# Rosemount™ 2410 Tank Hub

Enraf® emulation instruction

1.1 Introduction

The purpose of this document is to provide guidelines on how to change from Enraf to Rosemount equipment by exchanging gauges. When an Enraf gauge is replaced with a Rosemount gauge, it is necessary to configure the Rosemount 2410 Tank Hub for emulation.

The Rosemount field devices, for example Rosemount 5900 Radar Level Gauge and Rosemount 2240S Temperature Transmitter, are connected to the tank hub using the intrinsically safe Tankbus as usual. Emulation is done in the tank hub only. Each tank hub can emulate up to 10 tanks (10 separate Enraf gauges).

Figure 1-1. Rosemount Devices Replacing Old Gauges in an Existing Enraf System

EMERSON™
Process Management
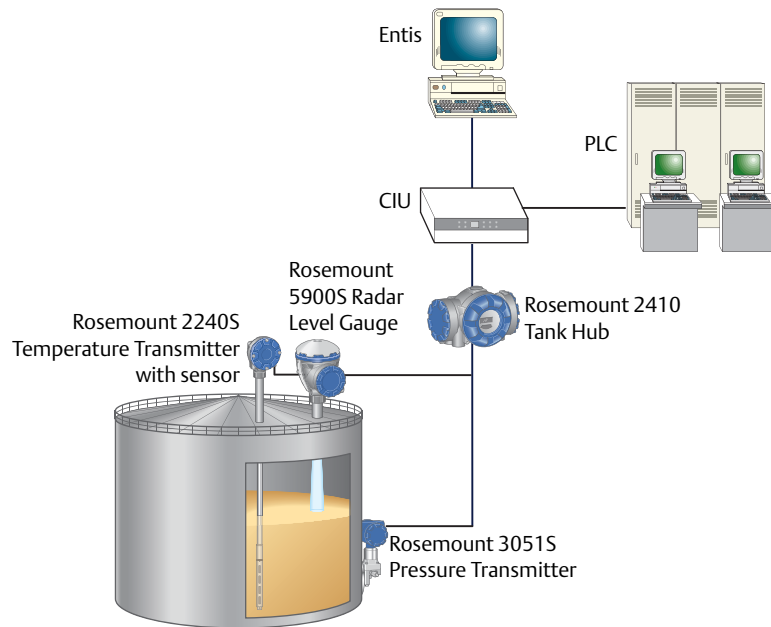
1.1.1 Enraf system characteristics

A typical Enraf tank gauging system consists of a number or field devices such as level, temperature and pressure devices. These devices are connected to a host computer via a Communication Interface Unit (CIU).

Different versions of the CIU:

- CIU 858

- CIU 880 Prime

- CIU 880 Plus

The host computer can either be a PC with Entis monitoring system, or an Enraf Microlect station.

The Rosemount 2410 Tank Hub supports the Enraf GPU protocol. It can therefore be connected directly to Entis/CIU systems using the GPU protocol.

Enraf GPU communication parameters

Start bits: 1
Data bits: 7 (ASCII)
Parity: Odd
Stop bits: 1
Baud rate: Selectable 1200 (default)/2400

Enraf gauges for emulation

The Rosemount 2410 can emulate Enraf gauges with Type of Instrument (TOI), B or C.

Table 1-1. Typical Enraf Devices

| TOI	Devices with GPU protocol
B	811, 854, 894, 873, 973
C	813 MTG

1.1.2   Rosemount 2410 Tank Hub communication

The tank hub has slots for two independent communication boards, primary and secondary field bus, for TRL2 Modbus®, RS485 Modbus, emulation or wireless communication.

Primary and secondary field bus

A tank hub equipped with both primary (TRL2 Modbus) and secondary (Enraf GPU) field bus, can be configured for Enraf emulation using the Rosemount 2180 Field Bus Modem (FBM) as usual. Since the tank hub simultaneously communicates on both ports, the TankMaster™ PC can in addition to configuration also be used to monitor the devices in operation, during Enraf emulation. Section "Configuration using the FBM" on page 7 describes configuration of the tank hub with the FBM.

For a tank hub equipped with only a primary field bus, the Rosemount 3180 Enraf Field Bus Modem (EBM) will be used to configure the tank hub for Enraf emulation. Configuration is done using the TRL2 Modbus protocol. When configuration is completed, the field bus will be connected to the CIU for operation and the protocol will be switched to Enraf GPU. See "Configuration using the EBM" on page 14 for instructions on how to configure the tank hub using the EBM.

**Figure 1-2. Tank Hub Communication Board for Enraf Emulation**
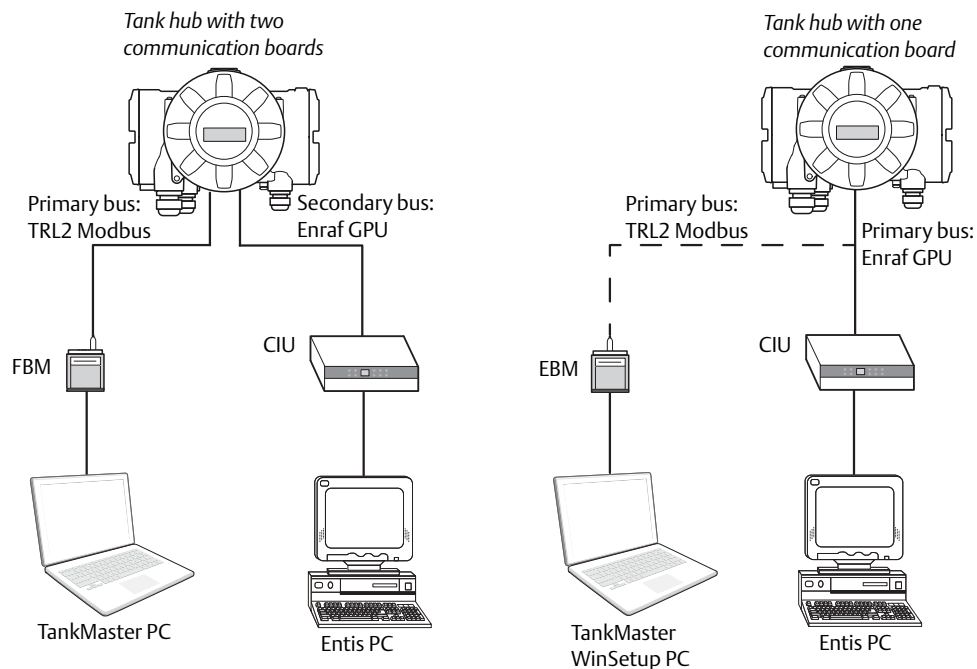
Wireless communication

The tank hub supports Emerson™'s wireless technology, which is based on *Wireless*HART®, the emerging industry standard for wireless field networks. The Emerson Smart Wireless THUM™ Adapter acts as a wireless data link between the tank hub and a Smart Wireless Gateway.

The tank hub can simultaneously combine wireless and Enraf communication. The primary field bus communicates via Enraf GPU and the secondary field bus via *Wireless*HART. With this tank hub communication configuration, control room redundancy is achieved.

