ABB MEASUREMENT & ANALYTICS | 2106280MNAA

Modbus configuration guide

XSeries^{G4}

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Additional information

Additional information pertaining to ABB G4 Modbus Communications can be found at www.abb.com/totalflow. The following table has links to documents that may be helpful with Modbus.

Table 1 Related documentation

Item	Description	Document number
ABB Download Center	Location for all documents available for download	ABB Document download center
Document	Totalflow Modbus protocol document	2017384
Technical Bulletin 180	TFIO Communication Interface Module (2100421 BD) (CIM) and Modbus Protocol	Tekbul 180
Technical Bulletin 182	NGC Modbus Registers assignments in the NGC 8200	Tekbul 182
User Drawing	XFC^{G4} Com 1 to ABB Coriolis Meter using Hart Modbus Converter	2104918
User Drawing	XRC^{G4} Adapting K-TEK for Modbus RS-485/COM2 on a 12 V System	2104955
User Drawing	TFIO Communication Interface Module (2100421 BD) to XMV Modbus with RTD (RS-485)	2102345
User Drawing	XRC^{G4} (2100355 BD) COM1 (RS-485) to XMV Modbus with RTD	2102347
User Drawing	NGC 8200 Port 2 (RS-485) to XMV Modbus with RTD	2102350

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- Training or instruction and/or authorization to operate and maintain devices or systems according to safety engineering standards for electrical circuits, high pressures, and aggressive media
- Training or instruction in accordance with safety engineering standards regarding maintenance and use of adequate safety systems

WARNING: According to EN 60 900, only sufficiently insulated tools may be used for the electrical connection.

The following regulations must also be considered:

- The applicable standards and safety regulations concerning the construction and operation of electrical installations, e.g., the regulation on technical working materials (safety guidelines for tools)
- The regulations and recommendations relating to explosion protection if devices with explosion protection are to be installed
- The recommendations for safe working in the case of installation in an SIL loop

The device can be operated at high levels of pressure and with aggressive media. Serious injury and/or considerable material damage can, therefore, be caused if the device is handled incorrectly. Ensure compliance with the regulations applicable in the country of use.

Safety symbol conventions

The following convention is used throughout this document to bring attention to important information:

IMPORTANT NOTE: This symbol indicates operator tips, particularly useful information, or important information about the product or its further uses.

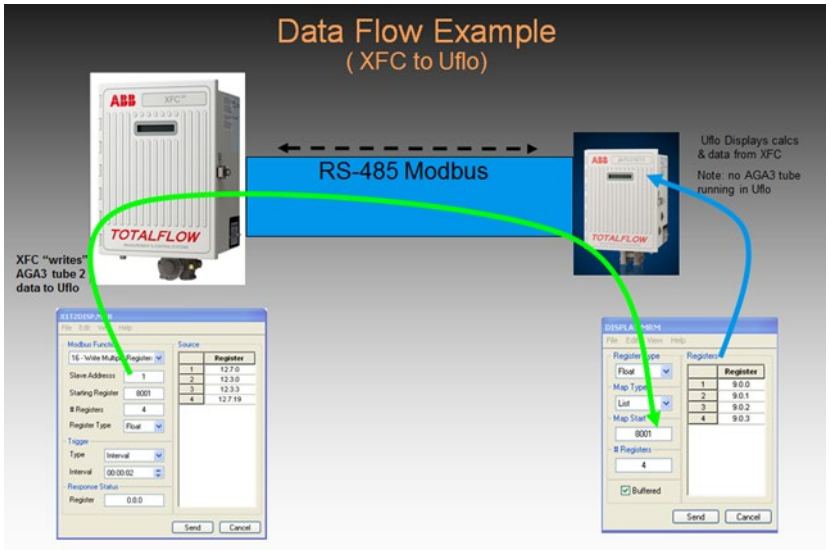
1 Overview

ABB Totalflow Modbus implementation within the XSeries Generation 4 (G4) hardware architecture allows the use of Modbus protocol on all communication ports. Modbus protocol uses the master/slave communication concept. Slave devices respond only when commanded by the master. Each slave is identified by an unsigned, one-byte number ranging from 1 to 247. A slave must send a single response to a master's request for data. The Modbus protocol is generally seen in two forms, RTU and ASCII. Masters are configured in the G4 by the setup of an MRB (Master Request Block). Slaves are configured by the setup of an MRM (Modbus Register Map). These will be discussed in greater detail later in this document.

Totalflow PCCU software is required to interface to the Totalflow G4 hardware for setup and configuration of Modbus on communication ports.

Figure 1 indicates the basic components required to implement Modbus in the Totalflow G4.

Figure 1 Basic Modbus components



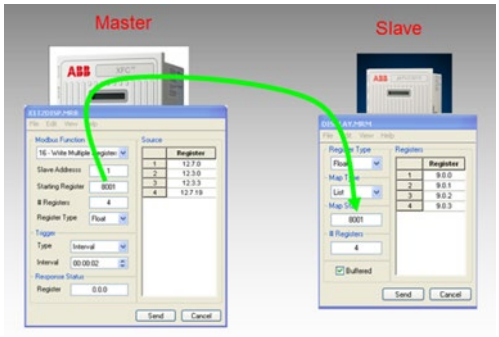
1.1 Modbus background

The Modbus protocol is described in the document "Gould Modbus Protocol Reference Guide" published January 1985 by Gould Inc., Programmable Control Division, Andover, Massachusetts.

Modbus communications will always have devices designated as either masters or slaves. Only one master can exist on any system at one time, while multiple units can be designated as slaves. This master-slave relationship is at the core of how Modbus communications work.

Masters perform the role of requesting the slaves to report data to them or they write data into the registers of the slaves. This requesting or writing of data is determined by the MRB (Master Request Block) set up within the master device communication port. Slave devices have a similar setup but differ in that they only respond to master requests and do not initiate any communications. In the slave device, an MRM (Modbus Request Map) is configured that builds a lookup table that matches Modbus addresses to Totalflow AAR (Application Array Registers). The Master can only request or write data to registers that the slave has mapped in its MRM.

Figure 2 MRB and MRM



1.2 Totalflow Modbus protocol format

This information describes the format of Modbus communications protocol implemented by ABB Totalflow. Modbus messages may be one of two formats: RTU or ASCII.

Table 2 Modbus RTU message frame format

Packet	CRC
N x 8 bits	16-bits
The packet field is the Modbus packet that is sent or received. Packet format varies with the function performed and the register group accessed.	The error check field is a 16 bit cyclic redundancy check calculated over the length of the packet field.

Table 3 Modbus ASCII message frame format

BOF	Packet	LRC	EOF	Ready
:	2 x Number of bytes in Modbus packet	8-bits	CR	LF
A colon (:) character is used to indicate beginning of a frame.	The packet field consists of hexadecimal ASCII characters representing the Modbus packet being sent or received. The number of characters is twice the number of bytes in the Modbus packet because each packet byte is converted into two hexadecimal ASCII characters (0-9, A-F.)	The error check field is an 8 bit longitudinal redundancy check calculated over the length of the packet field before it is converted to hexadecimal ASCII.	A carriage return and line feed are used to delineate end of frame.	A carriage return and line feed are used to delineate end of frame.

IMPORTANT NOTE: The total message frame length cannot exceed 256 bytes.

1.3 Totalflow Modbus implementation

Totalflow Modbus supports RTU or ASCII mode. Support has also been added for long integer, floating point, and archive record registers. Totalflow Modbus supports the following subset of the Gould Modbus defined functions:

Table 4 Gould Modbus defined functions

Code	Function	Description
01	Read Boolean	Reads group of Boolean registers
03	Read Registers	Reads group of 16/32 bit registers
05	Set Single Boolean	Set or clear a Boolean register
06	Set Single Register	Set a 16/32 bit register to specified value
16	Set Multiple Register	Set multiple 16/32 bit registers
128-143	Exception Response	Used in FCU response packets to indicate errors in processing function codes 1-16.

Table 5 Read query

Address	Function	Register	Quantity
8-bits	8-bits	16-bits	16-bits

Table 6 Read response

Address	Function	Byte Count	Data
8-bits	8-bits	8-bits	N x 8 bits

Table 7 Set query

Address	Function	Register	Data
8-bits	8-bits	16-bits	N x 8 bits

Table 8 Set response

Address	Function	Register	Data
8-bits	8-bits	16-bits	N x 8 bits

Table 9 Set multiple query

Address	Function	Register	Quantity	Byte Count	Data
8-bits	8-bits	16-bits	16-bits	8-bits	N x 8 bits

Table 10 Set multiple response

Address	Function	Register	Quantity
8-bits	8-bits	16-bits	16-bits

Table 11 Exception response

Address	Function	Code
8-bits	8-bits	8-bits

- Address: the slave address of the FCU intended to receive the packet. Each FCU must be assigned a unique address in the range of 1 to 247.
- Function: a code which tells the FCU what to do or what data to send. The high order bit in this field may be set by the FCU in the response packet to indicate an error response.
- Register: the register number of the FCU data item to fetch or set. For read functions, this is the starting register number.
- Code: an error value for the exception response. Currently there are three values used; 1 indicates that the function code is unsupported, 2 indicates the register number requested is invalid, 3 indicates that too many data values were requested and that the maximum packet size was exceeded. The maximum packet size for ASCII is 122 bytes and for RTU the maximum packet size is 250.
- Quantity: the number of consecutive registers to fetch or set. This field is not present in all packets (only read and set multiples queries)
- Byte Count: the number of bytes of data being transferred. This field is not present in all packets (only read and set multiple queries).
- Data: the actual data values being transferred. This field is not present in all packets. The size and format of the data values depend on the register group being accessed. The byte order of data items is high to low (MSB first, LSB last).

2 How to use this guide

This document will instruct how to set up and operate Modbus in the ABB Totalflow G4 environment including the basic steps required to configure three (3) different Modbus scenarios.

2.1 Procedure overview

The following general steps are needed from a system perspective for a Modbus communication to be set up properly. The actual components required will depend on the specific scenario.

- Connect components to Totalflow Device (wiring)
- Connect Totalflow devices using PCCU

- Configure communication ports in devices
- Program MRB/MRM blocks
- Verify Modbus communication

2.2 Assumptions

This guide focuses on the initial configuration of Modbus in Totalflow G4. It is intended to give a basic understanding and instruction to implement Modbus communication in the G4 environment. More advanced instructions are included in separate documents provided in Additional information at the beginning of this document.

The following is assumed:

- All components are installed correctly
- End devices are calibrated
- All components are wired correctly to provide or receive signals
- Power is provided, and all the devices are connected
- Minimal verification has been performed to ensure the devices are drawing the correct power voltages for their operation.
- Proper grounding has been performed
- PCCU software is installed on the machine used to set up Modbus communications and is configured properly to communicate locally with the XSeries G4 hardware.

2.3 Requirements

The procedures described in this document require the following:

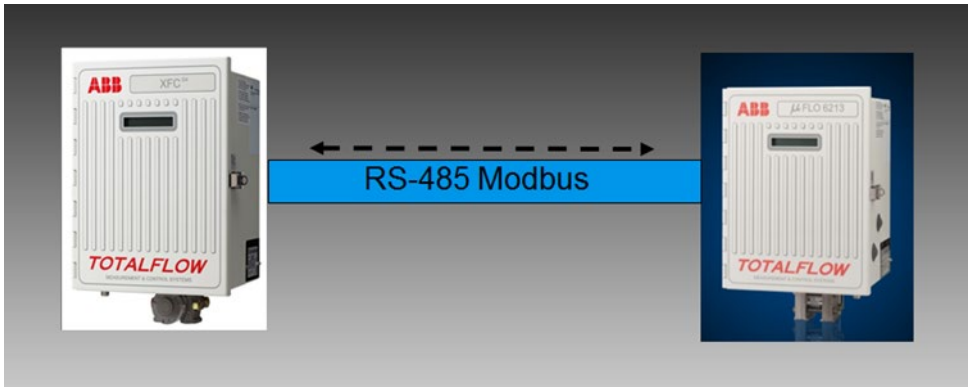
- PCCU software version 7.31 and later
- PCCU interface cable (serial, USB or IP)
- XRC (G4) Part 2103329-001 software version 2103132-039 and later
- XFC (G4) Part 2103328-001 software version 2102861-045 and later

3 Scenario 1: XFC^{G4} to XFC^{G4} with RS-485 link

3.1 XFC to XFC scenario overview

In this scenario, use an XFC^{G4} as a master and an additional XFC^{G4} as a slave. The master will be given the task of monitoring flow data from the slave. This will be accomplished via an RS-485 hardwire communication link on Com 2 between both units. The link will use Modbus (RTU) as the protocol and a register format of 32 bit Totalflow. Flow data from the slave needs to be read (updated) to the master every 3 seconds. Specific registers for flow rate, differential pressure, static pressure, and temperature are required in the slave for this scenario. The master will assign the registers to read from the slave in its Holding Registers interface for viewing updates.

Figure 3 XFC to XFC



3.2 Assumptions

This example makes the following installation assumptions:

- An XFC^{G4} flow computer will interface to another XFC^{G4} flow computer via a hardwire RS-485 link on Com 2. See section 3.3 Connect components (wiring).
- Each XFC^{G4} has an RS-485 com module (part 2015193) installed in the Com port 2 position on the board.

- The distance between the XFCs is less than 4000 feet.
- Modbus RTU protocol and 32 bit Totalflow Register format will be used.
- Master XFC^{G4} requires flow data from slave XFC^{G4}.
- PCCU software is available for connections to both master and slave devices.

3.3 Connect components (wiring)

IMPORTANT NOTE: The wiring of Com 2 depends on the XSeries device used and whether these are direct connections (onboard) or use extension modules. Wire the terminations with the device powered off.

The example used in this basic configuration illustrates the connections required to use an XFC to connect to another XFC to create a hardwire RS-485 connection. The diagram for this scenario shows direct connections to the board.

1. Connect the XFCs together via an RS-485 cable on J4 pin 12 (Bus+) and pin 13 (Bus-).
2. After completing connections, power on the devices.
3. Verify that the power on sequence is correct.

Figure 4 Comm2 XFC (master) to XFC (slave) wiring

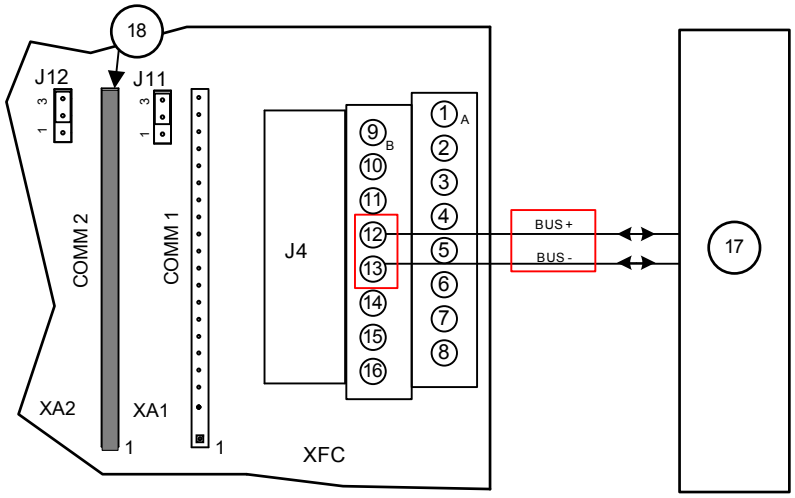


Table 12 Legend for Comm2 wiring

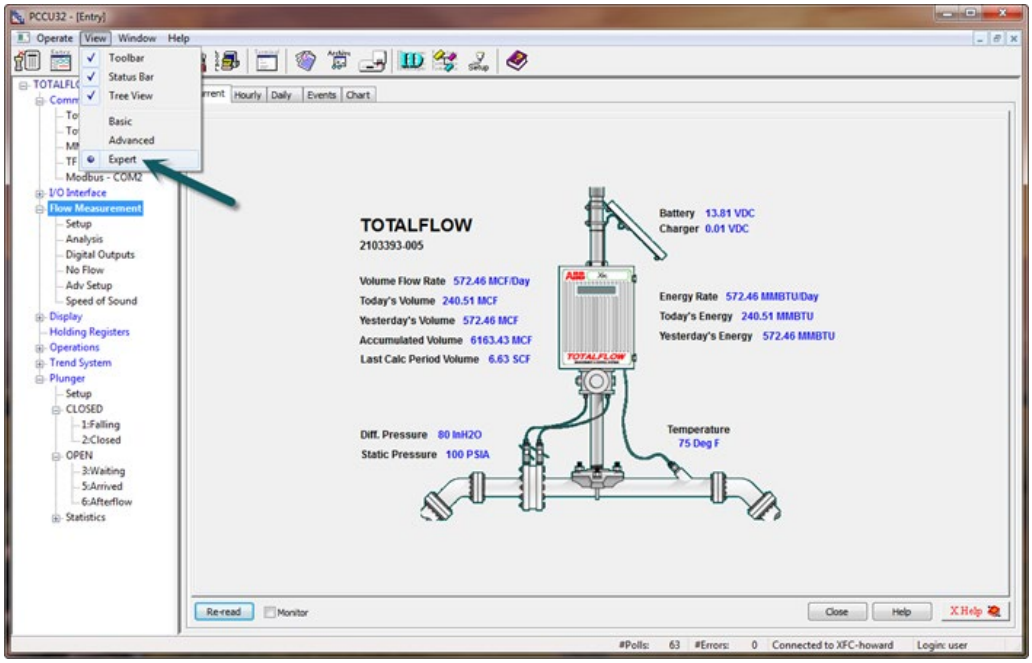
PIN	Signal	Comm		RS-232		RS-485
		1	2	OUT	IN	
1	GND	●	●			●
2	VBATT	●	●	●		
3	SWVBAT	●	●	●		
4	TXD/BUS+	●		●		●
5	BUS+	●				●
6	RXD/BUS-	●			●	●
7	BUS-	●				●
8	RTS	●		●		●
9	CTS	●			●	
10	DTR	●		●		
11	CD	●			●	
12	TXD/BUS+		●	●		●
13	RXD/BUS-		●		●	●
14	RTS		●	●		●
15	CTS		●		●	
16	OPER	●	●	●		●
Item						
17	Another XFC					
18	RS-485 Comm module					

3.4 Connect using PCCU

Verify that the devices can connect using PCCU and change the view to prepare for configuration.

