

HART® to Modbus® Adaptor

Eirmware Version 1.7



Eclipse[®] Model 706 Guided Wave Radar Level Transmitter

Jupiter[®] Model JM4 Magnetostrictive Level Transmitter

Pulsar® Model R96 Pulse Burst Radar Level Transmitter









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INTRODUCTION

This document is intended to provide a guide for utilizing the various features of the Magnetrol HART to Modbus Adaptor (HMA). 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 HMAs. 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 that allows for reading and writing Modbus registers to a slave device can be used.

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>

A unique feature of the HMA is that it 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 attached devices do not have to all the same type transmitter.
- The HMA provides power for all attached HART units.
- The attached units should be set to a fixed 4 mA loop current.

Communication

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

To ensure a standard method to communicate with the HMA, setting DIP switch positions 1 - 3 to OFF, and 4 to ON, (see Appendix A) will configure the HMA to communicate via Modbus RTU with the default communications settings shown in Appendix F.

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

Operating Modes

Modbus RTU and Modbus ASCII

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

- <u>HMA with a single transmitter (HMA mode)</u> The Modbus host addresses the HMA directly, using the address of the HMA. The registers in the HMA for the attached device follow the numbers listed for Slave 1 in the device register appendices L through S. In this mode, the allowable Modbus addresses are in the range of 1 through 247. This is the default configuration for the HMA.
- <u>HMA with multiple transmitters and one Modbus address (HMA mode)</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 as listed in Appendices L through S. The HMA will appear to be a Modbus device capable of providing multiple level measurements. In this mode, the allowable Modbus addresses are in the range of 1 through 247.
- 3. <u>HMA with multiple transmitters and multiple Modbus addresses (Device mode)</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 HART devices will appear to be native Modbus devices to the Modbus host. The registers for each attached device type are the same regardless of the poll address. The registers in the HMA for each attached device follow the numbers listed for Slave 1 in the device register appendices L through S. In this mode, the allowable Modbus/HART addresses are limited to the range of 1 through 62.
- 4. <u>Single Modbus 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. Changing the HART poll address of the attached transmitter will automatically change the Modbus poll address of the HMA to match. Essentially, they appear to a Modbus master as a single native Modbus device. The registers in the HMA for the attached device follow the numbers listed for Slave 1 in the device register appendices L through S. In this mode, the allowable Modbus/HART addresses are limited to the range of 1 through 62.

LevelMaster

When using the <u>LevelMaster</u> protocol, 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. In this mode, the allowable Modbus/HART addresses are limited to the range of 1 through 62.

Supported Device Parameters

Not all of the parameters for a particular Magnetrol HART transmitter are supported by the HMA using Modbus communication. For each device type, the parameters that are available have been chosen to represent the most commonly for optimization and troubleshooting. The available parameters are listed in Appendices L through S.

Full Device Configuration

Using a HART DD or DTM, the full range of HART transmitter parameters can be accessed to configure an attached HART device. There are three ways to connect a HART host to the transmitter enclosed with the HMA. In each case, the HART Poll Address of the attached device must be used for communication rather than the Modbus poll address of the connected HMA.

- A HART modem can be connected directly to the HART terminal block on the HMA. The HMA will always act as a primary master on the HART loop. Therefore, if connecting another HART host to the terminal HART block, that additional host must either be capable of automatically setting itself to be a secondary master, or be manually configured as a secondary master. Note that the HART terminal block has a built-in 250-ohm resistor to facilitate HART communication. See the section on using a DTM with the HMA.
- 2. The HMA is capable of passing <u>HART commands using the RS-485 connection</u> to the attached devices.
- 3. A <u>TTL-232R-3V3-AJ</u> USB to TTL cable or equivalent can be connected between the computer running the DD host or DTM frame (such as PACTware) and the audio jack on the electronics module of the transmitter located underneath the LCD display. The HART host can be set as either a primary or secondary master. This feature is available on the Model 706 Guided Wave Radar, Model JM4 Magnetostrictive, and Model R96 Radar devices.

QUICK START PROCEDURE

The following procedure demonstrates basic steps for configuring a Magnetrol transmitter containing a HART to Modbus Adaptor (HMA) for use with a Modbus system. The example given is for an installation where a single HART transmitter is attached to the HMA.

More complete instructions are provided in the <u>SETUP PROCEDURES</u> section as well as other configurations and communication protocols.

- 1. Connect an RS-485 communications cable to the RS-485 terminal block of the HMA:
 - 1.1. Receive/Transmit Data lead (+, A) connected to the positive terminal
 - 1.2. Receive/Transmit Data lead (–, B) connected to the negative terminal.
 - 1.3. Connect a 120 Ω resistor between the two RS-485 terminal block positions.
 - 1.4. Connect the other end of the cable to a PC which has a Modbus host application installed.
- 2. Ensure that the DIP switches on the HMA are set as follows:
 - 2.1. 1 == OFF (Default Config Mode)
 - 2.2. 2 == OFF
 - 2.3. 3 == OFF
 - 2.4. 4 == ON.

See <u>Appendix A</u> for the location of the DIP switch, and <u>Appendix B</u> for a legend of the four switch positions.

- 3. Connect the device containing the HMA to a power supply via the power terminal block.
- 4. Apply power to the HMA.
- 5. Set the Modbus host application to communicate via the default Modbus RTU communication settings shown in <u>Appendix F</u>.
- 6. Set registers 3000 through 3006 to the desired communication settings for use with the host system. Register 3001 (Slave address) should be set to the Modbus address desired for communicating with the HMA.
- 7. Ensure that register 3007 (HMA Mode) is set to 0.
- 8. Change register 3012 to a value of 0. This will cause the HMA to scan the attached HART device at initial start-up, and record the poll address and other information for the device.
- 9. If RS-232 communication is to be used, set DIP switch 3 to ON, and DIP switch 4 to OFF.
- 10. Change DIP switch 1 to ON. The HMA will automatically reboot, scan for the attached device, and configure itself for the communication protocol and Modbus address selected in step 6.
- 11. By viewing the appropriate registers, verify that the desired transmitter measured values are being actively read by the Modbus host.
- 12. The device is ready to use.

SETUP PROCEDURES

1. Configuring communications settings in the HMA

1.1. Purpose

This 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, no parity, and 1 stop bit. When in the default configuration, the user-selectable communication settings can be adjusted. When the user communication 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 | <u>FDTIchip</u> | 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 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.
- 1.4.2 Open the Modbus Poll application.

1.4.3 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 |
| 9600 Baud 🔻 | 💿 RTU ₍ Ascii |
| 8 Data bits 🔹 | Response Timeout 5000 [ms] |
| None Parity ▼ 1 Stop Bit ▼ | Delay Between Polls 100 [ms] |
| Remote Server IP Address Port Conner 127.0.0.1 | ct Timeout [ms] |

1.4.4 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 | x | | |
|------------------------------|------------------------------|-------------------|---------------------|
| Slave ID: 247 | ОК | Feel 141 - 111 | |
| Function: 03 Read Holding Re | egisters (4x) 🔻 🛛 Cancel | Tx = 282: Err = 0 | : ID = 247: F = 03: |
| Address: 3000 Protoco | ol address. E.g. 40011 -> 10 | | |
| Quantity: 8 | | Alias | 03000 |
| Scan Rate: 1000 [ms] | Apply | 0 | 0 |
| Disable | | 1 | 247 |
| 🔲 Read/Write Disabled | | 2 | 1 |
| Disable on error | Read/Write Once | 3 | 8 |
| View | | 4 | 1 |
| Rows | | 5 | 2 |
| ● 10 ◎ 20 ◎ 50 ◎ |) 100 🔘 Fit to Quantity | 6 | 3 |
| Display: | 🔲 Hide Alias Columns | 7 | 0 |
| Unsigned 👻 | 🗖 Address in Cell | 8 | |
| | PLC Addresses (Base 1) | 9 | |
| | | | |

- 1.4.5 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.
- 1.4.6 Change DIP switch 1 to ON. This sets the device to run in the selected communications mode.
- 1.4.7 If communication at the new settings is not achieved, change DIP switch 1 to OFF. 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 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 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.
- 2.4.2 Open the Modbus Poll application.

2.4.3 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 Settings | Cancel |
| USB Serial Port (COM3) | Mode |
| 9600 Baud 🔻 | RTU O ASCII |
| 8 Data bits 🔻 | Response Timeout |
| None Parity 🔻 | Dolau Potucon Pollo |
| 1 Stop Bit ▼ | 100 [ms] |
| Remote ServerIP AddressPortConnect127.0.0.15023000 | t Timeout [ms] |

2.4.4 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 L through S, 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.

In general, the Address should be set to the number of the first register to be accessed. (Address numbers are listed in the Modbus Register Number columns in the appendices.) The Quantity should be set to the sum of the individual sizes of sequential registers to be accessed. In the below example, four registers are to be read and since each have a size of 2 (listed in the Number column in the appendices).

| Read/Write Definition | |
|--|--|
| Read/Write Definition Slave ID: Function: 04 Read Input Registers (3x) Function: 04 Read Input Registers (3x) Cancel Address: 1302 Protocol address. E.g. 30011 -> 10 Quantity: 8 Scan Rate: 1000 [ms] Apply Disable Read/Write Disabled Disable on error View Rows 10 9 10 9 10 9 10 9 10 9 10 9 10 9 10 9 10 9 10 9 10 < | Slave 1 PV - QV.mbp Image: Constraint of the system Tx = 17: Err = 0: ID = 1: F = 04: SR Alias 01302 1302 0 1303 1304 23.5039 1305 1306 0 1307 |
| Display: Float AB CD PLC Addresses (Base 1) | 1308 81.32 1309 |
| | |

2.4.5 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 L through S, 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 | Decl a st | | | |
| Function: 03 Read Holding Re | gisters (4x) 🔻 Cancel | Tx = 282 | 111 2: Err = 0: ID | = 247: F = 03: | 233 |
| Address: 3000 Protoco | ıl address. E.g. 40011 -> 10 | | | | |
| Quantity: 8 | | | Alias | 03000 | |
| Scan Bate: 1000 [ms] | Apply | 0 | | o | |
| Disable | | 1 | | 247 | |
| Read/Write Disabled | | 2 | | 1 | |
| Disable on error | Read/Write Once | 3 | | 8 | |
| View | | 4 | | 1 | |
| Rows | | 5 | | 2 | |
| ● 10 ○ 20 ○ 50 ○ | 100 🔘 Fit to Quantity | 6 | | 3 | |
| Display: | 🔲 Hide Alias Columns | 7 | | 0 | |
| Unsigned 🔻 | 🔲 Address in Cell | 8 | | | |
| | PLC Addresses (Base 1) | 9 | | | |
| | | | | | |

2.4.6 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. Using a DTM with the HMA

3.1. Purpose

This procedure instructs how to connect a HART DTM to the HMA to configure or troubleshoot an attached HART transmitter.

3.2. Equipment

| Item | Manufacturer | Model |
|------------------------|---------------------|-----------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| Power Supply | - | 20-24V, 0.5A |
| PACTware | PACTware Consortium | Version 4.1 or higher |
| HART Modem | MacTek | Viator |
| Level transmitter | MII | Model 706 |
| Probe | MII | Model 706 compatible |

3.3. Setup

Connect the HMA, with an attached HART transmitter, to a power supply via the power terminal block. Connect the HART Modem to the HART terminal block on the HMA. Note that the HMA provides 24 VDC on the terminal block and contains an internal 250-ohm resistor, so the modem can be directly connected to the terminal block.

- 3.4.1 Start PACTware.
- 3.4.2 Add a HART Comm DTM to the Project.
- 3.4.3 Left click on the Comm DTM in the Project tree and add a DTM to the Project for the listed device.
- 3.4.4 Right-click on the Comm DTM item and select Parameter. Select the correct COM port for the HART modem, set the Start address and End address to match the HART Poll Address for the attached device. (The Poll Address can be read from the Device Setup\Advanced Config\Analog Output menu on the transmitter's local display.) Set the Comm DTM to be a secondary master, then click OK.
- 3.4.5 Right-click on the Comm DTM 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.
- 3.4.6 Right-click on the Comm DTM item and select Connect.
- 3.4.7 Double click on the transmitter entry in the Project tree to open the Online parameterization window.
- 3.4.8 All features of the DTM will be available. Note that since the DTM is acting as a secondary master and the HMA is periodically sending commands as the primary master, the response of the DTM will be slower than when it is connected directly to a transmitter.

4. Using a Handheld Field Communicator with the HMA

4.1. Purpose

This procedure instructs how to connect a handheld communicator, such as the Emerson 475, to the HMA to configure or troubleshoot an attached HART transmitter.

4.2. Equipment

| Item | Manufacturer | Model |
|------------------------|---------------------|-----------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| Power Supply | - | 20-24V, 0.5A |
| PACTware | PACTware Consortium | Version 4.1 or higher |
| Field Communicator | Emerson | 475 |
| Level transmitter | MII | Model 706 |
| Probe | MII | Model 706 compatible |

4.3. Setup

Connect the HMA, with an attached HART transmitter, to a power supply via the power terminal block. Connect the field communicator to the HART terminal block on the HMA. Note that the HMA provides 24 VDC on the terminal block and contains an internal 250-ohm resistor, so the field communicator can be directly connected to the terminal block.

- 4.4.1 Start the field communicator.
- 4.4.2 Ensure that the field communicator is configured to scan for the HART Poll Address of the transmitter. (The Poll Address can be read from the Device Setup\Advanced Config\Analog Output menu on the transmitter's local display.)
- 4.4.3 When the field communicator finds the device, select it from the communicator's menu.
- 4.4.4 All features of the HART DD for the transmitter will be available. Note that since the field communicator is acting as a secondary master and the HMA is periodically sending commands as the primary master, the response of the field communicator will be slower than when it is connected directly to a transmitter.

5. Basic Modbus RTU Communication over RS-485

5.1. Purpose

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

5.2. Equipment

| Item | Manufacturer | Model |
|----------------------------|---------------------|----------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| RS485 Communications cable | <u>FDTIchip</u> | 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 |

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 for the Modbus RTU protocol settings used by the intended Modbus master. 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.
- 5.4.3 Connect the HMA to a Modbus master.
- 5.4.4 Apply power to the HMA.
- 5.4.5 Verify that the Modbus master is receiving responses from the HMA (Tx is increasing) and that there are no communication errors being reported.

6. Basic Modbus RTU Communication over RS-232

6.1. Purpose

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

6.2. Equipment

| Item | Manufacturer | Model |
|----------------------------|---------------------|--------------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| RS485 Communications cable | <u>FDTIchip</u> | USB-RS485-WE |
| RS232 Communications cable | FDTIchip | USB-RS232-WE-1800-BT_0.0 |
| 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 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.

- 6.4.1 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values for the Modbus RTU protocol settings used by the intended Modbus master. 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.
- 6.4.2 Change the DIP switches 3 and 4 to 3 == ON, 4 == OFF.
- 6.4.3 Change DIP switch 1 to ON. This sets the device to run in the selected communications mode.
- 6.4.4 Disconnect the RS-485 communication cable from the HMA.
- 6.4.5 Connect the HMA to a Modbus master using a RS-232 communications cable. Connect the master's RS-232 TX line (orange) to the '+' position of the RS-485 terminal block, and the RX line (yellow) to the '-' position.
- 6.4.6 Verify that the Modbus master is receiving responses from the HMA (Tx is increasing) and that there are no communication errors being reported.

7. Basic Modbus ASCII Communication over RS-485

7.1. Purpose

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

7.2. Equipment

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

7.3. 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.

- 7.4.1 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values for the Modbus ASCII protocol settings used by the intended Modbus master. Refer to Appendix G 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.
- 7.4.2 Change DIP switch 1 to ON. This sets the device to run in the selected communications mode.
- 7.4.3 Verify that the device is not communicating with the Modbus Poll application.
- 7.4.4 Select Connection\Disconnect from the Modbus Poll menu bar.

7.4.5 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 | Cancel |
| 9600 Baud | Mode |
| 8 Data bits 🔻 | Response Timeout 5000 [ms] |
| None Parity 1 Stop Bit ▲dvanced | Delay Between Polls 100 [ms] |
| Remote ServerIP AddressPortConnect127.0.0.15023000 | t Timeout [ms] |

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

8. Modbus RTU Communication in HMA Mode

8.1. Purpose

This procedure instructs how to configure the HART to Modbus Adaptor (HMA), when in the HMA mode, to support the various registers defined for one or multiple devices attached to a single HMA.

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 attached devices, the HMA register number to access various parameters in the attached HART devices will be different from HART device to HART device and will depend on the slave number of the device on the HMA.

The following procedure is an example of connecting two HART devices to a single HMA.

| Item | Manufacturer | Model |
|----------------------------|---------------------|-------------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| RS485 Communications cable | <u>FDTIchip</u> | 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

8.3.1 Single HMA

Connect an 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. Connect a 120Ω resistor between the two RS-485 terminal block positions. Connect additional supported Magnetrol HART devices to the HART loop terminal block of the HMA. 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 1 and 62 as long as it has a unique address from others connected to the same HMA, and there can be a maximum of 5 devices connected to an HMA including the device in the housing containing the HMA. It is suggested that the devices' poll addresses

be set to the range of 1 to 5 so that they correspond to the slave numbers shown in the registers tables of Sections L through S.

8.3.2 Multiple HMAs

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 HMA2 as well as the negative terminal of the two terminal blocks. Continue for the number of HMAs to be used on the line. Connect a 120Ω resistor between the two RS-485 terminal block positions of the last device on the RS485 line.