Figure 1-3. Tank Hub with Enraf and Wireless Communication
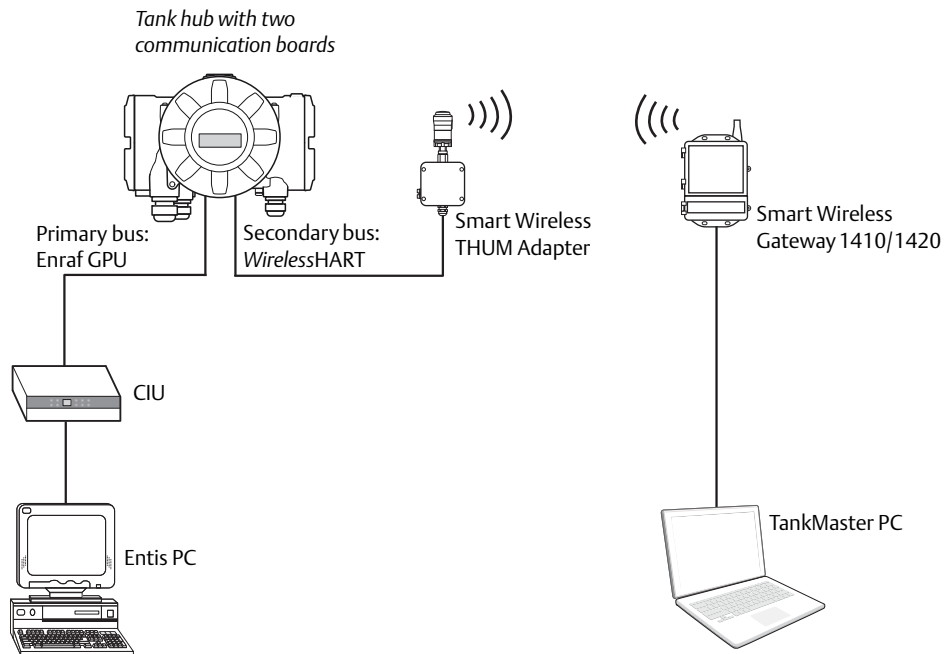
1.2 Electrical installation

1.2.1 Rosemount 2410 Tank Hub connections

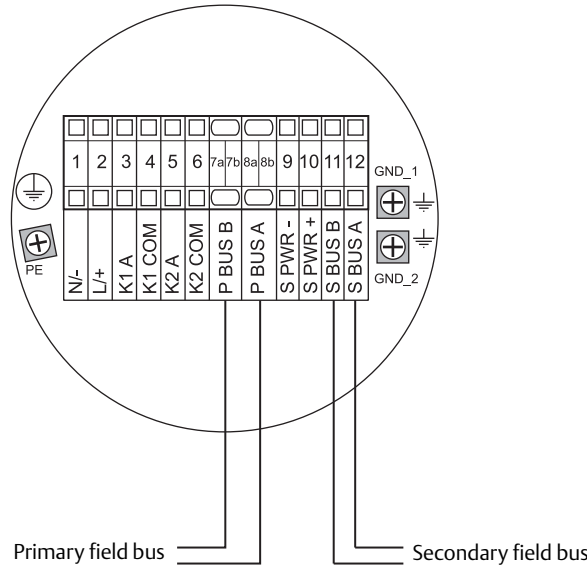**Figure 1-4. Terminal Block in the Explosion-Proof/Flameproof Compartment**

Table 1-2. Terminal Assignment for Non-Intrinsically Safe Side

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 B
8a/8b	P Bus A	Primary communication 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

1.2.2 Enraf Field Bus Modem (EBM)

Figure 1-5. Enraf Field Bus Modem Connection
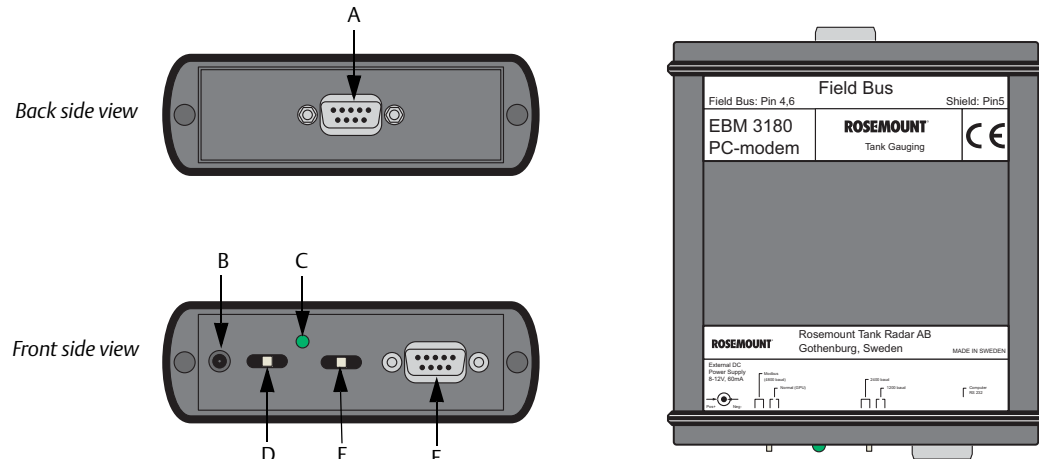
A. Field bus connector
B. Power connector
C. Communication status LED (flashing green)
D. Protocol switch[1]:
   Left position: Modbus
   Right position: Normal (GPU)
E. Baud rate switch[2]:
   Left position: 2400
   Right position: 1200
F. Connector for RS232 communication with the computer

1.2.3 How to connect the EBM

1. Connect the tank hub to the EBM[3].

2. Connect the EBM to the WinSetup computer.

3. Be sure the protocol switch is set to "Normal (GPU)" and the baud rate switch is set to "1200", see Figure 1-5 on page 6.

4. Supply the EBM with power.

5. Verify communication with the tank hub through the flashing green LED.

1.2.4 Baud rate

The Rosemount 2410 Tank Hub has a pre-configured baud rate (1200) that cannot be changed by the software configuration. The baud rate is controlled by hardware switches on the Enraf communication board. See "Change baud rate" on page 25 for information on how to change the baud rate.

1. *Select right position "Normal (GPU)" for Enraf emulation configuration.*
2. *Select right position "1200" for Enraf emulation configuration.*
3. *The cable to be connected to the field bus is delivered with the EBM.*

1.3 Configuration using the FBM

The Rosemount 2410 Tank Hub is configured by using the Rosemount TankMaster WinSetup configuration program[1]. WinSetup is a user-friendly software package that includes basic configuration options as well as advanced configuration and service functions.

A Tank hub with two communication boards is normally configured using an FBM[2]. To configure the tank hub for Enraf emulation, do the following:

1.3.1 Set up Modbus communication protocol

This section describes how to configure the Modbus Master protocol channel for communication with the FBM. Specify PC communication port and the standard communication parameters: Baud rate, Parity, and number of Stop Bits.

1. Open the **Protocols** folder in the *Workspace* window.

2. Select the **Modbus Master** icon.
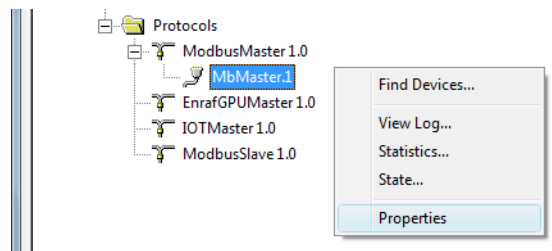
3. Right click the proper **MbMaster** icon and select **Properties** to configure the protocol channel.

