEX Directive Information

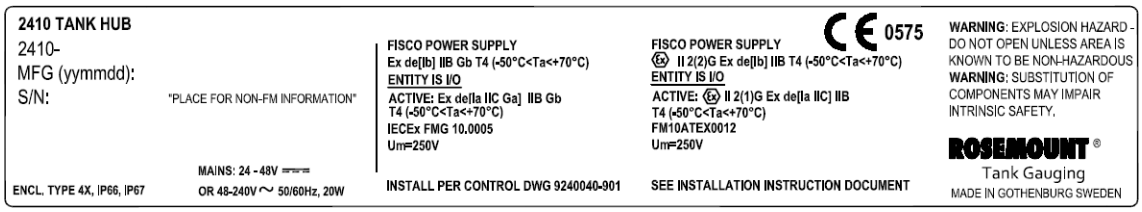
The Rosemount 2410 Tank Hubs that have the following label attached have been certified to comply with Directive 94/9/EC of the European Parliament and the Council as published in the Official Journal of the European Communities No. L 100/1 on 19-April-1994.

Figure B-3. ATEX approval labels

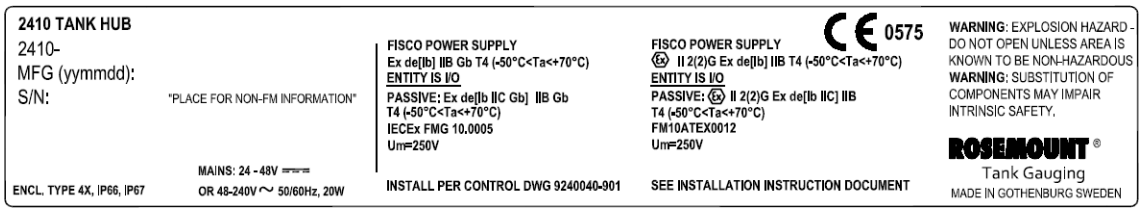
No Current Loop



Active Current Loop



Passive Current Loop



E1 The following information is provided as part of the label of the device:

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

  CE 0575

- Model number
- Serial number of the device
- Year of construction
- ATEX EC-Type Examination Certificate Number FM10ATEX0012
- Install per Control Drawing: 9240040-901

FISCO Power Supply

Ex de[ib] IIB T4 (-50 °C ≤ Ta ≤ +70 °C)

U_o=15V, I_o=354mA, P_o=5.32W

Um=250 V

HART/4-20 mA ENTITY IS I/O Option

Active Current Loop

Ex de[ia IIC] IIB T4 (-50 °C<Ta<+70 °C)

U_o = 23.1 V, I_o = 95.3 mA, P_o = 550 mW

Group IIC: $C_o \leq 0.14$ uF, $L_o \leq 3.9$ mH

Group IIB: $C_o \leq 1.0$ uF, $L_o \leq 15$ mH

Group IIA: Co ≤ 3.67 uF, Lo ≤ 33 mH

Passive Current Loop

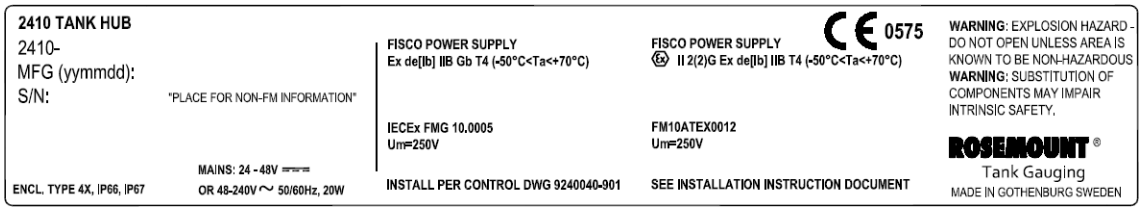
Ex de[ib IIC] IIB T4 (-50 °C<Ta<+70 °C)

U_i = 30.0 V, I_i = 300 mA, C_i = 0 μF, L_i = 0 mH

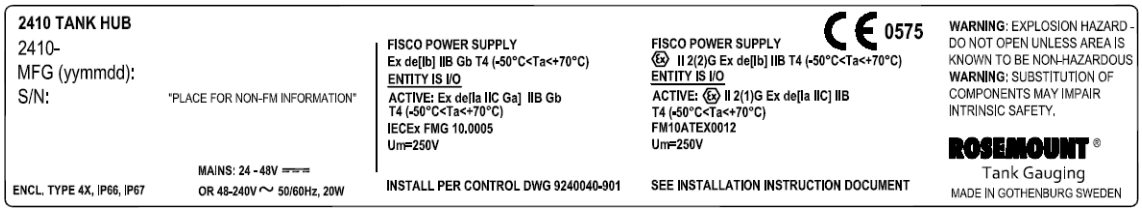
B.3.4 IECEx Approval

Figure B-4. IECEx approval labels

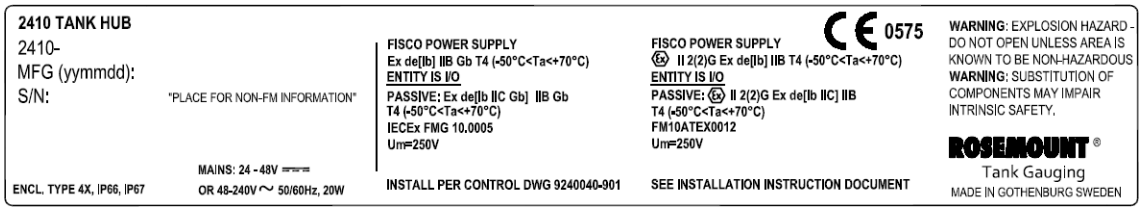
No Current Loop



Active Current Loop



Passive Current Loop



E7 The following information is provided as part of the label of the device

- Name and address of the manufacturer (Rosemount)
- Model number
- Serial number of the device
- IECEx Certificate of Conformity Number IECEx FMG 10.0005
- Install per Control Drawing: 9240040-901

FISCO Power Supply

Ex de[ib] IIB Gb T4 (-50 °C ≤ Ta ≤ +70 °C)

U_o=15V, I_o=354mA, P_o=5.32W

Um=250 V

HART/4-20 mA ENTITY IS I/O Option

Active Current Loop

Ex de[ia IIC Ga] IIB Gb T4 (-50 °C<Ta<+70 °C)

U_o = 23.1 V, I_o = 95.3 mA, P_o = 550 mW

Group IIC: $C_o \leq 0.14$ uF, $L_o \leq 3.9$ mH

Group IIB: $C_o \leq 1.0$ uF, $L_o \leq 15$ mH

Group IIA: $C_o \leq 3.67$ uF, $L_o \leq 33$ mH

Passive Current Loop

Ex de[ib IIC Gb] IIB Gb T4 (-50 °C<Ta<+70 °C)

U_i = 30.0 V, I_i = 300 mA, C_i = 0 μF, L_i = 0 mH

B.4 APPROVAL DRAWINGS

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

The following drawing is included in the documentation for the Rosemount 2410 Tank Hub:

9240040-901 System Control Drawing for hazardous location installation of intrinsically safe FM ATEX, FM IECEx, FM-US, and FM-C approved apparatus.

See the “Manuals & Drawings” CD ROM that is shipped with the 2410 Tank Hub for electronic copies of the system control drawings.

Drawings are also available on the Rosemount Tank Gauging web site: www.rosemount-tg.com.

Appendix C Advanced Configuration

C.1 SAFETY MESSAGES

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

⚠WARNING

Explosions could result in death or serious injury:

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

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

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

⚠WARNING

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

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

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

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

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

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

⚠WARNING

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

Avoid contact with leads and terminals.

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

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

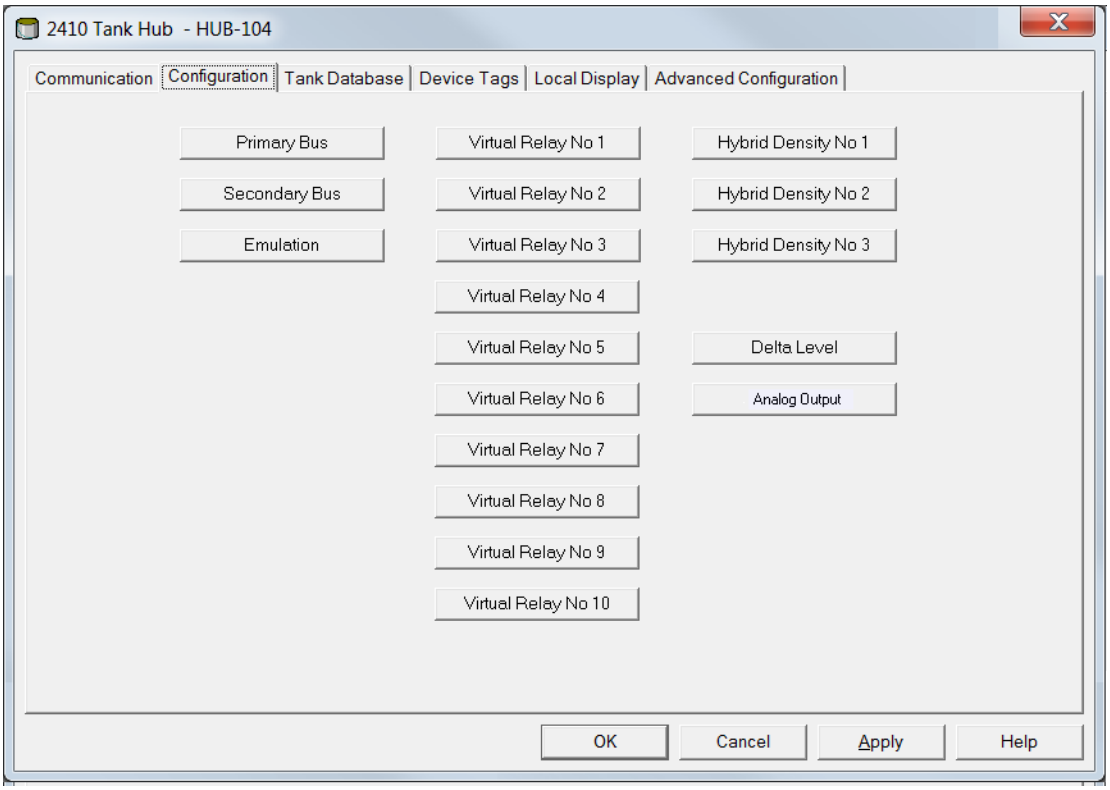
C.2 ADVANCED CONFIGURATION IN WINSETUP

There are advanced configuration options for the Rosemount 2410 Tank Hub which are not included in the TankMaster WinSetup installation wizard. These options are available via the **Properties** option in the WinSetup configuration software.

To access the advanced configuration options for the Rosemount 2410, do the following:

1. In the TankMaster WinSetup workspace, click the right mouse button on the 2410 Tank Hub icon.
2. Choose the **Properties** option. The *2410 Tank Hub* window appears.