- 8.4.1 Connect the HMA to a power supply, Modbus host and MII HART transmitters as specified in section 8.3.1.
- 8.4.2 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values for the Modbus RTU protocol settings used by the intended Modbus master. 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 to open the Write Single Register dialog, enter the new value, and then click on Send.
- 8.4.3 Using Procedure 2, change register 3001 to a value of 15. This changes the address of the HMA to 15 to be unique from other HMAs and from the attached devices. Note that the choice of address for the HMA is not critical as long as it is different from other HMAs to be used in the same system.
- 8.4.4 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.
- 8.4.5 Change register 3013 to a value of 2. This will cause the HMA to scan poll addresses 0 to 15 for attached devices at start-up, and record the poll address and other information for each device.
- 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 Change DIP switch 1 to ON.
- 8.4.8 Change the slave ID for the Read/Write Definition from 247 to 15 (or the Modbus address selected for the HMA).
- 8.4.9 Verify that register 3012 on each HMA has automatically changed to a value of 1 indicating that the HMA has found devices and stored their information in memory.
- 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 K for the register numbers. For example, with two devices attached:

| Read/Write Definition | | | | |
|--|-----------------------------|-----------|---------------|-----------------|
| Slave ID: 247 | ОК | 🔛 Mbpo | 114 | - • • |
| Function: 04 Read Input Regis | ters (3x) 🔻 Cancel | T× = 9: E | Err = 0: ID = | 247: F = 04: SI |
| Address: 1250 Protoco | l address. E.g. 30011 -> 10 | | Alian | 01250 |
| Quantity: 11 | | 1250 | Allds | 01230 0x0002 |
| Scan Rate: 1000 [ms] | Apply | 1251 | | 0x56E0 |
| Disable | | 1252 | | 0x00E5 |
| Read/Write Disabled Disable on error | Bead/Write Once | 1253 | | 0xFFFF |
| | | 1254 | | 0xFFFF |
| View | | 1255 | | 0xFFFF |
| © 10 © 20 © 50 ⊙ | 100 💿 Fit to Quantity | 1256 | | 0x0002 |
| Diaplaur | | 1257 | | 0x0003 |
| Hey - | Address in Coll | 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 If using more than one HMA, repeat steps 8.4.1 through 8.4.12 except disconnecting HMA1 and connecting another HMA. Set the Poll Address of the new HMA to something other than to be used for the other HMAs. Repeat for any additional HMAs.
- 8.4.14 Reconnect all HMAs to be used, following the setup in section 8.3.2.
- 8.4.15 Open a new Mbpoll window.

8.4.16 The supported parameters for the HART devices are listed in Appendices L through S. 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 HART device(s). For example, to read the PV through QV values for Slave ID 2, set the Read/Write Definition to:

| Read/Write I | Definition | | | × | 📴 Mb | poll2 🗖 | |
|-----------------|----------------|-----------|------------------|----------------|--------|-------------|--------------|
| Slave ID: | 2 |] | | OK | Tx = 4 | 18: Err = 1 | 0: ID = 247: |
| Function: | 04 Read In | put Regis | ters (3x) 🔹 | Cancel | | Alias | 01312 |
| Address: | 1312 | Protocol | address. E.g. 30 | 011 -> 10 | 1312 | | 1.9685 |
| Quantity | 8 | 1 | | | 1313 | | |
| quantity. | 1000 | | | | 1314 | | 0 |
| Scan Rate: | 1000 | [ms] | | Apply | 1315 | | |
| Disable Bead | Av/rite Disabl | ed | | | 1316 | | 1.9685 |
| Disabl | e on error | cu | B | ead/Write Once | 1317 | | |
| V. | | | | | 1318 | | 0 |
| Bows | | | | | 1319 | | |
| ◎ 10 | 20 | 50 🔘 | 100 💿 Fit to Qu | Jantity | | | |
| Display: | | | 🔲 Hide Alias Co | olumns | | | |
| Float AB | CD | • | Address in C | ell | | | |
| | | | PLC Address | es (Base 1) | | | |
| | | | | | | | |

8.4.17 Ensure that the values displayed match the values shown on the selected transmitter's local user interface.

9. Modbus RTU Communication in Device Mode

9.1. Purpose

This 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 1 to 62). 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 from the various attached HART devices (and from other HMAs) on the RS-485 line so that it can also be queried by the Modbus master.

| Item | Manufacturer | Model |
|----------------------------|---------------------|-------------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| RS485 Communications cable | <u>FDTIchip</u> | 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 | MI | E3 Modulevel |

9.2. Equipment

9.3. Setup

9.3.1 Single HMA

Connect an 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. Connect a 120Ω resistor between the two RS-485 terminal block positions. Connect additional supported Magnetrol HART devices to the HART loop terminal block of the HMA. There can be any combination of devices listed in Appendices L through S. Note that each device's Poll Address can be set to any value between 1 and 62 as long as it has a unique address from other devices and HMAs

connected to the same RS-485 line. There can be a maximum of 5 devices connected to an HMA including the device in the housing containing the HMA.

9.3.2 Multiple HMAs

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 HMA2 as well as the negative terminal of the two terminal blocks. Continue for the number of HMAs to be used on the line. Connect a 120 Ω resistor between the two RS-485 terminal block positions of the last device on the RS485 line.

- 9.4.1 Connect HMA1 to a power supply, Modbus host and MII HART transmitters as specified in section 9.3.1.
- 9.4.2 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values for the Modbus RTU protocol settings used by the intended Modbus master. 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 to open the Write Single Register dialog, enter the new value, and then click on Send.
- 9.4.3 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. Note that the choice of address for the HMA is not critical as long as it is different from other HMAs to be used in the same system.
- 9.4.4 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 for each attached device.
- 9.4.5 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.
- 9.4.6 Change DIP switch 1 to ON.
- 9.4.7 Change the slave ID for the Read/Write Definition from 247 to 15 (or the Modbus address selected for the HMA).
- 9.4.8 Using Procedure 2, verify that register 3012 of the HMA has automatically changed to a value of 1.
- 9.4.9 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 L through S. 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 for a HART device set to Poll Address 2 can be displayed in one Modbus Poll window by setting the Read/Write Definition to:

| Read/Write Definition | 🦳 Mbpoll2 📃 🗖 🗾 | |
|--|--------------------------------------|---|
| Slave ID: 2 OK | Tx = 113: Err = 0: ID = 2: F = 04: S | F |
| Function: 04 Read Input Registers (3x) Cancel | Alias 01300 | |
| Address: 1302 Protocol address. E.g. 30011 -> 10 | 0 | |
| Quantity: 8 | 2 42.6378 | |
| Scan Rate: 1000 [ms] Apply | 3 | |
| Disable Read/Write Disabled | 4 27.4016 | |
| Disable on error Read/Write Once | 6 32 | |
| View | 7 | |
| ○ 10 | 8 72.14 | |
| Display: 📃 Hide Alias Columns | 9 | |
| Float AB CD Address in Cell | | |
| PLC Addresses (Base 1) | 12 | |

- 9.4.10 Verify that the values displayed match the values shown on the device's local user interface.
- 9.4.11 For parameters that are defined as Holding registers in Appendix L, 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.
- 9.4.12 Repeat steps 9.4.9 through 9.4.11 for the other devices attached to the HMA. For each device, the Slave ID entered in step 9.4.9 must match the Poll Address for that device. The supported parameters for a device are listed in Appendices L through S.
- 9.4.13 If using more than one HMA, repeat steps 9.4.1 through 9.4.12 except disconnecting HMA1 and connecting another HMA. Set the Poll Address of the new HMA to something other than to be used for the other HART devices or HMAs. Repeat for any additional HMAs.
- 9.4.14 Connect all HMAs to be used, following the setup in section 9.3.2.
- 9.4.15 Verify that communication can be made to all HART devices and HMAs and that the correct data can be read from the Modbus master.

Modbus RTU Communication in Single Modbus Device Mode

10.1.Purpose

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

In the Single Modbus Device mode (register 3012 set to 2), the HMA and attached HART 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 commissioning process. When the HART poll address of the device is changed, the HMA will automatically change its Modbus address to match the HART address when it starts up. Note that the range of Modbus/HART addresses is limited to 1 through 62.

10.2. Equipment

| Item | Manufacturer | Model |
|----------------------------|---------------------|----------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| RS485 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 |

10.3. Setup

Connect the HMA (mounted in a housing with a HART device) 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.

- 10.4.1 Using Procedure 1 (with position 1 of the DIP switch set to OFF), configure the communication settings HMA to match the settings for the Modbus host.
- 10.4.2 Using Procedure 2 (with position 1 of the DIP switch set to OFF), verify that register 3012 on the HMA is set to a value of 2 Single Device.
- 10.4.3 Using the device's local display, change the HART Poll Address to the desired Modbus address (within the range of 1 to 62). On 4-button, multi-line displays, the Poll Address parameter can be found by navigating to the Device Setup\Advanced Config\Analog Output menu. On 3-button, 2-line displays, the Poll Address parameter can be found by repeatedly pressing the Up or Down arrow button.
- 10.4.4 Set position 1 of the DIP switch to ON.
- 10.4.5 The HMA will search through the 1 to 62 poll range for the attached HART device. Once the device is found, the HMA will automatically change its Modbus address to match, and then restart itself to use the new Modbus address.

10.4.6 The HMA / HART device can be communicated with using the Modbus address and the registers for Slave 1 as shown in Appendices L through S.

11. Basic LevelMaster Communication

11.1. Purpose

This 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.

| Item | Manufacturer | Model |
|----------------------------|----------------------|-------------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| RS485 Communications cable | <u>FDTIchip</u> | 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 |

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 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. Besides the Model 706 in the housing, connect any additional HART devices to the HART loop terminal block of the HMA. Set the HART Poll Address of the internal Model 706 device to 2. Set the HART Poll Address of the other attached devices to different, unique values. Note that other Magnetrol HART transmitters and HART poll addresses can be used.

11.4. Procedure

11.4.1 Using Procedure 1, ensure that registers 3002 through 3007 of the HMA match the values shown for the Modbus LevelMaster protocol default settings. Refer to Appendix H 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. Register 3001 can be left at 247.

| 🤔 мі Тх = 3 | opoll2 27080: Err = 22 | 2569: ID = 247: |
|----------------|---------------------------|------------------------|
| | Alias | 03000 |
| 3000 | | 0 |
| 3001 | | 247 |
| 3002 | | 3 |
| 3003 | | 8 |
| 3004 | | 1 |
| 3005 | | 0 |
| 3006 | | 3 |
| 3007 | | 1 |
| <u>р</u> | | |

11.4.2 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 attached HART device.

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

- 11.4.3 Change DIP switch 1 to ON and then back to OFF.
- 11.4.4 Set up a window to read 11 registers starting at address 1250.

| Read/Write I | Definition | | | × | | | | |
|---|---|---------|------------------|----------------------|------|----------------|---------|------------------|
| Slave ID: | 247 |] | | ОК | | 📴 Att | ached | - • × |
| Function: 04 Read Input Registers (3x) 🔻 Cancel | | | | | | T x = 1 | 114: Er | r = 28: ID = 247 |
| Address: | 1250 Protocol address. E.g. 30011 -> 10 | | | | | | Alias | 01250 |
| Quantity: | 11 | | | | | 1250 | | 0x0001 |
| Scan Rate: | 1000 | [ms] | | | | 1251 | | 0x56E0 |
| Disable - | | | | | | 1252 | | 0xFFFF |
| Read/Write Disabled | | | | | 1253 | | 0xFFFF | |
| Disable on error <u>R</u> ead/Write Once | | | | | 1254 | | 0xFFFF | |
| View | | | | | | 1255 | | 0xFFFF |
| Bows ──10 ──20 ──50 ──100 ● Fit to Quantity | | | | | | 1256 | | 0x0002 |
| Disalar | 0 0 | · · · · | | | | 1257 | | 0x00FF |
| Uispiay: | | - | Hide Alias (| Columns | | 1258 | | 0x00FF |
| Inex | | • | PLC Address in I | Lell Mer (Race 1) | | 1259 | | 0x00FF |
| | | | | | | 1260 | | 0x00FF |

- 11.4.5 Verify that register 1251 shows the correct device type and register 1256 shows the HART Poll Address of the attached transmitter.
- 11.4.6 Change DIP switch 1 to ON.
- 11.4.7 Select Connection\Disconnect from the menu bar.
- 11.4.8 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.
- 11.4.9 Set the COM Port to match the COM port used for the communication cable (the same number as with the Modbus Poll application).
- 11.4.10 Set the Baud rate, Data bits, Parity, Stop Bits and Handshaking parameters to match the settings made in the HMA for LevelMaster communication.

11.4.11 The Terminal application settings should be as below.

| 🦼 Terminal v1.9b - 20040204 - by Br@y++ | × |
|--|--------|
| Connect COM Pot C COM1 Baud rate Data bits Parity Stop Bits Handshaking Disconnect C 600 C 14400 C 57600 C 5 C none C 1 C none Disconnect C 600 C 1200 C 19200 C 115200 C 6 C odd C RTS/CTS About C COM5 C 4800 C 38400 C 256000 C 7 C mark C 2 C RTS/CTS + X0N. Quit C 0007 9600 C 56000 C ustom S 8 C space C 2 C RTS on TX | /XOFF |
| Settings Auto Dis/Connect Time custom BR Rx Clear Set font Stay on Top CR=LF 9600 27 + | BI |
| Receive Clean Reset Counter 13 Counter = 9 C HEX StartLog StopLog Dec ✓ Hex | Bin |
| | ~ ~ |
| | |
| U02? -> Send | |
| Transmit Macros U02?\$0D ✓ M1 3000 ‡ ✓ M2 1000 ‡ | |
| Disconnected Rx: 342 Tx: 45 | 10 |

- 11.4.12 Click Connect.
- 11.4.13 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.
- 11.4.14 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 Pot C COM1 Disconnect Baud rate C COM1 C COM3 C COM4 C C C C C C C C C C C C C C C C C C C |
| 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 C HEX CLEAR Reset Counter 13 C Ounter = 13 C HEX CLEAR Reset Counter 13 C Ounter = 13 C HEX CLEAR Reset Counter 13 C Ounter = 13 C HEX CLEAR Reset Counter 13 C Ounter = 13 C HEX O String StartLog StopLog Dec ✓ Hex Bin |
| U02D025.23D046.77F100E0000W0000C4d29 U02D025.23D046.77F100E0000W0000C4d29 U02D025.27D046.73F100E0000W0000C7d19 U02D025.27D046.73F100E0000W0000C7d19 |
| CLEAR Send File CR=CR+LF DTR CRTS |
| U02? -> Send |
| U02? U02? U02? U02? U02? U02? U02? U02? |
| Connected Rx: 494 Tx: 65 |

- 11.4.15 Verify that the value after the U in the response matches the Poll Address of the Model 706 device.
- 11.4.16 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.
- 11.4.17 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.
- 11.4.18 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.
- 11.4.19 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 T for a listing of codes. Typically, the code should match the active diagnostic displayed on the device's LCD home screen.
12. Additional LevelMaster Commands

12.1. Purpose

This 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 |
| RS485 Communications cable | FDTIchip | USB-RS485-WE |
| Termination resistor | - | 120Ω |
| Modbus host application | www.modbustools.com | Modbus Poll |
| Terminal v1.9b application | hw-server.com | Version 1.9b - 20040204 |
| Power Supply | - | 20-24V, 0.5A |
| Level transmitter | MII | Model 706 |
| Probe | MII | Model 706 compatible |

12.2. Equipment

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 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. 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.

12.4. Procedure

12.4.1 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 H for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed to open the Write Single Register dialog, enter the new value, and then click on Send.

12.4.2 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.

| 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 |
| IU 2U 5U 100 Fit to Quantity | 7 |
| Display: 📃 Hide Alias Columns | 8 |
| Unsigned 🗾 🗖 Address in Cell | 9 |
| PLC Addresses (Base 1) | |
| | |

- 12.4.3 Change DIP switch 1 to ON.
- 12.4.4 Select Connection\Disconnect from the Modbus Poll menu bar.
- 12.4.5 Start the Terminal v1.9b application.
- 12.4.6 Set the COM Port to match the COM port used for the communication cable (the same number as with the Modbus Poll application).
- 12.4.7 Set the Baud rate, Data bits, Parity, Stop Bits and Handshaking parameters to match the settings made in the HMA for LevelMaster communication.
- 12.4.8 Click Connect.

- 12.4.9 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 floating point numbers that the attached device will return when responding to the Uxx? command. For the HMA implementation, there will always be two floating point numbers 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.
- 12.4.10 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++ | x |
|--|-------|
| Connect COM Pot C COM1 Baud rate Data bits Parity Stop Bits Handshaking Disconnect C CM3 C 600 C 14400 C 57600 C 5 Image: Connect Image: Conne Image: Conne Image: C | XOFF |
| Settings Auto Dis/Connect Time custom BR Rx Clear Set font Stay on Top CR=LF 9600 27 ♀ | (] RI |
| Receive C HEX CLEAR Reset Counter 13 C Counter = 18 C HEX Image: CLEAR Reset Counter 13 C Counter = 18 Image: StartLog StopLog Image: Dec Image: Hex Image: E | ∃in |
| U03F2C01f6 | * |
| Transmit CLEAR Send File CR=CR+LF DTR DTR RTS | |
| U02? -> Send | |
| U03F? U03F?\$0D 	 M1 3000 \$ U03F?\$0D 	 M2 1000 \$ U03DL0015\$0D 	 M3 1000 \$ | |
| Connected Rx: 303 Tx: 183 | 11 |

12.4.11 Verify that the value after the F in the response (indicating the number of floating point values that will be returned) equals '2' (from the above, U03F201f6).

- 12.4.12 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.
- 12.4.13 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 C COM1 Baud rate C COM1 Data bits Parity Stop Bits Handshaking Disconnect C 0M2 C 0000 C 14400 C 57600 C 5 © none © 1 © none Disconnect C 0003 C 2400 C 28800 C 128000 C 6 C odd C 1.5 C X0N/X0FF Duit C 0005 C 0006 C 4800 C 38400 C 256000 C 7 C mark C 2 C RTS/CTS + X0N/X0FF Quit C 0007 9600 C 56000 C custom © 8 C space C 2 C RTS on TX |
| Set font Stay on Top CR=LF 9600 RX Clear ASCII table CTS DSR CD RI |
| Receive O HEX CLEAR Reset Counter 13 Counter = 7 O HEX Image: Clear Counter Image: Clear |
| U03OL+0020C5624 |
| Transmit CLEAR Send File CR=CR+LF DTR RTS |
| U02? → Send |
| U03OL? U03OL? U03OL?\$0D 		 M1 3000 ↓ □ U030L?\$0D 		 M2 1000 ↓ □ U030L-0020\$0D 		 M3 1000 ↓ □ |
| Connected Rx: 182 Tx: 53 |

12.4.14 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 an integer 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 rounding. The value returned will be in terms of Level Units.

- 12.4.15 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.
- 12.4.16 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.

| 2 Terminal v1.9b - 20040204 - by Br@y++ |
|---|
| Connect COM Pot C COM1 Baud rate Data bits Parity Stop Bits Handshaking Disconnect C COM3 C 600 C 14400 C 57600 C 5 Onnoe Odd Odd Odd C 1 Onnoe Odd C 1 C STS/CTS Odd C 1.5 C SON/X0FF C SON/X0FF |
| Set font Stay on Top CR=LF 9600 27 CTS DSR CD RI |
| Receive CLEAR Reset Counter 13 	Counter = 40 	Counter String StopLog □ Dec ▼ Hex □ Bin |
| U02OLOKC9af4 U02OL+0019C96df U02OLOKC9af4 U02OL-0019Cf0df U02OL-0019Cf0df |
| Transmit CLEAR Send File CR=CR+LF CR CR=CR+LF |
| U02? -> Send |
| U02OL0020 U02OL? U02OL-0020 U02OL-0020 U02OL? U02OL-0020\$0D ▼ M1 3000 € □ U02OL?\$0D ▼ M2 1000 € □ U02OL-0020\$0D ▼ M3 1000 € □ |
| Connected Rx: 675 Tx: 353 |

- 12.4.17 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.
- 12.4.18 Repeat steps 12.4.15 through 12.4.17 while sending U03OL-0020\$0D to cause the writing of -2.0 as the Level Offset.