1. Connect a laptop with PCCU software to the device.
2. Click **Entry** on the top menu bar and verify that PCCU establishes a connection with the device.
3. Click **View** at the top menu, then choose **Expert** from the drop-down list.

Figure 5 Expert view setup

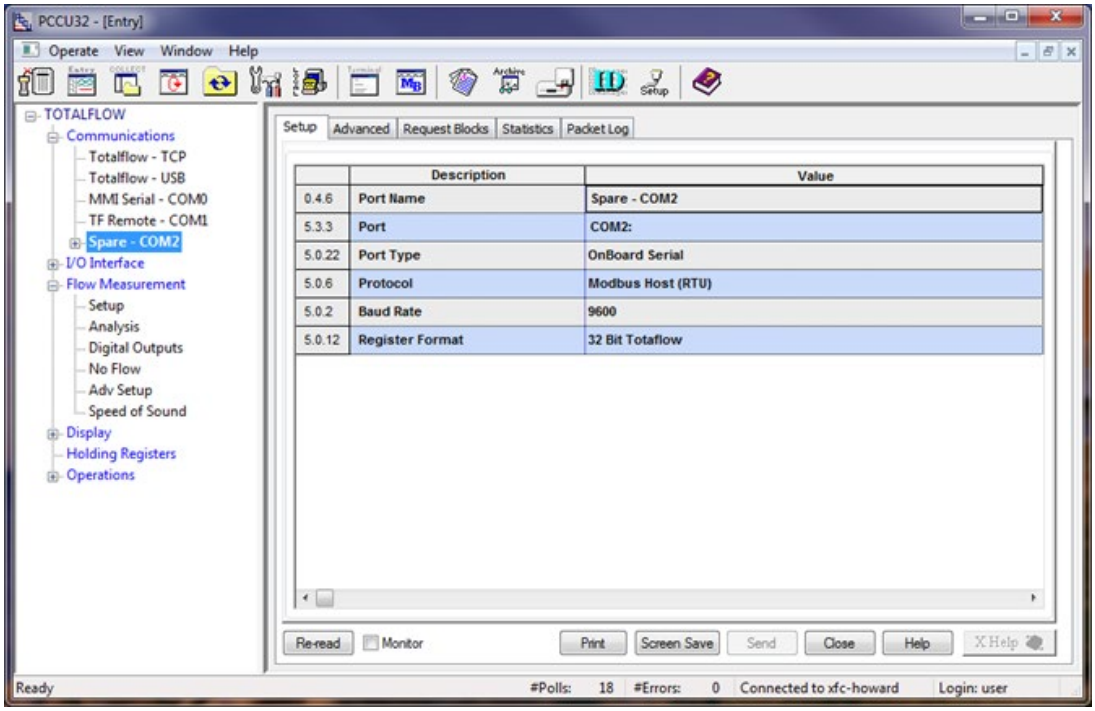


3.5 Configure master Setup tab

This instruction sets up the master XFC^{G4} first. The master Setup tab will provide for necessary setup of the com port on the master.

1. Go to **TOTALFLOW**>**Spare-com2**>**Setup** and verify that the Port value field is set for **COM2:** This indicates that com port 2 is now designated for use.
2. For Port Type, enter **Onboard Serial**.

Figure 6 Master setup tab



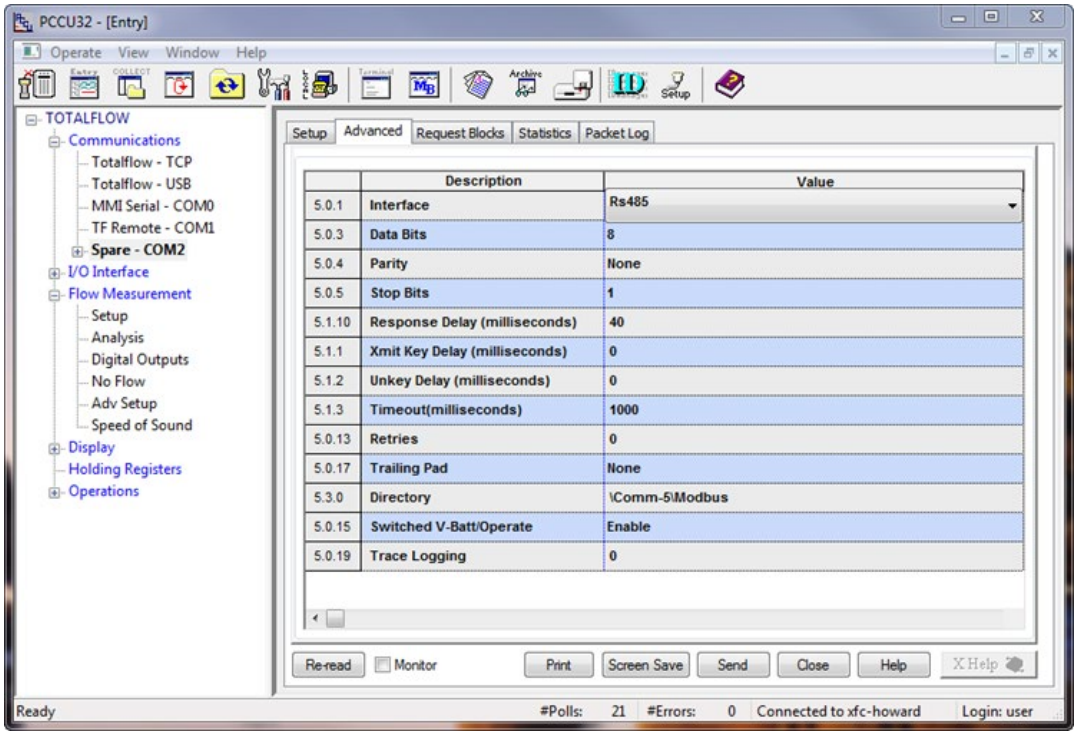
3. Set the Protocol value from the drop-down menu to **Modbus Host (RTU)**.
4. Set the Baud Rate for **9600**.
5. Set the Register Format to **32 Bit Totalflow**.

3.6 Configure the master Advanced tab

The Advanced tab will allow for detailed setup of the com port parameters.

1. Go to **TOTALFLOW**>**Spare-COM2**>**Advanced** and verify that Interface is set up for RS-485.
2. All other fields in this tab should require no changes because the default settings will be correct. Verify that the settings are the same as shown in the following screen (Figure 7).

Figure 7 Advanced setup

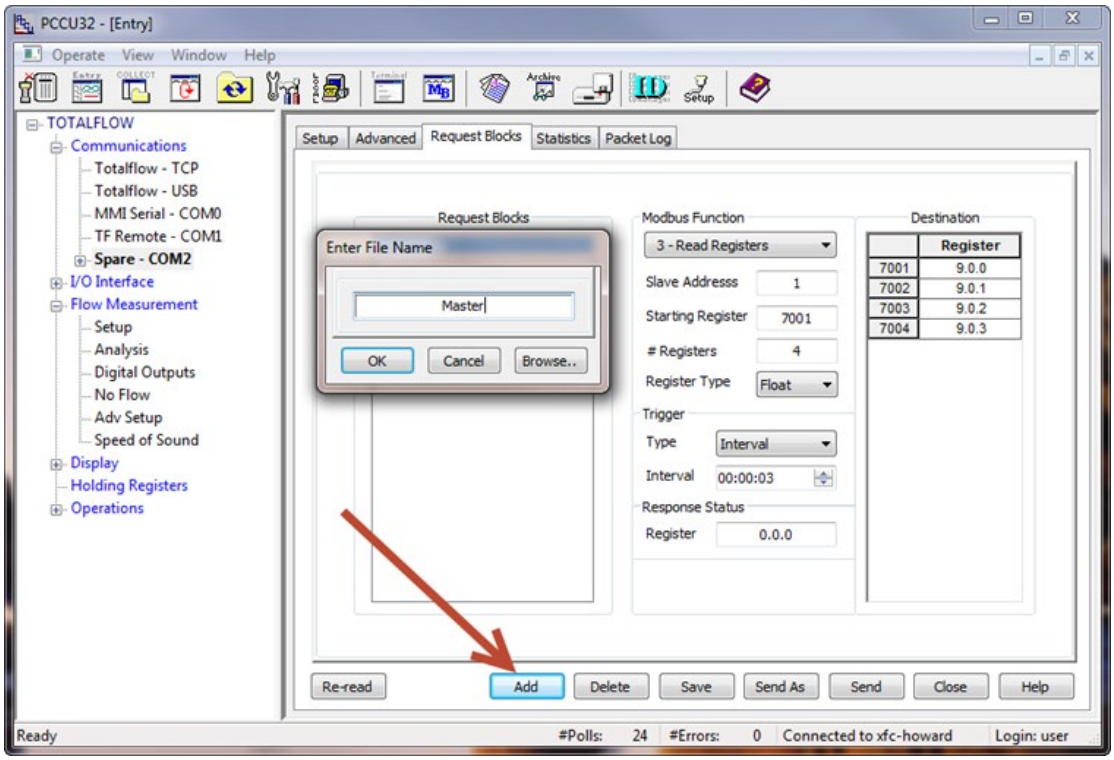


3.7 Create the master Request Block

The Master MRB (Modbus Request Block) will now need to be created. Build the request of (4) four Modbus registers and determine the location for them in the Holding Registers area within the Master.

1. Go to **TOTALFLOW**>**Spare-COM2**>**Request Blocks**.
2. Click **Add**.
3. Type **Master** as the name of the MRB file, then click **OK** to confirm.
4. In the Modbus Function area of the screen, select **3-read Registers** from the drop-down menu. This sets up the MRB to read registers from the slave.
5. Confirm the settings:
   a. Slave address: **1**
   b. Starting Register: **7001**
   c. # Registers: **4**
   d. Register Type: **Float**
6. Set the Trigger Type to **Interval**, with interval set to **3** seconds.
7. Determine the destination for the registers reading from the slave. Enter **9.0.0**, **9.0.1**, **9.0.2** and **9.0.3** for the AAR locations in Holding Registers. Verify that the setup looks like the screen below (Figure 8).
8. Click **Send** to save the changes to the Master.mrb file.

Figure 8 Master MRB

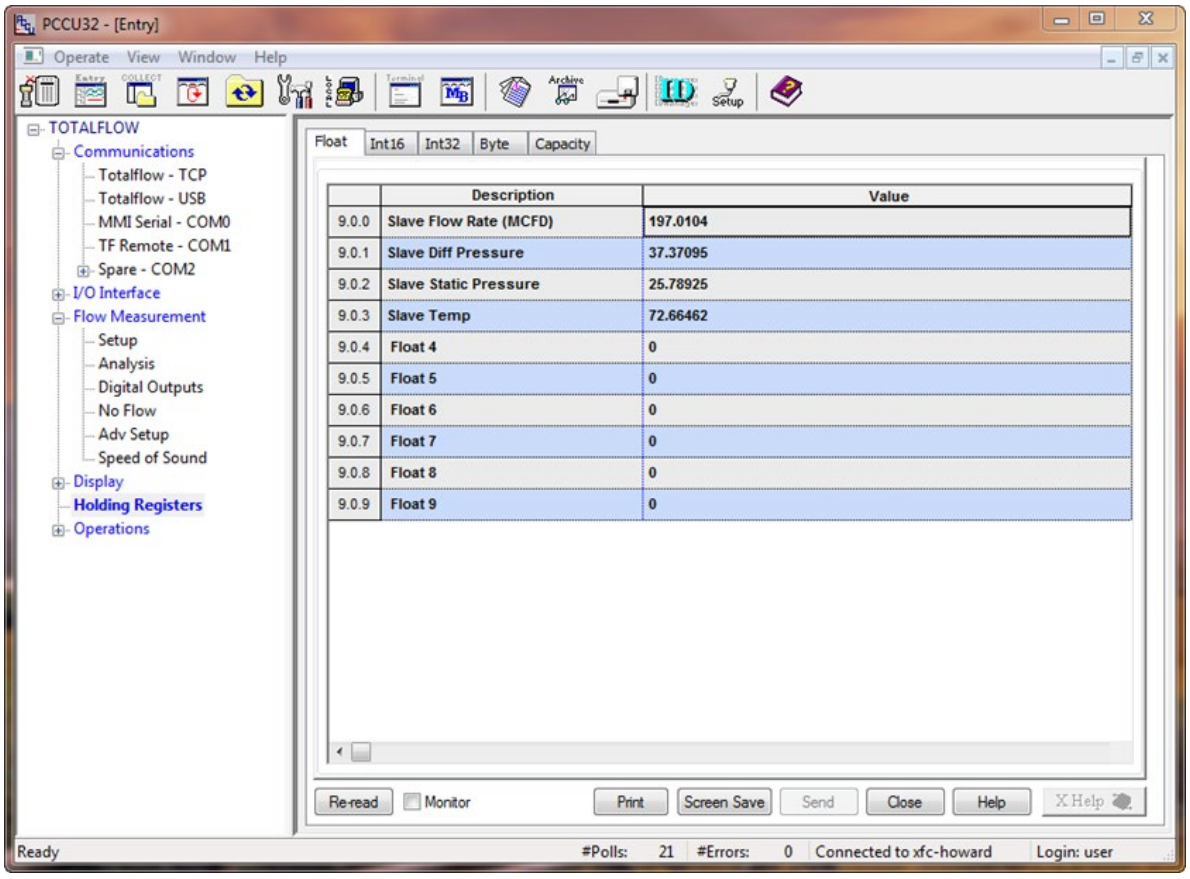


3.8 Configure the master Holding Registers

Now that the master is configured with destination locations for the data to be received from the slave, enter labels in the Holding Register area in the master.

1. Go to **TOTALFLOW**>**Holding Registers**>**Float** and in the Description column, enter the names as shown in the screenshot below (Figure 9).
2. Click **Send** to save the changes.