Figure C-1. The *2410 Tank Hub/Configuration* window includes tabs for basic and advanced configuration



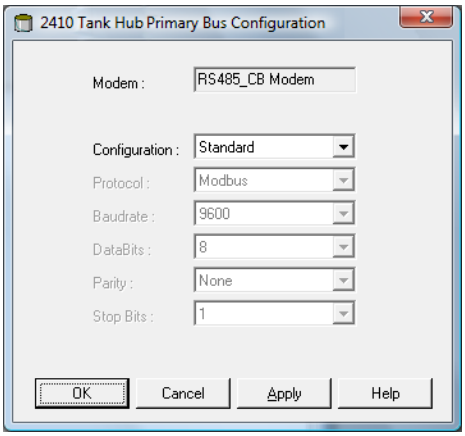
3. Select the *Configuration* tab.
4. The *Configuration* window contains buttons for Primary and Secondary Bus, Virtual Relays, and Hybrid Density calculation. See the following sections for more information on how to configure these functions.

C.3 PRIMARY BUS

The Rosemount 2410 has a Primary Bus which is used for communication with a Rosemount 2160 Field Communication Unit (FCU) or a control room computer. The Primary Bus supports TRL2 and RS-485 bus communication. To open the *Primary Bus* window:

1. In the WinSetup workspace click the right mouse button on the 2410 icon.
2. Choose the **Properties** option.
3. In the *2410 Tank Hub* window select the *Configuration* tab.
4. Click the **Primary Bus** button.

Figure C-2. *Primary Bus Configuration* window



The *Primary Bus Configuration* window allows you to configure protocol, baudrate, and other communication settings. This may, for example, be useful for maximizing communication speed when upgrading the software of a 2410 Tank Hub.

To change communication parameters:

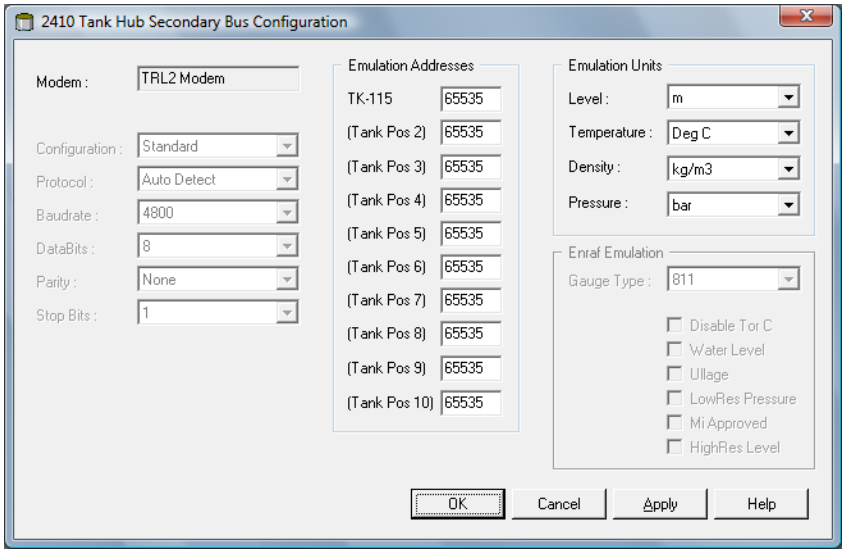
1. In the *Configuration* field, change from *Standard* to *Non Standard*.
2. Choose the desired communication parameter values.
3. Click OK to store the current configuration and close the *Primary Bus Configuration* window.

C.4 SECONDARY BUS

The Rosemount 2410 Secondary Bus is used for communication with emulated devices. It supports protocols such as the TRL2 Modbus, Enraf, Varec, L&J, and Profibus. To open the *Secondary Bus* window:

1. In the WinSetup workspace click the right mouse button on the 2410 icon
2. Choose the **Properties** option.
3. In the *2410 Tank Hub* window select the *Configuration* tab.
4. Click the **Secondary Bus** button.

Figure C-3. *Secondary Bus Configuration* window



The *Secondary Bus Configuration* window allows you to change protocol, baudrate, adress, and other communication settings.

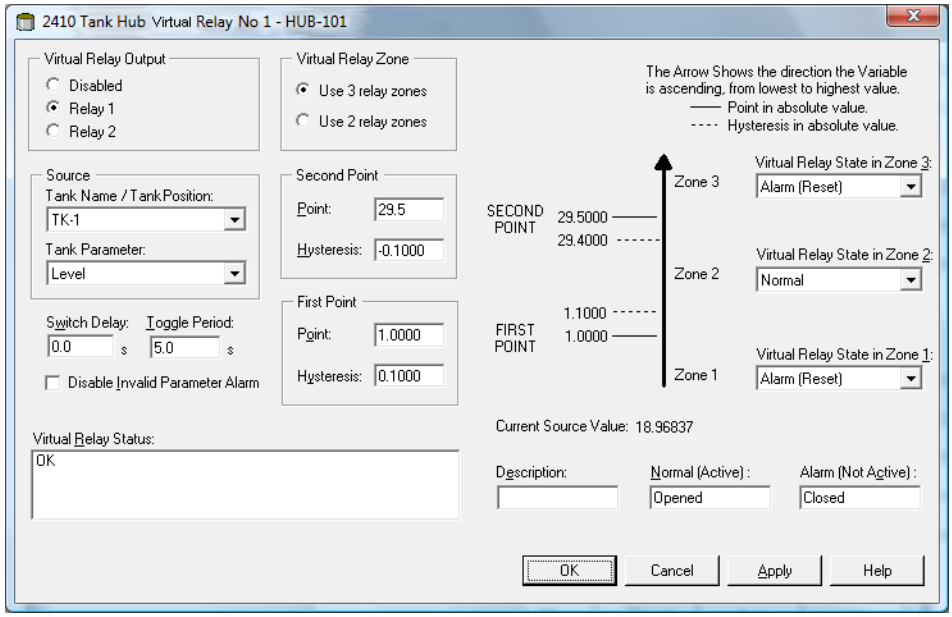
C.5 RELAY OUTPUT

The Rosemount 2410 has two relays which can be configured with one or two set points. Virtual relay output, (Disabled, Relay1, Relay2), source, set-point etc. can also be specified. The 2410 Tank Hub supports virtual relay functionality that lets you specify up to ten source parameters to control the two hardware relays. The output of a virtual relay can be directed towards any of the two relays, allowing a high configuration flexibility. You may, for example, use one of the relays (Relay1 or Relay2) as a high level alarm for several tanks by using Level as source parameter for each tank. Many other configurations are possible using the two relays for various virtual relay configurations.

To configure a 2410 Tank Hub Virtual Relay:

1. In the WinSetup workspace click the right mouse button on the 2410 icon, choose **Properties** and select the *Configuration* tab.
2. Click one of the *Virtual Relay No.* buttons (see “Advanced Configuration in Winsetup” on page C-3).

Figure C-4. 2410 Relay Output Configuration



Using two/three relay zones

You may use two or three relay zones. Different relay states can be used in each of these zones.

With two relay zones, use one set point: First Point.

With three relay zones, use two set points: First Point and Second Point.

First and second set points

The first and second set points define the transitions between Zone 1, 2 and 3. You can set different relay states in each of these zones.

First Point defines the transition between Zone 1 and 2.

Second Point defines the transition between Zone 2 and 3.

Hysteresis

When the source variable passes a set point, the relay switches from one state to the other. When the source signal returns back into the previous zone, the relay does not switch back to the previous state until it has passed both the set point and the hysteresis zone.

Virtual Relay States

There are three **virtual** relay states available:

Table C-1. 2410 Relay States

Virtual Relay State	Description
Alarm	In the Alarm state the relay is de-energized. Depending on how the relays are connected, they will be either open or closed in the de-energized state. Note that a relay defined as **Normally Open** will be open in the Alarm state. If the relay is configured as **Normally Closed** it will be closed in the Alarm state.
Normal	In the Normal state the relay is energized.
Toggle	The relay switches periodically between Normal and Alarm

Virtual Relay Output

The Virtual Relay Output setting determines whether the relays are active or disabled.

Table C-2. 2410 Relay Control Modes

Virtual Relay Output	Description
Disabled	The relay function is turned off.
Relay 1/Relay 2	Specifies the actual relay that the Relay Output is connected to. The Rosemount 2410 Tank Hub can be equipped with one or two relays.

Source

Specifies the measurement variable that triggers the relay switching.

“Tank Name/Tank Position” refers to the tank position in the Rosemount 2410 Tank Database. The Tank Database maps all devices connected to the 2410 Tank Hub to the specific tanks, see the *Raptor System Configuration Manual* (Document no. 300510EN) for more information about configuration of the 2410 Tank Database.

Tank Parameter refers to the measurement variable that triggers the relay switching. For example, *Level*, *Delta_Level*, *Ullage* or any other variable can be chosen as source.

Switch Delay

This is the delay time for the relay to switch into alarm state, i.e. the amount of time it takes for a relay to respond to an alarm. You can use this parameter to prevent the relay from switching due to small temporary variations of the source signal. This may for example occur if there is a turbulent product surface.

Toggle Period

When the relay is in Toggle state it switches between On and Off at a rate defined by the Toggle Period.

Relay output configuration

The relay output can be selected as either **Normally Open** or **Normally Closed** referring to the contact position when the relay is de-energized. This also refers to the Alarm (Reset) state.

The relay terminology can be summarized as shown in Table C-3:

Table C-3. Relay state terminology

Normally Closed		Normally Open	
Closed	Open	Open	Closed
De-energized	Energized	De-energized	Energized
Not Active	Active	Not Active	Active
Alarm (Reset)	Normal	Alarm (Reset)	Normal

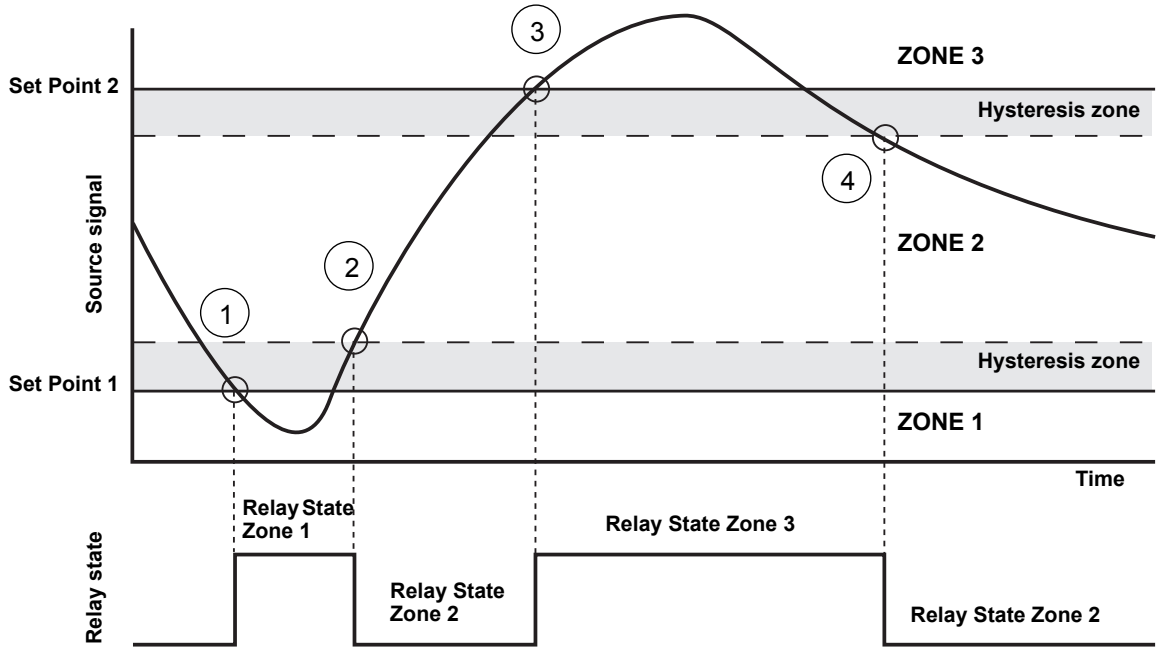
See “Relay Output Configuration” on page 6-15 for more information on how to set the Rosemount 2410 up for the desired relay output Normally Open or Normally Closed.

