

HART® to Modbus® Adaptor Operating Manual



Eclipse[®] Model 706 Guided Wave Radar Level Transmitter









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INTRODUCTION

The HART to Modbus Adaptor (HMA) is designed to allow Magnetrol HART transmitters to be utilized in a Modbus^{®1} system. The following Modbus protocols are supported:

- Modbus RTU Function codes 3, 4, 6, and 16
- Modbus ASCII Function codes 3, 4, 6, and 16
- Levelmaster Commands <u>Uxx?</u>, <u>UxxF?</u>, <u>UxxOL?</u>, and <u>UxxOLxxxx?</u>

The HMA will support up to five attached HART devices; one in the same housing as the HMA, and up to four external devices attached through a 4-20 mA loop. The HMA provides power for all attached HART units. Note that the unit should be set to a fixed 4 mA loop current.

Communication

Within the above protocols, it is possible to <u>change communications parameters</u> such as baud rate, parity, stop bits, etc. to match the settings for a particular Modbus RTU or host.

To ensure a standard way to communicate with the HMA, setting DIP switch position 1 to OFF (see Appendix A) will configure the HMA to communicate via Modbus RTU with the default communications settings shown in Appendix F.

Operating Modes

When using the Modbus RTU and ASCII protocols, the HMA can be used in two basic ways:

- 1. <u>Single Device</u> The HMA is connected to only the HART device present in the same transmitter housing. The HART poll address of the HART device and the Modbus poll address of the HMA are the same. Essentially, they appear to a Modbus master as a single native Modbus device.
- 2. Multiple Devices Up to five HART devices can be connected to an HMA. The devices can be accessed via two modes:
 - <u>Device</u> The Modbus host addresses the HART devices directly, using the HART Poll Address of each device as the Modbus address. (The HMA is essentially transparent.) The registers for each attached device type are the same regardless of the poll address. The HART devices will appear to be native Modbus devices to the Modbus host.
 - <u>HMA</u> The Modbus host addresses the HMA directly, using only the address of the HMA. The registers in the HMA for each attached device depend on the slave number of the attached devices. The HMA will appear to be a Modbus device capable of providing multiple level measurements.

Supported Device Parameters

Not all of the parameters for a particular HART device are supported by the HMA using Modbus communication. The parameters that are available have been chosen to represent the most commonly used or adjusted parameters for the device. The available parameters are listed in Appendices I through O.

Full Device Configuration

¹ Modbus[®] is a registered trademark of Schneider Electric, licensed to the Modbus Organization, Inc.

The HMA is also capable of passing <u>HART commands using the RS-485 connection</u> to the attached devices. Alternatively, a HART modem can be connected directly to the HART terminal block on the HMA². These modes can be used to utilize a hand-held communicator or PACTware with a DTM to set up or troubleshoot an attached HART device. Using a DD or DTM, the full range of the HART device's parameters can be accessed.

This document is intended to provide a guide for utilizing the various features of the Magnetrol HART to Modbus Adaptor. For each feature, a step-by-step procedure is provided to demonstrate how to set up the HMA and attached HART devices for a particular configuration. Other configurations are possible with various combinations of the number of HART to Modbus Adapters on a single RS-485 line and the number and type of Magnetrol HART devices attached to those HART to Modbus Adapters. The operations in those configurations can be accomplished by extending the procedures provided in this document. Additionally, it is not required to use the Modbus RTUs or host applications shown in this document. Any RTU or host application can be used that allows for reading and writing Modbus registers in a slave device.

² The HMA will always act as a primary master on the HART loop. Therefore, if connecting another HART host to the loop, it must either be capable of automatically setting itself to be a secondary master, or be manually configured as a secondary master.

SETUP PROCEDURES

1. Configuring communications settings in the HMA

1.1. Purpose

This setup procedure instructs how to configure HART to Modbus Adaptor (HMA) communications using a basic Modbus master simulator application. The procedure can also be performed using any Modbus master that permits reading and writing of the appropriate registers in the HMA.

To ensure that there is a known communication configuration for the HMA, position 1 of the DIP switch is used to select between a fixed communication setting and a user-configurable setting. When the switch is set to OFF, the HMA communicates using Modbus RTU with a poll address of 247 at 9600 baud, 8 data bits, even parity, and 1 stop bit. When in the default configuration, the user-selectable communication settings can be adjusted. When the user settings are desired to be used, position 1 of the DIP switch should be set to ON, and then input power cycled. Changing back to the fixed default settings also requires a power cycle.

1.2. Equipment

| Item | Manufacturer | Model |
|--------------------------|---------------------|--------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| USB Communications cable | FDTIchip | USB-RS485-WE |
| Termination resistor | - | 120Ω |
| Modbus host application | www.modbustools.com | Modbus Poll |
| Power Supply | - | 20-24V, 0.5A |

1.3. Setup

Connect the HMA to a power supply via the power terminal block. Connect an RS-485 communications cable to the RS-485 terminal block of the HMA, with the Receive/Transmit Data+ A lead (orange) on the positive terminal and the Receive/Transmit Data– B lead (yellow) on the negative terminal. Connect a 120Ω resistor between the two RS-485 terminal block positions. Connect the other end of the cable to a PC which has a Modbus host application.

- 1.4.1 Connect the HMA to a power supply and Modbus host as specified in section 1.3.
- 1.4.2 Ensure that the DIP switches on the HMA are set to 1 == OFF (Default Config Mode), 2 == OFF, 3 == OFF, 4 == ON. See Appendix A for the location of the DIP switch, and Appendix B for a legend of the four switch positions.
- 1.4.3 Open the Modbus Poll application.

1.4.4 Select Connection\Connect from the menu bar, ensure that the connection settings are as follows, and then click OK. Note that the USB Serial Port setting needs to match the port number for the communication cable that is being used.

| Connection Setup | <u> </u> |
|------------------------|---------------------|
| Connection | ОК |
| Serial Port | Cancel |
| Serial Settings | Cancer |
| USB Serial Port (COM3) | ▼ Mode |
| 9600 Baud 🔻 | RTU O ASCII |
| 8 Data bits 🔻 | Response Timeout |
| Even Parity 🔻 | 5000 [ms] |
| | Delay Between Polls |
| 1 Stop Bit 🔻 Advar | nced 100 [ms] |
| Remote Server | |
| IP Address Port | Connect Timeout |
| 127.0.0.1 - 502 | 3000 [ms] |
| | |

1.4.5 Open or click on an Mbpoll window, select Setup\Read\Write Definition from the menu bar, ensure that the settings are as follows, and then click OK:

| Read/Write I | Definition | | | × | Ŋ | | | | |
|--------------|---------------|------------|-------------------|----------------|---|------|---------------------------|-----------------|------------|
| Slave ID: | 247 |] | | OK | r | Dec. | | | |
| Function: | 03 Read Ho | olding Reg | gisters (4x) 🔻 | Cancel | | | Mbpoll1 = 282: Err = 0 | : ID = 247: F = | • X 03: |
| Address: | 3000 | Protocol | address, E.g. 400 |)11 -> 10 | | | | | |
| Quantity: | 8 |] | | | | | Alias | 03000 | |
| Scan Rate: | 1000 | [ms] | | Apply | | 0 | | 0 | |
| Disable | | | | | | 1 | | 247 | |
| 📃 Read/ | Write Disable | ed | | | | 2 | | 1 | |
| 📃 Disabl | e on error | | Re | ead/Write Once | | 3 | | 8 | |
| View | | | | | | 4 | | 1 | |
| Rows | | | | | | 5 | | 2 | |
| 10 | 0 20 0 | 50 🔘 | 100 🔘 Fit to Qu | antity | | 6 | | 3 | |
| Display: | | | 📃 Hide Alias Col | lumns | | 7 | | 0 | |
| Unsigned | Ь | • | 📃 Address in Ce | :11 | | 8 | | | |
| | | | PLC Addresse | es (Base 1) | | 9 | | | |
| | | | | | | | | | |

- 1.4.6 Verify that the values in the registers listed in the Mbpoll window match the values for the desired Modbus protocol settings. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.
- 1.4.7 Power down the HMA, change DIP switch 1 to ON, and then reapply power to the HMA. This sets the device to run in the selected communications mode.
- 1.4.8 If communication at the new settings is not achieved, power down the HMA, change DIP switch 1 to OFF, and then reapply power to the HMA. This sets the device to run in the default Modbus RTU communications mode. Check the communication setting registers to ensure that the desired values are present.

2. Reading and writing registers in the HMA

2.1. Purpose

This setup procedure instructs how to read and write HART to Modbus Adaptor (HMA) registers using a basic Modbus master simulator application. The procedure can also be performed using any Modbus master that permits reading and writing of the appropriate registers in the HMA.

2.2. Equipment

| Item | Manufacturer | Model |
|--------------------------|---------------------|--------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| USB Communications cable | FDTIchip | USB-RS485-WE |
| Termination resistor | - | 120Ω |
| Modbus host application | www.modbustools.com | Modbus Poll |
| Power Supply | - | 20-24V, 0.5A |

2.3. Setup

Connect the HMA to a power supply via the power terminal block. Connect an RS-485 communications cable to the RS-485 terminal block of the HMA, with the Receive/Transmit Data+ A lead (orange) on the positive terminal and the Receive/Transmit Data- B lead (yellow) on the negative terminal. Connect a 120Ω resistor between the two RS-485 terminal block positions. Connect the other end of the cable to a PC which has a Modbus host application.

- 2.4.1 Connect the HMA to a power supply and Modbus host as specified in section 2.3.
- 2.4.2 Ensure that the DIP switches on the HMA are set to 1 == OFF (Default Config Mode), 2 == OFF,
 3 == OFF, 4 == ON. See Appendix A for the location of the DIP switch, and Appendix B for a legend of the four switch positions.
- 2.4.3 Open the Modbus Poll application.

2.4.4 Select Connection\Connect from the menu bar, ensure that the connection settings are as follows, and then click OK. Note that the USB Serial Port setting needs to match the port number for the communication cable that is being used.

| Connection Setup | |
|---|---------------------|
| Connection | ОК |
| Serial Port | Cancel |
| Serial Settings | |
| USB Serial Port (COM3) | Mode |
| 9600 Baud 🔻 | RTU O ASCII |
| 8 Data bits 💌 | Response Timeout |
| Even Parity 🔻 | 5000 [ms] |
| | Delay Between Polls |
| 1 Stop Bit | 100 [ms] |
| Remote Server | |
| IP Address Port Connec 127.0.0.1 ▼ 502 3000 | t Timeout |
| | finol |
| | |

2.4.5 To read an input register, open or click on an Mbpoll window, and select Setup\Read\Write Definition from the menu bar. Set the Slave ID to match the Modbus Poll Address of the HMA. Set the Function to '04 Read Input Registers (3x)'. Using Appendices I through O, set the Address, Quantity and Display type in the pop-up dialog as required. Then click OK. The register value should appear in the Mbpoll window.

| Read/Write Definition | × | 🕎 N | /bpoll2 | | × |
|---|--------------|------|-----------------|-----------------|----|
| Slave ID: 2 | ОК | Tx = | = 113: Err = 0: | ID = 2: F = 04: | SF |
| Function: 04 Read Input Registers (3x) 💌 | Cancel | | Alias | 01300 | |
| Address: 1302 Protocol address. E.g. 3001 | 1 -> 10 | 0 | | | |
| Quantity: 8 | | 1 | | 42.6378 | |
| Scan Rate: 1000 [ms] | Apply | 3 | | | = |
| Disable Read/Write Disabled | | 4 | | 27.4016 | |
| | d/Write Once | 5 | | | |
| View | | 6 | | 32 | |
| Rows | | 7 | | | |
| 🔘 10 💿 20 🔘 50 🔘 100 🔘 Fit to Quar | ntity | 8 | | 72.14 | |
| Display: Hide Alias Colur | anns | 9 | | | |
| Float AB CD Address in Cell | | 10 | | | |
| PLC Addresses | (Base 1) | 11 | | | |
| | | 12 | | | Ŧ |

2.4.6 To read a holding register, open or click on an Mbpoll window, and select Setup\Read\Write Definition from the menu bar. Set the Slave ID to match the Modbus Poll Address of the HMA. Set the Function to '03 Read Holding Registers (4x)'. Using Appendices I through O, set the Address, Quantity and Display type in the pop-up dialog as required. Then click OK. The register value should appear in the Mbpoll window.

| Read/Write [| Definition | | × | | | | |
|--------------|----------------|-----------------------|-----------------|----------------|------------------------|-----------------|------------|
| Slave ID: | 247 | | ОК | BR2 . . | | | |
| Function: | 03 Read Holdi | ing Registers (4x) 🔻 | Cancel | | bpoll1 282: Err = 0 | : ID = 247: F = | • X 03: |
| Address: | 3000 P | rotocol address. E.g. | 40011 -> 10 | | | | |
| Quantity: | 8 | | | | Alias | 03000 | |
| Scan Rate: | 1000 (r | ns] | Apply | 0 | | 0 | |
| - Disable | | | | 1 | | 247 | |
| | Write Disabled | | | 2 | | 1 | |
| 📃 Disable | e on error | [| Read/Write Once | 3 | | 8 | |
| View | | | | 4 | | 1 | |
| Rows | | | | 5 | | 2 | |
| I0 | 0 20 0 50 | 0 🔘 100 🔘 Fit to | Quantity | 6 | | 3 | |
| Display: | | 📃 🔲 Hide Alias | Columns | 7 | | 0 | |
| Unsigned | 1 | 💌 🔳 Address in | n Cell | 8 | | | |
| | | 📃 PLC Addro | esses (Base 1) | 9 | | | |
| | | | | | | | |

2.4.7 To write a holding register, double-click on the register value displayed in step 2.4.6. Enter the new value and click on 'Send. Confirm that the new value appears in the Mbpoll window.

3. Basic Modbus RTU Communication over RS-485

3.1. Purpose

This setup procedure instructs how to configure the HART to Modbus Adaptor (HMA) to support the Modbus RTU protocol over RS-485.

3.2. Equipment

| Item | Manufacturer | Model |
|--------------------------|---------------------|----------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| USB Communications cable | FDTIchip | USB-RS485-WE |
| Termination resistor | - | 120Ω |
| Modbus host application | www.modbustools.com | Modbus Poll |
| Power Supply | - | 20-24V, 0.5A |
| Level transmitter | MII | Model 706 |
| Probe | MII | Model 706 compatible |

3.3. Setup

Connect the HMA to a power supply via the power terminal block. Connect an RS-485 communications cable to the RS-485 terminal block of the HMA, with the Receive/Transmit Data+ A lead (orange) on the positive terminal and the Receive/Transmit Data- B lead (yellow) on the negative terminal. Connect a 120Ω resistor between the two RS-485 terminal block positions. Connect the other end of the cable to a PC which has a Modbus host application.

- 3.4.1 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for the Modbus RTU protocol default settings. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.
- 3.4.2 Change DIP switch 1 to ON. This sets the device to run in the selected communications mode.
- 3.4.3 Remove power from the HMA.
- 3.4.4 Connect the HMA to a Modbus master.
- 3.4.5 Apply power to the HMA.
- 3.4.6 Verify that the Modbus master is receiving responses from the HMA (Tx is increasing) and that there are no communication errors being reported.

4. Basic Modbus RTU Communication over RS-232

4.1. Purpose

This setup procedure instructs how to configure the HART to Modbus Adaptor (HMA) to support the Modbus protocol over RS-232.

4.2. Equipment

| Item | Manufacturer | Model |
|-----------------------------|---------------------|----------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| Serial Communications cable | - | - |
| Termination resistor | - | 120Ω |
| Modbus host application | www.modbustools.com | Modbus Poll |
| Power Supply | - | 20-24V, 0.5A |
| Level transmitter | MII | Model 706 |
| Probe | MII | Model 706 compatible |

4.3. Setup

Connect the HMA to a power supply via the power terminal block. Connect an RS-485 communications cable to the RS-485 terminal block of the HMA, with the Receive/Transmit Data+ A lead (orange) on the positive terminal and the Receive/Transmit Data- B lead (yellow) on the negative terminal. Connect a 120Ω resistor between the two RS-485 terminal block positions. Connect the other end of the cable to a PC which has a Modbus host application.

- 4.4.1 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for the Modbus RTU protocol default settings. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.
- 4.4.2 Ensure that the DIP switches on the HMA are set to 1 == ON (Default Config Mode), 2 == OFF, 3 == ON, 4 == OFF.
- 4.4.3 Remove power from the HMA.
- 4.4.4 Connect the HMA to a Modbus master.
- 4.4.5 Apply power to the HMA
- 4.4.6 Verify that the Modbus master is receiving responses from the HMA (Tx is increasing) and that there are no communication errors being reported.

5. Basic Modbus ASCII Communication over RS-485

5.1. Purpose

This setup procedure instructs how to configure the HART to Modbus Adaptor (HMA) to support the Modbus ASCII protocol.

5.2. Equipment

| Item | Manufacturer | Model |
|--------------------------|---------------------|--------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| USB Communications cable | FDTIchip | USB-RS485-WE |
| Termination resistor | - | 120Ω |
| Modbus host application | www.modbustools.com | Modbus Poll |
| Power Supply | - | 20-24V, 0.5A |

5.3. Setup

Connect the HMA to a power supply via the power terminal block. Connect an RS-485 communications cable to the RS-485 terminal block of the HMA, with the Receive/Transmit Data+ A lead (orange) on the positive terminal and the Receive/Transmit Data- B lead (yellow) on the negative terminal. Connect a 120Ω resistor between the two RS-485 terminal block positions. Connect the other end of the cable to a PC which has a Modbus host application.

- 5.4.1 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for the Modbus ASCII protocol default settings. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.
- 5.4.2 Change DIP switch 1 to ON. This sets the device to run in the selected communications mode.
- 5.4.3 Cycle the power to the HMA.
- 5.4.4 Verify that the device is not communicating with the Modbus Poll application.
- 5.4.5 Select Connection\Disconnect from the Modbus Poll menu bar.

5.4.6 Select Connection\Connect from the menu bar, ensure that the connection settings are as follows, and then click OK. Note that the USB Serial Port setting needs to match the port number for the communication cable that is being used.

| Connection Setup | × |
|--|---------------------------------|
| Connection Serial Port | ОК |
| Serial Settings USB Serial Port (COM3) | Mode © RTU ASCII |
| 9600 Baud 7 Data bits | Response Timeout 5000 [ms] |
| Even Parity I Stop Bit Advanced | Delay Between Polls 100 [ms] |
| Remote Server IP Address Port Connect 127.0.0.1 502 3000 | t Timeout [ms] |

5.4.7 Verify that the Modbus Poll application is receiving responses from the HMA (Tx is increasing) and that there are no communication errors being reported.

6. Modbus RTU Communication in Single Device Mode

6.1. Purpose

This setup procedure instructs how to configure the HART to Modbus Adaptor (HMA), when in the Single Device mode, to support the various parameter registers defined for the attached device.

In the Single Device mode (register 3007 set to 2), the HMA and attached device will appear to be a single native Modbus device to the Modbus RTU/master. This mode is for instances where an HMA is used with a single HART device, and is designed to simplify the configuration and commissioning process. PACTware and a DTM or a HART host with a DD can be used to configure the attached device. When the HART poll address of the device is changed, the HMA will automatically change its Modbus address to match.

6.2. Equipment

| Item | Manufacturer | Model |
|--------------------------|---------------------|----------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| USB Communications cable | FDTIchip | USB-RS485-WE |
| Termination resistor | - | 120Ω |
| Modbus host application | www.modbustools.com | Modbus Poll |
| Power Supply | - | 20-24V, 0.5A |
| Level transmitter | MII | Model 706 |
| Probe | MII | Model 706 compatible |

6.3. Setup

Connect the HMA to a power supply via the 9-30 VDC terminal block. Connect a HART modem and HART host or a 475 Field Communicator to the HART terminal block.

- 6.4.1 Connect the HMA to a power supply and HART host as specified in section 6.3.
- 6.4.2 Using Procedure 2, verify that register 3012 on the HMA is set to a value of 2 Single Device.
- 6.4.3 Configure the HART device using the HART host.
- 6.4.4 Change the poll address of the HART device to the desired Modbus address (within the range of 0 to 63).
- 6.4.5 Set position 1 of the DIP switch to 1.
- 6.4.6 Cycle power to the HMA.
- 6.4.7 The HMA will search through the 0 to 63 poll range for the attached device. Once the device is found, the HMA will automatically change its Modbus address to match.
- 6.4.8 Note that the Modbus communication settings such as baud rate, parity, etc. require a Modbus master to change the settings. See Procedure 1.

7. Modbus RTU Communication in Device Mode

7.1. Purpose

This setup procedure instructs how to configure the HART to Modbus Adaptor (HMA), when in the Device mode, to support the various parameter registers defined for the attached devices. It also demonstrates how to use multiple HMAs when it is necessary to communicate with more than five attached HART devices when in the Device mode.

In the Device mode (register 3007 set to 1), the HMA will appear to be transparent to the Modbus RTU/master. The HART poll address of each attached HART unit should be set to the desired Modbus poll address for that device (within the range of 0 to 63). This mode can be useful when several devices are attached to the same RS-485 line. There is no need to maintain a record of which HART device is connected to each HMA device, or to read different register numbers for the same type HART device depending on which slave number it is on which HMA. In effect, the HART devices will appear to the Modbus master as native Modbus devices. For the same type device, the register number for various parameters will be the same from unit to unit. The HMA should have a different Modbus address so that it can also be queried by the Modbus master.

| Item | Manufacturer | Model |
|--------------------------|---------------------|-------------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| USB Communications cable | FDTIchip | USB-RS485-WE |
| Termination resistor | - | 120Ω |
| Modbus host application | www.modbustools.com | Modbus Poll |
| Power Supply | - | 20-24V, 0.5A |
| Level transmitter | MII | Model 706 |
| Probe | MII | Model 706 compatible |
| Level transmitter | MII | Model 705 3x |
| Probe | MII | Model 705 3x compatible |
| Level transmitter | MII | Model 355 |
| Level transmitter | MII | Model R82 R2 |
| Level transmitter | MII | Model RX5 |
| Level transmitter | MII | Enhanced Jupiter |
| Level transmitter | MII | E3 Modulevel |

7.2. Equipment

7.3. Setup

Connect two HMAs to a power supply via the power terminal block. Connect an RS-485 communications cable to a PC which has a Modbus host application. Connect the other end of the cable to the RS-485 terminal block of the HMA1. Install jumper wires connecting the positive terminal of the RS-485 terminal block of HMA1 and the positive terminal of the RS-485 terminal block of HMA1 and the positive terminal of the RS-485 terminal block of HMA2 as well as the negative terminal of the two terminal blocks. Connect a 120Ω resistor between the two RS-485 terminal block positions of HMA2. Connect additional supported Magnetrol HART devices to the HART loop terminal block of the two HMAs. There can be any combination of devices including the Model 706, Model 705 3x, Model 355, Model R82 R2, Model RX5, Enhanced Jupiter and E3 Modulevel device. Note that each device's Poll Address can be set to any value between 0 and 63 as long as it has a unique Poll Address, and

there can be a maximum of 5 devices connected to an HMA including the device in the housing containing the HMA.

- 7.4.1 Connect the HMAs to a power supply, Modbus host and MII HART transmitters as specified in section 7.3.
- 7.4.2 Temporarily disconnect HMA2.
- 7.4.3 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for the Modbus RTU protocol default settings. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.
- 7.4.4 Using Procedure 2, change register 3001 to a value of 15. This changes the address of the HMA to 15 to be unique from the other HMA and from the attached devices.
- 7.4.5 Using Procedure 2, change register 3007 to a value of 1. This sets the HMA to run in the Device mode which allows direct Modbus addressing of the HART devices. In this mode, the Modbus address will be the same as the HART Poll Address.
- 7.4.6 Using Procedure 2, change register 3012 to a value of 0. This will cause the HMA to scan the attached devices at start-up, and record the poll address and other information for each device.
- 7.4.7 Repeat steps 6.4.2 through 6.4.6 except disconnecting HMA1 and modifying settings on HMA2. Set the Poll Address of HMA2 to 20.
- 7.4.8 Power down the HMAs, change DIP switch 1 to ON for both units, and then reapply power to both HMAs.
- 7.4.9 Using Procedure 2, verify that register 3012 on each HMA has automatically changed to a value of 1.

7.4.10 Using Procedure 2, verify that parameters of the HART devices can be read through the appropriate registers. The supported parameters of the Magnetrol HART transmitters are listed in Appendices I through O. Use the Modbus Register number column labeled 'Device Mode' for the Address number. Note that the Slave ID number must match the HART Poll Address of the attached device. Multiple registers may be read at the same time as long as the register numbers are contiguous and can be shown as the same data type. For example, the PV, SV, TV and QV values can be displayed in one Modbus Poll window by setting the Read/Write Definition to:

| Read/Write Definition | Mbpoll2 |
|--|---------------------------------------|
| Slave ID: OK | Tx = 113: Err = 0: ID = 2: F = 04: SF |
| Function: 04 Read Input Registers (3x) Cancel | Alias 01300 _ |
| Address: 1302 Protocol address. E.g. 30011 -> 10 | 0 |
| Quantity: 8 | 1 2 42.6378 |
| Scan Rate: 1000 [ms] Apply | 3 |
| Disable Read/Write Disabled | 4 27.4016 |
| Disable on error Read/Write Once | 5 |
| View | 6 32 |
| Rows | 7 |
| 🔘 10 💿 20 🔘 50 🔘 100 🔘 Fit to Quantity | 8 72.14 |
| Display: 📄 Hide Alias Columns | 9 |
| Float AB CD Address in Cell | 10 |
| PLC Addresses (Base 1) | 11 |
| | 12 - |

- 7.4.11 Verify that the values displayed match the values shown on the device's local user interface.
- 7.4.12 For parameters that are defined as Holding registers in Appendix I, use Procedure 2 to verify that a value can be written to the device and that the new value appears on the local display of the device. To write a new value to the device, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.
- 7.4.13 Repeat steps 6.4.10 through 6.4.12 for the other devices attached to the HMAs. For each device, the Slave ID entered in step 6.4.10 must match the Poll Address for that device. The supported parameters for a device are listed in Appendices I through O.

8. Modbus RTU Communication in HMA Mode

8.1. Purpose

This setup procedure instructs how to configure the HART to Modbus Adaptor (HMA), when in the HMA mode, to support the various registers defined for the attached devices. It also demonstrates how to use multiple HMAs when it is necessary to communicate with more than five attached HART devices when in the HMA mode.