Figure 9 Master holding registers

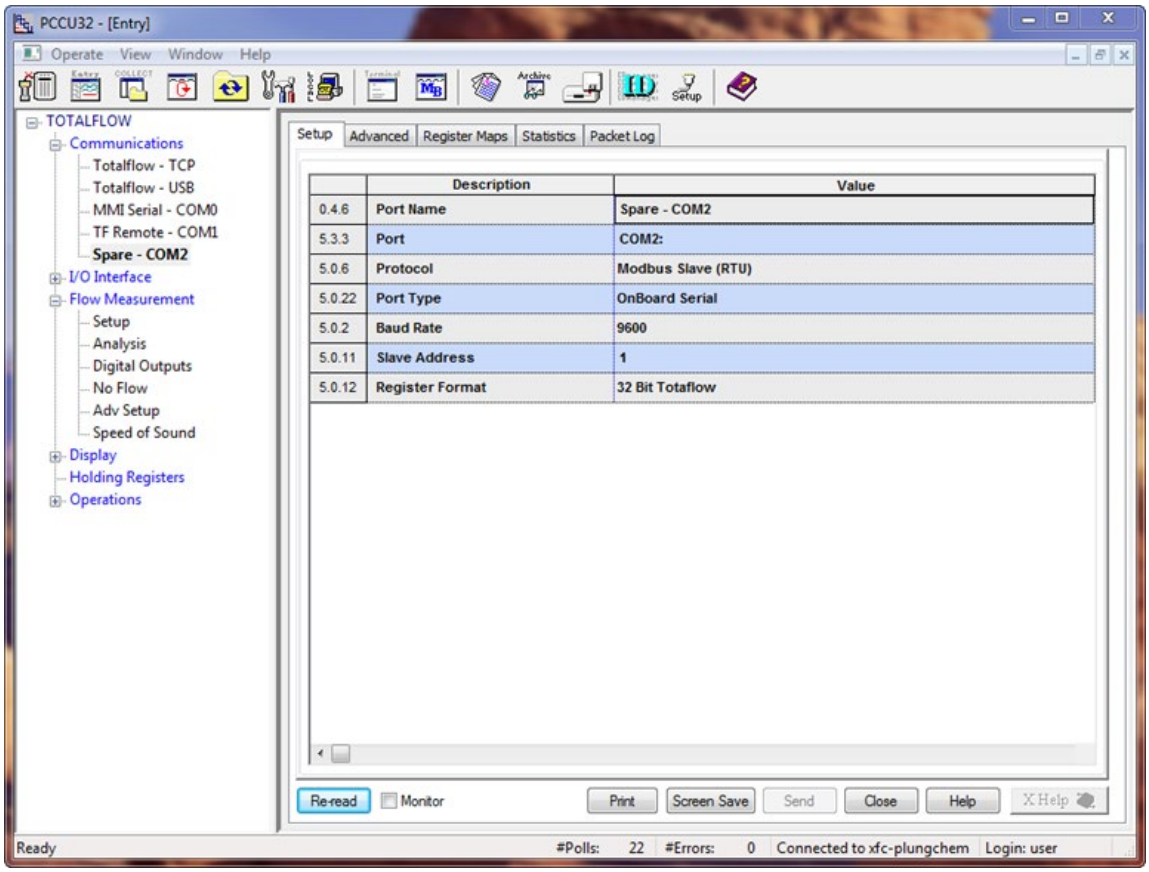


3.9 Configure the slave Setup tab

This instruction will assist in the setup of the slave XFC^{G4}.

1. Go to **TOTALFLOW**>**Spare-com2**>**Setup** and verify that the Port value field is set for **COM2:**. This indicates that the hardware com port 2 on the XFC^{G4} is now designated for use.
2. For Port Type enter **Onboard Serial** from the drop-down menu.
3. Set the Protocol value to **Modbus Slave (RTU)**.
4. Set the Baud Rate to **9600**.
5. Set the Register Format to **32 Bit Totalflow**.

Figure 10 Slave setup tab

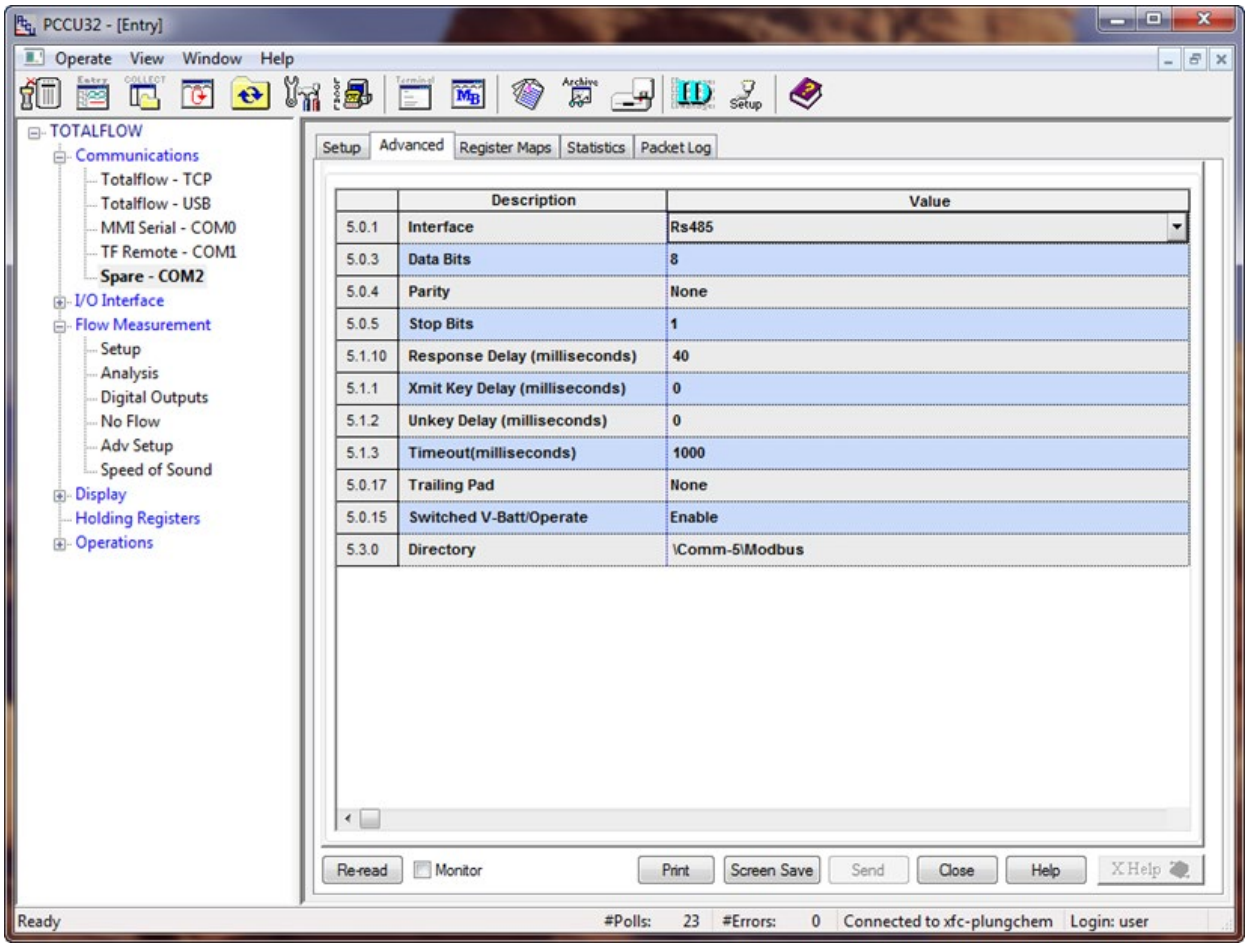


3.10 Configure the slave Advanced tab

The Advanced tab will allow for detailed setup of the com port parameters.

1. Go to **TOTALFLOW**>**Spare-COM2**>**Advanced** and verify that Interface is set for **RS-485**.
2. All other fields in this tab should require no changes because the default settings will be correct. Verify that the settings are the same as shown in the following screen (Figure 11).

Figure 11 Slave advanced tab



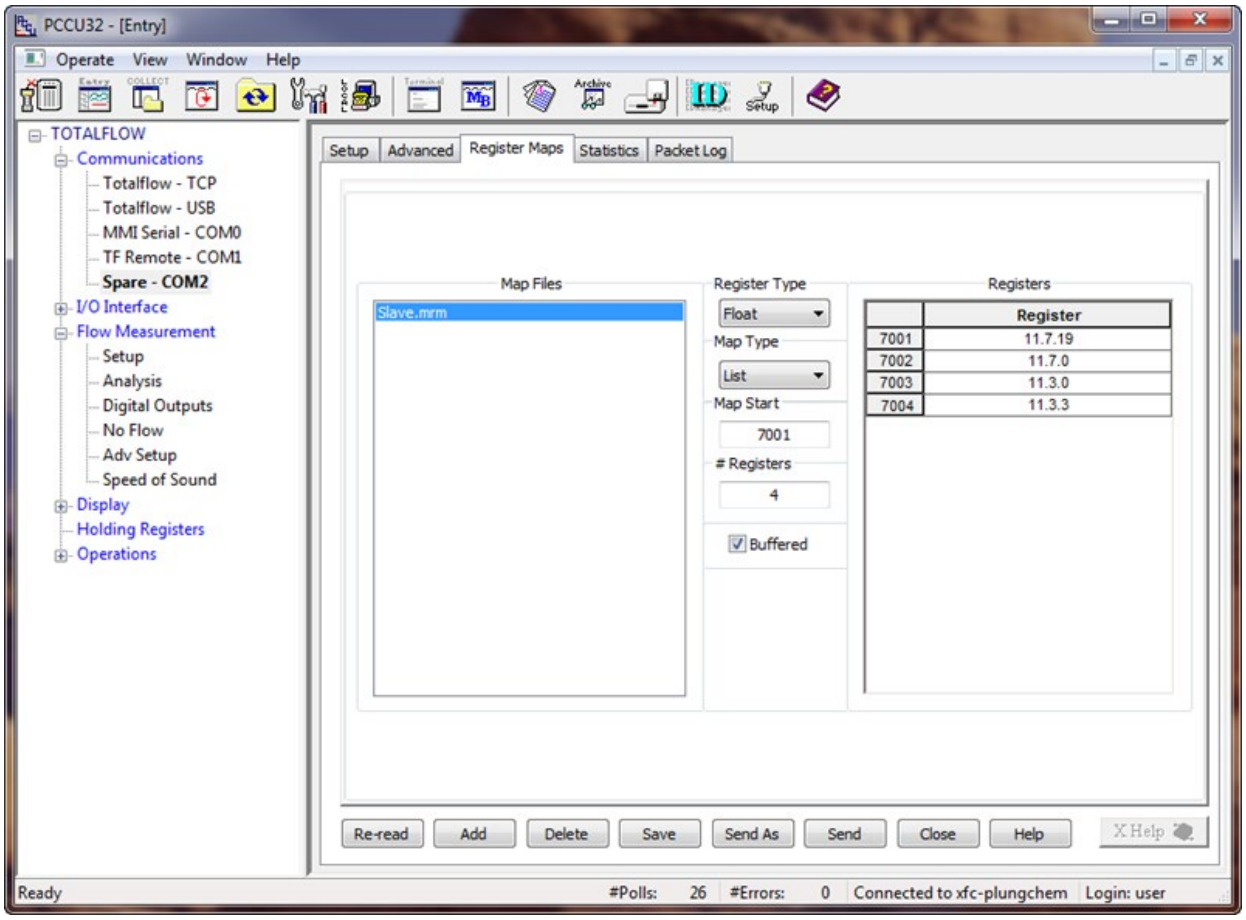
3.11 Create the slave register map

The slave MRM (Modbus Register Map) will now need to be created. Build the map of (4) four AARs (App Array Registers) that the master will be able to request data from.

1. Go to **TOTALFLOW**>**Spare-COM2**>**Register Maps.**
2. Click **Add**.
3. Type in **Slave** as the name of the MRM file, then click **OK** to confirm.
4. In the Register Type area of the screen, select **Float** from the drop-down menu. This sets up the MRM to map registers that are floating point numbers.
5. Set the following fields:
   a. Map Type: **List**
   b. Map Start: **7001**
   c. # Registers: **4**
   d. Select the **Buffered** check box.

6. Determine the registers mapped for the slave. In Registers, enter **11.7.19** (Flow rate), **11.7.0** (DP), **11.3.0** (SP) and **11.3.3** (Temp) for the AAR locations. Verify that the setup looks like the screen below (Figure 12).
7. Click **Send** to save the changes to the Slave.mrm file.

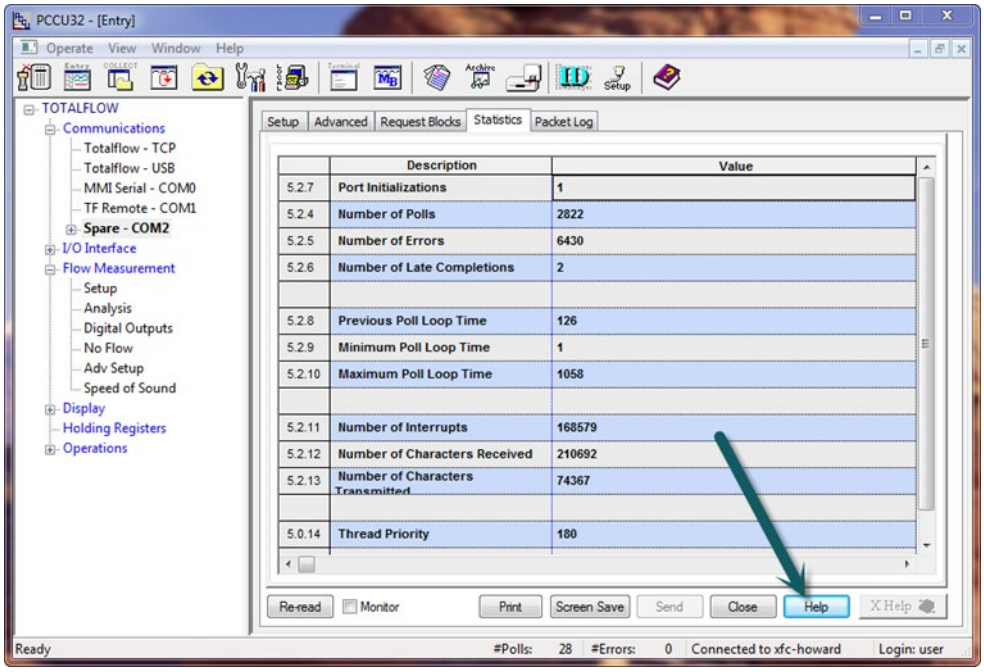
Figure 12 Slave register map



3.12 Monitor Statistics

The Statistics tab will give specific indications of how well the Modbus link is working between the master and slave. The statistics tab can be viewed on either the master or the slave com port. Descriptions of each field are documented in the Help files and can be accessed by clicking **Help**.

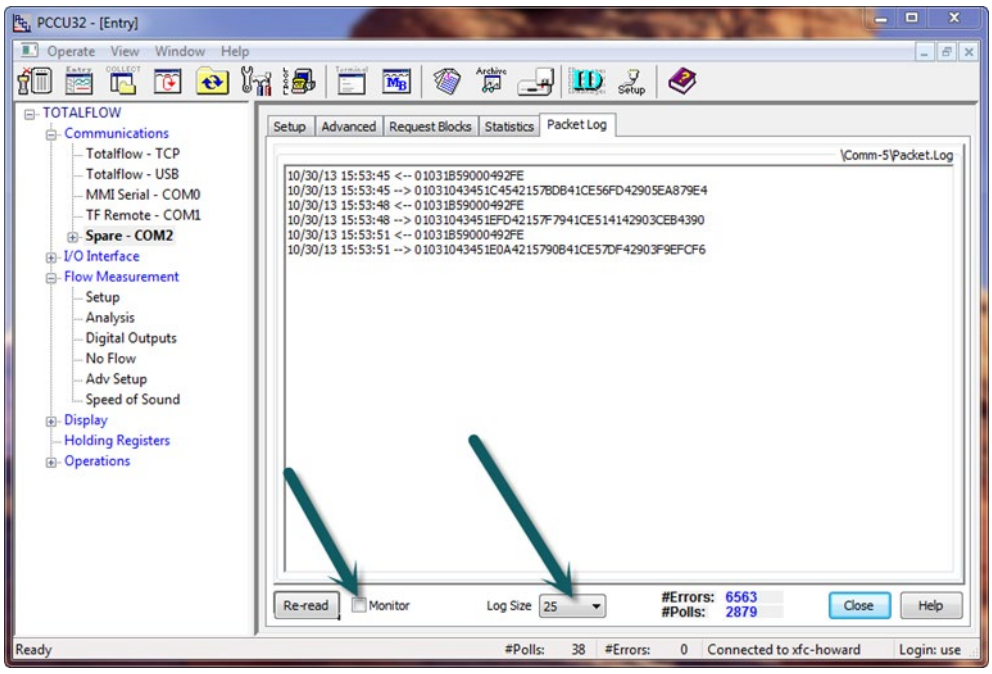
Figure 13 Statistics



3.13 View Packet Log

The Packet Log will give the advanced user the ability to see the request message that the master sent to the slave and the corresponding message received back to the master. The Packet Log tab can be viewed on either the master or the slave com port. To set this up, use the drop-down menu Log Size and select **25**, then select either **Monitor**, or **Re-read.**

Figure 14 Packet log



4 Scenario 2: XFC^{G4} to fixed slave device

4.1 XFC^{G4} to fixed slave device overview

This scenario uses an XFC^{G4} as a master to connect to another device that has a fixed Modbus register map. This means that the values in the fixed device cannot be changed and adjustments on the master will be required to receive the right information. The master will be given the task of monitoring gas quality information data from the slave. This will be accomplished via an RS-485 hardwire communication link between both units. The link will use Modbus (ASCII) as the protocol and a register format of 32 bit. Flow data from the fixed slave needs to be read (updated) to the master every 2 seconds. Specific registers for BTU, specific gravity, nitrogen, CO_2, and methane are required in the slave for this scenario. The master will assign the registers read from the slave to locations in its holding registers interface for viewing updates.