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

13.1. Purpose

This 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 procedure uses a Model 706 as the attached device as an example; other Magnetrol HART devices can also be used with this procedure.

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 13.4.2.

| Item | Manufacturer | Model |
|----------------------------|---------------------|-----------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| RS485 Communications cable | <u>FDTIchip</u> | 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 |

13.2. Equipment

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 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. 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.

13.4. Procedure

13.4.1 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for the Modbus RTU protocol default settings. The address shown in register 3001 can be between 0 and 14. 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 to open the Write Single Register dialog, enter the new value, and then click on Send.

- 13.4.2 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.
- 13.4.3 Change DIP switch 1 to ON.
- 13.4.4 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 13.4.2 for register 3001, and then click OK.
- 13.4.5 Verify that the Modbus Poll application is communicating with the HMA.
- 13.4.6 Change to value of register 3008 to 1. This causes the HMA to automatically reboot into the HART over RS-485 mode.
- 13.4.7 Verify that the HMA is not communicating with the Modbus Poll application.
- 13.4.8 Select Connection\Disconnect from the Modbus Poll menu bar.
- 13.4.9 Start PACTware.
- 13.4.10 Add a HART Comm DTM to the Project.
- 13.4.11 Left click on the Comm DTM in the Project tree and add a DTM to the Project for one of the listed devices.
- 13.4.12 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.
- 13.4.13 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.
- 13.4.14 Right-click on the Comm DTM Project item and select Connect.
- 13.4.15 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.
- 13.4.16 Verify that the attached Model 706 is listed and is shown with the correct Poll Address.
- 13.4.17 Right-click on the Comm DTM Project item and select Connect.
- 13.4.18 Double click on the device entry in the Project tree to open the Online parameterization window.
- 13.4.19 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.
- 13.4.20 Close the Online parameterization window.
- 13.4.21 Right-click on the Comm DTM Project item and select Disconnect.
- 13.4.22 Right-click on the Comm DTM Project item and select Parameter. Set both the Start address and End address to 63, then click OK.

- 13.4.23 Right-click on the Comm DTM Project item and select Connect.
- 13.4.24 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.
- 13.4.25 Shut down PACTware.
- 13.4.26 Open the Modbus Poll application.
- 13.4.27 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 Serial Port | |
| Serial Settings USB Serial Port (COM3) | Mode RTU ASCII |
| 8 Data bits 💌 None Parity 💌 | Response Timeout 5000 [ms] Delay Between Polls |
| 1 Stop Bit ▼ <u>A</u> dvanced | 100 [ms] |
| Remote Server IP Address Port Connect 127.0.0.1 502 3000 | t Timeout [ms] |

13.4.28 Open or click on an Mbpoll window, select Setup\Read\Write Definition from the menu bar, ensure that the settings are as follows (the Slave ID should match the address entered into register 3001 in step 13.4.1), and then click OK:

| Read/Write Definition | |
|---|-------------------|
| Slave ID: OK Function: 03 Read Holding Registers (4x) Cancel | Comm Settings.mbp |
| Address: 3000 Protocol address. E.g. 40011 -> 10 Quantity: 9 | Alias 03000 |
| Scan Rate: 1000 [ms] Apply | 3001 11 3002 1 |
| Read/Write Disabled Disable on error Read/Write Once | 3003 8 3004 1 |
| View Rows | 3005 2 3006 3 |
| Display: | 3007 0 3008 0 |
| Unsigned Address in Cell PLC Addresses (Base 1) | |

- 13.4.29 Verify that the Tx count in the Mbpoll window is increasing, the Err count is not increasing and there are no reported communication errors.
- 13.4.30 Verify that register 3008 is set to 0.
- 13.4.31 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. The HMA will switch into the default communication mode. Using Procedure 1, set register 3008 to 0. The HMA can be used either in that mode, or by setting DIP switch 1 to ON it can be used in its normal Modbus configuration mode.

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

14.1. Purpose

This 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. This procedure uses a Model 706 as the attached device as an example; other Magnetrol HART devices can also be used with this procedure.

14.2. Equipment

| Item | Manufacturer | Model |
|----------------------------|----------------------|-------------------------|
| HART to Modbus Adaptor | MII | 031-2859-001 |
| RS485 Communications cable | <u>FDTIchip</u> | 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 |
| HART Modem | MacTek | Viator |
| Level transmitter | MII | Model 706 |
| Probe | MII | Model 706 compatible |

14.3. 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. 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 1 and 62.

14.4. Procedure

- 14.4.1 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for the Modbus LevelMaster protocol default settings. The address shown in register 3001 can be between 1 and 62. Refer to Appendix H for the HMA Communication settings. If the settings do not match, double-click on a value that needs to be changed to open the Write Single Register dialog, enter the new value, and then click on Send.
- 14.4.2 Change DIP switch 1 to ON.
- 14.4.3 Ensure that the Modbus Poll application is not communicating with the HMA.
- 14.4.4 Select Connection\Disconnect from the Modbus Poll menu bar.
- 14.4.5 Start the Terminal v1.9b application.
- 14.4.6 Set the COM Port to match the COM port used for the communication cable (the same number as with the Modbus Poll application).

14.4.7 Set the Baud rate, Data bits, Parity, Stop Bits and Handshaking parameters to match the settings made in the HMA for LevelMaster communication.

| 14.4.8 | The Terminal application settings should be as below. | |
|--------|---|--|

| .7 Terminal v1.9b - 20040204 - by Br@v++ | - |
|--|---|
| Connect COM Port Baud rate Data bits Parity Stop Bits Handshaking Disconnect C COM1 C 600 C 14400 57600 C 5 © none © 1 Disconnect C COM3 C 2400 C 28800 C 128000 C 6 © odd © t1 © NX/XOFF About. C COM5 C 4800 C 38400 C 256000 © 7 © mark C 2 C RTS/CTS + XDN/XOFF Quit C COM7 © 9600 C 56000 C ustom © 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 <u>CLEAR</u> Reset Counter 13 	Counter = 9 	Counter = 9 	StartLog StopLog 	Dec 	Hex 	Bin | |
| | * |
| | |
| U02? → Send Transmit Macros U02?\$0D U02?\$0D M1 M2 1000 \$ M3 1000 \$ | |
| Disconnected Rx: 342 Tx: 45 | 1 |

- 14.4.9 Click <u>C</u>onnect.
- 14.4.10 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, so the number used should match the actual Poll Address of the attached device.
- 14.4.11 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 Pot C COM1 Disconnect Baud rate C COM1 C COM3 C COM4 C C COM4 C COM4 C C COM4 C COM4 C C C COM4 C C COM4 C C C C C C C C C C C C C C C C C C C |
| 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 = 13 O HEX CLEAR Reset Counter 13 Counter = 13 O HEX CLEAR Reset Counter 13 Counter = 13 O HEX StartLog StopLog □ Dec ✓ Hex □ Bin |
| U02D025.23D046.77F100E0000W0000C4d29 U02D025.23D046.77F100E0000W0000C4d29 U02D025.27D046.73F100E0000W0000C7d19 U02D025.27D046.73F100E0000W0000C7d19 |
| CLEAR Send File CR=CR+LF DTR CRTS |
| U02? → Send |
| U02? U02? U02? U02? U02? U02? U02? U02? |
| Connected Rx: 494 Tx: 65 |

- 14.4.12 Uncheck the checkbox to stop the macro from repeating.
- 14.4.13 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.
- 14.4.14 Check the checkbox to the right of the U02?\$0D macro definition.
- 14.4.15 Ensure that there is no response from the HMA.
- 14.4.16 Click on the <u>D</u>isconnect button.
- 14.4.17 Start PACTware.
- 14.4.18 Add a HART Comm DTM to the Project.
- 14.4.19 Left click on the Comm DTM in the Project tree and add a DTM to the Project for one of the listed devices.
- 14.4.20 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.

- 14.4.21 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.
- 14.4.22 Right-click on the Comm DTM Project item and select Connect.
- 14.4.23 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.
- 14.4.24 Ensure that the attached Model 706 is listed and is shown with the correct Poll Address.
- 14.4.25 Right-click on the Comm DTM Project item and select Connect.
- 14.4.26 Double click on the device entry in the Project tree to open the Online parameterization window.
- 14.4.27 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.
- 14.4.28 Close the Online parameterization window.
- 14.4.29 Right-click on the Comm DTM Project item and select Disconnect.
- 14.4.30 Right-click on the Comm DTM Project item and select Parameter. Set both the Start address and End address to 63, then click OK.
- 14.4.31 Right-click on the Comm DTM Project item and select Connect.
- 14.4.32 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.
- 14.4.33 Shut down PACTware.
- 14.4.34 Open the Terminal application.
- 14.4.35 Click on the <u>C</u>onnect button.
- 14.4.36 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.

14.4.37 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++ | 3 |
|---|----|
| 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 RTS/CTS About C COM5 C 4800 C 38400 C 256000 C mark C 2 C RTS/CTS + X0N/X0FF Quit C COM7 C 9600 C 56000 C ustom C 8 C space C 2 C RTS or TX | F |
| Set font Auto Dis/Connect Time custom BR Rx Clear ASCII table CTS CDSR CD CD RI | |
| ReceiveReset Counter 13 ♀ Counter = 13 ○ HEXStartLog_StopLog □ Dec ▼ Hex □ Bin | |
| U02D025.23D046.77F100E0000W0000C4d29 U02D025.23D046.77F100E0000W0000C7d19 U02D025.27D046.73F100E0000W0000C7d19 U02D025.27D046.73F100E0000W0000C7d19 | * |
| | |
| U02? → Send | |
| U02? U02? U02? U02? U02? U02? U02? U02? | F |
| Connected Rx: 494 Tx: 65 | 11 |

14.4.38 If unable to establish communication in the HART over RS-485 mode, the HMA can be reset to the default Modbus RTU operating mode by switching DIP switch 1 to OFF. The HMA will switch to the default communication mode. Using Procedure 1, set register 3008 to 0. The HMA can be used either in that mode, or by setting DIP switch 1 to ON it can be used in its normal Modbus configuration mode.

15. HMA Diagnostics

15.1. Purpose

This 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.

15.2. Equipment

| Item | Manufacturer | Model | |
|----------------------------|---------------------|----------------------|--|
| HART to Modbus Adaptor | MII | 031-2859-001 | |
| RS485 Communications cable | <u>FDTIchip</u> | 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 | |

15.3. 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. 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.

15.4. Procedure

- 15.4.1 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 to open the Write Single Register dialog, enter the new value, and then click on Send.
- 15.4.2 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.
- 15.4.3 Power cycle the HMA, or move DIP switch 1 to ON and then back to OFF.

15.4.4 **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 | |
|---|--|
| Slave ID: 247 OK Function: 04 Read Input Registers (3x) ▼ Cancel Address: 1200 Protocol address. E.g. 30011 -> 10 Quantity: 1 Scan Rate: 1000 Disable Read/Write Disabled Apply | Mbpoll4 Tx = 70454: Err = 1936: ID = 247: F = 0 ias 01200 1200 0000 0000 0001 0100 |
| View Rows 10 20 50 100 Fit to Quantity Display: Binary Address in Cell PLC Addresses (Base 1) | |

- 15.4.5 Remove one of the attached HART devices.
- 15.4.6 Verify that the corresponding slave malfunction bit (see Appendix J) changes to 1.
- 15.4.7 Reconnect the disconnected device.
- 15.4.8 Verify that the corresponding slave malfunction bit changes to 0.

15.4.9 **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 | |
|--|----------------------------|
| Slave ID: 247 OK Function: 04 Read Input Registers (3x) ▼ Cancel | Mbpoll1 |
| Address: 1250 Protocol address. E.g. 30011 -> 10 Quantity: 11 | Alias 01250 |
| Scan Rate: 1000 [ms] Apply | 1251 0x56E0 1252 0x00E5 |
| Read/Write Disabled Disable on error Read/Write Once | 1253 0x00E5 1254 0x00E8 |
| View | 1255 0x00E3 |
| ○ 10 ○ 20 ○ 50 ○ 100 ○ Fit to Quantity Display: □ Uida Alica Columna | 1257 0x0002 |
| Hex Address in Cell | 1258 0x0003 1259 0x0004 |
| PLC Addresses (Base 1) | 1260 0x0005 |

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

15.4.13 **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:

| Read/Write Definition Image: Stave ID: Alias 01000 Slave ID: Image: Stave ID: Imag | | Mbpoll1 Ξ Ξ Σ |
|---|---|-------------------------------------|
| Alias 0100 Read/Write Definition Image: Cancel Image: Cancel <t< td=""><td></td><td>Tx = 57: Err = 0: ID = 247: F = 04:</td></t<> | | Tx = 57: Err = 0: ID = 247: F = 04: |
| Read/Write Definition Alias 01000 Slave ID: CM 1001 0x0001 Slave ID: CM 1002 0x56E0 Function: 04 Read Input Registers (3x) Cancel 1004 0x0007 Address: 1000 Protocol address. E.g. 30011 -> 10 1005 0x0001 Quantity: 18 0100 0x0010 1006 0x0010 Disable Image: Comment of the Quantity 1008 0x0000 1009 0x8181E Initial Disable on error Read/Write Disabled 0x0000 1011 0x0005 View Nows 0100 Fit to Quantity 0x11 0x0005 Initial Disable 1010 0x0000 1011 0x0005 Initial Disable Initial Disable 0x0000 1011 0x0005 Initial Disable Initial Disable 0x0000 1011 0x0005 Initial Disable Initial Disable 0x0005 1012 0x0005 Initial Disable Initial Disable 0x0056 1014 0x0020 Initial Initial Disable 0x005 | | |
| Read/Write Definition 0 0x0001 Slave ID: 0 0x0005 Function: 04 Read Input Registers (3x) Cancel 1001 0x0007 Address: 1000 Protocol address. E.g. 30011 -> 10 1005 0x0001 Quantity: 18 0x0001 1006 0x0001 Scan Rate: 1000 (ms) Apply 1008 0x0000 Disable One error Read/Write Once 1009 0xE81E View Nows 0100 0x0000 1011 0x0000 1011 0x0000 1011 0x0000 1013 0xFFFF 1012 0x0000 1013 0xFFFF 1014 0x0020 1013 0xFFFF 1014 0x0020 1015 0x0056 1014 0x0005 1015 0x0056 1016 0x0056 | | Alias 01000 |
| Read/Write Definition I001 0x0000 Slave ID: ZIZ OK 1002 0x56E0 Function: 04 Read Input Registers (3x) Cancel 1004 0x0007 Address: 1000 Protocol address. E.g. 30011 -> 10 1005 0x0001 Quantity: 18 000 1007 0x0010 Scan Rate: 1000 (ms] Apply 1008 0x0000 Disable Read/Write Disabled 1009 0xE81E 1010 0x0000 View Rows 100 0x0000 1011 0x0000 1012 0x0000 1013 0xFFFF 1014 0x0020 1014 0x0020 1015 0x0056 1016 0x0056 | | 1000 0x0001 |
| Slave ID: 247 0K Function: 04 Read Input Registers (3x) Cancel Address: 1000 Protocol address. E.g. 30011 -> 10 Quantity: 18 Scan Rate: 1000 (ms) Disable 0x0000 Disable 0x0000 Disable on error Read/Write Once View Rows 0100 0x1000 100 20 50 100 Fit to Quantity Display: Hide Alias Columns 1014 0x0020 1015 0x0056 1015 0x0056 1016 0x0056 1016 0x0056 | Read/Write Definition | 1001 0x0000 |
| Slave ID: 247 OK 1003 0x0005 Function: 04 Read Input Registers (3x) Cancel 1004 0x0007 Address: 1000 Protocol address. E.g. 30011 -> 10 1005 0x0001 Quantity: 18 Apply 1006 0x0001 Scan Rate: 1000 [ms] Apply 1008 0x0000 Disable Read/Write Disabled 1009 0xE81E 1010 0x0100 View Read/Write Disabled 0x0005 1011 0x0005 1012 0x0000 View Nows 10 20 50 100 Fit to Quantity 1013 0xFFFF Display: Hide Alias Columns Address in Cell 1014 0x0020 1015 0x0056 1016 0x0056 1016 0x0056 1016 0x0056 1017 0x0000 | | 1002 0x56E0 |
| Function: 04 Read Input Registers (3x) Cancel 1004 0x0007 Address: 1000 Protocol address. E.g. 30011 -> 10 1005 0x0001 Quantity: 18 Apply 1006 0x0001 Scan Rate: 1000 (ms) Apply 1008 0x0000 Disable Read/Write Disabled 1009 0xE81E 1010 0x0005 View No 20 50 100 Fit to Quantity 1013 0xFFFF 1012 0x0000 1013 0x0020 1014 0x0020 1015 0x0056 1016 0x0056 1016 0x0056 | Slave ID: 247 | 1003 0x0005 |
| Address: 1000 Protocol address. E.g. 30011 -> 10 1005 0x0001 Quantity: 18 0x000 1006 0x0001 Scan Rate: 1000 (ms) Apply 1007 0x0000 Disable Read/Write Disabled 1009 0xE81E Disable on error Read/Write Once 1010 0x0000 View Nows 010 9 0xE81E Display: Hide Alias Columns 1012 0x000D 1014 0x0020 1015 0x0056 1016 0x0056 1016 0x0056 | Function: 04 Read Input Registers (3x) 💌 Cancel | 1004 0x0007 |
| Address. 1000 Instruction address. 1001 0x0001 Quantity: 18 1000 Instruction address. 1007 0x0010 Scan Rate: 1000 Imsl Apply 1008 0x0000 Disable Read/Write Disabled Imsl Imsl Imsl Imsl 0x0010 Disable on error Read/Write Once Imsl Imsl Imsl 0x0005 View Rows 100 20 50 100 Fit to Quantity Imsl Imsl 0xFFFF Display: Imsl Hide Alias Columns Imsl Imsl 0x0056 Imsl Imsl 0x0056 Imsl | Address: 1000 Protocol address E.g. 20011 -> 10 | 1005 0x0001 |
| Quantity: 18 Scan Rate: 1000 Disable Apply Read/Write Disabled 0x0000 Disable on error Read/Write Once View Rows 10 20 100 0x0000 Display: Hide Alias Columns Hex Addresses (Base 1) | Address. 1999 Photocol address. E.g. 30011 9/10 | 1006 0x0001 |
| Scan Rate: 1000 [ms] Apply 1008 0x0000 Disable Read/Write Disabled 1009 0xE81E Disable on error Read/Write Once 1010 0x0000 View Nows 101 0x0000 10 20 50 100 Fit to Quantity 1012 0x0000 Display: Hide Alias Columns 1014 0x0020 1015 0x0056 Hex Address in Cell PLC Addresses (Base 1) 1016 0x0056 | Quantity: 18 | 1007 0x0010 |
| Disable Read/Write Disabled 1009 0xE81E Disable on error Read/Write Once 1010 0x0005 View 10 20 50 100 Fit to Quantity Display: Hide Alias Columns 1014 0x0020 Hex Address in Cell 1016 0x0056 1016 0x0056 1016 0x0056 | Scan Rate: 1000 [ms] Apply | 1008 0x0000 |
| Read/Write Disabled Read/Write Once 1010 0x0100 View Nows 1010 0x000D 1011 0x000D 10 20 50 100 Fit to Quantity 1013 0xFFFF Display: Hide Alias Columns 1014 0x0020 Hex Address in Cell 1016 0x0056 1016 0x0056 1017 0x0000 | Disable | 1009 0xE81E |
| Disable on error Read/Write Once 1011 0x0005 View Nows 101 0x000 1012 0x000D 10 20 50 100 Fit to Quantity 1013 0xFFFF Display: Hide Alias Columns 1015 0x0056 Hex Address in Cell 1016 0x0056 1016 0x0056 | Read/Write Disabled | 1010 0x0100 |
| View 1012 0x000D Rows 10 20 50 100 Fit to Quantity Display: Hide Alias Columns 1012 0x0020 Hex Address in Cell 1015 0x0056 PLC Addresses (Base 1) 1017 0x0000 | Disable on error Read/Write Once | 1011 0x0005 |
| Hows 10 20 50 100 Fit to Quantity Display: Hide Alias Columns 1014 0x0020 Hex Address in Cell 1016 0x0056 PLC Addresses (Base 1) 1017 0x0000 | View | 1012 0x000D |
| Display: Hide Alias Columns Hex Address in Cell PLC Addresses (Base 1) 1014 0x0020 1016 0x0020 1017 | Hows | 1013 0xFFFF |
| Display: Hide Alias Columns 1015 0x0056 Hex Address in Cell 1016 0x0056 PLC Addresses (Base 1) 1017 0x0000 | | 1014 0x0020 |
| Hex Address in Cell 1016 0x0056 PLC Addresses (Base 1) 1017 0x0000 | Display: Hide Alias Columns | 1015 0x0056 |
| 1017 0x0000 | Address in Cell | 1016 0x0056 |
| | | 1017 0x0000 |