4. Select the **Communication** tab.
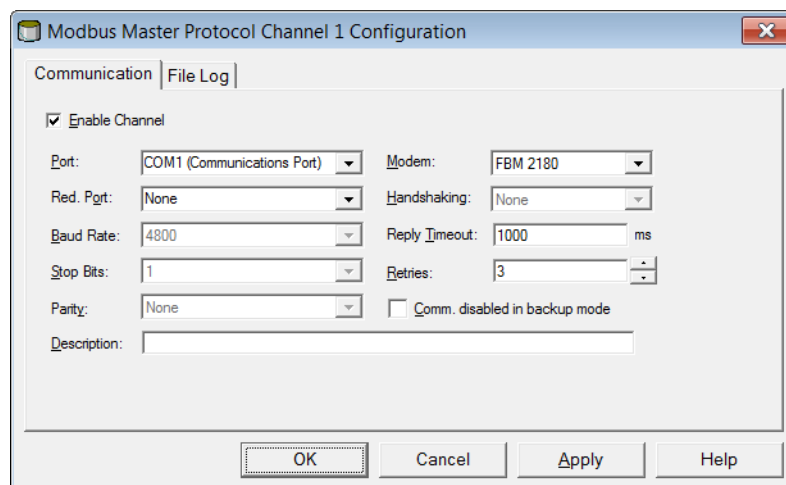
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1. *See the Rosemount Tank Gauging System Configuration Manual (document number 00809-0300-5100) for more information on how to use the TankMaster WinSetup software to configure the Rosemount 2410 Tank Hub.*
2. *A tank hub where the secondary field bus communicates via WirelessHART, can be configured by wireless communication with a Smart Wireless Gateway.*

5.   Set the communication parameters:

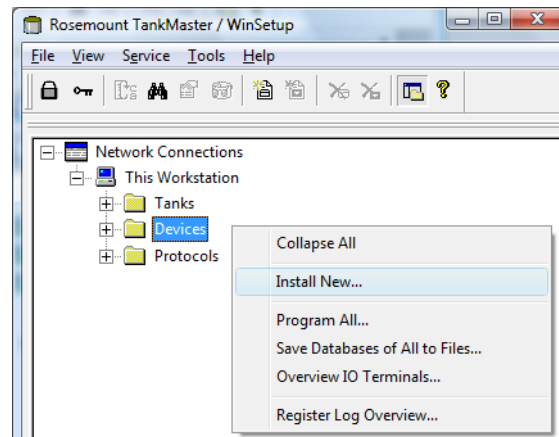|	
Port	The COM port the FBM will connect to
Baud rate	4800
Stop bits	1
Parity	None
Modem	FBM 2180
Handshaking	None
Reply timeout	1000 ms
Retries	3
Description	Text describing the configured channel

6.   Select the **Enable Channel** check box to activate the protocol channel.

7.   Select **OK** to store the current configuration and close the configuration window.

1.3.2   Install Rosemount 2410 Tank Hub in WinSetup

The TankMaster WinSetup wizard is the recommended tool for installing the tank hub. The installation wizard covers basic configuration of the tank hub.

Perform the following steps to start the installation wizard in TankMaster WinSetup:
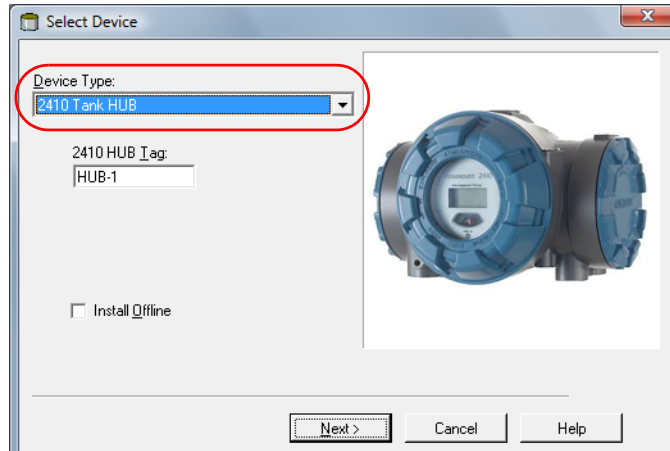
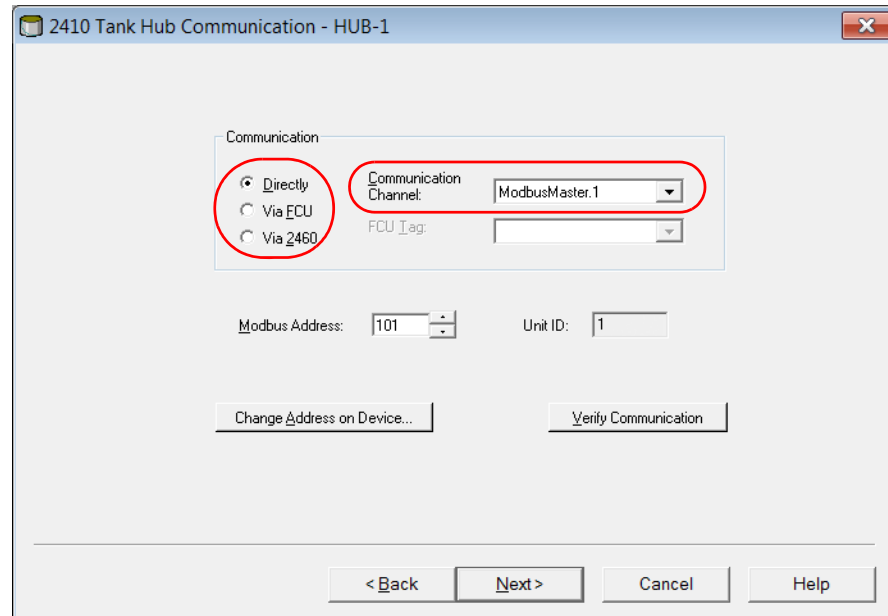1.   In the *Workspace* window select the **Device** folder.

2.   Right click and select **Install New**, or from the *Service* menu select the **Devices/Install New** option. The *Select Device* window appears.
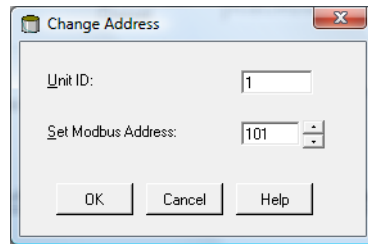
3. From the *Device Type* drop-down list, select the 2410 Tank Hub option.

4. Type a name in the *2410 HUB Tag* field.
The 2410 Hub Tag will be used as an identifier for the tank hub in various windows and dialogs.

5. Select **Next**. The *2410 Tank Hub Communication* window appears.

6. Make sure TankMaster communicates directly with the tank hub and that the proper communication channel is chosen.

7. Default Modbus Address is 247 for the tank hub. It is recommended to change it to an address 101-199. Do the following:

    a. In the *2410 Tank Hub Communication* window select **Change Address on Device...** to open the *Change Address* window.


    b. Enter the **Unit ID** and select the new **Modbus Address**.

        When changing the device address, the Unit Id is used as a unique identifier of the device. The Unit Id can be found on a label mounted on the device.

    c. Select **OK** to confirm the address settings and close the *Change Address* window.

    d. In the *2410 Tank Hub Communication* window select **Verify Communication** to check that communication is established between the TankMaster work station and the tank hub. The **Unit ID** will appear when TankMaster finds the tank hub.