In the HMA mode (register 3007 set to 0), the HMA will be the only device directly visible to the Modbus RTU/master. This mode can be useful when more devices are attached to the same RS-485 line then there are available Modbus addresses. With each HMA supporting up to 5 HART devices, far fewer Modbus addresses are required for a given number of HART devices. All commands to read or write to a device are accomplished by using only HMA registers. In effect, the HART devices will invisible to the Modbus master, and the HMAs will appear to be able to provide multiple level readings. For the same type device, the HART device to HART device and will depend on the slave number of the device on the HMA.

| Item | Manufacturer | Model |
|--------------------------|---------------------|-------------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| USB Communications cable | FDTIchip | USB-RS485-WE |
| Termination resistor | - | 120Ω |
| Modbus host application | www.modbustools.com | Modbus Poll |
| Power Supply | - | 20-24V, 0.5A |
| Level transmitter | MII | Model 706 |
| Probe | MII | Model 706 compatible |
| Level transmitter | MII | Model 705 3x |
| Probe | MII | Model 705 3x compatible |
| Level transmitter | MII | Model 355 |
| Level transmitter | MII | Model R82 R2 |
| Level transmitter | MII | Model RX5 |
| Level transmitter | MII | Enhanced Jupiter |
| Level transmitter | MII | E3 Modulevel |

8.2. Equipment

8.3. Setup

Connect two HMAs to a power supply via the power terminal block. Connect an RS-485 communications cable to a PC which has a Modbus host application. Connect he other end of the cable to the RS-485 terminal block of the HMA1. Install jumper wires connecting the positive terminal of the RS-485 terminal block of HMA1 and the positive terminal of the RS-485 terminal block of HMA1 and the positive terminal of the RS-485 terminal block of HMA2 as well as the negative terminal of the two terminal blocks. Connect a 120Ω resistor between the two RS-485 terminal block positions of HMA2. Connect additional supported Magnetrol HART devices to the HART loop terminal block of the two HMAs. There can be any combination of devices including the Model 706, Model 705 3x, Model 355, Model R82 R2, Model RX5, Enhanced Jupiter and E3 Modulevel. Note that each device's Poll Address can be set to any value between 0 and 63 as long as it has a unique address, and there can be a maximum of 5 devices connected to an HMA including the device in the housing containing the HMA.

- 8.4.1 Connect the HMAs to a power supply, Modbus host and MII HART transmitters as specified in section 8.3.
- 8.4.2 Temporarily disconnect HMA2.
- 8.4.3 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for the Modbus RTU protocol default settings. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.
- 8.4.4 Using Procedure 2, change register 3001 to a value of 15. This changes the address of the HMA to 15 to be unique from the other HMA and from the attached devices.
- 8.4.5 Change register 3007 to a value of 0. This sets the HMA to run in the HMA mode in which only the HMAs are directly addressed by the Modbus master.
- 8.4.6 Change register 3012 to a value of 0. This will cause the HMA to scan the attached devices at start-up, and record the poll address and other information for each device.
- 8.4.7 Repeat steps 7.4.2 through 7.4.6 except disconnecting HMA1 and modifying settings on HMA2. Set the Poll Address of HMA2 to 20.
- 8.4.8 Power down the HMAs, change DIP switch 1 to ON for both units, and then reapply power to both HMAs.
- 8.4.9 Verify that register 3012 on each HMA has automatically changed to a value of 1.
- 8.4.10 Verify that register 1250 on each HMA displays the correct number of attached devices.

8.4.11 Check that the Device Type (1251 – 1255) and Polling Address (1256 – 1260) registers display the correct values for the attached devices. All eight registers along with register 1250 can be displayed in one Mbpoll window if the Display parameter is set to 'Hex' in the Read/Write Definition dialog. Refer to Appendix H for the register numbers. For example, with two devices attached:

| Read/Write Definition | |
|---|---------------------------------------|
| Slave ID: 247 OK | 💬 Mbpoll4 📃 🖃 💌 |
| Function: 04 Read Input Registers (3x) Cancel | Tx = 9: Err = 0: ID = 247: F = 04: SI |
| Address: 1250 Protocol address. E.g. 30011 -> 10 | Alias 01250 |
| Quantity: 11 | 1250 0x0002 |
| Scan Rate: 1000 [ms] Apply | 1251 0x56E0 |
| Disable | 1252 0x00E5 |
| Read/Write Disabled Read/Write Disabled Read/Write Disabled | 1253 0xFFFF |
| Disable on error Read/Write Once | 1254 0xFFFF |
| View Bows | 1255 0xFFFF |
| ○ 10 ○ 20 ○ 50 ○ 100 	 Fit to Quantity | 1256 0x0002 |
| Display: 📄 Hide Alias Columns | 1257 0x0003 |
| Hex Aldress in Cell | 1258 0x00FF |
| PLC Addresses (Base 1) | 1259 0x00FF |
| | 1260 0x00FF |

- 8.4.12 Note that Poll Address and Device Type registers corresponding to Slave IDs with no attached device will show 0xFFFF and 0x00FF respectively.
- 8.4.13 Open a new Mbpoll window.

8.4.14 The supported parameters for the HART devices are listed in Appendices I through O. For each device, use the appropriate table and the Modbus Register number column labeled with the Slave ID number of the device. Read the registers for each parameter. Note that the Slave ID number for the Mbpoll window must match the Slave ID of the HMA, not the attached device. For example, to read the PV through QV values for Slave ID 2, set the Read/Write Definition to:

| Read/Write [| Definition | | | × | -1 | 🛒 Mb | poll2 🗖 | |
|--|--------------|-------------|-------------------|----------------|------|--------|-------------|--------------|
| Slave ID: | 247 |] | | ОК | וו | Tx = 4 | 18: Err = I | 0: ID = 247: |
| Function: | 04 Read In | iput Regist | ters (3x) 🛛 🔻 | Cancel | | | Alias | 01312 |
| Address: | 1312 | Protocol | laddress. E.g. 30 | 011 -> 10 | | 1312 | | 1.9685 |
| Quantity: | 8 | 1 | | | | 1313 | | |
| | | | | | , II | 1314 | | 0 |
| Scan Rate: | 1000 | [ms] | | Apply | J | 1315 | | |
| Disable | Write Disabl | ed | | | | 1316 | | 1.9685 |
| | e on error | cu | B | ead/Write Once | 1 | 1317 | | |
| | 0 011 01101 | | | | | 1318 | | 0 |
| -View - Rows- | | | | | | 1319 | | |
| ○ 10 ○ 20 ○ 50 ○ 100 	 Fit to Quantity | | | | | | | | |
| Display: | | | 🔲 Hide Alias Co | lumns | | | | |
| Float AB | CD | | 🔲 Address in Ce | ell | | - | | |
| | | | PLC Address | es (Base 1) | | | | |
| | | | | | | | | |

- 8.4.15 Ensure that the values displayed match the values shown on the device's local user interface.
- 8.4.16 Repeat steps 7.4.14 and 7.4.15 for the remaining parameters listed in Appendices I through O for the attached devices.
- 8.4.17 For parameters that are defined as Holding registers in Appendix I, ensure that a value can be written to the device and that the new value appears on the local display of the device. To write a new value to the device, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.
- 8.4.18 Repeat steps 7.4.11 through 7.4.17 for HMA2 (Slave address 20).

9. Basic LevelMaster Communication

9.1. Purpose

This setup procedure instructs how to configure the HART to Modbus Adaptor (HMA) to support the Modbus LevelMaster protocol.

In the LevelMaster configuration, the HMA will appear to be invisible to the LevelMaster host. This is due to the limited command set available with LevelMaster. Instead, the attached HART devices will appear to be native LevelMaster devices. They will respond to the Modbus poll address equivalent to their HART poll address. The devices will return the HART PV and SV as the two D (float) values in the Uxx? command response. The F value corresponds to the Echo Signal strength. The E and W values correspond to the highest active Error and Warning diagnostic in each category.

| 9.2. E | Equipment |
|---------------|-----------|
|---------------|-----------|

| Item | Manufacturer | Model |
|----------------------------|----------------------|-------------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| USB Communications cable | FDTIchip | USB-RS485-WE |
| Termination resistor | - | 120Ω |
| Modbus host application | www.modbustools.com | Modbus Poll |
| Terminal v1.9b application | <u>hw-server.com</u> | Version 1.9b - 20040204 |
| Power Supply | - | 20-24V, 0.5A |
| Level transmitter | MII | Model 706 |
| Probe | MII | Model 706 compatible |

9.3. Setup

Connect the HMA to a power supply via the power terminal block. Connect an RS-485 communications cable to the RS-485 terminal block of the HMA, with the Receive/Transmit Data+ A lead (orange) on the positive terminal and the Receive/Transmit Data- B lead (yellow) on the negative terminal. Connect a 120 Ω resistor between the two RS-485 terminal block positions. Connect the other end of the cable to a PC which has a Modbus host application. Connect a Model 706 level transmitter to the HART loop terminal block of the HMA. Set the HART Poll Address of the Model 706 device to 2. Note that other Magnetrol HART transmitters and HART poll addresses can be used.

- 9.4.1 Connect the HMA to a power supply, Modbus host and Model 706 HART transmitter as specified in section 9.3.
- 9.4.2 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for the Modbus LevelMaster protocol default settings. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.

9.4.3 Change register 3012 to a value of 0. This will cause the HMA to scan the attached devices at start-up, and record the poll address and other information for each attached HART device.

| Read/Write Definition | |
|---|------------------------------------|
| Slave ID: 247 OK | Mbpoll2 |
| Function: 03 Read Holding Registers (4x) 🔻 Cancel | Tx = 126963: Err = 2706: ID = 247: |
| Address: 3012 Protocol address. E.g. 40011 -> 10 | Alias 03010 |
| Quantity: 2 | 0 |
| Scan Rate: 1000 [ms] Apply | 1 |
| Disable | 20 |
| Read/Write Disabled | 3 2 |
| Disable on error Read/Write Once | 4 |
| View | 5 |
| Rows | 6 |
| ● 10 ○ 20 ○ 50 ○ 100 ○ Fit to Quantity | 7 |
| Display: 📃 Hide Alias Columns | 8 |
| Unsigned Address in Cell | 9 |
| PLC Addresses (Base 1) | |
| | |

- 9.4.4 Power down the HMA, change DIP switch 1 to ON, and reapply power to the HMA.
- 9.4.5 Select Connection\Disconnect from the menu bar.
- 9.4.6 Start the Terminal v1.9b application. Note that any similar application that supports transmission/reception of ASCII characters over the RS-485 connection may be used.
- 9.4.7 Set the COM Port to match the COM port used for the communication cable (the same number as with the Modbus Poll application).
- 9.4.8 Set the Baud rate, Data bits, Parity, Stop Bits and Handshaking parameters to match the settings made in the HMA for LevelMaster communication.

9.4.9 The Terminal application settings should be as below.

| 🦼 Terminal v1.9b - 20040204 - by Br@y++ | |
|---|---------------------------|
| <u>About.</u> COM4 C 2400 C 28800 C 128000 C 7 COM5 C 4800 C 38400 C 256000 C 7 C 0 m | |
| Settings Auto Dis/Connect Time custom BR Rx Clear Set font Stay on Top CR=LF 9600 27 🚖 | Itable CTS CDSR CDCD CBRI |
| Receive C HEX CLEAR Reset Counter 13 € Counter = 9 C HEX Image: Counter in the set of the set o | StopLog 🔽 Dec 🔽 Hex 🗔 Bin |
| | |
| Transmit CLEAR Send File CR=CR+LF | DTR RTS |
| U02? | smit Macros |
| | |

- 9.4.10 Click <u>Connect</u>.
- 9.4.11 Create a Transmit Macro that will send U02?\$0D and check the checkbox to the right of the macro definition. Note that the 02 in the macro represents the Poll Address of the Model 706 device.
- 9.4.12 Verify that the Terminal application is receiving responses from the HMA and that there are no communication errors being reported. The Receive buffer section should have the same number of responses as the Transmit buffer section.

| 2 Terminal v1.9b - 20040204 - by Br@y++ | |
|---|----------|
| Connect COM Port Baud rate Data bits Parity Stop Bits Handshaking Disconnect C COM1 C 600 C 14400 C 57600 C 5 C none C 1 C none C none C 1 C none C 8 C 0dd C 8TS/CTS C X0N/X0FF C 8 C 8 C 2 C 8TS/CTS +> C 8TS/CTS +> C 8 C 8 C 2 C 8TS/CTS +> C 8TS/CTS +> C 8 C 8 C 2 C 8TS/CTS +> C 8TS/CTS +> C 8 C 8 C 2 C 8TS/CTS +> C 8TS/CTS +> C 8 C 8 C 2 C 8TS/CTS +> C 8 C 8 C 2 C 8TS on TX | KON/XOFF |
| Set font Auto Dis/Connect Time custom BR Rx Clear ASCII table CTS DSR CD | 🗖 RI |
| Receive O HEX CLEAR Reset Counter 13 ♦ Counter = 13 O HEX CLEAR Reset Counter 13 ♦ Counter = 13 O HEX CLEAR Reset Counter 13 ♦ Counter = 13 O HEX | 🗖 Bin |
| U02D025.23D046.77F100E0000W0000C4d29 U02D025.23D046.77F100E0000W0000C4d29 U02D025.27D046.73F100E0000W0000C7d19 U02D025.27D046.73F100E0000W0000C7d19 U02D025.27D046.73F100E0000W0000C7d19 | * |
| Transmit CLEAR Send File CR=CR+LF | |
| U02? -> Send | |
| U02? U02? U02? U02? U02? U02? U02? U02? | • |
| Connected Rx: 494 Tx: 65 | 11. |

- 9.4.13 Verify that the value after the U in the response matches the Poll Address of the Model 706 device.
- 9.4.14 Verify that the value after the first D in the response matches the PV value shown on the local display of the Model 706 device.
- 9.4.15 Verify that the value after the second D in the response matches the SV value shown on the local display of the Model 706 device.
- 9.4.16 Verify that the value after the F in the response matches the Echo Strength value shown on the local display of the Model 706 device.
- 9.4.17 Verify that the values after the E and W in the response match the highest priority of any active diagnostics in the attached device. See Appendix P for a listing of codes. Typically, the code should match the active diagnostic displayed on the device's LCD home screen.

10. Additional LevelMaster Commands

10.1. Purpose

This setup procedure instructs how to configure the HART to Modbus Adaptor (HMA) to support the additional Modbus LevelMaster protocol commands implemented in the HMA.

Using this procedure, the Number of Floats (UxxF?) can be read from the attached HART device and the Level Offset parameter can be read (UxxOL?) and changed (UxxOLxxxx?).

Note that the returned value for Level Offset, as well as the value for writing to the device, is multiplied by a factor of 10. For instance, a value of 0015 in the UxxOL? command represents a value of 1.5 in the HART device. This is to allow a more precise adjustment capability within the context of the command being limited to whole numbers.

| Item | Manufacturer | Model |
|----------------------------|----------------------|-------------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| USB Communications cable | FDTIchip | USB-RS485-WE |
| Termination resistor | - | 120Ω |
| Modbus host application | www.modbustools.com | Modbus Poll |
| Terminal v1.9b application | <u>hw-server.com</u> | Version 1.9b - 20040204 |
| Power Supply | - | 20-24V, 0.5A |
| Level transmitter | MII | Model 706 |
| Probe | MII | Model 706 compatible |

10.2. Equipment

10.3. Setup

Connect the HMA to a power supply via the power terminal block. Connect an RS-485 communications cable to the RS-485 terminal block of the HMA, with the Receive/Transmit Data+ A lead (orange) on the positive terminal and the Receive/Transmit Data- B lead (yellow) on the negative terminal. Connect a 120 Ω resistor between the two RS-485 terminal block positions. Connect the other end of the cable to a PC which has a Modbus host application. Connect a Model 706 level transmitter to the HART loop terminal block of the HMA. Set the HART Poll Address of the Model 706 device to 3. Note that other Magnetrol HART transmitters and HART poll addresses can be used.

- 10.4.1 The HMA shall be connected to a power supply, Modbus host and Model 706 HART transmitter as specified in section 10.3.
- 10.4.2 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for the Modbus LevelMaster protocol default settings. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.

10.4.3 Change register 3012 to a value of 0. This will cause the HMA to scan the attached devices at start-up, and record the poll address and other information for each device.

| Read/Write [| Definition | | | × | | | |
|---|---|--------|-----------------------|--------|---|------------------|---------------------|
| Slave ID: | 247 |] | | ОК | | 🦻 Mbpoll2 | - • • |
| Function: 03 Read Holding Registers (4x) 💌 Cancel | | | | Cancel | Т | ́х = 126963: Егі | r = 2706: ID = 247: |
| Address: | 3012 Protocol address, E.g. 40011 -> 10 | | | 10 | | Alias | 03010 |
| Quantity: | 2 | | | | | 0 | |
| Scan Rate: | 1000 | [ms] | | Apply | | 1 | |
| - Disable | | | | | | 2 | 0 |
| 📃 Read/ | Read/Write Disabled | | | | | 3 | 2 |
| 🔲 Disable on error | | Read/W | rite Once | | 4 | | |
| View | | | | | | 5 | |
| -Rows- | ~ ~ | | | | | 6 | |
| 10 | 0 20 0 | 50 🔘 | 100 🔘 Fit to Quantity | | | 7 | |
| Display: | | | 📃 Hide Alias Columns | | | 8 | |
| Unsigned | 1 | • | Address in Cell | | | 9 | |
| | | | 🔲 PLC Addresses (Ba: | se 1) | | | |
| | | | | | L | | |

- 10.4.4 Power down the HMA, change DIP switch 1 to ON, and reapply power to the HMA.
- 10.4.5 Select Connection\Disconnect from the Modbus Poll menu bar.
- 10.4.6 Start the Terminal v1.9b application.
- 10.4.7 Set the COM Port to match the COM port used for the communication cable (the same number as with the Modbus Poll application).
- 10.4.8 Set the Baud rate, Data bits, Parity, Stop Bits and Handshaking parameters to match the settings made in the HMA for LevelMaster communication.
- 10.4.9 Click <u>Connect</u>.

- 10.4.10 Create a Transmit Macro that will send U03F?\$0D and click on the Mx button to the right of the macro definition. This command requests the number of floats that the attached device will return when responding to the Uxx? command. For the HMA implementation, there will always be two floats returned so '2' should always be returned by the UxxF? Command. Note that the 03 in the macro represents the Poll Address of the Model 706 device.
- 10.4.11 Verify that the Terminal application receives a response from the HMA each time the Mx button is clicked, and that there are no communication errors being reported. The Receive buffer section should have the same number of responses as the Transmit buffer section.

| - ☐ ☐ - X = |
|---|
| Connect COM Pot C COM1 Baud rate Data bits Parity Stop Bits Handshaking Disconnect C COM3 C 600 14400 57600 C 5 © none © 1 © none Disconnect C COM3 C 2400 28800 C 128000 C 6 C odd C 1.5 C X0N/X0FF About. C COM5 C 4800 C 38400 C 256000 C 7 C mark C 2 C RTS/CTS + X0N/X0FF Quit C COM7 © 9600 C 56000 C custom © 8 C space C 2 C RTS on TX |
| Set font Auto Dis/Connect Time oustom BR Rx Clear ASCII table CTS DSR CD RI |
| Receive ○ HEX CLEAR Reset Counter 13 ◆ Counter = 18 ○ HEX ③ String StartLog StopLog □ Dec ✓ Hex |
| U03F2C01f6 |
| Transmit CLEAR Send File CR=CR+LF DTR RTS |
| U02? → Send |
| U03F? U03F?\$0D ▼ M1 3000 ↓ □ U03F?\$0D ▼ M2 1000 ↓ □ U030L0015\$0D ▼ M3 1000 ↓ □ |
| Connected Rx: 303 Tx: 183 |

10.4.12 Verify that the value after the F in the response equals two.

- 10.4.13 Create a Transmit Macro that will send U03OL?\$0D and click on the Mx button to the right of the macro definition. This command requests the value for Level Offset in the attached device. Note that the 03 in the macro represents the Poll Address of the Model 706 device.
- 10.4.14 Verify that the Terminal application receives a response from the HMA each time the Mx button is clicked, and that there are no communication errors being reported. The Receive buffer section should have the same number of responses as the Transmit buffer section.

| 🛃 Terminal v1.9b - 20040204 - by Br@y++ |
|--|
| Connect COM Port Baud rate Data bits Parity Stop Bits Handshaking Disconnect COM3 COM3 1200 19200 115200 5 © none © 1 © none About. COM5 CA800 28800 128000 6 © even 0 1.5 C XONXOFF Quit COM7 9600 56000 C ustom 6 0 space 2 C RTS/CTS + XON/XOFF |
| Settings Auto Dis/Connect Time custom BR Rx Clear Set font Stay on Top CR=LF 9600 27 + ASCII table CTS DSR CD RI |
| Receive O HEX CLEAR Reset Counter 13 ♀ Counter = 7 O HEX CLEAR Reset Counter 13 ♀ Counter = 7 O HEX C String StartLog StopLog Dec ✓ Hex |
| U03OL+0020C5624 U03OL+0020C5624 |
| Transmit CLEAR Send File CR=CR+LF CR=CR+LF |
| U02? → Send |
| U03OL? U03OL? U03OL? U03?\$0D 	 M1 3000 	 □ U030L?\$0D 	 M2 1000 	 □ U030L-0020\$0D 	 M3 1000 	 □ |
| Connected Rx: 182 Tx: 53 |

10.4.15 Verify that the value after the OL in the response matches the Level Offset value shown on the local display of the Model 706 device. The value displayed is shown as a whole number to conform to the command requirements, but actually represents the Level Offset multiplied by 10. For example, a Level Offset of 1.5 inches will be displayed in the command response as 0015. The value returned by the command may vary from the value shown on the local display by a value of 1 due to the effects of rounding. The value returned will be in terms of Level Units.

- 10.4.16 Create a Transmit Macro that will send U03OL0020\$0D and click on the Mx button to the right of the macro definition. This command requests that the sent value be saved for Level Offset in the attached device. The value is in terms of Level Units.
- 10.4.17 Verify that the Terminal application receives a response from the HMA each time the Mx button is clicked, and that there are no communication errors being reported. The Receive buffer section should have the same number of responses as the Transmit buffer section.

| 🛃 Terminal v1.9b - 20040204 - by Br@y++ | | | | | | |
|--|--|--|--|--|--|--|
| Connect COM Pot COM1 Baud rate Data bits Parity Stop Bits Handshaking Disconnect COM3 COM4 C 2400 C 1200 C 19200 C 115200 C 6 C odd C 1 C BTS/CTS About. C COM5 C 4800 C 38400 C 256000 C 7 C mark C 2 C BTS/CTS + X0N/X0FF Quit C COM7 9600 C 56000 C custom C 8 C space C 2 C BTS on TX | | | | | | |
| Settings Auto Dis/Connect Time custom BR Rx Clear Set font Stay on Top CR=LF 9600 27 🖕 ASCII table CTS DSR CD RI | | | | | | |
| Beceive O HEX CLEAR Reset Counter 13 Counter = 40 O HEX Image: CLEAR Reset Counter 13 Counter = 40 Image: String Image: StopLog Image: Dec Image: Hex Image: Bin | | | | | | |
| U02OLOKC9af4 U02OL+0019C96df U02OLOKC9af4 U02OL-0019Cf0df U02OL-0019Cf0df | | | | | | |
| Transmit CLEAR Send File CR=CR+LF DTR CRTS | | | | | | |
| U02? -> Send | | | | | | |
| U02OL0020 U02OL? U02OL-0020 U02OL? U02OL?\$0D 	 M1 3000 	 □ U02OL?\$0D 	 M2 1000 	 □ U02OL-0020\$0D 	 M3 1000 	 □ | | | | | | |
| Connected Rx: 675 Tx: 353 | | | | | | |

- 10.4.18 Verify that the value after the OL in the response to command U03OL?\$0D matches the Level Offset value sent by the U03OL0020\$0D command and shown on the local display of the Model 706 device. The value returned by command U03OL?\$0D may vary from the value shown on the local display by a value of 1 due to the effects of rounding.
- 10.4.19 Repeat steps 10.4.16 through 10.4.18 while sending U03OL-0020\$0D to cause a write of -2.0 as the Level Offset.

11. Auto Switching Between Modbus RTU/ASCII and HART over RS-485 Communication

11.1. Purpose

This setup procedure instructs how to configure the HART to Modbus Adaptor (HMA) to automatically switch between Modbus RTU and HART over RS-485 communication when it receives the appropriate commands.

This provides a convenient method for configuring or troubleshooting an attached HART device using PACTware. The process is to set a register to a value of 1 while the HMA is in a Modbus communication mode. The HMA will automatically switch to the HART over RS-485 mode. No cycling of power is required. PACTware can then be connected to a device through the RS-485 terminal block on the HMA. Once the PACTware session is completed, by sending a HART command 0 with a poll address of 63, a user can cause the HMA to automatically revert to the previous Modbus configuration protocol settings. Again, no cycling of power is required.

This procedure demonstrates the auto-switching feature using the Modbus RTU protocol. The process can be used for the Modbus ASCII protocol by setting the HMA for that protocol in step 11.4.2.

| Item | Manufacturer | Model | |
|--------------------------|---------------------|-----------------------|--|
| HART to Modbus Adaptor | MII | 031-2859-001 | |
| USB Communications cable | FDTIchip | USB-RS485-WE | |
| Termination resistor | - | 120Ω | |
| Modbus host application | www.modbustools.com | Modbus Poll | |
| Power Supply | - | 20-24V, 0.5A | |
| PACTware | PACTware Consortium | Version 4.1 or higher | |
| Level transmitter | MII | Model 706 | |
| Probe | MII | Model 706 compatible | |

11.2. Equipment

11.3. Setup

Connect the HMA to a power supply via the power terminal block. Connect an RS-485 communications cable to the RS-485 terminal block of the HMA, with the Receive/Transmit Data+ A lead (orange) on the positive terminal and the Receive/Transmit Data– B lead (yellow) on the negative terminal. Connect a 120 Ω resistor between the two RS-485 terminal block positions. Connect the other end of the cable to a PC which has a Modbus host application. Connect a Model 706 transmitter and probe, or other supported Magnetrol HART transmitter, to the HART loop terminal block of the HMA. The device's Poll Address can be set to any value between 0 and 14.

- 11.4.1 Connect the HMA to a power supply and Modbus as specified in section 11.3.
- 11.4.2 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for the Modbus RTU protocol default settings. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.