- 15.4.14 Verify that registers 1000 through 1017 show the correct information for the attached device as listed in Appendix K.
- 15.4.15 Repeat steps 15.4.14 and 15.4.15 for the remaining four devices, changing the register addresses as appropriate.

16. Emerson ROC 800

16.1. Initial HMA Configuration

16.1.1 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 RTU 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 ROC 800 to a computer using an LOI RS-232 cable.
- 16.2.2 Connect an appropriate power supply to the power supply module 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 terminals A and B of the ROC 800 RS-485 module 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 ROC 800 Configuration

- 16.3.1 Start the ROCLINK 800 application.
- 16.3.2 Select ROC \ Direct Connect in the ROCLINK 800 Menu bar. An image of the front of the ROC 800 will appear.
- 16.3.3 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.



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

| Comm Port 2 X | | | | | | | | |
|--|--------------|-------------------|--|--|--|--|--|--|
| Comm Ports : 1 - Local Port 🔹 Iag : Local Port | | | | | | | | |
| General Modem SRBX Store & Forward Diagnostics | | | | | | | | |
| Comm Type : RS-232 | | | | | | | | |
| Baud Rate Parity Data Bits Stop Bits Key On Delay : 0 300 0 600 | | | | | | | | |
| 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 7 • Reserved • User Program 8 • • Solution 1 • Solution 1 | | | | | | | | |
| | 🕼 Update 🖌 🗸 | OK K Cancel Apply | | | | | | |

- 16.3.6 For Comm Ports, select the port number displayed in step 16.3.3.
- 16.3.7 Ensure that the communications settings match the settings of the HMA performed in step 16.1.1, then click OK. Ensure that the Port Owner is set to Modbus Master. For example,

| Comm Port | ? <mark>×</mark> |
|--|--|
| Comm Ports : 6 - COMM5 | |
| General Modem SRBX Store & Fo | orward Diagnostics |
| Comm Type : RS-485 | |
| Baud Rate Parity- ○ 300 ○ 600 ○ No ○ 1200 ○ 2400 ○ Evo ○ 4800 ● 9600 ○ 0d ○ 19.2 K ○ 38.4 K ○ 57.6 K ○ 115.2 K ■ Baud Rate ■ Baud Rate ■ Baud Rate ■ Baud Rate | ne Data Bits Stop Bits Key On Delay : ne 7 1 0.01 Secs en 8 0 2 Key Off Delay : d 0.01 Secs |
| Port Owner C ROC Plus Protocol/Modbus Slave C ROC Plus Protocol Only C Modbus Slave Only Modbus Master C DS 800 C LCD C I/O Module C Reserved | C User Program 1 C User Program 2 C User Program 3 C User Program 4 C User Program 5 C User Program 6 C User Program 7 C User Program 8 |
| | 🔁 Update 🖌 OK 🕺 Kancel ! Apply |

16.4. Reading registers from the HMA

- 16.4.1 Select Configure \ MODBUS from the ROCLINK 800 Menu bar.
- 16.4.2 Change the Comm Port to match the port to which the HMA is connected.
- 16.4.3 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.

- 16.4.4 For the General tab,
- 16.4.5 Ensure that the Byte Order and Comm Mode match the selections made in step 16.1.1.
- 16.4.6 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.
- 16.4.7 Select the Enabled radio button in the Continuous Polling group box.

| Modbus Configuration | ? X |
|--|-------|
| Comm Port : 6 - COMM5 | |
| General Scale Values Master Table Master Modem Registers History Table | 1 |
| Byte Order Comm Mode | |
| Most Significant Byte First C ASCII | |
| Slave Mode | |
| Exception Status : No Error C Disabled | |
| Master Mode | |
| Start Polling : 🔽 | |
| Starting Request : 1 Timeout : 5 Seconds | |
| Number of Requests : 5 Retries : 1 | |
| Continuous Polling | |
| Enabled | |
| C Disabled | |
| Request Delay : 1.0 Seconds | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| 🔁 Update 🛛 🗸 Cancel ! | Apply |

- 16.4.8 For the Master Table tab,
- 16.4.9 Set the Logical Point to 13 MastTbl 13 (COMM5).
- 16.4.10 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.
- 16.4.11 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 | MM5 👻 | | | | | | | |
| | _ | 1 | | | | | | | | |
| | cieneral j ocale values i master rable i master modem negisters History Lable | | | | | | | | | |
| | Logical Point : 13 - MastTbl 13 (COMM5) | | | | | | | | | |
| | | | | | | | | | | |
| RTU Slave Master Number Comm | | | | | | | | | | |
| | | Address | | rregister | riegister | Registers | Jiaius | | - | |
| | 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 | U - 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 🛛 🗸 | OK 🗙 Cancel ! App | y y | |
| | | | | | | | | | | |

16.4.12 For the Registers tab,

Modbus Configuration

| ndex | Start Begister | End Begister | Device Parameter(s) | Indexing | Conversion | Comm Port | | |
|------|----------------|--------------|---------------------|-----------|------------|----------------|--|--|
| 1 | 1302 | 1303 | SEP 1. DATA1 | Parameter | 67 | COMM5 | | |
| 2 | 1304 | 1305 | SFP 1, DATA2 | Parameter | 67 | СОММ5 | | |
| 3 | 1306 | 1307 | SFP 1, DATA3 | Parameter | 67 | СОММ5 | | |
| 4 | 1308 | 1309 | SFP 1, DATA4 | Parameter | 67 | СОММ5 | | |
| 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 | | |
| | | | | | | | | |

- 16.4.13 Set the Table to 1, and for each variable to be read,
- 16.4.14 Enter the Start and End Register numbers. Refer to Appendices F through S for register numbers of the HMA and attached HART devices.
- 16.4.15 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 | | | | | | | |
| | SFP 1, DATA2 | | | | | | | |
| | SEP 1 DATA3 | | F | | | | | |

? ×

| s | elect TLP | | | | ? × |
|---|---|---|--|--|----------|
| ſ | 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 Tall Show <u>A</u> II Point Types and Parameters SFP 1, DATA1 | * III III III III III III III III III I | 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 6 7 - Float 7 8 - Float 8 9 - Float 9 10 - Float 10 11 - Float 10 11 - Float 11 12 - Float 12 13 - Float 13 14 - Float 14 15 - Float 15 16 - Float 16 ✓ Show Current Value 1.968504 | |
| L | | | | 🖌 ок | X Cancel |

- 16.4.16 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.²
- 16.4.17 Set a Convert Code (see ROCLINK 800 Help) in the Conversion column () to properly interpret the data bytes into the correct numerical format.
- 16.4.18 Assign the correct Comm Port number.
- 16.4.19 Repeat as required for the remaining parameters to be read from the device.
- 16.4.20 Return to Master Table tab and ensure that the Comm Status for each line is 8, indicating a Valid Slave Response.

² Select 'Short' for the Parameter type when setting up to read the unsigned integer communication registers 3000 through 3007 in the HMA.

16.4.21 To display the values,

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

| 🚰 ROCLINK 800 - [On Line - Com1 - ROC800 - Remote Oprtns Cntrlr] | | | | | | | | | |
|--|--|-----------|------|-------------------|--------------|---------------------|--|--|--|
| 🖙 File Edit View ROC Configure Meter Utilities Tools Window Help | | | | | | | | | |
| D 🖆 🖬 3, 🖻 💼 🝜 🕸 🐂 🔍 🔍 14 M 🐜 17 M 🛱 🤻 🕑 🖀 🕒 🚰 14 🐻 2 N? | | | | | | | | | |
| 🖃 - 🂑 On Line - Com 1 - ROC800 - Rem | note Oprtn: 🔺 | LARTE CO. | | | | | | | |
| È | | | | | | | | | |
| Hand HABT Point | i∰√H System Analog Input | | | | | | | | |
| 🖃 🗝 🐝 Soft Point | | | · | | | | | | |
| 🐜 #1, Soft Pt 01 | Soft Point | | | | | ? × | | | |
| 🐂 #2, Soft Pt 02 | | | | | | Event Logging | | | |
| #3, Soft Pt U3 | Softpoints : 1 - Soft Pt 01 | | | | | | | | |
| 🐂 #5, Soft Pt 05 | Tag : Soft Pt 01 | | | | | C Disabled | | | |
| 🐜 #6, Soft Pt 06 | _ , | | | | | | | | |
| | - Float | | long | Short | Bute | Double | | | |
| ₩ #8, Soft Pt U8 | 1 20.27000 | 11 0.0 | 4 0 | 1 0 | 1.0 | 1 0.0 | | | |
| 🐝 #10, Soft Pt 10 | 1 23.37006 | | | | | 1 0.0 | | | |
| 🐝 #11, Soft Pt 11 | 2 58.73977 | 12 0.0 | 2 0 | 2 0 | 2 0 | 2 0.0 | | | |
| 🐝 #12, Soft Pt 12 | 3 29.37008 13 0.0 3 0 3 0 3 0.0 | | | | | | | | |
| #13, Soft Pt 13 | 4 58.73977 | 14 0.0 | 4 0 | 4 0 | 4 0 | 4 0.0 | | | |
| #14, Soft Pt 14 | 5 0.0 | 15 0.0 | 5 0 | 5 0 | 5 0 | 5 0.0 | | | |
| 🐜 #16, Soft Pt 16 | e 0.0 | 16 0.0 | e 0 | 6 0 | 6 0 | e 00 | | | |
| 🛶 🐝 #17, Soft Pt 17 | 7 00 | 10 0.0 | | 7 0 | | | | | |
| 🐝 #18, Soft Pt 18 | 7 0.0 | 17 0.0 | | | | 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 0.0 | 19 0.0 | 9 0 | 9 0 | 9 0 | 9 0.0 | | | |
| 🐝 #22, Soft Pt 22 | 10 0.0 | 20 0.0 | 10 0 | 10 0 | 10 0 | 10 0.0 | | | |
| 👐 #23, Soft Pt 23 | | , | 1 | 1 | 1 | , | | | |
| ** #24, Soft Pt 24 | (()))) | | | | _ (| | | | |
| ₩ #25, Soft Pt 25 ₩ #26, Soft Pt 26 | <u> 🖹 C</u> opy 📑 Paste | | | Aut <u>o</u> Scan | 🔹 Update 🛛 🗸 | OK 🗙 Cancel ! Apply | | | |
| #20, colt 1 (20 | | | | | | | | | |

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

16.5. Writing registers to the HMA

- 16.5.1 Configure the ROC 800 to access a register in the HMA or attached HART device as for reading a register from the HMA (section 16.4).
- 16.5.2 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.
- 16.5.3 Click Update to send the new setting to the ROC 800.
- 16.5.4 Open the Soft Point dialog by selecting I/O \ Soft Point in the Configuration Tree window, then double-clicking on #1, Soft Pt 01.
- 16.5.5 Highlight the value to be changed and enter the new value.
- 16.5.6 Click on Update to send the new value to the device.
- 16.5.7 Return to the Configure \ MODBUS \ Master Table tab.
- 16.5.8 Change the Function Code for the parameter to 3 Read Holding Registers or 4 Read Input Registers as appropriate.
- 16.5.9 Click on Update to send the new setting to the device.
- 16.5.10 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.
- 16.5.11 Click on Update to confirm that the device has accepted the new value.

17. 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 17.1.1 for the HMA settings and in step 17.3.10 for the ABB Totalflow XRC. 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 desired for Modbus communication with the 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.

17.2. Physical Connections

- 17.2.1 Connect the XRC to a computer using a USB-A to USB-B cable.
- 17.2.2 Connect an appropriate power supply to the battery terminal (J16) of the XRC.
- 17.2.3 Connect the HMA to a 9 30 VDC power supply via terminal block TB1.
- 17.2.4 Connect an RS-485 communications cable between the COM1 terminal block (lower position of J6) of the XRC and the RS-485 terminal block (TB2) of the HMA. The RS485+ terminal of the HMA should be connected to the BUS+ of the TotalFlow terminal block. The terminals should be connected correspondingly. See section 17.3.11.
- 17.2.5 Ensure that the appropriate communication module is inserted into the Comm 1 receptacle (XA1).
- 17.2.6 Connect a 120Ω resistor between the two RS-485 terminal block positions of the last HMA on the bus.

17.3. Initial XRC Configuration

- 17.3.1 Start the PCCU32 application.
- 17.3.2 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 | | | | | | |
| Communications | | Toolbar Buttons | | | | | |
| Serial port Connection param PCCU Com. Port: Initial Baud: Max Baud: Stop Bits: Timeout (ms): Retry Limit: | PCCU Connect Method: ● TCP/IP ● ActiveSync (NGC) ● Bluetooth eters Level 1-2 Security Code: 0000 COM10: • 2400 • 9600 • 2 • 3000 10 | Connect Connect Solution Connect Solution Solution Collision Collision Collision Collect File Transfer Collect File Transfer Valve Control Remote Protocol Remote Protocol Remote Communications TFModbus Solution Solution Collect Colle | | | | | |
| Show Comm St | ats on Status Bar | 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 | | | | | |

- 17.3.3 Select the COM port number corresponding to the XRC. The proper COM port number can be identified by navigating to the Device Manager in Windows and expanding the Ports entry.
- 17.3.4 Click Close.

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

| ि PCCU32 - [Local Connect | t] | | | - • × |
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| 👔 🧱 🛄 📀 | 🛛 🌃 🖉 | 🛄 Setup 🧇 | | |
| | 1 1 - | - • • | | |
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| | | | | |
| | | | | |
| Г | Station ID | Location | Device | |
| | TOTALFLOW | 2104062-004 | XRC | |
| | | | | |
| | Collect Hist | orical <u>D</u> ata | ntry Setup | |
| | Calib | rate | Registry | |
| | | | | |
| | Mor | ntor | | |
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| | | | | |
| | | | | |
| | | | | |
| <u> </u> | | | | |
| | | | Close | Help |
| Ready | | | #Polls: 11 #Errors: | 0 Connected to |

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

- 17.3.8 Click on Communications in the tree-view window.
- 17.3.9 Click on the Port name associated with Modbus RTU.
- 17.3.10 Ensure that the communications settings match the settings of the HMA performed in step 17.1.1. For example,

| 🔄 PCCU32 - [Entry] | | |
|---|---|--|
| 🔳 Operate View Window He | lp | _ <i>6</i> × |
| | 🍥 🛄 🐊 🥏 | |
| TOTALFLOW Ortalflow - TCP Totalflow - USB MII Serial - COM0 Modbus RTU - COM1 Used by LM- COM2 LevelMaster-COM2 I/O Interface Display Holding Registers Operations-1 Oper-2 Oil Xfer Oil Transfer Alarm System Trend System | Communication Setup Network Port Description COM0: MMI Serial - COM0 COM1: Modbus RTU - COM1 COM2: LevelMaster-COM2 USB1: Totalflow - USB Ethemet Totalflow - TCP Bluetooth (Unused) (Unassigned) Used by LM-COM2 | Port description: Modbus RTU - COM1 Protocol: Modbus Host(RTU) Port used by: Unknown Retries: 2 Timeouts & Delays Xmit key delay (ms): 2 Response delay (ms): 0 Unkey delay (ms): 1 Response timeout 1000 |
| | Add New Device/Application Delete Device/App Reread device | Port Settings Help: Click on any port parameter to display help on that topic Image: Wew port settings Image: Wew physical port Image: Wew wiring Image: Send changes to device Help Close |
| Ready | #P | olls: 26 #Errors: 0 Connected to TOTALFLOW Login: user |

17.3.11 Click on 'Send changes to device' after all settings are changed and verified.

17.3.12 The terminal block connections on the XRC can be verified by clicking on the View wiring radio button. Note that the RS485+ terminal of the HMA should be connected to the CTS/BUS+ position of the TotalFlow terminal block. The – terminals should be connected to the DCD/BUS- position of the TotalFlow terminal block.