8. In the *2410 Tank Hub Communication* window select **Next** to continue the installation procedure of the tank hub.

9. Continue configuration as usual for a tank hub installation.

1.3.3   Configure specific variables for Enraf

1. In the *Configuration* tab, select **Enraf Emulation**.
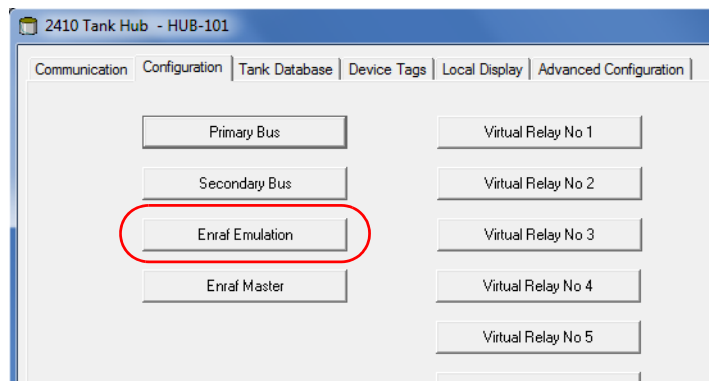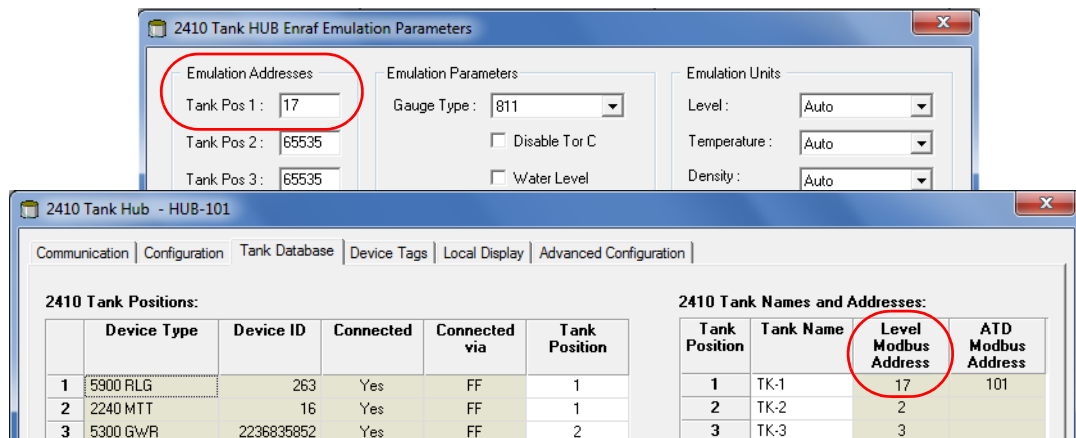
When replacing an Enraf gauge with a Rosemount device, the Rosemount device must have the same Enraf address as the replaced one.

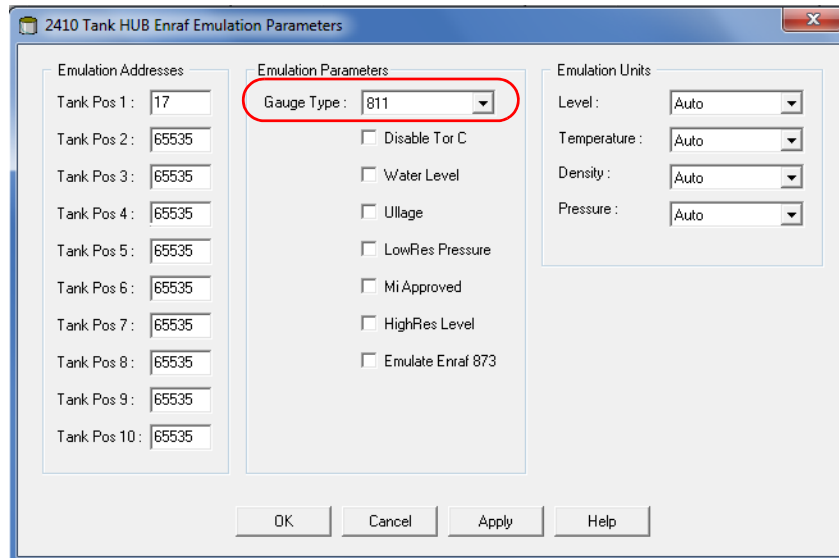2.   Set Emulation address for the Rosemount devices (possible Enraf addresses are 0-99)[1].
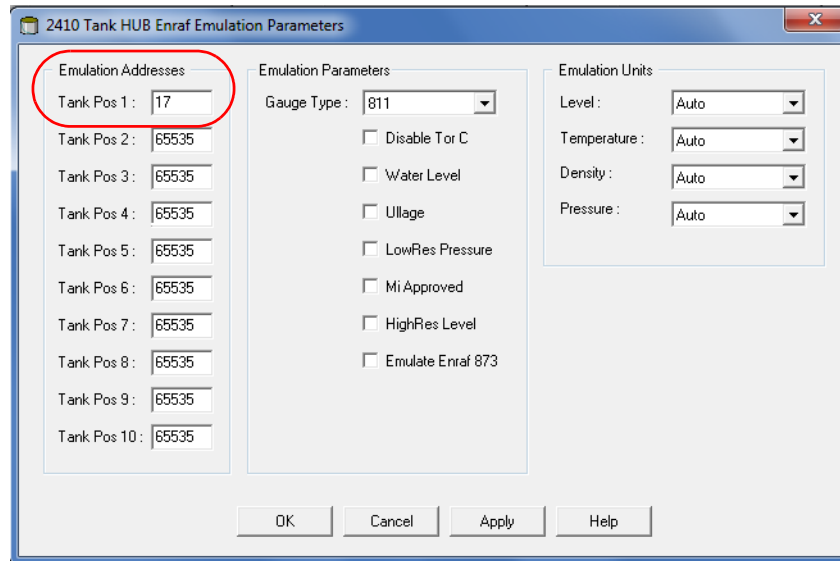
Tip!
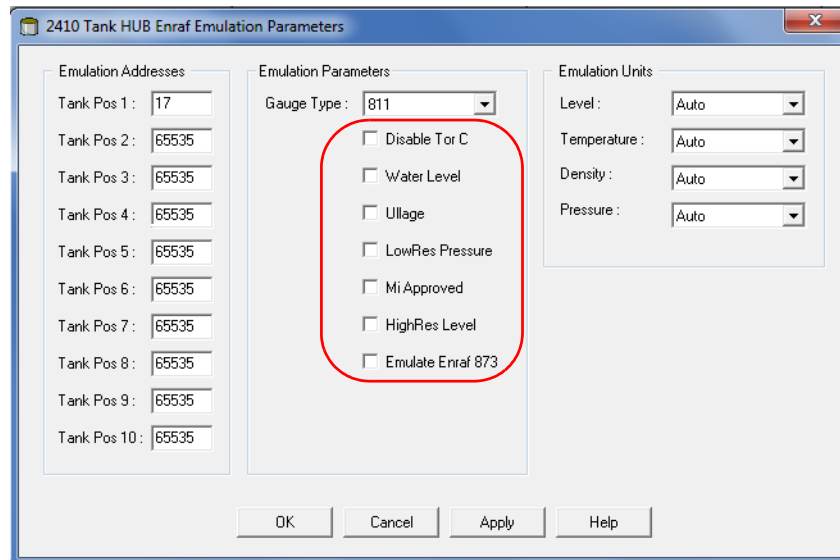In the *Tank Database* tab, set the Modbus address to the same as the chosen Enraf address for each device.

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1.   *Emulation address is by default set to "65535" for tank positions that are not in use.*

3. In the *Gauge Type* drop-down list select **811** for gauges such as 811, 854, 894, 873 and 973 (TOI B), or select **813** (TOI C).

There are several emulation configuration parameters that can be enabled for specific settings.
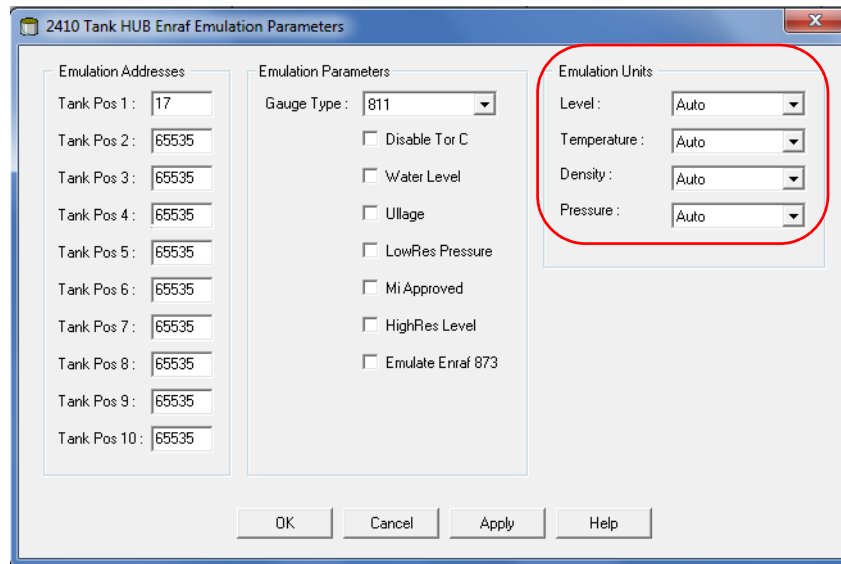
4. Select the desired check boxes to enable specific parameter settings. See parameter description below.