- 11.4.3 Note that when the HMA is in the Single Device Mode (register 3012 set to 2), the HMA address shown in register 3001 will match the HART Poll Address of the attached HART device.
- 11.4.4 Power down the HMA, change DIP switch 1 to ON, and reapply power to the HMA.
- 11.4.5 Click on the Mbpoll window, select Setup\Read\Write Definition from the menu bar, change the Slave ID to match the address shown in step 11.4.3 for register 3012, and then click OK.
- 11.4.6 Verify that the Modbus Poll application is communicating with the HMA.
- 11.4.7 Change to value of register 3008 to 1. This causes the HMA to automatically reboot into the HART over RS-485 mode.
- 11.4.8 Verify that the HMA is not communicating with the Modbus Poll application.
- 11.4.9 Select Connection\Disconnect from the Modbus Poll menu bar.
- 11.4.10 Start PACTware.
- 11.4.11 Add a HART Comm DTM to the Project.
- 11.4.12 Left click on the Comm DTM in the Project tree and add a DTM to the Project for one of the listed devices.
- 11.4.13 Right-click on the Comm DTM Project item and select Parameter. Select the correct COM port for the RS-485 communications cable, set the Start address and End address to cover the range of addresses for the attached devices. Set the Comm DTM to be a secondary master, then click OK.
- 11.4.14 Right-click on the Comm DTM Project item and select Additional functions\Change dtm address. Click on the Change address button. Select the poll address number corresponding to the attached Model 706 device, then click Close.
- 11.4.15 Right-click on the Comm DTM Project item and select Connect.
- 11.4.16 Right-click on the Comm DTM Project item and select Additional functions\Change device address. The DTM will scan for attached devices and display them in a list. If necessary, click on the Refresh button.
- 11.4.17 Verify that the attached Model 706 is listed and is shown with the correct Poll Address.
- 11.4.18 Right-click on the Comm DTM Project item and select Connect.
- 11.4.19 Double click on the device entry in the Project tree to open the Online parameterization window.
- 11.4.20 Verify that the DTM communicates with the device and features such are changing parameters and viewing Echo Curves, Echo History (as appropriate) and Trend Data are operational.
- 11.4.21 Close the Online parameterization window.
- 11.4.22 Right-click on the Comm DTM Project item and select Disconnect.
- 11.4.23 Right-click on the Comm DTM Project item and select Parameter. Set both the Start address and End address to 63, then click OK.
- 11.4.24 Right-click on the Comm DTM Project item and select Connect.

- 11.4.25 Right-click on the Comm DTM Project item and select Additional functions\Scan list. The DTM will scan for attached device, sending a HART Command 0 with an address of 63. Receipt of that command by the HMA will cause it to reboot into the Normal operating mode.
- 11.4.26 Shut down PACTware.
- 11.4.27 Open the Modbus Poll application.
- 11.4.28 Select Connection\Connect from the Modbus Poll menu bar, ensure that the connection settings are as follows, and then click OK. Note that the USB Serial Port setting needs to match the port number for the communication cable that is being used.

| Connection Setup | × |
|---|---------------------------------|
| Connection | OK |
| Serial Port 🔹 | |
| Serial Settings | Cancel |
| USB Serial Port (COM3) - | Mode |
| 9600 Baud 👻 | RTU O ASCII |
| 8 Data bits 🔹 | Response Timeout 5000 [ms] |
| Even Parity 🔹 | |
| 1 Stop Bit 💌 Advanced | Delay Between Polls 100 [ms] |
| Remote Server IP Address Port 127.0.0.1 502 | ct Timeout [ms] |
| | fillel |

11.4.29 Open or click on an Mbpoll window, select Setup\Read\Write Definition from the menu bar, ensure that the settings are as follows, and then click OK:

| Read/Write I | Definition | | | × | | | |
|--------------|---------------|------------|-----------------|-----------------|-------|-----------------|-------------------|
| Slave ID: | 15 |] | | ОК | | mm Settings.mbp | |
| Function: | 03 Read H | olding Reg | gisters (4x) 🔻 | Cancel | x = 2 | : Err = 1: ID = | 247: F = 03: SR = |
| Address: | 3000 | Protocol | address. E.g. 4 | 0011 -> 10 | | Alias | 03000 |
| Quantity: | 9 | | | | 3000 | | 0 |
| Scan Rate: | 1000 | [ms] | | Apply | 3001 | | 15 |
| - Disable | | | | | 3002 | | 1 |
| 📃 Read/ | /Write Disabl | ed | _ | | 3003 | | 8 |
| 📃 Disabl | e on error | | ŀ | Read/Write Once | 3004 | | 1 |
| View | | | | | 3005 | | 2 |
| Rows | 20 | 50 🔘 | 100 🔿 Eirige |) | 3006 | | 3 |
| 010 | 0 20 0 | 50 0 | 100 💿 Fit to G | lanuy | 3007 | | 0 |
| Display: | | | 📃 Hide Alias C | Columns | 3008 | | 0 |
| Unsigned | 4 | • | Address in (| | | | |
| | | | PLC Addres | ises (Base 1) | | | |
| | | | | | | | |

- 11.4.30 Verify that the Tx count in the Mbpoll window is increasing, the Err count is not increasing and there are no reported communication errors.
- 11.4.31 Verify that register 3008 is set to 0.
- 11.4.32 If unable to establish communication in the HART over RS-485 mode, the HMA can be reset to normal Modbus operating mode by switching DIP switch 1 to OFF, and cycling power to the unit. The HMA will power up into the default communication mode. Using Procedure 1, set register 1 to 0. The HMA can be used either in that mode, or by setting DIP switch 1 to ON and cycling power, it can be used in its normal Modbus configuration mode.

12. Auto Switching Between LevelMaster and HART over RS-485 Communication

12.1. Purpose

This setup procedure instructs how to configure the HART to Modbus Adaptor (HMA) to automatically switch between Modbus and HART over RS-485 communication when it receives the appropriate commands.

12.2. Equipment

| Item | Manufacturer | Model |
|----------------------------|----------------------|-------------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| USB Communications cable | FDTIchip | USB-RS485-WE |
| Termination resistor | - | 120Ω |
| Modbus host application | www.modbustools.com | Modbus Poll |
| Terminal v1.9b application | <u>hw-server.com</u> | Version 1.9b - 20040204 |
| Power Supply | - | 20-24V, 0.5A |
| PACTware | PACTware Consortium | Version 4.1 or higher |
| Level transmitter | MII | Model 706 |
| Probe | MII | Model 706 compatible |

12.3. Setup

Connect the HMA to a power supply via the power terminal block. Connect an RS-485 communications cable to the RS-485 terminal block of the HMA, with the Receive/Transmit Data+ A lead (orange) on the positive terminal and the Receive/Transmit Data- B lead (yellow) on the negative terminal. Connect a 120 Ω resistor between the two RS-485 terminal block positions. Connect the other end of the cable to a PC which has a Modbus host application. Connect a Model 706 transmitter and probe, or other supported Magnetrol HART transmitter, to the HART loop terminal block of the HMA. The device's Poll Address can be set to any value between 0 and 14.

12.4. Procedure

- 12.4.1 Connect the HMA to a power supply, Modbus host and Model 706 HART transmitter as specified in section 12.3.
- 12.4.2 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for the Modbus LevelMaster protocol default settings. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.
- 12.4.3 Power down the HMA, change DIP switch 1 to ON, and reapply power to the HMA.
- 12.4.4 Ensure that the Modbus Poll application is communicating with the HMA.
- 12.4.5 Select Connection\Disconnect from the Modbus Poll menu bar.
- 12.4.6 Start the Terminal v1.9b application.
- 12.4.7 Set the COM Port to match the COM port used for the communication cable (the same number as with the Modbus Poll application).

- 12.4.8 Set the Baud rate, Data bits, Parity, Stop Bits and Handshaking parameters to match the settings made in the HMA for LevelMaster communication.
- 12.4.9 The Terminal application settings should be as below.

| 7 Terminal v1 9b - 20040204 - by Br@y++ |
|---|
| 🛃 Terminal v1.9b - 20040204 - by Br@y++ |
| Connect COM Port Baud rate Data bits Parity Stop Bits Handshaking Disconnect C 0M3 C 1200 C 19200 C 115200 C 5 © none © 1 © none About C 0M4 C 2400 C 28800 C 128000 C 6 C even C 1.5 C XDN/XOFF Quit C 0M7 © 9600 C 56000 C custom © 8 C space C 2 C RTS on TX |
| Settings Auto Dis/Connect Time custom BR Rx Clear Set font Stay on Top CR=LF 9600 27 ♀ ASCII table CTS DSR CD RI |
| Receive ○ HEX CLEAR Reset Counter 13 ● Counter = 9 ○ HEX CLEAR Reset Counter 13 ● Counter = 9 ○ HEX CLEAR Reset Counter 13 ● Counter = 9 ○ HEX CLEAR Reset Counter 13 ● Counter = 9 ○ HEX CLEAR Reset Counter 13 ● Counter = 9 ○ HEX StartLog StorpLog □ Dec ✓ Hex □ |
| Transmit |
| CLEAR Send File CR=CR+LF |
| U02? → Send |
| Transmit Macros U02?\$0D M1 3000 ♀ ✓ ✓ M2 1000 ♀ ✓ ✓ M3 1000 ♀ ✓ |
| Disconnected Rx: 342 Tx: 45 |

- 12.4.10 Click <u>Connect</u>.
- 12.4.11 Create a Transmit Macro that will send U02?\$0D and check the checkbox to the right of the macro definition. Note that the 02 in the macro represents the Poll Address of the Model 706 device.
- 12.4.12 Verify that the Terminal application is receiving responses from the HMA and that there are no communication errors being reported. The Receive buffer section should have the same number of responses as the Transmit buffer section.

| 🦼 Terminal v1.9b - 20040204 - by Br@y++ 📃 💻 💻 💻 |
|--|
| Connect COM Port Baud rate Data bits Parity Stop Bits Handshaking Disconnect C COM1 C 600 C 14400 C 57600 C 5 C none C 1 C none Disconnect C COM3 C 2400 C 28800 C 128000 C 6 C odd C 1.5 C XON/X0FF About. C COM5 C 4800 C 38400 C 256000 C 7 C mark C 2 C RTS/CTS + X0N/X0FF Quit C COM7 9600 C 56000 C custom 8 C space C 2 C RTS on TX |
| Settings Auto Dis/Connect Time oustom BR Rx Clear ASCII table CTS DSR CD RI |
| Receive CLEAR Reset Counter 13 	Counter = 13 	Counter ■ Bin |
| U02D025.23D046.77F100E0000W0000C4d29 U02D025.23D046.77F100E0000W0000C4d29 U02D025.27D046.73F100E0000W0000C7d19 U02D025.27D046.73F100E0000W0000C7d19 U02D025.27D046.73F100E0000W0000C7d19 |
| CLEAR Send File CR=CR+LF |
| U02? → Send |
| U02? U02? U02? U02? U02? U02? U02? U02? |
| Connected Rx: 494 Tx: 65 |

- 12.4.13 Uncheck the checkbox to stop the macro from repeating.
- 12.4.14 Create another Transmit Macro that will send U63?\$0D and click on the Mx button to the right of the macro definition. This causes the HMA to automatically reboot into the HART over RS-485 mode. There shall be no response from the HMA.
- 12.4.15 Check the checkbox to the right of the U02?\$0D macro definition.
- 12.4.16 Ensure that there is no response from the HMA.
- 12.4.17 Click on the <u>D</u>isconnect button.
- 12.4.18 Start PACTware.
- 12.4.19 Add a HART Comm DTM to the Project.
- 12.4.20 Left click on the Comm DTM in the Project tree and add a DTM to the Project for one of the listed devices.
- 12.4.21 Right-click on the Comm DTM Project item and select Parameter. Select the correct COM port for the RS-485 communications cable, set the Start address and End address to cover the range of addresses for the attached devices. Set the Comm DTM to be a secondary master, then click OK.

- 12.4.22 Right-click on the Comm DTM Project item and select Additional functions\Change dtm address. Click on the Change address button. Select the address number corresponding to the attached Model 706 device, then click Close.
- 12.4.23 Right-click on the Comm DTM Project item and select Connect.
- 12.4.24 Right-click on the Comm DTM Project item and select Additional functions\Change device address. The DTM will scan for attached devices and display them in a list. If necessary, click on the Refresh button.
- 12.4.25 Ensure that the attached Model 706 is listed and is shown with the correct Poll Address.
- 12.4.26 Right-click on the Comm DTM Project item and select Connect.
- 12.4.27 Double click on the device entry in the Project tree to open the Online parameterization window.
- 12.4.28 Ensure that the DTM communicates with the device and features such are changing parameters and viewing Echo Curves, Echo History (as appropriate) and Trend Data are operational.
- 12.4.29 Close the Online parameterization window.
- 12.4.30 Right-click on the Comm DTM Project item and select Disconnect.
- 12.4.31 Right-click on the Comm DTM Project item and select Parameter. Set both the Start address and End address to 63, then click OK.
- 12.4.32 Right-click on the Comm DTM Project item and select Connect.
- 12.4.33 Right-click on the Comm DTM Project item and select Additional functions\Scan list. The DTM will scan for attached device, sending a HART Command 0 with an address of 63. Receipt of that command by the HMA will cause it to reboot into the Normal operating mode.
- 12.4.34 Shut down PACTware.
- 12.4.35 Open the Terminal application.
- 12.4.36 Click on the <u>C</u>onnect button.
- 12.4.37 Create a Transmit Macro that will send Uxx?\$0D to an attached device and check the checkbox to the right of the macro definition. Note that the xx in the macro represents the Poll Address of the target device.

12.4.38 Ensure that the Terminal application is receiving responses from the HMA and that there are no communication errors being reported. The Receive buffer section should have the same number of responses as the Transmit buffer section.

| 🛃 Terminal v1.9b - 20040204 - by Br@y++ 📃 💻 💌 |
|--|
| Connect COM Port Baud rate Data bits Parity Stop Bits Handshaking Disconnect C COM1 C 600 C 14400 C 57600 C 5 C none C 1 C none Disconnect C COM3 C 1200 C 19200 C 115200 C 6 C odd C 8TS/CTS About. C COM5 C 4800 C 38400 C 256000 C 7 C mark C 2 C RTS/CTS + X0N/X0FF Quit C COM7 G 9600 C 56000 C ustom G 8 C space C 2 C RTS or TX |
| Settings Auto Dis/Connect Time custom BR Rx Clear ASCII table CTS CDSR CD CD RI Stay on Top CR=LF 9600 27 € |
| Receive <u>CLEAR</u> Reset Counter I 13 	♀ Counter = 13 	○ HEX ⓒ String StartLog StopLog □ Dec ▼ Hex □ Bin |
| U02D025.23D046.77F100E0000W0000C4d29 U02D025.23D046.77F100E0000W0000C4d29 U02D025.27D046.73F100E0000W0000C7d19 U02D025.27D046.73F100E0000W0000C7d19 U02D025.27D046.73F100E0000W0000C7d19 |
| Transmit CLEAR Send File CR=CR+LF CR DTR CR |
| U02? → Send |
| U02? U02? U02? U02? U02? U02? U02? U02? |
| Connected Rx: 494 Tx: 65 |

12.4.39 If unable to establish communication in the HART over RS-485 mode, the HMA can be reset to normal Modbus operating mode by switching DIP switch 1 to OFF, and cycling power to the unit. The HMA will power up into the default communication mode. Using Procedure 1, set register 1 to 0. The HMA can be used either in that mode, or by setting DIP switch 1 to ON and cycling power, it can be used in its normal Modbus configuration mode.

13. HMA Diagnostics

13.1. Purpose

This setup procedure instructs how to configure the HART to Modbus Adaptor (HMA) to display diagnostic information. While the default Modbus RTU protocol is used to communicate with the HMA in this procedure, any supported Modbus RTU or ASCII communication configuration can be used.

13.2. Equipment

| Item | Manufacturer | Model |
|--------------------------|---------------------|----------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| USB Communications cable | FDTIchip | USB-RS485-WE |
| Termination resistor | - | 120Ω |
| Modbus host application | www.modbustools.com | Modbus Poll |
| Power Supply | - | 20-24V, 0.5A |
| Level transmitter | MII | Model 706 |
| Probe | MII | Model 706 compatible |

13.3. Setup

Connect the HMA to a power supply via the power terminal block. Connect an RS-485 communications cable to the RS-485 terminal block of the HMA, with the Receive/Transmit Data+ A lead (orange) on the positive terminal and the Receive/Transmit Data- B lead (yellow) on the negative terminal. Connect a 120 Ω resistor between the two RS-485 terminal block positions. Connect the other end of the cable to a PC which has a Modbus host application. Connect up to five Magnetrol HART level transmitters (including the transmitter in the housing containing the HMA) to the HART loop terminal block of the HMA.

13.4. Procedure

- 13.4.1 Connect the HMA to a power supply, Modbus host and MII HART transmitters as specified in section 13.3.
- 13.4.2 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for the Modbus RTU protocol default settings. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.
- 13.4.3 Change register 3012 to a value of 0. This will cause the HMA to scan the attached devices at start-up, and record the poll address and other information for each device.
- 13.4.4 Power cycle the HMA.

13.4.5 **To check the slave malfunction diagnostics**, open or click on an Mbpoll window, select Setup\Read\Write Definition from the menu bar, ensure that the settings are as follows, and then click OK:

| Read/Write Definition | |
|--|---|
| Address: 1200 Protocol address. E.g. 30011 -> Quantity: 1 Scan Rate: 1000 [ms] Disable Read/Write Disabled | OK Mbpoll4 Cancel Tx = 70454: Err = 1936: ID = 247: F = 0 10 ias 01200 Apply /rite Once 0 |
| View Rows 10 20 50 100 Fit to Quantity Display: Binary Address in Cell PLC Addresses (Ba | |

- 13.4.6 Remove one of the attached HART devices.
- 13.4.7 Verify that the corresponding slave malfunction bit (see Appendix G) changes to 1.
- 13.4.8 Reconnect the Model 706 device.
- 13.4.9 Verify that the corresponding slave malfunction bit changes to 0.

13.4.10 **To check the types and poll addresses of the attached HART devices**, open or click on an Mbpoll window, select Setup\Read\Write Definition from the menu bar, ensure that the settings are as follows, and then click OK:

| Read/Write [| Definition | | | × | ſ | | | |
|------------------------|---------------|------------------------|---------------|---------------|---|-----------------------|-------|---------------------|
| Slave ID: Function: | |) put Registers (3x |) 🔻 | OK Cancel | | <u> М</u> ь Тх = 1 | | 5: ID = 247: F = 04 |
| Address: | 1250 | Protocol addres | ss. E.g. 300 | 11 -> 10 | | | Alias | 01250 |
| Quantity: | 11 | | | | | 1250 | | 0x0005 |
| Scan Rate: | 1000 | [ms] | | Apply | | 1251 | | 0x56E0 |
| Disable | | | | | | 1252 | | 0x00E5 |
| 📃 Read/ | /Write Disabl | ed | _ | | | 1253 | | 0x00E5 |
| 📃 Disabl | e on error | | Rea | ad/Write Once | | 1254 | | 0x00E8 |
| View | | | | | | 1255 | | 0x00E3 |
| Rows | @ 10 @ | E0 @ 100 @ | | | | 1256 | | 0x0001 |
| ◎ 10 | ◎ 20 |) 50 🔘 100 🤇 |) Fit to Qua | andy | | 1257 | | 0x0002 |
| Display: | | E Hic | le Alias Colu | umns | | 1258 | | 0x0003 |
| Hex | | | dress in Cell | | | 1259 | | 0x0004 |
| | | PL | C Addresse: | s (Base 1) | | 1260 | | 0x0005 |

- 13.4.11 Verify that register 1250 indicates the correct number of attached devices.
- 13.4.12 Verify that registers 1256 through 1260 show the correct Poll Addresses of the attached devices.
- 13.4.13 Verify that registers 1251 through 1255 show the correct Device Types of the attached devices for each corresponding Poll Address.

13.4.14 **To check the device information for the attached HART devices**, open or click on an Mbpoll window, select Setup\Read\Write Definition from the menu bar, ensure that the settings are as follows, and then click OK:

| | IX = 57: E | rr = 0: ID = 247: F = 1 | 04: S |
|--|------------|-------------------------|-------|
| | | Alias 01 | 000 |
| | 1000 | 0x0 | 001 |
| ead/Write Definition | 1001 | 0x0 | 000 |
| | 1002 | 0x5 | 6E0 |
| Slave ID: 247 OK | 1003 | 0x0 | 005 |
| Function: 04 Read Input Registers (3x) 🔻 Cancel | 1004 | 0x0 | 007 |
| Address: 1000 Protocol address E.g. 30011 -> 10 | 1005 | 0x0 | 001 |
| Address: 1000 Protocol address. E.g. 30011 -> 10 | 1006 | 0x0 | 001 |
| Quantity: 18 | 1007 | 0x0 | 010 |
| Scan Rate: 1000 [ms] Apply | 1008 | 0x0 | 000 |
| Disable | 1009 | 0xE | 81E |
| Read/Write Disabled | 1010 | 0x0 | 100 |
| Disable on error Read/Write Once | 1011 | 0x0 | 005 |
| View | 1012 | 0x00 | 00D |
| Rows 10 20 50 100 In Fit to Quantity | 1013 | 0xF | FFF |
| | 1014 | 0x0 | 020 |
| Display: International Interna | 1015 | 0x0 | 056 |
| Hex Address in Cell | 1016 | 0x0 | 056 |
| PLC Addresses (Base 1) | 1017 | 0x0 | 000 |

- 13.4.15 Verify that registers 1000 through 1017 show the correct information for the attached device as listed in Appendix H.
- 13.4.16 Repeat steps 13.4.14 and 13.4.15 for the remaining four devices, changing the register addresses as appropriate.

14. ROCLINK 800

14.1. Initial HMA Configuration

14.1.1 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values desired for communication with the ROC 800. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.

14.2. Physical Connections

- 14.2.1 Connect the ROC 800 to a computer using an LOI RS-232 cable.
- 14.2.2 Connect an appropriate power supply to the power supply module of the ROC 800.
- 14.2.3 Connect the HMA to a 9 30 VDC power supply via terminal block TB1.
- 14.2.4 Connect an RS-485 communications cable between terminals A and B of the ROC 800 RS-485 module and the RS-485 terminal block (TB2) of the HMA.
- 14.2.5 Connect a 120Ω resistor between the two RS-485 terminal block positions of the last HMA on the bus

14.3. Initial ROC 800 Configuration

- 14.3.1 Start the ROCLINK 800 application.
- 14.3.2 Select ROC \ Direct Connect in the ROCLINK 800 Menu bar. An image of the front of the ROC 800 will appear.
- 14.3.3 Mouse over the image of the RS-485 module. A flyover text box will appear that identified the Comm Port used for RS-485 communication with the HMA.



- 14.3.4 Click on ROC \ Comm Ports in the ROCLINK 800 Menu bar.
- 14.3.5 Ensure that the communication settings for 1 Local Port are as follows.

| Comm Port | | 8 23 | | | | | | |
|--|--|--|--|--|--|--|--|--|
| Comm Ports : 1 - Local Port 🔹 Iag : Local Port | | | | | | | | |
| General Modem SRBX Store & Forward Diagnostics | | | | | | | | |
| Comm Type : RS-232 | | | | | | | | |
| Baud Rate C 300 C 600 C 1200 C 2400 | Parity Data Bits None 7 C Even 8 | Stop Bits Key On Delay : Image: Constraint of the state of the s | | | | | | |
| ○ 4800 ○ 9600 ④ 19.2 K ○ 38.4 K ○ 57.6 K ○ 115.2 K BBG: 0 | C Odd | Key Off Delay : 0.0 Secs | | | | | | |
| BRG: 0 Port Owner • ROC Plus Protocol/Modbus Slave • User Program 1 • ROC Plus Protocol Only • User Program 2 • Modbus Slave Only • User Program 3 • Modbus Master • User Program 4 • DS 800 • User Program 5 • LCD • User Program 6 • I/0 Module • User Program 8 • • Served • User Program 8 • • Served • Served | | | | | | | | |
| 😰 Update 🛛 🗙 Cancel 🕴 Apply | | | | | | | | |

- 14.3.6 For Comm Ports, select the port number displayed in step 14.3.3.
- 14.3.7 Ensure that the communications settings match the settings of the HMA performed in step 1.1.8, then click OK. Ensure that the Port Owner is set to Modbus Master. For example,

| Comm Port | ? × |
|--|--|
| Comm Ports : 6 · COMM5 | ✓ <u>I</u> ag: COMM5 |
| General Modem SRBX S | tore & Forward Diagnostics |
| Comm Type : RS-485 | |
| Baud Rate C 300 C 600 C 1200 C 2400 C 4800 € 9600 C 19.2 K C 38.4 K C 57.6 K C 115.2 K BRG: 1 | Data Bits Stop Bits Key On Delay : O None O 7 I 0.01 Secs Image: Even Image: 8 O 2 Key Off Delay : Image: 1 O Odd Image: 1 Image: 2 Image: 1 Image: 2 Image: 2 Image: 0 Odd Image: 2 Image: 2 Image: 2 Image: 2 Image: 2 Image: 0 Odd Image: 2 Image: 2 Image: 2 Image: 2 Image: 2 Image: 0 Odd Image: 2 Image: 2 Image: 2 Image: 2 Image: 2 Image: 0 Odd Image: 2 Image: 2 Image: 2 Image: 2 Image: 2 Image: 2 Image: 0 Odd Image: 2 Image: 0 Odd Image: 2 Image: 2 |
| Port Owner C ROC Plus Protocol/Modbu C ROC Plus Protocol Only C Modbus Slave Only Modbus Master C DS 800 C LCD C I/O Module C Reserved | Is Slave O User Program 1 O User Program 2 O User Program 3 O User Program 4 O User Program 5 O User Program 6 O User Program 7 O User Program 8 |
| | 🔁 Update 🗸 OK 🗶 Cancel ! Apply |

14.4. Reading registers from the HMA

- 14.4.1 Select Configure \ MODBUS from the ROCLINK 800 Menu bar.
- 14.4.2 Change the Comm Port to match the port to which the HMA is connected.
- 14.4.3 The followings steps demonstrate how to read the PV, SV, TV and QV as well as the Blocking Distance from a HART device attached to the HMA.