Figure 15 XFC to fixed slave

4.2 Assumptions

This example makes the following installation assumptions:

- An XFC^{G4} flow computer will interface to another Modbus device via a hardwire RS-485 link on Com2. (See section 3.3 Connect components (wiring)).
- The XFC^{G4} has an RS-485 com module (part# 2015193) installed in the comm port 2 position on the board (see Figure 16).
- The distance between the devices is less than 4000 feet.
- Modbus ASCII protocol and 32 Bit Register format will be used.
- Master XFC^{G4} requires gas quality data from fixed slave device.
- PCCU software is available for connection to the master device.

4.3 Connect components (wiring)

IMPORTANT NOTE: The wiring of Com 2 depends on the XSeries device used and whether these are direct connections (onboard) or use extension modules. Always power off the device before wiring.

The example used in this basic configuration case and shown in Figure 16 illustrates the connections required to use an XFC to connect to another device to create a hardwire RS-485 connection. The diagram for this scenario shows direct connection to the board.

1. Connect the XFC^{G4} via an RS-485 cable on J4 pin 12 (Bus+) and pin 13 (Bus-).
2. After completing connections, power the devices on.
3. Verify the power on sequence is correct.

Figure 16 Comm2 XFC (Master) wiring

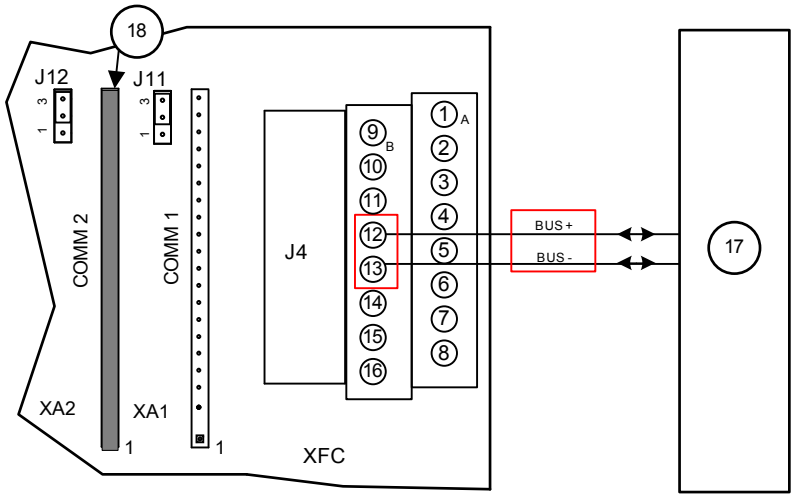


Table 13 Legend for Comm2 Master wiring

PIN	Signal	Comm		RS-232		RS-485
		1	2	OUT	IN	
1	GND	●	●			●
2	VBATT	●	●	●		
3	SWVBAT	●	●	●		
4	TXD/BUS+	●		●		●
5	BUS+	●				●
6	RXD/BUS-	●			●	●
7	BUS-	●				●
8	RTS	●		●		●
9	CTS	●			●	
10	DTR	●		●		
11	CD	●			●	
12	TXD/BUS+		●	●		●
13	RXD/BUS-		●		●	●
14	RTS		●	●		●
15	CTS		●		●	
16	OPER	●	●	●		●
Item						
17	Slave (fixed)					
18	RS-485 Comm module					

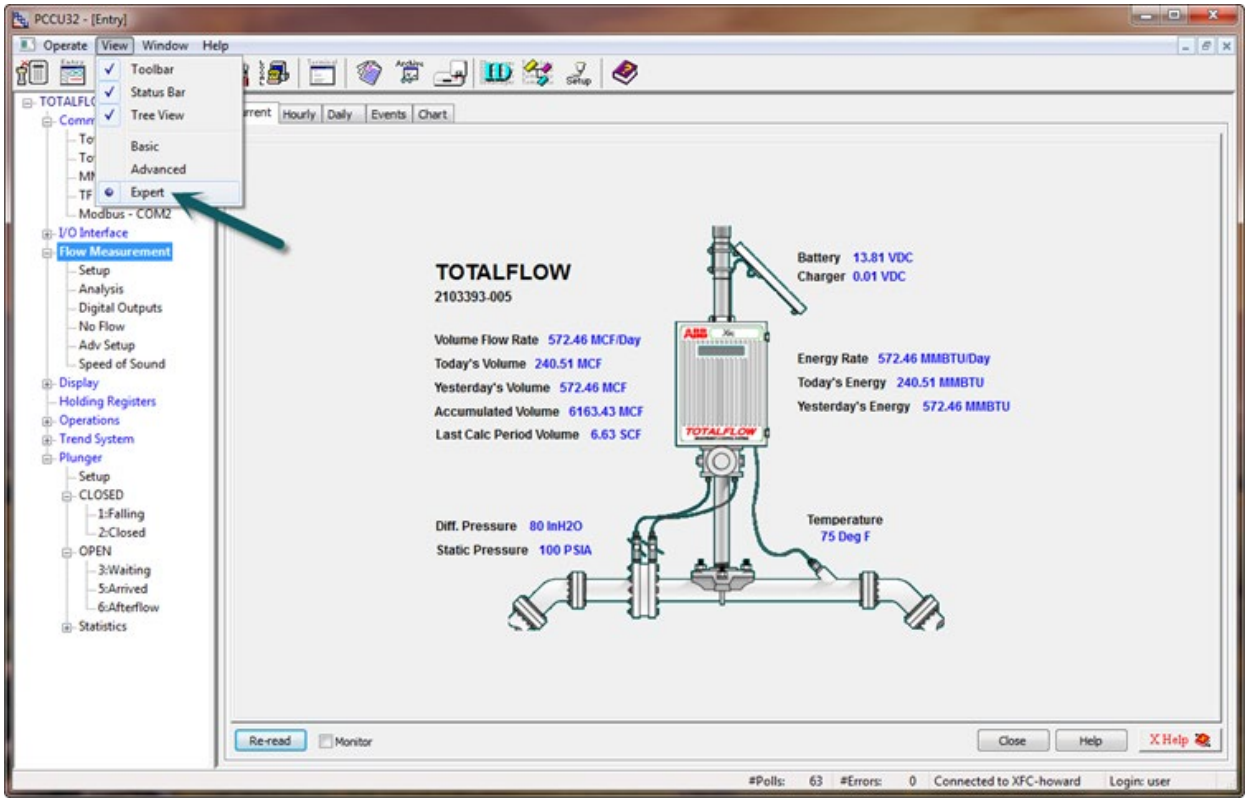
IMPORTANT NOTE: Comm 1 and Comm2 on J4 need to have a Comm Module on XA1 and/or XA2 to operate.

4.4 Connect using PCCU

Verify that you can connect with the device using PCCU and change the view to prepare for configuration.

1. Connect a laptop with PCCU software to the device.
2. Click **Entry** on the top menu bar and verify that PCCU establishes a connection with the device.
3. Click **View** at the top menu, and choose **Expert** from the drop-down list.

Figure 17 Expert view setup

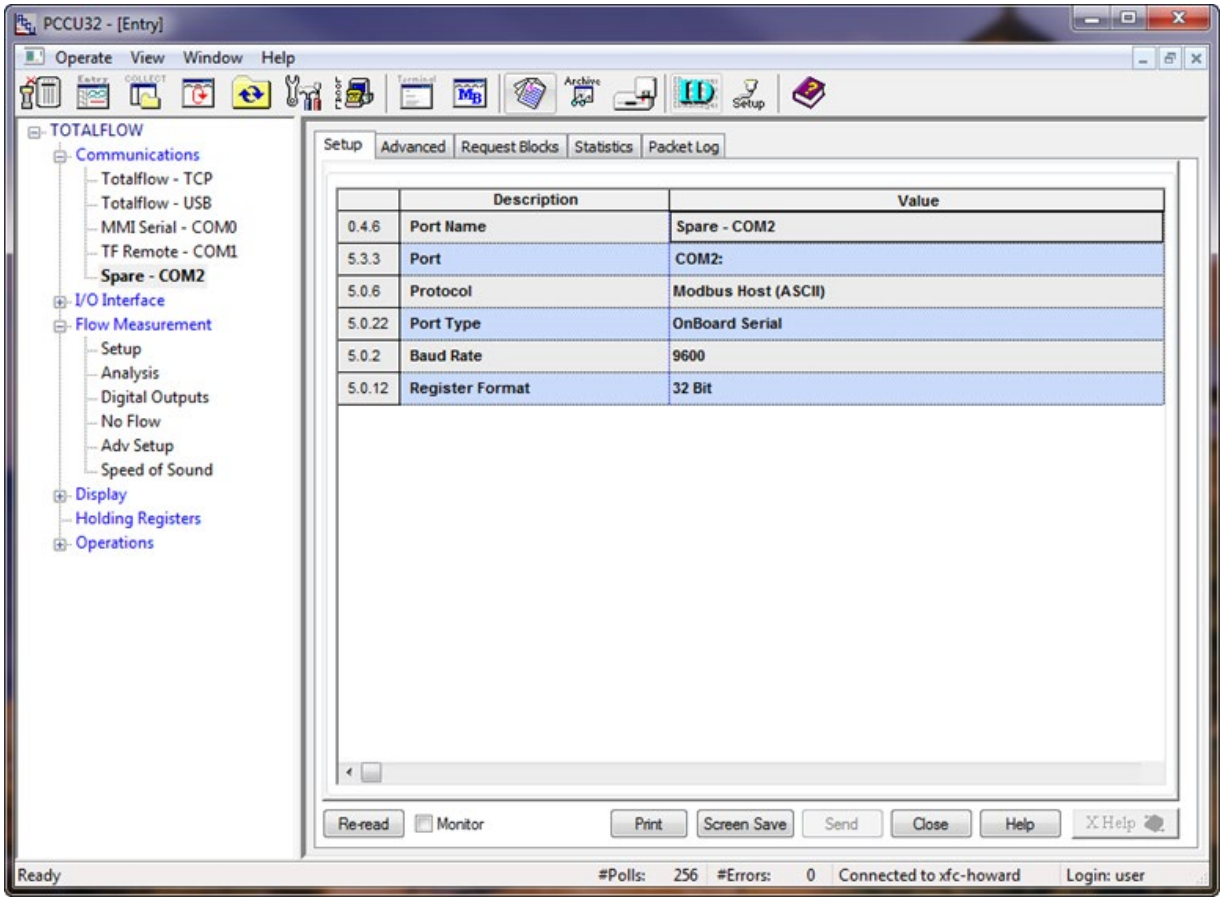


4.5 Configure the master Setup tab

This instruction will involve the master XFC^{G4} setup.

1. Go to **TOTALFLOW**>**Spare-com2**>**Setup** and verify that the Port value field is set for **COM2:**.
2. Set Port Type to **Onboard Serial**.
3. Set the Protocol value to **Modbus Host (ASCII)**.
4. Set the Baud Rate to **9600**.
5. Set the Register Format to **32 Bit**.

Figure 18 Master setup tab

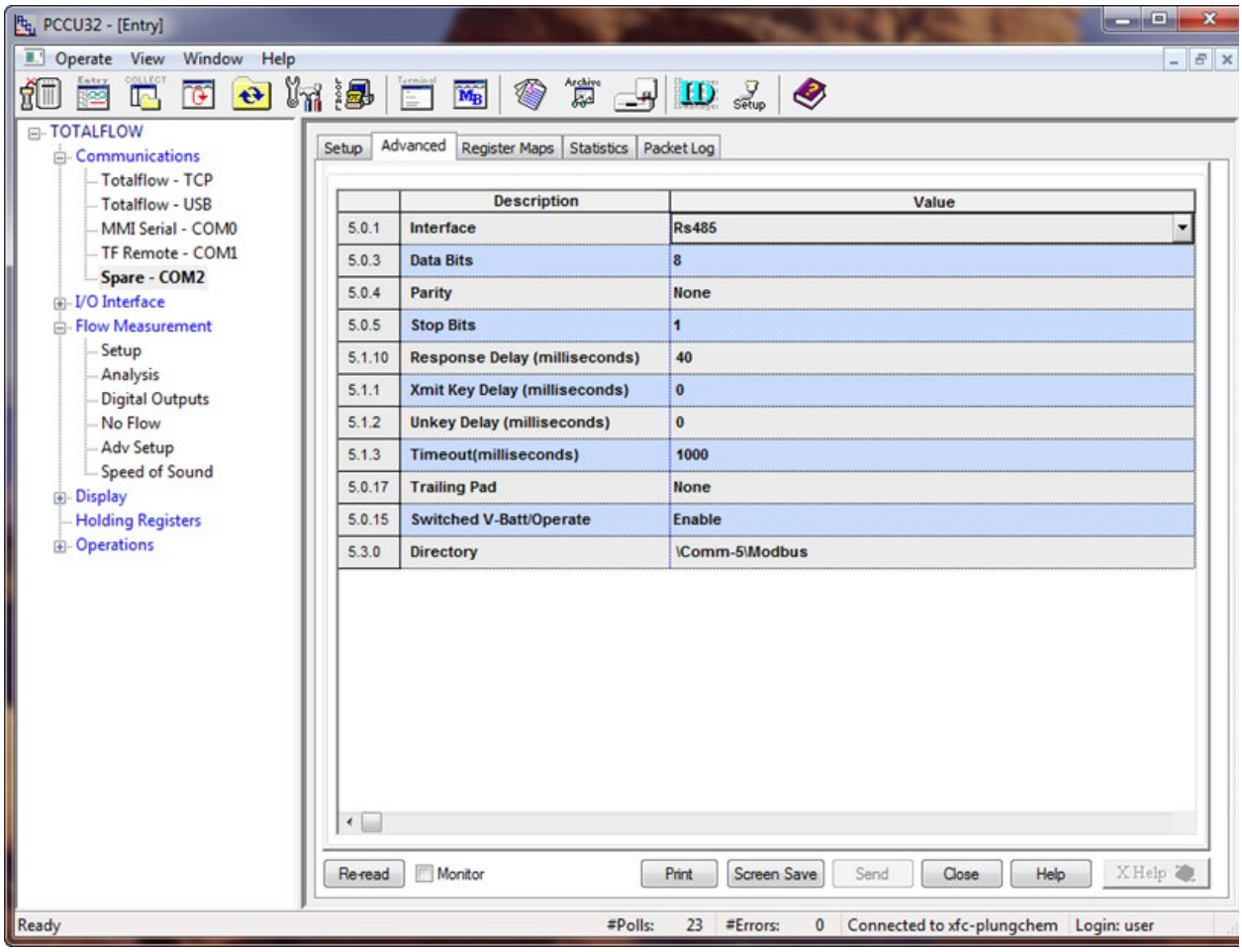


4.6 Configure the master Advanced tab

The Advanced tab will allow for detailed setup of the com port parameters.

1. Go to **TOTALFLOW**>**Spare-COM2**>**Advanced** and verify that Interface is set up for RS-485.
2. All other fields in this tab should require no changes because the default settings will be correct. Verify that the settings are the same as shown in the following screen (Figure 19).

Figure 19 Master advanced tab



4.7 Create the master Request Block

The Master MRB (Modbus Request Block) will now need to be created. Build the request of (5) five Modbus registers and determine the location for them in the holding registers area within the Master.

1. Go to **TOTALFLOW**>**Spare-COM2**>**Request Blocks**.
2. Select **Add** at the bottom of the screen.
3. Type **Quality** as the name of the MRB file, then click **OK** to confirm.
4. In the Modbus Function area of the screen, select **3-read Registers** from the drop-down menu. This sets up the MRB to read registers from the slave.
5. Set the follow fields:
   a. Slave address: **1**
   b. Starting Register: **8020**
   c. # Registers: **5**
   d. Register Type: **Float**

6. Set the Trigger Type to **Interval**, with the interval set to **2** seconds.
7. Set the Destination for the registers we are reading from the slave. Enter **9.0.0**, **9.0.1**, **9.0.2**, **9.0.3** and **9.0.4** for the AAR locations in Holding Registers. Verify that the setup looks like the screen below (Figure 20).
8. Click **Send** to save the changes to the Master.mrb file.