Disable Tor C	Disable Type of Request (TOR) C response (no response on temperature request).
Water Level	Enable Water interface measurement. The level value in TOR B and D, is replaced with the Water Level value when a TOR W is received.
Ullage	Respond with ullage instead of level.
LowRes Pressure	Resolution of the pressure value will be decreased by one decimal digit.
MiApproved	The level will be invalid if outside the legal level value range and temperature will be invalid outside legal temperature value range.
HighRes Level	Resolution of the level value will be increased by one decimal digit. (Only applicable for decimal feet and inches.)
Emulate Enraf 873	Respond with device 873 on identification requests.

All Enraf unit types are separately configurable (optional).

5.   In the drop-down list for Emulation Units, select desired unit types.

6.   Select **Apply**.

1.3.4   Configure field devices

When the tank hub configuration is completed, the Rosemount field devices, for example Rosemount 5900 Radar Level Gauge and Rosemount 2240S Multi-input Temperature Transmitter, must be configured as well. The field devices are configured as usual, for further information see the Rosemount Tank Gauging System Configuration manual (document number 00809-0300-5100).

1.   Configure the field devices by using the *Properties* window of each device.

2.   The tank hub will now send measured data to the Enraf host, acting as the replaced Enraf gauge.

1.4 Configuration using the EBM

The Rosemount 2410 Tank Hub is configured by using the Rosemount TankMaster WinSetup configuration program[1]. WinSetup is a user-friendly software package that includes basic configuration options as well as advanced configuration and service functions.

Configuration of a tank hub equipped with one communication board (Enraf GPU) must be performed using an EBM with the normal Modbus protocol. To configure the tank hub for Enraf emulation, do the following:

1.4.1 Set up Modbus communication protocol

This section describes how to configure the Modbus Master protocol channel for communication with the EBM. Specify PC communication port and the standard communication parameters: Baud rate, Parity, and number of Stop Bits.

1. Open the **Protocols** folder in the *Workspace* window.

2. Select the **Modbus Master** icon.
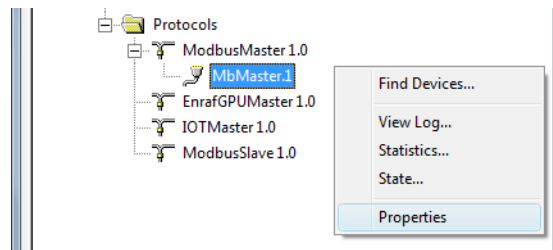
3. Right click the proper **MbMaster** icon and select **Properties** to configure the protocol channel.

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1. *See the Rosemount Tank Gauging System Configuration Manual (document number 00809-0300-5100) for more information on how to use the TankMaster WinSetup software to configure the Rosemount 2410 Tank Hub.*

4. Select the **Communication** tab.
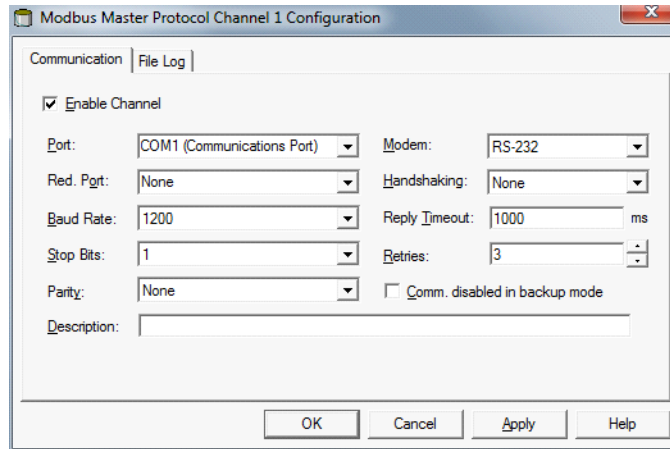
5. Set the communication parameters:

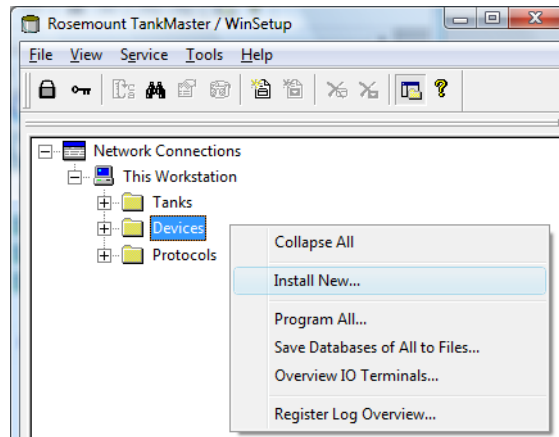| Port	The COM port the EBM will connect to
Baud rate	1200
Stop bits	1
Parity	None
Modem	RS-232
Handshaking	None
Reply timeout	1000 ms
Retries	3
Description	Text describing the configured channel

6. Select the **Enable Channel** check box to activate the protocol channel.

7. Select **OK** to store the current configuration and close the configuration window.

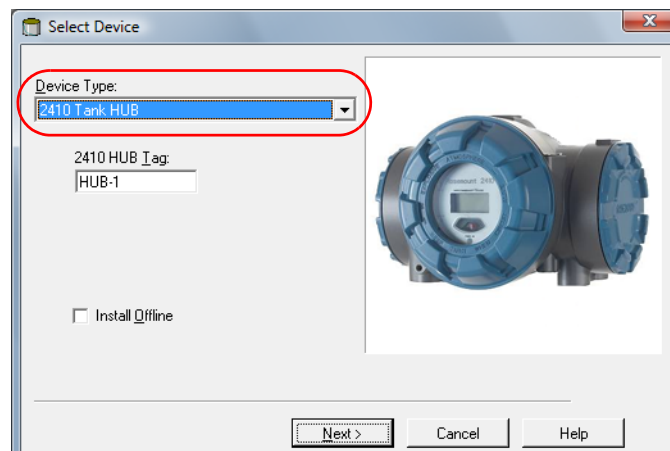## 1.4.2   Install Rosemount 2410 Tank Hub in WinSetup

The TankMaster WinSetup wizard is the recommended tool for installing the tank hub. The installation wizard covers basic configuration of the tank hub.

Perform the following steps to start the installation wizard in TankMaster WinSetup:

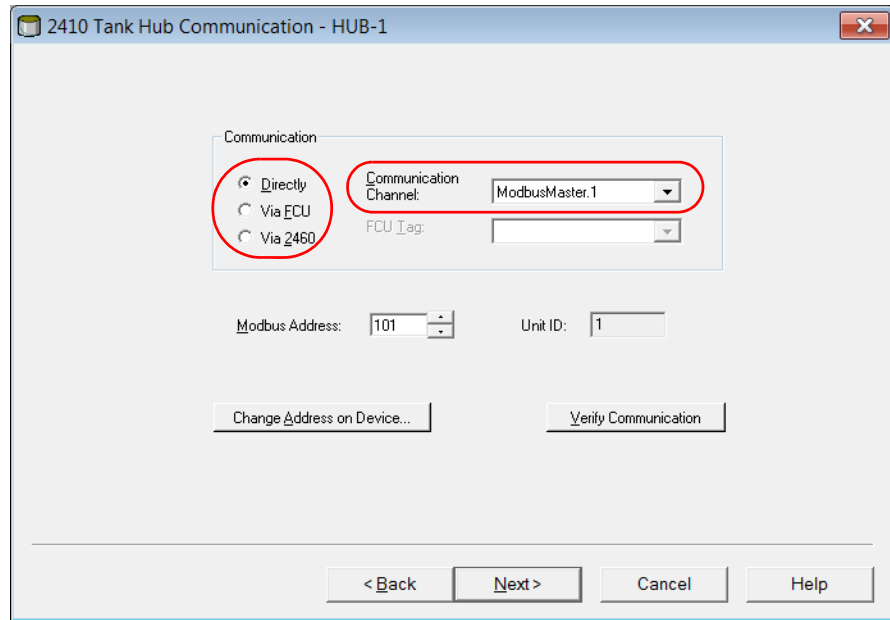1.   In the *Workspace* window select the **Device** folder.