- 14.4.4 For the General tab,
- 14.4.5 Ensure that the Byte Order and Comm Mode match the selections made in step 14.1.1.
- 14.4.6 Check 'Start Polling'. Set the Starting Request to 1 and the Number of Requests to match the total number of separate rows defined in the Master Table tab below.
- 14.4.7 Select the Enabled radio button in the Continuous Polling group box.

| Modbus Configuration | ? × |
|--|-----------------------|
| Modbus Configuration Comm Port: S:CDMMS General Scale Values Master Table Master Mode Byte Order Comm Mode C Least Significant Byte First Comm Mode C Mast Significant Byte First Comm Mode Slave Mode Event Logging Exception Status: No Error Event Logging Master Mode Event Logging Start Polling: V Starting Request: 1 Timeout: 5 Start Polling: V Continuous Polling Enabled Continuous Polling Enabled Cisabled Request Delay: 1.0 Seconds | |
| | |
| | |
| 😰 Update 🖌 V OK 🗡 Cancel | <u>!</u> <u>Apply</u> |

- 14.4.8 For the Master Table tab,
- 14.4.9 Set the Logical Point to 13 MastTbl 13 (COMM5).
- 14.4.10 Enter into the table the sets of registers to be read from the device. Set the RTU Address to that of the HMA when it is in the HMA mode. Set the RTU Address to that of the individual attached HART device to be queried when the HMA is in the 'Device' mode.
- 14.4.11 In the example below, the HMA is in 'HMA' mode and has an address of 247.

| Mod | Modbus Configuration | | | | | | | | | | |
|--------------|--|----------------|----------------------------|-------------------|--------------------|---------------------------|----------------|-------------------|--|--|--|
| Co | mm Po | ort : 6 - CO | IMM5 👻 | | | | | | | | |
| | General Scale Values Master Table Master Modern Registers History Table | | | | | | | | | | |
| ⁽ | | | | | | | | | | | |
| | Logical Point : 13 - MastTbl 13 (COMM5) - Tag : MastTbl 13 | | | | | | | | | | |
| | Logical one. [15 · mastrbir 5 (commo)] · · · · · · · · · · · · · · · · · · · | | | | | | | | | | |
| | | RTU Address | Function Code | Slave Register | Master Register | Number of Registers | Comm Status | | | | |
| | 1 | 247 | 4 - Read Input Registers | 1302 | 1302 | 2 | 8 | | | | |
| | 2 | 247 | 4 - Read Input Registers | 1304 | 1304 | 2 | 8 | | | | |
| | 3 | 247 | 4 - Read Input Registers | 1306 | 1306 | 2 | 8 | | | | |
| | 4 | 247 | 4 - Read Input Registers | 1308 | 1308 | 2 | 8 | | | | |
| | 5 | 247 | 3 - Read Holding Registers | 3100 | 3100 | 2 | 8 | | | | |
| | 6 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | 7 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | 8 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | 9 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | 10 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | 11 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | 12 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | 13 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | 14 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | 15 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | 16 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | 17 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | 18 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | 19 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | 20 | 0 | 0 - Disabled | 0 | 0 | 1 | 0 | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | 🖞 Update 🖌 🗸 O | IK X Cancel Apply | | | |

14.4.12 For the Registers tab,

Modbus Configuration

| Table : 1 🔽 Tag : Reg Map 1 | | | | | | | | | |
|-----------------------------|----------------|--------------|---------------------|-----------|------------|----------------|--|--|--|
| ndex | Start Register | End Register | Device Parameter(s) | Indexing | Conversion | Comm Port | | | |
| 1 | 1302 | 1303 | SFP 1, DATA1 | Parameter | 67 | COMM5 | | | |
| 2 | 1304 | 1305 | SFP 1, DATA2 | Parameter | 67 | COMM5 | | | |
| 3 | 1306 | 1307 | SFP 1, DATA3 | Parameter | 67 | COMM5 | | | |
| 4 | 1308 | 1309 | SFP 1, DATA4 | Parameter | 67 | COMM5 | | | |
| 5 | 3100 | 3101 | SFP 2, DATA1 | Parameter | 67 | COMM5 | | | |
| 6 | 0 | 0 | Undefined | Parameter | 0 | All Comm Ports | | | |
| 7 | 0 | 0 | Undefined | Parameter | 0 | All Comm Ports | | | |
| 8 | 0 | 0 | Undefined | Parameter | 0 | All Comm Ports | | | |
| 9 | 0 | 0 | Undefined | Parameter | 0 | All Comm Ports | | | |
| 10 | 0 | 0 | Undefined | Parameter | 0 | All Comm Ports | | | |
| 11 | 0 | 0 | Undefined | Parameter | 0 | All Comm Ports | | | |
| 12 | 0 | 0 | Undefined | Parameter | 0 | All Comm Ports | | | |
| 13 | 0 | 0 | Undefined | Point | 0 | All Comm Ports | | | |
| 14 | 0 | 0 | Undefined | Point | 0 | All Comm Ports | | | |
| 15 | 0 | 0 | Undefined | Point | 0 | All Comm Ports | | | |
| | | | | | | | | | |

- 14.4.13 Set the Table to 1, and for each variable to be read,
- 14.4.14 Enter the Start and End Register numbers. Refer to Appendices F through O for register numbers of the HMA and attached HART devices.
- 14.4.15 Create a Soft Point and Data number in the Device Parameter(s) column. Click on the ellipsis button that appears at the right side of the cell to open the 'Select TLP' dialog.

| r | Device Parameter(s) | | | | | | | |
|---|---------------------|------|--|--|--|--|--|--|
| | SFP 1, DATA1 | (] F | | | | | | |
| | SFP 1, DATA2 | F | | | | | | |
| | SEP 1 ΠΔΤΔ3 | F | | | | | | |

2

| Select TLP | | ? × |
|--|--|---|
| Point <u>T</u> ype | Logical Number | <u>P</u> arameter |
| Undefined 84 - Extended HART Parameters 85 - HART Parameters 91 - System Variables 93 - License Key Information 94 - User C Configuration 95 - ROC Comm Ports 96 - FST Parameters 97 - FST Register Tags 98 - Soft Point Parameters 99 - Configurable Opcode 100 - Power Control Parameters 109 - System Analog Inputs 110 - PID Control Parameters 117 - Modbus Configuration Parameters 118 - Modbus Register to TLP Mapping 119 - Modbus Event, Alarm, and History Ta | SFP 1 - Soft Pt 01 SFP 2 - Soft Pt 02 SFP 3 - Soft Pt 03 SFP 4 - Soft Pt 04 SFP 5 - Soft Pt 05 SFP 6 - Soft Pt 06 SFP 7 - Soft Pt 07 SFP 8 - Soft Pt 08 SFP 9 - Soft Pt 09 SFP 10 - Soft Pt 10 SFP 11 - Soft Pt 11 SFP 12 - Soft Pt 12 SFP 13 - Soft Pt 13 SFP 14 - Soft Pt 14 SFP 15 - Soft Pt 15 SFP 16 - Soft Pt 16 SFP 17 - Soft Pt 17 | 0 - Soft Point Description 1 - Float 1 2 - Float 2 3 - Float 3 4 - Float 4 5 - Float 5 6 - Float 5 6 - Float 5 7 - Float 7 8 - Float 8 9 - Float 9 10 - Float 10 11 - Float 11 12 - Float 12 13 - Float 13 14 - Float 14 15 - Float 15 16 - Float 16 ✓ Show Current Value |
| SFP 1, DATA1 | FL r/w | 1.968504 |
| | | 🗸 OK 🔀 Cancel |

- 14.4.16 Select 98 Soft Point Parameters for the Point Type, SFP 1 Soft Point 01 for the Logical Number, and 1 Float 1 for the Parameter. Note the name for the point, for example, SPF 1, DATA 1. By checking 'Show Current Value', one can confirm that the desired parameter is being read correctly. Then click 'OK' to close the Select TLP dialog.³
- 14.4.17 Set a Convert Code (see ROCLINK 800 Help) in the Conversion column () to properly interpret the data bytes into the correct numerical format.
- 14.4.18 Assign the correct Comm Port number.
- 14.4.19 Repeat as required for the remaining parameters to be read from the device.
- 14.4.20 Return to Master Table tab and ensure that the Comm Status for each line is 8, indicating a Valid Slave Response.

³ Select 'Short' for the Parameter type when setting up to read the unsigned integer communication registers 3000 through 3007 in the HMA.

- 14.4.21 To display the values,
- 14.4.22 Open the Soft Point dialog by selecting I/O \ Soft Point in the Configuration Tree window, then double-clicking on #1, Soft Pt 01.

| PROCLINK 800 - [On Line - Com1 - ROC800 - Remote Oprtns Cntrir] | | | | | | | | | | |
|--|--------------------|------|-----------|--------------|---------------------|--|--|--|--|--|
| 🖙 File Edit View ROC Configure Meter Utilities Tools Window Help | | | | | | | | | | |
| 🗅 📂 🖬 🕹 🕼 🌆 🌆 🕼 🎉 🔍 🔍 씨 씨 🦇 🕪 씨 씨 🖗 🎜 🏈 🖾 🎬 🔛 💕 🛛 🖓 | | | | | | | | | | |
| Er 💑 On Line - Com1 - ROC800 - Remote Optin: 🔺 | | | | | | | | | | |
| | | | | | | | | | | |
| in√A System Analog Input in III HART Point in Sett Point | | | | | | | | | | |
| Soft Point | | | - 15 | | | | | | | |
| 🐜 #1, Soft Pt 01 🛛 Soft Point | | | | | ? <mark>×</mark> | | | | | |
| 👐 🗰 #2, Soft Pt 02 | | | | | | | | | | |
| #3, Soft Pt 03 Softpoints : | s : 1 - Soft Pt 01 | | | | Event Logging | | | | | |
| ••• #4, Soft Pt 04 ••• #5, Soft Pt 05 Tag : | g: Soft Pt 01 | | | | C Disabled | | | | | |
| ₩ #6, Soft Pt 06 | 1:12011-1201 | | | | | | | | | |
| 🐂 🗰 #7, Soft Pt 07 👘 Paramete | | | | | | | | | | |
| 🛶 🐝 #8, Soft Pt 08 👘 📕 📕 📕 | | Long | Short | Byte | Double | | | | | |
| | 29.37008 11 0.0 | 1 0 | 1 0 | 1 0 | 1 0.0 | | | | | |
| • #10, Soft Pt 10 • #11, Soft Pt 11 2 58 | 58.73977 12 0.0 | 2 0 | 2 0 | 2 0 | 2 0.0 | | | | | |
| | 29.37008 13 0.0 | 3 0 | 3 0 | 3 0 | 3 0.0 | | | | | |
| #10 C-0 D 10 | 58.73977 14 0.0 | 4 0 | 4 0 | 4 0 | 4 0.0 | | | | | |
| 🔰 👘 🖬 14, Soft Pt 14 🚺 👘 💆 | | | | | | | | | | |
| 15, Soft Pt 15 5 0.0 | | 5 0 | 5 0 | 5 0 | 5 0.0 | | | | | |
| 116, Soft Pt 16 6 0.0 | 0.0 16 0.0 | 6 0 | 6 0 | 6 0 | 6 0.0 | | | | | |
| 117, Soler (17 | 0.0 17 0.0 | 7 0 | 7 0 | 7 0 | 7 0.0 | | | | | |
| 🐜 #19, Soft Pt 19 8 0.0 | 18 0.0 | 8 0 | 8 0 | 8 0 | 8 0.0 | | | | | |
| 🐂 #20, Soft Pt 20 | | 9 0 | 9 0 | 9 0 | 9 0.0 | | | | | |
| | | | | | | | | | | |
| ₩ #22, Soft Pt 22 10 0.0 ₩ #23, Soft Pt 23 | 0.0 20 0.0 | 10 0 | 10 0 | 10 0 | 10 0.0 | | | | | |
| 1 #23, Soft Pt 23 | | | | | | | | | | |
| ₩ #25, Soft Pt 25 | y 🖹 Paste | | Auto Scan | 🖞 Update 🗸 | OK 🗙 Cancel ! Apply | | | | | |
| ₩ #26, Soft Pt 26 ₩ #27, Soft Pt 27 | | | | | | | | | | |

14.4.23 Click on Update to read a single set of values from the device, or Auto Scan to repeatedly update the displayed values.

14.5. Writing registers to the HMA

- 14.5.1 Configure the ROC 800 to access a register in the HMA or attached HART device as for reading a register from the HMA (section 14.4).
- 14.5.2 When setting up the row in the Configure \ MODBUS \ Master Table tab, use Function code 16 – Preset Multiple Registers for multi-byte parameters, or 6 – Preset Single Register for single-byte parameters.
- 14.5.3 Click Update to send the new setting to the ROC 800.
- 14.5.4 Open the Soft Point dialog by selecting I/O \ Soft Point in the Configuration Tree window, then double-clicking on #1, Soft Pt 01.
- 14.5.5 Highlight the value to be changed and enter the new value.
- 14.5.6 Click on Update to send the new value to the device.
- 14.5.7 Return to the Configure \ MODBUS \ Master Table tab.
- 14.5.8 Change the Function Code for the parameter to 3 Read Holding Registers or 4 Read Input Registers as appropriate.
- 14.5.9 Click on Update to send the new setting to the device.
- 14.5.10 Return to the Soft Point dialog by selecting I/O \ Soft Point in the Configuration Tree window, then double-clicking on #1, Soft Pt 01.
- 14.5.11 Click on Update to confirm that the device has accepted the new value.

15. ABB Totalflow XRC – Modbus RTU / ASCII

The following procedure applies to operation with both RTU and ASCII communication. The choice of communication protocol is made in step 15.1.1 for the HMA settings and in step 15.3.10 for the Totalflow XRC. The Modbus RTU protocol is used for the following.

15.1. Initial HMA Configuration

15.1.1 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values desired for Modbus communication with the ABB TotalFlow XRC. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.

15.2. Physical Connections

- 15.2.1 Connect the ABB Totalflow XRC to a computer using a USB-A to USB-B cable.
- 15.2.2 Connect an appropriate power supply to the battery charging terminal (J17) of the ROC 800.
- 15.2.3 Connect the HMA to a 9 30 VDC power supply via terminal block TB1.
- 15.2.4 Connect an RS-485 communications cable between the RS-485 module of the ROC 800 and the RS-485 terminal block (TB2) of the HMA.
- 15.2.5 Connect a 120 Ω resistor between the two RS-485 terminal block positions of the last HMA on the bus

15.3. Initial XRC Configuration

- 15.3.1 Start the PCCU32 application.
- 15.3.2 Select on Operate \ Setup \ System Setup in the PCCU32 Menu bar. A dialog will appear allowing for communication settings between the PCCU32 application and the XRC.

| System Setup | | |
|---|---|--------------|
| Setup Directory Paths | Misc Macro Setup | |
| Setup Directory Paths Communications ■ Image: Setup Organization ■ Connection parameter PCCU Com. Port: Initial Baud: Max Baud: Stop Bits: Timeout (ms): Retry Limit: Image: Show Comm Stop | PCCU Connect Method: TCP/IP ActiveSync (NGC) Ceters Level 1-2 Security Code: 2400 • 9600 • 2 • 3000 10 | V Disconnect |
| Arts Connect | | |
| Default Role B | Entry Collect Initial C Based Access Control credentials ased Access Control Usemame ased Access Control Password | Connect |
| | | Close Help |

- 15.3.3 Select the COM port number corresponding to the XRC.
- 15.3.4 Click Close.

15.3.5 Select on Operate \ Connect to Totalflow in the PCCU32 Menu bar.

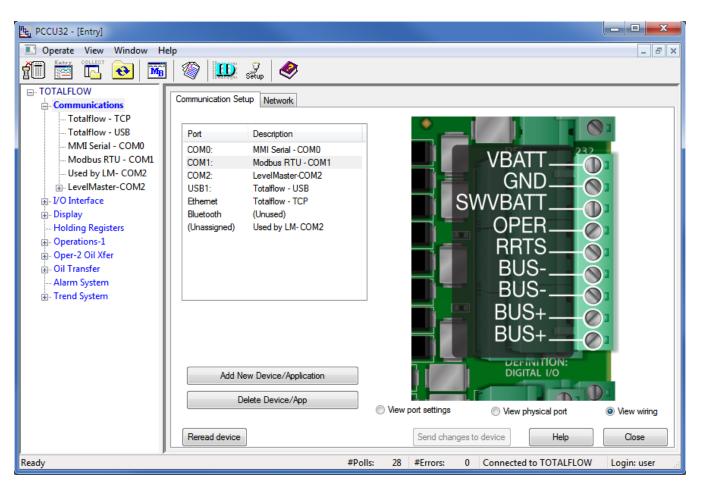
| <u>फि</u> PCCU32 - [Local Connec | :t] | | | - • × |
|----------------------------------|--------------|----------------------|---------------------|----------------|
| 💷 Operate View Win | | | | _ & × |
| |) 🌃 🚳 | 🛄 🧞 🧇 | | |
| | , ~ | | | 1 |
| | | | | |
| | | | | |
| | | | | |
| | Station ID | Location | Device | |
| | TOTALFLOW | 2104062-004 | XRC | |
| | | | | |
| | Collect Hist | rorical <u>D</u> ata | ntry Setup | |
| | C.11 | | P | |
| | Laiit | prate | <u>R</u> egistry | |
| | <u>M</u> or | nitor | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| <u></u> | | | Close | Help |
| | | | Close | |
| Ready | | | #Polls: 11 #Errors: | 0 Connected to |

- 15.3.6 Select Entry Setup from the Local Connect initial dialog.
- 15.3.7 Select View \ Advanced from the PCCU32 menu bar.

- 15.3.8 Click on Communications in the tree-view window.
- 15.3.9 Click on the Port name associated with Modbus RTU.
- 15.3.10 Ensure that the communications settings match the settings of the HMA performed in step 15.1.1, then click OK. For example,

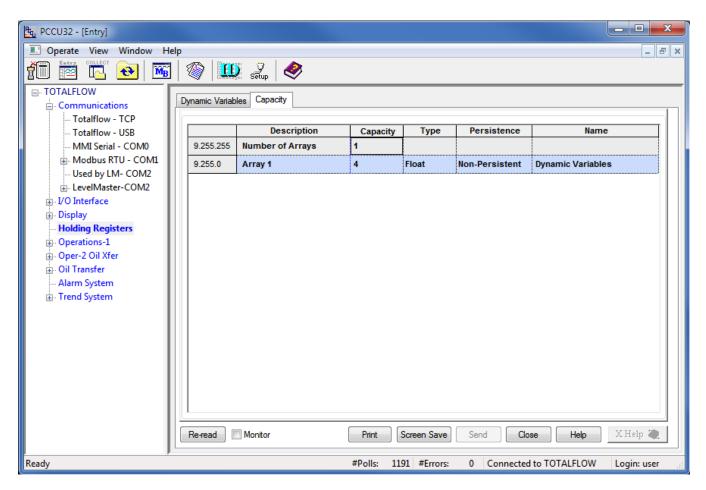
| 🖳 PCCU32 - [Entry] | | |
|--------------------------|---|--|
| I Operate View Window He | lp | _ 8 × |
| 1 🖾 🖫 🚾 | 🚳 🛄 🥪 🧇 | |
| | Port Description COM0: MMI Serial - COM0 COM1: Modbus RTU - COM1 COM2: LevelMaster-COM2 USB1: Totalflow - USB Ethernet Totalflow - TCP Bluetooth (Unused) (Unassigned) Used by LM- COM2 | Port description: Modbus RTU - COM1 Serial port settings Protocol: Modbus Host(RTU) Parity: Even Port used by: Unknown Stop bits: 1 Retries: 2 Interface: RS485 Timeouts & Delays Xmit key delay (ms): 2 Response delay (ms): 0 Unkey delay (ms): 1 |
| | Add New Device/Application Delete Device/App Reread device | Response timeout 1000 Modbus Format Settings Register format: 16 bit word swapper Trailing Pad: None Port Settings Help: Click on any port parameter to display help on that topic Wew port settings View physical port View wiring Send changes to device Help Close |
| Ready | #Po | olls: 26 #Errors: 0 Connected to TOTALFLOW Login: user |

15.3.11 The terminal block connections on the XRC can be verified by clicking on the View Wiring radio button.



15.4. Reading registers from the HMA

- 15.4.1 The followings steps demonstrate how to read the PV, SV, TV and QV from a HART device attached to the HMA. When making any changes to the settings, click on Send at the bottom of the window to write them to the XRC.
- 15.4.2 Select Holding Registers from the tree-view window of the PCCU32.
- 15.4.3 Select the Capacity tab.
- 15.4.4 Set the Capacity for the Number of Arrays to 1.
- 15.4.5 Set the Capacity for Array 1 to '4', the Type to 'Float', the 'Persistence' to 'Non-Persistent', and the Name to 'Dynamic Variables'.

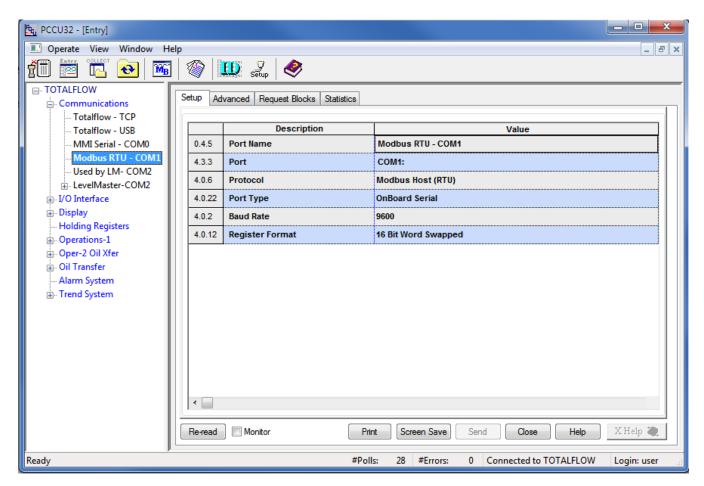


- 15.4.6 Select the Dynamic Variables tab.
- 15.4.7 Change the description of the four registers to 'PV' through 'QV'.

| ter PCCU32 - [Entry] | | | | | | | |
|---|----------------------------|-------------|---|--|--|--|--|
| 🔳 Operate View Window Help | | | _ & × | | | | |
| | 1 | 🛄 🧟 🕺 | | | | | |
| TOTALFLOW | | | | | | | |
| Communications Totalflow - TCP | Dynamic Variables Capacity | | | | | | |
| | | Description | Value | | | | |
| MMI Serial - COM0 | 9.0.0 | PV | 1.968504 | | | | |
| | 9.0.1 | SV | 3.936592 | | | | |
| Used by LM- COM2 H LevelMaster-COM2 | 9.0.2 | тν | 1.968504 | | | | |
| I/O Interface | 9.0.3 | QV | 1.968504 | | | | |
| ⊕ . Display | | | Ammuniani and a second s | | | | |
| Holding Registers Operations-1 | | | | | | | |
| ⊕. Oper-2 Oil Xfer | | | | | | | |
| 💮 ·· Oil Transfer | | | | | | | |
| Alarm System Trend System | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | Re-read | Monitor Pr | int Screen Save Send Close Help X Help 🗮 | | | | |
| Ready | | #Pol | IIs: 1243 #Errors: 0 Connected to TOTALFLOW Login: user | | | | |

15.4.8 Note the Register numbers displayed in the first column of the table. They will be used when setting the Request Blocks in a later step.

- 15.4.9 Select Communications \ Modbus RTU in the tree-view window.
- 15.4.10 For the Setup tab,
- 15.4.11 Ensure that the Protocol and Baud Rate match the selections made in step 15.1.1.



15.4.12 For the Advanced tab,

15.4.13 Ensure that the Data Bits, Parity and Stop Bits match the selections made in step 15.1.1.

| 🖳 PCCU32 - [Entry] | | | | | | | | | |
|---|---------|-------------------------------|--|--|--|--|--|--|--|
| 🔳 Operate View Window Help | | | _ 8 × | | | | | | |
| | | | | | | | | | |
| - TOTALFLOW - Setup Advanced Request Blocks Statistics | | | | | | | | | |
| Communications Setup Advanced Request Blocks Statistics | | | | | | | | | |
| Totalflow - USB | | Description | Value | | | | | | |
| MMI Serial - COM0 | 4.0.1 | Interface | Rs485 | | | | | | |
| Modbus RTU - COM1 | 4.0.3 | Data Bits | 8 | | | | | | |
| Used by LM- COM2 | 4.0.4 | Parity | Even | | | | | | |
| LevelMaster-COM2 | 4.0.4 | - | | | | | | | |
| in I/O Interface in Display | | Stop Bits | 1 | | | | | | |
| Holding Registers | 4.1.10 | Response Delay (milliseconds) | 5 | | | | | | |
| ⊕. Operations-1 | 4.1.1 | Xmit Key Delay (milliseconds) | 500 | | | | | | |
| 🚋 Oper-2 Oil Xfer | 4.1.2 | Unkey Delay (milliseconds) | 3 | | | | | | |
| Oil Transfer Marm System | 4.1.3 | Timeout(milliseconds) | 1500 | | | | | | |
| ⊕- Trend System | 4.0.13 | Retries | 2 | | | | | | |
| | 4.0.15 | Switched V-Batt/Operate | Enable | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | • | | | | | | | | |
| | Re-read | Monitor Prir | nt Screen Save Send Close Help XHelp 🔌 | | | | | | |
| Ready | | #Poll | s: 107 #Errors: 0 Connected to TOTALFLOW Login: user | | | | | | |

15.4.14 Ensure that the Unkey Delay is less than 7 milliseconds as the HMA typically responds within about 8 milliseconds. If the Unkey Delay time is too long, the XRC will start listening for a response after the HMA has already started transmitting. As a result, the XRC will not recognize the response.

- 15.4.15 For the Request Blocks tab,
- 15.4.16 Set the Slave Address to match the address of the HMA (if in HMA mode), or an attached device (if in Device mode).
- 15.4.17 Select '4 Read Input Registers' from the Modbus function drop-down.
- 15.4.18 Set the Starting Register to a value 1 greater than the desired starting Modbus register. Refer to Appendices F through O for register numbers of the HMA and attached HART devices.

| 변 PCCU32 - [Entry] |
|---|
| Operate View Window Help |
| Image: Set in the set in |
| Ready #Polls: 80 #Errors: 0 Connected to TOTALFLOW Login: user |

- 15.4.19 Set the # Registers to equal the total number of Dynamic Variables to be read. Note that in this case, 4 Dynamic Variables are to be read so that a value of 4 is entered even though the total number of 16-bit Modbus registers that will be read is 8.
- 15.4.20 Set the Register Type to Float.
- 15.4.21 Set the Trigger Type to Interval and the Interval time to the desired sampling rate.
- 15.4.22 Set the Destination Registers to the register numbers from step 15.4.8.

15.4.23 To check if transmissions and responses are being made, select View \ Expert from the PCCU32 Menu bar. This mode displays a Packet Log tab when selecting Communications \ Modbus RTU from the tree-view window.

| PCCU32 - [Entry] Operate View Window He Entry Collect | | _ D _ X |
|---|--|-------------------|
| Image: Second state of the second s | Image: Second Statistics Packet Log 3/14/14 12:15:32 -> F7041041EB468D426B46AE41EB468D41EB468D01A3 03/14/14 12:15:34 03/14/14 12:15:32 -> F7041041EB972E426B952341EB972E41EB972E5291 03/14/14 12:15:36 03/14/14 12:15:36 > F704051600080452 03/14/14 12:15:36 > F7040051600080452 03/14/14 12:15:36 > F70401041EB972E426B952341EB972E41EB972E5291 03/14/14 12:15:36 > F704051600080452 03/14/14 12:15:36 > F70401041EB972E426B952341EB972E41EB972E5291 03/14/14 12:15:40 > F7040161E972E426B952341EB972E41EB972E5291 03/14/14 12:15:40 > F7040161E972E426B952341EB972E41EB972E5291 03/14/14 12:15:40 > F7041041EB972E426B952341EB972E41EB972E5291 03/14/14 12:15:44 > F7041041EB972E426B952341EB972E41EB972E5291 03/14/14 12:15:44 > F7041041EB972E426B952341EB972E41EB972E5291 03/14/14 12:15:45 > F7041041EB468D426B46AE41EB468D41EB468D01A3 03/14/14 12:15:46 > F7041041EB468D426B46AE41EB468D41EB468D01A3 03/14/14 12:15:47 > F7041041EB468D426B46AE41EB468D41EB468D01A3 03/14/14 12:15:47 > F7041041EA75EC426AF58541EAF5EC41EAF5ECA1EAF5ECBAF7 03/14/14 12:15:52 > F7041041EAF5EC426AF58541EAF5EC41EAF5ECBAF7 | Comm-4\Packet.Log |
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- 15.4.24 Set the Log Size to 25, and check the Monitor checkbox. The log should start updating with the XRC commands being sent out and the responses from the HMA.
- 15.4.25 Right-click in the clear area between the Monitor checkbox and the Log Size drop-down. Select a shorter interval screen refresh interval if desired
- 15.4.26 To display the values,
- 15.4.27 Select Holding Registers from the tree-view window of the PCCU32.
- 15.4.28 Select the Dynamic Variables tab.
- 15.4.29 Click on Re-read to obtain a single set of readings from the HMA, or check the Monitor checkbox to repeatedly read values from the HMA at the Interval specified in the Request Blocks tabs in step 15.4.29.