Relay Zones

You can use one or two set points for relays connected to the Rosemount 2410 Tank Hub. Consequently, there are two or three zones in which different relay states can be specified. For each zone you can set any of the three available relay states Normal, Alarm or Toggle.

For each set point you can specify a hysteresis zone preventing the relay from switching back to its previous state as long as the source variable is changed only small amounts around a certain set point. The principle of relay set points and hysteresis zones is shown in the figure below. Note that in this example only two states are used.

Figure C-5. Relay zones



1. The source signal passes set point 1, and the relay state changes according to the definition for Zone 1.
2. When the source signal returns into Zone 2, it does not change to the Zone 2 state until it has passed the hysteresis zone.
3. The source signal passes set point 2, and the relay state is changed according to the definition for Zone 3.
4. The relay switches back to the Zone 2 relay state when the source signal has passed set point 2 and the associated hysteresis value.

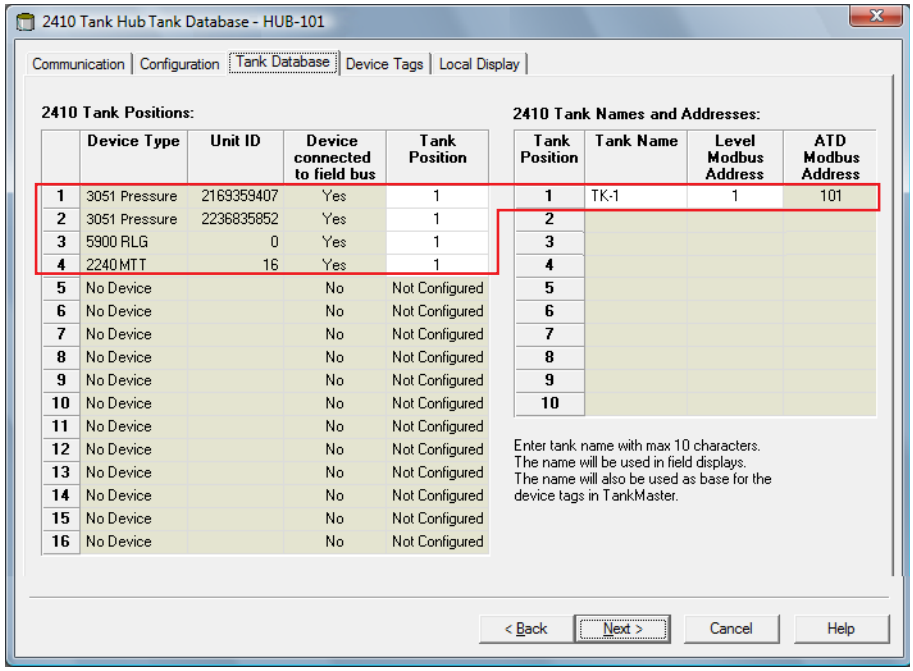
C.6 HYBRID DENSITY CALCULATION

The *Rosemount TankMaster* software can be used in a hybrid density system to calculate Observed Density. Density calculations are also available for a host system connected directly to a Rosemount 2410 without using *TankMaster*. Then the density calculations are performed internally by the 2410 Tank Hub.

To set up a Rosemount 2410 for hybrid density applications do the following:

1. Install and connect the devices on the tank including the Vapor Pressure sensor (P3) and the Liquid Pressure sensor (P1).
2. Start the *TankMaster Winsetup* configuration program.
3. Configure the Rosemount 2410 Tank Hub as described in the *Raptor System Configuration* manual (Document no. 300510EN). Ensure that the appropriate devices are associated with the current tank in the 2410 tank database as illustrated in Figure C-6.
   In the example below a Rosemount 5900S Radar Level Gauge, a Rosemount 2240S Multi-input Temperature Transmitter, and two Rosemount 3051S Pressure Transmitters (P1 and P3) are installed on the tank.

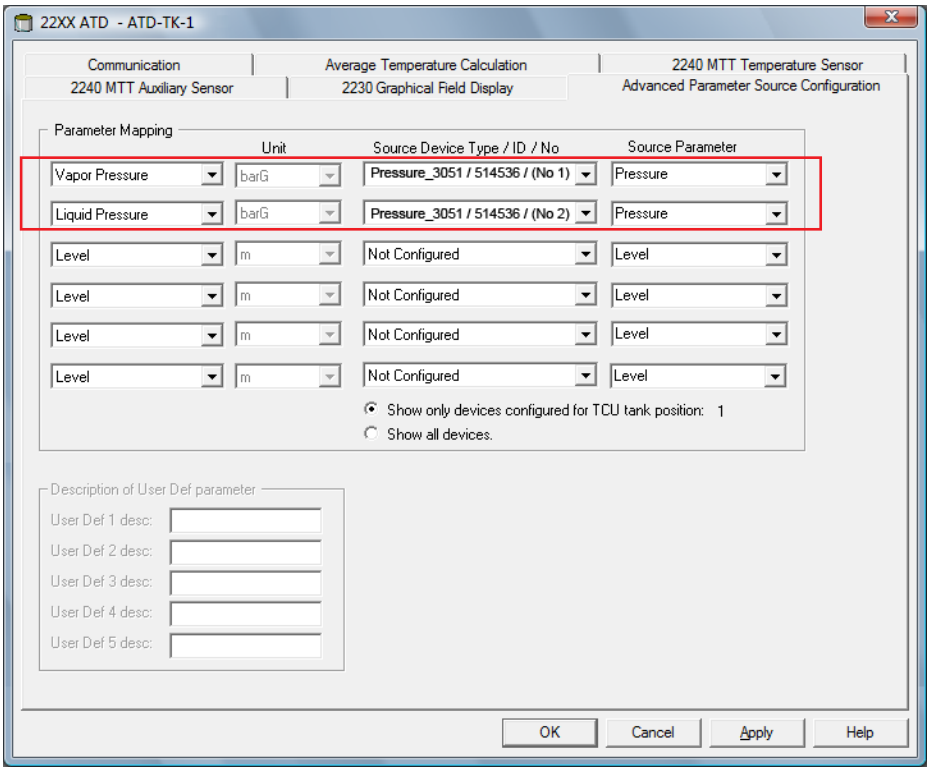
Figure C-6. 2410 Tank Database configuration



4. Configure the 5900S Radar Level Gauge as described in the *Raptor System Configuration* manual.
5. Configure the Auxiliary Tank Devices (Rosemount 2240S Multi-input Temperature Transmitter) as described in the *Raptor System Configuration* manual.

6. In the 22XX *ATD/Advanced Parameter Source Configuration* window, ensure that the **Vapor Pressure** (P3) and **Liquid Pressure** (P1) parameters are mapped to the actual source devices on the tank. In case there is no vapor pressure sensor installed, a manual value can be used instead.

Figure C-7. Pressure parameters are mapped to the actual sensors



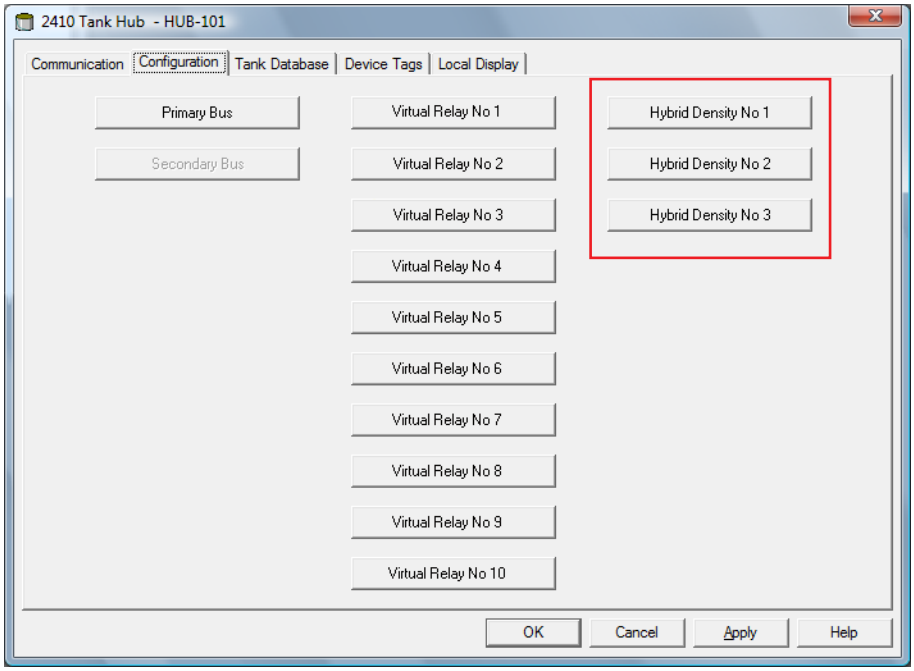
7. Configure the 2410 Hybrid Density function, see “Hybrid Density Configuration” on page C-12.
8. Configure the tank as described in the *Raptor System Configuration* manual.