2.   Right click and select **Install New**, or from the *Service* menu select the **Devices/Install New** option. The *Select Device* window appears.

3.   From the *Device Type* drop-down list, select the 2410 Tank Hub option.
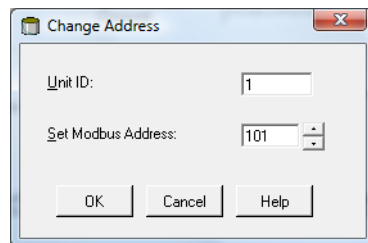

4.   Type a name in the *2410 HUB Tag* field.
       The 2410 Hub Tag will be used as an identifier for the tank hub in various windows and dialogs.

5.   Select **Next**. The *2410 Tank Hub Communication* window appears.

6. Make sure TankMaster communicates directly with the tank hub and that the proper communication channel is chosen.

7. Default Modbus Address is 247 for the tank hub. It is recommended to change it to an address 101-199. Do the following:

    a. In the *2410 Tank Hub Communication* window select **Change Address on Device...** to open the *Change Address* window.


    b. Enter the **Unit ID** and select the new **Modbus Address**.

       When changing the device address, the Unit Id is used as a unique identifier of the device. The Unit Id can be found on a label mounted on the device.

    c. Select **OK** to confirm the address settings and close the *Change Address* window.

d. The tank hub will not immediately switch from Enraf to Modbus protocol. See "Automatic protocol switch mechanism" on page 28 for more information. Select **OK** to retry. It takes a number of attempts.
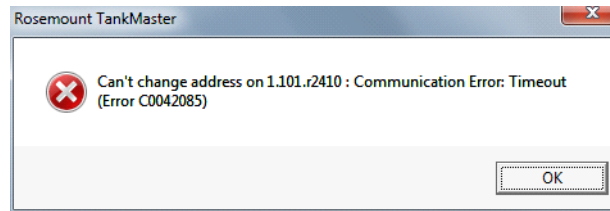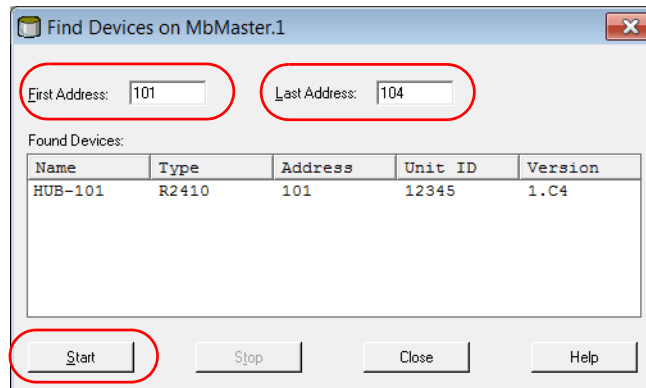

Tip!
To make the tank hub switch faster from Enraf to Modbus, you can make TankMaster search for devices on the communication protocol channels.
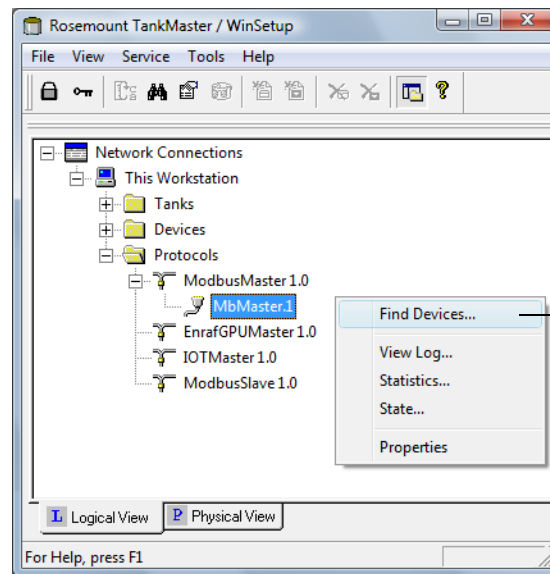

Right click and select **Find Devices**.

Type the desired values in the First and Last address input fields in order to restrict the search to a certain range of addresses (maximum range is 1-255).

Select **Start**.
The TRL2 field bus is scanned for devices within the specified address range.

e. In the *2410 Tank Hub Communication* window select **Verify Communication** to check that communication is established between the TankMaster work station and the tank hub. The **Unit ID** will appear when TankMaster finds the tank hub.

8. In the *2410 Tank Hub Communication* window select **Next** to continue the installation procedure of the tank hub.

9. Continue configuration as usual for a tank hub installation.

1.4.3   Configure specific variables for Enraf

1.   In the *Configuration* tab, select **Enraf Emulation**.
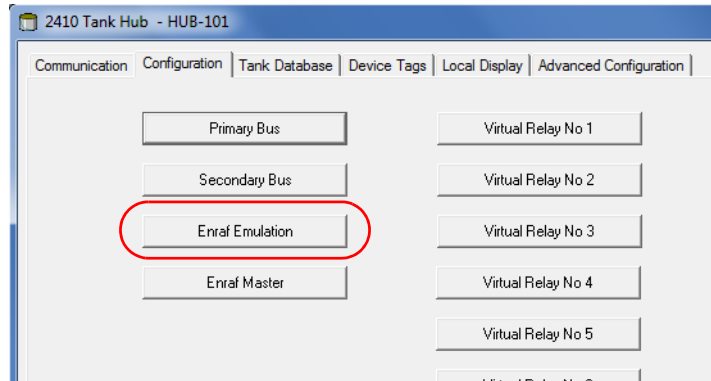
When replacing an Enraf gauge with a Rosemount device, the Rosemount device must have the same Enraf address as the replaced one.

2.   Set Emulation address for the Rosemount devices (possible Enraf addresses are 0-99)[1].
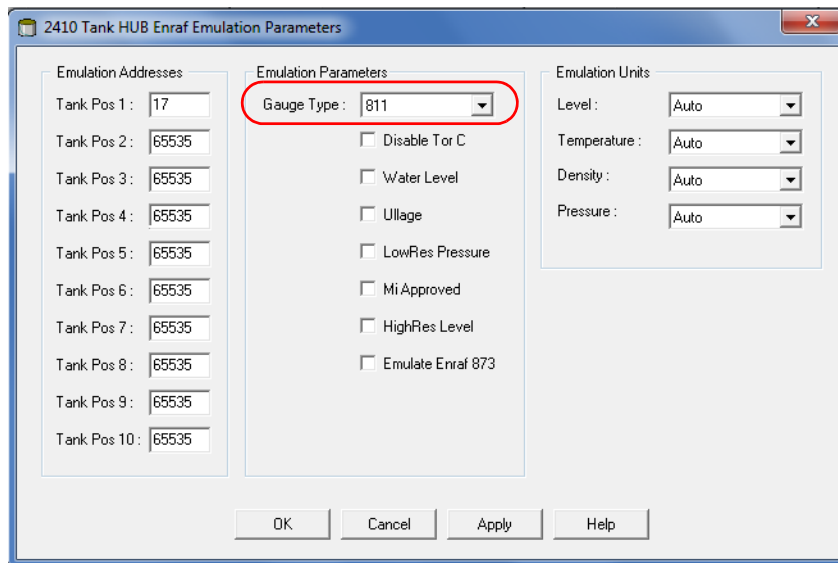