15.5. Writing registers to the HMA

- 15.5.1 The followings steps demonstrate how to change a parameter in a HART device attached to the HMA. When making any changes to the settings, click on Send at the bottom of the window to write them to the XRC.
- 15.5.2 Select Holding Registers from the tree-view window of the PCCU32.
- 15.5.3 Select the Capacity tab.

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| □- TOTALFLOW | Dynamic Variab | les Blocking Distance Cap | acity | | | | _ | |
| Communications | | | | | | | | |
| - Totalflow - USB | | Description | | Туре | Persistence | Name | | |
| - MMI Serial - COM0 | 9.255.255 | Number of Arrays | 2 | | | | | |
| Modbus RTU - COM1 Used by LM- COM2 | 9.255.0 | Array 1 | 4 | Float | Non-Persistent | Dynamic Variables | | |
| LevelMaster-COM2 | 9.255.1 | Array 2 | 1 | Float | Non-Persistent | Blocking Distance | | |
| | | | | | | | | |
| - Holding Registers | | | | | | | | |
| Operations-1 | | | | | | | | |
| ⊕. Oper-2 Oil Xfer ⊕. Oil Transfer | | | | | | | | |
| - Alarm System | | | | | | | | |
| ⊕ Trend System | | | | | | | | |
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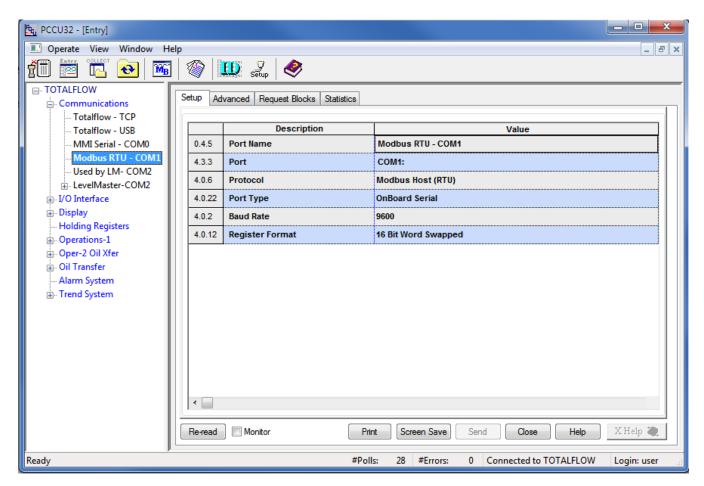
- 15.5.4 Set the Capacity for the Number of Arrays to 2.
- 15.5.5 Set the Capacity for Array 2 to '1', the Type to 'Float', the 'Persistence' to 'Non-Persistent', and the Name to 'Blocking Distance'.

- 15.5.6 Select the Blocking Distance tab.
- 15.5.7 Change the description of the four registers to 'Blocking Distance'.

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| | Dynamic \ | Variables Blocking Distance Capacity | | |
| Totalflow - TCP | | | | |
| Totalflow - USB | | Description | | Value |
| MMI Serial - COM0 | 9.1.0 | Blocking Distance | 4.2 | |
| Modbus RTU - COM1 | | _ | | |
| Used by LM- COM2 International States Sta | | | | |
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| Display | | | | |
| Holding Registers | | | | |
| • Operations-1 | | | | |
| Oper-2 Oil Xfer Oil Transfer | | | | |
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15.5.8 Note the Register number displayed in the first column of the table. It will be used when setting the Request Block in a later step.

- 15.5.9 Select Communications \ Modbus RTU in the tree-view window.
- 15.5.10 For the Setup tab,
- 15.5.11 Ensure that the Protocol and Baud Rate match the selections made in step 15.1.1.



15.5.12 For the Advanced tab,

15.5.13 Ensure that the Data Bits, Parity and Stop Bits match the selections made in step 15.1.1.

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| | Setup Ad | vanced Request Blocks Statistics | | | | | |
| Totalflow - TCP Totalflow - USB | Description Value | | | | | | |
| | 4.0.1 | Interface | Rs485 | | | | |
| Modbus RTU - COM1 | 4.0.3 | Data Bits | 8 | | | | |
| Used by LM- COM2 | 4.0.4 | Parity | Even | | | | |
| | 4.0.5 | Stop Bits | 1 | | | | |
| - Display | 4.1.10 | Response Delay (milliseconds) | 5 | | | | |
| Holding Registers Operations-1 | 4.1.1 | Xmit Key Delay (milliseconds) | 500 3 1500 2 | | | | |
| Oper-2 Oil Xfer | 4.1.2 | Unkey Delay (milliseconds) | | | | | |
| | 4.1.3 | Timeout(milliseconds) | | | | | |
| … Alarm System … Trend System | 4.0.13 | Retries | | | | | |
| | 4.0.15 | Switched V-Batt/Operate | Enable | | | | |
| | < Re-read |) 📝 Monitor 🛛 🏾 Prir | nt Screen Save Send Close Help X Help 🍋 | | | | |
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15.5.14 Ensure that the Unkey Delay is less than 7 milliseconds as the HMA typically responds within about 8 milliseconds. If the Unkey Delay time is too long, the XRC will start listening for a response after the HMA has already started transmitting. As a result, the XRC will not recognize the response.

- 15.5.15 For the Request Blocks tab,
- 15.5.16 Select '6 Write Single Register' from the Modbus function drop-down.
- 15.5.17 Set the Slave Address to match the address of the HMA (if in HMA mode), or an attached device (if in Device mode).
- 15.5.18 Set the Starting Register to a value 1 greater than the desired starting Modbus register. Refer to Appendices F through O for register numbers of the HMA and attached HART devices.

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- 15.5.19 Set the # Registers to 1. Note that in this case, 1 float value is to be written so that a value of 1 is entered even though the total number of 16-bit Modbus registers that will be read is 2.
- 15.5.20 Set the Register Type to Float.
- 15.5.21 Set the Trigger Type to Register and the Register number to the register number from step 15.5.8.
- 15.5.22 Set the Source to the register number from step 15.5.8.

- 15.5.23 Select Holding Registers from the tree-view window of the PCCU32.
- 15.5.24 Select the Blocking Distance tab.
- 15.5.25 Change the Value to the desired distance.

| E. PCCU32 - [Entry] | | | | | | |
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| TOTALFLOW | Dynamic | Variables Blockir | ng Distance Capacity | | | |
| Totalflow - TCP Totalflow - USB | 9.1.0 | Description | | | | |
| MMI Serial - COM0 | | Blocking Distance | | 4.2 | | |
| Hodbus RTU - COM1 | | _1 | | 1 | | |
| Used by LM- COM2 | | | | | | |
| . LevelMaster-COM2 | | | | | | |
| ⊕. I/O Interface ⊕. Display | | | | | | |
| Holding Registers | | | | | | |
| ⊕ Operations-1 | | | | | | |
| 💮 Oper-2 Oil Xfer | | | | | | |
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| - Alarm System | | | | | | |
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15.5.26 Click on Send at the bottom of the window.

15.5.27 To check if the value has been accepted, follow the steps in section 15.4 changing selections as needed to read the Blocking Distance parameter from the HMA or attached HART device.

16. ABB Totalflow XRC – LevelMaster

The ABB Totalflow XRC is only capable of sending and receiving command Uxx?. Note that with the LevelMaster protocol, the HMA operates only in the Device mode. Therefore, the ID in the request blocks must be set to the attached HART device's Poll Address rather than that of the HMA. The XRC displays the first float returned by Command Uxx? as Level 1 (the Upper Level for Magnetrol Devices) and the second float as Level 2 (typically the Interface Level for Magnetrol devices). Accordingly, it is recommended to configure the attached Magnetrol HART device for PV as Level, and SV as Interface level.

16.1. Initial HMA Configuration

16.1.1 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for LevelMaster communication with the ABB TotalFlow XRC. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.

16.2. Physical Connections

- 16.2.1 Connect the ABB Totalflow XRC to a computer using USB-A to USB-B cable.
- 16.2.2 Connect an appropriate power supply to the battery charging terminal (J17) of the ROC 800.
- 16.2.3 Connect the HMA to a 9 30 VDC power supply via terminal block TB1.
- 16.2.4 Connect an RS-485 communications cable between the RS-485 module of the ROC 800 and the RS-485 terminal block (TB2) of the HMA.
- 16.2.5 Connect a 120Ω resistor between the two RS-485 terminal block positions of the last HMA on the bus.

16.3. Initial XRC Configuration

- 16.3.1 Start the PCCU32 application.
- 16.3.2 Select on Operate \ Setup \ System Setup in the PCCU32 Menu bar. A dialog will appear allowing for communication settings between the PCCU32 application and the XRC.

| System Setup | | | | | | |
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| Setup Directory Paths Misc Macro Setup | | | | | | |
| Communications PCCU Connect Method: | Toolbar Buttons | | | | | |
| Serial port TCP/IP Active Sync (NGC) Bluetooth Connection parameters PCCU Com. Port: COM10: Initial Baud: 2400 Max Baud: 9600 Stop Bits: 2 Timeout (ms): 3000 | Connect Disconnect NGC Operate Entry Monitor Terminal Calibrate Collect File Transfer Valve Control Remote Protocol Remote Communications TFModbus | | | | | |
| Retry Limit: 10 Show Comm Stats on Status Bar | ✓ 32 Bit X-Series Loader ✓ NGC Startup Wizard ✓ Laptop File Utilities ▲ Archive Utilities | | | | | |
| Auto Connect | | | | | | |
| None Entry Collect Initial Connect Use default Role Based Access Control credentials Default Role Based Access Control Username Default Role Based Access Control Password | | | | | | |
| | Close Help | | | | | |

- 16.3.3 Select the COM port number corresponding to the XRC.
- 16.3.4 Click Close.

16.3.5 Select on Operate \ Connect to Totalflow in the PCCU32 Menu bar.

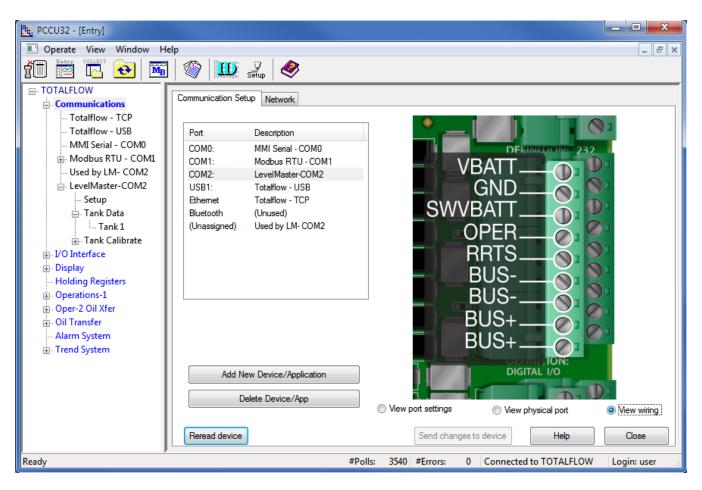
| 🖳 PCCU32 - [Local Connec | t] | | | |
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| I 1 | Station ID | Location | Device | |
| | TOTALFLOW | 2104062-004 | XRC | |
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| | Collect Hist | orical <u>D</u> ata | ntry Setup | |
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| Ready | | | #Polls: 11 #Error | s: 0 Connected to a |

- 16.3.6 Select Entry Setup from the Local Connect initial dialog.
- 16.3.7 Select View \ Advanced from the PCCU32 menu bar.

- 16.3.8 Click on Communications in the tree-view window.
- 16.3.9 Click on the Port name associated with Modbus RTU.
- 16.3.10 Select 'Tank Gauge' for the Protocol.
- 16.3.11 Set the Unkey delay to 3 ms.
- 16.3.12 Ensure that the communications settings match the settings of the HMA performed in step 16.1.1, then click OK. For example,

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| | 111 2 🔌 | | |
| TOTALFLOW | cation Setup Network | | |
| Communications Totalflow - TCP Totalflow - USB MMI Serial - COM0 COM0 Modbus RTU - COM1 COM1 Used by LM- COM2 LevelMaster-COM2 USB1: Setup Ethem Tank Data Blueto Tank 1 (Unass U/O Interface Display Holding Registers | Description Descri | Protocol: Tank Gauge Port used by: LevelMaster Retries: 1 Timeouts & Delays Xmit ke Response delay (ms): 0 Unkey | Serial port settings Baud: 9600 V Parity: None V Data bits: 8 V Stop bits: 1 V Interface: RS485 V ey delay (ms): 10 delay (ms): 3 up delay (ms): 0 |
| Operations-1 Oper-2 Oil Xfer Oil Transfer Alarm System O: Trend System Rereat | Add New Device/Application Delete Device/App d device | Port Settings Help: Click on any port parar that topic Image: Send changes to device | neter to display help on ort Ovew wiring elp Close |

16.3.13 The terminal block connections on the XRC can be verified by clicking on the View Wiring radio button.



16.4. Reading registers from the HMA

- 16.4.1 The followings steps demonstrate how to read the PV, SV, Echo Strength, Errors and Warnings from a HART device attached to the HMA. When making any changes to the settings, click on Send at the bottom of the window to write them to the XRC.
- 16.4.2 Select Communications \ LevelMaster \ Setup in the tree-view window of the PCCU32.
- 16.4.3 For the Setup tab,
- 16.4.4 Set the Number of Tanks to the number of attached HART devices to be read.

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| | Se | etup Comn | nunications | Request Blocks Statis | tics | Packet Log | |
| Totalflow - TCP | | | | | | | |
| Totalflow - USB | | | | Description | | Value | |
| MMI Serial - COM0 | | 0.4.52 | Device/AP | P ID | | LevelMaster-COM2 | |
| Modbus RTU - COM1 Used by LM- COM2 | | 51.107.0 | Number o | of Tanks | | 1 | |
| □ LevelMaster-COM2 | | | | | | | |
| | | | | | | | |
| 🖃 - Tank Data | | | | | | | |
| Tank 1 ⊕ Tank Calibrate | | | | | | | |
| Ho Interface | | | | | | | |
| ⊕ Display | | | | | | | |
| Holding Registers | | | | | | | |
| | | | | | | | |
| Oper-2 Oil Xfer Oil Transfer | | | | | | | |
| Alarm System | | | | | | | |
| ⊕ Trend System | | | | | | | |
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- 16.4.5 For the Communications tab,
- 16.4.6 Ensure that the communication settings match the selections made in steps 16.1.1 and 16.3.12.

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| Totalflow - TCP | Ē | | · · · | | | | |
| Totalflow - USB | | | Description | Value | | | |
| MMI Serial - COM0 | | 51.3.3 | Serial Port | COM2: | | | |
| Modbus RTU - COM1 | | 51.0.22 | Port Type | OnBoard Serial | | | |
| Used by LM- COM2 | | 51.0.6 | Protocol | Tank Gauge | | | |
| Setup | | 51.0.1 | Interface | Rs485 | | | |
| ⊡ · Tank Data | | 51.0.2 Baud Rate | | 9600 | | | |
| Tank Calibrate | 51.0.3 Data Bits | | Data Bits | 8 | | | |
| ⊕. I/O Interface | | 51.0.4 | Parity | None | | | |
| | | 51.0.5 | Stop Bits | 1 | | | |
| ⊕. Operations-1 | | 51.1.1 | Xmit Key Delay (milliseconds) | 10 | | | |
| ⊕. Oper-2 Oil Xfer | | 51.1.2 | Unkey Delay (milliseconds) | 3 | | | |
| Oil Transfer Alarm System | | 51.1.3 | Timeout (milliseconds) | 5000 | | | |
| ⊕. Trend System | | 51.0.15 | Switched V-Batt/Operate | Enable | | | |
| | | 51.1.0 | Power Up Delay (milliseconds) | 0 | | | |
| | | 51.0.13 | Retries | 1 | | | |
| | | | | | | | |
| Re-read Monitor Print Screen Save Send Close Help XHelp 🍇 | | | | | | | |
| Ready | | | #Polls: | : 3597 #Errors: 0 Connected to TOTALFLOW Login: user | | | |

- 16.4.7 For the Request Blocks tab,
- 16.4.8 In the Auto Config group menu, set the Application to 51, the Tank Num. to the appropriate value for the attached HART device, and the Sensor to 'Dual Level'. The HMA always returns a Dual Level response to Command Uxx? in order to provide data for the SV output of the attached HART device.
- 16.4.9 In the Registers group menu, set the ID to the Poll Address of the attached HART device to be read for that Tank Num. (Note that due to limitations of the LevelMaster protocol, the HMA only operates in the Device mode for that protocol.)

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| COTALFLOW Communications - Totafflow - TCP - Tank Data - Tank Data - Tank Tain Calibrate - Tank Calibrate - Display - Holding Registers - Oper-2 Oil Xfer - Oil Transfer - Alam System B - Trend System Reread Add Reread Add Reread Add |
| Ready #Polls: 3598 #Errors: 0 Connected to TOTALFLOW Login: user |

- 16.4.10 To check if transmissions and responses are being made, select View \ Expert from the PCCU32 Menu bar. This mode displays a Packet Log tab when selecting Communications \ Modbus RTU from the tree-view window.
- 16.4.11 Set the Log Size to 25, and check the Monitor checkbox. The log should start updating with the XRC commands being sent out and the responses from the HMA.
- 16.4.12 Right-click in the clear area between the Monitor checkbox and the Log Size drop-down. Select a shorter interval screen refresh interval if desired.

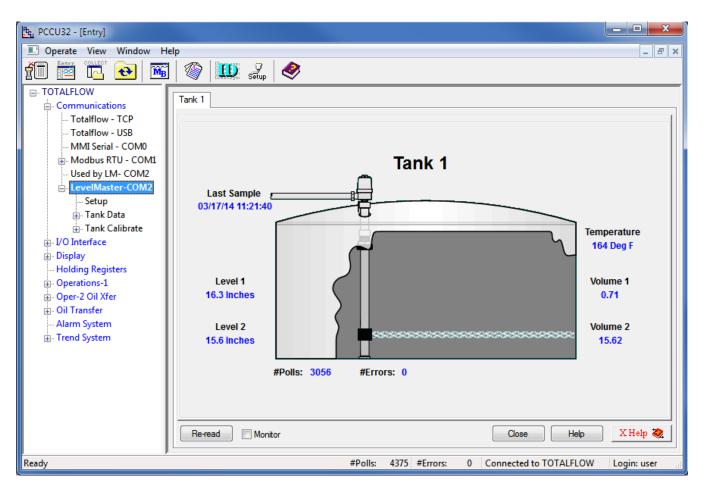
| Operate View Window Help Image: Communications Image: Communications Request Blocks Statistics Packet Log Image: Communications Totalflow - USB Image: Communications Request Blocks Statistics Packet Log Image: Communications Communications Request Blocks Statistics Packet Log Image: Communications Request Blocks Statistics Packet Log Image: Communications Image: Communications Image: Communications Request Blocks Statistics Packet Log Image: Communications Image: Communications Image: Communications Request Blocks Statistics Image: Communications Image: Communications Image: Communications | E PCCU32 - [Entry] | | |
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| • TOTALFLOW • Communications • Totalflow - TCP • Totalflow - TCP • Totalflow - USB • MMI Serial - COM0 • Modbus RTU - COM1 • Used by LM - COM2 • LevelMaster - COM2 • LevelMaster - COM2 • Setup • Tank 1 • Operations-1 • Operatisine • OliTankie • OliTankie • Oli | 🔳 Operate View Window He | elp _ ا | × |
| Communications → Totalflow - TCP Totalflow - USB MMI Serial - COM0 Ø Modbus RTU - COM1 Used by LM- COM2 Ø Stransform Ø Tank Data Ø Tank Data Ø Tank Data Ø Tank Data Ø Stransform | | 1 🚳 1 🛄 Setup 1 🥏 | |
| Totalflow - USB 03/17/14 09:37:54 → U01D029 44D058.89F083E0000W0000C7655[0D][0A] MMI Serial - COM0 03/17/14 09:37:56 → U01D029 44D058.89F083E0000W0000C7655[0D][0A] By By LM- COM2 03/17/14 09:37:58 → U01D029 44D058.89F083E0000W0000C7655[0D][0A] By LevelMaster-COM2 03/17/14 09:37:58 → U01D029 44D058.89F083E0000W0000C7655[0D][0A] 03/17/14 09:37:58 → U01D029 44D058.89F083E0000W0000C7655[0D][0A] 03/17/14 09:37:58 → U01D029 44D058.89F083E0000W0000C7655[0D][0A] 03/17/14 09:38:02 ← U0170D][0A] 03/17/14 09:38:02 ← U0170D][0A] 03/17/14 09:38:02 ← U0170D][0A] 03/17/14 09:38:02 ← U0170D][0A] 03/17/14 09:38:02 ← U0170D][0A] 03/17/14 09:38:02 ← U0170D][0A] 03/17/14 09:38:02 ← U0170D][0A] 03/17/14 09:38:02 ← U0170D][0A] 03/17/14 09:38:02 ← U0170D][0A] 03/17/14 09:38:04 ← U0170D][0A] 03/17/14 09:38:04 ← U0170D][0A] 03/17/14 09:38:04 ← U0170D][0A] 03/17/14 09:38:04 ← U0170D][0A] 03/17/14 09:38:06 ← U0170D][0A] 03/17/14 09:38:10 ← U0170D][0A] 03/17/14 09:38:10 ← U0170D29 40D058 81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:10 ← U0170D][0A] 03/17/14 09:38:16 ← U0170D2][0A] 03/17/14 09:38:16 ← U0170D][0A] 03/17/14 09:38:16 ← U0170D][0A] 03/17/14 09:38:16 ← U0170D2][0A] 03/17/14 09:38:16 ← U0170D2][0A] 03/17/14 09:38:16 ← U0170D][0A] 03/17/14 09:38:16 ← U0170D2][0A] | | | 7 |
| MMI Serial - COM0 MMI Serial - COM0 Modbus RTU - COM1 Used by LM- COM2 LevelMaster-COM2 Setup Tank Data Tank 1 Tank 1 Tank Calibrate Display Holding Registers Operations1 Operations1 Oil Transfer Alarm System District V1 to 938: 16 ~ U017(00)[0A] 03/17/14 09:38: 06 ~ U017(00)[0A] 03/17/14 09:38: 16 ~ U017(00)[0A] 03/17/14 09:38: 16 ~ U017(00)[0A] 03/17/14 09:38: 16 ~ U017(00)[0A] | | | |
| Image: State Construction (3):17/14 (9):37:56 ←> 00:10029:44D058.89F083E0000W0000C7655[0D][0A] (3):17/14 (9):37:56 ←> 00:10029:44D058.89F083E0000W0000C7655[0D][0A] (3):17/14 (9):37:58 ←> 00:10029:44D058.89F083E0000W0000C7655[0D][0A] (3):17/14 (9):37:58 ←> 00:10029:44D058.89F083E0000W0000C7655[0D][0A] (3):17/14 (9):38:06 ←> 00:10029:44D058.89F083E0000W0000C7655[0D][0A] (3):17/14 (9):38:06 ←> 00:10029:44D058.89F083E0000W0000C7655[0D][0A] (3):17/14 (9):38:06 ←> 00:10029:44D058.89F083E0000W0000C7655[0D][0A] (3):17/14 (9):38:06 ←> 00:10029:44D058.89F083E0000W0000C4360[0D][0A] (3):17/14 (9):38:06 ←> 00:10029:44D058.89F083E0000W0000C4360[0D][0A] (3):17/14 (9):38:06 ←> 00:10029:40D058.81F083E0000W0000C4360[0D][0A] (3):17/14 (9):38:06 ←> 00:17(0D][0A] (3):17/14 (9):38:06 ←> 00:17(0D][0A] (3):17/14 (9):38:06 ←> 00:17(0D][0A] (3):17/14 (9):38:16 ←> 00:17(0D][0A] (3):17/14 (9):38:18 ←> 00:17(0D][0A] (3):17/14 (9):38:18 ←> 00:17(0D][0A] (3):17/14 (9):38:18 ←> 00:17(0D][0A] (3):17/14 (9):38:18 ←> 00:17(0D][0A] (3):17/14 (9):38:16 | | | |
| Used by LM- COM2 03/17/14 09:37:58 -> U0110024 44D058.89F083E0000W0000C7655[0D][0A] 03/17/14 09:37:58 -> U0110029 44D058.89F083E0000W0000C7655[0D][0A] 03/17/14 09:38:00 -> U0110029 44D058.89F083E0000W0000C4560[0D][0A] 03/17/14 09:38:00 -> U0110029 44D058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:00 -> U0110029 40D058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:10 -> U0110029 40D058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:12 -> U0110029 40D058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:12 -> U0110029 40D058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:16 -> U0112[0D][0A] 03/17/14 09:38:16 -> U0112[0D][0A] 03/17/14 09:38:16 -> U0112029.40D58.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:16 -> U0112029.40D58.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:16 -> U0112029.44D058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:16 -> U0112029.44D058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:16 -> U011202 | | 03/17/14 09:37:56> U01D029.44D058.89F083E0000W0000C7655[0D][0A] | |
| □ LevelMaster-COM2 □ Setup □ Tank Data □ Tank Data □ Tank 1 □ Tank Calibrate □ Jost 17/14 09:38:00 ~> U0170D1[0A] 03/17/14 09:38:02 ~> U01029:44D058.89F083E0000W0000C7655[0D][0A] 03/17/14 09:38:02 ~> U0170D29:44D058.89F083E0000W0000C7655[0D][0A] 03/17/14 09:38:02 ~> U0170D29:44D058.89F083E0000W0000C7655[0D][0A] 03/17/14 09:38:06 ~> U0170D1[0A] 03/17/14 09:38:08 ~> U0170D20058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:12 ~> U0170D29.40D058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:12 ~> U0170D29.40D058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:16 ~> U0170D1[0A] 03/17/14 09:38:16 ~> U0170D29.40D058.81F083E0000W0000C4360[0D][0A] | | | |
| Setup Tank Data Tank 1 Tank 1 Tank 1 Tank 1 Tank 1 Tank 2 Tank 1 Tank 1 Tank 2 Tank 1 Tank 2 Tang 2 Tan | | 03/17/14 09:38:00 <- U01?[0D][0A] | |
| | | | |
| □ Tank Calibrate □ //7/14 09:38:04 -> U01D029.44D58.89F083E0000W0000C7655[0D][0A] □ //7/14 09:38:06 -> U017[0D][0A] □ //7/14 09:38:06 -> U01202.94D58.81F083E0000W0000C4360[0D][0A] □ //7/14 09:38:10 -> U01D029.44D58.81F083E0000W0000C4360[0D][0A] □ //7/14 09:38:10 -> U01D029.44D58.81F083E0000W0000C4360[0D][0A] □ //7/14 09:38:11 -> U012029.40D58.81F083E0000W0000C4360[0D][0A] □ //7/14 09:38:12 -> U012029.40D58.81F083E0000W0000C4360[0D][0A] □ //7/14 09:38:14 -> U01209.40D58.81F083E0000W0000C4360[0D][0A] □ //7/14 09:38:16 -> U0120D29.40D58.81F083E0000W0000C4360[0D][0A] □ //7/14 09:38:16 -> U0120D29.40D58.81F083E0000W0000C4360[0D][0A] □ //7/14 09:38:18 -> U012029.40D58.81F083E0000W0000C4360[0D][0A] □ //7/14 09:38:18 -> U012029.44D58.89F083E0000W0000C4360[0D][0A] □ //7/14 09:38:18 -> U012029.44D58.89F083E0000W0000C7655[0D][0A] □ //7/14 09:38:18 -> U01D029.44D58.89F083E0000W0000C7655[0D][0A] □ //7/14 09:38:18 -> U01D029.44D58.89F083E0000W0000C7655[0D][0A] □ //7/14 09:38:18 -> U01D029.44D58.89F083E0000W0000C7655[0D][0A] | | 03/17/14 09:38:02> U01D029.44D058.89F083E0000W0000C7655[0D][0A] | |
| ¹/₂ Tank Calibrate ¹/₂ VO Interface ¹/₂ VO Interface | Tank 1 | | |
| B: Display 03/17/14 09:38:08 <- U01?(0D)[0A] | 🗄 - Tank Calibrate | 03/17/14 09:38:06 <- U01?[0D][0A] | |
| Display Holding Registers Operations-1 Oper-2 Oil Xfer Oil Transfer Alarm System Trend System Trend System Monitor Log Size 25 #Errors: 32788 Wonitor Log Size 25 #Errors: 32788 Close Help | | | |
| 0. Operations-1 ⊕ Oper-2 Oil Xfer ⊕ Oil Transfer ⊕ Alarm System ⊕ Trend System ⊕ Trend System ⊕ Monitor Log Size 25 # read Wonitor Log Size 25 # Proofs 26 27 27 28 29 29 20 20 20 20 20 20 20 20 21 21 21 22 23 24 25 25 25 25 25 25 25 25 25 25 25 25 25 25 25 25 25 26 | | 03/17/14 09:38:08> U01D029.40D058.81F083E0000W0000C4360[0D][0A] | |
| ⓐ. Operations-1 ⓐ. Oper-2 Oil Xfer ⓐ. Oil Transfer Alarm System ⓐ. Trend System ⓑ. Oil Tansfer | | | |
| • Oil Transfer • Alarm System • Alarm System • Trend System • Trend System • Oil 7(1/14 09:38:14 <- U01?[0D][0A] 03/17/14 09:38:16 <- U01?[0D][0A] 03/17/14 09:38:16 <- U01?[0D][0A] 03/17/14 09:38:16 <- U01?[0D][0A] 03/17/14 09:38:18 <- U01D029.44D058.89F083E0000W0000C7655[0D][0A] • Monitor Log Size 25 | | 03/17/14 09:38:12 <- U01?[0D][0A] | |
| 03/17/14 09:38:14 → U01D029.40D058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:16 ← U017[0D][0A] 03/17/14 09:38:16 ← U017[0D][0A] 03/17/14 09:38:18 ← U0129.40D058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:18 ← U017[0D][0A] 03/17/14 09:38:18 ← U017[0D][0A] 03/17/14 09:38:18 ← U017[0D][0A] 03/17/14 09:38:18 ← U0129.44D058.89F083E0000W0000C7655[0D][0A] Reread ✓ Monitor Log Size 25 #Prolls: 37145 | | | |
| | | 03/17/14 09:38:14> U01D029.40D058.81F083E0000W0000C4360[0D][0A] | |
| 03/17/14 09:38:18 <- U01?[0D][0A] | · · · · · · · · · · · · · · · · · · · | U3/1//14 U9:38:16 <- U01?[UD][UA] 03/17/14 09:38:16 -> U01D029.40D058.81F083E0000W0000C4360(0D)[0A] | |
| Re-read Monitor Log Size 25 - #Errors: 32788 Close Help | i nena system | 03/17/14 09:38:18 < U01?[0D][0A] | |
| Heread V Monitor Log Size 25 ▼ #Polls: 37145 Close Help | | 03/1//14 09:38:18 -> 001D029.44D058.89F083E0000W0000C7655[0D][0A] | |
| Heread V Monitor Log Size 25 ▼ #Polls: 37145 Close Help | | | |
| Heread V Monitor Log Size 25 ▼ #Polls: 37145 Close Help | | | |
| Heread V Monitor Log Size 25 ▼ #Polls: 37145 Close Help | | #Errore: 22700 | 4 |
| Predice Dell Ordinize | | | |
| Heading Poli Statistics | J | Reading Poll Statistics | |