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 Send at the bottom of the window to write them to the XRC.
- 17.4.2 Select Holding Registers from the tree-view window of the PCCU32.
- 17.4.3 Select the Capacity tab.
- 17.4.4 Set the Capacity for the Number of Arrays to 1.
- 17.4.5 Set the Capacity for Array 1 to '4', the Type to 'Float', the 'Persistence' to 'Non-Persistent', and the Name to 'Dynamic Variables'.

| ዜ _ሚ PCCU32 - [Entry] | | | | | | | | x |
|--------------------------------------|--------|------------|------------------|------------|---|----------------|--------------------------|-----|
| 🔳 Operate View Window Hel | р | | | | | | _ 6 | 7 × |
| | 1 | | setup 🥏 | | | | | |
| TOTALFLOW | | 1 | | | | | | — |
| | Dynami | ic Variabl | es Capacity | | | | | 11 |
| Totalflow - TCP | | | Description | Canacity | Type | Persistence | Name | |
| MMI Serial - COM0 | 9.2 | 55.255 | Number of Arrays | 1 | .,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | | | |
| 🖽 Modbus RTU - COM1 | 9.2 | 55.0 | Array 1 | 4 | Float | Non-Persistent | Dynamic Variables | |
| Used by LM- COM2 | | | | | J | | | |
| | | | | | | | | |
| | | | | | | | | |
| Holding Registers | | | | | | | | |
| ⊕ Operations-1 ⊕ Oper-2 Oil Xfer | | | | | | | | |
| | | | | | | | | |
| - Alarm System | | | | | | | | |
| Irend System | | | | | | | | |
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| | | | | | | | | |
| | | | | | | | | |
| | Re-re | ead |] Monitor | Print | Screen Save | Send Close | se Help XHelp 🥘 | |
| , Ready | | | | #Polls: 11 | 91 #Errors: | 0 Connected | to TOTALFLOW Login: user | |

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

| ि PCCU32 - [Entry] | | | | | | - • • × |
|---------------------------------------|-------|------------------------|----------|--------------------|-----------------------|-------------|
| 💷 Operate View Window Hel | lp | | | | | - 5 × |
| 1 🖾 🖾 🚾 | 1 |) 🛄 Setup 🕻 | ۶ | | | |
| ⊡ TOTALFLOW | Dynan | nic Variables Capacity | | | | |
| Totalflow - TCP | | Des | cription | | Value | |
| I otalflow - USB MMI Serial - COM0 | 9.0 | 0.0 PV | 1.9 | 968504 | value | |
| ⊕ Modbus RTU - COM1 | 9.0 | 0.1 SV | 3.9 |)36592 | | |
| Used by LM- COM2 | 9.0 | 0.2 TV | | 68504 | | |
| | 9 (| 0.3 QV | 1.9 | 68504 | | |
| Display | | | | | | |
| Holding Registers | | | | | | |
| Operations-1 | | | | | | |
| 💮 Oil Transfer | | | | | | |
| - Alarm System | | | | | | |
| Irend System | | | | | | |
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| | • | | | | | |
| | Ren | read 🔲 Monitor | Print | Screen Save Send | Close Help | X Help 🥘 |
| Ready | | | #Polls: | 1243 #Errors: 0 Co | onnected to TOTALFLOW | Login: user |

17.4.8 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.

- 17.4.9 Select Communications \ Modbus RTU in the tree-view window.
- 17.4.10 For the Setup tab,
- 17.4.11 Ensure that the Protocol and Baud Rate match the selections made in step 17.1.1.



17.4.12 For the Advanced tab,

17.4.13 Ensure that the Data Bits, Parity and Stop Bits match the selections made in step 17.1.1.

| Operate View Window Help B Image: Seture View Window Help Image: Seture View View View View View View View Vie | PCCU32 - [Entry] | | | | | | | |
|--|---------------------------------------|--|----------------------------------|--------|--|--|--|--|
| Image: Constructions Image: Constructions Image: Constructions Image: Constructions Image: Totalflow - USB Image: Constructions Image: Constructions Image: Constructions Image: Totalflow - USB Image: Constructions Image: Constructions Image: Constructions Image: Image: Constructions Image: Constructions Image: Constructions Image: Constructions Image: Image: Constructions Image: Constructions Image: Constructions Image: Constructions Image: Image: Constructions Image: Constructions Image: Constructions Image: Constructions Image: Image: Constructions Image: Constructions Image: Constructions Image: Constructions Image: Image: Constructions Image: Constructions Image: Constructions Image: Constructions Image: Image: Constructions Image: Constructions Image: Constructions Image: Constructions Image: Image: Constructions Image: Constructions Image: Constructions Image: Constructions Image: Image: Constructions Image: Constructions Image: Constructions Image: Constructions Image: Constructions Image: Image: Constructions Image: Constructions Image: Constructions Image: Cons | 🔝 Operate View Window Help | | | | | | | |
| Communications Contactions Totalflow - TCP Totalflow - USB MMI Serial - COM0 Modbus RTU - COM1 Used by LM- COM2 U-LevelMaster-COM2 U/O Interface Display Holding Registers Oper-2 Oil Xfer Alarm System Trend System Trend System | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | | | | | | | |
| Totalflow - TCP Totalflow - USB -MMI Serial - COM0 Modbus RTU - COM1 -Used by LM- COM2 4.0.1 -LevelMaster-COM2 4.0.4 Public Display 1 -Holding Registers 1 -Operations-1 4.1.10 -Operations-1 4.1.2 -Alarm System 4.0.13 -Totalflow - USB 1500 -Alarm System 4.0.15 Switched V-Batt/Operate Enable | ⊡. TOTALFLOW | Setup Ad | vanced Request Blocks Statistics | 1 | | | | |
| - Totalflow - USB - MMI Serial - COM0 - MMI Serial - COM0 - MMI Serial - COM1 - Used by LM- COM2 4.0.1 - LevelMaster-COM2 4.0.4 - Display - Holding Registers - Operations-1 - Mit Key Delay (milliseconds) - Operations-1 - Mit Key Delay (milliseconds) - Alarm System - Marm System - Trend System - Mit Switched V-Batt/Operate | Totalflow - TCP | | | | | | | |
| Ministerial - COMU Modbus RTU - COMI Used by LM- COM2 U- LevelMaster-COM2 4.0.4 Parity 4.0.5 Stop Bits 4.1.0 Response Delay (milliseconds) 5 4.1.1 Xmit Key Delay (milliseconds) 500 4.1.3 Timeout(milliseconds) 1500 4.0.13 Retries 2 4.0.13 Retries 2 4.0.15 Switched V-Batt/Operate Enable | Totalflow - USB | 4.0.4 | Description | Value | | | | |
| 4.0.3 Data Bits 8 Used by LM- COM2 4.0.4 Parity Even Image: UO Interface 4.0.5 Stop Bits 1 Image: UO Interface 4.0.5 Stop Bits 1 Image: UO Interface 4.1.10 Response Delay (milliseconds) 5 Image: UO Interface 4.1.10 Response Delay (milliseconds) 500 Image: UD Interface 4.1.1 Xmit Key Delay (milliseconds) 3 Image: UD Interface 4.1.1 Xmit Key Delay (milliseconds) 3 Image: UD Interface 4.1.1 Xmit Key Delay (milliseconds) 3 Image: UD Interface 4.1.3 Timeout(milliseconds) 3 Image: UD Interface 4.1.3 Timeout(milliseconds) 1500 Image: UD Interface 4.0.13 Retries 2 Image: UD Interface Image: UD Interface Image: UD Interface Image: UD Interface Image: UD Interface Image: UD Interface Image: UD Interface Image: UD Interface Image: UD Interface Image: UD Interface Image: UD Interface Image: UD Interface Image: UD Interface Image: UD Interface | Modbus PTU - COMI | 4.0.1 | Interface | K\$465 | | | | |
| B: LevelMaster-COM2 4.0.4 Parity Even B: J/O Interface 4.0.5 Stop Bits 1 Holding Registers 4.1.10 Response Delay (milliseconds) 5 B: Operations-1 0.0 For 20 Oil Xfer 500 3 B: Oil Transfer 4.1.3 Timeout(milliseconds) 3 Alarm System 4.0.13 Retries 2 4.0.15 Switched V-Batt/Operate Enable | Used by LM- COM2 | 4.0.3 | Data Bits | 8 | | | | |
| I/O Interface Display Holding Registers Operations-1 Oper-2 Oil Xfer Oil Transfer Alarm System Trend System A.115 Switched V-Batt/Operate Inable | | 4.0.4 | Parity | Even | | | | |
| Display Holding Registers Operations-1 Oper-2 Oil Xfer Oil Transfer Alarm System Trend System 4.0.13 Retries 2 4.0.15 Switched V-Batt/Operate | | 4.0.5 | 4.0.5 Stop Bits 1 | | | | | |
| 4.1.1 Xmit Key Delay (milliseconds) 500 • Oper-2 Oil Xfer 4.1.2 Unkey Delay (milliseconds) 3 • Oil Transfer 4.1.3 Timeout(milliseconds) 1500 • Alarm System 4.0.13 Retries 2 • 0.15 Switched V-Batt/Operate Enable | | 4.1.10 Response Delay (milliseconds) 5 | | | | | | |
| Oper-2 Oil Xfer Oil Transfer Alarm System Trend System 4.0.13 Retries 4.0.15 Switched V-Batt/Operate | ⊕ Operations-1 | 4.1.1 Xmit Key Delay (milliseconds) 500 4.1.2 Unkey Delay (milliseconds) 3 | | | | | | |
| Image: Oil Transfer 4.1.3 Timeout(milliseconds) 1500 Image: Alarm System 4.0.13 Retries 2 Image: 4.0.15 Switched V-Batt/Operate Enable | ⊕. Oper-2 Oil Xfer | | | | | | | |
| 4.0.13 Retries 2 4.0.15 Switched V-Batt/Operate Enable | Oil Transfer | I Transfer 4.1.3 Timeout(milliseconds) 1500 | | | | | | |
| 4.0.15 Switched V-Batt/Operate Enable | Alarm System 4.0.13 Retries 2 | | | | | | | |
| | - , | 4.0.15 Switched V-Batt/Operate Enable | | | | | | |
| Re-read V Monitor Print Screen Save Send Close Help XHelp A | | | | | | | | |

17.4.14 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.
- 17.4.15 For the Request Blocks tab,
- 17.4.16 Set the Slave Address to match the address of the HMA (if in HMA mode), or an attached device (if in Device mode).
- 17.4.17 Select '4 Read Input Registers' from the Modbus function drop-down.
- 17.4.18 Set the Starting Register to a value 1 greater than the desired starting Modbus register. Refer to Appendices F through S for register numbers of the HMA and attached HART devices.

| 📴 PCCU32 - [Entry] |
|---|
| Operate View Window Help |
| Operate View Window Help Image: Second S |
| Ready #Polls: 80 #Errors: 0 Connected to TOTALFLOW Login: user |

- 17.4.19 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.
- 17.4.20 Set the Register Type to Float.
- 17.4.21 Set the Trigger Type to Interval and the Interval time to the desired sampling rate.
- 17.4.22 Set the Destination Registers to the register numbers from step 17.4.8.
- 17.4.23 Click on Send to update the RTU.

17.4.24 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.

| <u>ዜ</u> PCCU32 - [Entry] | |
|---------------------------|--|
| 💷 Operate View Window H | elp – B × |
| 10 📅 🖫 💽 | 🦚 🛄 seup 🧇 |
| ⊡.· TOTALFLOW | Setup Advanced Request Blocks Statistics Packet Log |
| Totalflow - TCP | \Comm-4\Packet.Log |
| Totalflow - USB | 03/14/14 12:15:32 -> F7041041EB468D426B46AE41EB468D41EB468D01A3 |
| MMI Serial - COM0 | 03/14/14 12:15:34 <- F704051600080452 03/14/14 12:15:34 -> F7041041FR972F426R952341FR972F41FR972F5291 |
| Modbus RTU - COM1 | 03/14/14 12:15:36 <- F704051600080452 |
| Used by LM- COM2 | 03/14/14 12:15:36 -> F7041041EB972E426B952341EB972E41EB972E5291 03/14/14 12:15:38 E704051600080452 |
| LevelMaster-COM2 | 03/14/14 12:15:38 -> F70410416B972E426B952341EB972E41EB972E5291 |
| ⊕ I/O Interface | 03/14/14 12:15:40 <- F704051600080452 03/14/14 12:15:40 -> E7041041EB972E426B952341EB972E41EB972E5291 |
| | 03/14/14 12:15:42 <- F704051600080452 |
| Operations 1 | 03/14/14 12:15:42 -> F7041041EB972E426B952341EB972E41EB972E5291 |
| Der-2 Oil Xfer | 03/14/14 12:15:44 -> F7041031000000432 |
| | 03/14/14 12:15:46 <- F704051600080452 |
| Alarm System | 03/14/14 12:15:48 <- F704051600080452 |
| Trend System | 03/14/14 12:15:48 -> F7041041EB468D426B46AE41EB468D41EB468D01A3 |
| - , | 03/14/14 12:15:50 -> F7041041EB468D426B46AE41EB468D41EB468D01A3 |
| | 03/14/14 12:15:52 <- F704051600080452 |
| | 03/14/14 12:15:52> r /04 104 TEAF5EC426AF5854 TEAF5EC4 TEAF5ECBAF7 |
| | 03/14/14 12:15:54 -> F7041041EAF5EC426AF58541EAF5EC41EAF5ECBAF7 |
| | 03/14/14 12:15:56 <- F /04051600080452 03/14/14 12:15:56> F7041041EAF5EC426AF58541EAF5EC41EAF5ECBAF7 |
| | |
| | |
| | |
| | Re-read Vonitor Log Size 25 V #Errors: 177 #Polls: 1778 Close Help |
| Ready | #Polls: 524 #Errors: 0 Connected to TOTALFLOW Login: user |

- 17.4.25 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.
- 17.4.26 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
- 17.4.27 To display the values,
- 17.4.28 Select Holding Registers from the tree-view window of the PCCU32.
- 17.4.29 Select the Dynamic Variables tab.
- 17.4.30 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 17.4.21.

17.5. Writing registers to the HMA

- 17.5.1 The followings steps demonstrate how to change a parameter in a HART device attached to the HMA. The Blocking Distance parameter is used as the example. When making any changes to the settings, click on Send at the bottom of the window to write them to the XRC.
- 17.5.2 Select Holding Registers from the tree-view window of the PCCU32.
- 17.5.3 Select the Capacity tab.

| 🖳 PCCU32 - [Entry] | | | | | | | | | |
|---------------------------------------|----------------|----------------------------|------------|-------------|----------------|--------------------------|--|--|--|
| 🔝 Operate View Window Help | | | | | | | | | |
| 1 🔤 🖫 🐼 🌆 🕸 🛄 🔍 🧇 | | | | | | | | | |
| - TOTALFLOW | Dynamic Variab | les Blocking Distance Capa | acity | | | | | | |
| Totalflow - TCP | · · · · · · | | | | | | | | |
| Totalflow - USB | | Description | Capacity | Туре | Persistence | Name | | | |
| MMI Serial - COM0 | 9.255.255 | Number of Arrays | 2 | | | | | | |
| i Modbus RTU - COM1 | 9.255.0 | Array 1 | 4 | Float | Non-Persistent | Dynamic Variables | | | |
| Used by LM- COM2 LevelMaster-COM2 | 9.255.1 | Array 2 | 1 | Float | Non-Persistent | Blocking Distance | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| Oper-2 Oil Xfer | | | | | | | | | |
| | | | | | | | | | |
| Alarm System | | | | | | | | | |
| ia. Trend System | | | | | | | | | |
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| | | | | | | | | | |
| | L | | | | | | | | |
| | Re-read | Monitor | Print | Screen Save | Send Clo | se Help XHelp 🍋 | | | |
| Ready | | | #Polls: 14 | 31 #Errors: | 0 Connected | to TOTALFLOW Login: user | | | |

- 17.5.4 Set the Capacity for the Number of Arrays to 2.
- 17.5.5 Set the Capacity for Array 2 to '1', the Type to 'Float', the 'Persistence' to 'Non-Persistent', and the Name to 'Blocking Distance'.

- 17.5.6 Select the Blocking Distance tab.
- 17.5.7 Change the description of the register to 'Blocking Distance'.

| PCCU32 - [Entry] | | | | | | _ 0 _ X |
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| TOTALFLOW | | vnamic \ | /ariables Blocking Distance Canacity | | | |
| Communications Totalflow - TCP | | ynanio i | Capacity | | | |
| Totalflow - USB | | | Description | | Value | |
| MMI Serial - COM0 | | 9.1.0 | Blocking Distance | 4.2 | | |
| 🖶 Modbus RTU - COM1 | | | L | 1 | | |
| Used by LM- COM2 | | | | | | |
| EevelMaster-COM2 I/O Interface | | | | | | |
| ⊕. Display | | | | | | |
| Holding Registers | | | | | | |
| | | | | | | |
| ⊕ Oper-2 Oil Xfer | | | | | | |
| Alarm System | | | | | | |
| Trend System | | | | | | |
| | | | | | | |
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| | | | | | | |
| | | • | | | | • |
| | | Re-read | Monitor Pr | int Screen Save Se | nd Close Help | X Help 🍋 |
| Ready | | | #Po | lls: 1431 #Errors: 0 | Connected to TOTALFLOW | Login: user |

17.5.8 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.

- 17.5.9 Select Communications \ Modbus RTU in the tree-view window.
- 17.5.10 For the Setup tab,
- 17.5.11 Ensure that the Protocol and Baud Rate match the selections made in step 17.1.1.



17.5.12 For the Advanced tab,

17.5.13 Ensure that the Data Bits, Parity and Stop Bits match the selections made in step 17.1.1.

| PCCU32 - [Entry] | | | | | | | | | | |
|----------------------------|---------|-----------------------------------|---|--|--|--|--|--|--|--|
| 🗈 Operate View Window Help | | | | | | | | | | |
| 1 🖾 🖾 🚾 | 1 | 🚳 🛄 Setup 🧇 | | | | | | | | |
| TOTALFLOW | Setup A | dvanced Request Blocks Statistics | | | | | | | | |
| Totalflow - TCP | | Description | | | | | | | | |
| Totalflow - USB | 404 | Description | Value | | | | | | | |
| Modbus BTU - COM | 4.0.1 | Interface | K\$465 | | | | | | | |
| Used by LM- COM2 | 4.0.3 | Data Bits | 8 | | | | | | | |
| . LevelMaster-COM2 | 4.0.4 | Parity | Even | | | | | | | |
| | 4.0.5 | Stop Bits | 1 | | | | | | | |
| ian Display | 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 | 4.1.3 | Timeout(milliseconds) | 1500 | | | | | | | |
| | 4.0.13 | Retries | 2 | | | | | | | |
| | 4.0.15 | Switched V-Batt/Operate | Enable | | | | | | | |
| Produ | Re-read | Monitor Pri | nt Screen Save Send Close Help X Help 💓 | | | | | | | |

17.5.14 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.