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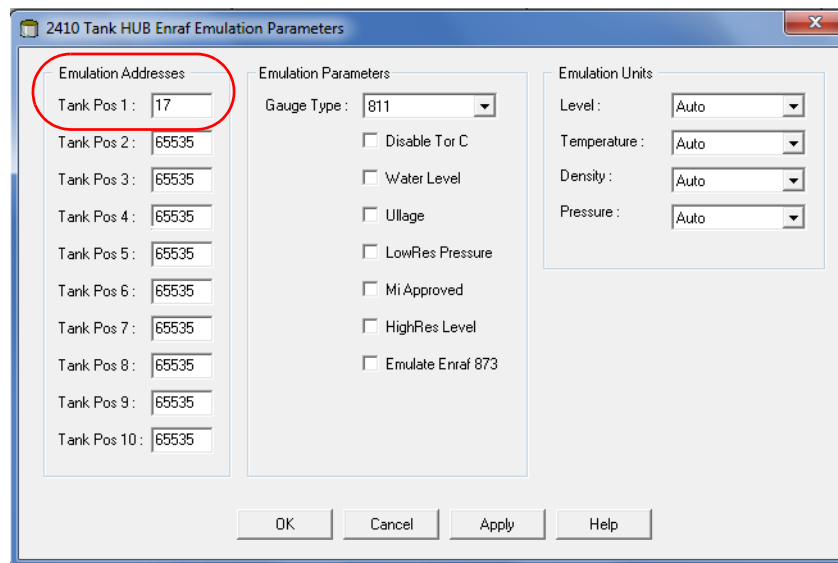
1.   *Emulation address is by default set to "65535" for tank positions that are not in use.*

Tip!
In the *Tank Database* tab, set the Modbus address to the same as the chosen Enraf address for each device.
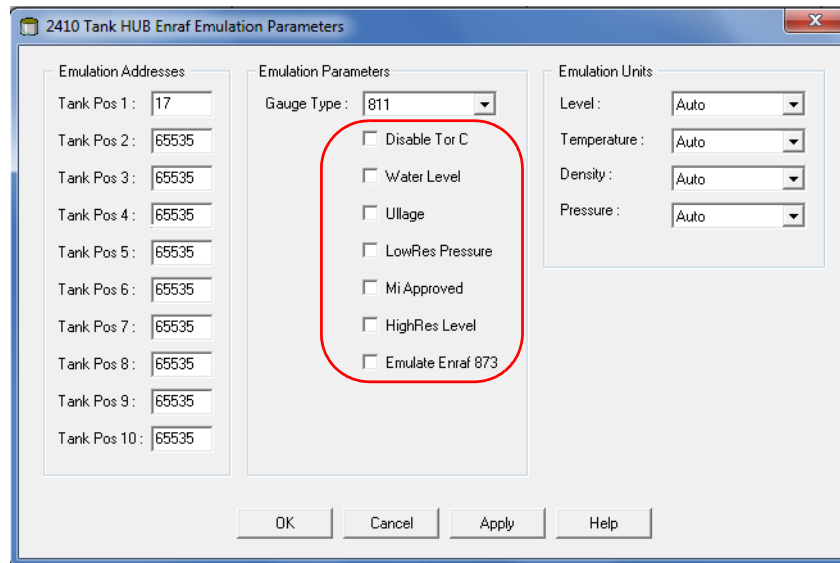

3.   In the *Gauge Type* drop-down list select **811** for gauges such as 811, 854, 894, 873 and 973 (TOI B), or select **813** (TOI C).

There are several emulation configuration parameters that can be enabled for specific settings.

4. Select the desired check boxes to enable specific parameter settings. See parameter description below.

Disable Tor C	Disable Type of Request (TOR) C response (no response on temperature request).
Water Level	Enable Water interface measurement. The level value in TOR B and D, is replaced with the Water Level value when a TOR W is received.
Ullage	Respond with ullage instead of level.
LowRes Pressure	Resolution of the pressure value will be decreased by one decimal digit.
MiApproved	The level will be invalid if outside the legal level value range and temperature will be invalid outside legal temperature value range.
HighRes Level	Resolution of the level value will be increased by one decimal digit. (Only applicable for decimal feet and inches.)
Emulate Enraf 873	Respond with device 873 on identification requests.

All Enraf unit types are separately configurable (optional).

5.   In the drop-down list for Emulation Units, select desired unit types.

6.   Select **Apply**.

1.4.4   Configure field devices

When the tank hub configuration is completed the Rosemount field devices, for example Rosemount 5900 Radar Level Gauge and Rosemount 2240S Multi-input Temperature Transmitter, must be configured as well. The field devices are configured as usual, for information see the Rosemount Tank Gauging System Configuration manual (document number 00809-0300-5100).

1.   Configure the field devices by using the *Properties* window of each device.

2.   Verify that measured data such as level, temperature etc. are valid.

1.4.5   Connect the CIU

1.   When configuration is completed, close TankMaster WinSetup and disconnect the EBM.

2.   Connect the bus to the CIU.

3.   The tank hub will now switch to Enraf mode and act like an Enraf gauge.

1.5   Advanced information

1.5.1   Type of Request (TOR)

The Enraf host system can request the following data from the tank hub:

Table 1-3. Data Requests

TOR	Message description
A	Send level alarm status
B	Send level alarm status and level
C	Send level alarm status and temperature
D	Send level alarm status, level and temperature
E	Send stored level alarm status and level[1]
F	Send stored level alarm status, level and temperature[1]
L	Send water alarm status and signed level[2]
M	Send water alarm status and signed level[2]

1.   *The tank hub sends the type of level (water or product depending on received operational requests).*
2.   *0.1 mm resolution.*

Table 1-4. Operational Requests

TOR	Message description
S	Store level alarm, level and temperature
U	Unlock[1]
W	Switch to Water Level in B, D and L-record[2]
Q	Quit Water Level

1.   *No action done.*
2.   *Only switched if bit is set in MiscCtrl holding register.*

Table 1-5. Testing Operation Requests

TOR	Message description
X	Send identification record[1]

1.   *Tank hub sends: "HUB". It is also possible to send: "873" (configured in MiscCtrl holding register).*

Table 1-6. Item Settings Requests

| TOR		Message description
Z	V0-VF	Send or request items: Spot temperatures
Z	AP	Send or request items: Average product temperature
Z	AG	Send or request items: Average gas temperature
Z	P1, P3	Send or request items: Pressure from transmitter 1 (tank bottom) and transmitter 3 (top of tank)
Z	DQ	Send or request items: Measured density
Z	RD	Send or request items: Radar signal strength amplitude
Z	RS	Send or request items: Transmitter reset
Z	RU	Send or request items: Radar ullage level
Z	RX	Send or request items: Relay status
Z	LD	Send or request items: Level dimension
Z	TD	Send or request items: Temperature dimension
Z	PI	Send or request items: Pressure dimension
Z	DI	Send or request items: Density dimension

1.5.2 Input and holding registers

Measured data is continuously stored in input registers of the tank hub. By viewing the input registers you can check that the device is working properly.