- 16.4.13 To display the values,
- 16.4.14 Select Communications \ LevelMaster \ Tank Calibrate \ Tank x from the tree-view window of the PCCU32.

| 🖳 PCCU32 - [Entry] | | | | | | |
|--|---|---------------------------|---|----------|--|--|
| 🔳 Operate View Window Help | | | | | | |
| | | | | | | |
| ⊡. TOTALFLOW | TOTALFLOW Calibrate Calibrate Calibrate | | | | | |
| Totalflow - TCP | | | | | | |
| Totalflow - USB | | Description | Value | <u>^</u> | | |
| MMI Serial - COM0 | 51.117.0 | Name | Tank 1 | | | |
| Modbus RTU - COM1 | 51.108.0 | No. of Tank Sections | 1 | | | |
| Used by LM- COM2 | | | | | | |
| Setup | | Section Heights | | Ξ | | |
| | 51.109.9 | Height 10 | 10 | | | |
| Tank Calibrate | 51.109.8 | Height 9 | 10 | | | |
| | 51.109.7 | Height 8 | 10 | | | |
| Display Holding Registers | 51.109.6 | Height 7 | 10 | | | |
| Holding Registers ⊕. Operations-1 | 51.109.5 | Height 6 | 10 | | | |
| 💮 Oper-2 Oil Xfer | 51.109.4 | Height 5 | 10 | | | |
| Oil Transfer Alarm System | 51.109.3 | Height 4 | 10 | | | |
| | 51.109.2 | Height 3 | 10 | | | |
| | 51.109.1 | Height 2 | 10 | | | |
| | 51.109.0 | Height 1 - Bottom Section | 100 | _ | | |
| | | | | | | |
| Re-read Monitor Print Screen Save Send Close Help X Help 🍇 | | | | | | |
| , , Ready | | #Polls: | 3907 #Errors: 0 Connected to TOTALFLOW Login: | iser 🔡 | | |

- 16.4.15 Set the number of Tank Sections in row 51.108.x.
- 16.4.16 For each tank section, set the height of that section in rows 51.109.x
- 16.4.17 For each tank section, enter the Factor in rows 51.110.x. The Factor value is the number of barrels per ¼ inch of height in that section. By clicking on the Help button of the PCCU32 and searching for 'tank calibration', a more detailed explanation of the calibration process can be obtained.

16.4.18 Select Communications \ LevelMaster from the tree-view window of the PCCU32.



- 16.4.19 Click on Re-read to obtain a single set of readings from the HMA, or check the Monitor checkbox to repeatedly read values from the HMA at the Interval specified in the Request Blocks tabs in step 16.4.9.
- 16.4.20 In the example above, the attached device has the Measurement Type set to Interface, the PV set to the Level reading and SV set to the Interface Level reading. The level reading from the device (PV is sent as Float 1 of Command Uxx?) is displayed as Level 1. The Interface Level reading from the device is displayed as Level 2. The Echo Strength from the device is displayed as the Temperature. The Volume 1 value is computed from the difference between the Level 1 and Level 2 readings. The Volume 2 value is computed from the Level 2 reading. The level to volume conversion is determined by the settings made in steps 16.4.15 through 16.4.17.
- 16.4.21 If the Measurement Type of the device is set to Level, the Level1 and Level 2 readings will be the same, Volume 1 will always be 0 and Volume 2 will represent the total volume.
- 16.4.22 Any Errors or Warnings from the attached HART device will appear under the bottom right section of the tank image.

16.5. Writing registers to the HMA

The ABB Totalflow XRC has no provisions for sending commands to LevelMaster devices other than the Uxx? command. Therefore, it is not possible to write registers in the attached HART devices.

17. ThermoScientific AutoPILOT PRO – Modbus RTU / ASCII

The following procedure applies to operation with both RTU and ASCII communication. The choice of communication protocol is made in step 4.1.8 for the HMA settings, and step 4.3.10. The Modbus RTU protocol is used for the following.

17.1. Initial HMA Configuration

17.1.1 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for LevelMaster communication with the AutoPilot Pro. Refer to Appendix F for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed in order to open the Write Single Register dialog, enter the new value, and then click on Send.

17.2. Physical Connections

- 17.2.1 Connect the AutoPILOT PRO to a computer using a CHIT computer connection cable for (ThermoScientific p/n 3-0446-090).
- 17.2.2 Connect an appropriate 12 VDC power supply to the terminals of TB-1 on the inside of the AutoPILOT PRO front panel.
- 17.2.3 Connect an RS-485 communications cable between the terminals of TB-16 of the AutoPILOT PRO and the RS-485 terminal block (TB2) of the HMA. The TX/RX+ terminal of the HMA should be connected to the TX+ terminal of TB-16. The TX/RX- terminal of the HMA should be connected to the TX- terminal of TB-16.
- 17.2.4 On the main board of the AuotPILOT PRO, add a jumper to pins 15-16 of J39 to select 2-wire mode.
- 17.2.5 On the main board of the AuotPILOT PRO, add a jumper to J40 to select RS-485 mode.
- 17.2.6 Connect a 120Ω resistor between the two RS-485 terminal block (TB2) positions of the last HMA on the bus.

17.3. Initial AutoPILOT PRO Configuration

- 17.3.1 Start the AutoCONFIG application.
- 17.3.2 A dialog will appear allowing for communication settings between the AutoCONFIG application and the AutoPILOT PRO. This example uses 'Local Connection' as the connection profile name.

| 🔞 Communication | n Parameters | | — × |
|-----------------|---------------------------------|--------------------------|------------------------------------|
| Connection I | nfo | Connection List | |
| *Name | Local Connection | Name Local Connection | Unit Type Adress C AutoEX 255 C |
| *Unit Type | AutoEXEC - AutoPilot Pro 💌 | Offline | AutoEX 255 C |
| *Address | 255 Extended Address | | |
| *Comm. Port | COM1 | | |
| Phone # | *CTS Wait 0 M | Sec | |
| *Baud Rate | 57.6 K • *RTS Wait 0 M | Sec | |
| *Parity Bit | None *RTS Rise 0 M | Sec | |
| *Stop Bit | 1 Stop • RTS Fall 0 M | Sec | |
| | | | |
| | | | |
| *Num Retries | 1 *Num. Nulls 0 *Max RX Delay 3 | Sec III | • |
| All fields with | * must be filled in | Connect Save | Delete Close |

- 17.3.3 Select the COM port number corresponding to the CHIT cable.
- 17.3.4 Ensure that the other communication settings are set as desired. Note: The settings displayed above have been found to result in successful connection to the AutoPILOT PRO.
- 17.3.5 If any changes to the settings have been made, click on Save.
- 17.3.6 Click on Connect to establish communication with the AutoPILOT PRO.

17.4. Reading registers from the HMA

- 17.4.1 The followings steps demonstrate how to read the PV, SV, TV and QV from a HART device attached to the HMA. When making any changes to the settings, click on Apply at the top of the window to write them to the AutoPilot Pro.
- 17.4.2 In the Navigation Bar, click on Communication(s), expand the 96-Communication Port(s) item, and then double-click on Host Comm Port.

| 🗑 Local Connection | | | | | |
|--|------------------------------------|---------------------------|--------------------------|-----------------------|---|
| <u>S</u> ystem <u>F</u> iles <u>T</u> ools <u>O</u> ptions | <u>C</u> olors <u>P</u> rogrammabl | e Screen <u>H</u> elp | | | |
| |) (L) (L) (L) | I | | | Advanced Mode |
| Navigation Bar 🕈 | Modbus Master Commu | nication Block - Entry #1 | Communication Port Defin | nition - H - Entry #1 | $\triangleleft \triangleright \mathbf{X}$ |
| Physical Data Point(s) > | Auto Refresh | Refresh Appl | у | Help | <mark>, ☆</mark> |
| Calculation(s) ¥ | | | | | |
| Communication(s) * | | | | | |
| ⊞ 64-Radio Scheduling | Calculation | Enabled - | Repeat | Timer | 0 |
| 96-Communication Port(s) | Descriptor | Host Comm Port | RTS De | lay | 0 mSec |
| Host Comm Port | Mode | Master - | Handsh | aking None | • |
| Comm Port# 2 | Baud Rate | 9600 🝷 | Protoco | I Format RTU | • |
| Comm Port# 3 | Data Bit | | | 1 | |
| Comm Port# 4 | Parity | 8 Bits Even 1 | | | |
| Comm Port# 5 | Stop Bit | 1 • | | | = |
| Comm Port# 6 | | | | | |
| Comm Port# 8 | | | | | |
| Ethernet Port #1 | Comm. Block Ref. | 1 💌 | Clear Entire | | |
| 97-Modbus Slave | Comm Block | Modbus Master 💌 | Block List | | |
| 98-Modbus Master | Block Index | Entry #1 🔻 | | | |
| Entry#1 {247} (2) [1302,1303] Entry#2 | | · | | | |
| Entry#3 | | | | | |
| Entry#4 | | | | | |
| 99-Ultrasonic Meter | | | | | |
| 🖶 100-Chromatograph | | | | | |
| i≟⊷ 101-Tank Gauge | | | | | |
| Interface | | | | | |
| Miscellaneous × | | | | | |
| User Configurable ¥ | • | | III | | • |
| · · · · · · · · · · · · · · · · · · · | | Access Level: Superuser | Add: 255 Baud: 57600 | SID = N/A | TX:1799 RX:1799 ERR:0 |

- 17.4.3 Set Calculation to Enabled.
- 17.4.4 Set the Repeat Timer to the desired sampling interval in seconds.
- 17.4.5 Ensure that the communication settings match the selections made in step 17.1.1.
- 17.4.6 Set the Comm. Block Ref to 1, the Comm Block to Modbus Master, and the Block Index to Entry #1.
- 17.4.7 Click on Apply to send the settings to the AutoPILOT PRO.

17.4.8 In the Navigation Bar, click on Communication(s), expand the 98-Modbus Master item, and then double-click on Entry#1.

| S Local Connection | | | | | | | | • X |
|---|---|---|---|--|--------------------------------------|---------|----------|----------|
| System Eiles Iools Optio | ns <u>Colors Programmat</u> | | | | | | | ced Mode |
| Navigation Bar 🛛 📮 | Modbus Master Communica | tion Block - Entry #1 | Floating Point Value - Blk Dist | Floating Point Value - Slave 1 | PV | | | 4 Þ 🗙 |
| Physical Data Point(s) * | Auto Defreeb | efresh Apply | | Help | | | | - |
| I-Floating Point Value Slave 1 PV = 120.0 in Slave 1 PV = 0.0 in Slave 1 TV = 0.0 in Slave 1 QV = 0.0 in Blk Dist = 3.6 in Table 1 Item 6 Pt 1-6 D Table 1 Item 7 Pt 1-7 D Table 1 Item 8 Pt 1-8 D 2-Discrete Value 3-Byte Value 4-16-Bit Word Value 15-Text 16-Physical Analog Input 17-Physical Discrete Inpu_ 20-Physical Accumulator | Master Comm. Comm. Type Address Status Protocol Format Start Register Num Enteries Host IP Address Host Port Number | Enable Read 247 Comm Ok Modbus RTU 1302 4 127.0.0.1 0 | AutoMitter Mode Extended Addressing Modbus Function Code Fit Pt Register Size FP Byte Order 16-Bit Register Encap Modbus Format | Disabled Disabled FC04 - Read Input Register 2*16-Bit Registers Daniel (4,3,2,1) Disabled IP TCP | | | | E |
| | Modbus Master Regis Register Poin | nt Number Field Descript | ion | | Value | _ | | |
| | * 1303 1304 1305 | i reio desclipi | | | (null) (null) (null) (null) | | | |
| | | | Access Level: Superuser | Add: 255 Baud: 57600 | SID = N/A | TX:2247 | RX: 2245 | ERR:2 |

- 17.4.9 Set Master Comm. to Enable.
- 17.4.10 Set Comm. Type to Read.
- 17.4.11 Set the Address to the Modbus address of the HMA.
- 17.4.12 Set the Start Register to 1302 (the start of the PV register for Slave 1 in the HMA).
- 17.4.13 Set the Num Entries to 4 (four 32-bit floating point numbers).
- 17.4.14 The Host IP Address, Host Port Number, AutoMitter Mode, Extended Addressing and Encap Modbus Format can be ignored.
- 17.4.15 Set the Modbus Function Code to FC04 Read Input Register.
- 17.4.16 Set the Flt Pt Register Size to 2 * 16-Bit register, and the FP Byte Order to Daniel (4,3,2,1).
- 17.4.17 Set the 16-Bit Register to Disabled.
- 17.4.18 Click on Apply to send the settings to the AutoPILOT PRO.

- 17.4.19 In the Navigation Bar, click on Physical Data Point(s), and expand the 1-Floating Point Value item.
- 17.4.20 Double click on the Table 1 Item 1 entry, and change Descriptor #1 to 'PV' and Engineering Unit to correspond to the level units in use by the HART transmitter to be read.

| S Local Connection | | | | _ _ X |
|--|---|-----------------------------|----------------------------------|--|
| <u>System Files Tools Options</u> | s <u>C</u> olors <u>P</u> rogrammable Scree | en <u>H</u> elp | | |
| 10 FF 🕅 🗟 🗲 | I 🕒 🏷 🤣 | | | Advanced Mod |
| | odbus Master Communication Block | Entry #1 Communication Port | | e - Slave 1 PV - Entry #1 |
| Physical Data Point(s) 🔦 🔺 | Auto Refresh Refresh | Apply | Help 💇 | |
| □ 1-Floating Point Value Slave 1 PV Pt 1-1 Des Table 1 Item 2 Pt 1-2 [| General | 1 | Value Limit | Alarm Limit |
| Table 1 Item 3 Pt 1-3 [Table 1 Item 4 Pt 1-4 [| Descriptor #1 | Slave 1 PV | Current Status | Normal |
| Table 1 Item 5 Pt 1-5 [Table 1 Item 6 Pt 1-6 [| Descriptor #2 Engineering Unit | Pt 1-1 Descr2 | Current Value | 42.0 |
| | Aud/Alm Reg Index | in O | Scale Factor Scale Value | 0 |
| | Alarm Hysteresis Value | 0 | | U |
| | Data Blocks Audit/Alarm Data Block In | | Security Access | |
| | Not Assigned | Log Audits | Measurement Control | Technician Supervisor |
| 19-Physical Discrete Inp | | Log Alarms | | |
| 20-Physical Accumulator 21-Physical Analog Outp | | | | |
| im 22-Physical Discrete Out | Low Alarm | Enabled | High Alarm | Enabled |
| Calculation(s) × Communication(s) × | Low Low Alarm | Enabled | High High Alarm | Enabled |
| econnication(s) × | Low Value Limit | Enabled | High Value Limit | Enabled |
| 96-Communication Port(Host Comm Port | | | | |
| Comm Port# 1 | | | | |
| | | | | |
| | | Access Level: | Superuser Add: 255 Baud: 57600 S | ID = N/A TX : 26252 RX : 26252 ERR : 0 |

- 17.4.21 Click on Apply to send the settings to the AutoPILOT PRO.
- 17.4.22 Right click on the Slave 1 PV entry in the Navigation Bar and select Copy.

17.4.23 Double click on the Entry #1 listing in the Communication(s) \ 98-Modbus Master section of the Navigation Bar.

| Local Connection | | | | | | - D X |
|--|---------------------------------------|--|---------------------------------|--------------------------------|--------------|--------------------------|
| <u>S</u> ystem <u>F</u> iles <u>T</u> ools <u>O</u> ption | s <u>C</u> olors <u>P</u> rogrammable | e Screen <u>H</u> elp | | | | |
| r F F & 4 | on († 1907) 🖉 🖉 | | | | | Advanced Mode |
| Navigation Bar 🛛 🕈 | Modbus Master Communicati | ion Block - Entry #1 | Floating Point Value - Blk Dist | Floating Point Value - Slave 1 | PV | ∢ ⊳ x |
| ⊕ 4-16-Bit Word Value ▲ ⊕ 15-Text | Auto Defeat | resh Apply | | Help | | <u>^</u> |
| | | | | | | |
| | | | | | | |
| ⊕ 19-Physical Discrete Inpu ⊕ 20-Physical Accumulator | Master Comm. | Enable < | | | | |
| | Comm. Type | Read 🔻 | AutoMitter Mode | Disabled | - | |
| i≟∾ 22-Physical Discrete Out | Address | 247 | Extended Addressing | Disabled | - | |
| Calculation(s) × | Status | Comm Ok | Modbus Function Code | FC04 - Read Input Registe | er 🔻 | |
| Communication(s) * | Protocol Format | Modbus RTU 🔻 | Flt Pt Register Size | 2 * 16-Bit Registers | - | = |
| ⊕ 64-Radio Scheduling ⊕ 96-Communication Port(s | Start Register | 1302 | FP Byte Order | Daniel (4,3,2,1) | - | |
| | Num Enteries | 4 | 16-Bit Register | Disabled | - | |
| 98-Modbus Master | Host IP Address | 127.0.0.1 | Encap Modbus Format | IP TCP | - | |
| Entry#1 {247} (4) [1302, Entrv#2 | Host Port Number | 0 | | , | | |
| Entry#3 | | | | | | |
| Entry#4 ⊛ 99-Ultrasonic Meter | Modbus Master Registe | | | | | |
| | | Number Field Descript | | | Value 120 | |
| | | 01.004 Table-ICurro 02.004 Table-1Curro | | | 120 | |
| Interface | | 03.004 Table-1 Curr | | | 120 | |
| Miscellaneous × | 1305 001.0 | 04.004 Table-1 Curr | ent Value | | 120 | |
| User Configurable 🛛 👻 | * | | | | | |
| | | | | | | |
| | | | Access Level: Superuser | Add: 255 Baud: 57600 | SID = N/A | TX: 2286 RX: 2284 ERR: 2 |

- 17.4.24 Right click on the Register number 1302 cell and select Paste.
- 17.4.25 To set up the SV, TV and QV readings, repeat steps 4.4.19 through 4.4.24 using Table 1 items 2 to 4. Paste the SV into address 1304, TV into address 1306 and QV into address 1308.
- 17.4.26 Click on Apply to send the settings to the AutoPILOT PRO.
- 17.4.27 Check on Auto Refresh to start the AutoPILOT PRO to repeatedly read the values from the device.

17.5. Writing registers to the HMA

- 17.5.1 The followings steps demonstrate how to write the Blocking Distance to a HART device attached to the HMA. When making any changes to the settings, click on Apply at the top of the window to write them to the AutoPilot Pro.
- 17.5.2 In the Navigation Bar, click on Communication(s), expand the 96-Communication Port(s) item, and then double-click on Host Comm Port.

| Local Connection | | | | | |
|--|------------------------------------|---------------------------|---------------------------|---------------------|---|
| <u>S</u> ystem <u>F</u> iles <u>T</u> ools <u>O</u> ptions | <u>C</u> olors <u>P</u> rogrammabl | e Screen <u>H</u> elp | | | |
| npt (d. 4) | 7 🕒 🏷 冬 | 1 | | | Advanced Mode |
| Navigation Bar 🛛 🕈 | Modbus Master Commu | nication Block - Entry #1 | Communication Port Defini | tion - H - Entry #1 | $\triangleleft \triangleright \mathbf{X}$ |
| Physical Data Point(s) × | Auto Refresh | Refresh Appl | у | Help | <u>.</u> |
| Calculation(s) × | | | | | |
| Communication(s) * | | | | | |
| | Calculation | Enabled - | Repeat T | ïmer | 0 |
| 96-Communication Port(s) | Descriptor | Host Comm Port | RTS Del | | 0 mSec |
| Host Comm Port | Mode | Master - | Handsha | · | - |
| Comm Port# 1 Comm Port# 2 | Baud Rate | 9600 - | Protocol | | |
| Comm Port# 2 | Data Bit | | | IRIO | |
| Comm Port# 4 | | 8 Bits | | | |
| Comm Port# 5 | Parity | 8 Bits Even 1 | | | |
| Comm Port# 6 | Stop Bit | 1 🔹 | | | E |
| Comm Port# 7 | | | | | |
| Comm Port# 8 | Comm. Block Ref. | 1 - | Clear Entire | | |
| 97-Modbus Slave | Comm Block | Modbus Master | Block List | | |
| B 98-Modbus Master | | modbub mabter | | | |
| Entry#1 {247} (2) [1302,1303] | Block Index | Entry #1 💌 | | | |
| Entry#2 | | | | | |
| Entry#3 | | | | | |
| Entry#4 ⊞ 99-Ultrasonic Meter | | | | | |
| ⊕- 99-Ultrasonic Meter ⊕- 100-Chromatograph | | | | | |
| i⊞ 100-Chiomatograph i⊞ 101-Tank Gauge | | | | | |
| Interface | | | | | |
| Miscellaneous ¥ | | | | | |
| User Configurable ¥ | | | | | + |
| | • | | | | • |
| | | Access Level: Superuser | Add: 255 Baud: 57600 | SID = N/A | TX:1799 RX:1799 ERR:0 |

- 17.5.3 Set Calculation to Enabled.
- 17.5.4 Set the Repeat Timer to the desired sampling interval in seconds.
- 17.5.5 Ensure that the communication settings match the selections made in step 17.1.1.
- 17.5.6 Set the Comm. Block Ref to 1, the Comm Block to Modbus Master, and the Block Index to Entry #1.
- 17.5.7 Click on Apply to send the settings to the AutoPILOT PRO.