Figure 20 Master request block

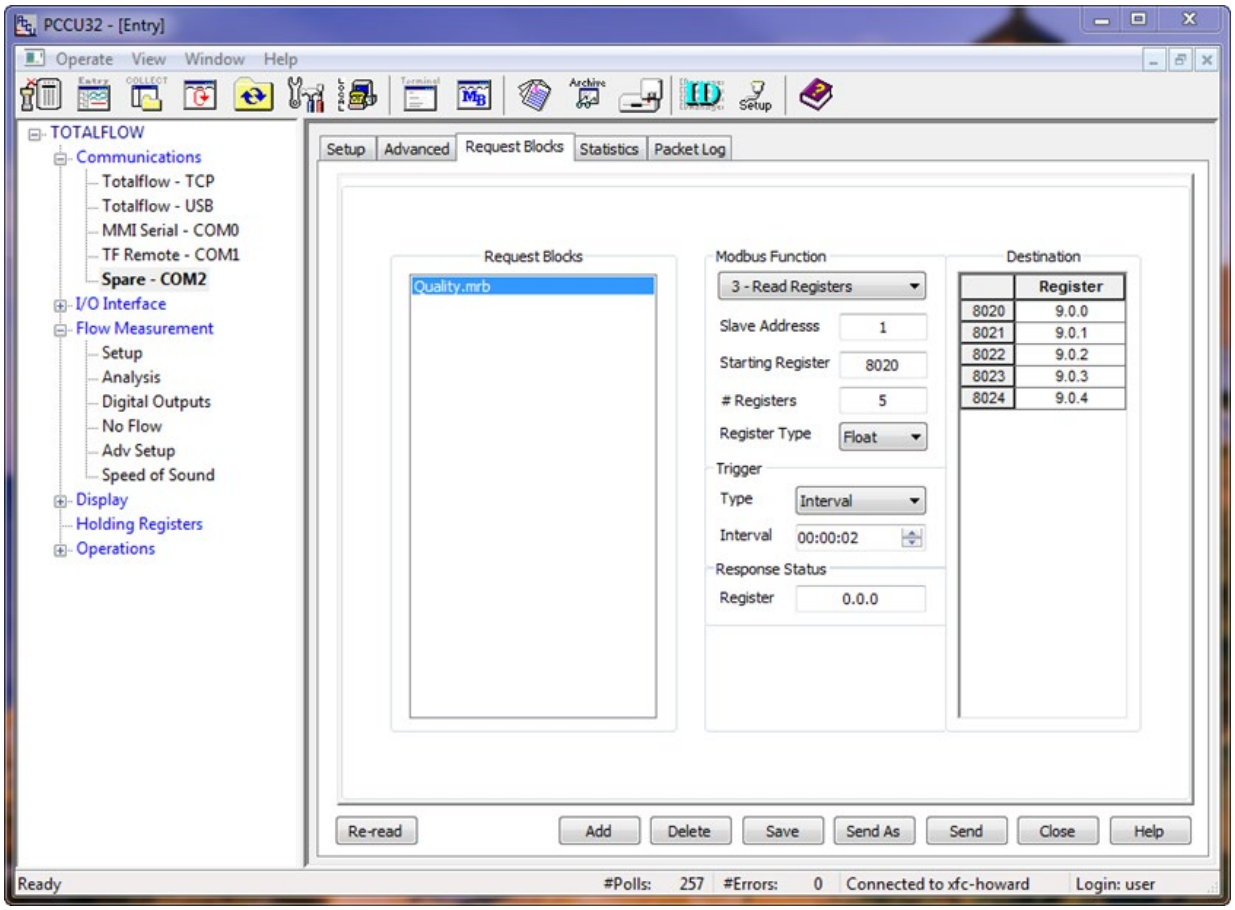


Table 14 Slave registers

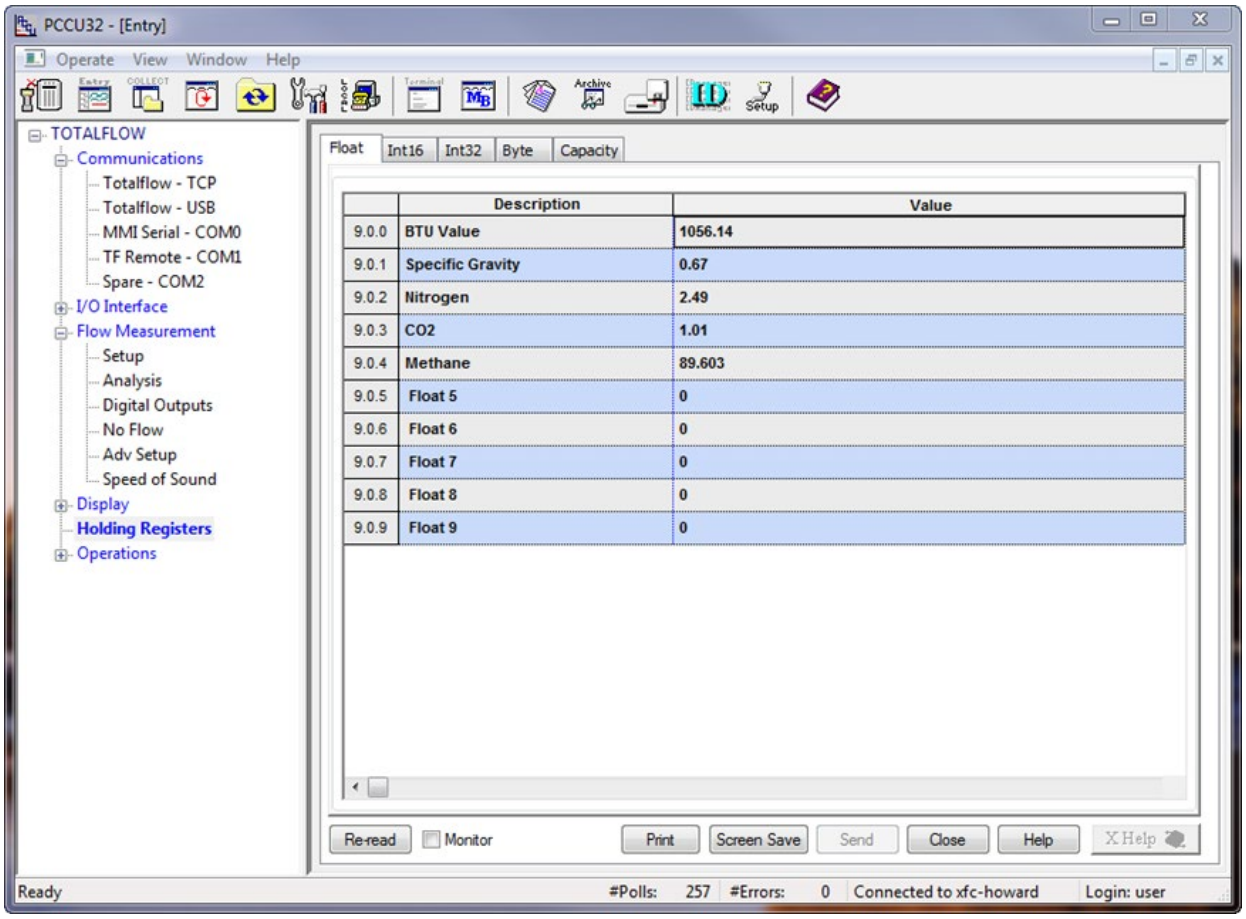
Modbus Address	Description
8020	BTU Value
8021	Specific Gravity
8022	Nitrogen
8023	CO_2
8024	Methane

4.8 Configure master Holding Registers

Now that the master is configured with destination locations for the data to be received from the slave, enter labels in the holding register area in the master.

1. Go to **TOTALFLOW**>**Holding Registers**>**Float.**
2. In the Description column, enter the names as shown in the screenshot below (Figure 21).
3. Click **Send** to save the changes.

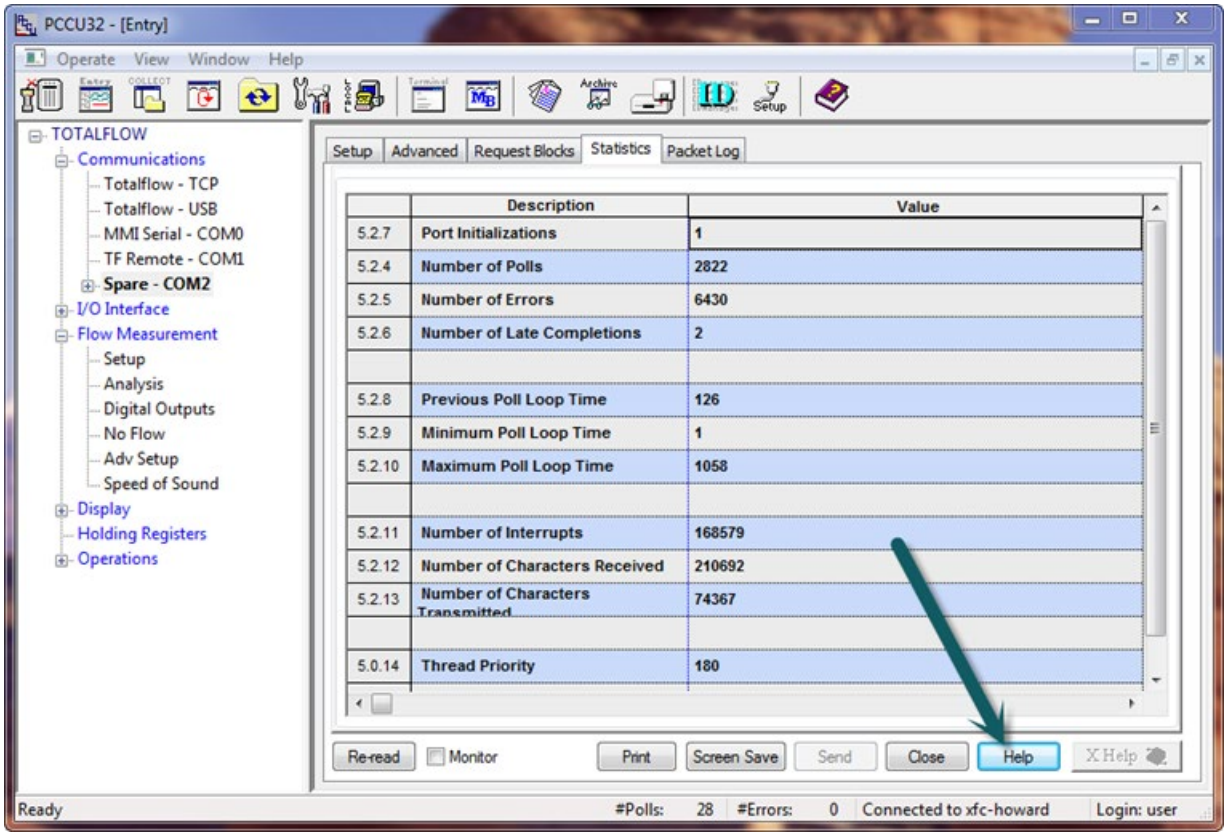
Figure 21 Master holding registers



4.9 Monitor statistics

The Statistics tab will give specific indications of how well the Modbus link is working between the master and slave. The statistics tab can be viewed on either the master or the slave com port. Descriptions of each field are documented in the Help files and can be accessed by clicking **Help**.

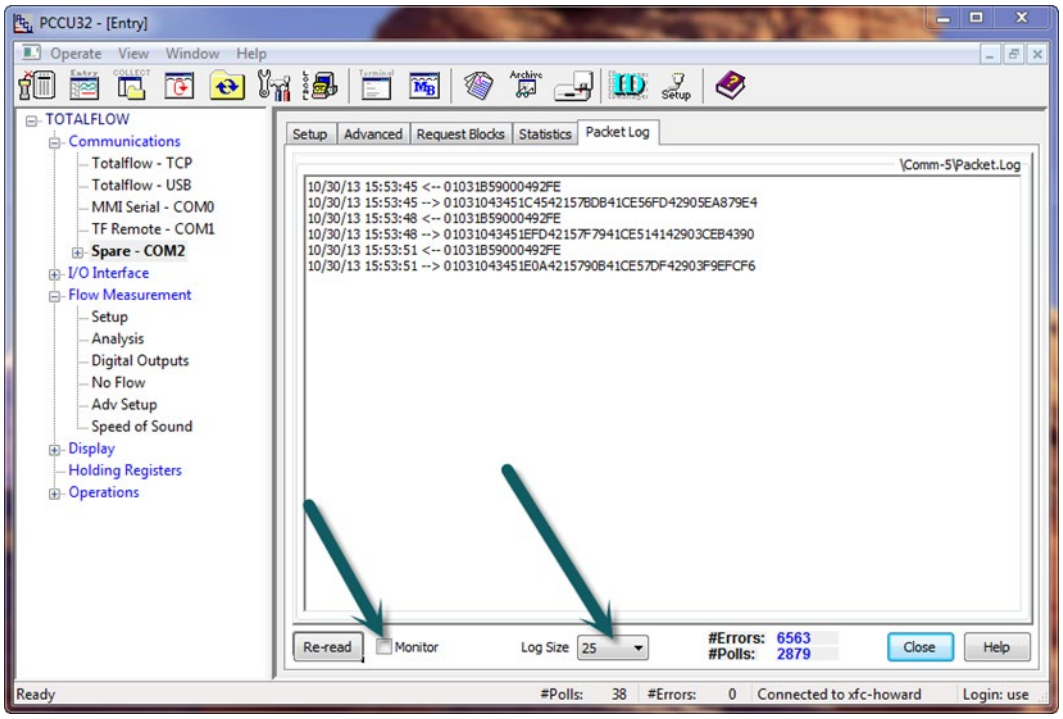
Figure 22 Statistics



4.10 View Packet Log

The Packet Log gives the advanced user the ability to see the request message that the master sent to the slave and the corresponding message received back to the master. The Packet Log tab can be viewed on either the master or the slave com port. To set this up, use the drop-down menu Log Size and select **25**, and then select either **Monitor**, or select **Re-read**.

Figure 23 Packet log

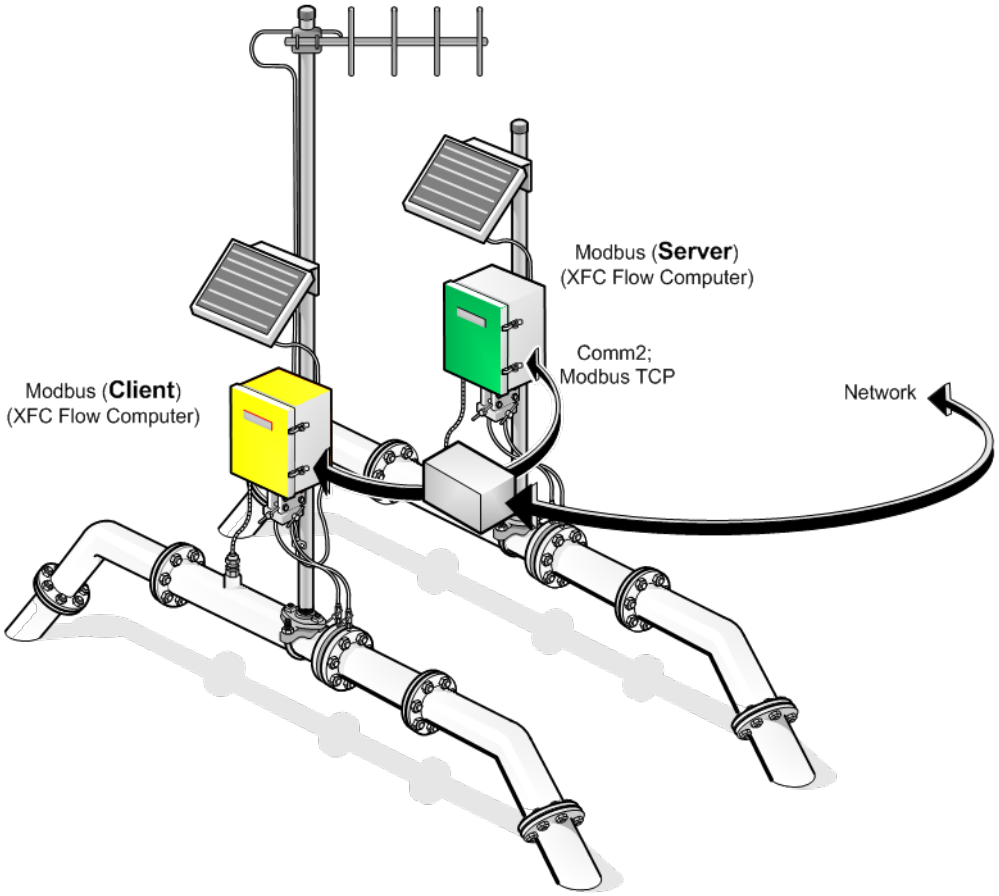


5 Scenario 3: Modbus TCP server to client

5.1 Modbus TCP server to client overview

This scenario uses an XFC^{G4} as a server and connects another XFC^{G4} (client) over a Modbus TCP link. The goal of this scenario is for the client to write the same gas quality data that it is using for its calculations to the server. This will allow both XFC^{G4}s to always have the same gas quality data. The link will use Modbus (TCP) as the protocol and a register format of 32 Bit Totalflow. The client will write gas quality to the server and keep it updated on a continuous basis.