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

| E PCCU32 - [Entry] |
|--|
| Operate View Window Help |
| Exp PCCU32 - [Entry] Operate View Window Help Image: State of the state of |
| Re-read Add Delete Save Send As Send Close Help |
| Ready #Polls: 1431 #Errors: 0 Connected to TOTALFLOW Login: user |

- 17.5.19 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.
- 17.5.20 Set the Register Type to Float.
- 17.5.21 Set the Trigger Type to Register and the Register number to the register number from step 17.5.8. This will cause the write to be sent when the assigned register is changed from the Holding Registers menu.
- 17.5.22 Set the Source to the register number from step 17.5.8.
- 17.5.23 Select a name for the Request Block if prompted.

- 17.5.24 Select Holding Registers from the tree-view window of the PCCU32.
- 17.5.25 Select the Blocking Distance tab.
- 17.5.26 Change the Value to the desired distance.

| Eg PCCU32 - [Entry] | | | | | | - • × |
|-------------------------|------|----------|---|--------------------|--------------------------|-------------|
| 🔳 Operate View Window H | lelp | | | | | _ 8 × |
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| TOTALFLOW | D | rnamic V | ariables Blocking Distance Capacity | | | |
| Totalflow - TCP | 116 | | Description of the second s | | | |
| Totalflow - USB | | 040 | Description | 4.0 | Value | |
| Madhus PTU COM | | 9.1.0 | BIOCKING DISTANCE | 4.2 | | |
| Ised by I M₂ COM2 | | | | | | |
| LevelMaster-COM2 | | | | | | |
| | | | | | | |
| . Display | | | | | | |
| - Holding Registers | | | | | | |
| • Operations-1 | | | | | | |
| ⊕ Oper-2 Oil Xfer | | | | | | |
| Oil Transfer | | | | | | |
| Trend System | | | | | | |
| B. Held System | | | | | | |
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| | | | | | | , |
| | | Re-read | Monitor P | rint Screen Save | Send Close Help | X Help 🧶 |
| Ready | p | | #Po | lls: 1431 #Errors: | 0 Connected to TOTALFLOW | Login: user |

17.5.27 Click on Send at the bottom of the window.

17.5.28 To check if the value has been accepted, follow the steps in section 17.4 changing selections as needed to create a request block to read the Blocking Distance parameter from the HMA or attached HART device.

18. 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 value returned by Command Uxx? as Level 1 (the Upper Level for Magnetrol Devices) and the second float value 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. The Echo Strength from the attached transmitter is displayed as the Temperature in the tank view diagram of the Communications \ LevelMaster menu in the PCCU application.

18.1. Initial HMA Configuration

18.1.1 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for LevelMaster communication with the 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.

18.2. Physical Connections

- 18.2.1 Connect the XRC to a computer using USB-A to USB-B cable.
- 18.2.2 Connect an appropriate power supply to the battery terminal (J16) of the XRC.
- 18.2.3 Connect the HMA to a 9 30 VDC power supply via terminal block TB1.
- 18.2.4 Connect an RS-485 communications cable between the COM2 terminal block (upper position of J6) of the XRC and the RS-485 terminal block (TB2) of the HMA. The RS485+ terminal of the HMA should be connected to the BUS+ of the TotalFlow terminal block. The terminals should be connected correspondingly. See section 18.3.14.
- 18.2.5 Ensure that the appropriate communication module is inserted into the Comm 2 receptacle (XA2).
- 18.2.6 Connect a 120Ω resistor between the two RS-485 terminal block positions of the last HMA on the bus.

18.3. Initial XRC Configuration

- 18.3.1 Start the PCCU32 application.
- 18.3.2 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 | | | | | | | | |
| Communications | Toolbar Buttons | | | | | | | |
| PCCU Connect Method: Image: Serial port TCP/IP Active Sync (NGC) Bluetooth Connection parameters Level 1-2 Security Code: 0000 PCCU Com. Port: COM10: ▼ Initial Baud: 2400 ▼ Max Baud: 9600 ▼ Stop Bits: 2 ▼ Timeout (ms): 3000 ▼ | Connect Disconnect NGC Operate Finty Monitor Terminal Calibrate Collect File Transfer Valve Control Remote Protocol Remote Protocol Remote Communications TFModbus 32 Bit X-Series Loader Valve Cotartup Wizard | | | | | | | |
| Show Comm Stats on Status Bar | | | | | | | | |
| Auto Connect Image: None Entry Collect Initial Connect Image: Use default Role Based Access Control credentials | | | | | | | | |
| Default Role Based Access Control Usemame | | | | | | | | |
| Default Role Based Access Control Password | | | | | | | | |
| | Close Help | | | | | | | |

- 18.3.3 Select the COM port number corresponding to the XRC. The proper COM port number can be identified by navigating to the Device Manager in Windows and expanding the Ports entry.
- 18.3.4 Click Close.

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

| ि दि PCCU32 - [Local Connec | ct] | | | _ D <mark>_ X</mark> |
|--------------------------------|-------------|------------------------|---------------------|----------------------|
| 💷 Operate View Win | dow Help | | | _ 8 × |
| | 🌃 🚳 | 🛄 🧟 🤣 | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | Station ID | Location | Device | |
| | TOTALFLOW | 2104062-004 | XRC | |
| | | | | |
| | Collect His | torical <u>D</u> ata E | ntry Setup | |
| | Calil | brate | Registry | |
| | | | | |
| | Mo | nitor | | |
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| | | | | |
| | | | | |
| | | | | |
| | | | Close | Help |
| Ready | | | #Polls: 11 #Errors: | 0 Connected to a |

18.3.6 Select Entry Setup from the Local Connect initial dialog.

- 18.3.7 Select View \ Advanced from the PCCU32 menu bar.
- 18.3.8 Click on Communications in the tree-view window.
- 18.3.9 Click on the Port name associated with Modbus RTU.
- 18.3.10 Select 'Tank Gauge' for the Protocol.
- 18.3.11 Set the Unkey delay to 3 ms.
- 18.3.12 Ensure that the communications settings match the settings of the HMA performed in step 18.1.1. For example,

| 📴 PCCU32 - [Entry] | | |
|---|--|---|
| Derate View Window He | elp | _ 8 × |
| | 🚳 🎹 🤰 🛷 | |
| TOTALFLOW Order Totalflow - TCP Totalflow - USB Totalflow - USB MMI Serial - COM0 Modbus RTU - COM1 Used by LM- COM2 LevelMaster-COM2 Setup Tank Data Tank 1 Tank Calibrate I/O Interface Display Holding Registers Operations-1 Oper-2 Oil Xfer Oil Transfer Alarm System Trend System | Image: Network Port Network Port Description Port description: L COM0: MMI Serial - COM0 Port description: L COM1: Modbus RTU - COM1 Protocol: Tank Gauge COM2: LevelMaster-COM2 Port used by: LevelMast Bluetooth (Unused) Port used by: LevelMast Retries: 1 (Unassigned) Used by LM- COM2 Port Settings Help: Of that topic Port Settings Help: Of that topic Add New Device/Application Delete Device/App @ View port settings Port settings | evelMaster-COM2 ge Serial port settings Baud: 9600 Parity: None Data bits: 8 Compared by Stop bits: 1 Timeouts & Delays Timeouts & Delays Xmit key delay (ms): 10 0 Unkey delay (ms): 3 Power up delay (ms): 0 Chick on any port parameter to display help on |
| | Reread device Send changes | s to device Help Close |
| Ready | #Polls: 3540 #Errors: (| 0 Connected to TOTALFLOW Login: user |

18.3.13 Click on 'Send changes to device' after all settings are changed and verified.

18.3.14 The terminal block connections on the XRC can be verified by clicking on the View Wiring radio button. Note that the RS485+ terminal of the HMA should be connected to the CTS/BUS+ position of the TotalFlow terminal block. The – terminals should be connected to the DCD/BUS- position of the TotalFlow terminal block.



18.4. Reading registers from the HMA

- 18.4.1 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.
- 18.4.2 Select Communications \ LevelMaster \ Setup in the tree-view window of the PCCU32.
- 18.4.3 For the Setup tab,
- 18.4.4 Set the Number of Tanks to the number of attached HART devices to be read.
- 18.4.5 Click on 'Send'.

| ित PCCU32 - [Entry] | | | | | | | | x |
|-----------------------|----|----------|-------------|------------------------|-------|--|-------------|------|
| Derate View Window He | lp | | | | | | _ 5 | '× |
| | 1 | 1 |) 2 | <i>i</i> | | | | |
| | | | Setup | \sim | | | | _ |
| - Communications | Se | tup Comm | nunications | Request Blocks Statist | tics | Packet Log | | |
| Totalflow - TCP | F | | | | | | | |
| Totalflow - USB | | | | Description | | Value | | 111 |
| MMI Serial - COM0 | | 0.4.52 | Device/Al | PP ID | | LevelMaster-COM2 | | |
| Modbus RTU - COM1 | | 51.107.0 | Number o | of Tanks | | 1 | | |
| I evelMaster-COM2 | | | | | | | | |
| Setup | | | | | | | | |
| Tank Data | | | | | | | | |
| Tank1 | | | | | | | | |
| ⊡ I ank Calibrate | | | | | | | | |
| | | | | | | | | |
| Holding Registers | | | | | | | | |
| ⊕. Operations-1 | | | | | | | | |
| 🕀 Oper-2 Oil Xfer | | | | | | | | 1.11 |
| Oil Transfer | | | | | | | | 1.11 |
| Trend System | | | | | | | | 1.11 |
| | | | | | | | | |
| | | | | | | | | 1.11 |
| | | | | | | | | |
| | | • | | | | | • | |
| | | Re-read | Monitor | P | nint | Screen Save Send Close Help | X Help 🔌 | 1 |
| Ready | | | | #Pc | olls: | 3545 #Errors: 0 Connected to TOTALFLOW | Login: user | |

- 18.4.6 For the Communications tab,
- 18.4.7 Ensure that the communication settings match the selections made in steps 18.1.1 and 18.3.12.

| Ptg. PCCU32 - [Entry] | | | | | | | | |
|-------------------------------|---|--------|---------------------------------------|--|--|--|--|--|
| 🔝 Operate View Window Help | | | | | | | | |
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| TOTALFLOW | | | | | | | | |
| Communications | Setup | Com | munications Request Blocks Statistics | Packet Log | | | | |
| Totalflow - TCP | | | | | | | | |
| ···· Totalflow - USB | | | Description | Value | | | | |
| MMI Serial - COM0 | 51 | 1.3.3 | Serial Port | COM2: | | | | |
| Head by I M₂ COM2 | 51 | 1.0.22 | Port Type | OnBoard Serial | | | | |
| EvelMaster-COM2 | 51 | 1.0.6 | Protocol | Tank Gauge | | | | |
| Setup | 51.0.1 51.0.2 | | Interface | Rs485 | | | | |
| ⊡ Tank Data | | | Baud Rate | 9600 | | | | |
| ⊞. Tank Calibrate | 51 | 1.0.3 | Data Bits | 8 | | | | |
| | 51 | 1.0.4 | Parity | None | | | | |
| Display Holding Perinters | 51 | 1.0.5 | Stop Bits | 1 | | | | |
| ⊕. Operations-1 | 51 | 1.1.1 | Xmit Key Delay (milliseconds) | 10 3 | | | | |
| ⊕. Oper-2 Oil Xfer | 51 | 1.1.2 | Unkey Delay (milliseconds) | | | | | |
| Oil Transfer | 51 | 1.1.3 | Timeout (milliseconds) | 5000 | | | | |
| | 51 | 1.0.15 | Switched V-Batt/Operate | Enable | | | | |
| | 51 | 1.1.0 | Power Up Delay (milliseconds) | 0 | | | | |
| | 51 | 1.0.13 | Retries | 1 | | | | |
| | • | | | | | | | |
| | | | | | | | | |
| | Re-read Monitor Print Screen Save Send Close Help XHelp 🍇 | | | | | | | |
| Ready | | | #Polls: | 3597 #Errors: 0 Connected to TOTALFLOW Login: user | | | | |

- 18.4.8 For the Request Blocks tab,
- 18.4.9 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? to provide data for the SV output of the attached HART device.
- 18.4.10 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.)
- Bc, PCCU32 - [Entry] Operate View Window Help _ 8 × 🗓 🪽 MB 6 Ø f 🗐 📼 ++ I TOTALFLOW Setup Communications Request Blocks Statistics Packet Log Communications - Totalflow - TCP Totalflow - USB MMI Serial - COM0 Modbus RTU - COM1 Request Blocks Auto Config Used by LM- COM2 Application Sensor Tank Num. LevelMaster-COM2 51 * * Dual Level 1 Setup Ŧ 🗄 - Tank Data Registers Tank 1 ID 1 -Register H Tank Calibrate Unit ID 51.100.2 Interval 00:00:02 🚔 # Levels 51.100.1 Display 51.105.0 Trigger Level 1 51.103.0 - Holding Registers . Operations-1 Status 51.105.1 Level 2 51.103.1 🗄 Oper-2 Oil Xfer Temp. 51.103.2 Power Cycle . Oil Transfer Error 51.102.0 Delay 51.111.0 - Alarm System Warning 51.102.1 Trend System PolITime 51.104.0 Output 51.105.2 X Help 🌏 Re-read Add Delete Save Send As Send Close Help Ready #Polls: 3598 #Errors: 0 Connected to TOTALFLOW Login: user
- 18.4.11 Click on 'Send'.

- 18.4.12 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.
- 18.4.13 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.
- 18.4.14 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 | i × |
|---|-----|
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| TOTALFLOW Setup Communications Request Blocks Statistics Packet Log | _ |
| Communications Constructions Construction Constructions Constructions Constructions Constru | |
| Totalflow - USB 03/17/14 09:37:54> U01D029.44D058.89F083E0000W0000C7655[0D][0A] | - |
| MMI Serial - COM0 03/17/14 09:37:56 U01?[0D][0A] 03/17/14 09:37:56> U012[0D][0A] | |
| Modbus RTU - COM1 [03/17/14 09:37:58 < U01?[0D][0A] | |
| Used by LM- COM2 03/17/14 09:37:58 -> 001D029.44D058.89F083E0000W0000C7655[0D][0A] | |
| LevelMaster-COM2 03/17/14 09:38:00 -> U01D029.44D058.89F083E0000W0000C7655[0D][0A] Setup | |
| □ 3/17/14 05:38:02 <- 001/[00][0A] | |
| 03/17/14 09:38:04 < U01?[0D][0A] | |
| Tank Calibrate [03/17/14 09:38:06 <- U01?[0D][0A] | |
| I/O Interface [03/1//14 09:38:06 -> 001D029.40D058.81F083E0000W0000C4360[0D][0A] [03/1//14 09:38:08 <- U01?0D1[0A] [03/17/14 09:38:08 <- U01?0D1[0A] | |
| Display 03/17/14 09:38:08 -> U01D029.40D058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:08 -> U01D029.40D058.81F083E0000W0000C4360[0D][0A] | |
| | |
| Operations=1 | |
| Oil Transfer Oil Transfer | |
| Alarm System 03/1//14 09:38:14 -> 001D029.40D058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:16 <- U01?(0D)[0A] | |
| Trend System 03/17/14 09:38:16 -> U01D029.40D058.81F083E0000W0000C4360[0D][0A] 03/17/14 09:38:16 -> U01D029.40D058.81F083E0000W0000C4360[0D][0A] | |
| 03/17/14 09:38:18> U01D029.44D058.89F083E0000W0000C7655[0D][0A] | |
| | |
| | |
| | 4 |
| Re-read V Monitor Log Size 25 - #Errors: 32788 #Polls: 37145 Close Help | |
| Reading Poll Statistics | |

18.4.15 To display the values,

18.4.16 Select Communications \ LevelMaster \ Tank Calibrate \ Tank x from the tree-view window of the PCCU32.

| E. PCCU32 - [Entry] | | | | | X |
|----------------------------|----|----------|---------------------------|---|--------|
| 🗈 Operate View Window Help | | | | | |
| 10 🖾 🖫 🚾 | : | 🎯 🛄 | 🔍 🦻 🧇 | | |
| E. TOTALFLOW | Ca | alibrate | | | |
| Totalflow - TCP | | | Dennistian | | |
| - Totalflow - USB | | 54 447 0 | Name | Value | Â |
| Modbus RTU - COM | | 51.117.0 | | | |
| Used by LM- COM2 | | 51.108.0 | No. of Tank Sections | 1 | |
| □ LevelMaster-COM2 | | | | | |
| Setup | | | Section Heights | | = |
| | | 51.109.9 | Height 10 | 10 | |
| ⊡ I ank Calibrate | | 51.109.8 | Height 9 | 10 | |
| ± I/O Interface | | 51.109.7 | Height 8 | 10 | |
| | | 51.109.6 | Height 7 | 10 | |
| Operations-1 | | 51.109.5 | Height 6 | 10 | |
| ⊕. Oper-2 Oil Xfer | | 51.109.4 | Height 5 | 10 | |
| Oil Transfer | | 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 | 2 |
| Ready | | | #Polls: | 3907 #Errors: 0 Connected to TOTALFLOW Login: u | iser 🔡 |

- 18.4.17 Set the number of Tank Sections in row 51.108.x.
- 18.4.18 For each tank section, set the height of that section in rows 51.109.x
- 18.4.19 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.

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



- 18.4.21 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 18.4.9.
- 18.4.22 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 Upper 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 18.4.15 through 18.4.19.
- 18.4.23 If the Measurement Type of the device is set to Level, the Level 1 and Level 2 readings will be the same, Volume 1 will always be 0 and Volume 2 will represent the total volume.
- 18.4.24 Any Errors or Warnings from the attached HART device will appear under the bottom right section of the tank image.

18.5. 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.

19. 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 19.1.1 for the HMA settings, and step 19.4.5. The Modbus RTU protocol is used for the following.

19.1. Initial HMA Configuration

19.1.1 Using Procedure 1, ensure that registers 3000 through 3007 of the HMA match the values shown for RTU 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 to open the Write Single Register dialog, enter the new value, and then click on Send.

19.2. Physical Connections

- 19.2.1 Connect the AutoPILOT PRO to a computer using a CHIT computer connection cable (ThermoScientific p/n 3-0446-090).
- 19.2.2 Connect an appropriate 12 VDC power supply to the terminals of TB-1 on the inside of the AutoPILOT PRO front panel.
- 19.2.3 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 '+' terminal of the HMA should be connected to the TX+ terminal of TB-16. The '-' terminal of the HMA should be connected to the TX- terminal of TB-16.
- 19.2.4 On the main board of the AutoPILOT PRO, add a jumper to pins 15-16 of J39 to select 2-wire mode.
- 19.2.5 On the main board of the AutoPILOT PRO, add a jumper to J40 to select RS-485 mode.
- 19.2.6 Connect a 120Ω resistor between the two RS-485 terminal block (TB2) positions of the last HMA on the bus.