C.6.1 Hybrid Density Configuration

To configure the Rosemount 2410 hybrid density function do the following:

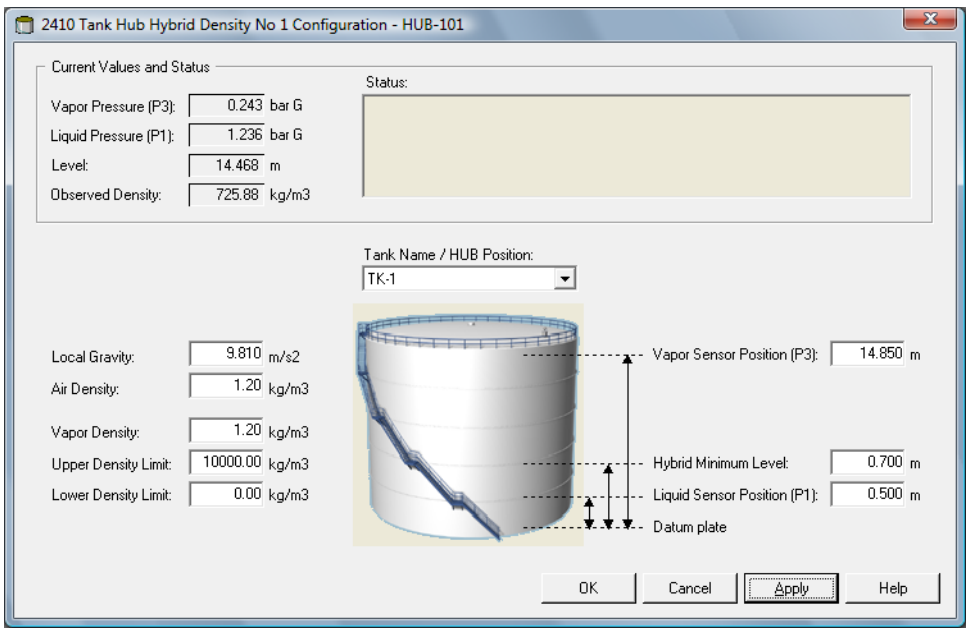
1. Open the *2410 Tank Hub/Configuration* window.

Figure C-8. 2410 Properties window



2. Click the **Hybrid Density No. [X]** button to open the *2410 Tank Hub Hybrid Density Configuration* window. Up to three tanks can be configured for Hybrid Density calculations.

Figure C-9. 2410 Hybrid Density Configuration window



3. From the Tank Name/Hub Position list select the tank to be configured for hybrid density calculations.
4. Enter Local Gravity, Air Density and Vapor Density. These parameters are used for calculating the Observed Density. See the TankMaster WinOpi Reference Manual (Document No. 303028EN) for more information on inventory calculations.
   Enter Upper and Lower Density Limits for the Observed Density. Density values outside this range will be notified by TankMaster.
5. Enter the P1 Sensor Position, i.e. the position of the center of the Liquid Pressure sensor membrane.
6. Enter the **Hybrid Min Level**. This value specifies the lowest product level at which TankMaster calculates the Observed Density. Normally, the accuracy of pressure sensors is reduced at low pressures, i.e. at product levels close to the sensor membrane. Therefore, you can specify a limit below which the density calculation is “frozen”. For example, if Hybrid Min Level is equal to 2.0 meter, the Raptor system will present a fixed density value for product levels below 2.0 meter.

NOTE!
Specify the actual product level and not the distance between the pressure sensor and the product surface.

7. Enter the P3 Sensor Position, i.e. the position of the center of the Vapor Pressure sensor membrane measured from the tank Zero Level/Datum Plate.
8. Click the OK button to save the Hybrid Density configuration.

C.7 VOLUME CONFIGURATION

To configure the Rosemount 2410 Tank Hub for volume calculations, choose one of the standard tank shapes, or the strapping table option, see Table C-4 on page C-15. Select None if volume calculation is not used. For the standard tanks, a Volume Offset parameter can be specified to be used for a non-zero volume that corresponds to the Zero Level. This may be useful, for example, if you like to include the product volume below the zero level.

Volume calculation is performed by using a predefined tank shape or a strapping table.

NOTE!
For application software version 1.B5 and older, tank volume calculation has to be enabled in Holding Register 6136 (see “Enable Volume Calculation in 2410 Tank Hub” on page C-17).

One of the following standard tank shapes can be chosen:

- Sphere
- Horizontal Cylinder
- Vertical Cylinder

The following parameters must be entered for a standard tank shape:

- Tank diameter
- Tank length (for horizontal cylinder)
- Volume Offset (use this parameter if you like to include product volume below the zero level)
- For application software version 1.B5 and older, tank volume calculation has to be enabled by setting bit 31 "TANK_VOLUME" in Holding Register 6136

Strapping Table

The Strapping Table option should be used when the tank shape deviates significantly from an ideal sphere or cylinder, or when high volume accuracy is required.

The Strapping Table divides the tank into segments. Level values and corresponding volumes are entered starting at the bottom of the tank. These figures can typically be obtained from tank drawings or from a certificate provided by the tank manufacturer. A maximum of 100 strapping points can be entered. For each level value the corresponding total volume up to the specified level is entered.

The volume value is interpolated if the product surface is between two level values in the table.

Holding and Input Registers for Volume Configuration

Holding registers 4300 to 4732 are used for volume configuration. The different parameters are given in Table C-4 below (see “Viewing Input and Holding Registers” on page 6-2 for more information on how to view and edit Holding Registers).

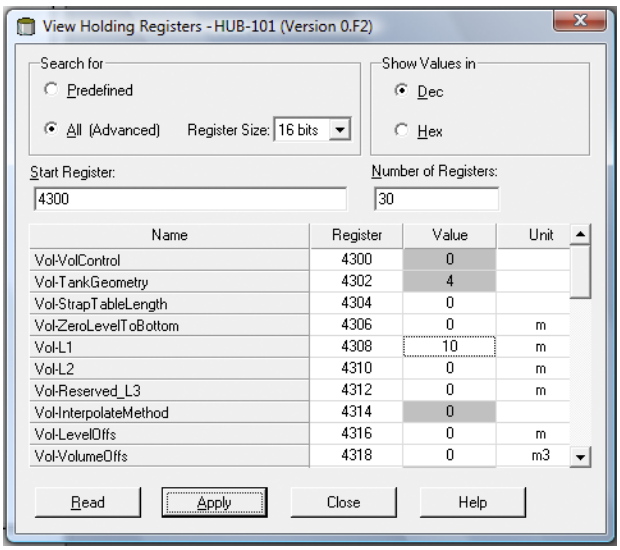
When the Rosemount 2410 is configured for volume calculations the resulting volume values are available in input register area IR3400 to IR3458, IR4700 to IR4710, and IR30000 to IR38000 as illustrated in Figure C-11 on page C-16.

Table C-4. Holding registers for volume configuration

Name	Holding Register no.	Description
Volume control	4300	Bit 1: Volume over Zero. By setting this bit presentation of negative volumes for product levels below the Zero level is prevented.
Tank Geometry	4302	0: None 1: Strapping table 2: Sphere 3: Horizontal cylinder 4: Vertical cylinder
Strap table length	4304	Number of strapping table points used
Zero Level To Bottom	4306	Distance from zero level to the tank bottom
L1	4308	Tank diameter
L2	4310	Tank length (for horizontal cylinder)
Interpolation method	4314	0: linear 1: Quadratic
Level offset	4316	Strapping table offset. You can use this function to shift the zero level (empty tank) from the Datum Plate to the bottom of the tank. The Level Offset will be added to the measured level and then used to find the corresponding volume value in the strapping table. A positive Level Offset value will increase the displayed volume.
Volume offset	4318	Strapping table volume offset. Use this function to include product volume below the zero level. This offset will be added to the calculated volume. **Note**: the Volume Offset is added when predefined tank shapes are used as well.
Volume unit	4320	40: Us Gallons 41: Liter 42: UK Gallons 43: Cubic Meter 46: Barrels 112: Cubic Feet
Tank no. (The 2410 Tank Database shows which devices are mapped to the different tanks)	4322	0: not active 1: tank 1 2: tank 2 n: tank n 10: tank 10
Strap table level 0	4334	Level value for strapping table point no. 0
Strap table volume 0	4336	Volume value for strapping table point no. 0
Strap table level 1	4338	Level value for strapping table point no. 1
Strap table volume 1	4340	Volume value for strapping table point no. 1
Strap table level 99	4730	Level value for strapping table point no. 99
Strap table volume 99	4732	Volume value for strapping table point no. 99

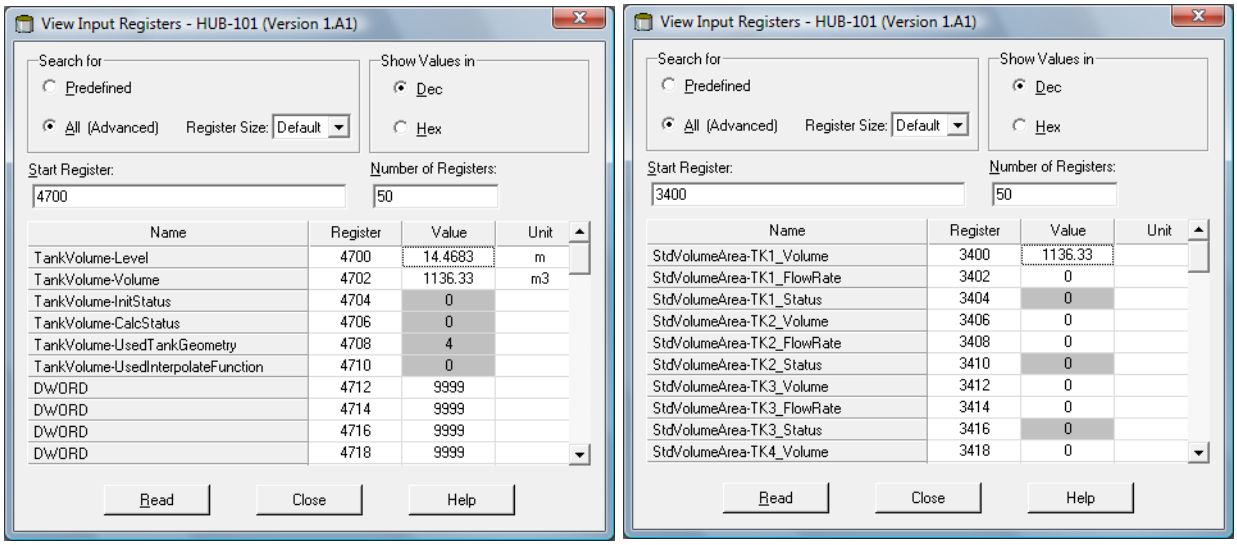
The TankMaster WinSetup program lets you edit Holding registers for volume calculations as illustrated in Figure C-10.

Figure C-10. Holding register view for volume configuration in TankMaster WinSetup



The volume calculation result is available in input register **IR4702** as well as in input register area starting with **IR3400** (tank 1). The result can be presented in the *View Input Registers* window as illustrated in Figure C-11:

Figure C-11. Input register view for volume read-out in TankMaster WinSetup

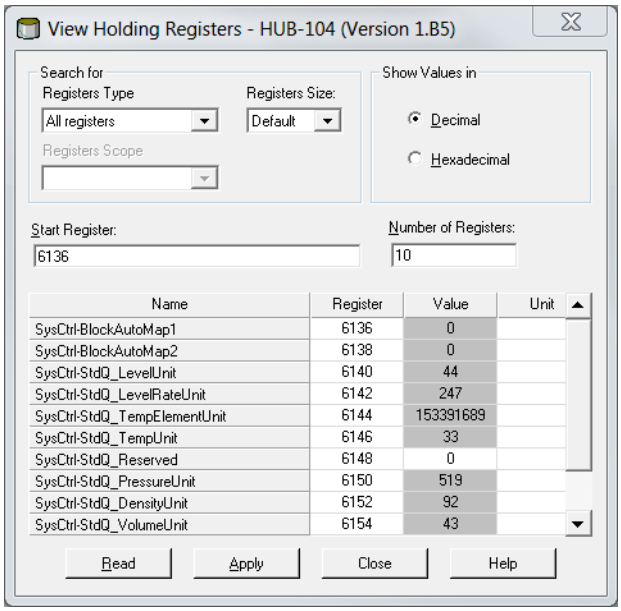


The volume values are also available in input register area starting with **IR30000** (IR30148 for tank 1).