In the Navigation Bar, click on Communication(s), expand the 98-Modbus Master item, and then doubleclick on Entry#1.

| Local Connection | | | | | | |
|--|-----------------------------------|---------------------------|--------------------------------|------------------------|-----------|-----------------------|
| <u>System Files T</u> ools <u>O</u> ptions | <u>C</u> olors <u>P</u> rogrammab | le Screen <u>H</u> elp | | | | |
| | o 🕒 🏷 🤣 | > | | | | Advanced Mode |
| Navigation Bar 4 M | odbus Master Communica | tion Block - Entry #1 | loating Point Value - Blk Dist | | | ↓ × |
| terrore 4-16-Bit Word Value ▲ □ terrore 15-Text | Auto Dofronk | fresh Apply | | Help 🔮 | | |
| | | | | | | |
| ⊕ 19-Physical Discrete Inpu ⊕ 20-Physical Accumulator | Master Comm. | Enable 🔹 | | | | |
| ⊕ 21-Physical Analog Outpu | Comm. Type | Write | AutoMitter Mode | Disabled | • | |
| ider 22-Physical Discrete Out | Address | 247 | Extended Addressing | Disabled | • | |
| Calculation(s) × | Status | Illegal Data Addr | Modbus Function Code | FC03/FC16 R/W Multiple | • | |
| Communication(s) | Protocol Format | Modbus RTU 💌 | Flt Pt Register Size | 2 * 16-Bit Registers | • | E |
| ⊕ 64-Radio Scheduling ⊕ 96-Communication Port(s | Start Register | 3100 | FP Byte Order | Daniel (4,3,2,1) | • | |
| 97-Modbus Slave | Num Enteries | 1 | 16-Bit Register | Disabled | - | |
| 98-Modbus Master Entry#1 {247} (1) [3100,] | Host IP Address | 127.0.0.1 | Encap Modbus Format | IP TCP | • | |
| Entry#1 (2473 (1) [3100, Entry#2 Entry#3 | Host Port Number | 0 | | | | |
| Entry#4 | Modbus Master Regis | tere | | | | _ |
| 99-Ultrasonic Meter | | nt Number Field Descripti | on | | Value | |
| ⊕ 100-Chromatograph ⊕ 101-Tank Gauge | 3100 | | | | (null) | |
| Interface | * | | | | | |
| Miscellaneous × | | | | | | |
| User Configurable 🛛 👻 🚽 | | | | | | |
| | | | | | | - |
| | | | Access Level: Superuser | Add: 255 Baud: 57600 | SID = N/A | TX:1905 RX:1903 ERR:2 |

- 17.5.8 Set Master Comm. to Enable.
- 17.5.9 Set Comm. Type to Write.
- 17.5.10 Set the Address to the Modbus address of the HMA.
- 17.5.11 Set the Start Register to 3100 (the start of the Blocking Distance register for Slave 1 in the HMA).
- 17.5.12 Set the Num Entries to 1 (one 32-bit floating point number).
- 17.5.13 The Host IP Address, Host Port Number, AutoMitter Mode, Extended Addressing and Encap Modbus Format can be ignored.
- 17.5.14 Set the Modbus Function Code to FC03/FC16 R/W Multiple for reading input registers.
- 17.5.15 Set the Flt Pt Register Size to 2 * 16-Bit Registers, and the FP Byte Order to Daniel (4,3,2,1).
- 17.5.16 Set the 16-Bit Register to Disabled.
- 17.5.17 Click on Apply to send the settings to the AutoPILOT PRO.

- 17.5.18 In the Navigation Bar, click on Physical Data Point(s), and expand the 1-Floating Point Value item.
- 17.5.19 Double click on the Table 1 Item 5 entry, and change Descriptor #1 to 'Blk Dist' and Engineering Unit to correspond to the level units in use by the HART transmitter to be read.

| Socal Connection | | | | |
|---|---|---------------------------------|---|---|
| <u>System Files Tools Options</u> | <u>C</u> olors <u>P</u> rogrammable Screen <u>H</u> elp | | | |
| r F F & 4 | ø 🕒 🏷 🤣 | | | Advanced Mo |
| Navigation Bar 4 M | odbus Master Communication Block - Entry #1 | Floating Point Value - Blk Dist | | 4 ▷ |
| Physical Data Point(s) 🔹 🗖 🗖 | Auto Refresh Refresh App | ply | Help 🕎 | |
| □ 1-Floating Point Value Slave 1 PV = 0.0 in Slave 1 SV = 0.0 in | General | Value Lir | | Alarm Limit |
| - Slave1 TV = 0.0 in - Slave 1 QV = 0.0 in - Blk Dist = 3.0 in - Table 1 Item 6 Pt 1-6 D - Table 1 Item 7 Pt 1-7 D - Table 1 Item 8 Pt 1-8 D ⊕ 2-Discrete Value ⊕ 3-Byte Value ⊕ 4-16-Bit Word Value ⊕ 15-Text ⊕ 16-Physical Analog Input | Not Assigned | Blk Dist in 0 0 | Current Status Current Value Scale Factor Scale Value Security Access Measurement Control | Normal 3.0 0 0 ℃ Technician ♥ Supervisor |
| - 17-Physical Smart XDuce - 19-Physical Discrete Inpu - 20-Physical Accumulator - 21-Physical Analog Outpu - 22-Physical Discrete Outpu Calculation(s) | Low Alarm | Enabled | High Alarm | Enabled |
| Communication(s) | | Enabled | High High Alarm High Value Limit | Enabled |
| | | Access Level: Superuser | Add: 255 Baud: 57600 | SID = N/A TX : 1905 RX : 1903 ERR : 2 |

- 17.5.20 Enter the value to be sent to the device in the Current Value textbox.
- 17.5.21 Click on Apply to send the settings to the AutoPILOT PRO.
- 17.5.22 Right click on the Slave 1 Blk Dist entry in the Navigation Bar and select Copy.

17.5.23 Double click on the Entry #1 listing in the Communication(s) \ 98-Modbus Master section of the Navigation Bar.

| S Local Connection | | | | | | | |
|---|--------------------------------------|-------------------------|---------------------------------|------------------------|-----------|----------|-------------------|
| System Eiles Iools Optio | ns <u>C</u> olors <u>P</u> rogrammab | | | | | | Advanced Mod |
| Navigation Bar 4 | Modbus Master Communicat | tion Plack Entry #1 | Floating Point Value - Blk Dist | | | | 4 Þ > |
| | Auto Defreeb | fresh Apply | | Help 💇 | | | |
| ⊕ 16-Physical Analog Input ⊕ 17-Physical Smart XDuce | | | | | | | |
| Physical Omat Abuce 19-Physical Discrete Inpu 20-Physical Accumulator | Master Comm. | Enable - | | | | | |
| ⊕ 21-Physical Analog Outpu | Comm. Type | Write | AutoMitter Mode | Disabled | <u> </u> | | |
| | Address | 247 | Extended Addressing | Disabled | <u>-</u> | | |
| Calculation(s) × | Status | Comm Ok | Modbus Function Code | FC03/FC16 R/W Multiple | - | | |
| Communication(s) * | Protocol Format | Modbus RTU 🝷 | Flt Pt Register Size | 2 * 16-Bit Registers | - | | |
| ⊕ 64-Radio Scheduling ⊕ 96-Communication Port(s | Start Register | 3100 | FP Byte Order | Daniel (4,3,2,1) | • | | |
| | Num Enteries | 1 | 16-Bit Register | Disabled | • | | |
| ⊟ 98-Modbus Master | Host IP Address | 127.0.0.1 | Encap Modbus Format | IP TCP | | | |
| Entry#1 {247} (1) [3100, Entry#2 | Host Port Number | 0 | | 1 | | | |
| Entry#2 | | | | | | | |
| Entry#4 | Modbus Master Regis | ters | | | | | |
| 99-Ultrasonic Meter | Register Poin | nt Number Field Descrip | tion | | Value | | |
| ⊕ 100-Chromatograph ⊕ 101-Tank Gauge | 3100 001. | 005.004 Table-1 Cur | rent Value | | 3.6 | | |
| Interface | * | | | | _ | | |
| Miscellaneous × | | | | | | | |
| User Configurable × | | | | | | | |
| <u>−−−−−</u> ↓ ↓ ↓ | | | | | | | |
| | | | Access Level: Superuser | Add: 255 Baud: 57600 | SID = N/A | TX: 1927 | RX : 1925 ERR : 2 |

- 17.5.24 Right click on the Register number 3100 cell and select Paste.
- 17.5.25 Click on Apply to send the settings to the AutoPILOT PRO.
- 17.5.26 Click on Refresh to command the AutoPILOT PRO to send the value to the device.
- 17.5.27 Change the Comm. Type to Read.
- 17.5.28 Click on Apply to send the settings to the AutoPILOT PRO.
- 17.5.29 Click on Refresh to confirm that the device has accepted the new value.

APPENDICES

A. HMA Terminal Block Layout



Notes:

- A. For Modbus devices using 'A' and 'B' for the RS-485 connection, connect 'A' to the '-' position of the RS-485 terminal block, and 'B' to the '+' position.
- B. The RS-485 terminal block is used as the RS-232 terminal block when the positions 3 and 4 DIP switches are set to the RS-232 mode. See Appendix B.
- C. It is recommended that the wires connected to the HART terminal block be dressed such that there is some exposed wire. This will permit connecting a HART modem without breaking the HART loop in the event that additional device configuration or troubleshooting is required.

B. HMA DIP Switch Settings

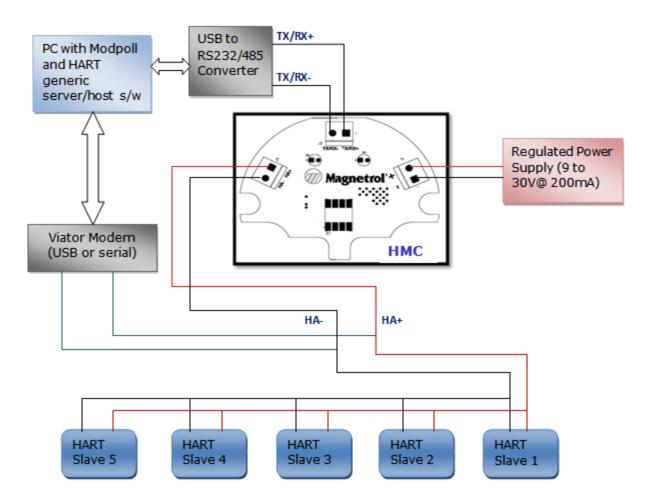
| Position 1 | ON | Normal mode | | | | |
|------------|-----|----------------------------|--|--|--|--|
| POSITION 1 | OFF | Default configuration mode | | | | |
| Position 2 | ON | Program mode | | | | |
| POSITION 2 | OFF | Run mode | | | | |
| Position 3 | OFF | RS485 mode | | | | |
| Position 4 | ON | K3465 III00e | | | | |
| Position 3 | ON | RS232 mode | | | | |
| Position 4 | OFF | RS232 III00e | | | | |

C. HMA LED Indicators

| LED D5 | Green: Indicates Power ON |
|--------|---|
| LED D4 | Red: Indicates Error (indicated by HMA status bits) |

After power on, check the LED status. If the Red LED is ON then check the HMA status by reading Modbus register 1200.

D. HMA System Connection Diagram



E. Nomenclature Table

| HMA Nomenclature | Modbus Poll Nomenclature |
|------------------------|--------------------------|
| Data Type | Display |
| Number of Registers | Quantity |
| Modbus Register Type | Function |
| Modbus Register Number | Address |
| | |

| | | | | | | | Pr | Protocol | | | |
|------------------------------------|-------|-----------|--------------------|--------------------|--|---------|--|----------|---|---------|-----------------|
| | Data | Number of | Modbus Register | Modbus Register | Modbus RTU | 2 | Modbus ASCII | E | LevelMaster | tter | HART over RS485 |
| Parameter | type | Registers | type | number | Values | Default | Values | Default | Values | Default | Values |
| Floating Point Format Code | UINT8 | 7 | Holding | 3000 | 0 - AB CD 1 - CD AB 2 - DC BA 3 - BA DC | 0 | 0 - AB CD 1 - CD AB 2 - DC BA 3 - BA DC | 0 | | | |
| Slave address | UINT8 | 1 | Holding | 3001 | 1 to 247 | 247 | 1 to 247 | 247 | 1 to 99 | 1 | |
| Protocol Type | UINT8 | 1 | Holding | 3002 | 1 | 1 | 1 | 2 | 3 | 3 | 4 |
| No of Data bits | UINT8 | 1 | Holding | 3003 | 7 - 7 bits 8 - 8 bits | 8 | 7 - 7 bits 8 - 8 bits | 7 | 7 - 7 bits 8 - 8 bits | 8 | ø |
| Stop bits | UINT8 | 1 | Holding | 3004 | 1 - 1 bit 2 - 2 bits | 1 | 1 - 1 bit 2 - 2 bits | 1 | 1 - 1 bit 2 - 2 bits | 1 | 1 |
| Parity | UINT8 | 1 | Holding | 3005 | 0 - None 1 - Odd 2 - Even | 0 | 0 - None 1 - Odd 2 - Even | 0 | 0 - None 1 - Odd 2 - Even | 0 | 1 |
| Baud rate | UINT8 | t. | Holding | 3006 | 0 - 1200 1 - 2400 2 - 4800 3 - 9600 4 - 19200 | m | 0 - 1200 1 - 2400 2 - 4800 3 - 9600 4 - 19200 | ε | 0 - 1200 1 - 2400 2 - 4800 3 - 9600 4 - 19200 | m | 0 |
| HMA Mode | UINT8 | 1 | Holding | 3007 | 0 - HMC 1 - Device | 0 | 0 - HMC 1 - Device | 0 | 0 - HMC 1 - Device | 1 | 1 |
| Auto-switch to HART over RS-485 | UINT8 | 1 | Holding | 3008 | 0 - no switch 1 - switch | 0 | 0 - no switch 1 - switch | 0 | 0 - no switch 1 - switch | 0 | 1 |
| Reserved/Unused | | | | | | | | | | | |
| No of retries (General) | UINT8 | 1 | Holding | 3010 | 0, 1, 2, 3 | | 0, 1, 2, 3 | | | | |
| Reserved/Unused | | | | | | | | | | | |
| Device Discovery mode (DDM) | UINT8 | 1 | Holding | 3012 | 0 - Polled 1 - Saved 2 - Single | | 0 - Polled 1 - Saved 2 - Single | | | | |
| Polling Range (if DDM = 0, 2) | UINT8 | - | Holding | 3013 | 0 - 0 only 1 - Find first only 2 - search 0-15 3 - search 0-63 4 - search 0-63 | | 0 - 0 only 1 - Find first only 2 - search 0-15 3 - search 0-63 4 - search 0-63 | | | | |

F. HMA Communication Modbus Registers

G. HMA Diagnostics Modbus Registers

| Parameter | Mod | bus Regist | er Info | Modbus Register | | |
|--|--------------|------------|---------|---|-----|--|
| | Data type | Number | Туре | Number | Bit | |
| Configuration data error | -71 | | - 71 | | 0 | |
| No HART communications | - | | | | 1 | |
| Communication Mode | - | | | | | |
| (0 == RS232, 1 == RS485) | | | | | 2 | |
| EEPROM failure | | | | | 3 | |
| HMA Ready | UINT8 | 1 | Input | | 4 | |
| Reserved/Unused | | | - | | 5 | |
| Reserved/Unused | | | | | 6 | |
| Configured & connected Slaves mismatch | | | | | | |
| (mismatch in number or mismatch in | | | | Number 1200 1200 1201 1201 1201 1205 1213 1250 1251 1252 1253 1254 1255 1256 1257 1258 1259 | | |
| device identification) | | | | Number 1200 1200 1201 1201 1201 1205 1213 1250 1251 1252 1253 1254 1255 1256 1257 1258 1259 | 7 | |
| Reserved/Unused | | | | | 8 | |
| Buckboost Fail | | | | | 9 | |
| Slave 1 malfunction (Comm error) | | | | Number 1200 1200 1201 1205 1213 1250 1251 1252 1253 1254 1255 1256 1257 1258 1259 | 10 | |
| Slave 2 malfunction (Comm error) | | | | | 11 | |
| Slave 3 malfunction (Comm error) | UINT8 | 1 | Input | | 12 | |
| Slave 4 malfunction (Comm error) | - | | | | 13 | |
| Slave 5 malfunction (Comm error) | - | | | | 14 | |
| Configuration data area checksum error | | | | Number 1200 1200 1201 1201 1201 1205 1213 1250 1251 1252 1253 1254 1255 1256 1257 1258 1259 | 15 | |
| Byte 3 bits - Reserved | UINT8 | 1 | Input | 1201 | | |
| Byte 4 bits - Reserved | UINT8 | 1 | Input | 1201 | | |
| HMA Firmware Version | UINT8 | 8 | Input | 1205 | | |
| HMA Serial Number | UINT8 | 6 | Input | 1213 | | |
| Number of attached devices | UINT8 | 1 | Input | 1250 | | |
| Slave 1 Device Type | UINT8 | 1 | Input | 1251 | | |
| Slave 2 Device Type | UINT8 | 1 | Input | 1252 | | |
| Slave 3 Device Type | UINT8 | 1 | Input | 1253 | | |
| Slave 4 Device Type | UINT8 | 1 | Input | 1254 | | |
| Slave 5 Device Type | UINT8 | 1 | Input | 1255 | | |
| Slave 1 Poll Address | UINT8 | 1 | Input | 1256 | | |
| Slave 2 Poll Address | UINT8 | 1 | Input | 1257 | | |
| Slave 3 Poll Address | UINT8 | 1 | Input | 1258 | | |
| Slave 4 Poll Address | UINT8 | 1 | Input | 1259 | | |
| Slave 5 Poll Address | UINT8 | 1 | Input | 1260 | | |

H. HMA Device Information Modbus Registers

| | Mod | bus Registe | er Info | | Modb | us Regi | ster Nur | nber | |
|-------------------------------|--------|-------------|---------|--------|-------|---------|----------|-------|-------|
| | | | | | | н | MA Moo | de | |
| | Data | | | Device | Slave | Slave | Slave | Slave | Slave |
| Parameter | type | Number | Туре | Mode | 1 | 2 | 3 | 4 | 5 |
| Polling Address | UINT8 | 1 | Input | 1000 | 1000 | 1020 | 1040 | 1060 | 1080 |
| Loop Current Mode | UINT8 | 1 | Input | 1001 | 1001 | 1021 | 1041 | 1061 | 1081 |
| Device Type | UINT16 | 2 | Input | 1002 | 1002 | 1022 | 1042 | 1062 | 1082 |
| Min Preambles in request | UINT8 | 1 | Input | 1003 | 1003 | 1023 | 1043 | 1063 | 1083 |
| Protocol Rev | UINT8 | 1 | Input | 1004 | 1004 | 1024 | 1044 | 1064 | 1084 |
| Device rev | UINT8 | 1 | Input | 1005 | 1005 | 1025 | 1045 | 1065 | 1085 |
| S/w rev | UINT8 | 1 | Input | 1006 | 1006 | 1026 | 1046 | 1066 | 1086 |
| H/W rev/physical sign code | UINT8 | 1 | Input | 1007 | 1007 | 1027 | 1047 | 1067 | 1087 |
| Flags | UINT8 | 1 | Input | 1008 | 1008 | 1028 | 1048 | 1068 | 1088 |
| Device ID | UINT8 | 4 | Input | 1009 | 1009 | 1029 | 1049 | 1069 | 1089 |
| Minimum Preambles in response | UINT8 | 1 | Input | 1011 | 1011 | 1031 | 1051 | 1071 | 1091 |
| Max Device Variables | UINT8 | 1 | Input | 1012 | 1012 | 1032 | 1052 | 1072 | 1092 |
| Reserved/Unused | | | | | | | | | |
| Extended field device status | UINT8 | 1 | Input | 1014 | 1014 | 1034 | 1054 | 1074 | 1094 |
| Manufacturer code | UINT8 | 1 | Input | 1015 | 1015 | 1035 | 1055 | 1075 | 1095 |
| Pvt Label Distributor code | UINT8 | 1 | Input | 1016 | 1016 | 1036 | 1056 | 1076 | 1096 |
| Device Profile | UINT8 | 1 | Input | 1017 | 1017 | 1037 | 1057 | 1077 | 1097 |

I. Model 706, Model JM4 Modbus Registers

| | Mode | ous Registe | r Info | | Mode | ous Regi | ster Nur | nber | |
|-----------------------------|--------|-------------|---------|--------|-------|----------|----------|-------|-------|
| | | | | | | н | MA Moo | de | |
| | Data | | | Device | Slave | Slave | Slave | Slave | Slave |
| HART parameter | Туре | Number | Туре | Mode | 1 | 2 | 3 | 4 | 5 |
| PV value | Float | 2 | Input | 1302 | 1302 | 1312 | 1322 | 1332 | 1342 |
| SV value | Float | 2 | Input | 1304 | 1304 | 1314 | 1324 | 1334 | 1344 |
| TV value | Float | 2 | Input | 1306 | 1306 | 1316 | 1326 | 1336 | 1346 |
| QV value | Float | 2 | Input | 1308 | 1308 | 1318 | 1328 | 1338 | 1348 |
| | | | | | | | | | |
| PV units code | UINT8 | 1 | Input | 104 | 104 | 124 | 144 | 164 | 184 |
| SV units code | UINT8 | 1 | Input | 108 | 108 | 128 | 148 | 168 | 188 |
| TV units code | UINT8 | 1 | Input | 112 | 112 | 132 | 152 | 172 | 192 |
| QV units code | UINT8 | 1 | Input | 116 | 116 | 136 | 156 | 176 | 196 |
| | | | | | | | | | |
| Command 48 status bytes | UINT8 | 5 | Input | 1101- | 1101 | 1111- | 1121- | 1131- | 1141- |
| | 01110 | 5 | input | 1105 | 1105 | 1115 | 1125 | 1135 | 1145 |
| | | | | | | | | | |
| Serial Number | UINT8 | 6 | Input | 2100 | 2100 | 2200 | 2300 | 2400 | 2500 |
| Software version | UINT8 | 8 | Input | 2112 | 2112 | 2212 | 2312 | 2412 | 2512 |
| Reserved/Unused | | | | | | | | | |
| Blocking Distance | Float | 2 | Holding | 3100 | 3100 | 3200 | 3300 | 3400 | 3500 |
| Level Unit <u>code</u> | UINT8 | 1 | Input | 2140 | 2140 | 2240 | 2340 | 2440 | 2540 |
| Level Offset | Float | 2 | Holding | 3102 | 3102 | 3202 | 3302 | 3402 | 3502 |
| Level Unit code | UINT8 | 1 | Input | 2141 | 2141 | 2241 | 2341 | 2441 | 2541 |
| Advanced Password | UINT32 | 2 | Input | 2156 | 2156 | 2256 | 2356 | 2456 | 2556 |
| Reserved/Unused | | | | | | | | | |
| HART entered password | UINT16 | 2 | Holding | 3110 | 3110 | 3210 | 3310 | 3410 | 3510 |
| Reserved/Unused | | | | | | | | | |
| Device variable assigned to | | | | | | | | | |
| <u>SV</u> | UINT8 | 1 | Holding | 3130 | 3130 | 3230 | 3330 | 3430 | 3530 |
| Sensitivity | UINT8 | 1 | Holding | 3131 | 3131 | 3231 | 3331 | 3431 | 3531 |
| Level Threshold <u>code</u> | UINT8 | 1 | Holding | 3132 | 3132 | 3232 | 3332 | 3432 | 3532 |
| Interface Level Threshold | | | | | | | | | |
| <u>code</u> | UINT8 | 1 | Holding | 3133 | 3133 | 3233 | 3333 | 3433 | 3533 |
| Level Threshold Amplitude | UINT8 | 1 | Holding | 3134 | 3134 | 3234 | 3334 | 3434 | 3534 |
| Interface Threshold | | | | | | | | | |
| Amplitude | UINT8 | 1 | Holding | 3135 | 3135 | 3235 | 3335 | 3435 | 3535 |

J. Model 705 3x Modbus Registers

| HART parameter | Modk | ous Registe | er Info | | Modbu | us Regist | er Numl | per | |
|----------------------------------|--------|-------------|------------|--------|---------|-----------|---------|-------|-------|
| - | | | | | | | | | |
| | Data | Number | Туре | Device | | Slave | Slave | Slave | Slave |
| | Туре | | | Mode | Slave 1 | 2 | 3 | 4 | 5 |
| PV value | Float | 2 | Input | 1302 | 1302 | 1312 | 1322 | 1332 | 1342 |
| SV value | Float | 2 | Input | 1304 | 1304 | 1314 | 1324 | 1334 | 1344 |
| TV value | Float | 2 | Input | 1306 | 1306 | 1316 | 1326 | 1336 | 1346 |
| QV value | Float | 2 | Input | 1308 | 1308 | 1318 | 1328 | 1338 | 1348 |
| PV units code | UINT8 | 1 | Input | 104 | 104 | 124 | 144 | 164 | 184 |
| SV units code | UINT8 | 1 | Input | 108 | 108 | 128 | 148 | 168 | 188 |
| TV units code | UINT8 | 1 | Input | 112 | 112 | 132 | 152 | 172 | 192 |
| QV units code | UINT8 | 1 | Input | 116 | 116 | 136 | 156 | 176 | 196 |
| | | | | | | | | | |
| | | | lue as set | 1101- | 1101- | 1111- | 1121- | 1131- | 1141- |
| Command 48 status bytes | UINT8 | 4 | Input | 1104 | 1104 | 1114 | 1124 | 1134 | 1144 |
| | | | | | | | | | |
| Serial Number | UINT8 | 6 | Input | 2100 | 2100 | 2200 | 2300 | 2400 | 2500 |
| Software version | UINT8 | 4 | Input | 2112 | 2112 | 2212 | 2312 | 2412 | 2512 |
| Reserved/Unused | | | | | | | | | |
| Blocking Distance | Float | 2 | Holding | 3100 | 3100 | 3200 | 3300 | 3400 | 3500 |
| Level Unit <u>code</u> | UINT8 | 1 | Input | 2140 | 2140 | 2240 | 2340 | 2440 | 2540 |
| Level Offset | Float | 2 | Holding | 3102 | 3102 | 3202 | 3302 | 3402 | 3502 |
| Level Unit code | UINT8 | 1 | Input | 2141 | 2141 | 2241 | 2341 | 2441 | 2541 |
| Reserved/Unused | | | | | | | | | |
| User Password | UINT16 | 1 | Holding | 3120 | 3120 | 3220 | 3320 | 3420 | 3520 |
| Reserved/Unused | | | | | | | | | |
| Device variable assigned to | | | | | | | | | |
| <u>SV</u> | UINT8 | 1 | Holding | 3130 | 3130 | 3230 | 3330 | 3430 | 3530 |
| Sensitivity | UINT8 | 1 | Holding | 3131 | 3131 | 3231 | 3331 | 3431 | 3531 |
| Negative Threshold <u>code</u> | UINT8 | 1 | Holding | 3132 | 3132 | 3232 | 3332 | 3432 | 3532 |
| Negative Threshold | | | | | | | | | |
| Amplitude | UINT8 | 1 | Holding | 3133 | 3133 | 3233 | 3333 | 3433 | 3533 |
| Interface Lvl Thresh <u>code</u> | UINT8 | 1 | Holding | 3134 | 3134 | 3234 | 3334 | 3434 | 3534 |
| Interface Lvl Thresh | | | | | | | | | |
| Amplitude | UINT8 | 1 | Holding | 3135 | 3135 | 3235 | 3335 | 3435 | 3535 |