The holding registers store parameters which are used to configure the tank hub for various applications. By using the 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, do the following:

1.   In the *TankMaster WinSetup* workspace window, right click the tank hub device icon.

2.   Choose the **View Input Registers** or **View Holding Registers** option.
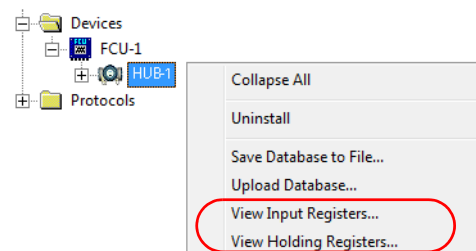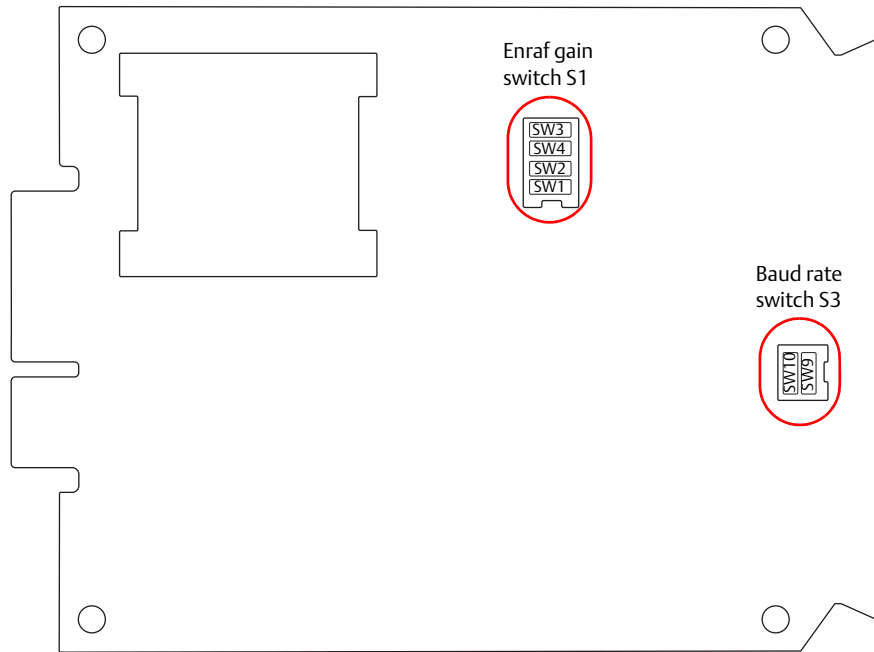
1.5.3   Configuration switches

The Enraf communication board is equipped with configuration switches that can be used to change settings such as baud rate and bus gain. Figure 1-6 shows where the switches are located on the communication board.

**Figure 1-6. Enraf Communication Board Switches**

Change baud rate

The tank hub is pre-configured with baud rate 1200. To change the baud rate set the switches SW9 and SW10 according to Table 1-7.

Table 1-7. Baude Rate Configuration Switch S3

| SW9	SW10	Baud rate
OFF (Open)	OFF (Open)	2400 or externally selected
OFF (Open)	ON (Closed)	1200 (default)
ON (Closed)	OFF (Open)	4800[1]
ON (Closed)	ON (Closed)	4800[1]

1.   Not used for Enraf emulation.
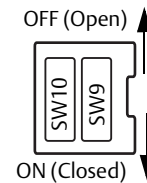
Change Enraf bus gain

The Enraf bus gain is by default 10 percent. A long cable and/or high impedance may result in the need to increase gain. Increased gain will improve detection of weaker signals, but also increase the risk of cross talk and EMC disturbance.
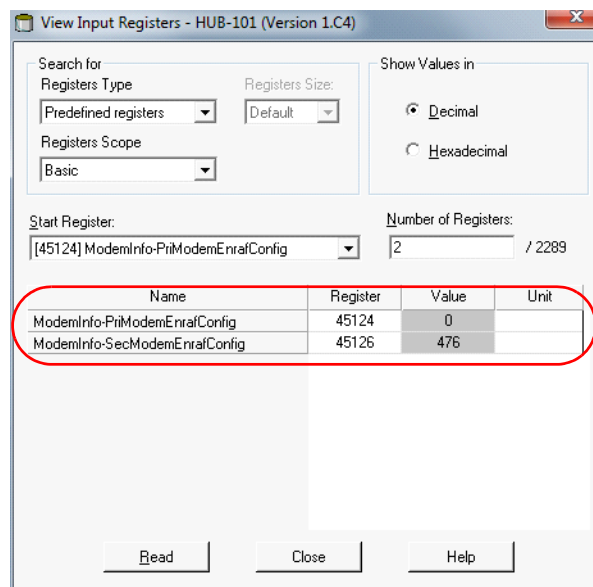
Table 1-8. Enraf Bus Gain Configuration Switch S1

SW1 SW2	SW3 SW4	Gain
OFF (Open)	OFF (Open)	100%
OFF (Open)	ON (Closed)	32%
ON (Closed)	ON (Closed)	10% (default)
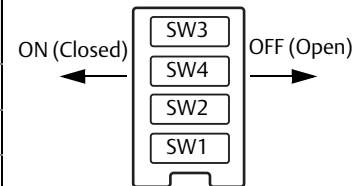
Check switch status

The input registers can be used to check the current status of the switches without having to dismount the communication board from the housing.

To view current status of the switches, left click the grey background colored *Value* field for the proper input register.

1.5.4   Troubleshooting

Tank hub with two communication boards

Verify that communication is working properly, by checking the input registers as described in Table 1-9. See Table 1-10 for troubleshooting actions.

Table 1-9. Enraf Slave Input Registers

| Register number		Input register	Description
Primary field bus	**Secondary field bus**		
1206	1256	RecMessages	Total queries received
1208	1258	MessagesToMe	Number of received queries addressed to me
1210	1260	SentMessages	Number of sent messages

Table 1-10. Troubleshooting Chart

Symptom	Action
Input register RecMessages does not enumerate	Check that: ■ the tank hub is powered. ■ cables are properly connected. ■ the tank hub is in Enraf mode. ■ the tank hub is configured for Enraf emulation.
Input register MessagesToMe does not enumerate	Check that the Enraf address is correct.
Input register SentMessages does not enumerate	Check that the host is sending proper requests.

1.5.5 Automatic protocol switch mechanism

The tank hub supports a special mechanism to switch protocol from Enraf to Modbus. If the tank hub detects about 20 corrupted messages in a row, the protocol will be switched[1].

Figure 1-7. Automatic Protocol Switch Mechanism
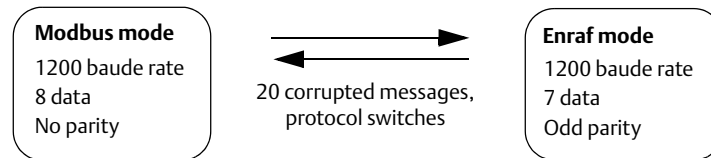
This mechanism can be disabled by clearing bit 1 in the following holding registers:

Table 1-11. Holding Register, Automatic Protocol Switch Mechanism

	Register number	Holding register
Primary field bus	706	MiscConfigPri
Secondary field bus	756	MiscConfigSec

1.5.6 Relay configuration

For application software version 1.D1 and later, the state of the tank hub relays, K1 and K2, can be included in the Enraf alarm status (as).

An example of use is when a dry contact is connected to a temperature device such as Rosemount 644 or 2240S Temperature Transmitter. The K1 and/or K2 relays are then configured to be controlled by the temperature value, and the relay status will be available in Enraf alarm status (as).

Alarm status

Bit 14 and/or bit 15 in holding register 1060 "EnrafMiscCtrl" can be used to have the High and Low alarms controlled by the K1 and K2 relay states instead of the alarm limits:

If bit 14 "Use_K1_High_Alarm_Status" is set:

- Alarm status is set to High alarm if K1 is de-energized
- Relay K2 will have no effect

If bit 15 "Use_K1_K2_High_Low_Alarm_Status" is set:

- Alarm status is set to High Alarm if K1 is de-energized, and set to Low alarm if K1 is energized and K2 is de-energized

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1. *It might take up to 60 seconds before the protocol switches.*

Contact status

If the device is a Type of Instrument C, relay status can also be included in the Enraf contact status. For more info, contact your local Emerson Process Management/
Rosemount Tank Gauging representative.

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