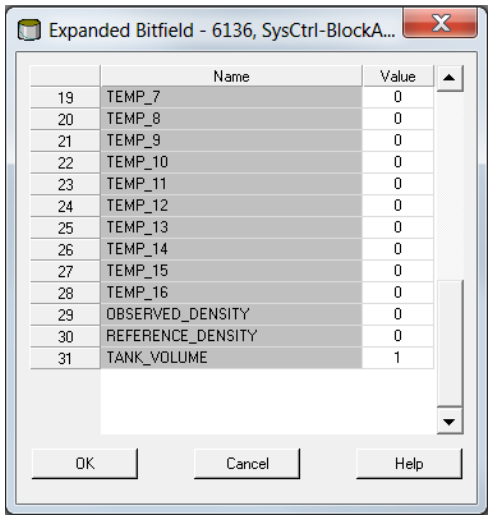
Enable Volume Calculation in 2410 Tank Hub

For application software version 1.B5 and older, tank volume calculation has to be enabled by setting bit 31 "TANK_VOLUME" in Holding Register 6136.

1. In the TankMaster Winsetup workspace click the right mouse button on the 2410 icon.
2. Choose the *View Holding Registers* option.



3. Choose Start Register 6136 and click the Read button.
4. For register 6136, double-click the Value field.



5. Scroll down to bit 31. If bit 31=0, double-click the Value field to set bit 31=1.
6. Click OK. In the *View Holding Registers* window, click the Apply button and close the window.

C.8 ARITHMETIC OPERATIONS

The Rosemount 2410 Tank Hub supports various arithmetic calculations. Holding Registers 4800 to 4879 are used for up to 10 arithmetic operations. You may perform several operations for one or many tanks.

Arithmetic operations can, for example, be used to calculate the difference between product levels measured by two different level gauges.

Figure C-12. Rosemount 2410 Holding registers for arithmetic operations

Name	Holding Register no.	Description
Arithmetic1 operation	4800	Arithmetic operation to perform 0: None 1: Subtraction 2: Addition 3: Multiplication 4: Division
Arithmetic1 miscellaneous configuration	4801	Ignore Source Unit
Arithmetic1 TMV type destination	4802	Tank measurement variable in which the result is stored. 56: TMV Delta Level 60: TMV User Defined 1 61: TMV User Defined 2 62: TMV User Defined 3 63: TMV User Defined 4 64: TMV User Defined 5
Arithmetic1 tank number destination	4803	Tank in which the result is stored. 0: Not active 1: Tank 1 2: Tank 2 3: Tank 3 4: Tank 4 5: Tank 5 6: Tank 6 7: Tank 7 8: Tank 8 9: Tank 9 10: Tank 10
Arithmetic1 A TMV Type	4804	Tank measurement variable type for the arithmetic operation parameter A
Arithmetic1 A tank number	4805	Tank for the arithmetic operation parameter A. 0: Not active 1: Tank 1 2: Tank 2 3: Tank 3 4: Tank 4 5: Tank 5 6: Tank 6 7: Tank 7 8: Tank 8 9: Tank 9 10: Tank 10
Arithmetic1 B TMV Type	4806	Tank measurement variable type for the arithmetic operation parameter B

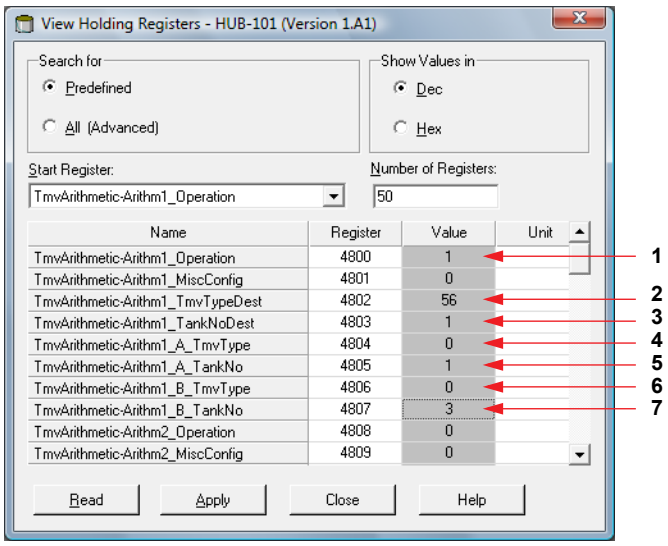
Name	Holding Register no.	Description
Arithmetic1 B tank number	4807	Tank for the arithmetic operation parameter B. 0: Not active 1: Tank 1 2: Tank 2 3: Tank 3 4: Tank 4 5: Tank 5 6: Tank 6 7: Tank 7 8: Tank 8 9: Tank 9 10: Tank 10
Arithmetic2 operation	4808	
Arithmetic3 operation	4816	
-	-	
Arithmetic10 operation	4872	

C.8.1 Delta Level Calculation

The following example illustrates how to use TankMaster WinSetup to configure a Rosemount 2410 to calculate the difference between product levels for two tanks **Tank 1** and **Tank 3**. The result is stored in tank measurement variable *Delta_Level* in Tank 1.

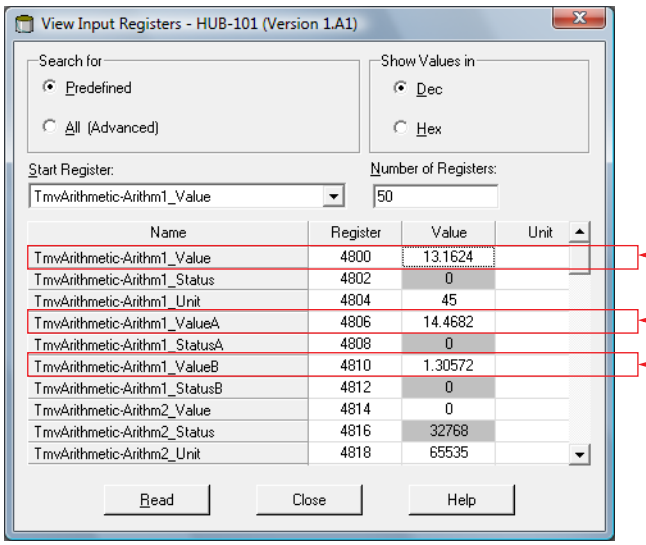
A Virtual Relay Output can be configured to use the measurement variable *Delta_Level* as source parameter to trigger the relay whenever the level difference exceeds a specified value. See “Relay Output” on page C-6 for more information on how to configure relay functions for a Rosemount 2410.

Figure C-13. Arithmetic operations are configured in Holding Registers 4800 to 4879



1. **Choose subtraction.**
2. **Put the result in Tank Measurement Variable TMV_Delta_Level.**
3. **Put the result in Tank 1. Now the result will be stored in TMV_Delta_Level for Tank 1.**
4. **For arithmetic operation parameter A choose Tank Measurement Variable=Level.**
5. **Choose arithmetic operation parameter A from Tank 1.**
6. **For arithmetic operation parameter B choose Tank Measurement Variable=Level.**
7. **Choose arithmetic operation parameter B from Tank 3.**

Figure C-14. The result is displayed in Input Register 4800 and higher



The result is displayed in Input Register 4800.

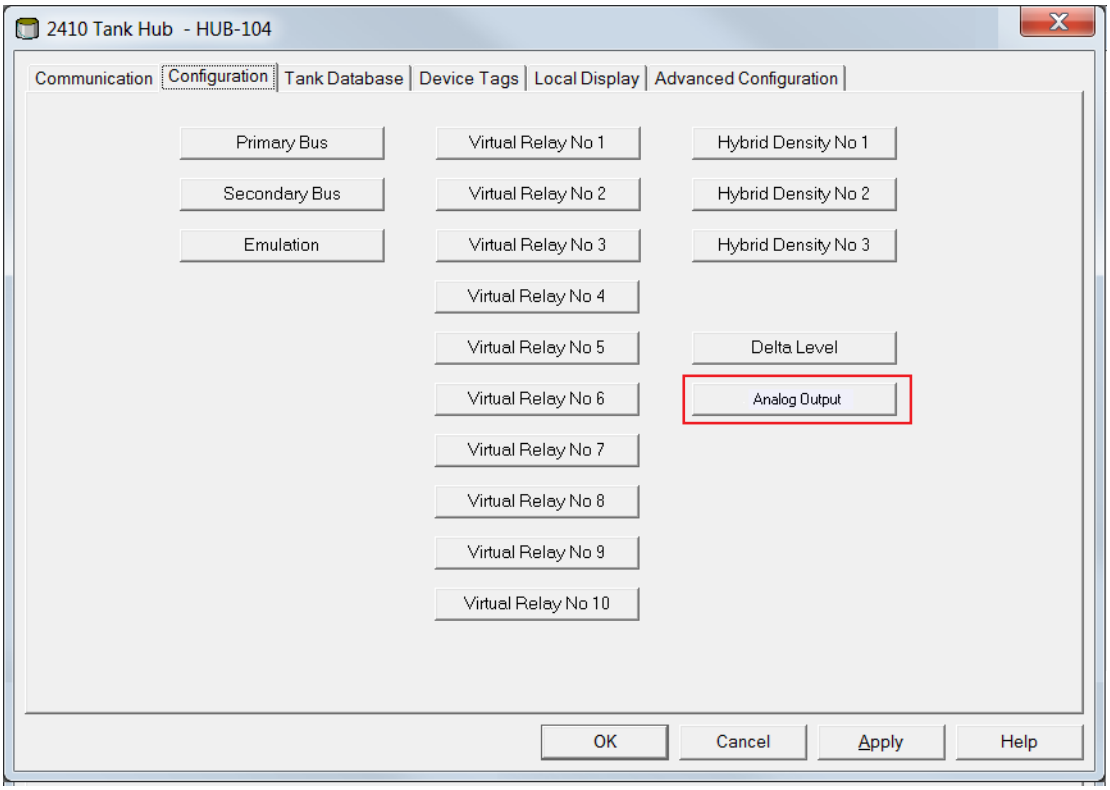
Parameter A

Parameter B

C.9 ANALOG OUTPUT

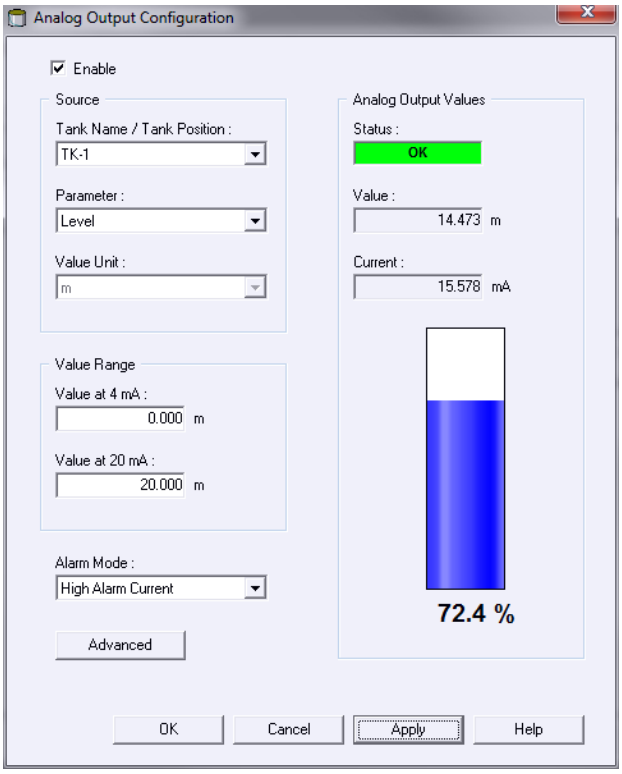
To configure the 2410 Tank Hub Analog Output:

1. In the WinSetup workspace click the right mouse button on the 2410 Tank Hub icon and choose the Properties option.
2. Select the *Configuration* tab:



3. Click the **Analog Output** button to open the *Analog Output Configuration* window(1).

(1) Note that for this button to be available, the Analog Output option must be activated for the 2410 Tank Hub.