Figure 24 Modbus TCP site



5.2 Assumptions

This example makes the following installation assumptions:

- An XFC^{G4} flow computer will interface to another Modbus device via TCP link on Com2. See section 3.3 Connect components (wiring).
- The XFC^{G4}s are connected on the same network.
- Modbus TCP protocol and 32 Bit Totalflow Register format
- Client XFC^{G4} has valid gas quality data.
- PCCU software is available for connection to the master and client devices.

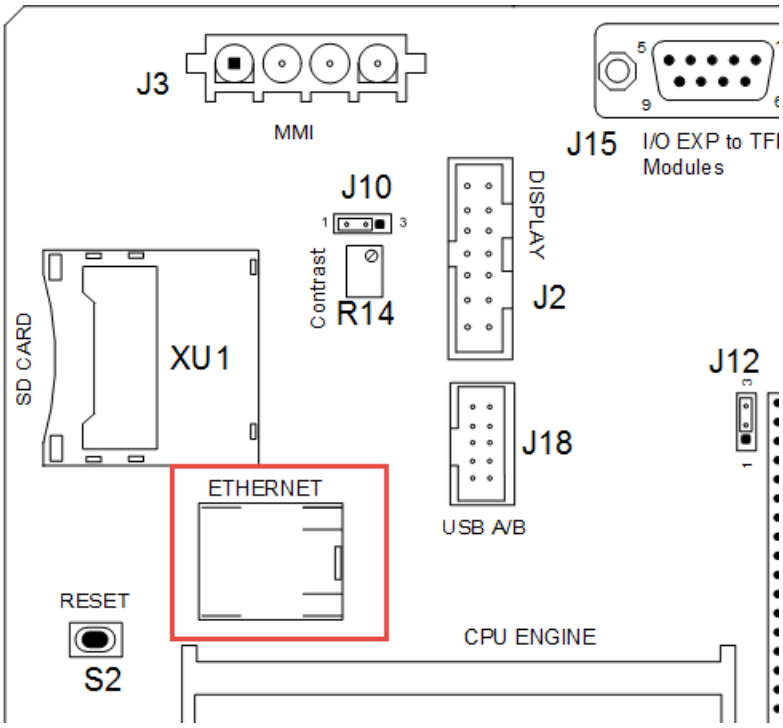
5.3 Connect components (wiring)

IMPORTANT NOTE: To configure the XFC[G4], use a valid IP address. A static IP address is recommended.

Connect the device to the network using the onboard Ethernet port shown in Figure 25 XFC.

1. Connect the network cables to both XFC[G4]s.
2. After completing connections, power on the devices.
3. Verify power on sequence is correct.

Figure 25 XFC onboard Ethernet port

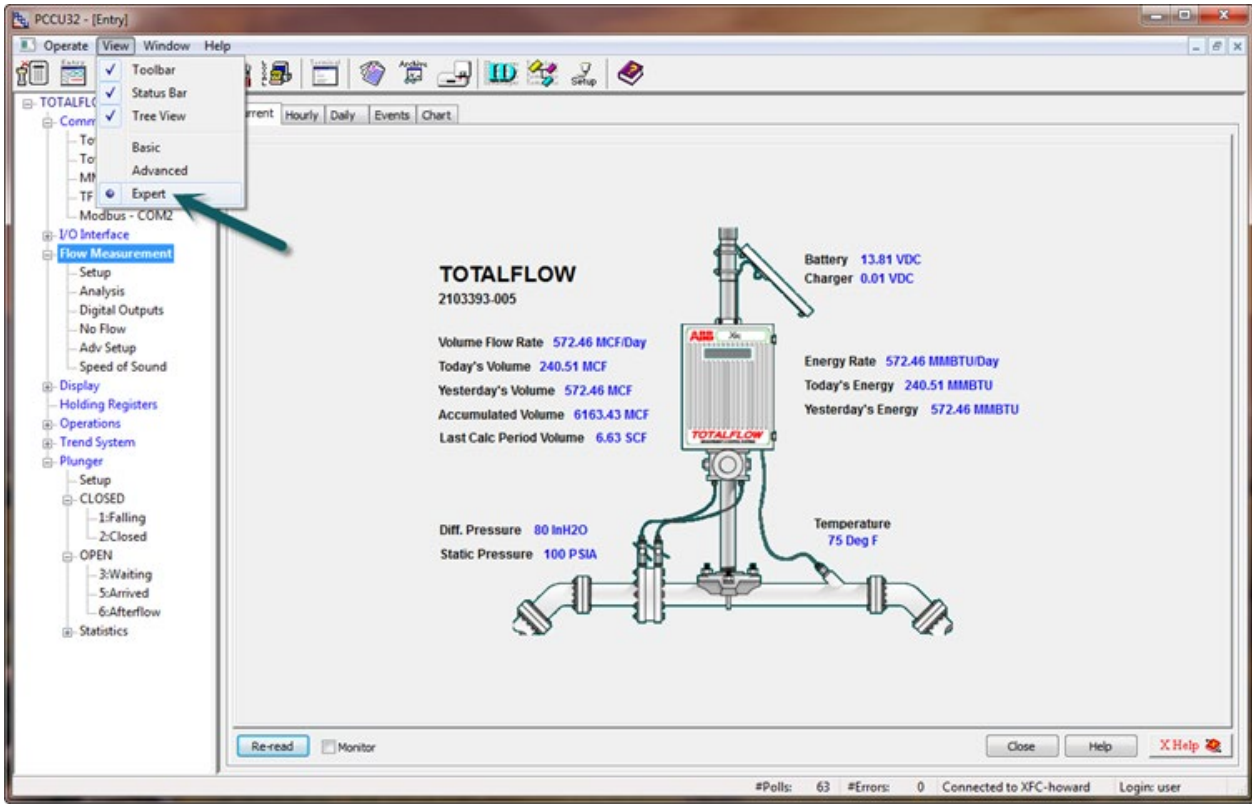


5.4 Connect using PCCU

Verify connection with the device using PCCU and change the view to prepare for configuration.

1. Connect a laptop with PCCU software to the device.
2. Click **Entry** on the top menu bar and verify that PCCU establishes a connection with the device.
3. Click **View** at the top menu, and then choose **Expert** from the drop-down list.

Figure 26 Expert view setup

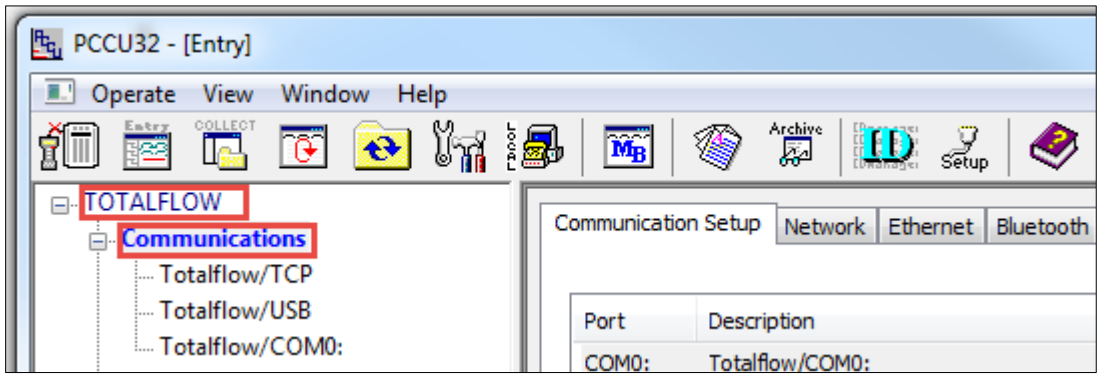


5.5 Configure XFC^{G4} network connections

This instruction will demonstrate how to set up the network connection for the XFC^{G4}s. In most cases it is recommended that each XFC^{G4} have a fixed IP address that will always be available for the location. Obtain the IP address information from your IT administrator.

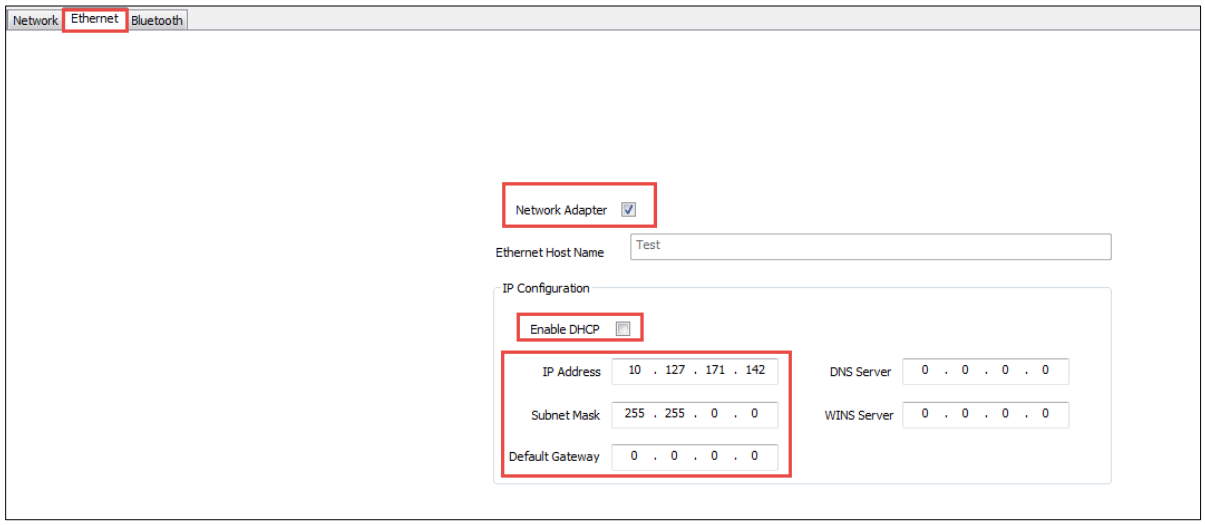
1. Connect the laptop to the XFC USB or MMI port.
2. Start PCCU and connecting using Entry mode.
3. Go to **TOTALFLOW**>**Communications** on the navigation tree (Figure 27).

Figure 27 Communication Setup



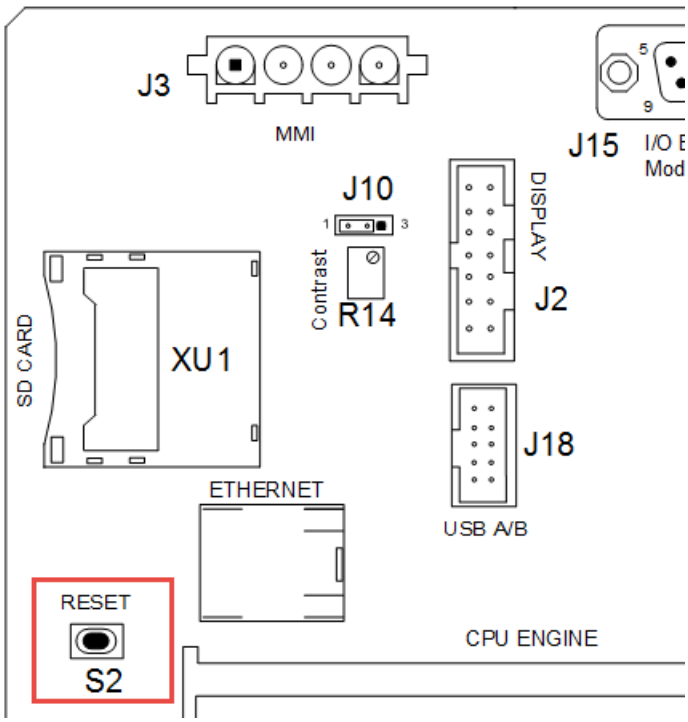
4. Click **Ethernet** (Figure 28).
   a. Select **Network Adapter** to enable the Ethernet port.
   b. Clear **Enable DHCP**.
   c. Type the IP address, subnet mask and default gateway. In this scenario, set the IP Address to **10.127.171.142**. Set the Subnet Mask to **255.255.0.0** for this location. Type the appropriate default gateway.

Figure 28 Network connection configuration



5. Click **Send** to commit changes.
6. Press the reset button once on the XFC^{G4} (Figure 29) to lock in changes to the network settings.

Figure 29 XFC onboard reset button



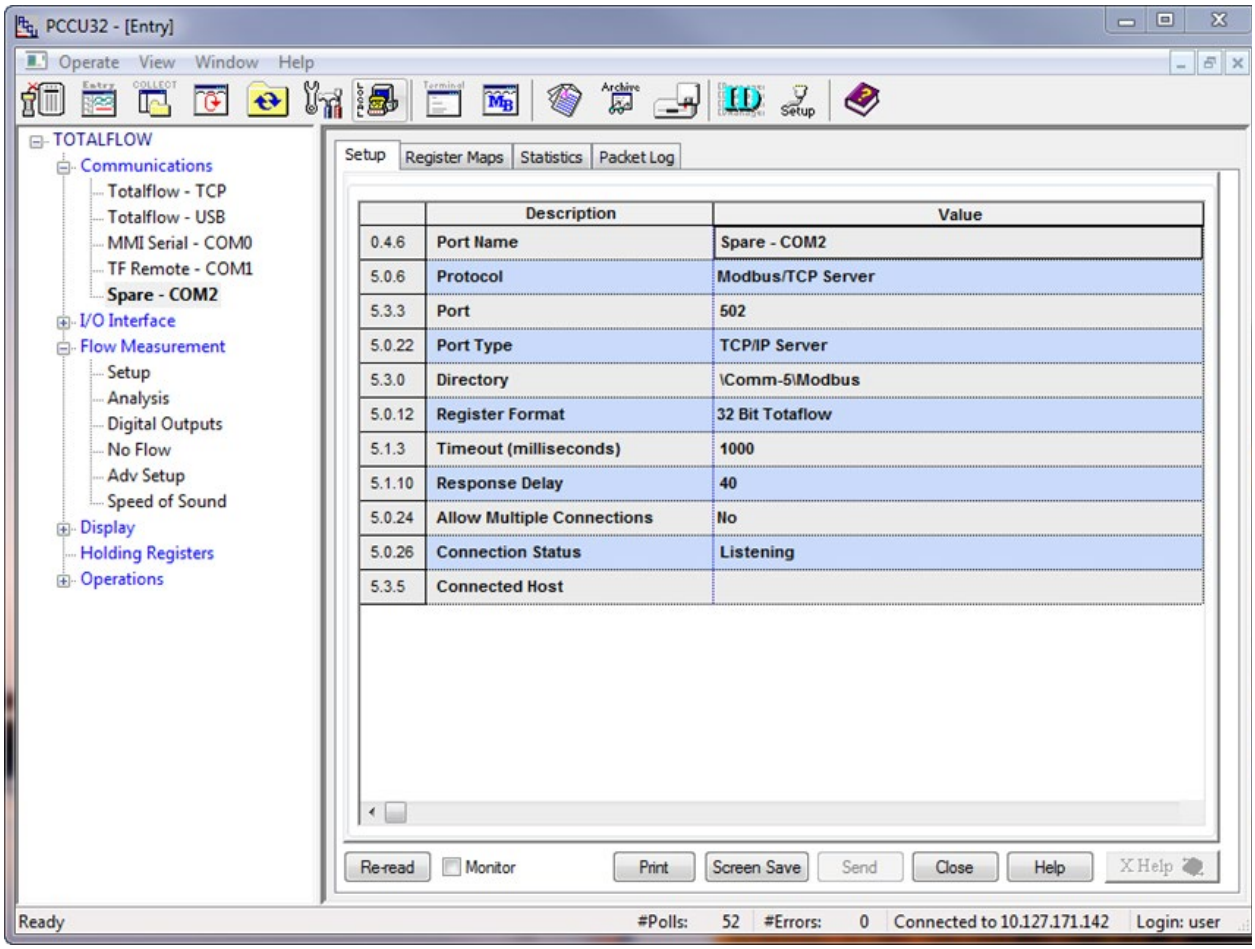
7. Follow steps 1-6 to configure the other XFC.
8. Connect the XFCs to the network ports (onsite network equipment).
9. Re-connect to the XFC^{G4} using the new IP address to verify. Connect laptop to the network and ping both XFCs to verify that both devices can communicate.