K. Model R82 R2 Modbus Registers

| | Mod | bus Registe | er Info | | Mod | ous Regi | ster Nur | nber | |
|------------------------------|--------|-------------|---------|---------------|---------------|---------------|---------------|-------------------|---------------|
| | | | | | | Н | MA Mo | de | |
| | Data | | | Device | Slave | Slave | Slave | Slave | Slave |
| HART parameter | Туре | Number | Туре | Mode | 1 | 2 | 3 | 4 | 5 |
| PV value | | | | 1302 | 1302 | 1312 | 1322 | 1332 | 1342 |
| SV value | Float | 2 | Input | 1304 | 1304 | 1314 | 1324 | 1334 | 1344 |
| TV value | Float | 2 | Input | 1306 | 1306 | 1316 | 1326 | 1336 | 1346 |
| QV value | Float | 2 | Input | 1308 | 1308 | 1318 | 1328 | 1338 | 1348 |
| | | | | | | _ | | | _ |
| PV units code | UINT8 | 1 | Input | 104 | 104 | 124 | 144 | 164 | 184 |
| SV units code | UINT8 | 1 | Input | 108 | 108 | 128 | 148 | 168 | 188 |
| TV units code | UINT8 | 1 | Input | 112 | 112 | 132 | 152 | 172 | 192 |
| QV units code | UINT8 | 1 | Input | 116 | 116 | 136 | 156 | 176 | 196 |
| Command 48 status bytes | UINT8 | 2 | Input | 1101- 1102 | 1101- 1102 | 1111- 1112 | 1121- 1122 | 1131 - 1132 | 1141- 1142 |
| Serial Number | UINT8 | 6 | Input | 2100 | 2100 | 2200 | 2300 | 2400 | 2500 |
| Software version | UINT8 | 6 | Input | 2112 | 2112 | 2212 | 2312 | 2412 | 2512 |
| Reserved/Unused | | | 1 | | | | | | |
| Blocking Distance | Float | 2 | Holding | 3100 | 3100 | 3200 | 3300 | 3400 | 3500 |
| Level Unit <u>code</u> | UINT8 | 1 | Input | 2140 | 2140 | 2240 | 2340 | 2440 | 2540 |
| Level Offset | Float | 2 | Holding | 3102 | 3102 | 3202 | 3302 | 3402 | 3502 |
| Level Unit code | UINT8 | 1 | Input | 2141 | 2141 | 2241 | 2341 | 2441 | 2541 |
| Reference Distance | Float | 2 | Holding | 3104 | 3104 | 3204 | 3304 | 3404 | 3504 |
| Level Unit code | UINT8 | 1 | Input | 2142 | 2142 | 2242 | 2342 | 2442 | 2542 |
| Reserved/Unused | | | | | | | | | |
| Password | UINT16 | 1 | Holding | 3120 | 3120 | 3220 | 3320 | 3420 | 3520 |
| TVG Min | UINT16 | 1 | Holding | 3122 | 3122 | 3230 | 3330 | 3430 | 3530 |
| Reserved/Unused | | | | | | | | | |
| Device variable assigned | | | | | | | | | |
| to <u>SV</u> | UINT8 | 1 | Holding | 3130 | 3130 | 3230 | 3330 | 3430 | 3530 |
| Dielectric Range <u>code</u> | UINT8 | 1 | Holding | 3131 | 3131 | 3231 | 3331 | 3431 | 3531 |
| Turbulence <u>code</u> | UINT8 | 1 | Holding | 3132 | 3132 | 3232 | 3332 | 3432 | 3532 |
| Rate of Change <u>code</u> | UINT8 | 1 | Holding | 3133 | 3133 | 3233 | 3333 | 3433 | 3533 |
| Foam <u>code</u> | UINT8 | 1 | Holding | 3134 | 3134 | 3234 | 3334 | 3434 | 3534 |

L. Model RX5 Modbus Registers

| | Mod | bus Regist | er Info | | Modb | us Regi | ster Nu | nber | |
|------------------------------|--------|------------|---------|--------|-------|---------|---------|-------|-------|
| | | | | | | Н | MA Mo | de | |
| | Data | | | Device | Slave | Slave | Slave | Slave | Slave |
| HART parameter | Туре | Number | Туре | Mode | 1 | 2 | 3 | 4 | 5 |
| PV value | | | | 1302 | 1302 | 1312 | 1322 | 1332 | 1342 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| PV units code | UINT8 | 1 | Input | 104 | 104 | 124 | 144 | 164 | 184 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| Command 48 status bytes | UINT8 | 1 | Input | 1101 | 1101 | 1111 | 1121 | 1131 | 1141 |
| | | | | | | | | | |
| Serial Number | UINT8 | 6 | Input | 2100 | 2100 | 2200 | 2300 | 2400 | 2500 |
| Software version | UINT8 | 6 | Input | 2112 | 2112 | 2212 | 2312 | 2412 | 2512 |
| Reserved/Unused | | | | | | | | | |
| Blocking Distance | Float | 2 | Holding | 3100 | 3100 | 3200 | 3300 | 3400 | 3500 |
| Level Unit <u>code</u> | UINT8 | 1 | Input | 2140 | 2140 | 2240 | 2340 | 2440 | 2540 |
| Level Offset | Float | 2 | Holding | 3102 | 3102 | 3202 | 3302 | 3402 | 3502 |
| Level Unit code | UINT8 | 1 | Input | 2141 | 2141 | 2241 | 2341 | 2441 | 2541 |
| Distance | Float | 2 | Input | 2150 | 2150 | 2250 | 2350 | 2450 | 2550 |
| Echo Strength | Float | 2 | Input | 2153 | 2153 | 2253 | 2353 | 2453 | 2553 |
| Reserved/Unused | | | | | | | | | |
| Password | UINT16 | 1 | Holding | 3120 | 3120 | 3220 | 3320 | 3420 | 3520 |
| Reserved/Unused | | | | | | | | | |
| Dielectric Range <u>code</u> | UINT8 | 1 | Holding | 3130 | 3130 | 3230 | 3330 | 3430 | 3530 |
| Turbulence <u>code</u> | UINT8 | 1 | Holding | 3131 | 3131 | 3231 | 3331 | 3431 | 3531 |
| Rate of Change code | UINT8 | 1 | Holding | 3132 | 3132 | 3232 | 3332 | 3432 | 3532 |
| Foam <u>code</u> | UINT8 | 1 | Holding | 3133 | 3133 | 3233 | 3333 | 3433 | 3533 |

M. Model 355 Modbus Registers

| | Mod | bus Registe | er Info | | Modk | ous Regi | ster Nur | nber | |
|--------------------------|--------|-------------|---------|--------|-------|----------|----------|-------|-------|
| | | | | | | Н | MA Mo | de | |
| | Data | | | Device | Slave | Slave | Slave | Slave | Slave |
| HART parameter | Туре | Number | Туре | Mode | 1 | 2 | 3 | 4 | 5 |
| PV value | Float | 2 | Input | 1302 | 1302 | 1312 | 1322 | 1332 | 1342 |
| SV value | Float | 2 | Input | 1304 | 1304 | 1314 | 1324 | 1334 | 1344 |
| TV value | Float | 2 | Input | 1306 | 1306 | 1316 | 1326 | 1336 | 1346 |
| QV value | Float | 2 | Input | 1308 | 1308 | 1318 | 1328 | 1338 | 1348 |
| | | | | | | | | | |
| PV units code | UINT8 | 1 | Input | 104 | 104 | 124 | 144 | 164 | 184 |
| SV units code | UINT8 | 1 | Input | 108 | 108 | 128 | 148 | 168 | 188 |
| TV units code | UINT8 | 1 | Input | 112 | 112 | 132 | 152 | 172 | 192 |
| QV units code | UINT8 | 1 | Input | 116 | 116 | 136 | 156 | 176 | 196 |
| | | | | | | | | | |
| Command 48 status | UINT8 | 2 | Input | 1101- | 1101- | 1111- | 1121- | 1131- | 1141- |
| bytes | UNITO | 2 | input | 1102 | 1102 | 1112 | 1122 | 1132 | 1142 |
| | | | | | | | | | |
| Serial Number | UINT8 | 6 | Input | 2100 | 2100 | 2200 | 2300 | 2400 | 2500 |
| Software version | UINT8 | 6 | Input | 2112 | 2112 | 2212 | 2312 | 2412 | 2512 |
| Reserved/Unused | | | | | | | | | |
| Blocking Distance | Float | 2 | Holding | 3100 | 3100 | 3200 | 3300 | 3400 | 3500 |
| Level Unit <u>code</u> | UINT8 | 1 | Input | 2140 | 2140 | 2240 | 2340 | 2440 | 2540 |
| Level Offset | Float | 2 | Holding | 3102 | 3102 | 3202 | 3302 | 3402 | 3502 |
| Level Unit code | UINT8 | 1 | Input | 2141 | 2141 | 2241 | 2341 | 2441 | 2541 |
| Range | Float | 2 | Holding | 3104 | 3104 | 3204 | 3304 | 3404 | 3504 |
| Level Unit code | UINT8 | 1 | Input | 2142 | 2142 | 2242 | 2342 | 2442 | 2542 |
| Damping Value | Float | 2 | Holding | 3106 | 3106 | 3206 | 3306 | 3406 | 3506 |
| Reference Distance | Float | 2 | Holding | 3108 | 3108 | 3208 | 3308 | 3408 | 3508 |
| Level Unit code | UINT8 | 1 | Input | 2144 | 2144 | 2244 | 2344 | 2444 | 2544 |
| Reserved/Unused | | | | | | | | | |
| Password | UINT16 | 1 | Holding | 3120 | 3120 | 3220 | 3320 | 3420 | 3520 |
| Reserved/Unused | | | | | | | | | |
| Device variable assigned | | | | | | | | | |
| to <u>SV</u> | UINT8 | 1 | Holding | 3130 | 3130 | 3230 | 3330 | 3430 | 3530 |
| Peak Threshold | UINT8 | 1 | Holding | 3131 | 3131 | 3231 | 3331 | 3431 | 3531 |
| TVG | UINT8 | 1 | Holding | 3132 | 3132 | 3232 | 3332 | 3432 | 3532 |
| Reserved/Unused | | | | | | | | | |
| Echo Strength | UINT8 | 1 | Input | 2160 | 2160 | 2260 | 2360 | 2460 | 2560 |

N. Enhanced Jupiter Modbus Registers

| | Mod | bus Registe | er Info | | Modk | ous Regi | ster nur | nber | |
|--|--------|-------------|---------|------|-------|----------|----------|-------|-------|
| | | | | | | | | | |
| | Data | | | | Slave | Slave | Slave | Slave | Slave |
| HART parameter | type | Number | Туре | | 1 | 2 | 3 | 4 | 5 |
| PV value | Float | 2 | Input | 1302 | 1302 | 1312 | 1322 | 1332 | 1342 |
| SV value | Float | 2 | Input | 1304 | 1304 | 1314 | 1324 | 1334 | 1344 |
| | | | | | | | | | |
| PV units code | UINT8 | 1 | Input | 104 | 104 | 124 | 144 | 164 | 184 |
| SV units code | UINT8 | 1 | Input | 108 | 108 | 128 | 148 | 168 | 188 |
| | | | | | | | | | |
| Command 48 status bytes | UINT8 | 1 | Input | 1101 | 1101 | 1111- | 1121 | 1131- | 1141 |
| Serial Number | UINT8 | 6 | loout | 2100 | 2100 | 2200 | 2300 | 2400 | 2500 |
| Software version | UINT8 | | Input | | | | | 2400 | |
| Reserved/Unused | UINTO | 4 | Input | 2112 | 2112 | 2212 | 2312 | 2412 | 2512 |
| Trim Level | Float | 2 | Holding | 3100 | 3100 | 3200 | 3300 | 3400 | 3500 |
| Level Unit code | UINT8 | 1 | Input | 2140 | 2140 | 2240 | 2340 | 2440 | 2540 |
| Trim Ifc Level | Float | 2 | Holding | 3102 | 3102 | 3202 | 3302 | 3402 | 3502 |
| Level Unit code | UINT8 | 1 | Input | 2141 | 2141 | 2241 | 2341 | 2441 | 2541 |
| Reserved/Unused | | ± | Πρατ | 6141 | 2141 | 2271 | 2341 | 2791 | 2341 |
| Password | UINT16 | 1 | Holding | 3120 | 3120 | 3220 | 3320 | 3420 | 3520 |
| Reserved/Unused | 510 | - | | 0120 | 5120 | 5225 | 3323 | 5.25 | 3323 |
| Device variable assigned to <u>SV</u> | UINT8 | 1 | Holding | 3130 | 3130 | 3230 | 3330 | 3430 | 3530 |

O. E3 Modulevel Modbus Registers

| | Mod | bus Registe | er Info | | Mode | ous Regi | ster nur | nber | |
|-------------------------|--------|-------------|---------|---------------|---------------|---------------|---------------|---------------|---------------|
| | | | | | | н | MA Mo | de | |
| | Data | | | Device | Slave | Slave | Slave | Slave | Slave |
| HART parameter | type | Number | Туре | Mode | 1 | 2 | 3 | 4 | 5 |
| PV value | Float | 2 | Input | 1302 | 1302 | 1312 | 1322 | 1332 | 1342 |
| | | | | | | | | | |
| PV units code | UINT8 | 1 | Input | 104 | 104 | 124 | 144 | 164 | 184 |
| | | | | | | | | | |
| Command 48 status bytes | UINT8 | 4 | Input | 1101- 1104 | 1101- 1104 | 1111- 1114 | 1121- 1124 | 1131- 1134 | 1141- 1144 |
| | | | | | | | | | |
| Serial Number | UINT8 | 6 | Input | 2100 | 2100 | 2200 | 2300 | 2400 | 2500 |
| Software version | UINT8 | 4 | Input | 2112 | 2112 | 2212 | 2312 | 2412 | 2512 |
| Reserved/Unused | | | | | | | | | |
| Trim Level | Float | 2 | Holding | 3100 | 3100 | 3200 | 3300 | 3400 | 3500 |
| Level Unit <u>Code</u> | UINT16 | 1 | Input | 2140 | 2140 | 2240 | 2340 | 2440 | 2540 |
| Process SG | Float | 2 | Holding | 3102 | 3102 | 3202 | 3302 | 3402 | 3502 |
| Trim SG | Float | 2 | Holding | 3104 | 3104 | 3204 | 3304 | 3404 | 3504 |
| Reserved/Unused | | | | | | | | | |
| Password | UINT16 | 1 | Holding | 3120 | 3120 | 3220 | 3320 | 3420 | 3520 |
| Operating Temperature | UINT16 | 1 | Holding | 3122 | 3122 | 3222 | 3322 | 3422 | 3522 |
| Temperature units code | UINT8 | 1 | Input | 2160 | 2160 | 2260 | 2360 | 2460 | 2560 |

| Error Code | Model 705 3x R2 | Model R82 | Model 355 | Enhanced Jupiter | E3 Madulevel | Model RX5 |
|--------------|---------------------|------------------|---------------------|------------------|--------------------|-------------------|
| 1 | Software Fault | Dflt Parm Fact | Dflt Parm Sys | Snsr Brd Failed | Fault | Default Params |
| 2 | ADC Failure | Dflt Parm Sys | Dflt Parm Adv | No Signal | Fault 2 | No Fiducial |
| 8 | EEPROM Error | Dflt Parm Adv | Dflt Parm I/O | Float 1 Fail | Secondary Fault Lo | Echo Lost |
| 4 | Default Params | Dflt Parm I/O | Dflt Parm Fact | Default Params | Default Params | Safety Zone Alarm |
| 5 | No Ramp | Dflt Parm HART | Dflt Parm HART | Loop Failure | Loop Failure | CPU Failure |
| 9 | Loop Fail | Dflt Strap Tbl | Dflt Strap Tbl | Float 2 Fail | Secondary Fault Hi | EE Read Failure |
| L | Fid Shift | Dflt Parm Total | Dflt Parm Total | Fault 2 | Primary Fault | EE Write Failure |
| 8 | Ramp Slope | Cnfg Conflict | Cnfg Conflict | Fault1 | Core Drop | Software Erro |
| 6 | Lvl Below Probe End | RF Brd Failure | Hardware Failure | | | |
| 10 | No Probe | Loop Failure | Fa | | | |
| ττ | No Fiducial | Fault 2 | Temperature Failure | | | |
| 12 | Safety Zone Alarm | Safe Zone Alrm | Blocking Distance | | | |
| 13 | No Signal | Echo Lost | Hi Volume Alrm | | | |
| 14 | EoP < Probe End | High Flow Alrm | High Flow Alrm | | | |
| 15 | EoP > Probe End | Hi Volume Alrm | Safe Zone Alarm | | | |
| 16 | High Vol Alarm | Fault 1 | Echo Lost | | | |
| Warning Code | | | | | | |
| 1 | Warning 1 | Initializing | Warning 1 | Warning 2 | Warning 1 | Factory Cal Req'd |
| 2 | Seal Leak | Warning 4 | Low VDC at 20 mA | Warning 1 | Cal Span Warning | Fiducial Unclear |
| 3 | Fid Spread | LowVDC@20mA | Noise | Hi Temperature | Calib Req'd | Corrupt Targ Rej |
| 4 | Warning 2 | Warning 3 | High Elec Temp | Low Temperature | Hi Temperature | No False Targ Rej |
| 5 | High Elec Temp | No Echo Rej | Low Elec Temp | System Warning | Lo Temperature | Button Failure |
| 9 | Low Elec Temp | Echo Rej Crpt | Echo Rej Crpt | Trim Req'd | Trim Req'd | Warning 04 |
| 7 | Cal Req'd | Echo Rej Invl | Echo Rej Invl | Initializing | Initilaizing | Warning 02 |
| 8 | EoP Low | Echo Rej Disable | Initializing | Calib Req'd | Warning 2 | Warning 01 |
| 6 | Trim Req'd | Echo Rej Insf | System Code | | | |
| 10 | No Target | Warning 2 | | | | |
| 11 | Warning 4 | High Elec Temp | | | | |
| 12 | Initializing | Low Elec Temp | | | | |
| 13 | May Be Flooded | Rate Of Change | | | | |
| 14 | Dry Probe | Warning 1 | | | | |
| 15 | Weak Signal | System Code | | | | |
| 16 | System Warning | | | | | |

P. LevelMaster Error and Warning Codes

| Error Code | Model 706 | Model JM4 |
|------------|-----------------------|----------------------|
| 1 | Software Error | SW Error (Main) |
| 2 | RAM Error | RAM Error (Main) |
| 3 | ADC Failure | ADC Error (Main) |
| 4 | EEPROM Error | EEPROM Error |
| 5 | Analog Board Error | CoP in Flash Mode |
| 6 | Analog Output Error | SW Conflict (CoP) |
| 7 | Spare 1 | Spare 1 |
| 8 | Default Parameters | Analog Board Error |
| 9 | No Probe | SW Error (CoP) |
| 10 | No Fiducial | RAM Error (CoP) |
| 11 | No Echoes | ADC Error (CoP) |
| 12 | Upper Echo Lost | Spare 2 |
| 13 | Spare 2 | Analog Ouput Error |
| 14 | EoP > Probe End | No Probe |
| 15 | Level Below Probe End | Probe Memory Error |
| 16 | EoP Below Probe End | Probe Info Corrupt |
| 17 | Safety Zone Alarm | Spare 3 |
| 18 | Config Conflict | New Probe |
| 19 | Hi Volume Alarm | Default Parameters |
| 20 | Hi Flow Alarm | No Float Detected |
| 21 | Spare 3 | Spare 4 |
| 22 | Initializing | Config Conflict |
| 23 | Analog Output Fixed | Hi Volume Alarm |
| 24 | Config Changed | Spare 5 |
| 25 | Spare 4 | Extra Float Detected |
| 26 | Spare 5 | 2nd Float Missing |
| 27 | Spare 6 | Initializing |
| 28 | Ramp Interval Error | Config Changed |
| 29 | Hi Elec Temp | Spare 6 |
| 30 | Lo Elec Temp | Xmtr Calib Req'd |
| 31 | Calib Req'd | Spare 7 |
| 32 | Echo Rej Invalid | Temp Calib Req'd |
| 33 | Spare 7 | Hi Elec Temp |
| 34 | Inferred Level | Lo Elec Temp |
| 35 | Adj Analog Output | Spare 8 |
| 36 | Totalizer Data Lost | Spare 9 |
| 37 | No Probe Target | Adj Analog Output |
| 38 | Low Supply Voltage | Low Supply Voltage |
| 39 | Dry Probe | Spare 10 |
| 40 | Spare 8 | Lo Echo Strength |
| 41 | Lo Echo Strength | Lo Ifc Echo Strength |
| 42 | Lo Ifc Echo Strength | Hi Noise / LvlThresh |
| 43 | Spare 9 | Hi Noise / IfcThresh |
| 44 | Spare 10 | Spare 10 |
| 45 | Sequence Record | Sequence Record |

Q. Level Unit Codes

| Code | 44 | 45 | 47 | 48 | 49 |
|------|------|--------|--------|-------------|-------------|
| Unit | feet | meters | inches | centimeters | millimeters |

R. Parameter Codes

| SV Code | Model 706 | Model JM4 | Model 705 3x R2 | Model R82 R2 | Model 355 | E3 Modulevel |
|---------|----------------------|----------------------|--------------------|---------------|--------------|--------------|
| 0 | Level | Level | Level | Level | Level | Level |
| 1 | Ifc Level | Ifc Level | Volume | Volume | Flow | Ifc Level |
| 2 | Ifc Thickness | Ifc Thickness | Ifc Level | Distance | Volume | Density |
| 3 | Volume | Volume | Ifc Volume | Echo Strength | Head | |
| 4 | Flow | Fill Rate | | Flow | Distance | |
| 5 | Distance | Distance | | Head | Totalizer R | |
| 6 | Echo Strength | Echo Strength | | Totalizer R | Totalizer NR | |
| 7 | Head | Elec Temp | | Totalizer NR | Process Temp | |
| 8 | Totalizer R | Ifc Echo Strength | | | Custom Unit | |
| 9 | Totalizer NR | | | | | |
| 10 | Elec Temp | | | | | |
| 11 | Ifc Echo Strength | | | | | |
| 12 | Probe Buildup | | | | | |

| SV Code | Enhanced Jupiter | | | |
|---------|---------------------|--|--|--|
| 0 | Level | | | |
| 1 | Ifc Level | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |

| Threshold | Model 706 | Model JM4 | Model 705 3x | | |
|-----------|--------------|--------------|--------------|--|--|
| Code | Wodel 706 | WOdel Jivi4 | R2 | | |
| 0 | Auto Largest | Auto Largest | Fixed | | |
| 1 | Fixed | Fixed | CFD | | |
| 2 | Auto Upper | Sloped | | | |
| 3 | Sloped | | | | |

| Dielectric Range Code | Model R82 R2 | Model RX5 | | |
|-----------------------------|--------------|-----------|--|--|
| 0 | 1.7 - 3 | 1.7 - 3 | | |
| 1 | 3 - 10 | 3 - 10 | | |
| 2 | 10 - 100 | 10 - 100 | | |

| Turbulence Code | Model R82 R2 | Model RX5 | | |
|--------------------|--------------|-----------|--|--|
| 0 | None | None | | |
| 1 | Light | Light | | |
| 2 | Medium | Medium | | |
| 3 | Heavy | Heavy | | |

| Rate of Change Code | Model R82 R2 | Model RX5 | | |
|---------------------------|----------------|----------------|--|--|
| 0 | < 5 in/min | < 5 in/min | | |
| 1 | 5 - 20 in/min | 5 - 20 in/min | | |
| 2 | 20 - 60 in/min | 20 - 60 in/min | | |
| 3 | >60 in/min | >60 in/min | | |

| Foam Code | Model R82 R2 | Model RX5 | | |
|-----------|--------------|-----------|--|--|
| 0 | None | None | | |
| 1 | Light | Light | | |
| 2 | Medium | Medium | | |
| 3 | Heavy | Heavy | | |

About Modbus

Our Mission

The Modbus Organization is a group of independent users and suppliers of automation devices that seeks to drive the adoption of the Modbus communication protocol suite and the evolution to address architectures for distributed automation systems across multiple market segments. The Modbus Organization will also provide the infrastructure to obtain and share information about the protocols, their application and certification to simplify implementation by users resulting in reduced costs.

Organization

The Modbus Organization is a membership-based trade association, incorporated as "Modbus Organization, Inc." under the laws of the Commonwealth of Massachusetts, USA and recognized by the U.S. Internal Revenue Service as a nonprofit organization under Internal Revenue Code 501(c)(6). Donations to the organization are not deductible as charitable contributions but may be deductible as a business expense. The Modbus Organization's annual IRS Form 990 is available upon request via our contact page, providing the complete name, address, and e-mail address of the requesting organization or individual.



Our Member Logo

Our membership logo symbolizes a round table, meaning that we invite all our members to participate in the technical and educational activities of our organization. Suppliers large and small, system integrators, end users, open source developers, educators and other interested parties are all invited to join in the discussions that will take the Modbus protocol into the future.

Our Activities

The Modbus Organization engages in a broad range of activities relating to the maintenance and proliferation of the Modbus protocol. Some of these activities include:

- Participation in standards activities worldwide.
- Leading the evolution of the Modbus protocol and its variants.
- Encouraging and assisting the use of Modbus across a broad spectrum of physical layers and transmission media.
- Maintaining and evolving a conformance testing program to insure greater interoperability of Modbus devices.
- Providing information to users and supplers alike to help them be successful in their use of Modbus.
- Engaging in educational and promotional efforts including trade shows, newsletters, this website, and other outreach activities.

Our Invitation

Our invitation is to you, as a Modbus user or supplier, to join in our activities, share in the benefits of Modbus Organization membership, and help us bring Modbus into the future. We are committed to maintaining Modbus as the world's leading protocol for industrial automation, and invite you to take your place at our roundtable.

For more information about Modbus Organization membership, please see our Membership Flyer and Membership Application. Refer to our contact page (http://modbus.org/contact.php) for ways to get in touch we'd be glad to hear from you!



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