4. Check the **Enable** box to activate the Analog Output option.
5. Configure Source Parameter, Value Range, and Alarm Mode as described below.

Tank Name/Tank Position

Choose the 2410 tank that will provide the desired measurement data source for the Analog Output. If no tank name is configured you can check the 2410 tank database in case you need to verify that the selected tank position corresponds to the desired tank.

Parameter and Unit

Choose the tank parameter and value unit to associate with the 4 - 20 mA Analog Output.

Value Range

Set the source values that correspond to the analog output values 4 mA and 20 mA, respectively. You can specify any value as long as the 20 mA value is above the 4 mA value. Alarm mode is activated in case the measurement value goes out of range.

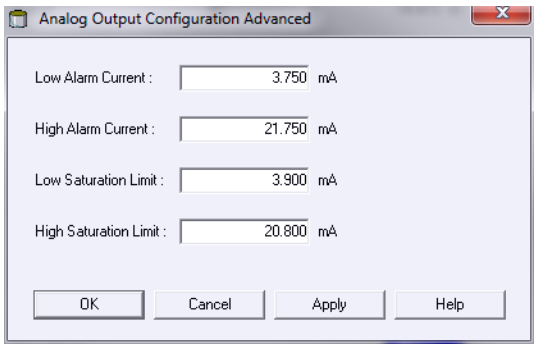
Alarm Mode

Alarm mode specifies the analog output state when a measurement error occurs, or when the measurement value is out of range:

- High: the output current is set to 21.75 mA (default setting).
- Low: the output current is set to 3.75 mA (default setting).
- Freeze current: the output current is set to the present value at the time when the error occurs.

Advanced

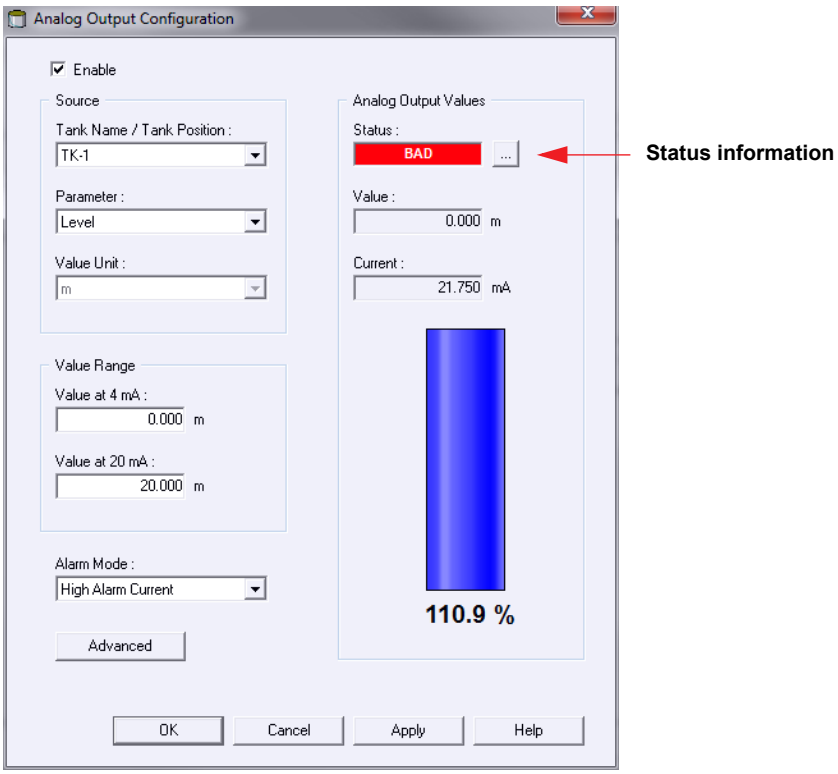
The Advanced button allows you to specify Low/High Alarm Currents and Low/High Saturation Limits.



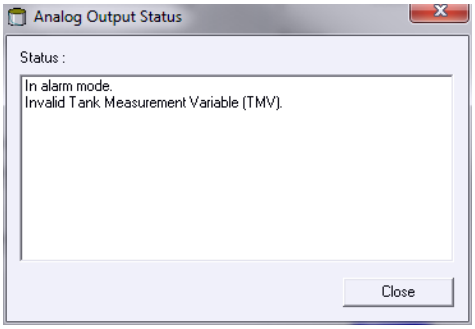
The output range for the analog output is 3.5 to 23 mA.

Status

In case an error has occurred the Status field indicates “BAD”:



To view the current status information, click the button to the right of the Status field.



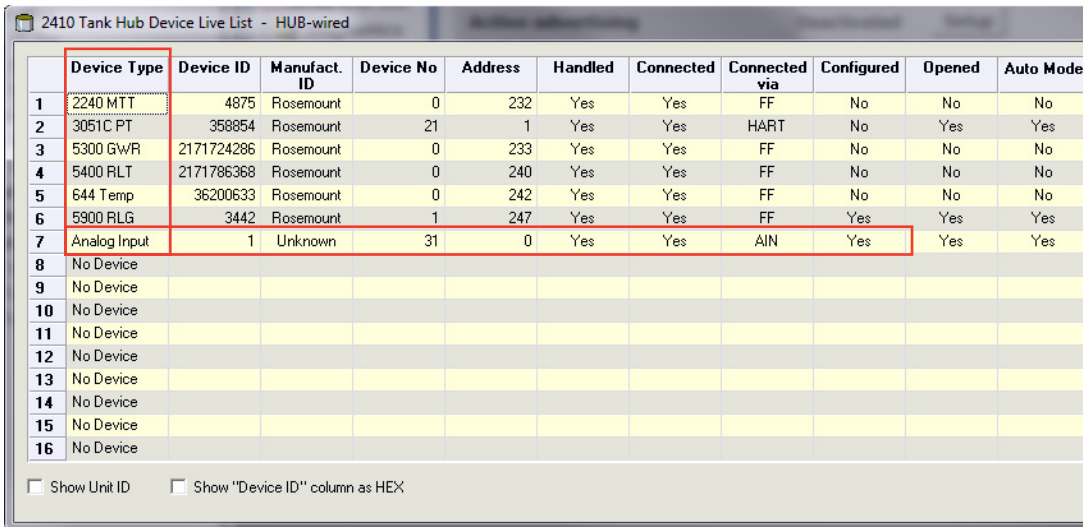
The *Analog Output Status* window displays information on the current status.

C.10 CONFIGURATION OF ANALOG INPUT / HART SLAVE

C.10.1 2410 Tank Hub Analog Input

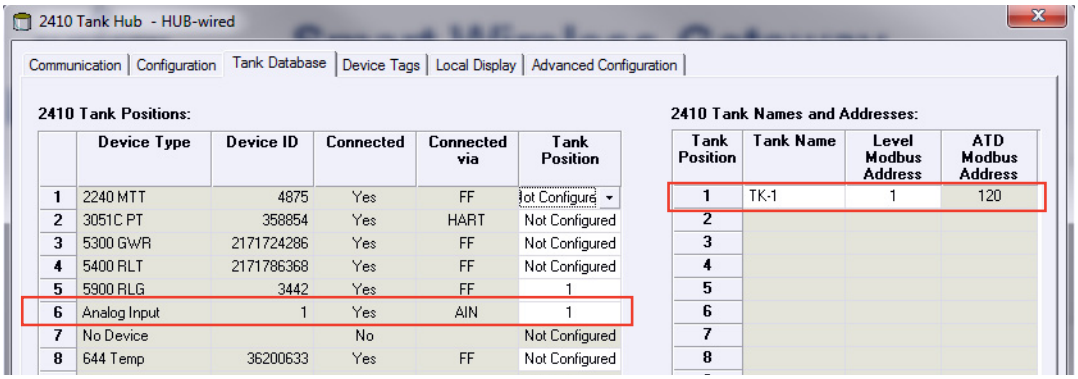
To configure a 4-20 mA device connected to the 2410 Tank Hub do the following:

1. In the TankMaster WinSetup workspace, click the right mouse button on the 2410 Tank Hub icon and choose the *Device Live List* option:



	Device Type	Device ID	Manufact. ID	Device No	Address	Handled	Connected	Connected via	Configured	Opened	Auto Mode
1	2240 MTT	4875	Rosemount	0	232	Yes	Yes	FF	No	No	No
2	3051C PT	358854	Rosemount	21	1	Yes	Yes	HART	No	Yes	Yes
3	5300 GWR	2171724286	Rosemount	0	233	Yes	Yes	FF	No	No	No
4	5400 RLT	2171786368	Rosemount	0	240	Yes	Yes	FF	No	No	No
5	644 Temp	36200633	Rosemount	0	242	Yes	Yes	FF	No	No	No
6	5900 RLG	3442	Rosemount	1	247	Yes	Yes	FF	Yes	Yes	Yes
7	Analog Input	1	Unknown	31	0	Yes	Yes	AIN	Yes	Yes	Yes
8	No Device										
9	No Device										
10	No Device										
11	No Device										
12	No Device										
13	No Device										
14	No Device										
15	No Device										
16	No Device										

2. Identify the Analog Input device in the *2410 Tank Hub Device Live List*. The Analog Input appears as Device Type=Analog Input.
3. In TankMaster WinSetup, click the right mouse button on the 2410 Tank Hub icon and choose the *Properties* option.
4. Select the *Tank Database* tab.