5.6 Configure server Setup tab

This instruction will involve the server XFC^{G4} setup. Use the server setup tab.

1. Go to **TOTALFLOW**>**Spare-com2**>**Setup** and select the Protocol value field to **Modbus/TCP Server**.
2. Click **Send**.
3. Verify the setting shown below (Figure 30). The default settings will be correct in this scenario.

Figure 30 Server setup tab



5.7 Create the server Register Maps

The server MRM (Modbus Register Map) now needs to be created. Build the map of (5) five AAR (App Array Register) locations that the client can write data to.

Table 15 Address reference

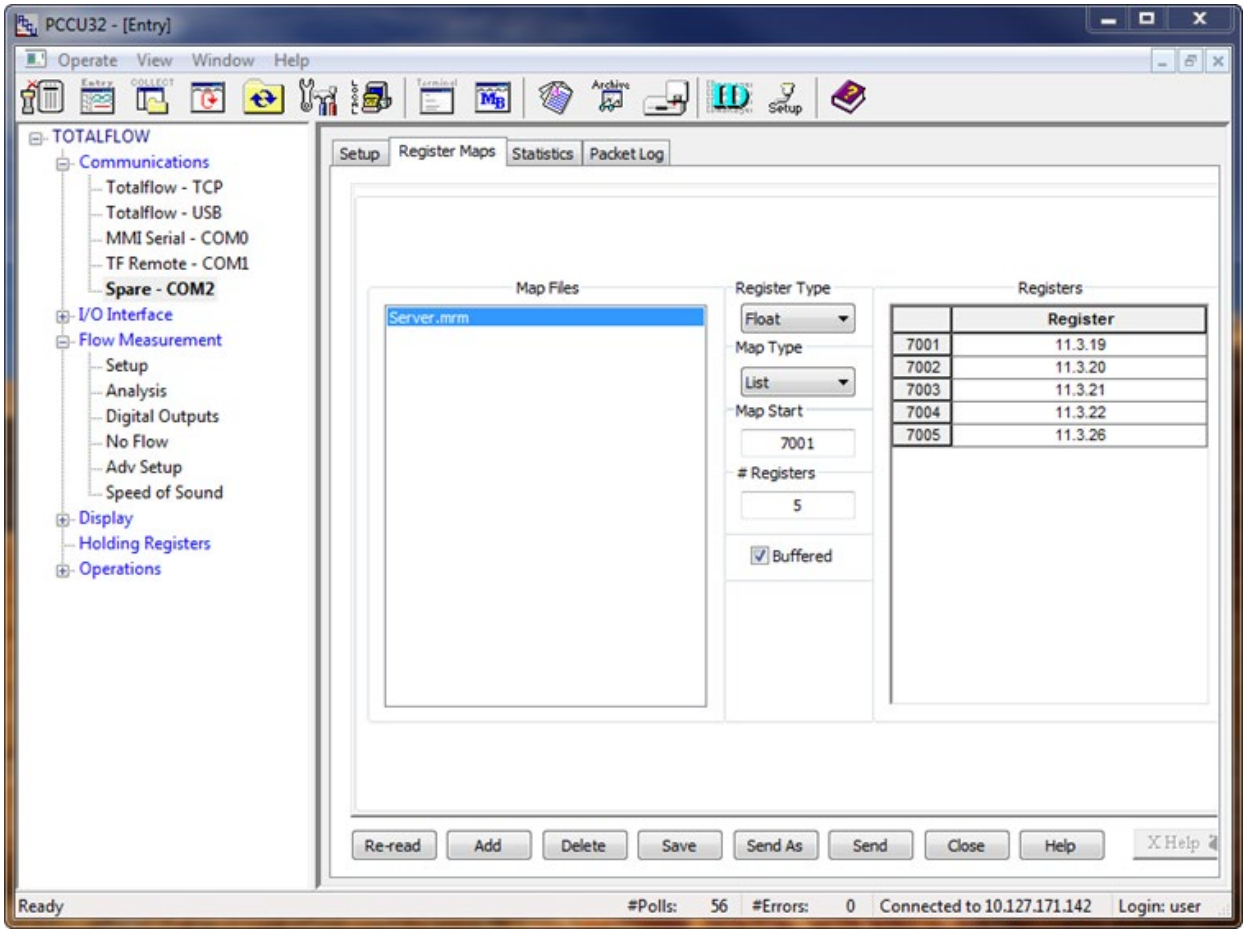
Modbus Address	Description	App Array Reg
7001	BTU Value	11.3.19
7002	Specific Gravity	11.3.20
7003	Nitrogen	11.3.21
7004	CO_2	11.3.22
7005	Methane	11.3.26

1. Go to **TOTALFLOW**>**Spare-COM2**>**Register Maps**. Click **Add**.
2. Type **Server** as the name of the MRM file.
3. Click **OK** to confirm.
4. In the Register Type area, select **Float** from the drop-down menu. This sets up the MRM to map registers that are floating point numbers.
5. Set the following fields:
   a. Map Type: **List**
   b. Map Start: **7001**
   c. # Registers: **5**

d. Select the **Buffered** check box.

6. Determine the registers we are mapping for the server. Enter **11.3.19** (BTU), **11.3.20** (Sp Gravity), **11.3.21** (N2), **11.3.22** (CO2), and **11.3.26** (Methane) for the AAR locations in Registers.
7. Verify that the setup looks like the screen below (Figure 31).
8. Click **Send** to save the changes to the slave.mrm file.

Figure 31 Server register map

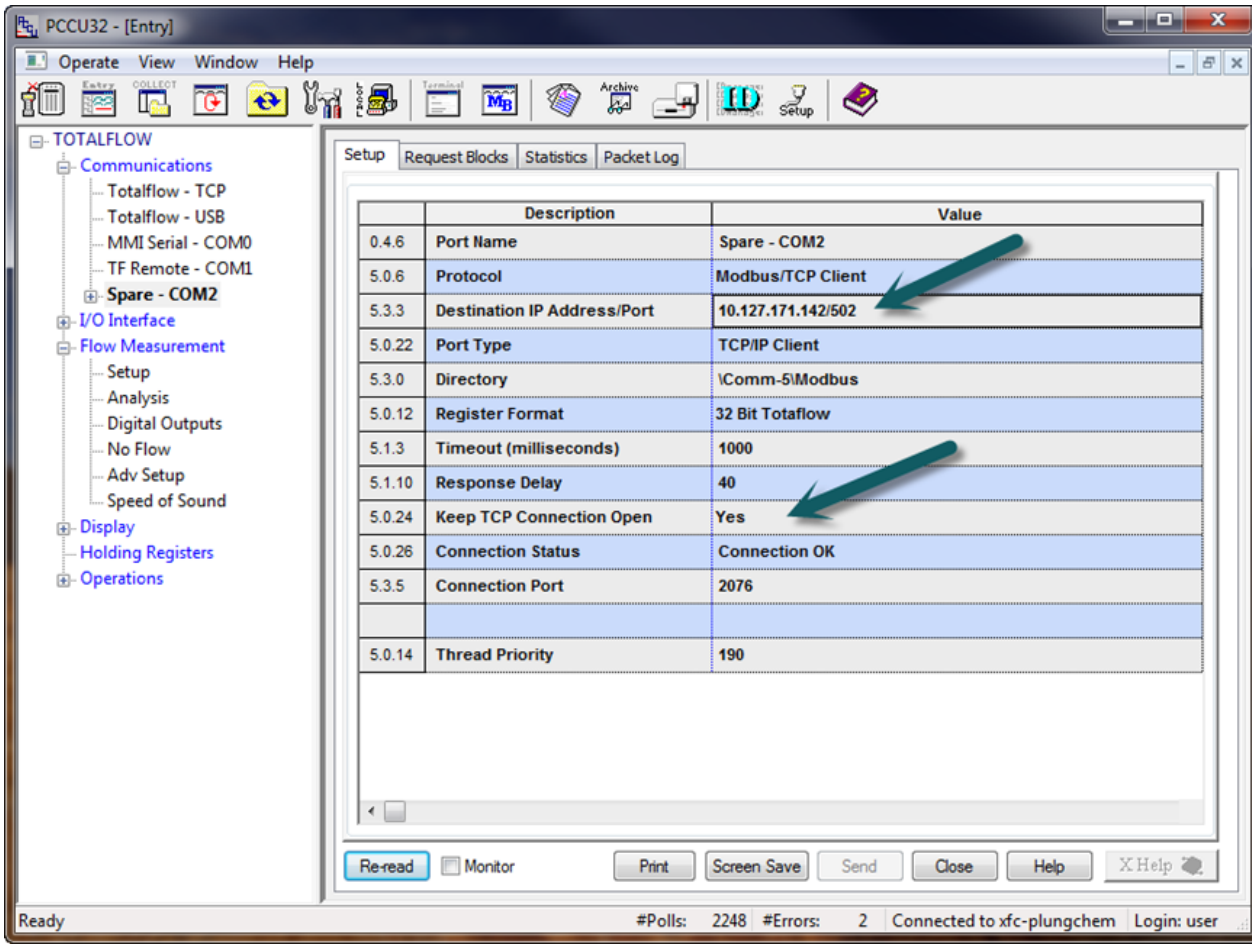


5.8 Configure the client Setup tab

This instruction will involve the client XFC^{G4} setup.

1. Go to **TOTALFLOW**>**Spare-com2**>**Setup** and set the Protocol value field to **Modbus/TCP Client**.
2. Click **Send**.
3. Verify the setup screen shown below (Figure 32).
4. In the Destination IP Address/Port location enter **10.127.171.142/502**. This connects the IP address of the server to the client. They will use port 502.
5. In the Keep TCP Connection Open field, select **Yes**. This will keep the port open for data between the server and the client.
6. Click **Send** to save the changes.

Figure 32 Client setup tab



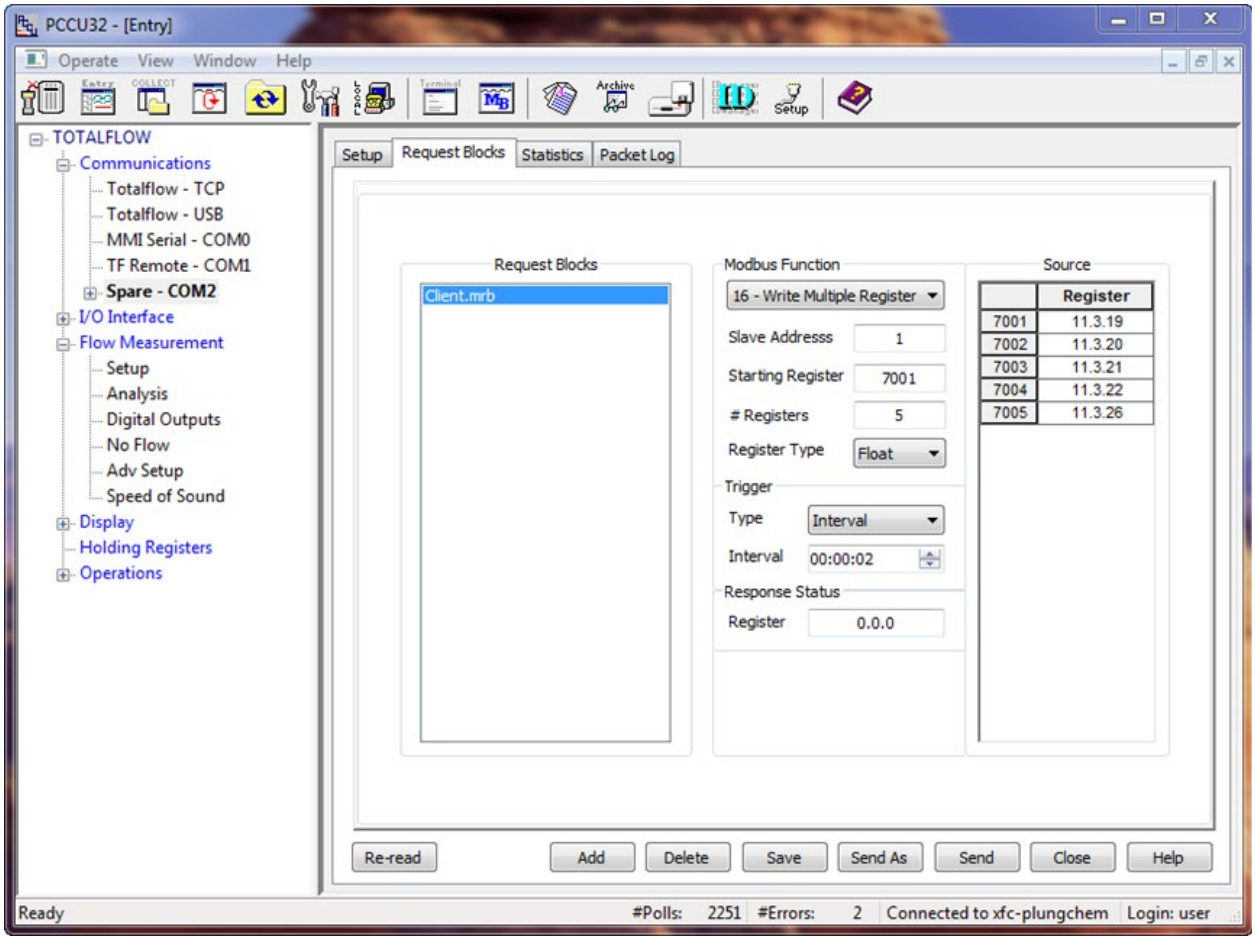
5.9 Create client write block

The client MRB (Modbus Request Block) now needs to be created. Build the write block of (5) five Modbus register locations and the Source (locations from within the client) that the values come from.

1. Go to **TOTALFLOW**>**Spare-COM2**>**Request Blocks.** Click **Add**.
2. Type **Client** as the name of the MRB file, then click **OK** to confirm.
3. In the Modbus Function area, select **16-Write Multiple Register** from the drop-down menu. This sets up the MRB to write registers from the client to the master.
4. Set the following fields:
   a. Slave address: **1**
   b. Starting Register: **7001**
   c. # Registers: **5**
   d. Register Type: **Float**

5. Set the Trigger Type to **Interval**, with the interval set to **2** seconds.
6. Determine the source for the registers we are getting from the client. Enter **11.3.19**, **11.3.20**, **11.3.21**, **11.3.21**, **11.3.22** and **11.3.26** for the AAR locations in the client.
7. Verify that the setup looks like the screen below (Figure 33).
8. Click **Send** to save the changes to the Client.mrb file.

Figure 33 Client MRB

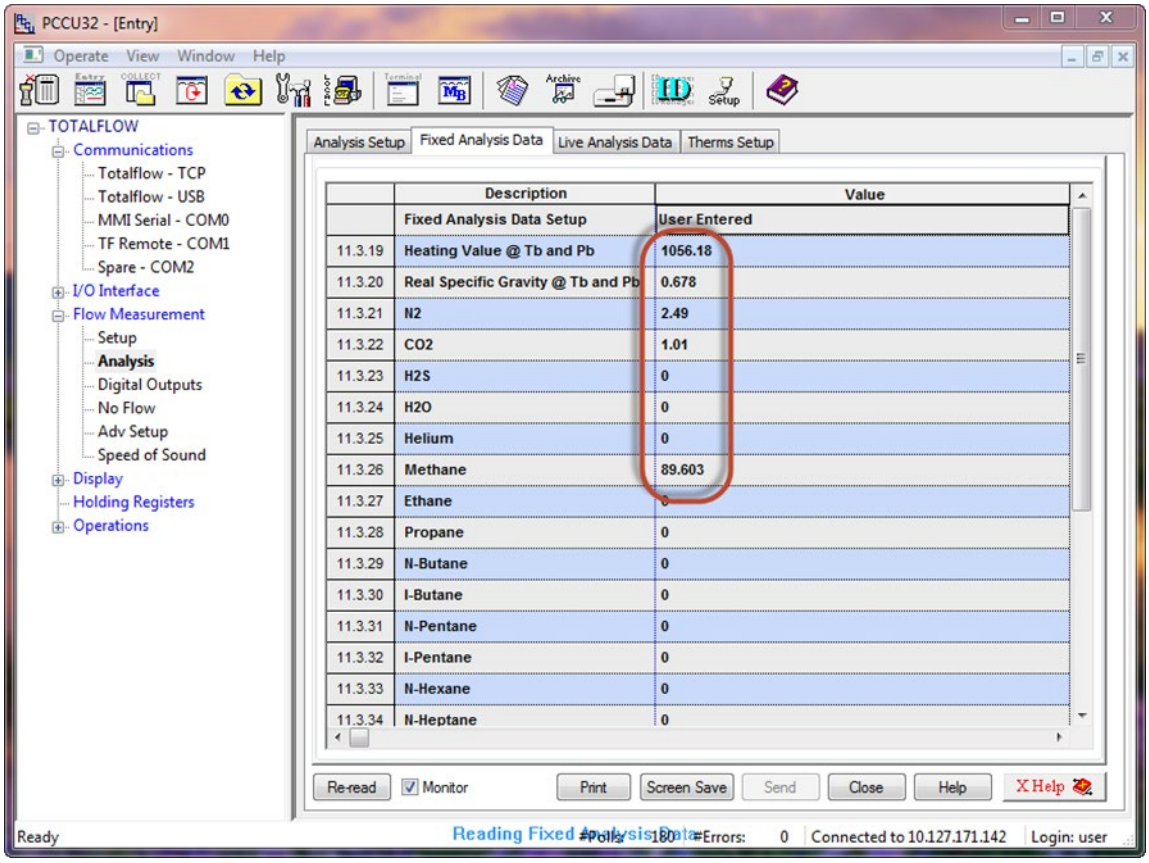


5.10 Verify client write to master

Now that the master and the client are completely set up, verify that the values are being written to the master from the client.