19.3. Initial AutoPILOT PRO Configuration

- 19.3.1 Start the AutoCONFIG application.
- 19.3.2 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 | Parameters | | | | X | - |
|-----------------|---------------------------|-------------|-----------------------------|-----------|-----------|---|
| Connection In | fo | Connec | tion List | | | |
| *Name | Local Connection | | Name | Unit Type | Adress | C |
| | | | Local Connection Offline | AutoEX | 255 | ď |
| *Unit Type | AutoEXEC - AutoPilot Pro | | | | | |
| *Address | 255 🗖 Exten | ded Address | | | | |
| *Comm. Port | COM1 | | | | | |
| Dhono # | SCT & Weit | | | | | |
| Phone # | | 0 MSec | | | | |
| *Baud Rate | 57.6 K • RTS Wait | 0 MSec | | | | |
| *Parity Bit | None *RTS Rise | 0 MSec | | | | |
| *Stop Bit | 1 Stop *RT S Fall | 0 MSec | | | | |
| | | | | | | |
| | | | | | | |
| *Num Retries | 1 *Num. Nulls 0 *Max RX [| Delay 3 Sec | < | | | Þ |
| All fields with | * must be filled in | , | Connect Save | Delete | Close | |

- 19.3.3 Select the COM port number corresponding to the CHIT cable.
- 19.3.4 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.
- 19.3.5 If any changes to the settings have been made, click on Save.
- 19.3.6 Click on Connect to establish communication with the AutoPILOT PRO.

19.4. Reading registers from the HMA

- 19.4.1 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.
- 19.4.2 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 | | | | | | - 0 - x | 3 |
|---|-----------------------------------|----------------------------|------------------------------|------------------|------------------|----------------|-----|
| <u>System Files T</u> ools <u>O</u> ptions | <u>C</u> olors <u>P</u> rogrammab | le Screen <u>H</u> elp | | | | | |
| h ff f Q 4 (| 7 🕒 🏷 冬 | 3 | | | Ad | dvanced Mo | ode |
| Navigation Bar 🛛 🕈 | Modbus Master Commu | inication Block - Entry #1 | Communication Port Definitio | n - H - Entry #1 | | 4 ⊳ | x |
| Physical Data Point(s) ¥ | Auto Refresh | Refresh Appl | у | Help | · 😨 🛛 | | - |
| Calculation(s) ¥ | | | | | | | |
| Communication(s) * | | | | | | | |
| ⊪⊸ 64-Radio Scheduling | Calculation | Enabled 🔹 | Repeat Tim | er | 0 | | |
| 96-Communication Port(s) | Descriptor | Host Comm Port | RTS Delay | | 0 | mSec | |
| -Host Comm Port | Mode | Master - | Handshakin | g None | • | | |
| Comm Port# 2 | Baud Rate | 9600 - | Protocol Fo | rmat RTU | • | | |
| Comm Port# 3 | Data Bit | 8 Bits 🔻 | | 1 | | | |
| Comm Port# 4 | Parity | Even 🔻 | | | | | |
| 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] | | | I | | | | |
| Entry#2 | | | | | | | |
| Entry#4 | | | | | | | |
| 99-Ultrasonic Meter | | | | | | | |
| iangleright for the second se | | | | | | | |
| ⊞ 101-Tank Gauge | | | | | | | |
| Interface | | | | | | | |
| Miscellaneous × | | | | | | | |
| User Configurable ¥ | 4 | | | | | | Ŧ |
| | | Access Level: Supervisor | Mdd: 255 Baud: 57600 | SID = N/A | TX - 1799 DX - 4 | 799 EBB · 0 | 1 |
| | | Access Level, superuser | Aug. 200 Daug. 07000 | 310 - M/A | 1A. 1733 RA: 1 | 100 ERR : 0 | 10 |

- 19.4.3 Set Calculation to Enabled.
- 19.4.4 Set the Repeat Timer to the desired sampling interval in seconds.
- 19.4.5 Ensure that the communication settings match the selections made in step 19.1.1.
- 19.4.6 Set the Comm. Block Ref to 1, the Comm Block to Modbus Master, and the Block Index to Entry #1.
- 19.4.7 Click on Apply to send the settings to the AutoPILOT PRO.

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

| S Local Connection | | | | | | |
|---|---|--|--|---------------------------------------|--------------------|--------------|
| System Files Iools Optio | ns <u>Colors</u> Programmable Screen | Help | | | Advan | nced Mode |
| Navigation Bar 4 | Modbus Master Communication Block | - Entry #1 Floating Point \ | alue - Blk Dist Floating Point Value - S | lave 1 PV | | ∢ ⊳ × |
| Physical Data Point(s) * | Auto Refresh Refresh | Apply | Help | | | _ |
| I-Floating Point Value Slave 1 PV = 120.0 in Slave 1 SV = 0.0 in Slave 1 QV = 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 Smart XDuce 19-Physical Accumulator 20-Physical Accumulator | Master Comm. Enable Comm. Type Read Address | AutoMitter 247 Extended / Comm Ok Modbus Fi sRTU ▼ Fit Pt Regi 1302 FP Byte O 4 16-Bit Reg 7.0.0.1 Encap Mod 0 | Mode Disabled Addressing Disabled Inction Code FC04 - Read Input Re ster Size 2 * 16-Bit Registers der Daniel (4,3,2,1) ster Disabled Ibus Format IP TCP | ■ egister ■ ■ ■ ■ ■ | | E |
| | Register Point Number | Field Description | | Value | | |
| Calculation(s) ▼ Communication(s) ★ ⊕ - 64-Radio Scheduling ⊕ ⊕ - 96-Communication Port(s ♥ ⊕ - 97-Modbus Slave ▼ | 1302 1303 1304 1305 * | | | (null) (null) (null) (null) | | |
| | | Access Lev | el: Superuser Add: 255 Baud: 576 | 00 SID = N/A T | X : 2247 RX : 2245 | ERR:2 |

- 19.4.9 Set Master Comm. to Enable.
- 19.4.10 Set Comm. Type to Read.
- 19.4.11 Set the Address to the Modbus address of the HMA.
- 19.4.12 Set the Start Register to 1302 (the start of the PV register for Slave 1 in the HMA).
- 19.4.13 Set the Num Entries to 4 (four 32-bit floating point numbers).
- 19.4.14 The Host IP Address, Host Port Number, AutoMitter Mode, Extended Addressing and Encap Modbus Format can be ignored.
- 19.4.15 Set the Modbus Function Code to FC04 Read Input Register.
- 19.4.16 Set the Flt Pt Register Size to 2 * 16-Bit register, and the FP Byte Order to Daniel (4,3,2,1).
- 19.4.17 Set the 16-Bit Register to Disabled.
- 19.4.18 Click on Apply to send the settings to the AutoPILOT PRO.

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

| Scal Connection | | | | | - 🗆 🗙 |
|---|---|-----------------------------|--|------------------------------|---------------|
| <u>System Files T</u> ools <u>O</u> ptions | s <u>C</u> olors <u>P</u> rogrammable Scree | en <u>H</u> elp | | | |
| 8) FF F & 4 | ø 🕒 🏷 🤣 | | | | Advanced Mode |
| Navigation Bar 4 | odbus Master Communication Block - | Entry #1 Communication Port | t Definition - H - Entry #1 Floating Point Value | 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 | <u> </u> |
| Table 1 Item 3 Pt 1-3 [Table 1 Item 4 Pt 1-4 [| Descriptor #1 | Slave 1 PV | Current Status | Normal | |
| | Descriptor #2 Engineering Unit | Pt 1-1 Descr2 | Current Value | 42.0 | |
| Table 1 Item 8 Pt 1-8 [| Aud/Alm Reg Index Alarm Hysteresis Value | 0 | Scale Value | 0 | |
| | Data Blocks | | Security Access | | |
| B[™] 15-Text B[™] 16-Physical Analog Input T7-Physical Smart XDuc | Not Assigned | Log Audits | Measurement Control | I Technician I Supervisor | |
| 19-Physical Discrete Inpu 20-Physical Accumulator 21-Physical Analog Outr | | | | | |
| | Low Alarm | Enabled | High Alarm | Enabled | |
| Communication(s) * | Low Low Alarm | Enabled | High High Alarm High Value Limit | Enabled | |
| e4-Radio Scheduling e→ 96-Communication Port(: e→ Host Comm Port | | , | | | |
| Comm Port# 1 Comm Port# 2 ↓ | | | | | |
| | | Access Level: | Superuser Add: 255 Baud: 57600 S | SID = N/A TX : 26252 RX : | 26252 ERR : 0 |

19.4.21 Click on Apply to send the settings to the AutoPILOT PRO.

19.4.22 Right click on the Slave 1 PV entry in the Navigation Bar and select Copy.

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

| Local Connection | | |
|--|---|---|
| <u>S</u> ystem <u>F</u> iles <u>T</u> ools <u>O</u> ptio | is <u>C</u> olors <u>P</u> rogrammable Screen <u>H</u> elp | |
| r f (<u> </u> | | Advanced Mode |
| Navigation Bar 🛛 📮 | Modbus Master Communication Block - Entry #1 Floating Point Value - B | Ik Dist Floating Point Value - Slave 1 PV |
| | Auto Refresh Apply | Help 🔮 |
| | | |
| 19-Physical Discrete Inpu 20-Physical Accumulator | Master Comm. Enable | |
| 🐵 21-Physical Analog Outpu | Comm. Type Read AutoMitter Mode | Disabled |
| ⊞- 22-Physical Discrete Outr | Address 247 Extended Address | sing Disabled |
| Calculation(s) ¥ | Status Comm Ok Modbus Function | Code FC04 - Read Input Register 💌 |
| Communication(s) | Protocol Format Modbus RTU - Flt Pt Register Siz | e 2*16-Bit Registers - |
| 64-Radio Scheduling 06 Communication Bot(a | Start Register 1302 FP Byte Order | Daniel (4,3,2,1) |
| ⊕- 97-Modbus Slave | Num Enteries 4 16-Bit Register | Disabled |
| 98-Modbus Master | Host IP Address 127.0.0.1 Encap Modbus Fo | IP TCP 👻 |
| Entry#1 {247} (4) [1302, | Host Port Number 0 | |
| Entry#2 | _ | |
| Entry#4 | Modbus Master Registers | |
| 99-Ultrasonic Meter | Register Point Number Field Description | Value |
| 100-Chromatograph | 1302 001.001.004 Table-1 Current Value | 120 |
| to refail Gauge | 1303 001.002.004 Table-1 Current Value | 120 |
| Interface | 1304 001.003.004 Table-1 Current Value | 120 |
| Miscellaneous × | * | |
| User Configurable 🛛 👻 🚽 | | |
| ↓ | | |
| | Access Level: Supe | eruser Add: 255 Baud: 57600 SID = N/A TX : 2286 RX : 2284 ERR : 2 |

- 19.4.24 Right click on the Register number 1302 cell and select Paste.
- 19.4.25 To set up the SV, TV and QV readings, repeat steps 19.4.19 through 19.4.24 using Table 1 items 2 to 4. Paste the SV into address 1304, TV into address 1306 and QV into address 1308.
- 19.4.26 Click on Apply to send the settings to the AutoPILOT PRO.
- 19.4.27 Check on Auto Refresh to start the AutoPILOT PRO to repeatedly read the values from the device.

19.5. Writing registers to the HMA

- 19.5.1 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.
- 19.5.2 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 | | | | | | - 0 - x | 3 |
|---|-----------------------------------|----------------------------|------------------------------|------------------|------------------|----------------|-----|
| <u>System Files T</u> ools <u>O</u> ptions | <u>C</u> olors <u>P</u> rogrammab | le Screen <u>H</u> elp | | | | | |
| hptd 4 | 7 🕒 🏷 冬 | 3 | | | Ad | dvanced Mo | ode |
| Navigation Bar 🛛 🕈 | Modbus Master Commu | inication Block - Entry #1 | Communication Port Definitio | n - H - Entry #1 | | 4 ⊳ | x |
| Physical Data Point(s) ¥ | Auto Refresh | Refresh Appl | у | Help | · 😨 🛛 | | - |
| Calculation(s) ¥ | | | | | | | |
| Communication(s) * | | | | | | | |
| ⊪⊸ 64-Radio Scheduling | Calculation | Enabled 🔹 | Repeat Tim | er | 0 | | |
| 96-Communication Port(s) | Descriptor | Host Comm Port | RTS Delay | | 0 | mSec | |
| -Host Comm Port | Mode | Master - | Handshakin | g None | • | | |
| Comm Port# 2 | Baud Rate | 9600 - | Protocol Fo | rmat RTU | • | | |
| Comm Port# 3 | Data Bit | 8 Bits 🔻 | | 1 | | | |
| Comm Port# 4 | Parity | Even 🔻 | | | | | |
| 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] | | | I | | | | |
| Entry#2 | | | | | | | |
| Entry#4 | | | | | | | |
| 99-Ultrasonic Meter | | | | | | | |
| iangleright for the second se | | | | | | | |
| ⊞ 101-Tank Gauge | | | | | | | |
| Interface | | | | | | | |
| Miscellaneous × | | | | | | | |
| User Configurable ¥ | 4 | | | | | | Ŧ |
| | | Access Level: Supervisor | Mdd: 255 Baud: 57600 | SID = N/A | TX - 1799 DX - 4 | 799 EBB · 0 | 1 |
| | | Access Level, superuser | Aug. 200 Daug. 07000 | 310 - M/A | 1A. 1733 RA: 1 | 100 ERR : 0 | 10 |

- 19.5.3 Set Calculation to Enabled.
- 19.5.4 Set the Repeat Timer to the desired sampling interval in seconds.
- 19.5.5 Ensure that the communication settings match the selections made in step 19.1.1.
- 19.5.6 Set the Comm. Block Ref to 1, the Comm Block to Modbus Master, and the Block Index to Entry #1.
- 19.5.7 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 double-click on Entry#1.

| local Connection | | | | | | - • • × |
|---|--------------------------------------|-------------------------|---------------------------------|------------------------|-----------|---------------------------------|
| <u>System Files T</u> ools <u>O</u> ption | is <u>C</u> olors <u>P</u> rogrammab | le Screen <u>H</u> elp | | | | |
| r f f Q 4 | or (* 19 🖉 | 3 | | | | Advanced Mode |
| Navigation Bar 🕈 🕈 | Modbus Master Communicat | tion Block - Entry #1 | Floating Point Value - Blk Dist | | | $\triangleleft \flat {\bf X}$ |
| | Auto Refresh Re | fresh Apply | | Help 🏆 | | |
| ⊕ 17-Physical Smart XDuce ⊕ 19-Physical Discrete Inpu ⊕ 20-Physical Accumulator | Master Comm. | Enable 💌 | | | | |
| 21-Physical Analog Outpu | Comm. Type | Write | AutoMitter Mode | Disabled | - | |
| i≟- 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 06 Communication Det(| Start Register | 3100 | FP Byte Order | Daniel (4,3,2,1) | • | |
| | Num Enteries | 1 | 16-Bit Register | Disabled | - | |
| B-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 | | , | | |
| Entry#3 | | | | | | |
| Entry#4 | Modbus Master Regist | ters | | | | |
| 99-Ultrasonic Meter | Register Poin | t Number Field Descript | ion | | 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 |

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

- 19.5.18 In the Navigation Bar, click on Physical Data Point(s), and expand the 1-Floating Point Value item.
- 19.5.19 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.

| S Local Connection | | | | | |
|---|---|---|--|--|--|
| System Eiles Lools Options Colors Programmable Screen Help Image: Image | | | | | |
| Navigation Bar 4 | Modbus Master Communication Block - Entry #1 Floating Point Value - Blk Dist | 4 ⊳ 3 | | | |
| Physical Data Point(s) * | Auto Refresh Refresh Apply | Help 🥎 | | | |
| □- 1-Floating Point Value Slave 1 PV = 0.0 in Slave 1 SV = 0.0 in | General Value Lim | mit 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 | Descriptor #1 Blk Dist Descriptor #2 Engineering Unit in Aud/Alm Reg Index 0 Alarm Hysteresis Value 0 | Current Status Normal Current Value 3.0 Scale Factor 0 Scale Value 0 | | | |
| 4-10-Bit Word Value 4-10-Bit Word Value 16-Physical Analog Input 17-Physical Smart XDuce 19-Physical Discrete Inpu_ 20-Physical Accumulator 21-Physical Acalog Outpu 22-Physical Discrete Outp | Audit/Alarm Data Block Index Not Assigned Log Audits Log Alarms Low Alarm | Measurement Technician Control Supervisor | | | |
| Calculation(s) ▼ Communication(s) ≈ ⊕ - 64-Radio Scheduling ⊕ 96-Communication Port(s ⊕ - 97-Modbus Slave | Low Value Limit Enabled | High High Alarm Enabled High Value Limit Enabled | | | |
| | Access Level: Superuser | Add: 255 Baud: 57600 SID = N/A TX : 1905 RX : 1903 ERR : 2 | | | |

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

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

| Local Connection | | | | | | | - 🗆 🗙 |
|--|--------------------------------------|-------------------------|---------------------------------|------------------------|-----------|-------------------|--------------|
| <u>S</u> ystem <u>F</u> iles <u>T</u> ools <u>O</u> ptio | ns <u>C</u> olors <u>P</u> rogrammab | le Screen <u>H</u> elp | | | | | |
| r f f @ @ | 0 🕑 🏵 🏈 | 3 | | | | Ac | wanced Mode |
| Navigation Bar 🛛 🕈 | Modbus Master Communica | tion Block - Entry #1 | Floating Point Value - Blk Dist | | | | ∢ ⊳ x |
| 🐵 4-16-Bit Word Value | Auto Refresh Re | fresh Apply | | Help 🕎 | | | <u>^</u> |
| ter 15-Text ter 16-Physical Analog Input | | | | | | | |
| | | | | | | | |
| ⊕ 19-Physical Discrete Inpu | Master Comm. | Enable 🔹 | | | | | |
| 20-Physical Accumulator 21-Physical Analog Outpu | Comm. Type | Write 💌 | AutoMitter Mode | Disabled | - | | |
| | Address | 247 | Extended Addressing | Disabled | • | | |
| 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 | - | | E |
| erection Scheduling | 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, | Host Port Number | 0 | · · · · · | 1 | | | |
| Entry#2 | | | | | | | |
| Entry#4 | Modbus Master Regis | ters | | | | | |
| 99-Ultrasonic Meter | Register Poir | nt Number Field Descrip | tion | | Value | | |
| ⊞ 101-Tank Gauge | 3100 001. | 005.004 Table-1 Cur | rent Value | | 3.6 | | |
| Interface | | | | | | | |
| Miscellaneous × | | | | | | | |
| User Configurable × | | | | | | | |
| • | | | | | | | - |
| | | | Access Level: Superuser | Add: 255 Baud: 57600 | SID = N/A | TX : 1927 RX : 19 | 925 ERR : 2 |

- 19.5.24 Right click on the Register number 3100 cell and select Paste.
- 19.5.25 Click on Apply to send the settings to the AutoPILOT PRO.
- 19.5.26 Click on Refresh to command the AutoPILOT PRO to send the value to the device.
- 19.5.27 Change the Comm. Type to Read.
- 19.5.28 Click on Apply to send the settings to the AutoPILOT PRO.
- 19.5.29 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. Connect the RS-232 TX line to the '+' position of the RS-485 terminal block, and the RX line to the '-' position.
- C. It is recommended that any 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 if additional device configuration or troubleshooting is required.