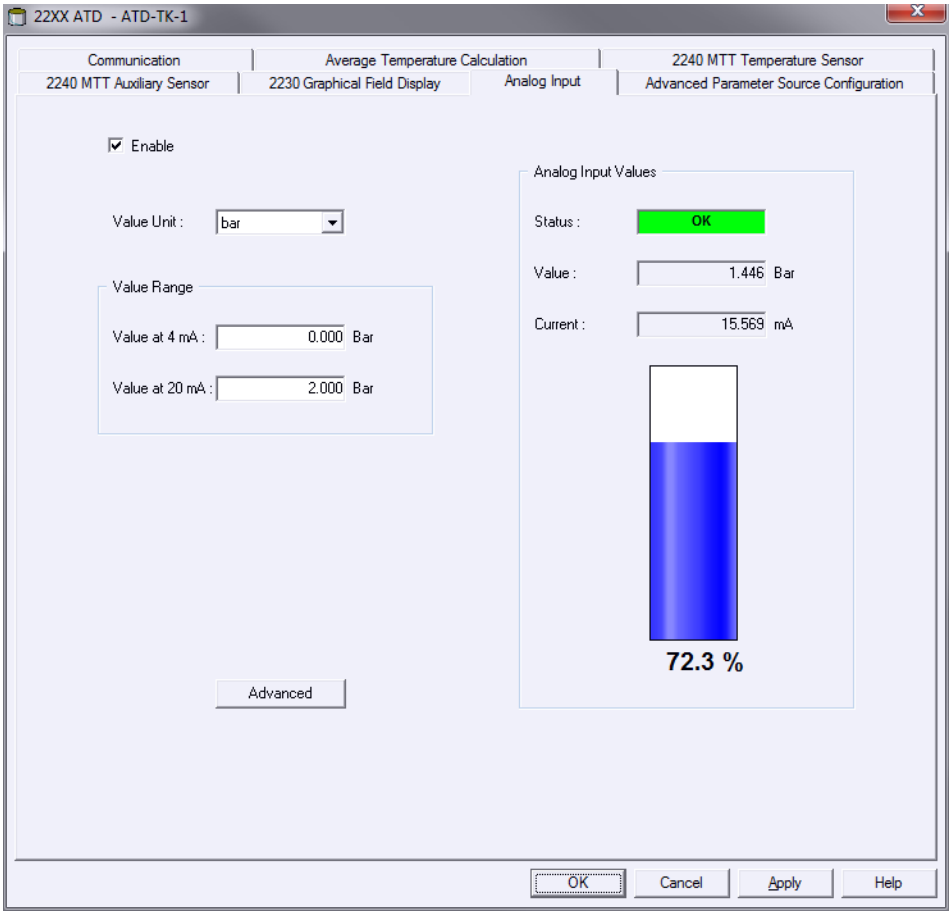


	Device Type	Device ID	Connected	Connected via	Tank Position
1	2240 MTT	4875	Yes	FF	Not Configure
2	3051C PT	358854	Yes	HART	Not Configured
3	5300 GWR	2171724286	Yes	FF	Not Configured
4	5400 RLT	2171786368	Yes	FF	Not Configured
5	5900 RLG	3442	Yes	FF	1
6	Analog Input	1	Yes	AIN	1
7	No Device		No		Not Configured
8	644 Temp	36200633	Yes	FF	Not Configured

Tank Position	Tank Name	Level Modbus Address	ATD Modbus Address
1	TK-1	1	120
2			
3			
4			
5			
6			
7			
8			

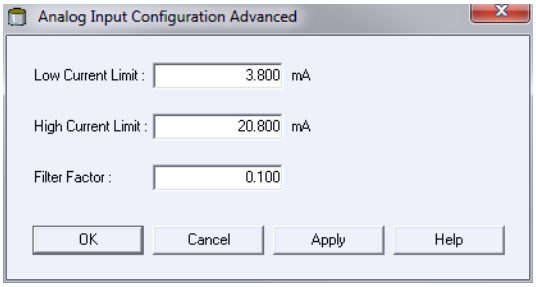
5. Associate the Analog Input with a tank in the 2410 Tank Database and click the Apply button. See the *Raptor System Configuration* manual (Document no. 300510EN) for more information on how to configure the Tank Database.

6. Select the *Device Tags* tab and click the “Install New Devices in TankMaster” button. Now the Analog Input will be installed as an ATD in the TankMaster WinSetup workspace. Note that although the analog input is actually connected to the 2410 Tank Hub, it is handled as an ATD.
7. In the TankMaster WinSetup workspace, click the right mouse button on the ATD device icon and choose the *Properties* option.
8. Select the *Analog Input* tab.



9. Ensure that the **Enable** check box is selected.
10. In the **Value Unit** field choose a suitable unit to match the input source.
11. In the **Value Range** pane, enter the parameter values that correspond to the analog input values 4 and 20 mA. You can specify any value as long as the 20 mA value is above the 4 mA value. If the measured value goes outside the range values, the analog input enters alarm mode.

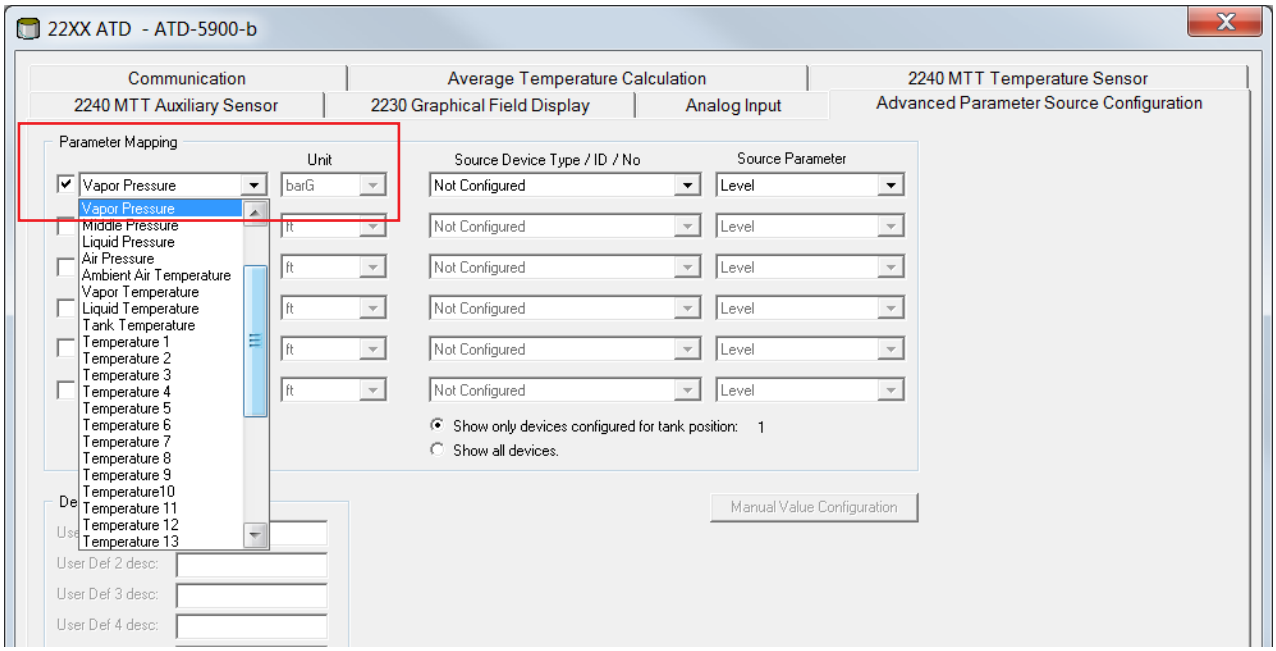
12. Use the **Advanced** button in case you would like to configure Filter Factor and Current Limits.



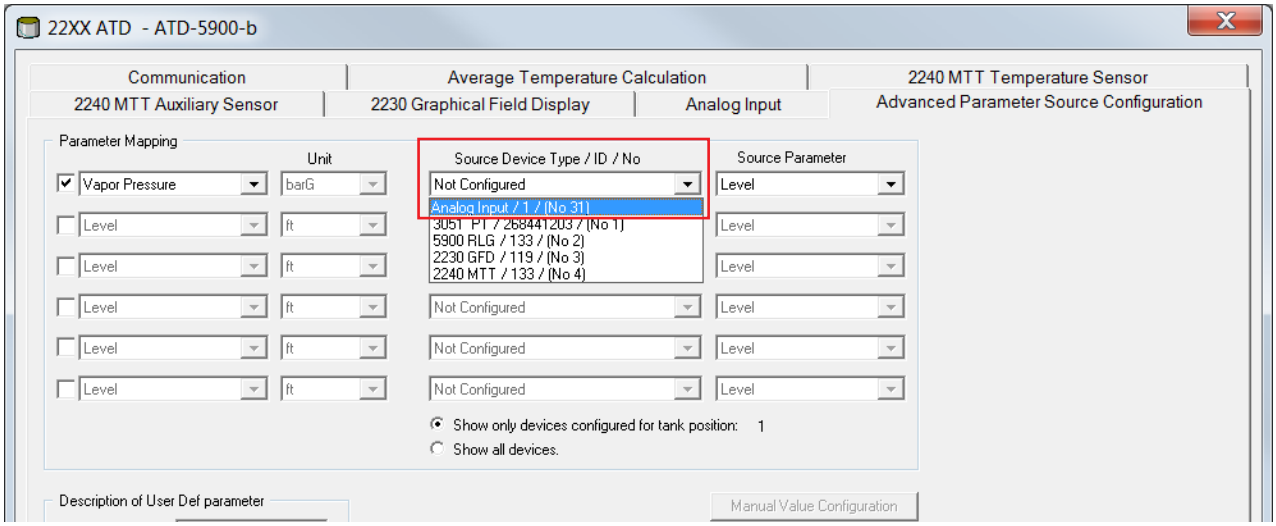
By setting a Filter Factor you can suppress spurious fluctuations in the analog input signal. A value between 0 and 1 can be used. The default value is 0.1. A higher value means less filtering.

The Current Limits define the lower and upper limits of the input currents. Outside this range an error will be indicated. The current limits should correspond to the error limits of connected instruments. If for example an instrument sets the output current in alarm mode to 3.8 mA, you should set the lower error limit to 3.8 or higher.