1. In the client XFC^{G4}, go to **TOTALFLOW**>**Flow Measurement**>**Analysis**>**Fixed Analysis Data**, and record the values found there for Heating Value (BTU), Gravity, N_2, CO_2, and Methane.
2. Proceed to the same location in the master and verify that the identical values are present.
3. To further test the Modbus link, change values for BTU, Gravity etc. in the client and verify that the master indicates the updates.

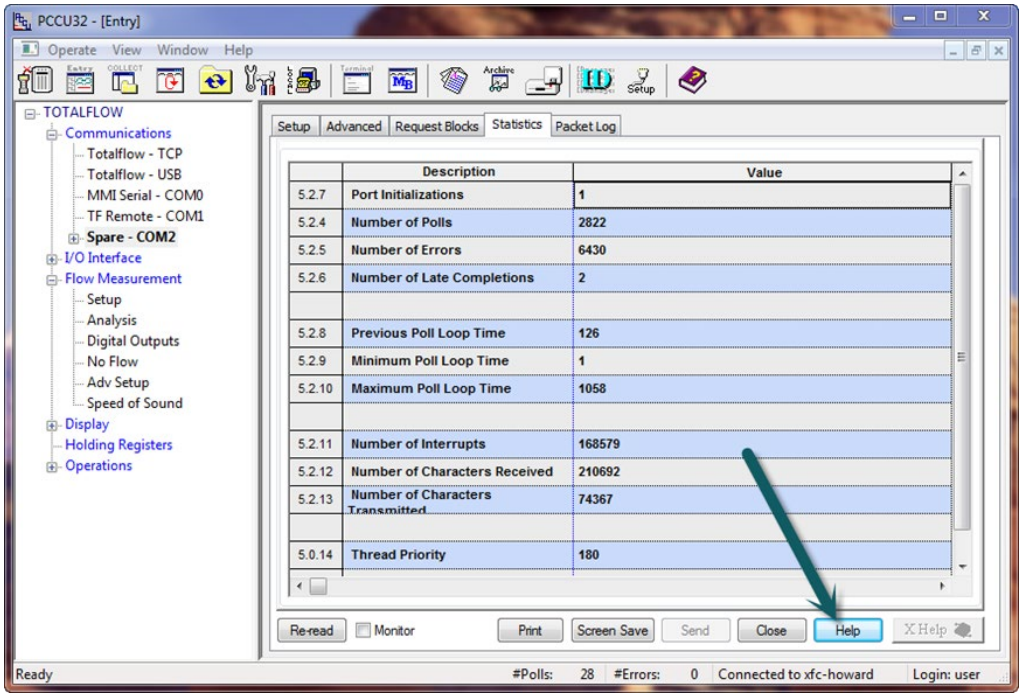
Figure 34 Verify writes



5.11 Monitor statistics

The Statistics tab gives specific indications of how well the Modbus link is working between the master and slave. The statistics tab can be viewed on either the master or the slave com port. Descriptions of each field are documented in the Help files and can be accessed by clicking **Help**.

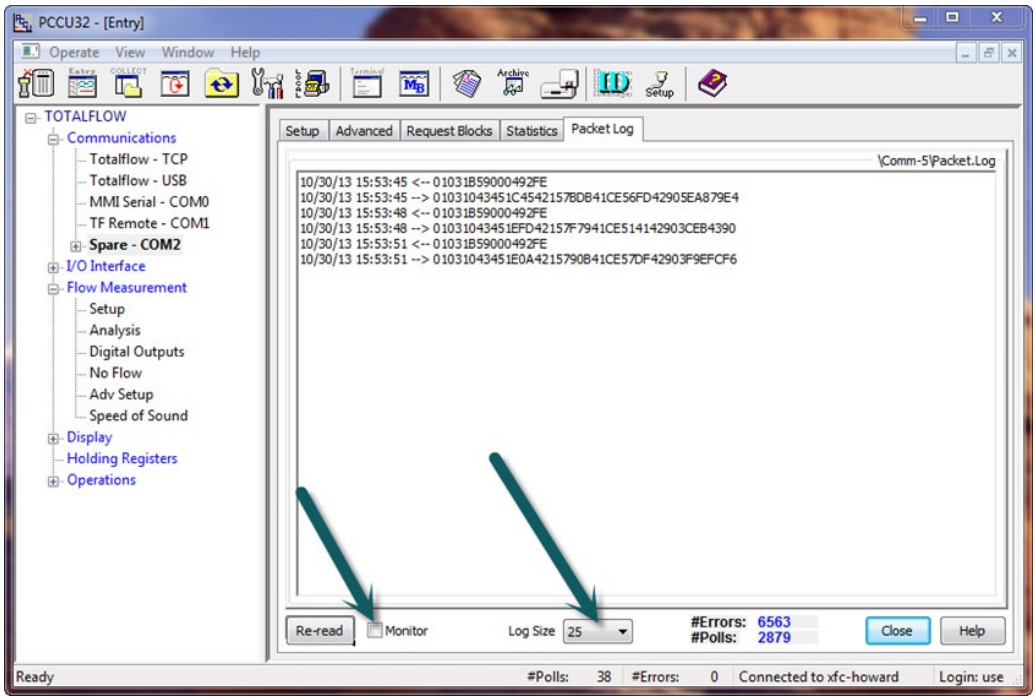
Figure 35 Statistics



5.12 View Packet Log

The Packet Log gives the advanced user the ability to see the request message that the master sent to the slave and the corresponding message received back to the Master. The Packet Log tab can be viewed on either the master or the slave com port. To set this up, use the drop-down menu Log Size and select **25**, then either check **Monitor**, or click **Re-read**.

Figure 36 Packet log



6 XSeries^{G4} Modbus device parameters

Below is a table of the default Modbus communications parameters for typical XSeries^{G4} devices. Some units may vary depending on special software or special requests by the customer. XSeries devices have three communication ports (COM0, COM1 and COM2). COM0 is an RS-232 interface typically called the local port and is connected to the round military-type connector on the outside of the box. COM0 is always used for communicating with the PCCU device for performing data collections, calibrations and setup. COM1 and COM2 have on-board screw-type terminations for connecting to outside cabling. Use the parameters in the table as a guideline especially when communicating with other Totalflow devices as shown below.

Table 16 Modbus communications parameters

	TF Remote Port	XMV ABB 267	XMV Rosemount	XMV Foxboro IMV25	XMV ABB 266	Therms Master	Therms Slave	K-TEK Generic	LevelMaster K-TEK KT500
Setup Tab									
Port Name	Com 1	Com 2	Com 2	Com 2	Com 2	Com 2	Com 2	Com 2	Com 2
Protocol	Modbus Host RTU	Modbus Host RTU	Modbus Host RTU	Modbus Host RTU	Modbus Host RTU	Modbus Host ASCII	Modbus Slave ASCII	Modbus Host RTU	Tank Gauge
Baud Rate	9600	9600	9600	9600	9600	9600	9600	9600	9600
Listen Cycle	0	0	0	0	0	0	0	0	0
Slave Address									
Reg Format	32 Bit	32 Bit	32 Bit	16 Bit Word swap	32 Bit	32 Bit TF	32 Bit TF	32 Bit TF	
Advanced Tab									
Interface	RS485	RS485	RS485	RS485	RS485	RS485	RS485	RS485	RS485
Data Bits	8	8	8	8	8	7	8	8	7
Parity	None	None	None	None	None	Even	None	None	Even
Stop Bits	1	1	1	1	1	1	1	1	1
Power Up Delay(ms)	80								
Xmit Key Delay(ms)	420	5	10	5	5	10	10	5	10
UnKey Delay(ms)		5	1	5	5	10	10	5	10
Timeout(ms)		150	80	150	150	3000	30000	550	5000
Response Delay(ms)		0	0	0	0	0	5	5	
Wait for Host Timeout(Sec)	7								
Inactive Timeout(Sec)	1								
Trailing Pad		None	None	None	None	None	None	None	None
Retries		0	0	0	0	2	0	0	0

6.1 Modbus protocol parameter definitions

The following table provides definitions of the protocol parameters used in configuring the various ports for Modbus.

Table 17 Protocol parameters

Parameter	Units	Description	Limits	Default
Port Name		Override the default name given to the port by entering in another name (31 characters max.)		
Port		You may be required to enter the port name or there may be a drop-down selection of ports such as Com0:, Com1:, Com2 etc. If the port is a TFIO Serial (CIM) module, the port name depends on the position of the switch on the module. For		

Parameter	Units	Description	Limits	Default
		example, the port name for the switch in the 0 position is CIM0:, the 1 position would be CIM1:, etc. No two modules can have the same switch position.		
Protocol		Select a protocol from the drop-down menu. All selections are listed but Modbus Host selections will be either Modbus Host (ASCII) or Modbus Host (RTU). – None - Select when the port is not being used. – Modbus Slave (ASCII) - Select when communicating with a Host using Modbus ASCII protocol. – Modbus Slave (RTU) - Select when communicating with a Host using Modbus RTU protocol. – Modbus Host (ASCII) - Select when communicating with a Slave using Modbus ASCII protocol. – Modbus Host (RTU) - Select when communicating with a Slave using Modbus RTU protocol. – LevelMaster - Select when communicating with the LevelMaster Tank Gauging System. – Totalflow / TCP - TCP enables two hosts to establish a connection and exchange streams of data. TCP guarantees delivery of data and guarantees that packets will be delivered in the same order in which they were sent. – Modbus / TCP Server - A TCP Server primarily waits for other applications (clients) to send commands and then acts upon that command, which instructs the server to perform a specific function or to send data back to the client. – Modbus / TCP Client - A TCP Client initiates conversations with the server by asking the server to perform a task.		
Port Type		Select the port type from the drop-down list. Available selections are: – Onboard Serial - Select if using one of the serial communication ports located physically on the device's main electronics board. – TCP/IP Client - Select if communicating via TCP/IP protocol. This will be the only Ethernet selection if a Modbus Host or Client protocol was selected. – TCP/IP Server - Select if communicating via TCP/IP protocol. This will be the only Ethernet selection if a Modbus Slave or Server protocol was selected. – TFIO Serial - Select when using a TFIO communications module referred to as a Communications Interface Module (CIM). These will be mounted on a rail external to the main electronics board.		
Baud Rate	Baud	Select the baud rate from the drop-down menu. The host must match this baud rate and any communication equipment must be able to communicate at the same rate.	1200, 2400, 4800, 9600, 19200	
Slave Address		If the device is used as a Modbus slave, enter the slave address, typically 1 - 247. Each device must have a unique address. (This parameter is only displayed if a slave protocol was selected.)	1-247	1
Register Format		(Host and slave) Select the appropriate format from the drop-down list. – 32 Bit Totalflow: 32 Bit values are transferred as a single 32 Bit register. Register list entries are biased one greater than standard Modbus (7002 = 7001 Standard). – 32 Bit: 32 bit values are transferred as a single 32 Bit register. – 16 Bit Modicon: 32 Bit values are transferred as two consecutive 16 Bit registers. – 16 Bit Word Swapped: 32 Bit values are transferred as two consecutive 16 Bit registers and swaps the order of the registers. – 16 Bit ROS Modulo 10000: Multiplies the floating-point number by 1000 and then divides by 10000. The integer portion (before the		

Parameter	Units	Description	Limits	Default
		decimal point) goes into the first 16 Bit register and the fractional portion (after the decimal point) goes in the second 16 Bit register.		
Interface		Select the interface type from the drop-down list that will be used on this port. Available selections are: – RS-232: Select if the port is connected to a radio or an RS-232 device. – RS-485: Select if communicating via RS-485. – RS-422: Select if communicating via RS-422. – Modem: Select if the port is connected to a dial-up modem. Required when using the Cryout option.	RS232, RS485, RS422, Modem	
Data Bits		Selections are 7 and 8 data bits. Leave at the default of 8 when communicating with Totalflow host software such as WinCCU.	7,8	8
Parity		Parity bit that is transmitted and received from the remote device. This parameter is valid for both packet and non-packet protocol Definition: An error detection procedure in which a bit (0 or 1) is added to each group of bits so that it will have either an odd number of 1s or an even number of 1s; For example: If the parity is odd then any group of bits that arrives with an even number of 1s must contain an error.	None, Odd, Even	None
Stop Bits		Must match the remote device and communications equipment. This parameter is valid for both packet and non-packet protocol. Definition: A 1 or space to indicate the end of the byte. It can be 1, 1.5, or 2 bit periods in length.	1,2	2
Response Delay	ms	Response Delay is a delay that is on the front end of communications between devices. It can be used by the device initiating a request and/or by the device responding to the request. Either way, it delays the start of communication to another device. Set to zero for no delay or enter a delay value in milliseconds. In cases where there is a master polling multiple slave devices, a value of 10 milliseconds typically works well.	0-?	10
Xmit Key Delay(ms)	ms	Typically used when communicating via radio but can affect any communications equipment, this is a delay time to allow a radio's transmitter to stabilize after being keyed up before data is transmitted. This can typically be left at the default time of 420 milliseconds if using a radio.	0-?	0
UnKey Delay	ms	Typically used when communicating via radio but can affect any communications equipment, this is a delay time to keep the radio's transmitter keyed up after the last data bit is transmitted. This can typically be left at the default time of 40 milliseconds.	0-?	40
Time-out	ms	Used with Modbus host and slave. – Host: Length of time the XSeries will wait for a response before clearing the input buffer and reinitializing the port. – Slave: Length of time the XSeries will wait for an ACK or NACK before clearing the input buffer and reinitializing the port. Proper setting of this parameter requires the user to observe the statistics tab under remote communications. Gradually increase this value until the FCU stops reinitializing the port. Typical values will be 50-2000.	0-2000	0
Trailing Pad		Trailing Pad allows you to add some zeroes to the end of a transmission sequence to make sure the transmission is done before the remote device tries to respond. This is more for devices that have a quick turnaround time. This can be used in place of having an Unkey Delay. Select 2 bytes, 3 bytes or 4 bytes from the drop-down list (Expert view only.)	2, 3, 4	None
Directory		Displays a directory/path in the device for Request Block files. Typically, this would be under the directory associated with the communication port being used.		

Appendix A Typographical conventions

Table 18 Typographical conventions

Element	Convention	Example
Cross-reference to a figure or table in the document	Hyperlink to the figure or table	See Figure 2.
Cross-reference to a specific section in the document	Hyperlinks to sections referenced throughout the document appear in blue, with underline.	See section 3.3.
Cross-reference to another document or website	Hyperlink to the website in blue, with underline	Go to the XSeries^{G5} User Manual at abb.com.
Greater-than character (>)	Indicates that the following item is an additional menu selection	From the menu, locate and select **Calibrate** > **Diff. Press. Sensor** > **Calibration Units** > **Edit**.
Name of selection buttons, menus, or navigation tree items in instructions that the user will locate and click	Bold text, and the capitalization agrees with the name as displayed on the user interface	Click the **Monitor** tab and select the **Add Advanced Setup** tab.
Programs, including utility and accessory programs	Title capitalization	Microsoft Word
URL	All lowercase for a fully specified URL with blue to indicate active link.	www.abb.com/totalflow
User input	Bold and lowercase, unless case sensitive. If the user-input string contains placeholder text, that text is in small caps.	Type **config** SMALL CAPS FOR PLACE HOLDERS.

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