B. HMA DIP Switch Settings

| Desition 1 | ON | Normal mode | | |
|----------------|-----|----------------------------|--|--|
| POSICIONI | OFF | Default configuration mode | | |
| Decition 2 | ON | Program mode | | |
| Position 2 | OFF | Run mode | | |
| Position 3 | OFF | BS485 mode | | |
| Position 4 | ON | K3485 III00e | | |
| Position 3 | ON | | | |
| Position 4 OFF | | K3232 MODE | | |

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 | | | |
| | | | | |

F. Modbus RTU Communication Registers

| Parameter | Data Type | Number of Registers | Modbus Register type | Modbus Register number | Values | Default |
|------------------------------------|-----------|------------------------|-------------------------|------------------------------|--|---------|
| Floating Point Format Code | UINT8 | 1 | Holding | 3000 | 0 - AB CD 1 - CD AB 2 - DC BA 3 - BA DC | 0 |
| Slave address | UINT8 | 1 | Holding | 3001 | 1 to 247 | 247 |
| Protocol Type | UINT8 | 1 | Holding | 3002 | 1 | 1 |
| No of Data bits | UINT8 | 1 | Holding | 3003 | 7 - 7 bits 8 - 8 bits | 8 |
| Stop bits | UINT8 | 1 | Holding | 3004 | 1 - 1 bit 2 - 2 bits | 1 |
| Parity | UINT8 | 1 | Holding | 3005 | 0 - None 1 - Odd 2 - Even | 0 |
| Baud rate | UINT8 | 1 | Holding | 3006 | 0 - 1200 1 - 2400 2 - 4800 3 - 9600 4 - 19200 | 3 |
| HMA Mode | UINT8 | 1 | Holding | 3007 | 0 - HMA 1 - Device | 0 |
| Auto-switch to HART over RS-485 | UINT8 | 1 | Holding | 3008 | 0 - no switch 1 - switch | 0 |
| Reserved/ Unused | | | | | | |
| No of retries (General) | UINT8 | 1 | Holding | 3010 | 0, 1, 2, 3 | |
| Reserved/Unused | | | | | | |
| Device Discovery mode (DDM) | UINT8 | 1 | Holding | 3012 | 0 - Polled 1 - Saved 2 - Single | |
| Polling Range (if DDM = 0, 2) | UINT8 | 1 | Holding | 3013 | 0 - 0 only 1 - Find first only 2 - search 0-15 3 - search 0-31 4 - search 0-63 | |

G. Modbus ASCII Communication Registers

| Parameter | Data Type | Number of Registers | Modbus Register type | Modbus Register number | Values | Default |
|------------------------------------|-----------|------------------------|-------------------------|------------------------------|--|---------|
| Floating Point Format Code | UINT8 | 1 | Holding | 3000 | 0 - AB CD 1 - CD AB 2 - DC BA 3 - BA DC | 0 |
| Slave address | UINT8 | 1 | Holding | 3001 | 1 to 99 | 1 |
| Protocol Type | UINT8 | 1 | Holding | 3002 | 2 | 2 |
| No of Data bits | UINT8 | 1 | Holding | 3003 | 7 - 7 bits 8 - 8 bits | 7 |
| Stop bits | UINT8 | 1 | Holding | 3004 | 1 - 1 bit 2 - 2 bits | 1 |
| Parity | UINT8 | 1 | Holding | 3005 | 0 - None 1 - Odd 2 - Even | 0 |
| Baud rate | UINT8 | 1 | Holding | 3006 | 0 - 1200 1 - 2400 2 - 4800 3 - 9600 4 - 19200 | 3 |
| HMA Mode | UINT8 | 1 | Holding | 3007 | 0 - HMA 1 - Device | 0 |
| Auto-switch to HART over RS-485 | UINT8 | 1 | Holding | 3008 | 0 - no switch 1 - switch | 0 |
| Reserved/ Unused | | | | | | |
| No of retries (General) | UINT8 | 1 | Holding | 3010 | 0, 1, 2, 3 | |
| Reserved/Unused | | | | | | |
| Device Discovery mode (DDM) | UINT8 | 1 | Holding | 3012 | 0 - Polled 1 - Saved 2 - Single | |
| Polling Range (if DDM = 0, 2) | UINT8 | 1 | Holding | 3013 | 0 - 0 only 1 - Find first only 2 - search 0-15 3 - search 0-31 4 - search 0-63 | |

H. LevelMaster Communication Registers

| Parameter | Data Type | Number of Registers | Modbus Register type | Modbus Register number | Values | Default |
|------------------------------------|-----------|------------------------|-------------------------|------------------------------|--|---------|
| Floating Point Format Code | UINT8 | 1 | Holding | 3000 | 0 - AB CD 1 - CD AB 2 - DC BA 3 - BA DC | 0 |
| Slave address | UINT8 | 1 | Holding | 3001 | 1 to 247 | 247 |
| Protocol Type | UINT8 | 1 | Holding | 3002 | 3 | 3 |
| No of Data bits | UINT8 | 1 | Holding | 3003 | 7 - 7 bits 8 - 8 bits | 8 |
| Stop bits | UINT8 | 1 | Holding | 3004 | 1 - 1 bit 2 - 2 bits | 1 |
| Parity | UINT8 | 1 | Holding | 3005 | 0 - None 1 - Odd 2 - Even | 0 |
| Baud rate | UINT8 | 1 | Holding | 3006 | 0 - 1200 1 - 2400 2 - 4800 3 - 9600 4 - 19200 | 3 |
| HMA Mode | UINT8 | 1 | Holding | 3007 | 0 - HMA 1 - Device | 1 |
| Auto-switch to HART over RS-485 | UINT8 | 1 | Holding | 3008 | 0 - no switch 1 - switch | 0 |
| Reserved/ Unused | | | | | | |
| No of retries (General) | UINT8 | 1 | Holding | 3010 | 0, 1, 2, 3 | |
| Reserved/Unused | | | | | | |
| Device Discovery mode (DDM) | UINT8 | 1 | Holding | 3012 | 0 - Polled 1 - Saved 2 - Single | |
| Polling Range (if DDM = 0, 2) | UINT8 | 1 | Holding | 3013 | 0 - 0 only 1 - Find first only 2 - search 0-15 3 - search 0-31 4 - search 0-63 | |
I. HART over RS485 Communication Registers

| Parameter | Data Type | Number of Registers | Modbus Register type | Modbus Register number | Values | Default |
|------------------------------------|-----------|------------------------|-------------------------|------------------------------|--|---------|
| Floating Point Format Code | UINT8 | 1 | Holding | 3000 | 0 - AB CD 1 - CD AB 2 - DC BA 3 - BA DC | |
| Slave address | UINT8 | 1 | Holding | 3001 | 1 to 247 | |
| Protocol Type | UINT8 | 1 | Holding | 3002 | 2 | 4 |
| No of Data bits | UINT8 | 1 | Holding | 3003 | 7 - 7 bits 8 - 8 bits | 8 |
| Stop bits | UINT8 | 1 | Holding | 3004 | 1 - 1 bit 2 - 2 bits | 1 |
| Parity | UINT8 | 1 | Holding | 3005 | 0 - None 1 - Odd 2 - Even | 1 |
| Baud rate | UINT8 | 1 | Holding | 3006 | 0 - 1200 1 - 2400 2 - 4800 3 - 9600 4 - 19200 | 0 |
| HMA Mode | UINT8 | 1 | Holding | 3007 | 0 - HMA 1 - Device | 1 |
| Auto-switch to HART over RS-485 | UINT8 | 1 | Holding | 3008 | 0 - no switch 1 - switch | 1 |
| Reserved/ Unused | | | | | | |
| No of retries (General) | UINT8 | 1 | Holding | 3010 | 0, 1, 2, 3 | |
| Reserved/Unused | | | | | | |
| Device Discovery mode (DDM) | UINT8 | 1 | Holding | 3012 | 0 - Polled 1 - Saved 2 - Single | |
| Polling Range (if DDM = 0, 2) | UINT8 | 1 | Holding | 3013 | 0 - 0 only 1 - Find first only 2 - search 0-15 3 - search 0-31 4 - search 0-63 | |

J. HMA Diagnostics Modbus Registers

| Parameter | Mod | bus Regist | er Info | Modbus Re | egister |
|--|--------------|------------|---------|-----------|---------|
| | Data type | Number | Туре | Number | Bit |
| Configuration data error | | | | | 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 | | | | 1200 | |
| device identification) | | | | 1200 | 7 |
| Reserved/Unused | | | | | 8 |
| Buckboost Fail | | | | | 9 |
| Slave 1 malfunction (Comm error) | - | | | | 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 | | | | | 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 | |

| | 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 | 1 | 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 | HEX | 2 | 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 |

K. HMA Device Information Modbus Registers

L. 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 | ιιινιτο | E | Input | 1101- | 1101 | 1111- | 1121- | 1131- | 1141- |
| Command 48 status bytes | UINTO | 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 | UINT32 | 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 |

Note: Reference Appendices U and V for SV and parameter code definitions.

M. Model 705 3x Modbus Registers

| HART parameter | Modk | ous Registe | er Info | | Modbu | us Regist | er Numl | ber | |
|----------------------------------|--------|-------------|---------|--------|---------|-----------|---------|-------|-------|
| | Data | | | | | Н | A Mod | e | |
| | Dala | 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 |
| | | | | | | | | | |
| Command 48 status butos | ιμνιτο | 4 | Input | 1101- | 1101- | 1111- | 1121- | 1131- | 1141- |
| Command 48 status bytes | UINTO | 4 | πραι | 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 code | 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 |

N. Model R82 R2 Modbus Registers

| | Mod | bus Registe | er Info | | Mod | bus 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 | | | | 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 | | | | | | | | 1131 | |
| hytes | UINT8 | 2 | Input | 1101- | 1101- | 1111- | 1121- | - | 1141- |
| Sytes | | | | 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 |
| 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 |

O. 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 code | 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 <u>code</u> | UINT8 | 1 | Holding | 3132 | 3132 | 3232 | 3332 | 3432 | 3532 |
| Foam <u>code</u> | UINT8 | 1 | Holding | 3133 | 3133 | 3233 | 3333 | 3433 | 3533 |

P. 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 | | 2 | Input | 1101- | 1101- | 1111- | 1121- | 1131- | 1141- |
| bytes | UINTO | 2 | πραι | 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 |

Q. Enhanced Jupiter Modbus Registers

| | Mod | bus Registe | er Info | | Modb | 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 | 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> | UINT8 | 1 | Input | 2140 | 2140 | 2240 | 2340 | 2440 | 2540 |
| Trim lfc Level | Float | 2 | Holding | 3102 | 3102 | 3202 | 3302 | 3402 | 3502 |
| Level Unit code | UINT8 | 1 | Input | 2141 | 2141 | 2241 | 2341 | 2441 | 2541 |
| 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 |

R. 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 | | 1 | Innut | 1101- | 1101- | 1111- | 1121- | 1131- | 1141- |
| | Onvio | - | mpat | 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 | | | | | | | | | |
| 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 |

S. Model R96 Modbus Registers³

| | Modk | ous Registe | r Info | | Modk | 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 bytos | ιιινιτο | E | Input | 1101- | 1101 | 1111- | 1121- | 1131- | 1141- |
| Command 48 status bytes | UINTO | 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 | | | | | | | | | |
| Top 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 |
| Bottom Blocking Distance | 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 | UINT32 | 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 |
| 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 |
| Target Algorithm <u>code</u> | UINT8 | 1 | Holding | 3135 | 3135 | 3235 | 3335 | 3435 | 3535 |
| Level Threshold Mode code | UINT8 | 1 | Holding | 3137 | 3137 | 3237 | 3337 | 3437 | 3537 |
| Auto Threshold value | UINT8 | 1 | Holding | 3138 | 3138 | 3238 | 3338 | 3438 | 3538 |
| Fixed Threshold value | UINT8 | 1 | Holding | 3139 | 3139 | 3239 | 3339 | 3439 | 3539 |

³ For firmware version 1.6a0 and later.

| 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 |
| 3 | 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 |
| 6 | Loop Fail | Dflt Strap Tbl | Dflt Strap Tbl | Float 2 Fail | Secondary Fault Hi | EE Read Failure |
| 7 | 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 | Fai | | | |
| 11 | 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 |
| 6 | 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 | | | | | |

T. LevelMaster Error and Warning Codes

| Error | | | |
|-------|-----------------------|----------------------|------------------------|
| Code | Model 706 | Model JM4 | Model R96 |
| 1 | Software Error | SW Error (Main) | Software Error |
| 2 | RAM Error | RAM Error (Main) | RAM Error |
| 3 | ADC Failure | ADC Error (Main) | ADC Failure |
| 4 | EEPROM Error | EEPROM Error | EEPROM Error |
| 5 | Analog Board Error | CoP in Flash Mode | Analog Board Error |
| 6 | Analog Output Error | SW Conflict (CoP) | Analog Output Error |
| 7 | Spare 1 | Spare 1 | Spare 1 |
| 8 | Default Parameters | Analog Board Error | Default Parameters |
| 9 | No Probe | SW Error (CoP) | No Antenna |
| 10 | No Fiducial | RAM Error (CoP) | Spare 2 |
| 11 | No Echoes | ADC Error (CoP) | No Fiducial |
| 12 | Upper Echo Lost | Spare 2 | Too Many Echoes |
| 13 | Spare 2 | Analog Ouput Error | Safety Zone Alarm |
| 14 | EoP > Probe End | No Probe | Echo Lost |
| 15 | Level Below Probe End | Probe Memory Error | Spare Indicator 3 |
| 16 | EoP Below Probe End | Probe Info Corrupt | Configuration Conflict |
| 17 | Safety Zone Alarm | Spare 3 | High Volume Alarm |
| 18 | Config Conflict | New Probe | Spare Indicator 4 |
| 19 | Hi Volume Alarm | Default Parameters | Initializing |
| 20 | Hi Flow Alarm | No Float Detected | Configuration Changed |
| 21 | Spare 3 | Spare 4 | Spare Indicator 5 |
| 22 | Initializing | Config Conflict | Ramp Slope Error |
| 23 | Analog Output Fixed | Hi Volume Alarm | High Electronics Temp |
| 24 | Config Changed | Spare 5 | Low Electronics Temp |
| 25 | Spare 4 | Extra Float Detected | Calibration Required |
| 26 | Spare 5 | 2nd Float Missing | Echo Rejection Invalid |
| 27 | Spare 6 | Initializing | Spare Indicator 6 |
| 28 | Ramp Interval Error | Config Changed | Inferred Level |
| 29 | Hi Elec Temp | Spare 6 | Adjust Analog Output |
| 30 | Lo Elec Temp | Xmtr Calib Req'd | Low Supply Voltage |
| 31 | Calib Req'd | Spare 7 | Spare Indicator 7 |
| 32 | Echo Rej Invalid | Temp Calib Req'd | Spare Indicator 8 |
| 33 | Spare 7 | Hi Elec Temp | Marginal Echo |
| 34 | Inferred Level | Lo Elec Temp | Hi Surface Velocity |
| 35 | Adj Analog Output | Spare 8 | Spare Indicator 9 |
| 36 | Totalizer Data Lost | Spare 9 | Spare Indicator 10 |
| 37 | No Probe Target | Adj Analog Output | Sequence Record |
| 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 / LVIThresh | |
| 43 | Spare 9 | HI NOISE / ItcThresh | |
| 44 | Spare 10 | Spare 10 | |
| 45 | Sequence Record | Sequence Record | |

Note: Diagnostics mapped to the NE 107 Failure category will appear as a LM Error, those mapped to other categories will appear as a LM Warning.

U. Level Unit Codes

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

V. 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 | Model R96 | | |
|---------|---------------------|---------------|--|--|
| 0 | Level | Level | | |
| 1 | Ifc Level | Volume | | |
| 2 | | Distance | | |
| 3 | | Echo Strength | | |
| 4 | | Temperature | | |
| 5 | | Signal Margin | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |

| Threshold | Model 706 | Model IM4 | Model 705 3x | | |
|-----------|--------------|--------------|--------------|--|--|
| Code | Widdel 700 | WOULEI 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 | Model R96 | | |
|-----------------------------|--------------|-----------|-----------|--|--|
| 0 | 1.7 - 3 | 1.7 - 3 | Below 1.7 | | |
| 1 | 3 - 10 | 3 - 10 | 1.7 - 3 | | |
| 2 | 10 - 100 | 10 - 100 | 3 - 10 | | |
| | | | 10 - 100 | | |

| Turbulence Code | Model R82 R2 | Model RX5 | Model R96 | | |
|--------------------|--------------|-----------|-----------|--|--|
| 0 | None | None | None | | |
| 1 | Light | Light | Light | | |
| 2 | Medium | Medium | Medium | | |
| 3 | Heavy | Heavy | Heavy | | |

| Rate of Change Code | Model R82 R2 | Model RX5 | Model R96 | | |
|---------------------------|----------------|----------------|----------------|--|--|
| 0 | < 5 in/min | < 5 in/min | < 5 in/min | | |
| 1 | 5 - 20 in/min | 5 - 20 in/min | 5 - 20 in/min | | |
| 2 | 20 - 60 in/min | 20 - 60 in/min | 20 - 60 in/min | | |
| 3 | >60 in/min | >60 in/min | >60 in/min | | |

| Foam Code | Model R82 R2 | Model RX5 | Model R96 | | |
|-----------|--------------|-----------|-----------|--|--|
| 0 | None | None | None | | |
| 1 | Light | Light | Light | | |
| 2 | Medium | Medium | Medium | | |
| 3 | Heavy | Heavy | Heavy | | |

| Target Algorithm | Model R96 | | | |
|---------------------|--------------|--|--|--|
| 0 | First Peak | | | |
| 1 | Largest Peak | | | |

| Lvl Thresh Mode | Model R96 | | | |
|--------------------|--------------|--|--|--|
| 0 | Auto Largest | | | |
| 1 | Fixed | | | |

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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