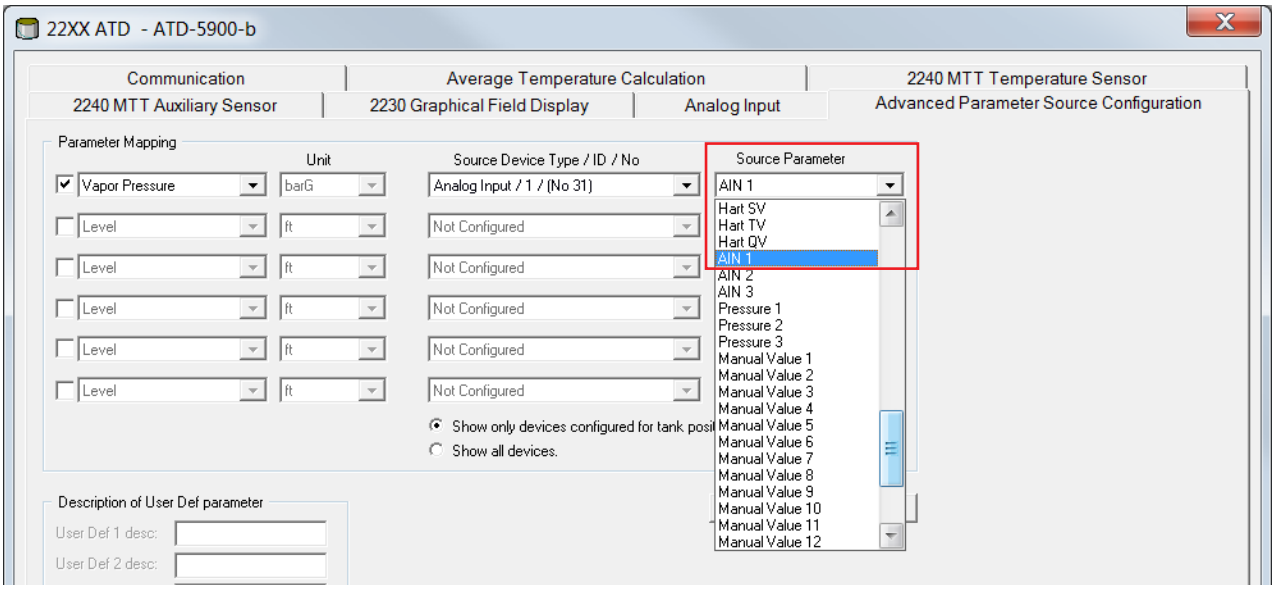
13. In the Analog Input Values pane, verify that Status is OK and that the expected measurement results appear in the Value and Current fields.
14. Select the *Advanced Parameter Source Configuration* tab:



15. Map the Analog Input to the desired tank parameter. In the example above it is mapped to Vapor Pressure.



16. Select **Analog Input** as Source Device Type to make sure that the 4 - 20 mA signal of the connected instrument is mapped to the selected parameter.



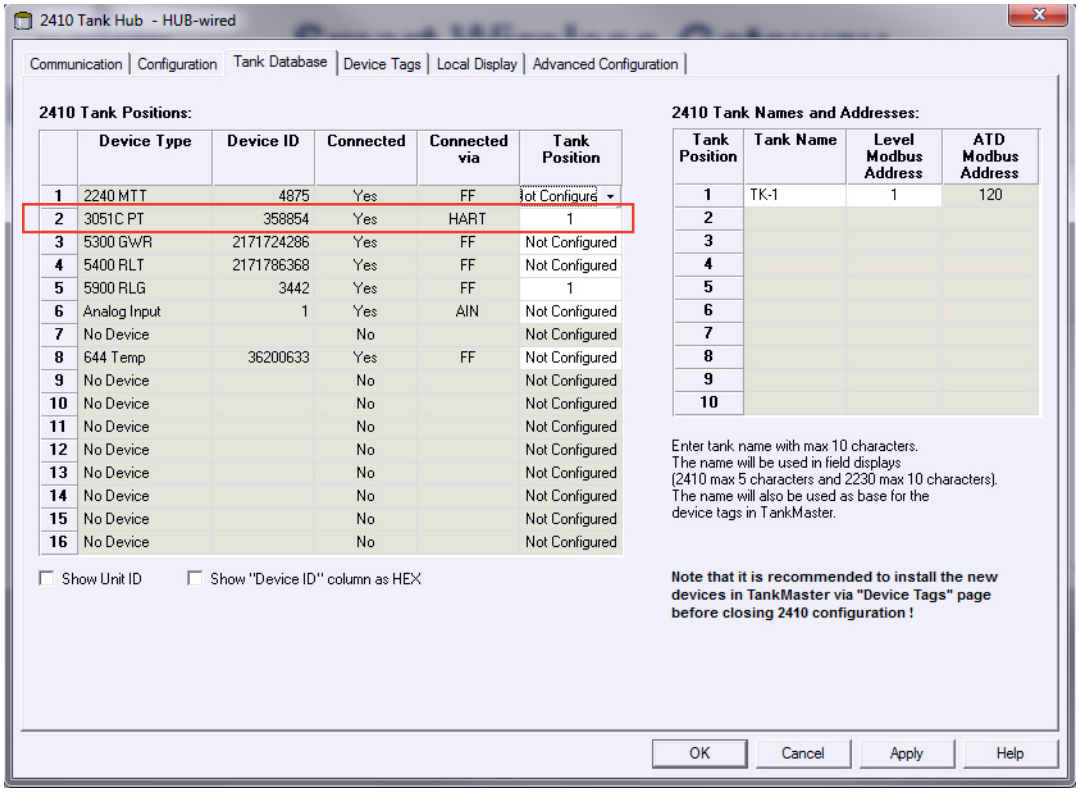
17. Select **AIN1** for Source Parameter.
18. In TankMaster WinSetup, install and configure the tank that the analog input was associated with in the 2410 Tank Database (see step 5).
19. Verify that the tank parameter receives measurement data from the analog input by, for example, opening the *Tank View* window in TankMaster WinOpi.

C.10.2 HART Slave Configuration

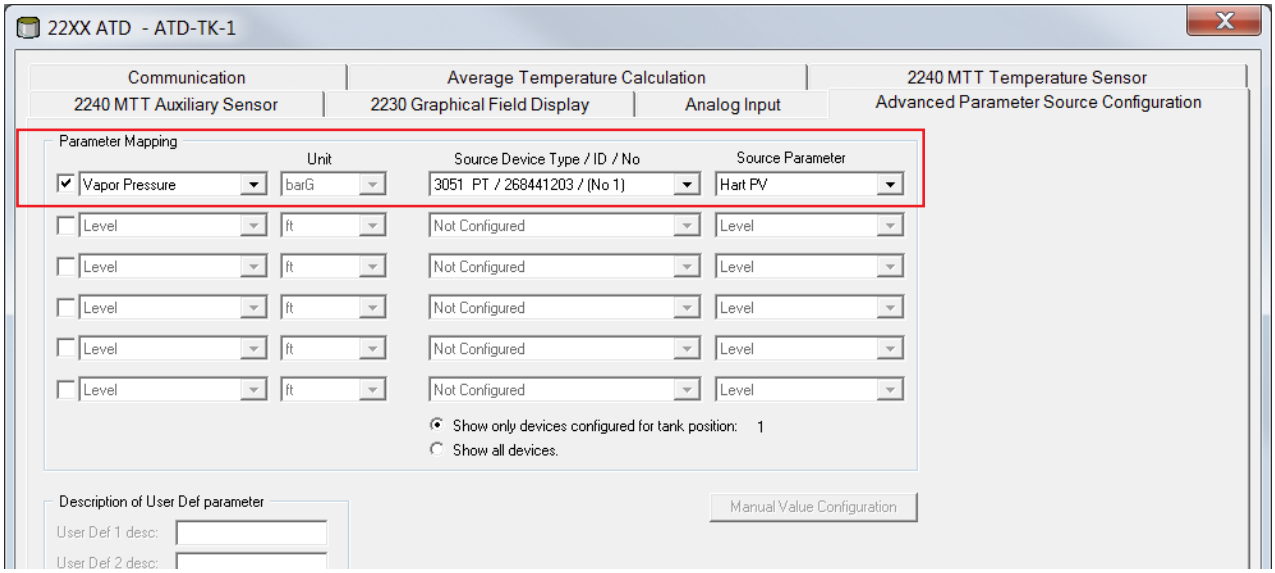
The 2410 Tank Hub can act as HART Master for up to three HART slaves in multi-drop configuration. Current mode 4-20 mA is supported in case only one HART device is connected.

To configure HART slave devices for the 2410 Tank Hub do the following:

1. Identify the HART Slave in the 2410 Tank Hub *Device Live List*. It will appear as “HART” in the column named “Connected via”.
2. Open the 2410 Tank Database and locate the device which will act as a HART Slave.



3. Associate the HART slave with a tank position in the 2410 Tank Database and click the Apply button.
4. Select the *Device Tags* tab and click the button named “Install New Devices in TankMaster”. Now the HART Slave device will be installed as an Auxiliary Tank Device (ATD) in the TankMaster WinSetup workspace. Note that although the HART device is actually connected to the 2410 Tank Hub, it is handled as an ATD in TankMaster.
5. In the TankMaster WinSetup workspace, click the right mouse button on the ATD device icon and choose *Properties*.
6. Select the *Advanced Parameter Source Configuration* tab.



7. Select the desired check box to enable mapping of tank measurement variable to source device and parameter.
8. Choose the desired tank parameter and value unit. In the example above Vapor Pressure is selected.
9. In Source Device Type column select the appropriate HART device. In the example above, a 3051 PT is selected.
10. Choose the appropriate source parameter; Hart PV, Hart SV, Hart TV, or Hart QV.
11. In case there are more HART slaves connected, repeat steps 4 to 7.
12. In TankMaster WinSetup, install and configure the tank that the HART Slave device was associated with in the 2410 Tank Database (see step 3).
13. Verify that the tank parameter receives measurement data from the HART Slave by, for example, opening the *Tank View* window in TankMaster WinOpi.

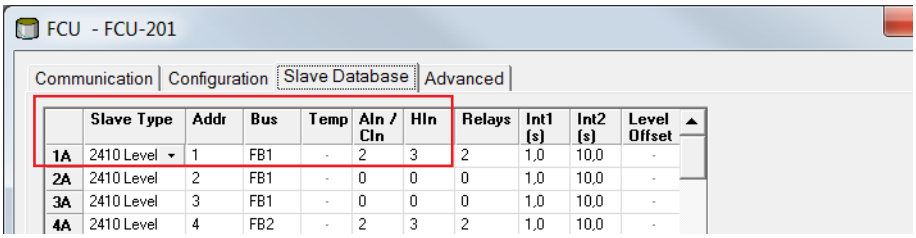
C.10.3 FCU 2160 Mapping

In case a FCU 2160 is included in the Raptor system, make sure that the Slave Database is configured accordingly.

The 2410 Tank Hub which includes an analog input and/or a HART slave should be configured as follows:

- Ain=2
- Hin=3

Figure C-15. Configuration of FCU 2160 Slave Database



In case a 2240 Multi-Input Temperature Transmitter is used, some parameters can not be manually mapped to a HART Slave as described in section “HART Slave Configuration” on page C-29. See Table C-5 for a list of parameters that can be mapped.

Table C-5. Possible parameter mapping with 2410 Tank Hub via FCU 2160.

Parameters	Mapping
Free Water Level	X
Vapor Pressure	X
Liquid Pressure	X
Vapor temperature	X*
Liquid temperature	X*
Temperature 1	X*
Temperature 2	X*
Temperature 3	X*
Temperature 4	X*
Temperature 5	X*
Temperature 6	X*
Temperature 7	X*
Temperature 8	X*
Temperature 9	X*
Temperature 10	X*
Temperature 11	X*
Temperature 12	X*
Temperature 13	X*
Temperature 14	X*
Delta level	X**
User defined 1	X

* In case no 2240 Temperature Transmitter is mapped

** Not available at the same time as User Defined 1

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